WILLISTON PROJECT - 1981
GEOLOGY AND DRILL REPORT

Hudbay Coal Company

A Division of Hudson's Bay Oil and Gas Company Limited

GEOLOGICAL AND DRILL REPORT ON

THE WILLISTON PROJECT

(Coal Licences 6793-6862)

HUDSON'S BAY OIL AND GAS COMPANY LIMITED
and
CYPRUS ANVIL MINING CORPORATION

LOCATION: Peace River Land District
N.T.S. 94-B-1
122°24'W longitude, 56°12'N latitude

DATES: January 1 to May 31, 1981

Submitted by
E. Ronayne
Geologist
June 10, 1981

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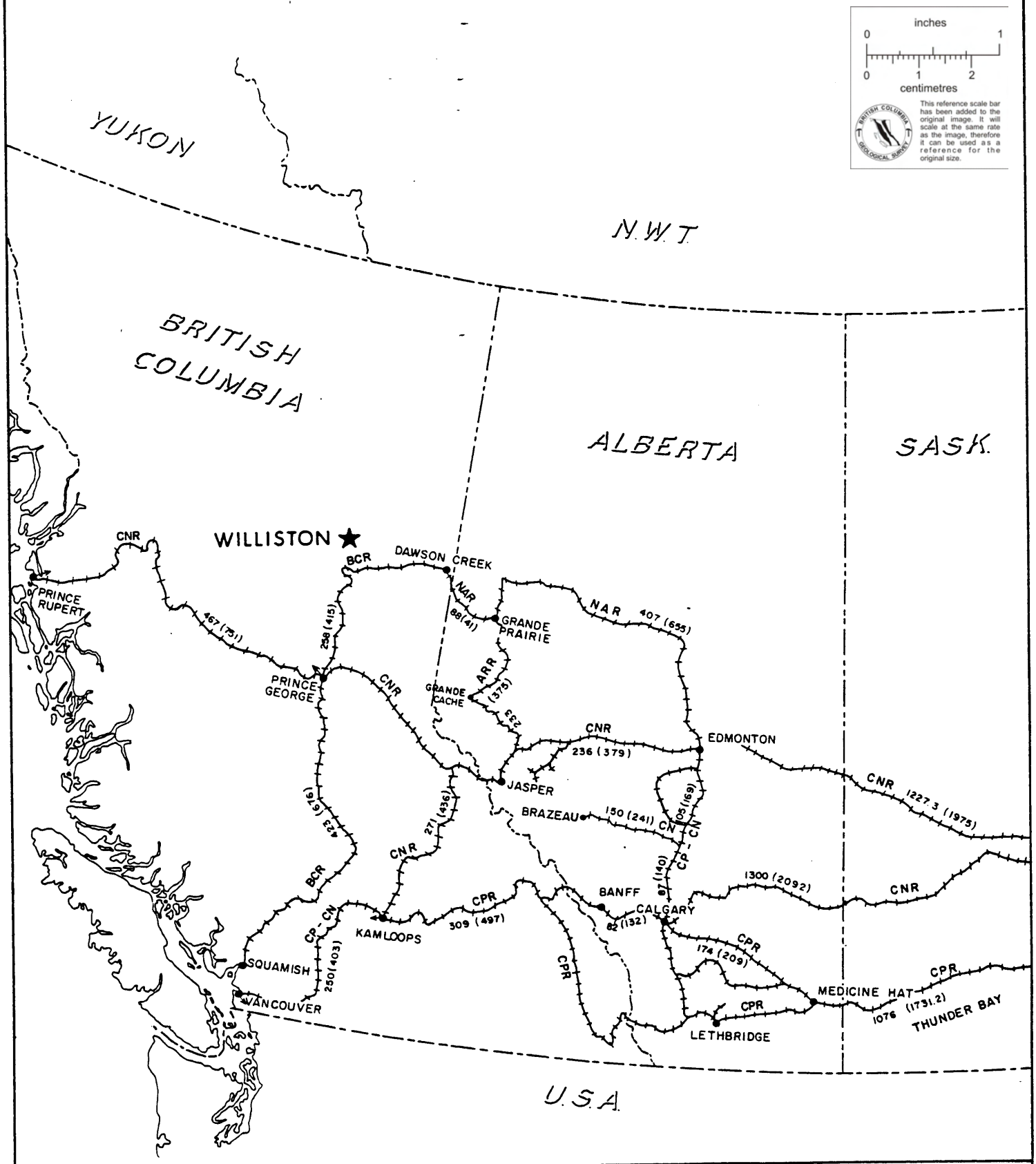


ARR - ALBERTA RESOURCES RAILWAY (CNR OPERATOR)
BCR - BRITISH COLUMBIA RAILWAY
CNR - CANADIAN NATIONAL RAILWAY
CPR - CANADIAN PACIFIC RAILWAY
NAR - NORTHERN ALBERTA RAILWAY

100 50 0 100 200 STATUTE MILES

100 0 100 200 KILOMETERS

inches
0 1
0 1 2
centimetres

This reference scale bar has been added to the original image. It will scale at the same rate as the image, therefore it can be used as a reference for the original size.

Hudbay Coal Company
A Division of Hudson's Bay Oil and Gas Company Limited
CALGARY ALBERTA

WILLISTON

GENERAL LOCATION MAP

SCALE 1" = 125 miles	DWN BY J. Loader		DATE 1980-09
APPR BY		FILE No.	HC 2189 R

1.0 SUMMARY

A reconnaissance, helicopter-assisted geological mapping program was initiated by the Hudson's Bay Oil and Gas Company Limited (50%) and Cyprus Anvil Mining Corporation (50%) joint venture with Hudson's Bay as operator, to locate an area capable of producing 20 million tonnes of strippable thermal coal in the Williston Lake area. Following the program, seventy coal licences, totalling 20 142 ha were acquired north of Williston Lake. The licences form two blocks on either side of Butler Ridge, and are underlain by Lower Cretaceous strata of the Fort St. John and Crassier Groups.

The mapping program outlined four target areas in the coal-bearing Gething Formation with potential resources to meet the needs of the joint venture. A drilling program was proposed to test the areas, and to determine geology and structure at depth.

In February and March, 1981, eleven open holes totalling 1684.7 m were drilled on the Williston Properties. The three holes within the east block of licences did not penetrate through the top of the Gething Formation, and no coal seams were intersected. In the west block, all holes intersected thin coal beds, but the potentially mineable seam near the base of the Gething, exposed in the Reschke and Packwood Mines south of the property, was not penetrated. A 3.0 m coal/shale interval in the middle of the Gething, intersected at 22.5 m in hole W1MH81-11, was sampled. Analysis indicated the coal to be high volatile bituminous C in rank. Environmental restrictions prevented the drilling of three holes planned in the northern half of the block, and this area could not be properly tested.

2.0 CONCLUSIONS AND RECOMMENDATIONS

The drill program helped define the limit and coal potential of the Gething Formation in the east block and the southern part of the west block. However, the northern half of the west block could not be drill-tested for environmental reasons.

Information from drill holes in the east block indicates that the Gething Formation and potential strippable coal reserve in this area are less extensive than was estimated. It is recommended that these licences not be renewed, as distance from the lake is also a factor.

The geology in the southern part of the west block was revised as a result of the drill program. No major coal seams were intersected. However, stratigraphic information obtained in the course of the program indicates that a potentially mineable seam near the base of the Gething was not penetrated. This seam is exposed in workings south of the property boundary. Analysis of a coal/shale interval intersected at 22.5 m in drillhole W1MH81-11 indicates a high volatile bituminous C coal seam. Thickness is indeterminate from drilling records due to the nature of the program, but geophysical logs suggest a width of up to 3.0 m.

It is recommended that a program be implemented to test the seam in the Lower Gething and the seam intersected by drilling in the middle Gething. Using the geological information obtained during the drill program, a series of shallow holes should be drilled along existing access to establish the existence and determine the trend and economic potential of the two seams.

It is also recommended that four holes be drilled in the northern licences to test the potential in that area, porobably using a tracked, mounted rig. The licences should not be relinquished until the area has been fully tested.

3.0 INTRODUCTION

3.1 PROPERTY DESCRIPTION

The Williston coal property comprises 70 licences totalling 20 142 ha registered under the name of Hudson's Bay Oil and Gas Company Limited, and owned by the joint venture consisting of Hudson's Bay Oil and Gas Company Limited (50%) and Cyprus Anvil Mining Corporation (50%). Operator on the project is Hudson's Bay.

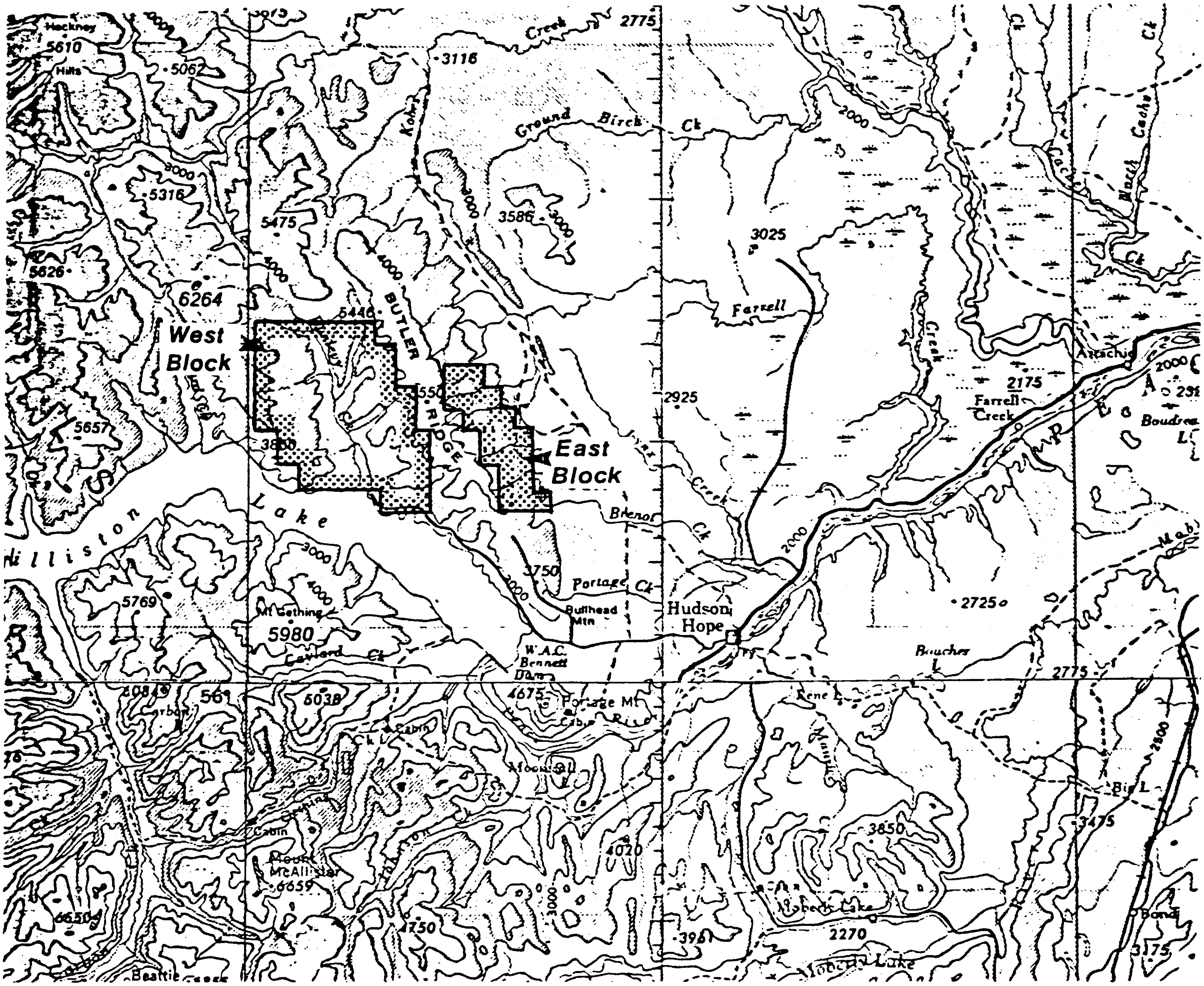
The licences were executed by the Honourable Minister of Energy, Mines and Petroleum Resources of the Province of British Columbia and issued on December 10, 1980.

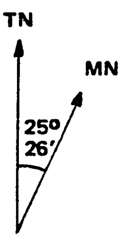
Legal description of the licences is given in Appendix A at the back of this report. Map HC 461 D, in the back pocket, is an index map showing the location of each licence.

3.2 LOCATION AND ACCESS

The coal licences are located in the Peace River Land District in the province of British Columbia on N.T.S. map sheet 94-B-1 (Fig.1). They form 2 blocks, the east block (16 licences totalling 4622 ha) centered at $122^{o}12'$ W longitude and $56^{o}10'$ N latitude, and the west block (54 licences totalling 15 520 ha) centered at $122^{o}24'$ W longitude and $56^{o}12'$ N latitude.

Hudson's Hope, the nearest town, is located approximately 40 km from the licences. It contains sufficient facilities to provide a base of operations for field work. Services and supplies unavailable in Hudson's Hope can be obtained in Chetwynd, 66 km to the south or in Fort St. John, 100 km east.



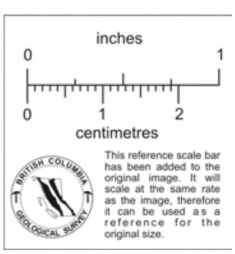


ELEVATIONS IN FEET

SCALE: 1:500 000

Kilometres	10	0
Nautical Miles	5	0
Statute Miles	5	0

LICENCE BOUNDARY



Hudbay Coal Company
A Division of Hudson's Bay Oil and Gas Company Limited
CALGARY ALBERTA

WILLISTON PROJECT

AREA LOCATION MAP

SCALE: 1:500 000	DWN. BY: E. Ronayne	DATE: 1981-06
APPR. BY:	FILE No.	HC 2205 R

Hudson's Hope is accessible from Fort St. John or Chetwynd via Highway 29, by automobile or by daily bus service. Scheduled flights arrive in Fort St. John from Vancouver and from Edmonton and Calgary, Alberta. Chartered aircraft can land at a paved, uncontrolled airstrip 5 km west of town.

