

UTAH GEOLOGICAL AND MINERAL SURVEY

REPORT OF INVESTIGATION

NO. 201

THE HILL CREEK OIL-IMPREGNATED
SANDSTONE DEPOSIT

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INTRODUCTION

The Hill Creek oil-impregnated sandstone deposit is located on the rugged, southern flank of the Uinta Basin, in Uintah County, Utah. It lies westward of the P.R. Springs oil-impregnated sandstone deposit, being separated by the Willow Creek drainage system. It also lies eastward of the Sunnyside oil-impregnated sandstone deposit, being separated by the Green River drainage.

The area of this report is bounded by latitude $30^{\circ} 30'$ to $39^{\circ} 45'$ north and $109^{\circ} 37' 30''$ to $110^{\circ} 00' 00''$ west. The USGS Firewater Canyon 15' quad, the Agency Draw NW and the Flat Rock Mesa 7.5' quads cover the area.

Two federal administrative units exist within the study area. They are 1) the Naval Oil Shale Reserve No. 2, which covers Townships 12 and 13 South, 18 and 19 east, and 2) a portion of the Uintah and Ouray Indian Reservation.

PURPOSE

This report is to present a compilation, interpretation and discussion of the geological and technical data that are currently available on the study area. Funding for the project was provided by the U.S. Department of the Interior, Bureau of Land Management.

STRATIGRAPHIC SETTING

The major stratigraphic units or formations that are present in the Hill Creek area are the Eocene Green River Formation and the underlying Wasatch Formation. The Green River Formation is broken into a number of individual members. Members of particular interest in the Hill Creek area, in ascending order, are the Douglas Creek, Parachute Creek and Evacuation Creek. The important Mahogany oil-shale bed occupies a stratigraphic position at the base of the Parachute Creek Member and conformably overlies the Douglas Creek Member.

Oil-impregnated sandstones of the Hill Creek deposit are positioned stratigraphically both above the Mahogany oil-shale in the lower Parachute Creek Member and below it in the upper Douglas Creek Member. These oil-impregnated sandstones are part of a persistent set of sandstone beds that are traceable for hundreds of miles throughout the southern portion of the basin. The Mahogany oil shale is of great economic importance and has been used as a key marker bed in studies within the area and throughout the Uinta Basin.

STRUCTURAL SETTING

The general structural setting, within the southern flank of the Uinta Basin, is that of a variety of sedimentary lithologies dipping gently northward towards the central portion of the basin. In the vicinity of the Hill Creek area, the dip of the beds is about 1.5 degrees as determined from

structural contours drawn on top of the Mahogany oil-shale bed (Cashion, 1967; plate 1).

The Hill Creek anticline, the only major structural feature which interrupts the gentle, northward regionally dipping beds (Cashion, 1967, p.22), is a northwest-trending structure occurring within the southeast quarter of the study area. Faulting and jointing along the southern flank of the Hill Creek anticline also create a zone of disturbance and weakness within the southeastern quarter of the study area, just south of Flat Rock Mesa and through Lower Wagon Canyon.

SOURCES OF GEOLOGIC DATA

Stratigraphic data and field observations pertaining to the Hill Creek oil-impregnated sandstone deposit have been taken from the following sources: Baldwin (1971), Blair (1971), Cashion (1959), Cashion (1967), Gwynn and Dalton (1969), Peterson (1975), and Quigley (1970).

Data from Cashion (1959) consist of short, graphic logs of core holes within the Naval Oil-Shale Reserve No. 2. Both the location and surface elevation are given for each hole; the presence of tar sand was determined from lithologic log descriptions.

Data from Cashion (1967) consist of portions of measured sections from throughout the southern Uinta Basin. The general locations of the sections and the presence of any oil-impregnated sandstone are noted. Neither surface elevation nor depth below the surface are given on the logs.

Data from Peterson (1975) consist of carefully documented stratigraphic or lithologic logs of three core holes from the Flat Rock Mesa area.

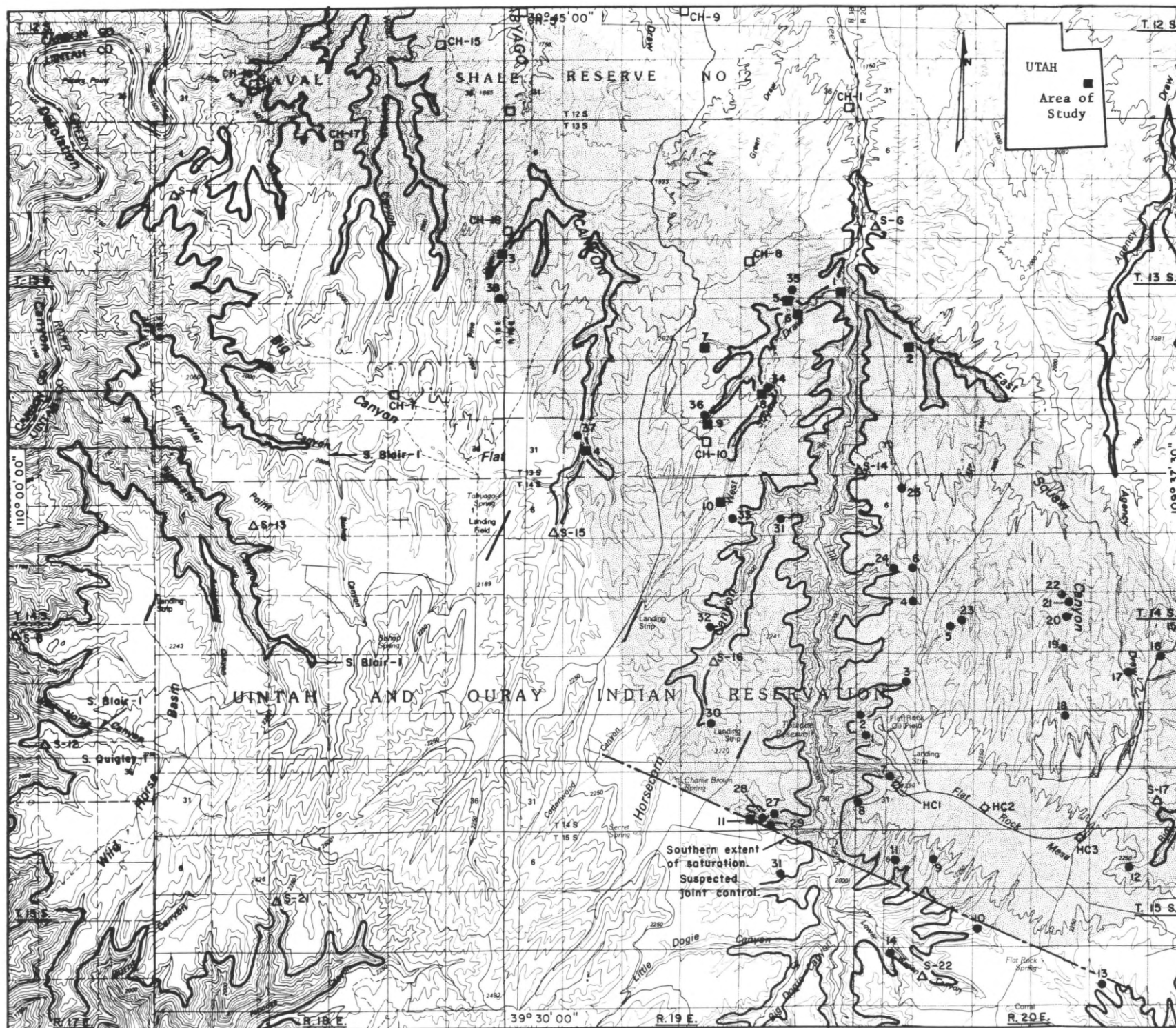
Data from Baldwin (1971) consist of brief notes concerning oil-impregnated outcrops within the area. Exact locations, elevations and stratigraphic relationship to the Mahogany oil shale bed are not provided.

Data from Gwynn and Dalton (1969) consist of brief notes concerning oil-impregnated outcrops or very general lithologic sections. These data do not contain accurate elevations or stratigraphic reference to the Mahogany oil shale.

Data from Quigley (1970) and from Blair (1971) consist of brief reports on field investigations as reported in work progress reports.

Point locations represented by the above data or observations are described in appendix A, and are plotted on figure 1, (a 1:100,000 scale topographic map), using the following symbols.

Cashion (1959).....	△
Cashion (1967).....	□
Peterson (1975).....	○
Baldwin (1971).....	■
Gwynn and Dalton (1969).....	●
Quigley (1970).....	S. Quigley-1
Blair (1971).....	S. Blair-1



EXPLANATION

Outcrop of the Mahogany Oil-Shale bed



Cashion (1959)



Cashion (1967)



Peterson (1975)



Baldwin (1971)



Gwynn and Dalton



Quigley (1970)



Blair (?)



S Quigley-1

S Blair-1

Area underlain by
oil-impregnated
sandstone



Figure 1 - Topographic map of the Hill Creek Area, showing the outcrop of the Mahogany oil-shale bed, data sites and the approximate area underlain by the oil-impregnated sandstone.

