



00509114

OPERATOR: Union Pacific Resources Company

WELL NAME: #4 Harker 12-35

LOCATION: 2060' FNL, 1320' FEL
S/2 (S/NW) Section 35-T12S-R43W
 Cheyenne County, Colorado

FIELD: Harker Ranch

TOTAL DEPTH: 5370' Driller, 5377' Logger, 5375.95' Strap

ELEVATION: 4083' G.L., 4093' K.B.

SPUD DATE: April 14, 1990

COMPLETION DATE: April 24, 1990

SURFACE CASING: Set 16 joints new 8 5/8" casing at 657' K.B. with 290 sacks 15:35 poz mix + 75 sacks Class A. Plug down 11:45 AM, April 15, 1990.

CONTRACTOR: Exeter Drilling, Rig 14

DRILLING SUPERVISION: Ed Martin

WELLSITE GEOLOGY: John D. Pruit

MUD: Millpark Drilling Fluids, Hays, Kansas
 Dusty Rhoades, Engineer

CORING: Coring by HOMCO Coring Services, Casper, Wyoming
 Bob Richardson, Engineer
 Core Analysis by Core Laboratories, Aurora, Colorado

LOGS: Western Atlas, Ft. Morgan, Colorado: Dual Induction focused Log-Gamma Ray; Z Density-Compensated Neutron Log-Gamma Ray

WELL HISTORY:

<u>Date</u>	<u>Depth</u>	<u>Formation</u>	<u>Operation</u>
4-14-90	0'	Surface	Spud 7:45 PM
4-15-90	665'	---	Trip Out for Casing. Made 665' in 7 hrs. dev 1/2° @ 98', 1/2° @ 183', 0° @ 297', 1/4° @ 380', 1/4° @ 493', 1/2° @ 585', 1 1/4° @ 665'

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WELL HISTORY: (Continued)

<u>Date</u>	<u>Depth</u>	<u>Formation</u>	<u>Operation</u>
4-16-90	1262'	---	Drilling. Made 597' in 24 hrs. VIS 27, MW 8.9. Drilling with water. WOB 30, RPM 120, PP 1000, SPM 66 dev 3/4° @ 1168'
4-17-90	2970'	---	Drilling. Made 1708' in 24 hrs. VIS 24, MW 9.2. Drilling with water. WOB 30, RPM 100, PP 1000, SPM 66 dev 1 3/4° @ 1575', 1 1/4° 2 2077', 1 1/4° @ 2576
4-18-90	3826'	---	Drilling. Made 856' in 24 hrs. VIS 27, MW 9.5. Drilling with water. WOB 40, RPM 100, PP 1100, SPM 66 dev 1 3/4° @ 3069', 1 1/4° 2 3597'
4-19-90	4022'	---	Tripping. Made 196' in 24 hrs. VIS 27, MW 9.5. Drilling with water. Tested drill collars for leaks. Laid down 15 drill collars.
4-20-90	4302'	Heebner	Drilling. Made 280' in 24 hrs. VIS 37, MW 8.8, Cl 2300, pH 11.5 WL 12.0, FC 2/32, LCM TRACE WOB 80, RPM 40, PP 1100, SPM 66 dev 1 1/4° @ 4089'
4-21-90	4799'	Marmaton	Drilling. Made 497' in 24 hrs. VIS 41, MW 9.0, Cl 1400, pH 10.0, WL 11.2, FC 2/32, LCM 2# WOB 40, RPM 80, PP 1100, SPM 66
4-22-90	5252'	Morrow	Circulating for samples. Made 453' in 24 hrs. VIS 51, MW 9.0, Cl 700, pH 9.5, WL 6.8, FC 2/32, LCM 1/2#
4-23-90	5267'	Morrow	Tripping out with Core Barrel. Made 15' in 24 hrs. VIS 56, MW 9.1, Cl 900, pH 9.0 WL 7.6, FC 2/32, LCM TRACE
4-24-90	5320'	Lower Morrow	Drilling. Made 46' in 24 hrs. VIS 56, MW 9.1, Cl 900, pH 8.5, WL 8.6, FC 2/32, LCM 0 WOB 40, RPM 80, PP 1100, SPM 66

WELL HISTORY: (Continued)

<u>Date</u>	<u>Depth</u>	<u>Formation</u>	<u>Operation</u>
	5370 DTD		dev 3/4° @ 5370'
	5377 LTD		
	5375.95 STD		

FORMATION TOPS:

<u>Formation</u>	<u>Sample</u>	<u>Datum</u>	<u>E. Log</u>	<u>Datum</u>
Stone Corral			3096'	(+ 997')
Shawnee	4112'	(- 19')	4118'	(- 25')
Heebner	4301'	(- 208')	4306'	(- 218')
Lansing	4356'	(- 263')	4359'	(- 266')
Marmaton	4715'	(- 622')	5721'	(- 628')
Cherokee	4885'	(- 692')	4888'	(- 795')
Atoka	5041'	(- 949')	5043'	(- 950')
Morrow	5174'	(-1081')	5177'	(-1084')
V-3 Sand	5220'	(-1127')	5219'	(-1126')
V-5 Sand ??	5247'	(-1154')	5239'	(-1146')
V-7 Sand	5272'	(-1179')	5292'	(-1179')
Lower Morrow	5297'	(-1204')	5300'	(-1207')

SHOW DESCRIPTION:

<u>Formation</u>	<u>Interval</u>	<u>Description</u>
Shawnee	4173'-4198'	Dolomite. Tan, microsucrosic-sucrosic, occasional shell fragments, tight-good intercrystalline and fair vuggy porosity, light brown-brown oil stain, strong oil odor, bright yellow fluorescence, instant streaming cut, strong ring. EXCELLENT SHOW.
V-5? Sand	5247'-5260'	Sandstone. Gray, very fine-coarse grained, trace granules, trace gravel, subangular-subrounded, well-poorly sorted, glauconitic, siliceous and calcareous cement in part, amber chert, tight-good visible porosity, brown oil stain, bright yellow gold fluorescence. EXCELLENT SHOW.
V-7 Sand	5272'-5295'	Sandstone. Gray, very fine grained-granules, subangular-subrounded, well-poorly sorted, glauconitic, amber chert, black chert and coal? grains, white clay filling and white sparry calcareous cement in part, brown-light brown oil stain, tight-excellent visible porosity, bright yellow white fluorescence. EXCELLENT SHOW.

