Indian and Northern Affairs Canada / Affaires indiennes et du Nord Canada

AM ⟶ Dec 23/9[illegible] File Date

APPLICATION FOR LAND USE PERMIT
DEMANDE DE PERMIS D'UTILISATION DES TERRES

FILE COPY

Office use only - Réservé pour usage interne seulement					
Application - Droits de demande de permis	Land use fee - Droits d'utilisation des terres	General receipt no. - Nº de reçu	Date	Class - Catégorie	Permit no. - Nº de permis
					[illegible](2

To be completed by all applicants - A remplir par tous les requérants ▶ [X] New application / Nouvelle demande [ ] Amendment / Modification

1. Applicant's name and mailing address (Full name, no initials) - Nom et adresse du ou des requérant (s) (Nom au complet, pas d'initiales)

Peter Tsaparas, President
San Andreas Resources Corporation
Suite 900, 595 Howe Street
Vancouver, B.C. V6C 2T5

Fax no. - Nº de télécopieur: 604-688-2043
Telephone no. - Nº de téléphone: 604-688-2001

2. Head office address - Adresse du siège social

As per above

EN0809-002 submitted by INAC Nov 19/08
DM
RFR#12

Fax no. - Nº de télécopieur: as per above
Telephone no. - Nº de téléphone: as per above

3. Field supervisor - Chef de chantier

Al Mitton, P. Eng. Delcan Engineers

Radio telephone - Téléphone-radio:
Telephone no. - Nº de téléphone: 604-525-9333

4. Other personnel (Subcontractor, contractors, company staff, etc.) - Autre personnel (Sous-traitants, entrepreneurs, personnel de société, etc.)

Three subcontractors, not including San Andreas personnel
TOTAL: 128 men employed (maximum) at any given time.

5. a) Summary of operation (Describe purpose, nature and location of all activities - refer to Section 22 (2) (b) - Territorial Land Use Regulations). (Use last page of form if additional room is required).
Résumé des opérations (exposez le but, la nature ainsi que l'emplacement de toutes les activités - consultez l'article 22 (2) b) - du Règlement sur l'utilisation des terres territoriales). Utilisez la dernière page du formulaire si vous avez besoin d'espace supplémentaire).

Constructrion of all-weather access road, 163 km long between the Prair Creek Mine and the Liard Highway near Lindberg's Landing. Cadillac exploration previously constructed a winter road during 1980. The general corridor for the all-weather road remains the same as proposed and follows much of the old winter road. Attached to this application is the preliminary route alignment.
A tote road will have to be constructed and a temporary structure for provision of moving equipment over the Liard River. Three bridge locations have (see attached).

b) Please indicate if a camp is to be set up (Use last page to provide details).
Indiquez si un camp doit être aménagé (Utilisez la dernière page pour donner des détails).

There will be two temporary construction camps: 1. at km132 the Grainger Airstrip ...over

6. Summary of potential environmental and resource impacts (Describe the effects of the proposed program on land, water, flora & fauna and related socio-economic areas (Use separate pages if necessary)
Résumé des conséquences possibles sur l'environnement et les ressources (décrire les effets du programme proposé sur les terres, l'eau, la flore et la faune et les domaines socio-économiques connexes (Utilisez des pages supplémentaires au besoin)

Design of the all-weather access road and ensuring that it be routed to avoid ecologically-sensitive areas and constructed with minimal environmental damage has been an important development issue for San Andreas. The road will be routed to avoid critical wildlife habitat an karst topography. Stream crossings will be culverted, or bridged as neccessary, so as not to impede fish passage or impair habitat utilizat Once the route is open for use, access will be controlled so that traditional land and resource use will not be compromised by unregulate entry to remote locations through the new road.

Socio-economic benefits are expected to be realized owing to the construction, maintenance and operation of the road.

Canada

7. Proposed restoration plans (please use last page if required) - Plans proposés de remise en état des terres (au besoin, utilisez la dernière page)

No restoration plans proposed at this time but will follow accepted reclamation procedures on abandonment.

8. Other rights, licences or permits related to this permit application (mineral claims, timber permits, water licences, etc.)
Autres droits, autorisations ou permis associés à cette demande de permis (claims miniers, permis de coupe, permis d'exploitation hydraulique, etc.)

Water Licence will be applied for the Prairie Creek Mine.

Roads: / Routes:

Is this to be a pioneered road? Please provide details on back page / La route doit-elle être aménagée ? Donnez les détails sur la dernière page: [Y] In certain sections

Has the route been laid out or ground truthed? / Le tracé a-t-il été établi et le terrain nivelé ? [Y]

Has funding been applied for i.e. RTAP? / Avez-vous demandé du financement ? [N] Not at this time

9. Proposed disposal methods - Méthodes d'élimination proposées

a) Garbage: / Ordures : disposal at camps and removed from site and/or incinerated

b) Sewage (Sanitary & Grey Water): / Eaux usées (Eaux d'égoût et eaux ménagères) portable treatmentsystem

c) Brush & trees: / Broussailles et arbres: cleared where neccessary

d) Overburden (Organic soils, waste material, etc.): / Terrain de recouvrement : (Dépôts organiques, déchets, etc.) (see attached)

10. Equipment (Includes drills, pumps, etc.) (Please use last page if required)
Matériel (comprend foreuses, pompes, etc.) (Utilisez la dernière page au besoin)

Type & Number - Type et nombre	Size - Dimension	Proposed use - Utilisation proposée
D-8 Caterpillars eqipped with rippers	(up to 8-10)	road construction
Loaders (3-4)		Materials transport
Backhoe(s)		Trenching
Dump trucks	(12-15 tonne)	Materials transport
Rock crusher		crush materials for road prep.
Fuel trucks		Fuel transport

11. Fuels - Combustibles	(√)	Number of containers - Nombre de réservoirs	Capacity of containers - Capacité des réservoirs
• Diesel	X		Total capacity 326,000L
• Gasoline - Essence	X	to be trucked in	No storage
• Aviation Fuel - Carburant aviation			very small quantities for
• Propane	X	Two; one at each camp	cooking and heating
• Other			

12. Containment fuel spill contingency plans (Please attach separate contingency plan if necessary)
Plans d'urgence d'isolement de carburant en cas de déversement (veuillez joindre un plan d'urgence distinct au besoin)

Please see attached Spill Contingency Plan

13. Methods of fuel transfer (To other tanks, vehicles, etc.) - Méthodes de transfert des combustibles (vers d'autres réservoirs, véhicules, etc.)

Diesel to be pumped from tanks into tanker trucks and equipment refueled as necessary.
Gasoline to be trucked in and transfered directly to 4x4 vehicles.

14. Period of operation (includes time to cover all phases of project work applied for, including restoration)
Période d'opération (comprend toute période du début à la fin des projets, y compris la remise en état)

May 1995 to May 2005 assuming a 10 year mine life.
Operation of road beyond that likely during mine reclamation period or if reserves are more extensive.

15. Period of permit (up to two years, with maximum of one year extension)
Période du permis (valide pour une durée de deux ans et prolongation maximale d'un an)

Start date - Date du début du projet	Completion date - Date d'achèvement
05 01 95	05 31 97

16. Location of activities by map co-ordinates (attached maps and sketches)
Emplacement des activités selon les coordonnées géographiques (cartes et esquisses ci-jointes) see attached maps

MN Lat Deg	MN Lat Min	MAX Lat Deg	MAX Lat Min
MN Long Deg	MN Long Min	MAX Long Deg	MAX Long Min

Map Sheet No.
Nº de feuille de carte

17. Applicant - Requérant
Print name in full - Écrire votre nom au complet en lettre moulées

PETER P. TSAPARAS

Signature [signature] Date Dec. 23/94

18. Fees - Droits

[X] Class / Catégorie A $ 20.00 [ ] Class / Catégorie B $ 10.00

Land use fees:
Droits d'utilisation des terres 237 Hectare @ $ 20.00 = $ 4740 - 40 (2 hectares free

Hectare @ $ 12.00 = $
(Above 65 N - au-dessus de 65)

Total application and land use fees
Total des droits de demande de permis et d'utilisation des terres $ 4,700

Office use only - Réservé pour usage interne seulement

19. Calculation of area involved (includes access, staging areas, airstrips, campsites, etc.)
Calcul des aires en cause (comprend l'accès, les aires de transit, les pistes d'atterrissage, les camps, etc.)

Total area (Ha) / Superficie totale	Less 2 hectares / Moins 2 hectares (– 2)	TOTAL (For fee calculation) (aux fins du calcul des droits)

20. Application checklist - Vérification de la demande

a) [ ] Application signed and dated / Demande signée et datée
b) [ ] Fees attached / Droits ci-joints
c) [ ] Map included / Carte incluse
d) [ ] Address and telephone number / Adresse et numéro de téléphone
e) [ ] Screening report / Rapport d'examen
f) [ ] Timber permit applied for / Permis de coupe du bois demandé
g) [ ] Fees attached / Droits ci-joints
h) [ ] Lease applied for / Bail demandé

Accepted by - Acceptée par

Date

Remarks - Remarques

Please use reverse page if additional space is required
Utiliser la dernière page si vous avez besoin d'espace supplémentaire

21. Additional information (attach additional pages if necessary) - Renseignements additionnels (joindre des pages supplémentaires au besoin)

5a. continued:

been identified. These are at Grainger River, Tetcela River and the Sundog at the Cat Camp Airstrip (see attached alignment). Culverts will be installed at all locations where the road is to cross existing water courses. These installations will be made prior to the road construction so that equipment does not pass through the channel and cause sedimentation problems. Construction of a borge landing will occur on the south side of the Liard River at km 165.1.

9d. continued:

Proposed disposal methods (overburden, organic soils etc.)
Some overburden will require removal and may be suitable for fill material. When the route proposed traverses permafrost or wet terrain, extreme care will be taken not to destroy or cause rutting in the organic mat or insulating layer. A filler fabric material may be used in these areas before placing fill material.

EA0809-002 Submitted by INAC Nov 19/08

Rescan Environmental Services Ltd.
Sixth Floor, Coopers & Lybrand Building
1111 West Hastings Street
Vancouver, British Columbia
Canada, V6E 2J3
Telephone: (604) 689-9460
Facsimile: (604) 687-4277

Refer to File no. 12284741.LET

December 23, 1994

VIA FACSIMILE AND COURIER

Indian and Northern Affairs Canada
P.O. Box 1500
Yellowknife, N.W.T.
X1A 2R3

Attention: Ms. Brenda Kuzyk, Chair,
Regional Environmental Review Committee

Dear Ms. Kuzyk:

Re: Prairie Creek Project Description Report and Land Use Permit Application for Road Access

Please find attached herewith ten (10) copies of a Project Description Report for the Prairie Creek Project proposed for development by San Andreas Resources Ltd. This document follows recommendations arising from our meeting with the RERC earlier this year. It summarizes the baseline data collected for the project (which in turn supplement those data gathered in support of the original Water Licence granted for the Prairie Creek Project in 1982). It is intended that an Initial Environmental Evaluation (IEE) will be submitted early in 1995.

Accompanying the *Prairie Creek Project Description Report* is an Application for a Land Use Permit to authorize the initiation of construction of an all-weather access road from the Liard Highway to the project site.

It is our understanding that filing these documents with your office, in advance of the promulgation of the *Canadian Environmental Assessment Act*, will ensure that the Prairie Creek Project will be reviewed under the federal EARP Guidelines Order.

If it is acceptable to you, and if it will allow the RERC adequate time to first review the subject documents, we would like to suggest that a meeting be scheduled for late January 1995 to discuss the project with you, most particularly the key scooping issues to be addressed in the Prairie Creek Project IEE. Would you please advise us if this timing is suitable for the RERC?

We trust you will find the *Prairie Creek Project Description Report* and Application for Land Use Permit to be in good order. Should you have questions or require clarification on anything presented please do not hesitate to contact myself or Kelvin Dushnisky, Vice-President, at your convenience.

Sincerely,

RESCAN ENVIRONMENTAL SERVICES LTD.

per:

David Flather,
Project Manager

DF/gc

cc: P. Tsaparas, San Andreas Resources Ltd.

Enclosures (10)

San Andreas
Resources Corporation

Prairie Creek Project

Project Description Report

Rescan

Rescan Environmental Services Ltd.
Vancouver, Canada

December 1994

PROJECT FACT SHEET

CORPORATE DATA

Project Name:	Prairie Creek Project
Company Name and Address:	San Andreas Resources Corporation Suite 900, 595 Howe Street Vancouver, B.C. V6C 2T5 Telephone: (604) 688-2001 Fax: (604) 688-2043
Contact/Title and Address:	Colin McAleenan, Project Manager As above

PROJECT DETAILS

Project Location:	500 km West of Yellowknife, NWT 61° 33' N latitude 124° 48' W longitude
Product:	Zinc concentrate Lead concentrate Copper concentrate
Mining Method:	Underground mine using room-and-pillar in the stratiform deposits, undercut and fill for the vein deposit. All stopes to be backfilled with tailings
Tonnage:	Up to 1,650 tonnes mined and milled per day
Duration of Project:	Mid-1996 to mid-2006 and possibly beyon
Concentration Process:	Flotation

Tailings Disposal:	On site tailings impoundment facility. Backfill of underground workings

WATER SUPPLY

Potable:	On-site wells
Process:	Prairie Creek and/or the on-site wells

ACCESS/TRANSPORTATION

Road:	Proposed upgrade of present 160-km winter road to an all-weather access road from the Liard Highway
Air Access:	1,000 m gravel airstrip to accommodate up to DC3, Buffalo-type aircraft

POWER SUPPLY	On-site installed diesel generation capacity of 4.4 MW (planned to be raised to 7.4 MW)
Fuel Storage:	No. 1 winter diesel fuel, approximately 8.5 million litres in four 10,400 bbls steel tanks

WORKFORCE INFORMATION

Construction Workforce:	300
Operations Workforce:	230
Permanent Camp:	250-person camp adjacent to process plant
Proposed Work Schedule:	Underground: 2 x 10-hour shifts/day, 7 days/week Process Plant: 2 x 12-hour shifts/day, 7 days/week

EXECUTIVE SUMMARY

San Andreas Resources Corporation (San Andreas) owns the Prairie Creek property which contains reserves of zinc, lead, copper, and silver. The Prairie Creek Project is located in the eastern Mackenzie Mountains within the South Mining District of the Northwest Territories at latitude 61° 33' N and longitude 124°48' W. The mine site is situated on Prairie Creek, 17 km from the boundary of the Nahanni National Park Reserve.

The Prairie Creek property was first staked in 1958. Following the discovery and exploration of zinc and lead mineralization, surface site construction and pre-production development was carried out from 1981 to May 1982. When the owners at that time could not raise sufficient funding in concert with low silver prices, project development ceased, leaving the plant, equipment and camp *in situ*. San Andreas Resources Corporation acquired interests in the property and development in 1991 and carried out further exploration, at which time stratiform mineralization was discovered in addition to previously delineated vein mineralization. Mineral reserves are presently estimated to be on the order of 6.2 million tonnes with grades of 13% zinc, 12% lead, 0.3% copper and 180 grams per tonne silver.

San Andreas continues to work towards start-up of operation in 1996. Although an environmental assessment was completed and a Water Licence granted for the original mine development in 1982, re-application will be necessary prior to start-up in 1996. This Project Description Report has been prepared prior to submission of the Initial Environmental Evaluation in order to meet the requirements of the present environmental review process administered by the Northwest Territories Regional Environmental Review Committee and to initiate applications for the water licence and land use permit for the proposed all-weather access route corridor among other approvals.

The key environmental issues addressed in this Project Description Report are:

- that water quality in Prairie Creek not be measurably altered by the operation;
- that the tailings pond be rehabilitated; and

- that the proposed all-weather access road be routed to avoid ecologically sensitive areas.

An important environmental management issue will be to ensure that the discharge of pre-treated tailings effluent into Prairie Creek does not degrade the quality of the water downstream where the creek enters the Nahanni National Park Reserve and later joins the South Nahanni River, thus having a potentially negative effect on fisheries resources and water quality. Proper treatment of the tailings effluent will be ensured by San Andreas so that aquatic resources will not be affected, and the water quality of Prairie Creek will not be measurably altered, downstream of the park boundary.

An additional waste management issue is that the tailings pond must be upgraded and properly designed to withstand flood conditions. The tailings pond is located on the flood plain of Prairie Creek, but has been engineered to withstand an one-in-200 year flood. Consequently, no accidental spills of tailings, due to breaching of the dykes by flood waters, are expected to occur at any time. Geotechnical work has been initiated to upgrade this impoundment to meet the standards of San Andreas as well as the regulatory agencies and public.

Design of the all-weather access road and ensuring that it be routed to avoid ecologically-sensitive areas and constructed with minimal environmental damage has been an important development issue for San Andreas. The road will be routed to avoid critical wildlife habitat and karst topography. Stream crossings will be culverted, or bridged as necessary, so as not to impede fish passage or impair habitat utilization. Once the route is open for use, access will be controlled so that traditional land and resource use will not be compromised by unregulated entry to remote locations through the new road.

Despite the presence of massive sulphide deposits at Prairie Creek, acid generation testwork conducted to date has indicated that an overwhelming abundance of neutralizing rocks would prevent the on-set of acid generation at the site.

The environmental monitoring program has been designed to investigate the above issues in more detail and provide strategies for an ecologically sound environmental management program. Initial environmental surveys will gather baseline data on the current status of existing land use and biophysical resources, from water quality to wildlife, and will evaluate the socioeconomic considerations related to mine development and its potential impacts on local communities and resources.

This Project Description Report is submitted to provide a review of the development plan and the environmental monitoring and management strategies that are being advanced to ensure sound development of the Prairie Creek Project. It is also recognized that this report will form the foundation for issuance of the terms of reference for submission of an Initial Environmental Evaluation.

San Andreas Resource Corporation

Prairie Creek Project

Project Description Report

TABLE OF CONTENTS

List of Tables

List of Figures

List of Plates

1.0 INTRODUCTION

1.1 Project Overview

The Prairie Creek property is located in the remote southwest part of the Northwest Territories. The property is geologically and geographically removed from all other mineral development projects in the Territories and is closer to known oil and gas deposits than to the gold and diamond projects on the Shield.

The project is geologically unique among lead-zinc massive sulphide deposits in the Northern Cordillera in that the stratiform deposits are hosted by carbonate rocks. The other major sulphide deposits in this part of the Cordillera, for example Macmillan Pass and Howards Pass, 350 km and 250 km northwest of Prairie Creek and the Faro deposits to the west are contained in black shales. This places the Prairie Creek stratiform deposits genetically closer to the world class Irish carbonate-hosted lead-zinc deposits than to its geographic neighbours. This fact as well as the presence of two other major styles of mineralization enhance the property's potential to develop major additional reserves in the future.

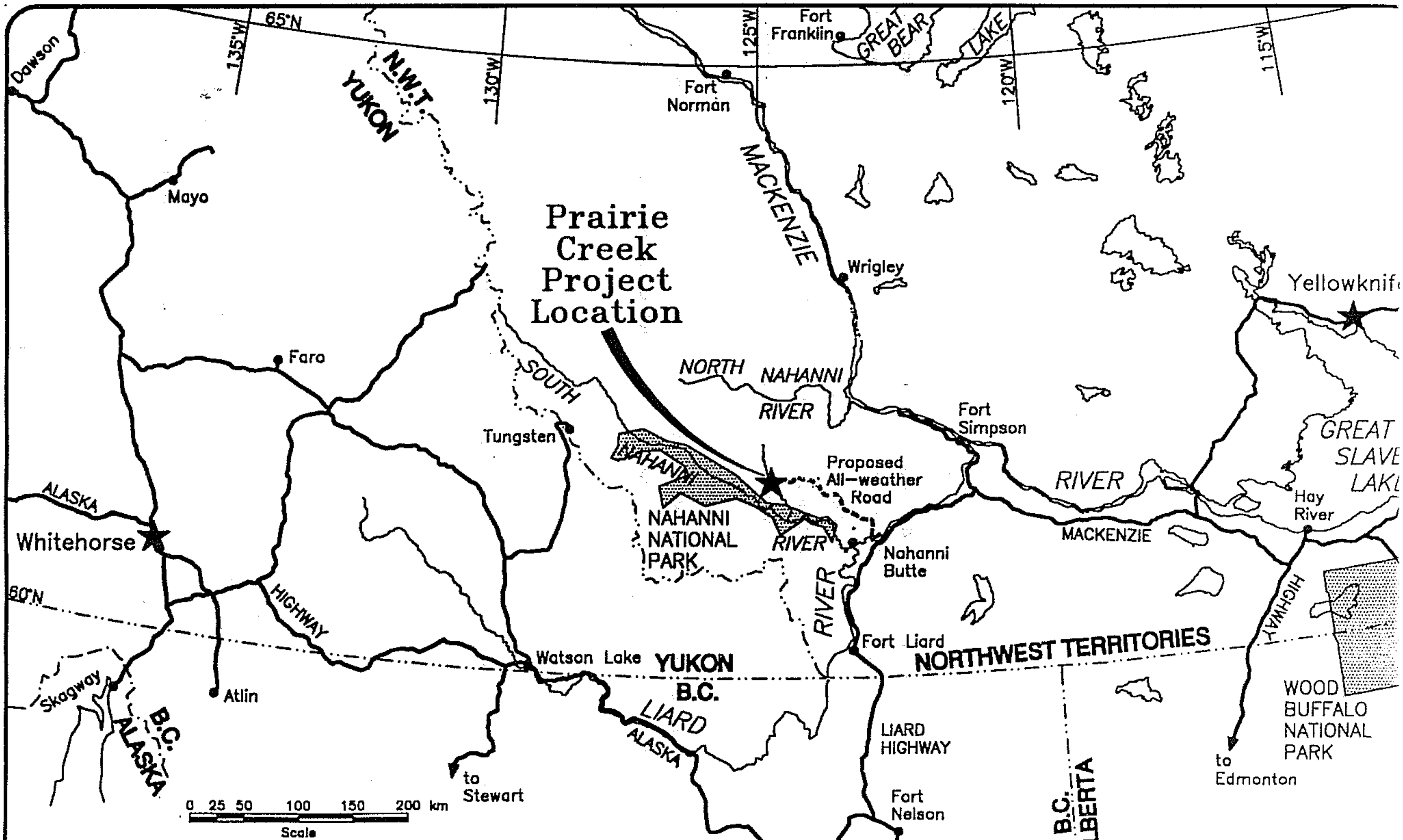
If economic reserves can be established on this property the carbonate rocks of the western part of the Interior Platform may be viewed as prospective for lead-zinc deposits.

1.1.1 Ownership

The Prairie Creek Property is 100% owned by San Andreas Resources Corporation (VSE, TSE). Titan Pacific Resources Ltd. holds a 40% interest in the plant at the minesite and have a net smelter royalty of 2% on the existing mining lease. This royalty is capped at approximately $8.0 million.

1.1.2 Project Location

The Prairie Creek property is located in the South Mining District of the Northwest Territories near the Yukon border, at 61°33' N latitude and 124°48' W longitude (Figure 1-1). The nearest communities include: Yellowknife, NWT, 550 km east; Fort Nelson, B.C., 340 km south (and the nearest railhead); Fort Liard 170 km south and Fort Simpson, NWT, 185 km east. The mine site is



San Andreas Resources Corporation

Figure 1-1: Project Location Map

Rescan

situated on the east side of Prairie Creek approximately 17 km north of Nahanni National Park boundary, and 43 km from the confluence of Prairie Creek and the South Nahanni River (Figure 1-2).

The project area is characterized by low mountains and narrow valleys with variable elevation: the mine site is 850 metres above sea level, while 5 km west the elevation is 1,750 m above sea level. Short summers and long winters are typical of the area's subarctic climate, where the mean annual temperature is -5°C. Annual precipitation is approximately 40 cm, most of which falls as rain.

The Prairie Creek Mine area lies within the Alpine Forest-Tundra section of the Boreal Forest. The region is characterized by stunted white spruce and understories of grasses, shrubs or bare rock occurring up to treeline level at 1,100 to 1,200 m. Alpine fir dominates on the north and east aspects at this elevation, giving way to black and white spruce at lower elevations. Lodgepole pine and jack pine are common on dry south and west aspects.

The on-site vegetation is dominated by a mixture of white and black spruces up to 10 m in height. The understory consist of a variety of shrubs such as juniper, dwarf birch and bearberry. The ground flora is dominated by mosses, lichens and some forbs. Permafrost in the general area is reported to occur at a depth of 1 to 2 m in August, although there may be zones of discontinuity.

Important wildlife species in the project area include Dall's sheep, grizzly bear, moose and woodland caribou. Furbearers such as the gray wolf and wolverine also occur. Small mammals such as the arctic ground squirrel and red squirrel have also been observed. Avian species reported in the area include trumpeter swans, bald eagles, golden eagles, ptarmigan and snow buntings.

Fish species known to occur in Prairie Creek and drainages between the mine site and the Liard River include bull trout, arctic grayling, slimy sculpins, longnose suckers, and lake chub.

Year-round access to the mine site is presently provided by air from commercial airports with scheduled service located in Yellowknife, Fort Simpson and Fort Nelson to an airstrip two kilometres north of the mine site. At present, overland access to the mine site is made possible by a 165-km winter road that intersects with the Liard Highway near Nahanni Butte. Plans for mine development include

Cad No. C0687 1 P1 | Job No. 474-1 | 12/15/1994- 1:25pm RES_BH

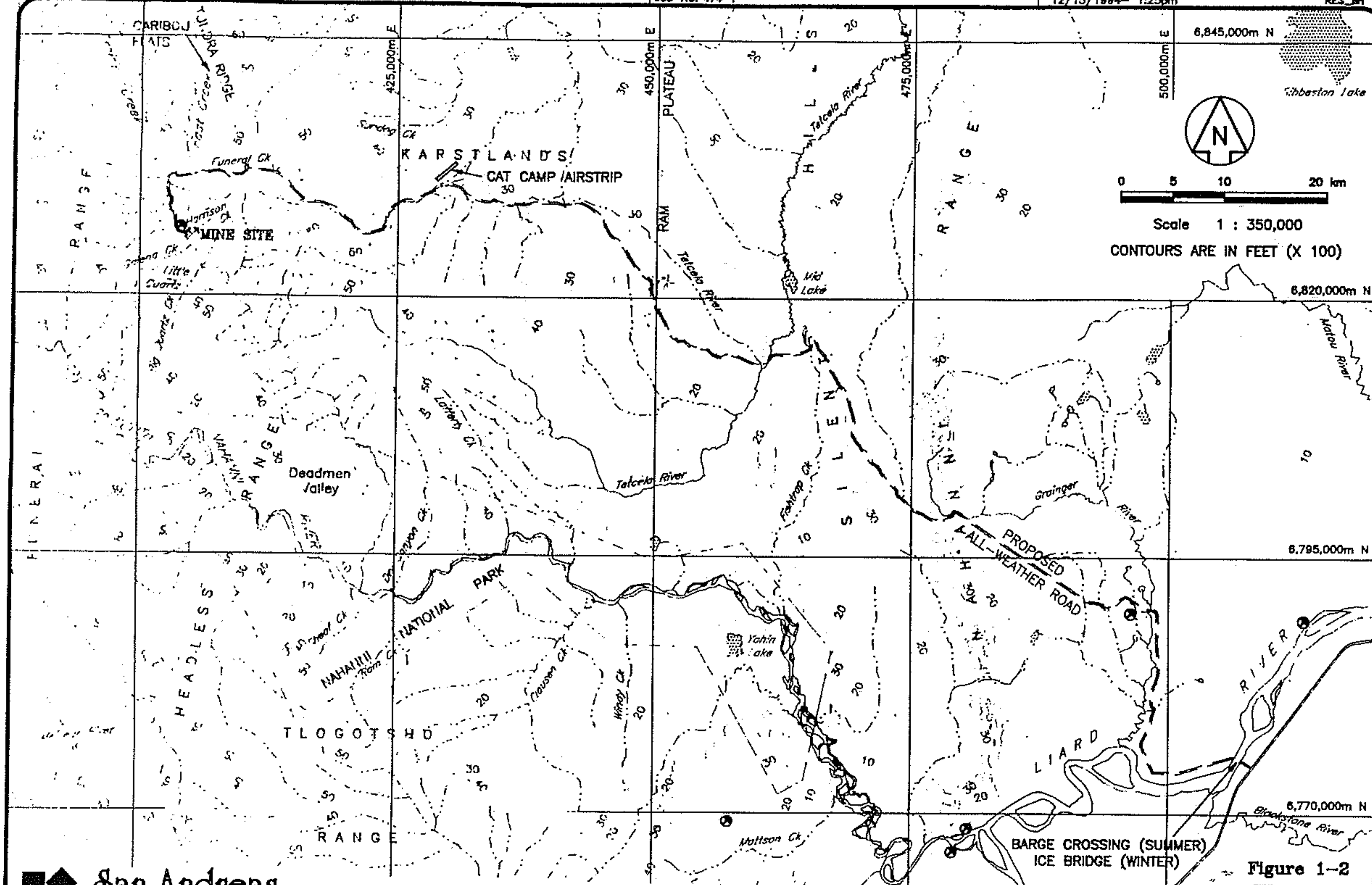


Figure 1-2

San Andreas Resources Corporation

Mine Site and Proposed All-Weather Road

Rescan

upgrading this road to provide all-weather land access to the mine site, and improvements to a disused airstrip at Cat Camp along the all-weather route at approximately km 40.

1.1.3 Project History

The first recorded discovery of lead zinc mineralization at Prairie Creek was made by native trappers in 1928. The property was first staked in 1958 when it was acquired by Fort Reliance Minerals Limited, who carried out prospecting and geological mapping. The claims were allowed to lapse in 1965.

The property was restaked and conveyed to Cadillac Explorations Ltd. in 1966. Leases acquired in 1969 form the basis of the present property/lease outline. Between 1966 and 1969 surface diamond drilling and underground development was conducted in Zones 3, 7 and 8. The exploration work had defined a strongly mineralized sulphide-quartz vein zone with high silver grades. The structure had been intermittently exposed on surface over a strike distance of approximately 10 km.

In 1970 Penarroya Canada Limited acquired an option for a 50 percent interest in the property in exchange for funding exploration costs. Pennarroya extended underground development/exploration and conducted bulk sampling and metallurgical testing of the vein material in Zone 3. Surface diamond drilling was conducted on Zones 6, 7, 8 and 9 and extensive soil geochemistry surveys were also carried out.

A legal dispute between Cadillac and Penarroya was resolved in 1974 in favour of Cadillac, who retained full ownership of the property. Penarroya was to receive compensation for their exploration expenditures from any future revenues.

In 1975 Noranda drilled eight holes in Zones 5 and 6 after optioning the southern part of the property. Their option was dropped at the end of the same year.

In 1980 Kilborn Engineering (B.C.) Ltd. carried out a feasibility study of the deposit for Cadillac Explorations. The feasibility study was positive at a mining rate of 1,000 tons per day. Reserves were also calculated by Kilborn as part of the feasibility study. Cadillac purchased a used 1000-ton-per-day concentrator complex and built a 165-km winter road from the Liard Highway to transport the mill to the site. Also in 1980, Procan Exploration Company Ltd. (the Canadian minerals division of the Hunt brothers of Texas) acquired a 40 percent interest in the property.

Surface site construction and underground pre-production development proceeded from 1981 until May of 1982. The world silver price fell from a high of approximately $50 per ounce to about $8 per ounce in this period, and Cadillac Explorations Ltd. could not raise sufficient funds to place the operation into production. Cadillac subsequently declared bankruptcy. At the time construction ceased, Kilborn estimated that surface facilities were 90 to 95 percent complete and underground development was capable of sustaining a production rate of 500 tons per day (Figure 1-3).

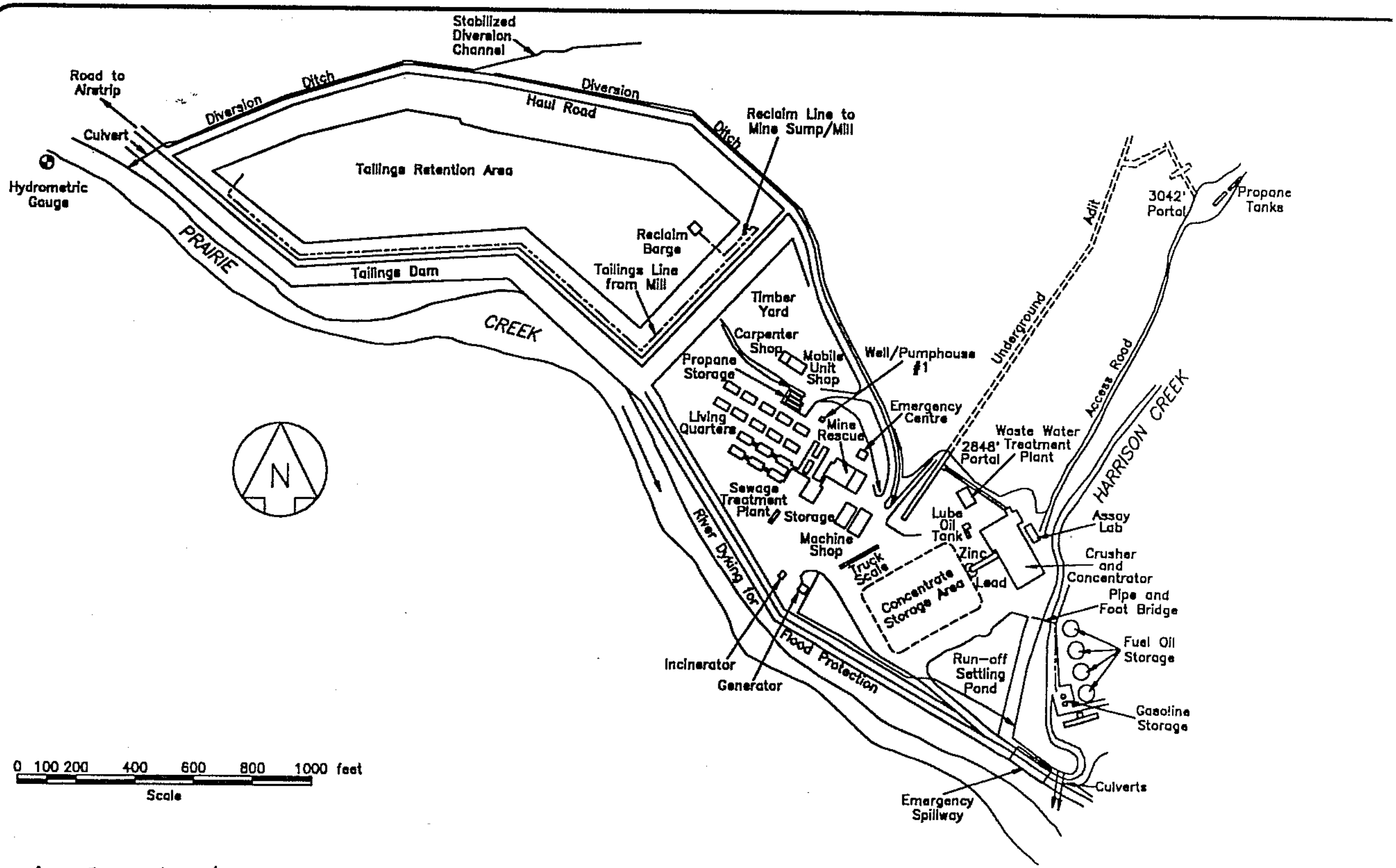
A caretaker has been retained on-site from the time of closure until the commencement of exploration by San Andreas Resources in 1992, from which time San Andreas staff have been continuously present.

In 1991, Nanisivik Mines Limited acquired the property and in August 1991 granted an option to San Andreas Resources Limited to acquire a 60 percent interest. In June 1993, San Andreas purchased 100 percent interest in the property from Nanisivik Mines Ltd. and 60 percent of the installed plant and equipment with an option on the remaining 40 percent.

1.1.4 Geology

Host rock geology at Prairie Creek is predominantly Upper Ordovician through to Lower Devonian carbonates of the southern Mackenzie Mountains. Lead-zinc-silver mineralization occurs in three different styles; vein-type, carbonate hosted stratiform-type, and Mississippi Valley Type (MVT) *i.e.,* cavity infilling style.

Vein mineralization is generally high-grade lead, zinc, silver and copper. The stratiform mineralization is also high-grade lead, zinc and iron with lower values of silver and copper than are found in the vein. The MVT mineralization thus far discovered is low grade zinc with minor amounts of lead.



San Andreas Resources Corporation

Figure 1-3: Mine Site Plan - Existing Facilities

Rescan

1.1.5 Project Feasibility

The mineral resources on the Prairie Creek property have more than tripled since San Andreas started its exploration programs in 1992. Extensive metallurgical testwork and discussions with smelters over the past two years have shown that marketable concentrates of lead, zinc and copper can be produced from the vein and stratiform deposits.

Unlike the situation in 1982 most of the value in the deposits lies in the zinc and lead minerals and silver is relegated to the status of a by-product in the proposed operation. At the maximum throughput envisaged, the property will produce an average of 110,000 tonnes of zinc concentrate, 60,000 tonnes of lead concentrate and 6,000 tonnes of copper-s concentrate per year.

Current mineral resources indicate a mine life of 10 years is feasible. If a 10 year mine life is not firmly established by the time of completion of the pre-feasibility study, the Company will have to conduct further exploration programs. With ongoing exploration programs, new reserves can be delineated in stratiform and vein deposits in the southern part of the property and possibly also within the Mississippi Valley Type (*i.e.*, the Pine Point Type) deposits in the northern part of the property. The potential for discovering these kinds of deposits on the property is considered high and if found would have the effect of extending the mine life. To date less than 10 percent of the vein has received the level of exploration required to determine mineral resources.

The economic viability of the property has been enhanced by the increase in the known mineral resources and by the presence of a nearly complete mill and ancillary facilities. A previous operator spent $64 million on developing the site. This infrastructure has a current replacement value of greater than $100 million. Preliminary estimates indicate that up to $80 million is still required to put the property into production. The single most costly element in developing the site is the upgrading of the 165-km winter access road to an all-weather route. This item alone could cost $40 million and has the potential to alter the viability of the project.

A production decision is expected to be made in May 1995 following the completion of a detailed feasibilty study by an outside engineering firm. The company anticipates construction could begin as soon as the fall of 1995.

Demand for lead and zinc is expected to rise significantly during 1996/97. The fact that the economies of the developed countries are pulling out of the recession, coupled with rising demand from the developing economies of Asia, bodes well for zinc and lead prices over the course of the next few years. It is critical for the project that it be ready to capitalize on the anticipated high prices for its products in the start-up 1996/1997 period.

1.2 Regulatory Framework

San Andreas Resources Corporation complies with all laws, regulations and standards in conducting its business as a resource company. The Prairie Creek development is subject to environmental requirements and conditions of operation that are administered by the following federal and territorial authorities under specified laws and regulations.

1.2.1 Federal Regulatory Agencies

The regulation of mining activity in the Northwest Territories is administered by several federal government departments. In the northern territories, the resources are owned by the federal government and managed by the Minister of Indian Affairs and Northern Development. Environment Canada, the Department of Fisheries and Oceans and Transport Canada also have decision-making authority for certain procedures, permits and licences related to mining.

Department of Indian Affairs and Northern Development (DIAND)

DIAND administers the *Canada Mining Regulations*, which state the requirements for the development of mines on federal lands. The *Territorial Lands Act*, which includes the *Territorial Lands Regulations*, specifies procedures for the protection of federal lands. The *Territorial Land Use Regulations* specifies the requirements for land use permits or leases on federal lands.

