PROPOSED

HAT CREEK DEVELOPMENT

DETAILED ENVIRONMENTAL STUDIES

TERMS OF REFERENCE

BRITISH COLUMBIA HYDRO & POWER AUTHORITY

August 1977

CONTENTS

APPENDICES

DETAILED ENVIRONMENTAL STUDIES OF THE PROPOSED HAT CREEK DEVELOPMENT

TERMS OF REFERENCE

1. PURPOSE OF STUDIES

Identify and evaluate the effects of the design alternatives of the proposed Hat Creek coal mine, associated thermal generating station and off site facilities on the natural and cultural resources of the area, both in the short and in the long term. Compare these with the evolution of the area and its resources without the project. Assist in the development of practical mitigation measures. In cooperation with the design consultants and B.C. Hydro, ensure a satisfactory compromise between environmental constraints and engineering requirements. An Environmental Impact Statement, to be authored by B.C. Hydro with assistance from the Coordinator of these studies, will be required for use by government agencies, public interest groups and B.C. Hydro's design consultants.

2. SCOPE

The capacity of the initial development is 2,000 megawatts but specific resources, such as air and water, which could restrict the potential expansion to 5,000 megawatts should also be considered in a general way and reported upon. Possible expansion to 5,000 megawatts would be the subject of a separate report.

Within the broad goal of providing information for the establishment of the thermal generating station and the Hat Creek coal mine, the studies shall include:

(a) An Inventory of Resources

Provide an inventory of existing resources in sufficient detail so that kinds (species) and amounts of the important entities can be listed.

Provide historical perspective where available.

(b) Identification of Project Impacts

Identify project impacts and resource sensitivity to project construction and operation.

(c) Evaluation of Project Impacts

Evaluate project impacts both quantitatively and qualitatively.

(d) Opportunity for Mitigation and Compensation

Assist in the development of practical ways to:

i) avoid impacts

ii) minimize adverse impacts

iii) compensate for resource losses due to the project

iv) enhance beneficial effects

The studies should explicitly delineate resource losses and benefits so that values can be extracted for benefit-cost analyses.

3. COORDINATION OF STUDIES

A coordinator will be appointed to direct the environmental studies, prepare an Environmental Impact Assessment Report and assist B.C. Hydro in authoring the Environmental Impact Statement. The studies will be conducted concurrently with design. Information from the studies is to be made available continuously to the design consultants and to the other environmental study groups. Design information on all related systems and all the project actions listed will likewise flow from the design team to the environmental study groups for analysis of alternatives.

The Terms of Reference for the Coordinator are presented in Appendix F.

4. STUDY METHODOLOGY

Among the responsibilities of the Coordinator will be the definition and development of an appropriate environmental impact assessment and evaluation methodology. This may include the use of various impact matrices, mapping techniques and benefit-cost analyses. While direction on assessment methodology will come from the Coordinator, the techniques to be used will be worked out in consultation with those firms undertaking the various studies. It is intended that a common framework for evaluation should be applied to the overall impact assessment work especially with regard to providing information suitable for inclusion in a benefit-cost type of analysis (see Socio-economic Subgroup, Appendix C).

The following information requirements give an indication of the level of assessment needed:

(a) The significance of any resource affected, both with and without the project, to local, regional and provincial socio-economic conditions based on:

- i) present value of resource
- ii) potential value of resource.

(b) Beneficial and adverse primary, secondary, induced and combined project impacts.

(c) The distributional aspects of impacts

- i) geographical - local, regional, provincial and national.
- ii) social - impact on various segments of the population, ethnic or special interest groups.
- iii) transfer of resource demands to other locations.

(d) The probability of occurrence of an impact or, if necessary, reasons for uncertainty of occurrence.

(e) Expected time and duration of impact occurrence.

(f) The distinction between short term impacts (those which arise during construction and operational lifetime of the plant), and long term impacts (those which arise during and after the lifetime of the plant).

(g) The possible benefits of any enhancement or mitigation program.

(h) The costs associated with enhancement and mitigation alternatives in terms of 1) costs related to reduction in plant output due to a mitigation program, and 2) the actual cost of the mitigation program itself.

(i) The relationship between project impacts and long term regional development prospects.

Sources of information used in reports should be documented.

5. STUDY ITEMS

The items to be studied are shown below, grouped into five subgroups. Details of the study requirements are given in attached appendices as indicated.

Each subgroup is made up of closely related studies and separate reports from each of the five subgroups will be included as appendices to the consultant's Environmental Impact Assessment Report.

The appendices under each subgroup are subject to further refinement and the inclusion of more detailed study instructions can be expected in some cases.

A. LAND RESOURCES SUBGROUP

Appendix A1 - Physical Habitat and Range Vegetation
A2 - Wildlife
A3 - Forests
A4 - Agriculture
A5 - Recreation
A6 - Solid Waste Disposal, Coal Storage and Land Reclamation

B. WATER RESOURCES SUBGROUP

Appendix B1 - Hydrology, Drainage and Water Quality and Use
B2 - Fisheries and Benthic Fauna
B3 - Water Intake

C. SOCIO-ECONOMIC SUBGROUP

Appendix C1 - Impacts on Human Society
C2 - Impacts on Community Services and Infrastructure
C3 - Resource Evaluation for Provincial, Environmental and Regional Accounts
C4 - Archaeological and Historic Sites

D. AIR QUALITY SUBGROUP

Appendix D1 - Meteorological and Air Quality Equipment
D2 - Ambient Air Quality
D3 - Epidemiology (Health)
D4 - Climatic Assessment Study
D5 - Meteorological Control Potential

E. GENERAL SUBGROUP

Appendix E1 - Noise
E2 - Minerals and Petroleum
E3 - Trace Elements
E4 - Aesthetics

6. PROJECT ACTIONS

The project actions which will impact on the environment must include the complete range of developments from the site preparation and construction to operation and finally abandonment of the mine, power plant and support facilities.

A partial list of these follows:

Preliminary Site Activity

- camps
- roads
- powerline facilities
- exploratory drilling
- surveying
- test burn
- land acquisition
- environmental sampling
- archaeological exploration

Site Development

- installation and expansion of services
- test drilling for foundations
- clearing
- land acquisition
- stripping
- excavating for structures, borrow areas, mine
- spoil dumping
- hauling
- surveying
- deploying of contractors' labour, equipment and supplies
- construction of shops and warehouses
- substation construction

Off Site Development

- water line construction
- transmission line construction
- roads and airport construction
- transportation facilities
- community infrastructure expansion
- land subdivision
- housing construction

Plant and Mine Construction

- excavation
- diversion of Hat Creek
- construction of a reservoir
- hauling
- installation of footings
- concreting
- placing of fill and spoil
- steel erection
- installation of equipment
- waste disposal

Commissioning

- demobilization of construction forces and removal of facilities and equipment.

Operation

- overburden removal
- coal excavation
- coal transport
- coal stock piling
- stack and cooling tower emissions

- ash disposal
- liquid effluent
- sewage
- noise
- road traffic
- reclamation

Abandonment

- *demolition of plant*
- reclamation of the pit, plant and sites of other facilities

7. STUDY AREA

The various studies, such as the air quality impact program will determine the limits of the geographical area. The study items are designed to apply to a thermal plant site at elevation 4,600 feet in the Trachyte Hills near Harry Lake east of the mine site in the Upper Hat Creek Valley. The preliminary study area is bounded on the north by an east-west line through 100 Mile House, on the south by an east-west line through a point eight miles south of Lytton, on the west by a north-south line through the west end of Seton Lake and on the east by a north-south line through the eastern boundary of Kamloops. However, it will be the responsibility of each individual consultant to delineate the areas where the primary, secondary, induced and combined impacts will occur. Thus *the study area for any given appendix may be revised as the study progresses.*

8. EXISTING REPORTS

Completed reports listed here will be made available to the consultants awarded the study.

(a) "Preliminary Environmental Impact Study of the Proposed Hat Creek Development" by B.C. Research and Dolmage Campbell & Associates Ltd., dated August 1975.

(b) Hat Creek Coal Fired Thermal Power Plant Feasibility Report and Cost Estimate; System Design Division Report No. 104, July 1975, B.C. Hydro.

(c) Preliminary Report on Underground Water Conduit Possibilities - Thompson River to Hat Creek Plant Sites, Dolmage Campbell & Associates Ltd.