CORE DESCRIPTIONS:

Coring services were provided by Bob Richardson of Homco Coring Service, Casper, Wyoming. Mr. Richardson was efficient and knowledgeable. His equipment performed effectively.

Core analysis was performed by Core Laboratories, Aurora, Colorado. Cores 1 and 2 were picked up on location by a Core Lab driver at the same time. He was prompt and efficient. The driver who picked up Core #3, Steve Mergenmier, took more than 7 hours to reach location from Aurora (a 4 hour trip at the outside) and arrived more than 30 minutes after core was laid down.

Descriptions (Depths are given in driller's depths)

Core #1 5252'-5257' V-5 Sand Cut 5', recovered 3.4'

- 1' Sandstone. Gray, fine grain-medium, subangular-subrounded, moderate sorting, trace glauconite, slightly siliceous, good visible porosity, brown oil stain, bright white gold fluorescence.
- 1' Sandstone. Gray, fine grain-medium, subangular-subrounded, moderate sorting, trace glauconite, slightly siliceous, tight-poor visible porosity, brown oil stain, bright white gold fluorescence.
- 1.4' Sandstone. Gray, very fine grain-granules, trace gravel, subangular-subrounded, poorly sorted, amber chert, abundant calcareous and siliceous cement, abundant vugs and pits on surface of core, no visible porosity under microscope, trace spotty white gold fluorescence.
- 3.4' Total recovery

Core #2 5257'-5267' V-5 Sand Cut 10', recovered 10'

- 1' Sandstone. Gray, very fine grain-fine grain, subangular-subrounded, well sorted, glauconitic, good visible porosity, brown oil stain, bright white gold fluorescence.
- 1' Sandstone. Gray, very fine grain-granules, subangular-subrounded, poorly sorted, amber chert, glauconitic, white clay filling, tight-poor visible porosity, brown oil stain, bright white gold fluorescence.
- 1.25' Sandstone. Gray, very fine grain-granules, subangular-subrounded, poorly sorted, amber chert, glauconitic, white clay filling, tight-good visible porosity, brown oil stain, bright white gold fluorescence.
- 6.75' Shale. Greenish gray, waxy (thickness of shale section estimated - core was badly brecciated).
- 10.00' Total recovery

CORE DESCRIPTIONS: (Continued).

Core #3 5274'-5297' V-7 Sand Cut 23', recovered 23'

- 5' Sandstone. Gray, very fine grain-fine grain, silty, trace medium grain, subangular-subrounded, moderate-well sorted, micaceous partings at top, gray shale partings (<1mm) near base, glauconitic, calcareous and siliceous cement in part, tight-fair visible porosity, brown oil stain, bright yellow white fluorescence.
- 1' Sandstone. White, very fine grain, trace medium grain, silty, subangular-subrounded, moderately sorted, trace micaceous, abundant white clay filling and white calcareous cement, gray shale partings (<1mm), Trace spotty gold fluorescence.
- 3' Sandstone. Very fine grain-granules, subangular-subrounded, poorly sorted, amber chert, interbedded clean and very calcareous and clay filled sand, clean sand is tight-good visible porosity, brown oil stain, bright yellow white fluorescence.
- 7' Sandstone. Very fine grain-granules, subangular-subrounded, poorly sorted, glauconitic, black chert and coal (?) grains, siliceous and calcareous in part, occasional gray shale partings (<1mm), tight-good visible porosity, brown oil stain, bright yellow white fluorescence.
- 1' Sandstone. White, fine grain-granules, subangular-subrounded, poorly sorted, amber chert, glauconitic, abundant white sparry calcite cement and white clay filling, tight, white gold fluorescence along fractures.
- 3' Sandstone, very fine grain-granules, subangular-subrounded, poorly sorted, white sparry calcareous cement in part, tight-excellent porosity, light brown-brown oil stain, bright yellow white fluorescence.
- 2' Shale. Greenish gray, waxy.
- 1' Shale. Greenish gray, waxy, interbedded with limestone, brown, mudstone, micritic, slightly argillaceous, pyritic, tight, no stain, fluorescence or cut.
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- 23' Total recovery

BIT RECORD:

<u>No.</u>	<u>Size</u>	<u>Make</u>	<u>Type</u>	<u>Depth Out</u>	<u>Feet</u>	<u>Hours</u>
1	12 1/4	STC	S44	665'	665	7
2	7 7/8	STC	F-17	3826'	3161	48 3/4
3	7 7/8	STC	F-17	4537'	711	32 1/4

BIT RECORD: (Continued)

<u>No.</u>	<u>Size</u>	<u>Make</u>	<u>Type</u>	<u>Depth Out</u>	<u>Feet</u>	<u>Hours</u>
4	7 7/8	STC	F-17	5252'	715	25 1/2
5	7 27/32	HOMCO	CT-300	5257'	5	1 1/2
6	7 27/32	HOMCO	CD-80	5267'	10	3
7	7 7/8	STC	F-17	5274'	7	1/2
8	7 27/32	HOMCO	CD-80	5297'	23	3 3/4
9	7 7/8	STC	F-17	5370'	77	4

SAMPLE DESCRIPTION:

30 foot samples were caught from base of surface casing to 4000'. 10 foot samples were caught from 4000' to total depth at 5370'. One foot drilling time was kept from 4000' to total depth. One dry cut was prepared of samples from 4000' to total depth and shipped to Union Pacific Resources Company in Ft. Worth, Texas for storage. Sample examination commenced at 4000' and continued to total depth. Samples were caught by crews and lagged by geologist. Sample depths reported herein are lagged depths.