The *Northern Inlands Water Act*, which provides authority for the NWT Water Board to licence water use and disposal, is also administered by DIAND. This department is responsible for spill response on inland waters.

The *Indian Act* provides administrative authority on aboriginal lands, rights and lands agreements. The Archaeological Sites Regulations, which are contained within the Northwest Territories Act, provides the authority to protect archaeological sites.

Transport Canada

The federal government enforces the "handling and offering" (storage) and the transport of dangerous goods by air or water under the authority of the *Transport of Dangerous Goods Act.*

Under the authority of the *Navigable Waters Act*, the Canadian Coast Guard ensures that navigable channels are maintained.

Environment Canada

The Minister of the Environment administers the Canadian Environmental Protection Act and related Clean Air Regulations and Contaminant Release Regulations through Environment Canada.

Environment Canada also enforces sections of *the Fisheries Act* dealing with spills in water. Federal responsibilities for conducting environmental assessments and public reviews are outlined in the *Environmental Assessment and Review Process (EARP) Guidelines.*

The protection of migratory birds, waterfowl and their habitats are regulated by the *Migratory Birds Convention Act* and endangered animals and marine mammals are protected by *The Canada Wildlife Act.*

Department of Fisheries and Oceans (DFO)

Protection of fish habitat, the prevention of deleterious substances from entering fish habitat, the regulation of water crossings and the requirement for permits to conduct fish research are included within the *Fisheries Act.*

1.2.2 Territorial Regulatory Agencies

Territorial jurisdiction over mining activity is administered by the following territorial departments: Education, Culture and Employment; Renewable Resources; Safety and Public Services; and Transportation.

Education, Culture and Employment

This department enforces the *Historical Resources Act* which protects heritage resources and requires permits for archaeological surveys.

Renewable Resources

Air quality, hazardous substance control, pesticides and environmental protection are regulated under the *Environmental Protection Act.*

NWT residents can cause the Government of the NWT to take certain actions (such as conducting investigations), to preserve the environment through the authority of the *Environmental Rights Act.*

The *Wildlife Act* provides responsibility for wildlife management in the NWT.

Safety and Public Services

The *Mining Safety Act* governs the safe development and operation of mines.

The *Safety Act* ensures safety in the workplace and the Workplace Hazardous Materials Information System (WHMIS) requires the training of workers who handle dangerous materials.

Transportation

The Government of the NWT (GNWT) has authority for the transport of Dangerous Goods by the road system (including ice roads) through the *Transportation of Dangerous Goods Act.*

1.2.3 First Nations

The Deh Cho have land claims in the area of the Prairie Creek project and, for this reason, San Andreas Resources Corporation initiated contact with the leaders of the Dene bands in Nahanni Butte, Fort Simpson and Fort Liard. Land negotiations have not yet begun, although the Deh Cho have submitted a proposal to the government. San Andreas will continue to inform the Dene bands and the Regional Council of any activity in what they consider to be traditional territory. The Deh Cho Tribal Council may develop a resource development policy encompassing principles to protect the environment, land claims, culture and employment which will be relevant to the project. San Andreas will negotiate an agreement with the communities closest to the site — Nahanni Butte, Fort Simpson and Fort Liard — pertaining to employment and benefits.

The Deh Cho Regional Council, based in Fort Simpson, is an umbrella organization that encompasses the following communities: the Hay River reserve; Kakisa Lake, Fort Providence; Jean Marie River; Trout Lake; Fort Liard; Nahanni Butte; Fort Simpson; and Wrigley. Since mid-1994, a Sahtu community of mountain-dwelling people have also been part of the Deh Cho Regional Council.

The Chiefs of Nahanni Butte, Fort Simpson and Fort Liard are Francis Betsaka, Herb Norwegian and Henry Deneron (re-elected December 12, 1994), respectively.

1.3 Report Objectives

The purpose of the Project Description Report is to provide project-specific information to the NWT Regional Environmental Review Committee (RERC) for the Level II screening process. The NWT RERC is a multi-agency interdisciplinary body through which the Department of Indian Affairs and Northern Development (DIAND) implements its Environmental Assessment and Review Process (EARP). DIAND represents the Government of Canada, which administers virtually all lands and regulates the development of natural resources within the northern territories.

The level of screening within the EARP is determined by several factors including the degree of environmental impact, methods of mitigation, previous knowledge of technology etc. The Level I screening usually pertains to Land Use Permits and Water Licences and is completed by the RERC's Northern Affairs Program (NAP). The Level II screening process requires a Project Description Report and may also require an Initial Environmental Evaluation (IEE) if further study of potentially significant environmental impacts is deemed necessary. The Level III screening is recommended in cases where little is known about the type of development and its impacts, where environmental issues are especially sensitive, where the public is opposed to the project or questions its impact *etc.*

1.3.1 Water Licence

Similar to land use requirements, a Water Licence must be obtained prior to the initiation of development. Under authority of the *Northern Inland Waters Act and Regulations*, licences are issued by the NWT Water Board upon approval by DIAND. The term of the licence can be up to twenty-five years.

A Water Licence was granted to Cadillac Explorations Limited for Prairie Creek Mine in 1982 for water use up to 1,150 m^3/day and not exceeding 420,000 m^3/year. A copy of the granted licence is provided in Appendix A.

2.0 DEVELOPMENT PLAN

2.1 Overview

The following development plans are geared to place the property into production by late 1996. It is considered imperative for the project to be in production at this time to capitalize on anticipated high world prices for zinc and lead.

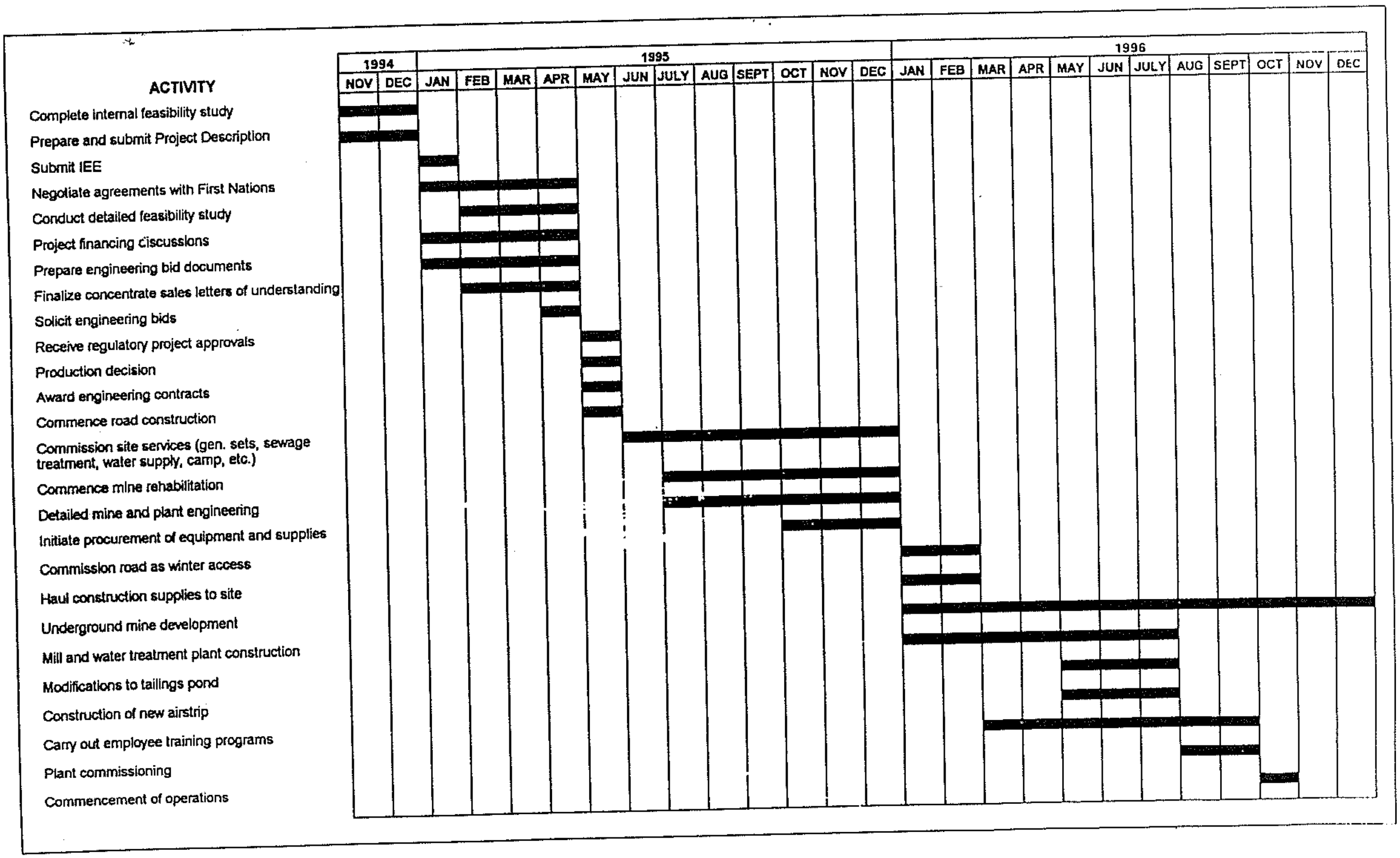
2.2 Project Schedule

The following highlights the important milestones for commissioning of the Prairie Creek Project. These items are graphically presented in Figure 2-1.

Year	Months	Activity
1994	11, 12	Complete internal feasibility study
	11, 12	Prepare and submit Project Description
1995	1 - 4	Negotiate agreements with First Nations
	1	Submit IEE
	2 - 4	Conduct detailed feasibility study
	1 - 4	Project financing discussions
	1 - 4	Prepare engineering bid documents
	2 - 4	Finalize concentrate sales letters of understanding
	4	Solicit engineering bids
	5	Receive regulatory project approvals
	5	Production decision
	5	Award engineering contracts
	5	Commence road construction
	6 - 12	Commission site services (gen. sets, sewage treatment, water supply, camp etc.)
	7 - 12	Commence mine rehabilitation
	7 - 12	Detailed mine and plant engineering
	10 - 12	Initiate procurement of equipment and supplies
1996	1 - 2	Commission road as Winter access
	1 - 2	Haul construction supplies to the site
	1 - 12	Underground mine development
	1 - 7	Mill and water treatment plant construction
	5 - 7	Modifications to tailings pond
	5 - 7	Construction of new airstrip
	3 - 9	Carry out employee training programs
	8 - 9	Plant commissioning
	10	Commencement of operations

Figure 2-1

Prairie Creek Project Schedule



2.3 Geology and Mineral Resources

The mineral resources at the Prairie Creek property are hosted in carbonate rocks. The north-south trending main vein/fault structure is traceable for a distance of over 10 km on the property on which twelve separate mineralized occurrences have been found. The bulk of the mineral resources outlined to date on the property are established on only one of these occurrences (Zone 3).

The mineralization within the vein is best developed where the vein cuts through the Whittaker Formation and is least well developed where it cuts the Cadillac Formation. Mineralization within the quartz vein is heavy lead-zinc-copper sulphides with very significant silver grades. Mineralization within the stratiform deposits consists of heavy zinc-lead-iron mineralization with less significant silver and minor amounts of copper.

All mineral resources outlined to date are contained within the vein and stratiform deposit. In addition to these deposits significant zinc-iron mineralization has recently been found in the northern part of the property within structures similar to some of those mined-out at Pine Point, NWT. Economic values have yet to be intersected within this type of deposit on the property.

2.3.1 Regional Geology

The Prairie Creek property is located in the southern portion of the Mackenzie Mountains physiographic subdivision within the Northern Cordillera Geosyncline. The Southern Mackenzie Mountains are underlain by Lower Paleozoic carbonates of the Mackenzie shelf, and associated basinal limestones, dolostones and shales. No igneous rocks have been identified in the area.

Structurally the prevalent orientation of faulting and folding is north - south. Faults and fold axial planes dip both east and west. A number of north trending thrust faults cut through the region. The west dipping Gate Fault and east dipping Tundra Thrust Fault are two of the larger tectonic structural features proximal to Prairie Creek.

The geology of the Prairie Creek/South Nahanni area was the focus of the Geological Survey of Canada Memoire 412 by D.W. Morrow and D.G. Cook.

2.3.2 Property Geology and Mineralization

The Prairie Creek property is located on the eastern margin of the Prairie Creek Embayment which is composed primarily of Lower Ordovician Silurian Whittaker Formation dolostones, Road River Formation shales, and Cadillac Formation thinly bedded dolostone. Lower to Middle Devonian Arnica and Funeral Formation dolostone and limestone overlie this unit on the northern part of the property. Faulting and folding trends N-S in the property area, resulting in windows of older Road River and Whittaker Formation rocks exposed along the core of the main anticline.

The carbonate hosted stratiform style of mineralization discovered in 1992 occurs within the Upper Whittaker Formation. For property - scale stratigraphic control, the Upper Whittaker has been subdivided into seven geological sub units.

The Whittaker Formation is conformably overlain by the Silurian to Devonian aged finely bedded argellaceous dolomitic Road River Formation. Most of the numbered mineralized zones at Prairie Creek (vein style mineralized surface showings) occur in Road River Formation 'shales'.

There are three main styles of mineralization at Prairie Creek; vein, stratiform and cavity - infilling style (MVT). Vein mineralization, the first style of mineralization discovered on the property, occurs in a N-S trending (010 degrees) 10 km long trend. Surface showings of mineralized vein exposures are numbered from one to twelve from north to south. The veins trend at approximately 000 degree azimuth and dip steeply both east and west.

Mineralization comprises galena, sphalerite, lesser pyrite, tennantite-tetrahedrite as massive to disseminated in a quartz-carbonate matrix. Silver is present both in galena and in the tennantite-tetrahedrite. Vein grades and widths are variable. The most extensive known vein occurrence is in Zone 3 where underground development and drilling have outlined 940 metres of strike length. Zone 3 vein mineralization is known to be offset by several shallow dipping reverse faults (Figure 2-2).

Stratiform mineralization was first discovered in 1992 while drilling to extend vein reserves at depth. Up to six mineralized stratiform lenses have been intersected varying in thickness from between less than one metre to several metres in thickness. Total thickness of the stratiform zone reaches up to 28 metres. Stratiform

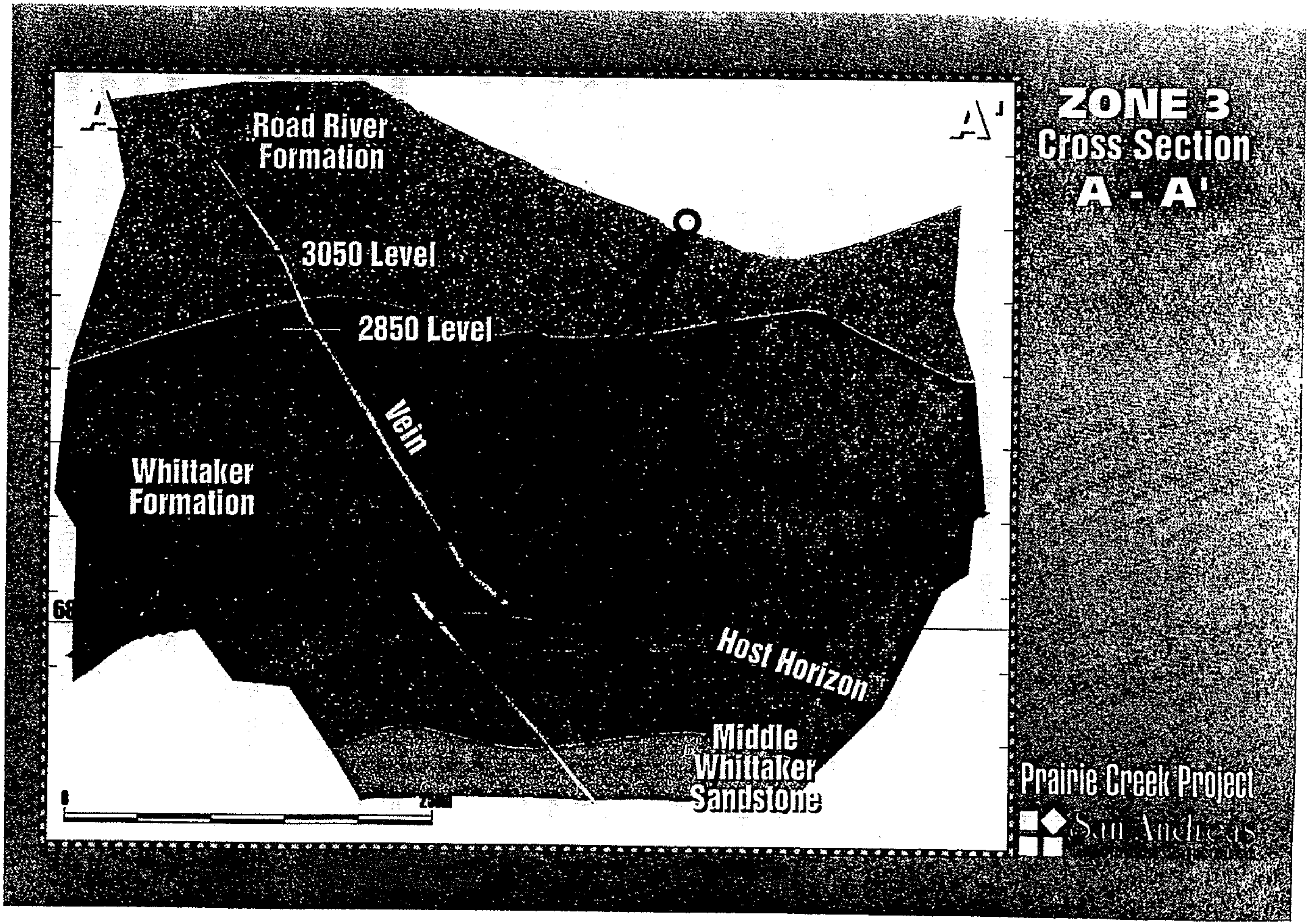

A
A'
Road River Formation
3050 Level
2850 Level
Vein
Whittaker Formation
Host Horizon
Middle Whittaker Sandstone
ZONE 3
Cross Section
A - A'
Prairie Creek Project
San Andreas

Figure 2-2:

mineralization is generally fine grained, banded to semi massive, consisting of massive fine grained grey sphalerite, 'framboidal' reddish brown, and coarse grained yellowish sphalerite, coarse grained galena and disseminated to massive fine grained pyrite. Variably sphalerite replaced black chert nodules and bands are common. Silver and copper grades are generally lower than in the vein style mineralization.

Stratiform style mineralization has now been identified in three separate zones within three stratigraphic horizons of the Upper Whittaker Formation. In Zone 3 the second lowest stratigraphic unit (Mottled Unit) contains the majority of the known stratiform mineralization. However, in the northern part of Zone 3 , unit 4 (Lower Spar) is also mineralized. At Zone 6, unit 6 (Upper Spar) hosts stratiform style mineralization (Figure 2-3).

Cavity infilling style mineralization (MVT) discovered at the Zebra area is comprised of colliform bands of dark reddish sphalerite and brassy pyrite with or without later dolomite infilling. Mineralization is hosted within the Root River Formation. Rare medium grained galena mineralization occurs within the sphalerite. This style of mineralization is similar to some of the deposits mined at Pine Point, NWT. Zebra is located near the southern end of a 10 km long trend of showings discovered in 1993. Mineralization occurs discontinuously at approximately the same stratigraphic horizon along this NNW trend..

2.3.3 Geological Resource

Current calculations indicate a total *in situ geological resource* of 6,213,000 million tonnes grading 12.82% zinc, 12.15% lead, 0.318% copper and 179.69 grams/tonne silver. These resources are distributed as shown in Table 2-1.

2.4 Proposed Mine Plan

2.4.1 Production Rate and Mine Life

The mill will have a rated capacity of 1,800 tonnes per operating-day after modifications have been made.

Using a ramp-in-ore cut-and-fill method of mining in the vein and a room-and-pillar/post-pillar cut-and-fill stoping method in the stratiform deposits average 1,650

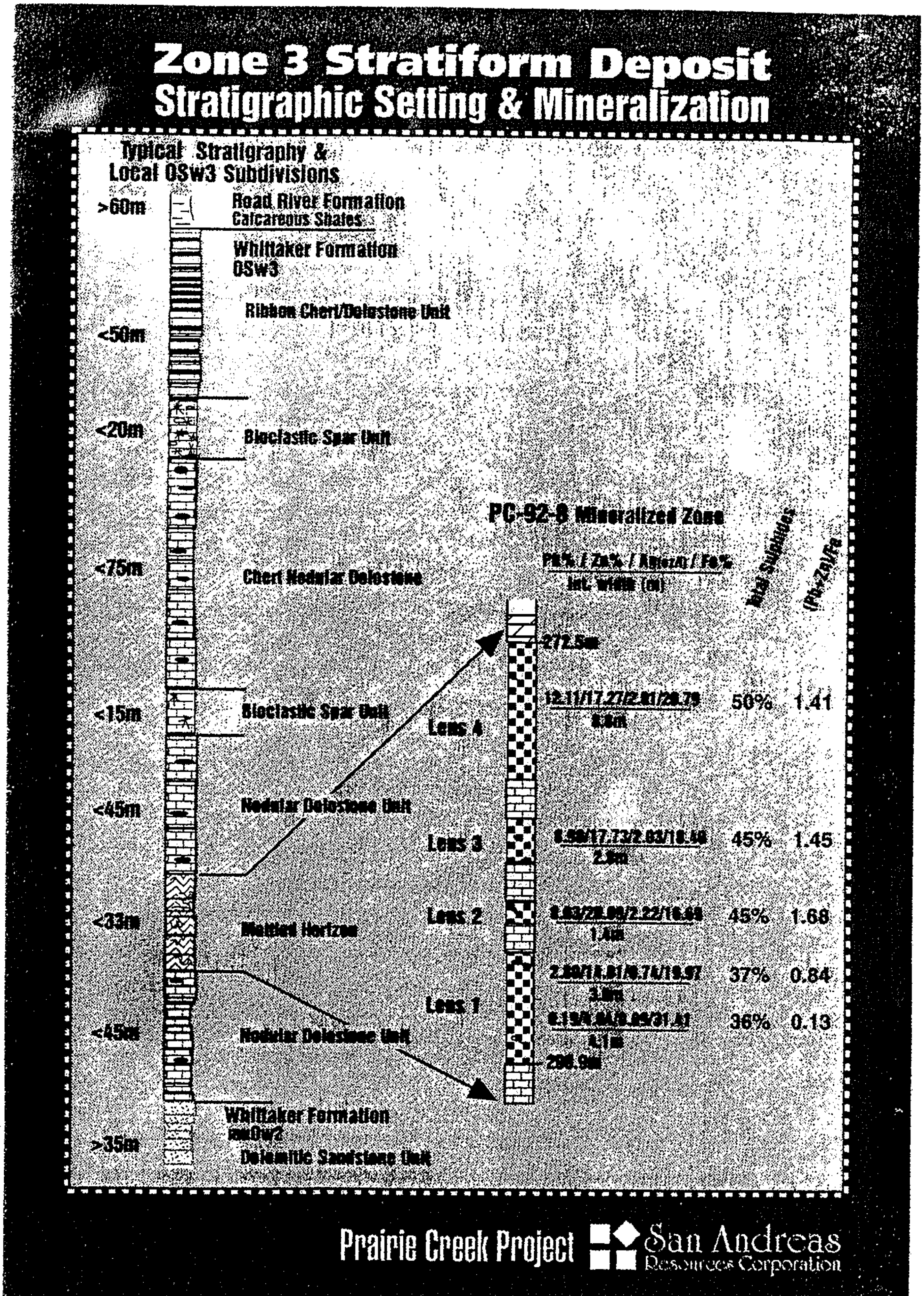

Zone 3 Stratiform Deposit
Stratigraphic Setting & Mineralization
Typical Stratigraphy &
Local OSw3 Subdivisions
>60m
Road River Formation
Calcareous Shales
Whittaker Formation
OSw3
Ribbon Chert/Dolostone Unit
<50m
<20m
Bioclastic Spar Unit
<75m
Chert Nodular Dolostone
<15m
Bioclastic Spar Unit
<45m
Nodular Dolostone Unit
<33m
Mottled Horizon
<45m
Nodular Dolostone Unit
>35m
Whittaker Formation
Dolomitic Sandstone Unit
PC-92-8 Mineralized Zone
Int. width (m)
Total Sulphides
(Pb+Zn)/Fe
272.5m
Lens 4
50%
1.41
Lens 3
45%
1.45
2.3m
Lens 2
45%
1.68
Lens 1
37%
0.84
36%
0.13
Prairie Creek Project
San Andreas
Resources Corporation

Figure 2-3:

Table 2-1

In Situ Mineral Resources of Prairie Creek Project

	Tonnes	%Lead	%Zinc	%Copper	Silver gms/tonne
Zone 3					
Main Vein	4,019,000	14.29	12.02	0.421	218.23
Stockwork Vein	720,000	8.20	17.44	0.270	122.35
Stratiform Type	1,144,000	7.08	12.95	0.022	73.13
Total Zone 3	*5,884,000*	*12.14*	*12.86*	*0.325*	*178.27*
Other Zones					
Zone 7 Vein	124,000	13.06	8.58	0.20	203.31
Zone 8 Vein	205,000	11.79	14.10	0.20	206.06
TOTAL RESOURCES	**6,213,000**	**12.15**	**12.82**	**0.318**	**179.69**

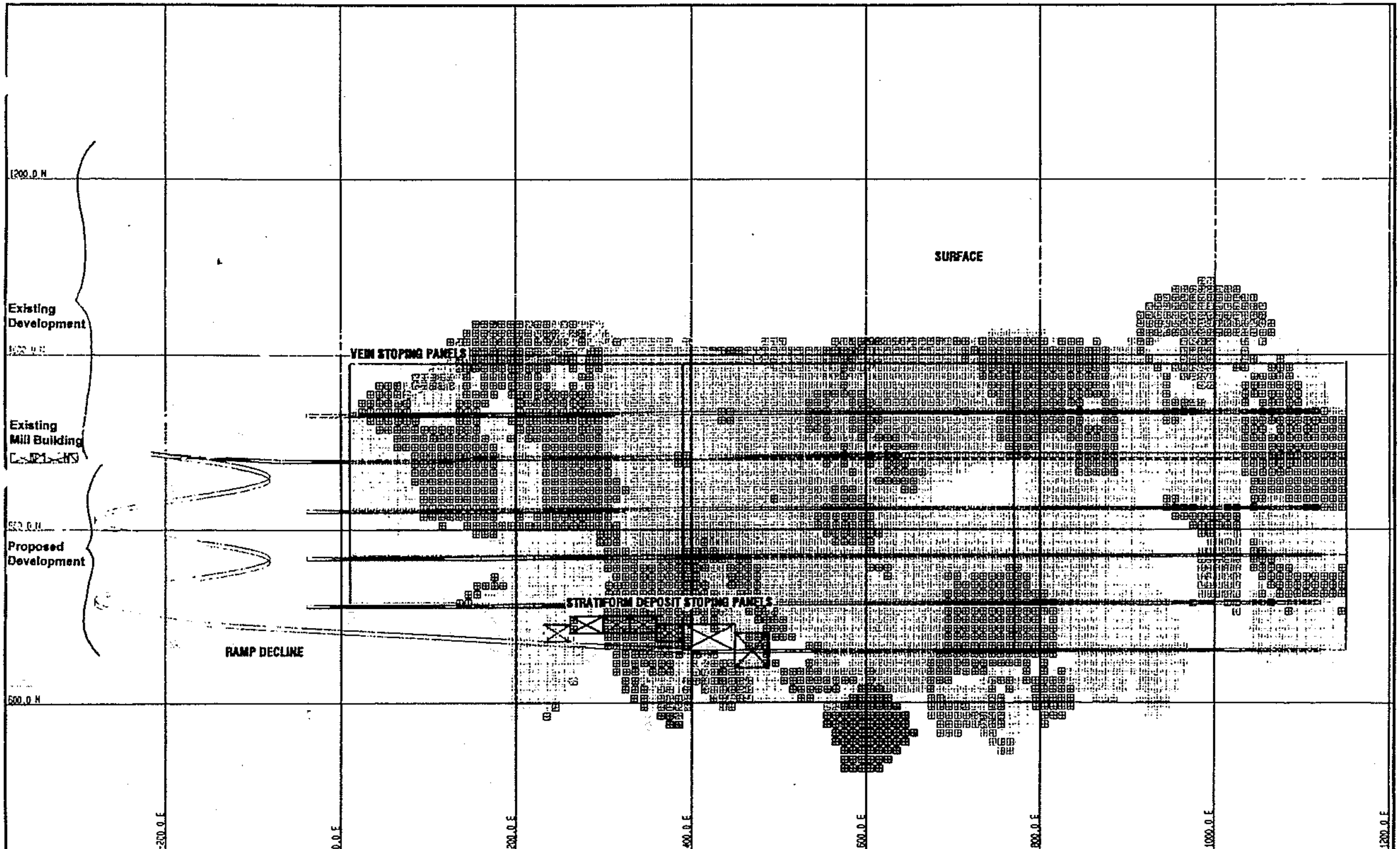
tonnes per day production from the mine is feasible. Based on current reserves, and using this rate of production, approximately a 10 year mine life is anticipated.

2.4.2 Production Schedule and Pre-Production Development

The pre-production development in Zone 3 will consist of the following main elements:

- extend the three existing levels to full length;
- drive decline to the base of the stratiform deposit;
- cut four lower levels on the vein from the decline at 55 m intervals;
- drive in-stope ramps for the vein stope panels;
- establish haulage and ventilation for all levels.

The provisional stope layout is shown in the attached sketch. Seven vein stoping levels and several stratiform stoping panels are outlined (Figures 2-4). All extraction is by some form of mechanised cut-and-fill stoping method. The above



San Andreas Resources Corporation

DATE: 12/16/94 TIME: 10:05:56

SCALE (HOR) 1:4000 SCALE (VERT) 1:4000

Software by GENCOM Services Inc.

PRAIRE CREEK PROJECT
ZONE 3 - VEIN LONGITUDINAL SECTION
NSR BLOCKS AND PROPOSED DEVELOPMENT

Figure 2-4:

scenario will give the maximum production rate of 1,650 tonnes per day. The optimum production rate has yet to be defined.

2.4.3 Mining Method

Vein Deposit

A mechanised ramp-in-stope cut-and-fill mining method is envisaged for the vein deposit. The sequence of stoping and filling is illustrated on Figure 2-5.

Production from one of these stopes would be approximately 100 tonnes per shift or 200 tonnes per day. Six to seven such stoping panels would give the maximum required production.

Stratiform Deposit

For those parts of the deposit that are greater than two mining heights thick (6.0 m) the post-pillar cut-and-fill mining method will be used. This method is very similar to the room and pillar method but mining takes place from the bottom up. Panels might be four pillars wide *i.e.* 32 m (a pillar of 3 m and a room of 5 m) depending on the results of more detailed geotechnical studies. For those parts of the deposit that are less than 6 m thick a form of conventional room-and-pillar mining would be used.

Productivities from these stopes would be in the order of 1,000 tonnes per month per metre of face.

2.4.4 Backfilling

The mining method chosen will maximise the use of tailings for backfilling the stopes. The requirements for paste backfill or cemented tailings as opposed to unconsolidated backfill await more detailed study.

2.5 Proposed Milling Plan

San Andreas will utilize conventional crushing, grinding and differential froth flotation in the production of copper, lead and zinc concentrates at Prairie Creek. The following sections outline the milling and metallurgical process proposed for Prairie Creek. Figure 2-6 provides a schematic representation of the process.

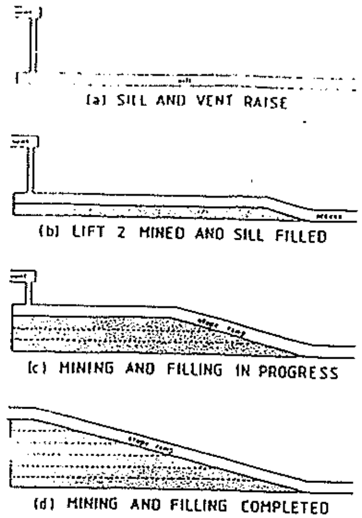


Figure 6. Underhand mining

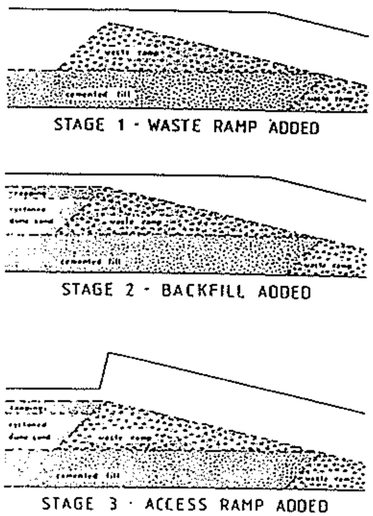


Figure 7. Formation of the ramp using waste rock

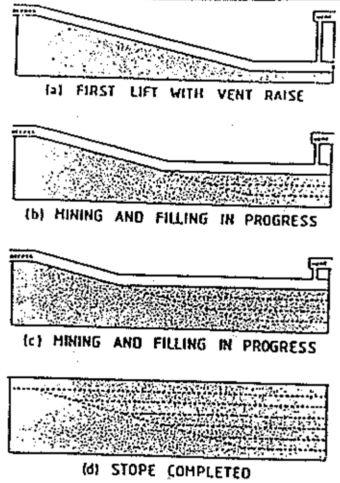


Figure 8. Overhand mining

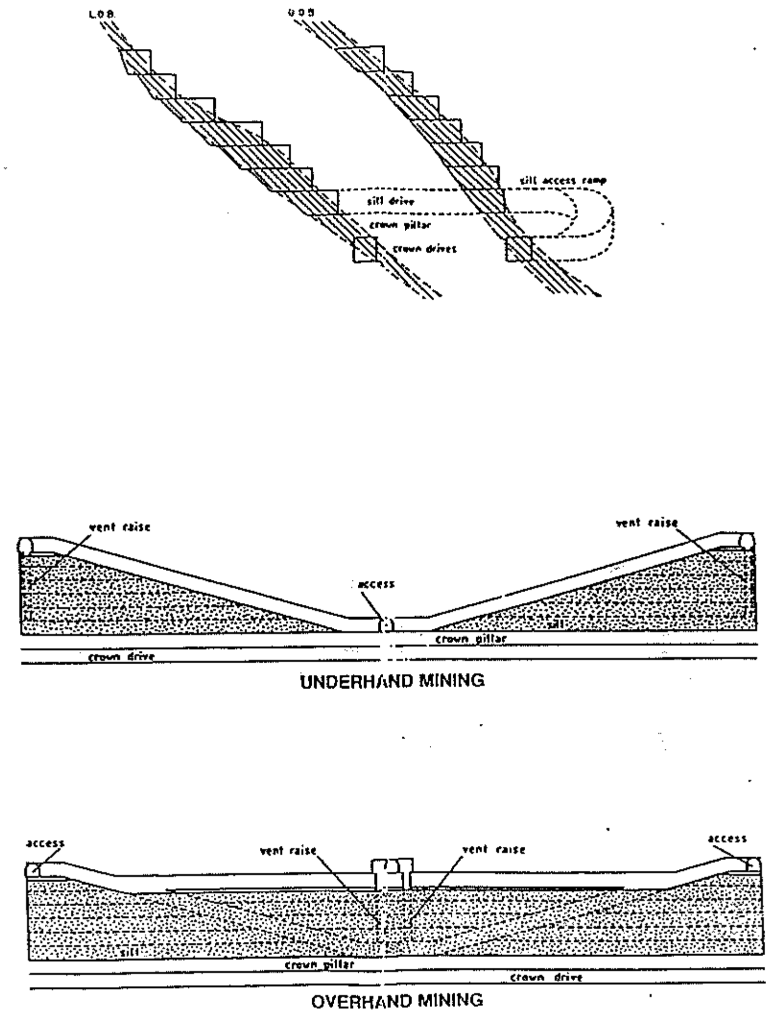


Figure 10. The sequence for two double stopes in crown ramp-in-stope mining

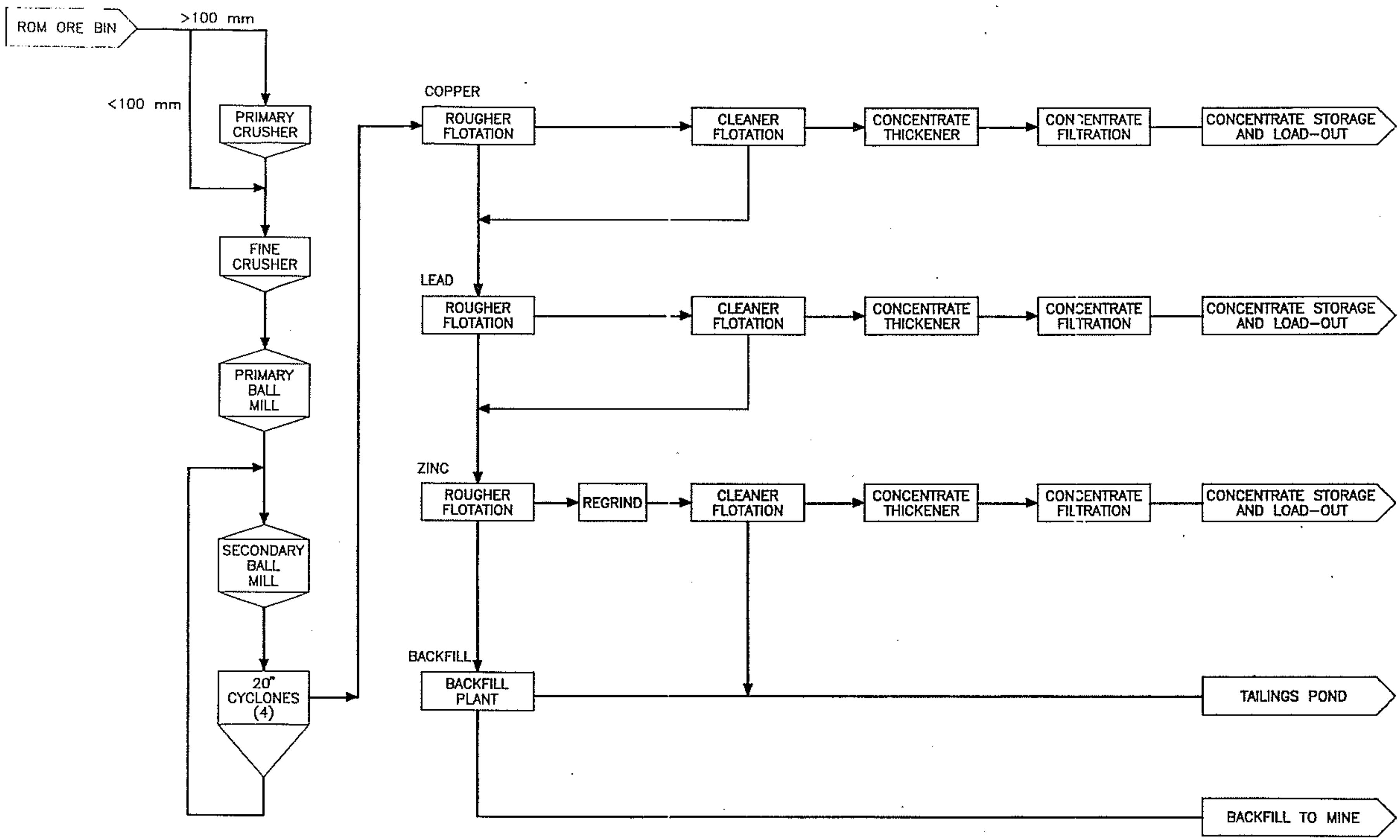
San Andreas Resources Corporation

Sequence of Stoping and Filling Planned at Prairie Creek

Figure 2-5:

Rescan

Cad No. C0688 2 P1 | Job No. 474-1 | 12/15/1994- 3:35pm RES_BH



San Andreas Resources Corporation

Figure 2-6

Proposed Milling Process Flow Sheet

Rescan

2.5.1 Crushing and Grinding

San Andreas intends to utilize the crushing circuit which was constructed by Cadillac Explorations.

