

W110 1857

N.F. -  
PY

## Wellsite Geological Report

on

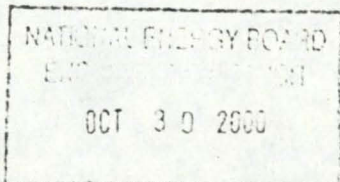
Paramount Berkley Arrowhead C-02  
60° 40' 123° 00'

for

**Paramount Resources Ltd.**

Prepared by:

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C.L. Bredin Holdings Ltd.  
1-780-621-1276



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## Casing Data Summary

Storage Units:

Metric

**Casing Type:** Surface

**Casing Size:** 339.7

**Hole Size:** 444.5

**Casing Landed @:** 504.00

**Total Joints:** 38

**Casing Date:** Mar 20, 1999 @ 09:45

**Plug Down Date:** Mar 20, 1999 @ 13:16

**# of Joints / Length / O.D. / Weight:** Ran 37 Joints ( 505.1m ) of 339.7mm 81.1kg/m Lonestar K-55 8rnd ST&C

**Cementing Details:** Flushed with 3m3 water, Cement with 52 tonnes (39.6m3) 0-1-0 G & 1% CaCl2.

**Remarks:** 7m3 returns

# Wireline Logging Summary

Storage Units:

Metric

Logging Suite Number: 1  
Wireline Logging Company: Baker Atlas  
District: Grande Prairie  
Witness: Colin Bredin

Engineer: Khafizov / Spelay  
Unit Number: HL 6544

Was Pressure Control Equipment Utilized:  
Was the Logging Job Mechanically Assisted:

Maximum Deviation: 1.300°  
Hole Size: 311.0

Total Lost Time: 2.00  
Loggers' Total Down Time:  
Total Job Time (From Rig up to Rig down): 8.00

	Measured Depth	True Vertical Depth
Casing Depth Driller	504.00	504.00
Casing Depth Logger	503.20	503.20
Total Depth Driller (Tally)	694.00	694.00
Total Depth Driller (Strap or SLM)	504.00	

General Remarks: Loggers left location without presenting field prints to geologist for inspection. The sonic log was not logged as requested.

Logging Run #: 1  
Date: Mar 24, 1999

## Drilling Fluid Data

Drilling Fluid Type: Invert  
Fluid Density: 985      Viscosity: 50      pH:      Fluid Loss:

Mud Resistivity (Rm): @ °  
Mud Resistivity (Rm) @ BHT: @ °      Maximum Temperature: 42.6°  
Mud Filtrate Resistivity (Rmf): @ °      Source (Rmf):  
Mud Cake Resistivity (Rmc): @ °      Source (Rmc):

## Logging Run Information

Date on Bottom: Mar 24, 1999  
Total Depth Logger: 692.20 (MD)      692.20 (TVD)

Logging Tools: HDIL - GR from 688.3m to 503.2m  
ZDL-CNL-GR-XYCAL from 682m to Surface

Remarks: No problems

Hole Conditions: Good



## Wireline Logging Summary

Storage Units:

Metric

Logging Run #: 2  
Date: Mar 24, 1999

### Drilling Fluid Data

Drilling Fluid Type: Invert  
Fluid Density: 985      Viscosity: 50      pH:      Fluid Loss:

Mud Resistivity (Rm): @ °  
Mud Resistivity (Rm) @ BHT: @ °  
Mud Filtrate Resistivity (Rmf): @ °  
Mud Cake Resistivity (Rmc): @ °  
Maximum Temperature: °  
Source (Rmf):  
Source (Rmc):

### Logging Run Information

Date on Bottom: Mar 24, 1999  
Total Depth Logger: 692.20 (MD) (TVD)

Logging Tools: MAC-GR-CAL tool failed

Remarks: Unable to log, no backup available.

Hole Conditions: Good

Logging Run #: 3  
Date: Mar 24, 1999

### Drilling Fluid Data

Drilling Fluid Type: Invert  
Fluid Density: 985      Viscosity: 50      pH:      Fluid Loss:

Mud Resistivity (Rm): @ °  
Mud Resistivity (Rm) @ BHT: @ °  
Mud Filtrate Resistivity (Rmf): @ °  
Mud Cake Resistivity (Rmc): @ °  
Maximum Temperature: °  
Source (Rmf):  
Source (Rmc):

### Logging Run Information

Date on Bottom: Mar 25, 1999  
Total Depth Logger: 692.40 (MD) 692.40 (TVD)

Logging Tools: DAL-GR-CAL from 688.3m to 503.2m

Remarks: Sonic was not pulled through casing to surface as requested. Loggers left location without presenting field logs to geologist.

