APPENDIX B

BORING LOGS AND WELL CONSTRUCTION DIAGRAMS

Section 1: PBRF Logs
Section 2: PBS Logs

Section 1: PBRF Logs

EB-RA-01

EB-RA-02

Project: NASA Plum Brook, Reactor Area
Project Location: Plum Brook, Ohio
Project Number: 19-F0087521.00

RECEIVED MAR 15 2000 OHIO E.P.A. N.W.D.O.

Log of Boring RA-MW-02

Sheet 1 of 1

Date(s) Drilled and Installed	September 9, 1998	Geologist	J. Anderson	Reviewer	J. Berk
Drilling Method	Hollow-stem auger	Drilling Contractor	Summit Drilling, Inc.	Total Depth of Borehole	25.0 feet
Sampling Method	2-inch-dia. unlined split spoon	Hammer Data	140 lbs / 30-inch drop	Top of Casing Elevation	628.07 feet MSL
Size and Type of Well Casing	2-inch-dia. stainless steel	Screen Perforation	#10 slot (19-25 feet)	Approximate Surface Elevation	628.5 feet MSL
Seal or Backfill	Bentonite-cement grout 3.5-15 feet, bentonite pellets 15-17 feet	Comments	Refer to site plan for well location.		

Elevation feet	Depth, feet	Type	Number	Sampling Resistance, blows / 6 in.	Recovery, %	Headspace HNu, ppm	Lithologic Log (USCS Code)	MATERIAL DESCRIPTION	FIELD NOTES AND WELL DETAILS
	0		1	2-4-5-9	75	<1		Topsoil	8-in.-dia. borehole
							SM	Loose, moist, brown, silty fine SAND	
			2	2-3-4-8	100	<1		With occasional silt interbeds	Concrete (0-3.5 ft)
625			3	8-7-12-12	100	<1		Becomes medium dense	
	5								Bentonite-cement (3.5-15 ft)
			4	2-3-4-5	100	<1		Becomes loose, wet, gray	
							CL	Medium stiff, wet, gray, sandy CLAY with some dark gray organic streaking	
620			5	3-2-4-6	75	<1	SM	Loose, wet, medium dark gray, silty fine SAND; grades lighter gray with depth	2-in.-dia. stainless steel casing
	10		6	2-2-3-4	100	<1	CL	Medium stiff, wet, gray, silty plastic CLAY	
			7	2-3-2-4	100	<1			
615			8	1-2-4-3	100	<1			
	15		9	1-2-3-3	100	<1			Bentonite pellets (15-17 ft)
610			10	1-2-1-1	100	<1		Becomes soft	#5 Global sand pack (17-25 ft)
	20		11	1-1-2-1	100	<1			
			12	1-1-2-10	100	<1	CL	Soft, wet, gray CLAY	#10 slot stainless steel screen (19-24 ft)
605			13	4-50/3"	20	<1		Weathered SHALE, wet, friable	
	25							Boring terminated at 25.0 feet due to auger refusal	
600	30								

Report Eng 12 CLEVELAND File NASAPLUM.GPJ 5/5/99

URS Greiner Woodward Clyde

EB-RA-03

Project: NASA Plum Brook, Reactor Area **Project Location:** Plum Brook, Ohio **Project Number:** 19-F0087521.00	**Log of Boring RA-MW-03** Sheet 1 of 1

Date(s) Drilled and Installed	September 9, 1998	Geologist	J. Anderson	Reviewer	J. Berk
Drilling Method	Hollow-stem auger	Drilling Contractor	Summit Drilling, Inc.	Total Depth of Borehole	22.0 feet
Sampling Method	2-inch-dia. unlined split spoon	Hammer Data	140 lbs / 30-inch drop	Top of Casing Elevation	627.82 feet MSL
Size and Type of Well Casing	2-inch-dia. stainless steel	Screen Perforation	#10 slot (15.5-20.5 feet)	Approximate Surface Elevation	628 feet MSL
Seal or Backfill	Bentonite-cement grout 3.5-11.5 feet, bentonite pellets 11.5-13.5 feet	Comments	Refer to site plan for well location.		

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance, blows / 6 in.	Recovery, %	Headspace HNu, ppm	Graphic Log	Lithologic Log (USCS Code)	MATERIAL DESCRIPTION	Well Completion Schematic	FIELD NOTES AND WELL DETAILS
	0		1	NA	75	<1			Topsoil		8-in.-dia. borehole
								ML	Moist, brown mottled SILT		Concrete (0-2 ft)
625			2	NA	75	<1		SM	Moist, gray-brown mottled, silty fine SAND with trace clay		
	5		3	NA	75	<1		SP-SM	Moist, brown mottled, fine SAND with trace silt		Bentonite-cement (2-11.5 ft)
			4	NA	90	<1		ML	Wet, gray, fine sandy SILT with some clay		
620			5	NA	NA	<1		ML	Wet, medium dark gray, fine sandy SILT with trace clay, some very fine sand seams at 2- to 3-inch intervals, some dark gray organic staining		2-in.-dia. stainless steel casing
	10		6	NA	100	<1			Becomes moist, gray, with no sand seams, trace dark gray organic streaking		
			7	NA	100	<1		ML	Damp, gray SILT with little clay, trace dark gray organic streaking		Bentonite pellets (11.5-13.5 ft)
615			8	NA	100	<1		CL	Damp, light to dark gray mottled CLAY with thin silt seams		#5 Global sand pack (13.5-22 ft)
	15		9	NA	100	<1					
610			10	NA	100	<1			Becomes dark gray, with trace dark black organic streaking		#10 slot stainless steel screen (15.5-20.5 ft)
	20		11	NA	100	<1			Becomes more plastic		
									With little shale fragments at end of split-spoon sampler		
605									Boring terminated at 22.0 feet due to auger refusal		
	25										
600											
	30										

Report ENV 12 CLEVELAND, File NASAPLUM GPJ, 5/5/99

URS Greiner Woodward Clyde

EB-RA-04

Project: NASA Plum Brook, Reactor Area Project Location: Plum Brook, Ohio Project Number: 19-F0087521.00	**Log of Boring RA-MW-04** Sheet 1 of 1

Date(s) Drilled and Installed	September 9, 1998	Geologist	J. Anderson	Reviewer	J. Berk
Drilling Method	Hollow-stem auger	Drilling Contractor	Summit Drilling, Inc.	Total Depth of Borehole	26.0 feet
Sampling Method	2-inch-dia. unlined split spoon	Hammer Data	140 lbs / 30-inch drop	Top of Casing Elevation	628.36 feet MSL
Size and Type of Well Casing	2-inch-dia. stainless steel	Screen Perforation	#10 slot (20-25 feet)	Approximate Surface Elevation	628.5 feet MSL
Seal or Backfill	Bentonite-cement grout 3.5-16 feet, bentonite pellets 16-18 feet	Comments	Refer to site plan for well location.		

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance, blows / 6 in.	Recovery, %	Headspace HNu, ppm	Graphic Log	Lithologic Log (USCS Code)	MATERIAL DESCRIPTION	Well Completion Schematic	FIELD NOTES AND WELL DETAILS
	0		1	NA	75	<1			Topsoil		8-in.-dia. borehole
								SM	Moist, brown, silty fine SAND		
			2	NA	90	<1					Concrete (0-4 ft)
625			3	NA	60	<1					
	5										Bentonite-cement (4-18 ft)
			4	NA	100	<1		SP	Wet, gray SAND with some dark gray organic streaking grading to ...		
								CL	Moist, gray, silty CLAY with thin sand seams		
620			5	NA	100	<1		SM	Wet, gray, silty fine SAND		2-in.-dia. stainless steel casing
	10		6	NA	90	<1		ML	Wet, gray SILT with some sand and clay, some organic streaking		
			7	NA	NA	<1		CL	Moist, gray, silty CLAY with trace fine sand and organic streaking		
615			8	NA	NA	<1		CL	Moist, gray, plastic CLAY		
	15		9	NA	100	<1			Silty With trace organic streaking and sand seams to 1/8 inch thick		Bentonite pellets (16-18 ft)
610			10	NA	80	<1			With trace gravel fragments, no organic streaking or sand		#5 Global sand pack (18-26 ft)
	20		11	NA	100	<1			With trace dark gray organic streaking, no gravel fragments		
			12	NA	NA	<1			Becomes wet, more plastic		#10 slot stainless steel screen (20-25 ft)
605			13	NA	20	<1			With shale and limestone fragments 3/4 to 1 inch size		
	25										
									Boring terminated at 26.0 feet due to auger refusal		
600											
	30										

URS Greiner Woodward Clyde

Report ENV 12_CLEVELAND, File NASAPLUM.GPJ, 5/5/99

EB-RA-05

Project: NASA Plum Brook, Reactor Area **Project Location:** Plum Brook, Ohio **Project Number:** 19-F0087521.00	**Log of Boring RA-MW-05** Sheet 1 of 2

Date(s) Drilled and Installed	September 21 and 29, 1998	Geologist	J. Anderson	Reviewer	J. Berk
Drilling Method	Hollow-stem auger, NX core, air rotary with roller bit	Drilling Contractor	Summit Drilling, Inc.	Total Depth of Borehole	50.0 feet
Sampling Method	No sampling performed (boring logged from cuttings)	Hammer Data	Not applicable	Top of Casing Elevation	627.87 feet MSL
Size and Type of Well Casing	6-inch-ID galvanized steel 0-28 feet; 2-inch-dia. stainless steel 0-50 feet	Screen Perforation	#10 slot (44-49 feet)	Approximate Surface Elevation	628 feet MSL
Seal or Backfill	Bentonite-cement grout 26-30.5 feet, bentonite pellets 30.5-34.5 feet	Comments	Drilled to 26 ft using 8-1/4-in.-ID auger; to 28 ft with air rotary to set outer casing; cored through casing to 38.5 ft, reamed and drilled 50 ft with 5-7/8-in. roller bit		

Elevation feet	Depth, feet	SAMPLES: Type	Number	Sampling Resistance, blows / 6 in.	Recovery, %	Headspace HNu, ppm	Graphic Log	Lithologic Log (USCS Code)	MATERIAL DESCRIPTION	Well Completion Schematic	FIELD NOTES AND WELL DETAILS
	0							ML	Moist, medium brown to light brown, sandy SILT		12-in.-dia. borehole (0-28 ft)
											Concrete (0-2.5 ft)
625											
	5							SM	Wet, brown, silty fine SAND		6-in.-ID galvanized steel outer casing, flush-threaded to 28 ft
620											
	10										Bentonite-ce (2.5-25 ft)
									grading to ...		
								CL	Wet, gray, sandy CLAY		
615											2-in.-dia. stainless steel well casing
	15							CL	Wet, gray, plastic CLAY with trace silt and sand		
610											
	20								No silt or sand		
605											
									Weathered LIMESTONE, fractured		
	25								[Auger refusal at 26.0 feet]		Concrete plug (25-26 ft)
									Gray LIMESTONE		
600									...Bedrock releasing 18 ppm H_2S, LEL=16%		Bentonite-cement (26-30.5 ft)
											6-in.-dia. boreh... (28-50 ft)
	30										

Report ENV_12_CLEVELAND, File: NASAPLUM.GPJ, 5/5/98

URS Greiner Woodward Clyde

Project: NASA Plum Brook, Reactor Area
Project Location: Plum Brook, Ohio
Project Number: 19-F0087521.00

Log of Boring RA-MW-05

Elevation feet	Depth, feet	SAMPLES: Type	SAMPLES: Number	SAMPLES: Sampling Resistance, blows / 6 in.	SAMPLES: Recovery, %	SAMPLES: Headspace HNu, ppm	Graphic Log	Lithologic Log (USCS Code)	MATERIAL DESCRIPTION	Well Completion Schematic	FIELD NOTES AND WELL DETAILS
	30								Gray LIMESTONE (continued)		2-in.-dia. stainless steel well casing
595											Bentonite pellets (30.5-34.5 ft)
	35										#5 Global sand pack (34.5-50 ft)
590											
	40										
585											
	45										#10 slot stainless steel screen (44-49 ft)
580											
	50								Bottom of boring at 50.0 feet Unconsolidated material was logged using soil cuttings.		
575											
	55										
570											
	60										
565											
	65										

EB-RA-06

Project: NASA Plum Brook, Reactor Area **Project Location:** Plum Brook, Ohio **Project Number:** 19-F0087521.00	**Log of Boring RA-MW-06** Sheet 1 of 1

Date(s) Drilled and Installed	September 8, 1998	Geologist	J. Anderson	Reviewer	J. Berk
Drilling Method	Hollow-stem auger	Drilling Contractor	Summit Drilling, Inc.	Total Depth of Borehole	23.8 feet
Sampling Method	2-inch-dia. unlined split spoon	Hammer Data	140 lbs / 30-inch drop	Top of Casing Elevation	627.64 feet MSL
Size and Type of Well Casing	2-inch-dia. stainless steel	Screen Perforation	#10 slot (18-23 feet)	Approximate Surface Elevation	628 feet MSL
Seal or Backfill	Bentonite-cement grout 3.5-14 feet; bentonite pellets 14-16 feet	Comments	Refer to site plan for well location.		

Elevation feet	Depth, feet	SAMPLES Type	Number	Sampling Resistance, blows / 6 in.	Recovery, %	Headspace HNu, ppm	Graphic Log	Lithologic Log (USCS Code)	MATERIAL DESCRIPTION	Well Completion Schematic	FIELD NOTES AND WELL DETAILS
	0		1	NA	90	<1		GP	Sandy GRAVEL		8-in.-dia. borehole
								SM	Moist, brown, silty fine SAND		Concrete (0-2.5 ft)
625			2	NA	90	<1					
	5		3	NA	80	<1					Bentonite-cement (2.5-14 ft)
			4	NA	NA	<1					
620			5	NA	75	<1			grading to ...		
								ML	Moist, gray, clayey SILT		2-in.-dia. stainless steel casing
	10		6	NA	100	<1			Becomes wet		
			7	NA	100	<1		CL	Wet, gray, silty CLAY		
615											
	15		8	NA	100	<1					Bentonite pellets (14-16 ft)
			9	NA	100	<1			Becomes moist		#5 Global sand pack (16-23.8 ft)
610			10	NA	100	<1					
	20		11	NA	100	<1		CH	Moist, gray, very plastic CLAY		#10 slot stainless screen (18-23 ft)
			12	NA	50	<1			Becomes wet		
605									SHALE		
	25								Boring terminated at 23.8 feet due to auger refusal		
600											
	30										

Report EHV 12 CLEVELAND, File HASAPLUM.GPJ, 5/5/99

URS Greiner Woodward Clyde

RA-07S

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

964877

WELL LOCATION

County ERIE Township PERKINS

Owner/Builder (Circle One or Both) First PLUM BROOK Last ORDINANCE WORKS

Address of Well Location Number COLUMBUS Street Name RD.

City SANDUSKY Zip Code +4 44870

Permit No. RA-075 Section/Lot No. (Circle One or Both) N/A

Location of Well in State Plane coordinates, if available: Use of Well MONITORING

N ☐ X _____ . _____ +/- _____ ft. or m

S ☐ Y _____ . _____ +/- _____ ft. or m

Elevation of Well _____ . _____ +/- _____ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other _____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: _____ Long: _____

North

West — S/A — East

South

WELL TEST*

Pre-Pumping Static Level _____ ft. Date _____

Measured from: ☐ Top of Casing ☐ Ground Level ☐ Other _____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality _____

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BOWSER-MORNER INC

Address 4518 TAYLORSVILLE RD

City, State, Zip DAYTON OH 45424

Signed [signature] Date 10/27/03

ODH Registration Number 1631

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☐ Augered ☐ Driven ☒ Other SONIC

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7 inches Depth 235 ft

Casing Diameter 2 in. Length 205 ft. Thickness SCH 40 in

2☐ Borehole Diameter _____ inches Depth _____ ft

Casing Diameter _____ in. Length _____ ft. Thickness _____ in

Casing Height Above Ground 20 ft

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv.; 1☒ 2☐ PVC; 1☐ 2☐ Other _____

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other _____

SCREEN

Diameter 2" Slot Size .10 Screen Length 5 ft.

Type SLOTTED Material PVC

Set Between 235 ft. and 185 ft.

GRAVEL PACK (Filter Pack)

Material/Size SILICA #5 Volume/Weight Used 1 CF / 100#

Method of Installation TREMIE THROUGH CASING

Depth: Placed FROM 23.5 ft. TO 15 ft.

GROUT

Material BENTONITE Volume/Weight Used 2 CF / 150#

Method of Installation TREMIE

Depth: Placed FROM 12.5 ft. TO 1 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
TOPSOIL	0.0	1.5
BR CLAYEY SAND & SILT (WET)	1.5	8
GR CLAYEY SILT & SAND	8	9
GR SILTY CLAY	9	23
GR SHALE	23	235
COPB 23.5		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 10/15/03 Total Depth of Well 235 ft.

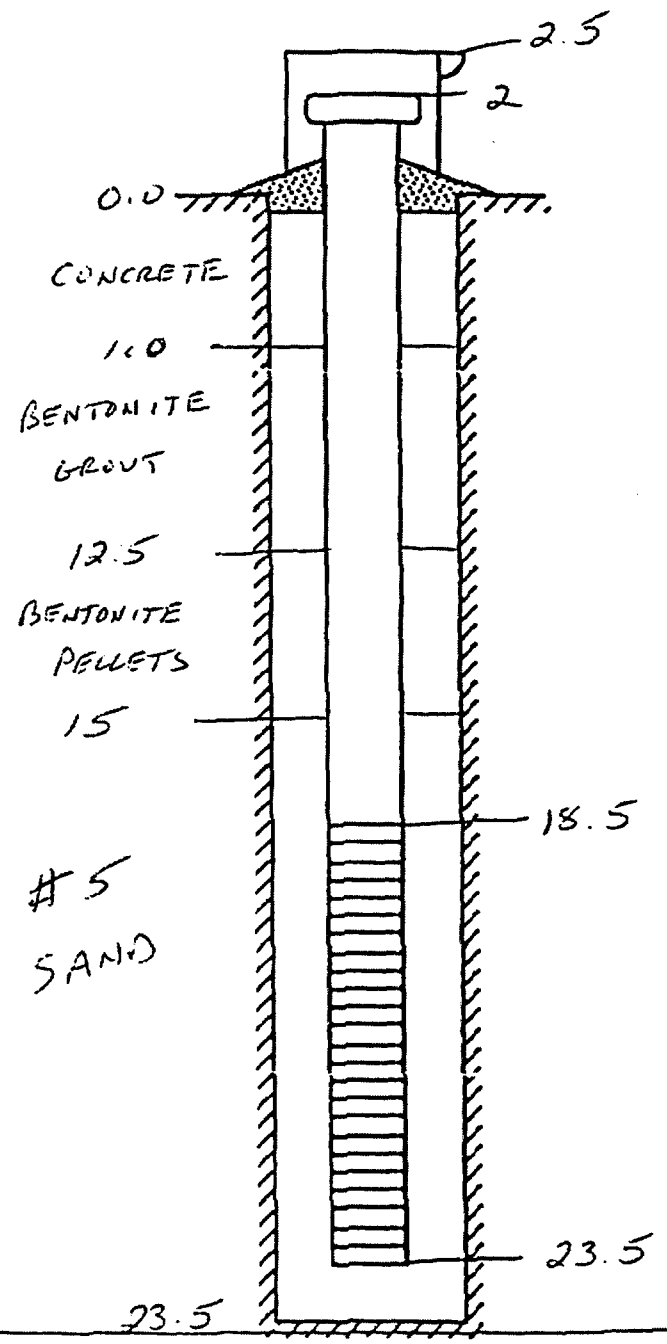
Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER, 1939 FOUNTAIN SQ., DRIVE, BLDG. B

LOG OF WELL NO.

RA-07S

129550	Job Number
10-15-03	Date Installed
BK	Technician
	Surface Elevation
PVC	Riser Pipe Material
PVC	Screen Material
2"	Screen Diameter
.10	Screen Slot Size
23.5	Bottom of Boring
23.5	Bottom of Screen
18.5	Top of Screen
15	Top of Sand
12.5	Top of Bentonite Pellet
1.0	Top of Bentonite ~~Slurry~~ GROUT
0.0	Top of ~~Bentonite~~ / Cement ~~Grout~~
	Top of Soil Backfill
2	Top of Well Riser Pipe
2.5	Top of Guard Pipe
3	Initial Water Depth
16.25	Completion of Water Depth
	24 Hour Water Depth
	48 Hour Water Depth
	Hour Water Depth



Remarks:

BOWSER MORNER

RA-08S

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

970708

WELL LOCATION

County ERIE Township PERKINS

Owner/Builder (Circle One or Both) PLUM BROOK ORDNANCE WORKS
First Last

Address of Well Location COLUMBUS RD
Number Street Name

City SANDUSKY Zip Code +4 44870

Permit No. RA-08 S Section/Lot No. (Circle One or Both) N/A

Location of Well in State Plane coordinates, if available: Use of Well MONITORING

N ☐ X _____ . _____ +/- _____ ft. or m

S ☐ Y _____ . _____ +/- _____ ft. or m

Elevation of Well _____ . _____ +/- _____ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other _____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: _____ Long: _____

North

West

S/A

East

South

WELL TEST*

Pre-Pumping Static Level _____ ft. Date _____

Measured from: ☐ Top of Casing ☐ Ground Level ☐ Other _____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

*(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality _____

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BOWER - MORAN INC

Address 4516 TAYLORSVILLE RD

City, State, Zip DAYTON OH 45424

Signed [signature] (TS) Date 10/27/03

ODH Registration Number 631

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☐ Augered ☐ Driven ☒ Other SONIC

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7 inches Depth 22 ft.

Casing Diameter 2 in. Length 19.5 ft. Thickness SCH 40 in.

2☐ Borehole Diameter _____ inches Depth _____ ft.

Casing Diameter _____ in. Length _____ ft. Thickness _____ in.

Casing Height Above Ground 2.5 ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv.; 1☒ 2☐ PVC; 1☐ 2☐ Other _____

Joints: 1☒ 2☐ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other _____

SCREEN

Diameter 2" Slot Size .10 Screen Length 5 ft.

Type SLOTTED Material PVC

Set Between 22 ft. and 17 ft.

GRAVEL PACK (Filter Pack)

Material/Size SILICA #5 Volume/Weight Used 30 cf/2000#

Method of Installation TREMIE THROUGH CASING

Depth: Placed FROM 22 ft. TO 14 ft.

GROUT

Material BENTONITE Volume/Weight Used 2 cf/50#

Method of Installation TREMIE

Depth: Placed FROM 12 ft. TO 1 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
TOPSOIL	0.0	.5
OA SILTY SAND W/ CLAY	.5	1.5
BR SILTY SAND (WET)	1.5	9.5
GR SILTY CLAY	9.5	18.5
GR GRAVELLY CLAY	18.5	22
GR LIMESTONE	22	22
LIEB 22.0		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 10/16/03 Total Depth of Well 22 ft.

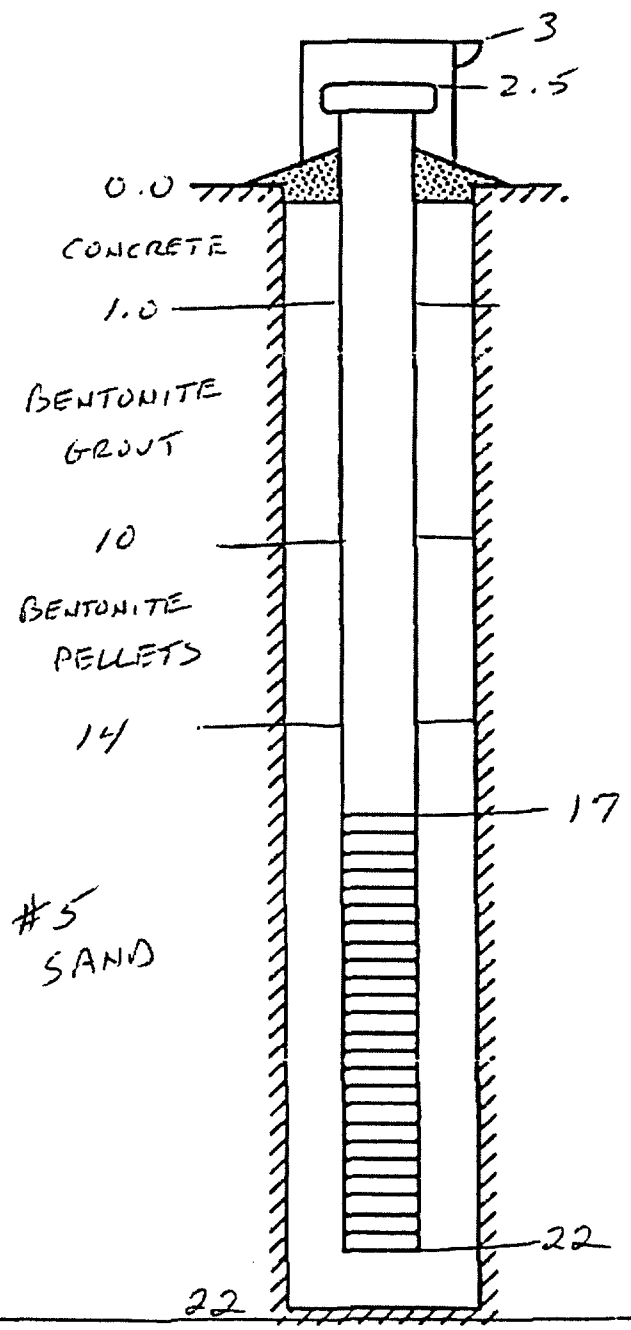
Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER 1939 FOUNTAIN SQ. DRIVE COLS., OHIO 43224-9971

LOG OF WELL NO.

RA-08S

129550	Job Number
10-16-03	Date Installed
BK	Technician
	Surface Elevation
PVC	Riser Pipe Material
PVC	Screen Material
2"	Screen Diameter
.10	Screen Slot Size
22	Bottom of Boring
22	Bottom of Screen
17	Top of Screen
14	Top of Sand
10	Top of Bentonite Pellet
1.0	Top of Bentonite ~~Slurry~~ GROUT
0.0	Top of ~~Bentonite~~ / Cement ~~Grout~~
	Top of Soil Backfill
2.5	Top of Well Riser Pipe
3	Top of Guard Pipe
2	Initial Water Depth
5	Completion of Water Depth
	24 Hour Water Depth
	48 Hour Water Depth
	Hour Water Depth



Remarks:

BOWSER MORNER

Reactor 1 – Rx01

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 244868

County Erie Township Perkins Section of Township

Owner U.S. Gov't. N.A.S.A. Address 21000 Brookpark Rd. Cleveland 35, Ohio

Location of property Plum Brook Ordinance Sandusky, Ohio

#1 CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 34'4"

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 6/3 60

BAILING OR PUMPING TEST

Pumping rate 15 G.P.H. Duration of test 2 hrs.

Drawdown ft. Date 6/3/60

Developed capacity 15 gal. per Hr.

Static level—depth to water 36'2" ft.

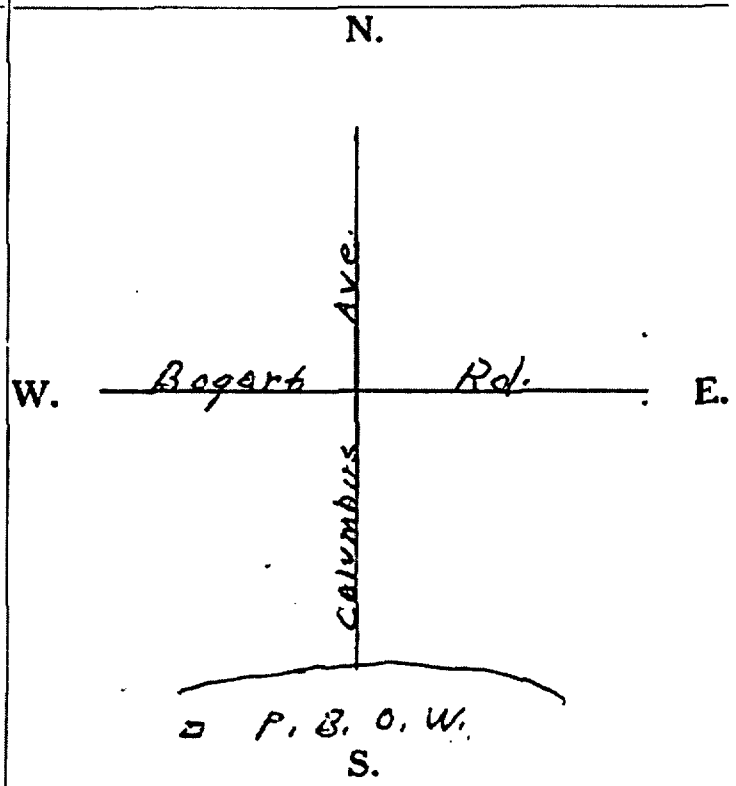
Pump installed by —

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Gray Muck	0 Feet	23 Ft.
Hardpan	23	25'11"
Limestone	25'-"	80
Water Approx. 36' + 75'		

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Robertson's Date 6/10/60

Address Bellevue, Ohio Signed H. W. Robertson

B

Reactor 2 – Rx02

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 244867

County Erie Township Perkins Section of Township

Owner U.S. Gov't. N.A.S.A. Address 21000 Brookpark Rd. Cleveland 35, Ohio

Location of property Plum Brook Ordinance Sandusky, Ohio

CONSTRUCTION DETAILS

#2

Casing diameter 8" Length of casing 32'2" +

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 5/24/60

BAILING OR PUMPING TEST

Pumping rate ..... G.P.M. Duration of test ..... hrs.

Drawdown ..... ft. Date .....

Developed capacity .....

Static level—depth to water Dry Hole ft.

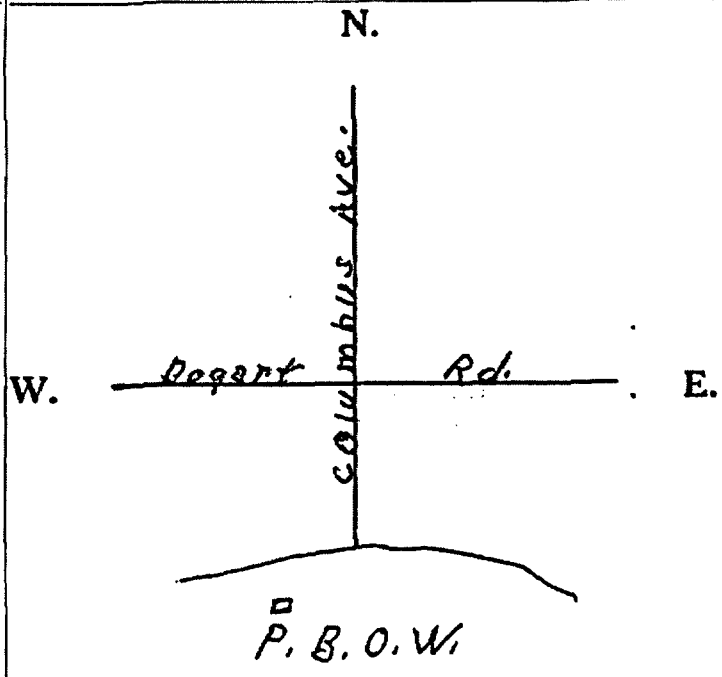
Pump installed by .....

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Gray Muck	0 Feet	25 Ft.
Limestone	25	40

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Robertson's Date 6/10/60

Address Bellevue, Ohio Signed H. W. Robertson

B

Reactor 3 – Rx03

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 244865

County Erie Township Perkins Section of Township

Owner U.S. Gov't. N.A.S.A. Address 21000 Brookpark Rd. Cleveland 35, Ohio

Location of property Plum Brook Ordinance, R.D. Sandusky, Ohio

#3 CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 32' (1" x 8" +)

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 5/16/60

BAILING OR PUMPING TEST

Pumping rate G.P.M. Duration of test hrs.

Drawdown ft. Date

Developed capacity

Static level—depth to water Dry Hole ft.

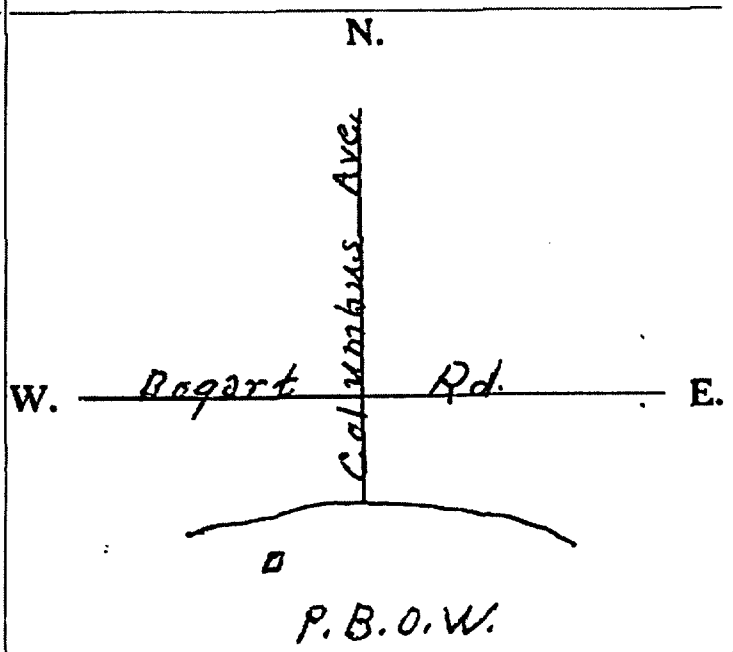
Pump installed by

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Gray Muck	0 Feet	24 Ft.
Limestone	24	40

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Robertson's Date 6/10/60

Address Bellevue, Ohio Signed H. W. Robertson

B

Reactor 4 – Rx04

ORIGINAL

WELL LOG AND DRILLING REPORT

State of Ohio
DEPARTMENT OF NATURAL RESOURCES
Division of Water
1562 W. First Avenue
Columbus, Ohio

PLEASE USE PENCIL OR TYPEWRITER. DO NOT USE INK.

