K- Sage Creek 75(?)C

RIO ALGOM LIMITED

THE SAGE CREEK PROJECT

STAGE I

ENVIRONMENTAL AND GEOTECHNICAL ASSESSMENT

Piteau Gadsby Macleod Limited
(Geotechnical Consultants)

in Association with

B.R. Hinton and Associates Limited
(Environmental Consultants)

75-085

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TABLE OF CONTENTS

Page

FIGURES

1. INTRODUCTION

Piteau Gadsby Macleod Limited (geotechnical consultants) in association with B. R. Hinton and Associates Limited (Environmental Consultants) were retained by Rio Algom Ltd. in their letter of May 29th, 1975 to carry out a "Stage Zero" study on the geotechnical/environmental aspects of the proposed Sage Creek Coal Mine in the Flathead Valley, British Columbia.

During the course of this study, the Environmental Services Unit of the British Columbia Lands Service issued general guidelines for Environmental Control of Development on British Columbia Crown Lands. Three stages of project evaluation defined in the guidelines are:

Stage I	-	Project Justification
Stage II	-	Evaluation of Alternatives
Stage III	-	Determination of Project Development Criteria

The Stage I study referred to above is in effect the "Stage Zero" study discussed in this report. Consequently, this report is referred to as a Stage I study in accordance with the new guidelines (a copy of the Guidelines is included in the Appendix).

The objectives of the "Stage I" study were as follows:

(i) to undertake a general review of all readily available biophysical and geotechnical information on the aspects of the proposed project;

(ii) to assist in planning the detailed site investigation program and geotechnical studies;

(iii) to establish a study plan for the environment aspects of the project with the appropriate government agencies;

(iv) to obtain approval in principle for the project. At the suggestion of the B. C. Environmental and Land Use Committee Secretariat, this report also includes a brief projection of general environmental impacts.

This report summarises the work carried out by the Piteau Gadsby Macleod Limited/B.R. Hinton and Associates Limited team in the period June 1st to July 20th, 1975.

2. DESCRIPTION OF "STAGE I" STUDIES

2.1 Environmental

The environmental studies consisted of the following:

(i) A preliminary review of readily available information on the biophysical characteristics of the region;

(ii) A general evaluation of the mine and associated services, which include a townsite, railway and port facilities;

(iii) Meetings with appropriate government agencies, viz:

B.C. Mines Reclamation Committee
B.C. Department of Lands, Forests and Water Resources - Environmental Services Unit
B.C. Environment and Land Use Committee Secretariat
B.C. Fish and Wildlife Branch
Government of Canada, Department of Environment - Environmental Protection Service

(iv) Observation of the public meeting in Kalispell, Montana in June;

(v) A site visit on June 19th, 1975;

(vi) Evaluation of the regional socio-economic and planning aspects as well as regional and local biological concerns;

(vii) Development of a detailed study plan for Stage II work in accordance with governmental guidelines;

(viii) Monitoring of public opinion through review of newspapers from South Eastern B.C., Vancouver and Montana.

2.2 Geotechnical

The geotechnical studies consisted of the following:

(i) A review of all readily available geological reports on the site area;

(ii) An airphoto study;

(iii) Site inspections on June 5th, 18th and 19th, 1975;

(iv) Review of the proposed 1975 drilling program with Rio Algom Limited;

(v) Review of the readily available geologic, climatic and hydrologic data of the Flathead area.

3. RESULTS OF STUDIES

The results of the Stage I studies are described below. The project is discussed with respect to regional environmental considerations followed by more specific environmental and geotechnical aspects of the individual components of the mine project.

3.1 Southeast Kootenay Area

For this study, the southeast Kootenay area is defined as that portion of the Kootenays east of the Kootenay River and south of the latitude of Sparwood. It includes most of the coal mining area of the East Kootenay. A topographic map of the area is shown on Figure 1.

The major communities in this area include Sparwood, Natal, Michel, Fernie and Elko. This region is generally mountainous with flat land in the Kootenay Valley, the Elk River valley and the Flathead Valley.

The general land capability of the region may be assessed from the land capability analysis of the Canada Land Inventory (CLI) shown on Figure 2.*

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*Field data for this analysis was obtained in 1966 and is now under revision by the B. C. Land Inventory (ELUC Secretariat).

This information was provided by the Environment and Land Use Committee (ELUC) Secretariat of the Government of British Columbia.

The analysis notes that:

> "the most outstanding characteristic of the East Kootenay is its capability to support large populations of big game. In this regard the region is unique in North America and ranks highly on a global scale. There are prime winter range and summer production areas for wild ungulates as well as other species including grizzly bear, black bear and cougar--- The recreation capability for upland and mountain activities is also of wide importance. 'Quality recreation' represents outstanding landscapes where a variety of outdoor activities can centre. These lands are usually found along natural scenic river corridors offering potential for the development of several recreation routes in the area---Forestry is relatively---low value in the provincial scale".

The analysis continues with particular reference to big game:

> "the land can support a wide variety of wild ungulate species, including whitetail and mule deer, elk, moose, mountain goat, mountain sheep and cariboo. Habitat protection and active management of highly productive units is essential for the maintenance of big game populations. This would necessitate the control and management of many critical winter ranges primarily for the production of the wild ungulates".

Areas considered valuable for ungulate prodiction are shown on Figure 3, which is developed from the CLI Ungulate Capability Analysis.

For Figure 3, a modification to the standard CLI description was made to define better this particular area as shown below:

Descriptive Grouping		Corresponding Ungulate Capability Class
CLI	Figure 3	
"Prime"	"Prime"	1, 1W, 2, 2W
"Moderate"	"Moderate"	3, 3W
	"Moderately Limited"	class 4 area containing at least 25% class 3 pockets
"Limited"	"Limited"	remainder of all class 4
	"Very Limited"	5, 6

The Sage Creek Coal Development and its main options for railway access are also shown on Figures 2 and 3. The mine is in an area of relatively low ungulate capability. Portions of the railway access corridors, however, would seem to conflict with high capability ungulate winter range.

Some major regional implications of this project involve the construction of a new townsite or expansion of existing communities. The proposed mine will employ about 600 people and, if a new town is established, a population of 3,000 may be expected.

If the mine's employees locate in established communities, a smaller population increase can be expected. The three alternative growth centres are Sparwood, Elko and Fernie.

Further expansion of Sparwood may strain its present municipal services. The people likely to be employed in the Sage Creek development should be socially compatable with those already in the area, as Sparwood is essentially a mining company town.

Elko is a small agricultural and pulp mill cummunity. An increased population would require significant expansion of community services and alteration to the social and cultural structure. However, this community is in the open Kootenay River Valley, where physical expansion would be relatively easy.