Hole Conditions: Good

Paramount Resources Ltd.  
UWI 300C026040123000  
Mar 25, 1999

Para et al Arrowhead C-02  
60 40' 123 00'  
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# Deviation Survey Points

Storage Units Metric

Survey Type: /

Measured Depth	Drift Angle (°)	Azimuth (°)	Measured Depth	Drift Angle (°)	Azimuth (°)
52.00	0.125				
100.00	1.000				
130.00	0.500				
175.00	0.750				
212.00					
260.00	0.875				
310.00	0.500				
348.00	1.000				
376.00					
385.00	1.000				
415.00	1.000				
444.00	0.750				
472.00	1.000				
500.00	0.750				
550.00	0.750				
598.00	1.250				
635.00	1.000				
674.00	1.250				

## Drilling Fluid Summary

Storage Units:

Metric

Drilling Fluid Type: Water based Gel Mud

From:

0

To:

504

Drilling Fluid Type: Invert

From:

504

To:

694

## Formation Top Summary

Store Units

Metric

Kelly Bushing Elevation:

454.10

Casing Flange Elevation:

Ground Elevation:

447.20

**\*\* All Depths measured from Kelly Bushing Elevation \*\***

Group Formation Member	Prognosis (TVD)	Sample Top (MD)	Sample Top (TVD)	Log Top (MD)	Log Top (TVD)	Subsea	Thickness
Ft. St. John <i>Scatter</i>	457.00	450.00	450.00	449.00	449.00	5.10	60.00
Ft. St. John <i>Garbutt</i>	518.00	510.00	510.00	509.00	509.00	-54.90	94.80
Ft. St. John <i>Chinkeh</i>	618.00	605.50	605.50	603.80	603.80	-149.70	44.70
<i>Flett</i>	641.00	649.50	649.50	648.50	648.50	-194.40	



**Formation Evaluations**

Storage Units:

Metric

Kelly Bushing Elevation: 454.10

Casing Flange Elevation:

Ground Elevation: 447.20

**All Depths Measured from Kelly Bushing Elevation**

Group: Ft. St. John  
Formation: Scatter  
Member:  
Boundary Type: conformable  
Fault Type:

Era: Mesozoic  
Series: lower  
Period: Cretaceous  
Stage:  
Age (Approx): Million years.

	Measured Depth	True Vertical Depth	Subsea	Thickness
Sample Top	450.00	450.00	4.10	60.00
Log Top	449.00	449.00	5.10	60.00

**Evaluation:**

Upper Scatter is interbedded SHALE and SANDSTONE light gray, light brown, salt and pepper, very fine to fine grained, subangular to subround, well sorted, firm to very friable, calcareous cement, siliceous in part, speckled glauconitic, patchy oil stain, no dry, fair streaming wet cut fluorescence, scattered intergranular porosity 12-14%, no significant gas effect. Lower Scatter is interbedded SHALE and SANDSTONE light gray, light to medium brown, salt and pepper, very fine to fine grained, subangular to subround, medium to well sorted, friable, siliceous cement, argillaceous to very argillaceous in part, speckled glauconitic, patchy oil stain, streaming wet cut fluorescence, no visible porosity.

**Conclusion:**

Reservoir potential but no apparent gas. Looks wet.

Group: Ft. St. John  
Formation: Garbutt  
Member:  
Boundary Type: conformable  
Fault Type:

Era: Mesozoic  
Series: lower  
Period: Cretaceous  
Stage:  
Age (Approx): Million years.

	Measured Depth	True Vertical Depth	Subsea	Thickness
Sample Top	510.00	510.00	-55.90	95.50
Log Top	509.00	509.00	-54.90	94.80

**Evaluation:**

The Garbutt is predominately SHALE medium gray, medium gray silty, fissile, platy to blocky.

**Conclusion:**

No reservoir potential.

## Formation Evaluations

Storage Unit:

Matrix

Kelly Bushing Elevation: 454.10  
Ground Elevation: 447.20

Casing Flange Elevation:

*All Depths Measured from Kelly Bushing Elevation*

Group: Ft. St. John  
Formation: Chinkeh  
Member:  
Boundary Type: conformable  
Fault Type:

Era: Mesozoic  
Series: lower  
Period: Cretaceous  
Stage:  
Age (Approx): Million years.

