

Geolog

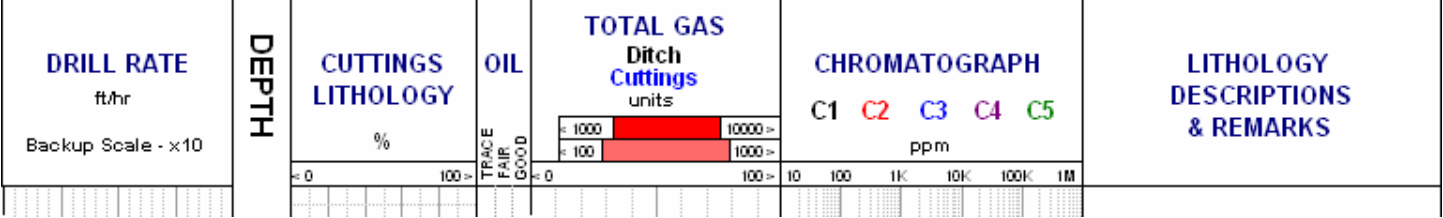


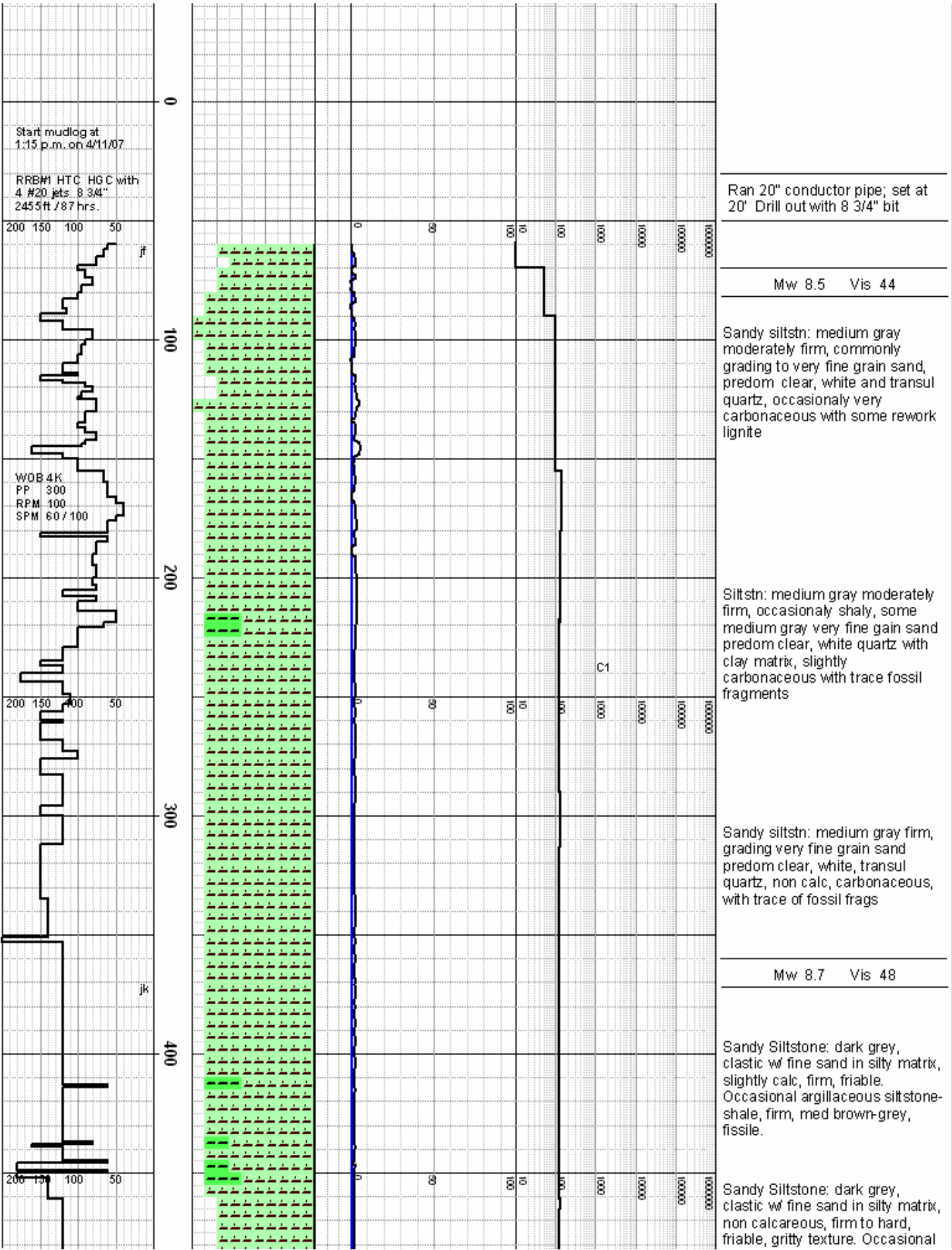
FORMATION EVALUATION LOG

Scale: 2" = 100'

