APPENDIX 6-1

TYPICAL DRILL LOGS
OF
COAL CORE HOLES
S-32, S-27, S-14, IPA#1, IPA#2, IPA#3

Information for Appendix 6-1 is ALL hard copies. Electronic copies do not exist for the information contained within the Appendix.

3.0 DATA SUMMARIES

3.1 IPA-1

Location

N 400,026 E 2,336,932 (feet)
Section 13 T 16 S R 14 E (SLBM)
Emery County, Utah
Ground Elevation: 7,034 feet above mean sea level
Top-of-Casing Elev. 7,032.51 feet above mean sea level
Total Depth Drilled: 1,741 feet below ground level

Formation Tops

Stratigraphic Unit	Depth Below Ground Level (feet)	Elevation (feet above mean sea level)
Flagstaff-North Horn Formation	at surface (incomplete section)	
Bluecastle Member, Price River Formation	816	6,218
Mudstone Member, Price River Formation	1,074	5,960
Castlegate Sandstone	1,290	5,744
Upper Mudstone Member, Blackhawk Formation	1,486	5,548
Grassy Member, Blackhawk Formation	1,605	5,429
Sunnyside Coal Seam	1,655	5,379
Sunnyside Member, Blackhawk Formation	1,670	5,364

Geologic Log

EarthFax

PROJECT No.: UC-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: _____

DRILLER: BEEMAN LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
DRILL ROTARY W/ FOAM TO 105' W/ 6½ bit TO SET SURF CASING REAM W/ 8¾"			0		UNCONSOLIDATED ALLUVIAL MATERIAL 0-18'. VF grained SAND W/ SILT ORANGE, GRAY, BROWN SS CLASTS
			10		A.A.
			20		SS PREDOMINANT vf grained. BRN-GRY-ORNG. CALC. GR HRD SR-R
			30		SS. Lt gray. vfu-F grained. SA-SR. CALC. APPROX 15% DARK MINERALS. FRIABLE
			40		A.A. OCC Lt gray-white STSIT.
			50		50% STS - Lt gray-white 50% S.S. AA STS contains DRK MIN. SOFT.
			60		90% SS fine grained. W SR-SA Grains. 20% DARK MINERALS. HARD. OCC RED-ORANGE CLASTS 10% STS
			70		A.A. W/ APPROX 30% MUDSTONE. MST IS MOTTLED BROWN-RED TO LT GRY. ANGULAR - SOFT
			80		60% MST. SHALE LIKE GRY. SOFT. 40% vf gr. S.S. A.A.
			90		70% MST. AA. SHALEY. BREAKS IN SHARP FRACTURE.
			100		

TRAY A

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-20-93 DATE END: _____

DRILLER: SEEMAN LOGGER: JDG/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
0700 HRS, 10-29-93			100		50% SS, UFG, FRM-HRD, MOD CALC, GRY, SRND-RND, TR DRK MINS. 50% MST, BRN, RDBRN, CALC, FIRM-SFT. TR PYRITE IN SS.
			110		AA - PRED LT BRN (MST)
			120		70% SS AA, 30% MST AA PRED LT BRN
			130		-AA - OCC CLAST OF SS F-MG, SANG, ≈ 15% DRK MINS, LOOSELY CEMENTED.
			140		-AA-
			150		-AA-
			160		-AA-
			170		40% SS AA 60% MST AA, PRED LT GRY, LT BRN FRM-SFT
			180		AA -
			190		60% SS AA 40% MST AA
			200		

TRAY "A"

1005 HRS 10-29-93

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-20-93 DATE END: _____

DRILLER: BREEMAN LOGGER: SDG/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
1005 HRS, 10-24-93			200		80% MST UCOL GRY, LTGRY, BRN, OCC SNDY, CALC, FRM-HRD 20% SS, F-MG, SANG, CLR-WHT 5% DRC MINS, WKLY CALC CEMENT, FIRM.
			210		-AA-
			220		-AA-
			230		100% SS, UF-MG, SRND-RND, PRED LT BRN. UWKLY CALC FRM-HRD
1130 HRS			240		-AA- LOTS OF LOOSE GRAINS
			250		-AA-
			260		20% SS AA 80% MST, SNDY, BRN, DRK BRN, CALC, SFT-FRM
			267		
			270		80% SS AA PRED LOOSE GRAINS, 20% MST AA
			274		
			280		100% LOOSE QTZ SAND GRAINS, UF-MG, CLR, YELL, AMBER, SANG-RND.
			290		-AA-
			300		

TRAY "B"

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: ___

DRILLER: BREEMAN LOGGER: JDG/KHB FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			300		100% LOOSE SAND GRAINS, UF-MG, CLR, YELL, AMBER, SANG-RND.
			310		40% SAND AA, 60% MST VCOL GRY, BRN. CALC. FRM.
			320		-AA-
			330		-AA- SS IS MG-WHT-CLR, ANG-SRND, NONCALC FRM. 10% DRK MINS
			340		-AA-
			350		20% SS, UFG, LT GRY, OCC DRK MINS, 80% MST AA
			360		-AA-
1400 HRS			370		-AA- MST HAS OCC CARBONACEOUS FRAGS & STREAKS
			380		100% MST AA
			390		100% MST AA
1500 HRS			400		

TEAM C

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: _____

DRILLER: BEEMAN LOGGER: JDG/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			400		100% SS, F-MG, ANG-RND, CLR QTZ, 10% DRK MINS NONCALC CEMENT, FRM-HRD.
			410		90% SS AA 10% MST, GRY, CALC, SFT-FIRM, BRN-DRK BRN, DRK GRY
			420		100% LOOSE QTZ GRAINS, UFG, SANG.
			430		50% SS AA MIX OF LOOSE GRAINS & CLASTS 50% MST AA, CLAYBALLS.
			440		10% SS UFG, GRY-LT GRY, SANG, NONCALC, FRM-HRD. 90% MST AA
			450		-AA-
TRAY "A"			460		100% MST AA
			470		-AA-
			480		-AA-
1700 HRS, 10-29-93			490		100% SS AA
			500		

Geologic Log

EarthFax

PROJECT No.: C-28405 HOLE No.: JPA-1

DATE BEGIN: 10-26-93 DATE END: ___

DRILLER: BEEMAN LOGGER: JDG/KHB FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			500		100% SS, UFG, GRY - DRK GRY, HARD, AND MG CLR-WHT ANG W/10% DRK MINS. FRM-HRD CALC CEMENT
			510		40% SS AA 60% MST, BRN-DRK BRN, SANDY IN PART, NONCALC. OCC CARBONIZED PLANT FRAGS
			520		30% SS AA 70% MST AA OCC CLAYSTONE, BUFF-CRM, SOFT
TWIST OFF !!! 1900 HRS SHUT DOWN - NO NIGHT TOUR RESUME AT 1100 HRS			530		50% SS AA, PRED UFG 50% MST AA, LESS SANDY
			540		100% LOOSE SAND GRAINS, CLR, AMBER, WHT, DRK MINS SRND-RND MG
			550		50% SS AA 50% MST AA OCC RED-BRN CLAST, SFT
			560		AA -
			570		60% SS AA UCOL GRY, WHT, YELL, AMBER. 40% MST AA, OCC CRM-WHT CLAYST. OCC SELENITE CRYSTAL
			580		70% SS AA, PRED VF-FG, WKLY CALC 30% MST GRY, BRN, DRK BRN SANDY IN PART CALC
			590		50% SS AA 50% MST AA
			600		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-83 DATE END: _____

DRILLER: BEEMAN LOGGER: JDL/KMB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			600		70% SS VF-fg, MOD CALC. LT GRY W/ OCC GRY-WHT-YELL
					30% MST A.A.
			610		A.A
			620		90% SS. - WKLY CALC. INCLS INQUERATED. SALT & PEPPER LOOK TO SOME. VCOL - PURP - GRY - WHT - ORNG
					10% MST - LT GRY
			630		- AA - OCC WHT CALC CLAST - HARD
			640		100% S.S. LT GRY - GRY W/ OCC RED - PRP - ORG GRAINS. PREDOM FINE GRAINED. SA - SR. WKLY CALC APPEARS AS LOOSE GRAINS.
			650		- A.A -
			660		- A.A - PRED VF - F GRAINED FINING DOWN
			670		- A.A -
			680		90% S.S. A.A. W/ OCC CARB MIN.
					10% MST
			690		100% SS AA OCC PYRITE. SAND IS NON CALC. POORLY CEMENTED. INDIVIDUAL GRAINS ARE CLEAR - GREEN - OPAQUE W/ OCC ORE MIN.
			700		

TRAY C

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1
DATE BEGIN: 10-26-93 DATE END: ___
DRILLER: BEEMAN LOGGER: SJL/KHB FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			700		100% S.S. -A-A-
			710		90% SS AA VF-FG. INDURATED. 10% MST - LT GRY - SOFT. NON CALC
			720		-AA-
			730		SS AA SALT & PEPPER LOOK. INDURATED. NON CALC CEMENT. OCC DRK MIN. CARB. MST IS GRY GRN - SOFT. APPROX 10%
			740		100% SS AA. SOME PYRITE, OCC ORNG-BRN-RED. MSTLY VF-FG S.S. (SALT & PEPPER LOOK)
			750		SS AA W/ INCRS AMT OF PYRITE. PREDOM F-GR OCC GREEN SS CLUMPS.
1ST H_2O @ 2760' APPROX 100gpm			760		90% SS AA DECREASED PYRITE. SS PREDOM MED GR 10% MST. RED-BRN, OCC GREEN. SOFT.
			770		AA
			780		70% S.S. AA, F-MGR, SR; CLEAR GRN W/ OCC ORNG-RED 30% MST. GRN-RED BRN. SOFT. NON CALC
			790		AA W/ OCC PYRITE.
			800		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: _____

DRILLER: BEEMAN LOGGER: JDL/KHB FIRST WATER AT: 760'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			800		80% S.S. F-MGR, SA-SR, GRANS ARE CLEAR RED-ORN-GRN. NON CALC. POORLY INDURATED. OCC. PYRITE. 20% MST. PREDOM GREEN. SOME WHT-RED. SOFT
			810		AA
			820		AA
			830		-AA-
			840		SS AA GRAIN SIZE PREDOM FINE. LOOSE GRAINS NON CALC
			850		90% S.S. AA VF GR. LOOSE QTZ GRAINS 10% MST AA
			860		100% S.S. AA VF GRAINED. MSTLY CLR-GRN NON CALC. LOOSE GRAINS (POORLY CEMENTED) GRAINS ARE PREDOM QTZ.
			870		-AA-
			880		-AA-
			890		-AA- GRAIN SIZE ~VF-FINE. CONTAINS OCC PYRITE LOOSE QTZ GRAINS.
			900		

TRAY B

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: _____

DRILLER: BEEMAN LOGGER: JDG/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			900		90% S.S. VF GRAINED, PREDOM LOOSE QTZ GRAINS. ANG-SANG. NON CALC. MSTLY CLEAR QTZ BUT OCC RED-ORN-BLK. OCC PYRITE 10% MST. (GREEN-GREY - SOFT.
			910		
			920		100% SS
			930		A A
			940		A A
			950		80% SS AA FINE GRAINED, SANG-SRND. LOOSE QTZ GRAINS DOMINATE. OCC WHT CALCITE, MANY BLK-GRN GRAINS 20% MST GRN-REDBRN, SOFT
			960		A A
			970		A A
			980		90% SS AA W/ PREDOM VFGR. SRND. LOOSE 10% MST AA
			990		A A
			1000		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: ___

DRILLER: BEEMAN LOGGER: JOL/KMB FIRST WATER AT: 760'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1000		80% SS PRED LOOSE GRAINS F-CG 10% CARBONATE, WHT-CRM SFT-FRM 10% MST, UCL LT BRN, GRY FRM TR PYRITE
			1010		-AA-
			1020		70% SS AA 30% MST AA, TR CARBONATE & PYRITE
0700 HRS 10-31-93			1030		100% LOOSE GRAINS, CLR
0800 HRS. TRIP OUT HAMMER, TRIP IN TRI-CONE BIT			1040		80% SAND GRAINS AA, 20% MST AA, TR CARBONATE, PYRITE
			1050		-AA-
			1060		-AA
			1070		-AA-
			1080		-AA-
			1090		-AA-
			1100		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: ___

DRILLER: BEEMAN LOGGER: JOH/KWB FIRST WATER AT: 760'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1100		90% LOOSE SAND GRAINS, VF-MG, SANG-ANG, WHT CLR, ULT GRY 10% VCOL MST, OCC CARB. FRAGS. TR CARBONATE, PYRITE
			1110		-AA- OCC BLUGRY CLYST
			1120		-AA-
			1130		-AA-
1815 HRS 10-31-93			1140		20% SS, VFG, RND, FRM-HRD, CALC CMT OCC CARBON. STREAKS 80% MST, SANDY, BRN, DRK BRN, GRY, CALC, FRM
1900 HRS			1150		-AA-
			1160		-AA-
			1170		40% SS VF-FLG, SRND-RND. HRD LOOSE QTZ GRNS 60% MST-SANDY AA BRN-GRY-REDBRN. FRM-HRD. MINOR AMT BLUE-GRN CLYST W/ATTACHED PYRITE
			1180		-AA-
			1190		60% SS VF GRN. SANG-SRND. OCC CARBON STREAKS. 35% MST AA TR CARBONATE. 5% CLYSTN - BLUE-GREEN, SOFT.
			1200		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1
DATE BEGIN: 10-26-93 DATE END: ___
DRILLER: BEERMAN LOGGER: JDG/KHB FIRST WATER AT: 760'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1200		60% S S. AA 40% MST AA
			1210		-AA- OCC BLU-GRY AND PURP CLYST. OCC PYRITE
			1220		-AA-
			1230		-AA-
			1240		-AA-
			1250		50% SS VF GR SRND-RND. MOSTLY LOOSE QTZ GRNS. WEAKLY CALC. OCC CALCITE CH.D. 50% MST. BRN, GRY, DRK BRN, HARD-FRM. OCC CARBON INCLUSION. OCC PYRITE AND BLUE-GRN CLYSTN.
			1260		-AA-
			1270		-AA-
			1280		-A.A-
			1290		70% MST AA W/INCES AND CALC CEMENT 30% SS AA
			1300		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1
DATE BEGIN: 10-26-93 DATE END: ___
DRILLER: BEEMAN LOGGER: JDG/KHB FIRST WATER AT: 760'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
GRASSY SS(?)			1300		90% LOOSE QTZ SAND, UF-FG, SANG-RND, CLR, BRN, AMBER 10% MST SANDY, BRN, REDBRN DRKGRY, FRM-HRD, CALC TR CARBONATE, WHITE-BUFF, SFT
			1310		100% LOOSE QTZ GRAINS, AA
UNSTUCK @ 1100 HRS 11-01-93			1320		80% SAND AA 20% MST AA, TR CARBONATE, TR PYRITE
			1330		100% SS AA
			1340		-AA-
1245 HRS			1350		-AA-
			1360		-AA-
			1370		90% SS AA 10% MST
			1380		100% SS AA
			1390		-AA-
1530 HRS			1400		

TRAY "C"

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: _____

DRILLER: BEEMAN LOGGER: JDW/KHB FIRST WATER AT: 760'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1400		90% S.S. LOOSE QTZ GRNS. VF-FGR SANG-SRND. MSTLY CRL, SOME ORC BRN. WKLY-NON CALC. 10% MST. RED-REDBRN-GRY. HARD. MOD CALC TR PYRITE, CARBN. BLUEGRN CLYST - SOFT
			1410		-AA-
			1420		-AA-
			1430		60% SS. AA 40% MST AA
			1440		AA INCRS BLUE-GREEN MST
1455' @ 1830 hrs			1450		-AA-
			1460		70% MST A.A. SANDY DKRBRN, GRY, ORKGRY HARD. 30% SS AA
			1470		-AA-
			1480		-AA- TR COAL
11-1-93 1500' @ 2130' TRIP TO CORE			1490		-AA-
			1500		

NOTE SCALE CHANGE

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: IPA-1

DATE BEGIN: 10-20-93 DATE END: _____

DRILLER: SEEMAN LOGGER: JDG/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
1400 1500' 1540' 100'					
1200 HRS 11-02-93			1500		SS, VFG MUDDY STRINGERS INCR FROM 0.5-1.0'
					HIGHLY CARBONACEOUS MST, & COAL STRINGERS
					PARTING AT 1501.25, 1501.8, 1502.1, 1502.8, 1503.3, 1503.7
					1504.7
			1505		MUDDY SS, VFG, HRD. BIOTURB. TO 1507.6'
					PARTING AT 1508.0 1510.2' 1511.7' 1513.5, 1513.8
					MUDDY CONTENT ALTERNATING, BIOTURB FROM 1508.0
			1510		TO 1515.2
		CORE NO. 1			
					1514.75-1515.2 LOW & X-BEDS, BURROWS, LESS BIOTURB.
			1515		THAN UPPER PORTION
					1515.4 CORE COMPRESSED SHATTERED TO TO OVERBILLING,
					WATER WASHOUT OF 1-1½' COAL
					HIGHLY CARBONACEOUS MST w/ COAL STRINGERS 3-4 mm
					ABUNDANT
1415 HRS			1520		CARBONACEOUS MUDSTONE A.A COAL STRINGERS UP TO 5MM
1730 TRIP BACK IN					GRY TO DRK GRY. HRD.
0430 Core out					BIOTURB. 1525.7'-1526'. COAL STRINGER @ 1521.5 and 1522.4'
19.7' RECV					
			1525		
1.8' < 4"		CORE NO 2			
					1527.6'-1527.9' COAL STRINGER
					SANDY MST 1527.9'-1529.3' LT GRY-WHITE. VFG. HRD.
					ABUNDANT BIOTURB 1528.6'-1528.1'
					COAL STRINGER 1529.3'-1529.5'
			1530		COAL STRINGER. 1530.1'-1530.2'
					MUDDY SS. @ 1530.2' LT. GRY-WHT. VFG. HRD. LOW & X-BEDS.
					BIOTURB 1532'-1532.4' MANY CARB. STRINGERS.
					CORE IS FRACTURED ALONG MANY CARB PARTINGS.
			1535		1537.1' ABRUPT CHANGE TO SANDY MST. DRK GRY. HARD.
					SANDY. COAL STRINGERS @ 1537.2' & 1537.5'
			39.7		
			1540		
1245 HRS, 11-03-93					As Above. DK GRAY, hard, dense
2015 Core out					Some Bioturbation
19.9' RECV.					1543.1 Bedding Plane Break
Bed Plane Break 1540.25					
1540.39					
1542.35					
			1545		1544.1-44.25 Coal [illegible]
43.1					1545.0 Bioturbation
43.85		CORE NO. 3			1546.1 Bioturbation 1" w/ [illegible] fracture lets @ 46.4
					1547.4 Bedding Plane fract 1547.7 bedding fract
					48.8 " " "
			1550'		1549.3 Bioturbation. Grained [illegible] light gray to light brownish

Geologic Log

EarthFax

PROJECT No.: 0-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-20-93 DATE END: ___

DRILLER: BEEMAN LOGGER: DW/COH FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
Bedding Fract. @ 50.1, 51.9, 53.45			1550		Gray silty sandstone, decrease in silt content, increase fine bands. Increase permeability, bioturbation increasing, organic laminations @ 1549.1 to 1550.3'. Carbonaceous stk lam @ 42.7-44.3 cloudy lam.
			1555		1551.2 Coal stringer. Abnt ch to dk gray sandy mst, tr sand. 1555.7 Fract alon. Bed. 1556.9 SILTY SANDSTONE, Bioturb. w/ lt & dk gray, silt in biker sandstone. 1557.7 Sandstone lt gray to lt br gray, fine-mgr, bioturbated, some silty lamination - distorted by bioturb.
		Cont Abv	1560		1558.4 Sandstone, lt gray, f to vf-gr, clean, friable, increase fnb w/ depth. SS AA, but more indurated. Hy weak eff. in HCl.
1600 HRS			1565		1564.8' MST, DK GRY, MED V WEAK EFF in HCl.
1565.3' Bottom of core pots plugged, catcher broken. 14' cored 13.1' recov. 1.1' lost of stuff					As but dark brown. 1566.9 Lt gray SS, fine-gr, carb, bioturb. 1567.3 MED Br MST Coal stringers between 67.3 - 67.7. 1568 MDST AA interbedded w/ lt gray SS, bioturb. Parting @ 68.9, 68.4, 69.9. 1569 SS Lt gray, carbd mdst strings, sl bioturb. Parting @ 70.4, 70.6.
			1570		1570 SS lt gray massive, fgr. 1571 SS vlt gray, DK br MDST & carb str bioturb. Parting @ 73.75. 1572 Coal 0.4' thick - grades to Br MDST.
PROJECTED COAL TOP					1573 Br MDST w/ some lt gray SS bioturb. 1573.8 0.3' COAL
			1575		MDST dark to MED Br Coal stringer @ 1574.8. Parting @ 74.6. Coal stringer 1576 1" thick. Parting @ 74, 77.8. " " 1576.9 1" thick. Parting @ 77.[illegible]. SS @ 1578.1 grad contact w/ MDST. Bioturb, MDST [illegible]
NO core @ 1579.1-1580				NR	
RQD = 100%			1580		SS AA 1580 to 1581. PARTING AT 1580.35, 1581.2, 1581.9. 1582 TO 1587 PRED. MASSIVE SANDY MDST occ "BLEB" OF SS AA. PARTING AT 1583.5, 1585.3, 1586.8, 1587.3
			1585		
PROJECTED COAL BOTTOM					1587' TO 1591.2 MUDDY SS MUDDY LAMINATIONS, BIOTURB. THIN COALS UP TO 3mm THICK 1588.5, 1589.6
			1590		1591.2 TO 1594 SANDY MDST, DRK BRN. OCC SANDY "BLEB". MUDDY HAIRLINE PARTING AT 1591.2.
			1595		1594 TO 1597.6 MUDDY BIOTURB, SS AA.
1330 CORE TO KRD OUT OF HOLE			1600		1597.6 TO 1600 MDST SANDY DRK BRN COAL 4mm THICK AT 97.7' PARTING AT 1598.41'

