FM0 4616 SA 10-3-2

HUDWALKER & ASSOCIATES, INC

Engineers Surveyors
P O Box 676
FARMINGTON MO 63640

(314) 756 6775

LETTER OF TRANSMITTAL

DATE 11/12/87 | JOB NO

ATTENT ON Mr Bob Overfelt

RE Design Tailings Pile

Site Big River Mines
ID# MOD981216999
Break: 1.3
Other: E+E
11/12/87

TO Ecology & Environment, Inc
4445 Metcalf
Building 3 Suite 400
Overland Park, KS 66202

WE ARE SENDING YOU ☒ Attached ☐ Under separate cover via _____ the following items OVCR

☐ Shop drawings ☒ Prints ☐ Plans ☐ Samples ☐ Specifications

☐ Copy of letter ☐ Change order ☐ _____

COPIES	DATE	NO	DESCRIPTION
1			Plan of Monitoring well locations
1			Monitoring well Details

THESE ARE TRANSMITTED as checked below

☐ For approval ☐ Approved as submitted ☐ Resubmit _____ copies for approval

☒ For your use ☐ Approved as noted ☐ Submit _____ copies for distribution

☒ As requested ☐ Returned for corrections ☐ Return _____ corrected prints

☐ For review and comment ☐ _____

☐ FOR BIDS DUE _____ 19 _____ ☐ PRINTS RETURNED AFTER LOAN TO US

REMARKS _____

40108326
SUPERFUND RECORDS

COPY TO _____

SIGNED [signature]

If enclosures are not as noted kindly notify us at once

Surface Elevation 780
Datum MSL

Completion Date 01/16/87

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	SHEAR STRENGTH tsf (Δ-UU/2, O-QU/2, ◇ SV; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ BLOWS PER FOOT / WATER CONTENT % (PL, 10, 20, 30, 40, 50, LL)	
	Tan to gray very loose to loose slightly silty fine SAND becoming gray and more silty below 14 feet		SS		
10			SS		
			SS		Grain Size Analysis
20			SS		
			SS		Grain Size Analysis
	Intermixed gray loose to medium dense silty clayey SAND to sandy clayey SILT		SS		
30			SS		Grain Size Analysis
40	Auger refusal on SANDY DOLOMITE at 37 5 feet				
50					
60					
70					

NOTE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

GROUNDWATER DATA

ENCOUNTERED AT 23 5 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 9 HOLLOW STEM
____ WASH BORING FROM ____ FEET
MM DRILLER KDO LOGGER
CME 55 DRILL RIG

REMARKS PVC monitoring well casing installed

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

UG-1

GEOTECHNOLOGY
St Louis Missouri

PROJECT [illegible] NO [illegible]

Surface Elevation 784
Datum MSL

Completion Date 01/16/87

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT / SPT VALUE	SAMPLES	SHEAR STRENGTH tsf (Δ-UU/2, O-QU/2, ◇ SV; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ BLOWS PER FOOT / WATER CONTENT % (PL, 10, 20, 30, 40, 50, LL)	
	Tan loose to medium dense fine SAND with zones of gray clay up to 3		SS		
10			SS		
			SS		
20			SS		
			SS		
30			SS		
	Gray medium dense silty SAND to sandy SILT with zones of gray clay and silt		SS		Grain Size Analysis
40			SS		
			SS		
50			SS		
	Gray medium dense silty to slightly clayey fine SAND		SS		
60			SS		
			SS		Grain Size Analysis
70			SS		
	Gray very loose sandy and clayey SILT with green and black organics at 99 feet		SS		
			SS		

NOTE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

GROUNDWATER DATA

ENCOUNTERED AT 34 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 9 HOLLOW STEM
____ WASH BORING FROM ____ FEET
MM DRILLER KDO LOGGER
CME 55 DRILL RIG

REMARKS PVC monitoring well casing installed

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

DG-1

GEOTECHNOLOGY
St Louis Missouri

PROJECT NO

CONTINUATION OF BORING DG-1

SURFACE ELEVATION 784

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	SHEAR STRENGTH tsf (Δ-UU/2, O-QU/2, ◇ SV; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ BLOWS PER FOOT / WATER CONTENT % (PL, 10, 20, 30, 40, 50, LL)	
	Gray very loose, sandy and clayey SILT with green and black organics at 99 feet		SS	▲	
90			SS	▲ ●	Grain Size Analysis
			SS ▲		
100			SS	▲	
	TERMINATED AT 100 DUE TO INSTABILITY OF TAILINGS				
110					
120					
130					
140					
150					
160					
170					