Access to the property is by paved highway and gravel road. Seismic lines, trails and fence lines permit restricted four-wheel drive travel within the east block and the southern part of the west block. An excellent gravel road, built by Quasar Petroleums Ltd., traverses the southwestern portion of the west block. The northern half of the west block is accessible only by foot or helicopter year round, and by snowmobile in the winter months.

3.3 PHYSIOGRAPHY

Two physiographic regions, the Rocky Mountain Foothills and the Interior Plains, characterize the land in the vicinity of the Williston coal licences. The Interior Plains comprise slightly undulating country, incised deeply by creek and river valleys. They are truncated abruptly to the west by the high, treeless ridges of the foothills which slope gently to valley floors along rounded or flat-topped spurs. Narrow, steep-sided ravines carved by intermittent streams divide and separate the spurs.

The eastern licence block lies along the eastern slope of Butler Ridge, a northwesterly trending feature marking the eastern front of the Rocky Mountain Foothills (Photo 1). The western block is centered in the broad, rounded Dunlevy Creek valley west of Butler Ridge, and extends upslope on either side of the valley to just below ridge crests. Elevations on the property range from a minimum of approximately 670 m at Williston Lake to greater than 1650 m along the ridges.

Abundant streams and streamlets, many intermittent, drain into larger creeks which feed the Peace River system. In the west block, streams drain into Dunlevy Creek which flows directly into Williston Lake, a massive reservoir formed by the construction of the W.A.C. Bennett Dam, completed in 1967 (Photo 2). Creeks in the east block terminate in the Peace River downstream of the Peace Canyon Dam completed in 1980 (Photo 3).

Outcrop is sparce within the licences, being limited to sides of valleys and ridge tops. The area is heavily forested with spruce, pine, alpine fir and occasionally birch. The treeless ridges are blanketed with grasses, mosses, lichens and alpine flowers.

Big game is plentiful in the region. The forested areas are home to moose, mule deer and black bear, while mountain sheep and woodland caribou graze the ridges above tree-line. Abundant smaller game also inhabit the area and two traplines are registered within the property boundaries.

Lower elevations are snow-covered from December to late March. Snow persists longer at higher elevations, but the winter climate is moderated by warm, dry Chinook winds. Summers are warm and fairly dry. Temperatures decrease notably with elevation and ridge tops are almost always windy.

3.4 PREVIOUS WORK

3.4.1 Work History

When Alexander Mackenzie, the first white man in the area, travelled the Peace River in 1793 on his way to the Pacific Coast, he noted the occurrence of coal seams in the Peace Canyon. A trading post established at Hudson's Hope in 1805 by Simon Fraser remained the only building until the early twentieth century. Alfred Selwyn of the Geological Survey of Canada, headed the first geological expedition into the region in 1875, and the first coal investigation in the Peace River Canyon was conducted by C.F.J. Galloway for the British Columbia Department of Mines in 1912. Several geological reports have since been published by both the British Columbia and Federal Governments.

Construction of a railway into the Peace River District in 1916 brought settlers and a need for coal for local and industrial uses. Several small coal mines sprang up in the Peace River Canyon. The Packwood Mine, 1.5 km south of the southeast corner of the west block of licences was established in 1942 and produced 7260 tons (6534 tonnes) of coal from a 1.5 m seam

until 1947 when mining conditions forced its closure. The owners opened the Reschke Mine in the same seam approximately 1.5 km north along strike (Photo 4). Coal was hauled by truck to Fort St. John and the Alaska Highway. The mine remained in operation until 1960, but only seasonally for local use.

Three companies acquired coal licences in the area in the early 1970's, to explore for metallurgical coal. Utah Mines Ltd. acquired forty-four coal licences from Trend Exploration in Dunlevy Creek Valley, and drilled one core hole on the property in 1973. Canada West Petroleums Ltd. staked nine licences in 1970 north of the Utah Block, in which they conducted a geological mapping program in 1972. Amax Coal Company Inc. drilled four holes on a group of sixty-four licences in the Farrel Creek area in 1971. Insufficient resources to support a large scale metallurgical coal operation were delineated and none of the licences were subsequently renewed.

3.4.2 Work Done by Hudson's Bay Oil and Gas

A regional reconnaissance geological program was conducted by Hudson's Bay in the summer of 1980 to explore for an area that could contain 20 million tonnes of surface mineable thermal coal near Williston Lake. All unlicenced areas mapped as Lower Cretaceous strata on published government maps were checked. As a result of the program, two licence blocks were acquired in 1980 in the Dunlevy Creek Valley and on the east side of Butler Ridge covering known outcroppings of the coal-bearing Gething Formation. In February and March, 1981, a large scale reconnaissance open hole drilling program was carried out on the property. Within the two blocks, eleven vertical holes, totalling 1684.7 m, were drilled and geophysically logged using a caliper/gamma/resistivity/gamma density combination tool. Diameter of the holes was 16 cm (6.5 in.) Location of each hole is given in Table 1.

Table 1

DRILL HOLE LOCATIONS

Hole No.	Latitude	Longitude	Elevation	Licence No.
W1MH81-1	56°10'18"N	122°11'54"W	994 m	6819
W1MH81-2	56°10'18"N	122°13'16"W	1042 m	6820
W1MH81-3	56°12'13"N	122°13'52"W	1018 m	6824
W1MH81-4	56°10'17"N	122°22'41"W	683 m	6838
W1MH81-5	56°11'15"N	122°29'14"W	1347 m	6847
W1MH81-6	56°8'49"N	122°25'12"W	1000 m	6794
W1MH81-7	56°8'57"N	122°23'35"W	920 m	6793
W1MH81-8	56°10'13"N	122°20'49"W	972 m	6826
W1MH81-9	56°9'5"N	122°21'3"W	774 m	6810
W1MH81-10	56°8'43"N	122°17'35"W	1072 m	6804
W1MH81-11	56°7'37"N	122°20'16"W	698 m	6802

4.0 GEOLOGY

4.1 REGIONAL GEOLOGY

4.1.1 Stratigraphy

The Lower Cretaceous in northeastern British Columbia comprises a thick succession of marine and non-marine strata. Several stratigraphic classifications have been proposed for the area, the more important ones listed in Table 2. This report uses a slightly modified version of Hughes' (1967) classification (Table 3).

Marine Jurassic strata of the Fernie Group underly the Lower Cretaceous beds. The Fernie shales grade through a transitional zone into the sandstones, quartzites and minor shales of the Monteith Formation. Hughes places the upper Jurassic boundary within this lowermost unit of the Beaudette Group.

Conformably overlying the Monteith Fomation, are the thinly interbedded marine shales, siltstones and sandstones of the Beattie Peaks Formation. The sandstone beds increase in size and abundance towards the top, grading transitionally into the prominent sandstones characteristic of the Monach Formation. The sandstones are argillaceous to quartzitic, generally medium-grained and massive bedded, with minor siltstone and shale intervals. The top of the unit is, in most places, marked by a fine-to coarse-grained, non-fossiliferrous quartz arenite of variable thickness, and probably represents deposition and reworking of sediments in a littoral zone.

The Beaudette Group is overlain by the dominantly non-marine sedimentary rocks of the Crassier Group, a cyclic series of thick sandstone units interlayered with thinly interbedded sandstones, siltstones and shales, with or without coal (Photo 5). The group is divided on the basis of sand/shale ratios, abundance and thickness of coal seams, and clastic grain size. The formational boundaries are probably diachronous and gradational. One or more disconformities, localized and/or widespread may be represented in the succession. Figure 3 depicts a generalized section through the Crassier Group, highlighting formational differences.

The lowermost unit, the Brenot Formation, is characterized by thinly bedded fine- to medium-grained sandstone units and poorly developed coal cycles. Comminuted plant debris is common, but coal seams are thin or absent.

Thick, massive, medium- to coarse-grained sandstones mark the transition into the Dresser Formation. The sandstones commonly contain conglomeratic lenses and locally, thin, lenticular conglomerate beds. Trough cross-beds are abundant and are often defined at their base by conglomeratic horizons, fining upward to fine-grained sandstones (Photo 6). Thinly interbedded sequences of sandstone, siltstone and shale sandwiched between the massive sandstone units attain thicknesses of up to 30 m, but are usually 20 m or less. (Photo 7). Coal seams are common but thin, generally less than 0.5 m, and increase in abundance and thickness towards the top of the formation. Locally, in the Carbon Creek Basin, seams to 4.3 m have been reported in the upper part of the Dresser Formation (Stott and Gibson, 1981). Elsewhere, coal seams show less extensive development.

The upper contact appears to be variable with location. In places, a well developed conglomerate horizon, the Cadomin Formation, clearly defines the boundary and may indicate a disconformity. Elsewhere, the contact appears to grade into Gething Formation strata.

The Gething Formation has a much smaller sandstone/shale ratio and lacks the massive sandstone beds common to the Dresser. It comprises well developed coal cyclothems - fine-grained sandstones interbedded with shales, siltstones, mudstones and coal (Photo 8). The sandstone units decrease in thickness from the bottom, where minor conglomerate lenses are common, to the top of the formation. Where no distinctive Cadomin Conglomerate is present, the lower limit of the formation is placed at the top of the first major conglomeratic sandstone unit exceeding 5-10 m. The top of the Gething Formation is marked by a thick sandstone unit which grades upwards into a pebble conglomerate very similar to the Cadomin Conglomerate. The contact with the overlying marine mudstones, shales and minor sandstones of the Fort St. John Group is abrupt. Section 1 shows the generalized lithology of the Gething Formation.

Coal seams are abundant throughout the Gething - more than 40 seams have been reported (McLearn, 1923). The coal was deposited in well developed cyclothems which range in thickness from 1.5-7.5 m and consist of:

> "dark-grey mudstones and shales; shale and siltstones with sandstone interbeds; very fine- to medium-grained sandstones; silty, sandy mudstones and argillaceous silty sandstone; lithified seat earths; black soft mudstones; coals; black fissile carbonaceous shale." (Hughes, 1967)

Analyses indicate coals are high volatile bituminous C in rank (A.S.T.M.) with fair to good coking properties.

4.1.2 Geological History

In northeastern British Columbia, Beaudette Group marine sediments infilled the Liard Trough, a foredeep associated with the Cordilleran Geosyncline, at the beginning of the Lower Cretaceous. Uplift along the Omineca Geanticline to the west increased sedimentation and the Albian Sea regressed to the northwest. The quartzites at the top of the Monach Formation represent the last deposition of marine sediments in a neritic environment.

Continued uplift in the Columbian Orogen resulted in deposition of the Crassier Group in fluvial, deltaic, lacustrine and paludal environments. The thick, coarse-grained sandstones in the Dresser Formation indicate increased uplift at that time culminating in the deposition of the alluvial Cadomin Formation near uplift centers. Fluvial/alluvial transport was to the northeast as sediment thickness decreases rapidly in that direction. Greatest sedimentation was in the region of the former Peace River Arch, where the Crassier Group reaches maximum thickness. The beginning of quiescence resulted in decreased clastic sedimentation and eventual incursion of the Moosebar Sea.

Coal seams in the Crassier Group were formed in forests and swamps associated with lakes and deltas. The thinly bedded coal bearing intervals in

the Dresser Formation represent deposition of overbank sediments in a mainly fluvial/alluvial environment. Thick seams in the Carbon Creek Basin appear to be localized and probably represent a unique environment. Decreased tectonic activity and clastic sedimentation during Gething time permitted more extensive development of peat forming environments. Gething sediments appear to be more deltaic than fluvial in nature.

4.1.3 Structure

Lower Cretaceous strata were deposited in what is now the Outer Rocky Mountain Foothills structural zone, which is characterized by tight anticlines and broad, shallow synclines. The anticlines are complex with associated faults and minor folds. Limbs are steep and axial planes plunge to the west. Synclines are simple with shallow dips and little deformation. Structures trend northwesterly and generally plunge to the south, though some features plunge northward.

4.2 LOCAL GEOLOGY

4.2.1 General

The Williston coal licences are underlain by Lower Cretaceous Beaudette, Crassier and Fort St. John Groups strata. Two prominent structural features, the Portage-Butler Structural Zone and the Gething-Stott Structural Zone separated by the Dunlevy Syncline dominate the area.

The Portage-Butler Structural Zone is a complex of faults and folds, of which the major component is a thrust-faulted anticline on the crest of Butler Ridge. From south to north, the zone narrows and many of the smaller folds merge into a fault-dominated structural zone. The Gething-Stott structure forms the ridge west of the property boundaries. The crest of the ridge is an anticline with associated faults and folds. Faulting is more prominent to the north. The westernmost limit of the zone is a westerly dipping fault which thrusts Triassic marine sediments over the Lower Cretaceous strata.

4.2.2 East Block

The oldest rocks within the east block of licences, Dresser Formation sediments, outcrop along the Bullhead Anticline in the southeast corner of the block, and on the upper flanks of the Butler Anticline-Fault Zone along the western edge of the property. Outcrops comprise coarse-grained sandstones and conglomerates with chert pebbles to 2 cm in diameter. Red, hematitic staining is common. The siltstone/shale interbeds weather recessively and rarely outcrop. A thick conglomerate bed outcrops on Bullhead Mountain south of the licences and probably represents development of the Cadomin Formation.

Overlying the Dresser (Cadomin) Formation are Gething sandstones, siltstones and shales. Fine-grained sandstones are common in the lower part of the formation, decrease in the middle, and increase in thickness towards the top. A prominent sandstone, at least 30 m in thickness, capped by a chert pebble conglomerate, marks the top of the Gething Formation in this area. Abundant coal cyclothems were recorded in holes drilled by Amax Coal Co. north of the property boundary, but individual coal seams rarely exceeded 1.0 m. Total thickness of the Gething was reported to be approximately 300 m.