ECONOMIC GEOLOGY

The economic aspects of the Hill Creek oil-impregnated sandstone deposit to be considered include its areal extent, its lenticular nature, thickness, overburden, engineering properties and land status.

Areal Distribution

From an interpretation of available data, it is estimated that some 120 square miles within the study area are underlain by oil-impregnated sandstones, as indicated on figure 1. The saturation is abruptly terminated on the south by a system of joints which trend approximately N 66° W. To the northeast, the saturation appears to become very weak, and the beds become thin. To the west, saturation is not found within the deeply incised canyons extending eastward from the Green River.

Lenticular Nature and Thickness

The oil-impregnated sandstones of the Hill Creek area do not consist of either vertically- or horizontally-continuous, massive units. Instead, the deposit actually consists of zones of individual oil-impregnated sand lenses, separated by non-impregnated lithologic units. Vertically, both the thickness and the stratigraphic pattern within a zone can change from one location to another. These changes can readily be seen in figure 2, which shows a cross-section through the Flat Rock Mesa area, developed from the Hill Creek cores number one through three from Peterson (1975). This same type of

changing oil-impregnated sandstone pattern has also been observed by the author in the P.R. Springs deposit to the east.

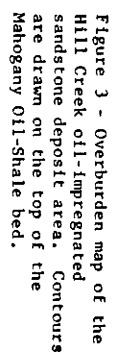
The thickest and the richest sections of oil-impregnated sandstone within the Hill Creek deposit appear to be located within the general vicinity of Flat Rock Mesa. Northward from this area, both the thickness and grade of the individual beds or lenses seem to diminish. The data that are available concerning the presence, thickness and richness of oil-impregnated sands at the numerous sites indicated on figure 1 are given in appendix A.

Overburden

The thickness of overburden, or that non-impregnated rock which covers the oil-impregnated sandstones, varies from less than 100 feet to more than 1000 feet within the bounds of the study area. Due to a lack of stratigraphic data, however, an accurate representation of the overburden thickness cannot be given in this report.

A generalization of the overburden thickness can be made by using the thickness of strata above the top of the Mahogany oil-shale bed, as shown in figure 3. This generalized map was developed, using Cashion's (1967) structural contours drawn on the top of the Mahogany oil-shale bed.

To obtain the actual overburden thickness, the thickness of non-impregnated rocks sandwiched between the top of the Mahogany bed and the bottom of the overlying oil-impregnated sands as well as the thickness of these sands, must be subtracted from the generalized overburden thickness.



— 400 —

Note: The thickness of the overburden is measured from the top of the Mahogany Oil-Shale bed, and not from the top of the uppermost oil-impregnated sandstone bed above the oil-shale. Zones of lenticular, oil-impregnated sandstone units, of variable thickness, often separated by non-impregnated units, are found both above and below the Mahogany Oil-Shale zone throughout some or all of the area.

The actual location and elevation of an overburden measurement must also be taken into consideration. In the vicinity of Flat Rock Mesa, for example, the apparent overburden thickness is about 400 feet but, after subtracting the appropriate values (as indicated above), the actual thicknesses range from 40 feet at the HC-1 core site to 310 feet at the HC-3 site.

Farther to the north and east of Flat Rock Mesa, the thicknesses of the "mahogany-to-impregnated rock" interval appear to increase, both above and below the Mahogany oil-shale bed. An interpretation of Cashion's work (1959 and 1967) suggests that these thicknesses can be at least as great as 65 feet above the top of the Mahogany, and at least 50 feet below the bottom of the Mahogany. The thickness of the oil-impregnated zone and of the individual beds above the non-impregnated interval varies greatly.

Engineering Properties

Important factors in evaluating the economic potential of an oil-impregnated sandstone include permeability, porosity, pore saturation, gallons of bitumen per ton, percent volume, percent weight, percent sulfur and oil API gravity. A listing of these data taken from Peterson (1975) is given in appendix B, pages a-g, and a summary of these data is given in table 1. These data show a definite west-to-east trend in the sands as follows: an increase in the permeability, an increase in the porosity, a decrease in pore saturation for oil but an increase in water, a decrease in the gallons per ton of oil, its percent of the volume, and its weight percent. The percent sulfur, and the gravity (API/density) of the oil vary, but not in a consistent manner.

Table 1. Physical and Chemical Properties of Hill Creek
Oil-Impregnated Sandstones and Oils.

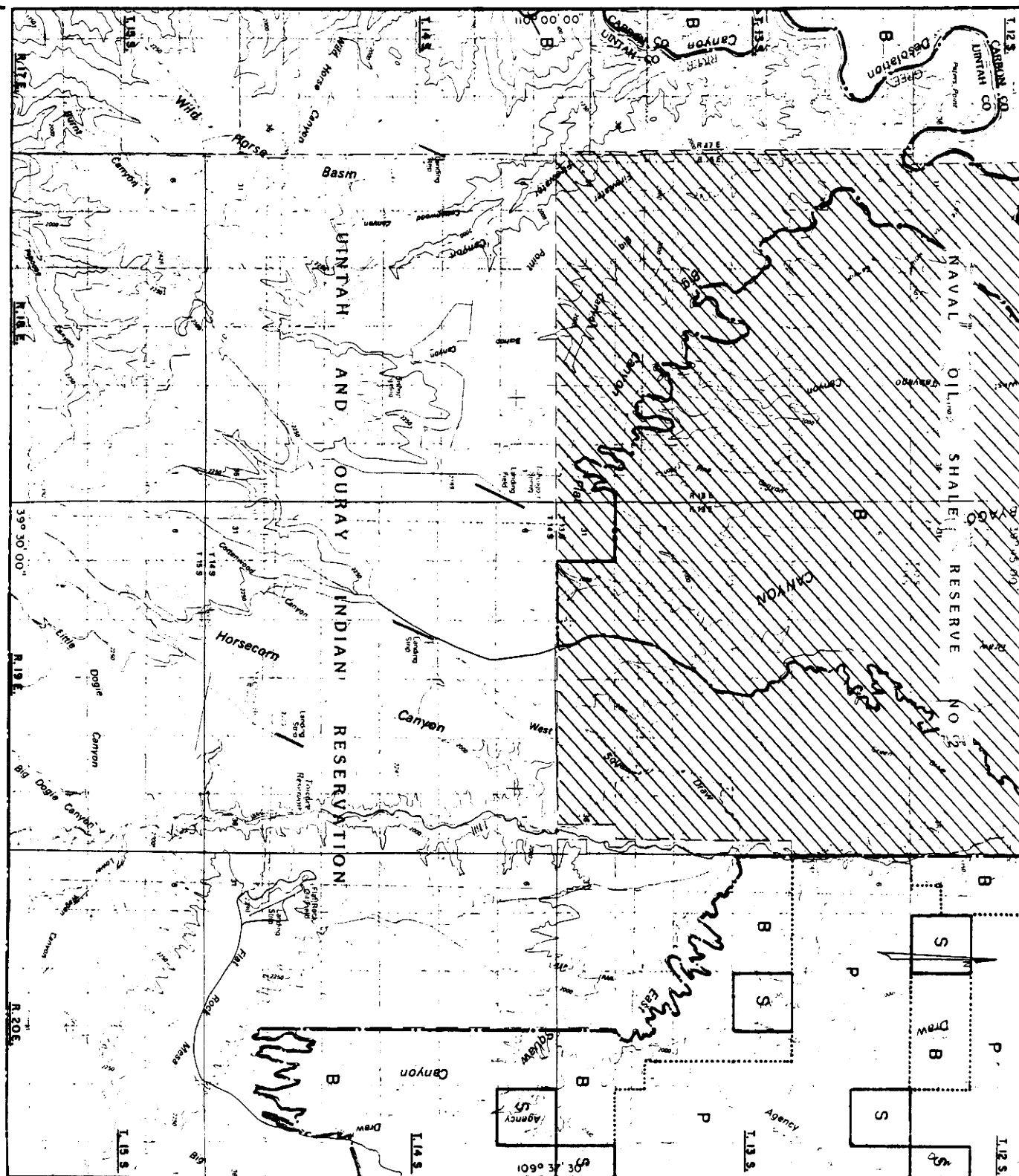
<u>Core Hole</u>	<u>Permeability Before</u>	<u>Permeability After</u>	<u>Porosity</u>	<u>Pore Saturation Oil</u>	<u>Pore Saturation Water</u>	<u>Gal/ Ton</u>	<u>% Vol</u>	<u>% Wt.</u>	<u>% S</u>	<u>Grav. Ext. Oil API/Dens.</u>
*HC-1	41.02	228.4	21.6	45.09	9.57	10.63	9.80	4.30	.39	7.5/1.018
(low value)	.01	2.4	11.6	13.80	2.00	4.30	4.40	1.80		
(high value)	240.00	1355.0	30.5	82.10	27.40	21.10	20.10	8.50		
*HC-2	108.42	341.9	22.56	34.46	15.86	8.36	7.59	3.37	.45	10.5/0.996
(low value)	.01	2.4	14.9	6.90	1.00	2.60	1.20	0.50		
(high value)	412.00	980.0	30.1	67.90	89.20	15.30	14.20	6.20		
*HC-3	277.78	367.09	23.59	23.93	29.38	5.93	5.48	2.40	.41	6.5/1.026
(low value)	.60	2.50	16.50	3.70	7.90	1.00	0.90	0.40		
(high value)	1140.00	1145.00	28.30	73.10	64.50	17.70	17.20	7.20		

* Average value

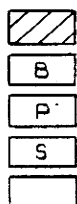
Other engineering data are found in Johnson, L.A., Marchant, L.C., and Cupps, C.Q., 1976.

