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# PAN OCEAN OIL LTD.

## CALGARY ALBERTA

# Preliminary Feasibility Mining Study
# Illtyd Creek Deposit
# Bonnet Plume Coalfield

This report has been examined; declared acceptable as Representation Work under Section 32 and Schedule B of the Canada Mining Regulations and valued in the amount of $ 319,214.54
44,498.64
14,957.78
378,670.96 Total

for Chief, J.H. Blaine

Date: Feb. 17, 1982

Wright Engineers Limited

Project 1098 May 1981

TRANSMITTAL
LETTER

# Pan Ocean Oil Ltd.

300 Fifth Avenue S.W. Calgary, Alberta, Canada T2P 3C4
Mailing Address:
P.O. Bag 2533, Station "M", Calgary, Alberta, Canada T2P 2M7

Telephone: (403) 268-0811
Telex: 038-22681
TWX: 610-821-6034

July 20, 1981

Mr. Manfred Klein
Director Northern Economic Planning
Department of Indian Affairs and
Northern Development
Les Terrasses de la Chaundierre
10 Wellington Street
Hull, Quebec

Dear Mr. Klein:

RE: THERMAL POWER STATION, BONNET PLUME, YUKON TERRITORY

Enclosed please find:

1) Preliminary Feasibility Mining Study, Illtyd Creek Deposit Bonnet Plume Coalfield, Wright Engineers Ltd., Project 1098 May 1981.

2) Yukon Thermal Power Generating Study for Pan Ocean Oil Ltd.; Addendum 1, Monenco Consultants Ltd., May 1981.

3) Wernecke Mountain Caribou Studies; Progress Report, October 1980, Yukon Wildlife Branch.

4) An Overview Study of the Vegetation, Wildlife and Fish Resources of the Bonnet Plume Lease, Northeastern Yukon Territory, LGL Ltd., April 1981.

The studies listed above comprise the most recent information concerning the proposed Bonnet Plume Thermal Generating Station to supply power for the Yukon Territory.

I shall be contacting you in early August to arrange meetings to discuss the project.

Yours truly,

PAN OCEAN OIL LTD.

James S. McKinney
Manager, Exploration Operations

JSM/kj
Enclosures

JUL 22 1981
M409

CANADA )
) Yukon Territory Coal Exploration Licences Nos.
) 137, 142, 144 and 146 - 154

TO WIT ) On behalf of PAN OCEAN OIL LTD.

I, William E. Brimacombe, for PAN OCEAN OIL LTD. of 300 - Fifth Avenue S.W., Calgary, Alberta, do solemnly declare that expenditures in the amount of $44,498.64 as summarized in Appendix "B" hereto attached and by this reference made a part hereof were incurred during the course of this work.

And I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath and by virtue of the Canada Evidence Act.

Declared before me at the City of )
Calgary in the Province of Alberta )
this 5th day of February, 1982 )

William E. Brimacombe
WILLIAM E. BRIMACOMBE

A Notary Public in and for the
Province of Alberta

This report has been examined; declared acceptable as Representation Work under Section 32 and Schedule B of the Canada Mining Regulations and valued in the amount of $ 44,498.64

for Chief, J.H. Laine

Date: Feb. 17, 1982.

This is Appendix "B" attached to and forming part of that certain Statutory Declaration of William E. Brimacombe dated the 5th day of February, 1982

Bonnet Plume Area - 1981
Coal Exploration Licences
Nos. 137, 142, 144 and 146 - 154 (Group II)

| | | |
|---|---|---|
| Salaries and Burden | | $ 4,253.95 |
| Travel and Business Expense | | 1,617.70 |
| Communications | | 83.74 |
| Materials, Supplies and Freight | | 278.79 |
| Outside Reproduction | | 794.86 |
| Contract Services | | 687.23 |
| Contract Project Management: | | |
| Salaries and Burden | $ 946.52 | |
| Travel and Business Expense | 442.69 | |
| Communication | 50.26 | |
| Materials, Supplies and Freight | 173.60 | |
| Demobilization | 11,996.34 | |
| Equipment Rentals | 462.86 | |
| Camp and Supplies | 242.86 | |
| Aviation Expense - Fixed Wing | 4,920.34 | |
| - Helicopter | 1,766.56 | |
| Management Fee | 1,830.85 | $ 22,832.88 |
| Environmental: | | |
| Impact Studies | $ 17,210.66 | |
| Aviation Expense - Fixed Wing | 213.70 | |
| - Helicopter | 1,937.00 | |
| Equipment Rental and Expense | 49.17 | |
| Geochem Analysis (Water) | 1,181.71 | $ 20,592.24 |
| Sub-Total | | $ 51,141.39 |
| Less Overpayment of helicopter charges in 1980 | $ 5,813.37 | |
| Return of drum deposit | 4,874.71 | $ 10,688.08 |
| Sub-Total | | $ 40,453.31 |
| Administration Overhead 10% | | 4,045.33 |
| Total | | $ 44,498.64 |

Total Acreage = 476,424 acres

Cost per Acre = $\frac{\$\ 44,498.64}{476,424}$ = $0.09

CANADA )
)
TO WIT )

Yukon Territory Coal Exploration Licences Nos. 129, 132 and 133

On behalf of PAN OCEAN OIL LTD.

I, William E. Brimacombe, for PAN OCEAN OIL LTD. of 300 - Fifth Avenue S.W., Calgary, Alberta, do solemnly declare that expenditures in the amount of $14,957.78 as summarized in Appendix "C" hereto attached and by this reference made a part hereof were incurred during the course of this work.

And I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath and by virtue of the Canada Evidence Act.

Declared before me at the City of Calgary in the Province of Alberta this 5th day of February, 1982

William E. Brimacombe
WILLIAM E. BRIMACOMBE

A Notary Public in and for the Province of Alberta

This report has been examined; declared acceptable as Representation Work under Section 32 and Schedule B of the Canada Mining Regulations and valued in the amount of $ 14,957.78

for Chief, L.H. Lamie

Date: Feb. 17, 1982

This is Appendix "C" attached to and forming part of that certain Statutory Declaration of William E. Brimcombe dated the 5th day of February, 1982

Bonnet Plume Area - 1981
Coal Exploration Licences
Nos. 129, 132 and 133 (Group III)

| | | |
|---|---|---|
| Salaries and Burden | | $ 1,701.58 |
| Travel and Business Expense | | 647.07 |
| Communications | | 33.50 |
| Materials, Supplies and Freight | | 111.51 |
| Outside Reproduction | | 317.95 |
| Contract Services | | 274.89 |
| Contract Project Management: | | |
| Salaries and Burden | $ 378.61 | |
| Travel and Business Expense | 177.08 | |
| Communication | 20.10 | |
| Materials, Supplies and Freight | 69.44 | |
| Demobilization | 4,798.53 | |
| Equipment Rentals | 185.14 | |
| Camp and Supplies | 97.14 | |
| Aviation Expense - Fixed Wing | 1,968.14 | |
| - Helicopter | 706.62 | |
| Management Fee | 732.34 | $ 9,133.14 |
| Environmental: | | |
| Impact Studies | $ 4,300.94 | |
| Aviation Expense - Fixed Wing | 85.48 | |
| - Helicopter | 774.80 | |
| Equipment Rental and Expense | 19.67 | |
| Geochem Analysis (Water) | 472.68 | $ 5,653.57 |
| Sub-Total | | $ 17,873.21 |
| Less Overpayment of helicopter charges in 1980 | $ 2,325.35 | |
| Return of drum deposit | 1,949.88 | $ 4,275.23 |
| Sub-Total | | $ 13,597.98 |
| Administration Overhead 10% | | 1,359.80 |
| Total | | $ 14,957.78 |

Total Acreage = 119,010 acres

Cost per Acre = $\frac{\$ 14,957.78}{119,010} = \$0.13$

TABLE I

GROUPING OF EXPENDITURES

BONNET PLUME PROJECT

| | A Licences | B Area (Acres) | C 3 Yr. Req. Expenditure to Nov. 77-80' $0.35/Acre | D Approved Expenditures 77-80' | E 3 Yr. Req. Expenditure to Nov. 80-83' $0.35/Acre | F Spent Nov.80-81' | G Total Spent | H 3 Yr.Excess Credit Nov. 80-83' | I Per Acre Excess |
|---|---|---|---|---|---|---|---|---|---|
| GROUP I | 134 | 40,428 | 14,149.80 | 356,507.98 | 14,149.80 | 35,690.16 | 392,198.14 | 363,898.54 | 9.00 |
| | 135 | 40,428 | 14,149.80 | 356,507.98 | 14,149.80 | 35,690.16 | 392,198.14 | 363,898.54 | 9.00 |
| | 136 | 40,428 | 14,149.80 | 356,507.98 | 14,149.80 | 35,690.16 | 392,198.14 | 363,898.54 | 9.00 |
| | 138 | 40,051 | 14,017.85 | 353,183.47 | 14,017.85 | 35,357.34 | 388,540.81 | 360,505.11 | 9.00 |
| | 139 | 40,051 | 14,017.85 | 353,183.47 | 14,017.85 | 35,357.34 | 388,540.81 | 360,505.11 | 9.00 |
| | 140 | 40,051 | 14,017.85 | 353,183.47 | 14,017.85 | 35,357.34 | 388,540.81 | 360,505.11 | 9.00 |
| | 141 | 40,051 | 14,017.85 | 353,183.47 | 14,017.85 | 35,357.34 | 388,540.81 | 360,505.11 | 9.00 |
| | 143 | 40,051 | 14,017.85 | 353,183.47 | 14,017.85 | 35,357.34 | 388,540.81 | 360,505.11 | 9.00 |
| | 145 | 40,051 | 14,017.85 | 353,183.47 | 14,017.85 | 35,357.34 | 388,540.81 | 360,505.11 | 9.00 |
| | Sub-Total | 361,590 | 126,556.50 | 3,188,624.76 | 126,556.50 | 319,214.52 | 3,507,839.28 | 3,254,726.28 | 9.00 |
| GROUP II | 137 | 40,051 | 14,017.85 | 40,508.57 | 14,017.85 | 3,740.82 | 44,249.39 | 16,213.69 | 0.40 |
| | 142 | 40,051 | 14,017.85 | 40,508.57 | 14,017.85 | 3,740.82 | 44,249.39 | 16,213.69 | 0.40 |
| | 144 | 40,051 | 14,017.85 | 40,508.57 | 14,017.85 | 3,740.82 | 44,249.39 | 16,213.69 | 0.40 |
| | 146 | 40,051 | 14,017.85 | 40,508.57 | 14,017.85 | 3,740.82 | 44,249.39 | 16,213.69 | 0.40 |
| | 147 | 39,670 | 13,884.50 | 40,123.22 | 13,884.50 | 3,705.23 | 43,828.45 | 16,059.45 | 0.40 |
| | 148 | 39,670 | 13,884.50 | 40,123.22 | 13,884.50 | 3,705.23 | 43,828.45 | 16,059.45 | 0.40 |
| | 149 | 39,670 | 13,884.50 | 40,123.22 | 13,884.50 | 3,705.23 | 43,828.45 | 16,059.45 | 0.40 |
| | 150 | 39,670 | 13,884.50 | 40,123.22 | 14,884.50 | 3,705.23 | 43,828.45 | 16,059.45 | 0.40 |
| | 151 | 39,670 | 13,884.50 | 40,123.22 | 14,884.50 | 3,705.23 | 43,828.45 | 16,059.45 | 0.40 |
| | 152 | 39,290 | 13,751.50 | 39,738.87 | 13,751.50 | 3,669.74 | 43,408.61 | 15,905.61 | 0.40 |
| | 153 | 39,290 | 13,751.50 | 39,738.87 | 13,751.50 | 3,669.74 | 43,408.61 | 15,905.61 | 0.40 |
| | 154 | 39,290 | 13,751.50 | 39,738.87 | 13,751.50 | 3,669.74 | 43,408.61 | 15,905.61 | 0.40 |
| | Sub-Total | 476,424 | 166,748.40 | 481,866.99 | 166,748.40 | 44,498.65 | 526,365.64 | 192,868.84 | 0.40 |
| | Cumulative Total | 838,014 | 293,304.90 | 3,670,491.75 | 293,304.90 | 363,713.17 | 4,034,204.92 | 3,447,595.12 | 4.11 |
| GROUP III | 132 | 39,670 | 13,884,50 | 55,149.23 | 13,884.50 | 4,985.93 | 60,135.16 | 32,366.16 | 0.82 |
| | 133 | 39,670 | 13,884.50 | 55,149.23 | 13,884.50 | 4,985.93 | 60,135.16 | 32,366.16 | 0.82 |
| | 129 | 39,670 | 13,884.50 | 55,149.23 | 13,884.50 | 4,985.93 | 60,135.16 | 32,366.16 | 0.82 |
| | Sub-Total | 119,010 | 41,653.50 | 165,447.69 | 41,653.50 | 14,957.79 | 180,405.48 | 97,098.48 | 0.82 |
| | Grand Total | 957,024 | 334,958.40 | 3,835,939.44 | 334,958.40 | 378,670.96 | 4,214,610.40 | 3,544,693.60 | 3.70 |

CANADA )
)
TO WIT )

Yukon Territory Coal Exploration Licences Nos. 134 - 136, 138 - 141, 143 and 145

On behalf of PAN OCEAN OIL LTD.

I, William E. Brimacombe, for PAN OCEAN OIL LTD. of 300 - Fifth Avenue S.W., Calgary, Alberta, do solemnly declare that expenditures in the amount of $319,214.54 as summarized in Appendix "A" hereto attached and by this reference made a part hereof were incurred during the course of this work.

And I make this solemn declaration conscientiously believing it to be true and knowing that it is of the same force and effect as if made under oath and by virtue of the Canada Evidence Act.

Declared before me at the City of Calgary in the Province of Alberta this 5th day of February, 1982

William E. Brimacombe

WILLIAM E. BRIMACOMBE

A Notary Public in and for the Province of Alberta

This report has been examined; declared acceptable as Representation Work under Section 32 and Schedule B of the Canada Mining Regulations and valued in the amount of $319,214.54

for Chief, J.H. Blaine

Date: Feb. 17, 1982

This is Appendix "A" attached to and forming part of that certain Statutory Declaration of William E. Brimacombe dated the 5th day of February, 1982

Bonnet Plume Area - 1981
Coal Exploration Licences
Nos. 134 - 136, 138 - 141, 143 and 145 (Group I)

| | | |
|---|---|---|
| Salaries and Burden | | $ 22,594.47 |
| Travel and Business Expense | | 8,592.23 |
| Communications | | 444.81 |
| Outside Professional Services | | 125,157.87 |
| Materials, Supplies and Freight | | 1,480.83 |
| Outside Reproduction | | 4,221.84 |
| Geochem Analysis (Coal) | | 17,302.45 |
| Contract Services | | 3,650.17 |
| Contract Project Management: | | |
| Salaries and Burden | $ 5,027.38 | |
| Travel and Business Expense | 2,351.32 | |
| Communication | 266.96 | |
| Materials, Supplies and Freight | 922.09 | |
| Demobilization | 63,717.46 | |
| Equipment Rentals | 2,458.42 | |
| Camp and Supplies | 1,289.94 | |
| Aviation Expense - Fixed Wing | 26,133.94 | |
| - Helicopter | 9,382.93 | |
| Management Fee | 9,724.37 | $121,274.81 |
| Environmental: | | |
| Impact Studies | $ 13,061.85 | |
| Aviation Expense - Fixed Wing | 1,434.25 | |
| - Helicopter | 10,288.20 | |
| Equipment Rental and Expense | 5,761.16 | |
| Camp Supplies | 5,422.36 | |
| Geochem Analysis (Water) | 6,276.54 | $ 42,244.36 |
| Sub-Total | | $346,963.84 |
| Less Overpayment of helicopter charges in 1980 | $ 30,877.20 | |
| Return of drum deposit | 25,891.60 | $ 56,768.80 |
| Sub-Total | | $290,195.04 |
| Administration Overhead 10% | | 29,019.50 |
| Total | | $319,214.54 |

Total Acreage = 361,590 acres

Cost per Acre = $\frac{\$319,214.54}{361,590} = \$0.88$

# Pan Ocean Oil Ltd.

300 Fifth Avenue S.W. Calgary, Alberta, Canada T2P 3C4
Mailing Address:
P.O. Bag 2533, Station "M", Calgary, Alberta, Canada T2P 2M7

Telephone: (403) 268-0811
Telex: 038-22681
TWX: 610-821-6034

**William J. Stephen, Ph.D.**
ENVIRONMENTAL CO-ORDINATOR

**Pan Ocean Oil Ltd.***
300 Fifth Avenue S.W.
Calgary, Alberta, Canada T2P 3C4
Bus. (403) 268-0811
Telex: 038-22681
* A SUBSIDIARY OF MARATHON OIL COMPANY

Mr. Dennis Watson
Director Yukon Region
Department of Indian Affairs and
Northern Development
200 Range Road
Whitehorse, Yukon Territory

Dear Mr. Watson:

RE: THERMAL POWER STATION, BONNET PLUME, YUKON TERRITORY

Enclosed please find:

* 1) Preliminary Feasibility Mining Study, Illtyd Creek Deposit Bonnet Plume Coalfield, Wright Engineers Ltd., Project 1098 May 1981.

* 2) Yukon Thermal Power Generating Study for Pan Ocean Oil Ltd.; Addendum 1, Monenco Consultants Ltd., May 1981.

* 3) Wernecke Mountain Caribou Studies; Progress Report, October 1980, Yukon Wildlife Branch.

* 4) An Overview Study of the Vegetation, Wildlife and Fish Resources of the Bonnet Plume Lease, Northeastern Yukon Territory, LGL Ltd., April 1981.

The studies listed above comprise the most recent information concerning the proposed Bonnet Plume Thermal Generating Station to supply power for the Yukon Territory.

I shall be contacting you in early August to arrange meetings to discuss the project.

Yours truly,

PAN OCEAN OIL LTD.

James S. McKinney
Manager, Exploration Operations

cc -> C. Ogilvy
H. Beaubier
Rm.

JSM/kj
Enclosures * Study papers -> Cam Ogilvy
Rm.

WRIGHT ENGINEERS LIMITED

Phone: 684-9371 • Cable "WRIGHTENG" • Telex: 04-54367

1444 Alberni Street, Vancouver, British Columbia, Canada, V6G 2Z4

Project 1098-100

April 10, 1981

Pan Ocean Oil Limited
300-5th Avenue S.W.
Calgary, Alberta
T2P 2M7

Attention: Mr. O. Cullingham

Dear Owen:

We enclose a copy of the report **"Preliminary Feasibility Mining Study, Illtyd Creek Deposit, Bonnet Plume Coalfield".**

We thank you for the opportunity of working on the project and look forward to its successful conclusion.

Yours very truly,

WRIGHT ENGINEERS LIMITED

W.P. Stokes, P.Eng.
Project Manager

WPS/sd
Enc.

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SECTION 9 - PREPARATION FACILITIES

SECTION 10 - MANPOWER REQUIREMENTS

SECTION 11 - DRAWINGS

## DRAWING LIST

| Dwg. No. | Title |
|---|---|
| D-1098-101-1201 | Location Plan |
| D-1098-100-1201 | General Arrangement of Site |
| D-1098- SK-1201 | Perspective Layout |
| D-1098-103-1201 | Borehole No. BP-79-13 |
| D-1098-103-1202 | Proposed Diamond Drill Holes |
| D-1098-103-1203 | North-South Longitudinal Section W-W |
| D-1098-103-1204 | Longitudinal Section N-N' (Along Baseline) |
| D-1098-103-1205 | North-South Longitudinal Section 0-0' (500 m East of Baseline) |
| D-1098-102-1201 | Surface Facilities and Production Schedule 500,000 tonnes/year |
| D-1098-102-1202 | Surface Facilities and Production Schedule 750,000 tonnes/year |
| X-1098-102-1203 | No. 1 Seam Production Schedule by Years 500,000 tonnes/year, 15% ash |
| X-1098-102-1204 | No. 2 Seam Production Schedule by Years 500,000 tonnes/year, 15% ash |
| X-1098-102-1205 | No. 1 Seam Production Schedule by Years 750,000 tonnes/year, 15% ash |
| X-1098-102-1206 | No. 2 Seam Production Schedule by Years 750,000 tonnes/year, 15% ash |
| D-1098-102-1207 | Perspective of Pillar Mining |
| D-1098-102-1208 | Perspective of Longwall Mining |
| A-1098-102-1209 | No. 1 Seam - Typical Mining Section |
| A-1098-102-1210 | No. 2 Seam - Typical Mining Section |
| B-1098-102-1211 | Typical Roadway Junction |
| X-1098-102-1212 | No. 1 Seam Horizon - Structure Contours |

## DRAWING LIST - Cont'd.

| Dwg. No. | Title |
|---|---|
| X-1098-102-1213 | No. 2 Seam Horizon - Structure Contours |
| X-1098-102-1214 | No. 1 Seam Isopach Plan - Seam Thickness |
| X-1098-102-1215 | No. 2 Seam Isopach Plan - Seam Thickness |
| D-1098-102-1220 | No. 1 Seam - Schematic of Ventilation System |
| D-1098-102-1221 | No. 2 Seam - Schematic of Ventilation System |
| D-1098-104-1201 | Preliminary Plant Site |
| D-1098-104-1202 | Preliminary Flowsheet - Underground Mine |
| D-1098-104-1203 | Preparation Plant GA Plan and Sections |
| D-1098-104-1204 | Preparation Plant Maintenance Shop and Office |
| D-1098-104-1205 | Full Portal Scraper Plans and Section Typical Option 1 |
| D-1098-104-1206 | Stacker Reclaimer Plans and Sections Typical Option 2 |
| D-1098-104-1207 | Tubular Conveyor Gallery Preliminary Concept |
| D-1098-108-1201 | Mayo Access Road Plan |
| D-1098-108-1202 | Mayo Access Road Profile |
| D-1098-108-1203 | Access Road Bridges |
| D-1098-108-1204 | Manpower Fly-in/Fly-out Schedule 500,000 mtpy case |
| D-1098-108-1205 | Manpower Fly-in/Fly-out Schedule 700,000 mtpy case |
| D-1098-110-1201 | Plant Site - Preliminary Layout |
| D-1098-110-1202 | Services Building Preliminary Ground Floor Plan |

## DRAWING LIST - Cont'd.

| Dwg. No. | Title |
|---|---|
| D-1098-110-1203 | Services Building<br>Preliminary Second Floor Plan |
| D-1098-110-1204 | Services Building<br>Preliminary Section & Elevation |
| D-1098-110-1205 | Surface Electrical One Line Diagram |

# SECTION 1

# TERMS OF REFERENCE

# SECTION 1

## TERMS OF REFERENCE

The terms of reference for this report were first outlined during a telephone call on August 21, 1980, from Mr. J.S. McKinney of Pan Ocean Oil Ltd. to Mr. C.T. Penney of Wright Engineers Limited. Mr. McKinney invited Wright Engineers to submit a proposal for a preliminary study of a coal mine which would be located in the Yukon Territory and which would be developed to supply a mine-mouth power station. The scope of work was detailed further at meetings on September 5, 1980, in the offices of Wright Engineers in Vancouver, and on September 10, in the offices of Pan Ocean Oil Ltd. in Calgary. Attending the meeting in Vancouver were Mr. C.T. Penney and Mr. W.P. Stokes of Wright Engineers and Ms K. Jumpsen of Pan Ocean Oil Ltd. Attending the meeting in Calgary were Mr. C.T. Penney and Mr. J.S. McKinney.

# SECTION 2

# SECTION 2

# INTRODUCTION

# SECTION 2

# INTRODUCTION

The Bonnet Plume Coalfield is located in the Yukon Territory, approximately 65° 30' N, 135° W in the Wind River map area.

The area is approximately 210 kilometres north of Mayo, 240 kilometres northeast of Dawson City and 300 kilometres south of Inuvik. Air transportation is available out of Mayo. The Dempster Highway passes 130 kilometres to the west of the property and a winter road from Elsa (Keno Hill), 165 kilometres long, enters the west side of the property via the Wind River valley.

The Bonnet Plume Basin is a structural and physiographic depression containing at least twelve known coal deposits. Seven of these contain measured, indicated and inferred in situ coal resources in excess of 650 million tonnes.

A preliminary feasibility mining study of one of these deposits, the Illytd Creek Deposit, is considered in this report for defining a 30-year mining plan. The plan optimizes the mining methods, layouts and production schedules, plus the layout of surface buildings, site access, living accommodation and ancillary facilities capable of delivering suitable prepared coal to a thermal power plant. The power plant study will be completed by others. This report also itemizes capital and operating costs.

# SECTION 3

# SUMMARY AND RECOMMENDATIONS

# SECTION 3

# SUMMARY AND RECOMMENDATIONS

## 3.1 SUMMARY

### 3.1.1. Introduction

The investigations discussed in this report are based on providing a mining plan and associated facilities capable of producing 500,000 tonnes per year or 750,000 tonnes per year clean coal for thermal plant feed. Two qualities of feed were assessed, the basic difference being ash content:

| | Quality A | Quality B |
|---|---|---|
| Moisture | 7% | 7% |
| Ash | 15% | 18% |
| Vol. Matter | 33.0% | 31.8% |
| Fixed Carbon | 45.0% | 43.2% |
| Sulphur | 0.5% | 0.5% |
| Calorific Value | 9832-9791 Btu/lb. | 9570-9485 Btu/lb. |
| Ash Fusion | 2400°F | 2400°F |

The effect of the higher ash is not significant since the overall increase in reserves for No. 1 Seam is 367,797 tonnes, 3.63% of the total 10,112,862 clean tonnes, and for No. 2 Seam is 414,181 tonnes, some 3.36% of the 12,334,819 clean tonnes total for this seam. The decrease in calorific value is calculated as 262 in 9832 Btu/lb, some 2.66% in the 500,000 tonnes/year case, and 306 in 9791 Btu/lb, some 3.13% for the 750,000 tonnes/year case.

Based on a hypothetical selling price of $70/tonne at 15% ash, the equivalent price at 18% ash would be $68/tonne. Since the differences in tonnages are small, operating costs for both situations will remain substantially the same. The main advantage of the higher ash is that it ensures the required productivity will be achieved. The main disadvantage is that the power station will have to deal with a greater quantity of ash per tonne of coal and will be burning coal of a lower heating value.

### 3.1.2 Geological Resources

The in-situ measured and indicated resources as calculated in this report indicate a total resource of 160,535,474 tonnes, compared to the 150,131,765 tonnes calculated by Pan Ocean Oil Ltd. The higher figure calculated by Wright Engineers Limited indicates that Pan Ocean's estimates are acceptable.

### 3.1.3 Mining Plan

The mining plan has been based on using a modified pillar mining method for No. 1 Seam, and the longwall method for No. 2 Seam.

The modified pillar mining system has been used for No. 1 Seam since, in the opinion of Wright Engineers Limited, the thick conglomerate bed directly above the seam will not cave. Excavating roadways within the seam and leaving pillars of predetermined size will provide full support for the roof, enabling safe and efficient mining operations to proceed.

Pillar mining will incorporate the use of 3 continuous miners, 3 shuttle cars and 3 feeder breakers, plus conveyors for coal transportation. In the 500,000 tonnes/year case, 4 machine shifts will be required per day at a production rate of 500 tonnes per machine shift. In the 750,000 tonnes/year case, 6 machine shifts are required per day at 500 tonnes production per machine shift.

The in-situ minable reserves for No. 1 Seam have been calculated as 31,866,020 tonnes, with minable reserves of 12,612,001 tonnes; thus, minable recovery is 40%.

In the opinion of Wright Engineers Limited, No. 2 Seam lends itself to mining by the longwall method. The interval between No. 2 and No. 1 Seams ( 10m to 40m thick, dependent on location) is fairly competent but, with the layering of different rock types and the partial extraction of No. 1 Seam, caving can be expected.

A single longwall face will provide sufficient capacity for both the 500,000 tonnes and 750,000 tonnes/year production rates. For the 500,000 tonnes/year case, 2 shift operations per day will suffice, while 3 shifts per day will be required for the 750,000 tonnes/day case.

A single set of longwall equipment will be required for the 500,000 tonnes/year case due to overlap of production of No. 1 and No. 2 Seams, but in the 750,000 tonnes case, a second set of longwall equipment will be required to ensure continuity of production during production from No. 2 Seam only.

The in-situ minable reserves for No. 2 Seam have been calculated as 20,807,540 tonnes with minable reserves of 13,758,702 tonnes, for 66% minable recovery.

### 3.1.4 Schedule

The schedules for both the 500,000 tonnes/year and 750,000 tonnes/year cases have been based on mining No. 1 Seam to the south of the main entries and, when the continuous miners are moved to the northern side, commencing production in No. 2 Seam from the south side of the main entries. This ensures that No. 1 Seam is not undermined and that feed of an average quality is provided for the preparation plant facilities.

The mining procedure enables both seams to be mined simultaneously for approximately 11 years in the 500,000 tonnes/year case, and for 9 years in the 750,000 tonnes/year case.

Four schedules are provided in this report, based upon 500,000 tonnes/year and 750,000 tonnnes/year at both 15% ash and 18% ash.

### 3.1.5 Site Access

Site access has been provided via a 200-kilometre long by 6.1-metre wide road from Elsa to the mine site.

A gravel airstrip, 1,525 metres long by 60 metres wide, has been included which will allow a Hawker Siddley 748, capacity 50 persons or maximum payload 5,360 kilograms, to land.

### 3.1.6 Fly-in/Fly-out

A fly-in/fly-out operation has been incorporated in the mine plan, based upon a 7 days in, 7 days out schedule. Assuming 350 operating days per year, working days per man total 175. Two separate and complete crews are required to ensure coverage at all times; based on a working shift of 8 hours per day and an allowance of 6 hours each way for travel to and from the site, a work-week consist of 68 hours, or 34 hours per week.

It is planned to schedule a maximum of 212 flights per year for the 500,000 tonnes/year case, and 312 flights per year for the 750,000 tonnes/year case.

### 3.1.7 Surface Facilities

The surface facilities included in this study are as follows:

- maintenance, dry and office building
- cold storage garage
- diesel power generation
- conveyor from the mine portals to the preparation plant
- sewage system
- water supply system
- access roadways
- fuel tanks
- garage facilities
- catering and accommodation for 230 men

The above have been designed to provide an efficient flow of materials and personnel. Buildings have been designed for a northern climate and, as far as possible, have been integrated to form self-contained units. Provision has been made to transport personnel from the surface buildings to the portals by bus.

### 3.1.8 Preparation Facilities

From review of the quality of No. 1 Seam based on bore hole data, it is indicated that the raw coal requires some preparation to meet the minimum specification for power plant feed stock. While investigation of No. 2 Seam reveals a better quality seam in general, portions of this seam also require preparation.

The preparation plant flowsheet describes a basic jig washery. Provision is made to allow by passing of the wet cleaning process, as a portion of the raw coal may be blended with washed coal to produce an acceptable quality product coal.

As the Illtyd deposit is in a region of severe winter conditions, it is recommended that all product coal be stored within an appropriate building. Provisions are made to stack product coal to form a semi-homogenous pile using a travelling boom stacker; coal would be reclaimed by a scraper reclaimer. The feed for the power plant would be of consistent quality over the period of time required to completely recover the storage pile.

It is recommended that, whenever possible, facilities be concentrated in one building to minimize the effect of adverse winter conditions. Thus all raw coal preparation is done within a unit enclosure. Maintenance and preparation plant services are included in the preparation plant facility.

The conveyor galleries in the preparation plant area are designed for protection from the elements and ease of maintenance; the concept features modular construction off site for erection on site.

### 3.1.9 Manpower

The manpower required to operate the mine, preparation plant, surface facilities and ancillary requirements are as follows:

| | 500,000 tonnes/year | | | 750,000 tonnes/year | | |
|---|---|---|---|---|---|---|
| Supervision | 16 | 18 | 13 | 21 | 21 | 15 |
| Underground | 68 | 65 | 48 | 102 | 96 | 78 |
| Yard Crew | 28 | 26 | 23 | 39 | 36 | 32 |
| Office | 12 | 12 | 12 | 13 | 13 | 13 |
| Preparation Plant | 30 | 24 | 23 | 30 | 30 | 30 |
| Catering & Accommodation | 25 | 25 | 20 | 25 | 25 | 25 |
| Total | 179 | 170 | 139 | 230 | 221 | 193 |

## 3.2 RECOMMENDATIONS

### 3.2.1. Exploration

In order to confirm correlations, structure and quality of the seams, it is recommended that an additional six infill coreholes be completed. These coreholes should be geophysically logged using a gamma-neutron, gamma-gamma, resistivity density and caliper log suite to assist in correlation work. The following lists proposed corehole locations, projected depths and lowest seam targets:

**Proposed Infill and Development Core Program**

| Location | Projected Depth (m) | Lowest Seam Target |
|---|---|---|
| 35 + 00 N - 5 + 00 E | 350 | No. 5 Seam |
| 25 + 00 N - 5 + 00 E | 390 | No. 5 Seam |
| 15 + 00 N - 5 + 00 E | 360 | No. 5 Seam |
| 5 + 00 N - 5 + 00 E | 235 | No. 5 Seam |
| 0 + 00 N - 10 + 00 E | 220 | No. 5 Seam |
| 5 + 00 S - 5 + 00 E | 225 | No. 5 Seam |

A total of 1780 m (5,840 ft) of coring is involved in this proposed program.

### 3.2.2 Site Access and Site Investigations

It is recommended that the following investigations or information be carried out or obtained:

(a) Preliminary survey of the access route identifying soil types, locating trouble areas, selecting sites for crossings and checking borrow pits. A minimum of two parties are required, one on the muskeg and Braine Creek section, the other in the Wind River area. This information is needed to finalize the construction schedule.

(b) Accurate topographical mapping of the plant site, airstrip, Wind River crossing and several sections of the access road. This will probably involve obtaining new low-level photography.

(c) Examination of the used aerial tram at the Yukon Territory Department of Highways in Dawson City for use on the Wind River Crossing.

(d) Preliminary engineering design of major obstacles encountered on the access road, including all major stream crossings.

(e) Detailed engineering analysis to predict maximum flows in all major streams affected by the work. Selection of sites for stream gauging, in order that levels measured during the annual flood can be correlated with design work.

(f) Soils report for the area of the plant site, and examination of one alternative site in the event soils are not completely acceptable.

### 3.2.3 Preparation Facilities

Portions of the coal seams mined will need processing through a preparation facility. The refinement of the preparation process depends on the analytical data available. Therefore, it is recommended that when bulk samples are available, analysis should include a size range determination at 4 inch, 1½", ½", ¼" and 28 mesh. Ash determination for each size should be included. A washability study for each size range at 1.40, 1.50, 1.60, 1.70, 1.80, 1.90 and 2.00 specific gravity, including ash distribution, should be carried out and analysed. Additional Hardgrove Grindability Indices for the various coal seam areas should be determined. The plus 4-inch coal

product from the screen analysis of bulk samples should be subjected to drop-shatter tests to determine friability and breaking requirements.

### 3.2.4 Mining

The mining methods included in this report have been based on information available to date. In order to confirm the suitability of the mining methods, the cavability of the roof rock and the ability of the shale floor to withstand loading should be investigated. It is recommended that an in-depth rock mechanics study be implemented in conjunction with further exploratory drilling to investigate these two most important factors. In addition the capability of the coal to support the associated strata through the utilization of pillars should be investigated.

It is also recommended that investigations be carried out, in conjunction with such organizations as Canmet, to determine the cutting characteristics of the coal, dust production during cutting, dust suppression, spontaneous combustion and "methane make". Any of the above could result in major problems for the underground operations if major differences from assumed conditions should be encountered.

### 3.2.5 Production Rates

The production rates as given in the terms of reference are 500,000 tonnes/year and 750,000 tonnes/year.

The seams available in the Illtyd Creek Deposit contain sufficient reserves to support higher production rates than those used in this study. In order to reduce costs and, in turn, reduce the selling price of the coal, it is recommended that an increased production rate be studied, and that this production rate be optimized to assure the lowest costs under the prevailing conditions.

# SECTION 4

# GEOLOGICAL RESOURCES

# SECTION 4

# GEOLOGICAL RESOURCES

## 4.1 INTRODUCTION

The Illtyd Creek coal deposit is classified (ASTM Standard) as High Volatile Bituminous "C" with the following average clean coal specifications:

| | | |
|---|---|---|
| Moisture | 5.2% | |
| Ash | 15.4% | |
| Vol. Matter | 34.0% | |
| Fixed Carbon | 45.1% | |
| Sulphur | 0.5% | |
| Calorific Value | 9,700 | Btu/lb |
| Ash | 2,400 | °F |

Approximately 150,000,000 tonnes of in-situ measured and indicated coal resources to a depth of 300 metres have been delineated by Pan Ocean diamond drill programs during 1978 and 1979. This coal is found in three main seams. Additional seams may be present at depths below the No.3 Seam and additional resources may be present below 300 metres.

The Pan Ocean Report No. 25-79, prepared by Mr. Cullingham and entitled "Reserves and Grade of Coal in the Bonnet Plume Basin, Yukon Territory", describes the structure, stratigraphy and seam characteristics of the Illtyd Creek deposit in great detail. This report has been used as the base reference for the current preliminary feasibility study.

## 4.2 SCOPE OF GEOLOGICAL WORK

The following is a description of the geological work that was undertaken by Wright Engineers Limited pertaining to the preliminary feasibility study:

(a) A calculation of the in-situ measured and indicated resources for each seam, utilizing the same parameters as the Pan Ocean study. This was primarily designed to verify the Pan Ocean figures.

(b) Preparation of detailed cross-sections of the coal seams and their immediate surrounding strata on a scale of 1:100. These sections verified Pan Ocean correlation work and allowed for a detailed correlation of each successive coal and parting band within the seams necessary for underground mine design.

(c) Calculation of true dips on each coal seam from the Structure Contour maps contained in the Pan Ocean report; also necessary for preliminary mine design.

(d) Preparation of an additional in-fill drilling program in order to complete the quality assessment of the deposit area, as well as confirm the stratigraphic correlation of the coal seams at the south end of the deposit.

## 4.3 STRUCTURE AND STRATIGRAPHY

On Page 8 of Pan Ocean Report 25-79, Mr. Cullingham outlines the basic structure of the Illtyd Creek Deposit:

> "The structure of the Illtyd Creek Deposit consists of a broad syncline plunging to the east. Maximum dips of 20° occur along the western outcrop trace and at the north end of the deposit. Generally flatter dips occur at depth to the south and east".

The following is a description of the structure of each seam as related to the structure contour maps constructed by Pan Ocean (see Report No. 25-79, Figures E0728, E0729 and E0730):

> **No.1 Seam:** In general, the No.1 Seam is more steeply dipping near the outcrop trace (parallelling Illtyd Creek). Dips along the outcrop range between 11-3/4° to 17-1/2°with the steepest dips occurring near Hole BP-79-8. On the southern limb of the syncline (i.e. south of Hole BP-79-15), the dip flattens out to less than 5° approximately 500 m east of the outcrop. On the northern limb of the syncline (i.e. north of BP-78-4), the dips are

much more regular. From outcrop, the seam dips at approximately 16° and flattens slightly to 14-1/2° near the 300 m overburden limit. At the axis of the syncline (i.e. in the vicinity of holes BP-79-9 and BP-79-10), dips are also very regular. From a 12-1/2° dip near outcrop, the seam flattens slightly to 10-1/2 °.

**No.2 Seam:** In general, the No.2 Seam dips more steeply on the northern limb of the structure than on the southern limb of the axis area. Dips on the north limb vary between 13° and 17-1/2° and tend to average 16°. On the southern limb of the syncline, the No.2 Seam exhibits the same structural characteristics as the No.1 Seam, dipping steeply at the outcrop trace (17°), then flattening out rapidly to 8° or less (in some instances to 3°) about 500 m east of the outcrop. In the axis of the syncline, the No.2 seam dips uniformly at 11-12°.

**No.3 Seam:** Structurally, the No.3 Seam is almost identical to the No.2 Seam. On the southern limb of the structure, it dips at 11-12° near outcrop, shallowing to 3-8° down dip. At the axis of the syncline, the seam dips normally and regularly at 10-12° as far as the 300 m overburden limit. On the north limb, steeper dips of approximately 16° are found throughout the resource area.

There is some question as to the correlation of the No.2 and the No.3 seams on the southern limb of the syncline. It would appear that the No.2 Seam in the southern part of the deposit splits apart into two separate and identifiable seams over a short distance. The No.3 Seam is present below the two separate entities of the No.2 Seam. There is some uncertainty as to whether the No.2 Seam merges to the north or remains split. While the question of seam correlations has no bearing on the results of this pre-feasibility mine study, proper identification and correlation of seams will be necessary before detailed mine planning on a pre-production scale can be undertaken.

## 4.4 ENVIRONMENT OF DEPOSITION

Drawing No. E-1098-103-1205 is a longitudinal section from north to south running 500 m east of the baseline and parallel to it. This stratigraphic section best illustrates the depositional trend of the coal measures in the Lower Bonnet Plume Formation in the Illtyd Creek area. These measures represent a cyclical marine regression to the north, resulting in a deltaic alluvial fan pro-grading northwards. During the buildup of this alluvial sequence at least four coal seams have been generated. The coal seams diverge northwards; the earliest coal seams are replaced by silt in a northward direction much more rapidly than those deposited in the latter stages of deltaic deposition.

Following this period of alluvial-deltaic buildup, a major conglomeratic member was deposited directly over the latest coal seam (the No.1 Seam). At no location does the No.1 Seam appear to be eroded, even when directly overlain by the conglomeratic sequence. This would indicate that a fluviatile environment of deposition could not be considered for this conglomeratic series. This conglomerate has the appearance of a beach shingle and possibly indicates a major transgression of the Arctic Sea southwards.

## 4.5 EXAMINATION OF CORE

An examination of the drill core at the site, plus a study of the slides taken of the core soon after it was recovered, allowed for some observations of roof and floor material immediately adjacent to the coal seams:

**No.1 Seam:** The roof of the No.1 Seam is generally a massive conglomerate. The contact between the conglomerate and coal is sharp, except north of line 30+00N where the conglomerate is separated from the coal by a 1 to 4 metre section of siltstone or shale. The conglomerate section can be over 100 metres thick, except on the western edge of the deposit where its upper zones have been eroded. Examination of the core revealed that the conglomerate can be very broken and rubbly over the upper sections of the member; however, that section of conglomerate immediately overlying the

No.1 Seam appears massive, unbroken and competent. The conglomerate is fractured in places and has a medium- to coarse- grained sandstone matrix; therefore it has the potential to transmit relatively large volumes of groundwater. The floor of the No.1 Seam is uniformly composed of a shale/mudstone that is immediately subjected to rapid weathering upon exposure to air and/or water.

**No.2 Seam:** The roof of the No.2 Seam is usually a conglomerate or a conglomeratic sandstone. Some silt bands are usually present within the roof strata. In general, roof sections above the No. 2 Seam appear to be of a competent nature. The floor of the No.2 Seam is identical to that of the No.1 Seam - a soft mudstone or siltstone that weathers rapidly and easily.

**No.3 Seam:** The roof of the No. 3 Seam varies from a shale to shaly sandstone grading upward to a conglomerate. It appears to be of a relatively competent nature. The floor of the No.3 Seam is again a soft mudstone that is easily broken down upon exposure to water and air.

In order to gain a better understanding of the varying rock strengths, representative samples of the roof rock were extracted from the drill cores for compressive strength test. The following Table 4-1 indicates samples taken from the core boxes.

## TABLE 4-1

## ROOFROCK CORE SAMPLES

HOLE BP-79-8

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. 1 | seam roof | - | sample interval: | 88.30 | m | - | 88.53 | m |
| No. 3 | seam roof | - | sample interval: | 131.95 | m | - | 132.30 | m |

HOLE BP-79-12/12A

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. 1 | seam roof | - | no sample (conglomerate rubble) | | | | | |
| No. 3 | seam roof | - | sample interval: | 186.42 | m | - | 186.57 | m |
| | | | sample interval: | 186.68 | m | - | 186.78 | m |
| | | | sample interval: | 182.93 | m | - | 183.00 | m |

HOLE BP-79-14

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. 1 | seam roof | - | sample interval: | 88.09 | m | - | 88.30 | m |
| No. 2 | seam roof | - | sample interval: | 116.43 | m | - | 116.69 | m |
| No. 3 | seam roof | | (no sample: soft shale) | | | | | |

HOLE BP-79-15

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. 1 | seam roof | - | sample interval: | 215.06 | m | - | 215.49 | m |
| | | | sample interval: | 217.58 | m | - | 217.84 | m |
| No. 2 | seam roof | - | sample interval: | 248.55 | m | - | 248.76 | m |
| | | | sample interval: | 249.03 | m | - | 249.32 | m |

## 4.6 IN-SITU RESOURCES

Table 2 of Pan Ocean Report No. 25-79 summarizes the total in-place coal reserve in the upper three seams on the Illtyd Creek Deposit. This "Table of In-Situ Measured and Indicated Resources: Illtyd Deposit" has been reproduced as Table 4-2 of the present report for comparison purposes.