Outcrops are rare as the formation tends to weather recessively, but the upper sandstone/conglomerate commonly outcrops in ledges on the flat-topped spurs on the east flank of Butler Ridge. The Gething outcrops and subcrops as a thin wedge generally less than 1000 m across, of easterly dipping strata (10^{o}-20^{o}) parallel to Butler Ridge. The wedge increases in the southern part of the licence block across the Bullhead Syncline and in the northern part across the Ruddy Anticline.

Thinly bedded marine shales and mudstones of the Moosebar Formation lie directly on the upper conglomerate. The Moosebar is recessive and does not outcrop on the property, but was intersected in the three holes drilled by Hudson's Bay in 1981. It represents the youngest formation which subcrops within the licence block.

4.2.3 West Block

The West Block is centered in the Dunlevy Syncline and is flanked to the east and west by the Butler-Portage and the Gething-Stott Structural Zones respectively. Structure within the property boundaries appears to be relatively simple. However, subsidiary faults and folds associated with the more intensely deformed zones to the east and west are probably present but undetectable due to lack of outcrop.

The Brenot Formation, the oldest rocks exposed within the licence block, outcrop along the north shore of Williston Lake west of Dunlevy Inlet. Fine-grained sandstones, siltstones and shales lie disconformably on well-indurated, medium-grained, quartz arenite of the Monach Formation (Photo 5) and grade upwards into the more clastic Dresser Formation.

Massive, medium to coarse-grained conglomeratic Dresser sandstones outcrop along the eastern, western and southwestern boundaries of the property. The sandstones, which weather prominently, form terraced ridges. Cross-beds, often marked by conglomeratic lenses indicative of channel sands, are common (Photo 6). The finer grained, thinly bedded, coal-bearing interlayers weather recessively and rarely outcrop. Where exposed without sandstone units, they are difficult to distinguish from the overlying Dresser Formation or the underlying Brenot Formation (Photo 7). A few coal seams were noted within the formation but were thin and discontinuous.

The Dresser Formation is overlain by the Gething Formation. The contact, arbitrarily placed at the top of the first massive conglomerate or conglomeratic sandstone, is rarely exposed. A stratigraphic section along Dunlevy Inlet Road in the vicinity of the Packwood Mine (Sections 2a,b,c) transgresses the contact. No identifiable Cadomin Formation is exposed at this location and the contact appears to be gradational. On the ridge west of Dunlevy Inlet, a thin conglomerate bed, approximately 3 m in thickness, marks the contact with a small wedge of Gething strata.

The Gething Formation is generally thin-bedded and contains numerous coal seams. The presence of well developed coal cyclothems distinguishes the

Gething Formation from the thinly bedded intervals in the Dresser Formation and the Brenot Formation. Coal float and exposures of coal seams along Dunlevy Creek (Section 3) indicate the presence of Gething Formation along the axis of the syncline. However, thickness is indeterminate.

Lack of distinctive outcrop on the sides of the syncline prevents accurate stratigraphic correlation in the northern half of the block and the location of the Gething-Dresser boundary is tenuous. Siltstones and shales at the north end of Dunlevy Creek are tentatively mapped as Gething strata. However, these outcrops may actually represent Dresser intervals. If so, the extent of the Gething Formation in the northern half of the area would be greatly reduced.

Best development of the Gething Formation is in the southwest corner of the property where total thickness exceeds 260 m. The Dunlevy Inlet Road cuts several coal seams; most were thin but a few were greater than 1.0 m.

The lowermost seam is exposed in the ventilation shaft of the Reschke Mine (Section 4) and is the thickest seam which outcrops in the area. It is the same seam exposed in the adit of the Packwood Mine (Sections 2a,b,c) and is stratigraphically equivalent to the 1.0 m seam exposed on the ridge west of the property (Section 5) and 2.0 m Grant and King seams which were mined in the Peace River Canyon. A 1.0 m seam outcrops along the road approximately 2 km west of Gravel Hill Creek. This seam was intersected in drill hole WIMH 81-11 at 22.5 m.

5.0 DRILL PROGRAM

5.1 INTRODUCTION

As a result of the reconnaissance mapping program carried out in the 1980 summer field season, four areas were outlined that could possibly provide 20 million tonnes of strippable thermal coal:

1. The area south of Dunlevy Lake shows a dip slope potential with regional reserves in the order of 15 million tonnes.

2. The area on the west slope of Butler Ridge just north of the abandoned Packwood Minesite. This area is generally steep in a dip slope situation with regional reserve potential in the order of 5 million tonnes.

3. The upper Gething Contact on the east side of Butler Ridge in which the Trojan Seam could provide regional reserves in the order of 5 million tonnes.

4. The anticline-syncline pair east of Butler Ridge in which the Lower Gething Seam could show structural thickening. Regional reserves of this area may be in the order of 10 million tonnes.

(Loader, 1981)

Due to lack of definitive information in the northern half of the west block, no estimates of potential resources were made.

A drill program was recommended to determine:

1. geology and structure at depth;
2. the existence and depth of mineable seams in the four recommended areas; and
3. the potential of the northern part of the west block.

Eleven open holes, 16 cm in diameter, totalling 1685 m were drilled vertically and geophysically logged using a caliper/gamma/ resistivity/gamma density combination tool, from mid-February to mid-March in 1981. A winter program was implemented to take advantage of existing access along seismic lines, old roads and fence lines, and to minimize environmental damage and reduce costs.

Access was cleared using a D7 cat operated by Sandy Miller, a local resident familiar with the area. A truck-mounted T985H Schramm Hammer drill rig and Kenworth Pipe truck were employed for drilling, while support was provided by 4x4 3/4 ton pick-ups.

For environmental reasons, the 3 holes proposed in the northern half of the west block could not be drilled. The Dunlevy/Dresser Creek valley is a wintering ground for moose, and the ridges provide snow-free grazing for sheep and caribou. Environmental personnel of the British Columbia Government did not wish to create easy access to these ranges without a long-term work commitment. Existing trails along Dunlevy and Dresser Creeks would have required extensive and costly upgrading to permit access of the drill equipment and minimize potential damage to the waterways. Consequently, Hudson's Bay elected to delete the three holes from its program.

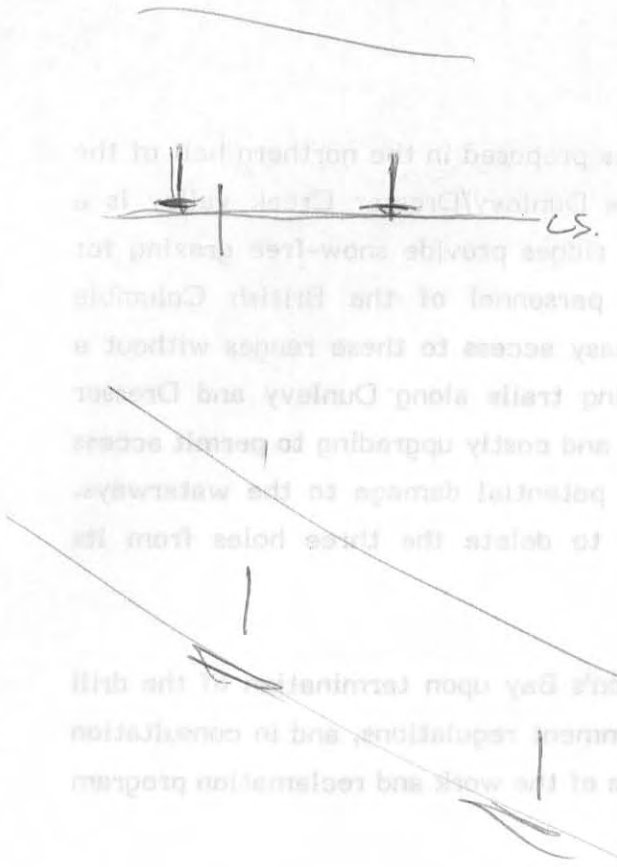
Reclamation was completed by Hudson's Bay upon termination of the drill program in accordance with the government regulations, and in consultation with environmental personnel. Details of the work and reclamation program are contained in Appendix B.

Map HC 461 E showing the location of all drill holes, and all geophysical logs with lithology are attached to the back of this report. Driller's logs of chip samples and drill hole summary sheets are located in Appendices C and D respectively.

5.2 RESULTS

5.2.1 East Block

Three holes totalling 428.6 m were drilled within the east block of licences. All holes were spudded in Moosebar Formation shales and mudstones. Holes WIMH 81-1 and WIMH 81-3 did not penetrate through the Moosebar. Hole WIMH 81-2 intersected the upper Gething conglomerate at 110.2 m. The formation proved to be a strong aquifer and drilling had to be terminated at 137.2 m without penetrating the upper sandstone. No coal seams were intersected.



5.2.2 West Block

The majority of the drilling program was concentrated in the western licence block. A total of 1256.1 m were drilled in 8 holes. Due to the reconnaissance nature of the program, holes were widely spaced, and detailed correlation of all holes is not feasible. However, a general correlation can be made.

Two holes, W1MH81-4 and 5, were spudded in Dresser Formation sediments. The remainder started in the Gething Formation and did not intersect the Dresser-Gething contact. Small coal seams were recorded in all holes. Details of each hole are given below.

W1MH81-4 - The intention of this hole was to penetrate a thick section of Gething strata to provide a means of correlation with other holes. Based on outcrop exposed at the Dunlevy Inlet narrows, it was thought that the Gething Formation reached maximum thickness in this area. However, drilling intersected a thick, medium-grained sandstone unit with conglomerate lenses near the top and thick sandstone units from 110 to 180 m depth, indicating Dresser Formation strata. The outcrop is now interpreted as a section of the thinly bedded interval in the upper Dresser Formation. Several coal seams were intersected, but all were thin and shaly.

Drilling was terminated at 183.8 m in fine-to medium-grained sandstone due to adverse drilling conditions caused by hardness of strata being penetrated and the presence of a high pressure aquifer. This hole was cemented to surface upon completion to halt the flow of water and gas.

WIMH81-5 - This hole was drilled along the Quasar road near the Gething-Dresser contact to intersect the coal seam at the base of the Gething Formation. Lithology indicates it was spudded near the top of the Dresser Formation at approximately the same stratigraphic level as WIMH81-4.

Several small coal seams were interesected in the thinly bedded interval. However, none was thicker than 0.5 m. The hole was abandoned at 199 m.

WIMH81-6 - This hole was drilled to test reserve Area 1 outlined during the mapping program. It was hoped to intersect the Gething-Dresser boundary at shallow depth and to establish the presence and thickness of a coal seam at the same stratigraphic level as seams previously mined in the area - near the base of the Gething Formation.

Several thin coal seams and carbonaceous beds were noted, but no seams greater than 0.5 m were intersected. Drilling was terminated at 153.3 m in a hard siltstone which reduced penetration to less than 5 m per hour. Geological interpretation indicates the hole was spudded in the Gething Formation and did not penetrate the lower contact. Drilling was discontinued because hole depth had already greatly exceeded surface mining limits.

WIMH81-7 - This hole was also drilled to test for the coal seam near the Gething-Dresser contact in reserve Area 1. The geology interpreted from the geophysical log indicates the hole penetrated approximately the same stratigraphic interval as hole WIMH81-6. However, the lack of definitive marker horizons does not permit an exact correlation. Drilling was terminated at 153.5 m.

WIMH81-8,9,10 - These holes were drilled to test for the existence and thickness of the coal seam near the base of the Gething Formation in reserve Area 2, the southern portion of the east flank of the Dunlevy Syncline. The holes reached depths of 183.8 m, 153.3 m and 137.2 m respectively.

The holes were drilled entirely within the Gething Formation. Several carbonaceous horizons and thin coal seams, less than 0.5 m in width, were intersected. A lower sandstone/shale ratio, interpreted from the geophysical logs, indicates the holes penetrated the middle to lower Gething Formation, stratigraphically above holes WIMH81-6 and 7 located on the west limb of the syncline. However, the lack of definitive horizons, the distance between holes and the dirth of surface outcrop prevents a detailed correlation. The apparent increase in the sand/shale ratio to the west may also be partly controlled by depositional parameters.

WIMH81-11 - This hole was drilled along the Dunlevy Inlet road to intersect a coal seam which outcrops along the road approximately 300 m east of the drill site.

A 3.0 m coal-coal/shale interval was intersected at 22.5 to 25.5 m. Lithology interpreted from geophysical logs indicates the seam is in the middle to upper (?) Gething and is stratigraphically above the seam at the Packwood and Reschke Mines. Two bags of chip samples from the zone were collected and sent for analysis. Coal quality results are given in section 6.0.

Drilling was continued beneath the coal horizon to help establish the startigraphic location of the seam, and was terminated at 92.4 m when sufficient data had been collected to determine its location well within the Gething Formation.

The drilling operation had to be terminated upon completion of WIMH81-11 due to the placement of road bans on all season roads, as a result of the early spring break-up. The secondary roads and trails were next to impassable for the rig, even with cat assistance.

Although the drill program did not intersect the target seam at surface mineable depths, it greatly clarified the geology of the southern part of the licence block. The lack of outcrop in the area and great similarity of the lithologies of the formations makes exact placement of the Gething-Dresser contact extremely difficult. With strata dipping less than 10^{o}, a surface displacement of the contact 1500 m would result in a vertical displacement greater than 250 m. Given the poor surface control due to lack of outcrop, coupled with a change in elevation, it is difficult to locate a single site where the contact and the overlying seam, if present, could be intersected at reasonable depths.

The reconnaissance nature of the drill program, the time factor and budgetary constraints did not allow for fence drilling to locate the target seam above the contact if the seam were not intersected at the chosen site.

It is recommended that a series of shallow holes be drilled across the contact along the Quasar Road near Dunlevy Inlet and near the western end of the Quasar Road east of WIMH81-5 to determine the existence and trend of the coal seam at the base of the Gething Formation at these locations; and a series of shallow holes be drilled along the Dunlevy Inlet Road near Gravel Hill Creek to define the seam intersected in WIMH81-11.