NOTE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

GEOTECHNOLOGY
St. Louis Missouri

PLATE 9

Surface Elevation 794
Datum MSL

Completion Date 01/13/87

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	SHEAR STRENGTH tsf (△-UU/2, ○-QU/2, ◇-SV; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ BLOWS PER FOOT / WATER CONTENT % (PL, LL; 10, 20, 30, 40, 50)	
	Gray loose SAND with zones of silty to clayev SAND		SS		
10			SS		Grain Size Analysis
	Gray very loose sandy to slightly clayey SILT		SS		
20			SS		
			SS	H	Grain Size Analysis
30			SS		
	Medium stiff dark brown and gray silty CLAY				S-6
	Split spoon refusal on SANDY DOLOMITE at 30.5 feet				
40					
50					
60					
70					

NOTE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

GROUNDWATER DATA

ENCOUNTERED AT 13.5 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 9 HOLLOW STEM
____ WASH BORING FROM ____ FEET
MM DRILLER KDO LOGGER
CME 55 DRILL RIG

REMARKS PVC monitoring well casing installed

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

DG-2

GEOTECHNOLOGY
St Louis Missouri

Surface Elevation 784
Datum MSL

Completion Date 01/13/87

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	SHEAR STRENGTH tsf (Δ-UU/2, O-QU/2, ◇ SV) 0.5 1.0 1.5 2.0 2.5 / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ BLOWS PER FOOT / WATER CONTENT % PL 10 20 30 40 50 LL	
	Tan loose to medium dense fine to medium SILT and silty SAND		SS		
10			SS		
			SS		Grain Size Analysis
20			SS		
			SS		
30			SS		
			SS		
40	Brown gray loose fine gravelly SAND with wood and black organics		SS		Grain Size Analysis
	Brown medium stiff silty CLAY with sandy DOLOMITE fragments		SS		Grain Size Analysis
50	Boring terminated at 45 feet				
60					
70					

NOTE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

GROUNDWATER DATA

ENCOUNTERED AT 33 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 9 HOLLOW STEM
____ WASH BORING FROM ____ FEET
MM DRILLER KDO LOGGER
CME 55 DRILL RIG

REMARKS PVC monitoring well casing installed

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

LOG OF BORING

DG-3

GEOTECHNOLOGY
St Louis Missouri

PLATE 11

Surface Elevation 768
Datum MSL

Completion Date 01/19/87

DEPTH IN FEET	DESCRIPTION OF MATERIAL	UNIT DRY WEIGHT SPT VALUE	SAMPLES	SHEAR STRENGTH tsf (Δ-UU/2, O-QU/2, ◇-SV; 0.5, 1.0, 1.5, 2.0, 2.5) / STANDARD PENETRATION RESISTANCE (ASTM D 1586) ▲ BLOWS PER FOOT / WATER CONTENT % (PL, 0, 20, 30, 40, 50, LL)	
	Tan loose to medium dense SAND				
			SS	▲	
			SS	● ▲	Grain Size Analysis
10			SS	▲	
			SS	▲	Grain Size Analysis
20	Brown silty CLAY with dolomite fragments		SS	●	▲ 5-8"
	Split spoon refusal at 29 feet				
30					
40					
50					
60					

NOTE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARIES BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL

GROUNDWATER DATA

ENCOUNTERED AT 24 FEET
AT ____ FEET AFTER ____ HOURS
AT ____ FEET AFTER ____ HOURS
____ FREE WATER NOT ENCOUNTERED DURING DRILLING