Pan Ocean's in-situ resources were determined by constructing a polygon around each drill hole data point, and the area calculated by constructing internal triangles and applying Hero's formula for the area of a triangle.

In order to verify these resource figures, Wright Engineers Limited used the polygons constructed around the drill hole data points by Pan Ocean and calculated these areas with the aid of a planimeter. Minable thickness values for each seam discounted partings greater than or equal to 1 metre in thickness. Wright Engineers Limited resource figures were calculated on gross coal seam thicknesses (excluding 1 m partings); these figures do not necessarily reflect mining thicknesses or minable resources. The calculations furnish an indication of total coal resources in Nos. 1, 2 and 3 Seams in the Illtyd Creek area, and compare favourably with the Pan Ocean figures. In some instances an increase in seam thickness due to inclusion of carbonaceous roof and floor material occurs; in these cases, Wright Engineers Limited figures are slightly higher than the Pan Ocean figures. Tables 4-3, 4-4 and 4-5 summarize the coal seam thicknesses and Wright Engineers Limited resource calculations for the Illtyd Creek deposit.

## TABLE 4-2

## IN-SITU MEASURED & INDICATED RESOURCES: ILLTYD DEPOSIT

**(From Pan Ocean Report No. 25-79)**

| | Average Thickness (m) | Total Area ($m^2$) | Tonnes (Factor of 1.3 s.g.) |
|---|---|---|---|
| Measured | | | |
| No. 1 Seam | 6.96 | 7,060,921 | 63,866,892 |
| No. 2 Seam | 3.66 | 7,190,298 | 34,179,153 |
| Total Measured | 10.62 | 14,251,219 | 98,046,045 |
| Indicated | | | |
| No. 1 Seam | 6.43 | 1,917,936 | 16,036,047 |
| No. 2 Seam | 3.70 | 1,449,035 | 6,965,081 |
| Total Indicated | 10.13 | 3,366,971 | 23,001,128 |
| Measured and Indicated | | | |
| No. 1 Seam | 6.85 | 8,978,857 | 79,902,939 |
| No. 2 Seam | 3.66 | 8,639,333 | 41,144,234 |
| Total Measured and Indicated | 10.51 | 17,618,190 | 121,047,173 |
| Measured | | | |
| No. 1 Seam | 6.96 | 7,060,921 | 63,866,892 |
| No. 2 Seam | 3.66 | 7,190,298 | 34,179,153 |
| No. 3 Seam | 2.33 | 7,353,723 | 22,880,741 |
| Total Measured | 12.95 | 21,604,942 | 120,926,786 |
| Indicated | | | |
| No. 1 Seam | 6.43 | 1,917,936 | 16,036,047 |
| No. 2 Seam | 3.70 | 1,449,035 | 6,965,081 |
| No. 3 Seam | 2.42 | 1,975,629 | 6,203,851 |
| Total Indicated | 12.55 | 5,342,600 | 29,204,979 |
| Measured and Indicated | | | |
| No. 1 Seam | 6.85 | 8,978,857 | 79,902,939 |
| No. 2 Seam | 3.66 | 8,639,333 | 41,144,234 |
| No. 3 Seam | 2.40 | 9,329,354 | 29,084,591 |
| Total Measured and Indicated | 12.91 | 26,947,544 | 150,131,764 |

## TABLE 4-3

## ILLTYD CREEK DEPOSIT

## SUMMARY OF COAL SECTIONS AS INTERSECTED BY 1978 & 1979 DRILLHOLES

### Depth/Thickness (Metres)

| Hole No. | No.1 Seam | No.2A Seam | No.2B Seam | No.3 Seam | No.4A Seam | No.4B Seam | Total Depth |
|---|---|---|---|---|---|---|---|
| BP-78-2 | 23.47/7.27 | 61.58/3.49 | 66.84/3.17 | 81.76/2.10 | - | - | 89.00 |
| BP-78-3 | 94.70/5.80 | 119.22/2.43 | - | - | - | - | 130.20 |
| BP-78-4 | - | - | - | - | - | - | 122.53 |
| BP-79-7 | 29.20/6.58 | 54.22/1.29 | - | 77.27/1.87 | 126.60/1.51 | - | 159.11 |
| BP-79-8 | 88.68/7.99 | 113.83/3.08 | - | 132.97/4.41 | 146.43/.62 | - | 159.21 |
| BP-79-9 | 134.82/9.86 | 155.73/3.47 | - | 178.60/4.52 | - | - | 196.90 |
| BP-79-10 | 237.46/8.27 | 259.69/3.18 | - | 279.75/3.22 | - | - | 291.31 |
| BP-79-11 | 133.51/8.15 | 156.98/4.35 | - | 174.18/5.46 | - | - | 185.74 |
| BP-79-12/12A | 110.34/7.93 | 155.03/4.07 | 160.41/2.96 | 186.78/2.19 | - | - | 209.09 |
| BP-79-13 | 125.05/6.67 | 158.22/2.76 | 165.60/2.65 | 180.44/2.19 | 204.01/2.22 | 209.45/1.42 | 215.80 |
| BP-79-14 | 88.42/8.20 | 116.69/3.62 | 128.58/4.42 | 141.80/0.73 | 171.13/1.68 | 179.31/1.77 | 191.11 |
| BP-79-15 | 218.05/7.63 | 249.32/3.25 | - | 264.83/4.44 | - | - | 274.93 |
| BP-79-16/16A | - | - | - | - | - | - | 211.84 |
| BP-79-17/17A | 303.20/8.00 | 331.88/2.17 | - | 353.02/3.08 | - | - | 361.80 |
| BP-79-18 | 21.95/9.98 | 58.52/3.15 | - | 77.56/4.43 | - | - | 86.96 |
| BP-79-19 | 58.36/6.86 | 84.52/2.96 | - | 106.33/3.34 | - | - | 114.16 |
| BP-79-20 | 75.28/7.69 | 98.14/2.32 | - | 121.89/3.83 | - | - | 131.67 |
| BP-79-21 | 122.00/4.21 | 144.00/2.01 | - | 164.52/2.63 | - | - | 174.34 |
| BP-79-22/22A | 191.63/6.97 | 221.84/2.72 | - | 234.40/3.13 | - | - | 249.02 |
| Mean Thickness | 7.53 | 2.96 | 3.34 | 3.22 | 1.51 | 1.60 | |
| Mean Separation | | 20.39 | 3.99 | 26.80 | 26.62 | 4.86 | |

## TABLE 4-4

## ILLTYD CREEK DEPOSIT

## IN-SITU MEASURED RESOURCES, IN-SITU INDICATED RESOURCES*

| | Average Thickness (m) | Total Area ($m^2$) | Tonnes (Factor of 1.3 s.g.) |
|---|---|---|---|
| Measured | | | |
| No. 1 Seam | 7.53 | 7,040,567 | 67,740,766 |
| No. 2 Seam | 3.74 | 7,054,180 | 36,894,181 |
| Total Measured | 11.27 | 14,094,747 | 104,634,947 |
| Indicated | | | |
| No. 1 Seam | 7.10 | 1,955,445 | 17,059,962 |
| No. 2 Seam | 4.08 | 1,496,975 | 9,277,945 |
| Total Indicated | 11.18 | 3,452,420 | 26,337,907 |
| Measured and Indicated | | | |
| No. 1 Seam | 7.53 | 8,996,012 | 84,800,728 |
| No. 2 Seam | 3.74 | 8,551,155 | 44,172,126 |
| Total Measured and Indicated | 11.27 | 17,547,167 | 128,972,854 |
| Measured | | | |
| No. 1 Seam | 7.53 | 7,040,567 | 67,740,766 |
| No. 2 Seam | 3.74 | 7,054,180 | 36,894,181 |
| No. 3 Seam | 3.22 | 6,661,166 | 27,921,948 |
| Total Measured | 14.49 | 20,755,913 | 132,556,895 |
| Indicated | | | |
| No. 1 Seam | 7.10 | 1,955,445 | 17,059,962 |
| No. 2 Seam | 4.08 | 1,496,975 | 7,277,945 |
| No. 3 Seam | 3.40 | 964,245 | 3,930,645 |
| Total Indicated | 14.58 | 4,416,665 | 28,268,552 |
| Total Measured and Indicated No. 1 Seam, No.2 Seam, and No. 3 Seam | 14.49 | 25,172,578 | 160,825,447 |

* As calculated by Wright Engineers Limited

# TABLE 4-5

## ILLTYD CREEK DEPOSIT

## IN-SITU RESOURCES: AREAL DISTRIBUTION*

## NO. 1 SEAM

| Hole Number | No. 1 Seam Thickness (m) | Measured Resources Area ($m^2$) | Indicated Resources Area ($m^2$) | Measured Resources (Tonnes) | Indicated Resources (Tonnes) |
|---|---|---|---|---|---|
| BP-79-12A | 7.93 | 460,121 | 277,090 | 4,743,387 | 2,856,521 |
| BP-79-13 | 6.67 | 658,416 | 173,405 | 5,709,125 | 1,503,594 |
| BP-79-22A | 6.97 | 427,943 | 904,978 | 3,877,591 | 8,200,005 |
| BP-78-2 | 7.27 | 254,675 | - | 2,406,933 | - |
| BP-79-14 | 8.20 | 310,644 | - | 3,311,465 | - |
| BP-79-18 | 9.98 | 118,812 | - | 1,541,467 | - |
| BP-79-11 | 8.15 | 505,776 | - | 5,358,697 | - |
| BP-79-8 | 7.99 | 295,930 | - | 3,073,825 | - |
| BP-79-15 | 7.63 | 701,595 | 180,281 | 6,959,121 | 1,788,207 |
| BP-79-19 | 6.86 | 251,925 | - | 2,246,667 | - |
| BP-79-10 | 8.27 | 691,282 | 29,015 | 7,431,973 | 311,940 |
| BP-79-9 | 9.86 | 336,221 | - | 4,309,680 | - |
| BP-79-20 | 7.69 | 311,606 | - | 3,115,125 | - |
| BP-78-3 | 5.80 | 511,964 | - | 3,860,209 | - |
| BP-79-17/17A | 8.00 | 409,103 | 53,080 | 4,254,671 | 552,032 |
| BP-79-7 | 6.58 | 386,964 | - | 3,310,090 | - |
| BP-79-21 | 4.21 | 407,950 | 335,596 | 2,230,740 | 1,847,663 |
| Total | | 7,040,567 | 1,955,445 | 67,740,766 | 17,059,962 |

* Areas calculated by the planimeter method, using each drillhole as a separate data point (Wright Engineers Limited)

TABLE 4-5 - Cont'd.

IN-SITU RESOURCES: AREAL DISTRIBUTION

NO. 2 SEAM

| Borehole | Thickness (m) | Measured Resources Area ($m^2$) | Indicated Resources Area ($m^2$) | Measured Resources (Tonnes) | Indicated Resources (Tonnes) |
|---|---|---|---|---|---|
| No.2A Seam | | | | | |
| BP-79-12A | 4.07 | 622,937 | 270,902 | 3,295,960 | 1,433,342 |
| BP-79-13 | 2.76 | 656,766 | 170,517 | 2,356,476 | 611,815 |
| BP-79-22A | 2.72 | 434,543 | 737,074 | 1,536,544 | 2,606,294 |
| BP-78-2 | 3.49 | 53,080 | - | 240,824 | - |
| BP-79-14 | 3.62 | 305,281 | - | 1,436,652 | - |
| BP-79-18 | 3.15 | 136,139 | - | 557,489 | - |
| BP-79-11 | 4.35 | 506,326 | - | 2,863,274 | - |
| BP-79-8 | 3.08 | 299,780 | - | 1,200,319 | - |
| BP-79-15 | 3.25 | 701,870 | 107,261 | 2,965,401 | 453,178 |
| BP-79-19 | 2.96 | 263,476 | - | 1,013,856 | - |
| BP-79-10 | 3.18 | 673,267 | - | 2,783,286 | - |
| BP-79-9 | 3.47 | 342,684 | - | 1,545,848 | - |
| BP-79-20 | 2.32 | 349,010 | - | 1,052,614 | - |
| BP-78-3 | 2.43 | 548,955 | - | 1,734,149 | - |
| BP-79-17/17A | 2.17 | 330,308 | - | 931,799 | - |
| BP-79-7 | 1.29 | 419,967 | - | 704,285 | - |
| BP-79-21 | 2.01 | 409,791 | 211,221 | 2,471,040 | 551,920 |
| Totals | | 7,054,180 | 1,496,975 | 28,689,816 | 5,656,549 |
| No.2B Seam | | | | | |
| BP-79-12A | 2.96 | 726,073 | 268,702 | 2,793,929 | 1,033,965 |
| BP-79-13 | 2.65 | 654,565 | 170,517 | 2,254,976 | 587,431 |
| BP-78-2 | 3.17 | 339,659 | - | 1,399,735 | - |
| BP-79-14 | 4.42 | 305,556 | - | 1,755,725 | - |
| Totals | | 2,025,853 | 439,219 | 8,204,365 | 1,621,396 |
| Total In-Situ Resource: No. 2 Seam (Seam 2A and 2B) | | | | 36,894,181 | 7,277,945 |

## TABLE 4-5 - Cont'd.

## IN-SITU RESOURCES: AREAL DISTRIBUTION

### NO. 3 SEAM

| Hole Number | No.3 Seam Thickness | Measured Resources | Indicated Resources | Measured Resources | Indicated Resources |
|---|---|---|---|---|---|
| | (m) | Area ($m^2$) | Area ($m^2$) | (Tonnes)( | (Tonnes) |
| BP-78-2 | 2.10 | 342,684 | - | 935,527 | - |
| BP-79-7 | 1.87 | 467,547 | - | 1,136,607 | - |
| BP-79-8 | 4.41 | 313,531 | - | 1,797,473 | - |
| BP-79-9 | 4.52 | 353,685 | - | 2,078,253 | - |
| BP-79-10 | 3.22 | 570,682 | - | 2,388,875 | - |
| BP-79-11 | 5.46 | 506,601 | - | 3,595,854 | - |
| BP-79-12/12A | 2.19 | 715,072 | - | 2,035,810 | - |
| BP-79-13 | 2.19 | 411,166 | - | 1,170,589 | - |
| PB-79-14 | 0.73 | 305,556 | - | 289,973 | - |
| PB-79-15 | 4.44 | 684,818 | 53,630 | 3,952,769 | 309,552 |
| BP-79-17/17A | 3.08 | 261,276 | - | 1,046,149 | - |
| BP-79-18 | 4.43 | 167,767 | - | 966,170 | - |
| BP-79-19 | 3.34 | 296,480 | - | 1,287,316 | - |
| BP-79-20 | 3.83 | 399,340 | - | 1,988,314 | - |
| BP-79-21 | 2.63 | 411,166 | 129,537 | 1,405,777 | 442,887 |
| BP-79-22/22A | 3.13 | 453,795 | 781,078 | 1,846,492 | 3,178,206 |
| Totals | | 6,661,166 | 964,245 | 27,921,948 | 3,930,645 |

## 4.7 RECOMMENDATIONS

The following recommendations result from this evaluation of existing data:

(a) That an additional 6 infill coreholes be completed on the Illtyd Creek Deposit, in order to provide additional data for correlation work, structure, seam quality and geotechnical information.

(b) That these coreholes be geophysically logged using a gamma-neutron, gamma-gamma, resistivity, density and caliper log suite to assist in seam correlation.

(c) That these coreholes be considered for purposes of acquiring groundwater data after their completion.

(d) That the holes be cored to the and No.5 seam in order to determine their continuity, quality and structures.

**PROPOSED INFILL AND DEVEOPMENT CORE PROGRAM**

**ILLTYD CREEK DEPOSIT**

| Location | Projected Depth (m) | Lowest Seam Target |
|---|---|---|
| 23 + 00 N - 5 + 00 E | 350 | No. 5 Seam |
| 25 + 00 N - 5 + 00 E | 390 | No. 5 Seam |
| 15 + 00 N - 5 + 00 E | 360 | No. 5 Seam |
| 5 + 00 N - 5 + 00 E | 235 | No. 5 Seam |
| 0 + 00 N - 10 + 00 E | 220 | No. 5Seam |
| 5 + 00 S - 5 + 00 E | 225 | No. 5 Seam |

A total of 1,780 m (5,840 ft) of coring is involved in this program. The program should be initiated in the southern part of the deposit area. If the first two holes demonstrate that the lower seams are absent or shale out to the north, the program could be curtailed to encompass only the upper three seams.

The accompanying map, Dwg. No. 1098-103-1202, shows the locations of the proposed holes and their relation to existing holes.

# SECTION 5

# MINING PLAN

# SECTION 5

# MINING PLAN

## 5.1 GENERAL

The mining plan has been based on two production rates, 500,000 clean tonnes/year and 750,000 clean tonnes/year, and two ash content levels of 15% and 18%, giving four separate cases.

As the clean coal reserves in No.1 and No.2 Seams are more than sufficient to sustain either production rate, No.3 Seam has not been considered in the mining plan.

## 5.2 DESCRIPTION OF SEAMS

### 5.2.1 No.1 Seam

No.1 Seam varies in thickness from 4.21 m to 9.98 m, averaging 6.85 m. The coal is interspaced with shale bands of variable thickness. The seam is overlain with a thick conglomerate which weathers upon exposure to air and moisture. The contact is usually sharp and provides a very strong roof.

The floor of the seam is mostly a medium dark grey shale which weathers rapidly when exposed to air and moisture, producing pebble-size pieces of shale.

A typical section is shown on Dwg. No. 1098-102-1209.

### 5.2.2 No.2 Seam

No.2 Seam lies stratigraphically below No.1 Seam at an interval varying from 10 m to 40 m. These strata comprise a basal pebble conglomerate or coarse sandstone grading to a shale towards the base of No.1 Seam.

No.2 Seam varies in thickness from 1.29 m to 4.35 m, with an average thickness of 3.66 m. Its roof varies from conglomerate to sandstone and is considered fairly competent. The roof contact is again usually sharp. As with No.1 Seam, the floor is a shale which weathers rapidly when exposed to air and moisture.

A typical section of No.2 Seam is shown on Dwg. No. 1098-102-1210.

### 5.2.3 Seam Gradients

The dip at the outcrop of No.1 and No.2 Seams is approximately 17½ degrees, decreasing to 3 degrees in the southeast. In the northern part of the reserve area, the dip ranges from 12 degrees to 18 degrees. Seam structure contours are shown on Dwg. Nos. 1098-102-1212 and 1213.

## 5.3 SELECTION OF MINING METHODS

### 5.3.1 Surface Mining

Preliminary investigations of mining by open pit methods were carried out to determine the economic and technical acceptability of this approach. A strip ratio of 6:5 to 1 was selected, and a preliminary layout was produced from which capital and operating costs were determined.

Upon comparison with underground methods, the open pit concept was rejected on the following basis:

(a) The 500,000 tonnes/day case gave an operating life of 9.5 years at a mining capital cost of $25.8 million, while the 750,000 tonnes/year case gave an operating life of 6.5 years at $30.0 million. Production would commence from the underground operations upon completion of the open pit; the redundant surface mining equipment would be sold.

For comparison purposes a hypothetical a cash flow analysis was completed to enable an economic comparison of the underground and combined open

pit/underground options to be made. The cash flow was based on a selling price of $75/tonne clean coal, and on equity capital. The open pit capital and operating costs for both production cases are shown on Table 5-1. These costs were combined with the costs of the surface facilities and subsequent underground mining to provide a 30-year cash flow.

Over 30 years, the total capital expenditure, including underground equipment, surface facilities and replacement capital, is estimated as $168,890,760 for the 500,000 tonnes/year case and $207,333,600 for the 750,000 tonnes/year case.

The cash flows indicated an improved return on investment for an exclusively underground mining application in both production cases. The cost differences are tabulated below:

| | Underground Only | Open Pit/Underground |
|---|---|---|
| | Cumulative Cash Flow Discounted at 10% ($000's) | |
| 500,000 tonnes/year | 3,041 | -5,466 |
| 750,000 tonnes/year | 59,008 | 43,471 |
| | Rate of Return After Tax (%) | |
| 500,000 tonnes/year | 10.40 | 9.27 |
| 750,000 tonnes/year | 17.14 | 15.04 |

Thus at the above production rates the underground only application is more economically acceptable.

## TABLE 5-1

## OPEN PIT CAPITAL AND OPERATING COSTS

**($000's)**

| | Year of Production | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pre-Prod. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| **Case 1 - 500,000 tonnes/year** | | | | | | | | | |
| Capital Cost | 8,350 | 4,040 | 3,268 | 451 | 3,662 | 2,417 | 1,757 | 295 | 1,649 |
| Operating Costs: | | | | | | | | | |
| - Mining | - | 23.45 | 28.58 | 28.58 | 31.79 | 31.79 | 31.79 | 31.79 | 31.79 |
| - Prep.plant, etc. | - | 12.21 | 12.56 | 12.56 | 12.96 | 12.96 | 12.96 | 12.96 | 12.96 |
| Total Operating | - | 35.66 | 41.14 | 41.14 | 44.75 | 44.75 | 44.75 | 44.75 | 44.75 |
| **Case 2 - 750,000 tonnes/year** | | | | | | | | | |
| Capital costs | 10,772 | 11,595 | 818 | 4,262 | 3,451 | 48 | - | - | - |
| Operating Costs: | | | | | | | | | |
| - Mining | - | 26.76 | 27.19 | 27.93 | 27.53 | 27.53 | 28.26 | - | - |
| - Prep.plant, etc. | - | 10.41 | 10.47 | 10.59 | 10.52 | 10.52 | 10.52 | - | - |
| Total Operating | - | 37.17 | 37.66 | 38.52 | 38.05 | 38.05 | 38.78 | - | - |

(b) The open pit is in exactly the same location as the underground portals, which were selected on the basis of seam outcrop locations and the optimum division of the reserve area to facilitate mining and ventilation. The excavation for the open pit would therefore have to be partly refilled to provide access to the underground workings.

(c) After the open pit had been excavated, the elevation of the portals would be lower than that of Illtyd Creek. This would result in the need for special methods of water and flood control and also present the possibility of flooding the mine.

## 5.3.2 Underground Mining

### 5.3.2.1 No.1 Seam

The seam appears to be well-suited to longwall mining since: the seam is continuous and not cut by known faulting; seam mining thickness appears constant over significant areas; and dips are not significant. However, in addition to these criteria, the economics of the longwall mining method also depend upon the nature of the strata above and below the seam. Longwall mining depends, as do many methods of coal mining where high recovery is required, on control and caving of the strata above and below the seam to be extracted.

The strata in the floor of No.1 Seam weather severely upon exposure to air and moisture. While this can be overcome to a certain extent by leaving a covering of coal in the floor, should "floor lift" sufficient to prevent good access along the roadway occur, dinting (excavation of the floor) could again expose the shale to potential weathering. The amount of floor lift or heave is dependent upon the strength of both the roof and the coal.

The conglomerate above No.1 Seam ranges in thickness from 20 m to 125 m; this roof rock was investigated to determine whether it would cave and thus enable longwall mining to maximize recovery. During this examination the cores were inspected, field samples were selected for preliminary testing, the photographic slides of the core were inspected and the opinions of experienced personnel were obtained regarding the cavability of the conglomerate.

Based on these investigations, it is the opinion of Wright Engineers Limited that the conglomerate above No.1 Seam will not cave and that the expected roof conditions are not suitable for longwall mining or any other method where caving of the roof rock is required to provide ground control. This is emphasized in the following statements extracted from a letter dated December 4, 1980 from Piteau and Associates dealing with cavability of conglomerate above No.1, 2, and 3 Seams.

"Based upon the thickness of the massive conglomerate and sandstone units, relatively high RQD, low degree of fracturing and moderate estimated compression strength of samples tested, it is felt that the rock may not be suitable for caving. There does not appear to be sufficient bedding or factures within the conglomerate to result in uniform failure of the thick conglomerate member behind the proposed longwall".

The above discussion eliminates any method which would enable maximum extraction from No.1 Seam. Thus a partial extracting system, pillar mining with pillars remaining in place for support of the roof, is recommended. This method of mining will maximize recovery while providing adequate support for the roof, enabling safe mining to proceed efficiently.

#### 5.3.2.2 No.2 Seam

The conditions of No.2 Seam are similar to those of No.1 Seam, but with significant differences which, in the opinion of Wright Engineers Limited, accommodate utilization of the longwall mining method.

The floor of the seam also comprises a shale which weathers upon exposure to air and moisture. Thus a covering of coal will have to be left over the shale.

The roof above the coal seam and the strata between seams are also expected to be competent, but are by no means as thick as the roof strata above No.1 Seam, and tend to be more layered. When coupled with the fact that No.1 Seam will be mined-out above No.2 Seam, providing a "weakness zone", it is considered likely that caving will occur and that the caving will follow the longwall face such that efficient, safe operations can be expected.

The selected mining method for No.2 Seam is longwall.

## 5.4 MINING RESERVES

### 5.4.1 General

The area selected for mining the seams has been based on the following:

(a) Sufficient area to provide mining reserves for both the 500,000 tonnes/year and the 750,000 tonnes/year cases at the given quality.

(b) Single access for each seam and portal site, minimizing rock driveage and taking advantage of any outcrops.

(c) Mining in the lower seam (No.2) restricted such that it does not sterilize any potential reserves in No.1 Seam.

(d) The length of roadways maintained to enable adequate efficient ventilation systems to be designed.

### 5.4.2 No.1 Seam

The reserve area of No.1 Seam is shown on Dwg. Nos. 1098-102-1203 and 1205, the northeast limit being the 300-m overburden contour. This is an arbitrary limit based upon suggested limiting load factors to minimize possible ground control problems. The northern limit is based on splitting the area into "equal" parts and ventilation considerations. The southeast limit is based on a possible fault line, while the outcrop serves as the southwest limit.

In order to provide adequate support for the roof rock and to control "weighting", the minable section has been split up into areas where different sized pillars will be established and left in place.

The pillar sizes have been established on the basis of the depth of cover, seam thickness and width of roadway (6.1 m).

| Area | Pillar Size | Mining Recovery |
|---|---|---|
| A | 15.2 m x 15.2 m | 49.0% |
| B | 18.3 m x 18.3 m | 43.75% |
| C | 21.3 m x 21.3 m | 39.5% |
| D | 27.4 m x 27.4 m | 33.0% |
| E | 15.2 m x 15.2 m | 49.0% |
| F | 18.3 m x 18.3 m | 43.75% |
| G | 21.3 m x 21.3 m | 39.5% |
| H | 27.4 m x 27.4 m | 33.0% |

The reserves have been based on the following mining thicknesses and on the areas of influence as shown on Dwg. No. X 1098-102-1201.

| Borehole Number | Minable Thickness |
|---|---|
| BP-79-12/12A | 3.66 m |
| BP-79-13 | 3.66 m |
| BP-78-2 | 3.66 m |
| BP-79-14 | 3.65 m |
| BP-79-18 | 3.00 m |
| BP-79-22/22A | 3.26 m |
| BP-79-15 | 3.66 m |
| BP-79-11 | 3.66 m |
| BP-79-8 | 2.93 m |
| BP-79-19 | 2.38 m |
| BP-79-10 | 3.66 m |
| BP-79-9 | 3.66 m |

Support pillars have been left as follows:

- minimum cover of 60 m above the seam
- 40 m between main entries
- 30 m betweeen main entry and mining area

The in-situ minable resources have been calculated as 31,866,020 tonnes, and the recoverable mining reserves as 12,612,001 tonnes raw. Mining recovery averages 40%.

### 5.4.3 No.2 Seam

The reserve area for mining of No.2 Seam is shown on Dwg. No. X1098-102-1202 and 1206. The mining limits are similar to No.1 Seam, with the west limit being south of the limit in the No.2 Seam. This ensures No.1 Seam is not undermined prior to extraction.

The mining area has been divided into 100 m long longwall faces located to maximize recovery.

Support pillars have been left as follows:

- minimum cover of 60 m above the seam
- 40 m between main entries
- 30 m between the main entry and mining area
- 15 m between adjacent longwall roadways

The reserves have been based on the following mining thicknesses:

| Borehole Number | Minable Thickness |
|---|---|
| BP-79-12/12A | 1.85 m |
| BP-79-13 | 1.56 m |
| BP-78-2 | 3.18 m |
| BP-79-14 | 1.83 m |
| BP-79-18 | 1.95 m |
| BP-79-22/22A | 2.43 m |
| BP-79-15 | 2.95 m |
| BP-79-11 | 3.46 m |
| BP-79-8 | 2.07 m |
| BP-79-19 | 1.31 m |
| BP-79-10 | 2.88 m |
| BP-79-9 | 2.39 m |

The in-situ minable reserves have been calculated as 20,807,540 tonnes, and the recoverable mining reserves as 13,758,702 tonnes. Overall mining recovery is 66%.

## 5.5 MINING PLAN

### 5.5.1 No.1 Seam - Pillar Mining

Access to the seam will be via three main entries driven from the outcrop of the seam, as shown on Dwg. No. X1098-102-1203. These roadways will be on 46 m centres, 6.1 m wide x 3.66 m high, at a dip not exceeding 12 degrees. The initial 30 m will be provided with rectangular steel supports and timber lagging where required. The remaining roadway length will be rockbolted, with rectangular steel supports set where ground conditions demand. Timber chocks will be built at junctions, with steel beams spanning the roadway (see Dwg. No. X1098-102-1211).

When the main drifts have been advanced past the support pillar, i.e. 60 m of cover, production entries will be turned off to the southeast, generally parallel to the outcrop. The entries are shown on the ventilation plan, Dwg.No. 1098-102-1220. Pillar formation will commence approximately 30 m from the main entry and will continue to the southeast on 21.3 m centres until the limit of the mining area is reached. It is proposed to drive a minimum of five parallel roadways in the production areas to ensure that the required production can be sustained and that headings are available for the cutting machines at all times.

In the 500,000 tonnes/year case, four machine-shifts are required to ensure production is achieved. Thus, three sets of production/development equipment will be purchased, two sets to be in the production development mode at all times and the third to be installed and available for maintenance/repair or operation. One set of production/development equipment consists of one continuous miner, one shuttle car and one feeder breaker. A fourth set of equipment would be purchased for the 750,000 tonnes/year case, ensuring sufficient back-up equipment is available for six machine -shifts daily.

The mining operation comprises a continuous miner cutting and loading coal into a shuttle car for transfer to a feeder breaker, at which point the coal is sized and fed to the production entry conveyor. With transfer points incorporated where necessary, the coal is then passed to a series of in-line conveyors for transport to the

surface and subsequently to the preparation plant. A perspective of the system is outlined on Drawing No. D1098-102-1207.

All production equipment will be electrically-operated and approved for use in underground coal mines.

### 5.5.2 No.2 Seam - Longwall Mining

Access to the No.2 Seam will also be provided by three main entries, commencing adjacent to and north of the portals for No.1 Seam and as shown on Dwg. No. 1098-102-1204. Maximum dip is again 12 degrees. Advancing longwall faces, 100 m long and with a maximum panel length of 2,000 m, are set off to the south of the main entries. Fifteen-metre pillars will be left between adjacent faces. The reserve area has been divided as per Dwg. No. X1098-102-1204 to maximize recovery.

The main entries will be supported in a manner similar to those of No.1 Seam. In the roadways servicing the longwall faces, steel beams supported on round wooden posts will be set at 1.5-m intervals and lagged as required.

Every effort will be made to reduce roadway maintenance. After initial production parameters have been achieved, development will continue to the furthest points of the reserve area; retreat mining of the reserve are can thus be achieved. This will enable main entries to be developed in virgin ground, with a "break line" established from the furthest point from the portals. As the area is mined out on the retreat, access roadways in the most stressed areas will become redundant, thus reducing maintenance and also easing ventilation control.

Development will be completed with a continuous miner, shuttle car and conveyors. The longwall face will consist of shields set on 1.5-m centres for support. The armoured flexible conveyor, located ahead of the supports, will provide the base upon which the shearer (cutting unit) will traverse the face. The system will incorporate "stable hole" elimination, which involves utilizing the shearer to cut the face ends as it completes its run along the face.

The coal will flow from the armoured flexible conveyor to the stageloader, a short, high-capacity chain conveyor, to a roadway conveyor for subsequent transport to surface. A perspective of the system is outlined on Dwg. No. 1098-102-1208.

### 5.5.3 Materials Handling

Eimco 975 diesel-operated vehicles have been included in this study for materials handling. These flat-deck type trucks are approved for use in underground coal mines in British Columbia, and no difficulty is anticipated in obtaining approval for use in the Yukon Territory.

The trucks will operate on maximum dips of 12 degrees and will be fitted with a boom for loading and unloading.

### 5.5.4 Personnel Transportation

As described elsewhere in this report, mining personnel will be bussed from the dry to the mine portal, where they will mount a diesel vehicle designed for personnel transport only. One of the face crew will drive the truck into the mine, with the truck remaining close to the face. While the vehicle can be used any time during the shift for necessary transport, e.g. in case of accidents, etc., it will generally be reserved for shift changes. Two such vehicles have been included in this study.

### 5.5.5 Ventilation

The ventilation system will be based on an exhausting system, with the main fans located adjacent to the main portals and connected to the main return roadway.

Three main entries, at intervals of 46 m, have been provided for each seam. During initial development these main entries will be ventilated with 75 hp auxiliary fans and 36-inch duct. A 30-m pillar will be left on the mining side of each of the outer roadways.

The main fans for No.1 Seam will provide 180,000 cfm at a static pressure of 4" WG and 250 hp. Two fans will be installed in parallel to ensure that, should one fail, a second unit is available for start-up. The main fans for No.2 Seam have been based on providing 110,000 cfm @ 6" WG and 200 hp, and will again be installed in parallel.

Heaters are provided for ensuring suitable working temperatures for underground operations.

A diesel generator is provided to ensure that ventilation of the mine is sustained in the event of a power failure.

Fan selection has been based on the following parameters:

**No.1 Seam**

- exhausting system
- main entry air velocity not to exceed 1,200 ft/min
- methane release in all areas not to exceed 50 cu ft/tonne
- intervals between cross-cuts not to exceed 400 ft
- volumetric efficiency of the system 42%
- frictional coefficient of the roadways 0.008 x $10^{-6}$
- quantities of air in working area:

  development and production headings

  utilizing continuous miners - 15,000 cfm
- cross-sectional area of roadway (allowing for convergence) 200 sq ft
- perimeter of the roadway (allowing for convergence) 60 ft
- series ventilation avoided
- auxiliary ventilation fans and duct where necessary
- splitting of air where practicable

**No.2 Seam**

- exhausting system
- main entry for velocity not to exceed 1,200 ft/min
- methane release in all areas not to exceed 50 cu ft/tonne
- intervals between cross-cuts not to exceed 400 ft

- volumetric efficiency of system 50%
- frictional coefficient of roadways 0.009 x $10^{-6}$
- frictional coefficient of face 0.01 x $10^{-6}$

- quantities of air in working areas:

| | |
|---|---|
| development headings | 15,000 cfm |
| longwall face | 40,000 cfm |

- cross-sectional area of roadway (allowing for convergence) 128 sq ft
- cross-sectional area of face 96 sq ft
- perimeter of roadway (allowing for convergence) 48 ft
- perimeter of face 40 sq ft
- series ventilation avoided
- auxiliary ventilation fans in development only
- splitting of air where practicable

A schematic of the proposed ventilation system on both No.1 and No.2 Seams is shown on Dwg. No. 1098-102-1220 and 1221.

## 5.6 PRODUCTION RATES

The calculations below are based on the quantity of raw coal that must be mined to ensure production of, in Case 1, 500,000 tonnes/year of clean coal and in Case 2, 750,000 tonnes/year of clean coal.

It is proposed to operate 350 days/year to achieve this production, allowing a 15-day Christmas/New Year break.

### 5.6.1 Case 1 - 500,000 tonnes/year

#### 5.6.1.1 No.1 Seam

The mining height of No.1 Seam varies from 2.37 m to 3.66 m, the latter being the approximate maximum excavation height for continuous miners. Average preparation plant yield for the section of the seam planned to be mined is calculated as 80.2%.

Raw coal production/year = $\frac{\text{clean coal production/year}}{\text{average yield}}$ x dilution

= $\frac{500,000}{.802}$ x 1.05

= 654,613 tonnes

Production/day (assuming 350 working days/year) = 1,870 tonnes

Production/shift (assuming 3 shifts/day) = 624 tonnes

At a maximum mining height of 3.65 m and with an average roadway width of 6.1 m, it is estimated that one continuous miner will obtain an average advance of 15 m/shift when utilizing multiple headings.

Expected production/machine shift (1.48 = estimated S.G.) = 15 m x 6.1 m x 1.48 m x 3.65 m

= 500 tonnes

Production/day (assuming 4 machine shifts/day) = 2,000 tonnes

Three shifts per day are considered adequate for required production. Two machines will provide for 4 machine shifts/day, with a third installed and fully operational to take-over production should one of the other machines break down.

<u>At a mining height of 2.37 m:</u>

Expected advance/machine shift = 21 m

Expected production/machine shift = 21 m x 6.1 m x 1.48 x 2.37 m

= 450 tonnes

Production/day = 1,800 tonnes
(assuming 4 machine/shifts day)

### 5.6.1.2 No.2 Seam

The calculation of production from No.2 Seam is based on longwall faces 100 m long and 0.78 m advance/cut (i.e. pass of the shearer). The mining height ranges from 1.56 m to 3.46 m. Preparation plant recovery of coal from this seam is expected to average 89.7%.

Raw coal production/year = $\frac{\text{clean coal production/year}}{\text{average yield}}$ x dilution

= $\frac{500,000}{0.897}$ x 1.05

=

= 585,300 tonnes

Production/day = 1,672 tonnes
(assuming 350 working days/year)

At mining height of 1.56 m:

Production/metre advance = 100 x 1.48 x 1 x 1.56

= 230 tonnes

Advance required/day = $\frac{1,672}{230}$

=

= 7.27 m

Cuts/shift = $\frac{7.27}{0.78 \times 2}$
(based on 2 shifts/day

= 4.66

At mining height of 3.46 m:

Production/metre advance = 100 x 1.48 x 1 x 3.46

= 512 tonnes

Advance required/day = $\frac{1,672}{512}$

=

= 3.27 m

Cuts/shift (based on 2 shifts/day) = $\frac{3.27}{0.78 \times 2}$

= 2.1

## 5.6.2 Case 2 - 750,000 tonnes/year

### 5.6.2.1 No.1 Seam

Raw coal production/year = $\frac{\text{clean coal production/year}}{\text{average yield}}$ x dilution

= $\frac{750,000}{0.802}$ x 1.05

= 981,920 tonnes

Production/day (assuming 350 working days/year) = 2,805 tonnes

Production/shift (assuming 3 shifts/day) = 935 tonnes

At mining height of 3.65 m:

Expected production/machine shift = 500 tonnes (as calculated in Case 1)

Total production/day (assuming 6 machine shifts/day) = 3,000 tonnes

At mining height of 2.37 m:

Expected production/machine shift = 450 tonnes

Total production/day (assuming 6 machine shifts/day) = 2,700 tonnes

### 5.6.2.2 No.2 Seam

Raw coal production/year = $\frac{\text{clean coal production/year}}{\text{average yield}}$ x dilution

= $\frac{750,000}{0.897}$ x 1.05

= 877,930 tonnes

Production/day = 2,510 tonnes
(assuming 350 working days/year)

Advance/cut = 0.78 m
(for 100-m long face)

At mining height of 1.56 m:

Advance required/day = $\frac{2,510}{230}$

= 10.9 m

Cuts/shift = $\frac{10.9}{0.78 \times 3}$

= 4.7

At mining height of 3.46 m:

Advance required/day = $\frac{2,510}{512}$

= 4.9 m

Cuts/shift = $\frac{4.9}{0.78 \times 3}$
(assuming 3 shifts)

= 2.09

### 5.6.3 Production Schedules

Four production schedules have been calculated as follows:

| | | | |
|---|---|---|---|
| 500,000 | tonnes/year at | 15% Ash | (Table 5-2) |
| 500,000 | tonnes/year at | 18% Ash | (Table 5-3) |
| 750,000 | tonnes/year at | 15% Ash | (Table 5-4) |
| 750,000 | tonnes/year at | 18% Ash | (Table 5-5) |

The schedules are based on mining No.1 Seam first and bringing No.2 Seam, which utilizes a low-cost mining method, into production as soon as possible. Thus, an average yield is maintained over the life of the mine at the most economic cost.

The calorific value of the product coal corresponding with each production schedule is presented on Table 5-6.