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-1

DATE BEGIN: 10-26-93 DATE END: ___

DRILLER: BOEMAN LOGGER: JXA/CDH FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
BEGIN CORING @ 1600' @ 1045 HRS 19.5' recovery 20' cored			1600		MOST. M. BROWN, Laminated, sl biotur[illegible] some ltgr ss stringers 1601.2 -- S LTGR. MOST interbeds, biotur[illegible] 1602.2 MOST. sd [illegible] more-low & x-bd- tr biotur[illegible] 1604.5 SS, ltgray, low & xbedding, OCC. carbonaceous lam [illegible]
	core		1605		Bedding Plane Partings: 1600.9, 1601.2, 1601.5, 1602.9, 1603.2 1604.5, 1605.3, 1605.9, 1606.4 1607.2, 1608.9, 1609.4, 1611 ?, 1615 ?
			1610		
			1615		SS. Light gray to mdlt gray [illegible] & x-bedding [illegible]
core to 1640 20' recovered			1620		MUDDY SS 1620' TO 1621' BIOTURB 1621' TO 1631 MASSIVE CLEANER GRAY SS, F-MG, HARD, OCC BIOTURB - MUCH LESS THAN ABOVE U. SLI EFF W/HCl
			1625		
			1630		PARTING AT 1628.9' 3mm COAL STRINGER AT 1630.6' AA, BUT BIOTURB. INCR DOWNWARD PARTING AT 1632'
			1635		PARTING AT 1635.7, 1636.2' ABRUPT CONTACT W/MASSIVE GRY SS AS IN 1621-1631' FAINT LOW & X-BEDS 1639-1640'
1200 HRS 11-06-93 OUT OF HOLE W/ CORE			1640		SS - AS above
11-6-93 1125. begin trip out core to 1660 19.8' recovered			1645		1644.5 - 1648 TOTO AA Bioturb. dark lam. low & x-bedding SS Gray AS 1640 to 1645
			1650		

Geologic Log

EarthFax

PROJECT No.: _____ HOLE No.: IFA-1

DATE BEGIN: _____ DATE END: _____

DRILLER: _____ LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
Partings @ 1641, 1643, 1644.9, 1645.7, 1646.4, 1647, 1648.1, 1650.4, 1652.5, 1653.5, 1653.8			1650		SS AA but @ ~1652 increasing silt & [illegible]
No vertical fractures in SS overlying COAL					1655.1 COAL short transition zone ~2" thick; coal has many fractures - [illegible] to core axis & also vertical [illegible]
Remove core @ 1235					1656.7 0.1' vitrious bed, large fract @ 17.4 - core is broken
			1660		PARTING AT 1660.6' FRACTURE AT 1663'
			1665		FRAC AT 1667.1', 1667.6', 1667.8' 1669.5'
					BOTTOM OF COAL @ 1669.5'
			1670		MDST 1669.5 TO 1676.1' DRK BRN-BLK, HIGHLY CARBONACEOUS; PARTING ≈ 20° AT 1670.5', 45° AT 1672.4, 1672.7'; HORIZ. PARTING AT 1673.5, 1675.6', 1676.1 (CONTACT W/SS
			1675		
0830, 11-07-93					SS, BIOTURB & MUDDY FROM 1676.1' TO 1676.4', CLEANER TO 1677.5' F-MG, GRY-BRN, NONCALC, FRIABLE, FIRM-HRD; 1678' TO 1686.5' SS, UF-FG, GRY, FRIABLE IN PART, NONCALC; BIOTURB 1678'-1679', LOW ANGLE X-BEDS 1679' - 1686.5', SPOTTY
			1680		BIOTURB FROM 1681 TO 1685' PARTINGS AT 1679', 1682.3'; 1686.5 TO 1687.3' SS AA, MORE CARB LAMS, LOW ∠
			1685		
					1687.3 TO 1687.9 SS AA W/ DARK GRY ROUNDED INCLUSIONS FROM 0.25 TO 6" (EST) DIAM MAY BE SOFT-SED DEFORMATION/RIP-UP CLAST; 1688 - 1696.5' MASSIVE SS, AA, FAINT LOW ∠ X-BEDS
			1690		1690 - 70° FAULT OFFSET ≈ 2", HEALED W/CARBONATE
					SLI INCR MUD/CARB CONTENT W/DEPTH
			1695		
CORE OUT AT 1600 HRS, 11-07-93					END OF CORE 1696.5'
			1700		

NOTE SCALE

Geologic Log

EarthFax

PROJECT No.: _____ HOLE No.: _____

DATE BEGIN: _____ DATE END: _____

DRILLER: _____ LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1700		
			1710		
			1720		
			1730		SS vf to f, ~~subangular to~~ subrounded, some rounded grains qtz, some heavy dark minerals, some pyrite, slight eff.
			1740		SS AA.
T.D. @ 1760			1750		SS AA. some light green grains.
			1760		

IPA -1

DEPTH	DESCRIPTIONS
0-18'	Alluvium: orange, gray and brown, very fine-grained sand with some silt, occasional sandstone clasts, dry.
18-30'	Sandstone: brown, gray and orange, very fine-grained, grains are quartz, sub-round to round, calcareous cement.
30-50'	Sandstone: light gray, very fine to fine-grained, sub-angular to sub-round quartz grains, approximately 15% dark minerals, friable, calcareous.
(40')	Occasional light gray to white siltstone fragments.
50-60'	Interbedded sandstone and siltstone: sandstone, siltstone is light gray to white, contains some dark minerals, soft.
60-70'	Sandstone: light gray, fine-grained, sub-angular to sub-round quartz grains with 20% dark minerals, hard, occasional reddish orange sandstone fragments. Cuttings have approximately 10% siltstone fragments.
70-100'	Interbedded mudstone and sandstone: mudstone is mottled brownish red to light gray, angular soft fragments.
(80')	Mudstone increasing to 60% of total, gray, fissile.
(90')	Mudstone increasing to 70% of total, sharp fractures in fragments.
100-200'	Interbedded sandstone and mudstone: sandstone is gray, very fine-grained, sub-round to round quartz grains, moderately calcareous, firm to hard, trace of dark minerals and pyrite. Mudstone is brown to reddish brown, calcareous, firm to soft. 50% sandstone and 50% mudstone.
(110')	Mudstone becoming light brown.
(120')	70% sandstone and 30% mudstone.
(130')	Occasional clast of fine to medium-grained sandstone, sub-angular grains, loosely cemented, approximately 15% dark minerals.
(170')	40% sandstone and 60% mudstone.
(190')	60% sandstone and 40% mudstone.
200-230'	Interbedded mudstone and sandstone: mudstone is varicolored gray, light gray, and brown, occasionally sandy, calcareous, firm, and hard. Sandstone is clear to white, fine to medium-grained, sub-angular, 5% dark minerals, weakly calcareous, and firm.

230-260'	100% Sandstone (100%): light brown, very fine to medium-grained, sub-round to round, very weakly calcareous, firm and hard.
(240)	Many loose grains.
260-280'	Interbedded mudstone and sandstone: mudstone is varicolored brown and dark brown, sandy, and soft to firm. Sandstone sample recovery consists predominantly of loose grains.
280-310'	100% loose quartz sands grains: varicolored clear, yellow and amber, very fine to medium-grained, and sub-angular to sub-round.
310-400'	Interbedded mudstone and sand: varicolored gray and brown, calcareous, firm. 60% mudstone and 40% sandstone.
(335')	Sandstone is white, clear, medium-grained, angular to sub-round, non-calcareous, contains 10% dark minerals, and firm.
(350')	20% sandstone: light gray, very fine-grained, and occasional dark minerals. 80% mudstone.
(372')	Mudstone has occasional carbonaceous fragments and streaks.
(380')	100% mudstone.
(390')	100% mudstone.
400-430'	Sandstone (100%): clear quartz with 10% dark minerals, angular to round, non-calcareous cement, firm and hard.
(410')	10% mudstone, varicolored gray, brown and dark brown, calcareous, and soft to firm.
(420')	100% loose quartz sand grains, very fine-grained, sub-angular.
430-440'	Interbedded sandstone and mudstone: mix of loose grains, clasts, and clayballs. 50% sandstone, 50% mudstone.
440-490'	Sandy mudstone: gray to light gray, non-calcareous, firm to hard. Very fine-grained sand (10%).
(460')	100% mudstone.
490-510'	Sandstone (100%): varicolored dark gray, gray, clear and white, very fine to medium-grained, angular, 10% dark minerals, calcareous cement, firm to hard.
510-540'	Interbedded mudstone (60%) and sandstone (40%): mudstone is brown to dark brown, sandy in part, non-calcareous, with occasional carbonaceous plant fragments.

(520')	30% sandstone and 70% mudstone, with occasional buff to cream colored claystone, soft.
(530')	50% predominantly very fine-grained sandstone, and 50% mudstone.
540-550'	Sandstone: varicolored clear, amber, and white, loose sand grains, sub-round to round, with dark minerals.
550-621'	Interbedded sandstone (50%), and mudstone (50%): occasional red-brown clasts, soft.
(570')	60% sandstone and 40% mudstone, sandstone is varicolored gray, white, yellow, and amber. Mudstone contains occasional cream to white colored claystone clasts and occasional selenite crystals.
(580')	70% sandstone is predominantly very fine to fine-grained, 30% mudstone is varicolored gray, brown and dark brown, sandy in part, and calcareous.
(590')	50% sandstone and 50% mudstone.
(600')	70% sandstone is light gray, very fine to fine-grained, and moderately calcareous. 30% mudstone.
621-690'	Sandstone: varicolored purple, gray, white and orange, looks like a mixture of salt and pepper.
(630')	Occasional white, hard, calcic clasts.
(640')	Predominantly fine-grained, sub-angular to sub-round, weakly calcareous, loose sand grains.
(662')	Predominantly very fine to fine-grained and fining downward.
(680')	10% mudstone with carbonaceous material present.
690-730'	Sandstone (100%): varicolored clear, green and opaque, non-calcareous, poorly cemented, occasional pyrite and dark minerals.
(700')	100% sandstone.
(710')	90% sandstone and 10% mudstone. Sandstone is very fine to fine-grained and indurated. Mudstone is light-gray, soft, and non-calcareous.
730-800'	Sandstone: mixed salt and pepper color (due to quartz and dark mineral content), very fine to fine-grained, indurated, non-calcareous.
(730-732')	Mudstone, gray, soft.
(740')	100% sandstone. Some pyrite present. Occasional orange-brown-red mineralization.

	(750')	Sandstone, pyrite more frequent, predominantly fine-grained, occasional green sandstone clumps.
	(760')	First water encountered.
	(763')	Mudstone present. Sandstone is red, brown, with occasional green, predominantly medium-grained, pyrite decreasing, soft.
	(780')	70% sandstone and 30% mudstone. Sandstone is varicolored clear, green, orange, and red, sub-round. Mudstone is soft and non-calcareous.
Flagstaff/N. Horn	(790')	Occasional pyrite.
— 816' — Blumcastle	800-860'	Interbedded sandstone (80%) and mudstone (20%): varicolored clear, red, orange, green, sub-angular to sub-round, poorly indurated, non-calcareous, with occasional pyrite. Mudstone is predominantly green, white and red, and soft.
	(840')	Sandstone is predominantly fine-grained, with loose grains, and non-calcareous.
	(850')	90% sandstone and 10% mudstone. Sandstone is very fine-grained with loose quartz grains.
	860-900'	Sandstone (100%): clear to green color, very fine-grained, loose quartz grains, non-calcareous.
	(890')	Very fine to fine-grained, loose quartz grains, with occasional pyrite.
	900-1000'	Sandstone (90%): varicolored clear (predominant), red, green, and gray, very fine-grained, angular to sub-angular, loose quartz grains, occasional pyrite, non-calcareous. Mudstone (10%) green to gray, soft.
	(920')	100% sandstone.
	(950')	80% sandstone, varicolored clear with black and green grains, fine-grained, sub-angular to sub-round, loose quartz grains dominant, occasional white calcite clasts. Mudstone (20%) is green to reddish brown, and soft.
	(980')	90% sandstone and 10% mudstone, predominantly very fine-grained, sub-round, with loose grains.
	1000-1100'	Sandstone (80%): fine to coarse-grained, with loose grains. Carbonate (10%): white to cream colored grains. Mudstone (10%): varicolored light brown to gray, firm, with a trace of pyrite.
	(1020')	70% sandstone and 30% mudstone, trace of carbonate and pyrite.
	(1030')	100% clear loose grains.
	(1040')	80% sand grains, and 20% mudstone, with a trace of carbonate.

— 1074' —

Mudstone Mbr
P.R.

1100-1140′ Sandstone (90%): varicolored white, clear, and light gray, very fine to medium-grained, sub-angular to angular. Mudstone (10%), occasional carbonate fragments, trace of pyrite.

(1110′) Occasional blue-gray claystone clasts.

1140-1250′ Interbedded sandy mudstone, and sandstone: brown to dark brown, calcareous, occasional carbonaceous streaks, firm to hard.

(1170′) 40% sandstone and 60% mudstone. Sandstone is very fine to fine-grained, sub-round to round, hard, with loose quartz grains. Mudstone is varicolored brown, gray, and reddish brown, firm to hard, with minor amount of blue-gray claystone with attached pyrite.

(1190′) 60% sandstone, 35% mudstone and 5% claystone: sand is very fine- grained, sub-angular to sub-round, occasional carbon streaks, with a trace of carbonate. Claystone is blue-green and soft.

(1200′) 60% sandstone and 40% mudstone.

Mudstone Mbr P.R. (1210′) Occasional blue-gray and purple claystone clasts with pyrite.

- 10′ — Castlegate

1250-1300′ Interbedded sandstone (50%) and siltstone (50%): very fine-grained, sub-round to round, mostly loose quartz grains, weakly calcic, occasional calcite chips. Mudstone is varicolored brown, gray, and dark brown, hard to firm, occasional carbonaceous inclusions, occasional pyrite and blue-green claystone clasts.

(1290′) 70% mudstone and 30% sandstone. Increased amount of calcic cement.

1300-1400′ Sandstone (90%): varicolored clear, brown, and amber, very fine to fine-grained, sub-angular to round, loose quartz grains. Mudstone (10%) varicolored brown, reddish brown, and dark gray, sandy, calcareous, with a trace of white to buff colored carbonate, soft.

(1310′) 100% loose quartz grains.

(1320′) 80% sand and 20% mudstone, trace of carbonate and pyrite.

(1330′) 100% sandstone.

(1370′) 90% sandstone and 10% mudstone.

(1380′) 100% sandstone.

1400-1500′ Interbedded sandstone (90%) and mudstone (10%): sandstone is clear to dark brown, very fine to fine-grained, sub-angular to sub-round, and weakly calcic. Mudstone is varicolored red, reddish brown, and gray, moderately calcic, hard, trace of pyrite, trace of soft blue-green claystone.

(1430') 60% sandstone and 40% mudstone.

(1440') Increasing frequency of blue-green mudstone.

(1460') 70% mudstone and 30% sandstone. Mudstone is varicolored dark brown, gray, and dark gray, hard.

Castlegate (1480') Trace of coal.

—1486'—

1500' BEGIN CORING. NOTE SCALE CHANGE.

Upper-Mudst. Blackhawk 1500-1505' Sandstone and mudstone: very fine-grained, muddy stringers increasing downward, highly carbonaceous mudstone, and occasional coal stringers.

(1501.25') Parting.
(1501.8') Parting.
(1502.1') Parting.
(1502.8') Parting.
(1503.3') Parting.
(1503.7') Parting.
(1504.7') Parting.

1505-1510' Muddy sandstone: very fine-grained, hard, bioturbated.

(1505-1507.6') Bioturbated.
(1510.2') Parting.
(1511.7') Parting.
(1513.5') Parting.
(1513.8') Parting.
(1508.4-1515.2') Muddy content alternating, bioturbated.

1510-1515' Burrows, bioturbation decreases downward.

(1514.75-1515.2') Low-angle cross-beds.

1515-1520' Water wash-out of 1 to 1.5 inches of coal. Highly carbonaceous mudstone, 3 to 4-millimeters thick coal stringers are abundant.

(1515.4') Core shattered due to over-drilling.

1520-1530' Carbonaceous mudstone: gray to dark gray, hard, coal stringers up to 5-millimeters thick.

(1527.7-1526.0') Bioturbated.
(1521.5') Coal stringer.
(1522.4') Coal stringer.
(1527.6-1527.9') Coal stringer.
(1527.9-1529.3') Sandy mudstone, light gray to white, very fine-grained, hard.
(1528.1-1528.6') Bioturbated.
(1529.3-1529.5') Coal stringer.

1530-1537′ Muddy sandstone, light gray to white, very fine-grained, hard, with low-angle cross-beds. Many carbonaceous stringers. Core is fractured along many carbonaceous partings.

(1530.1-1530.2′) Coal stringer.
(1532.0-1532.4′) Bioturbated.

1537-1540′ Abrupt change to hard, dark gray, sandy mudstone.

(1537.2′) Coal stringer.
(1537.5′) Coal Stringer.

1540-1545′ Dark gray, hard dense with some bioturbation.
(1543.1′) Bedding-plane break.
(1544.1-1544.25′) Coaly split and stringers.

1545-1550′ Bioturbated. Gradual color change from light gray to brown.

(1546.1′) Bedding-plane fracture.
(1546.4′) Bedding-plane fracture.
(1547.4′) Bedding-plane fracture.
(1547.7′) Bedding-plane fracture.
(1547.8′) Bedding-plane fracture.

1550-1555′ Silty sandstone, gray, decreasing silt content with increasing fine-grained sand content. Increase in permeability, bioturbation increasing, organic laminations increasing. Abrupt change to dark gray sandy mudstone, sand is very fine-grained.

(1549.1′) Carbonaceous lamination.
(1550.3′) Carbonaceous lamination.
(1542.3′) Wavy lamination.
(1544.3′) Wavy lamination.
(1554.2′) Coal stringer.

1555-1560′ Silty sandstone, light and dark gray, very fine-grained, bioturbated.

(1555.7′) Fracture along bedding.
(1556.9′) Sandstone is light gray to light brown, fine-grained, with silty-laminations, and bioturbated.

1560-1565′ Sandstone, light gray, fine to very fine-grained, clean, and friable. Sandstone becoming more indurated and weakly calcareous with depth.

(1564.8′) Mudstone, dark gray, hard, very weakly calcic.

1565-1570′ Color change to dark brown. Partings at 1566.9, 1568.4, and 1569.9. Sandstone, light gray with carbonaceous mudstone and stringers, slightly bioturbated. Partings at 1570.4, and 1570.6.

(1566.9') Sandstone, light gray, fine-grained, carbonaceous, bioturbated.
(1567.3') Mudstone, brown.
(1567.7') Coal stringer.
(1568.0') Becoming interbedded with a light gray, bioturbated sandstone.
(1570.4') Parting.
(1570.6') Parting.

1570-1575' Sandstone, light gray, fine-grained, massive-bedded, interbedded with mudstone, dark brown, and coaly stringers.

(1571') Bioturbated.
(1572') Coal thin-bed (.4-feet thick) grades to brown mudstone.
(1573') Partings. Mudstone, brown, and sandstone, gray, bioturbated.
(1573.8') Coal thin-bed, .3-feet thick.
(1575.3') Parting.

1575-1580' Mudstone, dark to medium brown.

(1574.8') Coal stringer.
(1576.0') Coal stringer, 1-inch thick. Parting.
(1576.8') Parting.
(1576.9') Coal stringer, 1-inch thick.
(1577.4') Parting.
(1577.8') Parting.
(1578.1') Sandstone has gradual contact with mudstone. Mudstone is bioturbated, with sandstone stringers.
(1578.5') Parting.
(1578.6') Parting.

1580-1587' Sandstone.

(1580.3') Parting.
(1581.2') Parting.
(1581.9') Parting.
(1582.0') Sandy mudstone, massive-bedded, occasional bleb of sandstone.
(1583.5') Parting.
(1585.3') Parting.
(1586.8') Parting.
(1587.3') Parting.

1587-1590' Muddy sandstone, muddy laminations, bioturbated.

(1589.5-1589.6') Thin coal laminations up to 3-millimeters thick.

1590-1597' Sandy mudstone, dark brown, occasional sandy blebs.

(1594.0') Muddy sandstone, bioturbated.
(1591.2') Muddy hairline parting.

1597-1600' Sandy mudstone, dark brown.

(1597.7') Coal 4-millimeters thick at 1597.7.
(1598.4') Parting.

1600-1605' Mudstone, medium brown, laminated, slightly bioturbated, some light gray sandstone stringers.

Upper Mudst. of Blackhawk

(1601.2') Interbedded mudstone and light gray sandstone, bioturbated.
(1602.2') Mudstone, sandy, horizontal to low-angle cross-beds, bioturbated.
— 1605' — (1604.5') Sandstone, light gray, very fine to fine-grained, with low-angle cross-beds, occasional carbonaceous laminations.

Grassy Mbr Blackhawk

1605-1615' Bedding plane partings at 1600.9, 1601.2, 1601.5, 1602.9, 1603.2, 1604.5, 1605.3, 1605.9, 1606.4, 1607.2, 1608.9, 1609.4, 1611.9, and 1615.5.

1615-1620' Sandstone, light gray, very fine to fine-grained, occasional carbonaceous lamination, low-angle cross-beds, color darkens slightly with depth.

1620-1625' Muddy sandstone from 1620 to 1621, bioturbated. Sandstone, gray, fine to medium-grained, massive-bedded, clean, hard, occasionally bioturbated, and slightly calcic, from 1621 to 1631.

1625-1630' Parting at 1628.9.

1630-1635' Bioturbation is increasing downward.

(1630.6') Coal stringer at 1630.6 is 3 millimeters thick.
(1632.0') Parting.

1635-1650' Sandstone.