DRILLING DATA

____ AUGER 9 HOLLOW STEM
____ WASH BORING FROM ____ FEET
MM DRILLER KDO LOGGER
CME 55 DRILL RIG

REMARKS PVC monitoring well casing installed

SEE NOTATION SHEET FOR DESCRIPTION OF ABBREVIATIONS

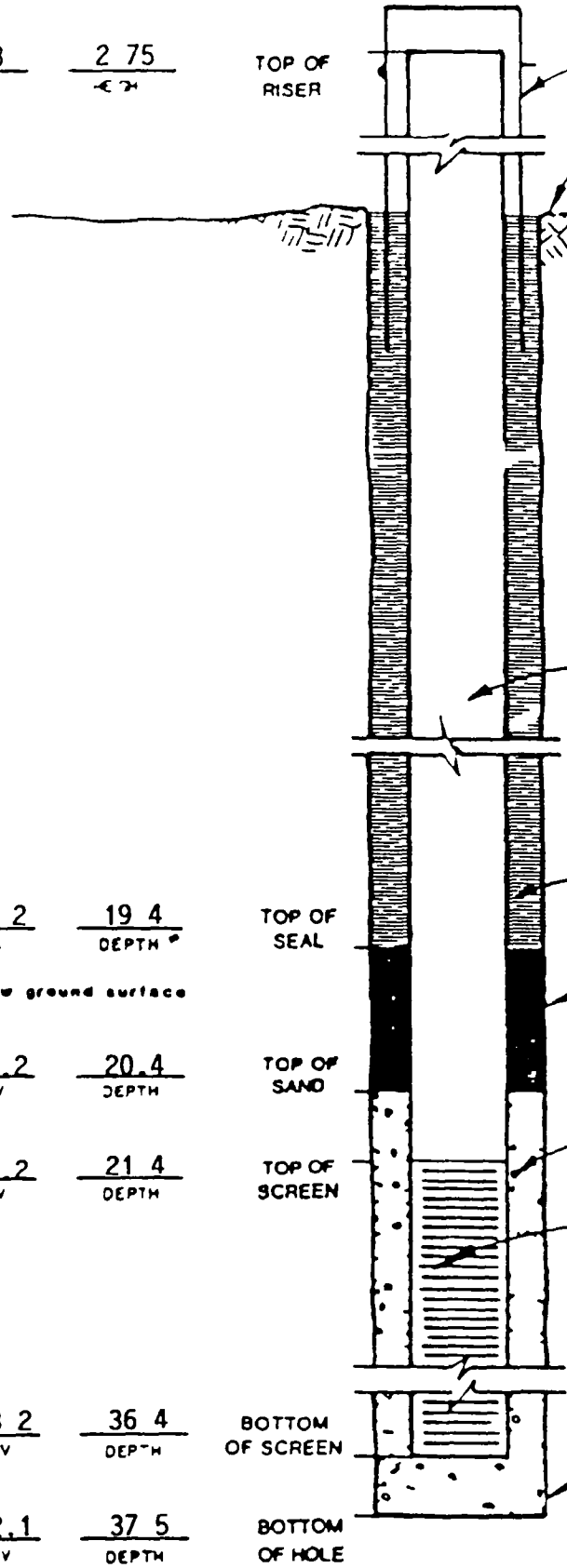
LOG OF BORING

DG-4

GEOTECHNOLOGY
St Louis Missouri

DATE INSTALLED 1/16/87

DATE DEVELOPED N/A - dry



ELEV	DEPTH	
782.3	2.75	TOP OF RISER
760.2	19.4	TOP OF SEAL
759.2	20.4	TOP OF SAND
758.2	21.4	TOP OF SCREEN
743.2	36.4	BOTTOM OF SCREEN
742.1	37.5	BOTTOM OF HOLE

* below ground surface

PROTECTIVE COVER 4 x 4 Steel

LOCATION N12461 E8637

GROUND ELEVATION 779.6 DATUM MSL

DETERMINED BY Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/21	39.1	Dry
1/21	37.1	25 Gallons added
1/21	38.6	6 Minutes later
3/11	39.1	Dry

depth measured from top of riser

RISER TYPE flush coupled PVC

DIAMETER 2 IN

LENGTH 24 FT

BACKFILL bentonite/cement grout

SEAL bentonite pellets

SAND medium sand (WB40)

