F1304 C-MJV for B.C. Hydro

October 1978

Hat Creek Coal Beneficiation
INTERIM REPORTS

VOLUME IV

PRELIMINARY DESIGN AND COSTING:
MODULAR COAL WASHERY
BAUM WASHERY
TAILINGS DISPOSAL EQUIPMENT

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SIMON-CARVES

HAT CREEK
COAL BENEFICIATION

INTERIM REPORTS 1977-8

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PRELIMINARY DESIGN AND COSTING OF A MODULAR COAL WASHERY (HEAVY MEDIUM BATH AND WATER ONLY CYCLONES)

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PRELIMINARY DESIGN AND COSTING OF ALTERNATIVE EQUIPMENT FOR TAILINGS DISPOSAL

F1304 C-MJV for B.C. Hydro
Hat Creek - Modular Coal Washery

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VOLUME IV

PRELIMINARY DESIGN AND COSTING OF A MODULAR COAL WASHERY

SECTION

SECTION 1

SUMMARY

This Report is a Summary of work undertaken by Simon-Carves of Canada Ltd., between June and September 1977, to develop a Preliminary Design and Costing for a Coal Washing Plant to form part of the Hat Creek Mine and Thermal Generating Plant Complex.

The Basis of Design for a Modular Coal Washery has been prepared in such a manner that any proportions of the coarser or finer raw coals may be treated within the total context of the Mining and Product Blending Schemes. This design has been detailed sufficient to permit site planning and to give Order of Magnitude Costs for Coal Preparation. Thus the product yields and coal washing costs associated with alternative raw coal or product specifications may be calculated.

SECTION 2

INTRODUCTION

Previous mining studies, culminating in the PD-NCB Report No. 9, had appreciated the need for Coal Preparation due to the extreme variability and general low grade of the Hat Creek deposit. No costs data had, however, been provided in these studies, and thus the C-MJV Team realized that Preliminary Order of Magnitude Costs would be needed at an early stage in the Phase I Study.

Simon-Carves of Canada thus suggested the preparation of a Modular Design of Coal Washery such that basic decisions on possible alternative mine plans and boiler fuel specifications could be quantified. These decisions were co-ordinated in the study schedule with the intention of making the "First Washplant Decision" at the beginning of November 1977. This decision is essentially whether the mine complex needs coal beneficiation to upgrade raw coal to the Draft Boiler Fuels Specification.

Previous work on coal preparation was essentially limited to a report on Washability Analyses and Test Washes of three samples by Coal Science and Minerals Testing of Calgary. No attempt was made to interpret these results into a conceptual plant design or to show the relationship between product quality and yield.

SCAN have examined, with the aid of Computer Predictions:-

2.1 The capability of alternative coal preparation methods

- 2.1.1 Dense Medium Bath
- 2.1.2 Dense Medium Cyclones
- 2.1.3 Water Only Cyclones
- 2.1.4 Baum Jigs
- 2.1.5 Dry Cleaning
- 2.1.6 Fines Extraction and/or Blending.

From these individual methods practical combinations have been examined.

2.2 The practical quality/yield relationship, using a selected scheme of Dense Medium Bath and Water Only Cyclones and Fines Blending, such that the Mine Planning Engineers could relate R.O.M. Coal Qualities to Product Yields.

SECTION 2

INTRODUCTION

2.3 The costs of a Modular Coal Washery in accordance with the selected scheme as above.

Detailed examination has been limited to the three 1976 data sets. However, in preparing the Basis of Design, full account was taken of site and laboratory observations on current testwork, and observations contained in relevant sections of reports by J. Howard Griffiths and Integ-Ebasco.

In preparing this Modular Coal Washery design and Order of Magnitude costing SCAN have made maximum use, within the process requirements, of "in-house" information. The inclusion, for example, of DSM equipment should be seen, therefore as a matter of expediency, and does not represent a recommendation of this equipment.

FOOTNOTE: October 1978

During 1978 the basis of design was updated to take account of the Washability and Size Consist Data obtained as part of the 1977 Bulk Sample Programme. Since however, the final scheme presented by the Cominco-Monenco Joint Venture did not require a coal preparation plant, this Preliminary Design was not updated. The costs data was however reviewed to give schemes 1 (Total Washing) and 2 (Partial Washing) as set out in Simon-Carves' Final Report on "Hat Creek Coal Beneficiation".

SECTION 3

CONCLUSIONS

3.1 The Heavy Medium Bath appears to be the most practical process for the coarser coals, whilst the Water Only Cyclone has advantages for the finer sizes over other processes considered. This scheme is therefore the base case for coal preparation cost evaluation.

3.2 Considerations in other parts of the Study led to a final review on the basis of installing a 1200 TPH (3 x 400 TPH modules) scheme. This would be designed to suit A, B and C Zone coals.

3.3 Capital cost of these 3 modules for total washing is estimated at $25,922,926 and the operating costs at $4,585,080 per annum.

3.4 Capital cost of 3 modules equipped only for Partial Washing is estimated at $15,849,114 and the operating costs at $3,001,605 per annum.

SECTION 4

RAW COAL DATA

This section contains the washability data that was used in predicting the performance of various washing schemes. The 1976 Birtley Engineering report was the source of the float-sink analyses for raw coals of varying quality: type "A" represents the worst quality, type "B" the average, and type "C" the best quality.

Although this washability data was based on a raw coal sample crushed to minus 2", when, in fact, no crushing is to occur prior to washing, it was felt that variations in the size consist of the run of mine coal as well as mechanical degradation could give the raw coal feed to an actual washplant a similar size consist. Another reason for using the data based on the crushed sample was the fact that float-sink tests were performed on 8 individual size fractions giving a much more comprehensive analysis than that done on 4" x 0 samples, the data for which is also given in the Birtley Report.

SECTION 4

RAW COAL DATA

Birtley Engineering Raw Coal

Size Analysis - Type "A"

Size	% Weight (Dry Basis)	% Ash
2" x 1"	10.8	42.9
1" x 1/2"	15.5	45.1
1/2" x 1/4"	10.2	44.3
1/4" x 1/8"	13.2	47.9
1/8" x 28M	35.9	54.2
28M x 48M	6.9	64.9
48M x 100M	4.6	62.2
100M x 0	2.9	65.8

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 503
DATA SET NAME: HAT CREEK A 2x1

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	18.10	18.10	7.90	7.90
1.300 - 1.350	8.90	27.00	20.30	11.99
1.350 - 1.400	16.30	43.30	26.60	17.49
1.400 - 1.450	12.40	55.70	40.00	22.50
1.450 - 1.500	5.30	61.00	45.50	24.50
1.500 - 1.600	8.40	69.40	51.80	27.80
1.600 - 1.700	6.80	76.20	65.90	31.20
1.700 - 1.800	10.10	86.30	72.20	36.00
1.800 - 1.900	4.20	90.50	81.20	38.10
1.900 - 2.800	9.50	100.00	93.90	43.40

HEAD ASH OF WASHABILITY DATA = 43.40
(HEAD ASH OF BULK SAMPLE = 42.90)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 505
DATA SET NAME: HAT CREEK A 1x1/2

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	14.60	14.60	7.40	7.40
1.300 - 1.350	10.30	24.90	19.00	12.20
1.350 - 1.400	11.90	36.80	25.50	16.50
1.400 - 1.450	10.80	47.60	37.20	21.20
1.450 - 1.500	14.40	62.00	47.50	27.31
1.500 - 1.600	7.50	69.50	58.80	30.70
1.600 - 1.700	9.30	78.80	63.70	34.60
1.700 - 1.800	9.90	88.70	78.50	39.50
1.800 - 1.900	6.80	95.50	92.90	43.30
1.900 - 2.800	4.50	100.00	96.60	45.70

HEAD ASH OF WASHABILITY DATA = 45.70
(HEAD ASH OF BULK SAMPLE = 45.10)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 507
DATA SET NAME: HAT CRK A 1/2x1/4

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	17.10	17.10	8.20	8.20
1.300 - 1.350	7.10	24.20	17.10	10.81
1.350 - 1.400	13.20	37.40	27.50	16.70
1.400 - 1.450	7.60	45.00	35.00	19.79
1.450 - 1.500	1.20	46.20	39.40	20.30
1.500 - 1.600	16.90	63.10	46.80	27.40
1.600 - 1.700	7.40	70.50	61.70	31.00
1.700 - 1.800	8.60	79.10	62.30	34.40
1.800 - 1.900	10.30	89.40	74.30	39.00
1.900 - 2.800	10.60	100.00	92.80	44.70

HEAD ASH OF WASHABILITY DATA = 44.70
(HEAD ASH OF BULK SAMPLE = 44.30)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 509
DATA SET NAME: HAT CRK A 1/4x1/8

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	11.60	11.60	7.50	7.50
1.300 - 1.350	10.40	22.00	17.00	11.99
1.350 - 1.400	8.40	30.40	24.30	15.39
1.400 - 1.450	7.00	37.40	29.90	18.11
1.450 - 1.500	5.20	42.60	42.60	21.10
1.500 - 1.600	12.40	55.00	43.70	26.19
1.600 - 1.700	12.00	67.00	59.70	32.19
1.700 - 1.800	10.40	77.40	68.00	37.01
1.800 - 1.900	12.40	89.80	80.40	43.00
1.900 - 2.800	10.20	100.00	92.00	48.00

HEAD ASH OF WASHABILITY DATA = 48.00
(HEAD ASH OF BULK SAMPLE = 47.90)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 511
DATA SET NAME: HAT CRK A 1/8x28M

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	4.40	4.40	7.40	7.40
1.300 - 1.350	6.10	10.50	15.30	11.99
1.350 - 1.400	6.00	16.50	20.50	15.08
1.400 - 1.450	4.20	20.70	27.50	17.60
1.450 - 1.500	7.10	27.80	31.70	21.20
1.500 - 1.600	10.70	38.50	41.70	26.90
1.600 - 1.700	11.90	50.40	52.70	32.99
1.700 - 1.800	23.70	74.10	65.80	43.49
1.800 - 1.900	7.70	81.80	80.80	47.00
1.900 - 2.800	18.20	100.00	81.10	53.20

HEAD ASH OF WASHABILITY DATA = 53.20
(HEAD ASH OF BULK SAMPLE = 54.20)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 513
DATA SET NAME: HAT CRK A 28x100M

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.400	2.60	2.60	11.50	11.50
1.400 - 1.450	3.40	6.00	15.90	13.99
1.450 - 1.500	4.70	10.70	25.40	19.00
1.500 - 1.600	9.80	20.50	35.50	26.89
1.600 - 1.700	8.50	29.00	46.00	32.49
1.700 - 1.800	12.00	41.00	56.10	39.40
1.800 - 1.900	19.10	60.10	75.60	50.91
1.900 - 2.800	39.90	100.00	95.00	68.50

HEAD ASH OF WASHABILITY DATA = 68.50
(HEAD ASH OF BULK SAMPLE = 63.80)

SECTION 4

RAW COAL DESIGN

Birtley Engineering Raw Coal

Size Analysis - Type "B"

Size	% Weight (Dry Basis)	% Ash
2" x 1"	10.0	25.8
1" x 1/2"	14.6	30.0
1/2" x 1/4"	11.9	31.6
1/4" x 1/8"	18.5	32.9
1/8" x 28M	33.8	40.2
28M x 48M	5.2	50.2
48M x 100M	3.5	53.6
100M x 0	2.5	58.3

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 515
DATA SET NAME: HAT CREEK B 2x1

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	23.80	23.80	9.80	9.80
1.300 - 1.350	20.30	44.10	16.50	12.88
1.350 - 1.400	27.00	71.10	22.40	16.50
1.400 - 1.450	7.50	78.60	28.00	17.60
1.450 - 1.500	7.50	86.10	42.90	19.80
1.500 - 1.600	2.10	88.20	49.20	20.50
1.600 - 1.700	3.40	91.60	55.50	21.80
1.700 - 1.800	1.30	92.90	61.40	22.35
1.800 - 1.900	2.60	95.50	65.00	23.51
1.900 - 2.800	4.50	100.00	69.60	25.59

HEAD ASH OF WASHABILITY DATA = 25.59
(HEAD ASH OF BULK SAMPLE = 25.80)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 517
DATA SET NAME: HAT CREEK B 1x1/2

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	18.10	18.10	7.50	7.50
1.300 - 1.350	22.70	40.80	14.90	11.62
1.350 - 1.400	20.20	61.00	28.20	17.11
1.400 - 1.450	10.40	71.40	37.00	20.01
1.450 - 1.500	9.20	80.60	41.90	22.50
1.500 - 1.600	6.60	87.20	51.40	24.69
1.600 - 1.700	4.30	91.50	58.60	26.29
1.700 - 1.800	2.20	93.70	66.60	27.23
1.800 - 1.900	1.60	95.30	69.30	27.94
1.900 - 2.800	4.70	100.00	72.30	30.02

HEAD ASH OF WASHABILITY DATA = 30.02
(HEAD ASH OF BULK SAMPLE = 30.00)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 519
DATA SET NAME: HAT CRK B 1/2x1/4

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	16.40	16.40	7.50	7.50
1.300 - 1.350	23.10	39.50	15.70	12.30
1.350 - 1.400	18.50	58.00	24.00	16.03
1.400 - 1.450	8.40	66.40	33.00	18.18
1.450 - 1.500	6.80	73.20	40.60	20.26
1.500 - 1.600	7.60	80.80	50.50	23.10
1.600 - 1.700	4.40	85.20	56.90	24.85
1.700 - 1.800	6.10	91.30	63.50	27.43
1.800 - 1.900	4.30	95.60	70.00	29.35
1.900 - 2.800	4.40	100.00	74.30	31.32

HEAD ASH OF WASHABILITY DATA = 31.32
(HEAD ASH OF BULK SAMPLE = 31.60)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 521
DATA SET NAME: HAT CRK B 1/4x1/8

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	9.00	9.00	8.40	8.40
1.300 - 1.350	19.70	28.70	12.60	11.28
1.350 - 1.400	20.50	49.20	21.10	15.37
1.400 - 1.450	6.50	55.70	30.00	17.08
1.450 - 1.500	6.10	61.80	39.50	19.29
1.500 - 1.600	14.40	76.20	46.50	24.43
1.600 - 1.700	8.70	84.90	52.70	27.33
1.700 - 1.800	5.10	90.00	57.70	29.05
1.800 - 1.900	2.90	92.90	68.60	30.29
1.900 - 2.800	7.10	100.00	75.20	33.48

HEAD ASH OF WASHABILITY DATA = 33.48
(HEAD ASH OF BULK SAMPLE = 32.90)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 523
DATA SET NAME: HAT CRK B 1/8x28M

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	2.30	2.30	6.50	6.50
1.300 - 1.350	10.40	12.70	11.50	10.59
1.350 - 1.400	9.70	22.40	18.50	14.02
1.400 - 1.450	9.00	31.40	22.00	16.31
1.450 - 1.500	15.80	47.20	29.10	20.59
1.500 - 1.600	10.60	57.80	44.00	24.88
1.600 - 1.700	14.00	71.80	50.10	29.80
1.700 - 1.800	8.10	79.90	54.30	32.28
1.800 - 1.900	5.50	85.40	64.90	34.38
1.900 - 2.800	14.60	100.00	75.10	40.33

HEAD ASH OF WASHABILITY DATA = 40.33
(HEAD ASH OF BULK SAMPLE = 40.20)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 525
DATA SET NAME: HAT CRK B 28x100M

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.400	3.60	3.60	10.10	10.10
1.400 - 1.450	4.70	8.30	14.30	12.48
1.450 - 1.500	6.10	14.40	22.40	16.68
1.500 - 1.600	14.60	29.00	27.60	22.18
1.600 - 1.700	9.90	38.90	42.20	27.27
1.700 - 1.800	11.80	50.70	50.10	32.59
1.800 - 1.900	19.20	69.90	59.50	39.98
1.900 - 2.800	30.10	100.00	75.60	50.70

HEAD ASH OF WASHABILITY DATA = 50.70
(HEAD ASH OF BULK SAMPLE = 51.60)

SECTION 4

RAW COAL DESIGN

Birtley Engineering Raw Coal

Size Analysis - Type "C"

Size	% Weight (Dry Basis)	% Ash
2" x 1"	6.1	24.5
1" x 1/2"	10.2	22.3
1/2" x 1/4"	16.0	24.4
1/4" x 1/8"	14.0	26.0
1/8" x 28M	33.4	30.2
28M x 48M	8.7	37.5
48M x 100M	7.6	37.9
100M x 0	4.0	39.0

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 527
DATA SET NAME: HAT CREEK C 2x1

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	40.90	40.90	9.80	9.80
1.300 - 1.350	23.90	64.80	17.10	12.49
1.350 - 1.400	14.00	78.80	26.60	15.00
1.400 - 1.450	5.90	84.70	35.10	16.40
1.450 - 1.500	2.00	86.70	42.40	17.00
1.500 - 1.600	2.30	89.00	51.80	17.90
1.600 - 1.700	1.80	90.80	58.30	18.70
1.700 - 1.800	.80	91.60	64.50	19.10
1.800 - 1.900	1.00	92.60	74.70	19.70
1.900 - 2.800	7.40	100.00	78.30	24.04

HEAD ASH OF WASHABILITY DATA = 24.04
(HEAD ASH OF BULK SAMPLE = 24.50)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 537
DATA SET NAME: HAT CRK C 28x100M

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.350	11.70	11.70	8.60	8.60
1.350 - 1.400	15.00	26.70	14.10	11.69
1.400 - 1.450	16.20	42.90	22.60	15.81
1.450 - 1.500	12.60	55.50	32.10	19.51
1.500 - 1.600	13.40	68.90	42.60	24.00
1.600 - 1.700	8.90	77.80	52.00	27.20
1.700 - 1.800	7.30	85.10	63.30	30.30
1.800 - 1.900	7.80	92.90	68.40	33.50
1.900 - 2.800	7.10	100.00	78.30	36.68

HEAD ASH OF WASHABILITY DATA = 36.68
(HEAD ASH OF BULK SAMPLE = 37.70)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 535
DATA SET NAME: HAT CRK C 1/8x28M

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	21.70	21.70	6.10	6.10
1.300 - 1.350	20.80	42.50	13.70	9.82
1.350 - 1.400	14.10	56.60	18.20	11.91
1.400 - 1.450	3.60	60.20	28.60	12.91
1.450 - 1.500	10.80	71.00	37.90	16.71
1.500 - 1.600	4.20	75.20	48.90	18.51
1.600 - 1.700	4.20	79.40	58.20	20.61
1.700 - 1.800	7.60	87.00	64.30	24.42
1.800 - 1.900	4.00	91.00	69.90	26.42
1.900 - 2.800	9.00	100.00	76.70	30.95

HEAD ASH OF WASHABILITY DATA = 30.95
(HEAD ASH OF BULK SAMPLE = 30.20)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 533
DATA SET NAME: HAT CRK C 1/4x1/8

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	35.90	35.90	6.90	6.90
1.300 - 1.350	20.30	56.20	16.60	10.40
1.350 - 1.400	9.90	66.10	20.40	11.90
1.400 - 1.450	5.40	71.50	26.50	13.00
1.450 - 1.500	6.70	78.20	35.20	14.91
1.500 - 1.600	5.40	83.60	49.00	17.11
1.600 - 1.700	1.40	85.00	59.60	17.81
1.700 - 1.800	3.90	88.90	65.70	19.91
1.800 - 1.900	3.60	92.50	71.30	21.91
1.900 - 2.800	7.50	100.00	78.20	26.13

HEAD ASH OF WASHABILITY DATA = 26.13
(HEAD ASH OF BULK SAMPLE = 26.00)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 531
DATA SET NAME: HAT CRK C 1/2x1/4

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	41.70	41.70	7.90	7.90
1.300 - 1.350	21.70	63.40	16.40	10.81
1.350 - 1.400	7.80	71.20	26.30	12.51
1.400 - 1.450	8.40	79.60	34.30	14.81
1.450 - 1.500	4.00	83.60	42.00	16.11
1.500 - 1.600	2.10	85.70	48.70	16.91
1.600 - 1.700	2.20	87.90	56.90	17.91
1.700 - 1.800	2.80	90.70	63.30	19.31
1.800 - 1.900	2.80	93.50	72.70	20.91
1.900 - 2.800	6.50	100.00	78.20	24.63

HEAD ASH OF WASHABILITY DATA = 24.63
(HEAD ASH OF BULK SAMPLE = 24.40)

** S I M O N - C A R V E S O F C A N A D A **

DATA SET NUMBER: 529
DATA SET NAME: HAT CREEK C 1x1/2

GIVEN WASHABILITY DATA

S.G. FRACTION	FLOATS	CUM. FLOATS	ASH	CUM. ASH
0.000 - 1.300	47.70	47.70	8.70	8.70
1.300 - 1.350	16.30	64.00	13.80	10.00
1.350 - 1.400	11.10	75.10	26.90	12.50
1.400 - 1.450	9.10	84.20	34.70	14.90
1.450 - 1.500	2.00	86.20	40.80	15.50
1.500 - 1.600	2.80	89.00	50.50	16.60
1.600 - 1.700	1.90	90.90	54.90	17.40
1.700 - 1.800	3.10	94.00	59.90	18.80
1.800 - 1.900	.80	94.80	66.20	19.20
1.900 - 2.800	5.20	100.00	75.00	22.10

HEAD ASH OF WASHABILITY DATA = 22.10
(HEAD ASH OF BULK SAMPLE = 22.30)

SECTION 4

RAW COAL DATA

1977 Bulk Sample Programme Results

The design was reviewed on the basis of this testwork which was considered to give a more realistic "as mined" size consist. The feed to the plant is now considered on average to be:-

Effective Top Size	200 mm
Size(mm)	% by weight
+50	15
50 - 25	18
25 - 13	26
13 - 6	15
6 - 3	10
3 - 1.5	7
1.5 - 0.6	4
0.6 - 0	5

The proposed screening between coarse and fine coal fractions at 6mm and 13mm was therefore revised to 13mm and 25mm. Adjustments between these two separation sizes would permit maintenance of a balance of 50% each to the coarse and fine coal processing sections. The dense medium bath sections could readily cater for the increased ton per hour loadings by virtue of the increased mean particle size. There could be some reduction in the number of fine coal water only washing cyclones, but not such as to materially alter the scheme price.

The washability data for these samples is set out in Volume I "Washability Testwork of 1977 Bulk Samples".

The study of this data, together with the 1976 data summarized above, is set out in Volume II "Potential Application of Alternative Processes for the Beneficiation of Hat Creek Coals".

SECTION 5

BASIS OF DESIGN & OPERATING PHILOSOPHY

5.1 NOMINAL PLANT CAPACITY

The Mine Complex (including the Coal Washery) has been sized in accordance with the Parameters set out in Mr. O.L. DeLa Cuesta's memo File 1301.4-2 of July 11, 1977. This sets, for the maximum capacity factor period 1989-1998, product production requirements of:

(a) 10,894,000 MTPY at 5,500 BTU/lb
or (b) 10,119,000 MTPY at 5,900 BTU/lb
or (c) 9,272,000 MTPY at 6,300 BTU/lb.

(These values all assume a coal moisture content of 20%.)

For an initial estimate of Coal Washery Capacity we assumed that the worst raw coal quality over "a period" to be catered for would be 45% ash (dry basis). This would give yields, as summarized in our graph "Beneficiation Yields for Hat Creek Coals" - Revision (2) August 19, 1977 of the above qualities:-

		Equivalent Raw Coal Tonnage
(a)	82.6%	13,188,862 MTPY
(b)	72.3%	13,995,850 MTPY
(c)	64.2%	14,442,368 MTPY

Taking therefore case (c) and the operating hours as set out in the above document, we obtained the following requirement:

$$\frac{14,442,368}{350 \times 24} = 1719 \text{ MTPH}$$

A nominal capacity of 2000 MTPH was therefore selected which demands an availability of 86.0%.

SECTION 5

BASIS OF DESIGN & OPERATING PHILOSOPHY

5.2 MODULAR CONCEPT

The Modular Concept which we propose for large Coal Washeries envisages a number of similar design self-contained washing circuits with a minimum of common facilities. Usually these common facilities would be restricted to high availability items such as product conveyors, feed hoppers and the like, and items which would not cause the plant to be immediately shutdown. Stagewise development to any capacity is thus possible by placing modules side by side over a set of common lengthwise conveyors.

The modular design of Coal Preparation Plant embodies two concepts. From a design and construction viewpoint it is a philosophy which is equivalent to the proposed stagewise development of the Mine and Thermal Plant. As an operational philosophy it offers two advantages:-

(i) The achievement of high net availability. Since only relatively few items - principally feed and product conveyors - can put the whole facility out of operation, the typical "unit" availability of 75 to 80% can be increased to 85 to 90% overall. Moreover, this can be achieved simultaneously with a reduction in the amount of standby equipment.