(d) Meteorological Assessment of the Hat Creek Valley: MEP Co. Ltd.,
Study 1 (winter) dated May 1975
Study 2 (summer) dated December 1975

(e) Transportation Study of the Proposed Hat Creek Development - Swan Wooster Engineering Co. Ltd. June 1976.

(f) Hat Creek Coal Characteristics Study - concurrent, to be completed in 1977.

(g) Hat Creek Mining Feasibility Study - PD-NCB Consultants - concurrent, to be completed in 1977.

(h) Conceptual Design of the Hat Creek Thermal Plant - Integ-Ebasco - Hat Creek Diversion Study - concurrent, including Hat Creek Diversion Study (Monenco Consultants Pacific Ltd.) and Water Supply Study (Sandwell and Company Ltd.), to be completed in 1977.

(i) Preliminary Engineering of the Hat Creek Thermal Plant - assigned in February 1977.

(j) Detailed Mine Design - to be assigned in 1977.

(k) Vancouver Island Thermal Generating Plant, Site Selection Inventory; completed July 1975 - Beak Consultants Ltd., Montreal Engineering Co. Ltd., and Commonwealth Associates Ltd.

(l) Alternate Uses of Hat Creek Coal - Stone and Webster Canada Ltd. - concurrent, to be completed in 1977.

(m) Holman, P.J. 1974. Preliminary Hat Creek Impact Statement. Ungulate and Waterfowl Section plus Fisheries Survey. Fish and Wildlife Branch, Kamloops. Mimeographed.

(n) Holman, P.J. 1975. Management Alternatives for Waterfowl in Hat Creek Valley. Fish and Wildlife Branch, Kamloops, B.C. Mimeographed.

(o) Hall, Barry J. "Preliminary Hat Creek Regional Economic Impacts," Strong, Hall & Associates Ltd., Mimeographed, 1976.

A. LAND RESOURCES SUBGROUP

APPENDIX A1
PHYSICAL HABITAT AND RANGE VEGETATION

INVENTORY

1. Inventory soils and land forms.

2. Describe climate by precipitation, temperature, humidity and growing season, in cooperation with the measurement program of the Air Quality Impact Study.

3. Map and quantify present and climax plant communities, indicating increaser and decreaser species.

4. Provide a plant species check list showing the relationship and importance to wildlife, livestock, man, or other organisms. Also identify rare or endangered plant species or communities.

5. Assess forage productivity, present and potential carrying capacity and present conditions of range areas (include land capability for grazing).*

6. Study relative utilization of range by livestock and wildlife and relate to productivity. (Attention should be given to management practices and resource conflicts.)

7. Prior to development, establish permanent vegetation plots to monitor the effects of the operation from the standpoint of gaseous, particulate and heat emissions.

---

* This work should be done in close liaison with Appendix A4 - Agriculture.

EFFECT OF DEVELOPMENT

1. Identify sensitivity of range components to construction and operation activities. Where possible, include quantitative impacts. Note maximum exposure limits, regulatory requirements and sensitive species (liaison required with air program to identify sensitive areas).

2. Identify potentially irrigable lands which could serve as possible compensation measures and establish their feasibility, productivity, and costs. Identify specifications for water quality for irrigation water with view to using plant waste water.*

---

* This work should be done in close liaison with Appendix A4 - Agriculture.

APPENDIX A2
WILDLIFE

INVENTORY

1. GAME SPECIES

In relation to major habitat types determine the seasonal distribution and numbers of big game animals, including the sheep herd in the area southeast of the Upper Hat Creek Valley.

2. WATERFOWL

Determine the distribution and numbers of species of waterfowl in relation to nesting, feeding and staging. Provide an inventory of all suitable and potential waterfowl habitat including seasonal physical dimension, invertebrate organisms, bottom composition, edge vegetation and water quality.

3. OTHER AVIAN FAUNA

Determine the major habitat types occupied by upland game birds, passerines, and raptors. Include information on migratory status, and seasonal distribution and on numbers where readily available: an elaborate census is not required.

4. SMALL MAMMALS

Census small mammal and fur bearer populations for each major habitat type.

5. Relate numbers and densities of above species to the regional and provincial resource of the same species.

6. Identify rare or endangered species.

7. Determine present and potential harvest and catch success of registered trap lines.

EFFECT OF DEVELOPMENT

1. Assess potential impacts of all aspects of the project on the above species - include displacements, barriers, disturbances, lethal conditions, loss of habitat.

2. Assess consumptive and non-consumptive demand for annual resources in terms of hunter-days, viewing days or other appropriate measure and in consideration of accessibility to various population centres.

3. Prepare site specific recommendations for improvement of ungulate and waterfowl habitat affected by proposed projects.

4. Establish a range of options for compensation lying within and outside the Hat Creek Valley, their feasibilities, productivities and costs.

5. Provide input to Appendix C3 Section 3.

APPENDIX A3
FORESTS

INVENTORY

1. Inventory and map species, site-index, watershed value, logging, and log reserves.

2. Give present Allowable Annual Cut and commitments.

3. Map existing forest road patterns and projected developments.

4. Describe relationships with soils, landforms, agriculture land reserves, wildlife, fisheries and grazing.

5. In conjunction with the Forest Research Division, establish and document permanent vegetation plots suitable for monitoring expected long term impacts upon tree species identified in Appendix A1.

6. Provide input to Appendix C3 Section 1.

EFFECT OF DEVELOPMENT

1. Identify sensitivity of forest tree components to project construction activity. Impacts should be quantitative, where possible, and related to construction and operation periods.

2. Assess project impacts on Allowable Annual Cut, grazing and other forest values.

3. Assess alternatives and recommend measures to avoid or minimize adverse impacts, enhance beneficial impacts and compensate for losses. Practical alternative proposals should include estimated costs.

APPENDIX A4
AGRICULTURE

INVENTORY

1. Map Agricultural Land Reserves.

2. In consultation with ranchers and range specialists, determine agricultural land use and capabilities. (Consider climate, soil type, acreage and crop suitability. Land use should include livestock inventory, crops, farm structures, etc.)

3. Describe relationships with other resource uses.

4. Provide input to Appendix C3 Section 7.

EFFECT OF DEVELOPMENT

1. Assess feasibility of application of waste heat to agricultural production. Estimate increase in average production for proposed crops or livestock through the addition of water.

2. Establish criteria (specifications) for water for irrigation.

3. List crop species which are inadvisable due to sensitivity to plume contents and concentrations. Consider greenhouse crops, ornamentals, house plants, cut flowers, etc. which may be grown under cover but utilize ambient air.

4. Assess impact of project on agricultural land use and capability.

APPENDIX A5
RECREATION

NOTE

- consultant will incorporate data on consumptive uses (i.e. hunting and fishing) covered by others.

- distinction should be made between local and tourist use.

- inventory of regional stock of indoor recreational assets and analysis of adequacy in view of increased regional population due to the project, to be handled separately.

INVENTORY

1. Describe existing level of recreational activity
   - by type of activity
   - by use areas
   - by number of user-days

2. Describe recreation capability of the area without the project as determined by existing development plans and future management possibilities.

3. Evaluate cost of developing this recreation potential of the area without the project.

4. Provide input to Appendix C3 Section 4.

EFFECT OF DEVELOPMENT

1. Assess change in recreational activity with the addition of the project.

- by type of activity
- by use areas
- by number of user-days

Distinguish between:

- construction phase
- operation phase
- rehabilitation phase of post-operation

2. Evaluate cost of developing the recreational potential of the area with the project.

APPENDIX A6

SOLID WASTE DISPOSAL - COAL STORAGE - LAND RECLAMATION

WASTE DISPOSAL

1. WASTE ROCK AND OVERBURDEN

(a) Examine potential sites for dumps, noting water drainage in the area.

(b) Determine and quantify in terms of chemical quality the total leachable material and the rate of leaching from the waste rock and overburden material by laboratory studies.* Examine proposed methods of containment and/or disposal.

(c) Examine potential for revegetation of waste dumps. Make laboratory studies to determine physical and chemical properties of waste material. Carry out growth chamber tests to evaluate revegetation requirements and potential. Revegetation studies should include plant species which will naturalize in the long term.

(d) Recommend a program for the field test of revegetation of various slopes and aspects of soil materials when test burn coal has been mined. Comment on trace element migration through vegetation systems.

(e) Examine alternatives for re-use of waste rock and/or overburden. Examine impacts of any proposed alternatives.