	Measured Depth	True Vertical Depth	Subsea	Thickness
Sample Top	605.50	605.50	-151.40	44.00
Log Top	603.80	603.80	-149.70	44.70

### Evaluation:

Upper Chinkeh is SANDSTONE light to medium brown, salt and pepper, predominately quartz, very fine to medium grained, subangular to subround, medium to well sorted, firm to friable, siliceous cement, slightly argillaceous in part, trace of clay infilling, predominately well indurated, patchy oil stain, no fluorescence, scattered intergranular porosity 12 to 14%, very weak gas effect. Middle Chinkeh is Interbedded SILTSTONE, COAL and SANDSTONE light to medium brown, salt and pepper, silty to very fine grained, subangular to subround, medium sorted, very argillaceous in part, firm, siliceous cement, very patchy oil stain, no fluorescence, no visible porosity, minor coal gas. Lower Chinkeh is a SANDSTONE light gray, salt and pepper, fine to medium grained, subangular to subround, medium to well sorted, very friable to poorly consolidated, clayey in part, no stain, no fluorescence, intergranular porosity 15 to 18%, looks wet. Basal Chinkeh ( Fantasque ? ) is predominately CHERT clear, white, light brown, dark brown, dark blue gray variegated, massive, high torque while drilling may suggest fracturing, no apparent gas effect.

### Conclusion:

Upper Chinkeh has reservoir potential.

Group:  
Formation: Flett  
Member:  
Boundary Type: unconformable  
Fault Type:

Era: Paleozoic  
Series: upper  
Period: Mississippian  
Stage:  
Age (Approx): Million years.

	Measured Depth	True Vertical Depth	Subsea	Thickness
Sample Top	649.50	649.50	-195.40	
Log Top	648.50	648.50	-194.40	

### Evaluation:

Flett is predominately a LIMESTONE light gray white, medium gray argillaceous, mottled medium to dark brown, cryptocrystalline, mudstone, tight, trace of pellets and crinoid plates, minor dark brown CHERT laminae, common SHALE thinbeds

### Conclusion:

No reservoir potential to this point.

**Sample Descriptions**

Storage Units

Metric

10.00 to 15.00 (5.00)	100% CEMENT Oilfield cement
	100% TILL glacial drift, sand and clay with occasional cobblestones
15.00 to 20.00 (5.00)	100% TILL as above
20.00 to 25.00 (5.00)	100% TILL glacial drift, sand and clay with occasional cobblestones
25.00 to 30.00 (5.00)	100% TILL as above
30.00 to 35.00 (5.00)	100% TILL glacial drift, sand and clay with occasional cobblestones
35.00 to 40.00 (5.00)	100% TILL as above
40.00 to 45.00 (5.00)	100% TILL glacial drift, sand and clay with occasional cobblestones
45.00 to 50.00 (5.00)	100% TILL as above
50.00 to 55.00 (5.00)	100% TILL glacial drift, sand and clay with occasional cobblestones
55.00 to 60.00 (5.00)	100% TILL as above
60.00 to 65.00 (5.00)	100% TILL glacial drift, sand and clay with occasional cobblestones
65.00 to 70.00 (5.00)	100% TILL as above
70.00 to 75.00 (5.00)	50% SHALE medium gray, light to medium gray, subfissile to fissile, platy
	50% TILL glacial drift, sand and clay with occasional cobblestones
75.00 to 80.00 (5.00)	100% SHALE medium gray, dark gray, minor light brown, subfissile to fissile, platy
80.00 to 85.00 (5.00)	100% SHALE medium gray, dark gray, minor medium brown sideritic, fissile, platy
85.00 to 90.00 (5.00)	100% SHALE as above, abundant sand cavings

