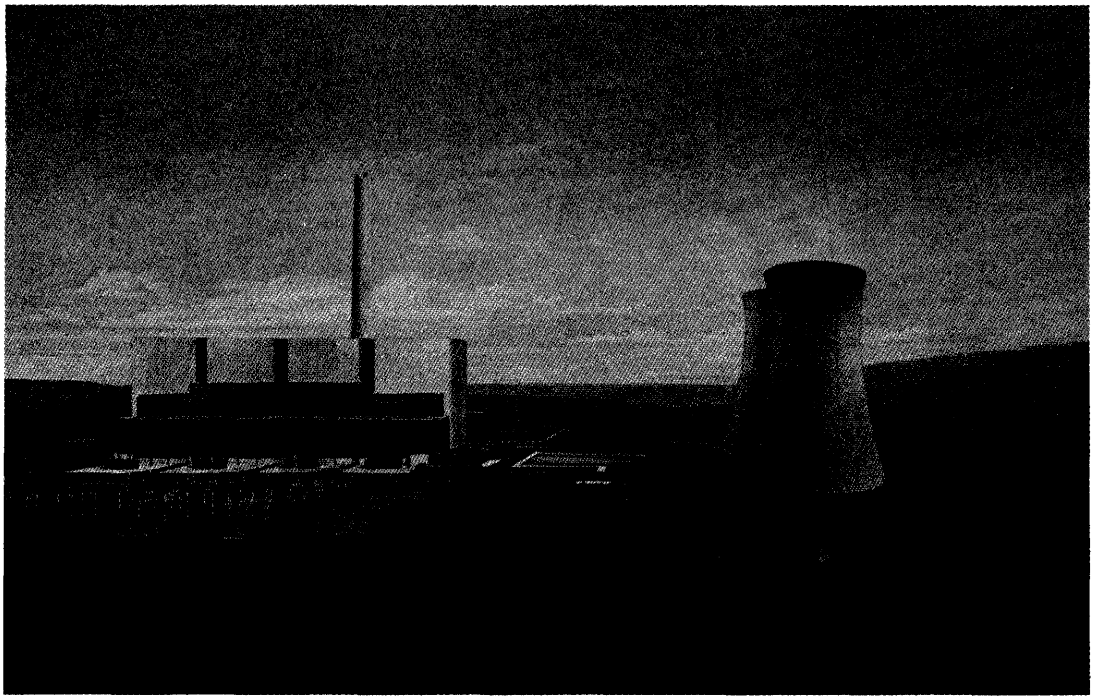


THE HAT CREEK PROJECT

Paper for Presentation at Spring Meeting of

CANADIAN ELECTRICAL ASSOCIATION
ENGINEERING AND OPERATING DIVISION
THERMAL AND NUCLEAR POWER SECTION

26 – 29 MARCH 1979

by

C.B. GUELKE, Manager – GENERATION PLANNING DEPT. (PART I)

and

D.K. WHISH, Manager – THERMAL ENGINEERING DEPT. (PART II)

B.C. HYDRO AND POWER AUTHORITY

SUMMARY

The proposed Hat Creek Project in southeastern British Columbia has involved very extensive engineering and environmental studies. This paper describes the highlights of the work undertaken.

Part I describes the planning and environmental studies while Part II presents a brief technical description of the overall project.

The Hat Creek Project is still under study and no decision has yet been made on whether or not B.C. Hydro should apply for the licences that would be required if the project should proceed.

The detailed information in this paper could therefore change prior to such a decision.

THE HAT CREEK PROJECT

CONTENTS

CONTENTS - (Cont'd)

EXHIBITS

EXHIBITS - (Cont'd)

THE HAT CREEK PROJECT

PART I - PLANNING AND ENVIRONMENTAL STUDIES OF THE PROPOSED HAT CREEK PROJECT

1.0 INTRODUCTION

In 1960 the B.C. Electric Company acquired title to coal property in the Hat Creek valley approximately 240 km (150 mi) northeast of Vancouver (see Exhibit I-1).

Exploration work was undertaken and the B.C. Electric Company commissioned studies to determine the feasibility of constructing a coal-fired powerplant utilizing this resource.

Subsequently the takeover of the B.C. Electric Company by the Crown Corporation B.C. Hydro and the provincial commitment to a "Two Rivers Policy" for the harnessing of hydroelectric power on the Peace and Columbia rivers resulted in the indefinite postponement of plans for thermal generation at Hat Creek.

A study in 1974/75 by a B.C. Hydro Task Force on future generation and transmission brought the Hat Creek deposit back into consideration as it was recommended that the first unit of a 2000 MW plant be constructed at Hat Creek in 1983, following completion of the hydroelectric project at Revelstoke which was then scheduled for 1981.

Following this recommendation, intensive detailed work commenced on the major technical issues and on environmental studies. The technical highlights of the project are covered in Part II of this paper.

B.C. Hydro's environmental studies on potential power generation projects are normally developed in two phases - a preliminary, or overview, phase followed by a detailed phase if the project continues to prove attractive. The purpose of the initial phase is to identify the major environmental constraints and outline the areas requiring attention in the detailed studies. This aids Hydro's management in deciding whether to continue investigations on a project.

As B.C. Hydro had no prior experience in coal mining or the design and construction of coal-fired powerplants, it was evident that the extensive use of engineering and environmental consultants would be required in order to successfully undertake the depth of study necessary to place the project information on a par with studies of hydroelectric alternatives and to obtain formal government approval for the project.

The major environmental impacts identified in the preliminary environmental studies, which were undertaken for B.C. Hydro by B.C. Research and Dolmage Campbell and Associates in 1975, included:

EXHIBITS - (Cont'd)

Exhibit No.

THE HAT CREEK PROJECT

PART I - PLANNING AND ENVIRONMENTAL STUDIES OF THE PROPOSED HAT CREEK PROJECT

1.0 INTRODUCTION

In 1960 the B.C. Electric Company acquired title to coal property in the Hat Creek valley approximately 240 km (150 mi) northeast of Vancouver (see Exhibit I-1).

Exploration work was undertaken and the B.C. Electric Company commissioned studies to determine the feasibility of constructing a coal-fired powerplant utilizing this resource.

Subsequently the takeover of the B.C. Electric Company by the Crown Corporation B.C. Hydro and the provincial commitment to a "Two Rivers Policy" for the harnessing of hydroelectric power on the Peace and Columbia rivers resulted in the indefinite postponement of plans for thermal generation at Hat Creek.

A study in 1974/75 by a B.C. Hydro Task Force on future generation and transmission brought the Hat Creek deposit back into consideration as it was recommended that the first unit of a 2000 MW plant be constructed at Hat Creek in 1983, following completion of the hydroelectric project at Revelstoke which was then scheduled for 1981.

Following this recommendation, intensive detailed work commenced on the major technical issues and on environmental studies. The technical highlights of the project are covered in Part II of this paper.

B.C. Hydro's environmental studies on potential power generation projects are normally developed in two phases - a preliminary, or overview, phase followed by a detailed phase if the project continues to prove attractive. The purpose of the initial phase is to identify the major environmental constraints and outline the areas requiring attention in the detailed studies. This aids Hydro's management in deciding whether to continue investigations on a project.

As B.C. Hydro had no prior experience in coal mining or the design and construction of coal-fired powerplants, it was evident that the extensive use of engineering and environmental consultants would be required in order to successfully undertake the depth of study necessary to place the project information on a par with studies of hydroelectric alternatives and to obtain formal government approval for the project.

The major environmental impacts identified in the preliminary environmental studies, which were undertaken for B.C. Hydro by B.C. Research and Dolmage Campbell and Associates in 1975, included:

1. Topographic changes and land alienation caused by the mine open pit, waste disposal areas and the powerplant.

2. Diversion of Hat Creek which runs through the proposed open pit mine.

3. Potential dusting, erosion and silting problems due to the friable nature of surficial materials.

4. Atmospheric emissions from a powerplant in the valley, in particular SO_2, and the resulting ground level concentration.

5. Withdrawal of make-up cooling water from the Thompson River.

6. Demand for housing, recreation and social services in local communities as a result of the construction and operating work force.

7. Close proximity of native Indian bands to the proposed project facilities and the potential for alteration of their lifestyle in the area.

In addition to engineering and environmental studies, B.C. Hydro retained Stone and Webster Canada Limited to conduct a coal utilization study. This study was used by B.C. Hydro to confirm the economic advantages of using the coal for electricity generation rather than as feedstock for petrochemicals or other hydrocarbon fuels.

Following the preliminary phase the project appeared sufficiently feasible to warrant a detailed site evaluation study as well as more detailed environmental studies including extensive air quality, socio-economic and land resource studies. The main alternative powerplant locations evaluated are shown on Exhibit I-2. Criteria for evaluation of sites included:

1. Proximity to Hat Creek coal and cooling water supplies.

2. Location relative to load centre.

3. Elevation and terrain for atmospheric emission dispersion considerations.

4. Land use and other resource impacts.

5. Differential comparative costs.

The site evaluation study was undertaken by Integ-Ebasco, a joint venture of Intercontinental Engineering, Vancouver, and Ebasco Services of Canada Limited, Toronto.

On the basis of engineering and economics the preferred site for the plant was in the Hat Creek valley adjacent to the proposed mine. However, air quality considerations justified a more costly location on a plateau 460 m (1500 ft) above the valley floor (see Exhibit I-3).

1.0 INTRODUCTION - (Cont'd)

The identification of the selected site was an essential prerequisite for the detailed engineering and environmental studies that followed.

2.0 ENVIRONMENTAL IMPACT ASSESSMENT

2.1 Terms of Reference

When B.C. Hydro developed comprehensive terms of reference for the Hat Creek detailed environmental studies it was evident that, compared with more familiar hydroelectric projects, a coal-fired powerplant and mine presented a further dimension of complexity. This complexity was compounded by the fact that B.C. Hydro had not previously been involved in a licensing procedure for such a project.

Draft terms of reference provided the basis for requests for proposals from environmental consultants. Refinement of the terms of reference was an ongoing process involving input from the public and government agencies, as well as the selected consultants. Over 80 consultants responded to B.C. Hydro's request for proposals. The subsequent evaluation process was extensive and, ultimately, eight consultants were selected to undertake the 22 studies outlined in the terms of reference. The breakdown of the components of the environmental studies is presented in Exhibit I-4.

B.C. Hydro did not wish to limit the opportunity of consultants - particularly local consultants - to participate in what had become a well publicized project. Several of the selected consultants in turn employed subconsultants for technical assistance, which finally resulted in more than 20 consultants participating in the studies.

Exhibit I-5 presents some of the major criteria considered by B.C. Hydro in the selection of consultants.

Ebasco Services of Canada Limited, using a subcontractor Envirosphere Company of New York, with their extensive thermal plant and environmental background, were appointed to provide scheduling, cost control and overall coordinating and reporting functions to B.C. Hydro for the complete detailed environmental studies.

2.2 Detailed Environmental Studies

B.C. Hydro's environmental studies can generally be divided into two phases; a data assembly and presentation phase and a data evaluation phase.

Thus, for the Hat Creek studies the first and relatively straightforward exercise was the collection of environmental resource inventory data to allow definition of the present and projected environmental conditions without the project.

The second, and more difficult, phase required that the impacts of construction, operation and decommissioning of the project on the environment be identified. Emphasis was placed on participation by the environmental consultants in development of satisfactory compromises between environmental constraints and engineering or economic requirements.

The methodology developed for environmental impact assessment was carefully scrutinized to ensure continuity and consistency in presentation of results by the consultants.

The complexity of the project and the involvement of so many consultants was not without its coordinating challenge. Scopes of work, budgets and schedules underwent several rounds of revision as the environmental and project design studies progressed.

As with the preliminary study, the priority issue addressed in the detailed studies was the effect of the project on air quality. The topography of the area required that the air modelling studies be supplemented with gas tracer studies to assist in the calibration of the modelling. State of the art techniques were developed for modelling in rough terrain as well as for predicting effects of thermal plant emission on the chemistry of precipitation.

Although the sulphur content of the coal is low, it was considered important to demonstrate that the ambient SO_2 levels would be within acceptable limits and not present hazards to health or vegetation.

In order to achieve this objective, several air quality control strategies were evaluated. These included:

1. Flue gas desulphurization with a tall powerplant stack, 366 m (1200 ft).

2. Meteorological control system with a tall stack, 366 m (1200 ft).

3. Meteorological control system with a shorter stack, 244 m (800 ft).

The meteorological control strategy involves load reductions and/or switching to lower sulphur coal to reduce plant emissions during adverse meteorological conditions.

Exhibit I-6 presents some of the potential environmental impacts of the project on air, land, water, socio-economic and other resources which the consultants discussed in their reports. B.C. Hydro will address these and other impacts in mitigation and compensation proposals should a decision be made to seek approval for the project. Several consultants' reports identified areas which warranted additional investigation that B.C. Hydro has acted upon. For example, supplemental work has been initiated on trace element analysis, effects of long-range transport of powerplant emissions and the implications of acid precipitation and mine dust control to more explicitly define the potential for environmental impacts.

3.0 PROJECT LICENSING

Unlike hydroelectric projects, where B.C. Hydro has had a familiarity with the formal project application process as required by the Water Act, large-scale coal-fired powerplants have not previously been constructed in the province and the various formal approvals required are quite cumbersome.

In the case of the Hat Creek Project, the pollution control permit, mine reclamation permit and water licence represent important approvals.

In British Columbia, pollution control objectives are developed for various industries which provide for flexibility in application of the Pollution Control Act. The objectives, which are periodically reviewed by the Pollution Control Board, are used by applicants for general guidance in preparing specific projects for permit applications. The permit issued by the Pollution Control Branch defines the specific limitations or regulations which apply to each project.

B.C. Hydro participated in the January 1978 inquiry conducted by the province's Pollution Control Board. This inquiry into the pollution control objectives for the mining, mine-milling and smelting industries included review of appropriate emission and ambient objectives for coal-fired powerplants. At the time of writing the final powerplant objectives to be adopted by the Board have not been released.

The detailed environmental studies of the project comprise more than 30 volumes of reports (approximately 8000 pages). A condensed environmental impact statement, of perhaps 200 pages, will be authored by B.C. Hydro, to accompany licence applications, if the decision is made by B.C. Hydro to proceed with the project. This statement would include a description of the project, highlight the impacts, present a benefit-cost analysis of project component alternatives and present B.C. Hydro's plans for mitigation and compensation of impacts.