Ore from the mine will be discharged from mine cars into a run-of-mine ore bin. A vibrating feeder will withdraw ore from the bin to feed a conveyor which will discharge into the primary crusher feed bin. Ore will be withdrawn at a controlled rate by an apron feeder which will discharge onto a fixed grizzly. Material coarser than 100 mm will pass into the 24" x 36" jaw crusher while the grizzly undersize product will fall directly onto the primary crusher discharge conveyor.

The fine crushing circuit will comprise a 5½' short head cone crusher in closed circuit with a 5' x 14" double deck vibrating screen.

The final crushed product will be conveyed to the 1,800 tonne capacity fine ore bin. The primary and secondary crushing circuits will be serviced by two bag house dust collectors to minimize airborne emissions.

Ore will be taken from the fine ore bin by means of a conveyor which will discharge into the 10' diametre x 14' long primary ball mill. The ball mill will discharge into a pumpbox from which the slurry will feed a new 10' diametre x 14' secondary ball mill in closed circuit with 4, 20" cyclones. The cyclone underflow product will be returned to the secondary ball mill while the cyclone overflow pulp will constitute the feed to the flotation circuit (Figure 2-6).

The use of Programmable Logical Controllers (PLCs), together with conventional instrumentation and video monitors, will permit the crushing plants to be controlled from the main control room. The entire crushing and grinding circuits are housed in a heated and insulated, metal-clad building.

2.5.2 Flotation

The expanded concentrator will have the capability to produce three selective flotation concentrates (Figure 2-6). When treating vein ore, copper, lead and zinc concentrates will be produced. Since stratiform ore contains minimal amounts of copper, only lead and zinc concentrates will be produced from this material. The stratiform and vein ores will be processed separately in order that the flotation environment can be optimized for each ore.

The existing flotation circuitry will be re configured to become the copper flotation circuit. This circuit will include rougher/scavengers and two stages of cleaner flotation. When treating stratiform ore, the flotation feed pulp will be diverted from the copper circuit directly to the lead rougher feed.

An expansion will be made to the west of the existing plant to house the new lead and zinc flotation circuits. These circuits will both incorporate rougher scavenger flotation machines. The lead circuit will include two stages of cleaning while the zinc will require three stages. A new 9' x 12' zinc regrind mill will be installed in an expansion of the plant to the south. This mill will regrind the zinc rougher concentrate prior to the cleaner flotation stages.

Based upon testwork to date, the following standard suite of reagents will be used in the flotation process:

- ethyl xanthate
- methyl isobutyl carbinol (MIBC)
- lime
- Minerec 2030
- copper sulphate
- butyl xanthate
- frother(s)
- sodium metabisulphite

Each of these reagents is commonly used in the flotation of base metal concentrates.

2.5.3 Concentrate Dewatering and Loadout

Final concentrates from each of the flotation circuits will be pumped to the respective thickeners. The thickened products will be transferred to concentrate stock tanks prior to filtration. The plant currently includes two Larox pressure filters. These units will be upgraded and augmented with an identical third new machine. The filters discharge on to 2 loadout conveyor belts which transport the material into a loadout shed. One conveyor will be used to carry both lead and copper concentrates on an alternating basis while the other conveyor will be dedicated to the movement of zinc concentrates.

The loadout building will be a Sprung, or equivalent structure, constructed on concrete foundations with a concrete slab and retaining walls. The building will be sized to accommodate the equivalent of 6 weeks' concentrate production to ensure that all the material can be stored under cover during the suspension of concentrate shipping activities in the Spring and the Fall.

A front-end loader will be used to load the concentrates into the haulage trucks. The boxes of the trucks will be securely covered before the truck is dispatched.

2.5.4 Process Alternatives

The separation of base metal sulphide concentrates from barren rock depends upon the selective flotation process. Flotation technology has been used world-wide on a commercial basis since the beginning of the century. No economically viable alternative has yet been developed. It has been clearly established, over many years, that a plant based upon flotation technology can be designed, built and operated to satisfy all normal environmental requirements.

Flowsheets developed in the early 1980s depended upon the use of sodium cyanide to achieve effective selective flotation results. San Andreas has completed a series of flotation tests on both vein and stratiform ore in an effort to eliminate the use of this reagent. The results of this work have been positive and, as a result, sodium cyanide will not be used in the proposed flotation circuit.

Economic considerations dictate that the mill be located as close to the mine as practical, thereby minimizing the distance which waste rock must be moved. In addition, there are obvious economic benefits to be derived through the consolidation of all the mining processing and service activities.

In the case of the Prairie Creek mine, the existing facilities were built with the above fundamental principles in mind. Further, the scarcity of suitable building sites limited the options for the mill location. The fact that mining, milling and service infrastructure facilities are currently in place is a major economic benefit to the

Project. Were these facilities not available, or if it were necessary to move the surface plant and equipment, the project would no longer be economically viable.

2.6 Site Facilities

2.6.1 Existing Infrastructure

(a) *Road* - A 160 km long winter road was constructed and used over the winters of 1980-81 and 1981-92. The road made use of an ice bridge across the Liard River near the Blackstone River off the Liard Highway.

(b) *Airstrip* - A 3000' airstrip is located approximately 1 km to the north of camp. DC-3 aircraft and D4 Caribou aircraft have used this strip in the past.

(c) *Tailings Disposal* - A tailings impoundment area was constructed immediately adjacent to, and to the NW of camp. Geotechnical work is presently ongoing to determine the status of this facility.

(d) *Camp Accommodation* - Trailer accommodations for 240 people have been erected on site. Kitchen facilities to meet a full camp compliment of employees were also completed.

(e) *Maintenance Shops* - Maintenance shops were erected and equipped during construction. Some modern machinery is presently required.

(f) *Office and Warehouse* - Office and warehouse facilities exist and are in good repair. The office complex houses the office, main warehouse, dry first aid, and mine rescue and recreation facilities.

(g) *Laboratory* - A pre-engineered laboratory building exists behind the mill. Much of the equipment for the laboratory is required.

2.6.2 Power Supply

The existing power supply for the mill consists of four 1.1 megawatt Cooper - Bessmer diesel powered generators. Two additional 1.5 megawatt generators will be required to power the expanded plant bringing the total to 7.4 megawatts. Two smaller standby generators have also been installed.

2.6.3 Fuel Supply and Storage

Four 10,400 barrel diesel storage tanks and one 25,000 gallon gasoline storage tank were erected beside the mill. Associated loading and pumping facilities are completed.

2.6.4 Water Supply

Process Water

Process water would be drawn from the underground workings, the potable water wells, and if necessary, Prairie Creek.

Fire Water

The main source of water for fire propection is an underground sump on the 3050 Level.

Potable Water

Water is obtained from two wells located in the floodplain adjacent to camp. The well water does not have to be treated to make it potable.

2.6.5 Sewage Disposal

All sewage will be pumped directly to a sewage treatment plant. The plant has a capacity of 18,000 gallons per day and uses a biological aeration system and clarifier. The effluent is discharged into the tailings pond.

2.7 Waste Rock and Tailings Disposal

In the production of concentrate from ore processing at Prairie Creek, waste rock and tailings will necessarily be generated that will require physical and environmentally stable storage. The following sections describe the current plans for storage of waste rock and tailings at the Prairie Creek Project.

2.7.1 Waste Rock Disposal

Waste rock will be generated both during the mine development and pre-production phases as well as throughout the mine life. Pre-production development will generate less than 100,000 tonnes of non-acid generating waste rock. The exact location of the waste dumps has not been finalized; however, the decision will centre largely on stability issues as acid rock drainage from the waste dumps are not considered to be an environmental concern (Section 4.18). Accordingly, all waste dumps will be designed and constructed to acceptable engineering standards to ensure long-term physical stability.

2.7.2 Tailings Impoundment Design

Generalized Background

Initial geotechnical investigation and design work on the tailings retention pond was carried out in the early 1980s by Golder Associates. Performance from 1982 through 1985 was reviewed by Hardy Associates (1978) Ltd. A summary of these early studies follows:

Two potential tailings retention areas, denoted T2 and T3, were selected for detailed site investigation from amongst nine alternatives. T2 is the present location. T3 is situated on the east side of Prairie Creek approximately 1 km downstream where the meteorological station is now located.

Detailed site investigations were carried out between July 7 and September 3, 1980 using a skid mounted Longyear 38 diamond drill. Samples were collected and laboratory testing completed. Piezometers and temperature sensing instruments were installed.

T2 was selected as the better location because of:

- its proximity to the plant site;
- it was substantially cleared of brush;
- it was enclosed by existing river dykes which could be incorporated into the design cross-section; and

- an impervious clay stratum present over most of the base area was extensive enough to provide a basal seal as well as borrow material for construction of an impervious clay core in the upstream side of the perimeter embankment.

Construction of the T2 tailings retention impoundment involved expanding the river dykes to form the perimeter embankment dyke. It is believed that material excavated from the natural slope against the north valley wall was also used to construct the embankment dyke. Excavating this slope, which is referred to as the backslope, also served to increase the available pond volume.

Construction of the perimeter embankment dyke was, for the most part, completed between July and September, 1981. Further field investigations in 1981 led to suspicion that the basal clay stratum was not continuous in the vicinity of the backslope. A synthetic liner and drainage system associated with it was installed in March 1982.

Almost continuous shallow failures developed on the upstream face of the perimeter dyke in June 1982 in conjunction with a period of heavy rain which followed melting of a higher than average snow pack. Observations through 1985 attest to increased severity in the extent of sloughing. In particular, gravel covering the clay blanket was almost completely removed and cracking retrogressed into the crest of the embankment.

The backslope also became unstable during this period. Numerous imbricate failures ranging from shallow to moderately deep-seated and causing distortion and local tearing of the synthetic liner were reported. Permafrost degradation was believed to have been a factor in parts of the backslope.

Despite poor performance of the tailings pond slopes, no seepage from the pond was detected in observations reported as late as 1985.

Site Investigation

A site reconnaissance was carried by Dr. Wayne Savigny of Bruce Geotechnical Consultants Inc. on June 12, 1994. Three landslide mechanisms were confirmed or identified as listed below:

- shallow instability affecting the upstream face of the perimeter embankment dyke:
- shallow to moderately deep-seated instability affecting the backslope; and
- possible deep-seated translational instability affecting the backslope.

The first two are consistent with the failure characteristics discussed above for the perimeter embankment dyke and backslope. Evidence suggesting the third mechanism was recognized during the site reconnaissance. A detailed site investigation program was planned on the basis of the June 1994 visit and with a view to complementing earlier geotechnical studies.

Drilling, sampling and instrumentation activities were carried out between October 18 and November 3, 1994, using a skid mounted Longyear 38 diamond drill owned by San Andreas Resources Corp. A total of nine holes were advanced with NW casing and NQ triple tube coring equipment. Eight are in the backslope area and one is in an undisturbed region of the T3 area for the purpose of establishing base-line ground temperatures and permafrost conditions. Holes ranged in depth from 20.1 to 29.7 m. Three piezometers, five slope indicator casings and four thermistor strings were installed.

Five test pits were excavated into the upstream face of the perimeter embankment dyke. *In situ* tests were completed with a pocket penetrometer and vane shear device in each test pit. Samples were collected at each *in situ* test site.

Planned Work

Laboratory testing on samples collected during the site investigation program is underway. A site visit for follow-up instrument monitoring is scheduled for late in December, 1994. Geotechnical analysis and design of remedial measures will follow.

2.7.3 Tailings Supernatant Treatment and Discharge

The decant from the tailings pond will be treated in a plant designed to precipitate the metals dissolved in the water. The effluent treatment plant will have the capability to process the entire tailings pond decant stream. The treated water will be re-used in the milling circuit as water balance conditions allow. The excess treated water will be discharged to the environment.

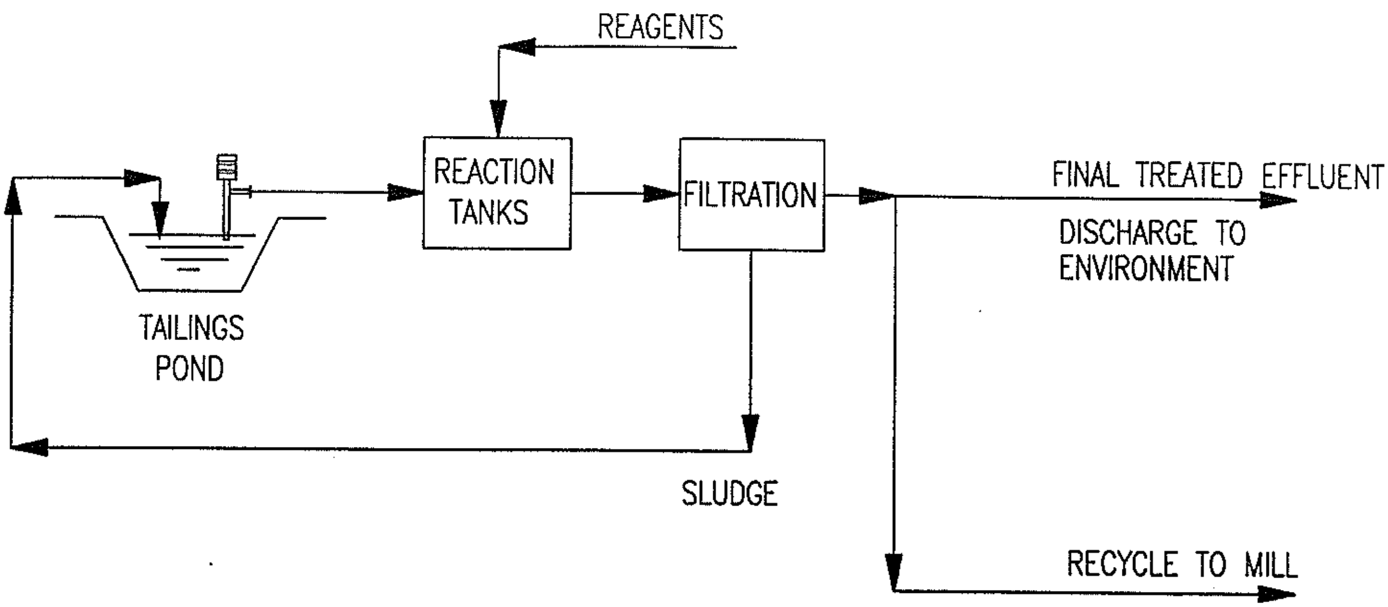
The design capacity of the effluent treatment plant will be based on the overall site water balance which incorporates processing requirements, mine water, site run-off and other hydrological considerations.

The expected quality of the tailings decant water has been based on flotation tailings samples from metallurgical testwork as well as typical mine water samples collected at the site. The effluent treatment plant design is a result of bench scale laboratory testwork conducted on samples which were determined to have the highest concentrations of dissolved metals.

The effluent treatment plant will consist of the unit operations as shown in Figure 2-7. Dissolved metals mill be precipitated in agitated reaction tanks with a total of two hours retention time. Reagent additions of ferrous sulfate, sodium hydrosulfide and lime will precipitate the dissolved metals as sulfides and hydroxides. A single aeration tank with 30 minutes retention will be incorporated following precipitation to ensure any residual ferrous iron is oxidized to the ferric state for subsequent precipitation as hydroxide. Due to the low concentrations of metals in solution in the tailings pond decant, very little mass of precipitate will be formed. As such, a clarification step utilizing a high density sludge bed with sludge recycle is not deemed feasible. The solid precipitates will be separated from the treated water using a sand type filter. The backwashed filter residue containing the solid precipitates will be disposed of in the tailings pond. The clear final treated effluent is recycled to the process plant and/or discharged to the environment as required.

2.8 Property Access

The property is situated in a remote location in the South Mining District of the Northwest Territories with the closes community of Fort Liard being approximately 170 km to the south. Currently there are no permanent roads or navigable waterways permitting access to the site.



SAN ANDREAS RESOURCES		
SITE AREA		**LOCATION**

NO	DESCRIPTION	DATE

SCALE:	NONE	
DRAWN BY:	TS	DEC/94
CHECK. BY		
APP. BY:		

PRAIRIE CREEK

EFFLUENT TREATMENT PLANT
SCHEMATIC FLOWSHEET

Figure 2-7:

RESCAN ENGINEERING LTD.

FILENAME:	PROJECT NUMBER	DRAWING NUMBER	REV.
FLOW01A.DWG	2701-01	FLOW-01-A	A

RES_1A.DWG .../12/06 15:53

2.8.1 Airstrip

Apart from the construction of an all-weather road, an airstrip currently existing at the site will be utilized for transportation of equipment, supplies and personnel. The airstrip is 1000 m long and is located 1 km to the north of the camp. The airstrip is capable of handling DC-3 aircraft and D4 Caribou aircraft.

2.8.2 All-weather Access Route

An all-weather access road is proposed that would traverse several valleys and various types of terrain for a distance of 163 km between the mine and the Liard Highway near Lindberg's landing.

Background

Considerable work has been carried out in conjunction with an all-weather access road. Cadillac Exploration, a previous owner of the mine property constructed a winter road during the winter of 1980. Subsequently, this road was used by Procan Exploration Company during the winters of 1981 and 1982 to haul a large amount of mining equipment and supplies over the route. Approximately 41 km of the road, between the mill and Cat Camp, was passable during the summer season for drill crews and also provide access to the airstrip at Cat Camp. This road has now deteriorated so that many sections are no longer passable.

In June 1983, Delcan Corporation undertook an assessment of the construction requirements and estimated the cost for an all-weather road to serve the Prairie Creek Mine.

Although the general corridor for the road remains the same as proposed in 1983, there are some significant differences in the magnitude of construction effort and the standard of road to be built. These include:

- significant portions of the road between the Mill and Cat Camp (km 41) will need to be rebuilt;
- the roadway profile has been developed to ensure that the proposed grades are compatible with present trucking technology and capacity;
- criteria relative to hydrology and drainage needs have been enhanced; and

- the roadway standards have been improved to conform to the Indian and Northern Affairs Guidelines for Access Roads and Trails.

The original winter road can be observed in the field in several forms, notably:

- km 0.0 (mine) to km 19 although substandard can be driven with a four wheel drive vehicle;
- km 19 to km 23 has a number of washouts and slides but with some repair can be made passable;
- km 23 to km 39 (Cat Camp) was constructed along the bed of a tributary of Sundog Creek for the most part. Only portions of the original road remains.
- km 39 to km 162 (Liard River) is covered by new vegetation along the route. A portion of the route near the Grainger Pass has been travelled recently by all-terrain vehicles.

The scope of work includes:

- design criteria for the proposed all-weather road;
- a preliminary layout of the horizontal and vertical alignment of 1:50,000 scale topographic mapping;
- analysis of field reconnaissance information, assessment of the impact and subsequent revision from the winter road alignment;
- preliminary assessment of the major culvert locations;
- preliminary assessment of the environmental and geotechnical concerns along the projected alignment;
- a barge crossing of the Liard River;
- a preliminary description of the route alignment is included in Section 6.

Methodology

A preliminary route location was established on 1:50,000 scale mapping over the 162 km distance from the mine site to the Liard Highway. The alignment of the existing road, between km 0.0 and km 22, and the winter road, as evidenced by new vegetation, was used as a reference to establish the route for the all-weather road.

Approximately 35 km of the alignment were observed by walking while the remainder was flown by helicopter with periodic stops to observe soil conditions and the terrain.

Creek crossings were identified on the topographic mapping and all major crossings were observed in the field. Visual examinations were made of these crossings as well as, an estimation of the flood characteristics.

Bruce Geotechnical Consultants Inc. carried out a geotechnical overview along the route of the road. The work included an assessment of:

- the regional geology;
- location of swampy areas;
- location of possible permafrost;
- general soil types; and
- location of Karstic limestone terrain.

A preliminary road bed structure design has been considered as well as alternatives for crossing soft ground locations.

Rescan Environmental Services Ltd. in association with Robertson Environmental Services have undertaken the various environmental studies and collected relevant data from field visits.

Extensive efforts have been made to mitigate the potential geotechnical and/or environmental problem areas.

Appendix B contains the topographic maps of all sections of the proposed route selection. The IEE will contain all of the information regarding geotechnical/ environmental design concerns as well as a full description of engineering requirements for the entire route.

3.0 EXISTING LAND USE AND ENVIRONMENTAL SETTING

The following section describes the project area in terms of land use and capability, as well as biophysical and cultural resources.

3.1 Land Use Overview

Because of its remote northerly location and relative inaccessibility, the project area receives very little human use. Industrial activity is also limited: the nearest operating mines are Con, Giant and Ptarmigan, all gold mines in the immediate vicinity of Yellowknife, approximately 550 km to the east.

Nahanni National Park Reserve, 17 km south of the mine site, is a World Heritage Site, and the South Nahanni is a Canadian Heritage River. The main recreational activities in the park are canoeing, rafting, kayaking, hiking, and camping. There is also limited fishing for Dolly Varden and arctic grayling. The main attractions are Virginia Falls and the South Nahanni River, as well as a number of unique and variable landforms. Moose, Dall's sheep, mountain goats, woodland caribou and wolves are among the wildlife that occurs in the 4,800 km^2 reserve. In 1994 there were 729 overnight users and between 450 and 500 day users. The park is used for recreational purposes during the open water season between May 15 and October 15. The alluvial fan portion of Prairie Creek may experience limited use by canoers in the spring when water levels are high, but reaches upstream of this point are probably too shallow to be navigable (Groat 1994).

There are no land claims being actively negotiated within the project area (Laporte 1994), nor is there any indication that the mine site or access route experience any current use by humans, with the exception of an area to the west of Grainger Pass, where there is an old cabin and recent signs of hunting (moose feet). The hunters using this area are likely from Nahanni Butte, approximately 30 km to the southeast, who probably access the area by four-wheel-drive or all-terrain vehicles (Mitton 1994). There may also be limited trapping in the area, although furbearers are uncommon. An airstrip is located about 20 km east, and another 35 km east of Grainger Pass. The condition or degree of use of these facilities is not known.

With regard to land capability in the project area, its severe climate, remoteness and lack of infrastructure preclude any type of agricultural development or commercial logging. Minor logging for mine and road construction was likely undertaken in the past during development of the Cadillac mine.

Construction of the all-weather access road will involve minor clearing and could increase wildlife viewing, hunting and stream fishing. As well, the road passes near an area that features karst topography (the closest approach of the road is approximately between kilometres 41 and 45, although the zone of accessibility to this geological feature is between kilometres 30 and 50). Although the road itself will not directly affect the karstland, it could provide access to hikers, climbers and spelunkers interested in exploring the area.

3.2.2 Hydrology

Prairie Creek and its tributaries in the vicinity of the mine (*e.g.* Harrison, Quartz, Fast, and Galena Creeks) and the main water courses along the proposed access route (Tetcela, Sundog, Grainger, Fishtrap) are fed by snowmelt and rainfall at higher elevations, as well as run-off from the surrounding terrain. Peak flows generally occur in June (freshet) with low flows occurring from November to April (winter). Smaller streams may be intermittent on a seasonal basis or temporary during heavy rainfall events. Due to the rugged relief of the area, streams and rivers follow glacially scoured valleys between mountains, eventually draining into the South Nahanni River or sometimes ending in alluvial fans on the tundral plain (Plate 3-1).

Large, diurnal fluctuations in stream flow may occur depending on local meteorological conditions (occasional rainstorms or periods of fair weather). Due to the geology and vegetative cover of the region, water storage potential is limited such that run-off contributes to flooding. The soils consist chiefly of particles with a moderately fine to fine texture, which when thoroughly wetted have relatively slow water infiltration and transmission rates. Hydrogeological characteristics will vary depending on the area of land developed for the mine (*e.g.*, waste rock piles, roads, tailings pond and camp).

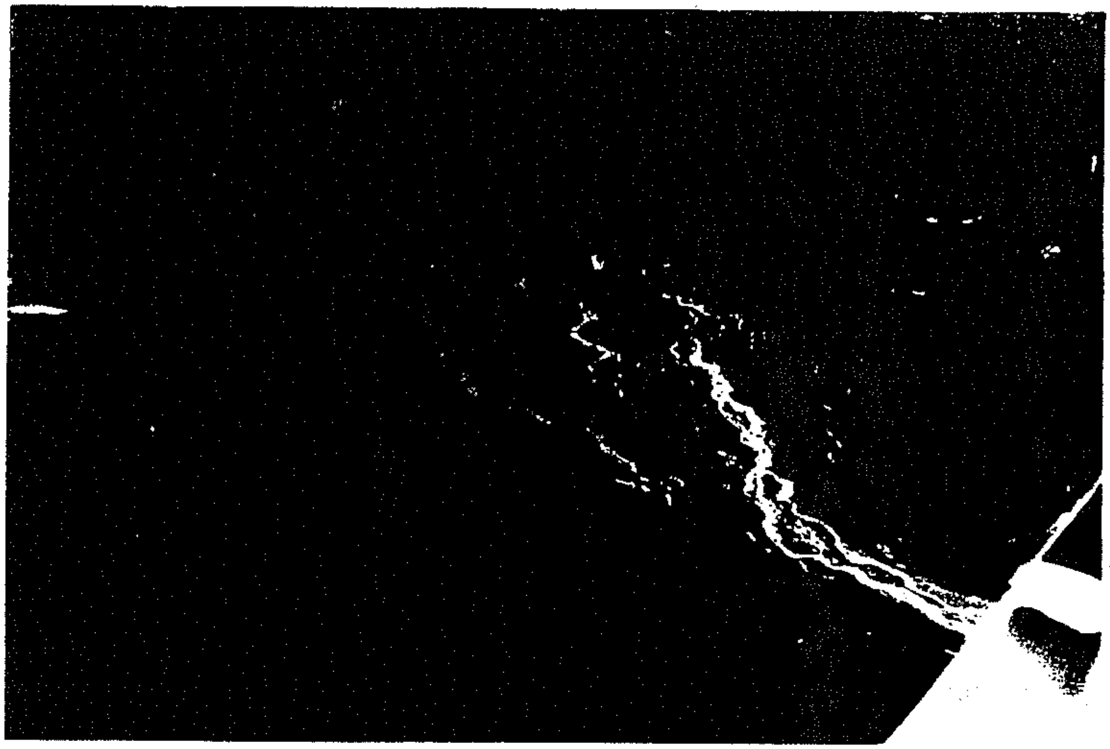


Plate 3-1: Some streams, originating in the mountains, end in alluvial fans on the tundral plain.

3.2.3 Water Quality

Water quality measurements have been taken within the Nahanni Park Reserve area in the South Nahanni River and many of its tributaries, including Prairie Creek. Temperatures range from 0°C in winter to 18°C in the summer (depending on fair weather). Rainfall causes water temperature to drop to 5°C or less (Parks Canada 1984). The pH ranges from 7.5 to 8.2, due to the predominately carbonate terrain.

Turbidity is high in the mainstem flows throughout the summer seasons, but tributaries often run clear during fair weather, with suspended solids measured at less than 100 mg/L. During intense rainfall when glacial deposits are eroded and when snowmelt releases silts and clays frozen within them, turbidity increases, reaching 20,000 mg/L in some rivers in the area (Parks Canada 1984). A single slump in a creek can cause the suspended load to exceed 1,000,000 mg/L.

The dissolved solids were also measured along the South Nahanni River and at the mouth of its tributaries, including Prairie Creek, within the park boundaries. Sodium, potassium, sulfate and chloride levels were found to be negligible at most sites. The Nahanni system was described as "simple bicarbonate waters, the most common type in the western cordillera" (Parks Canada 1984, p. 5-49), due to the carbonate content of the water samples, which ranged from 90-300 mg/L. The water is potable, and when turbid, will clarify quickly when allowed to stand.

3.2.4 Terrain and Soils

In an engineering assessment of the all-weather access road (Delcan 1983), divided the route into 15 homogeneous terrain sections commencing with Km "0" at the mine site. Their description is summarized in Table 3-1. While some adjustments have been made in the proposed route, to avoid problem areas on the winter road alignment, the general description of the terrain remains valid.

3.2.4.1 Karst Features

Between 30 and 50 km east of the mine site, the access road approaches a valued and sensitive area of karstland topography. This is characterized by mainly underground drainage, steep-walled flat-bottomed depressions called "poljes," sinkholes and relatively soft calcareous bedrock and surficial materials. These features are formed by a process called karstification, which is essentially the solution of limestone bedrock by CO_2-laden water, creating underground channels and caverns and sculptured surficial landforms. Other surface features are depressions called dolines, also formed by solution processes and subsidence (Selby 1985).

Table 3-1

Access Road Corridor Terrain and Soils

Section	Distance from Mine Site	Terrain Features
1	0 - 3 km	Prairie Creek valley above rocky flood plain
2	3 -7 km	Prairie Creek flood plain
3	7 -11 km	Beginning of south pass through Mackenzie Mountains follows narrow steep sided valley
4	11-14 km	Highest portion of alignment at Km 11, descending through steep valley
5	17 -41 km	Descent into flood plain of Sundog Creek. Surrounding steep and heavy talus slopes
6	41 - 49 km	Well drained gravel, Mackenzie Plain
7	49-58 km	Limestone outcrops and sinkholes, poorly drained areas in eastern portion
8	58 - 72 km	Well drained gravel ridge
9	72 - 84 km	Slope down to Tetcela River, with two crossings
10	84 -88 km	Tetcela to Fish Trap Creek, wet plain with deep organic layer
11	88 - 95 km	Heavily forested shale slopes up toward Silent Hills Pass
12	95 - 114 km	From Silent Hills Pass to Grainger Pass, crossing broad valley with deep organic soil, route realigned to higher valley slopes
13	114 - 130 km	From Grainger Pass to Grainger airstrip, gradual descending slope with thick organic soil layer
14	130 - 162 km	Low relief, well treed and drained slopes between Grainger and Liard Rivers
15	162 - 164.5	Includes 600 m crossing of Liard River, level holding area and junction with Liard Highway

Adapted from Delcan 1983.

Poljes are subject to flooding by surface runoff, snowmelt and precipitation. When subsurface thawing occurs, flood water can drain precipitously through underground channels or overflow through gaps in the rim. The level alluvial soils may then support lush sedge meadows, providing good forage for ungulates. The soft limestone geology of the karstland features is vulnerable to traffic damage from people and vehicles.

While this karstland area is not within the Nahanni National Park Reserve, and has no officially protected status, its uniqueness makes it worthy of preservation. Accordingly, the proponent has recognized it in its environmental management program.

3.2.4.2 Permafrost

The project site and access road lie within a zone of discontinuous permafrost. Where soil has developed or been deposited by fluvial processes, for example, on lower valley slopes, in wetlands of the Liard flood plain, and in karstland depressions, an active layer of up to a metre in depth or more may develop in summer on south-facing slopes and in unshaded vegetated areas. On north-facing and shaded slopes, the active layer may be much shallower. Disturbance of the vegetation layer on permafrost areas can lead to long-term disruption of surface drainage, soil subsidence and scarring. Where adequately protected, permafrost can serve as support for engineered structures such as roadways, airstrips, building foundations, *etc.*

Vulnerable sites would likely be the airstrip, access road, tailings dam, stream crossings, or other containment structures, or any areas where the soil cover is removed and the permafrost exposed.

3.2.5 Vegetation

For the sections discussing vegetation and wildlife, the study area was divided into two sectors: Area 1, which encompasses the mine site, Prairie Creek and the access route to approximately Km 20; and Area 2, which includes the area traversed by the access route east of approximately Km 20 to the Liard River.

Vegetation communities in Area 1 can be segregated into four basic units: spruce/lichen; subalpine shrub; alpine tundra; and pine parkland (Beak 1981).

Vegetation in Area 2 is composed of twelve vegetation units: aspen-Liard floodplain, floodplain/tillplain, Grainger tillplain, burn, black spruce muskeg, pine parkland, subalpine shrub, alpine tundra, mixed coniferous deciduous, black spruce parkland, riparian alluvial, and spruce/lichen. The information is based on 1981 and 1982 vegetation studies by Beak (1981, 1982) and by observations and mapping completed in September, 1994.

3.2.5.1 Spruce/Lichen

With an elevational range extending from 975-1,280 m in Area 1, this unit is dominated by a ground cover of reindeer lichen (*Cladina stellaris*) and is distributed entirely within the Mackenzie Mountains (Plate 3-2). Tree cover is limited and typically consists of black spruce (*Picea mariana*). The "South Pass" component (Km 17 - Km 35 of the proposed access route) exhibits less total plant cover than the "Prairie Creek" component (Km 0 - Km 17). Observations in September 1994 indicated use by caribou and, to a lesser extent moose, along Prairie Creek.

In Area 2 and east of the Prairie Creek/Ram River system divide, spruce/lichen is distributed in limited areas in the valley floors of four of the Ram River tributaries. This vegetation unit is considered to be the best woodland caribou habitat in both Areas 1 and 2 (Beak 1981; Plate 3-3).

3.2.5.2 Subalpine Shrub

In Area 1, this unit varies in elevation from 1,070 m to 1,340 m (Beak 1981). Shrub cover is variable, but typically consists of dwarf birch (*Betula nana*), Labrador tea (*Ledum groenlandicum*), and willow (*Salix glauca*). Herb cover is limited, but ground cover is dominated by lichens (*Cladina stellaris, Cetraria sp.,* and *Alectoria*). Indications are that this vegetation unit receives limited use, primarily by Dall's sheep, and to a lesser extent by woodland caribou.

In Area 2 this vegetation unit occurs on the eastern slopes of the Mackenzie Mountains, and the Nahanni Range. In the former, the elevational range extends

Plate 3-2: The Spruce - Lichen unit is dominated by a thick mat of cream-coloured reindeer lichen, *Cladina stellaris.*

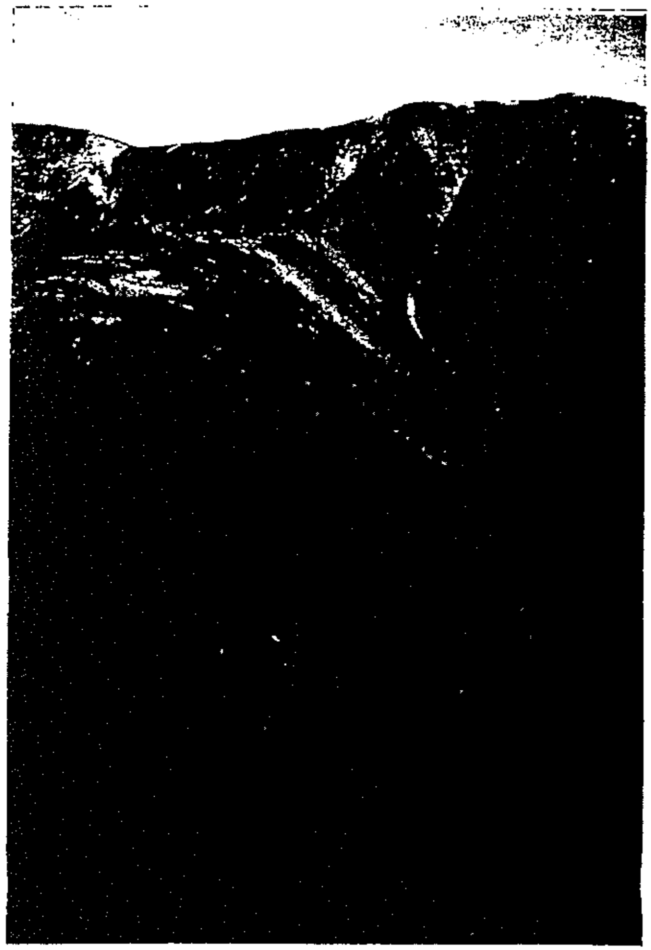


Plate 3-3: Three Highland Vegetation Types in the Mackenzie Mountains. The lower slopes are part of the Spruce - Lichen vegetation unit (the light coloured mat is the lichen *Cladina stellaris*). Immediately upslope is the Subalpine Shrub unit, primarily shrub birch, willow, and some spruce. The mountain crests are covered with a ground carpet of Alpine Tundra vegetation. All three habitat types are important to woodland caribou and Dall's sheep.

from 1,325 m downslope to 1,070 m, whereas in the Nahanni Range the elevational extent is considerably lower, from approximately 1,220 m to 700 m. Although there was no systematic sampling of the Nahanni Range component, the above description of this unit is presumed to apply to these areas as well (Plate 3-3).

3.2.5.3 Alpine Tundra

Comprising all areas above the treeline in Area 1, this unit characterizes much of the Mackenzie Mountains area. Elevations in the project area range from 1,373 m to 1,708 m. Despite limited vegetative cover, it provides key winter range and lambing ground for Dall's sheep, as well as calving areas for woodland caribou (Beak 1981b, 1982). Characteristic vegetation includes *Cetraria nivales*, mountain avens (*Dryas integrifola*), lapland cassiope (*Cassiope tetregona* — a type of heather), and creeping willow (*Salix nivalis*). Browse includes alpine blueberry (*Vaccinium uliginosum*), dwarf birch (*Betula nana*), and sedges (*Carex albo-nigra*).

In Area 2, alpine tundra occurs as a large area on the eastern slope of the Mackenzie Mountains, and as a much smaller component in the Nahanni Range. Major cover species are similar to Area 1.

This unit is important as key year-round range and lambing areas for Dall's sheep, and calving areas for woodland caribou (Beak, 1981, 1982). Pellet groups of both Dall's sheep and woodland caribou were relatively common during July 1981 sampling.

3.2.5.4 Pine Parkland

This unit occurs only in a small section of Area 1, on well-drained upland slopes between 425 m and 750 m, in a low-elevation valley immediately north of Second Canyon on the South Nahanni River.

Pine parkland is characterized by jack pine (*Pinus banksiana*), black spruce, white spruce (*Picea glauca*), and the willow *Salix arbusculoides*. The shrub layer is denominated by dwarf birch and Scouler's willow (*S. scouleriana*); in the herb layer the predominant species is bunchberry (*Cornus canadensis*) and twinflower (*Linnaea borealis*). At ground level, where the greatest coverage occurs, are red-stemmed feathermoss (*Pleurozium schereberi*) and *Cladonia* lichen.

This vegetation unit appears to be moderately well-used in Area 1, based on pellet counts and browse utilization, with moose as the predominant ungulate species (Beak 1981b).

In Area 2, it occurs on the lower slopes of the Nahanni Range between 549 and 763 m, and on the Ram Plateau between Km 53 and 63, within a limited elevational range (915-975 m). Studies of tree cover indicated two forest communities within this unit: one dominated by the jack pine on 10% slope and southwest aspect, the other by black spruce in poorly drained depressions. Like many of the lowland units, the ground cover is 100%, composed in the jack pine type primarily of red-stemmed feathermoss and reindeer lichen (Beak 1981). Habitat studies indicated limited browsing.

3.2.5.5 Black Spruce Parkland

This unit extends from the eastern base of the Mackenzie Mountain ramparts eastward to the eastern edge of the Ram Plateau. It starts at Km 32 of the access route and extends more or less continuously to Km 64. The elevational range is 793-915 m (Beak 1981b).

Tree cover varies from 5% - 30% comprised mostly of black spruce, with patches of white spruce on well-drained, south-aspect slopes. Ground cover is 100%, and is composed primarily of reindeer lichen and red-stemmed feathermoss (Beak 1981b). This unit should represent an important habitat for woodland caribou at certain times of year (Plate 3-4).