- 4000'-4010' No sample caught until 4020'-4030' (lag depth 4010'-4020').
- 4010'-4020' Shale. Light gray, blocky, marly.
 Limestone. Gray, mudstone, micritic, argillaceous, microfossils, tight, no stain, fluorescence or cut.
 Shale. Dark gray, chippy-splintery, waxy in part.
- 4020'-4030' Shale. Dark gray, chippy-splintery, waxy in part.
 Limestone. Buff, mudstone-wackestone, micritic, slightly argillaceous, microfossils, tight, no stain, fluorescence or cut.
 Limestone. Buff-light brown, wackestone-packstone, fine grain, micritic matrix, oolites, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4030'-4040' Limestone. Buff-light brown, wackestone-packstone, fine grain, micritic matrix, oolites, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4040'-4050' Limestone. Buff-light brown, wackestone-packstone, fine grain, micritic matrix, oolites, microfossils, no visible porosity, no stain, fluorescence or cut.
 Shale. Shale. Gray, platy, silty in part, waxy in part.
- 4050'-4060' Limestone. Tan-grayish brown, mudstone, micritic, slightly argillaceous in part, tight, no stain, fluorescence or cut.
 Shale. Dark gray, platy-splintery.

- 4060'-4070' Shale. Dark gray, platy-splintery.
Limestone. Light brown, mudstone-wackestone, micritic, oolites, shell fragments, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4070'-4080' Limestone. Light brown, mudstone-wackestone, micritic, oolites, shell fragments, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4080'-4090' Limestone. Light brown, mudstone-wackestone, micritic, oolites, shell fragments, microfossils, no visible porosity, no stain, fluorescence or cut.
Shale. Gray-dark gray, trace black, chippy-splintery-blocky, silty in part, shell fragments in part.
Limestone. Light gray-light brown, mudstone-wackestone, micritic, shell fragments, no visible porosity, no stain, fluorescence or cut.
- 4090'-4100' Limestone. Light gray-light brown, mudstone-wackestone, micritic, shell fragments, no visible porosity, no stain, fluorescence or cut.
Shale. Gray-dark gray, splintery-platy-blocky.
Limestone. Light brown, mudstone-wackestone, micritic, shell fragments, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4100'-4110' Shale. Gray-dark gray, splintery-platy-blocky.
Limestone. Light gray, wackestone, micritic, slightly argillaceous, shell fragments, tight, no stain, fluorescence or cut.
- Top Shawnee 4112' (-19')
- 4110'-4120' Shale. Gray-dark gray, splintery-platy-blocky.
Limestone. Light brown-white, mudstone-wackestone, micritic, microfossils, tight, no stain, fluorescence or cut.
- 4120'-4130' Limestone. Light brown-white, mudstone-wackestone, micritic, microfossils, tight, no stain, fluorescence or cut.
- 4130'-4140' Shale. Gray, silty, chippy, dolomitic.
Dolomite. Buff, finely crystalline, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4140'-4150' Dolomite. Buff, finely crystalline, microfossils, no visible porosity, no stain, fluorescence or cut.
Limestone. Buff-light brown, mudstone-wackestone, micritic, dolomitic, microfossils, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Light brown, packstone, fine grain, dolomitic matrix, oolites, shell fragments, no visible porosity, no stain, fluorescence or cut.

- 4150'-4160' Limestone. Light brown, packstone, fine grain, dolomitic matrix, oolites, shell fragments, no visible porosity, no stain, fluorescence or cut.
Shale. Slate gray-dark gray, platy-splintery, microfossils.
No sample caught during displacement.
- 4160'-4170' No sample caught during displacement lag depths 4157'-4173'.
- 4170'-4180' No sample caught during displacement lag depths 4157'-4173'.
Dolomite. Light gray, microsucrosic-sucrosic, shell fragments, tight-good intercrystalline and fair vuggy porosity, light brown-brown oil stain, instant flashing streaming cut, bright yellow fluorescence, strong ring.
- 4180'-4190' Dolomite. Light gray, microsucrosic-sucrosic, shell fragments, tight-fair intercrystalline and poor vuggy porosity, light brown-brown oil stain, instant flashing streaming cut, bright yellow fluorescence, strong ring.
- 4190'-4200' Dolomite. Light gray, microsucrosic-sucrosic, shell fragments, tight-excellent intercrystalline and fair vuggy porosity, light brown-brown oil stain, instant flashing streaming cut, bright yellow fluorescence, strong ring.
Shale. Gray-dark gray, chippy-blocky, very calcareous in part, shell fragments.
- 4200'-4210' Shale. Gray-dark gray, chippy-blocky, very calcareous in part, shell fragments.
Shale. Gray-slate gray, blocky, laminated, silty.
- 4210'-4220' Shale. Gray-slate gray, blocky, laminated, silty.
Limestone. Brown-wackestone, micritic, shell fragments, no visible porosity, pyrite, no stain, fluorescence or cut.
- 4220'-4230' Limestone. Buff-light brown, mudstone-wackestone, micritic, slightly dolomitic, shell fragments, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4230'-4240' Limestone. Buff-light brown, mudstone-wackestone, micritic, slightly dolomitic, shell fragments, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4240'-4250' Shale. Gray-dark gray, chippy-flaky, laminated, pyrite in part.
Limestone. Light gray-light brown, mudstone, micritic, shell fragments, trace pyrite, tight, no stain, fluorescence or cut.

