GR-Sustut 80(1)A

GULF CANADA RESOURCES INC.

SUSTUT COAL PROJECT GEOLOGICAL REPORT

1980

COAL LICENCE NUMBERS 5469 TO 5483 INCLUSIVE

CASSIAR LAND DISTRICT

NTS MAP NO. 94 D

LATITUDES BETWEEN 56° 28' AND 56° 34'

LONGITUDES BETWEEN 126° 52' AND 127° 02'

GULF CANADA RESOURCES INC.

- and -

J. MATTHEW DUFORD

CONSULTING GEOLOGIST

NOVEMBER, 1980

SUSTUT PROJECT

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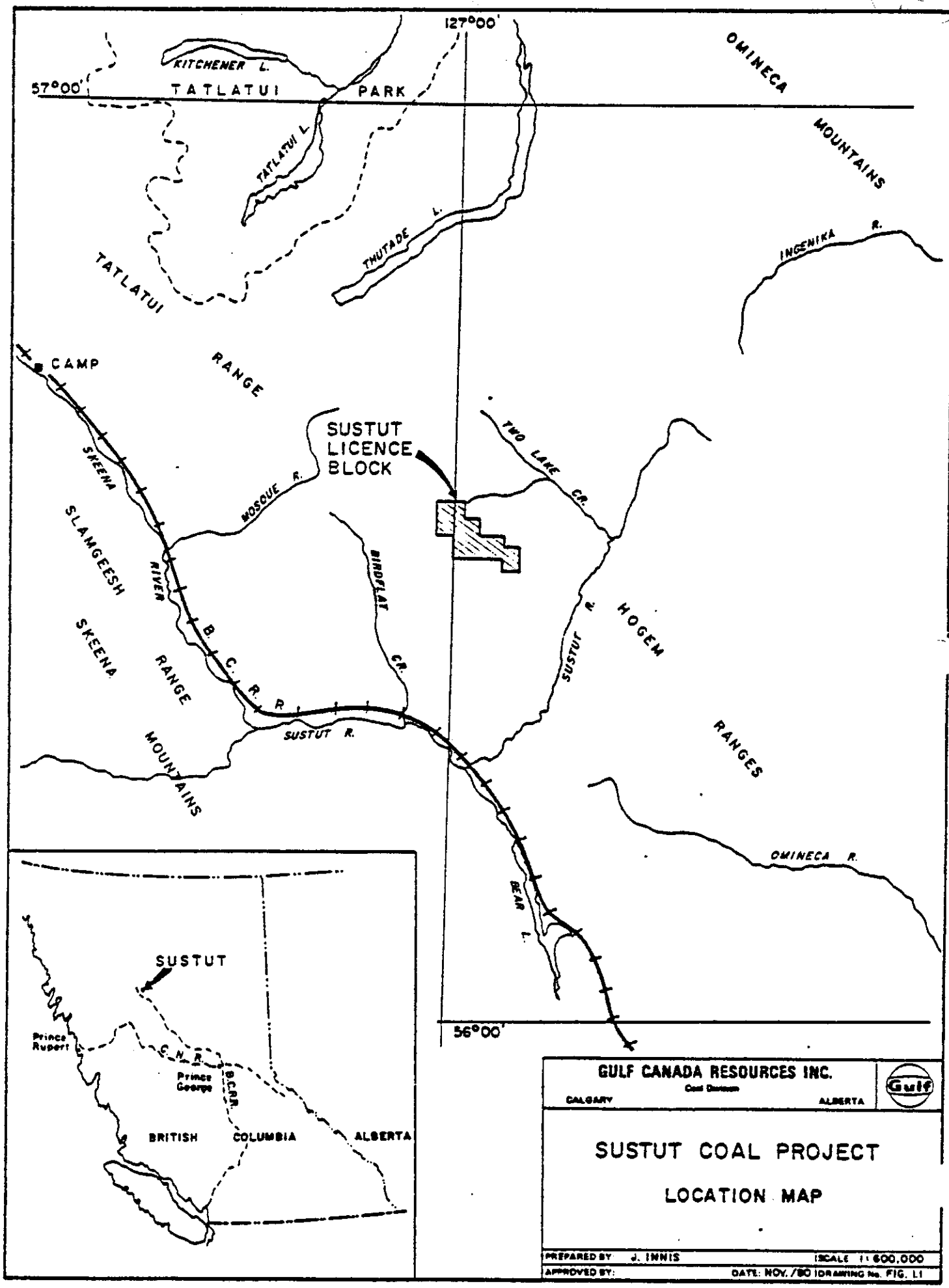
SUSTUT COAL PROJECT

1.0 SUMMARY



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT

LOCATION MAP

PREPARED BY: J. INNIS
SCALE 1:500,000
APPROVED BY:
DATE: NOV./80 DRAWING No. FIG. L1

LOCATION

THE SUSTUT COAL LICENCES ARE LOCATED IN NORTHWESTERN BRITISH COLUMBIA APPROXIMATELY 192 AIR KILOMETRES NORTH OF SMITHERS, BRITISH COLUMBIA. THE LICENCE BLOCK LIES IN THE HOGEM RANGE JUST NORTH OF THE CONFLUENCE OF THE SUSTUT AND SKEENA RIVERS.

ACCESS

THE ABANDONED PRINCE GEORGE - DEASE LAKE BRITISH COLUMBIA RAILWAY LINE WAS COMPLETED TO WITHIN 39 KILOMETRES OF THE SUSTUT LICENCE BLOCK. THE SEA PORT OF STEWART IS 195 AIR KILOMETRES TO THE WEST, BUT NO ACCESS IN THIS DIRECTION PRESENTLY EXISTS.

LICENCES

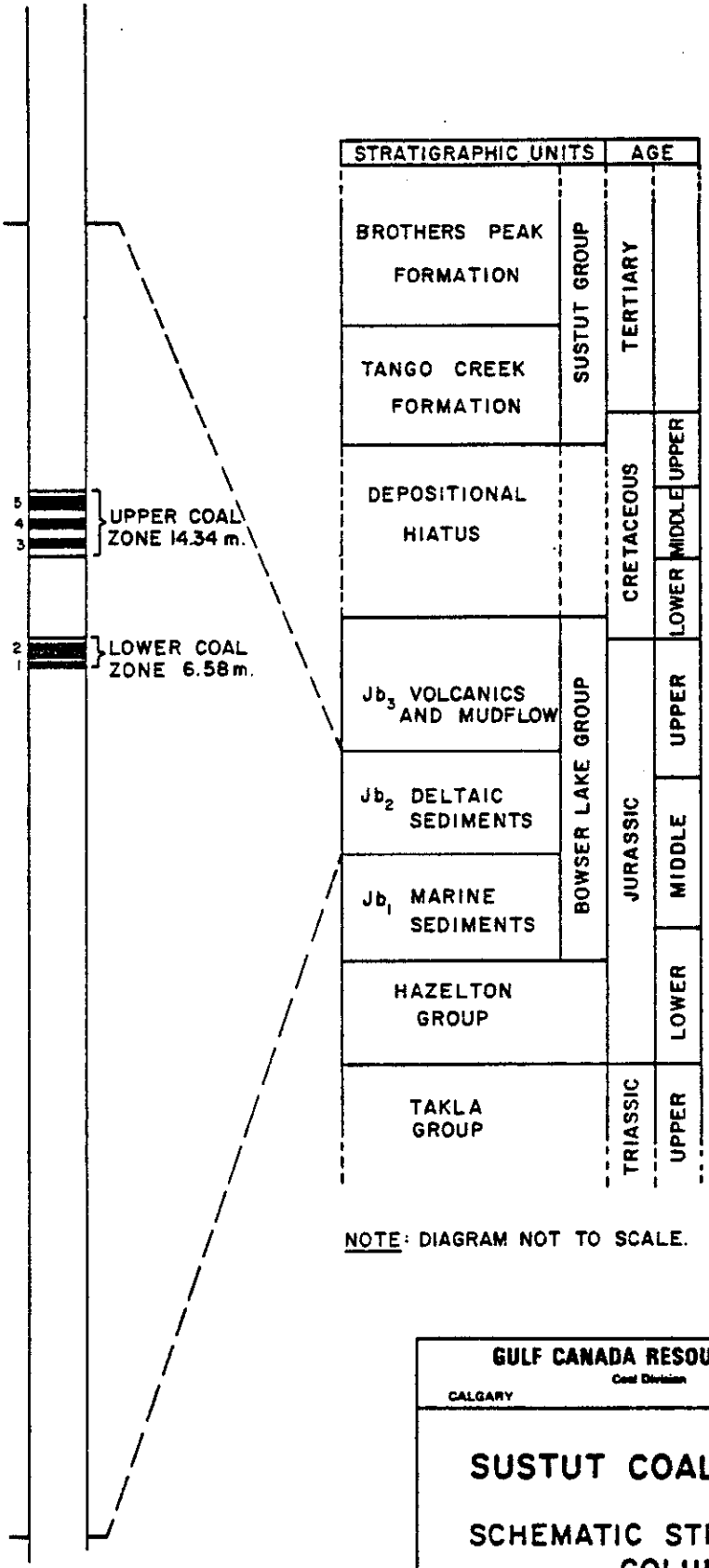
THE SUSTUT LICENCE BLOCK CONTAINS 15 LICENCES COMPRISING 4 290 HECTARES.

OWNERSHIP

GULF CANADA RESOURCES INC. HOLDS 100% INTEREST IN THE SUSTUT LICENCES, WHICH WERE ACQUIRED NOVEMBER 5, 1979.

EXPLORATION

TO DATE, INVESTIGATION OF THE SUSTUT LICENCE AREA HAS INCLUDED HELICOPTER-SUPPORTED GEOLOGICAL MAPPING OF THE ENTIRE AREA ON A 1:10 000 SCALE, HAND TRENCHING OF ALL SEAMS DISCOVERED IN EXCESS OF 0.5 METRES IN THICKNESS, AND ANALYSIS OF SAMPLES TAKEN FROM THE TRENCHES.



NOTE: DIAGRAM NOT TO SCALE.

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT

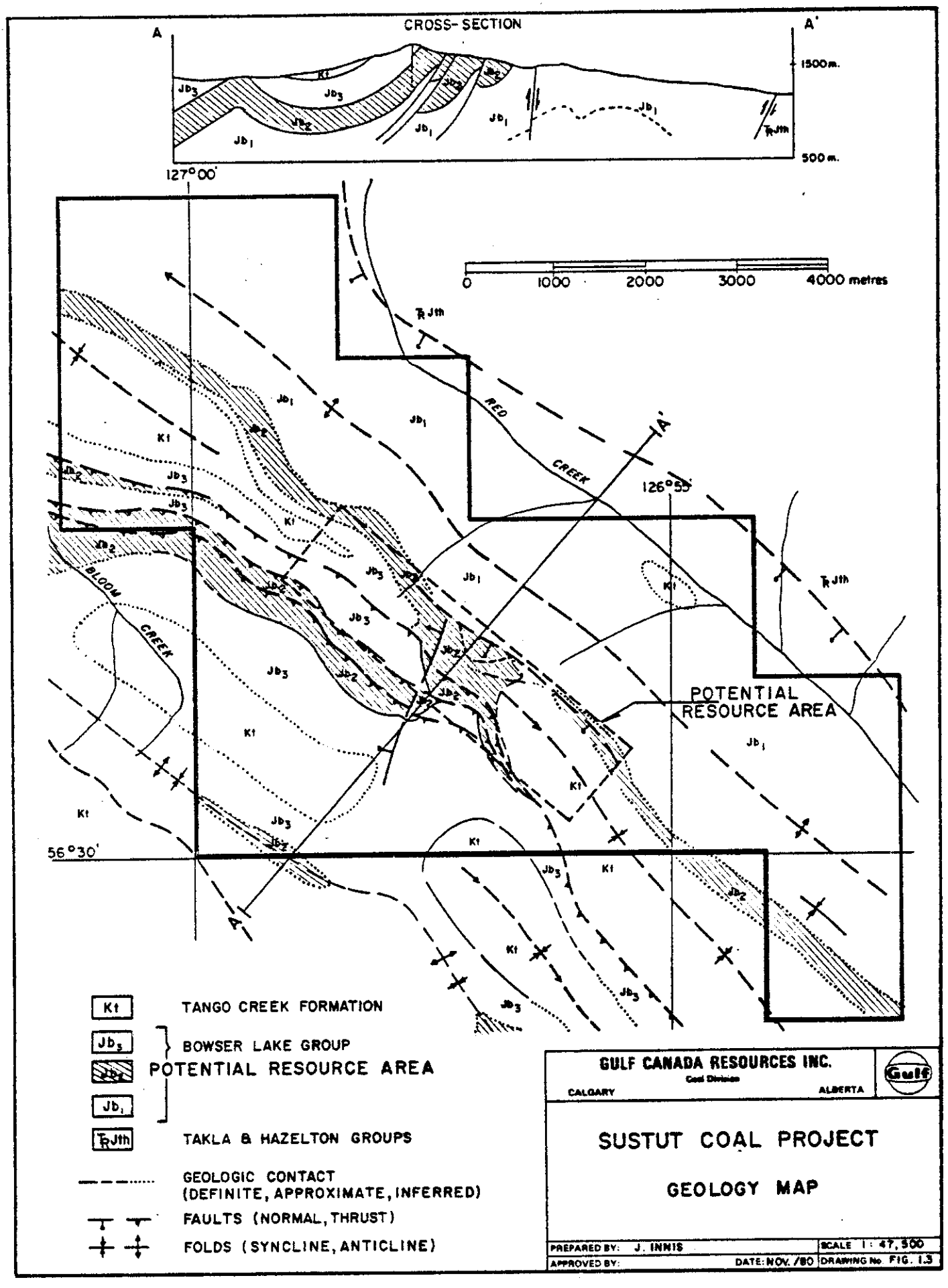
SCHEMATIC STRATIGRAPHIC COLUMN

PREPARED BY: J. INNIS
SCALE N.T.S.
APPROVED BY:
DATE: DEC. 80
DRAWING No. FIG. 1.2

GEOLOGY

THE SUSTUT LICENCE AREA IS UNDERLAIN BY THE UPPER JURASSIC -LOWER CRETACEOUS BOWSER LAKE GROUP. THE BOWSER LAKE GROUP WAS FIELD SUBDIVIDED INTO 3 UNNAMED SUBUNITS: A LOWER MARINE SEQUENCE, A MIDDLE DELTAIC SEQUENCE CONTAINING COAL AND AN UPPER MUDFLOW SEQUENCE CLOSELY ASSOCIATED WITH VOLCANICS.

SHALY COAL OCCURS IN 5 SEAMS IN TWO ZONES, 6.58 METRES AND 14.34 METRES THICK, IN THE SECOND SUBUNIT, AND TO DATE, HAS ONLY BEEN TRACED OVER A LIMITED AREA.


CROSS- SECTION
A
A'
1500m.
500m.
127°00'
126°55'
56°30'
0
1000
2000
3000
4000 metres
RED CREEK
BLOOM CREEK
POTENTIAL RESOURCE AREA
Kt
Jb3
Jb2
Jb1
TRJth
Kt TANGO CREEK FORMATION
Jb3
Jb2
Jb1
BOWSER LAKE GROUP
POTENTIAL RESOURCE AREA
TRJth TAKLA & HAZELTON GROUPS
GEOLOGIC CONTACT (DEFINITE, APPROXIMATE, INFERRED)
FAULTS (NORMAL, THRUST)
FOLDS (SYNCLINE, ANTICLINE)
GULF CANADA RESOURCES INC.
Coal Division
CALGARY
ALBERTA
Gulf
SUSTUT COAL PROJECT
GEOLOGY MAP
PREPARED BY: J. INNIS
SCALE 1 : 47,500
APPROVED BY:
DATE: NOV. /80
DRAWING No. FIG. 1.3

RESOURCE POTENTIAL

THE MAP OPPOSITE SHOWS THE DISTRIBUTION OF THE COAL-BEARING UNIT 2 OF THE BOWSER LAKE GROUP. THE COAL DEVELOPMENT IS CONFINED TO TWO COAL ZONES WHICH ARE MUCH MORE RESTRICTED IN LATERAL EXTENSION THAN UNIT 2 AS A WHOLE.

WHERE FULLY DEVELOPED, THE 3 SEAMS OF THE UPPER COAL ZONE COMPRISE A TOTAL OF 5.37 METRES AND THE LOWER COAL ZONE CONTAINS 2 SEAMS TOTALLING 3.95 METRES.

THE RESOURCE POTENTIAL OF THE SUSUT COAL LICENCES IS APPROXIMATELY 63 MILLION TONNES OF RAW COAL.

AVERAGE SUSTUT COAL QUALITY

RAW HEAD ANALYSIS[1]

ASH	38.24%
RESIDUAL MOISTURE	3.09%
VOLATILE MATTER	15.81%
VOLATILE MATTER (DMMF)	22.86%
FIXED CARBON	42.86%
BTU/LB	7 949
SULPHUR	0.35%
S.G.	1.73
H.G.I.	88

SIMULATED PRODUCT ANALYSIS[2]

YIELD	61.78%
ASH	18.43%
RESIDUAL MOISTURE	2.14%
VOLATILE MATTER	17.62%
VOLATILE MATTER (DMMF)	20.46%
FIXED CARBON	61.81%
BTU/LB	11 534
SULPHUR	0.50%
S.G.	1.49
H.G.I.	103

1 AVERAGE WEIGHTED BY THICKNESS OF SEAMS

2 CUT AT 1.8 SPECIFIC GRAVITY

COAL QUALITY

THE COAL IN THE SUSTUT AREA IS A LOW VOLATILE BITUMINOUS COAL. THE TABLES OPPOSITE PROVIDE THE RESULTS OF ANALYSIS ON AN AIR-DRIED BASIS OF THE RAW SUSTUT COAL AND A SIMULATED PRODUCT COAL CUT AT 1.8 SPECIFIC GRAVITY. THE FIGURES ARE AN AVERAGE OF VALUES FOR SAMPLES FROM EACH OF THE TWO COAL ZONES WEIGHTED BY THE THICKNESS OF THE SAMPLED SEAMS.

2.0 INTRODUCTION

2.1 Objectives

The objectives of the 1980 Sustut exploration program were:

a) to subdivide the sedimentary package into mappable units,

b) to determine the structural style of the area covered by the licences,

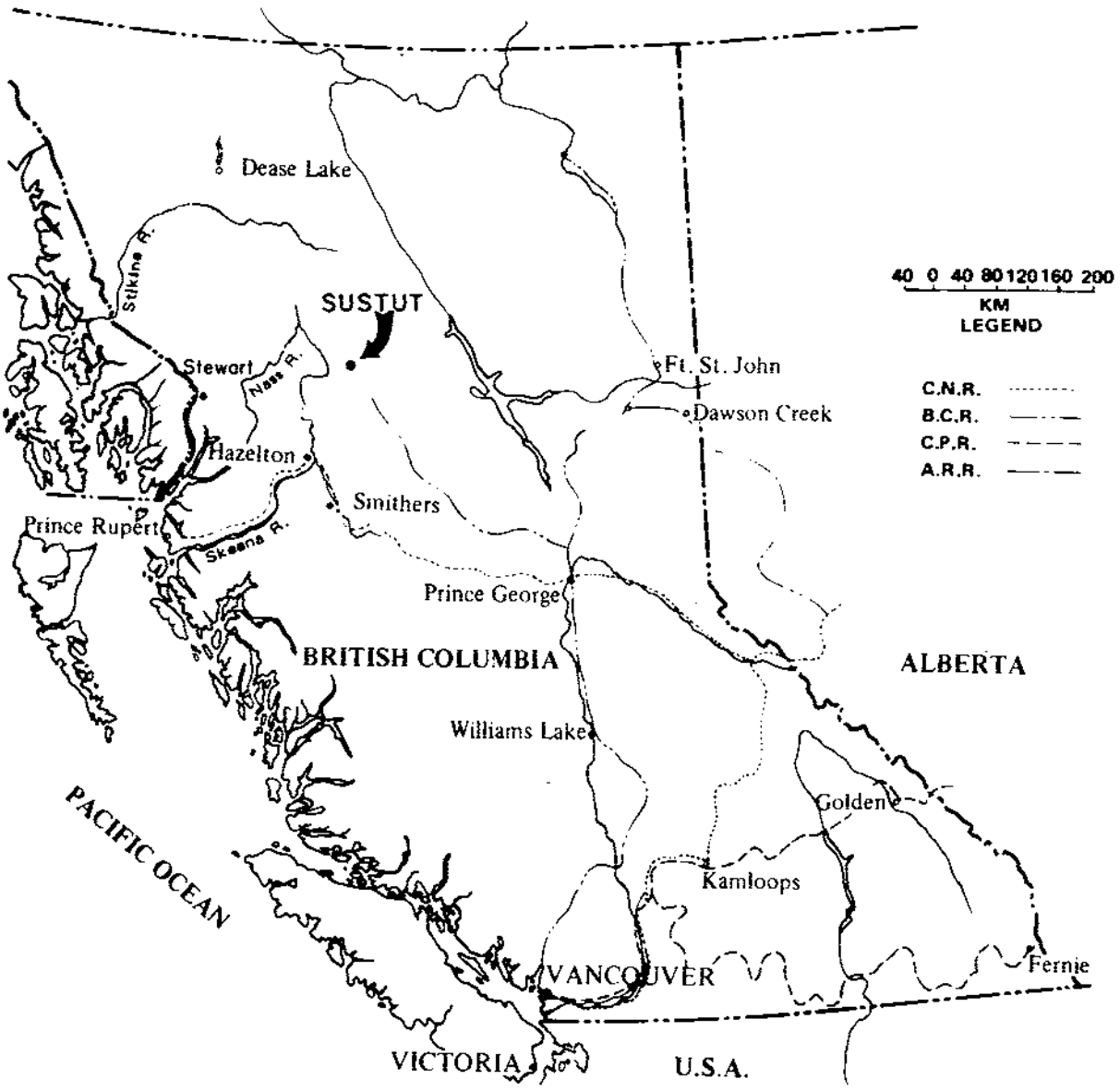
c) to locate and expose by trenching all coal seams greater than 1 metre in thickness,

d) to sample all significant coal seams for coal quality analyses and,

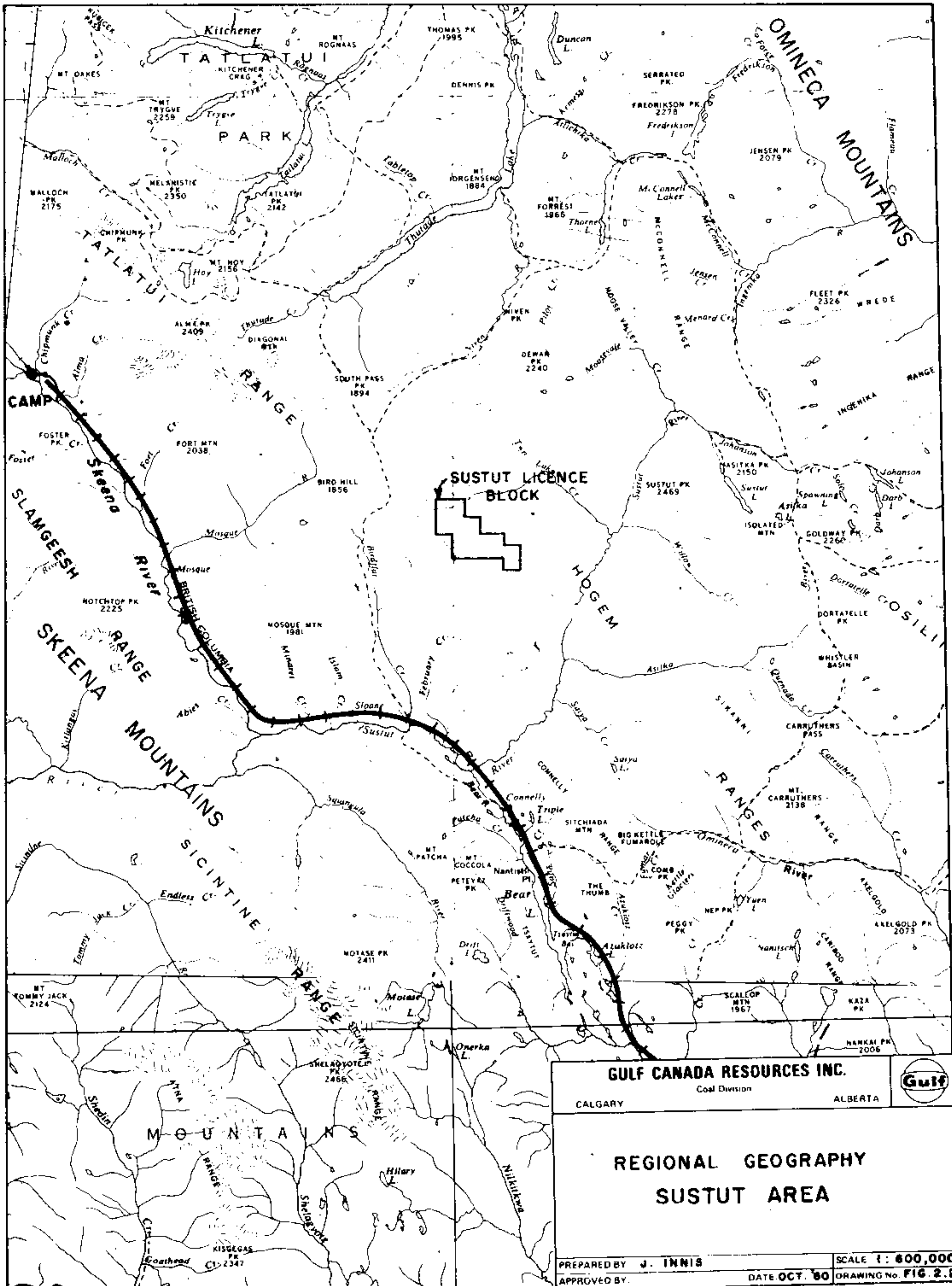
e) to delineate areas of potential surface mineable coal for future drilling.

2.2 Location

The Sustut coal licences are located between the Omineca and Skeena Mountains of northwestern British Columbia, just west of the Hogem Range (Figure 2.1 and 2.2). The area between 56° and 28' and 56° 34' North latitude and 126° 52' and 127° 02' West longitude includes all of the Sustut licences. The property is approximately 13 kilometres in length and covers a total area of 4 290 hectares (10 601 acres).