COMPANY: Northwest Natural WELL: IW 23adh-3-65 FIELD: Mist (Flora Pool Storage) COUNTY: Columbia, OR Location: S.E. 1/4 Sec.3,T.6N-R.5W, WB&M Coordinates: 1509.41' S 86°38'36"E and 1985.04' N 03°21'24"E from S.W. 1/4 of Sec. 3, Y:874602.1 X:1291029.6 API No.: 36-009-00365 Spud Date: 4/11/07 Total Depth: 4/21/07 Elevation: K.B. 1089.5' G.L. 1075.5' Company Geologist: Jack Meyer Company Engineer: Clayton Roth Company Pusher: Ed Vader Directional Engineer: Scientific Drilling Mud Company: Beaver Drilling Fluids Mud Engineer: Ed Vader Drilling Contractor: TD Well Service Rig Pusher: Jerry Gann Rig No.: 101 Geolog Unit No.: 19 Logging Geologists: Jim Ferguson Joe Klamecki	LOG INTERVAL DATES: 4/11/07 TO TO DEPTHS: 60' TO 3581' TO	TOTAL DEPTH MEASURED: 3581' TRUE VERTICAL: 2636.40' HOLE SIZE 17-1/2" TO 572' 12-1/4" TO 694' 8-3/4" TO 3581'
	MUD TYPES Gel Chem TO 3581' TO TO	CASING DATA 20" AT 20' 13-3/8" AT 565' AT
	MUD PUMPS PUMP #1: EMSCO DB 550 (16" x 5-1/2") PUMP #2: OILWELL H 560 37 (8" x 5-1/2")	
	LEGEND BG - Background Gas CB - Core Bit CG - Connection Gas CK - Filter Cake CKF - Check for Flow CL - Salinity, ppm Cl CR - Circulate Returns DB - Diamond Bit DC - Depth Correction DCB - Diamond Core Bit DF - Derrick Floor DG - Drilling Gas DS - Directional Survey DST - Drill Stem Test EL - Electric Log E.M.A. - Equivalent Methane in Air, 1% = 50 Units F - Filtrate, API cc/s F/T - Flowline Temperature GCM - Gas Cut Mud GCW - Gas Cut Water G & OCM - Gas and Oil Cut Mud GL - Ground Level KB - Kelly Bushing LAT - Logged After Trip NB - New Bit NCB - New Core Bit NR - No Returns PDC - Polycrystalline Diamond Compact Bit LC - Lost Circulation PPM - Parts Per Million PR - Poor Returns PP - Pump Pressure PV - Plastic Viscosity RM - Mud Resistivity, Ohm-Meter RMC - Mud Cake Resistivity, Ohm-Meter RMF - Mid-Filtrate Resistivity, Ohm-Meter RPM - Revolutions Per Minute RRB - Rerun Bit RT - Rotary Table SD - Sand % SO - Show of Oil SOL - Solids % SPM - Strokes Per Minute STG - Short Trip Gas SWG - Swab Gas SVG - Survey Gas S/T - Suction Temperature T.D. - Total Depth TCL - Trip Chlorides TG - Trip Gas TVD - True Vertical Depth V - Viscosity, API seconds W - Weight of Mud, ppg/pp WOB - Weight on Bit	

CEMENT	COAL & LIGNITE	FINE SAND	KAOLINITE	VOLCANIC
LIMESTONE	CLAY	MEDIUM SAND	TUFF	IGNEOUS
DOLOMITE	SHALE	COARSE SAND	DIATOMITE	METAMORPHIC
GYPSUM	SILTSTONE	CONGLOMERATE	PORCELANITE	
ANHYDRITE	SANDY SILTSTONE	SANDSTONE	CHERT	





Start mudlog at
1:15 p.m. on 4/11/07

RRB#1 HTC HGC with
4 #20 jets 8.34"
2455 ft / 87 hrs.

Ran 20" conductor pipe; set at
20' Drill out with 8 3/4" bit

Mw 8.5 Vis 44

Sandy siltstn: medium gray moderately firm, commonly grading to very fine grain sand, predom clear, white and translucent quartz, occasionally very carbonaceous with some rework lignite