- 4250'-4260' Limestone. Light gray-light brown, mudstone, micritic, shell fragments, trace pyrite, tight, no stain, fluorescence or cut.
Shale. Gray-dark gray, chippy-blocky, slightly-very silty, calcareous in part.
- 4260'-4270' Shale. Gray-dark gray, chippy-blocky, slightly-very silty, calcareous in part.
Limestone. Brown, mudstone, micritic, shell fragments, tight, no stain, fluorescence or cut.
- 4270'-4280' Limestone. Light brownish gray, mudstone, micritic, shell fragments, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, chippy-splintery.
- 4280'-4290' Limestone. Light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, dolomitic in part, shell fragments, microfossils, tight-poor vuggy porosity, no stain, fluorescence or cut.
- 4290'-4300' Limestone. Light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, dolomitic in part, shell fragments, microfossils, tight-poor vuggy porosity, no stain, fluorescence or cut.

Top Heebner 4301' (-208')

- 4300'-4310' Shale. Dark gray-black, chippy-splintery, microfossils.
Limestone. Gray-brown, mudstone, micritic-microcrystalline, tight, no stain, fluorescence or cut.
- 4310'-4320' Limestone. Gray-brown, mudstone, micritic-microcrystalline, tight, no stain, fluorescence or cut.
Sandstone. Clear-light gray, very fine grain, siliceous, tight-fair porosity, no stain, fluorescence or cut.
Limestone. Brown, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
- 4320'-4330' Limestone. Light grayish brown, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
Shale. Gray, blocky, calcareous, microfossils.
- 4330'-4340' Limestone. Light grayish brown, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
Shale. Black, chippy, microfossils.
- 4340'-4350' Limestone. Tan, mudstone-wackestone, micritic, slightly dolomitic in part, shell fragments, tight, no stain, fluorescence or cut.
Shale. Gray, blocky, silty, calcareous.

Top Lansing 4356' (-263').

- 4350'-4360' Shale. Gray, blocky, silty, calcareous.
Limestone. Brown packstone, fine grain-medium grain, micritic matrix, very dolomitic, oolites, fair-good oomoldic and vuggy porosity, no stain, fluorescence or cut.
- 4360'-4370' Limestone. Brown packstone, fine grain-medium grain, micritic matrix, very dolomitic, oolites, fair-good oomoldic and vuggy porosity, no stain, fluorescence or cut.
Limestone. Buff-light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, dolomitic, oolites, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
- 4370'-4380' Limestone. Buff-light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, dolomitic, oolites, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
Limestone. Gray-light brown, mudstone, micritic, tight, no stain, fluorescence or cut.
- 4380'-4390' Limestone. Light gray-light brown, mudstone-wackestone, micritic, oolites, shell fragments, tight, no stain, fluorescence or cut.
- 4390'-4400' Limestone. Light gray-light brown, mudstone-wackestone, micritic, oolites, shell fragments, tight, no stain, fluorescence or cut.
Shale. Gray, blocky, laminated, very silty.
Limestone. Grayish brown-brown, mudstone, micritic, shell fragments, tight, no stain, fluorescence or cut.
- 4400'-4410' Limestone. Grayish brown-brown, mudstone, micritic, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Buff-light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, dolomitic, oolites, shell fragments, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
- 4410'-4420' Limestone. Buff-light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, dolomitic, oolites, shell fragments, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
Limestone. Buff-light grayish brown, mudstone-wackestone, micritic, shell fragments, gray chert, tight, no stain, fluorescence or cut.
- 4420'-4430' Limestone. Buff-light grayish brown, mudstone-wackestone, micritic, shell fragments, gray chert, tight, no stain, fluorescence or cut.
- 4430'-4440' Shale. Black, chippy.
Limestone. Buff-light brown, mudstone-wackestone, micritic, shell fragments, gray chert, tight, no stain, fluorescence or cut.

- 4440'-4450' Limestone. Buff-light gray, mudstone-wackestone, micritic, shell fragments, gray chert, tight, no stain, fluorescence or cut.
Shale. Slate gray-greenish gray, chippy-splintery, very silty in part.
- 4450'-4460' Limestone. Light brown, mudstone-wackestone, micritic, oolites, shell fragments, tight, no stain, fluorescence or cut.
- 4460'-4470' Limestone. Light brown-light grayish brown, mudstone-wackestone, micritic, oolites, shell fragments, tight, no stain, fluorescence or cut.
Shale. Gray-dark gray, splintery-blocky, silty in part.
- 4470'-4480' Shale. Gray-dark gray, splintery-blocky, silty in part.
Limestone. Light grayish brown, mudstone, micritic, shell fragments, trace oolites, microfossils, tight, no stain, fluorescence or cut.
- 4480'-4490' Limestone. Light grayish brown, mudstone, micritic, shell fragments, trace oolites, microfossils, tight, no stain, fluorescence or cut.
Shale. Gray-greenish gray, blocky, pyritic in part.
Limestone. Buff-grayish brown, mottled in part, mudstone-packstone, fine grain-medium grain, micritic matrix, shell fragments, oolites, tight, no stain, fluorescence or cut.
- 4490'-4500' Limestone. Buff-grayish brown, mottled in part, mudstone-packstone, fine grain-medium grain, micritic matrix, shell fragments, oolites, tight, no stain, fluorescence or cut.
- 4500'-4510' Limestone. Buff-light brown, mudstone, micritic, shell fragments, microfossils, tight, no stain, fluorescence or cut.
- 4510'-4520' No circulating samples before bit trip at 4537.
No sample lag depth 4508'-4537'
- 4520'-4530' No circulating samples before bit trip at 4537.
No sample lag depth 4508'-4537'
- 4530'-4540' No circulating samples before bit trip at 4537.
No sample lag depth 4530'-4537'
Limestone. Light brown, mudstone-wackestone, micritic, microfossils, shell fragments, tight, no stain, fluorescence or cut.
- 4540'-4550' Limestone. Light brown, mudstone-wackestone, micritic, microfossils, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Dark gray, chippy-splintery, calcareous in part, micritic, shell fragments, slightly dolomitic in part, tight, no stain, fluorescence or cut.