GULF CANADA RESOURCES INC. Coal Division	
CALGARY	ALBERTA
LOCATION MAP	
SUSTUT COAL PROJECT	
PREPARED BY: M. DUFORD	SCALE
APPROVED BY: DATE: OCT. '80	DRAWING No. FIG. 2.1



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

REGIONAL GEOGRAPHY
SUSTUT AREA

PREPARED BY J. INNIS
APPROVED BY.
DATE OCT. '80
SCALE 1 : 600,000
DRAWING No. FIG. 2.2

2.3 Coal Licences

The Sustut licence block consists of a total of 15 contiguous coal licences (numbers 5469 to 5483 inclusive) which are illustrated on Figure 2.3. A listing of the licences is indicated in Appendix I.

2.4 Ownership

The Sustut coal licences are wholly owned by Gulf Canada Resources Inc.

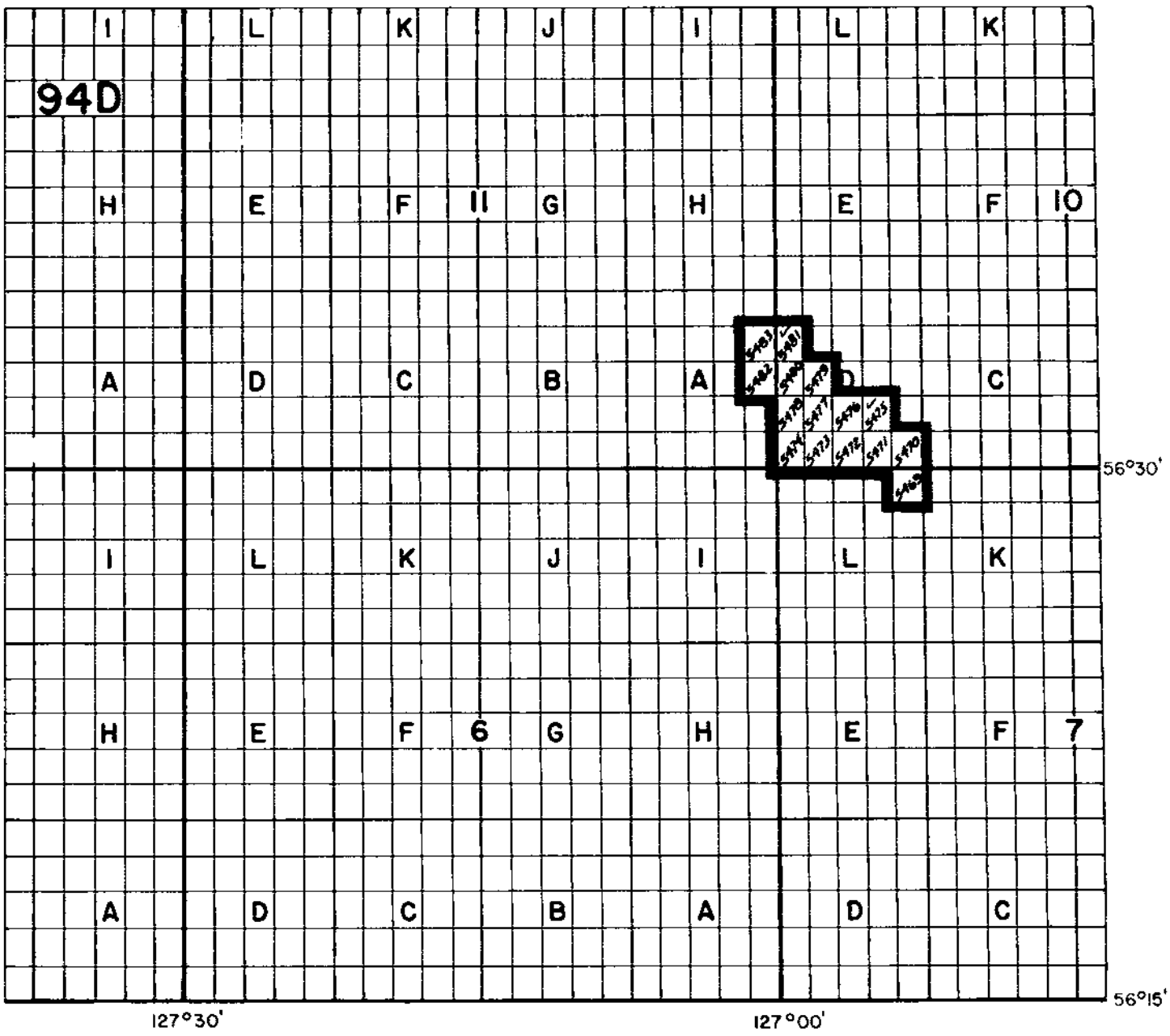
2.5 Access

At present, there are no roads providing access to the Sustut coal licences; however the abandoned British Columbia Railway line between Prince George and Dease Lake does lie within 39 kilometres of the property centre (see Figure 2.1).

The coal licences are 195 air kilometres from Stewart (population 1 357), 243 kilometres from Terrace (population 9 991), and 192 kilometres from Smithers (population 3 864).

2.6 Biophysical Environment

The Sustut licences are located within the Omineca Mountains' physiographic region. Topography follows structure and is predominantly northwest-southeast trending. Birdflat Creek, Bloom Creek and Red Creek, for



GULF CANADA RESOURCES INC. Coal Division	
CALGARY ALBERTA	Gulf
SUSTUT COAL PROJECT	
COAL LICENCES	
PREPARED BY M. DUFORD	SCALE
APPROVED BY DATE OCT. 80	DRAWING No. FIG. 2.3

the most part, follow this trend flowing to the Sustut River. The latter two creeks essentially form the licence boundary. The Sustut River and the Mosque River disect the major trend and drain into the Skeena River which flows to the Pacific. Elevations range from approximately 1 000 metres near the Sustut River to nearly 1 900 metres at the top of Sydney Ridge. The Sustut River area lies near the eastern edge of an area of abundant precipitation. Approximately half of the precipitation falls as snow. Most summers are reported as "exceptionally wet" (Buckham and Latour, 1950), with frequent days of precipitation. Daily temperatures range between 0° C and 23° C during the summer months.

The most abundant trees are alpine fir, white and black spruce, lodgepole pine, aspen, balsam poplar, and white birch. The timber line is approximately 1 520 metres above sea level with timber quite dense below 1 070 to 1 220 metres (Lord, 1948).

Game appeared plentiful with frequent sightings of moose, caribou, mountain goat, and black bear. Grizzly bears are probably present, although none were observed. Grouse and ptarmigan are abundant as are Canada geese in the late summer. Sockeye salmon, as well as spring salmon, cohoe salmon, and other game fish are reported in the Sustut and Bear rivers (Lord, 1948).

3.0 EXPLORATION

3.1 Introduction

The Sustut coal licences were applied for in June, 1979 on the basis of coal occurrences reported in the area by Lord (1948). The 1980 Sustut coal exploration program immediately followed the Panorama coal exploration program. For logistical reasons, exploration operations for the Sustut licences to the south and the Panorama licences to the north were based at one camp (see Panorama Coal Project Geological Report, 1980).

3.2 Cartography

The only government maps available for the Sustut area are at the 1:250 000 scale. However, reasonable survey control was available and pencil manuscripts were prepared from existing aerial photography by Hardy and Associates (1978) Ltd. (Appendix VII). These maps are at a scale of 1:10 000 with 10-metre contour intervals. The 1:10 000 maps cover approximately twice the licence area.

3.3 Field Camp

Field camp operations began July 17, 1980 at a site adjacent to the Chipmunk airstrip along the Skeena River. All initial supplies and equipment were flown from Smithers, British Columbia as were weekly supplies. The camp

consisted of 3, 16 x 14 foot common tents and 6 smaller personnel tents. Power for the lights and freezer was supplied by a 3.5 KW diesel generator. Camp operations ceased on September 8, 1980 at which time the majority of the camp equipment was stored at Smithers Transport in Smithers.

3.4 Geologic Mapping

The Sustut coal project utilized 3 crews, each consisting of a geologist and a geological assistant. The crews were air-supported by a Hughes 500 C helicopter. Outcrops were plotted on 1:10 000 scale map cards or 1:10 000 scale orthophotos which became available later in the program. Altimeters were used to provide elevation control. Aerial photographs were used in conjunction with the topographic maps to verify locations and outcrop patterns. All geologic information was transferred from the map cards, orthophotos and field notes to 1:10 000 scale dylar maps in the field office. The results of the geologic mapping program are summarized at a scale of 1:50 000 at the end of the text (Appendix IV). More detailed maps and cross-sections are provided in Appendix VIII. A map outlining each of the traverse locations is presented in Appendix V.

3.5 Trenching

A hand-trenching program was undertaken during the latter portion of the field mapping. A two-man crew worked under the direction of geologists responsible for mapping particular areas. The objective of trenching was to prove the thickness of coal seams where it was deemed possible to expose the coal section with hand-shovel trenches, and to collect coal samples for quality analyses. Due to the fact that overburden tends to mask the true extent of a seam, all coal exposures greater than 0.5 metres were trenched to avoid missing more extensive seams.

The trenches were approximately 0.7 metres wide and cut to a depth of 1 metre. All trench lithologies were logged in detail. A total of 5 trenches were dug and logged on the Sustut coal licences. Several others were dug, but the actual coal thickness did not warrant logging and sampling.

All coal seams greater than 0.5 metres were sampled for coal quality analyses. In each trench, the channel sample was approximately 0.1 m x 0.1 m x the length of the coal seam. The trench logs illustrating the sampled sections are presented in Appendix II at the end of the text, while the trench location map may be found in Appendix VI. Trench locations are also plotted on the geology maps.

3.6 Reclamation

The area of environmental disturbance associated with the 1980 Sustut coal exploration program was minimal since all transportation was via helicopter or fixed-wing aircraft. Only minor disturbances were associated with the camp and with trenching. Several hand trenches were left open for later viewing, while the remaining trenches were filled in. The camp utilized a pre-existing clearing, cleared by construction activities of the British Columbia Railway. The camp site was left in its original condition.

3.7 Project Management & Contractors

The 1980 Sustut coal exploration program was managed by B.P. Flynn (Project Supervisor) of Gulf Canada Resources Inc. Field operations were supervised by J.M. Duford, Consulting Geologist. The geological report was prepared by J.M. Duford and J.W. Innis of Gulf Canada Resources Inc.

The following additional professional and technical personnel contributed to the Panorama coal project:

G. Johnson	Senior Geological Assistant
R. Brezovski	Geological Assistant
E. Legresley	Geological Assistant
D. Spencer	Geological Assistant

J. Currie	Helicopter Pilot

The following also contributed to the project:

B. Warren	Cook
M. Hatch	Cook
P. Russell	Trencher

The following is a list of the suppliers and service companies used during the project:

Smithers Air Service	Smithers, B.C.	(604) 847-9666
Norcrown Air Ltd.	Kelowna, B.C.	(604) 765-1437
Quasar Helicopters Ltd.	Richmond, B.C.	(604) 270-9696
Smithers Hardware Ltd.	Smithers, B.C.	(604) 847-4277
Super Valu Stores	Smithers, B.C.	(604) 847-9737
Canadian Propane Gas & Oil Ltd.	Smithers, B.C.	(604) 847-9928
MR Rentals	Smithers, B.C.	(604) 847-3897
J & D Rewind	Smithers, B.C.	(604) 847-3894
C J L Enterprises	Smithers, B.C.	(604) 847-3612
Cyclone Engineering Sales Ltd.	Edmonton, Alta.	(403) 436-1385
Hardy & Associates (1978) Ltd.	Calgary, Alta.	(403) 272-8761

4.0 GEOLOGY

4.1 Introduction

The Sustut coal licences are situated within the Intermontane Belt of northwestern British Columbia between the Coast Crystalline Belt to the west and the Omineca Belt to the east.

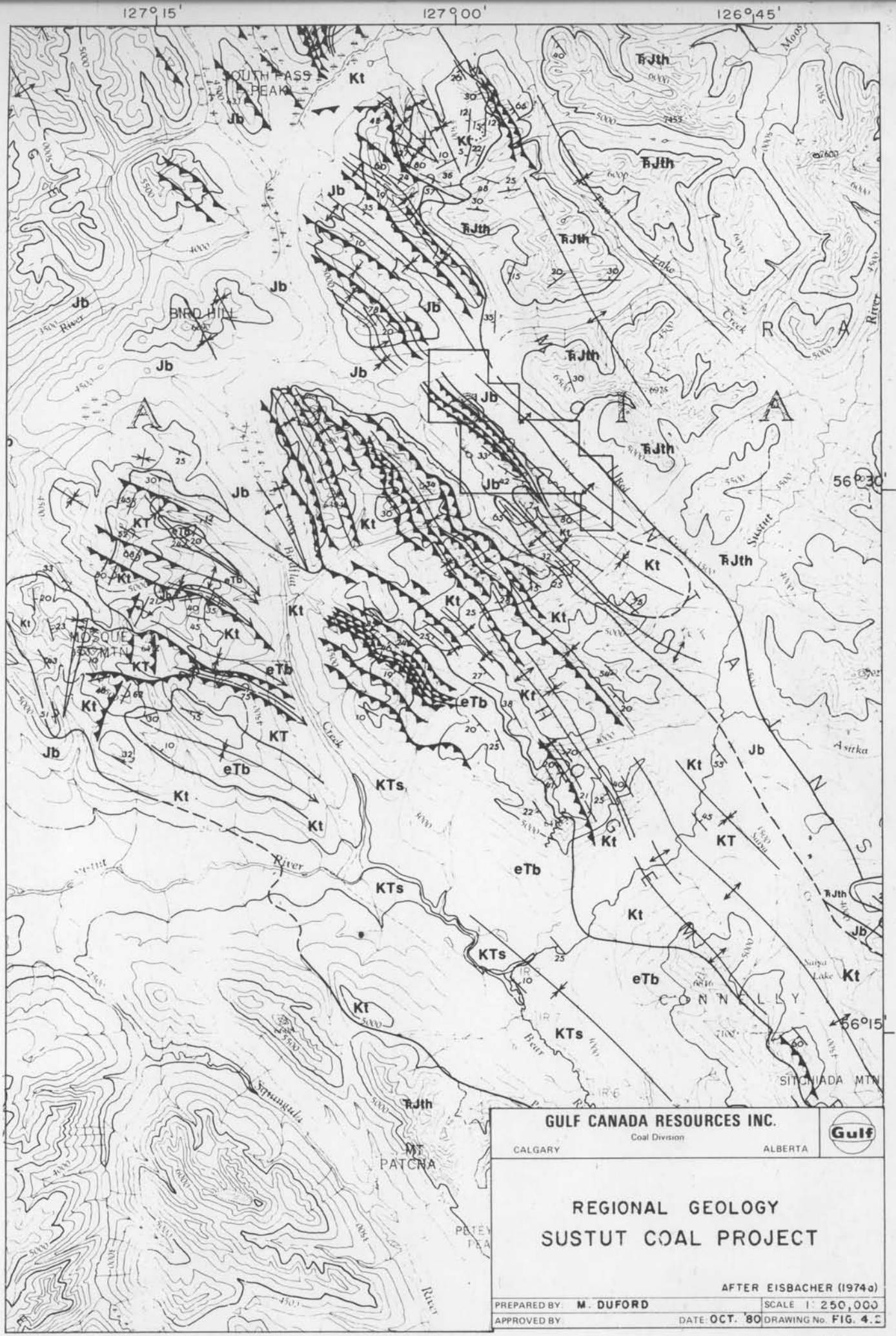
The oldest rocks exposed are the Jurassic Takla and Hazelton volcanics (see Figure 4.1). Unconformably above these rocks is the Upper Jurassic - Lower Cretaceous Bowser Lake Group, representing the fill of a large successor basin developed southwest of the rising Columbian core zone (Souther and Armstrong, 1966; Eisbacher, 1974(b)). The Bowser Lake Group is mainly marine and records the withdrawal of the sea to the southwest. The upper portion of this assemblage however, represents a coarsening upward deltaic facies sequence which contains coal. Unconformably above the Bowser Lake sediments are the non-marine clastic sediments of the Upper Cretaceous - Paleocene Tango Creek Formation of the Sustut Group.

Structurally, the area is characterized by numerous tight anticlines and synclines which are commonly thrust-faulted (see Figure 4.2). Where the mainly pelitic Bowser Lake Assemblage is not present, open folds and gentle dips are more characteristic (Eisbacher, 1974(a)).

STRATIGRAPHIC COLUMN

AGE		GENERAL LITHOLOGY	GROUP	
TERTIARY				
		Conglomerate and interlayered ash-fall tuffs overlain by interbedded pebbly sandstone, ash-fall tuffs and claystone 300–900 m	BROTHERS PEAK FORMATION	SUSTUT GROUP
		Gray, polymictic conglomerate at base overlain by green and red silty claystone and dark grey claystone. Minor lignite seams high in the section. 600 m	TANGO CREEK FORMATION	SUSTUT GROUP
CRETACEOUS		**Depositional Hiatus**		
JURASSIC	Upper	3. Grey, brown and green, marginal marine mudflow. Silty claystone matrix, very poorly sorted with large (up to 5 m) clasts of carbonaceous tree fragments, fine sediment containing carbonized wood fragments, limestone, powdered mudflow and volcanic material. 300 m 2. Grey to lt. brown, marine and non marine, silty claystone. Interbedded with coarse sands, grits and cherty conglomerate Claystone locally carbonaceous and coaly in middle zones. 300 m	BOWSER LAKE GROUP	
	Middle	1. Dark grey, marine claystone, partially silicified, sandy low in section, volcanic conglomerate near base. 500 m+	BOWSER LAKE GROUP	
	Lower	Grey and red, marine and non-marine, interbedded sedimentary and volcanic rocks.	HAZELTON GROUP	
		Red, nonmarine tuff, breccia, conglomerate local flows ranging from basalt to rhyolite in composition.	HAZELTON GROUP	
		Mainly red, polymictic conglomerate, sandstone, breccia, tuff and argillite. 450 m in Total	HAZELTON GROUP	
Upper TRIASSIC		Red and green, nonmarine and marine, volcanic breccia, conglomerate, sandstone, tuff, argillite	TAKLA GROUP	
		Grey green, well bedded tuff, volcanic sandstone and argillite. 2000+ in Total	TAKLA GROUP	

FIG. 4.1



GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

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REGIONAL GEOLOGY
SUSTUT COAL PROJECT

AFTER EISBACHER (1974a)

PREPARED BY: M. DUFORD	SCALE 1: 250,000
APPROVED BY:	DATE: OCT. '80 DRAWING No. FIG. 4.2

The northern licence area consists mainly of southwest dipping (40^{o}) Bowser sediments containing several imbricate thrusts (see Figure 4.3). To the south, these sediments are capped by folded and thrust-faulted clastics of the Tango Creek Formation (Figure 4.4). Most of the folding and faulting occurred during Eocene times and outlived the clastic deposition (Eisbacher, 1974(a)).

4.2 Stratigraphy

The Bowser Lake Group, the sequence upon which the Sustut program was concentrated can be distinguished with little difficulty from the sequence that bounds it above and below. There is a marked difference in character between it, the very prominent extrusives of the underlying Takla and Hazelton Groups, and the variegated red and green mudstones near the base of the overlying Sustut Group.

The contact with the older volcanics appears to be structural. A high angle fault, though not directly observable, can be traced well out of the licence area both to the northwest and southeast.

The contact with the Cretaceous - Tertiary Sustut sediments is an angular unconformity marked by a conglomerate at the base of the Sustut Group. Distinction of this contact is further enhanced by the color difference between rocks above and below the conglomerate.

The program's observations of the Bowser Lake Group allow a more detailed definition of the sequence and its relationship to older and younger groups (see Figure 4.1).

4.2.1 Takla and Hazelton Volcanics

The name Takla Group was first applied by Lord (1948) to rocks of Upper Triassic to Upper Jurassic age. The stratigraphy of this and surrounding areas has been redefined by several workers and recently by Richards (1976).

As presently defined, the Takla Group of Upper Triassic age includes a lower sequence of grey-green, well-bedded tuff, with volcanic sandstone, siltstone, and claystone. Locally correlative are grey-green (with minor red) basic pillows, flows, and massive volcanic breccias. The upper part of the group is red and green, non-marine and marine volcanic breccia, conglomerate, sandstone, tuff and argillite. Local variation in the thickness of individual beds contribute to major fluctuations in the thickness of the Takla Group overall. A range of 300 metres to over 3 000 metres is given by Monger (1976), but an average of slightly

over 2 000 metres is reasonable.

Lower to lower Middle Jurassic rocks are included within the Hazelton Group as defined by Tipper and Richards (1976). The boundary with the Takla Group is marked by a reddish polymictic conglomerate including material derived from the Takla rocks. Also in the lowest part of the Hazelton Group, are volcanic sandstones, breccias, tuffs, and claystones. The sequence passes up into a thick, extensive section of red, non-marine tuff, breccia conglomerate and local flows ranging from basalt to rhyolite in composition (Monger, 1976). The uppermost Hazelton rocks include grey and red, marine and non-marine sediments interbedded with volcanics and containing fossils of Early to Middle Jurassic age (Monger 1976). An approximate thickness of 450 metres is given for the Hazelton Group in the area of the Sustut licence (Tipper and Richards, 1976).

4.2.2 Bowser Lake Group

The Bowser Lake Group contains coal and is of principal interest in this report. The name Bowser Lake Group was defined by Tipper and Richards (1976) to include rocks of Late Middle to

Late Jurassic age. For the purpose of this report, the Bowser Lake Group has been further divided into three units with the intent of distinguishing the coal-bearing section.

4.2.2.1 Unit 1

The lowest unit is very similar in character to the highest unit of the Hazelton Group, but with a far greater predominance of marine sediments as opposed to volcanic material within the licence block area. This unit is a sequence of claystone, dark grey, and thinly bedded. Silicification affects a few horizons and the resulting weathering pattern is a characteristic sequence of discrete appearing beds. Sandstone is minor, but increases downward. It is grey, medium-grained, medium-bedded and appears in isolated interbeds in the claystone, often containing small lenses of siltstone. Not seen at the base of the section, but reported by Richards (1976) is a volcanic chert-pebble conglomerate. Near the transition into the more continental sediments above, are beds containing fossil bivalves and cephalopods. Thickness of this unit is unknown, but is estimated to be at least 500 metres.

4.2.2.2 Unit 2

The middle unit of the Bowser Lake Group cotnains both marine and non-marine sediments derived from deltaic clastic deposition (Richards, 1976).

The lowest part of the unit is comprised of a claystone, light grey to brown, thin to medium bedded and parallel cross-bedded with interbeds of siltstone and sandstone. The sandstone grades up to a medium grain size and has very gradational margins with the surrounding silty claystone. There are a few carbonaceous horizons, some of which contain wood fragments. Bivalve fossils appear at the base.

This essentially fine-grained sequence grades upward into increasingly abundant interbedded zones of coarse-grained to conglomeratic sandstone. The sandstone is generally brown to light brown and rarely green. It is thickly bedded with parallel cross-bedding and coarsens to a grit (composed of angular granules) or conglomerate containing sub-rounded chert pebbles. The weathering character of these coarse-grained intervals is resistant and massive, forming steep outcrops up to 10 metres in vertical extent.

Above the sequence just described, and included between a few of the uppermost sandstones is coal-bearing claystone. The claystone is grey and thinly-bedded, quite recessive and locally iron-stained. Silty zones are numerous, and in some cases, lead into localized bodies of fine-grained brown sandstone. Development of coal horizons is accompanied by carbonaceous halos stratigraphically above and below. The coal that occurs is generally very rich in mineral matter and extended patches of carbonaceous bloom have been found without any true coal development. Field observations of the coal sequence suggest it may lack appreciable lateral extent.

Another coarse-grained interval follows the coal, consisting of an alternation of coarser and finer sandstone. The more prominent, thicker beds are coarse to very coarse-grained sandstone, grey with pebbly to conglomeratic bands and zones. The sand grains are sub-angular and moderately to well sorted. Conglomeratic intervals include sub-rounded to round chert pebbles up to 2 centimetres in diameter in a matrix of sand that remains relatively well sorted. Large fossilized plant fragments are included in the matrix.

Cross-bedding is quite clearly defined in the coarser horizons.

The sandstone interbedded with the conglomeratic material is fine to medium-grained and grey in colour; however, the medium, slightly greenish brown weathering colour is more diagnostic. Bedding is thin with some vaguely defined cross beds. These sands are moderately recessive and are found on close inspection to be quite friable. Low in this part of the sequence, a more competent bed of dark brown sandstone contains well-preserved bivalve fossils.

At the top of the middle unit of the Bowser Lake Group is an interval of claystone, slightly silty with minor sandstone, that is distinctive in being quite carbonaceous, but lacking in any real coal development. Outcrop of the claystone is minimal; its presence is usually expressed as a dark talus slope immediately beneath the mudflow unit that caps the Bowser Lake Group. The entire sediment sequence just described, lying above the marine claystone, is estimated to be approximately 300 metes thick in the west and appears to thin somewhat to the east.

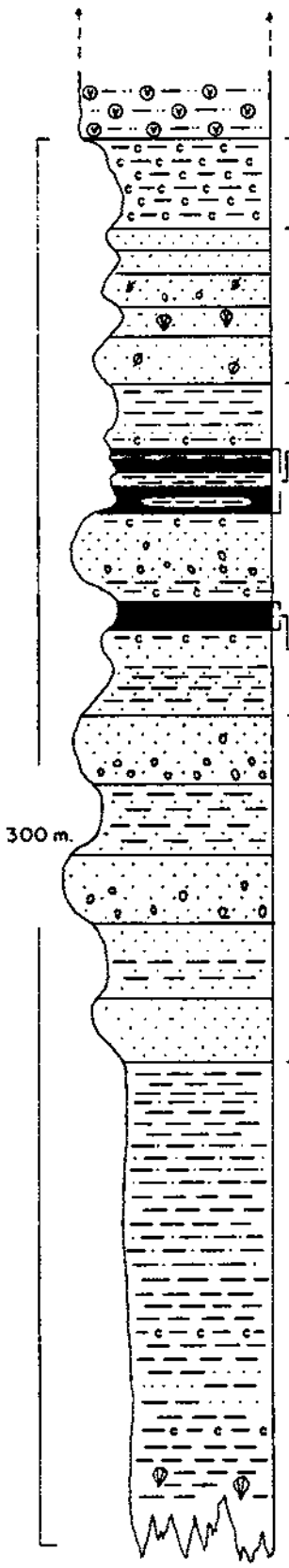
4.2.2.3 Unit 3

The uppermost unit of the Bowser Lake Group is also about 300 metres thick and consists of what has been described as a mudflow (Richards, 1976), interbedded with brecciated volcanics. The matrix of the mudflow is a very poorly sorted mixture of claystone and siltstone and encloses a variety of clast types. The color varies from grey to brown, to green where volcanics make a major contribution to the debris. No bedding is apparent. Clasts up to 5 metres in diameter are composed of siltsone, containing large tree fragments, and in places, coal bands, limestone, previously deposited mudflow material, large chunks of carbonized wood not enclosed in sediments, and volcanic "augite porphyry" (Richards, 1976). Some fine-grained, well-bedded bodies of sediment within the flow are autochthonous and not allochthonous blocks. The mudflow as a whole is quite resistant and caps Sydney Ridge.

