

Kacy Murillo (adpce.ad)

Subject: RE: Response to Comments Dye Test Study Workplan

From: McCullough, Dan [<mailto:DMcCullough@scsengineers.com>]
Sent: Friday, January 27, 2023 12:29 PM
To: Travis Atwood (adpce.ad); Bill Sadler (adpce.ad)
Cc: Linda Hanson (adpce.ad)
Subject: Response to Comments Dye Test Study Workplan

AFIN: 03-00051

PMT#: 0249-S1-R2

Received

By Kacy Murillo at 1:53 pm, Jan 30, 2023

DOC ID#: 83332

TO: BS>FILE <KM

Travis;

Attached is our response to you recent comments of the Dye Test Study Work Plan. If all possible, we would like to do the injection next week. In order to do that, we need your approval of the plan, (at least an email) so that we can give that approval to Linda Hanson for approval from the water didvision.

Dan McCullough PG
SCS Engineers
Cell: (501) 350-8867
Office (501) 503-4778
dmccullough@scsengineers.com
scsengineers.com

January 26, 2023
File No.: 27222139.01

Mr. Travis Atwood
Arkansas Department of Energy & Environmental Division of Environmental Quality (DEQ)
5301 Northshore Drive
North Little Rock, AR 72118-5317

Subject: **Response to Comments on Dye Trace Study Work Plan
Former NABORS Landfill, Baxter County, Arkansas
Permit No: 0249-S1-R2; AFIN: 03-00051
Cross Reference: Document ID: 83281**

Dear Mr. Atwood:

SCS Engineers has prepared the following responses to the comments provided by the Arkansas Department of Energy & Environmental Division of Environmental Quality (DEQ) on January 18, 2023, regarding the January 2023 Dye Trace Study Work Plan at the above referenced facility.

DEQ Comment 1.0 Please provide a sampling point in Hutch Creek above the low water crossing at county road 16.

Reply: *A sampling point will be added at the requested location.*

DEQ Comment 2.0 Table 6 in Ozark Underground Laboratory's book shows that fluorescein can be affected by landfill leachate. Nearby wells MW-1, MW-1R and CAO-1 are elevated in arsenic, cobalt, 1-1-Dichloroethane, and MTBE with vinyl chloride also elevated in two of the three wells. These three wells are also higher in chloride than the other wells on site; indicating a possible leachate component to the impact. Please provide justification of fluorescein over the use of other dyes with considering to this observation.

Reply: *As indicated in the Ozark Underground Laboratory (OUL) Groundwater Tracing Handbook Table 6, landfill leachate can be a potential source of background fluorescence in the range of commonly used tracer dyes, including fluorescein because this dye is used in a number of commercially available consumer products. To address the potential for background interference, SCS Engineers is in the process of performing background sampling prior to the introduction of the tracer dye. The first round of background sampling results has been completed and indicated no fluorescence in the range of fluorescein dye at any of the sampling locations. A second round of background sampling will be performed prior to the dye introduction to provide additional background information.*

DEQ Comment 3.0 Within 15 days of this letter, please provide DEQ with the report detailing the previous work done at the site from the supplemental subsurface investigation. In addition,



section 4.1 describes already performed background sampling. Please provide DEQ with the results analyzed by the Ozark Underground Laboratory.

Reply *A supplemental investigation activities report will be submitted on or before February 10, 2023. The borings and borehole geophysical logs are included in Attachment 1. In addition, the laboratory report from the OUL for the first round of background sampling can be found in Attachment 2.*

DEQ Comment 4.0 40 CFR §§ 144 and 146.6 address requirements for Class V UIC wells. Since these are permitted by rule, you must obtain authorization to inject. Please note that authorization is required from the Permits Branch of the Office of Water Quality, Division of Environmental Quality. Please contact Linda Hanson, P.G. at hanson@adeq.state.ar.us or at 501.682.0646 for information pertaining to these requirements.

Reply: *SCS Engineers has contacted Linda Hanson, P.G. with the DEQ Permits Branch of the Office of Water Quality and has submitted the requested UIC Inventory information.*

DEQ Comment 5.0 Please do not proceed with dye injection until these comments are addressed.

Reply: *SCS Engineers will not proceed with the implementation of the Dye Trace Study Work Plan until these responses are accepted by DEQ, and we have the necessary authorization from the Permits Branch of the Office of Water Quality at DEQ.*

If you have any questions during your review of this submittal, please contact our office at (501) 812-4551.