Land Status

The major portion of the Hill Creek oil-impregnated sandstone deposit is on the Uintah and Ouray Indian Reservation, as shown on figure 4. Townships 12 and 13 South, Ranges 18 and 19 East constitute the Naval Oil Shale Reserve No. 2, and the remainder of the land consists of patented, BLM and State land.



EXPLANATION



Naval Oil Shale Reserve No. 2

BLM land

Patented Land

State Land

Uintah and Ouray Indian Reservation

Figure 4 - Land Status map of the Hill Creek oil-impregnated sandstone deposit.

Note: Much of the Uintah and Ouray Indian Reservation and the BLM land is also covered by other Federal Agency Protective withdrawals. Land ownership taken from BLM 1:100,000 scale metric topographic map, Seep Ridge, Utah-Colorado, 1981.

REFERENCES CITED.

- Baldwin, T.A., 1971, unpublished data furnished to the Utah Geological and Mineral Survey by Tetra Tech, Inc.: UGMS files.
- Blair, G.N., and Blair, A.S., 1971, unpublished "work progress report to the Utah Geological and Mineral Survey": UGMS files.
- Cashion, W.B., 1959, Geology and oil-shale resources of Naval Oil-Shale Reserve No. 2, Uintah and Carbon Counties, Utah: U.S. Geological Survey Bulletin 1072-0, p. 753-793.
- Cashion, W.B., 1967, Geology and fuel resources of the Green River Formation, Southeastern Uinta Basin, Utah and Colorado: U.S. Geological Survey Professional Paper 548, 48 p.
- Gwynn, J.W., and Dalton, E., 1969, unpublished data consisting of notes taken on specific oil-impregnated sandstone sites for the Utah Geological and Mineral Survey within the Hill Creek deposit: UGMS files.
- Johnson, L.A., Marchant, L.C., and Cupps, C.Q., 1976, Properties of Utah tar sands - Flat Rock Mesa Area, Hill Creek Deposit: Laramie Energy Research Center, 18 p.
- Peterson, P.R., 1975, Lithologic logs and correlation of core holes, P.R. Spring and Hill Creek oil-impregnated sandstone deposits, Uintah County, Utah: Utah Geological and Mineral Survey Report of Investigation No. 100, 30 p.
- Quigley, S., 1970, unpublished report to Utah Geological and Mineral Survey: UGMS files.

APPENDIX A

APPENDIX A

For each of the seven references cited, either a summary, direct insert or an illustration will be included within this appendix.

Cashion, W.B., 1959: These data, copies of lithologic logs, are found on pages a-c of this appendix.

Cashion, W.B., 1967: Data interpreted from Plate 3, Stratigraphic Sections, is as follows.

(A) Big Canyon - Section 14, T. 13 S., R. 17 E. and Sec. 7, T. 13 S., R. 18 E.: No oil-impregnated sandstone shown in the 480 feet above, or in the 1550 feet below the Mahogany oil shale.

(B) Wild Horse Canyon - Secs. 15 and 16, T. 14 S., R. 17 E.: No oil-impregnated sandstone shown in the 2250 feet below the Mahogany oil shale; stratigraphic section does not extend above oil shale.

(G) Green Canyon - Secs. 7, 8, 9 and 10, T. 13S., R. 20 E.: No oil-impregnated sandstone shown in the 950 feet above the Mahogany oil shale; stratigraphic section does not extend below the oil shale.

Data interpreted from plate 4, Stratigraphic Sections, showed no oil-impregnated sandstone to be present in any of the following eight locations. The distance above or below to which the section extended from the top or bottom of the Mahogany oil-shale bed is given.

<u>No.</u>	<u>Sec.</u>	<u>Twp.</u>	<u>Rng.</u>	<u>Location</u>	<u>Above</u>	<u>Below</u>
12	26	14	17	Near Wild Horse Canyon	75	40
13	8	14	18	Firewater Canyon	100	25
14	1	14	19	Mouth Horsecorn Canyon	75	25
16	6	14	19	Tabyago Canyon	60	40
16	22	14	19	Horsecorn Canyon	60	40
17	36	14	20	Flat Rock	50	60
21	9	15	18	Chandler Canyon	60	50
22	17	15	20	Wagon Canyon	70	50

Peterson, P.R., 1975: Data presented (see figure 2 of this report) as Cross Section 4-Hill Creek.

Baldwin, T.A., 1971: These data include some eleven, short, site-specific observations. The observations are as follows:

- (1) Sec. 14, T. 13 S., R. 19 E.: 15' of "Channel ss" w/ good oil stn at top of "Colored School Section."
- (2) Sec. 19, T. 13 S., R. 20 E.: 15' channel ss w/ good oil stain, out into top of "Hacky" unit.
- (3) Sec. 13, T. 13 S., R. 18 E.: "Hacky" ss w/ v slt oil stn.
- (4) Sec. 32, T. 13 S., R. 18 E.: 15' ss w/ slt oil stain @ 80 feet "Hacky" mbr.
- (5) Sec. 23, T. 13 S., R. 19 E.: "Towave", No permeable ss.
- (6) Sec. 23, T. 13 S., R. 19 E.: 5' of "Towave" sd w/ lt. speckled oil stain.
- (7) Sec. 22, T. 13 S., R. 19 E.: 20' of Towave sd w/ oil stain, rich at top, weak @ bottom.
- (8) Sec. 26, T. 13 S., R. 19 E.: 15' of "Towave: Sd w/ good oil sat. in top 1' grading down to v slt stn at bottom.
- (9) Sec. 27, 34, T. 13 S., R. 19 E.: 40' of "Towave" w/ 30' of oil stain grading from saturated in top 3' to slt specks @ bot.
- (10) Sec. 3 T. 14 S., R. 19 E.: "Towave", No permeable ss.
- (11) Sec. 35, T. 14 S., R. 19 E.: "Towave", 10' w/ 6' of good oil saturation.

Gwynn, J.W., and Dalton, E., 1969: These data consist of notes on specific localities and are found on pages d-j of this appendix.

Quigley, S., 1970: This reference consists of a short progress report, and is included in this appendix as page k.

Blair, (1971). This reference consists of a short "work progress report," and is included in this appendix as page l.

NAVAL OIL-SHALE RESERVE NO. 2, UTAH

Lithologic logs of cores from holes 1-18, Naval Oil-Shale Reserve No. 2, Uintah and Carbon Counties, Utah