2. ASH

(a) Examine ash from combustion tests and determine and quantify in

---

* The assessment of the impact on the leachate is being carried out under Appendix B1.

terms of chemical quality the leachates by laboratory studies.*

(b) Examine the ash transport system for potential hazards to the environment. Examine containment facilities and excess water disposal facilities, if any.

(c) Carry out laboratory revegetation studies of ash material. Comment on trace element migration through the vegetation system.

(d) Examine alternatives for use of ash, e.g. aluminum feedstock, cement.

3. BENEFICIATION PLANT AND SCRUBBER WASTES

(a) Determine and quantify in terms of chemical quality the leachates from beneficiation plant waste material by laboratory studies.*

(b) Carry out laboratory revegetation studies of beneficiation plant waste material.

(c) Examine selected methods for disposal of flue gas scrubber wastes and predict potential leachates from scrubber waste material.*

COAL STORAGE

1. Examine locations of coal storage piles, noting water drainage in the area.

---

* The assessment of the impact of the leachate is being carried out under Appendix B1.

2. Determine and quantify in terms of chemical quality the total leachable material and the rate of leaching from the coal material by laboratory studies.* Examine coal pile drainage collection and disposal facilities.

3. Examine coal transportation systems for hazards to the environment.

4. Examine criteria for water quality for use in dust suppressant systems.

LAND RECLAMATION

1. Examine methods of mine site and land reclamation. Consult with mining consultants on areas requiring reclamation and provide input to the mining consultant in the preparation of a comprehensive plan of reclamation together with an assessment of the costs.

---

* The assessment of the impact of the leachate is being carried out under Appendix B1.

B. WATER RESOURCES SUBGROUP

APPENDIX B1

HYDROLOGY, DRAINAGE AND WATER QUALITY AND USE

INVENTORY

1. Determine the seasonal variation in the quantity of surface flows in the Hat Creek Valley.

2. Determine subsurface flow patterns and identify major aquifers in the Hat Creek Valley.

3. - Determine areas of interaction between surface and subsurface flows.
   - Collect, summarize and interpret piezometric data on groundwater systems, including limit of zone of saturation.

4. Determine the morphology of Hat Creek and its floodplain, and delineate areas subject to flooding.

5. Determine the present and future consumptive use of water supplies in the Hat Creek Valley without the project for livestock, agriculture and domestic purposes and by wildlife.

6. Map all known wells used by inhabitants and analyze waters (see item 9) from these wells in winter and summer.

7. Conduct a comprehensive water quality survey of Hat Creek (see item 9) above and below the proposed development and of water courses which would be affected by the development.

8. Determine the comprehensive chemistry of selected standing waters on

either side of the Valley to provide baseline data.

9. The recommended sampling program shall be:

Primary Program

(a) Sampling frequency:
- once per quarter
- once per week during freshet
- once per day for turbidity and suspended solids during freshet.

(b) Physical Parameters:
- pH
- Specific Conductance
- Turbidity
- Total Solids
- Suspended Solids (1 μ)
- Dissolved Solids
- Water Temperature at time of sampling
- Residues at 105°C and 550°C

(c) Chemical Parameters:
- Alkalinity (total)
- Hardness - Calcium and Magnesium
- Dissolved Oxygen
- C.O.D.
- Sulphate
- Phosphate (total)
- Chloride
- Nitrite
- Nitrate
- Kjeldahl nitrogen
- Sodium
- Fluoride
- Mercury

- Strontium
- True color

Supplementary Program

(a) Sampling frequency: - every 6 months, but to include periods of freshet.

(b) Chemical Parameters:

- Lithium
- Arsenic
- Cadmium
- Chromium
- Vanadium
- Iron
- T.O.C.
- Boron
- Zinc
- Selenium
- Lead
- Copper
- Aluminum
- Uranium
- Molybdenum
- Phenol

NOTE: Methods used for analysis must be documented

10. Provide input to Appendix C3, Section 5.

EFFECTS OF DEVELOPMENT

These terms of reference may require upgrading as the conceptual design evolves.

1. Hat Creek Diversion - Evaluate effect on water quality, replacement of stream flow, physical effects, e.g. stream flow rate, channel morphology.

2. Reservoirs, lagoons, impoundments - evaluate water quality, and comment on use as recreation facilities and irrigation possibilities.

3. Downstream communities - Evaluate the overall effect of the project on the quality and quantity of the water resources in the area, and estimate the impact on consumptive water use in the Hat Creek Valley and by downstream communities, e.g. Cache Creek.

4. Examine plant and site drainage systems for hazards to the environment. Estimate and evaluate the quantity and quality of the leachates and surface runoffs from the waste rock and overburden, ash dumps, process wastes and coal storage piles. (Basic data on total leachable material and rate of leaching to be supplied by consultant for Appendix A6).

5. Estimate the quantity and quality of water accumulating in the open pit and examine the disposal of this water.

WASTE WATER RECYCLING

1. Examine the potential for waste water recycling and re-use.

2. Examine ultimate disposal of waste waters.

APPENDIX B2
FISHERIES AND BENTHIC FAUNA

INVENTORY OF FISH POPULATIONS

1. Establish the species and relative number of fish in Hat Creek, especially, but not exclusively, in development area.

2. Record the basic life history data, as well as ages, growth, food, etc., of major fish species.

3. Determine fish spawning and rearing areas and general habitat and minimum flow requirements.

4. Prepare annotated (physical, biological) Thalweg curves for mainstream and tributaries of Hat Creek.

5. Establish the species and relative abundance of benthic fauna, including baseline downriver stations and diversity indices.

6. Relate relative abundance of the food to the fish present (see 1. above).

7. Provide input to Appendix C3, Section 2.

EFFECT OF DEVELOPMENT

1. Evaluate the effect of various diversion, reservoir, pondage requirements on Hat Creek fish populations.

2. Comment on the value of the pit as a future lake for fish. Suggest improvements that would enhance its value to fish populations.

3. Comment on the possible impact of increased fishing by the construction work force.

4. Estimate consequences of project impact on benthic fauna.

5. Advise on methods and possibilities to avoid, mitigate and compensate for adverse impacts of project developments on Hat Creek fishery resources.

6. Establish a range of options for compensation lying outside Hat Creek Valley, their feasibilities, productivities (species, populations and catch) and costs.

7. Evaluate impact relative to regional and local fish values.

REGIONAL FISHERIES RESOURCES

1. HYDROLOGY

(a) Inventory

i) Prepare an inventory of the major watersheds shown on the 1/250,000 project base map. Drainage basins should be depicted graphically and an inventory of the primary streams, rivers and lakes listed.

(b) Hydrogeomorphology

i) Classify and summarize all water bodies in terms of their pH regime (i.e. acid, neutral, alkaline), total dissolved solids, sulphates, hardness, temperature and buffering capacity.

ii) Identify the major geological formations underlying each watershed, including geochemical data on them.

2. REGIONAL FISHERIES

(a) Inventory

i) Provide an inventory of the regional anadromous fisheries resources for the area covered by the 1/250,000 base map.

ii) Map the runs of anadromous fishes on the 1/250,000 and 1/50,000 base map and indicate all known spawning areas.

iii) Map the juvenile migrations of anadromous fish and show known rearing areas (1/250,000 and 1/50,000 scale).

iv) Describe the timing of juvenile and adult migrations in i) and ii) above for peak and 90 percent of run.

v) Describe Provincial management practices, including: seasons gear restrictions, closures, stocking and enhancement programs.

vi) Provide an inventory of the non-anadromous fishes in the region covered by the 1/250,000 and 1/50,000 base map, noting important lake and river sport fisheries.

vii) Identify known rare, endangered or threatened fish species and their distribution in the region.

(b) Harvest - Sport

i) Provide a description of the regional (1/250,000) and local (1/50,000) sports fishery.

ii) Estimate the current fishery yield of the resource in i) above by evaluating Provincial creel census data, steelhead punch card results, stocking practices and other pertinent management information.

(c) Harvest - Commercial

i) Summarize the commercial fishing statistics for fish populations in the Thompson River, including commercial catch for the period of record.

ii) Summarize the escapement estimates for this fishery.

iii) Summarize the catch-escapement ratio for the period of record for the species shown in i) and ii) above.

(d) Harvest - Other

i) Estimate the catch and significance of subsistence fishing by Native Indians exclusive of commercial and sport landings (i.e. for tribal and ceremonial purposes, etc...).

(e) Summarize, briefly, the existing stresses from natural causes, present industry and land-use practices and competition - predation by "pest" species which limit the success of the anadromous fish (1/250,000 and 1/50,000).