4.2.2.4 Coal Development

Coal development within the Bower Lake Group is confined to two major coal zones in the upper portion of Unit 2 (Figure 4.7). The coal appears

SCHEMATIC STRATIGRAPHIC COLUMN OF BOWSER LAKE GROUP, UNIT 2 (Jb_2)



Coal seams intersected by trenches S–TR–80–04 and S–TR–80–05 lie below and above (respectively) the basal conglomerate of the Tango Creek formation (K_t).

Base of Jb_3 Mudflow

CARBONACEOUS CLAYSTONE

Slightly silty, minor sandstone

INTERBEDDED COARSE AND FINE SANDSTONE

Coarse, cross-bedded units contain plant fossils, finer zones contain rare, more resistant beds with bivalve fossils

14.34 m. COAL/ROCK = 5.58/8.76

COAL BEARING INTERVAL

Upper coal zone, exposed in trench S–TR–80-03 and S–TR–80–02

Coarse-grained sandstone, conglomerate at base

Lower coal zone, exposed in trench S–TR–80–01

6.58 m. COAL/ROCK = 3.81/2.77

INTERBEDDED CONGLOMERATIC SANDSTONE AND SILTY CLAYSTONE

Alternating cross-bedded resistant coarse sands and finer recessive claystone and siltstone

CLAYSTONE

Minor fine sandy and silty intervals, thin cross-bedding, a few carbonaceous horizons, bivalve fossils near base

FIG. 4.7

to be limited in distribution to the Australia Lake Cirque (Figure 4.6) though the Unit 2 sequence is traceable along strike beyond the cirque. The lower coal zone is 6.58 metres thick and contains two seams 0.68 metres and 3.27 metres thick. The upper coal zone is 14.34 metres thick and includes three seams 1.09 metres, 1.42 metres and 2.86 metres thick. The lower zone is exposed in trench S-TR-80-01 (Appendix II). The upper zone is interpreted to be tightly folded and is exposed in two locations: trench S-TR-80-03 and a large stream cut exposure in a structurally contorted zone approximately 20 metres southwest of the trench. Although the coal-bearing strata of Unit 2 is repeated southwest of Sydney Ridge thrust, no coal development was observed here, indicating that lateral extension of the seams is even more restricted along dip than it is along strike. Additional coal is present above Bowser Lake Group Unit 3, however, the quality of the coal is poor and the seams are thin.

4.2.3 Tango Creek Formation

Stratigraphically, the youngest rock encountered within the licence area belongs to the Lake Cretaceous-Early Tertiary Tango Creek Formation (see Figure 4.1). This formation comprises the lower part of the Sustut Group as defined by Lord (1948), and lies unconformably above the Bowser Group. At the unconformity, Tango Creek sediments lie above successively older Bowser sediments from west to east (cross-section S 5000).

Eisbacher (1974(a)), has defined the Niven Member at the base of the Tango Creek Formation. It consists of a basal conglomerate succeeded by a sequence of red and green mudstones and quartz-pebble conglomerates. A carbonaceous sequence just beneath the basal conglomerate contains one of the poorly-developed coals above the Bowser Lake Group; a second coal was trenched just above the basal conglomerate (Figure 4.7). The Niven Member is overlain by the Tatlatui Member, composed of dark grey mudstone and "chert-pebble-bearing" sandstones (Eisbacher, (1974 (a)). Above the Tango Creek Formation, within the Sustut Group, is the Brothers Peak Formation which,

although outcropping locally, does not occur in the immediate vicinity of the licence block. The thickness of the Tango Creek Formation is somewhat less than 1 000 metres in this area (Eisbacher, 1974(a)).

4.3 Structure

The structure of the Sustut licences and adjacent areas is dominated by thrust faults and overturned folds. Both the fold axes and thrust fault traces generally follow the northwest-southeast regional strike (N 140°). Beds dip predominantly to the west at approximately 30° to 40°, but the southwest limb of several synclines is considerably steeper and frequently overturned. Most of the structure is associated with deformation during Eocene times. Some deformation did occur during a late Cretaceous depositional hiatus as evidenced by the angular unconformity between Bowser Lake sediments and those of the Sustut Group.

4.3.1 Folding

As previously mentioned, the general structural style consists of tight, commonly thrust faulted folds. The amplitude of these folds varies from a few metres to several hundred metres. Anticlines tend to be closed, overturned and

frequently broken, whereas the synclines are more open, though also frequently overturned.

The largest scale folds are found on either side of Sydney Ridge (Figure 4.3). Both of these synclines are assymetrical and in places overturned on the southwest limb. The anticline between these two synclines is faulted (see cross-section S 7000). Axial plunge on these folds appears to vary over relatively short distances along strike from 0^{o} to 30^{o}. Generally, the large scale folds are hinged about the ridge between cross-sections S 6260 and S 5000, and plunge away from this ridge along strike.

North of the licence area, synclinal drag folds in the order of 10 to 20 metres can be seen directly beneath the several thrust faults present. Smaller, broken folds, several metres across, exist in the crumpled zone beneath the Sydney Ridge thrust.

Associated with the westernmost syncline is a very tight (closed) anticline locally overturned. The fold is probably broken in the north and is traceable south along strike for at least 8 kilometres. The fold is not traceable north in the vicinity of Bloom Creek due to the valley fill.

Airphoto interpretation indicates a large scale fold pair near the northeastern licence boundary, mostly within the marine unit of the Bowser Lake Group. Superimposed on the large-scale folds are numerous smaller scale folds. This fold pair is not traceable for much more than 5 kilometres.

4.3.2 Faulting

Within the general Sustut area, there are basically three different types of faults; normal faults of considerable displacement, normal faults of negligible displacement, and most commonly, imbricate thrust faults.

The Red Creek Valley is the trace of a normal fault with over 500 metres displacement. This fault has brought the Takla-Hazelton volcanic rocks up relative to the younger Bowser Lake Group. Parallel to the Red Creek fault is an additional high angle fault with normal displacement. This fault displaces the older, mainly marine unit upward relative to Unit 2 (cross-section S 5000). Displacement along this fault decreases to the northwest. Faulting of this type probably took place prior to the deposition of the Sustut Group.

During the Eocene, numerous relatively small scale, northeast directed imbricate thrusts developed (Figure 4.5). Displacement on these faults appear to vary from less than 10 metres to over 400 metres. The largest of these faults on the property is the Sydney Ridge fault which repeats both the two upper units of the Bowser Lake Group (see cross-section S 8000). In places, extensive deformation can be observed within the footwall. Associated with the largest thrusts are several smaller thrusts which have approximately 30 to 40 metres of stratigraphic displacement. Disturbed rock beneath these smaller thrusts is evident, but confined to a limited zone of several metres. These faults are roughly parallel to the Sydney Ridge fault and one joins it just southeast of cross-section S 5000.

Visible along several of the cirque headwalls of Sydney Ridge are high-angle faults which are not associated with the thrusting (Figure 4.6). Displacement here is normal and about 40 to 75 metres with virtually no disturbance of the surrounding rock. These faults cut across the trace of the thrust faults (see cross-section S 6260), and are interpreted as a result of later tensional forces.

The surface trace of these faults resembles that of tear faults associated with the thrusting, however, since the movement appears to be mainly vertical, they are interpreted to be normal faults.

Figure 4.3 Northern Licence Area (Looking Southwest)

Figure 4.4 Southern Licence Area (Looking Northwest)

Figure 4.5 Faults and Folds in the Northern Licence Area (Looking Northwest)

Figure 4.6 Australia Lake Cirque (Looking West)

5.0 RESOURCE POTENTIAL

5.1 Introduction

The resource potential figure calculated below is only in tended as a guide to the possible magnitude of the Sustut coal resource, to be proved out by further exploration.

The significant coal resource potential of the Sustut licence is divided between two zones; each being composed of several coal seams with numerous rock partings. Both zones are situated in the upper portion of Unit 2 of the Bowser Lake Group. The zone in a stratigraphically higher postiion - termed the "upper zone" - is intersected by trench S-TR-80-03 (Appendix VIII). It contains three seams which comprised a total of 5.37 metres of mineable coal. Sample 01387 was taken from the uppermost seam (2.86 metres thick) and provides the only representation of coal quality in the upper zone.

The "lower zone" was exposed in trench S-TR-80-01. The quality of its coal was assessed by a composite analysis of samples 10379, 01380, and 01381, all of which were taken from the uppermost of the two seams in the lower zone (3.27 metres thick). These two seams total 3.95 metres.

The area of coal development within the Sustut licence area is quite limited. Though trenches S-TR-80-01 and S-TR-80-03 are quite close together relative to the total area of the Sustut project, their coverage does

represent almost the complete extent of Sustut coal development. The carbonaceous zone surrounding the coal is much more extensive than the coal itself. Beneath the Sydney Ridge thrust, the coal is apparent only in the immediate area of the trenches and exposure is poor elsewhere. Above the Sydney Ridge thrust, though the carbonaceous zone is repeated (and well exposed), there is no significant coal development. The magnitude of the Sustut resource potential is mainly limited by the area over which the coal zones can be confidently extrapolated.

5.2 Resource Potential

The structural deformation of the coal seams and their limited exposure make estimation of the areal distribution of the seams difficult. However, the trenches do provide reasonably reliable information on seam thicknesses. The current model for coal distribution allows an order-of-magnitude estimate of a possible, potential resource of 63 million tonnes of raw coal (Table 5.1).

5.3 Resource Potential Procedures and Parameters

The preceeding resource figure was calculated using those geological cross-sections that were interpreted to intersect the coal seams (see Appendix VIII).

The coal zones were judged to extend through only one cross-section to the southeast of the trenches because of the lack of carbonaceous exposure in this direction. Topography and structure appeared to be more promising to

TABLE 5.1

SUSTUT RESOURCE POTENTIAL DATA

Section and Zone	Mining Section Thickness[1]	Length	Section Influence	Specific Gravity	In Place Raw Coal (million tonnes)	Weighted Head Ash[2]
S-5000 Upper	5.37	700	1 630	1.70	10.4	35.28
Lower	3.95	700	1 630	1.70	7.7	40.58[3]
S-6240 Upper	5.37	655	800	1.70	4.8	35.28
Lower	3.95	960.5	800	1.70	5.2	40.58
S-7000 Upper	5.37	1 455	870	1.70	11.6	35.28
Lower	3.95	1 595	870	1.70	9.3	40.53
S-8000 Upper	5.37	749	1 230	1.70	8.4	35.28
Lower	3.95	742	1 230	1.70	6.1	40.58
				TOTAL	63.5	

[1] Trenches S-TR-80-03 and S-TR-80-01.

[2] Weighted by Length of Mining Sections Within Zone

[3] Excludes Two Rock Partings .30 and .11 Metres Thick Which are Part of the Mining Section

the southwest, but the coal zones were only extended through two cross-sections in this direction due to the lack of geologic evidence to support a further continuation.

Seam thickness, length, width and specific gravity constitute the basic data for the calculation. The seam thickness data is based on the trench logs (see Appendix II) and is an aggregate including all seams greater than 0.5 metres in thickness. The seam length is a length measured from the cross-sections, between the topographic surface and a vertical depth of 600 metres.

The seam width is a measure of the extent of the seams between the geologic cross-sections. Since cross-sections were constructed first where geological control was best, and secondly, to arrive at a minimum spacing of 2 000 metres, the section spacing varied from 740 metres to 2 000 metres. The section influence (half the distance to the adjacent section) varied from 870 to 1 630 metres. In addition to the section spacing, the location of fault contacts also affected the section influence, decreasing one width measurement to only 800 metres.

The specific gravity of raw coal was based on coal analyses, both from Sustut and other properties. This value (1.70) is thought to accurately reflect the insitu specific gravity of the Sustut coal.

The Sustut resource was calculated using the following formula:

In Place Raw Coal = Seam Length x Seam Thickness x Seam Width x Specific Gravity of Mining Section

6.0 COAL QUALITY

6.1 Procedures

During the 1980 field program, coal samples were collected from five trenches. In several trenches where the coal was separated by significant rock bands, the coal intervals were sampled separately. At the end of the program, the samples were sent to the laboratory for analyses as per the flow diagram presented in Figure 6.1.

After the 1.5 float/sink tests were reviewed and composites determined. Two samples were selected on the basis of these initial tests to follow the complete flow diagram (excluding the option work on the 100 x 0 mesh material). Based on the composite washability results, 1.8 specific gravity was selected as the clean coal cut point for each of the three fractions. This cut point was used because of the relative lack of near gravity material, reasonably high BTU/LB content and maximum yield which would result.

All values in this report are presented on an air-dried basis unless otherwise noted.

6.2 Results

The average coal analyses from the two major coal zones indicate a low volatile bituminous coal. Definition of rank on a dmmf basis present some difficulties in obtaining

PANORAMA - SUSTUT TRENCH SAMPLE
FLOW SHEET

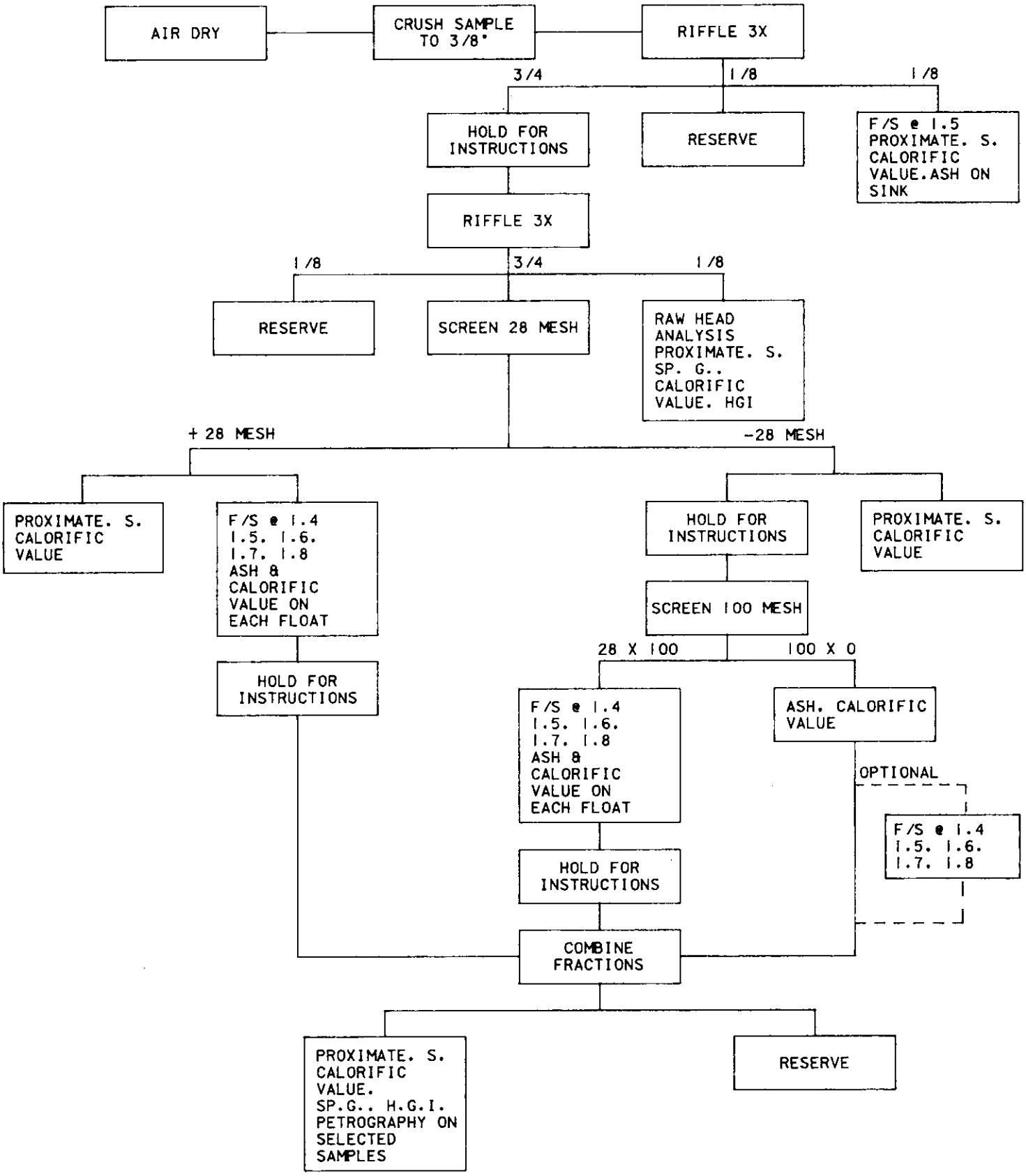


FIG. 6.1

TABLE 6.2

CLEAN COAL ANALYSES*

COAL ZONE SEAM SAMPLE NUMBER	UPPER UPPER 01387	LOWER UPPER 01379-91+	AVERAGE
Yield	62.81%	60.88%	61.78%
Ash	15.58%	20.92%	18.43%
Residual Moisture	3.53%	0.92%	2.14%
Volatile Matter	20.59%	15.03%	17.62%
Volatile Matter (dmmf)	24.12%	17.26%	20.46%
Fixed Carbon	60.30%	63.13%	61.81%
BTU/LB	10 819	12 053	11 534
Sulphur	0.52%	0.49%	0.50%
Specific Gravity	1.53	1.46	1.49
HGI	120	89	103

* Based on Combination of 1.8 S.G. For All Three Size Fractions

\+ Composite Excludes Two Rock Bands Totalling 0.41 Metres in Thickness

a definitive answer with regards to rank as illustrated on Table 6.2 and Appendix III. However, in the uppermost part of the section, the very thin coal seam at S-TR-80-05 contains a medium volatile coal. The 1.50 float/sink results and summary are found in Appendix III.

The composite washabilities for samples 01387 and 01379-81, from the uppermost seam in the lower coal zone respectively, are found in Appendix II. The clean coal analyses resulting from combining the 1.8 specific gravity float portion from each size fraction are presented in Table 6.2, along with the average of these values. The Sustut coal has relatively high ash content and consequently, has a low yield. Despite the high ash, the BTU/LB remains reasonably high.

The two clean coal analyses indicate remarkably different coals with respect to the relative proximity of the two samples sites. The sediments in the Sustut area suggest rapidly fluctuating environments of deposition and fluctuating sources of sedimentation which may account for the variability in the quality data.

7.0 RECOMMENDATIONS

The following recommendations are presented regarding the Sustut coal licences:

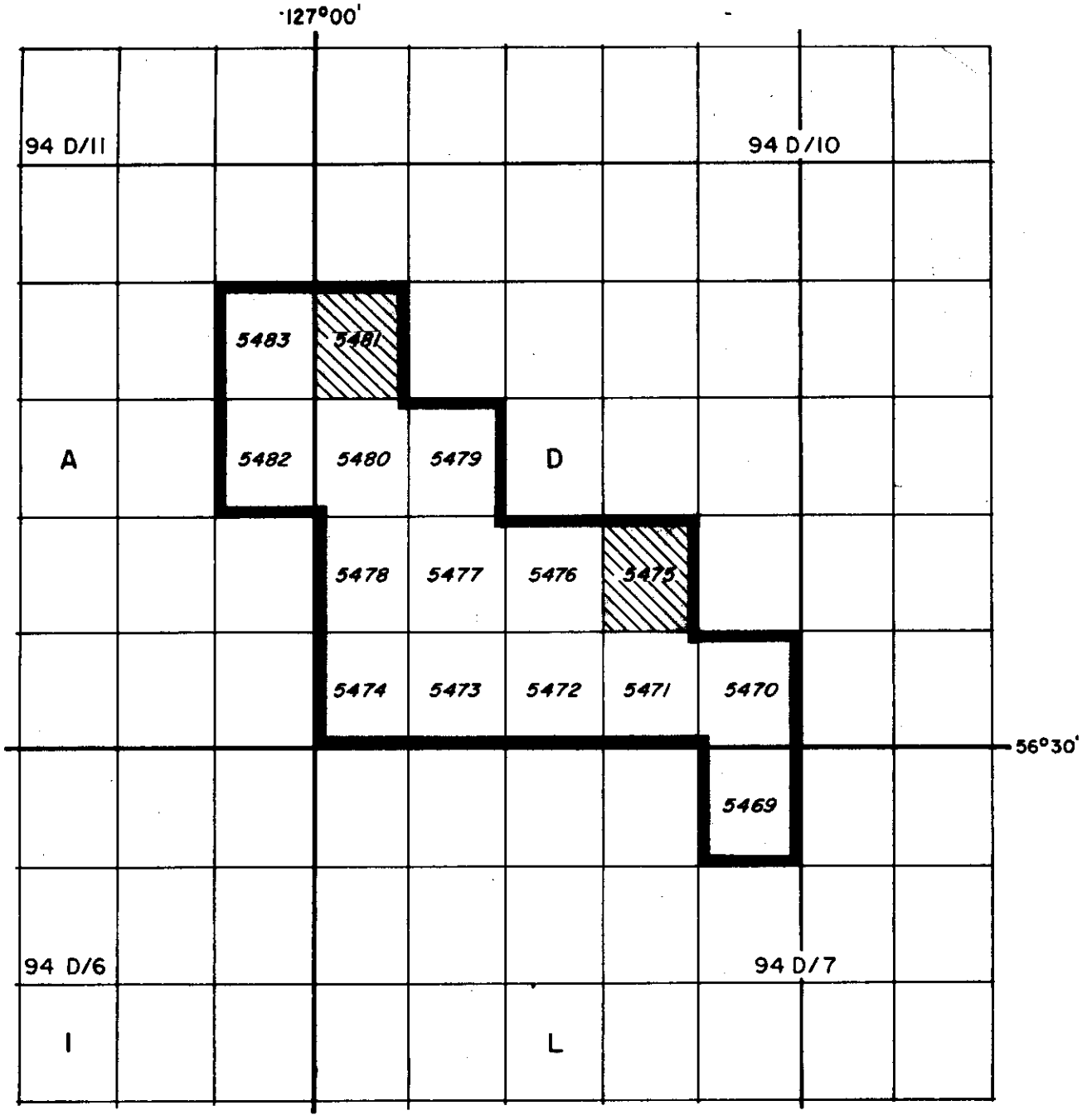
a) Additional work is required to trace the surface extent of the coal zones which appear economic.

b) Additional work is required to further define the stratigraphy of the upper portion of the Bowser Lake Assemblage and hence more specifically determine where the coal is.

c) Reconnaissance mapping should continue past the licence boundaries along strike.

d) The present mining situations, seam thicknesses, and coal quality data do not warrant drilling at this time.

e) On the basis of the 1980 Sustut coal project results, it is recommended that licences 5475 and 5481 be surrendered (Figure 7.1). Geological mapping has resulted in reasonable control of the stratigraphy and structure of the coal-bearing Unit 2. There is no indication that the coal-bearing unit outcrops in or underlies these two licences.



GULF CANADA RESOURCES INC.

Coal Division

CALGARY ALBERTA

SUSTUT COAL PROJECT

COAL LICENCE MAP

5470 LICENCES TO BE SURRENDERED

5469 LICENCE NUMBER

FIG. 7.1

PREPARED BY: J. M. DUFORD DATE: OCT. 23/80 SCALE 1:100,000

f) Should the additional work on the licences and land adjacent to the licences not indicate additional coal in a favourable mining situation, it would be recommended that all of the licences be surrendered.