WOB 4K
PP 300
RPM 100
SPM 60 / 100

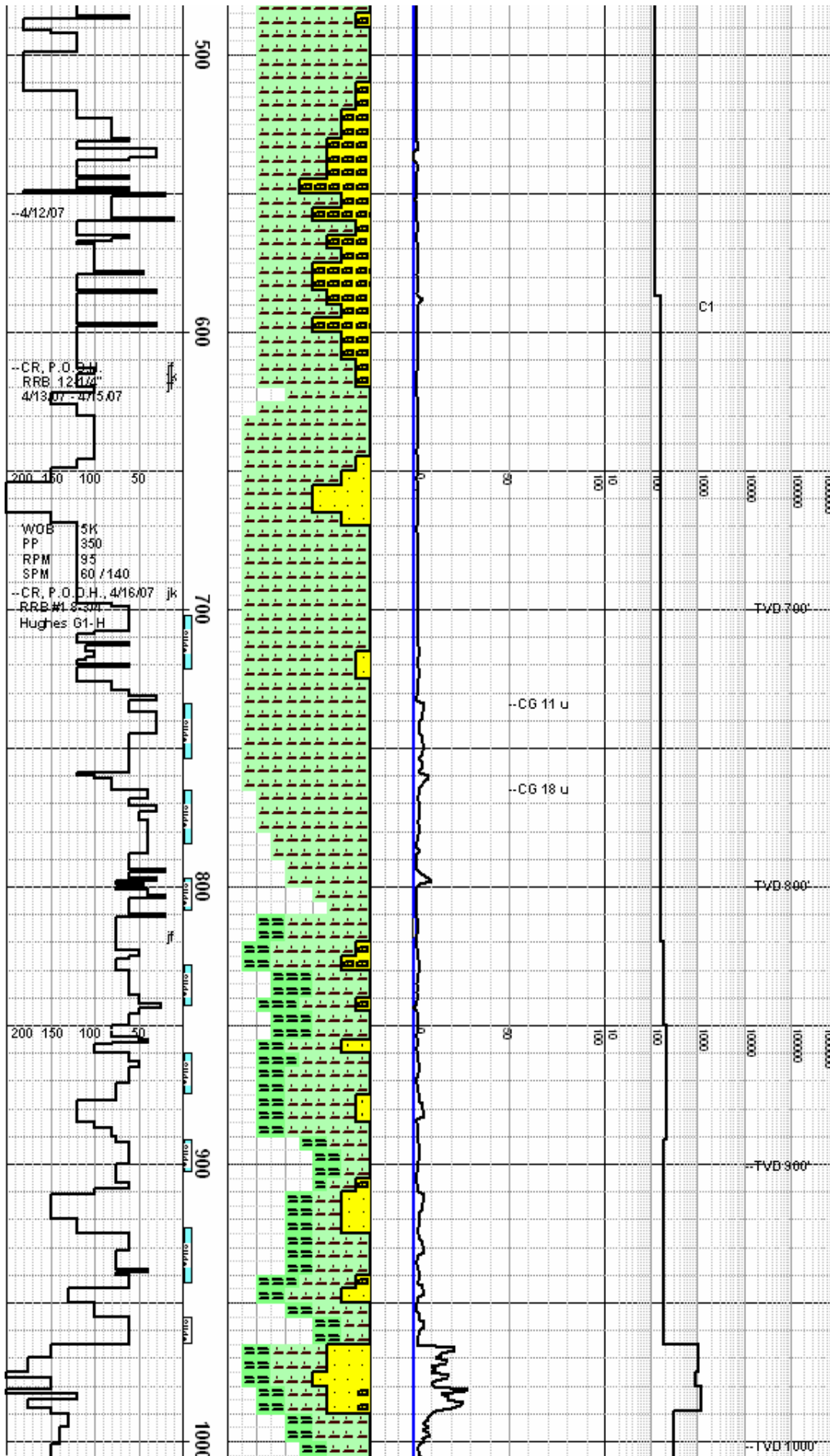
Siltstn: medium gray moderately firm, occasionally shaly, some medium gray very fine gain sand predom clear, white quartz with clay matrix, slightly carbonaceous with trace fossil fragments

Sandy siltstn: medium gray firm, grading very fine grain sand predom clear, white, translucent quartz, non calc, carbonaceous, with trace of fossil frags

Mw 8.7 Vis 48

Sandy Siltstone: dark grey, clastic w/ fine sand in silty matrix, slightly calc, firm, friable. Occasional argillaceous siltstone-shale, firm, med brown-grey, fissile.

Sandy Siltstone: dark grey, clastic w/ fine sand in silty matrix, non calcareous, firm to hard, friable, gritty texture. Occasional



well indurated, v. fine detritus, light grey-beige, possible ash. Fossil frags present.

Mw 8.7 Vis 53

Siltstone & Sandstone: dark grey, clastic w/ fine sand and shell frags in silty matrix, mod firm, friable, gritty texture. Fine to med grain sandstone, well cemented, non calc. Gastropod and fossil frags present.

Drill 8 3/4" hole 613'; open 17-1/2" to 572'. Drill 12-1/4" to 694'. Run 13 jts 13-3/8" #48 casing with shoe set at 565'.

Siltstone: dark grey, clastic w/ fine sand in silty matrix, non calcareous, soft to firm, friable, gritty texture. Shell frags present.