3. HAT CREEK VALLEY FISHERY IN REGIONAL PERSPECTIVE

(a) Summarize the current status of the Hat Creek Valley fishery resource (1/50,000).

(b) Summarize usage estimates from available data.

(c) Comment on the potential capability of the Hat Creek fishery.

APPENDIX B3
WATER INTAKE

1. Assemble information on and evaluate the Thompson River as a water supply source considering such fish factors as:
   - timing of fry/juvenile downstream migrations by species
   - size, behaviour of downstream migrants and also sufficiency of supply of water and water quality.

2. (a) Consider impact of reduced river flow on downstream ecology of the Thompson River.

   (b) Identify and advise of any probable options for future use of Thompson River water which are foreclosed by this development.

3.* Discuss intake design, location and screening with reference to Canada Department of Environment, Fisheries and Marine Service recommendations and requirements. Explain the critical factors which protect against:
   - entrainment of migrating fish
   - creating a haven for predators
   - disorientation, and
   - clogging of intakes

4.* Evaluate the experience of Lornex Mines and other intakes for reference in the Hat Creek intake design.

5.* Indicate the reasons for the selection of the Thompson River as preferred source of water for the Hat Creek Project.

---

* To be provided by consultants carrying out the preliminary engineering for the water supply.

6. A report covering all items in this appendix will be prepared by the consultant responsible for items 1 and 2. Input on items 3 to 5 will be provided by the consultant assigned the preliminary engineering for the water supply study.

C. SOCIO-ECONOMIC SUBGROUP

APPENDIX C1
IMPACTS ON HUMAN SOCIETY*

1. EMPLOYMENT

(a) New Direct Employment

List number of new direct positions created by: **

i) open-pit mine during - construction phase
- operating phase

ii) thermal plant during - construction phase
- operating phase

Identify in cooperation with B.C. Hydro the union, trade and professional conditions related to hiring, education, training and experience requirements.

Discuss seasonality of employment.

(b) New, Indirect and Induced Employment

i) List employment in social, cultural, education, health facilities
- number of employees by category;
- education;
- community and regional recreation facilities and services;
- medical and health facilities and services;
- cultural facilities and services;
- court and judicial services;
- fire and police protection.

* Substantial information on regional multipliers, regional development and impact methodology is contained in Reference Report "O".

** To be provided by B.C. Hydro's design consultants.

ii) List employment in auxiliary (support) industrial and service economic activity
- employment derived from company and employee purchases of goods and services in the area.

(c) Discuss Labour Force Under Following:
- effect on unemployed and underemployed labour pool of local communities, region and province (special attention should be paid to groups such as women, high school dropouts, etc., who have particular problems finding work). Identify ways of utilizing this pool.
- effect on regional out-migration and school dropout rates.
- effect on local area labour supply for ranching, sawmills, etc., of new high wage employment opportunities.
- recruitment programs
  - existing training programs which can be utilized locally, regionally and provincially to meet employment needs.
  - new training programs required.

(d) Transition Strategies
- Identify type of employment possibilities in the region that might utilize the skills of the construction work force after project completion.
- Determine degree of compatibility of construction work force skills with requirements in primary, secondary manufacturing and service sectors.
- Discuss strategies for transition from construction to alternative employment possibilities.

2. INCOME
- Estimate total personal income generated by the project over the anticipated lifetime

  - construction phase
  - operation phase
- Distribution of income (wages, employee spending, company purchases) (by community, in the region and province) with typical patterns shown by type of trade.
- Effect of income distribution.
- Disparities between traditional wage levels in the region and wages associated with employment on the thermal project; and the anticipated effect of these disparities, including possible inflationary impacts on consumer goods and services in the region.

3. POPULATION IMPACTS

- Estimate population totals of existing and/or new communities with and without the project - distinguish between population generated from direct (thermal project) and indirect (service) employment.
- Discuss age-sex characteristics of total population.
- Discuss household types anticipated (family size).
- *Estimate dependent population:*
  - number of persons brought into the area as a result of their spouses' employment
  - number of children (approximate age e.g. preschool, elementary school, secondary school).
- Predict socio-cultural characteristics of in-coming population e.g. ethnic background and educational level.

4. SOCIAL ADJUSTMENT CONSIDERATIONS

Note: Some of these are listed under employment.

(a) Social Impact

- discuss social problems which may arise based on comparable situations (e.g. mental health, crime, drug abuse, alcoholism

and marital breakdown); indicate the factors contributing to these problems and outline proposed approach.

(b) Community Integration

- Discuss predicted areas of conflict between newcomers and existing population (based on experiences in other such developments) and proposals for resolving. Include an assessment of the factors involved in integrating the construction work force into the existing communities as an alternative to building a large construction camp.

(c) Consider community attitudes to the project with special attention being given to the local ranching community in the valley.

5. LOCAL GOVERNMENT IMPACT

- Appraise expected increases in tax revenue by local governments, regional districts and school districts by year for a ten-year period, with and without the project.
- Describe expected increase in local, regional and school district expenses (capital and operating) by year for a ten-year period, with and without the project.
- Describe the current and anticipated financial circumstances (with and without the project) of local governments, regional districts and school districts with respect to mill rate, debenture debt, allowable debt.
- Discuss need for transfer payments to local government and/or private agencies to overcome project induced budgetary shortfalls.
- Discuss impact on local government structure and boundaries.

6. IMPACTS ON NATIVE INDIAN COMMUNITY *

(a) Population

Provide the following population data on the various reserves in the study area:

i) Determine the number of people on each reserve (past, present and future forecast - use ten year interval).

ii) Identify the age-gender distribution.

iii) Determine the personal and family income levels - compare generally to the rest of study area.

iv) Assess the use of public services by Native Indian community:
- schools
- recreation facilities
- health and other social services

Describe life style of existing community and indicate probable future trends or developments, with and without the Hat Creek project.

(b) Employment

i) Determine the number and percent of Native Indian population in workforce.

ii) Determine the number and percent employed and unemployed.

iii) Describe past and present types of employment and forecast future trends and opportunities, with and without the Hat Creek project.

iv) Assess the potential of Native Indians to obtain employment on the project - construction and operation phases.

---

* Information on the Native Indian Community is expected to be available from the Upper Hat Creek Indian Communications Committee Impact Study as funded by Indian and Northern Affairs.

v) Determine the qualifications and skills of the Native Indians in relation to project work force requirements.

vi) Define special counselling and training programs needed by Native Indians to benefit from project employment opportunities.

vii) Identify employment opportunities in services of functions ancillary to project, e.g. local retail and service employment, tourist facility (camp and picnic grounds).

(c) Native Indian Land, Water and Air

i) Describe the effect of improved, or new, site access requirements, if any, on Native Indian Reserves.

ii) Assess the impact of increased traffic through Native Indian Reserves.

iii) Assess the effects of air and noise pollution.

iv) Assess the effect of possible deterioration in water quality.

v) Define any impact on Native Indian Reserves when the project is completed.

vi) Investigate means for avoiding, mitigating and compensating for negative project impacts, and enhancing positive impacts.

(d) Other Native Indian Concerns

i) Define the effects of the project on present Native Indian hunting and fishing and traditional burial grounds.

ii) Report on means to ensure Native Indian input and involvement as the project develops and affects them.

iii) Describe the effects of the project in terms of local and regional population changes on the existing Native Indian lifestyles.

APPENDIX C2

IMPACTS ON COMMUNITY SERVICES AND INFRASTRUCTURE*

1. HOUSING DEVELOPMENT

- *List aggregate housing requirements for:*
  - power project related employees and dependents;
  - service employees and dependents.
- *Discuss type, tenure and cost to householder of housing*
  - breakdown according to rental versus owner-occupied, and single family, multi-family and 'mobile' units.
- Estimate the capacity of the existing housing market to meet housing requirements. Include the ability of the local construction sector to meet increases in housing demand, and source of shortfall housing i.e. prefabs.
- Forecast anticipated effect of project on local housing prices and rents.
- Discuss capability of various groups in community to afford increased housing costs, if any.
- Discuss the availability of mortgage funding and applicant requirements. Analyze the ability of labour force from both thermal project and service sectors to afford proposed housing.
- Propose alternative programs for meeting housing requirements. What forms of subsidy, if any, will be necessary? Discuss anticipated investment in housing construction industry in the surrounding communities.

2. SERVICES

(a) Education

- Estimate number of school age children expected from thermal project households and service households.
- Discuss required expansion in existing school facilities.