4.0 COMMUNITY RELATIONS

The Hat Creek valley is picturesque and while the few residents in the area, largely ranchers and native Indians, were aware that the huge deposits of coal existed in the valley, it did not make their acceptance of a possible mine and powerplant any easier.

The project planning has included pursuit of an active program of community involvement. The purpose was to develop a dialogue with those who may be affected or concerned about the potential impacts of the Hat Creek development so that issues of local and general public concern could be identified at a flexible stage of planning. Numerous meetings were arranged with local, regional and municipal officials, residents of the valley, local Indian bands, regional government resource agencies and the general public.

The results of this program included:

1. The adoption by B.C. Hydro of a purchase - leaseback policy for local landholders or residents who felt their future planning jeopardized by uncertainty about the development of the project.

2. Ongoing discussions with the local Indian bands which allowed them to carry out their own independently funded assessment of the project.

3. The identification of a number of environmental concerns that were subsequently included in the consultants' terms of reference.

4. The formation of a subcommittee of the regional government to advise on social and land use issues.

5. Generally good communications between the project planners, the consultants and those who might be affected by the project.

5.0 HAT CREEK PLANNING STATUS

The environmental studies for the Hat Creek Project have covered a period of over 2 years, a time in which B.C. Hydro has significantly increased its environmental appreciation of coal-fired powerplants as well as its appreciation of how it could improve its utilization of consultants in studying a large-scale project of this nature.

By working closely with government agencies throughout the study and by keeping the public informed as the project progressed, surprises in the licensing process should be kept to a minimum, if B.C. Hydro decides to make formal application to construct the project.

Since detailed studies on the project began, load growth projections for the B.C. Hydro system have been reduced. This has resulted in a rescheduling of the Revelstoke project to 1983 and has deferred the requirement for B.C. Hydro's subsequent generation project to about 1986.

Also, this breathing space has permitted alternative hydroelectric sources to be considered for service in advance of the Hat Creek project. Thus, while the Hat Creek project is in a most advanced stage of planning, one cannot predict a firm commitment date at this time.

In the event of an early commitment to the Hat Creek Project, design would proceed on the basis of conventional combustion technology (pulverized firing). However, B.C. Hydro has also been closely following other possible conversion processes such as fluidized bed combustion and coal gasification. These technologies may be available for large scale electrical utility application by the mid to late-1990s.

6.0 CONCLUSIONS

The Hat Creek detailed environmental studies probably represent the most extensive environmental planning studies conducted for any new coal-fired power project in Canada and possibly in North America.

B.C. Hydro now has a wealth of environmental information on the project and this should prove to be invaluable, irrespective of when the decision is finally made to harness the vast Hat Creek coal resource.

While one may have proceeded differently with the studies, given the benefit of hindsight, it is anticipated that when the environmental reports are eventually made public they will be a credit to B.C. Hydro's environmental efforts and those of the environmental consultants who undertook the studies.

1.0 INTRODUCTION

1.1 Basic Project

The Hat Creek Project, for which the extensive planning and environmental study activities outlined in Part I have been carried out, is essentially:

1. A 2000 MW (net) powerplant with 4 x 500 MW (net) units, a 16.6 MPa/538^{o}C/538^{o}C (2400 psig/1000^{o}F/1000^{o}F) conventional cycle, suitable for base load operation and with provision for two-shift operation, and located on a plateau near the mine.

2. An openpit mine to produce blended coal from deposit No. 1 at the north end of the Hat Creek valley.

3. Related offsite facilities, including a 21-km (13-mi) pipeline for make-up water from the Thompson River.

The project is a "minemouth" operation located in rugged terrain near Ashcroft in the dry interior of B.C. (see Exhibit II-1) where ambient temperatures range from -40^{o}C (-40^{o}F) in winter to 40^{o}C (104^{o}F) in summer.

1.2 Consultants

The project has been developed, in the three main project areas above, using the following main consultants:

(a) Powerplant

Conceptual design and preliminary engineering have been carried out by Integ-Ebasco, a joint venture of Intercontinental Engineering and Ebasco Services.

(b) Mine

A preliminary study was carried out by a joint venture of Powell Duffryn-National Coal Board Consultants Ltd. in association with Wright Engineers Ltd. and Golder Associates. This was followed by detailed mining and coal quality studies by a Vancouver-based joint venture of Cominco and Montreal Engineering, with Simon-Carves and others as sub-consultants.

(c) Offsite Services

The Hydroelectric Design Division of B.C. Hydro provided overall coordination and also detailed design study input in the areas of the offsite services within their normal field of activities. For the Thompson River make-up system conceptual and preliminary engineering services were provided by Sandwell and Company Limited.

Related architectural services for all parts of the project have been provided, where necessary, by Toby, Russell, Buckwell & Partners, of Vancouver.

2.0 HAT CREEK COAL

2.1 Deposit Description

The Hat Creek valley runs north-south and is about 26 km (16 mi) long and 6 km (3.8 mi) wide. It contains two large near-surface coal deposits. The local map (Exhibit II-2) shows No. 1 deposit at the north end of the valley and the larger No. 2 deposit further south. The existence of coal has been confirmed down the length of the valley with the total resource estimated at between 10 and 15 billion tonnes, making it one of the largest concentrations of coal, in such a small area, in the world.

The proposed Hat Creek Project is based upon use of only the No. 1 deposit, with mining to a depth of approximately 244 m (800 ft), to provide coal for the 2000 MW powerplant over a period of 35 years at a lifetime capacity factor of 65 percent.

A photograph of the Hat Creek valley, from the north end, showing the openpit No. 1 area is shown on Exhibit II-3.

No. 1 deposit contains over 700 Mt (772 million short tons) in four basic zones, or thick "seams". The zones vary from horizontal to almost vertical as shown on Exhibits II-4 and II-5, which show north-south and east-west sections respectively through the No. 1 deposit. The "seams" are over 100 m in thickness in many areas.

Hat Creek is to be diverted where it runs across the No. 1 deposit area.

About half of the coal in No. 1 deposit will provide the lifetime powerplant fuel requirements of approximately 350 Mt (386 million short tons). Waste materials removed from the No. 1 openpit in the powerplant lifetime will be about 900 Mt (992 million short tons) with an average stripping ratio of 1.3 bank m^3/t of coal.

2.2 Mining Operation

It is proposed to mine in benches by a truck/shovel operation to a final pit depth of approximately 244 m (800 ft). Pit slopes of only 16 to 25 degrees are necessary due to the surrounding geotechnical limitations. After 35 years the top of the pit will be approximately 4 km (2.5 mi) wide x 2.7 km (1.7 mi) long.

Exhibit II-6 shows the predicted pit outline in year No. 35. Coal and waste will be conveyed to the surface.

Waste materials will then be conveyed to two large dumps, behind engineered retaining embankments, adjacent to the pit.

Run-of-mine coal for the powerplant will be crushed to -300 mm (-12 in) in primary crushers in the pit and to -50 mm (-2 in) in secondary crushers at the surface and then conveyed to blending/storage piles.

A "datum" blended coal will be reclaimed from the blending/storage piles for delivery by an overload conveyor some 4 km (2.5 mi) long, with a lift of 460 m (1500 ft), to the powerplant area.

2.3 Coal Quality

Considerable drilling and analysis work has been done to assess the coal in No. 1 deposit and its optimum use. In general, it is low in heating value, high in ash, fairly high in moisture and low in sulphur. It ranks somewhere near the borderline of sub-bituminous and lignite-type coals. The presence of large proportions of bentonitic-type clays in the ash affects its physical characteristics, especially when it is wet.

Four coal zones are disposed in the unique manner shown on Exhibits II-4 and II-5. Three of these zones show considerable variation within the zone, presenting a challenge to the mining and preparation of a reasonably uniform powerplant coal.

Various mine cutoff levels and beneficiation and blending schemes were studied, resulting in the present decision to produce powerplant coal by blending run-of-mine coal above a cutoff level of 9300 kJ/kg (4000 Btu/lb).

On this basis a powerplant "datum" fuel of the following analysis is proposed:

	Dry	As Received
Volatile Matter, %	32.2	24.2
Fixed Carbon, %	31.4	23.6
Ash, %	36.3	27.2
Sulphur (total), %	0.48	0.36
Moisture (total), %	-	-
HHV kJ/kg	17 043	12 782
(Btu/lb)	7,327	5,495

Grindability (Hardgrove Index)	50
Ash Initial Deformation Temperature in Reducing Atmosphere	1330°C (2426°F)
Ash Fluid Temperature in Reducing Atmosphere	1400°C+ (2550°F)

At full load the 2000 MW powerplant will consume about 1800 t/h (2000 short tons/hour) of the proposed "datum" coal. The annual consumption will be about 11 Mt (12 million short tons).

3.0 POWERPLANT

3.1 General

Exhibit II-7 shows an artist's impression of the overall project from the air.

Exhibit II-8 shows a close-up impression of the powerplant which would comprise 4 x 560 MW (gross) units. The high auxiliary power requirement of 60 MW per unit includes the electrical load for the mining operation and also pumping power for lifting make-up water from the Thompson River.

The proposed powerplant site layout is shown on Fig. II-9.

3.2 Powerplant Coal Handling System

The overland conveyor from the blending/storage area of the mine will normally deliver coal direct to the boiler silos. Provision is made, however, at the powerplant site, for both "live" and "dead" storage. Provision is also made for the handling and storage of very low sulphur coal from the "good" zone of the mine for use, if and when required, in the proposed meteorological control system for SO_2 reduction.

3.3 Boilers

With coal of low quality and difficult physical characteristics the specifications for the boilers and auxiliaries are of vital importance.

Some of the performance requirements and design features proposed are as follows:

MCR Capacity	-	488 kg/s (3,875,000 lb/hr)
Steam Conditions	-	17 600 kPa/541°C/541°C (2550 psig/1005°F/1005°F)
Gas Exit Temperature	-	150°C (300°F)
Overall Design	-	Conservative North American practice for low-rank coals. Indoor design

		(except for precipitators, I.D. fans). Very specific maintainability requirements.
Furnace	-	"Open" type, balanced draft, opposed or tangential firing, bottom designed to suit continuous bottom ash removal. Conservative heat release rates, e.g. 19.3 GJ/m^2 (1.7 x 10^6 Btu/ft^2) plan area/hour.
Circulation	-	Natural or controlled.
Gas Velocity	-	Under 13.7 m/s (45 ft/sec)
Sootblowers	-	Steam
Pulverizers	-	Of proven throughput capacity with similar low-rank coals. Eight per unit of which seven can produce full load continuously with "datum" coal.

Preliminary submissions by major boiler suppliers indicate furnace dimensions around 18 m (60 ft) wide x 16.8 m (55 ft) deep. The total boiler height will be in the order of 88 m (290 ft).

The development work on coal quality assessment, fuel specifications and basic boiler parameters has included two series of burn tests on Hat Creek coals.

In 1976 some washed and unwashed samples from augered holes were taken to Ottawa for combustion tests in the CCRL facilities. A preliminary run was first carried out with coal from the Sundance plant of Calgary Power for comparative purposes. These tests enabled a first assessment of combustion characteristics, boiler fuel low quality limit, precipitator performance and other parameters to be established.

In the summer of 1977 burn tests were carried out on a larger scale, using coal near the proposed low quality limit, on a 32 MW unit at the Battle River Powerplant of Alberta Power Limited. This unit has a new electrostatic precipitator, which allowed some basic design parameters for Hat Creek to be established. Comparative tests were also run on Battle River coal. The Battle River tests confirmed the very reactive nature of the Hat Creek coal, its low slagging and moderate fouling characteristics, and established that the proposed low quality limit was realistic.

Oil is proposed as auxiliary fuel. The studies also considered the use of coal for warm-up and stabilizing to restrict auxiliary fuel usage to ignition only.

3.0 POWERPLANT - (Cont'd)

3.4 Ash

As each boiler will produce about 30 t of bottom ash and 92 t of fly ash per hour at full load, particular attention has been given to ash removal and subsequent disposal.

For bottom ash a continuous drag-bar conveyor in a water trough below the furnace throat is proposed.

Fly ash from the electrostatic precipitators will be collected dry and subsequently moistened for conveying with the bottom ash to a "dry" ash disposal area in a nearby valley. The disposal area will also be used later for disposal of some mine waste and eventually covered with topsoil for reclamation.

3.5 Other Powerplant Features

A conventional four-unit layout as shown on the General Arrangements (Exhibits II-10, II-11 and II-12) is proposed.

The 560 MW (gross) turbine-generator specifications will call for features which allow reasonable flexibility in operation of the boilers. For example, separate HP and IP cylinders may be preferred to allow reasonable tolerance in temperature difference between superheat and reheat.

A four-flow exhaust end is expected, and twin shell dual-pressure series condensers, to produce a mean winter design back pressure of approximately 6.75 kPa (2-inch Hg), are proposed. In summer mean back pressure will rise to about 10 kPa (3-inch Hg).

Seven stages of feedwater heating are proposed, with four low-pressure heaters, a deaerator and two high-pressure heaters.

A single 100 percent turbine-driven boiler feedpump, one electric motor-driven 100 percent booster pump and a small start-up feedpump are proposed for each unit. Exhibit II-13 shows a simplified diagram of the main cycle. A station net heat rate, at full load, of 11 278 kJ/kW.h (10,700 Btu/kWh) is predicted.

3.6 Cooling Water System

Cooling water for the condensers will be pumped from two natural draft hyperbolic cooling towers, one tower serving two units. Each tower will be about 135 m (443 ft) high and 102 m (335 ft) diameter. The principal design parameters for the circulating water system are wet-bulb temperature 13.9°C (57°F), range 19°C (34°F) and approach 13°C (23°F). Cooling water flow over each tower at full load will be 19 000 L/s (300,000 USgal/min).

Make-up water to the cooling towers and other powerplant systems will come from a man-made reservoir in an adjacent valley. Replenishment of the reservoir is described later.

3.0 POWERPLANT - (Cont'd)

3.7 Electrical

There are no unusual features in the proposed electrical systems.

The powerplant site is close to the route of a planned 500 kV transmission line running from Kelly Lake to Nicola. The Hat Creek powerplant would feed into this line at a point about 240 km (150 mi) from Vancouver. Exhibit II-14 shows the relative location of Hat Creek on the B.C. Hydro electrical system.

A 60 kV switchyard and transmission line would serve the mining operation in the Hat Creek valley.

Powerplant auxiliary power requirements are higher than normal due to the low quality fuel and high ash content. 6.9 kV motors are proposed for the large horsepower drives.

3.8 Civil

The powerplant civil works do not involve any unusual design problems. Foundation conditions are good at the proposed site, which is in seismic zone 1. Major design features will include the two reinforced concrete natural draft cooling towers and the single stack for four units which will be some 244 m (800 ft) high and 22 m (72 ft) in diameter at the top.