All holes would be drilled along existing all-weather access routes to the target or to a depth of approximately 50 m, whichever is less. It is felt the program is necessary to determine the coal resource potential of the southern portion of the west block of licences.

It is also recommended that four holes be drilled in the northern section of the licence block. Due to environmental sensitivity, a helicopter transportable diamond rig should be used.

5.2.2 West Block

The majority of the drilling program was concentrated in the western licence block. A total of 1256.1 m were drilled in 8 holes. Due to the reconnaissance nature of the program, holes were widely spaced and detailed correlation of all holes is not feasible However, a general correlation can be made.

Two holes, W1MH81-4 and 5, were spudded in Dresser Formation sediments. The remainder started in the Gething Formation and did not intersect the Dresser-Gething contact. Small coal seams were recorded in all holes. Details of each hole are given below.

W1MH81-4 - The intention of this hole was to penetrate a thick section of Gething strata to provide a means of correlation with other holes. Based on outcrop exposed at the Dunlevy Inlet narrows, it was thought that the Gething Formation reached maximum thickness in this area. However, drilling intersected a thick, medium-grained sandstone unit with conglomerate lenses near the top and thick sandstone units from 110 to 180 m depth, indicating Dresser Formation strata. The outcrop is now interpreted as a section of the thinly bedded interval in the upper Dresser Formation. Several coal seams were intersected, but all were thin and shaly.

W1MH81-5 - This hole was drilled along the Quasar road near the Gething-Dresser contact to intersect the coal seam at the base of the Gething Formation. Lithology indicates it was spudded in the top of the Dresser Formation and can be correlated with W1MH81-4. Several thin coal seams were intersected.

W1MH81-6,7 - Both holes were drilled to test reserve Area 1 outlined in the mapping program. It was hoped to intersect the Gething-Dresser boundary at shallow depth and to determine the existence of a thick coal seam above the contact in the same stratigraphic position as the seams previously mined in the area. The holes were spudded in Gething Formation and intersected several thin seams. The abundance of sand intervals indicates penetration of the lower part of the formation, but the contact was not intersected.

W1MH81-8,9,10 - These holes were drilled to test Area 2 and to intersect the seam above the Gething-Dresser contact. All holes began and remained in Gething Formation to completion. Lithology indicates penetration of the middle part of the formation. Numerous thin coal seams were intersected.

W1MH81-11 - This hole intersected a 3.0 m coal-coal/shale interval at 22.5 m. Two bags of chip samples were taken for analysis. The seam has not been correlated with named seams, but is probably in the mid-section of the Gething Formation.

Although the drill program did not intersect any surface mineable coal seams, it greatly clarified the geology of the southern part of the block. The previously mined seam, which is known to exist at the base of the Gething, was not intersected and still remains a potential target. As a result of the program, the location of the Gething-Dresser contact is now better defined.

6.0 COAL QUALITY

6.1 INTRODUCTION

Most seams intersected in the drilling program were thin or shaly. Only one seam, intersected from 22.5 to 25.6 m in hole W1MH81-11, was sampled for analysis. Two samples were collected through the seam; Sample A from 22.5 to 24.5 m and Sample B from 24.5 to 25.5 m. The chip samples were collected in plastic bags using a cyclone attached by metal pipe to the drill collar (Photo 9). Sample depths are approximate.

The samples were sent to Birtley Coal and Minerls Testing in Calgary, Alberta for analysis. Residual moisture, ash, volatile matter, fixed carbon, specific gravity, free swelling index, calorific value and sulphur content were determined for the total raw sample and 1.6 S.G. float fraction of each interval.

6.2 RESULTS

Analysis ranks the coal as high volatile bituminous C. Results are given in Table 4.

Analysis indicates that the coal seam is of better quality than was indicated on the geophysical log. The ash content and specific gravity in Sample A was much lower than expected. Although a mineable seam at this level of the Gething Formation was not expected, the analysis indicates it to be a potential target. A mineable seam at this location would increase the potential coal resource in the area.

Table 4 COAL QUALITY ANALYSES

HEAD RAW ANALYSIS

Adm %	Moist %	Ash %	Vol %	F.C. %	S%	Cal/gm	FSI	S.G.	Calc. Basis
6.3	0.6	27.5	19.3	52.6	0.59	5970	1 1/2	1.52	a.d.b.
	6.9	25.8	18.1	49.2	0.55	5594	-	-	a.r.b.
		27.7	19.4	52.9	0.59	6006	-	-	d.b.

ANALYSIS OF FLOATS @ 1.60 S.G.

RCY %	Moist %	Ash %	Vol %	F.C. %	S%	Cal/gm	FSI	S.G.	Calc. Basis
76.7	0.7	12.8	21.8	64.7	0.64	7239	2	1.39	a.d.b.
		12.9	22.0	65.1	0.64	7290	-	-	d.b

SAMPLE B

HEAD RAW ANALYSIS

Adm %	Moist %	Ash %	Vol %	F.C. %	S%	Cal/gm	FSI	S.G.	Calc. Basis
8.2	0.5	69.4	12.4	17.7	0.25	-	N.A.	2.09	a.d.b.
	8.7	63.7	11.4	16.2	0.23	-	-	-	a.r.b.
		69.7	12.5	17.8	0.25	-	-	-	d.b.

ANALYSIS OF FLOATS @ 1.60 S.G.

RCY %	Moist %	Ash %	Vol %	F.C. %	S%	Cal/gm	FSI	S.G.	Calc. Basis
14.8	0.6	16.1	23.1	60.2	0.71	6935	1 1/2	1.41	a.d.b.
		16.2	23.2	60.6	0.71	6977	-	-	d.b.

Note: ADM - air dried moisture
a.d.b. - air dried basis
a.r.b. - as received basis
d.b. - dried basis

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APPENDIX A

LICENCE DESCRIPTIONS

WILLISTON COAL LICENCES - EAST BLOCK

LICENCE NUMBER	LEGAL DESCRIPTION			AREA (ha)
	NTS AREA	BLOCK	UNITS	
6811	94-B-1	G	41,42,51,52	289
6812	94-B-1	G	43,44,53,54	289
6813	94-B-1	G	45,46,55,56	289
6814	94-B-1	G	63,64,73,74	289
6815	94-B-1	G	65,66,75,76	289
6816	94-B-1	G	83,84,93,94	289
6817	94-B-1	G	85,86,95,96	289
6818	94-B-1	G	87,88,97,98	289
6819	94-B-1	J	5,6,15,16	289
6820	94-B-1	J	7,8,17,18	289
6821	94-B-1	J	9,10,19,20	289
6822	94-B-1	J	27,28,37,38	289
6823	94-B-1	J	29,30,39,40	289
6824	94-B-1	J	49,50,59,60	288
6828	94-B-1	K	21,22,31,32	289
6832	94-B-1	K	41,42,51,52	288
				4622 ha

WILLISTON COAL LICENCES - WEST BLOCK

LICENCE NUMBER	LEGAL DESCRIPTION			AREA (ha)
	NTS AREA	BLOCK	UNITS	
6793	94-B-1	E	61,62,71,72	289
6794	94-B-1	E	63,64,73,74	289
6795	94-B-1	E	65,66,75,76	289
6796	94-B-1	E	81,82,91,92	289
6797	94-B-1	E	83,84,93,94	289
6798	94-B-1	E	85,86,95,96	289
6799	94-B-1	E	87,88,97,98	289
6800	94-B-1	F	43,44,53,54	289
6801	94-B-1	F	45,4755,56	289
6802	94-B-1	F	45,48,57,58	289
6803	94-B-1	F	63,64,73,74	289
6804	94-B-1	F	65,66,75,76	289
6805	94-B-1	F	67,68,77,78	286
6806	94-B-1	F	69,70,79,80	236
6807	94-B-1	F	83,84,93,94	289
6808	94-B-1	F	85,86,95,96	289
6809	94-B-1	F	87,88,97,98	289
6810	94-B-1	F	89,90,99,100	279
6825	94-B-1	K	5,6,15,16	289
6826	94-B-1	K	7,8,17,18	289
6827	94-B-1	K	9,10,19,20	289
6829	94-B-1	K	25,26,35,36	289
6830	94-B-1	K	27,28,37,38	289
6831	94-B-1	K	29,30,39,40	289
6833	94-B-1	K	47,48,57,58	288
6834	94-B-1	K	49,50,59,60	288
6835	94-B-1	K	67,68,77,78	288
6836	94-B-1	K	69,70,79,80	288
6837	94-B-1	K	89,90,99,100	288
6838	94-B-1	L	1,2,11,12	289
6839	94-B-1	L	3,4,13,14	289
6840	94-B-1	L	5,6,15,16	289
6841	94-B-1	L	7,8,17,18	289
6842	94-B-1	L	9,10,19,20	289
6843	94-B-1	L	21,22,31,32	289
6844	94-B-1	L	23,24,33,34	289
6845	94-B-1	L	25,26,35,36	289
6846	94-B-1	L	27,28,37,38	289
6847	94-B-1	L	29,30,39,40	289
6848	94-B-1	L	41,42,51,52	288
6849	94-B-1	L	43,44,53,54	288
6850	94-B-1	L	45,56,55,56	288
6851	94-B-1	L	47,48,57,58	288
6852	94-B-1	L	49,50,59,60	288
6853	94-B-1	L	61,62,71,72	288
6854	94-B-1	L	63,64,73,74	288
6855	94-B-1	L	65,66,75,76	288

WILLISTON COAL LICENCES - WEST BLOCK (cont'd)

LICENCE NUMBER	LEGAL DESCRIPTION			AREA (ha)
	NTS AREA	BLOCK	UNITS	
6856	94-B-1	L	67,68,77,78	288
6857	94-B-1	L	69,70,79,80	288
6858	94-B-1	L	81,82,91,92	288
6859	94-B-1	L	83,84,93,94	288
6860	94-B-1	L	85,86,95,96	288
6861	94-B-1	L	87,88,97,98	288
6862	94-B-1	L	89,80,99,100	288
				15 520

APPENDIX B

NOTICE OF WORK/RECLAMATION PROGRAM

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

MINERAL RESOURCES BRANCH
INSPECTION AND ENGINEERING DIVISION

NOTICE OF WORK ON A COAL LICENCE

(Section 7 of the *Coal Mines Regulation Act*)

This notice is to be completed by all companies or individuals carrying out exploration work prior to commencement of work and at cessation of work and forwarded to the Chief Inspector of Mines with a copy to the District Inspector of Mines. If mechanical equipment is used in surface work, Form 8 overleaf must be completed.

1. NAME OF PROPERTY . Williston .....
Coal Licence Numbers . . . . 6793 to 6862 inclusive .....
.....

2. LOCATION . . Peace River Land District ..... NTS map sheet no. 94-B-1 .
Lat. . . . . 56° . . . 10 . ' Long. . . 122 . ° . . 20 . . ' Access Via . Established all weather paved . .
. and . gravel . roads .....

3. OWNER'S NAME . . Hudson's Bay Oil & Gas Co. . Ltd .....
Address . . 700 . - . 2nd Street S.W. . . Calgary . . Alberta ..... Telephone No. (403) 231-6711

4. OPERATOR'S NAME Hudson's Bay Oil & Gas Company Limited .....
Address . 700 . - . 2nd Street S.W. . . Calgary . . Alberta ..... Telephone No. (403) 231-6711

5. ESTIMATED DURATION OF WORK: From ..... to .....
OR: ACTUAL DATE WORK COMPLETED: From . . 81-02-20 ..... to . . 81-03-19 .....

6. DESCRIPTION OF WORK (Use metric measure — 1 metre = 3.3 feet.) (Show on 1:50 000 scale map.)
Linecutting (distance, width, method) . . . Nil .....
.....
(Requires approval of Ministry of Forests, "Licence to Cut" or "Free Use Permit" may be witheld until reclamation program is approved.)

(a) Road Construction: Total length . . . 15 . . . . . m Approximate width . . . . 5 . . . m Area . . . . 75 . . m²

(b) Test Pits: No. . . . 0 . . . Maximum dimensions: Width . . . . . m Length . . . . . m Depth . . . . . m
Total disturbed area of test pits . . . . . 0 . . . . . m²

(c) Drilling: No. of holes . . . 11 . . . Type . Rot . Size . . . . 13 . cm Maximum hole length . . . . . 199.0 m
Approximate size of drill pads . . . 15 . . x . 15 . . . m Total disturbed area of drillsites . 1800 . . . . . m² *

(d) Adits: No. rising at . . . . . ° is . . . . . No. level . . . . No. dipping at . . . . . ° is . . . . .
Maximum length adit . . . . . m Total disturbed area of adits . . . . 0 . . . . . m²

(e) Trenches: No. . . 0 . . . Maximum dimensions: Width . . . . . m Length . . . . . m Depth . . . . . m
Total disturbed area of trenches . . . . 0 . . . . . m²

(f) Other (for example, please specify underground work) . . . . . .
.....

GRAND TOTAL OF AREA DISTURBED . 1875 . . . . . m²
. . . . . ha

7. APPROXIMATE NUMBER OF MEN EMPLOYED . . . . . 6 . . . . . .

8. DATE FOREST SERVICE ADVISED BY OPERATOR . . . . . .
Name of Official . . . . . Title . . . . . .
Address . . . . . .

COAL EXPLORATION FORM 8

PERMIT NO. C .....

Province of British Columbia
Ministry of Energy, Mines and Petroleum Resources

MINERAL RESOURCES BRANCH
INSPECTION AND ENGINEERING DIVISION

RECLAMATION PROGRAM

(Section 8 of the *Coal Mines Regulation Act*)

This form is to be completed when exploration work is done with mechanical equipment. Submission is required prior to commencement of work and at completion of work. One copy is sent to each of the following:

- *Senior Reclamation Inspector, Victoria
- *District Inspector of Mines
- *Regional Reclamation Inspector-Technician
- Regional Manager, Fish and Wildlife Branch
- District Forester or Ranger
- Regional Manager, Water Resources Branch
- Regional Manager, Lands Branch
- Ministry of Agriculture, ATTN: .....