## TABLE 5-2

## UNDERGROUND PRODUCTION SCHEDULE

### 500,000 tonnes/year @ 15% Ash

| | Seam 1 | | | Seam 2 | | | |
|---|---|---|---|---|---|---|---|
| Year | Raw Coal (Tonnes) | Clean Coal (Tonnes) | Plant Yield | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | % Overall Plant Recovery |
| 5 | 550,661 | 500,000 | 90.8 | | | | 90.8 |
| 6 | 550,661 | 500,000 | 90.8 | | | | 90.8 |
| 7 | 581,443 | 500,000 | 86.0 | | | | 86.0 |
| 8 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 9 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 10 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 11 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 12 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 13 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 14 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 15 | 600,240 | 500,000 | 83.3 | | | | 83.3 |
| 16 | 609,283 | 500,000 | 82.1 | | | | 82.1 |
| 17 | 615,764 | 500,000 | 81.2 | | | | 81.2 |
| 18 | 618,220 | 500,000 | 80.9 | | | | 80.9 |
| 19 | 346,362 | 264,340 | 76.3 | 276,140 | 235,660 | 85.3 | 80.3 |
| 20 | 404,521 | 280,000 | 69.2 | 220,000 | 220,000 | 100 | 80.1 |
| 21 | 421,941 | 300,000 | 71.1 | 200,000 | 200,000 | 100 | 80.4 |
| 22 | 443,744 | 320,000 | 72.1 | 180,000 | 180,000 | 100 | 80.2 |
| 23 | 453,920 | 330,000 | 72.7 | 170,000 | 170,000 | 100 | 80.1 |
| 24 | 398,900 | 290,000 | 72.7 | 224,448 | 210,000 | 93.6 | 80.2 |
| 25 | 281,981 | 205,000 | 72.7 | 338,302 | 295,000 | 87.2 | 80.6 |
| 26 | 288,858 | 210,000 | 72.7 | 332,568 | 290,000 | 87.2 | 80.5 |
| 27 | 308,929 | 225,000 | 72.8 | 309,580 | 275,000 | 88.8 | 80.8 |
| 28 | 319,293 | 235,000 | 73.6 | 296,887 | 265,000 | 89.3 | 81.1 |
| 29 | 434,783 | 320,000 | 73.6 | 189,616 | 180,000 | 94.9 | 80.1 |
| 30 | 180,827 | 133,522 | 73.8 | 406,202 | 366,478 | 90.2 | 85.2 |
| 31 | | Completed | | 540,000 | 500,000 | 92.4 | 92.4 |
| 32 | | | | 529,575 | 500,000 | 94.4 | 94.4 |
| 33 | | | | 534,844 | 500,000 | 93.5 | 93.5 |
| 34 | | | | 540,704 | 500,000 | 92.5 | 92.5 |
| Total | 12,612,011 | 10,112,862 | 80.2 | 5,288,866 | 4,887,138 | 92.4 | |

# TABLE 5-3

## UNDERGROUND PRODUCTION SCHEDULE

### 500,000 tonnes/year @ 18% Ash

| | Seam 1 | | | Seam 2 | | | |
|---|---|---|---|---|---|---|---|
| Year | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | % Overall Plant Recovery |
| 5 | 538,793 | 500,000 | 92.8 | | | | 92.8 |
| 6 | 538,793 | 500,000 | 92.8 | | | | 92.8 |
| 7 | 559,724 | 500,000 | 89.3 | | | | 89.3 |
| 8 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 9 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 10 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 11 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 12 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 13 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 14 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 15 | 576,701 | 500,000 | 86.7 | | | | 86.7 |
| 16 | 579,107 | 500,000 | 86.3 | | | | 86.3 |
| 17 | 593,824 | 500,000 | 84.2 | | | | 84.2 |
| 18 | 593,824 | 500,000 | 84.2 | | | | 84.2 |
| 19 | 608,435 | 485,000 | 79.7 | 16,741 | 15,000 | 89.6 | 80.0 |
| 20 | 392,426 | 291,709 | 74.4 | 232,220 | 208,291 | 89.7 | 80.0 |
| 21 | 470,430 | 350,000 | 74.4 | 150,000 | 150,000 | 100 | 80.6 |
| 22 | 475,610 | 354,481 | 74.5 | 145,519 | 145,519 | 100 | 80.5 |
| 23 | 487,968 | 365,000 | 74.8 | 135,000 | 135,000 | 100 | 80.3 |
| 24 | 487,968 | 365,000 | 74.8 | 135,000 | 135,000 | 100 | 80.3 |
| 25 | 487,968 | 365,000 | 74.8 | 135,000 | 135,000 | 100 | 80.3 |
| 26 | 518,000 | 394,241 | 76.1 | 105,759 | 105,759 | 100 | 80.2 |
| 27 | 518,960 | 397,523 | 76.6 | 102,477 | 102,477 | 100 | 80.5 |
| 28 | 146,566 | 112,365 | 76.6 | 422,260 | 387,635 | 91.8 | 87.9 |
| 29 | | Completed | | 541,141 | 500,000 | 92.4 | 92.4 |
| 30 | | | | 531,112 | 500,000 | 94.1 | 94.1 |
| 31 | | | | 531,724 | 500,000 | 94.0 | 94.0 |
| 32 | | | | 528,505 | 500,000 | 94.6 | 94.6 |
| 33 | | | | 517,998 | 500,000 | 96.5 | 96.5 |
| 34 | | | | 521,203 | 500,000 | 95.9 | 95.9 |
| Total | 12,612,004 | 10,480,319 | 83.1 | 4,751,659 | 4,519,681 | 95.1 | |

# TABLE 5-4

## UNDERGROUND PRODUCTION SCHEDULE

### 750,000 tonnes/year @ 15%Ash

| | Seam 1 | | | Seam 2 | | | |
|---|---|---|---|---|---|---|---|
| Year | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | % Overall Plant Recovery |
| 5 | 825,991 | 750,000 | 90.8 | | | | |
| 6 | 856,774 | 750,000 | 87.5 | | | | |
| 7 | 900,360 | 750,000 | 83.3 | | | | |
| 8 | 900,360 | 750,000 | 83.3 | | | | |
| 9 | 900,360 | 750,000 | 83.3 | | | | |
| 10 | 900,360 | 750,000 | 83.3 | | | | |
| 11 | 900,360 | 750,000 | 83.3 | | | | |
| 12 | 909,403 | 750,000 | 83.1 | | | | |
| 13 | 923,645 | 750,000 | 81.2 | | | | |
| 14 | 637,904 | 493,393 | 77.3 | 297,087 | 256,607 | 86.4 | 80.2 |
| 15 | 628,234 | 446,941 | 71.1 | 303,059 | 303,059 | 100 | 80.5 |
| 16 | 628,022 | 450,199 | 71.7 | 299,801 | 299,802 | 100 | 80.8 |
| 17 | 660,248 | 480,000 | 72.7 | 271,795 | 270,000 | 99.3 | 80.5 |
| 18 | 465,517 | 338,431 | 72.7 | 471,983 | 411,569 | 87.2 | 80.0 |
| 19 | 481,421 | 350,000 | 72.7 | 452,929 | 400,000 | 88.3 | 80.3 |
| 20 | 504,096 | 370,000 | 73.4 | 431,648 | 380,000 | 88.0 | 80.2 |
| 21 | 577,446 | 425,000 | 73.6 | 353,020 | 325,000 | 92.1 | 80.6 |
| 22 | 11,500 | 8,898 | 77.4 | 803,624 | 741,102 | 92.2 | 92.0 |
| 23 | | Completed | | 796,003 | 750,000 | 94.2 | 94.2 |
| 24 | | | | 809,120 | 750,000 | 92.7 | 92.7 |
| 25 | | | | 826,071 | 750,000 | 90.8 | 90.8 |
| 26 | | | | 834,461 | 750,000 | 89.9 | 89.9 |
| 27 | | | | 850,215 | 750,000 | 88.2 | 88.2 |
| 28 | | | | 863,625 | 750,000 | 86.8 | 86.8 |
| 29 | | | | 914,832 | 750,000 | 82.0 | 82.0 |
| 30 | | | | 923,057 | 750,000 | 81.3 | 81.3 |
| 31 | | | | 874,226 | 750,000 | 85.8 | 85.8 |
| 32 | | | | 855,591 | 750,000 | 87.7 | 87.7 |
| 33 | | | | 819,217 | 750,000 | 91.6 | 91.6 |
| 34 | | | | 707,338 | 697,681 | 98.6 | 98.6 |
| Total | 12,612,011 | 10,112,862 | 80.2 | 13,758,702 | 12,334,631 | 90.0 | |

## TABLE 5-5

## UNDERGROUND PRODUCTION SCHEDULE

### 750,000 tonnes/year @ 18%Ash

| | Seam 1 | | | Seam 2 | | | |
|---|---|---|---|---|---|---|---|
| Year | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | Raw Coal (Tonnes) | Clean Coal (Tonnes) | % Plant Yield | % Overall Plant Recovery |
| 5 | 808,190 | 750,000 | 92.8 | | | | 92.8 |
| 6 | 829,514 | 750,000 | 90.4 | | | | 90.4 |
| 7 | 865,052 | 750,000 | 86.7 | | | | 86.7 |
| 8 | 865,052 | 750,000 | 86.7 | | | | 86.7 |
| 9 | 865,052 | 750,000 | 86.7 | | | | 86.7 |
| 10 | 865,052 | 750,000 | 86.7 | | | | 86.7 |
| 11 | 865,052 | 750,000 | 86.7 | | | | 86.7 |
| 12 | 867,455 | 750,000 | 86.5 | | | | 86.5 |
| 13 | 890,736 | 750,000 | 84.2 | | | | 84.2 |
| 14 | 925,509 | 750,000 | 81.0 | | | | 81.0 |
| 15 | 607,479 | 451,709 | 74.4 | 323,961 | 298,291 | 92.1 | 80.5 |
| 16 | 737,563 | 549,821 | 74.5 | 200,179 | 200,179 | 100 | 80.0 |
| 17 | 735,294 | 550,000 | 74.8 | 200,000 | 200,000 | 100 | 80.2 |
| 18 | 735,294 | 550,000 | 74.8 | 200,000 | 200,000 | 100 | 80.2 |
| 19 | 785,838 | 600,000 | 76.4 | 150,000 | 150,000 | 100 | 80.1 |
| 20 | 364,274 | 279,129 | 76.6 | 505,466 | 470,871 | 93.2 | 86.2 |
| 21 | | | | 812,472 | 750,000 | 92.3 | 92.3 |
| 22 | | | | 790,505 | 750,000 | 94.9 | 94.9 |
| 23 | | | | 779,609 | 750,000 | 96.2 | 96.2 |
| 24 | | | | 788,097 | 750,000 | 95.2 | 95.2 |
| 25 | | | | 793,547 | 750,000 | 94.5 | 94.5 |
| 26 | | | | 788,317 | 750,000 | 95.1 | 95.1 |
| 27 | | | | 802,861 | 750,000 | 93.4 | 93.4 |
| 28 | | | | 791,816 | 750,000 | 94.7 | 94.7 |
| 29 | | | | 811,132 | 750,000 | 92.5 | 92.5 |
| 30 | | | | 838,406 | 750,000 | 89.5 | 89.5 |
| 31 | | | | 852,775 | 750,000 | 87.9 | 87.9 |
| 32 | | | | 835,557 | 750,000 | 89.8 | 89.8 |
| 33 | | | | 802,344 | 750,000 | 93.5 | 93.5 |
| 34 | | | | 808,529 | 750,000 | 92.8 | 92.8 |
| Total | 12,612,406 | 10,480,657 | 83.1 | 12,875,573 | 12,019,341 | 93.4 | |

## TABLE 5-6

## AVERAGE CALORIFIC VALUE OF PRODUCT COAL

## (BTU/lb)

| Year | 15% Ash Product | | 18% Ash Product | |
|---|---|---|---|---|
| | 500,000 (mtpy) | 750,000 (mtpy) | 500,000 (mtpy) | 750,000 (mtpy) |
| 5 | 10,538 | 10,538 | 10,442 | 10,442 |
| 6 | 10,538 | 10,318 | 10,442 | 10,173 |
| 7 | 10,207 | 10,002 | 10,038 | 9,725 |
| 8 | 10,002 | 10,002 | 9,725 | 9,725 |
| 9 | 10,002 | 10,002 | 9,725 | 9,725 |
| 10 | 10,002 | 10,002 | 9,725 | 9,725 |
| 11 | 10,002 | 10,002 | 9,725 | 9,725 |
| 12 | 10,002 | 10,002 | 9,725 | 9,685 |
| 13 | 10,002 | 10,002 | 9,725 | 9,490 |
| 14 | 10,002 | 9,702 | 9,725 | 9,501 |
| 15 | 10,002 | 9,777 | 9,725 | 9,359 |
| 16 | 9,818 | 9,653 | 9,679 | 9,372 |
| 17 | 9,704 | 9,521 | 9,490 | 9,312 |
| 18 | 9,689 | 9,532 | 9,490 | 9,289 |
| 19 | 9,710 | 9,536 | 9,499 | 9,195 |
| 20 | 9,781 | 9,521 | 9,309 | 9,194 |
| 21 | 9,737 | 9,518 | 9,474 | 9,215 |
| 22 | 9,584 | 9,805 | 9,356 | 9,470 |
| 23 | 9,507 | 9,810 | 9,315 | 9,585 |
| 24 | 9,522 | 9,795 | 9,304 | 9,478 |
| 25 | 9,550 | 9,784 | 9,291 | 9,433 |
| 26 | 9,545 | 9,795 | 9,215 | 9,510 |
| 22 | 9,549 | 9,666 | 9,190 | 9,424 |
| 28 | 9,543 | 9,619 | 9,135 | 9,165 |
| 29 | 9,496 | 9,661 | 9,235 | 9,202 |
| 30 | 9,642 | 9,632 | 9,406 | 9,138 |
| 31 | 9,821 | 9,641 | 9,386 | 9,153 |
| 32 | 9,831 | 9,716 | 9,451 | 9,212 |
| 33 | 9,800 | 9,784 | 9,608 | 9,511 |
| 34 | 9,776 | 9,831 | 9,537 | 9,564 |
| Average | 9,830 | 9,792 | 9,570 | 9,490 |

Note: All the above figures are on a "dry basis".

SECTION 6

# SECTION 6

# SITE ACCESS

# SECTION 6

# SITE ACCESS

## 6.1 ACCESS ROAD

### 6.1.1 Route Selection

Three routes were investigated for this study, all using Stewart Crossing, 365 km north of Whitehorse, as the take-off point for cost assessment.

The first, the Mayo route, is the shortest by far and, as shown on Dwg. No. D1098-108-1201, follows an existing winter road from Elsa to the site for most of its length.

The Chapman Lake route connects to the Dempster Highway 10 km north of Chapman Lake and comprises new road from this point to the site. The route crosses the Blackstone River, proceeds due east through the Michelle Creek Valley, and crosses the Hart River; it then runs northeast through the Waugh Creek and Little Wind River valleys to the Wind River crossing which is common to all alternatives.

The Peel River route commences at the Dempster Highway at 66°N latitude, follows an existing trail south-easterly past an abandoned air field located on the height of land, and then drops into the Peel River valley. It crosses the Peel and Hart rivers and then follows the Hungry Creek valley to its confluence with the Wind River. The route then proceeds south along the Wind River to the proposed crossing.

A comparison of the major factors taken into account in selecting the best access route is presented in Table 6-1. The Mayo route has been selected as the most economic for the following reasons:

(a) Travel Time - The Mayo route is the shortest overall (315 km, cf.Chapman Lake - 410 km, and Peel River - 580 km) for hauling construction materials and camp supplies from Stewart Crossing to site.

## TABLE 6-1

## COMPARISON OF ACCESS ROUTE ALTERNATIVES

| | Mayo Route | Chapman Lake Route | Peel River Route |
|---|---|---|---|
| Length of New Road | 200 km | 170 km | 160 km |
| - Muskeg Section | 20 km | 10 km | 50 km |
| - Ridge Section | 0 km | 20 km | 40 km |
| - Valley Section | 180 km | 140 km | 70 km |
| Total Distance from Stewart Crossing to Site | 315 km | 410 km | 580 km |
| Maintenance Costs | above average | average | average |
| Up-grading Potential | good | poor | fair |
| Present Condition | existing winter road | no road | existing winter road |
| Environmental Impact | minor | major | minor |
| Cost Sharing Potential | good | fair | fair |
| Other Benefits | power line access | - | - |
| Major Bridges | Beaver Creek, Wind River | Blackstone River, Hart River, Wind River | Peel River, Hart River, Hungry Creek, Wind River |

(b) Ease of Construction - With the exception of the Wind River bridge, common to all alternatives, there are no major stream crossings or other time- and/or cost-intensive obstacles to construction along the Mayo route.

(c) Capital Cost - As the Chapman Lake and Peel River routes require the construction of two and three, respectively, major bridges, and as new trail must be broken along the entire length of the Chapman Lake route, the Mayo Route is expected to cost significantly less than either. While the Mayo Route crosses twice as much muskeg as the Chapman Lake, its approximately 20 km are considerably less than the 50 km or so of muskeg estimated to lie along the Peel River route. (Muskeg areas have varying and often unpredictable construction requirements due to the irregularity and localized nature of the underlying permafrost zones.)

(d) Present Condition - The Mayo route has been used sporadically over the years; exploration equipment was hauled in over it in the winter of 1979-80. With continuing usage, the road can be gradually upgraded to year-round status as exploration work intensifies. Thus sections requiring lengthy construction periods, such as bridges, may be accessible at the outset of the project and trouble areas demanding specialized design can be identified early-on.

(e) Maintenance Costs - The Mayo route is expected to incur above-average maintenance costs because of its relatively long muskeg section and its extensive sidehill portions, which will be subject to frequent "icing" or glacier formation from cross-flows. While the short muskeg section of the Chapman Lake route will require less maintenance, savings in this area are offset by the cost of maintaining the long sidehill sections and the bridges. The high maintenance cost of the Peel River route's extensive muskeg section and its bridges is offset by savings from the long sections located on crests and ridges. The lower overall elevation of the Peel River is an additional advantage, providing a longer frost-free period.

(f) Environmental Impact - Only the immediate environmental effects of road construction have been considered in this report; further studies would be required to determine long-term effects on the ecology of the area.

In addition to entailing its share of construction and maintenance difficulties, the Chapman Lake route is considered the least environmentally acceptable by virtue of its very "newness"; the uncertainties of road-building in permafrost regions make the upgrading of existing roads, trails or rights-of-way preferable by far. As the Mayo route has already received considerable usage, is much shorter overall than the Peel River route, and requires less construction in sensitive muskeg areas, it is considered to impose the least environmental impact of the three alternatives.

(g) Cost Sharing Potential - The Mayo route was at one time considered a viable alternative to the Dempster Highway as a road to the Mackenzie River Delta. One of the arguments in favor of the Mayo route had been its provision of access to potential developments on the north slope of the Mackenzie Mountains. Any of the three routes investigated in this study will provide this access; however, assuming an average travelling speed of 40 km/h,return travel time from site to Stewart Crossing via the Mayo route would be 5 hours shorter than via the Chapman Lake route, and 13 hours shorter than the Peel River route. It is estimated that for this project alone, $500,000 would be saved in transporting construction materials and equipment by the Mayo road rather than by the next shortest alternative. Similar benefits would accrue to the several projects of similar magnitude which may commence in the Yukon Territory over the next decade. Cost sharing for optimization of the Mayo road is thus considered a viable possibility.

(h) Other Benefits - The Mayo route intersects the right-of-way of the proposed powerline (under study by others), thus providing access for its construction and maintenance.

### 6.1.2 Design Considerations

The major problems of road-building in permafrost zones result from disruption of the thermal regime and vary with the type of ground cover encountered. The increased insulation resulting from build-up of the road-bed can create frost boils

or ice lenses in fine-grained soils, and in muskeg areas, particularly where the permafrost is discontinuous, the subgrade may thaw, causing the road to sink or settle.

Changes in the thermal regime also affect drainage patterns. On sidehill roads, removal of the insulating cover on the cut slopes often turns them into active spring areas due to thawing of the subsurface materials. As a result, glaciers (layers of ice and water) may form from water flowing across the road.

Existing water courses present unique problems. During winter, the constant seepage which occurs in many streams may rise to the surface and freeze in layers, building up an ice dam which causes the stream to divert its course. Similarly,when a culvert is placed beneath the road, its entrance is often blocked by ice early in the winter, creating a continuing maintenance problem e.g. ice must be cleared from the road, the end of the culvert located, and ice thawed from the inside of the culvert.

In taking account of the special difficulties of road-building in permafrost areas, the following design features have been incorporated:

(a) The road is kept as narrow as possible (6 metres) to minimize surface disturbance and reduce maintenance costs.

(b) In muskeg areas, it is proposed to remove unsuitable material below grade and replace it where possible with coarse granular materials. If permafrost is present, an organic insulating blanket (see next point) may be required before the road base is placed.

(c) It may be of benefit to lay filter cloth directly over the organic ground cover to preserve it as an insulating blanket beneath the road base.

(d) In areas of fine-grained soils where frost-heaving may be a problem, filter cloth may be used under the granular materials, preventing the coarse layer from sinking into the sub-grade and keeping it free-draining.

(e) Oversized culverts are used where possible to reduce ice-plugging; the minimum culvert size has been set at 600 mm. It is proposed to use corrugated pipes rather than any other kind wherever possible because of their ease of installation, even during freezing weather.

(f) In sidehill areas, it is suggested that fill be hauled to the site and used to build up the road bed, thus minimizing disruption of the uphill slope and reducing groundwater seepage.

(g) All base material will be hauled from select coarse granular or talus borrow pits. As indicated on Dwg. No. D1098-108-1202, many outwash fans and gravel bars are available near the route to provide good quality and plentiful borrow.

(h) It is proposed to relocate the existing route to the north side of Clark Lakes. This relocation eliminates 10 km of muskeg and two difficult crossings of Scougale Creek, and makes available an additional gravel fan for borrow.

(i) With the exception of the Wind River crossing, it is expected that the road will be washed out at stream crossings during years of extreme flooding. The cost of providing facilities designed to accommodate peak annual flows is uneconomic for the type of service required, as all manpower and supplies, excluding construction materials and equipment, can be flown in to the site during extreme flood periods.

(j) As it provides access from the air strip to the site, the Wind River bridge should be available year-round. However, as it will not have been constructed by the outset, an overhead tram will be necessary for access during flooding. It has been determined that the tram formerly used to serve Dawson City is available for such service from the Yukon Department of Highways. In addition, three arch culverts and a connecting roadway will be installed for heavy truck access during average flow conditions.

### 6.1.3 Construction Methods

Construction methods will vary, depending on the nature of the surface in a particular section. Six types of ground cover have been identified along the route, which are listed and briefly described below in increasing order of cost:

Type 1

Ground Features - coarse gravels, little or no organic cover, no permafrost, usually on a side slope

Method - large backhoe picks material from downhill side and casts in front to prepare own road

- one bulldozer pushes material to backhoe and grades road as backhoe proceeds

Borrow - half from local sources, half hauled in from nearest available pit

Type 2

Ground Features - coarse gravels, shallow organic cover, no permafrost, usually on a side slope

Method - hand clearing of trees and large shrubs so as not to disturb ground cover, bulldozer removes ground cover sub-grade, filter cloth installed, then road materials placed as described in Type 1

Type 3

Ground Features - coarse gravels to fine-grained materials, organic cover, permafrost

Method - filter cloth placed in advance of coarse road material, bulldozer levels and compacts road grade

Borrow - all from selected pits

Type 4

Ground Features - muskeg, permafrost

Method - similar to Type 2, but coarse granular bed is laid to a minimum thickness of 2 metres

- additional organic materials may be placed beneath gravel to ensure ground remains frozen

Borrow - all hauled from selected pits

Type 5

Ground Features - muskeg, discontinuous permafrost, depth and stability indeterminate, often unworkable in summer due to presence of groundwater

Methods - where shallow, muskeg may be removed and replaced by granular material

- where muskeg cannot be removed, large quantities of gravel may be placed requiring frequent levelling as the road settles over time

Borrow - all hauled from selected pits

Type 6

Ground Features - canyon terrain, steep side slopes, occasional instability and snow chutes

Methods - deep sections of granular materials, snow chute diversion, bank stabilization, other features to be determined later

Borrow - all hauled from selected pits

The lengths of each type of surface expected to be encountered along the route are shown on Table 6-2; the cost of the access road has been estimated by combining these lengths with the average cost of construction for each type.

## TABLE 6-2

## OCCURRENCE OF GROUND TYPES ALONG THE MAYO ROUTE

(kilometres)

| Station | Area | Ground Type | | | | | |
|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 |
| 0 - 20 | McQuesten Lake | - | - | - | 10 | 10 | - |
| 20 - 30 | Clark Lakes | - | - | 5 | 5 | - | - |
| 30 - 40 | Scougale Creek | - | 5 | 5 | - | - | - |
| 40 - 70 | Beaver River | 5 | 10 | 15 | - | - | - |
| 70 - 80 | South Braine Valley | 5 | 5 | - | - | - | - |
| 80 - 100 | Braine Canyon | - | - | - | - | - | 20 |
| 100 - 200 | Wind River Valley | 40 | 40 | 20 | - | - | - |
| Total Length | | 50 | 60 | 45 | 15 | 10 | 20 |

## 6.2 AIRSTRIP

The airstrip will be built by levelling and compacting the top of the gravel terrace adjacent to the access road near the 170 km marker. The single runway will be aligned in the direction of the valley, providing straight approaches of approximately 20 km. The runway will be 1,525 m x 60 m, and gravel-surfaced with 100 mm of minus 25 mm crushed rock.

Essential equipment includes a diesel generator, field lighting, fuel storage, communication and meteorological apparatus.

A waiting room will be provided for personnel boarding the aircraft.

# SECTION 7

# SECTION 7

# TOWNSITE VS FLY-IN/OUT PERMANENT CAMP

# SECTION 7

# TOWNSITE VS FLY-IN/FLY-OUT PERMANENT CAMP

## 7.1 SUMMARY

A comparison was carried out of the cost of developing a townsite near the proposed mine with that of establishing a permanent, fly-in/fly-out camp for the workforce. While operating costs for both concepts are approximately equal, the capital cost differential is greatly in favour of the fly-in/fly-out camp. These costs are summarized below:

| | Capital Cost | Operating Cost |
|---|---|---|
| Townsite | $25,128,000 | $3,400,000 |
| Fly-in/fly-out permanent camp | 1,650,000 | 3,279,000 |
| Cost Differential | $23,478,000 | $ 121,000 |

The factors in favour of a townsite are not considered sufficient to justify this differential. The current state of technology and the reliability of commercial air transportation further support the incorporation of a fly-in/fly-out camp for the project, with personnel based at an existing community.

## 7.2 TOWNSITE

### 7.2.1 Scope

The following facilities have been included in the townsite:

(a) housing for married personnel and their families

(b) a hostel for single personnel

(c) a community centre containing a gymnasium, curling rink, indoor swimming pool and library

(d) an elementary school

(e) a medical centre

(f) a commercial centre containing retail stores, pharmacy, bank, supermarket, laundry, restaurant and liquor store

(g) a transportation and service centre

### 7.2.2 Population

Based on a mine workforce of 230 personnel and 10 non-company townsite personnel, the total townsite population is established to be 744 persons, made up as follows:

| | | | |
|---|---|---|---|
| Mine Workforce | | 230 persons | |
| Townsite Personnel | | 10 | |
| Total | | 240 | |
| | | | |
| Assume 60% married | = | 144 | |
| Assume 40% single | = | 96 | |
| Assume average family | = | 4.5 | |
| Total family population | = | 144(4.5)= | 648 |
| Total single population | = | | 96 |
| Total population | = | | 744 |

It is assumed that some members of the families of the mine workforce will find employment in the town.

### 7.2.3 Capital Cost

From previous studies on similar projects and making the necessary adjustments for size and escalation factors, the estimated capital cost of the townsite is $25,128,000.

### 7.2.4 Operating Cost

Operating costs include the following:

- property taxes and insurance
- maintenance and operation of utilities and buildings
- servicing allowances
- transportation assistance
- subsidy allowance

From previous studies on similar projects and making the necessary adjustments for size and escalation factors, the estimated annual operating cost of the townsite is $3,400,000.

## 7.3 FLY-IN/FLY-OUT PERMANENT CAMP

In estimating the cost of a fly-in/fly-out camp, two home locations for the workforce were considered - Edmonton, Alberta, and Whitehorse in the Yukon Territory. The comparison indicated both time and cost savings in basing the workforce at Whitehorse.

The costs of the permanent camp are shown in the Capital Cost section of this report.

Aircraft operating costs are shown on Tables 7-1 and 7-2; the logistics of commuting to and from the camp and on which cost estimates are based are as follows:

## TABLE 7-1

## BREAKDOWN OF AIRCRAFT OPERATING COSTS

## (HAWKER SIDDELEY HS-748)

| | 500,000 tonne/yr | 750,000 tonne/yr |
|---|---|---|
| **Fixed Costs per Year** | $/Year | $/Year |
| Pilot Salaries | 60,000 | 120,000 |
| Engineer | 26,000 | 26,000 |
| Insurance | 24,000 | 24,000 |
| Hangar, Office and Storage (Whitehorse) | 25,000 | 25,000 |
| Maintenance | 12,600 | 12,600 |
| Miscellaneous | 5,000 | 5,000 |
| TOTAL - Fixed Costs per Year | $152,600 | $212,600 |
| **Operating Costs per Hour** | | |
| Consumable Costs | $/Hour | $/Hour |
| Fuel/Oil (220 gal. x 1.30) | 286 | 286 |
| Maintenance, Materials/Supplies | 45 | 45 |
| Landing Fees, Commissary, Misc. Charges | 30 | 30 |
| Crew Expenses | 50 | 50 |
| Casual Maintenance Labour | 60 | 60 |
| Cycle Timed Items (tires, etc.) | 55 | 55 |
| Total Consumable Costs | $ 526 | $ 526 |
| Major Overhaul | | |
| Airframe Systems & Components | 130 | 130 |
| Avionics (parts/labour) | 15 | 15 |
| Aircraft Paint/Interior Modernization | 25 | 25 |
| Total Major Overhaul Costs | $ 170 | $ 170 |
| TOTAL Hourly Operating Costs (excluding fixed costs) | $ 696/hr | $ 696/hr |

## TABLE 7-2

## AIRCRAFT OPERATING COST/YEAR

| | 500,000 tonnes/yr | | | 750,000 tonnes/yr | | |
|---|---|---|---|---|---|---|
| | Years | | | Years | | |
| | 5 to 18 | 19 to 30 | 31 to 34 | 5 to 13 | 14 to 22 | 23 to 34 |
| Total manpower on payroll | 358 | 340 | 278 | 460 | 442 | 386 |
| Number of flights/year | 212 | 212 | 162 | 312 | 312 | 262 |
| Operating hours/yr | 636 | 636 | 486 | 936 | 936 | 786 |
| Yearly Operating Cost @ $696/hour (excluding fixed costs) | $442,656 | $442,656 | $338,256 | $651,456 | $651,456 | $547,056 |
| Fixed Costs | $152,600 | $152,600 | $152,600 | $212,600 | $212,600 | $212,600 |
| Total Cost/year | $595,256 | $595,256 | $490,256 | $864,056 | $864,056 | $759,656 |

(a) The normal schedule will be a 7-day, 56-hour work week, followed by a 7-day leisure period. There will be 350 working days per year.

(b) The aircraft to be used is an HS 748 or equivalent, with a seating capacity of 50.

(c) A 3-hour round-trip from Whitehorse to the site airstrip is assumed.

(d) It is estimated that a peak 6 flights per week (750,000 mtpy) or 4 flights per week (500,000 mtpy) will be required. Therefore, at 750,000 mtpy, one flight per day on Tuesday and Thursday, two on Wednesday and Friday; at 500,000 mtpy, one flight per day, Tuesday through Friday.

(e) Flights will arrive 4:00 p.m. and depart at 6:00 p.m. Tuesdays and Thursdays. Flights will arrive before noon and depart at 2:00 p.m. Wednesdays and Fridays.

(f) The first line supervisor (foreman or overman) will fly with his crew, the next line supervisor will overlap both crews.

(g) The mine manager, superintendent, etc., will not necessarily follow the 7 day in/out schedule, depending on requirements for their presence at the site.

# SECTION 8

# SECTION 8

# SURFACE FACILITIES AND SERVICES

# SECTION 8

# SURFACE FACILITIES AND SERVICES

## 8.1 PERMANENT CAMP

The permanent camp at the plantsite will provide accommodation for approximately 230 persons. The sleeping wings will be two-storey, with single bedrooms and communal washrooms. Each wing will also have a quiet recreation room and a laundry.

A kitchen-dining-recreation complex will be attached to the sleeping wings. The kitchen will include dry food storage, coolers, freezers, food preparation facilities and food serving lines. The dining hall will seat 100 hourly; staff will dine in a separate area designed to accommmodate the full staff complement. The active recreation area will be adjacent to the dining hall and will contain games tables, such as pool and table tennis, together with a television lounge. A commissary will also be located in this area.

The camp will be of standard wood-frame construction, factory-built to Northern Canadian standards for transport to and erection at site.

An enclosed, covered walkway will connect the permanent camp to the maintenance complex and the coal preparation plant.

## 8.2 ANCILLARY BUILDINGS

### 8.2.1 Building Design and Construction

All buildings are designed in accordance with the National Building Code of Canada and with Canadian Health & Safety Regulations.

The maintenance shop, warehouse, dry and administration offices have been integrated into one building for efficiency of operation and in consideration of the harsh climatic conditions of the Yukon Territory.

All facilities have been laid out for efficient flow of work through storage, reception, cleaning, strip down, inspection, repair, reassembly and test stages. Similar principles have been applied to the flow of personnel in the dry and office accommodation. Proximity of related facilities allows maximum utilization of specialized equipment such as the overhead travelling cranes, machine tools, etc., in the heavy vehicle repair shop. Shop sizes allow for efficient use of floor space and accessibility around and between machines.

Construction consists of concrete foundations and slabs on grade, steel framing with insulated metal cladding system, steel roof trusses and steel decking with insulation and built-up roofing membrane.

### 8.2.2 Maintenance Shop

The maintenance shop is designed to cater for the maintenance and repair of all light service and heavy vehicles and their components, repair and overhaul of mining equipment and components, new fabrication and construction, etc. Major repairs and overhauls to specialized equipment such as diesel engines, transmissions, etc., will be contracted out; however, most other repair and overhaul facilities will be provided due to the isolated nature of the minesite. The maintenance shop contains:

(a) Heavy Vehicle Bays

Four bays, each 9 m wide x 5 m long, are provided for the maintenance, repair and overhaul of all heavy vehicles. These include specialized bays for tracked vehicles and for steam cleaning.

One 10-ton overhead travelling crane, span 15 m vertical lift 5 m, serves the heavy vehicle repair area.

Concrete bollards have been provided at each bay door to protect the jambs and columns.

A concrete apron has been provided in front of the repair bays to facilitate clean-up.

(b) Light Vehicle Bays

Three bays, each 5 m wide x 10 m long, are provided for the maintenance, repair and overhaul of all light vehicles. Hose/reel/lube service is provided in these bays.

One 5-ton overhead travelling crane, span 10 m vertical lift 5 m, services this area.

(c) Support Facilities

Support facilities consist of the following:

- a combined machine and plate shop
- a component repair shop for repairs to specialized equipment
- an electrical shop for repairs to AC and DC equipment, together with battery charging and instrumentation
- carpentry shop
- paint shop

The machine, plate, component repair and electric shops are served by two 10-ton overhead travelling cranes, spanning 18 m, lift 5 m.

### 8.2.3 Warehouse

A 975 $m^2$ enclosed heated warehouse is provided for the storage of spare parts, tools, materials and supplies for the mine, the service areas and the permanent camp. When expansion is required, a mezzanine can be built for the storage of small components. A loading/unloading dock has been provided to facilitate materials handling by forklift truck.

A 1,500 $m^2$ fenced storage yard is provided adjacent to the heated warehouse.

A 500 $m^2$ enclosed unheated warehouse is provided for the storage of oil drums, tires, chemicals, paints, etc.

### 8.2.4 Change Rooms

Change rooms are provided for mine, maintenance and preparation plant personnel. The facilities are based on a clean/dirty concept, with sufficient showers and toilets provided to accommodate the maximum shift size. Locker rooms are designed to accommodate the total work force.

Separate facilities are provided for senior personnel.

It is assumed that 10% of the work force will be women, thus separate facilities have been provided.

Additional space is provided for laundry, lamp storage, shifter offices and on/off shift deployment.

### 8.2.5 Offices

Group offices are provided on the second floor above the change rooms for Engineering, Maintenance, Mining, Purchasing, Accounting and General Administration. A training area is also provided adjacent to these group offices.

Support offices for shop foremen are located at "in plant" locations.

### 8.2.6 Rescue and First Aid

Rescue co-ordination and first aid rooms are provided adjacent to the ambulance station.

### 8.2.7 Vehicle Garage

A 600 $m^2$ vehicle garage is provided for the storage of buses, road maintenance equipment and light vehicles. The garage is unheated but is provided with outlets for block heaters.

### 8.2.8 Future Expansion

The complex has been designed so that each part can be expanded logically without serious disruption of neighbouring areas.

## 8.3 SURFACE ELECTRICAL SYSTEM

During the construction phase of the project and initial stages of mine development, electrical power would be supplied by two 2,500 kW engine generator sets. In order to obviate low temperature operating problems associated with residual fuels, these sets would use diesel fuel oil.

Power would be generated at 4,160 volts, three-phase 60 Hz, and would be distributed from a main switchboard comprising two generator circuit breaker cubicles, a synchronizing panel and five outgoing feeder circuit breaker cubicles. These circuit breakers would supply the following individual loads:

(a) One 500 kVA 4.16 kV - 600 volt transformer providing power for the service building and dormitories.

(b) One 500 kVA 4.16 kV - 600 volt transformer providing power for the diesel generator auxiliaries.

(c) Two 750 kVA 4.16 kV - 600 volt transformers, each with primary fused load break switches, supplying power to the coal preparation plant.

(d) One 3,750 kVA 4.16 kV - 13.8 kV transformer supplying power via a 13.8 kV overhead line to the overland conveyors No. 1 and No. 2 and to the underground services at the portals of No. 1 and No. 2 seams.

(e) The fifth feeder circuit breaker would provide the tie between the thermal generating plant and the diesel generating station. During the construction phase power would be supplied to the thermal plant; after commissioning, however, the diesel generators would act as standby equipment, and power would be received from the thermal plant for distribution as outlined above.

Overland conveyor No. 3 would be supplied from the coal preparation plant 600 volt distribution system, while overland conveyors No. 1 and No. 2 would each have a 500 kVA 13.8 kV - 600 V transformer protected by pole-mounted fused switches.

The 13.8 kV overhead line would terminate at a 3,750 kVA 13.8 kV - 4.16 kV transformer located close to the seam portals and protected by a pole-mounted fused switch. The secondary side of this transformer would be connected to a 4.16 kV distribution board supplying power via cables to the underground services, including the ventilation fans.

## 8.4 WATER SUPPLY AND SEWAGE DISPOSAL

Water will be supplied from two wells located near Illtyd Creek; freeze-up will thus be prevented and the water will be pure, requiring no treatment for potable use. An underground concrete water storage tank and pumphouse will be constructed at the plantsite, providing sufficient supply for fire protection, domestic use and process water. An 8-inch water supply main will run between the plantsite and mine area to provide fire protection for the mine. This centralized distribution of all water requirements will ensure the fire protection system is always operable.

Sewage from the temporary and permanent camps and from the plantsite will be piped to a sewage plant, treated, and discharged to a ground disposal field set below the frost line. The sewage treatment unit will be a preassembled package offering a high degree of secondary treatment. This type of unit requires a minimum of set-up time and will be used almost immediately upon delivery to serve the construction camp. Disposal of the effluent to underground gravels will eliminate pollution during spring thaw, which can be a major problem in northern developments. A similar system will be required for the mine services area, but of only half the size.

## 8.5 SERVICE ROADS

Service roads are those adjacent to the plantsite and housing areas, and the connection to the Mayo access road. The road subgrade will be shaped during rough grading of the site. A 300 mm base of pit-run gravel will be placed once a suitable borrow pit is established, and the finished grade will consist of an additional 900 mm of minus 25-mm crushed rock. A system of ditches and culverts will lead drainage to a settling pond before being discharged to an existing watercourse.

# SECTION 9

# PREPARATION FACILITIES

# SECTION 9

# PREPARATION FACILITIES

## 9.1 SUMMARY

Borehole data obtained from Pan Ocean Oil Ltd. with respect to No. 1 and 2 Seams of the Illtyd deposit were reviewed to assess raw coal quality and to determine the need for preparation of the coal to meet minimum plant fuel specifications. It was considered that all coal from No. 1 Seam as well as portions of No. 2 Seam would require preparation.

The preparation plant flowsheet, Dwg. No. 1098-104-1202, describes a basic jig washery. Provision is made to allow bypassing of the wet cleaning process, as a portion of the raw coal may be blended with washed coal to produce an acceptable quality product coal.

The Illtyd deposit lies in a region of severe winter conditions and it is thus recommended that all product coal be stored within an appropriate building. Provisions are made to stack product coal to form a semi-homogenous pile using a travelling boom stacker. Coal would be reclaimed by utilizing a scraper reclaimer. The feed for the power plant would be consistent in its quality over the period of time required to completely recover the storage pile. A typical example of this system is illustrated in Dwg. No. 1098-104-1206.

It is recommended that whenever possible facilities be concentrated in one building to minimize the effects of adverse winter conditions; all raw coal preparation is done within a unit enclosure as shown on general arrangement Dwg. No. 1098-104-1203.

Maintenance and preparation plant services are a part of the preparation plant facility and are shown on Dwg. No. 1098-104-1204.

The conveyor galleries in the preparation plant site area are designed for protection from the elements and ease of maintenance. The concept shown on Dwg. No. 1098-104-1207 facilitates modular construction off-site for erection on site.

## 9.2 DATA ANALYSIS

Pan Ocean Oil Ltd. undertook a test drilling program in the Bonnet Plume coal field in 1979; drill core was recovered and logged, and samples of the drill core were transported to Birtley Coal and Minerals Testing in Calgary, Alberta, for float-sink tests. The products from these tests were analysed and tabulated along with descriptions of each bore hole section. Dwg. No. 1098-103-1201 is a typical information sheet representing a bore hole as provided for this study.

Wright Engineers Limited reviewed each borehole description to select the section of each seam deemed minable, and then reviewed each minable section to determine the raw coal quality. Raw coal ash, volatiles, fixed carbon and heating values were mathematically cumulated to represent the probable quality of the raw coal mined from the selected section. Projected yields at 1.9 specific gravity, as well as the float product ash and heating values, were derived from the analysis provided.

Interpolations were necessary for derivation of data from some of the drill hole information when the selected minable section floor and roof did not coincide with sample analysis cut points.

Petrography data was the only analytical information provided for drill hole BP-79-19. The values given for this hole are thus derived from comparison with similar core. It was also noted that drill hole BP-79-12-12A, No. 1 Seam section analysis is missing 1.14 metres of core from the 3.42 metres of selected minable seam. The coal quality of this core is an anomaly and should be considered seriously as such with little credence given it. However, given the information available, no adjustments have been made.

Tables 9-1 and 9-2 present the cumulations of data for each minable section of each hole. This information was used to derive potential recovery for each area represented by a particular drill hole.

Tables 9-4 and 9-5 are representations of mathematically derived recovery potentials by blending high quality raw coal with clean coal. Heating value is not tabulated; however, the ash value in the final product will reflect a corresponding heating value inversely. For the purpose of this study it can be assumed that within the limits of 15% and 18%, the heating value would range from 9800 Btu/lb to 9500 Btu/lb. Therefore, in derivation of the yield tables:

Where: $P$ = the final product ash

$R$ = raw coal ash

$C$ = clean coal ash

$Y_w$ = yield as determined by float/sink analysis

$C_2$ = percentage of clean coal in the product

$R_1$ = percentage of raw coal in the product

$R_2$ = percentage of raw feed mined that must be washed

$Y_n$ = net yield

Then: $$C_2 = \frac{R-P}{R-C} \quad (100)$$

$$R_2 = \frac{C_2}{(Yw)(R_1) + c_2} \quad (100) \quad (R_1 \text{ as a decimal})$$

$$Y_n = \frac{1}{\frac{C_2}{Y_w} + R_1} \quad (100) \quad (R_1 \text{ as a decimal})$$

R:C = Ratio of Raw Coal to Clean Coal in the product.

As presented on the yield tables, both net yield and the percentage of raw coal to be washed (of the total mined) can be ascertained for any given product ash level. For example, where product ash equals 18% it can be expected that, for the minable area influenced by drill hole BP-78-2, the ratio of raw coal to clean coal

contained in the product would be 1 to 1.4. The amount of mined coal to be washed would be 64.7%, while yield from the wash plant would be 76%. The total net yield can be expected to be 84.5% of the mined coal seam.

From the yield data on the tables, it is apparent that provision should be made on the preparation plant flowsheet to divert a portion of the raw coal to product. At 1.9 specific gravity, the clean coal produced in the float-sink tests was of low ash and high heating value, indicating on easy separation of gangue from the coal. The refuse or sink portion in these tests was high in ash and, from the data available, there does not appear to be an excessive amount of middling.

Based on this analysis it is suggested that a standard baum jig would produce a quality coal; recirculation of near gravity product is not necessary. The jig will normally be operated at 1.6 specific gravity, producing a slightly lower ash coal product than the 1.9 specific gravity test work.

It is difficult to arrive at a definite conclusion with regard to the washability of the Illtyd coal seams. However, the data available indicate that the as received raw coal fines may be of high enough quality to permit them to be routed to product without washing. The amount of fines, using minus 6 mm as an arbitrary cut-off size, is not anticipated to be great.

Further testing would confirm the evaluations presented herein. In particular, drill hole BP-79-12-12A for No.1 Seam would be proven, as this hole greatly influences the test results and subsequent analysis of No. 1 Seam. Further screen analyses, as well as bulk sampling of the reserves, would provide additional washability and sizing data for preparation planning.

## 9.3 PREPARATION PLANT

The equipment shown on the flowsheet (Dwg. No. 1098-104-1202) has been sized on the basis of currently available information regarding particle size distribution in the raw coal. Using the equipment shown on the flowsheet a general arrangement layout was developed.

### 9.3.1 Pre-preparation

The raw coal, having been broken in the mine to 150 mm or as needed to provide the proper feed to the preparation plant, is conveyed from the mine portal to the preparation plant, a distance of 2.4 km, at a rate of 450 tph. The mine conveyor is an overland unit consisting of three flights. The coal is placed on a vibrating scalping screen 8 feet wide by 20 feet long with a single screening surface and openings of 50 mm. All or a portion of the screen undersize (-50 mm) can be diverted; if of poor quality, the undersize will be conveyed to the raw coal storage silo, and if of high quality, this material may be conveyed to product storage.

Scalping screen oversize (+50 mm) is fed into a rotary breaker 10 feet in diameter by 20 feet long with plate openings of 100 mm. If the raw coal is suitable for product, a provision is made to divert the feed to the breaker. This material is conveyed to the double roll coal crusher to be crushed to -30 mm for product. Rotary breaker undersize (-100 mm) is conveyed to the raw coal silos for storage, whereas the oversize material is rejected and conveyed to the refuse bin.