Building enclosures will be conventional insulated metal siding with a general appearance as shown on Exhibit II-8.

3.9 Powerplant Emissions

Part I of this paper has described the extensive studies on possible environmental impacts of the proposed Hat Creek Project.

From the powerplant design and operation viewpoint, work has proceeded assuming normal Canadian plant design practices, with appropriate inclusion of features to meet environmental requirements.

For instance, a 244-m (800-ft) four-flue single stack is proposed in addition to location, for air quality reasons, of the powerplant 460 m (1500 ft) higher than the valley floor at No. 1 openpit.

Preliminary work completed has assumed reasonable emission and ambient levels and the present project design position is as follows:

(a) SO_2

Assuming that all sulphur is emitted as SO_2 the emission level, with the "datum" coal, would be just under 1.4 lbs. of $SO_2/10^6$ Btu input. The powerplant base scheme does not include flue gas desulphurization but space has been left at the rear of the stack for partial scrubbers or other devices, should these prove necessary.

A meteorological control system (MCS), as described in Part I of the paper, is proposed to serve during adverse weather conditions if ambient SO_2 levels approach a permit limit.

(b) Particulates

The powerplant base scheme includes "cold" electrostatic precipitators, with an efficiency of approximately 99.6 percent to provide an emission level below 0.1 grains/scf.

Baghouses have been studied as an alternative.

(c) NO_x

An emission level below 0.7 lbs $NO_x/10^6$ Btu input will be called for in the boiler specifications and provided by appropriate furnace/burner/air flow designs.

4.0 OFFSITE FACILITIES

4.1 Water Make-up System

To replenish the make-up water reservoir adjacent to the powerplant, water from the Thompson River will be delivered 21 km (13 mi) by pipeline with a static lift of some 1013 m (3325 ft).

An intake pumphouse on the Thompson River just north of Ashcroft will house screens and river water pumps which will supply the first high-pressure pumphouse located on the bank nearby. Exhibit II-15 shows the proposed intake and pumphouse which incorporates special features to maintain water velocity past the screens and minimize the impact on fish in this important river. A hydraulic model was built to confirm satisfactory flow conditions past the screen openings.

Two high-pressure pumphouses, one at the river bank and a similar one halfway in the rise to the powerplant, will deliver water to the reservoir. Each high-pressure pumphouse includes four pumps of about 4800 hp each. The design flow rate (maximum) is 1580 L/s (25,000 USgal/min). Exhibits II-16 and II-17 show respectively the route and profile of the proposed pipeline.

The reservoir capacity near the powerplant will allow considerable flexibility in the pumping regime from the Thompson River.

4.0 OFFSITE FACILITIES - (Cont'd)

4.2 Other Offsite Facilities

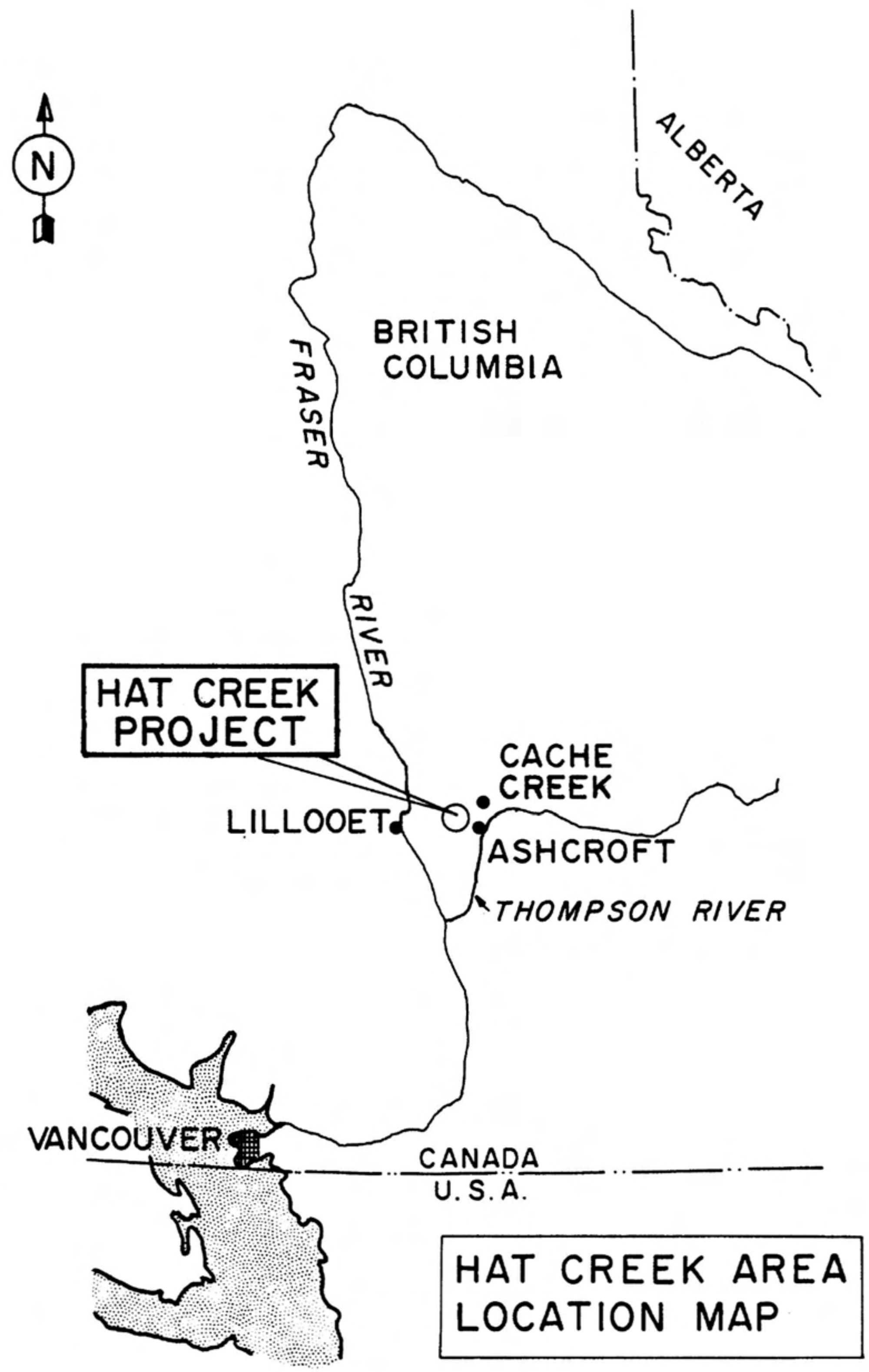
All project-related works other than the mine and powerplant are part of the offsites services, which include the water make-up system, roads, diversion of Hat Creek and other creeks, provision of earthwork containments such as the plant reservoir, and camp facilities. A small airstrip may be included.

5.0 CONCLUSION

Part II of this paper offers only a necessarily brief description of the technical highlights of a very large and complex project.

A peak construction work force of over 3000, and a permanent operating staff, in powerplant and mine, of around 1000 would be required.

A design, construction and commissioning schedule spanning 5 years from start to commissioning of the first unit would be required, with the other three units following at 1-year intervals. This does not include time for licence applications and approvals.



HAT CREEK AREA LOCATION MAP

EXHIBIT I-1

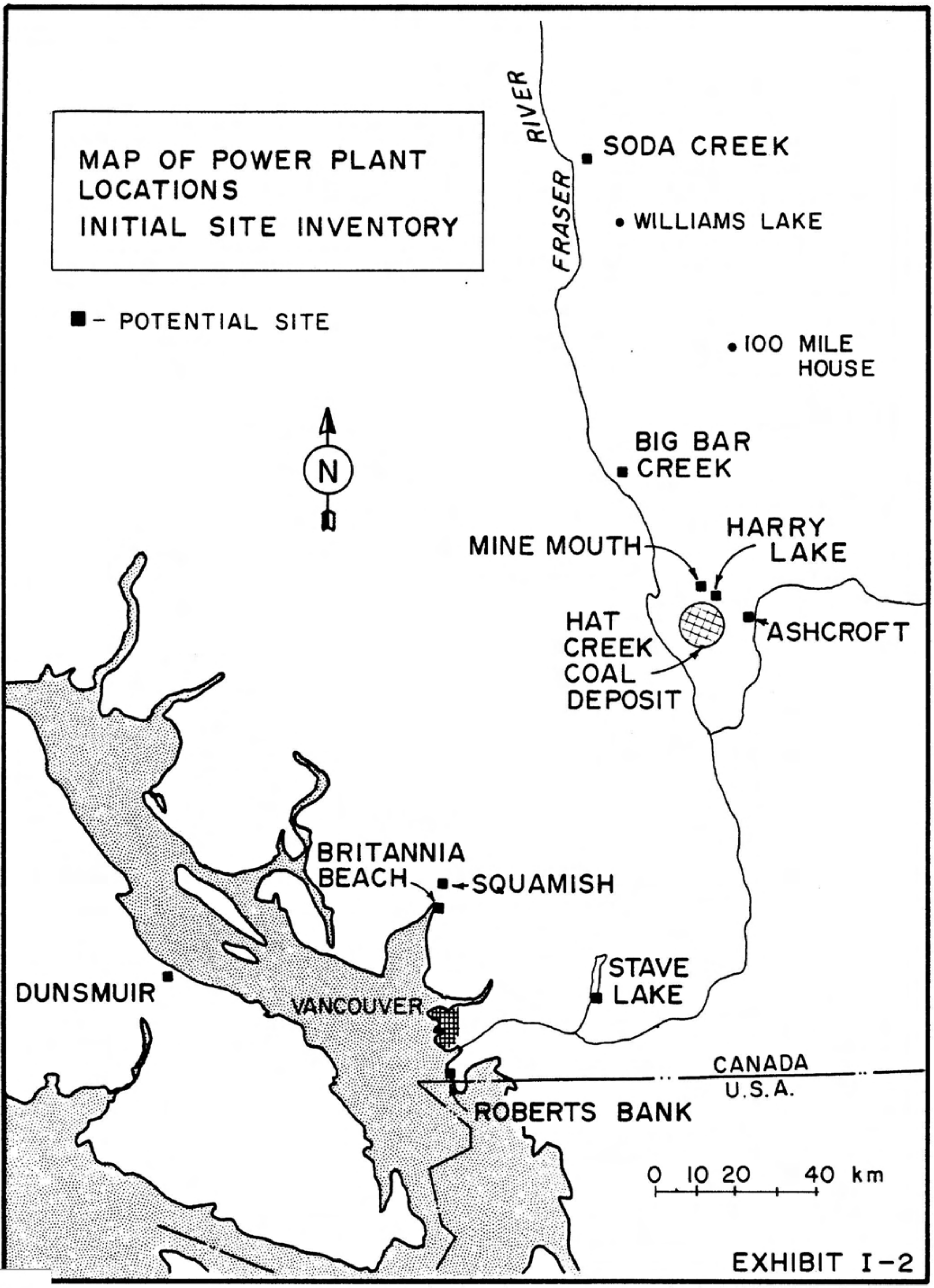
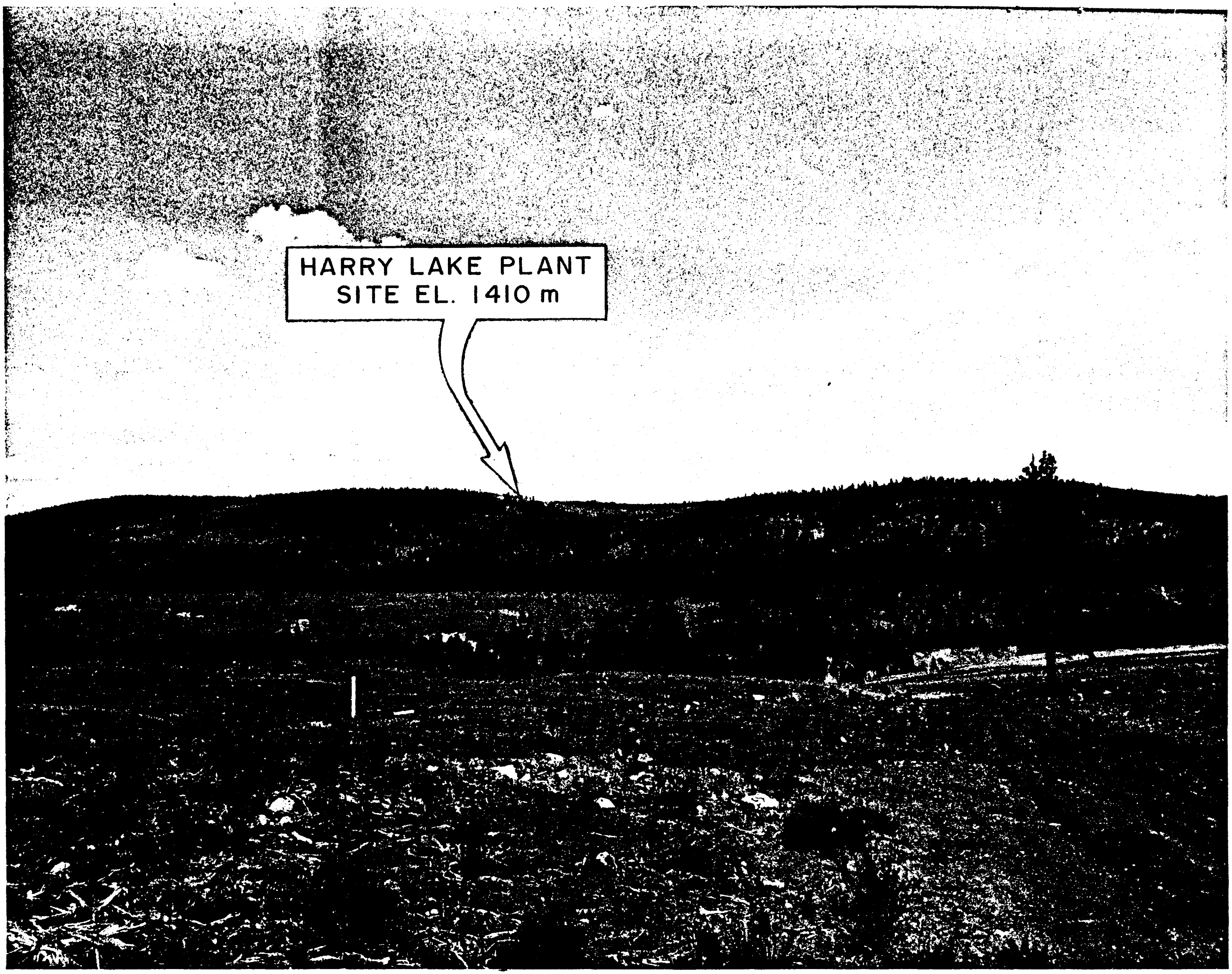

MAP OF POWER PLANT LOCATIONS
INITIAL SITE INVENTORY
■ - POTENTIAL SITE
N
FRASER RIVER
SODA CREEK
WILLIAMS LAKE
100 MILE HOUSE
BIG BAR CREEK
MINE MOUTH
HARRY LAKE
HAT CREEK COAL DEPOSIT
ASHCROFT
BRITANNIA BEACH
SQUAMISH
STAVE LAKE
DUNSMUIR
VANCOUVER
CANADA
U.S.A.
ROBERTS BANK
0 10 20 40 km

EXHIBIT I-2



VIEW OF HAT CREEK VALLEY
(FACING EAST FROM ELEVATION 975 meters)

EXHIBIT I-3

PROPOSED HAT CREEK DEVELOPMENT DETAILED ENVIRONMENTAL STUDIES

A. Land Resources Sub-group

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

B. Water Resources Sub-group

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

C. Socio-economic Sub-group

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

D. Air Quality Sub-group

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

E. General Sub-group

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

Exhibit I-4

MAJOR CRITERIA* FOR SELECTION OF CONSULTANTS

1.	Experience	Staff Resumes
2.	Professional Qualifications	
3.	Technical Capability	

4. Cost
5. Organizational Structure
6. Dependability, Reliability and Stability
7. Quality Assurance Techniques
8. Tenure of Staff
9. References
10. Size of Staff, Facilities and Resources
11. Subcontracting Requirements
12. Assignment of Project Managers, Leaders or Coordinators
13. Flexibility and Promptness to Questioning
14. Responsiveness to the Needs of the Client
15. Proximity to the Client and Familiarity with Local, Regional, Provincial and Other Conditions

---

* Not necessarily listed in any particular order.