- 4550'-4560' Limestone. Dark gray, chippy-splintery, calcareous in part, micritic, shell fragments, slightly dolomitic in part, tight, no stain, fluorescence or cut.
- 4560'-4570' Limestone. Dark gray, chippy-splintery, calcareous in part, micritic, shell fragments, slightly dolomitic in part, tight, no stain, fluorescence or cut.
Shale. Dark gray-trace black, chippy-blocky.
- 4570'-4580' Limestone. Grayish brown-gray, mottled in part, mudstone, argillaceous, pyritic, shell fragments, tight, no stain, fluorescence or cut.
Dolomite. Very light gray-white, finely crystalline-microsugrosic, shell fragments, limy in part, tight-fair intercrystalline and vuggy porosity, no stain, fluorescence or cut.
- 4580'-4590' Dolomite. Very light gray-white, finely crystalline-microsugrosic, shell fragments, limy in part, tight-fair intercrystalline and vuggy porosity, no stain, fluorescence or cut.
Limestone. Light gray-light brownish gray, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
- 4590'-4600' Shale. Dark gray-black, chippy-blocky.
Limestone. Gray-grayish brown, mudstone, micritic, argillaceous, silty-sandy in part, pyritic, shell fragments, tight, no stain, fluorescence or cut.
- 4600'-4610' Limestone. Light brown-brown, mudstone, micritic, shell fragments, trace pyrite, tight, no stain, fluorescence or cut.
Sandstone. Light gray-buff, very fine grain-silty, dark lithic grains, very calcareous, no visible porosity, no stain, fluorescence or cut.
- 4610'-4620' Sandstone. Light gray-buff, very fine grain-silty, dark lithic grains, very calcareous, no visible porosity, no stain, fluorescence or cut.
Limestone. Tan, mudstone, micritic-microcrystalline, tight, no stain, fluorescence or cut.
- 4620'-4630' Dolomite. Buff, finely crystalline-microsugrosic, limy in part, oolites, shell fragments, tight-poor intercrystalline and vuggy porosity, no stain, fluorescence or cut.
Limestone. Buff-light brown, mudstone-wackestone, micritic, slightly dolomitic in part, oolites, tight, no stain, fluorescence or cut.
- 4630'-4640' Limestone. Gray-dark brown, mudstone, micritic, tight, no stain, fluorescence or cut.
Shale. Gray, platy-blocky, calcareous in part.

- 4640'-4650' Sandstone. Buff-light gray, very fine grain, salt and pepper, calcareous, tight, no stain, fluorescence or cut.
Limestone. Light gray-brownish gray, mudstone, micritic, slightly argillaceous, tight, no stain, fluorescence or cut.
- 4650'-4660' Limestone. Light gray-brownish gray, mudstone, micritic, slightly argillaceous, tight, no stain, fluorescence or cut.
Shale. Black, chippy-flaky, micaceous.
Shale. Dark gray, platy, very silty.
Limestone. Light brown-light gray, mudstone-wackestone, micritic, argillaceous, oolites, pyrite, occasional shale laminae, tight, no stain, fluorescence or cut.
- 4660'-4670' Limestone. Light brown-light gray, mudstone-wackestone, micritic, argillaceous, oolites, pyritic, occasional shale laminae, tight, no stain, fluorescence or cut.
Limestone. Grayish brown-brown, mudstone, micritic, slightly argillaceous, pyrite, shell fragments, tight, no stain, fluorescence or cut.
- 4670'-4680' Limestone. Grayish brown-brown, mudstone, micritic, slightly argillaceous, pyrite, shell fragments, tight, no stain, fluorescence or cut.
- 4680'-4690' Sandstone. Light gray, very fine grain-silty, salt and pepper, argillaceous, micaceous, tight, no stain, fluorescence or cut.
Limestone. Brown-gray, mudstone, micritic, very argillaceous in part, tight, no stain, fluorescence or cut.
Limestone. Light brown-grayish brown, mottled, wackestone-packstone, fine grain-medium grain, micritic, matrix, oolites, shell fragments, tight, no stain, fluorescence or cut.
- 4690'-4700' Limestone. Light brown-grayish brown, mottled, wackestone-packstone, fine grain-medium grain, micritic, matrix, oolites, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Grayish brown-dark gray, mudstone, micritic, very argillaceous in part, pyrite, tight, no stain, fluorescence or cut.
- 4700'-4710' Limestone. Buff-light brown, packstone, fine grain, dolomitic matrix, oolites, shell fragments, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
Shale. Gray-dark gray, blocky, laminated in part, very silty in part, calcareous.

Top Marmaton 4715' (-622')