---

* Information on community infrastructure is available in Reference Report "O".

(b) Community and Regional Recreational Facilities and Services

- List existing facilities and show patterns of use (pressures).
- Discuss change in type and amount of recreational activity related to new populations.
- Consider financial capability of local communities to provide expanded facilities.

(c) Commercial Services

- Anticipate type and amount of expected commercial expenditures of population as indicated by experiences of other thermal project employees, personal income and availability of goods and services in community and region.
- Consider which commercial services will likely be added to the commercial mix due to enlarged local payroll. The impact on commercial services should consider regional implications e.g. impact on facilities provided in Kamloops.

(d) Medical and Health Facilities and Services

- Discuss adequacy of present facilities.
- Estimate required expansion based on population projections and past experience of thermal project households.

(e) Cultural Facilities and Social Services

- Consider the expected demand for entertainment and cultural facilities such as restaurants, theatres, arts and crafts, churches, child care centres (relate this to consideration of age structure of population, and projection of women in the workforce with children requiring child care).
- Estimate the need for social and counselling services (social workers, marital counselling, foster homes and transition houses, women's centres, alcoholism and drug treatment, and community

resource board services).

(f) Communication Facilities and Services

- List existing media and communication facilities and impact of new populations on demand.

(g) Court and Judicial Services

- Discuss the amount and type of demand for these services.

(h) Fire and Police Protection

- Show incremental demand for these services.
- Discuss the levels of service that would be desirable.

(i) Support Industrial Activities

- Estimate equipment sales and services to thermal project and related population.

3. SETTLEMENT PATTERN AND LAND REQUIREMENTS

- How can the project workforce and dependents be most efficiently and desirably accommodated in terms of economic, social, environmental and planning factors (e.g. in existing communities or in a new community)?
- Consideration should be given to the long term development of the Hat Creek coal field.
- Should a particular type of population distribution be encouraged?

4. COMMUNITY LAND

- Examine requirements for land for residential, commercial, industrial, institutional and other uses.
- Survey availability of land in various communities and any problems with respect to access, servicing and price.

5. COMMUNITY INFRASTRUCTURE

(a) Sewage Disposal

- Discuss adequacy of existing sewage systems.
- Estimate predicted demand on existing sewage disposal systems and for new (expanded) systems; collection, disposal.
- Consider impact on the environment and cost.

(b) Water System

- Judge adequacy of existing water systems.
- Assess predicted demand on existing water systems and for new (expanded) water systems resulting from thermal project population; source and cost considerations.

(c) Utilities

- Assess capability for expansion of electric, telephone and gas services.

6. REGIONAL INFRASTRUCTURE

(a) Transportation

- Discuss need for additional transportation facilities for community and local services.
- Discuss location, function and construction and maintenance responsibility.
- Consider safety, aesthetics, ecology, noise and pollution aspects as well as engineering and economic aspects.

(b) Utilities

- Comment on adequacy of existing utilities in region
    - gas lines and supply;
    - electrical system;
    - petroleum supply and distribution system.

- Compute expansion of existing transportation network which will be required (safety, pollution and noise factors to be included).
- Investigate new types of transportation services which may be required or desired (e.g. transit service between thermal project and residential communities).

APPENDIX C3
RESOURCE EVALUATION FOR
PROVINCIAL, ENVIRONMENTAL AND REGIONAL ACCOUNTS

*Power developments create positive and negative impacts on environ-*mental systems. Some of these will be readily measured in monetary terms, for example, loss of agricultural production, and can be incorporated directly into *the efficiency account. Others will not be amenable to monetary evaluation* due to data or mensuration problems and will have to be evaluated in bio-physical terms. However, in all three accounts, resource impacts should be systematically identified.

The socio-economic consultant is required to evaluate all resources examined in the study. The methods for this evaluation are outlined below. For each resource, evaluation should be made for the case "with" and "without" the proposed development. Direction on the development of a methodology for this study will be given by the coordinating consultant. Input will be provided from study Appendices A2, A3, A4, A5, B1, B2 and E2.

1. FORESTRY

(a) Forests should be evaluated at the potential value of the timber harvested at its optimal harvest age, net of harvesting costs.

(b) The terms "Optimal Harvesting Age" and "Costs" are defined by present forest management and harvesting techniques as practiced by the B.C. Forest Service.

(c) Net present value should be calculated by using discount rates of 4, 6, 8, 10 and 12 percent.

2. FISHERY

Evaluate the net change in angler use following project development. Theoretically, this requires estimates of change in angler days plus non-consumptive use days, evaluation of this change according to travel cost method or some appropriate surrogate.

Estimate the net change in value to the commercial fishery.

3. WILDLIFE

Evaluate loss in terms of foregone hunter days and non-consumptive use in region using same mensuration techniques as in the fishery section.

4. RECREATION

(a) Information on recreation demand will be supplied by Recreation Consultant, Land Use Subgroup, Appendix A5.

(b) Tabulate local, provincial income gains through increased tourism.

(c) Show net change in recreation values.

5. WATER RESOURCES

Evaluate changes in water resource uses - irrigation, domestic uses, industrial uses.

6. MINERALS

Evaluate mineral potential (except coal) in area affected by the development (net value of minerals).

7. AGRICULTURE

Evaluate economic rent associated with changes in agricultural production resulting from the development.

8. COMMUNITY SERVICES AND INFRASTRUCTURE

Evaluate the benefits and costs to the region of service and infrastructure expansion required for the new population.

APPENDIX C4

ARCHAEOLOGICAL AND HISTORIC SITES

Archaeological sites to be investigated by Archaeological Sites Advisory Board.

Historical sites to be investigated by the Historical Sites Advisory Board.

Adequate lead time for site investigations will be necessary. The Advisory Boards will work closely with the Native Indian bands on Indian sites.

The research and investigations will be determined by the appropriate Advisory Board and B.C. Hydro.

A report on the work will be prepared for integration into the overall Environmental Impact Statement.

D. AIR QUALITY SUBGROUP

METEOROLOGICAL STUDY

The B.C. Hydro Meteorological Study was initiated in November 1974 in order to supplement the existing Hat Creek Climate Station (Atmospheric Environment Service) and a B.C. Hydro wind sensor. The Climate Station and wind sensor have operated since the early 1960's.

The Meteorological Study has consisted of, but is not limited to, the following:

1. WEATHER STATIONS

Eight Weather Measures Ws 755 weather stations were installed in November and December 1974 to measure:

- wind run
- wind direction
- temperature
- relative humidity

While these stations are capable of measuring precipitation when the temperatures are consistently above freezing, the option has not been utilized to date. The measurement of precipitation with certain of the stations is under consideration for the summer of 1976.

The wind, temperature and relative humidity data collected is reduced to hourly values and stored on the Hat Creek Meteorological Data Base. Maximum-minimum thermometers and current dry and wet bulb temperatures are recorded during monthly chart changes.

2. HYGROTHERMOGRAPH MEASUREMENTS

Four hygrothermographs were located on the eastern slope of the

Upper Hat Creek Valley during the winter of 1975. The instruments, which were on loan from the Environment Land Use Committee Secretariat, were calibrated against dry bulb and wet bulb temperature measurements taken during weekly chart changes.

3. CLIMATE STATION AND WIND SENSOR

The wind sensor has operated since July 1961 at the junction of the Upper and Lower Hat Creek Valleys with Marble Canyon.

The Climate Station, operated by Mrs. I.E. Lehman adjacent to her residence since November 1960, measures dry and wet bulb temperatures, temperature and relative humidity (hygrothermograph), precipitation and visual observations.

4. UPPER LEVEL STUDIES

Field programs have been conducted in conjunction with consultants as follows:

- a winter 1975 minisonde (upper air temperature and wind) study;
- a summer 1975 minisonde and constant volume balloon (wind trajectory) study;
- a winter 1976 gas tracer and minisonde study;
- a spring 1976 gas tracer, minisonde and constant volume balloon study;
- a summer 1976 gas tracer and minisonde study for the Upper Hat Creek Valley and the Trachyte Hills.

5. COMPUTERIZED METEOROLOGICAL DATA STORAGE AND RETRIEVAL SYSTEM

The meteorological data collected from the eight mechanical weather stations and the hygrothermograph data is entered in the computerized meteorological data base. This hourly data is sorted in chronological order and then put through a series of checks with respect to wind, temperature and humidity as well as routine

date, time and format checks. The flagged data is investigated and either modified or verified and then re-edited prior to adding the data to a master tape. The system is designed with several routines and two backup master tapes in order to prevent inadvertent destruction of the data.