Exhibit I-5

SOME OF THE POTENTIAL ENVIRONMENTAL IMPACTS* OF THE PROPOSED 2000 MW HAT CREEK DEVELOPMENT

1. Direct land alienation within the Hat Creek valley and at the water intake site.

2. Possible sulphur dioxide impacts on vegetation at higher elevations.

3. Intermittent pH reductions in precipitation due to H^+ ion loading (natural wind variability would preclude widespread acidification).

4. Possible forest production losses due to land clearing and SO_2 and fluoride emissions.

5. Possible decrease in forage production and subsequently the beef cattle industry due to land alienation and stack emissions.

6. Short-term local area population increase of ≅ 6000** during construction.

   Permanent increase of ≅ 4000** during operation.

7. Increased local and regional employment and expansion and diversification of commercial, recreational and cultural facilities.

8. Localized effects on groundwater regime due to openpit mining.

9. Loss of natural Hat Creek stream channel due to diversion of creek around the openpit.

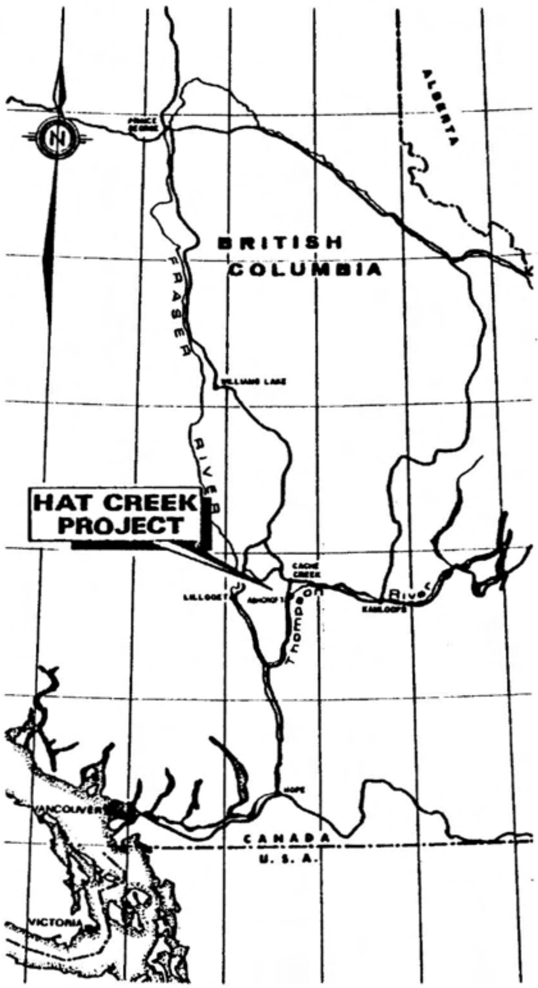
10. Visual impact on the north end of the Hat Creek valley along Highway 12 to Marble Canyon.

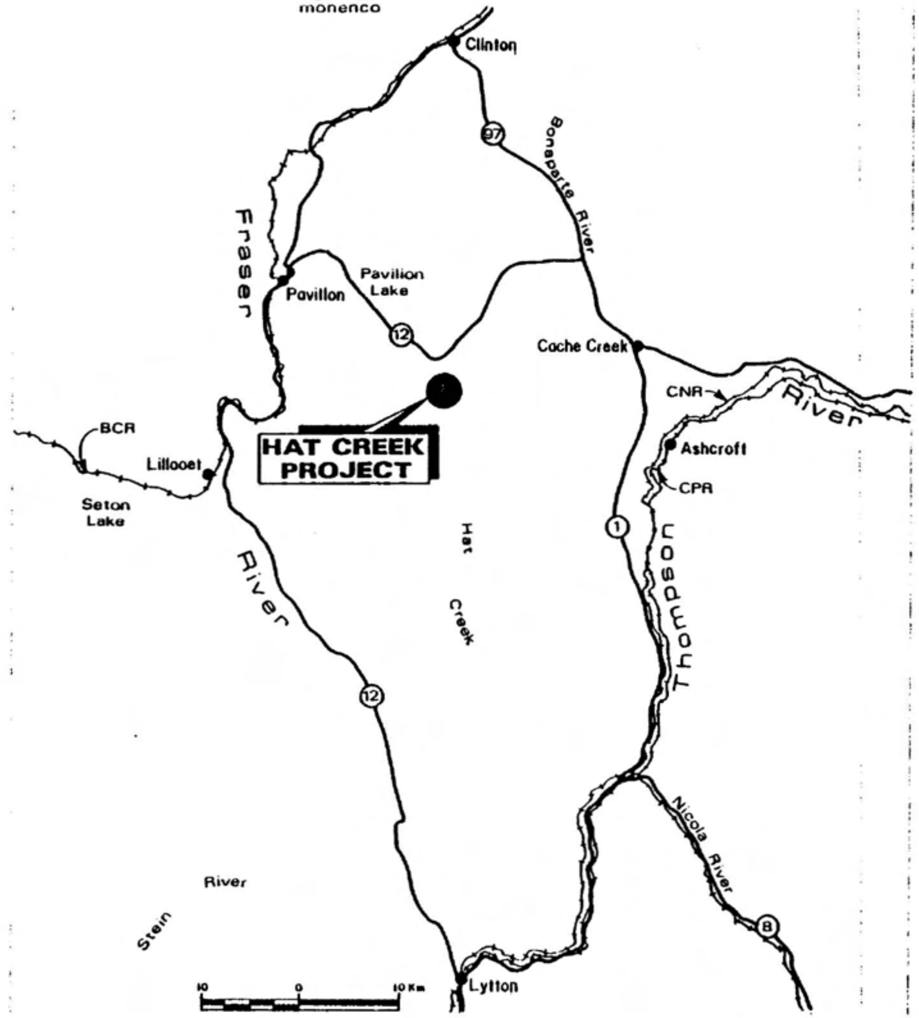
---

* Not necessarily listed in any particular order.