- 4710'-4720' Sandstone. Gray, very fine grain-fine grain, very argillaceous, calcareous, tight, no stain, fluorescence or cut.
Shale. Gray-greenish gray, blocky.
Limestone. Brown, wackestone-packstone, micritic matrix, oolites, shell fragments, no visible porosity, no stain, fluorescence or cut.
- 4720'-4730' Limestone. Brown, wackestone-packstone, micritic matrix, oolites, shell fragments, no visible porosity, no stain, fluorescence or cut.
Limestone. Buff-light gray, mudstone, micritic, slightly-very dolomitic, shell fragments, tight, no stain, fluorescence or cut.
- 4730'-4740' Limestone. Gray, mudstone, micritic, argillaceous, pyritic, tight, no stain, fluorescence or cut.
Shale. Gray, splintery-platy, micaceous.
Dolomite. Gray, finely crystalline-microsugrosic, microfossils, no visible porosity, no stain, fluorescence or cut.
- 4740'-4750' Dolomite. Gray, finely crystalline-microsugrosic, microfossils, no visible porosity, no stain, fluorescence or cut.
Limestone. Brownish gray, mudstone, micritic, slightly argillaceous, tight, no stain, fluorescence or cut.
Shale. Gray-green, interbedded, platy, silty.
- 4750'-4760' Dolomite. Buff-light brown, finely crystalline-microsugrosic, shell fragments, no visible porosity, no stain, fluorescence or cut.
Limestone. Brown, wackestone, micritic, slightly dolomitic, oolites, tight, no stain, fluorescence or cut.
- 4760'-4770' Limestone. Grayish brown, mudstone-wackestone, micritic, abundant milky white chert, oolites, shell fragments, tight, no stain, fluorescence or cut.
Sandstone. Gray-pale greenish gray, very fine grain-fine grain, salt and pepper, very calcareous, clay filled in part, tight, no stain, fluorescence or cut.
- 4770'-4780' Limestone. Light gray-tan, mudstone-wackestone, micritic, dolomitic in part, shell fragments, abundant gray chert, tight, no stain, fluorescence or cut.
Shale. Dark chocolate brown-dark gray-black, chippy-splintery.
- 4780'-4790' Dolomite. Light brown-brown, finely crystalline, oolites, shell fragments, no visible porosity, no stain, fluorescence or cut.
Limestone. Grayish brown-dark brownish gray, wackestone, micritic, argillaceous, shell fragments, tight, no stain, fluorescence or cut.

- 4790'-4800' Limestone. Gray-dark gray, mudstone, micritic, very argillaceous, pyritic, tight, no stain, fluorescence or cut.
Limestone. Brownish gray, mudstone, micritic, shell fragments, abundant gray chert, tight, no stain, fluorescence or cut.
- 4800'-4810' Limestone. Brownish gray, mudstone, micritic, shell fragments, abundant gray chert, tight, no stain, fluorescence or cut.
Limestone. Dark brown-gray-dark gray, mudstone, micritic, very argillaceous, tight, no stain, fluorescence or cut.
Shale. Gray-dark gray, chippy-platy, micaceous in part.
- 4810'-4820' Limestone. Brown-gray, mudstone, micritic, slightly-very argillaceous, shell fragments, chert, pyrite, tight, no stain, fluorescence or cut.
Limestone. Grayish brown, mudstone, micritic, slightly dolomitic, oolites, shell fragments, tight, no stain, fluorescence or cut.
- 4820'-4830' Limestone. Grayish brown, mudstone, micritic, slightly dolomitic, oolites, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Brown, packstone, fine grain-medium grain, micritic matrix, very dolomitic, oolites, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
Limestone. Brown-dark brown, mudstone, micritic, slightly argillaceous, tight, no stain, fluorescence or cut.
- 4830'-4840' Limestone. Brown-dark brown, mudstone, micritic, slightly argillaceous, tight, no stain, fluorescence or cut.
- 4840'-4850' Limestone. Brown-dark brown, mudstone, micritic-microcrystalline, trace pyrite, slightly argillaceous, tight, no stain, fluorescence or cut.
- 4850'-4860' Limestone. Brown-dark brown-grayish brown, mudstone, micritic-microcrystalline, trace pyrite, slightly argillaceous, trace light gray chert, tight, no stain, fluorescence or cut.
- 4860'-4870' Limestone. Brown-dark brown-grayish brown, mudstone, micritic-microcrystalline, trace pyrite, slightly argillaceous, trace light gray chert, tight, no stain, fluorescence or cut.
Limestone. Gray-dark brownish gray, mudstone, micritic, argillaceous, dark gray-black chert, tight, no stain, fluorescence or cut.
- 4870'-4880' Limestone. Dark brown-dark gray, mudstone, micritic, very argillaceous, dark gray-black chert, tight, no stain, fluorescence or cut.
Shale. Gray-dark gray, chippy, calcareous.

Top Cherokee 4884' (-791')

- 4880'-4890' Limestone. Dark brown-dark gray, mudstone, micritic, very argillaceous, dark gray-black chert, tight, no stain, fluorescence or cut.
Shale. Black, chippy, laminated, pyritic.
Limestone. Light gray-light brown, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
- 4890'-4900' Limestone. Light gray-light brown, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
- 4900'-4910' Limestone. Light gray-light brown, mudstone-wackestone, micritic, shell fragments, tight, no stain, fluorescence or cut.
Shale. Black, chippy, laminated.
Limestone. Gray, wackestone-packstone, fine grain, micritic matrix, slightly argillaceous, shell fragments, tight, no stain, fluorescence or cut.
- 4910'-4920' Limestone. Gray, wackestone-packstone, fine grain, micritic matrix, slightly argillaceous, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Brown, packstone, fine grain-medium grain, micritic matrix, very dolomitic, oolites, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
- 4920'-4930' Limestone. Brown, packstone, fine grain-medium grain, micritic matrix, very dolomitic, oolites, tight-fair oomoldic and vuggy porosity, no stain, fluorescence or cut.
Limestone. Gray-dark gray, mudstone, micritic, very argillaceous, dark gray chert, tight, no stain, fluorescence or cut.
- 4930'-4940' Shale. Greenish gray-dark gray, chippy-platy.
Limestone. Gray, wackestone-packstone, fine grain, micritic, argillaceous, shell fragments, tight, no stain, fluorescence or cut.
- 4940'-4950' Limestone. Gray, wackestone-packstone, fine grain, micritic, argillaceous, shell fragments, tight, no stain, fluorescence or cut.
Shale. Black, chippy.
Limestone. Brown-dark brown, mudstone, micritic, argillaceous, brown chert, tight, no stain, fluorescence or cut.
- 4950'-4960' Limestone. Brown-dark brown, mudstone, micritic, argillaceous, brown chert, tight, no stain, fluorescence or cut.
Limestone. Gray-brownish gray, mudstone, micritic, very argillaceous in part, trace pyrite, tight, no stain, fluorescence or cut.

