

TAR SAND DATA

FOR THE P.R. SPRING AND HILL CREEK AREAS, UINTAH AND GRAND COUNTIES, UTAH

by
J. Wallace Gwynn



OPEN-FILE REPORT 527
UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources
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Cover photo: Tar sand outcrop, P.R. Spring area.



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EXECUTIVE SUMMARY

The P.R. Spring - Hill Creek tar sand deposit lies within an area extending from T. 12 S. through T. 17 S., and R. 20 E. through R. 25 E., Salt Lake Baseline and Meridian, in Uintah and Grand Counties, Utah. The tar sands are found in the upper part of the Douglas Creek Member and the lower part of the Parachute Creek Member of the Green River Formation. The two members are separated by the Mahogany oil shale. The area is made up of U.S. Bureau of Land Management (BLM), Utah School and Institutional Trust Lands (SITLA), Uintah and Ouray Indian Reservation, and private lands. The purpose of this report is to assemble the available tar sand core, measured section, bitumen content, composition, and other data into one report. Tar sand data and the interpretation of these data for this area are found scattered throughout the literature; academic research, theses, and dissertations; company reports; and in the Utah Geological Survey's (UGS) files. From these sources, 124 measured sections and/or core holes were identified and converted to common-scale lithologic sections. For each lithologic section, a one-square-mile topographic map was drawn that shows the location of the drill hole or measured section, and the area(s) estimated to be underlain by tar sands. The lithologic section and the topographic map are combined on one sheet, together with additional information, and presented in appendix A. This report also presents data on tar sand beds, zones, continuity, and properties such as bitumen and water content, sand-grain size, sulfur isotopes, and bitumen chemistry. Most of the tabular information found within the report is also found as Excel-format files.

INTRODUCTION AND PURPOSE

This report on the P.R. Spring tar sand deposit was completed as part of an on-going cooperative agreement between Utah's School and Institutional Trust Lands Administration (SITLA) and the UGS to evaluate the mineral resources of Utah. The Hill Creek area is included because it adjoins the western end of the P.R. Spring area. Figure 1 shows the land-ownership status and the P.R. Spring and Hill Creek tar sand areas. Tar sand data and interpretations for these two areas are found scattered throughout the literature, theses and dissertations, academic and governmental research, company reports, and the Utah Geological Survey files. Confidential and proprietary data are not included in this report. Considerable research would be required to find additional data from obscure references or sources. The purpose of this report is to assemble the readily available tar sand core, measured section, bitumen content, chemical composition,

physical properties, and other data into one report. Data are presented for SITLA lands as well as BLM, Uintah and Ouray Indian Reservation, private, and other lands. To facilitate the use of these data, lithologic column data from core holes or measured sections are presented in both graphical and tabular form within the report, and as Excel® spreadsheet files. Hydrocarbon content and all other data are found as tables or appendices within this report, as well as in Excel® spreadsheet files. All material is on the CD. It is not the intent of the author to interpret these data at length, nor to attempt to calculate the bitumen resource for the P.R. Spring area.

DATA SOURCES

A number of resource-characterization and hydrocarbon-reserve investigations have focused on the P.R. Spring and Hill Creek tar sand deposits. The investigations containing most of the specific resource data used in this report include Whittier and Becker (1962), Byrd (1967), Cashion (1967), Wiley (1967), Gwynn (1971), Wood and Ritzma (1972), Mauger and others (1973), Marchant and others (1974), Peterson and Ritzma (1974), Johnson and others (1975a, b, c), Johnson and others (1976), Dahm (1980), Clem (1984), Dana and Sinks (1984a, b), Gwynn (1985), Sinks (1985), Mason and others (1986), and Anderson and Massoth (2006). In addition to the wealth of data obtained from the above reports, data obtained from Enercor, Mobil Oil, and Mono Power, companies that explored the P.R. Spring tar sand, have added greatly to the compilation and completeness of this report. These latter data were gleaned from the Utah Geological Survey's tar sand files and are not referenced further.

METHOD OF STUDY

Research initially revealed 136 core holes and measured sections in the study area that were numbered sequentially from one to 136. For a variety of reasons, the number of core holes and measured sections that could be used with confidence was reduced to 124; numbers 2, 20, 30, 34, 35, 48, 50, 60, 76, 125, 128, and 133 were eliminated. The 124 reliable core holes and measured sections (undifferentiated) are plotted on figure 2. All 124 of the core holes and measured sections have lithologic and location information, and 54 have associated physical and chemical data, which are presented in a variety of figures, tables, and appendices. No physical and chemical data are associated with the 38 measured sections by Byrd (1967), and core holes by Mobil (6), Whittier and Becker (1962) (14), and Enercor (12).

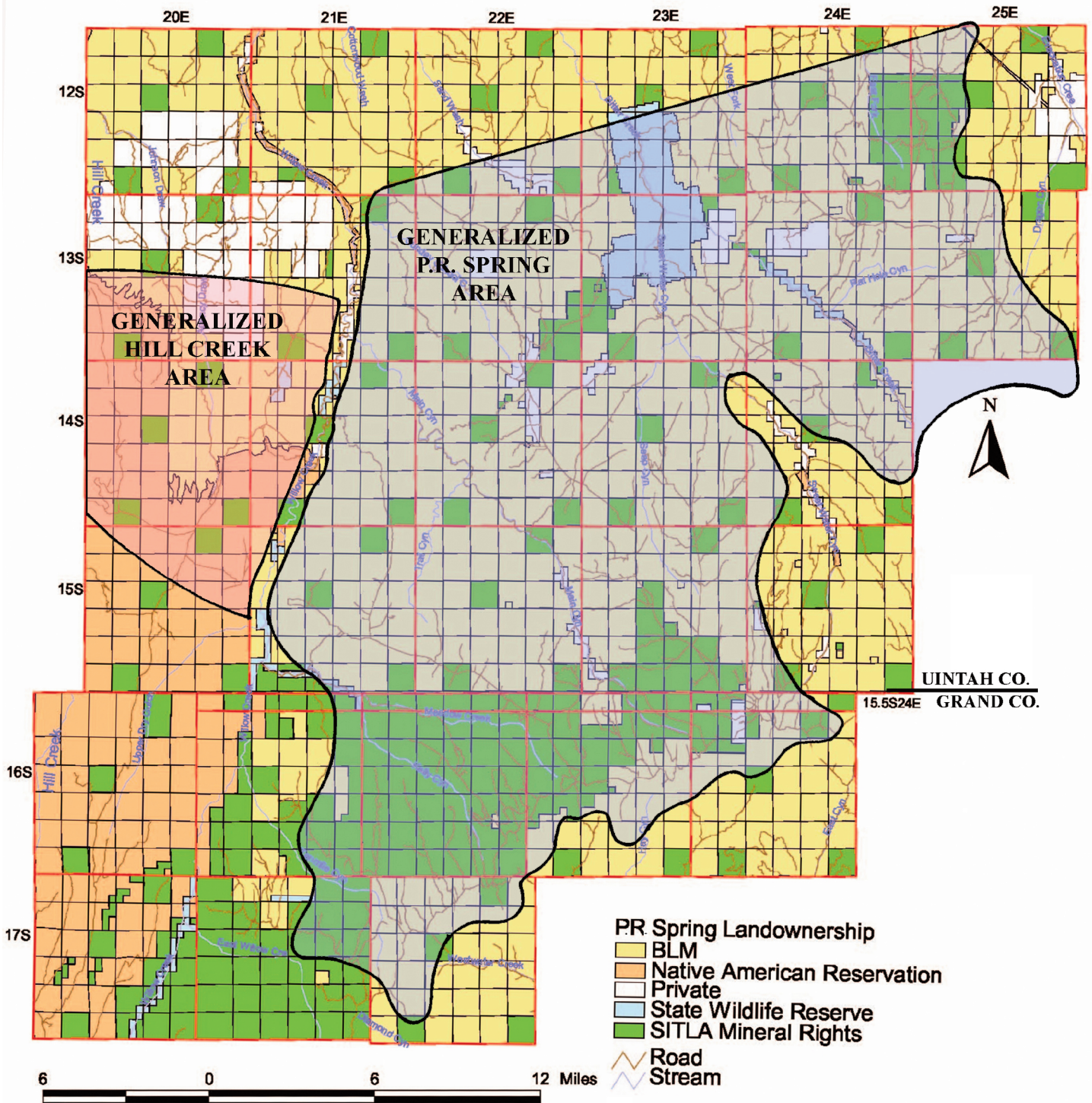


Figure 1. Land ownership and generalized P.R. Spring and Hill Creek tar sand areas, Uintah and Grand Counties, Utah.

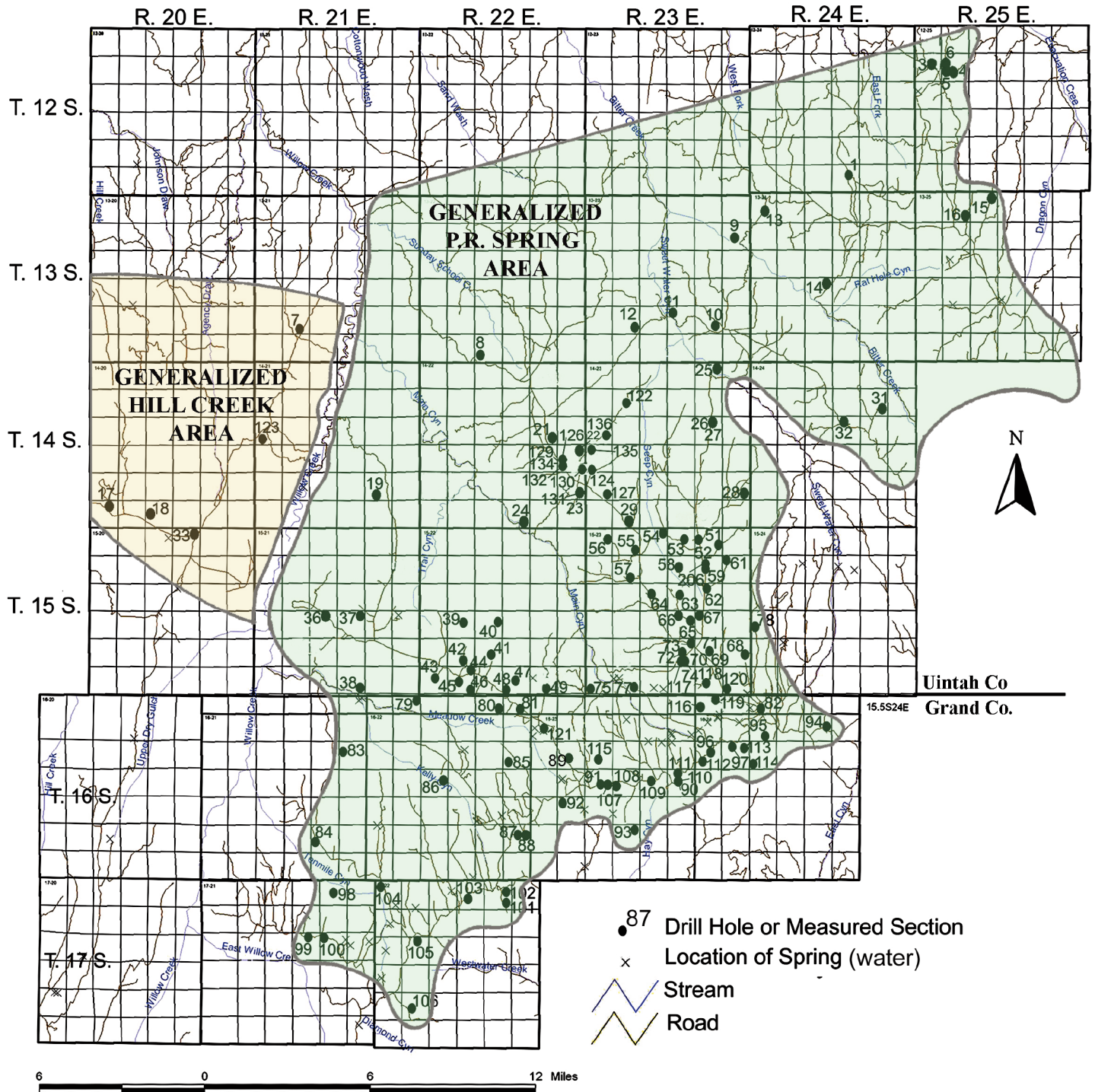


Figure 2. Locations of 124 measured sections and core holes (undifferentiated) and generalized P.R. Spring and Hill Creek tar sand areas, Uinta and Grand Counties, Utah.

The diverse data sources and wide variety of data reported made data organization challenging. A data sheet was designed to organize and report the tar sand resource information in a systematic, uniform style. A data sheet was also created for each mile-square section that contained a drill hole or measured section.

Preparation of Uniform-Scale Lithologic Sections

The thicknesses and vertical intervals of all lithologies were determined from the core and measured section (column) data, and entered into an Excel® spreadsheet. The bed-thickness data for each column were then converted into a stacked column, and lithologic types were color coded. The Y axis, labeled “depth below land surface,” was set to a uniform 500 feet for all sections, with the scale subdivided into 25-foot increments. These Excel® plots were then saved in a Web-Page format. The Web-Page format images were then imported into Adobe Photoshop® where well or section name, top elevation, and location information were added at the top of each section. An even-100-foot reference elevation, 6900 feet above mean sea level (MSL) for example, was placed at a convenient location within each section for vertical-correlation purposes. In some instances, the top elevation of the column does not agree with the ground elevation at the location of the section. This is most likely due to inaccurate elevation control at the time the core hole or measured section was done. Such discrepancies will either raise or lower the top elevation of the column and thus affect the calculated area underlain by tar sand as discussed in the “combined column, map, and data representations” section. Each of the 124 lithologic columns is presented as a (jpg) file in the file folder titled “Lithologic Sections.”

As a word of caution, the identification of the lithologic types, the degree of lumping and splitting of units, the determination of surface elevations, and the measurement of unit thicknesses were originally made by numerous geologists over a period of many years. As such, these identifications and measurements are not uniform or consistent from one column to another. This variability may affect the usefulness of these columnar data in making lateral correlations across the deposit and any subsequent resource estimates.

Preparation of Column Location and Underlying Tar-Sand Area Maps

One square-mile topographic section maps, labeled with section, township, and range, and showing the approximate location of all measured sections or core holes within the section, were prepared using the National Geographic Society’s TOPO® software program. The exact locations of the lithologic columns within each map are not precisely known, but were first positioned by quarter sections (if given), secondly, by the ground elevations for the top of the column, and third, on the best judgment of the author. These section maps were then imported into Adobe Photoshop® where the area(s) devoid of and underlain by tar sand, and other information, were added.

The areas devoid of tar sand are those exposed within canyons whose elevations are less than the bottom elevation of the lowest tar sand bed found in the core(s) or measured

section(s). The areas devoid of tar sands are denoted by a dark-gray infill, while the remaining area(s) in the section is assumed to be underlain by tar sand. Sections containing no tar sand are clearly labeled by notation, and the dark-gray infill is not used.

The delineation of the area within each section underlain by tar sand is based on the assumption that the number, thickness, and depth range of the tar sand beds in the stratigraphic column(s) are constant throughout the entire section (see the Tar Sand Bed Continuity sub-section), and that the tar sand beds are flat lying. Table 1 summarizes the total area of each of the 126 sections, the total area devoid of tar sand, and the total area underlain by tar sand. These area values were determined by GIS analyst Sharon Wakefield of the UGS. All three values were originally reported in square meters, but are also reported in square yards.

Combined Column, Map, and Data Representations

The lithologic columns, section topographic maps, and associated data are combined into data sheets that are presented in Appendix A. Each data sheet contains, (1) a uniform-scale lithologic column showing tar sand beds, (2) a topographic map of the section showing drill hole or measured section locations and areas underlain by tar sand, and (3) a text that summarizes topographic map coverage, land administration, area underlain by tar sand, vertical distribution of tar sand beds, and availability of associated data on physical and chemical characteristics of the tar sand. These brief summaries provide a quick overview of the information that is available for a given map section.

The following notes are important to understanding the data sheets in appendix A:

1. Tar sand beds in the lithologic columns are shown in black, and extend beyond the right margin of the column. Black lines that do not extend beyond the right margin of the column are not tar sand beds.
2. The number of tar sand beds shown in the column may not equal the number shown in text. This is because minor beds are not shown, or two or more beds are combined together when the intervening beds are too thin to show. These discrepancies are often due to software or printer limits on depicting very thin beds.
3. Unless otherwise noted, all sections are administered by the U.S. Bureau of Land Management.
4. The availability of physical and chemical data is noted on the data sheets. If available, these data are found in the tables and appendices. The physical and chemical data are not the same for all data sheets because different investigators reported different data. The correlation chart on the title page of appendix A links a data source with the appropriate table or appendix. For example, Skyline core data are found in table 4, and in appendix B.

Table 1 - Data point location (Township, Range, and section, UTM), area of section, area underlain by tar sand, and area with no tar sand.

DATA POINT*	TWP	RNG	Section	UTM-N (NAD83)	UTM-E (NAD83)	AREA OF SECTION (SQUARE METERS)	AREA OF SECTION (SQUARE YARDS)	NO TAR SAND (SQUARE METERS)	NO TAR SAND (SQUARE YARDS)	AREA WITH TAR SAND (SQUARE METERS)	AREA WITH TAR SAND (SQUARE YARDS)
1	12S	24E	1	656,125.0405	4,407,895.8687	2,564,589.88	3,067,249.49	0.00	0.00	2,564,589.88	3,067,249.49
3	12S	25E	7	657,614.6119	4,406,168.8968	2,592,270.58	3,100,355.61	0.00	0.00	2,592,270.58	3,100,355.61
4	12S	25E	8	658,815.5789	4,405,894.2570	2,612,214.90	3,124,209.02	114,675.48	137,151.88	2,497,539.42	2,987,057.14
5	12S	25E	8	658,564.2137	4,405,982.7004	2,612,214.90	3,124,209.02	114,675.48	137,151.88	2,497,539.42	2,987,057.14
6	12S	25E	8	658,345.4329	4,406,164.2419	2,612,214.90	3,124,209.02	114,675.48	137,151.88	2,497,539.42	2,987,057.14
7	13S	21E	29	621,053.8604	4,389,985.2888	2,611,020.42	3,122,780.42	0.00	0.00	2,611,020.42	3,122,780.42
8	13S	22E	33	631,688.5457	4,388,597.6946	2,593,115.43	3,101,366.05	0.00	0.00	2,593,115.43	3,101,366.05
9	13S	23E	12	646,438.7993	4,396,290.1287	2,570,960.70	3,074,869.00	1,060,659.82	1,268,549.15	1,510,300.88	1,806,319.85
10	13S	23E	26	645,311.9964	4,390,822.8681	2,598,938.50	3,108,330.45	0.00	0.00	2,598,938.50	3,108,330.45
11	13S	23E	27	643,063.1864	4,391,246.6389	2,600,559.03	3,110,268.59	0.00	0.00	2,600,559.03	3,110,268.59
12	13S	23E	29	640,742.8930	4,390,462.5159	2,608,693.43	3,119,997.34	882,881.99	1,055,926.87	1,725,811.43	2,064,070.47
13	13S	24E	6	647,788.6915	4,397,457.2844	2,764,693.85	3,306,573.84	0.00	0.00	2,764,693.85	3,306,573.84
14	13S	24E	21	651,974.4270	4,393,564.0337	2,598,760.50	3,108,117.56	945,845.44	1,131,231.15	1,652,915.06	1,976,886.41
15	13S	25E	4	662,738.6814	4,394,777.4699	2,565,146.81	3,067,915.58	1,671,592.07	1,999,224.11	893,554.74	1,068,691.47
16	13S	25E	5	659,189.2659	4,397,525.0038	2,851,103.47	3,409,919.75	1,577,738.27	1,886,974.97	1,273,365.20	1,522,944.78
17	14S	20E	31	610,256.5343	4,379,725.8976	2,836,652.70	3,392,636.63	175,437.15	209,822.84	2,661,215.55	3,182,813.79
18	14S	20E	33	612,429.4302	4,379,003.5806	2,550,067.40	3,049,880.61	0.00	0.00	2,550,067.40	3,049,880.61
19	14S	21E	26	625,938.9239	4,380,414.7291	2,620,227.55	3,133,792.15	28,847.74	34,501.90	2,591,379.81	3,099,290.25
21	14S	22E	14	635,530.2423	4,384,362.7041	2,590,526.58	3,098,269.78	0.00	0.00	2,590,526.58	3,098,269.78
22	14S	22E	24	637,541.4979	4,383,086.4258	2,601,502.97	3,111,397.55	87,702.97	104,892.75	2,513,800.00	3,006,504.80
23	14S	22E	25	637,427.2784	4,381,109.9326	2,588,025.64	3,095,278.67	0.00	0.00	2,588,025.64	3,095,278.67
24	14S	23E	34	634,613.7550	4,379,360.7616	2,577,494.80	3,082,683.78	1,859,105.02	2,223,489.61	718,389.78	859,194.17
25	14S	23E	2	645,481.5047	4,388,466.7029	2,549,515.83	3,049,220.93	578,758.57	692,195.25	1,970,757.26	2,357,025.68
26	14S	22E	14	645,153.9972	4,385,426.4749	2,590,526.58	3,098,269.78	0.00	0.00	2,590,526.58	3,098,269.78
27	14S	22E	14	645,174.5966	4,385,204.0012	2,590,526.58	3,098,269.78	0.00	0.00	2,590,526.58	3,098,269.78
28	14S	23E	25	637,517.5307	4,381,333.8092	2,603,869.18	3,114,227.53	0.00	0.00	2,603,869.18	3,114,227.53
29	14S	23E	32	640,616.1647	4,379,290.5620	2,564,789.98	3,067,488.82	91,079.13	108,930.64	2,473,710.85	2,958,558.18
31	14S	24E	11	654,755.3774	4,386,036.1908	2,570,737.42	3,074,601.96	2,570,737.42	3,074,601.96	0.00	0.00
32	14S	24E	15	652,932.5761	4,385,449.1870	2,598,112.95	3,107,343.09	339,262.52	405,757.97	2,258,850.43	2,701,585.12
33	15S	20E	3	615,318.6980	4,378,419.9802	2,591,065.36	3,098,914.17	0.00	0.00	2,591,065.36	3,098,914.17
36	15S	21E	21	623,097.5712	4,373,622.3547	2,591,101.13	3,098,956.95	0.00	0.00	2,591,101.13	3,098,956.95
37	15S	21E	22	624,927.0422	4,373,536.3294	2,579,998.05	3,085,678.08	10,450.39	12,499.08	2,569,547.66	3,073,179.00
38	15S	21E	34	624,792.8359	4,369,667.4452	2,583,922.08	3,090,370.80	1,276,710.01	1,526,945.17	1,307,212.07	1,563,425.63

