# PROPOSED GROUNDWATER MONITORING SYSTEM SUNRAY SERVICES SANITARY LANDFILL TONTITOWN, ARKANSAS

A9939 A9940 Permit 123-SR-2 and 162-SR-2

#### Prepared for:

Sunray Services, Inc. P.O. Box 1310 Springdale, Arkansas 72765-1310

#### Prepared by:

SCS Engineers 10401 Holmes Road, Suite 400 Kansas City, Missouri 64131 (816) 941-7510

> August 21, 1992 File No. 08-89015.06



# TABLE OF CONTENTS

<u>Section</u>	<u>Pa</u>	age
Introduction		. 1
Bedrock Aquifer	r Characterization	. 1
Monitoring Well	Assessment	. 2
Groundwater Mo	onitoring Plan	. з
Figures		
1 Monitoring	g Well Construction Diagram	
Appendices		
A Boring Logs		
B Well Constru C Packer Test	<b>9</b>	
Drawings		
Sheet 1 of 2:	Potentiometric Surface Contours, Top of Limestone Elevation, and Exist Monitoring Well Locations	ing
Sheet 2 of 2:	Proposed Monitoring Well Locations	

#### PROPOSED GROUNDWATER MONITORING SYSTEM SUNRAY SERVICES SANITARY LANDFILL TONTITOWN, ARKANSAS

#### INTRODUCTION

SCS Engineers (SCS) is currently conducting a hydrogeologic investigation of Sunray Services, Inc., Tontitown Landfill Complex, as requested by the Arkansas Department of Pollution Control and Ecology (ADPC&E), as outlined in the Permit Modifications 123-SR-2 and 162-SR-2, dated September 20, 1991.

The initial phase of the work has been completed. The initial phase of the project involved the installation of two groundwater monitoring wells and hydrogeologic characterization of the bedrock aquifer. A downhole camera was utilized to characterize the bedrock aquifer and well construction. The downhole camera work indicated that four of the existing monitoring wells were either damaged or improperly constructed.

This report will present the findings of the initial work and make recommendations for a revised groundwater monitoring well network.

#### BEDROCK AQUIFER CHARACTERIZATION

#### Monitoring Well Installation

Two groundwater monitoring wells were installed as part of the bedrock aquifer characterization. The two additional wells were labeled MW-10 and MW-11. Monitoring well MW-10 is located near the southern border of the site, and monitoring well MW-11 is located near the northern border of the site. Boring Logs are presented in Appendix A.

The soil borings were advanced at each well location using mud rotary drilling methods. The borings were logged by observing cuttings during drilling. The soil borings were advanced to bedrock.

Upon completion of the soil borings, Nx size casing was set and the limestone was cored using a Nx double-tube core barrel. The borings were logged by SCS personnel in the field with written documentation. All cores were preserved in cardboard boxes.

Each borehole was then reamed to 8 inches in diameter from ground surface to the total depth of the well using air rotary drilling methods.

The monitoring wells were constructed of 4-inch diameter, 0.010-inch factory slotted, schedule 40 PVC well screen. The well screen extended from the bottom of the boring to approximately 4 feet below the soil bedrock interface. Schedule 40 PVC riser pipe was connected to the screen and extended from 2 to 2.5 feet above the ground surface.

A clean sand filter pack was tremied into the annular space around the screen to a point 1 to 2 feet above the top of the screen, and a 3 to 5-foot thick bentonite pellet seal was placed above the filter sand. The bentonite seal extended across the soil rock interface. The remaining annular space was filled with a portland cement-bentonite mix tremied into position.

Upon completion, each well was developed using a submersible pump until clean formation water was observed.

An oversized steel casing with locking cap was placed over the PVC well casing and sealed in concrete. A 4-foot square concrete protective pad was constructed around the protective casing and sloped away from the casing. A well construction diagram is presented in Figure 1. Well construction logs are presented in Appendix B.

#### Rock Coring and Packer Testing

The rock cores indicate that the bedrock is composed of a gray cherty limestone with chert interbeds. Numerous horizontal fractures were also observed. The fractures ranged in thickness from 1 to 10 millimeters. The fracture density for bedrock core collected from well MW-11 was 1.8 fractures per foot. The fracture density for bedrock core collected from MW-10 was 1.3 fractures per foot.

Packer test data from packer tests conducted in the bedrock at monitoring wells MW-10 and MW-11 indicated a range of hydraulic conductivities from 1.50 x  $10^{-5}$  to 3.04 x  $10^{-4}$  cm/sec. Packer test data is presented in Appendix C.

#### Downhole Camera Survey

A downhole camera was lowered into existing monitoring wells to determine the extent and size of fractures in the bedrock aquifer. Bedrock was observed in monitoring wells MW-1, MW-2, MW-4, and MW-8. The camera survey indicated horizontal fractures similar to those observed in the rock cores.

#### Groundwater Flow Conditions

Groundwater level measurements were taken at each monitoring well and a potentiometric surface map prepared. This map indicates that groundwater is flowing to the south-southeast. In addition, the potentiometric surface contours generally reflect the bedrock surface contours. It appears that the groundwater is flowing in the highly fractured cherty limestone. A potentiometric surface map is shown on Sheet 1 of 2.

#### MONITORING WELL ASSESSMENT

The downhole camera survey indicated that four existing monitoring wells (MW-3, MW-4, MW-7, and MW-9) were improperly constructed. The survey indicted that the well casing in well MW-3 was broken near the soil rock interface and that the grout seal at the soil rock interface was damaged. A leaking seam was observed at approximately 14 feet below land surface in well MW-4. A hole was observed in the well casing at approximately 80 feet below land surface in

well MW-7. The well casing was cracked in well MW-9 from approximately 61 to 65 feet below land surface.

It is the opinion of SCS that the integrity of these wells has been compromised as a result of the improper well construction.

#### **GROUNDWATER MONITORING PLAN**

The proposed groundwater monitoring plan consists of three monitoring wells on Site 3 and four monitoring wells on Site 4. Monitoring wells for Site 3 include existing wells MW-1 and MW-10 and one well (MW-12) located between MW-3 and MW-4. Monitoring wells MW-3 and MW-4 will be abandoned.

Monitoring wells for Site 4 include wells MW-11, MW-5, MW-8, and one well located between MW-6 and MW-7. Monitoring wells MW-7 and MW-9 will be abandoned. Proposed monitoring well locations are shown on Sheet 2 of 2.

Monitoring wells MW-1, MW-5, and MW-11 will be utilized as upgradient wells. Monitoring wells MW-8, MW-10, MW-12, and MW-13 will be utilized as downgradient wells.

\* No sustification for moveing wells. The present system was Located base open:

A) photo lineament analysis

B) Resistivity soundings

\*\*What about MW-2 and MW-6?

\*\*MW-11 is accordaged on from MW-5.