No. 244866

County Erie Township Perkins Section of Township

Owner U.S. Gov't. N.A.S.A. Address 21000 Brookpark Rd. Cleveland 35, Ohio

Location of property Plum Brook Ordinance, Sandusky, Ohio

#4 CONSTRUCTION DETAILS

Casing diameter 8" Length of casing 32'-6" 1'8" +

Type of screen — Length of screen —

Type of pump —

Capacity of pump —

Depth of pump setting —

Date of completion 5/19/60

BAILING OR PUMPING TEST

Pumping rate ..... G.P.M. Duration of test ..... hrs.

Drawdown ..... ft. Date .....

Developed capacity .....

Static level—depth to water Dry Hole ft.

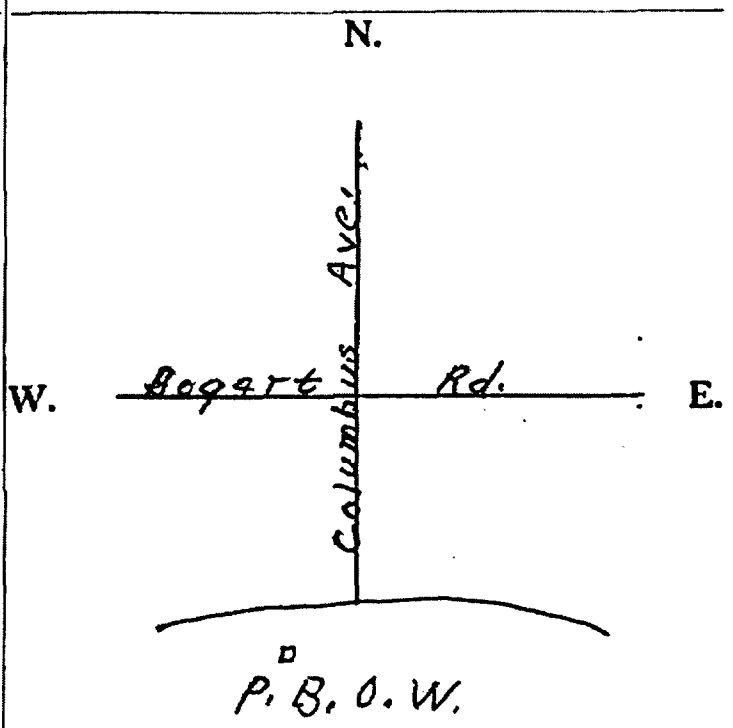
Pump installed by .....

WELL LOG

Formations Sandstone, shale, limestone, gravel and clay	From	To
Gray Muck	0 Feet	25 Ft.
Limestone	25	50

SKETCH SHOWING LOCATION

Locate in reference to numbered State Highways, St. Intersections, County roads, etc.



See reverse side for instructions

Drilling Firm Robertson's Date 6/10/60

Address Bellevue, Ohio Signed H. W. Robertson

B

RA-07D

DNR 7802.96

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

WELL LOG AND DRILLING REPORT

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

964876

WELL LOCATION

County ERIE Township PERKINS

Owner/Builder (Circle One or Both) PLUM BROOK ORDNANCE WORKS (First / Last)

Address of Well Location COLUMBUS RD (Number / Street Name)

City SANDUSKY Zip Code +4 44870

Permit No. RA-070 Section/Lot No. (Circle One or Both) N/A

Location of Well in State Plane coordinates, if available: Use of Well MONITORING

N ☐ X _____ . _____ +/- _____ ft. or m

S ☐ Y _____ . _____ +/- _____ ft. or m

Elevation of Well _____ . _____ +/- _____ ft. or m

Datum Plain ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other _____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: _____ Long: _____

North

West S/A East

South

WELL TEST*

Pre-Pumping Static Level _____ ft. Date _____

Measured from: ☐ Top of Casing ☐ Ground Level ☐ Other _____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

(Attach a copy of the pumping test record, per section 1521.05, ORC)

Is Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality _____

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm BOWLER-MORNER INC

Address 4514 TAYLORSVILLE RD

City, State, Zip DAYTON OH 45424

Signed [signature] Date 10/27/03

ODH Registration Number 1631

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☐ Augered ☐ Driven ☑ Other SONIC

BOREHOLE/CASING (measured from ground surface)

1 ☒ Borehole Diameter 7 inches Depth 25.5 ft.

Casing Diameter 2 in. Length 22.5 ft. Thickness SCH 40 in.

2 ☒ Borehole Diameter 5 inches Depth 24.5 ft.

Casing Diameter 2 in. Length 14.5 ft. Thickness SCH 40 in.

Casing Height Above Ground 2.0 ft.

Type: 1 ☐ 2 ☐ Steel; 1 ☐ 2 ☐ Galv.; 1 ☒ 2 ☒ PVC; 1 ☐ 2 ☐ Other _____

Joints: 1 ☒ 2 ☒ Threaded; 1 ☐ 2 ☐ Welded; 1 ☐ 2 ☐ Solvent; 1 ☐ 2 ☐ Other _____

SCREEN

Diameter 2" Slot Size .10 Screen Length 10 ft.

Type SLOTTED Material PVC

Set Between 55 ft. and 45 ft.

GRAVEL PACK (Filter Pack)

Material/Size SILICA #5 Volume/Weight Used 1 SCF/150#

Method of Installation POURED THROUGH CASING

Depth: Placed FROM 55 ft. TO 42.5 ft.

GROUT

Material BENTONITE Volume/Weight Used 4 SCF/100#

Method of Installation TREMIE

Depth: Placed FROM 35 ft. TO 1.0 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED.
Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.

	From	To
TOPSOIL	0.0	1.5
BR CLAYEY SAND (WET)	1.5	3
BR GR SANDY CLAY	3	3.5
BR GR SILT + SAND	3.5	7
GR SILTY CLAY	7	9
GR CLAY	9	10
GR SILTY SANDY CLAY	10	19
GR CLAY	19	25.5
GR LIMESTONE	25.5	55
TOTAL 55.0		

*If more space is needed to complete drilling log, use next consecutively numbered form.

Date of Well Completion 10-17-03 Total Depth of Well 55 ft.

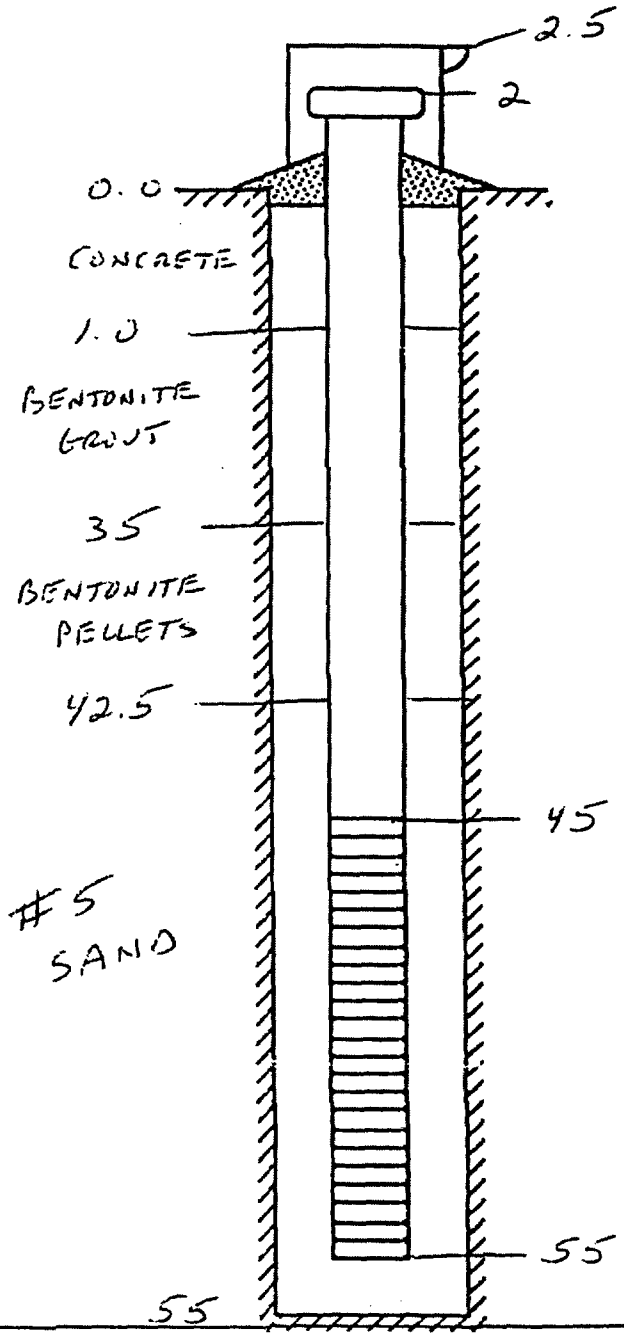
Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling

ORIGINAL COPY TO - ODNR DIVISION OF WATER

LOG OF WELL NO.

RA-07D

129550	Job Number
10-17-03	Date Installed
BIC	Technician
	Surface Elevation
PVC	Riser Pipe Material
PVC	Screen Material
2"	Screen Diameter
.10	Screen Slot Size
55	Bottom of Boring
55	Bottom of Screen
45	Top of Screen
42.5	Top of Sand
35	Top of Bentonite Pellet
1.0	Top of Bentonite ~~Slurry~~ GROUT
0.0	Top of ~~Bentonite~~ / Cement ~~Grout~~
	Top of Soil Backfill
2	Top of Well Riser Pipe
2.5	Top of Guard Pipe
4	Initial Water Depth
15	Completion of Water Depth
	24 Hour Water Depth
	48 Hour Water Depth
	Hour Water Depth



Remarks:

BOWSER MORNER

RA-08D

WELL LOG AND DRILLING REPORT

TYPE OR USE PEN
SELF TRANSCRIBING
PRESS HARD

Ohio Department of Natural Resources
Divison of Water, 1939 Fountain Square Drive
Columbus, Ohio 43224-9971 Voice (614) 265-6739 Fax (614) 447-9503

970709

WELL LOCATION

County ERIE Township PERKINS

Owner/Builder (Circle One or Both) PLUM BROOK ORDINANCE WORKS (First / Last)

Address of Well Location COLUMBUS RD (Number / Street Name)

City SANDUSKY Zip Code +4 44870

Permit No. RA-0840 Section/Lot No. (Circle One or Both) N/A

Location of Well in State Plane coordinates, if available: Use of Well MONITORING

N ☐ X _____ . _____ +/- _____ ft. or m

S ☐ Y _____ . _____ +/- _____ ft. or m

Elevation of Well _____ . _____ +/- _____ ft. or m

Datum Plain: ☐ NAD27 ☐ NAD83 Elevation Source _____

Source of Coordinates: ☐ GPS ☐ Survey ☐ Other _____

Sketch a map showing distance well lies from numbered state highways, street intersections, county roads, buildings or other notable landmarks. If latitude and longitude are available please include here: Lat: _____ Long: _____

North

S/A

West East

South

WELL TEST*

Pre-Pumping Static Level _____ ft. Date _____

Measured from: ☐ Top of Casing ☐ Ground Level ☐ Other _____

☐ Air ☐ Bailing ☐ Pumping* ☐ Other _____

Test Rate _____ gpm Duration of Test _____ hrs.

Feet of Drawdown _____ ft. Sustainable Yield _____ gpm

(Attach a copy of the pumping test record, per section 1521.05, ORC)

Copy Attached? ☐ Yes ☐ No Flowing Well? ☐ Yes ☐ No

Quality _____

PUMP/PITLESS

Type of pump _____ Capacity _____ gpm

Pump set at _____ ft. Pitless Type _____

Pump installed by _____

I hereby certify the information given is accurate and correct to the best of my knowledge.

Drilling Firm GUSER MOZNER INC

Address 4518 TAYLORSVILLE RD

City, State, Zip DAYTON OH 45424

Signed [signature] Date 10/27/03

ODH Registration Number 1631

CONSTRUCTION DETAILS

☐ Rotary ☐ Cable ☐ Augered ☐ Driven ☒ Other SONIC

BOREHOLE/CASING (measured from ground surface)

1☒ Borehole Diameter 7 inches Depth 23.5 ft

Casing Diameter 2 in. Length 26 ft. Thickness SCH40 in.

2☒ Borehole Diameter 5 inches Depth 31.5 ft.

Casing Diameter 2 in. Length 21.5 ft. Thickness SCH40 in.

Casing Height Above Ground 2.5 ft.

Type: 1☐ 2☐ Steel; 1☐ 2☐ Galv.; 1☒ 2☒ PVC; 1☐ 2☐ Other _____

Joints: 1☒ 2☒ Threaded; 1☐ 2☐ Welded; 1☐ 2☐ Solvent; 1☐ 2☐ Other _____

SCREEN

Diameter 2" Slot Size .10 Screen Length 10 ft.

Type SLOTTED Material PVC

Set Between 55 ft. and 45 ft.

GRAVEL PACK (Filter Pack)

Material/Size SILICA #5 Volume/Weight Used 1 bag / 100#

Method of Installation POURED THROUGH CASING

Depth: Placed FROM 55 ft. TO 41.5 ft.

GROUT

Material BENTONITE Volume/Weight Used 4.2 bags / 100#

Method of Installation TREMIE

Depth: Placed FROM 32.5 ft. TO 1 ft.

DRILLING LOG*

INDICATE DEPTH(S) AT WHICH WATER IS ENCOUNTERED. Show color, texture, hardness, and formation: sandstone, shale, limestone, gravel, clay, sand, etc.	From	To
TOPSOIL	0.0	1.0
BR SILTY SAND w/CLAY	1.0	3
GR SILT w/CLAY WET	3	6
GR SILT & CLAY	6	21
GR GRAVELLY CLAY	21	23
GR LIMESTONE	23	55
BORED 55.0		

*(If more space is needed to complete drilling log, use next consecutively numbered form.)

Date of Well Completion 10/16/03 Total Depth of Well 55 ft.

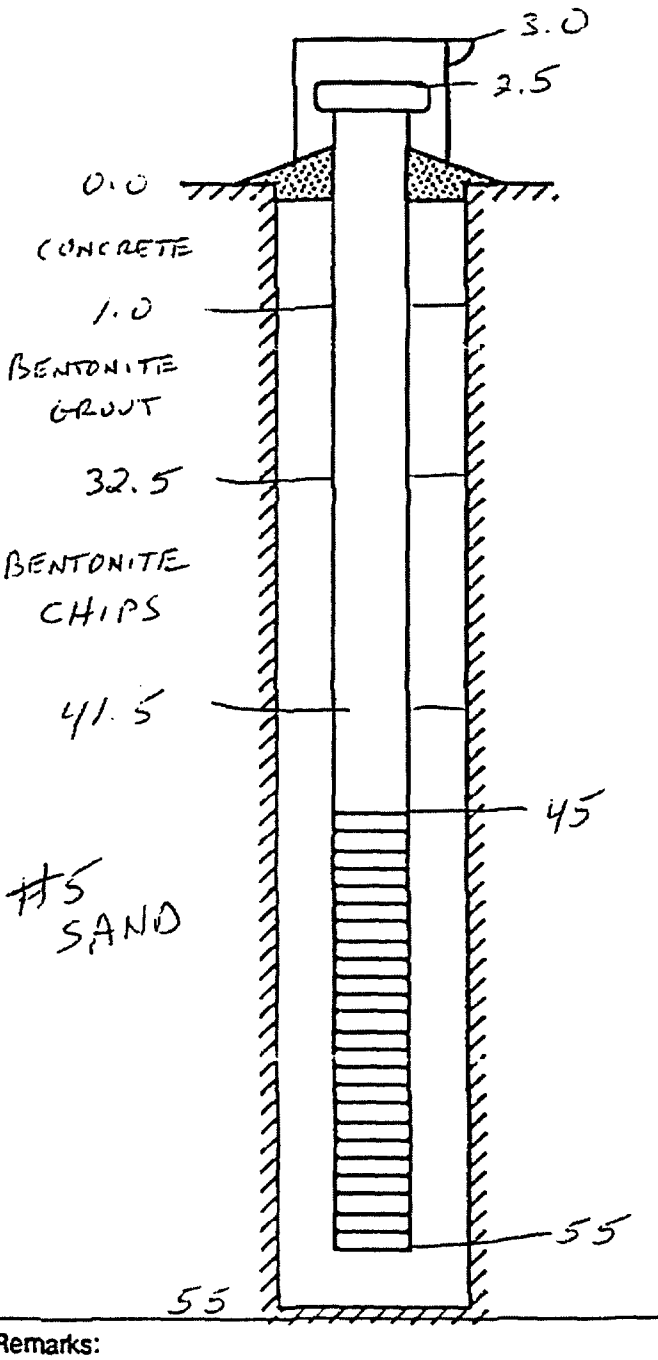
Completion of this form is required by section 1521.05, Ohio Revised Code - file within 30 days after completion of drilling.

ORIGINAL COPY TO - ODNR, DIVISION OF WATER 1939 FOUNTAIN SQ. DRIVE COLS. OHIO 43224-9971

LOG OF WELL NO.

RA-08D

129550	Job Number
10-16-03	Date Installed
BK	Technician
	Surface Elevation
PVC	Riser Pipe Material
PVC	Screen Material
2"	Screen Diameter
.10	Screen Slot Size
55	Bottom of Boring
55	Bottom of Screen
45	Top of Screen
41.5	Top of Sand
32.5	Top of Bentonite ~~Pellet~~ CHIPS
1.0	Top of Bentonite ~~Slurry~~ GROUT
0.0	Top of ~~Bentonite~~ / Cement ~~Grout~~
	Top of Soil Backfill
2.5	Top of Well Riser Pipe
3	Top of Guard Pipe
3.0	Initial Water Depth
15	Completion of Water Depth
	24 Hour Water Depth
	48 Hour Water Depth
	Hour Water Depth



Remarks:

BOWSER MORNER

Section 2: PBS Wells

PB-BED-MW22

HTRW DRILLING LOG

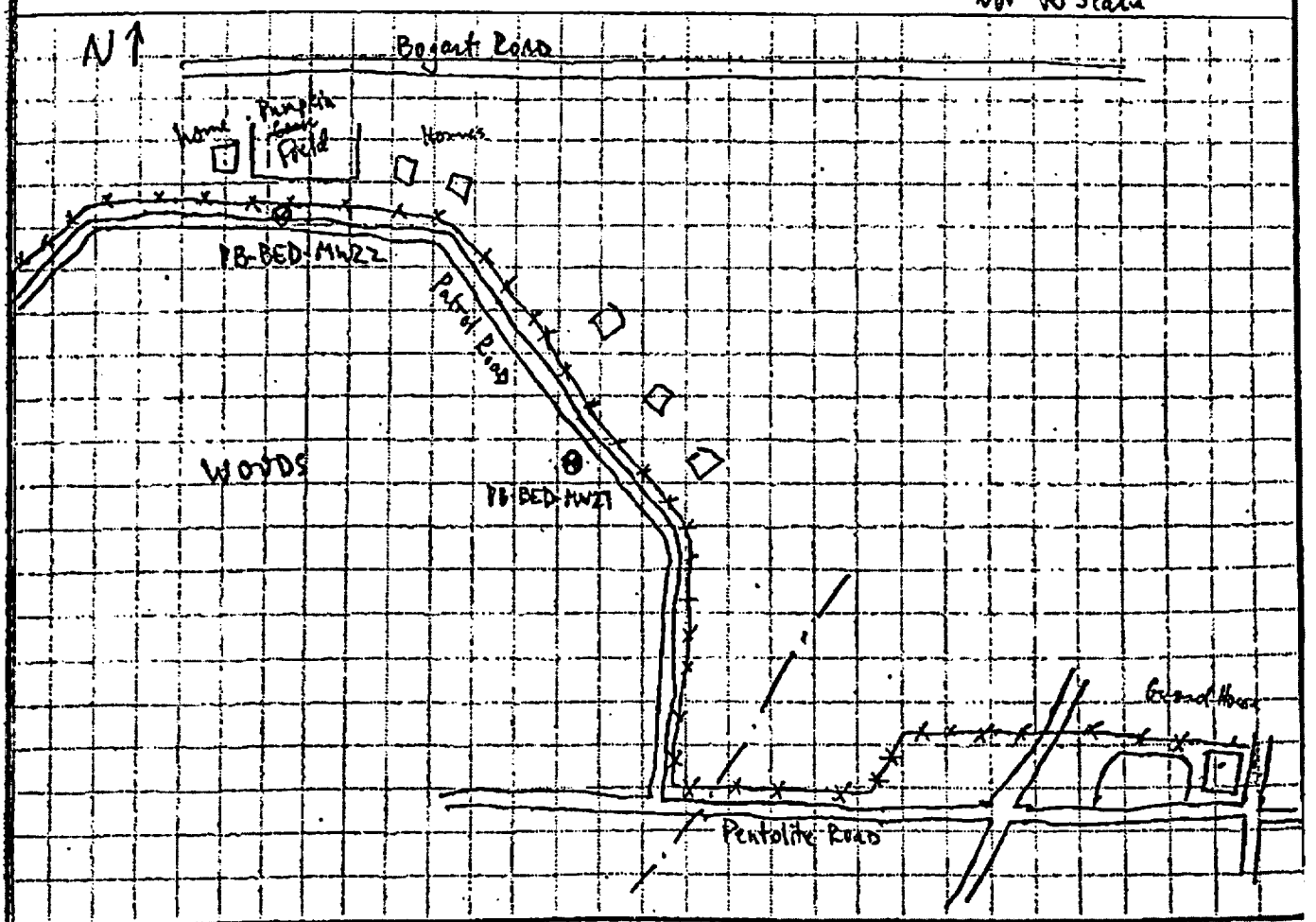
DISTRICT: Nashville, TN	HOLE NUMBER: PB-BED-MW22	SHEET 1 OF 6 SHEETS
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Boart Longyear	
3. PROJECT: PBOW	4. LOCATION: NASA Plum Brook Station, Sandusky, OH	
5. NAME OF DRILLER: Paul Dickinson / Paul Schandelt	6. MANUFACTURER'S DESIGNATION OF DRILL: BK81 / Cantera C2-250	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Core 3" OD, borehole 6" OD. ~~Installed 2" PVC monitoring well bore~~ Stat.	8. HOLE LOCATION: See Sketch	
	9. SURFACE ELEVATION: 627.22 Ft	
	10. DATE STARTED: 8/24/01	11. DATE COMPLETED: 9/10/01
12. OVERBURDEN THICKNESS: 19.5 Ft	15. DEPTH GROUNDWATER ENCOUNTERED: 4.7 Ft (overburden) ~40 Ft Bedrock	
13. DEPTH DRILLED INTO ROCK: 23.5 Ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 43 Ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	6

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %
	NA	NA	NA	NA	NA	100

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kesler / Reed Fidoris

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: PBOW

HOLE NO: PB-BED-MW22

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW22

Project: PBOW | Geologist: D. Kessler | Sheet 2 of 6

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Code	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample or Blows	Recovery (ft)	Remarks
		Grass ORGANICS (grass, roots) 0.2			NA			Began drilling 8/24/01
	1	FILL (Loose, Dark brown (10YR 3/3), very fine grain, SAND, trace silt (10%), very well sorted, dry)	SP	0		2/3/5/8	1.5/2.0	Blow Counts w/ 140 lb Hammer Background/Breathing 0.0 ppm = PID
	2	FILL (Loosey, dark yellowish brown (10YR 4/6), fine grain, SAND, trace silt (5%), very well sorted, dry, mottled (brownish yellow, light/dark brown) (moist at 4.7 ft))		0	NA	1530 2/2/5/9	1.7/2.0	VRAE: CO = 0 ppm LEL = 0% H_2S = 0 ppm O_2 = 21.0 %
	4					1535		
	5	Medium dense, olive brown (2.5Y 4/3), homogeneous, vfg, SAND, very well sorted, wet	SP	0	NA	5/7/12/25	1.8/2.0	▽ Encountered (overburden) groundwater at 4.7 ft
	6					1538		
	7	Dense, dark olive gray (5Y 3/2), homogeneous, vfg, SAND very well sorted, trace of pebbles (2%), rounded (black/gray), wet 7.4		0	NA	8/13/20/27	2.0/2.0	
	8	Stiff, dark gray (2.5Y 4/1), homogeneous, SILT, little sand (15%), high plasticity, trace pebbles (8mm), soft, trace light pink "specks" (2) saturated	mh	0	NA	1544 8/9/6/5	2.0/2.0	
	10							

Project: PBOW | Hole Number: PB-BED-MW22

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW22

Project: PBOW | Geologist: D. Kessler | Sheet 3 of 6 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample ~~No.~~ Blows	Recovery (ft)	Remarks
	10	Very stiff, dark gray (2.5Y 4/1), homogeneous, SILT, trace to little sand (10%), ~~the~~ high plasticity black spot (manganese?), trace light pink spots (3mm), wet trace clay (5%)	Inh	0	NA	5/6 / 17/22 / 1555	2.0 / 2.0	
	12	As above, 3% black spots, ~~trace~~ few sand pockets (2)		0	NA	7/8 / 9/12 / 1558	2.0 / 2.0	
	14	As above, 5% black spots,		0	NA	3/4 / 6/6 / 1603	2.0 / 2.0	
	16	As above Trace rock pebbles (black, dark gray) 2-4 mm, rounded, no sand, wet		0	NA	2/4 / 6/5 / 1613	2.0 / 2.0	
	18	Hard, ~~stiff~~ above, as above, rounded pebbles increase in number 15%, moist		0	NA	5/6 / 50 for 6" / 1621	1.5 / 1.5	
	20	spoon refusal @ 19.5 Ft						

Project: PBOW | Hole Number: PB-BED-MW22

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW22

Project: PBOW

Geologist: D. Kressler/S. McLeod

Sheet 4 of 6

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	20	Very Hard, dark gray, LIMESTONE	NA	NA	NA	NA	NA	Began cutting with 8" rotary bit at 19.5 ft Recirculated w/ water
	21							Distinct H_2S odor
	22	Soft zone 22 to 22.3 ft (22.3)						URAE: CO - 0 ppm LEL - 0% H_2S - 0 ppm O_2 - 20.9%
	23							
	24					Began Coring 9/10/0		Drilled to 24.5' w/ 8" OD roller bit. 6" ID/6 5/8" OD casing installed to 24.5'
	25	gray, hard, massive limestone, no bedding, no weathering				HRCS	Run 2	Depth - 24.5-31 Run - 6.5' Rec - 4' Start time: 10:20 End " - 10:45
	26				BOX 1 24.5-28.5	26.5		PID - NA MSA - 20.7 - O_2 0 - H_2S 0 - CO 0 - LEL
	27					27.5		
	28					28.5		
	29							
	30							

Project: PBOW

Hole Number: PB-BED-MW22

HTRW DRILLING LOG (continuation sheet)

Project: PBOW | Geologist: S. M. Jewell | Sheet 5 of 6

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Uhs	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Fnass	Recovery (ft)	Remarks
	30							
	31	gray, hard, massive ls. no bedding, no weathering			BOX 2 31-34	31.4	Run 2	Run 5' Rec - 5' End time: 11:27 depth - 31-36' MSA - 0 - H_2S 0 - LEL 0 - CO 20.7 - O_2
	32					32.2		
						32.3		
	33					33.3		
	34				BOX 3 34-38	34.5		
	35					35.5		
	36					35.8		
	37	very hard. gray, mass. lm. no weathering, no bedding			Box # 4	37.0	Run 3	Run - 4' Rec - 3' Run 36-40
	38					38		
	39				Box # 5	39		
	40					40		pull pump 11:40

Project: PBOW | Hole Number: PBBED-MW22

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW22

Project: PBDW

Geologist: [illegible]

Sheet 6 of 6 Sheets

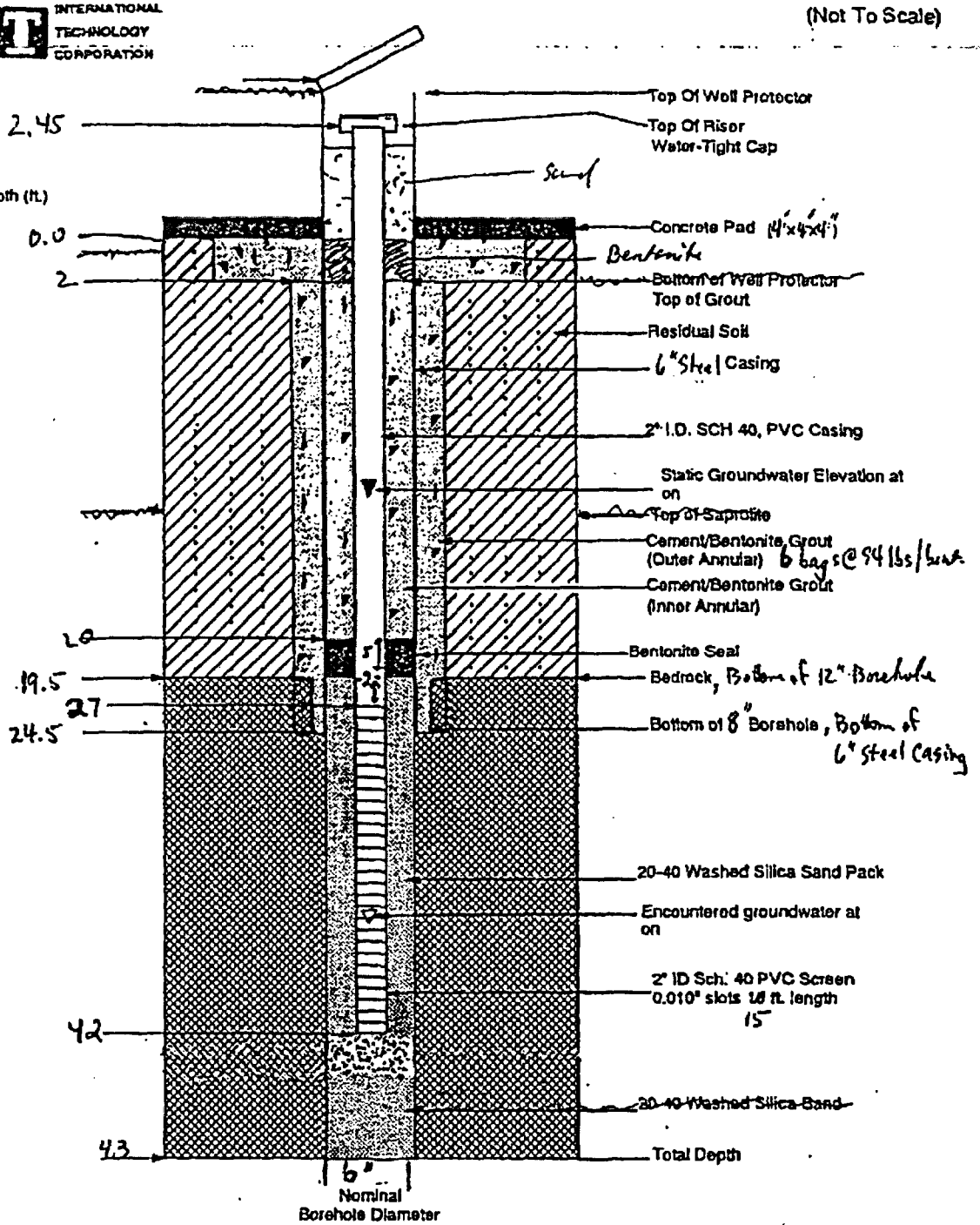
Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		gray, massive, hard, limestone, w/no bedding, no weathering, hc. odor, visible			Box 5		Run 4	Depth - 40.43' Run - 3' Rec - 3'
	41					40.7		End time 13:25
					Box 6			MSA 20.7% O_2 0-CO 0-H_2S 0-LEL
	42					41.8		
						42.3		SET WELL MW22
	43	Total Depth = 43 Ft				43.0		
	44							
	45							
	46							
	47							
	48							
	49							
	50							

Project: PBDW

Hole Number: PB-BED-MW22

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Notes:

Well No.: PB-BED-MW22

Date Installed: 9-10-01

Elevation Top of Casing: 629.67 ft.