Depth to top of unit (feet)	Thickness (feet)	Description	Depth to top of unit (feet)	Thickness (feet)	Description
Core hole 1; SE¼SE¼ sec. 36, T. 12 S., R. 19 E.; ground elev 5,658 ft					
61.0	5.0	Marlstone, gray and brown; lower half is silty.	87.3	6.0	Marlstone, tan, with chert stringers 2-10mm thick.
66.0	.1	Tuff, yellow-brown.	93.3	6.2	Oil shale, dark-gray.
66.1	4.2	Marlstone, gray.	99.5	1.9	Marlstone, tan.
70.3	.4	Tuff, tan.	101.4	1.9	Oil shale, dark-gray.
70.8	2.7	Marlstone, gray.	103.3	7.0	Marlstone, gray and tan.
73.5	1.8	Oil shale, dark-gray.	110.3	6.2	Oil shale, dark-gray.
75.3	3.9	Marlstone, gray.	116.5	9.9	Marlstone, tan and brown, varved; upper 1.5 feet is silty
79.2	8.1	Oil shale, dark-gray.			
Core hole 5; NE¼NW¼ sec. 30, T. 12 S., R. 19 E.; ground elev 5,556 ft					
105.0	6.5	Siltstone, blue-gray, limy.	135.9	4.9	Oil shale, dark-gray.
111.5	3.5	Marlstone, brown, silty.	140.8	.3	Oil shale, dark-gray, with tuff stringers.
115.0	1.8	Marlstone, brown.	141.1	1.8	Oil shale, dark-gray.
116.8	13.7	Oil shale, dark-gray.	142.9	2.9	Marlstone, brown.
130.5	.1	Tuff, oil-stained.	145.8	3.0	Oil shale, dark-gray.
130.6	.4	Oil shale, with tuff stringer at top.	148.8	.4	Oil shale with stringers of tuff.
131.0	1.7	Marlstone, brown.	149.2	.9	Marlstone brown.
132.7	1.5	Oil shale, dark-gray.			
134.2	1.7	Marlstone, brown.			
Core hole 7; NW¼SW¼ sec. 26, T. 13 S., R. 18 E. (unsurveyed); ground elev 6,881 ft					
390.0	60.3	Sandstone, fine-to medium-grained, limy, and interbedded blue-gray marlstone.	469.2	0.7	Limestone, tan, with contorted bedding at base.
450.3	2.9	Marlstone, tan.	469.9	1.4	Marlstone, tan, containing contorted tuff bed.
453.2	3.2	Oil shale, dark-gray.	471.3	1.1	Oil shale, dark-gray.
456.4	.9	Lost core.	472.4	.6	Conglomerate, with pebbles of marlstone.
457.3	6.8	Oil shale, dark-gray.	473.0	3.1	Marlstone, tan.
464.1	.1	Tuff, tan.	476.1	.3	Oolite.
464.2	.9	Marlstone, tan.	476.4	2.4	Sandstone, light-gray, fine-grained.
465.1	3.6	Oil shale.			
468.7	.5	Marlstone, tan.			
Core hole 8; SW¼NW¼ sec. 14, T. 13 S., R. 19 E.; ground elev 6,247 ft					
130.0	26.0	Siltstone and marlstone, interbedded.	167.8	7.9	Oil shale, dark-gray, with brown contorted tuff stringer at base.
156.0	2.0	Oil shale, dark-gray.	175.7	1.0	Marlstone, brown.
158.0	2.6	Marlstone, dark-brown, with 0.2 in. tuff bed.	176.7	1.5	Oil shale, dark-gray.
		Oil shale, dark-gray, with tuff bed 0.1 ft thick at base.	178.2	2.7	Marlstone, tan.
160.6	7.2		180.9	2.3	Oil shale, dark-gray.
			183.2	.1	Tuff, tan.
			183.3	6.1	Oil shale, dark-gray.
			189.4	2.2	Marlstone, tan.
Core hole 9; NE¼NW¼ sec. 27, T. 12 S., R. 19 E.; ground elev 5,887 ft					
475.0	4.2	Oil shale, dark-gray.	523.0	2.9	Marlstone, tan.
479.2	15.4	Marlstone, brown.	525.9	10.1	Oil shale, dark-gray.
484.6	.3	Tuff, tan.	536.0	2.6	Marlstone, tan.
484.9	15.0	Marlstone, brown.	538.6	2.1	Oil shale, dark-gray, with tuff 0.1 ft thick near middle.
509.9	4.1	Oil shale, dark-gray.			
514.0	1.9	Marlstone, tan.	540.7	5.4	Marlstone, gray and brown.
515.9	6.9	Oil shale, dark-gray.			
622.8	.2	Tuff(?).			
Core hole 10; SE¼NW¼ sec. 34, T. 13 S., R. 19 E.; ground elev 6,763 ft					
125.0	23.0	Sandstone, gray, fine-grained, and interbedded gray limy siltstone.	163.4	4.6	Marlstone, brown and gray.
		Marlstone, gray and brown.	168.0	2.2	Oil shale, dark-gray.
148.0	2.9	Marlstone, gray and brown.	170.2	2.5	Marlstone, brown.
150.9	2.0	Oil shale, dark-gray.	172.7	9.9	Sandstone, asphaltic, gray, medium-grained, and interbedded gray, limy siltstone.
152.9	4.1	Marlstone, brown.			
157.0	6.4	Oil shale, dark-gray.			

NAVAL OIL-SHALE RESERVE NO. 2, UTAH

Lithologic logs of cores from holes 1-18, Naval Oil-Shale Reserve No. 2, Uintah and Carbon Counties, Utah—Continued

Depth to top of unit (feet)	Thickness (feet)	Description	Depth to top of unit (feet)	Thickness (feet)	Description
Core hole 11; NW¼SW¼ sec. 31, T. 12 S., R. 19 E.; ground elev 5,871 ft					
97.0	14.0	Marlstone, gray and brown.	133.9	1.8	Siltstone, gray, sandy, with oil-shale stringers; bleeding small amount of oil 0.6 ft below top.
111.0	1.4	Lost core.			
112.4	1.2	Marlstone, brown, with some pyrite stringers.	135.7	2.7	Oil shale, dark-brown, with stringers of gray tuff.
113.6	.2	Tuff, yellow-brown.	138.4	.1	Tuff, yellow-brown.
113.8	4.9	Oil shale, dark-gray and brown, with limestone stringers.	138.5	2.5	Oil shale, dark-brown, with stringers of gray tuff.
118.7	7.3	Marlstone, gray and brown.	141.0	3.9	Siltstone, gray, with thin tuff beds.
126.0	.8	Siltstone, gray, limy.	144.9	1.0	Marlstone, gray and brown.
126.8	5.2	Oil shale, dark-gray and brown.			
132.0	1.2	Siltstone, gray, tuffaceous.	145.9	.5	Siltstone, gray, tuffaceous.
133.2	.7	Oil shale, brown, bedding contorted.	146.4	4.1	Marlstone, gray, tuffaceous; silty at base.

Core hole 15; NW¼SE¼ sec. 26, T. 12 S., R. 18 E. (unsurveyed); ground elev 5,690 ft

10.0	20.9	Siltstone, gray, limy, with a few thin beds of very fine grained sandstone.	95.5	0.1	Tuff, yellow-brown.
			95.6	.6	Oil shale, dark-gray and brown.
30.9	1.9	Marlstone, dark-gray and brown.	96.2	.7	Marlstone, gray and brown, silty.
32.8	1.0	Marlstone, gray, silty.	96.9	1.3	Siltstone, gray and brown.
33.8	2.0	Siltstone, gray, limy.	98.2	1.1	Marlstone, gray and brown.
35.8	3.2	Marlstone, gray, silty.			
39.0	1.2	Oil shale, gray and brown, with several very thin stringers of nahcolite.	99.3	2.2	Oil shale, dark-gray and brown.
40.2	1.4	Marlstone, gray and brown, silty.	101.5	2.1	Marlstone, dark-gray, silty.
41.6	2.4	Siltstone, gray, limy, micaceous.	103.6	27.7	Siltstone, gray and brown.
44.0	3.0	Marlstone, gray and brown.	131.3	.1	Tuff, yellow-brown, oil-stained.
47.0	.1	Tuff, yellow-brown.	131.4	1.9	Siltstone, gray and brown.
47.1	.7	Marlstone, gray and brown.	133.3	.1	Tuff, yellow-brown, oil-stained.
47.8	.5	Oil shale, gray and brown.	133.4	1.6	Siltstone, gray and brown.
48.3	.1	Tuff, yellow-brown, oil-stained.	135.0	2.2	Marlstone, gray and brown, silty.
48.4	4.3	Oil shale, dark-gray and brown.	137.2	6.4	Oil shale, dark-gray and brown.
52.7	.1	Tuff, yellow-brown.	143.6	3.3	Marlstone, gray and brown.
52.8	1.2	Oil shale, brown.	146.9	2.5	Siltstone, gray, limy.
54.0	8.0	Siltstone, gray, micaceous.	149.4	.6	Marlstone, brown.
62.0	1.3	Marlstone, brown, silty.	150.0	.9	Oil shale, dark-gray and brown.
63.3	3.6	Siltstone, gray, micaceous.	150.9	1.5	Marlstone, gray, silty.
66.9	1.3	Marlstone, gray and brown.	152.4	1.0	Siltstone, gray, limy.
68.2	4.0	Oil shale, dark-gray and brown.	153.4	.4	Tuff, yellow-brown.
72.2	3.8	Marlstone, brown, cherty.	153.8	2.6	Marlstone, gray and brown; upper half is silty.
76.0	7.7	Oil shale, dark-gray and brown.	156.4	2.7	Siltstone, gray, micaceous.
83.7	.1	Tuff, yellow-brown.	159.1	.3	Tuff, yellow-brown, oil-stained.
83.8	3.8	Oil shale, dark-gray and brown.	159.4	2.0	Siltstone.
87.6	2.9	Marlstone, gray and brown.	161.4	.9	Oil shale, dark-gray and brown.
90.5	.9	Oil shale, dark-gray.	162.3	3.1	Marlstone, gray and brown.
91.4	.1	Tuff, yellow-brown.	165.4	1.2	Oil shale, gray and brown.
91.5	1.0	Oil shale, dark-gray.	166.6	2.5	Tuff, gray with inclusions of siltstone.
92.5	2.5	Marlstone, gray and brown.	169.1	4.4	Siltstone, gray, tuffaceous.
95.0	.5	Oil shale, dark-gray and brown.			

Core hole 16; SE¼SW¼ sec. 28, T. 12 S., R. 18 E. (unsurveyed); ground elev 5,890 ft

10.0	14.4	Siltstone, gray, limy.	47.5	5.1	Marlstone, gray and brown, silty.
24.4	1.2	Marlstone, brown, silty.			
25.6	1.8	Siltstone, gray, limy.	52.6	.1	Tuff, yellow-brown.
27.4	.9	Marlstone, gray and brown, silty.	52.7	1.8	Siltstone, gray, limy.
28.3	.1	Tuff, yellow-brown.	54.5	1.6	Sandstone, brown, fine-grained, oil-stained.
28.4	1.1	Oil shale, dark-gray and brown.	56.1	1.9	Siltstone, gray, limy.
29.5	3.6	Siltstone, gray and brown, limy.	58.0	2.6	Sandstone, brown, fine-grained, oil-stained.
33.1	2.7	Marlstone, gray and brown.	60.6	1.0	Siltstone, gray, limy.
35.8	.1	Tuff, yellow-brown.	61.6	2.5	Sandstone, brown, fine-grained, oil-stained.
35.9	3.9	Oil shale, dark-gray and brown.	64.1	.3	Siltstone, gray, limy.
39.8	.1	Tuff, yellow-brown.	64.4	7.0	Sandstone, brown, fine-grained, oil-stained.
39.9	1.6	Marlstone, gray and brown.	71.4	9.5	Siltstone, gray, limy.
41.5	6.0	Siltstone, gray, limy.	80.9	4.0	Sandstone, gray, fine-grained.
			84.9	4.1	Siltstone, gray, micaceous.