**Sample Descriptions****Storage Units****Metric**

90.00 to 95.00 (5.00)	100% <b>SHALE</b> as above, common cavings
95.00 to 100.00 (5.00)	100% <b>SHALE</b> medium to dark gray, medium gray, medium gray silty, fissile, platy to blocky
100.00 to 105.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray very silty, sandy in part, fissile, blocky, common disseminated pyrite
105.00 to 110.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, trace of disseminated pyrite, fissile, platy to blocky
110.00 to 115.00 (5.00)	100% <b>SHALE</b> as above
115.00 to 120.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray brown, fissile, platy to blocky
120.00 to 125.00 (5.00)	100% <b>SHALE</b> as above
125.00 to 130.00 (5.00)	-1% <b>NO SAMPLE</b>
130.00 to 135.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, silty in part, fissile, platy to blocky
135.00 to 140.00 (5.00)	100% <b>SHALE</b> as above
140.00 to 145.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, silty in part, fissile, platy to blocky
145.00 to 150.00 (5.00)	100% <b>SHALE</b> as above
150.00 to 155.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, platy to blocky, minor SILTSTONE dark brown, argillaceous, sideritic
155.00 to 160.00 (5.00)	100% <b>SHALE</b> as above
160.00 to 165.00 (5.00)	60% <b>SANDSTONE</b> light gray, medium gray, salt and pepper, silty to fine grained, subangular to subround, medium sorted, friable, calcite cement, clay infilling, speckled glauconitic, slightly argillaceous, no stain, no fluorescence, no visible porosity
	40% <b>SHALE</b> as above
165.00 to 170.00 (5.00)	50% <b>SANDSTONE</b> as above, sideritic in part

**Sample Descriptions**

Storage Units

Metric

165.00 to 170.00 (5.00)	50% <b>SHALE</b> medium gray, medium gray brown, silty, fissile, platy to blocky
170.00 to 175.00 (5.00)	80% <b>SANDSTONE</b> light gray, salt and pepper, silty to very fine grained, subangular to subround, well sorted, firm to friable, argillaceous in part, speckled glauconitic, calcite cement, clay infilling in part, no stain, no fluorescence, patchy intergranular porosity 6-8%
	20% <b>SHALE</b> as above
175.00 to 180.00 (5.00)	50% <b>SANDSTONE</b> as above
	50% <b>SHALE</b> medium gray, medium gray silty, sandy in part, fissile, blocky to platy
180.00 to 185.00 (5.00)	50% <b>SANDSTONE</b> as above, very argillaceous in part
	50% <b>SHALE</b> as above
185.00 to 190.00 (5.00)	100% <b>SANDSTONE</b> light gray, salt and pepper, silty to very fine grained, subangular to subround, well sorted, very friable to poorly consolidated, light calcite cement, argillaceous in part, speckled glauconitic, no stain, no fluorescence, intergranular porosity to 20%, minor SHALE as above
190.00 to 195.00 (5.00)	100% <b>SANDSTONE</b> as above
195.00 to 200.00 (5.00)	50% <b>SANDSTONE</b> as above, abundant cavings
	50% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
200.00 to 205.00 (5.00)	90% <b>SANDSTONE</b> light gray, salt and pepper, predominately quartz, silty to very fine grained, subangular to subround, well sorted, very friable, light siliceous cement, slightly calcareous in part, minor speckled glauconitic, no stain, no fluorescence, scattered intergranular porosity to 15%
	10% <b>SHALE</b> as above
205.00 to 210.00 (5.00)	100% <b>SANDSTONE</b> as above
210.00 to 215.00 (5.00)	100% <b>SANDSTONE</b> light gray, salt and pepper, predominately quartz, silty to very fine grained, subangular to subround, well sorted, very friable, light siliceous cement, slightly calcareous, speckled glauconitic, no stain, no fluorescence, scattered intergranular



## Sample Descriptions

Storage Units:

Metric

porosity to 15%

215.00 to 220.00 (5.00)	100% <b>SANDSTONE</b> as above
220.00 to 225.00 (5.00)	90% <b>SANDSTONE</b> light gray, salt and pepper, predominately quartz, silty to very fine grained, subangular to subround, well sorted, slightly argillaceous, very friable to poorly consolidated, slightly calcareous, light siliceous cement, speckled glauconitic in part, no stain, no fluorescence, scattered intergranular porosity 8-10%
	10% <b>SHALE</b> as above
225.00 to 230.00 (5.00)	80% <b>SANDSTONE</b> as above
	20% <b>SHALE</b> medium gray, medium gray silty, sandy in part, fissile, platy to blocky, trace medium brown sideritic
230.00 to 235.00 (5.00)	100% <b>SANDSTONE</b> as above
235.00 to 240.00 (5.00)	70% <b>SANDSTONE</b> light gray, salt and pepper, silty to very fine grained, subangular to subround, well sorted, very friable, slightly argillaceous, calcareous in part, light siliceous cement, speckled glauconitic, no stain, no fluorescence, scattered intergranular porosity 6-8%
	30% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
240.00 to 245.00 (5.00)	90% <b>SANDSTONE</b> as above
	10% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky
245.00 to 250.00 (5.00)	80% <b>SANDSTONE</b> light gray, light to medium gray argillaceous, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, very friable, slightly calcareous, light siliceous cement, speckled glauconitic, no stain, no fluorescence, scattered intergranular porosity 6-8%
	20% <b>SHALE</b> medium gray, medium gray silty, medium brown, fissile, blocky
250.00 to 255.00 (5.00)	60% <b>SANDSTONE</b> as above
	60% <b>SHALE</b> as above