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

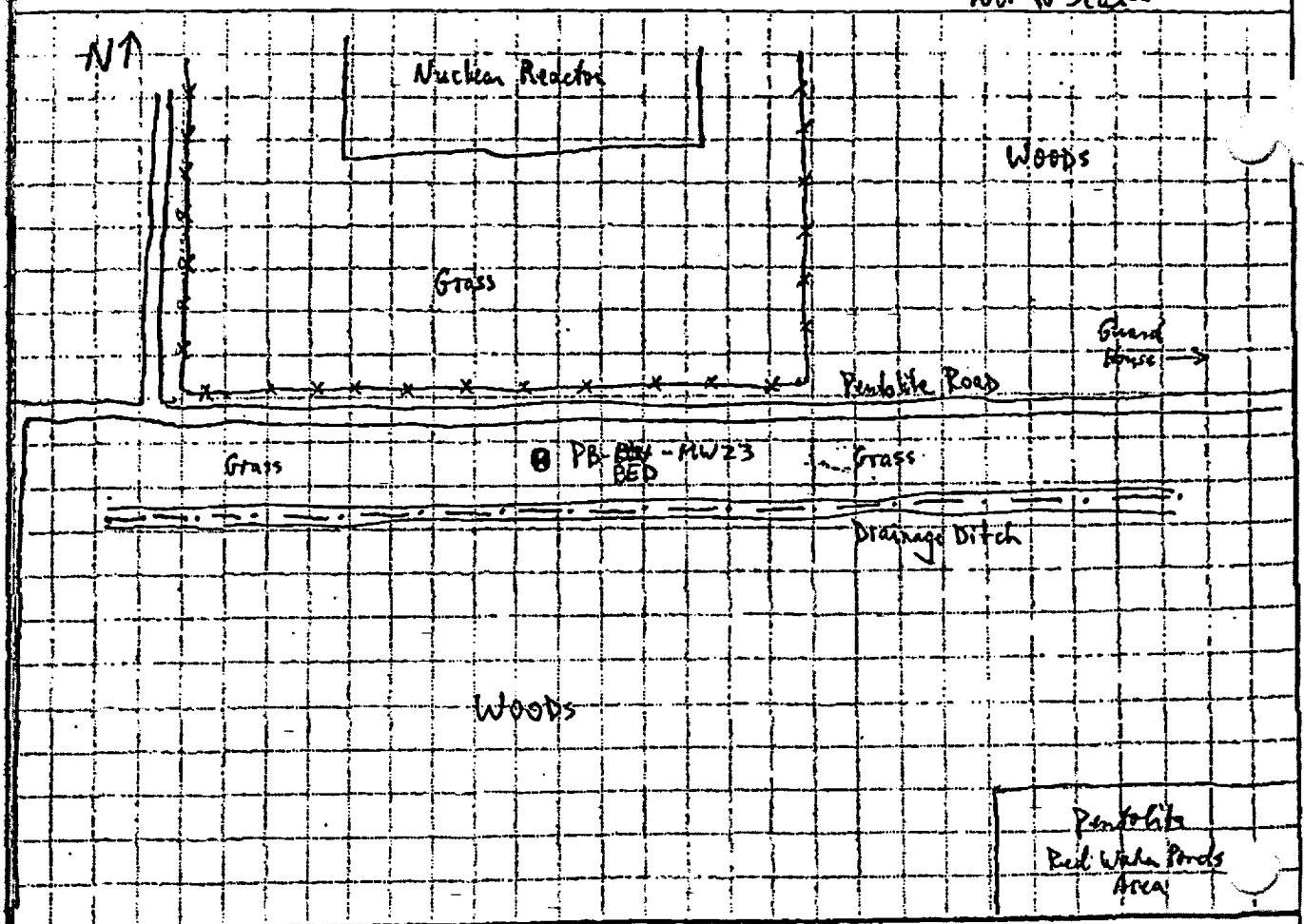
D:\MWA23DWG.DRW 3-28-00

PB-BED-MW23

HTRW DRILLING LOG

DISTRICT	Nashville, TN
HOLE NUMBER	PB-BED-MW23
SHEET / SHEETS	1 of 9
1. COMPANY NAME	IT Corporation
2. DRILL SUBCONTRACTOR	Boart Longyear
3. PROJECT	PBOW
4. LOCATION	NASA Plum Brook Station, Sandusky, OH
5. NAME OF DRILLER	Paul Dickinson / Schandfeldt
6. MANUFACTURER'S DESIGNATION OF DRILL	BK81 / Cantera C2-250
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4¼" ID/8" OD HSA with 1.4" ID Stain-less Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 4" OD. Installed 2" PVC monitoring well.
8. HOLE LOCATION	See Sketch
9. SURFACE ELEVATION	631.11 Ft
10. DATE STARTED	8/25/01
11. DATE COMPLETED	9/06/01
12. OVERBURDEN THICKNESS	26.3 Ft
13. DEPTH DRILLED INTO ROCK	47.7 Ft
14. TOTAL DEPTH OF HOLE	74 Ft
15. DEPTH GROUNDWATER ENCOUNTERED	7.1 Ft (overburden)
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	~~15.8 Ft~~ 58.8 Ft 9/08/01 1430
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA
18. GEOTECHNICAL SAMPLES	DISTURBED: NA; UNDISTURBED: NA
19. TOTAL NUMBER OF CORE BOXES	
20. SAMPLES FOR CHEMICAL ANALYSIS	VOC: NA; METALS: NA; OTHER (SPECIFY): NA; OTHER (SPECIFY): NA; OTHER (SPECIFY): NA
21. TOTAL CORE RECOVERY	%
22. DISPOSITION OF HOLE	BACKFILLED: NA; MONITORING WELL: X; OTHER (SPECIFY): NA
23. SIGNATURE OF INSPECTOR	David Kessler / [signature]

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT	PBOW
HOLE NO.	PB-BED-MW23

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW23

Project: PBOW | Geologist: D. Kyssler | Sheet 2 of 9

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
		Grass						
		Fill: Soft, very dark grayish brown (2.5Y 3/2), sandy SILT with organics, moist 0.3			NA	2/4	1.5	Began drilling 8/25/01 1230
	1	Fill: Loose, (10YR 4/6) dark yellowish brown, homogeneous, vfg, silty SAND, silt (40%), dry 1.2	Sm	0		6/7	2.0	Backg
		color change 1.0-1.2 ft; (2.5Y 3/3) dark olive brown						
	2	Fill: Loose (10YR 5/6) yellowish brown, homogeneous vfg. SAND, trace silt (5%), very well sorted, dry 2.0	SP					
			SP		NA	5/5	1.4	
		Fill: Stiff, (10YR 4/6) dark yellowish brown, mottled (tan, black), sandy SILT, low plasticity, dry 2.8	ML					
	3			0		7/8	2.0	
		Fill: Loose, (2.5Y 4/4) olive brown, mottled, (whitish brown) 30%, vfg, SAND, trace silt, moist 3.4	SP					
						1205		
	4	Stiff, (10YR 5/2) grayish brown, mottled (brown), silty CLAY, little sand (10%), high plasticity, moist	CL		NA	4/5	2.0	
	5	Sand content begins increasing at 5 ft		0		8/9	2.0	
		Sand layer 5.8-6.0; very fine grain (10YR 3/6) dark yellowish brown 5.8						
		6.0	SP			1233		
	6	Medium stiff (10YR 5/2) grayish brown, mottled brown, high plasticity, silty CLAY with sand, moist.	CH		NA	4/4	1.9	
	7	Loose, (2.5Y 3/3) dark olive brown, homogeneous vfg, SAND, trace silt (10%), very well sorted, wet	SP	0		6/6	2.0	Encountered ▽ overburden groundwater at 7.1 ft
						1242		
	8	8.3			NA			
		Medium stiff, (2.5Y 4/1) dark gray, homogeneous, high plasticity, clayey SILT little sand (20%), vfg sand, black manganese spots (2), wet	MH	0		2/3	2.0	
	9					2/2	2.0	
	10					1245		

Project: PBOW | Hole Number: PB-BED-MW23

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW23

Project: PBOW | Geologist: D. Kessler | Sheet 3 of 9 sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	10	Soft, (2.5Y 4/1) dark gray, homogeneous, high plasticity, clayey SILT, trace sand (<5%), black manganese spots (2), pink spots (<5%), wet (5-8mm) (3mm)	mh	0	NA	2/2 / 2/5 / 1249	2.0 / 2.0	
	12	As above		NM	NA	1/3 / 4/5 / 1251	2.0 / 2.0	
	14	As above	mh	NM	NA	1/3 / 4/3 / 1253	2.0 / 2.0	
	16	As above		NM	NA	1/2 / 4/5 / 1303	2.0 / 2.0	
	18	As above		NM	NA	1/2 / 3/4 / 1307	2.0 / 2.0	
	20							

Project: PBOW | Hole Number: PB-BED-MW23

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW23

Project: PBOW | Geologist: D. Kessler | Sheet 4 of 9

Elev (ft)	Depth (ft) bgs	Description of Materials	Unc. Soil/Rock	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	20	Soft, (2.5 y 4/1) dark gray, homogeneous, high plasticity, clayey SILT, trace sand (10%). black manganese spots, light pink spots (3mm) (5-8mm) trace pebbles (5mm), rounded	mh	NM	NA	1/1/ 2/4 1314	2.0/ 2.0	
	22	As above, stiff, pebbles and granules increase w/depth	mh	NM	NA	3/5/ 7/9 1318	2.0/ 2.0	
	24	As above, hard, pebbles and granules 30-40%,		NM	NA	5/7/ 27/32 1336	2.0/ 2.0	Best spoon; Limestone pebbles in shoe 28x60mm and 22x22x22 mm
	26	As above, pebbles/granules 45%		NM	NA	50 for 3" 1354	0.3/ 0.3	Bottom of 12" OD Borehole
	27	Spoon Refusal @ 26.3 ft. LIMESTONE, dark gray, soft, fossiliferous (bracks), very slight weathering	NA	NA	NA	NA	NA	Began cutting rock w/ 8" OD tricone roller bit. Flushed with recirculated water. Competent drilling. VRAE: CO = 0ppm, LEL = 0%, H_2S = 0ppm, O_2 = 21.2% Occasional faint H_2S odor. 8" OD Borehole to 30 ft. 6" Casing Set at 30 ft.
	28							
	29							
	30							

Project: PBOW | Hole Number: PB-BED-MW23

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW23

Project: PBOW | Geologist: R. Poderis | Sheet 5 of 9

Elev (ft)	Depth (ft) bgs	Description of Materials	Water Level	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample Interval Frac	Recovery (%)	Remarks: Coring Starts at 30' 9/6/01
	30	limestone, grey, hard, massive, not weathered natural hydrocarbon odor			Box #1 1			Depth 30-33 Start time 730 end 915 LEL 0 9/6/01
	31					Photo RSP 1 #1		CO 0 H_2S 0 O_2 20.7
	32							PID 0.0 Run 3' Recovery 1' Run #1
	33	Some			Run 2 33			Depth 33-38 Start time 930 end 945 Run 5' recovery 5' Run #2
	34	@ nat. hydrocarbon odor. not be visible throughout			Box # 2	33.5		
	35					35.5 36		
	36				Photo 2			945 LEL 0 CO 0 H_2S 0
	37							O_2 20.7 PID 1.6
	38				Run 3 38			Depth 38-43 Start 945 end 1000 Run 5' recovery 5' Run #3
	39				Box 3 + Box 4 (Box 3 = 38-41.5)	38.5		
	40							

Project: PBOW | Hole Number: PB-BED-MW23

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW-23

Project:

Geologist: R. Podesis

Sheet 6 of 9 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	40							
	41				Box 4 44.5 – 46.5			
	42							
	43				43 Run #4			depth 43-48 run 5' recovery 4' start 1000 end 1110
	44	massive gray limestone oil seeps from core				44.2 44.5		
	46					46		
	47				Box 5 44.5 – 48	47.2 47.8		
	48				48 Run 5			48-53 run 5' recov 5' end 1130
	49	same			Box 6 48 – 51	48.8 48.9 50.4 50.6 51.8		
	50							

Project: PBOW

Hole Number: PB-BED-MW23

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW23

Project: PBOW

Contractor: R Poden's

Sheet 7 of 9 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Uses	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. fractures	Recovery (%)	Remarks
	50	gray massive hard limestone nat. hc odor + oil seeps						LEL Q CO Q H_2S Q O_2 20.6 PID 0.0
	51				51	52		
	52				Box 7 (51-54')			Box 7 51-54
	53					53 Run 6		depth 53-58 run 5' recovery 5' end time 1200 start time 1130
	54				54	54		
	55				Box 8 (54-57.5')	55		Box 8 54-57.5
	56					56		
	57							
	57.5				57.5	57.5		
	58					58 Run 7		depth 58-63 run 5' recov 5' start 1200 end 1210
	59				Box 9 (57.5-60')			
	60							

Project: PBOW

Hole Number: BED MW-23

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED MW23

Project: PBOW

Geologist: RPiden's

Sheet: 8 of 9 Sheets

Elev (ft)	Depth (ft)	Description of Materials	Unit/Lithology	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	60	Massive grey limestone, hard			Box 10 (60-63')	61.5		Box ~~10~~ 9 57.5-60.6 Box ~~9~~ 10 60-63
	61							
	62							
	63	Same			~~63~~ Run 8 63			depth 63-68 run 5' recov 5' end 1230
	64				Box 11 (63-66.5')	64.7		Box ~~11~~ ~~60.6~~ 60-66 Box ~~10~~ 11 63-66.5
	65				66.5			
	66				Box 12 (66.5-69.5')	67		
	67							depth 68-73 run 5' Box 12 66.5-69.5 recov. 5' end 1 pm
	68				69.5			
	69							
	70							

Project: PBOW

Hole Number: MW-23

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB BED MW-23

Project: PBOW

Contractor: PDeLeo

Sheet 9 of 9 Sheets

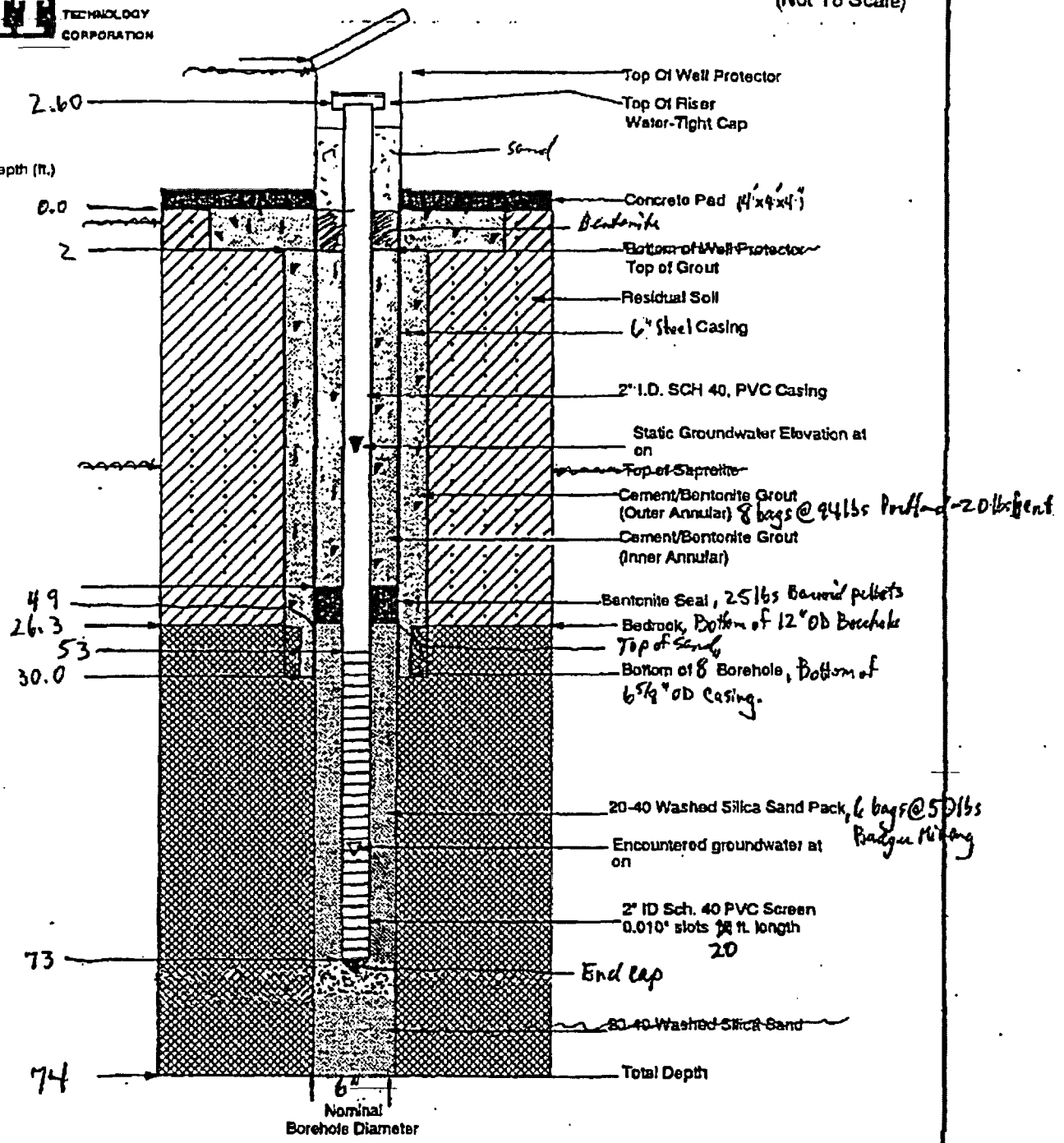
Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	70	grey limestone, hard, massive hc odor			Box 13 (69.5-74')	70.5		
	1							
	2							Box 13 ~~DX~~ DICK 69.5-74
	3				74			(Stop and pump test) 1 PM
	4	Total Depth = 74 ft						slowly recharging 230 PM
	5							
	6							
	7							
	8							
	9							
	80							

Project

Hole Number

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Notes:

Well No.: PB-BED-MW23
Date Installed: 9/8/01
Elevation Top of Casing: 633.71 ft

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

BWMWA23DWG.DFW/9-28-01

PB-BED-MW27

HTRW DRILLING LOG

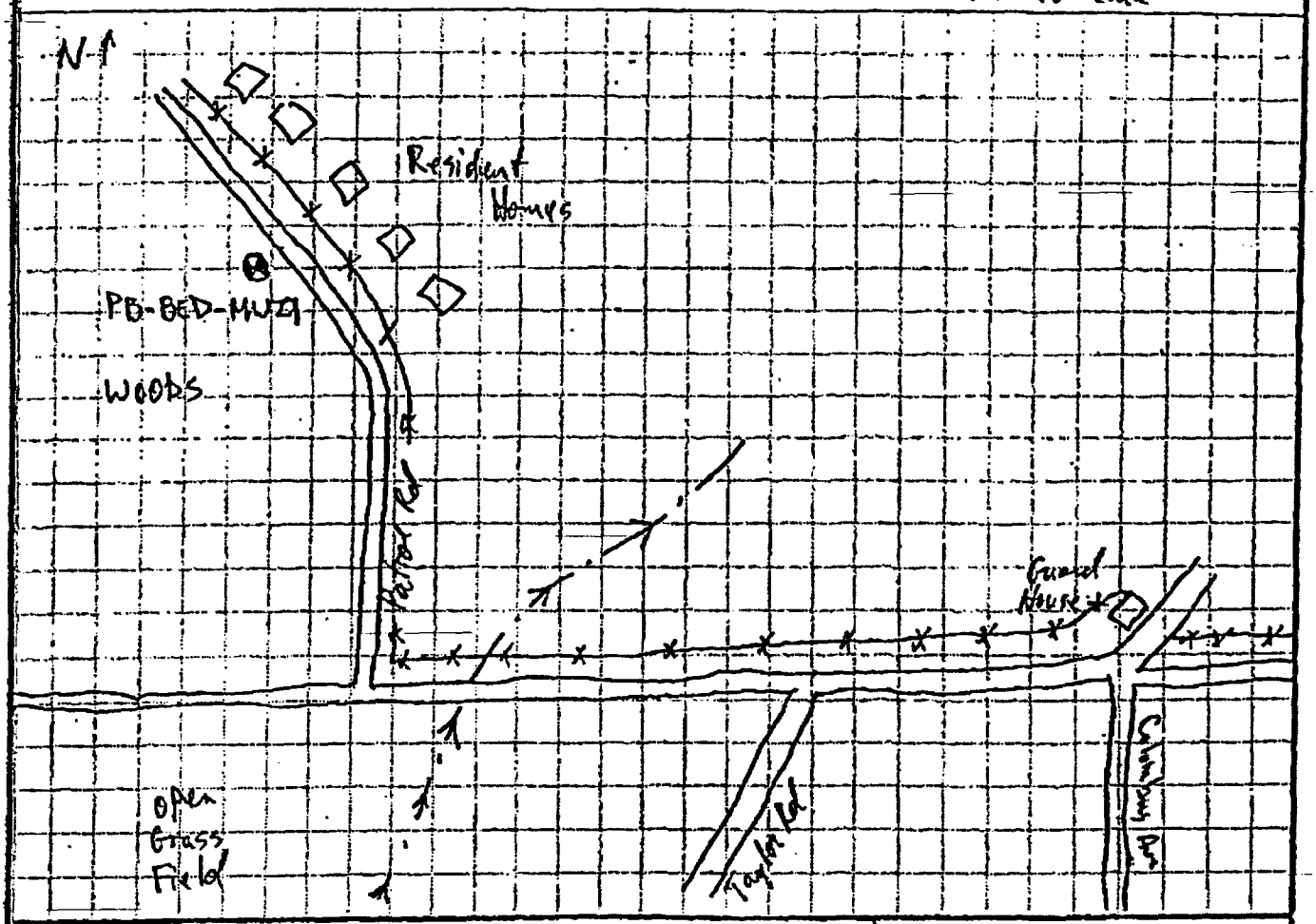
DISTRICT: Nashville, TN	HOLE NUMBER: PB-BED-MW21	
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Boart Longyear	SHEET 1 OF 12 SHEETS
3. PROJECT: PBOW	4. LOCATION: NASA Plum Brook Station, Sandusky, OH	
5. NAME OF DRILLER: Paul Dickinson / Todd Schmelfeldt	6. MANUFACTURER'S DESIGNATION OF DRILL: BK81 / Cantera CZ-250	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 4" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 6" OD. ~~Installed 2" PVC monitoring well block~~	8. HOLE LOCATION: See Sketch	
	9. SURFACE ELEVATION: ~~627.14 ft~~ 625.24 Ft	
	10. DATE STARTED: 8/23/01	11. DATE COMPLETED: 9/8/01
12. OVERBURDEN THICKNESS: 18.8 Ft	15. DEPTH GROUNDWATER ENCOUNTERED: 4.2 Ft (Overburden)	
13. DEPTH DRILLED INTO ROCK: ~~105 feet~~ 86.2 Ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: ~~103.15~~ 14.8 / 1hr	
14. TOTAL DEPTH OF HOLE: 105 feet	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	24

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	76 feet

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Keach / [illegible]

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: PBOW	HOLE NO: PB-BED-MW21

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW21

Project: PBOW

Geologist: D. Kessler

Sheet 2 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Uses	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
		Grass						
		SAND, very dark grayish brown, organics 0.3			NA			Began drilling 8/23/01 1630
	1	Fill: SAND, trace silt (5%), medium dense, yellowish brown (10YR 5/8), homogeneous till 0.9 Ft. At 0.9 Ft, becomes mottled with (10YR 7/6) yellow, vfg, very well sorted, dry)	SP	0		3/5 / 8/10	1.5 / 2.0	Breathing Air: CO = 0ppm LEL = 0% H_2S = 0ppm O_2 = 20.9%
	3	Fill: (SAND, some clay (35%), clay content increases w/ depth, dry) 4		0		3/4 / 7/10	2.0 / 2.0	Water pocket at 2.5 Ft
	4	SILT, some sand (30%), grayish brown (10YR 5/2), mottled (5%) with strong brown (7.5YR 5/8), high plasticity, sand vfg, wet		0		2/2 / 4/7	1.8 / 2.0	Encountered groundwater ▽ 4.2 Ft
		sand content decreases w/ depth	mh			1650		
	6	Medium stiff, SILT, same color as above, sand content 5%, wet		0		2/3 / 4/6	2.0 / 2.0	
	8	Stiff, SILT, dark gray (10YR 4/1), homogeneous, high plasticity, wet		0		2/3 / 6/6	2.0 / 2.0	
	10							

Project: PBOW

Hole Number: PB-BED-MW21

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW27

Project: PBOW

Geologist: D. Kessler

Sheet 3 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	10	Stiff, dark gray (10YR 4/1), homogeneous, SILT, high plasticity, wet		0	NA	3/5 / 8/8	2.0 / 2.0	
	11							
	12					1705		
	13	As above	mh	0		2/3 / 6/8	2.0 / 2.0	
	14					1708		
	15	As above		0		2/4 / 6/9	2.0 / 2.0	
	16					1711		
	17	As above		0			2.0 / 2.0	
	18					1730		Drilled to 18.8 ft w/ 12" OD HSA
	18	As above, with rounded pebbles (3 mm), broken shale fragments				2/50 for 3"	0.5 / 0.8	
	19	Spoon Refusal @ 18.8 ft Auger Refusal @ 18.8 ft SHALE bedrock, very dark gray / black						Began drilling 8/24/01 0843 w/ 8" OD Tricone Roller Bit for casing.
	20	20 ft						

Project: PBOW

Hole Number: PB-BED-MW27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW27

Project: PBOW

Geologist: D. Kessler

Sheet 4 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Lithy	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	20	LIMESTONE, weathered, fractured, soft, gray	NA	NM	NA	NA	NA	Drilling w/ 8" OD Tricone Roller bit to set 6" steel casing.
	21	21' LIMESTONE, hard, gray						Observing only chips of bedrock
		21.5'						Background/ Breathing Air: PID: 0.0 ppm
	22	Shaley LIMESTONE, greenish gray, soft, thinly bedded						
		22.5'						VRAE:
		LIMESTONE, gray, hard, competent						CO = 0 ppm
	23							LEL = 0%
								H_2S = 0 ppm
	24							O_2 = 20.9 ppm
	25							
								Drilled to 26.5' with 8" Tricone Roller Bit. 6" OD casing set at 26.5 ft.
	26							
		26.5						
			NA		NA	NA	NA	
	27							
	28							
								Began coring 9/7/01
	29	massive limestone, gray, hard, no weathering, no bedding			BOX 1 29-33			Start time - 10:30 End " - 11:00
	30					30		

Project: PBOW

Hole Number: PB-BED-MW27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED mw27

Project: PBOW

Geologist: McLeod

Sheet 5 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Symbol	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
								Run - 5' Rec - 5' Depth 29-34' PID - 0.0 MSA - 0 - comb 20.3 - O_2 0 - H_2S 0 - CO
	31							
	32							
	33					33		
	34					34	Run 2	Run 5' Rec - 5'
	35	Massive limestone gray, no weathering, no bedding, hard nat. hydrocarbs. odor			BOX 2 33-37	35 35.5		Depth 34-37 End time : 11:15 PID - 0.0 MSA - 0 - comb 20.4 - O_2 0 - H_2S 0 - CO
	36							
	37					37.0		
	38					38		
	39	gray massive limestone w/fracture ~ 42'-43'			BOX 3 37-41		Run 3	Run 5' Rec. 5' Depth - 39-44
	40					40		

Project: PBOW

Hole Number: PB-BED mw27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BCD-mw27

Project: PBOW

Contractor: S McLeod

Sheet 6 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
						40.5		End time - 11:30
	41							
						41.5		
	42							fracture
					BOX 4 41-44'			
	43					43.0		
	44							
		light-gray, massive limestone, hydrocarbon odor no bedding, no weathering				44	run 4	Run - 5' Rec - 5' Depth - 44-49 End time - 11:45
	45					45		
					BOX 5 44-48'			stop - pump to check for water - none detected
	46					46		
	47					47		PID - 0.0 MSA - 0 - combl 0 H_2S 0 - CO 20.7 - O_2
	48					48		
	49					49	run 5	
								PID - 0.0 MSA - 0 - combl 20.6 O_2 0 - CO 0 - H_2S
	50					50		

Project: PBOW

Hole Number: PB-BCD-mw27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW27

Project: PBOU

Geologist: S. McGuire

Sheet 7 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Symbol	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		same as above			BOX 6 48-51			Run 5' Rec. 5 End time 13:18 Depth - 49-54
	51					51.5		Start - 13:00 PID - 0.0
	52				BOX 7 51-54			
	53					53.5		
	54					54	Run 6	mech
		gray, massive limestone no weath., no bedding hard						Run - 5 Rec - 5 End: 13:30 Depth - 54-59
	55				BOX 8 54-57.5	56.5		mech
	56							PID - 0.0 MSA - 0 comb 20.8 O_2 0 - H_2S 0 CO
	57							
						57.5		
	58				BOX 9 57.5-59			
						58.5		mech
	59	gray massive limestone no weath, no bedding hard					Run 7	Run 5' Rec 5' Depth - 59-64 End time - 13:45
	60							

Project: PBOU

Hole Number: PB-BED-MW27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BEB-MW27

Project: PBOW

Geologist: S Mozel

Sheet 8 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	Unified Class	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
					BOX 10 6763	1 0015		PID - 0.0 MSA - 0 - comb 20.8 - O_2 0 - H_2S 0 - CO
	61					1 61		1
	62					1 62		2
	63							3
	64				BOX 11 63-65		Run 8	Run 5' Rec - 5' Depth - 64-69 End time - 14:00 4
	65	gray massive limestone w/ hydrocarbon odor hard						5
	66				BOX 12 65-69	1 68		PID - 0.0 MSA - 0 comb 20.8 O_2 0 - H_2S 0 - CO 6
	67					1 67		7 Stop and pump for water - the water came up very little ~0.4 30 to 75
	68							8
	69						Run 9	9 Start - 16:30 End - 16:00 Run 8' Rec - 5.5
	70							10

Project: PBOW

Hole Number: PB-BEB-MW27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB BED-MW23

Project: PBDW

Contractor: Soil Test

Sheet 9 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sampler or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		gray, massive, hard nats ha. odor no bedding, no weathering				70.5		PID-0-0 MSA-0 Comb 0-H_2S 0-CO 20.8-O_2
	71				BOX 13 69-72.5			Depth- 69-75'
	72					72.6		
	73							
					BOX 14 72.5- 74.5			
	74					74.5		
	75	massive, gray, hard limestone, no weathering, no bedding					run 10	depth-75-80 end time-9:46 run-5' rec. 5'
					BOX 15 74.5- 78.5			
	76							
	77					77		
	78							
						78.5		
	79				BOX 16 78.5- 81.5			
	80					80		

Project: PBDW

Hole Number: PB BED-MW23

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW21

Project: PBOW

Geologist: S. Reed

Sheet 10 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		gray, massive, hard limestone, no bed, no weath.					Run 11	Depth - 80-85 run - 5' rec - 5' End time: 10:00 PID - 0.0 MSA 0 comb 0 - H_2S 20.7 - O_2 0 - CO
	81					81.5		
	82					82		
					BOX 17 81.5-85-5	82.3		
	83					83.5		
	84							
	85					85	Run 12	
		Same as above w/ minor fracture breaks				85.5		depth. 85-90 Run 5' Rec. 5' End time: 10:20
	86							
					BOX 18 85.5-	87		
	87							Photo of all three runs left to right (Run 10-12)
	88				BOX 19 88-90	88.5		
	89					89.5		Drillers to put together pump (10:35)
	90							

Project: PBOW

Hole Number: PB-BED-MW21

HTRW DRILLING LOG

(continuation Sheet)

Hole Number: PB-BED-MW 27

Project: PBOW

Contractor: Gill Grant

Sheet 11 of 12 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	91	gray, massive, limestone hard, no weath. no bedding			Box 20 90-92	91.5	Run 5	Depth - 90-95 Run - 5' Rec - 5' End time 13:10 Start: 12:50 PID - 0.0 MSA - 0% LEL 0 - CO 20.4 - O_2 0 - H_2S
	92				Box 21 92-95	92.5		
	93							
	94					94.5		
	95							
	96	Same as above w/ hydrocarbon visibility and odor.			Box 22 95-98		Run 4	Depth - 95-100 Run - 5' Rec - 5' End time: 13:25 1-3' section 1-2' section PID - 0.0 MSA - 0% LEL 0 - CO 20.3 O_2 0 - H_2S
	97							
	98					98		
	99				Box 23 98-100			
	100					100		