Fernie is the largest community of the Southeast Kootenay area, and the one most likely to be able to absorb an increased population. In addition, we understand plans are now under way to move 550 employees of existing mining operations from Fernie to Sparwood. Accordingly, the introduction of about 600 employees from the Sage Creek development into the Fernie area would cause very few adverse impacts and could, in fact, avoid a decline in economic and social activity.

These four community options will be examined during the Stage II study with a view to defining better their relative impacts.

3.2 Roberts Bank

It is proposed that the coal mined from the Sage Creek project be shipped to offshore customers via the Roberts Bank superport. This facility is now close to its designed capacity for coal shipments and the addition of 3 million tons per year of coal from the Sage Creek property may require an expansion.

The Fraser Estuary, including the Roberts Bank area, is known to be highly valuable biologically. It is the largest resting, feeding and over-wintering area for migratory waterfowl on the Pacific flyway. Migratory waterfowl are covered by an international agreement to which Canada is a signatory and are protected in Canada by the Migratory Birds Convention Act. This act permits the Federal Minister of the Environment to stop any project which is likely to disrupt waterfowl habitat.

The estuary provides an important rearing area for Fraser River salmon; (The Fraser River commercial salmon fishery produces about $100 million per year in landed value). Juvenile salmon migrating downstream pass from fresh water into the saltwater environment. In this transition they need to acclimatize themselves slowly and the estuary provides this acclimatization. In addition, for various biophysical reasons, an estuary

Popular myth! In certain this one isnt!

is the most productive ecosystem in the world. Estuarine animals at the lower trophic levels are fed upon very heavily by juvenile salmon migrating to the ocean. Reduction of the intertidal and shallow subtidal area of Roberts or Sturgeon Banks will reduce the salmon feeding area and may cause a decline in the survival rate of juvenile salmon. Such a decline would be reflected in the economy of British Columbia.

The biological value of the Roberts Bank intertidal area has been established since construction of the superport in the mid 1960's. Strong public and governmental opposition has been noted for any further development of this area. It is anticipated that expansion of the filled area of Roberts Bank may not be environmentally acceptable.

Little is known at present of the options available for expansion of the superport facilities. It is possible that future expansion may not cause a decrease in productive intertidal area. An increase in the mechanical handling and loading facilities on the existing property may permit a doubling or tripling of the ship handling capability of the site. The existing filled area cannot accommodate more coal storage, so any expansion would require storage of coal on the upland area of Delta Municipality and secondary transportation to the loading site.

The Stage II study will investigate alternative means of transporting the coal to appropriate markets.

3.3 Railway Routes

The three options for rail routes from the proposed Sage Creek Coal Mine to the CPR main line involve connections at McGillivray, Morrisey or Elko. Preliminary engineering evaluations have been conducted on these routes, and further feasibility studies are scheduled for 1975.

The choice of route will be affected by engineering feasibility, cost, biological suitability, and future community development. The use of the railway by commuter trains will also be considered.

The impact projections discussed below have been developed in a preliminary fashion for the three railway routes using basic data supplied by the B. C. Government.

3.3.1 The McGillivray Route

The route north from the Sage Creek project crosses moderately valuable ungulate range and parallels the Flathead River for about ten miles. Interruption of the land/water interface in ungulate range is considered to be a significant impact. In addition, construction along the river itself could result in siltation of the stream during construction and operation.

It is known that the unique Montana Grayling spawn in the headwaters of the Flathead River and would be affected by siltation and coal dust. Moving the railway to the west side of the valley as far as possible will significantly reduce these impacts, although it may add to the capital cost. A number of streams are crossed by the railway in the Flathead Valley, and extensive culverting will be necessary to avoid disruption of the surface drainage pattern.

For engineering reasons, a tunnel would be necessary at the divide into the Leach River Drainage. Accordingly, minimal impact on mountain goat and bighorn sheep in this area is expected. The proposed route follows Leach and Michel Creeks to McGillivray through prime ungulate range. Impacts on fish and wildlife will be of the same nature as noted above, but should be more severe than in the Flathead Valley.

The steep sided narrow valley topography makes it difficult for the engineering designers to consider environmental constraints along Leach and Michel Creeks.

3.3.2 The Morrissey Route

The proposed route parallels the McGillivray route for the first few miles, but breaks away from the Flathead River to follow Harvey Creek westward. The railway would be built some distance from the creek bed itself, well up the mountain side. Harvey Creek basin is not noted as containing particularly valuable ungulate range, nor is it thought to contain a significant fish population.

Across the divide, the railway would enter the Lodgepole drainage. The north side of Lodgepole Creek Valley contains valuable ungulate winter range, but the railway generally would follow the south side before crossing the stream to head for Morrissey. Conflict with ungulate range is minimal along this route. Impacts on fish are difficult to determine, but because the railway only occassionally approaches the stream, fish impacts may be small.

3.3.3 The Elko Route

This proposed route parallels Cabin Creek, well back from the creek itself. During the June 1975 site visit, Cabin Creek was noted to have a high silt load relative to other streams in the valley. As a result, it is not anticipated that significant fish habitat exists. In addition, there is little or no valuable ungulate range in the Cabin Creek basin.

As the proposed route crosses into the Bighorn and Wigwam Creek basins, however, it enters significant winter range for bighorn sheep, elk and deer. Near the confluence of Wigwam Creek and Elk Creek, the proposed route approaches Elko through the entire length of what the Canada Land Inventory describes as one of the three most important areas for big game in the entire East Kootenay.

The fish populations in Wigwam and Bighorn Creeks are unknown at the moment, but the impact on such populations may be significant because of the locational constraints imposed by the topography of the route.

3.4 Flathead Valley

3.4.1 Physiographic Setting and Related Geology

The Flathead Valley in British Columbia lies between the rugged alpine peaks of the MacDonald Range on the west and the Clark Range on the east. The regional geology of the Flathead Valley and related areas is described by Price (1959 and 1965). The Valley marks the northern end of a prominent north-west trending linear physiographic depression more than 70 miles long.

The Flathead River is the main drainage course in the Valley, flowing practically due south into Montana. Sage Creek rises in the Clark Range, flows westward to drain the south-eastern corner of the Valley, and joins the Flathead River south of the Canada/U.S. border.

The most outstanding physiographic feature of the alluvial plain which forms the Flathead Valley floor, is the downcut trench which is occupied by the Flathead River and which has cut banks of up to 100 to 200 feet in places. The gradient of the river, over a 6 mile stretch in the mine area is about 20 feet per mile.

