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CASAMIRO RESOURCE CORPORATION
SHERWOOD PROJECT
ENVIRONMENTAL EVALUATION

Prepared for:

WRIGHT ENGINEERS LIMITED

and

PROVINCE OF BRITISH COLUMBIA
MINISTRY OF THE ATTORNEY GENERAL

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EXECUTIVE SUMMARY

Hatfield Consultants Ltd. were retained by Wright Engineers Ltd. to review the environmental aspects of the Sherwood project as part of the overall feasibility assessment commissioned by the Ministry of the Attorney General of the Province of British Columbia. The environmental evaluation has been conducted by Mr. John Villamere, M. Eng., P.Eng., Senior Engineer, Hatfield Consultants Ltd. with the assistance of biological staff of Hatfield Consultants Ltd. Mr. Villamere represented the environmental discipline on a project Study Team consisting of representatives from Wright Engineers Ltd. and Piteau Associates Engineering Ltd. This report addresses the procedures and major activities that were undertaken in carrying out this assessment. The procedures and activities include a field site assessment, a review of pertinent literature, meetings with governmental resource scientists, an assessment of aerial photographs and topographical maps, participation in the Study Team, etc. A project development plan was developed in order that an environmental evaluation of this project could be undertaken.

The environmental mitigative measures, including the use of flotation rather than cyanide in gold separation, the discharge of tailings to a lined tailings impoundment, the recycling of supernatant from the tailings pond to the mill, etc. presented in the project development plan assist in reducing the environmental concerns relative to this project. However, based on the author's experience, and noting the environmental and social sensitivity of the area, following the completion of detailed environmental studies and the development of detailed environmental management practices, the required environmental approvals, permits and licenses will still be difficult to obtain. Public concerns and the results of the public information program, and possible public hearings, would result in significant opposition to the project, making it difficult for government regulatory agencies to allow this project to proceed. At the very least, public opposition will result in major project approval delays and result in significant additional costs to the proponent.

The pre-operational phase costs for the required environmental studies, sample analysis, licensing, bonding, etc. will be very significant noting the environmentally and socially sensitive location of the project (i.e. socially sensitive as a result of the current and planned park usage (recreation) and the public's perception of reasonable and acceptable activities within a Provincial Park). The overall pre-development environmental costs will exceed $400,000 and could be as high as 1.1 million dollars. Even with this expenditure of funds, these studies still may not generate all the information required to satisfy the needs of government regulatory agencies and the public.

Assuming acid generation is not a concern, initial reclamation bonding costs will be at least $85,000 and must be paid before the mine is allowed to proceed to the operating phase. Bonding will be increased to $200,000 - $300,000 during the operating life of the mine. If acid mine drainage is proven to be a problem, initial pre-development bonding could be increased to approximately $300,000, increasing during the operating phase to two to three times that amount. Comprehensive studies would have to be undertaken to determine whether an acid generation problem does or does not exist.

There are a number of other environmental concerns that also must be addressed. These include the construction of a haul road adjacent to Drinkwater Creek through difficult terrain in a heavy rainfall area. Government regulatory agencies responsible for managing the fishery resource will have major concerns with respect to a haul road development in the Drinkwater Creek valley. Noise and visual impacts within and adjacent to Strathcona Provincial Park are also a concern that will have to be addressed noting that recreation is the most important usage of the area. The construction of loading facilities in Great Central Lake will generate fisheries and aquatic concerns. The fishery resources of Great Central Lake are extremely valuable. If dredging and filling are minimized, these concerns would be somewhat reduced. There are environmental concerns associated with power supply, air pollution control, refuse and solid waste disposal, sewage disposal, etc. that will also have to be addressed. The most significant development problem faced by Casamiro for the Sherwood Property relates to the fact that a small, short term project is being proposed in a very environmentally and socially sensitive area.

1.0 INTRODUCTION AND METHODOLOGY

Hatfield Consultants Ltd. were retained by Wright Engineers Ltd. to review the environmental aspects of the Sherwood project as part of the overall feasibility assessment commissioned by the Ministry of the Attorney General of the Province of British Columbia. The results of the environmental evaluation that has been undertaken as part of this project are summarized in this report. In this report where environmental requirements, processes, licenses, permits, studies, etc. are discussed, it should be noted that the discussion is based upon environmental procedures and requirements in place between 1987-1989. The cost information that is provided with respect to the environmental studies required, permits, licenses, bonding, etc. is also based on 1987-1989 fee structures. As discussed later in this report, it is apparent that the environmental regulatory agencies would undertake a very rigorous assessment of this development noting the environmental sensitivities in the area of the proposed development and the anticipated organized public opposition to further mining activities in Strathcona Provincial Park.

This environmental evaluation has been conducted by John Villamere, M.Eng., P.Eng., senior engineer, Hatfield Consultants Ltd. with the assistance of biological staff of Hatfield Consultants Ltd. Mr. Villamere is a registered professional engineer in the Province of British Columbia and has more than 20 years of experience in addressing the environmental aspects of mining industry projects in various areas of Canada and abroad. A copy of Mr. Villamere's *curricula vitae* is included as Appendix 1. Mr. Villamere was assisted by fisheries, aquatic and wildlife biologists also employed by Hatfield Consultants Ltd. Mr. Villamere represented the environmental discipline on a project team consisting of Mr. William Norquist, P.Eng. and Mr. David Wortmann, P.Eng. of Wright Engineers Ltd. who were responsible for engineering and construction aspects relative to the proposed Sherwood project and Mr. Dennis Martin, P.Eng. of Piteau Associates Engineering Ltd. who was responsible for geotechnical considerations. In the text that follows, the term "Study Team" refers to all of the aforementioned individuals.

The procedures and major activities that were undertaken in carrying out an assessment of environmental concerns relative to the Sherwood project are discussed in the text that follows:

a) participated in project Study Team meetings;

b) based on a literature review and meetings with government environmental resource scientists, determined the extent of, and where applicable, gathered environmental resource information for the area of the proposed development;

c) carried out an assessment of aerial photographs and topographical maps in order to relate this information to the environmental resources of the area;

d) carried out a one-day field assessment involving helicopter aerial reconnaissance and ground truthing;

e) participated, with the Study Team, in the development of a project development plan that, while unproven on the basis of technical feasibility, would minimize environmental concerns and would have had some possibility of being approved by government regulatory agencies and accepted by the public;

f) developed and costed the environmental studies that would be required to complete a Stage I report to the standards required by the Mine Development Steering Committee and its members; and

g) developed an estimate of all pre-development environmental expenditures that this project would have faced.

The project development plan generated by the Study Team and reported by Wright Engineers Ltd. is presented in Appendix 2. As stated in item e) above, in order to carry out an environmental evaluation of this project, it was necessary to have in place a project development plan. The author's participation in developing the project development plan should not be interpreted to mean that this project plan, from an environmental perspective, will meet regulatory agency requirements. Nor should it be assumed that the project as defined is technically and economically feasible. In fact, the project development plan addresses, inherently, a number of environmental concerns, (as discussed later, many concerns still remain) and provides a project description for discussion purposes. Without a project development plan, from an environmental perspective, this report could address the environmental resources at risk in the area but could not address the type of project impacts that could take place and the extent of the required environmental studies. The availability of a project development plan provided a basis for discussions with government regulatory agency staff.

For the purposes of this evaluation, a 50 to 100 tonnes per day mining and milling operation, operating for a period of up to 2 years, has been assumed. A larger (e.g. 200-500 tonnes per day mining and milling operation), longer term (e.g. 2-5 years) development would not result in significant changes to the discussion in this report. The increases in the benefits to the Province of British Columbia from an economic perspective associated with the larger operation, would be offset (negated) by increased environmental concerns and risks, increased costs of pre-development environmental studies, increased bonding, increased public concern, etc. These and other subjects are discussed in more detail in the text that follows.

2.0 ENVIRONMENTAL RESOURCES

2.1 BACKGROUND

The Sherwood property is located within the boundaries of Strathcona Provincial Park in mountainous terrain near the southern end of the Vancouver Island mountain range. Topography at the minesite is very rugged and features steep cliffs, waterfalls and avalanche chutes. Vegetation on the property makes a transition from coniferous forests in the valley to alpine tundra at approximately 1500 metres. Commercially valuable timber includes cedar, hemlock, balsam and Douglas fir which grow near the Drinkwater Creek valley bottom.