Project: PBOW

Hole Number: PB-BED-MW27

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW27

Project: PBOW

Geologist: S. McLeod

Sheet: 12 of 12 Sheets

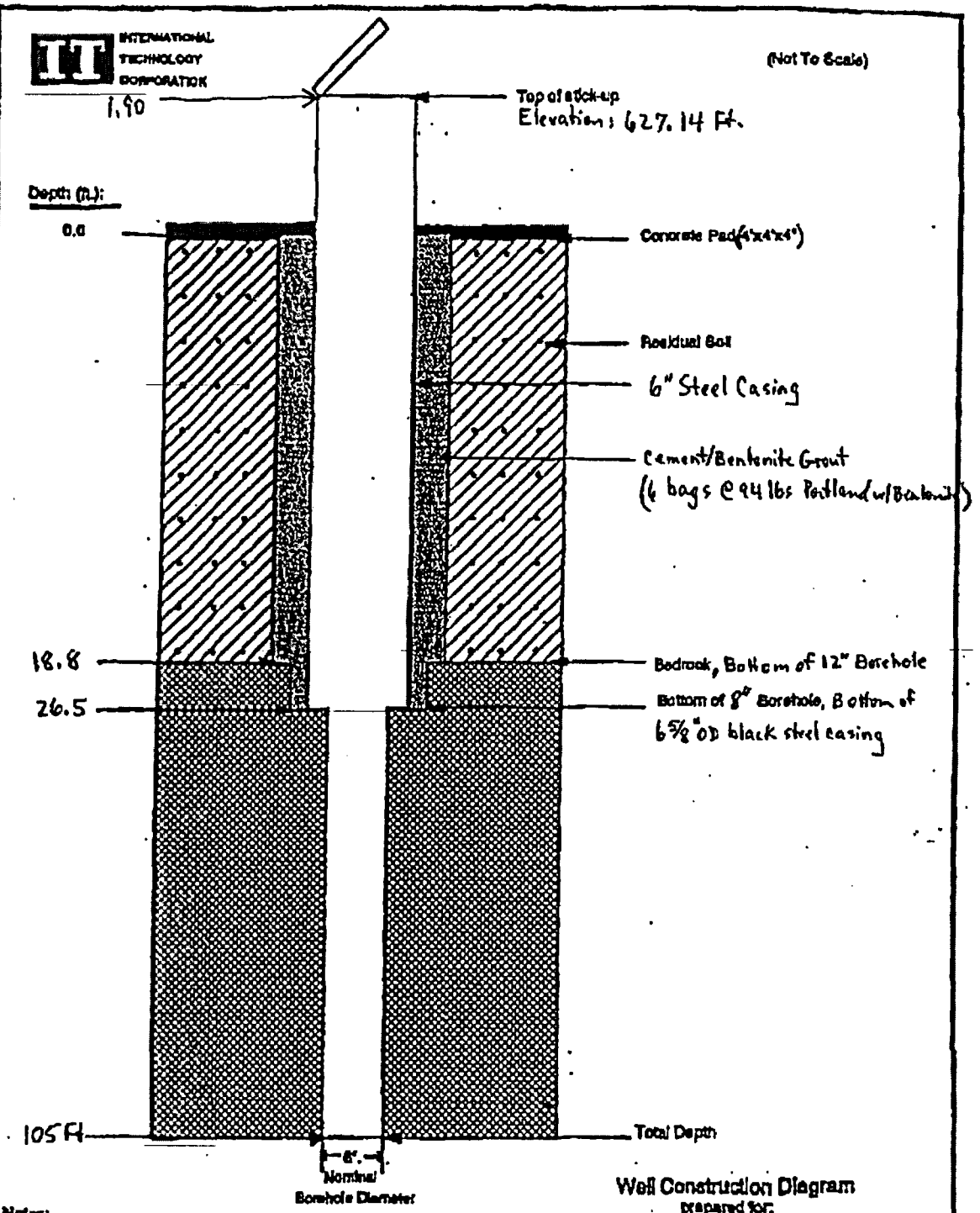
Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Unit	Field Screening Results (ppm)	Geotech Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		gray, mas. limestone w/no bedding, no weathering					Run 15	Depth - 100-105 Run - 5' Rec. 5' End: 13:45
	10 1					101.5		PID - 0.0 MSA - O - LEL 0 - CO
	10 2					102		20.3 - O_2 0 - H_2S
					Box 24 101.5-105			
	10 3							2' piece section 3' piece section
	10 4							
	10 5	Total Depth - 105 Ft						
	10 6							
	10 7							
	10 8							
	10 9							
	10 10							

Project: PBOW

Hole Number: PB-BED-MW27

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Well Construction Diagram
prepared for:

Plum Brook Ordnance Works
Sandusky, Ohio

Notes:

Well No.: PB-BED-MW27

Date Installed: 9/8/01

Elevation Top of Casing: 627.14 Ft
(outer edge of protective casing with lid open)

AA1-BEDGW-002

HTRW DRILLING LOG

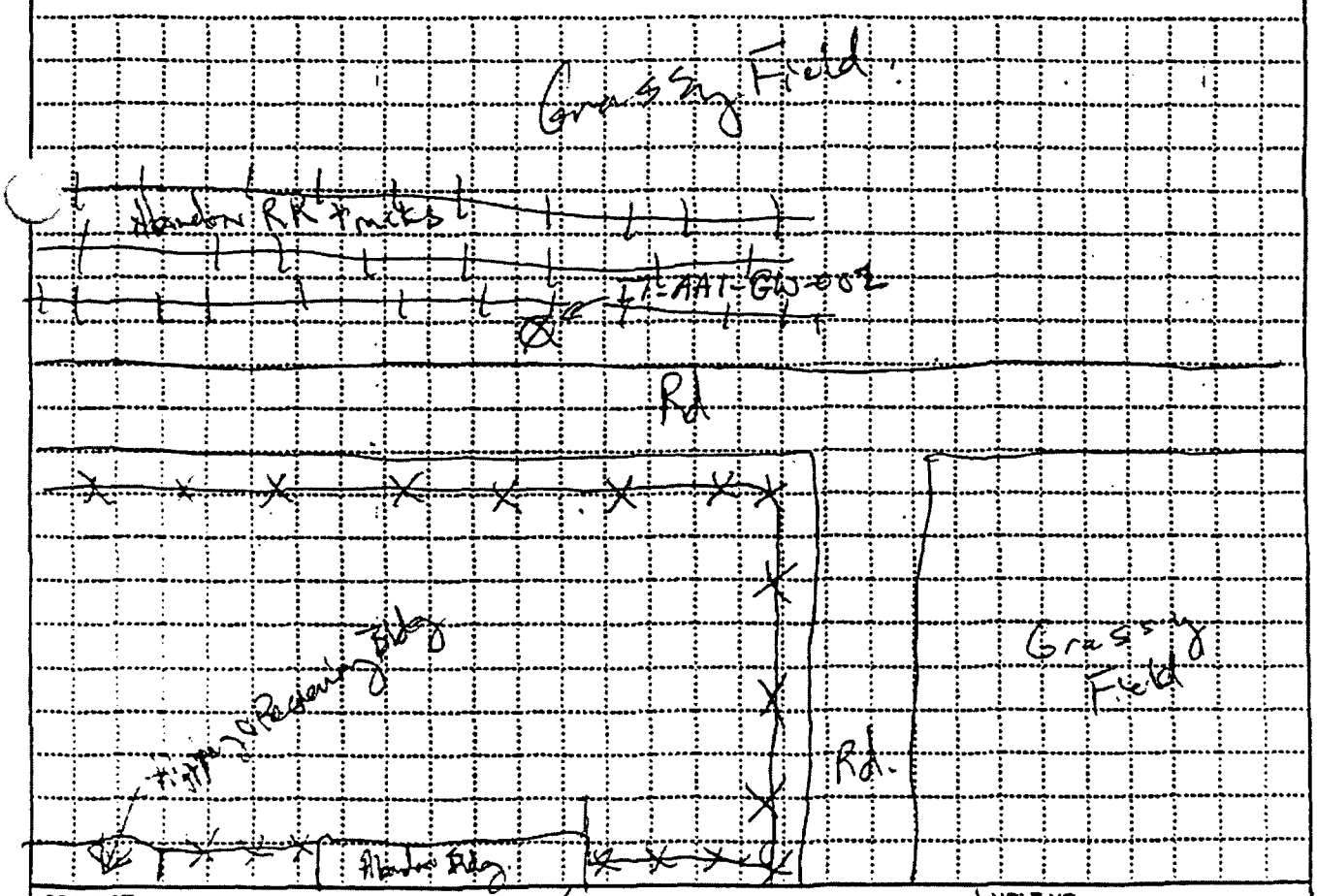
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-AA1-GW-002
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 4 SHEETS
3. PROJECT: AA1 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Dimich D 120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Dimich D120 drill Rig. 8¼ OD. HSA. 2" x 24" SS Split Spoon, 140 lb Hammer	8. HOLE LOCATION: N=623068.35 E=1917727.57 See sketch	
	9. SURFACE ELEVATION: 638.60 Ft. ~~642.05~~ (From Topo) DRK	
	10. DATE STARTED: 9/19/97	11. DATE COMPLETED: 9/19/97
12. OVERBURDEN THICKNESS: 23.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 21.5'	
13. DEPTH DRILLED INTO ROCK: none	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 5.59 on 10-5-97	
14. TOTAL DEPTH OF HOLE: 23.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
3	X		NA

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						N/A %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / [signature]

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: Plum Brook Ordnance Works | HOLE NO. IT-AA1-GW-002

HTRW DRILLING LOG

HOLE NUMBER: IT-AA1-GW-002

PROJECT: Plum Brook Ordnance Works | INSPECTOR: G. Buckner | SHEET 2 OF 2 SHEETS 4

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	BLOW COUNTS	REMARKS
		Gravel Surface 0.7 Gravel, tan, Dry Fill. 0.5	HNU		Blow counts	Sample thru 4 1/4" I.D. HSA. Using 2'x2" s.s. split spoon.
	1	SAND, sing (30%) Damp Grayish br v F gr lo	19.0 ppm	3/4 (68) 3/5	3/4 3/5	Ran 2.0' Rec 1.8' Loss 0.2' 15:30
	2	2.3 Becoming orange & Br. 2.5'				Auger to 2.0' 2.0'
	3	SILT Sdy (10%) Black (has burn odor) v F gr Dry to slightly Damp. lo pl.	4.5 ppm	4/3 (68) 3/4	4/3 3/4	Ran. 2.0' Rec 1.7' Loss 0.3
	4	4.2' Becoming mottled Gray, orange brown. other remains the same. 5.1'				Auger to 4.0' 4.0'
	5	Silt Cly rice to slightly stiff moist (slightly Damp) mottled 0.2 [illegible] Gray. med pl. to high pl.	3.5 ppm	2/3 (68) 5/7	2/3 5/7	Ran 2.0' Rec 1.6' Loss 0.4'
	6	7.0'				Auger to 6.0' 6.0'
	7	Silt Sdy (30%) v F gr Damp (wet) lo pl. mottled br + gray. 8.0'	3.0 ppm	3/4 (68) Geotech Sample IT-AA1-GW-001 6'-8'	2/3 3/4	Ran 2.0' Rec 1.8' Loss 0.2'
	8	Silt Clay (25-20%) Sdy (5%) v F gr stiff moist orangish br to gray. med Plasticity	2.0 ppm		2/4 5/8	15:00 Ran 2.0' Rec 1.9' Loss 0.1'
	9					
	10					Auger to 10.0 10.0'

PROJECT: AA1 / Plum Brook Ordnance Works | HOLE NO. IT-AA1-GW-002

HTRW DRILLING LOG

HOLE NUMBER: IT-AA1-GW-002

PROJECT: AA1/Plum Brook Ordnance Works | INSPECTOR: G. Buckner | SHEET 3 OF 4 SHEETS

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	BLOWS/COUNTS	REMARKS
		Silt Silty (25%) Wet (Damp) lo to stiff v F grn or	HNU		Blow Counts	
	11	11.5 decreasing Sand content (10%)	3.0 ppm		4/6 12/12	Raw: 2.0', Rec: 1.8 Loss: 0.2
	12	12.5'				Auger to 12' 12.0'
		Silt slightly damp. Clay (40%) Gray, moist to High Plasticity 12.8'				15:10
	13	Clay, silty (60%) Gray slightly Damp to Dry ~~Homogeneous~~ lots of Plant slightly stiff	2.0 ppm		3/5 5/6	Raw 2.0', Rec 1.6', loss 0.4'
	14					Auger to 14' 14'
	15		2.2 ppm	Geotech Sample IT-AA1-GW-001 14'-16'	3/4 7/8	15:18 Raw 2.0' Rec 1.9 Loss 0.1
	16	16.0				Auger to 16.0' 16.0
		Clay, silty v F grn (5%) Gray, slightly Damp 16.5'				
	17	Clay, silty ~~Hard~~ Pl. slightly Damp to Dry gray lots of Pl slightly S+F	1.5 ppm		2/3 5/7	Raw 2.0' Rec 2.0' ~~Loss~~ 0.0'
	18					Auger to 18.0' 18'
	19		1.8 ppm		8/14 14/14	Raw Rec Loss
	20					Auger to 20.0 20'

HTRW DRILLING LOG

HOLE NUMBER: IT-AA1-GW-002

PROJECT: Plum Brook Ordnance Works | INSPECTOR: G. Buckner | SHEET 4 OF 4 SHEETS

D.CY.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	BLOW COUNTS	REMARKS
		Gravel/Silty (Coarse grained) Clay (45%) gray Fine gr. Silty Clay to Clay Stiff	ppm 2.8	Geotech Sample IT-AA1-GW-001 20'-22' 16:00 -	9/21 20/58	16:00
	21	21.5 wet				
	22					Augered 22.0'
			1.6 ppm		6/50/6 inches	
	23	23.0' Top of Bedrock (shale) 23.0' T.D of Hole				Auger Refusal 23.0'
						16:30 Begin well construction
	24					15' screen 22'-7' 1' sand 6' 3' Bentonite 3' bottom Protection Casing 5' 7.5' 2.5' stickup
	25					
	26					
	27					
	28					
	29					
	30					

AA2-BEDGW-002

HTRW DRILLING LOG

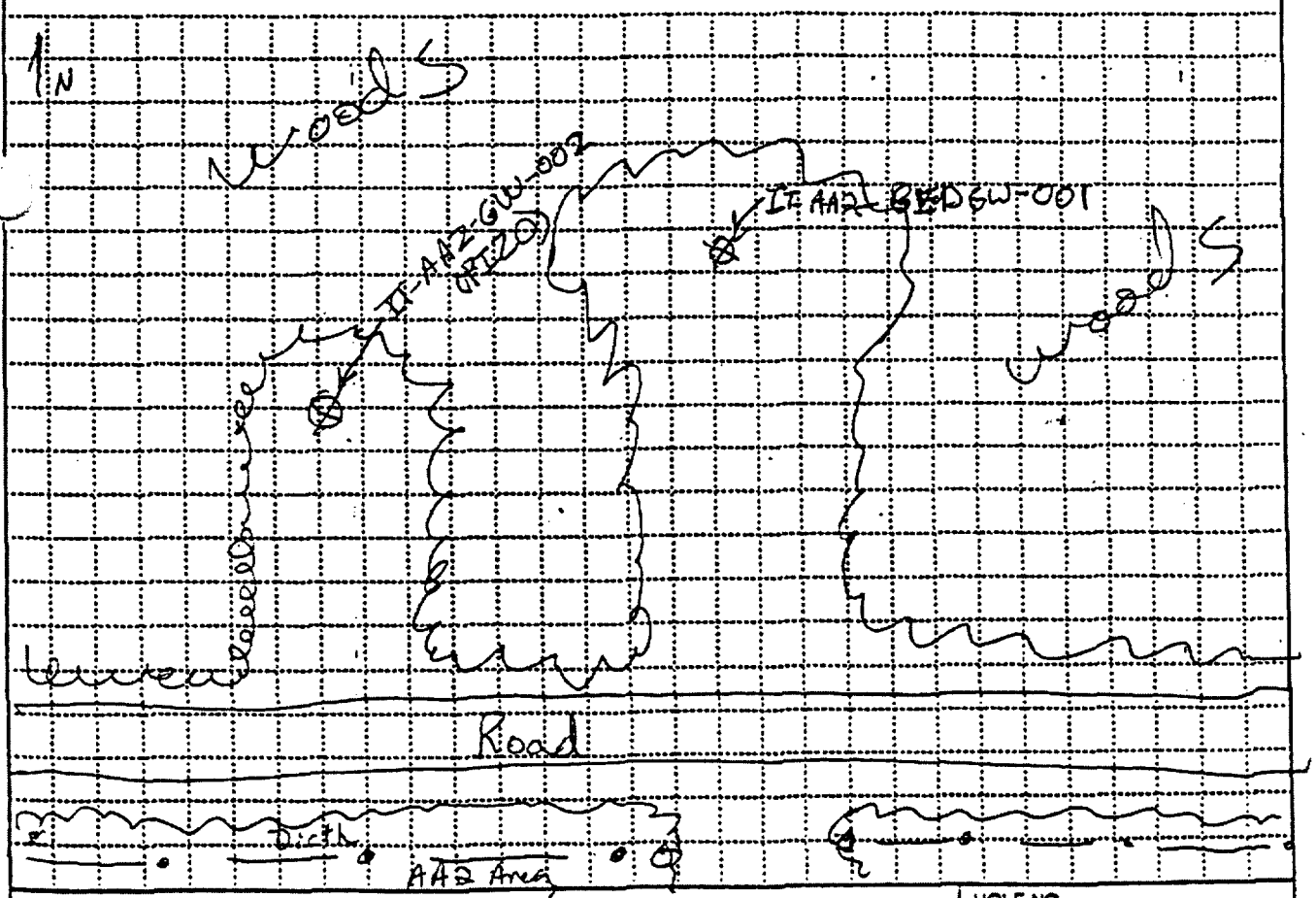
DISTRICT: USACE / Nashville	HOLE NUMBER: IT-AA2-GW-002	
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 3 SHEETS
3. PROJECT: AA2 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Dierich D 120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Dierich D 120 (Drill Rig), 8 1/4 O.D. HSA, 2" x 2" SS. split spoon, 140 lb Hammer	8. HOLE LOCATION: N = 623589.11 E = 1404481.30 See Sketch	
	9. SURFACE ELEVATION: 641.50 Ft. ~~6450 (From Topo) Dike~~	
	10. DATE STARTED: 9/22/97	11. DATE COMPLETED: 9/22/97
12. OVERBURDEN THICKNESS: 19.5'	15. DEPTH GROUNDWATER ENCOUNTERED: Not encountered	
13. DEPTH DRILLED INTO ROCK: None	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: No water Present	
14. TOTAL DEPTH OF HOLE: 19.5'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
3	X		NA

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						NA

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
Piezometer			Piezometer	Greg Brekner /

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT	HOLE NO.
AA2 / Plum Brook Ordnance Works	IT-AA2-GW-002

HTRW DRILLING LOG

HOLE NUMBER: IT-AA2-GW-002

PROJECT: Plum Brook Ordnance Works/AA2 | INSPECTOR: G. Buckner | SHEET 2 OF 2 SHEETS 3

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	PENETRATION RESISTANCE (ft)	REMARKS (ft)
		Sample 0-0 (approx) 0.1	HNU		Blow Counts	Sample three 4 1/4" ID HSA using 2'x2" SS Split spoon 1350
		Silt Silty (20%) v Fine Sand. (low Pl.) Pt Soft/loose (Fill) Brn.		2/3	2/3	
				5/7	5/7	
644	1		12.0 ppm			Raw 2.0' Rec 1.2' Loss 0.8
643	2	2.2'				Auger to 2.0' 2.0'
		Silt br to yellowish br. (mottled) Soft Dry Fine to Med Pl.		5/9	5/9	Raw 2.0'
	3		6.0 ppm	12/12	12/12	Rec 1.3' Loss 0.7'
641	4	4.0' Becoming mottle orange brown & gray is to be other replacing the same				Auger to 4.0' 4.0'
				6/9	6/9	Raw 2.0'
640	5		6.2 ppm	13/14	13/14	Rec 0.8' Loss 1.2'
	6			1.0'		Auger to 6.0' 6.0' 14:40
				3/4	3/4	Raw 2.0'
638	7		4.0 ppm	5/7 Geotech Sample IT-AA2-GW-002 6'-8' 14:10	5/7	Rec 1.7' Loss 0.3
	8			3.0'		Auger to 8.0' 8.0'
				3/5	3/5	Raw 2.0'
	9		3.0 ppm	5/7	5/7	Rec 2.0' Loss
635	10					Auger to 10.0' 10.0'

HTRW DRILLING LOG

HOLE NUMBER IT-AA2-GW-002

PROJECT Plum Brook Ordnance Works/AA2 | INSPECTOR G. Buckner | SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
635		Clay Silty (10%) Gravelly Red Med to high Plasticity slightly Damp. Homogeneous	NA	Geotech Sample	Blow Counts	14:20
	11		2.0 ppm	IT-AA2-GW-002 10'-12' - 14:20	2/3 5/4	Rqd 2.0' Rec 1.8' loss 0.2'
633	12					Auger to 12.0' 12.0'
		12.2 slight increase in silt content (25%) other Remain the same			2/3	
	13		1.5 ppm		3/5	Rqd 2.0' Rec 1.8' loss 0.2'
	14					Auger to 14.0' 14.0'
630	15		1.2 ppm		1/2 3/3	Rqd 2.0' Rec 1.7' loss 0.2'
629	16					Auger to 16.0' 16.0'
		16.4'		Geotech Sample		14:35
628	17	Clay Gravel (Shale) (20%) Med to Fine grain Soft Slightly Damp to Damp Gray	1.8 ppm	IZAA2-GW-002 14:35, 16'-18'	1/2 4/7	Rqd 2.0' Rec 1.8' Loss 0.2'
627	18					Auger to 18.0' 18.0'
		18.3				14:40
626	19	Gravel (Fine to med grained shale) Clay Dry to slightly Damp. Stiff	0.8 ppm		5/10 50-5 inches	Rqd ~~2.0~~ 1.5' Rec 1.5' Loss 0.0'
		Spoon Refusal 19.5'				14:50
		19.5' T.D. of Hole.				
625	20					

AA3-BEDGW-002

HTRW DRILLING LOG

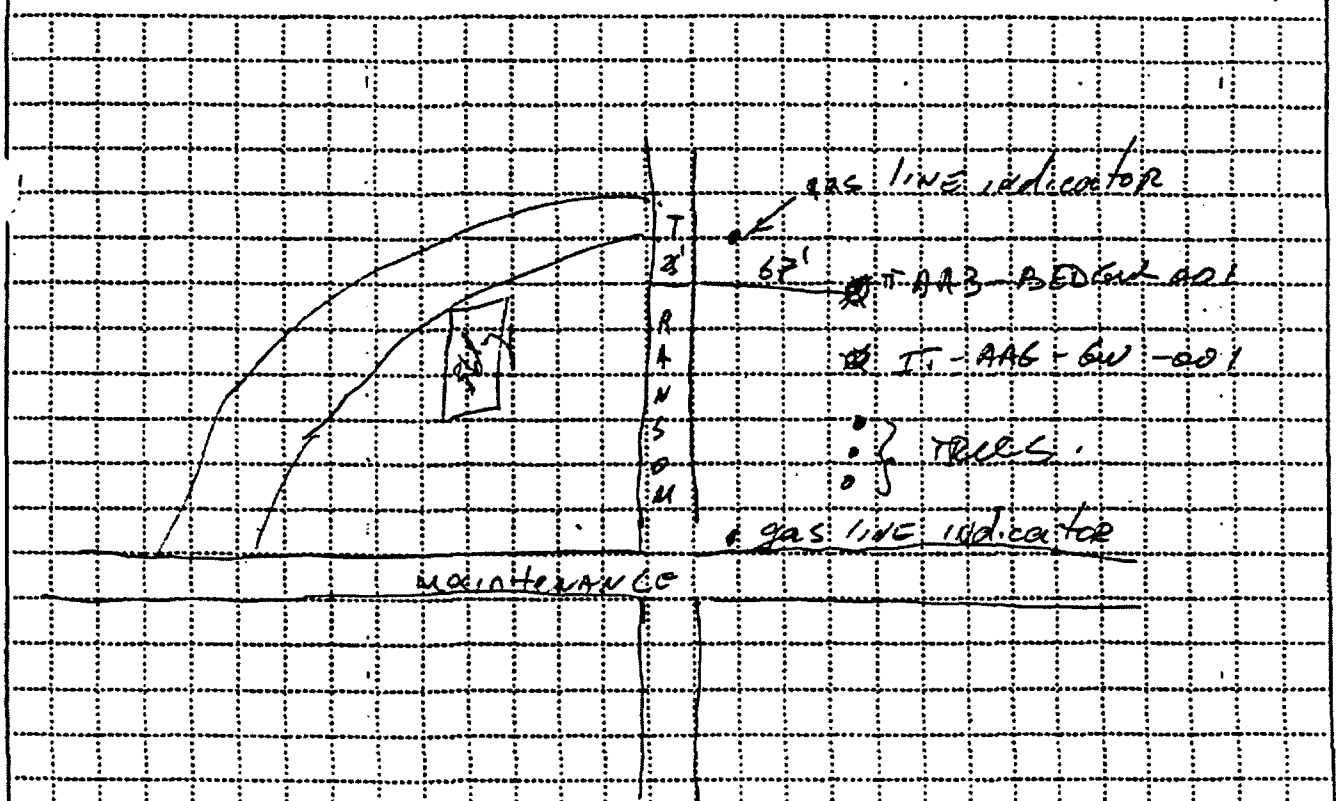
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-AA3-GW-002
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 3 SHEETS
3. PROJECT: AA3 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley / Greg Conrad	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich 50	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich 50, 8.25" HSA 2" x 2' SS. Split Spoon, 140 lb Hammer	8. HOLE LOCATION: N = 625027.71 E = 1414956.35 See sketch	
	9. SURFACE ELEVATION: 634.10 Ft. ~~635.0 (From Topo)~~ DKK	
	10. DATE STARTED: 9/18/97	11. DATE COMPLETED: 9/18/97
12. OVERBURDEN THICKNESS: unknown	15. DEPTH GROUNDWATER ENCOUNTERED: ~8.0	
13. DEPTH DRILLED INTO ROCK: None	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 5.75 on 10/4/97	
14. TOTAL DEPTH OF HOLE: 17.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
3	X		NA

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						NA

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / Elkhanna

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: AA3 / Plum Brook Ordnance Works — HOLE NO. IT-AA3-GW-002

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

HOLE NUMBER: IT-AA3-GW-002

PROJECT: ~~Plum Brook Ordnance~~ IT Corp

INSPECTOR: Ed Kanensky

SHEET 2 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Top Soil	HNU	2		10% recovery
		Silty sand	ppm	6		
		Black		6		
	1	dry	Ø	8		
		Loose				
	2					
		Silty Clay	2 ppm	2		50% recovery
		Low plasticity		3		
		Medium dense		14		
	3	~~damp~~ slightly damp		13		
	4				4.0'	
		Clayey silt	4 ppm	2	Geotech sample	100% recover
		Medium ~~low~~ plasticity		3	Sample bottle	
		Loose		5	IT-AA3-GW-002	
	5	Yellowish brown		6	4'-6'	
		moist			9-18-92	
	6				6.0	
		Clayey silt	2 ppm	2		
		medium plasticity		3		
		yellowish brown		1		
	7	Loose		4		
		moist				
	8				8.0'	
		Clayey silt	4 ppm	2	Geotech sample	50% recover
		medium plasticity		2	Sample bottle	
		some fine sand		4	IT-AA3-GW-002	water table
	9	yellowish brown		5	8'-10'	at 10'
		Loose				
		saturated				

HTRW DRILLING LOG

HOLE NUMBER: IT-AA3-GW-002

PROJECT:

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	CONTROL SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Silty sand	2 ppm	4		50% recovery
		Fine		4		
		Loose		4		
		Low plastisity		4		
	11	Yellowish Brown				
		wet				
	12	Clayey silt	10 ppm	1	12' Geotech sample sample IT-AA3-GW-002 12'-14'	90% recovery
		medium plastisity		1		
		Grey		2		
	13	Saturated		3		
	14	Same as above	2 ppm	1	14'	100% recovery
				2		
				3		
				4		
	15					
	16					
	17	BOH @ 17				
	18	~~BOH @ 18'~~				
	19					

PROJECT

HOLE NO. IT-AA3-GW-002

ABG-BEDGW-002

HTRW DRILLING LOG

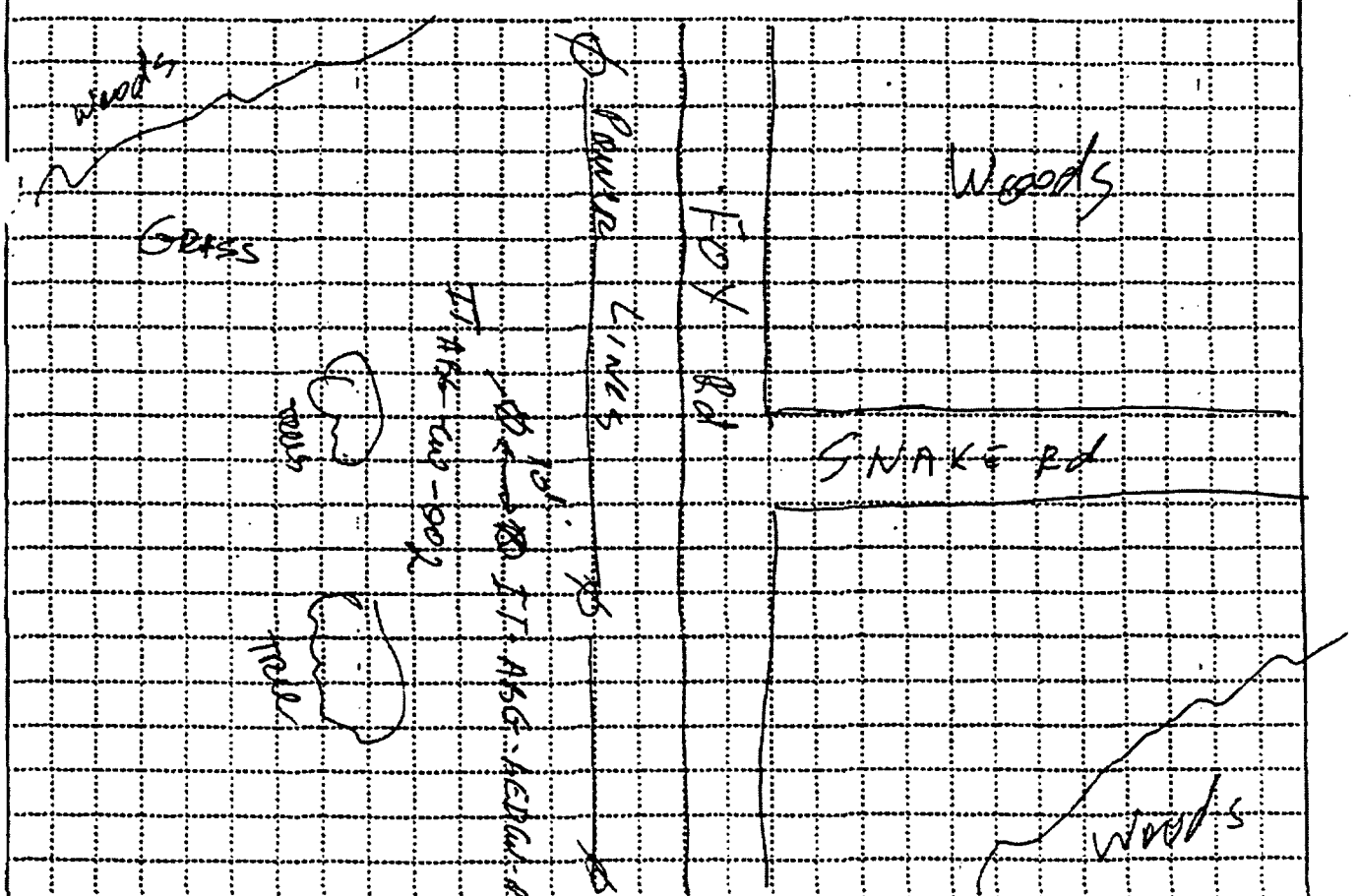
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-ABG-EW-002
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 2 SHEETS
3. PROJECT: ABG / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley / Greg Conard	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-50	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich D-50 Drill Rig; 4 1/4" ID HSA, 2' 12' SS; 2" Split Spoon; 140 lb. Hammer	8. HOLE LOCATION: N=621578.51, E=1921515.58 See Sketch	
	9. SURFACE ELEVATION: 658.20 Ft. ~~654.06 (From Topo)~~ DKK	
	10. DATE STARTED: 9/11/97	11. DATE COMPLETED: 9/11/97
12. OVERBURDEN THICKNESS: 6.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 2.3'	
13. DEPTH DRILLED INTO ROCK: 1.0'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	
14. TOTAL DEPTH OF HOLE: 7.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	X		NA

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		~~Greg Brooker~~ / ED KAUGVAR

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT	HOLE NO.
ABG / Plum Brook Ordnance Works	IT-ABG-EW-002

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

HOLE NUMBER: IT-ABG-GW-002

PROJECT: Plum Brook Ordnance Work

INSPECTOR: ED RANKERSLY

SHEET: 1 OF 2 SHEETS 2

ELEV. (m)	DEPTH (m)	DESCRIPTION OF MATERIALS (m)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (m)	ANALYTICAL SAMPLE NO. (m)	REMARKS (m)
		Grass Top soil 0.4	HNU	2		2½"-2'-split spoon
		sand, fine well sorted	Brek sand Q	5 7 10	2/5 7/10	80% recovery
657	1	~~damp~~ slightly damp Yellowish Brown Loose	HNU 0.8 ppm	Geotech-Sample. Sample # IT-ABG-GW-002 0'-2'		
		2.0		2.0		
656	2	St Blaed ash 2.3	HNU	11		80% recovery
		Silty sand fine ~~damp slightly~~ damp Green well sorted dense	9.8 PPM	12 20 19	11/12 20/19	
				Geotech Sample Sample # IT-ABG-GW-002 2'-4'		
655	3					
654	4	4.0		4.0		
		Silty SAND, gray, moist LOOSE 2" - shale, gray, LOOSE 4.4	HNU 8.6 ppm	6 50/4	6/ 50/4 inches	4" recovery
653	5	No recovery				
652	6	6.0 Shale				Auger to 7.0'
651	7	BOH @ 7'				

IT-MW01

BORING NO. MW01

COORDINATES N 616864.39 E 1945986.24

FIELD ENGINEER J. SHIREMAN DATE BEGAN 10/15/89
EDITED BY D. BURTON DATE FINISHED 10/18/89
CHECKED BY _____ GROUND SURFACE EL. 674.52

DEPTH IN FEET	LABORATORY TEST DATA: SAMPLE NO.	SAMPLE DEPTH	ATTERBERG LIMITS: LIQUID LIMIT (%)	PLASTICITY INDEX (%)	MOISTURE CONTENT (%)	WELL SUMMARY/BACKFILL	PENETRATION RESISTANCE (BLOWS/FT) SAMPLE	USCS	PROFILE	DESCRIPTION
0	601879*	0-2	46	17.8	26.3			ml		SILTY CLAY, REDDISH GREY (10 y 6/6). UPPER 2 FEET CONTAINS GRASS
			(GRAIN SIZE)							
	MW01	2-3 1/2								SAMPLING DEPTH 3.5 FEET
5										SHALE, WEATHERED BEDROCK. PARTINGS ARE .05 TO .15 INCHES APART
										SHALE BECOMES HARD
10										TOTAL BORING DEPTH 8.5 FEET AUGER REFUSAL AT 8.5 FEET
15										
20										
25										
30										
35										

NOTE:

* - Geotechnical sample

Screen: B & K schedule 40, 2 inch threaded PVC, 0.01 inch from 4 to 8 feet.
Riser: B & K schedule 40, 2 inch threaded PVC, approximately 7.2 feet, (including stick up.)
Bentonite: 1/4 inch bentonite pellets from 2 to 4 feet in depth.
Filter Sand: 40/60 mesh silica sand, tremied through augers from 8.5 to 2 feet in depth.
Grout: Portland cement with 3% bentonite from 0 to 1 feet.
Well Protection: Locking steel well protector and concrete apron with (3) 3 foot guard posts.
Static Water Level: 3.03 feet from top of riser, 10/21/89

PROJECT NO. 409658
CLIENT: PLUM BROOK

ACAD\GENERAL\409658-1

IT ...Creating a Safer Tomorrow

APPENDIX E

IT-MW02

BORING NO. MW02

COORDINATES N 622474.41 E 1941725.48

FIELD ENGINEER J. SHREMAN DATE BEGAN 10/17/89

EDITED BY D. BURTON DATE FINISHED 10/17/89

CHECKED BY _____ GROUND SURFACE EL. 636.53

DEPTH IN FEET	SAMPLE NO.	SAMPLE DEPTH	LABORATORY TEST DATA: ATTERBERG LIMITS LIQUID LIMIT (%)	PLASTICITY INDEX (%)	MOISTURE CONTENT (%)	WELL SUMMARY/BACKFILL	PENETRATION RESISTANCE (BLOWS/FT) SAMPLER	USCS	PROFILE	DESCRIPTION
0	MW02	0–2						sm/ml		CLAYEY SANDY SILT, DARK BROWN (7.5 yr 3/2), DRY, 20% FINE SAND
	GG1880	2–4[a]						sm		GRADES TO VERY FINE SAND, PINKISH YELLOW (7.5 yr 6/8) LOOSE
5	MW02	4–6						cl		SILTY CLAY, VERY STIFF, OLIVE BROWN (2.5 yr 3/4)
	MW02	6–8						sm/ml		SILTY CLAYEY SAND, SATURATED, GRADES DOWN TO VERY FINE GRAINED SANDY SILT DARK BROWN (7.5 yr 3/2), CHANGES TO REDDISH GREY (10 r 6/1)
10	GG1881	8–10[a]	34.2	12.3				ml/cl		SANDY SILT TO SILTY CLAY, MOTTLED REDDISH YELLOW, DRY TO SLIGHTLY MOIST, SLIGHTLY PLASTIC
15	GG1881	13.5–15.5[a]	(GRAIN SIZE)		14.9			cl		SILTY CLAY, REDDISH GREY, MOIST MED. STIFF SLIGHTLY PLASTIC
	MW02	16.5–18.5						cl		SILTY CLAY, REDDISH GREY (10 r 6/1), MOIST
20										TOTAL DEPTH 18.3 FEET SAMPLING DEPTH 18.5 FEET LIMESTONE, GREY CONTAINING PYRITIZED BRACOPODS
25										
30										
35										

NOTE:

a – Geotechnical sample

Screen: B & K schedule 40, 2 inch threaded PVC, 0.01 inch from 8 to 18 feet.