3.2.5.6 Riparian Alluvial

Riparian alluvial is essentially sparsely vegetated borders of alluvial streams and rivers of the Ram River system. The braided streams in this unit are relatively wide in places, and on some of the instream islands which survive for several years there may be colonization by willow, *Dryas integrifolia*, and various grasses and sedges. The unit was not sampled in earlier studies by Beak (1981b), but is likely to represent an occasional wildlife corridor, and for moose a Class 2 winter range.

Plate 3-4: An example of the <u>Black Spruce Parkland</u> vegetation unit, showing blanched snags of black spruce burned in an earlier fire. Within this habitat are most of the wetlands of the access corridor; these provide habitat for trumpeter swans, other waterfowl, and aquatic mammals.

3.2.5.7 *Mixed Coniferous/Deciduous*

The mixed coniferous/deciduous unit covers the low elevational parts of the Tetcela and Fishtrap Creek drainages from Km 64 to 110 where the access approaches Grainger pass. This a post-fire successional forest, estimated to have resulted from a burn occurring approximately between 1940 and 1950 (Beak 1981b).

The western slopes of the Silent Hills are well drained, and the tree cover was calculated at 78%. Of this, 80% was deciduous, primarily trembling aspen (*Populus tremuloides*) and paper birch (*Betula papyrifera*), and the remainder (20%) white spruce (Beak 1981b).

The Tetcela Valley transect was variable and included elements of black spruce parkland mixed with a dense coniferous-deciduous forest. The vegetational succession appears to be returning to black spruce parkland. In 1981, the forest cover at the tree level varied from 60-100%, and comprised birch, alder (*Alnus crispa*), and Scouler's willow, with lesser amounts of black spruce and jack pine. Coverage at the lower strata (shrub, herb, and moss) were considerably less than tree cover (Beak 1981b). The forest includes a significant portion of black spruce snags.

Habitat studies indicated in terms of browse availability and utilization the major species in this unit were alder, and Scouler's willow. Nine moose pellet groups were recorded.

3.2.5.8 *Black Spruce/Muskeg*

This vegetation unit is distributed in lowland, waterlogged drainages which grade into open wetlands. It occurs in three areas:

- Fishtrap Creek, west of the Silent Hills within an elevational range of 244-305 m;
- An eastern tributary of the Tetcela/Ram River system in the valley between the Silent Hills and the Nahanni Range at an elevation of approximately 490 m; and
- A lowland area west of the Grainger River near its mouth.

The representative site for sampling was located in the Tetcela component, and its basic elements were a shrub layer (coverage 35-60%) of black spruce, blueberry, willow (*Salix myrtillifolia*), Labrador tea and dwarf birch (Beak 1981b). Coverage in the herb layer was 25-50% comprising red bearberry (*Arctostaphalus rubra*), grass and Labrador tea. *Dicranum* moss and lichens provided a thick ground cover.

Habitat studies indicated some browsing on dwarf birch and willow. A total of three moose pellet groups were found. The wetlands within this habitat represent productive waterfowl habitat, particularly for trumpeter swans (Section 5.2.3.6).

3.2.5.9 Burn

Since the vegetation studies of 1981 and 1982, there have been two burns along the access corridor. The earliest is situated within black spruce parkland near Km 66, and appears to be 5 to 10 years old. No examination of regenerating vegetation was made. The second burn took place in July and August of 1994 and covers an enormous area immediately east of the Nahanni Range.

3.2.5.10 Grainger Tillplain

The Grainger tillplain unit is a rolling, drumlinized tillplain in Area 2 with little elevational range (approximately 460 m to 670 m), and an absence of forest cover (Beak 1981b; Plate 3-5). The basic subtypes include depressions and drier meadows. The former are wet sedge meadows dominated by *Carex rostrata.* The drier meadows consist of a shrub layer of dwarf birch, cinquefoil (*Potentilla fruticosa*), Labrador tea and *Myrica gale*, a herb cover of sedges, red bearberry, and horsetails (*Equisetum* sp.), and a ground cover of *Dicranum* moss. In other areas, there is a taller shrub community of alder, dwarf birch, and willow (*Salix planifolia*), or coniferous thickets of black spruce. Over 40% of this habitat occurring along the access corridor has been recently burned.

Habitat studies showed considerable availability of browse, with utilization greatest on willow (*S. planifolia*). Four caribou and 3 moose pellet groups were found.

3.2.5.11 Floodplain/Tillplain

Major tree species in this heterogeneous unit include trembling aspen, white spruce, black spruce, paper birch, jack pine and alder. The densest of the mixed forest

Plate 3-5: A wet sedge meadow of *Carex rostrata* within the Grainger Tillplain vegetation unit. Surrounding vegetation is composed of scattered black spruce, and a shrub community of alder, willow, and dwarf birch.

communities, comprising more than 50% coverage, it is distributed along parts of the Grainger River, and hypothetically provides (because of forest structure) a degree of thermal cover important to ungulates in winter (Beak 1982).

3.2.5.12 Aspen/Liard Floodplain

This vegetation unit borders the Liard River from Km 151 to 162, excluding the Liard crossing itself. The climax tree species is white spruce, but frequent fires have led to a dis-climax of aspen (Beak 1981b). Within the aspen subunit, the canopy was estimated to reach a height of 20 m, with other understory trees between 12 m and 16 m. The shrub layer was predominantly alder and prickly rose (*Rosa acicularis*). There was limited ground cover (5%) owing to a thick layer of deciduous litter.

Habitat studies showed moderate browsing of highbush-cranberry (*Viburnum edule*), and light browsing of trembling aspen.

3.2.6 Wildlife Resources

As with vegetation (Section 3.2.5), this section addresses wildlife resources in terms of two separate regions: Area 1, which encompasses the mine site, Prairie Creek and the access route to approximately Km 20; and Area 2, which includes the area traversed by the access route east of approximately Km 20 to the Liard River (Km 162).

Wildlife of principal importance in Area 1 are Dall's sheep, woodland caribou, moose, and grizzly bear. Black bear and trumpeter swans, in addition to the same species in Area 1, are of importance in Area 2. The following provides a brief description of current knowledge on the distribution and abundance for each species within the combined study area. Discussions are based on surveys conducted in 1980 and 1981, information from other sources (*e.g.*, GNWT, Parks Canada) and incidental sightings in 1994 by Rescan staff and camp personnel).

3.2.6.1 Dall's Sheep

According to previous surveys, Dall's sheep occur at high elevations in both the Nahanni Range and the Mackenzie Mountains, and nowhere in between (Beak

1981b). Based on sightings and tracks, they frequently cross valleys within the mountains, but are restricted to mountain ranges (Plate 3-6).

Area 1

Sheep observations in the Mackenzie Mountains on the east side of Prairie Creek increased approximately three-fold (from about 15 to 45) between the months of January and March. In summer, Dall's sheep appear to exhibit typical social concentration patterns, with rams tending to congregate into groups (observed on the west side of Prairie Creek), while nursery bands, consisting of ewes and lambs, appear to form associations (observed west of the mine and east of Caribou Flats). In fall (after August) incidental sightings indicate a sharp reduction of sheep near the mine and along the access route as far as Km 18.

With regard to lambing, it appears that sheep move from superior winter range east of Prairie Creek to superior lambing grounds in the mountains immediately adjacent to Prairie Creek, where there is more escape terrain and secluded areas. Of all 220 animals observed incidentally in 1994, 155 were in three groups of lambs and ewes on the airstrip near the mine site. Further observations indicate a dispersal away from the mine in late summer.

Area 2

The Nahanni Range represents some of the study area's best sheep range, and was ranked as Class 1, using the rating scale developed by the Canada Land Inventory (Beak 1981b). Exposure to prevailing winds limits snow accumulation, making forage available year round. Escape terrain is abundant. Forage was considered to be "somewhat limited," but sampling of vegetation and habitat use of this area was limited to one site. Only one winter survey covered the Nahanni Range. In March of 1981, a total of 32 Dall's sheep were observed, supporting the area's high capability rating for sheep.

Surveys in 1980 and 1981 provided observations on possible lambing areas. All areas identified are west of the Ram River/Prairie Creek divide. No potential calving areas were found on the eastern plateaus of the Mackenzie Mountains. June surveys of the Nahanni Range were not attempted.

Plate 3-6: Five Dall's sheep on a southwest facing slope near ridge line in the Nahanni Mountains.

In July of 1980, wildlife surveys covered the Nahanni Range and confirmed the presence of a substantial number of ewes and lambs. It was too late to make any inferences on lambing areas, but the upper elevation slopes clearly represent important nursery areas.

In general, the density of sheep habitat use may be highest in the Nahanni Range. The greatest concentration of Dall's sheep pellets was found here.

3.2.6.2 Woodland Caribou

Area 1

Winter observations are limited to one sighting of five individuals approximately eight kilometres southwest of the mine site. The preferred winter habitat requirements of woodland caribou are characterized by the spruce/lichen vegetation unit in the valley floors of the Mackenzie Mountains; however, snow depths in these areas may limit mobility and access to forage.

In summer, limited observations indicate that caribou move down to lower elevations as forage conditions in high-altitude, xeric habitats deteriorate (Plate 3-7). This scenario would involve some female caribou and their young moving into spruce-lichen habits at lower elevations, while others would move into the black spruce-parkland immediately east of the Mackenzie Mountains.

In early June 1981 at total of 74 woodland caribou were observed in the Mackenzie Mountains, most of which were females and calves. Probable calving areas are on either side of Caribou Flats (an area of low relief essentially forming the basin of Fast Creek, a Prairie Creek tributary, and extending 10-25 km north of the mine site); and in scattered pockets on either side of the proposed access corridor to approximately Km 20.

In the fall months, based on a small number of incidental observations by San Andreas personnel, indications are that caribou remain in the mountains.

Area 2

Observations of woodland caribou east of the Mackenzie Mountains are limited to a sighting of 13, approximately two kilometres north of the Grainger River in March

Plate 3-7: Woodland caribou on Alpine Tundra in the Mackenzie Mountains.

of 1981, and a solitary individual just east of Grainger Pass in July (Beak 1981b). Tracks were not enumerated; thus useful evidence of recent occurrence was not recorded. Two areas were classified as winter range. The first starts at the eastern base of the Mackenzie Mountains and extends eastwards through black spruce parkland, pine parkland, and the western fringe of the mixed coniferous deciduous habitat. This area is classified as potential winter range, hypothetically linked to the alpine plateaus immediately outside the study area. The Beak (1981b) classification was based on the abundant corticolous lichens of the black spruce parkland habitat. There is also a significant ground cover of reindeer moss.

The other winter range is immediately east of the Nahanni Range in habitat classified as Grainger tillplain and floodplain/tillplain habitats. It was identified by Watson *et al.* (1973, cited in Beak 1981b) as part of the winter range of the Martin Hills caribou herd. Although habitat studies confirmed browsing and caribou pellet groups in these habitats, the season of use could not be determined.

The western part of the access route is below important caribou calving grounds. These are located on the broad eastern plateaus of the Mackenzie Mountains. No surveys were conducted in the Nahanni Range during or immediately after the calving period.

Beak investigators assessed the alpine tundra and subalpine shrub of the Nahanni Range to represent summer range for woodland caribou. This assessment was based on its abundant forage, particularly lichens, shrubs, forbs and sedges, and the relief from insect harassment (Beak 1981b).

The low-elevation habitats of the lower Grainger River/Liard River, the Fishtrap and Tetcela drainages were judged to have little capacity as summer or winter range.

3.2.6.3 Moose

Area 1

The majority of moose sightings have been made outside the mine site - Prairie Creek area, in the area traversed by the eastern portion of the access route. There was one sighting north of Folded Mountain in January of 1981 (Beak 1981b).

Moose habitat in Area 1 is rated as r due to sparse forage and high elevations. The remainder of the area surrounding the mine to Km 20 of the road is rated as insignificant, with the exception of a small area north of second Canyon, which is rated as moderate winter habitat for moose.

Area 2

Moose and their sign were found along most of the length of the access route (Beak 1981b). Only in the sparsely vegetated eastern slope of the Mackenzie Mountains was there little evidence of this species.

Class 1 winter range was estimated to occur in two areas (Beak 1981b). One was located adjacent to the north shore of the Liard River and extending part way up the Grainger River. It main components was its combination of forage and thermal cover (Beak 1981b). The other was the valley bottoms of the Tetcela River and Fishtrap Creek. The mixed coniferous deciduous vegetation unit in this area ranked highest in moose production capacity of the six lowland habitat transects sampled.

Several other areas were judged to represent moderate winter range (Beak 1981b). These include:

- The Grainger tillplain, primarily because of high forage production;
- Mixed coniferous deciduous habitat of the Silent Hills and adjacent well-drained areas, based on high productivity and evidence of high browse utilization;
- Pine parkland on the Ram Plateau, combined with small depressions of black spruce parkland; and
- Components of the riparian alluvial habitat of the Ram River system (Beak 1981b).

Summer habitat was not assessed with the same emphasis as winter habitat, as summer habitat requirements are generally a less critical issue.

No surveys were especially directed at moose in the summer, but surveys of wetlands frequently produce sightings of moose, confirming their use of vegetation in and around wetlands. For this reason, summer habitats were recognized as those which combined substantial forage capability in association with wetlands.

Several areas were judged to represent good moose habitat. These included:

- the valley bottoms of the Tetcela and Fishtrap drainages;
- Grainger tillplain;
- Silent Hills and its mixed coniferous deciduous habitat; and
- Pine parkland habitat of the Ram Plateau.

3.2.6.4 Grizzly and Black Bears

Area 1

One grizzly bear was sighted west of Folded Mountain, and another along Tundra Ridge east of Caribou Flats in June of 1981 (Beak 1981b). In the summer of 1980, a sow and two cubs were sighted at the treeline southwest of the mine site. A ground survey in September of 1994 recorded tracks near the airstrip and on a sandbar near Prairie Creek approximately ten kilometres north of Folded Mountain.

Area 2

Both species are believed to occur along the access corridor. Recorded observations are limited to the sighting of a black bear in September, 1994.

Grizzly bears usually den from mid-October to early May, and potential denning areas may occur on the eastern slope of the Mackenzie Mountains and the Nahanni Range. Early June surveys failed to locate recently used dens in the former area, but the Nahanni range was not surveyed at that time. They occupy very large home ranges, from 86 to 287 km^2 (Pearson 1975); thus the scarcity of sightings is not unusual.

According to information assembled by Polar Gas (1984), the eastern slopes of the Mackenzie Mountains comprise many Class 1 (high-use area) and Class 2 areas for grizzly bears. The Nahanni Range is has been classified as Class 2.

Black bears are more likely than grizzly bears to occur in low elevation habitats. They are considered common along the forested habitats of the Mackenzie Valley. An area of special abundance, based on large annual harvests, is the area around Fort

Simpson (Polar Gas 1984). It is suspected that this area of abundance extends to the Liard and Grainger portions of the study area.

3.2.6.5 Wolves

Area 1

Wolves are sighted infrequently in the mine area, but are assumed to be a persistent element of the area's wildlife. Sightings of lone wolves have been reported at Caribou Flats and in the camp area (1980), and east of Folded Mountain on the access route (1994).

Area 2

Five wolves were observed on one occasion along the access route, on September 13, 1994. The pack consisted of three black-phase and two grey-phase animals. A brief search was made from the air, but no kills were observed in the area.

Their abundance along the access corridor is unknown, but they are suspected of being important predators of woodland caribou and moose.

3.2.6.6 Furbearers

Area 1

In a review of Mackenzie Valley wildlife, Polar Gas (1984) identified marten as being the important upland furbearer in the Norman Wells to Fort Simpson area, and lynx as being relatively abundant between Norman Wells and the NWT/Alberta border. Among the aquatic furbearers, beaver and beaver dams were common on wetlands surveyed in 1980 and 1994, but the survey information is not sufficiently quantified. At least one beaver has been observed at the mine site itself (1994). Very little information is available on muskrat, and few have been recorded during surveys. Polar Gas (1984) pointed out that south of the Camsell Bend, muskrat habitat is relatively poor. One wolverine was observed on alpine tundra habitat in July of 1980 (Ker Priestman 1980b), and at that time, mine personnel identified wolverine among species seen infrequently during the previous twelve years (1968-1980) of exploration activity (Ker Priestman 1980a).

Area 2

In 1980, a review of trapping along the road corridor was completed by Beak (in Ker Priestman 1980a). At that time, three traplines were being operated on lands crossed by the corridor. The major species harvested at that time included beaver, marten, mink, lynx, weasel and wolverine.

3.2.6.7 Aquatic Birds

Area 1

The minesite-Prairie Creek area is dominated by steep terrain, and the only aquatic habitat is Prairie Creek, its tributaries and the tailings pond at the minesite. One green-winged teal and a flock of seven American widgeons were sighted in the area during the September 1994 fisheries surveys.

Area 2

Surveys of wetlands were undertaken in September 1994 primarily to identify ponds and lakes which might be important to trumpeter swans and other waterfowl during the fall staging period. A total of 55 ponds were surveyed, with emphasis on those located in the Fishtrap Creek and Tetcela River drainages. Thirty are located between the Liard River and Grainger Pass.

During the surveys, a total of 629 waterfowl were counted in the 55 wetlands surveyed. These included 7 swans, 233 dabbling ducks, 304 diving ducks, and 85 shorebirds. The swans included one pair with one young of the year. The most productive wetlands are widely distributed, indicating considerable use by waterfowl in all three drainages surveyed: Tetcela, Fishtrap, and Ram.

Species composition, other than trumpeter swan, included green-winged teal, mallard, northern pintail, American widgeon, ring-necked duck, scaup *sp.*, surf scoter, goldeneye *sp.*, and bufflehead.

3.2.6.8 Raptors

Area 1

In April of 1980 golden eagles were observed in Caribou Flats north of the mine site. In July of that year an active eyrie was sighted in the cliffs between Caribou Flats and the road corridor. In January 1981, a gyrfalcon was observed at high elevations less than 5 km NNE of the minesite. Ptarmigan, a likely prey of gyrfalcons, were frequently flushed from alpine areas during that survey.

Area 2

The July 1980 surveys of the study area included coverage of possible raptor eyries on cliff faces. One golden eagle was found in a steep canyon in the Nahanni Range opening onto Grainger Pass. Other golden eagles have been seen in the Nahanni Range, along the Grainger River, and in the Silent Hills. Neither bald eagles nor peregrine falcon were sighted, but both species can be expected to occur along the access route.

3.2.6.9 Rare and Endangered Species

Areas 1 and 2

According to the Committce on the Status of Endangered Wildlife in Canada (COSEWIC 1992) there are several designated species which could occur in the study area in the endangered, threatened, or vulnerable categories. The *anatum* subspecies of peregrine falcon, listed by COSEWIC as endangered, could breed in the Mackenzie Mountains, although Beak surveys of all likely cliffs did not locate any nests or individual birds.

There are no likely species in the study area in the threatened category, but several species are listed as vulnerable. This list includes woodland caribou, grizzly bear, wolverine, great grey owl, and trumpeter swan. Trumpeter swans are an increasingly common breeding species, particularly in the Tetcela and Fishtrap Creek drainages.

Great grey owls have not been recorded in the area of the minesite and Prairie Creek, although the area is within their range.

Three species considered in this account were recently examined by COSEWIC (1992) and not designated in any risk category. These include the bald eagle, golden eagle, and gyrfalcon.

3.2.7 Aquatic Life

Information on the aquatic life in the region is limited and has focused mainly on fish, due to their potential as a recreational resource. No studies have been done on stream algae or aquatic plants or phytoplankton. Zooplankton samples were collected only in a few lakes within the Nahanni National Park Reserve. Benthic invertebrates were collected in Prairie Creek and some of its tributaries above and below the mine site and along the winter access road (Beak 1981a), and have provided provisional species lists. The invertebrates consisted mainly of larvae of various terrestrial insects, but were low in diversity and abundance. Other phyla represented by the occasional individual were the Turbellaria, Annelida, and Nematoda.

Fish have been studied more intensively and habitat in the various water courses has been classified on the basis of its suitability for over-wintering, spawning and rearing. Fish species which may spawn in water courses around the mine and along the proposed access route, and are reported for the general area include Dolly Varden (*Salvelinus malma*), and/or bull trout (*Salvelinus confluentus;* see Beak 1981a), mountain whitefish (*Prosopium williamsoni*), arctic grayling (*Thymallus arcticus*), and northern pike (*Esox lucius*). The slimy sculpin (*Cottus cognatus*), is a ubiquitous species, while others, such as the less common longnose sucker (*Catostomus catostomus*) and lake chub (*Couesius plumbeus*), may be incidental.

3.3 Heritage Resources

The project site is in the traditional territory of the Deh Cho, a Dene people whose traditional or resource-based activities include hunting, fishing, trapping and guiding.

Two public hearings, which included Deh Cho representatives, were held in Fort Simpson in 1981 and 1982 by the NWT Water Board regarding Cadillac Exploration Ltd.'s application for a water license for operation of the Prairie Creek mine. During those hearings, the principal focus was on potential effects the mine could have on water quality in Prairie Creek and points downstream. In 450 pages of recorded proceedings, there was no specific mention of historic or archaeological sites in relation to the mine site itself or the 165-km winter road that connected the mine site to the Liard Highway, and any passing reference to the subject was in conceptual terms.

In a resource study of the Nahanni National Park conducted by Parks Canada (1984), 21 historic and as many as 10 prehistoric sites were identified within the park boundaries and near Nahanni Butte. One prehistoric archaeological site, on Yohin Lake, was considered significant. All sites were associated with either Yohin Lake, the South Nahanni River or Flat River.

In November 1994 a request was submitted to the Prince of Wales Northern Heritage Centre (Education, Culture and Employment, GNWT) to list any known archaeological sites enclosed by the following coordinates: 60°25' N to 61°45' N and 123°25' W to 124°50' W. This area includes Prairie Creek, the mine site, the existing winter road or the alignment for the proposed all-weather road (collectively, the project area). Of the 21 sites recorded, none were within the project area; most were located within Nahanni National Park or just south of it. Again, all sites were associated with either the South Nahanni River or watercourses within the park. It was, however, advised that the project area had not been surveyed, and as such, the absence of recorded sites did not necessarily indicate that no archaeological sites existed within the study area (Andrews 1994).

The choice of a final alignment for the 165-km all-weather access route depended, in addition to heritage features, on a large number of other considerations. These included geomorphology and terrain features, karst topography, stream crossings, permafrost, wildlife habitat, weather, time of year, and economics. Consequently, the alignment could not determined until the late fall of 1994, and a systematic, on-site survey of potential heritage resources within the study area was not possible due to the early onset of winter in the project area.

A full-scale archaeological survey will be undertaken in 1995 as soon after snowmelt as possible, in consultation with the GNWT and Deh Cho Tribal Council. A fully qualified Heritage Resource Assessor familiar with sites in the Northwest Territories will be assigned to the task. Prior to commencing field studies, a further review of archaeological records and aerial photographs of the project area will be necessary to confirm the presence or absence of archaeological sites.

Due to the remoteness and inaccessibility of the project area, and because of the largely nomadic existence of its early inhabitants, it is expected that few if any potential sites will be identified. However, if any archaeological sites are encountered during the field survey that are considered significant or warrant further research beyond the basic recording and reporting of data, appropriate measures will be taken to ensure they are protected from encroachment or damage until they can be properly assessed and documented. All identified sites will be duly reported to GNWT Heritage Centre in Yellowknife. Areas where archaeological sites may be encountered could include proposed stream crossings such as at the Tetcela, Grainger, and Liard Rivers, as well as passes such as Silent Hills and Grainger Passes (through which any human traffic would likely have been funneled).

Should any site(s) not identified in the field survey be encountered during construction of the access route or project development in general, all necessary precautions will be taken to ensure that no further disturbance is incurred, and that the proper authorities are notified. In such an event, further fieldwork would likely be necessary to verify the site's presence, record the necessary information, evaluate its significance, and determine whether activities associated with the project would have an impact on the site.

3.4 Native Land Use

The Slavey Dene who occupy the area in communities such as Nahanni Butte, Fort Simpson and Fort Liard, value the land and use it extensively in the pursuit of traditional activities, such as hunting, trapping and fishing. Although these activities do not take place at the existing mine site, an all-weather access road could potentially expose animals to traffic, noise and increased hunting pressures.

Land use and water quality impact concerns were addressed in public hearings in 1981 and 1982. In addition, San Andreas held information meetings with First Nations representatives, RERC, DIAND and the interested public in the fall of 1993. The proponent will continue to work closely with the First Nations bands in the area, with whom they have established a positive relationship, in order to ensure that efforts are made to avoid or mitigate potential impacts.

4.0 ENVIRONMENTAL AND SOCIOECONOMIC CONSIDERATIONS

During the development of a mine, there are potential environmental and socioeconomic impacts to be considered. However, before the potential impacts can be properly assessed, baseline data on present conditions must be gathered in order to determine which aspects may be impacted, their magnitude and whether positive or negative in nature. In the latter case, mitigation measures can then be promulgated to minimize such impacts. The background data will also be used to monitor any changes that do occur and to provide the baseline against which later monitoring programs may be compared. Closure plans will also rely on the baseline data to indicate aspects of the mine site/road that will need to be returned to their natural state or reclaimed.

4.1 Environmental Monitoring Program

The environmental monitoring program is designed to collect baseline data specific to the mine site and all-weather access route. This information will supplement those historical site-specific data collected in the late 1970s. The current program encompasses meteorology, water quality, aquatic resources, soils and terrain, vegetation and wildlife, waste management, and acid generation testwork. The following sections summarize the individual studies to be conducted and briefly outline the monitoring to be continued once mining operations begin.

4.1.1 Meteorology

Meteorological data are needed primarily as inputs to water and waste management plans. Precipitation and evaporation information are necessary components of the tailings pond water balance. Wind speed and direction data are often used in calculating wind loading for building design and are important parameters to consider in environmental management of fugitive dust.

Long-term temperature and precipitation records are available from the Atmospheric Environment Service (AES) climatological stations for several regional stations, including Fort Simpson, Wrigley, Watson Lake and Fort Nelson.

Snow cover data have been collected at various locations since the early 1960s, while rainfall has been collected at the above-mentioned centres, with the exception of Wrigley, since the early 1970s. Evaporation data is very limited; AES recorded the meteorological conditions at the former Cadillac mine site for approximately one year in 1970, although it is not known which parameters were collected. Historical site-specific data are also very limited. The closest regional meteorological stations are at Fort Liard, approximately 170 km southeast, and Fort Simpson, approximately 190 km east of the mine site. Because it is a key component in developing an environmental management plan for the project, regional data are being supplemented by on-site recording equipment.

An automated weather station was installed in June 1994, approximately 500 m south of the mill and ore processing facilities (Plate 4-1). The station records the following variables: air temperature, relative humidity, wind speed and direction, and rainfall. A Campbell Scientific CR-10 datalogger monitors each sensor every five seconds and stores hourly and daily data summaries. The CR-10 is accepted by the AES for autostation applications and the logger was programmed in accordance with AES requirements (AES 1992).

4.1.2 Hydrology

Hydrological information for catchments within the Prairie Creek project area is necessary for the development of water and waste management plans. Harrison Creek, a tributary of Prairie Creek, flows near the mill and ore processing facilities. Estimates that accurately reflect variations in average flows, floods and low-flow conditions for these two streams will be key components in developing an effective water management plan.

Two regional hydrometric stations operated by the Water Survey of Canada (WSC) will provide the necessary historical data. One stream-gauging station is located upstream of the project site on Prairie Creek (10EC002) and was operated from late 1974 until early 1990. The second nearest WSC station, located downstream of the confluence of Prairie Creek and the South Nahanni River (10EC001), has been operating since installation in July 1968. This historical data will be supplemented with site-specific data.

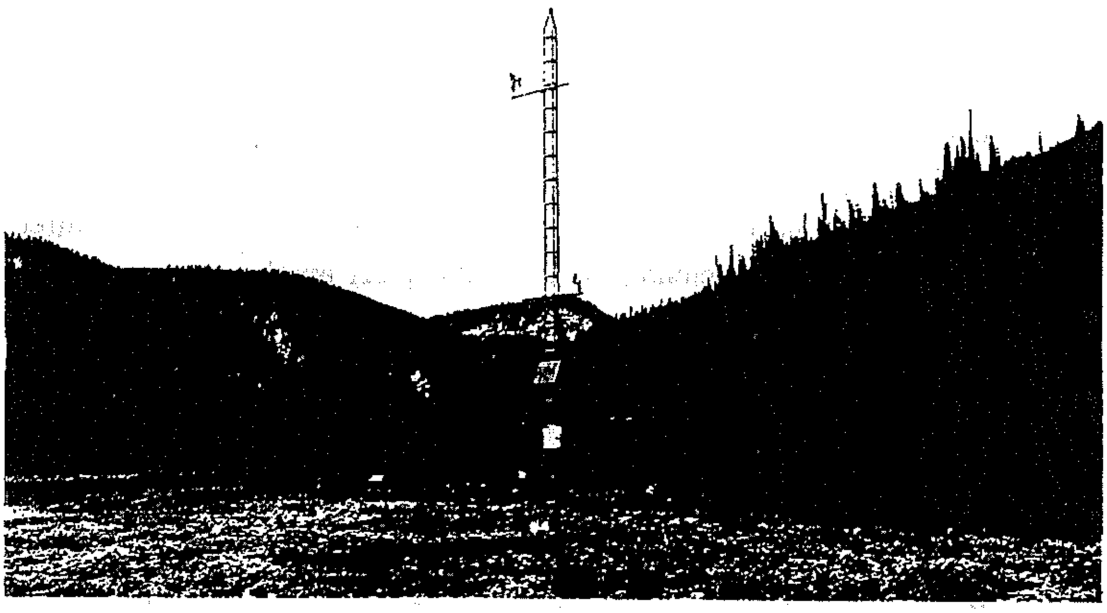


Plate 4-1: The automated weather station at Prairie Creek includes sensors for wind speed and direction, temperature, relative humidity, and rainfall. The weather station's Campbell Scientific CR-10 datalogger is powered by a 12-volt battery which is recharged with the 30-watt solar panel shown mounted on the tower above the white instrument enclosure box.

Two stream-gauging stations were installed by Rescan in June 1994. The first station is located upstream of the Prairie Creek mine site, near the site of the old WSC station (Plate 4-2). The second is located in Harrison Creek, upstream from the mill (Plate 4-3). The stream-gauging stations consist of a staff gauge for manual reading of the water depth and a pressure transducer connected to a datalogger which records hourly water depths. Site personnel have been trained to service the dataloggers periodically, collect manual staff gauge readings, and maintain the stations.

Stream discharges are measured by taking water velocity readings with a flow meter at selected points along a cross-section of a stream. The calculated flow, in m^3/s, is referenced to a staff gauge reading and water depths recorded by the datalogger in order to generate a stage-discharge relationship. The stage-discharge curve is in turn used to predict average, low and flood flows for Prairie and Harrison Creeks. These estimates will serve as inputs to a model of water quality impacts downstream of the tailings impoundment.

4.1.3 Water Quality

Baseline data on water quality will be collected during freshet and fall in order to establish present receiving-environment conditions in Prairie Creek. Creeks, such as Galena, Harrison, and Quartz, that drain into Prairie Creek from various directions on the mine property will be sampled in order to provide background information on water quality in the area. Major watercourses, such as Grainger, Tetcela, Sundog, and Fishtrap Creeks, to be crossed or paralleled by construction of the all-weather access route will also be included.

Water quality variables to be monitored will include physical parameters (*e.g.* pH, dissolved oxygen, total and dissolved suspended solids, alkalinity), total and dissolved metals to sub-ppb levels, ions (chloride, fluoride, and sulphate), and nutrients (nitrogen and phosphorus compounds). Temperature, pH, and dissolved oxygen will be measured with the appropriate instruments on site. Table 4-1 lists the parameters and elements to be monitored and laboratory-achievable detection limits. CCME receiving water guidelines are included for limits of drinking water, aquatic life, and wildlife (based upon livestock watering limits); however, some guidelines are based upon aesthetic qualities rather than any inherent toxicity of the element or its importance to nutrition. Dissolved organic carbon is included in

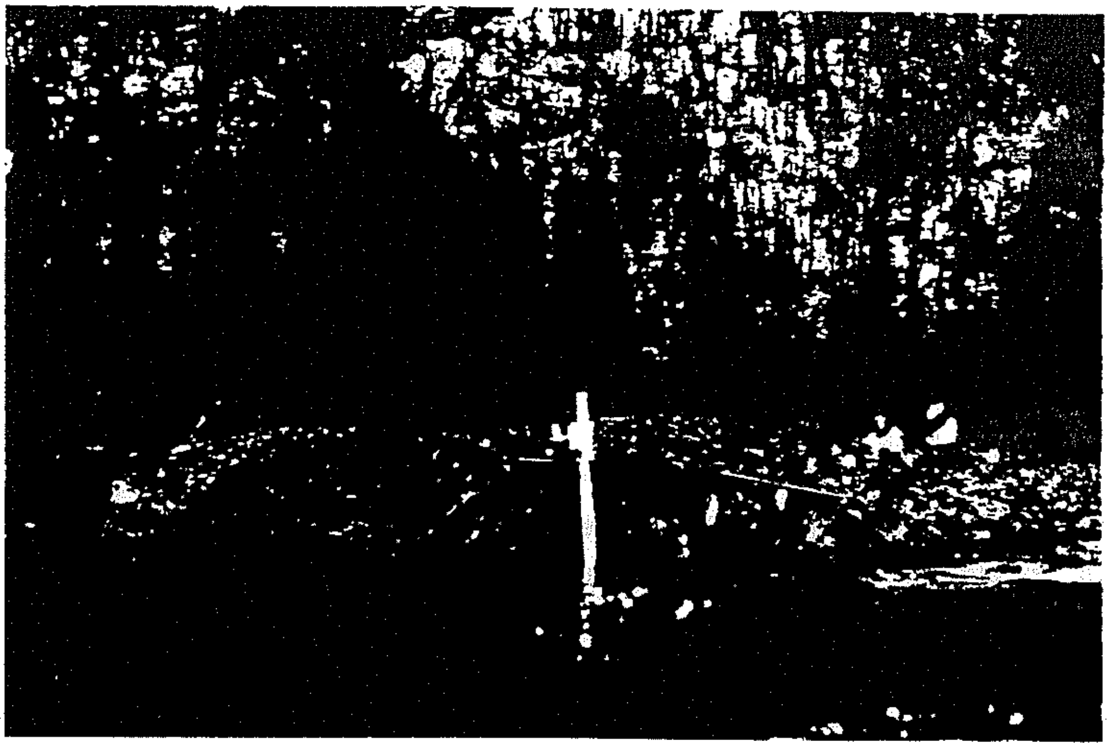


Plate 4-2: The hydrometric station on Prairie Creek includes a staff gauge, pressure transducer and Terrascience EIF datalogger (inside of the aluminium instrument enclosure). Water depths are recorded hourly by the datalogger.

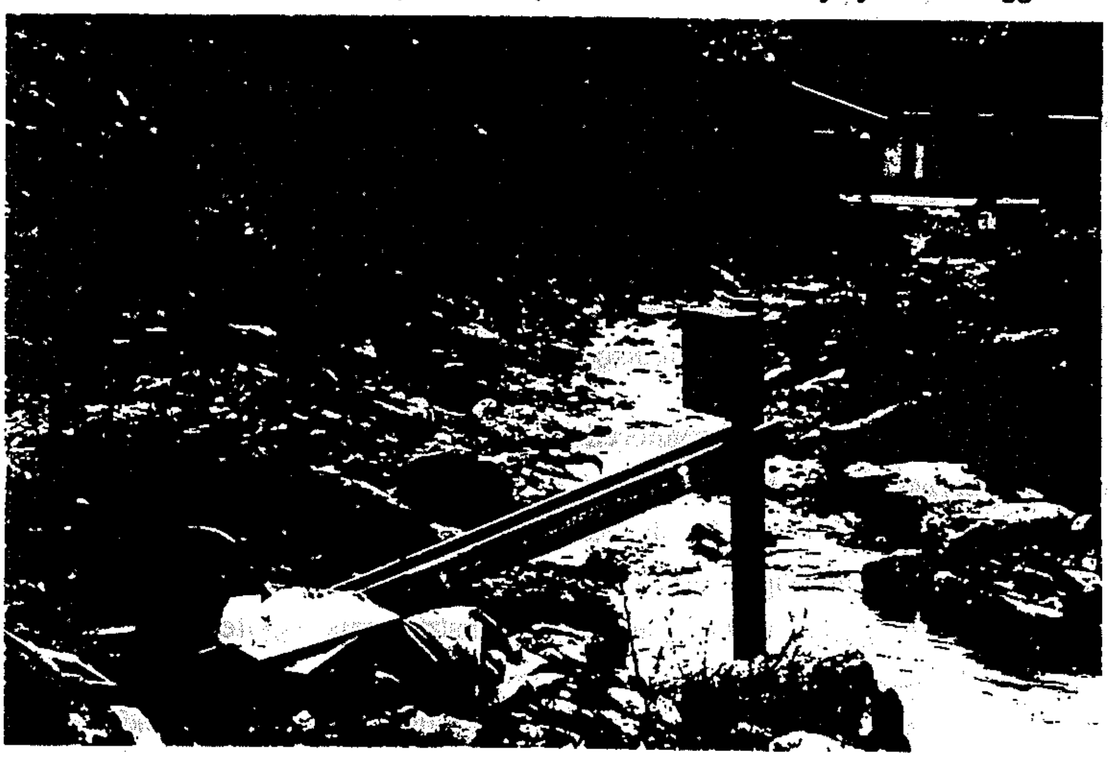


Plate 4-3: The second hydrometric station was installed in June 1994 on Harrison Creek above the mill.

Table 4-1

Water Quality Parameters, CCME Guidelines and Laboratory Detection Limits

Parameters		Drinking Water Limit (mg/L)	Fresh Water Aquatic Life Limit (mg/L)	Livestock Drinking Water Limit (mg/L)	Detection Limits (mg/L)
Field Measurements					
Temperature (°C)		-	-	-	N/A*
pH		6.5 - 8.5	6.5 - 9	-	N/A
Dissolved Oxygen (mg/L)		-	5 - 9.5[a]	-	N/A
Laboratory (mg/L)					
Conductivity					
Total Suspended Solids	(TSS)	-	Increase of 10[b]	Increase of 20[b]	<1
Total Dissolved Solids	(TDS)	500	-	3,000	<1
Turbidity	(NTU)	5	-	-	N/A
Alkalinity to pH 4.5	(mg $CaCO_3$/L)	-	-	-	<1
Carbonate	(mg $CaCO_3$/L)	-	-	-	<1
Bicarbonate	(mg $CaCO_3$/L)	-	-	-	<1
Hardness - CALC	(mg/L)	-	-	-	<1
Anions/Cations (mg/L)					
Chloride	(Cl^-)	250	-	-	<0.5
Fluoride	(F^-)	1.5	-	2.0	<0.5
Sulphate	(SO_4^{-2})	500	-	1,000	<0.10
Potassium	(K^+)	-	-	-	<1.0
Sodium	(Na^+)	-	-	-	<1.0
Nutrients (mg/L)					
Ammonia	(mg NH_3-N/L)	-	1.37[c]	-	<0.005
Nitrate	(mg NO_3-N/L)	10[d]	-	100[e]	<0.001
Nitrite	(mg NO_2-N/L)	1[d]	0.06	10[e]	<0.001
Total Phosphorus		-	-	-	<0.002
Dissolved Phosphorus		-	-	-	<0.002
Ortho-phosphate	(PO_4^{3-})	-	-	-	<0.002
Dissolved Organic Carbon		-	-	-	<0.5

* N/A = Not aplicable.