The Sherwood property is located near the divide separating the windward and leeward slopes of Vancouver Island. Locally, mountains exceed an elevation of 2,000 metres forming a barrier to the eastward passage of weather from the Pacific. As a result, very changeable weather conditions often exist in the area and precipitation is highly variable and frequently very intense. Precipitation is in excess of 250 cm per year with heavy snows in the winter months. Temperatures range from -18°C to 25°C between winter and summer.

The Sherwood property is within the Drinkwater Creek drainage basin. Drinkwater Creek flows into Great Central Lake. Based upon a review of existing sources of information, hydrology and water quality information for Drinkwater Creek and its tributaries are virtually nonexistent. B.C. Ministry of Environment, Water Management Branch records indicate that there have never been any surface water licenses issued for this creek. Groundwater resource information for the Drinkwater Creek Valley is also unavailable. B.C. Ministry of Environment records again indicate that groundwater extraction has never taken place in the Drinkwater Creek Valley. It is expected that peak flows in Drinkwater Creek would occur during late fall, early winter in response to intense rainstorms and possibly during late spring as a result of snow melt during periods of heavy precipitation. Minimum flows in the system would occur in late summer.

It appears that comprehensive wildlife and wildlife habitat studies of the Drinkwater Creek basin have not been undertaken. However, based upon discussions with B.C. Ministry of Environment staff, a review of literature applicable to Vancouver Island in general, a review of aerial photographs and an assessment of area topography, it appears that the two species that may be of most interest in the upper Drinkwater Creek Valley are the Roosevelt elk and the Vancouver Island marmot, the latter being an endangered species. Black bear are also known to frequent the area. Roosevelt elk are known to spend summers on slides and other wet sites at higher elevations and to move down to lower elevations to winter generally along valley bottoms near the 400 m elevation level. Although Vancouver Island marmot have not been identified as a species utilizing the Drinkwater Creek valley, there are areas at high elevations within the Drinkwater Creek valley where habitat meeting their requirements does exist, hence the possibility of their presence in these areas. Other big game species known to utilize areas of the Drinkwater Creek valley are cougar and deer.

With respect to historical land use, in addition to mine exploration activities that have taken place in the Drinkwater Creek Valley, forest industry logging operations took place during the 1940's. Logging activities resulted in the construction of a dock on Great Central Lake near the discharge point of Drinkwater Creek and a railway haul line in the Drinkwater Creek Valley. The railway line has since been de-commissioned and the dock is in a state of disrepair. In recent years, recreation has been the most important land use activity within the Drinkwater Creek Valley. The abandoned railway line has provided the basis for an access trail to the upper reaches of Drinkwater Creek allowing the public to gain access to Della Falls, one of the highest waterfalls in the world. Noting that most of this trail, and Della Falls itself, are within Strathcona Provincial Park, the B.C. Ministry of Parks maintains the trail thereby encouraging recreational usage of the Drinkwater Creek Valley. Archaeological and heritage resource studies have not been carried out in the area.

2.2 FISHERIES RESOURCES

From a biological perspective, the most significant environmental resource at risk as a result of a proposed development of any kind within the Drinkwater Creek Valley is the fisheries resource of Drinkwater Creek and Great Central Lake, in particular Great Central Lake.

Sockeye salmon *(Oncorhynchus nerka)* is the most important fish species within Great Central Lake (GCL). Economically, GCL sockeye are important contributors (currently the single most important stock) to the Barkley Sound salmon fishery. Ecologically, sockeye are the most numerous fish species within GCL (as juveniles) and represent an influential member of the pelagic community of the lake. The history of the Barkley Sound (Statistical Area 23) sockeye salmon fishery is given by Hyatt and Steer (1987). Passage of adult sockeye into GCL was greatly improved by the 1927 construction of the Stamp Falls fishway in the Stamp River outlet to GCL. Subsequently, outplants of sockeye eggs and fry from the Henderson Lake sockeye hatchery (mostly into Drinkwater Creek) between 1921 and 1932 served to establish a new sockeye stock within GCL. Recently, the combined effects of lake fertilization and escapement optimization, have served to boost sockeye production from GCL to record-high levels. Between 1970 and 1982, sockeye escapements to GCL averaged about 150,000 fish (Hyatt and Steer 1987). Catch:escapement ratios for Barkley Sound sockeye during this period were on the order of 1:1, suggesting an average annual sockeye production of about 300,000 sockeye during this period. The economie value associated with this level of sockeye production would be on the order of millions of dollars annually. In the past 2 decades, increasing numbers of GCL sockeye have been obtained by sports fishermen, further increasing the economic value associated with the GCL population.

During the early 1970's, GCL was a test site for the development of lake fertilization as a sockeye salmon enhancement technique. Fertilization within the lake was undertaken by the Fisheries Research Board of Canada with inorganic nutrients in an attempt to enhance the production of sockeye salmon within the system. Measured responses to fertilization include a fivefold increase in mean summer primary production, a ninefold increase in zooplankton standing stock, and an increase in the mean stock size of adult sockeye from 50,000 to 360,000 fish (LeBrasseur et al. 1978). LeBrasseur et al. (1978) concluded that *"the substantial increase in Great Central Lake adult sockeye returns coincident with the fertilization program is of sufficient magnitude to render most difficult attempts to discount fertilization as the major causal factor."* Due to the measured success of the program within GCL, the approach was expanded to include 17 sockeye lakes along the B.C. coast (Hyatt and Stockner 1985), and was recently initiated in Chilko Lake. Currently, lake fertilization is an integral component of the Salmonid Enhancement Program, and GCL has been fertilized annually since 1977.

Lake fertilization technology within GCL has evolved over time with previous application methods including floating barge, fixed-wing aircraft (DC6), and helicopter. At present, there are 18 weekly helicopter applications of fertilizer spread over the summer-fall growth period of juvenile sockeye. The 1991 costs for fertilization of GCL are estimated as follows (E. MacIsaac, Dept. of Fisheries and Oceans, pers. comm.):

Helicopter application	$81,000.
Fertilizer	45,000.
Program monitoring	50,000.
Total	$176,000.

To date, in excess of 3 million dollars has been spent on this lake fertilization/salmon enhancement project.

Most sockeye within GCL are lake spawners, utilizing shoal areas with adequate groundwater input for egg incubation. Sockeye hatch and recruit directly into the pelagic zone of the lake where they feed largely on zooplankton (Barraclough and Robinson 1972). Following a year-long lake residency, sockeye emigrate to the ocean in the spring of their second year. Most GCL sockeye return as 4 year-old adults, with a small proportion returning at older ages (Hyatt and Stockner 1985). Besides sockeye, there are at least 7 other fish species present within GCL, including coho salmon *(O. kisutch)*, cutthroat trout *(O. clarki)*, rainbow trout *(O. mykiss)*, Dolly

Varden *(Salvelinus malma)*, prickly sculpin *(Cottus asper)*, pumpkinseed *(Lepomis gibbosus)*, river lamprey *(Lampetra ayresi)*, and threespine stickleoack *(Gasterosteus aculeatus)*. With the exception of stickleback (Manzer 1976), there is not much information available concerning these other GCL fish populations.

3.0 ENVIRONMENTAL IMPACT ASSESSMENT STUDY DESIGN AND COST CONSIDERATIONS

3.1 BACKGROUND

In September 1987, Casamiro Resource Corporation submitted a Prospectus to the Mine Development Steering Committee with respect to the Sherwood property. In the Prospectus, Casamiro Resource Corporation have identified, in general terms, the types of environmental studies that would be undertaken by the company in order to satisfy the requirements of government regulatory agencies with the ultimate objective of obtaining the required licenses and permits for the project. In the Prospectus, the issues to be addressed during the Stage I studies are presented on an "overview" level. The subjects addressed by Casamiro include hydrology, water quality, groundwater resources, fisheries, vegetation, wildlife, resource use and heritage resources. In the Prospectus, Casamiro also indicate that as part of their Stage I submission they will include a comprehensive project development description, including geology, exploration work done to date, mining plans and methods, milling and tailings disposal, facility location, transportation, project scheduling, etc. Casamiro also indicated that they would include a water management plan, an environmental/waste management plan addressing acid generation potential, tailings effluent management, sewage disposal, refuse disposal, dust control, mine water, etc. and a conceptual reclamation plan. The Table of Contents for a typical Stage I report is presented as Appendix 3 to this report. At the time this project was stopped as a result of the change in the park status, very little of the Stage I work had been initiated.