Sand Sump: B & K Schedule 80 2 inch threaded PVC from 18 to 16 feet.

Riser: B & K schedule 40, 2 inch threaded PVC, approximately 8 feet, (including stick up.)

Bentonite: 1/4 inch bentonite pellets from 2 to 3.8 feet in depth.

Filter Sand: 40/80 mesh silica sand, tremied through augers from 3.8 to 16.3 feet in depth.

Grout: Portland cement with 3% bentonite from 0 to 2 feet.

Well Protection: Locking steel well protector and concrete apron with (3) 3 feet guard posts.

Static Water Level: 10.72 feet from top of riser, 10/21/89

PROJECT NO. 409658

CLIENT: PLUM BROOK

ACAD\GENERAL\BORELOG\409658-2

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APPENDIX D

APPENDIX E

IT-MW05

BORING NO. MW05

COORDINATES N 625309.03
E 1950536.35

FIELD ENGINEER J. SHREMAN DATE BEGAN 10/16/89
EDITED BY D. BURTON DATE FINISHED 10/17/89
CHECKED BY _____ GROUND SURFACE EL. 632.38

DEPTH IN FEET	SAMPLE NO.	SAMPLE DEPTH	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	MOISTURE CONTENT (%)	USCS	DESCRIPTION
0	GG-1873	0-2'	(GRAIN SIZE)			sp	SAND VERY FINE GRAINED, DRY, LOOSE, WELL ROUNDED, POORLY GRADED, REDDISH YELLOW (7.5 yr 6/8)
							MOIST AT 2 1/2 FT.
	GG-1874	3-4'			26.0	cl	CLAY/ SILTY CLAY STIFF CONTAINS UP TO 15% SILT
5	GG-1875	4-6'	26.6	7.4		ml	CLAYEY SANDY SILT
						cl	CLAY, SLIGHTLY PLASTIC, MOIST TO WET
						sm	SILTY SAND, VERY FINE GRAINED, LOOSE TO MED. DENSE, DRY
	GG-1876	6-8'	(GRAIN SIZE)			cl	CLAY, VERY PLASTIC, WET MED. STIFF TO STIFF, GREY (N 5/0)
	GG-1877	8-10'	26.9	8.6			
10						cl	CLAY, REDDISH GREY, MED. STIFF WET
15	MW-05	14-16				cl	CLAY, VERY PLASTIC, SATURATED TO VERY WET, REDDISH GREY
20	GG1878	19-21'			14.0	cl	CLAY WITH ABOUT 20% COARSE SAND TO SMALL GRAVEL GRAVEL IS VERY ANGULAR
25							TOTAL BORING DEPTH 21 FEET TOTAL SAMPLE DEPTH 21 FEET
30							
35							

LABORATORY TEST DATA

WELL SUMMARY/ BACKFILL

PENETRATION RESISTANCE (BLOWS/FT) SAMPLE

PROFILE

NOTE:

G - Geotechnical sample

Screen: B & K schedule 40, 2 inch threaded PVC, 0.01 inch from 8.5 to 18.5 feet.
Sand Pack: B & K Schedule 80 2 inch threaded PVC from 18.5 to 20.5 feet.
Riser: B & K schedule 40, 2 inch threaded PVC, approximately 11.8 feet, (including stick up.)
Bentonite: 1/4 inch bentonite pellets from 4.5 to 8.5 feet in depth.
Filter Sand: 40/60 mesh silica sand, tremied through augers from 6.5 to 21 feet in depth.
Grout: Portland cement with 3% bentonite from 0 to 4.5 feet.
Well Protection: Locking steel well protector and concrete apron with (3) 3 feet guard posts.
Static Water Level: 19.78 feet from top of riser, 10/21/89

PROJECT NO. 409658
CLIENT: PLUM BROOK

ACAD\GENERAL\BORELOG\409658-5

IT ...Creating a Safer Tomorrow

APPENDIX E

IT-MW06

BORING NO. MW06

COORDINATES N 628604.10
E 1950228.42

FIELD ENGINEER J. SHIREMAN DATE BEGAN 10/17/89
EDITED BY D. BURTON DATE FINISHED 10/17/89
CHECKED BY _____ GROUND SURFACE EL. 628.90

DEPTH IN FEET	SAMPLE NO.	SAMPLE DEPTH	LABORATORY TEST DATA: ATTERBERG LIMITS: LIQUID LIMIT (%)	PLASTICITY INDEX (%)	MOISTURE CONTENT (%)	WELL SUMMARY/ BACKFILL	PENETRATION RESISTANCE (BLOWS/FT) SAMPLE	USCS	PROFILE	DESCRIPTION
0										TWO FEET OF CONCRETE ROADWAY
	GC1883	0-2'			14.4					
	GC1884	2-4'	(GRAIN SIZE)					sp		SAND, FINE GRAINED LOOSE TO MED. DENSE, POORLY GRADED, COLOR CHANGE AT 1.2 FEET FROM BROWNISH YELLOW (10 yr 6/8) TO OLIVE BROWN (2.5 y 4/4)
5	GC1885	4-6'	(GRAIN SIZE)							
	GC1886	6-8'	28.3	9.6						CLAY, VERY PLASTIC DARK GREY (N 4/0) TO GREY, DRY TO SLIGHTLY MOIST, VERY LITTLE TO NO SILT. CLAY, VERY TO SLIGHTLY PLASTIC, MED. STIFF CONTAINS UP TO 1 % SAND GRADES TO SILTY CLAY AT 9 FEET
	GC1887	8-10'			22.8					
10										▼
								cl		
15	GC1888	13.5-15.5'	26.9	9.2						TOTAL SAMPLING DEPTH 15.5 FEET
										TOTAL BORING DEPTH 18.5 FEET, AUGER REFUSAL
20										
25										
30										
35										

NOTE:

G = Geotechnical sample

Screen: B & K schedule 40, 2 inch threaded PVC, 0.01 inch slotted from 8 to 18 feet.
Sand Sump: B & K Schedule 80 2 inch threaded PVC from 18 to 18 feet.
Riser: B & K schedule 40, 2 inch threaded PVC, approximately 7.4 feet. (including stick up.)
Bentonite: 1/4 inch bentonite pellets from 4.4 to 2.4 feet in depth.
Filter Sand: 40/80 mesh silica sand, tremied through augers from 18.4 to 4.4 feet in depth.
Grout: Portland cement with 3% bentonite from 0 to 2.4 feet.
Well Protection: Locking steel well protector and concrete apron with (3) 3 foot guard posts.
Static Water Level: 13.46 feet from top of riser

PROJECT NO. 409658
CLIENT: PLUM BROOK

ACAD\GENERAL\BORLOG\409658-6

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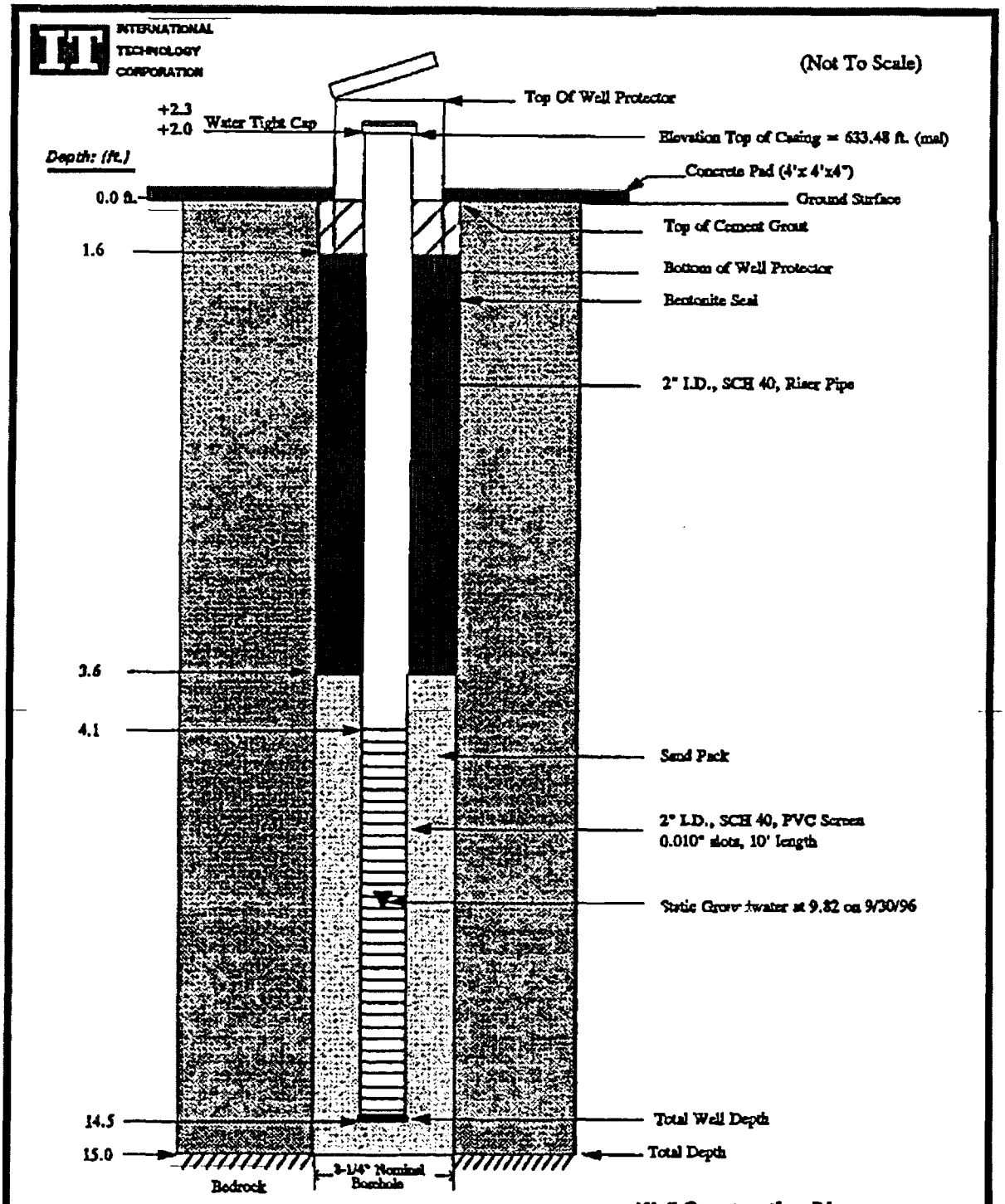
APPENDIX E

IT-MW07

IT-MW08



Well Construction Diagram
prepared for:
USACE - NASHVILLE
PLUM BROOK ORDNANCE WORKS

Notes:

Well No.: IT-MW8
Date Installed: 9/27/96
Elevation Top of Casing*:
* Based on Mean Sea Level (MSL)

HTRW DRILLING LOG

DISTRICT: Nashville		HOLE NUMBER: IT-MW8
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Alliance	SHEET 1 OF 3 SHEETS
3. PROJECT: PBOW	4. LOCATION: Erie County, Ohio	
5. NAME OF DRILLER: Paul D. McAdams	6. MANUFACTURER'S DESIGNATION OF DRILL: Dietrich D-50	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" Split Spoons, 8-1/2" O.D. Augers	8. HOLE LOCATION: Near Old Pump House by Powerhouse #2	
	9. SURFACE ELEVATION: 630.92 feet (MSL)	
	10. DATE STARTED: 9/25/96	11. DATE COMPLETED: 9/27/96
12. OVERBURDEN THICKNESS: 10.4 ft.	15. DEPTH GROUNDWATER ENCOUNTERED:	
13. DEPTH DRILLED INTO ROCK: 4.6 ft.	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 9.82 ft./5 days	
14. TOTAL DEPTH OF HOLE: 15.0 ft.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

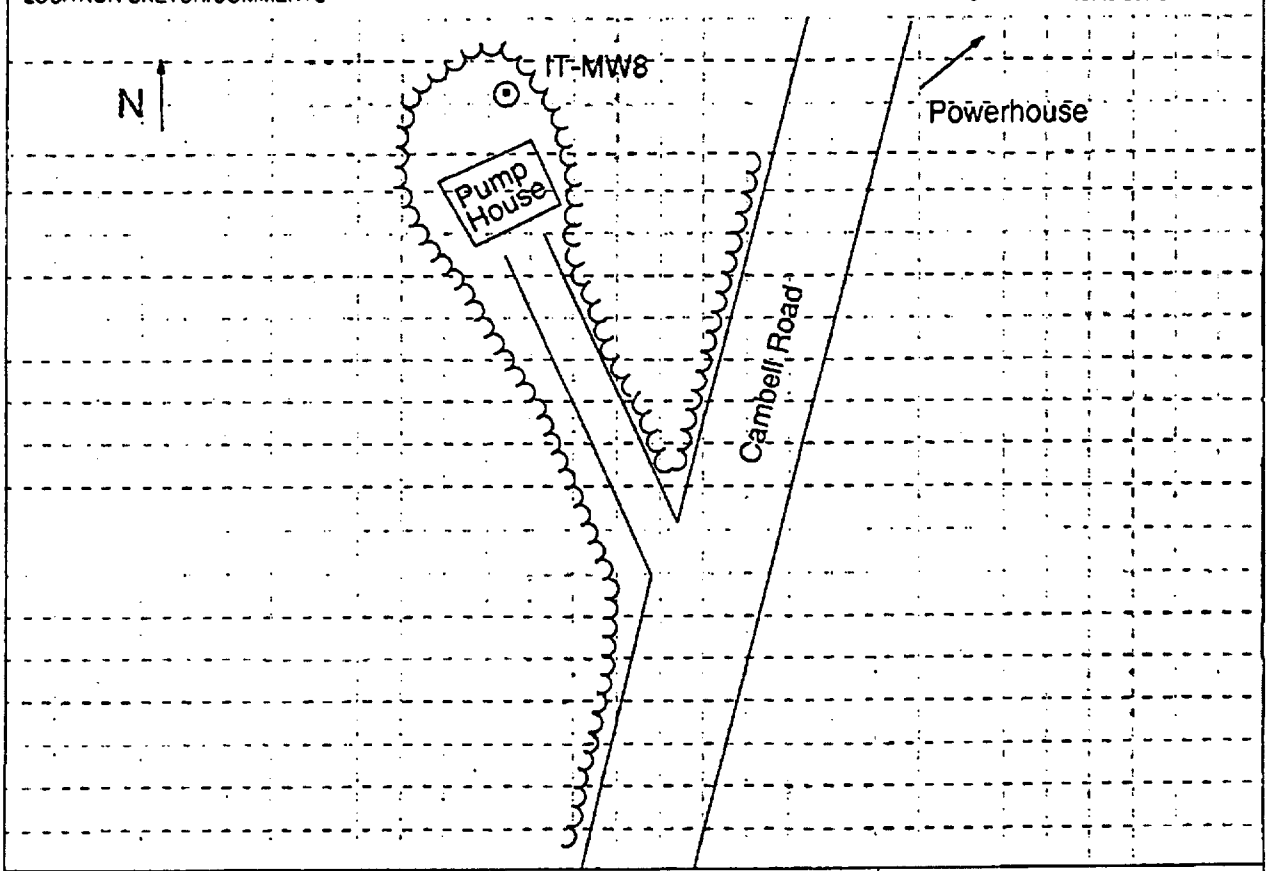
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
X	X		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
NA						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Wesley White

LOCATION SKETCH/COMMENTS

SCALE: Not to scale



PROJECT	HOLE NO.
PBOW	IT-MW8

PBOW/BORINGS/MW8.DRW/MC/11-12-96

INTERNATIONAL TECHNOLOGY CORPORATION

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NO. IT-MW8

PROJECT: PBOW | INSPECTOR: W. White | SHEET 2 OF 3 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	USCS f	BLOW COUNTS g	REMARKS h
	1	Stiff to hard, dark gray (10 YR 4/1) clayey SILT, medium to low plasticity, low dry strength, trace organics (roots), moist	0.0	S-1	ML	2,3 5,6	
	2	2.2					2
	3	Hard, brown (10 YR 5/3), clayey SILT, trace very fine sand, low to medium plasticity, low dry strength, dry to moist (well below plastic limit)	0.0	S-2 Geotechnical Sample	ML	6,7 9,11	
	4	4.2					4
	5	Dense, strong brown (7.5 YR 5/6) mottled with pinkish gray (7.5 YR 7/2), silty very fine SAND, well sorted, poorly graded, well rounded, dry to moist	0.0	S-3 Geotechnical Sample	SP	6,5 4,4	
		5.75					
	6	Hard, gray (10 YR 5/1), very fine sandy SILT, low plasticity, low dry strength, dry to moist 6.3			ML		6
	7	Very stiff to hard, grayish brown (10 YR 5/2) CLAY, medium to high plasticity, moist	0.0	S-4 Geotechnical Sample	CL/CH	4,5 5,10	
		8.0					
	8	Hard, grayish brown (10 YR 5/2) silty CLAY, trace medium to coarse sand, medium plasticity, moist					8
	9		0.0	S-5	CL	5,11 14,17	
		9.5					
	10	Very stiff to hard, silty CLAY and weathered shale, bluish gray (5 PB 6/1), low			CL		10

Project: PBOW | Hole No. IT-MW8

INTERNATIONAL TECHNOLOGY CORPORATION

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NO. IT-MW8

PROJECT: PBOW | INSPECTOR: W. White | SHEET 3 OF 3 SHEETS

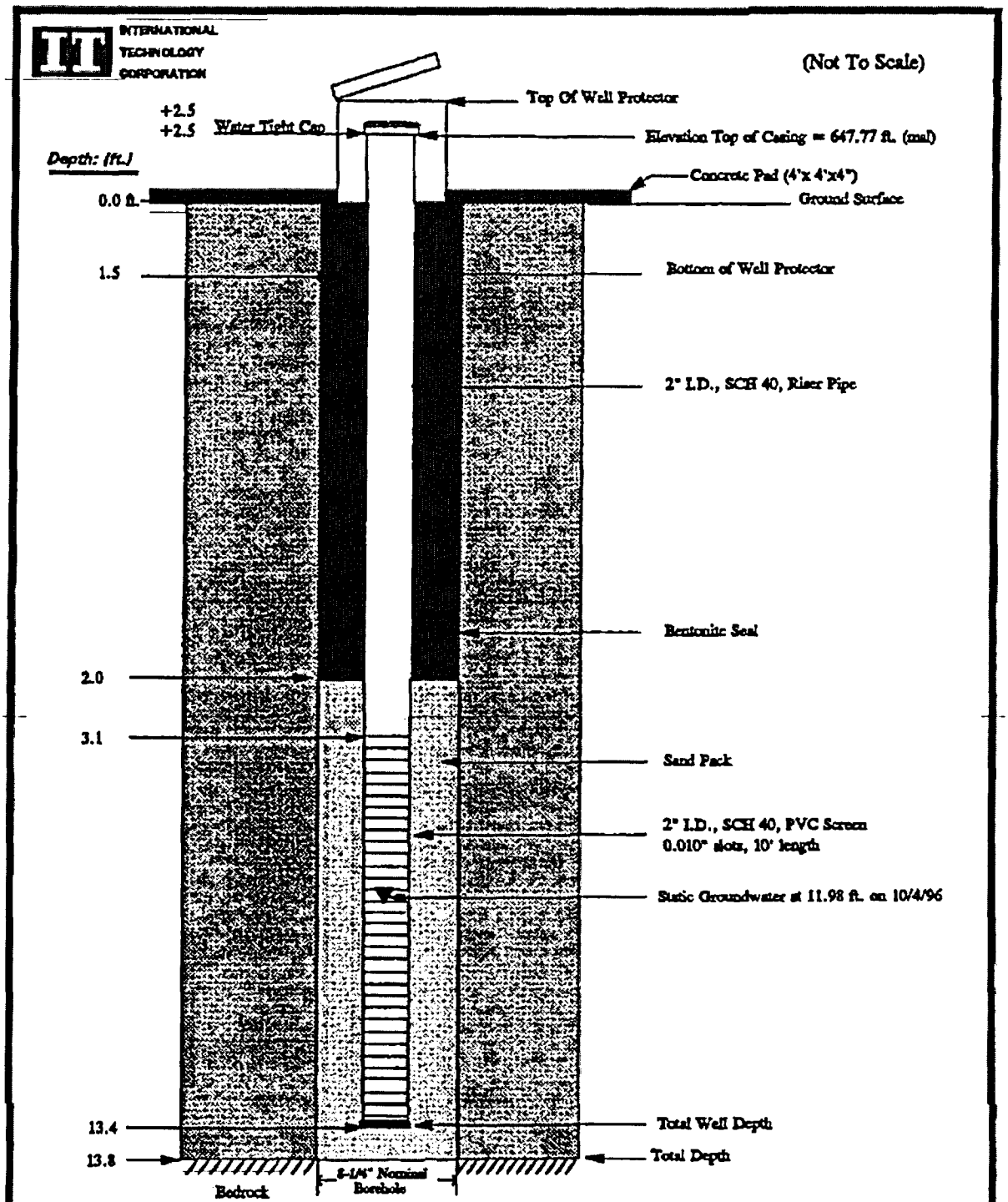
ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	USCS f	BLOW COUNTS g	REMARKS h
	10	10.4			CL		
		Very hard, bluish gray (10 B 6/1), shale, dry 10.8	0.0	S-6		10,12 13,16	
	11	Weathered shale zone, bluish gray (5 PB 6/1), moist 11.3					
		Very hard, bluish gray (10 B 6/1), shale, dry 12.0					
	12	Weathered shale zone, bluish gray (5 PB 6/1), moist 12.8					
	13	Very hard, bluish gray (10 B 6/1), shale, dry	0.0	S-7		7,14 80-6	
	14						Augered down 1 ft. hard
	15	15.0 Total Depth = 15.0 Ft.					Hit refusal at 15 ft.
	16						
	17						
	18						
	19						
	20						

Project: PBOW | Hole No. IT-MW8

PBOW/BORINGS/MW-8B.DRW/mc/11-12-86

INTERNATIONAL TECHNOLOGY CORPORATION

IT-MW09



Notes:

Well No.: IT-MW9

Date Installed: 9/26/96

Elevation Top of Casing*:

* Based on Mean Sea Level (MSL)

Well Construction Diagram
prepared for:

USACE - NASHVILLE

PLUM BROOK ORDNANCE WORKS

HTRW DRILLING LOG

DISTRICT: Nashville		HOLE NUMBER: IT-MW9
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Alliance	SHEET 1 OF 3 SHEETS
3. PROJECT: PBOW	4. LOCATION: Erie County, Ohio	
5. NAME OF DRILLER: Paul D. McAdams	6. MANUFACTURER'S DESIGNATION OF DRILL: Dietrich D-50	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" Split Spoons, 8-1/2" O.D. Augers	8. HOLE LOCATION: North at TOT Area C	
	9. SURFACE ELEVATION: 645.72 feet (MSL)	
	10. DATE STARTED: 9/25/96	11. DATE COMPLETED: 9/27/96
12. OVERBURDEN THICKNESS: 9.0 ft.	15. DEPTH GROUNDWATER ENCOUNTERED	
13. DEPTH DRILLED INTO ROCK: 6.0 ft.	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 12.2 ft./5 days	
14. TOTAL DEPTH OF HOLE: 15.0 ft.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

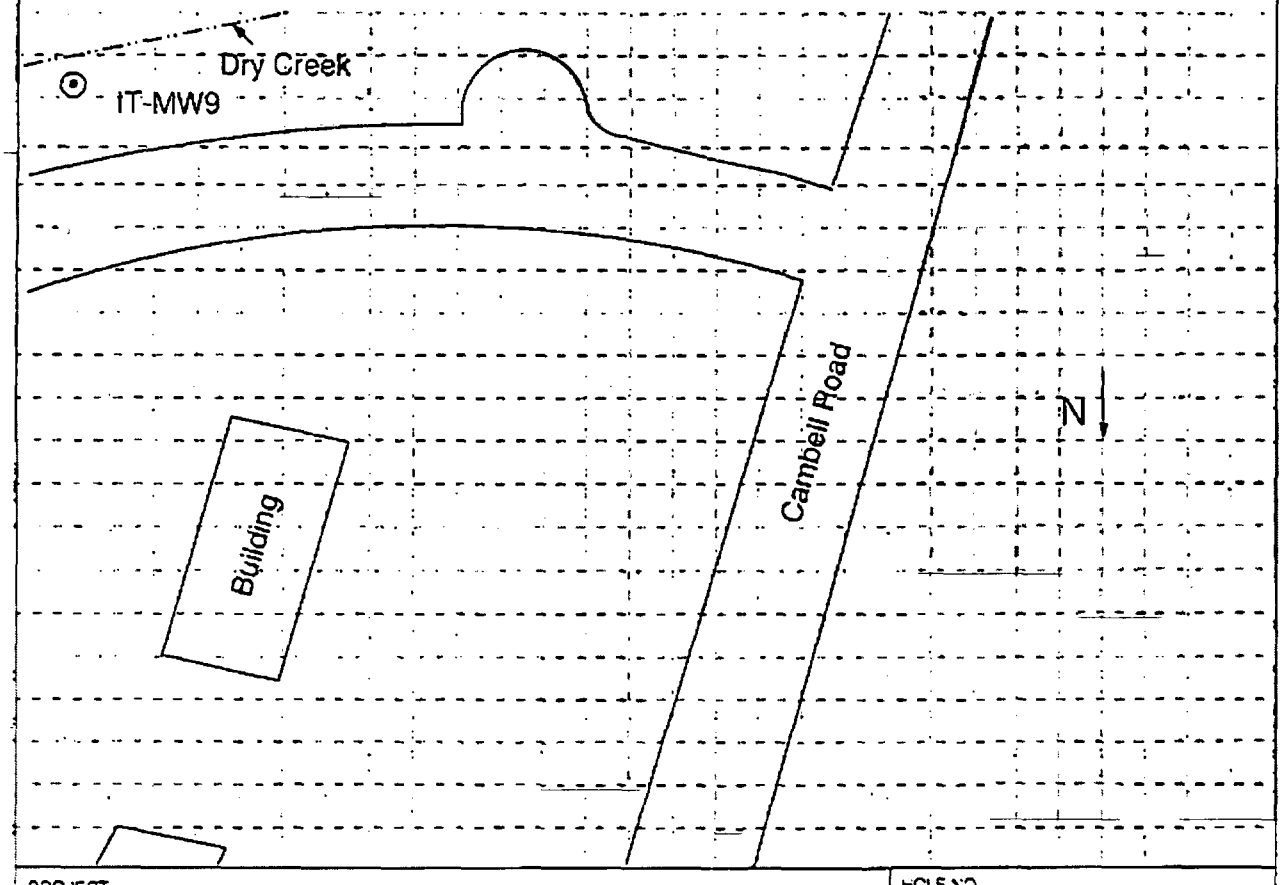
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
X	X		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
NA						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Wesley White

LOCATION SKETCH/COMMENTS

SCALE: Not to scale



PROJECT	HOLE NO.
PBOW	IT-MW9

PBOW/BORINGS/MW-9.DRW/MC/11-12-96

INTERNATIONAL TECHNOLOGY CORPORATION

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NO. IT-MW9

PROJECT: PBOW | INSPECTOR: W. White | SHEET 2 OF 3 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	USCS f	BLOW COUNTS g	REMARKS h
	1	Firm to hard, dark grayish brown (10 YR 4/2), silty CLAY, medium plasticity, blocky, dry to moist (near the plastic limit) 2.0	0.0	S-1	CL	1,3 6,6	
	2	Hard to very hard, brown (10 YR 5/3) silty CLAY, medium plasticity, blocky, trace medium sand, dry to moist (below plastic limit)	0.0	S-2 Geotechnical Sample	CL	7,10 14,21	
	4		0.0	S-3 Geotechnical Sample		8,15 21,25	
	5	10% fine to medium SAND, trace fine gravel and coarse sand size shale fragments					
	6		0.0	S-4 Geotechnical Sample		12,19 25,20	
	7	7.25					
	8	Hard, dark grayish brown (10 YR 4/2) silty CLAY, 25% sand of various sizes, medium plasticity, trace fine gravel, blocky, dry to moist 8.2			CL		
	9	Hard to very hard, bluish gray (10 B 5/1) silty CLAY, medium plasticity, blocky to platey, trace medium sand, dry to moist 9.0	0.0	S-5	CL	9,14 19,29	
	10	Weathered shale, platey					

Project: PBOW | Hole No. IT-MW9

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NO. IT-MW9

PROJECT: PBOW | INSPECTOR: W. White | SHEET 3 OF 3 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	USCS f	BLOW COUNTS g	REMARKS h
	10	Very hard, buish gray (10 B 6/1) shale, dry					
			0.0	S-6		29,44 59, 50=3-1/2	Shale broke up easily
	11						
	12						
			0.0	S-7		23.5 100:5	
	13						
	14						
							Augered down to 15 ft.
	15	15.0					
		Total Depth = 15.0 Ft.					
	16						
	17						
	18						
	19						
	20						