At the U.S. border, the Flathead Valley is about 8 miles wide and the Flathead River flows along the western wall of the valley. The eastern part of the valley is occupied by glacial deposits in the form of glacial moraines which appear to have accumulated from the slopes of the Clark Range. North of the easterly flowing Couldrey Creek, the sharp bare 7,000-foot summits of the MacDonald Range are replaced by a series of lower, rounded, tree-clad hills extending northward for about 7 miles, which includes the general area of the proposed mine site.

The Flathead valley is about 4 miles wide in the mine area. The lower hills in the mine area rise to the westward where they regain the height of the MacDonald Range over a distance of about 6 miles. Thus, a definite recess is evident in the Flathead Valley with dimensions about 8 miles north and south and 6 miles east and west. This recess is occupied by the down faulted Blairmore, Kootenay and Fernie Formation rocks as well as other sedimentary rocks so that it represents a graben between the walls formed of the bounding older limestones which run on the west and north flanks of this recessed area.

The valley bottom and sides lie in the Englemann Spruce-Alpine Fir biogeoclimatic zone (sub alpine forest biotic area). The higher elevations are in the sub-alpine tundra biogeoclimatic zone (southern alplands biotic area). Most of the valley bottom does not appear to be covered by climax vegetation.

References: Price, R. A. (1959) Flathead, British Columbia and Alberta, Geol. Surv. Can. Map 1-1959.

Price, R.A. (1965) Flathead Map Area, British Columbia and Alberta, Geol. Surv. Can. Memoir 336.

3.4.2 Climatic Data

Climatic data for the period 1941 to 1970 is readily available from Cranbrook, Elko and Fernie. This data is summarised on Table 1. In addition, the precipitation records for 1972 and 1973 at Cranbrook, Elko, Fernie and Natal are shown on Table 1.

Climatic stations are also located on the Flathead River at the Canada/U.S. border and near Morrissey. The data for these stations is obtainable from Ottawa, but was not available in time for this report.

The data on Table 1 shows that the temperature ranges for the three East Kootenay stations are reasonably similar. It can be expected, therefore, that similar temperatures generally occur in the Flathead Valley.

The precipitation data for the 1941-1970 period indicates a significant increase in the rain and snowfall at Fernie compared to Cranbrook and Elko. The mean rainfall and snowfall at Fernie are 28 inches and 145 inches, respectively. The maximum rainfall for a 24-hour period at Fernie is in excess of 4 inches, compared to approximately 2.3 inches at Cranbrook and 1.7 inches at Elko. All the above three stations are located between elevations 3,050, and 3,290 feet.

The annual precipitation data for two Natal Stations, Harmer Ridge and Kaiser Resources are shown on Table 1. These stations were installed in 1971. These data are compared with the data from Cranbrook, Elko and Fernie Stations for the same year. The data show that there are significant differences in precipitation and snow cover depending upon the specific location and elevation.

Previous wildlife surveys by the CLI indicate that the Flathead Valley had deeper snow cover than the surrounding S. E. Kootenay.

At present, data has not been obtained for wind velocities at the above stations.

The East Kootenay valleys are known to have intense rainfalls and high winds. These short intense storms generally occur from June to August. A large windfall of timber occurred in the upper reaches of the Lodgpole and Flathead Creeks in 1964 as a result of one of these storms.

Climatic stations will be required at the proposed coal mine and possibly along the railway routes to obtain reliable data on precipitation (snowfall and rainfall), temperature, wind velocities, and evaporation for establishing baseline data and for engineering design purposes.

3.4.3 Hydrology and Water Quality

The Flathead River starts about 28 miles north of the Canada/U.S. border. Shepp, Harvey, Howell, Cabin, Couldrey and Burham are the main creeks from the west side of the valley and the Commerce Creek is the main creek from the eastern mountains flowing into the Flathead River above the border. Sage Creek, some six miles east of the mine area, crosses the international border independent of the Flathead River, then joins the Flathead River just south of the border.

The drainage basin of the Flathead River in Canada is approximately 430 square miles. The drainage divide between Sage Creek and the Flathead River is indefinite. Sage Creek is estimated to have a drainage area of approximately 40 square miles above the Canada/U.S. border.

At present, the only permanent river gauge is at the Flathead Border Station. Records for the period 1952 to 1973 show that the mean discharge is 970 cfs. The highest recorded instantaneous discharge of 16,300 cfs occurred on June 8, 1964 and the minimum value of 74 cfs on January 20, 1966. The monthly mean discharges together with the maximum and minimum values are shown on Figure 6.

The lower reaches of Howell, Cabin and Couldrey Creek and the Flathead River above the Canadian/ U.S. border are characterised by meandering stream beds and oxbow features within wide flood plains. The maximum extent of the flood plains is indicated by the predominant sand and gravel terraces. The Flathead River drains into Flathead Lake approximately 65 miles south of the border in Montana.

Detailed information on water quality and quantity will be required for developing environmental and engineering studies. A total of six sampling stations are suggested located on Leslie, Howell, Cabin and Couldrey Creeks and the Flathead River. These locations are shown on Figure 4.

The stations are selected to provide hydrological and water quality data on streams before and after they pass through the proposed mining area.

Samples will be required monthly at the six stations for water quality analysis. Gauges will be required at four stations for water quantity measurements. Temporary gauges were installed on the Cabin and Howell Creek Bridges in June 1975. Readings on creek levels have been taken weekly. These creek level readings will be correlated with the proposed permanent stations. A handbook for field water sampling procedures will be prepared for monitoring water quality.

3.4.4 Biological Resources of the Valley

The Flathead River system contains populations of dolly varden and cutthroat trout, the unique Montana Grayling and other species. The grayling, at least, are known to spawn in the upper Flathead River and its tributaries. All these species are sensitive to habitat changes, including chemical and thermal alterations.

As noted above, the East Kootenay is generally very valuable for wildlife. In the Flathead Valley itself, a number of species are present (such as the grizzly bear and wolves) which are sensitive to any disturbance by man.

Many species of ungulate are present, including moose, elk, whitetail deer, mule deer, mountain goat and bighorn sheep. As shown on Figure 3, the central valley contains moderate winter range for moose and elk with an area of prime range along Sage Creek. Lengthy strips of moderate winter range for deer, elk and moose exist along many of the tributary streams except Cabin Creek, Howell Creek and Harvey Creek. The upland areas tend to contain variously limited habitat for elk, moose, deer, goats and sheep, with occasional patches of moderate range, while the west side of the valley (where the mine site is located) is generally of limited capability for ungulates.

The tree cover of the valley floor appears to be in intermediate successional stages with many small open meadows interspersed in the forest cover. As the forest moves towards climax, its value for ungulate production may be expected to decline naturally. Selective logging would reintroduce the earlier successional stages and maintain its present high ungulate capability.