### 9.3.2 Wet Preparation

Raw coal which has been stored in the 7500-tonne surge silo is reclaimed onto a 30-inch conveyor and transferred to a 30-inch plant feed conveyor. The feed is weighed and may be sampled before entering the process. At a rate of 200 tonnes per hour, the feed is passed over the plant feed screen, an 8-foot wide by 16-foot long vibrating screen designed to size the raw feed at 1/4" (6 mm). The undersize product (-6 mm) from the plant feed screen is conveyed to the product storage building. Provision has been made on the flowsheet for a cyclone plant if required to upgrade the -6 mm coal; a simple hydro cyclone circuit would be used for this purpose. However, the need for a hydro cyclone system cannot be determined conclusively at this time.

Plant feed screen oversize (+6 mm) is fed to a baum jig sized to handle 200 tph of raw feed. It is anticipated that there will be two products from the jig. As the



amount of near-gravity material appears to be very small, no middling product will be considered. The clean coal product is dewatered on a double-deck vibrating screen 6 feet wide by 16 feet long. The top deck separates the coal at 30 mm and the second deck dewaters the -30 mm coal on a profile wire surface with 0.5 mm spacing. Screen oversize is conveyed to a double roll crusher set to reduce the coal to -30 mm, from where the crushed coal is then conveyed to the product storage building. Clean coal from the second deck screening is placed into a centrifuge to further reduce the free moisture content and is then also conveyed to the product coal storage building.

Effluent from the centrifuge and the -0.5 mm product from the coal dewatering screen is piped to the thickener.

Refuse product from the jig is dewatered on a vibrating screen 6 feet wide by 16 feet long containing a single deck of profile wire with 1 mm spacing. The refuse is discharged from the screen to the refuse conveyor to be disposed of in the refuse bin. Dewatering screen undersize product is piped to the thickener.

The thickener is a high capacity type utilizing a small diameter of 50 feet. The sludge from the thickener is pumped to a slurry pond. All clarified water is reclaimed and used in the plant. Water pumps to supply make up water and fire protection will be located in housed areas to prevent freezing.

In addition to possibly indicating the need to clean the -6 mm fraction, further washability studies may show that cleaning can be done on smaller bottom size feed by the jig, that is, reducing the plant screening size to something less than 6 mm.

### 9.3.3 Conceptual Layout

In consideration of the harsh winter conditions, it is proposed that the raw coal screen and rotary breaker be housed in the same building with the wash plant, thus facilitating the processing of raw coal for product and reducing heating and servicing requirements. Partitioning walls will ensure dust and noise protection. All maintenance can be carried out in the same location, excluding the conveyor system, using the total span overhead crane.

The shop and office complex is separate, but is still adjacent and convenient to the plant complex. Individual lockers are supplied for employees working at the plant, along with a lunchroom and restroom facilities. There is sufficient additional room in the shop and office complex for meeting areas as well as for electrical shop and laboratory. This concept is shown on Dwg. No. 1098-104-1204.

### 9.3.4 Tubular Conveyor Gallery

The use of tubular conveyor galleries is becoming more evident in new facilities in the United States and in Canada for several reasons. Except for electrical wire and belting, the gallery can be constructed in complete modules. The structure allows for longer spans between vertical supports. The vertical snow load and wind resistance are less than with the conventional square units. All clean-up and extraneous spillage migrates to the centre of this tubular construction for easy removal. This concept is thus being analysed for all inclined conveyor units on this project (refer to Dwg. No. 1098-104-1207).

A capital cost comparison of standard construction insulated units versus the tubular structures indicates the tubular units would be 2 to 3% higher in cost.

## 9.4 CONCLUSION & RECOMMENDATIONS

The bore hole analyses indicate that a portion of the mined coal must be washed, although mining can be scheduled to maximize the recovery of product quality raw coal. Coal of suitable quality can be obtained by washing in a simple jig plant at 1.6 specific gravity, and consequently blending this product with a percentage of raw coal to maintain an ash level of 15% or 18%. Product moisture will be determined by the percentage of washed coal in the final product. As received moisture in the raw coal ranges between 4 and 8%, whereas washed coal without thermal drying will contain 12 to 15% moisture. Thus a final product of approximately 12 to 13% moisture should be obtainable. The heating value of the product coal on a dry basis will fall in the range of 9500 Btu/lb to 9800 Btu/lb, which should provide a suitable feed stock for the thermal generating plant. It is recommended that the results from additional sampling be studied to establish plant requirements in more detail.

# TABLE 9-1

## MINABLE SECTION DATA

## ILLTYD DEPOSIT B

### No. 1 Seam

| Hole Number | Depth Elevation | | Minable Thickness (m) | Raw - No Dilution Included % Ash | % Volatile | % Fixed Carbon | Btu/lb | Clean % Ash | Annual Yield | Btu/lb |
|---|---|---|---|---|---|---|---|---|---|---|
| BP-78-2 | 127.42 | 131.07 | 3.65 | 26.2 | 33.9 | 37.5 | 8,403 | 12.1 | 76.0 | 10,030 |
| BP-78-3 | 97.5 | 100.0 | 2.50 | 39.0 | 25.9 | 27.3 | 6,126 | 18.7 | 54.9 | 9,109 |
| BP-79-7 | 30.86 | 33.22 | 2.36 | 52.6 | 21.4 | 21.6 | 5,803 | 11.4 | 39.6 | 9,892 |
| BP-79-8 | 91.74 | 94.66 | 2.92 | 29.6 | 29.6 | 33.0 | 7,720 | 14.6 | 76.5 | 9,662 |
| BP-79-9 | 138.24 | 141.89 | 3.65 | 35.4 | 27.4 | 30.7 | 7,034 | 18.2 | 67.1 | 9,260 |
| BP-79-10 | 239.67 | 243.32 | 3.65 | 32.3 | 28.7 | 31.6 | 7,387 | 14.6 | 68.5 | 9,869 |
| BP-79-11 | 136.66 | 140.30 | 3.64 | 30.0 | 29.7 | 31.6 | 7,497 | 16.4 | 74.0 | 9,253 |
| BP-79-12* | 112.28 | 115.93 | 3.65 | 12.5 | 34.6 | 43.7 | 9,659 | 7.3 | 88.9 | 10,987 |
| BP-79-13 | 127.42 | 131.07 | 3.65 | 26.2 | 30.3 | 37.2 | 8,038 | 14.8 | 76.3 | 9,940 |
| BP-79-14 | 91.66 | 94.89 | 3.23 | 29.1 | 30.2 | 33.9 | 7,883 | 26.0 | 75.4 | ** 8,040 |
| BP-79-15 | 220.71 | 224.36 | 3.65 | 27.7 | 31.1 | 36.3 | 7,831 | 17.7 | 80.1 | 9,632 |
| BP-79-17 | 306.76 | 309.86 | 3.10 | 38.8 | 25.0 | 31.8 | 7,064 | 19.7 | 48.0 | 9,494 |
| BP-79-18 | 26.04 | 29.04 | 3.00 | 35.7 | 27.7 | 31.2 | 6,763 | 13.5 | 68.6 | 9,339 |
| BP-79-19 | 63.74 | 66.12 | 2.38 | *** 27.0 | | | 7,900 | 15.0 | 75.0 | 9,700 |
| BP-79-20 | 79.80 | 83.33 | 3.53 | 30.8 | 31.3 | 30.5 | 7,565 | 19.2 | 73.8 | 8,558 |
| BP-79-21 | 123.08 | 124.62 | 1.54 | 31.3 | 30.0 | 31.9 | 7,454 | 23.1 | 83.8 | 8,323 |
| BP-79-22 | 192.82 | 196.08 | 3.26 | 24.0 | 29.9 | 37.9 | 8,724 | 13.6 | 79.7 | 9,929 |

* 1.33 metre lost core

** Btu/lb est. from curve

*** Petrograph was the only analysis available; values derived from comparison to similar core.

Note: Btu/lb values on a dry basis.

## TABLE 9-2

## MINABLE SECTION DATA

## ILLTYD DEPOSIT B

### No. 2 Seam

| Hole Number | Depth Elevation | | Minable Thickness (m) | Raw - No Dilution Included % Ash | % Volatile | % Fixed Carbon | Btu/lb | Clean % Ash | Annual Yield | Btu/lb |
|---|---|---|---|---|---|---|---|---|---|---|
| BP-78-2 | 61.58 | 64.77 | 3.19 | 23.3 | 32.1 | 37.3 | 8,293 | 9.7 | (75.7) | 10,509 |
| BP-78-3 | 119.22 | 121.55 | 2.33 | 27.8 | 30.6 | 41.6 | 8,630 | 21.4 | 87.0 | 8,990 |
| BP-79-7 | 54.22 | 55.21 | .99 | 34.6 | 26.4 | 31.6 | 6,430 | 16.2 | 62.8 | 9,277 |
| BP-79-8 | 113.83 | 115.90 | 2.07 | 10.2 | 34.2 | 46.3 | 9,957 | 8.9 | 96.6 | 10,210 |
| BP-79-9 | 155.73 | 158.12 | 2.39 | 11.2 | 34.3 | 45.6 | 9,600 | 9.8 | 95.2 | 10,322 |
| BP-79-10 | 259.69 | 262.57 | 2.88 | 19.6 | 32.9 | 40.4 | 8,800 | 11.0 | 82.8 | 10,060 |
| BP-79-11 | 156.98 | 160.44 | 3.46 | 22.9 | 32.3 | 35.9 | 8,172 | 12.5 | 70.0 | 10,176 |
| BP-79-12 | 155.03 | 156.88 | 1.85 | 11.5 | 34.5 | 45.2 | 9,937 | 8.3 | 93.3 | 10,818 |
| BP-79-13 | 158.22 | 159.78 | 1.56 | 12.8 | 35.2 | 44.2 | 9,780 | 9.8 | 94.0 | 10,565 |
| BP-79-14 | 116.69 | 118.52 | 1.83 | 12.0 | 34.4 | 42.8 | 9,680 | 9.8 | 95.0 | 10,530 |
| BP-79-15 | 249.32 | 252.27 | 2.95 | 21.7 | 32.7 | 40.1 | 8,826 | 13.3 | 84.2 | 10,048 |
| BP-79-17 | 331.88 | 333.75 | 1.87 | 30.1 | 38.7 | 36.5 | 7,696 | 15.3 | 74.4 | 9,925 |
| BP-79-18 | 58.52 | 60.47 | 1.95 | 13.4 | 34.7 | 45.3 | 9,764 | 8.5 | 92.5 | 10,607 |
| BP-79-19 | 84.52 | 85.83 | 1.31 | * 11.0 | - | - | 9,600 | 9.0 | 95.0 | 9,700 |
| BP-79-20 | 98.14 | 100.16 | 2.02 | 29.8 | 28.6 | 34.9 | 7,455 | 14.7 | 73.6 | 9,570 |
| BP-79-21 | 144.40 | 146.31 | 1.91 | 33.9 | 26.2 | 32.9 | 6,803 | 23.3 | 78.3 | 8,318 |
| BP-79-22 | 221.84 | 224.26 | 2.42 | 22.7 | 30.1 | 39.3 | 8,308 | 12.8 | 84.1 | 10,134 |



* Petrograph analysis only; values estimated by comparison to similar core.

Note: Btu/lb values on a dry basis.

## TABLE 9-3

## YIELD POTENTIALS

### No. 1 Seam

| | P | $Y_w$ | R | C | $R_1$ | $C_2$ | $Y_n$ | $R_2$ | R:C |
|---|---|---|---|---|---|---|---|---|---|
| BP-78-2 | 14 | 76.0 | 26.2 | 12.1 | 13.5 | 86.5 | 78.5 | 89.4 | 1: 6.4 |
| | 15 | 76.0 | 26.2 | 12.1 | 20.6 | 79.4 | 80.0 | 83.5 | 1: 3.9 |
| | 16 | 76.0 | 26.2 | 12.1 | 27.7 | 72.3 | 81.4 | 77.4 | 1: 2.6 |
| | 17 | 76.0 | 26.2 | 12.1 | 34.8 | 65.2 | 82.9 | 71.1 | 1: 1.9 |
| | 18 | 76.0 | 26.2 | 12.1 | 41.8 | 58.2 | 84.5 | 64.7 | 1: 0.6 |
| | 19 | 76.0 | 26.2 | 12.1 | 48.9 | 51.1 | 86.1 | 57.9 | 1: 1.0 |
| | 20 | 76.0 | 26.2 | 12.1 | 56.0 | 44.0 | 87.8 | 50.1 | 1: 0.8 |
| BP-78-3 | 14 | 54.9 | 39.0 | 18.7) | | | | | |
| | 15 | 54.9 | 39.0 | 18.7) | | | | | |
| | 16 | 54.9 | 39.0 | 18.7) | | | | | |
| | 17 | 54.9 | 39.0 | 18.7) | | 100.0 | <54.9 | 100.0 | 0: 1.0 |
| | 18 | 54.9 | 39.0 | 18.7) | | | | | |
| | 19 | 54.9 | 39.0 | 18.7 | 1.5 | 98.5 | 55.3 | 99.2 | 1: 65.7 |
| | 20 | 54.9 | 39.0 | 18.7 | 6.4 | 93.6 | 56.5 | 96.4 | 1: 14.6 |
| BP-79-7 | 14 | 39.6 | 52.6 | 11.4 | 6.3 | 93.7 | 41.2 | 97.4 | 1: 14.9 |
| | 15 | 39.6 | 52.6 | 11.4 | 8.7 | 91.3 | 41.8 | 96.4 | 1: 10.5 |
| | 16 | 39.6 | 52.6 | 11.4 | 11.2 | 88.8 | 42.5 | 95.2 | 1: 7.9 |
| | 17 | 39.6 | 52.6 | 11.4 | 13.6 | 86.4 | 43.1 | 94.1 | 1: 6.4 |
| | 18 | 39.6 | 52.6 | 11.4 | 16.0 | 84.0 | 43.8 | 93.0 | 1: 5.3 |
| | 19 | 39.6 | 52.6 | 11.4 | 18.4 | 81.6 | 44.6 | 91.8 | 1: 9.7 |
| | 20 | 39.6 | 52.6 | 11.4 | 20.9 | 79.1 | 45.3 | 90.5 | 1: 3.8 |
| BP-79-8 | 14 | 76.5 | 29.6 | 14.6 | 0 | 100.0 | 76.5 | 10.0 | 0: 1.0 |
| | 15 | 76.5 | 29.6 | 14.6 | 2.7 | 97.3 | 77.0 | 97.9 | 1: 36.0 |
| | 16 | 76.5 | 29.6 | 14.6 | 9.3 | 90.7 | 78.2 | 92.7 | 1: 10.0 |
| | 17 | 76.5 | 29.6 | 14.6 | 16.0 | 84.0 | 79.5 | 87.3 | 1: 5.3 |
| | 18 | 76.5 | 29.6 | 14.6 | 22.7 | 77.3 | 80.8 | 81.7 | 1: 3.4 |
| | 19 | 76.5 | 29.6 | 14.6 | 29.3 | 70.7 | 82.2 | 75.9 | 1: 2.6 |
| | 20 | 76.5 | 29.6 | 14.6 | 36.0 | 64.0 | 83.6 | 69.9 | 1: 1.8 |
| BP-79-9 | 14 | 67.1 | 35.4 | 18.2) | | | | | |
| | 15 | 67.1 | 35.4 | 18.2) | | | | | |
| | 16 | 67.1 | 35.4 | 18.2) | 0 | 100.0 | 67.1 | 100.0 | 0: 1.0 |
| | 17 | 67.1 | 35.4 | 18.2) | | | | | |
| | 18 | 67.1 | 35.4 | 18.2) | | | | | |
| | 19 | 67.1 | 35.4 | 18.2 | 4.7 | 95.3 | 68.2 | 96.8 | 1: 20.3 |
| | 20 | 67.1 | 35.4 | 18.2 | 10.5 | 89.5 | 69.5 | 92.7 | 1: 8.5 |



TABLE 9-3 - Cont'd.

YIELD POTENTIALS

No. 1 Seam - Cont'd.

| | P | $Y_w$ | R | C | $R_1$ | $C_2$ | $Y_n$ | $R_2$ | R:C |
|---|---|---|---|---|---|---|---|---|---|
| BP-79-10 | 14 | 68.5 | 32.3 | 14.6 | 0 | 100.0 | 68.5 | 100.0 | 0: 1.0 |
| | 15 | 68.5 | 32.3 | 14.6 | 2.3 | 97.7 | 69.0 | 98.4 | 1: 42.5 |
| | 16 | 68.5 | 32.3 | 14.6 | 7.9 | 92.1 | 70.2 | 94.5 | 1: 11.7 |
| | 17 | 68.5 | 32.3 | 14.6 | 13.6 | 86.4 | 71.6 | 90.3 | 1: 6.4 |
| | 18 | 68.5 | 32.3 | 14.6 | 19.2 | 80.8 | 72.9 | 86.0 | 1: 4.2 |
| | 19 | 68.5 | 32.3 | 14.6 | 24.5 | 75.5 | 74.2 | 81.7 | 1: 3.1 |
| | 20 | 68.5 | 32.3 | 14.6 | 30.5 | 69.5 | 75.8 | 76.9 | 1: 2.3 |
| BP-79-11 | 14 | 74.0 | 30.0 | 16.4 | 0 | 100.0 | < 74.0 | 100.0 | 0: 1.0 |
| | 15 | 74.0 | 30.0 | 16.4 | 0 | 100.0 | < 74.0 | 100.0 | 0: 1.0 |
| | 16 | 74.0 | 30.0 | 16.4 | 0 | 100.0 | < 74.0 | 100.0 | 0: 1.0 |
| | 17 | 74.0 | 30.0 | 16.4 | 4.4 | 95.6 | 74.9 | 96.7 | 1: 21.7 |
| | 18 | 74.0 | 30.0 | 16.4 | 11.8 | 88.2 | 76.3 | 91.0 | 1: 7.47 |
| | 19 | 74.0 | 30.0 | 16.4 | 19.1 | 80.9 | 77.9 | 85.1 | 1: 4.2 |
| | 20 | 74.0 | 30.0 | 16.4 | 26.5 | 73.5 | 79.5 | 78.9 | 1: 2.8 |
| BP-79-12 | 14 | 88.9 | 12.5 | 7.3 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-13 | 14 | 76.3 | 26.2 | 14.8 | 0 | 100.0 | 76.3 | 100.0 | 0: 1.0 |
| | 15 | 76.3 | 26.2 | 14.8 | 1.8 | 98.2 | 76.6 | 98.6 | 1: 54.6 |
| | 16 | 76.3 | 26.2 | 14.8 | 10.5 | 89.5 | 78.2 | 91.8 | 1: 8.5 |
| | 17 | 76.3 | 26.2 | 14.8 | 19.3 | 80.7 | 80.0 | 84.6 | 1: 4.2 |
| | 18 | 76.3 | 26.2 | 14.8 | 28.1 | 71.9 | 81.7 | 77.0 | 1: 2.6 |
| | 19 | 76.3 | 26.2 | 14.8 | 36.8 | 63.2 | 83.6 | 69.2 | 1: 1.7 |
| | 20 | 76.3 | 26.2 | 14.8 | 45.5 | 54.4 | 85.6 | 61.0 | 1: 1.2 |
| BP-79-14 | >14 | 75.4 | 29.1 | 26.0 | 0 | 100.0 | 75.4 | 100.0 | 0: 1.0 |
| BP-79-15 | 14 | 80.1 | 27.7 | 17.7 | 0 | 100.0 | < 80.1 | 100.0 | 0: 1.0 |
| | 15 | 80.1 | 27.7 | 17.7 | 0 | 100.0 | < 80.1 | 100.0 | 0: 1.0 |
| | 16 | 80.1 | 27.7 | 17.7 | 0 | 100.0 | < 80.1 | 100.0 | 0: 1.0 |
| | 17 | 80.1 | 27.7 | 17.7 | 0 | 100.0 | < 80.1 | 100.0 | 0: 1.0 |
| | 18 | 80.1 | 27.7 | 17.7 | 3.0 | 97.0 | 80.6 | 97.6 | 1: 32.3 |
| | 19 | 80.1 | 27.7 | 17.7 | 13.0 | 87.0 | 82.2 | 89.3 | 1: 3.8 |
| | 20 | 80.1 | 27.7 | 17.7 | 23.0 | 77.0 | 83.9 | 80.9 | 1: 2.3 |
| BP-79-17 | >14 | 48.0 | 38.8 | 19.7 | 0 | 100.0 | 48.0 | 100.0 | 0: 1.0 |
| BP-79-18 | 14 | 68.6 | 35.7 | 13.5 | 0 | 100.0 | 68.6 | 100.0 | 0: 1.0 |
| | 15 | 68.6 | 35.7 | 13.5 | 6.8 | 93.2 | 70.1 | 95.2 | 1: 13.7 |
| | 16 | 68.6 | 35.7 | 13.5 | 11.3 | 88.7 | 71.1 | 92.0 | 1: 8.1 |
| | 17 | 68.6 | 35.7 | 13.5 | 15.8 | 84.2 | 72.2 | 88.6 | 1: 5.3 |
| | 18 | 68.6 | 35.7 | 13.5 | 20.3 | 79.7 | 73.3 | 85.1 | 1: 3.9 |
| | 19 | 68.6 | 35.7 | 13.5 | 24.8 | 75.2 | 74.4 | 81.6 | 1: 3.0 |
| | 20 | 68.6 | 35.7 | 13.5 | 29.3 | 0.7 | 75.6 | 77.9 | 1: 2.4 |

TABLE 9-3 - Cont'd.

YIELD POTENTIALS

No. 1 Seam - Cont'd.

| | P | | $Y_w$ | R | C | $R_1$ | $C_2$ | $Y_n$ | $R_2$ | R:C |
|---|---|---|---|---|---|---|---|---|---|---|
| BP-79-19 | 14 | | 75.0 | 27.0 | 15.0 | 0 | 100.0 | < 75.0 | 100.0 | 0: 1.0 |
| | 15 | | 75.0 | 27.0 | 15.0 | 0 | 100.0 | < 75.0 | 100.0 | 0: 1.0 |
| | 16 | | 75.0 | 27.0 | 15.0 | 8.3 | 91.7 | 76.7 | 93.6 | 1: 11.0 |
| | 17 | | 75.0 | 27.0 | 15.0 | 16.7 | 83.3 | 78.3 | 86.9 | 1: 5.0 |
| | 18 | | 75.0 | 27.0 | 15.0 | 25.0 | 75.0 | 80.0 | 80.0 | 1: 3.0 |
| | 19 | | 75.0 | 27.0 | 15.0 | 33.3 | 66.7 | 81.8 | 72.8 | 1: 2.0 |
| | 20 | | 75.0 | 27.0 | 15.0 | 41.7 | 58.3 | 83.7 | 65.1 | 1: 1.4 |
| BP-79-20 | 14 | 20 | 73.8 | 30.8 | 19.2 | 0 | 100.0 | < 73.8 | 100.0 | 0: 1.0 |
| BP-79-21 | 14 | 23 | 83.8 | 31.3 | 23.1 | 0 | 100.0 | < 83.8 | 100.0 | 0: 1.0 |
| BP-79-22 | 14 | | 79.8 | 24.0 | 13.6 | 0 | 100.0 | 79.8 | 100.0 | 0: 1.0 |
| | 15 | | 79.8 | 24.0 | 13.6 | 13.5 | 86.5 | 82.1 | 88.9 | 1: 6.4 |
| | 16 | | 79.8 | 24.0 | 13.6 | 23.1 | 76.9 | 83.7 | 80.7 | 1: 3.3 |
| | 17 | | 79.8 | 24.0 | 13.6 | 32.7 | 67.3 | 85.4 | 72.1 | 1: 2.1 |
| | 18 | | 79.8 | 24.0 | 13.6 | 42.3 | 57.7 | 87.3 | 63.1 | 1: 1.4 |
| | 19 | | 79.8 | 24.0 | 13.6 | 51.9 | 48.1 | 88.8 | 54.1 | 1: 0.9 |
| | 20 | | 79.8 | 24.0 | 13.6 | 61.5 | 38.5 | 91.1 | 44.0 | 1: 0.6 |

## TABLE 9-4

## YIELD POTENTIALS

### Seam 2

| | P | $Y_w$ | R | C | $R_1$ | $C_2$ | $Y_n$ | $R_2$ | R:C |
|---|---|---|---|---|---|---|---|---|---|
| BP-78-2 | 14 | 75.7 | 23.3 | 9.7 | 31.6 | 68.4 | 82.0 | 74.1 | 1: 2.2 |
| | 15 | 75.7 | 23.3 | 9.7 | 39.0 | 61.0 | 83.6 | 67.4 | 1: 1.5 |
| | 16 | 75.7 | 23.3 | 9.7 | 46.3 | 53.7 | 85.3 | 60.1 | 1: 1.6 |
| | 17 | 75.7 | 23.3 | 9.7 | 53.7 | 46.3 | 97.1 | 53.2 | 1: 0.9 |
| | 18 | 75.7 | 23.3 | 9.7 | 61.3 | 38.7 | 89.6 | 45.5 | 1: 0.6 |
| | 19 | 75.7 | 23.3 | 9.7 | 68.3 | 31.6 | 90.9 | 37.9 | 1: 0.5 |
| | 20 | 75.7 | 23.3 | 9.7 | 75.7 | 24.3 | 92.8 | 29.8 | 1: 0.2 |
| BP-78-3 | 14 | 87.0 | 27.8 | 21.4 | 0 | 100.0 | 87.0 | 100.0 | 0: 1.0 |
| BP-79-7 | 14 | 62.8 | 34.6 | 16.2 | 0 | 100.0 | 62.8 | 100.0 | 0: 1.0 |
| | 15 | 62.8 | 34.6 | 16.2 | 0 | 100.0 | 62.8 | 100.0 | 0: 1.0 |
| | 16 | 62.8 | 34.6 | 16.2 | 0 | 100.0 | 62.8 | 100.0 | 0: 1.0 |
| | 17 | 62.8 | 34.6 | 16.2 | 4.4 | 95.6 | 63.8 | 97.2 | 1: 22.0 |
| | 18 | 62.8 | 34.6 | 16.2 | 9.8 | 90.2 | 65.2 | 93.4 | 1: 9.2 |
| | 19 | 62.8 | 34.6 | 16.2 | 15.2 | 84.8 | 66.6 | 89.9 | 1: 5.6 |
| | 20 | 62.8 | 34.6 | 16.2 | 20.7 | 79.3 | 68.0 | 85.9 | 1: 3.8 |
| BP-79-8 | 14 | 96.6 | 10.2 | 8.9 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-9 | 14 | 95.2 | 11.2 | 9.8 | 1.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-10 | 14 | 82.8 | 19.6 | 11.0 | 34.9 | 65.1 | 88.1 | 69.3 | 1: 1.9 |
| | 15 | 82.8 | 19.6 | 11.0 | 46.5 | 53.5 | 90.0 | 58.2 | 1: 1.2 |
| | 16 | 82.8 | 19.6 | 11.0 | 58.1 | 41.9 | 92.0 | 46.6 | 1: 0.7 |
| | 17 | 82.8 | 19.6 | 11.0 | 69.8 | 30.2 | 94.1 | 34.3 | 1: 0.4 |
| | 18 | 82.8 | 19.6 | 11.0 | 81.4 | 18.6 | 96.3 | 21.6 | 1: 0.2 |
| | 19 | 82.8 | 19.6 | 11.0 | 93.0 | 7.0 | 98.6 | 8.3 | 1: 0.1 |
| | 20 | 82.8 | 19.6 | 11.0 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-11 | 14 | 70.0 | 22.9 | 12.5 | 14.4 | 85.6 | 73.2 | 89.5 | 1: 5.9 |
| | 15 | 70.0 | 22.9 | 12.5 | 24.0 | 76.0 | 75.4 | 81.5 | 1: 3.1 |
| | 16 | 70.0 | 22.9 | 12.5 | 33.7 | 66.3 | 77.9 | 73.8 | 1: 2.0 |
| | 17 | 70.0 | 22.9 | 12.5 | 43.3 | 56.7 | 80.5 | 65.2 | 1: 1.3 |
| | 18 | 70.0 | 22.9 | 12.5 | 52.9 | 47.1 | 83.2 | 56.0 | 1: 0.9 |
| | 19 | 70.0 | 22.9 | 12.5 | 62.5 | 37.5 | 86.2 | 46.2 | 1: 0.6 |
| | 20 | 70.0 | 22.9 | 12.5 | 72.1 | 27.9 | 87.3 | 35.6 | 1: 0.4 |
| BP-79-12 | 14 | 93.3 | 11.5 | 8.3 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-13 | 14 | 94.0 | 12.8 | 9.8 | 100.0 | 0 | 100.0 | 0 | 1: 0 |

TABLE 9-4 - Cont'd.

YIELD POTENTIALS

No. 2 Seam - Cont'd.

| | P | $Y_w$ | R | C | $R_1$ | $C_2$ | $Y_n$ | $R_2$ | R:C |
|---|---|---|---|---|---|---|---|---|---|
| BP-79-14 | 14 | 95.0 | 12.0 | 9.8 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-15 | 14 | 84.2 | 21.7 | 13.3 | 8.3 | 91.7 | 85.3 | 92.9 | 1: 11.0 |
| | 15 | 84.2 | 21.7 | 13.3 | 20.3 | 79.7 | 87.0 | 82.3 | 1: 3.9 |
| | 16 | 84.2 | 21.7 | 13.3 | 32.2 | 67.8 | 88.7 | 71.4 | 1: 3.4 |
| | 17 | 84.2 | 21.7 | 13.3 | 44.0 | 56.0 | 90.5 | 60.2 | 1: 1.3 |
| | 18 | 84.2 | 21.7 | 13.3 | 56.0 | 44.0 | 92.4 | 48.3 | 1: 0.8 |
| | 19 | 84.2 | 21.7 | 13.3 | 67.9 | 32.1 | 94.3 | 36.0 | 1: 0.5 |
| | 20 | 84.2 | 21.7 | 13.3 | 79.8 | 20.2 | 96.3 | 23.1 | 1: 0.3 |
| BP-79-17 | 14 | 74.4 | 30.1 | 15.3 | 0 | 100.0 | 74.4 | 100.0 | 0: 1.0 |
| | 15 | 74.4 | 30.1 | 15.3 | 0 | 100.0 | 74.4 | 100.0 | 0: 1.0 |
| | 16 | 74.4 | 30.1 | 15.3 | 4.7 | 95.3 | 75.3 | 96.5 | 1: 20.2 |
| | 17 | 74.4 | 30.1 | 15.3 | 11.5 | 88.5 | 76.7 | 91.2 | 1: 4.9 |
| | 18 | 74.4 | 30.1 | 15.3 | 18.2 | 81.8 | 78.0 | 85.8 | 1: 4.5 |
| | 19 | 74.4 | 30.1 | 15.3 | 25.0 | 75.0 | 79.5 | 80.1 | 1: 3.0 |
| | 20 | 74.4 | 30.1 | 15.3 | 31.8 | 68.2 | 81.0 | 74.2 | 1: 2.1 |
| BP-79-18 | 14 | 92.5 | 13.4 | 8.5 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-19 | 14 | 95 | 11.0 | 9.0 | 100.0 | 0 | 100.0 | 0 | 1: 0 |
| BP-79-20 | 14 | 73.6 | 29.8 | 14.7 | 0 | 100.0 | 0 | 100.0 | 0: 1.0 |
| | 15 | 73.6 | 29.8 | 14.7 | 2.0 | 98.0 | 74.0 | 98.5 | 1: 49.0 |
| | 16 | 73.6 | 29.8 | 14.7 | 8.6 | 91.4 | 75.3 | 93.5 | 1: 10.6 |
| | 17 | 73.6 | 29.8 | 14.7 | 15.2 | 84.8 | 76.7 | 88.3 | 1: 5.6 |
| | 18 | 73.6 | 29.8 | 14.7 | 21.9 | 78.1 | 78.1 | 82.9 | 1: 3.5 |
| | 19 | 73.6 | 29.8 | 14.7 | 28.5 | 91.5 | 79.6 | 77.3 | 1: 2.5 |
| | 20 | 73.6 | 29.8 | 14.7 | 35.1 | 64.9 | 81.1 | 71.5 | 1: 1.9 |
| BP-79-21 | 14 | 78.3 | 33.9 | 23.3 | 0 | 100.0 | 78.3 | 100.0 | 0: 1.0 |
| BP-79-22 | 14 | 84.1 | 22.7 | 12.8 | 12.1 | 87.9 | 85.7 | 89.6 | 1: 7.3 |
| | 15 | 84.1 | 22.7 | 12.8 | 22.2 | 77.8 | 87.2 | 80.6 | 1: 3.5 |
| | 16 | 84.1 | 22.7 | 12.8 | 32.3 | 67.7 | 88.7 | 71.4 | 1: 1.6 |
| | 17 | 84.1 | 22.7 | 12.8 | 42.4 | 57.6 | 90.2 | 61.8 | 1: 1.4 |
| | 18 | 84.1 | 22.7 | 12.8 | 52.5 | 47.5 | 91.8 | 51.8 | 1: 0.9 |
| | 19 | 84.1 | 22.7 | 12.8 | 62.6 | 37.4 | 93.4 | 41.5 | 1: 0.6 |
| | 20 | 84.1 | 22.7 | 12.8 | 72.7 | 27.3 | 95.1 | 30.9 | 1: 0.4 |

# SECTION 10

# MANPOWER REQUIREMENTS

# SECTION 10

# MANPOWER REQUIREMENTS

This section presents estimated manpower requirements per shift, and subsequent projected manpower schedules over the 30-year life of the project.

## 10.1 PILLAR MINING

It is estimated that a six-man crew would be required, comprising two machine operators, one operating the continuous miner and the other the shuttle car, and four persons rockbolting, timbering and assisting with ancillary face operations.

The manpower requirements are estimated as follows:

| | 500,000 tonnes/year | | | 750,000 tonnes/year | | |
|---|---|---|---|---|---|---|
| | Shift | | | Shift | | |
| Supervision | Day | Aft. | Night | Day | Aft. | Night |
| Manager | 1 | - | - | 1 | - | - |
| Underground Manager | 1 | - | - | 1 | - | - |
| Overman | 2 | 1 | 1 | 2 | 2 | 2 |
| Deputy/Firemen | 2 | 1 | 1 | 2 | 2 | 2 |
| Engineering | 2 | - | - | 2 | - | - |
| Surveyor | 2 | - | - | 3 | - | - |
| Maintenance Superintendent | 1 | - | - | 1 | - | - |
| Electrical Superintendent | 1 | - | - | 1 | - | - |
| Total | 12 | 2 | 2 | 13 | 4 | 4 |
| Underground | | | | | | |
| Miner Crew | 12 | 6 | 6 | 12 | 12 | 12 |
| Conveyor Crew | 4 | - | - | 4 | 4 | 4 |
| Miner Maint. | 2 | 1 | 1 | 2 | 2 | 2 |
| Ventilation | 4 | 4 | - | 4 | 4 | 4 |
| Repair/Labourers | 4 | 4 | 4 | 4 | 4 | 4 |
| Supply Men | 4 | 4 | - | 4 | 4 | 4 |
| Mechanic | 1 | 1 | - | 2 | 1 | - |
| Helper | 1 | 1 | - | 2 | 1 | - |
| Electrician | 1 | 1 | - | 2 | 1 | - |
| Helper | 1 | 1 | - | 2 | 1 | - |
| Total | 34 | 23 | 11 | 38 | 34 | 30 |
| Yard Crew | | | | | | |
| Yardman | 2 | 2 | - | 3 | 3 | - |
| Labourer | 2 | 2 | 1 | 3 | 3 | - |
| Maintenance | 5 | 5 | - | 7 | 7 | 1 |
| Dryman | 1 | 1 | 1 | 1 | 1 | 1 |
| Miscellaneous | 2 | 2 | 2 | 4 | 3 | 2 |
| Total | 12 | 12 | 4 | 18 | 17 | 4 |
| Office | | | | | | |
| Accountant Paymaster | 2 | - | - | 2 | - | - |
| Office Clerks | 3 | - | - | 4 | - | - |
| Office Manager | 1 | - | - | 1 | - | - |
| First Aid | 1 | 1 | 1 | 1 | 1 | 1 |
| Efficiency | 1 | - | - | 1 | - | - |
| Personnel Manager | 1 | - | - | 1 | - | - |
| Safety Supervisor | 1 | - | - | 1 | - | - |
| Total | 10 | 1 | 1 | 11 | 1 | 1 |

## 10.2 LONGWALL MINING

The length of the longwall face has been established as 100 m, requiring the following manpower:

| | 500,000 tonnes/year | | | 750,000 tonnes/year | | |
|---|---|---|---|---|---|---|
| | Shift | | | Shift | | |
| Supervision | Day | Aft. | Night | Day | Aft. | Night |
| Manager | 1 | - | - | 1 | - | - |
| Underground Manager | 1 | - | - | 1 | - | - |
| Overman | 1 | 1 | - | 1 | 1 | 1 |
| Deputy/ Fireman | 1 | 1 | 1 | 1 | 1 | 1 |
| Engineering | 2 | - | - | 2 | - | - |
| Surveyor | 2 | - | - | 3 | - | - |
| Maintenance Superintendent | 1 | - | - | 1 | - | - |
| Electrical Superintendent | 1 | - | - | 1 | - | - |
| Total | 10 | 2 | 1 | 11 | 2 | 2 |
| Underground | | | | | | |
| Miner Crew | 6 | - | - | 6 | - | - |
| Machine Operator | 1 | 1 | - | 1 | 1 | 1 |
| Shields | 2 | 2 | - | 2 | 2 | 2 |
| Cable/Miscellaneous | 4 | 4 | - | 4 | 4 | 4 |
| Shield Maintenance | 2 | 2 | - | 2 | 2 | 2 |
| Miner Maintenance | - | - | - | 1 | - | - |
| Ventilation | 2 | - | - | 2 | 2 | 2 |
| Conveyor Crew | 4 | - | - | 4 | 4 | - |
| Repair Labourers | 4 | 2 | - | 4 | 4 | 4 |
| Supply Men | 4 | 4 | - | 4 | 4 | 2 |
| Mechanic | 1 | - | - | 1 | 1 | - |
| Helper | 1 | - | - | 1 | 1 | - |
| Electrician | 1 | - | - | 1 | 1 | - |
| Helper | 1 | - | - | 1 | 1 | - |
| Total | 33 | 15 | - | 34 | 27 | 17 |

| | 500,000 tonnes/year | | | 750,000 tonnes/year | | |
|---|---|---|---|---|---|---|
| | Shift | | | Shift | | |
| Yard Crew | Day | Aft. | Night | Day | Aft. | Night |
| Yardman | 2 | 2 | - | 3 | 3 | - |
| Labourer | 2 | 2 | - | 3 | 3 | - |
| Maintenance | 5 | 3 | - | 5 | 5 | - |
| Dryman | 1 | 1 | - | 1 | 1 | 1 |
| Miscellaneous | 3 | 2 | - | 4 | 3 | - |
| Total | 13 | 10 | - | 16 | 15 | 1 |
| Office | | | | | | |
| Accountant/Paymaster | 2 | - | - | 2 | - | - |
| Office Clerks | 3 | - | - | 4 | - | - |
| Office Manager | 1 | - | - | 1 | - | - |
| First Aid | 1 | - | - | 1 | 1 | 1 |
| Efficiency | 1 | 1 | - | 1 | - | - |
| Personnel Manager | 1 | - | - | 1 | - | - |
| Safety Supervisor | 1 | - | - | 1 | - | - |
| Total | 10 | 1 | - | 11 | 1 | 1 |

## 10.3 PREPARATION PLANT

| | Shift | | |
|---|---|---|---|
| | Day | Aft. | Night |
| Surface Plant | 5 | 5 | 3 |
| Maintenance | 5 | 5 | 2 |
| Foreman | 2 | 1 | 1 |
| Superintendent | 1 | - | - |
| Total | 13 | 11 | 6 |

## 10.4 PERMANENT CAMP

| | Shift | | |
|---|---|---|---|
| | Day | Aft. | Night |
| Catering | 6 | 6 | 6 |
| Janitorial | 2 | 2 | 2 |
| Camp Administration | 1 | - | - |
| Total | 9 | 8 | 8 |

## 10.5 MANPOWER SCHEDULE - CASE 1

| | 500,000 tonnes/year | | |
|---|---|---|---|
| | Year | | |
| | 5 to 18 | 19 to 30 | 31 to 34 |
| **Supervision** | | | |
| Manager | 1 | 1 | 1 |
| Undermanager | 1 | 1 | 1 |
| Overman | 4 | 4 | 2 |
| Deputy Fireman | 4 | 5 | 3 |
| Engineering | 2 | 2 | 2 |
| Surveyor | 2 | 3 | 2 |
| Maintenance Superintendent | 1 | 1 | 1 |
| Electrical Superintendent | 1 | 1 | 1 |
| **Underground** | | | |
| Miner Crew | 24 | 18 | 6 |
| Machine Operator | - | 1 | 2 |
| Shields | - | 2 | 4 |
| Cable Miscellaneous | - | 2 | 8 |
| Shield Maintenance | - | 1 | 4 |
| Conveyor Crew | 4 | 4 | 4 |
| Miner Maintenance | 4 | 3 | - |
| Ventilation | 8 | 6 | 2 |
| Repair/Labourers | 12 | 12 | 6 |
| Supplymen | 8 | 8 | 8 |
| Mechanic | 2 | 2 | 1 |
| Helper | 2 | 2 | 1 |
| Electrician | 2 | 2 | 1 |
| Helper | 2 | 2 | 1 |
| **Yard Crew** | | | |
| Yardman | 4 | 4 | 4 |
| Labourer | 5 | 5 | 4 |
| Maintenance | 10 | 8 | 8 |
| Dryman | 3 | 3 | 2 |
| Miscellaneous | 6 | 6 | 5 |

## 10.5 MANPOWER SCHEDULE - CASE 1 - Cont'd.

| | 500,000 tonnes/year | | |
|---|---|---|---|
| | Year | | |
| | 5 to 18 | 19 to 30 | 31 to 34 |
| Office | | | |
| Accountant/Paymaster | 2 | 2 | 2 |
| Office Clerks | 3 | 3 | 3 |
| Office Manager | 1 | 1 | 1 |
| First Aid | 3 | 3 | 2 |
| Industrial Engineer | 1 | 1 | 1 |
| Personnel Manager | 1 | 1 | 1 |
| Safety Supervisor | 1 | 1 | 1 |
| Preparation Plant | | | |
| Surface Plant | 13 | 10 | 10 |
| Maintenance | 12 | 10 | 10 |
| Foreman | 4 | 3 | 3 |
| Superintendent | 1 | 1 | 1 |
| Catering | | | |
| Catering | 18 | 18 | 14 |
| Janitorial | 6 | 6 | 5 |
| Camp Administration | 1 | 1 | 1 |
| TOTAL | 179 | 170 | 139 |