** Includes population influx in addition to the project work force.

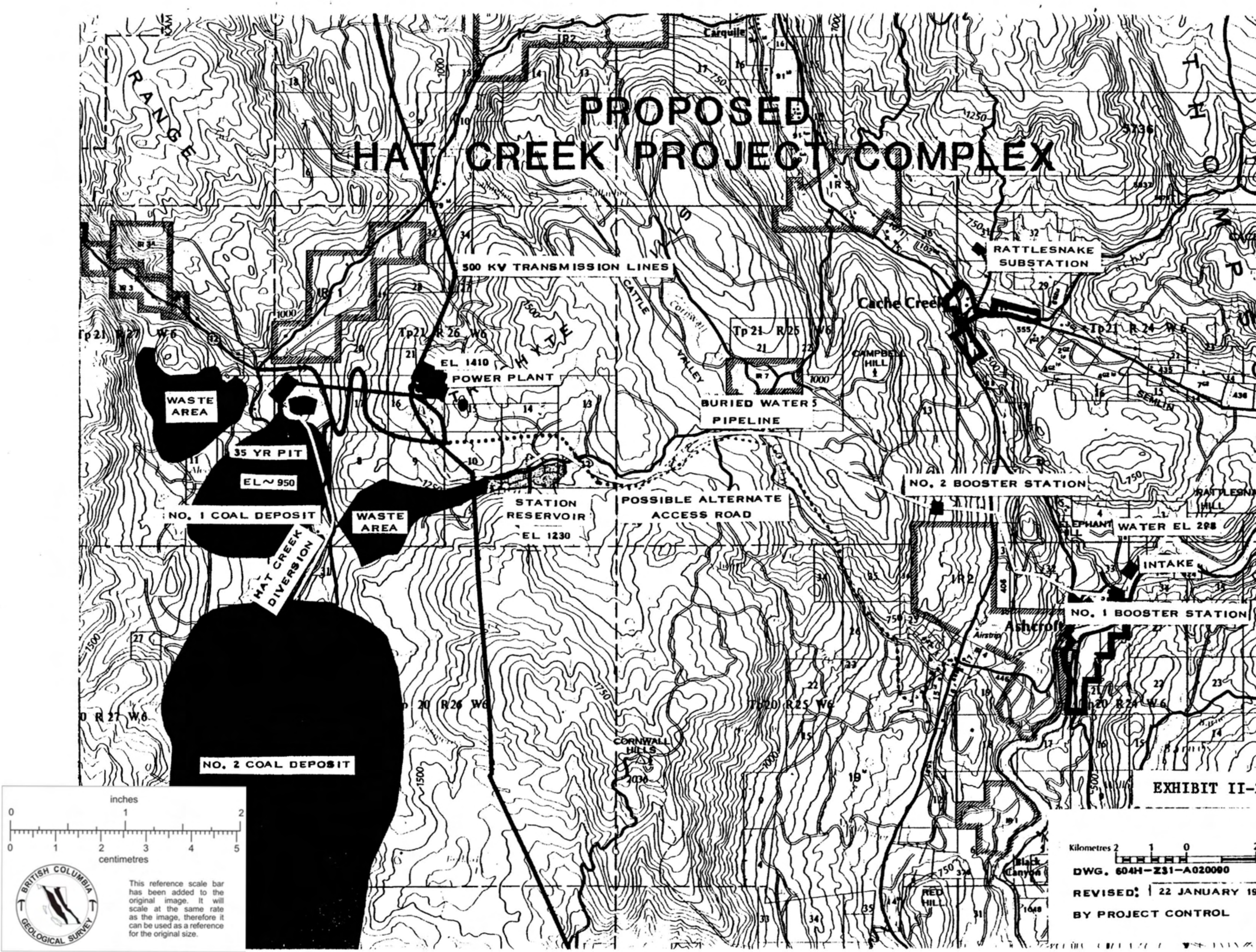
cominco-monenco joint venture

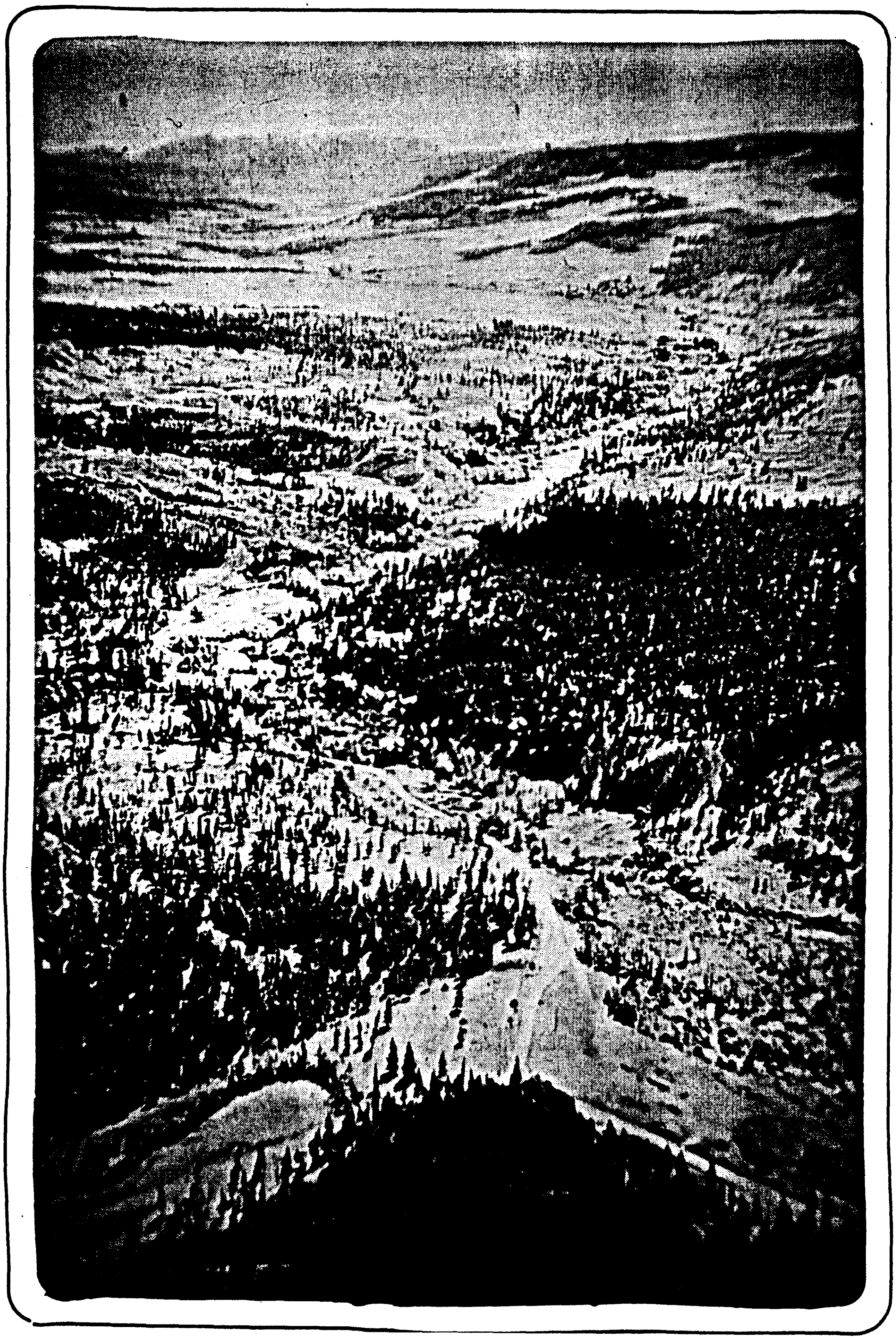




BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
PROJECT LOCATION

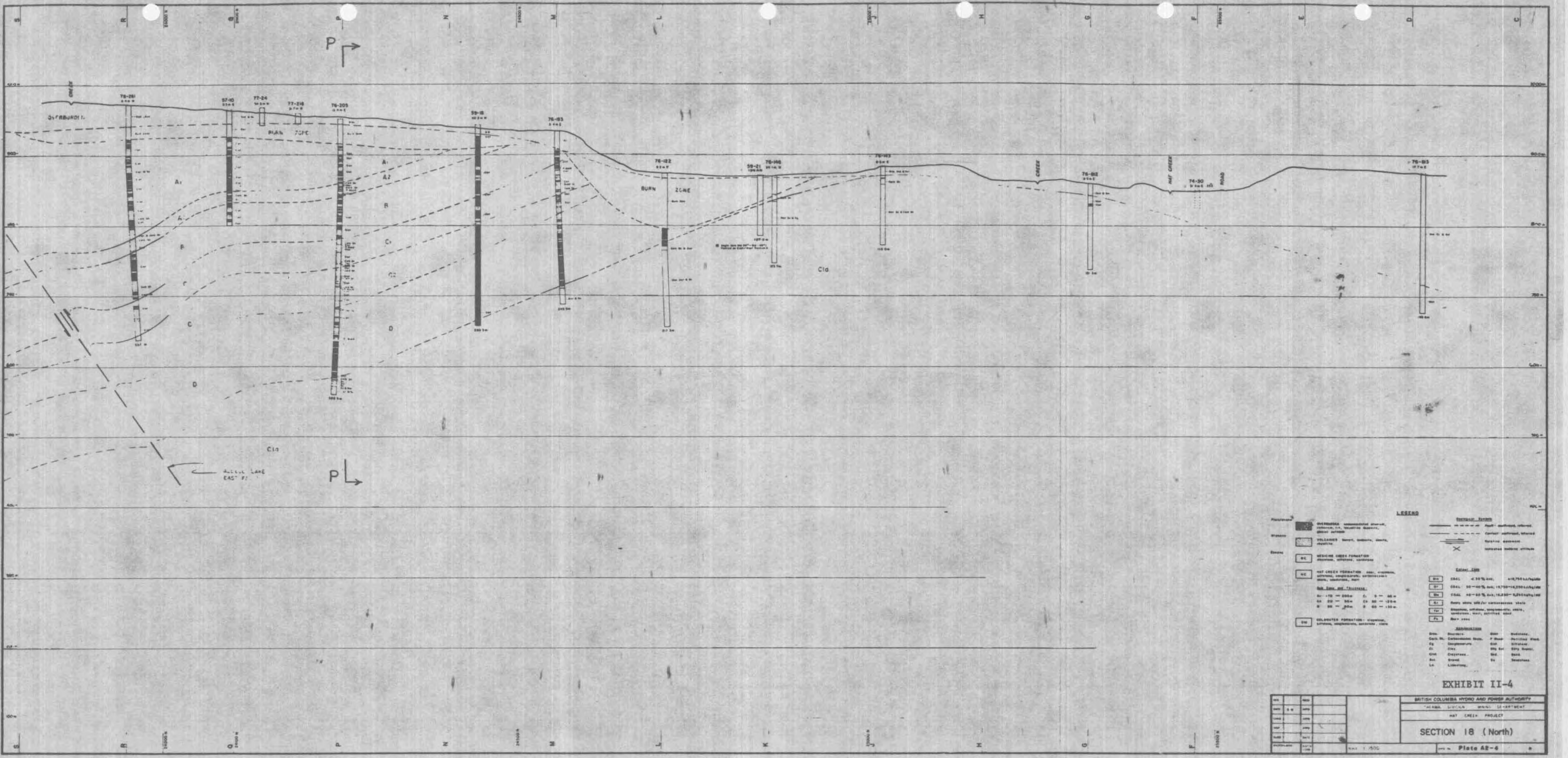
EXHIBIT II-1


PROPOSED
HAT CREEK PROJECT COMPLEX
RANGE
500 KV TRANSMISSION LINES
RATTLESNAKE SUBSTATION
Cache Creek
EL 1410
POWER PLANT
WASTE AREA
35 YR PIT
EL~950
NO. 1 COAL DEPOSIT
HAT CREEK DIVERSION
WASTE AREA
STATION RESERVOIR
EL 1230
POSSIBLE ALTERNATE ACCESS ROAD
BURIED WATER PIPELINE
CAMPBELL HILL
NO. 2 BOOSTER STATION
WATER EL 298
INTAKE
NO. 1 BOOSTER STATION
Ashcroft
NO. 2 COAL DEPOSIT
CORNWALL HILLS
RED HILL
EXHIBIT II-
Kilometres 2 1 0
DWG. 604H-Z31-A020090
REVISED: 22 JANUARY 19
BY PROJECT CONTROL
inches
0 1 2
0 1 2 3 4 5
centimetres
BRITISH COLUMBIA GEOLOGICAL SURVEY
This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

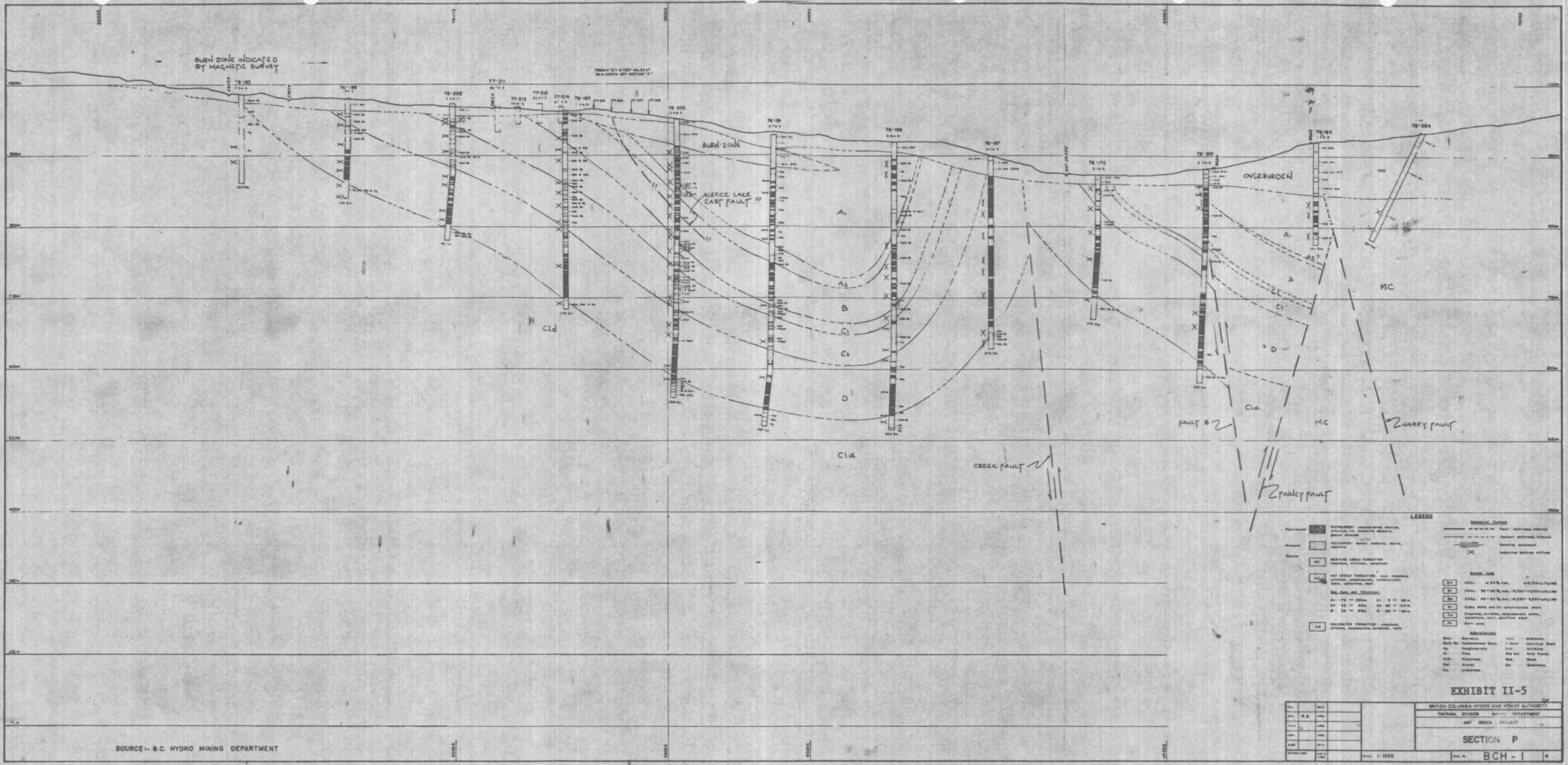


VIEW OF HAT CREEK VALLEY
FROM NORTH END

EXHIBIT II-3



LEGEND
HAT CREEK FORMATION
COLDWATER FORMATION
EXHIBIT II-4
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
SECTION 18 (North)
Plate A2-4
BURN ZONE
OVERBURDEN
HAT CREEK
CREEK
ROAD


BURN ZONE INDICATED BY MAGNETIC SURVEY
BURN ZONE
ALEECE LAKE EAST FAULT ??
OVERBURDEN
CREEK FAULT
FAULT B
FINNEY FAULT
HARRY FAULT
MC
Cld
A₁
A₂
B
C₁
C₂
D
76-182
76-188
76-202
77-211
77-213
77-212
77-214
76-190
76-205
76-191
76-199
76-187
76-172
76-201
76-184
78-284
LEGEND
EXHIBIT II-5
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
THERMAL DIVISION MINING DEPARTMENT
HAT CREEK PROJECT
SECTION P
1:1500
BCH-1
SOURCE:- B.C. HYDRO MINING DEPARTMENT