For advice on procedure and reclamation methods, see booklet entitled, *"Handbook of Environmental Protection and Reclamation in Coal Exploration."*

1. THIS IS: A proposed reclamation program ☐ a completed reclamation program ☐.

2. PRESENT STATE OF LAND ON WHICH EXPLORATION WILL BE DONE IS:

Canada Land Inventory (where possible) .....

Present Land Use (ranching, timber, etc.) .....

Type of Vegetation . Scrub timber .....

Access Road (present use, condition) . All weather gravel road - exellent condition .....

Other .....

3. EQUIPMENT TO BE USED FOR EXPLORATION (List size, capacity, and number.)

(a) 985 Schramm Drill Rig ..... (d) 1 Kenworth Flatbed Pipe Truck .....

(b) D 7 Cat ..... (e) .....

(c) 4 4x4 Pick-up Trucks ..... (f) .....

4. RECLAMATION EQUIPMENT TO BE USED (for example, resloping, harrowing, or specialty equipment):

(a) Cyclone Seeder ..... (b) ..... (c) .....

5. GENERAL DESCRIPTION OF PROTECTIVE MEASURES PURSUANT TO SECTION 8

(Show work and reclamation on 1:50 000 scale map and include with full distribution noted above.) [*For proposed work programs include with submissions to Ministry of Energy, Mines and Petroleum Resources documentation on 1:10 000 (approximate scale) air photograph or air photograph overlay.]

Only existing roads, fence lines and seismic lines were used for access to drill sites. One 15 m length of road was constructed to lessen the grade on the existing road . Drill sites were constructed on level ground and kept to minimum size using cleared areas where possible. Three sites required no new construction. Roads and sites were cleared with a D 7 Cat leaving as much vegetation as possible. All new sites and roadway were seeded upon completion of work using Foresty # 1 Standard Mixture. All Leaners were bucked and scattered. Only one drill hole, no. 4, flowed water - this hole was plugged with 50' of cement. No drill holes intersected coal seams mineable by underground methods.

6. SUMMARY OF AREA DISTURBANCE AND RECLAMATION

Area disturbed current year . 1875 m^2 ... Previous years .....0..... Total to date ..1875 m^2 ....

Area reclaimed current year . 1875 m^2 ... Previous years (final) ..0..... Total to date ..1875 m^2 ....

7. RECLAMATION MANAGER'S NAME . Elizabeth Ronayne .....

APPENDIX C

DRILLER'S LOGS

TR

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston HOLE NUMBER WIMH 81-1

COMPANY Nielsen Drilling Co. Ltd. LOCATION East Butler Ridge

DATE 25, 26/02/81 SURVEYED LOCATION 56° 10' 18" N, 122° 11' 54" W

LOGGING COMPANY Davies Exploration Logging Ltd ELEVATION 994 m

LOGS RUN Caliper, Gamma, Resistivity, Density ANGLE / BEARING 90°

DEVIATION (TEST) WATER HORIZON

COMMENTS Moose bar Formation

FROM	TO	LOG	REMARKS
0	5	Overburden - loose sand	
5	183.8	Shale with some mudstone	
183.8		EOH	

(1) Field Office (2) Head Office Geology (3) Head Office Engineering

TR

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD WILLISTON — HOLE NUMBER WIMH 81-2

OMPANY Nielsen Drilling Co. Ltd. — LOCATION East Butler Ridge

DATE 27, 28/02/81 — SURVEYED LOCATION 56° 10' 18" N, 122° 13' 16" W

OGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 1042

LOGS RUN Caliper, Resistivity, Gamma, Density — ANGLE / BEARING 90°

EVIATION (TEST) — WATER HORIZON

COMMENTS Moosebar Formation and top of Gething Formation

FROM	TO	LOG	REMARKS
0	1.0	Overburden - sand	
1.0	110.0	Soft black mudstone with some shale and siltstone interbeds	
110.0	114.8	Chert pebble conglomerate	
114.8	116.4	Broken conglomerate	Pyritic
116.4	118.2	Chert pebble conglomerate	
118.2	137.2	Conglomerate with Vcg sandstone grading to f-mg sandstone	
137.2		EOH	

(1) Field Office, (2) Head Office Geology, (3) Head Office Engineering

TR 18

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD WILLISTON — HOLE NUMBER WIMH 81-3

COMPANY Nielsen Drilling Co. Ltd. — LOCATION East Butler Ridge

DATE 01/03/81 — SURVEYED LOCATION 56° 12' 13" N, 122° 13' 52"W

LOGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 1018 m

LOGS RUN Caliper, Gamma, Resistivity, Density — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON

COMMENTS Moosebar Formation

FROM	TO	LOG	REMARKS
0	2.0	Overburden - clay	
2.0	6.5	Soft blackmudstone	
6.5	7.5	Grey "soapy" clay	
7.5	25.0	Black soft mud stone	
25.0	107.6	Black shale and mudstone	
107.6		EOH	

(1) Field Office, (2) Head Office Geology, (3) Head Office Engineering

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston — HOLE NUMBER WIMH81-4

COMPANY Nielsen Drilling Co. Ltd. — LOCATION Dunlevy CK.

DATE 03, 04/03/81 — SURVEYED LOCATION 56° 10' 17" N, 122° 22' 41" W

LOGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 683 m

LOGS RUN Caliper, Gumma, Resistivity, Densit — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON 21.0

COMMENTS Hole flowed water and gas

plugged with cement 11/03/81

FROM	TO	LOG	REMARKS
0	19.3	Overburden - coarse wet gravel	
19.3	21.1	Grey siltstone	
21.1	24.0	m.g. salt and pepper sandstone	
24.0	24.7	Brown/Black m.g. Carb. sandstone	
24.7	33.7	m.g. salt and pepper sandstone	
33.7	33.8	f.g. brown sandstone	
33.8	35.6	m.g. salt and pepper sandstone	
35.6	36.0	Carbonaccous shale	
36.0	38.1	f.g. salt and pepper sandstone with minor conglomerate	
38.1	38.4	Carbonaceous shale	
38.4	39.0	f.g. sandstone and shale	
39.0	40.2	f.g. sandstone	
40.2	41.9	siltstone and f.g. sandstone	
41.9	42.6	shale	
42.6	42.7	shale and f.g. sandstone/siltstone	
42.7	43.7	f.g. sandstone/siltstone/shale	
43.7	44.4	shale and siltstone	
44.44	46.3	f.g. sandstone with siltstone/shale	
46.3	47.1	siltstone/shale	
47.1	47.7	f.g. sandstone with siltstone	
47.7	49.2	siltstone with minor shale/sandstone	
49.2	50.3	v.f.g. sandstone and siltstone	
50.3	50.6	shale with coal lenses	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-4

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
50.6	52.1	f.g. sandstone with shale lenses	
52.1	52.5	carbonaceous siltstone/shale	
52.5	53.0	sandstone with siltstone lenses	
53.0	55.5	shale	
55.5	55.8	coal	
55.8	57.4	f.g. sandstone/siltstone	
57.4	58.9	sandstone	
58.9	60.3	siltstone with minor shale	
60.3	60.7	carbonaceous shale/coal	
60.7	61.3	shale	
61.3	63.6	siltstone/f.g. sandstone	
63.6	69.9	hard f.g. sandstone	
69.9	71.65	siltstone	
71.65	71.75	coal	
71.75	72.7	shale	
72.7	73.4	siltstone with shale/sandstone	
73.4	73.5	shale	
73.5	75.8	f.g. hard sandstone	
75.8	77.4	siltstone with minor shale	
77.4	78.7	shale with siltstone	
78.7	79.3	shale and siltstone	
79.3	85.3	f.g. sandstone with siltstone/shale	
85.3	85.8	carbonaceous sandstone/siltstone	
85.8	89.3	v.f.g. sandstone/siltstone	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-4

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
89.3	89.5	coal with shale splits	
89.5	90.0	carbonaceous sandstone	
90.0	90.5	sandy siltstone	
90.5	92.9	f.g. sandstone	
92.9	93.7	shale and coal	
93.7	95.6	f.-m.g. sandstone	
95.6	95.8	carbonaceous shale	
95.8	96.8	f.g. sandstone	
96.8	99.0	siltstone/shale	
99.0	100.5	black shale	
100.5	101.7	f.g. sandstone with shale/siltstone	
101.7	103.4	black shale with coal lenses	
103.4	104.5	f.g. sandstone	
104.5	104.9	grey shale and siltstone	
104.9	105.0	sandstone/siltstone	
105.0	105.1	coal	
105.1	107.8	f.g. sandstone and shale	
107.8	109.6	grey shale	
109.6	115.8	f.g. salt and pepper sandstone	
115.8	117.2	f.g. sandstone with shale interbeds	
117.2	120.6	f.g. sandstone	
120.6	120.8	coal	
120.8	121.15	shale	
121.15	124.6	f.g. sandstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-4

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
124.6	125.7	carbonaceous shale with coal lenses	
125.7	126.3	v.f.g. sandstone	
126.3	135.2	salt and pepper sandstone	04-03-81
135.2	135.6	carbonaceous shale and coal	
135.6	137.0	salt and pepper sandstone	
137.0	137.4	coaly shade	
137.4	140.5	grey shale	
140.5	140.6	carbonaceous shale	
140.6	143.4	grey shale	
143.4	144.1	grey siltstone	
144.1	144.2	carbonaceous shale	
144.2	147.3	grey siltstone	
147.3	183.8	f.-m.g. sandstone	
183.8		E O H	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston — HOLE NUMBER WIMH81-5

COMPANY Nielsen Drilling Co. Ltd. — LOCATION Quasar Camp Site

DATE 05, 06/03/81 — SURVEYED LOCATION 56° 11' 15" N, 122° 29' 14" W

LOGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 1347 m

LOGS RUN Caliper, Resistivity, Gamma, Density — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON

COMMENTS Driller's log lost. Drill hole log from Geophysical log

FROM	TO	LOG	REMARKS
0	5.0	overburden	
5.0	6.8	siltstone	
6.8	7.5	shale	
7.5	8.7	siltstone	
8.7	9.2	shale	
9.2	10.5	siltstone	
10.5	11.1	shale	
11.1	11.5	siltstone	
11.5	12.8	shale	
12.8	15.1	siltstone	
15.1	16.0	shale	
16.0	16.7	siltstone	
16.7	17.4	shaley siltstone	
17.4	35.9	sandstone	
35.9	36.5	siltstone	
36.5	36.6	carbonaceous shale	
36.6	37.1	shale	
37.1	37.4	siltstone	
37.4	37.7	carbonaceous shale	
37.7	37.9	shale	
37.9	38.1	carbonaceous shale	
38.1	38.3	shale	
38.3	38.5	carbonaceous shale	
38.5	41.0	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-5

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
41.0	41.8	shale	
41.8	43.3	siltstone	
43.3	45.7	sandstone	
45.7	46.2	shale	
46.2	47.3	siltstone	
47.3	48.8	sandstone	
48.8	49.3	shale	
49.3	50.2	siltstone/shale	
50.2	51.4	siltstone	
51.4	53.9	sandstone	
53.9	55.9	siltstone	
55.9	56.2	coal	
56.2	56.7	carbonaceous shale	
56.7	57.1	siltstone	
57.1	57.8	carbonaceous shale	
57.8	58.9	siltstone/shale	
59.9	61.6	shale	
61.6	63.8	siltstone	
63.8	64.2	siltstone/shale	
64.2	66.0	siltstone	
66.0	66.6	sandstone	
66.6	66.7	coal	
66.7	67.7	siltstone	
67.7	68.3	shale	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-5

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
68.3	68.7	coal	
68.7	70.2	siltstone	
70.2	70.4	shale	
70.4	71.3	siltstone	
71.3	71.8	sandstone	
71.8	72.8	shale	
72.8	74.8	siltstone	
74.8	75.5	sandstone	
75.5	77.2	shale/siltstone	
77.2	77.8	siltstone	
77.8	78.6	siltstone/shale	
78.6	79.1	shale	
79.1	80.0	siltstone/shale	
80.0	82.4	siltstone	
82.4	82.9	coal	
82.9	84.0	siltsone	
84.0	84.2	shale	
84.2	85.2	siltstone	
85.2	85.3	shale	
85.3	86.6	sandstone	
86.6	87.2	siltstone	
87.2	87.3	coal	
87.3	87.8	shale	
87.8	88.8	siltstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-5

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
88.8	89.6	siltstone/shale	
89.6	91.5	siltstone	
91.5	91.7	sandstone	
91.7	92.6	siltstone	
92.6	94.3	siltstone/shale	
94.3	94.5	shale	
94.5	95.3	siltstone	
95.3	95.7	carbonaceous shale	
95.7	98.5	siltstone	
98.5	98.9	shale	
98.9	99.0	coal	
99.0	99.2	carbonaceous shale	
99.2	99.7	siltstone	
99.7	100.0	shale	
100.0	102.7	siltstone	
102.7	103.0	shale	
103.0	107.0	siltstone	
107.0	111.0	sandstone	
111.0	111.1	coal	
111.1	111.5	carbonaceous shale	
111.5	112.0	shale	
112.0	115.0	siltstone	
115.0	117.3	sandstone	
117.3	117.5	coal	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-5

OMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

OGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

EVIATION·(TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
17.5	118.1	shale	
118.1	120.6	siltstone	
120.6	121.6	siltstone/shale	
121.6	122.9	siltstone	
122.9	123.5	sandstone	
123.5	127.5	siltstone	
127.5	130.0	sandstone	
130.0	131.1	siltstone	
131.1	132.1	sandstone	
132.1	132.3	carbonaceous sandstone	
132.3	132.8	shale	
132.8	133.0	siltstone	
133.0	133.6	shale	
133.6	133.8	coal	
133.8	137.5	siltstone	
137.5	138.1	siltstone/shale	
138.1	139.9	siltstone	
139.9	144.4	sandstone	
144.4	144.5	coal	
144.5	146.5	siltstone/shale	
146.5	149.6	siltstone	
149.6	156.1	sandstone	
156.1	156.3	coal	
156.3	158.6	sandstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-5

