UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Geophysical Logs, Lithologic Descriptions, and Geochemical Results from Federal Coal Drilling, Castle Valley Ridge North Tract Area, Utah, 1985

By

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INTRODUCTION

In 1985 the U.S. Geological Survey (USGS) drilled coal test holes at five locations in the Wattis and Candland Mountain quadrangles, Utah, as part of an interagency agreement between the USGS and the Bureau of Land Management (BLM) to investigate the coal geology of the Castle Valley Ridge North (CVRN) tract.

Rotary holes were drilled using air and air-water foam at each site with truck-mounted rigs. Upon completion, these holes were logged with geophysical probes by the Century Geophysical Corporation.

Geophysical logs included gamma-ray, gamma-gamma (density), and caliper. The logs were examined and representative coal-bearing sections in two of the holes (CST-2 and CST-3) were selected for coring. The sites of these drill holes were then reoccupied and the intervals of interest cored in offset holes.

Field descriptions of drill-hole cuttings collected at 5-foot intervals were made by Jean Dillinger, Courteney Williamson, and Mark Kirschbaum of the USGS and by Barbara Korzendorfer of the BLM. Cored intervals were described by Courteney Williamson and Jean Dillinger. Georgia Eccles, USGS, transcribed the field descriptions.

This report includes copies of the geophysical logs at a scale of 1 inch equals 50 feet and the descriptions of the cuttings and cored intervals.

LOCATION AND ACCESS

The CVRN tract is located 19 miles northwest of Huntington, Utah, and 5 miles southeast of Clear Creek, Utah, in Emery and Carbon Counties (fig. 1), within the Wattis and Candland Mountain 7 1/2-minute quadrangles (figs. 2 and 3). The tract contains approximately 1,260 acres of land in the Manti-La Sal National Forest that is underlain by Federally owned coal administered by the BLM. A legal description of the tract is as follows:

T. 14 S., R. 7 E.

sec. 26, SW1/4, W1/2NW1/4SE1/4;
sec. 27, E1/2E1/2SW1/4, SE1/4;
sec. 34, NE1/4, N1/2SE1/4, lots 3, 4;
sec. 35, N1/2N1/2SW1/4, N1/2N1/2SE1/4, lots 1, 2

The CVRN tract is located along a generally north-south-trending ridge of the Wasatch Plateau in an area of rugged topography and limited access, where elevations range from 6,500 ft to in excess of 9,800 ft. The boundaries of the study area are constrained on the west by Nuck Woodward Canyon, a downdropped structural block with over 300 ft of displacement relative to Castle Valley Ridge (CVR), and to the east by deep canyons and cliff faces, which formed by drainages flowing eastward into Castle Valley (fig. 1). One jeep trail runs up Nuck Woodward Canyon from Highway 31 to the town of Clear Creek, Utah, and gives access to the western margin of the tract. A bladed road along CVR, built and reclaimed by Getty Mining Company, was reopened in 1985 to allow drilling operations by the USGS. This road has since been reclaimed by Environmental Industrial Supply under contract with the USGS.

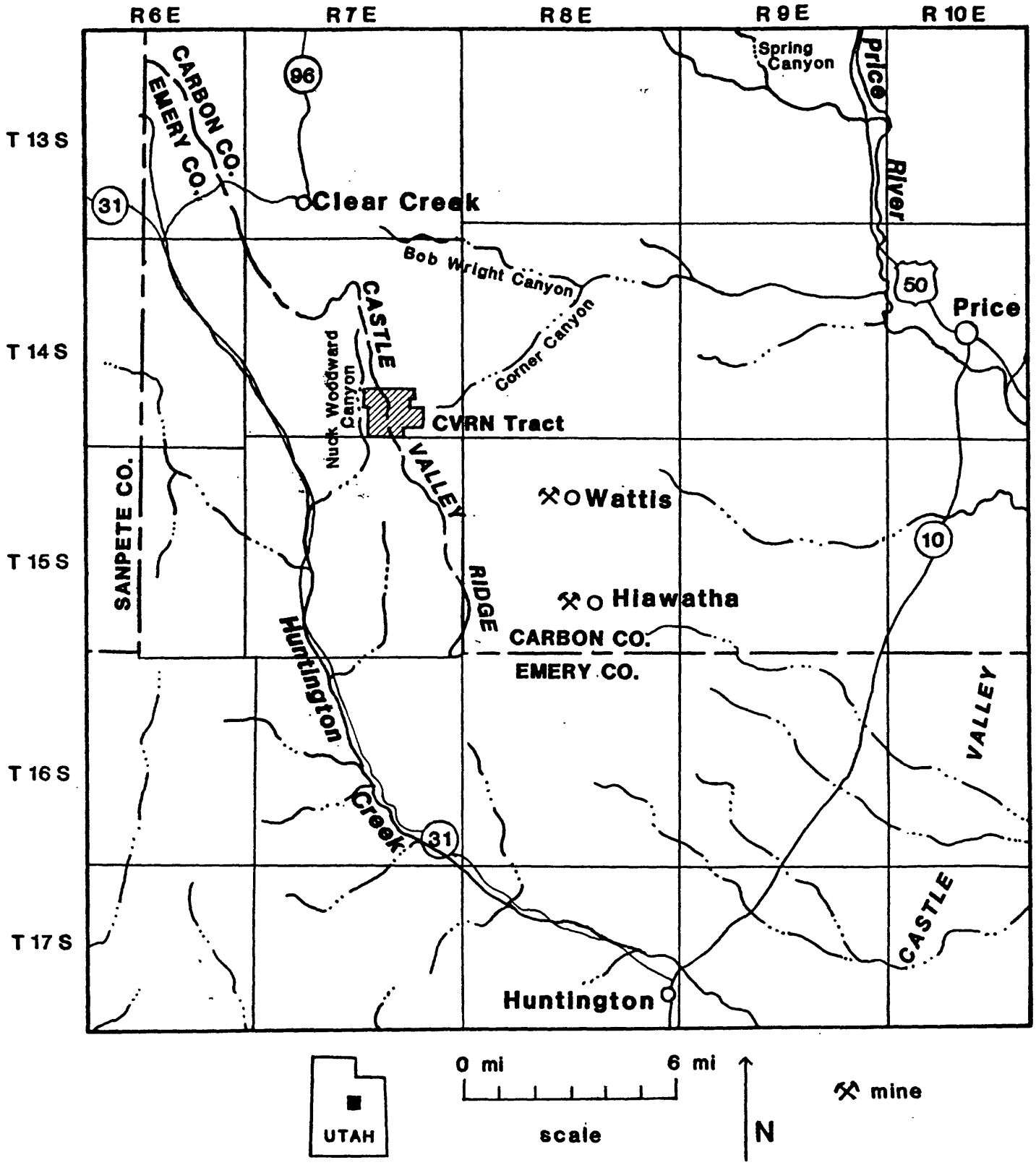


Figure 1.--Index map of the CVRN tract.

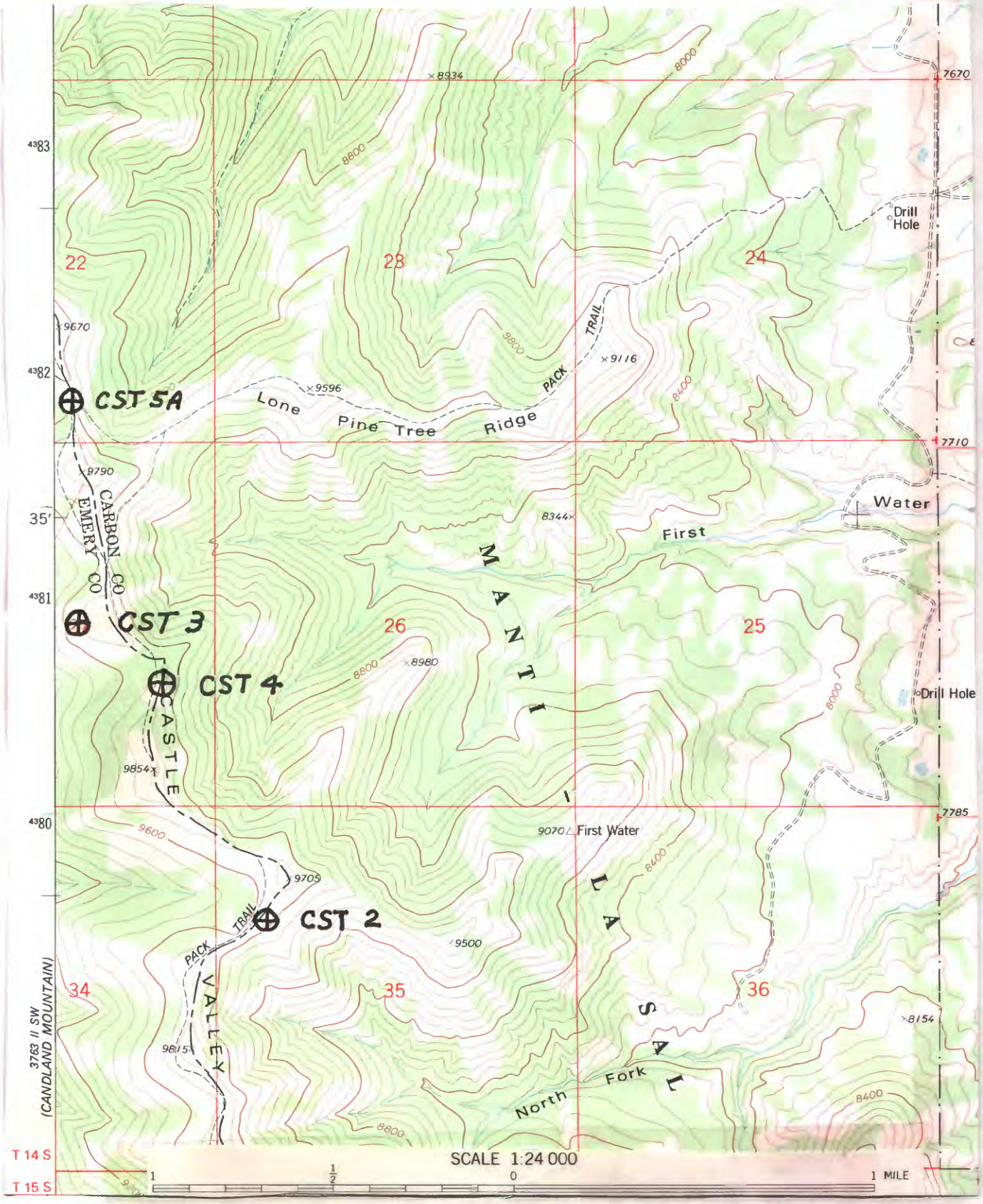


Figure 2.--Map showing location of drill holes in the Wattis quadrangle, Carbon and Emery Counties, Utah