- 4960'-4970' Limestone. Brown, mudstone, micritic, trace shell fragments, tight, no stain, fluorescence or cut.
Limestone. Buff-light gray, mudstone, micritic, argillaceous in part, dolomitic, micaceous, shell fragments, tight, no stain, fluorescence or cut.
- 4970'-4980' Limestone. Brown, mudstone, microcrystalline, brown chert, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, laminated, chippy.
Limestone. Gray-dark gray, mudstone-wackestone, micritic, slightly argillaceous, shell fragments, tight, no stain, fluorescence or cut.
- 4980'-4990' Limestone. Gray-dark gray, mudstone-wackestone, micritic, slightly argillaceous, shell fragments, tight, no stain, fluorescence or cut.
Shale. Black, chippy-splintery.
- 4990'-5000' Shale. Black, chippy-splintery.
Limestone. Light brown, wackestone-packstone, fine grain-medium grain, micritic matrix, oolites, shell fragments, no visible porosity, no stain, fluorescence or cut.
Shale. Dark gray, splintery-platy.
- 5000'-5010' Limestone. Buff-gray, mudstone, micritic-microcrystalline, shell fragments, tight, no stain, fluorescence or cut.
- 5010'-5020' Limestone. Gray, mudstone, micritic, very argillaceous, dolomitic, micaceous in part, tight, no stain, fluorescence or cut.
Limestone. Grayish brown-dark grayish brown, mudstone-wackestone, argillaceous in part, oolites, shell fragments, trace pyrite, tight, no stain, fluorescence or cut.
- 5020'-5030' Limestone. Grayish brown-dark grayish brown-dark gray, mudstone-wackestone, argillaceous in part, oolites, shell fragments, trace pyrite, tight, no stain, fluorescence or cut.
- 5030'-5040' Limestone. Grayish brown-dark grayish brown-dark gray, mudstone-wackestone, argillaceous in part, oolites, shell fragments, trace pyrite, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, splintery-chippy, pyritic.
- Top Atoka 5041' (-948')
- 5040'-5050' Limestone. Dark brown-dark gray, mudstone, micritic, argillaceous, dark brown chert, tight, no stain, fluorescence or cut.
Shale. Greenish gray-dark gray, platy, waxy in part.

- 5050'-5060' Limestone. Dark brown-dark gray, mudstone, micritic, argillaceous, dark brown chert, tight, no stain, fluorescence or cut.
Shale. Black, flaky-chippy, trace pyrite.
Limestone. Gray-greenish gray, mudstone, micritic, very argillaceous, dolomitic, shell fragments, micaceous in part, tight, no stain, fluorescence or cut.
- 5060'-5070' Limestone. Light grayish brown-brown, mudstone-wackestone, micritic-microcrystalline, shell fragments, tight, no stain, fluorescence or cut.
- 5070'-5080' Limestone. Grayish brown-gray, very argillaceous, mudstone-wackestone, micritic-microcrystalline, shell fragments, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, flaky-splintery.
Dolomite. Buff, finely crystalline, very silty-sandy, tight, no stain, fluorescence or cut.
Sandstone. Gray, salt and pepper, fine grain-medium grain, clay filled, calcareous chert grains, tight, no stain, fluorescence or cut.
- 5080'-5090' Limestone. Gray-dark gray, mudstone, micritic, very argillaceous, shell fragments, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, splintery-flaky, shell fragments.
Limestone. Gray-dark gray, mudstone, micritic, dolomitic in part, very argillaceous, pyrite, shell fragments, tight, no stain, fluorescence or cut.
- 5090'-5100' Limestone. Gray-dark gray, mudstone, micritic, dolomitic in part, very argillaceous, pyrite, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Light brown, packstone, medium grain, micritic matrix, shell fragments, oolites, no visible porosity, no stain, fluorescence or cut.
- 5100'-5110' Limestone. Dark gray, mudstone, micritic, very argillaceous, pyritic, tight, no stain, fluorescence or cut.
Limestone. Brownish gray, mudstone, micritic, shell fragments, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, chippy.
- 5110'-5120' Limestone. Light gray-light brown, mudstone-wackestone, micritic, very dolomitic in part, shell fragments, brown chert, tight, no stain, fluorescence or cut.
Limestone. Dark brown-dark gray, mottled, mudstone, micritic, very argillaceous, shell fragments, tight, no stain, fluorescence or cut.

- 5120'-5130' Limestone. Dark brown-dark gray, mottled, mudstone, micritic, very argillaceous, shell fragments, tight, no stain, fluorescence or cut. Shale. Dark gray-black, chippy, very calcareous in part.
- 5130'-5140' Limestone. Grayish brown-light brown, wackestone-packstone, fine grain, micritic matrix, dolomitic, shell fragments, tight, no stain, fluorescence or cut.
- 5140'-5150' Limestone. Grayish brown-light brown, wackestone-packstone, fine grain, micritic matrix, dolomitic, shell fragments, tight, no stain, fluorescence or cut.
Limestone. Light brown-brown, mudstone-wackestone, dolomitic, micritic, shell fragments, pyrite, tight, no stain, fluorescence or cut.
- 5150'-5160' Limestone. Light grayish brown-light brown, mudstone-wackestone, micritic, shell fragments, oolites, tight, no stain, fluorescence or cut.
- 5160'-5170' Limestone. Dark brown-dark gray, mudstone, micritic, very argillaceous, tight, no stain, fluorescence or cut.
Shale. Dark gray, splintery-flaky.