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
158.6	158.7	coal	
158.7	159.9	shale	
159.9	161.5	siltstone	
161.5	162.0	coal	
162.0	162.1	carbonaceous shale	
162.1	162.6	siltstone	
162.6	162.8	coal	
162.8	163.4	shale	
163.4	165.4	siltstone	
165.4	165.5	coal	
165.5	167.0	siltstone	
167.0	179.3	sandstone	
179.3	180.4	siltstone	
180.4	192.3	sandstone	
192.3	192.5	coal	
192.5	192.9	shale	
192.9	196.0	siltstone	
196.0	196.2	coal	
196.2	199.0	siltstone	
199.0		EOH	

(1) Field Office, (2) Head Office Geology, (3) Head Office Engineering

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston
HOLE NUMBER WIMH81-7
COMPANY Nielsen Drilling Company Ltd.
LOCATION East of Dunlevy Lake
DATE 09-03-81
SURVEYED LOCATION 56° 8' 57" N, 122° 23' 35" W
LOGGING COMPANY Davies Exploration Logging Ltd
ELEVATION 920 m
LOGS RUN Caliper, Resistivity, Gamma, Density
ANGLE / BEARING 90°
DEVIATION (TEST)
WATER HORIZON
COMMENTS

FROM	TO	LOG	REMARKS
0	13	overburden - sand/clay	
13	15.1	vfg sandstone	
15.1	20.5	mg brown sandstone	
20.5	21.0	shale with coal bands	
21.0	21.4	siltstone	
21.4	21.7	carbonaceous shale	
21.7	22.0	siltstone	
22.0	23.5	shale	
23.5	25.5	mg sandstone	
25.5	25.8	shale	
25.8	26.0	siltstone	
26.0	26.8	fg sandstone	
26.8	28.1	shale	
28.1	28.3	coal	
28.3	29.4	silstone	
29.4	30.6	cola with shale splits	
30.6	32.4	siltstone	
32.4	33.0	shale	
33.0	36.7	silstone and shale	
36.7	37.1	fg sandstone	
37.1	37.3	carbonaceous shale	
37.3	37.9	mg sandstone	
37.9	40.3	siltstone and shale	
40.3	40.6	sandstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD WILLISTON
HOLE NUMBER WIMH81-6
COMPANY Nielsen Drilling Co. Ltd.
LOCATION Dunlevy Lake
DATE 08-03-81
SURVEYED LOCATION 56° 8' 49" N, 122° 25' 12" W
LOGGING COMPANY Davies Exploration Logging Ltd
ELEVATION 1000.0
LOGS RUN Caliper, Gamma, Resistivity, Density
ANGLE / BEARING 90°
DEVIATION (TEST)
WATER HORIZON
COMMENTS Driller's log lost. Drill hole log from Geophysical log.

FROM	TO	LOG	REMARKS
0	4.5	overburden - clay and gravel	
4.5	6.8	siltstone	
6.8	7.2	shale	
7.2	9.2	siltstone	
9.2	9.6	shale	
9.6	9.8	carb. shale	
9.8	11.2	siltstone	
11.2	11.7	sandstone	
11.7	12.6	siltstone	
12.6	12.8	dirty coal	
12.8	13.0	carb. shale	
13.0	15.0	siltstone	
15.0	17.8	sandstone	
17.8	18.2	shale	
18.2	18.7	coal	
18.7	19.3	carb. shale	
19.3	19.5	dirty coal	
19.5	19.7	siltstone	
19.7	20.3	shale	
20.3	20.6	carb. shale	
20.6	21.2	siltstone	
21.2	22.5	shale/siltstone	
22.5	23.0	shale	
23.0	23.7	siltstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-6

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
23.7	24.0	carb. shale	
24.0	24.1	coal	
24.1	24.6	siltstone	
24.6	24.7	carb. shale	
24.7	25.4	siltstone	
25.4	25.7	shale	
25.7	26.7	siltstone	
26.7	27.2	siltstone/shale	
27.2	27.7	shale	
27.7	28.8	siltstone	
28.8	29.6	siltstone/shale	
29.6	33.3	siltstone	
33.3	33.9	shale	
33.9	34.3	silstone	
34.3	34.6	shale	
34.6	34.8	dirty coal	
34.8	35.7	carb. shale	
35.7	36.0	shale	
36.0	36.8	siltstone	
36.8	47.8	siltstone and shale w minor coal lenses.	
47.8	51.2	siltstone	
51.2	51.4	carb. shale	
51.4	51.6	shale	
51.6	52.3	siltstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81 - 6

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
52.3	52.5	carb. shale	
52.5	52.9	shale	
52.9	53.1	coal	
53.1	54.9	siltstone	
54.9	55.0	coal	
55.0	56.5	siltstone	
56.5	56.6	coal	
56.6	58.9	siltstone	
58.9	60.2	sandstone	
60.2	61.3	siltstone	
61.3	61.9	shale	
61.9	65.3	siltstone	
65.3	65.6	shale	
65.6	68.8	siltstone	
68.8	69.0	carb. shale	
69.0	70.6	shale/siltstone	
70.6	72.1	siltstone	
72.1	7.25	shale	
72.5	72.6	carb. shale	
72.6	73.0	siltstone	
73.0	73.5	carb. shale	
73.5	73.7	coal	
73.7	76.0	shale/siltstone	
76.0	76.3	carb. shale	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-6

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
76.3	83.2	shale and siltstone w minor coal lenses	
83.2	86.0	silstone	
86.0	86.6	shale	
86.6	87.9	siltstone	
87.9	88.2	shale/carb. shale	
88.2	90.1	siltstone	
90.1	90.5	dirty coal	
90.5	91.3	shale	
91.3	93.0	siltstone	
93.0	93.1	coal	
93.1	102.4	siltstone and shale	
102.4	102.7	dirty coal	
102.7	105.2	siltstone/sandstone	
105.2	105.5	carb. shale	
105.5	106.1	siltstone	
106.1	109.3	shale	
109.3	110.1	siltstone	
110.1	110.5	carb. shale	
110.5	112.8	shale	
112.8	113.9	siltstone	
113.9	114.4	shale	
114.4	116.1	siltstone	
116.1	129.3	shale and siltstone w minor coal lenses	
129.3	131.9	siltstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-6

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
131.9	139.0	sandstone	
139.0	139.8	shale	
139.8	141.8	siltstone	
141.8	142.0	carb. shale	
142.0	142.2	shale	
142.2	153.3	siltstone	
153.3		E O H	

(1) Field Office, (2) Head Office Geology, (3) Head Office Engineering

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-7

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
40.6	40.8	siltstone	
40.8	41.1	sandstone	
41.1	41.3	carbonaceous shale	
41.3	41.6	interbedded siltstone and shale	
41.6	42.4	mg sandstone	
42.4	42.6	carbonaceous shale/siltstone	
42.6	43.1	sandstone	
43.1	43.9	carbonaceous shale	
43.9	44.2	shale	
44.2	44.6	carbonaceous shale	
44.6	45.0	coal	
45.0	46.0	interbedded siltstone and shale	
46.0	47.8	siltstone	
47.8	48.0	shale	
48.0	48.2	coal with shale splits	
48.2	48.8	shale	
48.8	50.9	sandy siltstone	
50.9	56.2	f-mg grey sandstone	
56.2	58.4	interbedded siltstone and shale	
58.4	58.5	coal	
58.5	58.7	siltstone	
58.7	60.2	fg sandstone	
60.2	60.4	siltstone	
60.4	60.5	coal	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-7

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
60.5	63.3	interbedded siltstone and shale	
63.3	65.2	siltstone	
65.2	65.7	shale	
65.7	66.8	interbedded siltstone and shale	
66.8	66.9	shale with coal bands	
66.9	68.8	siltstone with shale lenses	
68.8	69.3	sandstone	
69.3	69.8	shale	
69.8	71.2	interbedded siltstone and shale	
71.2	71.3	shale with coal bands	
71.3	71.4	carbonaceous siltstone	
71.4	71.9	dark grey siltstone with shale lenses	
71.9	73.5	siltstone and sandstone	
73.5	73.9	carbonaceous shale	
73.9	74.2	carbonaceous siltstone	
74.2	74.5	siltstone	
74.5	74.7	carbonaceous shale	
74.7	75.2	carbonaceous siltstone and shale	
75.2	76.3	grey siltstone	
76.3	77.1	sandstone	
77.1	78.3	siltstone	
78.3	78.5	shale	
78.5	78.9	shale with coal bands	
78.9	79.3	siltstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-7

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
79.3	81.6	sandstone	
81.6	82.7	siltstone	
82.7	82.9	carbonaceous shale	
82.9	85.0	siltstone	
85.0	85.2	shale	
85.2	85.5	coal with shale splits	
85.5	87.6	carbonaceous sandstone	
87.6	88.1	sandstone	
88.1	88.6	carbonaceous shale	
88.6	89.3	siltstone	
89.3	91.8	sandstone	
91.8	92.3	carbonaceous shale	
92.3	93.2	siltstone	
93.2	93.3	coal with shale splits	
93.3	94.7	sandstone	
94.7	95.2	siltstone	
95.2	95.5	sandstone	
95.5	96.1	siltstone	
96.1	99.7	interbedded sandstone and siltstone	
99.7	100.1	shale	
100.1	100.7	siltstone	
100.7	103.1	interbedded sandstone and siltstone	
103.1	105.1	siltstone	
105.1	105.6	carbonaceous shale	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-7

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
105.6	106.3	interbedded shale and siltstone	
106.3	106.6	sandstone	
106.6	107.8	siltstone	
107.8	109.8	shale	
109.8	109.9	coal	
109.9	110.5	shale	
110.5	112.7	siltstone	
112.7	113.1	sandstone	
113.1	113.3	shale	
113.3	113.7	siltstone	
113.7	114.0	shale	
114.0	114.4	siltstone	
114.4	115.1	carbonaceous shale	
115.1	117.3	siltstone	
117.3	118.1	fg sandstone	
118.1	120.2	siltstone	
120.2	122.4	fg sandstone	
122.4	122.8	carbonaceous sandstone	
122.8	123.1	sandstone	
123.1	125.5	siltstone	
125.5	125.7	carbonaceous siltstone	
125.7	129.3	siltstone	
129.3	130.3	sandstone	
130.3	133.3	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-7

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
133.3	133.4	carbonaceous siltstone	
133.4	135.1	siltstone	
135.1	135.8	carbonaceous shale with coal bands	
135.8	136.8	interbedded siltstone and shale	
136.8	138.0	siltstone and vfg sandstone	
138.0	146.8	mg poorly consolidated sandstone	
146.8	147.0	siltstone	
147.0	148.3	clean f-mg sandstone	
148.3	148.8	interbedded grey siltstone and sandstone	
148.8	149.6	shale with siltstone lenses	
149.6	150.4	siltstone with shale lenses	
150.4	150.5	f-mg grey sandstone	
150.5	151.4	grey siltstone wuth shale lenses	
151.4	151.5	carbonaceous shale	
151.5	153.05	siltstone with shale lenses	
153.05		End of Hole	

(1) Field Office (2) Head Office Geology (3) Head Office Engineering

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston — HOLE NUMBER WIMH81-8

COMPANY Nielsen Drilling Company Ltd. — LOCATION West Butler Ridge

DATE 13-01-81 — SURVEYED LOCATION 56° 10' 13" N, 122° 20' 49" W

LOGGING COMPANY Davies Exploration Logging Ltd. — ELEVATION 972 m

LOGS RUN Caliper, Gamma, Resistivity, Densit — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON

COMMENTS

FROM	TO	LOG	REMARKS
0	15	overburden - sandy clay	
1.5	2.4	shale	
2.4	2.9	coal	
2.9	4.4	shale	
4.4	4.7	siltstone	
4.7	6.9	shale	
6.9	7.1	carbonaceous shale	
7.1	7.15	coal	
7.15	9.1	sandstone with shale lenses	
9.1	9.9	sandstone	
9.9	12.6	siltstone	
12.6	12.8	shale	
12.8	13.4	coal with shale splits	
13.4	14.4	shale	
14.4	14.5	coal	
14.5	14.7	shale	
14.7	15.0	siltstone	
15.0	15.4	shale	
15.4	16.4	carbonaceous shale	
16.4	16.5	coal	
16.5	17.3	siltstone	
17.3	17.6	shale	
17.6	20.9	fg sandstone	
20.9	21.4	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-8

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
21.4	23.4	interbedded siltstone and sandstone	
23.4	24.7	interbedded shale and siltstone	
24.7	25.7	siltstone	
25.7	27.9	carbonaceous shale with shale	
27.9	28.9	siltstone	
28.9	31.8	fg poorly consolidated sandstone	
31.8	32.6	shale	
32.6	32.7	coal	
32.7	33.0	carbonaceous shale	
33.0	33.6	shale	
33.6	33.7	coal	
33.7	35.1	shale	
35.1	35.3	siltstone	
35.3	37.6	interbedded shale and siltstone	
37.6	37.9	f.g. sandstone	
37.9	38.2	siltstone	
38.2	40.2	sandstone	
40.2	40.3	coal	
40.3	42.6	siltstone	
42.6	42.9	shale	
42.9	43.3	sandstone	
43.3	43.6	siltstone	
43.6	43.9	carbonaceous shale	
43.9	44.2	interbedded siltstone and sandstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-8

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
44.2	45.5	sandstone	
45.5	46.0	siltstone	
46.0	46.2	sandstone	
46.2	47.4	siltstone	
47.4	49.3	shale	
49.3	49.5	sandstone	
49.5	50.0	shale	
50.0	50.1	coal	
50.1	50.4	shale	
50.4	50.8	siltstone	
50.8	51.2	sandstone	
51.2	51.5	shale	
51.5	51.9	siltstone	
51.9	52.8	sandstone	
52.8	53.7	siltstone	
53.7	56.5	black shale	
56.5	57.5	sandstone with shale split	
57.5	58.8	siltstone	
58.8	59.0	shale with coal bands	
59.0	59.3	shale	
59.3	61.4	siltstone	
61.4	61.9	carbonaceous shale	
61.9	63.7	siltstone	
63.7	65.1	shale	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-8