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APPENDIX I

LEGAL DESCRIPTION OF LICENCES

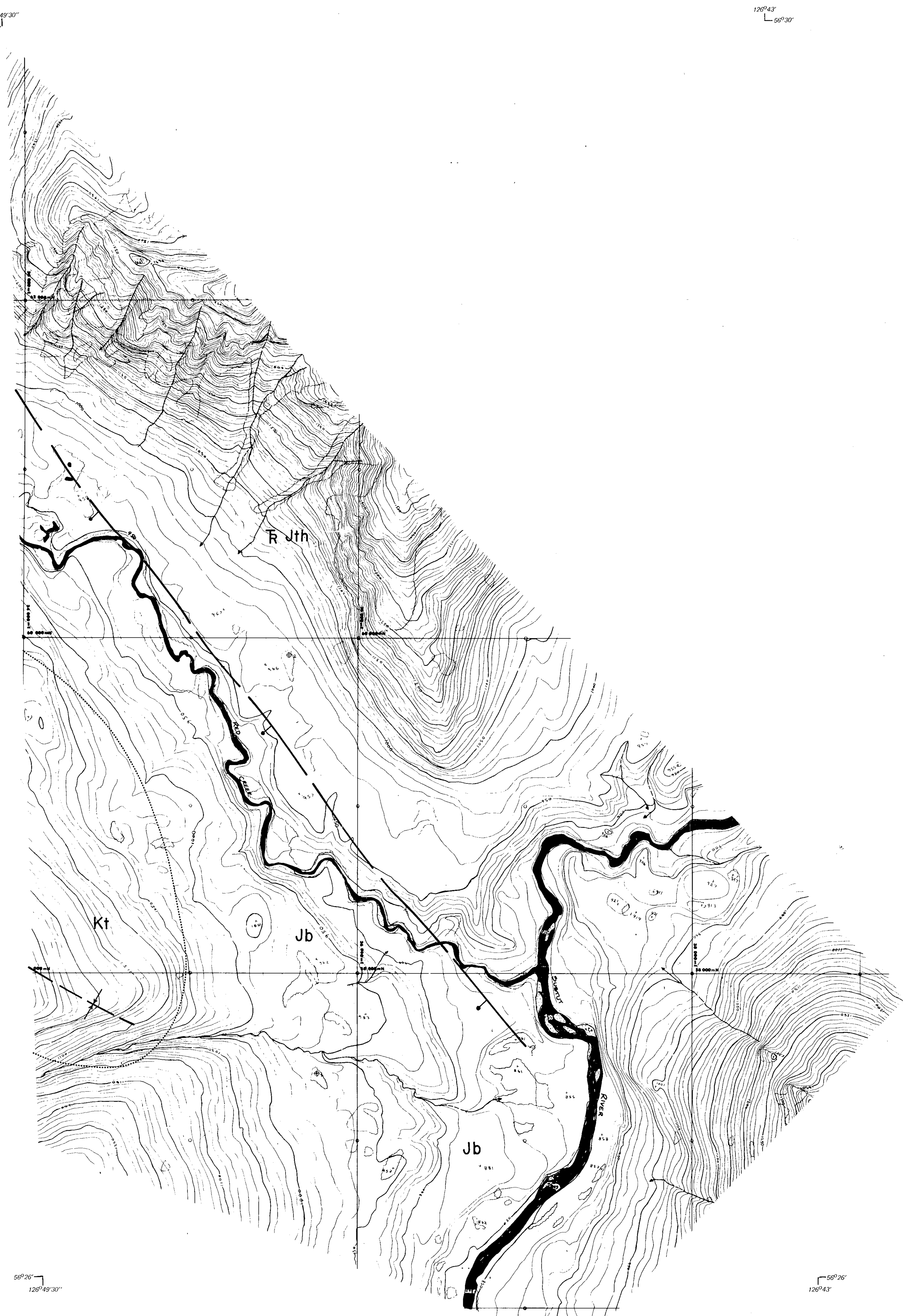
SUSTUT COAL PROJECT LICENCES, 1980

Licence No.	Date Issued	Hectares	Land Description		
			Series	Block	Units
5469	October 31/79	286	94-D-7	L	81, 82, 91, 92
5470	"	"	94-D-10	D	1, 2, 11, 12
5471	"	"	"	"	3, 4, 13, 14
5472	"	"	"	"	5, 6, 15, 16
5473	"	"	"	"	7, 8, 17, 18
5474	"	"	"	"	9, 10, 19, 20
5475	"	"	"	"	23, 24, 33, 34
5476	"	"	"	"	25, 26, 35, 36
5477	"	"	"	"	27, 28, 37, 38
5478	"	"	"	"	29, 30, 39, 40
5479	"	"	"	"	47, 48, 57, 58
5480	"	"	"	"	49, 50, 59, 60
5481	"	"	"	"	69, 70, 79, 80
5482	"	"	94-D-11	A	41, 42, 51, 52
5483	"	"	"	"	61, 62, 71, 72
TOTAL		4 290			

"Sustut Coal Project Geological Report, 1980"
Gulf Canada Resources Ltd.
Maps, Cross Sections

APPENDIX IV

GEOLOGY MAP AND CROSS-SECTIONS (1:50 000)



GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

ANTICLINE: (defined, approximate)

SYNCLINE: (defined, approximate)

ANTICLINE AND SYNCLINE: (overturned)

THRUST FAULT: (defined, approximate, inferred)

FAULT: (circle on downthrow side) (defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

BEDDING: (vertical, horizontal)

—S-7000 CROSS SECTION LOCATION

S-TR-8001 TRENCH LOCATION

LEGEND

RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
MAIN ROAD
SECONDARY ROAD
TRACK
TRAIL
CUT LINE
RAILROAD
BUILDING
COAL LICENCE 5857

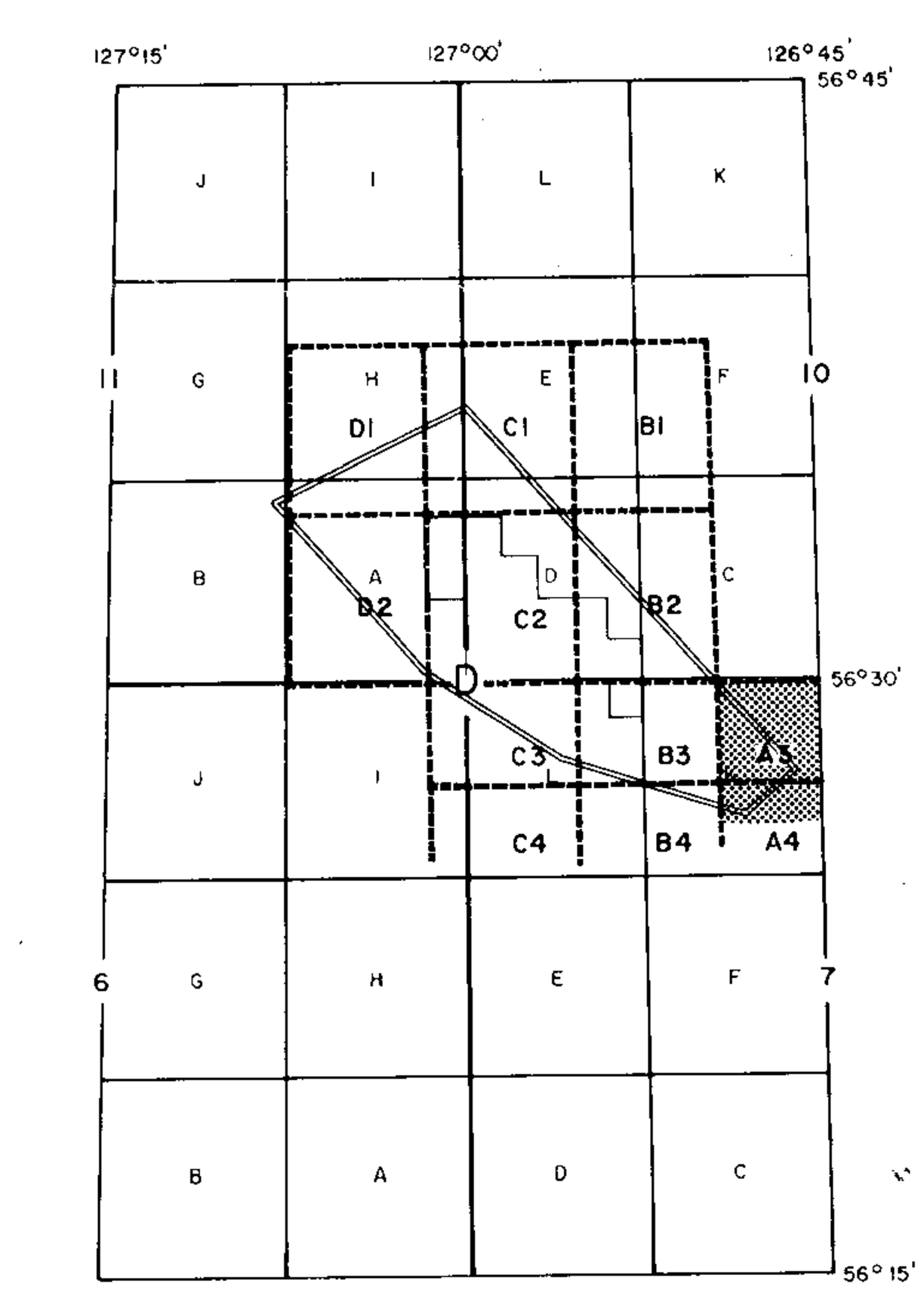
FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE

0 100 200 400 600 800 1000 METERS



SUSTUT AREA
INDEX MAP

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GR-Sustut 80(a)A

SUSTUT MAP
GEOLOGIC LEGEND

Kt	TANGO CREEK FORMATION — basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.
Jb_3	BOWSER LAKE GROUP — mudflow, containing carbonized tree fragments, interbedded with volcanics
Jb_2	— interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.
Jb_1	— thinly bedded marine claystone
Jb	— undifferentiated
TR Jth	TAKLA & HAZELTON GROUPS — basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

CONGLOMERATE	COAL
SANDSTONE	LIMESTONE
SILTSTONE	VOLCANICS
CLAYSTONE	VOLCANIC MUDFLOW
CARBONACEOUS CLAYSTONE	SILTY CLAYSTONE

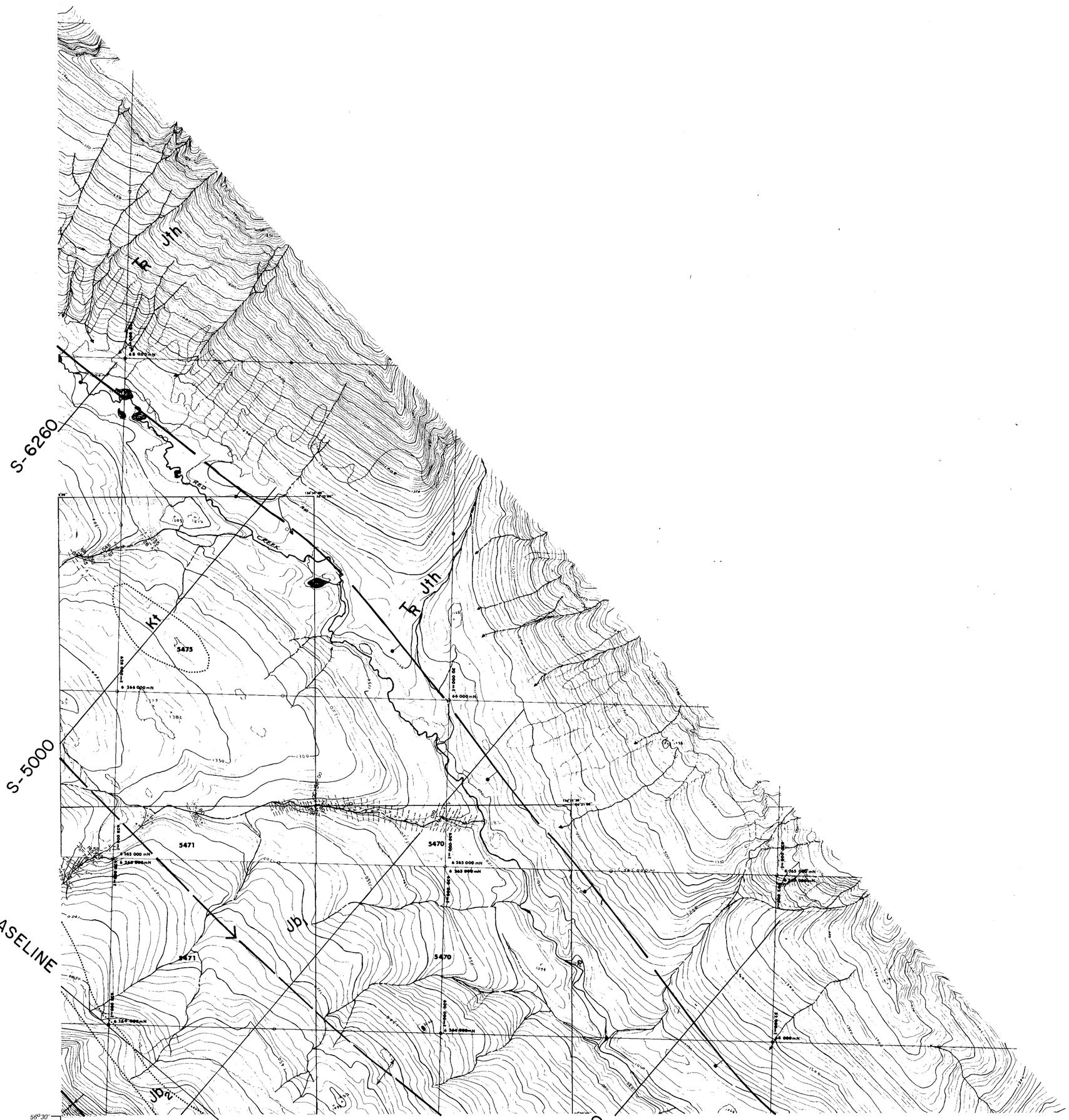
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
GEOLOGY
MAP A-3, A-4

PREPARED BY: M. DUFORD	SCALE 1:10,000
APPROVED BY: DATE: OCT. 80	Ss. Dwg. No. 80-001

126°55'30"
56°34'

126°49'30"
56°34'



GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

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SYNCLINE: (defined, approximate)

ANTICLINE AND SYNCLINE: (overturned)

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FAULT: (circle on downthrow side) (defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

BEDDING: (vertical, horizontal)

S-7000 CROSS SECTION LOCATION

S-TR-8001 TRENCH LOCATION

LEGEND

RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
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SECONDARY ROAD
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TRAIL
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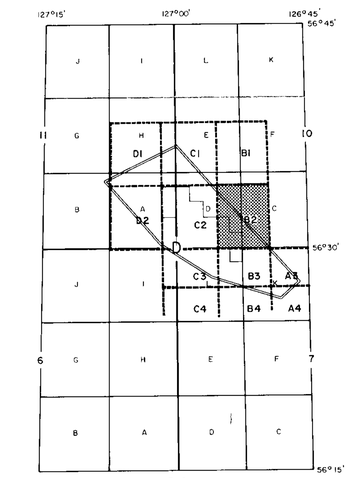
SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
0 100 200 400 600 800 1000 METERS



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115 SUSTUT AREA

INDEX MAP

G.R. Sustut 80(6)A

SUSTUT MAP
GEOLOGIC LEGEND

CONGLOMERATE
SANDSTONE
SILTSTONE
CLAYSTONE
CARBONACEOUS CLAYSTONE
COAL
LIMESTONE
VOLCANICS
VOLCANIC MUDFLOW
SILTY CLAYSTONE

Kt — TANGO CREEK FORMATION
– basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.

Jb_3 — BOWSER LAKE GROUP
– mudflow, containing carbonized tree fragments, interbedded with volcanics

Jb_2 – interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb_1 – thinly bedded marine claystone

Jb – undifferentiated

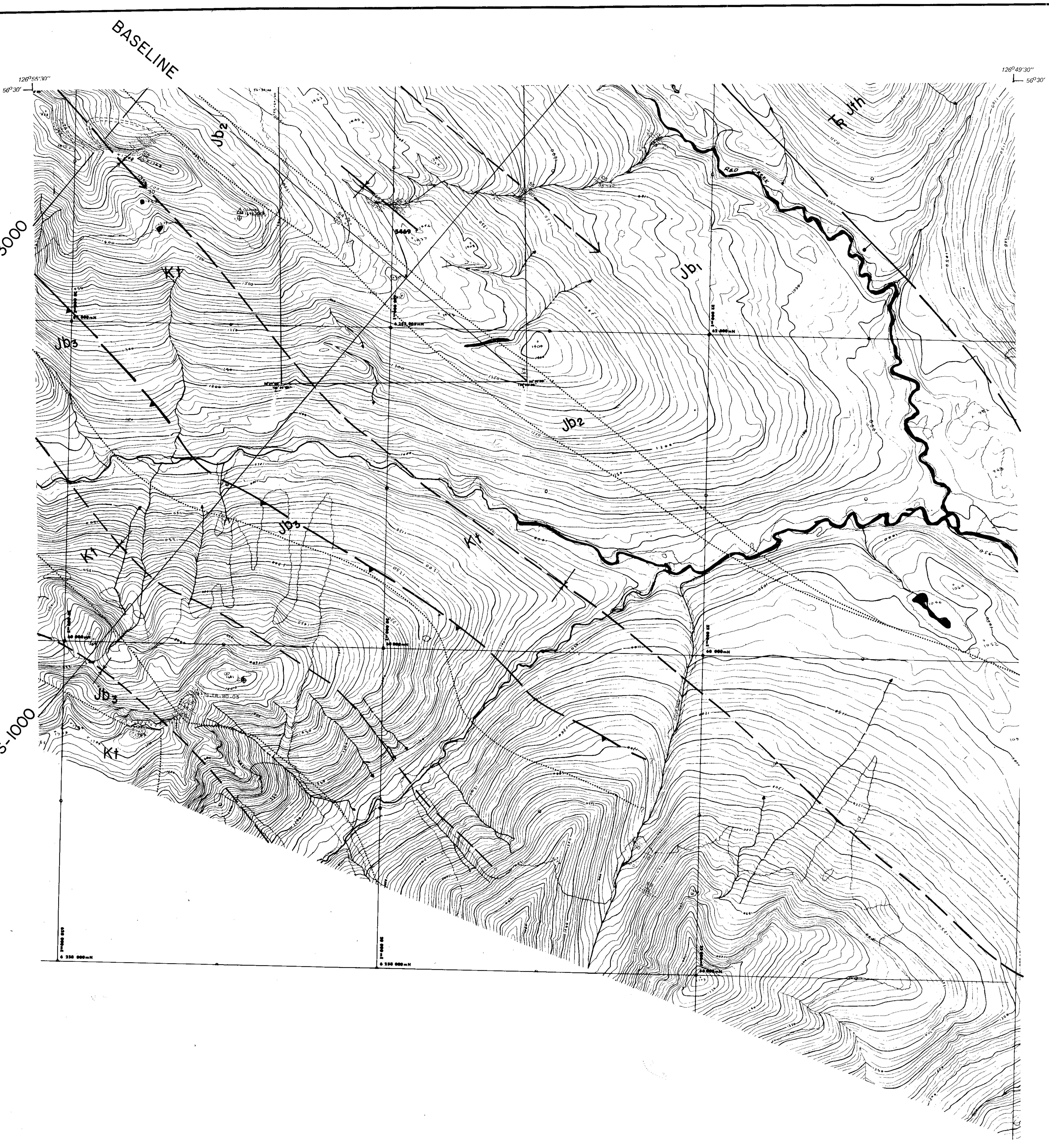
$\overline{T_R}$ Jth — TAKLA & HAZELTON GROUPS
– basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
GEOLOGY

MAP B-2

PREPARED BY: M. DUFORD	SCALE 1:10,000
APPROVED BY: DATE: OCT. 80	Ss Dwg. No. 80-002



GEOLOGICAL BOUNDARY: (defined, approximate, inferred)
COAL ZONE
ANTICLINE: (defined, approximate)
SYNCLINE: (defined, approximate)
ANTICLINE AND SYNCLINE: (overturned)
THRUST FAULT: (defined, approximate, inferred)
FAULT: (circle on downthrow side) (defined, approximate, inferred)
DIP AND STRIKE: (bedding overturned)
BEDDING: (vertical, horizontal)
S-7000 CROSS SECTION LOCATION
S-TR-8001 TRENCH LOCATION

LEGEND

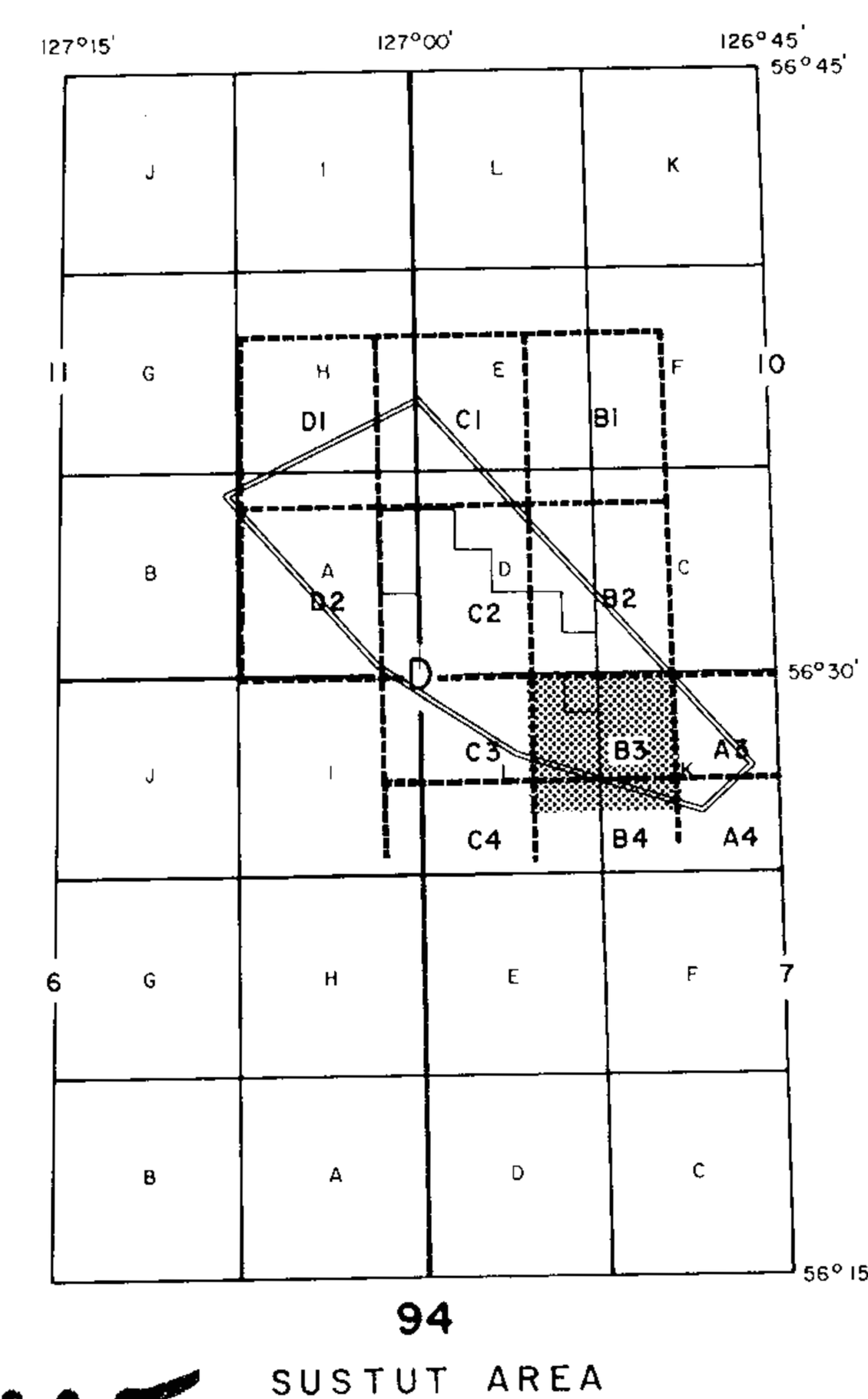
RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
MAIN ROAD
SECONDARY ROAD
TRACK
TRAIL
CUT LINE
RAILROAD
BUILDING
COAL LICENCE 5857

FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
0 100 200 400 600 800 1000 METERS



SUSTUT AREA
INDEX MAP

115

56°26'
126°49'30"

SUSTUT MAP
GEOLOGIC LEGEND

Kt — TANGO CREEK FORMATION
— basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.