Project: PBOW | Hole No. IT-MW9

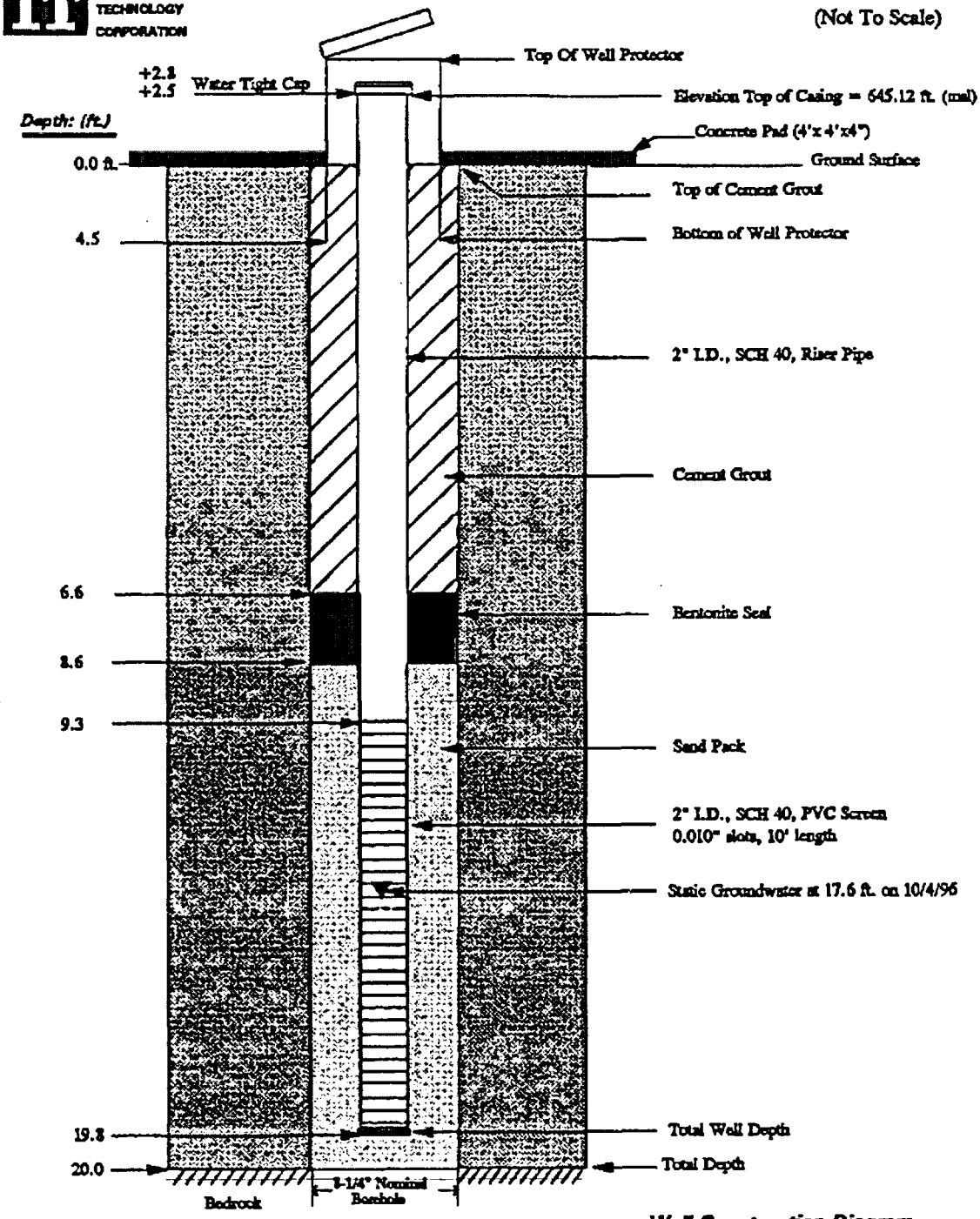
PBOW:BORINGS/MW-SB.DRW:rc/11-12-95

INTERNATIONAL TECHNOLOGY CORPORATION

IT-MW10

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Well Construction Diagram
prepared for:

USACE - NASHVILLE

PLUM BROOK ORDNANCE WORKS

Notes:

Well No.: IT-MW10

Date Installed: 9/26/96

Elevation Top of Casing*:

* Based on Mean Sea Level (MSL)

HTRW DRILLING LOG

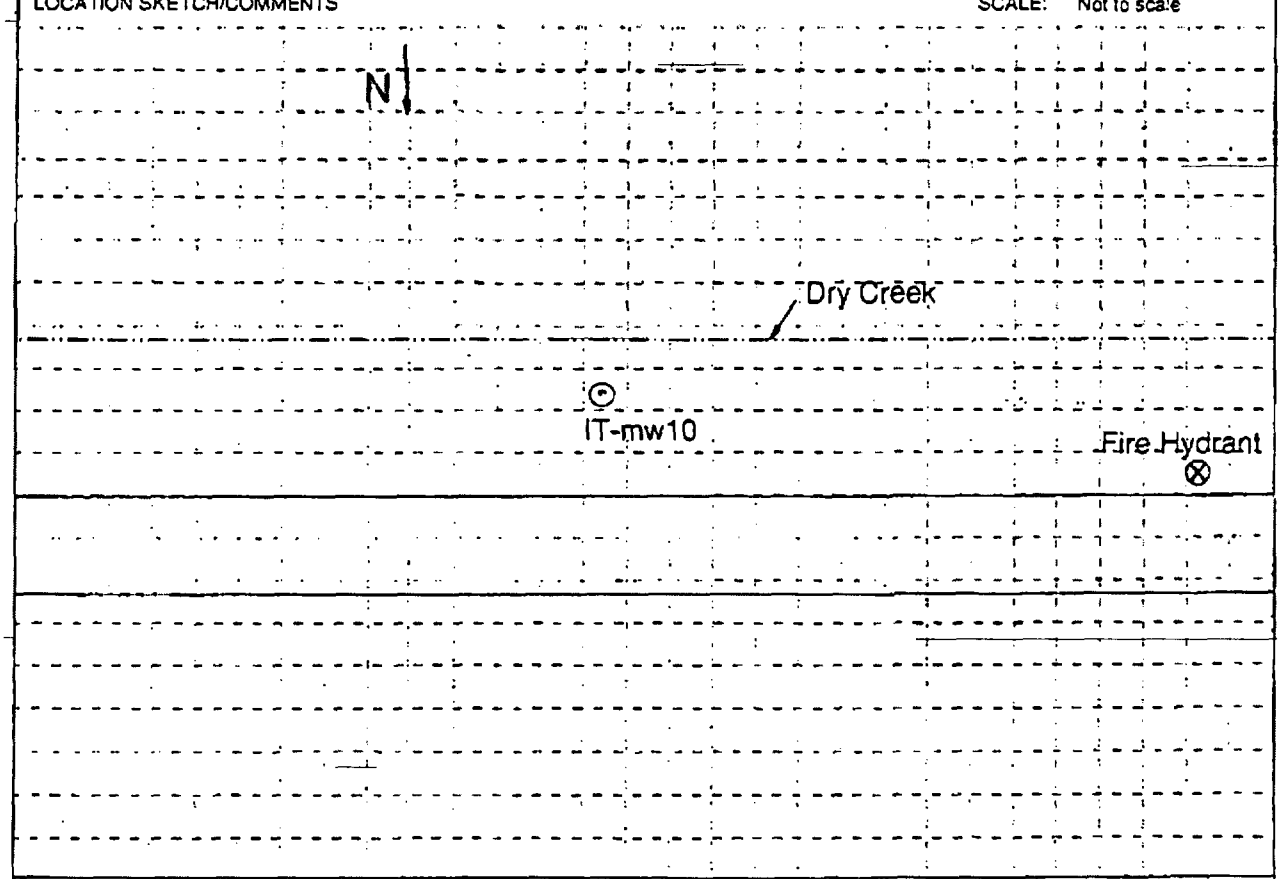
DISTRICT: Nashville		HOLE NUMBER: IT-MW10
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Alliance	SHEET 1 OF 3 SHEETS
3. PROJECT: PBOW	4. LOCATION: Erie County, Ohio	
5. NAME OF DRILLER: Paul D. McAdams	6. MANUFACTURER'S DESIGNATION OF DRILL: Dietrich D-50	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2" Split Spoons, 8-1/2" O.D. Augers	8. HOLE LOCATION: Northwest of Redwater Pond	
	9. SURFACE ELEVATION: 642.51 feet (MSL)	
	10. DATE STARTED: 9/26/96	11. DATE COMPLETED: 9/27/96
12. OVERBURDEN THICKNESS: 19.5 ft.	15. DEPTH GROUNDWATER ENCOUNTERED: NA	
13. DEPTH DRILLED INTO ROCK: 0.5 ft.	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 17.9 ft./5 days	
14. TOTAL DEPTH OF HOLE: 20.0 ft.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
X	X		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
NA				Pest/PCBs	Nitro	NA %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Wesley White/

LOCATION SKETCH/COMMENTS — SCALE: Not to scale



PROJECT	HOLE NO.
PBOW	IT-MW10

PBOW/BORINGS/MW-6.DRW/MC/11-11-96

INTERNATIONAL TECHNOLOGY CORPORATION

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NO. IT-MW10

PROJECT: PBOW | INSPECTOR: W. White | SHEET 2 OF 3 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	USCS f	BLOW COUNTS g	REMARKS h
	1	Firm, dark gray (10 YR 4/1) mottled with pale brown (10 YR 6/3) silty CLAY, medium plasticity, moist, roots	0.0	S-1	CL	1,3 3,5	
	2	Hard, very pale brown (10 YR 7/4), clayey SILT, low to medium plasticity, moderately low dry strength, dry to moist (below plastic limit)	0.0	S-2	ML	4,4 5,6	
	4	Firm, very pale brown (10 YR 7/3) clayey SILT to SILT, low plasticity, low dry strength, dry	0.0	S-3 Geotechnical Sample		7,8 11,15	
	6	Firm to soft, gray (10 YR 5/1), interbedded silty CLAY and SILT, medium to low plasticity, silts are dilatent, silty clays are moist to wet, silts are moist to dry	0.0	S-4	ML/CL	5,6 7,9	
	8	Silts are becoming moist to wet Fewer clay beds (predominant silts)	0.0	S-5	ML	3,3 4,4	
	10						

Project: PBOW | Hole No. IT-MW10

HTRW DRILLING LOG (CONTINUATION SHEET)

HOLE NO. IT-MW10

PROJECT: PBOW | INSPECTOR: W. White | SHEET 3 OF 3 SHEETS

ELEV. a	DEPTH b	DESCRIPTION OF MATERIALS c	FIELD SCREENING RESULTS d	GEOTECH SAMPLE OR CORE BOX NO. e	USCS f	BLOW COUNTS g	REMARKS h
	10						
	11		0.0	S-6		3,2 3,4	
	12						12
	13		0.0	S-7	ML	1,3 4,4	
	14						14
	15		0.0	S-8 Geotechnical Sample		1,3 3,3	
	16						16
	17		0.0	S-9 Geotechnical Sample		2,3 3,4	
	18	Hard, dark bluish gray (5PB 4/1) clayey SILT, trace gravel and sand, low to medium plasticity, moist to dry, limestone float					18
	19	19.5	0.0	S-10	ML	8,11 50, 50-1/2"	
		Limestone 20.0					
	20						20

Project: PBOW | Hole No. IT-MW10

PR-MW07

PB-PR-S4

HTRW DRILLING LOG

PB-PR-MW7

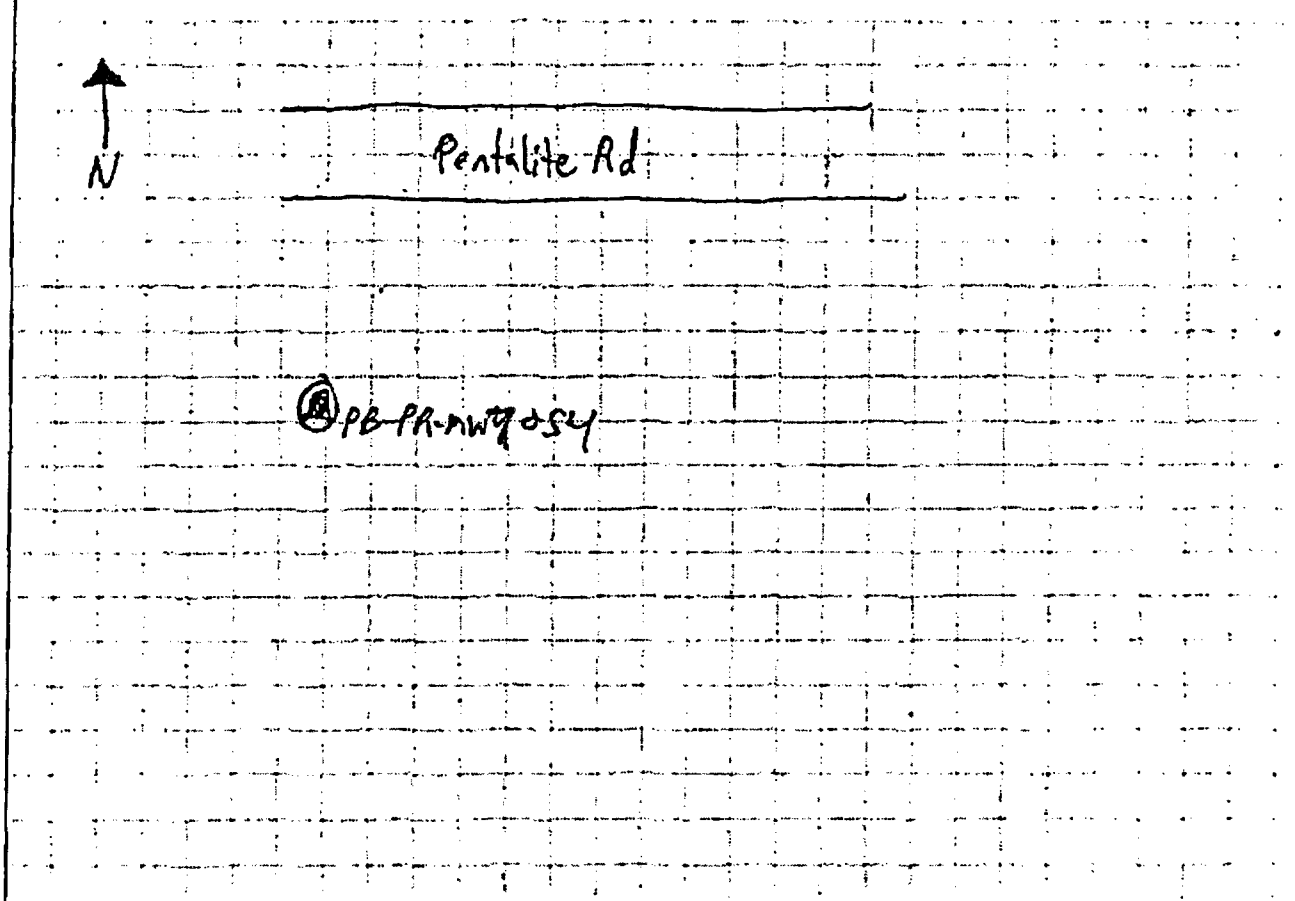
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: ~~Bladder~~ Belasco Drilling Services
SHEET 1 OF 1 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darry	6. MANUFACTURER'S DESIGNATION OF DRILL: CME45 ATV
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 24" split spoon; 140 lb drop hammer; Stainless steel bowls & spoons	8. HOLE LOCATION: Pentalite Rd
	9. SURFACE ELEVATION: N/A
	10. DATE STARTED: 10-30-94 / 11. DATE COMPLETED: 10-31-94
12. OVERBURDEN THICKNESS: 22.0 ft	15. DEPTH GROUNDWATER ENCOUNTERED: 9/10/94 10.5 ft
13. DEPTH DRILLED INTO ROCK: 0.3 ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 22.3 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: N/A
	-					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Dentley

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

PB-PA-MW7

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deathrage / Ted Barry | SHEET 2 OF 4 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	1	Dark Brown Sandy organic material; dry	Hnu=18 (Background =0)		PB-PA-S4-0.0/3.0	Blow Count: 1,2,3,4 Ran: 2.0 Rec: 1.2 Lost: 0.8
	2	Brown to dark Brown Sandy organic material; dry				
	3	Brownish yellow Well graded Sand w/ Silt; moist	Hnu=2 (Background =0)			Blow Count: 3,3,3,4 Ran: 2.0 Rec: 2.0 Lost: 0
	4	Brown Sandy clay w/ brownish yellow mottling; moist; moderate Plasticity			PB-PA-S4-3.0/5.0	
	5	Brown Clay w/ brownish yellow ~~as~~ sandy mottling; soft; moderate plasticity; moist to wet	Hnu=2 (Background =0)			Blow Count: 1,1,1,4 Ran: 2.0 Rec: 2.0 Lost: 0
	6	Brown sandy clay w/ brownish yellow mottling; moist to wet	Hnu=7 (Background =0)		PB-PA-S4-5.0/10.0	Blow Count: 1,3,5,4 Ran: 2.0 Rec: 2.0 Lost: 0
	7	Gray clay w/ some brownish yellow mottling				
	8	Gray clay w/ some brownish yellow mottling; moist to wet; very soft; high plasticity	Hnu=3 (Background =0)			Blow Count: 3,2,4,4 Ran: 2.0 Rec: 2.0 Lost: 0
	9					
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

PB-PR-MW-8 S4

PROJECT	INSPECTOR	SHEET OF SHEETS
Plum Brook Ordnance Works	Joe Deatherage / Ted Berry	3 of 4

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	10	Gray clay; soft; high plasticity; wet with some red water noted; wet	Hnu=0			Blow Count: 0, 2, 2, 5 Ran: 2.0 Rec: 1.6 Lost: 0.4
	11					
	12	Gray soft clay, high plasticity; wet w/ ~~[illegible]~~ ~~water brown water~~ yellowish red water	Hnu=0			Blow Count: 2, 3, 4, 5 Ran: 2.0 Rec: 2.0 Lost: 0
	13					
	14	Gray very soft clay; high plasticity; wet w/ yellowish red water	Hnu=0			Blow Count: 2, 2, 3, 4 Ran: 2.0 Rec: 2.0 Lost: 0
	15					
	16	Gray clay, a bit more hard and tight; moderate plasticity; wet w/ brownish yellow water	Hnu=0			Blow Count: 4, 7, 10, 13 Ran: 2.0 Rec: 1.6 Lost: 0.4
	17					
	18	Gray clay; moderately hard; moderate plasticity; wet w/ brownish yellow water	Hnu=0			Blow Count: 3, 6, 14, 18 Ran: 2.0 Rec: 1.3 Lost: 0.7
	19					
	20					

PROJECT: Plum Brook Ordnance Works

HXE NO.

HTRW DRILLING LOG

PB-PR-MW725A

PROJECT: Plum Brook Ordnance Works

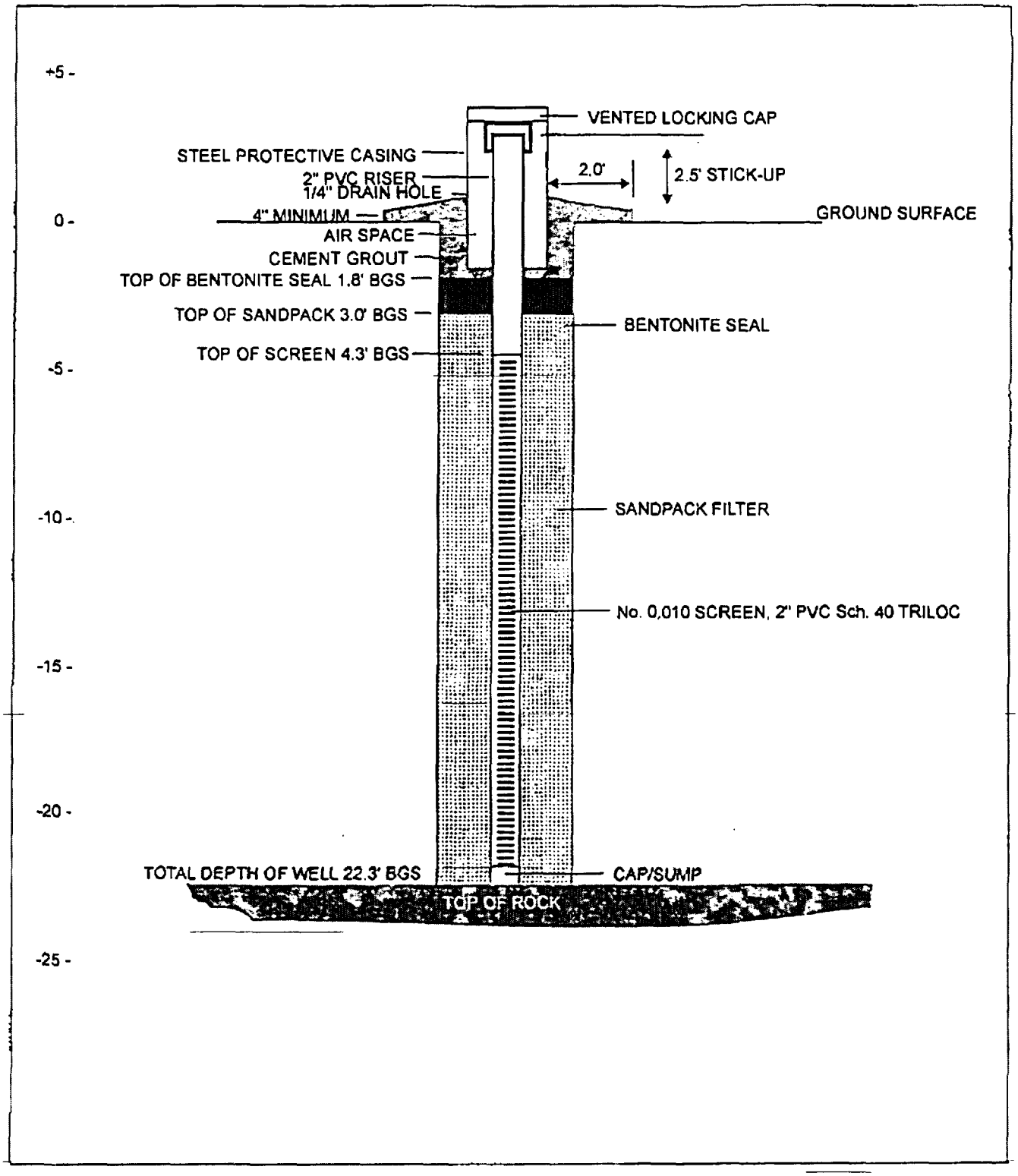
INSPECTOR: Joe Deatherage / Ted Bern

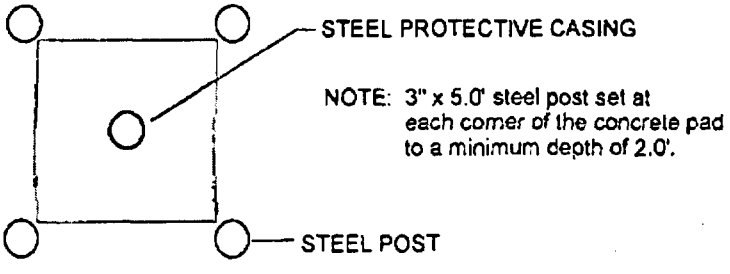
SHEET 4 OF 4 SHEETS

ELEV. (5)	DEPTH (6)	DESCRIPTION OF MATERIALS (7)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	20	Gray sandy clay; hard; low plasticity; moist soil, wet spoon w/ brownish yellow water. Some shale fragments.	Hnu=0			Blow Count: 2, 12, 17, 20 Ran: Rec: Lost:
	22	Weathered Shale; dry w/ wet spoon refusal at 22.3 ft	Hnu=0			Blow Count: 19, 47, refusal Ran: 1.0 Rec: 0.7 Lost: 0.3

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-PR-MW7
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PR-MW08

HTRW DRILLING LOG

HOLE NUMBER: PB-PR-514/MW8

SHEET 4 OF 4 SHEETS

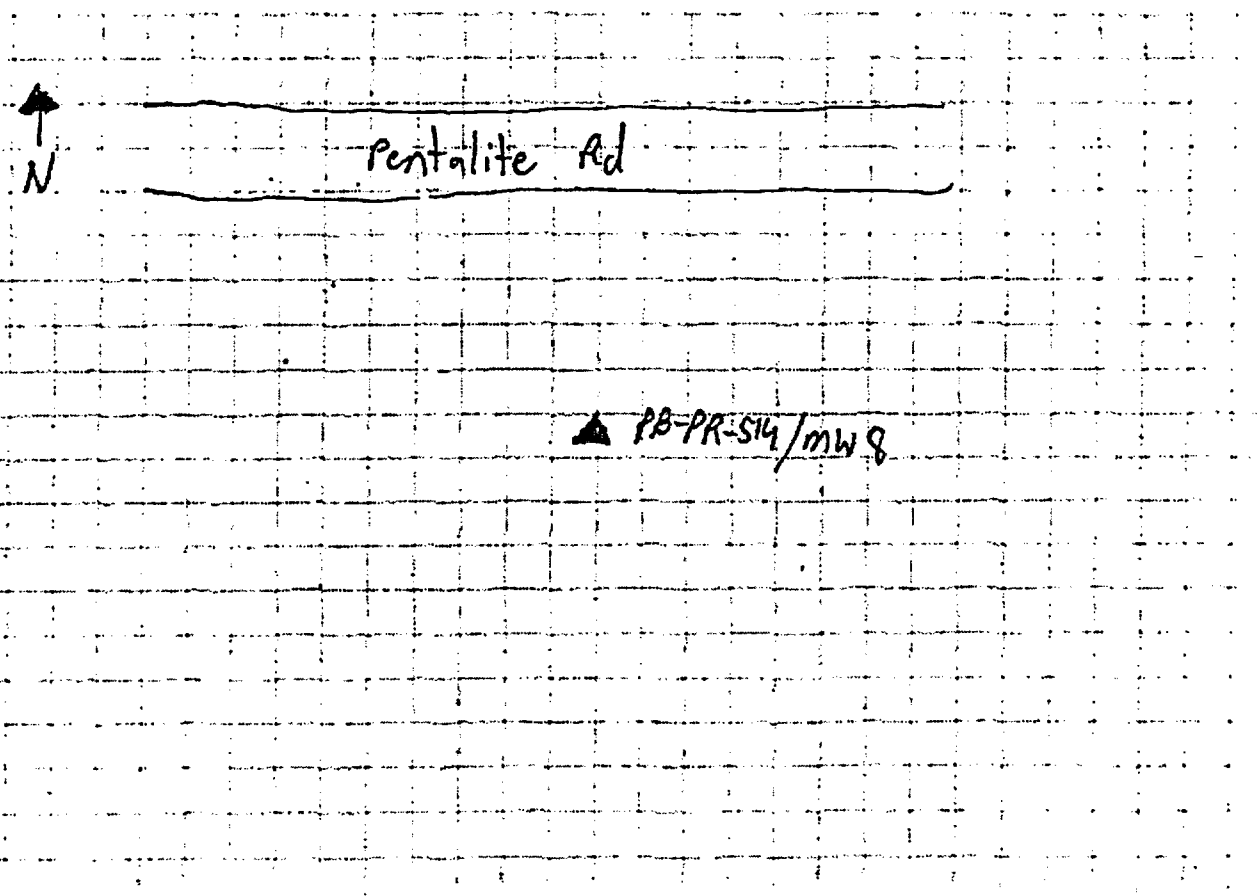
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services, Inc.
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER	6. MANUFACTURER'S DESIGNATION OF DRILL: D120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 24" split spoons; 140 lb drop hammer; stainless steel bowls & spoons	8. HOLE LOCATION: Pentalite Rd
	9. SURFACE ELEVATION
	10. DATE STARTED: 11-7-94 / 11. DATE COMPLETED: 11-7-94
12. OVERBURDEN THICKNESS: 27.5	15. DEPTH GROUNDWATER ENCOUNTERED: approx 7 feet
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 27.5	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: N/A

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Deallung

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

PB-PR-S14/MW3

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 2 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	0	Dark brown sandy organic material	Hnu=2 (Background)		PB-PR-S14-00/30	Blow Count: 2, 2, 8, 10 Ran: 2.0 Rec: 1.4 Lost: 0.6
	1	Brown well graded sand w/ brownish yellow flecks; slightly moist				
	2	Brown well graded sand w/ some brownish yellow mottling; slightly moist	Hnu=0		PB-PR-S14-30/50	Blow Count: 7, 10, 7, 8 Ran: 2.0 Rec: 1.8 Lost: 0.2
	3					
	4	Dark brown sandy clay; stained	Hnu=0			Blow Count: 2, 3, 5, 5 Ran: 2.0 Rec: 1.6 Lost: 0.4
	5	Brown sandy clay w/ some brownish yellow mottling; moist				
	6	Brown clay w/ some sand; brownish yellow mottling; soft; moderate plasticity; wet	Hnu=3 (Background =1)		PB-PR-S14-50/100	Blow Count: 2, 1, 2, 2 Ran: 2.0 Rec: 1.6 Lost: 0.4
	7					
	8	Dark brown stained layer				
		Brown clay w/ sand; yellowish brown and reddish brown mottling; soft; moderate plasticity; wet	Hnu=4 (Background =0)			Blow Count: 1, 2, 3, 4 Ran: 2.0 Rec: 2.0 Lost: 0
	9					
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

PB-PR-S14/MW8

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 3 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (g)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (o)	ANALYTICAL SAMPLE NO. (p)	REMARKS (q)
	10–11	Brown to gray clay w/ some sand; brown'sh yellow & reddish brown mottling: wet	Hnu=0			Blow Cont: 2,2,2,4 Ran: 2.0 Rec: 2.0 Lost: 0
	12–13	Gray clay w/ reddish brown sand layers; soft; high plasticity; wet	Hnu=0			Blow Cont: 1,2,4,4 Ran: 2.0 Rec: 2.0 Lost: 0
	14–15	Gray clay w/ reddish brown sand layers: wet	Hnu=0			Blow Cont. 1,2,3,3 Ran: 2.0 Rec: 2.0 Lost: 0
	16–17	Gray clay w/ traces of shale; no mottling; moist to wet	Hnu=0			Blow Cont: 2,2,7,8 Ran: 2.0 Rec: 2.0 Lost 0
	18–19	Gray soft weathered shale w/ traces of shale: moist	Hnu=0			Blow Cont: 4,9,11,12 Ran: 2.0 Rec: 2.0 Lost: 0
	20					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

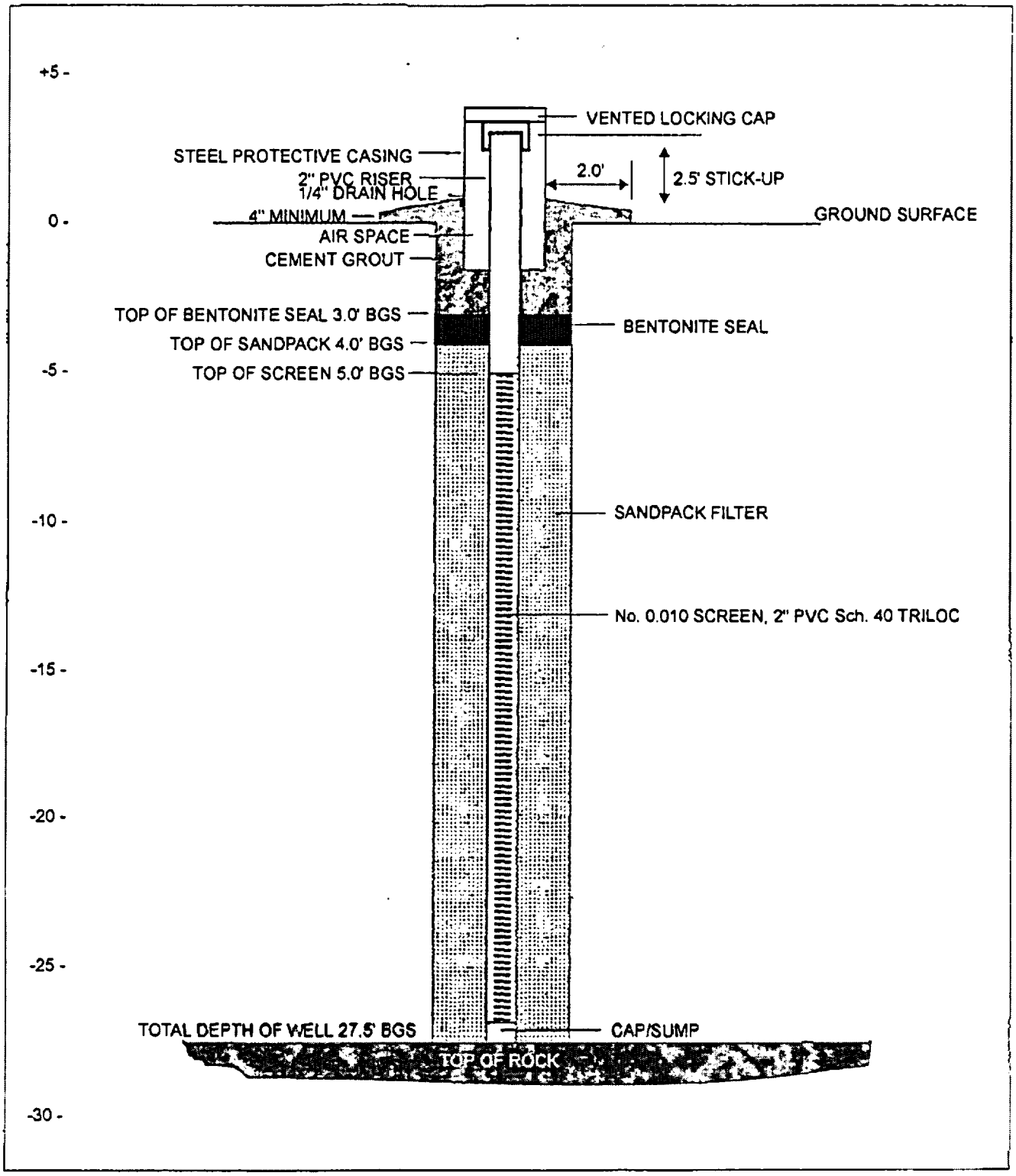
PB-PR-S14/MW8

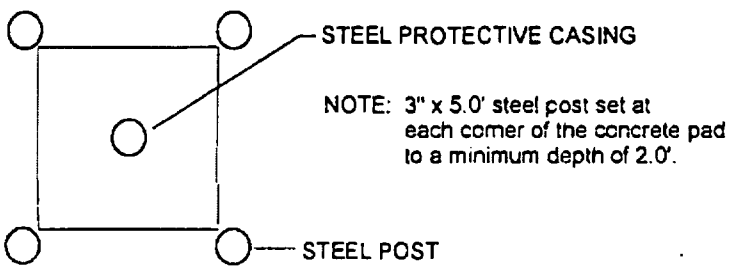
PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	20	Gray weathered shale; harder; moist	Hnu=0			Blow Count: 5, 12, 23, 28 Ran: 2.0 Rec: 1.8 Lost: 0.2
	21					
	22	Gray weathered shale w/ traces of sand and shale; moist	Hnu=0			Blow Count: 12, 17, 24, 27 Ran: 2.0 Rec: 2.0 Lost: 0
	23					
	24	Gray weathered shale moist	HNu 0			Blow Count: 5, 16, 21, 32 Ran: 2.0 Rec: 2.0 Lost: 0
	25					
	26	Gray weathered shale large shale fragments present.	HNu 0			Blow Count: 11, 28, 50/5 Ran: 1.4' Rec: 1.4' Lost: 0
	27					
	28					Well terminated at 27.5 ft

