HAT CREEK PROJECT

MINING FEASIBILITY REPORT

VOLUME IV

MINE SUPPORT FACILITIES

prepared for
British Columbia Hydro and Power Authority

by
Cominco-Monenco Joint Venture

1978

HAT CREEK PROJECT

MINING FEASIBILITY REPORT

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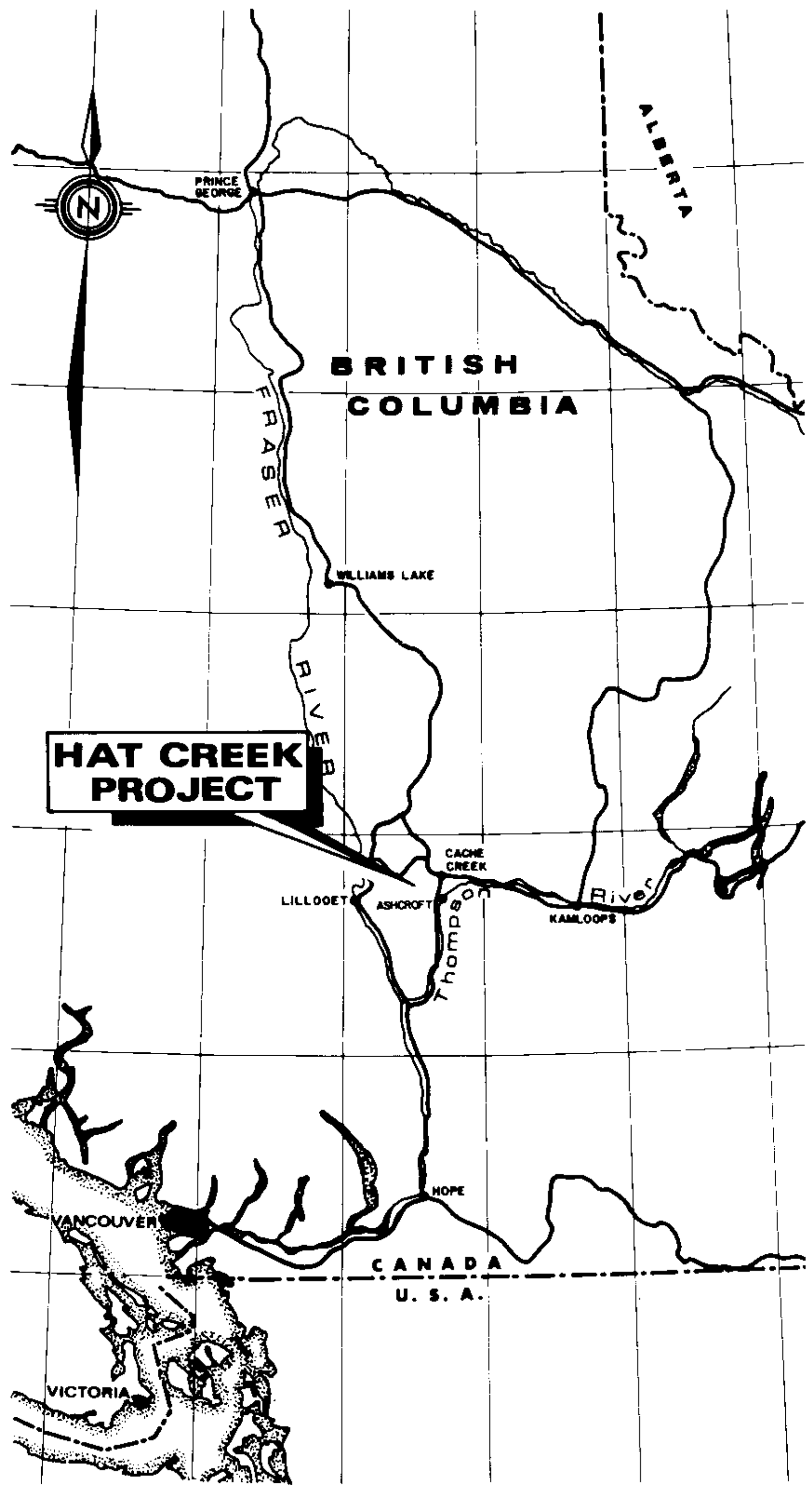

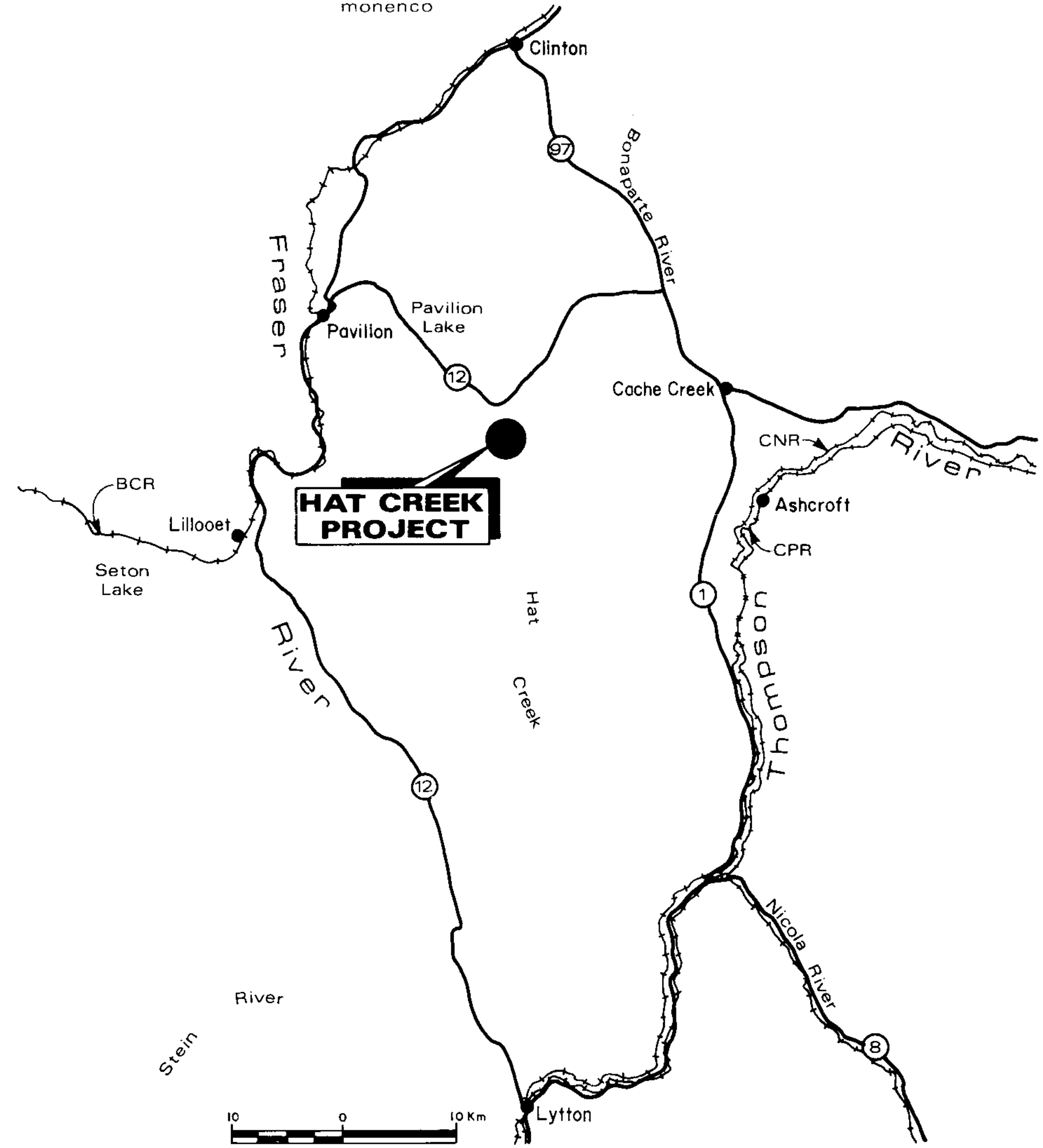

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
PROJECT LOCATION

VOLUME IV

MINE SUPPORT FACILITIES

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SECTION 1

INTRODUCTION

INTRODUCTION

This volume describes the facilities required to support mining operations at Hat Creek. These support facilities include an administrative centre, maintenance, service, and emergency facilities, provisions for drainage of the mine area, and utilities supply and distribution. In all cases, consideration has been given to functionality, safety, fire protection, and provision for expansion.

As shown on the Project Location Map which precedes this volume, the proposed Hat Creek mine area is located in southwestern British Columbia, approximately 240 kilometres northeast of Vancouver, and is accessible from Highway 12. An overall project layout plan is given on Figure 1-1, from which it can be seen that the mine services area would be just northeast of the pit, covering an area of approximately 40 hectares.

Included within the services area are buildings for administrative and personnel requirements, equipment repair shops, storage, and laboratories, and open areas for parking, additional storage, and equipment erection. Initial development of the services area would commence in mid-Year -4, concurrently with erection of some major mining equipment, and nine months prior to "breaking ground" in the actual pit. A more complete description of the structures and facilities provided in this area, including a discussion of construction period requirements for the project, is provided in Section 2 of this volume.

A comprehensive mine drainage scheme was developed during the course of this feasibility study, which incorporated the results of studies and recommendations by other consultants and which complies with present regulatory requirements. The scheme was devised primarily to prevent major flood damage and/or shut-down of mining operations, improve the stability of working surfaces, and minimize disruption of the natural drainage system.

As described in some detail in Section 3, the drainage scheme comprises three major activities: diversion of Hat and Finney creeks and of other smaller creeks and watersheds which drain into the pit and waste dump areas; drainage of Aleece Lake and of over 20 small ponds and sloughs prior to the commencement of mining; and surface and sub-surface drainage within the mine development area. A system of ditches and sumps would transport surface water from the pit and waste dump

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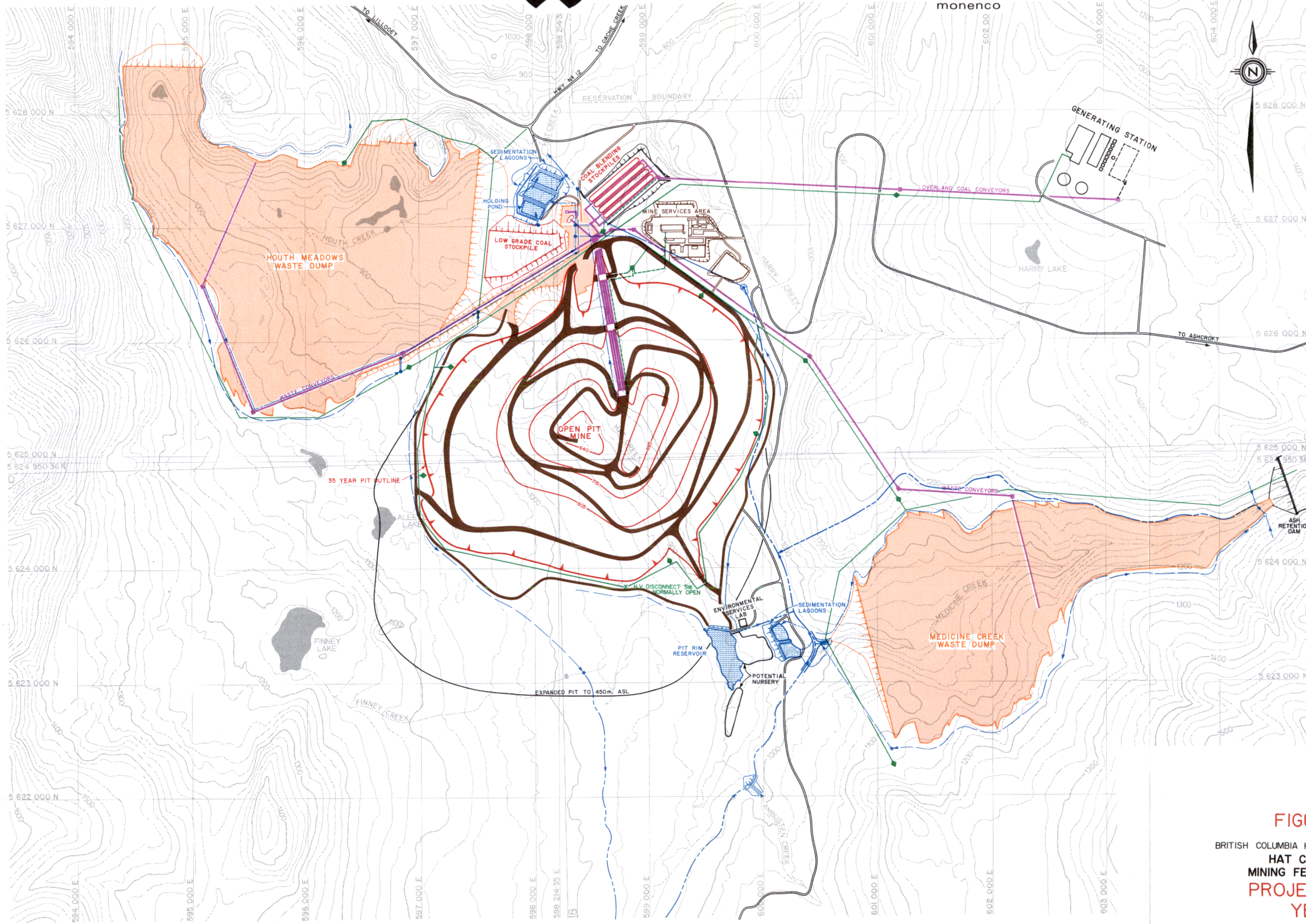

LEGEND

- HAUL ROAD
- SERVICE ROAD
- PUBLIC ROAD
- WASTE DUMP AREA
- CONVEYOR
- POWER SYSTEM
- DRAINAGE SYSTEM

FIGURE I-I

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PROJECT LAYOUT
YEAR 35

areas to sedimentation lagoons prior to discharge into Hat Creek north of the mine area. Leachates, poor-quality seepage, and pre-treated sewage from various areas of the mine complex would be collected separately and re-cycled for use in dust control on the pit haul roads and coal stockpiles.

The two utility services costed in this study, water and power supply, are discussed in Sections 4 and 5, respectively.

The overall recommended mining operation does not require large quantities of water; at full mine development, the maximum average daily requirement would be 2855 cubic metres, which would be sufficient for potable water use, fire protection, irrigation, and dust control. Water would be drawn primarily from Hat Creek, the pit rim reservoir on Hat Creek, and drainage from the mine area as discussed above.

The electrical power supply and distribution system at the mine is designed to accept power from the 60 kV busbar at the proposed Hat Creek generating station, and to distribute it wherever required at voltages varying from 60 kV to 120 volts. Construction power requirements would be met from an existing 60 kV line adjacent to Highway 12, north of the mine development. A maximum of eight portable sub-stations would be strategically located in the mine area. Operation of equipment is the largest power requirement of the project, the major equipment functions comprising mining in the pit, coal conveying, crushing, and blending, and spreading operations at the waste dumps. Additional power demands include pit dewatering, mine area lighting, and complete electrical servicing of the buildings and facilities in the mine services area.

SECTION 2

MINE SERVICE AREA

2.1 LOCATION

The proposed location of the mine services area, to the northeast of the pit, was chosen for its proximity to the pit access road, out-of-pit conveying system, and coal blending area. An additional consideration in choosing this location is that it does not affect the mining of future coal reserves in the Upper Hat Creek Valley. Geologicial investigations to date have indicated that no coal re-reserves are present beneath the proposed mine service area. Furthermore, the proposed area for development is well drained, sufficiently level to preclude any major problems in site preparation, and large enough (40 hectares) to accommodate the proposed service area, with ample room for expansion, during the anticipated 35-year life of the mine.

2.2 FACILITIES REQUIRED

The following structures and facilities comprise the mine service area for the Hat Creek mine; their size, usage, and locations are discussed in this section.

- Administration Building
- Maintenance Complex
- Mine Services Building
- Field Maintenance Centre
- Rubber Repair Shop
- Laboratories
- Lubrication Storage Building
- Fuel Storage and Dispensing Area
- Mine Dry
- Storage Areas

The general layout of these facilities is shown on Figure 2-1

221 ADMINISTRATION BUILDING

The proposed administration building, located in landscaped surroundings on the eastern edge of the mine service area, is close to the entrance to the proposed Ashcroft access road and is also easily accessible from all other facilities in the area (see Figure 2-1). The proposed building is a two-storey structure with a total floor area of 1770 m^2, containing 50 office spaces as well as adequate storage areas, service facilities, and a conference room (see Figure 2-2).

The ground floor has been arranged to provide offices for senior staff members and service and administrative departments such as accounting, data processing, payroll, personnel, and purchasing. Engineering departments such as mine planning and geology would be located on the upper floor with adequate office space and drafting area.

222 MAINTENANCE COMPLEX

This structure, of dimensions 189.0 m x 50.0 m and 0.945 ha area, is centrally located in the mine service area, providing easy access to the repair and service shops for the in-pit vehicles, as well as to the other support facilities such as the rubber repair shop, administration building, and the mine dry (see Figure 2-1). The building layout is shown on Figure 2-3 and consists of the following work and storage areas.

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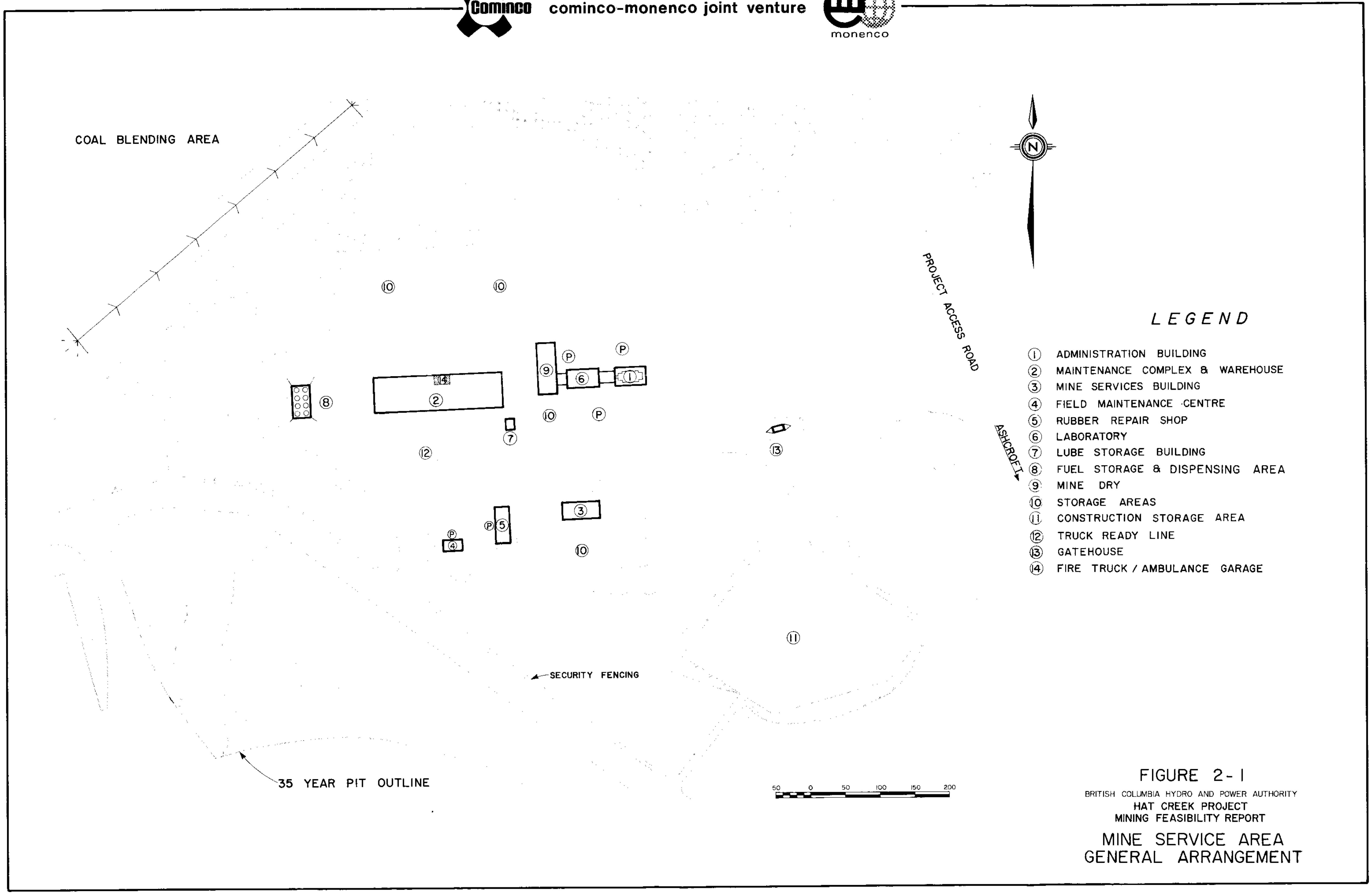

FIGURE 2-1

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
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MINING FEASIBILITY REPORT

MINE SERVICE AREA
GENERAL ARRANGEMENT

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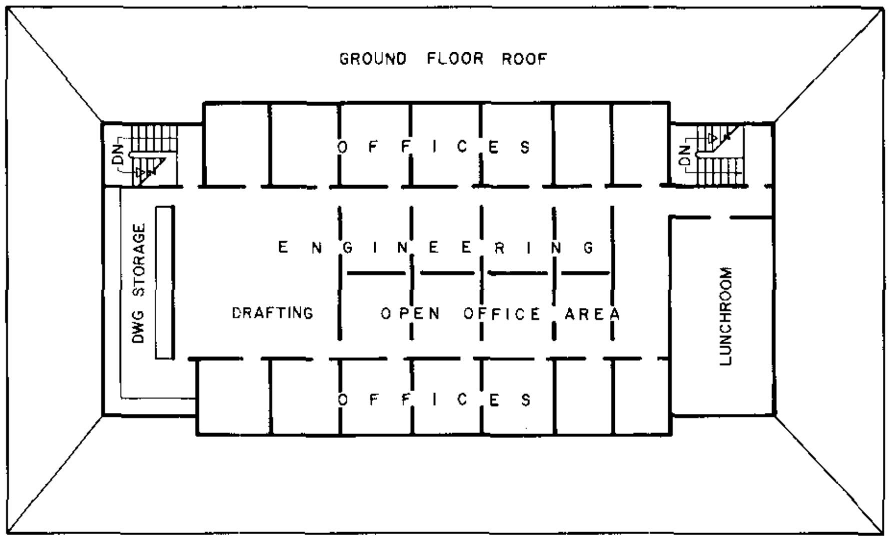
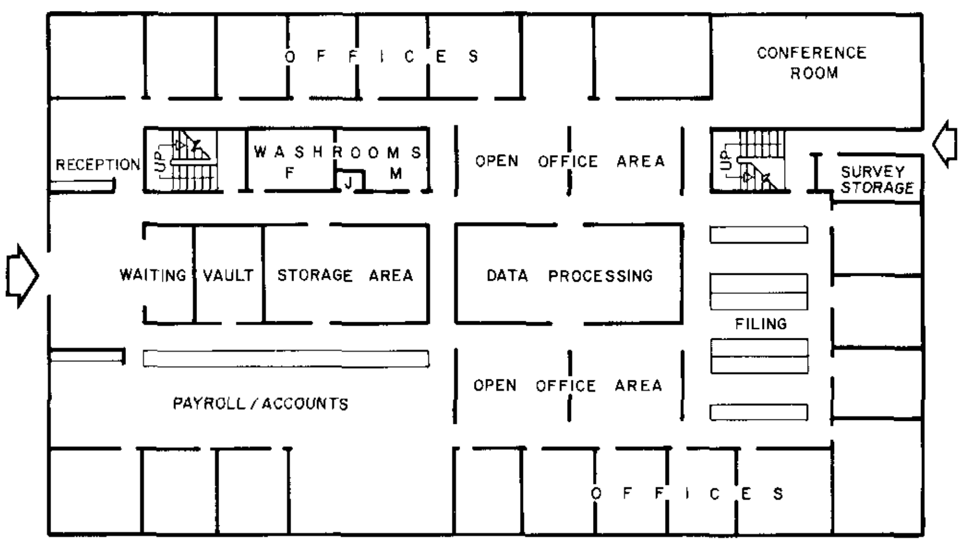


SECOND FLOOR PLAN



GROUND FLOOR PLAN

FIGURE 2-2

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
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ADMINISTRATION BUILDING