Rig up new BHA, pick up directional tools MWD and MM

Mw 8.5 Vis 39

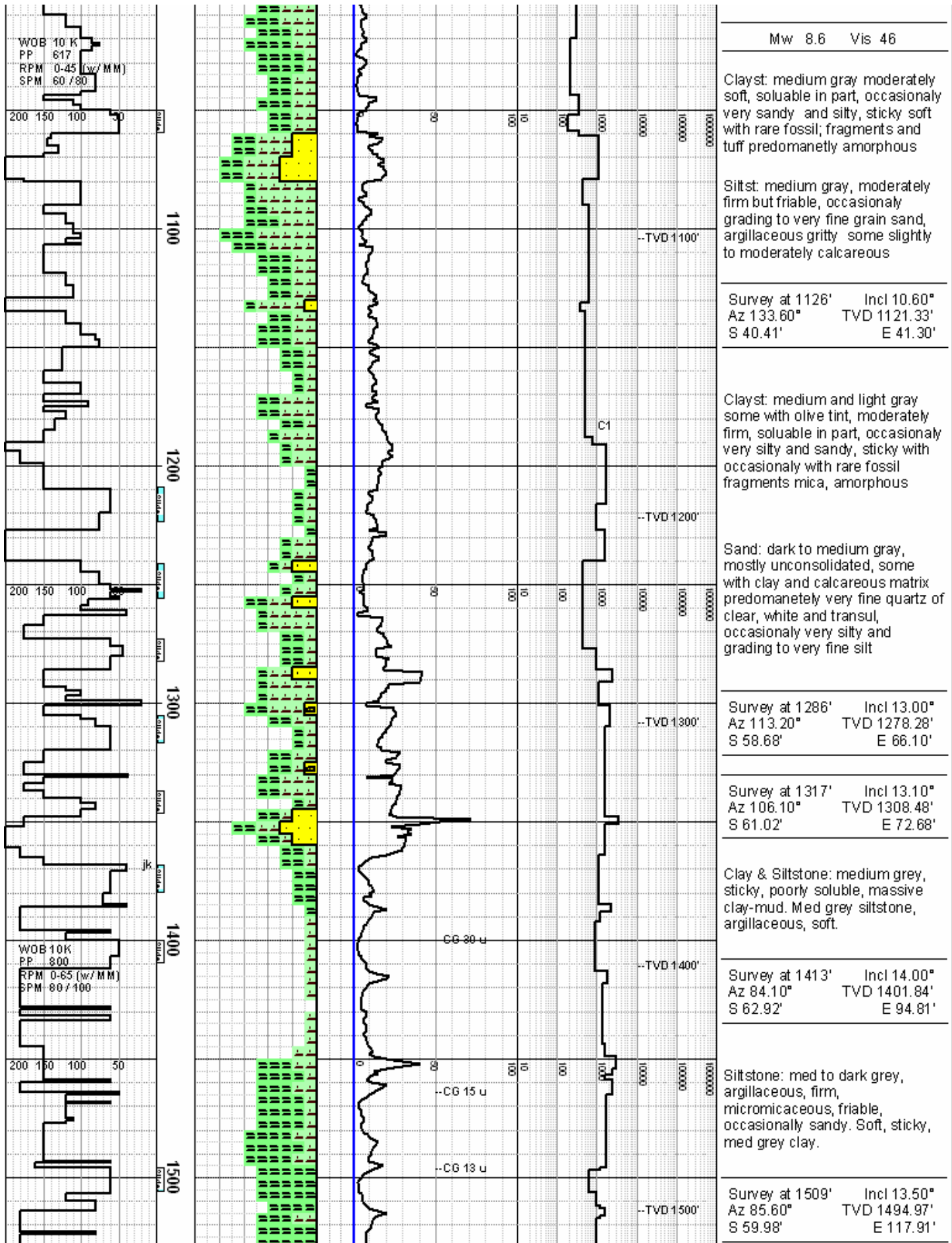
Siltstone: dark grey, clastic w/ fine sand in silty matrix, non calcareous, soft to firm, friable, gritty texture. Sticky, partially soluble, grey clay.

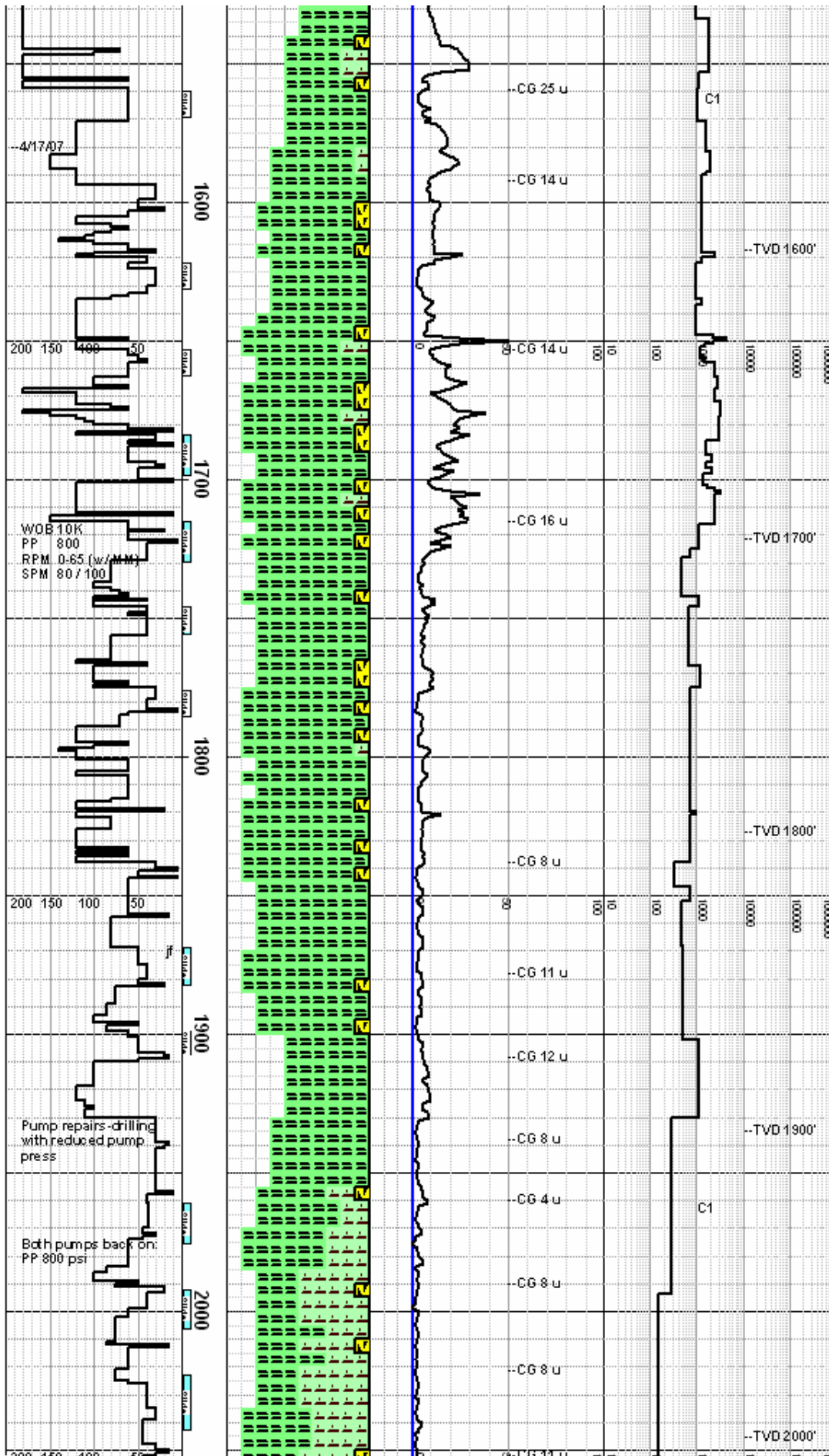
Survey at 809' Incl 4.76°
Az 142.85° TVD 808.85'
S 5.35' E 2.94'

