PRELIMINARY ASSESSMENT OF AIR QUALITY IMPACTS FOR AN 800 MW HAT CREEK THERMAL PLANT AND ASSOCIATED FACILITIES

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TABLE OF CONTENTS

1. INTRODUCTION

Environmental Research & Technology, Inc. (ERT) has been retained by British Columbia Hydro & Power Authority (B.C. Hydro) to conduct a preliminary assessment of the air quality effects of an 800 MW coal-fired power plant to be located in the Trachyte Hills of south-central British Columbia. This project, including the supporting coal mining operations and auxiliary facilities, is referred to as the Hat Creek Project. Previous studies of air quality impacts associated with operation of a 2,000 MW thermal generating station on the same site have been described in earlier reports (ERT 1978, 1980, 1981).

1.1 Study Objectives

The specific objectives of the present program of work include:

- Conduct air quality modeling to compute the effects of the 800 MW power plant's emissions within a 25-km radius from the plant site for each hour of a representative one-year period.
- Process the hourly model calculations to compute multiple-hour average contaminant concentrations for comparison with Provincial guideline levels and other selected threshold values.
- Develop isopleths of contaminant concentrations and tabular displays of modeling results in a form compatible with the requirements for further environmental impact assessments.
- Examine the operating characteristics and physical parameters for a single natural draft cooling tower to meet the cooling needs of the 800 MW plant, and compare with corresponding data assumed in a previous assessment of the cooling system for a 2000 MW plant. On the basis of this comparison, estimate the relative impacts on icing, fogging, visible plume lengths and drift deposition for the 800 MW facility.
- Estimate the relative impacts of the 800 MW power plant plume on ambient contaminant concentrations and deposition rates beyond 25 km from the plant site and pH effects at selected

water bodies, using the previous results for the 2000 MW plant as the basis for these projections.

- Estimate the relative air quality impacts of dust emissions resulting from Hat Creek mining operations in support of an 800 MW plant, using the previous results for a 2000 MW plant as the basis for these projections.

1.2 Methods of Analysis

ERT's Multiple Point Source Diffusion Model (MPSDM) was used to estimate near-field air quality effects for the 800 MW Hat Creek power plant configuration. This model represents a standard straight-line Gaussian approach, with modifications to simulate the effects of variable terrain height, enhanced plume dispersion for highly buoyant sources, stack-tip downwash and adjustment of measured winds to stack top. The model incorporates the plume rise formulae of Briggs (1975). Technical details of the MPSDM model have been presented in previous reports to B.C. Hydro (e.g., ERT 1981).

Meteorological data to drive the dispersion model were derived from hourly measurements on the B.C. Hydro 100-meter tower near Harry Lake from 1 October 1979 through 30 September 1980. Wind speeds and directions at the 100-meter tower level; atmospheric stabilities determined from 100-meter turbulence and wind speed measurements; ambient temperatures at 100 meters and mixing depths estimated from morning and afternoon radiosonde measurements at Vernon BC and 10-meter temperatures and winds at the on-site tower (Benkley and Schulman 1979) constitute the meteorological inputs to the model for each hour of the one-year period of analysis. The substitution protocol for missing data and the methodologies employed to derive stabilities and mixing depths from the raw measurement data were described fully in a previous report (ERT 1981).

Physical stack parameters, operational characteristics and emission rates for the 800 MW power plant were provided by B.C. Hydro. These data are summarized in Tables 1-1 and 1-2.

The results presented in this report for cooling tower impacts, long range transport, acid deposition and air quality effects of mining

TABLE 1-1

EMISSION CHARACTERISTICS FOR 800 MW HAT CREEK POWER PLANT*

Stack Height	152.4 m
Inside Stack Diameter of Each Flue	5.5 m
Equivalent Diameter of 2-Flue Stack	7.8 m
Exit Velocity	28 m/sec
Flue Gas Temperature	73°C
SO_2 Emission Rate	2,152 Kg/hr
Particulate Emission Rate	250 Kg/hr
NO_x (as NO_2) Emission Rate	2,152 Kg/hr

* Source: B.C. Hydro.

TABLE 1-2

ESTIMATED TRACE ELEMENT EMISSIONS FOR A
800 MW HAT CREEK POWER PLANT*

Element	Concentration in coal (ppm)	Assumed % Emitted	Emission Rate Kg/day
Sb	0.5	1.0	0.06
As	9	6.4	6.4
Be	0.7	1.5	0.12
B	<17	5	<9
Cd	<0.3	2.1	<0.07
Cr	74	0.15	1.2
Co	5.3	0.3	0.2
Cu	38	2	8
F	121	10 scrubbed (57%) 63 unscrubbed (43%)	440
HF			460
Pb	6	3	2
Mn	213	1.1	26
Hg	0.13	100	1.4
Mo	2.3	5	1.3
Ni	24	1.0	2.7
Se	<0.8	25	<2.2
Ag	<0.4	0.2	<0.009
Tl	<0.5	0.1	<0.006
Th	<5.3	0.11	<0.065
Sn	0.83	0.5	0.05
W	<1.0	0.1	<0.01
U	2.4	1.0	0.27
V	110	0.3	3.7
Zn	35	1.5	5.8

*Source: B.C. Hydro.

operations were derived by engineering approximations and extrapolation from results obtained by model calculations for the 2,000 MW facility (ERT 1978, 1980). No new modeling was performed in addressing these impacts. This approach was considered adequate to provide reasonable impact estimates for the 800 MW project. In any case, cooling tower, acid deposition and mining impacts for the 800 MW facility will certainly be smaller than those projected by the more rigorous previous analyses for the 2000 MW project.

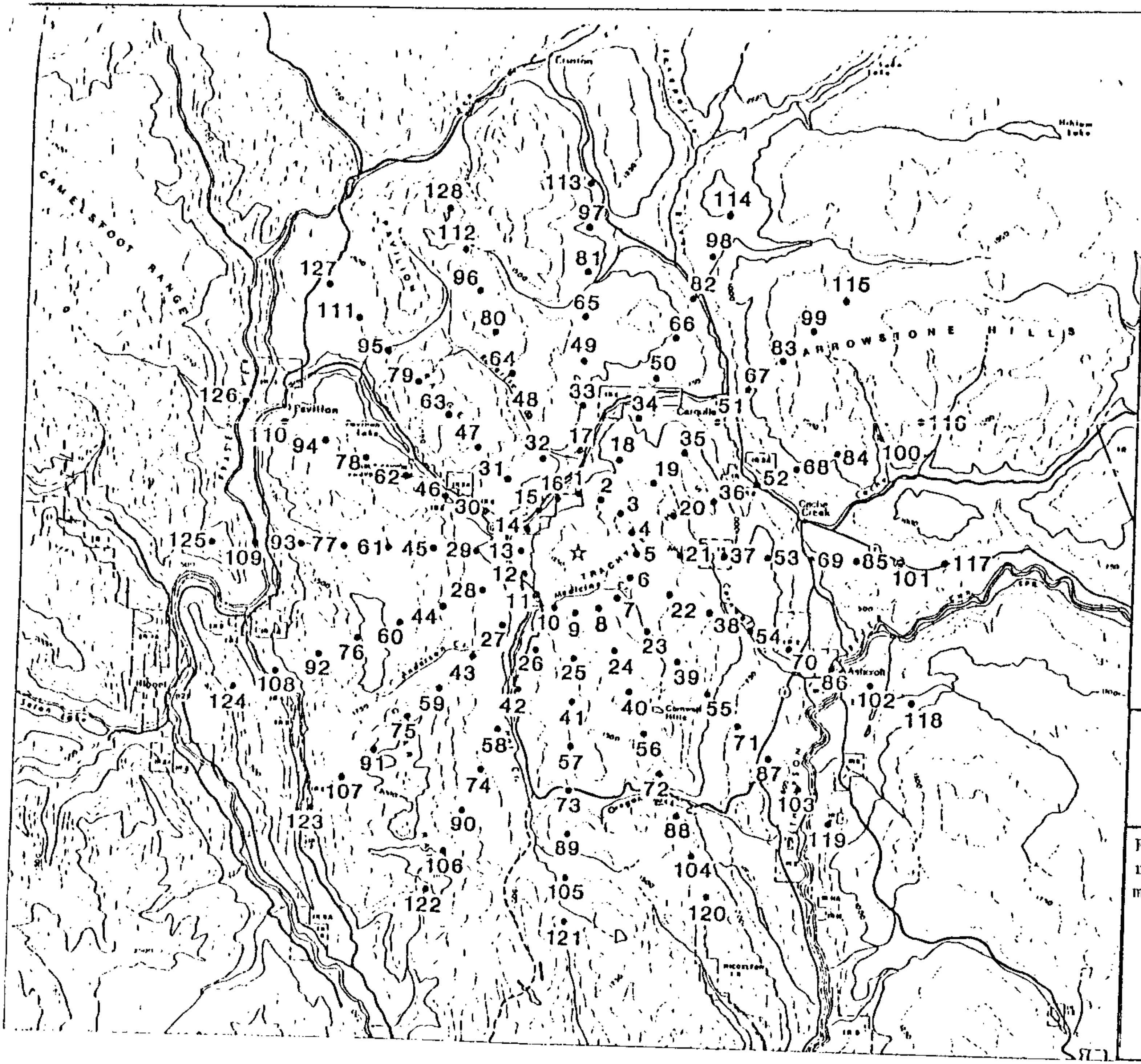
2. NEAR-FIELD AIR QUALITY IMPACT ASSESSMENT

This section presents the results of the dispersion model calculations to assess the incremental air quality effects of the 800 MW Hat Creek thermal plant for the area within 25 km from the plant site. Average contaminant concentrations were computed for each hour of an annual period at all receptor locations indicated in Figure 2-1. Subsequently, 3-hour, 24-hour and annual average concentrations were developed from the consecutive hourly values for comparison with the British Columbia ambient guidelines. The results were processed to identify peak predicted concentrations for each averaging time, and to develop concentration frequency distributions for each receptor location. Separate sets of calculations were performed for the full annual period, for the growing season (April through October) and for the calendar seasons.

The results presented here are expressed in terms of sulfur dioxide (SO_2) concentrations. To a first approximation, the ambient levels of other pollutants may be scaled from the SO_2 results by multiplying the SO_2 concentrations by the ratios of the power plant emissions for the other species to the SO_2 emission rate. Table 2-1 indicates these multiplicative factors, which have been supplied by B.C. Hydro.