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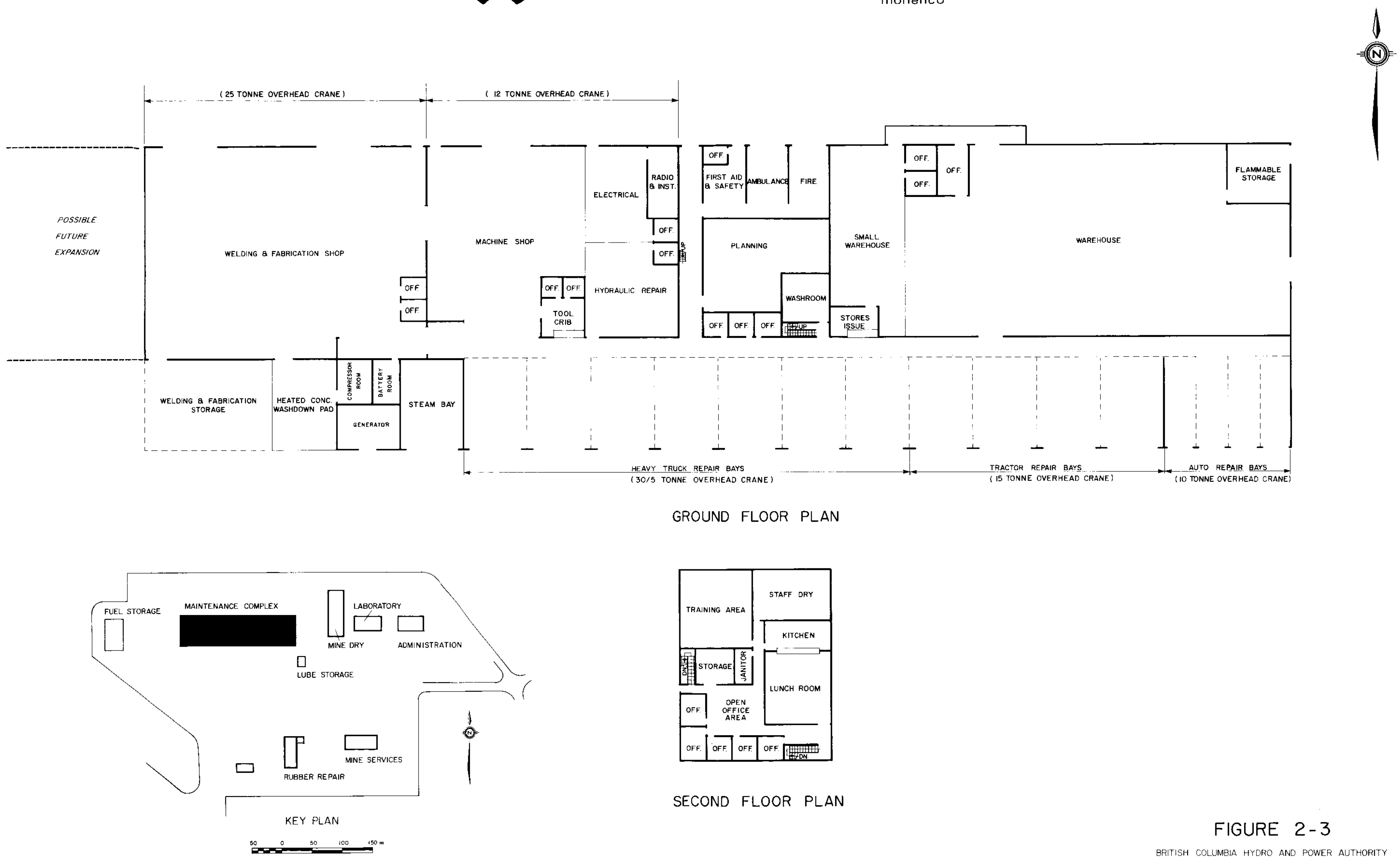

FIGURE 2-3

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
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MINING FEASIBILITY REPORT

MAINTENANCE COMPLEX

7 Haul truck repair bays	10.5 x 18.5 m
4 Tractor repair bays	10.5 x 18.5 m
8 Auto repair bays	5.25 x 9.25 m
2 Steam clean bay/wash down bays .	10.5 x 15.0 m
Welding and fabricating shop	1350 m^2
Machine shop	850 m^2
Electrical repair shop	280 m^2
Radio and instrument repair shop .	60 m^2
Hydraulic repair shop	200 m^2
Warehouse areas	
- palletized	2000 m^2
- small piece (shelved)	385 m^2
- flammable goods store	100 m^2
- tool crib	70 m^2
Planning area	300 m^2
Fire truck storage bay	6.5 x 12.0 m
Ambulance storage bay	6.5 x 12.0 m
First aid centre	78 m^2
Training centre	150 m^2
Mechanical service rooms	110 m^2
Battery room	25 m^2

The internal layout of the maintenance complex was designed to the following assumed criteria:

(a) maintenance, planning, and supervisory office areas should be central and have easy access to all parts of the complex;

(b) the vehicle repair bays should be within easy reach of warehouse storage of spare parts and materials; and

(c) the vehicle repair bays should have easy access to ancillary repair and service areas such as the machine shop, welding and fabricating shop, etc.

The number of repair bays was determined by using anticipated mechanical availabilities for the various types of equipment.

All work areas in the complex will be supplied with compressed air, water, power, and oxyacetylene from bulk storage facilities. General service equipment such as welding machines, powered hand tools, welding screens, bench and floor-mounted grinders, and drill presses will also be supplied as required. In areas where fumes and dust will be a problem, such as the welding shop and steam bay, fume hoods and/or extractor fans should be provided.

Each shop area will include a foreman's office in addition to specialized equipment.

Truck repair shop - will be equipped with a 30-tonne overhead electric travelling crane fitted with a 5-tonne auxiliary crane, controlled from floor level, to accommodate work on the 109 and 136-tonne mine trucks. Other equipment will include 100-tonne hydraulic jacks, a lubrication rack complete with hose reels to dispense all necessary fluids and greases in the service bays, and waste oil disposal tanks from which the waste oil is pumped to a holding tank in the fuel storage and dispensing area (see Figure 2-1). A 10-metre wide concrete apron will be provided adjacent to the entrances to this and the following two shops.

Tractor repair shop - will be equipped with a 15-tonne overhead electric travelling crane with floor-level controls suitable for use in this area. A lubrication rack and a waste oil disposal system as described earlier will be supplied in the service bays.

Auto repair shop - will be equipped with a 10-tonne overhead electric crane plus floor-mounted hydraulic vehicle lifts of 5000 kg capacity.

Welding/fabricating shop - will be equipped with a 25-tonne crane as earlier described as well as 2-tonne jib-type cranes. The specialized equipment in this shop should include a universal iron worker, plate rolls, profile cutter, air-arcing equipment, blacksmith furnace, and welding booths.

Machine shop - will be equipped with a 12-tonne overhead electric crane, plus 2-tonne jib cranes to service various machine tools such as 750-, 430-, and 275-mm lathes, 150-mm horizontal boring mill, 1400-mm x 280-mm milling machine, 2000-mm radial arm drill, 550-mm stroke shaping machine, key-seater, surface plate, 75-tonne and 300-tonne hydraulic presses, cleaning tanks, and precision gauges. A strip-down and assembly area will be designated.

Electrical repair shop - will be equipped with a 12-tonne overhead crane and other required equipment such as testing equipment, cleaning tanks, and drying oven.

Warehouse - will be equipped with 2250- and 4500-kg capacity forklift trucks in the covered warehouse area to handle the loading, unloading, and storing of palletized parts. Handling of larger and heavier components will be by mobile yard cranes as required, either in outside yards or cold storage buildings. Small parts will be stored in bins.

Necessary office space for warehouse personnel and inventory records is included.

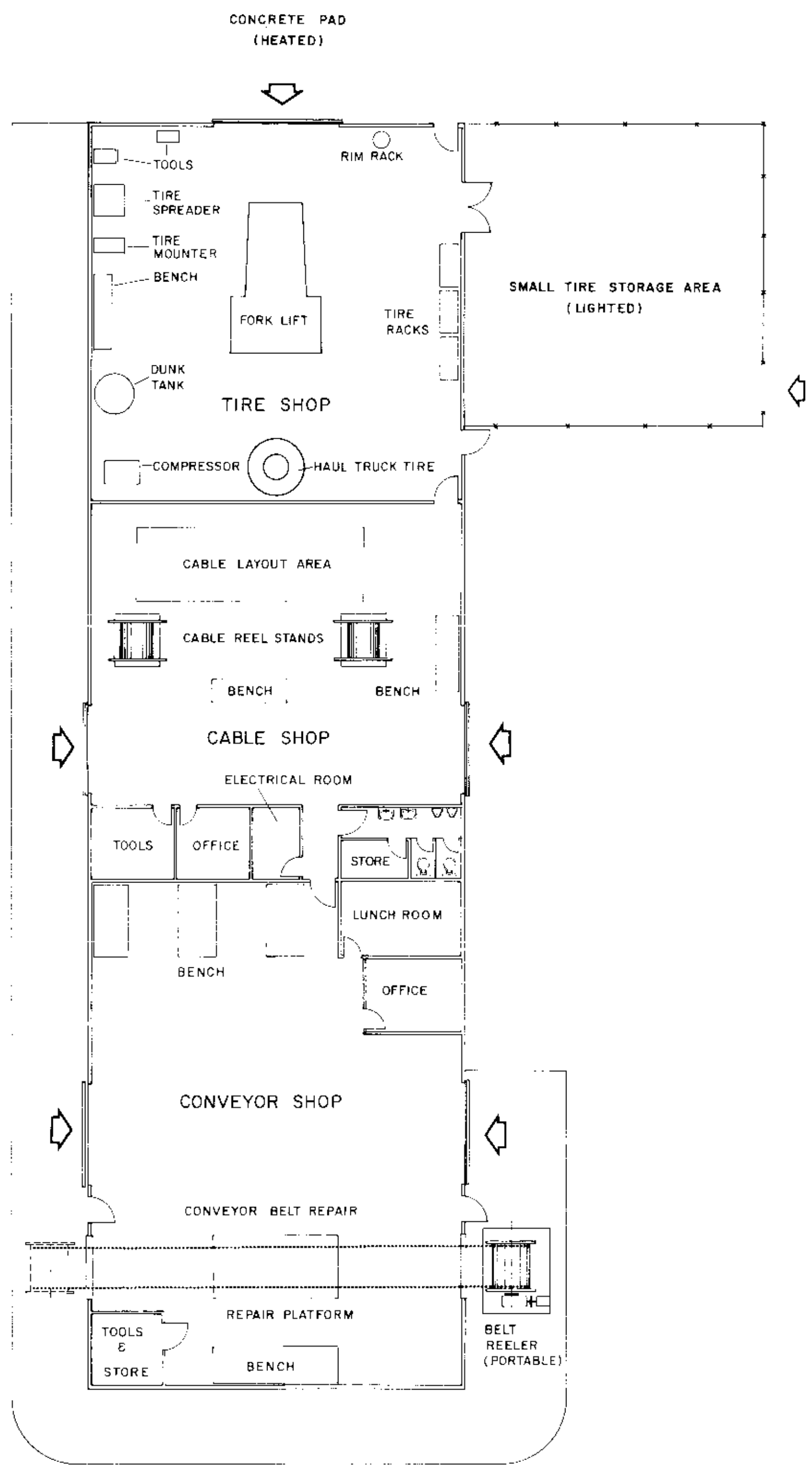
223 MINE SERVICES BUILDING

This building, with its ancillary storage yard, is located in the southeast section of the mine service area (see Figure 2-4) and covers an area of approximately 1.8 hectares. It is easily accessible for "in-pit" and maintenance building requirements as well as delivery of raw materials and spare parts via the mine access road.

The following services are included in this facility:

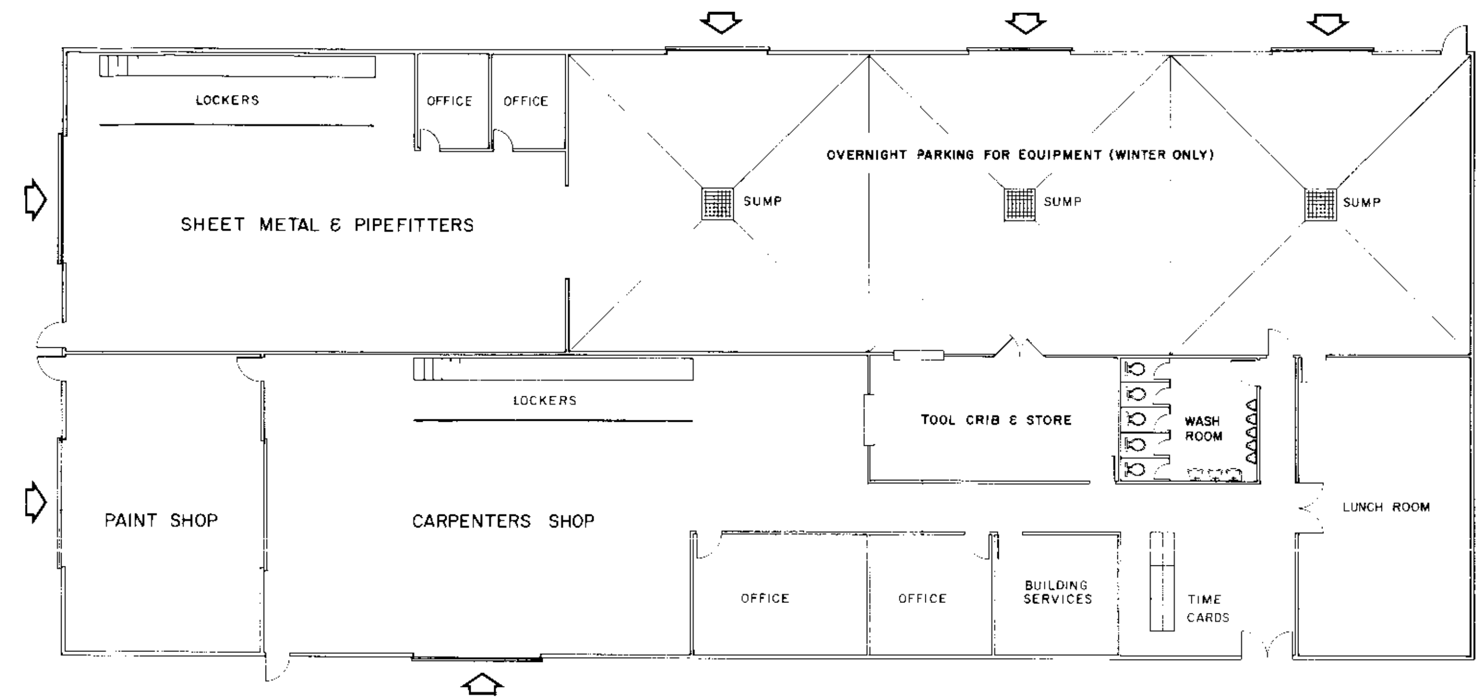
Sheet metal and pipefitter shop	215 m^2
Carpenter's shop	245 m^2
Painter's shop	95 m^2
Supervisory office space	85 m^2
Winter and/or night storage for vehicles (will also serve as extra workspace for carpenters and pipefitters when required)	400 m^2
Material storage area and tool crib	50 m^2
Personnel areas - punch in/out area, washrooms, locker space, lunchroom, and janitorial room	200 m^2
Open storage yard	1.6 hectares
Covered plywood and timber storage	100 m^2

The various shop areas in the building will be equipped with necessary tools and equipment as follows:



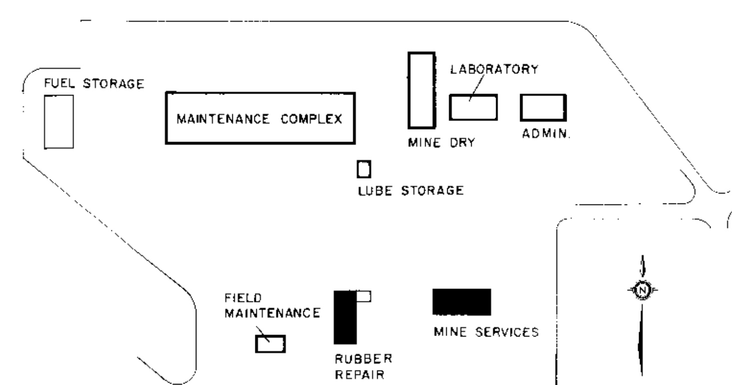
RUBBER REPAIR SHOP

0 1 2 3 4 5 6 7 8 9 10m



MINE SERVICES BUILDING

0 1 2 3 4 5 6 7 8 9 10m



KEY PLAN

50 0 50 100 150m

FIGURE 2-4

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

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MINE SERVICES BUILDING
& RUBBER REPAIR SHOP

Sheet metal and pipefitter's shop - will be equipped with a sheet metal shear and former, spot welder, bench grinder, drill press, pipe threader, bandsaw, overhead monorail and hoist and miscellaneous hand tools.

Carpenter's shop - will be equipped with a bench saw, radial arm saw, drill, planer, and necessary hand tools.

Painter's shop - will be equipped with spray painting equipment for use either in the shop or outside.

An outside parking area, equipped with electrical plug-in receptacles, will be provided to accommodate overnight parking of miscellaneous service vehicles.

224 FIELD MAINTENANCE CENTRE

Most of the work carried out by the crews operating from this building will be in the field and therefore no major equipment need be supplied in the building. Bench-mounted grinders and a pedestal drill press will be installed, along with a welding machine and oxyacetylene equipment.

Service trucks equipped with welding machines, oxyacetylene equipment, compressors, lifting equipment, hand tools, will provide the services required for the field work. Line trucks will be available for maintenance of the mine electrical power system.

Any other equipment required for major overhauls or major repairs will be supplied from the maintenance complex or mine services centre.

225 RUBBER REPAIR SHOP

This building houses three separate service and repair shops for tires (225 m^2), conveyor belting (300 m^2), and trailing cables (225 m^2), and is located in the southern section of the maintenance and service area within easy access of the pit and main conveyor routes (see Figure 2-4).

Tire shop Mine production vehicles requiring tire service will have easy access to a heated concrete apron in front of the tire repair building where tires will be mounted using portable hydraulic jacks and a 13 500-kg capacity forklift complete with tire manipulator attachment. Minor repairs only should be done in-shop while major repairs should be carried out off-site by a suitable contractor.

Conveyor belting shop The conveyor belt repair shop will be equipped to handle belt splicing and belt repairs, both in the shop and in the field, using portable vulcanizing equipment suitable for use with steel cord or fabric ply belting. The reels of belt will be handled by a mobile crane in the storage area and by an overhead monorail at the powered belt reelers in the shop area. The shop will be equipped with all necessary hand tools such as knives and belt cutters. Power supply to this building at 600 volts would be used directly for the vulcanizing equipment, while a step-down to 120 volts would be necessary for lighting, heating, ventilation, power tools, etc.

Cable shop This area will be provided for repairing and testing mine cables. Typical equipment in the shop includes powered reels, repair benches, test panels, overhead cranes, and necessary hand tools.

226 LABORATORIES

The following laboratory facilities will be provided:

- an assay/environmental analytical laboratory in the mine service area (see Figure 2-1)
- environmental services complex situated on a parcel of presently cultivated land to the southeast of the pit near the confluence of Hat Creek and Medicine Creek (see Figure 1-2)

Assay/Environmental analytical laboratory Located adjacent to the administration building, this facility consists of:

- general office area, conference room, and reception area (300 m^2)
- "wet" laboratory area to be used by both environmental and assay staff for sample analysis
- dry coal laboratory, used solely for coal sample analysis (150 m^2)

- core sample handling area (75 m^2)

- sample storage area (75 m^2)

- equipment storage (50 m^2)

A central enclosed walkway will separate the wet laboratory and office area from the dirtier, coal-handling facilities; precautions will be taken to prevent dust emissions from the latter area.

Core storage sheds will be provided in the vicinity of the coal blending area with only sufficient core for analytical testing being transported to the laboratory.

Adjacent parking space will be provided for staff work vehicles and vehicles delivering samples.

Environmental services complex This group of structures will be built on presently developed agricultural land (proposed as potential nursery area) and consist of:

- "Lord & Burnam" type greenhouse (aluminum and glass construction), heated, ventilated, and equipped with necessary lighting (105 m^2)

- "Quonset" type greenhouse (50 m^2)

- service building containing reception area, office and drafting areas, and sample preparation room (150 m^2)

- reclamation/agricultural machinery shed (300 m^2)

- bulk fertilizer storage (8 m^2)

227 LUBRICANT STORAGE BUILDING

As shown on Figure 2-1, this building is located adjacent to the southeast corner of the maintenance complex to provide good access for both delivery vehicles and mine service vehicles. The building should be heated and insulated and house bulk storage tanks for the various lubricating oils and greases required for the mine mobile equipment. The types and quantities of stored materials are as follows:

Motor oil	30 kL
Hydraulic oil	30 kL
Transmission fluid	30 kL
Gear oil	30 kL
Chassis grease	9000 kg
Track grease	9000 kg

The various lubricants will be pumped on demand in heated underground piping to the maintenance complex and then to dispensing racks in service bays in the truck, tractor, and auto repair shops.

The storage tanks of mine lube trucks will be replenished at an external loading station forming part of the building. A portable lube island in the mine complements this facility and will be located conveniently close to the main haulage route for quick servicing of trucks whenever necessary. Less-mobile equipment such as tracked equipment will be serviced on location by the lube truck.

228 FUEL STORAGE AND DISPENSING AREA

A fuel tank farm with diesel fuel and gasoline dispensing pumps will be located in the western edge of the mine service area, close to the main mine haulage access road and approximately 100 m from the maintenance complex. Access will be provided around the tank farm for the mine fuel trucks, other service vehicles, pick-up trucks, and the fuel supplier's tank truck. A safety berm will be constructed around the farm area to contain any spillage of fuel.

The tank farm will contain diesel fuel, gasoline, mixed anti-freeze, and waste oil storage tanks of 364, 90, 55, and 45 kL, respectively, these amounts of fuel being equal to approximately one week's predicted consumption rates.

Metered bulk loading and unloading facilities for use by the mine fuel trucks and fuel supplier's trucks as well as dispensing pumps for the general mine use will be supplied in this area.

An in-pit fuel facility is also provided for the use of the haulage truck fleet and is located in the same area as the in-pit lube island. Less mobile equipment such as tracked vehicles will be fuelled by the mine fuel trucks. The fuel island, receiving its supplies from the supplier's tank truck as required, will have portable horizontally mounted diesel fuel tanks of approximately 45 kL total capacity, provided with trays to contain accidental spillage, and will be complete with metered loading and unloading facilities.

229 MINE DRY

The mine dry will be divided into four basic areas - dirty lockers, clean lockers, washing area, and mine supervision and marshalling area. Provision will be made for installation of 700 "clean" lockers and 700 "dirty" lockers so as to allow a locker of each type for every person on the mine labour force. As the mine will work on a four-shift basis, approximately 175 pairs of lockers will be used each shift (see Figure 2-5).

Janitorial space and mechanical equipment rooms will also be provided.

Separate dry areas will be provided for male staff members as well as female work crew members.

The heating and ventilating systems will be designed to accommodate the hot and humid conditions expected in a washroom area. The ventilation system will be designed so that the air is directed through the locker spaces to facilitate drying of clothes, and then into the building. The building will be constructed of non-combustible materials and provision of a full complement of hydrants and fire extinguishers is recommended, rather than installation of a sprinkler system.

2210 STORAGE AREAS

The location and size of various storage facilities in the mine service area have been based on consideration of their expected use, access from the work areas in which the stored materials are to be used, the ease of moving materials within the storage area, the need to monitor incoming and outgoing materials, and the possible need for future expansion.