APPENDIX A
BORING LOGS

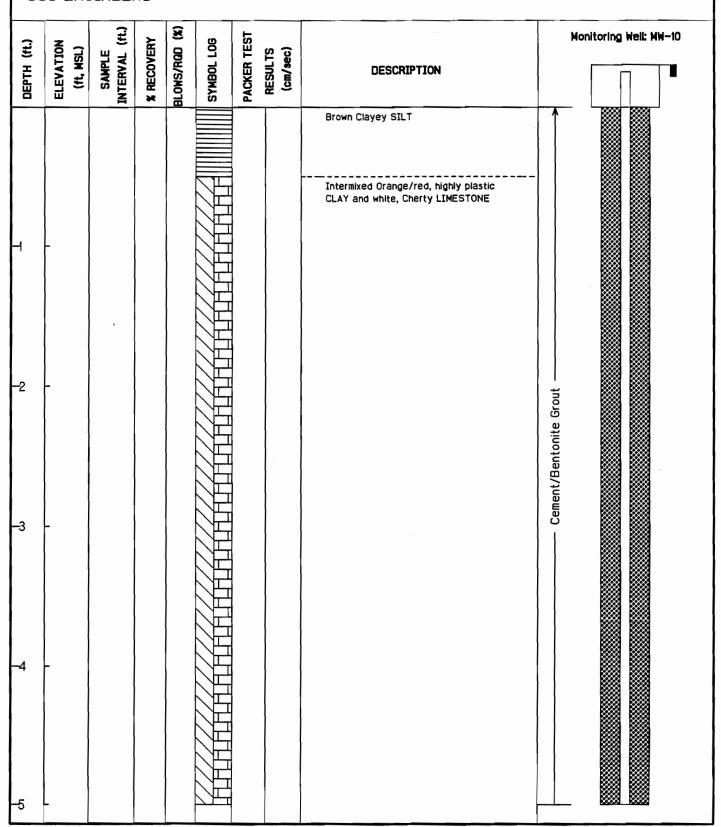
Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06



Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

	O LINC									
DEPTH (ft.)	ELEVATION (ff, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monitoring Well: MW-10	
<del>-</del> 6	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE		
-7	-								Cement/Bentonite Grout	
<del>-</del> 8	- -		12"							
9	-	SS								
-10					\P					

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149,9993; N2198,0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

30	O ENG	TINEE	no						•
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (%)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
<b>⊢</b> 11	_							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
<del>-1</del> 2	-	•						·	Cement/Bentonite Grout
13	-								Cement/B
  -14	-	ss	4"						
<b>⊣</b> 5	-								

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RQD (%)	SYMBOL LOG	FACKEN LEST RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
<b>-</b> 16							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Cement/Bentonite Grout
<b>⊣</b> 8	-	90	6"					Ce
-20	_	SS					,	

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

ОЕРТН (#.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (%) SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-21 -22	ELEVI (ft.	SAM	* REC	PLOWS STATES TO	HHHHHHHHHHHHHHHHHHH	RESU (cm/	As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	— Cement/Bentonite Grout
-23	-							Cement/Be
-24 -25	- -	SS	3"					

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (%) SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
	ш	4	*	Na S			As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
-26	_			77777777	HHHHHH			
<del>-</del> 27	-			777777777				tonite Grout
-28	_			7777777777			·	Cement/Bentonite Grout
-29	-	SS	6"	\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\				
-30	-							

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-31	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
-32	_								Cement/Bentonite Grout
-33	-				didddd				
-34	_	SS	6"		111111111111111111111111111111111111111				
-35	_								

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

	2 EING	TINEE	13	ŧ				
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (%)	SYMBOL LOG	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-36	-						As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
-37		•						Cement/Bentonite Grout
-38	- /4%						. ·	Cement/Ber
<del>-</del> 39	1/2/d/24	SS	4"					
<del>-</del> 40	-							

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-41 -42	ELE (A	SA	EX X	MOTIB		PACK RES	As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Cement/Bentonite Grout
-44 -45	-							

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

		)	_						
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-46	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
-47	-								onite Grout
-48	-								Cement/Bentonite Grout
<del>-4</del> 9	-	SS							
-50	-								

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (%)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-51			104	40				Intermixed white, weathered Cherty LIMESTONE with dark gray LIMESTONE  Begin core run #1 at 51'	Cement/Bentonite Grout
<del>-</del> 52	-	Run 1						Broken from 51.7 to 52.1  LIMESTONE: White/light gray, competent	
-53	-		99	48				Begin core run #2 at 53' LIMESTONE: White marbled with dark gray, Cherty  weathered horizontal fracture at 53.2 weathered horizontal fracture at 53.3 weathered horizontal fracture at 53.5	Bentonite Seal ——
-54	-	Run 2						weathered horizontal fracture at 53.7  weathered horizontal fracture at 54  LIMESTONE: Dark gray, fine-grained, competent	
-55								CHERT: White marbled with gray, Limey, weathered horizontal fracture between	

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

# SCS ENGINEERS

ОЕРТН (11.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-56	-							brown styolite at 55.3  weathered horizontal fracture at 55.4  weathered horizontal fracture at 55.8  weathered horizontal fracture at 55.8	— Bentonite Seal ———
-57	-	٠						LIMESTONE: Dark gray, coarse-grained. Black styolite at contact CHERT: White marbled with gray, Limey. Weathered fracture between beds LIMESTONE: Dark gray, coarse-grained	
<del>-</del> 58	_	Run 2						LIMESTONE: Dark gray, coarse-grained, intermixed with CHERT: Gray; Separated with gray a cemented vertical fracture filled with pyrite. Weathered horizontal fracture above.  CHERT: Light gray marbled with dark gray, Limey	— Silica Sand ————————————————————————————————————
-59	-							LIMESTONE: Dark gray, coarse-grained  CHERT: Light gray marbled with dark gray	
-60								LIMESTONE: Dark gray, coarse-grained. Black styolite at contact CHERT: Light gray marbled with dark gray, Limey	

Begin core run #3 at 60'

Page12 of 18

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (X)	SYMBOL LOG PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
			95	88			LIMESTONE: medium gray marbled with light and dark gray, competent Cherty.	
							Horizontal fracture at 60.4	
							Horizontal fracture at 60.6  Horizontal fracture at 60.8	
-61	-						Horizontal fracture at 61.1	
	.						LIMESTONE: Dark gray, coarse-grained	
	ı						Cemented 60 degree fracture, black	
							CHERT: Light gray marbled with dark gray, Limey	
-62							LIMESTONE: Dark gray, coarse-grained	
-02							CHERT: Light gray marbled with dark gray, Limey	
				▎╠			groj, amej	- pues
		Run 3		=				S S S S S S S S S S S S S S S S S S S
	ļ						LIMESTONE: Medium gray,	Silica
00							coarse-grained. Black styolite at contact.	
<del>-</del> 63							CUEDT: Light grow Lineary with allight	
							CHERT: Light gray, Limey; with slight weathered horizontal fracture at contact.	
		Run 4					LIMESTONE: Medium gray,	
					干		coarse-grained  Cemented 70 degree fracture from 63.4	
							to 63.6  LIMESTONE: Light gray marbled with	
-64	-						dark gray, Cherty Cemented horizontal fracture	
					<u> </u>		Schicited Horizontal Hactars	
							LIMESTONE: Medium gray, fine-grained,	
							competent  Begin core run #4 at 65'	
<del>-</del> 65	-	·					3-9 55.5 . 31.7 . 31.7 .	