3.2 ANALYTICAL COST CONSIDERATIONS

The environmental studies to be undertaken by consultants for Casamiro Resource Corporation, as outlined in the Prospectus, were reviewed by a number of government regulatory agencies involved in the Mine Development Review Process. Not unexpectedly, the environmental agencies expressed significant concern with respect to this proposed development, and indicated a requirement to expand the proposed environmental studies and the need to prepare a comprehensive Stage I report. The government regulatory agencies, in responding to the proposed Stage I environmental studies presented in the Prospectus, have clearly indicated that more extensive environmental studies are required than what had been proposed by Casamiro in their Prospectus. Noting that there are very significant cost considerations associated with the pre-development environmental impact assessment studies and the preparation of a Stage I report, the additional requirements of government regulatory agencies will, in essence, increase the costs of the pre-development phase of the project significantly. Examples of activities in which the government regulatory agencies have indicated a requirement to go beyond what was proposed in the Casamiro Prospectus include the following:

a. The assessment of acid mine drainage by Casamiro in the Prospectus was considered to be inadequate for assessing whether acid mine drainage was or was not a concern. Substantially more acid mine drainage data would be required and many additional samples of ore, waste rock, tailings, etc. would have to be collected and analyzed. The analytical costs associated with this undertaking would be approximately $25,000 based upon the requirement for approximately 100 static tests and three kinetic tests. The costs of collecting and transporting these samples would be additional. It should be noted that the provincial government have spent 1.5 million dollars in efforts to clean up the Mt. Washington mine site abandoned in the 1960's. (The Mt. Washington mine site location is approximately 35 km north of the Sherwood Property.) Acid mine drainage has led to the aquatic environmental problems that exist downstream of the abandoned Mt. Washington mine. Addressing this environmental issue (i.e. acid generation) thoroughly prior to development taking place and incorporating the results of this assessment into the design of the environmental management plan had become a regulatory agency requirement and concern prior to 1987.

b. Both Environment Canada and the B.C. Ministry of Environment have made it clear in their response to the Casamiro Prospectus, that an extensive water quality monitoring program in the Drinkwater Creek system would be required. The analyses to be performed on the samples collected are indicated in Appendix 4. The minimum sampling frequency required based on Environment Canada input would be once per month. Although not defined, it appears that the number of sampling stations required would be approximately ten. The need for replicate (triplicate) sampling was indicated by Environment Canada, thereby requiring that three samples be collected and analyzed at each sampling station during each sampling event. Cost considerations with respect to these additional water quality sampling and analysis undertakings would be very significant. The cost of analyzing one water quality sample is approximately $350 (1988 dollars). Assuming ten water quality stations (more may have been required by government agencies) and one sampling event per month, with only a single sample being collected at each station, the costs of water quality analysis for a one year period would be approximately $40,000. (This cost figure does not include the actual costs of collecting the samples, i.e. fees for professional consultants to collect the samples, transportation to and from each sampling station, probably involving helicopter time, etc.). If replicate samples were collected, i.e. three samples at each sampling during each sampling event, the water quality analysis costs for a one year period would be essentially tripled to approximately $125,000. If the frequency is increased to twice-monthly as requested in correspondence from the by B.C. Ministry of Environment, this cost could increase again to $250,000 or more for the first year of the studies. It should also be noted that the water quality monitoring program would not end at the end of one year of sampling and analysis. Additional water quality monitoring would be required, throughout the development phase, possibly on a reduced frequency and scale.

3.3 ENVIRONMENTAL IMPACT ASSESSMENT STUDY DESIGN

The preceding discussion addresses primarily baseline water quality requirements for the Drinkwater Creek Basin and Great Central Lake. In order to carry out the complete environmental studies required, an environmental consulting firm and a team of environmental specialists would be required. The team would include a Project Manager, a fisheries biologist, an aquatic scientist, a hydrologist, a groundwater hydrologist, a terrestrial wildlife and vegetation specialist, a soil scientist, an archaeologist and heritage resource specialist, an environmental engineer, a social scientist, an acoustics specialist and a visual resource specialist as well as technicians required for data collection, processing, mapping, etc. The activities to be undertaken and the subjects to be addressed by the team of specialists are briefly summarized in the text that follows:

a. Fisheries Biologist

Extensive fish habitat and fishery resource studies of Drinkwater Creek would be required to determine the extent and nature of fish utilization on this system and in particular, the location of important habitat features such as spawning areas and over-wintering areas, the extent of upstream migration of salmonid resources, populations of resident species, etc. Habitat would have to be mapped according to a system developed by B.C. Ministry of Environment. Electroshocking, angling or other methods would have to be utilized to assess the fishery resources. Seasonal field assessments would be required. Regulatory agencies would take this information into account in addressing the project development plan and the effluent treatment and disposal scenarios suggested by Casamiro and Casamiro consultants.

b. Aquatic Resource Specialists

Aquatic resource specialists would be required to establish and implement the water quality monitoring program previously discussed and to evaluate the analytical results obtained. Carrying out an evaluation of stream benthic invertebrate populations under baseline (pre-development) conditions would also probably be required. Studies of metal levels in Drinkwater Creek and Great Central Lake sediments as well as fish tissue heavy metal levels for resident fish in Drinkwater Creek would probably also be required. Reporting on the results of these investigations would be required.

c. Surface Water Hydrologist

Existing hydrological information for the system is virtually non-existent. An automatic water level recorder and data logger would be required and would have to be installed, maintained and operated. Staff gauges would also be required. The hydrologist would have to evaluate the data obtained and ultimately produce stream stage discharge curves. This information would be integrated into the overall water management plan for the proposed project.

d. Groundwater Specialist

A groundwater hydrologist would be required to evaluate existing groundwater resource conditions including quality and quantity. It is expected that drilling and the installation of piezometers to monitor the extent of groundwater resources and to provide access to groundwater for sampling and analysis purposes would be required.

e. Vegetation and Wildlife Biologist

Wildlife habitat and wildlife resource studies would be required for the Drinkwater Creek Basin. Activities to be undertaken would include seasonal field reconnaissance studies, a review of aerial photographs and topographical maps, establishing a wildlife log, monitoring input to the log, meetings with government scientists and others familiar with the area, a literature review, etc. The wildlife specialist would ultimately be required to address the wildlife resources at risk and to determine the project related mitigation required. The presence/absence of special vegetation (i.e. rare or endangered plant species, special vegetation groupings etc.) would have to be determined based on field reconnaissance studies, discussions with government scientists, and a review of pertinent literature, etc.

f. Soils Scientist

A field evaluation by a soils specialist would have to be undertaken to map and classify soils, to determine topsoil handling and storage procedures in order to ensure that effective reclamation could be undertaken during and following the project.

g. Archaeologist and Heritage Resource Specialist

Field reconnaissance studies, a review of existing literature and discussions with staff of the B.C. Heritage Conservation Branch and other knowledgable individuals would be required in order to access the heritage and archaeological resources of the area. Measures to protect these resources would be dependent on the study findings.

h. Land Use/Recreation Specialists

Current and past land uses for this area are reasonably well known. Recreation is the future anticipated land use for the area within Strathcona Provincial Park. However, a land use specialist will be required to document information and to undertake meetings and interviews with government, industry and other knowledgeable people in order to ensure that this subject is thoroughly addressed. Mitigating project impacts upon recreational usage of the Park during the operation and abandonment phases of the project will be an important Stage I undertaking.

i. Acoustics and Visual Resource Specialists

Although not generally required for mining projects, an acoustic and a visual resource specialist would be required noting that this proposed development would be taking place in a Provincial Park and within an area used extensively for recreational purposes. The acoustics specialist would need to address in particular ways to minimize noise impacts from exhaust fans at the mine as well as controlling noise levels as a result of milling and ore transportation activities. The visual resource specialist would be highly involved in ensuring that both the operational phase and long term visual impacts of this proposed project are minimized.

j. Environmental Engineer

The environmental engineer would be responsible for the development of the water management, waste management plan and the conceptual reclamation plan. In carrying out these activities, the engineer would work closely with one or more of the environmental specialists on the study team.

The team may also consist of a number of other specialists such as specialists in air pollution control, solid waste and refuse disposal, etc. The role of these specialists would be less significant than those discussed previously. Coordination and integration of the inputs from each specialist would be the responsibility of the environmental component Project Manager. It should be noted that the Casamiro Prospectus identifies or suggests the participation of the fisheries biologist, the aquatic resource specialist, surface and groundwater hydrologists, vegetation and wildlife biologist, archaeologist and heritage resource specialist, the land use specialist and the environmental engineer. However, the activities defined in the Prospectus for several of these specialists have been understated. The need for other disciplines and the recognition of their role in addressing project impacts (e.g. acoustics and visual resource specialists) have been omitted from the studies defined in the Casamiro Prospectus.