Sincerely,



Dan McCullough, P.G.
Senior Project Manager



Stacie Whitmer, REM, ASP, JD
Senior Project Manager

SCS ENGINEERS
slb/dm

cc: Bill Sadler, P.G., DEQ
Blake Whittle, P.G., DEQ

Attachments

Attachment 1

Investigation Boring Logs and Geophysical Logs

11219 Richardson Drive
North Little Rock, AR

DRILLER: Kevin Murphy

SURFACE ELEVATION: 1051 ft

DRILLING RIG: CME-55

TOC ELEVATION: 1051 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 81.95 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181061.5

PROJECT LOCATION: Three Brothers, AR

EASTING: 774701.35

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Core

WATER LEVEL: 63.11 fbgs

START DATE: 10/5/2022

BORING DIAMETER: 3"

WATER ELEVATION: 987.84 ft

FINISH DATE: 10/14/2022

WELL DIAMETER: 3"

WATER LEVEL DATE: 10/20/2022

DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
0	Dolomite	Dolomite; grey to light grey with brown and dark grey banding	Core	0-5		52			1055
5	Shale	Shale; brown, thinly bedded, non calcareous	Core	5.0-10.0		62			1045
10	Dolomite	Dolomite; grey with brown & dark grey banding. Some chert layers & small vugs.	Core	10.0-15.0		19			1040
15	Sandstone; tan Dolomite; coarse, gray to tan, with occasional chert layers	Sandstone; tan Dolomite; coarse, gray to tan, with occasional chert layers	Core	15.0-20.0		79		3" Open borehole GS to 81.95' bgs	1035
20	Dolomite; dark grey with some chert layers. Some large vugs (1" diam) ~16.3-17'	Dolomite; dark grey with some chert layers. Some large vugs (1" diam) ~16.3-17'	Core	20.0-25.0		100			1030
25	Dolomite; tan with small vugs ~18.1'	Dolomite; tan with small vugs ~18.1'	Core						1025
	Dolomite	Dolomite; grey with iron staining							
	Dolomite	Dolomite; grey							

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

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North Little Rock, AR

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30	[Brick pattern]	to tan with brown banding & some chert. Zones of small vugs. Large vugs (1" diam) noted from 25.4-25.75' and 31-31.3'.	Core	25.0-30.0		72			1020
			Core	30.0-35.0		73			
35	[Brick pattern]	Shale; thinly bedded, brown to black	Core	35.0-40.0		86			1015
			Core	40.0-45.0		100			
40	[Brick pattern]	Dolomite; grey to tan, vuggy, with brown banding and chert. Increased chert ~37.04'. Vuggy. At 39.05' and 41.6-41.8, larger vuggy cavities w/ precipitate including iron minerals	Core	40.0-45.0		100			1010
			Core	45.0-50.0		91			
45	[Brick pattern]	Dolomite; Heavily weathered, vuggy, grey to tan, with brown banding and chert. Brecciated zones beginning ~51.6'. Frequent	Core	50.0-55.0		75			1000
			Core	55.0-					
50	[Brick pattern]								
55	[Brick pattern]								
									995

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60		solution features 56.16'. Large vugs w/ iron mineralization.	Core	60.0		95			990
65		Dolomite; grey with chert. Small vugs 60.9-62.9' and 63.04-63.3'. At 67.9', coarser tan irregularly shaped dolomite infill noted.	Core	60.0-65.0		96			985
70	Dolomite	Shale; black, non calcareous.	Core	65.0-70.0		100			980
75	Dolomite	Dolomite; grey w/ chert.	Core	70.0-75.0		85			975
80	Dolomite	Shale; black, non calcareous. Dolomite; grey w/ chert. Brecciated zones, notably at 72.7'. Dolomite; grey w/ chert. Brecciated/vuggy zone at 78.13'.	Core	75.0-80.0		90			970
85									

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90									

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11219 Richardson Drive
North Little Rock, AR

DRILLER: Kevin Murphy

SURFACE ELEVATION: 1057.7 ft

DRILLING RIG: CME-75

TOC ELEVATION: 1059 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 84.58 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1180694.47

PROJECT LOCATION: Three Brothers, AR

EASTING: 774358.91

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Core

WATER LEVEL: 66.48 fbgs

START DATE: 9/27/2022

BORING DIAMETER: 3"

WATER ELEVATION: 991.2 ft

FINISH DATE: 9/29/2022

WELL DIAMETER: 3"