BOWSER LAKE GROUP
Jb_3 — mudflow, containing carbonized tree fragments, interbedded with volcanics
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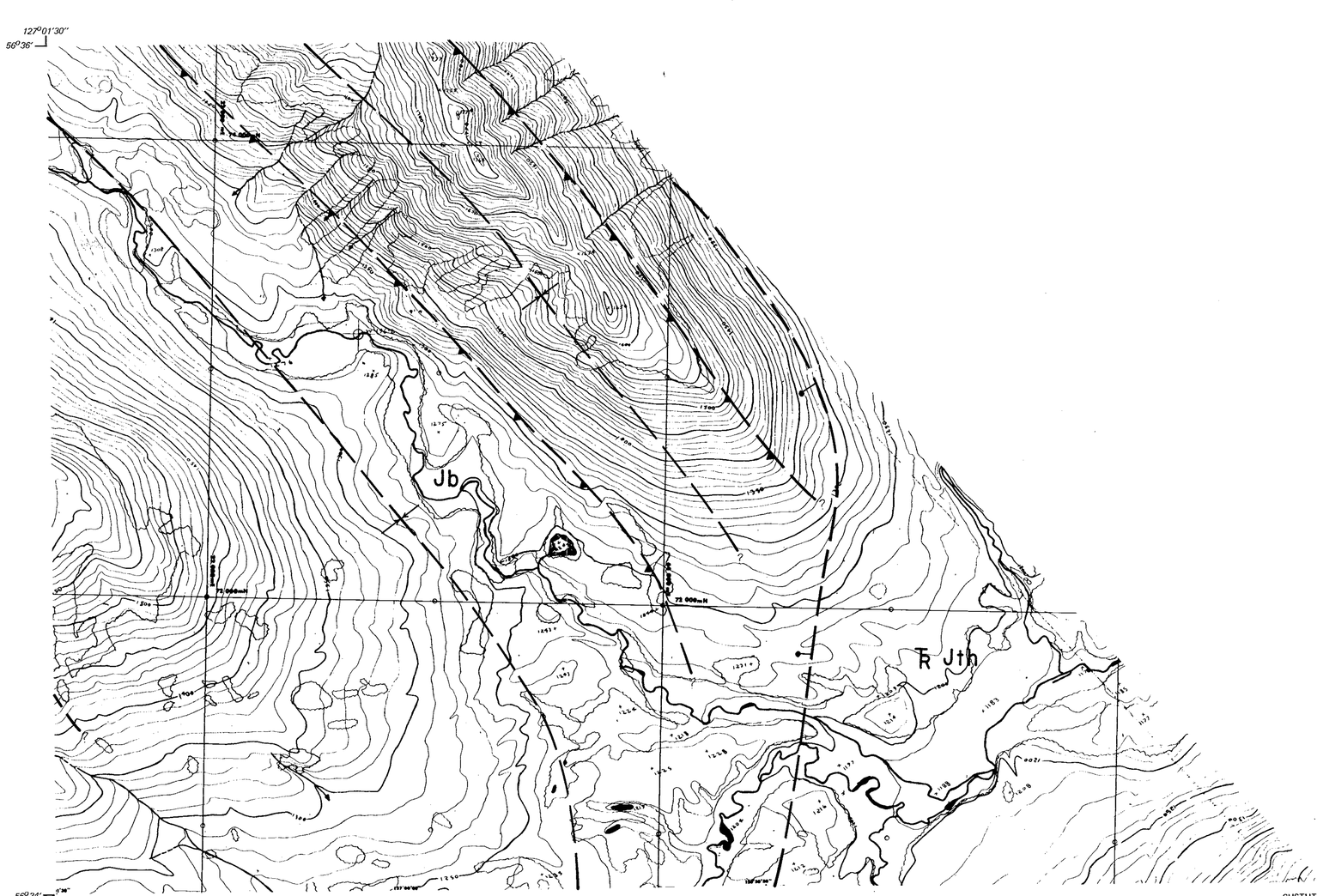
Jb_1 — thinly bedded marine claystone
Jb — undifferentiated

TAKLA & HAZELTON GROUPS
TR Jth — basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

CONGLOMERATE
SANDSTONE
SILTSTONE
CLAYSTONE
CARBONACEOUS CLAYSTONE
COAL
LIMESTONE
VOLCANICS
VOLCANIC MUDFLOW
SILTY CLAYSTONE

GR-Sustut 80(2)A

GULF CANADA RESOURCES INC. Coal Division CALGARY ALBERTA	Gulf
SUSTUT COAL PROJECT GEOLOGY MAP B-3	
PREPARED BY: M. DUFORD	SCALE 1: 10,000
APPROVED BY: DATE: OCT. 80	Ss. Dwg. No. 80-003



GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

ANTICLINE: (defined, approximate)

SYNCLINE: (defined, approximate)

ANTICLINE AND SYNCLINE: (overturned)

THRUST FAULT: (defined, approximate, inferred)

FAULT: (circle on downthrow side) (defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

BEDDING: (vertical, horizontal)

S-7000 CROSS SECTION LOCATION

S-TR-8001 TRENCH LOCATION

LEGEND

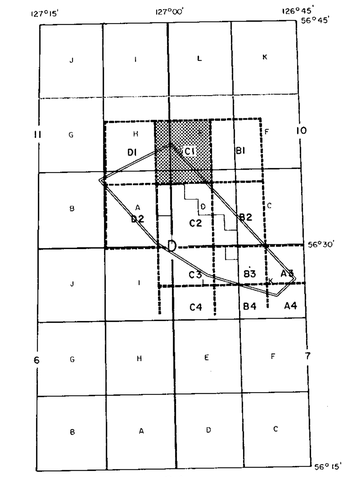
RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES 1000 1050
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
MAIN ROAD
SECONDARY ROAD
TRACK
TRAIL
CUT LINE
RAILROAD
BUILDING
COAL LICENCE 5857

FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
0 100 200 400 600 800 1000 METERS



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SUSTUT AREA

INDEX MAP

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GR Sustut 80/GIA

SUSTUT MAP
GEOLOGIC LEGEND

CONGLOMERATE
SANDSTONE
SILTSTONE
CLAYSTONE
CARBONACEOUS CLAYSTONE
COAL
LIMESTONE
VOLCANICS
VOLCANIC MUDFLOW
SILTY CLAYSTONE

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Jb_1 – thinly bedded marine claystone

Jb – undifferentiated

Tr Jth — TAKLA & HAZELTON GROUPS
– basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
GEOLOGY

MAP C-1

PREPARED BY: M. DUFORD	SCALE 1:10,000
APPROVED BY: DATE: OCT. 80	Ss. Dwg. No. 80-004

127°01'30"
56°34'

126°55'30"
56°34'

BASELINE

S-11000

S-9460

S-8000

S-7000

S-6260

S-5000

56°30'
127°01'30"

126°55'30"
56°30'

RED CREEK FAULT

SYDNEY RIDGE THRUST

AUSTRALIA LAKE

WHITE SEAL PEAK

5483 5481 5482 5480 5479 5478 5477 5476 5475 5474 5473 5472

Jb1 Jb2 Jb3 Kt Jth

GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

ANTICLINE: (defined, approximate)

SYNCLINE: (defined, approximate)

ANTICLINE AND SYNCLINE: (overturned)

THRUST FAULT: (defined, approximate, inferred)

FAULT: (circle on downthrow side) (defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

BEDDING: (vertical, horizontal)

S-7000 CROSS SECTION LOCATION

S-TR-8001 TRENCH LOCATION

LEGEND

RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES 1000 / 950
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
MAIN ROAD
SECONDARY ROAD
TRACK
TRAIL
CUT LINE
RAILROAD
BUILDING
COAL LICENCE 5857

FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
100 200 400 600 800 1000 METERS

127°15' 127°00' 126°45' 56°45'
56°30'
56°15'

J I L K
H E F 10
G 11
D1 C1 B1
A B2 C
B2 D B2
C3 B3 A3
C4 B4 A4
J I
6 G H E F 7
B A D C

94 SUSTUT AREA
INDEX MAP

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GR. Sustut 80(21)A

SUSTUT MAP
GEOLOGIC LEGEND

CONGLOMERATE
SANDSTONE
SILTSTONE
CLAYSTONE
CARBONACEOUS CLAYSTONE
COAL
LIMESTONE
VOLCANICS
VOLCANIC MUDFLOW
SILTY CLAYSTONE

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Jb1 — thinly bedded marine claystone

Jb — undifferentiated

Jth — TAKLA & HAZELTON GROUPS
— basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

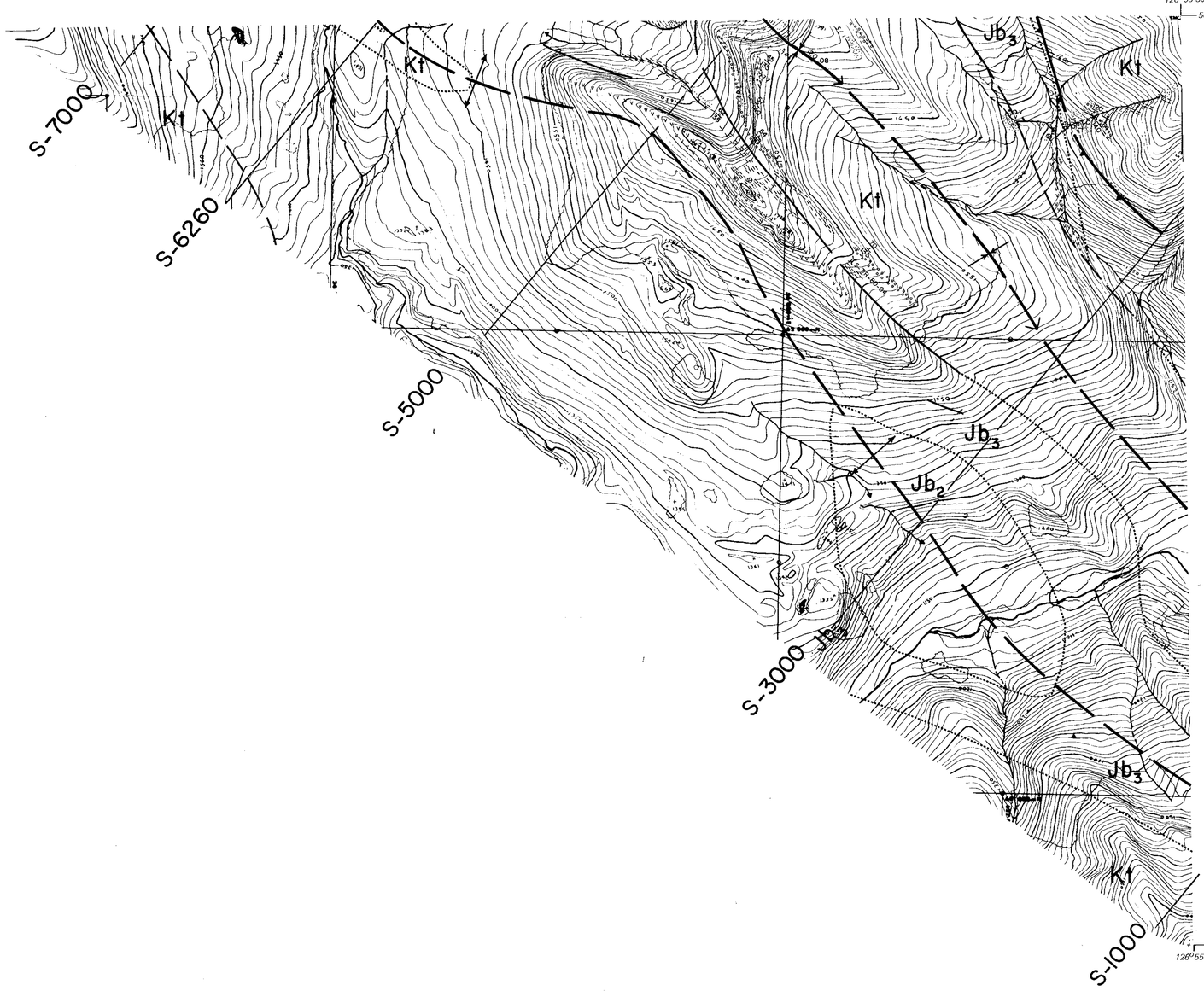
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
GEOLOGY

MAP C-2

PREPARED BY: M. DUFORD	SCALE 1: 10,000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80-005



GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

ANTICLINE: (defined, approximate)

SYNCLINE: (defined, approximate)

ANTICLINE AND SYNCLINE: (overturned)

THRUST FAULT: (defined, approximate, inferred)

FAULT: (circle on downthrow side) (defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

BEDDING: (vertical, horizontal)

S-7000 CROSS SECTION LOCATION

S-TR-8001 TRENCH LOCATION

LEGEND

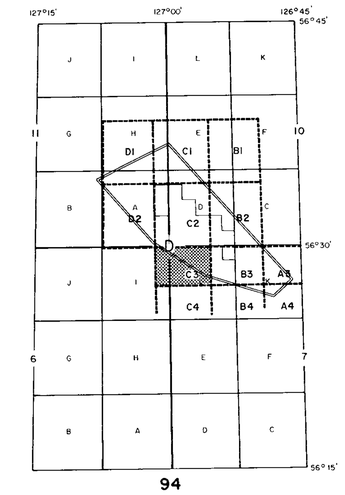
RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES 1000 1050
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
MAIN ROAD
SECONDARY ROAD
TRACK
TRAIL
CUT LINE
RAILROAD
BUILDING
COAL LICENCE 5857

FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
0 100 200 400 600 800 1000 METERS



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SUSTUT AREA

INDEX MAP

GR-Sustut 80-03A

SUSTUT MAP
GEOLOGIC LEGEND

CONGLOMERATE
SANDSTONE
SILTSTONE
CLAYSTONE
CARBONACEOUS CLAYSTONE
COAL
LIMESTONE
VOLCANICS
VOLCANIC MUDFLOW
SILTY CLAYSTONE

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Jb – undifferentiated

T_R Jth — TAKLA & HAZELTON GROUPS
– basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
GEOLOGY
MAP C-3

PREPARED BY: M. DUFORD	SCALE 1:10,000
APPROVED BY: DATE: OCT. 80	Ss. Dwg. No. 80-006

GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

ANTICLINE: (defined, approximate)

SYNCLINE: (defined, approximate)

ANTICLINE AND SYNCLINE: (overturned)

THRUST FAULT: (defined, approximate, inferred)

FAULT: (circle on downthrow side) (defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

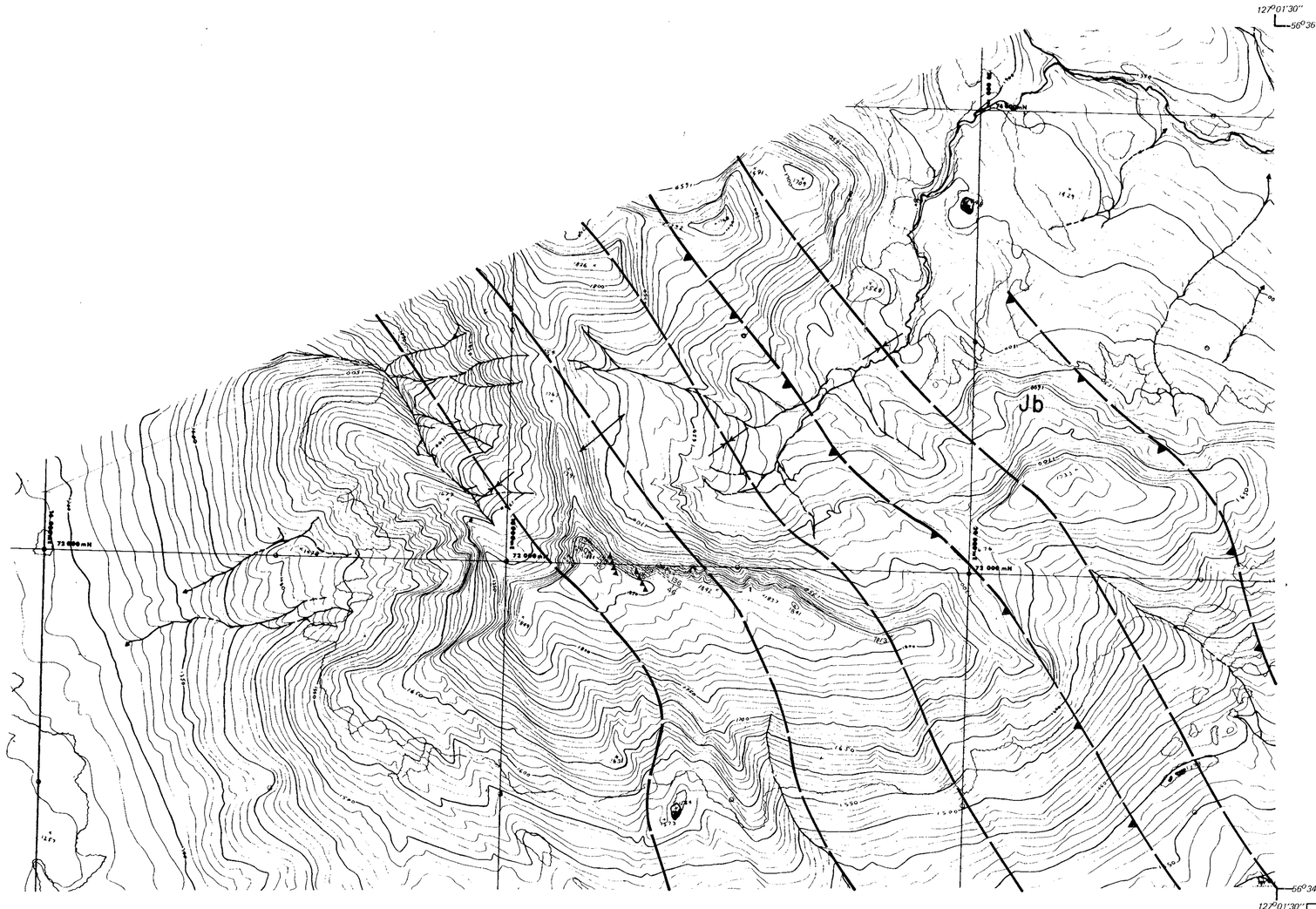
BEDDING: (vertical, horizontal)

S-7000 CROSS SECTION LOCATION

S - TR - 8001 TRENCH LOCATION

127°07'30"
56°36'

127°01'30"
56°36'



56°34'
127°07'30"

127°01'30"
56°34'

LEGEND

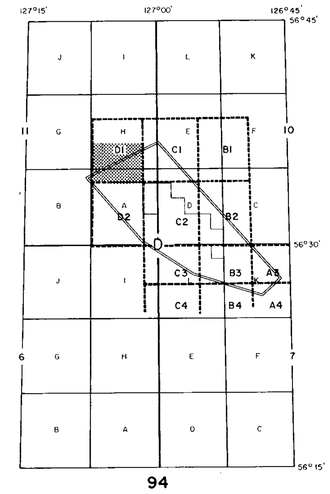
RIVER
STREAM
LAKE
SAND
TREE LINE
FORM LINES 1000 1050
DEPRESSION FORM LINE
SPOT HEIGHT × 1012
MAIN ROAD
SECONDARY ROAD
TRACK
TRAIL
CUT LINE
RAILROAD
BUILDING
COAL LICENCE 5857

FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
0 100 200 400 600 800 1000 METERS



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SUSTUT AREA
INDEX MAP

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GSR - Sustut 80(19)

SUSTUT MAP
GEOLOGIC LEGEND

CONGLOMERATE
SANDSTONE
SILTSTONE
CLAYSTONE
CARBONACEOUS CLAYSTONE
COAL
LIMESTONE
VOLCANICS
VOLCANIC MUDFLOW
SILTY CLAYSTONE

Kt — TANGO CREEK FORMATION
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Jb_2 – interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb_1 – thinly bedded marine claystone

Jb – undifferentiated

TR Jth — TAKLA & HAZELTON GROUPS
– basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

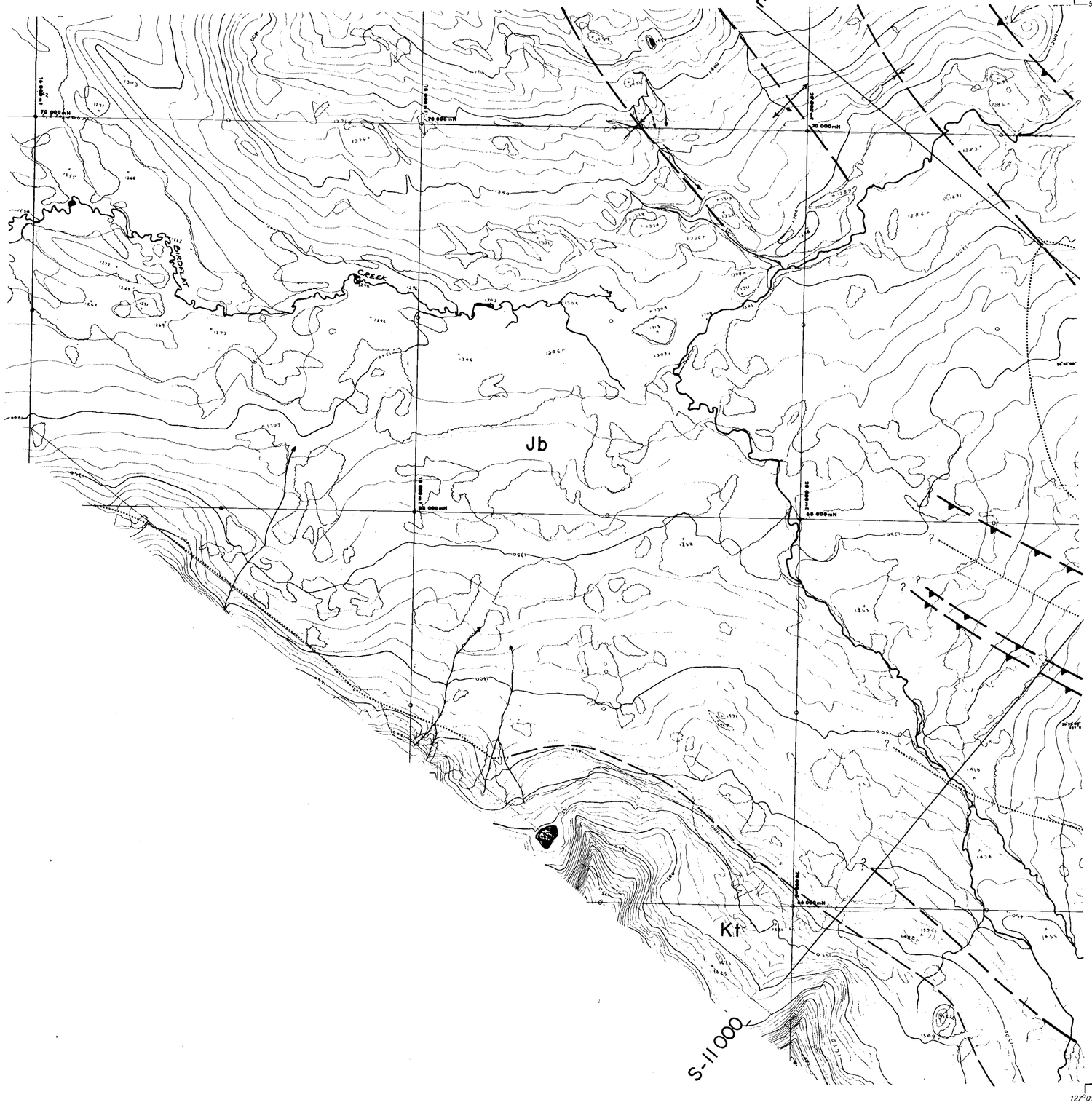
SUSTUT COAL PROJECT
GEOLOGY

MAP D-I

PREPARED BY: M. DUFORD	SCALE 1 : 10,000
APPROVED BY: DATE: OCT. 80	Ss. Dwg. No. 80-007

127°01'30"
56°34'

BASELINE



56°31'
127°07'30"

56°31'
127°01'30"

- GEOLOGICAL BOUNDARY: (defined, approximate, inferred)
- COAL ZONE
- ANTICLINE: (defined, approximate)
- SYNCLINE: (defined, approximate)
- ANTICLINE AND SYNCLINE: (overturned)
- THRUST FAULT: (defined, approximate, inferred)
- FAULT: (circle on downthrow side) (defined, approximate, inferred)
- DIP AND STRIKE: (bedding overturned)
- BEDDING: (vertical, horizontal)
- S-7000 CROSS SECTION LOCATION
- S-TR-8001 TRENCH LOCATION

LEGEND

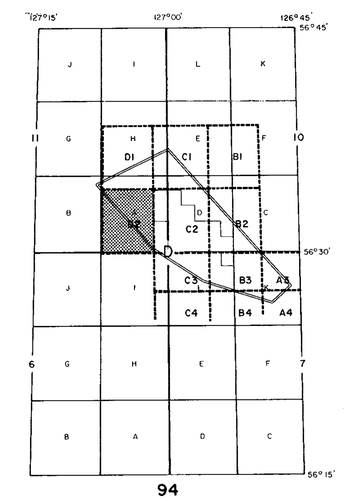
- RIVER
- STREAM
- LAKE
- SAND
- TREE LINE
- FORM LINES (1000 / 1050)
- DEPRESSION FORM LINE
- SPOT HEIGHT × 1012
- MAIN ROAD
- SECONDARY ROAD
- TRACK
- TRAIL
- CUT LINE
- RAILROAD
- BUILDING
- COAL LICENCE 5857

FORM LINE INTERVAL 10 METRES

SURVEY NOTE
SURVEY CONTROL TAKEN FROM EXISTING PHOTO IDENTIFIABLE GOVERNMENT SURVEY MONUMENTS AND N.T.S. MAPS. MAPPING IS BASED ON UNIVERSAL TRANSVERSE MERCATOR GRID AND GEODETIC DATUM.

SCALE : 1:10,000

0 1/8 1/4 1/2 3/4 MILE
0 100 200 400 600 800 1000 METERS



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SUSTUT AREA
INDEX MAP

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GR-Sustut 80(a)A

SUSTUT MAP
GEOLOGIC LEGEND

- Kt — TANGO CREEK FORMATION — basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.
- Jb_3 — BOWSER LAKE GROUP — mudflow, containing carbonized tree fragments, interbedded with volcanics
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- Jb_1 — thinly bedded marine claystone
- Jb — undifferentiated
- T_R Jth — TAKLA & HAZELTON GROUPS — basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

- CONGLOMERATE
- SANDSTONE
- SILTSTONE
- CLAYSTONE
- CARBONACEOUS CLAYSTONE
- COAL
- LIMESTONE
- VOLCANICS
- VOLCANIC MUDFLOW
- SILTY CLAYSTONE

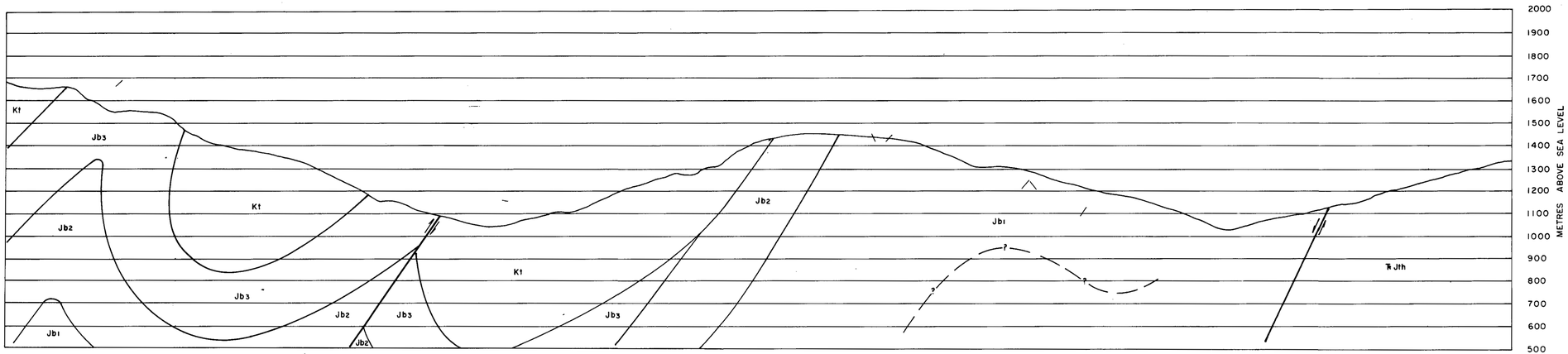
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
GEOLOGY

MAP D-2

PREPARED BY: M. DUFORD	SCALE 1:10,000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. No. 80-008

S.W.



N.E.

2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500

METRES ABOVE SEA LEVEL

Kt		TANGO CREEK FORMATION - basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.
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Jb3		- mudflow, containing carbonized tree fragments, interbedded with volcanics.
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Jb		- undifferentiated
TrJth		TAKLA & HAZELTON GROUPS - basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115 GR-Sustut BOGIA

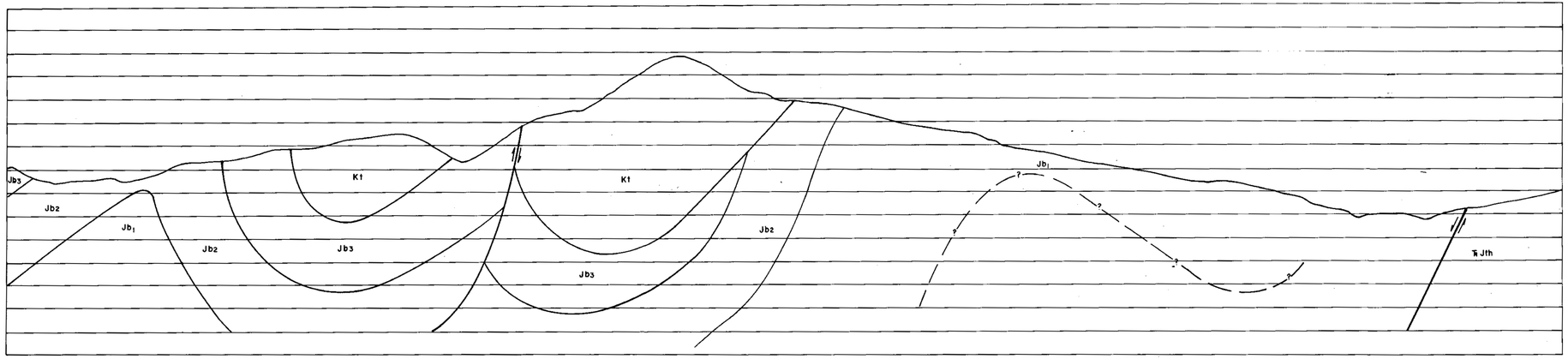
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
CROSS SECTION S 1000

PREPARED BY: M. DUFORD	SCALE 1:10000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80-009

S.W.