Annual Average Concentrations

Figure 2-2 shows the geographical distribution of computed annual average SO_2 concentrations due to emissions from an 800 MW Hat Creek Project. The results presented in the figure represent calculations for the area within 25 km from the project site. The maximum predicted annual value for the 800 MW power plant is 12.0 $\mu g/m^3$ at a point 13 km northwest of the Hat Creek stack in the elevated terrain of the Pavilion Range. For perspective, the upper and lower guidelines established by the B.C. Pollution Control Branch (PCB) are 75 and 25 $\mu g/m^3$, respectively. The locations of the four secondary maxima in the figure also correspond to relatively high elevations to the north-northwest, west, southeast and south-southwest.



NOTE: Receptors in rings at 4 km, 7 km, 10 km, 13 km, 16 km, 19 km, 22 km, and 25 km from plant site.

SCALE - 1:250,000

CONTOUR INTERVAL - 250 METRES

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HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-1. Location of the 128 receptors for the local modeling.

TABLE 2-1

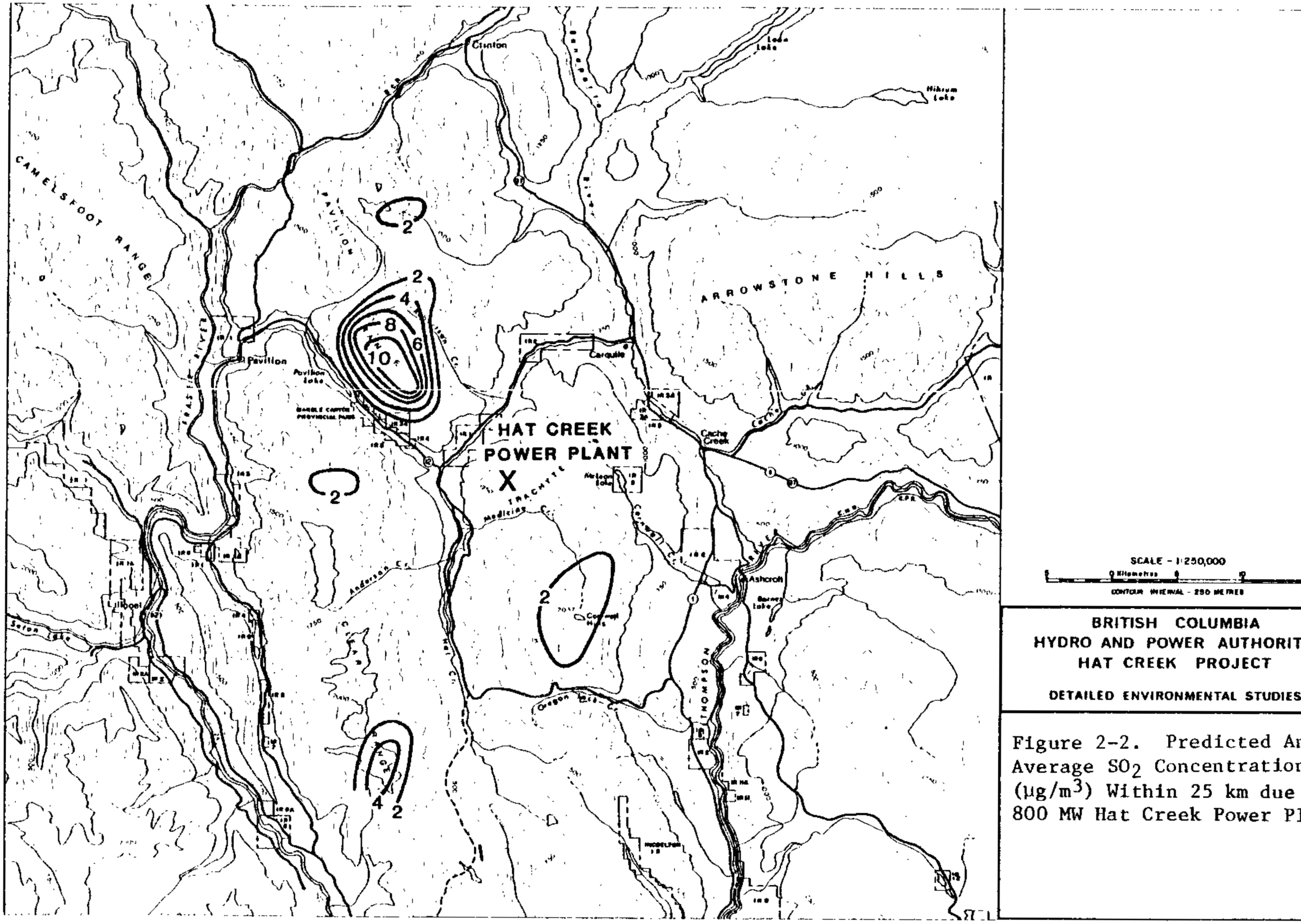
MULTIPLICATIVE SCALING FACTORS FOR ESTIMATING AMBIENT CONCENTRATIONS OF OTHER POLLUTANTS FROM REPORTED SO_2 RESULTS

Pollutant	Scaling Factor
SO_2	1.0
TSP	0.12
NO_x	1.0
NO_2	0.23
Sb	0.00001
As	0.0001
Be	0.000003
B	<0.0002
Cd	<0.000001
Cr	0.00002
Co	0.000004
Cu	0.0002
F	0.008
Pb	0.00004
Mn	0.0005
Hg	0.00003
Mo	0.00003
Ni	0.00005
Se	<0.00004
Ag	<0.0000002

TABLE 2-1 (Continued)

Pollutant	Scaling Factor
Tl	<0.0000001
Th	<0.000001
Sn	0.000001
W	<0.0000002
U	0.000005
V	0.00007
Zn	0.0001

NOTES:
- Scaling Factor = Emission Rate of Trace Element (Kg/d) ÷ Emission Rate of SO_2 (Kg/d).
- NO_2 scaling factor was estimated by ERT letter 3 March 1982, J. Lague to A. Brotherston.



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HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-2. Predicted Annual Average SO_2 Concentration ($\mu g/m^3$) Within 25 km due to 800 MW Hat Creek Power Plant.

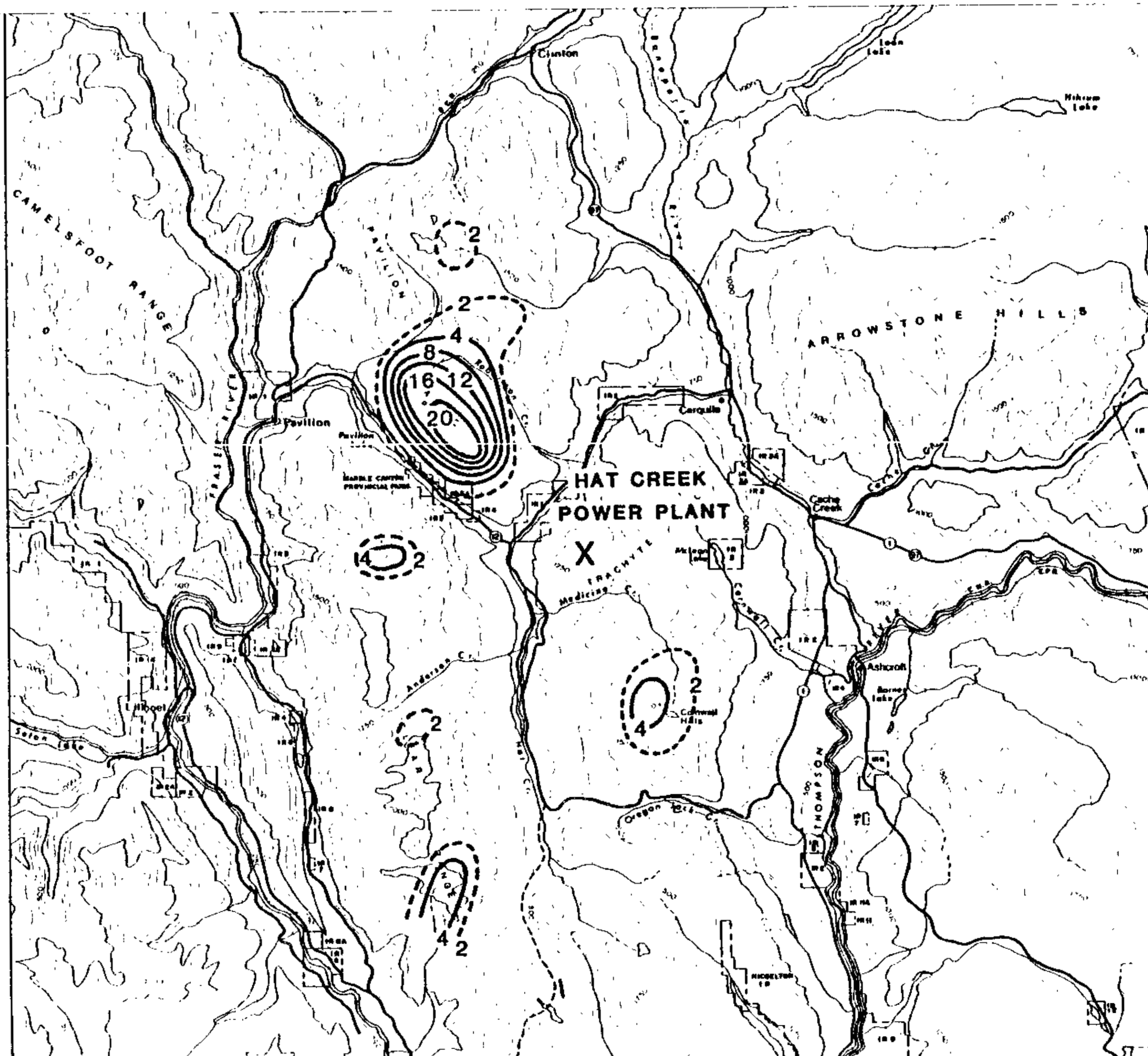
When these results are compared with predicted inpacts for the 2,000 MW plant (ERT, 1981), it is apparent that the reduction in stack height to 152.4 m for the 800 MW plant offsets to some degree the reduced emissions for the latter facility design in terms of predicted concentrations at the nearest high-terrain areas. For example, with a 244 meter stack and 2,000 MW plant emissions of 190 tons per day (more than three times the emissions assumed for 800 MW), the peak computed annual average SO_2 concentration was 18.3 $\mu g/m^3$, i.e., just 53% higher than the maximum predicted for 800 MW (ERT 1981). Nonetheless, the maximum predicted concentrations for 800 MW are less than 50% of the most stringent applicable guidelines.