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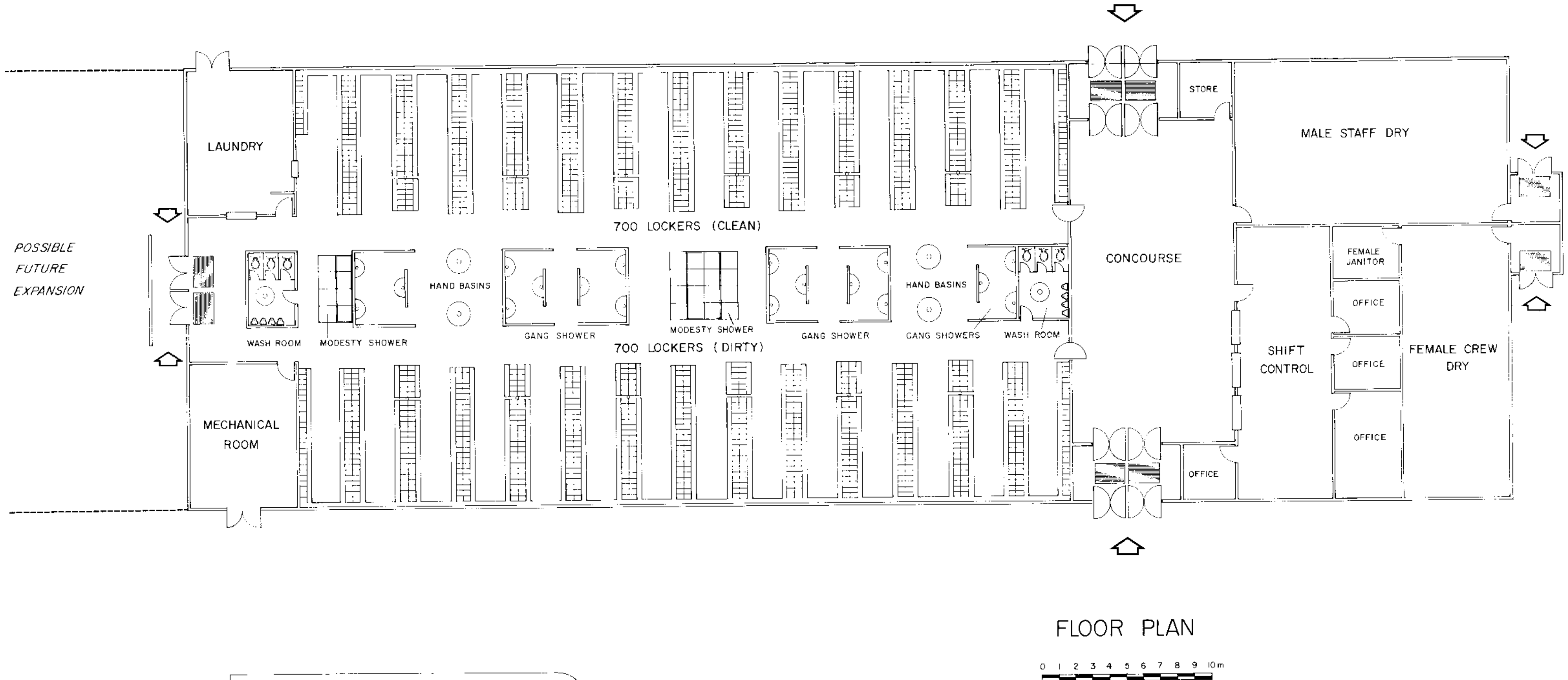
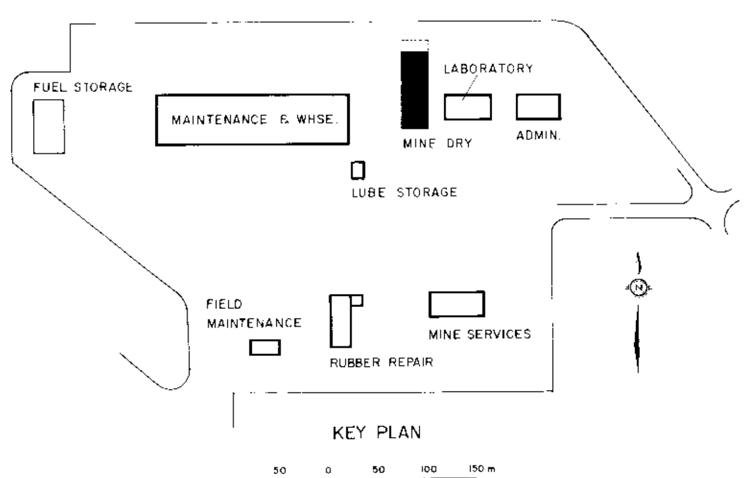


FLOOR PLAN



KEY PLAN

FIGURE 2-5

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MINE DRY

The main storage areas are shown on Figure 2-1 and are described below.

Yard storage - an area of approximately 3.6 ha will be fenced and manned for materials control. Large parts requiring covered storage will be housed in an unheated building constructed of light metal. The area will be arranged to allow easy access for service vehicles and yard cranes.

Shop area storage - individual storage areas are recommended for the parts and materials used in the various shop areas. The area recommended (approximately 2.7 ha) is centred mainly around the mine services building and rubber repair shop, where a large area is required for storage of tires, rolls of belting, cable reels, and lumber.

A separate fenced area adjacent to the tire repair shop will be provided to permit the secure storage of small vehicle tires. Various rubber repair materials may be stored in a refrigerated building within this fenced area.

Construction storage area - the construction storage, or "laydown" area will be used initially for the storage of materials and equipment during the construction period and thereafter for the storage of supplies for the pit and mine service area.

2.3 STRUCTURAL DESCRIPTION OF BUILDINGS

Buildings will be constructed of light structural steel frame over reinforced concrete floors and footings. Where necessary, structures have been designed for extra loading imposed by travelling cranes, overhead office space, heating and ventilating units.

External walls will generally be built of insulated metal cladding as specified and detailed by Toby, Russell, Buckwell and Partners, architectural consultants to B.C. Hydro. Sections of the wall adjacent to vehicle access roads or doors into the building will be constructed of reinforced concrete to doorhead height so as to minimize damage in case of vehicular collision.

Internal dividing walls will be built of concrete blockwork or moveable prefabricated panels.

Roofs will be constructed of insulated metal cladding and will be sufficiently sloped to facilitate proper drainage. The exterior cladding is insulated to conserve heat in winter and keep the shops cool in summer. The thickness of insulation is designed to accommodate the large variations in temperature expected in Hat Creek valley. As with the wall cladding, the roofing is specified and detailed by the architectural consultant.

Because of their very rough usage in heavy-duty repair shops, shop floors will generally be constructed of reinforced concrete, using only a hard abrasion-resistant aggregate. In particularly hardworked areas, a chemically-hardened wearing surface will be applied to minimize surface break-up and "dusting". To permit a good workable floor, special consideration will be given to producing a well-compacted, capable, load-bearing sub-grade. As drainage of shop areas is of prime importance, care should be taken in pre-designing all floor openings and trenches for services such as water, electrical cables, and exhaust piping so as to prevent future disruption of drainage systems.

2.4 SERVICES TO BUILDINGS

241 WATER SUPPLY

Water will be provided to all buildings in the mine service area by a buried pipe reticulation system. The water supply system is detailed in Section 4 of this volume.

242 ELECTRICAL DISTRIBUTION

Each of the maintenance, office, and service buildings will receive incoming power supply at 6.9 kv transmitted via underground cable. A 1 MVA 6.9 kv line to a 600/347 volt substation will be located adjacent to each building. The large size and high winter heating load of the maintenance complex may necessitate three 1 MVA sub-stations, one to be located centrally and one at each end of the building. Power from these substations will be distributed within the buildings at 600/347 volts with 600-volt receptacles provided throughout. Transformers of 600/120-volt and panel boards complete with single-phase 120-volt circuitry and receptacles will be provided where necessary. The type and number of power outlets will be designated according to the layout and designed use of each building and an adequate number of spare panel board circuits will be made available to allow for future growth of building power load.

In workshop areas such as the machine shop and welding/fabricating shop, a plug-in three-phase 600/347 volt bus duct will be used. This bus duct may be suspended from the ceiling structure of the building and would provide a high degree of flexibility in future equipment locations.

243 HEATING, VENTILATING, AND AIR CONDITIONING

Electrical heating units are planned throughout and air conditioning systems will be provided for the administration building, as well as the office areas in the mine dry and maintenance complex. Ventilating systems will be provided throughout all buildings, with special attention given to hazardous areas such as the paint shop, woodworking shop, and rubber repair shop.

244 LIGHTING

Lighting in maintenance and service facilities is designed to standards recommended by The Illuminating Engineering Society. Specific recommendations for lighting fixtures and intensity are as follows:

(a) High-ceiling bay areas - in any inside work area with a ceiling height greater than 4.0-metres, 1000-watt high-intensity discharge lamps should be spaced so as to provide even light intensity.

(b) Office areas should be lit with 4-tube, 1.2-metre flourescent luminaires.

(c) Where required, outdoor floodlighting should be provided by 1000-watt high-intensity discharge lamps. The fixtures should be suspended from buildings themselves, where possible, or mounted on poles or towers.

(d) Emergency lighting fixtures should be provided in stairways and passageways of all buildings. Self-contained twin lamp battery packs will be used.

(e) Lighting in hazardous areas such as the rubber repair shop, paint shop, and lubricant storage area should be provided using suitably enclosed and sealed 3-tube, 1.2-metre fluorescent units.

245 SEWAGE DISPOSAL

Sanitary effluent from the mine service complex will be pre-treated and discharged to a holding pond, and will be seasonally used for dust control in the mine. Allowance has been made for a package wastewater treatment plant capable of handling 140 m^3/day of effluent at 400 ppm BOD_5.

If necessary the treated effluent could be disinfected prior to being sprayed on roads in the mine area; however, no provision has been made for this at present.

Water from equipment washdown facilities will be discharged to stormwater drains via a grease and grit trap from where it will flow to sedimentation lagoons for primary treatment prior to discharge. The integration of these facilities into the overall mine drainage and water supply systems is discussed further in Sections 3 and 4 of this volume.

246 FIRE PROTECTION SYSTEMS

A fire protection system will be provided to protect capital investment in building and equipment and to minimize the danger of fire causing a major shutdown of coal supply to the generating station.

Permanent automatic systems will be installed in high-risk areas. Where there is "medium" risk, a permanent water supply will be provided for hoses or fire trucks. There will be no permanent installations in low-risk areas; spot fires will be extinguished by fire trucks supplied by water tankers.

246.1 Mine Service Area

This is a relatively high-risk area within the mine development and insurance underwriters' standards have been used to define fire protection requirements. Automatic fire detection systems will be installed in all buildings, with a central alarm panel in the proposed fire truck bay.

Automatic sprinkler systems are proposed for all maintenance workshops and service buildings other than the administration building and mine dry building, which would be relatively low-risk areas, constructed of non-combustible materials.

All buildings will have a standard complement of fire extinguishers, as well as 40-mm standpipes complete with run-out hoses situated to provide coverage of the builidng floor plan.

Fire hydrants will be located within the service area so as to further protect buildings and the open yard storage areas around the perimeter.

The water supply system to the service area will maintain a reserve of 1000 m^3 of water for firefighting, and will be capable of supplying 95 L/s at 415 kPa at connections to buildings.

Two four-wheel drive fire trucks will be based at the mine service area which will be used as required throughout the entire mine development area. These trucks will carry about 2000 litres of water, fire pumps, hose reels, and ladders.

246.2 Coal Handling Systems

The coal conveyor from the pit to the coal blending area and the overland conveyor to the generating station will be under the surveillance of an automatic fire detector system which will identify the location of a fire and prevent its spread by stopping the conveyor.

Conveyor transfer stations and enclosed sections of the overland conveyor will be protected by automatic sprinkler systems fed from a buried water main adjacent to the conveyorway. Exposed sections of conveyor will be protected by fire trucks which will gain access by a proposed service road, and will draw water from fire hydrants adjacent to the conveyor. In the coal blending area buried water mains between the stockpiles will supply water to fire hydrants. Service roads will be provided between stockpiles to allow access for fire trucks and crews.

246.3 Open Pit

Within the open pit water tankers and fire trucks will be used to extinguish spot fires. A permanent water supply will be available from the water main at the north conveyor incline; a hydrant will be provided at each bench. A further allowance has been made for 10 000 metres of 75-mm aluminum pipe should an in-pit water supply main be required during mining operations.

246.4 Waste Conveyors

These systems will be surveyed by an automatic fire detection system similar to that for the coal conveyors. Permanent fire protection systems will not be installed on the conveyorways to the waste dumps and water tankers; rather, fire trucks will be used.

246.5 Mine Equipment and Vehicles

All mine vehicles will be equipped with portable extinguishers for vehicle safety. Supervisors' and safety officers' vehicles will carry larger units for emergency use on mine equipment.

247 SURFACE DRAINAGE

Because of the need for ample drainage in the mine service area, a comprehensive system of ditches and culverts is recommended to cope with the estimated 10-year flood.

A 750-mm corrugated steel pipe installed with catch basins will be routed through the centre of the maintenance and service area to receive runoff from the central yard area, as well as the roof drainage from the administration building, laboratory, mine dry, and maintenance complex.

Storage areas, parking areas, general landscaped areas, and service shops should be drained by means of a network of ditches channelling the runoff to the water treatment area. To facilitate this drainage, general areas should be sloped at 0.5% to perimeter ditches or catch basins, and buildings would be drained via 300-mm buried corrugated pipes to the perimeter ditches or central 750-mm pipe.

All of the runoff from this area is planned to be collected at the west end of the service area from where it would be carried by culverts and ditches to the water treatment lagoon.

248 SECURITY

It is intended that a 2-metre high maximum security barrier will enclose the mine service area, the coal blending area, and the construction storage area. This barrier will be a heavy duty mesh fence topped with a barbed-wire strung overhang section.

Controlled access to this area will be provided at the following five points around its perimeter:

(a) A main entrance from the public access road will lead into the mine service area and the entrance to the pit and blending areas. A guardhouse will be provided at this entrance to maintain a 24-hour full security check of incoming and outgoing traffic. The entrance will be large enough for two opposite flows of traffic, with the guardhouse located centrally between the traffic lanes.

(b) A second entrance from the main access road to the coal blending yard is planned but a permanent guardhouse will not be provided. It is intended that this gate be locked and opened-up as required by selected mine personnel.

(c) A gate will be provided in the vicinity of the main conveyor transfer point and adjacent to the Houth Meadows waste conveyor for the use of the conveyor service crews with their vehicles.

(d) A similar gate will be provided adjacent to the Medicine Creek waste conveyor.

(e) A lockable gate will be provided between the construction area/scrap-yard area and the pit haulage road to the southwest of the services area.

North of the project area, security fencing will be strung across Hat Creek valley adjacent to Highway 12 to discourage public ingress to the congested area in the valley bottom between the blending area and the Houth Meadows retaining embankment. A lockable gate will be provided across the existing Hat Creek road.

Security fencing will also be provided around the larger, fixed electrical substations. Security and safety barriers for other electrical components, moveable or fixed, within the mine area are included in the design and construction of those components. A further run of security fencing would surround the explosives magazine. In total, approximately 7.5 km of security fencing is to be installed.

As the mine will operate on a 24-hour basis, general lighting for the security fence need not be provided but future illumination of selected areas should be considered by the mine security personnel.

It is proposed to enclose the entire mine project area within a low-security barrier to keep out livestock, as well as to provide a visual deterrent to the public. This barrier would be a three-strand barbed-wire fence strung between 1.5-m high metal posts at 4-m intervals. At the commencement of mining operations, 24 km of this type of fencing should be erected around the 35-year limits of the pit and the Houth Meadows waste dump, and up both sides of the main coal conveyor. In about Year 16, a further 14.5 km of ranch fencing should be erected around the 35-year Medicine Creek waste dump and waste conveyor. A fenced corridor should be provided through the project area for the diverted access road to the Upper Hat Creek area. Notices should be posted at suitable intervals around this fenceline, warning people against trespass for the sake of their own safety.

2.5 CONSTRUCTION PERIOD REQUIREMENTS

Temporary facilities for personnel, materials, and equipment will be required during construction of the permanent mine support facilities. These temporary facilities are outlined below.

251 CONSTRUCTION SCHEDULE

A construction schedule has been drawn up and is shown on Figure 2-6. According to this schedule, all mine support facilities will be ready for use when required for the general mining operations. The schedule takes into account engineering and purchasing, anticipated delivery periods, and assembly of equipment and materials.

252 CONSTRUCTION PERIOD FACILITIES

Construction period facilities would include a temporary camp to house the construction work force; the camp does not form part of this study and is not discussed further. It is assumed that the supply of the necessary construction buildings, shops, etc., would be the responsibility of the respective contractors during construction of the various structures and erection of the initial mining and conveying equipment. It is assumed that temporary office and warehousing facilities would be erected to house the construction management team and B.C. Hydro's construction and management group during the construction period.

253 MINE EQUIPMENT ERECTION AREA

A mine equipment erection area of 12 ha is provided at the northern end of the proposed mine perimeter (see Figure 1-1), close to the conveyor ramp, the mine service ara, and serviced by access roads for the movement of materials and equipment. The area is large enough for the simultaneous erection of two 16.8 m^3 mining shovels, and has sufficient storage space for miscellaneous components of other equipment awaiting erection, as well as for various small buildings, offices, and other facilities.

The area will be well-drained and supplied with water and power.

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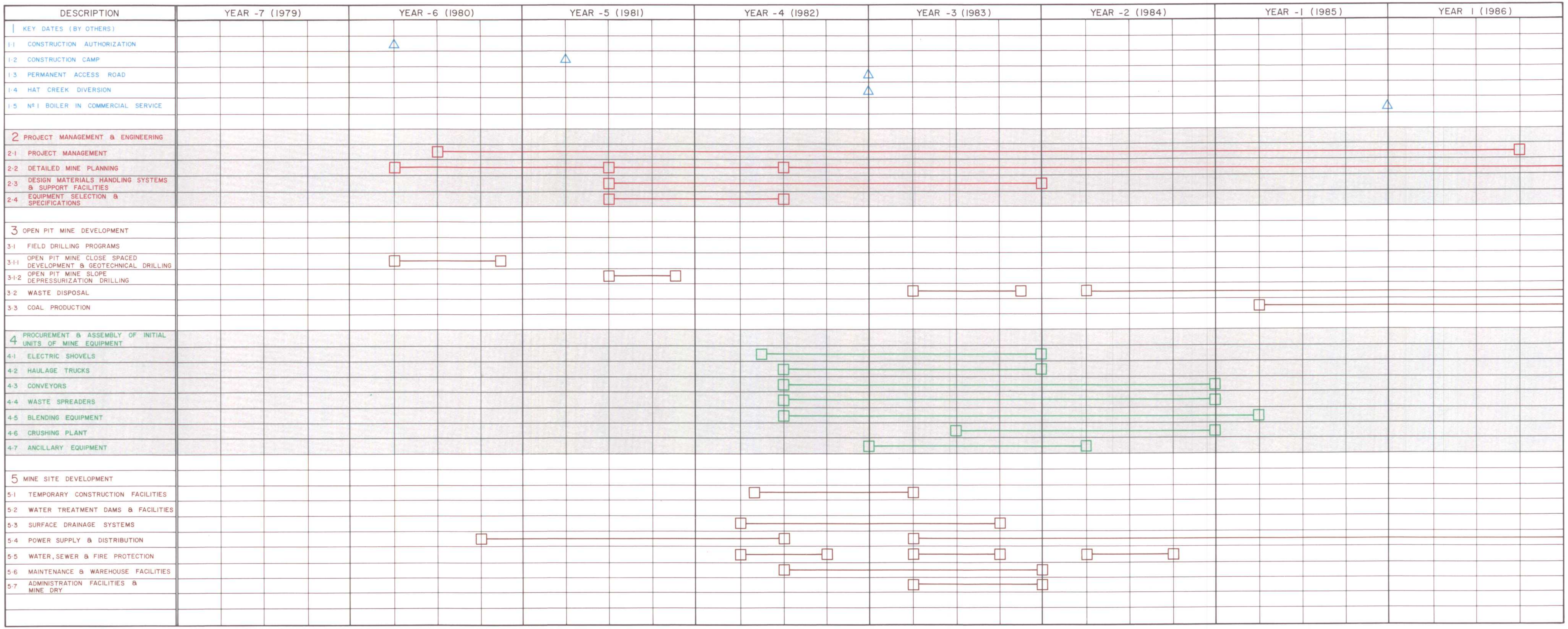
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

CONSTRUCTION SCHEDULE

FIGURE 2-6



SECTION 3

MINE DRAINAGE

3.1 INTRODUCTION

Based on mine planning studies developed to date as described in Volume III, four major priorities were identified which are considered essential to the design of a mine drainage system. These are:

- to prevent flood damage to excavations and equipment
- to keep mine areas, both in-pit and out-of-pit, dry enough to assure continuous operation
- to improve the stability of excavations by reducing the infiltration of surface waters
- to assure compliance with present government regulations, particularly those regarding protection of the environment

This section of the report describes the potential quantity and source of waters to be considered for design purposes and sets out a comprehensive mine drainage system for those aspects involved in the diversion, collection, and possible treatment thereof.

3.2 SUMMARY

In developing a drainage system for the proposed Hat Creek mine, consideration has been given to both safety of mine operations and protection of the natural environment. Establishment of the mine drainage system would begin with initial mine development in Year -5 and would expand to accommodate mine growth up to Year 35.

Five years prior to commencement of mining, work will commence on directing Hat Creek and Finney Creek by sidehill canals around the proposed mine. Lakes on the southwest perimeter and within the proposed Houth Meadows waste dump would be drained by lowering their natural outlets and the first stage of a pit dewatering well system would be installed. During this time temporary sedimentation lagoons would prevent excessive discharge of sediment downstream.

In Year -3, the diversion of Hat Creek would be functioning and sedimentation and leachate storage ponds would be constructed to the north of the mine from surficial material excavated from the north end of the pit.

A conveyor causeway will be constructed from the north pit access incline to the south abutment of the Houth Meadows waste embankment in Year -2. Corrugated steel pipes, buried in the crest of this causeway, will drain water from the west perimeter of the pit and the Houth Meadows waste dump. Water in these perimeter diversion drains will be discharged to the Hat Creek Diversion and drainage from within the developing dump area will be discharged to sedimentation lagoons prior to discharge to Hat Creek.

During the expansion of the open pit, a system of open drains outside of the main perimeter road will divert surface water inflow away from the excavation. Within this outer perimeter, a system of ditches and sumps will collect surface water and seepage to be pumped from the pit at the north incline to sedimentation lagoons. Poor quality seepage is planned to be isolated and retained for in-pit dust control.

Surface water drainage from the mine service area will be collected by ditches and stormwater pipes and discharged to the sedimentation lagoons. Runoff and leachates from the coal handling area and low-grade coal stockpile are to be collected and stored in a central holding pond for seasonal disposal by use for dust control on pit roads and in coal handling areas. Seepage from the base of Houth

Meadows waste dump embankment may also be collected and discharged to this system. Surplus accumulations of leachates in the system in excess of dust control requirements may be disposed of by spray evaporation on the active surface of the Houth Meadows waste dump.

In Year 16, a second waste dump is expected to be started in Medicine Creek valley. In Year 15, Medicine Creek will need to be diverted north in a sidehill canal above the proposed 35-year dump perimeter. Two smaller diversions on the south slopes of the valley will divert surface water from the hillside above. Sedimentation lagoons will be constructed downstream of the proposed waste embankment prior to placement of waste. Surface runoff from the disturbed dump area will be routed to these sedimentation lagoons by an open drain adjacent to the north side of the dump and a buried pipe in the abutment of the proposed embankment. If necessary, seepage from the embankment could be collected in a holding pond for seasonal disposal by spray evaportation on the dump surface

3.3 MINE WATER: SOURCE AND QUANTITY

Control measures for mine drainage must consider the following sources;

- direct precipitation onto the mine site
- streamflow
- standing surface waters
- groundwaters
- mine wastewater

A description of these water sources and the potential quantities to be considered is provided below.

331 DIRECT PRECIPITATION

Annual precipitation at the surface of the open pit, based on the period of record (1961-1975), is estimated to average 300 mm. Approximately 55% of this total is received as rainfall and the balance as snow. A summary of the seasonal distribution of precipitation is shown on Figure 3-1; from this, it can be seen that most precipitation occurs during summer and winter months with spring and fall being somewhat drier. The frequency distribution of total annual precipitation, total annual rainfall, and daily rainfall utilized in predicting the magnitude of extreme runoff (refer Section 343) is also depicted on Figure 3-1.