(continued)

Table 4-1 (completed)

Water Quality Parameters, CCME Guidelines and Laboratory Detection Limits

Parameters		Drinking Water Limit (mg/L)	Fresh Water Aquatic Life Limit (mg/L)	Livestock Drinking Water Limit (mg/L)	Detection Limits (µg/L)
Elements					
Aluminum	(Al)	-	0.1[f]	5.0	<1.0
Antimony	(Sb)	-	-	-	<0.20
Arsenic	(As)	0.05	0.05	5.0	<1.0
Barium	(Ba)	1.0	-	-	<0.1
Beryllium	(Be)	-	-	0.1[g]	<0.20
Boron	(B)	5.0	-	5.0	<1.0
Cadmium	(Cd)	0.005	0.0008[h]	0.02	<0.060
Chromium	(Cr)	0.05	0.002	1.0	<1.0
Cobalt	(Co)	-	-	1.0	<0.040
Copper	(Cu)	1	0.002[h]	0.5[i]	<0.40
Iron	(Fe)	0.3	0.3	-	<10
Lead	(Pb)	0.05	0.002[h]	0.1	<0.10
Manganese	(Mn)	0.05	-	-	<0.10
Mercury	(Hg)	0.001	0.0001	0.003	<0.050
Molybdenum	(Mo)	-	-	0.5	<0.1
Nickel	(Ni)	-	0.065[h]	1.0	<0.40
Selenium	(Se)	0.01	0.001	0.05	<1.0
Silver	(Ag)	0.05	0.0001	-	<0.010
Uranium	(U)	0.020	-	0.2	<0.02
Vanadium	(V)	-	-	0.1	<1.0
Zinc	(Zn)	5	0.03	50.0	<1.0

a: Dependent on life stage of organisms and ambient temperature.
b: For background suspended solids ≤ 100 mg/L.
c: For pH 8.0 at 10°C.
d: When nitrite present, sum of both nitrate and nitrite not to exceed 10 mg/L.
e: When nitrite present, sum of both nitrate and nitrite not to exceed 100 mg/L.
f: For pH > 6.5, although reduced levels of Ca and/or dissolved organic carbon can increase the toxic effects of aluminum.
g: Tentative guideline.
h: For hardness 60-120 mg/L as $CaCO_3$; guidelines increase/decrease with increasing /decreasing hardness.
i: Lower limit used for sheep.

the list of water quality parameters due to the mixing of trace quantities of flotation reagents in with the tailings and the expected discharge of such materials with the supernatant into Prairie Creek. Moreover, dissolved organic carbon plays an important role in trace metal chemistry, particularly in complexing metals and reducing their overall toxicity.

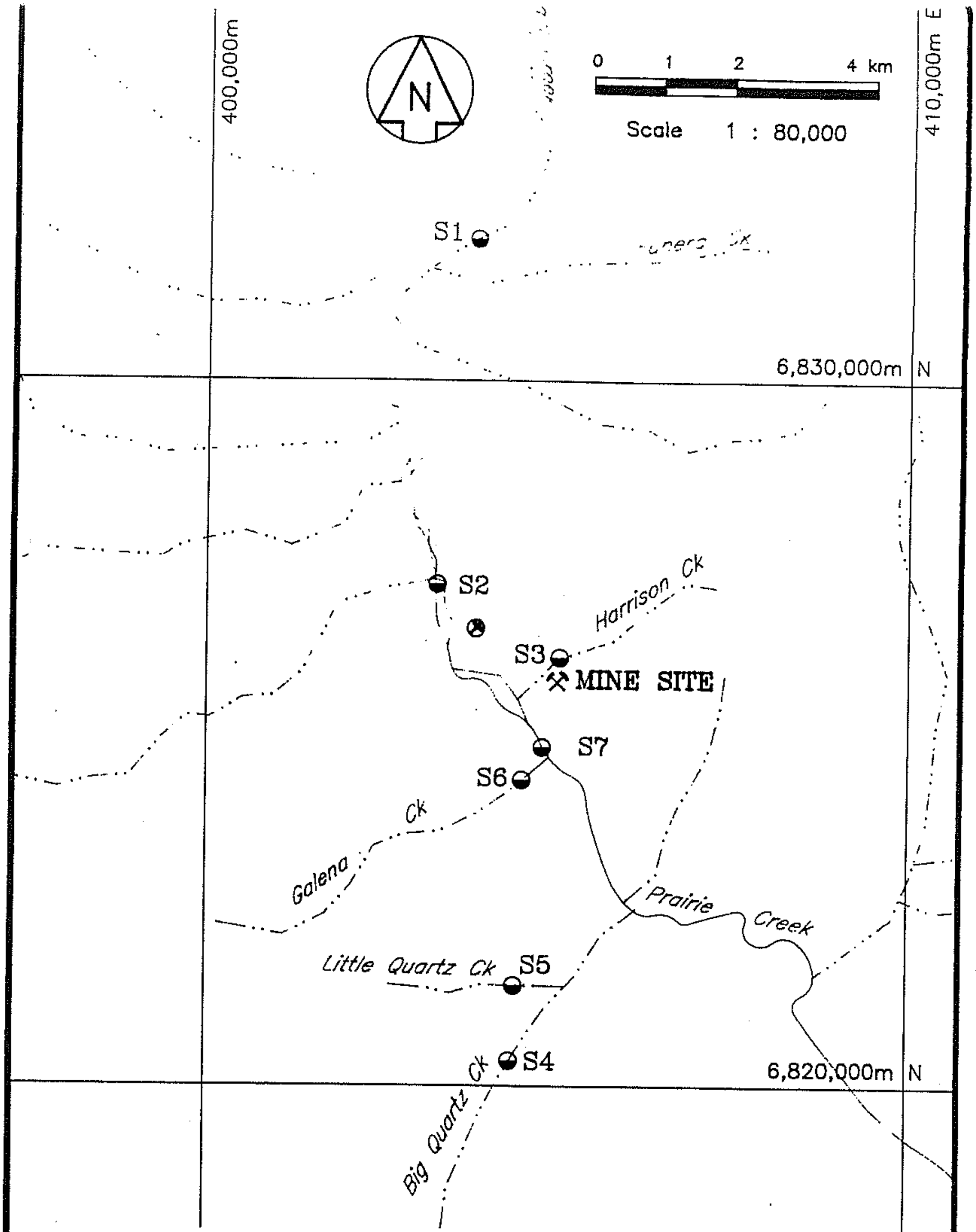
Monitoring of the tailings supernatant discharged into Prairie Creek will continue during the operational life of the mine. Water quality will be monitored at stations set at intervals along Prairie Creek from the mine site to the boundary of the Nahanni National Park. Sites in Prairie Creek upstream of the mining-influenced area will be established as controls. Figure 4-1 shows the sites currently in use for monitoring of baseline conditions.

Due to the nature of the Prairie Creek area (glacially-scoured and snowmelt-fed streams), sediment samples are difficult to obtain as depositional areas in the creeks are not present. Freshet conditions also sweep deposited sediments out of the area on a regular basis. Sediment samples may be collected from wetlands and other areas along the proposed access route, but are not pertinent to the mining operations themselves; consequently, sediment sampling is not recommended at this time.

Additional parameters/elements may be added to the analyses as mining operations get under way. The list of elements may be modified as baseline information is gathered on which elements should be monitored due to their presence in significant quantities in the area or in the ore, and as government water quality guidelines are revised and updated. Elements without recommended guidelines and not crucial to the monitoring program may be dropped.

4.1.4 Aquatic Resources

Aquatic resources in the Prairie Creek area and along the proposed access route include algae (periphyton) and benthic plants, benthic invertebrates (part or entire life cycle spent in the water), and fish. Algae and aquatic plants are primary producers which form the base of the food chain; they are grazed by other aquatic organisms (*e.g.* herbivorous snails) and some large mammals (*e.g.* moose). They are also important substrate for the attachment of egg cases and colonies of sedentary organisms, as well as providing camouflage and shelter for various life



Water Quality Monitoring Sites

Figure 4-1

San Andreas Resources Corporation

Rescan

stages of invertebrate (including insects) and vertebrate (fishes) species. Larger organisms then prey on smaller organisms, with the fishes generally at the top of the aquatic food chain. In turn, fish may form part of the diet of higher vertebrates such as raptorial birds, bears, and man.

The drainage systems of the Prairie Creek project area and the proposed access corridor support an apparently sparse population of aquatic species with limited diversity. Algal growth is composed mainly of benthic diatoms and aquatic invertebrates are represented almost entirely by larval stages of various terrestrial and aerial insects. Reported fish species are limited to Dolly Varden (*Salvelinus malma*) and/or bull trout (*Salvelinus confluentus*), lake chub (*Couesius plumbeus*), arctic grayling (*Thymallus arcticus*), mountain whitefish (*Prosopium williamsoni*), longnose suckers (*Catostomus catostomus*) and the ubiquitous slimy sculpin (*Cottus cognatus*). Limited information is available on the aquatic resources of the area from previous studies done for mining developments in the Prairie Creek and Flathead River drainages and the resource description report for the Nahanni National Park (Parks Canada 1984; Beak 1981).

Environmental monitoring of aquatic flora and fauna will start with initial reconnaisance surveys of species present/absent in the area and their relative abundances. Periphyton and benthic invertebrate samples will be collected from the same stations being used for the current water quality program as well as at proposed stream crossings along the access corridor. Such data will provide the baseline community structure against which later samplings can be compared. However, changes in species diversity and abundance occur naturally with time due to physical changes in the environment unrelated to mining; thus, such data will have to be interpreted with care. Nevertheless, this data will provide information on available food and shelter for other organisms important for aesthetic or socioeconomic reasons. In addition, certain species can be used as indicators of changes in water quality parameters as some organisms are more sensitive then others.

The aquatic resource considered most important from a human perspective due to subsistence and recreational uses is the fisheries value of the area. Fisheries studies will be conducted to determine species diversity and abundance in the area, habitat will be characterized (*i.e.* for spawning or rearing), and specimens will be collected in order to evaluate dietary preferences (stomach content analyses), population age structure (otoliths, fin rays, and scales, where appropriate), and tissue metals burden. Such data will allow monitoring of Prairie Creek fish populations for increases in metals content due to bioaccumulation from effluent discharge as well as other effects such as reduced fecundity and survivability as a result of acute and/or chronic toxicity. Retention of fish for laboratory analyses will be restricted to ten specimens per species so as not to deplete existing populations before their numbers can be fully assessed.

After mine start-up, aquatic resources should be monitored on a seasonal basis for species diversity and relative abundance in order to test for any decreases/increases that take place. Sites upstream of the mining-influenced area in Prairie Creek must be included in order to detect any natural changes in the system. Seasonal sampling is required due to the ephemeral nature of some of the watercourses as well as the variable life cycles of many of the aquatic organisms, and the monitoring program should be continued every year of mine life.

4.1.4.1 Stream Sampling and Habitat Characterization

Because of the diffuse drainage patterns, the evaluation of many watercourses as fish migration routes and forging, spawning or nursery habitat will be based on visual observations and sampling during periods of fish activity, and will be largely qualitative. Observations will be made to detect migration and spawning activity by char and other species known or suspected of being in the area, including various whitefish, slimy sculpins and lake chubs.

The stream sampling method of preference would be three-pass electroshocking, using barrier nets set to block off the sampling sections following the depletion method of Zippin (1958) and Platts *et al.* (1983). It should be noted that electrofishing efforts thus for have yielded few fish. Alternative methods for stream sampling will also be investigated.

Habitat characterization will be undertaken in those streams which have defined channels and sufficient post-freshet flow. Methods will follow the *Stream Survey Field Guide* published by DFO and B.C. MOE (1989) and B.C. MOE (1984). Basic habitat unit types such as pool, riffle, run, cascade, *etc.*, will be identified and noted within each study site in the study streams. Within each sampling site, measurements or estimates of wetted width, depth, slope and substrate composition will be made. In addition, the composition of cover provided by overstream vegetation (OSV), undercut banks (UCB), pools and boulders will be visually estimated. Where practical, stream velocities and discharges will be measured at the sample site. Flow measurements at a given site will be obtained along a cross-sectional transect located in an unobstructed section of stream (*e.g.* run habitat). Measurements will be recorded at intervals of 0.5 m across the stream at 0.6 times the depth. Stream discharge will be calculated as the product of cross-sectional area (average depth x wetted width) and average flow velocity across the entire wetted width.

Fish species presence/absence in project area streams at access road crossings will be assessed and habitat conditions evaluated with the aim of providing advice on the placement of fill, bridges and culverts as defined by Dane (1978) and B.C. MOE (1984). The sampling program will seek to determine the seasonal distribution of fish species in the lakes and connecting watercourses and provide the basis for mapping the critical habitat utilized by all life stages of the major species.

4.1.5 Soil Quality and Terrain

Soil quality and terrain will be mapped by qualified professionals during engineering and design studies of the mine site and all-weather access road. Adherence to proper engineering will protect the quality of the surrounding terrain. Those areas sensitive to destruction (*e.g.* Karst features) will be avoided.

The management program for soil quality will principally involve the prevention of spills of contaminant throughout the project site and along the all-weather access road. The process chemical and fuel storage areas will be isolated by impermeable liners and berms of sufficient capacity to contain any foreseeable leakage. Fuelling stations will be similarly protected. Areas around the mine site where soil is excavated or moved and cut banks, borrow pits and fills areas along the access road will be graded and configured to prevent or minimize soil erosion. Unnecessary off-road movement of heavy machinery and vehicles will be avoided to limit soil compaction and damage to vegetation and permafrost, where it occurs.

Some of the terrain features requiring protection include steep talus slopes slide area and river banks which could be destabilized by machinery, wetlands where drainage patterns may be disrupted by filling and karst features which are a valued ecosystem component vulnerable to degradation by foot and vehicle traffic.

4.1.6 Vegetation and Wildlife

Vegetation mapping and wildlife surveys will be conducted in the mine site area and along the all-weather access road. Such studies will identify sensitive areas that should be protected or avoided due to the presence of vegetation/wildlife that are susceptible to destruction or disturbance. Particular attention will be paid to nesting areas favoured by Trumpeter swans and birthing/denning areas of conspicuous mammals (bears, moose, caribou, sheep, wolves, *etc.*). A wildlife log will be maintained at the camp and personnel will be encouraged to record sightings and observations.

Terrestrial vegetation stabilizes the soil surface and protects underlying permafrost (where present), provides shelter, browse and forage for mammals and birds, and attenuates the runoff from snowmelt and precipitation. The management program for vegetation in the project area will focus heavily on fire prevention because the effects on wildlife of habitat destruction can be devastating and burned areas regenerate only very slowly. During the short, dry summer, fire precautions will need to encompass staff training to raise awareness of fire hazards, including careless smoking, sparks from equipment, and open fires along the access road and around the camp / mine / mill complex. The measures applied to the protection of soil, principally avoidance of unnecessary off-road traffic, will also protect vegetative ground cover.

Environmental management for the protection of wildlife will include preserving habitat as outlined above and limiting as much as possible the harassment and destruction of animals by mine personnel and public who may take advantage of enhanced accessibility. Some accommodation of air traffic schedules to the presence of wildlife near the airstrip(s) may be necessary to avoid disturbance.

Large ungulates (Dall's sheep, woodland caribou and moose) are expected to move across and along various parts of the access road to utilize birthing, shelter and foraging areas. Part of the protection program will involve briefing the drivers of all vehicles to be alert and avoid collisions with animals. Hunting for big game and waterfowl in the project area by mine personnel may be restricted by endorsing a no-hunting policy. However, if the all-weather road cannot be gated because of federal regulations, increased accessibility may bring in outside hunters and exert increasing pressure on the game populations. The ultimate responsibility for off-site wildlife management will continue to lie within the Renewable Resources Branch of the Territorial government.

Possible hazardous encounters between project personnel and wildlife will be discouraged by proper management of food waste so that animals are not attracted to the camp area, as well as briefings on seasonal and species-specific behaviour.

In general, a camp policy against harassment or wanton killing of any wildlife should be promulgated and made clear to all personnel. The maintenance of a wildlife log will also provide information specific to the area for the years of mine life and will encourage personnel to take an active interest in preserving their surroundings.

4.1.7 Waste Management

One of the most important issues surrounding the development of the Prairie Creek Project will be a waste management plan acceptable to the proponent and regulatory authorities. The waste management plan, which will be based in part on the water management plan and several components of the biophysical assessment will constitute the primary environmental strategy for the mine. Perhaps of greatest consideration will be the management of the tailings pond discharge water quality. Currently, a water treatment plant is being designed (Section 2.6.2) which ensures acceptable water quality in Prairie Creek.

4.1.8 Acid Generation Testwork

Assessment of acid drainage for proposed mines is primarily based on static and kinetic tests. Static tests involve laboratory measurements of acid-generating and acid-neutralizing capacities of a sample, and the subsequent determination of the sample's potential to generate net acidity at some point in time. Static tests also include detailed mineralogical examinations and total-metal analyses of samples. Kinetic tests expose selected samples to optimum conditions for sulphide oxidation and acid generation. Weekly rinses of these samples reveal the kinetic rates of acid generation, acid neutralization, and metal leaching.

Through the static test known as acid-base accounting (ABA), San Andreas has already analyzed more than 25 samples of rock from drillcore and outcrops. These results have indicated that none of the rock has potential for net acid generation. The ABA results to data have shown that acid-neutralizing carbonate minerals exceeded the total capacity to generate acidity by a factor of approximately 200. Because the possibility of acidic drainage is so remote, humidity cells will not be justified for predictions of acidic drainage.

San Andreas is committed to continuing to expand their ARD database throughout future exploration in order to verify the continuity of these conclusions.

4.2 Socio-economic Considerations

The San Andreas Resources Prairie Creek project may affect the socio-economic conditions of certain communities in the Northwest Territories on a temporary or long-term basis. Although there are no people currently residing at the site, the proposed mine is likely to affect nearby communities that supply and host the project workforce and that are involved in related business activity. This chapter describes the communities that may experience impacts from project development and outlines potential socio-economics impacts in those settlements and in the region.

4.2.1 Socio-economic Setting

The Prairie Creek project is located in an unpopulated area nearly 100 kilometres from Nahanni Butte, the nearest settlement,. Other nearby communities are Fort Liard, 170 kilometres southeast of the site, and Fort Simpson, almost 200 kilometres northeast of the site. These three communities, which are part of the Fort Smith Region of the Northwest Territories, are expected to be the most affected by this project. If Yellowknife is designated as the fly in/ out point for shift rotation, then the potential socio-economic impact in that settlement will also have to be estimated.

The majority of the residents of these communities are Slavey Dene, who still pursue a traditional lifestyle based on hunting and trapping. Dene, a word similar to the word for "people" in most Athapaskan languages, includes several cultural and linguistic groups: the Chipewyan, the Dogrib, the Slavey, and the Tetlit

Gwich'in. The dialect of the Slavey Dene is similar to that of the Chipewyan and Dogrib Dene, but these three are quite different from the Gwich'in dialect. Most Slavey Dene live in the vicinity of the Hay River, between Lake Athabasca in Alberta and Great Slave Lake. They also reside in British Columbia, southern NWT and down the Mackenzie River as far north as Fort Norman.

An access to the Nahanni National Park Reserve is located approximately 33 kilometres west of Nahanni Butte. This 4,766 km^2 park was recognized as a World Heritage Site by UNESCO World Heritage Convention in 1978, but is also known for the wild river touring on both the South Nahanni and Flat rivers.

Although there is currently mineral, oil and gas exploration in the area, the majority of economic activity involves government employment, transportation, hunting and trapping.

Nahanni Butte

Nahanni Butte, the closest settlement to the project site, is located on the South Nahanni River close to its junction with the Liard River. The primarily South Slavey settlement has existed for many years at its current site and, previously, at the Netla River, 24 kilometres away. The Chief of the Nahanni Butte Dene Band is Francis Betsaka.

Nahanni Butte is located 33 kilometres downstream of the eastern border of the Nahanni National Park Reserve. A winter road to the Liard Highway (Highway 7) connects the community to Fort Simpson, to the north, and Fort Liard, to the south. Highway 7, which was completed in 1983, becomes the Mackenzie Highway (Highway 1) just south of Fort Simpson.

The population of Nahanni Butte is estimated at approximately 85 people, of whom 95 per cent are Dene and 5 per cent are non-native. The 1991 Canada Census survey shows that the South Slavey language is the only mother tongue for over 70 per cent of the population of this small settlement.

Trapping and tourism form the basis of economic activity, although primary industries, construction, education and government services are also important. Hospital, medical and social services are provided from Fort Simpson.

Fort Simpson

Fort Simpson is located nearly 200 kilometres northeast of the Prairie Creek project site on the west bank of the Mackenzie River at the confluence with the Liard River. Established in 1804 by the Northwest Company, it is the oldest continuously occupied trading post on the Mackenzie River. The community has been used as a base for exploration activities in the past and is currently the Area administrative centre for the Territorial government (Fort Simpson Area of the Fort Smith Region).

The population of Fort Simpson is approximately 1,200 people, of whom half are Dene, over one-tenth are Metis, a tiny percentage are Inuit and the remainder are non-native. The population distribution by mother tongue shows almost 64 per cent English, less than two per cent French and over 34 per cent a non-official language, primarily South Slavey. A very small minority speak Dogrib, Chipewyan or German.

At the municipal level, Fort Simpson was incorporated as a village in 1973. The current Mayor is Raymond Michaud. The Fort Simpson Dene Band, of which Herb Norwegian is the Chief, is located in the village, as is the Deh Cho Tribal Council and the Deh Cho Dene Regional Council.

Fort Simpson is also the regional government centre of Fort Smith Region. Therefore, government employment is one of the major economic activities. Transportation, tourism, trapping and handicrafts are also very important.

There are medical and social services and facilities available in Fort Simpson, including a hospital. Residents have access to a community hall and several other recreation facilities.

Fort Liard

Fort Liard, located about 170 kilometres southeast of the Prairie Creek mine site, is located on the south side of the Liard River, close to the British Columbia border. The Liard Highway (Highway 7), passes through Fort Liard, connecting it to Fort Nelson, BC to the south and Fort Simpson, NWT to the north.

Fort Liard appears to be one of oldest continuously occupied aboriginal sites in the Northwest Territories. It was an important trading post for native peoples before contact with Europeans and later, for Northwest Company and Hudson's Bay Company.

The current population of Fort Liard is estimated at approximately 500. A 1987 estimate shows that approximately three-quarters of the population are Dene, less than 10 per cent are Metis and approximately 16 per cent are non-native. According to the 1991 Canada Census, three per cent of the population is bilingual - either English/ French or English/ Slavey. The remainder of the population reported one language as "mother tongue", distributed roughly as follows: 45 per cent English; one per cent French; 51 per cent Slavey; and two per cent "other".

The Fort Liard Dene Band Council, of which Henry Deneron was re-elected as the Chief on December 12, 1994, is located within the hamlet. Fort Liard became a hamlet on April 3, 1987 and the mayor is Judy Kotchea.

Trapping, hunting and fishing are important economic activities at Fort Liard. Construction, trade, transportation and government services are also important. A small medical staff provides medical services. Social services are provided from Fort Simpson, although there are a few facilities in the settlement.

4.2.2 Socio-economic Impacts

Since there are no human settlements at the mine site, the main socio-economic impact is expected to be the creation of employment opportunities for the nearest communities and the related spin-off effects. Other socio-economic impacts may relate to the traditional economy of the region.

The construction and development period is expected to last from mid-1995 until the third quarter of 1996. Employment during this time is expected to be in the order of a 300-person workforce. The socio-economic impact during construction is usually less than during the operations phase because it is a short-term phase that does not generally change regional populations and incomes. However, any local procurement and local employment during this phase will have some effect on the existing social and economic structure.

The mine is expected to operate for at least 10 years, from 1996 to at least 2006. During this time, the workforce will be 230, housed at the site in a 250-person camp adjacent to the process plant. The underground mine shift rotation will be two 10-hour shifts per day, seven days per week. The process plant will also run seven days per week, but with two 12-hour shifts, instead. The pick up and drop off point will be determined after careful consideration of all options and consultation with community leaders.

San Andreas Resources Corporation is committed to hiring Northwest Territories residents first, as qualifications allow, before looking to southern Canada. Throughout 1994, efforts were made to hire locally for the exploration program. Four of the eight drillers' helpers were from the Northwest Territories: Nahanni Butte (1); Fort Simpson (2); and Hay River (1).

Mine employees from outside the Northwest Territories may choose to relocate in Fort Simpson, or one of the other nearby communities, leading to increased population, increased economic activity and greater use of the existing social, medical, recreation and transportation infrastructures.

4.2.2.1 Economic Benefits

During the mine, road and airstrip construction, there will be direct economic benefits from the employment of northern residents at the site. However, the balance of those workers will be from outside the region and are not likely to relocate to communities closest to the mine. Therefore, the indirect and induced benefits from this employment will be less significant than during the operations phase.

During the 10-year operations phase, the mine and plant employment will be maintained at approximately 230, which represents 2,300 person years of employment over a 10-year mine life. The majority of the economic impact is expected to occur in Nahanni Butte, Fort Simpson and Fort Liard. Impact will occur in Yellowknife if it is used as a pick up/ drop off point for shift rotations.

Direct economic benefits will be derived directly from the employment of northerners. Indirect benefits due to procurement by the mine and induced benefits from these employees and their families spending wages locally and regionally are also expected. In addition, benefits will be derived from any increase in population due to southern Canadian workers accepting employment at Prairie Creek. The additional consumption from these workers and their families will increase the local induced benefits.

The NWT Bureau of Statistics estimates that for every 10 mining jobs held by NWT residents, seven additional jobs are created in the NWT to service the 10 mining jobs and that for every dollar spent by a mine worker's household, an additional $0.22 in indirect expenditure results. This means that if all Prairie Creek workers are, or become, NWT residents, an estimated additional 160 indirect and induced jobs could be created in the NWT. Indeed, this estimate may be conservative in that more jobs are expected to be created due to the construction and maintenance of the 165 km all-weather road and the associated haulage of concentrate along this route.

It is expected that economic development will occur through increased sales at existing businesses and secondary development in support services and related businesses. In addition, the mine will act to diversify the economic base of the area as companies that supply goods and services to the mine and to its employees are formed locally.

A commitment to northern employment means that local Aboriginal people will derive direct benefits from income and the attainment of portable skills.

An increase in government revenue, due to taxes and royalties and a reduction in expenditures, such as Unemployment Insurance and Welfare, are important economic benefits to the NWT and Canada. Taxes to various levels of governments include corporate, investment, income, property and sales taxes.

4.2.2.2 Economic Costs

Population increases may cause some overburden to the existing supply of public utilities. The inconvenience may initially be borne by the current users and the cost of its adjustment, by the government. The increase in population and employment may also put pressure on existing medical, social, education and recreation services and facilities. San Andreas Resources Corporation expects to convey expected requirements to relevant municipal government departments in order to mitigate any impact to current public utility service.

Although existing small businesses may face stiffer competition from new businesses, an early effort by San Andreas Resources Corporation to procure locally may serve to develop strong ties with existing businesses and give them sufficient time to make necessary adjustments to supply.

The increase in demand for goods and services by the mine and its employees may have short-term inflationary effects until the local supply meets demand. However, long-term, permanent improvements and opportunities for consumers may occur in the local economy as a result of businesses expanding in scale and product lines.

Land use may become an issue in the area if competition arises between renewable resource users (*i.e.* First Nations groups), non-renewable resource users, recreation users and wilderness users.

4.2.3 Social Benefits

One of the most noticeable social benefits of the Prairie Creek mine is expected to be improved choices and conditions of lifestyles for NWT residents. This will be the result of direct mine employment, indirect employment and other spin off benefits and should lead to greater regional independence and autonomy for the people of the North.

Within communities, social benefits should also arise due to increased skills training, employment stability, permanent incomes and possible reductions in social assistance payments. Young people will have a greater number and variety of job and lifestyle choices within their own communities. For aboriginals employed at the mine, the employment income could mean enhancing buying power for such items as traps, guns and snowmobiles for hunting and trapping.

4.2.4 Social Costs

Traditional native knowledge is passed by Elders to younger band members through teaching and by example. If a large number of young native men and women leave their communities to work at the mine, there may be a concern that traditional teaching will be interrupted, knowledge will be lost and the continuity of native education will be harmed. However, shift rotations allow time to be spent in the community and in the pursuit of traditional activities. Separation of families during shifts sometimes causes social adjustments.

In addition, wage income is not generally distributed in a community in the same manner that game is shared. An imbalance may be created within communities between those that are wage-employed and those that pursue traditional activities.

Another concern with sudden increases in disposable income in any community is the risk that it may lead to increases in the incidence of substance abuse and substance-related violence between work shifts.

A rapid rise in population may temporarily overburden the housing supply and social services such as police, fire, education and health. The rise in population may also cause temporary increases in inflation, which will affect residents with fixed incomes the most.

4.3 Public Consultation

One of the most important methods of environmental and socio-economic monitoring and management is good communication. San Andreas Resources Corporation initiated contact with the Chiefs of Nahanni Butte, Fort Liard and Fort Simpson. A meeting took place on June 22, 1994 involving the Chiefs and the senior management of San Andreas. At this meeting, the project was discussed, as well as employment and training opportunities, road construction and maintenance contracts, negotiations and a trip to the site. A follow-up meeting is scheduled for January, 1995.

San Andreas expects to maintain this relationship through regular contact with the Band Council and presentations to Band Members. In addition, presentations to the local government, residents and the business community are being considered in the future to facilitate open, public communication about the development.

5.0 POTENTIAL ENVIRONMENTAL IMPACTS

The development of a base metals mine in the Mackenzie Mountains Region requires the consideration of the impacts which such a project could have on its surrounding environment. Due to the severe climate, low fertility of soils and surface waters and the localized occurrence of permafrost, the recovery of various ecosystem components from damage by development activity is usually slow. Consequently, care must be exercised to minimize any disturbances which could persist long after the activity itself has ceased.

It is important to recognize the environmental issues associated with mining activities due to their potential implications for vegetation, fish and wildlife, as well as the First Nations and other populations who depend on the integrity of the resource base to ensure their social and economic well-being. The area of the mine site is considered particularly sensitive due to its proximity to the Nahanni National Park, which includes within its boundaries about 26 km of Prairie Creek above its junction with the South Nahanni River. Project development has the potential to disturb air quality, soil and vegetation which are key components of wildlife habitat. Any significant habitat alteration or loss, if combined with other possible project-related disturbances, could affect the well-being of resident and seasonal populations of major wildlife species, including migratory waterfowl and woodland caribou, Dall's sheep, moose, grizzly and black bears, wolves and other furbearers. Modification of local hydrology and water quality could affect the amount and quality of fish habitat, and fish populations within the development area, as well as in tributary and downstream waters.

Communities in the region may be affected by the environmental impacts of project development in several ways. Potential impacts to First Nations and non-native populations who may depend directly on biological resources for food and animal products, or indirectly on economic returns for recreational guiding are expected to be minor and largely positive. Access to hunting and fishing areas between the Liard Highway and the mine site could be improved through construction of the all-weather road. Moreover, communities in the region can be expected to experience long-term benefits of the development related to employment opportunities and land claims.

Project activities and attributes will interact with many biophysical components of the environment through both obvious and subtle linkages. Table 5-1 illustrates the principal interconnections. It is emphasized that the impacts identified here will be avoided or effectively mitigated through an environmental management program and that any residual effects will be very minor.

5.1 Atmospheric Impacts

The major sources of air emissions from the Prairie Creek project will be stationary sources, such as the diesel power-generating plant and ore-processing facilities, and mobile sources, such as haul trucks and personnel carriers. Fugitive dust from concentrate transfer points is also a potential concern. The sources are further described below along with the potential environmental impacts.

5.1.1 Diesel Power Generation

The diesel power-generating station will be a source of particulate and gaseous emissions. Most of the particulate emissions originate from the ash content of the diesel fuel. The gaseous emissions will consist of carbon dioxide (CO_2), nitrogen oxides (NO_X), carbon monoxide (CO), sulphur oxides (SO_X), aldehydes and various types of hydrocarbons (exhaust, evaporative, crankcase and refuelling) in decreasing order of magnitude. The quantity of emissions depends upon the size of the generating units, fuel consumption, load factor, utilization, presence/absence of pollution control devices and the quality of the diesel fuel, especially in terms of its sulphur content. Since the on-site testing of air emissions from the diesel power station would be quite expensive, the quantity of emissions may be estimated with factors supplied by the United States Environmental Protection Agency and with information supplied by the manufacturer.

As mentioned earlier in Section 2.6.2, the diesel power generation facilities for the Prairie Creek project will consist of four 1.1 MW generators (existing) and two mobile modular generators, each rated at 1.5 MW. The total capacity will, therefore, be 7.4 MW. During normal operation the power requirements will be 5 to 6 MW. Waste heat will be recovered from the units and used to heat the underground mine. Although the four generators for the mine/mill are installed, they have never been operated. A small diesel unit currently supplies power to the camp.

Table 5-1

Project - Environment Linkages

Project Activity	Affected Environmental Components	Potential Effects
Transportation		
All-weather Access Road Traffic (including realignment, upgrading, *etc.*)	Wildlife and Aquatic Life	Disturbance, diversion and migration barriers, road kills, hunting/fishing access created for persons not related to mining
	Soil and Terrain	Compaction, slope stability, erosion at stream crossings
	Permafrost	Removal of cover, active layer expansion
	Karstlands	Damage from foot traffic
Camp and Plant Site (Existing and Additional Construction)		
Human Presence, Odours, Noise, Dust, Smoke, Exhaust Gas,	Wildlife and Aquatic Life	Temporary disturbance, long-term displacement, population reduction, siltation
Grading, Paving, Erection of Structures	Vegetation	Compaction and removal
	Permafrost	Active layer expansion
Camp and Plant Site Operation	Wildlife	Habituation, attraction, disturbance
Mine Development		
Streams	Hydrology	Impaired water quality, disruption of fish habitat and migration patterns, displacement/reduction of other aquatic organisms (benthos, plankton)
Stream Diversions	Hydrology	Soil and terrain, vegetation, permafrost removal/disruption
Waste Rock Disposal	Soil and Terrain	Vegetation, wildlife removal/disruption
Tailings Disposal	Fish Habitat	Impaired water quality, abundance and diversity reduction of benthos, fish populations and plankton
Mine Operations		
Blasting, Excavation, Haulage, Ore Processing	Wildlife	Disturbance, avoidance, habituation

The emissions from the diesel power station will be discharged to the air at elevated temperatures. The high temperature of the stack gases will cause them to be somewhat buoyant compared to surrounding air. This buoyancy coupled with the velocity of the stack gas will assist in the dilution and mixing processes to ensure that ground level concentrations do not surpass the Canadian Ambient Air Quality Objectives. These objectives are summarized in Table 5-2.

Table 5-2

Canadian Ambient Air Quality Objectives

Air Contaminant	Acceptable Range of Quality	Averaging Period
SO_2	30 - 60 μg/m³	Annual arithmetic mean
	150 - 300 μg/m³	24 hour average
	450 - 900 μg/m³	1 hour average
Suspended Particulate Matter	60 - 70 μg/m³	Annual geometric mean
	0 - 120 μg/m³	24 hour average
CO	6 - 15 mg/m³	8 hour average
	15 - 35 mg/m³	1 hour average
Oxidants (ozone)	0 - 30 μg/m³	Annual arithmetic mean
	30 - 50 μg/m³	24 hour average
	100 - 160 μg/m³	1 hour average
NO_2	0 - 100 μg/m³	Annual arithmetic mean
	0 - 200 μg/m³	24 hour average
	0 - 400 μg/m³	1 hour average

The mine/mill diesel power plant will have to comply with the Canadian Environmental Protection Act's Thermal Power Generation Emissions National Guidelines for New Stationary Sources. The maximum allowable emissions for nitrogen oxides, particulate matter and sulphur dioxide are based upon the capacity of the plant and the type of fuel used. According to the Guidelines each new source should have continuous monitoring for opacity, sulphur dioxide and nitrogen oxides. Emissions testing should be carried out within 180 days of start-up and it should be witnessed by the appropriate regulatory authority. The emissions rate for each pollutant as read from the continuous monitoring equipment (rolling averages) should be reported to the regulatory authority on a quarterly basis.

5.1.2 Dust

The potential sources of dust at the Prairie Creek project will include fugitive emissions from the ore crusher, conveyors, ore handling operations, ore stockpile, concentrate stockpiles, road traffic, and exhaust from the underground workings. Environmental management strategies directed at controlling fugitive dust emissions from these operations include bag house dust collectors in the crushing and grinding circuit and covered concentrate storage shed. Owing to the amount of precipitation expected at the site, in concert with the environmental management strategies, a fugitive dust problem at the Prairie Creek mine is not expected. Approximately six months of site-specific precipitation data is available. During the period June 2 to September 13, 1994, a total of 233 mm of precipitation was recorded. The nearest Environment Canada Atmospheric Environment Service (AES) weather station, at the Fort Simpson airport, 160 km east of Prairie Creek, receives approximately 360 mm/year (AES 1993).

However, during periods of no rain, the road traffic within the camp may cause short-term visibility and air quality problems. If road traffic is found to cause excessive levels of ambient dust, a water truck will be used to wet the major routes around the site. If a dust problem still persists, a binding agent may be added to the water to enhance its wetting properties. In addition, water spray nozzles may be installed near the crusher to control fugitive dust emissions. These dust control strategies are commonly used at other mines and have been quite successful.

Fugitive dust from the waste rock piles will be minimized by its relatively high moisture content. Land reclamation activities are not expected to create a dust problem because of the small area of land involved and the small number of pieces of heavy equipment needed. Overall, fugitive dust in not anticipated to be a problem at the site mainly because of the occurrence of frequent rainfall and snow.

Fugitive dust from concentrate storage is similarly not expected to be a source as concentrate will be stored in covered sheds, minimizing wind transport of concentrate(s).

5.2 Terrestrial Impacts

The potential impacts of various project attributes and activities on terrestrial components of the local environment are outlined and methods are suggested for avoiding, minimizing or mitigating them in the following sections.

5.2.1 Vegetation

The impacts of road construction on vegetation will largely involve removal of ground cover by earth-moving and placement of fill. The proportion of various vegetation types along the road corridor which may be affected is small in relation to the amount available in adjacent undisturbed areas. Consequently, regeneration of disturbed areas can be expected to occur spontaneously. Around the mine/mill site, the original vegetative cover was disturbed by development activity in the early 1980s. Little additional impact is therefore expected from reactivation and operation of the project.

Loss of vegetative cover, as a direct result of road construction, is not considered a significant negative impact on the study area. The vegetation units are well represented in undisturbed areas adjacent to the corridor and mine.

The introduction of new plant species through road traffic is possible. If the most successful new colonizers are plants adapted to the disturbed conditions represented by the road, their distribution will likely be restricted to such areas. Later revegetation of the corridor, if required, could be planned to reduce the survival of such species.

Subalpine Shrub and Alpine Tundra habitats have a low threshold of disturbance. For this reason, recreational use by camp personnel and the general public should be controlled by establishment of designated access trails.

The recent fire east of the Nahanni Range (covering an area in excess of 100 km^2; Plate 5-1) confirms the prevalent nature of wildfires and the threat they represent to the operation of the mine. In order to protect natural vegetation, and in view of

Plate 5-1: Burnt landscape east of Mackenzie Mountains.

the proximity of Nahanni National Park, the mine should adopt a fire suppression policy. Of particular importance to wildlife would be fires in the Spruce Parkland and Spruce/Lichen vegetation units. Regeneration of burnt areas could be very slow with lichens for example, requiring many decades to established full cover.