DATA POINT*	TWP	RNG	Section	UTM-N (NAD83)	UTM-E (NAD83)	AREA OF SECTION (SQUARE METERS)	AREA OF SECTION (SQUARE YARDS)	NO TAR SAND (SQUARE METERS)	NO TAR SAND (SQUARE YARDS)	AREA WITH TAR SAND (SQUARE METERS)	AREA WITH TAR SAND (SQUARE YARDS)
39	15S	22E	20	631,106.9409	4,373,095.5338	2,554,939.76	3,055,707.95	256,895.31	307,246.79	2,298,044.45	2,748,461.17
40	15S	23E	21	642,560.1076	4,373,483.4970	2,586,907.28	3,093,941.10	247,999.03	296,606.85	2,338,908.24	2,797,334.26
41	15S	22E	28	632,539.1027	4,371,539.5541	2,591,962.00	3,099,986.55	0.00	0.00	2,591,962.00	3,099,986.55
42	15S	22E	42	630,929.4684	4,370,928.7185	2,576,545.94	3,081,548.94	0.00	0.00	2,576,545.94	3,081,548.94
43	15S	22E	32	629,410.6341	4,370,202.3195	2,595,927.48	3,104,729.26	775,461.92	927,452.46	1,820,465.56	2,177,276.80
44	15S	22E	32	631,503.1586	4,370,656.3189	2,531,804.91	3,028,038.67	0.00	0.00	2,531,804.91	3,028,038.67
45	15S	22E	32	631,610.4675	4,369,277.8116	2,531,804.91	3,028,038.67	0.00	0.00	2,531,804.91	3,028,038.67
46	15S	22E	32	630,413.5600	4,369,682.2838	2,531,804.91	3,028,038.67	0.00	0.00	2,531,804.91	3,028,038.67
47	15S	22E	34	634,057.9370	4,370,136.2832	2,562,726.98	3,065,021.46	0.00	0.00	2,562,726.98	3,065,021.46
49	15S	22E	35	635,787.2620	4,369,558.4658	2,590,865.96	3,098,675.69	1,206,421.71	1,442,880.36	1,384,444.25	1,655,795.33
51	15S	23E	2	645,639.0490	4,378,048.2546	2,598,697.33	3,108,042.00	111,022.10	132,782.43	2,487,675.23	2,975,259.57
52	15S	23E	2	644,673.2685	4,378,564.1630	2,598,697.33	3,108,042.00	111,022.10	132,782.43	2,487,675.23	2,975,259.57
53	15S	22E	3	643,649.7062	4,378,324.7815	2,591,801.25	3,099,794.30	548,287.13	655,751.41	2,043,514.12	2,444,042.89
54	15S	23E	4	642,597.2530	4,378,886.0898	2,602,319.17	3,112,373.72	0.00	0.00	2,602,319.17	3,112,373.72
55	15S	23E	5	641,057.7823	4,377,693.3096	2,580,480.34	3,086,254.49	1,337,398.92	1,599,529.10	1,243,081.42	1,486,725.38
56	15S	23E	6	639,406.8754	4,378,250.4907	2,540,110.08	3,037,971.65	1,792,726.88	2,144,101.35	747,383.20	893,870.30
57	15S	23E	8	640,463.4558	4,376,141.4571	2,586,942.40	3,093,983.11	602,728.36	720,863.11	1,984,214.04	2,373,120.00
58	15S	23E	10	643,294.7612	4,376,735.7836	2,572,969.14	3,077,271.09	495,408.55	592,508.63	2,077,560.59	2,484,762.46
59	15S	23E	11	644,776.4501	4,377,136.1285	2,572,205.55	3,076,357.84	82,384.45	98,531.80	2,489,821.10	2,977,826.04
61	15S	23E	12	646,175.5938	4,377,198.0375	2,590,285.93	3,097,981.97	764,380.80	914,199.44	1,825,905.12	2,183,782.53
62	15S	23E	14	644,953.9226	4,375,456.3307	2,541,901.58	3,040,114.28	369,582.56	442,020.75	2,172,319.01	2,598,093.54
63	15S	23E	15	643,311.2703	4,375,150.9129	2,560,868.13	3,062,798.28	40,968.27	48,998.05	2,519,899.86	3,013,800.23
64	16S	23E	16	641,941.0175	4,375,274.7310	2,583,691.80	3,090,095.39	164,441.81	196,672.40	2,419,249.99	2,893,422.99
65	15S	23E	22	644,817.7228	4,374,127.3507	2,587,744.50	3,094,942.42	121,442.28	145,244.97	2,466,302.22	2,949,697.45
66	15S	23E	22	644,355.4689	4,373,528.8969	2,587,744.50	3,094,942.42	121,442.28	145,244.97	2,466,302.22	2,949,697.45
67	15S	23E	23	643,563.0336	4,374,160.3688	2,584,918.99	3,091,563.11	281,721.80	336,939.28	2,303,197.18	2,754,623.83
68	15S	23E	25	647,340.9300	4,371,556.0622	2,585,027.70	3,091,693.13	1,684,572.28	2,014,748.45	900,455.42	1,076,944.68
69	15S	23E	26	645,279.9768	4,371,948.1535	2,588,589.41	3,095,952.93	0.00	0.00	2,588,589.41	3,095,952.93
70	15S	23E	26	645,279.9768	4,371,948.1535	2,588,589.41	3,095,952.93	0.00	0.00	2,588,589.41	3,095,952.93
71	15S	23E	26	645,279.9768	4,371,948.1535	2,588,589.41	3,095,952.93	0.00	0.00	2,588,589.41	3,095,952.93
72	15S	23E	27	643,703.3607	4,371,919.2627	2,584,853.79	3,091,485.13	16,371.90	19,580.79	2,568,481.89	3,071,904.34
73	15S	23E	27	644,438.0142	4,372,381.5166	2,584,853.79	3,091,485.13	16,371.90	19,580.79	2,568,481.89	3,071,904.34
74	15S	23E	27	643,488.7428	4,371,196.9909	2,584,853.79	3,091,485.13	16,371.90	19,580.79	2,568,481.89	3,071,904.34
75	15S	23E	31	638,362.6768	4,369,690.5383	2,580,698.97	3,086,515.96	1,961,368.00	2,345,796.13	619,330.97	740,719.84
77	15S	23E	32	640,698.7101	4,369,682.2838	2,579,636.60	3,085,245.37	1,582,853.35	1,893,092.61	996,783.24	1,192,152.76
78	15S	24E	19	647,958.5732	4,373,396.8243	2,588,552.23	3,095,908.46	2,588,552.23	3,095,908.46	0.00	0.00
79	15.5S	22E	32	628,461.3882	4,369,033.0454	1,794,113.10	2,145,759.27	1,001,439.00	1,191,556.00	792,674.00	954,203.00

DATA POINT*	TWP	RNG	Section	UTM-N (NAD83)	UTM-E (NAD83)	AREA OF SECTION (SQUARE METERS)	AREA OF SECTION (SQUARE YARDS)	NO TAR SAND (SQUARE METERS)	NO TAR SAND (SQUARE YARDS)	AREA WITH TAR SAND (SQUARE METERS)	AREA WITH TAR SAND (SQUARE YARDS)
80	15.5S	22E	35	633,161.6240	4,368,121.6083	1,846,011.70	2,207,829.99	6,969.90	8,336.00	1,839,041.80	2,199,493.99
81	15½S	22E	36	634,445.9002	4,368,192.3403	1,844,658.66	2,206,211.76	0.00	0.00	1,844,658.66	2,206,211.76
82	15½S	24E	33	648,292.8819	4,368,794.9213	1,830,229.98	2,188,955.06	37,964.12	45,405.09	1,792,265.86	2,143,549.96
83	16S	21E	12	623,888.4419	4,365,600.1681	2,600,031.15	3,109,637.26	2,600,031.15	3,109,637.26	0.00	0.00
84	16S	21E	26	622,523.7453	4,360,461.4409	2,604,312.70	3,114,757.99	2,604,312.70	3,114,757.99	0.00	0.00
85	16S	22E	12	633,690.6102	4,365,579.7801	2,594,501.58	3,103,023.88	88,513.35	105,861.96	2,505,988.23	2,997,161.92
86	16S	22E	16	630,166.3809	4,364,436.4514	2,544,750.68	3,043,521.81	2,544,750.68	3,043,521.81	0.00	0.00
87	16S	22E	25	634,329.4438	4,361,196.6614	2,590,756.63	3,098,544.92	573,734.90	686,186.94	2,017,021.73	2,412,357.99
88	16S	22E	25	634,882.1149	4,361,075.7646	2,590,756.63	3,098,544.92	573,734.90	686,186.94	2,017,021.73	2,412,357.99
89	16S	23E	8	637,087.3512	4,365,604.5437	2,600,477.76	3,110,171.40	13,151.20	15,728.84	2,587,326.56	3,094,442.57
90	16S	23E	13	643,514.3726	4,364,377.4615	2,580,339.98	3,086,086.61	2,091,360.06	2,501,266.63	488,979.91	584,819.98
91	16S	23E	16	639,185.4341	4,363,978.7114	2,584,002.30	3,090,466.75	1,043,578.84	1,248,120.29	1,540,423.46	1,842,346.46
92	16S	23E	20	637,077.4630	4,362,796.2101	2,592,379.70	3,100,486.12	1,045,593.51	1,250,529.84	1,546,786.18	1,849,956.27
93	16S	23E	27	640,862.7356	4,361,745.2861	2,568,671.96	3,072,131.66	2,424,078.73	2,899,198.16	144,593.23	172,933.50
94	16S	24E	2	651,825.8227	4,367,746.5954	2,577,479.77	3,082,665.80	816,933.90	977,052.94	1,760,545.87	2,105,612.86
95	16S	24E	7	648,994.5173	4,367,065.5963	2,590,756.63	3,098,544.92	162,935.66	194,871.05	2,427,820.96	2,903,673.87
96	14S	24E	7	645,149.1433	4,365,948.9821	2,488,729.70	2,976,520.72	1,597,984.67	1,911,189.67	890,745.02	1,065,331.05
97	16S	24E	8	646,939.6065	4,366,542.5596	2,580,571.30	3,086,363.27	2,071,245.25	2,477,209.32	509,326.05	609,153.95
98	17S	21E	2	623,599.5374	4,357,512.5691	2,700,178.20	3,229,413.13	1,572,995.43	1,881,302.53	1,127,182.77	1,348,110.59
99	17S	21E	15	622,232.9728	4,355,083.8313	2,594,423.20	3,102,930.15	1,139,921.49	1,363,346.11	1,454,501.71	1,739,584.04
100	17S	21E	14	623,286.7418	4,355,083.8313	2,597,930.50	3,107,124.88	500,151.31	598,180.96	2,097,779.19	2,508,943.91
101	17S	22E	2	633,713.0757	4,356,797.1946	2,745,363.01	3,283,454.16	1,093,973.69	1,308,392.53	1,651,389.32	1,975,061.63
102	17S	22E	2	633,958.8150	4,357,965.8216	2,745,363.01	3,283,454.16	1,093,973.69	1,308,392.53	1,651,389.32	1,975,061.63
103	17S	22E	3	631,545.1088	4,357,397.8907	2,727,601.80	3,262,211.75	859,228.77	1,027,637.61	1,868,373.03	2,234,574.14
104	17S	22E	6	626,220.7568	4,358,244.3262	2,615,689.40	3,128,364.52	565,009.81	675,751.73	2,050,679.59	2,452,612.79
105	17S	22E	17	628,847.1960	4,354,991.0466	2,603,799.58	3,114,144.29	1,240,139.62	1,483,206.98	1,363,659.96	1,630,937.31
106	17S	22E	30	626,269.1070	4,351,160.3642	2,531,017.04	3,027,096.37	1,569,785.23	1,877,463.14	961,231.80	1,149,633.23
107	16S	23E	16	639,636.6576	4,363,900.6534	2,584,002.30	3,090,466.75	1,043,578.84	1,248,120.29	1,540,423.46	1,842,346.46
108	16S	23E	15	639,977.2349	4,364,119.5959	2,567,412.63	3,070,625.50	294,843.80	352,633.19	2,272,568.82	2,717,992.31
109	16S	23E	14	642,020.6982	4,364,430.9808	2,582,722.72	3,088,936.37	1,017,749.41	1,217,228.29	1,564,973.31	1,871,708.08
110	16S	23E	13	643,514.3726	4,364,377.4615	2,580,339.98	3,086,086.61	2,020,113.14	2,416,055.32	560,226.83	670,031.29
111	16S	23E	13	643,600.6930	4,364,721.3435	2,580,339.98	3,086,086.61	2,020,113.14	2,416,055.32	560,226.83	670,031.29
112	14S	24E	7	644,969.1239	4,365,569.4818	2,488,729.70	2,976,520.72	1,597,984.67	1,911,189.67	890,745.02	1,065,331.05
113	16S	24E	8	647,246.1260	4,366,377.1364	2,580,571.30	3,086,363.27	2,071,245.25	2,477,209.32	509,326.05	609,153.95
114	16S	24E	9	648,008.1004	4,366,702.3968	2,566,308.78	3,069,305.29	2,343,100.49	2,802,348.18	223,208.29	266,957.11
115	16S	23E	9	639,006.5305	4,365,645.8164	2,591,617.84	3,099,574.93	559,780.33	669,497.27	2,031,837.51	2,430,077.66
116	16S	25E	31	645,174.4250	4,368,525.3238	1,755,303.70	2,099,343.23	371,847.87	444,730.06	1,383,455.83	1,654,613.17

DATA POINT*	TWP	RNG	Section	UTM-N (NAD83)	UTM-E (NAD83)	AREA OF SECTION (SQUARE METERS)	AREA OF SECTION (SQUARE YARDS)	NO TAR SAND (SQUARE METERS)	NO TAR SAND (SQUARE YARDS)	AREA WITH TAR SAND (SQUARE METERS)	AREA WITH TAR SAND (SQUARE YARDS)
117	15S	23E	27	643,950.9967	4,371,353.8270	2,584,853.79	3,091,485.13	16,371.90	19,580.79	2,568,481.89	3,071,904.34
118	15S	23E	35	645,069.4861	4,370,198.1922	2,583,389.50	3,089,733.84	313,461.92	374,900.46	2,269,927.58	2,714,833.38
119	15.5S	21E	31	645,498.9568	4,369,210.2861	1,759,484.75	2,104,343.76	1,354,001.11	1,619,385.32	405,483.64	484,958.44
120	14S	23E	32	646,414.9753	4,369,674.0293	2,564,789.98	3,067,488.82	843,568.72	1,008,908.19	1,721,221.26	2,058,580.62
121	16S	23E	6	635,799.6438	4,367,424.6686	2,451,548.80	2,932,052.36	335,955.44	401,802.71	2,115,593.36	2,530,249.66
122	14S	23E	8	639,673.0205	4,385,856.2752	2,552,760.75	3,053,101.86	1,225,064.99	1,465,177.73	1,327,695.76	1,587,924.13
123	14S	21E	18	618,743.4180	4,384,096.6414	2,555,397.60	3,056,255.53	0.00	0.00	2,555,397.60	3,056,255.53
124	14S	23E	19	638,311.2377	4,382,500.4304	2,569,128.78	3,072,678.01	695,228.53	831,493.32	1,873,900.25	2,241,184.69
126	14S	22E	24	636,478.7604	4,382,768.5978	2,601,502.97	3,111,397.55	87,702.97	104,892.75	2,513,800.00	3,006,504.80
127	14S	23E	30	639,274.8029	4,380,813.5236	2,589,702.60	3,097,284.31	437,995.05	523,842.08	2,151,707.55	2,573,442.23
129	14S	22E	24	636,523.4549	4,382,564.9892	2,601,502.97	3,111,397.55	87,702.97	104,892.75	2,513,800.00	3,006,504.80
130	14S	22E	24	637,566.3282	4,382,301.7878	2,601,502.97	3,111,397.55	87,702.97	104,892.75	2,513,800.00	3,006,504.80
131	14S	22E	25	637,467.0069	4,381,060.2720	2,588,025.64	3,095,278.67	0.00	0.00	2,588,025.64	3,095,278.67
132	14S	22E	24	636,925.7060	4,382,227.2969	2,601,502.97	3,111,397.55	87,702.97	104,892.75	2,513,800.00	3,006,504.80
134	14S	22E	24	636,836.3169	4,382,654.3783	2,601,502.97	3,111,397.55	87,702.97	104,892.75	2,513,800.00	3,006,504.80
135	14S	23E	19	637,958.6472	4,383,374.4575	2,569,128.78	3,072,678.01	695,228.53	831,493.32	1,873,900.25	2,241,184.69
136	14S	23E	18	638,961.7920	4,384,283.2471	2,555,498.10	3,056,375.73	1,080,732.44	1,292,555.99	1,474,765.66	1,763,819.73

* Missing map numbers (2, 20, 30, 34, 35, 48, 50, 60, 76, 125, 128, 133) are intentional, and represent unreliable data.

TAR SAND ZONES, BEDS, AND CONTINUITY

Tar Sand Zones

Gwynn (1971) identified five tar sand zones within the P.R. Spring deposit. Each zone is made up of one or more individual tar sand beds. Where more than one tar sand bed is present, the beds are interlayered with relatively thin beds of non-impregnated sandstone, limestone, siltstone, and shale. Tar sand zones are separated by relatively thick sections of interbedded clean sandstones, limestones, shales, and in some cases oil shales. Figure 3, a composite stratigraphic section modified from Gwynn (1971), shows zones A through E in the P.R. Spring area. Zones A through D are found in the upper portion of the Douglas Creek Member of the Green River Formation, just below the Mahogany oil shale, and zone E is located just above the Mahogany oil shale in the lower part of the Parachute Creek Member of the Green River Formation. Dahm (1980), Clem (1984), and Sinks (1985) followed the same zone conventions set forth by Gwynn (1971), whereas Dana and Sinks (1984a), in discussing the six core holes drilled by the Laramie Energy Technology Center, use a numerical zone convention (1, 2, and 3), starting with zone 1 at the top.

Sinks (1985) identified two additional tar sand zones (beds) below the bottom zone A of Gwynn (1971) in T. 15.5 and 16 S., R. 24 E. at Sink's mapped sites 41, 43, 44, and 45. Zone 1 is present in all four sites and averages 36 feet thick. Zone 2, found only at Sink's site 41, is about 123 feet thick.

Thickness, Depth-of-Burial, and Number of Tar Sand Beds

Within the 124 lithologic columns on the data sheets, a total of 544 individual tar-sand-bed occurrences have been identified, averaging 4.3 beds per column. A listing of the sources of the data, well name, location, ground elevation, tar-sand bed thickness, and the starting and ending depths and elevations of the individual tar-sand beds is given in table 2. Figure 4 shows the frequency distribution of the tar-sand-bed thicknesses using 2.5 foot bins for beds that range from less than one foot to more than 100 feet, and average 10.1 feet in thickness. The frequency distribution of the depth-of-burial of the individual tar sand beds in 100-foot bins is shown on figure 5. The depth-of-burial of the 544 individual tar sand beds ranges from 0 to 480 feet, with an average of 127.1 feet, but deeper beds are likely to exist. Table 3 provides average values for the information on table 2, and additionally gives the gross thickness of that portion of the column containing the tar sand beds, the net thickness of the tar sand beds, the number of beds, and the thickness of the thickest one to four tar sand beds in the column.

Tar Sand Bed Continuity

A comparison of one stratigraphic column to another, even over short distances (less than one mile), illustrates the variable nature of the stratigraphic units in the P.R. Spring deposit. For example, a single tar sand bed in one column may be divided into two or more beds, or be completely absent in a neighboring column. Examples of such disconti-

nities are seen in figures 6 and 7. Rapid lateral tar sand bed discontinuity makes it difficult to project, with any confidence, the thickness or volume of a given tar sand bed over what might seem a reasonable radius from any data point. A close-spaced coring program would be necessary to adequately define the thickness, lateral extent, and degree of saturation of individual beds, or of a tar sand zone, prior to mining or developing an in-situ extraction program.

TAR SAND PHYSICAL AND CHEMICAL PROPERTIES

Tar sand properties play an integral part in determining both the quantity and quality of the bitumen in individual beds, zones, or within a given geographical area. These properties also influence bitumen mining plans or in-situ extraction methods, the technologies used to upgrade the bitumen, and the economics of each step in the process. The following sections summarize tar sand properties; additional references containing physical and chemical properties, extraction, and upgrading of the P.R. Spring and Hill Creek tar sands are found in Gwynn and Hanson's (2007) annotated tar sand bibliography.

Bitumen and Water Content of Cores

Averaged tar sand properties are given in tables 4 through 8 for the tar sand beds in 48 of the lithologic columns. These data are from Gwynn (1971) for the Skyline cores, Peterson and Ritzma (1974) for the Utah Geological and Mineral Survey cores, Sinks (1985) for the Laramie Energy Technology Center cores, and the Mono Power MP, Mono Power SR, and Mono Power PRS-82-xx series (no dates given). The complete data sets are found in appendices B through F, and as Excel® files. These files are designated as (B) Skyline Core Holes, (C) UGMS tar sand chemical analyses, (D) LETC core holes, (E) Mono Power MP-5 – 9 and SR-14-A series, and (F) Mono Power PRS-82-xx series.

Grain Size and Mineralogical Analyses

Grain size and mineralogy play an important role in determining the bitumen content of tar sands. Wiley (1967) determined the grain size distribution and mineralogy for 50 tar sand samples from the P.R. Spring area, which, unfortunately, do not have locations associated with them. Table 9 gives the grain-size distribution of the bituminous sands in both millimeter and phi units, and table 10 gives the mineralogy and weight-percent bitumen of these samples.

Wiley (1967) drew a number of conclusions from his study with regard to the effects of grain size on bitumen saturation, the source of the reservoir sand, the depositional environment of the tar sands, and the tar sands diagenetic environment.

Factors that influenced bitumen saturation:

1. Within the area sampled, 80 percent of the variation in oil content of the bituminous sandstones can be explained by concomitant variation in the texture of the sediments. As the percentage of

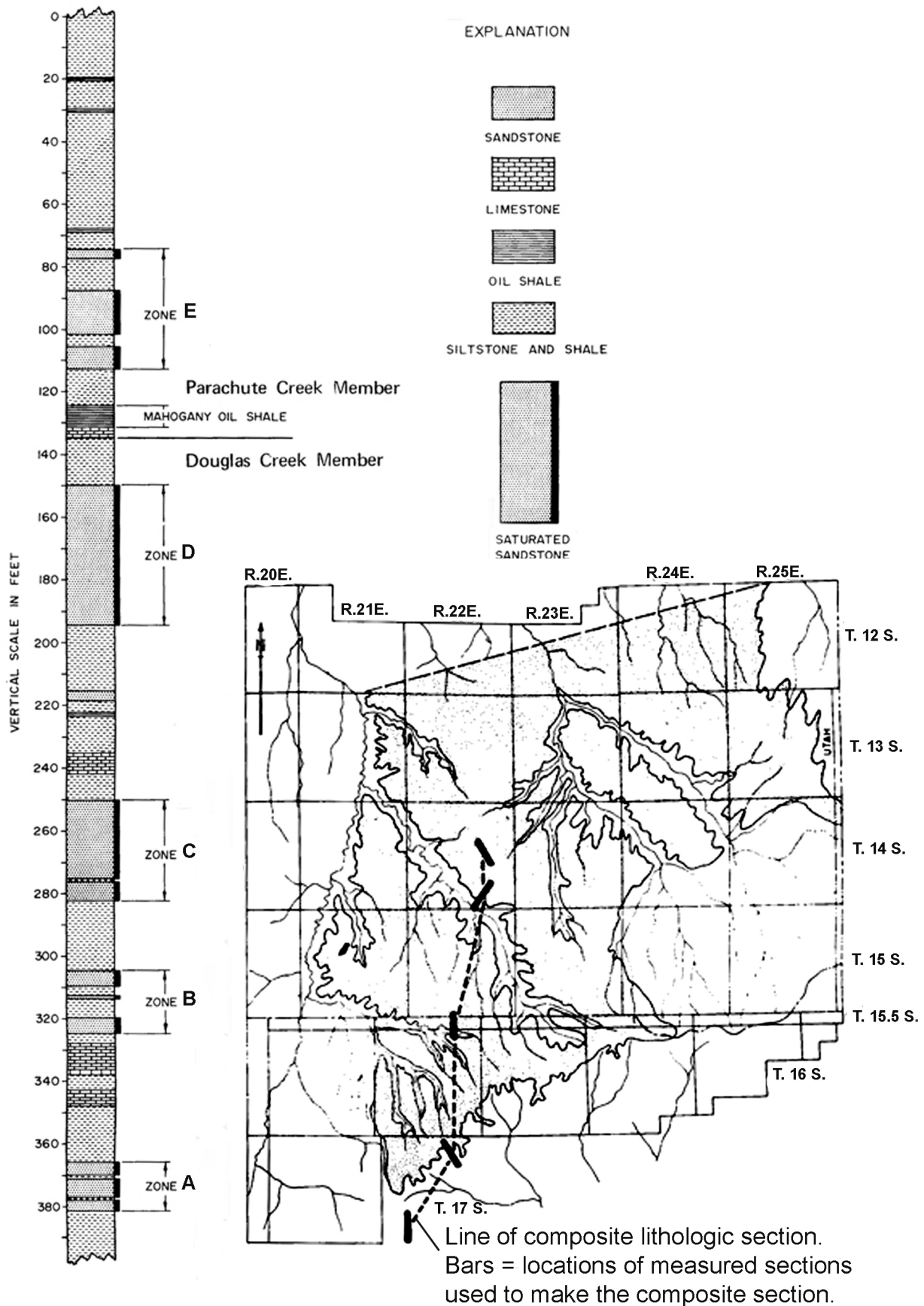


Figure 3. Composite lithologic section through P.R. Spring area showing the stratigraphic positions of tar sand zones A through E, and of the Mahogany oil shale.

Table 2 - Data point, data source, well number, well location, ground elevation, thickness of tar sand beds, top and bottom elevations of tar sand beds.