Top Morrow 5174' (-1081')

- 5170'-5180' Limestone. Dark brown-dark gray, mudstone, micritic, very argillaceous, tight, no stain, fluorescence or cut.
Shale. Dark gray-black, splintery-platy, very micaceous.
- 5180'-5190' Shale. Dark gray-black, splintery-platy, very micaceous.
Limestone. Light gray-light brown-grayish green, mudstone, micritic, very argillaceous, very silty in part, microfossils, tight, no stain, fluorescence or cut.
- 5190'-5200' Limestone. Light gray-light brown-grayish green, mudstone, micritic, very argillaceous, very silty in part, microfossils, tight, no stain, fluorescence or cut.
Sandstone. Gray-greenish gray, very fine grain-silty, very clay filled, calcareous in part.
Shale. Black, silty, abundant pyrite.
- 5200'-5210' Shale. Gray-greenish gray, splintery-platy, waxy in part.
Shale. Dark gray, splintery.
Shale. Dark gray-gray-black, very calcareous in part.
- 5210'-5220' Limestone. Brown, packstone, fine grain, shell fragments, oolites, tight, no stain, fluorescence or cut.
Shale. Gray, splintery-flaky.

Top V-7 Sand 5220' (-1127')

- 5220'-5230' Sandstone. White, very fine grain-fine grain, trace medium grain, subangular-subrounded, well sorted, glauconitic, amber chert, trace calcareous cement, tight-fair visible porosity, no stain, fluorescence or cut.
Shale. Gray-greenish gray-brownish gray, very silty in part, laminated in part.
- 5230'-5240' Shale. Gray-greenish gray-brownish gray, very silty in part, laminated in part.

Top V-5? Sand 5247' (-1154')

- 5240'-5250' Shale. Gray-greenish gray-brownish gray, very silty in part, laminated in part.
Sandstone. Gray, very fine grain-coarse grain, trace granules, subangular-subrounded, poorly sorted in part, glauconite, siliceous-calcareous cement, amber chert, tight-good visible porosity, brown oil stain, bright yellow white fluorescence.
- 5250'-5260' Sandstone. Gray, very fine grain-coarse grain, trace granules, subangular-subrounded, poorly sorted in part, glauconite, siliceous-calcareous cement, amber chert, tight-good visible porosity, brown oil stain, bright yellow white fluorescence.
- 5260'-5270' Shale. Greenish gray, waxy.

Top V-7 Sand 5272' (-1179')

- 5270'-5280' Shale. Greenish gray, waxy.
Sandstone. Gray, very fine grain-granules, subangular-subrounded, well-poorly sorted, glauconite, amber chert, trace pyrite, white clay filling in part, sparry white calcite cement in part, light brown-brown oil stain, tight-excellent visible porosity, bright yellow-white fluorescence.
- 5280'-5290' Sandstone. Gray, very fine grain-granules, subangular-subrounded, well-poorly sorted, glauconite, amber chert, trace pyrite, white clay filling in part, sparry white calcite cement in part, light brown-brown oil stain, tight-excellent visible porosity, bright yellow-white fluorescence.

Top Lower Morrow 5297' (-1204')

- 5290'-5300' Sandstone. Gray, very fine grain-granules, subangular-subrounded, well-poorly sorted, glauconite, amber chert, trace pyrite, white clay filling in part, sparry white calcite cement in part, light brown-brown oil stain, tight-excellent visible porosity, bright yellow-white fluorescence.
Shale. Greenish gray, waxy.
Limestone. Brown, mudstone-packstone, coarse grain, micritic matrix, slightly dolomitic, oolites, shell fragments, tight, no stain, fluorescence or cut.
- 5300'-5310' Limestone. Brown, mudstone-packstone, coarse grain, micritic matrix, slightly dolomitic, oolites, shell fragments, tight, no stain, fluorescence or cut.
- 5310'-5320' Shale. Dark greenish gray, splintery, waxy.
Limestone. Tan, packstone, coarse grain, dolomitic matrix, shell fragments, no visible porosity, no stain, fluorescence or cut.
- 5320'-5330' Limestone. Tan, packstone, coarse grain, dolomitic matrix, shell fragments, no visible porosity, no stain, fluorescence or cut.
Shale. Greenish gray, blocky, waxy.
Shale. Dark greenish gray, splintery.
Sandstone. Gray, very fine grain-fine grain, very siliceous in part, very silty in part, tight-poor visible porosity, no stain, fluorescence or cut.
- 5330'-5340' Sandstone. Gray, very fine grain-fine grain, very siliceous in part, very silty in part, tight-poor visible porosity, no stain, fluorescence or cut.
Limestone. Light brown, packstone, coarse grain, dolomitic matrix, shell fragments, no visible porosity, no stain, fluorescence or cut.
Limestone. Gray-brown, mudstone, micritic, shell fragments, pyrite, tight, no stain, fluorescence or cut.
- 5340'-5350' Limestone. Gray-brown, mudstone, micritic, shell fragments, pyrite, slightly dolomitic, argillaceous in part, tight, no stain, fluorescence or cut.
Limestone. Brown-buff, packstone, medium grain, micritic matrix, shell fragments, oolites, tight, no stain, fluorescence or cut.
- 5350'-5360' Limestone. Brown-buff, packstone, medium grain, micritic matrix, shell fragments, oolites, tight, no stain, fluorescence or cut.
Limestone. Light gray-light brown, very sandy (chert), shell fragments, micritic matrix, pyrite, tight, no stain, fluorescence or cut.

5360'-5370' Limestone. Light gray-light brown, very sandy (chert), shell fragments, micritic matrix, pyrite, tight, no stain, fluorescence or cut.
Limestone. Tan-light grayish brown, packstone, medium grain-coarse grain, micritic matrix, shell fragments, tight, no stain, fluorescence or cut.

REMARKS AND RECOMMENDATIONS:

Excellent visible porosity with strong shows of hydrocarbons were encountered in sample examination of the Shawnee, the V-5 Sand and the V-7 sand. All three of these zones deserve further evaluation, either by DST or by perforations through casing.

Respectfully submitted,

John D. Pruitt / slo
John D. Pruitt

JDP:slo