5.2.3 Wildlife

The impacts on wildlife of mine/mill operations and construction and utilization of the access road will vary between locations and seasons. The major large mammal species present are moose, woodland caribou, Dall's sheep, grizzly bear and gray wolf. The operation of machinery and the presence of humans may cause temporary avoidance of the areas of activity. The potential will exist for increased hunting pressure on big game and migratory waterfowl species by project personnel. Human/bear interactions could occur in vicinity of camp food waste disposal facilities. Road kills by ore trucks could happen when animals cross the access road or use it as a corridor to move between different parts of their range.

Among potential sources of non-lethal disturbance to wildlife are truck, machinery and aircraft noise, odours of people, and exhaust emissions. Potential impacts on wildlife may be avoided by adequate briefing of mine personnel and truck drivers, posting warning signs along the access road, prohibiting fire arms in the camp to all but authorized personnel, and discouraging harassment of animals with unnecessary noise, all-terrain vehicles, snowmobiles, camp dogs, and other avoidable disruptions.

Much of the Cadillac Exploration winter road is in early regeneration phase, and resembles an old seismic line. Although the proposed all-season road will follow the same alignment for most of its length, the necessary clearing represents an area which is the product of its length (140 km; 25 km is currently in use or is not yet regenerating), and its width (5 m). The area is approximately 0.7 km^2, most of which is plateau and lowland habitats. On a smaller scale, there will be equipment assembly areas, borrow areas, and possible sites used to support construction activity along the access route.

5.2.3.1 *Habitat Loss or Alteration*

Since committed exploration activities were initiated in the area of the Prairie Creek lead-zinc-silver deposit in the 1960s, various areas have been cleared to gain access to the deposit in order to provide camp and maintenance facilities, and for transportation. Most of this infrastructure has been in place since the early 1980s, and assuming there will be no major expansion of these, further habitat loss or alteration should be minimal. One exception might include additional roads to and surface equipment assembly areas at new exploration sites (Section 5.2.3.4).

5.2.3.2 *Noise Disturbance*

Noise disturbances associated with construction and mine operation activities include truck and aircraft movements, generators, exhaust fans, and the operation of heavy equipment. As long as the source of these disturbances remains within the existing infrastructure (*i.e.*, mine, mill, and camp), it is not likely to result in any measurable retreat of wildlife populations from their existing distribution around the mine area.

Noise associated with road or airstrip construction and improvement could have an impact depending on where its source is located, particularly in the May and June period of lambing in sheep and calving in caribou, both of which must be considered critical activities. Noise disturbances due to the routine movement of traffic along the road are expected to be minor.

5.2.3.3 *Impact from Air and Ground Traffic*

Studies on the heart rates of seven ewes and one ram of the mountain sheep (*Ovis canadensis canadensis*), implanted with subcutaneous electrodes connected to an externally mounted FM transmitter, showed that in response to vehicular traffic, elevation of heart rate occurred when vehicles approached within 25 metres (MacArthur *et al.* 1982). The latter situation would be unusual at Prairie Creek and is not expected to affect the one likely Dall's sheep lambing area, situated approximately 400 m from the existing airstrip (Beak 1982). However, heart rates increased with the following incremental disturbances:

- the approach of a human on foot:

- a human advancing on foot over a ridge; and
- a human approaching on foot accompanied by a dog.

These studies provide an explanation for the coexistence of the lambing site and the landing strip in that the potentially threatening object would be an airplane, 400 m away and below the site, and from most angles, not visible to the ewes. It also appears from this research that humans inside a vehicle represent a disturbing influence only when very close (< 25 m). Traffic has been infrequent to date and has not posed a noticeable threat or disturbance to wildlife in and around the mine site.

Aircraft, flying overhead, may potentially disturb ewes in labour and with newborns. Minimum heights should be established over any sensitive areas, and these recommended heights communicated to all aircraft approaching or leaving the Prairie Creek airstrip, or flying in the area.

Ground traffic, particularly large trucks hauling supplies, equipment, or concentrate, represent a substantial hazard at all seasons. The road is likely crossed by wildlife along its entire length, but traffic in some areas may warrant reduced speed zones, such as the Mackenzie Mountains (particularly Km 8 to 32), where steep grades already limit the speed of climbing traffic.

With regard to potential impacts from road maintenance activities, snow clearing in winter has the potential to create roadside banks of relatively compact snow. Such banks represent both a barrier (in fact, two barriers in most cases) to travel as well as a barrier to escape from vehicles or predators. Special procedures for snow clearing will have to be established to ensure that snow banks along the road in winter do not unintentionally entrap ungulates, so that they cannot escape traffic or predators.

5.2.3.4 Exploration Activities

Exploration in the area of the Zebra showing, immediately north of the main pass (north of Km 16) is at the border of Class 1 and Class 2 Dall's sheep winter range (Beak 1981), and is at the edge of a caribou calving area (Beak 1982). The direct habitat loss or alteration associated with this activity is expected to be minimal. However, there is considerable potential to disturb animals during critical periods, especially during lambing or calving. Consequently, exploration personnel should continue to approach Zebra site at a speed not exceeding 50 kph off the main road, and upon parking, proceed directly to the adit, according to procedures currently in practice. Surface prospecting or other activities in the area of the adit should be discouraged in May and/or June, unless a professional biologist can confirm that caribou calving is not taking place near this or other exploration areas.

Air traffic has represented a significant concern to environmental specialists reviewing projects which penetrate into wilderness areas (Shank 1979). The best strategy in dealing with this problem is avoidance. For this reason, the mine should establish procedures for fixed- and rotary-winged aircraft transiting to and from the mine. Special emphasis should be put on:

- avoiding birthing areas during the May and June period, when lambing and calving are taking place and nursery bands are forming; and
- limiting the use of helicopters, which are considered to be far more threatening to wild ungulates than fixed-wing aircraft.

The reappearance of a road may cause some initial hesitancy in wild ungulates, particularly caribou on their first contact with it. The second response may be to habituate and use the road as a trail because of easier travelling conditions. Should this habituation take place, increased caribou densities on and around the road would expose them to greater predation.

5.2.3.5 Mine Operation

The routine operation of the mine and associated activities are likely to have minor impacts on wildlife populations in the surrounding area. The use of firearms by all mine personnel should be prohibited, except by the camp manager or other authorized personnel, and then only in emergency situations. Employees and other personnel using the road or mine site should be educated in the policies of non-harassment and non-destruction of wildlife.

5.2.3.6 Trumpeter Swans

Trumpeter swans nest in the Tetcela River and Fishtrap Creek drainages. Recent studies of this species indicate that it is expanding its range in this part of the

Northwest Territories (Shandruk and McCormick 1987; Shandruk 1991). This expansion is based on a combination of suitable, unoccupied breeding habitat in a strip extending from Fort Liard through Nahanni Butte to Wrigley, and favourable wintering conditions. Not only are the breeding areas unoccupied, they are also largely undisturbed.

The road will introduce some disturbance to those wetlands situated near the road. Close examination of the proposed route shows that it avoids most wetlands by more than 500 m, and there are only three areas in the Tetcela and fishtrap drainages which are less than 200 m from the road. In addition to proximity to the road, another critical factor is the presence or absence of a forest buffer between road and wetland. It is possible that this species will avoid wetlands if the road can be observed within 500 m of the edge of the wetland. For this reason, road sections in such areas should be routed through forest wherever possible or hedges planted. These measures should minimize potential disturbances.

Other disturbing influences may increase due to improved access for predators, including humans. Waterfowl hunting, for example, may increase. Hunting, even if directed at other species, might have the effect of making certain wetlands too exposed for swans to use for nesting. Potential hunting pressure reinforces the need to control access.

Runoff of fines and other materials during road construction could affect water quality in the wetlands neighbouring the road. Appropriate sediment traps should be placed to collect such runoff.

5.2.3.7 Rare and Endangered Species

Rare and endangered species are addressed in Section 3.2.6.9 of this report. The three species, bald eagle, golden eagle, and gyrfalcon, considered in that section were recently examined by COSEWIC (1992) and not designated in any risk category.

5.2.3.8 Increased Access

The road to the mine, when completed, will potentially expose wildlife populations to considerably greater disturbance by the general public. The most obvious and most threatening will be increased hunting pressure, but disturbance by tourists attempting to view wildlife is also likely.

The risk from hunting is both direct and indirect. Beyond the direct effects of increased mortality, the harassment from hunting makes animals less tolerant of other disturbances (Cowan 1975 cited in Shank 1979). Other intrusions, facilitated by improved access, may include further penetration into the wilderness by off-road vehicles and snowmobiles.

Efforts will be made to control traffic along the mine road. The road will have a "dog-leg" approach near the Liard Highway to deter curious passers-by. Access could be fully restricted at the summer barge crossing or winter ice bridge over the Liard River. To discourage use by all-terrain vehicles and snowmobiles, signs will be posted at all crossings of the road and access locations to warn of the hazards of truck traffic.

5.2.4 Permafrost

Permafrost is the layer of soil that is permanently frozen at high latitudes. It is continuous over large areas of the far north but becomes discontinuous at lower latitudes. It may extend to great depth, even underlying lakes and rivers, but a surface layer of varying thickness, called the active layer, thaws in summer and refreezes in winter. Protected permafrost does not thaw and can form a vital part of engineered structures such as airstrips, roadbeds, dam cores and building foundations.

The active layer supports plant growth and allows groundwater movement. Vegetative cover provides insulation which limits the depth of thawing.

Project activities which damage the vegetative cover could expand the active layer, and cause surface subsidence, slope instability, ponding of surface water and permanent surface scarring.

Most potential impacts of the project are related to the realignment and upgrading of the old winter road to all-weather status and rehabilitation of old airstrips (for contractor use) and ferry terminals. Realignment and construction will involve the operation of borrow pits, earth moving, placement of fill, armouring at water crossings and operation of off-road vehicles and equipment.

The activation of existing mine, mill and camp facilities will cause little, if any change, in the status of permafrost on the site. However, expansion of the ore haul road network and rehabilitation of the tailings pond may cause localized changes in cover and permafrost stability.

To avoid or minimize impact on permafrost areas, project activities should avoid stripping or destroying vegetative cover. Where permafrost is incorporated into engineered structures such as ramps, bridge abutments, *etc.*, adequate insulation will be provided from warm air and water. The integrity of permafrost existing in the project area will be protected by proven arctic construction methods. As part of the environmental management program, the proponent will monitor its operations and take remedial action where impacts on permafrost are noted.

5.2.5 Karst Topography

The karstland described in Section 3.2.4.1 is recognized as a unique resource and is described as an attraction in a government tourism brochure. However, Parks Canada views it as a sensitive ecological component. While some fly-in trekking is said to occur, difficult access has protected it so far from much human traffic. Because of the soft limestone geology, karst features are vulnerable to damage by undirected foot traffic. The potential impact of the all-weather road will be to open the area to more hikers, cave explorers, and mineral claim stakers.

At present, the karstland lacks any legislated protection. While the Prairie Creek mine development will have no direct impact, the secondary impact of increased public use may require mitiation by the provision of brochures and explanatory signs at the Liard entrance and the development of viewing trails to contain foot traffic.

5.2.6 Heritage Resources

In the public hearings and environmental reviews held for license approval of the Cadillac mine, no traditional uses or potential heritage resources of the site and winter road corridor were identified.

Further development of the mine, road network and all-weather access road will be monitored for evidence of human occupation. Discovery of sites or artifacts will initiate a detailed field investigation by a qualified archaeologist and construction work will be diverted until the finds have been evaluated and catalogued.

5.3 Aquatic Impacts

The principal interactions between the project and the aquatic environment will be in the area of surface water quality. Project interactions with water quality will involve surface runoff, tailings supernatant discharge, camp effluents and shallow groundwater flow.

The project will interact with the sediments of lakes and streams of the drainage systems principally through the runoff of particulates from disturbed surfaces and the discharge of tailings supernatant into Prairie Creek. Apart from physical deposition on existing substrates, sediments resulting from the mining operation may be resuspended in streams in periods of high flow and moved down the system to more permanent depositional areas.

Mining operations could influence fish populations principally through potential changes in water quality that could have negative effects. However, as previously discussed, management techniques will be put in place to ensure no adverse effects are realized. The potential for interaction with the benthic fauna of the streams and rivers in the area is primarily mechanical and dependent on the initial disturbance during construction and the amount of maintenance required later, especially along the access roads.

5.3.1 Hydrology

There would be no deliberate alterations of surface water hydrology by either the mine/mill operations or construction of the all-weather road. However, the potential exists for inadvertent deposition of soil and rock in stream channels by slumping of the banks at road crossings or where the right-of-way approaches stream banks. The treated tailings water discharge to Prairie Creek will be regulated so as not to change the flow of the creek.

Surface run-off within the mine site will be directed into a holding pond and treated prior to discharge into Prairie Creek, thus greatly reducing the possibility of contamination of surface water by concentrate dust or other by-products of mining operations. Drainage ditches will also be dug around the mine site perimeter to divert run-off from entering the mine site. These two mitigative measures will practically eliminate potential impacts to surface water quality.

5.3.2 Water Quality

A major concern of Parks Canada, DFO and the Dene people is that the water quality of the South Nahanni River may be impaired by discharges into Prairie Creek which joins that river within the Nahanni National Park Reserve. Therefore, the impact of mining activity on the water quality of Prairie Creek will be mitigated by the management, treatment and monitoring of all waste discharges to the receiving environment. Contributions of dissolved and suspended chemical constituents from tailings effluent, mine water, surface runoff, camp wastewater and drainage from process chemical and fuel storage, and any other sources of pollutants, will be virtually eliminated by intercepting, detaining and treating all contaminated water before discharge into Prairie Creek. Any activity which could cause particulate material to enter Prairie Creek will also be controlled, as necessary, to preserve its existing oligotrophic condition.

The water quality of streams crossed by the access road, outside the Prairie Creek drainage, will also require protection under DFO's habitat protection objectives. Measures will be taken to control sediment runoff from construction activity and prevent the escape of ore concentrate from transport trucks. If established, any fuelling points along the access road will be protected by berms and will be lined to contain spills.

5.3.3 Aquatic Life

Prairie Creek, upstream of the park boundary, has been known to support fall congregations of bull trout and mountain whitefish (Beak 1981). Most fish have been found upstream of the mine site. Potential impacts of the project on fish in Prairie Creek would thus seem to lie in water quality factors which could discourage migration of fish from the South Nahanni past the mine site to holding pools and spawning sites. If the water quality objectives for Prairie Creek and the South Nahanni River are met by treatment of tailings effluent and runoff control, the impact on fish habitat and populations should be insignificant.

Of the water courses to be approached or crossed by the all-weather road, only the Grainger River, Sundog Creek tributary and Tetcela Creek mainstem, near the road alignment, showed potential spawning and rearing habitat for grayling, but yielded few fish (Beak 1981b). Beaver dams have created barriers to fish migration and eliminated spawning habitat in substantial parts of the drainage in the eastern part of the route. The impact of road realignment and upgrading will be minimal if the crossings are constructed with good control for surface runoff and bank erosion. The impacts of truck traffic along the access road on fish and their habitat will be negligible providing no concentrate or chemical spills occur where they could enter streams.

An additional impact of development may be the effect of angling pressure by the enlarged workforce on lightly fished or unexploited populations of bull trout (*Salvelinus confluentus*) and arctic grayling (*Thymallus arcticus*). Fishing by persons not related to the mining activities can be curtailed, if necessary, by restricting access to the mine area by gating the all-weather road and posting of no-fishing/hunting signs. Future studies will provide additional information on the species composition, size and age distribution, relative abundance, feeding habits, sex ratios and condition of the fish populations in the subject watercourses.

Since fish and other aquatic organisms have managed to negotiate the diffuse watercourses over time and colonize most streams in the area, care will be taken when installing bypass channels and culverts to ensure that gradients and flow rates continue to allow unimpeded upstream and downstream movement.

5.3.4 Vegetation and Wildlife

Impacts are not expected to either vegetation or wildlife. Vegetative growth around the tailings pond that could be browsed or otherwise used by wildlife will be eliminated. Beavers and terrestrial animals will be kept out by fencing. Should any manage to enter the pond area, they will be removed immediately. Unfortunately, waterfowl may still gain access to the pond but the nature of the tailings should minimize its use by birds of any kind. Overhead netting is not considered an option as injury is often caused to birds that get entangled in the netting material.

5.4. Impacts to Valued Ecosystem Components

Of all the attributes and components of the project environment, three in particular stood out in numerous discussions with regulatory agencies and earlier Water Board hearings as being of public and/or professional concern:

1. populations and habitats of several wildlife species, including moose, woodland caribou, Dall's sheep and trumpeter spawns; black and grizzly bears are also of professional interest, but numbers in the area are apparently low;
2. unique karstland topographic features situated between 30 and 50 km from the mine, along the all-weather access road corridor and not far (approximately 1.5 km) from the road alignment; and
3. the water quality of Prairie Creek, which enters Nahanni National Park approximately 17 km downstream of the mine site and joins the South Nahanni River about 26 km inside the park.

Potential impacts and mitigation options for these three components are discussed below in more detail.

5.4.1 Wildlife

The impacts on wildlife may be direct, such as displacement and harassment by aircraft, road traffic (noise, smell), mortality through vehicle/animal encounters and deliberate kills by licensed hunters as well as poachers. Other impacts may be indirect, but also significant, and include habitat destruction by clearing for roads and airstrips and fires caused by machinery, careless smoking, *etc.*

To the greatest extent possible, mitigation or avoidance of impacts will be part of mine policy. Measures to limit direct impacts will include, but may not be limited to:

- Monitoring the use of the access road;
- excluding firearms from the camp and all vehicles, except for emergency use;

- conducting information sessions for mine personnel, emphasizing fire prevention and road caution;
- posting prominent warning signs along roadways where the presence of wildlife is likely;
- restricting the potential for disturbance of animals by aircraft and land vehicles at critical times in their life cycle, such as when Dall's sheep may be lambing near the Prairie Creek airstrip, by avoiding use of those types of areas as much as possible;
- practicing good management of camp waste disposal to avoid creating an attraction point for scavengers (bears, wolves, foxes, rodents); and
- discouraging recreational off-road excursions in the vicinity of trumpeter swan nesting ponds during the breeding season.

5.4.2 Karstland Topography

Karstlands are created by weathering and groundwater dissolution of limestone terrain so that depressions and underground caverns are created. Because of the soft parent material, karstlands are easily eroded and natural formations can be damaged irreparably by foot and vehicle traffic. The karstlands near the access road alignment possess what could be the northernmost occurrence of "poljes". These are steep-sided flat-bottomed depressions which fill with snowmelt water and precipitation. Under summer conditions, drainage channels through rim fissures and beneath the poljes thaw out and the water is released to the underground drainage system, often rapidly. The poljes then behave like valley floors and often develop lush sedge meadows which help to support the herbivorous animals of the region.

The possibility exists that, if the all-weather access road is open to the public, visitors will drive to within walking distance and hike to see the formations, with adverse effects on the soil surface and vegetation. In order to preserve the integrity of the poljes and other karstland features until they can be protected by law, it would be prudent, if possible, to restrict casual traffic on the road. If placed under park or equivalent management, the karstland could be protected by posting information, creating designated paths and providing surveillance during the summers.

5.4.3 Water Quality

The preservation of present water quality in Prairie Creek and the South Nahanni River is regarded as essential by all concerned parties. Thus, San Andreas Resources Corporation will provide exemplary tailings and mine-water management, as well as control of runoff from all disturbed surfaces, storage areas, and construction sites.

The eastward drainage along the access road will similarly require protection of water quality and fish habitat, but the focus will be on preventing siltation of streams by surface water runoff from drainage ditches and disturbed surfaces connected with the rehabilitation of airstrips, road constructions and various sites, such as borrow areas and the ore truck ferry terminals on the banks of the Liard River.

Mitigation of impacts on water quality will require close monitoring of all discharges, a system for collecting, detaining and treating tailings effluent and runoff from disturbed soil surfaces, and providing secure emergency spill detention for chemicals, fuel oil, ore concentrates, *etc.*, at the mine and along the access road.

5.5 Cumulative Effects

The consideration of cumulative effects is an attempt to evaluate those impacts that arise as a result of multiple activities happening concurrently or sequentially. Cumulative effects occur when:

- impacts on the natural and social environments take place so frequently in time or so densely in space that the effects of individual events cannot be assimilated; or
- the impacts of one activity combine with those of another in a synergistic manner (Canadian Environmental Assessment Research Council 1988):

For the purposes of this report, the cumulative effects resulting from the Prairie Creek development can be classified according to the following categories:

- project impacts and their interactions with each other, *e.g.* effects of wildlife habitat loss from mining development combined with a potential increase in wildlife mortality from road traffic;
- project impacts combined with impacts from any potential future development, such as the effects of increased disturbance, road kills, *etc.*, on the distribution, migration and reproduction of wildlife;
- project impacts combined with impacts from developments by others, *e.g.* effects of mine development and other committed projects on local labour supply, social services and culture; and
- project impacts combined with other land use activities, *e.g.* effects of increased accessibility to hunting areas and on concurrent traditional hunting activity.

The Prairie Creek project is at present remote from other economic developments and any cumulative effects in the short term will result from interactions between concurrent and sequential project activities. In general, mineral exploration and development activity by multiple proponents can be expected to have cumulative environmental and socioeconomic effects. An increase in human activity over a large geographical area by exploratory and mining development activities may disrupt existing land use patterns where these have been established. The removal of habitat through such activities as road and building construction and the establishment of storage areas, tailings facilities and waste rock piles, combined with human activities, will have cumulative effects that are difficult to predetermine.

San Andreas Resources Corporation will endeavour to assess its interactions with other activities affecting ecological, social and economic systems, as future developments occur.

5.6 Residual Impacts

Residual impacts are defined as those effects of the project on the environment which remain after all mitigative measures have been carried out, buildings and machinery removed, mine openings sealed and tailings areas rehabilitated. Some project components which may be left in place indefinitely, depending on government policy and public need, are access roads, culverts, bridges and airstrips.

Long-term effects of the project will be limited mainly to physical changes in the terrain due to waste rock and tailings deposition and the persistence of roadways and drainage channels, which will deteriorate through weathering and become revegetated, although this process will be extremely slow.

6.0 IMPACTS OF MINING PROJECTS IN SIMILAR ENVIRONMENTS

The Northwest Territories has hosted a number of mines since the 1940s, including Lupin, Giant Yellowknife, Miramar Con, Nanisivik, Colomac, Pine Point, Polaris and Salmita (Table 6-1). All of these mines are still operating, with the exception of Pine Point and Salmita. In terms of ore reserves, the proposed zinc-lead-copper mining development at Prairie Creek is comparable to operations at Nanisivik (lead-zinc-silver), Pine Point (lead-zinc), and Polaris (lead-zinc).

Establishment of mining operations involves basic construction activities such as access to the site (road, airstrip, *etc.*); facilities for accommodation, warehousing, and fuel storage; bulk processing plant and mill; sewage disposal systems; and solid waste and tailings dumps. An overview of the environmental impacts of past and existing similar projects, and related mitigation/remediation measures are discussed in this section.

6.1 Impacts of Previous Mineral Exploration and Mine Development on the Arctic Environment

Environmental impacts associated with northern and arctic mineral exploration and mine development, such as water pollution, air pollution and land disturbance, may have direct or indirect effects on indigenous populations and arctic ecology. These impacts may be encountered throughout the life of an arctic mine, including exploration, development, operation and post-closure.

6.1.1 Solid Waste Management

It is not uncommon to find abandoned equipment, refuse, leaking fuel drums and waste oil at former exploration camps or abandoned mine sites. A study of 18 abandoned mine sites in the NWT reported the presence of empty fuel and oil drums, associated minor spills, and processing chemicals left at 15 of the 18 abandoned sites (Thurber 1993). These materials remain almost perfectly preserved many years after use, since decomposition is exceptionally slow in the arctic. Effluents resulting from this type of waste disposal can remain chronic

Table 6-1

NWT Mines Operating in 1994

Mine	Location	Product	Type
Nerco Con Mine Ltd.	1.5 km south of Yellowknife	Gold, some Silver (by-product: Arsenic Trioxide)	Underground
Giant Yellowknife Mines Ltd.	2.4 km north of Yellowknife	Gold, minor Silver (by-product: Arsenic Trioxide)	Underground and open pit
Lupin Mine (Echo Bay Mines Ltd.)	400 km northeast of Yellowknife	Gold, minor Silver	Underground
Nanisivik Mines Ltd. (Mineral Resources International Ltd.)	Northern tip of Baffin Island	Lead and Zinc concentrate with Silver	Underground
Polaris Mine (Cominco Ltd.)	Little Cornwallis Island, High Arctic	Lead, Zinc	Underground
Ptarmigan Mine (Treminco Resources Ltd.)	17 km northeast of Yellowknife	Gold	Underground
Colomac Mine (Northwest Gold Corp.)[2]	220 km north of Yellowknife	Gold	Open pit

NWT Mines Closed Since 1989

Mine	Location	Product	Type
Pine Point Mine (Cominco Ltd.)[1]	South Shore Great Slave Lake, 80 km east of Hay River	Lead, Zinc	Open pit
Salmita Mine (Giant Yellowknife Mines Ltd.)[3]	120 km east northeast of Yellowknife	Gold, minor Silver	Small open pit

1: Closed 1990.
2: Closed 1992. Purchased by Royal Oak whom have recently reopened the mine.
3: Closed ca. 1991.
Sources: NWT Data Book 1990/91; GNWT Energy, Mines and Petroleum Resources 1994.

water pollution sources (DIAND 1973, cited in van Diepen 1975), although the degrading effects on the receiving environment are retarded by the same processes that preserve them (Kalin 1988).

Another common problem is sewage disposal in the arctic environment due to permafrost and low ambient temperatures. Permafrost prevents absorption of effluent from conventional sewage-handling technology because it impedes effluent absorption into the ground, and low ambient temperatures slow the settling rate of sewage particles (van Diepen 1975). This is not an issue at Prairie Creek because of the intended use of a sewage treatment plant.

6.1.2 Transportation

Permanent roads and seasonal snow and ice roads can result in a variety of terrain disturbances, depending on the underlying soil composition, structure and the type and intensity of vehicular movement. Terrain damage is highest where the ice content of the soil is high (van Diepen 1975).

Other problems associated with access roads in the arctic include high maintenance costs and effort due to thawing and subsidence. Vehicular traffic can also result in long-term stream diversions or ponding, leading to gradual permafrost degradation spreading outward from the initial disturbed area (van Diepen 1975). However, and as planned by the Company, adequate culverting and engineering at stream crossings would offset this potential problem.

A 180-km winter road links the Prairie Creek mine site to the Liard Highway, and a 165-km all-weather road, which follows the same general alignment, is in the planning stages. Although a number of roads access the southwest portion of the Northwest Territories, aircraft remain the principal form of summer transportation for personnel and equipment to and from the Prairie Creek mine and most other arctic mines.

Although studies have indicated that vehicular traffic may have adverse effects on caribou (especially road kills and increased hunting pressure — van Diepen 1975; DIAND 1979), caribou herds also appear to be indifferent to the presence of humans in their vicinity, as suggested by the following anecdotal passage:

> "As for caribou . . . in 1957, I was in Uranium City . . . and in the spring when the caribou migrated, they came in large herds, they went right through the townsite, across the roads, and around the mining camp. When we were going to work, the bus had to stop for the caribou to cross the road. If man-made installations interfered that much with caribou migration patterns, I am sure the caribou would not have come to Uranium City at that time." (T. Yewchuk, NWT Water Board Public Hearing 1976).

The caribou being referred to here are probably barren ground, since they occur in large herds, while woodland caribou travel in smaller groups; however, it is expected that woodland caribou would have similar responses to human presence (Robertson 1994).

Increased hunting and fishing pressure have occurred in some areas by both exploration personnel and other hunters and fishers who benefit from improved road access. Bear fence and other deterrents remove habitat from bears, and conflicts have resulted in the removal or killing of bears in some camps. Bears have also been killed by vehicular traffic. The same risk could also be posed to other forms of wildlife in the project area, including wolves, woodland caribou and Dall's sheep.

Noise associated with low-flying aircraft can have detrimental effects on terrestrial wildlife (van Diepen 1975). Wildlife species of concern occurring in the Prairie Creek project area include woodland caribou, moose, Dall's sheep, wolves, and grizzly bears. In one systematic study (Jacobson 1979), the reactions of wildlife to aircraft passing at 800 ft (244 m) above ground level were observed. Reactions varied widely from species to species. Of 1,000 barren ground caribou responses, 725 were minimal, 213 were escape and 62 were panic. Again, woodland caribou would likely elicit similar response patterns (Robertson 1994). For wolves in winter, out of 32 responses, 24 were panic and 8 were escape. Of 8 responses to survey aircraft by wolves at den sites, 6 were minimal and 2 (with cubs) were escape. Of 29 observations made of grizzly bears on summer territory, 21 were escape and 8 (all with cubs) were panic. The results of this study indicate that grizzly bears and wolves generally have stronger reactions (*i.e.*, panic or escape) to low-flying aircraft than barren ground caribou (and by inference, woodland caribou), whose responses tend to be minimal. Over a three-year period, 195 responses of moose to survey aircraft were recorded in both summer and winter. Of these, 174 (89%) were minimal and 21 (11%) were escape.

6.1.3 Water Quality

Large quantities of drill chips, fines, and other drilling wastes can increase suspended solids in some local watercourses. Other chemicals associated with blasting, waste water from camps or fuel spills could potentially have an impact on water quality. Water quality in the receiving environment, such as downstream watercourses, can be adversely affected by seepage or releases from tailings ponds and runoff from mine adits. All of these discharges will in fact be treated prior to release at Prairie Creek.

6.2 Impact of Other Producing Mines on the Arctic Environment

The experience of other producing mines in the region should assist in the identification of potential environmental impacts resulting from the Prairie Creek development. While it may not be appropriate to compare directly the impacts of one mine to another, the previous consequences of similar types of resource development may provide helpful information regarding links between mining activities and various ecosystem components and/or processes.

6.2.1 Waste Rock and Tailings

The release of toxic chemicals and heavy metals into the aquatic environment are often associated with the operation of base metal mines. For example, high levels of arsenic, copper, and zinc were measured in water from the Giant Mine near Yellowknife; high arsenic, copper, and chloride levels were recorded from effluent water from Con Mine; and water samples from the old Echo Bay Mine near Great Bear Lake have contained high arsenic levels and high turbidity values (van Diepen 1975).

At the Lupin Mine, some indications of oxidizing surfaces were noted on exposed tailings. However, acid generation was not evident. The nature of the country rock (dolomite and shale) at the Nanisivik Mine, where lead, zinc and silver are recovered, is very beneficial in neutralizing the acidic conditions which occur naturally and in association with mining activities. Tailings materials and tailings pond supernatant at this mine do not result in unusual conditions. The Salmita Mine operation could produce tailings containing mercury and zinc, and the potential for acid generation from the waste material does exist, since the neutralization potential of the country rock is unknown (Kalin 1988).

The Pine Point lead-zinc operation, on the other hand, generated tailings and waste rock which had virtually no acid generation potential, as the ore was contained in dolomite and calcite with low sulphur content. It appears that the leaching potential from tailings is low at this site. Preliminary information for Prairie Creek indicates relatively low levels of sulphides and a preponderance of carbonate minerals in the host rock, suggesting that the potential for acid rock drainage is low at this site as well.

Acid rock drainage and contaminant leaching of metals have occurred at the Rankin Inlet Nickel Mine site which operated between 1957 and 1962. When exposed to weathering, mine tailings oxidized and generated acid. Solubilized metals were then able to enter the aquatic environment (Rescan 1990).

In addition to the potential neutralizing effects of the country rock, there are other characteristics of arctic regions that tend to have a naturally mitigating effect on mining activities. These include the brief ice-free season, which slows environmental degradation caused by changes in drainage patterns due to disturbances to the permafrost; and diminished biological activity, which slows acid-generation rates (Kalin 1988).

6.2.2 Other Impacts from Mining Operations

Fuel spills have occurred on mine sites due to equipment failure or accidents at storage tanks, fuel lines, diesel plants, vehicle filling areas, and from vehicle roll-overs. Spills of other products are also of concern and may lead to prolonged damage to the environment. Road access to other mining sites has been known to increase hunting or fishing pressure on the local area. Noise and human activity have disrupted wildlife near mine sites and along supply routes.

REFERENCES

AES. 1992. *AES Guidelines for Co-operative Climatological Autostations, Vol. 2.* Climate Information Branch, Canadian Climate Centre, Atmospheric Environment Service.

AES. 1993. *Canadian Climate Normals 1961-90 for Yukon and Northwest Territories.* Ministry of Supply and Services, Canada, Ottawa.

Andrews, T. 1994. *Personal communication.* Prince of Wales Northern Heritage Centre, Education, Culture and Employment, Government of the Northwest Territories, Yellowknife, NWT.

B.C. Ministry of Environment (BCMOE). 1984. *Environmental Objectives and Procedures for Water Crossings.* BCMOE Technical Report No. 6, 85 pp.

Beak Consultants Ltd. 1981a. *Prairie Creek Project: Fisheries and Invertebrate Studies, 1981.* Report prepared for Cadillac Explorations Ltd., Calgary, Alberta.

Beak Consultants Ltd. 1981b. *Prairie Creek Project: Vegetation and Wildlife Studies, 1981.* Report prepared for Cadillac Explorations Ltd., Calgary, Alberta.

Beak Consultants Ltd. 1982. *Prairie Creek Project: Wildlife Studies, 1982 Addendum.* Report prepared for Cadillac Explorations Ltd., Calgary, Alberta.

Canadian Council of Ministers of the Environment. 1991-1994. *Canadian Water Quality Guidelines.* Ottawa.

Canadian Environmental Assessment Research Council. 1988. *The Assessment of Cumulative Effects: A Research Prospectus.* Ministry of Supply and Services Canada, Ottawa.

Caughley, G. 1974. Bias in aerial survey. *Journal of Wildlife Management* 38(4):921-933.

Committee on the Status of Endangered Wildlife in Canada (COSEWIC). 1992. *Canadian Species at Risk.* Ottawa.

Dane, B.C. 1978. *A Review and Resolution of Fish Passage Problems at Culvert Sites in British Columbia.* Fisheries and Marine Service Technical Report No. 810, 66 pp. plus appendices.

DeL Can. 1983. *Engineering Assessment of Proposed All-weather Access Road Mine Site to Liard Highway.* Report prepared for Procan Exploration Company.

Department of Fisheries and Oceans (DFO) and B.C. Ministry of Environment. 1989. *Fish Habitat Inventory and Information Program - Stream Survey Field Guide.* Vancouver, B.C., 33 pp.

DIAND. 1979. *Wildlife and Wildlife Habitat in the Great Slave and Great Bear Lake Regions.* 1974-1977. Environmental Studies No. 10, Ottawa, Canada

Environment Canada Atmospheric Environment Service. 1993. *Canadian Climate Normals 1961-90 for Yukon and Northwest Territories.* Ministry of Supply and Services Canada.

Groat, W. 1994. *Personal Communication.* Nahanni National Park Staff, Parks Canada, Fort Simpson, Northwest Territories, December 2, 1994.

Jacobson, R. 1979. *Wildlife and Wildlife Habitat in the Great Slave and Great Bear Lake Regions, 1974-1977.* Department of Indian and Northern Affairs Canada, Northern Affairs Program, Environmental Studies No. 10, 134 pp.

Kalin, M. 1988. *Ecological Engineering for Gold and Base Metal Mining Operations in the Northwest Territories.* Department of Indian Affairs and Northern Development, Northern Affairs Program, Environmental Studies No. 59, Ottawa, 64 pp.

Ker, Priestman & Associates Ltd. 1980a. *Preliminary Environmental Evaluation for Winter Access Road.* Report prepared for Cadillac Explorations Limited, Prairie Creek Project, N.W.T.

Ker, Priestman & Associates Ltd. 1980b. *Preliminary Environmental Evaluation for Mine, Mill and Camp.* Report prepared for Cadillac Explorations Limited, Prairie Creek Project, N.W.T.

Laporte, P. 1994. *Personal Communication.* Claims Implementation Officer, DIAND, NWT Region, Aboriginal and Territorial Relations, Yellowknife, Northwest Territories, December 5, 1994.

MacArthur, R.A., V. Geist, and R.H. Johnston. 1982. Cardiac and Behavioral Responses of Mountain Sheep to Human Disturbance. *Journal of Wildlife Management* 46:351-358.

Mitton, A. 1994. *Personal Communication.* Delcan Corporation, New Westminster, B.C., November 25, 1994.

Parks Canada. 1984. *Nahanni National Park Reserve Resource Description and Analysis.* National Resource Conservation Section, Parks Canada, Prairie Region, Winnipeg, Manitoba.

Parks Canada. 1984. *Nahanni National Park Reserve Resource Description and Analysis.* Natural Resource Conservation Section, Parks Canada, Prairie Region. Winnipeg, Manitoba.

Pearson, A.M. 1975. The northern interior grizzly bear, *Ursus arctos* L. *Canadian Wildlife Service, Report Series* 34:1-86.

Platts, W.S., W.F. Megahan, and G. Wayne. 1983. *Methods for Evaluating Stream, Riparian, and Biotic Conditions.* General Technical Report INT-138, U.S. Dept. of Agriculture, Forest Service, Intermountain Forest and Range Experiment Station, Ogden, Utah, 70 pp.

Polar Gas. 1984. *Polar Gas Project Application, Vol. VI - Environmental Statement.* Report to the National Energy Board and Department of Indian Affairs and Northern Development.

Rescan Environmental Services Ltd. 1990. *Evaluation of Reclamation Options.* Report prepared for the Rankin Inlet Nickel Mine.

Robertson, I. 1994. *Personal Communication.* Principal, Robertson Environmental Services, Langley, B.C., December 2, 1994.

Scott, W.B., and E.J. Crossman. 1983. *Freshwater Fishes of Canada.* Bulletin 184, Fisheries Research Board of Canada, Ottawa, 966 pp.

Selby, M.J. 1985. *Earth's Changing Surface.* Clarendon Press, Oxford, 607 pp.

Shandruk, L.J. 1991. *A Survey of Trumpeter Swans in Alberta, Saskatchewan and Northwest Territories: 1990.* Technical Report Series No. 1991, Canadian Wildlife Service, Western and Northern Region, Alberta.

Shandruck, L.J. and K.J. McCormick. 1987. *Status of Trumpeter Swans in the Southern MacKenzie District, Northwest Territories, in 1987.* Progress Note No. 177, Canadian Wildlife Service, Edmonton.

Shank, C.C. 1979. *Human-Related Behavioural Disturbance to Northern Large Mammals: a Bibliography and Review.* Report prepared for Foothills Pipe Lines (South-Yukon) Ltd., Calgary.

Simmons, N. 1982. *Seasonal Distribution of Dall's Sheep in the Mackenzie Mountains, Northwest Territories.* File Report No. 21, N.W.T. Wildlife Service, Yellowknife.

Thurber Environmental Consultants. 1993. *Review and Summary of Assessment and Remediation Options for 18 Abandoned Mine Sites, N.W.T. Vol. II.* Report prepared for Public Works Canada, Architectural and Engineering Services Branch, Environmental Services, Edmonton, Alberta.

van Diepen, P. 1975. *The Impact of Mining on the Arctic Biological and Physical Environment.* Report prepared for the Renewable Resources Project, Inuit Tapirisat of Canada, Vol. 7, 56 pp.