Data Point	Data Source	Well Name or Measured Section (MS)		Section No.	Twp- S	Rng- E	Ground Elev. (feet)	Thick-ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section Number	Quarter Section									
1	UGMS	PR-5	NESWNE	34	12	24	6420.0	4.5	151.0	156.0	6269.0	6264.0
1	UGMS	PR-5	NESWNE	34	12	24	6420.0	2.5	160.0	162.5	6260.0	6257.5
1	UGMS	PR-5	NESWNE	34	12	24	6420.0	4.0	169.0	173.0	6251.0	6247.0
1	UGMS	PR-5	NESWNE	34	12	24	6420.0	3.0	218.5	221.5	6201.5	6198.5
1	UGMS	PR-5	NESWNE	34	12	24	6420.0	3.0	225.0	228.0	6195.0	6192.0
1	UGMS	PR-5	NESWNE	34	12	24	6420.0	1.5	241.0	242.5	6179.0	6177.5
3	UGMS	PR-3D	SWSWNE	7	12	25	6512.0	1.0	367.0	368.0	6145.0	6144.0
3	UGMS	PR-3D	SWSWNE	7	12	25	6512.0	7.5	373.0	380.5	6139.0	6131.5
4	UGMS	PR-3A	NWNESW	8	12	25	6302.0	30.0	39.0	69.0	6263.0	6233.0
5	UGMS	PR-3B	NENWSW	8	12	25	6361.0	29.5	122.5	152.0	6238.5	6209.0
6	UGMS	PR-3C	SWSWNW	8	12	25	6430.0	28.0	225.0	253.0	6205.0	6177.0
7	LETC	UTS-1	SWSWSE	29	13	21	6489.0	11.0	237.0	248.0	6252.0	6241.0
7	LETC	UTS-1	SWSWSE	29	13	21	6489.0	4.0	254.0	258.0	6235.0	6231.0
7	LETC	UTS-1	SWSWSE	29	13	21	6489.0	26.0	283.0	309.0	6206.0	6180.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	2.0	163.0	165.0	6547.0	6545.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	4.0	170.0	174.0	6540.0	6536.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	11.0	176.0	187.0	6534.0	6523.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	4.0	192.0	196.0	6518.0	6514.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	1.5	229.0	130.5	6481.0	6579.5
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	19.0	235.0	254.0	6475.0	6456.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	1.0	262.0	263.0	6448.0	6447.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	1.0	267.0	268.0	6443.0	6442.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	2.0	277.0	279.0	6433.0	6431.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	2.0	329.0	331.0	6381.0	6379.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	7.0	337.0	344.0	6373.0	6366.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	5.5	350.5	356.0	6359.5	6354.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	2.5	357.5	360.0	6352.5	6350.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	6.0	373.0	379.0	6337.0	6331.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	8.0	383.0	391.0	6327.0	6319.0
8	UGMS	PR-6	E1/2SWSW	33	13	22	6710.0	4.0	408.0	412.0	6302.0	6298.0
9	Byrd	MS35	C	12	13	23	6196.0	4.0	154.0	158.0	6042.0	6038.0
10	Skyline	26-33	SE	26	13	23	6441.0	3.0	119.5	122.5	6321.5	6318.5
10	Skyline	26-33	SE	26	13	23	6441.0	5.0	130.0	135.0	6311.0	6306.0
10	Skyline	26-33	SE	26	13	23	6441.0	2.0	156.0	158.0	6285.0	6283.0
10	Skyline	26-33	SE	26	13	23	6441.0	2.0	205.0	207.0	6236.0	6234.0
11	Byrd	MS31	NW	27	13	23	6280.0	37.0	5.0	42.0	6275.0	6238.0
11	Byrd	MS31	NW	27	13	23	6280.0	15.0	61.0	76.0	6219.0	6204.0
11	Byrd	MS31	NW	27	13	23	6280.0	21.0	84.0	105.0	6196.0	6175.0
11	Byrd	MS31	NW	27	13	23	6280.0	9.0	138.0	147.0	6142.0	6133.0
11	Byrd	MS31	NW	27	13	23	6280.0	2.0	186.0	188.0	6094.0	6092.0
11	Byrd	MS31	NW	27	13	23	6280.0	24.0	215.0	239.0	6065.0	6041.0
12	UGMS	PR-2	SESESE	29	13	23	6346.0	2.0	20.0	22.0	6326.0	6324.0
12	UGMS	PR-2	SESESE	29	13	23	6346.0	2.0	45.0	47.0	6301.0	6299.0
12	UGMS	PR-2	SESESE	29	13	23	6346.0	5.0	51.0	56.0	6295.0	6290.0
12	UGMS	PR-2	SESESE	29	13	23	6346.0	2.0	62.0	64.0	6284.0	6282.0
12	UGMS	PR-2	SESESE	29	13	23	6346.0	6.5	88.0	94.5	6258.0	6251.5
13	UGMS	PR-1	SWNESW	6	13	24	6210.0	10.0	176.0	186.0	6034.0	6024.0
13	UGMS	PR-1	SWNESW	6	13	24	6210.0	2.0	193.0	195.0	6017.0	6015.0
13	UGMS	PR-1	SWNESW	6	13	24	6210.0	2.0	198.0	200.0	6012.0	6010.0
13	UGMS	PR-1	SWNESW	6	13	24	6210.0	6.0	242.0	248.0	5968.0	5962.0
13	UGMS	PR-1	SWNESW	6	13	24	6210.0	13.5	251.5	265.0	5958.5	5945.0
14	Byrd	MS36	NE	21	13	24	6600.0	29.0	5.0	34.0	6595.0	6566.0
14	Byrd	MS36	NE	21	13	24	6600.0	4.0	88.0	92.0	6512.0	6508.0
14	Byrd	MS36	NE	21	13	24	6600.0	5.0	156.0	161.0	6444.0	6439.0
14	Byrd	MS36	NE	21	13	24	6600.0	3.0	168.0	171.0	6432.0	6429.0
14	Byrd	MS36	NE	21	13	24	6600.0	1.0	204.0	205.0	6396.0	6395.0
14	Byrd	MS36	NE	21	13	24	6600.0	2.0	213.0	215.0	6387.0	6385.0
14	Byrd	MS36	NE	21	13	24	6600.0	5.0	304.0	309.0	6296.0	6291.0
15	Byrd	MS38	NE	4	13	25	7200.0	23.0	0.0	23.0	7200.0	7177.0
15	Byrd	MS38	NE	4	13	25	7200.0	9.0	28.0	37.0	7172.0	7163.0

Data Point	Data Source	Well Name or Measured Section (MS)		Section No.	Twp- S	Rng- E	Ground Elev. (feet)	Thick-ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section Number	Quarter Section									
16	UGMS	PR-4	NESESW	5	13	25	7187.0	21.0	57.0	78.0	7130.0	7109.0
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	7.5	42.0	49.5	7219.0	7211.5
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	6.5	68.5	75.0	7192.5	7186.0
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	9.0	90.0	99.0	7171.0	7162.0
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	9.0	112.0	120.0	7149.0	7141.0
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	4.5	123.0	127.5	7138.0	7133.5
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	2.0	130.0	132.0	7131.0	7129.0
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	4.5	134.0	138.5	7127.0	7122.5
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	13.0	164.5	177.5	7096.5	7083.5
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	14.0	191.0	2.5	7070.0	7258.5
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	4.0	213.0	217.0	7048.0	7044.0
17	UGMS	HC-1	SESWNE	31	14	20	7261.0	7.0	222.5	229.5	7038.5	7031.5
18	UGMS	HC-2	SESWSW	33	14	20	7483.0	16.5	327.0	343.5	7156.0	7139.5
18	UGMS	HC-2	SESWSW	33	14	20	7483.0	9.0	366.0	375.0	7117.0	7108.0
18	UGMS	HC-2	SESWSW	33	14	20	7483.0	2.0	378.0	380.0	7105.0	7103.0
18	UGMS	HC-2	SESWSW	33	14	20	7483.0	13.0	427.0	440.0	7056.0	7043.0
18	UGMS	HC-2	SESWSW	33	14	20	7483.0	22.0	448.0	470.0	7035.0	7013.0
18	UGMS	HC-2	SESWSW	33	14	20	7483.0	5.0	475.0	480.0	7008.0	7003.0
19	LETC	UTS-2	SESESW	26	14	21	7003.0	8.0	92.0	100.0	6911.0	6903.0
19	LETC	UTS-2	SESESW	26	14	21	7003.0	22.0	225.0	247.0	6778.0	6756.0
21	Skyline	14-34	SE	14	14	22	7003.0	1.0	71.0	72.0	6932.0	6931.0
21	Skyline	14-34	SE	14	14	22	7003.0	3.0	78.5	81.5	6924.5	6921.5
21	Skyline	14-34	SE	14	14	22	7003.0	9.0	91.0	100.0	6912.0	6903.0
21	Skyline	14-34	SE	14	14	22	7003.0	1.0	117.5	118.5	6885.5	6884.5
21	Skyline	14-34	SE	14	14	22	7003.0	9.5	133.5	143.0	6869.5	6860.0
21	Skyline	14-34	SE	14	14	22	7003.0	4.5	164.0	168.5	6839.0	6834.5
21	Skyline	14-34	SE	14	14	22	7003.0	1.0	177.0	178.0	6826.0	6825.0
21	Skyline	14-34	SE	14	14	22	7003.0	14.0	219.5	233.5	6783.5	6769.5
22	Skyline	24-24	NE	24	14	22	7130.0	1.0	44.0	45.0	7086.0	7085.0
22	Skyline	24-24	NE	24	14	22	7130.0	1.5	49.0	50.5	7081.0	7079.5
22	Skyline	24-24	NE	24	14	22	7130.0	3.0	61.5	64.5	7068.5	7065.5
22	Skyline	24-24	NE	24	14	22	7130.0	2.0	65.5	67.5	7064.5	7062.5
22	Skyline	24-24	NE	24	14	22	7130.0	3.5	683.5	72.0	6446.5	7058.0
22	Skyline	24-24	NE	24	14	22	7130.0	8.5	76.5	85.0	7053.5	7045.0
22	Skyline	24-24	NE	24	14	22	7130.0	10.0	117.0	127.0	7013.0	7003.0
22	Skyline	24-24	NE	24	14	22	7130.0	5.0	128.0	133.0	7002.0	6997.0
23	Skyline	25-32	SE	25	14	22	7162.0	5.0	44.0	49.0	7118.0	7113.0
23	Skyline	25-32	SE	25	14	22	7162.0	1.0	61.0	62.0	7101.0	7100.0
23	Skyline	25-32	SE	25	14	22	7162.0	3.0	99.0	102.0	7063.0	7060.0
23	Skyline	25-32	SE	25	14	22	7162.0	1.0	108.0	109.0	7054.0	7053.0
23	Skyline	25-32	SE	25	14	22	7162.0	1.0	110.0	111.0	7052.0	7051.0
23	Skyline	25-32	SE	25	14	22	7162.0	1.0	122.0	13.0	7040.0	7149.0
23	Skyline	25-32	SE	25	14	22	7162.0	2.5	133.5	136.0	7028.5	7026.0
23	Skyline	25-32	SE	25	14	22	7162.0	6.0	137.5	143.5	7024.5	7018.5
23	Skyline	25-32	SE	25	14	22	7162.0	1.0	145.0	146.0	7017.0	7016.0
23	Skyline	25-32	SE	25	14	22	7162.0	1.0	164.0	165.0	6998.0	6997.0
23	Skyline	25-32	SE	25	14	22	7162.0	15.0	187.0	202.0	6975.0	6960.0
24	Byrd	MS33	SE	34	14	22	7234.0	20.0	0.0	20.0	7234.0	7214.0
24	Byrd	MS33	SE	34	14	22	7234.0	21.0	76.0	101.0	7158.0	7133.0
24	Byrd	MS33	SE	34	14	22	7234.0	1.0	101.0	102.0	7133.0	7132.0
24	Byrd	MS33	SE	34	14	22	7234.0	4.0	171.0	175.0	7063.0	7059.0
24	Byrd	MS33	SE	34	14	22	7234.0	5.0	201.0	206.0	7033.0	7028.0
24	Byrd	MS33	SE	34	14	22	7234.0	40.0	228.0	268.0	7006.0	6966.0
25	Byrd	MS34	NE	2	14	23	6520.0	2.0	10.0	12.0	6510.0	6508.0
25	Byrd	MS34	NE	2	14	23	6520.0	14.0	67.0	81.0	6453.0	6439.0
25	Byrd	MS34	NE	2	14	23	6520.0	3.0	98.0	101.0	6422.0	6419.0
25	Byrd	MS34	NE	2	14	23	6520.0	7.0	161.0	168.0	6359.0	6352.0
25	Byrd	MS34	NE	2	14	23	6520.0	4.0	172.0	176.0	6348.0	6344.0
25	Byrd	MS34	NE	2	14	23	6520.0	12.0	229.0	241.0	6291.0	6279.0
26	LETC	UTS-3	NWNWNE	14	14	23	6693.0	2.0	18.0	20.0	6675.0	6673.0
26	LETC	UTS-3	NWNWNE	14	14	23	6693.0	16.0	24.0	40.0	6669.0	6653.0
26	LETC	UTS-3	NWNWNE	14	14	23	6693.0	7.0	45.0	52.0	6648.0	6641.0
26	LETC	UTS-3	NWNWNE	14	14	23	6693.0	18.0	70.0	88.0	6623.0	6605.0

Data Point	Data Source	Well Name or Measured Section (MS)		Section No.	Twp-S	Rng-E	Ground Elev. (feet)	Thick-ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section Number	Quarter Section									
26	LETC	UTS-3	NWNWNE	14	14	23	6693.0	25.0	101.0	135.0	6592.0	6558.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	2.5	9.0	11.5	6789.0	6786.5
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	2.0	15.0	17.0	6783.0	6781.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	1.0	21.0	22.0	6777.0	6776.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	1.0	24.0	25.0	6774.0	6773.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	3.0	25.0	28.0	6773.0	6770.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	14.5	28.0	42.5	6770.0	6755.5
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	1.5	83.0	84.5	6715.0	6713.5
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	3.5	96.5	100.0	6701.5	6698.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	6.0	117.0	123.0	6681.0	6675.0
27	UGMS	PR-7	SWNWNE	14	14	23	6798.0	1.5	192.0	193.5	6606.0	6604.5
28	Byrd	MS37	SE	25	14	23	7220.0	22.0	19.0	41.0	7201.0	7179.0
28	Byrd	MS37	SE	25	14	23	7220.0	15.0	93.0	108.0	7127.0	7112.0
28	Byrd	MS37	SE	25	14	23	7220.0	7.0	303.0	310.0	6917.0	6910.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	19.0	23.0	42.0	7364.0	7345.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	5.5	43.5	49.0	7343.5	7338.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	3.0	62.0	65.0	7325.0	7322.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	9.0	85.0	94.0	7302.0	7293.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	2.0	96.0	98.0	7291.0	7289.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	1.5	111.0	112.5	7276.0	7274.5
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	2.0	117.5	119.5	7269.5	7267.5
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	6.0	128.0	134.0	7259.0	7253.0
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	6.0	152.5	158.5	7234.5	7228.5
29	UGMS	PRS-3	NESWSE	32	14	23	7387.0	1.5	216.0	217.5	7171.0	7169.5
31	Byrd	MS32	SE	11	14	24	7200.0	No tar sand in the section			0.0	0.0
32	Mono Power	PRS-82-19	SENEENW	15	14	24	7232.0	4.6	125.8	130.4	7106.2	7101.6
32	Mono Power	PRS-82-19	SENEENW	15	14	24	7232.0	6.2	176.2	182.4	7055.8	7049.6
33	UGMS	HC-3	NENENE	3	15	20	7409.0	2.0	307.0	309.0	7102.0	7100.0
33	UGMS	HC-3	NENENE	3	15	20	7409.0	20.0	313.0	333.0	7096.0	7076.0
33	UGMS	HC-3	NENENE	3	15	20	7409.0	2.0	336.0	338.0	7073.0	7071.0
33	UGMS	HC-3	NENENE	3	15	20	7409.0	5.5	343.5	349.0	7065.5	7060.0
33	UGMS	HC-3	NENENE	3	15	20	7409.0	5.5	399.0	404.5	7010.0	7004.5
33	UGMS	HC-3	NENENE	3	15	20	7409.0	27.5	408.5	436.0	7000.5	6973.0
33	UGMS	HC-3	NENENE	3	15	20	7409.0	10.5	448.5	459.0	6960.5	6950.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	33.0	44.0	77.0	7339.0	7306.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	53.0	148.0	201.0	7235.0	7182.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	3.0	259.0	262.0	7124.0	7121.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	1.0	272.0	273.0	7111.0	7110.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	18.0	300.0	318.0	7083.0	7065.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	8.0	365.0	373.0	7018.0	7010.0
36	LETC	UTS-4	SENEWNE	21	15	21	7383.0	5.0	383.0	388.0	7000.0	6995.0
37	Byrd	MS24	NENE	22	15	21	7290.0	3.0	86.0	89.0	7204.0	7201.0
37	Byrd	MS24	NENE	22	15	21	7290.0	25.0	234.0	259.0	7056.0	7031.0
38	Byrd	MS30	SE	34	15	21	7200.0	10.0	0.0	10.0	7200.0	7190.0
38	Byrd	MS30	SE	34	15	21	7200.0	2.0	284.0	286.0	6916.0	6914.0
39	Mono Power	PRS-82-12	NENWSE	20	15	22	7334.0	5.0	5.0	10.0	7329.0	7324.0
39	Mono Power	PRS-82-12	NENWSE	20	15	22	7334.0	2.0	113.5	115.5	7220.5	7218.5
39	Mono Power	PRS-82-12	NENWSE	20	15	22	7334.0	9.9	149.0	158.9	7185.0	7175.1
39	Mono Power	PRS-82-12	NENWSE	20	15	22	7334.0	8.8	174.8	183.6	7159.2	7150.4
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	20.9	83.3	104.2	7757.7	7736.8
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	1.6	113.4	115.0	7727.6	7726.0
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	1.3	115	116.3	7726.0	7724.7
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	2.8	128.4	131.2	7712.6	7709.8
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	9.5	156.7	166.2	7684.3	7674.8
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	3.1	177.0	180.1	7664.0	7660.9
40	Mono Power	PRS-82-08	SWSENE	21	15	23	7841.0	25.0	207.3	232.3	7633.7	7608.7
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	1.9	20.0	21.9	7461.0	7459.1
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	7.4	60.0	67.4	7421.0	7413.6
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	16.3	68.9	85.2	7412.1	7395.8
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	13.0	92.0	105.0	7389.0	7376.0
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	4.3	199.5	203.8	7281.5	7277.2
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	9.7	209.8	219.5	7271.2	7261.5
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481.0	2.8	220.9	223.7	7260.1	7257.3

Data Point	Data Source	Well Name or Measured Section (MS)		Section No.	Twp- S	Rng- E	Ground Elev. (feet)	Thick-ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section Number	Quarter Section									
42	LETC	UTS-5	SWSE	29	15	22	7472.0	6.0	14.0	16.0	7458.0	7456.0
42	LETC	UTS-5	SWSE	29	15	22	7472.0	10.0	30.0	40.0	7442.0	7432.0
42	LETC	UTS-5	SWSE	29	15	22	7472.0	7.0	75.0	82.0	7397.0	7390.0
42	LETC	UTS-5	SWSE	29	15	22	7472.0	32.0	227.0	259.0	7245.0	7213.0
43	Byrd	MS03	SWNE	31	15	22	7485.0	5.0	0.0	5.0	7485.0	7480.0
43	Byrd	MS03	SWNE	31	15	22	7485.0	2.0	81.0	83.0	7404.0	7402.0
44	Mono Power	MP-7	NENENE	32	15	22	7500.0	2.0	20.0	22.0	7480.0	7478.0
44	Mono Power	MP-7	NENENE	32	15	22	7500.0	1.6	24.8	26.4	7475.2	7473.6
44	Mono Power	MP-7	NENENE	32	15	22	7500.0	1.6	105.2	106.8	7394.8	7393.2
45	Mono Power	PRS-82-03	SWNWSW	32	15	22	7513.0	15.0	15.0	30.0	7498.0	7483.0
45	Mono Power	PRS-82-03	SWNWSW	32	15	22	7513.0	25.0	80.0	105.0	7433.0	7408.0
45	Mono Power	PRS-82-03	SWNWSW	32	15	22	7513.0	25.0	240.0	265.0	7273.0	7248.0
46	Mono Power	PRS-82-04	SESESE	32	15	22	7524.0	3.8	29.2	33.0	7494.8	7491.0
46	Mono Power	PRS-82-04	SESESE	32	15	22	7524.0	16.0	83.1	99.1	7440.9	7424.9
46	Mono Power	PRS-82-04	SESESE	32	15	22	7524.0	2.6	107.6	110.2	7416.4	7413.8
46	Mono Power	PRS-82-04	SESESE	32	15	22	7524.0	8.4	190.1	198.5	7333.9	7325.5
46	Mono Power	PRS-82-04	SESESE	32	15	22	7524.0	8.5	247.1	255.6	7276.9	7268.4
47	Mono Power	MP-9	C	34	15	22	7520.0	4.3	85.1	89.4	7434.9	7430.6
47	Mono Power	MP-9	C	34	15	22	7520.0	13.3	235.8	249.1	7284.2	7270.9
49	Mono Power	MP-8	NWSWSE	35	15	22	7600.0	1.5	39.5	41.0	7560.5	7559.0
49	Mono Power	MP-8	NWSWSE	35	15	22	7600.0	5.0	79.6	84.6	7520.4	7515.4
49	Mono Power	MP-8	NWSWSE	35	15	22	7600.0	4.5	86.8	91.1	7513.2	7508.9
49	Mono Power	MP-8	NWSWSE	35	15	22	7600.0	1.0	97.1	98.1	7502.9	7501.9
49	Mono Power	MP-8	NWSWSE	35	15	22	7600.0	1.4	100.4	101.8	7499.6	7498.2
49	Mono Power	MP-8	NWSWSE	35	15	22	7600.0	17.0	113.0	130.0	7487.0	7470.0
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	5.0	10.0	15.0	7614.0	7609.0
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	7.2	20.6	27.8	7603.4	7596.2
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	5.8	44.8	50.6	7579.2	7573.4
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	7.1	74.9	82.0	7549.1	7542.0
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	6.2	98.2	104.4	7525.8	7519.6
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	2.3	128.4	130.7	7495.6	7493.3
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	8.7	135.2	143.9	7488.8	7480.1
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	11.9	143.9	155.8	7480.1	7468.2
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624.0	4.1	203.8	207.9	7420.2	7416.1
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	2.7	12.5	15.2	7567.5	7564.8
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	0.9	15.2	16.1	7564.8	7563.9
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	3.1	16.1	19.2	7563.9	7560.8
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	4.0	19.2	23.3	7560.8	7556.7
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	0.2	23.3	23.5	7556.7	7556.5
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	1.1	23.5	24.6	7556.5	7555.4
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	6.3	33.5	39.8	7546.5	7540.2
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	0.4	49.6	50.0	7530.4	7530.0
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	3.1	80.3	83.4	7499.7	7496.6
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	3.4	94.1	97.5	7485.9	7482.5
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	1.3	102.7	104.0	7477.3	7476.0
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	8.2	115.4	123.6	7464.6	7456.4
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	7.8	144.4	152.2	7435.6	7427.8
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580.0	5.3	158.2	163.5	7421.8	7416.5
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	3.4	17.8	21.2	7542.2	7538.8
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	0.7	24.9	25.6	7535.1	7534.4
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	0.4	31.5	31.9	7528.5	7528.1
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	1.0	34.7	35.7	7525.3	7524.3
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	2.8	38.5	41.3	7521.5	7518.7
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	11.7	68.8	80.5	7491.2	7479.5
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	4.2	82.4	86.6	7477.6	7473.4
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	4.0	96.8	100.8	7463.2	7459.2
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	1.0	116.2	117.2	7443.8	7442.8
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	2.2	136.7	138.9	7423.3	7421.1
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	2.6	148.8	151.4	7411.2	7408.6
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560.0	4.9	153.2	158.1	7406.8	7401.9
54	Mono Power	SRI-4-A	NENENE	4	15	23	7450.0	No tar sand in the section			0.0	0.0
55	Mono Power	SRI-5	NESESE	5	15	23	7538.0	0.7	67.0	67.7	7471.0	7470.3
55	Mono Power	SRI-5	NESESE	5	15	23	7538.0	11.3	69.3	80.6	7468.7	7457.4