A complete computer card data record is stored in both Victoria and Vancouver as a further protection for the data base.

Scheduled future additions to the data base are:

- the existing weather station data;
- Kamloops and Lytton Environment Canada surface data;
- Vernon, Prince George and Port Hardy radiosonde station; surface, 850 mb (milliber), 700 mb and 500 mb temperature, altitude and wind data;
- the automatic weather station (Appendix D1) data;
- light intensity and temperature/dewpoint data (following checkout of these systems).

6. WEATHER MAPS

The Atmospheric Environment Service Pacific Weather Central surface, 500 mb and satellite maps are retained or converted to microfilm form for further study. The Pacific Region maps are preferred over the National or U.S. maps due to the greater resolution over B.C. and the eastern Pacific Ocean.

7. METEOROLOGICAL ANALYSIS COMPUTER FACILITIES

The following computer analysis programs are available in addition to simple dispersion modelling programs:

Program	Function
Meteorological Data Storage and Retrieval System	To read, re-format, sort, edit, update and extract meteorological data.

Program (cont.)	Function (cont.)
Minisonde	To calculate temperature, potential temperature, wind speed and direction parameters from a minisonde (temperature sensor and pibal) and wind trajectories from constant volume balloon data.
Mixing Height	Calculates mixing heights from valley, ridge and mountain top surface weather stations.
Wind Velocity	Calculates wind velocity profiles for selected weather stations for various segments of the day (i.e. to assist in evaluating diurnal circulations).
Summary	Generates annual charts of maximum and average wind speed, percentage calms, mixing heights and other parameters for each hour of the day for each month of the year.
Temperature Conversion	Converts Fahrenheit data to Celsius for entry to data base.
Extract	Routine to extract data from the data base as a function of specific criteria selected by the user (i.e. combination of temperature and wind speeds for a certain period of the year).
Plotting	Plots user selected meteorological parameters as a function of time via computerized plotter routines.

8. AIR QUALITY

In addition to the air quality monitoring outlined in Appendix D1, high volume samplers including one with a Sierra Instrument Co. particle sizing head, will be installed in the Region. These units are being prepared for operation in the Hat Creek Region. Dustfall and sulphation rate units will also be located in the Region.

The data collected is intended to assist in the background air quality and trace element study areas.

APPENDIX D1

METEOROLOGICAL AND AIR QUALITY EQUIPMENT

1. For the Upper Hat Creek Valley, Valley Ridge and a mountain site selected by B.C. Hydro (following plant site selection) in cooperation with the coordinating consultant, prepare meteorological station specifications to U.S. Weather Bureau, Atmospheric Environment Service and other applicable standards for the approval of B.C. Hydro. Obtain competitive quotes for major equipment. Supply, deliver, install and test the meteorological stations. The monitoring stations will be used to supplement and eventually replace the existing monitoring network.

These stations should be designed to provide background meteorological and air quality data. The network should be designed for future expansion over a period of years (prior to plant operation) in the event that B.C. Hydro proceed with the development of thermal facility.

The network shall also be capable of removal and transport to another area within or beyond the Hat Creek Region.

The valley and ridge stations shall be reviewed with respect to the requirement for the following equipment (plus additional or alternate equipment if required):

- a temperature controlled (heated and cooled) shelter;
- wind speed, wind direction recording system at 10 m (meters) above ground elevation (or greater if justified by topography and terrain);
- ground level (soil) temperature sensors to be installed to a depth greater than the frost penetration level;
- air temperature sensors at 10 m (or greater if justified by topography and terrain);

- a relative humidity or dewpoint sensor at 10 m above ground elevation (or greater if justified by topography and terrain);
- recording precipitation (snow, hail, rain etc.) sensor;
- light intensity sensor;
- evaporation sensor;
- three dimensional wind turbulence sensor at 10 m (or greater if justified by topography and terrain) to measure horizontal and vertical wind fluctuations;
- sulphur dioxide (SO_2) analyser;
- visibility sensor;
- barometric (station) pressure sensor;
- automatic digitizing, computer tape data collection and computer compatible data reduction system with backup strip charts;

The mountain station shall be reviewed with respect to the requirement for the valley station equipment with the exception of the following sensors:

- soil temperatures
- light intensity
- evaporation
- SO_2 analyser (allowance to be made for future addition)
- visibility (allowance to be made for future addition)

2. B.C. Hydro has received the following ambient air quality monitoring equipment:

Contaminant	Monitor
Nitrogen Dioxide Nitric Oxide	TECO Model 14D
Carbon Monoxide	Benedix Model 8501-5CA
Ozone	Monitor Labs Model 8410-A

Contaminant (cont.)	Monitor (cont.)
Sulphur Dioxide	Philips Electronics Model PW 9755 (including integrated automatic calibration system)

The above equipment together with the equipment noted in Part 3 of this appendix shall be installed in a temperature controlled (heated and cooled) trailer to be supplied by the consultant. The trailer shall be initially tested for B.C. Hydro's approval and thereafter shall be operated for four months by the Consultant at a maximum of two sites to be designated by B.C. Hydro in the Hat Creek Region. The data collected is to be supplied in the form specified in Part 4 of this appendix.

The Consultant shall review, recommend, specify, supply, fabricate, install and operate this unit for four months with appropriate filters to prevent interference of other gases or particulate for the above instruments and other air quality instruments supplied by the Consultant.

3. In addition to the equipment described in Part 2 of this appendix, the Consultant shall prepare specifications and drawings for B.C. Hydro's approval and thereafter supply, deliver (f.o.b. Upper Hat Creek Region), test and operate the trailer as outlined in Part 2 of this appendix. The additional equipment, to be evaluated by the Consultant, shall include but shall not be limited to the following:

- temperature controlled monitoring trailer
- high volume suspended particulate sampler
- dustfall and sulphation rate sampler
- low threshold wind speed and direction sensor
- barometric (station) pressure sensor
- visibility (i.e. nephelometer) sensor
- temperature/dewpoint sensors
- telescopic meteorological tower to mount wind sensors at 10 m above

ground elevation with the temperature sensor slightly below the wind sensor
- precipitation sensor
- short term (1-2 hours maximum cycle) particulate sensor
- ambient reactive and non-reactive hydrocarbon analyser
- calibration system for all gaseous contaminants including four months' supply of calibration gasses
- a trailer mounted data acquisition system capable of: computing 15 minute averages from the analog outputs from the sensors previously mentioned; storing these averages in a form immediately compatible with existing B.C. Hydro data processing equipment; interfacing with an existing B.C. Hydro telementary or other transmission system
- the output of all sensors will be continuously recorded with strip chart recorders mounted in the trailer

4. The data collection systems shall be designed for compatibility with existing or planned B.C. Hydro networks (i.e. the meteorological data base, the hydrometeorological data and the Burrard Thermal Meteorological Control Plan).

The data collection systems shall be reviewed by the consultant with respect to two alternatives, either complete data collection at each weather station and the ambient air trailer or telemetering of all data to a central location. The Consultant shall then submit a plan with a minimum design of 95 percent data recovery for B.C. Hydro's approval and thereafter implement the plan or revised plan.

Turbulence sensor recording shall be evaluated with respect to methods of determining standard deviation and a recommendation shall be submitted to B.C. Hydro.

5. Electrical power will be supplied by B.C. Hydro in a manner similar to a

normal residential power connection (110 volt, 60 hz, single phase, 100 amp service or greater if required).

APPENDIX D2
AMBIENT AIR QUALITY

1. Review, assess and report on the various types of mathematical models with respect to their applicability to the Region(s) and meteorological conditions under study.

2. Select and, if necessary, develop a mathematical dispersion Model(s) for the Region(s) under study. The model should be representative of the Region but shall utilize parameters which can be verified by the Air Quality Impact Program, or the literature. Flat terrain and similar assumptions are not acceptable for the dispersion model.

3. The Consultant will, based on meteorological and topographical considerations, delineate the primary area of impact or zone of influence of the proposed thermal facility and the mine. This zone of influence will be modified, as appropriate, by the other Consultants based on considerations pertinent to their individual disciplines. The Consultant will assimilate these modifications and define a final zone of influence to which the subsequent studies of all Consultants will be addressed. The zone of influence will be defined as the area within which the plant will have a significant impact; i.e., an impact which is measurable by standard monitoring techniques and/or accurately predictable by current atmospheric models.