## 10.6 MANPOWER SCHEDULE - CASE 2

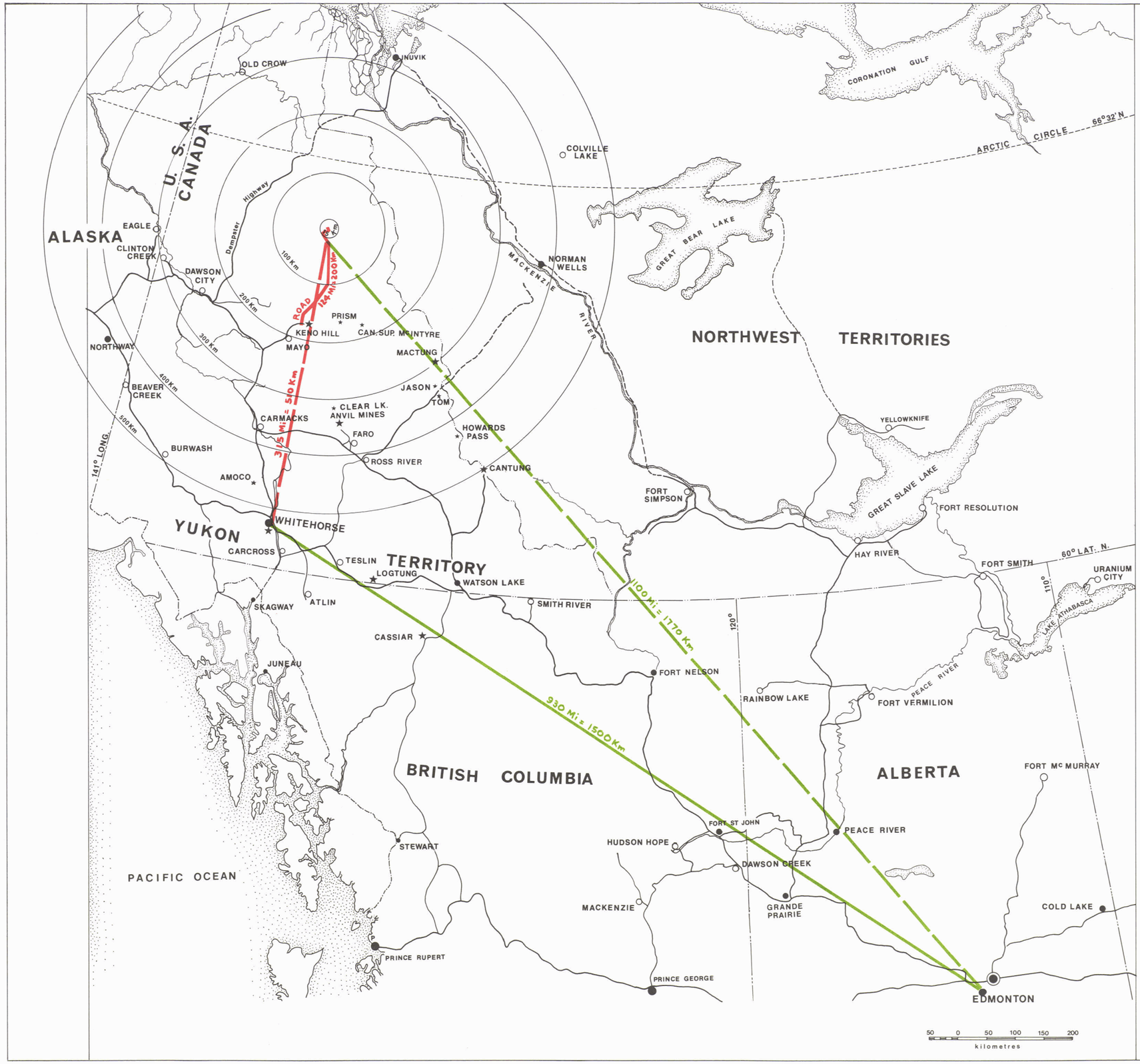
| | 750,000 tonnes/year | | |
|---|---|---|---|
| | Year | | |
| | 5 to 13 | 14 to 22 | 23 to 34 |
| **Supervision** | | | |
| Manager | 1 | 1 | 1 |
| Undermanager | 1 | 1 | 1 |
| Overman | 6 | 6 | 3 |
| Deputy/Fireman | 6 | 6 | 3 |
| Engineer | 2 | 2 | 2 |
| Surveyor | 3 | 3 | 3 |
| Maintenance Superintendent | 1 | 1 | 1 |
| Electrical Superintendent | 1 | 1 | 1 |
| **Underground** | | | |
| Miner Crew | 36 | 30 | 6 |
| Machine Operator | - | 1 | 3 |
| Shields | - | 2 | 6 |
| Cable Miscellaneous | - | 4 | 12 |
| Shield Maintenance | - | 2 | 6 |
| Conveyor Crew | 12 | 8 | 8 |
| Miner Maintenance | 6 | 5 | 1 |
| Ventilation | 12 | 10 | 6 |
| Repair Labourers | 12 | 10 | 12 |
| Supplymen | 12 | 12 | 10 |
| Mechanic | 3 | 3 | 2 |
| Helper | 3 | 3 | 2 |
| Electrician | 3 | 3 | 2 |
| Helper | 3 | 3 | 2 |
| **Yard Crew** | | | |
| Yardman | 6 | 6 | 6 |
| Labourer | 6 | 6 | 6 |
| Maintenance | 15 | 13 | 10 |
| Dryman | 3 | 3 | 3 |
| Miscellaneous | 9 | 8 | 7 |

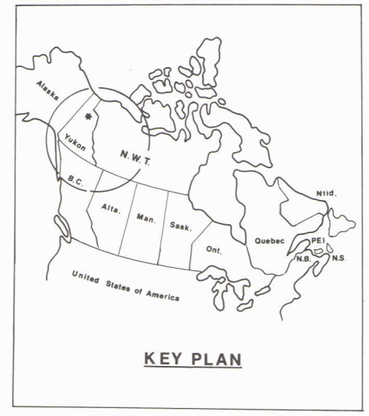
## 10.6 MANPOWER SCHEDULE - CASE 2 - Cont'd.

| | 750,000 tonnes/year | | |
|---|---|---|---|
| | Year | | |
| | 5 to 13 | 14 to 22 | 23 to 34 |
| **Office** | | | |
| Accountant/Paymaster | 2 | 2 | 2 |
| Office Clerks | 4 | 4 | 4 |
| Office Manager | 1 | 1 | 1 |
| First Aid | 3 | 3 | 3 |
| Industrial Engineer | 1 | 1 | 1 |
| Personnel Manager | 1 | 1 | 1 |
| Safety Supervisor | 1 | 1 | 1 |
| **Preparation Plant** | | | |
| Surface Plant | 13 | 13 | 13 |
| Maintenance | 12 | 12 | 12 |
| Foreman | 4 | 4 | 4 |
| Superintendent | 1 | 1 | 1 |
| **Catering** | | | |
| Catering | 18 | 18 | 18 |
| Janitorial | 6 | 6 | 6 |
| Camp Administration | 1 | 1 | 1 |
| TOTAL | 230 | 221 | 193 |

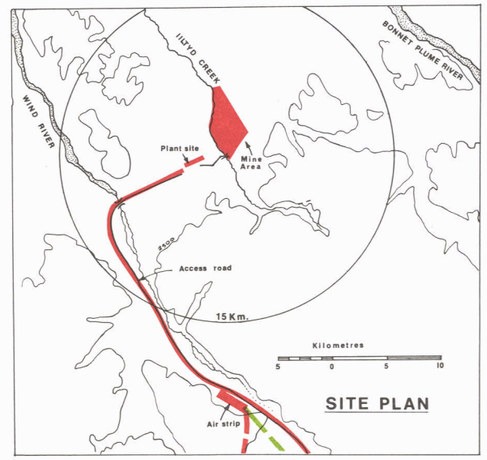
# SECTION 11

# DRAWINGS




KEY PLAN



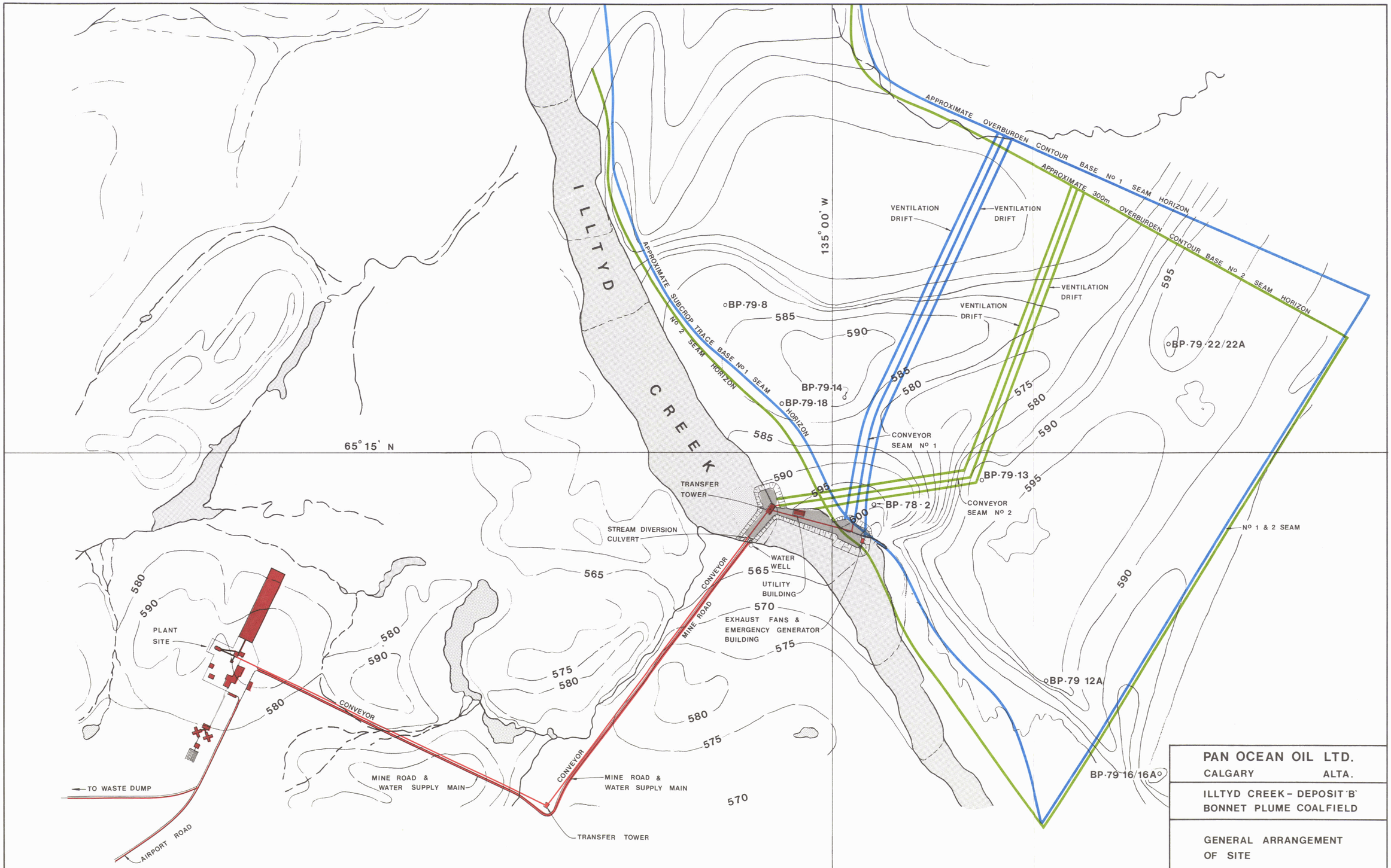

SITE PLAN

**PAN OCEAN OIL LTD.**
CALGARY ——— ALTA.

**ILLTYD CREEK – DEPOSIT 'B'**
**BONNET PLUME COALFIELD**
LOCATION PLAN

WRIGHT ENGINEERS LIMITED
VANCOUVER ——— CANADA

| | | | | | |
|---|---|---|---|---|---|
| Drawn | JE/SLM | Appr. | WS | DRAWING NO. | |
| Check | SLO | Appr. Date | Nov 27 1981 | A 1098 101 1201 | |




PAN OCEAN OIL LTD.
CALGARY ALTA.

ILLTYD CREEK - DEPOSIT 'B'
BONNET PLUME COALFIELD

GENERAL ARRANGEMENT OF SITE

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | JVD | S.L.O | | | L.J.S | | MAR/81 | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

SCALE: 1:7500

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 100 1201

C.E. 4180



**PAN OCEAN OIL LTD.**
CALGARY ALBERTA

ILLTYD CREEK - DEPOSIT 'B'
BONNET PLUME COALFIELD

# PERSPECTIVE LAYOUT

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | BSD | | | | WJS | | MAR. 81 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|

| REFERENCE | NO. | DWG. NO. |
|---|---|---|

| REFERENCE | NO. | DWG. NO. |
|---|---|---|

SCALE:

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098SK 1201

C.C.-4180

LOCATION MAP

TN

SCALE:

COORDINATES: Y12,820 m N X10,950 m W of S.E. Corner of CL 77
ELEVATION: 593.1 m BITS USED: J.K. SMIT Combination
DIP: 90° BEARING: MUD USED: 45 gals poly 325, 10gals poly 357
CORE SIZE: HQ CASING: PW 13.11m HW 29.26m m LEFT IN HOLE: 13.11 4.27 m
SAMPLED BY: D. HOPE

DATE START: JULY 6, 1979 FINISH: JULY 13, 1979
DRILLER: CARON DIAMOND DRILLING OVERALL RECOVERY: 95 %
TESTS: NONE
DATE: JULY 14, 1979 ANALYZED BY BIRTLEY COAL & MINERALS TESTING SIGNED 1098-103-1201

# BOREHOLE NO. BP-79-13

PAN OCEAN OIL LTD. (PAGE 1)

MINING DIVISION – COAL

LOGGED BY: D. HOPE, O. CULLINGHAM DATE: JULY 17, 1979

GEOLOGICAL LOG – SCALE: 1:500

DETAILS OF COAL SEAMS – SCALE: 1:100

| DEPTH | GRAPHIC LOG | THICKNESS | DESCRIPTION |
|---|---|---|---|
| | | 125.05 | CONGLOMERATE - LIGHT GRAY WEATHERING, POORLY SORTED, ROUNDED TO SUB-ROUNDED, MODERATE SPHERICITY CLASTS OF GRAY, BLACK AND GREEN CHERT AND WHITE AND HUFF QUARTZITE. AVERAGE SIZE 10-30mm, SOME CLASTS OVER 80mm DIAMETER. GOOD POROSITY AND PERMEABILITY, FAR THROUGHOUT MATRIX IS MEDIUM TO COARSE GRAINED SALT AND PEPPER SANDSTONE. |
| 125.05 | | 6.67 | NO. 1 SEAM HORIZON |
| 131.72 | | 8.76 | SHALE - CARBONACEOUS WITH COAL SPLINTS AT TOP - GRADES TO NON-CARBONACEOUS SILTSTONE BELOW |
| 140.48 | | 0.84 | SILTSTONE - CROSS LAMINATED AT 70° CORE AXIS |
| 141.32 | | 15.83 | SANDSTONE - LIGHT GRAY: INTERBEDS OF MEDIUM TO COARSE GRAINED TO CONGLOMERATIC PEBBLES UP TO 30mm DIAMETER GENERALLY COARSENS DOWNWARD. CROSS-BEDDING AT 60° TO CORE AXIS. WELL SORTED, ROUNDED TO SUB-ROUNDED, MODERATE TO HIGH SPHERICITY. THICK BEDDED. CONTACT AT BASE IS AT 25° TO CORE AXIS. |
| 157.15 | | 1.07 | SILTSTONE - SHALEY TO SANDY |
| 158.22 | | | CONTINUED ON PAGE 5 |

| DEPTH | GRAPHIC LOG | THICKNESS | DESCRIPTION | SAMPLE NUMBER | THICKNESS |
|---|---|---|---|---|---|
| | | | No. 1 SEAM HORIZON | | |
| | | | ROOF - CONGLOMERATE GOOD | A0117 | 0.55 |
| 125.05 | | 0.18 | COAL - VITREOUS WITH BRIGHT PANELS | | |
| 125.23 | | 0.05 | COALY SHALE | A0118 | 0.72 |
| 125.28 | | 0.32 | COAL - DULL TO VITREOUS | | |
| 125.60 | | 0.22 | CARBONACEOUS COALY SHALE | | |
| 125.82 | | 0.20 | CARBONACEOUS SHALE | | |
| 126.02 | | 0.16 | COALY SHALE | | |
| 126.18 | | 0.14 | COAL - BRIGHT | | 1.10 |
| 126.32 | | 0.85 | SHALEY COAL WITH CARBONACEOUS SHALE AND SHALE | A0119 | 1.61 |
| 127.17 | | 0.25 | CARBONACEOUS SHALE | | |
| 127.42 | | 0.21 | COAL - DULL TO VITREOUS | | |
| 127.63 | | 1.29 | COAL - MOSTLY BRIGHT, WITH CONCOIDAL FRACTURE, MINOR THIN BANDS OF SHALEY COAL (0.01m LOST CORE) | A0120 | |
| 128.93 | | 0.10 | COAL - MOSTLY BRIGHT | | |
| 129.03 | | 0.05 | CARBONACEOUS SHALE | A0121 | 0.42 |
| 129.08 | | 0.37 | COAL - MOSTLY BRIGHT | | |
| 129.45 | | 0.46 | CARBONACEOUS TO COALY SHALE | | |
| 129.91 | | 0.35 | COAL - DULL TO VITRE | A0122 | |
| 130.26 | | 0.19 | COAL - BRIGHT | | |
| 130.45 | | 0.60 | COAL - BRIGHT, BANDED, CONCOIDAL BLOCKY FRACTURE | A0123 | 0.46 |
| 131.05 | | 0.23 | COAL - DULL BANDED | | |
| 131.28 | | 0.05 | COALY SHALE | A0124 | |
| 131.33 | | 0.28 | COAL - VITREOUS TO BRIGHT | | |
| 131.61 | | 0.11 | CARBONACEOUS TO COALY SHALE | | |
| 131.72 | | | FLOOR - SHALE POOR | A0125 | 0.55 |
| | | | | A0126 | |
| | | | | A0127 | 0.79 |
| | | | | | 0.23 |
| | | | | | 0.33 |
| | | | | | 0.11 |

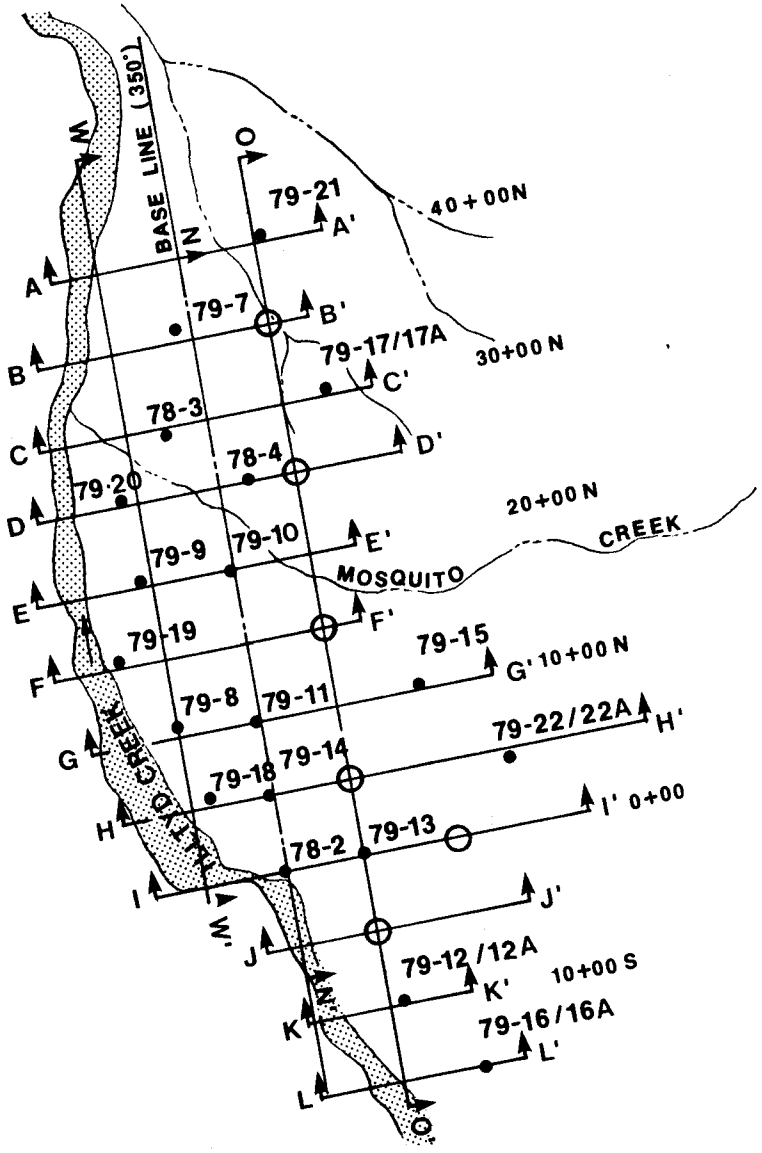
| SAMPLE NUMBER | SIZE DIAMETER | SIZE WT % | SPEC GRAV | WEIGHT PERCENT YIELD | PROXIMATE ANALYSIS RM | ASH | VOL | F.C. | BTU | F.S.I. | S | CUMULATIVE WEIGHT PERCENT YIELD | PROXIMATE ANALYSIS RM | ASH | VOL | F.C. | BTU | F.S.I. | S | CUMULATIVE SAMPLE VALUES THICKNESS | YIELD | PROXIMATE ANALYSIS RM | ASH | VOL | F.C. | BTU | F.S.I. | S | OTHER |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1/4×28 | 92.0 | -1.90 | 68.3 | 4.7 | 22.8 | 29.9 | 42.6 | 8749 | - | 0.26 | 68.3 | 4.7 | 22.8 | 29.9 | 42.6 | 8749 | - | 0.26 | | | | | | | | | | |
| | | | +1.90 | 31.7 | 2.9 | 56.7 | - | - | - | - | - | 100.0 | 4.3 | 33.5 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 8.0 | RAW | 100.0 | 4.6 | 30.0 | 26.7 | 38.7 | 7712 | - | 0.34 | 100.0 | 4.6 | 30.0 | 26.7 | 38.7 | 7712 | - | 0.34 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 3.8 | 34.3 | 28.1 | 33.8 | 6998 | - | 0.20 | CALC. | 4.3 | 33.2 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 92.0 | -1.90 | 1.3 | - | - | - | - | - | - | - | 62.8 | 4.7 | 22.8 | 29.9 | 42.6 | 8749 | - | 0.26 | | | | | | | | | | |
| | 28×0 | 8.0 | RAW | 100.0 | - | - | - | - | - | - | - | 8.0 | 4.6 | 30.0 | 26.7 | 38.8 | 7712 | - | 0.34 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 70.8 | 4.7 | 23.6 | 29.5 | 42.2 | 8632 | - | 0.27 | 6.56 | 65.5 | 4.5 | 18.9 | 33.3 | 43.4 | 9318 | | 0.24 | CASE I |
| | 1/4×28 | 92.9 | -1.90 | 24.5 | 4.3 | 18.8 | 32.6 | 44.3 | 9330 | - | 0.23 | 24.5 | 4.3 | 18.8 | 32.6 | 44.3 | 9330 | - | 0.23 | | | | | | | | | | |
| | | | +1.90 | 75.5 | 2.1 | 68.7 | - | - | - | - | - | 100.0 | 2.6 | 56.5 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 7.1 | RAW | 100.0 | 5.2 | 48.5 | 22.4 | 23.9 | 4950 | - | 0.16 | 100.0 | 5.2 | 48.5 | 22.4 | 23.9 | 4950 | - | 0.16 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 4.5 | 55.2 | 21.7 | 18.6 | 4035 | - | 0.10 | CALC. | 2.8 | 55.9 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 92.9 | -1.90 | 24.5 | - | - | - | - | - | - | - | 22.8 | 4.3 | 18.8 | 32.6 | 44.3 | 9330 | - | 0.23 | | | | | | | | | | |
| | 28×0 | 7.1 | RAW | 100.0 | - | - | - | - | - | - | - | 7.1 | 5.2 | 48.5 | 22.4 | 23.9 | 4950 | - | 0.16 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 29.9 | 4.5 | 25.9 | 30.2 | 39.5 | 8290 | - | 0.21 | 6.01 | 65.1 | 4.5 | 18.4 | 33.7 | 43.6 | 9386 | | 0.24 | |
| | 1/4×28 | 93.5 | -1.90 | 42.2 | 3.7 | 27.4 | 31.2 | 37.7 | 8233 | - | 0.19 | 42.2 | 3.7 | 27.4 | 31.2 | 37.7 | 8233 | - | 0.19 | | | | | | | | | | |
| | | | +1.90 | 57.8 | 1.9 | 75.4 | - | - | - | - | - | 100.0 | 2.6 | 55.1 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 6.5 | RAW | 100.0 | 4.5 | 50.4 | 22.8 | 22.3 | 4773 | - | 0.14 | 100.0 | 4.5 | 50.4 | 22.8 | 22.3 | 4773 | - | 0.10 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 3.7 | 54.1 | 22.8 | 19.4 | 4334 | - | 0.10 | CALC. | 2.7 | 54.8 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 93.5 | -1.90 | 42.2 | - | - | - | - | - | - | - | 39.5 | 3.7 | 27.4 | 31.2 | 37.7 | 8233 | - | 0.19 | | | | | | | | | | |
| | 28×0 | 6.5 | RAW | 100.0 | - | - | - | - | - | - | - | 6.5 | 4.5 | 50.4 | 22.8 | 22.3 | 4773 | - | 0.10 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 46.0 | 3.8 | 31.0 | 30.0 | 35.5 | 7744 | - | 0.18 | 5.29 | 69.8 | 4.5 | 18.0 | 33.9 | 43.8 | 9450 | | 0.24 | |
| | 1/4×28 | 92.5 | -1.90 | 84.4 | 4.5 | 12.0 | 35.5 | 48.0 | 10274 | - | 0.22 | 84.4 | 4.5 | 12.0 | 35.5 | 48.0 | 10274 | - | 0.22 | | | | | | | | | | |
| | | | +1.90 | 15.6 | 2.0 | 66.2 | - | - | - | - | - | 100.0 | 4.1 | 20.5 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 7.5 | RAW | 100.0 | 7.1 | 18.2 | 32.6 | 42.1 | 9071 | - | 0.20 | 100.0 | 7.1 | 18.2 | 32.6 | 42.1 | 9071 | - | 0.20 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 6.8 | 19.3 | 32.5 | 41.4 | 9002 | - | 0.18 | CALC. | 4.3 | 20.3 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 92.5 | -1.90 | 84.4 | - | - | - | - | - | - | - | 78.1 | 4.5 | 12.0 | 35.5 | 48.0 | 10274 | - | 0.22 | | | | | | | | | | |
| | 28×0 | 7.5 | RAW | 100.0 | - | - | - | - | - | - | - | 7.5 | 7.1 | 18.2 | 32.6 | 42.1 | 9071 | - | 0.20 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 85.6 | 4.7 | 12.5 | 35.3 | 47.5 | 10169 | - | 0.22 | 4.19 | 76.1 | 4.6 | 16.0 | 34.6 | 45.1 | 9721 | | 0.25 | |
| | 1/4×28 | 93.1 | -1.90 | 74.2 | 5.3 | 9.7 | 36.5 | 48.5 | 10574 | - | 0.23 | 74.2 | 5.3 | 9.7 | 36.5 | 48.5 | 10574 | - | 0.23 | | | | | | | | | | |
| | | | +1.90 | 25.8 | 1.6 | 73.7 | - | - | - | - | - | 100.0 | 4.3 | 26.2 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 6.9 | RAW | 100.0 | 7.2 | 19.5 | 33.5 | 54.2 | 8794 | - | 0.20 | 100.0 | 7.2 | 19.5 | 33.5 | 54.2 | 8794 | - | 0.20 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 6.3 | 25.1 | 31.5 | 37.1 | 8185 | - | 0.20 | CALC. | 4.5 | 25.7 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 93.1 | -1.90 | 74.2 | - | - | - | - | - | - | - | 69.1 | 5.3 | 9.7 | 36.5 | 48.5 | 10574 | - | 0.23 | | | | | | | | | | |
| | 28×0 | 6.9 | RAW | 100.0 | - | - | - | - | - | - | - | 6.9 | 7.2 | 19.5 | 33.5 | 54.2 | 8794 | - | 0.20 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 76.0 | 5.5 | 10.6 | 36.2 | 49.0 | 10412 | - | 0.23 | 2.58 | 70.2 | 4.5 | 18.4 | 34.0 | 43.3 | 9379 | | 0.27 | |
| | 1/4×28 | 94.5 | -1.90 | 27.2 | 3.6 | 39.1 | 25.9 | 31.4 | 6505 | - | 0.17 | 27.2 | 3.6 | 39.1 | 25.9 | 31.4 | 6505 | - | 0.17 | | | | | | | | | | |
| | | | +1.90 | 72.8 | 2.1 | 66.0 | - | - | - | - | - | 100.0 | 2.5 | 58.7 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 5.5 | RAW | 100.0 | 4.6 | 50.7 | 22.7 | 22.0 | 4695 | - | 0.13 | 100.0 | 4.6 | 50.7 | 22.7 | 22.0 | 4695 | - | 0.13 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 3.5 | 58.0 | 19.8 | 18.7 | 3762 | - | 0.09 | CALC. | 2.6 | 58.6 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 94.5 | -1.90 | 27.2 | - | - | - | - | - | - | - | 25.7 | 3.6 | 39.1 | 25.9 | 31.4 | 6505 | - | 0.17 | | | | | | | | | | |
| | 28×0 | 5.5 | RAW | 100.0 | - | - | - | - | - | - | - | 5.5 | 4.6 | 50.7 | 22.7 | 22.0 | 4695 | - | 0.13 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 31.2 | 3.8 | 41.1 | 25.3 | 29.7 | 6186 | - | 0.16 | 2.16 | 69.0 | 4.3 | 20.1 | 33.5 | 42.1 | 9158 | | 0.27 | |
| | 1/4×28 | 92.9 | -1.90 | 57.6 | 3.5 | 33.6 | 28.3 | 34.6 | 7172 | - | 0.28 | 57.6 | 3.5 | 33.6 | 28.3 | 34.6 | 7172 | - | 0.28 | | | | | | | | | | |
| | | | +1.90 | 42.4 | 1.9 | 64.4 | - | - | - | - | - | 100.0 | 2.8 | 46.7 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 7.1 | RAW | 100.0 | 6.2 | 36.9 | 27.4 | 29.5 | 6321 | - | 0.24 | 100.0 | 6.2 | 36.9 | 27.4 | 29.5 | 6321 | - | 0.24 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 4.8 | 45.4 | 23.7 | 26.1 | 5392 | - | 0.19 | 100.0 | 3.0 | 46.0 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 92.9 | -1.90 | 57.6 | - | - | - | - | - | - | - | 53.5 | 3.5 | 33.6 | 28.3 | 34.6 | 7172 | - | 0.28 | | | | | | | | | | |
| | 28×0 | 7.1 | RAW | 100.0 | - | - | - | - | - | - | - | 7.1 | 6.2 | 36.9 | 27.4 | 29.5 | 6321 | - | 0.24 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 60.6 | 3.6 | 34.0 | 28.2 | 34.0 | 7072 | - | 0.28 | 1.70 | 79.3 | 4.4 | 18.0 | 34.4 | 43.4 | 9475 | | 0.28 | |
| | 1/4×28 | 93.2 | -1.90 | 90.5 | 4.4 | 8.7 | 37.7 | 49.2 | 10800 | - | 0.28 | 90.5 | 4.4 | 8.7 | 37.7 | 49.2 | 10800 | - | 0.28 | | | | | | | | | | |
| | | | +1.90 | 9.5 | 1.9 | 66.8 | - | - | - | - | - | 100.0 | 4.2 | 14.2 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 6.8 | RAW | 100.0 | 8.0 | 13.3 | 35.2 | 43.5 | 9750 | - | 0.26 | 100.0 | 8.0 | 13.3 | 35.2 | 43.5 | 9750 | - | 0.26 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 7.6 | 13.7 | 34.1 | 44.6 | 9716 | - | 0.24 | CALC. | 4.5 | 14.4 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 93.2 | -1.90 | 90.5 | - | - | - | - | - | - | - | 84.4 | 4.4 | 8.7 | 37.7 | 49.2 | 10800 | - | 0.28 | | | | | | | | | | |
| | 28×0 | 6.8 | RAW | 100.0 | - | - | - | - | - | - | - | 6.8 | 8.0 | 13.3 | 35.2 | 43.5 | 9750 | - | 0.26 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 91.2 | 4.7 | 9.0 | 37.5 | 48.8 | 10722 | - | 0.28 | 1.35 | 84.1 | 4.5 | 14.9 | 36.0 | 45.0 | 9923 | | 0.29 | |
| | 1/4×28 | 94.7 | -1.90 | 80.0 | 3.5 | 40.0 | 27.2 | 29.3 | 6394 | - | 0.20 | 80.0 | 3.5 | 40.0 | 27.2 | 29.3 | 6394 | - | 0.20 | | | | | | | | | | |
| | | | +1.90 | 20.0 | 2.1 | 61.3 | - | - | - | - | - | 100.0 | 3.2 | 44.3 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 5.3 | RAW | 100.0 | 5.3 | 37.8 | 27.6 | 29.3 | 6485 | - | 0.20 | 100.0 | 5.3 | 37.8 | 27.6 | 29.3 | 6485 | - | 0.20 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 4.4 | 43.8 | 25.7 | 26.1 | 5704 | - | 0.16 | CALC. | 3.3 | 44.0 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 94.7 | -1.90 | 80.0 | - | - | - | - | - | - | - | 75.8 | 3.5 | 40.0 | 27.2 | 29.3 | 6394 | - | 0.20 | | | | | | | | | | |
| | 28×0 | 5.3 | RAW | 100.0 | - | - | - | - | - | - | - | 5.3 | 5.3 | 37.8 | 27.6 | 29.3 | 6485 | - | 0.20 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 81.1 | 3.6 | 39.9 | 27.2 | 29.3 | 6400 | - | 0.20 | 0.56 | 74.2 | 4.0 | 25.1 | 32.1 | 38.8 | 8538 | | 0.29 | |
| | 1/4×28 | 93.7 | -1.90 | 67.2 | 4.3 | 11.5 | 36.5 | 47.7 | 10519 | - | 0.37 | 67.2 | 4.3 | 11.5 | 36.5 | 47.7 | 10519 | - | 0.37 | | | | | | | | | | |
| | | | +1.90 | 32.8 | 1.3 | 73.4 | - | - | - | - | - | 100.0 | 3.3 | 31.8 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 6.3 | RAW | 100.0 | 5.3 | 27.8 | 32.0 | 34.9 | 7895 | - | 0.34 | 100.0 | 5.3 | 27.8 | 32.0 | 34.9 | 7895 | - | 0.34 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 4.3 | 31.8 | 30.8 | 33.1 | 7586 | - | 0.27 | CALC. | 3.4 | 31.5 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 93.7 | -1.90 | 67.2 | - | - | - | - | - | - | - | 63.0 | 4.3 | 11.5 | 36.5 | 47.7 | 10519 | - | 0.37 | | | | | | | | | | |
| | 28×0 | 6.3 | RAW | 100.0 | - | - | - | - | - | - | - | 6.3 | 5.3 | 27.8 | 32.0 | 34.9 | 7895 | - | 0.34 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 69.3 | 4.4 | 13.0 | 36.1 | 46.5 | 10281 | - | 0.37 | 0.33 | 69.3 | 4.4 | 13.0 | 36.1 | 46.5 | 10281 | | 0.37 | |
| | 1/4×28 | 87.7 | -1.90 | 16.3 | 4.6 | 12.8 | 35.1 | 47.5 | 10214 | - | 0.41 | 16.3 | 4.6 | 12.8 | 35.1 | 47.5 | 10214 | - | 0.14 | | | | | | | | | | |
| | | | +1.90 | 83.7 | 1.3 | 70.2 | - | - | - | - | - | 100.0 | 1.8 | 60.8 | - | - | - | - | - | | | | | | | | | | |
| | 28×0 | 12.3 | RAW | 100.0 | 3.7 | 45.3 | 24.9 | 26.1 | - | - | 0.34 | 100.0 | 3.7 | 45.3 | 24.9 | 26.1 | - | - | 0.34 | | | | | | | | | | |
| | 1/4×0 | 100.0 | RAW | 100.0 | 2.1 | 59.1 | 19.1 | 19.7 | - | - | 0.17 | CALC. | 2.0 | 58.9 | - | - | - | - | - | | | | | | | | | | |
| | 1/4×28 | 87.7 | -1.90 | 16.3 | - | - | - | - | - | - | - | 14.3 | 4.6 | 12.8 | 35.1 | 47.5 | 10214 | - | 0.14 | | | | | | | | | | |
| | 28×0 | 12.3 | RAW | 100.0 | - | - | - | - | - | - | - | 12.3 | 3.7 | 45.3 | 24.9 | 26.1 | - | - | 0.34 | | | | | | | | | | |
| | 1/4×0 | 100.0 | COMB. | - | - | - | - | - | - | - | - | 26.6 | 4.2 | 27.8 | 30.4 | 38.0 | 5491 | - | 0.23 | | | | | | | | | | |

EXCLUDED

LB

REVISED FEB. 23, 1981

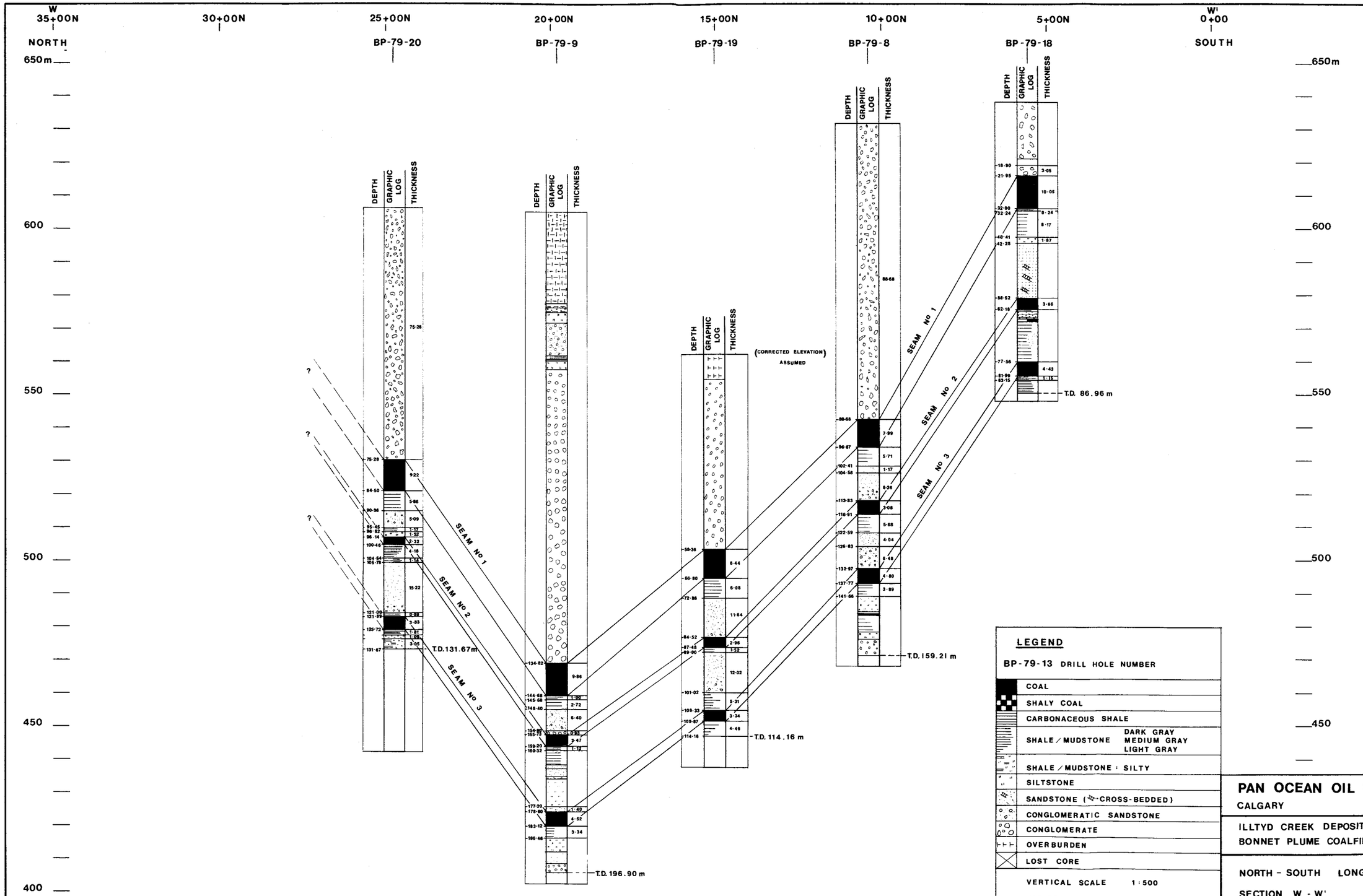
# FIGURE 2




○ PROPOSED DIAMOND DRILL HOLES

• EXISTING DIAMOND DRILL HOLES

| | |
|---|---|
| PAN OCEAN OIL LTD<br>CALGARY ALBERTA | PLAN - ILLTYD CREEK BLOCK<br>BONNET PLUME COALFIELD |
| WRIGHT ENGINEERS LIMITED<br>VANCOUVER CANADA | Drawn: TKS · Appr.: WS · Check: · Appr. Date: MAR. 81 · DRAWING NO. A 1098 103 1202 · REV |




## LEGEND

BP-79-13 DRILL HOLE NUMBER

- COAL
- SHALY COAL
- CARBONACEOUS SHALE
- SHALE / MUDSTONE — DARK GRAY, MEDIUM GRAY, LIGHT GRAY
- SHALE / MUDSTONE : SILTY
- SILTSTONE
- SANDSTONE (⌗ CROSS-BEDDED)
- CONGLOMERATIC SANDSTONE
- CONGLOMERATE
- OVERBURDEN
- LOST CORE

VERTICAL SCALE 1 : 500

HORIZONTAL SCALE 1 : 5000

**PAN OCEAN OIL LTD.**

CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

NORTH - SOUTH LONGITUDINAL SECTION W - W'

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| JM | TKS | S.Lo | | | | | MARCH 1981 | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

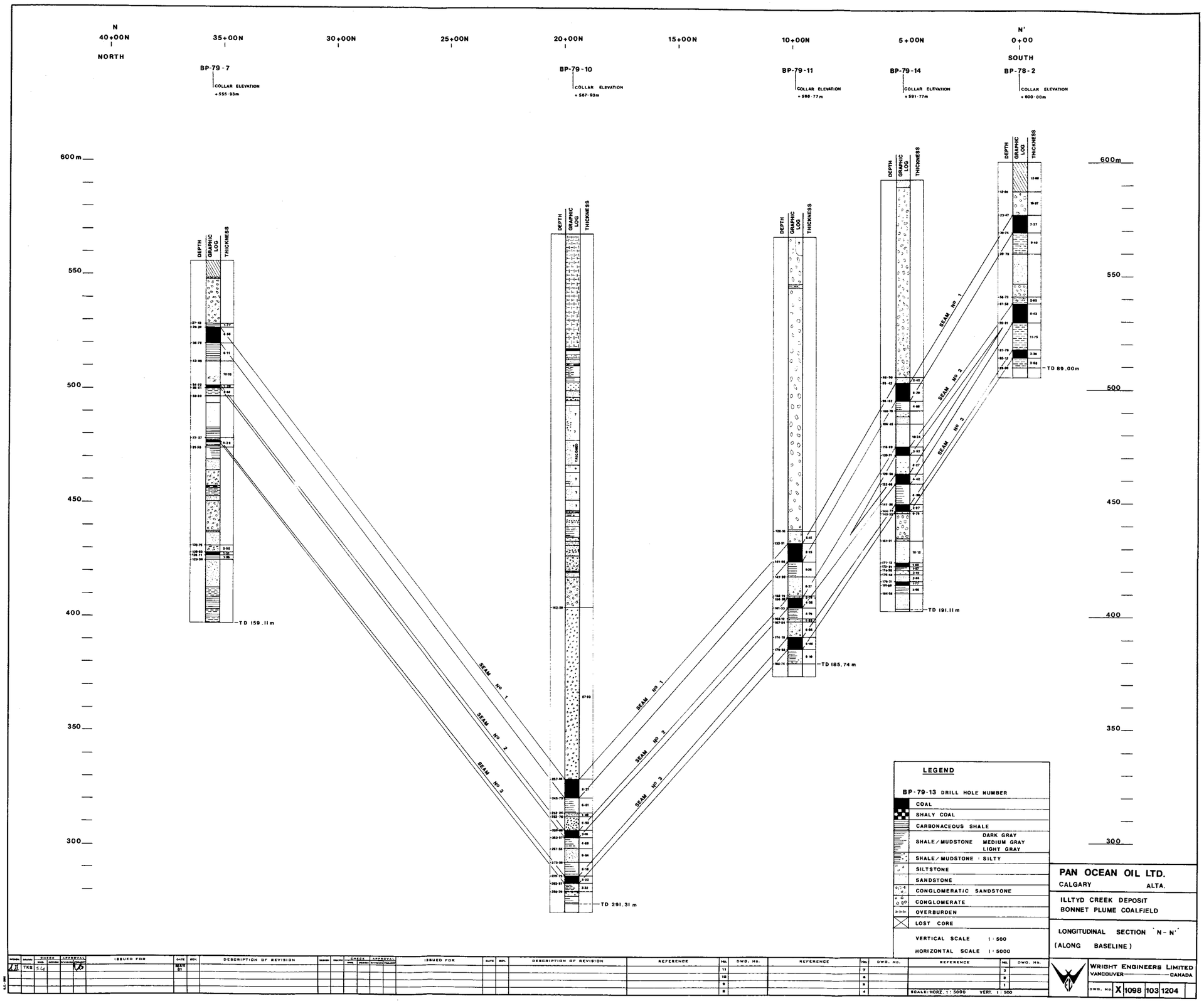
| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

SCALE: HORZ. 1:5000 VERT. 1: 500

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1098 103 1203

0.C.-1180




**LEGEND**

BP-79-13 DRILL HOLE NUMBER

- COAL
- SHALY COAL
- CARBONACEOUS SHALE
- SHALE/MUDSTONE — DARK GRAY, MEDIUM GRAY, LIGHT GRAY
- SHALE/MUDSTONE : SILTY
- SILTSTONE
- SANDSTONE
- CONGLOMERATIC SANDSTONE
- CONGLOMERATE
- OVERBURDEN
- LOST CORE

VERTICAL SCALE 1 : 500

HORIZONTAL SCALE 1 : 5000

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

LONGITUDINAL SECTION 'N-N'
(ALONG BASELINE)

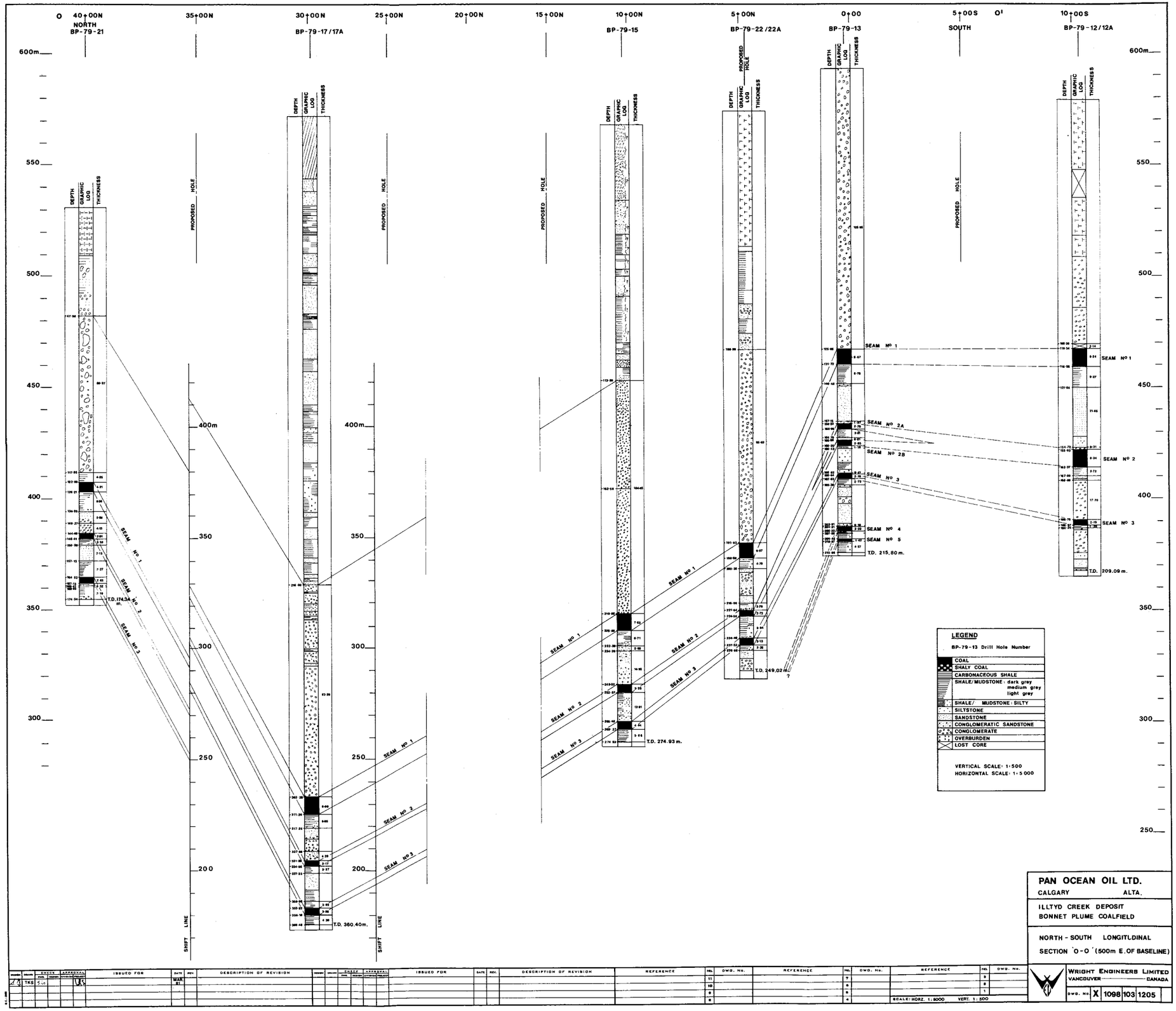
WRIGHT ENGINEERS LIMITED
VANCOUVER — CANADA

DWG. NO. X 1098 103 1204

SCALE: HORZ. 1 : 5000 VERT. 1 : 500

| DESIGN | DRAWN | CHECK | APPROVAL | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|
| TKS | SG | | | | MAR 81 | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | 13 | |
| | 10 | |
| | 9 | |
| | 8 | |
| | 7 | |
| | 6 | |
| | 5 | |
| | 4 | |
| | 3 | |
| | 2 | |
| | 1 | |




| DESIGN | DRAWN | CHECK | APPROVAL | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|
| | TKS | | | | MAR 81 | | |

| REFERENCE | No. | DWG. No. |
|---|---|---|
| | 11 | |
| | 10 | |
| | 9 | |
| | 8 | |

| REFERENCE | No. | DWG. No. |
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| | 7 | |
| | 6 | |
| | 5 | |
| | 4 | |

| REFERENCE | No. | DWG. No. |
|---|---|---|
| | 3 | |
| | 2 | |
| | 1 | |

SCALE: HORZ. 1:5000 VERT. 1:500

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

NORTH - SOUTH LONGITUDINAL
SECTION 'O-O' (500m E. OF BASELINE)

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. X 1098 103 1205

15000 N

65° 15' N

135° 00' W

39000 E

N

SEAM

HORIZON

BASE

NO. 1

TRACE

OUTCROP

MAIN ENTRIES

APPROX.