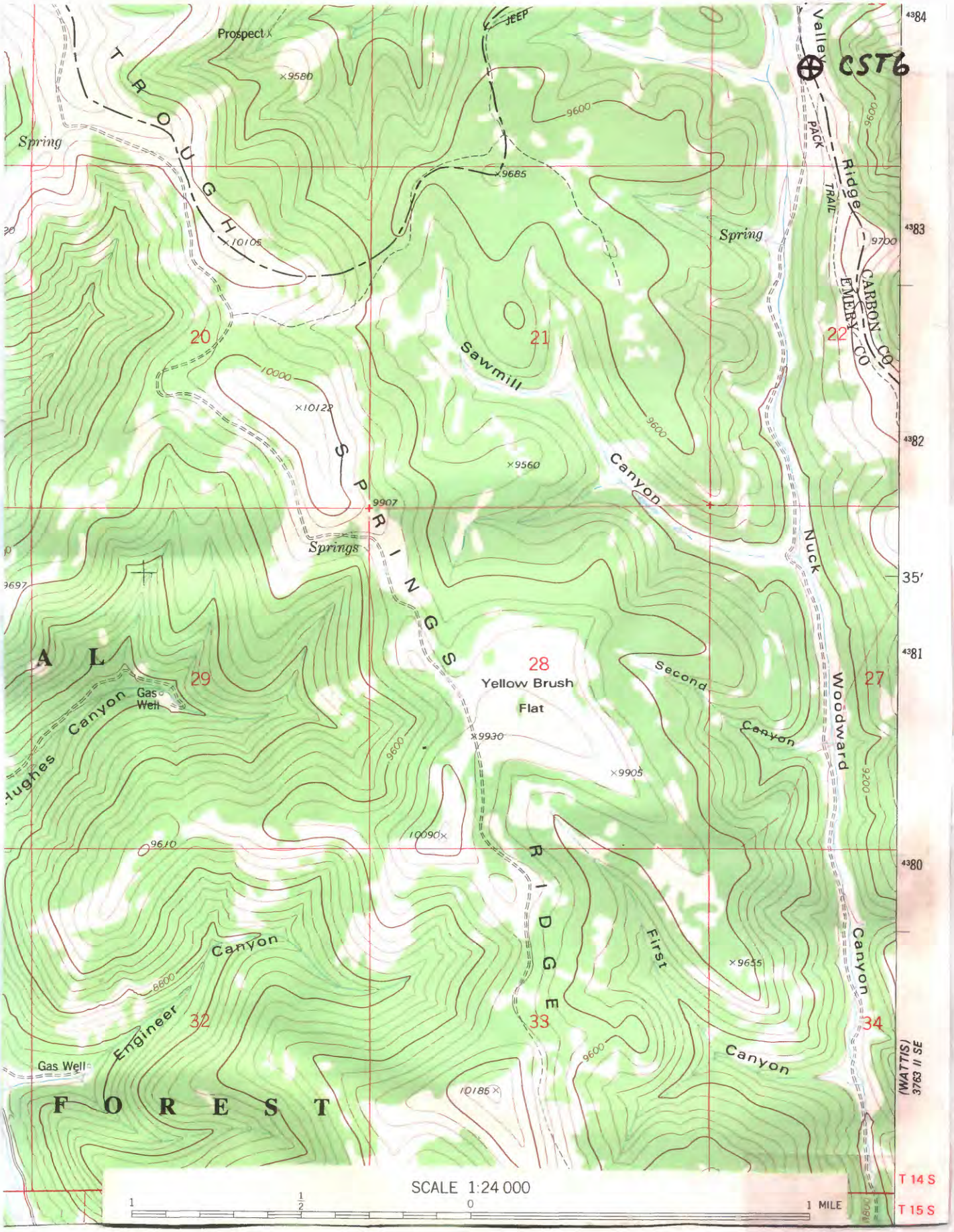


Figure 3.--Map showing location of drill hole in the Candland Mountain quadrangle, Carbon and Emery Counties, Utah

COAL SETTING

Coal in the CVRN tract is included in the Northern Wasatch Plateau coal field. It is Late Cretaceous in age and occurs in the Blackhawk Formation, a continental sequence consisting of sandstone, siltstone, shale, and coal. The holes were drilled down through the Blackhawk Formation and penetrated the top of the underlying Star Point Sandstone, a Cretaceous marine sandstone.

COAL QUALITY

Five core samples of coal collected from drill hole CST-3 (table 1) were submitted to the Geochemical Testing Laboratory in Somerset, Pa., for analysis. Proximate and ultimate analyses; calorific values (table 2); and forms-of-sulfur, free-swelling-index, ash-fusion-temperatures, Hardgrove-grindability index, and apparent-specific gravity determinations (table 3) were obtained for each sample according to current American Society for Testing and Materials (ASTM) standards and procedures. Additionally, equilibrium moisture for each sample was determined, and all of the as-received proximate and ultimate parameters and calorific values (table 2) were recalculated using the methods in ASTM designation D-3180-74 (ASTM, 1982a; J. D. Cathcart, written commun., 1986).

Apparent rank of all five coal samples, calculated using the formulae in ASTM designation D-388-82 (ASTM, 1982b), is high-volatile B bituminous coal. The calorific values (moist, mineral-matter-free basis) range from 13,170 to 13,710 Btu/lb (J. D. Cathcart, written commun., 1986).

For comparison, tables 2 and 3 include the arithmetic means and ranges for 40 coal samples from core holes and operating mines in the Wasatch Plateau coal field (Hatch and others, 1979). Apparent ranks calculated for the 40 samples range from subbituminous B to high-volatile A bituminous coal.

The data reported in Hatch and others (1979) show a regional variation in the quality of coal from beds in the Blackhawk Formation. Coal samples from the southern part of the Wasatch Plateau (Sevier County) have higher ash and sulfur contents and lower rank than samples from the northern part (Carbon and Emery Counties). Assuming that the analytical results for the five samples from hole CST-3 are representative, the coal quality within the CVRN lease tract is typical for coal in the Blackhawk Formation in the Northern Wasatch Plateau coal field.

REFERENCES CITED

American Society for Testing and Materials, 1982a, Standard methods for calculating coal and coke analyses from as-determined to different bases (ASTM designation D-3180-74): 1982 Annual book of ASTM standards, pt. 26, p. 424-427.

_____1982b, Standard classification of coals by rank (ASTM designation D-388-82): 1982 Annual book of ASTM standards, pt. 26, p. 238-242.

Hatch, J. R., Affolter, R. H., and Davis, F. D., 1979, Chemical analyses of coal from the Blackhawk Formation, Wasatch Plateau coal field, Carbon, Emery, and Sevier Counties, Utah: Utah Geological and Mineral Survey Special Studies 49, p. 69-102.

Table 1.--Summary of information on drilling at five sites, Carbon and Emery Counties, Utah

Drill hole	Location	Quadrangle	Depth drilled (ft)	Depth logged (ft)	Cored intervals
CST-2	SW1/4NW1/4 sec. 35 T. 14 S., R. 7 E.	Wattis	756	642	540.0-597.4
CST-3	SW1/4NE1/4 sec. 27 T. 14 S., R. 7 E.	Wattis	756	756	426-446 491.1-504 526-545.4 646-666
CST-4	NE1/4SE1/4 sec. 27 T. 14 S., R. 7 E.	Wattis	835	833	none
CST-5A	SW1/4SE1/4 sec. 22 T. 14 S., R. 7 E.	Wattis	677	677	none
CST-6	NE1/4SW1/4 sec. 15 T. 14 S., R. 7 E.	Candland Mountain	656	656	none

Table 2.--Proximate and ultimate analyses and calorific values for five coal samples from core hole CST-3, CVRN lease tract

[All values except calorific values in weight percent. For each sample, the analyses are reported four ways: first, as-received; second, moisture free; third, moisture and ash free; fourth, as-received recalculated using equilibrium moisture values and methods prescribed in ASTM designation D-3180-74. For comparison, arithmetic means and ranges (as-received basis) for 40 coal samples from the Wasatch Plateau coal field (WP) (Hatch and others, 1979, table 7) are included. Leaders (--) indicste no data]