NAVAL OIL-SHALE RESERVE NO. 2, UTAH

Lithologic logs of cores from holes 1-18, Naval Oil-Shale Reserve No. 2, Uintah and Carbon Counties, Utah—Continued

Depth to top of unit (feet)	Thickness (feet)	Description	Depth to top of unit (feet)	Thickness (feet)	Description
Core hole 16; SE¼SW¼ sec. 28, T. 12 S., R. 18 E. (unsurveyed); ground elev 5,890 ft—Continued					
89.0	3.8	Marlstone, gray and brown, silty.	109.9	0.8	Marlstone, brown.
92.8	2.2	Siltstone, gray, limy.	110.7	1.0	Oil shale, dark-gray and brown.
95.0	5.4	Marlstone, gray and brown, silty.	111.7	.1	Tuff, yellow-brown.
100.4	2.0	Oil shale, dark-gray and brown.	111.8	3.9	Oil shale, dark-gray and brown.
102.4	.9	Siltstone, gray, with thin stringers of oil shale.	115.7	.1	Tuff, yellow-brown.
103.3	1.1	Oil shale, dark-gray and brown.	115.8	3.4	Oil shale, dark-gray and brown.
104.4	.1	Tuff, yellow-brown.	119.2	.1	Tuff, yellow-brown.
104.5	.8	Oil shale, dark-gray and brown.	119.3	1.0	Oil shale, dark-gray.
105.3	2.9	Marlstone, brown.	120.3	.3	Siltstone, gray, micaceous.
108.2	.1	Tuff, yellow-brown.	120.6	.2	Oil shale, dark-gray.
108.3	1.5	Marlstone, brown.	120.8	.1	Tuff, yellow-brown.
109.8	.1	Tuff, yellow-brown.	120.9	1.7	Siltstone, gray, micaceous.
			122.6	.3	Oil shale, dark-gray.
			122.9	11.6	Siltstone, gray, micaceous.
Core hole 17; SW¼NW¼ sec. 3, T. 13 S., R. 18 E. (unsurveyed); ground elev 6,090 ft					
10.0	19.0	Siltstone, gray, micaceous.	123.8	7.3	Oil shale, dark-gray and brown.
29.0	1.9	Marlstone, gray and brown.	131.1	.1	Tuff, yellow-brown, oil-stained.
30.9	.1	Tuff, yellow-brown, oil-stained.	131.2	1.3	Oil shale, dark-gray and brown.
31.0	5.0	Oil shale, dark-gray and brown.	132.5	1.6	Marlstone, gray and brown.
36.0	.1	Tuff, yellow-brown.	134.1	.9	Oil shale, dark-gray and brown.
36.1	1.4	Marlstone.	135.0	2.5	Marlstone, gray and brown.
37.5	4.5	Siltstone, gray, micaceous.	137.5	.9	Oil shale, dark-gray.
42.0	1.2	Marlstone, gray and brown, silty.	138.4	.1	Tuff, yellow-brown.
43.2	.1	Tuff, yellow-brown.	138.5	.9	Oil shale, dark-gray.
43.3	1.9	Marlstone, gray and brown, silty.	139.4	2.4	Marlstone, brown.
45.2	4.2	Siltstone, gray, micaceous.	141.8	.3	Oil shale, dark-gray and brown.
49.4	1.5	Marlstone, brown.	142.1	.1	Tuff, yellow-brown.
50.9	1.0	Siltstone, gray, limy.	142.2	.5	Oil shale, dark-gray and brown.
51.9	4.0	Sandstone, dark-gray, micaceous, oil-stained.	142.7	2.3	Marlstone, gray and brown, silty.
55.9	1.1	Siltstone, gray, limy.	145.0	.8	Oil shale, dark-gray.
57.0	8.2	Sandstone, gray and brown, fine-grained.	145.8	.1	Tuff, yellow-brown.
65.2	51.2	Siltstone, gray, limy.	145.9	.2	Oil shale, dark-gray.
116.4	.9	Marlstone, gray and brown.	146.1	3.0	Marlstone, gray and brown, silty.
117.3	4.1	Oil shale, dark-gray and brown.	149.1	2.1	Siltstone, brown, limy.
121.4	2.4	Marlstone, brown.			
Core hole 18; SW¼SW¼ sec. 7, T. 13 S., R. 19 E.; ground elev 6,275 ft					
10.0	5.0	Marlstone, gray, silty.	55.0	4.0	Sandstone, gray and brown, fine to medium-grained.
15.0	6.1	Marlstone, gray and brown.	59.0	2.5	Marlstone, gray and brown, silty.
21.1	2.2	Oil shale, dark-gray and brown.	61.5	2.0	Sandstone, gray and brown, very fine grained.
23.3	7.3	Marlstone, gray and brown, silty.	63.5	1.5	Siltstone, gray, limy.
30.6	2.0	Siltstone, brown.	65.0	7.0	Sandstone, gray and brown, very fine to medium-grained.
32.6	12.4	Sandstone, gray and brown, very fine grained, with several thin beds of siltstone.	72.0	30.4	Siltstone, gray, with a few thin beds of limestone.
45.0	2.3	Marlstone, gray and brown, silty.	102.4	2.8	Marlstone, gray and brown, silty.
47.3	5.7	Sandstone, gray and brown, fine to medium-grained.	105.2	1.6	Oil shale, dark-gray.
53.0	2.0	Siltstone, gray.			
106.8	3.9	Marlstone, gray and brown.	129.4	1.0	Marlstone, gray and brown.
110.7	6.2	Oil shale, dark-gray and brown.	130.4	2.4	Siltstone, gray.
116.9	.1	Tuff, yellow-brown.	132.8	.9	Marlstone, gray and brown.
117.0	1.5	Oil shale, dark-gray and brown.	133.7	.1	Tuff, yellow-brown.
118.5	1.5	Marlstone, gray and brown.	133.8	1.0	Marlstone, gray and brown.
120.0	.6	Oil shale, dark-gray.	134.8	2.3	Marlstone, brown.
120.6	1.6	Marlstone, gray and brown.	137.1	1.3	Oil shale, brown.
122.2	.8	Oil shale, dark-gray.	138.4	2.7	Marlstone, gray and brown, silty.
123.0	.1	Tuff, yellow-brown.	141.1	1.5	Siltstone, gray.
123.1	.8	Oil shale, dark-gray.	142.6	.6	Marlstone, gray and brown.
123.9	2.2	Marlstone, gray and brown.	143.2	1.0	Oil shale, dark-gray and brown.
126.1	.5	Oil shale, dark-gray.	144.2	1.5	Marlstone, gray, silty.
126.6	.5	Marlstone, gray and brown.	145.7	.8	Siltstone, gray, limy.
127.1	2.3	Siltstone, gray and brown, stringers of oil shale and tuff.			

NOTES ON LOCALITIES EXAMINED IN SURVEY FOR OIL-
IMPREGNATED SANDSTONES, HILL CREEK DEPOSIT, UINTAH COUNTY

Locality	Description
#1	NE SW Sec. 30 T14S R20E Porous Sandstone - Persistent joint system very highly saturated throughout. Several seeps. Thick section approx. 60 feet thick (total section). Elevation is about 7,080. There are a few thin zones of shale and saturated sandstone above the main 40' zone (make up the 60').
#2	NW NW Sec. 30 T14S R20E Joints running N66°W
#3	SE NE Sec. 19 T14S R20E Saturation continues but weakens. Rock becomes less massive and finer grained. Joints strike N65°W.
#4	NE NE Sec. 18 T14S R20E No saturation found at 7,080' elevation - later found that saturation was to west at lower elevation of about 6,800'.
#5	NW SE Sec. 7 T14S R20E No saturation found at suspected 7,080' horizon, but found about 6,820 feet at a location 1/3 mile to northeast.
#6	NE SE Sec. 7 T14S R20E No saturation found at suspected 7,080 feet, rather found 1/4 mile to west at 6,680'.
#7	NE NW Sec. 31 T14S R20E About 40-50' of good massive saturated sandstone medium to fine grained and porous. On the road going down into canyon - Analyzed sample from this location.
#8	SE (SE cor) NE Sec. 36 T14S R19E The following lithologic section was measured: -- 5' saturated sandstone - coarse grained -- 40' brown sandy shale -- 50' saturated sandstone - coarse grained

- #9 NE SW Sec. 5 T15S R20E
 About 71' of saturated sandstone in the section.
 In general, not massive. Bleeding in places. Sandstone
 was coarse to medium grained.
- #10 SW SW Sec. 9 T15S R20E
 No saturation throughout or well below suspected
 zone. Although there are favorable sands present -
 Also presence of thick massive cap rock not noted before
 to the north.
- #11 NW SE Sec. 6 T15S R20E
 About 73' of saturated sandstone. Thinbedded
 at top becoming more massive towards the bottom. It
 is a medium to coarse grained sandstone. There are
 current ripple marks within the sat. sandstone zone
 which are running S80°W.
- #12 NW SE Sec. 2 T15S R20E
 About 5-10' of weakly saturated sandstone.
- #13 NW SW Sec. 14 T15S R20E
 No saturation in favorable beds at suspected
 horizon.
- #14 NW NE Sec. 18 T15S R20E
 No saturation in favorable beds at suspected
 horizon.
- #15 NW SE Sec. 13 T14S R20E
 Approximately 5 miles down from head of Ute
 Canyon there is a 3' zone of weakly saturated sandstone
 at top of a thick favorable sandstone. Lower in the
 same area - 50 to 75' lower is another zone about 28'
 thick of weak to moderately saturated sandstone. Both
 are below suspected 7,080' horizon, but down about
 6,680' approx.
- #16 NW NW Sec. 24 T14S R20E
 Suspected horizon is not present - possibly farther
 to east possibly down about 6,680' to 6,800'.