Sandst: dark and medium gray, moderately firm, but friable, predominately very fine clear, white and transl quartz subangular, commonly grading to silt, some slightly calcareous, mica, fossil fragments

Survey at 904' Incl 8.60°
Az 138.40° TVD 903.21'
S 13.52' E 10.11'

Sand: medium gray slightly firm, very fine to fine sub angular clear, white and transl quartz, occasionally grading to very fine grain silt with some calcareous matrix, some argillaceous with rare fossil fragments





Mw 8.7 Vis 55

Siltstone: med to dark grey, argillaceous, firm to mod hard, micromicaceous, friable, occasionally sandy, slight calcareous. Soft, sticky, silty, sol, med grey clay.

Survey at 1633' Incl 14.48°
Az 93.53° TVD 1615.43'
S 59.93' E 147.29'

Siltstone: med to dark grey, argillaceous, firm to mod hard, micromicaceous, fissile, mod indurated, occasionally sandy. Soft, maleable, sticky, silty, sol, med grey clay. Occasional thin lense v. fine detritus, indurated, poss tuffite.

Mw 8.8 Vis 65

Survey at 1756' Incl 19.23°
Az 87.42° TVD 1733.04'
S 60.41' E 183.16'

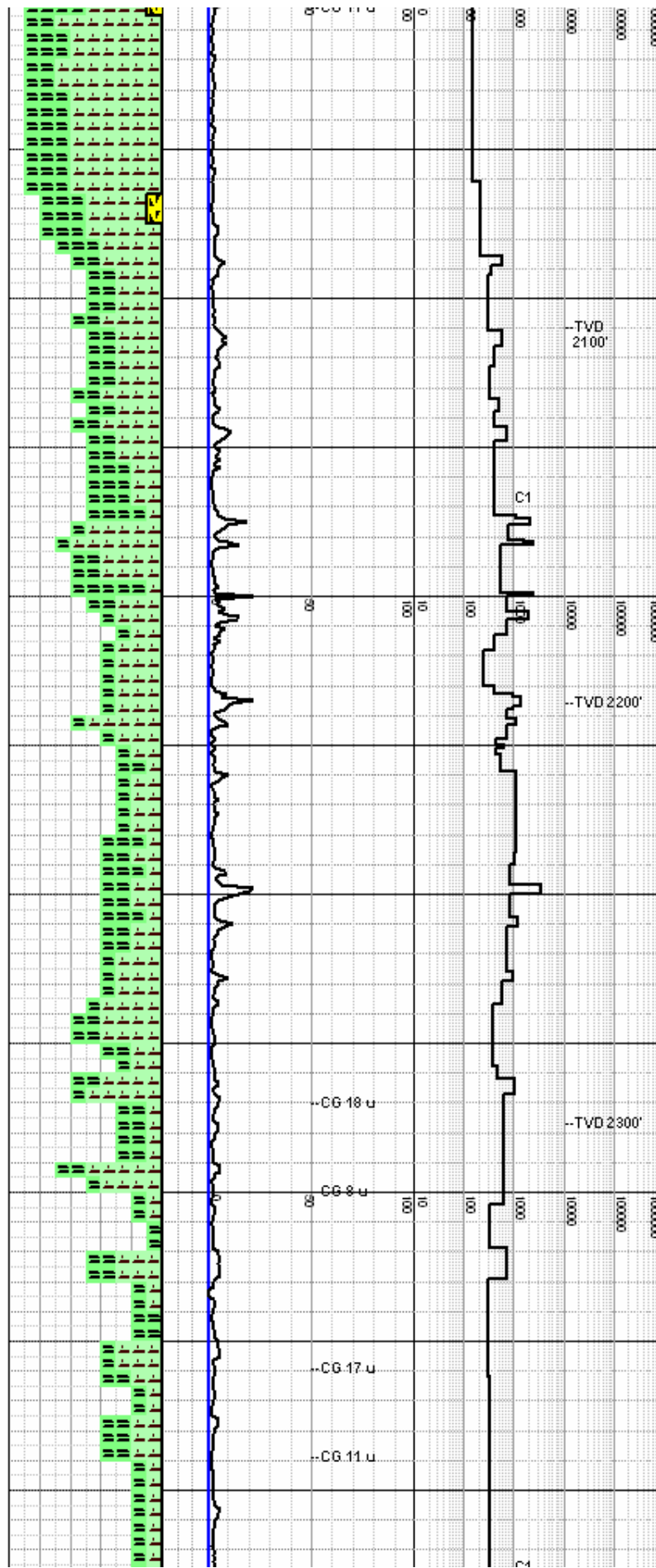
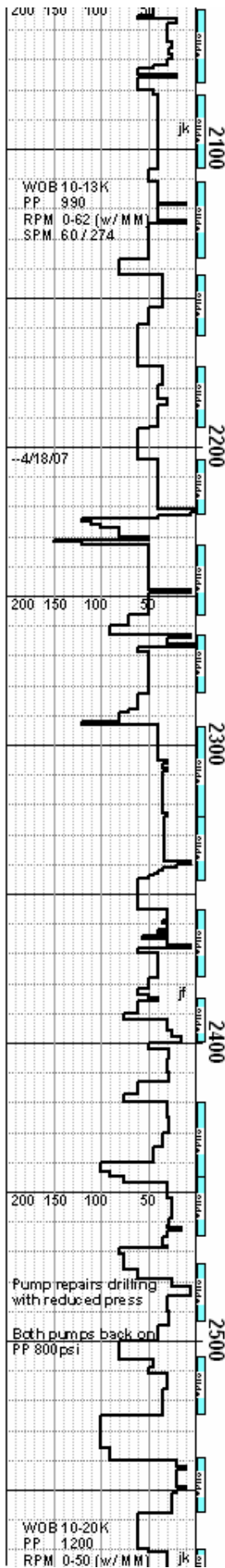
Siltstone: med to dark grey, argillaceous, firm to mod hard, micromicaceous, fissile, mod indurated, occasionally sandy. Soft, maleable, sticky, silty, sol, med grey clay. Occasional thin lense v. fine detritus, light grey-beige, mod-well indurated, poss tuffite.