Data Point	Data Source	Well Name or Measured		Sect- ion No.	Twp- S	Rng- E	Ground Elev. (feet)	Thick- ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section (MS) Number	Quarter Section									
56	Mono Power	SRI-6A	SESENE	6	15	23	7450.0	2.1	73.2	75.3	7376.8	7374.7
56	Mono Power	SRI-6A	SESENE	6	15	23	7450.0	2.1	75.3	77.4	7374.7	7372.6
57	Mono Power	SRI-8	NWSWSE	8	15	23	7600.0	1.9	69.0	70.9	7531.0	7529.1
57	Mono Power	SRI-8	NWSWSE	8	15	23	7600.0	0.7	76.8	77.5	7523.2	7522.5
57	Mono Power	SRI-8	NWSWSE	8	15	23	7600.0	3.6	85.8	89.4	7514.2	7510.6
58	Mono Power	PRS-83-03	SWSENW	10	15	23	7640.0	10.1	9.0	19.1	7631.0	7620.9
58	Mono Power	PRS-83-03	SWSENW	10	15	23	7640.0	1.8	56.3	58.1	7583.7	7581.9
58	Mono Power	PRS-83-03	SWSENW	10	15	23	7640.0	1.4	130.7	132.1	7509.3	7507.9
58	Mono Power	PRS-83-03	SWSENW	10	15	23	7640.0	8.2	142.1	150.3	7497.9	7489.7
59	Mono Power	PRS-82-15	SWNENW	11	15	23	7678.0	10.0	0.0	10.0	7678.0	7668.0
59	Mono Power	PRS-82-15	SWNENW	11	15	23	7678.0	15.0	15.0	30.0	7663.0	7648.0
59	Mono Power	PRS-82-15	SWNENW	11	15	23	7678.0	17.0	75.0	92.0	7603.0	7586.0
59	Mono Power	PRS-82-15	SWNENW	11	15	23	7678.0	24.0	150.0	147.0	7528.0	7531.0
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714.0	2.8	41.8	44.6	7672.2	7669.4
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714.0	3.2	72.0	75.2	7642.0	7638.8
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714.0	12.6	88.4	101.0	7625.6	7613.0
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714.0	6.2	101.0	107.2	7613.0	7606.8
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714.0	16.1	136.6	152.7	7577.4	7561.3
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714.0	22.5	213.3	235.8	7500.7	7478.2
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	2.7	20.0	22.7	7800.0	7797.3
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	3.2	30.4	33.6	7789.6	7786.4
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	2.0	35.8	37.8	7784.2	7782.2
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	1.4	78.7	80.1	7741.3	7739.9
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	7.4	92.0	99.4	7728.0	7720.6
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	0.6	122.5	123.1	7697.5	7696.9
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	14.9	139.9	154.8	7680.1	7665.2
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820.0	11.1	191.2	202.3	7628.8	7617.7
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	9.7	15.0	24.7	7714.0	7704.3
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	2.9	24.7	27.6	7704.3	7701.4
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	1.1	27.6	28.7	7701.4	7700.3
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	2.8	40.5	43.3	7688.5	7685.7
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	1.4	58.9	66.3	7670.1	7662.7
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	1.1	84.7	85.8	7644.3	7643.2
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	1.2	85.6	87.0	7643.4	7642.0
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	8.4	137.0	145.4	7592.0	7583.6
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	20.3	145.4	165.7	7583.6	7563.3
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	15.3	165.7	181.0	7563.3	7548.0
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729.0	3.6	243.9	247.5	7485.1	7481.5
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	1.0	57.0	58.0	7645.0	7644.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	5.0	60.0	65.0	7642.0	7637.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	2.5	67.5	70.0	7634.5	7632.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	6.5	75.5	82.0	7626.5	7620.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	1.0	123.0	124.0	7579.0	7578.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	2.0	126.0	128.0	7576.0	7574.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	1.0	132.0	133.0	7570.0	7569.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	3.0	135.0	138.0	7567.0	7564.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	8.0	172.0	180.0	7530.0	7522.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	20.0	192.0	212.0	7510.0	7490.0
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	0.5	245.0	245.5	7457.0	7456.5
64	UGMS	PRS-2	NESENEW	16	15	23	7702.0	2.5	250.5	253.0	7451.5	7449.0
65	Mono Power	PRS-82-09	SESENE	22	15	23	7901.0	35.0	10.0	45.0	7891.0	7856.0
65	Mono Power	PRS-82-09	SESENE	22	15	23	7901.0	35.0	80.0	115.0	7821.0	7786.0
65	Mono Power	PRS-82-09	SESENE	22	15	23	7901.0	20.0	150.0	170.0	7751.0	7731.0
65	Mono Power	PRS-82-09	SESENE	22	15	23	7901.0	45.0	175.0	220.0	7726.0	7681.0
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	10.2	10.0	20.2	7835.0	7824.8
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	0.6	25.0	25.6	7820.0	7819.4
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	0.5	55.2	55.7	7789.8	7789.3
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	1.3	57.5	58.8	7787.5	7786.2
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	4.3	59.2	63.5	7785.8	7781.5
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	0.9	109.7	110.6	7735.3	7734.4
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	32.7	126.3	159.0	7718.7	7686.0
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	8.5	172.9	181.4	7672.1	7663.6
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	2.4	182.6	185.0	7662.4	7660.0

Data Point	Data Source	Well Name or Measured		Sect- ion No.	Twp- S	Rng- E	Ground Elev. (feet)	Thick- ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)	
		Section (MS) Number	Quarter Section										
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	9.5	186.3	195.8	7658.7	7649.2	
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845.0	1.8	200.4	202.8	7644.6	7642.2	
67	Mono Power	PRS-82-14	NENWNW	23	15	23	7938.0	30.2	57.3	87.5	7880.7	7850.5	
67	Mono Power	PRS-82-14	NENWNW	23	15	23	7938.0	14.1	118.0	132.1	7820.0	7805.9	
67	Mono Power	PRS-82-14	NENWNW	23	15	23	7938.0	28.2	183.5	211.7	7754.5	7726.3	
67	Mono Power	PRS-82-14	NENWNW	23	15	23	7938.0	22.2	229.7	251.9	7708.3	7686.1	
68	Mono Power	PRS-82-10	SWNESE	25	15	23	8096.0	10.0	10.0	20.0	8086.0	8076.0	
68	Mono Power	PRS-82-10	SWNESE	25	15	23	8096.0	5.5	63.7	69.2	8032.3	8026.8	
68	Mono Power	PRS-82-10	SWNESE	25	15	23	8096.0	3.9	82.3	86.2	8013.7	8009.8	
68	Mono Power	PRS-82-10	SWNESE	25	15	23	8096.0	18.7	88.9	107.6	8007.1	7988.4	
69	Mobil Oil	RH-14	NG	26	15	23	8091.7	5.3	50.0	55.3	8041.7	8036.4	
69	Mobil Oil	RH-14	NG	26	15	23	8091.7	9.0	60.0	69.0	8031.7	8022.7	
69	Mobil Oil	RH-14	NG	26	15	23	8091.7	4.5	97.0	101.5	7994.7	7990.2	
69	Mobil Oil	RH-14	NG	26	15	23	8091.7	7.5	102.3	109.8	7989.4	7981.9	
69	Mobil Oil	RH-14	NG	26	15	23	8091.7	10.5	109.8	120.3	7981.9	7971.4	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	5.0	25.0	30.0	7983.5	7978.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	5.0	35.0	40.0	7973.5	7968.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	3.0	46.0	49.0	7962.5	7959.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	3.0	75.0	78.0	7933.5	7930.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	10.0	90.0	100.0	7918.5	7908.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	3.0	107.0	110.0	7901.5	7898.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	4.8	113.2	118.0	7895.3	7890.5	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	2.9	127.3	130.2	7881.2	7878.3	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	11.5	161.9	173.4	7846.6	7835.1	
70	Mobil Oil	RH-15	NG	26	15	23	8008.5	17.0	202.4	219.4	7806.1	7789.1	
71	Mobil Oil	RH-16	NG	26	15	23	8215.5	2.0	18.0	20.0	8197.5	8195.5	
71	Mobil Oil	RH-16	NG	26	15	23	8215.5	12.1	184.7	196.8	8030.8	8018.7	
71	Mobil Oil	RH-16	NG	26	15	23	8215.5	11.0	224.0	235.0	7991.5	7980.5	
71	Mobil Oil	RH-16	NG	26	15	23	8215.5	6.0	258.0	264.0	7957.5	7951.5	
71	Mobil Oil	RH-16	NG	26	15	23	8215.5	20.0	264.0	284.0	7951.5	7931.5	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	1.9	37.5	39.4	7912.7	7910.8	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	1.6	40.6	42.2	7909.6	7908.0	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	4.5	73.5	78.0	7876.7	7872.2	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	29.2	91.8	121.0	7858.4	7829.2	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	0.9	151.1	152.0	7799.1	7798.2	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	1.8	153.0	154.8	7797.2	7795.4	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	12.4	155.6	168.0	7794.6	7782.2	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	11.5	203.5	215.0	7746.7	7735.2	
72	Mobil Oil	RH-13	NG	27	15	23	7950.2	20.0	215.0	235.0	7735.2	7715.2	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	6.0	27.0	33.0	7983.0	7977.0	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	4.0	36.0	40.0	7974.0	7970.0	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	10.0	42.0	52.0	7968.0	7958.0	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	4.0	66.0	70.0	7944.0	7940.0	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	7.5	74.0	81.5	7936.0	7928.5	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	28.0	90.0	118.0	7920.0	7892.0	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	24.0	159.0	183.0	7851.0	7827.0	
73	UGMS	PRS-1	SENESE	27	15	23	8010.0	22.0	200.0	222.0	7810.0	7788.0	
74	Byrd	MS07	SESW	27	15	23	7900.0	28.0	0.0	28.0	7900.0	7872.0	
74	Byrd	MS07	SESW	27	15	23	7900.0	15.0	123.0	138.0	7777.0	7762.0	
74	Byrd	MS07	SESW	27	15	23	7900.0	53.0	152.0	205.0	7748.0	7695.0	
74	Byrd	MS07	SESW	27	15	23	7900.0	25.0	243.0	268.0	7657.0	7632.0	
75	Byrd	MS11	SWSW	31	15	23	7780.0	15.0	0.0	15.0	7780.0	7765.0	
75	Byrd	MS11	SWSW	31	15	23	7780.0	23.0	15.0	38.0	7765.0	7742.0	
75	Byrd	MS11	SWSW	31	15	23	7780.0	2.0	77.0	79.0	7703.0	7701.0	
75	Byrd	MS11	SWSW	31	15	23	7780.0	12.0	114.0	126.0	7666.0	7654.0	
75	Byrd	MS11	SWSW	31	15	23	7780.0	10.0	167.0	177.0	7613.0	7603.0	
75	Byrd	MS11	SWSW	31	15	23	7780.0	3.0	221.0	224.0	7559.0	7556.0	
77	Byrd	MS27	SE	32	15	23	7740.0	2.0	0.0	2.0	7740.0	7738.0	
77	Byrd	MS27	SE	32	15	23	7740.0	11.0	240.0	251.0	7500.0	7489.0	
78	Mono Power	PRS-82-11	NENWSW	19	15	24	7914.0	No tar sand in the section				0.0	0.0
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	5.1	40.5	45.6	7319.5	7314.4	
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	5.3	109.3	114.6	7250.7	7245.4	
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	2.0	132.3	134.3	7227.7	7225.7	

Data Point	Data Source	Well Name or Measured		Section No.	Twp-S	Rng-E	Ground Elev. (feet)	Thick-ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section (MS) Number	Quarter Section									
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	2.6	134.3	136.9	7225.7	7223.1
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	4.8	260.5	265.3	7099.5	7094.7
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	0.2	364.9	265.5	6995.1	7094.5
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	0.9	365.5	366.4	6994.5	6993.6
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	1.1	366.4	367.5	6993.6	6992.5
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	1.2	369.5	370.7	6990.5	6989.3
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	0.7	370.7	371.4	6989.3	6988.6
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	7.7	371.4	379.1	6988.6	6980.9
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	0.4	379.1	379.5	6980.9	6980.5
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	9.3	379.5	388.8	6980.5	6971.2
79	Mono Power	MP-6	NENENE	32	15.5	22	7360.0	3.4	388.8	392.2	6971.2	6967.8
80	Byrd	MS26	SESE	35	15.5	22	7560.0	71.0	60.0	131.0	7500.0	7429.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	24.0	236.0	260.0	7324.0	7300.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	7.0	274.0	281.0	7286.0	7279.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	4.0	284.0	288.0	7276.0	7272.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	15.0	306.0	321.0	7254.0	7239.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	5.0	329.0	334.0	7231.0	7226.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	8.0	351.0	359.0	7209.0	7201.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	16.0	363.0	379.0	7197.0	7181.0
80	Byrd	MS26	SESE	35	15.5	22	7560.0	10.0	388.0	398.0	7172.0	7162.0
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	5.0	2.5	7.5	7597.5	7592.5
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	10.2	71.8	82.0	7528.2	7518.0
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	4.4	82.0	86.4	7518.0	7513.6
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	5.3	86.4	91.7	7513.6	7508.3
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	0.3	191.8	192.1	7408.2	7407.9
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	0.6	211.0	211.6	7389.0	7388.4
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600.0	6.9	232.9	239.8	7367.1	7360.2
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	2.0	25.0	27.0	8270.0	8268.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	11.0	38.0	49.0	8257.0	8246.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	6.0	99.0	105.0	8196.0	8190.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	13.0	141.0	154.0	8154.0	8141.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	16.0	179.0	195.0	8116.0	8100.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	7.0	282.0	289.0	8013.0	8006.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	46.0	296.0	342.0	7999.0	7953.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	6.0	351.0	357.0	7944.0	7938.0
82	LETC	UTS-6	NWSESW	33	15.5	24	8295.0	8.0	364.0	372.0	7931.0	7923.0
83	Byrd	MS19	SWNW	12	16	21	7510.0	No tar sand in the section			0.0	0.0
84	Byrd	MS20	NWSW	26	16	21	7800.0	No tar sand in the section			0.0	0.0
85	Byrd	MS29	SW	12	16	22	7600.0	21.0	0.0	21.0	7600.0	7579.0
85	Byrd	MS29	SW	12	16	22	7600.0	31.0	233.0	264.0	7367.0	7336.0
86	Byrd	MS18	SENE	16	16	22	7320.0	No tar sand in the section			0.0	0.0
87	LETC	UTS-7	NWSWNE	25	16	22	7905.0	No tar sand in the section			0.0	0.0
88	Byrd	MS14	SENE	25	16	22	7950.0	4.0	0.0	4.0	7950.0	7946.0
88	Byrd	MS14	SENE	25	16	22	7950.0	2.0	198.0	200.0	7752.0	7750.0
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	12.0	3.0	15.0	7697.0	7685.0
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	3.0	18.0	21.0	7682.0	7679.0
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	6.5	46.0	52.5	7654.0	7647.5
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	2.0	55.0	57.0	7645.0	7643.0
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	3.5	60.5	64.0	7639.5	7636.0
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	12.0	69.0	81.0	7631.0	7619.0
89	Mobil Oil	RH-17	NG	8	16	23	7700.0	10.0	81.0	91.0	7619.0	7609.0
90	Byrd	MS12	SENW	13	16	23	8190.0	5.0	0.0	5.0	8190.0	8185.0
90	Byrd	MS12	SENW	13	16	23	8190.0	2.0	63.0	65.0	8127.0	8125.0
90	Byrd	MS12	SENW	13	16	23	8190.0	8.0	83.0	91.0	8107.0	8099.0
91	Byrd	MS10	NWSE	16	16	23	7880.0	26.0	0.0	26.0	7880.0	7854.0
92	Byrd	MS01	NW	20	16	23	7780.0	4.0	0.0	4.0	7780.0	7776.0
92	Byrd	MS01	NW	20	16	23	7780.0	12.0	81.0	93.0	7699.0	7687.0
93	Byrd	MS13	NENE	27	16	23	8130.0	6.0	15.0	21.0	8115.0	8109.0
93	Byrd	MS13	NENE	27	16	23	8130.0	8.0	21.0	29.0	8109.0	8101.0
93	Byrd	MS13	NENE	27	16	23	8130.0	3.0	35.0	38.0	8095.0	8092.0
93	Byrd	MS13	NENE	27	16	23	8130.0	25.0	181.0	206.0	7949.0	7924.0
94	Byrd	MS04	SWNE	2	16	24	8280.0	10.0	0.0	10.0	8280.0	8270.0
94	Byrd	MS04	SWNE	2	16	24	8280.0	21.0	175.0	196.0	8105.0	8084.0

Data Point	Data Source	Well Name or Measured	Quarter Section	Sect-			Ground Elev. (feet)	Thick-ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section (MS) Number		ion No.	Twp- S	Rng- E						
94	Byrd	MS04	SWNE	2	16	24	8280.0	15.0	201.0	216.0	8079.0	8064.0
95	Byrd	MS05	SWSE	4	16	24	8210.0	18.0	87.0	105.0	8123.0	8105.0
95	Byrd	MS05	SWSE	4	16	24	8210.0	3.0	115.0	118.0	8095.0	8092.0
95	Byrd	MS05	SWSE	4	16	24	8210.0	39.0	132.0	171.0	8078.0	8039.0
96	Byrd	MS28	SWNE	7	16	24	8160.0	40.0	30.0	70.0	8130.0	8090.0
97	Byrd	MS06	NENW	8	16	24	8130.0	15.0	0.0	15.0	8130.0	8115.0
97	Byrd	MS06	NENW	8	16	24	8130.0	28.0	155.0	183.0	7975.0	7947.0
98	Byrd	MS25	C	2	17	21	8280.0	16.0	290.0	306.0	7990.0	7974.0
99	Byrd	MS22	NWNE	15	17	21	8350.0	13.0	416.0	429.0	7934.0	7921.0
100	Byrd	MS23	NWNW	14	17	21	8300.0	8.0	137.0	145.0	8163.0	8155.0
100	Byrd	MS23	NWNW	14	17	21	8300.0	9.0	167.0	176.0	8133.0	8124.0
101	Byrd	MS08	SE	2	17	22	8210.0	9.0	50.0	59.0	8160.0	8151.0
101	Byrd	MS08	SE	2	17	22	8210.0	5.0	59.0	64.0	8151.0	8146.0
101	Byrd	MS08	SE	2	17	22	8210.0	3.0	73.0	76.0	8137.0	8134.0
102	Byrd	MS09	SENE	2	17	22	8210.0	8.0	35.0	43.0	8175.0	8167.0
102	Byrd	MS09	SENE	2	17	22	8210.0	4.0	213.0	217.0	7997.0	7993.0
103	Byrd	MS15	NESW	3	17	22	8200.0	2.0	138.0	140.0	8062.0	8060.0
103	Byrd	MS15	NESW	3	17	22	8200.0	3.0	140.0	143.0	8060.0	8057.0
103	Byrd	MS15	NESW	3	17	22	8200.0	10.0	143.0	153.0	8057.0	8047.0
103	Byrd	MS15	NESW	3	17	22	8200.0	14.0	153.0	167.0	8047.0	8033.0
103	Byrd	MS15	NESW	3	17	22	8200.0	7.0	171.0	178.0	8029.0	8022.0
104	Byrd	MS21	NWNW	6	17	22	8060.0	42.0	219.0	261.0	7841.0	7799.0
105	Byrd	MS16	NWNE	17	17	22	8360.0	8.0	189.0	197.0	8171.0	8163.0
106	Byrd	MS17	NWSW	30	17	22	8690.0	11.0	256.0	267.0	8434.0	8423.0
106	Byrd	MS17	NWSW	30	17	22	8690.0	6.0	271.0	277.0	8419.0	8413.0
107	Whittier	1	NESE	16	16	23	7920.0	33.0	0.0	33.0	7920.0	7887.0
108	Whittier	2	NWSW	15	16	23	7920.0	26.0	0.0	26.0	7920.0	7894.0
109	Whittier	3	SENE	14	16	23	8220.0	43.0	9.0	52.0	8211.0	8168.0
109	Whittier	3	SENE	14	16	23	8220.0	20.0	160.0	180.0	8060.0	8040.0
110	Whittier	4	SENE	13	16	23	8240.0	14.0	104.0	118.0	8136.0	8122.0
111	Whittier	5	NWNE	13	16	23	8200.0	107.0	35.0	142.0	8165.0	8058.0
112	Whittier	6	SW	7	16	24	8130.0	60.0	35.0	95.0	8095.0	8035.0
113	Whittier	7	NE	8	16	24	8200.0	13.0	5.0	18.0	8195.0	8182.0
113	Whittier	7	NE	8	16	24	8200.0	7.0	148.0	155.0	8052.0	8045.0
114	Whittier	8	NWNW	9	16	24	8240.0	35.0	110.0	145.0	8130.0	8095.0
114	Whittier	8	NWNW	9	16	24	8240.0	3.0	183.0	186.0	8057.0	8054.0
114	Whittier	8	NWNW	9	16	24	8240.0	15.0	195.0	210.0	8045.0	8030.0
115	Whittier	9	NWSE	9	16	23	7800.0	7.0	5.0	12.0	7795.0	7788.0
115	Whittier	9	NWSE	9	16	23	7800.0	15.0	22.0	37.0	7778.0	7763.0
115	Whittier	9	NWSE	9	16	23	7800.0	58.0	150.0	208.0	7650.0	7592.0
116	Whittier	10	SESW	31	15.5	24	7720.0	57.0	11.0	68.0	7709.0	7652.0
116	Whittier	10	SESW	31	15.5	24	7720.0	10.0	102.0	112.0	7618.0	7608.0
117	Whittier	11	SWSE	27	15	23	7920.0	15.0	60.0	75.0	7860.0	7845.0
117	Whittier	11	SWSE	27	15	23	7920.0	26.0	96.0	122.0	7824.0	7798.0
118	Whittier	12	NESW	35	15	23	8000.0	121.0	12.0	133.0	7988.0	7867.0
119	Whittier	13	W1/2NE	31	15.5	24	8000.0	22.0	0.0	22.0	8000.0	7978.0
119	Whittier	13	W1/2NE	31	15.5	24	8000.0	32.0	46.0	78.0	7954.0	7922.0
120	Whittier	14	SWSW	36	15	23	8080.0	55.0	5.0	60.0	8075.0	8020.0
121	Mobil Oil	RH-18	NG	6	16	23	7600.0	5.0	13.0	18.0	7587.0	7582.0
121	Mobil Oil	RH-18	NG	6	16	23	7600.0	10.9	28.6	39.5	7571.4	7560.5
121	Mobil Oil	RH-18	NG	6	16	23	7600.0	3.0	70.0	73.0	7530.0	7527.0
121	Mobil Oil	RH-18	NG	6	16	23	7600.0	21.6	75.7	97.3	7524.3	7502.7
122	Enercor	83-5	NG	8	14	23	6820.0	12.0	17.0	29.0	6803.0	6791.0
122	Enercor	83-5	NG	8	14	23	6820.0	2.0	31.0	33.0	6789.0	6787.0
122	Enercor	83-5	NG	8	14	23	6820.0	3.0	41.0	44.0	6779.0	6776.0
122	Enercor	83-5	NG	8	14	23	6820.0	10.0	57.0	67.0	6763.0	6753.0
122	Enercor	83-5	NG	8	14	23	6820.0	5.0	77.0	82.0	6743.0	6738.0
122	Enercor	83-5	NG	8	14	23	6820.0	1.0	84.0	85.0	6736.0	6735.0
122	Enercor	83-5	NG	8	14	23	6820.0	2.0	93.0	95.0	6727.0	6725.0
122	Enercor	83-5	NG	8	14	23	6820.0	1.0	104.0	105.0	6716.0	6715.0
122	Enercor	83-5	NG	8	14	23	6820.0	1.0	132.0	133.0	6688.0	6687.0
123	Enercor	84-1A	SW	18	14	21	7150.0	2.5	23.5	26.0	7126.5	7124.0
123	Enercor	84-1A	SW	18	14	21	7150.0	2.0	26.0	28.0	7124.0	7122.0