332 SURFACE WATERS

332.1 Flowing Surface Waters

The principal flowing waters which enter the proposed mine include Hat Creek, Medicine Creek, Finney Creek, and Houth Creek. The location and relative sizes of their watershed areas in respect to the mine area are presented on Figure 3-2 and Table 3-1. Of the total Hat Creek drainage area, estimated

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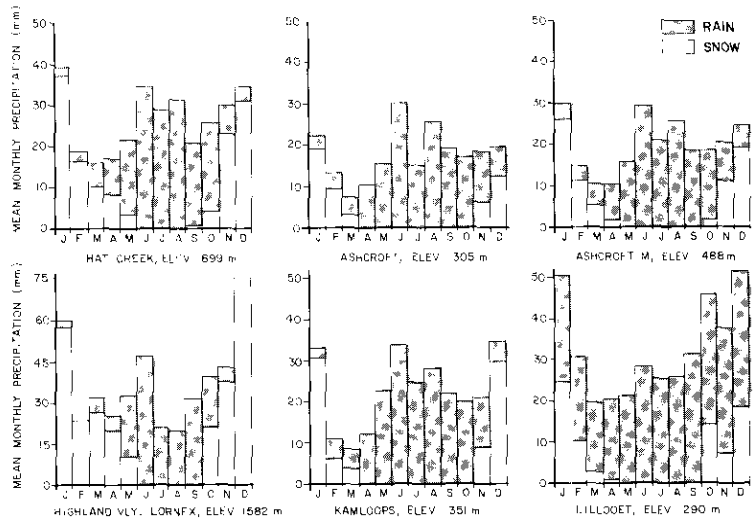
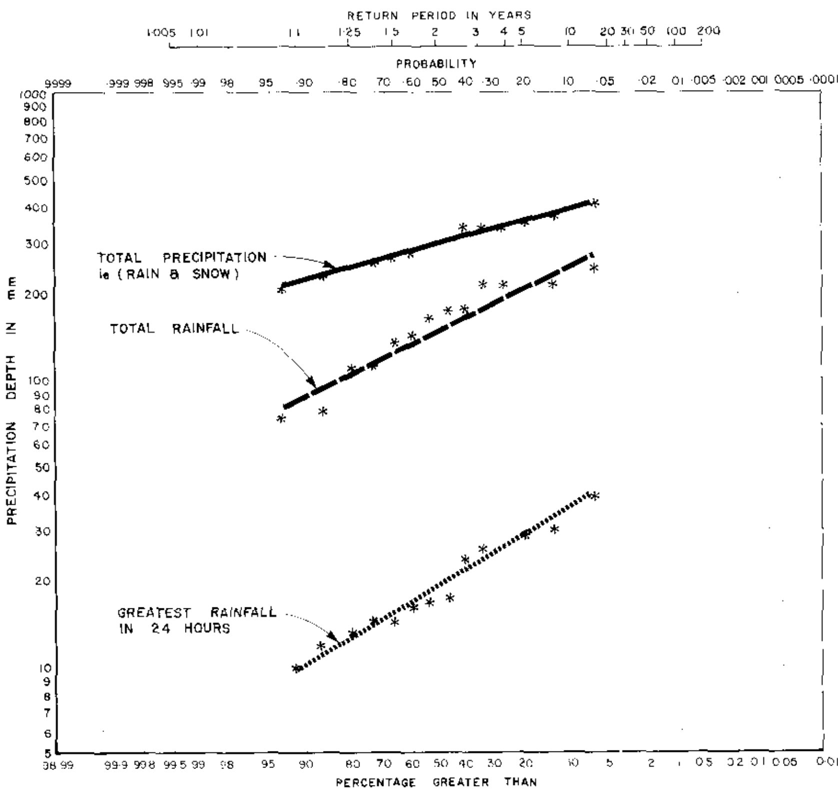


SEASONAL DISTRIBUTION OF MEAN MONTHLY PRECIPITATION IN THE HAT CREEK REGION

from Atmospheric Environment Service Canadian Normals, 1973



DISTRIBUTION OF PRECIPITATION DATA FOR HAT CREEK VALLEY

from Atmospheric Environment Service, Climatological Station Data

FIGURE 3-1

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

PRECIPITATION DATA

Source: Beak Hydrology Inventory Study, Draft March 1978

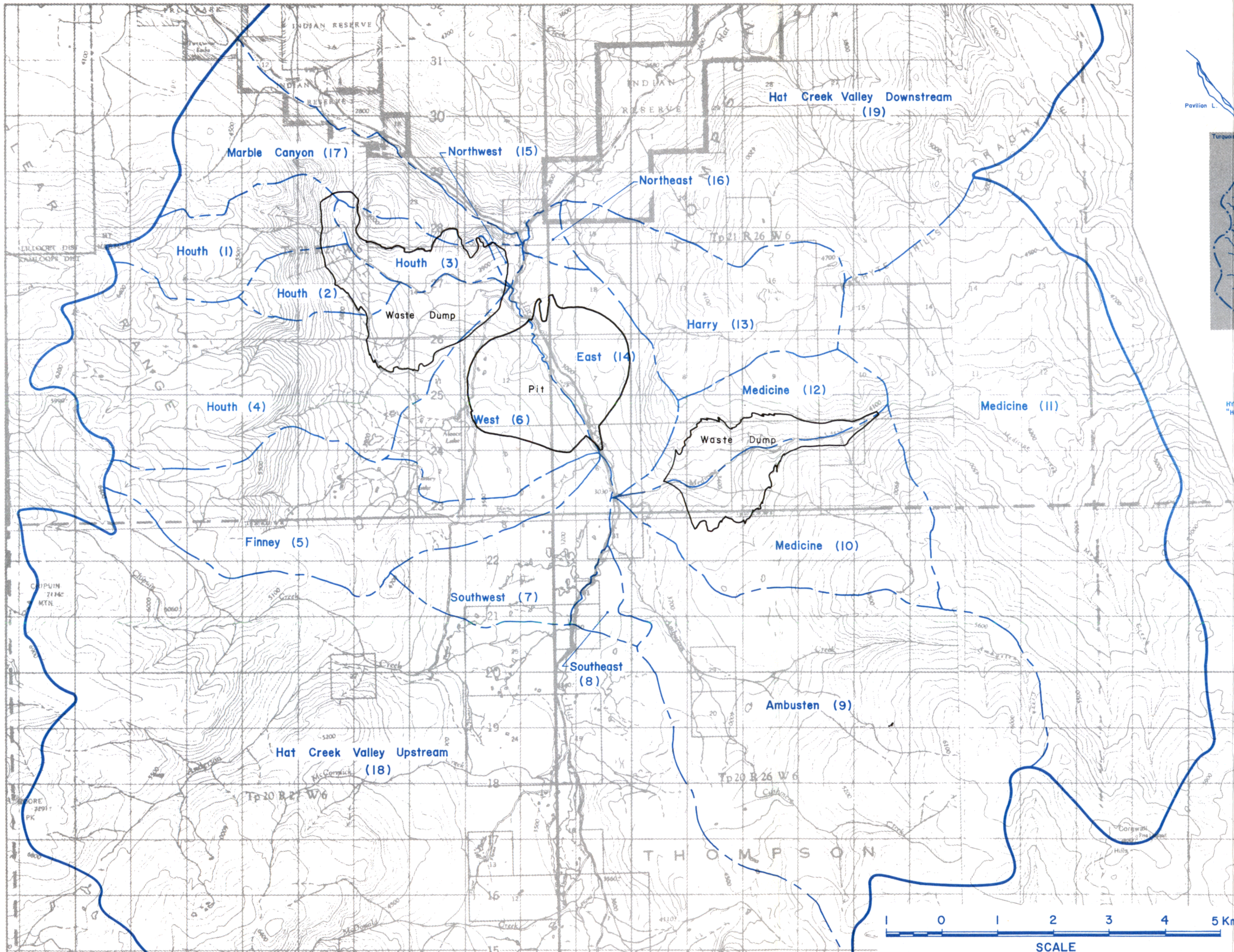
TABLE 3-1

Areas of Natural Watersheds

(Refer Figure 3-2)

Hat Creek Project Mining Feasibility Report 1978

Watershed	Reference No.	Plan Area (km^2)
Houth Meadows	1	5
	2	3
	3	2.5
	4	19
HOUTH MEADOWS SUBTOTAL		29.5
Finney Creek	5	13
West Pit	6	8.1
South West Pit	7	5.0
South East Pit	8	1.3
Ambusten Creek	9	35
Medicine Creek	10	12.6
	11	43.1
	12	5.9
MEDICINE CREEK SUBTOTAL		61.6
Harry Creek	13	9.9
East Pit	14	6.5
North West Pit	15	0.4
North East Pit	16	0.8
Marble Canyon	17	10.0
WATERSHEDS IN PROJECT AREA SUBTOTAL..........................		182
Hat Creek Watershed (upstream)	18	248
Hat Creek Watershed (downstream)	19	236
HAT CREEK WATERSHED TOTAL.......................		666



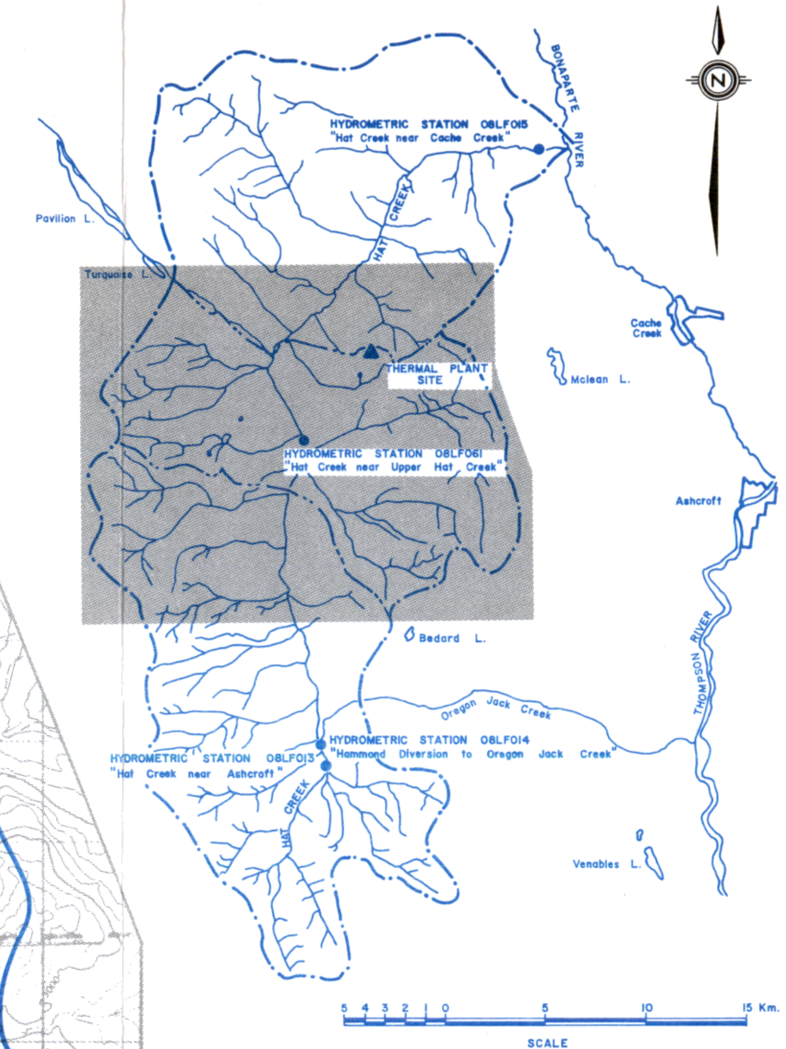


FIGURE 3-2

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

HAT CREEK WATERSHED

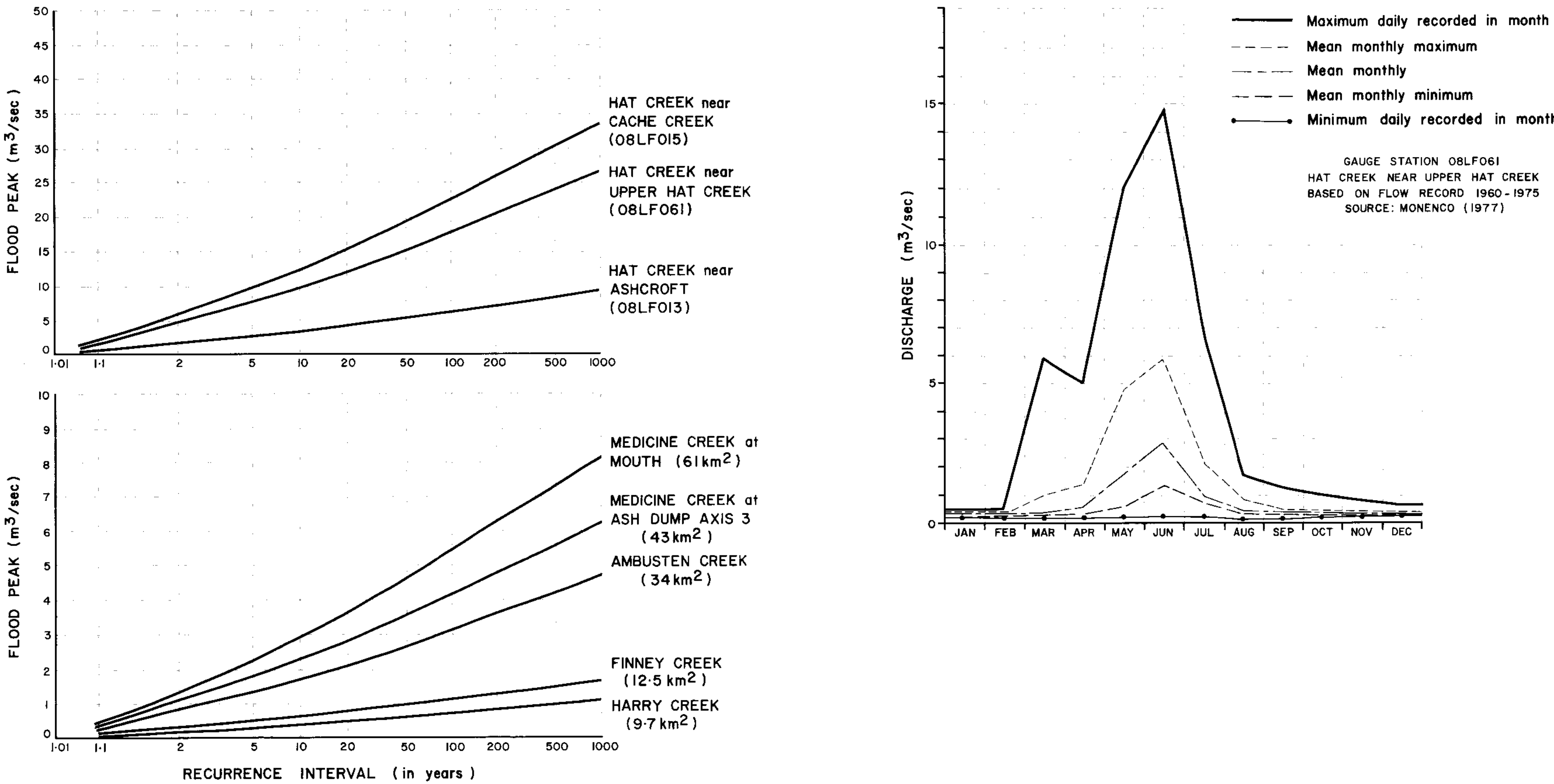
to be approximately 666 km^2, the watershed area of Hat Creek above the proposed mine is roughly 350 km^2. From the Water Survey of Canada gauging station No. 08LF061, located immediately upstream of the proposed open pit (refer Figure 3-2) and most representative of surface water flow at the mine, mean annual flow in Hat Creek has been calculated to be 0.72 m^3/sec. The seasonal distribution of streamflow at this gauge station is illustrated graphically on Figure 3-3. A wide variation in discharge over the course of a year is evident.

Watershed areas of Medicine Creek, Houth Creek, and Finney Creek are estimated to be 62 km^2, 30 km^2, and 13 km^2, respectively.

Flood frequency curves for Hat Creek and some smaller tributary creeks have been derived and are presented in Figure 3-3. These curves illustrate the magnitude of Hat Creek flood flows relative to those of the smaller creeks in the mine area. The open pit and waste dumps of the proposed mine divide some of these natural watersheds into new sub-watersheds which must be drained. Flood flows from the larger of these sub-watersheds may still be of similar character to Hat Creek flow and result from rain during a period of high snowmelt. Design flow for these watersheds was estimated from the nomograph presented on Figure 3-4. Small watersheds in the mine area, especially those which are stripped of native ground cover, may be more "flashy" than these larger watersheds and flood in response to thunderstorm type rainfall which is likely to occur in the valley during summer. Design flows for these watersheds were estimated from the nomograph on Figure 3-5 which yields conservatively higher estimates of drainage flows.

332.2 Standing Surface Waters

To the southwest of the proposed open pit there are approximately 60 lakes and small ponds which vary in area from 15 ha (Finney Lake) to less than 100 m^2. Current geotechnical studies are aimed at determining the future stability of this



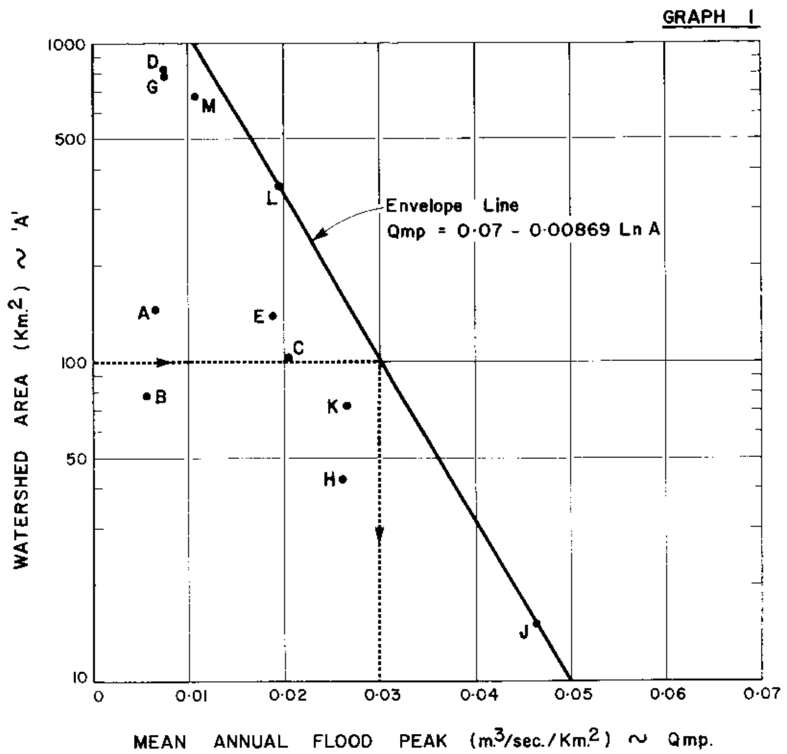
NOTE:
CURVES SHOWN ARE FOR ANNUAL SNOWMELT FLOODS

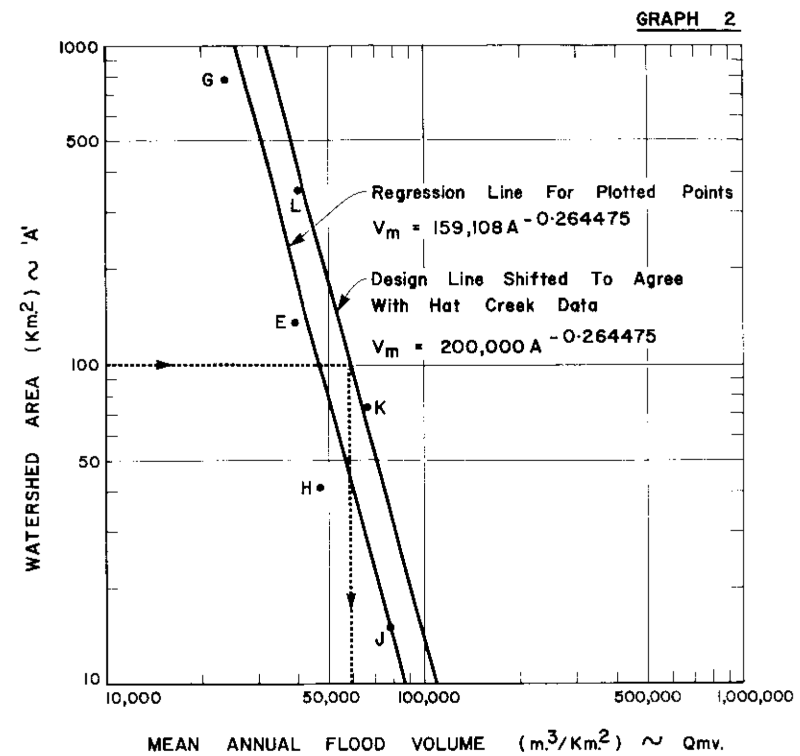
Source: B.C. Hydro H.E.D.D. 1978

FIGURE 3-3

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

STREAMFLOW DATA





EXAMPLE CALCULATION

DATA:

Watershed Area = 100 Km^2

Design Recurrence Interval = 10 Yrs.

CALCULATION:

From Graph 1, Qmp = 0·03 m^3/sec./Km^2

From Graph 3, Mp = 1·9

Flood Peak Discharge = 1·9 x 0·03 m^3/sec./Km^2 x 100 Km^2

= 5·7 m^3/sec.

From Graph 2, Qmv = 59,000 m^3/Km^2

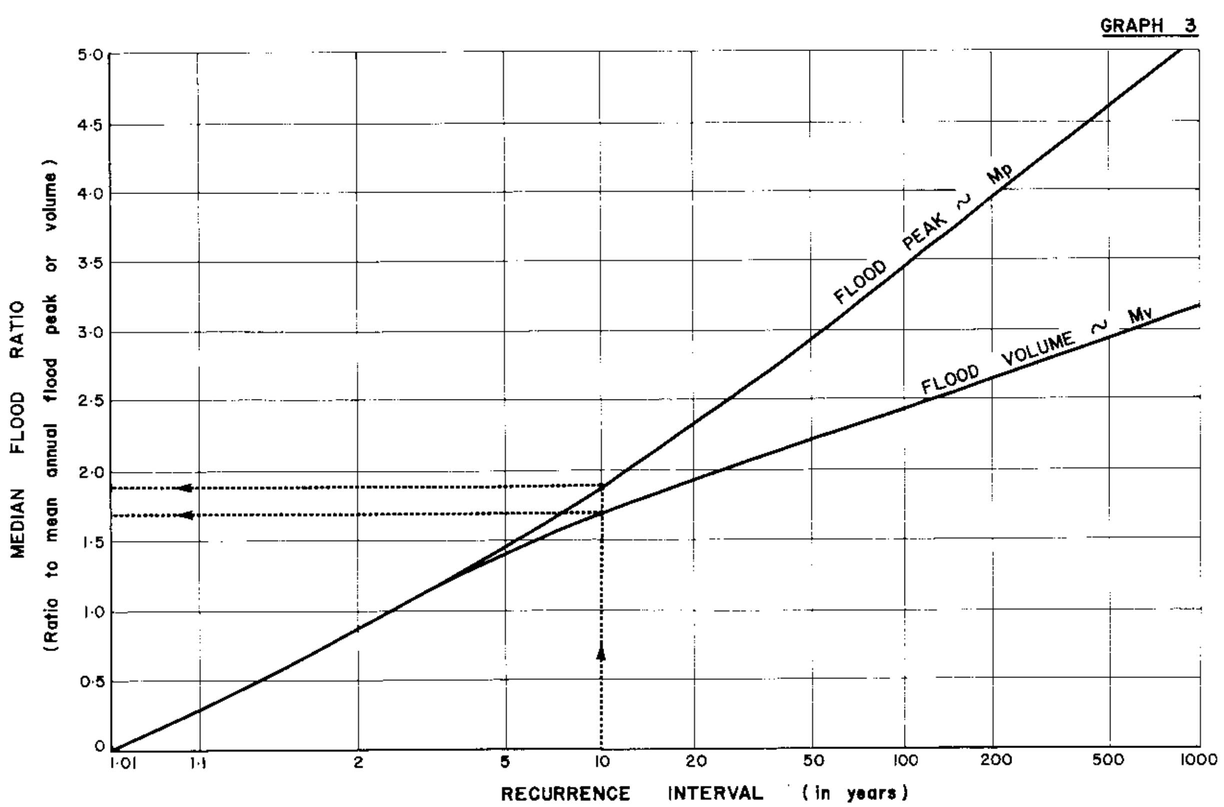
From Graph 3, Mv = 1·7

Flood Volume = 1·7 x 59,000 m^3/Km^2 x 100 Km^2

= 10·03 x 10^6 m^3

NOTE:

For preliminary estimates of floods from natural watersheds 10 Km^2 or greater in mine area.



KEY	WATER SURVEY OF CANADA GAUGE STATION	
A	08LF036	
B	08LF038	
C	08LF069	
D	08LG003	
E	08LG009	
F	08LG014	
G	08LG032	
H	08LG033	
J	08LG055	
K	08LF013	Stations in Hat Creek valley
L	08LF061	
M	08LF015	

SOURCE.

Adapted from Regional Analysis Of Streamflow Data in B.C. Hydro, H.E.D.D. Report No. 913. "Hat Creek Project - Diversion of Hat and Finney Creeks."