(1635.7') Parting.
(1632.2') Parting.
(1637.2') Abrupt contact with massive-bedded gray sandstone.
(1639-1640') Faint low-angle cross-beds.
(1644.5-1648') Sandstone, gray, bioturbated, carbonaceous laminations, and low-angle cross-beds.

1650-1655 Sandstone. Carbonaceous laminations.

(1653.0') Bioturbation increasing.

1655 Sunnyside Coal

1655-1670' Coal: Short transition zone is 0.1-inch thick. Coal has high-angle fractures at an approximate 1-inch spacing oriented perpendicular to the core. Axis also has vertical fractures.

(1656.7') 0.1-foot thick vitreous bed.
(1657.4') Large fracture, core is broken.
(1660.6') Parting.
(1663.0') Fracture.
(1667.1') Fracture.

(1667.6′) Fracture.
(1667.8′) Fracture.
(1669.5′) Fracture.
(1669.5′) Bottom of coal.

1670-1676′ Mudstone: dark brown. Horizontal partings at 1673.5, 1675.6, and 1676.1

(1670.5′) Highly carbonaceous parting oriented at 20-degrees.
(1672.4′) Highly carbonaceous parting oriented at 45-degrees.
(1672.7′) Highly carbonaceous parting oriented at 45-degrees.
(1673.5′) Parting.
(1675.6′) Parting.
(1676.1′) Parting. Contact with sandstone.

1676-1700′ Sandstone: bioturbated and muddy, cleaner with depth, fine to medium-grained, gray to brown, non-calcic, friable, firm to hard.

(1678-1686.5′) Sandstone is gray, very fine to fine-grained, friable in part, non-calcic.
(1678-1679′) Bioturbated.
(1679-1686.5′) Low-angle cross-beds.
(1679.0′) Parting.
(1681-1685′) Spotty bioturbation.
(1682.3′) Parting.
(1686.5-1687.3′) Sandstone, contains more laminations and low-angle cross-beds.
(1687.3-1687.9′) Sandstone with dark gray rounded inclusions from 0.25 to 6" (estimate) diameter, may be soft-sediment deformation or rip-up clasts.
(1688-1696.5′) Massive-bedded sandstone, contains faint low-angle cross-beds.
(1690′) 70-degree fault with approximately 2-inches of offset, healed with carbonate.
(1694′) Slight increase in mud and carbonaceous content with depth.
(1696.5′) End of core.

1700-1760′ Sandstone, very fine to fine-grained, sub-angular to sub-round, some rounded grains, contains quartz and some heavy dark minerals, some pyrite, slightly calcic.

(1750′) Some light green grains.

3.2 IPA-2

Location

N 397,355 E 2,333,735 (feet)
Section 23 T 16 S R 14 E (SLBM)
Emery County, Utah
Ground Elevation: 6,865 feet above mean sea level
Top-of-Casing Elev. 6,866.46 feet above mean sea level
Total Depth Drilled: 1,213 feet below ground level

Formation Tops

Stratigraphic Unit	Depth Below Ground Level (feet)	Elevation (feet above mean sea level)
Flagstaff-North Horn Formation	at surface (incomplete section)	
Bluecastle Member, Price River Formation	202	6,663
Mudstone Member, Price River Formation	482	6,383
Castlegate Sandstone	700	6,165
Upper Mudstone Member, Blackhawk Formation	884	5,981
Grassy Member, Blackhawk Formation	990	5,875
Sunnyside Coal Seam	1,060	5,805
Sunnyside Member, Blackhawk Formation	1,070	5,795

IPA -2

DEPTH	DESCRIPTION
0-20′	Alluvium, light brown to orange brown, very fine-grained sand, silty, gravely, dry.
20-50′	Sandstone: light gray, very fine-grained, sub-angular, calcareous, poorly cemented, weathered, dry.
(40′)	Moderately cemented.
50-60′	Siltstone: dark gray to black, non-calcareous, shaley fracture, firm, dry.
60-70′	Interbedded siltstone and sandstone: light gray, very fine-grained, silty, calcareous, hard.
80-100′	Sandstone: light gray, very fine-grained, silty, calcareous, hard.
(90′)	Sandstone, light gray, fine grained, silty, calcareous, hard.
100-120′	Sandstone: light gray, very fine to fine-grained, sub-angular to sub-round, loose, frosted quartz grains, calcareous, soft.
(110′)	Becoming more indurated.
120-140′	Siltstone: dark gray, some very fine-grained sandstone, coaly, soft non-calcic.
140-200′	Sandstone: light gray, white, frosted grains, very fine to fine-grained, sub-angular to sub-round, slightly calcic, soft.
(150′)	Sandstone, light gray, fine-grained, fairly clean, poorly cemented, slightly calcic, soft.
(180′)	Sandstone, becoming coarse to medium-grained, sub-rounded, calcareous.
Flagstaff - No Ho (190′)	Sandstone, dark brown to gray, hard, trace of dark brown siltstone.
~~202′~~ 200-250′ Blue castle	Sandstone: light gray, very fine to medium grained, sub-angular to sub-round, frosted quartz grains, slightly calcareous, poorly cemented, pyrite.
(210′)	Increasing amount of fine-grained quartz.
(220′)	HCl reaction weak to absent, loose grains, clear to light gray, sub-round.
250-270′	Sandstone (70%), very fine to fine-grained, loose quartz grains, sub-round, non-calcareous cement. Sandstone (30%), hard, slight HCl reaction, trace of dark minerals.

270-280′	Silty sandstone: light gray to light brown, very fine-grained, moderately calcic, firm, hard, occasional dark minerals, quartz grains are generally clear-colored with occasional pink to amber grains.
(280′)	Sandstone (80%), clear to pink, loose grains, very fine to medium-grained, silty, calcareous, firm, hard.
(290′)	Loose-grained sandstone (60%), and very fine-grained, hard, firm sandstone (40%).
300-330′	Sandstone, gray to dark brown, predominantly fine-grained, firm to hard, cemented, sub-angular to sub-round, clear quartz grains, occasional dark minerals.
(320′)	Slightly calcic, approximately 2% dark minerals, hard.
330-350′	Interbedded sandstone and siltstone: dark brown, laminated, calcareous, hard.
350-360′	Sandstone: gray, some siltstone, very fine to fine-grained, sub-angular to sub-round, clear to frosted quartz grains, well sorted, hard, slightly calcic.
360-370′	Interbedded sandstone and siltstone: siltstone is dark brown to grayish brown, occasional coal fragments, slightly calcic, varies hard to soft.
370-380′	Sandstone: very fine to fine-grained, sub-angular to sub-round, clear to frosted quartz grains, poorly cemented, calcareous.
380-400′	Siltstone, dark gray to dark brown, thinly bedded, slightly hard, slightly calcareous, coal fragments.
400-500′	Interbedded siltstone and sandstone: siltstone (80%) is brown to dark gray, hard, with occasional dark mineral streaks and pyrite. Sandstone (20%) is clear to light gray, very fine grained, with black mineral bands and inclusions, predominantly quartz.
(420′)	90% siltstone and 10% sandstone.
(450′)	60% siltstone and 40% sandstone.
(460′)	70% sandstone, varicolored clear, white, light gray, black inclusions, very fine to fine-grained, and 30% siltstone.
Bluecastle — 482′ — (480′)	80% siltstone, and 20% sandstone.
Mudstone Mb P.R. 500-600′	Interbedded siltstone and sandstone: Siltstone (90%) dark brown, hard, weakly calcareous, dark mineral inclusions, carbonaceous. Sandstone (10%) clear to white and light gray, very fine-grained.
(520′)	50% siltstone, and 50% sandstone.

(530')	80% siltstone, light brown to gray, and 20% sandstone.
(560')	Trace of pyrite and coal. Alternating dark mineral bands in sandstone, no HCl reaction.
(580')	90% siltstone, dark brown, carbon fragments, pyrite. 10% sandstone, white to clear, very fine to fine-grained, occasional dark mineral inclusions.
600-610'	Siltstone (100%): dark gray to brown, non-calcareous, occasional dark mineral streaks, carbonaceous, firm to hard.
610-700'	Interbedded siltstone and sandstone: 50% siltstone and 50% sandstone, light gray to white, fine to very fine-grained, well cemented, weakly calcareous. occasional coal with pyrite.
(630')	60% sandstone, and 40% siltstone.
(640')	70% siltstone, increasing amount of coal, occasional pyrite, and 30% sandstone.
(680')	90% siltstone, platy, with carbonaceous and pyrite veins, and 10% sandstone.
(690')	50% siltstone, and 50% sandstone, light to medium gray, very fine-grained, silty, carbonaceous, calcic, hard, brittle.
~~700'~~ 700-720'	Sandstone: light to medium gray, 10% siltstone fragments, sub-angular to sub-round, frosted quartz, non-calcareous, brittle, coaly fragments.
(710')	No siltstone.
720-730'	Interbedded sandstone and siltstone: siltstone is dark gray to black, organic rich, platy, brittle to soft. Sandstone is fine to medium grained, non-calcareous.
730-800'	Sandstone: light gray to light pinkish gray, fine to medium-grained, grains are clear to frosted, sub-angular to sub-round, poorly cemented, slightly calcic, trace of carbonaceous material and pyrite.
(740')	Poorly cemented, mostly very fine to fine-grained, trace of pyrite.
(770')	Trace of siltstone.
(780')	Poorly cemented with a trace of siltstone.
(790')	Very fine-grained fraction increasing.
800-870'	Sandstone: medium to light gray, very fine to fine grained, moderate to well sorted, quartz, clear to frosted grains, loose sand, soft.
(820')	Trace of siltstone.

(860') Induration increasing, fining down.

Castlegate 870-900' Interbedded sandstone and siltstone: siltstone is dark gray to black, brittle, non-calcareous, carbonaceous.

— 884' —

Upper Mid Blackhawk 900-910' Siltstone and shale: dark gray to dark brownish gray, shale is silty, brittle, slightly fissile, non-calcareous. Siltstone is dark gray, some very fine-grained sand, brittle, non-calcareous.

910-940' Interbedded siltstone and sandstone: light gray, very fine to fine-grained, silty, quartz grains are frosted to clear, sub-angular to sub-round, non-calcareous, hard, trace of coal.

(920') Siltstone increasing.

(940') BEGIN CORING. NOTE SCALE CHANGE.

940-942.8' Sandstone: light gray to gray, cross-bedded, slightly calcareous, firm to hard.

942.8-945.4' Shaley siltstone: dark gray, firm, platy, non-calcareous, fairly homogenous.

945.4-946.2' Coal.

946.2-948.6' Shaley siltstone.

948.6-949.4' Carbonaceous and coal stringers: interbedded with shale and siltstone.

949.4-949.9' Shale and siltstone.

949.9-950.7' Sandstone: light gray to gray, very fine-grained, hard, low-angle cross-beds.

950.7-951.4' Siltstone: dark gray to brown, hard, non-calcareous, homogenous.

951.4-951.6' Interbedded siltstone and coal.

951.6-952.0' Coal.

952-953.5' Sandstone: light gray, very fine-grained, many low-angle cross-beds, carbonaceous partings up to 2 millimeters thick.

953.5-955.1' Siltstone: gray, firm to hard, occasional carbonaceous stringers.

955.1-956.2' Interbedded coal and mudstone.

(955.6-956') Coal.

956.2-960' Sandy siltstone: gray to brown, with carbonaceous stringers.

(957.4') Carbonaceous stringer.
(957.6') Carbonaceous stringer.

(957.8') Carbonaceous stringer.

960-960.3' Sandy siltstone.

960.3-960.4' Coal and siltstone: dark brown and gray.

962-966.9' Sandstone: alternating light gray and dark brown, mottled, bioturbated, occasional coaly stringers.

(966.6') Coal stringer.

966.9-970' Sandstone: light gray to dark brown, fine to very fine-grained becomes silty with depth, coal blebs, some bioturbation.

(968.1') Coal stringer.
(961.3-970.0') Frequent breaks in core, fresh, probably drilling induced.

970-971.8' Sandstone: light gray, thin-bedded to laminated, bioturbated, interbedded with siltstone, occasional coal stringers.

971.8-973.6' Sandstone: light gray and brown, laminated, bioturbated, occasionally silty.

(973.5') Coal stringer.
(970.4-79.3') Frequent breaks in core, fresh, probably drilling induced.

973.5-979.4' Sandstone: dark brown to brown, fine-grained, silty, massive-bedded.

(979.3') Coal stringer.

979.4-980' Coal and silty coal: fragmented, brittle.

980-980.9' Siltstone: dark brown, finely laminated, gray sandstone interbeds.

980.0-981.5' Sandstone: light gray to light brown, fine-grained, silty laminations.

981.5'-982.6' Siltstone: dark brown, no sand.

(981.5') Coal stringer .01 feet thick.
(981.7') Coal stringer .01 feet thick.

982.6-988.1' Sandstone: light gray, very fine to medium-grained, laminated.

(984') End of lamination. Change to massive-bedded.
(988') End of massive-bedding. Lamination resumes with some bioturbation in the laminated zones.

(980.3-999.8') Frequent breaks in core, fresh, probably drilling induced.

988.1-989.2' Coal: sharp upper and lower contacts.

- Mudstone
Blackhawk

990-995′ Sandy siltstone: dark brown, very fine-sand, soft.

• 990′ —

(993.7′) Coal stringer.
(992.7′) Coal stringer.
Grassy Mbr (993.1′) Coal stringer.

993.7-995.9′ Sandstone and siltstone: gray, laminated, very fine-grained, hard, bioturbated, silt content decreasing with depth.

995.9-997.2′ Sandstone: light gray, very fine-grained, trace of siltstone, laminated, high-angle cross-beds.

(972.2′) Coal stringer.

972.2-1000′ Sandstone: gray, very fine-grained, quartz, massive-bedded, occasional coal stringer, hard, tight.

1000-1005.6′ Sandstone: massive-bedded, faint carbonaceous stringers.

1005.6-1010′ Sandstone, muddy beds up to .75-inches thick, laminated, partings, occasional bioturbation.

(1000.5-1015.6′) Frequent breaks in core, fresh, probably drilling induced.

1010-1014.5′ Muddy sandstone: small coal stringers, silty.

1015-1020′ Muddy sandstone: laminated, bioturbated, low-angle cross-beds.

(1019.5) Muddy fraction increasing.

1020-1021′ Muddy sandstone: dark gray, carbonaceous, bioturbated, bivalves.

(1020.3-1039.2′) Frequent breaks in core, fresh, probably drilling induced.
(1020.7′) Carbonaceous parting.

1021-1021.4′ Sandstone: medium-grained, bioturbated.

1021.4-1023.5′ Sandstone: medium-grained, low-angle cross-beds, very porous, light gray.

1023.5-1040′ Sandstone: less porous, low-angle cross-beds, faint bioturbation.

(1030′) Pyrite band 0.15" thick.
(1038′) Cross-beds increasing.

1040-1045.5′ Sandstone, mixture of salt and pepper colored, very-fine to medium-grained, low-angle cross-beds, laminated coal stringers, non-calcareous, moderate permeability, medium-grained sand laminations.

(1040.0-1049.8′) Frequent breaks in core, fresh, probably drilling induced.

1045.5-1047.9′ Sandstone: light gray, very fine to fine-grained, bioturbated, slightly friable, slightly calcic.

1047.9-1056′ Sandstone: very-fine to medium-grained, low and high-angle cross-beds, occasional coaly laminations and blebs, slightly friable, occasional bioturbation, wet.

(1052.7′) Siltstone, dark gray, .03-feet thick.
(1054.2′) Coaly lamination.
(1054.4′) Coaly lamination, wet.
(1055.0′) Bioturbation, wet.

1056.1-1056.8′ Siltstone, light to dark gray, laminated, bioturbated, non-calcareous, very fine-grained sandstone laminations, dense.

1056.8-1058.2′ Sandstone, light gray, very fine to fine-grained, laminated, heavily bioturbated, occasional siltstone laminations, hard.

Grams

1058.2-1060′ Sandstone: light gray, fine-grained, laminated.

(1050-1060′) Frequent breaks in core, fresh, probably drilling induced.

~~1062~~
S de

1060-1070′ Coal: occasional coaly stringers, non-calcic, dense.

(1061.6′) Coal, vitreous layer 0.15-feet thick.
(1062.1′) Coal, vitreous layer 0.2-feet thick, fractured.
(1062.3-1064.7′) Near-vertical fractures.
(1066-1070′) Horizontal and vertical fractures, broken.

Sunnyside Member

1070-1075′ Sandy siltstone and sandstone: gray and dark brown, coaly, soft poorly cemented, sharp contact with over-lying coal.

1075-1080′ No Recovery.

1080-1100′ Sandstone: fine to medium-grained, poorly cemented, low-angle cross-beds.

50′

(1087′) Increasing carbonaceous material, high-angle cross-beds.
(1089.2′) Carbonaceous parting.
1098.5-1099.2′ Coal.

1100′ End of core.

1100-1220′ Sandstone: gray, loose clear grains, very fine to fine-grained, sub-angular to sub-round, trace of coal.

(1130′) Sandstone, increasingly indurated, predominantly fragments.

(1140′) 50% sandstone, and 50% mudstone, brown, sandy, trace of dark minerals, pyrite.

(1150')	90% sandstone, and 10% mudstone.
(1160')	60% sandstone, and 40% mudstone.
(1170')	30% sandstone, and 70% mudstone, occasional dark brown to black.
(1180')	60% sandstone, and 40% mudstone.
(1190')	80% sandstone, and 20% mudstone.
(1200')	Sandstone, medium to light gray, very fine-grained, silty, 5% dark minerals, friable, no apparent mudstone.
(1210')	70% sandstone, and 30% mudstone, dark gray to dark brown, slightly calcic, hard.
(1220')	TD.

Geologic Log

EarthFax

PROJECT No.: UC 284-05 HOLE No.: IAA-2

DATE BEGIN: 5-18-94 DATE END: _____

DRILLER: BEEMAN LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
Drill Rotary w/Air to 41'. Set 9.7500 9.0 10 surface Casing			0		Unconsolidated Alluvium. 0-20' v.f. grained sand & silts, light brown to orangish brown. Dry some gravels
			10		
			20		100% sandstone: very fine grain, sub angular, light gray calcareous, poorly cemented weathered, dry
			30		AA
			40		AA. but somewhat better cemented
			50		SILTSTONE: Dark gray to black, non calc. shaley fracture. Firm, dry
			60		SILTSTONE - SANDSTONE interbedded: SILTSTONE AA SANDSTONE: med. lt gray to lt. gray, v.f grained, silty, calcareous, hard
			70		AA
			80		SANDSTONE: LIGHT GRAY, very fine grained, silty, calcareous, hard.
			90		SS AA but grains becoming fine grained, sub ang sub rounded, some loose grains, hard
			100		

Geologic Log

EarthFax

PROJECT No.: UC 284.05 HOLE No.: IPA-2

DATE BEGIN: 5-18-94 DATE END: _____

DRILLER: _____ LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
	Air Rotary		100		Sandstone: Light gray, vf to f, subang to subrd, loose, frosted qtz grains, calc., soft
			110		AA becoming more indurated
			120		Siltstone: Dk gray, some vfine grained ss, coaly, soft, non calc.
			130		AA
switched to using water and foam @ 140' Too much dust?			140		Sandstone: light to med. lt gray, vf to f, subang-subrd, frosted to white grains, sl calc. soft
1215pm			150		AA but lt gray & fine grained - fairly clean poorly cemented, sl. calc. soft
			160		AA
			170		AA
			180		AA becoming coarser grained to med. grain sub rounded, more calcareous.
1430			190		AA but becoming dark brown to med. gray hard trace of siltstone, dk brown
			200		

Geologic Log

EarthFax

PROJECT No.: HC284.05 HOLE No.: TPA-2
DATE BEGIN: 5-18-94 DATE END: ___
DRILLER: Beeman LOGGER: COL/KWB FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
Tray C			200		SS lt gray, very fine to fine w/ some med grained, sub ang to subrd, frosted qtz, sl. calcareous, poorly cemented pyrite
			210		AA w/ increasing amt of fine grained qtz ss.
			220		SS AA Little to no HCL REACTION. Loose grains. CLR-Lt gray. Predom SUBRND.
			230		-A.A.-
Having some minor problems w/ rotating stuck in hole			240		-A.A.-
			250		70% vf-f gr S.S. as above. Loose Qtz grains. SRND NON CALC CEMENT. 30% SS. HRD. SLIGHT CALC REACTION SMALL % of DRK MINERALS
			260		-AA-
Drilling very slow.			270		60% SS AA, 20% VFG-SILTY GRY. MOD CALC. FIRM-HARD. LT GRAY-LT BRN. OCC DARK MINERAL. QTZ GRAINS GENERALLY CLEAR W/ OCC PINK-AMBER GRAIN.
			280		AA W/ 80% SS (LOOSE GRAINS) CLR-PINK, F-MED HR 20% SS VFG, BRN-LT GRY, VFG-SILTY, CALC. FIRM-HARD.
			290		-AA- W/ 60% Loose gr SS AND 40% VFG SS. HRD-FIRM
			300		

Geologic Log

EarthFax

PROJECT No.: UL-284-05 HOLE No.: IDA-2
DATE BEGIN: 5-18-94 DATE END: _____
DRILLER: Bozman LOGGER: COH/KAB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			300		SS. Predom Fine grained. Firm-Hard. cemented. Sang-Sbrnd. Clear Qtz grns occ Orange-Brn vfg SS. Also occ dark minerals.
			310		AA
			320		AA sl. calc. Approx 2% dark grains hard
Drilling rate 5-10' hour			330		AA w/ interbedded siltstone, dark brown, laminated calcareous, hard.
			340		AA
			350		SANDSTONE: Med. Gray to lt. gray, some siltstone as above, ~~grain~~ vf to f, sub ang - sub rdd. qtz, clear to frosted, well sorted, hard, sl. calc.
			360		SS & SILTSTONE INTERBEDDED: SS AA, Siltstone is dark brown to grayish brown, occasional coal fragment, slightly calc. hard to soft
			370		SANDSTONE: Fine grained, Sub rd, frosted to clear some vf & sub angular gr, well sorted, poorly cemented, calcareous
			380		SILTSTONE: Dark gray to dk brown, thinly bedded, slightly hard, slightly calcareous, coal fragments.
			390		AA
			400		