4. Calibrate and verify mathematical dispersion model(s) for the assessment of local and long range ground level primary and secondary contaminant concentrations and deposition (from the mine and thermal plant) and visibility on a 1.0, 3.0, 24-hour, seasonal and annual basis. The contaminants shall include, but are not limited to:

   - sulphur oxides including sulphates;
   - nitrogen oxides including nitrates;

- particulates;
- condensed water droplets;
- photochemical smog;
- haze;
- precipitation augmentation;
- trace elements;
- acid rain and snow deposition

5. Calibrate and verify mathematical dispersion model(s) for the assessment of the following cooling tower impacts:

   - visible, elevated, vapor plumes
   - ground level fogging/icing
   - deposition of salts and water droplets

6. Optimize the stack(s) and cooling tower(s) heights, in order to comply with the ambient air quality objectives established under the Epidemiological (Health) Studies (Appendix D3) with plant source emission curtailment. Stack height and site selection shall give consideration to potential plant expansion.

7. Evaluate, in conjunction with the design consultants and B.C. Hydro various potential types of cooling towers being considered for the facility and, in conjunction with B.C. Hydro, Envirosphere, Ebasco and the appropriate consultants select the tower design most suitable for the site.

8. Using the calibrated models discussed in 4 and 5 above, calculate and evaluate the impacts of the operation of the proposed power plant. Subject to Part 6 of this Appendix, stack plume/cooling tower plume and drift impacts and interactions should be considered.

9. Supply measured and calculated ambient air quality levels, airborne salt

concentrations and drift disposition rates, to consultants considering fish, wildlife and vegetation (Subgroups A, B and C).

10. Evaluate and report the individual and additive effect of industry in Kamloops, the proposed Afton mines smelter and mine complex and Hat Creek to the air quality of urban, rural and recreational areas in the area of study. The potential additive effect of a copper smelter in the Highland Valley or Clinton areas should also be considered in this evaluation.

APPENDIX D3

EPIDEMIOLOGY (HEALTH)

1. Review the U.S., Canadian Federal, B.C., Alberta and Ontario ambient air quality objectives for criteria contaminants and recommend appropriate ambient air quality objectives for the proposed mine and thermal facility. The criteria contaminants include Sulphur Dioxide, Nitrogen Oxides (normally expressed as Nitrogen Dioxide), Carbon Monoxide, Oxidants and suspended particulates. The final report will include supporting documentation regarding health considerations for each contaminant.

2. In co-operation with the Meteorological and Trace Element Consultants, recommend guidelines for achievement in terms of Ambient Air Quality for the Hat Creek mine and thermal facility, relative to emissions of critical non-criteria contaminants which are known or potential hazards to human health. These include a number of trace elements and selected decay products of currently regulated criteria contaminants, such as oxides of Sulphur and Nitrogen. Consideration should also be given to the effects that may be engineered by the simultaneous co-existence of criteria contaminants which, although controlled separately, combine to potentially form greater than additive adverse (i.e. synergistic) health effects.

3. In co-operation with the other Consultants, provide assistance to B.C. Hydro at meetings with agencies and groups such as the Province of British Columbia and the Kamloops Medical Society. This would include possible attendance at meetings and/or providing specific technical information.

APPENDIX D4

CLIMATIC ASSESSMENT STUDY

1. Prepare a detailed description of the regional and local climatology based on both published climatological data and on meteorological data collected by B.C. Hydro. The climatological description should encompass, but not necessarily be limited to, the following variables:
   - normal and extreme precipitation;
   - normal and extreme temperature;
   - atmospheric water vapor;
   - visibility and fog;
   - solar radiation and/or percent of possible sunshine;
   - severe weather and extreme winds;
   - synoptic and local scale flow patterns.

2. Perform a comprehensive review of the recent literature concerning the probability, nature and the extent of potential climatic alterations which could result from the operation of an electric generating facility and mine such as that which is proposed. This literature review should treat potential climatic modification on the meso-, synoptic, and general circulation scales of the atmosphere.

3. Qualitatively assess and delineate the potential for mesoscale climatic alterations which might result from the operation of the proposed mine and thermal facility. The factors to be considered should include, but not be limited to:
   - enhanced precipitation;
   - thermal (radiative) alteration;
   - snow cover persistence and depth; accelerated snow melting;
   - length and intensity of growing season including the effect of heat emissions from the thermal plant and cooling towers;

- fog, ice fogs, point of impingement icing on the ground, vegetation and structures (i.e. mine, plant, transmission lines);
- wind flow and valley drainage.

4. Qualitatively assess and delineate the potential for synoptic and general circulation scale climatic alterations, which could result from the operation of the mine and thermal facility including, but not limited to:

   - atmospheric temperature structure;
   - heat balance;
   - chemical composition of the stratosphere.

5. If, as a result of the work required for parts 2-4 of this appendix, the Consultant decides that meaningful quantification of a climatic impact is feasible within the framework of this project; he will advise the Coordinating Consultant and B.C. Hydro of his findings and, after obtaining approval, proceed to perform appropriate studies to quantify the nature and extent of this impact.

APPENDIX D5

METEOROLOGICAL CONTROL POTENTIAL

1. This assessment shall be conducted in co-operation with the Design Consultants and B.C. Hydro.

2. Assess the potential for the operation of the thermal facility and mine on a meteorological control basis versus sulphur and nitrogen oxides scrubbers in terms of:

   - plume rise and negative plume rise;
   - ambient air quality (including fog and enhanced precipitation);
   - plant availability in terms of compliance with the air quality objectives;
   - frequency and duration of critical meteorological conditions;
   - energy requirements for maintenance of adequate plume rise and plant operation;
   - transfer of air emissions to solid and liquid wastes;
   - energy, environmental and resource utilization trade-offs;
   - the environmental effects of mitigating measures that could potentially be employed under a meteorological control plan.

   For the evaluation of the final four (4) items listed above, the Consultant shall receive from either the Coordinating Consultant or the Design Consultants all of the cost, engineering, operational and cross disciplinary (non-meteorological/air quality) data necessary to support this task. The Consultant shall utilize this information to evaluate potential multidisciplinary impacts.

3. The Consultant shall submit to the Coordinating Consultant and B.C. Hydro, in an appropriate report, a recommendation for implementation of either meteorological control or scrubbers for the Hat Creek thermal facility.

E. GENERAL SUBGROUP

APPENDIX E1
NOISE

ACOUSTIC MEASUREMENT

1. Select a number of measurement locations around the proposed site(s) that will describe adequately all of the significant regions of similar acoustic environment. These measurement locations should include noise sensitive land uses with emphasis on those closest to the proposed mine and thermal plant site(s).

2. Obtain acoustic data at the above measurement locations for night, day, weekday and weekend during both summer and winter periods.

3. Collect the acoustic data in the form of L_{dn}, L_{10}, L_{90} and L_{eq} quantities. Also ambient octave band sound levels (31.5Hz to 8000Hz), equivalent to L_{90}, should be collected and reported. These data will be needed later for the acoustical design of the station.

4. All measurement equipment should conform with the requirements of ANSI S1.4-1971 for type 1 sound level meters, ANSI S.11-1966 for octave band analyzers and SAE recommended practice J184 for sound data acquisition systems. If Canadian Federal or Provincial draft or final standards are promulgated prior to or during this study, the variation between the standards and their significance shall be stated in the final report.

5. All monitoring equipment should be periodically calibrated in accordance with manufacturers' published specifications and applicable ANSI and/or IEC standards, or Canadian Federal or Provincial equivalent standards.

EFFECT OF DEVELOPMENT

1. Estimate the sound levels of major noise sources during plant construction and operation.

2. Estimate the sound levels of major noise sources of the mine and processing plant (construction and operation).

3. Estimate the sound levels of major noise sources associated with the transportation of men and material during the construction and operation of the station (including conveyor systems and water intake pumping stations).

4. Estimate the sound levels of major noise sources during plant maintenance.

5. Combine the sound levels of major plant operation noise sources and project them around the station.

6. Combine the sound levels of major plant construction noise sources and project them around the station.

7. Perform steps 5 and 6 with the ambient sound levels added to the plant operation and construction noise levels.

8. Estimate sound levels during different stages of construction activities and present them in a graphical form (projected to the nearest property line). This will show the temporal characteristics of various construction activities.

9. Evaluate the noise impact on noise sensitive land uses, during plant construction and operation, taking into account any existing or proposed local, provincial or federal regulations. The noise impact of the station

should be evaluated for all the time periods mentioned in step 2 under Acoustic Measurement. Evaluate the noise impact during plant maintenance.