Sample number	Proximate analysis				Ultimate analysis					Calorific value (Btu/lb)
	Moisture	Ash	Volatile matter	Fixed carbon	Hydrogen	Carbon	Nitrogen	Sulfur	Oxygen	
U12753	7.4	3.2	43.9	45.5	5.9	71.9	1.4	0.5	17.1	12,840
	--	3.5	47.4	49.1	5.5	77.6	1.6	.5	11.3	13,860
	--	--	49.1	50.9	5.7	80.4	1.6	.6	11.7	14,350
	6.4	3.2	44.3	46.1	5.9	72.7	1.4	.5	16.3	12,970
U12749	7.0	7.6	43.1	42.3	6.1	67.1	1.6	.7	16.9	12,160
	--	8.2	46.4	45.4	5.7	72.2	1.7	.8	11.4	13,070
	--	--	50.6	49.4	6.2	78.7	1.8	.8	12.5	14,240
	5.7	7.8	43.7	42.8	6.0	68.1	1.6	.7	15.8	12,320
U12760	6.2	13.6	41.5	38.7	5.9	63.2	1.3	.6	15.4	11,530
	--	14.5	44.2	41.3	5.5	67.4	1.4	.6	10.6	12,290
	--	--	51.7	48.3	6.4	78.9	1.7	.7	12.3	14,370
	5.1	13.7	41.9	39.3	5.8	64.0	1.4	.6	14.5	11,660
U12756	7.4	3.9	43.8	44.9	6.3	70.3	1.5	.6	17.4	12,750
	--	4.3	47.3	48.4	5.9	75.9	1.6	.6	11.7	13,780
	--	--	49.4	50.6	6.2	79.3	1.7	.7	12.1	14,390
	6.0	4.0	44.5	45.5	6.2	71.4	1.5	.6	16.3	12,950
U12743	7.8	3.8	41.2	47.2	6.2	70.0	1.5	.4	18.1	12,480
	--	4.1	44.7	51.2	5.7	75.9	1.6	.5	12.2	13,540
	--	--	46.6	53.4	6.0	79.1	1.7	.5	12.7	14,110
	6.8	3.8	41.6	47.8	6.1	70.8	1.5	.4	17.4	12,620
WP mean	4.7	10.7	40.6	44.0	5.6	67.0	1.1	.6	15.0	12,000
WP range	1.9-	3.6-	25.6-	26.3-	4.3-	37.6-	.3-	.4-	11.0-	6,440-
	13.7	34.4	46.7	50.8	6.1	74.5	1.5	2.3	22.9	13,470

Table 3.--Forms-of-sulfur, free-swelling index, ash-fusion temperature, Hardgrove grindability index, and apparent-specific gravity determinations for five coal samples from core hole CST-3, CVRN lease tract

[Forms-of-sulfur analyses reported in weight percent. For each sample, forms of sulfur are reported three ways: first, as-received; second, moisture free; third, moisture and ash free. L means less than the value shown, + means greater than the value shown. For comparison, arithmetic means and ranges (as-received basis) for 40 coal samples from the Wasatch Plateau coal field (WP) (Hatch and others, 1979, table 7) are included. Leaders (--) indicate no data]

Sample number	Forms of sulfur			Free-swelling index	Ash-fusion temperatures, °F			Hardgrove grindability index	Apparent specific gravity	Air-dry loss
	Sulfate	Pyritic	Organic		Initial deform.	Softening	Fluid			
U12753	0.01	0.04	0.44	1.5	2,350	2,500	2,780	52	1.3	4.8
	.01	.04	.48							
	.01	.04	.50							
U12749	.01L	.19	.53	2.5	2,540	2,600	2,720	51	1.3	4.8
	.01L	.20	.58							
	.01L	.22	.63							
U12760	.01	.04	.52	1.5	2,720	2,770	2,800+	47	1.3	3.9
	.01	.05	.54							
	.01	.06	.63							
U12756	.01	.13	.46	2.0	2,400	2,480	2,660	48	1.3	5.2
	.01	.14	.49							
	.01	.15	.51							
U12743	.01	.04	.39	1.0	2,370	2,420	2,680	47	1.3	5.4
	.01	.05	.42							
	.01	.05	.44							
WP mean	.03	.19	.43	1.5	2,250	2,280	2,380	--	--	--
WP range	.01L-	.05-	.20-	.0-	1,780-	1,880-	1,980-	--	--	--
	.11	1.61	.67	3.5	2,800+	2,800+	2,800+	--	--	--

LITHOLOGIC AND GEOPHYSICAL LOGS

LOCATION NUMBER CST-2 DATE 9/10/85 SURFACE ELEVATION(ft) 9613

LOCATION 800' fwl, 1550' fnl Sec. 35 T. 14 S. R. 7 E. Quad. Wattis

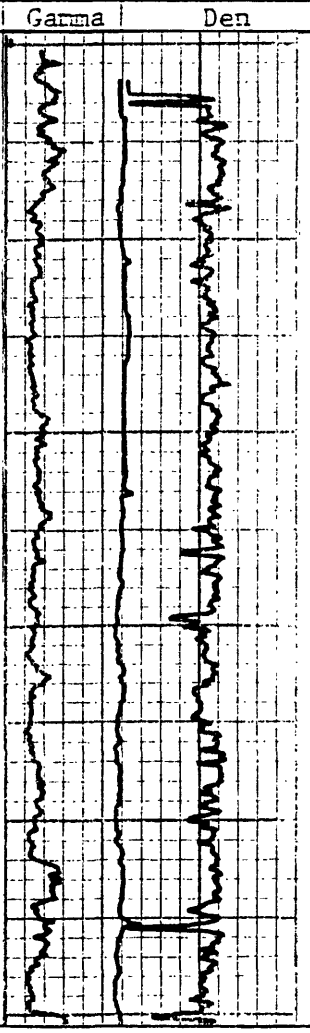
COUNTY Carbon STATE Utah TOTAL DEPTH(ft) 756

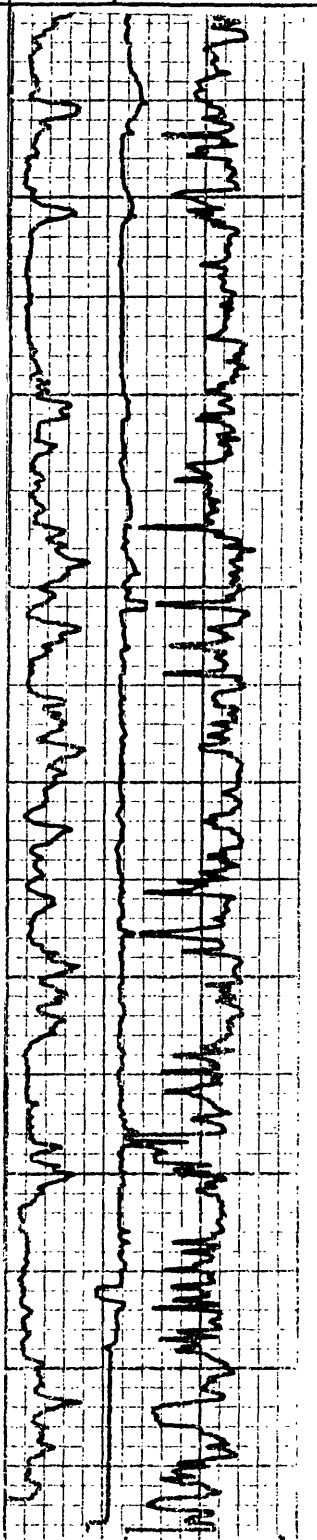
CORED YES [X] NO [ ] INTERVAL(s) 540-597.4

DRILLING MEDIUM: [X] AIR [X] FOAM [ ] MUD [ ] WATER OBSERVATION WELL

GEOPHYSICAL LOGS:

Natural Gamma	; Scale	1" = 500 cps	Logging Speed	15	fpm
Gamma Gamma	; Scale	1" = 3.75 cps	Logging Speed	15	fpm
Resistivity	; Scale		Logging Speed		fpm
Caliper	; Scale	1" = 25"	Logging Speed	15	fpm

Lithology		Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
0- 5	Soil		0	0	
5- 10	Sandstone, reddish-brown, fine-grained				
10- 20	Shale, gray				
20- 25	Shale, gray, carbonaceous				
25- 30	Sandstone, light-brown, fine-grained				
30- 35	Siltstone, reddish-brown				
35- 40	Mudstone, yellowish-brown, carbonaceous material				
40- 45	Siltstone, light-brown, gray				
45- 65	Sandstone, light-brown, fine-grained				
65- 70	Sandstone, light-brown, medium-grained				
70- 75	Sandstone, medium-brown, medium-grained				
75- 85	Sandstone, light-brown, medium-grained				
85- 90	Sandstone, light-brown, fine- to medium-grained				
90- 95	Sandstone, light-brown, fine-grained, trace clay				
95-100	Sandstone, light-brown, very fine grained to fine-grained; 10 percent claystone with coaly stringer				
100-105	Siltstone, light-brown, trace carbonaceous streak; 20 percent claystone, light-gray (also sand in sample)		100	30	
105-110	Siltstone, light-gray and light-brown, very fine grained sandstone; trace carbonaceous clay shale				
110-115	Sandstone, light-brown, very fine grained, some clay				
115-120	Sandstone, light-brown, fine-grained, some claystone				
120-125	Interbedded sandstone, light-brown, fine-grained, stem impression noted and claystone or shale, light-gray			40	
125-130	Interbedded sandstone and claystone, very fine grained				
130-135	Sandstone, light-brown, fine-grained; trace siltstone, light-gray		150	50	
135-140	Interbedded sandstone, light-yellowish-brown, very fine to fine-grained; siltstone, light-gray; claystone, light-gray				
140-145	Mostly sandstone in sample; very fine to fine-grained; some mudstone, light-gray				
145-150	Sandstone, light-gray to brown, very fine to fine-grained. Driller says that interval is probably interbedded sandstone with shale; water at approximately 150 ft			60	
150-155	Interbedded sandstone, very fine grained; siltstone; claystone, medium-gray		200		
155-160	Interbedded sandstone, light-brown; siltstone, yellowish-brown				
160-165	Sandstone, light-brown, very fine to fine-grained. Note all sands to this point have brown limonite stain; trace claystone, light-gray			70	
165-170	Interbedded sandstone, light-brown, very fine grained; limonite stained siltstone; claystone, light-gray		250		