Seasonal Average Concentrations

Figures 2-3 through 2-6 are isopleth representations of predicted seasonal average SO_2 concentrations for the 800 MW project. For purposes of these displays, the seasons are defined as follows:

Winter - December, January, February
Spring - March, April, May
Summer - June, July, August
Fall - September, October, November

Figure 2-7 is a similar presentation of results for the growing season, April through October. Taken together, Figures 2-3 through 2-7 show that the winter season, with peak values greater than 20 $\mu g/m^3$ corresponds by far to the largest contribution to annual levels. The highest predicted values by season are: winter, 23.5 $\mu g/m^3$; spring, 8.1 $\mu g/m^3$; summer, 4.8 $\mu g/m^3$; and fall, 12.0 $\mu g/m^3$. The peak average value during the growing season is 7.1 $\mu g/m^3$. Maximum concentrations for all seasons are projected to occur in the Pavilion Range, the nearest terrain with elevations above plume height, the same location identified in the annual average calculations.



SCALE - 1:250,000

CONTOUR INTERVAL - 250 METRES

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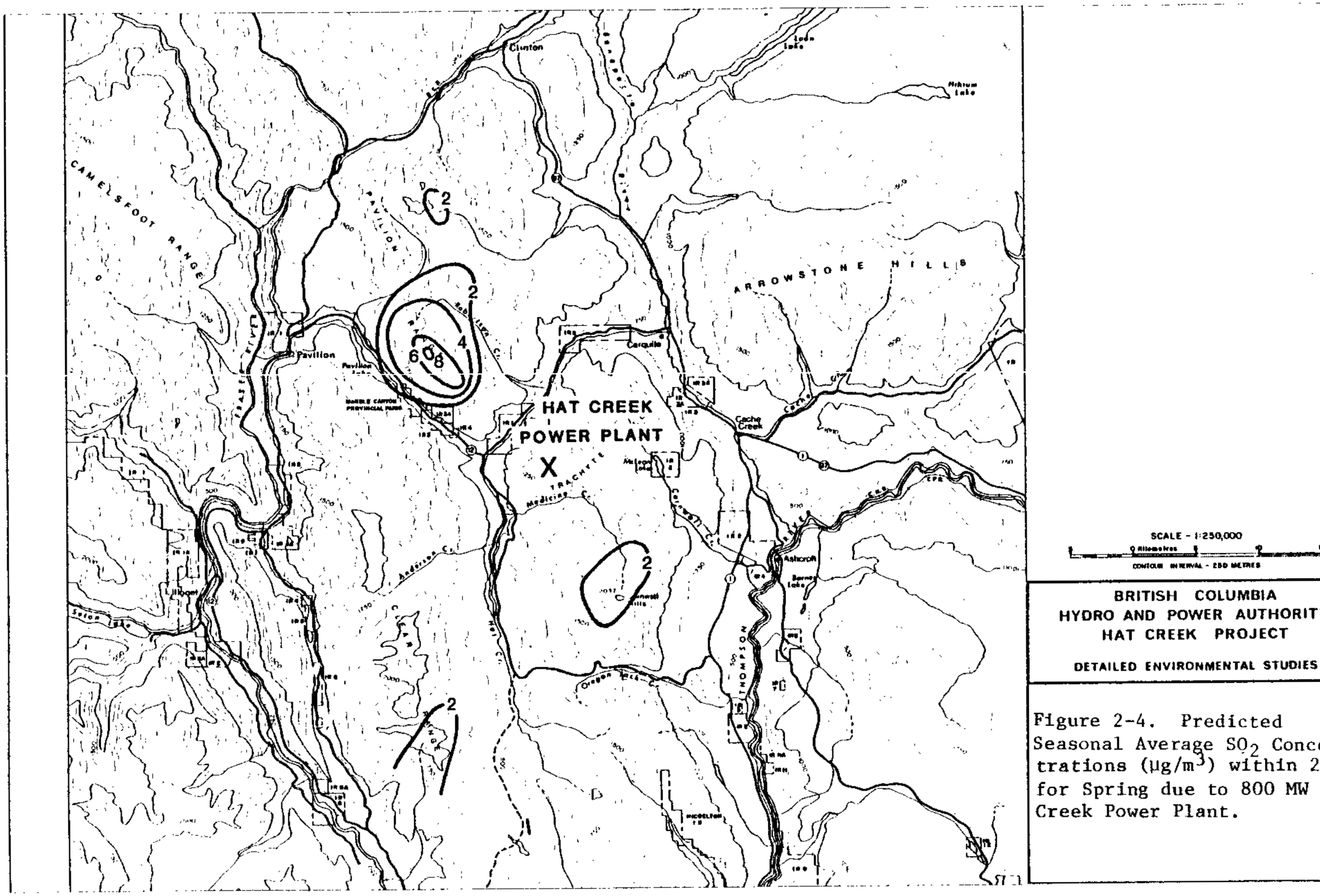
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-3. Predicted Seasonal Average SO_2 Concentrations ($\mu g/m^3$) within 25 km for Winter due to 800 MW Hat Creek Power Plant.



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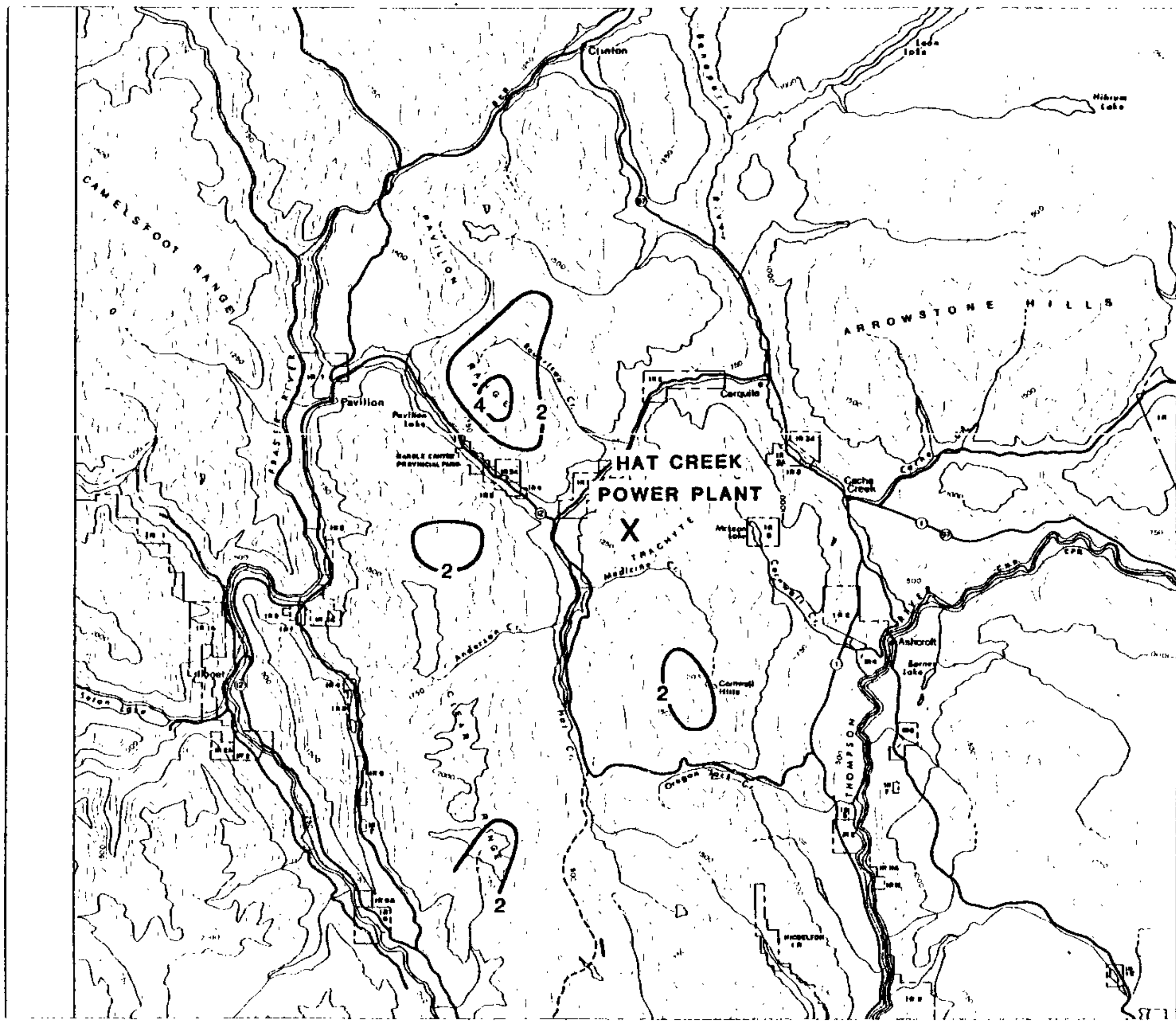
HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-4. Predicted Seasonal Average SO_2 Concentrations ($\mu g/m^3$) within 25 km for Spring due to 800 MW Hat Creek Power Plant.