10. Provide an engineering report that will include the following information:

(a) A map that shows regions of similar Acoustic Environment at the proposed site(s).

(b) A map that shows noise sensitive land uses at the proposed site(s).

(c) A map that shows monitoring points.

(d) All acoustic data obtained during the baseline noise survey in histogram and cumulative distribution form.

(e) Informal weather information taken during the sound survey such as wind speed and direction, relative humidity, temperature and barometric pressure.

(f) Informal traffic counts.

(g) An evaluation of the station noise impact during construction and operation.

(h) An evaluation of the noise impact during plant maintenance.

(i) Recommendations for noise abatement of major noise sources during plant maintenance, operation and construction.

(j) A description of measurement equipment and procedures that were utilized during the baseline noise survey.

(k) A complete description of the sound propagation computer model that will show all the sound propagation parameters that were taken into account.

(l) A description of the in-house prediction models that were used to calculate sound levels of fans and steam vents, including sample calculations.

(m) Provide a list of references.

APPENDIX E2
MINERALS AND PETROLEUM*

INVENTORY

1. Describe coal reserves by maps, cross sections, volume and quality.

2. Describe nature and composition and volumes of the overburden.

3. Describe in general terms the geology of Hat Creek Valley.

EFFECT OF DEVELOPMENT

1. Give plans for extraction of coal including excavation and dumping of overburden, and method of digging, transporting and storing of coal and production rates.

2. Assess impact of mining and coal processing operation on the geology of the valley.

3. Inventory mineral and petroleum resources other than coal affected by the development.

4. Provide input to Appendix C3, Section 6.

A report on the work will be prepared for integration into the overall Environmental Impact Statement.

---

* To be completed by B.C. Hydro

APPENDIX E3
TRACE ELEMENTS

NOTE:

1. Location for intensive study will be identified by studies such as the Air Impact Program and by the plant layout as described by the design consultants. Variability in site geology should determine the number and location of samples.

2. All analytical methods used to determine levels of trace elements must be documented in detail.

3. These studies would be of a continuing nature commencing before development is started and proceeding for some years after the area is fully developed. The terms of reference presented here are for the pre-operational stage. A schedule for post-operational studies should be made separately.

4. In developing the project schedule, time for review and discussion of sampled organisms, number of species from each habitat and trophic level, sampling periods and sampling methodologies should be provided.

INVENTORY

1. COAL, WASTE ROCK, OVERBURDEN, ASH AND SOIL

(a) Survey trace elements including radioactive material present in coal, waste rock, overburden and ash (fly ash and bottom ash).

(b) Determine materials leaching from waste rock, overburden, ash and coal. Determine trace elements present in plant liquid wastes.

(c) Obtain emission data as necessary in consultation with the Design Consultants and B.C. Hydro.

(d) Survey the literature and indicate those elements which, due to their toxicity, might present a hazard to the environment. Prepare a list of sig ificant trace elements for further study. Interface with Epidemiological Consultant in order to establish criteria for stack design studies.

2. VEGETATION, ANIMALS, WATER, AIRBORNE PARTICULATE AND SOILS

(a) From the literature, identify, for the biota of temperate North America, toxic concentrations, tolerance levels and bioaccumulation factors for those trace elements previously determined as significant (see 1(d) above).

(b) Vegetation. Particular attention should be given to those plant species which form part of the food chain of wild or domestic animals or are important cultivated crops. Samples of vegetation should be taken both in spring and fall. Use should be made of established vegetation plots; see Appendix A1.

(c) Animals, including fish and birds. Whole body and organ burdens of trace elements should be determined for those organisms selected for investigation. Seasonal variations in trace element concentration should be noted. Studies on fish and other aquatic biota should be performed during the fish spawning period, spring and fall.

(d) Water, including primary stream, surface runoff and ground

water. Seasonal variations in trace element concentrations should be noted to establish the baseline content of these components of the water body. Sampling should be coincident with aquatic biota sampling.

(e) Airborne Particulate. In cooperation with the Air Impact Program, and the Design Consultants, inventory the trace element content of suspended particulate material.

(f) Soils. Areas of study to be defined as in Note 1 above. Trace element analyses should be performed on leaf litter and a horizon soil.

EFFECT OF DEVELOPMENT

1. In conjunction with the Epidemiological Program, assess the impact of trace elements in emissions, liquid gas and particulate forms, on flora, fauna and man in the site region. Where possible, indicate tolerable levels of exposure. Indicate those species which might be adversely affected by trace element emissions.

2. Assist in studies of the potential re-vegetation of waste rock, overburden and ash dumps by providing technical backup in evaluating the migration of trace elements through vegetation systems.

APPENDIX E4
AESTHETIC CONSIDERATIONS*

NOTE

Elements of the plant to be included in aesthetic analyses are those listed in "Project Actions" section of Terms of Reference. Also to be considered are the plumes of the stack and cooling tower.

VIEWSHED

The area within which any and all elements of the plant can be seen shall be described.

Each element shall be considered, separately if it has a distinctive aesthetic effect. For example, the stack shall be considered separately from the cooling tower.

SENSITIVE LAND USES AND VIEWING AREAS

Land uses and viewing areas sensitive to aesthetic considerations and within viewshed of plant units shall be identified and described. An example of a sensitive land use is Marble Canyon Park; a sensitive viewing area is Route 12.

The number of people affected within each sensitive land use or viewing area shall be determined.

VISUAL IMPACT

The visual impact of plant elements upon each sensitive land use or viewing area shall be described.

---

* Site plans, renderings, color schemes, and/or descriptions of all plant elements sufficient to accurately assess aesthetic impact would be provided.

APPENDIX F

TERMS OF REFERENCE FOR COORDINATOR OF STUDIES

1. Report to the B.C. Hydro Coordinator. The Detailed Environmental Studies are to be controlled and coordinated by the General Manager for Engineering or his appointee.

2. Co-ordinate the Environmental Studies.

   (a) To prepare at the outset a master plan and schedule for the conduct of the studies; one of the functions of this plan will be to illustrate continuously the linkages and information flow between the various consultants.

   (b) Examine terms of reference for detailed Environmental and Socio-Economic Studies for omissions, alterations and unnecessary inclusions. *Examine cost estimates and schedules submitted by consultants.*

   (c) Monitor progress of the Studies and provide direction and emphasis to the environmental consultants. Indicate requirements for the Impact Statement, subject to B.C. Hydro approval.

   (d) Develop a format for assessment methodology and benefit cost analysis and ensure a consistent application by the individual consultants.

   (e) Monitor cost and expenditures - set budgetory forecasts.

   (f) Ensure requirements of terms of reference are fulfilled.

3. Submit reports to B.C. Hydro's environmental staff once per month, indicating work accomplished, planned work, expenditures and study coordination required. Report on and assist in the resolution of conflicts regarding the use of resources. Solicit comment from B.C. Hydro's environmental staff regarding progress and direction of the studies.

4. Ensure the environmental considerations and processes used by the design consultants for site selections are defensible and that the processes can be extended to arrive ultimately at specific recommendations for siting.

5. (a) In co-operation with B.C. Hydro's environmental staff and design consultants, participate in the development of satisfactory compromises between environmental constraints and engineering requirements. Ensure that input into this decision making process is made by the environmental consultants.

(b) Ensure that suggestions are received from individual environmental consultants for the mitigation of adverse effects and where feasible, suggestions for achieving non-efficiency environmental objectives.

(c) The work of the environmental consultants will be reviewed during the course of the studies by B.C. Hydro's environmental staff.

6. Prepare and circulate notes on all joint meetings held with B.C. Hydro's Environmental staff and during (5) (a) above.

7. Write an Environmental Impact Assessment Report. This report will include, but not be limited to:

(a) Initial conditions report.

(b) Assessment of the impact of the development

(c) Description of the design options available and the reasons for the adoption of the selected final design. This related to those plant facilities which in themselves have an environmental implication.

(d) Discussion of mitigation and/or compensation alternatives. Identification of those adopted and stating of the reasons.

The proposed format for the Environmental Impact Assessment Report shall be subject to approval by B.C. Hydro. A draft report will be submitted by September 1, 1977 and final report will be submitted by November 1, 1977.

8. Assist B.C. Hydro in the preparation of the Environmental Impact Statement.

9. Be prepared to take the witness stand during public hearings for approval of the project.