FIGURE 3-4

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

RAIN - SNOWMELT FLOOD NOMOGRAPH

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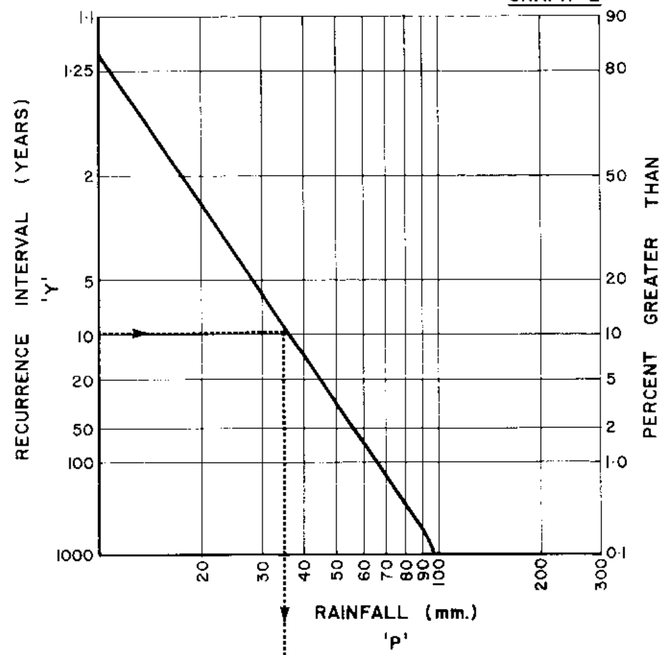
TABLE I

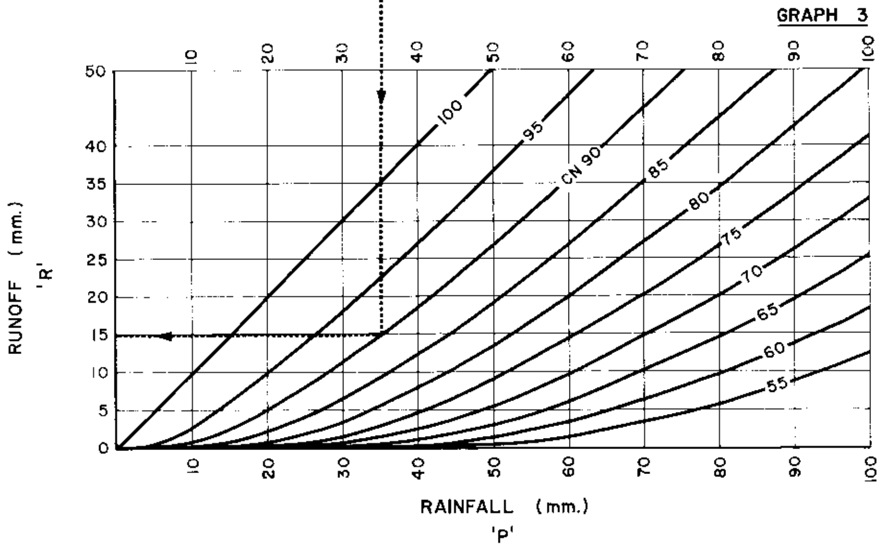
CURVE NUMBERS (CN)

NATURAL WATERSHEDS	=	60 - 70
REVEGETATED AREAS	=	70 - 80
DUMP SURFACE	=	90 (Surface storage not accounted for by this parameter)
PIT SLOPE	=	90
STORAGE YARDS	=	90
PAVED AREAS	=	98

GRAPH 2



GRAPH 3

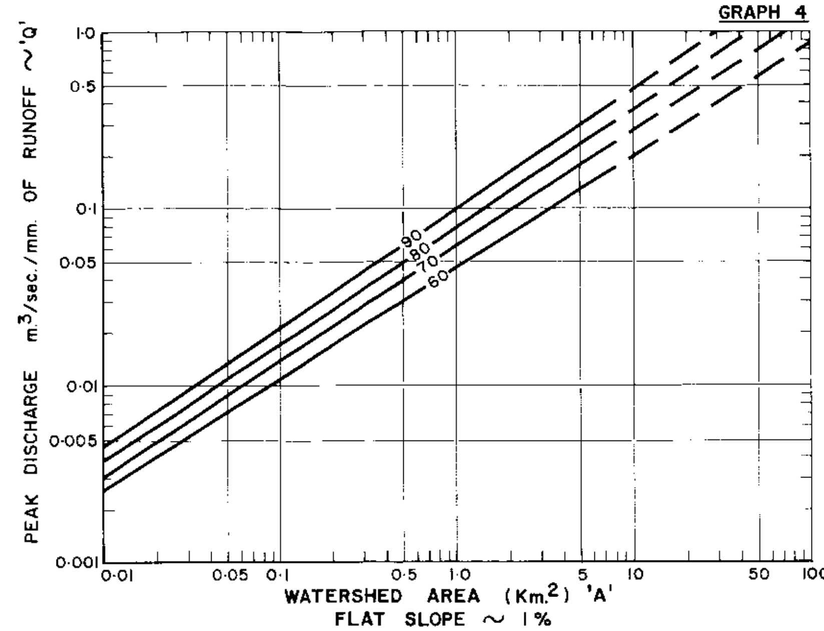


ASSUMPTIONS:

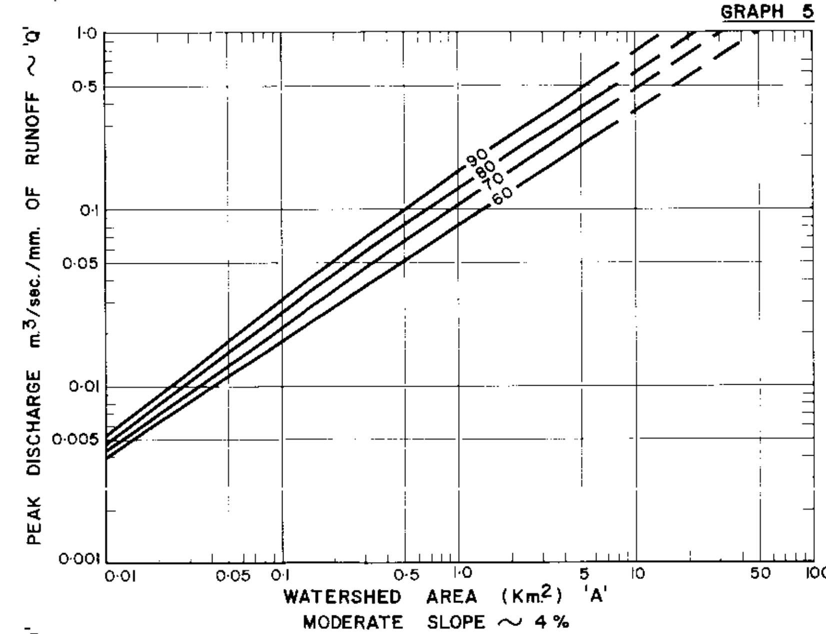
Antecedent Moisture Condition AMC = II

Initial Abstraction Ia = 0·2S ~ Potential Abstraction

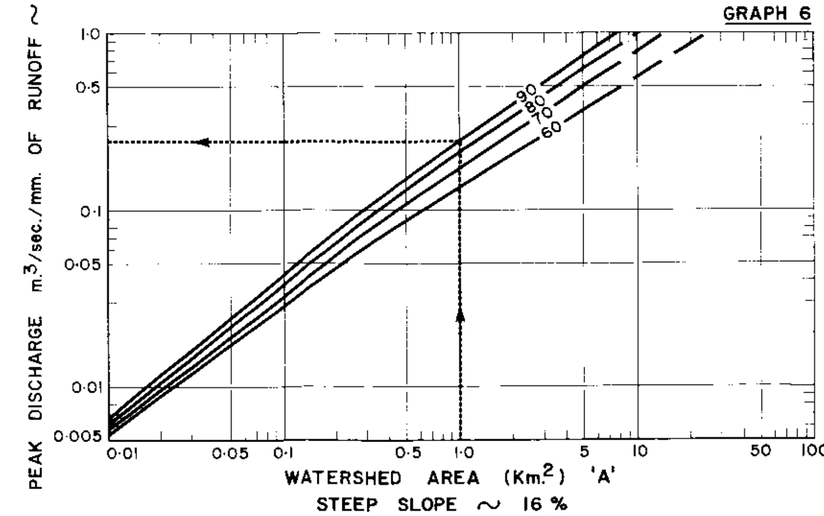
GRAPH 4



GRAPH 5



GRAPH 6



EXAMPLE CALCULATION

DATA:

DESIGN STORM

Recurrence Interval	10 Yrs.
Duration	24 Hrs.

WATERSHED

Area	1 Km^2
Slope	Steep (16%)
Surface	Pit Slope

CALCULATION:

(i) From Table I

CN = 90

(ii) From Graph 2

Design Rainfall 'P' = 35 mm.

(iii) From Graph 3

Runoff 'R' = 15 mm.

(iv) From Graph 6

Unit Peak Discharge 'Q' = 0·25 m^3/sec./mm.

(v) Peak Watershed Discharge = 'R' x 'Q' = 3·75 m^3/sec.

NOTE:

This nomograph is for preliminary estimates of flows from watersheds in mine area $<$ 10 Km^2

SOURCE:

Table I and Graphs 3,4,5 & 6
Adapted from U.S. Soil Conservation Service, National Engineering Handbook, Section 4, Hydrology & Technical Release No. 55, Urban Hydrology For Small Watersheds.

Graph 2
B.C. Hydro, H.E.D.D., Report No. 913.

FIGURE 3-5

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK PROJECT

MINING FEASIBILITY REPORT

RAINSTORM FLOOD NOMOGRAPH

region during pit excavation and in particular, in that area of the surficial inactive and active mudslide mass which has been previously identified near the pit perimeter.

Drainage of all or part of this lake system may reduce groundwater recharge to the slide material thereby improving pit slope stability. As well, it may also prevent the sudden release of a large volume of water into the pit should slide movement occur.

There are also 10-15 small lakes and ponds in the Houth Meadows waste dump area which are planned to be drained prior to being covered with waste.

333 GROUNDWATERS

Studies to date have identified three major geohydrologic units within the general mine area (Golder, 1978), which comprise:

(a) the surficial deposits which vary from slide debris and till in the west to gravels in the east. This is the major water bearing unit of highest average hydraulic conductivity 10^{-6} m/s;

(b) the coal which exhibits highly variable conductivity which is estimated to average 5×10^{-9} m/s; and

(c) the upper and lower Coldwater sediments which are essentiall impermeable with an average conductivity of 5×10^{-11} m/s.

General groundwater flow within the Upper Hat Creek Valley may be characterized by recharge in upland areas and discharge in the valley bottom. Most of the groundwater flow occurs through surficial deposits; less than 2% is estimated to move through clastic sediments in the valley bottom.

The eastern areas of the proposed open pit are reasonably well drained due to greater depths of surficial deposits and their moderately high rates of hydraulic conductivity. Surficial deposits in the western areas of the open pit are thinner and most materials are of lower permeability resulting in springs and groundwater seeps.

The two main aquifers in the vicinity of the pit are a small alluvial aquifer along the central valley and a buried bedrock channel on the east side of the valley. Flow is estimated to be in the order of 3×10^{-2} m^3/s.

Due to the low permeability of the coal and bedrock units, water yield from seepage and dewatering operations during mining is predicted to be minimal (Golder, 1978). Extensive depressurization of pit slopes is not likely and dewatering wells will therefore be selectively located in pervious zones where higher benefits can be realized, or in areas where stability is considered essential to maintain operations.

334 MINE WASTEWATER

Three main sources of wastewater produced by mining operations have been identified as: effluent from the mine service complex; leachate from coal handling areas, waste dumps, and low-grade coal stockpiles; and seepage from coal and bedrock faces within the open pit.

The mine service complex will include an administration building, mine dry building ("locker" rooms, shower, and laundry), maintenance workshops for mining equipment, and a laboratory. The major source of wastewater will be sanitary effluent from the daily work force which will peak at about 700 persons. The corresponding mean daily flow is estimated at 140 m^3/day. Allowance will also be made for approximately 90 m^3/day of wastewater discharged to stormwater drains as a result of vehicle washdown and general yard use.

Runoff and leachate from coal and low-grade coal stockpiles will require special drainage and disposal systems due to the predicted elevated levels of trace metals, dissolved solids, biochemical oxygen demand, and variable pH. It is expected that for most of the time these flows will be very small as the material will be moisture deficient; In the stockpile however, provision will need to be made for disposing of small volumes of seepage and occasional surface runoff due to snowmelt or rainfall.

The mine waste will be stored in valley fill type dumps and retained by an embankment at the valley mouth. The waste will consist of sands, gravels, till, sandstone, siltstone, and claystone. The granular sand and gravel material will be used for embankment construction and the weaker less pervious materials will be laid in the enclosed dump. Laboratory tests to date indicate that dump leachate may be of poor quality (Beak, 1978; Acres, 1977). Estimates of seepage from the dumps through the embankments indicate that flows of 300-1500 m^3/day may occur due to the relatively pervious nature of the upper layer of uncompacted waste and that of the embankment itself (Beak, 1978). However, during dump construction the migration of fine material into the embankment may act as a sealant and reduce these flows. Seepage may also be reduced somewhat by giving special treatment to the dump embankment interface by either laying a graded filter or carrying out local compaction. The practicality of including this process in the dump construction program has not been established at this stage of mine studies; therefore the original seepage estimates, although conservative, have been retained and disposal systems provided.

Analysis of groundwater samples has determined that water yield from coal seams within the pit or from dewatering wells may be of poor quality (Beak, 1978). It is expected that during normal mining operations the low yield of these latter wastewaters relative to surficial groundwater and surface water will have little impact on the quality of mine drainage. However, when localized pervious areas are encountered, special measures may be required to isolate this wastewater and dispose of it by evaporation.

3.4 MINE DRAINAGE SYSTEM

This portion of the report presents the rationale used in development of the overall mine drainage system and a description of the diversion, collection, and treatment systems proposed. Although specific site investigations would be required to confirm individual elements of the system, planning for the control of mine drainage has utilized all available field and laboratory test data.

341 DESIGN CRITERIA AND SELECTION OF SYSTEM CAPACITY

The capacities of the various drainage system elements have been selected in accordance with the flood risk which should be accepted in each area of the developing mine. This judgement is based on a qualitative assessment of acceptable flood risks and may be confirmed by an economic comparison of projected system costs and flood damage losses during detailed mine planning and throughout mine operations. The overall cost of mine drainage including major diversion canals and pit dewatering systems amounts to 1-2% of mining cost; therefore optimization of individual systems is not presently warranted.

Criteria used for selection of design floods are shown in Table 3-2. A differentiation is made between the allowable flood risk from rainstorm flood peaks on small watersheds and freshet floods from larger watersheds. This reflects the different consequences of the two types of flooding. Rainstorm floods from small watersheds would be of short duration (i.e., 0-2 days) and involve small volumes of runoff. The overtopping of a small drain, due to runoff from extreme storms, would therefore cause limited damage and delay to mine operation.

Should a major diversion canal which drains a large watershed be overtopped during a spring, freshet-type flood of 30-60 days duration, then the volumes of floodwater could be concomitantly large and cause disproportionately more damage to the mine. This is reflected in the acceptable flooding probability which has been selected as 3% in the life of the mine for spring freshet floods from large watersheds as opposed to a 30% probability for estimated small watershed flow during shorter duration, higher intensity rainfall.

The conceptual flow model of the mine drainage system is shown on Figure 3-6 and the design flows selected for sizing the individual drains and pipes are presented on Table 3-3.

TABLE 3-2

Design Floods for Preliminary Planning
of Mine Drainage Systems

Hat Creek Project Mining Feasibility Report 1978

Type of System	Watershed Area	Design Flood Used for Selecting System Capacity		Probability of Exceedence in 35-Year Life of Mine
		Spring Snowmelt	Summer Rainstorm	
Creek diversions and perimeter drainage around the mine development	>10 km^2	1000	-	3%
	<10 km^2	-	100	30%
Minor drainage system where flooding would not cause delay or damage	<10 km^2	-	10	97%

LEGEND

TABLE 3-3

MINE DRAINAGE AND WATER SUPPLY SYSTEM FLOWS

HAT CREEK PROJECT MINING FEASIBLITY REPORT 1978

Code (As on flow chart)	Description	Watershed Area Km^2	Flow Frequency	Flow Type	Estimated Flow m3/S	Estimated Volume $m^3 \times 10^3$	Sources of Data	Assumptions and Remarks
DIVERSION DRAINS								
D1	Upper Southwest Perimeter	2.5	100R	P	1.4		1	8mm Runoff
D2	Finney Creek Canal	19.5	1000F	P	4.3		2	
D3	Hat Creek Upstream of Headworks Reservoir	248	1000F	P	27		2	
D4	Ambusten Creek and Southeast Watershed	35	1000F	P	7		2	
D5	South Medicine Creek	6	100R	P	2		1	5mm Runoff
D6	Pit Rim Pump	4.4	-	P	0.12		5	*Flow limited to pump* capacity
D7	North Medicine Creek	43	1000F	P	8.5		2	Excludes ash pond and reservoir 6 Km^2
L1	Canal Leakage	-	DY	M	.01-.025		5	
D8	Hat Creek Downstream of Medicine Creek	360	1000F	P	34		2	Includes Dump Area
D9	East Watershed	2	100R	P	1.2		1	8mm Runoff
D10	West Perimeter	25	1000F	P	5		2	
D11	Hat Creek Downstream of Mine	383	1000F	P	35		2	
D12	North Perimeter	1	100R	P	1		1	5mm Runoff
P1	Lower Southwest *Diversion*	0.9	100R	P	0.7		1	8mm Runoff
P2	Southeast Diversion	0.5	100R	P	0.5		1	8mm Runoff
P3	Watershed below Canal	3	100R	P	1.5		1	8mm Runoff
MINE SURFACE WATER COLLECTION SYSTEM						24 Hour Volumes		
S1	*Disturbed Area Drainage to* North Valley Sedimentation Lagoons	3-6 Disturbed +3 Reclaimed	10R 10R	- -	- -	45-90 0-15	1 1	15mm Runoff 5mm Runoff
S2	Mine Service Area Drainage	0.35	10R	-	-	5 3	1	15mm Runoff
S3	Washdown Water		DY	M	-	0 09	1	
S4	Pit Surface Water	1-6	10R	-	-	17	1	Limited to Pump Capacity
S5	Surficials Groundwater and Seepage		DY DY	M M	.011-.024 .006-.016		6 4	Pumps and Seepage Pumps Only
S6	Disturbed Area Runoff Medicine Creek	2.5 Disturbed +1.3 Reclaimed	10R 10R	- -	- -	0-37.5 0-6 5	1 1	15mm Runoff 5mm Runoff
ZERO DISCHARGE SYSTEM						Annual Volumes		
Z1	*Sanitary Effluent*	-	DY	M	0.0016	51	7	700 Shifts x 0.2 m^3
Z2	Coal Blending Runoff and Seepage	0.2	A	M	-	2-20	7	10-100mm Annual Yield
Z3	Low-Grade Coal Runoff and Seepage	0.33	A	M	-	3-30	7	10-100mm Annual Yield
Z4	Embankment Seepage Houth Meadows	-	A	M	-	100-550	6	
L2	*Seepage lost to Evaporation*	-	A	M		2-20	7	1-10 ha x 200mm Loss
Z5	Holding Pond Inflow	-	A	M	-	154-631	7	
Z6	Coal and Bedrock Groundwater	-	A	M	-	9-25	4, 7	5% of Groundwater Flows
Z7	Dust Control Use	-	A	M	-	250-370	7	
L3	Holding Pond Loss	2	A	M	-	4	7	200mm Loss
Z8	Medicine Creek Embankment Seepage	-	A	M	-	55-365	6, 7	
L4	Seepage Lost to Evaporation	-	A	M	-	2-20	7	1-10 ha x 200mm Loss
WATER SUPPLY						Annual Volumes		
H1	Supply to Mine Service Area	-	DY	M	0.0041	10[illegible]	7	700 Shifts + Garden + Washdown
H2	*Supply to Revegetation Nursery*	-	A	M	-	7[illegible]	7	10 Ha.

KEYS TO SYMBOLS IN TABLE:

- 100R - 100 year recurrence interval rainstorm flood after snowmelt
- 1000F - 1000 year recurrence interval freshet flood during snowmelt
- 10R - 10 year recurrence interval rainstorm flood after snowmelt
- DY - DAILY
- A - ANNUAL
- P - PEAK Discharge
- M - MEAN Discharge

SOURCES OF DATA:

1. CMJV Rainstorm Nomograph
2. CMJV Freshet Nomograph
3. Hat Creek Flow Records
4. Golder Associates Geotechnical Report 1977
5. B.C. Hydro H.E.D.D. "Diversion of Hat and Finney Creeks" 1978
6. Beak Consultants "Hydrology Drainage and Water Use-Impact Report" 1978
7. CMJV Estimate

NOTE:

These data are based on Preliminary Mine Planning Data, Hydrological and Hydrogeological Studies. Surface water flows from small watersheds and seepage flows are estimates based on several arbitrary assumptions as to runoff infiltration factors and hydraulic conductivities therefore they should be upgraded when further site specific data becomes available.

Where a range of flow is shown this identifies the variability of flow in terms of the assumptions made.

Areas used correspond to the estimated maximum effective area of natural watersheds, disturbed areas or mine facilities to be drained.

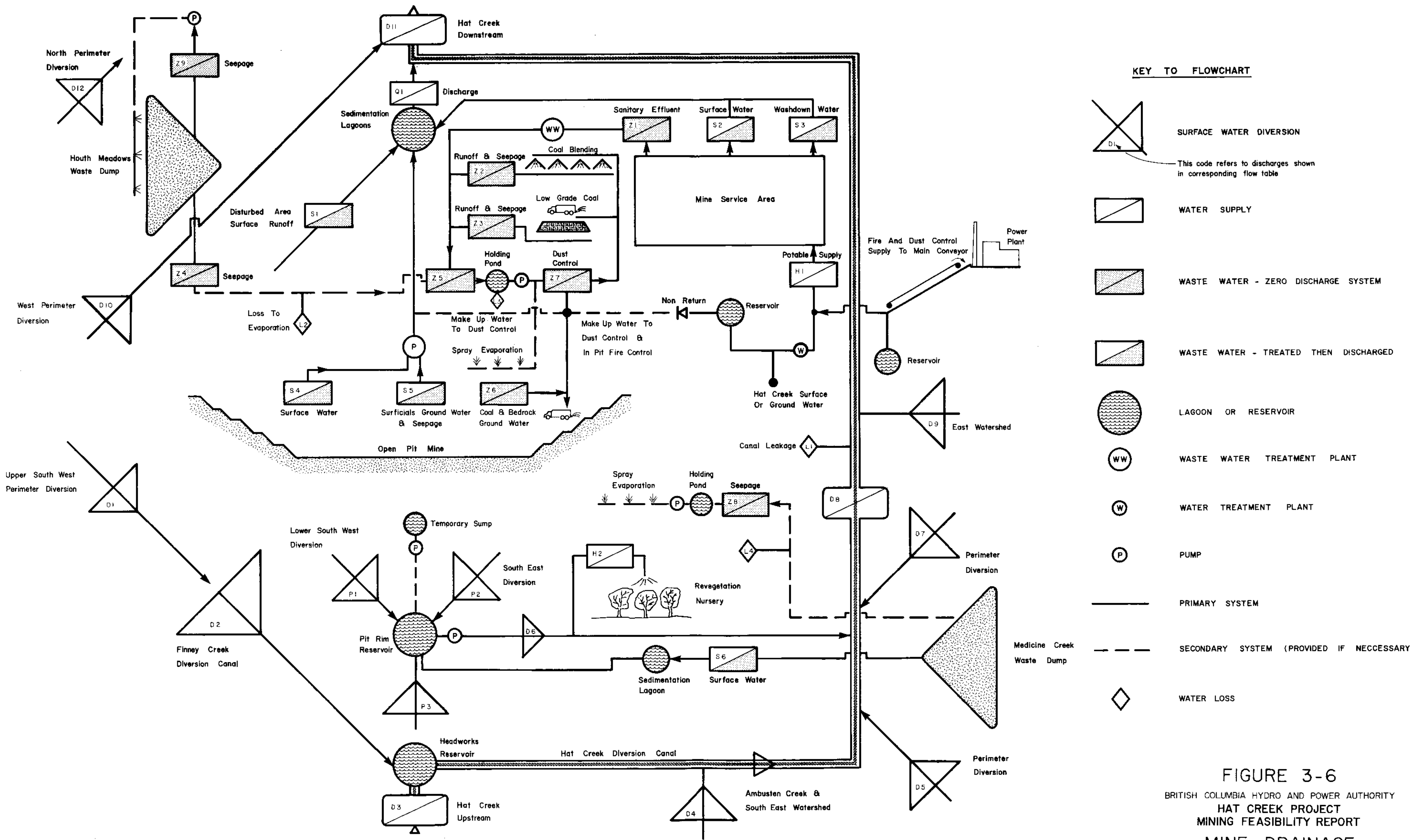


FIGURE 3-6

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

HAT CREEK PROJECT

MINING FEASIBILITY REPORT

MINE DRAINAGE & WATER SUPPLY FLOWCHART

342 SURFACE WATER DRAINAGE SYSTEM

342.1 Diversion of Creeks

Hat Creek and Finney Creek must be diverted to allow mining in the bottom of Hat Creek Valley. Medicine Creek and Houth Creek must be diverted prior to construction of waste dump embankments.

Hat and Finney Creeks The proposed Hat Creek Diversion arrangement comprises a headworks dam with a canal intake and an emergency spillway located immediately downstream of Anderson Creek; approximately 6.4 km of diversion canal on the east side of Hat Creek Valley at about elevation 975 m ASL; and some 1.9 km of buried conduit with intake and outlet works to convey the flow back to Hat Creek (Monenco, 1977; BCH-HEDD, 1978). A pit rim dam, spillway, pumphouse, and pipeline between the headworks dam and mine pit will intercept seepage and local inflow immediately upstream of the pit. The diversion works have been sized to accommodate, as a normal operating condition, a flow of 18 m^3/s (100 year recurrence interval flood) and as an emergency condition, a flow of 27 m^3/s (1000 year recurrence interval flood). The proposed Finney Creek Diversion canal is 2.75 km long and will divert Finney Creek flows south, along the west side of Hat Creek Valley with discharge to the Hat Creek Diversion headworks pond. The design capacity of the canal is 5.5 m^3/s corresponding to the estimated 1000 year return period rainstorm flood. Detailed plans and current cost estimates for this system are provided under separate cover (BCH-HEDD, 1978).