3.4 SOCIO-COMMUNITY CONSIDERATIONS

As indicated in the Casamiro Prospectus, a socio-economic/socio-community impact assessment would also be required. Consequently, a social scientist would have to be involved in this overall impact assessment study. This individual would be required to gather comprehensive socio-community information with respect to the neighbouring communities which would be affected, in either a positive or negative manner, as a result of this proposed development. It is expected that emphasis of this study would be on the community of Port Alberni. Although not stipulated in the Prospectus, an additional requirement of the socio-community program would be the implementation of a public information program to provide the public with information concerning the proposed project and the opportunity to input into the project design and environmental management. Public information programs have become a requirement for all new mining developments. Based on experiences with other mines in the general vicinity, e.g. the Westmin expansion, Quinsam coal, etc., it is expected that there would be significant public opposition to this proposed development. Significant public opposition to the Quinsam Coal project led to pre-development public hearings. (It should be noted that it cost Quinsam Coal in excess of $200,000 to participate in these hearings). These hearings are very costly to the company and may lead to significant project delays and quite possibly to the project being halted. Public opposition to this project would be expected to be very significant due to the following factors:

a. This project appears to be a very small, short duration project in which socio-economic benefits are consequently very limited;

b. The bio-physical environmental resources at risk, particularly the fisheries resources, are extremely valuable and would have to be safeguarded. Therefore, if an approval were obtained, the environmental management practices to protect this resource would be based on the best available technology (e.g. a lined tailings impoundment, supernatant recycle, extensive monitoring) for this industry sector; and

c. Mine development would have taken place in a Provincial Park thereby impacting on the aesthetic value of this Park and with significant negative impacts on recreational usage of the Park.

From a socio-community perspective, Casamiro's greatest difficulty will be to convince the public and the government regulatory and resource agencies involved, that the benefits of the project, e.g. job creation, are sufficiently extensive as to offset the environmental risks and the long term impacts that would be associated with this project. Without public support, it will be very difficult for government agencies to issue the necessary licenses and permits for a proposed mining development in an environmentally and socially sensitive area. (i.e. socially sensitive as a result of the current and planned park usage (recreation) and the public's perception of a Provincial Park). Organized public opposition to this project, led by knowledgeable groups such as the "Friends of Strathcona Park", would have played an important role in identifying the project's negative impacts and thereby influencing government agencies to withhold development approvals. At the very least, the public hearing process would have resulted in major project delays.

3.5 ENVIRONMENTAL PERMITS AND LICENSES

During and following the completion of the Stage I studies, the proponent may apply for the necessary environment licenses and permits. Permits required include a water license to extract water from a surface body of water for use in mining, milling, or camp activities; a permit to discharge effluent from mine, mill and camp facilities; a permit for emissions from incinerators, crushers, etc. and a refuse permit for the disposal of camp and mill refuse. All of these permits and licenses are issued by the B.C. Ministry of Environment. Costs of permits and licenses are as follows:

Effluent permit:	$3,825 per year;
Emissions permit:	$5,100 per year;
Refuse permit:	$2,250 per year; and
Water license:	$1,000 per year.

In other words, the annual costs associated with these licenses and permits would be approximately $12,500 paid in advance. In addition, the company would be required to post reclamation bonds. Partial bonding would have to be posted prior to the mine going into production. The amount of the bonding would be based upon a number of factors including the size of the proposed development, the location, environmental sensitivities, and most importantly, the anticipated cost of clean-up. The anticipated clean-up cost increases significantly if acid generating materials are encountered. If acid generation is not a concern, the reclamation bond (the cumulative requirement of the B.C. Ministries of Energy, Mines and Petroleum Resources, Environment and Parks) would be approximately $85,000-100,000 initially, increasing to $200,000-300,000 during the operating life of the project. If acid generating materials are encountered, initial bonding requirements will be $300,000 or more, increasing during the operating life of the project by two to three times that amount.

3.6 PRE-DEVELOPMENT ENVIRONMENTAL COST CONSIDERATIONS

Environmental costs associated with a water quality monitoring program and assessing acid mine drainage problems have already been discussed in Section 3.2. The environmental impact assessment study program has been discussed in Section 3.3. At this stage it is important to determine the costs that would be associated with professional consultants undertaking the environmental impact assessment studies discussed previously. It is important to note that these environmental studies would result in the preparation of Sections 13 to 25 of the Stage I report as defined in Appendix 3 (i.e. it should be noted that the costs that are presented here are not the costs for a total Stage I report submission). In fact, the costs to complete the entire Stage I would be significantly greater than those discussed in the following paragraph.

The costs to complete the Stage I field activities and prepare a comprehensive Stage I report, excluding analytical costs, is expected to be between $175,000 and $250,000. When the requirements for helicopter time, additional acid mine drainage studies, water quality sampling analysis, licenses, bonding, an open house public information program, and quite possibly a public hearing program are added to the front-end project development costs, the overall pre-development environmental costs will easily exceed $400,000 and could be as high as $1,100,000. A breakdown of costs is presented in the table that follows. It should be emphasized that, even after this large expenditnre, Casamiro would have no guarantees that the project would either be accepted by the public or receive the necessary government approvals.

TABLE 1: ENVIRONMENTAL COSTS - PRE-DEVELOPMENT PHASE

	Range
Consultant EIA studies & Stage I Report Preparation	\$175,000 - \$250,000
Analytical Costs (water quality, AMD assessment)	\$ 60,000[1] - \$240,000[2]
Helicopter Time	\$ 40,000 - \$ 80,000
Public Participation	\$ 25,000[3] - \$200,000[4]
Licensing	\$ 12,000
Bonding (reclamation & effluent)	\$ 85,000[5] - \$300,000[6]
TOTAL (Range)	\$397,000 - \$1,082,000

1 Water quality analyses on the basis of single samples collected at 10 locations on a once per month basis for a one year period plus acid mine drainage assessment.

2 Water quality analyses on the basis of triplicate samples collected at 10 stations on a twice per month basis for a one year period plus acid mine drainage assessment.

3 Public participation involves meetings as required and 2-3 days of drop-in open houses.

4 Public participation involves EARP style public hearings, similar to those undertaken for Quinsam Coal Ltd.

5 Assumes that acid generation is proven not to be a concern.

6 Assumes that acid generation is a concern.

4.0 CONCEPTUAL PROJECT DESIGN

4.1 BACKGROUND

As part of the Study Team, the author assisted in developing a project development plan that appeared to be technically feasible and also had a chance of being approved by government regulatory agencies responsible for environmental management. Noting that, in the author's opinion, for this project the environmental risks are substantial and the benefits to local communities and the province as a whole as a result of this proposed development appear to be very limited, developing an environmentally acceptable project scheme was a major and difficult undertaking. In order to carry out this undertaking, Study Team meetings were undertaken involving Piteau Associates Engineering Ltd., Wright Engineers Ltd. and the author, a one-day site reconnaissance was undertaken of the area, aerial photographs were obtained and reviewed, topographical information was assessed, meetings were held with the staff of government agencies familiar with the environmental resources of the area, pertinent literature was reviewed, etc. The experience of the author while participating in many other environmental impact assessment studies for proposed mining developments, was also taken into consideration.

The project development plan presented in Appendix 2 reflects the author's input on the environmental management side. The project development plan was discussed with staff of B.C. Ministry of the Environment, Environment Canada and Fisheries and Oceans Canada. The principal goals of the discussions with government regulatory agencies were as follows:

a. to determine if there are other development concepts that were inadvertently omitted that would have greater opportunity of meeting government regulatory agency environmental requirements and therefore having a greater likelihood of ultimately being approved; and

b. to determine the environmental concerns that exist with the conceptual design that has been presented.

With respect to point "a" above, no other more environmentally acceptable concepts were identified by the staff of the government environmental agencies interviewed. There are design features of this project that government agencies reviewing it felt were very positive, assuming they were technically feasible. This certainly should not imply that the environmental concerns are minimal with the existing project design; only that, to the maximum extent possible, some problems have been dealt with simply by the design that has been proposed. As an example, noting that a flotation mill will be used to recover gold and that cyanide will not be required in the milling process, the concerns related to the extremely high toxicity of cyanide in the aquatic environment and the potential cyanide related environmental impacts on an extremely valuable fisheries have been addressed. In addition, concerns with respect to the transportation and storage of cyanide have been eliminated. Solving, "on paper", the cyanide problem by using flotation for gold recovery is a major assumption. At this stage, it is uncertain whether flotation would have been an effective method of gold recovery.