Survey at 1879' Incl 22.16°
Az 89.86° TVD 1848.30'
S 59.56' E 226.05'

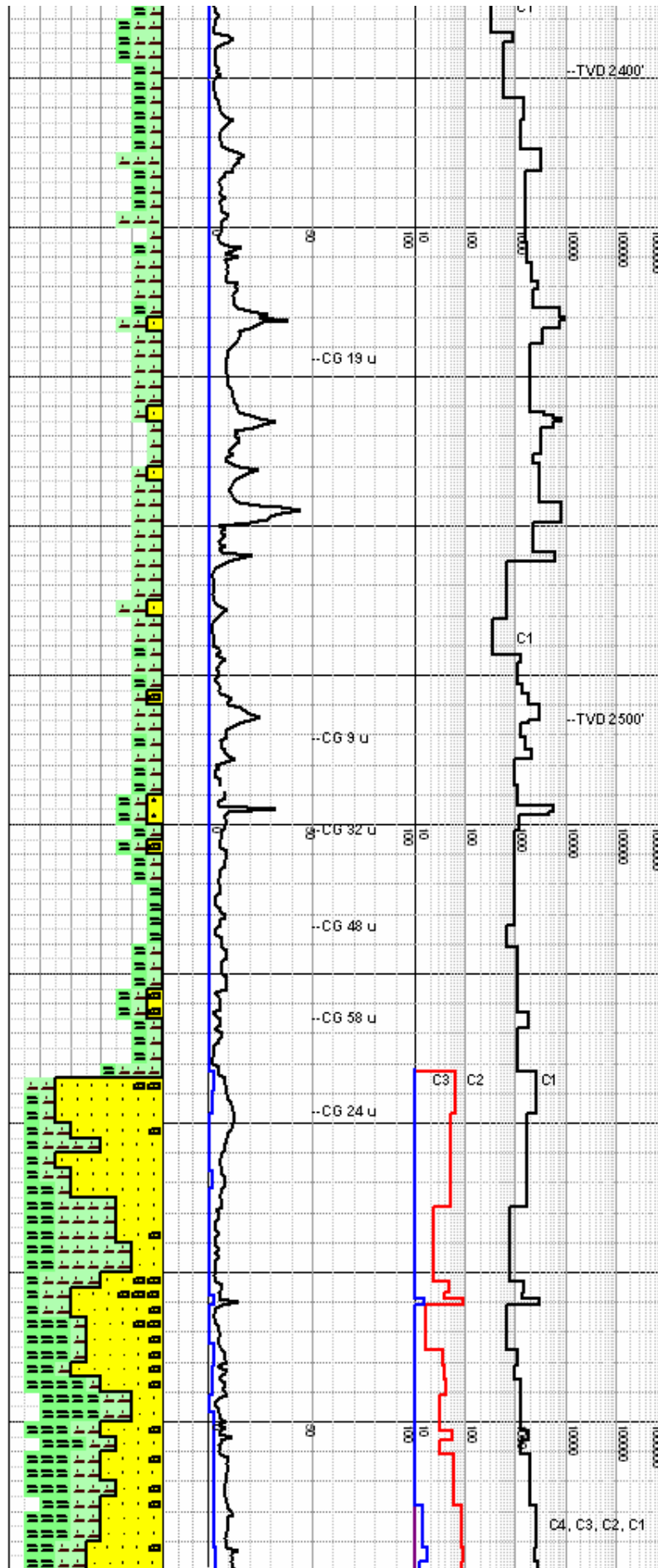
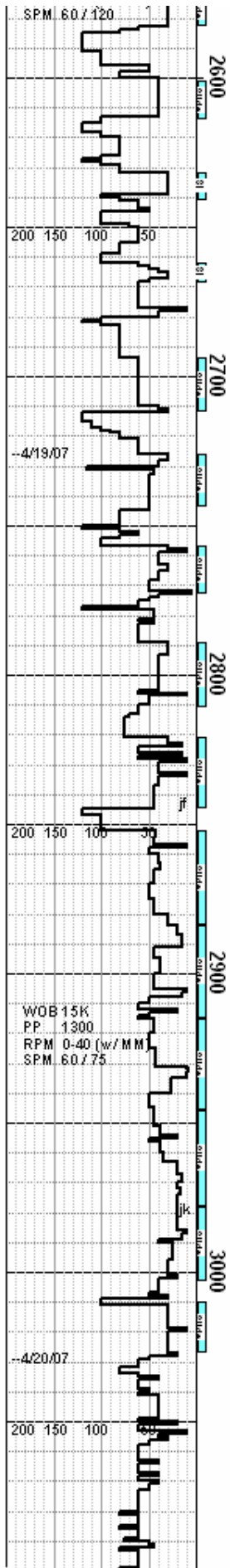
Clayst: predomanently medium to dark gray, moderately firm, soluable in part, occasionally very silty to sandy, sticky with minor fossil fragments and mica mostly amorphous