Data Point	Data Source	Well Name or Measured		Section No.	Twp- S	Rng- E	Ground Elev. (feet)	Thick- ness* (feet)	Depth Upper (feet)	Depth lower (feet)	Top of Bed Elevation (feet)	Bot. of Bed Elevation (feet)
		Section (MS) Number	Quarter Section									
123	Enercor	84-1A	SW	18	14	21	7150.0	2.0	28.0	30.0	7122.0	7120.0
123	Enercor	84-1A	SW	18	14	21	7150.0	5.0	30.0	35.0	7120.0	7115.0
123	Enercor	84-1A	SW	18	14	21	7150.0	2.0	39.0	41.0	7111.0	7109.0
123	Enercor	84-1A	SW	18	14	21	7150.0	3.0	46.5	49.5	7103.5	7100.5
123	Enercor	84-1A	SW	18	14	21	7150.0	1.0	49.5	50.5	7100.5	7099.5
123	Enercor	84-1A	SW	18	14	21	7150.0	28.0	83.0	111.0	7067.0	7039.0
124	Enercor	84-2A	SW	19	14	23	7120.0	16.0	23.0	39.0	7097.0	7081.0
124	Enercor	84-2A	SW	19	14	23	7120.0	4.0	48.0	52.0	7072.0	7068.0
124	Enercor	84-2A	SW	19	14	23	7120.0	19.0	86.0	105.0	7034.0	7015.0
126	Enercor	84-12	NWSW	24	14	22	7221.0	2.0	21.0	23.0	7200.0	7198.0
126	Enercor	84-12	NWSW	24	14	22	7221.0	31.0	55.0	86.0	7166.0	7135.0
127	Enercor	84-2	SESE	30	14	23	7392.0	34.0	23.0	57.0	7369.0	7335.0
127	Enercor	84-2	SESE	30	14	23	7392.0	7.0	105.0	112.0	7287.0	7280.0
128	Enercor	84-6A	CSW	30	14	22	7334.0	20.0	18.0	38.0	7316.0	7296.0
129	Enercor	84-9A	SW	24	14	22	7135.0	1.0	47.0	48.0	7088.0	7087.0
129	Enercor	84-9A	SW	24	14	22	7135.0	34.0	54.0	88.0	7081.0	7047.0
129	Enercor	84-9A	SW	24	14	22	7135.0	14.0	121.0	135.0	7014.0	7000.0
130	Enercor	84-10A	SE	24	14	22	7152.0	5.0	5.0	10.0	7147.0	7142.0
130	Enercor	84-10A	SE	24	14	22	7152.0	1.0	15.0	16.0	7137.0	7136.0
130	Enercor	84-10A	SE	24	14	22	7152.0	7.0	40.0	47.0	7112.0	7105.0
130	Enercor	84-10A	SE	24	14	22	7152.0	13.0	53.0	66.0	7099.0	7086.0
130	Enercor	84-10A	SE	24	14	22	7152.0	15.0	98.0	113.0	7054.0	7039.0
130	Enercor	84-10A	SE	24	14	22	7152.0	10.0	113.0	123.0	7039.0	7029.0
131	Enercor	84-11A	SE	25	14	22	7170.0	1.0	24.0	25.0	7146.0	7145.0
131	Enercor	84-11A	SE	25	14	22	7170.0	40.0	30.0	70.0	7140.0	7100.0
131	Enercor	84-11A	SE	25	14	22	7170.0	4.0	74.0	78.0	7096.0	7092.0
131	Enercor	84-11A	SE	25	14	22	7170.0	10.0	99.0	109.0	7071.0	7061.0
132	Enercor	84-12A	SW	24	14	22	7221.0	2.0	15.0	17.0	7206.0	7204.0
132	Enercor	84-12A	SW	24	14	22	7221.0	26.0	26.0	52.0	7195.0	7169.0
132	Enercor	84-12A	SW	24	14	22	7221.0	14.0	82.0	96.0	7139.0	7125.0
132	Enercor	84-12A	SW	24	14	22	7221.0	1.0	100.0	101.0	7121.0	7120.0
134	Enercor	84-3A	SW	24	14	22	7126.0	12.5	48.0	60.5	7078.0	7065.5
134	Enercor	84-3A	SW	24	14	22	7126.0	3.0	68.0	71.0	7058.0	7055.0
134	Enercor	84-3A	SW	24	14	22	7126.0	21.0	101.0	122.0	7025.0	7004.0
135	Enercor	84-4A	NW	19	14	23	7051.0	10.0	20.0	30.0	7031.0	7021.0
135	Enercor	84-4A	NW	19	14	23	7051.0	2.0	30.0	32.0	7021.0	7019.0
135	Enercor	84-4A	NW	19	14	23	7051.0	7.0	32.0	39.0	7019.0	7012.0
135	Enercor	84-4A	NW	19	14	23	7051.0	4.0	46.0	50.0	7005.0	7001.0
136	Enercor	84-5A	SE	18	14	23	6961.0	2.0	39.0	41.0	6922.0	6920.0
136	Enercor	84-5A	SE	18	14	23	6961.0	9.0	44.0	53.0	6917.0	6908.0

EXPLANATION

*Thickness = Thickness of tar sand bed.

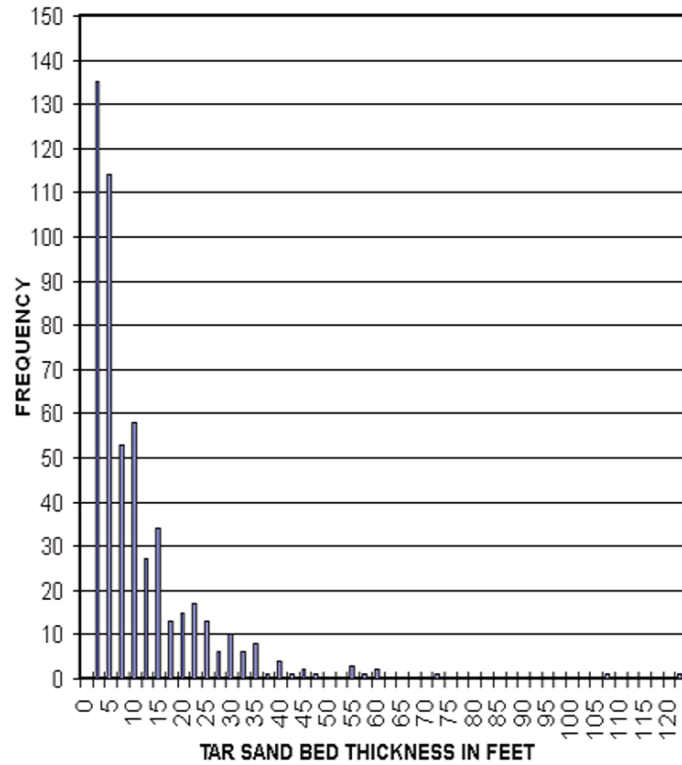


Figure 4. Histogram showing frequency distribution of tar sand bed thicknesses in 2.5-foot bins.

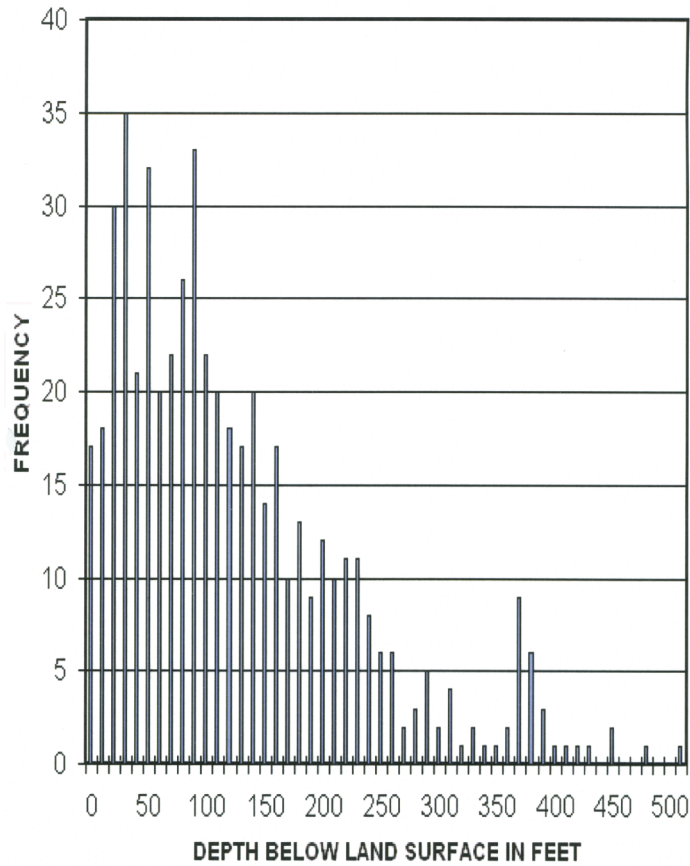


Figure 5. Histogram showing frequency distribution of tar sand depth below land surface in 10-foot bins.

Table 3 - Data point, data source, well number, location, ground elevation, gross and net tar sand thickness, number of tar sand beds, and thickest one to four tar sand beds.

Data Point*	Data Source	Well No.	Quarter Section	Section	Twp-S	Rng-E	Ground Elevation	Gross	Net Thick-	No. Beds	Thickest 1 to 4 tar sand beds (in feet)
							(feet above MSL)	ness (feet)	ness (feet)		
1	UGMS	PR-5	NESWNE	34	12	24	6420	91.5	18.5	6	4.5, 4
3	UGMS	PR-3D	SWSWNE	7	12	25	6512	13.5	8.5	2	7.5
4	UGMS	PR-3A	NWNESW	8	12	25	6302	30.0	69.0	1	30
5	UGMS	PR-3B	NENWSW	8	12	25	6361	29.5	29.5	1	29.5
6	UGMS	PR-3C	SWSWNW	8	12	25	6430	28.0	28.0	1	28
7	LETC	UTS-1	SWSWSE	29	13	21	6489	72.0	40.0	3	26, 11
8	UGMS	PR-6	SWSW	33	13	22	6710	24.0	15.0	2	11
9	Byrd	MS35	C	12	13	23	6196	24.0	16.0	3	7
10	Skyline	26-33	SE	26	13	23	6441	87.5	12.0	4	5
11	Byrd	MS31	NW	27	13	23	6280	234.0	108.0	6	37, 24, 21
12	UGMS	PR-2	SESESE	29	13	23	6346	74.5	17.5	5	6.5, 5
13	UGMS	PR-1	SWNESW	6	13	24	6210	89.0	33.5	5	13.5, 10
14	Byrd	MS36	NE	21	13	24	6600	304.0	49.0	7	29
15	Byrd	MS38	SE	4	13	25	7200	37.0	32.0	2	23
16	UGMS	PR-4	NESESW	5	13	25	7187	21.0	21.0	1	21
17	UGMS	HC-1	SENWNE	31	14	20	7261	187.5	81.0	11	14, 13
18	UGMS	HC-2	SENWSW	33	14	20	7483	153.0	67.5	6	22, 16.5
19	LETC	UTS-2	SESESW	26	14	21	7003	155.0	30.0	2	22
21	Skyline	14-34	SE	14	14	22	7003	162.5	43.0	8	14, 9.5
22	Skyline	24-24	NE	24	14	22	7130	89.0	34.5	8	10, 8.5
23	Skyline	25-32	SE	25	14	22	7162	158.0	37.5	11	15, 6, 5
24	Byrd	MS33	SE	34	14	22	7234	268.0	91.0	6	40, 21, 20
25	Byrd	MS34	NE	2	14	23	6520	231.0	42.0	6	14, 12
26	LETC	UTS-3	NWNWNE	14	14	23	6693	117.0	68.0	5	25, 18, 16
27	UGMS	PR-7	SWNWNE	14	14	23	6798	184.5	36.5	10	14, 6
28	Byrd	MS37	SE	25	14	23	7220	291.0	44.0	4	22, 15
29	UGMS	PRS-3	NESWSE	32	14	23	7387	194.5	55.5	10	19, 9
31	Byrd	MS32	SE	11	14	24	7200	0.0	0.0	0	0
32	Mono Power	PRS-82-19	SENENW	15	14	24	7232	56.6	10.8	2	6.2
33	UGMS	HC-3	NENENE	3	15	20	7409	152.0	73.0	7	27, 20, 10.5
36	LETC	UTS-4	SENWNE	21	15	21	7383	344.0	121.0	7	53, 33, 18
37	Byrd	MS24	NENE	22	15	21	7290	173.0	28.0	2	25
38	Byrd	MS30	SE	34	15	21	7200	286.0	12.0	2	10
39	Mono Power	PRS-82-12	NENWSE	20	15	22	7334	178.6	25.7	4	9.9, 8.8

Data Point*	Data		Quarter	Section	Twp-S	Rng-E	Ground	Gross	Net Thick-		Thickest 1 to 4 tar sand beds (in feet)
	Source	Well No.	Section				Elevation (feet above MSL)	Thick-ness (feet)	ness (feet)	No. Beds	
40	Mono Power	PRS-82-08	SWSENE	21	15	22	7841	149.0	64.2	7	25, 20.9, 9.5
41	Mono Power	PRS-82-05	NWNWSE	28	15	22	7481	203.7	55.4	11	16.3, 13
42	LETC	UTS-5	SWSE	29	15	22	7472	245.0	55.0	4	30
43	Byrd	MS03	SWNE	31	15	22	7485	83.0	7.0	2	5
44	Mono Power	MP-7	NENENE	32	15	22	7500	86.8	5.2	3	2
45	Mono Power	PRS-82-03	SENWSW	32	15	23	7513	250.0	65.0	3	25, 25, 15
46	Mono Power	PRS-82-04	SESESE	32	15	22	7524	226.4	39.3	5	16, 8.5
47	Mono Power	MP-9	C	34	15	22	7520	164.0	17.6	2	13.3
49	Mono Power	MP-8	NWSWSE	35	15	22	7600	90.5	30.4	6	17
51	Mono Power	PRS-82-16	SWNESE	2	15	23	7624	197.9	58.3	9	11.9, 8.7
52	Mono Power	PRS-83-01	NESWNW	2	15	23	7580	151.0	47.8	14	8.2, 7.8
53	Mono Power	PRS-83-02	SWSWNE	3	15	23	7560	140.3	38.9	12	11.7
54	Mono Power	SRI-4-A	NENENE	4	15	23	7450	47.5	35.5	2	21.4, 7.9
55	Mono Power	SRI-5	NESESE	5	15	23	7538	13.6	12.0	2	11.3
56	Mono Power	SRI-6A	SESENE	6	15	23	7450	4.2	4.2	2	2.1
57	Mono Power	SRI-8	NWSWSE	8	15	23	7600	20.4	6.2	3	3.6
58	Mono Power	PRS-83-03	SWSENW	10	15	23	7640	141.3	21.5	4	10.1, 8.2
59	Mono Power	PRS-82-15	SWNENW	11	15	23	7678	147.0	66.0	4	17, 15, 10
61	Mono Power	PRS-82-17	SWNWNW	12	15	23	7714	194.0	63.4	6	22.5, 16.1, 12.6
62	Mono Power	PRS-83-04	SWNENW	14	15	23	7820	182.3	43.3	8	14.9, 11.1
63	Mono Power	PRS-82-13	SWSENW	15	15	23	7729	232.5	67.8	11	20.5, 15.3, 9.7
64	UGMS	PRS-2	NESENW	16	15	23	7702	196.0	52.0	12	20, 6.5
65	Mono Power	PRS-82-09	SESENE	22	15	23	7901	210.0	135.0	4	45, 35, 35, 20
66	Mono Power	PRS-83-05	NENENW	22	15	23	7845	192.8	72.7	11	32.7, 10.2, 9.5
67	Mono Power	PRS-82-14	NENWNW	23	15	23	7938	194.6	94.7	4	30.2, 28.3, 22.2
68	Mono Power	PRS-82-10	SWNESE	25	15	23	8096	97.6	38.1	4	18.7, 10
69	Mobil Oil	RH-14	NG	26	15	23	8092	70.3	36.8	5	10.5, 9
70	Mobil Oil	RH-15	NG	26	15	23	8009	194.4	65.2	10	17, 11.5, 10
71	Mobil Oil	RH-16	NG	26	15	23	8216	266.0	51.1	5	20, 12.1, 11
72	Mobil Oil	RH-13	NG	27	15	23	7950	197.5	83.8	9	29.2, 20, 12.4, 11.5
73	UGMS	PRS-1	SENESE	27	15	23	8010	195.0	105.5	8	28, 24, 22, 10
74	Byrd	MS07	SESW	27	15	23	7900	268.0	121.0	4	53, 28, 25, 15
75	Byrd	MS11	SWSW	31	15	23	7780	224.0	65.0	6	23, 15, 12, 10
77	Byrd	MS27	SE	32	15	23	7740	251.0	13.0	2	11
78	Mono Power	PRS-82-11	NENWSW	19	15	24	7914	0.0	0.0	0	0
79	Mono Power	MP-6	NENENE	32	15.5	22	7560	351.7	45.1	14	9.3, 7.7
80	Byrd	MS26	SESE	35	15.5	22	7560	338.0	160.0	9	71, 24, 16, 10

Data Point*	Data Source	Well No.	Quarter Section	Section	Twp-S	Rng-E	Ground Elevation	Gross	Net Thick-	No. Beds	Thickest 1 to 4 tar
							(feet above MSL)	Thick-ness (feet)	ness (feet)		sand beds (in feet)
81	Mono Power	MP-5	SESWSE	36	15.5	22	7600	236.0	45.1	13	10.2, 6.9
82	LETC	UTS-6	NWSESW	33	15.5	24	8295	347.0	115.0	9	46, 16, 13, 10
83	Byrd	MS19	SWNW	12	16	21	7510	0.0	0.0	0	0
84	Byrd	MS20	NWSW	26	16	21	7800	0.0	0.0	0	0
85	Byrd	MS29	SW	12	16	22	7600	264.0	52.0	2	31, 21
86	Byrd	MS18	SENE	16	16	22	7320	0.0	0.0	0	0
87	LETC	UTS-7	NWSWNE	25	16	22	7905	0.0	0.0	0	0
88	Byrd	MS14	SENE	25	16	22	8736	200.0	6.0	2	4
89	Mobil Oil	RH-17	NG	8	16	23	7700	88.0	49.0	7	12, 12, 10
90	Byrd	MS12	SENW	13	16	23	8190	91.0	15.0	3	8
91	Byrd	MS10	NWSE	16	16	23	7880	26.0	26.0	1	26
92	Byrd	MS01	NW	20	16	23	7780	93.0	16.0	2	12
93	Byrd	MS13	NENE	27	16	23	8130	191.0	42.0	4	25
94	Byrd	MS04	SWNE	2	16	24	8280	216.0	46.0	3	21, 15, 10
95	Byrd	MS05	SWSE	4	16	24	8210	153.0	60.0	3	39, 18
96	Byrd	MS28	SENW	7	16	24	8160	40.0	40.0	1	40
97	Byrd	MS06	NENW	8	16	24	8130	183.0	43.0	2	28, 15
98	Byrd	MS25	C	2	17	21	8280	16.0	16.0	1	16
99	Byrd	MS22	NWNE	15	17	21	8350	13.0	13.0	1	13
100	Byrd	MS23	NWNW	14	17	21	8300	39.0	17.0	2	9, 8
101	Byrd	MS08	SE	2	17	22	8210	26.0	17.0	3	9
102	Byrd	MS09	SENE	2	17	22	8210	182.0	12.0	2	8
103	Byrd	MS15	NESW	3	17	22	8200	40.0	36.0	5	14, 10
104	Byrd	MS21	NWNW	6	17	22	8060	42.0	42.0	1	42
105	Byrd	MS16	NWNE	17	17	22	8360	8.0	8.0	1	8
106	Byrd	MS17	NWSW	29	17	22	8690	21.0	17.0	2	11
107	Whittier	1	NESE	16	16	23	7920	33.0	33.0	1	33
108	Whittier	2	NWSW	15	16	23	7920	26.0	26.0	1	26
109	Whittier	3	SENW	14	16	23	8220	171.0	63.0	2	43, 20
110	Whittier	4	SENW	13	16	23	8240	14.0	14.0	1	14
111	Whittier	5	NWNE	13	16	23	8200	107.0	107.0	1	107?
112	Whittier	6	SW	7	16	24	8130	120.0	80.0	3	60, 13
114	Whittier	8	NWNW	9	16	24	8240	100.0	53.0	3	35, 15
115	Whittier	9	NWSE	9	16	23	7800	203.0	80.0	3	58, 15
116	Whittier	10	SESW	31	15.5	24	7720	101.0	67.0	2	57, 10
117	Whittier	11	SWSE	27	15	23	7920	48.0	41.0	2	26, 15
118	Whittier	12	NESW	35	15	23	8000	121.0	121.0	1	121?

Data Point*	Data Source	Well No.	Quarter Section	Section	Twp-S	Rng-E	Ground Elevation	Gross	Net Thick-	No. Beds	Thickest 1 to 4 tar sand beds (in feet)
							(feet above MSL)	ness (feet)	ness (feet)		
119	Whittier	13	W1/2NE	31	15.5	24	8000	78.0	54.0	2	32, 22
120	Whittier	14	SWSW	36	15	23	8080	55.0	55.0	1	55
121	Mobil Oil	RH-18	NG	6	16	23	7600	84.3	40.5	4	21.6, 10.9
122	Enercor	83-5	NG	8	14	23	6820	116.0	37.0	9	12, 10
123	Enercor	84-1A	SW	18	14	21	7150	87.5	45.5	8	28
124	Enercor	84-2A	SW	19	14	23	7120	82.0	39.0	3	19, 16
126	Enercor	84-12	NWSW	24	14	22	7221	75.0	33.0	2	31
127	Enercor	84-2	SESE	30	14	23	7260	89.0	41.0	2	34
129	Enercor	84-9A	SW	24	14	22	7135	88.0	49.0	3	34, 14, 10
130	Enercor	84-10A	SE	24	14	22	7152	118.0	51.0	6	15, 13
131	Enercor	84-11A	SE	25	14	22	7170	85.0	55.0	4	40, 10
132	Enercor	84-12A	SW	24	14	22	7221	86.0	43.0	4	26, 14
134	Enercor	84-3A	SW	24	14	22	7126	74.0	36.5	3	21, 21.5
135	Enercor	84-4A	NW	19	14	23	7051	30.0	23.0	4	10
136	Enercor	84-5A	SE	18	14	23	6961	9.0	9.0	1	9

*Missing measured section or core numbers (2, 20, 30, 34, 35, 48, 50, 60, 76, 125, 128, 133) are intentional.

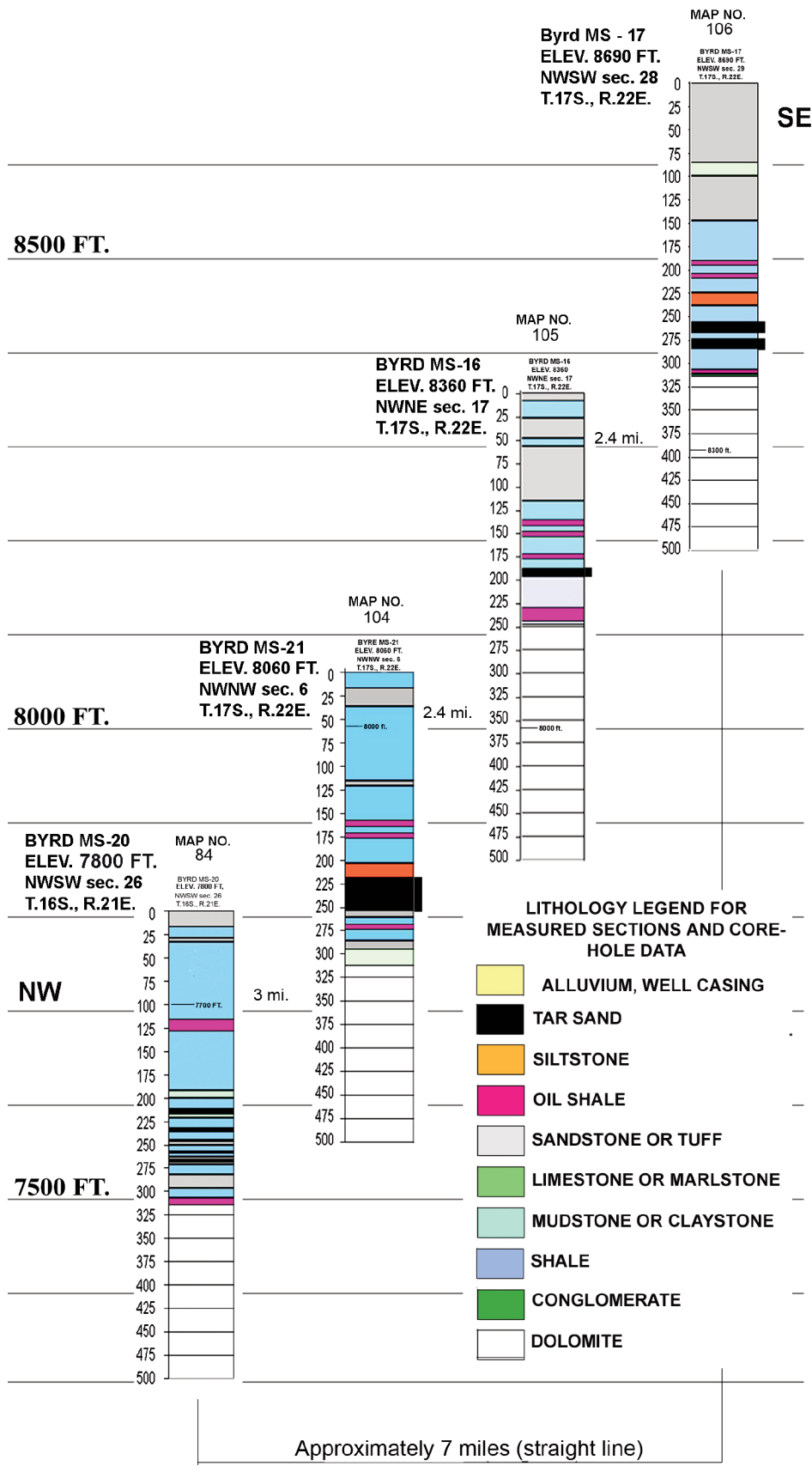


Figure 6. Four lithologic sections from the southern end of the P.R. Spring tar sand area showing the lateral variability in the tar sand and other lithologic units (data point locations are plotted on figure 2).