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RGD (%) SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
			100	95			LIMESTONE: Medium gray marbled with light and dark gray, Cherty	
-66	-						LIMESTONE: Dark gray, coarse-grained, competent. Black styolite at contact LIMESTONE: Medium gray, competent: horizontal fracture at contact	
		Run 4					LIMESTONE: Medium gray, slightly Cherty intermixed with dark gray coarse-grained LIMESTONE; Slightly weathered horizontal fracture at contact.	
-67	-						CHERT: Medium gray, marbled with light and dark gray, Limey; cemented vertical fractures throughout  Black styolite at 67.4	Silica Sand
-68	-						Thin lense of light blue LIMESTONE with black styolites above and below	Silice
			103	96			LIMESTONE: Dark gray, coarse-grained; 30 degree fracture  CHERT: Medium gray, marbled with light and dark gray, Limey; Sealed vertical fractures throughout  Begin core run #5 at 68.6'	
-69	-	Run 5					LIMESTONE: Medium gray marbled with light and dark gray, Cherty with black veins throughout  Weathered horizontal fracture at 69.0  Black styolite at 69.1	
							70 degree cemented fracture from 69.2 to 69.4 Weathered horizontal fracture at 69.6 Slightly weathered horizontal fracture	
-70	_						at 69.9	[···-··

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.) ELEVATION	SAMPLE INTERVAL (ft.)	X RECOVERY BLOWS/RGD (X)	PACKER TEST RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
-71 - -72 -	Run 5			LIMESTONE: Thin layer of dark gray, coarse-grained; weathered horizontal fracture at contact  CHERT: Light gray marbled with dark gray Limey; black styolite at contact  Black styolite at 72.0  LIMESTONE: Medium gray marbled with dark gray, Cherty  LIMESTONE: Thin seam of dark gray, coarse-grained Weathered horizontal fracture at 72.5  Highly weathered horizontal fracture at 73.3  LIMESTONE: Dark gray, coarse-grained intermixed with light gray CHERT; weathered 20 degree fracture at contact.  Black styolite at 74.0  LIMESTONE: Medium gray marbled with dark gray, Cherty  Weathered horizontal fracture at 74.7	Silica Sand

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-10
76 77 79		Run 5						LIMESTONE: Thin seam of dark gray, coarse-grained CHERT: Medium gray, marbled with dark gray, Limey Black styolite at 75.5  LIMESTONE: Dark gray, coarse-grained; black styolite at contact  CHERT: Light gray marbled with dark gray, Limey; black styolite at contact  Horizontal fracture at 76.2  LIMESTONE: Dark gray, coarse-grained  CHERT: Light gray, Limey; black styolite at contact.  LIMESTONE: Dark gray, coarse-grained  CHERT: Light gray, Limey; 40 degree fracture at contact  LIMESTONE: Dark gray, coarse-grained  LIMESTONE: Medium gray marbled with dark gray, Cherty  Black styolite at 77.5  End of coring at 78', borehole advanced from 78' to 85.5' using air rotary method.  Intermixed light and dark gray Chert, Limey Chert and Limestone	Silica Sand

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

Honitoring Welt: MW-10    Hard   Hard
As Above: Intermixed light and dark
-84 -

Location: Tontitown, Arkansas

Date Drilled: 6/27/92 Drilled by: Layne Western Surface Elevation: 1190.58 ft, MSL

Coordinates: E1149.9993; N2198.0005

Total corehole depth: 85.5 ft. Logged by: Joe Hoffmeister BORING LOG MW-10

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	M	onitoring Weil: MW-10
								AS Above: Intermixed light and dark gray CHert, Limey Chert and Limestone.	Silica Sand	
-86	-							Bottom of boring at 85.5°		
-87	-									
-88	-									
-89	-									
<del>-</del> 90	-									

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (%) SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monit	oring Well: MW-	-11 ■
<del>-</del>							Intermixed Orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Cement/Bentonite Grout		PVC, Schedule 40,

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

								<u> </u>			
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (%)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monito	oring Well: MW-1	1
<b>-</b> 6	3	NI .	**	11B		74		As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Cement/Bentonite Grout		PVC, Schedule 40,
<del>-</del> 8	_				HHILLILLE						PVC,
-9 10	-				HILLHILLIA						

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

		7111								
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST RESULTS (cm/sec)	DESCRIPTION	Monito	ring Well: MW	-11
±3 -14		INI	×	BIC		AA	As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE			PVC, Schedule 40, 4 in. ID
<b>⊣</b> 5					11111					

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

	JJ LINC							
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RQD (X)	SYMBOL LOG	PACKER TEST RESULTS (cm/sec)	DESCRIPTION	Monitoring Well: MW-11
<del>-1</del> 6	-						As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
<b>-</b> 47	<u>-</u>							Cement/Bentonite Grout
<del>-1</del> 8	-							
<del>1</del> 9	-				HILLIALIA			
-20	_				洱			

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

"	,5 ENG	) 11 1 L L I									
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitor	ring Welt: MW-	11
-21	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE			
-22	-								Cement/Bentonite Grout		PVC, Schedule 40, 4 in. ID
-23	-										PV
-24 -25	-										

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

"	O LINE	/11 1 L L									1
ОЕРТН (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Мо	nitoring Well: MW-11	
-26	_							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE			
-27	-								Cement/Bentonite Grout	Shootule 40	rvc, schedule 40,
-28	<b>-</b>				HHIHHH				Cement/E		LAC. 2
-29	-										
-30	_										

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Mon	itoring Well: MW	<b>-11</b>
-31	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE			
-32	-								Cement/Bentonite Grout		PVC, Schedule 40, 4 in. ID
-33	- -							·	Cement.		PVC,
-34	-							·			
<del>-</del> 35					7						

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monito	oring Welt: MW	<b>-11</b>
-36	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE			
-37	-	•							Cement/Bentonite Grout		PVC, Schedule 40, 4 in. ID
-38	-										PVC, S
-39	-										
<del>-</del> 40					Æ						

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

	J LINC		-						
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST RESULTS	(cm/sec)	DESCRIPTION	Monitoring Well: MW-11
-41	_							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
<del></del> 42	-								Cement/Bentonite Grout PVC, Schedule 40,
-43	-								
-44	-								
<del>-4</del> 5	_								

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RQD (X)	SYMBOL LOG	PACKER TEST	(cm/sec)	DESCRIPTION	Monitoring Well: MW-11
-46				8				As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	
<del>-</del> 47	-								Cement/Bentonite Grout — PVC, Schedule 40,
<del>-4</del> 8	-								
-49 -50	-								