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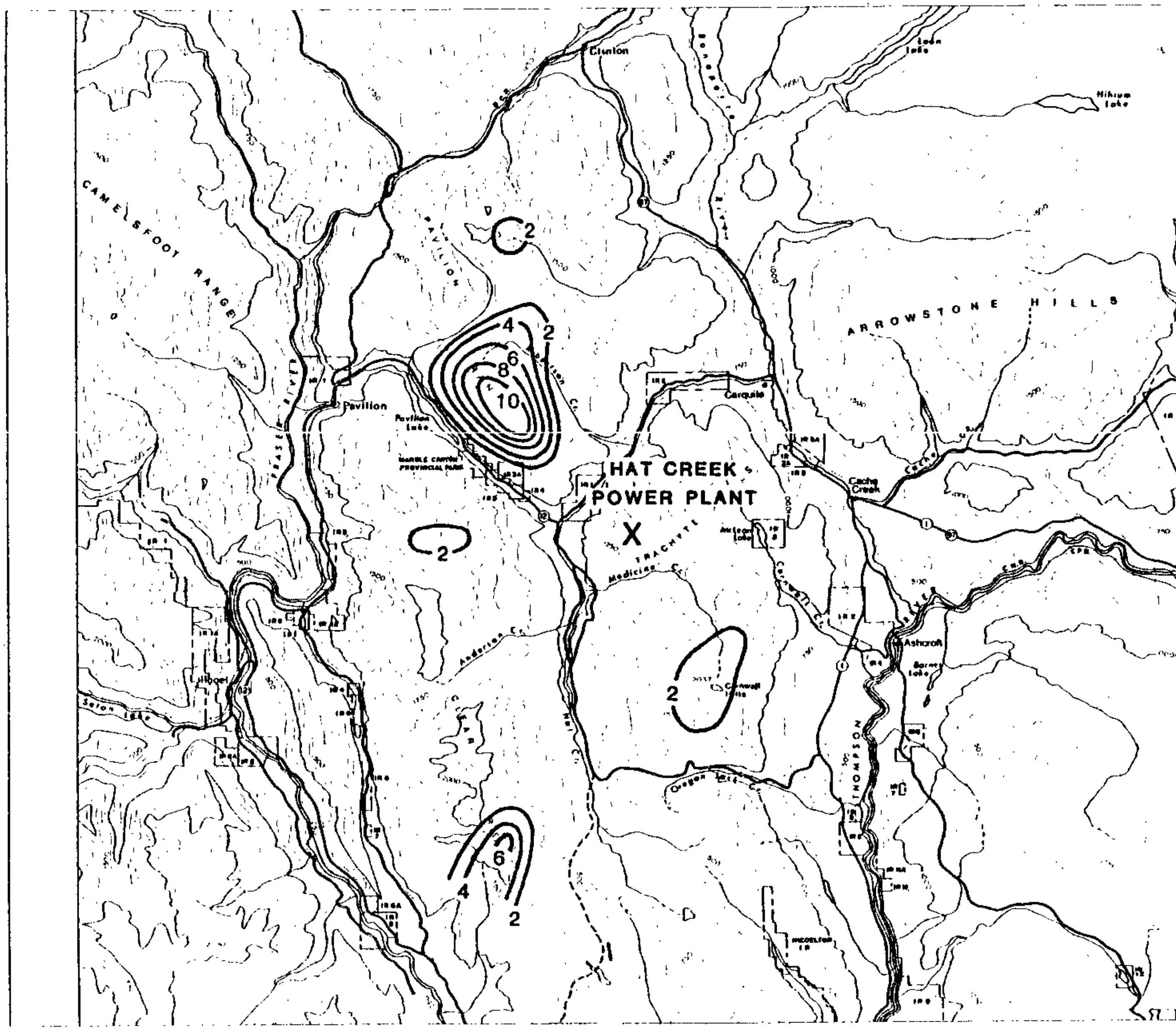
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-5. Predicted Seasonal Average SO_2 Concentrations ($\mu g/m^3$) within 25 km for Summer due to 800 MW Hat Creek power plant.



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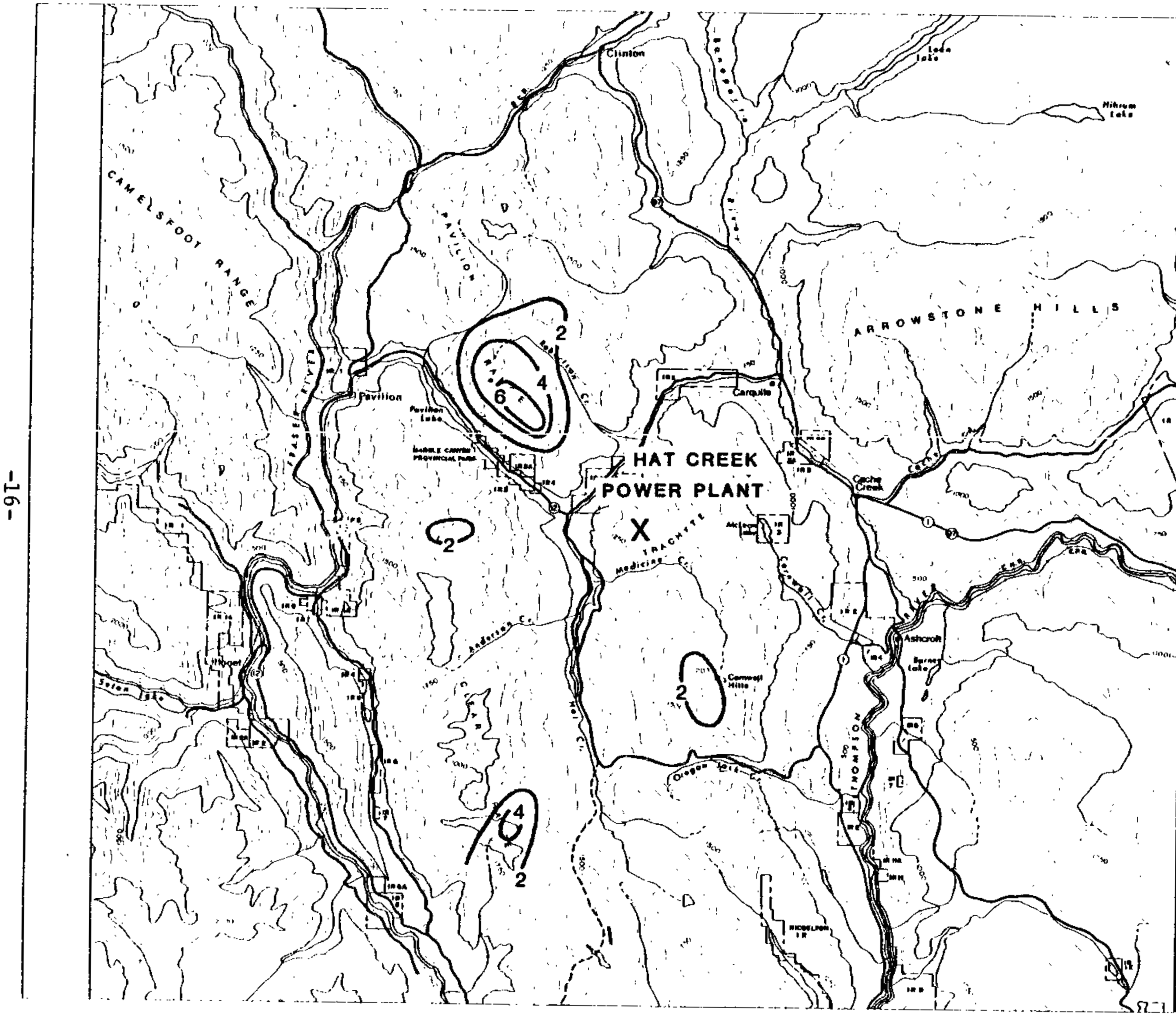
HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-6. Predicted Seasonal Average SO_2 Concentrations ($\mu g/m^3$) within 25 km for Fall Due to 800 MW Hat Creek Power Plant.



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HAT CREEK PROJECT

DETAILED ENVIRONMENTAL STUDIES

Figure 2-7. Predicted Average SO_2 Concentrations ($\mu g/m^3$) within 25 km for Growing Season due to 800 MW Hat Creek Power Plant.

Short-Term Concentrations

The annual sequence of predicted hourly concentrations at each of the 128 receptors identified in Figure 2-1 were processed to provide estimates of hourly, 3-hour and 24-hour SO_2 concentrations throughout the year. These results were further screened to determine maximum predicted values for each short-term averaging time for comparison with applicable ambient guidelines. The results are summarized in Table 2-2.

The highest four computed one-hour concentrations range from 693.7 to 742.6 $\mu g/m^3$, all below the upper PCB guideline level of 900 $\mu g/m^3$. In all, 43 individual values above the lower PCB Hourly guideline of 450 $\mu g/m^3$ were predicted, but the most at any single receptor was 13 in the Cornwall Hills. The atmospheric conditions producing values above 450 $\mu g/m^3$ are light wind speeds accompanied by stable stratification, primarily during the night and early morning hours.

The four highest predicted three-hour SO_2 concentrations during the year range from 353.8 $\mu g/m^3$ to 479.1 $\mu g/m^3$. For reference, the upper and lower PCB guidelines for three-hour SO_2 concentrations are 665 and 375 $\mu g/m^3$, respectively. Only three computed values exceeded the lower guideline level, all at the receptor location 13 km northeast of the Hat Creek site in the Pavilion Range. Persistent light wind and stable atmospheric conditions during winter nights are responsible for these maximum three-hour values.

The four highest predicted 24-hour average SO_2 concentrations due to the 800 MW plant emissions range from 143.4 to 195.2 $\mu g/m^3$. All predicted 24-hour values are below the lower PCB guideline of 160 $\mu g/m^3$ with the exception of one exceedance of this concentration level at each of two model receptors. Again, the dominant meteorological conditions giving rise to the highest 24-hour concentrations are very light winds with strong directional persistence and stable stratification during the winter.

Table 2-3 shows the maximum predicted concentrations for all major and trace pollutants to be emitted by the 800 MW plant for the 1-hour, 3-hour, 24-hour and annual averaging times. As noted earlier, the values for pollutants other than SO_2 were obtained by scaling the SO_2 results by the emission factors listed in Table 2-1. Tables showing the highest

TABLE 2-2

A.

FOUR HIGHEST PREDICTED GROUND-LEVEL SULFUR DIOXIDE CONCENTRATIONS WITHIN 25 km FROM THE HAT CREEK 800 Mw GENERATING STATION WITH 152 m STACK

Rank	Concentration (µg/m^3) 1-Hour	3-Hour	24-Hour	Annual
1	742.6	479.1	195.2	12.0
2	720.4	397.5	163.9	11.1
3	712.2	375.3	147.5	8.6
4	693.7	353.8	143.4	4.9

B.