Another important concern addressed in the design presented is minimizing the amount of infrastructure within Strathcona Provincial Park itself. Noting that the mill has been sited in an area outside Strathcona Provincial Park and that the tailings impoundment facilities are also located outside the park, concerns with respect to long term recreational usage of the park have been partially reduced. The fact that the tailings will be discharged to a lined tailings impoundment area, and that supernatant will be returned to the mill, is also an important consideration provided both of these procedures are technically feasible. Although these steps have been proposed, they are not the only environmental concerns that would have to be addressed. However, it is believed that by locating the mill, camp, tailings pond outside of Strathcona Provincial Park, avoiding the use of cyanide in the milling processes, and reclaiming and reusing supernatant from a lined tailings impoundment, would be important steps toward obtaining government regulatory agency approvals. However, public acceptance of this proposed development would still be outstanding. Locating the mill, camp, tailings pond, etc. outside of the Drinkwater Creek drainage was also identified as an approach that would also have to be evaluated.

4.2 REMAINING ENVIRONMENTAL CONCERNS

In the text that follows the major environmental concerns still associated with the project design are discussed. It should be noted that the discussion takes into consideration points addressed by staff of B.C. Ministry of Environment, Fisheries and Oceans Canada and Environment Canada. Some of the project components still requiring additional study for which mitigation measures would have to be very thoroughly addressed, in order to obtain project approval, include the following:

a) Haul Road Construction

To meet Fisheries and Oceans Canada requirements, the haul road would have to be constructed to Vancouver Forest District Road Building requirements. A major concern with respect to this road relates to the potential for increased siltation related impacts upon fish and fish habitat, downstream in Drinkwater Creek and within Great Central Lake. It would be essential that rock used or displaced in road construction be proven to be non-acid generating. Construction would have to be undertaken using end-hauling of materials rather than sidecasting of waste materials noting the close proximity of Drinkwater Creek and recognizing the need to limit physical disturbance in Strathcona Provincial Park. There are significant cost considerations associated with end-hauling practices.

Hydrological evaluations of the streams flowing into Drinkwater Creek and crossed by the haul road would be required to ensure that the stream crossings are properly designed and constructed to ensure that the road does not wash out during storm events. Culvert sizing would be an important design criteria. The engineering of the haul road would require the development of runoff control plans and the installation of silt control facilities to ensure that water quality within the Drinkwater Creek system is protected. Construction of stream crossings and other construction activities in close proximity to Drinkwater Creek would have to be undertaken during "Construction Windows" identified by regulatory agencies, probably from July to September. Experience elsewhere in the province has indicated that constructing and operating a resource road that does not have significant environmental impacts within an area of high rainfall and mountainous terrain is difficult to achieve. If Drinkwater Creek is crossed by the haul road, it would be essential that the bridges utilized do not encroach on the stream channel. Construction monitoring by a third party environmental specialist may also be required. This individual would be reimbursed by Casamiro Resource Corporation but report directly to a government regulatory agency.

Assuming that the tributaries to Drinkwater Creek crossed by the haul road will be culverted at stream crossing sites, it is important to note that culverts can result in:

a) physical disturbance of stream banks during installation resulting in habitat alteration, siltation and sublethal effects on downstream fishery resources;

b) changes in stream hydraulics, especially increased velocity;

c) erosion of stream bed and banks can result in downstream habitat alteration and siltation;

d) incorrect sizing of culverts can result in washouts; including downstream siltation effects and increased siltation during culvert replacement; etc.

Based on existing information, obtaining regulatory agency approvals to construct a road in the Drinkwater Creek valley to service this mine cannot be assumed.

b) Acid Mine Drainage

As discussed previously, the information currently available with respect to the potential for acid mine drainage is insufficient to determine whether acid mine drainage is or is not a concern. The presence of acid generating material does not necessarily preclude development taking place but will certainly make it more difficult for the proponent to obtain the necessary licenses and permits to undertake the development and it will result in increased operating costs for handling acid generating materials, mine water, mill tailings, etc. Reclamation costs and reclamation bonding requirements can also be expected to be significantly greater as discussed in Section 3.5 and 3.6. As discussed, the government of British Columbia has spent 1.5 million dollars in efforts to clean up acid-generating materials at the abandoned Mt. Washington mine on Vancouver Island. Government regulatory agencies now recognize the critical importance of controlling acid mine drainage from mining operations. If acid generating materials are present, approvals from Fisheries and Oceans Canada, B.C. Ministry of Environment and Environment Canada would certainly be far more difficult to obtain.

c) Noise and Visual Impacts

Noting that part of this proposed development will be taking place within a Provincial Park, in close proximity and directly opposite Della Falls, noise and visual impacts will have to be thoroughly addressed and impacts reduced to a minimum. Noise abatement procedures will have to be implemented to reduce, in particular, noise from ventilation fans at the mine site. Also noise impacts associated with the mill area and haul road will have to be addressed. Following the completion of mining operations, the haul road and other project features will have to be reclaimed to meet the requirements of the Provincial Ministry of Parks, (and other agencies), noting that the ultimate and only long term usage of the area is recreational.

d) Tailings Disposal/Supernatant Recycle

The tailings disposal problem would be greatly reduced by utilization of a mill processing technique that does not employ cyanide, by discharging tailings to a lined tailings impoundment located outside of the park and above the flood plain of Drinkwater Creek and by recycling tailings pond supernatant to the mill. Noting that the project is located in a high rainfall area, it may still be necessary to batch discharge supernatant to Drinkwater Creek, an event that would be regulated and closely scrutinized by government regulatory agency staff and one requiring a very high quality effluent. Public acceptance to the discharge of effluent to the Great Central Lake system will still be difficult to obtain. If the tailings are acid generating, the tailings disposal problem becomes more acute and the costs of dealing with it are increased.

e) Construction of Loading Facilities in Great Central Lake

For the purposes of this discussion, it is assumed that a loading facility can be constructed on Great Central Lake that does not require a significant amount of either dredging or filling. If loading facilities are constructed utilizing piers and pilings, then the impact of constructing this facility is likely to be acceptable to regulatory agencies. However, environmental studies will be required in the area of the proposed loading facility. These studies would be undertaken to determine the nature and extent of fish utilization of the area and to determine the nature and the extent of impacts. Compensation for any impacts identified would be required and would be an additional financial burden to Casamiro.

f) Other Environmental Concerns

Power will be required at both the mine and mill sites. There will be environmental concerns that will have to be addressed regardless of the power supply sources that are utilized. Other environmental concerns that would have to be addressed include air pollution control, refuse and solid waste disposal, sewage disposal, etc. Air emissions, refuse disposal and sewage disposal are not considered to be major issues but will require the implementation of pollution control practices to ensure adequate protection of the environment. There will be costs associated with the implementation of pollution control practices that are required.

5.0 CONCLUSIONS

The following summarizes the major conclusions from the environmental perspective for this proposed development.

1. The project design features and mitigative measures (e.g. a lined tailings impoundment with supernatant recycle) that are presented in Appendix 2 assist in reducing environmental concerns. However, based on the author's opinion, following the completion of detailed environmental studies and the development of detailed environmental management practices, the required environmental approvals, permits and licenses, would still be difficult to obtain. Public concerns and the results of the public information program and the pnblic hearings most likely required, would result in significant opposition to the project making it difficult for government regulatory agencies to allow this project to proceed. At the very least, public opposition will result in major project approval delays and result in significant additional costs to the proponent.

2. Assuming acid generation is not a concern, initial reclamation bonding costs will be at least $85,000 and must be paid before the mine is allowed to proceed to the operating phase. Bonding will be increased to $200,000 to $300,000 during the operating life of the mine. If acid mine drainage is proven to be a problem, initial pre-development bonding could be increased to approximately $300,000, increasing during the operating phase to 2 to 3 times that amount. Comprehensive studies would have to be undertaken to determine whether an acid generation problem does or does not exist.

3. The pre-operational phase costs for the environmental studies, analytical costs, licensing, bonding, etc. will be very significant noting the sensitive location of the project. The costs for these undertakings will exceed $400,000 and could be as high as $1,100,000. Even with this expenditnre of funds, these studies still may not generate all the information required to satisfy the needs of government agencies and the public.

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APPENDICES

MR. JOHN VILLAMERE - SENIOR ENGINEER
MINING INDUSTRY ENVIRONMENTAL EXPERIENCE

Education:

1967:	Bachelor of Engineering Science, Chemical Engineering, University of Western Ontario, London, Ontario, Canada.
1968:	Master of Engineering, Civil Engineering, University of Western Ontario, London, Ontario, Canada.