Walmsley, M., G. Utzig, T. Vold, D. Moon, and J. van Barneveld. 1980. *Describing Ecosystems in the Field.* RAB Technical Paper No. 2, Land Management Report No. 7, Victoria, B.C.

Zippin, C. 1958. The Removal Method of Population Estimation. *Journal of Wildlife Management* 22 (1): 82.

Appendix A - Copy of 1982 Water Licence for Prairie Creek Mine

COPY

Indian and Northern Affairs   Affaires indiennes et du Nord

WATER LICENCE

issued pursuant to
Northern Inland Waters Act and Regulations

(Licensee) CADILLAC EXPLORATIONS LIMITED

Licence Number N3L3-0932 issued on JULY 1, 19 82

Location PRAIRIE CREEK AT APPROXIMATELY LATITUDE 61° 33' N AND LONGITUDE 124° 48' W

IAND 52-230 (10-73)

NORTHWEST TERRITORIES WATER BOARD

Pursuant to the Northern Inland Waters Act and Regulations the Northwest Territories Water Board, hereinafter referred to as the Board, hereby grants to

CADILLAC EXPLORATIONS LIMITED
(Licensee)

of SUITE 630 10201 SOUTHPORT ROAD S.W., CALGARY ALTA. T2W 4X9
(Mailing address)

hereinafter called the Licensee, the right to alter, divert or otherwise use water subject to the restrictions and conditions contained in the Northern Inland Waters Act and Regulations made thereunder and subject to and in accordance with the conditions specified in this licence:

Licence Number N3L3-0932

Water Management Area NORTHWEST TERRITORIES 03

Location PRAIRIE CREEK AT APPROXIMATELY LATITUDE 61° 33' N AND LONGITUDE 124° 48 W

Purpose INDUSTRIAL

Description TO USE WATER AND DISPOSE OF WASTE IN MINING AND MILLING PROCESSES AND ASSOCIATED USES.

Quantity of Water Not to be Exceeded 1,150 CUBIC METRES PER DAY

Rate of Use of Water Not to be Exceeded 420,000 CUBIC METRES PER YEAR

Effective Date of Licence JULY 1, 1982

Expiry Date of Licence JUNE 30, 1986

This Licence issued and recorded at Yellowknife includes and is subject to the annexed conditions.

Northwest Territories Water Board

Witness Vice Chairman

Approved by

Minister of Indian Affairs and Northern Development

IAND 52-230 (10-73)

PART A

1. The purpose of this licence is: to authorize the use of Prairie Creek waters while ensuring the pristine quality of the said water is maintained; to ensure the quality of Prairie Creek water entering Nahanni National Park is unaltered; and to ensure the long term containment of mine tailings.

2. Definitions

In this Licence:

"Act" means the Northern Inland Waters Act;

"Regulations" means Regulations proclaimed pursuant to Section 26 of the Northern Inland Waters Act;

"Board" means the Northwest Territories Water Board established under Section 7 (1) of the Northern Inland Waters Act;

"Licensee" means the holder of this Licence;

"Controller" means the Controller of Water Rights for the Northwest Territories;

"Inspector" means an inspector designated by the Minister under Section 29 of the Northern Inland Waters Act;

"Waste" means waste as defined by Section 2 (1) of the Northern Inland Waters Act;

"Waste Treatment System" means the physical, chemical and/or biological processes applied to improve the quality of the waste;

"Prairie Creek Valley Aquifer" means the saturated bed, formation, or group of formations in Prairie Creek Valley which yeilds water in sufficient quantity to be of consequence as a source of water;

"Maximum Average Concentration" means the average of the last four analytical results submitted to the Board in accordance with the sampling and analysis requirements specified in the "Surveillance Network Program"; and

"Tailings Containment Area" means the engineered structure designed to contain solid and liquid waste fractions from the mill process as shown on Figure 2, Tailings Retention Area T-2, Revision B, dated January, 1982.

3. The licensee shall file reports pursuant to Section 10 (2) of the Act and Section 15 (1) of the Regulations not later than February 1st of the year next following the calender year reported.

4. The water use fee shall be paid annually in advance.

5. This Licence will not come into effect until the Licensee has submitted a security deposit in the amount of $500,000.00 pursuant to Section 11 (3) of the Act. This Licence shall be valid only while security is maintained in good standing. The security deposit shall only be refunded pursuant to Section 13 of the Regulations.

.../2

6. The Annual Report for the preceding year as required under Part A, Item 3, shall contain the following information:

(a) the daily and annual quantity of water in cubic metres pumped from the Prairie Creek Valley Aquifer;

(b) the daily and annual quantity of effluent in cubic metres discharged from the Industrial Waste Treatment System to Prairie Creek;

(c) the monthly and annual quantity of the solid and liquid fractions in cubic metres discharged to the Tailings Containment Area;

(d) the monthly and annual quantity of camp sewage effluent in cubic metres discharged to Prairie Creek;

(e) the mean daily and the mean annual rate of flow in cubic metres per second recorded at Surveillance Station No. 932-8;

(f) tabular summaries of all data generated under the "Surveillance Network Program";

(g) a detailed record of major maintenance work carried out on the water supply and the industrial and camp Waste Treatment Systems and all associated structures;

(h) a report on any methods incorporated or planned to conserve water so that the total quantity of waste will be reduced;

(i) any other details on water use or waste disposal as requested by the Board byNovember 1st of the year being reported; and

(j) approved revisions to the Contingency Plan.

7. This Licence is issued subject to the conditions contained herein with respect to the taking of water and the depositing of waste of any type in any waters or in any place under any conditions where such waste or any other waste that results from the deposit of such waste may enter any waters. However, in accordance with Section 10 (3) of the Northern Inland Waters Act, whenever new Regulations are made or existing Regulations are amended by the Governor in Council under the Northern Inland Waters Act, or other statute imposing more stringent conditions relating to the quantity or type of waste that may be so deposited or under which any such waste may be so deposited, this Licence shall be deemed, upon promulgation of such Regulations, to be automatically amended to conform with such Regulations

8. The Licensee shall comply with the "Surveillance Network Program" annexed to this Licence.

9. The "Surveillance Network Program" and its compliance dates may be modified at the discretion of the Board.

10. The Licensee shall locate any bulk chemical storage above the elevation of the Maximum Probable Flood and such sites shall be approved by the Board in advance.

11. The Licensee shall install, operate and maintain meters for measuring the volumes of water used and the wastes discharged

12. The Licensee shall inspect and maintain all flood protection work around the plant site.

13. Compliance with the terms and conditions of this Licence does not absolve the Licensee from responsibility for compliance with the requirements of other Federal or Territorial legislation including but not limited to matters of abandonment and/or restoration.

. . ./3

PART B

1. The Licensee shall obtain all fresh water from the Prairie Creek Valley Aquifer unless other freshwater sources are approved by the Board.

2. The quantity of water use shall not exceed 420,000 cubic metres per year.

3. The rate of water use shall not exceed 1,150 cubic metres per day.

4. The Licensee shall construct and maintain the Harrison Creek diversion channel as shown on Drawing Nos. 1561-100D, 1561-102B and 1561-103 so that no erosion occurs in the diversion channel.

CONDITIONS APPLYING TO WASTE DISPOSAL

PART C

1. The Licensee shall store all untreated minewater, mill tailings and mill process water in the Tailings Containment Area.

2. The Tailings Containment Area shall be constructed and maintained to engineering standards such that:

   (a) the solid fraction of the mill tailings not recycled to the mine is permanently contained within the Tailings Containment Area;

   (b) seepage from the Tailings Containment Area is minimized;

   (c) the Tailings Containment Area piezometers monitor any seepage;

   (d) seepage which does not meet the effluent quality limits specified in Part C, Item 4 is returned to the Tailings Containment Area;

   (e) the runoff water from outside the immediate drainage area of the Tailings Containment Area does not enter the Tailings Containment Area; and

   (f) erosion of Tailings Containment Area dam does not occur.

3. The Licensee shall operate and maintain the Tailings Containment Area, and the tailings line (s) such that:

   (a) at least one metre of freeboard is maintained in the Tailings Containment Area at all times;

   (b) inspection of the dams and tailings line (s) is carried out daily and records kept of these inspections for review upon the request of an inspector; and

   (c) more frequent inspections are performed and more information provided at the request of an inspector.

.../4

Creek shall meet the following requirements:

(a) discharge at a rate which will maintain a dilution of effluent of not less than thirty (30) parts Prairie Creek water to one (1) part effluent;

(b) discharge so as not to freeze and build up on land or on the ice covering Prairie Creek;

(c) discharge so as not to cause a barrier to fish migration;

(d) discharge so as not to be acutely lethal to fish as measured by a grab sample taken according to the Guidelines for the Measurement of Acute Lethality, at Surveillance Station No. 932-2 diluted at the ratio of one (1) part effluent to three (3) parts water; and

(e) the following effluent quality.

PARAMETER	MAXIMUM AVERAGE CONCENTRATION	MAXIMUM CONCENTRATION OF ANY GRAB SAMPLE
Total Chromium	0.150 mg/1	0.300 mg/1
Total Arsenic	0.150 mg/1	0.300 mg/1
Total Copper	0.075 mg/1	0.150 mg/1
Total Lead	0.150 mg/1	0.300 mg/1
Total Nickel	0.200 mg/1	0.400 mg/1
Total Zinc	0.300 mg/1	0.600 mg/1
Total Cadmium	0.015 mg/1	0.030 mg/1
Total Mercury	0.0015 mg/1	0.0030 mg/1
Total Cyanide	0.30 mg/1	0.60 mg/1
Total Residual Chlorine	0.05 mg/1	0.10 mg/1
Un-ionized Ammonia Nitrogen	0.20 mg/1	0.40 mg/1
Suspended Solids	15.0 mg/1	30.0 mg/1
Nitrite	0.15 mg/1	0.30 mg/1
Nitrate	2.00 mg/1	4.00 mg/1

pH between 6.5 and 10.5
no floating solids or visible oil or grease

. . ./5

(a) contain all industrial effluent in the Tailings Containment Area until the capability of the Waste Treatment System has been verified to the satisfaction of the Board.

(b) provide an interim report before September 1, 1982 outlining the approach to be taken to meet the effluent quality requirements and the construction timetable for a fully functional Waste Treatment System; and

(c) submit a final report by May 1, 1983 verifying the capability of the Waste Treatment System to achieve the effluent quality requirements specified in Part C, Item 4.

6. The Licensee shall notify the Controller at least fourteen (14) days prior to the discharge of effluent from the Waste Treatment System.

7. Runoff from the plant site shall be collected in an approved settling pond as shown on Drawing No. 100-13-6 dated March 30, 1982 and the runoff may be discharged to Prairie Creek provided its quality meets the industrial waste effluent requirements specified in Part C Item 4.

8. All camp waste effluent discharged by the Licensee shall meet the following effluent quality requirements:

PARAMETER	MAXIMUM AVERAGE CONCENTRATION	MAXIMUM CONCENTRATION OF ANY GRAB SAMPLE
BOD	45 mg/1	70 mg/1
Suspended Solids	55 mg/1	85 mg/1
Suspended Coliforms per 100 ml	10,000	20,000
Total Residual Chlorine	0.05 mg/1	0.10 mg/1

pH between 6.0 and 9.0
no visible oil or grease
discharged so as not to build up on land or on the ice covering Prairie Creek.

9. The Licensee shall submit to the office of the Board further studies as requested by the Board pending the results of the report on the physical, chemical and biological characteristics of Prairie Creek submitted February 16, 1982.

CONDITIONS APPLYING TO CONTINGENCY PLANNING

PART D

1. The Licensee shall have a Contingency Plan in place and approved by the Board by the effective date of this Licence. This plan shall include but not be limted to the following:

   (a) Oil Spill Contingency Plan;

   (b) Hazardous Material Contingency Plan; and

   (c) General Contingency Plan.

The [illegible] Spill Contingency Plan shall describe in detail:

(a) action to be taken to prevent, terminate, contain, recover and dispose of any discharges of oil or fluids and solids contaminated by petroleum products; and

(b) a program of studies and a program of oil spill recovery exercises over the term of this Licence to demonstrate the capability of the Licensee to contain, recover and report spills under a variety of environmental conditions.

3. The Hazardous Material Contingency Plan shall include the following:

(a) action to be taken to prevent and clean-up spilled material;

(b) on-site hazardous materials inventory for project construction and operations;

(c) normal and emergency handling procedures for hazardous materials; and

(d) on-site emergency equipment inventory and location index.

4. The General Contingency Plan shall include but not be limited to action to be taken should either the Tailings Containment Area dam or flood protection works lose their stability.

5. The Licensee shall undertake further field and communication exercises at the request of the Controller.

6. The Licensee shall submit to the office of the Board a detailed report on the successes and the failures of the exercises as well as recommendations for improvement within forty-five (45) days after completion of the exercise.

7. The Contingency Plan shall be reviewed annually by the Licensee and modified as necessary to reflect changes in operation and technology. The proposed modifications shall be approved by the Board.

8. If during the period of this Licence major damage occurs to facilities covered by this Licence, an authorized discharge of waste occurs, or if such damage or discharge is foreseeable, the Licensee shall:

(a) employ the Contingency Plans to prevent or terminate the damage or discharges and repair or contain and clean up the waste;

(b) advise an inspector immediately; and

(c) submit to the Controller a detailed report on each occurrence not later than thirty (30) days after initially reporting the event.

PART E

1. The Licensee may, without written consent from the Board, carry out modifications to the water supply and waste handling facilities provided that such modifications are consistant with the terms of this Licence and the following requirements are met:

   (a) the Licensee has notified the Board of such proposed modifications at least sixty (60) days prior to beginning the modification;

   (b) the Board has not, during the sixty (60) days following notification of the proposed modification, informed the Licensee that review of the proposal will require more than sixty (60) days; and

   (c) the Board has not rejected the proposed modification.

2. Modifications for which all of the conditions referred to in Part E, Item 1, have not been met, can be carried out only with written consent from the Board.

3. The Licensee shall provide as-constructed plans and drawings of modifications referred to in this Licence within ninety (90) days of their completion. These plans and drawings shall be submitted to the Controller on material that will reproduce with the use of a standard printer.

CONDITIONS APPLYING TO ABANDONMENT AND RESTORATION

PART F

1. The Licensee shall by July 1, 1983 submit to the office of the Board an Abandonment and Restoration Plan which shall describe the procedures and resources that will be utilized by the Licensee to ensure that no wastes will be released into Prairie Creek after abandonment. This plan shall be reviewed and updated annually to reflect changes in technology and in operations.

2. The Licensee shall consider the following areas of concern in completing or revising the Abandonment and Restoration Plan with respect to this or any subsequent Licence:

   (a) the final design and modification of the Tailings Containment Area dam considering the updated estimate of Maximum Probable Flood;

   (b) the water intake facilities;

   (c) the tailings disposal facilities;

   (d) the waste rock disposal sites;

   (e) any site affected by waste spills;

   (f) the petroleum and chemical storage areas;

   (g) the mine water discharge;

   (h) the natural runoff waters from the development site(s);

   (i) the random areas which may have been affected by development such that potential pollution problems exist;

   (j) the open pit areas; and

   (k) any other facilities which could potentially create a pollution problem.

. . ./8

3. The Licensee shall modify the proposal as referred to in Part F, Item 1, as required for its acceptance by the Board should the Plan be deemed unacceptable to the Board.

4. The Licensee shall complete the abandonment and restoration work within the time schedule specified in the Plan or as subsequently revised and approved by the Board.

5. Notwithstanding the time schedule referred to in Part F, Item 4, the Licensee shall, for all areas referred to in Part F, Item 2, which are abandoned prior to closure of operations, carry out the Abandonment and Restoration Plan as accepted by the Board upon abandonment of such areas unless approval for other restoration schedules is received in writing from the Board.

6. Compliance with the Abandonment and Restoration Plan stipulated in this Licence will not limit the legal liability of the Licensee, other than liability arising by operation of this Act.

Northwest Territories Board

Witness   Vice Chairman

LICENSEE:	CADILLAC EXPLORATIONS LIMITED
LICENCE NUMBER:	N3L3-0932
EFFECTIVE DATE OF LICENCE:	JULY 1, 1982
EFFECTIVE DATE OF SURVEILLANCE NETWORK PROGRAM:	JULY 1, 1982

SURVEILLANCE NETWORK PROGRAM

A. LOCATION OF SURVEILLANCE STATIONS

Station Number	Description
932-1	Freshwater pumphouse wetwell
932-2	Industrial waste treatment system effluent
932-3	Camp sewage effluent
932-4	Final discharge point from settling pond
932-5	Industrial waste treatment system influent
932-6	Prairie Creek at the confluence of Galena Creek
932-7	Prairie Creek upstream of the airstrip as shown on attached map
932-8	Prairie Creek at hydrometric station
932-9	Collection sump behind Tailings Containment Area
932-10	Piezometers on Tailings Containment Area dam as shown on Figure 2, Tailings Rentention Area T-2, Revision B, dated January, 1982

B. SAMPLING AND ANALYSIS REQUIREMENTS

1. Water at Station No. 932-1 shall be sampled every six (6) months during winter and summer and analysed for the following parameters:

Total Arsenic	Total Alkalinity
Total Copper	Total Hardness
Total Lead	Suspended Solids
Total Nickel	Conductivity
Total Zinc	Temperature
Total Cadmium	pH
Total Mercury	

2. Effluent at Station No. 932-2 shall be sampled weekly during periods of discharge and analysed for the following parameters:

Total Arsenic	Total Residual Chlorine
Total Copper	Un-ionized Ammonia Nitrogen
Total Lead	Suspended Solids
Total Nickel	Nitrite
Total Zinc	Nitrate
Total Cadmium	Conductivity
Total Mercury	Temperature
Total Cyanide	pH

analysed for the following parameters:

BOD	Total Residual Chlorine
Suspended Solids	Temperature
Total Coliforms	pH
Fecal Coliforms	

4. Discharge from Station No. 932-4 shall be sampled weekly during periods of flow and analysed for the following parameters:

Total Copper	Suspended Solids
Total Lead	Conductivity
Total Zinc	pH
Total Cyanide	Oil and Grease

5. Until otherwise advised by the Board, water at Station No. 932-6 shall be sampled every second week to coincide with sampling at Station No. 932-7 and analysed for the following parameters:

Total Arsenic	Total Residual Chlorine
Total Copper	Un-ionized Ammonia Nitrogen
Total Lead	Suspended Solids
Total Nickel	Conductivity
Total Zinc	Temperature
Total Cadmium	pH
Total Mercury	Total Coliforms
Total Cyanide	Fecal Coliforms

6. Until otherwise advised by the Board, water at Station No. 932-7 shall be sampled every second week to coincide with sampling at Station No. 932-6 and analysed for the following parameters:

Total Arsenic	Nitrate
Total Copper	Nitrite
Total Lead	Conductivity
Total Nickel	Temperature
Total Zinc	pH
Total Cadmium	Total Coliforms
Total Mercury	Fecal Coliforms
Suspended Solids	

7. Water at Station No. 932-9 shall be sampled monthly and analysed for the following parameters:

Total Copper	Total Cyanide
Total Lead	Conductivity
Total Zinc	Temperature

8. Piezometers at Station No. 932-10 shall be measured weekly for hydrostatic head. Simultaneous readings shall be taken of the water level in Prairie Creek and in the Tailings Containment Area adjacent to each piezometer station. If the readings suggest seepage, a water sample shall be collected at the respective piezometer and analysed for the following parameters:

Total Arsenic	Total Cyanide
Total Copper	Conductivity
Total Lead	Temperature
Total Cadmium	

9. All sampling and sample preservation shall be done in accordance with methods specified by the Controller.

10. All analyses shall be conducted in accordance with methods prescribed in the current edition of "Standard Methods for the Examination of Water and Wastewater" or by such other methods as are approved by the Controller.

.../3

C. OTHER REQUIREMENTS

1. Streamflow data shall be collected at Station No. 932 8.

2 Rainfall data shall be collected at the minesite.

3. The rate of flow at Station Nos. 932-1, 932 3, 932-4 and 932-5 shall be measured in cubic metres per month

4. The rate of flow at Station Nos. 932-1, 932-2 and 932-8 shall be measured in cubic metres per second and reported as a mean daily discharge.

5. Data collected at Station No. 932-8 shall be carried out such that it meets the Water Survey of Canada, Department of the Environment, National Standards.

6. The quantity of ore in tonnes milled per month shall be recorded.

7. A composite of ore shall be tested annually for acid generation potential.

D. REPORTS

1. The Licensee shall report to the Controller the results of the weekly sampling at Station No. 932-2 within ten (10) days of the date of sampling.

2. The Licensee shall within sixty (60) days following the month reported submit to the Controller all the data and information required by the "Surveillance Network Program".

Northwest Territories Water Board

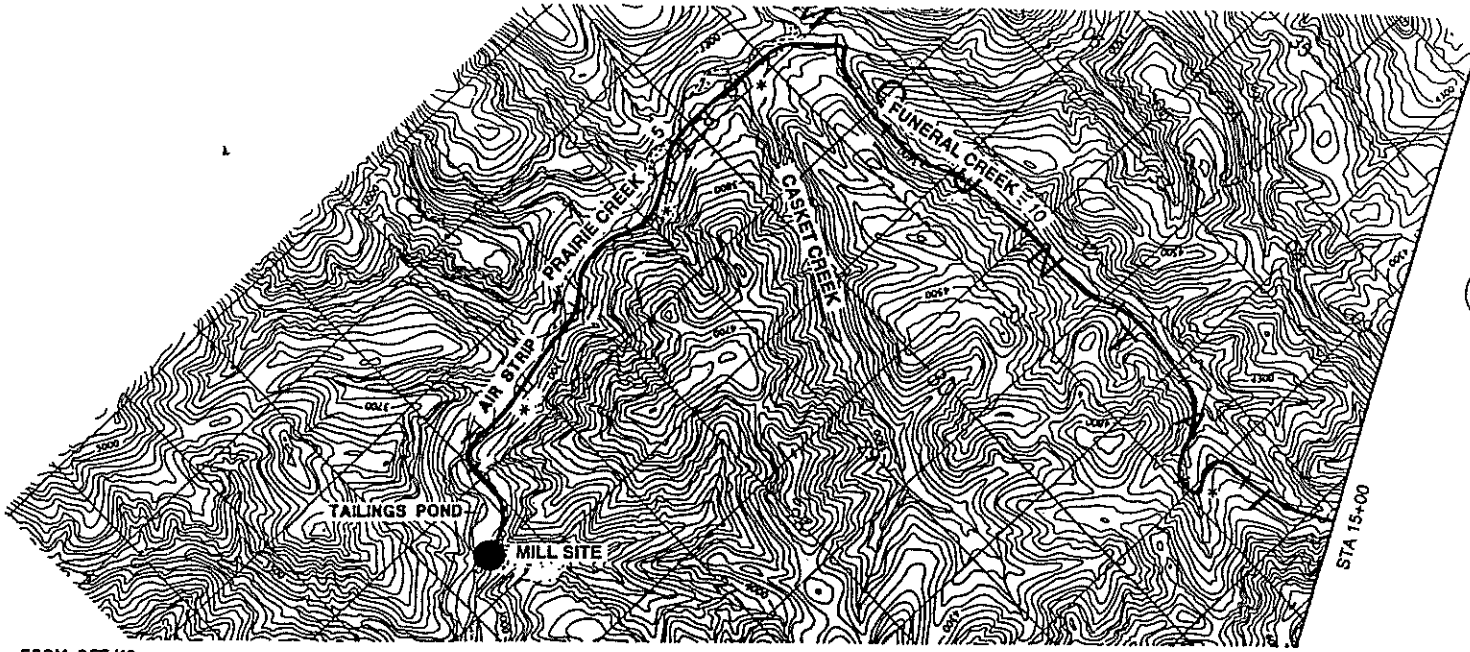
Witness

Vice - Chairman

Appendix B - Route Selection for All-weather Road

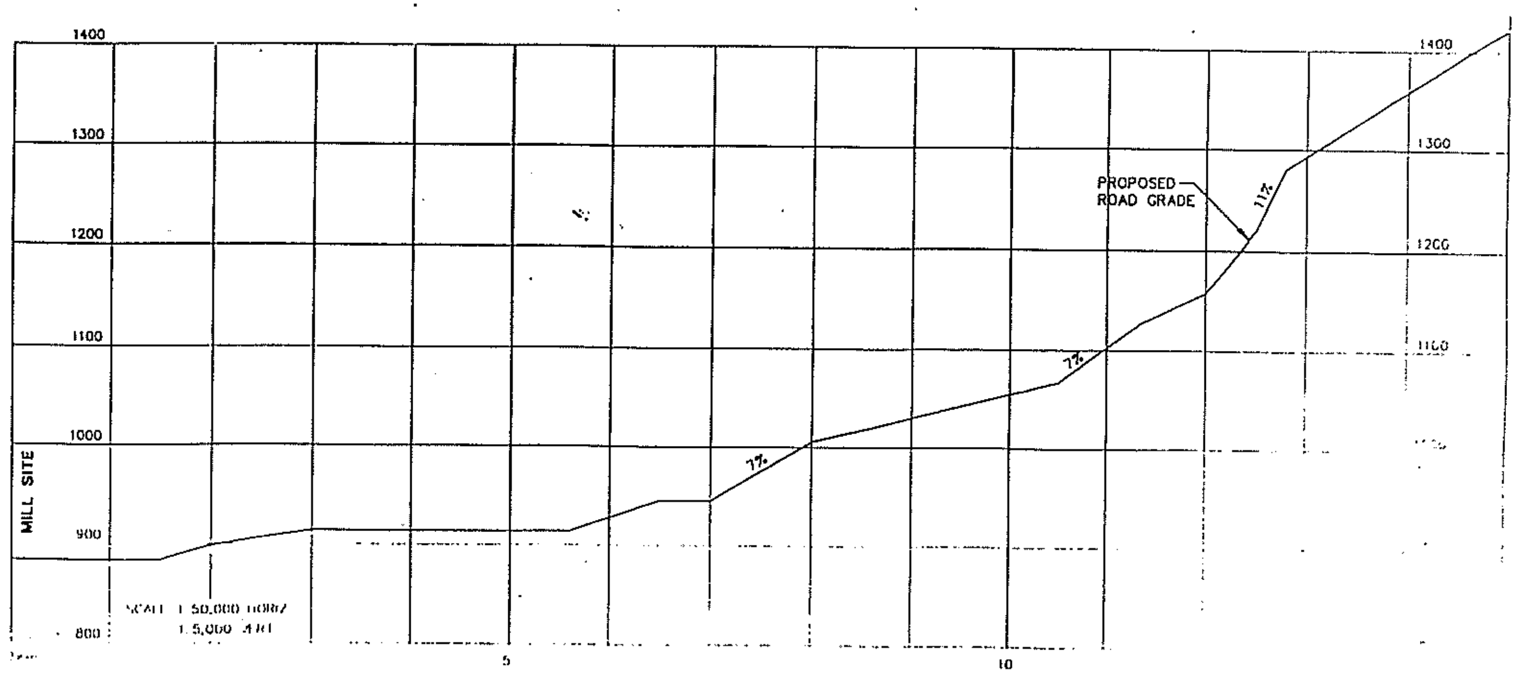
SAN ANDREAS RESOURC
PRAIRIE CREEK HA
PRELIMINARY ROUTE ALIG
STA 0+00 TO ST

OC



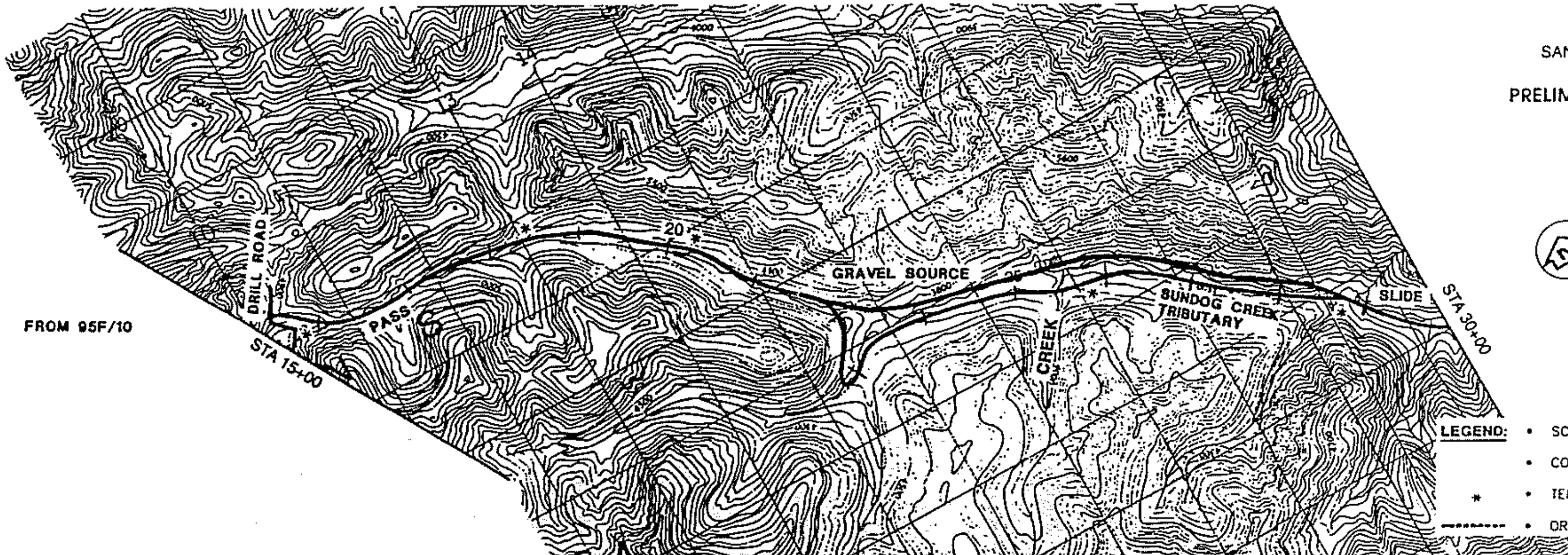
FROM 95F/10

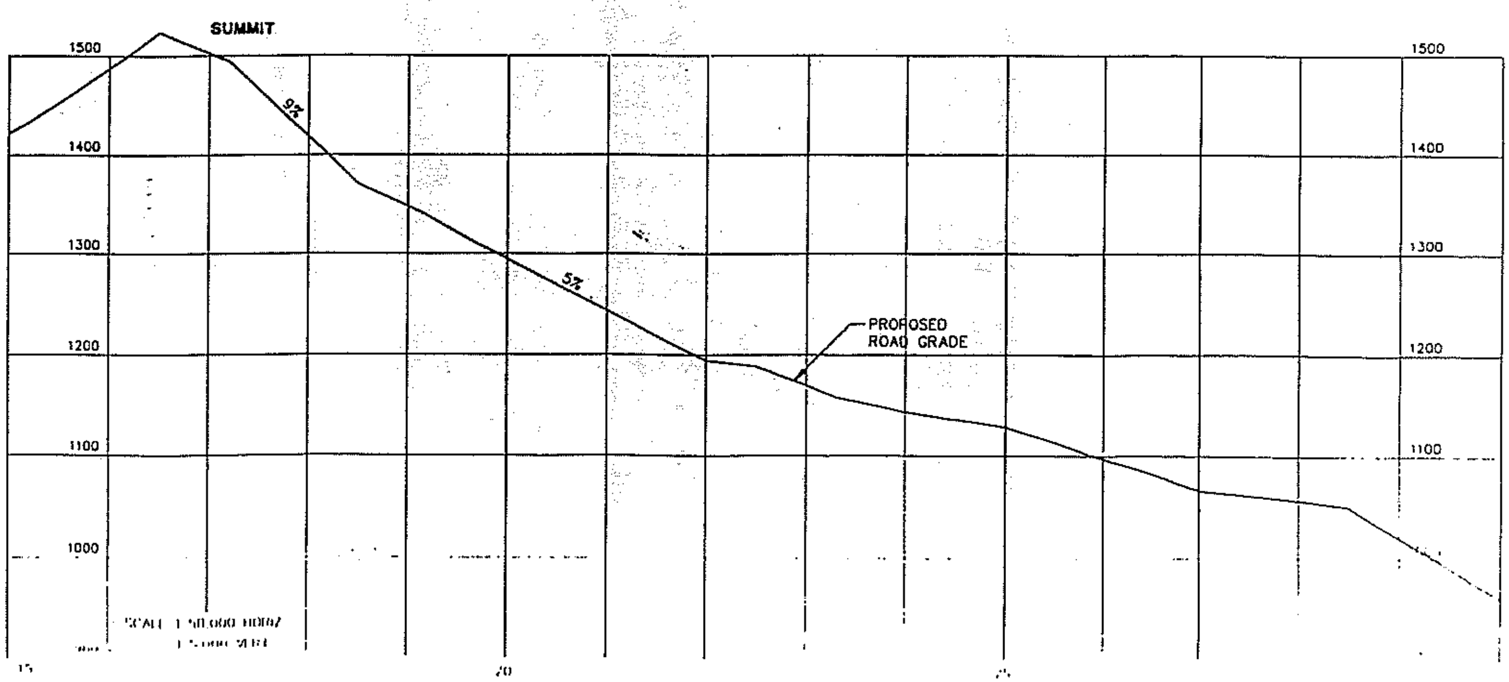
LEGEND:
- SCALE 1 : 5000
- CONTOURS NOTED IN FEE
- * TENTATIVE BORROW PIT
- ---------- ORIGINAL WINTER ROAD



DELCAN

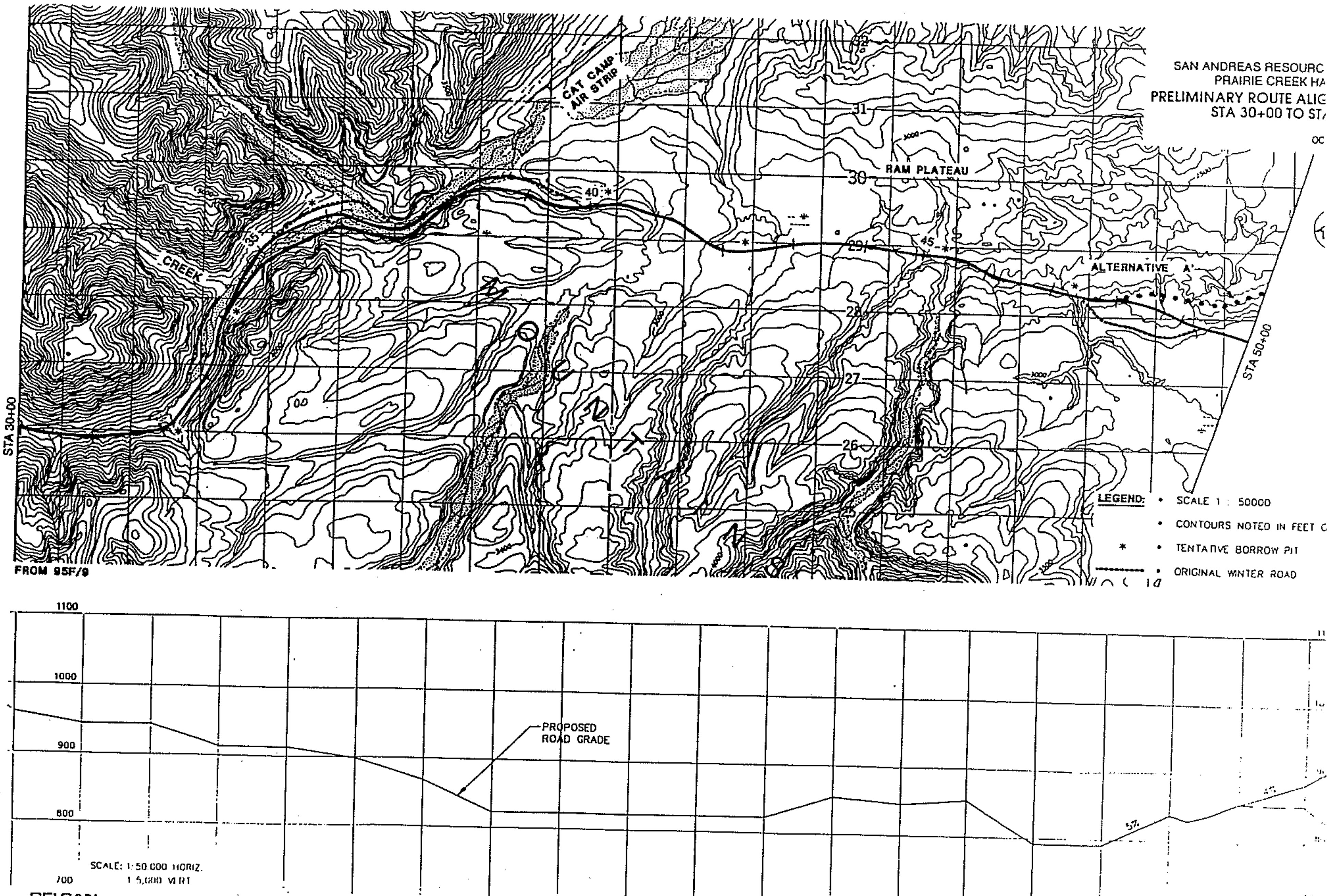
SAN ANDREAS RESOURCE
PRAIRIE CREEK HA
PRELIMINARY ROUTE ALIG
STA 15+00 TO STA
OCT





DELCAN

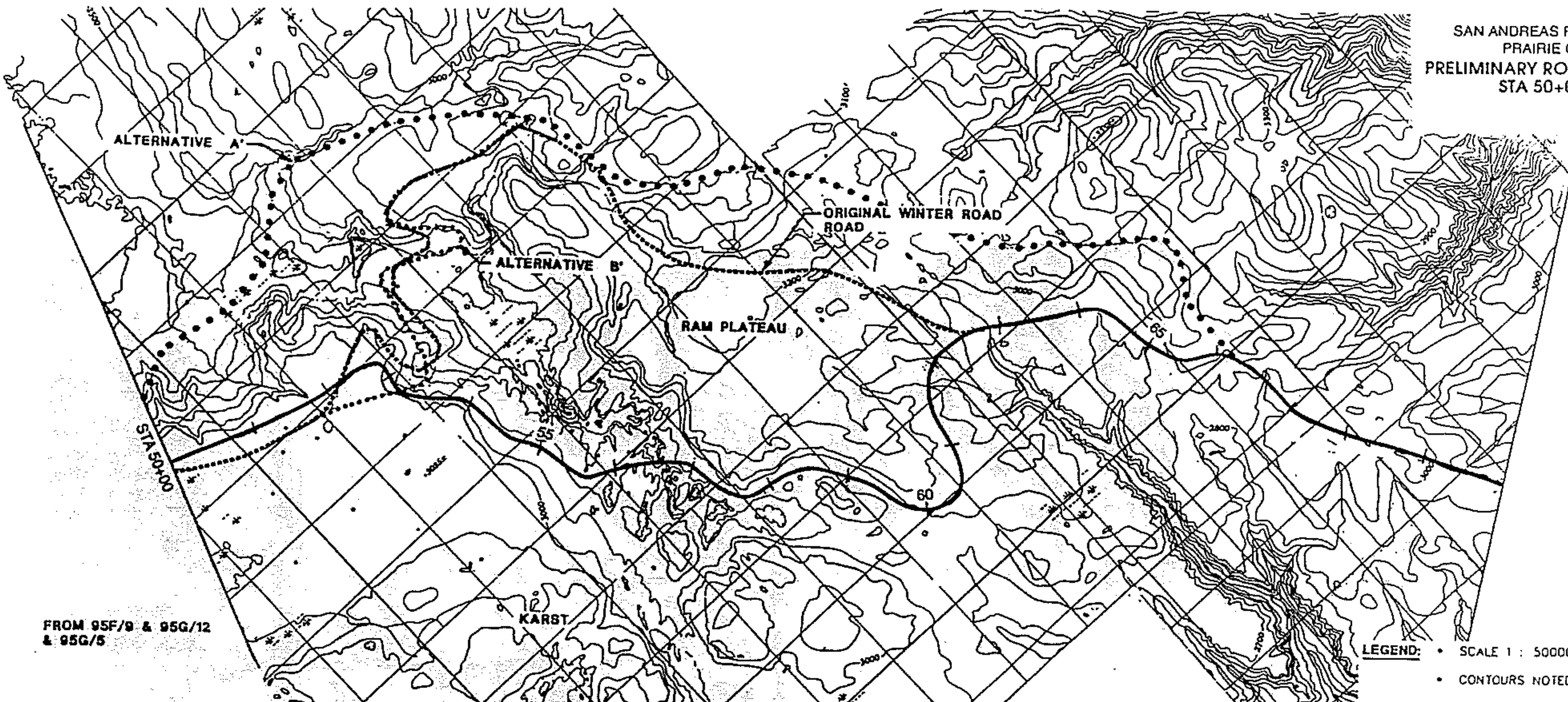
SAN ANDREAS RESOURC
PRAIRIE CREEK HA
PRELIMINARY ROUTE ALIG
STA 30+00 TO ST

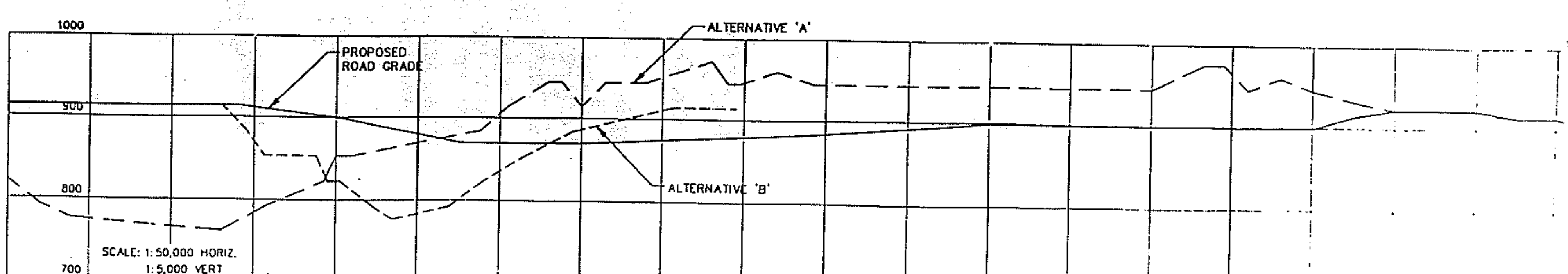


LEGEND:
- SCALE 1 : 50000
- CONTOURS NOTED IN FEET
- * TENTATIVE BORROW PIT
- ORIGINAL WINTER ROAD

DELCAN

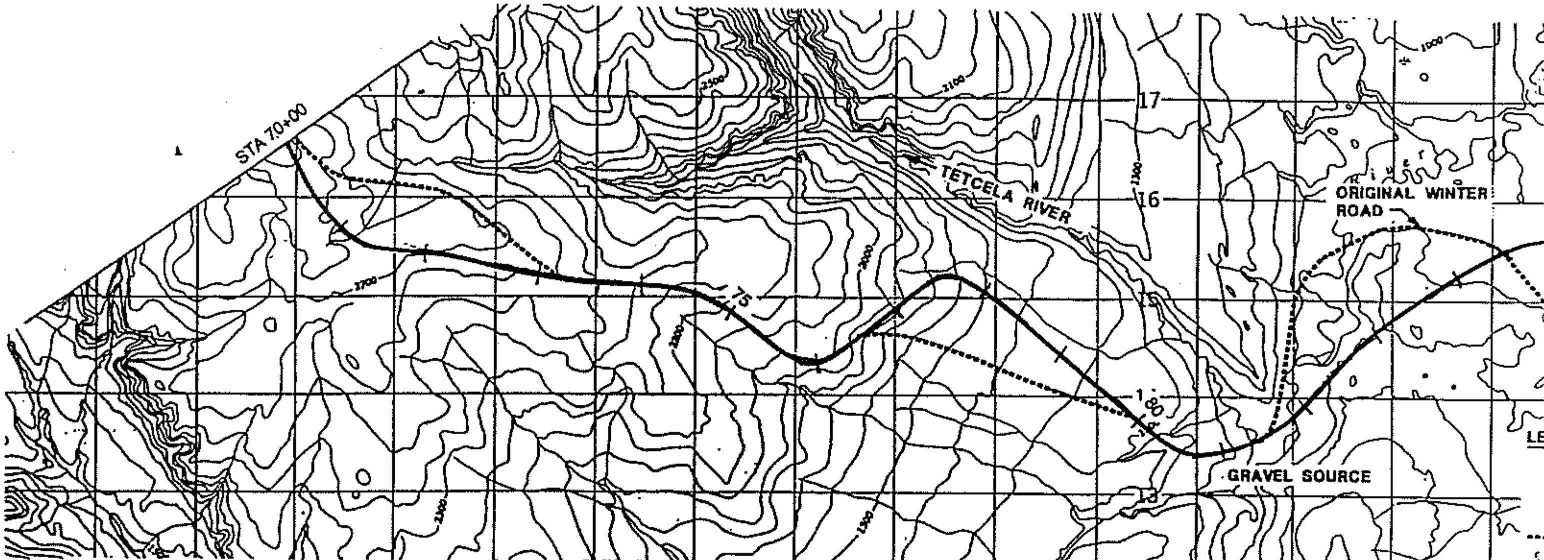
SAN ANDREAS RESOURC
PRAIRIE CREEK HA
PRELIMINARY ROUTE ALIG
STA 50+00 TO ST.