SCREEN DIA 2 IN LENGTH 15 FT

TYPE PVC

SLOT SIZE 0.01 IN

BOREHOLE DIAMETER 9 IN

DRILL METHOD 4.25 HSA

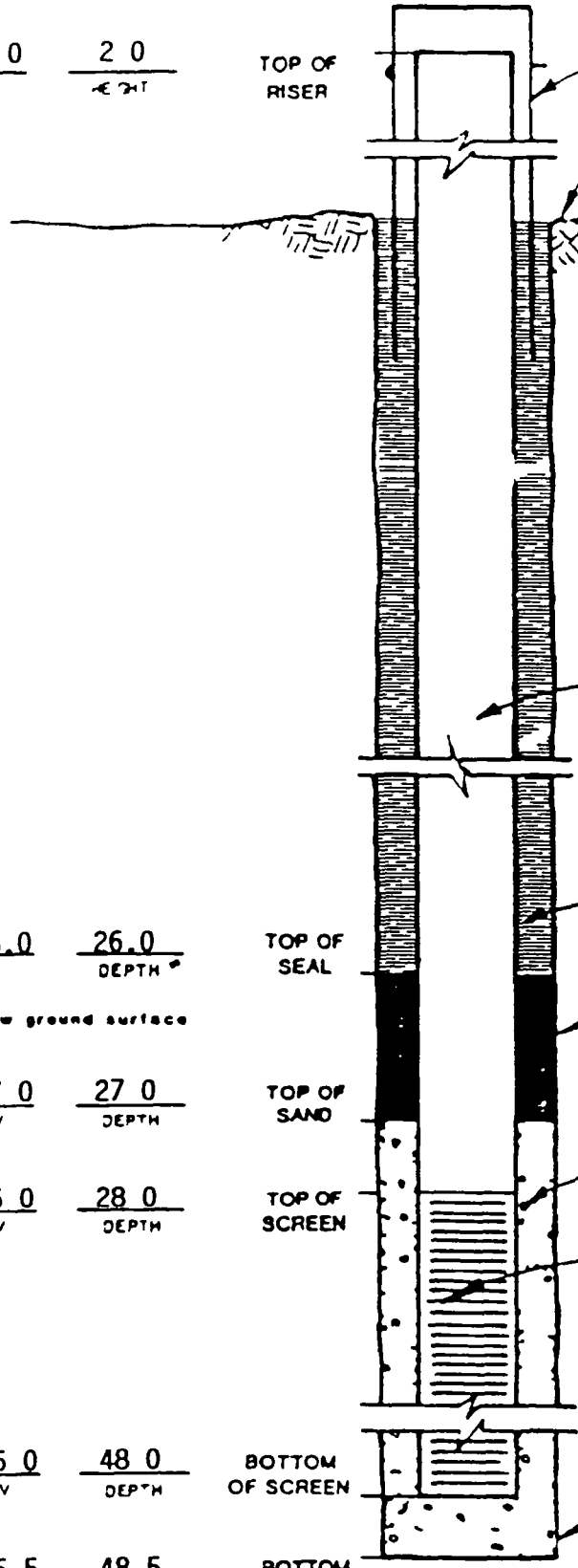
REMARKS

MONITORING WELL UG-1

GEOTECHNOLOGY
St. Louis, Missouri

DATE INSTALLED 1/16/87

DATE DEVELOPED 1/21/87



ELEV	DEPTH	
786 0	2 0	TOP OF RISER
758.0	26.0	TOP OF SEAL
757 0	27 0	TOP OF SAND
756 0	28 0	TOP OF SCREEN
736 0	48 0	BOTTOM OF SCREEN
735.5	48.5	BOTTOM OF HOLE

* below ground surface

PROTECTIVE COVER 4 x 4 Steel

LOCATION N11851 E9002

GROUND ELEVATION 784.0 DATUM MSL

DETERMINED BY Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/21	46 8	
1/21	37 0	Added 36 gallons
1/21	41.4	After 5 minutes
1/21	44.3	After 20 minutes
3/11	46.3	

depth measured from top of riser

RISER TYPE flush coupled PVC

DIAMETER 2 IN

LENGTH 30 FT

BACKFILL bentonite/cement grout

SEAL bentonite pellets

SAND medium sand (WB40)