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

"	JO LINE	) 1 1 V L L 1	,0								
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST RESULTS	(cm/sec)	DESCRIPTION	Mon	itoring Well: MW	-11
<del>-</del> 51	_							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE			
-52	-	·			HITHITHE				Cement/Bentonite Grout		PVC, Schedule 40, 4 in. ID
-53	-				HILLIAM				Cement/E		PVC, S
<b>⊢</b> 54	-				HIHIHHH						
-55	-										

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

۱ "	JO LINE	) # i 1 C C i	110								
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST RESULTS	(cm/sec)	DESCRIPTION	Мс	onitoring Welt: M	W11
-56 -57	Con De la Contraction de la Co			8				As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Cement/Bentonite Grout		PVC, Schedule 40, 4 in. ID
-60	_				A						

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

		) 1 1 1 L							
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	% RECOVERY	BLOWS/RGD (%)	SYMBOL LOG	PACKER TEST RESULTS	(cm/sec)	DESCRIPTION	Monitoring Well: MW-11
-61	-							As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Cement/Bentonite Grout
<del>-6</del> 2	<b>L</b>	•							PVC, Schedule 40,
-63	-								
<b>⊢</b> 64	-								Bentonite Seal
-65	_								

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

	J LINE									
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitoring N	ielt MN-11
								As Above: Intermixed orange/red, highly plastic CLAY and white, Cherty LIMESTONE	Bentonite Seal —	
-66	<del>-</del>		100	81				Begin core run #1  LIMESTONE: Medium gray, coarse-grained, intermixed with dark gray, fine grained LIMESTONE		PVC, Schedule 40,
-67	_							Slightly weathered horizontal fracture at 67  CHERT:Light gray, Limey; Slightly weathered horiz. fracture at contact  Brown styolite at 67.4  LIMESTONE: Dark gray, fine-grained.		DVG
-68	-1212 21	Run 1						Cemented 45 degree fracture 45 degree fracture at 67.6 Brown styolite at 67.8 Brown styolite at 68.2 Brown styolite at 68.3	Silica Sand — Silica Sand —	*
-69	- -							Slightly weathered horizontal fracture at 69.0  CHERT: White, Limey; Horizontal fracture at contact		PVC, Schedule 40,
<del>-7</del> 0	_							Horizontal fracture at 69.4  LIMESTONE: Dark gray, fine-grained, fossiliferous, vuggy		

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

		(#)		<b>(X</b> )		<u> </u>	_		Monitorin	g Well: MW-11
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (	* RECOVERY	BLOWS/RQD	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION		
-71	-							Weathered horizontal fracture at 70.6		PVC, Schedule 40, 4 in. ID, 0.010 in. slot
-72								Slightly weathered horizontal fracture at 71.4  LIMESTONE: Intermixed light and dark gray  LIMESTONE: Dark gray, fine-grained, non-weathered		
-73	-	Run 1						Tertical fracture from 71.8 to 72.5	Silica Sand	PVC, Schedule 40, 4 in. ID, 0.010 in. slot
								Weathered horizontal fracture at 73.6		
<del>-</del> 74	-							Cemented fracture at 74.1  LIMESTONE: White, coarse-grained,		
<del>-</del> 75	_							non-weathered; weathered horizontal fracture at contact.  Begin core run #2 at 75'		

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RQD (X) SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Moi	nitoring Well: M	W-11
			95	48			LIMESTONE: White, coarse-grained, non-weathered; weathered horizontal fracture at contact			
<del>-7</del> 6	-						CHERT: Medium gray, Limey  20 degree fracture at 76.3  LIMESTONE: Dark gray, fine-grained, non-weathered,			
<del>-</del> 77	-	Run 2					Brown styolite at 77.1  LIMESTONE: White, coarse-grained, weathered; slightly weathered 20 degree fracture at contact  Broken from 77.6 to 77.8	Silica Sand		PVC, Schedule 40, 4 in. ID, 0.010 in. slot
<del>-</del> 78	-						LIBESTONE: Intermixed light and dark gray CHERT: Medium gray, non-weathered, Limey			PV
-79	-						LIMESTONE: Dark gray, fine-grained, non-weathered CHERT: Medium gray, non-weathered, Limey			
<del>-</del> 80	_				II II		Begin core run #3 at 80'			

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

				<del>,</del>							
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (%)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitor	ing Well: Mi	N~11
			98	66				LIMESTONE: Medium gray, non-weathered, Cherty			
<del>-</del> 81	-							LIMESTONE: Intermixed light and dark gray, non-weathered			
<del>-8</del> 2	_	Run 3						LIMESTONE: Medium gray Cherty; intermixed with a small amount of dark gray LIMESTONE.  Vug at 82.0  Cemented fracture at 82.4  LIMESTONE: Light gray, Cherty; brown styolite at contact  Weathered horizontal fracture at 82.7	- Silica Sand		PVC, Schedule 40, 4 in. ID, 0.010 in. slot
-83	_							LIMESTONE: Dark gray, fine-grained, non-weathered; brown styolite at contact  Brown styolite at 83.4			4
-84	-							Slightly weathered horizontal fracture at 83.9  LIMESTONE: Light gray, Cherty; brown styolite at contact  70 degree fracture from 84.5 to 84.7			
<del>-8</del> 5	_							LIMESTONE: Intermixed light and dark gray; slightly weathered horizontal			

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

1											
ОЕРТН (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (%)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Moi	nitoring Well: Mi	W-11
-86 -87		Run 3						LIMESTONE: White, weathered, coarse-grained; slightly weathered horizontal fracture and brown styolite at contact.  Slightly weathered horizontal fracture at 85.7  Slightly weathered horizontal fracture at 86.0  LIMESTONE: Dark gray, fine-grained, non-weathered  LIMESTONE: White, weathered, coarse-grained; broken from 88.2 to 86.3  LIMESTONE: Dark gray, fine-grained, non-weathered; slightly weathered horizontal fracture at contact.  LIMESTONE: White, weathered, coarse-grained; slightly weathered 30 degree fracture at contact.  Weathered 30 degree fracture at 87.1  LIMESTONE: Dark gray, fine-grained, non-weathered  LIMESTONE: White, slightly weathered, coarse-grained  LIMESTONE: White, slightly weathered, coarse-grained  Begin core run #4 at 90'	Silica Sand ————————————————————————————————————		PVC, Schedule 40, 4 in. ID, 0.010 in. slot