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
65.1	67.3	grey sandstone	
67.3	67.8	carbonaceous shale	
67.8	76.8	siltstone	
76.8	77.3	shale	
77.3	77.7	siltstone	
77.7	78.8	sandstone	
78.8	80.3	siltstone	
80.3	80.8	shale	
80.8	96.7	siltstone	
96.7	97.0	shale	
97.0	97.2	coal	
97.2	101.6	siltstone	
101.6	102.5	sand stone	
102.5	113.3	siltstone	
113.3	117.2	shale	
117.2	117.7	siltstone	
117.7	118.7	sandstone	
118.7	120.7	siltstone	
120.7	121.1	coal	
232.2	121.4	shale	
121.4	122.1	siltstone	
122.1	124.7	sandstone	
124.7	124.9	carbonaceous shale	
124.9	125.1	shale	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-8

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
125.1	127.9	siltstone	
127.9	128.2	shale	
128.2	133.8	siltstone	
133.8	135.4	sandstone	
135.4	135.7	siltstone	
135.7	135.8	sandstone	
135.8	139.4	siltstone	
139.4	140.4	shale	
140.4	141.1	siltstone	
141.1	141.6	shale	
141.6	142.0	siltstone	
142.0	142.1	sandstone	
142.1	144.1	siltstone and sandstone	
144.1	144.6	shale with coal bands	
144.6	147.9	siltstone	
147.9	148.7	shale	
148.7	149.4	shale with siltstone lenses	
149.4	149.7	siltstone	
149.7	150.0	sandstone	
150.0	150.9	siltstone	
150.9	151.3	shale	
151.3	152.0	siltstone	
152.0	152.7	shale	
152.7	155.0	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-8

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
155.0	155.5	sandstone	
155.5	158.4	siltstone	
158.4	158.7	shale	
158.7	163.5	siltstone	
163.5	164.0	coal with shale splits	
164.0	164.7	siltstone	
164.7	165.0	shale	
165.0	166.1	siltstone	
166.1	166.5	coal with shale splits	
166.5	169.0	siltstone	
169.0	169.5	carbonaceous shale	
169.5	170.6	shale	
170.6	171.4	siltstone	
171.4	171.8	sandstone	
171.8	177.5	siltstone	
177.5	179.1	shale	
179.1	183.8	siltstone with shale lenses	
183.8		End of Hole	

(1) Field Office. (2) Head Office Geology. (3) Head Office Engineering

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston — HOLE NUMBER WIMH81-9

COMPANY Nielsen Drilling Company Ltd — LOCATION Quasar Rd near Dunlevy Rec. Area

DATE 14/03/81 — SURVEYED LOCATION 56° 9' 5" N, 122° 21' 3" W

LOGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 774 m

LOGS RUN Caliper, Resistivity, Gamma, Density — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON

COMMENTS

FROM	TO	LOG	REMARKS
0	3.5	overburden - sand/clay	
3.5	9.3	shale	
9.3	9.7	coal with shale splits	
9.7	11.5	siltstone	
11.5	12.6	shale	
12.6	12.7	coal	
12.7	13.4	carbonaceous shale	
13.4	13.7	coal	
13.7	14.6	shale with coal splits	
14.6	15.0	shale	
15.0	15.1	coal	
15.1	16.4	carbonaceous shale	
16.4	18.5	shale	
18.5	19.6	siltstone	
19.6	19.9	sandstone	
19.9	20.1	siltstone	
20.1	20.4	shale	
20.4	21.5	siltstone & shale interbedded	
21.5	22.0	carbonaceous shale	
22.0	24.2	coal	
24.2	25.3	siltstone	
25.3	25.4	shale	
25.4	25.8	fg. sandstone with siltstone	
25.8	26.0	shale	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-9

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
26.0	26.5	sandstone	
26.5	26.8	siltstone	
26.8	27.8	shale	
27.8	28.4	mg sandstone	
28.4	28.5	shale	
28.5	29.1	sandstone	unconsolidated
29.1	30.8	carbonaceous shale with minor siltstone	
30.8	31.3	siltstone	
31.3	31.4	shale	
31.4	32.3	siltstone shale stringers	
32.3	32.7	shale	
32.7	36.8	siltstone with minor sandstone	
36.8	37.1	shale	
37.1	37.7	siltstone	
37.7	38.1	carbonaceous shale	
38.1	41.9	siltstone	
41.9	42.4	shale	
42.4	42.9	coal with shale splits	
42.9	50.9	siltstone and shale	
50.9	51.3	coal with shale splits	
51.3	52.4	shale	
52.4	59.3	siltstone	
59.3	59.5	coal with shale splits	
59.5	67.6	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-9

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
67.6	67.8	carbonaceous shale	
67.8	68.8	siltstone	
68.8	77.5	mg grey carbonaceous sandstone	
77.5	77.8	black siltstone/shale with coal splits	
77.8	78.2	f.g. grey sandstone	
78.2	78.5	dark grey siltstone and shale	
78.5	79.1	grey siltstone	
79.1	79.5	fg grey sandstone	
79.5	80.3	f.g. light sandstone	80.1 - calcite stringer?
80.3	80.8	grey siltstone	
80.8	81.2	dark grey shale	
81.2	81.8	coal	
81.8	81.9	grey shale	
81.9	83.0	gark grey siltstone	
83.0	83.4	fg grey sandstone	
83.4	84.8	dark grey shale and siltstone	
84.8	85.2	f.g. dark grey sandstone	
85.2	85.5	fg.mg light grey sandstone	
85.5	85.8	black shale	
85.8	88.2	f.g. grey sandstone	
88.2	88.5	dark grey siltstone	
88.5	89.4	f.g. dark grey sandstone	
89.4	94.6	f.g.-m.g. light grey sandstone	

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Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-9

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
94.6	94.7	coal	
94.7	95.5	fg-mg. grey sandstone	
95.5	95.8	siltstone	
95.8	95.9	shale with coal splits	
95.9	96.4	f.g. sandstone	
96.4	96.6	siltstone	
96.6	97.3	fg-mg grey sandstone	
97.3	97.5	coal	
97.5	98.0	fg sandstone	
98.0	98.1	siltstone	
98.1	98.2	sandstone	
98.2	98.4	siltstone	
98.4	98.6	sandstone	
98.6	98.7	coal with shale splits	
98.7	100.0	f.g. sandstone/siltstone inteberbedded	
100.0	100.4	siltstone	
100.4	100.6	fg. sandstone	
100.6	100.7	coal	
100.7	101.4	f.g. sandstone and siltstone	
101.4	101.7	coal with shale splits	
101.7	102.0	siltstone	
102.0	109.4	f.g. sandstone	
109.4	109.5	coal	
109.5	110.4	m.g sandstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-9

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
110.4	110.8	siltstone	
110.8	114.2	fg. sandstone	
114.2	114.5	siltstone	
114.5	116.6	fg sandstone	
116.6	118.2	carbonaceous shale with coal splits	
118.2	118.4	coal	
118.4	123.5	mg sandstone	
123.5	124.9	shale with coal splits	
124.9	125.8	siltstone	
125.8	126.7	coal with shale splits	
126.7	127.1	siltstone	
127.1	127.4	f.g. sandstone	
127.4	128.0	siltstone	
128.0	128.4	coal with shale splits	
128.4	128.8	siltstone	
128.8	131.1	f.g. sandstone	
131.1	132.2	siltstone	
132.2	136.7	fg sandstone	
136.7	137.1	shale with coal splits	
137.1	140.1	siltstone	
140.1	140.5	shale with coal splits	
140.5	142.2	siltstone	
142.2	142.4	coal with shale splits	
142.4	142.5	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH81-9

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
142.5	142.7	coal with shale splits	
142.7	143.3	siltstone	
143.3	144.7	f.g. sandstone	
144.7		mg sandstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston — HOLE NUMBER WIMH 81-10

COMPANY Nielsen Drilling Company Ltd. — LOCATION Feneline Rd. West Bulter Ridge

DATE 16/03/81 — SURVEYED LOCATION 56° 8' 43" N, 122° 17' 35" W

LOGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 1072 m

LOGS RUN Caliper, Resistivity, Gamma, Density — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON

COMMENTS

FROM	TO	LOG	REMARKS
0	1.3	overburden - sand/clay	
1.3	5.4	shale	
5.4	5.5	coal	
5.5	10.5	shale	
10.5	11.4	siltstone	
11.4	11.8	carbonaceous shale	
11.8	12.2	coal	
12.2	12.5	shale	
12.5	13.6	f.g. sandstone	
13.6	14.2	siltstone	
14.2	14.9	shale	
14.9	15.6	siltstone	
15.6	16.8	shale	
16.8	17.6	siltstone	
17.6	18.0	carbonaceous shale	
18.0	18.9	siltstone	
18.9	19.4	shale/carbonaceous shale	
19.4	20.1	coal	
20.1	23.7	siltstone	
23.7	23.8	coal	
23.8	24.8	siltstone	
24.8	25.3	shale	
25.3	25.6	f.g. sandstone	
25.6	26.0	siltstone	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-10

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
26.0	26.3	shale	
26.3	28.3	siltstone	
28.3	28.6	shale	
28.6	28.8	siltstone	
28.8	29.6	carbonaceous shale/shale	
29.6	34.4	silstone	
34.4	34.7	shale	
34.7	35.3	coal	
35.3	35.7	shale	
35.7	35.8	coal	
35.8	36.1	shale	
36.1	38.4	siltstone	
38.4	38.9	shale	
38.9	40.5	siltstone	
40.5	42.1	shale/carbonaceous shale	
42.1	48.4	siltstone	
48.4	49.6	shale	
49.6	55.8	siltstone	
55.8	57.1	carbonaceous shale	
57.1	57.2	coal	
57.2	61.3	siltstone	
61.3	61.6	coal	
61.6	64.5	siltstone	
64.5	64.8	coal	

Hudbay Coal Company
ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-10

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
64.8	67.4	silstone	
67.4	69.8	f.g. sandstone	
69.8	71.6	siltstone	
71.6	72.0	shale with coal splits	
72.0	73.7	siltstone	
73.7	75.3	shale with coal splits	
75.3	75.5	coal	
75.5	76.3	siltstone	
76.3	76.8	shale	
76.8	77.2	sandstone	
77.2	78.1	siltstone	
78.1	81.7	coal with shale splits	
81.7	82.5	sandstone	
82.5	84.1	coal with shale splits	
84.1	87.8	sandstone	
87.8	89.2	shale with coal splits	
89.2	93.4	siltstone	
93.4	93.6	shale	
93.6	93.9	siltstone	
93.9	94.6	shale	
94.6	94.7	coal	
94.7	95.1	siltstone	
95.1	95.5	sandstone	
95.5	97.4	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-10

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
97.4	97.7	shale	
97.7	98.3	silstone	
98.3	98.9	sandstone	
98.9	99.8	shale with coal splits	
99.8	100.3	siltstone	
100.3	100.6	f.g. sandstone	
100.6	101.2	shale with coal splits	
101.2	102.1	shale	
102.1	102.4	shale with coal splits	
102.4	103.2	siltstone	
103.2	104.0	shale with coal splits	
104.0	104.2	coal	
104.2	104.5	shale	
104.5	105.6	silstone	
105.6	106.2	sandstone	
106.2	106.8	shale with coal splits	
106.8	106.9	coal	
106.9	107.2	shale	
107.2	112.2	siltstone	
112.2	113.5	shale with coal splits	
113.5	113.8	coal	
113.8	114.2	shale	
114.2	117.6	siltstone	
117.6	118.1	shale	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-10

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
118.1	118.4	siltstone	
118.4	118.9	shale	
118.9	119.8	siltstone	
119.8	122.0	sandstone	
122.0	125.7	siltstone	
125.7	125.9	shale with siltstone splits	
125.9	126.2	shale with coal splits	
126.2	126.3	sandstone	
126.3	126.7	siltstone	
126.7	126.8	coal	
126.8	127.7	siltstone	
127.7	128.8	shale	
128.8	128.9	coal	
128.9	131.7	shale with coal splits	
131.7	135.2	siltstone	
135.2	136.3	shale	
136.3		siltstone	

(1) Field Office (2) Head Office Geology (3) Head Office Engineering

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD Williston — HOLE NUMBER WIMH 81-11

COMPANY Nielsen Drilling Company Ltd. — LOCATION Dunlevy Inlet Rd.