(ii) The facility to treat different portions of the Run of Mine Coal at different operational settings if required, for example, to optimize yield or quality.

When the plant is to be operated on a 7-day week, 24 hours per day cycle, it is necessary to have a standby module so that production continues while maintenance is performed on a planned basis.

In developing a modular design of economic proportions, the total requirements are calculated as for one big plant - giving approximately 26 meters width of classifying screen, etc.
Larger standard sizes of items are then compared with these values to see which simple multiple will give the requirement. In this case, 9 and 10 looked useful, but only 5 of a few items appeared. We therefore selected 5 modules each comprised of a twin stream for most items.

The site layout is thus proposed for five operating and one standby module.

SECTION 5

BASIS OF DESIGN & OPERATING PHILOSOPHY

5.3 DESIGN CRITERIA

These were developed in detail from the data set out in Section 4. These factors include a very wide range of raw coal size consist: thus at the detail process design stage we would envisage the possibility of some savings, for example, a reduction in fine coal treatment capacity. However, these reductions would not substantially change the building/structural requirements.

As an illustration of the wide variations in load which are within the plant item capacities, we have included three Mass Balance Flowsheets showing a feed of 100 MTPH through a module operating in alternative "modes".

Total Washing of "A" Coal
Partial Washing (+1/4") of "B" Coal
Partial Washing (+1/2") of "C" Coal.

The design limiting criteria were in fact developed with somewhat wider variations:

5.3.1 Maximum Clean Coal Yield from any process section - a projection of raw coal data to 20% ash (dry basis), giving a yield of approximately 90%.

5.3.2 Minimum Clean Coal Yield from any process section - a projection of raw coal data to 55% ash (dry basis), giving a yield of approximately 45%. Variations could however be expected due to the higher discard content of the fine coal, and also for the coarser size fractions if partings are not segregated. A minimum yield of 40% was thus selected.

5.3.3 The very high fine clay content obtained by projection beyond the "A" coal sample was considered unrealistic. We therefore set a Maximum Tailings Yield of 5% of the Raw Coal Input.

SECTION 5

BASIS OF DESIGN & OPERATING PHILOSOPHY

5.3 DESIGN CRITERIA - cont.

It should be noted that the samples mined during recent weeks have shown a substantially increased proportion of coal in the 25 mm to 6 mm size fraction. The design has allowed for flexibility in this area, since the Water Only Washing Cyclones selected are capable of treating coal of 13 mm X 100 M size. Thus, in reviewing the screening and washing operations described in Section 6, it should be noted that the design has allowed for the stated 13 mm size to be between 13 mm and 25 mm and the 6 mm size to be between 6 mm and 13 mm in the event that a coarser raw coal is obtained.

5.4 REVISION FOR FINAL REPORT

This was based on the 1977 data as summarized on page 4.23. The study revealed that only coals from the A, B and C Zones could possibly warrant beneficiation, and thus the Final Report envisages 3 x 400 TPH modules, with a nominal utilization of 1000 TPH. This is reflected in the revised Mass Balance Diagrams included in this volume.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.1 OUTLINE OF MODULAR CONSTRUCTION

The plant will consist of a number of identical Modules each rated for a nominal 400 MTPH capacity. Each Module would be fed from the Raw Coal Handling System by a separate Raw Coal Feed Conveyor; thus each Module could be independently set to optimise the product yield from its particular raw coal feed. We currently envisage 5 Modules operating (= 2,000 MTPH ROM coal capacity) and have allowed for a sixth or standby Module to allow for maintenance.

The modules would be constructed to work with a common set of product conveyors:

Coarse Clean Coal Conveyor
Fine Clean Coal Conveyor
Fine Untreated Coal Conveyor
Discard Conveyor

The three coal product conveyors have been included for two reasons: firstly to facilitate separate product stockpiling if required and secondly to give flexibility in product blending without complicating the modular plant layout.

Each module would consist of:

Raw Coal Screening Section
Coarse Coal Washing Section
Fine Coal Washing Section
Thickener

The modular design has been conceived in such a manner that if Fine Coal Washing is not required then the plant could be constructed as a number of Raw Coal Screening + Coarse Coal Washing Sections working with a common Thickener. Or Fine Coal Washing Sections could be provided for only a selected number of Modules.

Alternative proposals are being investigated for treatment of the 13 mm x 0 raw coal. In this situation the Raw Coal Screening and Coarse Coal Washing Sections could remain unchanged and provide the feed to the alternative fine coal treatment.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.1 OUTLINE OF MODULAR CONSTRUCTION - cont.

The design as a series of independent modules facilitates the stagewise development of the plant, and will greatly simplify the initial commissioning and on-going operator training programme.

Please read this Description in Conjunction with our Drawings:

F1304-0001 Flowsheet for Coarse Coal H.M. Section (1 Module)
F1304-0002 Flowsheet for Fine Coal Section (1 Module)
F1304-1002 Washery Layout

The description is given for a single Module.

6.2 RAW COAL SCREENING SECTION

The Raw Coal, broken to below say 200 mm in the ROM Coal Breaker Stations, will be delivered at a steady rate not exceeding 400 MTPH to the Module.

The flow would be divided by a bi-furcated chute to two parallel streams. Raw Coal Sizing Screens will classify at 13 mm and 6 mm. The 6 mm x 0 Raw Coal will pass to Surge Hoppers. Automatic sampling facilities would deliver regular samples of 6 mm x 0 Raw Fine Coal to an Automatic Ash Monitor. From this ash measurement and the product yields, a computing system would determine the "mode" in which the module should be operating to meet current product blend requirements.

6.3 COARSE COAL WASHING SECTION

The feed to the Washing Units, 200 x 13 or 6 mm, will be passed over Wet Screens where sprays of Clarified Water will remove adhering fines which would otherwise contaminate the magnetite washing medium. (Space has been allowed for a -6 mm Raw Coal Dewatering Screen to recover these fines in the event that Fine Coal Modules are not installed).

The coal will be delivered from the Wet Screens into the LeeBar Dense Medium Baths. These baths will utilize a suspension of finely ground magnetite in water of carefully controlled density corresponding to the gravity separation required.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.3 COARSE COAL WASHING SECTION - cont.

The Clean Coal will float off, its removal being assisted by paddles, and delivered to Rinsing Screens fitted with heavy duty wedge wire panel sieves. The entrained magnetite medium will drain off in the first section, to be returned to the Bath via the Heavy Medium Cone.

The adhering medium will be removed by heavy spraying, firstly with Dilute Medium and then Clarified Water over the second or Rinsing section.

The third or Sizing Section of the Clean Coal Screen will deliver material less than 25 mm size to a Centrifuge for further dewatering, and material greater than 25 mm to a Crusher for reduction to below 25 mm. These products will be recombined on the Coarse Clean Coal Conveyor. This Conveyor will run the length of the Plant receiving products from all Modules.

The shale or rejects material which sinks to the base of the LeeBar Bath will be elevated out of the medium by an Extractor Chain Conveyor and delivered to a similar Discard Rinsing Screen. The Discard will be delivered to the Discard Conveyor which will run the length of the Plant to serve all Modules.

6.4 COARSE COAL WASHING LIQUID CIRCUITS

The Heavy Medium will be continually recirculated through the Baths via the Heavy Medium Cones and Pumps. The medium density will be monitored to control its gravity.

The Dilute Medium resulting from the product rinsing will be passed to a recovery circuit comprising a Settling Cone and two stages of Magnetic Separators. (The operating gravity in the bath is in the range 1.3 to 1.8 S.G. The magnetic separators give a recovered pulp of 2.2 to 2.6 S.G.).

Facilities for pump, pipeline and cone drainage within the magnetics circuit will be contained within a Reinforced Concrete Walled area, and Floor Sump and Pump would return contents to the working circuit to minimize magnetite losses.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.4 COARSE COAL WASHING LIQUID CIRCUITS - cont.

A similar Walled area and sump system will serve the non-magnetics sections of the plant and facilitate centrifuge effluent and other drainage recovery via the Raw Coal Dewatering Screen or Fine Coal Module.

Facilities have been included for a magnetite store, magnetite handling and medium preparation; a common system to service all Modules.

The Water Clafification facilities would be provided in conjunction with the Fine Coal Modules. In the event that Fine Coal Washing is not required, then one Thickener and its immediate equipment would service Five operational (+ standby) Large Coal Modules.

6.5 FINE COAL WASHING SECTION

The 6 mm - 0 Raw Coal will be fed at the required steady rate from the Surge Hoppers to the Classifying Cyclone Feed Cone where Clarified Water will be added under automatic control. The Raw Coal Slurry will be pumped in two parallel streams to a bank of Thirty-two Classifying Cyclones designed to remove the 100M x 0 material. This will be rejected as the cyclone overflow to the Tailings Thickener for disposal. The 6 mm x 100M material will be pumped in two parallel streams to a bank of Sixteen Primary Water Only Washing Cyclones and the partially cleaned overflow from this bank similarly to a bank of Sixteen Secondary Water Only Washing Cyclones.

The underflow from both sets of cyclones would be passed via a Dewatering Screen to the Discard Conveyor. (This will be a common conveyor with the Coarse Coal Section). The screen will retain only a portion of the 28 x 100M discard, the bulk of this fraction passing as tailings to the Thickener. The Fine Clean Coal Slurry (Secondary Washing Cyclone Overflow product) will be pumped to Thickening Cyclones to remove the bulk of the wash water and facilitate dewatering by means of Sieve Bend and Slurry Screens, effecting a partial classification at 28M, followed by conventional Basket Centrifuge (as in Coarse Coal Module) for the 6 mm x 28M and Screen Bowl Centrifuges for the 28M x 100M. These centrifuges will deliver product to the Fine Clean Coal Conveyor; a common conveyor running the length of the Plant.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.6 THICKENER

The washing circuit has already been described above. This circuit is completed by passing the Classifying Cyclones overflow and Discard Dewatering Screen Underflow to the Thickener where it will be dosed with Flocculating Reagents to provide a continuous recirculation of water for re-use.

This system is described in detail in Section 12 "Alternative Equipment for Tailings Disposal".

6.7 ALTERNATIVE OPERATIONAL "MODES"

The Automatic Ash Monitor within the Raw Coal Screening Section will be used to determine the "mode" in which the Module is to operate.

Reference to the Flowsheet and Washery Arrangement Drawing should be made to visualize the practical arrangement of automatically operated gates and overflow chutes by which this is achieved. The Conveyors will run the length of the Plant receiving products from all Modules.

There are fine "modes", the sequence for increasing ash content raw coal (and thus a greater degree of beneficiation requirement) being:

6.7.1 Coarse Coal Washing (+13mm)

Only the + 13 mm Raw Coal being passed to the Dense Medium Baths for washing. The Feeders at the base of the Raw Coal Surge Hoppers would be stopped, and all the 13 mm x 0 Raw Coal would overflow to the Untreated Fine Coal Conveyor.

6.7.2 Coarse Coal Washing (+6mm)

The + 13 mm and 13 x 6 mm Raw Coal being passed together to the Dense Medium Baths for washing. The Feeders at the base of the Raw Coal Surge Hoppers would be stopped, and thus the 6 mm x 0 Raw Coal would overflow to the Untreated Fine Coal Conveyor.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.7 ALTERNATIVE OPERATIONAL "MODES" - cont.

6.7.3 Partial Washing

The Coarse and Fine Coal Washing Sections would both be operating. The determined proportion of the 6 mm x 0 Raw Coal would be delivered from the Feeders at the base of the Surge Hopper to the Fine Coal (Classifying Cyclone) Feed Cone for washing. The remainder of the 6 mm x 0 Raw Coal would overflow to the Untreated Fine Coal Conveyor.

6.7.4 Total Washing

The Feeders at the base of the Surge Hopper would be operating at 100% thus passing all 6 mm x 0 Raw Coal to the Fine Coal Washing System.

6.7.5 Low Grade Coal Washing

The module would be set as in 6.7.1 above except that the 13 mm x 0 Raw Coal would be diverted to the Discard Conveyor. Thus Clean Coal would be recovered from the + 13 mm Raw Coal only. (All Raw Coals examined to date have shown better coal in the coarser size fractions, and higher discard contents in the finer size fractions. Thus with feeds of above say 50% ash content (dry basis), there would only be a worthwhile yield from the coarser size fractions).

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.2 DESCRIPTION OF RAW COAL SCREENING & COARSE COAL WASHING MODULE SECTIONS

6.2.3 Coarse Coal Module Liquid Circuits - cont.

Facilities have been included for a magnetite store, magnetite handling and medium preparation; a common system to service all Modules.

The Water Clarification facilities would be provided in conjunction with the Fine Coal Modules. In the event that Fine Coal Washing are not required then on Thickener and its immediate equipment would service Five operational (+ standby) Large Coal Modules.

6.2.4 Fine Coal Washing Module

The 6mm - 0 Raw Coal will be fed at the required steady rate from the Surge Hoppers to the Classifying Cyclone Feed Cone where Clarified Water will be added under automatic control. The Raw Coal Slurry will be pumped in two parallel streams to a bank of Thirty-two Classifying Cyclones designed to remove the 100M x 0 material. This will be rejected as the cyclone overflow to the Tailings Thickener for disposal. The 6mm x 100M material will be pumped in two parallel streams to a bank of Sixteen Primary Water Only Washing Cyclones and the partially cleaned overflow from this bank similarly to a bank of Sixteen Secondary Water Only Washing Cyclones.

The underflow from both sets of cyclones would be passed via a Dewatering Screen to the Discard Conveyor. (This will be a common conveyor with the Coarse Coal Section.) The screen will retain only a portion of the 28 x 100M discard, the bulk of this fraction passing as tailings to the Thickener. The Fine Clean Coal Slurry (Secondary Washing Cyclone Overflow product) will be pumped to Thickening Cyclones to remove the bulk of the washwater and facilitate dewatering by means of Sieve Bend and Slurry Screens, effecting a partial classification at 28M, followed by conventional Basket Centrifuge (as in Coarse Coal Module) for the 6mm x 28M and Screen Bowl Centrifuges for the 28M x 100M. These centrifuges will deliver product to the Fine Clean Coal Conveyor; a common conveyor running the length of the Plant.

SECTION 6

DESCRIPTION OF PROPOSED PLANT

6.2 DESCRIPTION OF RAW COAL SCREENING & COARSE COAL WASHING MODULE SECTIONS

6.2.5 Fine Coal Module Water Circuit

The washing circuit has already been described above. This circuit is completed by passing the Classifying Cyclones overflow and Discard Dewatering Screen Underflow to the Thickener where it will be dosed with Flocculating Reagents to provide a continuous recirculation of water for re-use. Note that a common Clarified Water Head Tank will supply the Coarse and Fine Coal Washing Sections.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.1 ONE SET per Raw Coal Screening Module as required.

7.1.2 ONE SET per Coarse Coal Washing Module as required.

7.1.3 ONE SET for the whole plant complex providing Ancilliaries for the Coarse Coal Washing Modules.

7.1.4 ONE SET per Fine Coal Washing Module as required.

7.1.5 ONE SET for each Fine Coal Washing Module, or if no fine coal washing modules are installed ONE SET to serve the total Coarse Coal facilities.

7.1.6 ONE SET for the whole plant complex providing Ancilliaries to the Fine Coal and Thickener Modules.

7.1.7 ONE SET of Miscellaneous Equipment to serve the whole plant complex.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.1 Raw Coal Screening Module

One set of each of the items listed below (4001 - 4021) would be required for each module.

ITEM	ITEM NUMBER(s)	QUANTITY
Head Chute for Raw Coal Feed Conveyor	4001	1
Bifurcated Chute to Raw Coal Sizing Screens	4002	1
Raw Coal Sizing Screens 8' x 16' AC Riplflo	4003 4004	2
Skirt Pls & Supports for Raw Coal Sizing Screens	4005 4006	2
Combined Discharge Chute & Gate for Raw Coal Sizing Screens to "Leebar" Baths	4007 4008	2
1/4" x 0 Surge Hoppers Under Raw Coal Sizing Screens	4009 4010	2
Drive Support for Raw Coal Sizing Screens	4011 4012	2
1/4" x 0 Overflow & 1/2" x 1/4" Bypass Chutes & Gate	4013 4014	2
Shut Off Gate for 1/4" x 0 Surge Hopper (Hand Operated)	4015 4016	2
Combined Discharge Chute from Surge Bin to Untreated Coal Conveyor	4021	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.2 Coarse Coal Washing Module

One set of each of the items listed below (4022 - 4109) would be required for each module.

ITEM	ITEM NUMBER(s)	QUANTITY
+ 1/4" Raw Coal Wet Screens 8' x 16' AC LH	4022 4023	2
Underpans for + 1/4" Raw Coal Wet Screens	4024 4025	2
Drive Support for + 1/4" Raw Coal Wet Screens	4026 4027	2
Discharge Chutes for + 1/4" Raw Coal Wet Screens	4028 4029	2
+ 1/4" Raw Coal "Leebar" H.M. Bath. Including Discard Extractor Chain & Clean Coal Paddle Wheels	4030 4031	2
Drive for Clean Coal Paddle Wheels (Chain Drive & Gear Box)	4032 4033	2
Drive for Discard Extractor Chain (Chain Drive & Gear Box)	4034 4035	2
"Leebar" Bath Clean Coal Discharge Chutes	4036 4037	2
Clean Coal Rinsing & Sizing Screens 8' x 20' AC LH	4038 4039	2

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.2 Coarse Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Underpans for Clean Coal Rinsing & Sizing Screens	4040 4041	2
Primary "Rainmaker" Sprays for Clean Coal Screens	4042 4043	2
Secondary "Rainmaker" Sprays for Clean Coal Screens	4044 4045	2
Drive & Spray Supports for Clean Coal Screens	4046 4047	2
Combined - 1" Clean Coal Chute to Centrifuge Incl. Bypass Chutes & Gates	4048	1
Tundish for + 1/4" Coal Centrifuge	4049	1
+ 1/4" Clean Coal Centrifuge Wemco 1100	4050	1
"Tell-Tale" Box for Clean Centrifuge	4051	1
Clean Coal Centrifuge Discharge Chute	4052	1
Combined + 1" Clean Coal Chute to Crusher	4053	1
Crusher Penn. TK2-24B	4054	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.2 Coarse Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Crusher Discharge Chute	4055	1
Bedplate for Crusher Drive	4056	1
"Leebar" Bath Discard Discharge Chutes	4057 4058	2
Discard Rinsing Screens 4' x 16' AC LH	4059 4060	2
Underpans for Discard Rinsing Screens	4061 4062	2
Primary "Rainmaker" Sprays for Discard Screens	4063 4064	2
Secondary "Rainmaker" Sprays for Discard Screens	4065 4066	2
Drive & Spray Supports for Discard Screens	4067 4068	2
Discard Screen Discharge Chutes	4069 4070	2
Sieve Boxes for "Leebar" Bath Drainage	4071 4072	2
Heavy Medium Cones	4073 4074	2
Heavy Medium Pumps Warman 6 x 4 EAH	4075 4076	2

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.2 Coarse Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Bedplates for Heavy Medium Pumps	4077 4078	2
Heavy Medium Distribution Boxes & Supports	4079 4080	2
Heavy Medium Splitter Boxes & Funnels	4081 4082	2
Dilute Medium Cone	4083	1
Dilute Medium Pumps Warman 6 x 4 EAH	4084 4085	2
Bedplates for Dilute Medium Pumps	4086 4087	2
Dilute Medium Distribution Boxes & Supports	4088 4089	2
Settling Cones & Curtains 10' - 0" Dia	4090 4091	2
Primary Magnetic Separator Eriez 36" Ø x 96"	4092	1
Concentrates Launder for Primary Magnetic Separator	4093	1
Underflow Collecting Box for Primary Magnetic Separator	4094	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATION

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.2 Coarse Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Spray Water Head Boxes	4095 4096	2
Secondary Magnetic Separator Eriez 36" Ø x 48"	4097	1
Concentrates Launder for Secondary Magnetic Separator	4098	1
Underflow Collecting Box for Secondary Magnetic Separator	4099	1
Combined Underflow Launder from Raw Coal Wet Screens	4100	1
Sieve Bend for Raw Coal Wet Screen Underflow	4101	1
- 1/4" Raw Coal Dewatering Screen 4' x 12' AC LH	4102	1
Underpan for - 1/4" Raw Coal Dewatering Screen	4103	1
Drive Support for - 1/4" Raw Coal Dewatering Screen	4104	1
Discharge Chute for - 1/4" Raw Coal Dewatering Screen	4105	1
Magnetite Floor Sump Pump Warman 4" x 3" CAM	4106	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.2 Coarse Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Bedplate for Magnetite Floor Sump Pump	4107	1
Skirt Plates for Large Clean Coal Conveyor (55'-0" Lgth)	4108	1
Skirt Plates for Discard Conveyor (55'-0" Lgth)	4109	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.3 Ancillaries for Coarse Coal Module

One set of the equipment as listed below (4144-4161) would provide common services to the Coarse Coal Washing Modules.

ITEM	ITEM NUMBER(s)	QUANTITY
Magnet for Raw Magnetite	4144	1
Electric Hoist for Magnet	4145	1
Trolley for Magnet	4146	1
Feed Hopper to Raw Magnetite Mixing Tank	4147	1
Discharge Chute for Raw Magnetite Feed Hopper	4148	1
Magnetite Mixing Tank	4149	1
Prepared Medium Cone	4150	1
Prepared Medium Pumps Warman 6 x 4 Dam.	4151 - 4153	3
Bedplates for Prepared Medium Pumps	4154 - 4156	3
Prepared Medium Splitter Box	4157	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.3 Ancillaries for Coarse Coal Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Prepared Medium Distribution Box & Funnels	4158	1
Agitation/Instrument Compressor	4159	1
Instrument Air Dryer	4160	1
Elevator	4161	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.4 Fine Coal Washing Module

One set of all the items listed below (4201 - 4379) will comprise one Fine Coal Washing Module.

ITEM	ITEM NUMBER(s)	QUANTITY
Skirt Plates for 1/4" x 0 Raw Coal Feeders	4201 4202	2
1/4" x 0 Raw Coal Feeders 36" x 72" LG.	4203 4204	2
Support for 1/4" x 0 Raw Coal Feeders	4205 4206	2
Combined Chute & Launder from Feeders to Classifying Cyclone Feed Cone	4207	1
Classifying Cyclone Feed Cone	4208	1
Classifying Cyclone Feed Pumps Warman 8 x 6 EAM	4209 - 4212	4
Bedplates for Classifying Cyclone Feed Pumps	4213 4214	2
Classifying Cyclones DSM 14" Dia. 20°	4215 - 4246	32
Support for Classifying Cyclones	4247	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.4 Fine Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Overflow Launder for Classifying Cyclones	4248	1
Underflow Launders for Classifying Cyclones	4249	1
Primary Water Only Washing Cyclone Feed Cone	4250	1
Primary Water Only Washing Cyclone Feed Pumps Warman 8 x 6 EAM	4251 - 4254	4
Bedplates for Primary W.O. Washing Cyclone Feed Pumps	4255 4256	2
Primary W.O. Washing Cyclones D.S.M. 14" Dia. 75^{0}	4257 - 4272	16
Support for Primary W.O. Washing Cyclones	4273	1
Overflow Launder for Primary W.O. Washing Cyclones	4274	1
Underflow Launders for Primary W.O. Washing Cyclones	4275	1
Secondary W.O. Washing Cyclone Feed Cone	4276	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.4 Fine Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Supports for Thickening Cyclones	4344 4345	2
Overflow Launders for Thickening Cyclones	4346 4347	2
Underflow Launders for Thickening Cyclones	4348 4349	2
-1/4" Clean Coal Sieve Bend	4350 4351	2
-1/4" Clean Coal Dewatering Screen 6' x 12' ACLH	4352 4353	2
Underpans for -1/4" Clean Coal Dewatering Screen	4354 4355	2
Drive Support for -1/4" Clean Coal Dewatering Screen	4356 4357	2
Combined chute from -1/4" c.c. Dewatering Screen to Centrifuge Inc. Bypass Chute & Gate	4358	1
Tundish for 1/4"-28m Clean Coal Centrifuge	4359	1
1/4"-28m Clean Coal Centrifuge Wemco 1100	4360	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.4 Fine Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
"Tell-Tale" Box for 1/4"-28m Clean Coal Centrifuge	4361	1
Discharge Chute for 1/4"-28m Clean Coal Centrifuge	4362	1
-28m Buffer Tank	4363	1
-28m Screen Bowl Centrifuges Bird 36x72 Continuous	4364 4365	2
Solids Discharge Chute for -28m Screen Bowl Centrifuges	4366 4367	2
Effluent Underpan for S.B. Centrifuge	4368 4369	2
Screen Section Effluent Underpan for S.B. Centrifuges	4370 4371	2
-1/4' Discard Sieve Bend	4372	1
-1/4' Discard Dewatering Screen 8' x 16' ACLH	4373	1
Underpan for -1/4" Discard Dewatering Screen	4374	1
Drive Support for -1/4" Discard Dewatering Screen	4375	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.4 Fine Coal Washing Module - cont.