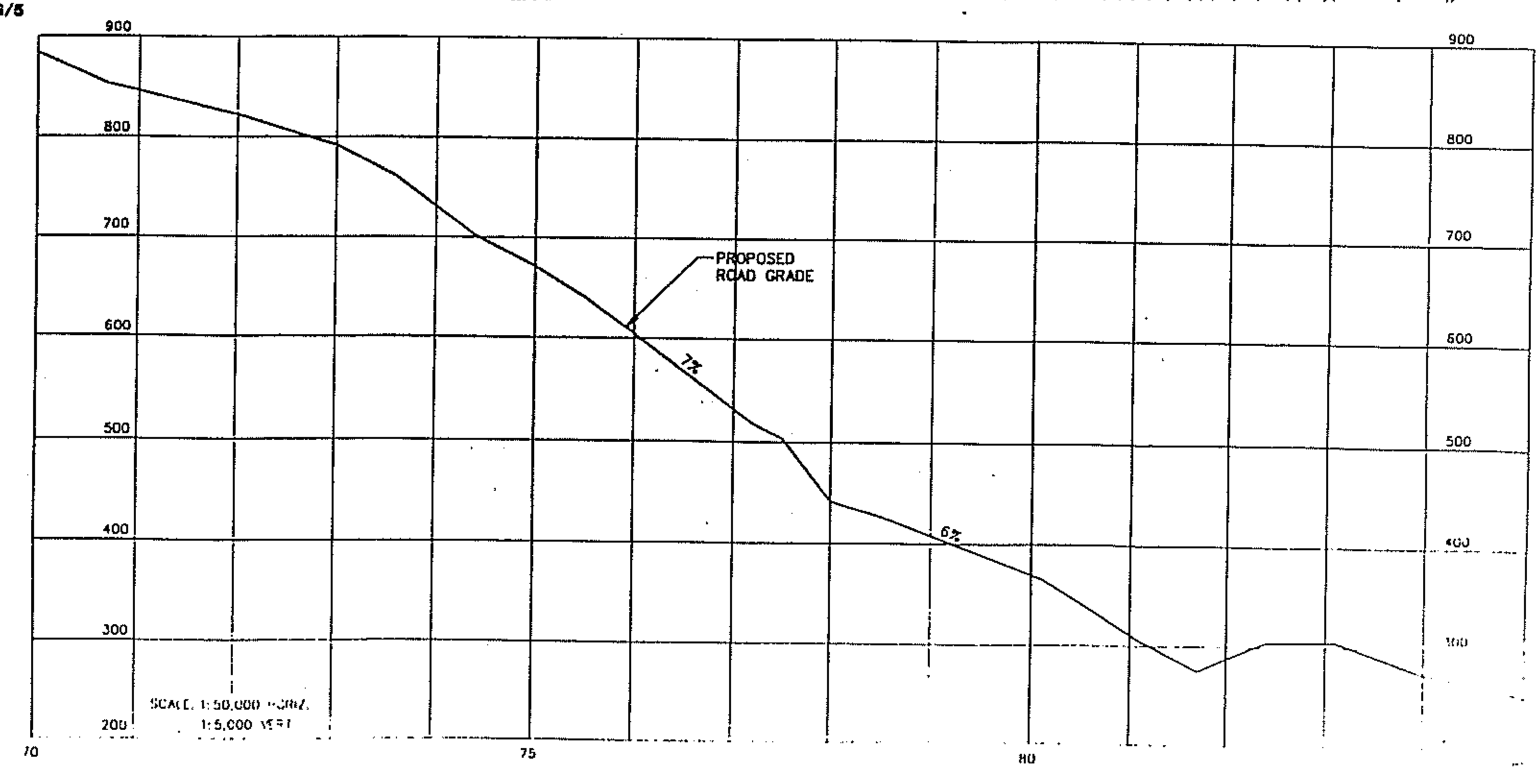


DELCAN

SAN ANDREAS RESOURC
PRAIRIE CREEK HA
PRELIMINARY ROUTE ALIG
STA 70+00 TO ST

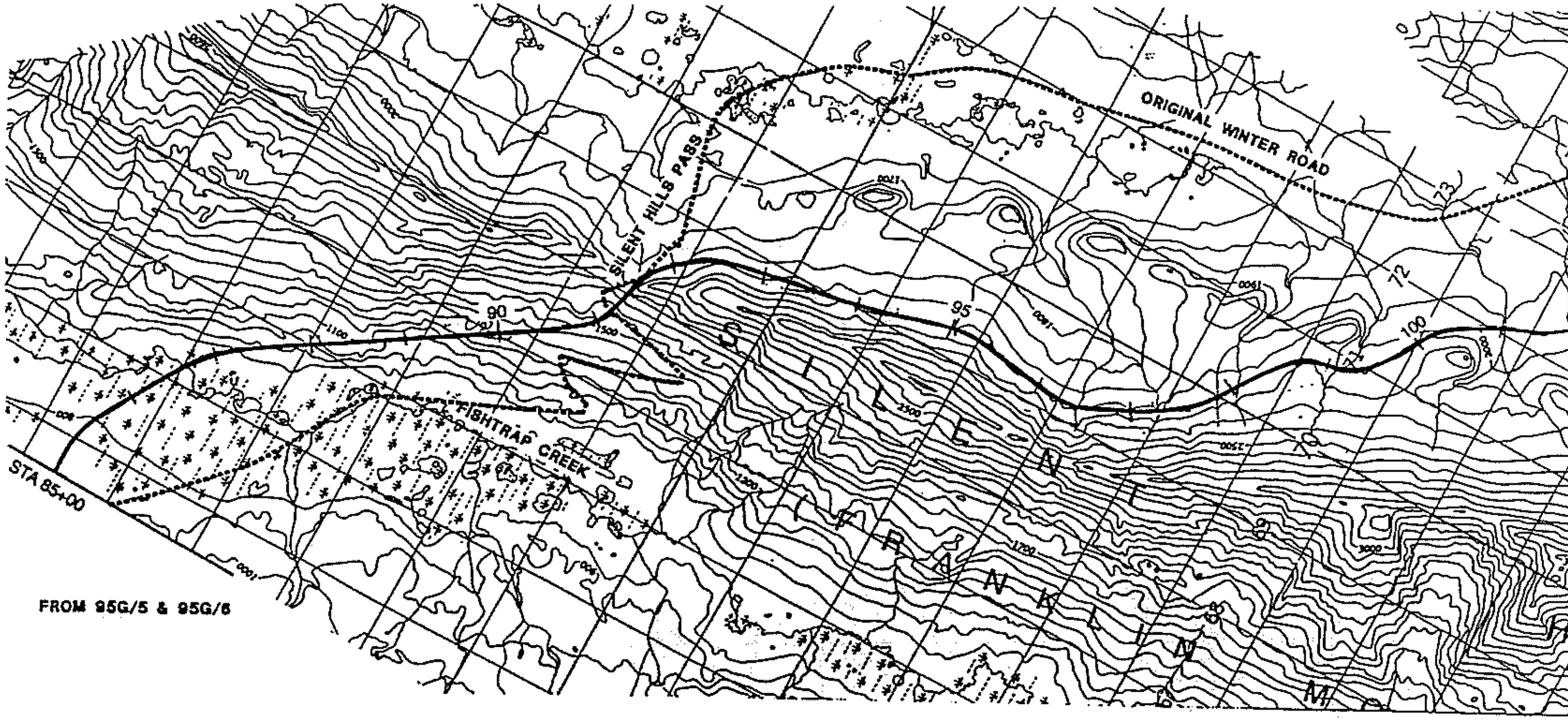


LEGEND:
- SCALE 1 : 50000
- CONTOURS NOTED IN FEET
- * TENTATIVE BORROW PIT
- ------- ORIGINAL WINTER ROAD

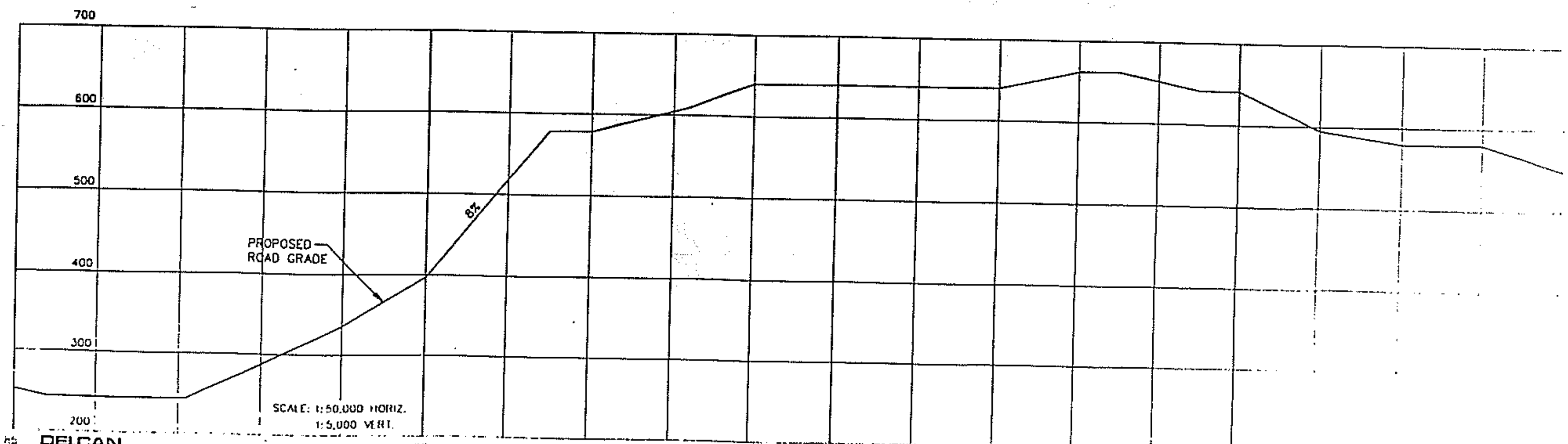


DELCAN

SAN ANDREAS RESOUR
PRAIRIE CREEK
PRELIMINARY ROUTE AL
STA 85+00 TO ST

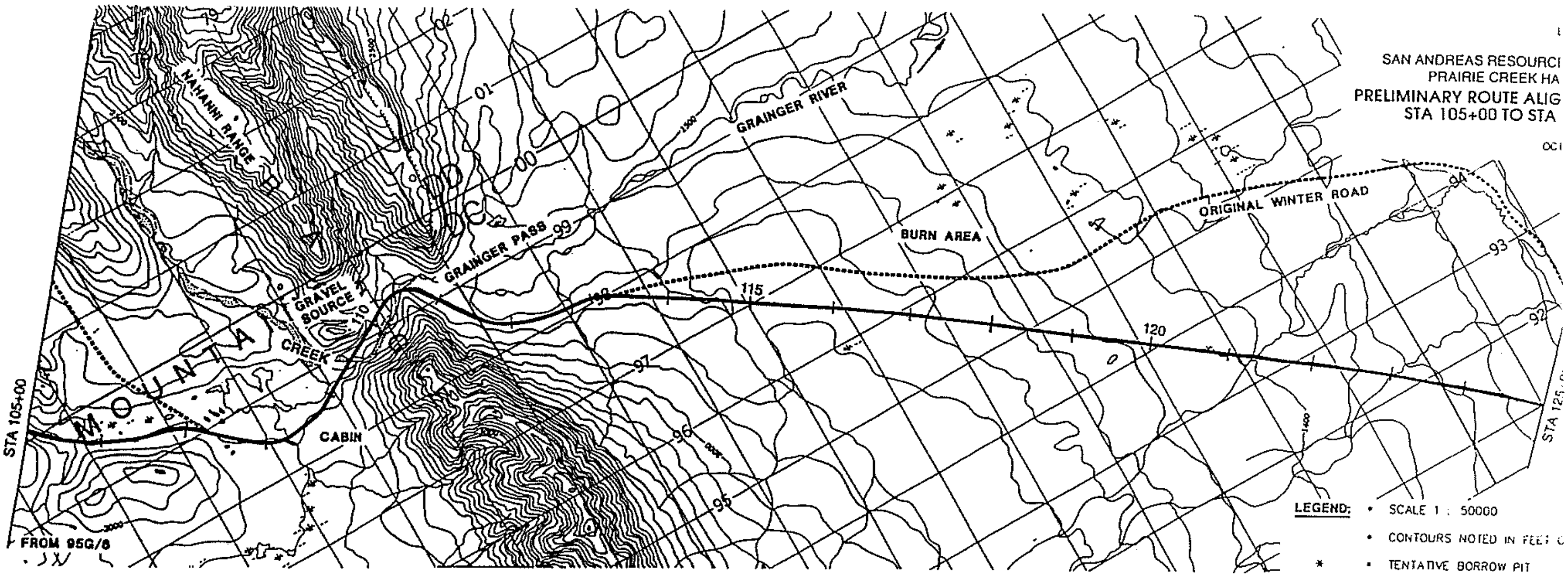


LEGEND:
- SCALE 1 : 50000
- CONTOURS NOTED IN FEE
- * TENTATIVE BORROW PIT
- ········ ORIGINAL WINTER ROAD

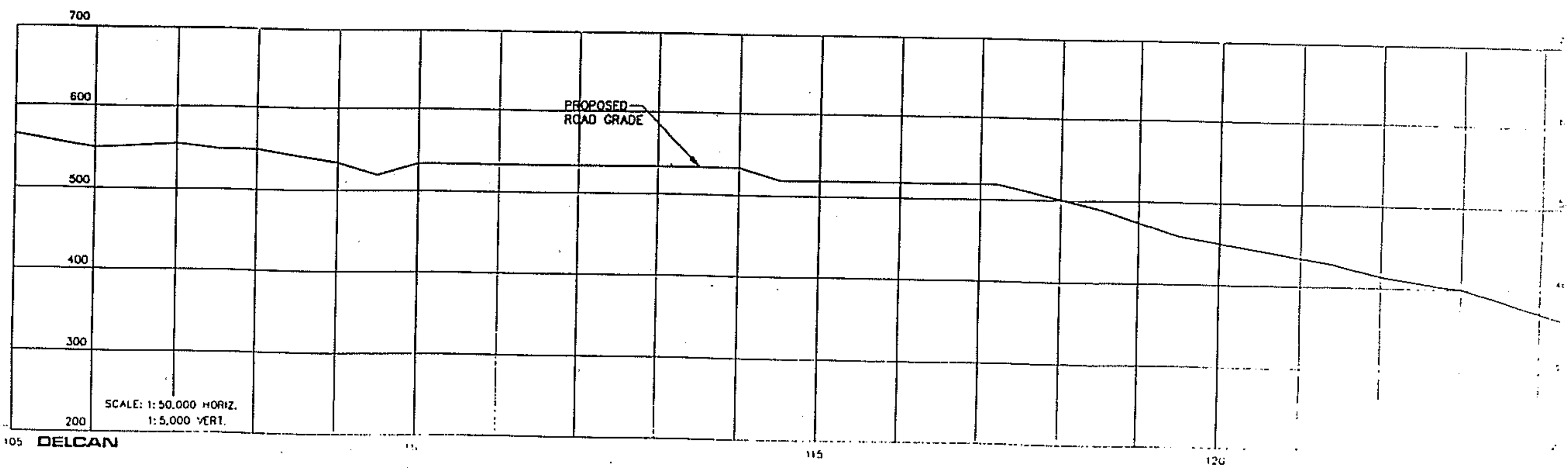


DELCAN

SAN ANDREAS RESOURCI
PRAIRIE CREEK HA
PRELIMINARY ROUTE ALIG
STA 105+00 TO STA
OCI

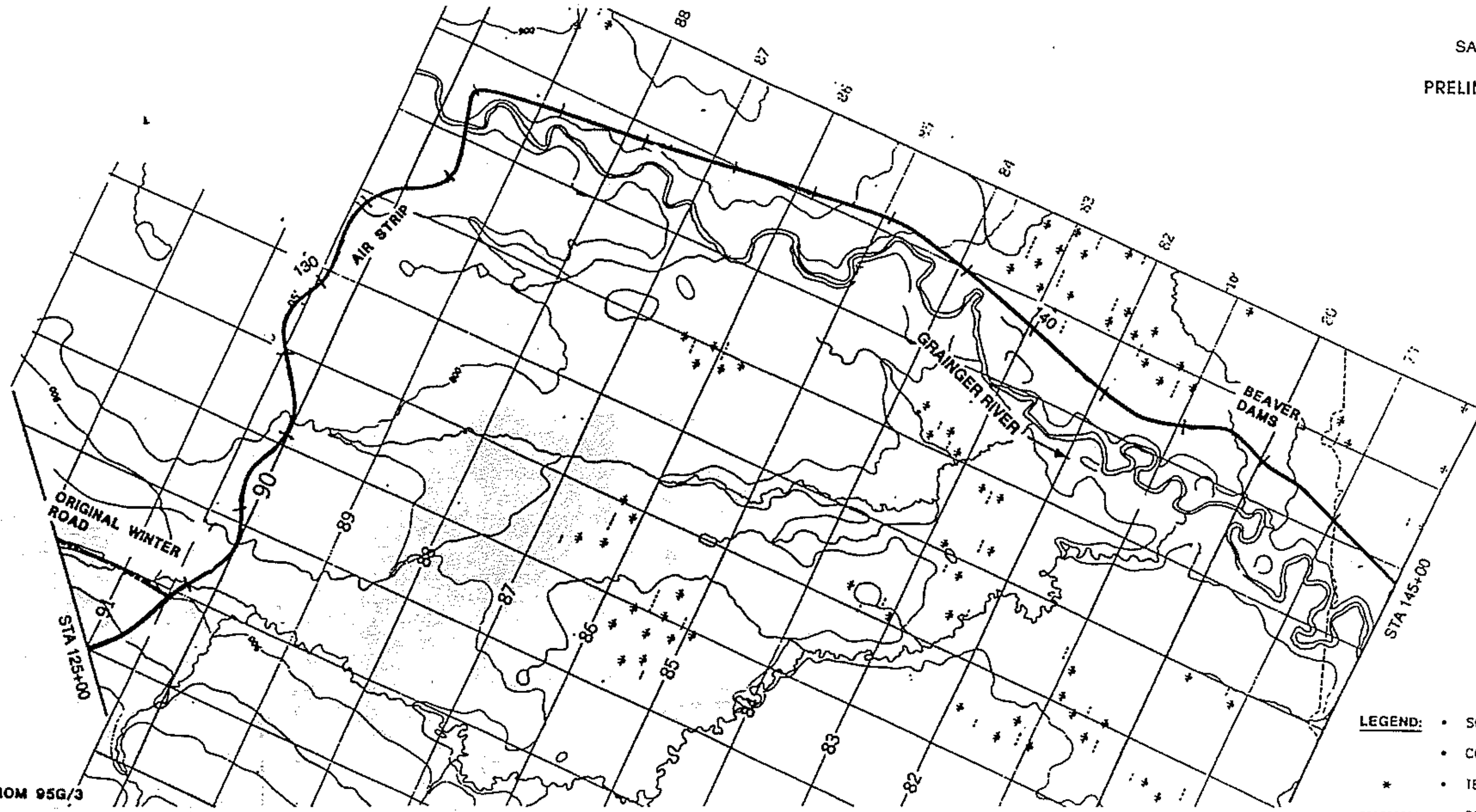


LEGEND:
- SCALE 1 : 50000
- CONTOURS NOTED IN FEET
- * TENTATIVE BORROW PIT
- .... ORIGINAL WINTER ROAD

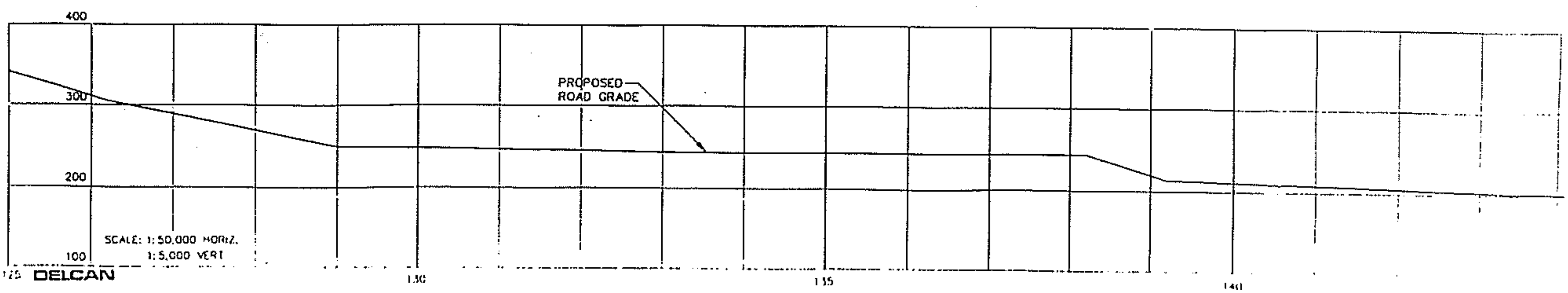


DELCAN

SAN ANDREAS RESOURC
PRAIRIE CREEK H.
PRELIMINARY ROUTE ALI(
STA 125+00 TO STA



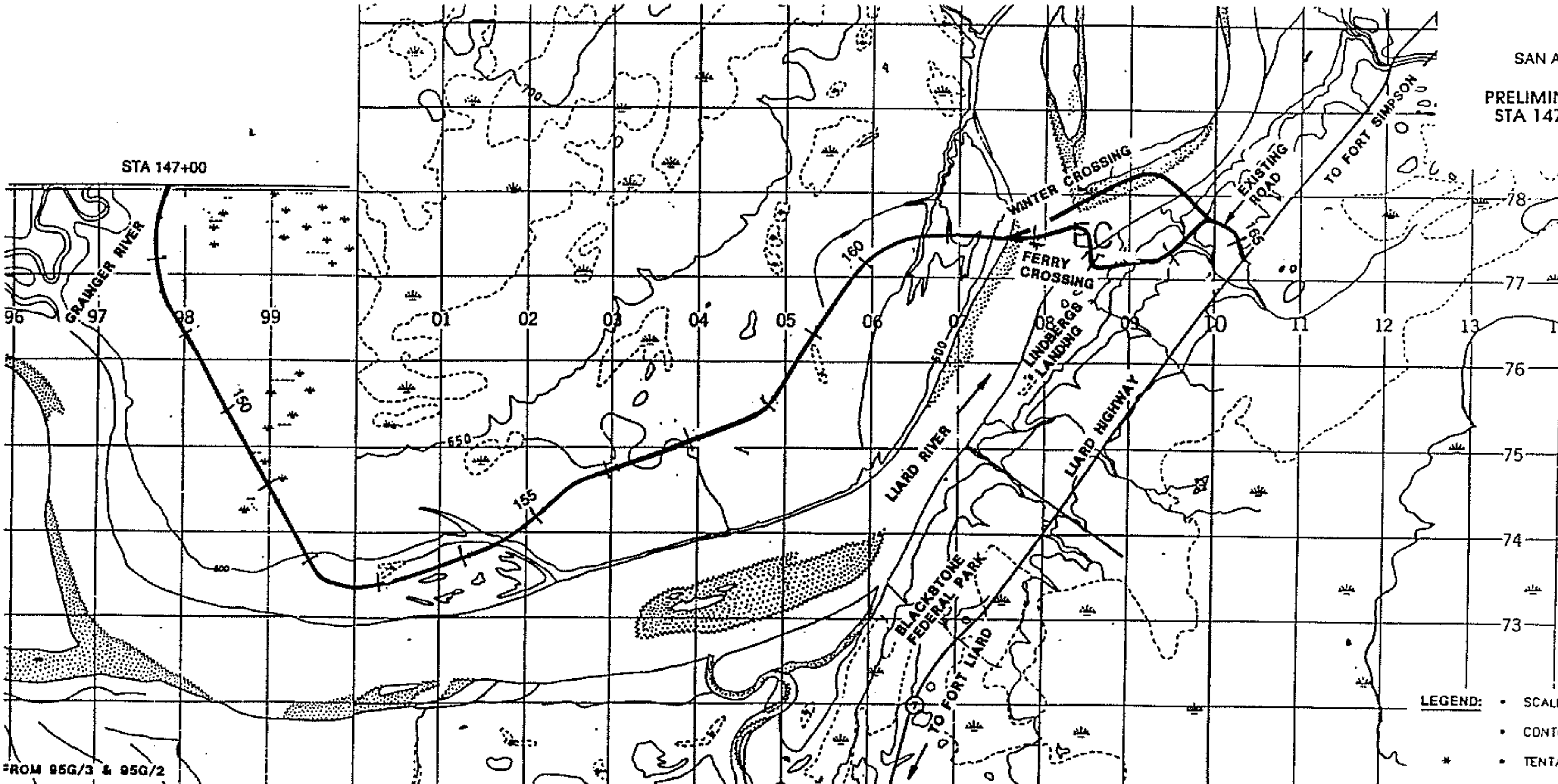
LEGEND:
- SCALE 1 : 50000
- CONTOURS NOTED IN FEET
- * TENTATIVE BORROW PIT
- .... ORIGINAL WINTER ROAD



DELCAN

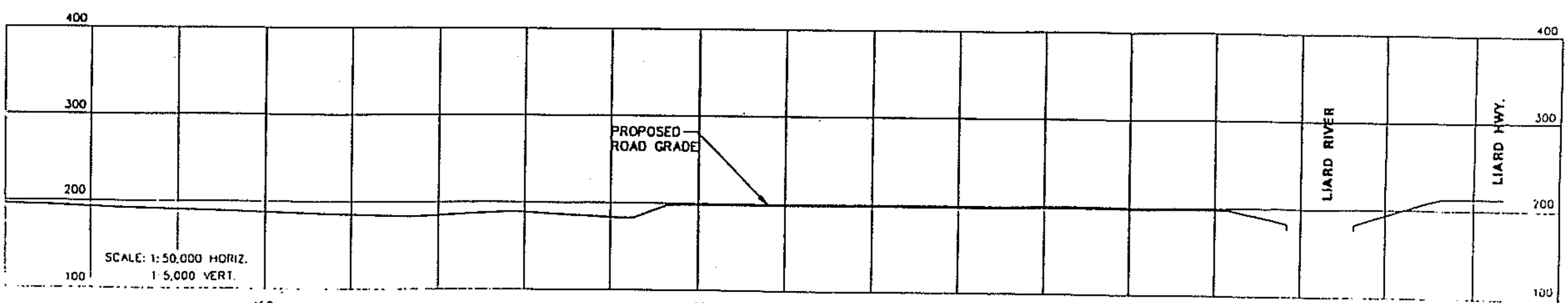
SAN ANDREAS RESOURC
PRAIRIE CREEK H.
PRELIMINARY ROUTE ALI(
STA 147+00 TO LIARD H

NO



LEGEND:

- SCALE 1 : 50000
- CONTOURS NOTED IN FEET
- * TENTATIVE BORROW PIT
- .... ORIGINAL WINTER ROAD



Appendix C - San Andreas Resources Corporation Occupational Health and Safety and Environmental Policies

SAN ANDREAS RESOURCES CORPORATION

OCCUPATIONAL HEALTH AND SAFETY POLICY

San Andreas Resources Corporation (the "Company") is committed to the highest standard of occupational health and safety performance throughout its business as an integral part of efficient and profitable business management.

The Company strives to improve its occupational health and safety performance by monitoring and improving its management practices where and when required and by applying new scientific knowledge and technology to the business of providing a safe working environment for all its employees.

IT IS THE COMPANY'S POLICY TO:

- comply with all applicable laws, regulations and standards and where adequate laws do not exist, adopt and apply standards to prevent adverse health and safety impacts associated with its operations, products or services;
- involve employees and contractors in the improvement of occupational health and safety performance; train and hold individual employees accountable for their area of responsibility;
- manage risk by implementing management systems to identify, assess, monitor and control hazards and by reviewing performance;
- ensure that employees, contractors and visitors are informed of and understand their obligations in respect of this policy;
- communicate openly with employees, government and the community on occupational health and safety issues;

SAN ANDREAS RESOURCES CORPORATION

ENVIRONMENTAL POLICY

It is San Andreas Resources Corporation's (the "Company") policy to achieve a high standard of environmental care in conducting its business as a resources company. The Company's approach to environmental management seeks continuous improvement in performance by taking into account evolving scientific knowledge and society's expectations.

IT IS THE COMPANY'S POLICY TO :

- comply with all applicable laws, regulations and standards; uphold the spirit of the law; and where laws do not adequately protect the environment, apply standards that minimize any adverse environmental impacts resulting from its operations, products or services;
- communicate openly with government and the community on environmental issues, and contribute to the development of policies, legislation and regulations that may affect the Company;
- ensure that its employees and suppliers of goods and services are informed about this policy and aware of their environmental responsibilities in relation to the Company's business;
- ensure that it has management systems in place to identify, control and monitor environmental risks arising from its operations.

Rescan

FILE COPY

RESCAN ENVIRONMENTAL SERVICES LTD.
6th Floor - 1111 West Hastings Street
Vancouver, B.C., Canada V6E 2J3
Phone (604) 689-9460
Fax (604) 687-4277

(c)

FACSIMILE MESSAGE

DATE: January 11/95

TOTAL NUMBER OF PAGES: 4

TO: Ms Brenda Kuzyk
Chair, RERC

CC:

FAX #: (403) 920 7809

FAX #:

FROM: D. Flather

RE: San Andreas Resources, Prairie Creek Project Desc. Report

PROJECT #: 474

Dear Ms. Kuzyk:

Please note the accompanying correction, which was made following submission of the report and could not be included.

Yours very truly.

Dmitry Stone, Senior Biologist

per. David Flather. Project Manager.

ERRATUM

In Table 4-1, p. 4-6, Detection limits (mg/L) should not be preceded by a "<" (less than) sign. Corrected pages are transmitted herewith.

Table 4-1

Water Quality Parameters, CCME Guidelines and Laboratory Detection Limits

Parameters		Drinking Water Limit (mg/L)	Fresh Water Aquatic Life Limit (mg/L)	Livestock Drinking Water Limit (mg/L)	Detection Limits (mg/L)
Field Measurements					
Temperature (°C)		-	-	-	N/A*
pH		6.5 - 8.5	6.5 - 9	-	N/A
Dissolved Oxygen (mg/L)		-	5 - 9.5[a]	-	N/A
Laboratory (mg/L)					
Conductivity					
Total Suspended Solids	(TSS)	-	Increase of 10[b]	Increase of 20[b]	1
Total Dissolved Solids	(TDS)	500	-	3,000	1
Turbidity	(NTU)	5	-	-	N/A
Alkalinity to pH 4.5	(mg $CaCO_3$/L)	-	-	-	1
Carbonate	(mg $CaCO_3$/L)	-	-	-	1
Bicarbonate	(mg $CaCO_3$/L)	-	-	-	1
Hardness - CALC	(mg/L)	-	-	-	1
Anions/Cations (mg/L)					
Chloride	(Cl^-)	250	-	-	0.5
Fluoride	(F^-)	1.5	-	2.0	0.5
Sulphate	(SO_4^{-2})	500	-	1,000	0.10
Potassium	(K^+)	-	-	-	1.0
Sodium	(Na^+)	-	-	-	1.0
Nutrients (mg/L)					
Ammonia	(mg NH_3-N/L)	-	1.37[c]	-	0.005
Nitrate	(mg NO_3-N/L)	10[d]	-	100[e]	0.001
Nitrite	(mg NO_2-N/L)	1[d]	0.06	10[e]	0.001
Total Phosphorus		-	-	-	0.002
Dissolved Phosphorus		-	-	-	0.002
Ortho-phosphate	(PO_4^{3-})	-	-	-	0.002
Dissolved Organic Carbon		-	-	-	0.5

* N/A = Not aplicable.

(continued)

Table 4-1 (completed)

Water Quality Parameters, CCME Guidelines and Laboratory Detection Limits

Parameters		Drinking Water Limit (mg/L)	Fresh Water Aquatic Life Limit (mg/L)	Livestock Drinking Water Limit (mg/L)	Detection Limits (µg/L)
Elements					
Aluminum	(Al)	-	0.1[f]	5.0	1.0
Antimony	(Sb)	-	-	-	0.20
Arsenic	(As)	0.05	0.05	5.0	1.0
Barium	(Ba)	1.0	-	-	0.1
Beryllium	(Be)	-	-	0.1[g]	0.20
Boron	(B)	5.0	-	5.0	1.0
Cadmium	(Cd)	0.005	0.0008[h]	0.02	0.060
Chromium	(Cr)	0.05	0.002	1.0	1.0
Cobalt	(Co)	-	-	1.0	0.040
Copper	(Cu)	1	0.002[h]	0.5[i]	0.40
Iron	(Fe)	0.3	0.3	-	10
Lead	(Pb)	0.05	0.002[h]	0.1	0.10
Manganese	(Mn)	0.05	-	-	0.10
Mercury	(Hg)	0.001	0.0001	0.003	0.050
Molybdenum	(Mo)	-	-	0.5	0.1
Nickel	(Ni)	-	0.065[h]	1.0	0.40
Selenium	(Se)	0.01	0.001	0.05	1.0
Silver	(Ag)	0.05	0.0001	-	0.010
Uranium	(U)	0.020	-	0.2	0.02
Vanadium	(V)	-	-	0.1	1.0
Zinc	(Zn)	5	0.03	50.0	1.0

a: Dependent on life stage of organisms and ambient temperature.
b: For background suspended solids ≤ 100 mg/L.
c: For pH 8.0 at 10°C.
d: When nitrite present, sum of both nitrate and nitrite not to exceed 10 mg/L.
e: When nitrite present, sum of both nitrate and nitrite not to exceed 100 mg/L.
f: For pH > 6.5, although reduced levels of Ca and/or dissolved organic carbon can increase the toxic effects of aluminum.
g: Tentative guideline.
h: For hardness 60-120 mg/L as $CaCO_3$; guidelines increase/decrease with increasing /decreasing hardness.
i: Lower limit used for sheep.