Geologic Log

EarthFax

PROJECT No.: UC 28405 HOLE No.: IDA-2

DATE BEGIN: 5-18-94 DATE END:

DRILLER: Beeman LOGGER: CDH/CHB FIRST WATER AT: 290'

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
TRUNK A CASING 0-410' 9.7500, 9.0 ID			400		80% SILTSTONE, BRN - DRK GREY, HARD. with occ DARK MINERAL STREAK, PYRITE INCLUSION. 20% SANDSTONE, CLEAR - LT. GRAY, vf grained with MANY black MINERAL BANDS AND INCLUSIONS. PREDOM Qtz.
RESUME DRILLING 5-21-94 2130'			410		-AA-
			420		-AA- 90% SLTST, 10% SS
			430		-AA-
			440		-AA-
			450		-AA- W/ increasing SS. 60% SLTSTN 40% SS
			460		70% SS vf-fg CLR WHT - LT GREY W/ BLACK INCLUSIONS AS ABOVE 30% SLTSTN AS ABOVE
Hole not MAKING WATER AFTER SURFACE CASING SET			470		-AA-
			480		80% SLTST, 20% SS
			490		-AA-
			500		

Geologic Log

EarthFax

PROJECT No.: 41-28405 HOLE No.: 1PA-2

DATE BEGIN: 5-18-94 DATE END: _____

DRILLER: BEEMAN LOGGER: CON/KHR FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			500		SILTSTONE 90% gray to dark brown. Hard. Slightly Calcareous. Dark mineral inclusions - (carbonaceous) Sandstone 10% f-vfg. CLR-WHT-Ltgray.
			510		-AA-
			520		50% SLTST, 50% SS. -AA- TRACE of COAL
			530		80% SLTST, 20% SS SLTST → LT BRN-GRAY
			540		-AA-
			550		-AA-
			560		-AA- Trace pyrite, coal. Alternating dark mineral bands in S.S. No visible HCL Reaction.
			570		60% SLTSTN, 40% SS
			580		90% SLTSTN - CARBON FRAGMENTS, PYRITE. DRK BRN. HARD 10% WHT-CLR vf-fgr S.S. occ. DRK MIN INCLUSION.
			590		-AA-
			600		

Geologic Log

EarthFax

PROJECT No.: LL-284.05 HOLE No.: 1PA-2

DATE BEGIN: 5-18-94 DATE END: _____

DRILLER: Bowman LOGGER: CAL/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			600		100% SILTSTONE. Dark Gray to Brown. Non calcareous. Occasional dark minerals / streaks (Carbonaceous). Firm - Hard.
			610		50% SILTSTN A.A. 50% f-vf grained SS. Well cemented. Slightly calcareous. LT GRY - WHT. OCC COAL - PYRITE.
			620		-AA-
			630		-AA- w/ 60% SS 40% SLTSTN
			640		70% SLTSTN. INCREASING AMOUNT OF COAL. OCC PYRITE 30% SS
			650		-AA-
			660		-AA-
			670		-AA-
			680		90% SLTSTN, 10% SS. SLTSTN IS PLATY W/ CARBON VEINS, PYRITE VEINS
			690		50% SLTST 50% SS. SLTST AA. SS is light to med dk gray, v.f. grained, silty carbonaceous, calc. Hard & brittle.
			700		

Geologic Log

EarthFax

PROJECT No.: IIC 284-05 HOLE No.: IPA-2

DATE BEGIN: 5-18-94 DATE END: _____

DRILLER: Beeman LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			700		SANDSTONE: Light gray to med gray, 10% SLTST frags, ss is subang - subrnd, clr, frosted, non calcareous, brittle, some coaly frags
			710		ss AA, no SLTST
			720		ss & SLTST ss AA SLTSTONE: dark gray to black, organic rich, platey brittle to soft ss is fine gr w/ some med grains, non calcareous
			730		Sandstone: Light gray to light pinkish gray fine grained, some med grains, clear to frosted, grains subangular to subrnd, poorly cemented, only slightly calc. trace of carbonaceous matl. trace of pyrite
			740		AA - poorly cemented, mostly vf-f grained, tr pyrite
			750		AA
			760		AA
			770		AA trace of SLST
			780		AA Poorly cemented - trace of SLTST
			790		AA. but more vf grains
			800		

Geologic Log

EarthFax

PROJECT No.: UC 284.05 HOLE No.: IPA-2

DATE BEGIN: 5-18-94 DATE END: _____

DRILLER: BEEMAN LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
Drilling rate ~20/hr			800		SS med light to light gray vf-f grained, mod well sorted, gray, clear to frosted grains, loose sand, slight
			810		AA
			820		AA w/ trace of SLTST
			830		AA
			840		AA
			850		AA
			860		AA but harder, finer grain SS
			870		SS & SLTST interbedded SS AA w/ some silt SLTSTONE - Dark Gray to black, brittle, non calcareous, carbonaceous.
			880		AA
			890		AA
			900		

Geologic Log

EarthFax

PROJECT No.: UC284.05 HOLE No.: IPA-2

DATE BEGIN: 5-28-94 DATE END: _____

DRILLER: Beeman LOGGER: CDH/KHB FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			900		SILTSTONE & Shale. dark gray to dark brownish gray, shale is silty, brittle, sl. fissile, non calc. SLTST is dark gray, vf gr sand, brittle non calc.
			910		SILTSTONE & SS interbedded. SLTST AA. SANDSTONE: Light gray, vf to fine gr. silty, plg, frosted to clear, subang to subrdd, non-calcareous, hard trace of coal
			920		AA but SLTST INCREASING
			930		AA
			940		
BEGIN CORING NOTE SCALE CHANGE!					940-942.8' vfg SS LIGHT GRAY TO LGRAY CROSS BEDDED EUHEDRAL SLIGHTLY CALCAREOUS. FIRM-HARD. 942.8-945.4 SHALEY SILTSTONE, DARK GRAY. FIRM. PLATY. NON CALC. FAIRLY HOMOGENEOUS.
			945		
99% RECOVERY 19.8'					945.4-946.2' COAL. 946.2-948.0 SHALEY SILTSTONE AA. 948.0 CARB STRINGER & COAL STRINGERS TO 949.4' INTERBEDDED W/ SH/SLTSTN. 949.4-949.9 SH/SLTSTN -AA-
1.2' FERC 4'long		CORE #1	950		949.9-950.7' SS. vfg. HARD. LT GRY-GRY. MANY LOW & CROSSBEDS. 950.7-951.4' SLTSTN. DRK GRY-BRN. HARD. NON CALC. HOMOGEN. 951.4'-957.6' INTERBED SLTST/COAL. COAL FROM 951.6-952'
			955		952-953.5' SS. vfg. LTGRY. MANY LOW & X-BEDS. CARB PARTINGS LARGEST = 0.2mm. 953.5'-955.1' SLTSTN. FIRM-HARD. GRAY. OCC CARB STRINGERS. 955.1-956.2' COAL/MUDST INTERBED W/ COAL FROM 955.6-956'. 956.2-960' SANDY SILTSTONE GRY-BRN CARB STRINGERS @ 957.4', 957.6, 957.8'.
			960		
20' Cored 19.95' Recovered					960-960.3 AA. 960.3-962.0 COAL 962.0 SLST DK br gray. 962.0-966.9 SANDSTONE: Lt gray indurated w/ brown mottling, bioturbated, occ coaly stringers @ 66.6, 68.1. 966.9-970 SS: Lt gray to dark brown, becomes silty w/ depth. coal blebs, some bioturb. ss is f to vf g.
		Core #2	965		Bk 61.3, 61.8; 62.8, 63.3, 63.7; 63.9, 64.5, 64.9; 65.1, 65.5, 65.8; 66.6, 66.6, 67.0; 67.3, 67.6, 68.1; 68.8, 69.2, 69.6; 70
			970		

Geologic Log

EarthFax

PROJECT No.: 1K28405 HOLE No.: IP4-2
DATE BEGIN: 5-18-94 DATE END: ___
DRILLER: Bauman LOGGER: CDW-JDG FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description	
Core 20' recovered 19.95'			970		970-971.8 SS. Lt gray, thinly bedded to thinly lam. brnt. interbeds of brown siltstone occ coal stringers	BK 970.4, 71.8 73.6, 73.9 74.3, 74.7
					971.8-973.6 SS. Lt gray, laminated, interbedded occ. silty brown lam. coal stringer @ 973.5	75.4, 76.1 76.5, 77.2 77.7, 77.9
			975		973.5-979.4 Siltstone dark brown to brown, f.g., silty massive bedding, 976-973.5, 977.0-977 SS AA Coal 0.05@ 79.35	79.3
1645 - Core out 1700 Trip in to ream 20' cored 20' recovered			980		979.4-980 Coal & silty coal, fragmented, brittle	
					980-980.9 SLST DK Brown finely laminated, lt gray interbeds	BK @ 80.3
					980.9-981.5 SS Lt gy to lt Br gy, fine grained, silty lam, Bio	80.5, 81.2
					981.5-982.0 SLST DK Br AA, no sand 0.1' coal at 1.5, 1.7	81.8, 82.15
					982.6-983.1 SS Lt to med gr, fine gr to vf, lam to massive bedding to BB w/ occ laminations some bio turbation in laminated zone	82.8 83.5 83.8, 84.2 85.2, 85.4 85.9, 86.6, 87.6
		Core #3	985		983.1-989.2 COAL abrupt contact w/ overlying SS sharp contact w/ underly SLST	87.2, 88.89.1 89.8, 91.0
			990		SLTST DK Brown, vf sand, soft. Coal stringers @ 93.7 89.9 91.1, occ bio, grad transition to SS	91.6, 91.8, 92.1 92.9, 93.5
					Coaly stringers 92.7 - 93.1	94.1, 95.9
					93.7-95.9 SS & SLST laminated SLST AA, SS lt gray vf grain, bio, hard, SLTST decreases w/depth	97.2, 97.7 98.1, 99.1
			995		95.9-97.2 SS. Lt gray, vf gr, tr silt lam Hi X-bedding.	99.8
					97.2 Coal stringer	
					97.2-1000 SS med gray vf to f gr, appears massively bedded, occ v. thin coal stringer, hard, tight	
RESUME CORING @ 2030 HRS 5-23-94			1000		1000-1005.6' SS AA, MASSIVE, FAINT CARB STRINGERS	BK @ 1000.5 1000.8, 1.2 1.6, 2.1 2.8, 3.4 3.8, 4.2
		Core #4	1005		1005.6' - 1010' SS AA, MUDDY BEDS UP TO 0.75', LAMS, FRACTURES. OCC BIOTURB.	4.9, 5.6 5.9 6.4 6.7 7.1 7.4 7.8 8.2 9.3
			1010		MUDDY SS SMALL COAL STRINGERS 1010-1014.5 INCR SILTY FROM 1013.4 - 1014.5	10.1 10.9 12.2 12.6 13.3 13.9 14.8 15.6
			1015		1014.5 - 1019.5 GRY MICACEOUS SS, OCC CARB FRACTURES, MUDDY LAMS, BIOTURB. LOW ∠ X-BEDS	
1145 HRS CORE OUT			1020		1019.5 - 1020 SS AA INCR MUDDY	

Geologic Log

EarthFax

PROJECT No.: UC-284-05 HOLE No.: IPA-2

DATE BEGIN: 5-18-94 DATE END: ___

DRILLER: BEEMAN LOGGER: CDH-JDG FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description	
5-24-94 0100 HRS TRIP IN TO CORE			1020		CARB MUDDY SS, DRK GRY, BIVALVES, BIOTURB. CARB	BRK @ 20.3
					PARTING @ 1020.7	20.7 21.2
					1021.0 - 1021.4 SS, MG, BIOTURB	26.4 29.3
					1021.4 - 1023.5 SS, MG, LOW & X-BEDS, V. POROUS (RAPID-	31.8 32.4
			1025		DRAINING) LT GRY	33.3 34.8
					1023.5 - 1040' SS AA, BUT SLOWER DRAINING (LESS POROUS)	36.4 39.2
					LOW & X-BEDS, OCC FAINT BIOTURB. X-BED & INCR	
					AT 1038'.	
			1030		PYRITE BAND 0.15" THICK AT 1030'	
			1035			
TRIP OUT 0515 CORE OUT 0615	CORE NO 5					
Core 6 out @ 1231 20' cored 19.94 recovered			1040		1040 - 1045.5	
					SS: lt to med, grained, qtz, salt & pepper, low & X-beds,	0.5" & hi fract
					laminated coal stringers vf to fine, non calc,	40.8 - 40.4
					mod perm. occ laminations of, med, gr. sand	brk @ 40.8, 41.3
						42.6 43.2
						44.4, 44.9,
			1045		1045.5 - 47.9 SS lt gray, vf to f, larger % vf, bioturbated	46.0, 47.7,
					SL. friable v. slightly calc.	48.9 49.8
					1047.9 - 1056 SS med gr, vf - f gr, low to hi & X-bedding	
					occ coaly laminations, occ coal blebs, sl. friable	
					occ bioturb, wet	
	Core #6		1050		1052.7 0.03' DK gr silt bone	51.5, 52.1
					1053.7 & 1054.4 coaly lam, wet	52.7, 53.7
					1055.0 Bioturb, coaly lam wet	54.2 55.5
						56.3 56.6
						57.8 58.8
			1055		1056.1 - 1056.8 SLTST: lt to DK gray, lam, bioturb	59.7
					non calc, inter lam vf ss, dense.	
					1056.8 - 1058.2 SS lt gray w/ inter laminated med gray	
					vf - f, heavy bioturb, occ siltst lam, hard	
					1058.8 - 1060' med - lt gr SS f w/ some vf in lam.	
Core 7 out @ 1745 19.5' cored 10.3' recovered			1060		1060 coal occ coaly stringers, non calc. dense	
					Coal 61.6 vitreous layer 0.15'	
					62.1 " 0.2' fractured	
					62.3 - 64.7 - near vert fract	
			1065		64 - 70 fractured vert & horiz broken	
			1070			

Geologic Log

EarthFax

PROJECT No.: 116-284-05 HOLE No.: 1PA-2

DATE BEGIN: 5-18-94 DATE END: ___

DRILLER: BECKMAN LOGGER: [illegible] FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description	
		CORE NO 7	1070		1070.5 SLIST DARK to Med BROWN, vf sands, coaly, soft Poorly cemented	
					1070.5-1070.7 MOD gray sand poorly cemented to not cemented loose sands, vf gr, silty sharp contact w/ overlying coal	
			1075			
5-25-94			1080		1080-1098.5 SS, F-MG, POORLY CEMENTED, LOW ∠ X-BEDS	BRK @ 80.2, 80.7, 81.6, 83.0, 83.6, 84.1, 84.7, 85.4, 86.4, 87.4, 87.9, 88.8, 89.2, 91.2, 95.5, 97.1, 98.5
			1085		SH INCR CARB, HIGH ∠ X-BEDS	
		CORE NO. 8			CARB PARTING @ 99.2'	
			1090			
			1095			
					1098.5-1099.2 COAL	
CORE OUT @ 0200					CARB SS	
SCALE CHANGE			1100		LOOSE SAND GRAINS UF-FG, SANG-SRND, CLR TR COAL (From above?)	
			1110		-AA-	
			1120		-AA-	
			1130		-AA- SS MORE INDURATED - PRETTY FRAGS.	
			1140			

Geologic Log

EarthFax

PROJECT No.: UC-284-05 HOLE No.: 1PA-2
DATE BEGIN: 5-18-94 DATE END: ___
DRILLER: BOEHMAN LOGGER: CDH-XX FIRST WATER AT: ___

7.481

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1140		50% SS AA 50% MUDST, BRN, SNDY, TR DRK MINS, PYRITE
			1150		90% SS AA 10% MUDST AA
			1160		60% SS AA 40% MUDST AA
			1170		30% SS AA 70% MUDST AA OCC DRK BRN-BLK
			1180		60% SS AA 40% MUDST AA
			1190		SS AA 80+% MUDST AA
			1200		SS mod to lt gray, very fine, silty, 5% dk minerals friable, no cement MDST
			1210		SS AA 70% MUDST DK Gray to dk brown, sl. calc. hard.
T.D. @ 0830 5-25-94			1220		

3.3 IPA-3A

Location

N 393,724 E 2,335,785 (feet)
Section 25 T 16 S R 14 E (SLBM)
Emery County, Utah

Ground Elevation:	6,810	feet above mean sea level
Top-of-Casing Elev.	6,812.52	feet above mean sea level
Total Depth Drilled:	1,268	feet below ground level

Formation Tops

Stratigraphic Unit	Depth Below Ground Level (feet)	Elevation (feet above mean sea level)
Flagstaff-North Horn Formation	at surface (incomplete section)	
Bluecastle Member, Price River Formation	200	6,610
Mudstone Member, Price River Formation	472	6,338
Castlegate Sandstone	715	6,095
Upper Mudstone Member, Blackhawk Formation	888	5,922
Grassy Member, Blackhawk Formation	995	5,815
Sunnyside Coal Seam	1,046	5,764
Sunnyside Member, Blackhawk Formation	1,054	5,756

IPA -3

DEPTH	DESCRIPTIONS
0-20′	Alluvium: gray, light gray, and light brown clasts of sandstone, limestone, silt and sand. Sand is very fine-grained, sub-angular to sub-round. Calcic clasts and dark minerals present.
20-150′	Sandstone: light gray and brown, very fine to fine-grained, sub-angular to round. Occasional calcic clasts, firm to hard. Trace of calcic vein filling.
(30′)	10% dark heavy minerals, fine-grained, angular.
(40′)	Sandstone, light gray, brown, and trace of white.
(50′)	90% sandstone and 10% limestone, light gray, hard.
(60′)	30% silty sandstone, soft.
(70′)	60% sandstone, very fine-grained, loose grains. 40% sandstone is light gray, hard.
(90′)	40% sandstone, loose grains, 40% sandstone, light gray, hard, 20% sandstone, light gray and white, fine-grained, angular to round, with 5% dark minerals.
(100′)	60% sandstone, light gray to white, loose grains, very fine-grained, silty. 40% sandstone, very fine-grained, silty, gray and dark gray, calcareous, firm to soft.
(110′)	90% sandstone, loose grains, grading to very fine to fine-grained. 10% sandstone, trace coal, and trace of dark minerals.
(140′)	90% sandstone, light brown and brown, loose grains, very fine-grained to silty. 10% sandstone, trace of dark minerals, trace of coal, occasional white calcic vein.
150-160′	Silty sandstone (80%), brown, gray, and dark gray, very fine-grained, firm, clayey. Weakly calcic. 10% of siltstone, brown, gray and dark gray. 10% of sandstone, clear, white, very fine-grained, calcareous cement.
160-200′	Sandstone (30%): loose grained, light brown to brown, very fine-grained to silty. 60% of sandstone is light gray to light brown, very fine-grained, sub-angular to round, soft. 10% of sandstone is dark brown to gray, very fine to fine-grained, sub-round to round, calcareous, hard.
Flagstaff No. Horn (192′)	Sandstone, silty in part.
-200′ 200-300′ Blue castle	Sandstone (80%), clear and white, loose grains, fine-grained, round to sub-round, moderately sorted. 20% of sandstone is dark brown and brown, very fine-grained, calcareous, firm to hard.

(210')	100% loose grains.
300-350'	Sandstone: 100% loose grains, clear, yellow, and orange, very fine to fine-grained, angular to round, moderate to poorly sorted.
350-370'	Sandstone (80%) and mudstone (80%), gray, occasional sand grain, non-calcic, firm.
(360')	Trace of pyrite. Occasional muddy band in sandstone.
370-460'	Interbedded sandstone and mudstone: 50% sandstone and 50% mudstone.
(380')	30% loose sand grains, 20% sandstone, 50% mudstone.
(390')	10% loose sand grains, 30% sandstone, 60% mudstone.
(400')	80% sandstone, light gray, very fine to fine-grained, with dark minerals. 20% claystone, dark gray, occasionally very fine-grained.
Blue castle (410')	Decreasing light gray siltstone.
— '72' — 460-495'	Claystone, dark gray, soft, occasional dark minerals.
stone Mbr (480') P.R.	50% claystone and 30% sandstone, fine-grained, with dark minerals, hard, light gray. 20% claystone, light olive brown, very soft. Trace of very fine-grained sandstone, dusky blue green, very soft.
(490')	50% claystone and 50% sandstone, light gray, fine-grained, with dark minerals, hard, trace of coal.
495-530'	Interbedded claystone and sandstone.
(500')	50% claystone and 50% sandstone.
(510')	60% sandstone, dark gray and white, very fine-grained, hard, laminated. 40% claystone.
530-600'	Sandstone (10%): clear and white, very fine to fine-grained, sub-round to round, moderate to well-sorted, calcareous, firm. Sandy mudstone (90%), gray and dark gray, non-calcareous, firm to hard.
(550')	20% sandstone with trace of pyrite, and 80% mudstone, dark gray, brittle.
(570)'	Mudstone, increasingly fissile.
(580')	10% sandstone and 90% mudstone.
(590')	100% mudstone.
600-700	100% shale, gray to dark gray, non-calcic, carbonaceous fragments, trace of

		white to clear sandstone, very fine-grained.
	(620')	10% sandstone and 90% shale.
	(630')	20% sandstone and 80% shale.
	(640')	30% sandstone and 70% shale.
	(660')	20% sandstone and 80% shale.
	(670')	100% shale.
	(680')	Trace of coal.
Mudstone Mbr P.R.	(690')	20% sandstone and 80% shale.
— 715' — Castlegate	700-780'	Interbedded sandstone (50%) and shale (50%): Sandstone is clear to white, very fine-grained, round to sub-round, calcareous cement, with occasional muddy stringers. Shale is brown to dark gray, sandy, some carbonized plant fragments, occasional pyrite.
	(750')	Sandstone, 80% loose quartz grains, 20% shale, occasional yellow stain.
	(760')	Clayballs in sample.
	(770')	30% sandstone, loose grains, 70% shale, occasional clayballs.
	780-880'	Sandstone, 100% loose grains, fine to very fine-grained, sub-round to sub-angular, equant.
	(800')	90% loose quartz grains, fine to medium-grained, occasionally coarse-grained, sub-round to sub-angular, equant. 10% shale, dark gray, sandy.
	(810')	90% loose quartz grains, 10% shale, trace of siltstone, light brown, calcic, firm to hard.
	(820')	100% loose quartz grains, trace of shale.
	(830')	100% loose quartz grains, trace of shale, carbonized plant fragments.
— 888 —	880-1005'	Interbedded sandstone (50%) and shale (50%); shale and mudstone content increasing downward.
Upper Mudstone Blackhawk	(890')	30% sandstone, loose grains, varicolored clear, light brown, and gray. 70% shale, firm non-calcareous.
	(900')	20% sandstone, light gray, very fine-grained, sub-round, weakly calcic, firm to hard. 80% sandy shale, varicolored very dark brown to very dark gray, non-calcic, hard.