3.5 Mine Area

3.5.1 Physiographic Setting and Related Geology

The tentative proposed limits of the two open pits, general topography and geology in the mine area are shown on Figure 4. Geology of the area is described by Hennesey (1975), Rio Algom 1975 Feasibility Report and Mackenzie (1916). The mine is located on the west side of the Flathead Valley near Cabin and Howell Creeks. Sage Creek, from which the mine takes its name, is actually located on the east side of the Flathead Valley about six miles east of the site.

The lowest point in the area is where the Flathead River flows cut cf the southeast corner of the area at elevation 4,100 feet. The highest altitude is near the northwest corner, where limestone peaks reach over 6,500 feet. The eastern portion of the mine site is very flat over extensive areas and is thinly wooded, whereas the western portion is typical irregular steep mountainous terrain and is fairly densly forested.

References: Hennesey, W. J, (1975) Geology of Sage Creek Coal Property, S. E. British Columia.

Mackenzie, J.D. (1916) The Geology of a Portion of the Flathead Coal Area, British Columbia, Geol. Surv. Can. Memoir 87.

Most of the mine area, except the higher and more exposed tops of the hills, is covered with overburden materials of various origins, consisting of glacial drift and reworked detritus, scree and poorly developed residual material in some locations. The river gravels, which are widespread in the eastern half of the map area, are largely composed of argillite, quartzite and basaltic pebbles and boulders which appear to be dirty gravels, containing a high proportion of sand, and fine material. These gravels appear to be at least 500 feet thick in places at the base of the North Hill within the proposed pit limits. At the toe of the South Hill, however, gravel does not appear to exist or is limited, and the majority of the material in this area is essentially silt and clay. The gravels essentially form the surface of the flat alluvial plain of the valley floor and it is these same materials that have been dissected to produce the intricate network of alluvial terraces indicated in Figure 4. These terraces in most cases appear to define the limits of the individual river and creek flood plains .

Marshy areas are abundant in the poorly drained portions of the alluvial plain, particularly in areas where freshet runoff spills out of the existing perennial stream or river channels. Steep-sided, undrained depressions similar to kettle holes in ice laid deposits or sink holes in limestone and a few shallow lakes occur in the northern half of the area (see Figure 4).

The alluvial plain is generally thinly wooded with jackpine, balsam, fir, tamarack, cottonwood, aspen, and poplar. In the mountainous terrain fir, tamarack and spruce are more common. Along stream courses in marshy areas, growth of willows are also found.

Detailed environmental assessment of the specific mine site area is beyond the scope of the Stage I report.

3.5.2 Open Pits

The proposed open pit operations consist of removing the surface materials to expose the coal seams. Locations of the mining areas are shown on Figure 4. Typical sections through the North and South Hills showing limits of proposed excavation are shown on Figure 5. Coal reserve may also be available from the area immediately south-west of the South Hill.

The open pit operations will result in exposing footwall slopes of sandstone with an average inclination of about 30°, which is the average dip of the bedding. The hanging wall in the valley floor will be made through over-burden material in the upper portions of the slope and in sedimentary rock in the base of the hanging wall slope. For preliminary feasibility studies slopes of 30° in the over-burden and 45° in the bedrock were assumed for the hanging wall slopes of both the North and South Hills.

Control of run-off seepage and groundwater during construction operations will be required. A system which will include berms, drainage ditches, deep wells and revegetation is envisaged. Artesian conditions have been encountered in the 1975 ore body exploration program. The artesian conditions will have an important effect upon the foot and hanging wall slope design, pit dewatering, and environmental control.

Stages II and III studies will investigate the effects of one or both open pits becoming man made "lakes" at the end of the mining operations.

3.5.3 Mine Plant

One possible location for the plant is shown on Figure 4. The mine plant will include coal preparation and washing plant, 40,000 ton clean coal stockpile, load-out, 18,000 ton raw coal stockpile, thickeners, emergency tailings pond, 40 megawatt power plant and cooling facility.

The proposed site is located near the confluence of Cabin and Howell Creeks at the foot of the South Hill. A sand and gravel terrace occurs in the northern portion and a boggy area exists in the southern limits of the site.

Deep deposits of clay and silts are known to occur in the east slope (hanging wall) of the south pit. Due to the variable deposition and erosion sequences caused by the creeks, subsoil deposits below the proposed mine plant are likely to range from clays to gravel and boulder sizes. Groundwater is likely to occur within 20 feet of ground surface.

From our preliminary study we do not believe there are any major geotechnical factors which will affect the proposed site for the mine plant.

We believe groundwater sources will be available for water supply. Process water used will be recycled entirely.

The detailed layout of the plant will be planned to avoid flood plains of creeks. Berms, roadside vegetation and screening with trees can be utilized to reduce the area of influence of coal dust and noise.

3.5.4 Waste Dumps

It is estimated that waste products over the proposed twenty to thirty year mine life will be at least 1.3 billion cubic yards of mine waste rock and at least 40 million cubic yards of plant reject.

Rio Algom is investigating the possibilities of dewatering all the tailings and depositing caked mine reject into disposal areas. If this is feasible, a lagoon will be provided in the mine plant area to handle emergency situations should there be a temporary breakdown in the drying plant.

Acid mine drainage is not believed to be of concern. The low sulphur content of the coal combined with the high calcium carbonate in natural waters will probably not produce acidic water in the waste piles.[1] This factor will require detailed study in selection of the plant reject site.

Possible waste rock sites are discussed in the Feasibility Report. From the general aerial inspection made on June 19th, 1975, logged areas west of the North and South Hills, and the upper reaches of the Cabin Creek are considered as possible sites. In addition, the open pits will be considered for disposal of waste rock.

Identification and comparison of suitable sites will be part of the Stage II studies.

3.6 Townsite

The Stage II studies will identify a suitable location for a townsite in the Flathead Valley. This townsite will be compared to the options of exanding existing communities. A choice which optimizes engineering, economic and environmental factors will be recommended.

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[1] Harrison, J.E., Geology Aspects of Mountain Coal Mine Waste Disposal. Proceedings of Int. Conf. on Land for Waste Management, Ottawa, Canada. October 1973.

From our preliminary study, we believe a groundwater supply may be developed from a deep aquifer in the area. A properly designed and developed groundwater supply will not adversely effect existing surface and near surface drainage patterns or streams.

Modern waste water recycling systems can collect sewage, treat, and discharge effluent into disposal fields. Effluent may be collected and treated in large plants or by several small units. A detailed study of the geohydrology of the area is required. From our preliminary evaluation of the area, it appears to be possible to design and operate a system which will maximise evapotranspiration, renovate effluent close to drinking standards and not contaminate surface or near surface waters.

A preliminary appraisal suggests that a properly designed cell type sanitary land fill is the most suitable method of garbage disposal.