BP 79-19

BP 79-20

BP 79-9

BP 78-3

BP 79-7

BP 79-8

BP 79-18

BP 79-10

BP 79-11

BP 79-14

BP 79-21

BP 79-17/17A

BP 79-13

BP 79-12/12A

BP 79-15

BP 79-22/22A

MINING SEQUENCE

Pillar Size 15.2m x 15.2m — A

Pillar Size 18.3m x 18.3m — B

Pillar Size 21.3m x 21.3m — C

Pillar Size 27.4m x 27.4m — D

Pillar Size 15.2m x 15.2m — E

Pillar Size 18.3m x 18.3m — F

Pillar Size 21.3m x 21.3m — G

Pillar Size 27.4m x 27.4m — H

YEAR 1
YEAR 2
YEAR 3
YEAR 4
YEAR 5
YEAR 6
YEAR 7
YEAR 8
YEAR 9
YEAR 10
YEAR 11
YEAR 12
YEAR 13
YEAR 14
YEAR 15
YEAR 16
YEAR 17
YEAR 18
YEAR 19
YEAR 20
YEAR 21
YEAR 22
YEAR 23
YEAR 24
YEAR 25
YEAR 26

SUPPORT PILLAR AREAS

CONTOUR

OVERBURDEN

AREA OF INFLUENCE FOR MINING RECOVERY BASED ON PILLAR SIZE

AREA OF INFLUENCE OF BOREHOLE

300m APPROX.

MINING AREA BY YEAR

COORDINATES SHOWN ARE BASED ON TRIANGULATION STATION "TYD" ASSUMED AS 25000.00 N AND 25000.00 E

0 100 200 300 400 500 m

SCALE

SEAM Nº 1 MINING SEQUENCE

PAN OCEAN OIL LTD.

CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PRODUCTION SCHEDULE BY YEARS
500,000 TONNES/YEAR - 15% ASH

| DESIGN | DRAWN | CHECK OVR | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | JLW | | | | | | | | |

REFERENCE No. DWG. NO.

REFERENCE No. DWG. NO.

SCALE: 1:5000

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. X 1098102 1203

15000N

65° 15' N

135° 00' W

39000 E

MAIN ENTRIES

OUTCROP

OUTCROP

⊙BP-79-19

⊙BP-79-20

⊙BP-79-9

⊙BP-78-3

⊙BP-79-8

⊙BP-79-7

⊙BP-79-18

⊙BP-79-10

⊙BP-79-11

⊙BP-79-14

⊙BP-79-21

135° 00' W

39000E

⊙BP-78-2

HORIZON

SEAM No. 2

⊙BP-79-17/17A

YEAR 15

YEAR 16

YEAR 16

YEAR 17

YEAR 18

YEAR 18

YEAR 19

YEAR 20

⊙BP-79-12

⊙BP-79-12/12A

⊙BP-79-13

YEAR 30

YEAR 29

YEAR 27

YEAR 28

YEAR 26

YEAR 25

YEAR 24

YEAR 23

YEAR 30

YEAR 29

YEAR 28

YEAR 27

YEAR 25

YEAR 26

YEAR 23

YEAR 24

YEAR 22

YEAR 21

YEAR 20

YEAR 30

YEAR 29

YEAR 28

⊙BP-79-22/22A

YEAR 29

YEAR 23

YEAR 22

YEAR 21

APPROXIMATE 300m OVERBURDEN CONTOUR BASE

MINING SEQUENCE

AREA OF INFLUENCE OF BOREHOLES

15000N

65° 15' N

SEAM No. 2 MINING SEQUENCE

COORDINATES SHOWN ARE BASED ON TRIANGULATION STATION "TYD" ASSUMED AS 25000.00 N AND 25000.00 E

0 100 200 300 400 500m

SCALE

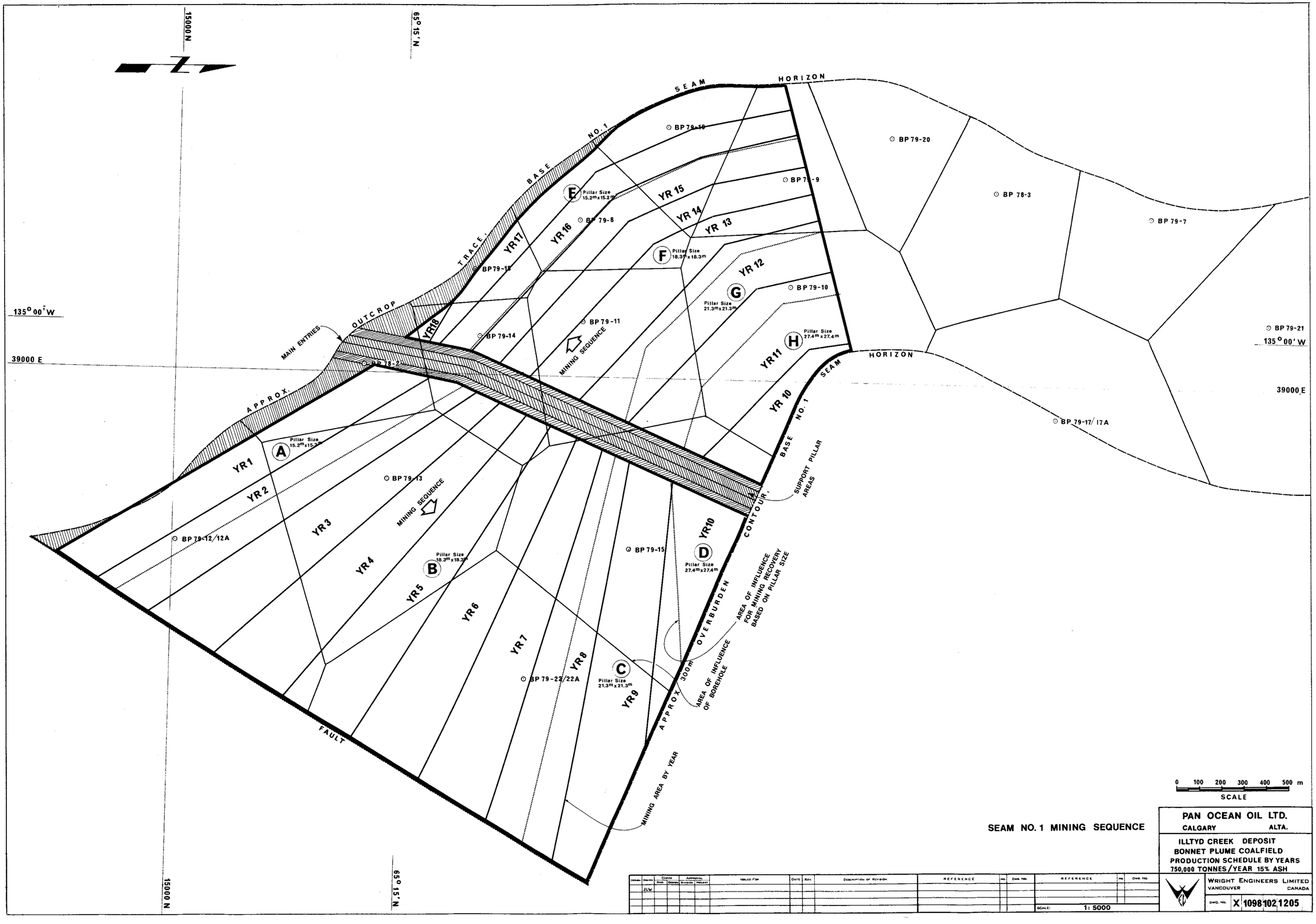
**PAN OCEAN OIL LTD.**

CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PRODUCTION SCHEDULE BY YEARS
500,000 TONNES/YEAR · 15% ASH

WRIGHT ENGINEERS LIMITED
Vancouver Canada

DWG. No. X 109810 21204




## SEAM NO. 1 MINING SEQUENCE

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

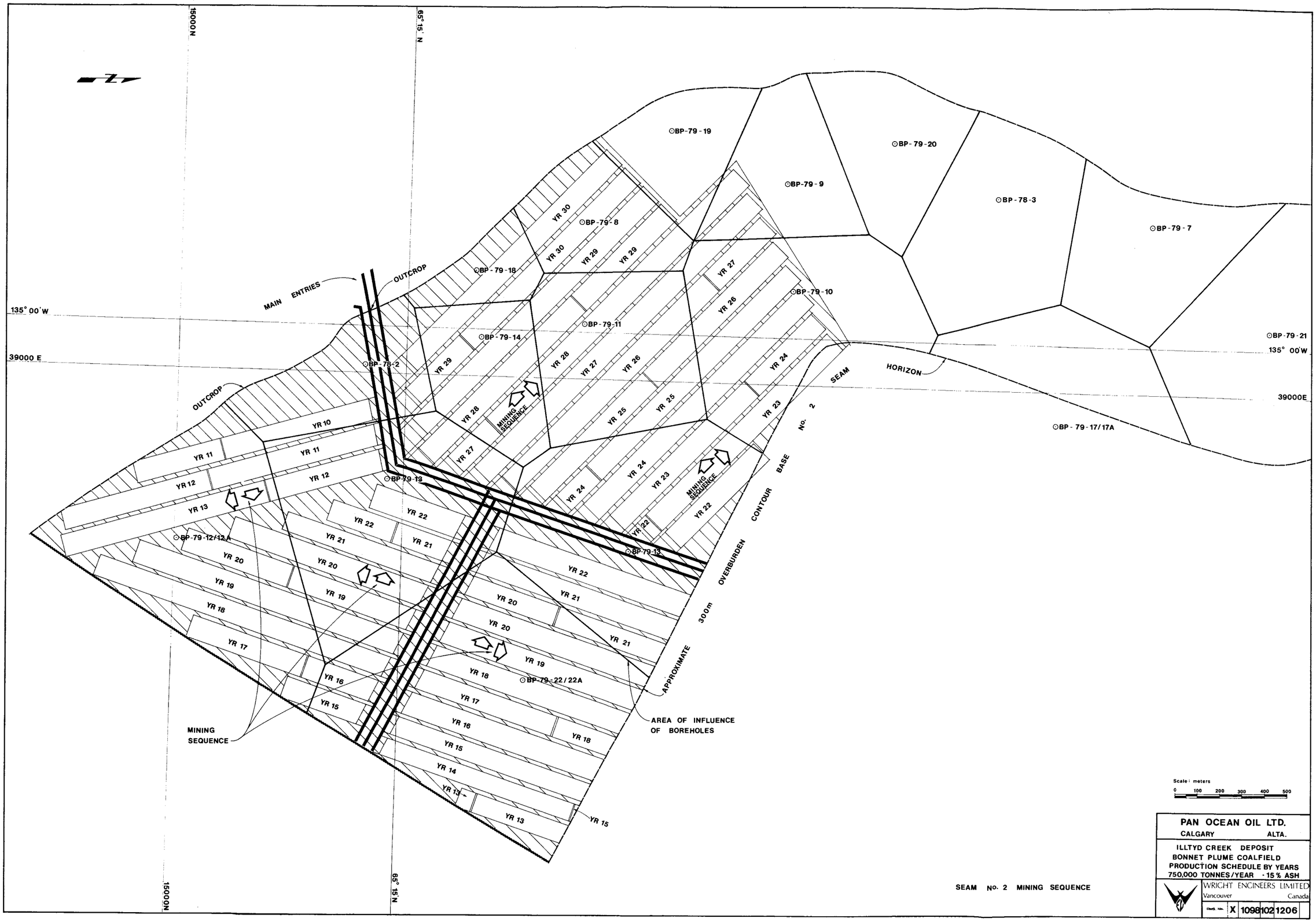
ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PRODUCTION SCHEDULE BY YEARS
750,000 TONNES/YEAR 15% ASH

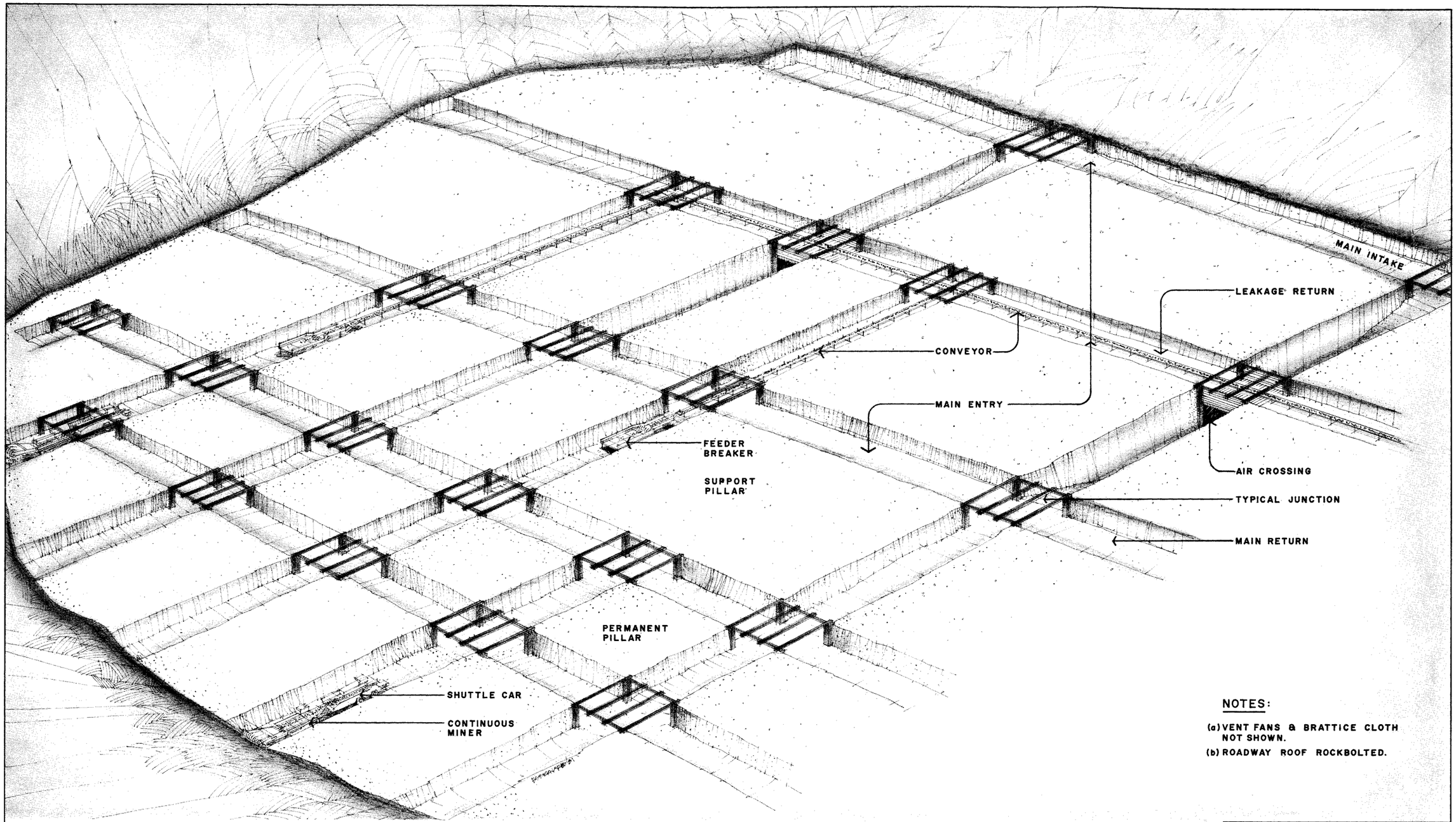
| Drawn | Checked | Approved | Issued For | Date | Rev. | Description of Revision | Reference | No. | Dwg. No. | Reference | No. | Dwg. No. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| JLW | | | | | | | | | | | | |

SCALE: 1: 5000

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. X 1098 102 1205


150000N
65° 15' N
135° 00' W
39000 E
MAIN ENTRIES
OUTCROP
OUTCROP
BP-79-19
BP-79-20
BP-79-9
BP-78-3
BP-79-7
BP-79-8
BP-79-18
BP-79-10
BP-79-11
BP-79-14
BP-78-2
BP-79-21
135° 00' W
39000E
HORIZON
SEAM
BP-79-17/17A
BP-79-13
BP-79-12/12A
BP-79-22/22A
MINING SEQUENCE
MINING SEQUENCE
MINING SEQUENCE
MINING SEQUENCE
YR 10
YR 11
YR 12
YR 13
YR 15
YR 16
YR 17
YR 18
YR 19
YR 20
YR 21
YR 22
YR 23
YR 24
YR 25
YR 26
YR 27
YR 28
YR 29
YR 30
APPROXIMATE 300m OVERBURDEN CONTOUR BASE
AREA OF INFLUENCE OF BOREHOLES
MINING SEQUENCE
150000N
65° 15' N
SEAM No. 2 MINING SEQUENCE
Scale : meters
0 100 200 300 400 500
PAN OCEAN OIL LTD.
CALGARY ALTA.
ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PRODUCTION SCHEDULE BY YEARS
750,000 TONNES/YEAR - 15% ASH
WRIGHT ENGINEERS LIMITED
Vancouver Canada
Dwg. No. X 109810212 06




NOTES:

(a) VENT FANS & BRATTICE CLOTH NOT SHOWN.

(b) ROADWAY ROOF ROCKBOLTED.

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PERSPECTIVE OF PILLAR MINING

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | BJE | | | | LJS | | MARCH 81 | | |

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
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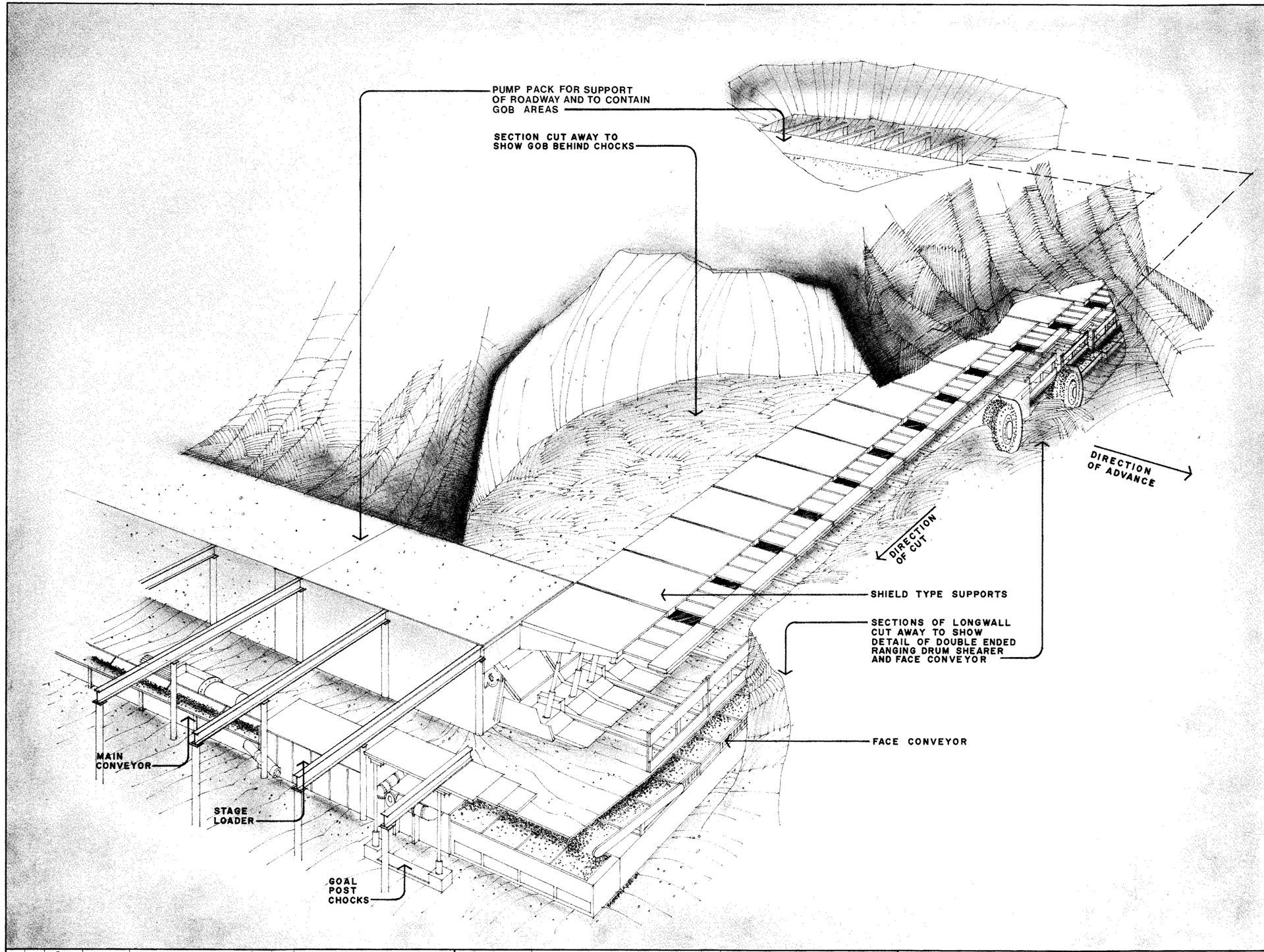
| REFERENCE | NO. | DWG. NO. |
|---|---|---|
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| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

SCALE:

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 102 1207




**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PERSPECTIVE OF
LONGWALL MINING

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | BMB | | | | | | MARCH 81 | | |

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
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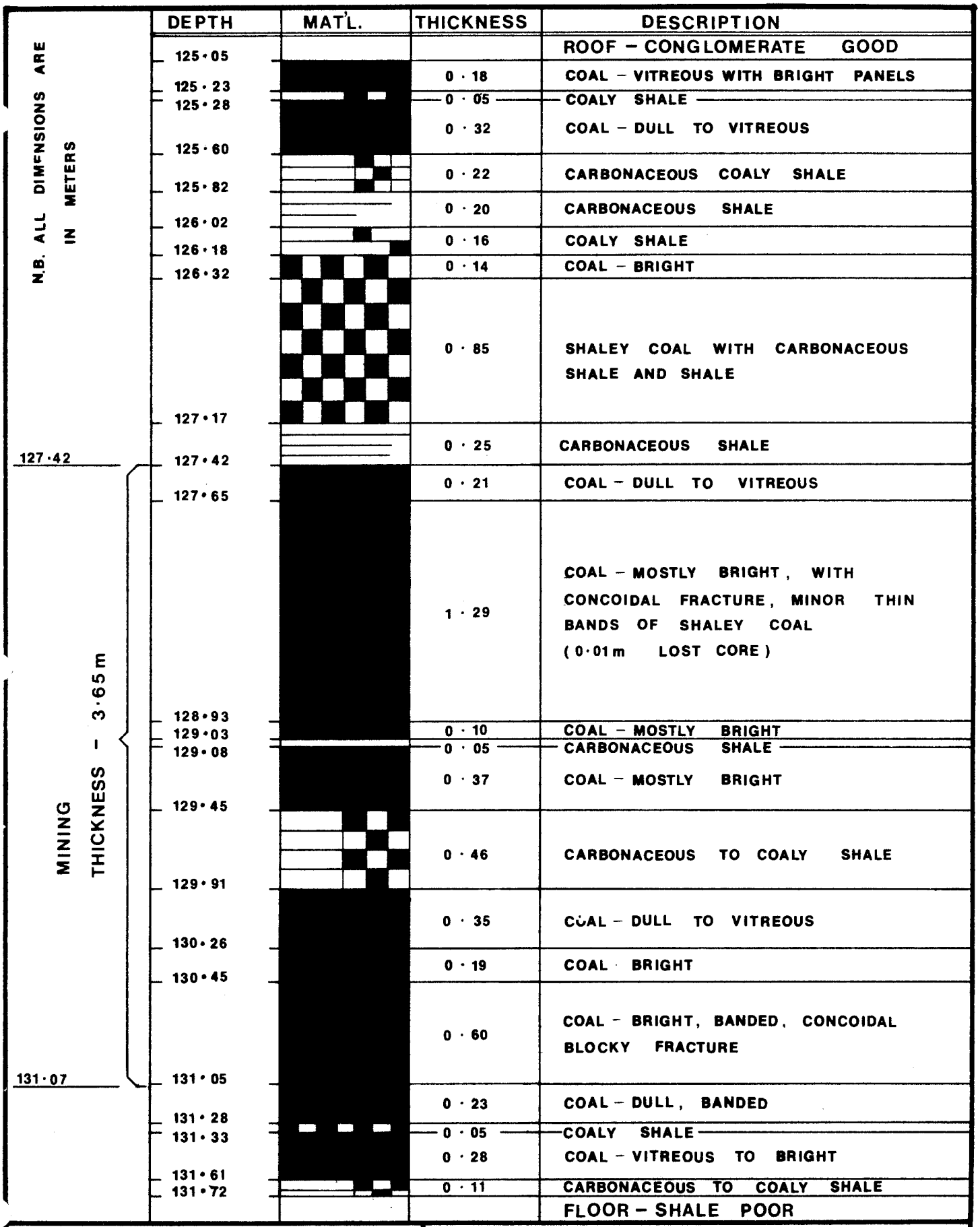
| REFERENCE | NO. | DWG. NO. |
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| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

SCALE:

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 102 1208

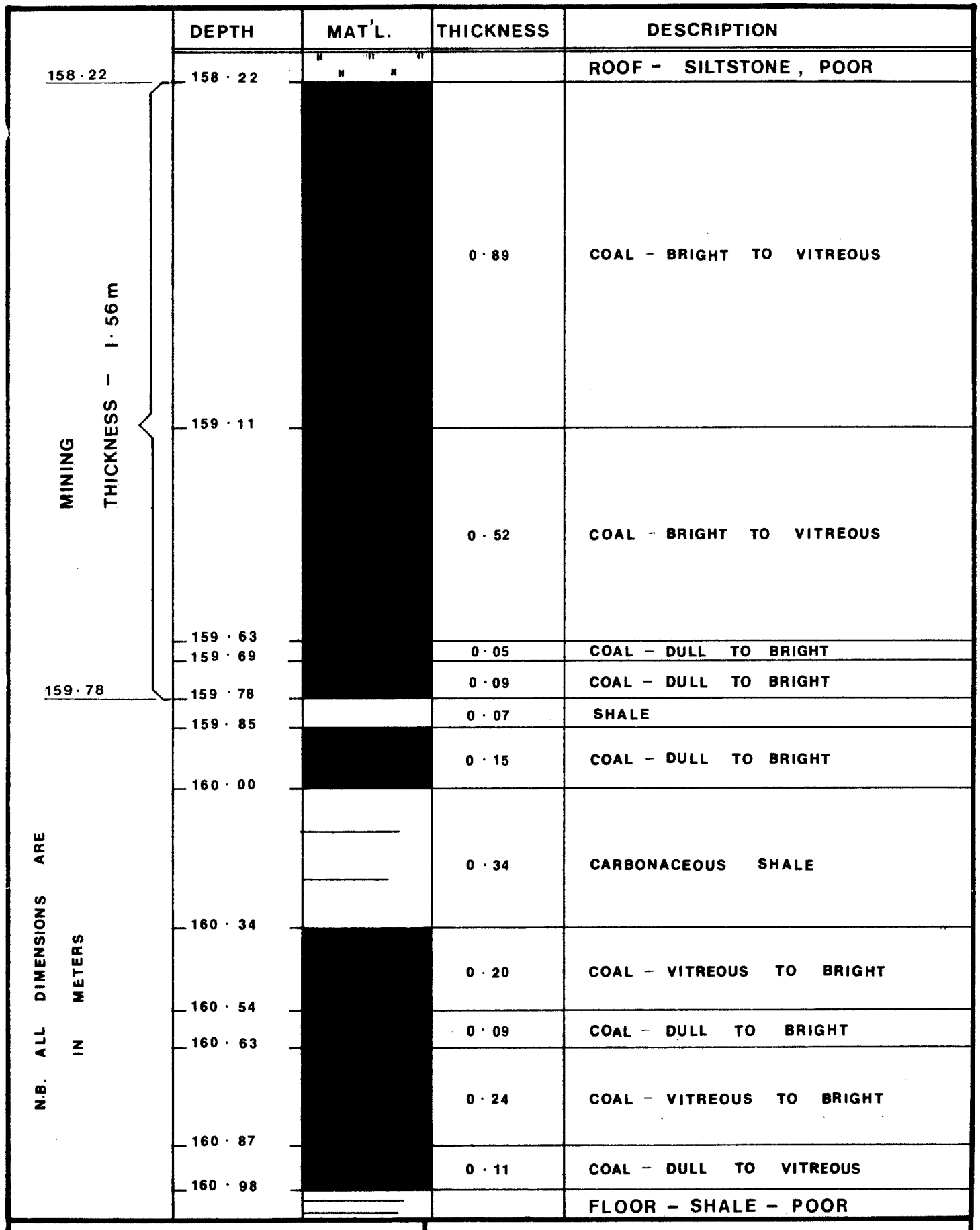



PAN OCEAN OIL LTD.
CALGARY, ALBERTA

# No 1 SEAM TYPICAL MINING SECTION

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

| Drawn | TKS | Appr. | WS | DRAWING NO. | | | | REV |
|---|---|---|---|---|---|---|---|---|
| Check | S. Lo | Appr. Date | MAR 81 | A | 1098 | 102 | 1209 | |




PAN OCEAN OIL LTD.
CALGARY ALBERTA

Nº 2 SEAM
TYPICAL MINING SECTION

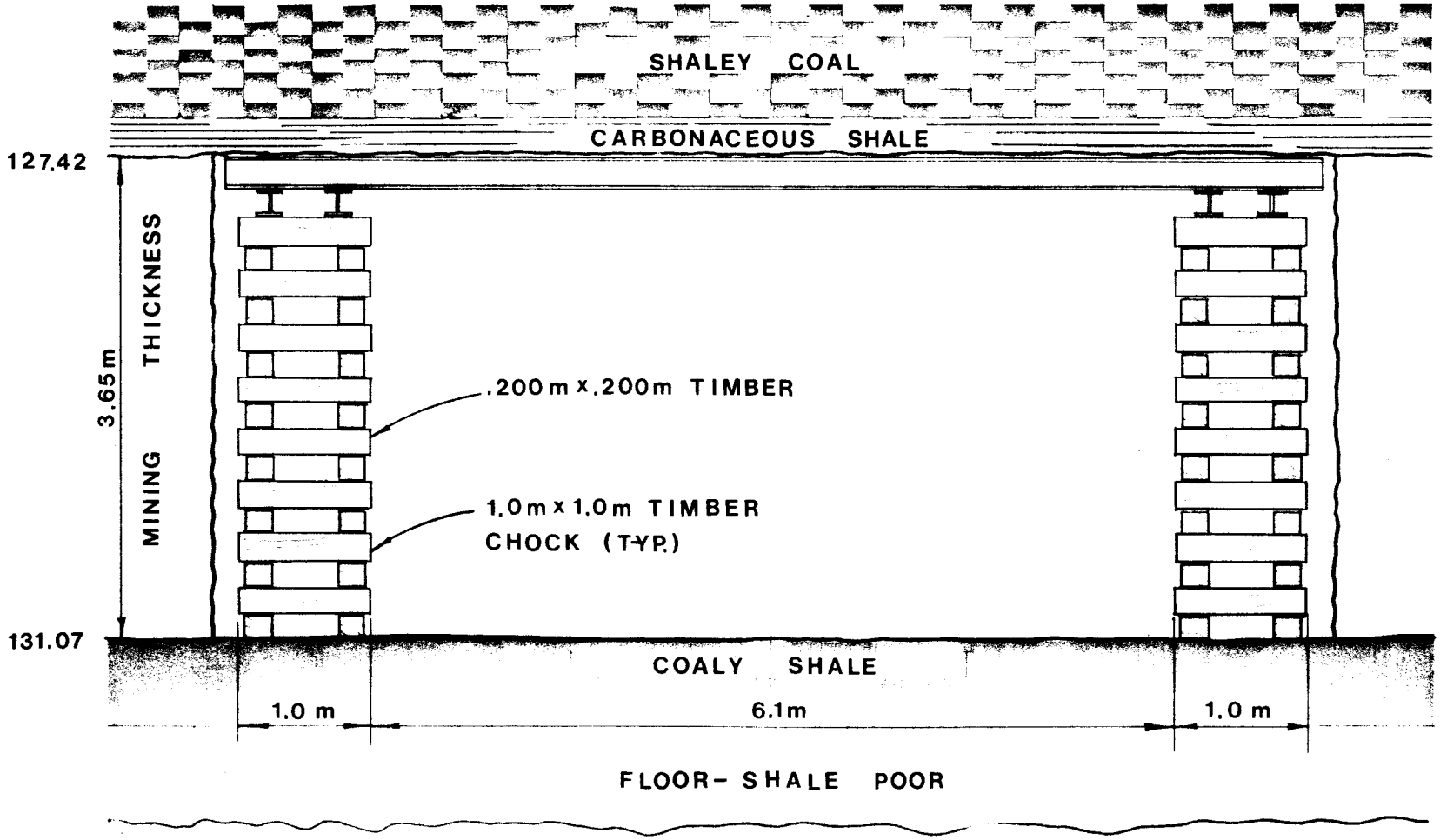
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

| Drawn | TKS | Appr. | |
|---|---|---|---|
| Check | S.Lo | Appr. Date | MAR 81 |

DRAWING NO. A 1098 102 1210 REV

PAN OCEAN OIL LTD
CALGARY, ALBERTA

# TYPICAL ROADWAY JUNCTION




WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

| Drawn | P.C. | Appr. | Appr. Date |
|---|---|---|---|
| Check | S.L. | | MARCH 1981 |

| REV | DRAWING NO. |
|---|---|
| A | 1098 102 1211 |

N

15000 N

65° 15' N

135° 00' W

39000 E

39° 00' W

39000 E

15000 N

65° 15' N

SEAM

HORIZON

NO. 1

BASE

TRACE

OUTCROP

APPROXIMATE

BP·79·19
498·0m

BP 79 20
471·79m

BP·79·9
410·56m

BP 78 3
453·06m

BP·79·7
520·15m

BP·79·8
488·11m

BP·79·18
556·34m

BP·79·10
322·20m

BP·78·4
306·36m
ESTIMATES

BP·79·11
425·11m

BP·79·21
404·38m

BP·79·14
495·15m

BP·78·2
569·26m

BP·79·17/17A
228·33m

BP·79·13
461·38m

BP·79·12/12
479.01m

BP·79·15
342·53m

BP 79 16/16A
NOT INTERSECTED

BP·79·22/22A
401·87m

APPROXIMATE 300m OVERBURDEN CONTOUR BASE NO.1 SEAM HORIZON

550 500 450 400 350 300 250

COORDINATES SHOWN ARE BASED ON TRIANGULATION STATION "TYD" ASSUMED AS 25000.00 N AND 25000.00 E

**LEGEND**

DEFINED

APPROXIMATE

ASSUMED TRACE BELOW ILLTYD CREEK

**NOTE**

THIS DRAWING COPIED FROM 'PAN OCEAN'S DWG. NO. E·0728

Scale : meters

100 0 100 200 300 400 500

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

STRUCTURE CONTOURS
BASE NO.1 SEAM HORIZON

WRIGHT ENGINEERS LIMITED
Vancouver Canada

Dwg. No. X 1098 102 1212

15000 N

65° 15' N

135° 00' W

39000 E

APPROXIMATE OUTCROP TRACE BASE NO.2 SEAM HORIZON

BP·79·19
522·98m

BP·79·20
544·17m

BP·79·9
303·96m

BP·78·3
568·09m

BP·79·7
499·58m

BP·79·8
532·13m

BP 79 18
473·85m

BP·79·10
691·94m

BP·78·4
288·0m
ESTIMATED

BP·79·21
615·82m

BP·79·11
594·58m

BP·79·14
541·23m

BP·78·2
470·0m

BP·79·17/17A
794·52m

BP 79 13
575·15m

BP 79 12/12A
565·78m

BP·79·15
315·64m

BP 79 16/16A
NOT INTERSECTED

BP·79·22/22A
624·09m

APPROXIMATE 300m OVERBURDEN CONTOUR BASE NO.2 SEAM HORIZON

500 450 400 350 300 250 200

COORDINATES SHOWN ARE BASED ON TRIANGULATION STATION "TYD" ASSUMED AS 25000.00 N AND 25000.00 E

LEGEND

DEFINED

APPROXIMATE

ASSUMED TRACE BELOW ILLTYD CREEK

NOTE

THIS DRAWING COPIED FROM PAN OCEAN'S E-0729

Scale: meter

100 0 100 200 300 400 500

**PAN OCEAN OIL LTD.**
CALGARY

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

STRUCTURE CONTOURS
BASE NO. 2 SEAM HORIZON

WRIGHT ENGINEERS LIMITED
Vancouver Canada

Dwg. No. X 1098 102 1213

15000 N

65° 15' N

ILLTYD CREEK

APPROX OUTCROP TRACE BASE No 1 SEAM HORIZON

BP79-19 6.87m

BP79-20 7.42m

BP 79-9 9.86m

BP 78-3 5.8m

BP79-7 3.6m

BP79-21 3.13m

BP 79-8 7.99 m

BP79-18 9.09m

BP 79-10 7.89m

BP 79-11 8.15m

BP 78-4 not intersected

135° 00' W

39000 E

BP 79-14 6.47 m

BP 78-2 7.27m

BP79-17/17A 7.02 m

BP79-13 6.56m

BP79-12A 7.95m

BP 79-15 7.05m

BP79-16A not intersected

BP 79-22A 6.97m

APPROXIMATE 300m OVERBURDEN CONTOUR BASE No 1 SEAM HORIZON

15000N

65° 15'N

COORDINATES SHOWN ARE BASED ON TRIANGULATION STATION "TYD" ASSUMED AS 25000.00 N AND 25000.00 E

LEGEND

DEFINED

APPROXIMATE

ASSUMED TRACE BELOW ILLTYD CREEK

NOTE

THIS DWG. WAS COPIED FROM PAN OCEAN'S DWG. No. E-0743.