(910′) Trace of coal.

(920′) Trace of coal.

Upper Mudstone Blackhawk (930′) Trace of coal.

(940′) Trace of coal and pyrite.

— 995′ —

1005′ BEGIN CORING. NOTE SCALE CHANGE.

Grassy Mbr

1005-1010′ Sandy mudstone: gray to dark gray, firm, gradual transition to sandstone, gray to light gray, very fine-grained, firm. Low-angle cross-beds and occasional muddy cross-bed laminations present. Occasional dark minerals and induced fractures.

(1006-1010.1′) Clean sandstone.

1010-1015′ Sandstone, occasional coaly streaks up to 3-millimeters thick, discontinuous, low-angle cross-beds, partings along carbonaceous stringers.

(1010.1′) Carbonaceous stringer.
(1011.2′) Carbonaceous stringer.
(1012.0′) Carbonaceous stringer.
(1012.5′) Carbonaceous stringer.
(1012.9′) Carbonaceous stringer.
(1014.0′) Carbonaceous stringer.
(1016.8′) Carbonaceous stringer.

1015-1020′ Sandstone with carbonaceous stringers.

(1019.4′) Formation becoming very soft.

1020-1025′ Sandy siltstone, dark gray.

(1020.1′) Formation becoming competent, gray.
(1022′) Low-angle carbonaceous stringer, unbroken.
(1022.3′) Low-angle carbonaceous stringer, broken.
(1023.6-1024.2′) Alternating sequence of < 1-inch thick competent sandstones and very soft sandy mudstones.
(1024′) Coal with thin mudstone partings.
(1024.05′) Fissile, shaley.
(1024.25′) Competent coal.
(1024.85′) Small nodule.

— 1046′ — (in 3A) 1025-1033′ Coal, fractured.

side coal
(1025.1′) Low-angle fracture.
(1025.45′) High-angle fracture.
(1026′) High-angle fracture.
(1028.5-1033′) Coal, highly fractured.

(1032.5') High-angle clay parting (45-degrees).

Sunnyside Member

1033-1040' Highly carbonaceous shale and mudstone, gray, with very fine to fine-grained sandstone stringers.

(1035.0') Mud stringers in sandstone.
(1041.4') Mud increasing.
(1039.2-1041.1') Bioturbated.

1040-1045' Mudstone and muddy sandstone.

(1041.4-1042.5') Seven highly carbonaceous muddy parings.
(1043-1044') Mudstone, dark gray.
(1044-1045.2') Sharp contact, change to muddy sandstone.

212'

1045-1055' Sandstone, light gray, fine to medium-grained, low-angle cross-beds.

(1046.8') Muddy carbonaceous parting.
(1047.4') Muddy carbonaceous parting.
(1047.7') Muddy carbonaceous parting.
(1048-1050') Massive bedded.
(1051.4') Muddy carbonaceous parting.
(1050-1053') Cross-bedded.
(1052.5-1055.5') Sandstone, light gray, very fine to medium-grained, low-angle cross-beds, occasional carbonaceous stringers, grading to clean sandstone, bioturbated.

1055-1065' Sandstone. Well-indurated. Non-calcic cement.

(1059-1060') Occasional very thin carbonate stringers. Sandstone fines to very fine-grained.
(1064') Very-thin carbonaceous, fractured, parting.

1065-1085' Sandstone: mixed salt and pepper color, fine-grained, low-angle cross-beds, occasional carbonaceous stringers, well-indurated throughout.

(1067.0') 1-2 millimeter thick carbonaceous parting, un-fractured.
(1068.1') Carbonaceous parting, fractured.
(1072.4') Carbonaceous parting, fractured.
(1073.7') Carbonaceous parting, fractured.
(1077.6') Carbonaceous parting, fractured.
(1080.0') Carbonaceous parting, fractured.
(1080.2') Carbonaceous parting, fractured.
(1080.5') Clean sandstone.

1085-1105' Clean sandstone.

(1093.8-1094') Carbonaceous stringers.
(1093.9') Thin carbonaceous parting, fractured.
(1103.6-1105') Alternating thin-beds of (< 1") sandstone and dark gray mudstone.
1105-1125' Alternating thin-beds of sandstone and muddy sandstone, occasionally

bioturbated.

(1106.2') Carbonaceous parting, fractured.
(1107.5') Carbonaceous parting, fractured.
(1108.2') Carbonaceous parting, fractured.
(1112.5') Carbonaceous parting, fractured.
(1120.3') Carbonaceous parting, fractured.
(1122.2') Carbonaceous parting, fractured.
(1124.0') Carbonaceous parting, fractured.

1125-1145' Sandstone, very fine to fine-grained, sub-angular to sub-round, low-angle cross-beds, non-calcic.
(1126.5-1129.5') Muddy sandstone, bioturbated, mud increasing with depth.
(1128.9') Coal parting, fractured.
(1129.5-1133.5') Massive-bedded, clean sandstone.
(1130') Well-indurated.
(1133.5-1145') Muddy sandstone, bioturbated.
(1141') Muddy parting.
(1142.4') Muddy parting.

1145' STUCK IN HOLE. OFFSET AND REDRILL. DRILL TO 1140' AND RESUME CORING ON 10-29-93.

1140-1160' Sandstone: light gray, very fine to fine-grained, low-angle cross-beds, carbonaceous partings, indurated, bioturbated.

(1147.5') Shaley parting, dark gray.
(1148.1') Shaley parting.
(1149.7') Shaley parting, fractured.
(1152.1') Fractured.
(1153.8') Carbonaceous stringer. Formation is bioturbated, well-indurated, fining downward to very fine-grained, non-calcic.
(1157.9') Broken.

1160-1180' Sandstone: mixture of salt and pepper color, very fine-grained, light gray, bioturbated.

(1160.5') Bioturbated, increasingly muddy.
(1167') Carbonaceous parting, very fine to fine-grained, low-angle cross-beds.
(1167.5') Carbonaceous parting.
(1169') Bioturbated.
(1173.5') Carbonaceous parting.
(1174') Carbonaceous parting.
(1174.5') Bioturbated.
(1177') Bioturbated.
(1177.5') Carbonaceous parting.

1180-1205' Sandy mudstone: muddy stringers, muddy content increasing downward, bioturbated.

(1195')	Abundant bioturbation, light gray to gray, indurated.
(1201.3')	Muddy stringer.
1205-1230'	Muddy sandstone/ sandy mudstone: light gray to gray, sand is predominantly very fine-grained, abundant bioturbation, non-calcareous.
(1209.2')	Fracture.
(1211.6')	Fracture.
(1214.8')	Fracture.
(1217.6')	Fracture. Fining with depth.
(1219.8')	Fracture.
1230-1265'	Mudstone, dark gray.
(1245')	End of core.

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: 1PA-3

DATE BEGIN: 10-05-93 DATE END: _____

DRILLER: REEMAN LOGGER: DOG/TM FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
SPUD HOLE 1300 HRS DRILL AIR ROTARY 6½" TRI-CONE TO SET SURF CASING			0		UNCONSOL. ALLUV. UF SAND, SILT, LT. BROWN OCC CLAST OF UF-FG SS, BRN, GRY, LT GRY, SANG-SRND, OCC DRK MINS CALC CMT OCC CLAST OF LS, GRY, LT BRN, CRM, SOFT-FIRM (SOME MAY BE CALCIC SOIL HORIZ)
			10		-AA-
			20		100% SS, UF-FG, SANG-SRND OCC RND, LT GRY-GRY, BRN CALC, FIRM-HRD, TR CALC VEIN FILLING
			30		100% SS UF-FG SANG-SRND OCC RND · LT GRY-WHT, GRY, WHT CLASTS HAVE UP TO 10% DRK HEAVY MINS, PRED ANG GRAINS, FG.
			40		100% SS AA, PRED GRY-LT GRY, BRN TR WHT SS AA
1615 HRS			50		90% SS AA 10% LS, LT GRY-GRY, HRD.
			60		AA- APPROX 30% SS IS SILTY, SOFT
			70		60% SS, UFG LOOSE GRAINS, 40% SS LT GRY-GRY HRD AA
			80		-AA-
			90		40% LOOSE GRAINS AA 40% SS LT GRY-GRY, HRD AA 20% SS LT GRY-WHT, FG, ANG-RND, 5% DRK MINS
			100'		

TRAY "A"

1700 HRS

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: 1PA-3

DATE BEGIN: 10-05-93 DATE END: _____

DRILLER: BEEMAN LOGGER: DOC/TM FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			100		60% LOOSE GRAINS, UFG-SILT, LT GRY-WHT 40% SS UFG SLTY, GRY-DRK GRY, CALC, FRM-SOFT
			110		90% LOOSE GRAINS AA, GRADING TO UF-FG, 10% SS AA TR COAL, TR DRK MINS.
			120		-AA-
			130		-AA-
			140		90% LOOSE GRAINS, UF-SILTY LTBRN-BRN 10% SS AA TR COAL, TR DRK MINS, OCC WHT CALC VEIN
			150		80% SILTY SS, UFG, BRN, GRY, DRK GRY, FIRM, CLAYEY. W. WEAK EFFERVESCENCE 10% SLTST, BRN, GRY, DRK GRY, 10% SS UF-FG, CLR-WHT, CALC CMT
TRAY 'B'	1830 HRS		160		30% LOOSE GRAINS, UF-SLTY, LTBRN-BRN 60% SS, UFG, SANG-RND LT GRY-LTBRN SOFT 10% SS UF-FG DRKBRN-GRY, SRND-RND, CALC HARD.
			170		-AA-
			180		-AA-
			190		-AA- SS SILTY IN PART
			200		

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: IPA-3
DATE BEGIN: 10-05-93 DATE END: ___
DRILLER: BEEMAN LOGGER: JDG/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			300		100% LOOSE GRAINS, UF-FG ANG-RND MOD-POOR SORT, CLR, YEL, ORG. TR SS, -AA-, FIRM.
			310		-AA-
			320		-AA-
			330		80% SLTY SS, UF-FG, SANG-RND, LT BRN, YEL-BRN. 20% SS AA
			340		100% SS, CLR-LT GRY, SANG-RND, MOD SORT, CALC HARD, OCC DRK MINS.
			350		80% SS AA, 20% MUDST, GRY OCC SAND GRAIN, NON-CALC, FIRM.
			360		-AA- TR PYRITE OCC MUDDY BAND IN SS
			370		50% SS AA 50% MUDST AA
			380		30% LOOSE GRAINS AS IN 300-310', 20% SS AA, 50% MUDST AA
			390		10% LOOSE GRAINS AA 30% SS AA, 60% MUDST AA SS INCR MUDDY.
			400'		

"TRAY A"

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: 1PA-3
DATE BEGIN: 10-05-93 DATE END: ___
DRILLER: BOOMAN LOGGER: DW/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			400'		80% SS, vf-f GRAINED, LT GRAY w/ DARK MINERALS. 20% CLAYSTONE, DARK GRAY OCC f-GRAIN SAND.
			410		AA DECREASING DARK GRAY SILTSTONE
			420		AA
			430		AA
			440		AA
			450		AA
10/6/93 0345			460		CLAYSTONE. DARK GRAY. SOFT. OCCASSIONAL DARK MINERAL.
STOP @ 480 TO SET SURFACE CASING TO 45'			470		AA
RESUME DRILLING 2200 (10/6/93)			480		50% CLAYSTONE AA. 30% SANDSTONE, f-GRAINED w/ DK MINERALS, HARD, LT GRAY. 20% CLAYSTONE, VERY SOFT, LT OLIVE BROWN. TRACE vf GRAINED SANDSTONE, VERY SOFT, DUSKY BLUE GREEN.
10/6/93 2240			490		50% CLAYSTONE AA. 50% SANDSTONE, f-GRAINED, w/ DARK MINERALS, HARD, LT GRAY. TRACE COAL
			500		

"TRAY B"

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: IPA-3
DATE BEGIN: 10-5-93 DATE END: ___
DRILLER: BEEMAN LOGGER: JOG/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			500		50% CLAYSTONE AA. 50% SS. AA
			510		60% SANDSTONE, LG GRAINED, HARD, ALTERNATING THIN BEDS OF DARK GRAY AND WHITE, HARD. 40% CLAYSTONE A.A.
			520		AA
			530		10% SS, VF-FG CLR-WHT SRND-RND, MOD-WEL SORT, CALC FIRM 90% SANDY MUDST, GRY-DRK GRY, NONCALC, FIRM-HRD.
2345			540		AA
TROY C"			550		20% SANDSTONE A.A. TRACE PYRITE 80% MUDST/SH AA, DARK GRAY, BRITTLE
10/7/93 0023			560		AA
			570		AA MUDST/SH INCR PLATEY - (MORE SHALEY)
01:05			580		10% SS AA 90% MUDST/SH AA
			590		100% SH/MUDST AA
01:45			600		

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: IPA-3

DATE BEGIN: 10-5-93 DATE END: _____

DRILLER: BEEMAN LOGGER: JDC/TM FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			600		100% SH GRY-DRK GRY, NONCALC, CARBON. FRAGS, OCC SNDY. TR SS, WHT-CLR, UFG.
			610		-AA-
02:25			620		10% SS AA 90% SH AA
			630		20% SS AA 80% SH AA
03:15			640		30% SS AA 70% SH AA
			650		-AA-
04:30			660		20% SS AA, 80% SH AA
			670		100% SH AA
05:20			680		-AA- TR COAL
			690		20% SS AA 80% SH AA
06:15			700		

TRAY A

Geologic Log

EarthFax

PROJECT No.: C-284-04 HOLE No.: IPA-3

DATE BEGIN: 10-5-93 DATE END: _____

DRILLER: BEEMAN LOGGER: JDG/TM FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			700		50% SS, UFG, RND-SRND, CLR-WHT CALC CMT MUDDY STRINGERS OCC, 50% SH, BRN-DRK GRY SH/CARBONIZED PLANT FRAGS IN SOME SS & SH CLASTS OCC PYRITE
			710		
0700 10-07-93					—AA—
			720		
ROAD IMPASSABLE SHUT DOWN 0900 HRS, 10-07-93					—AA—
RESUME 1500HRS, 10-10-93					
			730		
					—AA—
			740		
					—AA—
			750		80% LOOSE QTZ GRAINS & SS AA, OCC YELL STN. 20% SH AA
			760		
					AA— A lot of clyballs in sample (?)
			770		
					30% SS & LOOSE GRAINS AA 70% SH AA OCC clayballs
			780		
					100% LOOSE QTZ GRAINS, F-MG, SRND-SANG, EQUANT
			790		
					—AA—
			800		

"Tray B"

Geologic Log

EarthFax

PROJECT No.: 284-05 HOLE No.: IPA-3

DATE BEGIN: 10-05-93 DATE END: ___

DRILLER: BEEMAN LOGGER: JDA/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			800		90% LOOSE QTZ GRAINS, F-MG, OCC CG, SRND-SANR, EQ 10% SH, SNDY, DRK GRY
			810		90% LOOSE QTZ GRAINS AA, 10% SH AA TR SILTST, LT BRN, CALC, FIRM-SFT
			820		100% LOOSE QTZ GRAINS, AA TR SH
			830		100% LOOSE QTZ GRAINS, TR SH, CARBONIZED PLANT FRAGS
			840		-AA-
			850		-AA-
			860		-AA-
			870		-AA-
			880		50% GRAINS AA, 50% SH AA
			890		30% GRAINS AA & SS, UF-FG, CLR-LT BRN-GRY, 70% SH AA ↳ FIRM, NON-CALC
			900		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-3

DATE BEGIN: 10-05-93 DATE END: _____

DRILLER: BREMAN LOGGER: JDL/TM FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			900		20% SS, UFG, SRND, WK CALC CMT, FRM-HRD, LT GRY 80% SH, SNDY, UDRK BRN, GRY, UDRK GRY, NONCALC, HRD.
			910		AA - TR COAL
0730 10-11-93			920		AA - TR COAL
			930		AA - TR COAL
			940		AA - TR COAL TR PYRITE
			950		AA -
			960		AA -
			970		AA -
			980		AA -
			990		AA -
1030 HRS 10-11-93			1000'		

TRIP OUT TO CORE

TRAY "A"

• NOTE SCALE CHANGE •

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: IPA-3

DATE BEGIN: 10-05-93 DATE END: ___

DRILLER: BEEMAN LOGGER: JXL/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1000'		
1st core 13.4' (from 1005 to 1018.4') good recov, but cuttings in bottom		1	1005		SANDY MUDSTONE. GRAY-DK GRY FIRM TRANS. TO SS: SS VFG GRY-LT GRY FRM. LOW & X-BEDS OCC MUDDY X-BED LAMS OCC DRK MINS FRACS APPEAR INDUCED. CLEAN SANDST 1006' TO 1010.1'
13.4' total recov. 0.6' is <4" long,		CORE No. 1 + 2 Box 1 + 2	1010		CARB STRINGER ≈1mm THICK at 1010.1, 1011.2, 1012', 1012.5', 1012.9' OCC COALY STREAKS UP TO 3mm THICK, DISCONTINUOUS SS AA, LOW & X-BEDS AA, CARB STRINGER ≈1mm THICK AT 1014', 1016.8', PARTINGS AT NOTED CARB STRINGERS.
			1015		CARB STRINGERS FROM 1010.1 TO 1018.5'
	1018.5				SS AA TO 1019.4
Box No.3: 1018.5-1025.5' Box No.4: 1025.5-1033'		CORE No. 2	1020		↑ BECOMES VERY SOFT (ALMOST NON-CEMENTED) FROM 1019.4 TO 1020.1' WHERE IT GRADES TO A SANDY SILTSTONE TO A SANDY MUDSTONE (DK. GRAY.) BECOMES COMPETENT SS A.A. @ 1020.1. GRAY, LOW & CARB STRINGER @ 1022 (UNBROKEN) AND 1022.35' (BROKEN) → BOTH ~1mm THICK
~1' LOST OFF BOTTOM OF CORE No. 2. (IE, 1027.5-1028.5')	1028.5		1025		1022.6 TO 1024.2 ALTERNATING THIN (<1") SEQUENCES OF COMPETENT SS A.A. AND VERY SOFT SANDY MUDSTONE A.A. COAL @ 1024. THIN MUDSTONE PARTINGS (UNBROKEN) @ 1024.05. FISSILE/SHALEY 1024 TO 1024.25' BEFORE BECOMING COMPETENT COAL. SMALL (~1/4") CLAY NODULE @ 1024.85'. FRACTURES AT 1025.1 (LOW ∠), 1025.45 (HI ∠), AND 1026' (HIGH ∠) → LOST 2 FRACTURES ARE PARALLEL @ ~45°
CORE No.3 100% RECOVERY		CORE No.3	1030		1028.5 - 1033: CORE HIGHLY FRACTURED (DRILLING INDUCED?) HI ∠ CLAY PARTING @ 1032.5' (~45°) HIGHLY CARB. SHALE/MS, GRY F-FG SS STRINGERS GRADING TO MUDSTRINGERS IN SS AA AT 1035' INCR MUD TO 1041.4'
CORE No. 4 19.2' recov, 1.1' frac. <4" long 1033' TO 1052.2'			1035		BIOTURBATED. FROM 1039.2 TO 1041.1' SEVEN HIGH CARB. MUDDY PARTINGS 1041.4 TO 1042.5',
		CORE No. 4	1040		MUDST DRK GRY 1043 - 1044, SHARP CONTACT WITH UNDERLYING MUDDY SS FROM 1044 - 1045.2
			1045		SS FG-MG, LT GRY-GRY LOW & X-BEDS, OCC DARK MINS CARB X-BEDS, MASSIVE 1048 - 1050 X-BEDS RESUME 1050 - 1053' MILD-CARB PARTINGS ≈80° AT 1046.8' 1047.4' 1047.7' 1051.5'
			1050		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: IPA-3
DATE BEGIN: 10-05-93 DATE END: ___
DRILLER: BEEEMAN LOGGER: JDG/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1050		
			Core No 4		
		1052.5			SS, UF-MG, LTGRY, LOW-ANG X-BEDS, OCC CARB STRINGERS FROM 1052.5' TO 1055.5', THEN CLEAN SS THROUGH REMAINDER OF CORE BIOTURBATION IN 1052.5 TO 1055.5' INTERVAL (OCC). SS IS VERY WELL INDURATED - REPEATED BLOWS W/3lb SLEDGE & COLD CHISEL TO BREAK. NON-CALC CEMENT
			1055		
			Core No 5		
			1060		OCC V.THIN CARB STRINGERS 1059' TO 1060' SS GEN. FINES TO UF-FG
		1064.5			ONE V.THIN CARB. PARTING/FRACTURED AT 1064.0'
CORE No.6 (18.6' RECOVERY / 19 FT RUN)			1065		SS, fG SALT & PEPPER, LOW ∠ X-BEDS OCC CARB STRINGERS TO 1080.5, THEN CLEAN SS, (1-2mm. CARB PARTINGS @ 1067 (UNFRACTURED) 1068.1 (FRACTURED), 1072.4 (FRACTURED), 1073.7 (FRACTURED) 1077.6 (FRACTURED), 1080, + 1080.2 (FRACTURED) WELL INDURATED THROUGHOUT
			1070		
			CORE No.6		
			1075		
			1080		
			1085		
CORE No.7 19.0' RECOVERY (20' RUN)					CLEAN SS. AA.
			1090		
			CORE No.7		OCC. CARB STRINGERS 1093.8-1094
			1095		THIN CARB. PARTING/FROC. @ 1093.9
			1100		