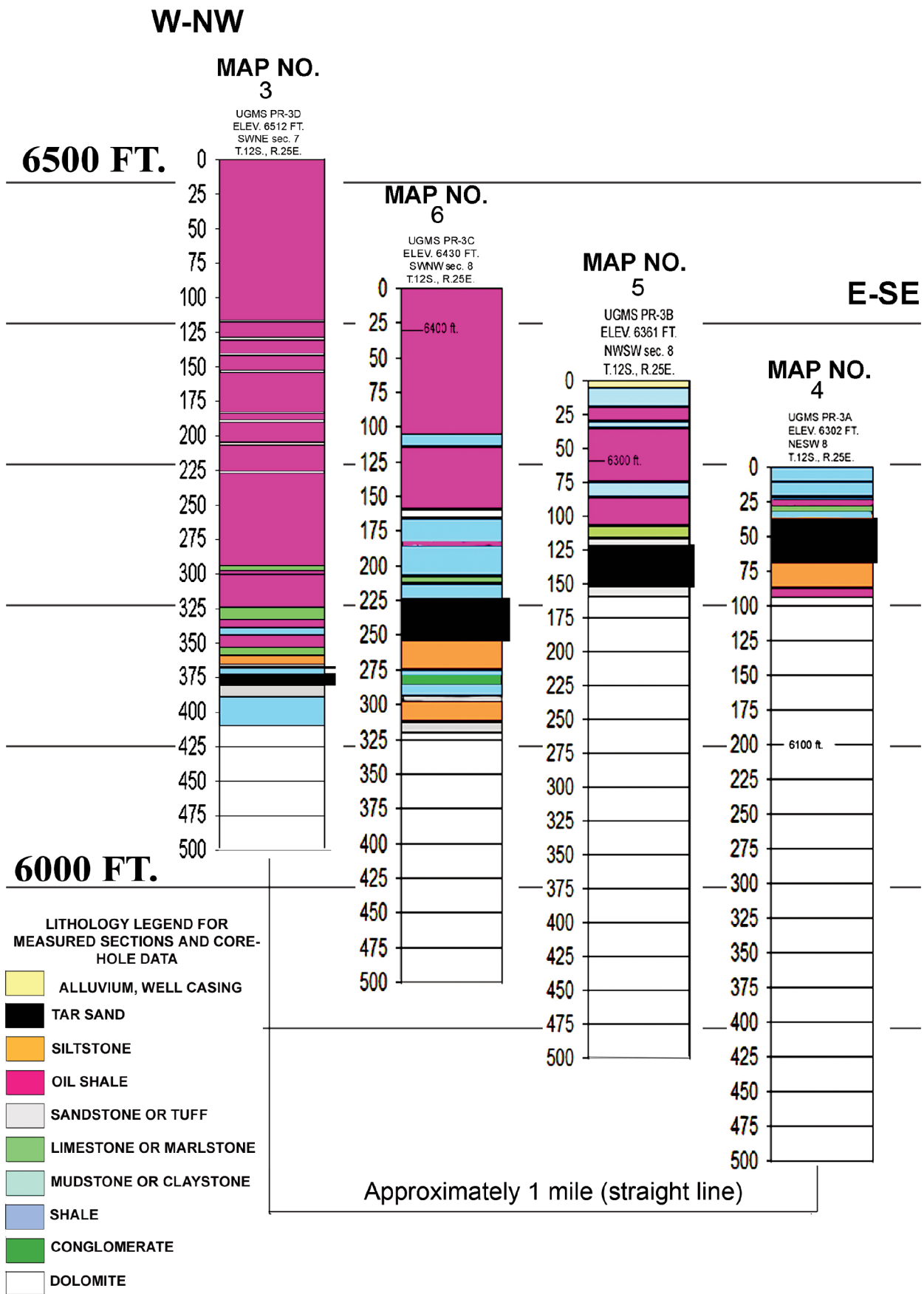


Figure 7. Four lithologic sections from the northern end of the P.R. Spring tar sand area showing the lateral variability in the tar sand and other lithologic units (data point locations are plotted on figure 2).

Table 4 - Averaged Skyline core hole tar sand physical properties - from Gwynn (1971).

Data Point	Site Name	Depth interval (feet from surface)	Permeability (millidarcies)	Porosity (percent)	Residual Saturation % Pore for Oil	Residual Saturation % Pore for total water	Estimated oil saturation (gallons per ton)
10	Skyline 26-33	91.5-092.5	295.00	27.90	67.40	7.90	19.30
10	Skyline 26-33	119-120	257.00	21.00	26.70	10.50	21.60
10	Skyline 26-33	120.5-123	2406.33	23.07	58.33	8.70	16.53
10	Skyline 26-33	124-125	246.00	23.80	43.30	13.40	11.60
10	Skyline 26-33	131-135	83.00	25.13	45.48	10.43	13.53
10	Skyline 26-33	158-159	790.00	21.40	36.50	11.70	8.80
21	Skyline 14-34	82-083	1581.00	31.50	58.70	10.20	21.10
21	Skyline 14-34	96-097	319.00	26.60	77.50	8.30	23.00
21	Skyline 14-34	133-134	330.00	25.80	43.70	12.40	6.00
21	Skyline 14-34	135-136	1778.00	29.40	37.10	10.90	12.40
21	Skyline 14-34	223-224	2470.00	28.80	60.00	7.60	19.70
21	Skyline 14-34	226-227	4940.00	28.70	43.50	11.20	14.30
22	Skyline 24-24	118-128	590.00	27.96	49.70	10.09	16.21
22	Skyline 24-24	129-130	440.00	23.60	71.20	6.40	19.30
22	Skyline 24-24	62-64	656.50	25.50	72.10	7.30	20.95
22	Skyline 24-24	83-86	6321.33	27.80	67.73	5.43	20.90
23	Skyline 25-32	101-102	151.00	25.70	40.10	12.70	11.50
23	Skyline 25-32	134-135	257.00	23.80	29.80	13.40	7.80
23	Skyline 25-32	138-139	116.00	26.50	54.80	8.30	16.50
23	Skyline 25-32	185-197	2873.73	26.85	27.53	13.91	8.20
23	Skyline 25-32	198-199	4940.00	27.10	18.80	15.80	5.60
23	Skyline 25-32	200-201	1037.00	25.50	16.50	12.60	4.50

Table 5 - Averaged tar sand physical properties from Utah Geological and Mineralogical Survey studies - from Peterson and Ritzma (1974).

Data Point	Well No.	Depth Interval (feet)	Permeability	Permeability	Porosity (%)	Pore	Pore	Oil - (Gal./Ton)	Oil	Oil
			Before Extraction (millidarcies)	After Extraction (millidarcies)		Saturation Oil (%)	Saturation Water (%)		(Volume %)	(Weight %)
17	HC-1	041-047	12.3	371.0	24.2	53.2	14.5	13.2	12.5	5.3
17	HC-1	068-073	6.0	238.4	25.9	61.9	10.5	17.2	16.1	6.9
17	HC-1	086-087	2.0	12.0	25.0	25.7	17.8	7.0	6.4	2.8
17	HC-1	094-094	36.3	195.3	22.1	34.4	9.2	8.4	7.7	3.4
17	HC-1	096-099	94.2	216.0	21.3	35.4	10.1	8.3	7.6	3.3
17	HC-1	108-108	70.0	278.0	20.4	44.6	8.8	9.8	9.3	3.9
17	HC-1	113-120	53.7	400.0	21.5	41.7	9.0	10.1	9.0	4.1
17	HC-1	123-127	101.2	909.4	22.3	41.7	7.2	10.5	9.4	4.2
17	HC-1	130-131	2.6	323.5	23.0	39.2	16.9	10.1	9.1	4.1
17	HC-1	134-138	9.9	164.2	22.8	28.1	15.8	7.0	6.5	2.8
17	HC-1	189-190	12.1	54.0	12.4	62.3	6.7	8.2	7.8	3.3
17	HC-1	195-200	37.2	303.7	20.1	52.3	3.2	11.5	10.4	4.7
17	HC-1	202-205	37.5	83.0	21.0	43.5	4.4	10.8	9.8	4.3
17	HC-1	214-216	0.1	42.0	19.4	60.7	5.6	13.4	12.5	5.4
17	HC-1	223-225	31.3	92.7	14.2	48.5	9.1	7.2	6.8	2.9
17	HC-1	227-228	102.5	253.5	20.6	28.1	6.1	6.7	5.8	2.7
18	HC-2	326-331	54.0	516.9	21.2	54.6	15.8	12.5	11.3	5.0
18	HC-2	333-337	41.8	265.8	24.3	42.9	13.0	11.0	10.3	4.5
18	HC-2	340-340	145.0	673.0	23.6	44.1	3.8	11.5	10.4	4.6
18	HC-2	343-343	116.0	533.0	23.5	39.1	3.8	10.3	9.1	4.0
18	HC-2	364-366	238.3	378.0	27.6	20.2	25.2	6.2	5.6	2.5
18	HC-2	369-370	207.1	329.2	24.4	23.3	19.4	6.5	5.7	2.4
18	HC-2	375-376	58.0	144.0	19.6	15.2	50.4	1.9	1.8	0.8
18	HC-2	428-428	84.0	168.0	23.8	23.5	2.5	6.5	5.6	2.6
18	HC-2	432-433	136.0	175.5	21.3	20.5	10.4	4.9	4.4	2.0
18	HC-2	448-449	108.5	137.5	18.6	21.0	10.0	4.3	4.0	1.7
18	HC-2	456-457	185.0	227.5	20.4	20.5	1.5	4.8	4.2	1.9
33	HC-3	306-314	16.6	236.4	21.4	55.2	15.9	13.0	12.1	5.2
33	HC-3	317-318	43.5	194.0	23.0	32.8	33.8	8.2	7.6	3.3
33	HC-3	320-326	118.1	183.4	22.8	24.0	42.3	5.8	5.4	2.3

Data Point	Well No.	Depth Interval (feet)	Permeability Before Extraction (millidarcies)	Permeability After Extraction (millidarcies)	Porosity (%)	Pore Saturation Oil (%)	Pore Saturation Water (%)	Oil - (Gal./Ton)	Oil (Volume %)	Oil (Weight %)
33	HC-3	404-404	111.0	119.0	25.5	16.8	16.8	4.9	4.4	2.0
33	HC-3	406-406	110.0	139.0	26.7	10.8	13.8	3.4	3.0	1.4
33	HC-3	414-415	153.5	158.0	25.6	7.8	20.6	2.3	2.1	0.9
33	HC-3	417-426	847.7	901.6	25.2	7.2	33.2	2.1	1.9	0.8
33	HC-3	433-433	113.0	130.0	21.2	11.8	35.3	2.7	2.6	1.1
33	HC-3	455-458	67.0	86.2	24.4	10.6	34.2	2.9	2.6	1.1
13	PR-1	175-197	41.5	343.5	23.4	63.7	4.6	16.3	14.8	6.6
13	PR-1	240-246	18.0	492.4	26.3	53.7	2.7	16.1	14.0	6.5
13	PR-1	250-262	68.2	524.8	26.1	39.7	4.4	12.1	10.6	4.8
12	PR-2	021-021	4.5	113.0	23.8	71.5	3.8	17.8	16.8	7.2
12	PR-2	045-046	7.7	180.5	18.0	69.2	1.7	13.0	12.0	5.3
12	PR-2	051-054	26.1	148.5	21.9	45.8	4.2	10.6	9.6	4.9
12	PR-2	060-060	10.0	64.0	14.4	26.1	2.1	5.4	5.1	1.8
12	PR-2	062-063	23.5	237.0	19.2	66.1	1.8	13.3	12.5	5.4
12	PR-2	066-067	2.2	132.0	16.6	48.2	2.8	8.5	8.0	3.4
12	PR-2	090-091	7.3	247.5	25.8	54.3	8.4	15.3	14.0	6.1
4	PR-3A	039-064	46	1618	29.2	57.5	13.1	19.7	16.9	7.9
5	PR-3B	119-147	9.8	1589	28.2	62.4	13.8	21.1	18.2	8.5
6	PR-3C	222-248	1	1830	25.4	82.3	3.1	24.3	22.5	9.7
3	PR-3D	376-383	316	2148	30.8	33.1	36.7	12.0	10.2	4.9
16	PR-4	058-077	18	613	26.8	60.2	7.6	18.4	16.2	7.4
1	PR-5	153-153	9	142	24.2	58.3	5.8	14.8	13.9	5.9
1	PR-5	159-160	1	232	26.0	57.9	5.9	16.8	15.0	6.8
1	PR-5	168-170	14	449	26.7	53.7	6.4	16.5	14.4	6.6
1	PR-5	218-220	11	399	26.7	60.1	8.9	17.9	16.2	7.2
1	PR-5	225-227	9	564	27.3	68.4	4.5	20.5	18.9	8.3
1	PR-5	239-239	8.9	625.0	19.3	38.9	5.7	10.2	7.6	4.1
8	PR-6	162-163	0.4	22.5	27.9	65.8	4.7	19.6	18.0	7.8
8	PR-6	169-173	47.7	376.6	21.0	55.6	21.7	12.5	11.5	5.0
8	PR-6	176-185	52.8	400.8	25.5	58.9	11.0	16.5	14.9	6.6
8	PR-6	192-193	6.1	126.0	29.5	55.2	7.1	18.6	16.2	7.4
8	PR-6	196-197	2.3	323.0	19.8	54.2	3.9	11.6	10.9	4.6
8	PR-6	235-253	54.2	192.4	26.4	41.8	18.0	12.1	11.0	4.9

Data Point	Well No.	Depth Interval (feet)	Permeability Before Extraction (millidarcies)	Permeability After Extraction (millidarcies)	Porosity (%)	Pore Saturation Oil (%)	Pore Saturation Water (%)	Oil - (Gal./Ton)	Oil (Volume %)	Oil (Weight %)
8	PR-6	277-278	25.9	99.0	25.1	32.8	10.0	9.5	8.3	3.8
8	PR-6	329-331	18.5	80.0	26.9	17.1	53.4	5.0	4.7	2.0
8	PR-6	338-339	3.4	8.9	22.3	16.3	58.1	3.9	3.7	1.5
8	PR-6	341-343	104.3	274.3	22.2	22.7	22.3	5.4	5.0	2.2
8	PR-6	350-351	2.2	3.1	27.4	6.9	36.4	2.2	1.9	0.9
8	PR-6	356-358	27.1	49.8	20.8	53.9	12.3	11.2	11.0	4.5
8	PR-6	374-374	440.0	574.0	25.8	17.4	4.7	5.4	4.6	2.2
8	PR-6	376-378	163.7	210.3	24.2	16.4	16.1	4.5	4.0	1.8
8	PR-6	384-389	156.2	298.2	23.9	14.3	16.0	4.1	3.6	1.7
27	PR-7	021-021	3.0	20.0	23.3	42.9	7.3	11.0	10.0	4.4
27	PR-7	027-041	12.8	1870.7	28.4	61.8	13.3	20.5	17.6	8.1
27	PR-7	082-083	28.5	119.5	23.2	39.8	22.1	10.1	9.2	4.0
27	PR-7	118-119	6.2	274.0	20.9	60.3	12.2	13.2	12.4	5.3
27	PR-7	184-184	22.0	1200.0	20.6	43.1	15.0	9.6	8.9	3.8
27	PR-7	260-261	8.5	627.5	20.9	52.7	7.4	12.5	11.1	5.0
73	PRS-1	027-031	72.6	103.2	22.1	43.9	5.9	10.0	9.3	4.1
73	PRS-1	035-039	107.7	152.6	26.5	26.0	24.2	7.4	6.8	3.0
73	PRS-1	042-043	10.5	16.9	24.5	56.1	14.1	14.6	13.8	5.9
73	PRS-1	045-045	1.8	226.0	26.4	51.2	6.4	14.9	13.5	6.0
73	PRS-1	047-049	0.5	120.2	21.4	49.9	22.1	13.2	10.7	4.8
73	PRS-1	065-065	134.0	188.0	24.1	29.4	44.5	7.7	7.1	3.1
73	PRS-1	068-069	5.3	10.1	30.4	14.0	38.1	4.8	4.3	1.9
73	PRS-1	074-080	12.9	37.5	28.0	34.9	19.2	10.7	9.6	4.3
73	PRS-1	092-094	21.7	46.2	24.1	27.5	14.2	7.0	6.4	2.8
73	PRS-1	097-117	312.5	726.1	27.5	42.9	8.8	13.2	11.5	5.3
73	PRS-1	159-173	426.5	2074.2	31.8	45.5	11.4	16.4	14.0	6.6
73	PRS-1	174-174	0.0	3.1	29.8	91.1	1.3	31.1	27.1	12.6
73	PRS-1	176-181	2950.5	4971.0	25.8	38.9	24.9	10.4	9.4	4.2
73	PRS-1	199-222	748.9	3300.3	31.0	34.9	14.0	12.6	10.6	5.1
64	PRS-2	062-064	207.2	338.7	30.1	34.5	7.6	11.9	10.1	4.8
64	PRS-2	066-069	366.9	1348.3	33.0	41.1	21.6	16.8	13.0	6.8
64	PRS-2	075-081	60.5	311.2	27.2	48.8	12.4	15.1	13.0	6.2
64	PRS-2	122-123	0.7	807.0	26.6	74.0	5.3	21.9	19.7	8.8

Data Point	Well No.	Depth Interval (feet)	Permeability	Permeability	Porosity (%)	Pore	Pore	Oil - (Gal./Ton)	Oil	Oil
			Before Extraction (millidarcies)	After Extraction (millidarcies)		Saturation Oil (%)	Saturation Water (%)		(Volume %)	(Weight %)
64	PRS-2	126-127	390.0	400.0	23.0	15.9	22.6	4.1	3.7	1.7
64	PRS-2	131-132	57.9	176.5	16.3	39.8	11.0	6.7	6.5	2.7
64	PRS-2	136-137	13.9	157.5	31.4	43.1	30.3	14.6	12.9	5.9
64	PRS-2	172-179	5.3	82.9	19.6	37.8	16.0	7.5	7.1	3.0
64	PRS-2	192-216	1067.5	2122.5	31.2	29.1	25.9	10.4	8.9	4.2
64	PRS-2	252-253	738.5	1094.0	24.8	16.4	26.5	4.4	4.0	1.8
29	PRS-3	022-040	307.3	1401.6	29.4	43.2	23.6	14.7	12.8	5.9
29	PRS-3	041-041	0.3	194.0	26.8	74.8	7.8	22.6	20.0	9.0
29	PRS-3	043-043	0.1	5.5	19.4	76.3	19.0	15.4	14.9	6.2
29	PRS-3	046-047	1.2	47.5	19.5	48.2	18.3	9.6	9.3	3.8
29	PRS-3	063-063	1.6	5.2	26.5	35.4	20.7	10.6	9.4	4.2
29	PRS-3	085-092	226.6	865.1	30.1	46.1	23.8	15.5	13.6	6.2
29	PRS-3	097-097	1.1	47.0	28.4	33.8	22.9	10.6	9.6	4.3
29	PRS-3	113-113	0.0	0.2	25.7	19.4	28.0	5.5	5.0	2.2
29	PRS-3	117-118	0.7	358.0	25.7	42.6	20.2	12.5	11.1	5.0
29	PRS-3	129-131	1.1	203.7	22.1	47.2	12.9	11.3	10.4	4.6
29	PRS-3	153-155	124.9	999.3	28.3	37.1	13.9	11.8	10.4	4.9

Table 6 - Averaged tar sand physical properties from Western Research Institute - from Sinks (1985).