WATER LEVEL DATE: 10/20/2022

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0	Silty Clay	Silty Clay; reddish brown to orange with chert gravels							1060
5								Sch 40 PVC Casing (gouted) 0'-7' bgs	1055
7-10			SPT (50/2") Core	7-10		50/2"			1050
10-15	Dolomite	Dolomite; light gray to gray, fine crystalline, iron staining in fractures, thin dark gray banding, vuggy between 19.5'-21.5'	Core	10-15		85			1045
15-20			Core	15-20		57			1040
20-25	Shale Chert	Shale; brown thinly bedded (no reaction to HCL) Chert, dark gray with light gray banding	Core	20-25		100		3" Open borehole to 7' to 84.58' bgs	1035
25						73			1030

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30	Dolomite	Dolomite, light gray to gray with dark gray banding, a thin sandstone layer (approx 4") noted at 28.5, chert nodules noted between 35'-40', vuggy between 45-47.5	Core	25-30		74			1030
			Core	30-35		100			1025
35			Core	35-40		100			1020
40			Core	40-45		78			1015
45			Core	45-50		86			1010
50			Core	50-53		82			1005
	Chert	Chert, dark gray with light gray and brown banding	Core	53-55		83			
55		Dolomite, light gray to gray, vuggy with							

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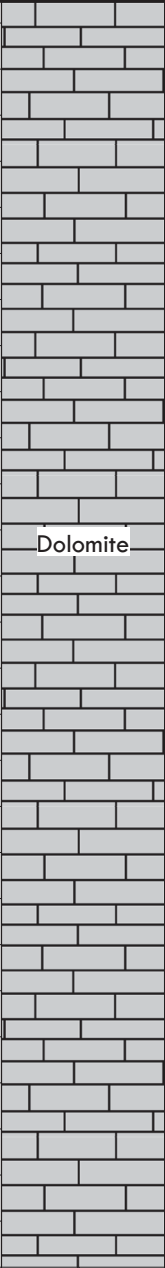
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60		interbedded Chert to 55, sporadic vuggs with quartz present at 59', vuggy at 62 approx 4" and between 63'-64' with chert nodules noted at 64'	Core	55-60		100			1000
			Core	60-65		97			995
65		Dolomite; gray, brecciated with chert nodules	Core	65-70		95			990
70			Core	70-75		98			985
75			Core	75-80		98			980
80		Dolomite; gray with dark gray banding, some chert nodules, vuggy 80.5'-83'	Core	80-85		90			975
85									970

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90									

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11219 Richardson Drive
North Little Rock, AR

DRILLER: Kevin Murphy
DRILLING RIG: CME-75

SURFACE ELEVATION: 1044.1 ft
TOC ELEVATION: 1044.1 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 81.49 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181096.52
EASTING: 775091.15

PROJECT LOCATION: Three Brothers, AR

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Core

WATER LEVEL: 54.69 fbgs

START DATE: 9/29/2022

BORING DIAMETER: 3"

WATER ELEVATION: 989.39 ft

FINISH DATE: 10/4/2022

WELL DIAMETER: 3"

WATER LEVEL DATE: 10/20/2022

DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
0	Silty Clay	Silty Clay; reddish brown to orange with chert gravels							1045
5							Sch 40 PVC Casing (grouted) 0'-6.5' bgs		1040
6.5-10			Core	6.5-10		32			1035
10-15		Dolomite, tan with brown banding, iron staining in fractures, some vuggy	Core	10-15		93			1030
15-18.75		12'-13.3' and 18'-18.75' (vugs filled with silty clay)	Core	15-20		88			1025
18.75-20			Core	20-25		100		3" Open borehole 6.5' to 81.49' bgs	1020
20-25									