100 0 100 200 300 400 500

metres

**PAN OCEAN OIL LTD.**

CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

ISOPACH PLAN SEAM THICKNESS
No. 1 SEAM

WRIGHT ENGINEERS LIMITED
Vancouver Canada

DWG. No. X 1098102 1214

15000 N

65° 15' N

135° 00' W

39000 E

ILLTYD CREEK

APPROXIMATE OUTCROP TRACE BASE No 2 SEAM HORIZON

BP-79-19
2·96m

BP-79-20
2·32m

BP-79-9
3·47m

BP-78-3
2·43m

BP-79-8
3·08m

BP-79-7
1·27m

3·67m BP-79-18

BP-79-10
3·18m

BP-78-4
NOT INTERSECTED

BP-79-11
4·35m

BP-79-14
16·31m
8·45m

BP-78-2
8·43m
7·77m

BP-79-21
2·01m

BP-79-17/17A
2·17m

BP-79-13
10·03m
4·22m

8·34m
1·69m BP-79-12A

BP-79-15
3·25m

BP-79-16A

BP-79-22A
2·72m

U

D

APPROXIMATE 300m OVERBURDEN CONTOUR BASE No 2 SEAM HORIZON

COORDINATES SHOWN ARE BASED ON TRIANGULATION STATION "TYD" ASSUMED AS 25000.00 N AND 25000.00 E

LEGEND

DEFINED

APPROXIMATE

ASSUMED TRACE BELOW ILLTYD CREEK

NOTE

THIS DWG. COPIED FROM PAN OCEAN'S DWG. No. E-0741.

meters 100 0 100 200 300 400 500

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

ISOPACH PLAN SEAM THICKNESS
No. 2 SEAM HORIZON

WRIGHT ENGINEERS LIMITED
Vancouver Canada

DWG. No. X 1098102 1215

LEGEND

TYPICAL VENTILATION FOR PILLAR MINING
INTAKE
RETURN
AIR CROSSING
AUXILIARY FAN & DUCT
STOPPING
BRATTICE CLOTH B
DOOR D
REGULATOR R

TO BE MINED

MINING LINE

AREA ENLARGED FOR CLARITY

AUXILIARY FANS

MINED OUT

PILLAR

EXHAUST FANS & DUST FILTERS

MAIN FAN 180,000 cfm at 4" WG STATIC PRESSURE
MAIN RETURN
CONVEYOR ROADWAY
LEAKAGE ONLY
MAIN AIR INTAKE
HEATER

MAIN ENTRY SUPPORT PILLARS

OUTCROP

TO BE MINED

PAN OCEAN OIL LTD.
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
NO. 1 SEAM - SCHEMATIC
OF VENTILATION SYSTEM

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | JLW | | | | WKS | | MARCH 1981 | | |

| REFERENCE | No. | DWG. NO. |
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| REFERENCE | No. | DWG. NO. |
|---|---|---|
| | | |

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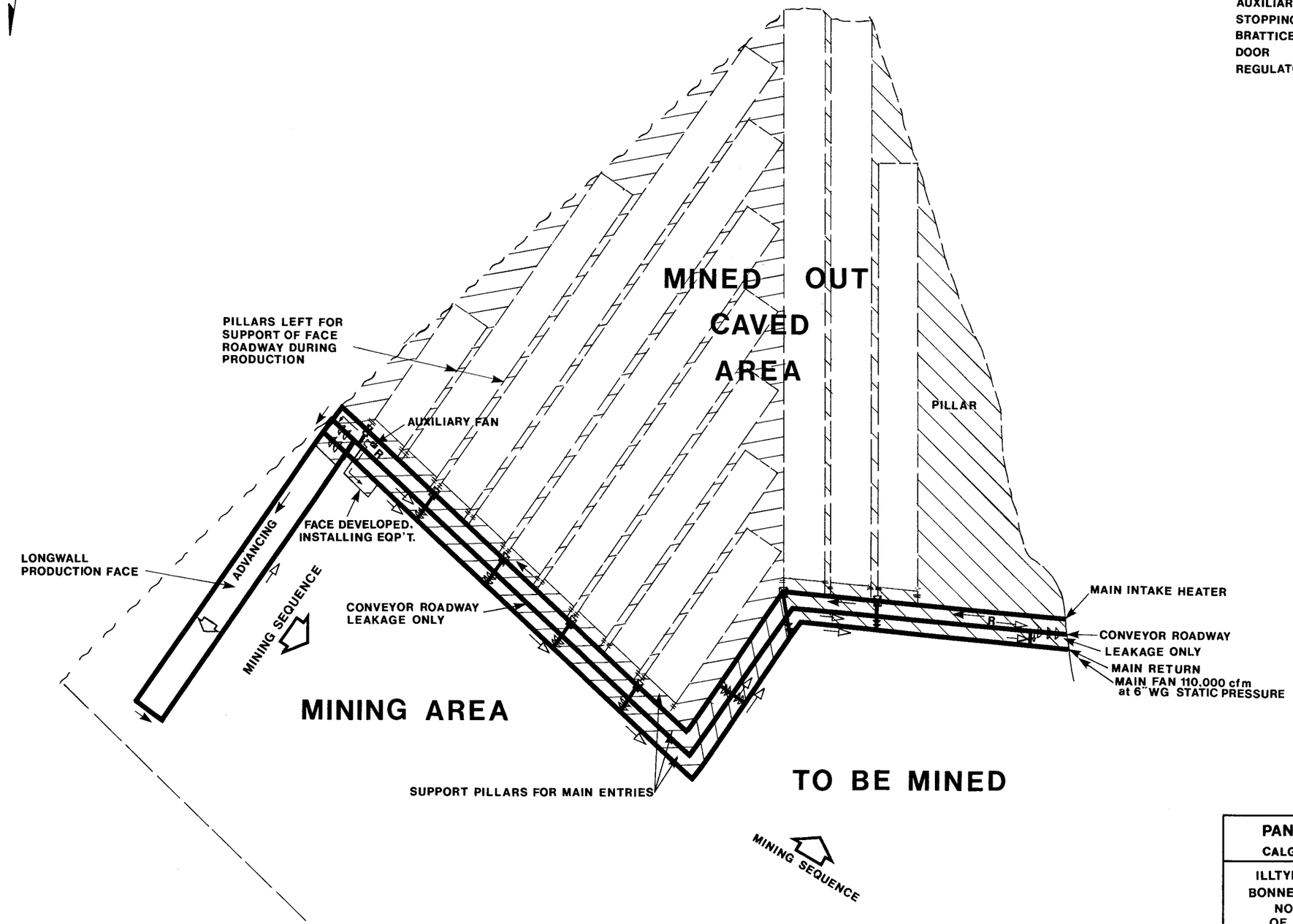
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 102 1220

G.C.4180

**LEGEND**

TYPICAL VENTILATION FOR PILLAR MINING
INTAKE
RETURN
AIR CROSSING
AUXILIARY FAN & DUCT
STOPPING
BRATTICE CLOTH B
DOOR D
REGULATOR R




| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | JLW | | | | WS | | MARCH 1981 | | |

| REFERENCE | NO. | DWG. NO. |
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| REFERENCE | NO. | DWG. NO. |
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SCALE: N. T. S.

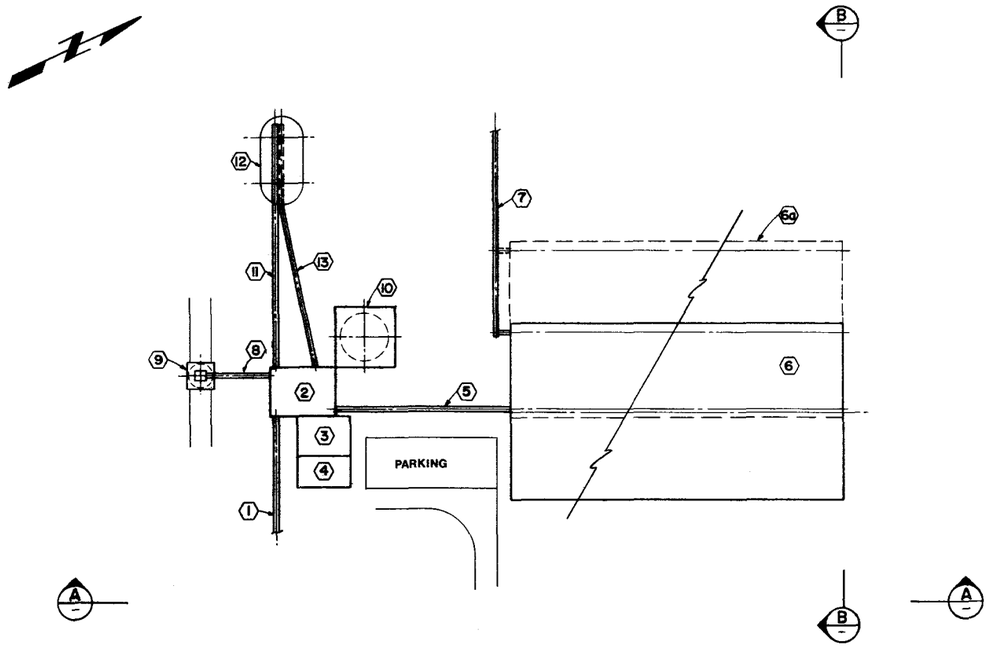
**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD.
NO. 2 SEAM-SCHEMATIC
OF VENTILATION SYSTEM

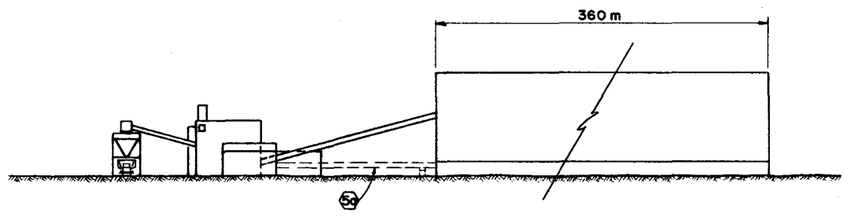
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 102 1221

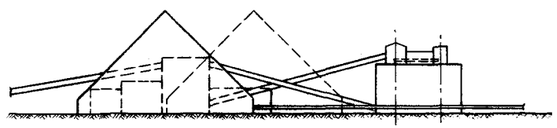
G.C. 4180




PLAN




ELEVATION (A)



ELEVATION (B)

## DESCRIPTION

1. RUN OF MINE FEED CONV.
2. PREPARATION PLANT
3. PLANT MAINTENANCE SHOP
4. OFFICES
5. CLEAN COAL CONV.
6. CLEAN COAL STORAGE BARN
7. POWER PLANT FEED
8. REFUSE CONV.
9. REFUSE BIN
10. THICKENER FACILITIES
11. RAW COAL CONV.
12. RAW COAL STORAGE
13. RAW COAL RECLAIM PLANT FEED CONV.

5a. ALTERNATE CLEAN COAL CONV.

6a. ALTERNATE CLEAN COAL STORAGE BARN

Scale: meters

0 10 20 30 40 50 60

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD
PRELIMINARY PLANT
SITE

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| K.R. | A.T.Z | | | | WS | | MARCH 1981 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
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| REFERENCE | NO. | DWG. NO. |
|---|---|---|

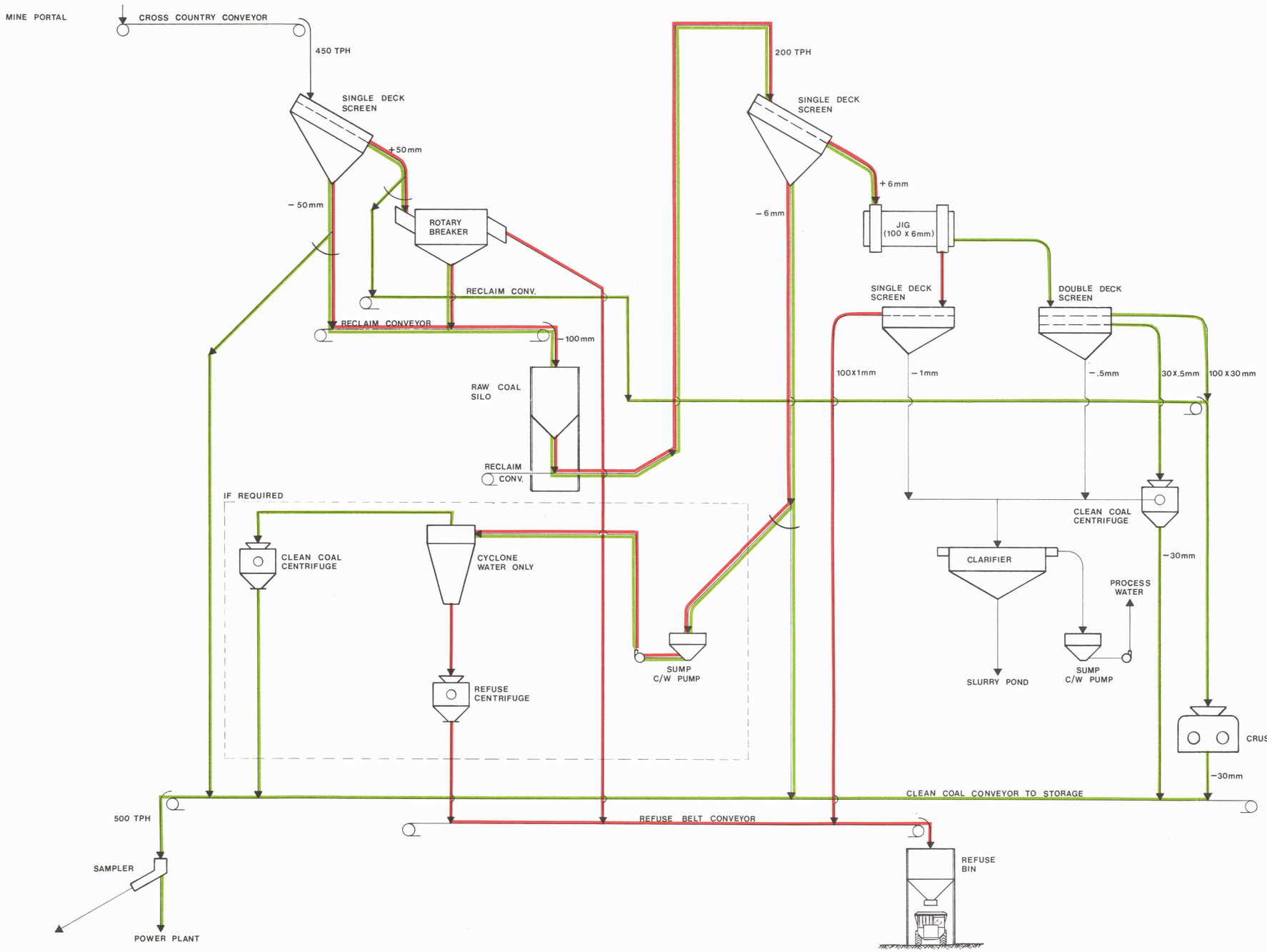
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SCALE: 1:1000

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098104 1201

G.C.-4180




PAN OCEAN OIL LTD.
CALGARY ALTA.

ILLTYD CREEK – DEPOSIT 'B'
BONNET PLUME COALFIELD
PRELIMINARY FLOW SHEET
UNDERGROUND MINE

| Design | Drawn | Check Dwg. | Check Design | Approval Division | Approval Project | Issued For | Date | Rev. | Description of Revision |
|---|---|---|---|---|---|---|---|---|---|
| K.R. | A.T.Z. | | | | | | MARCH 1981 | | |

| Design | Drawn | Check Dwg. | Check Design | Approval Division | Approval Project | Issued For | Date | Rev. | Description of Revision |
|---|---|---|---|---|---|---|---|---|---|

| Reference | No. | Dwg. No. |
|---|---|---|

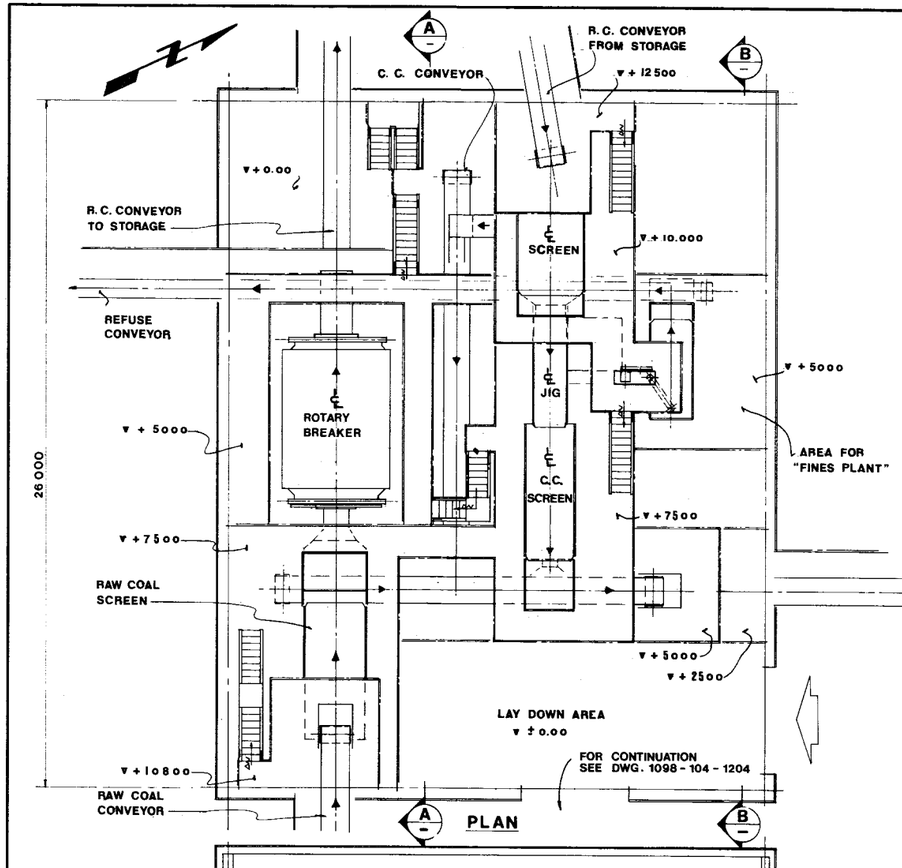
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|---|---|---|

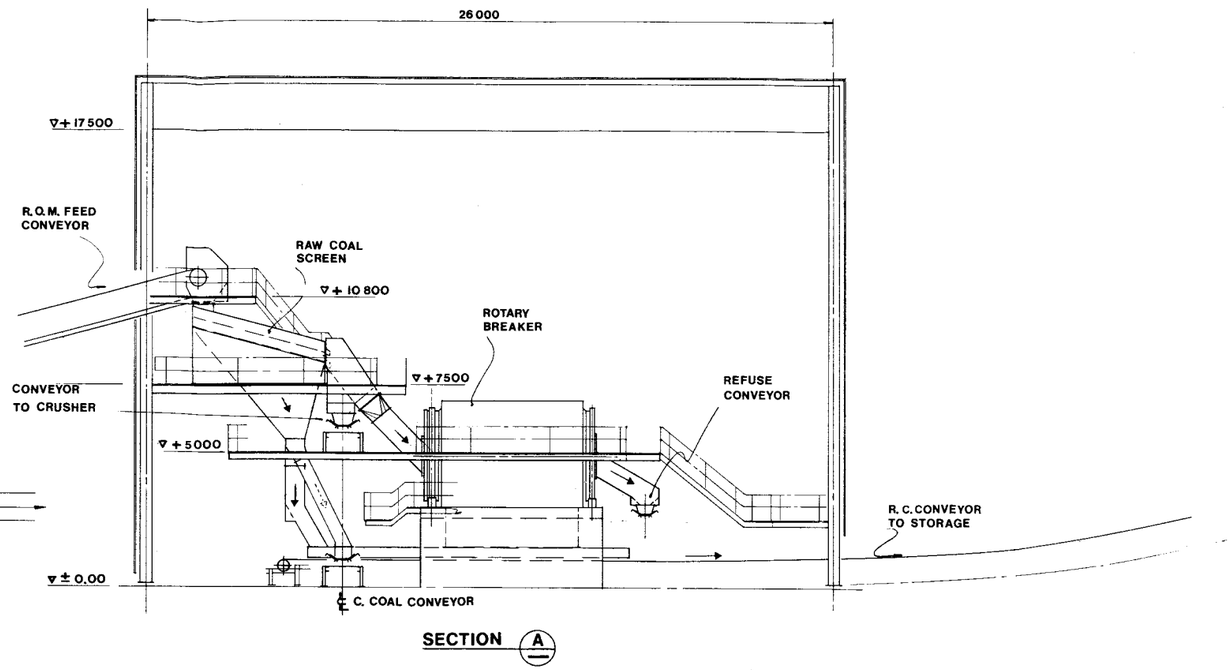
SCALE: NONE

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

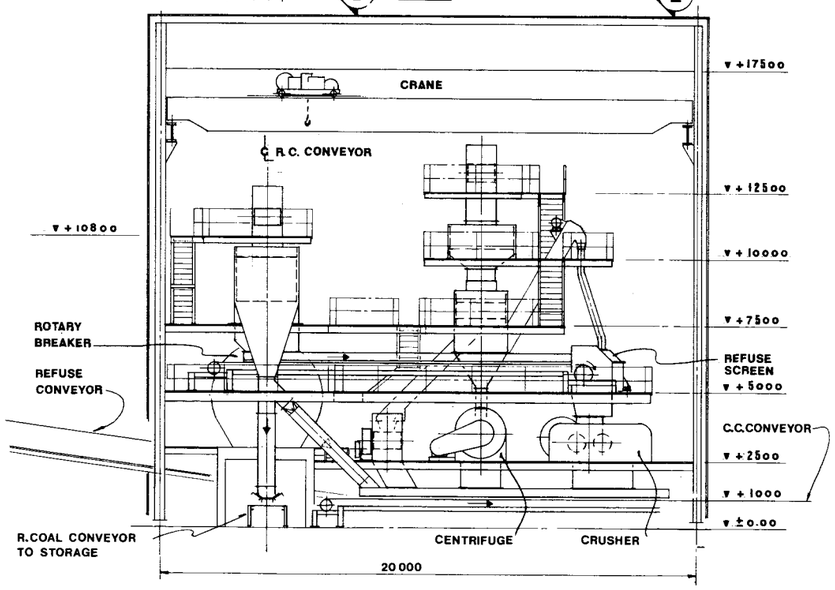
DWG. No. D 1098104 1202

C.C. 4180

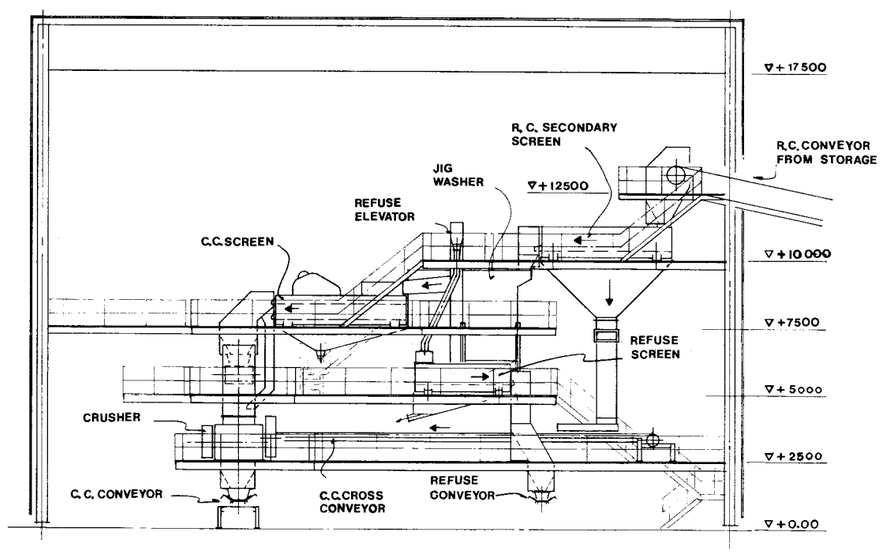



SECTION (A)




ELEVATION




SECTION (B)

Scale : meters
0 1 2 3 4 5

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

**ILLTYD CREEK DEPOSIT**
**BONNET PLUME COALFIELD**
PREPARATION PLANT G A
PLAN AND SECTIONS

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 104 1203

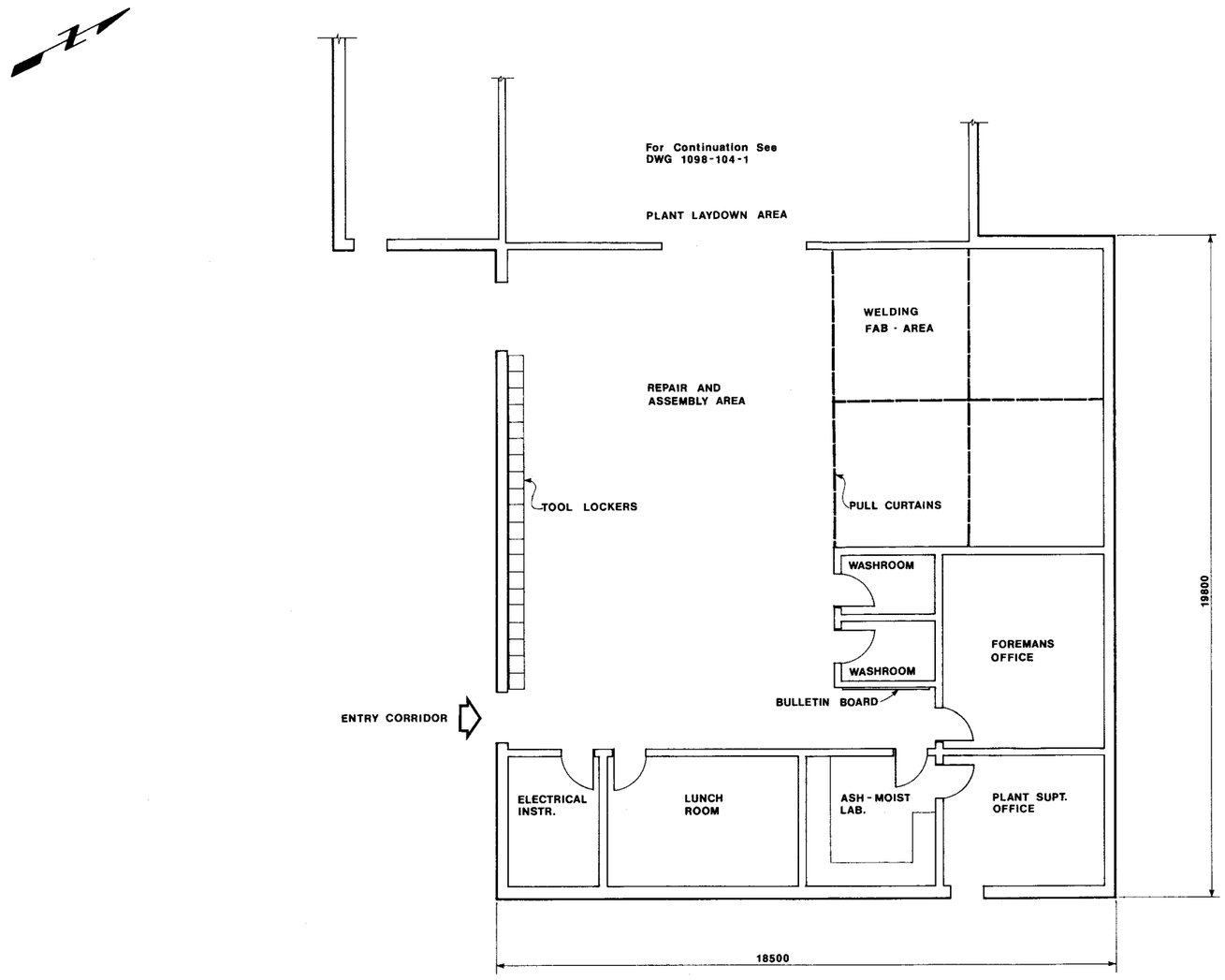
SCALE: 1 : 100

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| KR | K.C.N. | | | | WPS | | MARCH 1981 | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

C.C.-4180




Scale : Millimeters

0 100 200 300 400 500 600 700 800

**PAN OCEAN OIL LTD.**
CALGARY ALBERTA

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

# PREPARATION PLANT MAINTENANCE SHOP & OFFICES

| Design | Drawn | Check: Dwg. | Check: Design | Approval: Division | Approval: Project | Issued For | Date | Rev. | Description of Revision |
|---|---|---|---|---|---|---|---|---|---|
| [illegible] | [illegible] | | | | WJS | | MARCH 1981 | | |

| Design | Drawn | Check: Dwg. | Check: Design | Approval: Division | Approval: Project | Issued For | Date | Rev. | Description of Revision |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

| Reference | No. | Dwg. No. |
|---|---|---|
| | | |

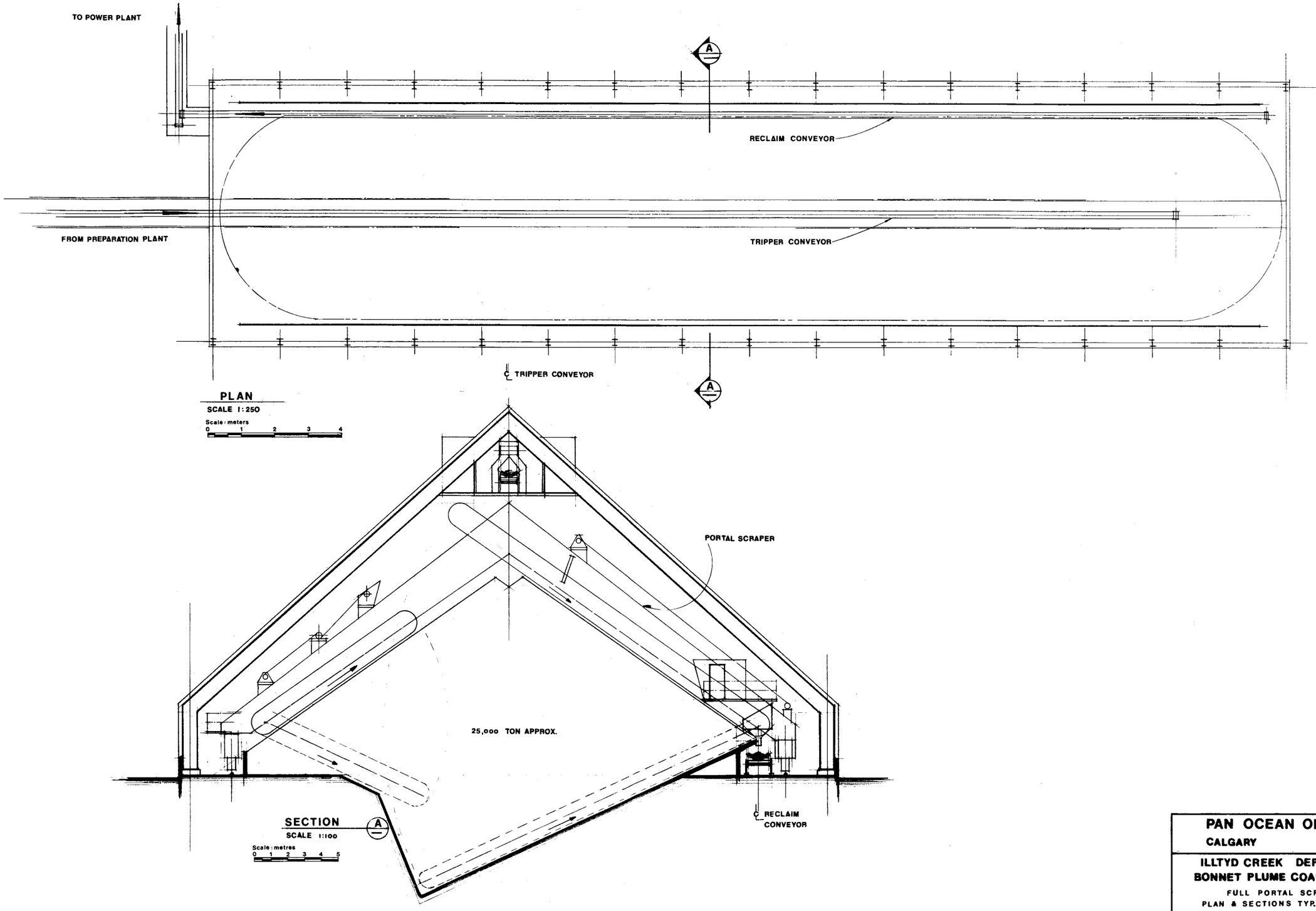
| Reference | No. | Dwg. No. |
|---|---|---|
| | | |

SCALE: 1 : 75

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 104 1204

GC-189




**PLAN**
SCALE 1:250
Scale: meters
0 1 2 3 4

**SECTION** A
SCALE 1:100
Scale: metres
0 1 2 3 4 5

# PAN OCEAN OIL LTD.
CALGARY ALTA.

## ILLTYD CREEK DEPOSIT
## BONNET PLUME COALFIELD

FULL PORTAL SCRAPER
PLAN & SECTIONS TYP. OPTION 1

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1098 104 1205

SCALE: A. N.

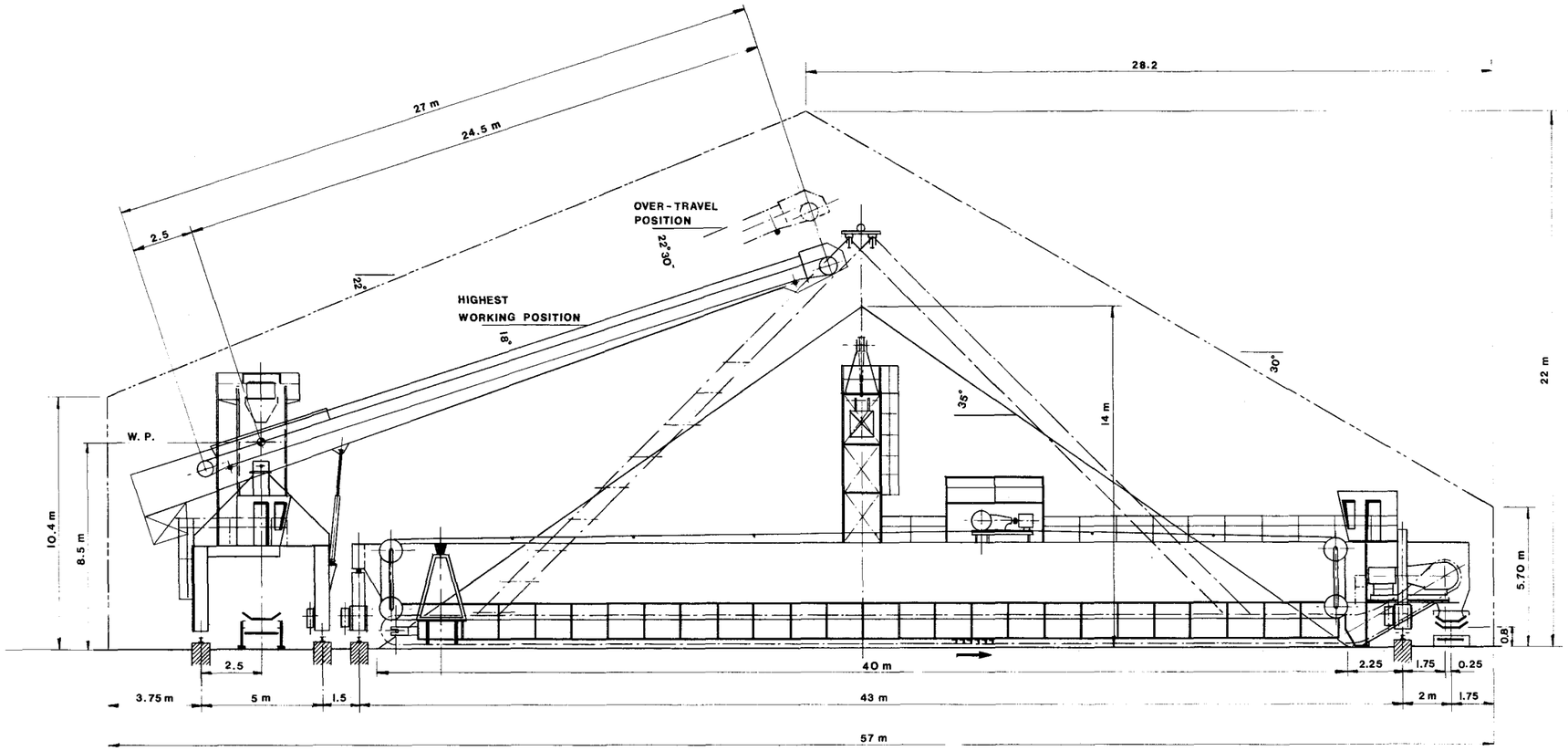
| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | JB | | | | WPS | | MARCH 1981 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|

| REFERENCE | No. | DWG. No. |
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| REFERENCE | No. | DWG. No. |
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IC-4180

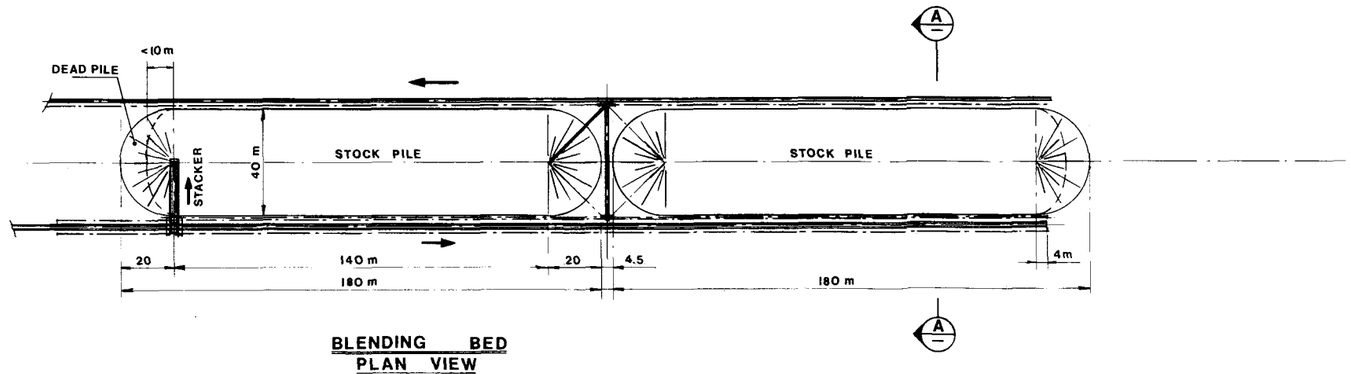



## BRIDGE SCRAPER SECTION A

SCALE 1:100

Scale : meters 0 1 2 3 4 5

TYPICAL




## BLENDING BED PLAN VIEW

SCALE 1:1000

Scale : meters 0 10 20 30 40 50

**PAN OCEAN OIL LTD.**

CALGARY ALTA.

**ILLTYD CREEK DEPOSIT**

**BONNET PLUME COALFIELD**

STACKER RECLAIMER

PLAN & SECTIONS TYP OPTION 2

| DESIGN | DRAWN | CHECK Dwg. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | G.S. | | | | | | MARCH 1981 | | |

| DESIGN | DRAWN | CHECK Dwg. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|

| REFERENCE | NO. | DWG. NO. |
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| REFERENCE | NO. | DWG. NO. |
|---|---|---|

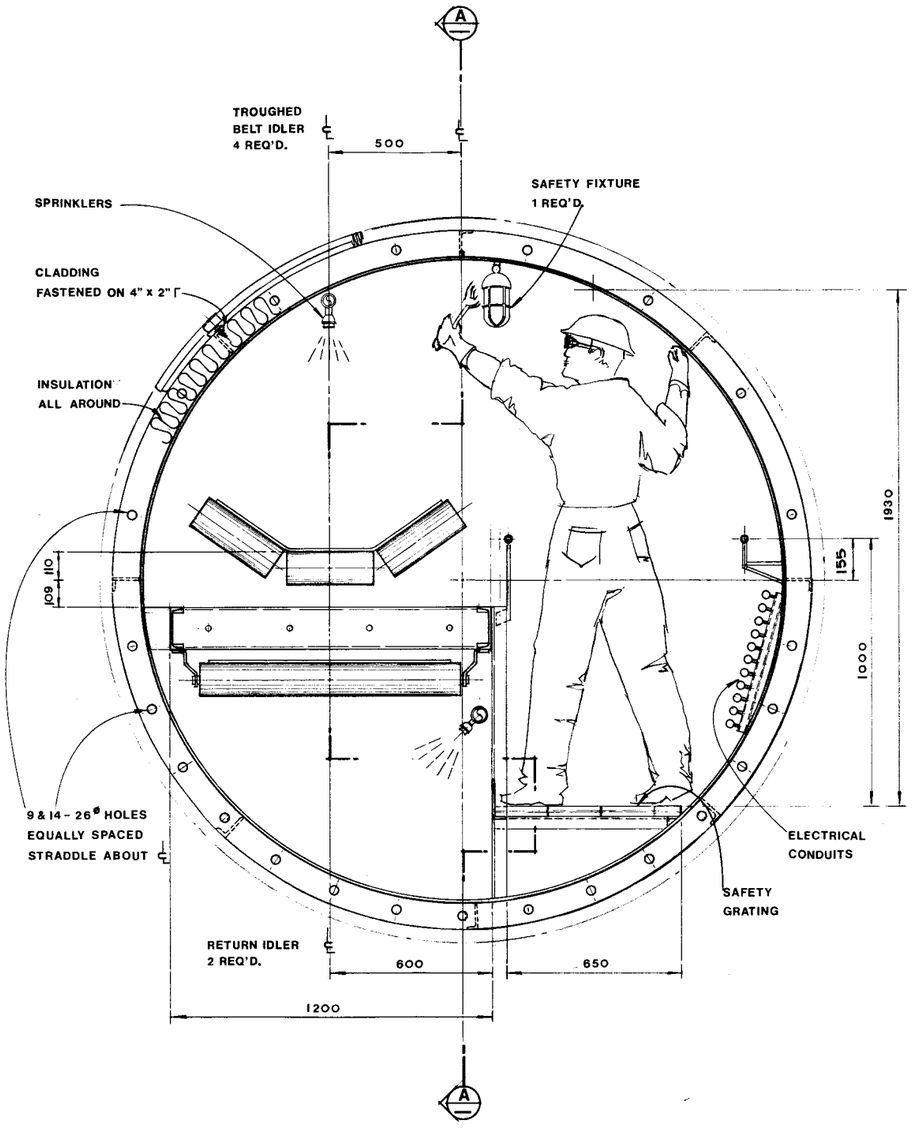
SCALE: A.N.