3.7 Reclamation

It is proposed that reclamation of the open pits and waste dumps will be carried out progressively as the mining proceeds. Detailed reclamation procedures will be developed during the Stage III studies, but the following steps are likely to be included:

(i) Detailed soil biochemistry and vegetation mapping of the area to be disturbed;

(ii) Development of nearby test plots and nursury areas to cultivate the vegetation now present on the site;

(iii) Stripping and disposal of the existing vegetation;

(iv) Stripping and stockpiling of the surface soil;

(v) After mining or waste deposition is completed, the original topsoil will be re-deposited, and nursury-reared natural vegetation transplanted.

The above will be modified as deemed necessary by pedologists and plant ecologists during the actual reclamation program. The use of local vegetation reared in the nursury should advance the natural regeneration.

3.8 General Impacts on the Flathead Valley Environment

As the site of the mine and processing plant is in a low capability area of the Flathead Valley, direct impacts on ungulate populations should be low. The impact on fur bearers is not yet determined. The effects of the rail routes were described previously.

One major objective is to design the facilities at the mine site so that the stream beds, flood plains, water quality and water quantity of the Flathead system are not changed. In the case of water quantity, this can be achieved through the use of groundwater and in-plant recycling. At present, such a system appears to be possible and the flow of the Flathead River should not be affected. A wide "green strip" of natural vegetation is planned along all significant streams.

Water quality maintenance is a more difficult problem which would be insurmountable if the design relied upon treatment facilities on the end of the effluent pipes. Accordingly, it is the plant process itself which must be designed using environmental ground rules. Specifically, all cooling and process water will be recycled. Make-up water will be provided from groundwater or from ponds designed to collect the increased runoff from the mine face.

Disposal of solid waste and waste rock have not been fully investigated at present. A disposal site must be carefully chosen in a low value land area which can be developed to minimise and control runoff to streams.

While water quality still ranks as a major concern, the objective of not altering the Flathead River is presently thought to be achievable. Insufficient design study has yet been done to project any impacts other than at the preliminary level of this Stage I report.

Only a few small "quality recreation" areas are located in the valley, and one of these occurs at the confluence of Cabin/Howell Creeks with the Flathead River. This swimming and picniking area should provide a pleasant diversion for off-duty mine employees, although the visual impact of the mine will have to be assessed. The only other recreational feature of note in the valley, (other than fishing or hunting) is the large area of hiking and viewing capability in the upper part of Cabin Creek, well removed from the mine site, and separated from it by undisturbed mountain slopes (Figure 2).

A number of biophysical impacts related to construction techniques, access roads, coal dust, accidents and equipment failures, reclamation programs and other activities are recognised. A comprehensive discussion of all such effects can be attempted only for the Stage II and III programs. The Stage II study program is appended to this report.

4. RECOMMENDATIONS

As a result of the above assessment, it is recommended that:

(1) Socio-economic and biophysical studies be undertaken to generate appropriate options for housing employees. All new options should be compared to existing towns and the best location identified. Such studies would be carried out in concert with the current "coal block studies" by the ELUC Secretariat and community development studies by others.

(2) The McGillivray, Elko and Morrissey routes for rail access to the site be investigated. Optimum designs for each route should be produced through interdisciplinary evaluation.

(3) The effects of exploration, construction, location operation, and the eventual mine shut-down be considered from the local and regional view points. Socio-economic effects are expected to be felt throughout the southeast Kootenay area and perhaps in Cranbrook and Kimberly (British Columbia), Blairmore and Coleman (Alberta).

(4) Sufficient mine and plant design be carried out during Stage II to permit an informed projection of biological impacts on the southeast Kootenay area. If necessary, these studies will include appropriate portions of the Flathead Valley in the state of Montana.

(5) All engineering design should take congnizance of environmental constraints.

(6) Climatic stations be installed to record precipitation (snowfall and rainfall) wind velocities, and temperatures at the mine site and along the proposed rail routes. At least one year of records is required for environmental and engineering design studies.

(7) Six stations be installed on creeks and rivers to record water quality and quantity. At least one year of records is required for environmental and engineering design studies.

(8) Detailed geotechnical studies be made on the North and South Hills and adjacent valley areas. Objectives of the geotechnical studies are to design stable slopes for mining and reclamation of the open pits.

(9) Geotechnical and environmental studies be made on possible sites for the mine plant and waste dumps. Subsurface drilling will be required at a later phase for detailed foundation design and ground-water supply.

Appendix

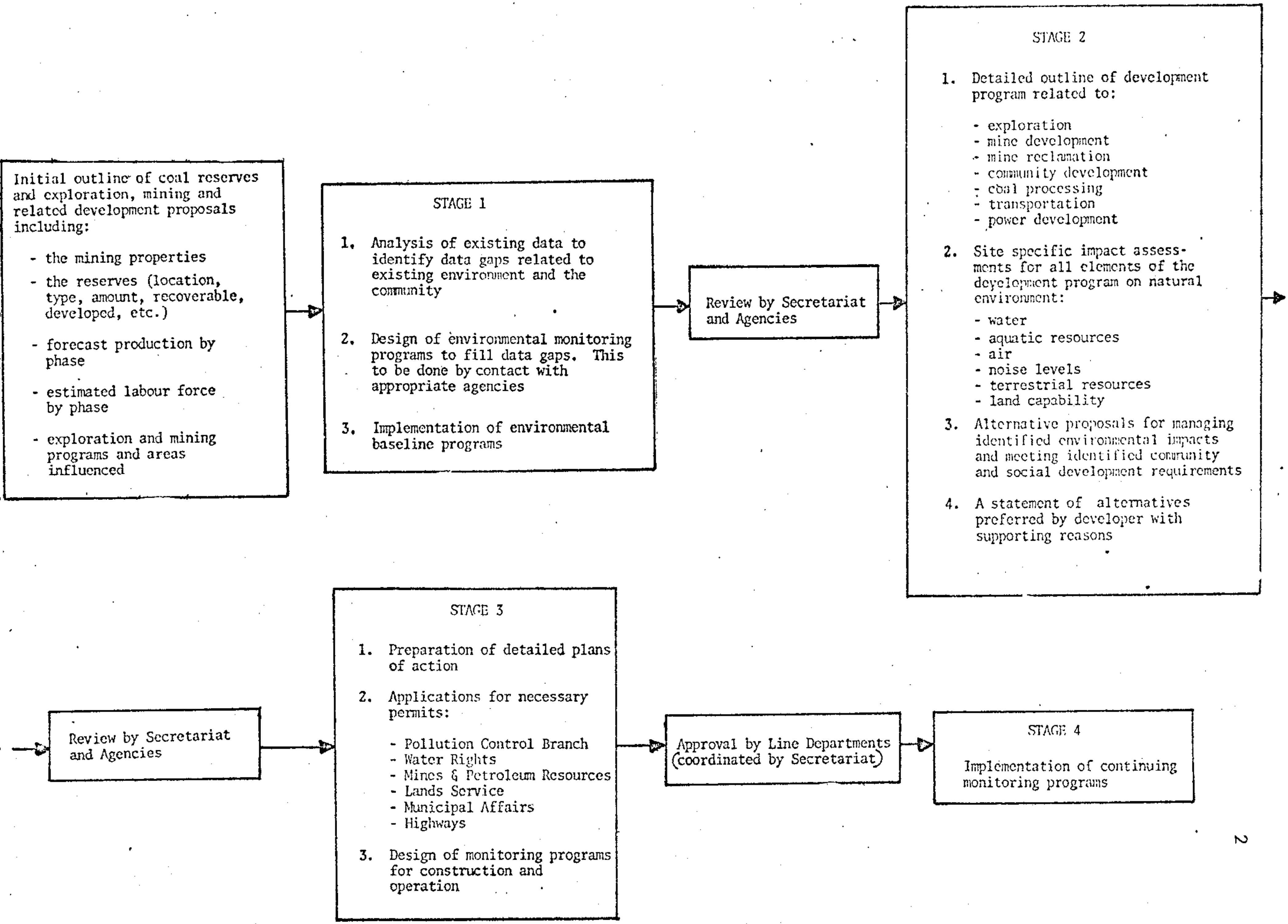
Stage II Environmental Assessment Study Plan