Experience:

1979-Present:	Vice-President and Senior Engineer, Hatfield Consultants Ltd., West Vancouver, British Columbia.
1977-1979:	Technical Advisor, Mining Industry, Environment Canada, Environmental Protection Service, West Vancouver, British Columbia.
1976-1977:	Head, Monitoring and Surveillance Unit, Environment Canada, Environmental Protection Service, West Vancouver, British Columbia.
1974-1976:	Senior Project Engineer, Municipal Section, Environment Canada, Environmental Protection Service, West Vancouver, British Columbia.
1972-1974:	Senior Project Engineer, Petroleum Chemical and Food Processing Industries Section, Environment Canada, Environmental Protection Service, West Vancouver, British Columbia.
1970-1972:	Pollution Control Engineer, Federal Department of Fisheries and Forestry (British Columbia and Yukon Region), Vancouver, British Columbia.
1968-1970:	Pollution Control Engineer, Federal Department of Fisheries and Forestry (Newfoundland and Labrador Region), St. John's, Newfoundland, Canada.
1967:	Public Health Engineer, New York State Department of Health, Buffalo, New York, U.S.A.

SPECIFIC EXPERIENCE OF J. VILLAMERE (P. Eng.) IN RELATION TO MINING INDUSTRY ACTIVITIES

1. **1990-Present:** Responsible for the design and implementation of environmental and socio-community impact assessment studies for the Eskay Creek project in Northwestern B.C. Responsibilities include the development of the project Prospectus, which was completed in 1990 and the Stage I Environmental and Socio-Community Report, Reclamation Plans, permitting and licensing that are scheduled for completion in 1991-1992. A public information program and the provision of assistance regarding Native issues are important components of the socio-community program.

2. **1990-1991:** Regarding a proposed expansion of an established ferro-nickel mining and smelting operation in Southeast Sulawesi, carried out an environmental evaluation of the environmental concerns/problems associated with the existing operations and developed terms of reference for the environmental studies to be undertaken in conjunction with the proposed expansion. (Study funding was provided by P.T. Aneka Tambang and the Environmental Management Development in Indonesia (EMDI) Project).

3. **1989-Present:** Co-Manager of environmental and socio-economic impact assessment study for the Continental Gold Corporation, Mt. Milligan project, located approximately 150 km. north of Prince George, British Columbia in the Williston Lake Drainage. Directly responsible for the socio-economic and public information aspects of the Stage I Assessment. Participated, on behalf of Continental Gold Corporation, in a number of meetings with provincial and regional government regulatory agencies.

4. **1989:** Prepared a Prospectus for submission to the B. C. Government regarding the re-opening of the former Dupont, Baker Mine by International Shasta Resources Limited. The Prospectus addressed environmental, engineering and socio-economic considerations. Also responsible for updating and amending of all permits associated with this project.

5. **1989:** Responsible for the development of a reclamation plan for Minnova Inc. relative to the handling of acid generating waste rock at the Lara Property, located west of Chemainus on Vancouver Island. Obtained the necessary government approvals for this activity.

6. **1987-1988:** Co-Manager of an environmental and socio-economic impact assessment study for the Minnova Inc. Samatosum Property located in the Adams River drainage area northeast of Kamloops, British Columbia. Responsible for the development of the project Prospectus, Stage I Environmental and Socio-Economic Report, Reclamation Plan, etc. Participaied on behalf of Minnova Inc. in a number of meetings with government regulatory agencies.

7. **1986-1988:** Manager of the environmental and socio-economic impact assessment study for the Laramide Resources Ltd. Lara Property, located west of Chemainus on Vancouver Island. Responsible for the development of a project Prospectus and the socio-economic aspects of the Stage I Report. Organized and participated in a number of project related meetings with the public and government regulatory agencies.

8. **1985-1986:** Project Manager and Senior Environmental Engineer for the production of a Stage I environmental management report for the proposed Mascot Gold Mines Ltd. mining project near Hedley, B.C. Designed and coordinated an environmental baseline field survey of the site. Participated in meetings with government regulatory agencies concerning the proposed development. Implemented the socio-economic assessment program associated with the Stage I report. Participated in public meetings held in the communities.

9. **1981-1984** and **1987-1988:** Project Manager for a field evaluation of aquatic and terrestrial resources and habitat near Giant Yellowknife Mines, Salmita property in the Northwest Territories. Lake water, fish tissue and sediment were analyzed for heavy metal and other parameters to determine baseline quality. An environmental and social impact assessment (i.e., an Initial Environmental Evaluation) was prepared for submission by Giant to regulatory agencies. Participated in Northwest Territories water licence hearings on behalf of Giant Yellowknife Mines with their public relations program. At the time of the mine closure, carried out a field study to evaluate impacts and assisted in the development of a reclamation plan.

10. **1986-1988:** Project Manager and Senior Engineer for the production of a Stage 1 environmental and social impact assessment for the proposed Skyline Explorations Ltd., Johnny Mountain mine north of Stewart, B.C. and the proposed Abermin Corporation, Lara Project near Chemainus on Vancouver Island. Designed and coordinated the environmental baseline studies and prepared the social impact assessment.

11. **1986-1987:** Prepared an evaluation of the environmental resources and environmental sensitivities of the area around the Cominco Ltd., Delaware properties in northern B.C. Developed a field environmental studies program!for implementation by Cominco Ltd. exploration staff.

12. **1987:** Assisted the Government of Indonesia, Department of Mines and Energy, to implement an Environmental Impact Assessment program to evaluate projects within their jurisdiction. Was responsible for training and staff development.

13. **1982-1985:** Project Manager and Senior Environmental Engineer for a study to determine the effects of effluent generated at the Westmin mine/mill on the aquatic resources of receiving waters (Buttle and Upper/Campbell Lakes on Vancouver Island, British Columbia). Fishery enhancement possibilities were studied to compensate for possible impacts form a proposed mine expansion. An environmental assessment of a proposed expansion of an existing hydroelectric development scheme was undertaken. Co-authored the British Columbia government Stage II environmental reports.

14. **1981-1984:** Project Manager for a field evaluation of aquatic and terrestrial resources and habitat near Giant Yellowknife Mines, Salmita property in the Northwest Territories. Lake water, fish tissue and sediment were analyzed for heavy metal and other parameters to determine baseline quality. An environmental impact assessment (i.e. an Initial Environmental Evaluation) addressing engineering and biological factors was prepared for submission by Giant to regulatory agencies. Participated in Northwest Territories water license hearings on behalf of Giant Yellowknife Mines Ltd.

15. **1984-1986:** Project Manager for an assessment of the environment and public health concerns relative to abandoned uranium mines (Rayrock Mines Ltd. mine near Edzo and Echo Bay Mines Ltd. mine at Port Radium) in the Northwest Territories. The work involved the development of a field program to assess radionuclide levels in water, sediments, fish, aquatic flora and fauna, etc., and the coordination and management of a study team composed of experts specializing in the evaluation of environmental and human health issues relative to mining projects.

16. **1984:** Carried out a field assessment of marine tailings disposal practices at the Codelco (Coporacion Nacional del Cobre de Chile), Salvador mine in northern Chile. Provided recommendations with respect to upgrading the tailings disposal system, environmental impact assessment approaches, environmental monitoring, etc.

17. **1982-1983:** Senior Environmental Engineer providing expert environmental adviceto Equity Silver Mines Ltd. of Houston, British Columbia, who were charged with violations of the Federal Fisheries Act. Based on previous experience and a literature review, advice was provided on the effects of heavy metals on the fish resources of the Buck Creek-Goosley Lake system. The Crown's evidence was evaluated and recommendations were forwarded to counsel. Assisted Equity at public and regulatory agency meetings and in the re-negotiation of their provincial Waste Management Branch permits.

18. **1983:** Senior Environmental Engineer providing advice to legal counsel for Placer Development Limited. Counsel was advised on the toxicity of spilled diesel oil to various fish species, the condition (i.e. degraded state, rate of flow) of the spilled fuel that reached the aquatic environment and the effects of dilution onee the fuel enters the watercourse.

DESIGN CRITERIA

SHERWOOD PROJECT

Issued July 12, 1991

CASE 1 (Base Case)

Based upon 18,000 tonnes per year average annual production rate
(50 tonnes per day)

General

1. It is the intention of Wright Engineers and their subconsultants (Piteau and Hatfield) to review the project in the same manner they would examine any similar mining project. It will be treated as a preliminary prefeasibility type study examining the issues and alternatives and selecting the most practical and cost effective options.