SCREEN DIA 2 IN LENGTH 20 FT

TYPE PVC

SLOT SIZE 0 01 IN

BOREHOLE DIAMETER 9 IN

DRILL METHOD 4 25 HSA

REMARKS

MONITORING WELL DG-1

GEOTECHNOLOGY
St. Louis, Missouri

DATE INSTALLED 1/13/87

DATE DEVELOPED 1/20/87

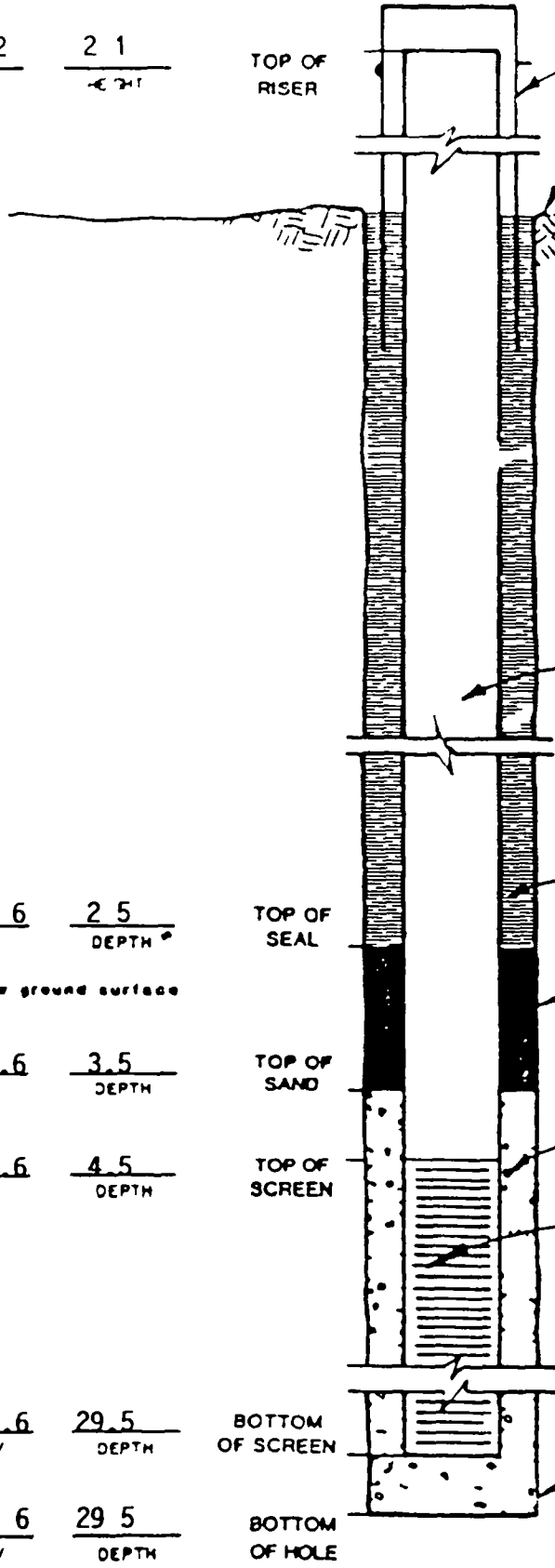
796 2 — 2 1 — TOP OF RISER

PROTECTIVE COVER 4 x 4 Steel

LOCATION N10707 E9781

GROUND ELEVATION 794 1 DATUM MSL

DETERMINED BY Survey



WELL WATER LEVELS		
DATE	DEPTH	REMARKS
1/16	24 9	Before development
1/20	24 5	After development
3/11	23 3	

depth measured from top of riser

RISER TYPE flush coupled PVC

DIAMETER 2 IN

LENGTH 6 6 FT

BACKFILL bentonite/cement grout

791 6 — 2 5 — TOP OF SEAL

ELEV — DEPTH*

* below ground surface

SEAL bentonite pellets

790.6 — 3.5 — TOP OF SAND

ELEV — DEPTH

SAND medium sand (WB40)