Sage Creek Coal Development
Stage II Environmental Assessment Study Plan

Introduction

Rio Algom Limited, in partnership with Pan Ocean Oil Limited, is considering the development of an open pit coal mine in the Flathead Valley of British Columbia. In June 1975, an environmental assessment of that development was commissioned. Stage I of the assessment involved discussing the project with provincial and federal environmental agencies and setting up this study plan. Stage II is intended to be a broad ranging six to eight month study examining the socio-economic and regional planning aspects of the project with a biological overview. Stage III will be a more site-specific and intensive biological study beginning after Stage II and lasting a further six to twelve months. Stage IV involves environmental monitoring during construction and operation. This staging follows the guidelines set out by the B.C. Department of Lands, Forests and Water Resources and the B.C. Environment and Land Use Committee Secretariat. A schematic drawing of the procedures to be followed as developed by the ELUC Secretariat is attached, followed by a summary of the guidelines from the Department of Lands, Forests and Water Resources.

ENVIRONMENTAL ASSESSMENT PROCEDURE



SUMMARY OF GENERAL GUIDELINES FOR ENVIRONMENTAL IMPACT CONTROL OF DEVELOPMENT ON BRITISH COLUMBIA CROWN LANDS

There are three distinct stages of project evaluation required in the planning of development projects in British Columbia. Each is oriented to supplying specific information to one of three decision making levels. Questions to be answered at each level deal with:

Stage I	Project Justification
Stage II	Evaluation of Alternatives (General environmental ramifications (extensive & intensive))
Stage III	Determination of Project Development Criteria (Specific environmental ramifications (extensive & intensive))

This process of project evaluation is sequential. The requirements of each ensuing stage are dependent on the successful completion of the preceding stage.

Stage I Project Justification

Objective: To obtain approval in principle for the project

Orientation: To determine the need for the project in terms of priority requirements of the province

Questions to be answered: To be detailed by Statutory Authoritative Body *

Responsibility for guidance and review of Stage I evaluations: Statutory Authoritative Body *

* eg. B.C. Lieutenant Governor in Council
or B.C. Environmental & Land Use Committee
or B.C. Energy Commission
or B.C. Mines Proposal Review Body

Stage II Evaluation of Alternative (General environmental ramifications)

Objective: Compliance with the specifications of the statutory authoritative body, and with the terms of the B.C. Environment and Land Use Act, Section 3, Subsection 6, and with the terms of the B.C. Land Act, Section 31 and with other relevant B.C. Statutes

Orientation: To determine the potential regional environmental & social effects of the project; to identify and priorize general route or site options; to examine and account for the effects of extra-regional related development such as rail & road links necessitated by the development and expanded port & other handling facilities generated by the development; To compare site specific aspects of proposed alternative location &/or routings

Questions to be answered: What extensive effects will this project have on the region; physically, biologically, socially? What are the route or site options for this project? What are the general environmental ramifications of the various route or site options? What is the priority of each route or site option? Which is the optimum route or site location?

Example Considerations: How will the provision of access for project construction affect hitherto isolated communities and ways of life (both native and non-native)? What effect will increased access created by the project have on previously isolated populations of wildlife?

Responsibility for guidance and review of Stage II evaluations: The Special Projects Unit of the B.C. Environment and Land Use Committee Secretariat

<u>Stage III Determination of Project Development Criteria</u> (Specific Environmental Ramifications)

Objective: Compliance with the specifications of the statutory authoratative body; and with the B.C. Environment and Land Use Act, Section 3 Subsection b; and with the B.C. Land Act, Section 31; & with other related statutes; and to obtain authorization to enter onto provincial Crown land for the purpose of construction within a specific area of reference.

Orientation: To determine the potential intensive environmental effects of the project within the corridor (at the site) selected on the basis of Stage II evaluation; to establish the appropriate location, design, timing, and construction program necessary to minimize environmental impacts within that corridor (at that site)

Questions to be answered: What are the environmentally sensitive areas (wildlife habitats, streams requiring crossings, archaeological and historic sites, recreational sites, natural livestock barriers, etc.) within the corridor or relating to the site? Where should they be avoided? (locational specifications) How should they be avoided? (design specifications) When should they be avoided? (temporal specifications) Where, how, and when should access roads be put in? Where are the appropriate locations for camps, borrow areas, and other related required facilities?

Example Considerations: For all streams to be crossed, what is the type and extent of the fishery resource? Where is the best point for crossing to minimize impacts? What type of structure is required to minimize impacts? When is the best time to construct the crossings to avoid impacts on the fishery

Responsibility for guidance and review of Stage III evaluations: The Environmental Services Unit of the Land Management Branch of the B.C. Lands Service **

<u>Stage IIIA</u>

In the cases of certain linear developments such as pipelines the detailed site specific environmental efforts may have to be accounted for in relation to the ongoing engineering location in an additional stage of evaluation (IIIa)

<u>Stage IV</u>

Environmental Monitoring of Construction & Operation
This constitutes an ongoing fourth phase

** Re Hydro electric dams, this responsibility lies with the Environmental Studies Division of the Water Investigation Branch of the Water Resources Service
Re Coal Mines, this responsibility lies with the B.C. Mines Reclamation Committee

<u>Background</u>

The Environment and Land Use Committee of the B.C. Cabinet is responsible for broad environmental and land use policy. Its Secretariat is an inter-disciplinary working body designed to aid the committee in its role of coordinating major regional development decisions and regional environmental management and land use allocation problems. The Special Projects Unit of the Environment and Land Use Committee Secretariat is involved with area wide policy problems of inter-departmental importance including the location of major utility corridors and sites.