cominco-monenco joint venture

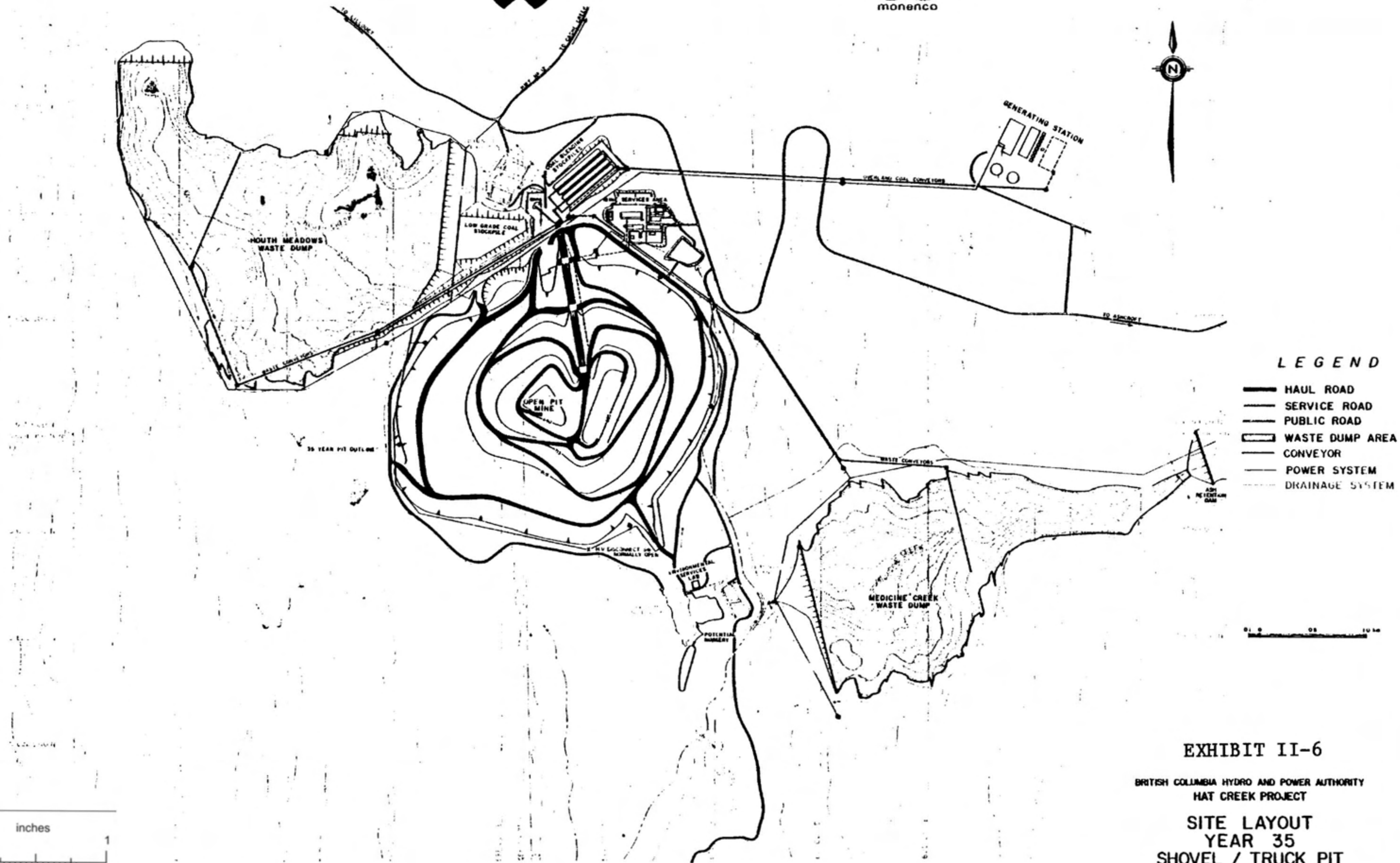
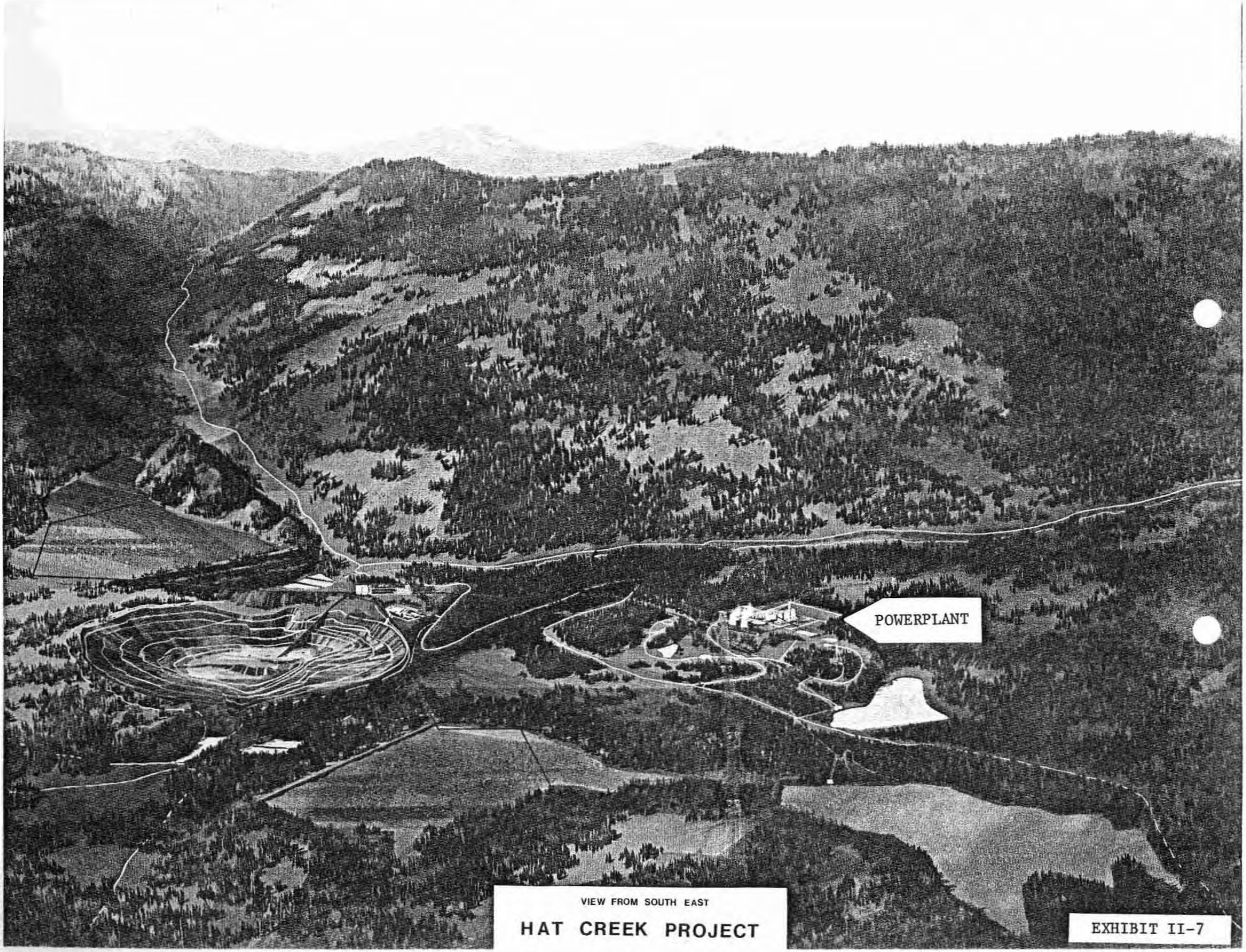


EXHIBIT II-6

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

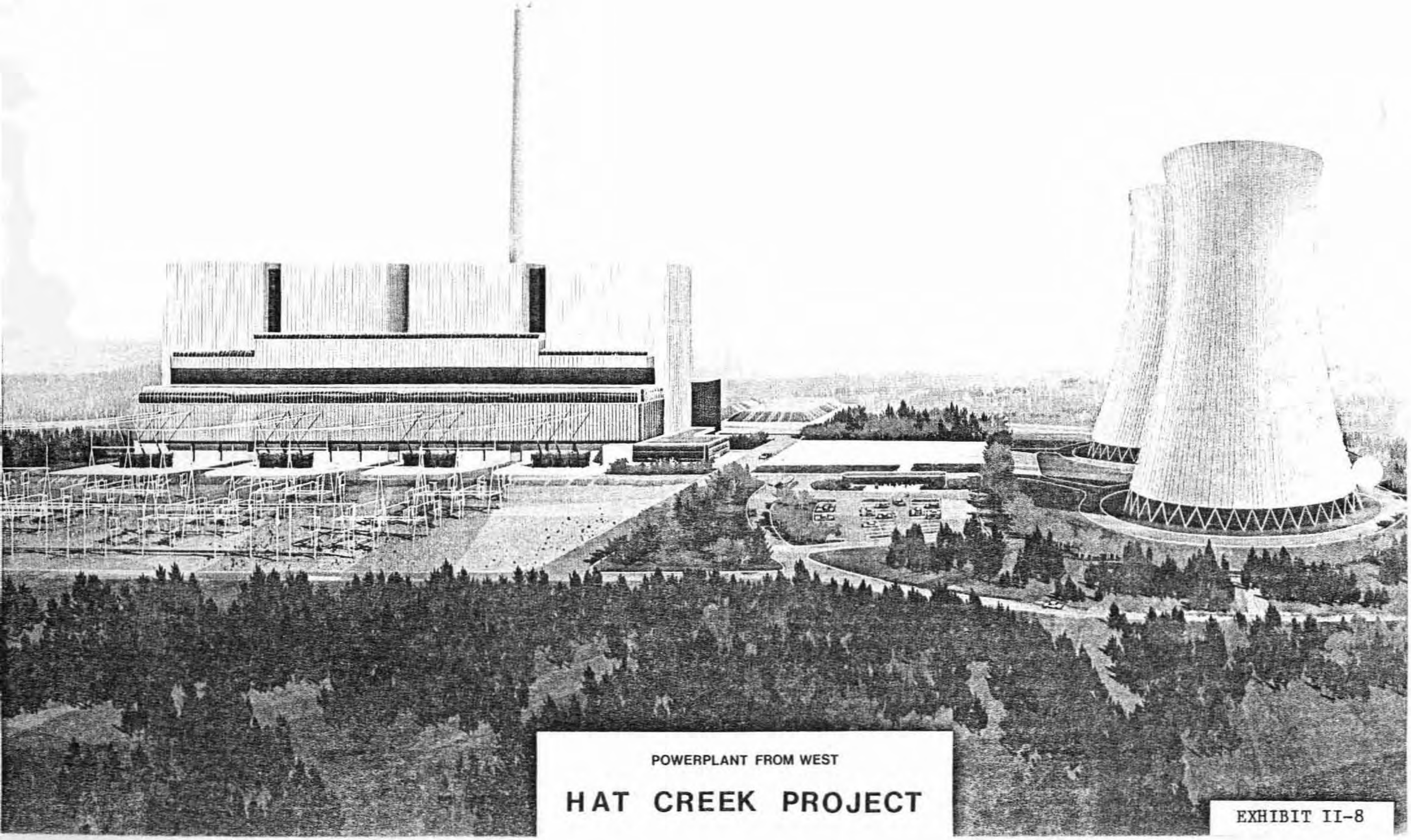
SITE LAYOUT
YEAR 35
SHOVEL / TRUCK PIT



VIEW FROM SOUTH EAST

HAT CREEK PROJECT

EXHIBIT II-7



POWERPLANT FROM WEST

HAT CREEK PROJECT

EXHIBIT II-8

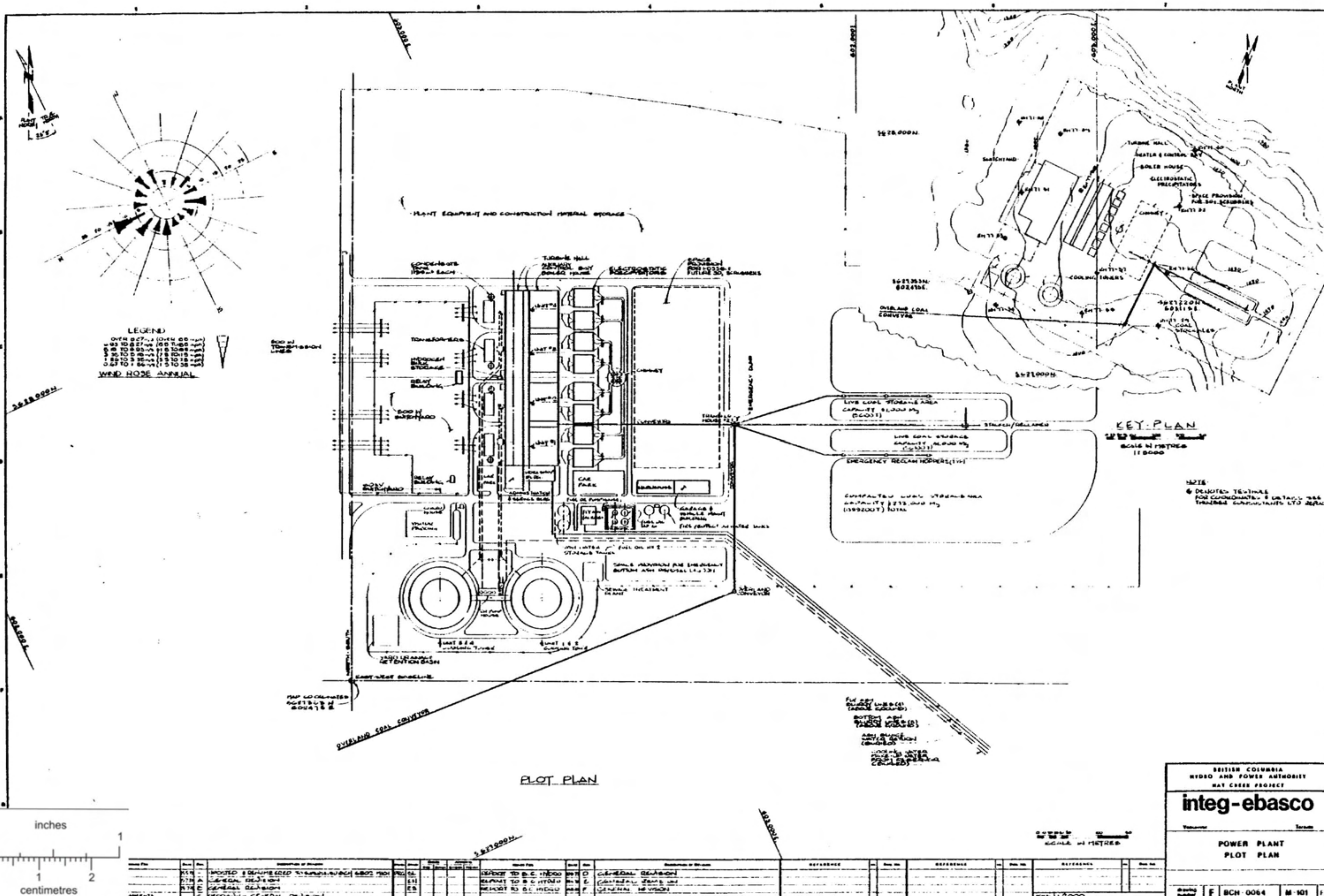

LEGEND
WIND ROSE ANNUAL
PLANT EQUIPMENT AND CONSTRUCTION MATERIAL STORAGE
TURBINE HALL
TRANSFORMERS
CHIMNEY
CAR PARK
EMERGENCY RECLAIM HOPPERS
OVERLAND COAL CONVEYOR
PLOT PLAN
KEY PLAN
BRITISH COLUMBIA
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
integ-ebasco
POWER PLANT
PLOT PLAN
F
BCH-0064
M-101