789.6 — 4.5 — TOP OF SCREEN

ELEV — DEPTH

SCREEN DIA 2 IN LENGTH 25 FT

TYPE PVC

SLOT SIZE 0.01 IN

764.6 — 29.5 — BOTTOM OF SCREEN

ELEV — DEPTH

BOREHOLE DIAMETER 9 IN

DRILL METHOD 4 25 HSA

763 6 — 29 5 — BOTTOM OF HOLE

ELEV — DEPTH

REMARKS

MONITORING WELL DG-2

GEOTECHNOLOGY
St. Louis, Missouri

DATE INSTALLED 1/13/87

DATE DEVELOPED N/A - Dry

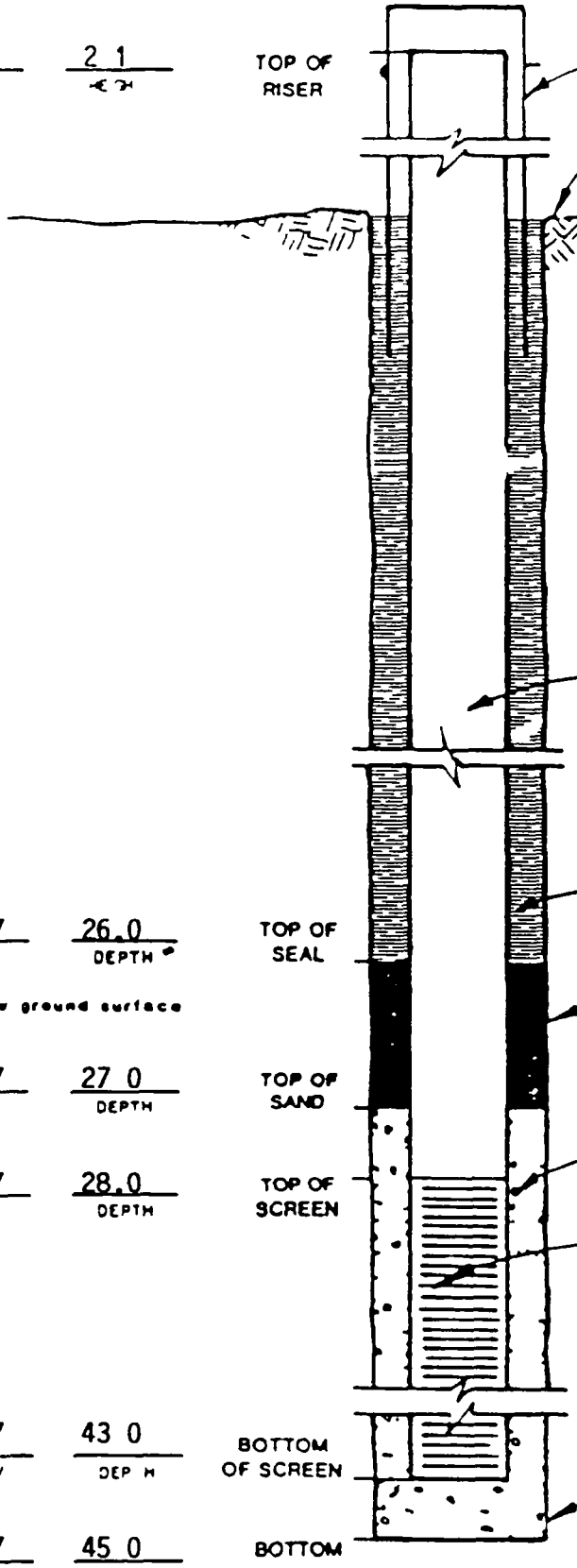
785.8 | 2.1 | TOP OF RISER

PROTECTIVE COVER 4' x 4 Steel

LOCATION N9746 E8892

GROUND ELEVATION 783.7 DATUM MSL

DETERMINED BY Survey



WELL WATER LEVELS		
DATE	DEPTH	REMARKS
1/16	44.1	
1/20	44.1	20 Gallons added
1/21	44.6	10 Gallons added

depth measured from top of riser

RISER TYPE flush coupled PVC

DIAMETER 2 IN

LENGTH 30 FT

BACKFILL bentonite/cement grout

757.7 (ELEV) | 26.0 (DEPTH *) | TOP OF SEAL

* below ground surface

SEAL bentonite pellets

756.7 (ELEV) | 27.0 (DEPTH) | TOP OF SAND

SAND medium sand (WB40)