Houth Creek During waste dump construction most of the surface water from the upper Houth Meadows watershed will be diverted around the dump via the West Perimeter Diversion as shown on Figure 3-7. This diversion consists of a 5 km x 8 m open drain around the west and south perimeters of the dump, with discharge east to a buried pipe (approximately 2.2 km in length and 1.4 m to 2.1 m in diameter) in the conveyor causeway. This pipe carries the flow northeast to rejoin Hat Creek flow north of the mine. The upper reach of the diversion will initially be constructed at elevation 950 m ASL in Year -2 and be relocated twice during the growth of the dump. The staged development of the dump and the diversion is illustrated on Figures 5-6, 5-7, 5-8, and 5-9 in Volume III.

The diversion is designed to carry the 1000 year flood thus requiring 2 m^3/s capacity in the upper reach and 5 m^3/s capacity downstream of the confluence with the major tributaries of Houth Creek.

cominco-monenco joint venture

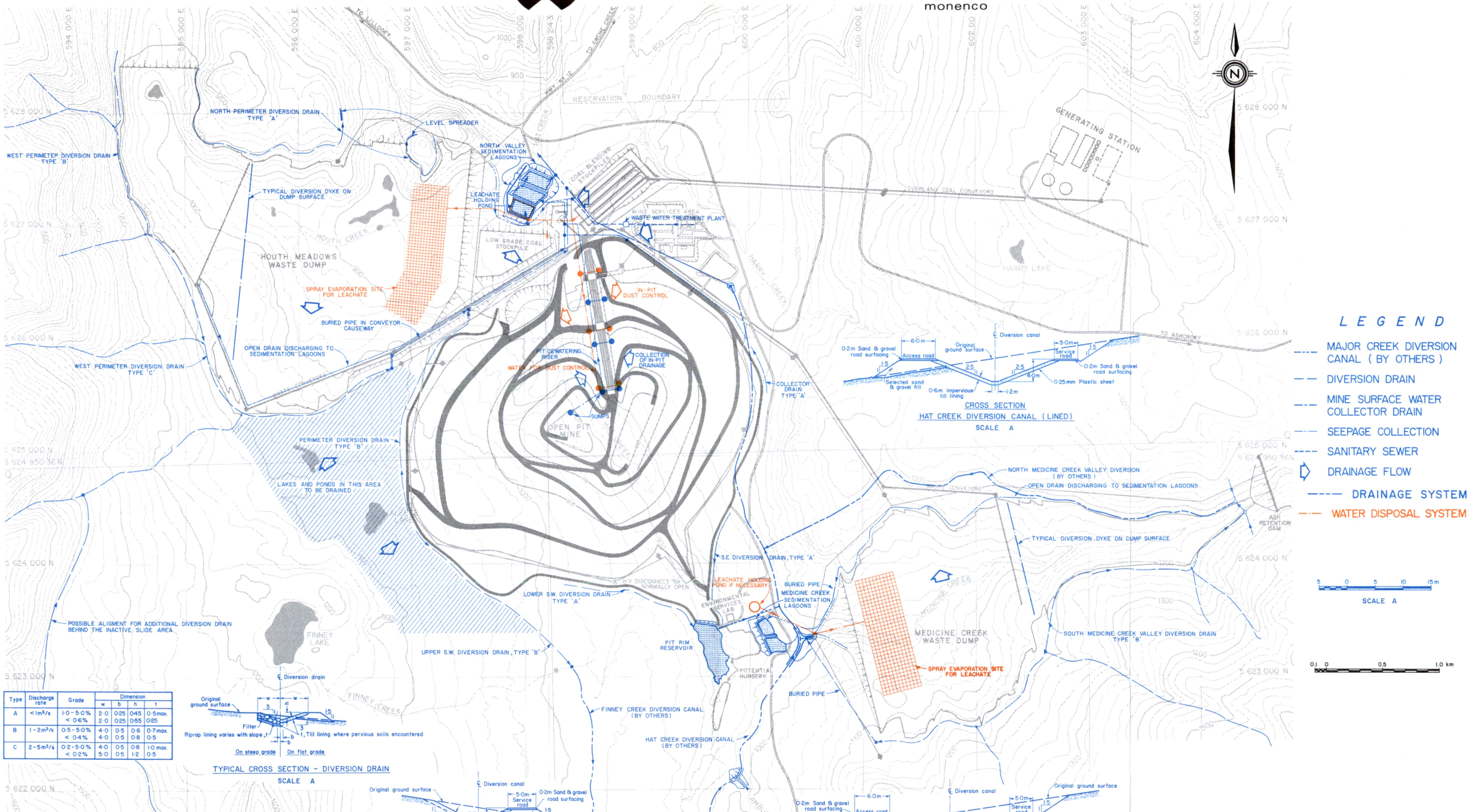


FIGURE 3-7
BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT
MINE DRAINAGE PLAN

A typical cross-section of the open drain is shown on Figure 3-7. The channel will be unlined where minimum gradients less than 0.2% - 0.5% can be achieved and the natural soil is relatively impervious. A compacted till lining will be laid in areas where pervious subsoil is encountered, and this layer would be later stabilized by revegetation with grasses. Where steeper gradients are encountered, a riprap lining will be laid to prevent scour. Icing of open drains may occur especially during early spring when there is late thawing during the daytime and freezing at night. To date, similar developments in the general region have not encountered icing problems in small drains or diversions serious enough to warrant special design configurations. Minor problems were dealt with by conventional winter maintenance operations.

Medicine Creek The construction of the Medicine Creek waste dump is planned to begin in Year 16. Prior to this, surface runoff from Medicine Creek Valley would be intercepted directly by the Hat Creek Diversion canal.

Before commencement of embankment construction, it would be necessary to divert Medicine Creek. This is presently being studied by B.C. Hydro H.E.D.D. For planning purposes, a sidehill canal north of Medicine Creek, as shown on Figure 3-7, would intercept surface runoff from the north watershed above the dump. South of Medicine Creek, diverted water from above the upper dump area will be discharged eastwards to the head of the Medicine Creek Diversion.

Water intercepted above the lower dump area would be discharged west to the Hat Creek Diversion canal via an open drain and discharge pipe. As an alternative, this water could be discharged south to Ambusten Creek.

342.2 Drainage of Lakes

Where required, a program for drainage of lakes and ponds on the southwest perimeter of the pit has been planned. The objective of the proposed program is to reduce seepage into active and marginally active slide zones (Golder, 1977).

Prior to mining, Aleece Lake and 20-30 other small lakes and ponds in the shaded area on Figure 3-7 would be drained. Some small diversion drains would also be dug to channel surface water away from major groundwater recharge areas. Care will be taken to prevent enrichment of streams and downstream erosion by slowly releasing the bulk of the water during spring freshet. This would be achieved by excavating a trench toward a pond, along the existing drainage course. Before breaking into the pond, the bulk of the water could be removed by a siphon or pump. Small pockets of water which may remain in the bottom of the pond could be removed by either dredging an outlet or displacement with surficial mine waste. Where possible, early reclamation would be carried out to protect disturbed areas from erosion.

Ongoing geotechnical investigations on the southwest perimeter of the proposed pit will confirm specific measures required to ensure stability during mining. The scope of the presently proposed drainage program may require revision when these studies are completed.

Within the proposed Houth Meadows waste dump area there are 10-15 small lakes and ponds which will be similarly drained prior to the area being covered with mine waste.

342.3 Drainage of the Mine Development Area

Open Pit The proposed open pit will be surrounded by approximately 8 km of perimeter drainage ditches. These will lie outside of the major perimeter access road and will intercept small amounts of local surface runoff. Five such drains are illustrated on Figure 3-7. The drain to the northeast, between the mine service area and the open pit will collect runoff from areas of heavy traffic for discharge to sedimentation lagoons north of the mine. Northwest of the open pit, an open drain, separated from the main access road by a 30 m buffer zone of vegetation to reduce dust contamination, will discharge to the buried diversion pipe located in the conveyor causeway. To the south of the mine there will be three similar drains: the upper southwest perimeter drain which discharges to the Finney Creek canal, and the lower southwest and southeast perimeter drains which discharge to the pit rim reservoir.

Surface water drainage within the open pit will be collected by roadside drainage systems on benches, or in sumps in low areas. These will be drained or pumped to a series of dewatering sumps near the main pit access incline. The water thus collected will be lifted out of the pit by a series of pumps. Provision has been made for a total installed capacity of 200 litres/second. This will be provided by establishing up to four sets of three electric vertical turbine pumps arranged in a cascading system with 60-metre (4 pit benches) vertical intervals. Water from this system will be discharged to the main sedimentation lagoons located north of the open pit (refer Figure 3-7).

Waste Dumps Mine waste will be placed on the dumps by a mechanical spreader. The dump surface should present a hummocky terrain of loose uncompacted material laid in a series of arcs. As such, surface drainage would not be possible without extensive regrading; such regrading is not practical, and therefore it is presently planned to rely on seepage and evaporation to remove precipitation from the dump surface. With potential evapotranspiration at the dump surface estimated to be 500-550 mm per year and average annual precipitation estimated to be 300 mm, the accumulation of water on the dump surface is unlikely other than during snowmelt when the surface may be frozen and evaporation is low. Analyses have confirmed the stability of the dump material under saturated conditions at the maximum design slope angle of 5° (Golder, 1978). During the later stages of dump construction, the surface will be at 5° overall slope angle; flow of runoff towards embankments should therefore be restricted by diversion dykes placed perpendicular to the direction of slope. This may be particularly necessary on final dump surfaces during reclamation, as the regrading operations will temporarily cause an increase in runoff. Drainage from these diversion dykes would be discharged to surface water drains near conveyorways, thence draining to sedimentation lagoons below the waste embankments.

Topsoil Storage Areas Surface water will be diverted away from the upper perimeter of topsoil storage areas by small ditches to minimize erosion of piles. The stockpile surface is to be progressively revegetated, thus minimizing erosion from the pile and contamination of downstream surface water.

Coal Blending Area The proposed coal blending area is located to the north of the mine and comprises four stockpiles of total area 15 ha. A compacted till blanket overlain by a pervious sand and gravel drainage layer would form the foundation for the stockpiles. Surface water and leachate will be drained to the northwest perimeter where it will be collected and piped to a leachate holding pond for temporary storage prior to disposal by recycling for dust control use within the mine.

Low-Grade Coal Stockpile The proposed low-grade coal stockpile north of the mine, between the Houth Meadows conveyor ramp and the water treatment lagoons, should primarily consist of claystone material with a varying percentage of coal. This material will be compacted as it is placed; therefore the permeability of the proposed stockpile will be low. Non-active stockpile surfaces will be covered by a non-sodic buffer material and suitable surface soil for early re-establishment of vegetation. Runoff and leachate from the bottom of the pile is planned to be collected in a sump at the north end and discharged to the holding lagoon located immediately to the north.

Mine Service Area Surface runoff from the mine service area would originate from roofs of buildings and the open yard space used for storage of mine equipment and vehicles. Yards would be sloped to open drains at the perimeter and drainage around buildings would be handled in buried stormwater drains. Drainage from the service area will be channelled west to the main sedimentation lagoons for primary treatment to remove sediment and oil.

Mine Roads All major roads in the northwest and northeast quadrants of the mine area and within the pit itself will drain to sedimentation lagoons for primary treatment. Roads to the south of the pit would drain to a temporary sedimentation lagoon located downstream of the pit rim reservoir. Temporary construction and haulage roads within the Medicine Creek dump area would drain to the proposed Medicine Creek treatment lagoon via a buried conduit beneath the Hat Creek Diversion canal.

Small service and access roads outside the mine area should be drained to local watercourses by sidehill drains. Particular care should be taken to limit erosion and scour by the use of stable drains and by early revegetation of areas disturbed by road construction.

343 GROUNDWATER COLLECTION SYSTEM

343.1 Pit Dewatering

A staged program of groundwater withdrawal is planned for the open pit. The system is summarized below.

- Starting in Year -5 two systems of wells should be drilled and operated: 25 wells in selected locations inside the ultimate pit perimeter at 50-metre depths, and 10 to 15 regional or extra-perimeter wells averaging 300-metres in depth. All well holes should be drilled 150 mm diameter and cased.

- From Year 10 through to Year 15 a final set of wells should be established beyond the projected perimeter of the 35-year pit. By Year 15 this system should increase to 75 pairs of wells - one shallow at 50-metres and one deep averaging 300-metres.

Indicated water yield is expected to be low; deep well water will be collected into boxes and sumps via a series of headers and used for dust control. Water from shallow wells in surficials will be discharged to the surface water collection system and pumped to sedimentation lagoons.

Most seepage to the open pit will originate from surficial sediments and be collected by surface water systems. The smaller quantities of seepage from coal seams will be isolated in local sumps and disposed of by recycling for use in dust control.

343.2 Leachate Collection

Leachate from the base of coal blending stockpiles, low-grade coal stockpiles, and the toe of waste embankments will be collected in field drains and piped to leachate storage ponds for recycling within the mine. An allowance has been made for 2000-metres of field drain to collect leachates from these areas.

344 WASTEWATER TREATMENT

In order to satisfy regulatory requirements, drainage discharged from the mine should meet present level A objectives for mine effluent discharge prescribed by the B.C. Department of Environment (1976).

Prediction of the quality of surface water drainage from areas disturbed by mining indicate that removal of suspended sediment will be required prior to discharge to streams (Beak, 1978). Sedimentation tests on laboratory prepared samples of slurry indicated that chemical coagulants would be necessary to obtain acceptable suspended sediment levels in sedimentation lagoons within realistic detention times (B.C. Research, 1978).

Projections of the quality of leachates from coal, low-grade coal, and mine waste based on laboratory tests indicate that these effluents would be unfit for stream discharge and would require chemical treatment or disposal in a zero discharge system (Beak, 1978). Analyses of a limited number of groundwater samples from the proposed pit area (Beak, 1978) show a decline in water quality with depth, and indicates that groundwater from coal and bedrock is of poor quality, unsuitable for direct discharge to streams.

Three wastewater treatment systems are proposed:

(a) a sedimentation lagoon system to treat surface water drainage from areas disturbed by mining;

(b) a sewage treatment plant to treat sanitary effluent from the mine service area; and

(c) a water recycling system to dispose of leachate and treated sanitary effluent by using them as a primary source of dust control water for in-pit roads and coal and low-grade coal stockpiles. Surplus accumulation of leachate would be disposed of by spray evaporation on active waste dump surfaces.

A schematic flow chart showing the mine drainage system and the wastewater treatment systems is shown on Figure 3-6. The volumes of water to be treated were estimated from hydrology and seepage data; flow data are presented on Table 3-3. The individual elements of the proposed system are described in the following sections.

344.1 Sedimentation Lagoons

Major sedimentation lagoon systems will be constructed at two sites: the first, termed the North Valley Lagoons, will lie in Hat Creek Valley to the north of the pit; the second system will lie in Medicine Creek Valley below the Hat Creek Diversion canal. Each system will consist of a primary and secondary pond with necessary inlets, outlets, baffles, and emergency spillways. Sufficient pond area is planned to treat the estimated 10-year 24-hour runoff volume from areas of disturbance, based on the lower coagulant-aided sedimentation rates of 2.5×10^{-5} m/s measured in laboratory tests (B.C. Research, 1978).

The North Valley Lagoons will have a total area of 6 hectares which is required to treat the estimated runoff volume of 122 000 m^3. Pond volume will total 450 000 m^3. The system is planned for Year -3 and will require the construction of three 15-metre high dams across the valley. Materials for dam construction would come from the sand, gravel, and till deposits on the east bench of the proposed pit. Zoned dam construction, consisting of a central till core supported by sand and gravel outer layers, would minimize seepage through the dams; this core will be continuous with a till pond liner to reduce seepage through the base of the pond or around the dam abutments.

Inflow to the lagoons would be from the southeast, with outflow to the northeast to the Hat Creek Diversion conduit. An emergency spillway is designed to protect the downstream dam from being overtopped in extreme storms, and riprap lined overflow sections between ponds would discharge flow in excess of the permanent decant system. Hat Creek should be diverted in the year prior to pond construction; the runoff from Houth Meadows and the pit area to be dealt with during this time should be diverted around the area by a temporary conduit.

A similar second set of lagoons downstream of the Medicine Creek waste dump will treat runoff from disturbed areas within this valley, and will discharge the treated effluent to the Pit Rim reservoir. The area of the pond will total 2.8 hectares, and its volume will be 130 000 m^3. The estimated 10-year 24-hour runoff is 44 000 m^3.

During construction and operation of the mine several smaller temporary lagoons may be required in areas remote from the major systems. A cost allowance has been made for three such temporary lagoons.

To provide acceptable discharge during the operation of the lagoons, pond influent, effluent, and receiving water quality should be monitored and laboratory jar tests carried out to determine coagulant type and dosage. To ensure efficiency, the ponds should be carefully maintained during the operation of the mine to ensure water inflow and outflow systems and baffle systems are functioning properly, and that any sediment accumulations in excess of 50% pond capacity are removed. Excess sediment should be dried and buried within selected areas of the waste dumps.

The chemical quality of water pumped from the pit will vary and should also be monitored. Should quality deteriorate due to leachate contamination then steps should be taken to either isolate the sources and recycle the water or provide chemical pre-treatment before discharge to the sedimentation lagoons.

344.2 Sewage Treatment Plant

Sanitary effluent from the mine service area will be biologically treated and recycled for dust control use. Provision has been made for treatment of 140 m^3/day of effluent containing 400 mg/L biochemical oxygen demand in an oxidation ditch type water treatment system.

Wastewater from equipment washdown facilities will be kept separate from this system and will be routed through a greasetrap prior to discharge by way of the mine service area stormwater drainage system to the North Valley Lagoons.

Sanitary effluent discharge from the environmental services laboratory estimated at 2 m^3 per day, will be disposed of in a septic tank with a field drain system downstream of the pit rim dam.

344.3 Water Recycling System

The following wastewaters are expected to be recycled in the mine operation:

(a) runoff from the coal blending area and the low-grade coal stockpile;

(b) seepage from the coal blending area, low-grade coal stockpile, waste embankments, and localized pervious areas of coal or bedrock within the pit; and

(c) pre-treated sanitary effluent from the mine service area.

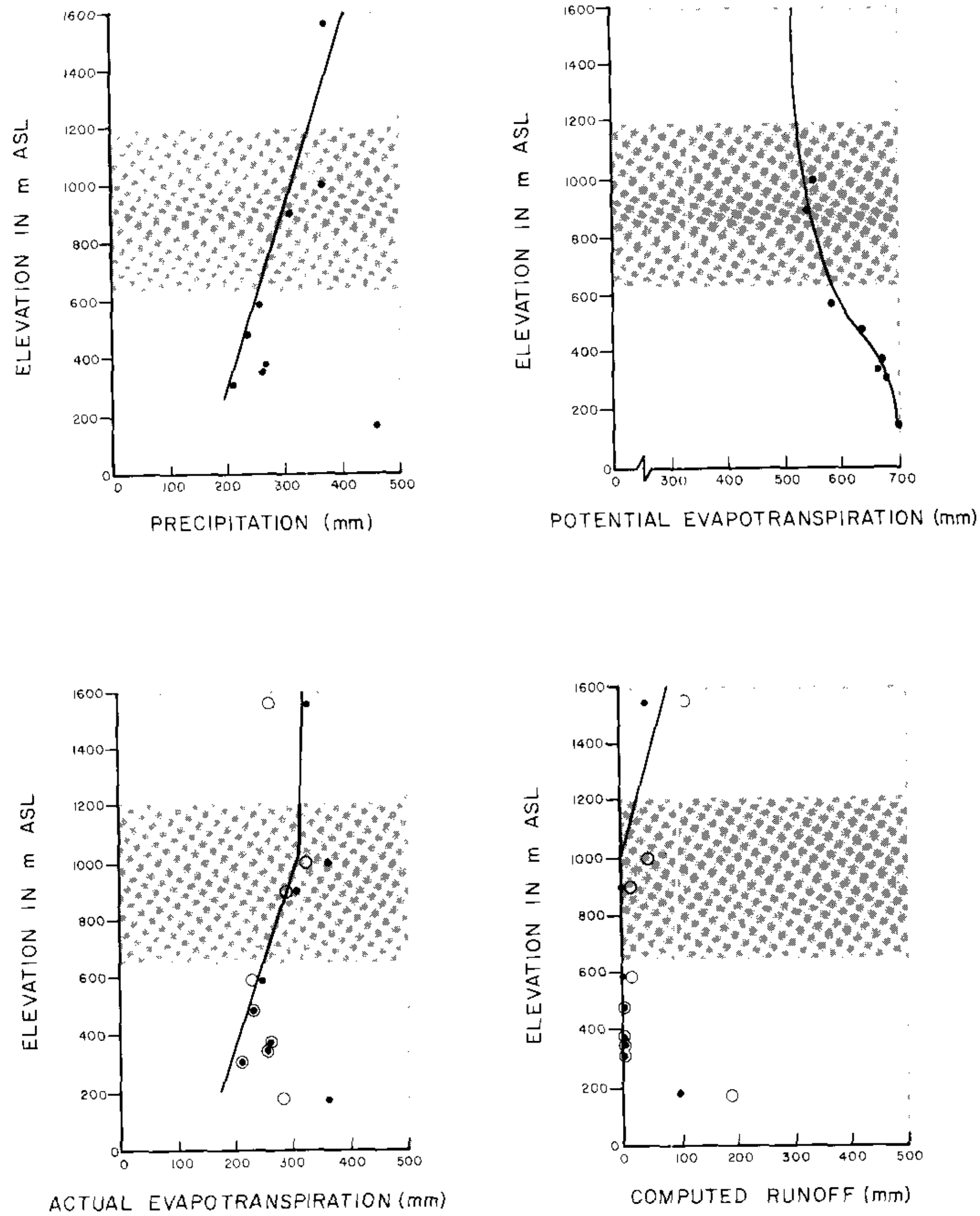
Water will be collected by stormwater and field drains and discharged to holding ponds which will balance annual flow for later use in suppressing dust on in-pit roads and coal stockpiles during the months of March through October.

The major holding pond, of area 2 hectares and volume 200 000 m^3, will be constructed in the valley bottom to the north of the pit. The pond would be formed by two 15 metre high dams across the valley: the one to the north will be between the pond and the sedimentation lagoon; the other to the south lies on the perimeter of the proposed low-grade stockpile. Seepage through the dam would be reduced by a compacted glacial till core which would be continuous with a compacted till lining on the bottom and sides of the pond. Influent would be piped from the low-grade coal stockpile, the coal blending area, the toe of the Houth Meadows waste embankment, and the sanitary treatment plant at the mine service complex. Recycle water would be pumped in a separate system to dust control operations, comprising pumped spray systems in the coal blending area and spraying by water trucks in the pit and on the active face of the low-grade coal stockpile. Any surplus accumulations of leachate during the mine operation will be pumped west onto the active surfaces of the Houth Meadows waste dump for disposal by evaporation. The water balance data shown on Figure 3-8 indicate that evaporation loss on the dump surface will exceed direct precipitation.

Poor quality seepage or pumpage within the pit excavation will be isolated in local sumps and disposed of by water trucks, either directly for dust control on roads, or when necessary, to the holding pond to the north.

The retaining embankments on the north perimeter of the Houth Meadows waste dump will be constructed from till and will be of low permeability. Water quality in Marble Canyon watershed, which lies downstream of these embankments, will be monitored and, if necessary, dewatering wells will be installed to pump seepage back to the dump surface.

Seepage from the Medicine Creek waste dump will be collected at the toe and pumped back up to the dump surface. A holding pond may be required for storage of leachates during winter; this could be constructed downstream of the Hat Creek Diversion canal alongside the proposed Medicine Creek Valley sedimentation lagoons.



LEGEND

- ○ 100 mm SOIL STORAGE
- • 200 mm SOIL STORAGE

FIGURE 3-8

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

WATERSHED YIELD

Source: Beak 1978.

SECTION 4

WATER SUPPLY

4.1 INTRODUCTION

This section of the report presents the estimated water supply requirements for the mine development and describes the conceptual layout of the proposed supply and distribution systems. Consideration was given to the integration of the mine supply with parallel systems proposed for the thermal generating station and the construction camps.

4.2 WATER REQUIREMENTS

The mine and adjacent service complex will require a permanent water supply during the years of operation of the mine. The mine water supply system must provide for the estimated demand from the following areas and services:

Potable Water for the Mine Services Area	- administration building - mine dry - laboratories - maintenance buildings
Fire Protection Systems	- buildings - in-pit coal conveyor - overland coal conveyor - coal blending area
Washdown Water	- vehicles and equipment
Irrigation Waters	- mine service area lawns and landscaping - revegetation nursery
Dust Control	- roads - coal blending area - low-grade coal stockpile
Temporary Construction Supply	- during construction of the Mine Services Area

A preliminary estimate of the water requirements of the mine at full development is shown on Table 4-1. Fire requirements are not shown as they do not form a day by day consumptive demand. Fire protection for buildings in the Mine Service Area would require the provision of 1000 m^3 of reservoir capacity and a flow of 95 L/s at a residual pressure of 415 kPa at risers (M&M Consultants 1978). At the coal blending area allowance has been made for a flow of 30 L/s at 415 kPa for fire control at the stockpiles.