ITEM	ITEM NUMBER(s)	QUANTITY
Tailings Pump to Thickener Warman 6 x 4 DAM	4376	1
Bedplate for Tailings Pump to Thickener	4377	1
S.B. Centrifuge Effluent Cone	4378	1
S.B. Centrifuge Effluent Pump Warman 3 x 2 CAH	4379	1
Bedplate for S.B. Centrifuge Effluent Pump	4380	1
Class & Thick.Cyclone Overflow Collecting Box & Support	4381	1
Skirt Plates for Fines Clean Coal Conveyor (55'-0" Lgth)	4382	1
Skirt Plates for Untreated Raw Coal Conveyor (55'-0" Lgth)	4383	1
Roof Fan	4384	1
Plant Heater	4385	1
Clarified Water Pump Warman 8 x 6 EAM	4386	1
Bedplate for Clarified Water Pump	4387	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.5 Thickener Module

One set of all the items listed below (4111 - 4124) will be used in conjunction with each Fine Coal Washing Module.

ITEM	ITEM NUMBER(s)	QUANTITY
Tailings Thickener 100'-0" Dia	4111	1
Launder to Tailings Thickener	4112	1
Thickener Tailings Underflow Pumps Warman 4 x 3 CAM	4113 4114	2
Bedplate for Thickener Tailings Underflow Pumps	4115 4116	2
Thickener Tunnel Sump Pump Warman 3 x 3 x 11 WPSC	4117	1
Bedplate for Thickener Tunnel Sump Pump	4118	1
Clarified Water Sump	4119	1
Clarified Water Pumps Warman 8 x 6 EAM	4120 - 4123	4
Bedplates for Clarified Water Pumps	4124 4127	4
Clarified Water Head Tank	4128	1

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.1 PROPRIETARY EQUIPMENT SCHEDULE

7.1.6 Thickener Module Ancillaries

See accompanying report "Alternative Equipment for Tailings Disposal".

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.1 Plate Specification

Plate and structural steel will be new and will be in accordance with CSA G4012, ASTM A7 or ASTM A36. Wear plate material will be T1 type A-360 or equal. All bolts and nuts will be in accordance with ASTM A307 or ASTM A36. Bolts will be regular semi-finished hexagon series with heavy semi-finished hexagon series nuts, both conforming to ANSI B18.2.

Arc welding design and practice will conform to the CSA Standard W59.1. The fabricator will be fully approved by the Canadian Welding Bureau in accordance with CSA Standard W47.

All dimensions given on the drawings will be in metric.

The dimensions of the tanks and launders will be within ± 3 mm.

Welds will be continuous, full strength and watertight except the stiffener bars on covers and access doors which may have intermittent welds 50 mm every 100 mm on each side of the bar.

Joints in chutes, boxes and launders flanges will use "EXPANDITE" or approved equal. Access doors will be sealed on left rubber gaskets 6 mm thick by 25 mm wide bonded to the chute or launder. The fabricator will supply the gaskets, bond them to the chutes or launders and fully assembly the access doors.

All wear plates will be plug welded into position of the platework by using intermittent 25 mm holes welded watertight. Internally intermittent welding 25 mm every 100 mm at wear plate joints and wear plate/casing joints.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.1 Plate Specification - cont.

Generally the platework will be fully shop assembled with all bolts fitted and tightened. Exceptions will only be shipping limitations and in this case, jointing and all bolts etc., will be supplied in a container preferably fastened to the platework sections.

All exterior platework surfaces will be painted except for mating flanged faces.

All sharp edges, burrs, etc., will be ground smooth prior to painting. The faces of all flanges will be smooth and flat. All exterior surfaces will be power brushed to remove rust and mill scale and washed with mineral spirits to remove any oil and grease.

One coat of zinc chromate primer, followed when thoroughly dry by one coat of machinery enamel with a total minimum paint thickness of two mils.

All fabricated platework, either wholly assembled or in sections, will be painted in 50 mm high letters with the applicable item number, prior to shipping.

Cones

Cones will have a minimum of 8 mm thick walls on the vertical sides and 10 mm thick walls on the conical section (13 mm thick walls for H.M. cones). The cones will be stiffened externally both vertically and peripherally where necessary to withstand all the imposed loads. The cones will be free standing on the base of the conical section at a minimum dia. of 1.0 m with a baseplate 25 mm thick. The baseplate to connect to the concrete base by cast-in bolts.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.1 Plate Specification

Cones - cont.

Where suction pipes enter the cones, a 19 mm thick plate will surround the pipe for a minimum distance of 305 mm from the outer diameter of the suction pipe. The suction pipe to extend a minimum of 38 mm into the cone past the 19 mm thick wearplate.

The overflow pipe will be 305 mm diameter for all cones.

All cones will be covered by floor grating to prevent tramp material entering the cones, at approximately the overflow level.

Heavy Medium Launders

Mixing tanks/launders will be constructed of 13 mm thick plate with no wearplates. Splash plates 5 mm thick.

All incoming and outgoing pipe inserts will be X-Strong and to extend 38 mm into the mixing tank. The flanged pipe stubs will be of sufficient length to enable bolting up to be relatively easy.

Underpans

Underpans will not be fitted with wearplates. The heavy medium section of any underpan will be fabricated from 13 mm plate. All other underpans to be fabricated from 10 mm thick plate.

All pipe inserts will be X-Strong for H.M., Schedule 80 for all others and to extend into the underpans 38 mm. The flanged pipe stubs to extend out of the underpans a sufficient length for bolting.

External bottom stiffeners will be required at approximately 1.0 m intervals.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.1 Plate Specification

Head Boxes

All head and splitter boxes containing heavy medium will be fabricated from 13 mm thick palte.

Flocculant head box will be fabricated from 6 mm thick plate.

All other head boxes will be fabricated from 10 mm thick plate.

Box cover plates will be 6 mm thick, except where feed pipes enter directly under, where plate thickness of the box is used. All cover plates will be bolted by external flange, with the bolts suitably pitched to prevent leakage.

Stiffening flats will be required where necessary.

All slats or doors in the box weirs will be 13 mm thick, slat depths to range from 13 mm, 25 mm and 50 mm for underpans and to project into each box for 38 mm and out of the box a suitable distance for bolting. All pipe stubs will be flanged.

Launders (Excluding Thickener Launder)

All launders will be fabricated from 6 mm plate and be equipped with abrasion resistant wearplate on wearing surfaces of 6 mm thickness.

Launders will not be fitted with cover plates except at change direction points or places where splash is anticipated.

Stiffening flats welded on the inside approximately 25 mm down from the top edge for the full length will be required, and should splash occur, loose cover plates can be located on them.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.1 Plate Specification

Thickener Launder

The launder will be fabricated from 6 mm plate and requires no wearplates.

Rest of specification as LAUNDERS.

Chutes

All chutes will be fabricated from 6 mm plate and be equipped with 6 mm thick abrasion resistant wearplates on all wearing surfaces.

Where access or inspection covers will be necessary, these are to be equipped with either hinged doors or quick release locating pins.

Surge Bins

Surge bins will be constructed from 13 mm plate suitable stiffened, complete with 6 mm stiffened cover plate.

Flanges

All flanges will be as for piping specification.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.2 Pipework Specifications

Simon-Carves of Canada Ltd. have developed standards for Coal Washery Pipework to suit the specialized requirements of handling abrasive media, coal slurries, etc. These would be fully detailed at an appropriate stage in a submission. They are developed from the ANSI B31.1 "Standards Code for Pressure Piping - Power Piping", and require installation by welders qualified in accordance with Section IX of the ASME "Boiler & Pressure Vessel Code".

The particular requirements call for features such as long radius bends and thick walls to allow for erosion, facility for dismantling due to pipe plugging, and design of lines sloped for gravity drainage allowing for the pipeline contents.

The Simon-Carves of Canada Ltd. Specifications are:

'A' Heavy Slurries, e.g. Magnetite Medium, 6 mm X 0 Fine Coal Suspensions and Tailings

'B' Light Slurries, e.g. Dilute Medium, 0.5 mm X 0 Fine Coal Suspensions, Slurry Cone Overflows and Drainage

'C' "Water", e.g. Effluent, Clarified Water, Floor Flushings, Flocculation and other reagent solutions

'D' Instrumentation Air

'E' Floor Drains

'F' Magnetic Separator Effluents

Pipework Supports standards, in addition to conforming with general standards and those mentioned for pipework above, make particular allowance for the additional loads placed by heavy slurries, and for support design to allow for the dismantling of pipework to clear plugging. Structural Attachments conform to CSA W59.1 and CSA W47.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.2 MECHANICAL ENGINEERING

7.2.3 Valves

Main pump suction valves will be cast iron, gear operated plug valves of Dezurik or equal supply.

Other shut-off, throttling and drain valves will be wrench operated, cast iron plug cocks of the Rockwell type.

Small bore valves for compressed air and fresh water will be handwheel operated, cast iron, diaphragm valves of the Saunders type, with screwed ends.

Automatic control valves will be cast steel, wafer type knife gate valves with pneumatic operators of Dezurik or equal supply. Valves on slurry applications will have ni-hard deflector cones.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.3 ELECTRICAL ENGINEERING

A complete electrical system will be provided for the preparation plant complex, including all power, control, lighting and grounding. The design will meet or exceed the requirements of CSA, CEMA and all provincial authorities having jurisdiction.

7.3.1 Incoming Supplies

Two main incoming 12.47 kV overhead feeders will be provided by others to terminal poles in the vicinity of the washery. From that point we will provide underground cables to the washery electrical rooms.

Each main incoming feeder will be capable of feeding the entire preparation plant complex.

7.3.2 Transformer Primary Protection

Primary protection of power distribution transformers at the washery will consist of fusible load-break disconnect switches arranged in suitable indoor metal-enclosed switchgear assemblies, with interlocking as necessary to prevent parallelling of incoming supplies.

7.3.3 Power Distribution Transformers

Power distribution transformers will be three phase, outdoor, oil-filled, sealed, epoxy painted, 65^{o} C rise, ONAN with provision for future addition of fans for ONAF rating. Transformers for 600 volt motor control centres will be 12,470 - 600 volts with secondary bus duct. Transformer neutrals will be grounded via integral resistors to limit ground fault current to a value less than 25 amps.

7.3.4 Motor Control Centres

Motor control centres will be 600 volts, CEMA 12 construction, CEMA 1B wiring, including full voltage starters with fusible disconnect switches. Each motor control centre will be protected by a main incoming circuit breaker with adjustable trips. Ground fault detection will be provided for each vertical section of each motor control centre.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.3. ELECTRICAL ENGINEERING

7.3.5 Essential Services

Systems which cannot be allowed to remain inoperative during a prolonged power outage will be fed from a separate "essential services" motor control centre. These systems include:

- thickener drives
- thickener tunnel sump pumps
- instrumentation
- air compressors
- washery heating units
- heating fuel pumps
- coal and discard loadout gates
- selected lighting

The "essential services" motor control centre will be fed from two sources, i.e., the normal distribution system and a 500 kw, 575 volts standby diesel-generator set located adjacent to the washery electrical rooms. The diesel-generator set will start automatically upon loss of incoming power, after a time delay, and the motor control centre will be equipped with an automatic transfer feature on the incoming curcuit-breakers.

7.3.6 Motors

Motors will be TEFC (wet process areas) and explosion-proof (dry process and below-grade areas). Voltages will be:

- fractional HP	115 volts, 1 ph
- 1 HP through 250 HP	575 volts, 3 ph
- 300 HP and up	4,000 volts, 3 ph

7.3.7 Cables

Cables will be stranded copper, multi-conductor Teck-type with a flame-retardant PVC jacket, installed in galvanized steel or aluminum cable trays.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.3 ELECTRICAL ENGINEERING

7.3.8 Lighting

Lighting fixtures generally will be vapour-tight type with mercury vapour lamps. Flourescent fixtures will be provided in enclosed rooms and explosion-proof enclosures will be provided in "dry coal" and below-grade areas.

Intensities will be:

- production areas	30 FC maintained
- offices	100 FC maintained
- electrical rooms	50 FC maintained

Battery-operated emergency lighting will be provided at stairways, doors and electrical rooms.

Outdoor lighting will be by means of mercury vapour or high pressure sodium floodlights with photo-cell controls.

7.3.9 Grounding

A complete grounding system will be provided for all metal structures and electrical equipment.

7.3.10 Process Controls

The main washery control desk will include switching, indication, instrumentation and annunciation for remote operation and control of the processing plant. Sequencing will be provided to ensure that a logical start-up and shutdown procedure is followed and to safeguard equipment and personnel against unsafe operating conditions. A mimic diagram will be provided showing the status of all major drives throughout the complex.

A programmable logic control system will be provided. This will accomplish the required control, sequencing and indication function with a minimum of long runs of multi-conductor cable.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.3 ELECTRICAL ENGINEERING

7.3.11 Communication Systems

A public address system, with facilities for semi-private conversation, will give full audible coverage throughout the preparation plant complex. Microphone handsets will be strategically located in all areas.

The communication system will also incorporate a process startup alarm which will be broadcast in the appropriate areas immediately prior to remote startup of equipment.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.4 INSTRUMENTATION & CONTROL

The three main process variables being controlled in the washery are liquid level, medium specific gravity, and coal ash. In addition thickener torque is being measured and recorded.

7.4.1 Liquid Level

Liquid levels are measured with a hydrostatic head type transmitter and controlled with either a cyclinder actuated splitter box and funnel assembly on medium services or a control valve on water service.

7.4.2 Specific Gravity

Specific gravities are measured with a nuclear type specific gravity transmitter. Control is achieved with a cylinder actuated splitter box and funnel assembly. The specific gravities are also recorded.

7.4.3 Coal Ash

Coal ash concentration of raw coal is continuously analyzed. The surge hopper feeders and coal chute gates are each controlled to maintain desired optimum ash concentrations.

Most control equipment will be pneumatic. Electronic signals from measuring instruments will be converted to pneumatic for operation of the controller and most final control elements. All recorders and controller will be of the 3 x 6 or 6 x 6 minature type and mounted on the control panel.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.5 STRUCTURAL & CIVIL DESIGN CRITERIA

7.5.5 Applied Loads

7.5.5 1) Vertical Load - Live

a) Snow = 35 x 0.8 - 30 lb/sq.ft.

Basic value to be increased for drifting to requirements of National Building Code Supplement No.4, Commentary H.

b) Floor, inclusive of access ways and stairs - 125 lb/sq.ft.

As a minimum condition, individual floor members only shall be designed for a single concentrated load of 2,000 lb., excluding the above uniform distribution.

c) Service Allowance - 15 lb/sq.ft.

To be applied to all structural members supporting floors and roofs.

d) Equipment and machine loadings shall be additive to those designated above. Design must conform to requirement of Article 7.10 of CSA Standard S16, i.e. special provision shall be made for effects of impact and/or vibratory loading.

7.5.5 2) Vertical Load - Dead

a) Roof system (complete with deck, insulation and roofing) - 10 lb/sq.ft.

b) Floor system (mechanical-lock deck under concrete topping) - 70 lb/sq.ft.

SECTION 7

OUTLINE ENGINEERING SPECIFICATIONS

7.6 PLANT HEATING AND VENTILATING UNITS

7.6.2 Basis of Design

a) Minimum ambient temperature - 25°C (minus 14°F)

b) Interior design temperature:

24°C (75°F) offices, lunchroom

27°C (80°F) washrooms, shower areas

21°C (70°F) electrical rooms, control rooms

15°C (60°F) flocculant store, tailing pumphouse

7.6.3 Air Changes per hour

Summer	Winter	Location
8	4	Offices
15	10	Lunchroom, Washrooms Shower Areas
10	5	Control Rooms
15	3 Fresh 12 Recir.	Electrical Rooms
4	2	Flocculant Store, Tailing Pumphouse Washery

SECTION 8

CAPITAL COST ESTIMATE

8.1 The "Order of Magnitude" estimate on labour and material for the coal washery has been broken down as shown in the enclosed estimate summary on a modular basis. This has been done to facilitate the analysis of costs for alternate schemes at a later date.

The following items are not included in the pricing shown:-

- Land Purchase
- Site Clearing
- Rough Grading
- Rail Tracks
- Roads
- Main Power Supply
- Potable and Process Water Supply
- Construction Camp
- General Workshops and Stores Facilities
- General Offices
- Plant Laboratory
- Sewage/Effluent Treatment
- Tailings Ponds

In addition, the following factors have not been taken into consideration:-

- Contingencies
- Escalation
- Allowance for Winter Work
- Premium Time
- Inspection and Testing
- Contract Indirects

SECTION 8

CAPITAL COST ESTIMATE

8.2 Head Office/Construction Management/Plant Commissioning manhour estimate.

COST CODE	DESCRIPTION	MANHOURS
100	Executive	1,000
110	Project	6,600
111	Civil/Structural	5,000
112	Mechanical	5,000
113	Electrical	1,500
114	Instrument	500
115	Process	3,000
144	Estimating	500
	ENGINEERING CATEGORY SUB-TOTAL	23,100
120	Management Services	4,000
121	Mechanical	30,300
124	Civil/Structural	10,800
127	Electrical	7,000
	DRAWING OFFICE CATEGORY SUB-TOTAL	52,100

SECTION 8

CAPITAL COST ESTIMATE

8.2 - cont.

COST CODE	DESCRIPTION	MANHOURS
130	Purchasing	3,800
131	Expediting	1,800
141	Accounts	1,400
142	Cost Control	3,300
143	Scheduling	1,300
145	Secretarial	7,400
	INDIRECT CATEGORY SUB-TOTAL	19,000
200	Management	13,600
203	Superintendent	6,200
240	Administration	6,800
250	Commissioning	8,400
	SITE CATEGORY SUB-TOTAL	35,000

SECTION 8

CAPITAL COST ESTIMATE

8.3 Engineering/Construction budget cost summary.

8.3.1	Head Office		$ 2,659,000
8.3.2	Site/Commissioning	- refer note (a)	1,365,000
8.3.3	Design fees	- refer note (b)	1,087,000
8.3.4	Disbursements	- refer note (c)	600,000
	PROJECT TOTAL	- refer note (d)	$ 5,711,000

Cost Estimation Criteria

a) Basis for evaluation premised upon construction/commissioning activities preceeding, on a continuing basis through completion, during an overall three-year period.

b) Costs inclusive of SCAN design fee and DSM license fee approximimating $800,000/$287,000, respectively.

c) Normally included under such a miscellaneous item are travel/living expense, reproduction/communication costs, et al, with suggested total value as above divided equally as between head and on-site offices.

d) Total estimated cost shall not be construed other than for use on an "order-of-magnitude" basis in terms of mid-1977 Canadian dollars. Further, direct comparison with included prime cost estimate is clearly precluded at this stage, since such costing excludes certain additive cost factors - i.e. related to contingency, escalation, winter-works, premium time, contractor's indirect charges.

e) In event it is desired to arbritrarily apportion engineering/construction costing to each of the six individual modules, the following allocation is recommended as such an approximation -

1.	Primary End Module	$1,713,300
2.	Primary Interior Module	1,142,200
3.	Succeeding Modules - (total value to be divided equally).	2,855,500

ESTIMATE SUMMARY

SIMON-CARVES OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: LARGE COAL END MODULE

PROJECT NO.: F1304

SHEET 1 OF 12

EST'D DATE

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		538,530		373,610		912,140
	Equipment and Platework	787,985	313,650	43,010	170,723		1,315,368
	Electrical	113,334	139,972		172,000		425,306
	Instrumentation	48,436	5,000	2,132	15,960		71,530
	Piping and Valves		157,850		129,150		287,000
		949,755	1,155,000	45,142	861,443		3,011,340

ESTIMATE SUMMARY

SIMON [illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: LARGE COAL INTERIOR MODULE
PROJECT NO.: F1304
SHEET 2 OF 12
EST'D
DATE

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		446,010		303,120		749,130
	Equipment and Platework	787,985	313,650	43,010	170,723		1,315,368
	Electrical	113,334	139,972		172,000		425,306
	Instrumentation	48,436	5,000	2,132	15,960		71,530
	Piping and Valves		157,850		129,150		287,000
		949,755	1,062,482	45,142	790,953		2,848,334

ESTIMATE SUMMARY

SIMON-[illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: THICKENER

PROJECT NO.: F1304

SHEET 3 OF 12

EST'D

DATE

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		262,720		290,060		552,780
	Equipment	125,545	10,960	4,165	16,760		157,430
	Instrumentation	1,638		65	-		1,703
		127,183	273,680	4,230	306,820		711,913

ESTIMATE SUMMARY

SIMON [illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: COMBINED LARGE AND FINES END MODULE
PROJECT NO.: F1304
SHEET 4 OF 12
EST'D
DATE

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		713,535		477,920		1,191,455
	Equipment and Platework	1,511,415	513,320	76,640	304,168		2,405,543
	Electrical	190,910	186,209		256,190		633,306
	Instrumentation	59,244	5,000	2,557	19,920		86,723
	Piping and Valves		253,230		207,190		460,420
		1,761,569	1,671,294	79,197	1,265,388		4,777,447

ESTIMATE SUMMARY

SIMON-[illegible] OF CANADA LTD.
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: COMBINED LARGE AND FINES INTERIOR MODULE

PROJECT NO.: F1304

SHEET 5 OF 12

EST'D DATE

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		569,490		375,230		944,720
	Equipment and Platework	1,511,415	513,320	76,640	304,168		2,405,543
	Electrical	190,910	186,209		256,190		633,306
	Instrumentation	59,244	5,000	2,557	19,920		86,723
	Piping and Valves		253,230		207,190		460,420
		1,761,569	1,527,249	79,197	1,162,698		4,530,712

ESTIMATE SUMMARY

Simon [illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: SUMMARY OF COMMON ITEMS

PROJECT NO.: F1304

SHEET 6 OF 12

EST'D

DATE

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Flocculant Mix House	18,360	44,370	1,220	30,295		94,245
	Pumphouse	24,056	31,815	750	45,035		101,656
	Elevator Bay		14,895		24,040	60,000	98,935
	Underground Ductwork		6,080		20,270		26,350
	Service Bay		43,735		65,615		109,350
	Common Services	201,195	121,754		227,035		549,984
		243,611	262,649	1,970	412,290	60,000	980,520

ESTIMATE SUMMARY

SIMON [illegible] CANADA LTD
2021 Clearwood Avenue East
Willowdale, Ontario M2J 3W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: FLOCCULANT MIXER HOUSE COMMON

PROJECT NO.: F1304

SHEET 7 OF 12

EST'D DATE

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		32,250		29,120		61,370
	Equipment	18,360	12,120	1,220	1,175		32,875
		18,360	44,370	1,220	30,295		94,245

ESTIMATE SUMMARY	CLIENT	DESCRIPTION	PROJECT NO.
SIMON [illegible] OF CANADA LTD 2025 [illegible] Avenue East [illegible], Ontario M2J 1W2	C-MJV for B.C. HYDRO PROJECT HAT CREEK - MODULAR COAL WASHERY LOCATION	ELEVATOR BAY COMMON	F1304 SHEET 8 OF 12

EST'D DATE

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		14,895		24,040		38,935
	Equipment					60,000	60,000
			14,895		24,040	60,000	98,935

ESTIMATE SUMMARY

SIMON-HARTLEY OF CANADA LTD
7025 Sherpard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: PUMPHOUSE COMMON

PROJECT NO.: F1304

SHEET 9 OF 12

EST'D

DATE

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil and Structural		31,215		41,215		72,430
	Equipment	24,056	600	750	3,820		29,226
		24,056	31,815	750	45,035		101,656

ESTIMATE SUMMARY

Simon [illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: UNDERGROUND DUCTWORK COMMON
PROJECT NO.: F1304
SHEET 10 OF 12
EST'D
DATE

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Civil		6,080		20,270		26,350
			6,080		20,270		26,350

ESTIMATE SUMMARY

SIMON [illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: SERVICE BAY COMMON
PROJECT NO.: F1304
SHEET 11 OF 12
EST'D
DATE

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT	TOTAL
	Civil and Structural		43,735		65,615		109,350
			43,735		65,615		109,350

ESTIMATE SUMMARY

SIMON-[illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. HYDRO
PROJECT: HAT CREEK - MODULAR COAL WASHERY
LOCATION:

DESCRIPTION: COMMON SERVICES

PROJECT NO.: F1304

SHEET 12 OF 12

EST'D DATE

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	Piping and Valves		53,900		44,100		98,000
	Electrical	201,195	67,854		182,935		451,984
		201,195	121,754		227,035		549,984

SECTION 9

OPERATIONAL REQUIREMENTS

The operating costs have been re-calculated on a common basis of design to permit comparison of schemes. These are set out in our Final Report, i.e. C-MJV Mining Feasibility Report, Volume VIII Appendix B, "Hat Creek Coal Beneficiation".