## Sample Descriptions

Storage Units:

Metric

255.00 to 260.00 (5.00)	60% <b>SHALE</b> as above
	40% <b>SANDSTONE</b> as above
260.00 to 265.00 (5.00)	50% <b>SANDSTONE</b> light gray, medium gray, salt and pepper, silty to very fine grained, subangular to subround, well sorted, argillaceous in part, very friable to poorly consolidated, slightly calcareous, speckled glauconitic, light siliceous cement in part, no stain, no fluorescence, scattered intergranular porosity 6-8%
	50% <b>SHALE</b> as above
265.00 to 270.00 (5.00)	70% <b>SANDSTONE</b> as above, medium gray argillaceous
	30% <b>SHALE</b> medium gray, medium to dark gray, medium to dark brown, subfissile to fissile, blocky to platy
270.00 to 275.00 (5.00)	70% <b>SANDSTONE</b> medium gray, light gray, salt and pepper, silty to very fine grained, subangular to subround, medium sorted, very argillaceous in part, very poorly consolidated, slightly calcareous, no stain, no fluorescence, no visible porosity
	30% <b>SHALE</b> as above
275.00 to 280.00 (5.00)	60% <b>SHALE</b> medium gray, medium gray brown, silty in part, subfissile to fissile, blocky, trace of disseminated pyrite
	40% <b>SANDSTONE</b> light to medium gray, medium gray, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, argillaceous, friable, slightly calcareous, speckled glauconitic, no stain, no fluorescence, no visible porosity
280.00 to 285.00 (5.00)	90% <b>SHALE</b> medium gray, medium gray silty, medium gray brown, subfissile to fissile, predominately blocky
	10% <b>SANDSTONE</b> as above
285.00 to 290.00 (5.00)	100% <b>SHALE</b> medium to dark gray, dark gray, silty in part, subfissile to fissile, blocky to platy, common sand cavings
290.00 to 295.00 (5.00)	100% <b>SHALE</b> as above

## Sample Descriptions

Storage Units

Metric

295.00 to 300.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, silty in part, subfissile to fissile, platy to blocky
300.00 to 305.00 (5.00)	100% <b>SHALE</b> as above
305.00 to 310.00 (5.00)	60% <b>SHALE</b> as above  40% <b>SANDSTONE</b> light gray, salt and pepper, predominately silty, very fine grained in part, subangular to subround, well sorted, friable, siliceous, argillaceous, no stain, no fluorescence, no visible porosity
310.00 to 315.00 (5.00)	90% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky  10% <b>SANDSTONE</b> as above
315.00 to 320.00 (5.00)	90% <b>SHALE</b> as above  10% <b>SANDSTONE</b> as above
320.00 to 325.00 (5.00)	80% <b>SHALE</b> medium gray, medium gray silty, medium gray brown, fissile, blocky to platy  20% <b>SANDSTONE</b> light to medium gray, salt and pepper, silty to very fine grained, fine grained in part, subangular to subround, medium to well sorted, firm to friable, siliceous cement, slightly calcareous, argillaceous, speckled glauconitic, no stain, no fluorescence, no visible porosity
325.00 to 330.00 (5.00)	80% <b>SHALE</b> as above  20% <b>SANDSTONE</b> light gray, medium gray, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, friable, siliceous in part, slightly calcareous, very argillaceous in part, no stain, no fluorescence, no visible porosity
330.00 to 335.00 (5.00)	70% <b>SHALE</b> medium gray, medium to dark gray, very silty in part, fissile, predominately blocky  20% <b>SILTSTONE</b> light gray, medium gray, argillaceous, slightly calcareous, tight  10% <b>SANDSTONE</b> as above