2. The scope and depth of study will, of course, be limited by the time and data available.

3. The perspective will be that existing at a time prior to the upgrading of the Sherwood area to Class A park status. Strathcona was upgraded in November of 1988.

A. MINE

1. Ore reserves - 50,000 tonnes at 0.4 opt gold (Carter, Heard Oct. 9/89).

2. Operating year, 7 months (summer only) plus one month start-up and shut-down. Operating day, 2 shifts/5 days per week.

3. Average annual production to be 50 tpd or about 120 tpd based on actual operating day. Annual production to be 18,000 tonnes per year.

4. Power generation to be diesel at mine. Stream flows too unreliable for hydro and distance too great for transmission from mill.

5. The only practical access is by adit from Drinkwater Creek, directly opposite Della Falls.

6. Mining method to be shrinkage stoping with access to levels by shaft/hoist.

7. Ore and waste by ore pass to access adit.

8. Ore to be loaded onto trucks at or in portal and hauled to mill on road down Drinkwater Creek.

9. Mining and ore truck haulage to mill possibly by contractor. (Note: Golden Bear uses Volvo BM 25 tonne trucks to haul ore down mountain from pit).

10. Compressor and fans probably located underground to help reduce visual impact and noise. There appears to be no officially published noise level requirements for mines or for parks. However, a best effort must be made to mitigate noise to preserve Park values.

11. Other facilities, such as sedimentation pond and maintenance area, may have to be located underground as well.

12. We must comment on snowfall and avalanche potential. Snowfall information is not available for Sherwood but is available for Westmin.

13. Ground is potentially quite bad. We will comment on tunnel development problems.

14. There are sulphides in ore but expected to be minimal.

15. Will comment on winter operation citing precedents for mines operating in summer only (Cantung pit, Premier, etc.)

16. We will assume development waste trucked out to be used as fill at mill site.

B. SEDIMENTATION POND/MINE DRAINAGE

1. Natural flows expected to be minimal.

2. Assume 10-15 gpm flows during operation. These flows through ore are potentially acid generation. Acid generation potential in uncrushed unground ore expected to be minimal because sulphide levels are expected to be less than 4%.

   Acid mine drainage can simply be treated with lime.

C. MILL

1. We will assume mill to be at head end of Great Central Lake but comment on reasons for selecting this over other sites. This site appears to be most cost effective because it minimizes road construction and maintenance.

2. Process assumed is flotation/gravity but we may comment on cyanidation and cyanide destruction. (Note: Golden Bear having problems with cyanide destruction).

   Mill recovery to be 80%. Assume 8 ounce per tonne concentrate grade.

3. Milling to be 12 month operation with ore stockpiled at mill site for winter operation.

4. Average annual milling rate to be 50 tpd with assumed head grade of 0.4 opt gold (Carter, Heard, October 1989). Other grades may be considered.

5. Mill to be modular construction where possible, to minimize disturbance.

6. Various other facilities to be low cost, easily removable.

   - Trailer offices
   - Pre-engineered shops
   - Semi-portable power generation, etc.
   - Trailer camp

D. ROAD/DOCK

1. We will assume logging road standard or less and road to be single lane with passing lanes.

2. Construction to be end haul to avoid leaving excavated material in park unless used for fill.

3. Road to be reclaimed at end of project.

4. Road from head of Great Central Lake. Expect 5 km flat, 6 km steep.

5. We will assume same standard of dock as now used by loggers in area.

E. TAILINGS

1. Finely ground tails are potentially acid generating.

2. We will assume a pond with impervious liner and supernatant recycle to mill.

3. Pond to be capped and re-vegetated at close of mine.

4. We will assume no cyanide in pond but will comment upon impact if cyanide or other lixivant used.

5. Assume 1.5 dry tonnes per cubic meter for tailings density (SG Solids 2.7 x 77% Solids Density).

F. WATER SUPPLY

1. Assume mine water from Love Creek.

2. Assume mill will be supplied by ground water to simplify permitting.

G. WILDLIFE

1. We will obtain existing wildlife information from The B.C. Ministry of Environment, the Ministry of Parks, etc. and comment on this information in the report. The extent of field environmental studies that would have been required will be determined as will the potential impacts of the mine on wildlife and wildlife habitat, the type of mitigation required, ongoing studies, etc.

H. WASTE DISPOSAL

1. We will comment on sewage, garbage, air emissions, etc., but they are not expected to be a major problem.

   - incinerate non-putrescible wastes, bury putrescible wastes to minimize bear concerns.
   - For sewage use septic tank-tile field system.
   - Controls on crusher and possibly other emissions.

I. FISHERY RESOURCES

1. Fisheries and Oceans Canada and the B.C. Ministry of Environment will be approached regarding the fishery resource information available for the area. The need for extensive fishery resource studies will be determined based upon these meetings. It is known that fisheries and aquatic environmental issues would have been a major concern of the regulatory agencies.

J. REVIEW PROCESS

1. We will prepare a description of the review process required for all areas impacted.

2. We will prepare estimated cost for review/approval process and a schedule.

K. MINE CLOSURE

1. We will possibly prepare a closure plan and schedule.

2. We will determine the cost of the closure plan and estimate the bonding requirement based upon other mines.

L. PREPARATION OF A STAGE 1 REPORT

1. The activities to be undertaken in the preparation of a Stage 1 Report will be addressed.

2. Costs associated with a Stage 1 environmental study will be developed recognizing the important environmental features of the area, i.e. a provincial park, significant recreational values, importance of the fishery resources, etc.

3. Consultant fees and field study and laboratory analysis costs associated with preparing a Stage 1 Report to meet regulatory agency requirements will be addressed.

M. LAND USE

1. Available land use information will be reviewed and, if additional studies e.g. for archaeological resources, recreational usage, etc., are required, study designs will be prepared and the costs to undertake these studies will be determined.

N. PUBLIC INFORMATION PROGRAM

1. As part of the feasibility stage of the project, the proponent would be requested by the Mine Development Steering Committee to undertake a public information program because of the location in a park.

2. The nature of this public information program will be determined and costs will be developed to implement a program consistent with the size, location and environmental sensitivities of the proposed development.

O. ACID GENERATION FROM WASTE ROCK AND ORE

1. Available information with respect to acid-base accounting is very limited.

2. In order to determine the nature and extent of the potential acid generation problem, more extensive sampling of the ore and waste rock would have been required.

3. Sampling and analytical costs associated with this activity will be determined.

DESIGN CRITERIA

SHERWOOD PROJECT

Issued September 19, 1991

CASE 2 (Alternate Case)

Based upon 72,000 tonnes per year average annual production rate
(200 tonnes per day)

General

The design criteria for 200 tpd opeation is identical to the 50 tpd operation except for the following changes:

A. MINE

1. Ore reserves greater than 200,000 tonnes.

2. Operating year 12 months to help stabilize work force and reduce mine development costs.

3. Annual production to be 200 tpd or 72,000 tonnes per year.

B. SEDIMENTATION POND/MINE DRAINAGE

2. Assume 20-30 gpm flows during operation.

C. MILL

3. Average annual milling rate to be 200 tpd.

D. ROAD/DOCK

1. We will assume two lane road because of higher traffic and to facilitate snow removal.

APPENDIX 3

STAGE I ENVIRONMENTAL AND SOCIO-ECONOMIC IMPACT ASSESSMENT

Prepared for:

**THE BRITISH COLUMBIA
MINE DEVELOPMENT STEERING COMMITTEE**

Prepared by:

**HATFIELD CONSULTANTS LIMITED
#201 - 1571 Bellevue Avenue
West Vancouver, B.C.
V7V 3R6**

May 1988

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TABLE 1 DETECTION LIMITS Surface and Groundwater Samples
(units in ug/l, unless otherwise stated)

PARAMETER	DETECTION LIMIT
Total and Dissolved Metals (ICAP Scan)	
Ag *	0.1
Al *	2.0
As	50.0
B	1.0
Ba	1.0
Be	1.0
Ca	0.1 mg/l
Cd *	0.1
Co	5.0
Cr	5.0
Cu *	0.5
Fe	5.0
Hg	0.05
Mg	0.1 mg/l
Mn	1.0
Mo	5.0
Na	0.1 mg/l
Ni	20.0
Pb *	0.5
Sb	50.0
Se	50.0
Si	0.1 mg/l
Sn	10.0
Sr	1.0
Ti	2.0
V	5.0
Zn	2.0
Residue, filterable	1.0 mg/l
Residue, non - filterable	1.0 mg/l
Turbidity	0.1 NTU
Sulphate	1.0 mg/l
Cyanide, total	5.0
Cyanide, weak acid dissociable	5.0

Alkalinity ($CaCO3$) and Hardness (total) should be measured to the nearest 1.0 mg/l whereas pH should be measured to the nearest 0.1 rel. unit. Specific Conductivty should be measured to the nearest 1.0 uS/cm.