N.E.

2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500

METRES ABOVE SEA LEVEL

	Kt	TANGO CREEK FORMATION - basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.
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	Jb3	- mudflow, containing carbonized tree fragments, interbedded with volcanics.
	Jb2	- interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.
	Jb1	- thinly bedded marine claystone.
	Jb	- undifferentiated.
	Tr Jth	TAKLA & HAZELTON GROUPS - basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115

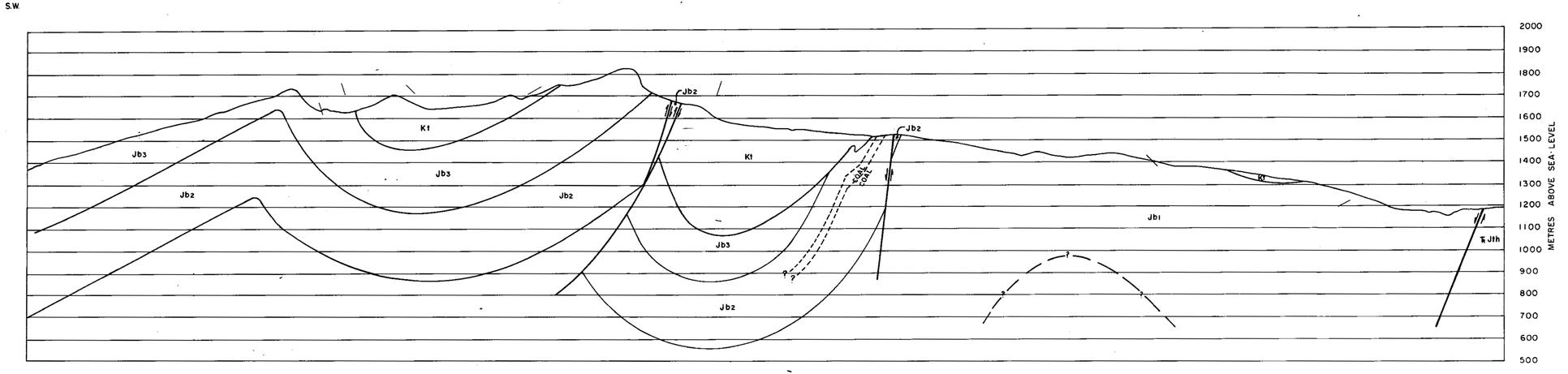
GR-Sustut 80(21)A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
CROSS SECTION S 3000

PREPARED BY: M. DUFORD	SCALE 1:10000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80-010



Kt — TANGO CREEK FORMATION
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BOWSER LAKE GROUP

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¾ Jth — TAKLA & HAZELTON GROUPS
- basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115

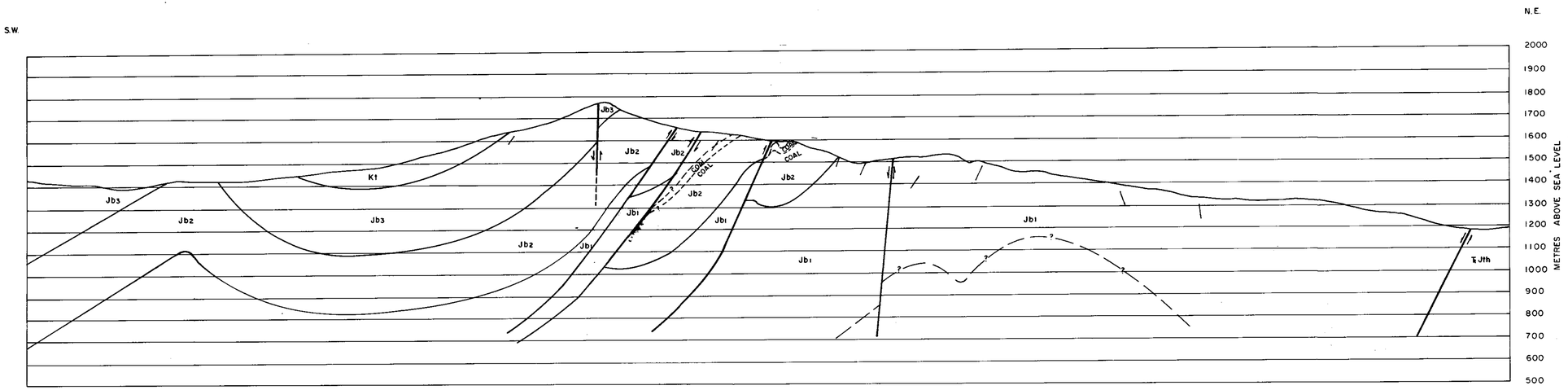
GR-Sustut 80(2)A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
CROSS SECTION S 5000

PREPARED BY: M. DUFORD	SCALE 1 : 10000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80 - 011



K1 TANGO CREEK FORMATION
- basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.

BOWSER LAKE GROUP

Jb3 - mudflow, containing carbonized tree fragments, interbedded with volcanics.

Jb2 - interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb1 - thinly bedded marine claystone.

Jb - undifferentiated.

TJth TAKLA & HAZELTON GROUPS
- basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

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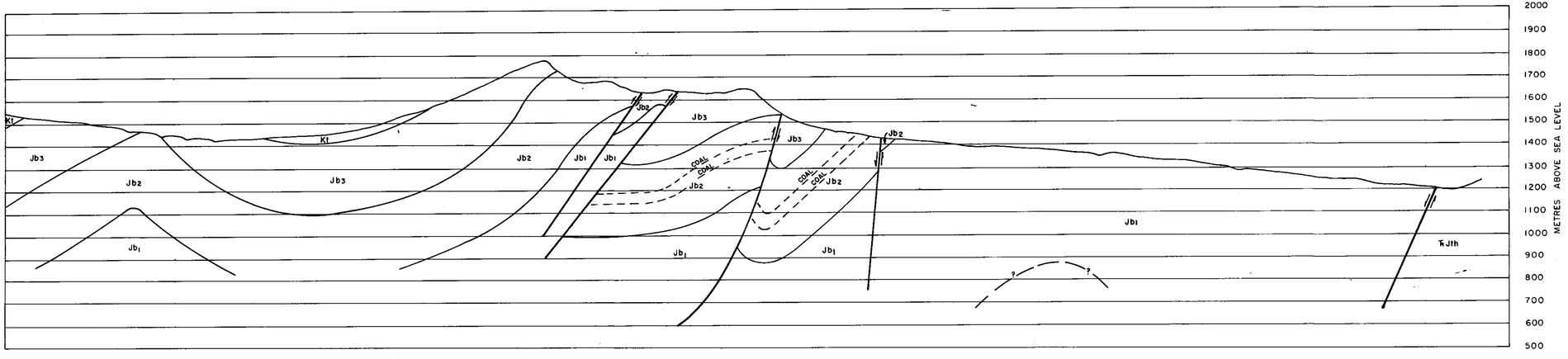
GR- Sustut 80(2)A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
CROSS SECTION S 6260

PREPARED BY: M. DUFORD	SCALE 1:10000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80-012



Kt — TANGO CREEK FORMATION
- basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey above.

BOWSER LAKE GROUP

Jb3 - mudflow, containing carbonized tree fragments, interbedded with volcanics.

Jb2 - interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb1 - thinly bedded marine claystone.

Jb - undifferentiated.

TrJth — TAKLA & HAZELTON GROUPS
- basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115

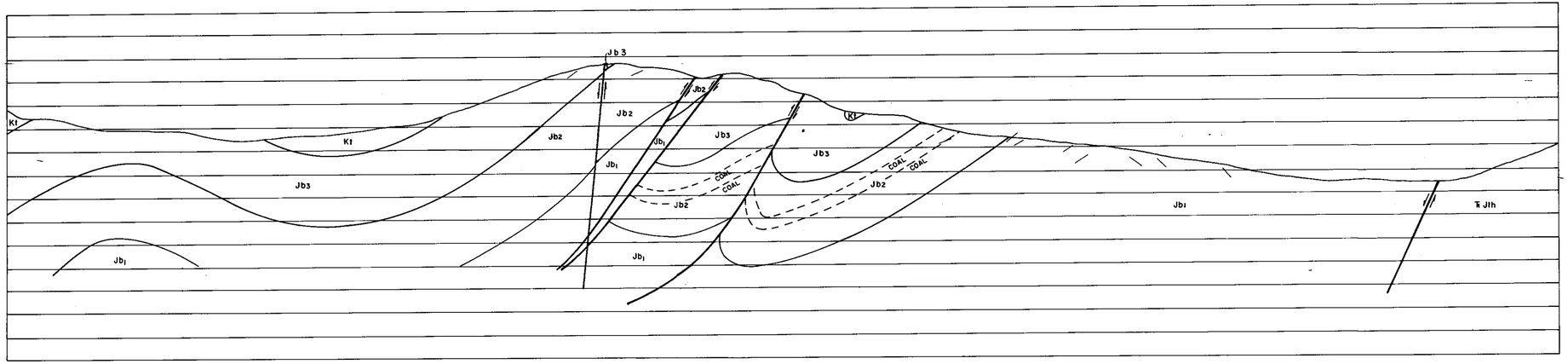
GR. Sustut 80(3)A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
CROSS SECTION S 7000

PREPARED BY: M. DUFORD | SCALE 1:10000
APPROVED BY: | DATE: OCT. '80 | Ss. Dwg. 80-013

S.W



N.E.

Kt — TANGO CREEK FORMATION
- basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.

BOWSER LAKE GROUP

Jb3 - mudflow, containing carbonized tree fragments, interbedded with volcanics.

Jb2 - interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb1 - thinly bedded marine claystone.

Jb - undifferentiated.

TrJth — TAKLA & HAZELTON GROUPS
- basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115

GR-Sustut 80(2)A

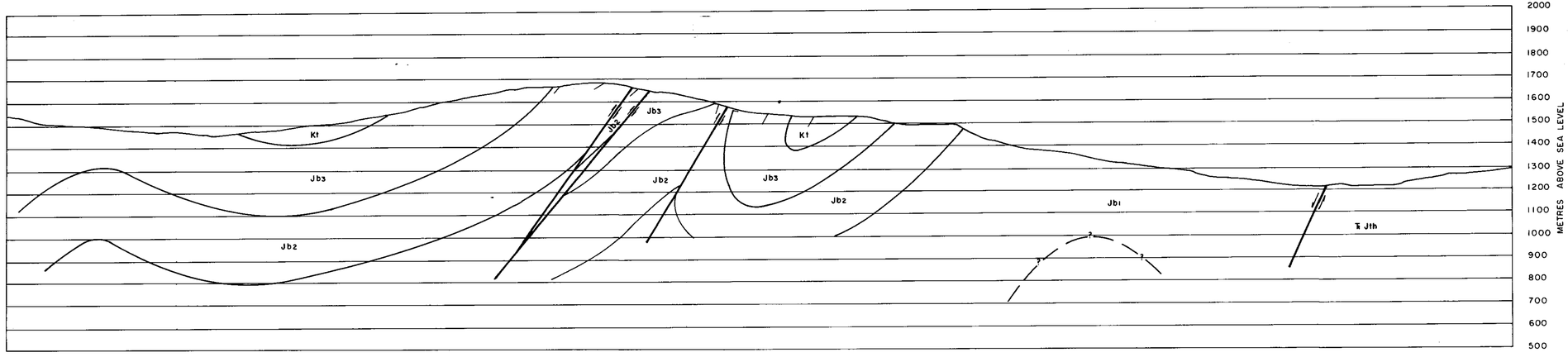
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
CROSS SECTION S 8000

PREPARED BY: M. DUFORD	SCALE 1:10000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80-014

S.W.



N.E.

2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500

METRES ABOVE SEA LEVEL

Kt		TANGO CREEK FORMATION - basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.
		BOWSER LAKE GROUP
Jb3		- mudflow, containing carbonized tree fragments, interbedded with volcanics.
Jb2		- interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.
Jb1		- thinly bedded marine claystone.
Jb		- undifferentiated.
Tr Jth		TAKLA & HAZELTON GROUPS - basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115

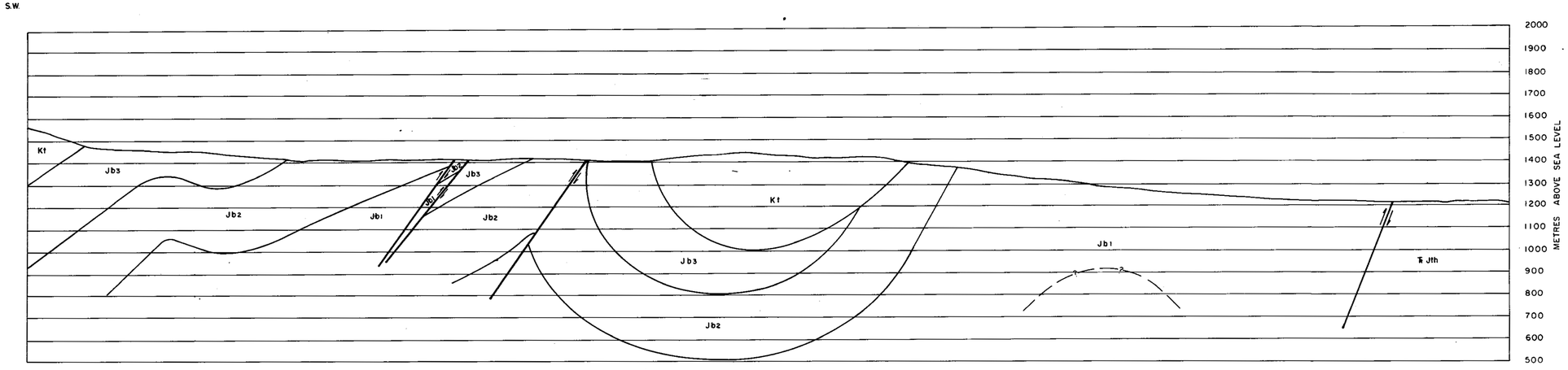
GR- Sustut 80(3)A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT
CROSS SECTION S 9460

PREPARED BY: M. DUFORD	SCALE 1:10000
APPROVED BY: DATE: OCT. '80	Ss Dwg. 80-015



Kt — TANGO CREEK FORMATION
- basal conglomerate overlain by silty claystones: red and green, in lower portion, dark grey in upper.

BOWSER LAKE GROUP

Jb3 - mudflow, containing carbonized tree fragments, interbedded with volcanics.

Jb2 - interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb1 - thinly bedded marine claystone.

Jb - undifferentiated.

TrJth — TAKLA & HAZELTON GROUPS
- basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

115

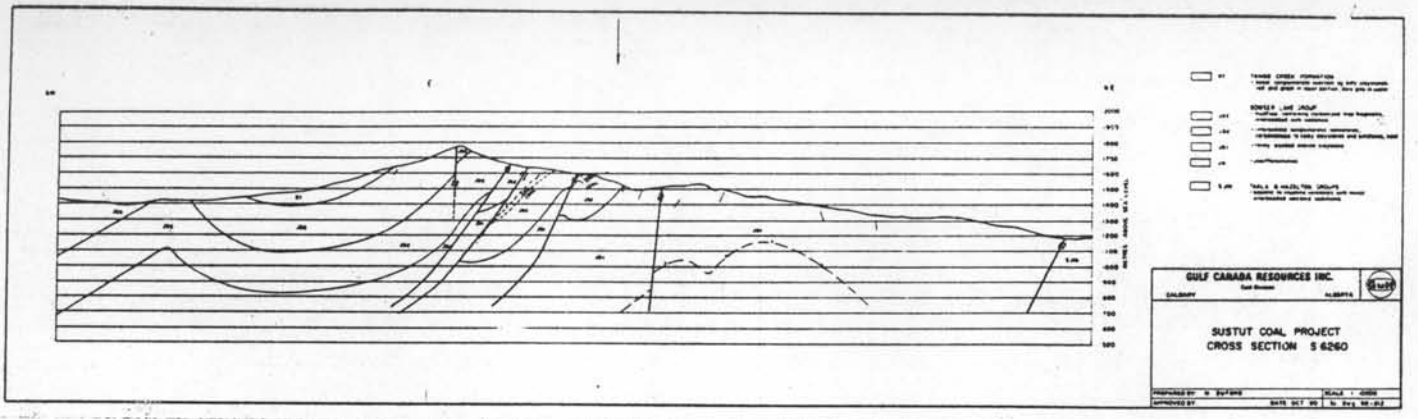
GR Sustut 80(2)A

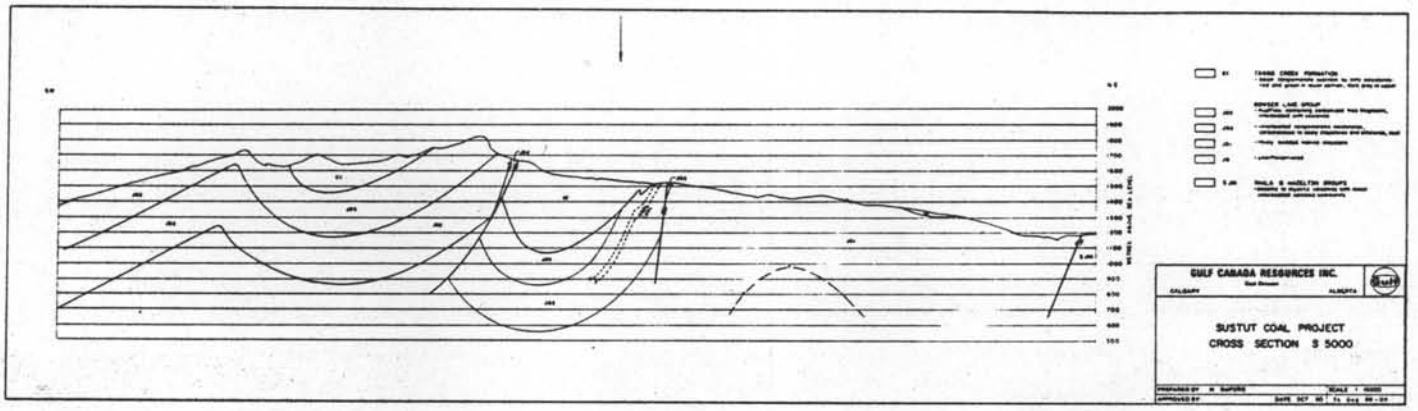
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

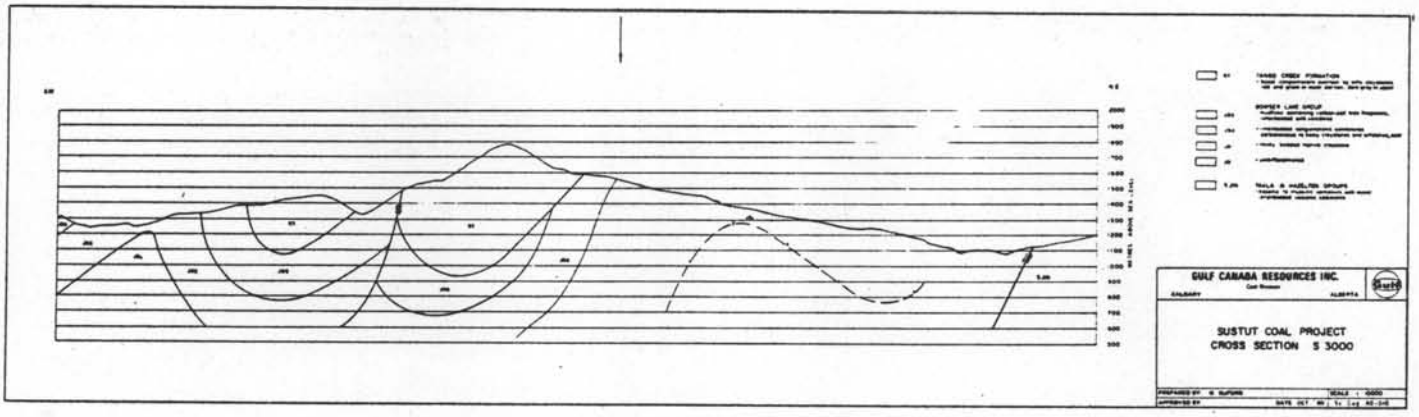
SUSTUT COAL PROJECT
CROSS SECTION S 11000

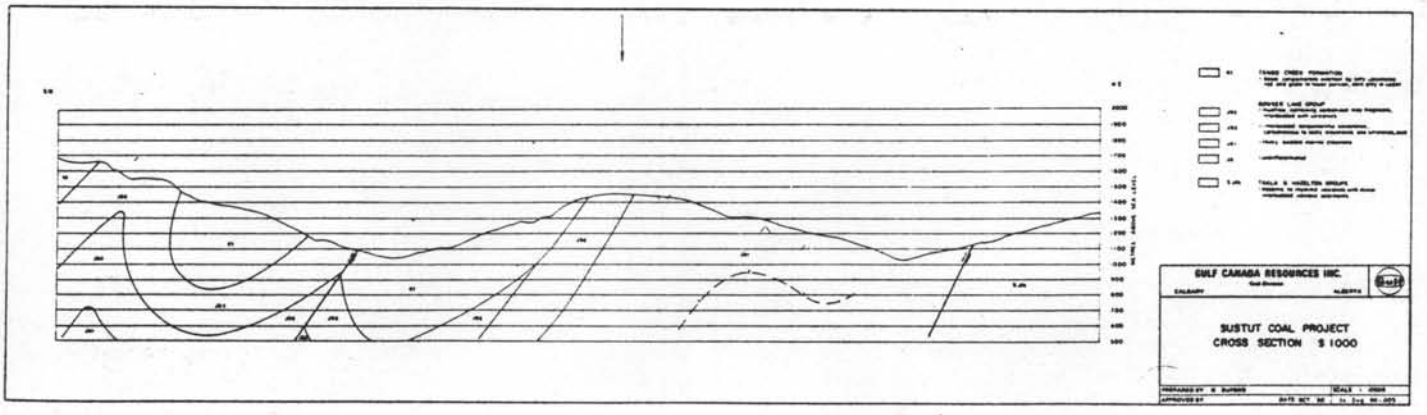
PREPARED BY: M. DUFORD	SCALE 1 : 10000
APPROVED BY: DATE: OCT. '80	Ss. Dwg. 80-016