- #17 SW NE Sec. 23 T14S R20E
Agency Draw - No saturation found at suspected horizon - however oil shale was found below cap rock. There was found suspected saturation possibly one mile to the north.
- #18 NW NE Sec. 27 T14S R20E
The following measured section is given:
--4' moderate saturation
-15' shale (brown)
--4' weakly saturated sandstone
- #19 SW SE Sec. 15 T14S R20E
About 15' of weakly to moderately saturated sandstone, medium to coarse graine size. Same thickness persists across canyon to the east. Possibly a channel.
- #20 C Sec. 15 T14S R20E
About 3.5' of saturated sandstone.
- #21 C W1/2 NE1/4 Sec. 15 T14S R20E
About 5 feet of saturated sandstone (weakly sat.) Joints noted trend N60°W. Probably a channel sand.
- #22 NW NE Sec. 15 T14S R20E
Saturation and favorable sand seem to be lensing out towards the east and the north. There is about two (2) feet of very weak questionable saturation.
- #23 C E1/2 Sec. 17 T14S R20E
About 10 feet of weakly saturated sandstone.
- #24 NE SE Sec. 7 T14S R20E
The following section was measured:
--2' weak saturation in medium grained sandstone
-25' barren brown sandstones and shales
--8' weakly sat. med gr. sandstone
--6' barren brown sandstones and shales
--3' weakly saturated, medium grained sandstone
It appears that favorable horizon is lensing out to N and E.

#25 About NE1/4 Sec. 6 T14S R20E

There are two thin zones of very weakly saturated fine grained sandstone separated by perhaps 10-15' of barren siltstones and shales. Tap bed about 2' and lower about 3'. Texture and thickness may indicate termination of saturation to the north.

#26 About C of NE Sec. 24 T14S R19E

The following section was measured.

- 18' fairly massive medium gr. wk-med. sat. sandstone.
- 35' brown siltstones and shales.
- 2' weakly saturated marlstones and siltstones.
- 6' brown siltstones and shales
- 6' weakly saturated fine-grained sandstone
- 8' brown thin bed siltstone and thin bed sat. ss.
- 33' weak to mod. med. gr. sandstone - some dry chunks of tar. (massive [sandstone]).

#27 NE SE Sec. 35 T14S R19 E (School Section Canyon)

Top zone about 10' thick saturated sandstone fractures trend N65°W. Bottom massive sand is not saturated.

#28 NW SE Sec. 35 T14S R19E (School Section Canyon)

Jointing N65°W dip 80°N to vertical. Sandstone is barren. Pyrite and limonite filled joint shows 3/4" solid saturation on south of joint, (none on north), stringers extend south into sandstone for perhaps 6". [the foregoing for the bottom zone]. Top zone is somewhat saturated.

#29 Just north and east of #28

Southward extent of saturation in lower massive sandstone. Following is measured section.

Horse Bench sandstone.

200' shales (according to topo map]

- 12' massive saturated sandstone.
- 27' thin bed brn ss shales and marlstones
- 22' thin sat beds interbed with brn siltstones and shales
- 38' more saturated to the north than to the south} massive sandstone.

- #30 SW NE Sec. 27 T14S R19E
Ripple marks S70W (direction of flow) also the following measured section.
-12' saturated sandstone
-23' barren sandstones and shales
-23' saturated sandstone
- #31 SE Sec. 2 T14S R19E
No saturation found in either upper or lower sandstone indicating possible joint control of oil migration southward as on Flat Rock.
- #32 NW SE Sec. 15 T14S R19E [Horsecorn Canyon]
Joints trending N65°W. Following is measured section:
--8' Barren sandstone
-30' siltstones and shales with few possible beds wk sat ss.
-23' thinbed bit ss interbed with non sat siltstones and shale
-12' massive ss - tap 6' slightly sat. bottom-barren
- #33 NW1/4 Sec. 2 T14S R19E
Following is measured section.
Brown shales
--2' wk sat. med. gr. ss.
-14' brown shales
--8' sat. med. gr. sandstone
2.5' brown shales
5.5' saturated sandstone with brown shales
--5' brown shales
--7' wk sat. (main) with some brown shales
8.5' brown shales
--7' wk sat ss - massive - med gr.
--6' brn shales with siltstones (no saturation)
--7' massive med. gr. med. sat. ss. (joints N70W)
-22' brown shales and siltstones
-18' alt. oil and gray shales
brown barren med. gr. sandstone
- #34 C Sec. 26 T13S R19E [West Squaw Creek]
The following section was measured:
Brown shales
--1' tuffaceous rock
-21' gray shales
--8' wk sat. ss.
--8' brown shales
-16' wk sat. ss.

- #34 (continued) -14' gray mudstones
 -18' brown shales
 -25' Pred oil shales and gray shales
 5.5' brown siltstones and shales
 -19' sandstone - lower 4' barren top 15' weak-
 moderately saturated
 Mudstones in creek
- #35 SE SE Sec. 14 T13S R19E
 6' wk sat sandstone at top only.
- #36 SE SW Sec. 27 T13S R19E
 The following section was measured:
 -30' massive ss sat. wk 2/3 sat at bottom top 1/3 barren
Fault was -60' mainly ss. slight sat. in massive parts. Inter-
noticed in this bedded with siltstone - forms slope and are barren
area, also -25' brown shales
sample was --1' oil shale
taken for 17.5' brown shales
analysis. --3' coarse gr. sat. sandstone - fair sat.
- #37 C NW Sec. 32 T13S R19E
 Following section was measured:
 Shales
 -14' saturated sandstone
 -11' brown shales
 --5' poorly saturated sandstone
 --5' brown shales and barren sandstones
 -12' sat. med. gr. sands.
 -19' brown shales
 --5' barren brown sandstones
 -10' brown shales
 -22' gray and oil shales interbedded
 -11' weakly sat. ss.
 --8' brn siltstones with minor barren sandstones
 -15' massive sandstone brown and barren
- #38 SE SE Sec. 13 T13S R18E [Pine Canyon]
 Joints N65°W. Following is measured section:
 16 (~5' total sat. (wk.) sandstone
 11' alt. 11 feet brown shales.
 --6' sandstone with spotty wk. sat.

Trend at south extent of saturation--joint system. Start
at S1/4 corner between Sec. 13 and 24 T15S R19 E and

#38 (continued)

moving N65°W through 1/4 corner between Sec. 1 and Sec. 6 between T15S R19 and 20E. South of this line no saturation was found, north of this line - saturation is found.

The sediments are dipping off to the north at about 2° off from the Hill Creek Anticline or projections thereof.

Field notes by Wally Gwynn and Ed Dalton
Summer 1969
Transcribed for files, April 1976

Sept. 28, 20
Sam Quigley

Wild Horse Canyon.

INVESTIGATION OF Wild Horse CANYON SHOWED NO OIL-IMPREG-NATED SANDS, EITHER JUST BELOW THE MAHOAGANY OR ALL THE WAY DOWN THE SECTION WHERE THE WASATCH TONGUES INTER BED WITH THE GREEN RIVER. NO FLOT WAS FOUND IN MAIN WILD HORSE OR IN TRIBUTARY LEADING OUT OF CANYON EAST TO HORSE BENCH FLATS.

WORK PROGRESS REPORT FOR THE MONTH OF JUNE FOR GORDON N BLAIR & ANN
STAUB BLAIR - U.G.M.S.

Date:

June 5-6. Survey of Keg Mtns. by private vehicle to look for possible campsites, and to familiarize self with road systems.

June 8-14 Climbed 5 peaks in Keg Mtns. noting and sampling lithologies to establish units for mapping. June 11 was spent in vehicular survey of small area of Kegs Mtns south of Weiss Highway. No climbing that day due to rainy weather.

June 16-21. Returned to Kegs to investigate Willow Springs area, 16-17. Left for Hill Creek Extension of Ute Indian Reservation on 18.

Investigated stratigraphic sections in Big and Firewater Canyons as per instructions. Initial results were negative. Returned to Salt Lake to have auxillary gas tank installed on truck June 22.

June 24- July 1.