NUMBER OF PREDICTED GROUND-LEVEL SULFUR DIOXIDE CONCENTRATIONS EXCEEDING LOWER AND UPPER LIMITS OF THE AMBIENT AIR CONTROL OBJECTIVES WITHIN 25 km FROM THE HAT CREEK 800 Mw GENERATING STATION WITH 152 m STACK

Averaging Time	Maximum Number of Lower Limit Exceedances at one Receptor	Upper Limit Exceedances
1-hour	13	0
3-hour	3	0
24-hour	1	0
Annual	0	0

TABLE 2-3

HIGHEST PREDICTED GROUND LEVEL CONCENTRATION WITHIN 25 KM FROM THE 800 MW GENERATING STATION WITH 152 m STACK

Concentration ($\mu g/m^3$)

Pollutant	Scaling Factor	1-hr	3-hr	24-hr	Annual
SO_2	1.0	742.6	479.1	195.2	12.0
TSP	0.12	86.2	55.7	22.7	1.4
NO_x	1.0	742.6	479.1	195.2	12.0
NO_2	0.23	170.6	110.0	44.8	2.8
Sb	0.00001	0.009	0.006	0.002	0.0001
As	0.0001	0.09	0.06	0.02	0.001
Be	0.000003	0.002	0.001	0.0005	0.00003
B	<0.0002	<0.01	<0.08	<0.03	<0.002
Cd	<0.000001	<0.001	<0.0006	<0.0003	<0.00002
Cr	0.00002	0.02	0.01	0.004	0.0003
Co	0.000004	0.003	0.002	0.0008	0.00005
Cu	0.0002	0.1	0.07	0.03	0.002
F	0.008	6.3	4.0	1.7	0.10
Pb	0.00004	0.03	0.02	0.008	0.0005
Mn	0.0005	0.4	0.2	0.10	0.006
Hg	0.00003	0.02	0.01	0.005	0.0003
Mo	0.00003	0.02	0.01	0.005	0.0003
Ni	0.00005	0.04	0.02	0.01	0.0006
Se	<0.00004	<0.03	<0.02	<0.008	<0.0005
Ag	<0.0000002	<0.0001	<0.00008	<0.00003	<0.000002
Tl	<0.0000001	<0.00009	<0.00006	<0.00002	<0.000001
Th	<0.000001	<0.0009	<0.0006	<0.0002	<0.00002
Sn	0.000001	0.0007	0.0005	0.0002	0.00001
W	<0.0000002	<0.0001	<0.00009	<0.00004	<0.000002
U	0.000005	0.004	0.002	0.001	0.00006
V	0.00007	0.05	0.03	0.01	0.0009
Zn	0.0001	0.08	0.05	0.02	0.001

NOTES: Scaling Factor = Emission Rate of Trace Element (Kg/d) ÷ Emission Rate of SO_2 (Kg/d).
Ambient Trace Element Conc ($\mu g/m^3$) = Scaling Factor x SO_2 conc ($\mu g/m^3$).
NO_2 Scaling Factor was estimated by ERT letter 3 March 1982, J. Lague to A.E. Brotherston.

concentrations for each averaging time at each receptor plus the frequencies of values above specified thresholds for each averaging time at each receptor are provided in Appendix A.

3. AIR QUALITY EFFECTS OF FUGITIVE DUST FROM THE MINE

3.1 Mine Plan

The Hat Creek Valley coal deposit will be mined as an open pit, using a truck/shovel and conveyor combination. With this method, the coal bed will be excavated using large mining shovels, and coal will be transferred from the pit to the nearby power plant using both truck transport and a conveyor system. Peak run-of-mine production is estimated to be 4.1 million tonnes per year over a 36-year mine life.

Coal and waste materials will be loaded into trucks at the mine face by hydraulic mining shovels for transport out of the pit area. Trucks carrying overburden and waste rock will proceed directly to the waste disposal area located in Houth Meadows, northwest of the pit. Coal will be trucked as far as the dump station, located at the northern edge of the pit, where it will be fed into the primary crusher, then transferred to the coal conveyor system. The single belt conveyor system will be used to transport coal from the pit edge to the blending area located northeast of the pit, to the live coal storage pile adjacent to the power plant and to the secondary crushing and screening facility within the power plant. Ash produced by coal combustion in the power plant will be collected and transferred via conveyor to an ash disposal area south of the power plant, where it will be deposited by a moveable conveyor.

Three coal storage areas will be maintained at the Hat Creek site. The major coal stockpile (capacity 220,000 tonnes) forms the basis of the blending system that will be used to ensure that a consistent product will be available to the power plant. The blending area will be the first stop for coal in its transport between the pit and the power plant. A large emergency coal pile (dead storage) will be located close to the plant. This coal will be utilized as fuel in the power plant if the coal supply from the mine is interrupted. A surge pile (live storage) will also be maintained adjacent to the emergency coal pile.

Material dumped in the disposal areas, be it overburden, waste rock, or ash, will be spread by dozers. Waste disposal areas, the pit and coal storage areas will be subject to wind erosion.

3.2 Emissions

Suspended particulate matter is the major contaminant resulting from open-pit mining operations. Airborne particles are produced by the mechanical disturbance of exposed earth and are termed fugitive dust because they are not discharged to the atmosphere in a defined flow stream. Fugitive dust is emitted from open sources, such as the operation of heavy, earth-moving equipment or the traffic along an unpaved road.

Mining operations that play a significant role in the generation of fugitive particulate emissions include:

- overburden and waste rock removal,
- coal removal,
- haul road traffic and repair, and
- coal storage.

Dust producing processes associated with these operations include shoveling, hauling, and dumping.

Emission rates for these activities are calculated using emission factors expressed in terms of mass of dust per unit operation and projected operating information from the proposed mine plan. In the previous study for a 2,000 MW plant at the Hat Creek site (ERT 1978), emission factors were selected from the published literature to best represent the proposed operations, local meteorological conditions, and soil properties. Since that time, the available information on selection of appropriate fugitive dust emission factors has increased significantly as a result of several special field studies conducted at operational mines throughout the western U.S. (PEDCo/MRI 1981, Schearer et al. 1981).

One major characteristic of fugitive dust emissions that has been identified by all field studies performed to date is the predominance of large sized particles. Due to this characteristic, the bulk of the dust emitted by a mining operation or other fugitive dust source is significantly influenced by gravitational settling and deposition. Most of the dust emitted at the source falls out of the dust plume very near to the source, so that only a fraction of the total particulate emitted contributes to suspended particulate levels downwind. Thus, emission factors should be used in conjunction with a "fallout function" when determining the ambient air quality impacts of emissions from mining operations. Alternatively, emission factors can be developed to account only for that mass fraction of dust with particle sizes small enough to remain suspended beyond the mine area. This approach was adopted by the Wyoming Department of Environmental Quality (DEQ) in developing fugitive dust emission factors for mining operations on the basis of field tests. This set of emission factors represents Wyoming DEQ's most recent recommendation, superceding the set of factors referred to in the Cominco-Monenco Joint Venture study on the 2000 MW Hat Creek Project (CMJV 1979). These factors were used to reassess emissions from the Hat Creek mining operations for the 800 MW power plant.

Table 3-1 lists emission factors, source operating units, and annual controlled emission rates calculated for each mining activity. The source operating units selected for the emission calculation represent the year when dust producing activities at the mine site will be at a maximum: highest stripping ratio and long haul distances for both coal and overburden. The dust emitting activities for the 800 MW plant during year 4 combine to give the highest overall emission rate of any year in the proposed mine plan. The major dust source at Hat Creek will be wind erosion of exposed areas (the open pit, the waste disposal areas and the emergency coal pile). After wind erosion, the major sources of fugitive dust are haul-road traffic, waste disposal operations, overburden removal and coal handling activities at the coal stockpiles.

3.3 Effects

The ambient air quality effects of fugitive particulate emitted by mining operations in the Hat Creek Valley were estimated based on the model results previously obtained for similar mining operations required to support a 2,000 MW power plant (ERT 1978). Reduction in the plant generating capacity from 2,000 MW to 800 MW will result in a commensurate reduction in coal production and activity level at the mine. The air quality effects for the reduced mine plan can then be estimated by scaling the results obtained for the 2000 MW plant.

TABLE 3-1

ESTIMATES OF PARTICULATE EMISSIONS FOR THE HAT CREEK PROJECT COAL MINE (BASED ON A MAXIMUM LEVEL OF ACTIVITY FOR PROJECT YEAR 4)

Source/Type of Activity	Emission Factor*	Source Operating Units	Emissions (kg/yr)
Overburden removal (truck/shovel)	0.008 kg/tonne	6.592×10^6 m^3/year x 1.78 tonne/m^3	93,870
Coal removal (truck/shovel)	0.001 kg/tonne	3.80×10^6 tonne kg/year in-situ coal	3,800
Coal haul road	0.31 kg/vehicle-km traveled	1.63×10^5 vehicle-km/yr	50,418
Overburden haul road	0.31 kg/vehicle-km traveled	4.41×10^5 vehicle-km/yr	136,704
Truck hopper dump	0.013 kg/tonne coal dumped	3.80×10^6 tonne/year in-situ coal	49,400
Coal stockpiles (active)	0.303 g/m^2-hr	35,000 m^2 x 6648 dry hr/yr	70,502
Haul road repair	7.26 kg/grader-hr	9000 grader-hr/year	65,340
Wind erosion	0.056 kg/m^2 yr	$1.17 \times 10^7 m^2$	655,200
Waste disposal	7.26 kg/dozer-hr	18,000 dozer-hr/yr	130,680
		TOTAL	1,255,914

*Reference (Collins 1979).

The maximum estimated annual concentration due to mining operations for the 800 MW plant is 145 $\mu g/m^3$, predicted near the northwest corner of the open pit, due south of the blending area. Calculated values greater than 60 $\mu g/m^3$ are confined to the immediate vicinity of the mine pit. The 30 $\mu g/m^3$ level extends northeastward approximately 3 km beyond the northernmost extent of mining operations, and southward to within about 1 km of Anderson Creek. Annual concentrations generally between 15 and 30 $\mu g/m^3$, with peak values of about 50 $\mu g/m^3$, are predicted at the Indian Reserve (IR1) north of the mine in the Lower Valley.

Nine sets of short-term meteorological conditions were used in the modeling analysis to predict worst-case and typical 24-hour concentrations resulting from dust emissions at the mine. These short-term conditions were selected on the basis of a wind persistence analysis of the sequential data set recorded at B.C. Hydro mechanical weather station (WS5) near the mine site. Specific meteorological assumptions for the nine cases are summarized in Table 3-2.

Cases 1, 2, and 3 represent standard, worst-case meteorology to produce maximum ground-level concentrations from surface-based, nonbuoyant emission sources: light, directionally persistent winds with stable dispersion conditions. In general, the highest local concentrations are expected for the lightest wind speeds. Thus, the predicted concentrations for Case 3 with an average wind speed of 0.77 mps are the highest values calculated for any of the nine meteorological conditions investigated. This case probably represents a reasonable worst-case dispersion condition in Hat Creek Valley, since south-southwesterly flow with stable conditions occurs frequently, especially during nighttime and early morning hours, when the synoptic flow is weak and circulations within the mountain-valley system are dominated by terrain effects.

With Case 3 conditions, 24-hour values of more than 200 $\mu g/m^3$ are expected near the coal blending area, northeast of the mine pit. Concentrations ranging from 100 $\mu g/m^3$ to 180 $\mu g/m^3$ are predicted for the southern section of the Indian Reserve (IR1) located north of the mining area. Concentrations in excess of 80 $\mu g/m^3$ are predicted near the northern boundary of the Reserve.