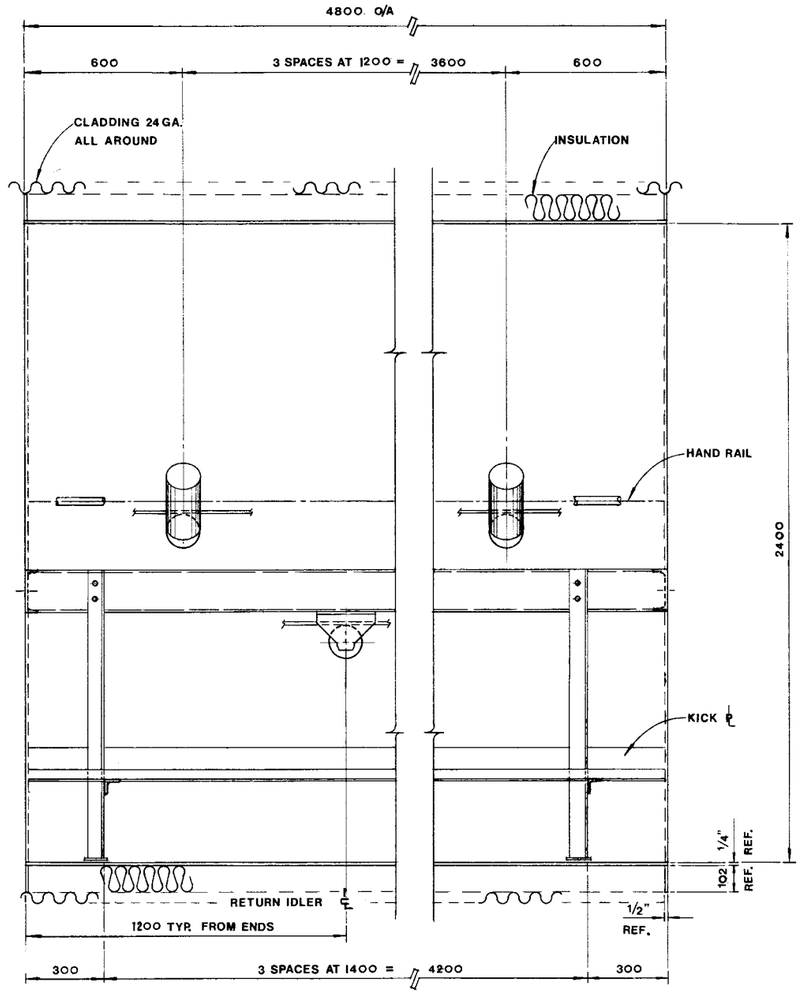
WRIGHT ENGINEERS LIMITED

VANCOUVER CANADA

DWG. NO. D 1098 104 1206

G.C. 4180




SECTION A

Scale : millimeter

0 200 400 600

**PAN OCEAN OIL LTD.**
**CALGARY ALTA.**

**ILLTYD CREEK DEPOSIT**
**BONNET PLUME COALFIELD**
TUBULAR CONVEYOR GALLERY
PRELIMINARY CONCEPT

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| K.R.L.M. | | | | | | | MARCH 1981 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|

| REFERENCE | NO. | DWG. NO. |
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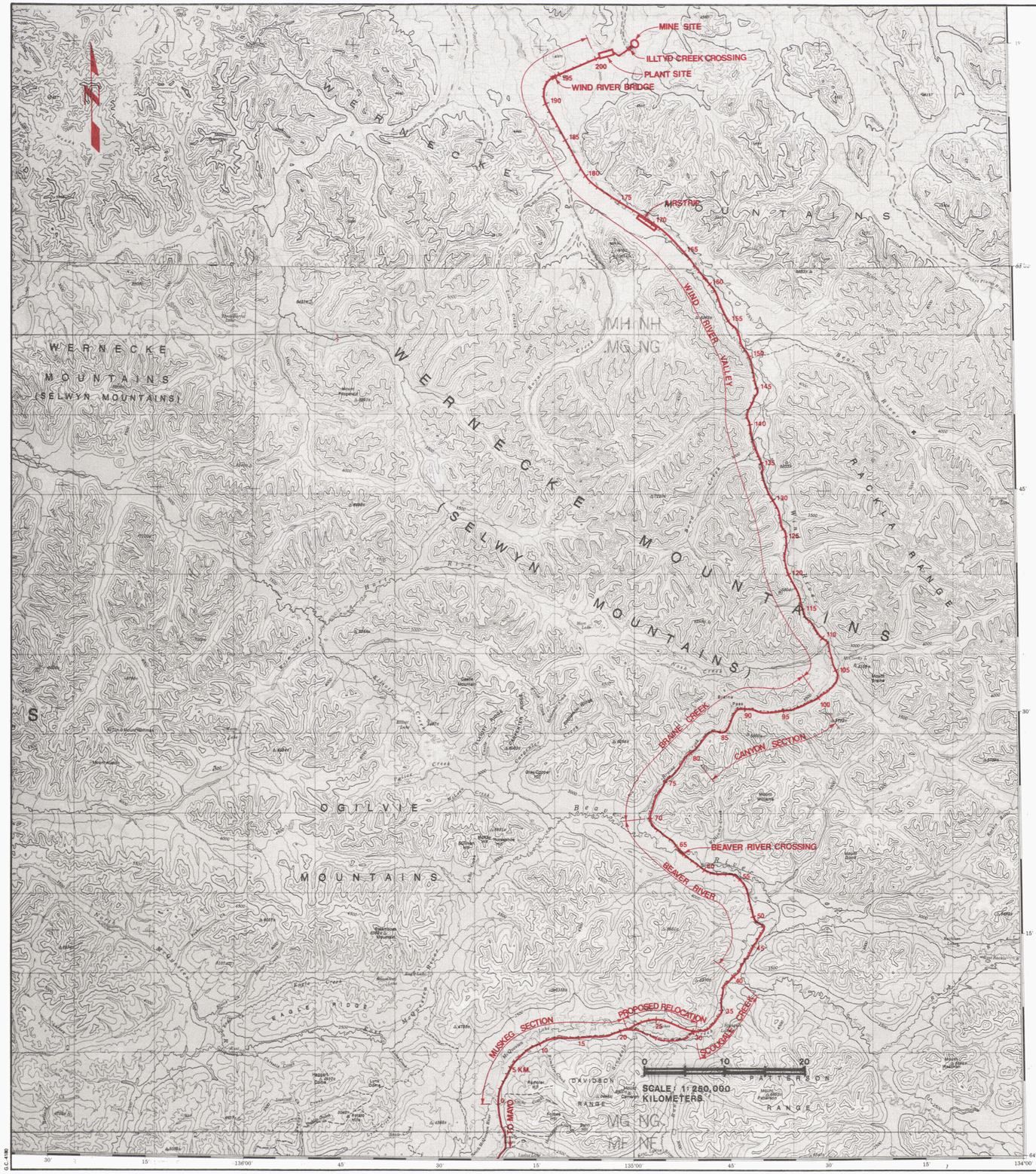
| REFERENCE | NO. | DWG. NO. |
|---|---|---|

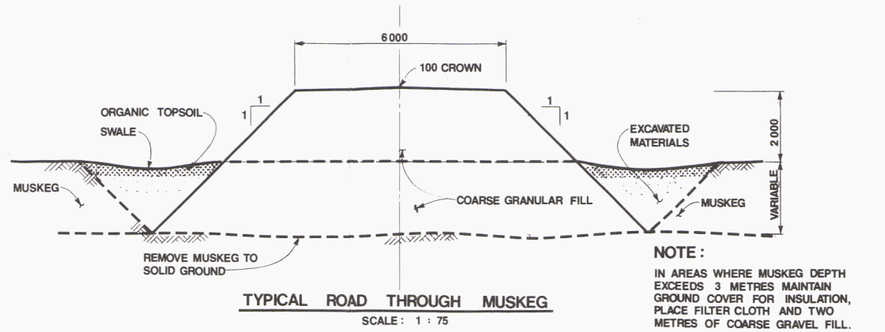
SCALE: 1:10

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 104 1207

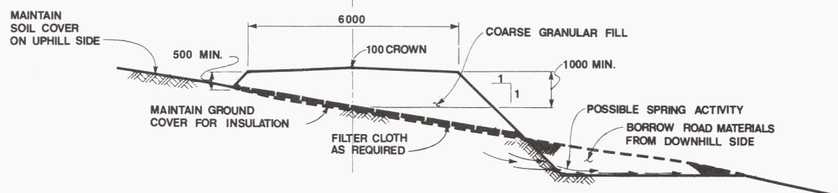
0.C.-4180



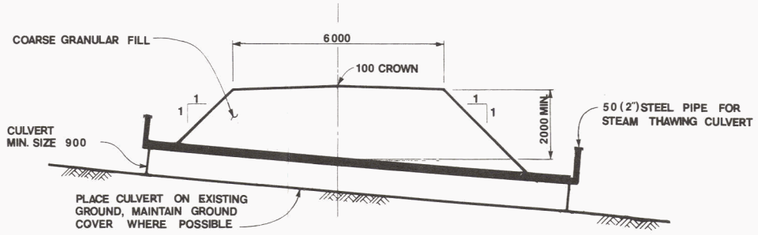




TYPICAL ROAD THROUGH MUSKEG
SCALE: 1 : 75

**NOTE:**
IN AREAS WHERE MUSKEG DEPTH EXCEEDS 3 METRES MAINTAIN GROUND COVER FOR INSULATION, PLACE FILTER CLOTH AND TWO METRES OF COARSE GRAVEL FILL.




TYPICAL SIDEHILL ROAD
SCALE: 1 : 75




TYPICAL CULVERT INSTALLATION
SCALE: 1 : 75

Scale: meters
0 1 2 3 4 5 6

| REFERENCE | No. | Dwg. No. |
|---|---|---|
| | | |

| REFERENCE | No. | Dwg. No. |
|---|---|---|
| | | |

SCALE: AS SHOWN

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK - DEPOSIT 'B'
BONNET PLUME COALFIELD
MAYO ACCESS ROAD PLAN

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1098 108 1201

# ILLTYD CREEK DEPOSIT

## SURFACE FACILITIES AND PRODUCTION SCHEDULE

500,000 TONNES / YR. 15% ASH

PROJECT APPROVAL

| DESCRIPTION | 1 YR. | | | | 2 | | | | 3 | | | | 4 | | | | 5 | | | | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q | 1Q | 2Q | 3Q | 4Q | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ENGINEERING & CONSTRUCTION MANAGEMENT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PROCUREMENT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ACCESS ROADWAY FROM MAYO | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| AIRSTRIP | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MOBILIZATION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SITE PREPARATION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SURFACE FACILITIES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| LIVING ACCOMODATIONS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DRY, OFFICE & MAINTENANCE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| COLD STORAGE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PREPARATION FACILITIES | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| COAL STORAGE SYSTEM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| WATER & SEWAGE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| POWER SUPPLY | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| POWER DISTRIBUTION | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ILLTYD CREEK CULVERT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ACCESS TO MINE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SURFACE ROADWAYS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CONVEYOR MINE TO PREP. PLANT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SITE PREPARATION AT PORTALS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PORTALS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| MAIN FANS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BUILDINGS AT PORTALS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DEVELOPMENT NO. 1 SEAM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PRODUCTION NO.1 SEAM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| DEVELOPMENT NO. 2 SEAM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PRODUCTION NO. 2 SEAM | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| THERMAL PLANT | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

FULL PRODUCTION

NO.1 SEAM ONLY

NO. 1 & NO 2 SEAMS

NO 2 SEAM ONLY

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

SURFACE FACILITIES AND
PRODUCTION SCHEDULE
500,000 TONNES / YEAR

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | JVD | | | | MS | | MARCH 1981 | | |

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
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| REFERENCE | No. | DWG. No. |
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| REFERENCE | No. | DWG. No. |
|---|---|---|
| | | |

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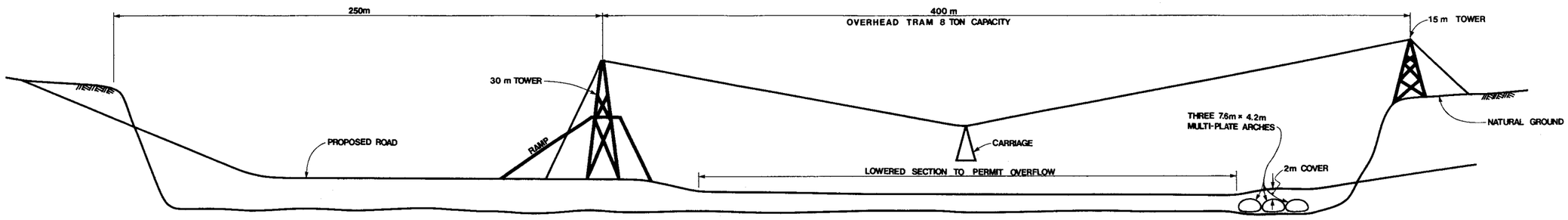
WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1098 102 1202

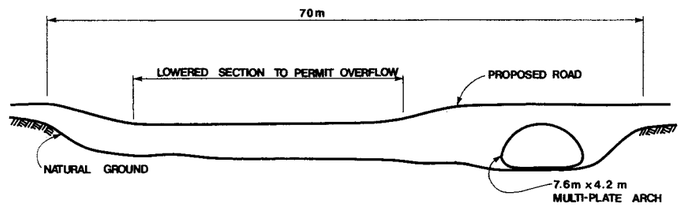
G.C. 4180



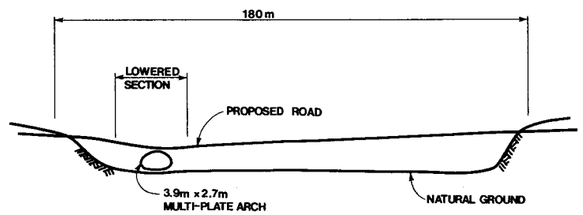

WIND RIVER CROSSING
FUTURE BRIDGE



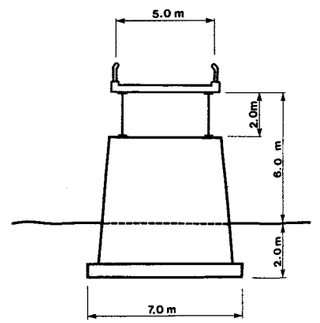

WIND RIVER CROSSING
ARCH CULVERTS AND OVERHEAD TRAM



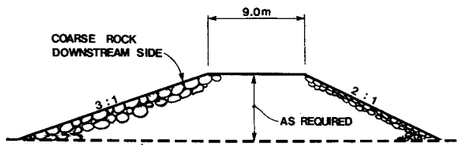

BEAVER RIVER CROSSING




ILLTYD CREEK CROSSING




WIND RIVER BRIDGE - SECTION




TYPICAL FILL SECTION

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| DNL | MK | | DNL | | | | MAR. 81 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|

| REFERENCE | No. | Dwg. No. |
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| REFERENCE | No. | Dwg. No. |
|---|---|---|

SCALE: N.T.S.

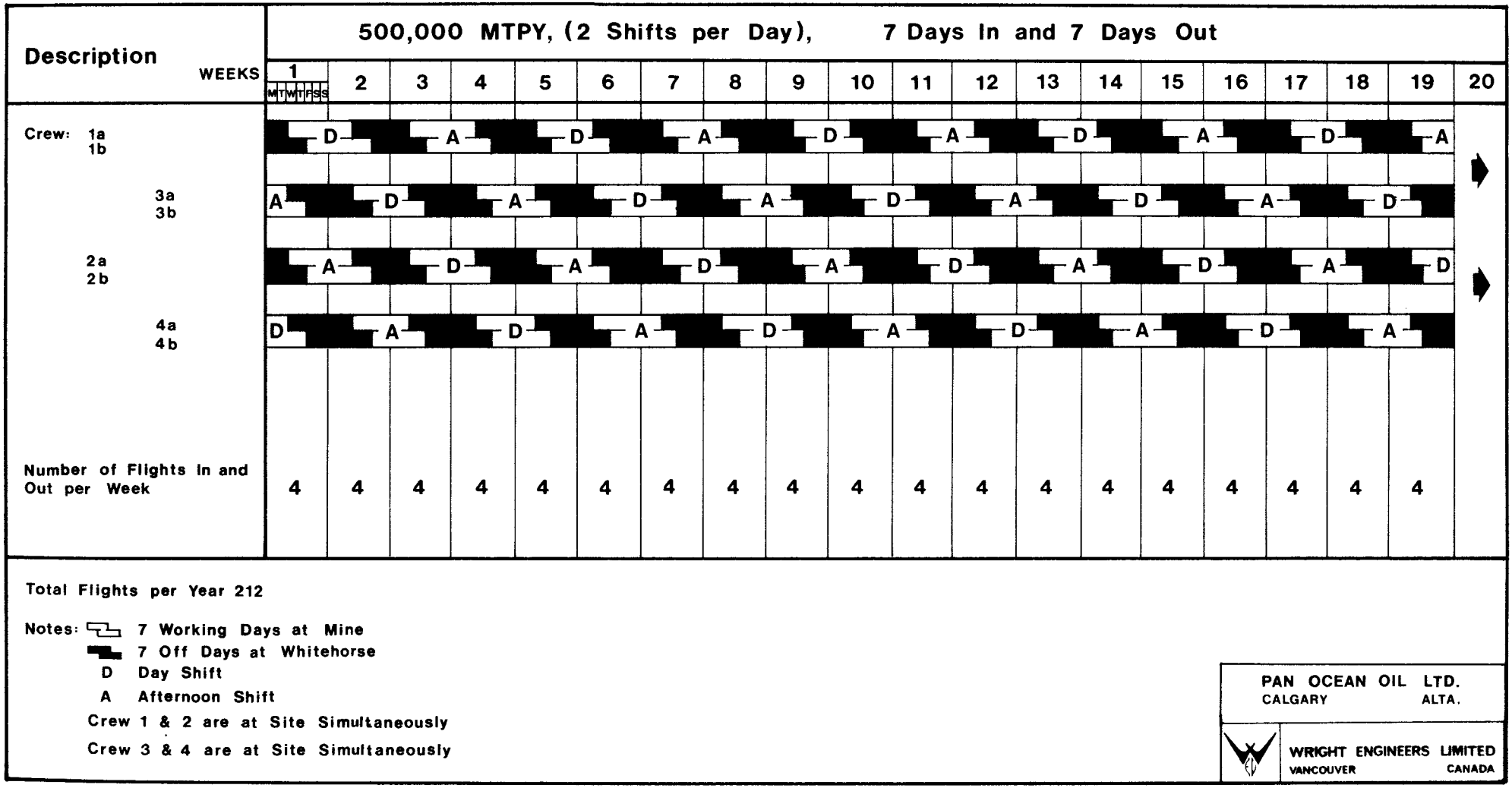
**PAN OCEAN OIL LTD.**
CALGARY ALTA.

**ILLTYD CREEK DEPOSIT**
**BONNET PLUME COALFIELD**
ACCESS ROAD BRIDGES

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

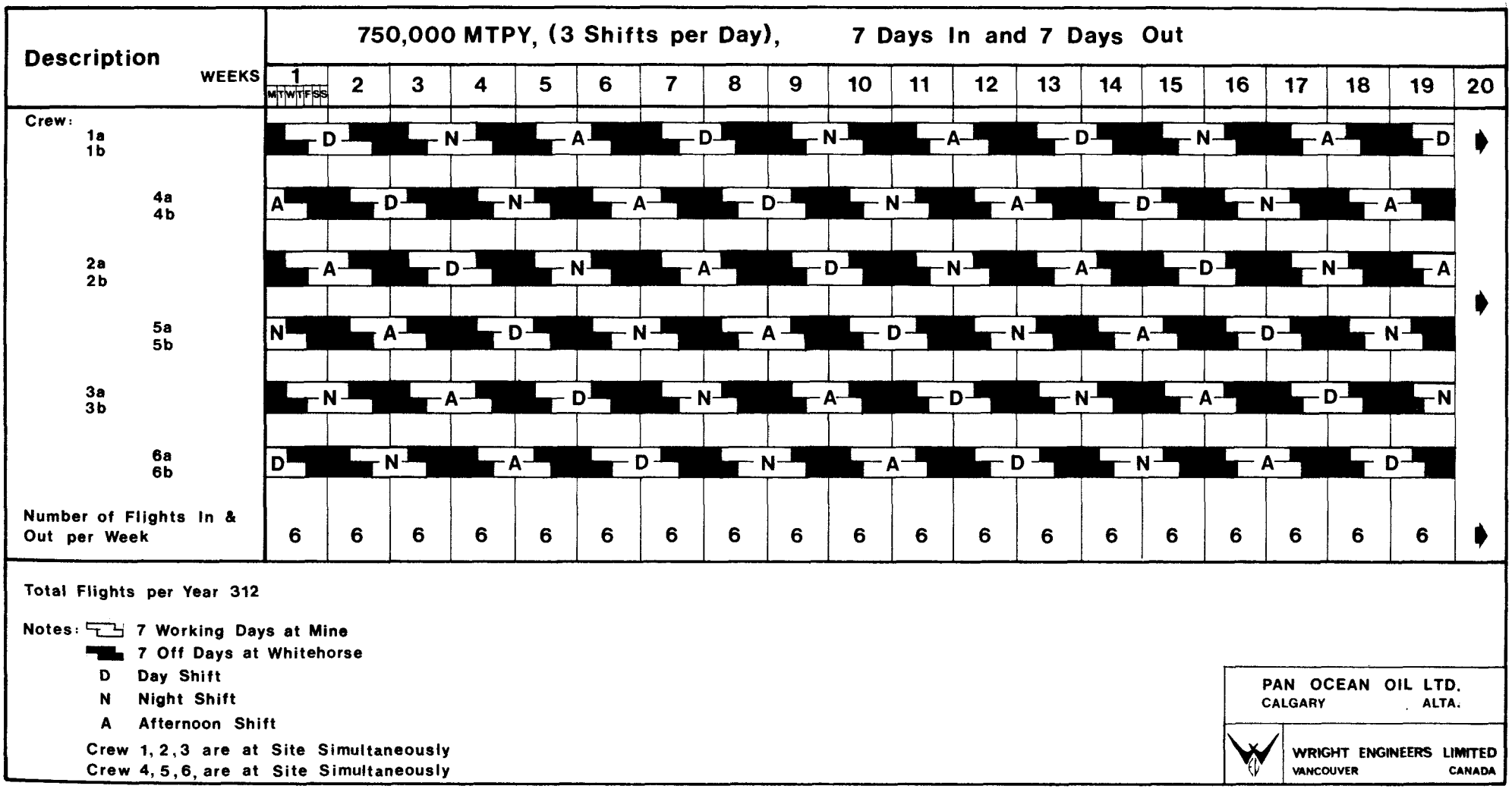
DWG. No. D 1098 108 1203

GC 4180



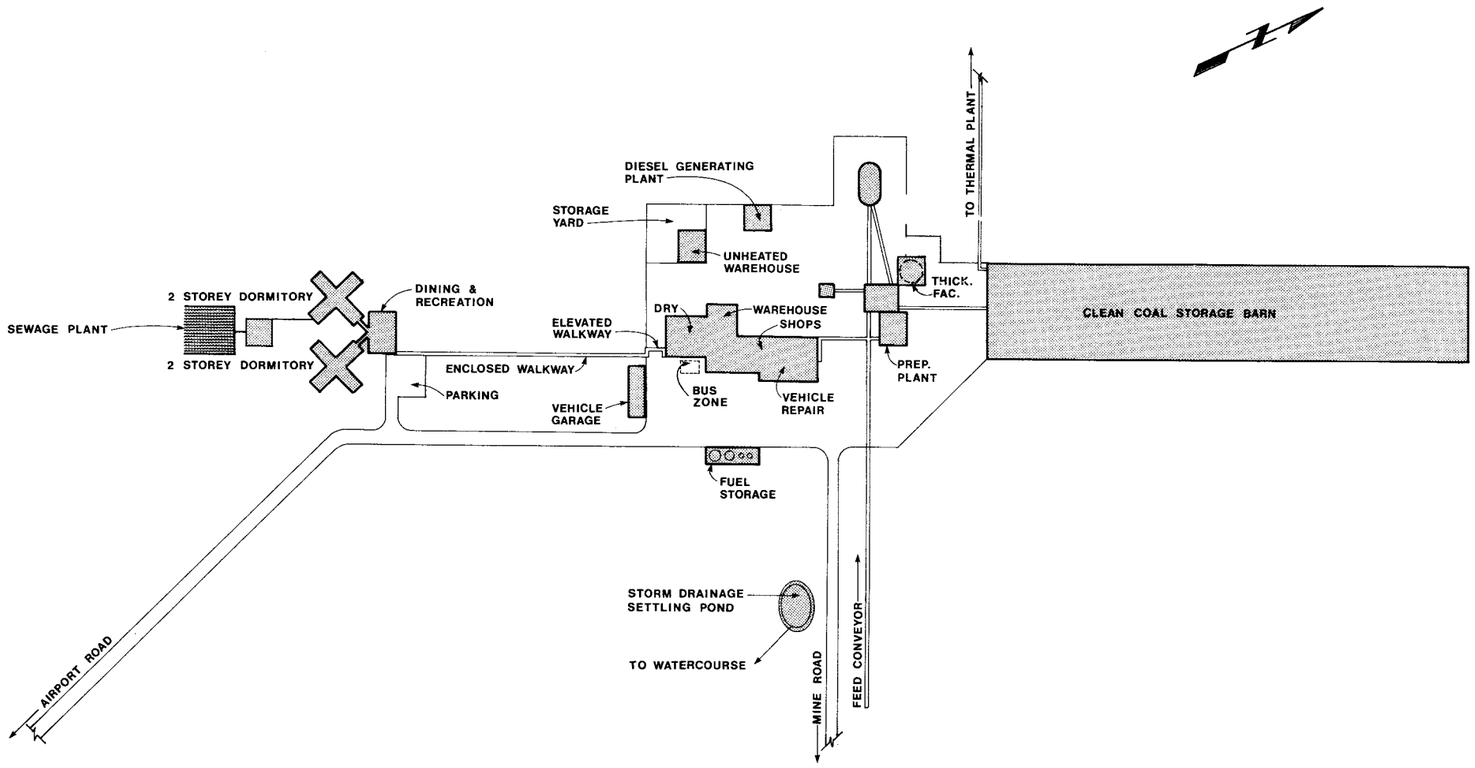

## MANPOWER FLY IN and FLY OUT SCHEDULE

Drawing No. 1098 108 1204




## MANPOWER FLY IN and FLY OUT SCHEDULE

Drawing No. 1098 108 1205




Scale : meters

0 25 50 75 100

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

# PLANTSITE
# PRELIMINARY LAYOUT

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| JGM | S.Z. | | | | LJS | | MAR/81 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
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| REFERENCE | No. | Dwg. No. |
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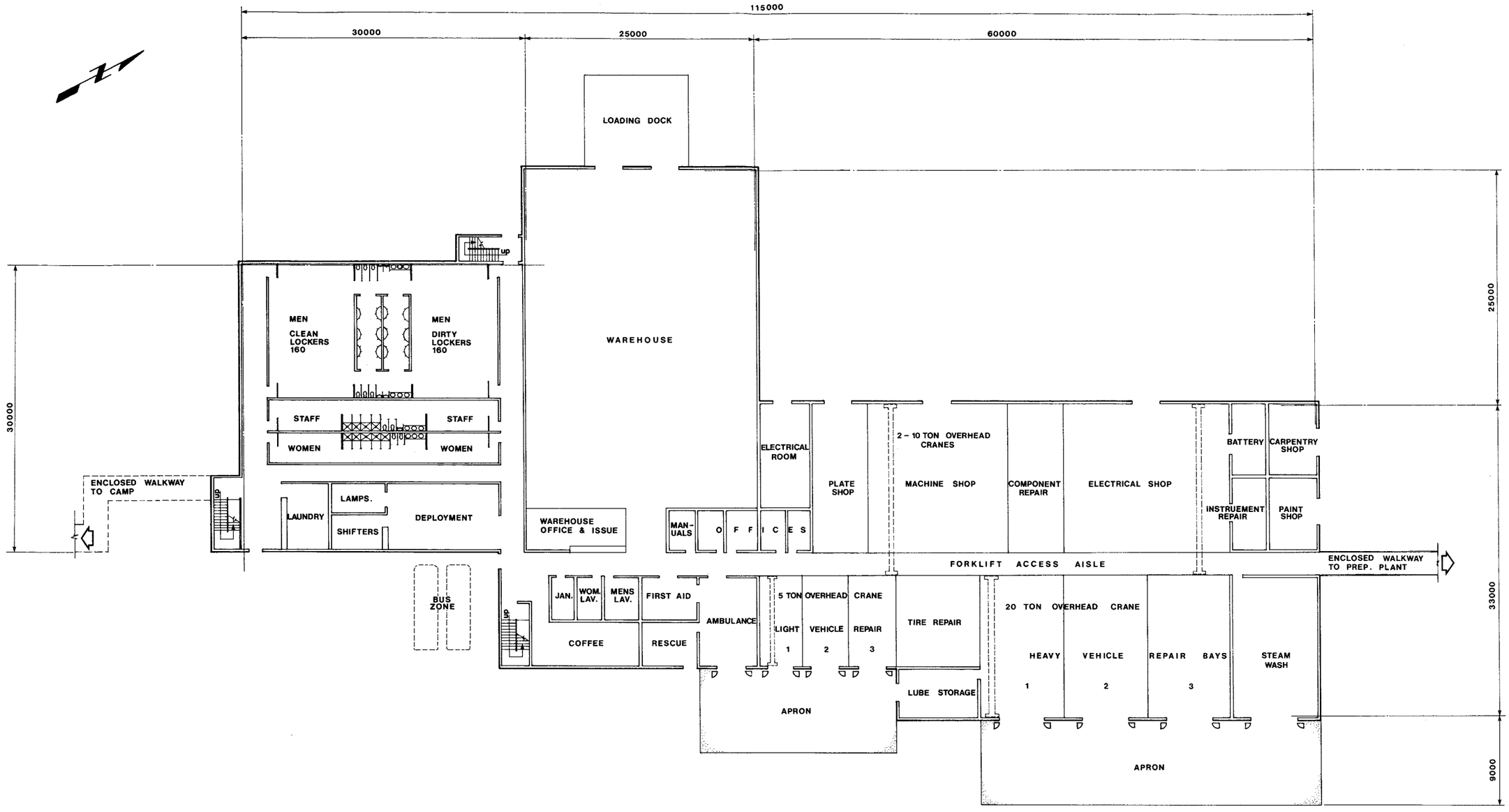
| REFERENCE | No. | Dwg. No. |
|---|---|---|
| | | |

SCALE: 1 : 2000

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. No. D 1098 110 1201

GE 4186




Scale : millimeters

0 500 1000

**PAN OCEAN OIL LTD.**
CALGARY ALBERTA

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

# SERVICES BUILDING PRELIMINARY GROUND FLOOR PLAN

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | B.T. | | | | | | | | |

| DESIGN | DRAWN | CHECK: DWG. | CHECK: DESIGN | APPROVAL: DIVISION | APPROVAL: PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
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| REFERENCE | NO. | DWG. NO. |
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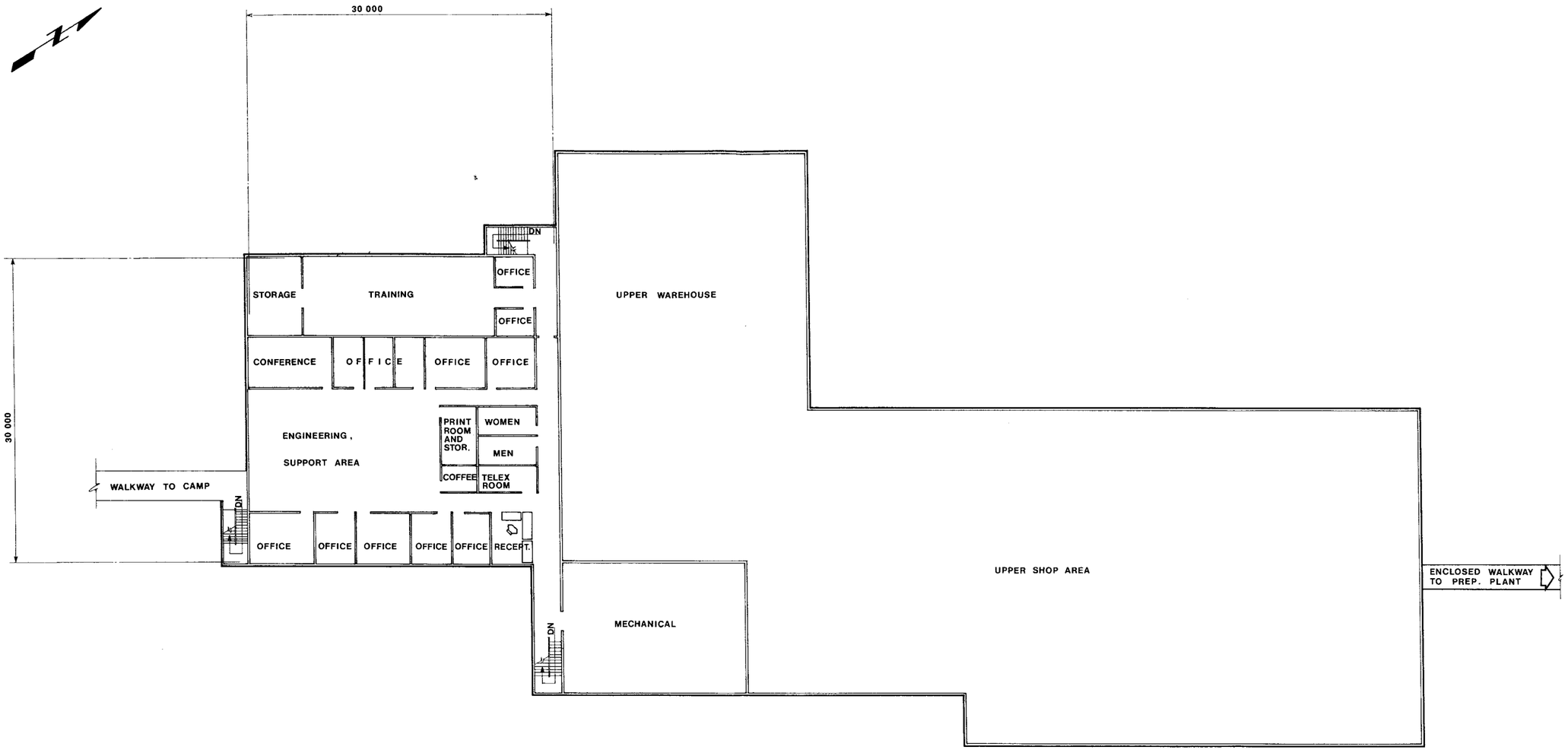
| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

SCALE: 1 : 200

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 110 1202

G.C. 4180




Scale: millimeters

0 4000 8000

2000 6000 10 000

# PAN OCEAN OIL LTD.

CALGARY ALTA.

ILLTYD CREEK DEPOSIT

BONNET PLUME COALFIELD

## SERVICES BUILDING
## PRELIM. SECOND FLOOR PLAN

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | B.T. | | | | | | JUNE/81 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
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| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

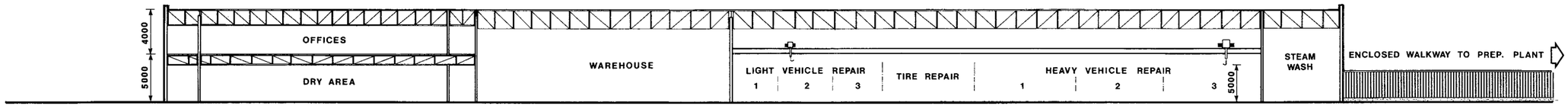
SCALE: 1 : 200

WRIGHT ENGINEERS LIMITED

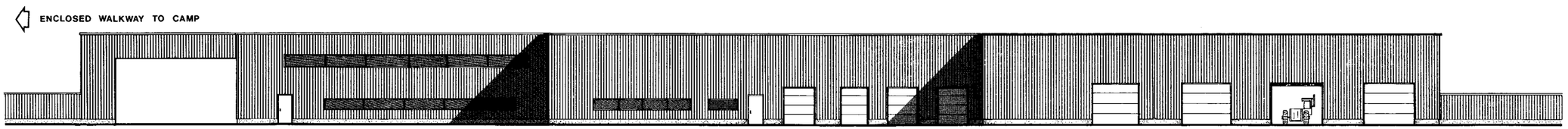
VANCOUVER CANADA

DWG. NO. D 1098 110 1203

GC 4180




## TYPICAL SECTION




## EAST ELEVATION

Scale: millimeters

0 4000 8000

2000 6000 10000

**PAN OCEAN OIL LTD.**
CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

**SERVICES BUILDING**
**PRELIMINARY SECTION & ELEVATION**

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | ET | | | | | | NOV/82 | | |

| DESIGN | DRAWN | CHECK DWG. | CHECK DESIGN | APPROVAL DIVISION | APPROVAL PROJECT | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | |

| REFERENCE | NO. | DWG. NO. |
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| | | |

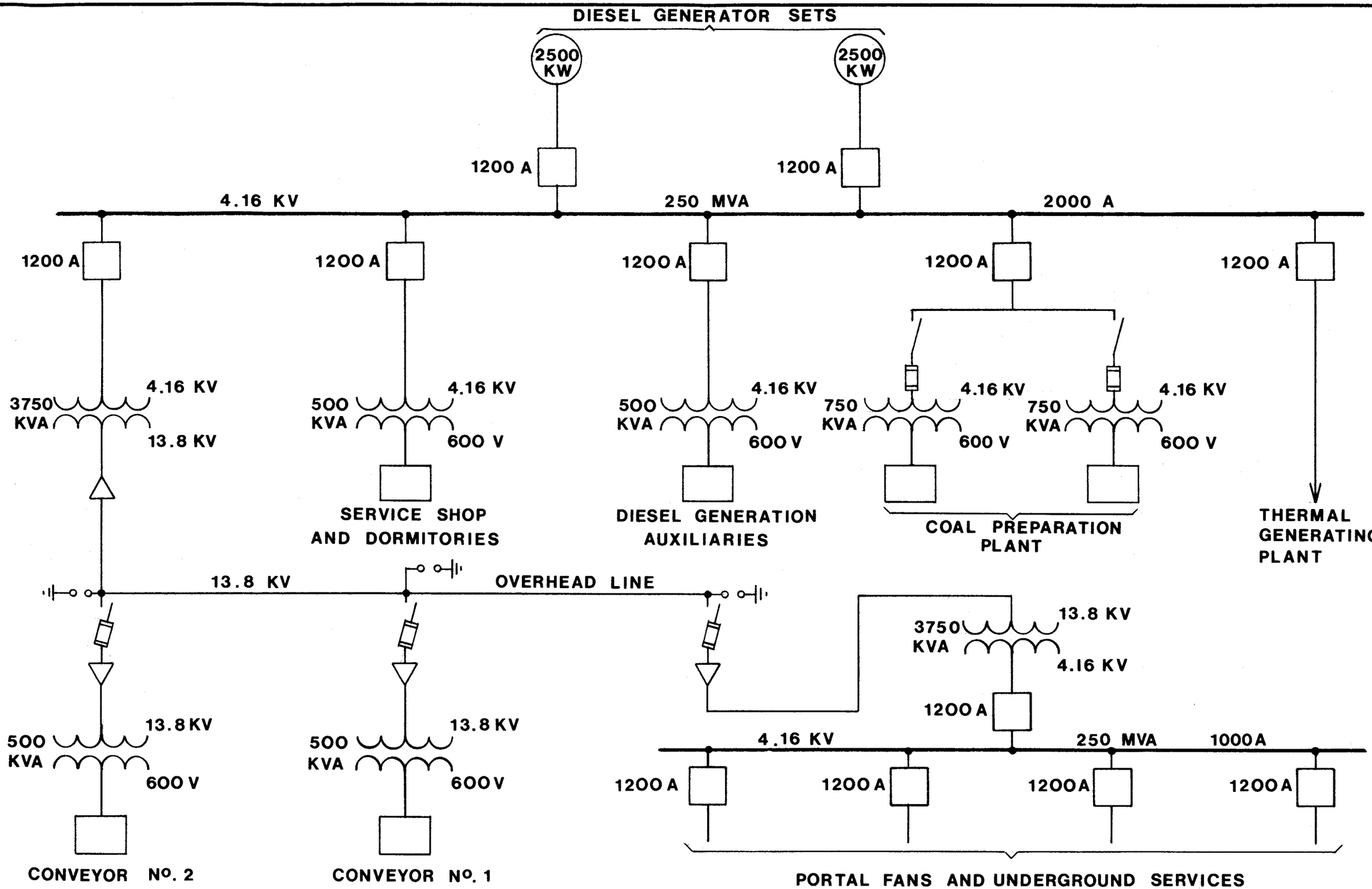
| REFERENCE | NO. | DWG. NO. |
|---|---|---|
| | | |

SCALE: 1 : 200

WRIGHT ENGINEERS LIMITED
VANCOUVER CANADA

DWG. NO. D 1098 110 1204

G.C. 4180




| DSGN. | DRAWN | CHECK | APPR. | ISSUED FOR | DATE | REV. | DESCRIPTION OF REVISION |
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CALGARY ALTA.

ILLTYD CREEK DEPOSIT
BONNET PLUME COALFIELD

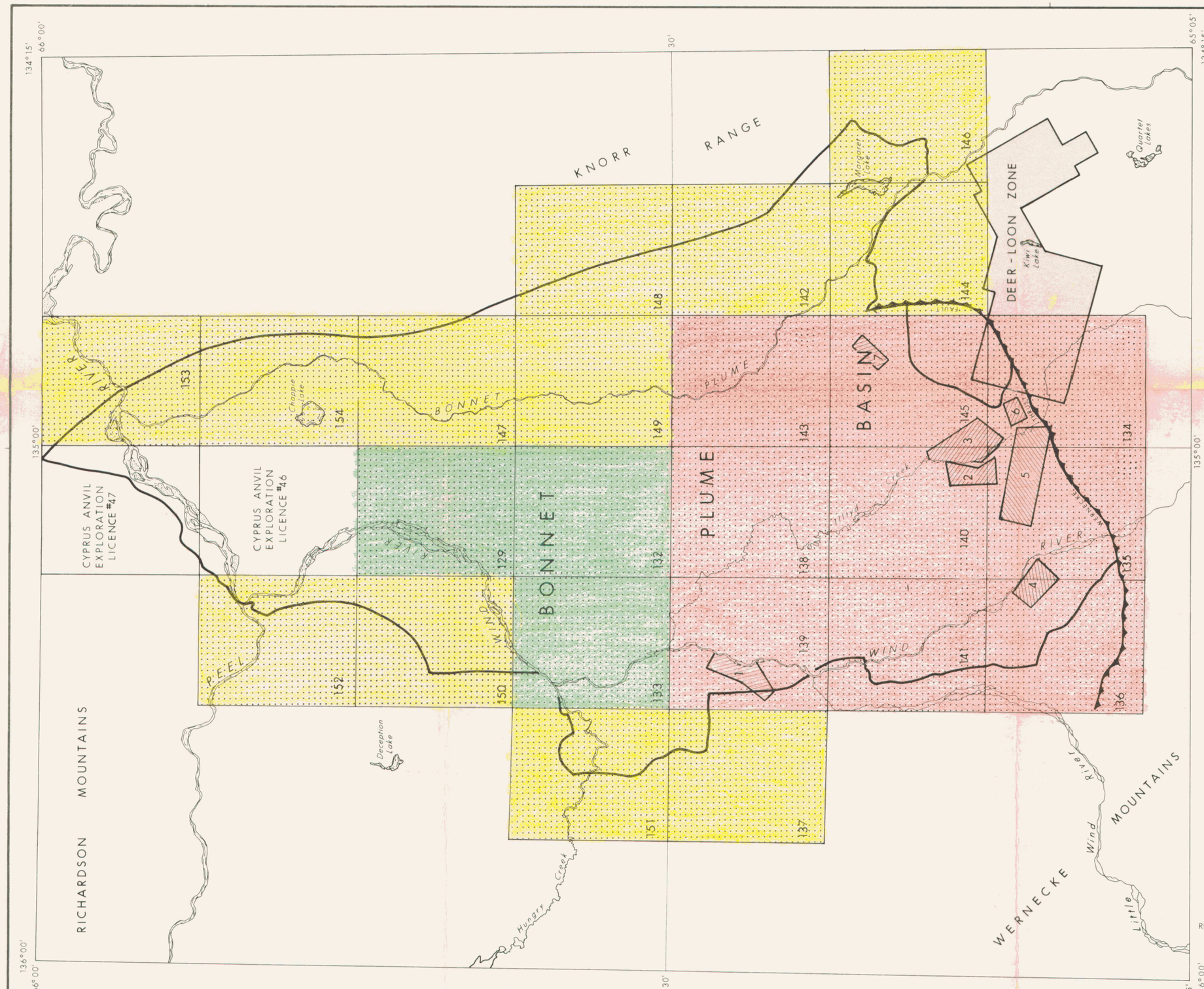
SURFACE ELECTRICAL
ONE - LINE DIAGRAM

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SCALE: N.A.

DRAWING No. B 1098 110 1205

REV.




GROUP I
GROUP II
GROUP III

Figure 1

## COAL OCCURRENCES

1 - WIND RIVER
2 - WEST ILLTYD
3 - ILLTYD
4 - AIRSTRIP
5 - WERNECKE
6 - SPACESHIP
7 - GARLIC RING

### SYMBOLS

COAL OCCURRENCES
BONNET PLUME BASIN BOUNDARY
COAL EXPLORATION LICENCE NO.
141 COAL EXPLORATION LICENCE NO.

km 5 0 5 10 15 km

REISSUED JAN., 1981

TO ACCOMPANY REPORT NO. 4-81 BY O.R.C.

REVISED SEPTEMBER, 1980 GEW

**PAN OCEAN OIL LTD.**
CALGARY ALBERTA

# COAL OCCURRENCES OF THE BONNET PLUME BASIN

YUKON TERRITORY

| DATE | SCALE | NTS | DRAWING NO. |
|---|---|---|---|
| LB/NOV., '77 | 1: 250,000 | 106 E | C-0069 |