Water quality standards for potable and irrigation water supply are presented by Beak (1978). These criteria were utilized in the selection of the source for these systems. The quality of dust control water is, however, not critical and the supply requirements may be satisfied by recycling waste water from the mine operation.

TABLE 4-1

Preliminary Estimate of Consumptive Water Requirements

Hat Creek Project Mining Feasibility Report 1978

		Daily Average(1) m^3/day	Annual Consumption $m^3 \times 10^3$
Mine Service Area			
Potable	700 shifts/day x $0.2m^3$/shift	140	51
Equipment Washdown, Laboratory and Service Building Use	Allow	90	35
Lawn and Garden	2 ha x 750 mm/year	120(2)	15
		350	101
Revegetation Nursery			
Irrigation	10 ha x 750 mm/year	500(2)	75
Potable	Allow	5	1
Open Pit and Coal Stockpiles			
Dust Control	Allow	2000(2)	250-370
Total		2855	427-547

Notes:

(1) Based on maximum 35-year mine development.
(2) Limited to summer use.

4.3 WATER SOURCES

Four alternative sources of supply were considered:

- water from the proposed generating station supply which will be taken from the Thompson River
- surface water from the proposed Hat Creek Diversion canal located to the east of the mine
- groundwater from a well sunk to the northeast of the mine service area
- recycled mine wastewater

The major factors in the selection of a suitable source are water availability, cost of treatment, and supply. The locations of ancillary plant and mine facilities were considered as well, in order to provide an integrated system and to avoid duplication.

431 WATER FROM THE GENERATING STATION

The permanent water supply to the generating station will originate from the Thompson River. Present planning indicates that a one month emergency water supply will be provided at an open reservoir adjacent to the station site. Thompson River water quality data shown on Table 4-2 indicate that this water should require minimum treatment prior to use. The operating cost of raising water to the generating station has been estimated at $1.00 to $1.05 per 1000 litres (B.C. Hydro Thermal Division, 1978). The mine service area is approximately 4 km distant and 450 m lower than the station site, and it is presently planned to construct a temporary water supply pipeline from a well in Hat Creek Valley near the mine service area site to the generating station in order to satisfy water requirements during construction (H.A. Simons, 1978). This supply line could later be used to backfeed good quality potable water to the mine and provide fire protection requirements for the adjacent main coal conveyor.

TABLE 4-2

Water Quality Data

Hat Creek Project Mining Feasibility Report 1978

Water Source	Hat Creek Surface Water	Thompson River Surface Water	Hat Creek Valley Groundwater
PARAMETER (mg/L)	System Mean	System Mean	One Sample Well V78-72
CATIONS - Trace Metals			
Aluminum (Al)	< 0.010	< 0.017	-
Arsenic (As)	< 0.005	< 0.005	-
Cadmium (Cd)	< 0.005	< 0.005	-
Chromium (Cr)	< 0.010	< 0.010	-
Copper (Cu)	< 0.005	< 0.005	< 0.03
Iron (Fe)	< 0.026	< 0.022	-
Lead (Pb)	< 0.010	< 0.010	-
Mercury (Hg)	< 0.00040	< 0.00034	-
Molybdenum (Mo)	< 0.020	< 0.020	-
Selenium (Se)	< 0.003	< 0.003	-
Vanadium (V)	< 0.005	< 0.005	-
Zinc (Zn)	< 0.007	0.017	-
Manganese (Mn)	-	-	0.05
CATIONS - Alkali Earths & Metals			
Calcium (Ca)	57	11	59.8
Lithium (Li)	0.002	< 0.001	-
Magnesium (Mg)	19	2.3	59.1
Potassium (K)	4.0	0.63	24.5
Sodium (Na)	20/23	3.3	220
Strontium (Sr)	0.32	0.055	-
ANIONS - General			
Boron (B)	0.10	< 0.10	-
Chloride (Cl)	1.1	1.6	8
Fluoride (F)	0.16	0.11	-
Sulfate (SO_4)	54	7.6	392
ANIONS - Nutrients			
Total Kjeldahl Nitrogen (N)	0.19	0.08	-
Nitrate Nitrogen (NO_3-N)	< 0.05	< 0.07	-
Nitrite Nitrogen (NO_2-N)	< 0.002	< 0.002	-
Total Orthophosphate Phosphorus (P)	0.043	0.020	-
ORGANIC, NONIONIC & CALCULATED VALUES			
COD	21	21	-
TOC	9	3	-
Phenol	< 0.002	< 0.002	-
Total Hardness ($CaCO_3$)	224	38	392
Total Alkalinity ($CaCO_3$)	226	35	760
PHYSICAL DATA			
pH (units)	8.4	7.8	8.2
Specific Conductance (umhos/cm @ 25°)	489	93	1470
True Color (Pt-Co Units)	12	9	-
Turbidity (NTU)	1.5	0.81	-
Temperature (°C)	6.6	8.0	-
PHYSICAL DATA - Residues			
Total Residue	348	77	-
Filterable Residue	342	74	1230
Nonfilterable Residue	6	3	-
Fixed Total Residue	281	50	-
Fixed Filterable Residue	278	49	-
Fixed Nonfilterable Residue	4	2	-
BIOCHEMICAL, DISSOLVED GASES & RELATED MEASUREMENTS			
BOD	< 1	< 1	-
D.O.	11.1	11.1	-
Data Sources:	Beak, 1978	Beak, 1978	H.A. Simons, 1978

432 GROUNDWATER FROM HAT CREEK VALLEY

The mine services area lies above a groundwater aquifer located in a buried valley. The water quality data shown on Table 4-2 indicate that treatment for elevated dissolved solids and hardness would be required to meet Canadian Drinking Water Standards. The cost of fully treating this water is estimated to be in the order of $0.80 to $1.60 per 1000 litres (H.A. Simons, 1978), which is similar to the operating cost of pumping water from the Thompson River.

At the present stage of project planning it is proposed that the generating station temporary water supply and construction supply would be extracted from this well together with the mine construction camp water supply. Should the needs of the mine service area be supplied from this system then a further 350 m^3/day of water would be required, increasing the capacity of this system from about 960 m^3/day to about 1310 m^3/day.

Integration of the two systems may save on system costs and avoid duplication of reservoirs, pumps, and water treatment facilities.

433 SURFACE WATER FROM HAT CREEK

The frequency of low flow on Hat Creek is shown on Figure 4-1. It can be seen that lowest flows occur in late summer and this corresponds with the time of maximum irrigation requirement for agricultural land in Upper Hat Creek Valley. The lowest recorded flow in 17 years of record was 0.027 m^3/s, measured in 1977, which is not much greater than the estimated average consumptive summer requirement of the mine .01 m^3/s (assuming 350 m^3/day for the service area, 505 m^3/day for the revegetation nursery and dust control requirements satisfied by recycling of waste water).

Commencing in Year -4, Hat Creek will flow around the mine in a diversion canal. Two reservoirs are proposed as part of this system, one at the canal headworks and one near the pit rim. Utilizing the pond drafts from elevation 970 m to 975 m on the headworks reservoir and 909 m to 912 m on the pit rim

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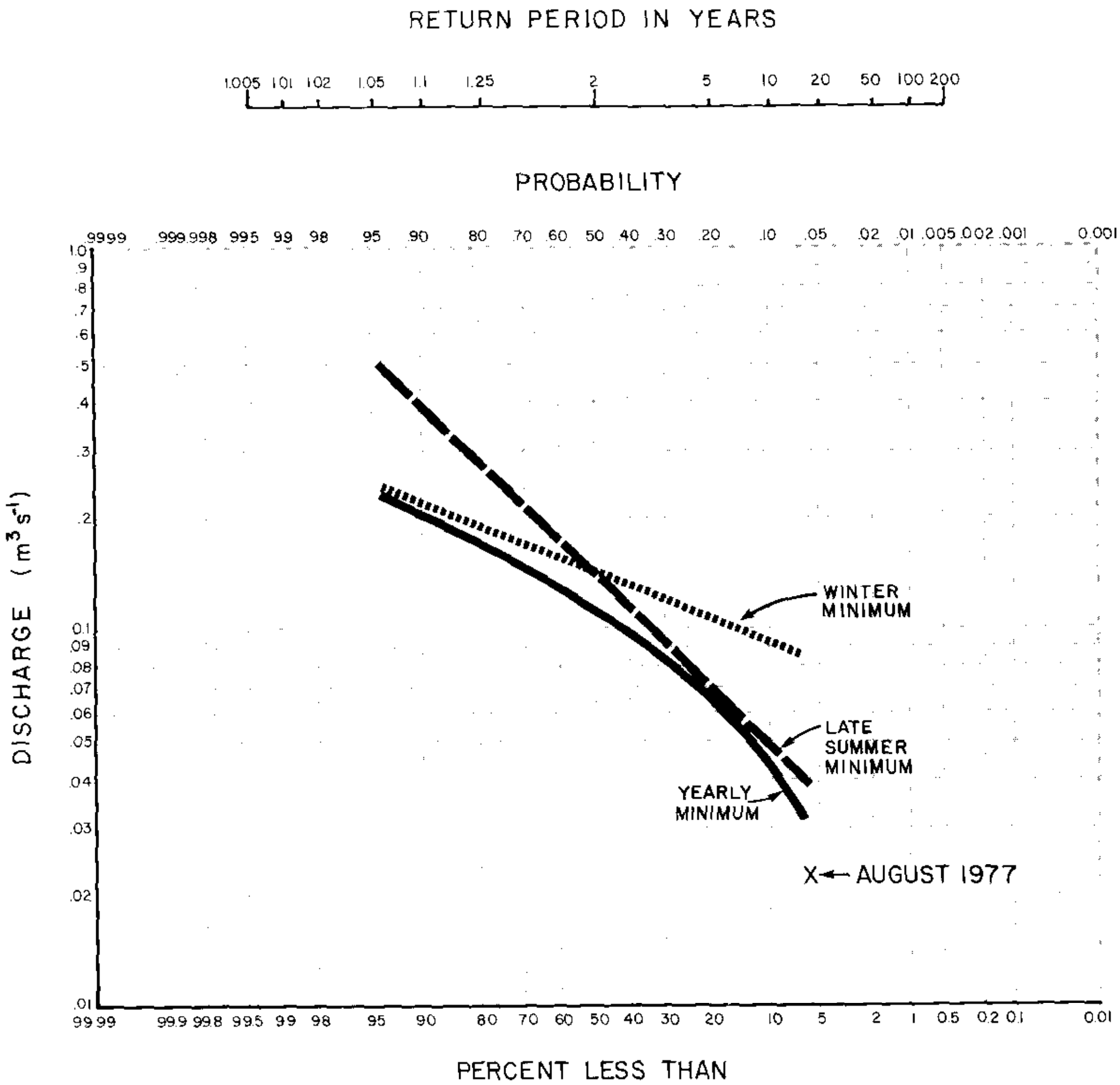

COMPARISON OF LOW FLOW FREQUENCY CURVES
FOR HAT CREEK NEAR UPPER HAT CREEK (08LF061)

FIGURE 4-1

Source: Beak 1978.

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HAT CREEK PROJECT
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LOW FLOW ON HAT CREEK

reservoir, 150 000 m^3 plus 110 000 m^3, respectively, of live water storage could be made available for flow augmentation. Allowing for an estimated 350 mm of water loss in the critical low flow period due to evaporation and seepage, a total of about 235 000 m^3 of this water could be used to augment low flow on Hat Creek flows during late summer. Water from the pit rim reservoir would be pumped into the canal and the draft in the headworks reservoir could be utilized by installing a temporary electric submersible pump in dry years and utilizing the long canal to balance flows. Alternatively, the section of canal between the Headworks Dam and Pit Rim Dam could be bypassed by releasing water from the Headworks Dam to Hat Creek and allowing it to replenish the live storage in the pit rim reservoir. The water could then be pumped from the pit rim dam to the remaining section of the canal at a relatively steady rate.

Figure 4-2 shows the effect that mine water demand and flow augmentation may have had on the 1977 low flow cycle. From this, it can be seen that using flow augmentation the minimum flow in Hat Creek could have been raised from 0.027 m^3/s to 0.1 m^3/s. Assuming an average summer mine demand of .01 m^3/s then the residual downstream flow in the creek would have been 0.09 m^3/s, which indicates that there is enough reservoir storage both to provide for consumptive needs at the mine and partially augment extreme low flow on Hat Creek.

It would therefore appear that Hat Creek is a possible all year round source of water for mine facilities.

In winter, water demand at the mine may average 235 m^3/day whereas creekflow will average 14 000 to 20 000 m^3/day. The diversion canal system proposed should develop a stable ice cover in winter which should permit a year round supply of water (B.C. Hydro HEDD, 1978).

Studies are currently being carried out by the B.C. Department of Agriculture to investigate the possibility of reinstating the Oregon Jack Creek diversion in the headwaters of Hat Creek. Should this proposal be implemented then the flow in Hat Creek may be reduced at various times depending on the proposed operating curve for this irrigation diversion and utilization of the proposed storage reservoir at Langley Lake. In view of the extreme low flow in recent years it may be assumed that a development in the creek headwaters would be

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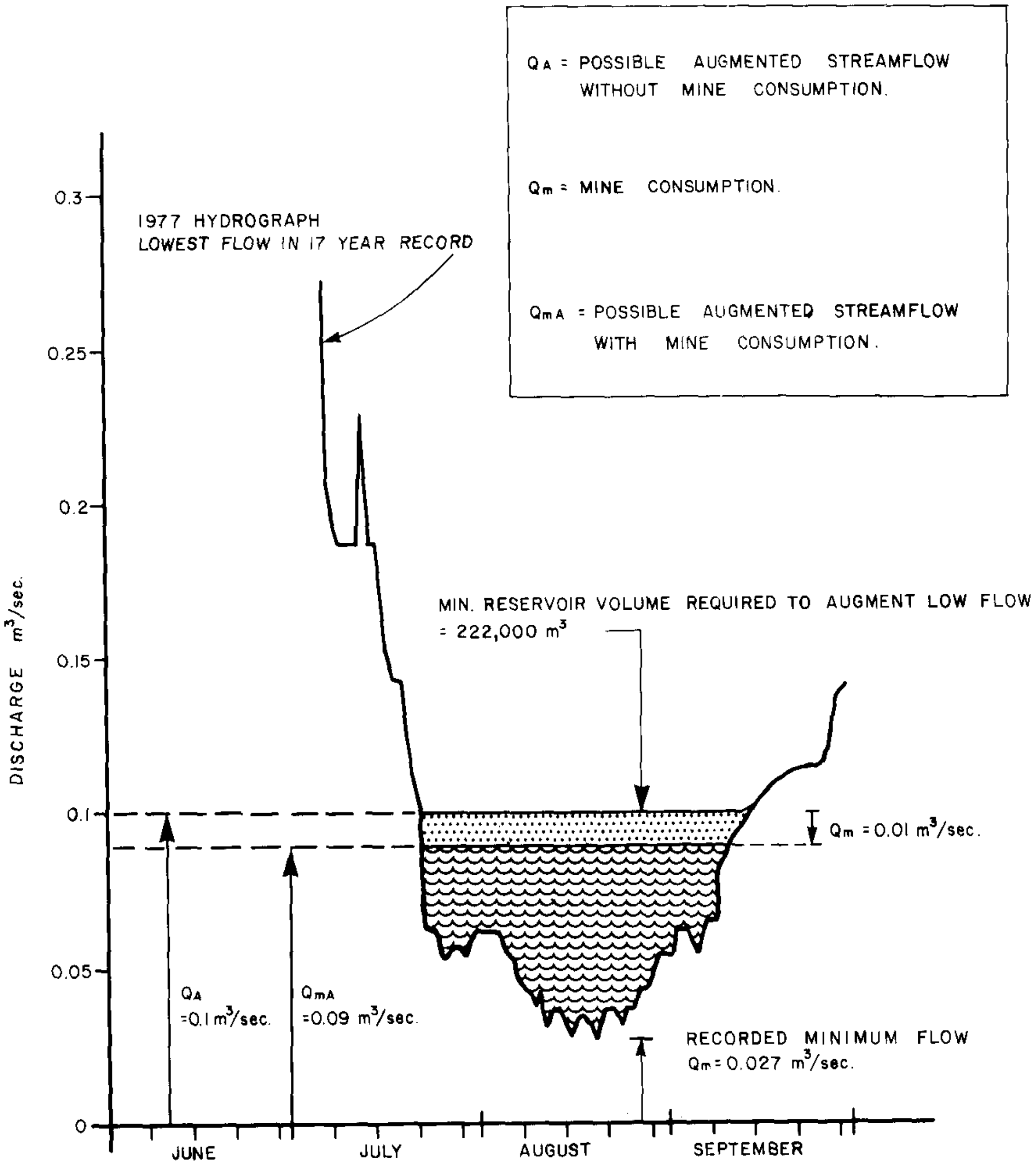

BASED ON RECORDED FLOW HYDROGRAPH
"HAT CREEK AT UPPER HAT CREEK"
WSC. STN. 08LF061. - 1977.

FIGURE 4-2

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
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HAT CREEK HYDROGRAPH
SUMMER - 1977

required to leave a specific flow for maintenance of the creek and downstream water users. Therefore it should not jeopardize the relatively minor water supply system at the mine.

Mean water quality parameters for Hat Creek in the vicinity of the mine are shown on Table 4-2. In its natural regime, low flows in late summer and throughout the winter consist mainly of groundwater and are relatively low in suspended solids (2-10 mg/L) but higher in dissolved solids (300-400 mg/L). During the spring freshet suspended solids levels are elevated to levels in the 100-300 mg/L range due to erosion processes in the valley.

Treatment of Hat Creek water to drinking water standards will probably require clarification and filtration to remove sediment during high flow, nominal disinfection due to the agricultural watershed above, and softening to reduce scale in hot water systems and reduce excessive soap consumption. An estimate of the approximate cost of treatment based on providing package water treatment plant indicates an initial capital investment of $100,000 plus operating costs in the order of $0.25 to $0.50 per 1000 litres. Raw Hat Creek water would be suitable for irrigation or vehicle washdown at minimal cost.

434 MINE DRAINAGE WATER

There will be three major sources of mine drainage water available for recycling:

- leachates and effluent collected in holding ponds
- pit dewatering flows
- surface drainage from disturbed areas

As previously discussed in Section 3, leachates and wastewater should be recycled for use in dust control to avoid direct discharge to streams. This system should satisfy the major summer consumptive water requirement at the mine, and when necessary pit dewatering flows could be used to augment this supply. Surface drainage will be collected in sedimentation lagoons and this water would be available for irrigation use if required.

4.4 PROPOSED SYSTEM

441 SOURCE OF SUPPLY

Water for the mine development will be supplied from the following sources.

Potable Water and Fire Protection Water for these uses will be initially supplied from an integrated system with the project temporary construction supply. When the permanent generating station supply from the Thompson River comes on line the temporary construction supply pipeline from Hat Creek Valley to the powerplant will be used for fire protection for the overland coal conveyor and as an auxiliary supply to the mine service area. Day-by-day consumptive requirements of the mine service complex will be met by a treated surface water supply from Hat Creek.

Irrigation Water for irrigation will be supplied from the pit rim reservoir to the south of the open pit.

Dust Control These requirements would be satisfied by recycling wastewater and pit dewatering flow.

The proposed water supply system is shown on the water supply plan, Figure 4-3, and on the mine drainage and water supply flow chart, Figure 3-6.

442 MINE SERVICE AREA

The mine service area would be fed from a reservoir located near the proposed construction camp. A booster pumphouse at the eastern perimeter would increase line pressure to 700 kPa using two electric pumps of total capacity 100 L/s. A gasoline driven fire pump of 100 L/s capacity would also be installed to provide water for fire control in the case of power failure. A water main approximately 1700-metres x 200 mm would provide a water supply for the mine service area, provide potable water to buildings, supply fixed sprinkler fire protection systems in buildings and fire hydrants in open yard storage.

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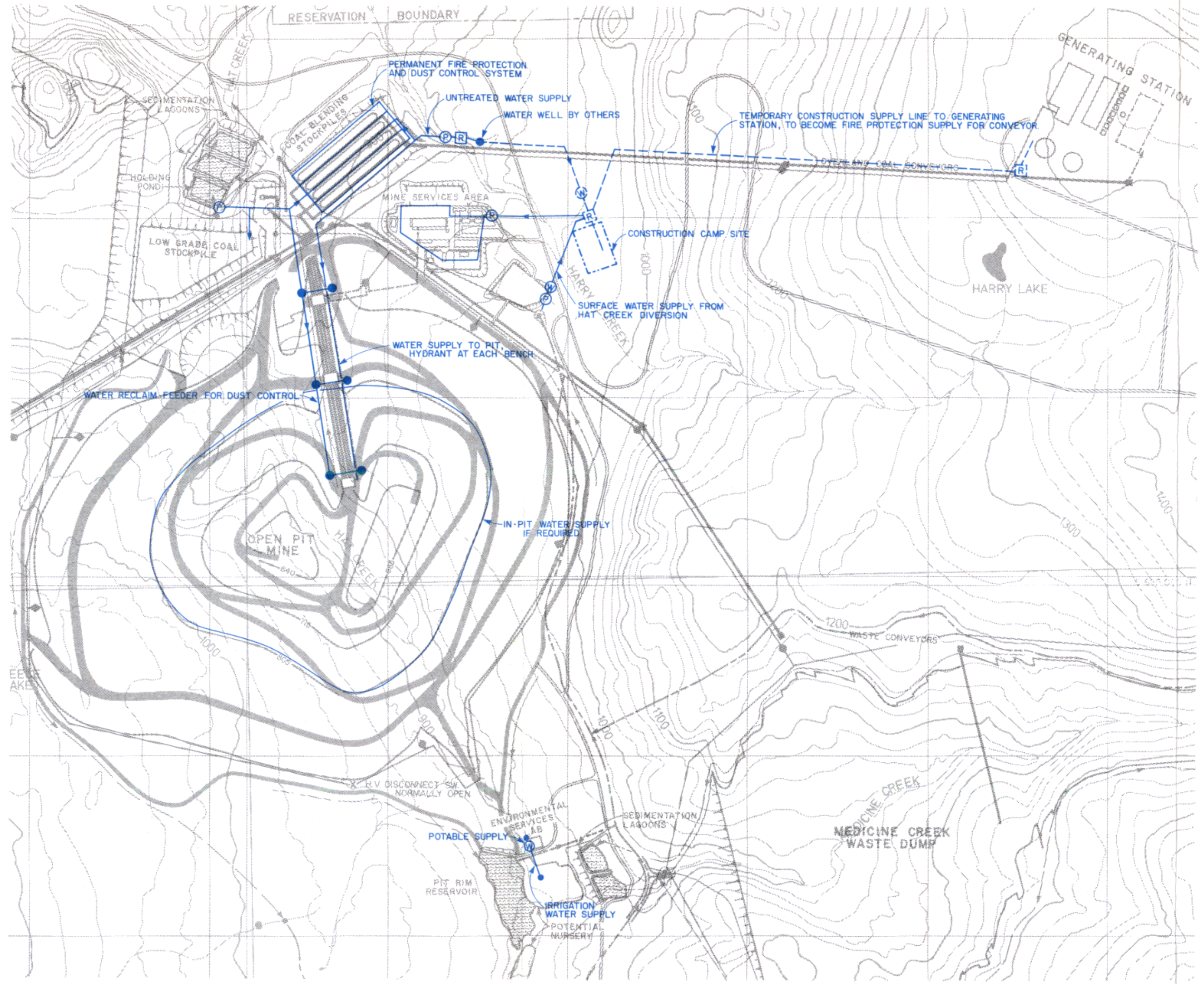

N

LEGEND

- WATER SUPPLY SYSTEM
- WATER SUPPLY SYSTEM (BY OTHERS)
- (R) RESERVOIR
- (W) WATER TREATMENT
- (P) PUMP

0.5 0 1.0 km

SCALE

FIGURE 4-3

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MINE WATER SUPPLY PLAN

443 COAL BLENDING AREA

Provision has been made for a permanent dust control and fire protection system at the coal blending area. Buried mains approximately 3500-metres in length, beneath the stacker corridors would supply water to fire hydrants located at 100-metre spacing between the coal piles. Dust control would be provided by temporary water jet standards which could be mounted between the stacker rails and reclaimer units. During summer the dust control system would be fed from the leachate holding pond as part of an evaporative disposal system for leachate. Make-up water to the system and fire reserve would be provided by the open pit fire protection supply.