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-PR-MW8
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PR-MW09

PB-PA-~~MW~~S19

HTRW DRILLING LOG

HOLE NUMBER: PB-PR-MW19

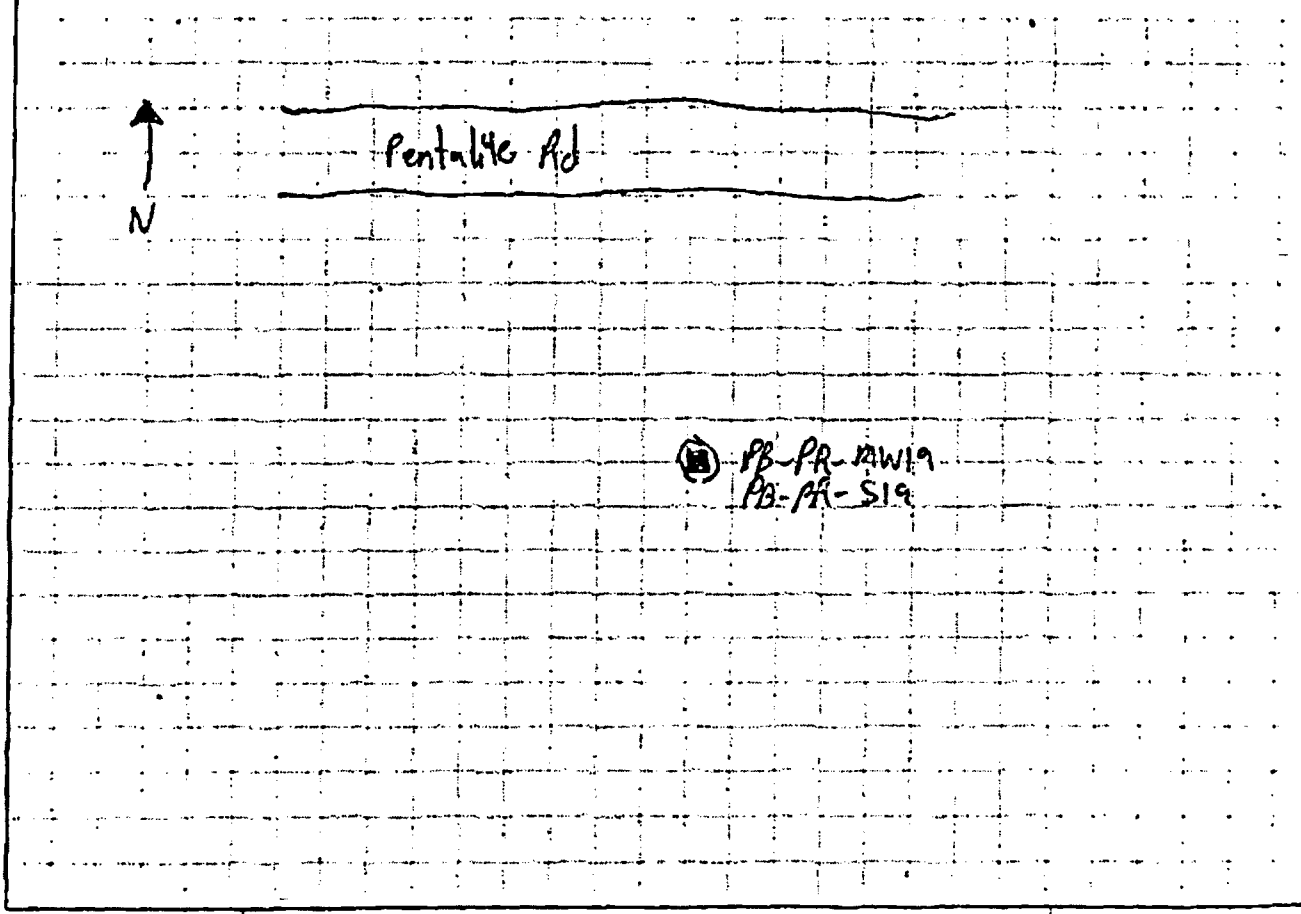
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services, Inc.
SHEET 1 OF 3 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 ATV
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 24" split spoon; 140 lb drop hammer; Stainless Steel bowls & spoons.	8. HOLE LOCATION: Pentalite Rd
	9. SURFACE ELEVATION: N/A
	10. DATE STARTED: 10-30-94 / 11. DATE COMPLETED: 11-1-94
12. OVERBURDEN THICKNESS: 19.0	15. DEPTH GROUNDWATER ENCOUNTERED: 4 ft/4 x 9 ft
13. DEPTH DRILLED INTO ROCK: N/A (0)	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED
14. TOTAL DEPTH OF HOLE: 19.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: N/A

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
				Joe Dattero

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

PB-LM-317
PB-PA-MW 9

PROJECT: Plum Brook Ordnance Works
INSPECTOR: Joe Deatherage / Ted Berry
SHEET 2 OF 2 SHEETS

ELEV. (3)	DEPTH (4)	DESCRIPTION OF MATERIALS (5)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	1	Dark Brown Sandy organic material Brown to brownish yellow well graded sandy silty clay; slightly moist	Hnu=3 (Background =0)		PB-PA-S19-0.0/3.0	Blow Count: 1,2,5,5 Ran: 2.0 Rec: 1.8 Lost: 0.2
	2		Hnu=10 (Background =0)			Blow Count: 5,5,5,5 Ran: 2.0 Rec: 1.1 Lost: 0.9
	3	Brown sandy clay with dark Brown mottling Brown sandy clay -no mottling			---- PB-PA-S19-3.0/5.0	
	4	Brown sandy clay w/ brownish yellow mottling and some dark brown streaks.	Hnu=2 (Background =0)			Blow Count: 2,3,3,3 Ran: 2.0 Rec: 2.0 Lost: 0
	5				----	
	6	Brown sandy clay w/ brownish yellow mottling and some pink streaks	Hnu=8 (Background =0)		PB-PA-S19-5.0/10.0	Blow Count: 2,3,4,5 Ran: Rec: Lost:
	7					
	8	Brown sandy clay w/ brownish yellow layers; moist to wet	Hnu=4 (Background =0)			Blow Count: 3,3,3,4 Ran: 2.0 Rec: 2.0 Lost: 0
	9	Gray clay w/ brownish yellow sandy layers and reddish brown sandy layers; wet				
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO.

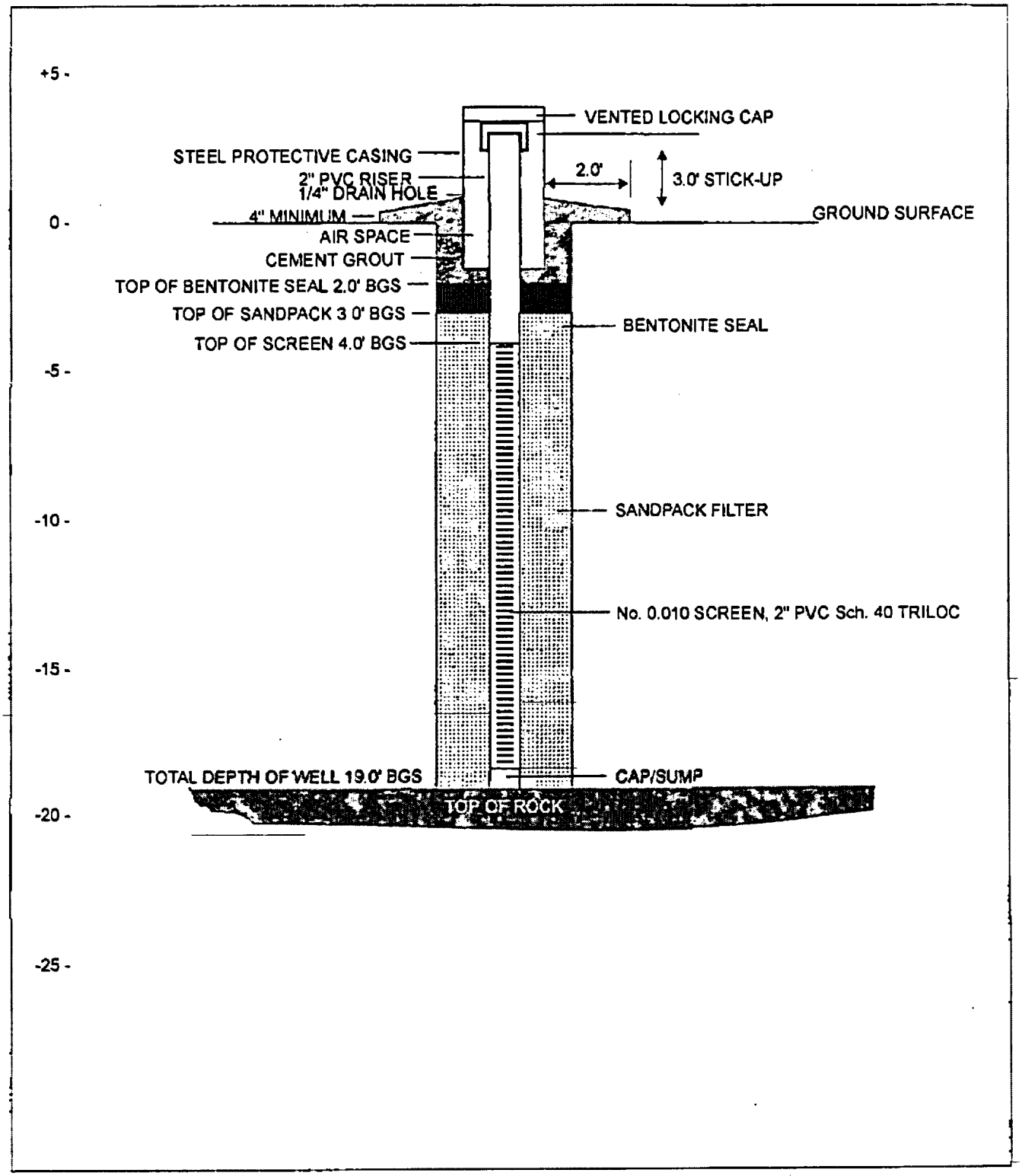
HTRW DRILLING LOG

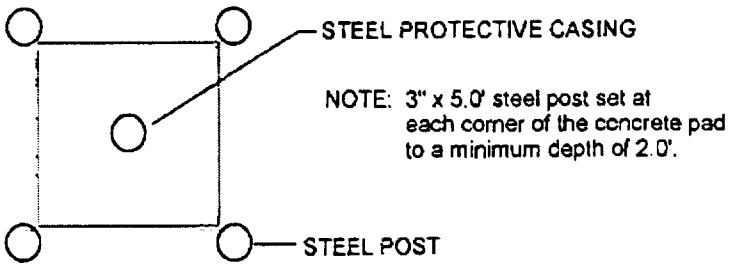
PB-PR-mwa

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Dentherose | SHEET 3 OF 8 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	10	Gray very soft clay; high plasticity; Some sand traces; wet	Hnu=0			Blow Count: 0,2,2,3 Ran: 2.0 Rec: 2.0 Lost: 0
	11					
	12	Gray very soft clay; high plasticity; no sand; wet	Hnu=0			Blow Count: 2,2,3,4 Ran: 2.0 Rec: 1.7 Lost: 0.3
	13					
	14	Gray very soft clay; high plasticity; wetness on spoon	Hnu=0			Blow Count: 3,2,2,3 Ran: 2.0 Rec: 1.7 Lost: 0.3
	15					
	16	Gray soft clay; high plasticity	Hnu=0			Blow Count: 6,10,15,15 Ran: 2.0 Rec: 2.0 Lost: 0
	17	Gray clay, harder, with traces of shale; moist soil, wet spoon				
	18	Gray clay; hard, with traces of shale; moist soil; wet spoon	Hnu=0			Blow Count: 4,14,25,26 Ran: 2.0 Rec: 1.0 Lost: 1.0
	19					Auger refusal at 19.0 ft
	20					

PROJECT: Plum Brook Ordnance Works | HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-PR-MW9
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

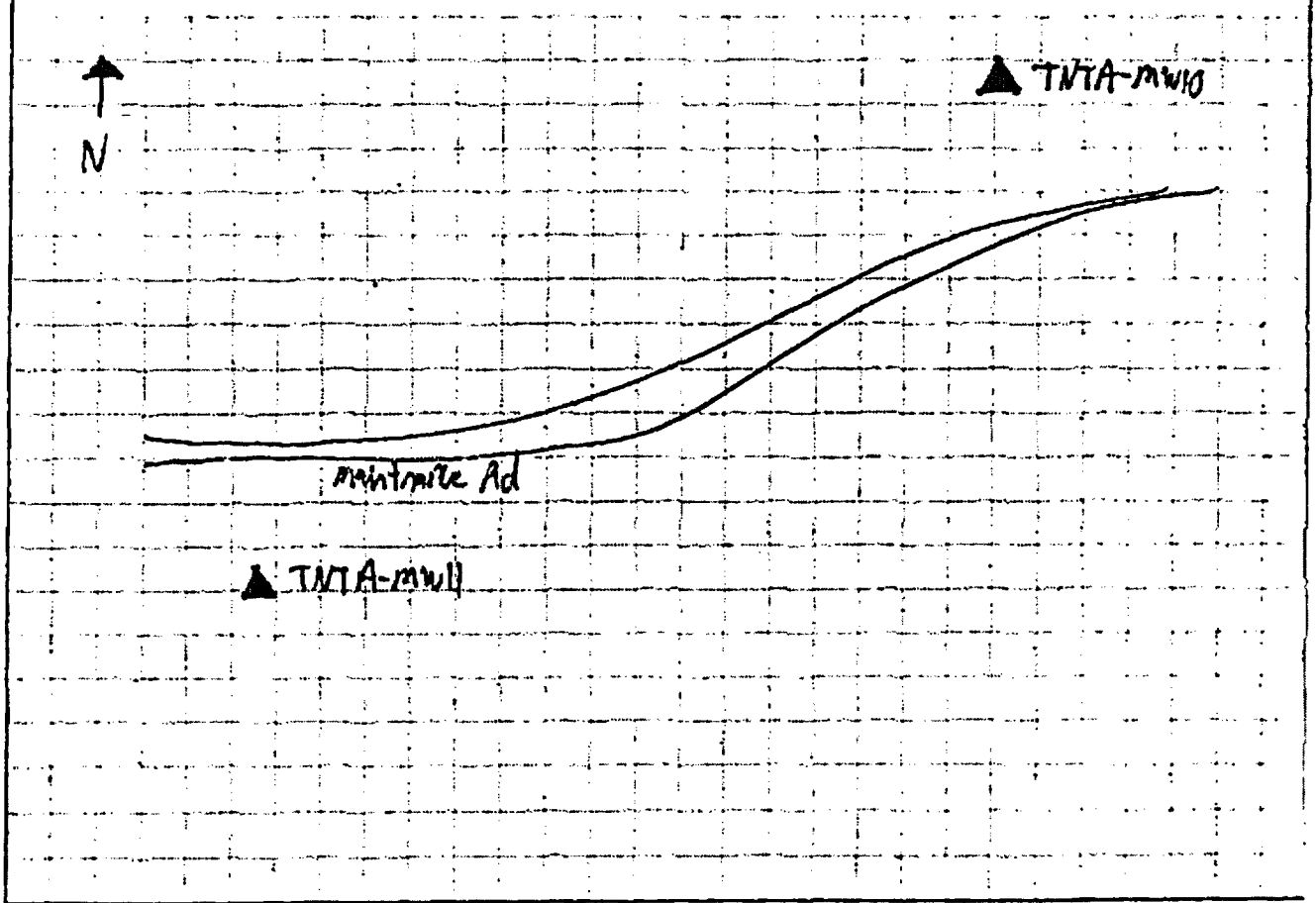
TNTA-MW10

HTRW DRILLING LOG

HOLE NUMBER: TNTA-MW10

1. COMPANY NAME: Dames & Moore
2. DRILLING SUBCONTRACTOR: Belsed Drilling Services, Inc.
SHEET 1 OF 3 SHEETS
3. PROJECT: Plum Brook Ordnance Works
4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl
6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 Diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID hollow stem; 5 ft long augers; 24" split spoons; 140 lb drop hammer
8. HOLE LOCATION: TNT Area A
9. SURFACE ELEVATION:
10. DATE STARTED: 10-15-94
11. DATE COMPLETED: 10-15-94
12. OVERBURDEN THICKNESS: 11.0 ft
13. DEPTH DRILLED INTO ROCK: 0
14. TOTAL DEPTH OF HOLE: 11.0 ft
15. DEPTH GROUNDWATER ENCOUNTERED:
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY):
18. GEOTECHNICAL SAMPLES: None — DISTURBED: --- — UNDISTURBED:
19. TOTAL NUMBER OF CORE BOXES: N/A
20. SAMPLES FOR CHEMICAL ANALYSIS: VOC | METALS | OTHER (SPECIFY): Explosives | OTHER (SPECIFY) | OTHER (SPECIFY)
21. TOTAL CORE RECOVERY: N/A
22. DISPOSITION OF HOLE: BACKFILLED | MONITORING WELL: X | OTHER (SPECIFY)
23. SIGNATURE OF INSPECTOR: Joe Deathrage

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works — HOLE NO.

HTRW DRILLING LOG

TNTA-MW10

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deathrage | SHEET 1 OF 2 SHEETS 3

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX I.D. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	1	Dark Brown Sandy organic material; dry Brownish yellow well graded sand; moist	Hnu = 1 (Background)			Blow Count: 2, 4, 7, 10 Ran: 2.0' Rec: 1.5' lost: 0.5
hole Plug	2	Dark Brown Sandy organic material; moist Brown to Brownish yellow well graded sand with fines; wet	Hnu = 1 (Background)			Blow Count = 6, 10, 9, 18 Ran: 2.0 Rec: 1.6 Lost: 0.4
0 0	3					scan
0 0 Sand 0	4 5	Brownish yellow well graded sand, wet Gray well graded sand, wet Gray moderately stiff clay; moist	Hnu = 1 (Background)			Blow Count: 3, 3, 5, 12 Ran: 2.0 Rec: 1.4 lost: 0.6
0 0	6 7	Gray highly weathered Shale; Slightly moist to dry	Hnu = 1 (Background)			Blow Count: 6, 15, 16, 19 Ran: 2.0' Rec: 1.2' lost: 0.8'
0 0	8 9	Gray highly weathered Shale; moist with traces of wetness in spoon	Hnu = 1 (Background)			Blow Count = 8, 31, 20, 35 Ran = 2.0' Rec = 1.4' lost: 0.6'
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

TVA-MW20

PROJECT: Plum Brook Ordnance Works

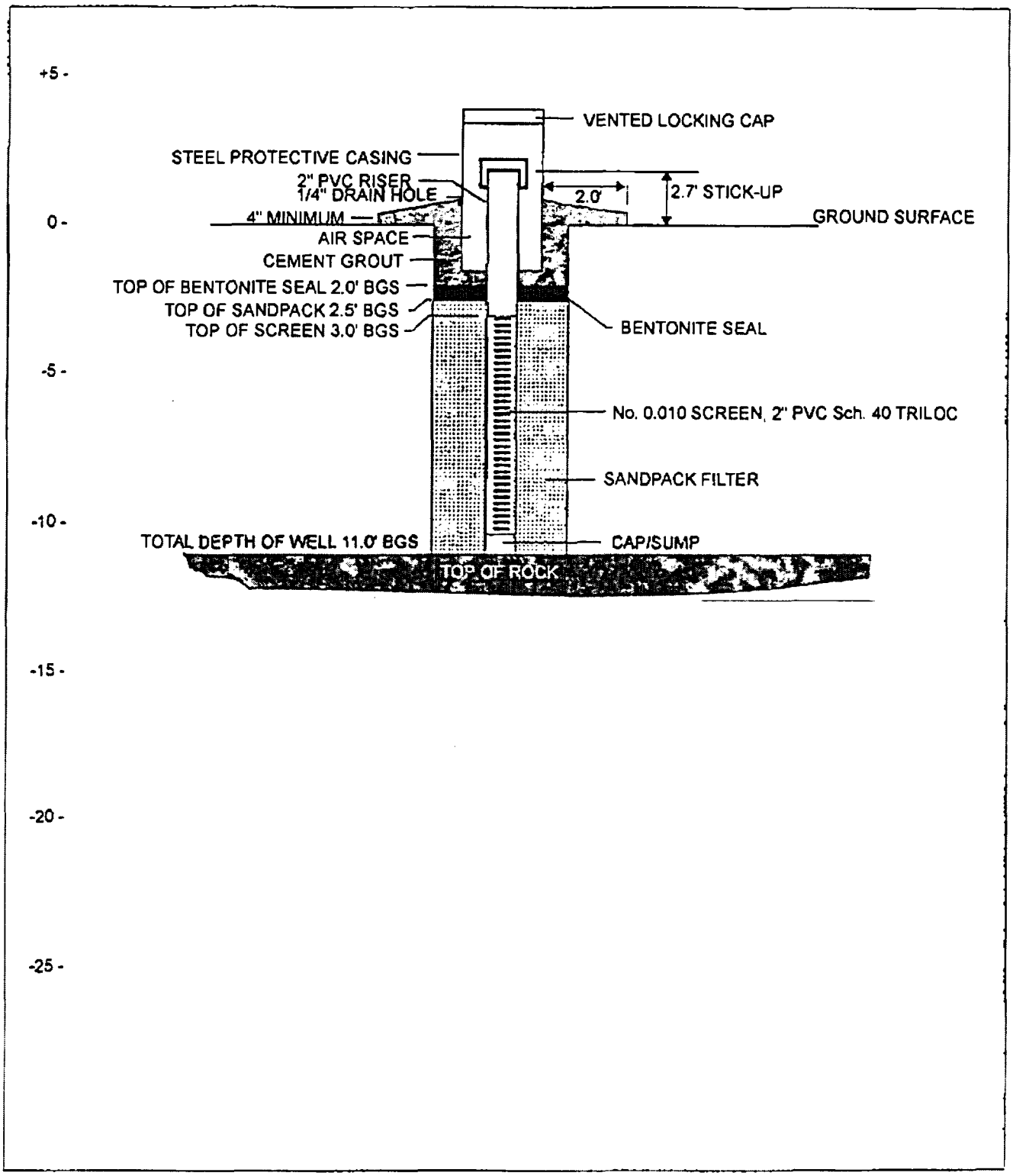
INSPECTOR: Joe Deatherage

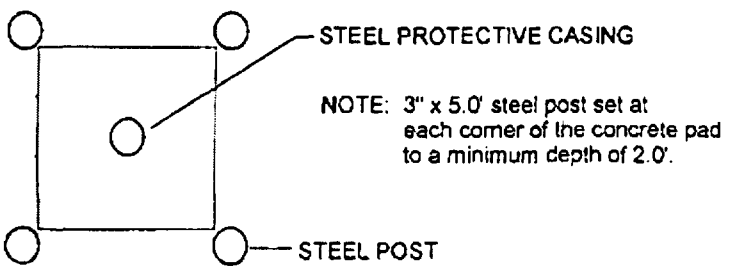
SHEET 3 OF 3 SHEETS

ELEV. (3)	DEPTH (3)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (3)	GEOTECH SAMPLE OR CORE BOX NO. (3)	ANALYTICAL SAMPLE NO. (3)	REMARKS (3)
0 Sand 0	10	Light Gray; weathered Shale, dry to moist	Hnu=1 (Background			Blow Count = 15, 43, 50 over 3 inches. Rqd=1.0 Rec=1.0 Lost: 0
	11					
	12					Spoon refusal. End of Drilling, Total Depth of hole is 11.0 ft.

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

TNTA-MW10
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

TNTA-MW11

HTRW DRILLING LOG

HOLE NUMBER: TNTA-MW11

SHEET 1 OF 1 SHEETS

1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling, Inc.
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D50 Diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼ hollow stem auger; 5 ft lengths; 2¼" split spoon; 140 lb drop hammer.	8. HOLE LOCATION: TNT Area A
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-15-94 / 11. DATE COMPLETED: 10-15-94
12. OVERBURDEN THICKNESS: 10.0 ft	15. DEPTH GROUNDWATER ENCOUNTERED: N/A
13. DEPTH DRILLED INTO ROCK: 1.4 ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A
14. TOTAL DEPTH OF HOLE: 11.4 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

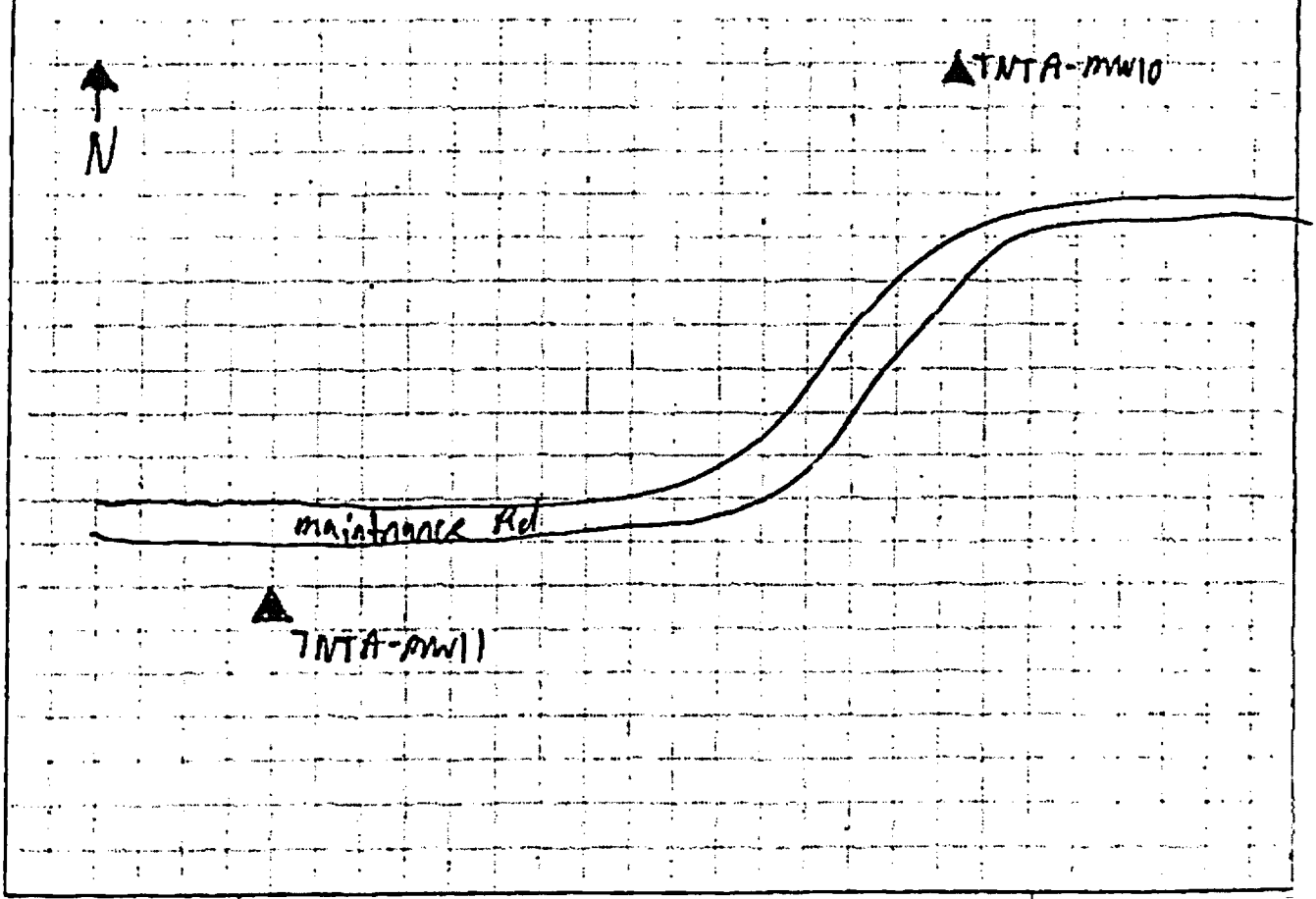
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	-					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Dentley

LOCATION SKETCH/COMMENTS

SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: TVTA-MW11

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 2 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	1	Dark Brown, sandy organic material; dry	Hnu=1 (Backgrand)			Blow Count=3,5,10,10 Ran: 2.0' Rec: 1.7' Lost: 0.3
	2–3	Dark Brown sandy organic materials; dry	Hnu=1 (Backgrand)			Blow Count=5,8,8,9 Ran: 2.0' Rec=1.5' Lost=0.5'
	4–5	Dark Brown sandy organic material, Dry	Hnu=1 (Backgrand)			Blow Count=4,5,7,8 Ran: 2.0' Rec: 1.6' Lost: 0.4'
	5–6	Olive gray clay w/ weathered Shale mix; dry				
	6–7	Gray highly weathered Shale; dry	Hnu=1 (Backgrand)			Blow Count=8,16,18,22 Ran: 2.0 Rec: 1.6 Lost: 0.4
	8–9	Gray highly weathered shale; dry	Hnu=1 (Backgrand)			Blow Count=12,22,28,48 Ran: 2.0' Rec: 1.7' Lost: 0.3'
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: TNTA-MW11

PROJECT: Plum Brook Ordnance Works

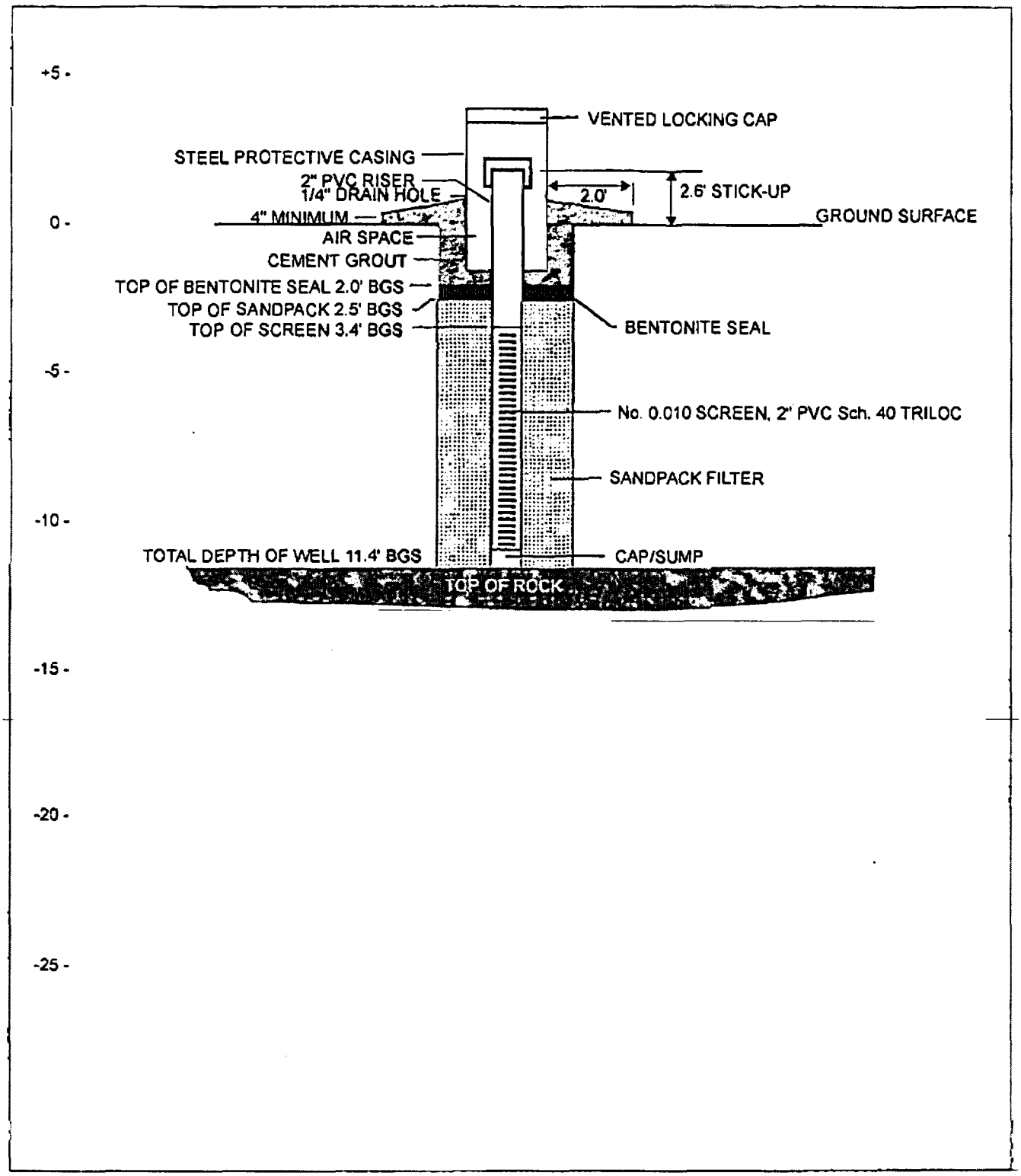
INSPECTOR: Joe Dealbuge

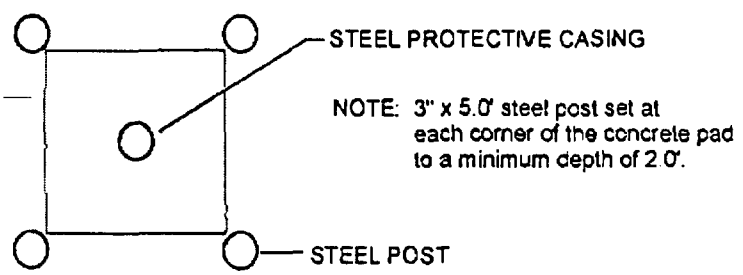
SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	HNU SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	10	gray shale: hard	Hnu = 1 (Background)			Blow Count: 28, 34, 50 over 4 inches. Run: 1.5 ft Rec: 1.5 Lost 10
	11					
	12					Refusal at 11.4 ft.
	13					
	14					
	15					
	16					
	17					
	18					