TABLE 3-2

METEOROLOGICAL INPUT PARAMETERS FOR CALCULATION OF
INCREMENTAL 24-HOUR TSP CONCENTRATIONS DUE AT THE HAT CREEK MINE

Case #	Wind Speed (mps)	Wind Direction	Stability	Persistence (hours)	Condition
1	1.34	SSE	Stable	16	Light wind/stable
2	1.74	SE	Stable	15	
3	0.77	SSW	Stable	14	
4a 4b	13.1	SSW N	Neutral	8	High wind/neutral
5a 5b	6.95	SSW N	Stable	8	Moderate wind/stable
6a 6b	5.0	SSW N	Neutral	8	Moderate wind/neutral

Predicted effects for Case 1 and Case 2 are smaller in magnitude, with incremental concentrations above 150 $\mu g/m^3$ restricted to small areas within the mine site. Only the very light winds assumed in Case 3 produce off-site concentrations above 150 $\mu g/m^3$ with stable conditions.

Cases 4a and 4b represent high wind speed conditions. The value of 13.1 mps chosen for these simulations corresponds to the highest wind speed recorded at WS5 during 1975. Both northerly and south-southwesterly wind directions were investigated to allow examination of the mine's air quality influence in the Upper and Lower Valleys.

The effects of emissions from the main pit for Cases 4a and 4b are not significantly different from those predicted for Cases 1 and 2. The contribution of the waste dump is greatly increased, since emissions from this source result from erosion by the wind. In the model, such emissions are proportional to the cube of the wind speed, and during high-wind periods, erosion contributes to significant localized TSP levels near exposed surfaces. However, no off-site 24-hour averaged concentration increments greater than 30 $\mu g/m^3$ are predicted for these conditions.

Cases 5a and 5b examine the effect of moderate wind speeds with stable conditions. Again, both northerly and south-southwesterly wind directions were analyzed. The wind speed value of 6.95 mps is the highest 1975 value recorded at WS5 during stable conditions. Maximum predicted incremental 24-hour TSP levels beyond the site boundary are between 30 and 55 $\mu g/m^3$ for winds from the south-southwest. Northerly winds produce off-site maxima between 15 and 30 $\mu g/m^3$ in the Upper Valley.

Cases 6a and 6b represent moderate wind speeds with neutral stability dispersion. These cases represent typical afternoon conditions in the Hat Creek Valley. The results for both wind directions indicate that the dust-producing processes in the mine contribute to much lower ambient TSP levels under this meteorological condition. No incremental values greater than 50 $\mu g/m^3$ are predicted, even near the mine pit, for these cases.

On the basis of limited TSP measurements, averaged background concentrations in the Upper Valley have been estimated at 10 $\mu g/m^3$, with about 20 μg/m^3 indicated in the Lower Valley. Thus, an incremental concentration of 50 μg/m^3 south of the main pit should be interpreted as contributing to a total value of 60 μg/m^3 and a value of 25 μg/m^3 within the Indian Reserve (IR1) represents a total concentration of 45 μg/m^3.

To summarize, emissions from the mine will contribute to off-site concentrations above the lower end of the ambient objective range (150 μg/m^3) only during sustained periods of stable conditions with very light winds (less than 1 m/sec). During such periods, TSP values (background plus mine-related) may approach the upper end of the ambient objective range (200 μg/m^3) in the Lower Valley. Annual concentrations greater than the allowable range of ambient levels for mining operations (60-70 μg/m^3) will be exceeded only within the confines of the active mining pit.

4. COOLING TOWER EFFECTS FOR THE 800 MW HAT CREEK PROJECT

Analyses of potential plume and drift deposition effects due to operation of alternate cooling tower systems for a 2,000 MW thermal plant have been conducted previously (ERT 1978, Appendix D). This section describes an examination of impacts associated with emissions from a single natural draft tower to accomplish cooling for an 800 MW power plant. Specific parameters addressed in this investigation include ground icing and fogging, visible plume length and deposition of salts in the drift.

Table 4-1 shows the important operational characteristics and physical dimensions for the 800 MW cooling tower, as supplied by B.C. Hydro. Tower dimensions are assumed to be the same as for the two natural draft tower system for the 2000 MW plant. The circulating water flow rate is taken as 0.75 times the flow rate per tower for the two-tower system.

Ground Fogging and Icing

As described in ERT (1978), large natural draft cooling towers which discharge effluents 300-500 feet above grade do not produce appreciable ground-level plume effects. This statement is supported by both observations and modeling studies. Since no ground icing or fogging impacts were predicted for a pair of essentially similar natural draft towers in previous Hat Creek analyses, it is quite reasonable to conclude that none will occur for the single tower required to support operations at 800 MW.

Visible Plume Length

Modeling results indicating the annual geographical distribution of visible (saturated) plumes for a two-tower natural draft system were presented in ERT 1978 (Appendix D, Figure D3-6). This analysis showed that visible plumes extending downwind on the order of 3-5 km could occur about 5 hours per year in all directions, while plume remaining visible as far as 10-15 km could occur about one hour per year with light winds

TABLE 4-1

OPERATIONAL CHARACTERISTICS AND DIMENSIONS* FOR SINGLE NETWORK DRAFT COOLING TOWER FOR THE 800 MW HAT CREEK THERMAL PLANT

Height	116.4 m (381.8 ft)
Diameter at top	67.1 m (220.1 ft)
Circulating water flow rate	14,198 ℓ/sec (225,000 gal/min)
Drift emissions	0.008% circulating water flow rate

*Source: B.C. Hydro.

from the north-northwest, south-southeast and east-northeast. The area bounded by the 40-hour per year isopleth extended at most, 3 kilometers from the plant site.

To interpret these results in terms of likely impacts associated with a single tower to support 800 MW operations, it must be understood that the modeling techniques employed incorporated an algorithm to simulate combinative effects of the plumes from two towers, i.e., the two plumes entrained each other, as well as (dryer) ambient air, which led to larger visible plume length predictions than would be obtained for either tower alone. In addition, the circulating water flow rate through the single tower for the 800 MW plant is 0.75 times the rate for either tower in the two-tower system previously investigated. For these reasons, the distribution of visible plume lengths for the 800 MW single-tower case is expected to have the following characteristics.

- approximately the same relative directional distribution as in Figure D3-6 of Appendix D (ERT 1978), but with slightly shorter plumes in the east-west directions (the directions of maximum additive effects for the two-tower system considered earlier); and
- slightly fewer long plumes in all directions, e.g., a contraction of the isopleths in Figure D3-6 toward the plant site.

Drift Deposition

The predicted annual pattern of salt drift deposition rates for a two-tower natural draft cooling system was presented in Figure D4-3 of ERT (1978), Appendix D. These results were obtained by graphical superposition of computed deposition of rates for the individual towers. Total drift emissions for the single tower associated with the 800 MW plant are about 0.4 times the combined emissions for the two-tower system. At downwind distances 2 km and further from the plant site, a good approximation for the single tower may be obtained by multiplying the previous deposition estimates by 0.4. Closer to the site, a conservative estimate would be to multiply predicted deposition rates by

0.75, the ratio of circulating water flow rates. This latter technique assumes that the two-tower results for near field impacts show separate (nonoverlapping) deposition patterns for the individual towers. With these considerations in mind, maximum deposition rates for the single-tower, 800 MW configuration are estimated at about 1680 $kg/km^2/year$ (15 tons/acre/year), to occur between 1 and 2 kilometers from the towers in both the easterly and westerly directions. The directional distribution of drift deposition about the plant site will be approximately the same as indicated in Figure D4-3, since the annual pattern depends primarily on the long-term wind speed-wind direction frequency distributions.

5. LONG RANGE TRANSPORT/ACID DEPOSITION DUE TO 800 MW HAT CREEK PROJECT EMISSIONS

A previous study examined potential effects of the 2000 MW Hat Creek Project on ambient concentrations and deposition patterns within 200 km from the power plant site (ERT 1980). The analysis considered uncontrolled emissions for a 366 m stack. Seasonal and annual average wet and dry deposition patterns for SO_2, $SO_4^{=}$, NO_x and NO_3 were computed by means of a diffusion deposition model to estimate corresponding patterns of total hydrogen ion (H^+) deposition resulting from Hat Creek emissions. Spatially-integrated total H^+ over selected watershed areas were estimated from the model results. Soil and vegetation characteristics were considered in computing the unneutralized fraction of the predicted H^+ in each watershed which would potentially reach specific water bodies of interest. Physical and chemical characteristics of the water bodies were used with the model predicted deposition totals to estimate potential effects of the stack emissions on pH in each selected water body. Because of uncertainties inherent in the methodology employed, many conservative assumptions were adopted to ensure that predicted effects were not underestimated.

A summary of the results obtained for the uncontrolled 2000 MW plant with a 366 m stack is given below.

Water Body	Current Annual Average pH	Predicted Annual Average pH Change
Adams River	7.6	-0.056
Boss Creek	7.1	-0.008
Pennask Lake	7.6	-0.073
Loon Lake	8.7	-0.153 to -0.894
Thompson River	7.56	-0.002 to -0.008
Clearwater River	7.56	-0.012
Deadman River	8.2	-0.101 to -0.369

Ranges of values appear in the table above for predicted annual pH changes in some water bodies. These ranges reflect multiple calculations utilizing different input assumptions where substantial uncertainties existed, e.g., the appropriate level of watershed soil neutralization capacity, etc.

Emissions for the 800 MW facility are shown in Table 1-1. For SO_x and NO_x the emissions for 800 MW represent 16% and 25%, respectively, of the values assumed in the previous study for 2000 MW. In addition, the assumed stack height for 800 MW is 152 m, whereas the height assumed for the 2000 MW plant analysis was 366 m. The substantially lower emissions and stack height for the 800 MW plant would change the predicted impacts from those previously computed for 2000 MW in the following general manner.

- Sulfate and nitrate deposition maxima will be lower and will occur further from the plant site, since the conversion rates from primary SO_x and NO_x emission rates are dependent on plume concentrations which will be lower for the controlled 800 MW plant.
- SO_2 and NO_x deposition maxima will be lower but nearer to the plant site because of the lower stack height for the 800 MW plant.
- Water bodies within the Hat Creek Project area of influence will experience smaller long-term and short-term pH reductions for the 800 MW controlled plant than for the 2000 MW uncontrolled plant, because of the substantially lower emissions of the former configuration. It is probable, for reasons noted above, that the distribution of sulfate and nitrate contributions to total H^+ deposition at any location will be different from that obtained for the uncontrolled 2000 MW plant.
- Although the locations of maximum H^+ deposition for 800 MW can be expected to be nearer to the plant site, the magnitudes of these peaks will be smaller than those predicted for 2000 MW. Inasmuch as the water bodies at shorter distances from Hat Creek were shown in ERT (1980) to have higher capacity for buffering acid inputs than those further from the plant, it may be concluded that no new areas of concern would be identified by a more rigorous analysis for the 800 MW plant.