Returned to Indian Reservation, examined two more sections in Big and Firewater Canyons. Still negative as per tar sands, but some asphaltic substance noted in one area as fracture filling. Adjacent rocks non-petroliferous and source of substance could not be determined. Investigated Canyons between Wild Horse and Firewater Canyons. No sign of any tar-sands was found. Left for Green River Utah on the 29th, in order to find a route up to Florence Creek area in Green River Canyon. An attempt was made to reach the desired area along the east side of the river. This was found to be impossible by vehicle. An alternate route up Tusher Canyon was also attempted but abandoned. An indirect route through Dragerton -Range Creek may be successful if and when we can obtain a gate key to pass through the Wilcox property. Other, more difficult alternatives are being considered

APPENDIX B

APPENDIX B

For the following reference, engineering property data from core holes HC-1, HC-2 and HC-3 are given on page numbers a-g: Peterson, P.R., 1974.

UTAH GEOLOGICAL AND MINERAL SURVEY

CORE HOLE NO HC-1, SE NW NE 31-14S-20E S.L.M. (1271 ENL, 1819 FEL)Uintah County, UtahLAND STATUS: SURFACE Indian MINERALS U.S.ELEVATION: 7261 GROUND TOTAL DEPTH 268SPUD: August 20, 1973 COMPLETE: August 22, 1973TOPS: SURFACE IN Parachute Creek TOP DATUM (msl)

PARACHUTE CREEK (Surface)

MAHOGANY OIL SHALE ZONE 8164 7095DOUGLAS CREEK 39 7222

VISUAL CLASSIFICATION

CLASS	IMPREGNATION	
V		VERY RICH
IV		RICH
III		MOD
II		WEAK
I		VERY WEAK

CORES

Sample
Number

DEPTH	VIS CLASS	PERMEABILITY		POROS. %	PORE SATURATION		2 analyses averaged			% SULF	GRAV EXT OIL	GRAV RET OIL	S ³⁴ /S ³² RATIO
		BEFORE	AFTER		OIL	WATER	GALS / TON	% vol	% wt				
459	41	IV	38	359	24.1	60.2	9.6	15.4	14.6	6.2			
460	42	IV	22	428	22.5	49.4	16.0	12.0	11.2	4.9			
461	43	IV	24	704	23.2	61.2	9.5	15.4	14.3	6.2	0.37	9.4	21.5 APT
462	44	IV	0.25	324	23.2	74.2	9.9	17.8	17.3	7.2			
463	45	IV	0.05	700	22.6	78.4	8.0	18.8	17.8	7.6			
464	46	III	0.45	34	23.3	35.1	27.4	8.7	8.2	3.5			
465	47	II	1.3	48	30.5	13.8	21.3	4.3	4.4	1.8			
466	68	III	0.50	20	28.2	66.0	7.8	20.2	18.7	8.1			
467	69	III	2.2	39	25.7	51.7	10.5	14.4	13.4	5.8			
468	70	III	0.03	2.4	29.1	68.8	6.5	20.7	20.1	8.3			
469	71	III	3.0	545	25.0	46.1	21.1	12.5	11.6	5.0			
470	72	III	24	98	23.3	66.6	7.7	16.8	15.6	6.8			
471	73	III	6.2	726	24.0	72.1	9.2	18.8	17.4	7.6			
472	86	III	0.90	12	25.4	22.4	17.3	6.3	5.7	2.5			
473	87	III	3.0	12	24.5	29.0	18.3	7.7	7.1	3.1			
474	92	III	28	102	22.3	31.3	11.6	7.8	7.1	3.2	0.34	5.5	21.3
475	93	III	57	430	22.1	35.3	7.7	8.8	8.0	3.5			
476	94	III	24	54	21.8	36.6	8.3	8.8	8.2	3.5			
477	96	III	3.7	15	18.8	43.5	9.6	8.8	8.4	3.5			
478	97	III	203	377	24.3	30.3	10.7	8.6	7.6	3.5			
479	98	III	46	142	20.2	37.5	14.3	8.3	7.7	3.4			
480	99	III	124	330	21.9	30.1	5.9	7.6	6.7	3.1			
481	108	III	70	278	20.4	44.6	8.8	9.8	9.3	3.9			
482	113	III	55	246	20.1	44.2	6.5	10.0	9.1	4.0			
483	114	III	57	885	20.1	51.3	10.9	11.6	10.5	4.7	0.46	7.6	20.0
484	115	III	32	295	22.3	40.7	5.8	10.4	9.2	4.2			
485	116	III	38	156	22.2	40.0	7.7	9.9	9.0	4.0			
486	117	III	81	319	21.6	44.2	8.8	11.1	9.7	4.5			
487	118	III	4.9	98	19.3	41.4	14.5	9.0	8.1	3.6			
488	119	III	84	446	22.1	32.5	9.5	8.2	7.3	3.4			
489	120	III	78	755	24.1	39.0	7.9	10.6	9.5	4.3			
490	123	III	72	1355	21.4	43.8	8.0	10.6	9.5	4.3			
491	124	III	177	475	21.0	34.7	4.3	8.2	7.3	3.4			
492	125	III	133	1015	22.3	42.2	5.8	10.6	9.5	4.3			
493	126	III	81	1320	24.1	45.7	5.4	12.6	11.2	5.1			
494	127	III	43	382	22.5	42.2	12.4	10.6	9.7	4.1			
495	130	III	4.5	96	23.6	29.2	25.3	7.5	7.0	3.1			

UTAH GEOLOGICAL AND MINERAL SURVEY

CORE HOLE NO HC-1 . 31-14S-20E

Uintah County, Utah

LAND STATUS SURFACE MINERALS

ELEVATION: 7261 GROUND TOTAL DEPTH 268

SPUD: _____ COMPLETE: _____

TOPS: SURFACE IN _____ TOP DATUM (msl)

PARACHUTE CREEK

MAHOGANY OIL SHALE ZONE

DOUGLAS CREEK

VISUAL CLASSIFICATION

CLASS	IMPREGNATION	
V		VERY RICH
IV		RICH
III		MOD
II		WEAK
I		VERY WEAK

CORES

PORE

2 analyses
averaged

Sample
Number[illegible]

UTAH GEOLOGICAL AND MINERAL SURVEY

CORE HOLE NO. HC-2, SE NW SW 33-14S-20E S.L.M. (1395 FSL, 821 FWL)

Uintah County, Utah

LAND STATUS SURFACE Indian MINERALS U.S.

ELEVATION: 7483 GROUND TOTAL DEPTH 488

SPUD: Aug. 23, 1973 COMPLETE: Aug. 28, 1973

TOPS: SURFACE IN Evacuation Creek TOP DATUM (msl)

PARACHUTE CREEK

80

7403

MAHOGANY OIL SHALE ZONE

525

4498

DOUGLAS CREEK

300

7183

VISUAL CLASSIFICATION

CLASS	IMPREGNATION	
V		VERY RICH
IV		RICH
III		MOD
II		WEAK
I		VERY WEAK

CORES

Sample
Number

DEPTH	VIS CLASS	PERMEABILITY		POROS. %	PORE SATURATION		2 analyses averaged			% Sulf	GRAV EXT OIL	GRAV RET OIL	S ³⁴ /S ³² RATIO
		BEFORE	AFTER		OIL	WATER	GALS / TON	% vol	% wt				
522	326	III	8.8	162	14.9	59.7	17.4	9.1	8.8	3.7			
523	327	III	64	521	20.9	67.9	11.5	15.3	14.2	6.2	0.45	10.5	22.1
524	328	III	0.01	52	24.0	48.7	10.4	13.1	11.7	5.3			
525	329	III	39	980	22.3	49.3	15.2	12.5	11.1	5.0			
526	329	III	40	446	22.5	44.4	27.1	11.0	10.0	4.4			
527	330	III	96	760	19.3	64.3	15.5	13.7	12.4	5.5			
528	331	III	130	697	24.3	48.1	13.2	13.2	11.7	5.1			
529	333	III	29	78	18.4	48.3	19.0	9.8	8.9	4.0			
530	334	III	38	255	23.4	41.8	20.9	9.6	9.7	4.2			
531	335	III	20	76	27.6	42.0	1.8	12.2	11.6	4.9			
532	336	III	24	203	24.6	45.2	10.1	11.7	11.1	4.7			
533	337	III	98	717	27.5	37.0	13.1	11.0	10.2	4.4			
534	340	III	145	673	23.6	44.1	3.8	11.5	10.4	4.6			
535	343	III	116	533	23.5	39.1	3.8	10.3	9.1	4.0			
536	364	II	281	451	26.4	20.4	32.1	6.0	5.4	2.4			
537	365	II	295	451	30.1	19.9	23.9	6.7	6.0	2.7			
538	366	II	139	232	26.4	20.4	19.7	6.0	5.4	2.4			
539	369	II	412	656	24.4	23.7	28.6	6.5	5.7	2.6			
540	370	II	2.1	2.4	24.4	22.9	10.2	6.5	5.6	2.6			
541	375	II	38	65	21.7	23.5	11.0	2.6	2.4	1.1			
542	376	II	78	223	17.4	6.9	89.8	1.2	1.2	0.5			
543	428	II	84	168	23.8	23.5	2.5	6.5	5.6	2.6			
544	432	II	226	284	23.9	21.7	2.5	6.0	5.2	2.4			
545	433	II	46	67	18.7	19.2	18.2	3.8	3.6	1.6			
546	448	II	130	133	15.3	19.6	15.0	3.1	3.0	1.3			
547	449	II	87	142	21.9	22.4	5.0	5.5	4.9	2.2			
548	456	II	272	336	21.2	23.6	1.9	5.8	5.0	2.3			
549	457	II	98	119	19.5	17.4	1.0	3.8	3.4	1.6			

UTAH GEOLOGICAL AND MINERAL SURVEY

CORE HOLE NO HC-3, NE NE NE 3-15S-20E S.L.M. (156 ENL, 443 FEL),
Uintah County, Utah

LAND STATUS: SURFACE Indian MINERALS U.S.