SECTION 9 - OPERATIONAL REQUIREMENTS

OPERATING COST ESTIMATE (5 Operating Module + 1 Standby)

1. Consumables

a) Electric Power

	Installed HP	Running HP		
Coarse Coal Section	6750	4500	Max. Demand @ $3.95/kVA month	= $ 991,845
Fine Coal Section	13500	9000	Max. Usage @ $0.42/kWHr	= 473,740
Auxilliary Equipment	4500	3000		
Feed Conveyor	900	600		
Lighting & Miscellaneous	900	900		
Emergency Power	1000			

b) Raw Magnetite — 2050 MTPA — @ $77.00/Tonne = $ 157,850

C) Plant Heating
Peak Periods — 36,000,000 BTU/HR — @ $ 0.50/140,000 BTU = $ 277,714

d) Flocculants — 335,000 kg/yr — @ $ 2.64/kg = $ 848,400

SUB-TOTAL 1) = $ 2,785,549

OPERATING COST ESTIMATE (5 Operating Module + 1 Standby)

2) Operating Manpower Requirements

	Shift Number 1	2	3	Swing	Total	MH *	Rate **	
Plant Superintendent	1	-	-	-	1	1 x	42,700	$ 42,700
Assistant Plant Superintendent	1	1	1	1	4	4 x	31,500	126,000
Shift Foreman	2	2	2	2	8	8 x	26,400	211,200
Central Control Room Operators	2	2	2	2	8	2100 x 8 x	13.37	224,616
Thickener & Fines Operators	6	6	6	6	24	2100 x 24 x	12.53	631,512
Dense Medium Operators	6	6	6	6	24	2100 x 24 x	12.07	608,328
Dewatering Operators	6	6	6	6	24	2100 x 24 x	11.84	596,736
Pumpman	2	2	2	2	8	2100 x 8 x	11.38	191,184
Samplers	4	4	4	4	16	2100 x 16 x	10.77	361,872
Maintenance Foreman (Mech)	2	-	-	-	2	2 x	26,400	52,800
Maintenance Foreman (Elect)	2	-	-	-	2	2 x	26,400	52,800
Millwrights	6	6	6	6	24	2100 x 24 x	13.37	673,848
Electricians	6	6	6	6	24	2100 x 24 x	13.37	673,848
Welders	4	4	4	4	16	2100 x 16 x	13.37	449,232
Labourers/Maintenance	3	3	3	3	12	2100 x 12 x	10.77	271,404
Magnetite Handlers	3	3	3	3	12	2100 x 12 x	10.77	271,404
Labourers/Cleanup	6	6	6	6	24	2100 x 24 x	10.77	542,808
	62	57	57	57	233		SUB-TOTAL 2) $	5,982,292

3) Spares Allowance 1% of Equipment Cost — SUB-TOTAL 3) $ 850,000

* Manhours equivalent to $\frac{350 \times 24}{4} = 2100$

TOTAL OPERATING COSTS $ 9,617,841

AVERAGE OPERATING COSTS (10,119,000 MTPA Clean Coal)
= $0.95/MT Clean Coal

** See Over....

SECTION 9

OPERATIONAL REQUIREMENTS

**

OPERATING COST ESTIMATE

Manpower rates include allowances for:

a) Statutory & Annual Vacation

b) Tool Allowances provided under Union Agreements

c) Canada Pension, Medical & Dental Plans, Unemployment Insurance

d) Retirement Plans

e) Clothing Allowance

f) Shift Differentials, Wet Pay Allowances

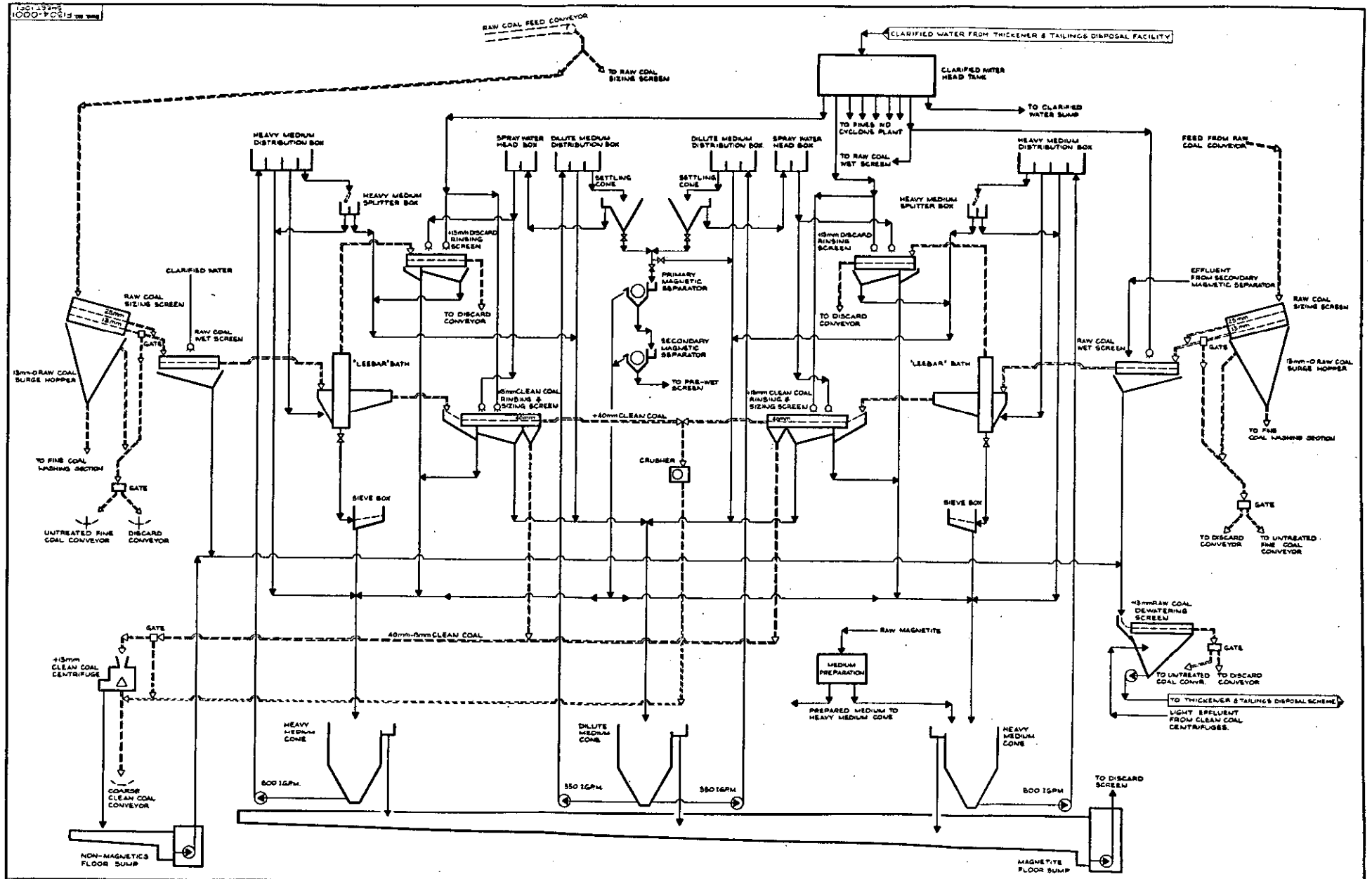
g) Absenteeism, Turnover, Travelling, Schedules Overtime

Supervisory personnel salary rates include 25.6% Payroll Burden.

SECTION 10

DRAWINGS

DRAWING NO.	TITLE
F1304-0001	Flowsheet for Coarse Coal H.M. Section (1 Module)
F1304-0002	Flowsheet for Fine Coal Section (1 Module)
F1304-1001	Site Plan for Alternate Washery Schemes
F1304-1002	Modular Coal Washery Layout
F1304-0006 Sheet 1 of 2	Materials Balance D.M. Bath and W.O. Cyclones Washery
F1304-0006 Sheet 2 of 2	Materials Balance Partial Washing Using D.M. Bath



THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORSE.
NON-RESIDENT LICENCE (EXPIRY DATE 83JAN 31)

REV	DESCRIPTION	BY	DATE	CHK
3	ISSUED WITH FINAL REPORT	K.B	OCT 83/JUN 84	
2	DRAFT FOR FINAL REPORT	C.W	OCT 83/JUN 84	
1	ISSUED WITH INTERIM REPORT		OCT 83/JUN 84	
P	PRELIMINARY	K.B	OCT 83/JUN 84	

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT, BRITISH COLUMBIA, CANADA
2600 M.T.PH. MODULAR COAL WASHERY.

SIMON-CARVES

DWG. TITLE: FLOWSHEET FOR COARSE COAL H.M. SECTION (1 MODULE)

DESIGNED	J.V.W	SCALE	PROJ. MGR.	S.C.B.
DRAWN	K.B	N.T.S.	PROJ. DES.	
CHECKED	S.C.B		D.D. MGR.	

REPORT FIGURE NUMBER: 5-1-2
DRAWING NUMBER: F1304-0001 SHEET 1 OF 1
REV. 3

DWG. NO. F1304-0002
SHEET 1 OF 1

FROM THICKENER

CLARIFIED WATER HEAD TANK

TO LARGE COAL SECTION

RAW COAL FEED CONVEYOR

RAW COAL SIZING SCREEN

25mm
13 mm

RAW COAL SIZING SCREEN

28 mm
13 mm

RAW COAL WET SCREEN

GATE

GATE

RAW COAL WET SCREEN

TO "LEEBAR" BATH

13mm-0 RAW COAL SURGE HOPPERS

TO "LEEBAR" BATH

13 mm-0 RAW COAL FEEDER

13mm-0 RAW COAL FEEDER

TO-13mm RAW COAL DEWATERING SCREEN

GATE

UNTREATED FINE COAL CONVEYOR

TO DISCARD CONVEYOR

THIS RAW COAL SCREENING SECTION IS ALSO SHOWN ON DWG F1304-0001

TO THICKENER & TAILINGS DISPOSAL

CLASSIFYING & THICKENING CYCLONE OVERFLOW COLLECTING BOX

PRIMARY WATER ONLY WASHING CYCLONES DSM 550 mm ø

SECONDARY WATER ONLY WASHING CYCLONES DSM 350 mm ø

THICKENING CYCLONES DSM 350 mm ø

CLASSIFYING CYCLONES DSM 350mm ø

-13mm CLEAN COAL DEWATERING SCREEN

10M

-13mm CLEAN COAL DEWATERING SCREEN

10M

- 10 MESH BUFFER TANK

13mm - 10M CLEAN COAL CENTRIFUGE

10x100M CLEAN COAL SCREEN BOWL CENTRIFUGES

SCREEN SECTION EFFLUENT CONE

-6mm DISCARD DEWATERING SCREEN

CLASSIFYING CYCLONE FEED CONE

3500 I.G.P.M.

3500 I.G.P.M.

PRIMARY WATER ONLY WASHING CYCLONE FEED CONE

3500 I.G.P.M.

3500 I.G.P.M.

SECONDARY WATER ONLY WASHING CYCLONE FEED CONE

3200 I.G.P.M.

3200 I.G.P.M.

THICKENING CYCLONE FEED CONE

3000 I.G.P.M.

3000 I.G.P.M.

800 I.G.P.M.

NON-MAGNETICS FLOOR SUMP

FINE CLEAN COAL CONVEYOR

DISCARD CONVEYOR

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORSE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN 1979)

REV.	DESCRIPTION	BY	DATE	CHK.
3	ISSUED WITH FINAL REPORT	K.S	OCT 23/78	
2	DRAFT FOR FINAL REPORT	C.H.	OCT 16/78	
1	ISSUED WITH INTERIM REPORT'		OCT 16/78	—
P	PRELIMINARY	K.S	SEP 13/77	

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT, BRITISH COLUMBIA, CANADA
2400 M.T.P.H. MODULAR COAL WASHERY

SIMON-CARVES

PHOTOGRAPHIC SCALE — MILLIMETRES 0 5 10 DIV./INCH

DESIGNED D.V.W.
DRAWN K.S. SEP. 28/77
CHECKED S.C.B.

SCALE N.T.S.

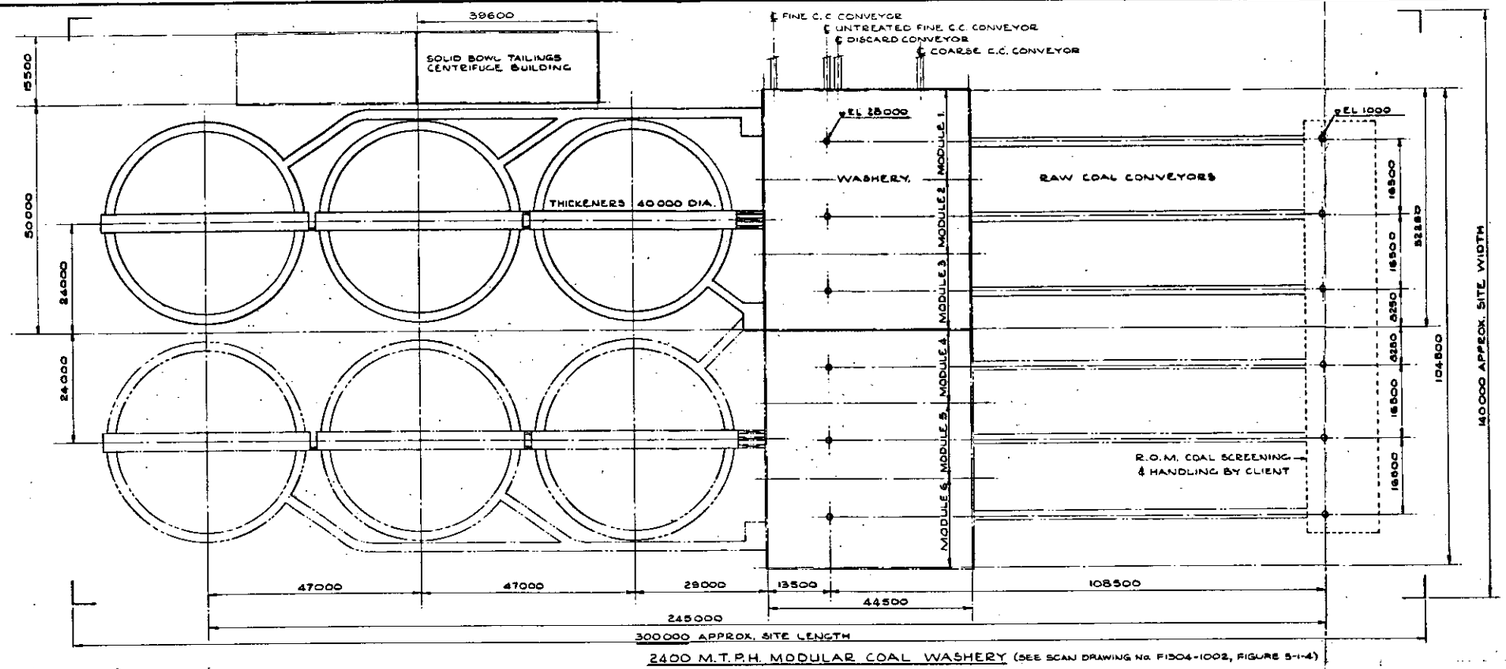
PROJ. MGR. S.C.B.
PROJ. DES.
D.C. MGR.

AREA:
DWG. TITLE: FLOWSHEET FOR FINE COAL SECTION (1 MODULE)

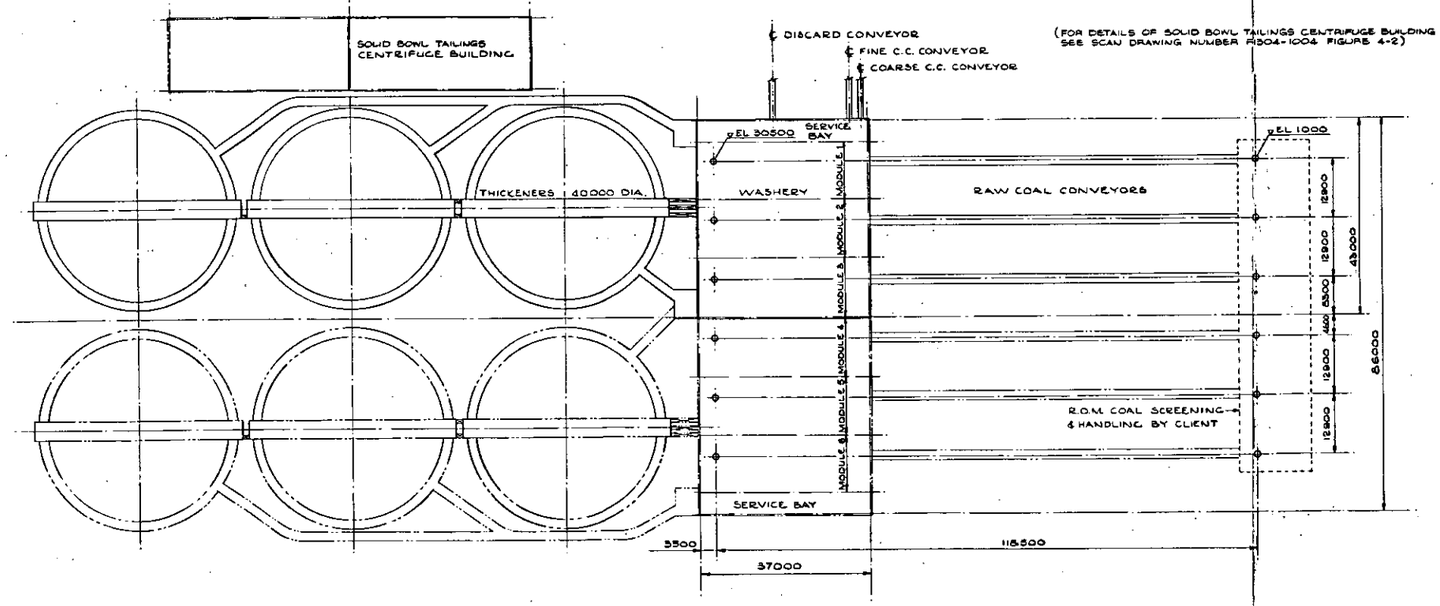
REPORT FIGURE NUMBER 5-1-3

SCAN DRAWING NUMBER F1304-0002 SHEET 1 OF 1

REV. 3



2400 M.T.P.H. MODULAR COAL WASHERY (SEE SCAN DRAWING No. F1304-1002, FIGURE 5-1-4)



MODULAR BAUM JIG WASHERY (SEE SCAN DRAWING No. F1304-1003, FIGURE 5-3-3)

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORBE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN. 1979)

REV.	DESCRIPTION	BY	DATE	CHK.
2	ISSUED WITH FINAL REPORT	K.S.	OCT 25/78	G
1	DRAFT FOR FINAL REPORT	C.W.	JAN 5/78	

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY,
HAT CREEK PROJECT,
BRITISH COLUMBIA, CANADA.

SIMON-CARVES

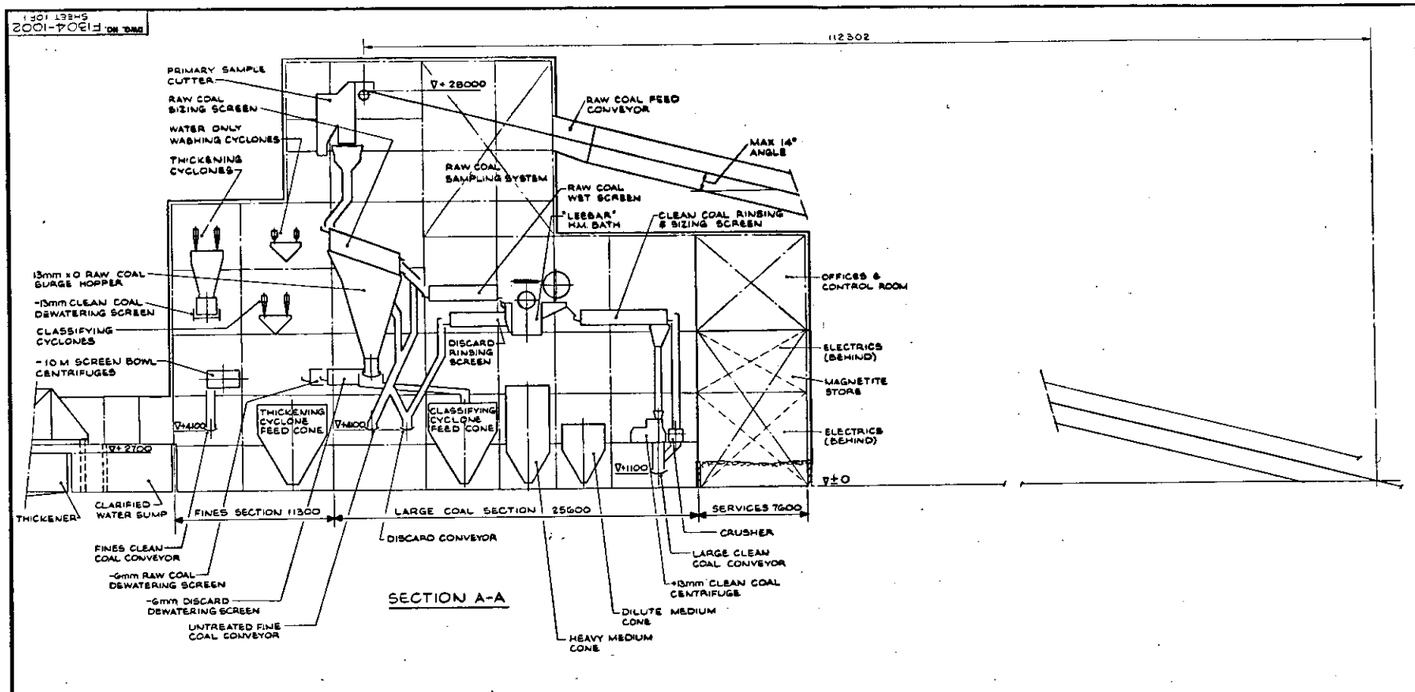
PHOTOGRAPHIC SCALE — MILLIMETRES 0 5 10 DIV/INCH

AREA: CATEGORY:
DWG. TITLE: SITE PLAN FOR ALTERNATE WASHERY SCHEMES.

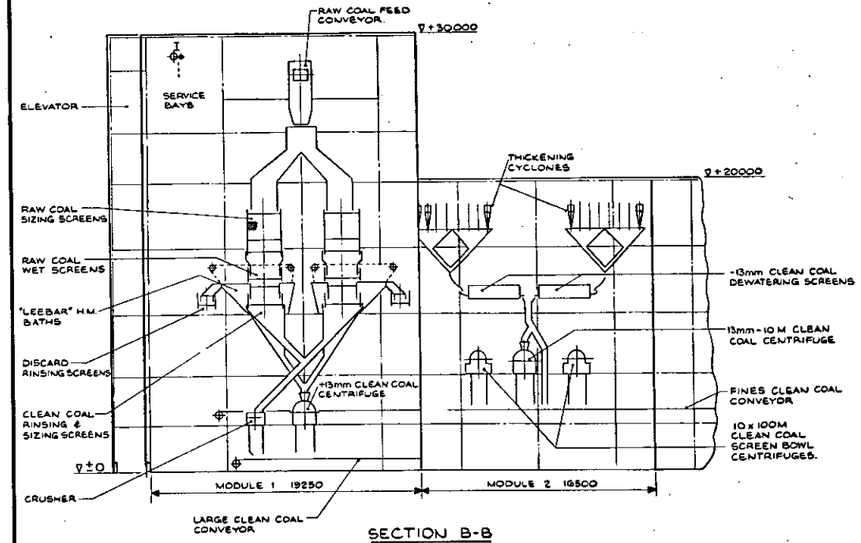
DESIGNED	D.V.W.	SCALE	PROJ. MGR.	S.C.B.
DRAWN	C.W.	1:400	PROJ. DES.	
CHECKED	S.C.B.		D.D. MGR.	