The Land Management Branch of the B.C. Lands Service has jurisdiction in matters pertaining to the disposition of provincial Crown land. Among other things, the authority of the Director of Land Management governs the preparation and issuance of right-of-way easements for power lines and pipelines, and of leases for dam sites and related developments. The Environmental Services Unit of the Land Management Branch has as one of its major roles, the control of environmental impacts (biological, physical, and social) of major & minor developments on Crown lands in B.C.

The activities of these two groups are governed by Section 3 Subsection b of the Environment and Land Use Act which states:

3. Upon establishment of the committee, it is the duty of the committee, and it is empowered to

(b) ensure that all aspects of preservation and maintenance of the natural environment are fully considered in the administration of land use and resource development commensurate with a maximum beneficial land use, and minimize and prevent waste of such resources, and despoliation of the environment occasioned thereby;

and by Section 31 of the Land Act which states:

31. The minister may require an applicant to obtain and file with the minister, at his own expense, feasibility studies, timber cruises, land valuation appraisals, and any other information as the minister may require respecting an application under this Act. 1970, c. 17, s. 31

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updated June 1975

Scope of the Stage II Study on the Sage Creek Development.

Following the rationale provided in the above guidelines, the Stage II study will concentrate on breadth rather than depth. It is intended to identify and examine all impacts of the project which have the potential to be significant. The main thrust of this stage is to eliminate from further study those aspects which involve minor or neutral impacts, and thus focus attention on the more important factors during Stage III. The geographic scope of the study is not restricted by political boundaries, although project approval authority is vested in the governments of Canada and British Columbia. Accordingly, the evaluation will follow all identified impacts so long as they remain significant.

Although information and analyses will flow back and forth between the various study groups, these studies are broken down as follows for administrative purposes:

(i) Socio-Economic, Regional and Community Planning (SEP)
(ii) Terrestrial Environmental Base (TE)
(iii) Climatic and Aquatic Environmental Base (CAE)
(iv) Fish and Wildlife Assessment (FW)
(v) Central Management and Integration (MI)

(iv) Roberts Bank Overview Assessment (RB)
The detailed study plan is as follows:

(i) Socio-Economic, Regional and Community Planning

The geographical scope of these studies includes the communities of the southeast Kootenay and neighbouring communities (such as Cranbrook, Coleman or Kalispell) which may be affected. Detailed studies will be carried out only for Fernie, Sparwood, Elko and a possible new townsite. These studies will be done with the cooperation of the Regional District of East Kootenay and the municipalities involved.

The general procedure will be to define the existing socio-economic conditions and superimpose on that the physical, biological, and population alterations caused by the mine. Community changes will be assessed, and the meaning of these changes to the people of the area evaluated.

Full use will be made of the Canada-British Columbia Interim Planning Agreement Studies carried out by members of our assessment team for the ELUC Secretariat, and the physical infrastructure studies of Fernie and Sparwood carried out by others. In some cases therefore, an activity noted below will involve only a reconstruction of existing information.

Activity Number	Activity Description
SEP 1	Demographic study of the southeast Kootenay region in general and of Sparwood, Fernie, and Elko in particular. Included will be a population breakdown by age, sex, origin, ethnic composition, family and household structure, and demand on community services. Historical growth rates and trends will be identified.
SEP 2	Employment and income evaluation of the area and the three communities. Included are a labour force statistical analysis, employment rate and income assessment, and income source tabulation. Historical changes and trends will be evaluated.
SEP 3	Economic base studies of the area and the communities, to include primary, secondary and tertiary industries, their diversity, past growth, development trends, susceptibility to economic cycles and long-term viability. Industrial interelationships will also be evaluated, as will the dependence upon the coal mining industry.
SEP 4	Evaluation of settlement patterns throughout the southeast Kootenay. This includes

identification of population concentrations, causes of concentration, historical perspectives, recent trends, and probable or known changes induced by others. This study will be linked to an evaluation of physical capacities.

SEP 5 Regional transportation systems assessment. This involves existing routes, capacities, demands, and potential for change and expansion of road/rail/air links.

SEP 6 Recreation resource inventory. Although this will concentrate on rurally-oriented recreation, all recreation needs will be considered. Recreation activities, locations, demands, and potential for expansion or development will be outlined.

SEP 7 Community physical infrastructure. Roads, sewers, water supply, other utilities, schools, churches, housing and commercial facilities will all be evaluated as to capacity, demand, potential for expansion, and implications if expansion does not occur (overdesigned for a "bust" period).

SEP 8 Land use in Fernie, Sparwood and Elko. Included will be existing and planned patterns (both community and Regional District plans), land capability, and biophysical suitability for residential, industrial, commercial, and recreational use. With the assistance of local and regional planners, an attempt will be made to determine the highest and best land use in each community.

SEP 9 Financial and administrative resources of each community will be assessed. The ability of the community to absorb increased development costs will be set against the potential for increasing tax revenue with expansion.

SEP 10 Attitude evaluation. The social capacities for change and growth will be assessed for each community. The outlook of the people of the towns with respect to development will be evaluated based upon structured and unstructured interviews as well as public meetings and questionaire returns. The emphasis in evaluation will be upon comparisons of each community relative to the others until the most suitable choice is identified. An attempt will be made to define the goals and objectives of the people of the region and of the top-ranked community, so impacts may be evaluated from the perspective of those inhabitants.

SEP 11 Projection of socio-economic impacts during exploration and construction. This includes an evaluation of probable demands for (and sources of) labour and services, labour training requirements, equipment, economic impact in regional supply centres, demands for accommodation (both on and off site), transportation systems and carriers, demand for recreation facilities, and impacts on existing facilities, activities, resources, and life styles.

SEP 12 Projection of socio-economic impacts during mine operation. This involves an evaluation of the numbers, composition and sources of the labour force; composition, size, and location of population changes (including induced changes); direct and indirect changes in community and regional income and expenditure levels and patterns; induced industrial, commercial, and recreational development; demands on transportation systems and the expansion requirements of such systems (with their impacts); and the relative changes in settlement patterns for development of one or more existing communities or a wholly new town. The effects of rail route choice will be considered along with access road location and company housing development.

SEP 13 Townsite design. This includes the layout and total land and servicing requirements of a town in the Flathead valley to be carried out by others.

SEP 14 Land use requirements. The impact of both single-community and dispersed development on residential, commercial, institutional and recreational land use will be assessed.