EXHIBIT II-9

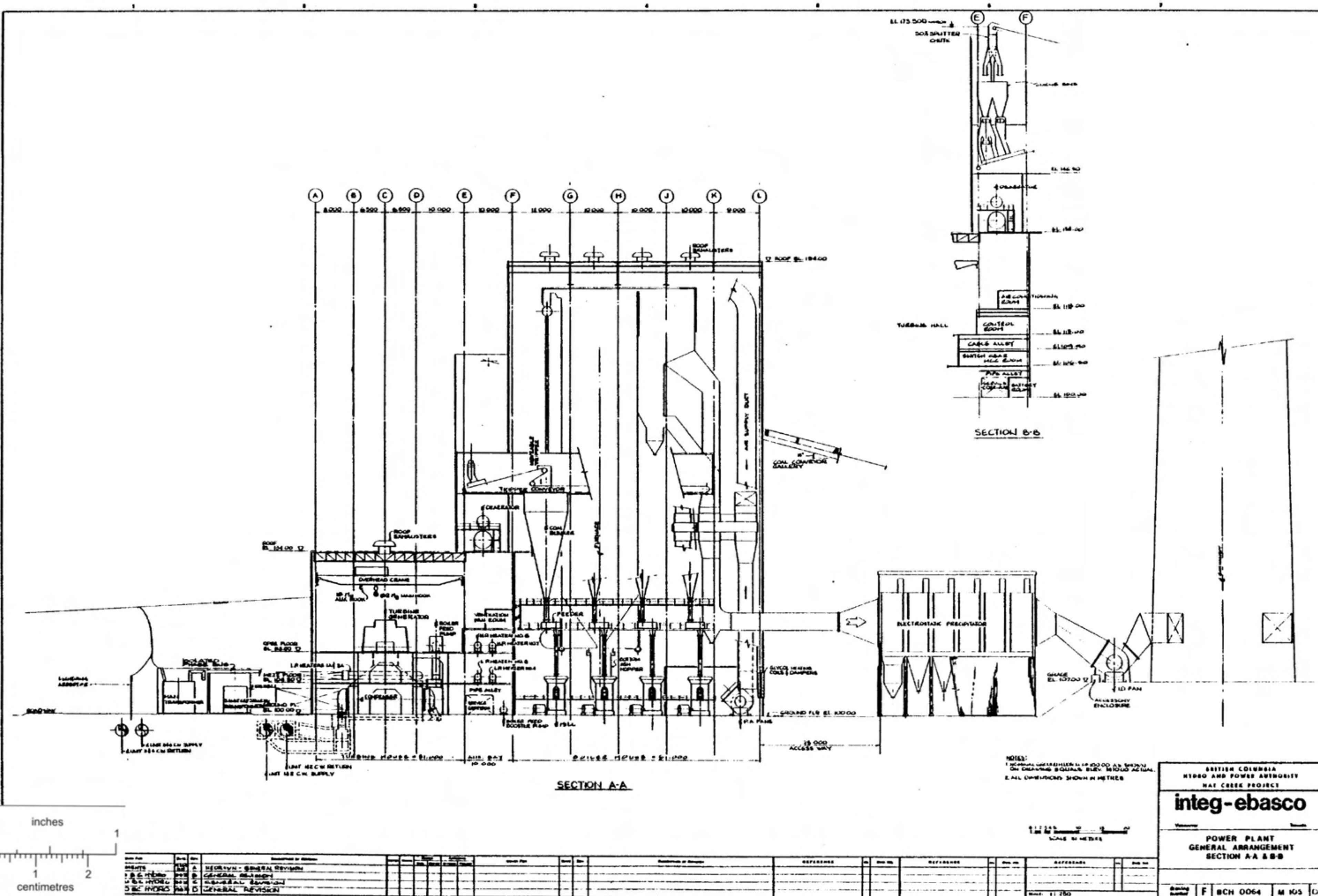


EXHIBIT II-10

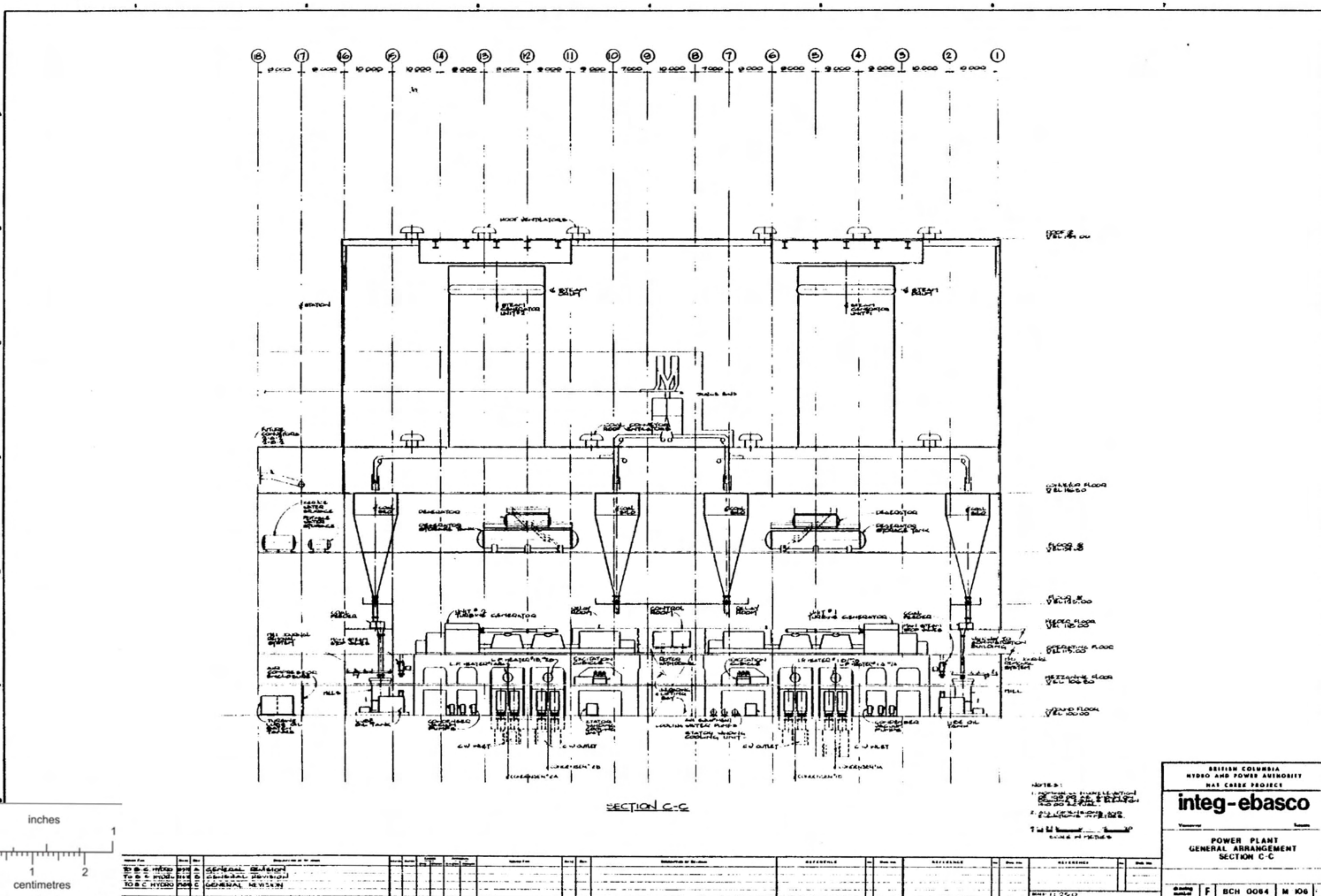
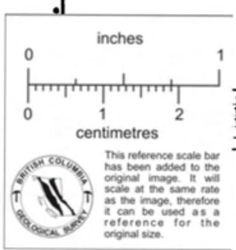


EXHIBIT II-11



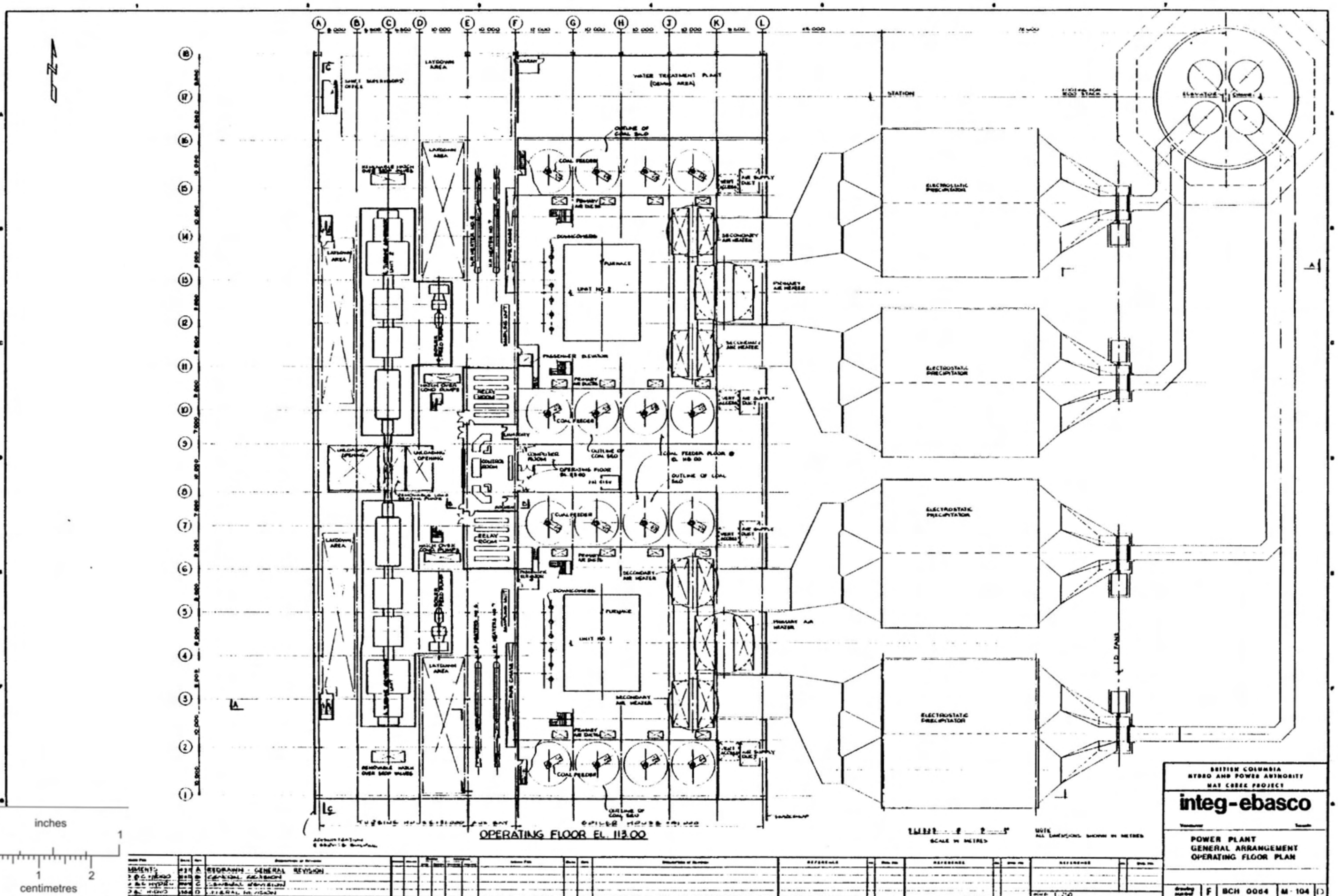
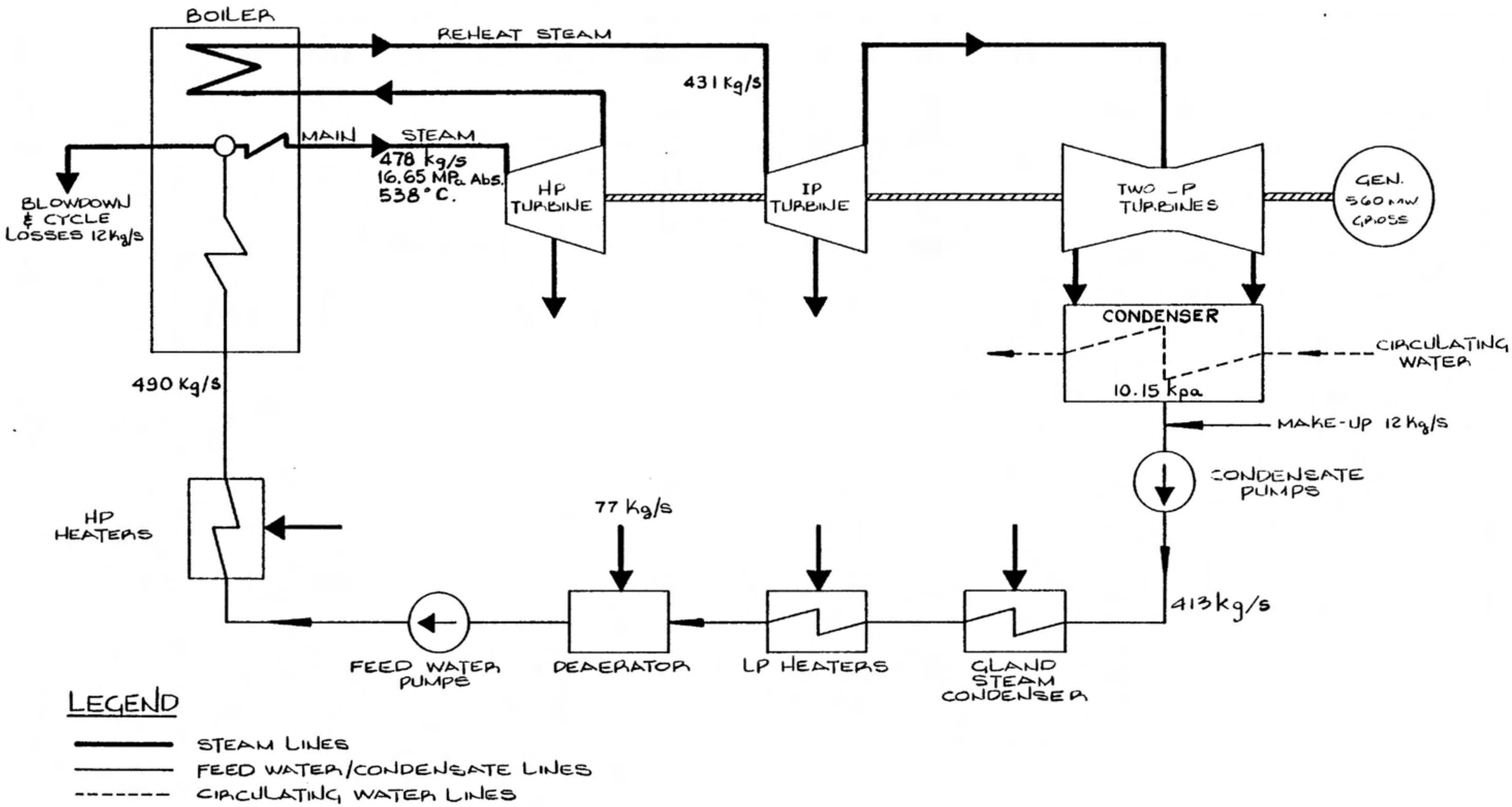


EXHIBIT II-12



FIGURES REPRESENT FLOWS AT 560 MW. GROSS OUTPUT AND DESIGN CONDITIONS.