Reduced. From GR-Sustut 80(2)A

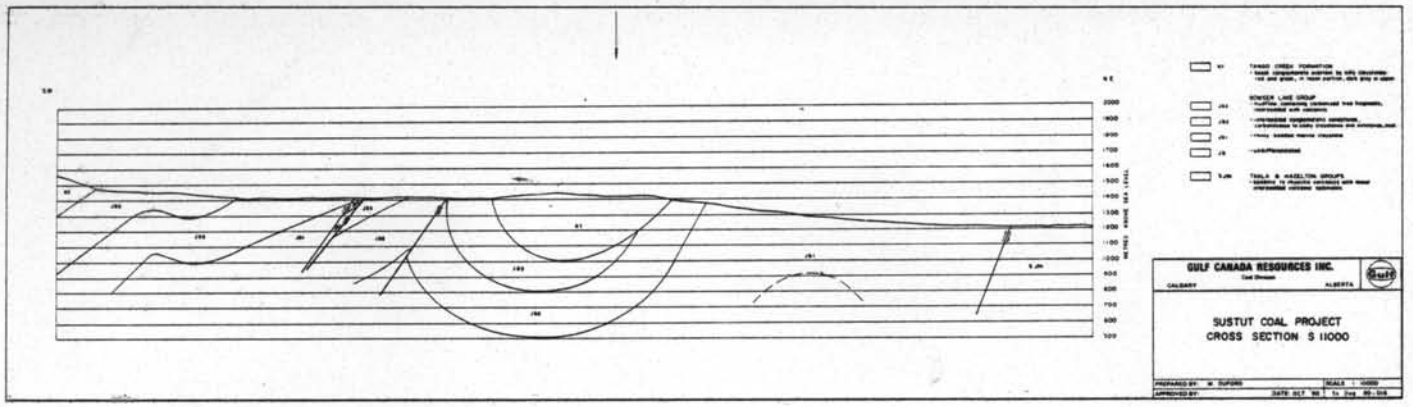


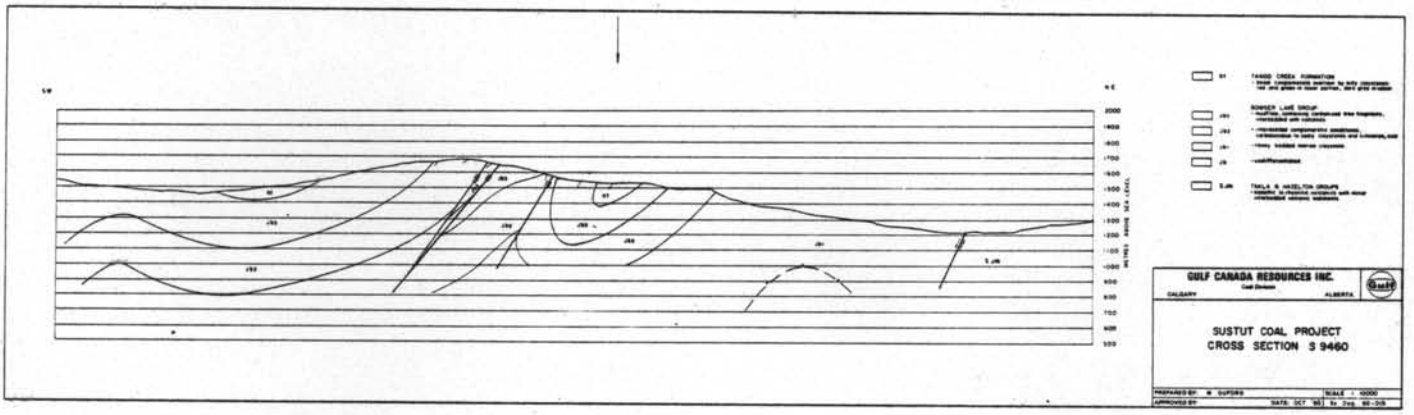


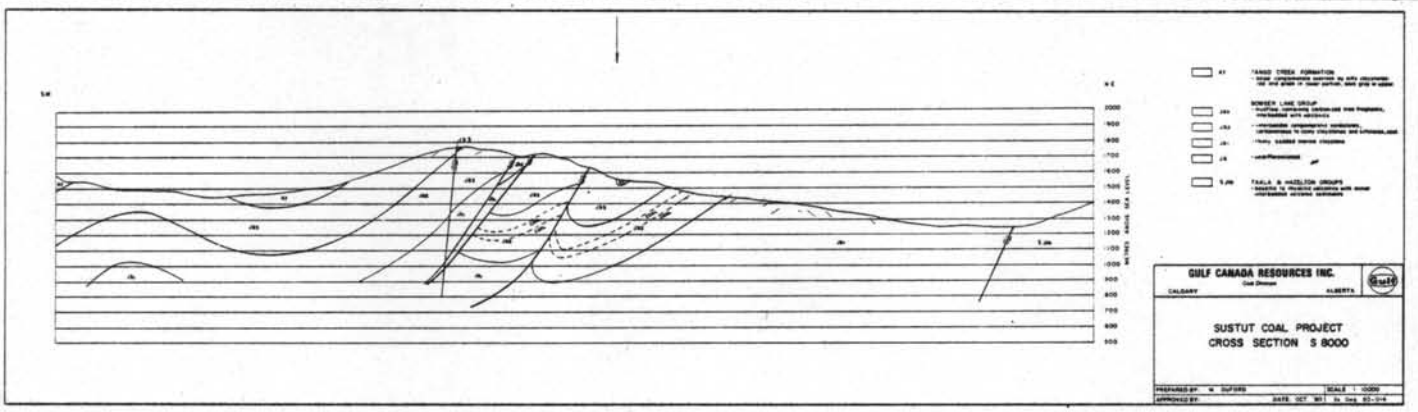


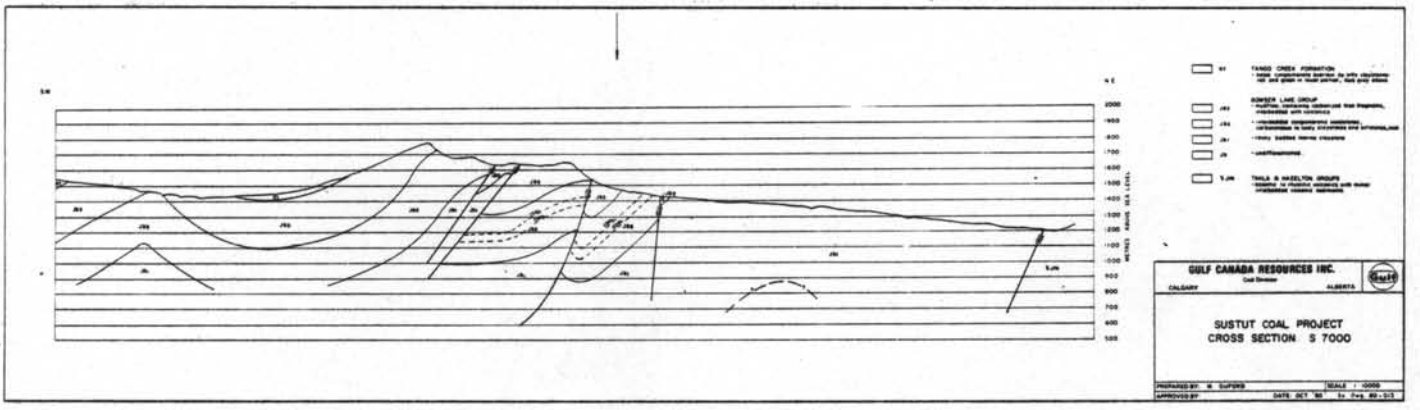


Ss. Dwg. 80-021


GULF CANADA RESOURCES INC.
CALGARY
ALBERTA
SUSTUT COAL PROJECT
CROSS SECTION S 11000


GULF CANADA RESOURCES INC.
CALGARY
ALBERTA
SUSTUT COAL PROJECT
CROSS SECTION S 9460

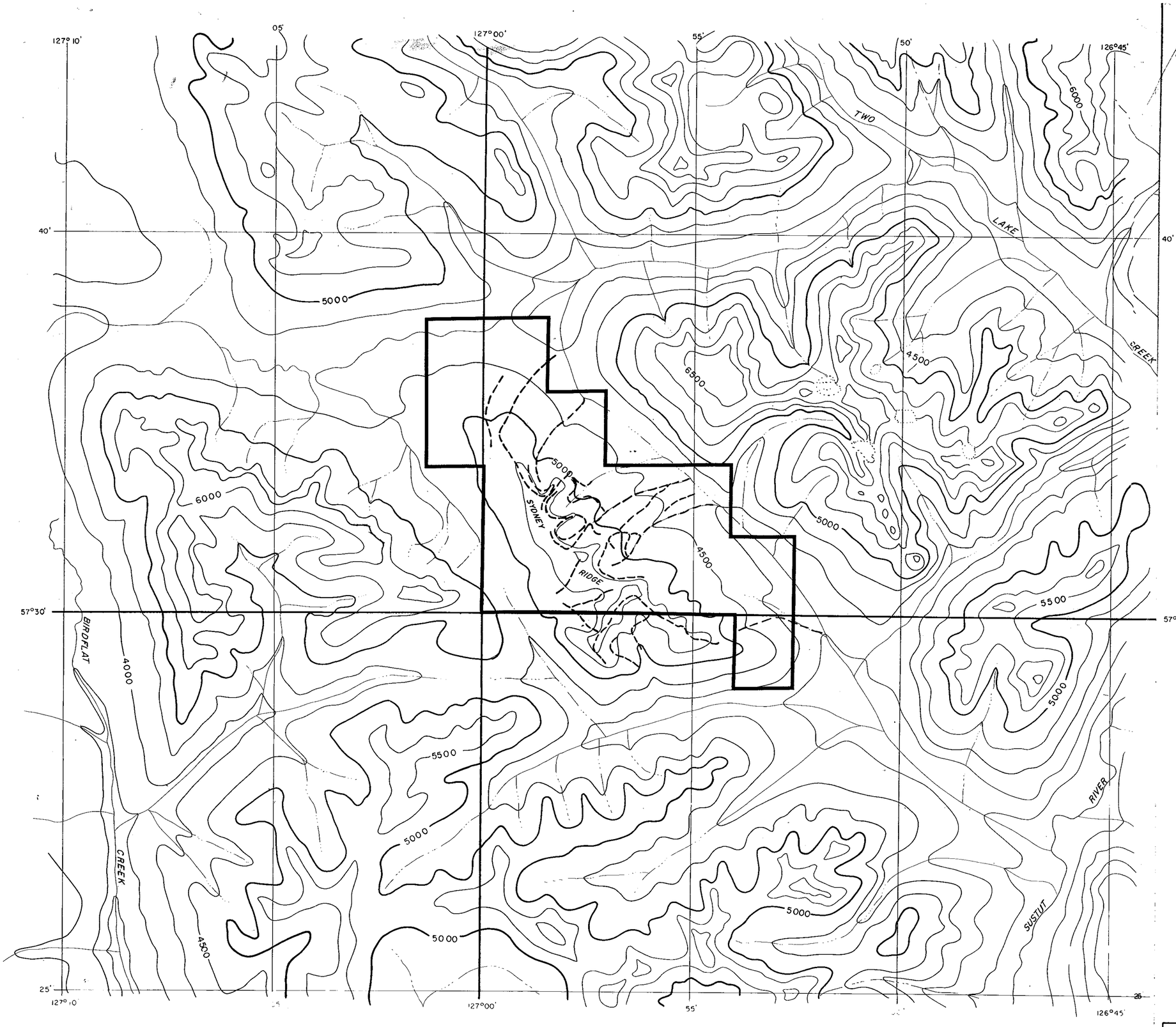

GULF CANADA RESOURCES INC.
CALGARY
ALBERTA
SUSTUT COAL PROJECT
CROSS SECTION S 8000


GULF CANADA RESOURCES INC.
CALGARY
ALBERTA
SUSTUT COAL PROJECT
CROSS SECTION S 7000

Ss. Dwg. 80-020

APPENDIX V

TRAVERSE LOCATION MAP



COAL LICENCES

TRAVERSES

LEGEND

ROADS AND RELATED FEATURES

- HARD SURFACE, ALL WEATHER
- LOOSE SURFACE
- CART TRACK, WINTER ROAD
- TRAIL, CUT LINE, PORTAGE
- BUILT-UP AREA
- RAILWAY, SIDING, STATION, STOP
- BRIDGE
- SEAPLANE BASE, ANCHORAGE

LANDMARK FEATURES

- HOUSE, BARN
- CHURCH, SCHOOL
- POST OFFICE
- HISTORICAL SITE
- TOWERS: FIRE, RADIO
- WELL: OIL, GAS
- TANK: OIL, GASOLINE, WATER
- TELEPHONE LINE
- POWER TRANSMISSION LINE
- MINE
- CUTTING, EMBANKMENT
- GRAVEL PIT

BOUNDARIES AND SURVEY CONTROL

- INTERNATIONAL, PROVINCIAL, BOUNDARY MONUMENT
- COUNTY, DISTRICT
- TOWNSHIP, PARISH-SURVEYED, UNSURVEYED
- TOWNSHIP, DLS - SURVEYED, UNSURVEYED
- SECTION CORNERS
- MUNICIPALITY
- INDIAN RESERVE, PARK, ETC
- HORIZONTAL SURVEY POINT
- BENCH MARK WITH ELEVATION
- SPOT ELEVATION, PRECISE: LAND, WATER

DRAINAGE AND RELATED FEATURES

- STREAM, SHORELINE: INDEFINITE
- DIRECTION OF FLOW
- LAKE, INTERMITTENT LAKE
- FLOODED LAND
- MARSH, SWAMP (WOODED)
- DRY RIVER BED WITH CHANNELS
- SAND ABOVE, IN WATER
- STRING BOG
- TUNDRA: PONDS, POLYGONS
- RAPIDS, FALLS, RAPIDS
- FORESHORE FLATS
- ROCK
- DAM
- WHARF
- DITCH

RELIEF FEATURES

- CONTOURS
- APPROXIMATE CONTOURS
- DEPRESSION CONTOUR
- SPOT ELEVATION, APPROXIMATE: LAND, WATER
- ESKER
- PINGO
- SAND, SAND DUNES
- PALSA BOG
- WOODED AREA
- CLEARED AREA

T.N.

M.N.

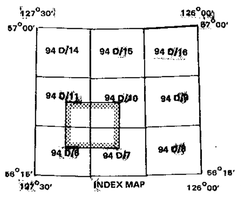
CORRECTED TO 1980

The declination of the compass needle at any place along a red line is the declination given on that red line. At other places the declination is between those given on the neighbouring red lines, those at the place marked A, the declination is between 31 45'E and 32 30'E. The annual decrement of the compass needle are decreasing 6.5 minutes annually.

SCALE

0 1 2 3 4 MILES

0 1000' 2000 3000 4000 5000' METRES



115

GR-Sustut 80(21)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT 1980
TRAVERSE LOCATION MAP

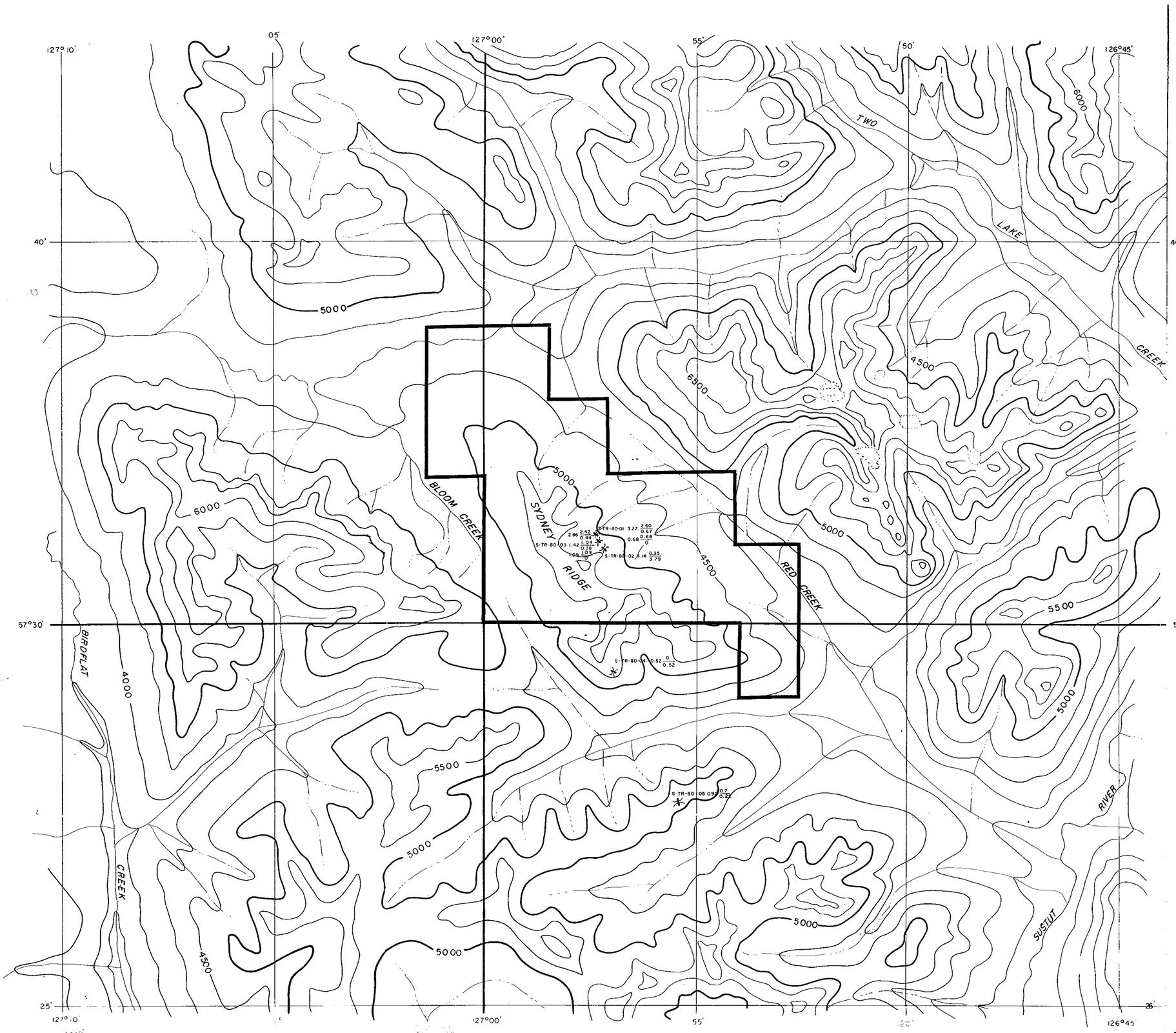
CONTOUR INTERVAL = 500'

DRAWN BY:	DATE:	SCALE 1:50 000
PREPARED BY:		DRAWING No.
APPROVED BY:	DATE: 1980	Ss. Dwg. 80 - 017

FILE No. 79519

APPENDIX VI

TRENCH LOCATION MAP



TRENCH
S-TR-80-01 TRENCH NUMBER
4.14 2.25 / 1.39 SEAM THICKNESS AND COAL / ROCK RATIO

A COAL LICENCES

LEGEND

ROADS AND RELATED FEATURES
HARD SURFACE, ALL WEATHER
LOOSE SURFACE
CART TRACK, WINTER ROAD
TRAIL, CUT LINE, PORTAGE
BUILT-UP AREA
RAILWAY, SIDING, STATION, STOP
BRIDGE
SEAPLANE BASE, ANCHORAGE

LANDMARK FEATURES
HOUSE, BARN
CHURCH, SCHOOL
POST OFFICE
HISTORICAL SITE
TOWERS: FIRE, RADIO
WELL: OIL, GAS
TANK: OIL, GASOLINE, WATER
TELEPHONE LINE
POWER TRANSMISSION LINE
MINE
CUTTING, EMBANKMENT
GRAVEL PIT GP

BOUNDARIES AND SURVEY CONTROL
INTERNATIONAL, PROVINCIAL, BOUNDARY MONUMENT
COUNTY, DISTRICT
TOWNSHIP, PARISH: SURVEYED, UNSURVEYED — UNSURVEYED
TOWNSHIP, DLS: SURVEYED, UNSURVEYED
SECTION CORNERS
MUNICIPALITY
INDIAN RESERVE, PARK, ETC
HORIZONTAL SURVEY POINT
BENCH MARK WITH ELEVATION — BM 965
SPOT ELEVATION, PRECISE: LAND, WATER — 397 721.2

DRAINAGE AND RELATED FEATURES
STREAM, SHORELINE: INDEFINITE
DIRECTION OF FLOW
LAKE, INTERMITTENT LAKE
FLOODED LAND
MARSH, SWAMP (WOODED)
DRY RIVER BED WITH CHANNELS
SAND: ABOVE, IN WATER
STRING BOG — SB
TUNDRA, PONDS, POLYGONS — TP: PG
RAPIDS, FALLS, RAPIDS
FORESHORE FLATS
ROCK
DAM — DAM
WHARF
DITCH

RELIEF FEATURES
CONTOURS
APPROXIMATE CONTOURS
DEPRESSION CONTOUR
SPOT ELEVATION, APPROXIMATE: LAND, WATER
ESKER
PINGO
SAND, SAND DUNES — SAND, PB
MUSKEG — W
WOODED AREA — C
CLEARED AREA

T.N. M.N.

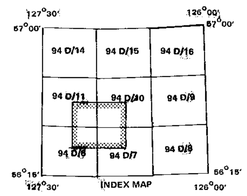
CORRECTED TO 1980

The declination of the compass needle at any place along a red line is the declination given on that red line. At other places the declination is between those given on the neighbouring red lines, close to the place marked A, the declination is between N 28°E and N 29°E
The yearly changes of the compass needle are decreasing
4.5 minutes annually

SCALE

0 1 2 3 4 MILES

0 1000' 2000 3000 4000' 5000 METRES



115 GR Sustut 80(2)A

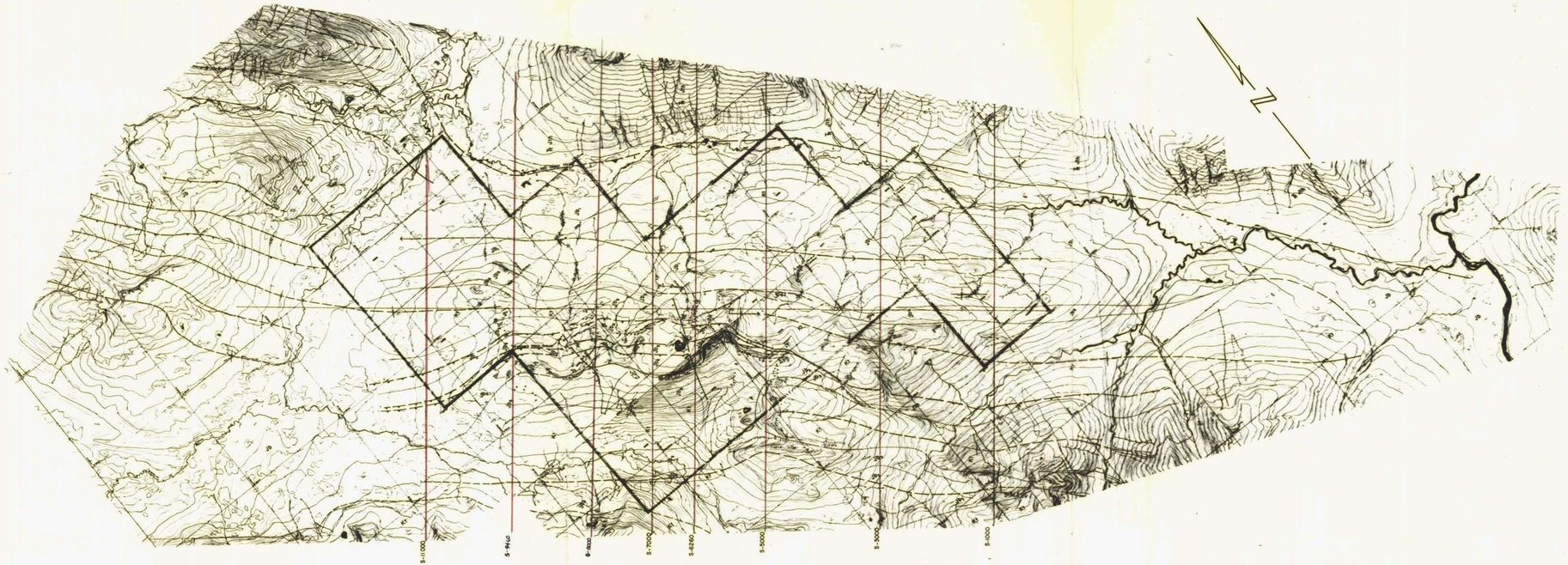
GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
TRENCH LOCATIONS

CONTOUR INTERVAL = 500'

DRAWN BY:	DATE:	SCALE 1:50 000
PREPARED BY:		DRAWING No.
APPROVED BY:	DATE: , 1980	Ss. Dwg. 80-018

FILE No. 79519



1:50,000

SUSTUT MAP
GEOLOGIC LEGEND

TANGO CREEK FORMATION

Kt - basal conglomerate overlain by silty claystones: red and green in lower portion, dark grey in upper.

BOWSER LAKE GROUP

Jb_3 - mudflow, containing carbonized tree fragments, interbedded with volcanics.

Jb_2 - interbedded conglomeratic sandstones, carbonaceous to coaly claystones and siltstones, coal.

Jb_1 - thinly bedded marine claystone

Jb - undifferentiated

TAKLA & HAZELTON GROUPS

T_R Jth - basaltic to rhyolitic volcanics with minor interbedded volcanic sediments.

GEOLOGICAL BOUNDARY: (defined, approximate, inferred)

COAL ZONE

ANTICLINE: (defined, approximate)

SYNCLINE: (defined, approximate

ANTICLINE AND SYNCLINE: (overturned)

THRUST FAULT: (defined, approximate, inferred)

FAULT: (circle on downthrow side)(defined, approximate, inferred)

DIP AND STRIKE: (bedding overturned)

BEDDING: (vertical, horizontal)

S-7000 CROSS SECTION LOCATION

S-TR-80-01 TRENCH LOCATION

115 GR-Sustut 80(3)A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

SUSTUT COAL PROJECT
GEOLOGY MAP

PREPARED BY: M. DUFORD
APPROVED BY:
SCALE 1:50,000
DATE OCT. '80
Ss. Dwg. 80-119

APPENDIX VII

BASE MAP PREPARATION PROCEDURE

HARDY ASSOCIATES (1978) LTD.

CONSULTING ENGINEERING & PROFESSIONAL SERVICES

File No.

December 21, 1979

CALGARY OFFICE (MAIN)
219 - 18th STREET S.E.
CALGARY, ALBERTA
T2E 6J5
TELEPHONE: (403) 272-8761
TELEX NO.: 03-826717

Gulf Resources Canada Inc.
401 Ninth Avenue S.W.
Calgary, Alberta
T2P 3C5

Attention: Mr. Brian Flynn

Dear Sir:

Re: Reconnaissance Type Photogrammetric Mapping of the Sustut and Panorama Project Areas

In reference to our meeting in your office with yourself and Mr. G.D. Childs, we are pleased to submit the following proposal to satisfy your photogrammetric mapping requirements on the above two project areas.

To obtain the 1:10 000 approximate scale reconnaissance type photogrammetric mapping with a 10 metre form line interval, we propose the following procedures:

1) We will obtain from the Federal Government photography and diapositives covering the Sustut Project at the approximate scale of 1:72 000; and we will obtain from the British Columbia Government the set of contact prints and diapositives for the Panorama Project at the approximate scale of 1:63 000.

2) For control in the above mapping, we shall utilize existing data, i.e. Government monuments and locations providing they are photo identifiable, and survey control from existing NTS maps.

3) Prior to mapping, we will carry out aerial triangulation and numerical adjustment for both project areas.

4) Mapping will be carried out on our first and second order stereo plotter instruments and we will submit to you, as an end product, pencil manuscripts showing the approximate position of UTM grids and all necessary details as specified for this type of reconnaissance mapping by the CAAS.

Production of this type of reconnaissance mapping is very economical and may be accomplished within a short period of time. However, the mapping will only be as accurate as existing data and their photo identifiability. In other words, the relative elevation between form lines will be good but absolute elevation differences for the whole property, plus the scale, will not be exact or as reliable as if special survey had been carried out for the project. The map, therefore, is only a reconnaissance type map which can only be used as a tool during the field geology, but cannot be used for detailed evaluation or engineering feasibility studies, etc.

The entire Sustut area will be mapped photogrammetrically, as aforementioned, and the maps will be produced on irregular sheet sizes on reproducible cronoflex sheets. However, the Panorama area which is outlined and marked number 10 on the 1:250 000 map sheets will be mapped photogrammetrically and the area between the two blocks will be mapped by enlarging the existing 1:50 000 map sheets to the 1:10 000 scale and hand interpolate 50 metre form lines and trace all other details. For both areas, the extent of the maps and mapping area is shown on the Appendix maps.

We estimate that producing both maps could take as long as 3 1/2 to 4 months of which 2 months would be spent obtaining necessary data, material, and carrying out aerial triangulation and numerical adjustments. It is our understanding that no photo reproduction, enlargements or reductions will be carried out by our organization, but that

this will be taken care of by your company in accordance with our specifications.

It is also our understanding that you may require ortho photos for both the above properties. For the ortho photos, we suggest we utilize the diapositives produced by us and controlled for the mapping. The ortho photos should be produced at the approximate scale of 1:20 000 (end product would not be good at the 1:10 000 approximate scale because of the 7 X enlargement) on the individual model basis. All photo reproduction in connection with the ortho photos should be carried out by your organization. To relate the ortho photos to the line map, we suggest the following procedures:

1) Obtain the original ortho photo negatives and Gulf will enlarge them to 1:20 000.