Lithology	Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
170-175 Poor recovery of sample due to washing of fine sand through screen 175-180 Claystone, light-gray, and interbedded sandstone, light-brown, very fine grained; limonite, yellowish-brown; stained siltstone 180-185 Sandstone, light-brown, fine- to medium-grained (most sand washed through screen) 185-190 Interbedded sandstone, siltstone, and claystone 190-195 Claystone, light-gray to yellowish-brown; some interbedded siltstone, yellowish-brown to moderate brown; trace sandstone, light-gray 195-200 Sandstone, light-brown (noted an ironstone concretion) 200-205 Sandstone, light-brown to yellowish-brown; claystone, light-gray 205-210 Poor recovery of sample; contained mostly sandstone, light-gray to brown, very fine grained; siltstone, yellowish-brown; possible burrow noted 210-215 Interbedded sandstone, light-brown and light-gray; siltstone; claystone 215-220 Claystone, light-gray; trace sandstone, light-gray 220-225 Claystone, light-gray 225-230 Interbedded claystone and siltstone, light-gray 230-240 Claystone and sandstone, light-gray 240-245 Sand, light-gray, medium-grained 245-250 Claystone, light-gray; some sandstone; poor recovery 250-255 Claystone, light-gray; coal stringer approximately 1 ft thick at 250-251 ft 255-260 Claystone, light-gray; carbonaceous shale; some sandstone; coal in sample may be from sloughing 260-265 Sandstone, light-gray, very fine to fine-grained; some coal in sample 265-270 Sandstone, light-gray, very fine grained; trace coal; driller says 0.2-0.3 ft coal at 270 ft 270-275 Sandstone, light-gray to yellowish-brown; poor recovery 275-280 Claystone, light-gray to yellowish-brown; some siltstone and sandstone; lost circulation at 279 ft 280-285 Sandstone, light-gray to yellowish-brown, very fine to fine-grained; some siltstone in cuttings; very hard at approximately 283-284 ft 285-290 Interbedded claystone and sandstone 290-295 Claystone, light-gray to medium-gray; interbedded sandstone, light-brown, very fine grained 295-300 Sandstone, yellowish-brown, fine-grained 300-305 Same as interval above 305-310 Sandstone, fine-grained, claystone, light-gray; trace coal in sample 310-315 Sandstone, yellowish-brown, fine- to medium-grained 315-320 Interbedded sandstone with claystone; poor recovery 320-325 Sandstone, yellowish-brown, fine- to medium-grained 325-330 Sandstone, yellowish-brown, fine- to medium-grained, subrounded to well rounded, well sorted 330-335 Sandstone, yellowish-brown 335-340 Sandstone, light-brown to light-gray, fine-grained; sandstone, light-gray, well-cemented; formed hard layer at 334 ft 340-345 Sandstone, light-gray to light-brown, fine-grained, well cemented 345-350 Sandstone, light-gray 350-355 Poor recovery; sandstone in sample; however, driller says mostly silty shale cuttings in pit confirm light-gray silty mud 355-360 Sandstone, light-gray, fine-grained; also silty shale with shale in interval 360-370 Same as interval above; poor recovery; no samples taken 370-375 Poor recovery; silty shale off Kelly table; no samples taken 375-380 Poor recovery; silty shale; clay shale; some sandstone in sample 380-385 Poor recovery; yellowish-brown clay in shale and silty shale; no cuttings taken 385-390 Siltstone, yellowish-brown; clay to silty shale and oxidized coal; coal at approximately 386 ft 390-395 Poor recovery; clay and silty shale; siltstone, light-gray to yellowish-brown 395-400 Interbedded claystone (clay shale); siltstone, yellowish-orange; some sandstone, light-gray, fine- to medium-grained 400-405 Interbedded clay shale, light- to medium-gray to yellowish-orange; siltstone, yellowish-brown; some sandstone, light-gray to yellowish-brown, very fine grained, well-cemented		300 350 400 450 500 550 600 650 700	90 100 110 120 130 140 150 160 170 180 190 200 210	

Lithology	Strip Log	Depth ft	Depth m	Geophysical Logs Gamma	Geophysical Logs Den	Geophysical Logs Res
405-410 Hit void at 405 ft--then hard drilling; siltstone, yellowish-orange to light-gray, well-cemented; some sandstone, light-gray, very fine grained; lost circulation at 410 ft						
410-415 No recovery; lost circulation						
415-470 No recovery						
470-475 Poor recovery; cuttings show shale, light-gray; sandstone, yellowish-brown; trace coal						
475-480 Poor recovery; cuttings show sandstone, yellowish-brown to light-gray, very fine to fine-grained; trace coal (probably from last 5 ft)						
480-485 Very poor recovery; no cuttings collected						
485-490 Sandstone, yellowish-orange, some shale, light-gray, and trace coal in cuttings; drilling indicates hard sandstone at approximately 485-487 ft; then interbedded sandstone (90 percent) and fine-grained rocks (10 percent); still poor circulation with little recovery; no samples collected						
490-491 Sandstone, hard, limy; samples as in last three intervals						
491-495 Probably sandstone; samples as in last three intervals; sandstone, yellowish-brown to light-gray, very fine grained; still very poor recovery and poor circulation						
495-500 No recovery						
500-505 No recovery; lost circulation						
505-540 No recovery 517-540 ft; hard sandstone, then softer, faster drilling sandstone						
540-597 Cored interval						
597-756 No recovery of samples						

CST-2

El. 9,613

Core description	Drill depth (ft)
Claystone, light-gray, disrupted laminations, bioturbated.....	540 -541
Coal.....	541 -541.3
Includes light-gray siltstone at top; lost section at 9.95 ft; carbonaceous shale at bottom.....	541.3 -551.25
Coal.....	551.25-551.4
Claystone, medium-dark-gray, carbonaceous, with coal streaks.....	551.4 -552.4
Sandstone, yellowish-orange, clayey with medium-gray clayey streaks, disrupted bedding.....	552.4 -553.6
Sandstone, yellowish-orange.....	553.6 -564.7
Lost core, 11.3 ft.....	564.7 -576
Sandstone, yellowish-orange to light-brown; 13.9 ft lost at top and middle, bottom light-gray well-cemented sandstone.....	576 -593.3
Sandstone, light-gray.....	593.3 -593.9
Sandstone, light-gray to yellowish-orange, highly fractured.....	593.9 -594.3
Sandstone, light-gray.....	594.3 -596.3
Sandstone, yellowish-orange, well-cemented.....	596.3 -596.5
Lost.....	596.5 -597.4
Rotary drilled, no recovery.....	597.4 -756

LITHOLOGIC AND GEOPHYSICAL LOGS

LOCATION NUMBER CST-3 DATE 9/25/85 SURFACE ELEVATION(ft) 9660

LOCATION 2000' fel, 2600' fsl Sec. 27 T. 14 S. R. 7 E. Quad. Wattis

COUNTY Emery STATE Utah TOTAL DEPTH(ft) 756

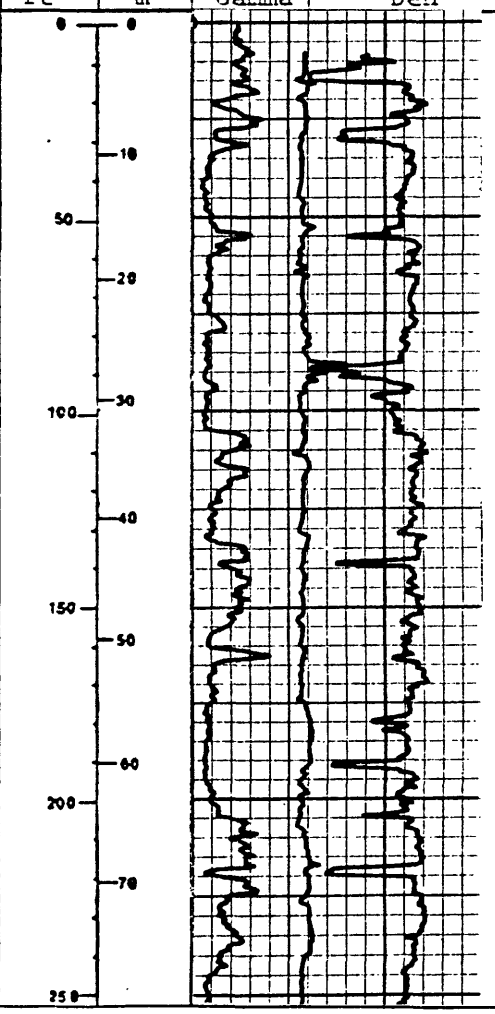
CORED YES [X] NO [ ] INTERVAL(s) 426-446, 491.1-504, 526-545.4, 646-666

DRILLING MEDIUM: [X] AIR [X] FOAM [ ] MUD [ ] WATER OBSERVATION WELL

GEOPHYSICAL LOGS:

Natural Gamma	; Scale	1" = 500 cps	Logging Speed	15	fpm
Gamma Gamma	; Scale	1" = 3.75 cps	Logging Speed	15	fpm
Resistivity	; Scale		Logging Speed		fpm
Caliper	; Scale	1" = 25"	Logging Speed	15	fpm