Check	Appd	Issued for	Date	Rev
		B.C.H. REPORT	23-6-78	
		B.C.H. REPORT	4-7-78	A
		B.C.H. REPORT	7-8-78	B

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

integ - ebasco
Vancouver Toronto

POWER PLANT
STEAM, FEED & COND. SYSTEM
BASIC FLOW DIAGRAM

B | BCH 0064 | SK. 120 | B

EXHIBIT II-13

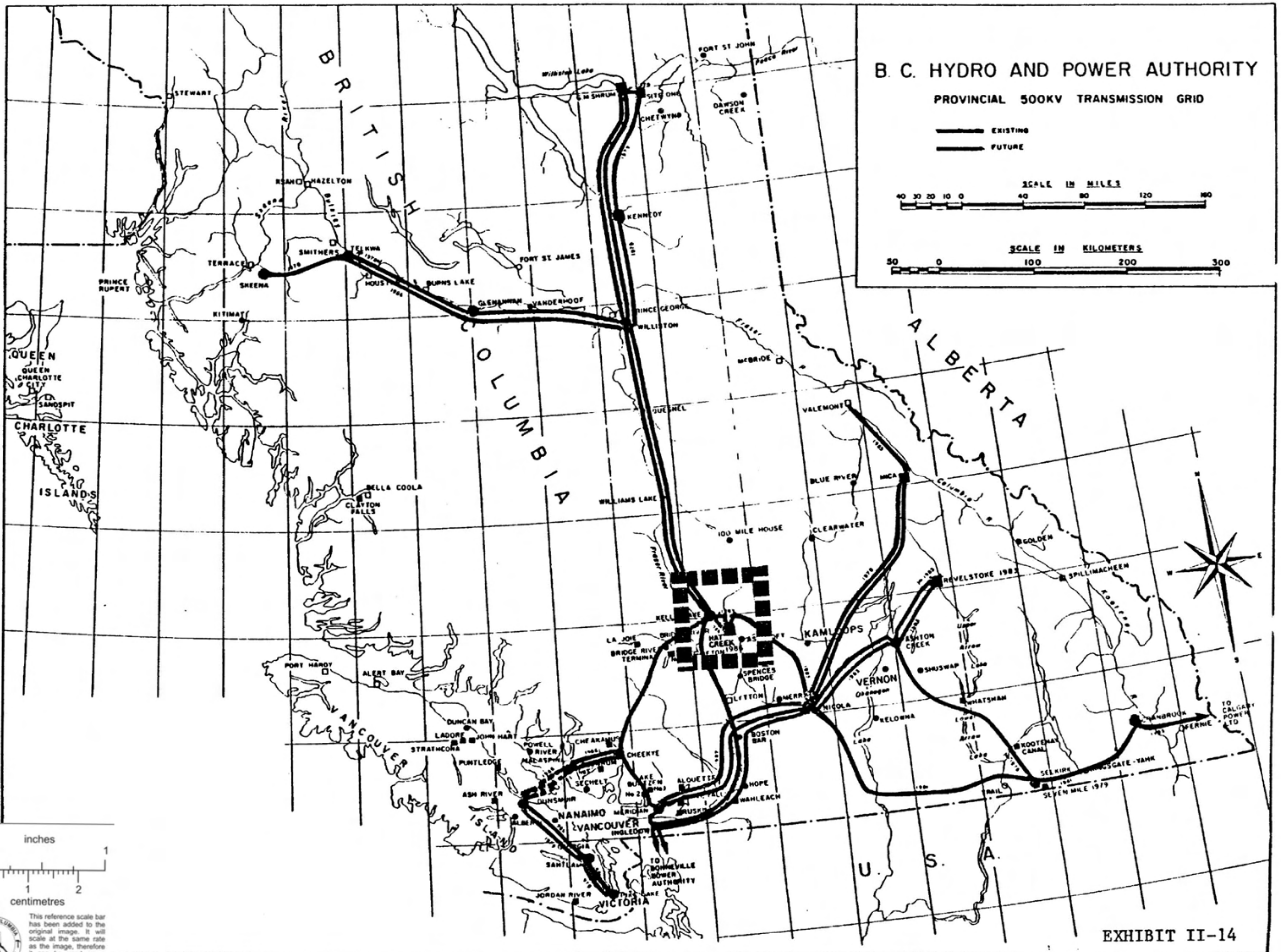


EXHIBIT II-14

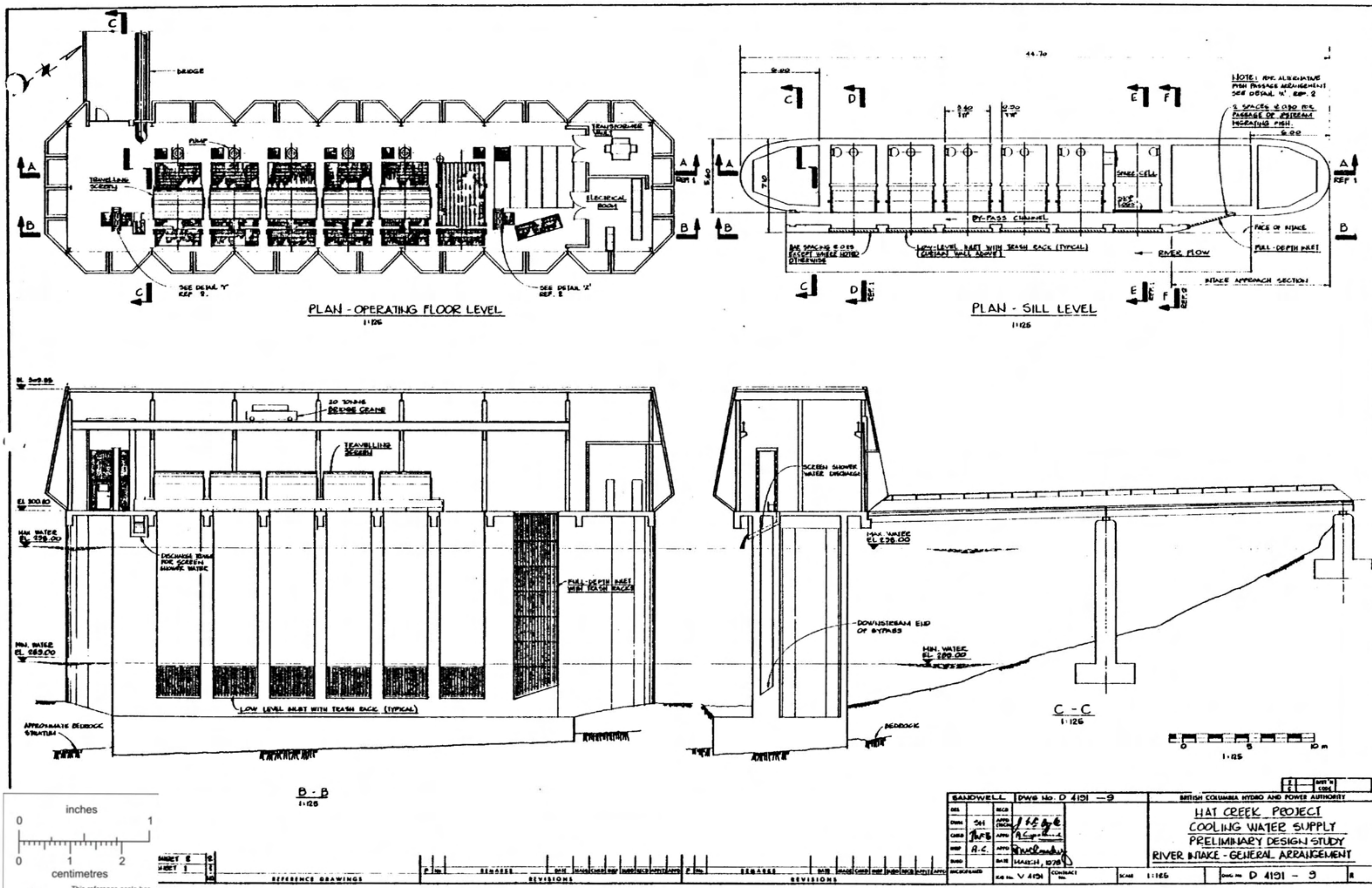


EXHIBIT II-15

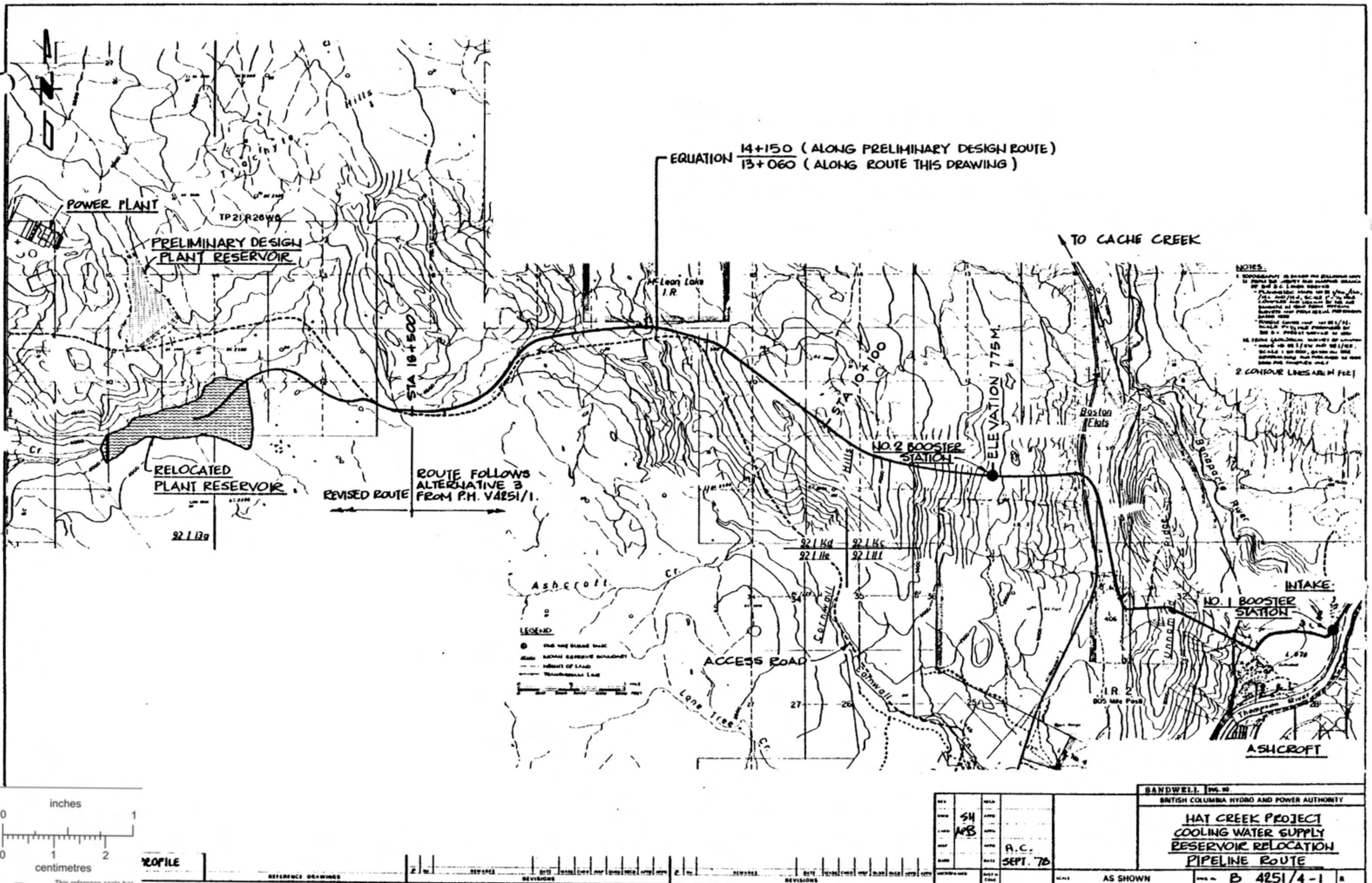


EXHIBIT II-16

inches 0 1 centimetres 0 1 2

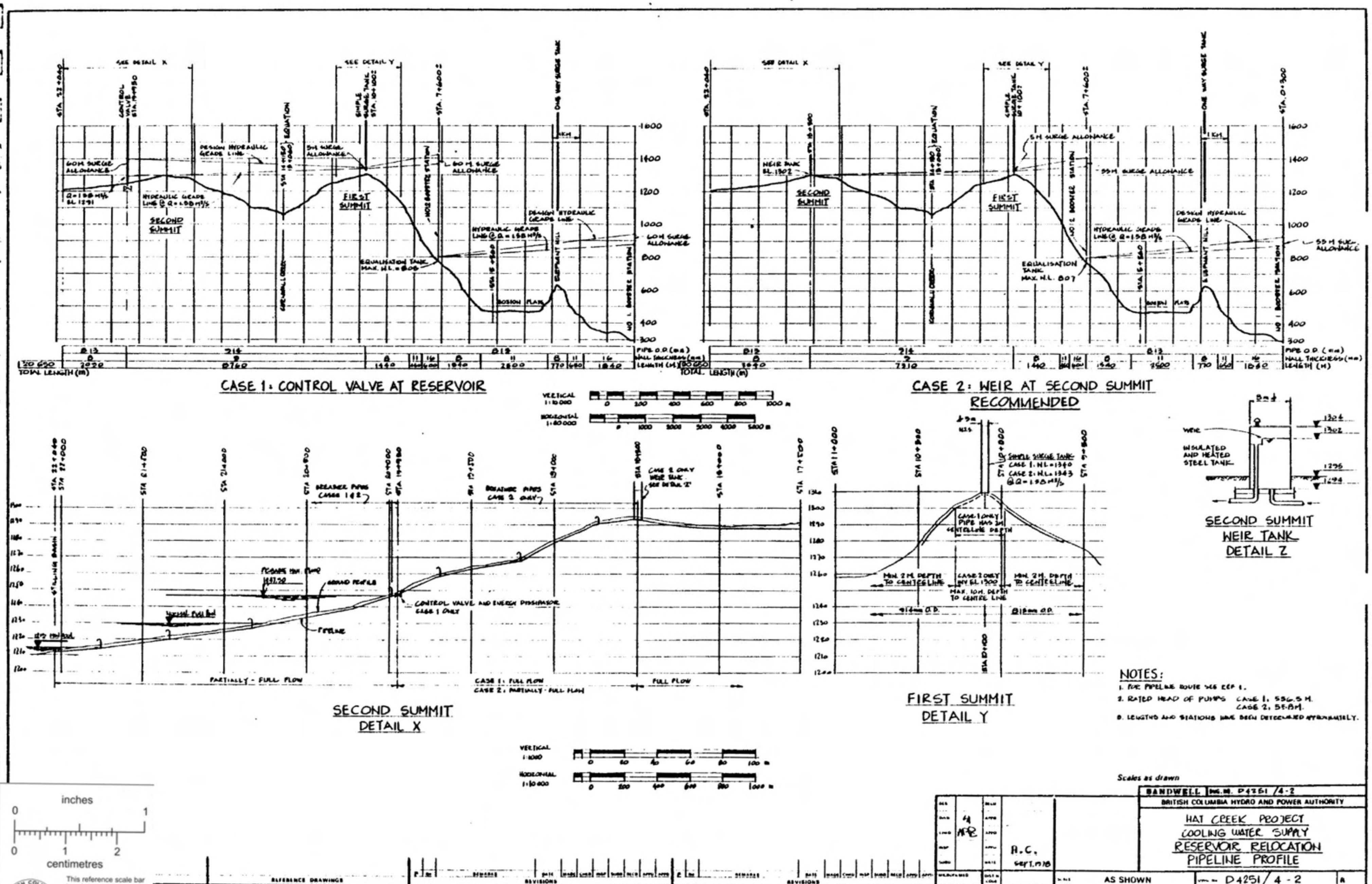


EXHIBIT II-17