**Sample Descriptions**

Storage Units

Metric

335.00 to 340.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, very silty in part, fissile, blocky to platy, common SILTSTONE laminae
340.00 to 345.00 (5.00)	80% <b>SHALE</b> as above
	10% <b>SANDSTONE</b> as above
	10% <b>SILTSTONE</b> as above
345.00 to 350.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray silty, fissile, platy to blocky, common SANDSTONE laminae
350.00 to 355.00 (5.00)	90% <b>SHALE</b> medium gray, medium gray silty to sandy, fissile, blocky to platy
	10% <b>SANDSTONE</b> light gray, medium gray argillaceous, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, friable, slightly calcareous, siliceous cement, speckled glauconitic, no stain, no fluorescence, no visible porosity, trace sideritic
355.00 to 360.00 (5.00)	100% <b>SHALE</b> light gray, medium gray silty, fissile, platy to blocky, common SANDSTONE thinbeds
360.00 to 365.00 (5.00)	100% <b>SHALE</b> as above
365.00 to 370.00 (5.00)	100% <b>SHALE</b> as above
370.00 to 375.00 (5.00)	90% <b>SHALE</b> medium gray, medium to dark gray, very silty in part, fissile, blocky to platy
	10% <b>SANDSTONE</b> light gray, medium gray argillaceous, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, friable, siliceous cement, calcareous in part, slightly argillaceous, speckled glauconitic, no stain, no fluorescence, no visible porosity
375.00 to 380.00 (5.00)	90% <b>SHALE</b> medium gray, medium gray silty, fissile, platy to blocky
	10% <b>SANDSTONE</b> as above
380.00 to 385.00 (5.00)	90% <b>SHALE</b> as above

**Sample Descriptions**

Storage Units:

Metric

380.00 to 385.00 (5.00)	10% <b>SANDSTONE</b> thinbeds, light to medium gray, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, friable, argillaceous, slightly calcareous, speckled glauconitic, no stain, no fluorescence, no porosity
385.00 to 390.00 (5.00)	90% <b>SHALE</b> as above
	10% <b>SANDSTONE</b> as above
390.00 to 395.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
395.00 to 400.00 (5.00)	100% <b>SHALE</b> as above
400.00 to 405.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
405.00 to 410.00 (5.00)	100% <b>SHALE</b> as above
410.00 to 415.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
415.00 to 420.00 (5.00)	100% <b>SHALE</b> medium to dark gray, medium gray silty, fissile, platy to blocky, common cavings
420.00 to 425.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy, minor cavings
425.00 to 430.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy, minor cavings
430.00 to 435.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
435.00 to 440.00 (5.00)	100% <b>SHALE</b> as above
440.00 to 445.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
445.00 to 450.00 (5.00)	100% <b>SHALE</b> as above
450.00 to 455.00 (5.00)	50% <b>SANDSTONE</b> light gray, salt and pepper, very fine grained, fine grained in part, subangular to subround, well sorted, friable to firm, siliceous cement, slightly argillaceous, speckled glauconitic, no stain, no fluorescence, no visible porosity
	50% <b>SHALE</b> medium gray, medium gray silty, light gray brown, fissile, platy to blocky



## Sample Descriptions

Storage Units

Matrix

455.00 to 460.00 (5.00)	60% <b>SANDSTONE</b> light gray, light brown, salt and pepper, very fine to fine grained, subangular to subround, well sorted, firm to very friable, calcareous cement, siliceous in part, speckled glauconitic, patchy oil stain, no dry, fair streaming wet cut fluorescence, scattered intergranular porosity 12-14%.
	40% <b>SHALE</b> as above
460.00 to 465.00 (5.00)	70% <b>SANDSTONE</b> as above
	30% <b>SHALE</b> medium gray, medium brown, fissile, platy
465.00 to 470.00 (5.00)	60% <b>SANDSTONE</b> light gray, light brown, salt and pepper, very fine to fine grained, subangular to subround, well sorted, firm to very friable, calcareous cement, siliceous in part, speckled glauconitic, patchy oil stain, no dry, fair streaming wet cut fluorescence, scattered intergranular porosity to 15%
	40% <b>SHALE</b> as above
470.00 to 475.00 (5.00)	70% <b>SANDSTONE</b> as above
	30% <b>SHALE</b> medium gray, medium brown, fissile, platy to blocky
475.00 to 480.00 (5.00)	70% <b>SANDSTONE</b> light gray, light to medium brown, salt and pepper, very fine to fine grained, subangular to subround, well sorted, friable to very friable, slightly calcareous, siliceous cement, speckled glauconitic, patchy oil stain, fair streaming wet cut fluorescence, scattered intergranular porosity 6-8%
	30% <b>SHALE</b> as above
480.00 to 485.00 (5.00)	80% <b>SANDSTONE</b> as above
	20% <b>SHALE</b> medium gray, medium brown, fissile, platy
485.00 to 490.00 (5.00)	60% <b>SHALE</b> medium gray, medium gray silty, fissile, blocky to platy
	40% <b>SANDSTONE</b> as above
490.00 to 495.00 (5.00)	70% <b>SHALE</b> light gray, medium gray, medium gray silty, fissile, blocky to platy