755.7 (ELEV) | 28.0 (DEPTH) | TOP OF SCREEN

SCREEN DIA 2 IN LENGTH 15 FT

TYPE PVC

SLOT SIZE 0.01 IN

740.7 (ELEV) | 43.0 (DEPTH) | BOTTOM OF SCREEN

BOREHOLE DIAMETER 9 IN

DRILL METHOD 4.25 HSA

738.7 (ELEV) | 45.0 (DEPTH) | BOTTOM OF HOLE

REMARKS

MONITORING WELL DG-3

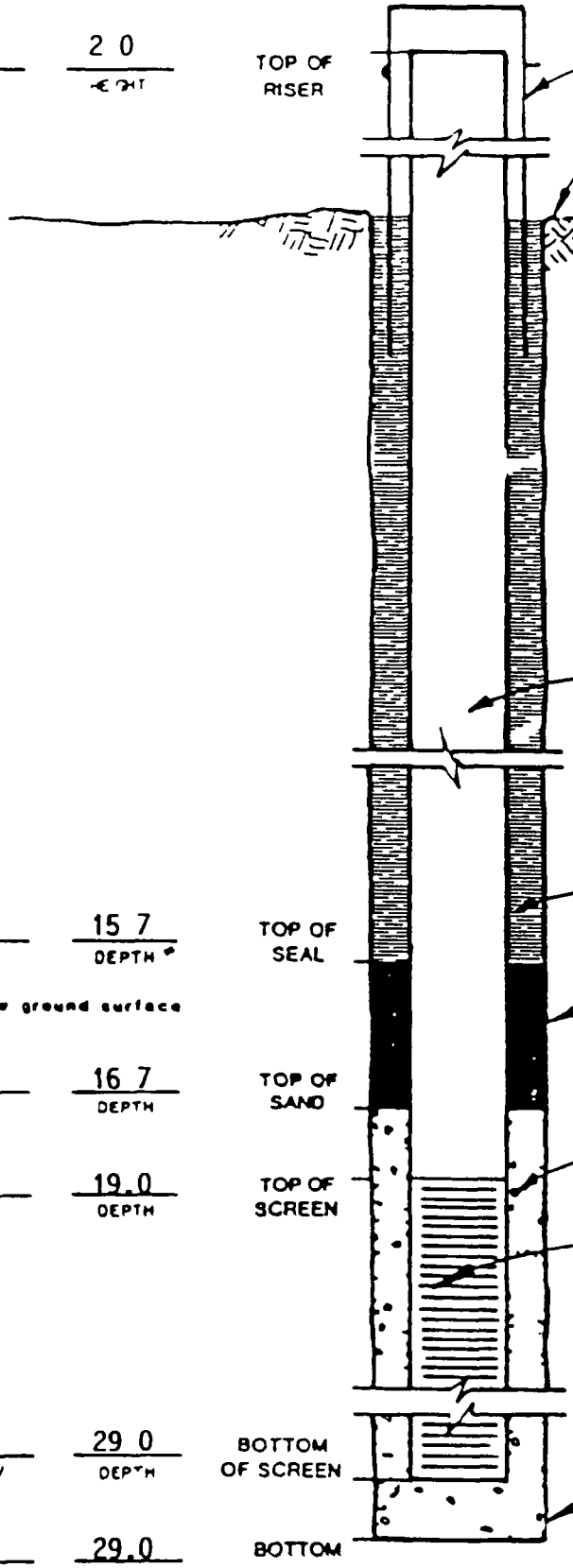
GEOTECHNOLOGY
St. Louis, Missouri

DATE INSTALLED 1/19/87

DATE DEVELOPED N/A - Dry

ELEV	DEPTH*	
770 2	2 0	TOP OF RISER
752 5	15 7	TOP OF SEAL
751.5	16 7	TOP OF SAND
749.2	19.0	TOP OF SCREEN
739 2	29 0	BOTTOM OF SCREEN
739.2	29.0	BOTTOM OF HOLE

* below ground surface



PROTECTIVE COVER 4 x 4 Steel

LOCATION N10934 E8137

GROUND ELEVATION 768 2 DATUM MSL

DETERMINED BY Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/21	28 3	
1/21	26 3	After 22 gallons
1/21	27 2	6 Minutes later

depth measured from top of riser

RISER TYPE flush coupled PVC

DIAMETER 2 IN

LENGTH 21 FT

BACKFILL bentonite/cement grout

SEAL bentonite pellets

SAND medium sand (WB40)