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

1											
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/RGD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Mon	itoring Well: M	W-11
<del>-</del> 91			101	57				LIMESTONE: White, slightly weathered, coarse-grained  Weathered horizontal fracture at 90.1  Weathered horizontal fracture at 90.2  Weathered horizontal fracture at 90.3  Weathered horizontal fracture at 90.6  Slightly weathered horizontal fracture at 90.8			
								Slightly weathered horizontal fracture at 91.2 Slightly weathered horizontal fracture at 91.8			
<del>-</del> 92	-	Run 4						Slightly weathered horizontal fracture at 91.8  Broken and weathered from 92.1 to 92.3	- Silica Sand		PVC, Schedule 40,
<del>-</del> 93								20 degree fracture at 92.8  20 degree fracture at 92.9  Slightly weathered 20 degree fracture at 93.1  LIMESTONE: Dark gray, fine-grained; weathered horiz. fract. at contact  LIMESTONE: White, slightly weathered, coarse-grained; weathered horiz. fracture at contact			P.
<del>-9</del> 4	-							LIMESTONE: Dark gray, fine-grained .8=93.7 LIMESTONE: White, slightly weathered, coarse-grained; brown styolite at contact.  Slightly weathered horizontal fracture at 94.3  LIMESTONE: Dark gray, coarse-grained  LIMESTONE: White, slightly weathered, coarse-grained; weathered 30 degree fracture at contact.			
-95								Weathered horizontal fracture at 94.7		· · · - · · ·	

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

	_									
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	X RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitorin	g Well: MW-11
								Weathered horizontal fracture at 95.2  Horizontal fracture at 95.3  LIMESTONE: Medium gray, medium-grained	-	
<del>-</del> 96	-							LIMESTONE: Light gray, coarse-grained; weathered horizontal fracture at contact. LIMESTONE: Intermixed light and dark gray, Cherty		
-97	_	•						LIMESTONE: Medium gray, medium grained  LIMESTONE: Dark gray, fine-grained, non-weathered  8IMESTONE: Medium gray marbled with	-	),
<del>-</del> 98	-	Run 4						dark gray, coarse-grained  Slightly weathered horizontal fracture	Silica Sand —	PVC, Schedule 40, 4 in. ID, 0.010 in. slot
								LIMESTONE: Medium gray marbled with dark gray, Cherty; weathered horizontal fracture at contact.  LIMESTONE: Dark gray, fine-grained;	-	
<del>-9</del> 9	-							LIMESTONE: Medium gray marbled with dark gray, Cherty; weathered 30 degree fracture at contact.		
<del>-1</del> 00 ⋅								LIMESTONE: Dark gray, fine-grained; slightly weathered horizontal fracture at contact. LIMESTONE: Medium gray marbled with dark gray, Cherty	-	

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

		) I I V C C I									
DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/ROD (X)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	М	ionitoring Well: MW-	11
			102	49				LIMESTONE: Medium gray, medium grained			
								LIMESTONE: Medium gray marbled with dark gray, Cherty; weathered horizontal fracture at contact			
H01								LIMESTONE: Medium gray, medium grained			1
								Weathered horizontal fracture at 101			
								Weathered horizontal fracture at 101.5			
								LIMESTONE: Intermixed light and dark gray, medium grained, fossiliferous			
-102	-				毌			weathered horizontal fracture at contact.			ايد
								LIMESTONE: Dark gray, fine-grained, and white, intermixed with Cherty	   D		e 40, in. sk
		Run 5						LIMESTONE divided by 70 degree fracture, with a weathered horizontal fracture at the contact.	Silica Sand		hedul 0.010
								LIMESTONE: White/light gray, Cherty	- Silica		PVC, Schedule 40, in. ID, 0.010 in. slot
-103	-							Weathered horizontal fracture at 102.9			   4
								Weathered horizontal fracture at 103.1  CHERT: Medium gray, Limey; weathered			
								horizontal fracture at contact.			
-104	-							LIMESTONE: Medium gray, medium grained, slightly weathered			
								Weathered horizontal fracture at 104.1			
								Weathered horizontal fracture at 104.4			
								LIMESTONE: Dark gray, fine-grained; weathered horizontal fracture at contact.			
⊣05	_									···I=1···	

Location: Tontitown, Arkansas

Date Drilled: 6/8/922 Drilled by: Layne Western Surface Elevation: 1280.21 ft, MSL

Coordinates: E-1153.254; N-1371.782

Total corehole depth: 110 ft. Logged by: Joe Hoffmeister BORING LOG MW-11

Project No: 0889015.06

DEPTH (ft.)	ELEVATION (ft, MSL)	SAMPLE INTERVAL (ft.)	* RECOVERY	BLOWS/RGD (%)	SYMBOL LOG	PACKER TEST	RESULTS (cm/sec)	DESCRIPTION	Monitorin	ng Well: MW-11
106 107 108	ELEV (ff.	SAL	X REC	BILOWS	BNAS	PACK	GEN (CE	LIMESTONE: White, weathered, coarse-grained; weathered horizontal fracture at contact.  Slightly weathered horizontal fracture at 105.4  Broken and weathered from 105.8 to 105.8  Weathered horizontal fracture at 106.2  LIMESTONE: Dark gray, fine-grained, non-weathered; weathered horiz. fracture and brown styolite at contact.  LIMESTONE: Intermixed dark gray and white divided by an 80 degree cemented fracture, with a weathered horiz. fract. at contact.  CHERT: White, non-weathered; weathered horiz. fract. at contact.  LIMESTONE: Dark gray, fine-grained, non-weathered LIMESTONE: White, weathered, coarse-grained Fractured and weathered from 109.0 to 109.3  LIMESTONE: Dark gray, fine-grained;	Silica Sand	PVC, Schedule 40,  4 in. ID, 0.010 in. slot
H10								LIMESTONE: Dark gray, fine-grained; \text{weathered horizontal fracture at the} \text{contact.}  Mechanically broken from 109.7 to 110.0	<u> </u>	

# APPENDIX B WELL CONSTRUCTION LOGS



V V	ng Protective Casing ented Cap  Sloped Concrete Pad  Land Surface  Porehole  Potentiometric Elevation  Cement Grout 6-5/8" Outside Diameter PVC	Project Sunray Landfill Cell # 3  Town/City Tontitown  County Washington  Permit No.  Land-Surface Elevation and Datum 1292.07 feet  Installation Dates(s) 7/23/87  Drilling Method Auger - Air Rotary  Drilling Contractor Environed/Mokat  Drilling Fluid	_StateArkansas
	Casing Bentonite Pellet Seal	Development Techniques(s) and Date(s)  Air Lifting 7/23/87	·
	D'Casing Depth 5-3/4" Open Hole Completion	Fluid Loss During Drilling Water Removed During Development Static Depth to Water	gallons
(AMESIA	Limestone	Pumping Depth to Water hours  Yield gpm	Date
125'	Total Depth	Specific Capacity gpr Well Purpose Upgradient Ground-W	
Measuring Point is		Remarks_Potentiometric Elevation	1217.05 ft msl 8/8/87
Well Casing Unles Noted. *Depth Below Land Surface	ss Otherwise		
Nation		Prepared by Brad King	