Possible industrial land required for induced developments will be indicated. The financial benefits for each community will be outlined.

SEP 15 Servicing requirements. The facilities necessary for servicing the new population will be outlined. Physical services, such as roads, schools, hospitals, recreation facilities, police and fire protection, water supply, sewage collection, and other utilities will be outlined and the costs for each community estimated. Social services required will be identified as to type and size.

SEP 16 Community and regional psychology. The psychological effects of the choice of growth centre on the people of both the chosen and not chosen communities will be projected. In addition, the effect of the location, facilities, and inhabitants on the new work force will be estimated.

SEP 17 Recreation resource impacts. This involves impact projections for existing recreation areas and activities, demand for new facilities, impact on underdeveloped recreation areas, and the effects of lost or gained recreation potential as a result of biophysical changes related to the mine development.

(ii) Terrestrial Environmental Base

Activity Number	Activity Description
TE 1	Structural and surficial geology outline for the southeast Kootenay area and the U.S. portion of the Flathead Valley as appropriate.
TE 2	Plot soil types throughout the Flathead Valley in Canada and along the three alternate rail routes, using air photos and spot field checks.
TE 3	Plot existing vegetation and establish habitat types throughout the Flathead Valley in Canada and along the three rail routes, using air photos and spot field checks.
TE 4	Using topography, geology, hydrology, soils, and vegetation data, develop biophysical suitability maps in conjunction with geotechnical and biological groups.
TE 5	Archaeological Studies - deferred to Stage III
TE 6	Development of mine reclamation program - deferred to Stage III

TE	7	Projection of climax vegetation - deferred to Stage III
TE	8	Forestry potential of the Flathead Valley - deferred to Stage III
TE	9	Land use capability analysis - being done by BCLI and available for Stage III

(iii) Climatic and Aquatic Environment

Activity Number	Activity Description
CAE 1	Review existing climatic data and project general characteristics for hydrological analysis.
CAE 2	Install and maintain one climate station for the duration of Stage II.
CAE 3	Using climatological projections and discharge records, develop hydrological characteristics of the Flathead River and major tributaries.
CAE 4	Overview assessment of major air pollution considerations, including blowing coal dust.
CAE 5	Detailed assessment of wind frequency and direction, diffusion capability, air emmissions, and need for air pollution control. - deferred to Stage III or later.
CAE 6	Sample existing water quality on Cabin Creek, Howell Creek, and Flathead River for the duration of Stage II. Sampling parameters are attached at the end of this appendix.

CAE 7 Overview assessment of water quality changes resulting from the open pits, processing plant, waste disposal, and townsite. This is based on preliminary engineering designs.

CAE 8 Detailed assessment of effluent quality requirements, treatment facilities needed, and water quality changes resulting from the project.
- deferred to Stage III.

CAE 9 Noise assessment
- deferred to Stage III.

(iv) Fish and Wildlife Assessment

Activity Number	Activity Description
FW 1	Benthic studies - deferred to Stage III
FW 2	Fish species composition, distribution population size, and migration in the Flathead River system to Flathead Lake.
FW 3	Fish species studies as above for the three rail routes
FW 4	Fish habitat studies, minimum flow assessment, angling analysis - deferred to Stage III
FW 5	Summer wildlife range utilization using helicopter surveys. Winter range is already well-documented.
FW 6	Wildlife migration route identification, consumptive and non-consumptive recreation uses - deferred to Stage III
FW 7	Projection of changes in fish survival rate, habitat area and suitability, and population sizes. Overview in Stage II,

detailed analysis deferred to Stage III

FW 8 Projection of changes in wildlife populations, critical habitat, and recreational use. Overview in Stage II, detailed analysis deferred to Stage III.

FW 9 Changes in fish and wildlife management practices necessitated by projected impacts.
- deferred to Stage III.

(v) Central Management and Integration

Activity Number	Activity Description
MI 1	General program management
MI 2	Liaison with federal, provincial and municipal agencies as well as the general public.
MI 3	Projection and balancing of impacts, provision of advice to engineering designers, layout of conceptual designs.
MI 4	Identification of environmentally acceptable locations and designs for a townsite in the Flathead Valley, including comparison of options.
MI 5	Identification of environmentally acceptable locations and designs for waste disposal areas, including comparison of options. Impacts on water quality will be projected if any.
MI 6	Write main assessment report for environmental approval in principle.

MI 7 Environmental inspection of exploration activity. A semi-resident biologist will observe mining exploration activity on the site and advise on appropriate environmental protection measures. Included will be evaluation of road construction, adit excavation, drilling, transport of test materials and wastes, and operation of the camp. A handbook will be prepared for all workers on measures to protect the environment. Existing environmentally unsound situations caused by previous exploration companies will be improved as appropriate.

MI 8 Development of a detailed plan for Stage III environmental studies. The program will emphasize biological factors, and will be broken into three separately-funded portions:

(i) The Flathead Valley
(ii) The Railway Connection
(iii) Roberts Bank

(vi) Roberts Bank Overview Assessment

Activity Number	Activity Description
RB 1	Review and summarize existing biological reports on the present environment of Roberts Bank.
RB 2	Examine alternative engineering designs and project biological impacts as appropriate.
RB 3	Discuss the options available with government resource managers.

WATER QUALITY ANALYSES AND THEIR PURPOSE

As a general function, water quality analyses provide the technical information required to assess any changes that may be harmful to life in the receiving water environment. To this end water quality analyses also provide the hard data required for compliance with government regulations and criteria.

Initial selections of the nature and extent of analyses required to develop a data base are made on the basis of past experience with the "normal" contaminant problems associated with a given industrial operation. Conversely this data base provides information on natural variations in water quality, that might otherwise be attributed to industrial operations. Accordingly, to provide some insight into the considerations for selection, a list of parameters recommended for monthly analysis are detailed together with their significance for the "ecological health" of receiving waters. In addition, there is a description of parameters recommended for inclusion in a more exhaustive analysis that ensures no contaminant has been overlooked. This type of extensive analysis should be conducted on a quarterly basis. Naturally, if some deleterious substances appear in significant concentrations they would be placed in the monthly or bi-monthly category for regular assessment.

The recommended list for water quality parameters for open pit coal mining operations is summarized below.

Monthly Analyses

- alkalinity
- chlorophyll
- color
- conductivity
- hardness
- iron
- nitrates
- pH
- phosphate
- sulphate
- solids
- total organic carbon
- turbidity

<u>Quarterly Analyses</u>

BOD_5 (Biochemical Oxygen Demand)

COD (Chemical Oxygen Demand)

Spectral Scan (for metals *e.g.* cadmium, zinc)

Toxicity Assessment