Data Point	Data Source (LETC Site Name)	Depth Interval (feet)	Permeability before extraction (Millidarcies)	Permeability after extraction (Millidarcies)	Porosity before Extraction (%)	Porosity after Extraction (%)	Residual Saturation of oil (%) pore)	Residual Saturation Oil (%) weight)	Estimated		Grain Density (g/cc)	Saturation Density (g/cc)	Extracted Density (g/cc)
									Residual Saturation oil (gallons per ton)	Residual Saturation total water (% pore)			
7	UTS-1	239-245	0.09	1.60	5.64	10.68	23.86	1.31	3.37	21.37	2.62	2.38	2.34
7	UTS-1	252-253	0.05	0.29	7.20	10.40	8.65	0.35	0.90	22.10	2.67	2.42	2.40
7	UTS-1	256-262	0.01	39.27	3.59	16.76	45.84	3.87	10.64	30.87	2.68	2.36	2.24
7	UTS-1	293-294	41.50	123.00	10.55	24.05	35.55	3.90	9.60	20.30	2.72	2.19	2.06
7	UTS-1	299-318	32.36	70.55	11.02	19.19	22.52	2.26	5.32	20.18	2.71	2.26	2.19
7	UTS-1	320-323	49.25	82.50	12.53	20.03	19.58	1.88	4.25	20.60	2.67	2.20	2.14
19	UTS-2	223-224	0.02	2.48	6.25	11.40	15.55	1.10	2.85	22.60	2.58	2.34	2.28
19	UTS-2	230-231	1.34	6.90	9.50	12.90	6.50	0.30	0.65	24.40	2.68	2.38	2.34
19	UTS-2	241-244	0.30	165.16	11.63	18.83	13.55	1.50	3.55	22.18	2.69	2.26	2.19
19	UTS-2	93-101	0.65	39.60	12.94	20.08	18.70	1.76	4.12	16.16	2.68	2.25	2.14
19	UTS-3	18-21	24.02	36.04	8.98	22.03	35.60	4.05	9.55	20.78	2.64	2.16	2.06
26	UTS-3	114-124	42.73	84.25	13.97	18.65	9.15	0.93	2.13	15.19	2.66	2.21	2.16
26	UTS-3	126-129	97.61	147.41	18.45	23.88	6.80	0.80	1.28	11.28	2.66	2.07	2.02
26	UTS-3	135-137	22.00	38.50	15.95	20.50	20.70	2.45	3.95	15.45	2.75	2.14	2.05
26	UTS-3	24-40	23.62	570.66	7.74	23.44	49.35	6.02	14.44	14.74	2.63	2.16	2.02
26	UTS-3	49-52	1.53	8.50	6.88	19.33	39.05	3.33	8.60	25.10	2.75	2.33	2.22
26	UTS-3	77-87	2.23	84.06	8.50	15.06	20.75	1.80	4.44	17.90	2.66	2.32	2.26
36	UTS-4	141-145	90.12	153.26	12.84	17.94	19.12	1.60	3.94	8.84	2.68	2.27	2.21
36	UTS-4	149-191	268.64	426.07	17.48	20.81	5.80	0.82	1.35	10.47	2.76	2.12	2.06
36	UTS-4	199-202	476.75	1107.50	17.20	21.58	7.60	0.98	2.05	14.70	2.65	2.07	2.08
36	UTS-4	251-255	36.96	47.02	15.72	18.52	2.34	0.30	0.42	13.72	2.68	2.21	2.18
36	UTS-4	265-267	138.67	150.02	18.67	20.40	1.60	0.20	0.30	7.83	2.70	2.17	2.15
36	UTS-4	290-292	4.73	11.84	13.13	18.07	11.37	0.87	1.90	18.27	2.70	2.26	2.21
36	UTS-4	298-299	320.50	290.50	15.35	20.85	14.45	1.45	3.20	11.95	2.66	2.17	2.10
36	UTS-4	304-312	81.03	213.01	15.23	19.03	10.12	0.88	1.89	12.06	2.68	2.20	2.16
36	UTS-4	356-362	22.17	24.15	13.94	16.26	2.73	0.29	0.50	12.37	2.63	2.22	2.20
36	UTS-4	376-381	94.38	94.38	18.70	20.77	0.82	0.12	0.12	7.52	2.64	2.11	2.09

Data Point	Data Source (LETC Site Name)	Depth Interval (feet)	Permeability before extraction (Millidarcies)	Permeability after extraction (Millidarcies)	Porosity before Extraction (%)	Porosity after Extraction (%)	Residual Saturation of oil (% pore)	Residual Saturation Oil (% weight)	Estimated		Grain Density (g/cc)	Saturation Density (g/cc)	Extracted Density (g/cc)
									Residual Saturation oil (gallons per ton)	Residual Saturation total water (% pore)			
36	UTS-4	45-70	337.22	446.46	18.15	21.96	6.55	0.78	1.75	10.64	2.63	2.10	2.06
42	UTS-5	16-22	0.01	44.48	6.09	17.19	40.69	3.73	9.53	16.50	2.67	2.31	2.21
42	UTS-5	210-216	108.50	15.96	19.22	15.72	1.82	1.66	10.67	2.59	2.25	2.19	
42	UTS-5	224-253	17.25	1821.80	11.03	25.33	45.75	5.79	13.80	8.57	2.66	2.13	1.99
42	UTS-5	29-31	25.67	40.67	14.60	17.97	7.37	0.73	1.60	10.17	2.68	2.23	2.20
42	UTS-5	37-40	0.04	0.39	11.70	13.50	1.70	0.10	0.20	11.95	2.66	2.32	2.30
42	UTS-5	74-83	213.04	560.70	18.72	25.04	14.82	1.72	3.89	10.83	2.67	2.07	2.01
82	UTS-6	131-145	127.47	207.60	11.91	23.82	41.15	4.65	10.97	10.61	2.66	2.15	2.03
82	UTS-6	175-177	125.97	330.07	14.43	25.63	30.93	3.83	9.40	13.83	2.61	2.07	1.94
82	UTS-6	184-186	3385.83	4616.67	11.43	31.10	53.83	8.30	19.10	9.23	2.60	2.00	1.79
82	UTS-6	240-248	14.69	56.27	10.64	18.56	25.79	4.02	6.06	15.17	2.66	2.26	2.17
82	UTS-6	24-26	6.65	8.35	11.77	16.33	8.17	0.84	1.70	19.73	2.65	2.26	2.21
82	UTS-6	252-263	46.77	166.48	15.98	23.35	18.97	11.85	5.73	10.42	2.65	2.13	2.03
82	UTS-6	272-279	241.75	461.35	11.80	23.00	35.89	4.08	9.69	13.25	2.66	2.16	2.05
82	UTS-6	287-295	366.90	995.68	15.00	26.52	25.78	3.73	8.52	12.77	2.64	2.05	1.83
82	UTS-6	302-306	51.94	124.28	8.90	20.96	38.10	4.04	9.74	18.22	2.65	2.21	2.10
82	UTS-6	314-315	0.02	0.04	8.05	10.75	1.30	0.15	0.10	17.25	2.67	2.40	2.38
82	UTS-6	318-323	20.80	40.99	12.30	19.48	19.63	2.10	4.98	14.72	2.66	2.22	2.26
82	UTS-6	325-331	10.75	46.57	11.93	22.26	34.30	3.46	9.13	12.19	2.66	2.18	2.06
82	UTS-6	37-48	653.05	1449.67	16.30	28.56	34.01	5.10	11.68	6.94	2.67	2.04	1.91
82	UTS-6	88-97	442.75	2728.25	12.56	26.00	39.47	5.61	12.98	8.37	2.64	2.10	1.95

These data are average values for a given tar sand interval or bed.

Table 7 - Averaged tar sand physical properties from Mono Power (MP and SR series) drill holes - from data in UGS files (no date).

Data Point	Data source	Depth Interval (feet)	% Water	Toluene	
				Extractable As Received (%)	Extractable on a Dry Basis (%)
44	MP-7	105.2-107.3	0.49	0.83	0.83
44	MP-7	20-22	0.18	4.25	4.27
44	MP-7	30.4-31.4	0.22	5.59	5.60
47	MP-9	100.08-101.08	0.07	0.30	0.30
47	MP-9	236.08-249.08	0.21	3.03	3.03
47	MP-9	72.92-73.83	0.21	1.50	1.50
47	MP-9	75.17-83.42	0.27	2.24	2.25
47	MP-9	87.83-95.17	0.21	0.38	0.38
49	MP-8A	100-101.3	0.04	4.51	4.51
49	MP-8A	112.6-145.4	0.23	6.52	6.54
49	MP-8A	145.5-145.8	0.20	4.72	4.73
49	MP-8A	69.6-75.1	0.21	5.99	5.99
49	MP-8A	75.8-76.5	0.17	11.89	11.91
49	MP-8A	80.4-98	0.17	6.34	6.35
54	SR-1-4	36.5-46	0.18	5.24	4.80
55	SR-1-5	67-67.7	0.16	3.26	3.27
55	SR-1-5	69.3-80.5	0.13	8.37	8.38
56	SR-1-6-A	69.5-74.7	0.26	2.38	2.39
56	SR-1-6-A	74.8-76.9	0.16	4.28	4.29
57	SR-1-8-A	79.3-81.4	0.20	3.67	3.68
57	SR-1-8-A	84.3-93.5	0.28	2.23	2.24
79	MP-6	40.5-45.6	0.29	4.47	4.48
79	MP-6	111.4-128.6	0.31	2.66	2.66
79	MP-6	265.7-271.2	0.25	3.30	3.31
79	MP-6	368.2-369.4	0.20	4.54	4.55
79	MP-6	370.1-377.8	0.20	5.81	5.82
79	MP-6	378.2-390.9	0.22	2.00	2.01
81	MP-5	72-93.5	0.21	2.38	2.38

Table 8 - Averaged tar sand physical properties from Mono Power (PRS-82-xx series) drill holes - from data in UGS Files (no date).

Data Point	Data source	Depth Interval (feet)	Bitumen (Weight %)	Bitumen (volume %)	Bitumen (gallons per ton)	Matrix (Weight %)	Water (Weight %)	Water (gallons per ton)
39	PRS-82-12	150.7-152.9	4.43	9.45	10.49	95.46	0.11	0.25
39	PRS-82-12	176.4-177.1	6.17	13.08	14.53	93.69	0.14	0.30
39	PRS-82-12	177.5-177.9	11.90	24.87	27.63	87.99	0.11	0.30
39	PRS-82-12	180.5-185.1	10.41	21.83	24.24	89.42	0.17	0.43
40	PRS-82-08	145-149.5	2.91	6.25	6.73	95.34	1.76	4.20
40	PRS-82-08	162.5-164.5	6.36	13.82	14.975	92.58	1.06	2.55
40	PRS-82-08	192.3-198.2	8.56	18.14	20.16	90.77	0.67	1.60
40	PRS-82-08	201-214	7.98	16.86	18.73	91.43	0.59	1.42
40	PRS-82-08	215-217.6	3.83	8.22	9.13	94.24	1.94	4.65
40	PRS-82-08	220.7-223.4	5.79	12.32	13.68	92.86	1.36	3.30
40	PRS-82-08	66.2-68.2	4.56	9.72	10.80	94.84	0.61	1.45
40	PRS-82-08	70.3-72.4	4.87	10.39	11.55	95.05	0.09	0.25
40	PRS-82-08	82-84	2.52	5.41	6.01	95.08	2.41	5.80
40	PRS-82-08	85.6-87.6	2.98	6.39	7.10	93.49	3.54	8.50
46	PRS-82-04	100.1-103.3	1.40	3.00	3.33	96.10	2.50	6.00
46	PRS-82-04	110.2-113.9	2.53	5.43	6.03	96.40	1.07	2.57
46	PRS-82-04	231.5-234	4.31	9.26	10.28	95.06	0.64	1.55
46	PRS-82-04	234.8-246	3.79	8.15	9.05	95.52	0.69	1.70
46	PRS-82-04	83.1-84.6	3.65	7.85	8.72	94.65	1.7	4.1
46	PRS-82-04	85.3-99.1	1.94	4.17	4.63	96.84	1.22	2.93
51	PRS-82-16	142-144	5.12	10.92	12.12	93.52	1.36	3.25
51	PRS-82-16	44.8-50	1.53	3.29	3.65	95.78	2.69	6.46
61	PRS-82-17	136.6-143	5.32	11.31	12.56	92.35	2.33	5.58
61	PRS-82-17	144.2-146	4.02	8.64	9.59	90.92	5.06	12.10
61	PRS-82-17	146.4-152.7	2.73	5.87	6.52	92.79	4.48	10.76
61	PRS-82-17	41.8-44.5	1.38	2.96	3.28	98.36	0.27	0.60
61	PRS-82-17	72.8-75.2	5.54	11.75	13.04	94.32	0.15	0.35
63	PRS-82-13	137.3-139.2	3.04	6.52	7.25	96.09	0.88	2.10
63	PRS-82-13	145.4-158.6	8.14	17.21	19.11	90.60	1.26	3.04
63	PRS-82-13	161-165.8	6.86	14.55	16.16	92.23	0.65	1.55
63	PRS-82-13	167.2-171.7	4.71	10.13	11.25	92.46	2.82	6.77
63	PRS-82-13	174.3-177.8	2.91	6.24	6.94	96.91	0.19	0.45
63	PRS-82-13	20-24.8	3.63	7.76	8.62	92.13	4.24	10.18
67	PRS-82-14	101.4-107	1.86	3.99	4.43	96.47	1.67	4.02
67	PRS-82-14	120-130.4	6.72	14.20	15.78	92.72	0.57	1.37
67	PRS-82-14	183.6-189	6.91	14.65	16.28	90.58	2.50	6.02
67	PRS-82-14	189.3-194.8	8.01	16.98	18.88	88.78	3.21	7.70
67	PRS-82-14	195.1-200.5	6.26	13.30	14.78	90.86	2.87	6.88
67	PRS-82-14	201-202.3	5.76	12.21	13.56	91.14	3.10	7.40
67	PRS-82-14	202.8-218.6	4.27	9.10	10.11	93.64	2.09	5.02

Data Point	Data source	Depth Interval (feet)	Bitumen (Weight %)	Bitumen (volume %)	Bitumen (gallons per ton)	Matrix (Weight %)	Water (Weight %)	Water (gallons per ton)
67	PRS-82-14	229.7-252	4.10	8.82	9.79	93.68	2.26	5.44
67	PRS-82-14	50.2-56	2.59	5.58	6.19	96.23	1.18	2.85
67	PRS-82-14	59.8-63.4	5.70	12.16	13.51	94.23	0.08	0.20
67	PRS-82-14	67.7-70.1	4.59	9.80	10.88	93.60	1.82	4.40
67	PRS-82-14	72.8-77.4	5.26	11.22	12.46	91.35	3.39	8.15
67	PRS-82-14	78.1-80.6	12.54	26.21	29.12	87.41	0.05	0.10
67	PRS-82-14	81.6-84.1	12.05	25.17	27.96	87.93	0.03	0.10
68	PRS-82-10	20-33	11.77	24.62	27.22	87.29	0.86	2.08
68	PRS-82-10	64.2-69.2	8.11	16.17	6265.77	90.68	1.21	2.90

Table 9 - Grain size data of 50 samples from throughout the P.R. Spring tar sand area - from Wiley (1967)

Sample Number*	phi 0 = 1 mm	phi 1 = 0.5 mm	phi 2 = 0.25 mm	phi 3 = 0.125 mm	phi 4 = 0.0625 mm	phi >4 = <.0625 mm
1	0.00	2.97	40.94	44.92	7.44	3.70
2	0.00	0.00	28.40	34.13	9.94	27.64
3	0.00	0.00	0.00	6.45	34.40	59.09
4	0.00	0.00	0.00	10.40	62.34	27.48
5	0.00	0.00	5.44	55.46	23.19	16.11
6	0.00	0.00	0.71	50.93	35.95	12.39
7	0.00	0.00	4.62	53.73	29.66	11.97
8	0.00	5.24	76.63	10.25	2.15	5.71
9	0.00	3.82	73.55	13.98	4.04	4.59
10	0.00	0.00	9.52	74.03	12.53	3.87
11	0.00	0.00	9.35	18.32	13.89	58.42
12	0.00	0.00	30.61	55.88	6.08	7.43
13	0.00	0.00	47.91	26.29	9.35	16.43
14	0.00	0.00	6.45	63.40	19.71	10.30
15	0.00	0.00	0.75	42.54	44.68	12.01
16	0.00	0.00	4.92	62.24	19.69	13.09
17	0.00	0.00	39.19	51.45	5.23	4.11
18	0.00	0.00	20.27	50.80	13.96	14.94
19	0.00	0.00	7.43	58.95	18.91	14.69
20	0.00	0.00	0.00	77.74	13.47	10.89
21	0.00	0.00	0.00	64.07	19.18	16.73
22	0.00	0.00	0.00	59.22	29.55	10.08
23	0.00	0.00	0.00	5.68	79.48	14.54
24	0.00	0.00	16.45	64.38	11.42	7.73
25	0.00	0.00	0.00	77.12	12.69	9.57
26	0.00	0.00	62.69	23.28	4.10	5.61
27	0.00	0.00	5.57	75.26	11.79	6.84

Sample Number*	phi 0 = 1 mm	phi 1 = 0.5 mm	phi 2 = 0.25 mm	phi 3 = 0.125 mm	phi 4 = 0.0625 mm	phi >4 = <.0625 mm
28	0.00	0.00	19.03	64.33	8.40	7.20
29	0.00	0.00	13.71	69.86	10.76	5.44
30	0.00	0.00	39.82	50.31	5.24	6.37
31	0.00	0.00	52.28	41.43	3.27	2.98
32	0.00	0.00	66.59	21.27	5.24	6.37
33	0.00	0.00	78.35	14.97	3.24	3.16
34	0.00	0.00	5.43	83.90	6.38	4.90
35	0.00	0.00	0.00	71.26	21.70	4.80
36	0.00	0.00	0.00	77.91	14.95	5.86
37	0.00	0.00	35.32	52.47	5.83	5.61
38	0.00	0.00	17.65	65.56	8.71	7.01
39	0.00	0.00	66.51	20.31	6.28	6.50
40	0.00	0.00	0.00	55.32	35.76	8.92
41	0.00	0.00	71.90	20.91	2.83	4.34
42	0.00	0.00	0.09	0.00	0.00	4.90
43	0.00	0.00	0.00	66.18	20.90	12.91
44	0.00	0.00	0.00	63.72	24.06	10.59
45	0.00	0.00	0.00	72.49	20.17	7.32
46	0.00	0.00	0.00	0.00	0.00	14.85
47	0.00	0.00	0.00	21.87	65.97	12.11
48	0.00	0.00	0.00	31.04	53.31	14.56
49	0.00	0.00	11.82	71.16	9.50	6.42
50	0.00	0.00	26.51	43.73	23.61	6.15

* No location data was given for these 50 samples, only a sample number.

The size of the grains in the terrigenous fraction of bituminous sandstones studied ranges from 5.11-phi (0.0297 mm) to 2.32-phi (0.21 mm), and averages 3.31-phi (0.105 mm).

Textural data (appendix B, % Corrected Weights) from Wiley (1967).

The Krumbein *phi* (Φ) scale, a modification of the Wentworth scale created by W.C. Krumbein (Krumbein & Sloss, 1963), is a logarithmic scale computed by the equation:

$$\Phi = -\log_2 D/D_0$$

Φ is the Krumbein phi scale, and

D is the diameter of the particle

D₀ is a reference diameter, equal to 1 mm (to make the equation dimensionally consistent.)

Table 10. Thin section mineralogical data for 35 samples from the P.R. Spring tar sand area – from Wiley (1967).

Thin- Section #	Main Rock-Forming Minerals					Access Minerals	Authigenic Minerals	Orig. Cement	Alteration & Introduced Minerals	% by wt. Bitumen
	Cal.	Qtz.	Ortho.	Micr.	Plag.					
1		60	35	4	1	M, B, T, Z	Qtz.	Spar.	Ser., Kaol.	5.75
2.	80	10	9	1	tr			Spar.	Ser., Kaol.	2.64
3.	99	1/2	1/2	tr				Spar.		2.95
4.	39	45	14	1	1	M, T, Z		Spar.	Ser., Kaol.	2.77
5.		64	26½	4	5	M, B, T, Z	Qtz.	Spar., Qtz.	Ser., Kaol.	4.82
6.		80	15	3	2	M, B, T, Z, S	Qtz.	Spar., Qtz.	Ser., Kaol.	3.57
7.		68	27	3	2	M, B, T, Z	Qtz.	Spar.	Ser., Kaol.	3.25
8.		58	25	15	2	M, B, T, Z, S, G	Qtz.	Spar.	Ser., Kaol.	10.00
9.		60	32	7	1	M, B, Z	Qtz.	Spar., Qtz.	Ser., Kaol.	8.83
10.		70	25	3	2	M, B, Z	Qtz.	Spar., Qtz.	Ser., Kaol.	3.44
11.	90½	¼	¼	tr	tr			Spar.		2.13
12.		56	33	7	4	M, B, T, Z, S	Qtz.	Spar., Qtz.	Ser., Kaol.	6.30
13.		60	34	5	1	M, B, T, Z, S		Spar., Qtz.	Ser., Kaol.	6.06
14.		80	18	1	1	M, B, T, Z, S, G	Qtz.	Spar., Qtz.	Ser., Kaol.	11.90
15.		70	25	3	2	M, B, T, Z, S, C	Qtz.	Spar., Qtz.	Ser., Kaol.	4.21
16.		60	30	4½	5	M, B, T, Z	Qtz., Plag.	Spar., Qtz.	Ser., Kaol., Epi.	3.15
17.		55	35	8	2	M, B, T, Z, S, C		Spar.	Ser., Kaol.	12.70
18.		68	24	5	3	M, B, T, Z, S	Qtz., Plag.	Spar., Qtz.	Ser., Kaol.	3.31
19.		60	32	8	tr	M, B, T, Z	Qtz.	Spar.	Ser., Kaol.	9.68
Core #3		60	27	8	5	M, B, T		Spar.	Ser., Kaol.	2.99
24.		69	22	8	1	M, B, T, Z, S	Qtz.	Spar.	Ser., Kaol.	6.29
40.		45	50	3	2	M, B, T, G, Z, C, H, S	Qtz.	Spar.	Ser., Kaol., Epi.	3.57
41.		47	45	5	3	M, B, T, H, G, Z, S, C	Qtz.	Spar., Qtz.	Ser., Kaol.	7.14
42.	99	½	½	tr				Spar.		6.42
43.		47	47	3	3	M, B, T, Z, S, H, G, C		Spar.	Ser., Kaol.	3.00
44.		60	38	1	1	M, B, T, Z, S, H, C, G		Spar.	Ser., Kaol.	6.43
45.		55	38	5	2	M, B, T, Z, S, H, C	Qtz.	Spar., Qtz.	Ser., Kaol.	5.28
46.	99½	¼	¼					Spar.		4.32
47.		40	48	7	5	M, B, T, Z, S, C, H	Qtz.	Spar., Qtz.	Ser., Kaol.	4.41

Table 10. (continued)

Thin- Section #	Main Rock-Forming Minerals					Access Minerals	Authigenic Minerals	Orig. Cement	Alteration & Introduced Minerals	% by wt. Bitumen
	Cal.	Qtz.	Ortho.	Micr.	Plag.					
E		55	32	10	3	M, B, T, Z S, H, C		Spar.	Ser., Kaol.	?
G.	99½	¼	¼	tr	tr			Spar.	Ser., Kaol.	?
H.	99½	¼	¼					Spar.		?
I.	83	11	4	1½	½	M, B, T		Spar.	Ser., Kaol.	?
J.	96	2½	1	¼	¼	M, B, T		Spar.		?
M.	99½	¼	¼	?	?			Spar.		?

Definition of Abbreviations

M – muscovite	Spar. – spary calcite
B – biotite	Ser. – sericite
T – tourmaline	Micro. – microcline
Z – zircon	Cal. – calcite
S – sphene	Plag. – plagioclase
H – hornblende	Ortho. – orthoclase
C – chlorite	Epi. – epidote
G – garnet	Kaol. – kaolin clays

the clay- and silt-size fraction of the sediment increases, the oil content decreases, and as the median diameter of the grains increases, all oil content increases.

2. Analyses of variance of the two independent variables show that both the median diameter and the percentage clay- and silt-size material are equally effective in determining the amount of bitumen in the sample.
3. Most of the bituminous sandstones studied have median diameters between 4-phi (0.0625 mm) and 2-phi (0.25 mm), and are thus within the range of grain size of most reservoir rocks or sandstone.

Environment of source:

1. The source of the bituminous sandstone was probably south and southeast of the Uinta Basin, mainly from the Uncompahgre uplift, the mountains in western Colorado, and possibly from the San Rafael Swell.
2. The source of the detrital material was igneous and metamorphic as well as reworked sediments.
3. The distance from source to area of deposition was relatively short, possibly 25 to 30 miles.

Environment of deposition:

1. The bituminous sandstone was deposited in a humid lacustrine environment.
2. Most of the sandstones with high percentages of bitumen seem to have been deposited along the margins of the lake.
3. The sandstones were deposited under conditions of intermittent turbulence.
4. Algal and oolitic materials are associated with sandstones of high bitumen content.

Environment of diagenesis:

1. Carbonate cementing prior to bitumen impregnation has reduced the pore space of the sediments appreciably in most cases, thus greatly affecting the bitumen content.
2. Authigenic overgrowths of quartz, although present in most samples, have only slightly affected the pore space of the sediments.
3. Probably, impregnation shortly followed deposition of the sediments.

Mason and others (1986) analyzed 47 samples from seven core holes in the P.R. Spring area. Analyses were done using optical microscopy for quantitative mineral identification and x-ray diffraction for determining bulk mineral composition. Clay mineralogy, and iron content by inductively coupled plasma (ICP) analysis were also determined. Table 11 gives the mineralogical point count data collected from

thin sections (in percent), table 12 reports the clay minerals as determined by x-ray diffraction (in percent), and table 13 gives the iron abundance as determined by ICP. Based on their work, Mason and others (1986) drew the following conclusions:

1. Forty-seven samples, selected on the basis of lithology and tar impregnation, were examined by petrographic and x-ray diffraction techniques in order to identify and quantify clay minerals. All samples except carbonate lithotypes contained significant quantities of clay minerals.
2. Petrographic results indicated that the P.R. Spring tar sand deposit is composed of quartz (51%), feldspars (22%), carbonates (13%), clay minerals (7%), heavy minerals (1%), chert (2%), mica (3%), and rock fragments (1%).
3. Five clay mineral species were identified in the tar sand deposit through x-ray diffraction: illite (44%), kaolinite (25%), chlorite (18%), smectite (9%), and mixed-layer structure (4%).
4. Iron content, measured by ICP, was on the average 8.0 mg Fe/g sample for the 47 samples analyzed.
5. Clay minerals identified in the P.R. Spring tar sand deposit differed from clay minerals in the Canadian Athabasca deposit in quantity and specific mineral abundances.
6. Few statistical correlations were identified between mineralogy and iron data. The only relationship that seemed consistent was between the carbonate lithotypes and low iron and low pyrite.

Sulfur Isotope Analyses

Mauger and others (1973) completed sulfur isotopes for a number of Uinta Basin hydrocarbon-rich samples. The analyses run specifically on tar sands from the four Skyline core holes in the P.R. Spring deposit are given in table 14. Figure 8 shows the locations of the four Skyline core holes (left), and the stratigraphic columns, oil impregnated intervals, and the $\delta^{34}\text{S}$ values (right). In addition to the isotope data, Mauger and others (1973) include several paragraphs discussing the P.R. Spring area and the implications of the isotope data.