	Locking Protective	Project Sunray Landfill Cell #3 Well MW-2
	Casing	Town/City Tontitown
	Vented Cap	County Washington State Arkansas
		Permit No.
	Sloped Concrete Pad	
ſ	Land Surface	Land-Surface Elevation and Datum 1238.95 feet ⊠ surveyed
<u> </u>	31 1 WIFE THE PARTY OF THE PART	•
	10" Diameter Borehole	
	Potentiometric Elevation	Installation Dates(s) 7/23/87
	$[\mathcal{L}_{\mathcal{L}}}}}}}}}}$	Drilling Method Auger - Air Rotary
•	Cement Grout 6-5/8" Outside	Drilling ContractorEnvironed/Moleat
	Diameter PVC	Drilling Fluid
24,	Casing	
	Bentonite Pellet Seal	Development Techniques(s) and Date(s)
		Air Lifting 7/23/87
sa .	50' Casing Depth	
	and the purifying the purifyin	
SH.		Fluid Loss During Drillinggallon:
	5-3/4" Open Hole Completion	Water Removed During Developmentgallon:
		Static Depth to Waterfeet below M.P
ia)		Pumping Depth to Waterfeet below M.P
	Limestone	Pumping Duration hours
		Yieldgpm Date
		Specific Capacity gpm/ft
		Well Purpose Piezometric Ground-Water Monitoring
SH)	80' Total Depth	Weil tulpose
ppen.		Remarks Potentiometric Elevation 1205.24 ft msl 8/8/87
		Remarks Potentionetric Elevation 1205.24 It msi 6/8/8/
iglija.	Measuring Point is Top of	
	Well Casing Unless Otherwise Noted.	
and .	140164.	•
	*Depth Below	
	Land Surface	
riid)		Prepared by Brad King



	Locking Protective Casing	Project Sunray Landfill Cell#3	WellNW-3
4	<u>-</u>	Town/City Tontitown	_
	Vented Cap	County Washington	StateArkansas
T	Sloped Concrete Pad	Permit No	
[E.S.]		Land-Surface Elevation	_
	Land Surface	and Datum <u>1209.94</u> feet	surveyed
30	10" Diameter Borehole		□ estimated
°4.2	(. <del>4</del> €)	Installation Dates(s) 7/23/87	
41	Potentiometric Elevation	Drilling Method Auger - Air Rot	ary
3.4	Cement Grout	Drilling ContractorEnvironed/Mokat	
1	6-5/8" Outside Diameter PVC	Drilling Fluid	
4 1	Casing		
7.4	Bentonite	Development Techniques(s) and Date(s)	-
	Pellet Seal	Air Lifting 7/23/87	
			·
	64' Casing Depth		
	5-3/4" Open	Fluid Loss During Drilling	-
	Hole Completion	Water Removed During Development	gallons
		Static Depth to Water	feet below M.P
		Pumping Depth to Water	feet below M.P
	Limestone	Pumping Duration hours	
		Yieldgpm	Date
		Specific Capacity gr	om/ft
		Well Purpose Downgradient Ground-	
	85' Total Depth		
		Remarks Potentionetric Elevation	1170 91 ft msl 8/8/87
		Remarks	1110,0110 1101
	ng Point is Top of		
Well Cas Noted.	sing Unless Otherwise		
Noted.		<del></del>	
*Depth !			
Land S	urface		
		Prepared by Brad King	



Locking Protective Casing	Project Sunray Landfill Cell # 3 Well MW-4 Town/City Tontitown
Vented Cap	County Washington State Arkansas
Sloped Concrete Pad  Land Surface  10" Diameter Borehole  Potentiometric Elevation  Cement Grout 6-5/8" Outside Diameter PVC Casing	Permit No
Bentonite Pellet Seal	Development Techniques(s) and Date(s)  Air Lifting 7/23/87
40' Casing Depth	<del></del>
5-3/4" Open Hole Completion	Fluid Loss During Drilling gallons  Water Removed During Development gallons
Anna Limestone	Static Depth to Water feet below M.P.  Pumping Depth to Water feet below M.P.  Pumping Duration hours
80' Total Depth	Yieldgpm Dategpm/ft  Specific Capacitygpm/ft  Well PurposeDowngradient Ground-Water Monitoring
Princes	Remarks Potentiometric Elevation 1173.27 ft msl 8/8/87
Measuring Point is Top of Well Casing Unless Otherwise Noted.	
*Depth Below Land Surface	·
, veci	Prepared by Brad King



_			
ny.	Locking Protective Casing	Project Sunray Landfill Cell #4	Well
4	<u></u>	Town/City Tontitown	
* Ē	Vented Cap	County Washington	State_Arkansas
<del>П</del>	Sloped Concrete	Permit No	_
FIG	Pad	Land-Surface Elevation	
	Land Surface	and Datum <u>1293.16</u> feet	⊠ surveyed
3-	10" Diameter		☐ estimated
** P 1	Borehole	Installation Dates(s) 7/29/87	
	Potentiometric Elevation	Drilling Method Air Rotary	
nua A	Cement Grout	Drilling Contractor Mokat	
	6-5/8" Outside	Drilling Fluid	
$\begin{bmatrix} \hat{a} & \hat{q}_2 \\ \hat{A} & \hat{q}_2 \end{bmatrix}$	Diameter PVC Casing	Drining Field	
7.4	Bentonite	Development Techniques(s) and Data(s)	
	Pellet Seal	Development Techniques(s) and Date(s)  Air Lifting 7/29/87	•
_ ///			<del></del>
	53' Casing Depth		
			<u> </u>
han Sign	5-3/4" Open	Fluid Loss During Drilling	
	Hole Completion		
		Static Depth to Water	
		Pumping Depth to Water	feet below M.P.
	Limestone	Pumping Duration hours	
		Yieldgpm	Date
		Specific Capacity gr	om/ft
	1105	Well Purpose Upgradient Ground-	Water Monitoring
	110 Total Depth		
		Remarks Potentionetric Elevation	1225.78 ft msl 8/8/87
	•		
	uring Point is Top of Casing Unless Otherwise		
Noted			
* D =	th Balani		
	th Belo <b>w</b> d Surface		
ABSOTT-		Prepared by Brad_King	
·		Prepared by Brad King	



Locking Protective Casing	Project Sunray Landfill Cell #4	Weil
	Town/City Tontitown	
Vented Cap	County Washington	State Arkansas
Sloped Concrete Pad	Permit No	-
Land Surface 10" Diameter	and Datum 1226.35 feet	⊠ surveyed  □ estimated
Borehole  Potentiometric Elevation	Installation Dates(s) 7/29/87  Drilling Method Air Rotary	_
Cement Grout 6-5/8" Outside Diameter PVC Casing	Drilling ContractorMokat  Drilling Fluid	
Bentonite Pellet Seal	Development Techniques(s) and Date(s)  Air Lifting 7/29/87	
33' Casing Depth		
5-3/4" Open Hole Completion	Fluid Loss During Drilling Water Removed During Development	<del>-</del>
	Static Depth to Water	feet below M.P
Limestone	Pumping Depth to Water hours	
100'Total Depth	Yield gpm  Specific Capacity gpn  Well Purpose Piezometer Ground-Wa	
To the second se	Remarks_ Potentionetric Elevation	1200.48 ft msl 8/8/87
		-
Measuring Point is Top of Well Casing Unless Otherwise Noted.		
*Depth Below Land Surface		
	Prepared by Brad King	