It is not possible to provide quantitative estimates of potential pH change in precipitation or in specific water bodies due to the 800 MW Hat Creek emissions without actually conducting a modeling study similar to that undertaken previously for the 2,000 MW plant. For example, deposition rates for various plume species cannot be simply scaled by the reduction in emissions from the 2000 MW case, since both primary and secondary contaminants are involved, and the conversions of SO_x and NO_x to $SO_4^=$ and NO_3^- occur at different, concentration-dependent rates. Determination of the effects of reducing the stack height on the computed deposition rates is also nontrivial, because of the highly variable terrain in the study area. However, as noted above, the significantly lower SO_x and NO_x emissions associated with the 800 MW facility will more than offset the effect of reducing stack height with the result that impacts due to long range transport will be less than those predicted for the 2000 MW plant.

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APPENDIX A

TABULAR PRESENTATIONS OF NEAR-FIELD MODELING RESULTS

(Receptor numbering system is illustrated in Figure 2-1.)

TABLE A-1

MAXIMUM PREDICTED AMBIENT ANNUAL AVERAGE SO_2 CONCENTRATIONS AND EXCEEDENCES
OF THRESHOLD VALUES WITHIN 25 km FROM THE HAT CREEK
800 MW GENERATING STATION WITH A 152 m STACK

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$)				Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$)				Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$)			
			225	450	900	1300		150	375	665	900		100	160	260	360
1	0.27	110.73					36.91					6.41				
2	0.61	123.08					64.60					15.34				
3	0.43	155.74					54.66					12.92				
4	0.75	205.92					76.48					14.28				
5	0.66	139.40					78.63					14.45				
6	0.45	147.67					87.01					11.21				
7	0.16	123.80					52.37					6.55				
8	0.13	153.9					51.33					7.51				
9	0.24	132.22					93.62					17.41				
10	0.31	136.57					81.25					10.69				
11	0.23	120.97					52.71					6.59				
12	0.07	118.38					39.46					6.42				
13	0.20	134.05					49.65					7.12				
14	0.08	105.73					50.06					8.58				
15	0.14	118.62					61.17					7.79				
16	0.09	108.64					44.26					6.88				
17	0.18	70.84					23.83					3.68				
18	0.37	75.23					39.34					9.19				
19	0.25	93.61					35.07					7.64				
20	0.31	86.20					48.77					8.39				
21	0.39	87.13					58.57					8.18				
22	0.28	89.90					55.14					7.34				
23	0.11	78.89					31.43					3.94				
24	1.40	244.11	1				192.16	3				31.81				
25	0.18	84.58					56.64					10.68				
26	0.22	83.89					49.50					7.05				
27	0.15	72.92					30.86					3.86				

TABLE A-1 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
28	0.04	76.38					25.46					5.25				
29	0.16	85.71					32.90					5.68				
30	0.07	69.95					31.66					5.27				
31	0.14	100.29					39.89					6.66				
32	0.07	71.93					28.62					4.52				
33	0.13	53.26					17.86					2.71				
34	0.21	41.79					21.63					5.10				
35	0.18	68.42					25.36					5.29				
36	0.24	65.34					40.56					6.37				
37	0.27	62.71					41.53					5.73				
38	0.20	64.82					38.74					5.06				
39	2.25	125.64					103.83					34.34				
40	2.93	742.57*	44	10			297.72	15				47.16				
41	0.14	62.45					41.00					7.71				
42	0.16	61.21					35.73					4.91				
43	0.11	60.86					23.09					2.89				
44	0.03	57.93					19.31					4.05				
45	1.61	187.36					168.34	1				45.74				
46	0.05	48.35					21.17					3.47				
47	11.10	361.97	209				328.38	64				163.91	3	1		
48	0.07	60.00					23.47					3.64				
49	0.13	51.96					17.40					2.41				
50	0.16	32.29					16.28					3.87				
51	0.10	47.06					15.69					3.55				
52	0.13	44.38					22.13					3.83				
53	0.21	50.15					32.93					4.48				
54	0.13	47.52					24.87					3.45				
55	0.11	50.58					19.08					3.61				
56	2.91	546.27	41	13			215.86	15				44.82				
57	0.24	62.37					32.81					6.43				
58	0.12	48.88					28.17					3.80				

TABLE A-1 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
59	0.17	62.11					20.70					2.59				
60	0.92	550.76	14	3			183.59	3				34.83				
61	3.50	542.43	53	5			288.16	16				147.46	1			
62	0.05	39.57					16.97					2.73				
63	12.07	549.48	202	12			479.09*	62	3			195.22*	2	1		
64	0.30	65.60					47.50					14.07				
65	0.11	43.13					16.84					2.33				
66	0.16	30.05					15.27					3.65				
67	0.10	43.02					14.77					3.19				
68	0.14	41.96					25.06					3.70				
69	0.14	31.77					20.61					3.28				
70	0.10	37.67					18.43					2.61				
71	0.04	31.86					10.62					1.33				
72	0.04	49.85					16.62					2.08				
73	0.11	46.19					26.37					4.93				
74	0.12	42.49					24.29					3.32				
75	1.71	408.36	34				220.59	5				37.65				
76	0.91	430.06	20				143.35					27.00				
77	0.16	64.73					35.08					6.42				
78	0.04	33.54					14.13					2.25				
79	8.60	406.26	75				352.70	24				143.36	1			
80	2.94	389.33	25				179.09	4				46.15				
81	0.10	35.75					15.57					2.43				
82	0.10	21.61					9.84					2.36				
83	0.14	39.69					20.31					2.91				
84	0.14	36.89					21.94					3.41				
85	0.12	28.23					18.21					2.82				
86	0.08	32.52					15.98					2.21				
87	0.03	26.16					8.72					1.09				
88	0.03	47.84					13.91					1.74				
89	1.06	92.91					40.99					13.48				

TABLE A-1 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
90	0.32	40.61					21.55					5.53				
91	0.54	135.20					117.52					19.80				
92	0.34	217.44					74.33					17.07				
93	0.05	31.24					12.19					1.99				
94	0.16	37.09					12.63					2.31				
95	0.09	44.35					15.87					2.75				
96	1.10	87.97					60.16					26.12				
97	0.07	26.72					10.29					1.29				
98	0.11	19.79					9.69					2.33				
99	0.65	70.76					31.93					5.27				
100	0.12	51.59					18.79					2.84				
101	0.10	24.31					15.59					2.43				
102	0.08	28.74					14.21					1.92				
103	0.03	23.92					7.97					1.00				
104	0.03	38.01					12.67					1.59				
105	0.11	53.62					19.59					3.68				
106	4.93	272.74	25				234.75	8				61.29				
107	0.63	171.57					133.56					22.64				
108	0.01	25.94					8.58					1.80				
109	0.04	25.94					9.67					1.56				
110	0.02	22.00					9.01					1.42				
111	0.09	45.28					15.09					2.41				
112	2.11	264.92	12				126.84					32.61				
113	0.12	50.25					24.08					5.40				
114	0.12	19.17					9.57					2.31				
115	0.20	52.30					24.01					3.70				
116	0.24	41.44					18.17					5.08				
117	0.09	22.64					14.46					2.19				
118	0.07	26.18					13.29					1.74				
119	0.02	20.46					6.82					0.85				
120	0.03	33.18					11.06					1.38				

TABLE A-1 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
121	0.71	77.00					31.99					9.21				
122	4.17	231.62	1				200.72	4				52.07				
123	0.04	23.72					9.04					1.13				
124	0.18	114.99					39.23					9.13				
125	0.06	33.65					18.18					3.26				
126	0.01	19.17					7.78					1.22				
127	0.09	44.62					14.87					2.28				
128	0.92	92.13					50.61					21.88				

*Indicates maximum concentration for each averaging period.

TABLE A-2

MAXIMUM PREDICTED AMBIENT AVERAGE SEASONAL SO_2 CONCENTRATIONS WITHIN 25 km FROM THE HAT CREEK 800 Mw GENERATING STATION WITH A 152 m STACK

Receptor Number	Winter	Spring	Summer	Fall
1	0.00	0.51	0.36	0.19
2	0.0005	0.91	1.10	0.39
3	0.05	0.35	0.93	0.38
4	0.15	0.52	1.95	0.38
5	0.004	0.69	1.43	0.52
6	0.0004	0.34	0.81	0.44
7	0.0002	0.21	0.34	0.11
8	0.004	0.23	0.27	0.02
9	0.002	0.57	0.30	0.10
10	0.04	0.33	0.58	0.29
11	0.005	0.17	0.57	0.16
12	0.00	0.03	0.26	0.001
13	0.00	0.15	0.61	0.03
14	0.00	0.09	0.21	0.02
15	0.00	0.19	0.24	0.12
16	0.00	0.08	0.15	0.12
17	0.00	0.35	0.24	0.12
18	0.003	0.45	0.70	0.23
19	0.03	0.19	0.55	0.24
20	0.01	0.18	0.89	0.16
21	0.0002	0.41	0.85	0.29
22	0.0003	0.35	0.50	0.27
23	0.002	0.15	0.22	0.07
24	1.79	1.44	1.30	1.05
25	0.002	0.42	0.23	0.06
26	0.02	0.23	0.42	0.21
27	0.002	0.10	0.38	0.11
28	0.00	0.02	0.16	0.002
29	0.00	0.11	0.46	0.05
30	0.0008	0.08	0.18	0.03
31	0.008	0.22	0.19	0.14
32	0.0001	0.08	0.10	0.10
33	0.0006	0.25	0.18	0.08
34	0.0004	0.32	0.40	0.13
35	0.03	0.15	0.38	0.17
36	0.03	0.14	0.66	0.12
37	0.0005	0.30	0.58	0.19
38	0.0001	0.25	0.34	0.19
39	2.62	2.52	1.39	2.46
40	4.04	2.25	3.31	2.14
41	0.007	0.33	0.18	0.05
42	0.02	0.16	0.30	0.15
43	0.001	0.07	0.30	0.09
44	0.00	0.01	0.11	0.0009

TABLE A-2 (Continued)