Geologic Log

EarthFax

PROJECT No.: C-28405 HOLE No.: IPA-3

DATE BEGIN: 10-05-93 DATE END: ___

DRILLER: BEEMAN LOGGER: JDL/TM FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1100 CORE No. 7 (CONT)		1103.6-1105 ALTERNATING THIN BEDS (<1") OF SS AA AND DARK GRAY MUDSTONE
CORE No. 8 19.9' RECOVERY (20' RUN)			1105		1105-1105.02 AA @ 1105.02 BECOMES S.S. A.A. w/ THIN ALTERNATING (<1") BIOTURBATED MUDSTONE/SS ~~BEDS~~ FROM 1107.5-1109.5; 1112-1113.4; 1120-1120.2; 1123.6-1124.1
			1110 CORE No. 8		CARB. PARTING/FRACT. @ 1106.2; 1107.5; 1108.2; 1112.5; 1120.3; 1122.2; + 1124'.
			1115		
			1120		
			1125		SS, VF-FG, SANG-SAND, LOW ∠ X-BEDS, OCC CARB X-BEDS, NON CARB 1126.5 TO 1129.5 MUDDY SS BIOTURBATED CARB/COAL PARTING AT 1128.9' FRACTURED. 1129.5 TO 1133.5 MASSIVE CLEAN SS AA
			1130		SS IS VERY WELL INDURATED
1000 HRS, 10-13-93			1135 CORE No. 9		1133.5 TO 1145' MUDDY SS, BIOTURB. AS IN 1126.5-1129.5 INTERVAL. GENERALLY INCR MUD W/ DEPTH
			1140		MUDDY PARTING AT 1141', 1142.4'
			1145		
			1150		

REDRILL (CORELOG)

Geologic Log

EarthFax

PROJECT No.: UL-284-05 HOLE No.: 17A-3A

DATE BEGIN: 10-29-93 DATE END: ___

DRILLER: BEEMAN LOGGER: HB/JDL FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
CORE POINT 17A-3A			1140		1140 - 1142.5' vf - f gr SS w/ Cross Beds. Bioturbation @ 1140.9 - 1141 Light Gray. CARB PARTING FROM 1140.2 - 1140.3 INDURATED. EXTREME BIOTURB FROM 1145 - 1147.00'
CORE NO. 1 19' CORED 18.8' Recovered 0.15' < 4"			1145	CORE 1	1147.5 & 1148.1' SHARP PARTINGS. DRK GRAY SH-MST. REST SS A.A. SS is ML - f grained. LT GRY - GRY
Core 1140 - 1159'			1150		1149.7' SHARP FRACTURE 1152.1' FRACTURED 1153.8 CARB STRINGER. BIOTURB. INDURATED. HARD TO BREAK. GRAIN SIZE FINING. NON CALC CEMENT.
MID SS of Fisher (1936)			1155		
MID SH of Fisher (1938)			1159		VF gr SS AA w/ MAJOR BIO ACTIVITY. VF grained NON CALC. GRAY - DRK GRAY. OCC DRK MIN (1155-1158) BROKEN @ 1157.9 (DRILLERS BROKE)
CORE NO. 2 9' CORED 8.6 Rec'd 0.2' < 4"			1160	CORE 2	S.S. vf grained A.A. Salt & Pepper Look Lt Gray BIOTURB @ 1160.5
Core catcher bored the bottom. Core is broken in several pieces			1165		AA INCREASING MUD - MUDDY S.S. MASSIVE. INDURATED BOTTM PCS. BROKEN DUE TO CORE CATCHER GETTING CAUGHT.
			1167.8		SS VF-FG, LT GRY, HRD LOW ∠ X-BEDS. CARB PARTING AT 1166.7', 1167.5', BIOTURB AT 1169'
			1170	CORE NO. 3	CARB. PARTING AT 1173.5', 1174' SOME BIOTURB FROM 1174.5 - 1177'
			1175		CARB PARTING AT 1177.5'
Full 20' recovery driller says: 1165'-1185'			1180		MUDDY STRINGERS AT 1181', INCR MUDDY & BIOTURB TO 1185'. (MUDDY SS)
			1185'		MUDDY S.S. A.A. INC MUDDY & BIOTURB AA
			1190		

Geologic Log

EarthFax

PROJECT No.: C-284-05 HOLE No.: 1PA-3A
DATE BEGIN: 10-29-93 DATE END: ___
DRILLER: BEEMAN LOGGER: JDG/KHB FIRST WATER AT: ___

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
FULL 20' RECV 1185 - 1205'			1190		A.A
			1195		1195 - 1205' ABUNDANT BIOTURB. CORE IS INOCULATED. LT GRY - GRY.
			1200		1201.3 MUDDY STRINGER
CORE NO. 5 CORD 20' RECV 20' 100% 0' < 4"			1205		MUDDY SS → SANDY MST. LT GRY - GRY. SAND IS PREDOM VF GRAINED. ABUNDANT BIOTURBATION. NON CALC.
1205-1225'			1210		FRACTURES @ 1209.2' - 1211.6' - 1214.8' - 1217.6' - 1219.8'
			1215		FINES W/ DEPTH
REAM HOLE			1220		
			1225		MUDDY SS / SANDY MST AA
			1230		MUDSTONE !! AT 1229' DARK GRY
			1235		
			1240		

CORE 4 CORE 5 CONTINUED

Geologic Log

EarthFax

PROJECT No.: _____ HOLE No.: TPA-3A

DATE BEGIN: _____ DATE END: _____

DRILLER: _____ LOGGER: _____ FIRST WATER AT: _____

Comments	Sample Method	Drilling Rate	Depth	Graphic Log	Lithologic Description
			1240		
			CORING		
END OF CORE 1330 HRS 10-31-93			1245		REAM TO 1245 DRILL 20' BEYOND FOR RATHOLE
DRILLED 20' OF RAT HOLE. TD 1265' AT 1730 HRS, 10-31-93			1250		
			1255		
			1260		
			1265		T.D.

Plate VI-8 - Pg. 1 of 27

T 17.5
R 15E
Lat.
Long.
2,430 FT FEL, 300 FT FSL
Location Diagram

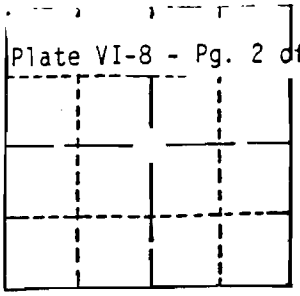
DRILL LOG

Hole Number: [illegible]
Collar Elevation: [illegible]
Determined by: [illegible]
Total Depth: 9[illegible] FEET
Total Plug Footage: 374 FEET
Total Core Footage: 75 FEET
Core Interval 937.8-944.4 Seam CONNYSIDE
Core Interval 952.8-956.4 Seam LOWER
Core Interval _____ Seam _____

Sheet 1 of 12
Drilling Company: [illegible]
Date Begun: [illegible]
Date Completed: [illegible]
Casing: 943 FEET OF 4 INCH STEEL PIPE

COMPOSITE LOG
SCALE: 1" = 10'

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6" 4' STEEL PIPE	CUTTINGS AIR + FOAM			0		0.0 - 58.0 MUDSTONE AND SANDSTONE
				10		MUDSTONE: LIGHT TAN, GRAY, SOFT. FLAGSTAFF - NORTH HORN FORMATION
				20		MUDSTONE: LIGHT GRAY, FIRM.
				30		MUDSTONE AND SANDY SILTSTONE: LIGHT GRAY.
				40		SANDSTONE: LIGHT GRAY, VERY FINE-GRAINED.
				50		SANDSTONE AND MUDSTONE: SANDSTONE; LIGHT TAN; MUDSTONE; DARK GRAY
				60		58.0 - 218.0 SANDSTONE SANDSTONE: LIGHT TAN, FINE-GRAINED, LOOSE, ANGULAR.
				70		
				80		



T____
R____
Lat.
____
Long.
____

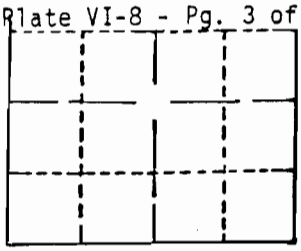
Location Diagram

DRILL LOG

Hole Number: [illegible]
Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 2 of 12
Drilling Company: [illegible]
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			80		SANDSTONE: LIGHT TAN, FINE-GRAINED.
						BLUECASTLE SANDSTONE MEMBER OF PRICE RIVER FORMATION
				90		
				100		SANDSTONE: LIGHT GRAY TO LIGHT TAN, VERY FINE GRAINED.
				110		MUDSTONE: GRAY, FICM.
						SANDSTONE: TAN, FINE TO MEDIUM-GRAINED, LOOSE TO WELL CEMENTED.
				120		
				130		
				140		SANDSTONE AND MUDSTONE: GRAY-
				150		SANDSTONE: LIGHT TAN-BROWN, VERY FINE-GRAINED.
				160		



T____
R____
Lat. ____
Long. ____

Location Diagram

DRILL LOG

Hole Number: [illegible]
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 3 of 13
Drilling Company: [illegible]
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
				160		
				170		SANDSTONE, SILTSTONE, AND MUDSTONE: GRAY, DARK GRAY.
				180		
				190		SANDSTONE: TAN, BROWN, SILTY TO VERY FINE-GRAINED, LOOSE, DAMP.
				200		
				210		
				220		218.0-563.0 SILTSTONE, SANDSTONE AND MUDSTONE.
				230		
				240		SANDSTONE: GRAY, SILTY TO VERY FINE-GRAINED.

DRILL LOG

Property: _____

Location Diagram

T____
R____
Lat. ____
Long. ____

Hole Number: [illegible]-5-32-31
Collar Elevation: _____
Determined by: _____
Total Depth: _____
Total Plug Footage: _____
Total Core Footage: _____
Core Interval _____ Seam _____
Core Interval _____ Seam _____
Core Interval _____ Seam _____

Sheet 4 of 13
Drilling Company: [illegible]
Date Begun: _____
Date Completed: _____
Casing: _____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			240		SANDSTONE: GRAY, SILTY TO VERY FINE-GRAINED.
						MUDSTONE MEMBER OF PRICE RIVER FORMATION
				250		
				260		SILTSTONE: GRAY, FIRM, SANDY, CARBONACEOUS CHECKS.
				270		
				280		SANDSTONE: GRAY, FINE-GRAINED, SUB-ANGULAR, WELL INDURATED, HARD, STREAKS OF MUDSTONE.
				290		
				300		SILTSTONE AND SANDSTONE: GRAY, FINE-GRAINED, THINLY LAMINATED.
				310		
				320		

T____
R____
Lat. ____
Long. ____

Location Diagram

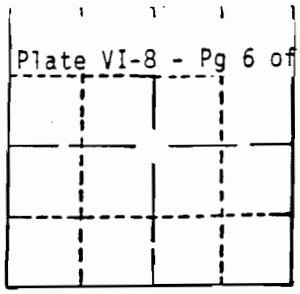
DRILL LOG

Hole Number: [illegible]-81
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Project: [illegible] SOUTH CENTRE

Sheet 5 of 12
Drilling Company:
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			320		
				330		
				340		SANDSTONE: GRAY, LIGHT GRAY, VERY FINE TO FINE-GRAINED, HARD, WEL-CEMENTED
				350		MUDSTONE: DARK GRAY
				360		
				370		SANDSTONE: LIGHT GRAY, FINE-GRAINED.
				380		
				390		
				400		



Location Diagram

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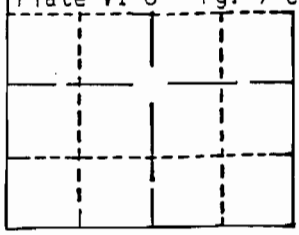
DRILL LOG

Hole Number: [illegible]
Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: [illegible]

Sheet [illegible] of [illegible]
Drilling Company: ____
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			400		
				410		
				420		SANDSTONE: GRAY, LIGHT GRAY, FINE-GRAINED, STREAKS OF MUDSTONE
				430		
				440		
				450		
				460		MUDSTONE: DARK GRAY, FIRM.
				470		
				480		



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Location Diagram

DRILL LOG

Hole Number: KCS-S-[illegible]-81
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

[illegible]: [illegible]
SOUTH LEASE

Sheet 7 of 13
Drilling Company: [illegible]
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			480		
						SANDSTONE: LIGHT GRAY, FINE-GRAINED, THIN SHALE STREAKS.
				490		
				500		
				510		
				520		
						SANDSTONE: GRAY, VERY FINE-GRAINED, THIN MUDSTONE STREAKS.
				530		
				540		
				550		MUDSTONE: DARK GRAY, HARD, CARBONACEOUS.
				560		

DRILL LOG

Hole Number: KSS-5-SS-91
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval Seam
Core Interval Seam
Core Interval Seam

Sheet 8 of 12
Drilling Company:
Date Begun:
Date Completed:
Casing:

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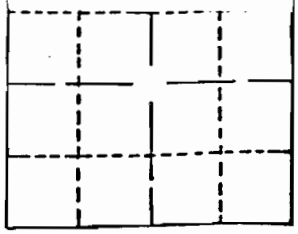
Long.
Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			560		563.0-748.0 SANDSTONE
						SANDSTONE: GRAY, FINE-GRAINED, WELL-INDURATED, HARD, ANGULAR GRAINS, ROSE COLORED QUARTZ GRAINS, PYRITE
				570		
						CASTLEGATE SANDSTONE
				580		
				590		
				600		
				610		
				620		SANDSTONE: GRAY, FINE TO MEDIUM-GRAINED, WELL INDURATED, HARD, ROSE QUARTZ, ANGULAR.
				630		
				640		



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Location Diagram

DRILL LOG

Hole Number: [illegible]
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: [illegible]

Sheet 9 of [illegible]
Drilling Company:
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			640		MUDSTONE: DARK GRAY, HARD, CARBONACEOUS.
				650		
						SANDSTONE: GRAY, MEDIUM-GRAINED, WELL INDURATED.
				660		
				670		
				680		
				690		
				700		
				710		
				720		

DRILL LOG

Property: [illegible]

T____
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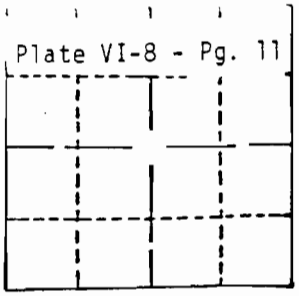
Location Diagram

Hole Number: ASS-S-TC-31
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 10 of 13
Drilling Company:
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6'	CUTTINGS			720		
						MUDSTONE: DARK GRAY, BLACK, COAL FRAGMENTS, CARBONACEOUS.
				730		
				740		
						743.0 - [illegible] 3.0 SILTSTONE, MUDSTONE & SANDSTONE
				750		MUDSTONE - BLACK, COAL FRAGMENTS
				760		SANDSTONE: GRAY, VERY FINE-GRAINED, CARBONACEOUS.
						UPPER MUDSTONE MEMBER OF BLACKHAWK FORMATION
				770		
				780		
				790		MUDSTONE: DARK GRAY, BLACK, COAL FRAGMENTS.
				800		



Location Diagram

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Long. ____

DRILL LOG

Hole Number: [illegible]-81
Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: [illegible]
Sheet 11 of [illegible]
Drilling Company: ____
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	CUTTINGS			800		SANDSTONE AND MUDSTONE: GRAY, DARK GRAY, BLACK.
				810		
				820		
						ABUNDANT COAL FRAGMENTS, RARE.
				830		
				840		
				850		COAL
						SANDSTONE: GRAY, FINE-GRAINED, SPECKLED WITH BLACK MINERAL, PYRITE.
				860		
				870		
				880		879.0-937.8 SANDSTONE

DRILL LOG

Hole Number: [illegible]-81
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval Seam
Core Interval Seam
Core Interval Seam

Sheet [illegible] of [illegible]
Drilling Company:
Date Begun:
Date Completed:
Casing:

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Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6" HOLE	CUTTINGS	COMMENCE CORE AT 894' 6" HOLE REAMED TO 929'		890		SANDSTONE: GRAY, FINE-GRAINED, SUB-ANGULAR, FRIABLE, SPECKLED. GRASSY MEMBER OF BLACKHAWK FORMATION
	3" CORE	CORE RUN #1 894.0'-909.0' CUT 15.0' REC. 15.0'		900		894.0-937.8 SANDSTONE: GRAY, FINE TO MEDIUM-GRAINED, WELL SORTED, SPECKLED WITH BLACK MINERAL, FELTINGS ALONG CROSS-BEDDING. BORROWED AND REWORKED IN LOWER SECTION.
	CEMENT BASKET	CORE RUN #2 909.0'-924.0' CUT 15.0' REC. 15.0'		910		
	CEMENT BASKET	CORE RUN #3 924.0'-939.0' CUT 15.0' REC. 15.0'		920		
		CORE RUN #4 939.0'-954.0' CUT 15.0' REC. [illegible]		930		UNEVEN CONTACT 937.8-944.4 COAL (6.6) BLACK, DULL TO VERY BRIGHT, FRIABLE AND FRACTURED, CALCITE, PYRITE UNNAMED SEAM SHARP CONTACT
OPEN 4 7/8"		CORE RUN #5		940		944.4-952.8 MUDSTONE: DARK GRAY, FIRM, [illegible] COAL LENSE AND BLEBS. 6.4 COAL AT 950.0 UNEVEN CONTACT
				950		952.8-[illegible] (COAL-12.6): BLACK, DULL TO BRIGHT, PYRITE. LOWER SEAM SHARP CONTACT
				960		[illegible]-963.0 SANDSTONE, GRAY, BROWN FINE TO MEDIUM-GRAINED.

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Location Diagram

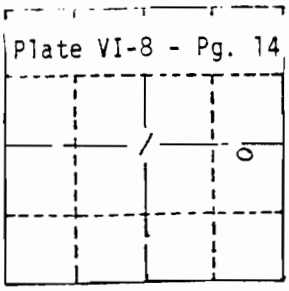
DRILL LOG

Hole Number: [illegible]-3-23-31
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: [illegible]

Sheet 13 of 13
Drilling Company: [illegible]
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
[illegible]	3" SOLE	954.0'-969.0' CUT. 15.0' REC. 15.0'		960		PYCITE SUNNYSIDE SANDSTONE
				970		DRILLER'S DEPTH: 969' E-LOG DEPTH: 966' FLUID LEVEL: 8-13-81; 957' STEEL PIPE SET: 8-13-81 CEMENTED: 8-14-81 BOTTOM 30 FEET OF PIPE SLOTTED WITH 1/3 INCH HOLES 1 FOOT APART ON 120 DEGREE CENTERS. ANNULUS CEMENTED TO SURFACE FROM 929 FEET. FLUID LEVEL: 9-14-81; 73[illegible]'



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Location Diagram
1,960'FSL - 850'FEL

DRILL LOG

Hole Number: KSC-S-27-80
Collar Elevation: 6309.5'
Determined by: SURVEY
Total Depth: 280'
Total Plug Footage: 205'
Total Core Footage: 75'
Core Interval 249.9-258.1 Seam SUNNYSIDE
Core Interval 262.9-267.0 Seam LOWER
Core Interval _____ Seam _____

Sheet 1 of 4
Drilling Company: FINLEY
Date Begun: JULY 12 1980
Date Completed: JULY 13, 198
Casing: 40' OF 6 7/8"

COMPOSITE
SCALE 1" = 10'

Hole Size	Type Sample	Core (%) Recovery	FT. Elevation	FT. Depth	Log	FT. Geologic Description and Comments
6" CASING 40'	CUTTINGS		6309.5	0		LOG INTERPRETATION FROM CUTTINGS AND E-LOG TO 205'.
			6300	10		ALLUVIUM: LIGHT BROWN SILT AND GRAVEL.
				20		SMALL AMOUNT OF WATER AT BASE OF ALLUVIUM.
				30		30.0-97.0 SANDSTONE AND SILTSTONE. LOG INTERPRETATION FROM CUTTINGS AND E-LOG. SANDSTONE: WHITE TO LIGHT GRAY, FINE TO MEDIUM-GRAINED, WELL SORTED.
5 7/8" FOAM + WATER				40		
				50		SANDSTONE: LIGHT GRAY, FINE-GRAINED WITH SILTY SHALE LAMINATIONS. CASTLEGATE SANDSTONE
			6250	60		SANDSTONE: LIGHT GRAY, SILTY TO FINE-GRAINED, SHALE LAMINATIONS.
				70		
				80		

Plate VI-8 - Pg. 15 of 27

Location Diagram

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Lat.
Long.