	Locking Protective	Project Sunray Landfill Cell #4 Well	<u>MW-7</u>
	Casing	Town/City Tontitown	
<b>37</b> 9	Vented Cap	County Washington State Art	kansas
	Sloped Concrete	Permit No	
مبر سد	Pad	Land-Surface Elevation	
	Land Surface	and Datum <u>1243.60</u> feet ⊠ surveyed	
	10" Diameter	= stimated	<b>.</b>
<b>र</b> ण्य	Borehole  Potentiometric	Installation Dates(s) 7/31/87	- · · · · · · · · · · · · · · · · · · ·
	Potentiometric Elevation	Drilling Method Air Rotary	
Design .	Cement Grout	Drilling ContractorMoka.t	
	6-5/8" Outside Diameter PVC	Drilling Fluid	
	Casing		
assas <sub>1</sub>	Bentonite	Development Techniques(s) and Date(s)	
	Pellet Seal	Air Lifting 7/31/87	
(g)(Re	84' Coning Book		
	84' Casing Depth		
SEPTIA.		Fluid Loss During Drilling	gallons
	5-3/4" Open Hole Completion	Water Removed During Development	_
	Tiole Completion	Static Depth to Water	•
School		Pumping Depth to Water	
	Limestone	Pumping Duration hours	
SÁI(SP)			ite
		Specific Capacity gpm/ft	
		Well Purpose Down-Gradient Ground-Water Monit	oring
(Audi	115 Total Depth	Well 1 dipose	
			_
Ken		Remarks Potentionetric Elevation 1154.13 ft	msl 8/8/87
		nemarks	2/2/2
haven	Measuring Point is Top of Well Casing Unless Otherwise		
	Noted.		
di ejuandi	*Dooth Roley	· · ·	
	*Depth Below Land Surface		
zeriara		Drawadhu Prod Vinc	
		Prepared by <u>Brad King</u>	



	Lock	ing Protective	Project Sunray Landfill Cell #4	Well MW-8
		Casing	Town/City Tontitown	
* (		Vented Cap	County Washington	State Arkansas
	1,7	Sloped Concrete	Permit No	_
·		- Pad	Land-Surface Elevation	
		Land Surface	and Datum 1186.59 feet	⊠ surveyed
٥		10''Diameter		☐ estimated
0.0 ايره ايره		Borehole	Installation Dates(s) 7/31/87	
		Potentiometric Elevation	Drilling Method Air Rotary	
a  }		_Cement Grout	Drilling ContractorMokat	
4		6-5/8" Outside	Drilling Fluid	
å	7.2	_Diameter PVC Casing		
7		Bentonite	Development Techniques(s) and Date(s)	·
		_Pellet Seal	Air Lifting 7/31/87	
_ /				·
	4	<u>5'</u> Casing Depth	-	
Ž				
		5-3/4" Open	Fluid Loss During Drilling	-
		_Hole Completion		_
			Static Depth to Water	
			Pumping Depth to Water	feet below M.P.
		_Limestone	Pumping Duration hours	
			Yield gpm	Date
E			Specific Capacity gpr	
		3,40	Well Purpose Downgradient Ground-W	later Monitoring
		Total Depth		
E				
T			Remarks Potentionetric Elevation	1150.20 ft msl 8/8/87
-casina	Managina Drint	·		
	Measuring Point Well Casing Unle			
	Noted.			
weisse	*Depth Polous			
	*Depth Below Land Surface		-	
ertekseks			Prepared by Brad King	
			Prepared by Brad King	