Lithology		Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
0- 5	Soil mixed with siltstone				
5- 10	Silty shale, grayish-brown				
10- 15	Siltstone to shale, gray, somewhat oxidized				
15- 20	Siltstone to shale, grayish-brown				
20- 25	Siltstone to shale, grayish-brown; few pieces carbonaceous shale, dark-brown				
25- 30	Claystone, gray to dark-gray; some coal				
30- 35	Coal; driller (Steve Grant) says approximately 1 ft thick, hard; some shale, dark-gray				
35- 40	Siltstone, light-gray to almost white				
40- 45	Siltstone, light-gray to white; some sand, cream colored, very fine grained				
45- 50	Sand, cream to white, very fine grained; siltstone				
50- 55	Beach sand, cream to white, very fine grained; minor siltstone (Last four samples: siltstone decreasing, sand increasing)				
55- 60	Siltstone, light-gray; claystone, dark-gray to black				
60- 80	Siltstone, light-gray to white				
80- 85	Siltstone, light-gray; sand, cream, very fine grained				
85- 90	Sand, cream, very fine grained; some siltstone, light-gray				
90- 95	Sand, cream colored, slightly orange (oxidized), very fine grained; very minor siltstone				
95-100	Sand, cream, very fine grained; minor siltstone				
100-105	Sand, mostly cream colored but partly orange (oxidized), very fine grained				
105-110	Sand, light-brown, very fine grained				
110-115	Claystone (shale), dark-gray				
115-120	Mixed siltstone, gray; claystone, dark-gray, organic-rich (almost carbonaceous shale)				
120-125	Mixed siltstone, gray; weathered sandstone, light-brown, fine-grained				
125-130	Mixed siltstone, light-gray; weathered sandstone, light-brown, fine-grained				
130-135	Sand, light-brown (slightly oxidized), very fine grained; sparse siltstone fragments				
135-140	Shale, dark-gray				
140-145	Siltstone to shale, gray; coal, hard; driller says approximately 1 1/2 ft of coal				
145-150	Siltstone, light-gray				
150-155	Siltstone, medium-light-gray				
155-160	Siltstone, medium-light-gray; sandstone, light-brown, very fine grained				
160-165	Sandstone, light-brown; clay shale, fissile, brown to black, carbonaceous with coaly streaks				



Lithology		Strip Log	Depth		Geophysical Logs		
			ft	m	Gamma	Den	Res
165-170	Sandstone, light-gray to gray, very fine to fine-grained; siltstone, medium-gray with some coaly streaks; trace carbonaceous claystone						
170-175	Sandstone, grayish-brown to pale-yellowish-orange, very fine grained, hard, sugary texture						
175-180	Sandstone as in interval above; siltstone, grayish-brown, well-cemented						
180-190	Sandstone, pale-yellowish-orange, very fine to fine-grained						
190-205	Sandstone, pale-yellowish-orange, fine- to medium-grained						
205-210	Siltstone, light-gray to brownish-black; less than 1 ft of coaly shale						
210-215	Siltstone and sandy siltstone, medium-gray to brownish-gray						
215-220	Siltstone, medium-gray						
220-225	Siltstone, brownish-gray, slightly clayey with some carbonaceous streaks and (or) possible roots; coal, bright black, shiny (vitrain); driller estimates coal approximately 2 ft thick						
225-230	Shale, silty; fissile, brownish-black; siltstone, medium-gray						
230-235	Siltstone, medium-gray						
235-240	Siltstone and sandy siltstone, medium-gray						
240-245	Sandstone, pale-yellowish-orange, very fine grained						
245-250	Sandstone, pale-yellowish-orange, fine- to medium-grained						
250-255	Sandstone, pale-yellowish-orange, medium-grained						
255-260	Sandstone, pale-yellowish-orange, fine-grained; trace coal chips						
260-265	Sandstone, same as above interval for 2 ft; then clay shale, medium-dark-gray; carbonaceous shale, brownish-black						
265-270	Siltstone, sandy siltstone and sandstone, medium-gray, very fine grained; abundant thin coaly streaks						
270-275	Siltstone, light-gray; sandstone, yellowish-orange, very fine grained						
275-280	Siltstone; sandstone, yellowish-orange; trace coal						
280-285	Sandstone, pale-yellowish-orange, highly oxidized; dark yellowish brown at 283 ft, hard sandstone at 284 ft						
285-290	Sandstone to approximately 286 ft; then siltstone, light-gray to medium-gray						
290-295	Claystone, dark-brownish-gray, hard sandy streak at 293 ft						
295-300	Siltstone, medium-gray						
300-305	Siltstone, medium-gray; sandstone, medium-grained to very fine grained; slight limonite staining at 304 ft						
305-310	Sandstone, pale-yellowish-orange, very fine grained to fine-grained; highly oxidized (limonite) at approximately 309 ft						
310-315	Sandstone, dark-yellowish-orange, fine- to medium-grained						
315-320	Sandstone; siltstone, light-gray						
320-325	Siltstone, medium-gray; some carbonaceous shale with trace coal						
325-330	Siltstone, medium-gray; sandstone, light-gray; trace carbonaceous shale						
330-335	Siltstone, medium-gray						
335-340	Siltstone, medium-brown, medium-gray; trace coal fragments						
340-345	Siltstone, medium-gray; trace hard sandstone, light-gray, fine-grained						
345-350	Siltstone, medium-gray; sandstone, yellowish-orange, very fine grained						
350-355	Siltstone, light-brown; sandstone, yellowish-orange, fine-grained, medium-hard						
355-360	Siltstone, medium-gray, grayish-brown, medium-brown						
360-365	Siltstone, medium-gray; coal about 1 ft thick						
365-370	Siltstone, light-gray, light-brown; sandstone, light-brown, yellowish-orange						
370-375	Siltstone, light-brown, light-gray; sandstone, light-brown, very fine grained						
375-485	Lost circulation; no returns						
485-490	Sandstone, light-gray, very fine grained						
490-495	Sandstone, light-gray, very fine grained; siltstone, medium-gray						
495-500	Siltstone, light-gray; some sandstone, light-gray, very fine grained; trace coal						
500-505	Siltstone, medium-dark-brown; clay shale, brownish-gray, some carbonaceous streaks						
505-510	Siltstone, dark-gray; sandstone, light-gray, very fine grained						
510-515	Siltstone, medium-gray; sandstone, light-gray; coal about 1.5-2 ft thick						

Lithology		Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
515-520	Siltstone, light-gray; carbonaceous shale, brownish-black with coaly streaks; trace sandstone, light-gray; coal				
520-525	Siltstone, medium-gray; sandstone, light-gray, very fine grained			230	
525-530	Siltstone, medium-gray, sandy; sandstone, light-gray, very fine grained; trace silty shale and carbonaceous shale				
530-535	Coal, bright-black (good return), approximately 6 ft thick		750	240	
535-540	Siltstone, medium-gray; carbonaceous shale; 1.5 ft of coal at 540 ft				
540-550	Siltstone, dark-gray, clayey				
550-555	Siltstone, dark-gray; sandstone, yellowish-orange, very fine grained			250	
555-560	Claystone, medium-light-gray; sandstone, yellowish-orange, very fine to fine-grained				
560-756	T.D.; no circulation		800	260	
			850	270	

CST-3

El. 9,660

Core description	Drill depth (ft)
First core run	
Sandstone, light-gray, fine- to medium-grained, well-rounded, well-sorted, few clay drapes and rip-up clasts, scour at base with 0.2 in. lag, unfractured	426 -427.7
Siltstone, sandy, crudely laminated upper portion, contorted bedding, bioturbated at base, burrows extend into next unit	427.7 -429.6
Sandstone, silty, light-gray with dark-gray clasts, inter-laminations, burrowed convoluted bedding, laminated at base with occasional burrows, sharp base	429.6 -431.3
Siltstone, medium-gray to dark-gray, massive, burrowed at top, coaly and carbonaceous material throughout	431.3 -434.75
Carbonaceous shale, coaly lenses squeezed 0.2 in. into previous unit	434.75-435
Coal, vertical fractures, resin blebs, pyrite lenses	435 -439.5
Carbonaceous shale, coal stringers and pyrite lenses	439.5 -439.8
Siltstone, dark-gray to medium-gray, burrowed at top, pyrite at 441 ft; resin at 441.4 ft; carbonaceous material throughout	439.8 -441.85
Sandstone, light-gray, fine-grained, well-rounded shale streaks, burrowed, limonite stains in upper portion; vertical fractures at 443.3-443.6 ft; dark-gray silty shale and interbedded sandstone with burrows	441.85-446
Second core run	
Mudstone, light-gray, siltstone clasts	491.1 -491.2
Siltstone, dark-gray, burrowed, rooted, carbonaceous	491.2 -493.4
Sandstone, light-gray, very fine grained, finely laminated dark-gray shale, plastic deformation, burrowed	493.4 -494.2
Siltstone, dark-gray, shaly, carbonaceous, rooted, burrowed, coal lenses near bottom	494.2 -496.6

CST-3--Continued

Core description	Drill depth (ft)
Coal, fractured resin blebs throughout; sandy shale lens at 497.4-497.45 ft	496.6 -500.6
Shale, coaly, pyrite	500.6 -500.7
Siltstone, medium-gray, fine-grained, massive	500.7 -500.95
Siltstone, light- to medium-gray, rooted, burrowed at top, grading to mudstone at bottom	500.95-503.75
Mudstone, yellowish-brown	503.75-504
Third core run	
Sandstone, gray, fine-grained, cross bedded, very thin carbonaceous shale streaks	526 -531.4
Coal, fractured, resin blebs at 533.4-533.7 ft, carbonaceous shale parting with resin	531.4 -534.6
Carbonaceous shale	534.6 -535.3
Coal, pyrite and resin blebs	535.3 -535.5
Sandstone, fine- to medium-grained, fining upward; thin carbonaceous shale interbedded, burrowed; plastic deformation at 536.7 ft; pyrite, carbonaceous shale lens at 537.5 ft	535.5 -537.9
Siltstone, yellowish-brown, burrowed	537.9 -538.1
Siltstone and interbedded carbonaceous shale, dark-gray, pyrite streaks and resin blebs	538.1 -538.9
Carbonaceous shale, coal lens, pyrite streaks, resin blebs	538.9 -539.1
Coal, fractured, resin blebs	539.1 -543.1
Siltstone, dark-gray, interbedded carbonaceous shale, pyrite streaks at top, carbonaceous streaks throughout, claystone at 545.2-545.4 ft	543.1 -545.4