2) Reduce manuscripts of the line map to 1:20 000 (some of the lines such as intermediate contours may not reproduce very well because the original is only pencil).

3) By fitting ortho photo negatives by their control points on the line map, the grids should be transferred onto the negatives.

4) From the above negatives, screen cronoflex positives on photographic paper prints should be produced as an end product.

5) If you should require a composite and ortho photos to be made from the line map, we strongly recommend that the line map should be redrafted for better reproduction purposes prior to the production of the composite map.

We also discussed the possibility of transferring the geological interpretation onto the line map using a photogrammetric method. It is quite possible and we suggest, some test models should

be done as soon as the field work is completed. We feel that photo geological interpretation could be extended during the plotting phase of the above, if needed, on the geological overlay.

FEE SCHEDULE:

1. To provide aerial triangulation and numerical adjustment to cover both project areas and to produce the above reconnaissance photogrammetric mapping at the approximate scale of 1:10 000 with 10 metre form line intervals as shown on the appendix maps:

   OUR ESTIMATED FEE: $26,000.

   The above fee will include the manual interpretation of the enlarged 1:50 000 map to cover the area between two blocks No. 10 on the Panorama Project, the end product on manuscripts on the reproducible cronoflex sheets as discussed in the attached proposal.

2. To provide ortho photo negatives from existing photograph at the same scale as the photography, our fee will be $120 per model, (please note that all photo reproductions will be done by Gulf Canada Resources Inc.

We thank you for the opportunity of submitting the above proposal and cost estimate. We look forward to hearing from you in the near future.

Yours truly,

HARDY ASSOCIATES (1978) LTD.

J. Kende, C.C.
Director, Mapping Section

JK:bc

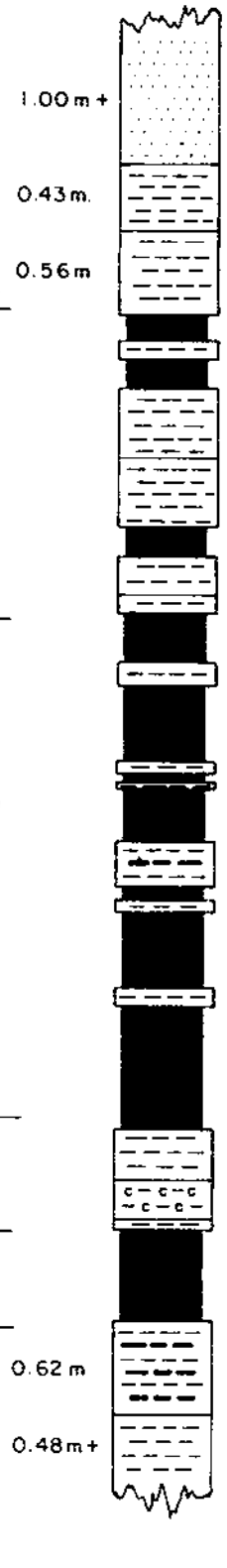
"Sustut Coal Project Geological Report, 1980"

Gulf Canada Resources Inc.

TRENCH LITHOLOGIC LOGS

APPENDIX II

TRENCH LITHOLOGIC LOGS



ROCK	COAL		
	0.18		COAL BRIGHT, HARD
0.13			CLAYSTONE
	0.17		COAL BRIGHT, HARD
0.52			CLAYSTONE, FE STAIN
0.46			CLAYSTONE, FE STAIN
	0.18		COAL DULL, BRIGHT STREAKS, VERY HARD
0.25			CLAYSTONE, FE STAIN
0.13			CLAYSTONE
	0.31		COAL, BRIGHT BANDS
0.14			CLAYSTONE
	0.48		COAL DULL, BRIGHT STREAKS, HARD
0.05	0.05		CLAYSTONE
0.03			COAL
	0.40		CLAYSTONE
			COAL DULL, VERY HARD
3.27			
0.30			CLAYSTONE, COALY BANDS
	0.10		COAL
0.04			CLAYSTONE, FE STAIN
	0.49		COAL DULL, MANY BRIGHT BANDS, HARD
0.11			CLAYSTONE, FE STAIN
	0.77		COAL DULL WITH BRIGHT BANDS
0.67	2.60		
SUB-TOTAL 0.33			CLAYSTONE
0.24			CLAYSTONE, CARBONACEOUS
0.04			CLAYSTONE
0.68	0.68		COAL DULL, FEW BRIGHT BANDS
SUB-TOTAL	0	0.68	
TOTAL	2.77	3.81	

1.00 m +
SANDSTONE, F. G.

0.43 m.
CLAYSTONE

0.56 m
CLAYSTONE

0.62 m
CLAYSTONE, COALY LENSES

0.48 m +
CLAYSTONE, CARBONACEOUS PLANT FRAGMENTS

01379
01380
01381
01382

Sa. No.

ATTITUDE OF ROOF : 128/63 SW
ATTITUDE OF FLOOR : 136/83 SW

GULF CANADA RESOURCES INC

Gulf

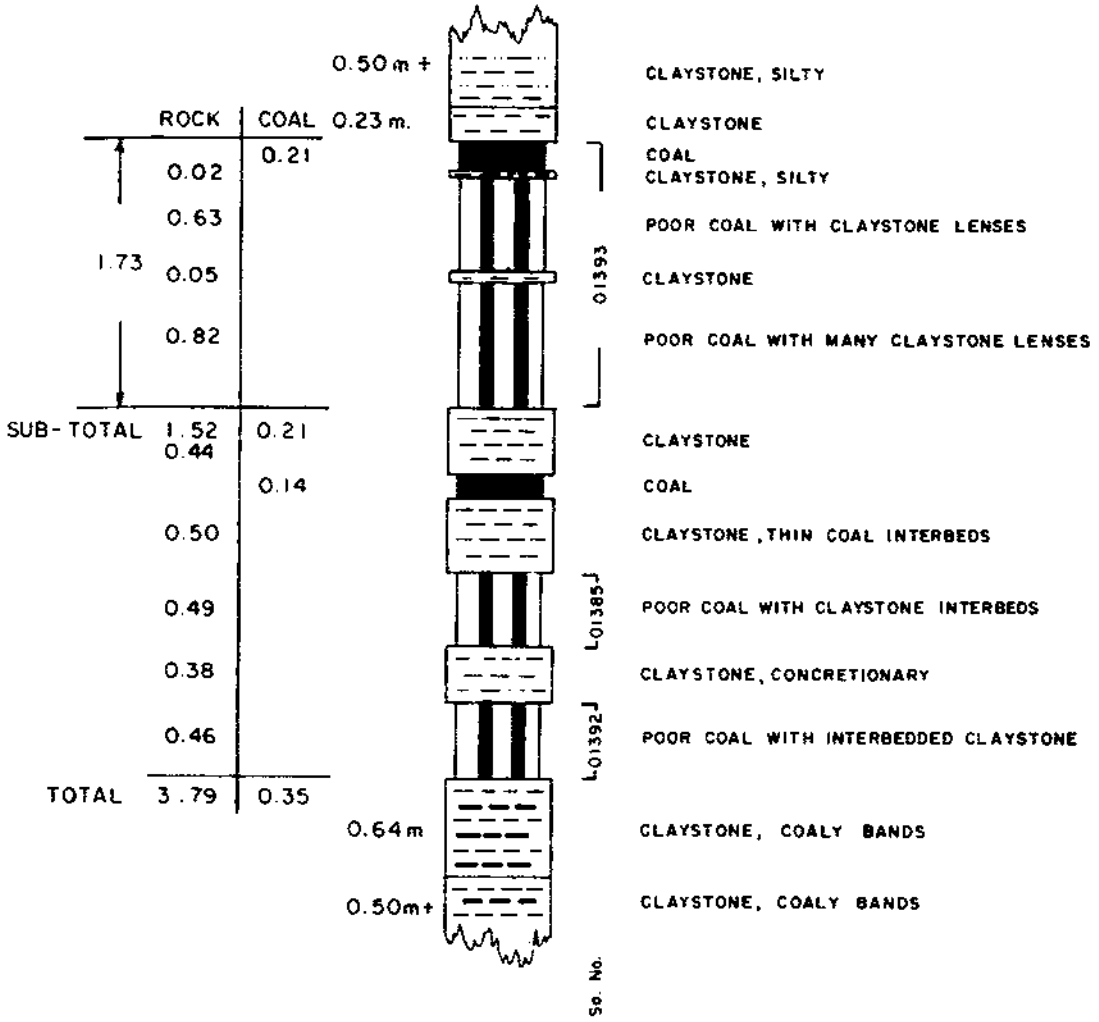
SUSTUT COAL PROJECT

TRENCH LOG

S-TR-80-01

L. CHILD — 25-9-80 — 1:50
J. INNIS

Sa. Dwg. 80-022



ATTITUDE OF ROOF : 119/50 SW
ATTITUDE OF FLOOR : N/A slumped

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT

TRENCH LOG

S-TR-80-02

DRAWN BY L CHILD DATE 25-9-80 SCALE 1:50
PREPARED BY J INNIS DRAWING NO.
APPROVED BY DATE Ss. Dwg. 80-023

ROCK	COAL		
	0.10		COAL
	0.18		
0.42			CLAYSTONE
	0.80		COAL
0.16			CLAYSTONE
	0.29		COAL,
2.86 0.02		01387	CLAYSTONE PARTINGS
	0.70		COAL, A FEW CLAYSTONE LENSES
0.15			CLAYSTONE, SOME COAL
	0.46		COAL
0.11			CLAYSTONE, LENSES OF BRIGHT COAL
	0.17		COAL, A FEW CLAYSTONE LENSES
SUB-TOTAL 0.44	2.42		
0.75			CLAYSTONE
	0.19		COAL
0.31			CLAYSTONE
0.76			CLAYSTONE, CARBONACEOUS
	0.04		COAL
0.86			CLAYSTONE
	0.25		COAL, CLAYSTONE LENSES
0.19			CLAYSTONE
	0.32	01388	COAL
1.42 0.19			CLAYSTONE, CARBONACEOUS
	0.47		COAL, CLAYSTONE BANDS
SUB-TOTAL 0.38	1.04		
0.21	0.09		COAL
0.89			CLAYSTONE
	0.17		COAL
0.39			CLAYSTONE, COALY
	0.06		COAL
0.85			CLAYSTONE
1.09	1.09	01389	COAL, DULL, CLAYSTONE BANDS
SUB-TOTAL 0	1.09		
2.50			CLAYSTONE, CARBONACEOUS, FEW COALY BANDS
	0.20		COAL
TOTAL 8.76	5.58		
1.00 m+			CLAYSTONE

So. No.

ATTITUDE OF ROOF : 121/50 SW

ATTITUDE OF FLOOR : N/A (creep)

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA
Gulf

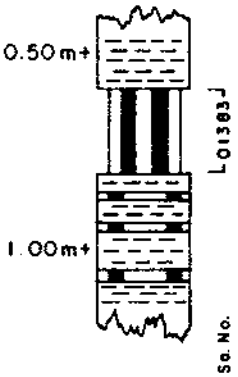
SUSTUT COAL PROJECT

TRENCH LOG

S-TR-80-03

DRAWN: L. CHILD
PREPARED: J. INNIS
APPROVED:
DATE: 25 9 80
SCALE: 1:50
DRAWING #: Ss. Dwg. 80-024

	ROCK	COAL
	0.52	
TOTAL	0.52	0



CLAYSTONE

POOR COAL

CLAYSTONE , PARTING AT 15 cm. INTERVALS

/

ATTITUDE OF ROOF : 132/64 NE

ATTITUDE OF FLOOR : N/A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT

TRENCH LOG

S-TR-80-04

DRAWN BY L. CHILD DATE 25-9-80 SCALE 1:50
PREPARED BY J. INNIS DRAWING No.
APPROVED BY DATE Ss. Dwg. 80-025

ROCK	COAL		
		0.30 m+	CLAYSTONE
		0.27 m	CLAYSTONE, CARBONACEOUS, SOME COALY STREAKS.
0.05	0.04		COAL
	0.26		CLAYSTONE, CARBONACEOUS COAL, SOME CLAYSTONE
0.08			CLAYSTONE, CARBONACEOUS
	0.22		COAL, CLAYBANDS
0.09			CLAYSTONE
	0.18		COAL, WEATHERED
		0.20 m+	CLAYSTONE
TOTAL 0.22	0.70		

ATTITUDE OF ROOF : 110/33°SW
ATTITUDE OF FLOOR : N/A

GULF CANADA RESOURCES INC.
Coal Division
CALGARY ALBERTA

Gulf

SUSTUT COAL PROJECT

TRENCH LOG

S-TR-80-05

DRAWN BY L. CHILD DATE 25-9-80 SCALE 1:50
PREPARED BY J. INNIS DRAWING No.
APPROVED BY DATE Ss. Dwg. 80-026

GR- Sustut 80(4)A

"Sustut Coal Project Geological Report, 1980"

GULF CANADA RESOURCES INC.

115

GR-Sustut 80(4)A

APPENDIX III

COAL QUALITY DATA

CONFIDENTIAL

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SUSTUT TRENCH SAMPLES

1.5 FLOAT/SINK RESULTS*

		FLOAT						SINK			
TRENCH	SAMPLE NUMBER	YIELD%	RESIDUAL MOISTURE%	ASH%	VOLATILE MATTER%	FIXED CARBON%	SULPHUR%	BTU/LB	YIELD%	ASH%	HEAD ASH%
S-TR-80-01	01379	41.85	0.63	10.34	14.80	74.23	0.47	14 162	58.15	57.34	37.67
S-TR-80-01	01380/81	33.00	0.82	11.11	14.97	73.10	0.54	13 849	67.00	56.29	41.38
S-TR-80-01	01382	30.64	0.59	5.73	16.28	77.40	0.48	14 847	69.36	62.58	45.16
S-TR-80-02	01385	2.19	3.08	12.38	21.37	63.17	0.47	11 979	97.81	75.96	74.57
S-TR-80-02	01392	9.33	5.22	10.71	24.62	59.45	0.57	11 069	90.67	74.00	68.09
S-TR-80-02	01393	7.47	5.30	10.63	25.56	58.51	0.52	10 854	92.53	66.23	62.08
S-TR-80-03	01387	30.06	2.35	6.63	20.45	70.57	0.56	12 958	69.94	53.37	39.32
S-TR-80-03	01388	24.91	1.90	8.11	22.21	67.78	0.60	12 563	75.09	44.70	35.59
S-TR-80-03	01389	35.97	3.61	8.28	21.33	66.78	0.64	12 434	64.03	33.11	24.18
S-TR-80-04	01383	13.41	2.51	10.88	23.11	63.50	0.50	12 071	86.59	53.44	47.73
S-TR-80-05	01390	38.15	2.35	9.94	26.23	61.48	0.69	11 911	61.85	50.22	34.85
AVERAGE+		32.74	1.65	8.37	18.34	71.64	0.55	13 469	62.26	30.74	37.22

* All Results Are Air Dried Basis Unless Otherwise Noted

+ Average Based on the Six Samples From Trenches S-TR-80-01 and S-TR-80-03

SUSTUT TRENCH SAMPLE ANALYSES

Sample Number:	01387	01379-81
Trench Number:	S-TR-80-03	S-TR-80-01
	RAW COAL ANALYSIS	
Ash	37.22	39.14
Mositure	5.51	0.97
Volatile	18.17	13.75
Fixed Carbon	39.10	46.14
BTU/LB.	7142	8656
Sulphur	0.35	0.35
Specific Gravity	1.75	1.71
H.G.I.	98	80
	SIZE CONSIST	
3/8" x 28 Mesh	68.80	84.95
28 x 100 Mesh	19.66	10.15
100 x 0 Mesh	11.54	4.90
	3/8" x 28 Mesh	
Ash	43.66	39.55
Moisture	4.51	0.92
Volatile	16.09	13.67
Fixed Carbon	35.74	45.86
BTU/LB.	6276	3505
Sulphur	0.21	0.30
	28 x 100 Mesh	
Ash	22.64	32.33
Moisture	6.42	1.03
Volatile	21.76	14.70
Fixed Carbon	49.18	51.94
BTU/LB.	9058	9940
Sulphur	0.52	0.38
	100 x 0 Mesh	
Ash	23.78	35.12
BTU/LB.	8205	9477

FLOAT/SINK RESULTS

Sample Number: 01387
Trench Number: S-TR-80-03

3/8" x 28 Mesh

S.G.	WT%	ASH%	BTU/LB.	CUM. WT.%	CUM. ASH%	CUM. BTU/LB.
1.4	17.23	1.47	14459	17.23	1.47	14459
1.5	5.32	9.98	11547	22.55	3.48	13722
1.6	11.04	18.43	9944	33.59	8.39	12514
1.7	10.81	27.70	8357	44.4	13.09	11502
1.8	7.83	37.05	7019	52.23	16.68	10830
+1.8	47.77			100		

28 x 100 Mesh

1.4	28.92	2.32	13785	28.92	2.32	13785
1.5	27.18	6.64	11953	56.10	4.41	12897
1.6	12.85	15.64	10138	68.95	6.51	12383
1.7	5.73	25.50	8386	74.68	7.96	12077
1.8	3.34	34.21	7301	78.02	9.09	11872
+1.8	21.98			100		

Sample Number: 01379-81
Trench Number: S-TR-80-01

3/8" x 28 Mesh

1.4	24.61	4.40	14877	24.61	4.40	14877
1.5	10.09	19.29	12323	34.70	8.73	14134
1.6	9.73	29.82	10422	44.43	13.35	13321
1.7	10.34	39.10	8920	54.77	18.21	12490
1.8	6.73	45.50	7571	61.5	21.20	11952
+1.8	38.50			100		

28 x 100 Mesh

1.4	45.43	4.85	14789	45.43	4.85	14789
1.5	8.75	17.22	12636	54.18	6.85	14441
1.6	7.89	27.05	11025	62.07	9.42	14009
1.7	4.95	37.51	8941	67.02	11.49	13633
1.8	3.51	45.88	7620	70.53	13.20	13334
+1.8	29.47			100		

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 1. ANALYSIS OF HEAD SAMPLE

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	39.14	39.52
Moisture %	0.97	-
Volatile Matter %	13.75	13.88
Fixed Carbon %	46.14	46.60
CALORIFIC VALUE: (CAL./gm.)	4,809	4,856
(B.T.U./lb.)	8,656	8,741
SULPHUR %	0.35	0.35
SPECIFIC GRAVITY	1.71	1.72
HARDGROVE GRINDABILITY INDEX	80	

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 2. SIZE CONSIST

Size	Wt. %
3/8" x 28 m.	84.95
28 m. x 100 m.	10.15
100 m. x 0	4.90
	100.00

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 3. ANALYSIS OF 3/8" x 28 MESH SIZE FRACTION

3a. RAW SAMPLE ANALYSIS

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	39.55	39.92
Moisture %	0.92	-
Volatile Matter %	13.67	13.80
Fixed Carbon %	45.86	46.28
CALORIFIC VALUE: (Cal./gm.)	4,725	4,769
(B.T.U./lb.)	8,505	8,584
SULPHUR %	0.30	0.30

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 3. ANALYSIS OF 3/8" x 28 MESH SIZE FRACTION

3b. FLOAT-SINK ANALYSIS (a.d.b.)

	FRACTIONAL			CUMULATIVE		
Sp. Gr.	Yield %	Ash %	BTU/lb.	Yield %	Ash %	BTU/lb.
- 1.40	24.61	4.40	14,877	24.61	4.40	14,877
1.40 - 1.50	10.09	19.29	12,323	34.70	8.73	14,134
1.50 - 1.60	9.73	29.82	10,422	44.43	13.35	13,321
1.60 - 1.70	10.34	39.10	8,920	54.77	18.21	12,490
1.70 - 1.80	6.73	45.50	7,571	61.50	21.20	11,952
+ 1.80	38.50	-	-	100.00	-	-

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 4. ANALYSIS OF 28 MESH X 0 SIZE FRACTION

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	32.33	32.67
Moisture %	1.03	-
Volatile Matter %	14.70	14.85
Fixed Carbon %	51.94	52.48
CALORIFIC VALUE: (Cal./gm.)	5,522	5,579
(B.T.U./lb.)	9,940	10,043
SULPHUR %	0.38	0.38

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 5. ANALYSIS OF 28 MESH X 100 MESH SIZE FRACTION (a.d.b.)

	FRACTIONAL			CUMULATIVE		
Sp. Gr.	Yield %	Ash %	BTU/lb.	Yield %	Ash %	BTU/lb.
- 1.40	45.43	4.85	14,789	45.43	4.85	14,789
1.40 - 1.50	8.75	17.22	12,636	54.18	6.85	14,441
1.50 - 1.60	7.89	27.05	11,025	62.07	9.42	14,007
1.60 - 1.70	4.95	37.51	8,941	67.02	11.49	13,633
1.70 - 1.80	3.51	45.88	7,620	70.53	13.20	13,334
+ 1.80	29.47	-	-	100.00	-	-

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 6. ANALYSIS OF 100 MESH X 0 SIZE FRACTION (a.d.b.)

ASH %		35.12
CALORIFIC VALUE:	(CAL./gm.)	5,265
	(B.T.U./lb.)	9,477

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 7. SIMULATED PRODUCT

7a. CONTRIBUTION BY SIZE FRACTION

Size	Cut Point	Yield %	% of Raw	% of Product
3/8" x 28 m.	1.8	61.50	52.24	83.20
28 m. x 100 m.	1.8	70.53	7.16	11.40
100 m. x 0	1.8	69.10	3.39	5.40
Total	-	-	62.79	100.00

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01379, 01380, 01381

TABLE 7. SIMULATED PRODUCT

7b. ANALYSIS

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	20.92	21.11
Moisture %	0.92	-
Volatile Matter %	15.03	15.17
Fixed Carbon %	63.13	63.72
CALORIFIC VALUE: (Cal./gm.)	6,696	6,758
(B.T.U./lb.)	12,053	12,165
SULPHUR %	0.49	0.49
SPECIFIC GRAVITY	1.46	1.46
HARDGROVE GRINDABILITY INDEX	89	

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 46

Date: Nov.21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 1. ANALYSIS OF HEAD SAMPLE

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	37.22	39.39
Moisture %	5.51	-
Volatile Matter %	18.17	19.23
Fixed Carbon %	39.10	41.38
CALORIFIC VALUE: (CAL./gm.)	3,968	4,199
(B.T.U./lb.)	7,142	7,558
SULPHUR %	0.35	0.37
SPECIFIC GRAVITY	1.75	1.79
HARDGROVE GRINDABILITY INDEX	98	

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 2. SIZE CONSIST

Size	Wt. %
3/8" x 28 m.	68.80
28 m. x 100 m.	19.66
100 m. x 0	11.54
	100.00

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov.21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 3. ANALYSIS OF 3/8" x 28 MESH SIZE FRACTION

3a. RAW SAMPLE ANALYSIS

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	43.66	45.72
Moisture %	4.51	-
Volatile Matter %	16.09	16.85
Fixed Carbon %	35.74	37.43
CALORIFIC VALUE: (Cal./gm.)	3,486	3,651
(B.T.U./lb.)	6,276	6,572
SULPHUR %	0.21	0.22

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 3. ANALYSIS OF 3/8" x 28 MESH SIZE FRACTION

3b. FLOAT-SINK ANALYSIS (a.d.b.)

	FRACTIONAL			CUMULATIVE		
Sp. Gr.	Yield %	Ash %	BTU/lb.	Yield %	Ash %	BTU/lb.
- 1.40	17.23	1.47	14,459	17.23	1.47	14,459
1.40 - 1.50	5.32	9.98	11,547	22.55	3.48	13,722
1.50 - 1.60	11.04	18.43	9,944	33.59	8.39	12,514
1.60 - 1.70	10.81	27.70	8,357	44.40	13.09	11,502
1.70 - 1.80	7.83	37.05	7,019	52.23	16.68	10,830
+ 1.80	47.77	-	-	100.00	-	-

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 4. ANALYSIS OF 28 MESH X 0 SIZE FRACTION

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	22.64	24.19
Moisture %	6.42	-
Volatile Matter %	21.76	23.25
Fixed Carbon %	49.18	52.56
CALORIFIC VALUE: (Cal./gm.)	5,032	5,377
(B.T.U./lb.)	9,058	9,679
SULPHUR %	0.52	0.56

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 5. ANALYSIS OF 28 MESH X 100 MESH SIZE FRACTION (a.d.b.)

	FRACTIONAL			CUMULATIVE		
Sp. Gr.	Yield %	Ash %	BTU/lb.	Yield %	Ash %	BTU/lb.
- 1.40	28.92	2.32	13,785	28.92	2.32	13,785
1.40 - 1.50	27.18	6.64	11,953	56.10	4.41	12,897
1.50 - 1.60	12.85	15.64	10,135	68.95	6.51	12,383
1.60 - 1.70	5.73	25.50	8,396	74.68	7.96	12,077
1.70 - 1.80	3.34	34.21	7,301	78.02	9.09	11,872
+ 1.80	21.98	-	-	100.00	-	-

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 6. ANALYSIS OF 100 MESH X 0 SIZE FRACTION (a.d.b.)

ASH %		23.78
CALORIFIC VALUE:	(CAL./gm.)	4,559
	(B.T.U./lb.)	8,205

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 7. SIMULATED PRODUCT

7a. CONTRIBUTION BY SIZE FRACTION

Size	Cut Point	Yield %	% of Raw	% of Product
3/8" x 28 m.	1.8	52.23	35.93	58.23
28 m. x 100 m.	1.8	78.02	15.34	24.86
100 m. x 0	1.8	90.36	10.43	16.91
Total	-	-	61.70	100.00

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80

GULF CANADA RESOURCES INC.

PROJECT: Sustut

SAMPLE: 01387

TABLE 7. SIMULATED PRODUCT

7b. ANALYSIS

	Air-Dry Basis	Dry Basis
PROXIMATE ANALYSIS:		
Ash %	15.58	16.15
Moisture %	3.53	-
Volatile Matter %	20.59	21.34
Fixed Carbon %	60.30	62.51
CALORIFIC VALUE: (Cal./gm.)	6,011	6,231
(B.T.U./lb.)	10,819	11,215
SULPHUR %	0.52	0.54
SPECIFIC GRAVITY	1.53	1.55
HARDGROVE GRINDABILITY INDEX	120	

CYCLONE ENGINEERING SALES LTD.

File: S1-316

Sample: 39

Date: Nov. 21/80