REPORT FIGURE NUMBER 5-7-1
SCAN DRAWING NUMBER F1304-1001 SHEET 1 OF 1
REV. 2

DWG. NO. F1304-1002 SHEET 1 OF 1

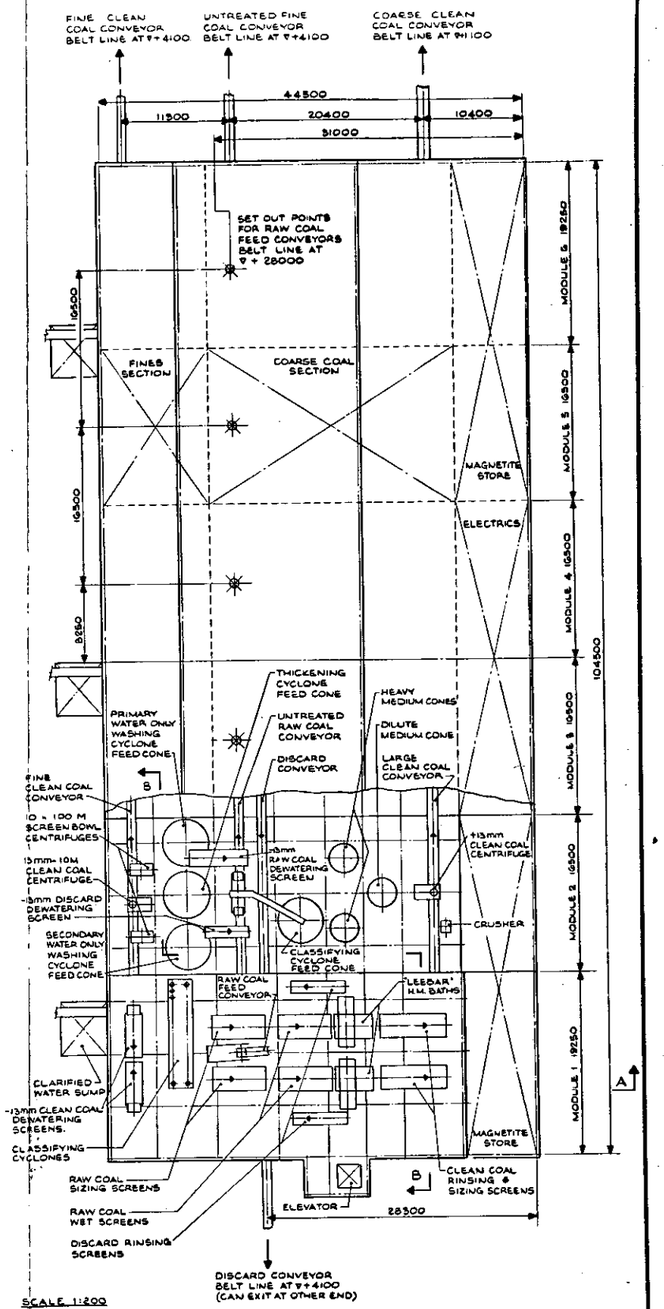


SECTION A-A



SECTION B-B

SCALE 1:125



SCALE 1:200

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORSE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN 1979)

REV	PLAN	CONC	ARCH	STRUC	PIPE	ELEC	MECH	HVAC	PROJ MGR	PROJ DES
11										
10										
9										
8										
7										
6										
5										
4										
3										
2										
1										

REV.	DESCRIPTION	BY	DATE	CHK.
3	ISSUED WITH FINAL REPORT	K.S	OCT 29/76	
2	DRAFT FOR FINAL REPORT	C.W	31 MAY 76	
1	"ISSUED WITH INTERIM REPORT"		OCT 14/72	
P	PRELIMINARY	K.S.		

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BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT, BRITISH COLUMBIA, CANADA
2400 M.T.P.H. MODULAR COAL WASHERY

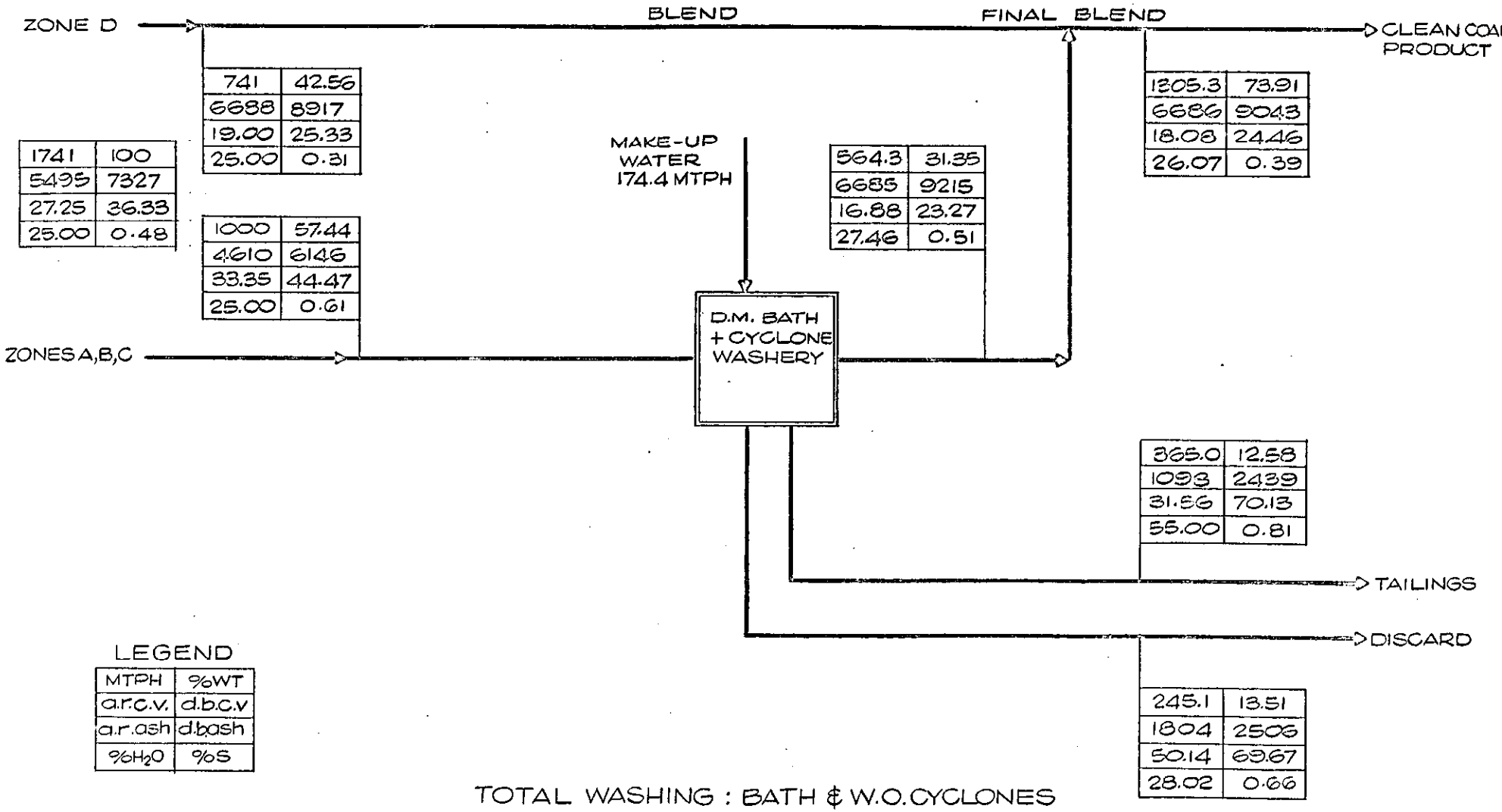
SIMON-CARVES

PHOTOGRAPHIC SCALE — MILLIMETRES 0 5 10 DIV/INCH

AREA:
DWG. TITLE: MODULALAR COAL WASHERY LAYOUT.
CATEGORY:

DESIGNED	D.V.W.	SCALE	PROJ. MGR.	S.C.C.	
DRAWN	K.S	AS NOTED	PROJ. DES.		
CHECKED	S.C.B.		D.O. MGR.		

REPORT FIGURE NUMBER: 5-1-4
SCAN DRAWING NUMBER: F1304-1002 SHEET 1 OF 1
REV. 3



LEGEND

MTPH	%WT
a.r.c.v.	d.b.c.v
a.r.ash	d.bash
$\%H_2O$	%S

TOTAL WASHING : BATH & W.O. CYCLONES

REV	DESCRIPTION	BY	DATE	CHK
2	ISSUED WITH FINAL REPORT SULPHUR VALUES ADDED	KS	OCT 2017	B
1	DRAFT FOR FINAL REPORT	TG	MAY 2012	B

B.C. HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
BRITISH COLUMBIA, CANADA

DESIGNED PVT
DRAWN T.G.
CHECKED SG B
SCALE
PROJ MGR B
PROJ DES
D.D. MGR.

SIMON-CARVES

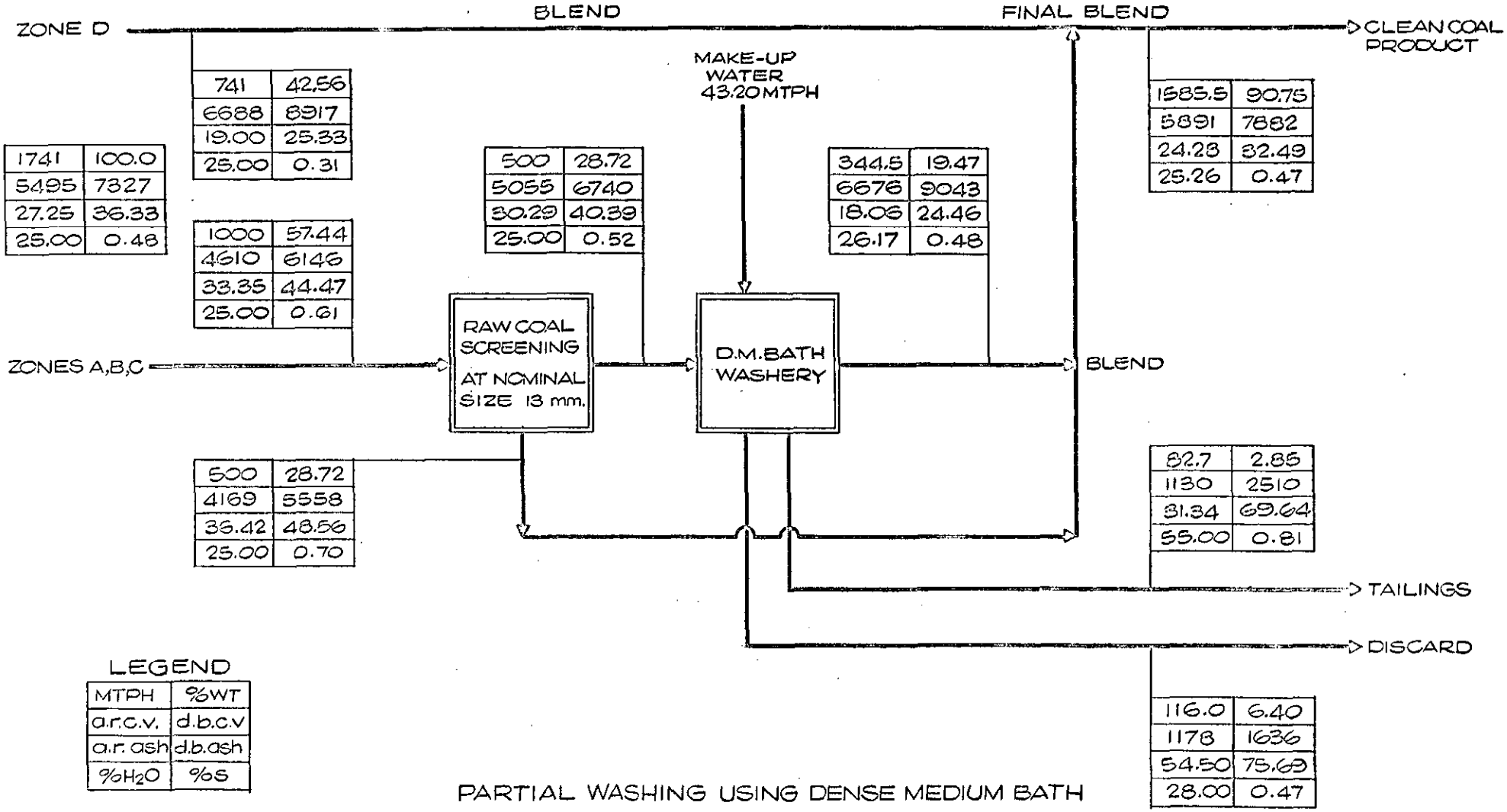
AREA CATEGORY
DWG TITLE MATERIALS BALANCE
D.M. BATH & W.O. CYCLONES WASHERY

REPORT FIGURE NUMBER 5-1-1

SCAN DRAWING NUMBER F1304-0006 SHT 1 OF 6

REV. 2

SHEET SIZE I.S.O. A3



PARTIAL WASHING USING DENSE MEDIUM BATH

REV	DESCRIPTION	BY	DATE	CHK
2	ISSUED WITH FINAL REPORT SULPHUR VALUES ADDED	KS	OCT 20/77	S
1	DRAFT FOR FINAL REPORT	TG	MAY 31/77	S

B.C. HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
BRITISH COLUMBIA, CANADA

SIMON-CARVES

DWG. TITLE: MATERIALS BALANCE
PARTIAL WASHING USING D.M. BATH

DESIGNED	P.V.T	SCALE	PROJ. MGR. S
DRAWN	T.G.		PROJ. DES.
CHECKED	S.G. S		D.O. MGR.

REPORT FIGURE NUMBER: 5-2-1
DRAWING NUMBER: F1304-0006 SHT 2 OF 6
REV: 2

SHEET SIZE I.S.O. A3

VOLUME IV

SECTION 11

PRELIMINARY DESIGN AND COSTING OF A BAUM WASHERY SCHEME

SECTION 1

SUMMARY

This report gives the results of the work undertaken by Simon-Carves of Canada Ltd., to develop a preliminary Design and Costing for a Washery Scheme using Baum Washboxes to form part of the Hat Creek Mine and Thermal Generating Plant Complex. Two previous reports have given alternate beneficiation schemes and a detailed Dense Medium bath scheme. In this report a Baum washbox scheme is examined. As in the previous scheme, this Baum Washbox Coal Washery has been designed to be a series of self-contained modular plants.

This design has been sufficiently detailed to give Order of Magnitude Costs for Coal Preparation.

SECTION 2

INTRODUCTION

The "Alternate Beneficiation Report" of December 1977, shows that a Baum Washery may be almost as efficient as the Dense Medium Bath and Water Only Cyclone plant if total washing is required. Therefore, it was decided that a Baum Washery Scheme should be costed for comparison with the Dense Medium Scheme.

It is envisaged that initially only the plus 12mm would be washed. When washing this size fraction, the Baum washbox is less efficient than the Dense Medium Bath. The Baum scheme has, therefore, to be compared in terms of its Capital and Operating costs and an evaluation made in conjunction with the final mining plans. Hence this report can only be of a preliminary nature.

This Modular Baum Washbox scheme, although designed with the idea of washing the plus 12mm materials, could easily be modified to treat the 150 - 0mm material.

This proposed scheme does not include any raw coal screening or crushing.

Attention must be drawn to the slight reservations of treating this coal, which contains soft bentonitic clays using a Baum Washbox.

The intention of this report is, therefore, to establish whether Capital and Operating cost savings of a Baum Washbox scheme are such that this process should merit consideration.

In preparing this preliminary scheme SCAN have made maximum use, within the process requirements, of "in-house" information. The inclusion, for example, of Simonacco Washboxes should be seen therefore, as a matter of expediency and does not represent a recommendation of this equipment.

FOOTNOTE: October 1978

Since the final scheme presented by the Cominco-Monenco Joint Venture did not require a Coal Preparation Plant this preliminary design and costing was not evaluated in more detail. The costs data was, however, reviewed to give a three module Scheme 3 for Simon-Carves' Final Report on "Hat Creek Coal Beneficiation". The pages which have been modified to correlate with this report are dated October 1978.

SECTION 3

CONCLUSIONS

3.1 Reservations remain regarding the application of the Baum Jig to the Hat Creek Coals which generally contain soft clays.

3.2 Considerations in other parts of the study led to a final review on the basis of installing a 3 module scheme to treat the A, B and C zone coals. The merits of alternative schemes are considered in the summary reports.

3.3 Capital cost of these 3 modules within a partial washing scheme is estimated at $12,714,026 and the operating costs at $2,325,679 per annum.

SECTION 4

BASIS OF DESIGN

4.1 The total expected raw coal feed to the plant is 2000 MTPH. The greater majority of the dirt content of this coal tends to be in the smaller size ranges. The raw coal would therefore be screened to remove these size ranges. This would remove between 40 and 50% of the total raw coal feed.

If the screening is done at 12mm the size consist of the screen overflow would be as in the following table.

The average of all the samples is taken as a possible worst case size consist.

If the size consist of the raw feed were better than this, the throughput of the proposed washery scheme would not be able to be increased, because the limiting factor on this design is the total tonnage and percentage reject and not the percentage minus 12mm size range.

Size (mm)	Sample Weights (MTPH)			
	Z	Y	X	Average
100	62	8	8	26
100 - 50	128	28	44	67
50 - 25	481	376	322	393
25 - 12	525	437	448	470
12 - 0.5	173	262	253	229
- 0.5	11	24	28	21
	1380	1135	1103	1206

Data for Raw Coal Screened at 12mm

SECTION 4

BASIS OF DESIGN

4.1 As screening is never 100% efficient, as shown above, there will be some carry-over of minus 12mm material. The figures given were calculated using known screening efficiencies.

It has been assumed that the worst case would be the average of the size analysis for the three seams, which gives a total tonnage to the plant of 1206 MTPH.

In order that a direct comparison can be made to the dense medium bath and water only cyclone modular washery, this plant also consists of 6 washery modules, i.e. 5 modules in use with 1 module as standby for ease of maintenance.

This gives 241.5, say 240, MTPH per module. Allowance has been made in the design for 50% reject from the Baum washbox and a middlings recycling scheme has also been incorporated. Even though this middlings recycling scheme is optional, at this present stage in the feasibility study, allowances have been made for this section of the plant in the design and plant layout.

4.2 It would be possible to wash a 150 - 0mm product in this Baum Jig, however the tonnage fed to the jig would have to be reduced to 215 MTPH because of the increased percentage of minus 12mm material. It has been assumed that the percentage minus 12mm will be 55%.

4.3 It would also be possible for only minimal additions to each module to include a fine coal washing system. This could wash, for example, the minus 28 mesh material in a similar way to the fine coal section as described in the "Modular Coal Washery" report October 1977, using water only cyclones.

4.4 The feed to the washbox would be deslimed at 0.25mm to remove all the fine clay materials, and all other material that breaks down upon immersion in water, as soon as possible.

The removal of this clay before washing also gives a cleaner slurry product from the slurry cyclones.

SECTION 5

DESCRIPTION OF PROPOSED PLANT

5.1 Outline of Construction and Operation

The plant will consist of a number of identical modules each rated at 240 MTPH. Each module would be fed from the Raw Coal Handling system by a separate raw coal feed conveyor.

Each module performs the following duties: -

Raw Coal Desliming
Coal Washing
Clean Coal Classifying

The modules would be constructed to work with three common product conveyors: -

Coarse Clean Coal
Fine Clean Coal
Discard

It would be possible for these conveyors to run in either direction.

The washery is designed to operate with the separate Raw Coal Screening/ Crushing plant scheme as depicted in C-MJV Drawing CMV400-005.

5.2 The description is given for a single module and should be read in conjunction with our drawings F1304-0/SK-5 Flowsheet for Baum Washery and F1304-1/SK-6 Baum Washery Layout.

n.b. This layout is only representative, it would be possible for a mirror image of this plant to be built.

5.2.1 Raw Coal Handling

The raw coal, broken to below 150mm in the R.O.M. coal breaker station, and classified at 12mm, will be conveyed to the washery giving an average of 240 MTPH to each module. The raw coal is received in a 200 MT surge bin. This bin is installed to cushion any variations in the amount of feed to the plant. This is required because a baum jig operates much more efficiently when receiving a constant feed rate.

SECTION 5

DESCRIPTION OF PROPOSED PLANT

5.2 cont.

5.2.2 Coal Washing

The raw coal is then fed to a desliming launder and screen using a vibrating feeder.

The screen overflow passes to the baum washbox via a feed launder, the underflow goes to the thickener.

The washbox reject leaves via the first two elevators and the middlings by the third elevator.

The middlings are screened at 12mm, the plus 12mm being crushed and returned to the washbox feed and the minus 12mm being rejected.

5.2.3 Clean Coal Classifying

The clean coal from the washbox will be dewatered using sieves and dewatering screens.

The screens also classify the coal into plus 12mm and minus 12mm. The plus 12mm will be put onto the plus 12mm clean coal conveyor.

The drainage from the clean coal screens gravitates to the main washery sump.

The contents of this sump are pumped up to a batch of slurry cyclones. The cyclone overflow will be used as desliming and wash water.

The cyclone underflow will be flushed to a slurry dewatering sieve bend and screen.

The slurry product will join the minus 12mm clean coal from the washbox and be centrifuged to remove excess moisture.

SECTION 5

DESCRIPTION OF PROPOSED PLANT

5.2 cont.

5.2.4 Tailings Disposal

The desliming screen underflow, discard dewatering screen underflows and some of the slurry cyclone overflow will be sent to the thickener where it will be dosed with flocculating reagents to provide a continuous circulation of water in the washery.

It should be mentioned that two modules will share a thickener and a clarified water sump.

The flocculating requirements will be a common service to all thickeners.