DRILL LOG

Hole Number: KSC-5-27-80
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval _____ Seam
Core Interval _____ Seam
Core Interval _____ Seam

Property: SUNNYSIDE SOUTH LEASE

Sheet 2 of 4
Drilling Company:
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
5 7/8"	CUTTINGS			80		SANDSTONE: LIGHT GRAY, SILTY TO FINE-GRAINED, MODERATE WELL CEMENTED, SILTY SHALE LAMINATIONS.
				90		
				100		97.0 - 200.0 INTERBEDDED SILTSTONE, SANDSTONE, MUDSTONE AND THIN COAL. MUDSTONE: BLACK TO DARK GRAY, SILTY, SANDY, SHALY, CARBONACEOUS, COALY. UPPER MUDSTONE MEMBER OF BLACKHAWK FORMATION
			6200	110		
				120		SANDSTONE: LIGHT GRAY, VERY FINE TO FINE GRAINED, MODERATE TO WELL CEMENTED, SHALE LAMINATIONS.
				130		MUDSTONE AND SILTSTONE: BLACK TO DARK GRAY, SANDY, CARBONACEOUS, FINE SANDSTONE LAMINATIONS.
				140		SANDSTONE: LIGHT GRAY, VERY FINE-GRAINED, INTERLAMINATED, WITH SANDY SILTSTONE.
				150		
			6150	160		

DRILL LOG

SOUTH LEASE

Hole Number: KSC-S-87-80
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval Seam
Core Interval Seam
Core Interval Seam

Sheet 3 of 4
Drilling Company:
Date Begun:
Date Completed:
Casing:

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Long.
Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
5 7/8"	CUTTINGS			160		
				170		SILTSTONE: BLACK, BRITTLE, MODERATLY HARD, SANDY.
				180		MUDSTONE: BLACK, CARBONACEOUS, COALY.
				190		SANDSTONE: GRAY, VERY FINE TO FINE GRAINED, SHALE LAMINATIONS.
				200		200.0 - 249.9 SANDSTONE, SANDSTONE: GRAY, FINE TO MEDIUM-GRAINED, MODERATE TO POORLY CEMENTED, SUGARY APPEARANCE, DARK COLORED GRAINS ALONG LOW ANGLE CROSS-BEDDING, WELL SORTED, CARBONACEOUS LAMINATIONS, PYRITE.
4 7/8"	3" CORE	CORE RUN #1 205.0'-220.0' CUT 15.0' REC. 15.0'	6100	210		GRASSY MEMBER OF BLACKHAWK FORMATION
		CORE RUN #2 220.0'-235.0' CUT. 15.0' REC 15.0		220		
				230		SHARP CONTACT — SANDSTONE: GRAY, SHALE LAMINATIONS, HIGHLY CONTORTED BEDDING, BURROWED, TRACES OF PYRITE.
				240		

DRILL LOG

SOUTH CREEK

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Long.

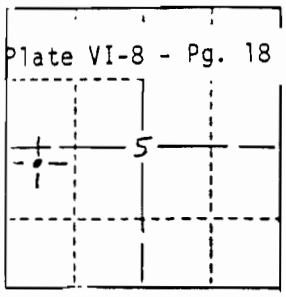
Location Diagram

Hole Number: MSC-S-27-80
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval _____ Seam _____
Core Interval _____ Seam _____
Core Interval _____ Seam _____

Sheet 4 of 4
Drilling Company:
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
47/8"	3" CORE	CORE RUN #3 235.0-250.0' CUT 15.0' REC 15.0'		240		SANDSTONE: GRAY, FINE-GRAINED, CONTORTED BEDDING
						SANDSTONE: GRAY, FINE-GRAINED, CONTORTED BEDDING, BURROWED
	TUBE 10FS COAL	CORE RUN #4 250.0-265.0 CUT 15.0' REC 15.0'	6059.6	250		249.9-258.1 COAL: MODERATE BRIGHT TO BRIGHT BANDED, GOOD CLEAT IN ONE DIRECTION, SOME DULL BANDING. SUNNYSIDE MAIN SEAM
	TUBE 20FS COAL					BONE TO SHALY COAL, SANDY MUDSTONE
			6050	260		258.1-262.9 SANDSTONE AND MUDSTONE. GRAY TO BLACK, CARBONACEOUS MUDSTONE. CONTORTED SANDSTONE. PYRITE.
	TUBE 4OFS COAL		6046.6			262.9-267.0 COAL: MODERATE BRIGHT TO BRIGHT, GOOD CLEAT IN ONE DIRECTION, CALCITE ON CLEAT SURFACES. LOWER SEAM
	5OFS	CORE RUN #5 265.0-279.95 CUT 14.95' REC 14.95'	6042.5	270		267.0- SANDSTONE: GRAY, FINE-GRAINED WELL SORTED, SLIGHT CARBONACEOUS, PYRITE. SUNNYSIDE SANDSTONE
				280		DRILLERS DEPTH: 280.0' E-LOG DEPTH: 279.0' FLUID LEVEL: 7-27-80; 159' CEMENTED WITH 64 SACKS PORTLAND CEMENT: 8-11-80
				290		
				300		
				310		
				320		

Plate VI-8 - Pg. 18 of 27



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DRILL LOG

Property: South Lease

Hole Number: S-14
Collar Elevation: 6630
Determined by: Aerial Survey
Total Depth: 1430
Total Plug Footage: 1300
Total Core Footage: 130
Core Interval _____ Seam _____
Core Interval _____ Seam _____
Core Interval _____ Seam _____

Sheet 1 of 10
Drilling Company: Boyles
Date Begun: 12/3/74
Date Completed: 12/22/74

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
6" CSG.	CUTTINGS				6630	0'-10' yellow-orange sandy soil
			10			
			20			
5 5/8" AIR 1,300' OF 4" CSG LEFT IN HOLE			30		6600	10'-60' Ss, Lt gray-brown, sub rounded
			40			
			50			
			60			60'-70' Cg Ss 70% / sts 30%
			70			70'-80' vfg Ss
			80			80'-90' sts w/5% mg Ss
			90			
			100			H_2O 90'-110' vfg Ss w/5-10% mafics
			110			110'-120' sts w/5% vfg Ss
			120			
			130		6500	120'-140' sts
			140			140'-150' sts w/60% vfg Ss
			150			150'-160' carb mst
			160			160'-180' vfg Ss
			170			
			180			180'-200' carb sts
			190			
			200			

Plate VI-8 - Pg. 19 of 27

T____
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DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval _____ Seam _____
Core Interval _____ Seam _____
Core Interval _____ Seam _____

Sheet 2 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			210			200'-220' Lt gray sts w/15% Ss
			220			
			230		6400	220'-240' Lt gray mst/Ss 10%/sst 40%
			240			
			250			240'-250' Lt gray mst/Ss 5%
						250'-260' dk gray mst
			260			260'-270' dk gray mst 60%/vfg Ss 40%
			270			270'-280' Lt gray fg Ss
			280			
			290			280'-290' dk gray mst 80%/Lt gray fg Ss 20%
						290'-300' dk gray mst 15%/Lt gray fg Ss 85%
			300			
			310			300'-310' Lt gray mst 80%/Ss 20%
			320			310'-320' Lt gray sts.
			330		6300	320'-330' gray sts 90%, gray mst 10%
			340			
			350			330'-370' dk gray mst
			360			
			370			
			380			370'-400' dk gray sts
			390			
			400			

Plate VI-8 - Pg. 20 of 27

T ___
R ___

N E

DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ___ Seam ___
Core Interval ___ Seam ___
Core Interval ___ Seam ___

Sheet 3 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
AIR MIST			410			400'-410' sts 60% / mst 40%
			420			
MUD			430		6200	410'-450' dk gray mst grading down to sts,
			440			
			450			
			460			450'-500' dk gray sts w/few grains mg Qtz Ss
			470			
			480			
			490			
			500			LOST CIRCULATION
			510			500'-510' dk gray sts / 90% gray Ss
			520			510'-520' mg Ss
			530		6100	520'-530' Lt gray mst 80% / mg Ss 20%
			540			530'-560' Lt gray well consolidated fg Ss w/5% gray mst.
			550			
			560			
			570			560'-590' disorganized Qtz mg Ss
			580			
			590			590'-600' dk gray mst 60% / Lt gray sts 10% w/30% fg Ss
			600			

Plate Vi-8 - Pg. 21 of 27

T___
R___

N E

DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 4 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			610			
			620			600'-640' vfg Ss, Qts, ltgray, 95% /5% mst
			630		6000	
			640			
			650			640'-650' mst, silty, dk gray, well indurated
			660			650'-680' mst 80% / qtz Ss 20%
			670			
			680			
			690			680'-710' Ss fg, Lt gray mafics < 1%
			700			
			710			710'-720' mst, dk gray
			720			
			730		5900	720'-730' Ss, mg, gray disaggregated w/5% mst 730'-740' mst, well indurated w/5% Ss mg
			740			
			750			740'-760' mst dark gray
			760			
			770			760'-770' mst / Ss
			780			770'-800' Ss, med gray, disaggregated
			790			
			800			

Plate VI-8 - Pg. 22 of 27

T ___
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N E

DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 5 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
						800'-810' sts/vfg Ss 35%/mst
			810			
			820			810'-830' NO SAMPLE
			830		5800	
			840			830'-840' dk gray mst.
			850			840'-850' dk gray mst/20% Lt gray sts
						850'-860 mst/sts
			860			860'-870' mst 60%/sts 40%
			870			870'-880' gray mst
			880			
			890			
						880'-920' mst 60%/sts 40%
			900			
			910			
			920			
						920'-940' sts/mst
			930		5700	
			940			
						940'-950' dk gray mst 80%/Ss 20% vfg
			950			950'-960' dk gray mst 60%/Ss 40% vfg
			960			
						960'-970' dk gray mst/Lt gray sts
			970			970-980' sts/vfg Ss
			980			
						980'-1000' Ss vfg 60%/green mst 40%
			990			
			1000			

Plate VI-8 - Pg. 20 of 27

T ___
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N E

DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 3 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			410			400'-410' sts 60% / mst 40%
AIR MIST			420			
MUD			430		6200	410'-450' dk gray inst grading down to sts,
			440			
			450			
			460			
			470			450'-500' dk gray sts w/few grains Mq Qtz Ss
			480			
			490			
			500			LOST CIRCULATION
			510			500'-510' dk gray sts / 90% gray Ss
			520			510'-520' Mq Ss
			530		6100	520'-530' Lt gray inst 80% / Mq Ss 20%
			540			530'-560' Lt gray well consolidated Fg Ss w/5% gray mst.
			550			
			560			
			570			560'-590' disaggregated Qtz Mq Ss
			580			
			590			590'-600' dk gray mst 60% / Lt gray sts. 10% w/30% Fg Ss
			600			

Plate VI-8 - Pg. 23 of 27

T ___
R ___

N E

DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 6 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			1010			1000'-1020' sst lt gray / vfg Ss 75%
			1020			
			1030		-5600	1020'-1040' Lt. gray Qts vfg Ss / green mst 25%
			1040			
			1050			1040'-1060' Ss, gray qts, vfg / mst 35% tfeS
			1060			
			1070			1060'-1070' mst, dk gray 60% / vfg Ss 40% unconsolidated
			1080			
			1090			1080'-1100' mst dk gray w/ 60% vfg Ss
			1100			1100'-1110' mst / ss
			1110			1110'-1120 mst 10% / Ss mg 90%
			1120			
			1130		-5500	1120'-1150' gray-green mst 90% w/ 5% Ss, orange-tan / 5% wh Qtz Ss
			1140			
			1150			
			1160			
			1170			1150'-1230' vfg Ss
			1180			
			1190			
			1200			

T ___
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DRILL LOG

Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Sheet 7 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			1210			1150'-1230' (See sheet 6)
			1220			
			1230		-5400	CASTLEGATE
					5332	BLACKHAWK
			1240			1230'-1250' vfg Ss 60%/mst 40%
			1250			1250'-1260' mst 80% / qtz Ss fg 20%
			1260			1260'-1250' lt gray mst w/5% sst
			1270			CEMENT DRILLED 1,270-1,300
			1280			
4" CSG	CUTTINGS	scale change	1290			1280'-1300' sst/mst/ss
			1300			
3.7	NC	90%				1300'-1301'6" sb, dark gray 2" coal at base
						1301'6"-1303 sts, dark gray
						1303'-1303'8" convolute vfgSs 80%/sst 20%
						1303'8"-1304'8" dk gray sts
						1304'8"-1305' mst, coaly
			1305			1305'-1307' 1" coal, 5" coaly mst, 6" vfg Ss, 6" gray sts, 3" conv. Ss/sts 15%
						1307'-1310' sts, dark gray
			1310			
		100%				1310'-1312' sts/vfg Ss, interbedded, fissile mottled 1311'-1312'
						1312'-1312'10" Ss vfg
			1315			1312'10"-1317' mst, carb, grading down into dk gray sts, abund. coal lenses top 1'
						1317'-1320' sts carb w/vfg Ss bands 2" ea 6" apart
			1320			1320'-1321'6" interbedded vfgSs/sts, fissile
						1321'6"-1321'9" coal
						1321'9"-1322'3" mst, coaly
						1322'3"-1323'3" sts
			1325			1323'3"-1325' 9" interbedded Ss/sts, 1' carb mst

Plate VI-8 - 25 of 27

T ___
R ___

N ___ E ___

DRILL LOG

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ___ Seam ___
Core Interval ___ Seam ___
Core Interval ___ Seam ___

Property: SOUTH LEASE
Sheet 8 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
						1325'-1326' carb, coaly mst
						1326'-1326'5" Ss vfg
						1326'5"-1327'5" carb sts
			1330			1327'5"-1332'8" interbedded vfg Ss/sts poorly developed fissility
						1332'8"-1333'6" vfg Ss/sts, mottled
			1335			1333'6"-1335' vfg Ss
						1335'-1337'6" Interbedded vfg Ss/sts 30%
						1337'6"-1340' sts dark gray
			1340			
					5287	1340'-1343'1" Interbedded vfg Ss/sts 30%
		100%	1345			
			1350			
						1343'1"-1388'7" Ss, vfg, poorly indurated thin planar bedding to 1353', x-bedding increasing w/depth, becomming fg w/depth
			1355			
			1360			
			1365			
			1370			
			1375			

Plate VI-8 - Pg. 26 of 27

T ___
R ___

N E

DRILL LOG

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: SOUTH LEASE
Sheet 9 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			1380			1343'-1388'7" (See sheet 8), good fissility bottom 3' of unit
		100%	1385			
					5241.0	
			1390			1388'7"-1392'7" Interbedded vfg Ss/sts 35% mottled, contorted, poor fissility
						1392'7"-1394'1" sts Light gray
						1394'1"-1394'1½" coal
			1395			1394'1½"-1396'2" LT gray sts-mst slightly mottled
						1396'2"-1396'7½" thin interbedded carb-mst/sts
					5233.4	TOP OF SEAM
			1400			1396'7½"-1401'8½" Coal
					5228.3	1401'8¼"-1402'4¾" Interbedded carb-mst/sts
						1402'4¾"-1402'11¼" Coal
			1405			1402'11¼"-1403'3¾" sts, carb
						1403'3¾"-1404'1¾" Coaly, carb sts
						1404'1¾"-1405'2" convolute fg Ss/mst (FeS2 in Ss)
						1405'2"-1406'5" mottled fg Ss/mst
			1410			
						1406'5"-1416'3" Ss mg w/carb lam on indistinct x-bedding at top becoming more distinct with depth
			1415			
						1416'3"-1418' Interbedded carb Ss/mst
			1420			
						1418'-1430' Ss fg w/irregular LA x-bedding
			1425			

Plate VI-8 - Pg. 27 of 27

T____
R____

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DRILL LOG

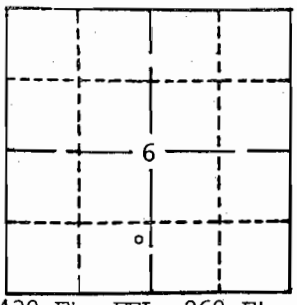
Property: SOUTH LEASE

Hole Number: S-14
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval _____ Seam _____
Core Interval _____ Seam _____
Core Interval _____ Seam _____

Sheet 10 of 10
Drilling Company:
Date Begun:
Date Completed:

Hole Size	Type Sample	Core (%) Recovery	Depth	Log	Elev.	Geologic Description and Comments
			1430		5200	BOTTOM OF HOLE
						7 SACKS CEMENT

Appendix C-1



2,430 Ft. FEL, 960 Ft. FSL
Location Diagram

T 17S
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Lat. ____
Long. ____

KAISER STEEL CORPORATION

DRILL LOG (WMH 3D)

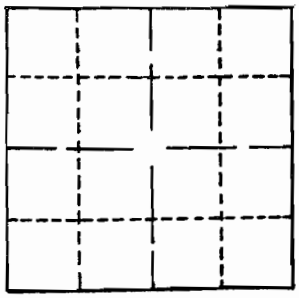
Hole Number: KSC-S-32-81
Collar Elevation: 6567
Determined by: Topo
Total Depth: 969 Feet
Total Plug Footage: 894 Feet
Total Core Footage: 75 Feet
Core Interval 937.8- Seam Sunnyside
Core Interval 944.4 Seam ____
Core Interval 952.8-956.4 Seam Lower

Property: Sunnyside South Lease
Sheet 1 of 13
Drilling Company: Finley
Date Begun: 8/8/81
Date Completed: 8/14/81
Casing: 949 feet of 4-inch steel pipe

Composite Log
Scale: 1"=10'

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6" 4" Steel Pipe	Cuttings Air + Foam			0		0.0-58.0 Mudstone and Sandstone
				10		Mudstone: Light tan, gray, soft.
			6550			FLAGSTAFF-NORTH HORN FORMATION
				20		Mudstone: Light gray, firm.
				30		Mudstone and sandy siltstone: Light gray.
				40		Sandstone: Light gray, very fine-grained.
				50		Sandstone and mudstone: Sandstone, light tan; mudstone, dark gray.
				60		58.0-218.0 Sandstone Sandstone: Light tan, fine-grained, loose, angular.
			6500			
				70		
				80		

Figure VI-15



Location Diagram

T____
R____
Lat. ____
Long. ____

KAISER STEEL CORPORATION

DRILL LOG

Hole Number: KSC-S-32-81
Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: Sunnyside South Lease
Sheet 2 of 13
Drilling Company: Finley
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			80		Sandstone: Light tan, fine-grained.
						BLUECASTLE SANDSTONE MEMBER of PRICE RIVER FORMATION
				90		
				100		Sandstone: Light gray to light tan, very fine-grained.
				110		Mudstone: Gray, firm.
			6450			Sandstone: Tan, fine- to medium-grained, loose to well cemented.
				120		
				130		
				140		Sandstone and mudstone: Gray.
				150		Sandstone: Light tan-brown, very fine-grained.
				160		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 3 of 13

Collar Elevation:

Determined by:

Total Depth:

Total Plug Footage:

Total Core Footage:

Core Interval Seam

Core Interval Seam

Core Interval Seam

Drilling Company: Finley

Date Begun:

Date Completed:

Casing:

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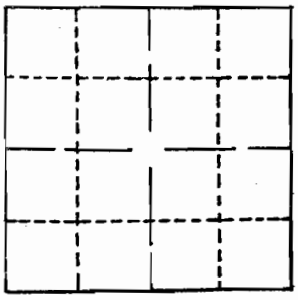
Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
				160		
			6400			
				170		Sandstone, siltstone, and mudstone: Gray, dark gray.
				180		
						Sandstone: Tan, brown, silty to very fine-grained, loose, damp.
				190		
				200		
				210		
			6350			
				220		218.0-562.0 Siltstone, sandstone and mudstone.
				230		
						Sandstone: Gray, silty to very fine-grained.
				240		



Location Diagram

T____
R____
Lat. ____
Long. ____

KAISER STEEL CORPORATION

DRILL LOG

Hole Number: KSC-S-32-81
Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: Sunnyside South Lease
Sheet 4 of 13
Drilling Company: Finley
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			240		Sandstone: Gray, silty to very fine-grained.
						MUDSTONE MEMBER of PRICE RIVER FORMATION
				250		
				260		Siltstone: Gray, firm, sandy, carbonaceous specks.
			6300			
				270		
				280		Sandstone: Gray, fine-grained, subangular, well indurated, hard, streaks of mudstone.
				290		
				300		Siltstone and sandstone: Gray, fine-grained, thinly laminated.
				310		
			6250	320		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 5 of 13

T____
R____
Lat. ____
Long. ____

Location Diagram

Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Drilling Company: ____
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			320		
				330		
				340		Sandstone: Gray, light gray, very fine to fine-grained, hard, well-cemented.
				350		Mudstone: Dark gray.
				360		
			6200	370		Sandstone: Light gray, fine-grained.
				380		
				390		
				400		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 6 of 13

Collar Elevation:

Determined by:

Total Depth:

Total Plug Footage:

Total Core Footage:

Core Interval Seam

Core Interval Seam

Core Interval Seam

Drilling Company:

Date Begun:

Date Completed:

Casing:

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Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			400		
				410		
			6150			
				420		Sandstone: Gray, light gray, fine-grained streaks of mudstone.
				430		
				440		
				450		
				460		Mudstone: Dark gray, firm.
			6100			
				470		
				480		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 7 of 13

T____
R____
Lat. ____
Long. ____

Location Diagram

Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Drilling Company: ____
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			480		
						Sandstone: Light gray, fine-grained, thin shale streaks.
				490		
				500		
				510		
			6050			
				520		
						Sandstone: Gray, very fine-grained, thin mudstone streaks.
				530		
				540		
				550		Mudstone: Dark gray, hard, carbonaceous.
				560		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 8 of 13

Collar Elevation:

Determined by:

Total Depth:

Total Plug Footage:

Total Core Footage:

Core Interval Seam

Core Interval Seam

Core Interval Seam

Drilling Company:

Date Begun:

Date Completed:

Casing:

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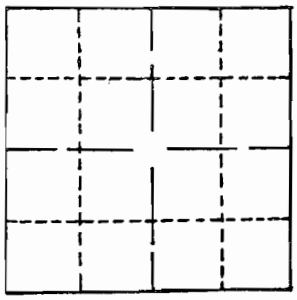
Long.

Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			560		562.0-748.0 Sandstone
			6000			Sandstone: Gray, fine-grained, well-indurated, hard, angular grains, rose colored quartz grains, pyrite.
				570		
				580		CASTLEGATE SANDSTONE
				590		
				600		
				610		
			5950			
				620		Sandstone: Gray, fine to medium-grained, well indurated, hard, rose quartz, angular.
				630		
				640		



Location Diagram

T____
R____
Lat. ____
Long. ____

KAISER STEEL CORPORATION

DRILL LOG

Hole Number: KSC-S-32-81
Collar Elevation:
Determined by:
Total Depth:
Total Plug Footage:
Total Core Footage:
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: Sunnyside South Lease
Sheet 9 of 13
Drilling Company:
Date Begun:
Date Completed:
Casing:

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			640		Mudstone: Dark gray, hard, carbonaceous.
				650		Sandstone: Gray, medium-grained, well indurated.
				660		
			5900	670		
				680		
				690		
				700		
				710		
			5850	720		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 10 of 13

T____
R____
Lat. ____
Long. ____

Location Diagram

Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Drilling Company: ____
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			720		Mudstone: Dark gray, black, coal fragments, carbonaceous.
				730		
				740		
				750		748.0-878.0 Siltstone, Mudstone & Sandstone Mudstone: Black, coal fragments.
				760		Sandstone: Gray, very fine-grained, carbonaceous.
			5800	770		UPPER MUDSTONE MEMBER OF BLACKHAWK FORMATION
				780		
				790		Mudstone: Dark gray, black, coal fragments.
				800		

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 11 of 13

Collar Elevation:

Determined by:

Total Depth:

Total Plug Footage:

Total Core Footage:

Core Interval Seam

Core Interval Seam

Core Interval Seam

Drilling Company:

Date Begun:

Date Completed:

Casing:

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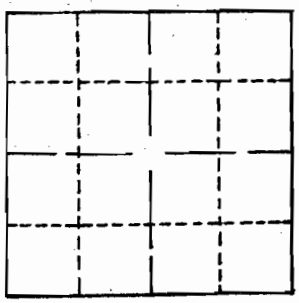
Lat.

Long.

Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6"	Cuttings			800		Sandstone and mudstone: Gray, dark gray, black.
				810		
			5750			
				820		Abundant coal fragments, pyrite.
				830		
				840		
				850		Coal.
						Sandstone: Gray, fine-grained, speckled with black mineral, pyrite.
				860		
			5700			
				870		
				880		878.0-937.8 Sandstone



Location Diagram

T____
R____
Lat. ____
Long. ____

KAISER STEEL CORPORATION

DRILL LOG

Hole Number: KSC-S-32-81
Collar Elevation: ____
Determined by: ____
Total Depth: ____
Total Plug Footage: ____
Total Core Footage: ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____
Core Interval ____ Seam ____

Property: Sunnyside South Lease
Sheet 12 of 13
Drilling Company: ____
Date Begun: ____
Date Completed: ____
Casing: ____

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
6" 4"pipe	Cuttings	Commence core at 894'. 6" hole reamed to 929'.		880, 890		Sandstone: Gray, fine-grained, subangular, friable, speckled. GRASSY MEMBER OF BLACKHAWK FORMATION
	3" core	Core Run #1 894.0'-909.0'. Cut.15.0' Rec.15.0'		900		894.0-937.8 Sandstone: Gray, fine to medium-grained, well sorted, speckled with black mineral, partings along cross-bedding. Burrowed and reworked in lower section.
	Cement basket	Core Run #2 909.0'-924.0'. Cut.15.0' Rec.15.0'	5650	910, 920		
	Cement basket	Core Run #3 924.0'-939.0'. Cut.15.0' Rec.15.0'		930		Uneven Contact
		Core Run #4 939.0'-954.0'. Cut.15.0' Rec.15.0'		940, 950		937.8-944.4 Coal (6.6) Black, dull to very bright, broken and fractured, calcite, pyrite SUNNYSIDE SEAM. Sharp Contact. 944.4-952.8 Mudstone: Dark gray, firm, massive, coal lense and blebs. 0.6 coal at 950.2. Uneven Contact
		Core Run #5		960		952.8-956.4 Coal (3.6): Black, dull to bright, pyrite. Sharp Contact LOWER SEAM. 956.4-969.0 Sandstone, gray, brown, fine to medium-grained.

KAISER STEEL CORPORATION

DRILL LOG

Property: Sunnyside South Lease

Hole Number: KSC-S-32-81

Sheet 13 of 13

Collar Elevation:

Drilling Company: Finley

Determined by:

Date Begun:

Total Depth:

Date Completed:

Total Plug Footage:

Casing:

Total Core Footage:

Core Interval Seam

Core Interval Seam

Core Interval Seam

T

R

Lat.

Long.

Location Diagram

Hole Size	Type Sample	Core (%) Recovery	Elevation	Depth	Log	Geologic Description and Comments
	3" core	954.0'-969.0' Cut. 15.0' Rec. 15.0'	5600	960		Pyrite. SUNNYSIDE SANDSTONE
Open 4-7/8" hole				970		Driller's Depth: 969' E-Log Depth: 966' Fluid Level: 8/12/81, 957' Steel Pipe Set: 8/13/81 Cemented: 8/14/81 Bottom 20 feet of pipe slotted with 1/2-inch holes 1 foot apart on 180 degree centers. Annulus cemented to surface from 929 feet. Fluid Level: 9/14/81, 736'

Figure VII-4

SOUTH LEASE COAL PROPERTY

DRILL HOLE #32

CHRONOLOGY OF DEVELOPMENT

	Date
Commenced plug drilling - 6" dia. bit	8/8/81
Completed plug drilling - 894' depth	8/9/81
Cored from 894' to 969' - 4-7/8" dia.	8/10/81-8/11/81AM
Reamed 4-7/8" dia. core hole to 6" dia. from 894' to 929'	8/11/81PM
Cleaned out hole with drill pipe - mud and water encountered	8/12/81
Ran E-log - encountered foam and fluid at 943' to 969'	8/12/81
Ran in 4" I.D. steel casing (lower 20' perforated and installed two cement catches	8/13/81PM
Completed cementing of the annulus to the surface	8/14/81AM
Ran drill pipe to bottom of the hole - encountered foam, rust and water at depth of 925'	8/14/81PM
Next measurement of water level - 736'	8/14/81
4th Q 1981 measurement of water level - 731'	12/9/81
2nd Q 1982 measurement of water level - 738'	5/27/82
3rd Q 1982 measurement of water level - 742.5'	8/31/82
Bail sample - 742'	11/39/82
4th Q 1982 measurement of water level and pump test and samples (3)	12/3/82

Figure VII-5

SOUTH LEASE COAL PROPERTY

DRILL HOLE S-32/WMH #32

WATER PUMP TESTS AND SAMPLES

Hole Description

Depth - Total		969'
Hole Diameter	- to 929'	6"
	- 929' to 969'	4-7/8"
Casing - diameter and type		
	- to 929'	nominal 4" steel (4.5" O.D.)
	- 929' to 949'	nominal 4" steel perforated (4.5" O.D.)
	- 949' to 969'	None
Cement catchers		
	- number	2
	- type	canvas and steel
	- depth from surface	909' & 929'

Cementation

- at time of installing the cement catchers, a limited thick cement charge was made and allowed to stand for 24 hours; this would provide a secure cement base above the higher cement catcher for taking the weight of the full cement column.

- the next day the annulus was cemented in full column to the surface.

Pump Test Methodology and Procedures

Contractor: Rhodes Brothers
P. O. Box 271
Filmore, Utah 84631

Dates	- bail sample	11/30/82
	- pump test	12/3/82

KSC personnel present: D. Pearce

Test procedure:

A bail sample was first taken (11/30/82) to ensure that the drill hole was clear. Three pump samples were taken on 12/3/82.

A submersible 440-volt pump mounted on the lower end of a 1-1/4" (1.660" O.D.) diameter string of drill pipe was lowered within

the nominal 4" (4.026" I.D.) hole casing to a depth of 900' below the surface. Pump capacity at this depth approximated 9 gpm. A 1/2" (0.840" O.D.) pipe strapped to the 1-1/4" drill pipe housed the conductors to an electrical conductivity meter for measuring the depth of the water level in the drill hole below the surface.

Prior to pumping the water level in the drill hole was 743' from the surface. Previous measurements of this level were: 3rd Q 1981-736'; 4th Q 1981-731'; 2nd Q 1982-738'; and 3rd Q 1982-742.5'.

The three pump samples were taken as follows. The pump was first run for about an hour. It took approximately 15 minutes to bring the water to the surface (the drawdown of each foot in the 4.026" I.D. casing provides about 2' of water column in the 1-1/4" pipe.

The first pump sample was then taken (sample #2 on the lab sheets); it approximated 1/2 gallon and was taken over a period of something more than one minute.

Two additional samples (samples #3 and #4 on the lab sheets) with intervals of approximately 45 minutes to one hour between samples. These pump samples were taken over an interval of about four hours; the pump was operated continuously over the sampling period.

At the end of the sampling period, the pump was shut and recharge and time measurements made (see attached graphs and charts).

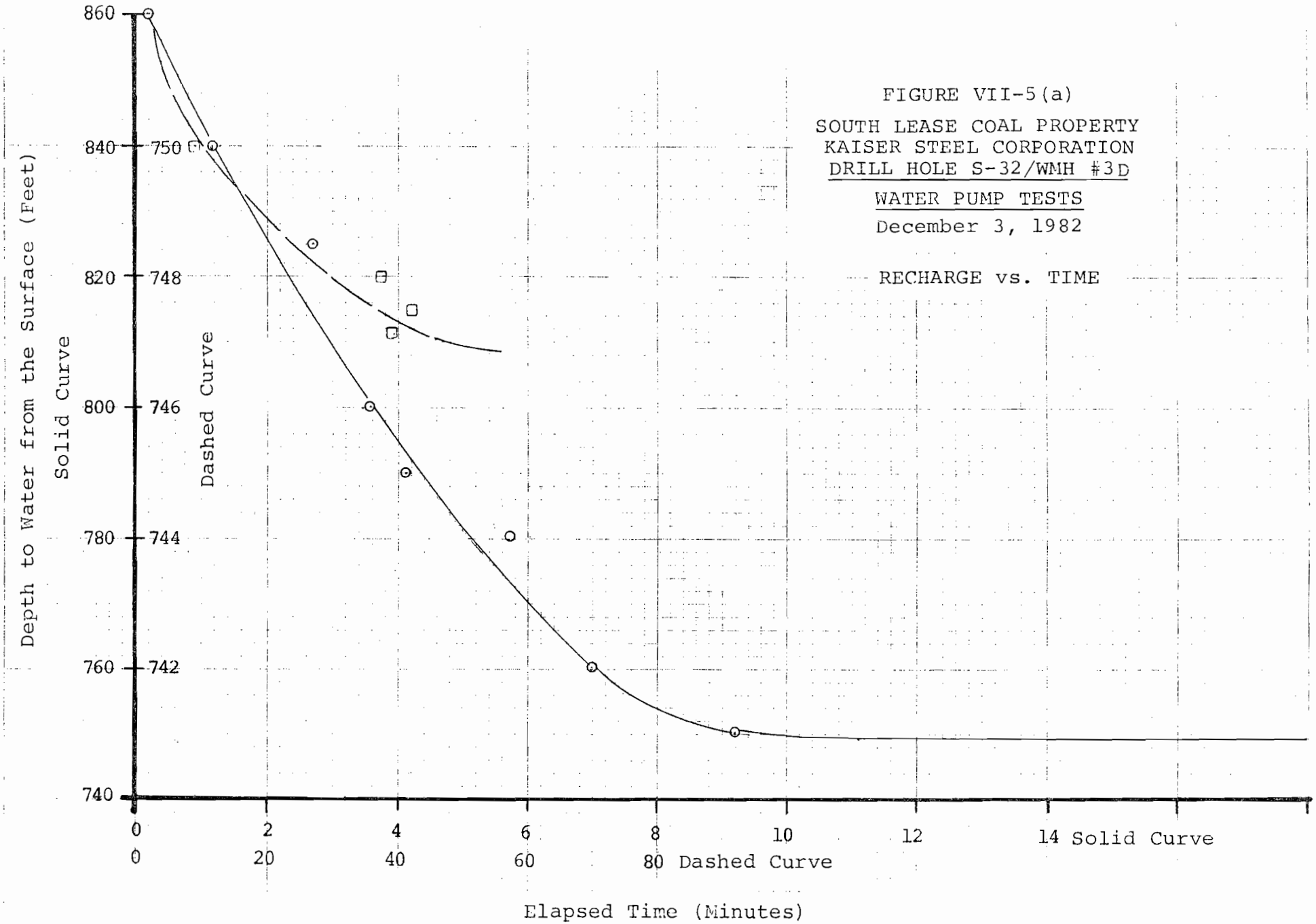


FIGURE VII-5(a)
SOUTH LEASE COAL PROPERTY
KAISER STEEL CORPORATION
DRILL HOLE S-32/WMH #3D
WATER PUMP TESTS
December 3, 1982
RECHARGE vs. TIME
Depth to Water from the Surface (Feet)
Solid Curve
Dashed Curve
860
840
820
800
780
760
740
750
748
746
744
742
0
2
4
6
8
10
12
14 Solid Curve
0
20
40
60
80 Dashed Curve
Elapsed Time (Minutes)

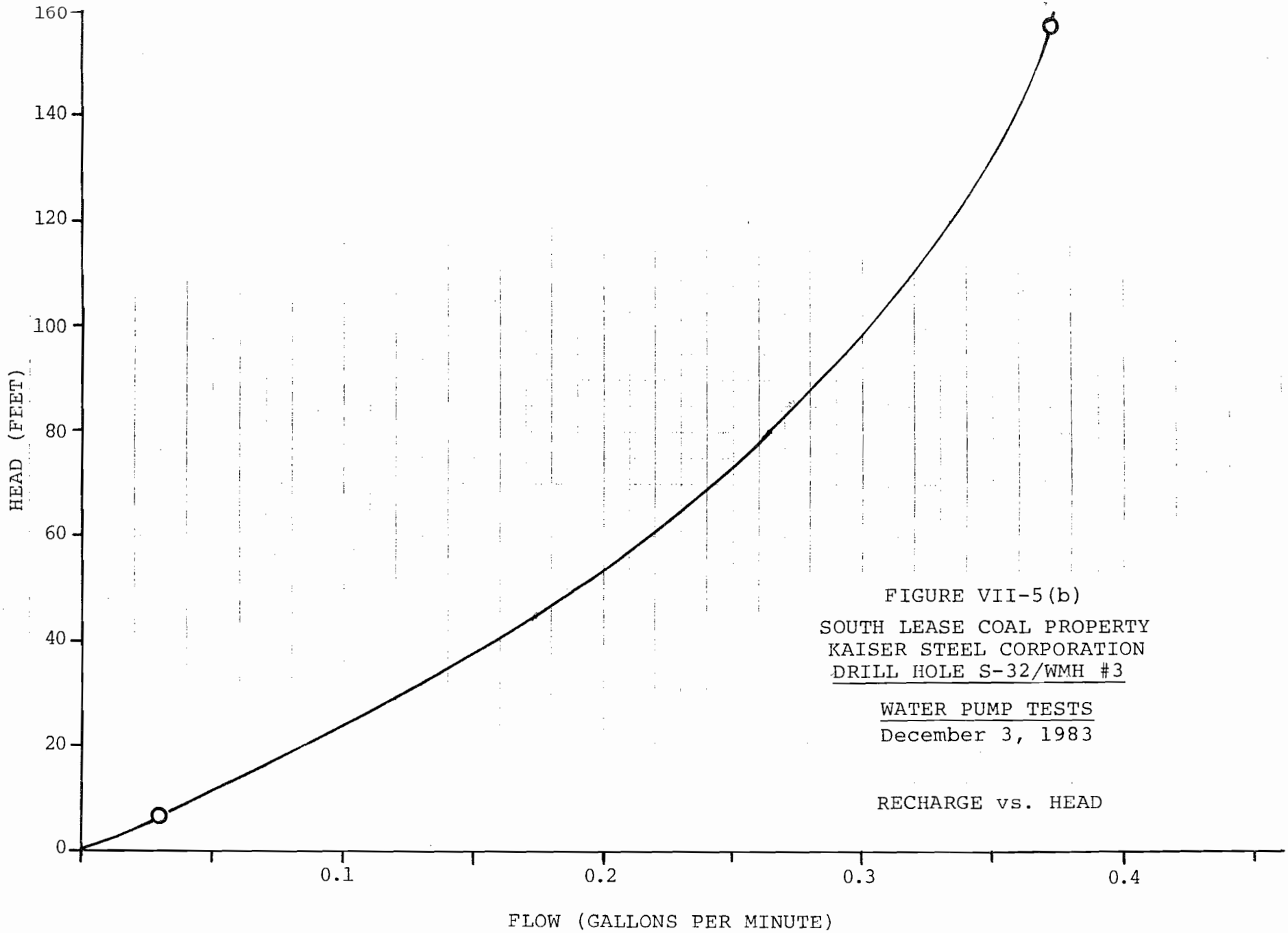


FIGURE VII-5(b)

SOUTH LEASE COAL PROPERTY
KAISER STEEL CORPORATION
DRILL HOLE S-32/WMH #3

WATER PUMP TESTS
December 3, 1983

RECHARGE vs. HEAD

Figure VII-5(c)

SOUTH LEASE COAL PROPERTY

KAISER STEEL CORPORATION

DRILL HOLE S-32/WMH #32

WATER PUMP TESTS
December 3, 1982

Raw Data - Recharge

Elapsed Time		Depth to Water (Feet)
Min.	Sec.	
0	00	900
0	13	860
1	12	840
2	42	825
3	27	800
4	07	790
5	43	780
6	56	760
9	10	750
38	15	748
39	10	747
42	25	747.5

Notes: (1) Static hole depth to water 743 feet.
(2) Natural inflow rate 0.375 gallons per minute.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 12/20/82

KAISER STEEL CORP.
P.O. BOX D
SUNNYSIDE, UTAH
JOHN HUEFNER 84539

CERTIFICATE OF ANALYSIS

82-009203

SAMPLE: WATER SAMPLES RECEIVED 12-10-82 FOR SCHEDULE "C" ANALYSIS UNDER P.O. 280-71064.

	#1 BAIL SAMPLE HOLE #32 11-30-82	#2 PUMP SAMPLE HOLE #32 12-3-82	#3 PUMP SAMPLE HOLE #32 12-3-82	#4 PUMP SAMPLE HOLE #32 12-3-82
Acidity as CaCO3 mg/l	4.00	4.00	3.00	3.00
Alkalinity as CaCO3 mg/l	62.10	77.80	58.30	59.40
Ammonia as NH3-N mg/l	1.56	1.39	1.18	1.16
Antimony as Sb (Tot) mg/l	<.001	<.001	<.001	<.001
Arsenic as As (Tot) mg/l	<.001	<.001	<.001	<.001
BOD 5 Day mg/l	24.0	21.0	26.0	25.0
Beryllium as Be (Tot) mg/l	<.01	<.01	<.01	<.01
Bicarbonate as HCO3 mg/l	75.70	94.90	71.10	72.50
Boron as B Total mg/l	2.010	.820	.620	.600
Cadmium as Cd (Tot) mg/l	<.001	<.001	<.001	<.001
Calcium as Ca mg/l	88.00	80.00	80.00	72.00
Carbonate as CO3 mg/l	<.01	<.01	<.01	<.01
Chloride as Cl mg/l	57.80	52.00	50.00	59.20

Figure VII-6
Chemical Analysis of Water Samples

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LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

82-009203

CERTIFICATE OF ANALYSIS

	#1 BAIL SAMPLE HOLE #32 11-30-82	#2 PUMP SAMPLE HOLE #32 12-3-82	#3 PUMP SAMPLE HOLE #32 12-3-82	#4 PUMP SAMPLE HOLE #32 12-3-82
Phosphate PO4-P Ortho mg/l	.090	.110	.110	.110
Potassium as K mg/l	16.50	14.50	8.30	8.10
Selenium as Se (Tot) mg/l	<.001	<.001	<.001	<.001
Silver as Ag (Total) mg/l	<.001	<.001	<.001	<.001
Sodium as Na mg/l	88.5	89.0	80.5	99.0
Sulfate as SO4 mg/l	340	330	315	316
Sulfide as S mg/l	.60	.62	.39	.38
Suspended Solids mg/l	96.0	630	172	40.0
Thallium as Tl (Total) mg/l	<.01	<.01	<.01	<.01
Total Diss. Solids mg/l	640	645	490	608
Total Organic Nitrogen mg/l	.75	.80	.65	.65
Turbidity NTU	26.00	40.00	60.00	29.00
Zinc as Zn (Total) mg/l	2.500	5.850	.700	.195
pH Units	7.60	7.70	7.80	7.40

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40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 12/20/82

CERTIFICATE OF ANALYSIS

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (2) #2 PUMP SAMPLE HOLE #32 12-3-82

C A T I O N S	mg/l	meq/l
Calcium as Ca mg/l	80.000	3.992
Magnesium as Mg mg/l	19.200	1.579
Sodium as Na mg/l	89.000	3.872
Potassium as K mg/l	14.500	.371

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l	.000	.000
Bicarbonate as HCO3 mg/l	94.900	1.556
Sulfate as SO4 mg/l	330.000	6.871
Chloride as Cl mg/l	52.000	1.467
Nitrate as NO3-N mg/l	.360	.006

B A L A N C E I N F O R M A T I O N

CATIONS:	9.814
ANIONS:	9.900
TOTAL:	19.714
DIFFERENCE:	.086
SIGMA:	.004

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40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 466-8761

DATE: 12/20/82

CERTIFICATE OF ANALYSIS

FORD CHEMICAL LABORATORIES

BALANCE SHEET FOR SAMPLE: (4) #4 PUMP SAMPLE HOLE #32 12-3-82

C A T I O N S	mg/l	meq/l
Calcium as Ca mg/l	72.000	3.593
Magnesium as Mg mg/l	16.800	1.382
Sodium as Na mg/l	99.000	4.307
Potassium as K mg/l	8.100	.207

A N I O N S	mg/l	meq/l
Carbonate as CO3 mg/l	.000	.000
Bicarbonate as HCO3 mg/l	72.500	1.189
Sulfate as SO4 mg/l	316.000	6.579
Chloride as Cl mg/l	59.200	1.670
Nitrate as NO3-N mg/l	.120	.002

B A L A N C E I N F O R M A T I O N

CATIONS:	9.489
ANIONS:	9.440
TOTAL:	18.929
DIFFERENCE:	.049
SIGMA:	.002

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