Receptor Number	Winter	Spring	Summer	Fall
45	2.08	0.44	2.48	1.44
46	0.0003	0.05	0.11	0.01
47	22.14	7.09	3.40	11.91
48	0.03	0.07	0.07	0.09
49	0.02	0.25	0.17	0.08
50	0.001	0.24	0.30	0.09
51	0.007	0.07	0.22	0.10
52	0.003	0.08	0.39	0.07
53	0.001	0.25	0.45	0.15
54	0.00	0.16	0.23	0.13
55	0.03	0.16	0.15	0.09
56	3.67	2.05	3.64	2.30
57	0.16	0.38	0.29	0.12
58	0.01	0.12	0.23	0.12
59	0.11	0.09	0.31	0.15
60	0.64	0.53	1.36	1.17
61	5.21	1.03	3.87	3.91
62	0.002	0.05	0.09	0.01
63	23.57*	8.13*	4.75*	11.95*
64	0.45	0.30	0.17	0.27
65	0.03	0.22	0.14	0.06
66	0.01	0.25	0.28	0.10
67	0.02	0.09	0.21	0.10
68	0.02	0.08	0.38	0.07
69	0.00	0.16	0.29	0.10
70	0.00	0.12	0.18	0.09
71	0.00	0.05	0.08	0.02
72	0.003	0.06	0.28	0.007
73	0.02	0.24	0.14	0.03
74	0.02	0.11	0.20	0.14
75	3.12	0.65	1.33	1.74
76	0.74	0.56	1.19	1.14
77	0.07	0.09	0.38	0.09
78	0.006	0.04	0.08	0.02
79	17.13	5.49	3.12	8.73
80	3.85	3.08	2.05	2.81
81	0.03	0.20	0.11	0.05
82	0.002	0.15	0.19	0.06
83	0.08	0.17	0.21	0.11
84	0.04	0.20	0.35	0.06
85	0.0001	0.14	0.25	0.08
86	0.00	0.11	0.15	0.08
87	0.00	0.04	0.06	0.02
88	0.003	0.05	0.06	0.006
89	1.41	0.93	1.13	0.76
90	0.26	0.25	0.33	0.46
91	0.82	0.26	0.54	0.57

TABLE A-2 (Continued)

Receptor Number	Winter	Spring	Summer	Fall
92	0.16	0.18	0.60	0.40
93	0.00	0.04	0.16	0.02
94	0.22	0.11	0.13	0.19
95	0.06	0.13	0.07	0.12
96	1.46	1.01	0.56	0.87
97	0.02	0.14	0.09	0.04
98	0.009	0.17	0.18	0.06
99	0.61	0.66	0.66	0.66
100	0.04	0.08	0.30	0.05
101	0.0002	0.12	0.21	0.07
102	0.00	0.10	0.13	0.07
103	0.0001	0.03	0.06	0.02
104	0.005	0.05	0.06	0.008
105	0.04	0.21	0.14	0.04
106	5.93	3.87	3.90	6.05
107	1.00	0.30	0.57	0.67
108	0.00	0.004	0.04	0.0002
109	0.00	0.03	0.13	0.01
110	0.0004	0.02	0.03	0.005
111	0.07	0.13	0.06	0.12
112	2.71	2.19	1.50	2.04
113	0.08	0.25	0.11	0.06
114	0.02	0.20	0.19	0.08
115	0.16	0.24	0.23	0.16
116	0.17	0.21	0.47	0.11
117	0.0005	0.11	0.20	0.07
118	0.00	0.10	0.12	0.07
119	0.0001	0.03	0.05	0.02
120	0.004	0.04	0.05	0.007
121	0.93	0.65	0.76	0.51
122	5.02	3.28	3.31	5.11
123	0.0003	0.03	0.11	0.03
124	0.08	0.10	0.33	0.21
125	0.0005	0.04	0.18	0.02
126	0.0004	0.02	0.04	0.005
127	0.07	0.12	0.05	0.12
128	1.32	0.96	0.55	0.84

*Indicates maximum concentration for each season.

TABLE A-3

MAXIMUM PREDICTED AMBIENT AVERAGE GROWING SEASON SO_2
CONCENTRATIONS AND EXCEEDENCES OF THRESHOLD VALUES
WITHIN 25 km FROM THE HAT CREEK 800 MW
GENERATING STATION WITH A 152 m STACK

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
1	0.44	110.73					36.91					6.41				
2	1.00	123.08					64.60					15.34				
3	0.69	155.74					54.66					12.96				
4	1.13	205.92					76.48					14.28				
5	1.00	139.40					78.63					12.77				
6	0.69	147.67					87.01					11.20				
7	0.26	123.80					52.37					6.55				
8	0.22	153.98					51.33					7.51				
9	0.39	132.22					93.62					17.41				
10	0.49	136.56					81.25					10.69				
11	0.36	120.97					52.71					6.59				
12	0.12	118.38					39.46					6.42				
13	0.34	134.05					49.65					7.12				
14	0.13	105.23					50.06					8.58				
15	0.22	118.62					61.17					7.79				
16	0.15	108.64					44.26					6.88				
17	0.29	70.84					23.83					3.68				
18	0.62	75.23					39.24					9.19				
19	0.40	93.61					35.07					7.63				
20	0.50	82.20					48.77					8.39				
21	0.58	87.13					58.57					7.65				
22	0.43	89.90					55.15					7.34				
23	0.16	78.89					31.43					3.94				
24	0.95	244.11	1				181.15	1				25.48				
25	0.28	84.58					56.64					10.68				

TABLE A-3 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
26	0.35	83.89					49.50					7.05				
27	0.24	72.92					30.86					3.86				
28	0.08	76.38					25.46					5.25				
29	0.27	85.71					32.90					5.68				
30	0.12	69.95					31.66					5.27				
31	0.22	100.29					39.29					6.66				
32	0.11	71.93					28.62					4.52				
33	0.21	53.25					17.86					2.71				
34	0.35	41.79					21.63					5.10				
35	0.28	64.42					25.36					5.29				
36	0.37	65.34					40.56					6.37				
37	0.40	62.71					41.53					5.39				
38	0.30	64.82					38.74					5.06				
39	1.74	125.64					103.83					30.49				
40	1.24	742.57*	18	4			247.52	5				41.14				
41	0.21	62.44					41.00					7.71				
42	0.25	61.21					35.73					4.91				
43	0.19	60.86					23.09					2.89				
44	0.05	57.93					19.31					4.05				
45	1.32	187.36					168.34	1				37.73				
46	0.07	48.35					21.17					3.47				
47	6.21	361.97	70				328.38	20				91.90				
48	0.09	17.26					23.47					3.64				
49	0.21	51.96					17.40					2.41				
50	0.27	32.29					16.28					3.87				
51	0.16	47.06					15.69					3.55				
52	0.22	44.38					27.13					3.83				
53	0.31	50.15					32.93					4.26				
54	0.20	47.52					24.87					3.45				
55	0.11	47.17					17.21					2.25				

TABLE A-3 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
56	2.41	546.27	20	10			182.09	10				41.85				
57	0.29	62.37					32.81					6.43				
58	0.19	48.88					28.17					3.80				
59	0.22	62.11					20.70					2.59				
60	0.90	492.66	11	2			173.13	2				34.83				
61	2.23	526.15	21	1			288.16	6				59.15				
62	0.06	39.57					16.97					2.73				
63	7.12	462.66	77	3			375.27*	17	1			71.89				
64	0.25	53.94					20.85					3.18				
65	0.18	43.13					16.81					2.33				
66	0.26	30.05					15.27					3.65				
67	0.16	43.02					14.77					3.19				
68	0.21	41.96					25.06					3.70				
69	0.20	31.77					20.61					2.66				
70	0.15	37.67					18.43					2.61				
71	0.06	31.86					10.62					1.33				
72	0.06	49.85					16.62					20.80				
73	0.16	46.19					26.37					4.93				
74	0.18	42.49					24.28					3.32				
75	0.15	366.11	10				122.04					22.83				
76	0.83	383.32	10				138.04					27.00				
77	0.22	64.73					35.08					6.42				
78	0.06	33.54					14.13					2.25				
79	4.91	356.16	25				290.51	8				55.62				
80	2.57	389.33	15				179.09	3				31.00				
81	0.15	35.75					15.57					2.43				
82	0.17	21.61					9.84					2.36				
83	0.19	39.69					20.31					2.91				
84	0.20	36.89					21.94					3.41				
85	0.17	28.23					18.21					2.34				
86	0.13	32.52					15.98					2.21				

TABLE A-3 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$)				Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$)				Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$)			
			225	450	900	1300		150	375	665	900		100	160	260	360
87	0.05	26.16					8.72					1.09				
88	0.05	41.82					13.94					1.74				
89	0.92	92.91					40.99					13.48				
90	0.38	40.61					21.56					5.53				
91	0.49	135.20					45.07					6.00				
92	0.37	217.44					74.33					17.07				
93	0.09	31.24					12.19					1.99				
94	0.13	30.39					12.63					2.02				
95	0.11	42.01					15.87					2.76				
96	0.80	87.97					48.60					10.10				
97	0.11	26.72					10.29					1.29				
98	0.17	10.80					9.67					2.33				
99	0.66	70.76					31.93					4.32				
100	0.17	31.59					18.79					2.84				
101	0.15	24.31					15.59					2.00				
102	0.12	28.74					14.21					1.92				
103	0.04	23.92					7.97					1.00				
104	0.04	38.01					12.67					1.59				
105	0.14	53.62					19.59					3.68				
106	4.52	272.74	16				234.75	4				48.22				
107	0.53	166.59					55.53					7.19				
108	0.02	25.74					8.58					1.80				
109	0.07	24.75					9.67					1.56				
110	0.03	22.00					9.01					1.42				
111	0.11	36.84					13.84					2.41				
112	1.85	264.92	9				126.30					22.09				
113	0.17	48.64					24.08					5.40				
114	0.19	19.17					9.57					2.31				
115	0.23	52.30					24.01					3.00				
116	0.28	34.00					18.17					3.62				
117	0.13	22.64					14.46					1.85				

TABLE A-3 (Continued)

Receptor Number	Overall Average SO_2 Conc	Max. 1-hr SO_2 Conc	No. of 1-hr Values Above: ($\mu g/m^3$) 225	450	900	1300	Max. 3-hr SO_2 Conc	No. of 3-hr Values Above: ($\mu g/m^3$) 150	375	665	900	Max. 24-hr SO_2 Conc	No. of 24-hr Values above: ($\mu g/m^3$) 100	160	260	360
118	0.11	26.18					13.29					1.74				
119	0.04	20.46					6.82					0.85				
120	0.04	31.18					11.06					1.38				
121	0.66	77.00					31.99					9.21				
122	3.83	231.62	1				200.72	3				41.10				
123	0.07	23.72					9.04					1.13				
124	0.21	114.99					39.23					9.13				
125	0.11	33.65					18.18					3.26				
126	0.02	19.17					7.78					1.22				
127	0.10	32.85					12.73					2.15				
128	0.76	92.13					49.27					9.28				

*Indicates maximum concentration for each averaging period.