SECTION 6

OUTLINE ENGINEERING SPECIFICATIONS

The terminal points for this plant are as follows: -

Materials

a) Commence; Head Chute Raw Coal Feed Conveyor

b) Terminate; Skirt Plates of plus 12mm Clean Coal Conveyor

c) Terminate; Skirt Plates of minus 12mm Clean Coal Conveyor

d) Terminate; Skirt Plates of Discard Conveyor

Liquids

a) Commence; Fresh Water Make-Up Control Valve

b) Commence; End Flocculant Discharge Pipe into Thickener Launder

c) Terminate; Thickened Tailings Discharge from Thickener

6.1 Proprietary Equipment Schedule

6.1.1 Equipment required for one washery module.

6.1.2 Middlings recycling system for one washery module.

6.1.3 Equipment common to two washery modules.

6.1.4 Equipment common to six washery modules.

6.1.5 Flocculant dosing system and thickened tailings disposal system.

SECTION 6

OUTLINE ENGINEERING SPECIFICATIONS

6.1.1 Equipment required for one washery module.

Item Nos.	Item	Quantity
4001	Head Chute for Raw Coal Feed Conveyor	1
4002	Raw Coal Surge Bunker	1
4003 4004	Skirt Plates for Raw Coal Feeders	2
4005 4006	Raw Coal Feeders	2
4007 4008	Supports for Raw Coal Feeders	2
4009 4010	Raw Coal Launders	2
4011 4012	Raw Coal Desliming Fixed Sieves & Casings	2
4013 4014	Desliming Screens 6' x 16' Double Deck	2
4015 4016	Underpans for Desliming Screens	2
4017 4018	Combined Discharge Chute for Desliming Screens	2
4019	Twin Feed Launder to Baum Washbox	1
4020	Simon-Acco Washbox SJL 3000/9: 2 Discard plus 1 Middlings Elevators	1
4021	Twin Discharge Launder from Baum Washbox. Incl. 2 Fixed Sieves	1
4022 4023	Clean Coal Dewatering/Classifying Screens 6' x 16' Double Deck	2
4024 4025	Underpans for Clean Coal Screens	2

SECTION 6

OUTLINE ENGINEERING SPECIFICATIONS

6.1.1 Equipment required for one washery module. - cont.

Item Nos.	Item	Quantity
4026 4027	Plus 12mm Discharge Chutes from Clean Coal Screens	2
4028 4029	Minus 12mm Discharge Chutes from Clean Coal Screens	2
4030	Minus 12mm Clean Coal Distribution Scraper Conveyor. Approx. 30' - 0" Crs. of Sprockets with 3 Inlets, Partial Top Carrying Deck, 2 Discharge Outlets c/w Gates, 1 End Discharge Outlet, Drive and Guard. Supports to Floor Level	1
4031 4032	Discharge Chutes from Scraper Convr. to Centrifuges	2
4033 4034	Tundishes for Centrifuges	2
4035 4036	Clean Coal Centrifuges Wemco 1100	2
4037 4038	Centrifuge Discharge Chutes	2
4039	End Discharge Chute for Scraper Convr.	1
4040 4041	Centrifuge "Tell Tale" Boxes	2
4042	Skirt Plates for plus 12mm C.C. Convr.	1
4043	Skirt Plates for 12mm - 0 C.C. Convr.	1
4060	Discard Elevator No. 1 Discharge Chute to Discard Conveyor	1

SECTION 6

OUTLINE ENGINEERING SPECIFICATIONS

6.1.1 Equipment required for one washery module. - cont.

Item Nos.	Item	Quantity
4061	Discard Elevator No. 2 & 3 Combined Discharge Chutes. Inc. (2 Fixed Sieves) to Screen	1
4062	Discard Dewatering Screen 5' x 14' Double Deck	1
4063	Underpan for Discard Screen	1
4064	Discharge Chute for Discard Screen	1
4065	Skirt Plates for Discard Convr.	1
4066	Main Washery Sump	1
4067 4068	Main Washery Pumps to Slurry Cyclones	2
4069 4070	Distributors to Slurry Cyclones	2
4071 4072 4073 4074 4075	Slurry Cyclones D.S.M. 350mm 20^{o}	5
4076 to 4080	Slurry Cyclones D.S.M. 350mm 20^{o}	5
4081 to 4085	As Above	5

SECTION 6

OUTLINE ENGINEERING SPECIFICATIONS

6.1.1 Equipment required for one washery module. - cont.

Item Nos.	Item	Quantity
4086 to 4090	Slurry Cyclones D.S.M. 350mm 20^{o}	5
4091 4092	Cyclone Underflow Collection Cones & Supports (Support Distributor)	2
4093 4094	Cyclone Overflow Collection Launders	2
4095 4096	Support for Cyclones and Overflow Launder (plus Access to Valves)	2
4097	Wash Water/Desliming Head Box	1
4098	Washbox Water Cone	1
4099	Cyclone Underflow Collection Launder to Sieve Bend	1
4100	Slurry Sieve Bend 4'-0" Wide 5'-0" Rad. 45^{o}	1
4101	Slurry Dewatering Screen 5'x14' Single Deck	1
4102	Underpan for Slurry Screen	1
4103	Discharge Chute for Slurry Screen	1
4104 4105	Bedplates for Main Washery Pumps	2
4106 4107	Sprays and Supports for Desliming Screens	2

SECTION 6

OUTLINE ENGINEERING SPECIFICATION

6.1.1. Equipment required for one washery module. - cont.

Item Nos.	Item	Quantity
4108	Washbox Blower	1
4109	Bedplate for Washbox Blower	1
4110	Clarified Water Pump	1
4111	Bedplate for Clarified Water Pump	1
4112	Floor Sump Pump (Includes Centrifuge Effluent)	1
4113	Bedplate for Floor Sump Pump	1
4114 4115 4116	Roof Fans	3
4117 4118 4119	Plant Heaters 1 Million BTU/Hr Each	3
4120	Sieve Box for Washbox Elevator Drain	1
4121	Inlet Duct for Washbox Blower	1

SECTION 6

OUTLINE ENGINEERING SPECIFICATION

6.1.2 Middlings Recycle system for one washery mdoule:-

Item Nos.	Item	Quantity
	Elevator Length 16'-6" Additional to Discard Elevators	1
4050	Middlings Elevator Discharge Chute and Gate	1
4051	Middlings Screen 3'x 10' Single Deck	1
4052	Underpan for Middlings Screen	1
4053	Discharge Chute for Middlings Screen	1
4054	Middlings Crusher	1
4055	Bedplate for Crusher Drive	1
4056	Crushed Middlings Launder	1
4057	Undersize Chutes from Middlings Screen	1

6.1.3 Water Clarification Circuit and Tailings Disposal

See Section 12 "Alternative Equipment for Tailings Disposal.

SECTION 6

OUTLINE ENGINEERING SPECIFICATION

6.1.4 Equipment common to six washery modules.

Item Nos.	Item	Quantity
4136	Elevator	1
4137 4138	Electric Service Hoist & Trolley	2
	Trolleys	20

SECTION 6

OUTLINE ENGINEERING SPECIFICATIONS

6.2 Mechanical Engineering

The mechanical engineering specifications for this plant will be identical to the applicable specifications in Section 7.2 of the SCAN "Modular Coal Washery" Report of October 1977.

6.3 Electrical Engineering

The electrical engineering specifcation for this plant will be identical to the specification listed in Section 7.3 of the SCAN "Modular Coal Washery" Report of October 1977.

6.4 Instrumentation and Control

As Section 7.4 in "Modular Coal Washery" Report of October 1977.

6.5 Structural and Civil Design Criteria

As Section 7.5 in "Modular Coal Washery" Report of October 1977.

6.6 Plant Heating and Ventilating Units

As Section 7.6 in "Modular Coal Washery" Report of October 1977.

SECTION 7

CAPITAL COST ESTIMATE

7.1 The "Order of Magnitude" estimate on labour and material for the coal washery has been broken down as shown in the enclosed estimate summary.

a) Combined service bay and end process module, inclusive single thickener installation.

b) Additional interior process module, costed on an individual basis.

c) Additional thickener installation, costed on an individual basis.

7.1.1 The following items are not included in the pricing shown:-

a) Land Purchase
b) Site Clearing
c) Rough Grading
d) Rail Tracks
e) Roads
f) Main Power Supply
g) Potable and Process Water Supply
h) Construction Camp
i) General Workshops and Stores Facilities
j) General Offices
k) Plant Laboratory
l) Sewage/Effluent Treatment
m) Tailings Ponds

7.1.2 In addition, the following factors have not been taken into consideration:-

a) Contingencies
b) Escalation
c) Allowance for Winter Work
d) Premium Time
e) Inspection and Testing
f) Contract Indirects

SECTION 7

CAPITAL COST ESTIMATE

7.2 Head Office/Construction Management/Plant Commissioning manhour estimate.

COST CODE	DESCRIPTION	MANHOURS
100	Executive	500
110	Project	3,300
111	Civil/Structural	2,500
112	Mechanical	2,500
113	Electrical	750
114	Instrument	250
115	Process	1,500
144	Estimating	250
	ENGINEERING CATEGORY SUB-TOTAL	11,550
120	Management Services	2,000
121	Mechanical	15,150
124	Civil/Structural	5,400
127	Electrical	3,500
	DRAWING OFFICE CATEGORY SUB-TOTAL	26,050

SECTION 7

CAPITAL COST ESTIMATE

7.2 - cont.

COST CODE	DESCRIPTION	MANHOURS
130	Purchasing	1,900
131	Expediting	900
141	Accounts	700
142	Cost Control	1,650
143	Scheduling	650
145	Secretarial	3,700
	INDIRECT CATEGORY SUB-TOTAL	9,500
200	Management	10,200
203	Superintendent	5,100
240	Administration	5,100
250	Commissioning	4,200
	SITE CATEGORY SUB-TOTAL	24,600

SECTION 7

CAPITAL COST ESTIMATE

7.3 Engineering/Construction budget cost summary.

7.3.1	Head Office		$ 1,330,000
7.3.2	Site/Commissioning - refer note (a)		970,000
7.3.3	Design fee		680,000
7.3.4	Disbursements	- refer note (b)	350,000
	PROJECT TOTAL	- refer note (c)	$ 3,330,000

Cost Estimation Criteria

a) Basis for evaluation premised upon construction/commissioning activities preceeding,on a continuing basis through completion, during an overall two-year period.

b) Normally included under such a miscellaneous item are travel/ living expense, reproduction/communication costs, et al, with suggested total value as above divided equally as between head and on-site offices.

c) Total estimated cost shall not be construed other than for use on an "order-of-magnitude" basis in terms of mid-1977 Canadian dollars, as for previous report submitted October, 1977. Direct comparison with included prime cost estimate is clearly precluded at this stage, since such costing excludes certain additive cost factors - i.e. related to contingency, escalation, winter-works, premium time, contractor's indirect charges.

ESTIMATE SUMMARY

SIMON-CARVES OF CANADA LTD.
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV for B.C. Hydro
PROJECT: Baum Washery Scheme
LOCATION: Hat Creek

DESCRIPTION: ESTIMATE SUMMARY
ORDER OF MAGNITUDE - EQUIPMENT/MATERIALS/LABOUR
(Costs summarized by Sub-Section 7.3 excl.)

PROJECT NO.: F1304

SHEET 1 OF 1

EST'D J. Wrigley DATE March/78

CODE	ITEM	TOTAL COST					
		EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
7.1(a)	1 Module, 2 Service Bays and 1 Thickener, plus						
	Middlings System and Prorated Common Items						$ 3,605,240
7.1(b)	Each additional Module (including Middlings)						2,513,447
7.1(c)	Each additional Thickener						676,878
	TAKE-OUT PRICE FOR MIDDLINGS SYSTEM (PER MODULE)						(56,225)

SECTION 7

CAPITAL COST ESTIMATE

SUMMARY

For the 3 module scheme as included in our Final Report on the total Capital Cost summarized above is:

First Module including Common Items	$ 2,928,362
Modules 2 and 3	5,026,894
Thickener, 1 x 42.5m	1,428,770
Engineering	3,330,000
3 Module Baum Washery Total	$12,714,026

SECTION 8

OPERATIONAL REQUIREMENTS

The Operational Requirements have been re-calculated on a common basis of design to permit comparison of schemes. These are set out in our Final Report, Section 523.6:-

Power	$ 137,724	
Heating	86,786	
Flocculants	44,517	
Spares	178,800	
Labour	1,877,852	
		2,325,679
Anticipated Tailings Disposal		1,176,070
		$3,502,070

Per tonne of washery output this is $1,717.

SECTION 8

OPERATIONAL REQUIREMENTS

Operating Cost Estimate (5 Operating Module + 1 Standby)

1. Consumables

a) Electric Power	Installed HP	Running HP		$/Year
Washbox & Blower	1200	960		
Screens	690	550	Max. Demand @ $3.95/KVA month =	182,032
Pumps	2220	1775	Max. Usage @ ¢0.42/KWHr =	83,167
Centrifuges	545	440		
Thickener	45	40		
Lighting & Misc.	450	450		
Emergency Power	670			

b) Plant Heating	36 x 10^6 BTU/H	@ $0.5/140,000 BTU	=	277,714
c) Flocculants	12,000 Kg/Year	@ $2.64/Kg	=	31,680
		SUB-TOTAL (1)	=	574,593
Spares Allowance 10% of Equipment Cost.		SUB-TOTAL (2)	=	178,800

SECTION 8

OPERATIONAL REQUIREMENTS

Operating Cost Estimate (5 Operating Module + 1 Standby)

3. Manpower Requirements

	Shift 1	2	3	Swing	Total Manpower	Total Manhours	Rate	$/Year
Plant Superintendent	1				1		42,700	42,700
Asst. Plant Superintendent	1				1		31,500	31,500
Shift Foreman	1	1	1	1	4		26,400	105,600
Thickener Operator	1	1	1	1	4	8,400	11.84	99,456
Washbox Operator	1	1	1	1	4	8,400	12.53	105,252
Raw Feed Dewatering Operator	1	1	1	1	4	8,400	11.84	99,456
Clean Coal Operator	1	1	1	1	4	8,400	11.84	99,456
Pump Man	1	1	1	1	4	8,400	11.84	99,456
Maintenance Foreman (Mech)	1				2		26,400	52,800
Maintenance Foreman (Elec)	1				2		26,400	52,800
Millwright	3	3	3	3	12	25,200	13.37	336,924
Electricians	3	3	3	3	12	25,200	13.37	336,924
Welders	3	3	3	3	12	25,200	13.37	336,924
Labourers/Maintenance	3	3	3	3	12	25,200	10.77	271,404
Labourers/Clean-Up	3	3	3	3	12	25,200	10.77	271,404
							SUB-TOTAL (3)	2,342,056
							TOTAL OPERATING COST	3,095,449

SECTION 8

OPERATIONAL REQUIREMENTS

Operating Cost Estimate

Manhours are equivalent to $\frac{350 \times 24}{4}$ = 2100 p.a./man

Manpower rates include allowance for: -

a) Statutory and Annual Vacation

b) Union Agreement - Tool Allowance

c) Canada Pension, Medical & Dental Plans, Unemployment Insurance

d) Retirement Plans

e) Clothing Allowance

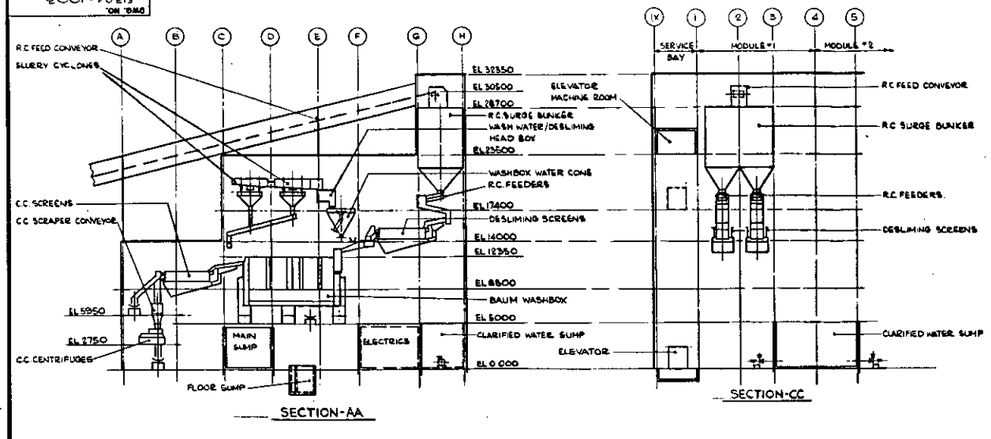
f) Shift Differentials, Wet Pay Allowance

g) Absenteeism, Turnover, Travelling, Scheduled Overtime
Supervisory Personnel Salary Rates include 25.6% Payroll Burden

SECTION 9

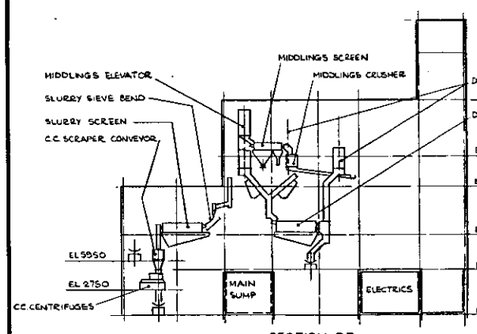
DRAWINGS

Drawing No.	Title
F1304-0004	Flowsheet for Baum Washery (One Module)
F1304-1003	Modular Baum Washery Layout
F1304-0006 Sheet 3 of 6	Material Balance: Partial Washing using Baum Jig

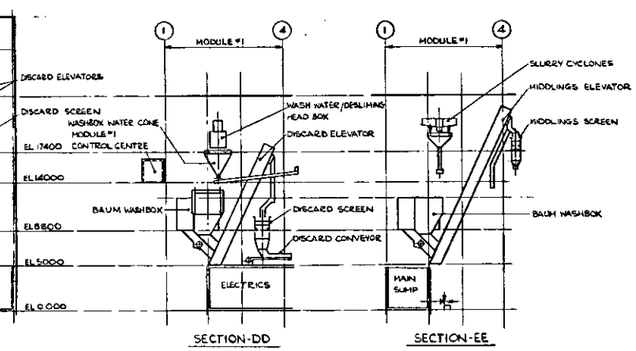


SECTION-AA

SECTION-CC

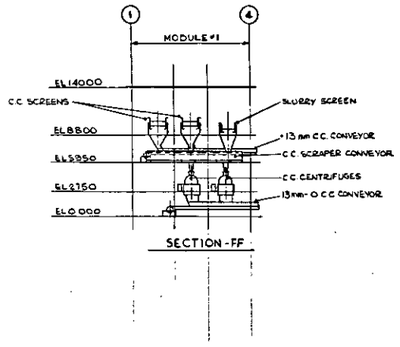


SECTION-BB

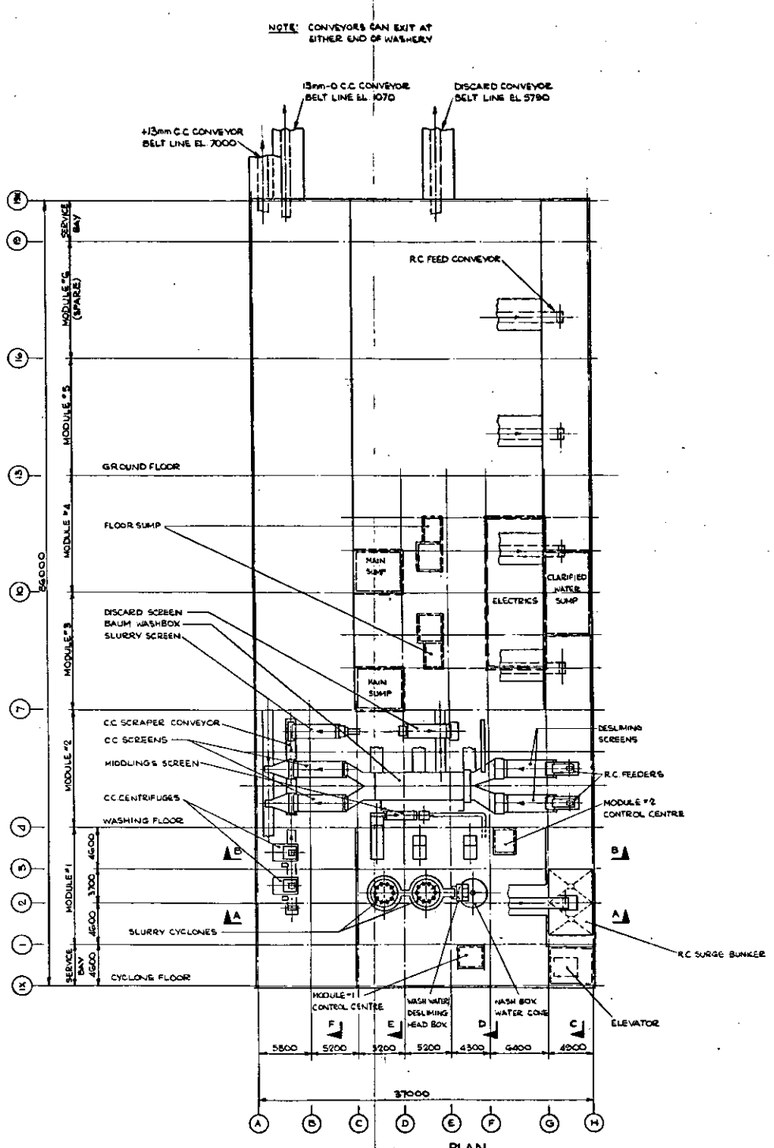


SECTION-DD

SECTION-EE



SECTION-FF



PLAN

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORSE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN 1979)

REV.	DESCRIPTION	BY	DATE	CHK.
2	ISSUED WITH FINAL REPORT	K.S	OCT 23/78	
1	DRAFT FOR FINAL REPORT	C.W.	MAY 31/78	
P	PRELIMINARY	KGL	FEB 27/78	

BRITISH COLUMBIA HYDRO & POWER AUTHORITY.
HAT CREEK PROJECT, BRITISH COLUMBIA, CANADA.
MODULAR BAUM JIG WASHERY.

SIMON-CARVES

AREA: CATEGORY:
DWG. TITLE MODULAR BAUM WASHERY LAYOUT.

DESIGNED	D.V.W.	SCALE	PROJ. MGR. S.C.B.
DRAWN	K.G.L. FEB 27/78	1:200	PROJ. DES.
CHECKED	S.C.B.		D.D. MGR.

REPORT FIGURE NUMBER	SCAN DRAWING NUMBER	REV.
5-3-3	F1304-1003 SHEET 1 OF 1	2

DWG. NO. F1304-0004

CLARIFIED WATER FROM THICKENER & TAILINGS DISPOSAL SCHEME

RAW COAL PLANT FEED

WASH WATER/ DESLIMING HEAD BOX

SLURRY CYCLONES

WASH BOX WATER CONE

MIDDLINGS SCREEN

MIDDLINGS CRUSHER

SURGE BUNKER

SIEVE BEND

SLURRY DEWATERING SCREEN

VIBRATING FEEDERS

DISCARD DEWATERING SIEVES

DISCARD DEWATERING SCREEN

DISCARD CONVEYOR

DESLIMING SIEVE

DESLIMING SCREEN

BAUM WASHBOX

TO THICKNER & TAILINGS DISPOSAL SCHEME

CLEAN COAL DEWATERING SIEVES

CLEAN COAL DEWATERING/ CLASSIFYING SCREENS

CLEAN COAL CENTRIFUGES

SLURRY CYCLONE FEED PUMP

MAIN WASHERY SUMP

DRAINAGE SUMP

FINE CLEAN COAL CONVEYOR

COARSE CLEAN COAL CONVEYOR

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORGE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN 1979)

REV.	DESCRIPTION	BY	DATE	CHK.
2	ISSUED WITH FINAL REPORT	K.S.	OCT 23/78	B
1	DRAFT FOR FINAL REPORT	C.W.	MAY 1/78	

BRITISH COLUMBIA HYDRO & POWER AUTHORITY
NAT CREEK PROJECT, BRITISH COLUMBIA, CANADA.
MODULAR BAUM COAL WASHERY

SIMON-CARVES

PHOTOGRAPHIC SCALE — MILLIMETRES 8 9 10 ON INCH

AREA: CATEGORY:

DWG. TITLE: FLOWSHEET FOR BAUM WASHERY (ONE MODULE)

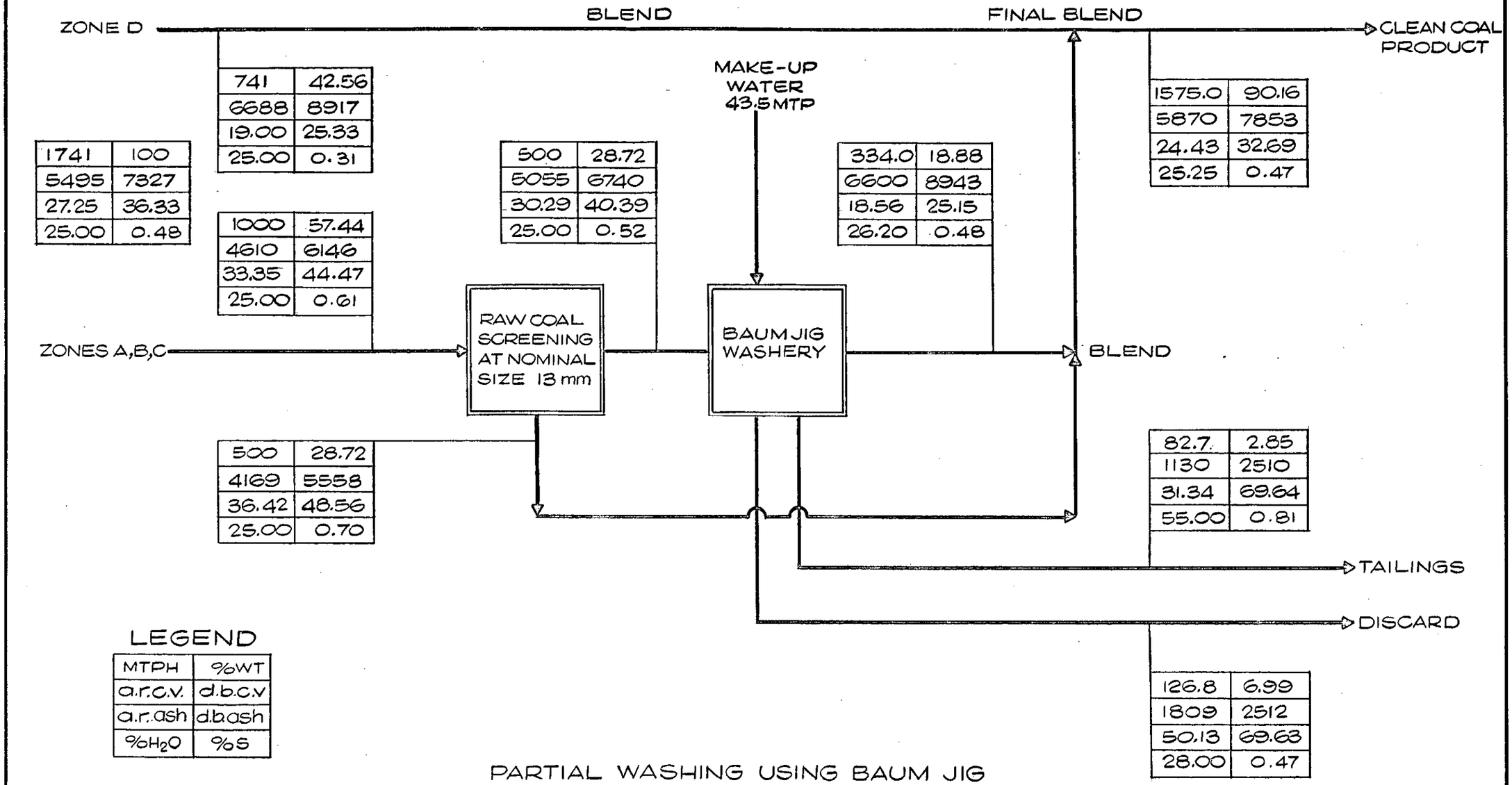
DESIGNED	D.V.W.		PROJ. MGR.	S.C.B.
DRAWN		SCALE	PROJ. DES.	
CHECKED	S.C.B.		D.O. MGR.	