**Sample Descriptions****Storage Units****Matrix**

490.00 to 495.00 (5.00)	30% <b>SANDSTONE</b> light gray, light to medium brown, salt and pepper, very fine to fine grained, subangular to subround, medium to well sorted, friable, siliceous cement, argillaceous to very argillaceous in part, speckled glauconitic, patchy oil stain, strong wet cut fluorescence, no visible porosity
495.00 to 500.00 (5.00)	70% <b>SHALE</b> as above
	30% <b>SANDSTONE</b> as above
500.00 to 505.00 (5.00)	80% <b>SHALE</b> medium gray, medium gray brown, silty in part, fissile, platy to blocky
	20% <b>SANDSTONE</b> as above
505.00 to 510.00 (5.00)	60% <b>SHALE</b> medium gray, silty to sandy, fissile, blocky
	40% <b>SANDSTONE</b> light to medium gray brown, salt and pepper, silty to very fine grained, subangular to subround, medium to well sorted, argillaceous, slightly calcareous, patchy oil stain, no visible porosity
510.00 to 515.00 (5.00)	90% <b>SHALE</b> medium gray, medium gray silty, sandy in part, fissile, blocky to platy
	10% <b>SANDSTONE</b> as above
515.00 to 520.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, platy to blocky
520.00 to 525.00 (5.00)	100% <b>SHALE</b> as above
525.00 to 530.00 (5.00)	100% <b>SHALE</b> medium gray, medium gray silty, fissile, predominately platy
530.00 to 535.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, fissile, platy
535.00 to 540.00 (5.00)	100% <b>SHALE</b> as above
540.00 to 545.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, fissile, platy
545.00 to 550.00 (5.00)	100% <b>SHALE</b> as above

**Sample Descriptions****Storage Units:****Metric**

550.00 to 555.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, fissile, platy
555.00 to 560.00 (5.00)	100% <b>SHALE</b> as above
560.00 to 565.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, fissile, platy, minor medium gray silty
565.00 to 570.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, fissile, platy
570.00 to 575.00 (5.00)	100% <b>SHALE</b> as above
575.00 to 580.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, minor medium gray silty, fissile, platy
580.00 to 585.00 (5.00)	100% <b>SHALE</b> as above
585.00 to 590.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, minor medium gray silty, fissile, platy
590.00 to 595.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, fissile, platy, trace of bentonite
595.00 to 600.00 (5.00)	100% <b>SHALE</b> as above, minor bentonitic laminae, trace of <b>SANDSTONE</b> light to medium brown, quartzose, argillaceous, silty to very fine grained, subangular to subround, firm, sideritic, tight
600.00 to 605.00 (5.00)	100% <b>SHALE</b> medium gray, medium to dark gray, medium to dark brown sideritic, minor dark green glauconitic, fissile, platy to blocky, Thinbeds of <b>SANDSTONE</b> light brown, salt and pepper, quartzose, silty to very fine grained, subangular to subround, medium to well sorted, firm, siliceous cement, calcareous in part, no visible porosity, trace of chert, minor nodular and disseminated pyrite
605.00 to 610.00 (5.00)	90% <b>SANDSTONE</b> light to medium brown, salt and pepper, predominately quartz, very fine to medium grained, subangular to subround, medium to well sorted, firm to friable, siliceous cement, slightly argillaceous in part, trace of clay infilling, predominately well indurated, patchy oil stain, no fluorescence, scattered intergranular porosity 12 to 14%
	10% <b>SHALE</b> as above
610.00 to 615.00 (5.00)	30% <b>SANDSTONE</b> light to medium brown, salt and pepper, silty to very fine grained, subangular to subround, medium sorted, very argillaceous in part, firm, siliceous cement, very patchy oil stain, no fluorescence, no visible porosity