444 OVERLAND COAL CONVEYOR

Water for fire protection of conveyor belts and transfer stations will be supplied from a buried main following the conveyor. A service road along the conveyor would allow access by fire truck to hydrants along the conveyor route. Frost protection may be required to prevent freeze-up of this pipeline during winter. The relatively high head loss in the pipe (i.e., 450-metres over its 4 km length) may require water hammer protection and pressure reducing valves at lower points of supply.

445 IN-PIT WATER SUPPLY

Allowance has been made for the construction of a 150 mm water main on the main conveyor incline to provide a supply of water for fire protection of the conveyor and loading stations. Further provision has been made for 10 000 metres of 75 mm aluminum in-pit distribution main which would be available for temporary use. The primary source of water for dust control on pit roads would stem from the reclaim water system which would recycle wastewater from the leachate holding pond. Make-up water for this system would come from pit dewatering flows or the permanent fire supply as required.

446 REVEGETATION NURSERY

The proposed revegetation nursery to the south of the mine would be remote from the mine service area and would therefore have a separate water supply.

Water would be taken from the pipeline which interconnects the pit rim reservoir with the Hat Creek Diversion canal and supplied to irrigation spray systems.

Potable water requirements at the adjacent reclamation laboratory would be provided by a small package water treatment unit.

SECTION 5

MINE POWER SUPPLY

5.1 INTRODUCTION

This section of the report describes the electrical power distribution system used as the basis for estimating the cost of supplying power to the pit, waste dumps, and support facilities. The network developed includes all electrical equipment required to supply power from the 60 kV busbars of the proposed Hat Creek generating station to the open pit and dump areas, and to distribute the power within these areas to the shovels, conveyors, spreaders, and to the crushing and blending equipment. The developed network also includes supply for the various service buildings and provides the construction power required during the development phase of the mine.

5.2 ELECTRICAL LOADS

521 POWER SHOVELS

The load cycle for a large electrically-powered shovel is oscillatory in nature, fluctuating from the surge of power required to hoist and swing the load to a small negative load (generation) during the dump portion of the cycle.

The acceptability of such a load or the need to compensate for the power swings generated can normally only be resolved through a comprehensive study of the utility network. However, the proximity of the proposed generating station to the Hat Creek mine and the choice of shovels equipped with rectifier inverters should preclude the need for any in-depth study or concerns for sufficient supply.

The use of rectifier inverter equipped shovels will result in lower energy consumption due to a reduction in machine losses from approximately 10% for the normal Ward Leonard system to approximately 3% for the inverter system. In addition, shovel availability will be increased due to the reduced maintenance required by the solid state equipment relative to rotating machinery. The reduced losses and maintenance level of the rectifier inverter shovels is expected to more than offset any additional capital costs involved.

522 VOLTAGE REGULATION

The start-up of large motors results in the imposition of a large reactive power demand upon the transmission network and, accordingly, a significant drop in voltage at the terminals of the motors. These voltage drops can be compensated for by the use of appropriate equipment comprising either synchronous or static compensators. At Hat Creek, the use of static capacitors on individual motor loads would be restricted to the pre-production years, when limited construction power is available for operation of the pit and the Houth Meadows waste dump.

No voltage regulation problems are foreseen at the time that the main 60 kV lines are installed to the powerhouse.

523 ESTIMATED ANNUAL POWER DEMANDS AND ENERGY CONSUMPTION

Table 5-1 shows the estimated mine loads for peak consumption during Years 22 to 25, inclusive. The three types of load specified on the table are defined as follows:

> Connected Load - the sum of all equipment and motor loads installed in the plant or site.
>
> Typical Load - that load most likely to be exerted upon the power supply system during normal production periods.
>
> Annual Average Load - although never actually applied to the power system, this is an estimate of the annual energy consumption presented as a continuous load.

The estimated annual power demands and energy consumption for Years -1 to 35, inclusive, are listed on Table 5-2.

TABLE 5-1

Total Estimated Mine Load During Peak Years
Hat Creek Project Mining Feasibility Report 1978

Requirement	Connected Load (kW)	Typical Load (kW)	Annual Average Load (kW)
Out-of-Pit Loads			
Conveyor Load	53 500	31 500	15 600
Maintenance Complex	2760	1681	1320
Mine Dry Building	841	427	363
Rubber Repair Building	359	165	125
Mine Service Building	805	383	278
Administration Building	644	349	178
	58 909	34 505	21 618
In-Pit Loads			
8 Shovel Sub-stations (1 spare)	12 000	5900	2268
Pumping and Miscellaneous	455	180	126
	12 455	6080	2394
TOTAL	71 364	40 585	24 012

TABLE 5-2

Estimated Annual Load and Energy Demands

Hat Creek Project Mining Feasibility Report 1978

Year	Average Annual Load (kW)	Typical Load (kW)	Annual Energy (MW hours)
-2	2,921	4,016	2,260.0
-1	14,018	23,110	10,846.7
1	17,671	29,132	13,673.3
2	18,454	30,423	14,280.0
3	18,894	31,149	14,620.0
4	20,299	33,465	15,706.7
5	20,402	33,635	15,786.7
6	22,711	33,072	17,573.3
7	22,711	33,072	17,573.3
8	22,711	33,072	17,573.3
9	22,711	33,072	17,573.3
10	22,711	33,072	17,573.3
11	19,833	32,697	15,346.7
12	21,677	35,737	16,773.3
13	21,677	35,737	16,773.3
14	23,797	39,232	17,640.0
15	23,797	39,232	17,640.0
16	22,814	37,611	17,653.3
17	22,814	37,611	17,653.3
18	22,814	37,611	17,653.3
19	22,814	37,611	17,653.3
20	22,771	37,540	17,620.0
21	24,012	39,586	18,580.0
22	24,012	39,586	18,580.0
23	24,012	39,586	18,580.0
24	24,012	39,586	18,580.0
25	24,012	39,586	18,580.0
26	19,445	32,057	15,046.7
27	18,256	30,097	14,126.7
28	17,636	29,075	13,646.7
29	17,636	29,075	13,646.7
30	17,636	29,075	13,646.7
31	17,636	29,075	13,646.7
32	17,636	29,075	13,646.7
33	17,636	29,075	13,646.7
34	17,636	29,075	13,646.7
35	17,636	29,075	13,646.7

5.3 NETWORK DESIGN CRITERIA

The proposed electrical system is shown in Figure 5-1 and has been developed on the basis of the following criteria:

(a) Two mine feeders will be available from B.C. Hydro at the Hat Creek generating station's 60 kV busbar; together these feeders are estimated to be capable of supplying the total mining load, make-up water for the generating station, and ash disposal pumping requirements.

(b) Construction power at 60 kV will be available from the existing powerline at the junction of Highway No. 12 and the present Hat Creek road.

(c) Development of the major supply network to the open pit and to Houth Meadows and Medicine Creek waste dumps will take place over a period of 14 years. Primary distributation network throughout the complex will be rated at 60 kV while supplies to shovels, conveyors, etc., will be rated 6.9 kV. Auxiliary mine equipment, pumps, lighting, and air compressors, together with internal systems for auxiliary buildings will be 600/347 volt, while other building voltages will be 120 volt single-phase, where desirable. Transformers will be selected to be interchangeable within standard ratings.

(d) The rating of the apparatus, transformer impedances, line and cable conductor, etc., will be sized such that the voltage fluctuation at the terminals of a shovel will not exceed +10%, -5% under the worst operating conditions. Voltage regulation of the 60 kV power supply from the Hat Creek generating station is not expected to exceed ± 5%.

(e) The electrical power network for the mine has been designed based on the overall economic optimization of both the remote power loads from the generating station and the remote mining loads, under the control of a single operating entity.

(f) Power distribution within the pit and waste dump areas will be by portable substations and power cables. The portable power cables will be generally TYPE SHD-GC, three conductor with two

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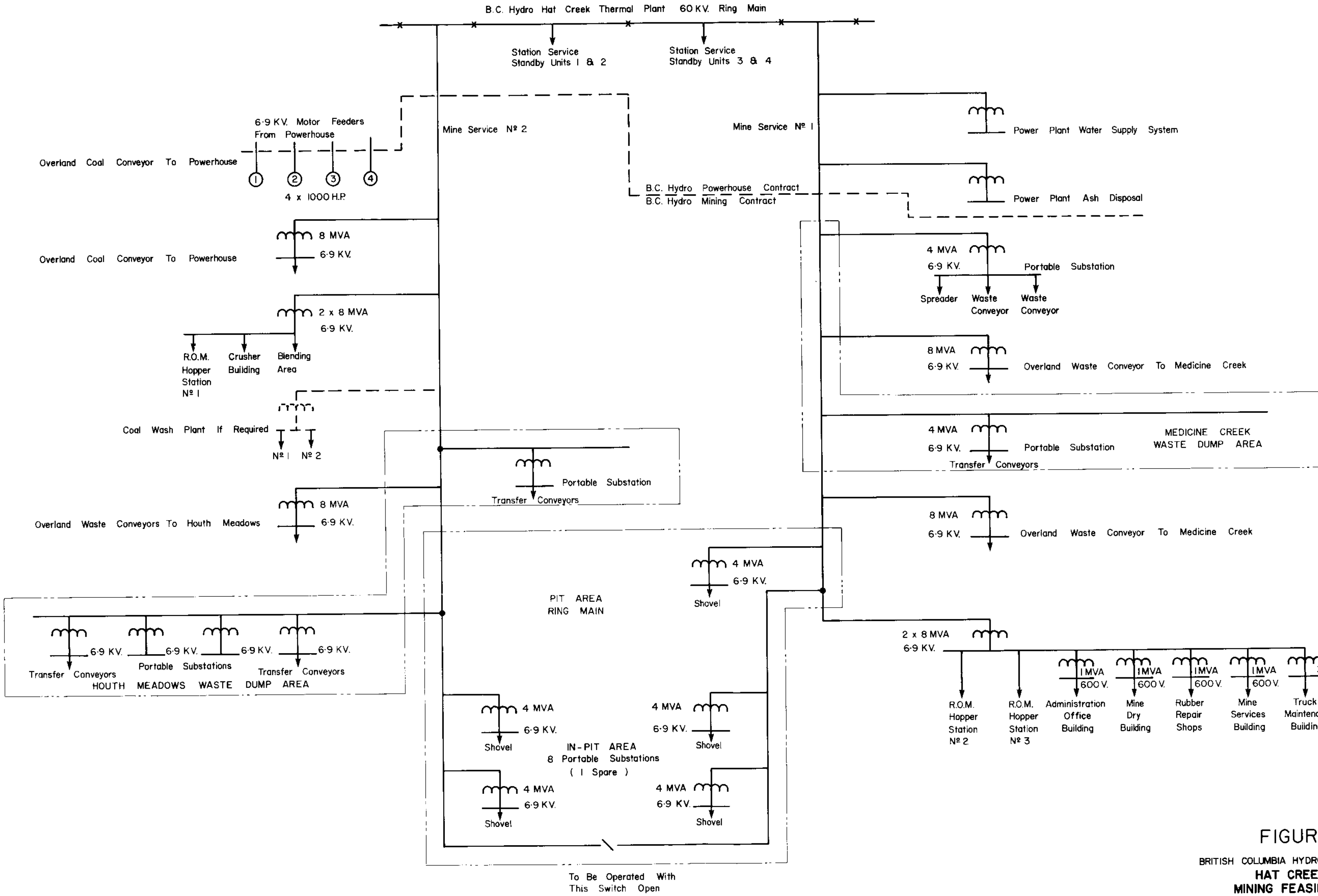

FIGURE 5-1

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
MINING FEASIBILITY REPORT

MINE POWER DISTRIBUTION NETWORK
SINGLE LINE DIAGRAM

ground and one ground check conductor terminated at their extremeties with plug and socket type couplers. The portable substations will be of one common design and will consist of the following elements:

- a portable high voltage (60 kV) switching unit
- a skid-mounted 4 MVA 60 kV/6.9 kV 3 PH., 60 Hz oil filled transformer
- a portable 6.9 kV totally enclosed switching unit complete with three feeder circuits and female cable couplers
- a portable low voltage 600/347 volt switching and distribution unit complete with 600 volt female cable couplers, as well as one 1 MVA 6.9 kV/600/347 volt 3 PH., 60 Hz oil filled transformer

Figure 5-2 shows a typical in-pit arrangement of portable substations and cables.

(g) Fixed loads at permanent locations will be supplied from the 60 kV powerlines via permanent substations similar to the one shown in Figure 5-3; this drawing depicts a typical permanent substation which is designed to tap onto a 60 kV transmission line, and which can be equipped with either one or two stepdown transformers and 6.9 kV switching units.

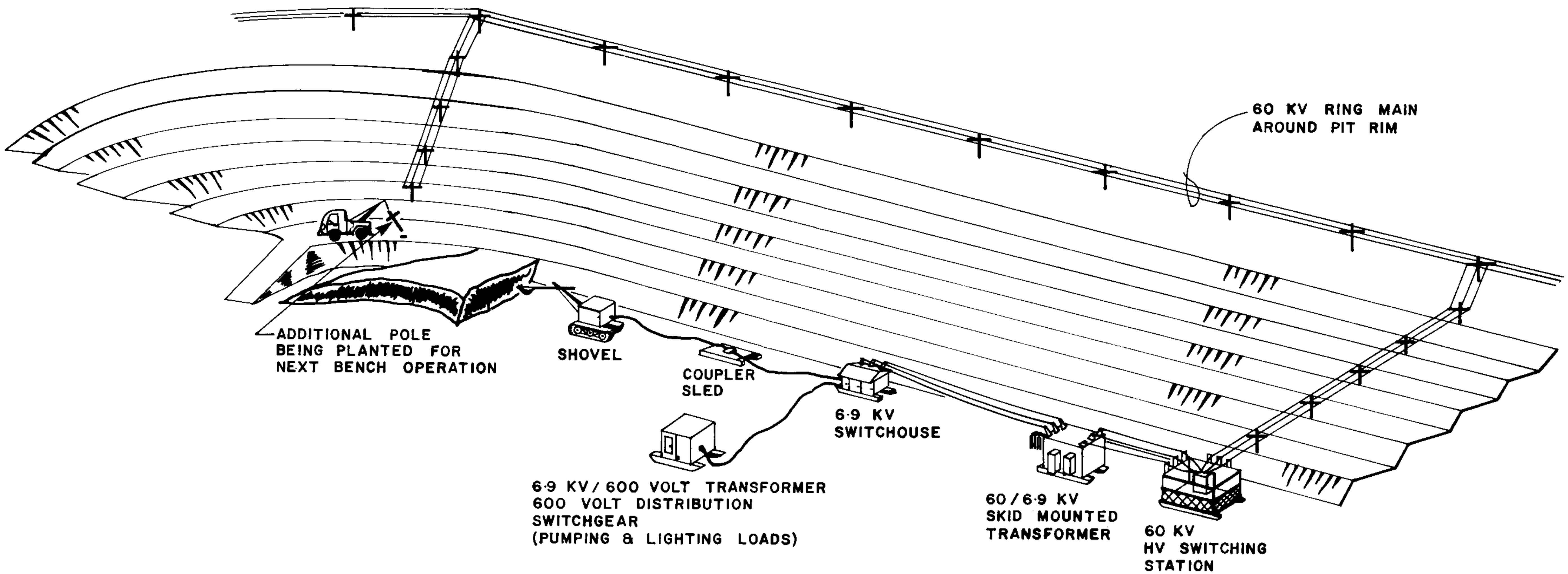

FIGURE 5 - 2

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
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MINING FEASIBILITY REPORT

PORTABLE SUBSTATION
& TRAILING CABLE
TYPICAL LAYOUT

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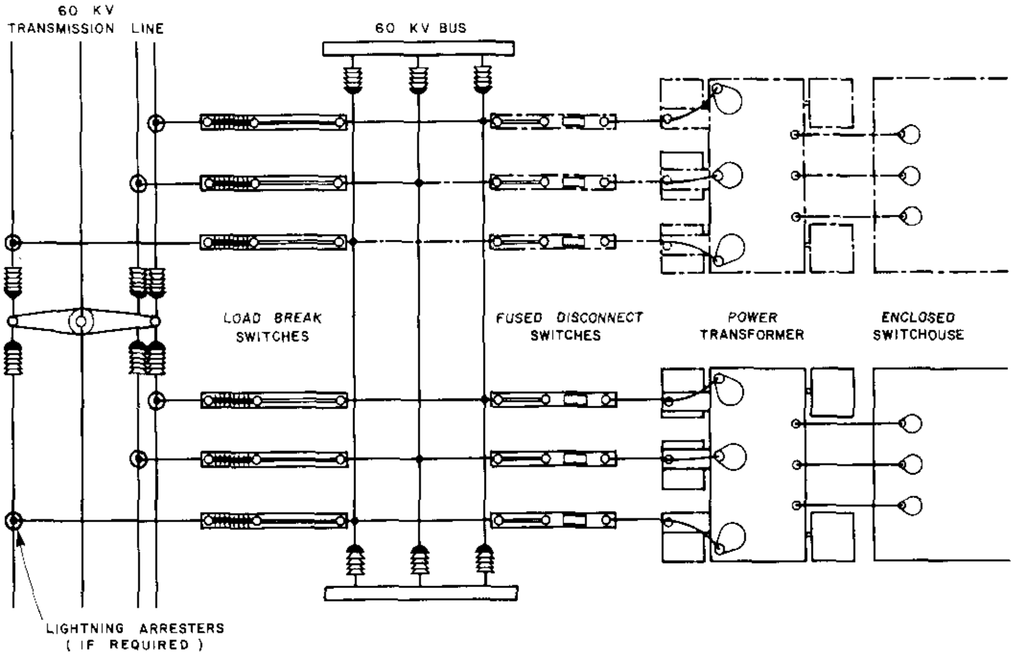
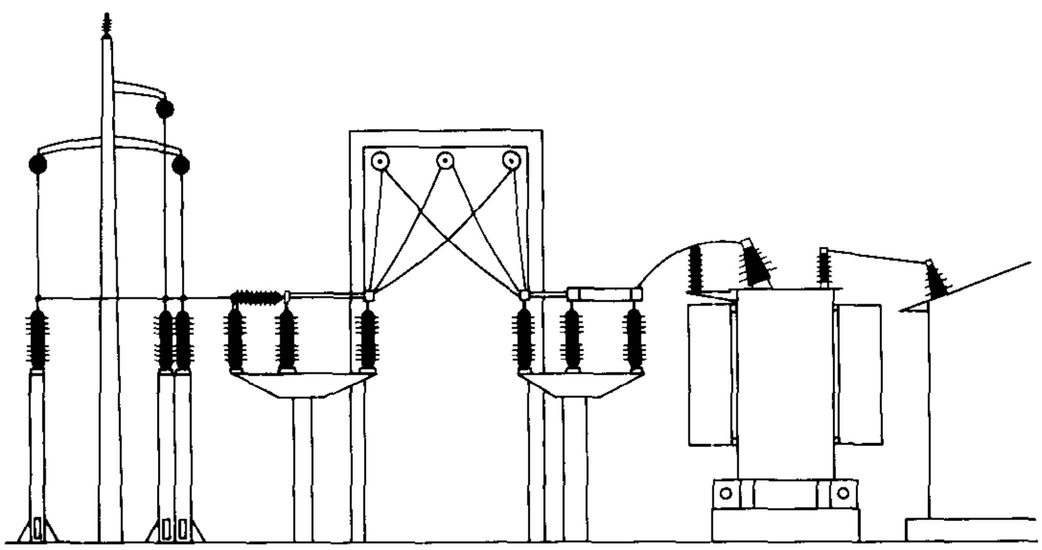


PLAN



ELEVATION

FIGURE 5-3

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY

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MINING FEASIBILITY REPORT

TYPICAL PERMANENT SUBSTATION LAYOUT

5.4 SYSTEM DESCRIPTION

541 GENERAL

In assessing the sizing of lines, transformers, etc., recognition has been made of diversity in operation of the various items of plant. Transformer ratings have been established from consideration of both the thermal loading and voltage drop during start-up of the motor loads, and the standardization of the MVA ratings.

Utilization voltages are based on economic optimization, technical desirability, and standardization of all portable substations for the highest degree of interchangeability and reliability. For the portable substations, 6.9 kV was selected, as this is the preferred shovel voltage.

The initial supply network to the mine up to and including Year 13 will consist of two 60 kV lines from the substation at the generating station. The first parallels the coal conveyor and the Houth Meadows waste material conveyor, and is routed so as to encompass the west side of the pit. The second 60 kV line runs from the vicinity of the ash disposal pond adjacent to the extreme northern boundary of the Medicine Creek waste dump, then parallels the Medicine Creek waste conveyor right-of-way so as to encompass the east side of the pit. The power distribution network at the mine is shown in green on the site layout plans, Figures 5-6 to 5-9* of Volume III - Mine Planning.

542 PIT AREA

The in-pit supply network will consist of eight portable skid-mounted 60 kV/6.9 kV substations, i.e., one per shovel plus one spare. The spare unit will be used to prepare for shovel relocations. Eight low voltage portable skid-mounted 6.9 kV/600 volt substations, one per shovel plus one spare, will also

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* Figure 5-9 of this series in Volume III is duplicated as Figure 1-1 of this volume.

be provided. All in-pit cabling will be via 6.9 kV or 600 volt trailing cables, depending on the equipment being served.

543 HOUTH MEADOWS WASTE DUMP

The Houth Meadows supply network will initially consist of one 8 MVA permanent 60 kV/6.9 kV substation to feed the overland waste conveyors. In Year 4, this substation will be extended to 2 x 8 MVA to accommodate the increased loading of these conveyors. With the opening of the Medicine Creek dump in Year 16, the substation can be reduced to 1 x 8 MVA.

Power supply to the transfer conveyors and spreaders will be provided by portable skid-mounted 60 kV/6.9 kV substations supplemented by portable skid-mounted 6.9 kV/600 volt substations where low voltage 600 volt loads are present. The number of complete portable substations varies according to the following schedule:

Years -2 to 8	3 units
Years 8 to 14	4 units
Years 14 to 21	5 units
Years 21 to 35	4 units

All distribution within the dump will be via 6.9 kV or 600 volt trailing cables, depending on the equipment being served.

544 MEDICINE CREEK WASTE DUMP

The Medicine Creek supply network will comprise two overland conveyor substations, each consisting of one 8 MVA transformer rated at 60 kV/6.9 kV. A maximum of two complete, portable skid-mounted 60 kV/6.9 kV substations, each supplemented by a portable skid-mounted 6.9 kV/600 volt substation, will be required and will be installed in Year 15. The schedule of complete portable substations is as follows:

Years 15 to 17 .... 1 unit
Year 18 .... 2 units
Years 18 to 24 .... 1 unit
Years 24 to 27 .... 2 units
Years 27 to 35 .... 1 unit

All distribution within the dump will be via 6.9 kV or 600 volt trailing cables, depending on the equipment being served.

545 MINE SERVICE FACILITIES

All service and office building areas are planned to be supplied by underground 6.9 kV cables from the Truck Unloading Station No. 1 permanent substation. Supply provisions will be made for the following facilities:

- maintenance complex
- administration building
- mine dry
- rubber repair shops
- mine service building

Other minor loads, such as those for the laboratory and gate house, will be supplied from an adjacent service or office building by 600 volt underground cables.

546 CRUSHING/BLENDING PLANT

A 2 x 8 MVA substation will supply a common 6.9 kV service to the crusher building, blending area, and Truck Unloading Station No. 1 to be built in Year 1. This substation will supply most of the power requirements of the coal crushing and blending plant. A separate 16 MVA substation would be required to supply a coal wash plant, should one be installed.

547 RELIABILITY

The 60 kV transmission lines have been physically located to provide maximum reliability for all the major electric loads. It will be possible to operate the network as a ring main system for the pit and part of the Medicine Creek waste dump. However, the Houth Meadows waste dump 60 kV network will operate as a radial feeder.

Should failure of an 8 MVA 60 kV transformer occur, requiring several months for repair, it is intended that one of the 8 MVA transformers installed at the Truck Unloading Station No. 1 or No. 2 would be used. Since these two stations are not expected to be simultaneously operating at maximum capacity due to the yearly change in mining activity, one transformer should always be available for use as a temporary replacement elsewhere.

548 CONSTRUCTION POWER

The erection of special construction powerlines is not required, with the exception of:

(a) a short 60 kV line connecting the most easterly leg of the Houth Meadows waste dump line to the existing 60 kV circuit at the junction of Highway No. 12 and the Hat Creek road; and

(b) a short 60 kV line connecting Truck Unloading Station No. 1 to the line supplying the crusher substation.

By installation early in the construction period of these two short temporary 60 kV lines, about 2 km of 60 kV permanent transmission lines, and Hopper Station No. 1 substation, an adequate power supply at 6.9 kV can be realized. In general, the construction power supply will be provided by the early installation of the permanent electrical supply equipment. The pre-production power supply system is shown in green on the site layout plans, Figures 5-6 to 5-9, Volume III - Mine Planning.

APPENDIX 1

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