Survey at 1972' Incl 24.12°
Az 90.46° TVD 1933.84'
S 59.91' E 262.54'

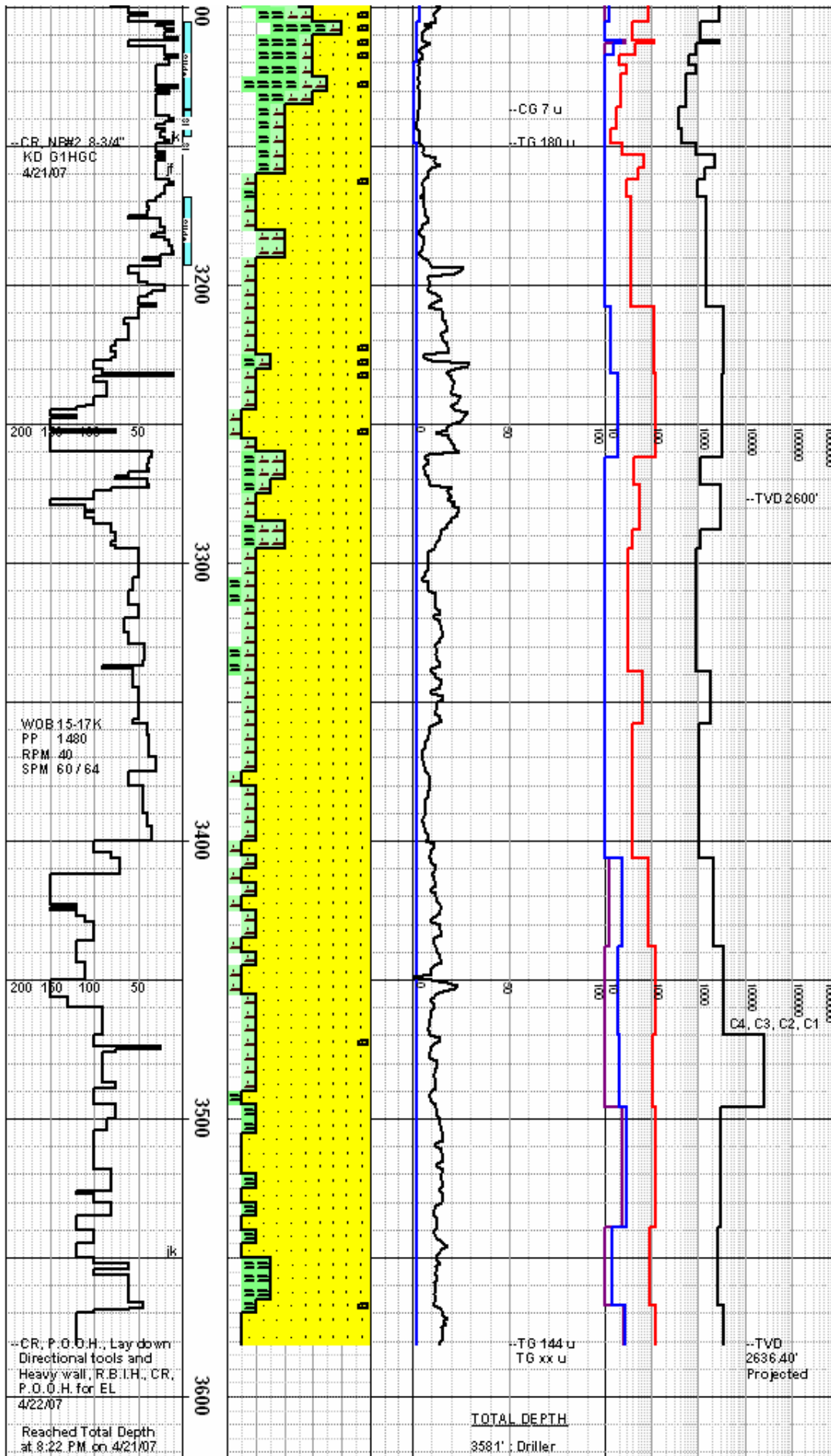
Siltst: medium to dark gray, moderately firm, calcareous, grading to very fine grain sand, rare sandst laminations, blocky poor to any fissility, argillaceous with rare tuff fragment