CST-3--Continued

Core description	Drill depth (ft)
Fourth core run	
Sandstone, yellowish-brown, medium- to fine-grained, carbonaceous streaks, crossbedded.....	646 -648.5
Sandstone, yellowish-brown, fine-grained, crossbedded, rippled, shale streaks at base.....	648.5 -653.75
Coal, sharp contact above and below contact.....	653.75-659.4
Sandstone, medium- to light-gray, fine-grained, crossbedded, upper part of core rooted to 663 ft.....	659.4 -666

LITHOLOGIC AND GEOPHYSICAL LOGS

LOCATION NUMBER CST-4 DATE 9/22/85 SURFACE ELEVATION(ft) _____

LOCATION 700' fel, 1900' fsl Sec. 27 T. 14 S. R. 7 E. Quad. Wattis

COUNTY Carbon STATE Utah TOTAL DEPTH(ft) 835

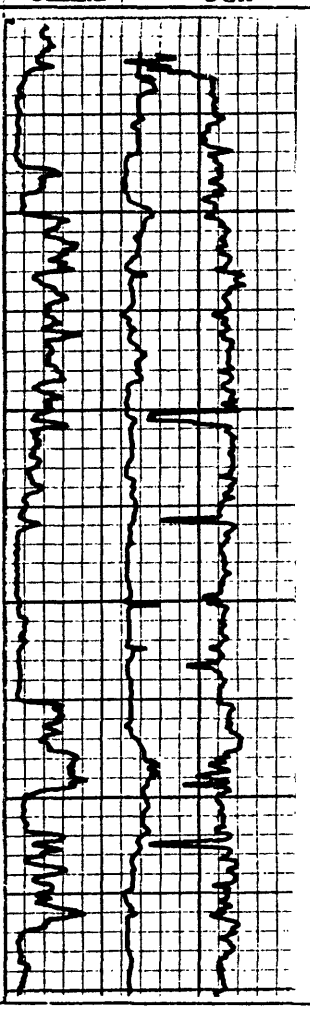
CORED YES [ ] NO [X] INTERVAL(s) _____

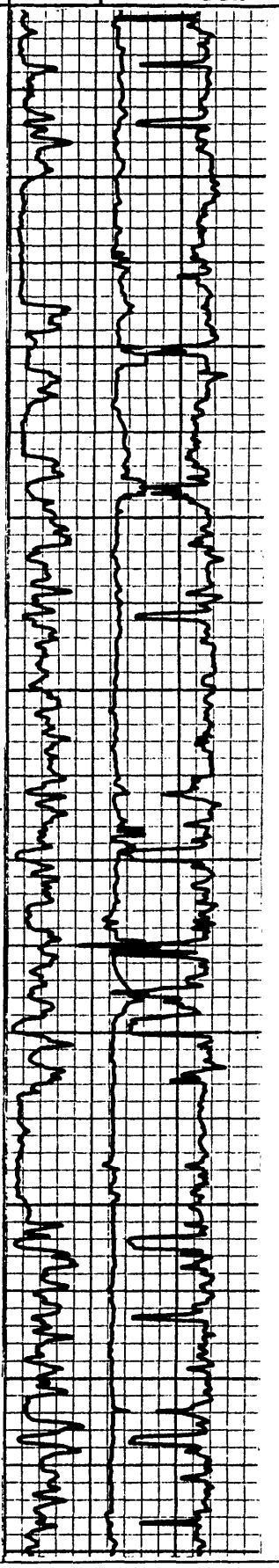
DRILLING MEDIUM: [X] AIR [X] FOAM [ ] MUD [ ] WATER OBSERVATION WELL

GEOPHYSICAL LOGS:

Natural Gamma	; Scale	1" = 500 cps	Logging Speed	15	fpm
Gamma Gamma	; Scale	1" = 3.75 cps	Logging Speed	15	fpm
Resistivity	; Scale		Logging Speed		fpm
Caliper	; Scale	1" = 25"	Logging Speed	15	fpm

Lithology		Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
0- 5	Soil with some siltstone and claystone		0	0	
5- 10	Sandy siltstone, thin oxidized coal at 8 ft; siltstone with organic fragments				
10- 15	Sandstone, light-brown, very fine grained; 0.3 ft coal at 11 ft; medium-gray claystone at 14 ft			10	
15- 20	Sandstone, light-brown, medium- to fine-grained, slightly oxidized		50		
20- 35	Sandstone, light-brown to cream colored, very fine grained; few pieces of gray claystone, iron staining around grains; driller (Steve Grant) says hole is starting to cave in because of fractured rock			20	
35- 40	Sandstone, light-brown or cream, fine-grained				
40- 45	Claystone (clay shale), very dark brown, carbonaceous, well-oxidized, much iron staining				
45- 50	Sandstone, light-gray, very fine grained; some clay siltstone		100	30	
50- 55	Sandstone, orange, fine-grained, with common very dark brown clays (clay shale) Mixing mud at 55 ft; rock is highly fractured and keeps caving				
55- 60	Sandstone, brown; claystone (mud balls), dark-gray, fine-grained			40	
60- 65	Claystone, medium-gray; driller says back to sand at approximately 67 ft				
65- 70	Sandstone, light-brown, fine-grained, some iron staining; still a lot of gray claystone; also gray siltstone		150		
70- 75	Siltstone, medium-gray			50	
75- 80	Mixed sandstone and shale (claystone), light-brown, cream colored, fine-grained, some iron staining; driller says silty shale at approximately 78 ft				
80- 85	Claystone (shale), gray; sandstone, light-brown; driller hit sandstone at approximately 83 ft)			60	
85- 90	Driller says mixed sandstone-shale; sandstone, light-brown; claystone, gray		200		
90- 95	Mixed sandstone and claystone, light-brown; went through zone of very oxidized rock, bright-orange; driller hit hard sand at 96 ft			70	
95-100	Mixed sandstone, light-brown; shale, gray; slightly oxidized				
100-105	Shale, gray; coal; 2 1/2-3 ft of coal at depth of 103 ft		250		
105-110	Sandstone, light-brown to cream, very fine grained; minor amount of gray claystone; some black carbonaceous material				
110-115	Sandstone, cream colored, very fine grained				



Lithology	Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
115-120 Sandstone, mostly light-brown to cream, very fine grained; minor amount shale; part of interval moderately oxidized, orange 120-125 Sandstone, light-brown, fine-grained; some claystone, gray 125-130 Sandstone, cream colored; beach sand, very fine grained; 1 ft of coal at 130 ft 130-135 Coal at bottom; sandstone, very light gray or cream (almost white), very fine grained 135-165 Beach sand, white to tan, very fine grained 165-170 No sample; lost circulation 170-175 No sample 175-180 No sample; lost circulation 180-185 Hard spot or fracture; 182 ft still in thick sandstone of measured section CST-4 185-195 No sample 195-415 No sample; approximately 8-in. void at 255 ft 415-715 No circulation or samples; void at 525 ft 715-835 No circulation		300 350 400 450 500 550 600 650 700	90 100 110 120 130 140 150 160 170 180 190 200 210	

Lithology	Strip Log	Depth		Geophysical Logs		
		ft	m	Gamma	Den	Res
		750	230			
			240			
			250			
		800	260			
		850	270			

LITHOLOGIC AND GEOPHYSICAL LOGS

LOCATION NUMBER CST-5A DATE 10/15/85 SURFACE ELEVATION(ft) 9560

LOCATION 2400' fel, 580' fsl Sec. 22 T. 14 S. R. 7 E. Quad. Candland Mtn.

COUNTY Emery STATE Utah TOTAL DEPTH(ft) 677

CORED YES [ ] NO [X] INTERVAL(s) _____

DRILLING MEDIUM: [X] AIR [X] FOAM [ ] MUD [ ] WATER OBSERVATION WELL

GEOPHYSICAL LOGS:

Natural Gamma	;	Scale	1" = 500 cps	Logging Speed	fpm
Gamma Gamma	;	Scale	1" = 3.75 cps	Logging Speed	fpm
Resistivity	;	Scale		Logging Speed	fpm
Caliper	;	Scale	1" = 25"	Logging Speed	fpm

Lithology		Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
0- 5	Soil, brownish-gray, sandy		0	0	
5- 10	Soil, reddish-brown, oxidized, with bits of clay and sandstone				
10- 15	Soil, reddish-brown, oxidized, with carbonaceous clay and sandstone pieces			10	
15- 20	Mud with clay; sandstone, fine-grained, carbonaceous 20- 25Sandstone, fine-grained, oxidized, carbonaceous; clay; loose sand; dirt		50		
25- 30	Sandstone, gray, very hard, well-cemented, very fine to fine-grained; clay bits; sandstone, yellowish-brown, very oxidized, carbonaceous			20	
30- 35	Silt, loose; clay, brown; shale, carbonaceous				
35- 40	Silt, loose, oxidized; sandstone, oxidized, fine- to medium-grained, ironstone concretions with pyritized centers				
40- 45	Clay, carbonaceous; sandstone, gray, very fine grained; sandstone, oxidized, fine-grained, with ironstone concretions		100	30	
45- 50	Clay, partially oxidized; siltstone, very hard; sandstone, very fine grained				
50- 55	Sandstone, fine-grained, partially oxidized				
55- 60	Siltstone, oxidized, sandy; shale, carbonaceous with gypsum coatings				
60- 65	Sandstone, gray, very fine to fine-grained, silty, carbonaceous, partially oxidized; minor siltstone			40	
65- 70	Sandstone, very fine to fine-grained, oxidized, carbonaceous				
70- 75	Sandstone, fine-grained, carbonaceous, oxidized, partially weathered; some silty sandstone		150		
75- 80	Sandstone, very fine to fine-grained, partly silty, carbonaceous, unweathered; sandstone, very fine grained, silty, carbonaceous, pyritized; some siltstone			50	
80- 85	Sandstone, well-cemented, very fine-grained; sandstone, carbonaceous, oxidized, uncemented, fine-grained				
85- 90	Shale, dark-gray, carbonaceous; sand, oxidized, carbonaceous, fine-grained			60	
90- 95	Shale, dark-gray, carbonaceous, sandy, with coal stringers; sandstone, hard, quartzitic, oxidized in part, fine-grained		200		
95-100	Shale, hard; coal at 97-100 ft			70	
100-105	Coal; shale, sandy, carbonaceous; sandstone, some gray, fine-grained, quartzitic				
105-110	Shale, sandy, carbonaceous; bits of coal				
110-115	Sandstone, silty, very fine grained; shale, carbonaceous, silty				
115-120	Siltstone, dark-gray, sandy		250		