## Sample Descriptions

Storage Units

Metric

610.00 to 615.00 (5.00)	30% <b>SHALE</b> medium gray, fissile, platy
	30% <b>SILTSTONE</b> light to medium brown, medium gray, sandy, argillaceous, tight
	10% <b>COAL</b> black, vitreous
615.00 to 620.00 (5.00)	60% <b>SHALE</b> medium gray, medium to dark brown, light gray bentonitic, fissile, platy
	40% <b>SANDSTONE</b> light gray brown, light to medium brown, salt and pepper, silty to very fine grained, fine grained in part, subangular to subround, medium to well sorted, firm to friable, clean to argillaceous, siliceous cement, very spotty oil stain, no fluorescence, no visible porosity
620.00 to 625.00 (5.00)	100% <b>SANDSTONE</b> light gray brown, salt and pepper, predominately quartz, fine to medium grained, subangular to subround, medium to well sorted, very friable, light siliceous cement, very spotty oil stain, no fluorescence, scattered intergranular porosity 12 to 18%
625.00 to 630.00 (5.00)	50% <b>SANDSTONE</b> as above, white clay infilling in part
	50% <b>SHALE</b> medium gray, light to medium gray, dark brown to black carbonaceous, fissile, platy to blocky
630.00 to 635.00 (5.00)	100% <b>SANDSTONE</b> light gray, salt and pepper, fine to medium grained, subangular to subround, medium to well sorted, very friable to poorly consolidated, clayey in part, no stain, no fluorescence, intergranular porosity 15 to 18%, minor SHALE as above
635.00 to 640.00 (5.00)	100% <b>SANDSTONE</b> as above
640.00 to 645.00 (5.00)	60% <b>SANDSTONE</b> as above
	20% <b>CHERT</b> varicolored, massive
	20% <b>SHALE</b> medium gray, medium gray sandy, fissile, blocky to platy
645.00 to 650.00 (5.00)	60% <b>CHERT</b> clear, white, light brown, dark brown, dark blue gray variegated, massive
	20% <b>SANDSTONE</b> as above

## Sample Descriptions

Storage Units:

Metric

645.00 to 650.00 (5.00)	20% <b>SHALE</b> medium to dark gray, dark gray, fissile, platy
650.00 to 655.00 (5.00)	90% <b>LIMESTONE</b> mottled light to dark brown, cryptocrystalline, mudstone, argillaceous in part, tight
	10% <b>CHERT</b> as above
655.00 to 660.00 (5.00)	100% <b>LIMESTONE</b> mottled light to medium brown, dark brown argillaceous in part, cryptocrystalline, mudstone, tight, trace of dark brown laminar <b>CHERT</b>
660.00 to 665.00 (5.00)	80% <b>LIMESTONE</b> light gray white, medium gray argillaceous, mottled medium to dark brown, cryptocrystalline, mudstone, tight, trace of pellets and crinoid plates
	20% <b>SHALE</b> medium gray, dark gray, calcareous, fissile, platy
665.00 to 670.00 (5.00)	90% <b>LIMESTONE</b> light gray, medium gray, mottled light to medium brown, argillaceous in part, cryptocrystalline, mudstone
	10% <b>SHALE</b> as above
670.00 to 675.00 (5.00)	90% <b>LIMESTONE</b> light gray, medium gray, mottled gray brown, cryptocrystalline, mudstone, no visible porosity, minor dark brown Chert laminae
	10% <b>SHALE</b> medium gray, dark gray, calcareous, fissile, platy
675.00 to 680.00 (5.00)	100% <b>LIMESTONE</b> as above
680.00 to 685.00 (5.00)	100% <b>LIMESTONE</b> mottled light to medium brown, gray brown, dark gray brown, cryptocrystalline, mudstone, trace of dark brown laminar Chert, trace of <b>SHALE</b> medium to dark gray, calcareous, fissile, platy
685.00 to 690.00 (5.00)	100% <b>LIMESTONE</b> as above
690.00 to 695.00 (5.00)	100% <b>LIMESTONE</b> mottled light to medium brown, medium gray brown, dark gray brown, cryptocrystalline, mudstone, argillaceous in part, trace of Chert, minor <b>SHALE</b> medium to dark gray, dark gray brown, calcareous, fissile, platy