Survey at 2061' Az 89.40° S 60.27'	Incl 27.20° TVD 2014.14' E 300.90'
Mw 8.8	Vis 60
Siltstone: medium to dark gray, moderately firm to hard, slight fissility, clastic w/ v. fine sand, calcareous, massive, blocky cuttings. Med grey clay, sticky, mod-poorly soluble.	
Survey at 2180' Az 89.60° S 58.74'	Incl 34.40° TVD 2116.32' E 361.71'
Siltstone: medium to light grey-brown, moderately soft to hard, friable, clastic w/ v. fine sand, micaceous, oriented fabric, massive, blocky cuttings, occas interbedded w/ beige-light grey, well indurated v. fine detritus. Med grey clay, sticky, mod-poorly soluble.	
Survey at 2301' Az 91.94° S 60.61'	Incl 41.73° TVD 2211.40' E 436.38'
Mw 8.8	Vis 70
Siltstone: medium to light grey, moderately soft to hard, friable, clastic w/ v. fine sand, micaceous, gritty texture, blocky cuttings, occas interbedded w/ beige-light grey, well indurated v. fine detritus. Med grey clay, sticky, mod-poorly soluble.	
Survey at 2423' Az 90.85° S 60.91'	Incl 48.80° TVD 2297.45' E 522.75'
Survey at 2454' Az 90.62° S 61.22'	Incl 50.90° TVD 2317.43' E 546.44'
Clayst: medium gray with common lt brown with some olive mottling, predominately soluble in part, sticky occasionally very silty and sandy appears to be laminations, rare tuff, calcareous occ mica, amorphous	
Survey at 2576' Az 89.70° S 61.27'	Incl 57.70° TVD 2388.59' E 645.44'



S 01.27		E 045.44	
Mw 8.9		Vis 51	
Siltstone & Clay: medium to light olive grey, moderately soft to firm, friable, commonly sandy, gritty texture. Med grey clay, sticky, massive, poorly soluble.			
Siltstone & Sand: medium to light grey, mod soft to firm, friable, commonly sandy, gritty texture, oriented micas. Minor clear to cloudy qtz sand, med grain, subrounded, thin stringer, coarse pyrite, minor mafic grains. Occasional foraminifera present.			
Survey at 2734'		Incl 63.63°	
Az 91.50°		TVD 2466.33'	
S 62.34'		E 782.90'	
Mw 9.0		Vis 60	
Survey at 2766'		Incl 65.19°	
Az 91.30°		TVD 2480.15'	
S 63.05'		E 811.75'	
Siltstone & Clay: medium to light grey, mod soft to firm, friable, sandy, gritty texture, oriented micas. Med grey clay, v. sticky, poorly soluble.			
Mw 9.2		Vis 55	
Survey at 2928'		Incl 73.30°	
Az 91.90°		TVD 2538.84'	
S 66.72'		E 962.55'	
Sand: Predomanetely light gray with minor light gray brown, unconsolidated, v. fine to fine with some med subang clear, white and transul qtz common mica, pyrite with rare chlorite and foram frags, some with calc cemented matrix, firm.			
Sand & Sandstone: Translucent to cloudy qtz, fine to med grain, mod to well sorted, dom subrounded, abundant mica. Calc well-cemented sandstone, fine-med grain, well sorted, quartzose.			
Mw 8.9		Vis 44	
YP 12		Gel 4 / 20	
PV 13		pH 8.4	
Survey at 3086'		Incl 79.67°	
Az 93.41°		TVD 2572.52'	
S 73.64'		E 1116.64'	



Siltstone & Sand: med to light grey, mod soft to firm, friable, occas clastic w/ v. fine sand, interbedded w/ shell frags, oriented fabric, gritty texture. Clear to cloudy qtz, v. fine to med grain, subangular to subrounded, mod to well sorted, pyrite, mafics, occas calc cemented. Rare lignite.

Mw 9.0 Vis 62

Survey at 3214' Incl 82.28°
Az 89.90° TVD 2591.73'
S 77.86° E 1243.09'

Sand: Light gray, mostly unconsolidated, very fine to medium sunangular and subrounded, predominately clear, white and translucent quartz, common mica with rare chlorite, pyrite, common mafics some well cemented with calcareous matrix, minor clay matrix

Survey at 3341' Incl 82.70°
Az 89.70° TVD 2607.89'
S 77.53° E 1369.05'

Sand: Light gray unconsolidated v. fine to fine with common to abund med grains, subangular to subrounded clear, white and translucent qtz some minor light tan clay matrix, rare pyrite, chlorite w/ common mica and mafics, occas some w/ calc matrix, but friable and firm.

Survey at 3437' Incl 83.40°
Az 89.70° TVD 2619.23'
S 77.25° E 1464.38'

Sandst: light gray to minor light gray gray brown, very fine to medium with some coarse grains, predominately cemented with calcareous matrix friable with traces of pyrite, mica, chlorite and mafics

Survey at 3530' Incl 83.00°
Az 89.80° TVD 2630.18'
S 77.07° E 1556.73'

Mw 9.2 Vis 46

Projection to 3581' Incl 83.00°
Az 89.90° TVD 2636.40'
S 76.89° E 1607.35'

Run Halliburton FI · HRID-

XXXX' : Halliburton

EMIT-SDLT-DSNT-NGRT
Free Fall to 2986', Push to XXXX'

Comments:

Northwest Natural

IW 23adh-3-65

Mist (Flora Pool Storage)

S.E. 1/4 Sec.3,T.6N-R.5W, WB&M



FORMATION EVALUATION LOG

Scale: 2" = 100'