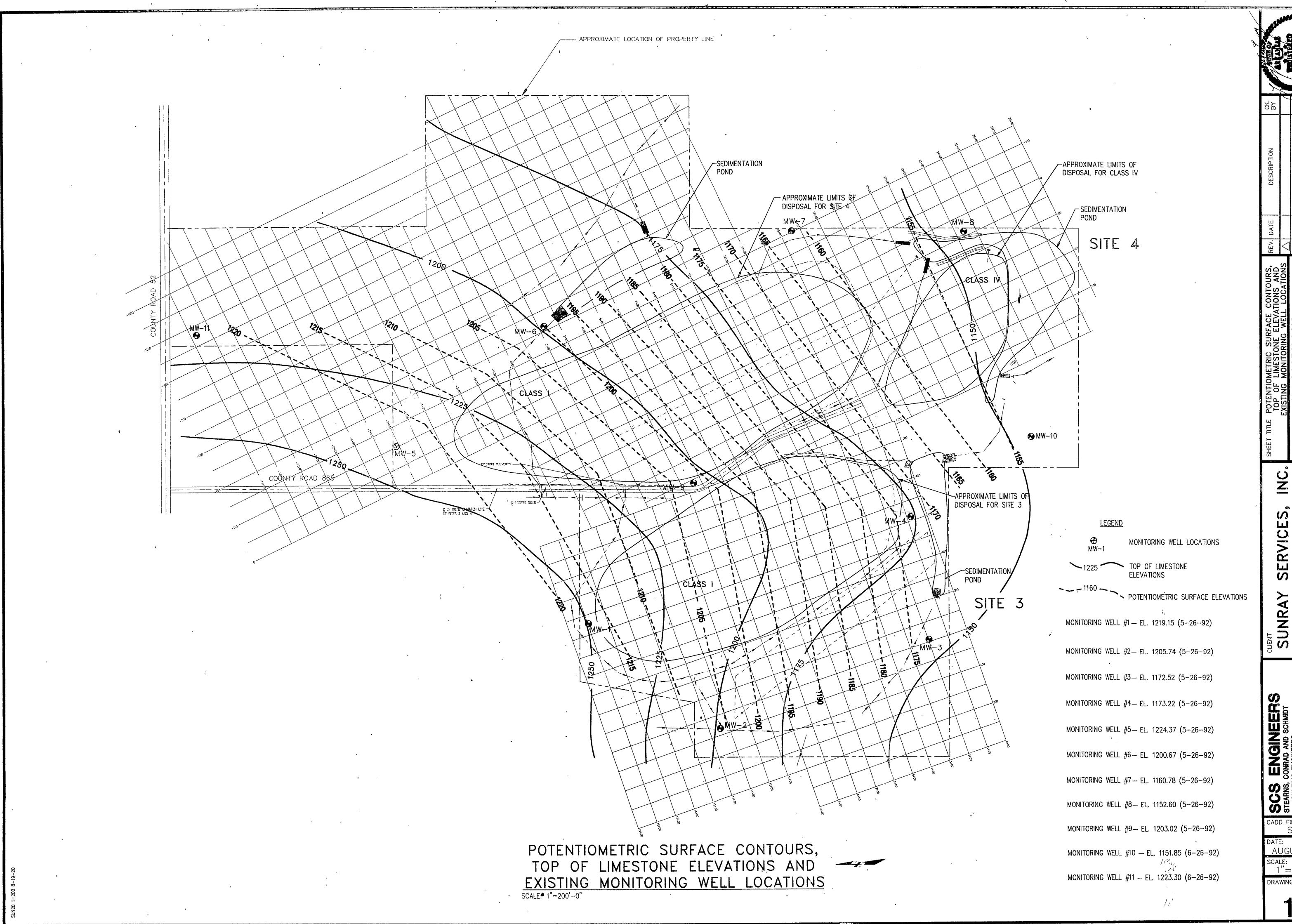


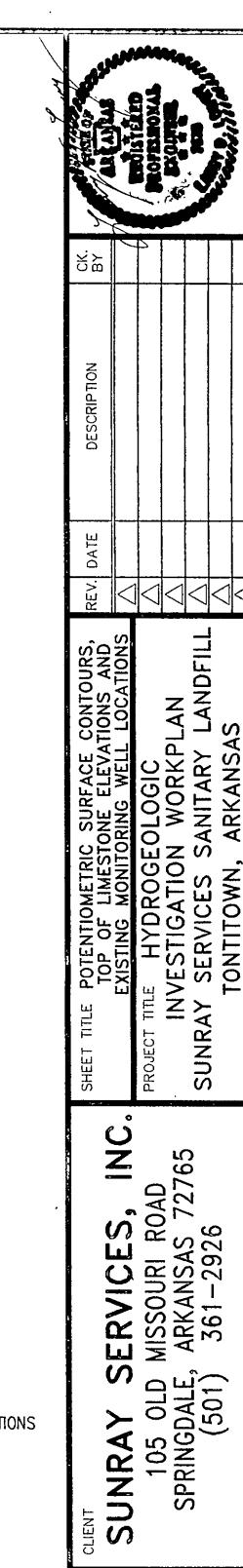
	Locking Protective	Project Sunray Landfill Cell #4 Well	<u> </u>
<b></b>	Casing	Town/City Tontitown	
* (1)	Vented Cap	County Washington State	Arkansas
1	Sloped Concrete	Permit No	
*	Pad	Land-Surface Elevation	
	Land Surface	and Datum <u>1271.82</u> feet ⊠ survey	ed ed
8 6	10" Diameter Borehole		ited
°4.2	Potentionetric	Installation Dates(s) 7/30/87	
-24	Elevation	Drilling Method Air Rotary	
· · · · · · · · · · · · · · · · · · ·	Cement Grout	Drilling ContractorMokat	
7.	6-5/8" Outside Diameter PVC	Drilling Fluid	
å %	Casing		<u> </u>
7/1	Bentonite Pellet Seal	Development Techniques(s) and Date(s)	
	Periet Sear	Air Lifting 7/30/87	<u>.                                    </u>
- ///	73' Casing Depth		
		Fluid Loss During Drilling	gallons
	5-3/4" Open Hole Completic	Water Removed During Development	gallons
		Static Depth to Water	feet below M.P.
		Pumping Depth to Water	feet below M.P.
	Limestone	Pumping Duration hours	
			Date
		Specific Capacity gpm/ft	
		Well Purpose Piezometric Ground-Water Mon	itoring
	105 Total Depth		
TAIN TO THE TAIN THE		Remarks Potentiometric Elevation 1203.12	ft msl 8/8/87
			<u> </u>
Trista.	anda Balaki, Tara		
	suring Point is Top of Casing Unless Otherwise		
Note			
*Dec	oth Below	•	
	nd Surface		
rantam		Prepared by Brad King	
		1 10paide by	

# APPENDIX C PACKER TEST DATA

Hole	Test Zone	L	r	Pressure	Н	Q avg	K	K(AVG)
No.	(ft)	(ft)	(ft)	(Psi)	<u>(ft)</u>	(gpm)	(cm/s)	(cm/s)
}						~		
MW-10	100.34-106.34	6.00	0.13	12	131.03	0.05	3.478E-05	
			0.13	25	161.03	0.26	1.449E-04	8.984E-05
	94-100	6.00	0.13	10	120.00	0.04	3.615E-05	
				20	143.15	0.30	2.165E-04	
				30	166.23	0.35	2.175E-04	1. <b>5</b> 67E-04
	88-94	6.00	0.13	20	137.15	0.35	2.636E-04	
				30	160.23	0.43	2.740E-04	2.688E-04
	82-88	6.00	0.13	20	131.15	0.30	2.363E-04	
				30	154.23	0.40	2.679E-04	2.521E-04
	76-82	6.00	0.13	14	111.31	0.18	1.670E-04	
				20	125.15	0.30	2.435E-04	
				30	148.23	0.41	2.857E-04	2.321E-04
	70÷76	6.00	0.13	14	105.31	0.25	2 452F-04	
		5.55	50					
				30	142.23	0.50	3.631E-04	3.039E-04
	70-76	6.00	0.13	14 20 30	105.31 119.15 142.23	0.25 0.35 0.50	2.452E-04 3.034E-04 3.631E-04	3.039E-0

Hole	Test Zone	L	r F	ressure	Н	Q avg	K	K(AVG)
No.	(ft)	(ft)	(ft)	(Psi)	(ft)	(gpm)	(cm/s)	(cm/s)
MW-11	73-80'	7.00	0.13	10	99.58	0.18	1.71E-04	
		7.00	0.13	20	122.65	80.0	6.18E-05	
		7.00	0.13	30	145.73	0.02	1.30E-05	
		7.00	0.13	40	168.81	0.033	1.85E-05	1.577E-05
	66-73'	7.00	0.13	10	92.58	0.10	1.02E-04	
		7.00	0.13	20	115.65	0.14	1.15E-04	
		7.00	0.13	30	138.73	0.19	1.30E-04	
		7.00	0.13	40	161.81	0.18	1.05E-04	1.167E-04
	5966'	7.00	0.13	10	85.58	0.04	4.43E-05	
		7.00	0.13	20	108.65	0.01	8.73E-06	
		7.00	0.13	30	131.73	0.01	7.20E-06	
		7.00	0.13	40	154.81	0.00	0.00E+00	1.506E-05





cadd file: SUN20

AUGUST 1992 SCALE: 1"=200'-0"

DRAWING NO.



LEGEND

MW-1

MONITORING WELLS

JNRAY SERVICES, INC.
105 OLD MISSOURI ROAD
SPRINGDALE, ARKANSAS 72765
(501) 361-2926
PROJECT TITLE
PROJECT TITLE
PROJECT TITLE
PROJECT TITLE
FINAL

SCS ENGINEERS
STEARNS, CONRAD AND SCHMIDT
CONSULTING ENGINEERS
FOLOTHOLIES ROAD, SUITE 400, KANSAS CITY, MISSOURI 8
PROJ. NO.
PROJ. NO.
DWN. BY:
GAN
JDW
JDW

のはらませ CADD FILE: SUN21

DATE: AUGUST 19 SCALF:

1"=200'-0

of 2