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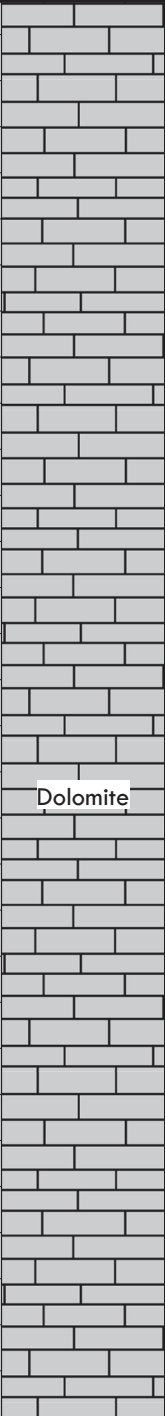
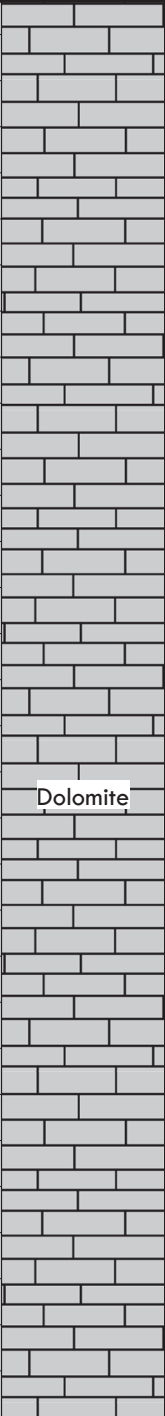
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30		Dolomite, light gray to gray with some chert nodules, vuggy with brown and dark gray banding 22'-25', gastropod fossils noted 26.5'-27.5', appears weathereed and fractured at 29'-30', some interbedded chert 30'-35 up to 2" thick, some brown banding	Core	25-30		51			1015
			Core	30-35		49			1010
35			Core	35-40		63			1005
40			Core	40-45		62			1000
45				Dolomite					
		Dolomite; gray, brecciated with chert nodules	Core	45-50		75			995
50			Core	50-55		86			990
55									

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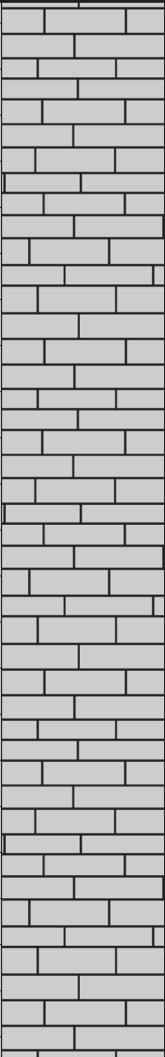
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60		Dolomite; tan to gray with dark gray and brown banding, 50-55 some vugs with calcite present in vugs., chert bands up to 1" from 55-60	Core	55-60		86			985
			Core	60-60 .5		0			
65			Core	60.5-65.5		31			980
70			Core	65.5-70.5		50			975
75			Core	70.5-75.5		81			970
80			Core	75.5-80.5		93			
85									

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SAMPLING METHOD: Core

WATER LEVEL: 54.69 fbgs

START DATE: 9/29/2022

BORING DIAMETER: 3"

WATER ELEVATION: 989.39 ft

FINISH DATE: 10/4/2022

WELL DIAMETER: 3"

WATER LEVEL DATE: 10/20/2022

DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
90									

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

11219 Richardson Drive
North Little Rock, AR

DRILLER: Kevin Murphy

SURFACE ELEVATION: 989.42 ft

DRILLING RIG: CME-55

TOC ELEVATION: 989.42 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 80.3 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181622.96

PROJECT LOCATION: Three Brothers, AR

EASTING: 774465.66

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Core

WATER LEVEL: 67.93 fbgs

START DATE: 10/17/2022

BORING DIAMETER: 3"

WATER ELEVATION: 921.49 ft

FINISH DATE: 10/18/2022

WELL DIAMETER: 3"

WATER LEVEL DATE: 10/20/2022

DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
0	Rip Rap	Silty clay; overburden with minor chert Rip rap							990
5	Clay Loam Silty Clay	Clay loam - brown, with some coarse sand Silty Clay; Yellowish brown						Sch 40 PVC Casing (grouted) 0'-16.5' bgs	985
10	Clay	Clay, red, stiff with occasional chert pebbles							980
16.5			Cuttings	16.5-20.5		68			975
20.5			Cuttings	20.5-25.5		88			970
25	Dolomite	Dolomite; grey with dark grey						3" Open borehole 16.5' to 80.30' bgs	

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

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North Little Rock, AR

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TOC ELEVATION: 989.42 ft

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DRILLING METHOD:

WELL DEPTH COMPLETION: 80.3 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181622.96

PROJECT LOCATION: Three Brothers, AR

EASTING: 774465.66

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WATER LEVEL: 67.93 fbgs

START DATE: 10/17/2022

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DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
30	[Brick pattern]	banding & interbedded chert.	Cuttings	25.5-30.5		92			
			Cuttings	30.5-35.5		50			
35	[Brick pattern]	Dolomite; light grey with dark grey banding; some interbedded chert beginning 40.5'	Cuttings	35.5-40.5		85			
40			Cuttings	40.5-45.5		80			
45	[Brick pattern]	Dolomite	Cuttings	45.5-50.5		100			
50			Cuttings	50.5-55.5		100			
55	[Brick pattern]								

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

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TOC ELEVATION: 989.42 ft

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DRILLING METHOD:

WELL DEPTH COMPLETION: 80.3 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181622.96

PROJECT LOCATION: Three Brothers, AR

EASTING: 774465.66

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Core

WATER LEVEL: 67.93 fbgs

START DATE: 10/17/2022

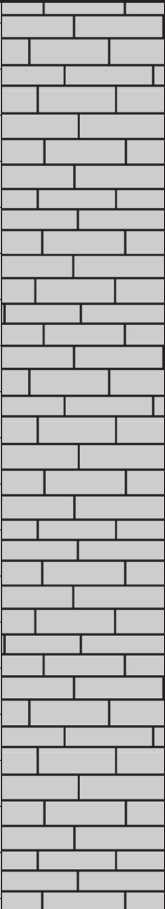
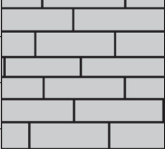
BORING DIAMETER: 3"

WATER ELEVATION: 921.49 ft

FINISH DATE: 10/18/2022

WELL DIAMETER: 3"

WATER LEVEL DATE: 10/20/2022

DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
60		Dolomite; grey with dark grey banding. Some small vugs 59-59.5'	Cuttings	55.5-60.5		100			
			Cuttings	60.5-65.5		100			
65			Cuttings	65.5-70.5		88			
70			Cuttings	70.5-75.5		97			
75		Dolomite, Heavily weathered, vuggy, grey	Cuttings	75.5-80.5		61			
80									
85									

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

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WELL DEPTH COMPLETION: 80.3 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: GTS

LOCATION:

PROJECT NUMBER: 27222139.01

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90									

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

11219 Richardson Drive
North Little Rock, AR

DRILLER: Wayne Johnson

SURFACE ELEVATION: 1061.1 ft

DRILLING RIG: Hillyard

TOC ELEVATION: 1062.7 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 91.29 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: Anderson Engineering

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181622.96

PROJECT LOCATION: Three Brothers, AR

EASTING: 774716.18

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Cuttings

WATER LEVEL: 62.76 fbgs

START DATE: 10/20/2022

BORING DIAMETER: 4.25"

WATER ELEVATION: 998.35 ft

FINISH DATE: 10/20/2022

WELL DIAMETER: 4.25"

WATER LEVEL DATE: 10/20/2022

DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
0	Silty Clay	Silty Clay; Reddish brown to orange with gravels					Sch 40 PVC Casing	0'-3' bgs	1065
5									1060
10									1055
15									1050
20									1045
25								4.25" Open borehole GS to 91.29' bgs	1040
									1035

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

11219 Richardson Drive
North Little Rock, AR

DRILLER: Wayne Johnson

SURFACE ELEVATION: 1061.1 ft

DRILLING RIG: Hillyard

TOC ELEVATION: 1062.7 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 91.29 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: Anderson
Engineering

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181622.96

PROJECT LOCATION: Three Brothers, AR

EASTING: 774716.18

GEOLOGIST: Robert Fowler

SAMPLING METHOD: Cuttings

WATER LEVEL: 62.76 fbgs

START DATE: 10/20/2022

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DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
30	Dolomite	Dolomite; less dust around 60' below ground	Cuttings						1030
35				1025					
40				1020					
45				1015					
50				1010					
55				1005					

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

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TOC ELEVATION: 1062.7 ft

CLIENT: LRS

DRILLING METHOD:

WELL DEPTH COMPLETION: 91.29 fbgs

PROJECT NAME: NABORS

DRILLING CONTRACTOR: Anderson
Engineering

LOCATION:

PROJECT NUMBER: 27222139.01

NORTHING: 1181622.96

PROJECT LOCATION: Three Brothers, AR

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60									1000
65									995
70									990
75									985
80									980
85									975

THE STRATIFICATION LINES REPRESENT APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL TRANSITIONS MAY BE GRADUAL

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WATER LEVEL: 62.76 fbgs

START DATE: 10/20/2022

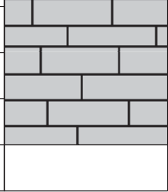
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DEPTH (FT)	LITHOLOGY	LITHOLOGY DESCRIPTION	Sample Type	Sample Depth	RECOVERY (in)	Blow Counts	MONITORING WELL CONSTRUCTION	MONITORING WELL DESCRIPTION/ DRILLING NOTES	ELEVATION (FT)
90									970

THE STRATIFICATION LINES REPRESENT APPROXIMATE
BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: ACTUAL
TRANSITIONS MAY BE GRADUAL