REPORT FIGURE NUMBER: 5-3-2

SCAN DRAWING NUMBER: F1304-0004 SHEET 1 OF 1

REV.: 2

DWG. NO F1304-0006 SHT 3 OF 6



LEGEND

MTPH	%WT
a.r.c.v.	d.b.c.v
a.r.ash	d.b.ash
$\%H_2O$	%S

PARTIAL WASHING USING BAUM JIG

REV	DESCRIPTION	BY	DATE	CHK.
2	ISSUED WITH FINAL REPORT SULPHUR VALUES ADDED	K.S.	OCT 20/78	
1	DRAFT FOR FINAL REPORT	TG	MAY 31/78	

REV	PLWK	CONC	ARCH	STWK	PIPG	ELEC	MECH	HVAC	PROJ MGR	PROJ DES
11										
10										
9										
8										
7										
6										
5										
4										
3										
2										
1										

B.C. HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT
BRITISH COLUMBIA, CANADA

DESIGNED	P.V.T.		SCALE	PROJ. MGR.	
DRAWN	T.G.			PROJ. DES.	
CHECKED	S.C.B.			D.O. MGR.	

SIMON-CARVES

AREA: CATEGORY:

DWG. TITLE: MATERIAL BALANCE
PARTIAL WASHING USING BAUM JIG

REPORT FIGURE NUMBER	SCAN DRAWING NUMBER	REV.
5-3-1	F1304-0006 SHT 3 OF 6	2

SHEET SIZE I.S.O. A3

VOLUME IV

SECTION 12

PRELIMINARY DESIGN AND COSTING OF ALTERNATIVE EQUIPMENT FOR TAILINGS DISPOSAL

SECTION 1

SUMMARY

This is a Preliminary Consideration of the requirements for Tailings Disposal Equipment assuming that a Partial Washing Scheme is adopted.

Alternative facilities are discussed and Solid Bowl Centrifuges recognized as the only acceptable equipment for a very difficult tailings problem.

Emergency pond facilities will be needed in conjunction with any such mechanical dewatering plant.

FOOTNOTE: October 1978

This section was issued in draft form in January 1978 prior to receipt of the EMR Test Wash and Flocculant Evaluation Report. Also, this section is based on a degree of partial washing which was substantially revised in mid-1978 to suit the data from revised Mine Plans and Fuel Specifications. This section should be read primarily for technical considerations. For quantities and costs of the actual tailings plant and disposal facilities required by alternative schemes reference should be made to the final report, i.e. C-MJV Mining Feasibility Report Volume VIII, Appendix B, "Hat Creek Coal Beneficiation".

SECTION 2

INTRODUCTION

When coal is cleaned by wet processing or washing, "fines" (i.e. material below 0.5mm or 28 mesh) remain in the washwater, the coarser products having been dewatered by screening and/or basket centrifuging. Coal fines may be further recovered (down to say 100 mesh) using hydrocyclones, fine mesh screens, and filters or screen bowl centrifuges. The reject washwater thus contains high ash fines (minus 28 mesh or minus 100 mesh), which are termed "tailings".

The washwater is therefore, recovered by clarifiers, the clasification being made effective by the use of tailings flocculation re-agents. From the base of the clarifiers (or thickeners) a tailings sludge is produced.

The Hat Creek 1976 Test Programme included three bulk washing tests, and difficulty was experienced during these tests in dealing with the relatively large quantity of tailings resulting from the clay bands in the samples tested. It was also noted that this quantity of tailing was several times greater than would be predicted from the raw coal washability data.

The 1977 Test Programme was, therefore, designed to investigate the tailings flocculation and dewatering requirements. Firstly B.C. Hydro had included a full study of flocculation as part of the Test Wash to be undertaken by the E.M.R. "Canmet" Pilot Plant at Edmonton. Secondly, Simon-Carves introduced a Wet Attrition Test Procedure which has been developed in Australia. The full report on this programme is not yet available, but preliminary data has been used in formulating the Basis of Design for this Draft Report. (Details are, therefore, subject to revision.)

As a result of the 1976 Bulk Washing Tests (which treated 20mm x 0 raw coal) it was recognized that a total washing scheme at Hat Creek might be totally impracticable, and the emphasis of the coal beneficiation studies has been to wash the minimum of the anticipated raw coal necessary to achieve the desired boiler fuel quality. This report, therefore, is based on the requirement to wash all of the plus 12mm raw coal, and to blend this with the 12mm x 0 untreated fine coal. The tailings disposal schemes in this report are, therefore, based on requirements resulting from fines carryover and attrition within this scheme.

The requirements for a total washing scheme are briefly outlined for reference.

Alternative methods for dewatering and disposal of tailings are reviewed. Order of magnitude costs are developed for a scheme utlizing Solid Bowl Centrifuges and for equipment for use with a Tailings Lagoon.

SECTION 3

CONCLUSIONS AND RECOMMENDATIONS

3.1 Tailings Impoundment in Lagoons is practicable, but the large lagoons required are likely to be "environmentally unacceptable".

3.2 Solid Bowl Centrifuges are considered to be the only mechanical dewatering plant effective on the Hat Creek tailings.

3.3 Consideration must be given to the means of transporting the Centrifuge Cake to the Waste Disposal system: the high moisture content anticipated is likely to give substantial problems.

3.4 Provision MUST be made for Emergency Ponds/Lagoons for use in event of dewatering plant problems.

3.5 The Solid Bowl Centrifuge scheme as envisaged in this study would be operating at the fringe of present experience. It is most strongly recommended that pilot plant investigations of tailings production and dewatering plant design be completed prior to any further considerations of wet processing of Hat Creek coals.

SECTION 4

METHODS FOR TAILINGS DISPOSAL

4.1 Conventional Flocculation

This employs whichever flocculant or combination of flocculants is found to give: -

a) acceptable clarified water for re-use

b) initial settling rates of the order of 1.5 to 2.5 m/hr

c) acceptable sludge compaction for subsequent dewatering/disposal

Frequently, the tailings sludge would be of the order of 25 to 30% solids by weight. Lower flocculant usages, whilst giving lower initial settling rates, frequently give a better degree of sludge compaction. A practical compromise is often necessary. In some cases flocculation is aided by addition of lime which also corrects clarified water pH.

Suitable flocculants have been found to achieve requirements (a) and (b) for Hat Creek tailings. The nature of the clays, with a very fine size consist, are thought responsible for the fact that with or without flocculant re-agents, the compacted tailings are consistently of the order of 17 to 18% solids by weight. This is a clear initial indication that tailings disposal at Hat Creek presents serious problems.

4.2 Super-Flocculation

Some high ash tailings are amenable to treatment with "super-flocculant" in special deep cone thickeners to give a very thick sludge (say over 60% solids) which can be passed to the solid discards conveyor.

Hat Creek materials have not shown the high degree of thickening compaction necessary for this process.

In any case, the large proportion of tailings at Hat Creek and the high cost of flocculants would exclude this method which is generally employed at smaller short life mines.

SECTION 4

METHODS FOR TAILINGS DISPOSAL

4.3 Incorporation in Product

Where a relatively hard shale is associated with the coal, the ash content of the minus 28 mesh fines contained in the washwater may be relatively low. If this material is consistently below say 25% ash, the flocculated fines sludge from the base of the conventional clarifier/thickener can be dewatered by disc filter, and the filter cake incorporated in a part-washed blended smalls product.

The very soft shales, virtually unconsolidated clays, at Hat Creek, give a high ash sludge which cannot be considered for this method. It is in fact, desirable to exclude these shales from the boiler plant fuel.

4.4 Lagoon Clarification

Large settling ponds or lagoons have in the past been used by some smaller mining operations to receive the washwater, often without flocculation. The top-water is returned as the normal supply of clarified water to the coal washing circuit. This method is attractive where unflocculated tailings have relatively high initial settling rates and give good tailings compaction. (Eventual reclaim as below.) Tests to-date rule this out for Hat Creek.

4.5 Lagoon Disposal

Conventional flocculation and clarifiers are frequently followed by lagoons for the final gravity compaction of the tailings. For example, tailings can be pumped relatively easily at 20 to 25% solids, and on standing for some months many tailings will compact to say 55 to 60% solids. Top-water is regularly returned to the washery circuit.

Where lagoon space is restricted, a series of lagoons are used in say a 1 to 2 year cycle. After some months filling the lagoon is then left for a long compaction period: top-water return continuing. The lagoon begins to dry out in summer conditions, and the sludge is drawn out and stacked by drag-line. After further air-drying to give say 65 - 70% solids the lagoon cake is disposed of with lump mine waste. The lagoon may then be re-used: in practice 2 or 3 effective re-uses may be made of a lagoon constructed using compacted mine waste.

SECTION 4

METHODS FOR TAILINGS DISPOSAL

4.5 Lagoon Disposal - cont.

To overcome some environmental objections, large lagoon ponds constructed with reinforced concrete liners have been installed in recent years. These may be re-used many times, a variety of equipment, e.g. front bucket shovels, being used for emptying according to design and nature of solids.

The Hat Creek tailings tend to be thixotropic and do not give the degree of compaction necessary to envisage lagoon reclaiming as a possibility.

N.B.

4.5.1 There are developing pressures against lagoons from environmental and safety standpoints. It would be inadvisable to plan on the basis of using permanent lagoons.

4.5.2 Mechanical tailings dewatering plants have a reputation of initial teething troubles. Thus any plant scheme should include temporary or emergency lagoons so that the washery may continue in operation. The form of these would depend on "permits" and any need to recycle to dewatering plant.

4.5.3 Similarly suitable emergency ponds are required for emptying clarifiers and washery circuits generally.

4.6 Filter Presses

Filter Presses were developed primarily in the clay industry, and have proved most successful for many coal washing tailings, giving cakes of 65 - 70% solids.

They are batch process units with a cycle time from 1 hour upwards. Due to the arduous labour of moving the cast iron filter-chamber plates they have been unfashionable at times. During the past decade, rubber plates and/or mechanisation have led to their introduction on a large scale under environmental pressures.

SECTION 4

METHODS FOR TAILINGS DISPOSAL

4.6 Filter Presses - cont.

The capital costs, both equipment and buildings, are high.

The 100 chamber by four feet square plate unit has a capacity of four tons of dry solids per cycle. Cycle times of between 1 and 2 hours are found acceptable where it is necessary to obtain this dry quality filter cake due to the low dry waste: tailings ratio resulting from say an underground mine.

From the size consist and compaction characteristics of the Hat Creek tailings, we envisage a cycle time of 4 hours. A sticky cake would result which would necessitate additional labour for even a highly mechanised scheme.

We consider, therefore, that filter presses would be excessively expensive.

4.7 Tube Presses

Tube Presses have been the subject of considerable development expenditure to obtain a continuous process giving comparable results to Filter Presses. Costs are very high, and the mechanism not fully established.

4.8 Solid Bowl Centrifuges

High speeds are used to achieve a high degree of cake compaction in a horizontal bowl centrifuge, which is removed by a scroll rotating at a controlled speed somewhat less than the bowl. The centrate overflows axially. Dosing the feed with "super-flocculants" is necessary to retain ultrafines in the cake and achieve centrate clarity: effective pre-thickening in a conventional clarifier- thickener is required to maintain throughput.

Acceptable results are now being achieved on coal washery tailings with high clay contents. In conjunction with the machine manufacturers, we currently estimate 45 - 50% solids as attainable at Hat Creek. (The large units now in production would have a capacity of the order of 30 TPH.)

SECTION 4

METHODS FOR TAILINGS DISPOSAL

4.8 Solid Bowl Centrifuges - cont.

A cake of this solids content could be carried to disposal if sandwiched between dry solids using normal belt conveyors. Alternatively separate trucking could be used, and the material dumped in the centre core of a waste tip for greater stability.

SECTION 5

HAT CREEK TAILINGS DISPOSAL REQUIREMENTS

NOTE: Quantities given in this Section have been revised - see page 1.

This section of the report considers the Basis of Design for the alternative schemes. It may be read in conjunction with the Modular Coal Washery Report (October/December 1977) for a description of the proposed coal washing schemes. The cases under consideration here are firstly, Coarse Coal Washing (plus 13mm), see paragraph 6.7 of Modular Coal Washery Report, and secondly, Total Washing, see paragraph 6.7.4.

The Basis of Design of the Modular Coal Washery Report assumed the 1976 Washability Tests represented the "worst case" in terms of raw coal size consist. This is indeed so in terms of the proportion of raw coal less than say 6mm. However, the 1977 Washability Testwork has shown that after allowing for the breakdown of coal in washing process equipment (wet attrition tests) there will be a relatively greater quantity of ultra-fines reporting to tailings.

The more detailed screening test data has also allowed more sophisticated calculations related to the efficiency of screening operations.

It will be noted that the Wet Attrition Test has not yet been proved for Western Canadian Coals in general, or Hat Creek in particular.

Nevertheless, the results are in closer agreement with the 1976 Bulk Wash Tests than predicted by normal calculations from conventional data. Further review can be made when full information is available from the 1977 E.M.R. Pilot Plant Tests.

At this stage the design is, therefore, based on a greater tailings production than earlier reports (e.g. Graph August 19, 1977, Fig. 1 of Alternative Beneficiation Report). The data is however, believed to be adequate for an order of magnitude costing of Tailings Disposal Scheme requirements.

5.1 Requirements for Partial Washing

Partial washing will entail dry screening the run-of-mine coal at 12.5mm with the 12.5mm to 0 raw coal being placed directly on the clean coal product conveyor. The plus 12.5mm fraction will then pass on to the dense medium bath for further beneficiation. Should the efficiency of screening be 100%, the tailings system would only be required to handle any minus 0.5mm product produced by breakage in the bath or subsequent rinsing and dewatering.

SECTION 5

HAT CREEK TAILINGS DISPOSAL REQUIREMENTS

5.1 Requirements for Partial Washing - cont.

The minus 0.5mm raw coal loading to the tailings system was then calculated by combining the individual loadings from each of the X,Y and Z samples in the yielding a maximum loading. Design of the tailings system, therefore, has been based on a blend of X,Y and Z coals in the ratio of 35%, 35% and 30% respectively.

These calculations, therefore, give the following values: -

		Samples		
		X	Y	Z
Raw Coal Feed	MTPH	2,000	2,000	2,000
Plus 1/2" Bath Feed	MTPH	794	820	1,180
	%	40	41	59
Minus 1/2" From Wet Screens	MTPH	309	315	200
	%	15	16	10
Minus 1/2mm Tailings	MTPH	138	129	80
	%	7	6	4

Taking, therefore, the "worst sustained" situation as given above, the tailings plant capacity required = 117 MTPH.

Note that in this Partial Washing Scheme, it is assumed that all minus 1/2mm material in the washwater circuit is discarded as tailings. If water only cyclones were incorporated it may be possible to reduce this by recovery of 1/2mm x 100 mesh coal. This would reduce 117 MTPH towards 79 MTPH as the system feed.

SECTION 5

HAT CREEK TAILINGS DISPOSAL REQUIREMENTS

5.1 Requirements for Partial Washing - cont.

However, in practice dry screening efficiencies do not approach such perfection. Therefore, to prevent minus 0.5mm coal from entering the dense medium bath, the plus 12.5mm raw coal will pass onto a pre-wet screen. Any adhering minus 0.5mm particles will then be removed and will gravitate to the tailings system. The second source of minus 0.5mm tailings will be from the effluent system which consists of underflow from the dilute medium system and vibratory centrifuge centrate.

In order to size the tailings disposal system, it was necessary to estimate the amount of 0.5mm raw coal to be treated. This amount is directly related to the efficiency of screening at 12.5mm in addition to the degree of attrition involved in washing.

In certain cases the efficiency of screening is in the order of 90% for a separation at 12.5mm (square hole). That is, the weight of the screen underflow expressed as a percentage of the total weight of material below 12.5mm in the feed is 90%. However, due to the high percentage of near size material in the X,Y and Z samples, together with the coal having a relatively high moisture content and clay inclusions, a 90% efficiency is far too high.

To accurately assess the screening efficiency, the size consistencies of the X,Y and Z samples were examined. Reasonable partition coefficients were placed on each size fraction. For example, the efficiency of screening a 100 x 50mm piece of coal is 100%, whereas the efficiency of screening a piece 25 x 12.5mm is approximately 80%. As these factors were applied to the size consistencies of the samples, the high amount of near size material greatly depressed the overall screening efficiency.

This analysis yielded an average screening efficiency in the order of 70%. In turn it was assumed that removal of minus 0.5mm raw coal from the misplaced minus 12.5mm fraction at the pre-wet screens would be 100% efficient. In wet screening this is a reasonable assumption.

This enabled the minus 0.5mm raw coal loading to the tailings system to be determined for each of the three samples. In addition, breakage was estimated to be 10 - 12%, that of the natural run-of-mine minus 0.5mm content.

SECTION 5

HAT CREEK TAILINGS DISPOSAL REQUIREMENTS

5.2 Requirements for Total Washing

The values calculated below assume that a two stage Water Only Cyclone System is used for the 1/2" x 0 coal, the tailings being 100 mesh x 0 material.

		Samples		
		X	Y	Z
Feed	MTPH	2,000	2,000	2,000
Plus 1/2" Bath Feed	MTPH	794	820	1,180
	%	40	41	59
Minus 1/2" to W.O. Cyclones	MTPH	1,206	1,180	820
	%	60	59	41
Minus 1/2mm in W.O. Cyclone Circuit	MTPH	377	561	109
	%	19	28	5
Minus 100 mesh in Circuit	MTPH	231	389	89
	%	11	19	4

Thus taking the "worst sustained" situation as before we require a tailings plant capacity of 237 MTPH. (In practice this estimate may be low as some of the 28 mesh x 100 mesh reject would also find its way to the clarification and tailings disposal plant.)

SECTION 6

TAILINGS LAGOON

6.1 Summary of Calculations of Plant Design (NOTE: See Page 1)

The loading of minus 0.5mm raw coal to the tailings system was calculated as outlined in Section 4.2. These loadings are 138 MTPH, 129 MTPH and 80 MTPH of coals with properties similar to samples from X, Y and Z, respectively. Once thickened, these tailings will be pumped to a common tailings holding sump from where they will be pumped to the tailings lagoon. This tailings lagoon will be provided by others.

The thickener underflow will have a maximum solids concentration of 18% on a weight for weight of water basis. Assuming that the specific gravity of the solid particles will be 1.85, the volumetric capacity range will be 11.76 m^3/min, 10.99 m^3/min, and 6.81 m^3/min for the X, Y and Z samples, respectively.

The pumps selected to pump the thickened tailings to the lagoon have been sized to handle 10.0 m^3/min which will be the worst expected tailings loading.

From the drawing (viz Cominco-Monenco drawing No. 620-001) showing the site layout and elevations, it is evident that a downhill pumping situation exists. The elevation of the plant is 907 m while the elevation of the lagoon is 853 m. However, pumping will be required since there will be considerable runs of level ground. In order to provide adequate slope ensuring sufficient slurry velocity and hence preventing settling of solids, considerable excavation would be required. Therefore, pumping will be installed to move the tailings approximately 120 m from the sump. At this point the pipeline will undergo a 16 m vertical drop. This drop will provide sufficient velocity to carry the slurry the remaining distance.

The pipe diameter selected was 8" (20.32cm) nominal bore. This size will minimize friction losses while maintaining sufficient velocity to prevent settling in the line.

The pipeline will terminate in the proximity of the south west corner of the Administration Building. At this point the tailings will exit into a 30" (76.2cm) diameter corrugated culvert. The culvert will feed directly into the lagoon. Considerable grade exists along this final run enabling the pipeline to terminate at this point.

SECTION 6

TAILINGS LAGOON

6.1 Summary of Calculations of Plant Design - cont.

The clean water return system has been designed to handle the maximum amount of top-water which could be available. This was based on the fact that the maximum compaction of solids in the lagoon will be 40% weight for weight of water. Since maximum compaction will retain minimum water, the available water for return to the washery will also be maximum. Therefore, this design flow rate was calculated to be 5.32 m^3/min.

The return water system will employ two 8" (20.32cm) diameter schedule 40 pipelines. Each line will carry 50% of the return water. Larger diameter pipe has been selected to reduce velocity and hence friction losses. This also permits reduction of installed horsepower.

The pumping will be accomplished in two stages. The primary stage will pump to a sump located near the terminus of the tailings discharge line. From this sump, secondary pumps identical to the primary pumps will pump the return water to the washery.

A standby pump has been incorporated into the design at each pumping station in the tailings disposal system. These stations are located at the tailings sump, the clean water return pump house and at the terminus of the tailings discharge line. These standby pumps will be able to discharge into either pipeline. A further advantage of the additional installed equipment is that should unforeseen tailings overloading occur, all three pumps could be operated for brief periods of time in emergency situations.

The location of the clean water return pump house has been selected because of its proximity to the discard conveyor shown on the site layout. Periodic inspection of this conveyor could include inspection of the pumphouse. It has also been assumed that the rear dam will be located at this point.

SECTION 6

TAILINGS LAGOON

6.2 Description of Proposed Scheme

The thickened tailings underflowing from the three tailings thickeners will be pumped to a common tailings holding sump. This sump will be fitted with three pump suction lines. Each suction line will feed into a 8/6 E-AM Warman slurry pump. Two pumps will be in an operating mode while the remaining pump will be in a standby mode.

The pumps will deliver the tailings into two 8" (20.32cm) diameter pipelines for transport to the lagoon. Actual pumping will occur only to a point a few metres past the roadway. The pipelines will remain horizontal from the sump to this point. A bridge spanning the roadway will carry the pipelines. At the terminus of this bridge the pipeline will continue at ground level. The energy developed in the 16 m drop from the top of the bridge to ground level will carry the slurry the remaining distance. This vertical section of pipeline will be vented to the atmosphere at the top to reduce turbulence.

The pipeline will exit into a 30" (76.2cm) diameter corrugated culvert for final delivery to the lagoon. The entrance point to the lagoon will be at the lower end near the dam.

At the upper end of the lagoon the clean water return pump house will accept lagoon top-water. This top-water will be relatively clean as the solids will have settled out.

This clean water will be pumped via two 6 / 4 E-AH Warman pumps into two 8" (20.32cm) diameter pipelines. A third identical pump will be installed in a standby mode of operation. These pipelines will carry the clean water to a sump located at the termini of the tailings discharge lines. This sump will be fitted with three pump suction lines. These lines will each feed into a 6/4 E-AH pump for delivery through two pipelines to the clarified water sumps located in the washery. This sump provides a two part purpose. Firstly, level control of the clarified water sumps will be provided by shutting down only the second stage pumping. This will cause the sump to overflow into the tailings delivery culvert and back to the lagoon. The primary stage pumps will continue running. Secondly, if the quality of top-water is not suitable for use in the washery it will be diverted back to the lagoon.

SECTION 6

TAILINGS LAGOON

ITEM LIST

6.3 Alternate Tailings Disposal & Clean Water Return

No.	Item
4260	Standby Thickened Tailings Pump - Warman 8 x 6 F-AH
4261	Bedplate for Thickened Tailings Pump
4262	Clean Water Return 1st Stage Pump House
4263 - 4265	1st Stage Clean Water Return Pumps Warman 6 x 4 E-AH
4266 - 4268	Bedplates for 1st Stage Clean Water Return Pumps
4269	Clean Water Return 2nd Stage Pump House
4270 - 4272	2nd Stage Clean Water Return Pumps Warman 6 x 4 E-AH
4273 - 4275	Bedplates for 2nd Stage Clean Water Return Pumps
4276 - 4278	Heaters for Tailings Pump House & 1st and 2nd Stage Clean Water Pump Houses

SECTION 7

SOLID BOWL CENTRIFUGES

7.1 Summary of Calculations of Plant Requirements

The loading of minus 0.5mm raw coal to the tailings system was calculated as outlined in Section 4.2. These loadings are 138 MTPH, 129 MTPH and 80 MTPH of coals of properties similar to samples from X, Y and Z, respectively. Once thickened, these tailings will be pumped to a common tailings holding sump from where they will be pumped to Solid Bowl Centrifuges for dewatering.

The "H" Series Centrifuge has a capacity of 33 MTPH. Therefore, a minimum of three and a maximum of five operational centrifuges will be required for the calculated tonnage ratings.