Lithology		Strip Log	Depth		Geophysical Logs		
			ft	m	Gamma	Den	Res
120-125	Shale, sandy, coaly, carbonaceous; small amount of sandstone, fine-grained						
125-130	Sandstone, gray, fine-grained, quartzitic Note: Water first entered drill hole at about 130-ft depth.						
130-135	Siltstone, gray, sandy; shale, carbonaceous; sandstone, silty						
135-140	Clay, muddy, wet; claystone; bits of coal; shale, carbonaceous						
140-145	Siltstone, sandy; shale, carbonaceous; bits of coal; sandstone, bright orange, fine-grained, very oxidized						
145-150	Siltstone, gray, hard, sandy; shale, carbonaceous, bits of coal; sandstone, fine-grained, very oxidized, carbonaceous						
150-155	Same as interval above with coaly carbonaceous shale						
155-165	Sandstone, fine-grained, very oxidized; bits of coal; shale, carbonaceous; siltstone, gray, hard, sandy						
165-170	Sandstone, yellow, loose, oxidized; sandstone, gray, fine-grained; sandstone, yellow, oxidized; ironstone						
170-175	Shale, gray, sandy, carbonaceous; sandstone, yellowish-orange, oxidized; claystone						
175-180	Sandstone, gray, fine-grained, carbonaceous; bits of coal; sandstone, yellow, medium-grained, oxidized						
180-185	Coal; sandstone, gray, fine-grained, carbonaceous, hard; sandstone, yellow, medium-grained, oxidized						
185-190	Same as interval above; not as much coal; sandstone, yellow, fine-grained						
190-195	Sandstone, yellow, fine-grained, oxidized; sandstone, gray, fine-grained; shale, carbonaceous; bits of coal						
195-200	Sandstone, yellow, fine- to medium-grained, oxidized, very carbonaceous; sandstone, gray, fine-grained, carbonaceous; shale, carbonaceous, coaly						
200-205	Siltstone, sandy; shale, carbonaceous; claystone; sandstone, yellow to beige, fine-grained						
205-210	Sandstone, yellow, fine-grained, very carbonaceous, iron-stained; siltstone, sandy, carbonaceous; shale; bits of coal						
210-220	Sandstone, strongly iron stained, fine- to medium-grained; bits of coal; shale, gray						
220-225	Sandstone, dark-gray, fine-grained, silty; siltstone; shale, carbonaceous, coaly; sandstone, yellow, shaly, oxidized						
225-230	Siltstone, gray; shale; a few bits of coal; sandstone, yellow, very fine grained						
230-235	Shale, carbonaceous; partly coaly						
235-240	Siltstone, gray, shaly; a few bits of coal (probable washup)						
240-245	Same as interval above but no coal; more carbonaceous shale						
245-250	Same as 235- to 240-ft interval but no coal						
250-255	Sandstone, gray, fine-grained, carbonaceous; shale, carbonaceous; coal; sandstone, yellow, fine-grained, carbonaceous						
255-265	No sample						
265-270	Sandstone, gray, fine-grained; shale, black, carbonaceous; coal						
270-275	Siltstone, gray, sandy; coal at 273 ft (2-3 ft thick)						
275-280	Shale, gray, carbonaceous; shale, black, carbonaceous; sandstone, yellow, fine-grained						
280-285	Lost circulation						
285-290	Sandstone, yellow, fine-grained, oxidized						
290-295	Siltstone, gray; shale, black; sandstone, yellow, fine-grained, oxidized; coal at 293-294 ft (approximately 1 ft thick)						
295-300	Shale, black, coaly, carbonaceous; sandstone, gray, fine-grained; sandstone, orange, very weathered; coal						
300-305	Sandstone, gray, fine-grained, well-cemented, hard; shale, carbonaceous; coal; sandstone, orange, fine- to medium-grained, very oxidized						
305-315	Siltstone, gray; sandstone, gray, fine-grained; sandstone, yellow, fine- to medium-grained; some coal pieces						
315-320	Shale, gray, carbonaceous; siltstone; sandstone, yellow, fine-grained, oxidized; claystone, yellow, oxidized						
320-325	Siltstone, gray; sandstone, fine-grained; pieces of coal						
325-330	Shale, carbonaceous; some coal (probably interbedded); siltstone, carbonaceous						
330-335	Siltstone, gray; coal interbedded with carbonaceous shale; sandstone, orange, fine-grained						
335-340	Siltstone, gray, carbonaceous; shale, carbonaceous, coaly; some coal; sandstone, yellowish-orange, fine-grained, very oxidized						

Lithology		Strip Log	Depth		Geophysical Logs		
			ft	m	Gamma	Den	Res
140-350	Sandstone to siltstone, gray, fine-grained, carbonaceous; coal; sandstone, yellowish-orange, fine-grained, very oxidized						
350-355	Shale, black, coaly, carbonaceous; siltstone, gray; sandstone, fine-grained, oxidized						
355-360	Siltstone, gray, fine-grained, sandy grading to sandstone; sandstone, yellow, fine-grained, weathered						
360-365	Shale, black, carbonaceous, coaly; siltstone, gray, carbonaceous; sandstone, yellow, weathered						
365-375	Same as interval above with bits of coal						
375-380	Same as 360- to 365-ft interval						
380-390	Siltstone, gray, carbonaceous; shale, black, coaly, carbonaceous; sandstone, yellow, weathered						
390-395	Siltstone, gray, carbonaceous, grading to shale; sandstone, yellow, small amount, weathered						
395-400	Siltstone, gray; shale, dark-gray, carbonaceous; sandstone, beige, fine-grained; sandstone, yellow, fine- to medium-grained, weathered						
400-405	Coal; shale, dark-gray, carbonaceous; sandstone, yellow, fine-grained, weathered, small amount; siltstone, gray, small amount						
405-410	Same as interval above with coal						
410-415	Same as 400- to 405-ft interval; another stringer of coal around 415 ft (approximately 1 ft thick)						
415-440	Siltstone, gray; shale, dark-gray, carbonaceous; coal flecks; sandstone, yellowish-orange, small amount						
440-445	Same as interval above but more carbonaceous shale						
445-450	About half of sample is coal; shale, carbonaceous; siltstone; hit coal at 447 ft						
450-460	Mostly siltstone and shale, carbonaceous; some coal						
/465	Shale, carbonaceous; siltstone, carbonaceous; some coal; sandstone, yellowish-orange, weathered						
465-470	Siltstone, gray; shale, carbonaceous						
470-475	Shale, carbonaceous; siltstone; sandstone, weathered, small amount						
475-480	Coal; shale, carbonaceous; siltstone, small amount, weathered						
480-485	Coal; shale, carbonaceous; siltstone, yellow, weathered						
485-490	Shale, carbonaceous; siltstone; bits of coal						
490-495	Shale, carbonaceous; siltstone						
495-500	Shale, carbonaceous; siltstone; bits of coal						
500-520	Mostly siltstone; minor bits of coal; sandstone, weathered						
520-530	Same as interval above; more carbonaceous shale and coal						
530-535	Mostly siltstone						
535-540	Mostly siltstone and shale; more sand						
540-555	Coal; shale, carbonaceous; siltstone						
555-565	Coal; sandstone, gray, fine-grained; siltstone; shale						
565-570	Coal; sandstone, gray, fine- to medium-grained; siltstone; shale						
570-585	Sandstone, gray, fine-grained, carbonaceous; siltstone; shale; few bits of coal						
585-590	Same as interval above with larger bits of coal						
590-595	Same as 570- to 585-ft interval with no coal						
595-600	Same as 570- to 585-ft interval; sandstone						
600-605	More than half of sample is coal; some siltstone; sandstone						
605-610	Coal (60-70 percent)						
610-620	Very small sample; some coal						
620-630	Sandstone, weathered; sandstone, gray, unweathered; some shale and siltstone, carbonaceous; some coal						
630-635	Same as interval above; sandstone, fine-grained, weathered						
635-640	Sandstone, carbonaceous, weathered, crumbles easily						
640-645	Sandstone, medium-grained, carbonaceous						
645-650	Sandstone, weathered, carbonaceous, medium-grained; bits of coal; shale, carbonaceous						
650-655	Same as 645- to 650-ft interval, with carbonaceous clay						
655-665	Same as 645- to 650-ft interval; mostly sandstone						

LITHOLOGIC AND GEOPHYSICAL LOGS

LOCATION NUMBER CST-6 DATE 10/18/85 SURFACE ELEVATION(ft) 9425

LOCATION 1650' fwl, 1430' fsl Sec. 15 T. 14 S. R. 7 E. Quad. Candland Mtn.