Additional sulfur isotope ratio data, run by Geochron Laboratories, Inc. for the Utah Geological and Mineral Survey, are given in table 15.

Analyses of Extracted Bitumen

Four multi-parameter chemical analyses on bitumen extracted from fresh outcrop samples in the P.R. Spring and Hill Creek areas were reported by Wood and Ritzma (1972). These analyses are given in table 16. There are no specific locations given for these samples.

Peterson and Ritzma (1974) reported 42 sample analyses for sulfur content of the bitumen from the P.R. Spring and Hill Creek areas. The 37 bitumen samples from the P.R. Spring

Table 11 - Thin section point count data (percentage basis) for 42 samples from seven cores in the P.R. Spring tar sand area - from Mason and others (1986).

Data Point	Data		Quartz	Clays	Feldspars	Carbonates	Heavy Minerals	Rock Fragments	Mica	Chert
	Source	Depth (feet)	%	%	%	%	%	%	%	%
1	PR-5	153.0-153.3	66	7	19	2	1	2	2	1
1	PR-5	160.0-160.3	62	8	19	8	1	<1	2	ND
1	PR-5	219.0-219.3	38	3	24	34	<1	ND	ND	1
1	PR-5	241.0-241.3	45	9	33	4	1	ND	7	1
7	UTS-1	241.0-241.3	44	7	5	42	1	<1	1	ND
7	UTS-1	243.5-243.8	45	7	24	13	2	2	7	<1
7	UTS-1	252.5-252.8	43	7	20	23	2	1	4	ND
7	UTS-1	305.1-305.4	44	9	25	20	ND	ND	1	1
7	UTS-1	308.7-309.0	57	3	23	10	ND	2	2	3
7	UTS-1	315.0-315.3	ND	ND	ND	100	ND	ND	ND	ND
19	UTS-2	94.0-94.3	51	8	20	13	1	1	3	3
19	UTS-2	99.8-100.1	47	12	28	5	ND	<1	6	2
26	UTS-3	31.0-31.3	54	9	20	9	ND	2	5	1
26	UTS-3	32.6-32.9	57	8	21	7	<1	2	4	1
26	UTS-3	37.7-38.0	46	6	32	11	ND	1	2	2
26	UTS-3	49.0-49.3	<1	ND	ND	100	<1	ND	ND	ND
26	UTS-3	77.8-78.2	56	10	21	8	ND	1	2	2
26	UTS-3	81.3-815.5	49	6	16	24	ND	1	1	3
36	UTS-4	48.7-49.0	44	14	23	9	3	2	1	4
36	UTS-4	66.9-67.2	Siltstone - too fine grained for point count analysis							
36	UTS-4	150.0-150.3	64	6	12	13	1	<1	1	3
36	UTS-4	156.1-156.4	58	11	17	9	1	1	3	<1
36	UTS-4	200.9-201.23	66	2	23	2	<1	3	2	2
36	UTS-4	309.0-309.3	Carbonate - too fine grained for point count analyses							
36	UTS-4	310.2-310.6	66	4	18	5	<1	1	2	4
42	UTS-5	20.3-20.6	51	9	14	16	2	2	6	<1
42	UTS-5	20.9-21.2	31	7	1	59	<1	ND	2	<1
42	UTS-5	81.0-81.3	64	6	17	6	ND	2	4	1

Data Point	Data		Quartz	Clays	Feldspars	Carbonates	Heavy Minerals	Rock Fragments	Mica	Chert
	Source	Depth (feet)	%	%	%	%	%	%	%	%
42	UTS-5	225.7-226.0	63	5	11	12	<1	2	6	1
42	UTS-5	229.9-230.2	54	4	21	16	1	<1	4	ND
42	UTS-5	235.9-236.2	52	5	23	17	1	ND	1	1
42	UTS-5	238.7-239.0	56	7	25	4	ND	<1	3	5
42	UTS-5	243.9-244.1	52	6	28	5	<1	ND	5	4
42	UTS-5	247.8-248.1	39	2	19	29	8	ND	1	2
42	UTS-5	251.7-252.0	55	2	31	3	<1	ND	1	8
82	UTS-6	4631-46.4	58	5	24	3	3	ND	6	1
82	UTS-6	92.4-92.7	57	7	28	2	2	ND	4	ND
82	UTS-6	139.2-139.5	54	12	23	2	2	ND	6	1
82	UTS-6	289.0-289.3	55	7	28	2	1	ND	4	3
82	UTS-6	293.2-293.5	50	10	29	5	4	ND	2	ND
82	UTS-6	242.3-242.5	30	2	7	59	1	ND	<1	1
82	UTS-6	346.0-346.3	32	6	26	26	3	ND	1	4

Table 12 - Clay mineralogy for 42 samples from seven cores in the P.R. Spring tar sand area - from Mason and others (1986). Quantities determined from peak heights and peak widths at one-half peak maximum.

Data Point	Data Source	Sample interval (feet)	Clay content (%)	Illite (%)	Chlorite (%)	Kaolinite (%)	Smectite (%)	Mixed Layer (%)	Comments
1	PR-5	153.0-153.3	7	20	10	10	40	20	Kaolinite/smectite mixed layer
1	PR-5	160.0-160.3	7.5	30	40	30	TR	ND	
1	PR-5	219.0-219.3	3	55	15	30	ND	ND	
1	PR-5	241.0-241.3	9.5	20	40	40	ND	ND	
7	UTS-1	241.0-241.3	7	40	20	ND	ND	40	Chlorite/smectite mixed layer
7	UTS-1	243.5-243.8	6.5	70	10	20	ND	ND	
7	UTS-1	252.5-252.8	7	60	35	5	ND	ND	
7	UTS-1	305.1-305.4	8.5	50	30	20	ND	ND	
7	UTS-1	308.7-309.0	3.5	50	25	25	ND	ND	
7	UTS-1	315.0-315.3	ND	ND	TR	ND	ND	ND	Carbonate
19	UTS-2	94.0-94.3	8	65	15	20	ND	ND	
19	UTS-2	99.8-100.1	12	60	10	30	ND	ND	
26	UTS-3	31.0-31.3	9.5	20	ND	5	70	5	Kaolinite/smectite mixed layer
26	UTS-3	32.6-32.9	8	15	5	10	65	5	Kaolinite/smectite mixed layer
26	UTS-3	37.7-38.0	6.5	30	15	30	25	ND	
26	UTS-3	49.0-49.3	ND	TR	TR	ND	ND	ND	Carbonate
26	UTS-3	77.8-78.2	10	40	20	40	ND	ND	
26	UTS-3	81.3-81.5	6	40	40	20	ND	ND	
36	UTS-4	48.7-49.0	14.5	60	20	20	ND	ND	
36	UTS-4	66.9-67.2	ND	80	10	10	ND	ND	
36	UTS-4	150.0-150.3	5.5	50	15	35	ND	ND	
36	UTS-4	156.1-156.4	10	60	10	30	ND	ND	
36	UTS-4	200.9-201.2	2	35	20	45	ND	ND	
36	UTS-4	309.0-309.3	ND	TR	ND	ND	ND	ND	Carbonate
36	UTS-4	310.2-310.6	4	65	10	25	ND	ND	
42	UTS-5	20.3-20.6	8.5	70	15	15	ND	ND	
42	UTS-5	20.9-21.2	7	75	10	15	TR	ND	
42	UTS-5	81.0-81.3	6	70	10	20	ND	ND	
42	UTS-5	225.7-226.0	5	40	10	50	TR	ND	
42	UTS-5	229.9-230.2	3.5	40	10	50	TR	ND	

Data Point	Data Source	Sample interval (feet)	Clay content (%)	Illite (%)	Chlorite (%)	Kaolinite (%)	Smectite (%)	Mixed Layer (%)	Comments
42	UTS-5	235.9-236.2	4.5	30	20	50	ND	ND	
42	UTS-5	238.7-239.0	7	30	10	60	ND	ND	
42	UTS-5	243.9-244.1	6	30	20	50	ND	ND	
42	UTS-5	247.8-248.1	2.5	25	10	65	ND	ND	
42	UTS-5	251.7-252.0	2	25	20	55	ND	ND	
82	UTS-6	46.1-46.4	5.5	20	30	30	20	ND	
82	UTS-6	92.4-92.7	7	20	15	15	20	30	Kaolinite/smectite mixed layer
82	UTS-6	139.2-139.5	12	15	10	15	50	10	Kaolinite/smectite mixed layer
82	UTS-6	289.0-289.3	7	40	20	30	10	ND	
82	UTS-6	293.2-293.5	10	50	10	TR	40	ND	
82	UTS-6	242.3-242.5	2.5	50	20	30	ND	ND	
82	UTS-6	346.0-346.3	6	50	20	20	10	ND	

**Table 13 - Iron content for 42 samples .
from seven cores in the P.R. Spring tar
sand area - from Mason and others (1986).**

Data Point	Data Source	Depth interval (feet)	Iron (mg /g)*
1	PR-5	153.0-153.3	9.5
1	PR-5	160.0-160.3	10.5
1	PR-5	219.0-219.3	3.1
1	PR-5	241.0-241.3	13.6
7	UTS-1	241.0-241.3	10.7
7	UTS-1	243.5-243.8	7.6
7	UTS-1	252.5-252.8	10.5
7	UTS-1	305.1-305.4	5
7	UTS-1	308.7-309.0	6.3
7	UTS-1	315.0-315.3	2.3
19	UTS-2	94.0-94.3	8
19	UTS-2	99.8-100.1	16.7
26	UTS-3	31.0-31.3	11
26	UTS-3	32.6-32.9	6.9
26	UTS-3	37.7-38.0	7.4
26	UTS-3	49.0-49.3	3.8
26	UTS-3	77.8-78.2	4.4
26	UTS-3	81.3-81.5	11.7
36	UTS-4	48.7-49.0	6.6
36	UTS-4	66.9-67.2	12.1
36	UTS-4	150.0-150.3	11.2
36	UTS-4	156.1-156.4	10.2
36	UTS-4	200.9-201.2	6.1
36	UTS-4	309.0-309.3	3
36	UTS-4	310.2-310.6	6.6
42	UTS-5	20.3-20.6	9.8
42	UTS-5	20.9-21.2	10
42	UTS-5	81.0-81.3	12.2
42	UTS-5	225.7-226.0	13.7
42	UTS-5	229.9-230.2	13.7
42	UTS-5	235.9-236.2	7.5
42	UTS-5	238.7-239.0	8.4
42	UTS-5	243.9-244.1	3.5
42	UTS-5	247.8-248.1	3.7
42	UTS-5	251.7-252.0	4.8
82	UTS-6	46.1-46.4	15.5
82	UTS-6	92.4-92.7	5
82	UTS-6	139.2-139.5	11.8
82	UTS-6	289.0-289.3	7.6
82	UTS-6	293.2-293.5	8.9
82	UTS-6	242.3-242.5	7.5
82	UTS-6	346.0-346.3	19.7

* All samples run at 20x dilution.

Table 14 - ^{34}S isotope data for the four Skyline core holes in the P.R. Spring tar sand area - from Mauger and others (1973).

Data Point	Skyline Core Hole No.	Core Hole Location	Top Elevation (in feet)	Sample Depth (in feet)	Sulfur (%)	$\delta^{34}\text{S}$ + values)	(all values)
10	26-33	SE sec. 26, T.13S., R.23E.	6441	92.5	0.3	21.8	
10	26-33	SE sec. 26, T.13S., R.23E.	6441	116.8	0.3	18.1	
10	26-33	SE sec. 26, T.13S., R.23E.	6441	121	0.3	12.7	
10	26-33	SE sec. 26, T.13S., R.23E.	6441	124-125	0.2	21.2	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	73	0.3	21	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	77.4	0.3	19.5	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	82.4	0.4	29.5	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	96.5	0.3	18.2	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	144.7	0.4	16.6	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	220.7	0.3	17.2	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	227	0.3	17.2	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	232	0.3	17.7	
21	14-34	SE sec. 14, T.14S., R.22E.	7003	135-136	0.3	16.6	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	55.1	0.3	20.3	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	67	0.3	20.5	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	70	0.4	19.9	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	119.5	0.3	15.2	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	127	0.3	17.3	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	140	0.3	18.1	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	171	0.2	17.3	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	63-64	0.3	19.9	
22	24-24	NE sec. 24, T.14S., R.22E.	7130	84-88	0.4	20.2	

Data Point	Skyline Core Hole No.	Core Hole Location	Top Elevation (in feet)	Sample Depth (in feet)	Sulfur (%)	$\delta^{34}\text{S}$ + values	(all values)
23	25-32	NE sec. 25, T.14S., R.22E.	7161	99.2	0.3	14	
23	25-32	NE sec. 25, T.14S., R.22E.	7161	110.5	0.3	14.9	
23	25-32	NE sec. 25, T.14S., R.22E.	7161	139	0.2	12.7	

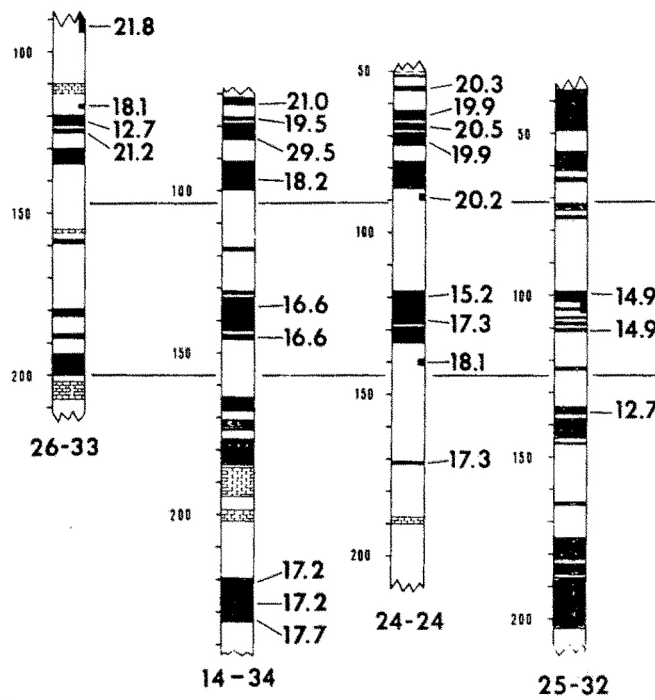
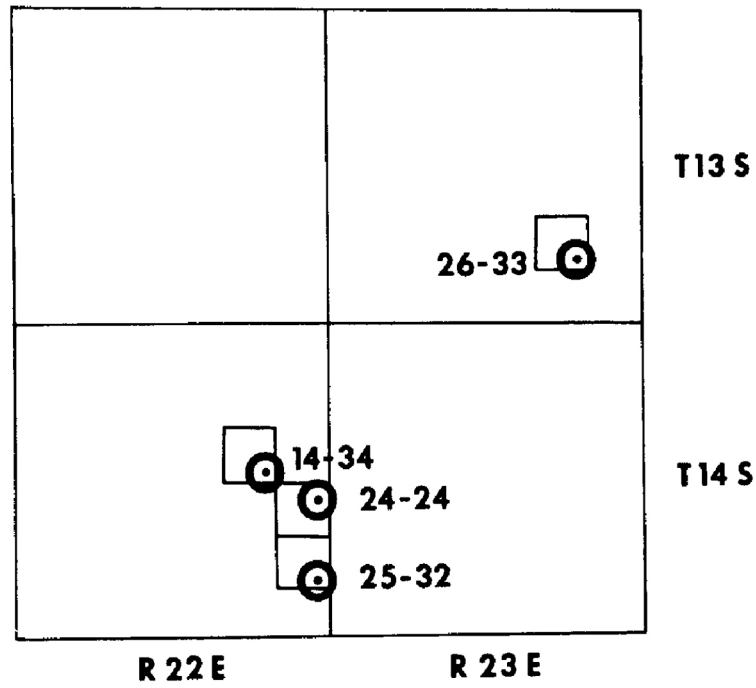


Figure 8. Location map and the lithology, tar impregnation intervals (black), and $\delta^{34}S$ values for the four Skyline core holes, P.R. Spring tar sand area – from Mauger and others (1973).

Table 15 - $^{34}\text{S}/^{32}\text{S}$ values from four P.R. Spring locations - from Utah Geological survey files (no date).

Data source	Map no. (Data point)	Sample depth (in feet)	Sample origin	Analysis $^{34}\text{S}/^{32}\text{S}$ (values are all +)
UGS - PR - 3A	4	233	Tar sand core	22.1
UGS - PR - 6	8	246	Tar sand core	20.7
UGS - PR - 7	27	35	Tar sand core	12.5
UTS - PRS - 1	73	36	Tar sand core	11.0
UTS - PRS - 1	73	43	Tar sand core	14.8
UTS - PRS - 1	73	88	Tar sand core	22.9
UTS - PRS - 1	73	101	Tar sand core	15.8
UTS - PRS - 1	73	168	Tar sand core	10.7
UTS - PRS - 1	73	210	Tar sand core	11.6

Table 16 - Chemical analyses of four bitumen samples from the P.R. Spring and Hill Creek tar sand areas - from Wood and Ritzma (1972).

Deposit	Formation (Age)	Tar (weight %)	C (%)	H ₂ (%)	N ₂ (%)	S (%)	Sp.Gr.	Gravity (°API)
P.R. Spring Dragon- Asphalt Wash	Douglas Cr. Mbr. Green River Fm. (Eocene)	12.4	80.0	9.5	1.0	0.45	1.012	8.3
P.R. Spring Dragon- Asphalt Wash	Parachute Cr. Mbr. Green River Fm. (Eocene)	14.8	88.0	10.0	1.8	0.35	1.031	5.7
P.R. Spring	Douglas Cr. Mbr. Green River Fm. (Eocene)	97.6*	86.0	10.9	0.7	0.36	0.969	14.5
Hill Creek	Douglas Cr. Mbr. Green River Fm. (Eocene)	11.2	81.5	11.8	1.4	0.40	1.017	7.6

* Sample very likely from a tar seep.
No specific locations are given for these samples.

area had a high of 0.76 percent, and a low of 0.30 percent with nearly 65 percent of the samples falling within the 0.4 to 0.49 percent range. Five bitumen samples from the Hill Creek area had a high of 0.46 percent, and a low of 0.34 percent. There are no specific locations given for these samples.

Gwynn (1971) reported 34 sulfur analyses for bitumen from the P.R. Spring area. These samples had a high of 0.42 percent and a low of 0.22 percent, with an average of 0.33 percent. Twenty-nine of these samples came from four sections 14, 24, 25, and 26, T. 14 S., R. 22 E.; four came from surface samples, one from section 36, T. 15 S., R. 22 E.; and one from a seep in section 6, T. 15.5 S., R. 24 E.

SUMMARY AND CONCLUSIONS

In this report, data are provided that give the locations and lithologic sections of 124 core holes or measured sections in the P.R. Spring and Hill Creek tar sand areas, along with section by section topographic maps that show the areas devoid of, and underlain by, tar sand. For 48 core holes, tar sand properties are given, while other data are given for the P.R. Spring area as a whole. Because of the very lenticular nature of the bitumen-saturated and non-saturated beds, the thickness, lateral extent, and degree of saturation of any given tar sand bed change rapidly from one location to another. Additional drilling and testing of specific areas will be necessary before either surface mining, or in-situ recovery programs can be designed or implemented. Bitumen-extraction and bitumen-upgrading information exists in the literature to guide these aspects of a tar sand industry (see Gwynn and Hanson, 2007).

REFERENCES

- Anderson, P.B., and Massoth, T.W., 2006, Book Cliffs block oil shale and tar sand resources, Grand County, Utah: unpublished report for the Utah School and Institutional Trust Lands Administration (TLS), 17 p, 15 plates, and four appendices.
- Byrd, W.D., III, 1967, Geology of the bituminous sandstone deposits, southeastern Uinta Basin, Uintah and Grand Counties, Utah: Salt Lake City, University of Utah, M.S. thesis, 45 p. (folded maps and lithologic sections in pocket).
- 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.
- Clem, Keith, 1984, Economic potential of the P.R. Spring oil-impregnated deposit, Uinta Basin, Utah: Utah Geological and Mineral Survey Special Studies 65, 35 p.
- Dahm, J.N., 1980, Tar sand reserves, P.R. Spring deposit, Uintah and Grand Counties, Utah: Utah Geological and Mineral Survey Open-File Report 27, 20 p.
- Dana, G.F., and Sinks, D.J., 1984a, Characteristics of the P.R. Spring tar sand deposit, Uinta Basin, Utah, USA, *in* Meyer, R.F., Wynn, J.C., and Olson, J.C., editors, The future of heavy crude and tar sands: New York, Coal Age Mining Information Services, McGraw-Hill, Inc., p. 220-236.
- Dana, G.W., and Sinks, D.J., 1984b, The P.R. Spring tar sand deposit, Uinta Basin, Utah, USA: United Nations Institute for Training and Research (UNITAR)/CF10/II/2, variously paginated.
- Gwynn, J.W., 1971, Instrumental analysis of tars and their correlations in oil-impregnated sandstone beds, Uintah and Grand Counties, Utah: Utah Geological and Mineralogical Survey Special Studies 37, 64 p.
- Gwynn, J.W., 1985, The Hill Creek oil-impregnated sandstone deposit: Utah Geological and Mineral Survey Report of Investigation 201, variously paginated.
- Gwynn, J.W., and Hanson, F.V., 2007, Annotated bibliography of Utah tar sands and related information: Utah Geological Survey Open-File Report 503 (on CD), 119 p.
- Johnson, L.A., Marchant, L.C., and Cupps, C.Q., 1975a, Properties of Utah tar sands – Asphalt Wash area, P.R. Spring deposit: U.S. Bureau of Mines Report of Investigation 8030, 11 p.
- Johnson, L.A., Marchant, L.C., and Cupps, C.Q., 1975b, Properties of Utah tar sands – north Seep Ridge area, P.R. Spring deposit: Laramie, Laramie Energy Research Center Report of Investigation 75/6, 17 p.
- Johnson, L.A., Marchant, L.C., and Cupps, C.Q., 1975c, Properties of Utah tar sands – south Seep Ridge area, P.R. Spring deposit: U.S. Bureau of Mines Report of Investigation 8003, 14 p.
- Johnson, L.A., Marchant, L.C., and Cupps, C.Q., 1976, Properties of Utah tar sands – Properties of Utah tar sands – Flat Rock Mesa area, Hill Creek deposit: Laramie, Laramie Energy Research Center Report of Investigation 76-5, 18 p.
- Krumbein, W.C., and Sloss, L.L., 1963, Stratigraphy and Sedimentation, 2nd Edition: San Francisco, W.H. Freeman and Company, 660 p.
- Marchant, L.C., Johnson, L.A., and Cupps, C.Q., 1974, Properties of Utah tar sands – Threemile Canyon Area, P.R. Spring deposit: U.S. Bureau of Mines Report of Investigation 7923, 14 p.
- Mason, G.M., Owen, T.E., Daley, R.L., and Donovan, R.C., 1986, Clay minerals in a Utah tar sand and their potential effects on processing: Laramie, U.S. Department of Energy, Western Research Institute, 36 p.
- Mauger, R.L., Kayser, R.B., and Gwynn, J.W., 1973, A sulfur isotopic study of Uinta Basin hydrocarbons: Utah Geological and Mineralogical Survey Special Studies 41, 17 p.
- Peterson, P.R., and Ritzma, H.R., 1974, Informational core drilling in Utah's oil-impregnated sandstone deposits, southeast Uinta Basin, Uintah County, Utah: Utah Geological and Mineral Survey Report of Investigation 88, variously paginated.
- Sinks, K.J., 1985, Geologic evaluation and reservoir properties of the P.R. Spring tar sand deposit, Uintah and Grand Counties, Utah: Laramie, U.S. Department of Energy Western Research Institute, 190 p.
- Whittier, W.H., and Becker, R.G., 1962, Geologic map and sections of the bituminous sandstone deposits in the P.R. Spring area, Grand and Uintah Counties, Utah: U.S. Geological Survey Open-File Report (no number), scale 1:18,635.
- Wiley, D.R., 1967, Petrology of bituminous sandstones in the Green River Formation, southeastern Uinta Basin, Utah: Salt Lake City, University of Utah, M.S. thesis, variously paginated.
- Wood, R.E., and Ritzma, H.R., 1972, Analyses of oil extracted from oil-impregnated sandstone deposits in Utah: Utah Geological and Mineralogical Survey Special Studies 39, 20 p.