The thickener underflow will have a maximum solids concentration of 18% on a weight for weight of water basis. Assuming that the specific gravity of the solid particles will be 1.85, the volumetric capacity range will be 11.76 m^3/min, 10.99 m^3/min and 6.81 m^3/min for the X, Y and Z samples, respectively.

In view of the relatively low solids concentration (viz 18% wt/wt maximum) the centrifuges were sized based on their volumetric capacity rather than their solids handling capacity. Each machine has been designed to handle a volumetric capacity of 1.82 m^3/min. Therefore, a minimum of four and a maximum of seven operating centrifuges will be required. Incorporating one standby centrifuge predicates a total of eight centrifuges installed.

In the event of failure of two or more centrifuges, the thickened tailings can be pumped to an emergency storage lagoon via one of two installed 8/6 E-AM slurry pumps. (E.g. Scheme A as in Section 6)

The amount of flocculant required was determined assuming a dosage rate of 0.227 kg per metric ton of solids to be treated. This dosage is required due to bentonitic content to achieve an acceptable moisture content and handleable cake. The nominal loading of tailings to the system will be 117 MTPH.

7.2 Description of Proposed Scheme

Please read this description in conjunction with our Flowsheet No. F1304-0005 (starting from Tailings Sump) and General Arrangement Drawing No. F1304-1004.

SECTION 7

SOLID BOWL CENTRIFUGES

7.2 Description of Proposed Scheme - cont.

The minus 0.5mm tailings will originate in the washery at the following locations. Firstly, 30% of the 12.5mm to 0 run-of-mine coal will not be removed at the 12.5mm dry screening section. This misplaced coal will then pass onto a pre-wet screen fitted with 0.5mm wedge wire. The 0.5mm - 0 fraction will effectively be wet screened out and these fines, together with the desliming water, will gravitate to the tailings system.

Secondly, the plus 12.5mm raw coal will be washed in a dense medium bath and separated into two products. Each of these two products will pass onto medium drainage and rinsing screens fitted with 0.5mm wedge wire. Any minus 0.5mm product produced by breakage in the bath will enter the medium recovery system. Being non-magnetic, these minus 0.5mm tailings will pass out with the magnetic separator underflow into the tailings system.

The third source of tailings will be from the vibratory centrifuges. Any minus 0.5mm particles produced by breakage between the rinsing screens and centrifuges will be removed.

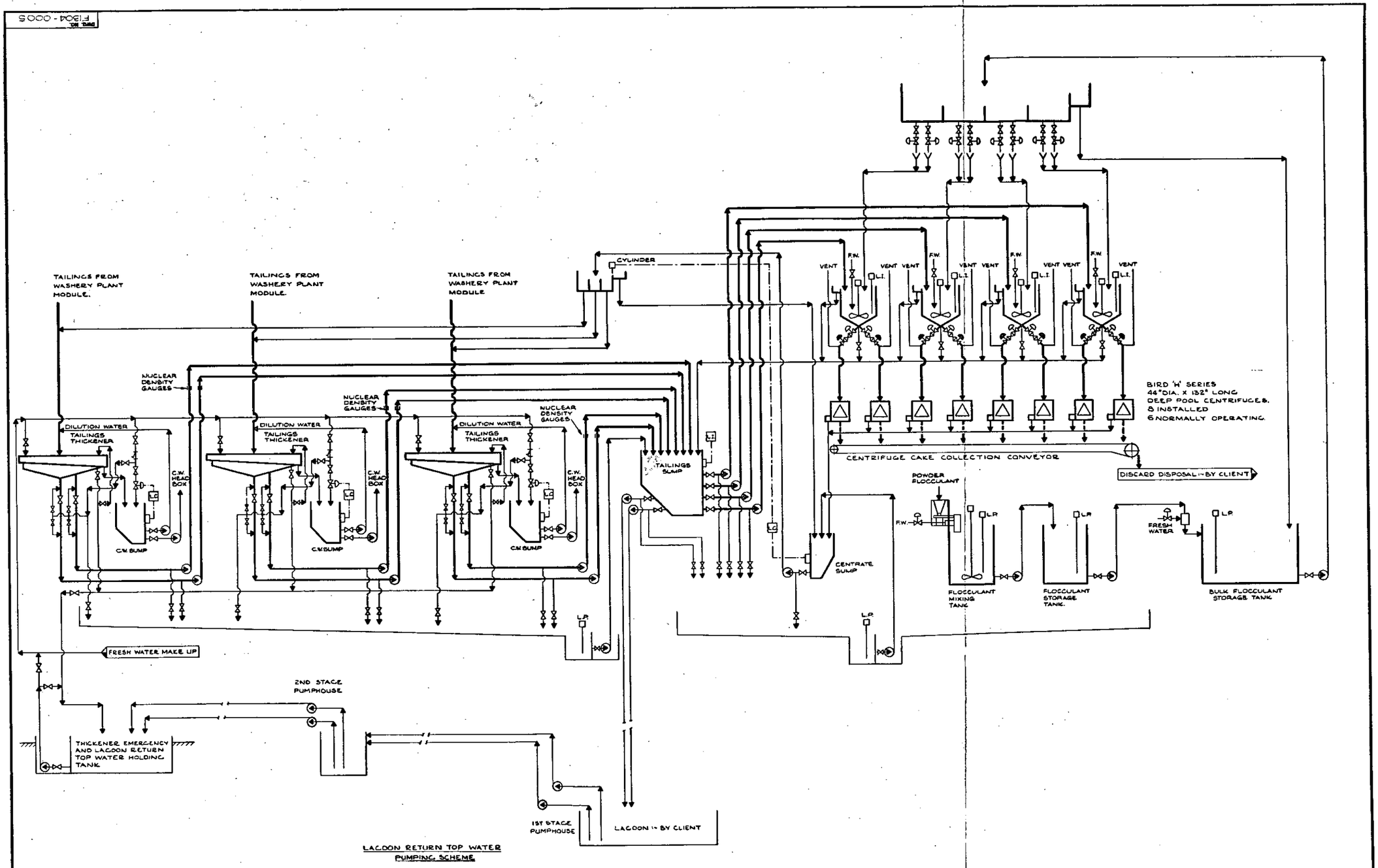
The tailings will then be thickened in three 38 m thickeners. Flocculants added to the thickener feeds will assist in settling. The solids will then be raked by rotating mechanisms to the thickener centres from where they will be pumped to a single common sump.

This tailings sump will be fitted with four slurry pump suction lines. Each line will deliver feed to two of eight series "H" solid bowl centrifuges. A maximum of seven centrifuges will be required to operate at any one time. From one to four centrifuges can be shut down into a standby mode of operation.

The tailings sump will also have an additional two slurry pumps suctions feeding into two emergency slurry pumps. Should two or more centrifuges not be available for duty, the tailings can be pumped to an emergency lagoon.

The water removed by the centrifuges will then be returned to the thickener via a centrate sump and pump. The solid cake will be deposited onto a conveyor and removed to the refuse disposal site.

DWG. NO. F1304 - 0005



LAGOON RETURN TOP WATER
PUMPING SCHEME.

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA.
WILLIAM CORSE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN 1979)

REV.	DESCRIPTION	BY	DATE	CHK.
2	ISSUED WITH FINAL REPORT	K.B.	OCT 23/78	
1	DRAFT FOR FINAL REPORT	C.W.	MAY 78	

BRITISH COLUMBIA HYDRO & POWER AUTHORITY.
HAT CREEK PROJECT, BRITISH COLUMBIA, CANADA.
TAILINGS DEWATERING SCHEME.

SIMON-CARVES

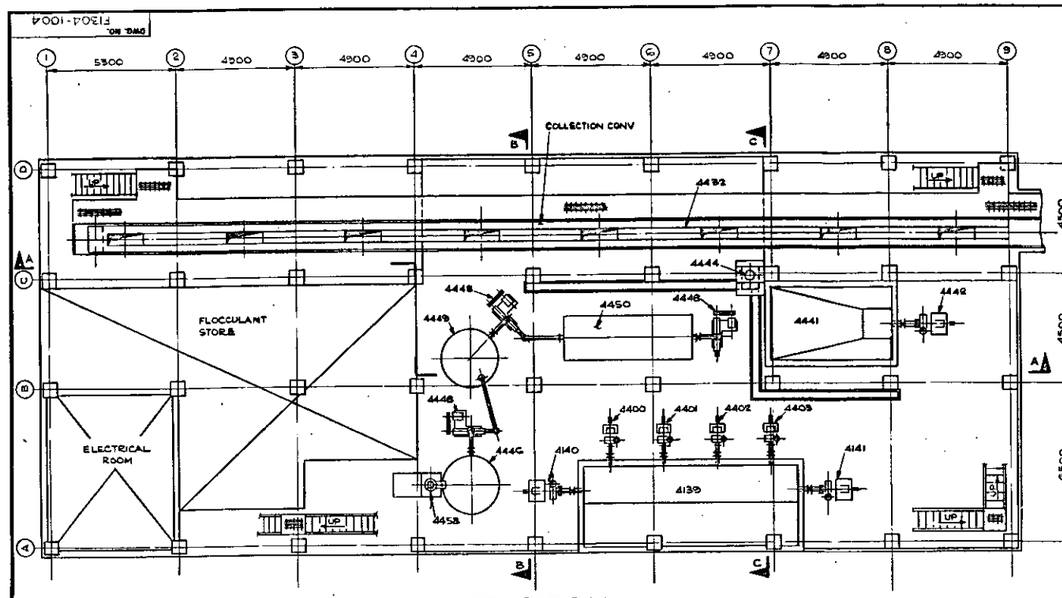
PHOTOGRAPHIC SCALE — MILLIMETRES 5 & 10 DIV./INCH

DESIGNED	D.V.W.	SCALE	PROJ. MGR.	S.C.B.	
DRAWN	K.C.L.		PROJ. DES.		
CHECKED	S.C.B.		D.O. MGR.		

AREA:
CATEGORY:
DWG. TITLE: FLOWSHEET FOR THICKENERS AND TAILINGS DISPOSAL SCHEME. (SOLID BOWL CENTRIFUGES)

REPORT FIGURE NUMBER: 4-1
SCAN DRAWING NUMBER: F1304-0005
SHEET 1 OF 1
REV.: 2

DWG. NO. F1304-1004



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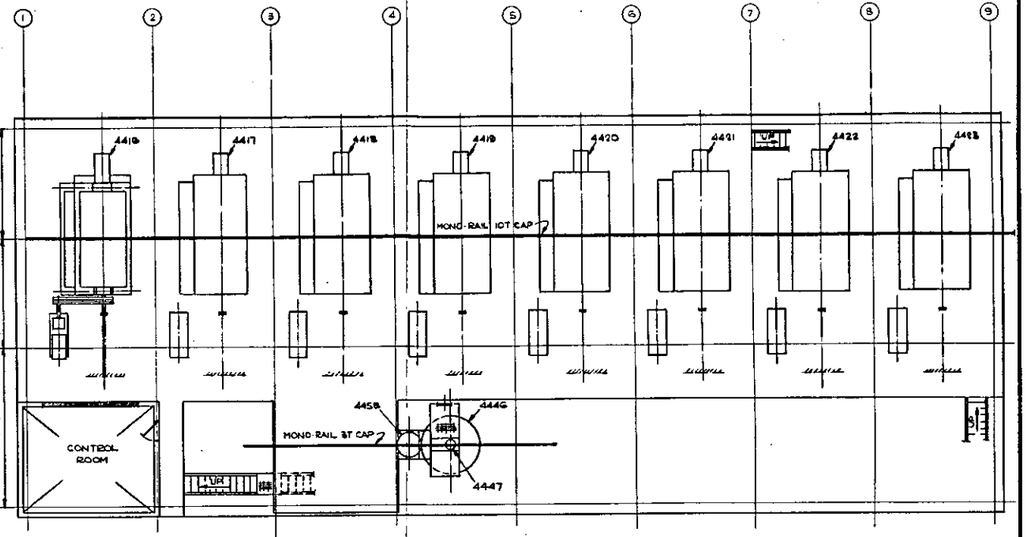
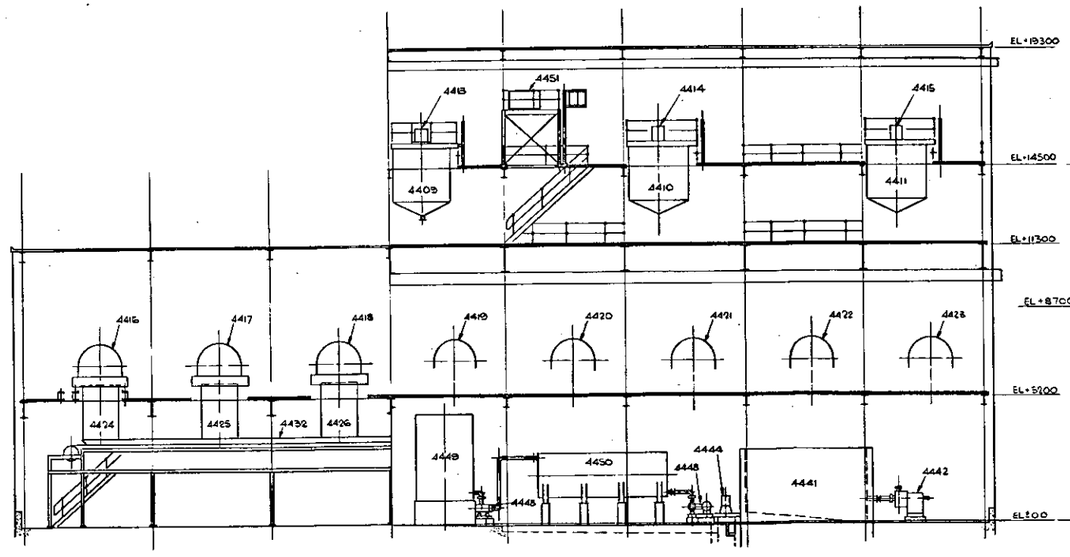
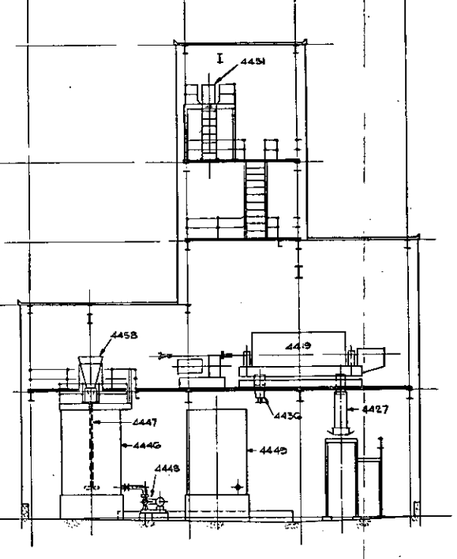


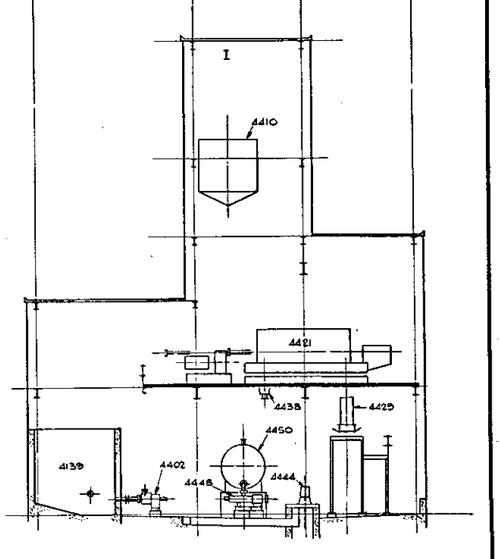
PLAN EL + 5200



SECTION-AA



SECTION-BB



SECTION-CC

THE ASSOCIATION OF PROFESSIONAL ENGINEERS OF THE PROVINCE OF BRITISH COLUMBIA
WILLIAM CORSE
NON-RESIDENTS LICENCE (EXPIRY DATE 8 JAN 1979)

REV.	PLAN	CONC	ARCH	STRUC	PIPE	ELEC	MECH	HVAC	PROJ MGR	PROJ DES
11										
10										
9										
8										
7										
6										
5										
4										
3										
2										
1										

REV.	DESCRIPTION	BY	DATE	CHK.
2	ISSUED WITH FINAL REPORT	K.S.	OCT 23/78	
1	DRAFT FOR FINAL REPORT	KGL	MAY 31/78	

BRITISH COLUMBIA HYDRO AND POWER AUTHORITY
HAT CREEK PROJECT, BRITISH COLUMBIA, CANADA.
2400 M.T.P.H. MODULAR COAL WASHERY.

SIMON-CARVES

AREA: CATEGORY:
DWG. TITLE: SOLID BOWL CENTRIFUGE - LAYOUT.

PHOTOGRAPHIC SCALE — MILLIMETRES 8 & 10 DIV./INCH

DESIGNED	D.V.W.		SCALE	PROJ. MGR.	S.C.B.
DRAWN	K.G.L.	MAY 31/78	1:75	PROJ. DES.	
CHECKED	S.C.B.			D.D. MGR.	

REPORT FIGURE NUMBER	SCAN DRAWING NUMBER	REV.
4 - 2	F1304-1004	2

SECTION 7

SOLID BOWL CENTRIFUGES

ITEM LIST

7.3 Tailings Centrifuge System

No.	Item
4200 - 4203	Thickened Tailings Pump Warman 6 x 4 D-AM
4204 - 4207	Bedplates for Thickened Tailings Pumps
4208 - 4211	Centrifuge Buffer Tanks
4212 - 4215	Slow Speed Stirrer for Centrifuge Buffer Tanks
4216 - 4223	Bird "H" Series 44" Diameter x 132" Lg. Deep Pool Centrifuge
4224 - 4231	Centrifuge Solids Discharge Chute
4232	Skirt Plates for Centrifuge Solids Collecting Conv.
4233 - 4240	Centrate Underpans
4241	Centrate Sump
4242	Centrate Pump Warman 8 x 4 E-AM
4243	Bedplate for Centrate Pump
4244	Floor Sump Pump Warman 4 x 3 C-AM
4245	Bedplate for Floor Sump Pump
4246	Flocculant Mixing Tank
4247	Stirrer for Flocculant Mixing Tank

SECTION 7

SOLID BOWL CENTRIFUGES

ITEM LIST

7.3 Tailings Centrifuge System - cont.

No.	Item
4248	Flocculant Pump Moyno Frame IL12
4249	Flocculant Storage Tank
4250	Bulk Flocculant Storage Tank
4251	Flocculant Distribution Box
4252	10 T. Capacity Lifting Trolley
4253	3 T. Capacity Lifting Trolley
4254 - 4255	Roof Fans
4256 - 4257	Heaters
4258	Flocculant Dosing System

SECTION 8

CAPITAL COST ESTIMATES

8.1 Basis of Estimate

The Capital Estimate is on an "Order of Magnitude" basis to permit estimation of an overall Coal Preparation Scheme. It has been conceived in conjunction with the Modular Coal Washery Scheme (October 1977) with this plant being used only as a Coarse Coal Washing (+ 13mm) Scheme - "mode" 6.7.1 - Revision December 1977. Should a greater degree of coal washing be required, multiples of this present tailings plant would be necessary.

This plant would be equally suitable for use in conjunction with Alternate Coal Washing Schemes for Hat Creek Coals. Simon-Carves will indicate the relevant requirements for these plants with reference to this plant.

8.1.1 The following items are not included in the pricing shown: -

Land Purchase
Site Clearing
Rough Grading
Rail Tracks
Roads
Main Power Supply
Potable and Process Water Supply
Construction Camp
General Workshops and Stores Facilities
General Offices
Plant Laboratory
Sewage/Effluent Treatment
Tailings Ponds
Construction of Conveyors and Disposal Facilities for Centrifuge Cake or Lagoon Solids

8.1.2 In addition, the following factors have not been taken into consideration: -

Contingencies
Escalation
Allowance for Winter Work
Premium Time
Inspection and Testing
Contract Indirects

SECTION 8

CAPITAL COST ESTIMATES

8.1 Basis of Estimate - cont.

8.1.3 Scheme 'A' refers to the Pumping Scheme for use in conjunction with a Tailings Lagoon as described in Section 6.

Scheme 'B' refers to the Tailings Centrifuge Plant as described in Section 7.

SECTION 8

CAPITAL COST ESTIMATE

8.2 Head Office/Construction Management/Plant Commissioning manhour estimate.

COST CODE	DESCRIPTION	MANHOURS SCHEME 'A'	MANHOURS SCHEME 'B'
100	*Executive	0	0
110	*Project	0	0
111	Civil/Structural	220	1,800
112	Mechanical	80	1,600
113	Electrical	40	800
114	Instrument	20	300
115	Process	70	140
144	Estimating	40	120
	ENGINEERING CATEGORY SUB-TOTAL	470	4,760
120	Management Services	80	400
121	Mechanical	400	4,500
124	Civil/Structural	600	1,200
127	Electrical	180	800
	DRAWING OFFICE CATEGORY SUB-TOTAL	1,260	6,900

SECTION 8

CAPITAL COST ESTIMATE

8.2 - cont.

COST CODE	DESCRIPTION	MANHOURS SCHEME 'A'	MANHOURS SCHEME 'B'
130	Purchasing	90	500
131	Expediting	50	200
141	Accounts	55	200
142	Cost Control	80	300
143	Scheduling	40	200
145	Secretarial	300	1,500
	INDIRECT CATEGORY SUB-TOTAL	615	2,900
200	Management		
203	Superintendent		
240	Administration		
250	Commissioning		
	*SITE CATEGORY SUB-TOTAL	0	0

SECTION 8

CAPITAL COST ESTIMATE

8.3 Engineering/Construction Budget Cost Summary

8.3.1 Manhour allocations as above are to be considered as additional budgets over and above our previous estimate for the modular coal washery - refer summary report October 1977. Hence, no further increment of any consequence is presently anticipated for cost code items noted thus (*), provided construction of tailings disposal systems proceeds concurrently with washery proper.

8.3.2 On the foregoing basis of evaluation, then, we estimate additional head office costs at $72,000 for Scheme 'A', tailings lagoon, and $437,000 for Scheme 'B', solid bowl centrifuges.

8.3.3 Disbursement items, as travel/living expense, reproduction/communication costs, et al, can be considered as included within our previously-estimated allowances, as noted in report above.

8.4 Equipment/Materials/Freight/Labour Estimate

Copies of the Estimate Summary Sheets are attached.

8.5 Total Scheme Price

We recommend that the Lagoon "Scheme A" be used in conjunction with the Tailings Centrifuge Plant "Scheme B". The total Order of Magnitude Cost is therefore: -

"A" Equipment	:	$ 688,395
"B" Equipment	:	$ 3,146,666
Engineering	:	$ 437,000
		4,272,061

SECTION 8

CAPITAL COST ESTIMATE

ESTIMATE SUMMARY

SIMON ... OF CANADA LTD
2025 Sheppard Avenue East
Willowdale, Ontario M2J 1W2

CLIENT: C-MJV
PROJECT: HAT CREEK
LOCATION:

DESCRIPTION: TAILINGS DISPOSAL
SCHEME 'A' - LAGOON

PROJECT NO.: F. 1304
SHEET 1 OF 23

EST'D: ...
DATE: 17. FEB. 78

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	EQUIPMENT & PLATEWORK	61,100	2100	2155	12,390		77,745
	PIPING & VALVES.		151,198	4433	145,176		300,807
	CIVIL / STRUCTURAL	4500			1600	157,380	163,480
	ELECTRICAL		116,397	3470	26,496		146,363
		65,600	269,695	10,058	185,662	157,380	688,395

SECTION 8

CAPITAL COST ESTIMATE

ESTIMATE SUMMARY

Simon-[illegible] OF CANADA LTD
2025 Sheppard Avenue East
Willowdale Ontario M2J 1W2

CLIENT: C-MJV.
PROJECT: HAT CREEK.
LOCATION:

DESCRIPTION: TAILINGS DISPOSAL SCHEME B - CENTRIFUGES

PROJECT NO.: F.1304

SHEET 1 OF 41.

EST'D WJ-G DATE 17 FEB 78

CODE	ITEM	TOTAL COST EQUIPMENT	MATERIAL	FRT./DUTY	LABOUR	SUB/CONT.	TOTAL
	EQUIPMENT & PLATEWORK	1,771,210	70,118	35590	103,485		1,980,403
	PIPING & VALVES		87,317	2618	31,524		121,459
	CIVIL/STRUCTURAL	46,000			15,000	546,079	607,079
	ELECTRICAL	118,438	108,221	6330	93150		326,138
	INSTRUMENTATION	79118		2339	30129		111,586
		2,014,766	265,656	46,877	273,288	546,079	3,146,666