COUNTY Carbon? STATE Utah TOTAL DEPTH(ft) 656

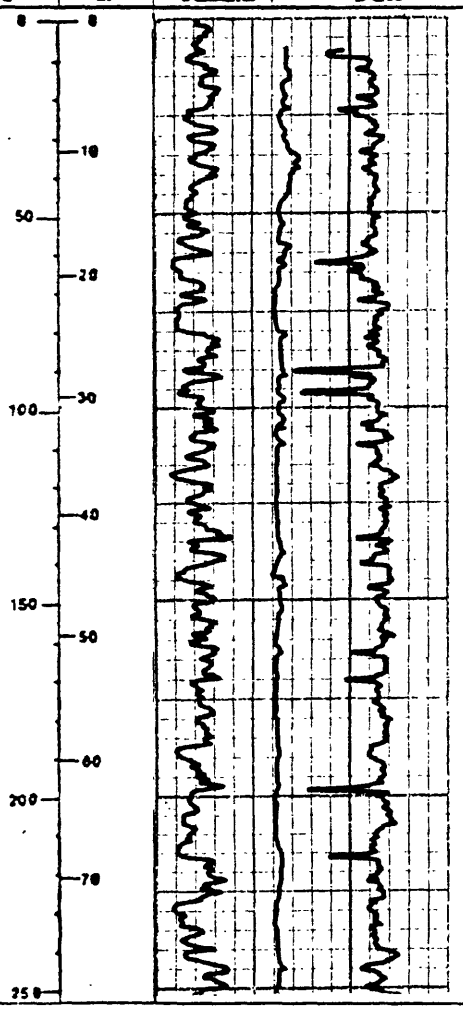
CORED YES [ ] NO [X] INTERVAL(s) _____

DRILLING MEDIUM: [X] AIR [X] FOAM [ ] MUD [ ] WATER OBSERVATION WELL

GEOPHYSICAL LOGS:

Natural Gamma	;	Scale	1" = 500 cps	Logging Speed	_____ fpm
Gamma Gamma	;	Scale	1" = 3.75 cps	Logging Speed	_____ fpm
Resistivity	;	Scale	_____	Logging Speed	_____ fpm
Caliper	;	Scale	1" = 25"	Logging Speed	_____ fpm

Lithology		Strip Log	Depth ft	Depth m	Geophysical Logs: Gamma / Den / Res
0- 5	Soil; clay				
5- 10	Shale and clay, coaly, carbonaceous; soil; sandstone, fine-grained (approximately 2 ft thick at depth of 8 ft)				
10- 20	Clay, carbonaceous; shale, carbonaceous; sandstone, carbonaceous, weathered; coal stringer at 15 ft				
20- 25	Clay, carbonaceous; shale; siltstone				
25- 30	Siltstone and shale, yellow, carbonaceous, weathered; sandstone, fine-grained, weathered				
30- 35	Clay, carbonaceous; shale, siltstone; some sandstone, fine-grained				
35- 40	Shale, carbonaceous, sandy; siltstone; some sandstone				
40- 45	Shale and siltstone, carbonaceous, sandy				
45- 50	Siltstone, carbonaceous; sandstone, fine-grained, weathered				
50- 55	Sandstone, fine-grained, carbonaceous, silty; shale				
55- 60	Sandstone, fine-grained, soft, carbonaceous; siltstone				
60- 65	Shale, carbonaceous; sandstone, fine-grained, very weathered; sand, loose				
65- 70	Shale, carbonaceous, sandy; sandstone, fine-grained, very weathered				
70- 75	Sandstone, fine-grained, very well cemented, hard, pyritized				
75- 80	Sandstone, fine-grained, carbonaceous, pyritized; some siltstone and shale, carbonaceous				
80- 85	Shale, carbonaceous				
85- 90	Shale and siltstone, carbonaceous, coaly; some sandstone, fine-grained				
90- 95	Coal (approximately 2 ft thick at 91- to 93-ft depth); shale, carbonaceous, coaly; some siltstone				
95-100	Coal (approximately 1 ft thick at about 96-ft depth); shale, carbonaceous; some siltstone				
100-105	Shale, carbonaceous, coaly, sandy; siltstone, sandy				
105-110	Shale, carbonaceous; sandstone, very fine grained, carbonaceous				
110-115	Shale, coaly, carbonaceous; shale, sandy, carbonaceous; sandstone, very fine grained				
115-135	Sandstone, gray, fine-grained, carbonaceous, well-cemented; some siltstone				
135-140	Siltstone, sandy, carbonaceous, grading to carbonaceous shale				
140-145	Sandstone, silty; shale, carbonaceous				
145-150	Coal; sandstone; shale and siltstone, carbonaceous				
150-160	Siltstone, carbonaceous; shale; sandstone				
160-165	Coal stringer at approximately 163 ft; sandstone, fine-grained; shale, carbonaceous				
165-175	Sandstone, gray, carbonaceous; siltstone; shale				
175-180	Mostly sandstone, gray, fine-grained; coal flecks				



Lithology		Strip Log	Depth		Geophysical Logs		
			ft	m	Gamma	Den	Res
180-185	Sandstone, very fine grained; siltstone						
185-190	Sandstone, very fine grained; shale and siltstone, carbonaceous						
190-195	Siltstone, carbonaceous; sandstone, very fine grained, carbonaceous						
195-205	Sandstone, carbonaceous, fine-grained; siltstone; bits of coal with coaly carbonaceous shale						
205-210	Siltstone, carbonaceous, fine-grained, silty; coal flecks						
210-215	Sandstone, carbonaceous, fine-grained; siltstone; coal flecks						
215-220	Sandstone, carbonaceous, silty; siltstone; shale						
220-225	Siltstone, carbonaceous, sandy; shale						
225-230	Siltstone, coaly, carbonaceous						
230-235	Siltstone, coaly, carbonaceous; sandstone, gray, fine-grained; some sandstone, fine-grained, weathered						
235-245	Sandstone, gray, fine- to medium-grained; shale, some weathered, some dark mineral grains, carbonaceous						
245-250	Siltstone, mostly carbonaceous; shale; a few bits of coal						
250-255	Shale and siltstone, carbonaceous (there have been large plant fragments in the last four or five samples)						
255-260	Coal, with resin in coal bits; shale and siltstone, carbonaceous, with plant fragments						
260-265	Shale and siltstone, carbonaceous, with plant fragments; bits of coal						
265-270	Shale, carbonaceous; siltstone; sandstone, silty						
270-275	Coal and carbonaceous shale; coal at approximately 271-273.5 ft; a coal stringer with much carbonaceous shale at approximately 276 ft						
275-280	Shale, carbonaceous; a few bits of coal						
280-285	Sandstone, carbonaceous, fine-grained; shale; siltstone						
285-290	Bits of coal; shale, carbonaceous; sandstone, weathered; some sandstone, gray, fine-grained; siltstone						
290-295	Sandstone, gray, fine- to medium-grained, mostly weathered and unweathered, carbonaceous; minor coal; shale, carbonaceous						
295-300	Siltstone and shale, mostly carbonaceous; minor sandstone, weathered						
300-305	Sandstone, fine-grained, mostly carbonaceous; siltstone						
305-310	Shale, coaly, carbonaceous; sandstone						
310-315	Siltstone, mostly carbonaceous, sandy						
315-325	Shale, carbonaceous; sandstone, carbonaceous; siltstone						
325-335	Mostly shale, carbonaceous						
335-340	Sandstone, fine-grained, mostly carbonaceous; siltstone, sandy						
340-345	Shale, carbonaceous, with plant fragments; sandstone, gray, fine-grained						
345-350	Siltstone, mostly sandy, carbonaceous; sandstone; shale, carbonaceous						
350-355	Coal, dirty; shale, coaly, carbonaceous; sandstone, gray, fine-grained; siltstone						
355-360	Sandstone, fine-grained, carbonaceous; siltstone						
360-365	Shale, carbonaceous, with plant fragments; siltstone						
365-370	Sandstone, gray; siltstone and shale, carbonaceous						
370-375	Coal (approximately 1 ft thick); shale, carbonaceous; siltstone; sandstone						
375-380	Coal; sandstone; shale, carbonaceous; siltstone						
380-385	Coal; sandstone, carbonaceous; siltstone						
385-390	Sandstone, gray, carbonaceous; shale, black; stringer of coal						
390-400	Siltstone and sandstone, carbonaceous						
400-405	Shale, carbonaceous; siltstone, sandy						
405-415	Shale, carbonaceous; siltstone; sandstone						
415-420	Mostly siltstone, sandy						
420-425	Mostly siltstone with sandstone and carbonaceous shale						
425-430	Mostly shale, black; bits of sandstone, gray						
430-435	Shale, mostly carbonaceous; siltstone; coal flecks						
435-440	Mostly siltstone and sandstone; some shale						
440-445	Sandstone, gray, very fine grained, hard						
445-470	Sandstone, fine-grained; siltstone and shale, carbonaceous						
470-475	Sandstone; siltstone; coal; hit coal seam from 474 to 479 ft						
475-480	Coal						
480-510	Sandstone, gray, fine-grained; siltstone; some shale						
510-515	Coal at approximately 510-513 ft; minor sandstone, siltstone, and shale						
515-525	Shale, carbonaceous, coaly; siltstone and sandstone, fine-grained						
525-530	Same as interval above; more sandstone than shale						
530-535	Same as 515- to 525-ft interval except 1 ft of coal at approximately 535 ft						

Lithology	Strip Log	Depth ft	Depth m	Geophysical Logs Gamma	Geophysical Logs Den	Geophysical Logs Res
535-545 Sandstone, fine-grained, hard						
545-550 Same as interval above; sand						
550-555 Sandstone, fine-grained; shale, carbonaceous						
555-565 Sandstone, medium-grained; with dark mineral grains, looks like beach sand						
565-570 Coal						
570-575 Coal; shale, carbonaceous; medium sand						
575-580 Shale, carbonaceous; siltstone; sandstone						
580-595 Siltstone, carbonaceous; sandstone						
595-600 Shale, carbonaceous; siltstone						
600-605 Shale, carbonaceous; siltstone; some sandstone						
605-610 Shale, carbonaceous; siltstone						
610-615 Shale, carbonaceous; siltstone with plant fragments						
615-620 Siltstone and shale, carbonaceous, with plant fragments						
620-625 Same as interval above; more coal						
625-630 Coal; a little carbonaceous shale						
630-635 Little coal; shale, mostly carbonaceous; sandstone, fine- to medium-grained, beach looking						
635-645 Sandstone, carbonaceous, beach looking						
645-655 Sandstone, good beach; with scattered dark mineral grains						