* Graphite Furnace / Atomic Absorption analysis

19. **1980-1981:** Project Manager and Senior Environmental Engineer for field evaluations of aquatic and terrestrial habitats in the area of two proposed gold mine and mill operations (Plaza Mining Corporation's Vollaug Mine Operation and United Hearne Resources Ltd.'s operation) near Cassiar, British Columbia. Designed pollution control practices necessary to meet government requirements and protect environmental resources in the area, and prepared the British Columbia government Stage I report for each proposed development.

20. **1979-1980:** Environmental Engineering Advisor to the British Columbia Royal Commission of Inquiry into Uranium Mining relative to issues associated with uranium mining in British Columbia. This work included an evaluation of the effectiveness of pollution control technology utilized by the industry, of bio-accumulation pathways and assessment of biological impacts, and identification and preparation of witnesses for the hearing process.

21. **1979-1980:** Senior Project Engineer for environemental studies at a proposed gold mine and mill operation (Scottie Gold Mines Ltd.) near Stewart, British Columbia. Consolidated field surveys of bird, mammal and fish habitat and resources and report preparation. Developed a pollution control strategy to minimize concerns and to meet the requirements of government agencies. Prepared a project Stage I report.

22. **1979:** Senior Project Engineer for the evaluation of the pollution control practices developed by Elco Mining Ltd. for their proposed coal mine near Fernie, British Columbia. Provided assistance to Elco regarding environmental factors associated with a proposed diversion of a section of the Elk River.

MINING INDUSTRY ACTIVITIES CARRIED OUT BY J. VILLAMERE AS SENIOR ENGINEER WITH ENVIRONMENT CANADA, ENVIRONMENTAL PROTECTION SERVICE, VANCOUVER, BRITISH COLUMBIA (1973-1979)

1. **Base Metal Mining:**

    - coordinated the implementation of the Federal Base Metal Mining Liquid Effluent Regulations and Guidelines in the Pacific Region (British Columbia and the Yukon)

    - through on-site inspections, evaluated the mining, milling and waste treatment practices of all operating mines (24) in the Pacific Region

    - selected sites and organized effluent monitoring studies designed to determine the effectiveness of the existing wastewater treatment facilities in meeting the effluent quality criteria defined in the Federal Guidelines

- worked with Environment Canada biologists in designing mining industry environmental impact studies

- worked in conjunction with the British Columbia Provincial Department of Environment, Waste Management Branch, in evaluating the pollution control and environmental impact considerations for a number of proposed mines

- organized and carried out multidisciplinary environmental impact studies for a number of proposed mining developments

- participated in the joint government-industry gold mining industry task force responsible for the development of industry sector effluent regulations and guidelines

2. **Uranium Mining:**

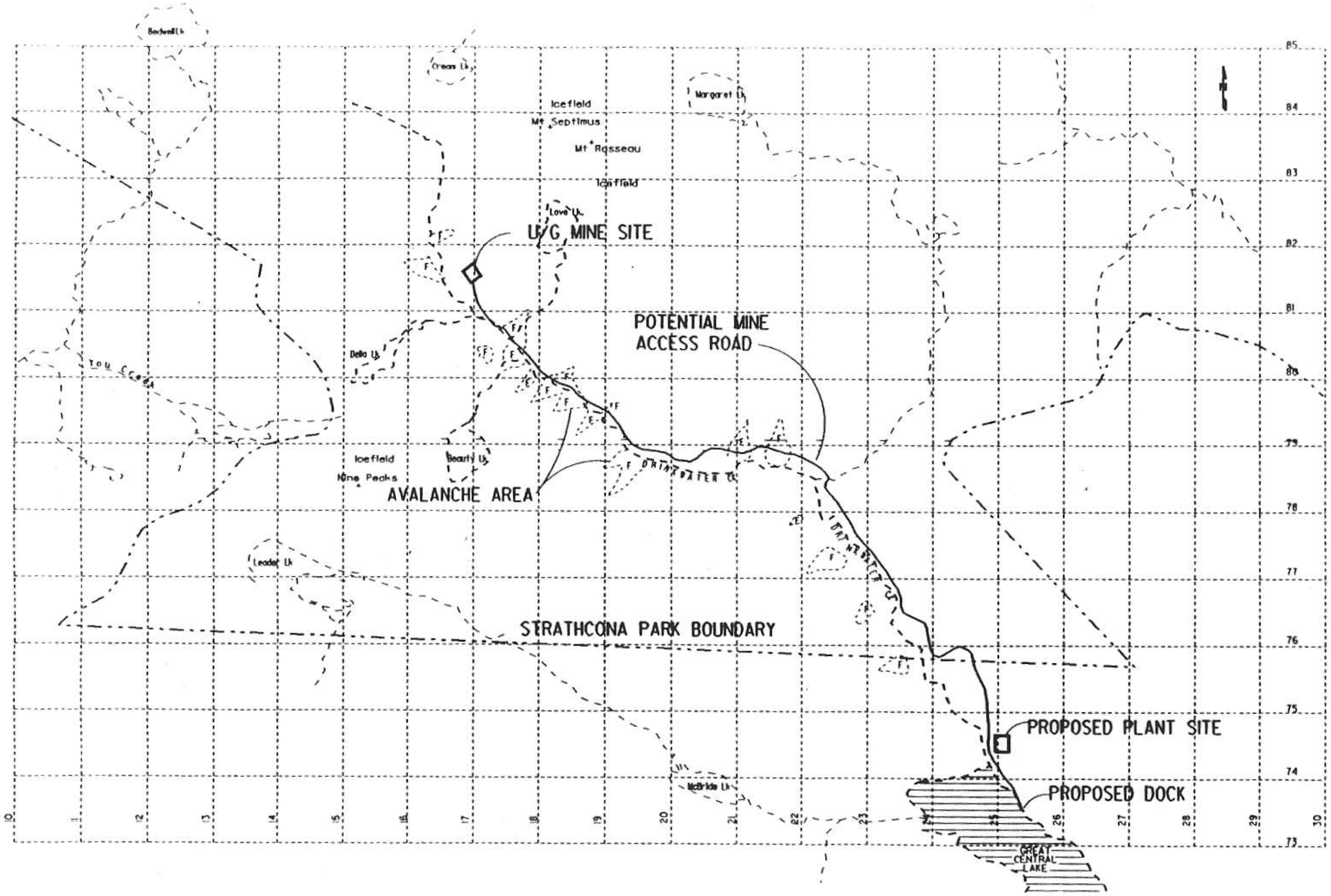
- overall coordinator and a principal author of the Environment Canada Department of Fisheries and Oceans' briefs to the British Columbia Uranium Mining Inquiry. Responsibilities included: 1) the coordination of a multidisciplinary task force including biologists, hydrologists, engineers, chemist, metallurgists, etc., 2) defining the subject matter to be addressed in the briefs, and 3) developing positions and policies regarding environmental protection

- through on-site inspections, evaluated the mining, milling and waste treatment practices of a number of operating uranium mines in Canada and the U.S.A.

3. **Mining Industry Public Hearings and Inquiries:**

- assisted in the preparation and defense of the Environment Canada brief to the British Columbia public inquiry into pollution control for the mining, mine-milling and smelting industries

- provided technical advice on environmental issues to the Province of British Columbia, Royal Commission of Inquiry into Uranium Mining



SHERWOOD PROJECT

PROJECT PLAN

WRIGHT ENGINEERS LIMITED

VANCOUVER — CANADA

D 1947 200 1201

Environmental Evaluation

p. 4 - No water quality or hydrology info available for Dunkwater Cr?
-No reference in Ref Section to Hoveol.

p. 5 - No baseline studies or inventory in Drinkwater Cr valley.

{ Great Central Lake salmon hatcheries - Babine Lake comparison.
$3M on lake fertilization VS spawning beds.

p. 8 - "little Stage I work completed by Cazamiro."

p. 16 - Organized public opposition - "knowledgeable" groups - Friends of Strathcona Park" ??

p. 21 - Cyanide problem?

p. 22 - Acid a Mine Drainage
do we know that this is a problem?
Mt Washington comparison may not be valid -