ELEVATION: 7409 GROUND TOTAL DEPTH 500

SPUD: Aug. 28, 1973 COMPLETE: Sept. 2, 1973

TOPS: SURFACE IN Evacuation Creek TOP 733 DATUM (msl) 733

PARACHUTE CREEK 332 733

MAHOGANY OIL SHALE ZONE 309 7169

DOUGLAS CREEK 296 7113

VISUAL CLASSIFICATION

CLASS	IMPREGNATION	
V		VERY RICH
IV		RICH
III		MOD
II		WEAK
I		VERY WEAK

Sample Number

CORES				DOUGLAS CREEK		2 analyses averaged							
DEPTH	VIS CLASS	PERMEABILITY		POROS. %	PORE SATURATION		GALS / TON	OIL		% SULF	GRAV EXT OIL	GRAV RET OIL	S ³⁴ /S ³² RATIO
		BEFORE	AFTER		OIL	WATER		% vol	% wt				
306	II	1.1	35	23.1	73.1	13.0	17.7	17.2	7.2				
307	II	2.5	37	16.7	34.7	34.7	6.1	5.9	2.5				
308	III	69	214	24.2	43.7	8.7	12.2	10.8	4.9				
309	III	0.01	440	20.2	69.6	9.8	15.5	14.4	6.3	0.41	6.5	21.0	
310	III	7.0	353	22.1	69.8	16.2	16.5	15.7	6.7		1.026	0.928	
311	III	4.9	400	24.3	51.9	16.8	14.1	12.7	5.7				
312	III	6.9	235	21.6	53.2	7.9	12.9	11.7	5.2				
313	III	43	214	19.4	45.7	15.9	9.7	9.0	3.9				
314	III	15	200	21.2	54.7	19.7	12.2	11.8	4.9				
317	II	68	353	22.2	43.2	19.8	10.5	9.7	4.2				
318	II	19	35	23.7	22.3	47.7	5.9	5.4	2.4				
320	II	0.60	2.5	16.5	45.9	23.0	7.8	7.7	3.2				
321	II	113	412	26.5	28.7	27.9	8.6	7.7	3.5				
322	II	275	174	25.5	18.8	42.8	5.4	4.9	2.2				
323	II	200	290	24.0	22.1	62.1	5.9	5.4	2.4				
324	II	71	116	20.8	16.3	64.5	3.7	3.5	1.5				
325	II	99	182	22.0	15.9	41.2	3.9	3.6	1.6				
326	II	68	107	24.1	20.3	34.8	5.4	5.0	2.2				
404	II	111	119	25.5	16.8	16.8	4.9	4.4	2.0				
406	II	110	139	26.7	10.8	13.8	3.4	3.0	1.4				
414	I	240	252	24.6	7.3	16.7	2.2	1.9	0.9				
415	I	67	64	26.5	8.3	24.5	2.5	2.4	1.0				
417	I	568	620	25.8	8.1	42.7	2.5	2.2	1.0				
418	I	782	782	24.4	3.7	49.6	1.0	0.9	0.4				
419	I	685	900	23.3	3.9	43.8	1.0	0.9	0.4				
420	I	574	614	24.3	6.2	38.6	1.7	1.5	0.7				
421	I	828	840	24.9	8.4	34.1	2.5	2.2	1.0				
422	I	995	1010	25.2	6.0	28.1	1.7	1.5	0.7				
423	I	1140	1150	26.5	7.9	28.3	2.5	2.1	1.0				
424	I	920	940	24.4	9.4	31.5	2.7	2.4	1.1				
425	I	955	1015	24.9	9.6	12.4	2.9	2.5	1.2				
426	I	1030	1145	28.3	8.8	22.9	2.9	2.6	1.1				
433	II	113	130	21.2	11.8	35.3	2.7	2.6	1.1				
455	II	89	113	24.1	12.8	49.8	3.4	3.2	1.4				
456	II	55	73	25.5	9.4	42.8	2.7	2.5	1.1				
457	II	53	68	22.5	9.8	22.2	2.5	2.2	1.0				
458	II	77	99	24.7	10.5	27.1	2.9	2.7	1.2				
459	II	61	78	25.3	10.3	29.2	2.9	2.7	1.2				

Appendix B

OIL-IMPREGNATED SANDSTONE ANALYSIS RESULTS

Company Utah Geological Survey
Sample Identification AS PROVIDED (SEE BELOW)
OIL-IMPREGNATED SANDSTONE FROM DEPOSITS
RIM ROCK = RR
P. R. SPRING = PR & PRS
HILL CREEK = HC

File RP-4-COA-147
Date 11-7-73
Chemist Cross

SULFUR DETERMINATION

RR-1-101	0.37	HC-2-327	0.45
PR-3A-40	0.48	HC-3-309	0.41
-53	0.44		
-64	0.42		
PR-3B-120	0.45		
-133	0.42		
-146	0.30		
PR-3C-222	0.44		
-235	0.40		
-247	0.42		
PR-3D-376	0.43		
-379	0.48		
-383	0.46		
PR-4-58	0.43		
PR-5-159	0.55		
-168	0.58		
-218	0.48		
-225	0.57		
PR-1-176	0.42		
-242	0.42		
-250	0.46		
PR-2-45	0.46		
-52	0.41		
PR-6-170	0.50		
-176	0.43		
-192	0.48		
-229	0.45		
-339	0.41		
PR-7-30	0.48		
PRS-1-42	0.41		
-93	0.40		
-159	0.49		
-200	0.76		
PRS-2-62	0.73		
-76	0.39		
-193	0.43		
PRS-3-25	0.33		
-86	0.35		
HC-1-43	0.37		
-92	0.34		
-114	0.46		

Company UTAH GEOLOGICAL SURVEY
Sample Identification AS PROVIDED (SEE BELOW)
OIL-IMPREGNATED SANDSTONE FROM DEPOSITS
RIM ROCK = RR
P.R. SPRING = PR & PRS
HILL CREEK = HC

File RP-4-2820
Date _____
Chemist KB-RH

RETORTED OIL		EXTRACTED OIL	
<u>SPECIFIC GRAVITY</u>	<u>API⁰</u>	<u>SPECIFIC GRAVITY</u>	<u>API⁰</u>
RR-1-101	0.930	1.026	6.5
PR-3A-40	0.928	1.015	7.9
-53	0.922	1.023	6.8
-64	0.918	1.016	7.8
PR-3B-120	0.917	1.019	7.4
-133	0.928	1.022	7.0
-146	0.926	1.018	7.5
PR-3C-222	0.920	1.030	5.9
-235	0.924	1.027	6.3
-247	0.927	1.031	5.8
PR-3D-376	0.932	1.010	8.6
-379	0.939	1.024	6.7
-383	0.940	1.020	7.2
PR-4-58	0.924	0.992	11.2
PR-5-159	0.927	0.982	12.6
-168	0.919	0.997	10.5
-218	0.927	1.012	8.4
-225	0.930	1.018	7.5
PR-1-176	0.935	0.978	13.1
-242	0.921	0.994	10.9
-250	0.923	1.009	8.8
PR-2-45	0.927	0.974	13.8
-52	0.935	0.964	15.3
PR-6-170	0.912	0.973	14.1
-176	0.909	0.973	14.1
-192	0.919	0.987	11.6
-229	0.920	1.029	6.0
-339	0.923	1.007	9.1
PR-7-30	0.910	1.001	9.9
PRS-1-42	0.916	0.999	10.1
-93	0.928	0.991	11.3
-159	0.937	0.995	10.6
-200	0.928	1.010	8.5
PRS-2-62	0.931	1.007	7.7
-76	0.918	0.999	10.1
-193	0.935	0.974	13.8
PRS-3-25	0.922	1.002	9.7
-86	0.925	1.002	9.7

Appendix B - f

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. All errors and omissions, excepting those

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Casper, Wyoming 82601
AC 307-265-2731

Page 2

Company UTAH GEOLOGICAL SURVEY
Sample Identification TAR SAND

File RP-4-2820
Date
Chemist KB-RH

	<u>RETORTED OIL</u> <u>SPECIFIC GRAVITY</u>	<u>API^o</u>	<u>EXTRACTED OIL</u> <u>SPECIFIC GRAVITY</u>	<u>API^o</u>
HC-1-43	0.925	21.5	1.004	9.4
-92	0.927	21.1	1.033	5.5
-114	0.934	20.0	1.017	7.6
HC-2-327	0.921	22.1	0.996	10.5
HC-3-309	0.928	21.0	1.026	6.5