DATE 17-03-81 — SURVEYED LOCATION 56° 7' 37" N, 122° 20' 16" W

LOGGING COMPANY Davies Exploration Logging Ltd — ELEVATION 698 m

LOGS RUN Caliper, Resistivity, Gamma, Density — ANGLE / BEARING 90°

DEVIATION (TEST) — WATER HORIZON

COMMENTS

FROM	TO	LOG	REMARKS
0	4.8	overburden - sand/clay	
4.8	5.6	siltstone and sandstone	
5.6	5.9	m.g. sandstone	
5.9	6.2	shale	
6.2	7.0	m.g. sandstone	
7.0	7.4	shale	
7.4	8.6	sandstone/clay split	
8.6	11.9	shale	
11.9	13.2	siltstone	
13.2	13.3	coal	
13.3	14.7	shale	
14.7	14.9	carbonaceous shale	
14.9	15.7	siltstone	
15.7	15.9	coal	
15.9	16.3	sandy clay	
16.3	17.5	shale	
17.5	19.2	siltstone	
19.2	21.7	sand	
21.7	21.8	coal	
21.8	22.3	shale	
22.3	23.0	siltstone and shale	
23.0	23.9	coal with shale splits	
23.9	26.1	coal	
26.1	26.9	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-11

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
26.9	27.1	coal with shale splits	
27.1	27.8	shale	
27.8	28.0	siltstone	
28.0	28.3	carbonaceous shale	
28.3	28.6	siltstone	
28.6	29.2	coal with shale splits	
29.2	29.9	carbonaceous shale	
29.9	30.0	shale	
30.0	33.4	siltstone	
33.4	33.8	shale	
33.8	36.0	siltstone	
36.0	36.5	shale with coal splits	
36.5	36.8	siltstone	
36.8	37.8	shale	
37.8	38.0	siltstone	
38.0	38.5	shale	
38.5	40.0	siltstone	
40.0	40.2	coal	
40.2	40.5	shale	
40.5	41.5	siltstone	
41.5	41.7	shale with coal splits	
41.7	44.8	siltstone	
44.8	46.3	shale with siltstone splits	
46.3	47.2	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-11

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
47.2	50.6	shale	
50.6	51.6	siltstone	
51.6	52.9	f.g. sandstone	
52.9	55.1	siltstone with sahle splits	
55.1	55.6	carbonaceous shale	
55.6	57.3	siltstone	
57.3	57.4	coal	
57.4	57.8	shale with siltstone splits	
57.8	59.8	siltstone	
59.8	59.9	coal	
59.9	62.1	siltstone with sandstone splits	
62.1	62.8	shale with coal splits	
62.8	65.6	siltstone	
65.6	66.6	shale with coal splits	
66.6	66.9	siltstone	
66.9	67.6	shale	
67.6	68.5	siltstone	
68.5	68.8	shale	
68.8	70.1	siltstone	
70.1	70.7	f.g. sandstone	
70.7	71.0	shale	
71.0	73.4	siltstone	
73.4	74.8	shale with siltstone splits	
74.8	79.7	siltstone	

Hudbay Coal Company

ROTARY (Reverse Circulation) DRILL HOLE LOG

COAL FIELD _____ HOLE NUMBER WIMH 81-11

COMPANY _____ LOCATION _____

DATE _____ SURVEYED LOCATION _____

LOGGING COMPANY _____ ELEVATION _____

LOGS RUN _____ ANGLE / BEARING _____

DEVIATION (TEST) _____ WATER HORIZON _____

COMMENTS _____

FROM	TO	LOG	REMARKS
79.7	80.2	coal with shale splits	
80.2	81.4	siltstone with shale splits	
81.4	83.8	siltstone	
83.8	84.1	coal with shale splits	
84.1	84.5	f.g. sandstone	
84.5	85.6	shale	
85.6	86.3	sandstone	
86.3	87.9	siltstone	
87.9	88.2	shale	
88.2		silstone	

(1) Field Office. (2) Head Office Geology. (3) Head Office Engineering

APPENDIX D

DRILL HOLE SUMMARIES

TS-615

Hudbay Coal Company

(1) Field Office, (2) Head Office

DRILL HOLE SUMMARY SHEET

Project Williston Year 1981

Hole Number	Incl. (deg)	Azimuth (degree)	Coordinates North South	Coordinates East West	Collar Elevation	Total Depth	Electric Log Nat. Gam.	Electric Log Density	Electric Log Resistivity	Electric Log Date	Electric Log Depth	Drill Log	Overburden Depth	Water Table Depth	Seam Data No.	Seam Data Depth Top	Seam Data Depth Bottom	Seam Data Thickness	Samples Core	Samples Bar	Samples Chips	Elevations Bottom of Hole	Elevations Seam Top	Elevations Seam Bottom	Rig rot.	Rig dia.	Fluid air	Fluid wtr.	Fluid mud	Comments
1	90	-	56°10'18"	122°11'54"	994	183.8	X	X	X	26/02	182	X	5	12.0								810.2			X		X			
2	90	-	56°10'18"	122° 13'16"	1042	137.2	X	X	X	28/02	136	X	1	00.0								904.8			X		X			
3	90		56°12'13"	122°13'52"	1018	107.6	X	X	X	01/03	106	X	2.0	27.4								910.4			X		X			
4	90		56°10'17"	122°22'41"	683	183.8	X	X	X	04/03	182	X	19.3	21.0		50.0	50.2	0.2				499.2	633.0	632.8	X		X			shale/coal
																71.0	71.2	0.2					612.0	611.8						dirty coal
																93.1	93.6	0.5					589.9	589.4						coal/sh.splits
																119.7	119.8	0.1					563.3	563.2						coal
																122.3	122.5	0.2					560.7	560.5						dirty coal
																134.3	134.5	0.2					548.7	548.5						coal & shale
																(136.5	136.7	0.2					546.5	-						carb sh.
																(136.7	137.2	0.5					-	545.8						coal
5	90		56°11'15"	122°29'14"	1347	199.0	X	X	X	06/03	198	X				36.5	36.6	0.1				1148	1310.5	1310.4	X		X			carb sh
																37.4	38.5	1.1					1309.6	1308.5						carb sh
																55.9	56.2	0.3					1291.1	1290.8						coal
																68.3	68.7	0.4					1278.7	1278.3						coal
																82.4	82.9	0.5					1264.6	1264.1						coal

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Hudbay Coal Company

(1) Field Office, (2) Head Office

DRILL HOLE SUMMARY SHEET

Project Williston Year 1981

Hole Number	Incl. (deg)	Azimuth (degree)	Coordinates North South	Coordinates East West	Collar Elevation	Total Depth	Electric Log Nat. Gam.	Electric Log Density	Electric Log Resistivity	Electric Log Date	Electric Log Depth	Drill Log	Overburden Depth	Water Table Depth	Seam Data No.	Seam Data Depth Top	Seam Data Depth Bottom	Seam Data Thickness	Samples Core	Samples Bulk	Samples Chips	Elevations Bottom of Hole	Elevations Seam Top	Elevations Seam Bottom	Rig rot	Rig dia	Fluid air	Fluid wtr	Fluid mud	Comments
5																98.9	99.0	0.1					1248.1	1248.0						coal/sh
																111.0	111.1	0.1					1236	1235.9						coal
																130.6	130.8	0.2					1216.4	1216.2						dirty coal
6	90		56°8'49"	122°25'12"	1000.0	153.3	X	X	X	08/03	152	X				12.6	12.8	0.2				846.7	987.4	987.2	X		X			dirty coal
																18.2	18.7	0.5					981.8	-						coal
																18.7	19.3	0.6					-	-						carb shale
																19.3	19.5	0.2					-	980.5						dirty coal
																24.0	24.1	0.1					975.5	975.4						dirty coal
																34.6	34.8	0.2					965.4	965.2						dirty coal
																52.9	53.1	0.2					947.1	946.9						coal
																54.9	55.0	0.1					945.1	945.0						coal
																56.5	56.6	0.1					943.5	943.4						dirty coal
																73.5	73.6	0.1					926.5	926.4						dirty coal
																90.1	90.5	0.4					909.9	909.5						sh & coal
																93.0	93.1	0.1					907.0	906.9						coal
																102.4	102.7	0.3					897.6	897.3						dirty coal
7	90		56°8'57"	122°23'35"	920	153.3	X	X	X	10/03	152	X	13	137.5		30.0	30.5	0.5				766.7	890.0	889.5	X		X			carb shale
																44.3	44.5	0.2					875.7	875.5						coal
																77.9	78.1	0.2					842.1	841.9						dirty coal

TR-615

Hudbay Coal Company

(1) Field Office, (2) Head Office

DRILL HOLE SUMMARY SHEET

Project WILLISTON Year 1981

Hole Number	Incl. (deg)	Azimuth (degree)	Coordinates North South	Coordinates East West	Collar Elevation	Total Depth	Electric Log: Nat. Gam.	Electric Log: Density	Electric Log: Resistivity	Electric Log: Date	Electric Log: Depth	Drill Log	Overburden Depth	Water Table Depth	Seam Data: No.	Seam Data: Depth Top	Seam Data: Depth Bottom	Seam Data: Thickness	Samples	Elevations: Bottom of Hole	Elevations: Seam Top	Elevations: Seam Bottom	Rig	Fluid	Comments
7																84.4	84.6	0.2			835.6	835.4			dirty coal
																121.5	121.6	0.1			798.5	798.4			coal & carbS S
																134.5	135.0	0.5			785.5	785.0			carb Sh & coal
8	90		56°10'13"	122°20'49"	972	183.8	X	X	X	13/03	183	X	1.5			2.4	2.9	0.5		788.2	969.6	969.1	X	X	in casing
																7.1	7.15	0.15			964.9	964.75			in casing
																31.9	32.1	0.2			940.1	939.2			dirty coal
																96.3	96.5	0.2			875.7	875.5			coal
																(120.0	120.4	0.4			852.0	-			coal
																(120.4	121.0	0.6			-	851.0			carb sh
																150.2	150.5	0.3			821.8	821.5			coal/shale
																165.4	165.6	0.2			806.6	806.4			coal
9	90		56°9'5"	122°21'3"	774	153.3	X	X	X	15/03	152	X	3.5			9.5	9.7	0.2		620.7	764.5	764.3	X	X	coal
																12.4	12.6	0.2			761.6	761.4			dirty coal
																23.6	24.0	0.4			750.4	750.0			coal
																37.0	37.4	0.4			737.0	736.6			dirty coal
																42.1	42.6	0.5			731.9	731.4			coal and sh. splits
																50.4	51.0	0.6			723.6	723.0			coal & sh.
																80.7	81.6	0.9			693.3	692.4			coal with shale splits

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Hudbay Coal Company

(1) Field Office, (2) Head Office

DRILL HOLE SUMMARY SHEET

Project Williston Year 1981

Hole Number	Incl. (deg)	Azimuth (degree)	Coordinates North South	Coordinates East West	Collar Elevation	Total Depth	Electric Log Nat. Gam.	Electric Log Density	Electric Log Resistivity	Electric Log Date	Electric Log Depth	Drill Log	Overburden Depth	Water Table Depth	Seam Data No.	Seam Data Depth Top	Seam Data Depth Bottom	Seam Data Thickness	Samples	Elevations Bottom of Hole	Elevations Seam Top	Elevations Seam Bottom	Rig	Fluid	Comments
9																(116.1	117.3	1.2			657.9			carb shale and coal
																(117.3	117.8	0.5				656.2		coal
																125.5	125.7	0.2			648.5	648.3		coal
																127.6	127.8	0.2			646.4	646.2		coal
																136.3	136.4	0.1			637.7	637.6		carb. sh.
10	90		56°8'43"	122°17'35"	1072	137.2	X	X	X	16/03	136	X	1.3	38.3		11.5	11.7	0.2		934.8	1060.5	1060.3	X	X	coal
																19.3	19.5	0.2			1052.7	1052.5		coal
																34.5	34.8	0.3			1037.5	1037.2		coal
																(40.5	40.7	0.2			1031.5	-		coal
																(40.7	41.0	0.3			-	-		shale
																(41.0	41.3	0.3			-	1030.7		coal
																56.5	57.0	0.5			1015.5	1015.0		coal
																63.0	63.4	0.4			1009.0	1008.6		coal
																130.1	130.9	0.8			941.9	941.1		coal & sh
11	90		56°7'37"	122°20'16"	698	92.4	X	X	X	17/03	91	X	4.8			12.3	12.4	0.1		605.6	685.7	685.6	X	X	dirty coal
																(22.5	23.4	0.9			675.5	-		carb sh
																(23.4	25.0	1.6			-	-		coal
																(25.0	25.7	0.7			-	672.3		carb sh

TB-615

Hudbay Coal Company

(1) Field Office, (2) Head Office

DRILL HOLE SUMMARY SHEET

Project Williston Year 1981

Hole Number	Incl. (deg)	Azimuth (degree)	Coordinates North South	Coordinates East West	Collar Elevation	Total Depth	Electric Log Nat Gam	Electric Log Density	Electric Log Resistivity	Electric Log Date	Electric Log Depth	Drill Log	Over-burden Depth	Water Table Depth	Seam Data No.	Seam Data Depth Top	Seam Data Depth Bottom	Seam Data Thickness	Samples	Elevations Bottom of Hole	Elevations Seam Top	Elevations Seam Bottom	Rig	Fluid	Comments
11																36.0	36.2	0.2			662.0	661.8			coal
																39.8	40.0	0.2			658.2	658.0			coal
																(65.5	65.8	0.3			632.5	-			coal
																((65.8	66.2	0.4			-	-			shale
																((66.2	66.4	0.2			-	631.6			coal

APPENDIX E

PHOTOS

Photo 1

Butler Ridge

Photo 2

W A C Bennett Dam

Photo 3

Peace Canyon Dam

Photo 4

Site of the Reshke Mine which operated from 1948 to 1960

Photo 5

Contact between well indurated Monach quartzite and thinly bedded Brenot siltstones, shales and sandstones.

Photo 6

Medium-to coarse-grained trough cross-bedded Dresser sandstone with conglomerate lenses.

Photo 7

Thinly bedded interval in Dresser Formation at Dunlevy Inlet Narrows.

Photo 8

Gething Formation in the Peace River Canyon

Photo 9

Drilling was completed using a truck-mounted T985H Schramm Hammer Drill. A cyclone was used for catching samples.

APPENDIX F

STATEMENT OF EXPENSES

STATEMENT OF EXPENDITURES

(01-01-81 to 31-05-81)

Wages and Benefits	$ 5 388.00
Travel and Accommodation	6 316.40
Automobile Expenses	6 039.07
Charter Aircraft	844.74
Printing, Reproduction, Drafting	1 175.07
Telephone, Telegraph	294.19
Trucking, Freight	742.64
Drilling	66 679.34
Geophysical Logging	14 362.61
Heavy Equipment	13 836.41
Reclamation	
Material	352.69
Labour	864.00
Analysis	243.00
Total	$ 117 138.16

ADDENDUM

Geophysical Logs

The density scales on the geophysical logs are inaccurate The scales should be half the width they are on the header. This effectively decreases the density measured off the logs and accounts for the discrepancy between the log of WIMH81-11 and the analysed sample. It does not change the width of the coal seams.

MEMORANDUM

1981-11-26

TO: Tom Adamson

SUBJECT: **WIMH81-9**

Driller's logs are approximations of the formation being penetrated.

True thickness and depths of lithologies must be measured off the geophysical log to obtain accurate data. The log of WIMH81-9 shows that the seam in question is less than 0.5 m thick. The chips were collected at the time, but discarded upon closer examination as they were mostly shale and carbonaceous shale.

E. Ronayne

ER:ma