SCREEN DIA 2 IN LENGTH 10 FT

TYPE PVC

SLOT SIZE 0 01 IN

BOREHOLE DIAMETER 9 IN

DRILL METHOD 4 25 HSA

REMARKS

MONITORING WELL DG-4

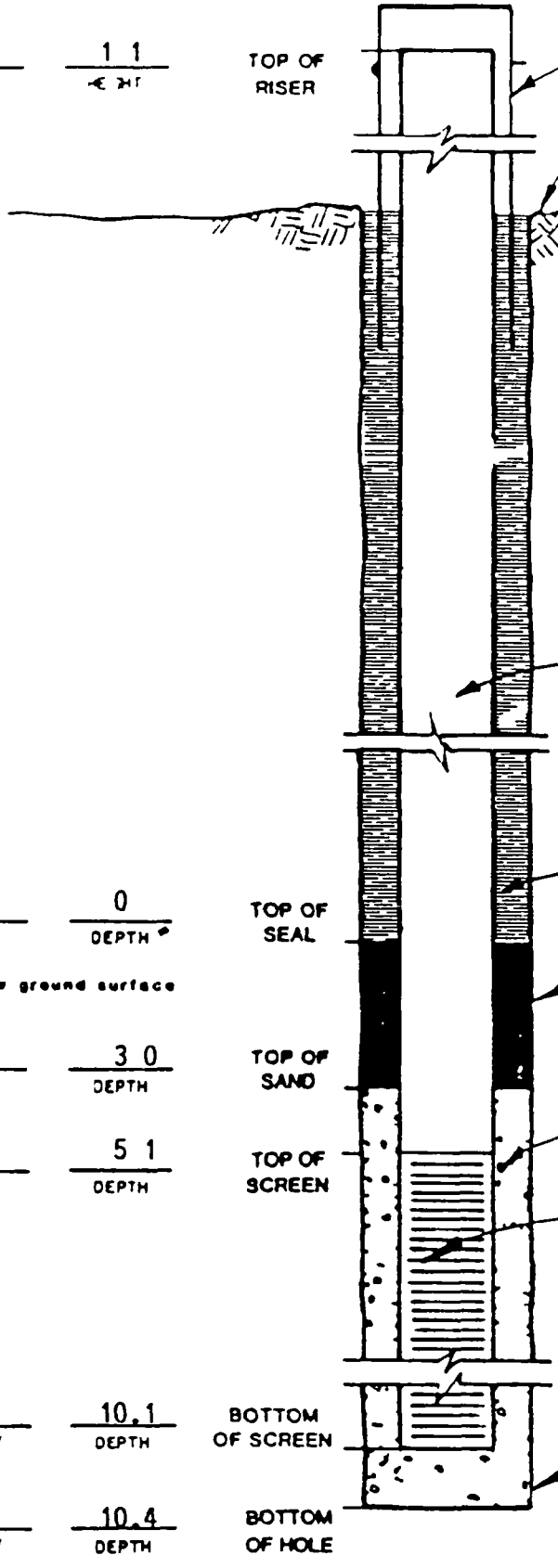
GEOTECHNOLOGY
St. Louis, Missouri

DATE INSTALLED 1/19/87

DATE DEVELOPED 1/19/87

ELEV	DEPTH	
683.1	1.1	TOP OF RISER
682.0	0	TOP OF SEAL
679.0	3.0	TOP OF SAND
671.9	5.1	TOP OF SCREEN
671.9	10.1	BOTTOM OF SCREEN
671.6	10.4	BOTTOM OF HOLE

* below ground surface



PROTECTIVE COVER 4 x 4 Steel

LOCATION N12069 E9185

GROUND ELEVATION 682 DATUM MSL

DETERMINED BY Survey

WELL WATER LEVELS

DATE	DEPTH	REMARKS
1/19	6.0	After installation
1/19	7.0	After development

depth measured from top of riser

RISER TYPE flush coupled PVC

DIAMETER 2 IN

LENGTH 6.2 FT

BACKFILL

SEAL cement

SAND natural sand

SCREEN DIA 2 IN LENGTH 5 FT

TYPE PVC

SLOT SIZE 0.01 IN

BOREHOLE DIAMETER 4 IN

DRILL METHOD 4" hand auger and casing

REMARKS

MONITORING WELL DG-5

GEOTECHNOLOGY
St. Louis, Missouri