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

TNTA-MW11
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

TNTC-MW03

HTRW DRILLING LOG

HOLE NUMBER: TNTC-MW03

SHEET 1 OF 3 SHEETS

1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belaska Drilling Services, Inc.
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4 1/4 inch ⌀ hollow stem auger. 24" split spoon sampler. The augers are 8 ft in length. 140 lb drop hammer & dropped 30 inches	8. HOLE LOCATION: TNT Area C
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-12-94 / 11. DATE COMPLETED: 10-12-94
12. OVERBURDEN THICKNESS: 14.5 ft	15. DEPTH GROUNDWATER ENCOUNTERED: Dry
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: Dry
14. TOTAL DEPTH OF HOLE: 14.5 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): Dry

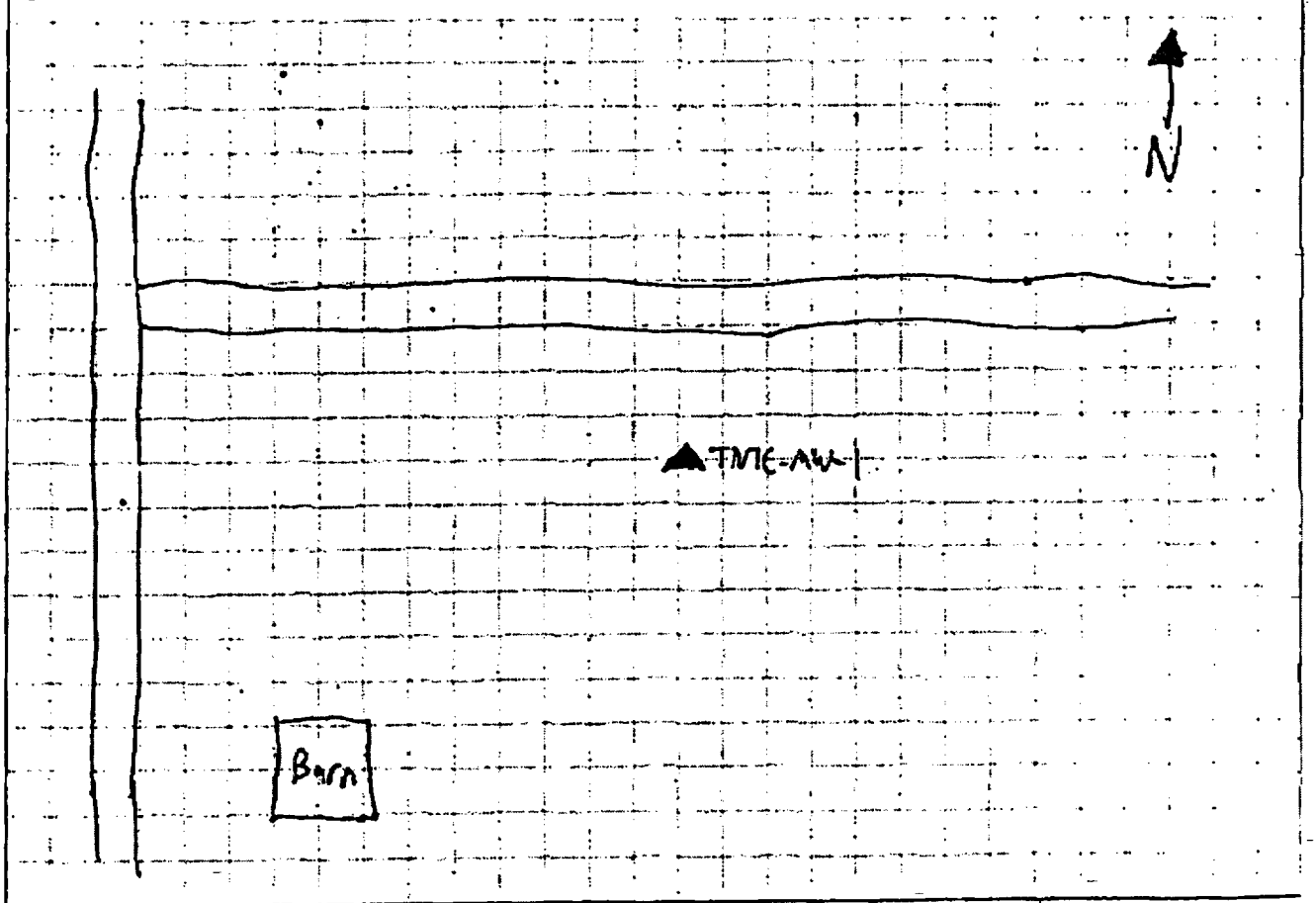
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
None	---		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: N/A
N/A	-					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR: Joe Deatherage
		X		

LOCATION SKETCH/COMMENTS

SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

TWC-MW3

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 2 OF 2 SHEETS 3

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	BLOW COUNT	ANALYTICAL SAMPLE NO. (e)	REMARKS (f)
	1 1.2	Dark Brown, well graded sandy material; dry. Shale encountered at 2 ft. ~~8 inches~~ recovery. 0.75 ft	0 (Background) Hnu	6, 10, 11, 11		
	2 3	8 tenths foot recovery. Light Brown to Brown Shale; Dry; weak (crumbles easily).	0 = Background Hnu	10, 16 18, 19		
	4 5	Brown Sandy shale; dry; From 4 ft to ~~5 ft~~ 5.8 ft. From 5.8 to 6 ft it is a sandy clay, dry: 1.3 ft recovery.	Hnu = 0 (Background)	16, 15 23, 29		
	6 7	Brown sandy clay w/ traces of shale; dry; slightly more stiff; 1.9 ft recovery	Hnu = 0 (Background)	10, 16 17, 26		
	8 9	Brown to yellowish brown sandy clay; ~~moist~~ wet at 8 ft, dry elsewhere. 1.1 ft recovery. Also traces of shale	Hnu = 0 (Background)	8, 17, 20, 26		
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: TMTC-MW 3

PROJECT: Plum Brook Ordnance Works

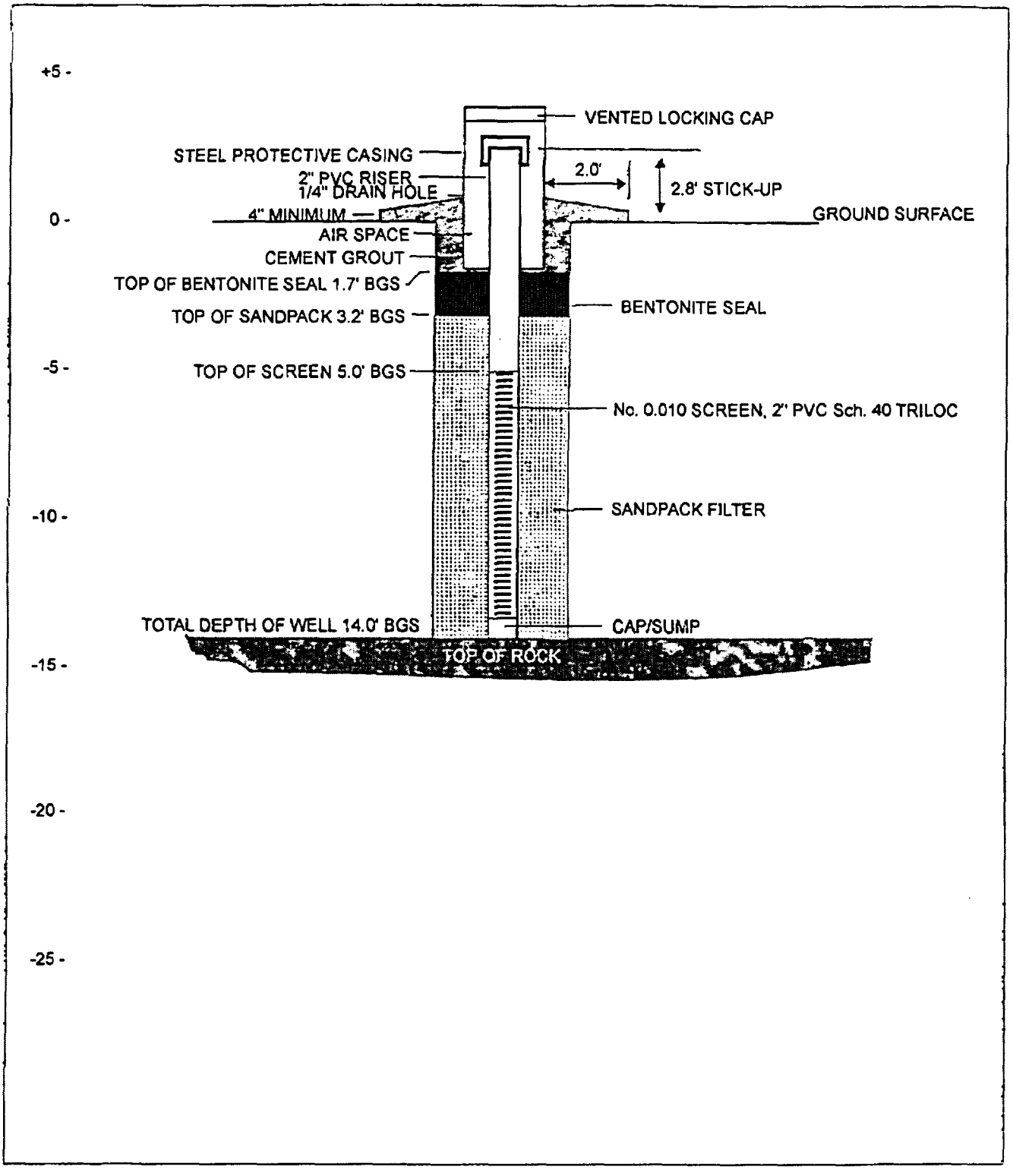
INSPECTOR: Joe Deatherage

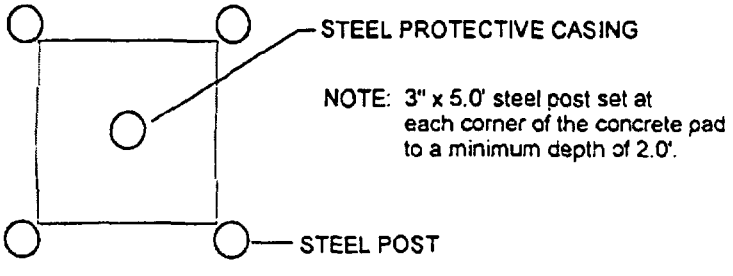
SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (S)	FIELD SCREENING RESULTS (ppm)	BLOWS PER 6 INCHES	ANALYTICAL SAMPLE NO. (ID)	REMARKS (ID)
	10 11	Brown to gray sandy clay w/ traces of chert; stiff; ~~moist~~ at 11.3 ft; moist elsewhere. 1.3 ft recovery	Hnu=0 (Background)	11,21 23,28		
	12 13	Light brown to gray sandy clay w/ shale to 13.0 ft. weathered light gray to gray shale from 13 ft to 13.5 ft. 1.2 ft recovery. moist.	Hnu=0 (Background)	9,15, 50 over 5"		
	14	gray highly weathered shale; dry; 0.9 ft recovery	Hnu=0 (Background)	47,50 over 1"		End of Drilling (refusal at 14.5 ft)
	15 16					

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

TNTC-MW3
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

TNTC-MW04

HTRW DRILLING LOG

HOLE NUMBER: TNTC-MW04

SHEET 1 OF 1 SHEETS

1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services Inc.
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4 1/4 inch ID hollowstem auger; SPT lang; 24" split spoon sampler. 140 lb drop hammer.	8. HOLE LOCATION: TNT Area C
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-12-94 / 11. DATE COMPLETED: 10-13-94
12. OVERBURDEN THICKNESS: 18 ft	15. DEPTH GROUNDWATER ENCOUNTERED: approx 16 ft
13. DEPTH DRILLED INTO ROCK: 0.7 ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A
14. TOTAL DEPTH OF HOLE: 18.7 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

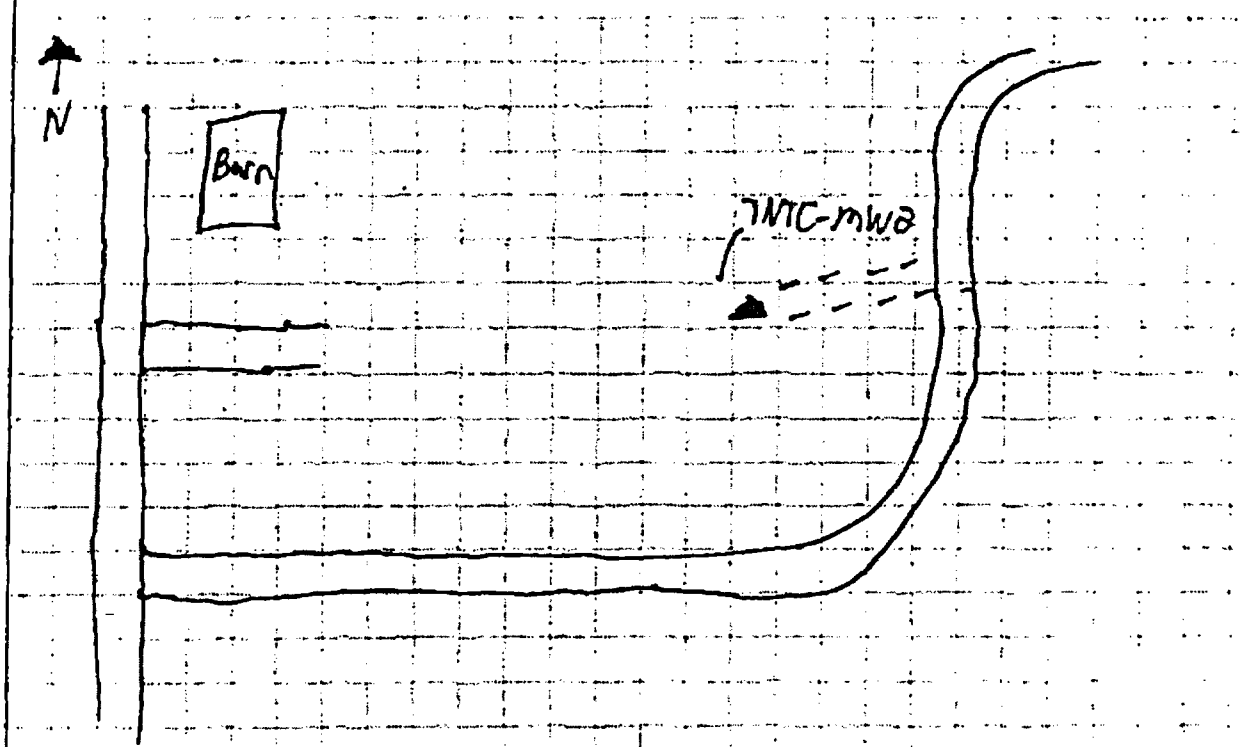
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A	-		Explosives			N/A

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Deatherage

LOCATION SKETCH/COMMENTS

SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: TNTC-MW4

PROJECT: Plum Brook Ordnance Works

INSPECTOR: Joe Deatherage

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	BLOW COUNTS	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	1	Brown to Brownish yellow sandy clay; dry; 1.5 ft recovery;	Hnu=0 (Background)	9,7, 9,10 30		
	2–3	Brown sandy clay; dry except moist at 4 ft; 0.8 ft recovery;	Hnu=0 (Background)	9,10, 10,11		
	4–5	Brown to gray sandy clay; dry; 1.0 ~~inches~~ feet recovery	Hnu=0 (Background)	12,17, 20,29		
	6–7	Brown sandy clay w/ ~~clayst~~ shale mixed; dry; a bit more stiff; 1.5 ft recovery	Hnu=0 (Background)	10,19 25,50 over 5"		
	8–9	Olive gray to brownish yellow sandy clay; small traces of shale; dry except moist at 8 ft; 1.5 ft recovery	~~16,25~~ ~~28,29~~ Hnu=0 (Background)	10,25, 26,29		
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

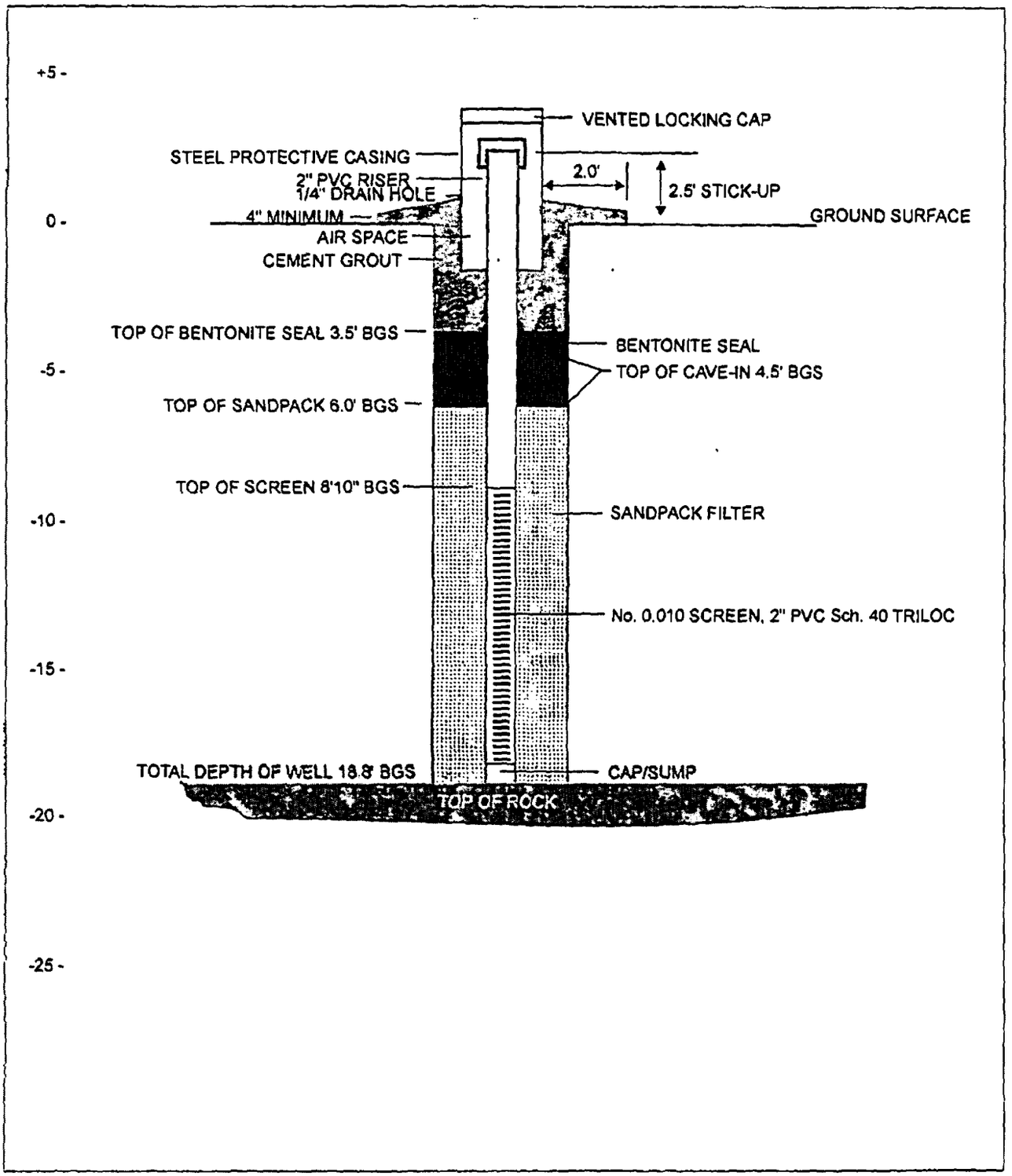
PNTC-mk4

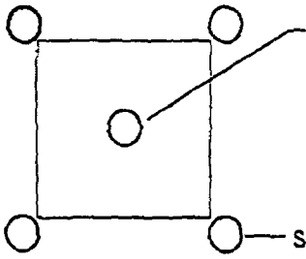
PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 3 OF 3 SHEETS

ELEV. (8)	DEPTH (8)	DESCRIPTION OF MATERIALS (2)	FIELD SCREENING RESULTS (2)	BLOW COUNTS (2)	ANALYTICAL SAMPLE NO. (2)	REMARKS (9)
	10	gray to olive gray sandy clay w/ traces of shale; slightly moist (damp); 1.7 feet recovery	Hnu=0 (Background)	7, 15, 21, 32		
	11					
	12	Olive gray sandy clay w/ traces of shale; very moist soil, wet spoon; stiffer; 1.3 feet recovery.	Hnu=0 (Background)	8, 17, 21, 27		
	13					
	14	Gray sandy clay w/ small traces of shale; stiff; wet at 16'; 0.2 ft recovery;	Hnu=0 (Background)	17, 20 20, 20		
	15					
	16	Gray clay; very stiff; small traces of shale; wet spoon; moist soil; 1.8 ft recovery	Hnu=0 (Background)	10, 15 21, 30		
	17					
	18	Gray weathered shale, dry spoon and dry shale	Hnu=0 (Background)	50 over 4 inches,		rock at 18' End of drilling,
	19					
	20					

HOLE NO.

PROJECT: Plum Brook Ordnance Works





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

TNTC-MW4
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

TNTC-MW05

HTRW DRILLING LOG *Offset

HOLE NUMBER: TNTC-MW5

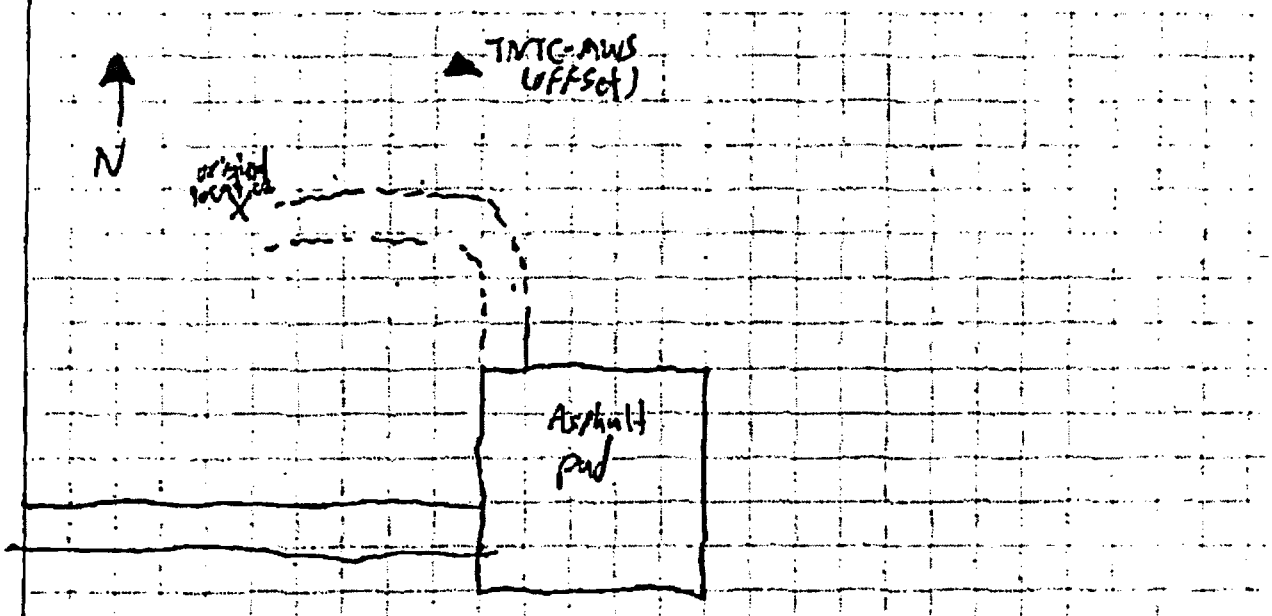
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: ~~Blue~~ Belaire Drilling Services Inc.
SHEET 1 OF 4 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼ inch ϕ hollow stem auger, 24" split spoon sampler. The augers are 5ft in length. 140lb drop hammer.	8. HOLE LOCATION: TNT Area C
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-13-94 / 11. DATE COMPLETED: 10-14-94
12. OVERBURDEN THICKNESS: ~~[illegible]~~ Unknown (refusal not met)	15. DEPTH GROUNDWATER ENCOUNTERED: ~~N/A~~ approx 7ft
13. DEPTH DRILLED INTO ROCK: ~~[illegible]~~ N/A (0)	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A
14. TOTAL DEPTH OF HOLE: 29.7ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A	-		Explosives			N/A

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Deatherage

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG *Offset*

TVTC-MWS

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Dentherage | SHEET 2 OF SHEETS 4

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	1	Dark Brown, wellgraded clayey Sand; dry	Hnu=0 (Backgrand)			Blow Count: 5,9,11,12 Pen: 2.0' Rec: 1.7' lost: 0.3'
	2 3	Dark Brown, wellgraded clayey sand; dry Brown Sandy clay; dry	Hnu=0 (Backgrand)			Blow Count: 6,9,13,15 Pen: 2.0' Rec: 1.7' lost: 0.3'
	4 5	Brown wellgraded sand; dry Dark brown sandy clay small traces of shale; dry	Hnu=0 (Backgrand)			Blow Count: 8,13,17,23 Pen: 2.0' Rec: 1.9' lost: 0.1'
	6 7	5.0 olive gray sandy clay; moderately stiff; slightly moist, with some wetness at 6.5 feet	Hnu=0 (Backgrand)			Blow Count: 8,12,13,17 Pen: 2.0' Rec: 1.2' lost: 0.8'
	8 9 10	Olive gray sandy clay: moderately stiff; moist; with wetness at 8.2ft; slight wetness of spoon	Hnu=0 (Backgrand)			Blow Count: 5,9,14,17 Pen: 2.0' Rec: 1.8' lost: 0.2'

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG *Offset*

HOLE NUMBER: TNTC-mw5

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 4 SHEETS

ELEV. (1)	DEPTH (2)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (5)	ANALYTICAL SAMPLE NO. (6)	REMARKS (7)
	10	Olive gray sandy clay; wet, almost no recovery	Hnu=0 (Backgrnd)			Blow Count=6,12,15,16 Run: 2.0' Rec: 0.1' lost: 1.9'
	11					
	12	Olive gray sandy clay; moderately stiff; moist with some traces of wetness within spoon,	Hnu=0 (Backgrnd)			Blow Count=6,10,11,16 Run: 2.0' Rec: 1.0' lost: 1.0'
	13					
	14	Olive gray sandy clay w/ small traces of shale; moist with spotty wetness in spoon;	Hnu=0 (Backgrnd)			Blow Count=7,9,9,12 Run: 2.0' Rec: 1.0' lost: 0.4'
	15					
	16	Olive gray clay; moderately stiff; moist with traces of wetness in spoon	Hnu=0 (Backgrnd)			Blow Count: 5,10,13,17 Run: 2.0' Rec: 2.0' lost: 0'
	17					
	18	Olive gray clay; moderately stiff; moist with traces of wetness in spoon	Hnu=0 (Backgrnd)			Blow Count=4,5,10,11 Run: 2.0 Rec: 0.6 lost: 1.4
	19					
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: TNTC-MW5

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	20	Olive gray clay; relatively soft; moist, with traces of wetness in the spoon	Hnu = 1 (Background)			Blow Count: 7, 8, 10, 11 Ran: 2.0' Rec: 2.0' lost: 0'
	21					
	22	Olive gray clay; relatively soft; moist with traces of wetness in spoon	Hnu = 1 (Background)			Blow Count: 4, 8, 13, 13 Ran: 2.0' Rec: 1.5' lost: 0.5'
	23					
	24	Olive gray clay; relatively soft; moist with traces of wetness in spoon	Hnu = 1 (Background)			Blow Count: ~~[illegible]~~ ~~Blow Ran: 2.0' Rec: 0.4' Lost: 0~~ ~~Blow Count: 3~~ ~~Ran: 2.0'~~ ~~Rec: 1.6'~~ ~~lost: 0.4'~~ Ran: 2.0' Rec: 1.6' lost: 0.4'
	25					
	26	Olive gray clay; relatively soft; a bit more wet; Traces of shale	Hnu = 1 (Background)			Blow Count: 5, 9, 10, 13 Ran: 2.0' Rec: 1.5' lost: 0.5'
	27					
	28	Olive gray clay; relatively soft; moist with traces of wetness; small traces of shale.	Hnu = 1 (Background)			Blow Count: 5, 10, 15, 12 Ran: 2.0' Rec: 1.2' lost: 0.8'
	29					
	30					End of drilling.

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG *original location*

HOLE NUMBER: TNTC-MW5

SHEET 1 OF 2 SHEETS

1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belaseo Drilling Services, Inc.
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼ inch ID hollow stem auger 24" split spoon sampler. The augers are 5ft in length. 140# drop hammer	8. HOLE LOCATION:
	9. SURFACE ELEVATION: ~~10-13-94~~
	10. DATE STARTED: 10-13-94 / 11. DATE COMPLETED: 10-14-94
12. OVERBURDEN THICKNESS: Unknown	15. DEPTH GROUNDWATER ENCOUNTERED: N/A
13. DEPTH DRILLED INTO ROCK: N/A	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: N/A
14. TOTAL DEPTH OF HOLE: 3.7ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

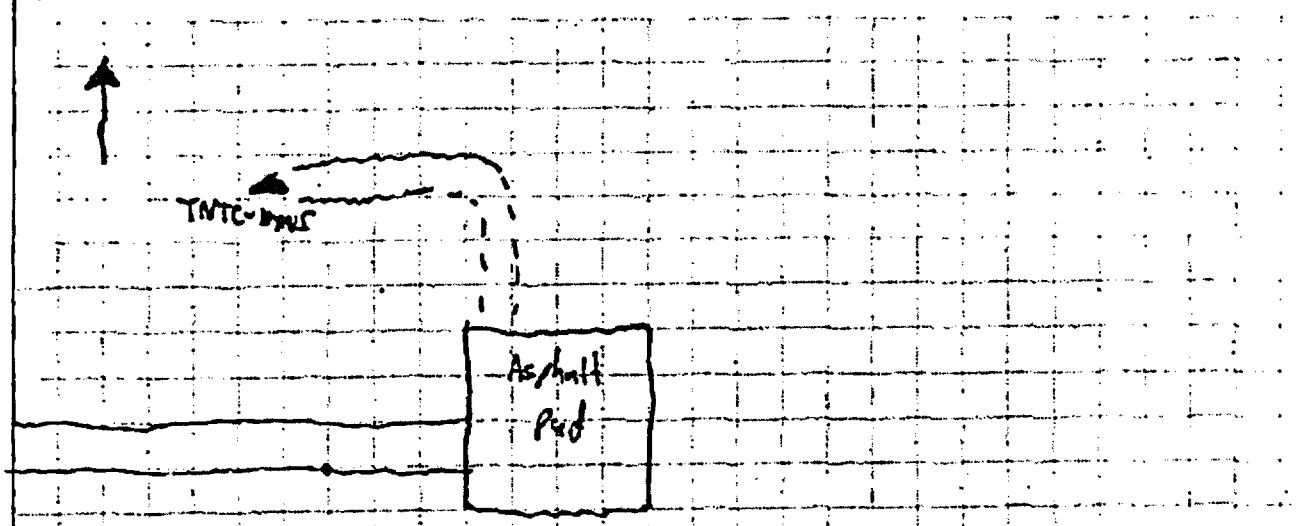
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
N/A			Explosives			N/A

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	X			Joe Leatherman

LOCATION SKETCH/COMMENTS

SCALE:



PROJECT: Plum Brook Ordnance Works

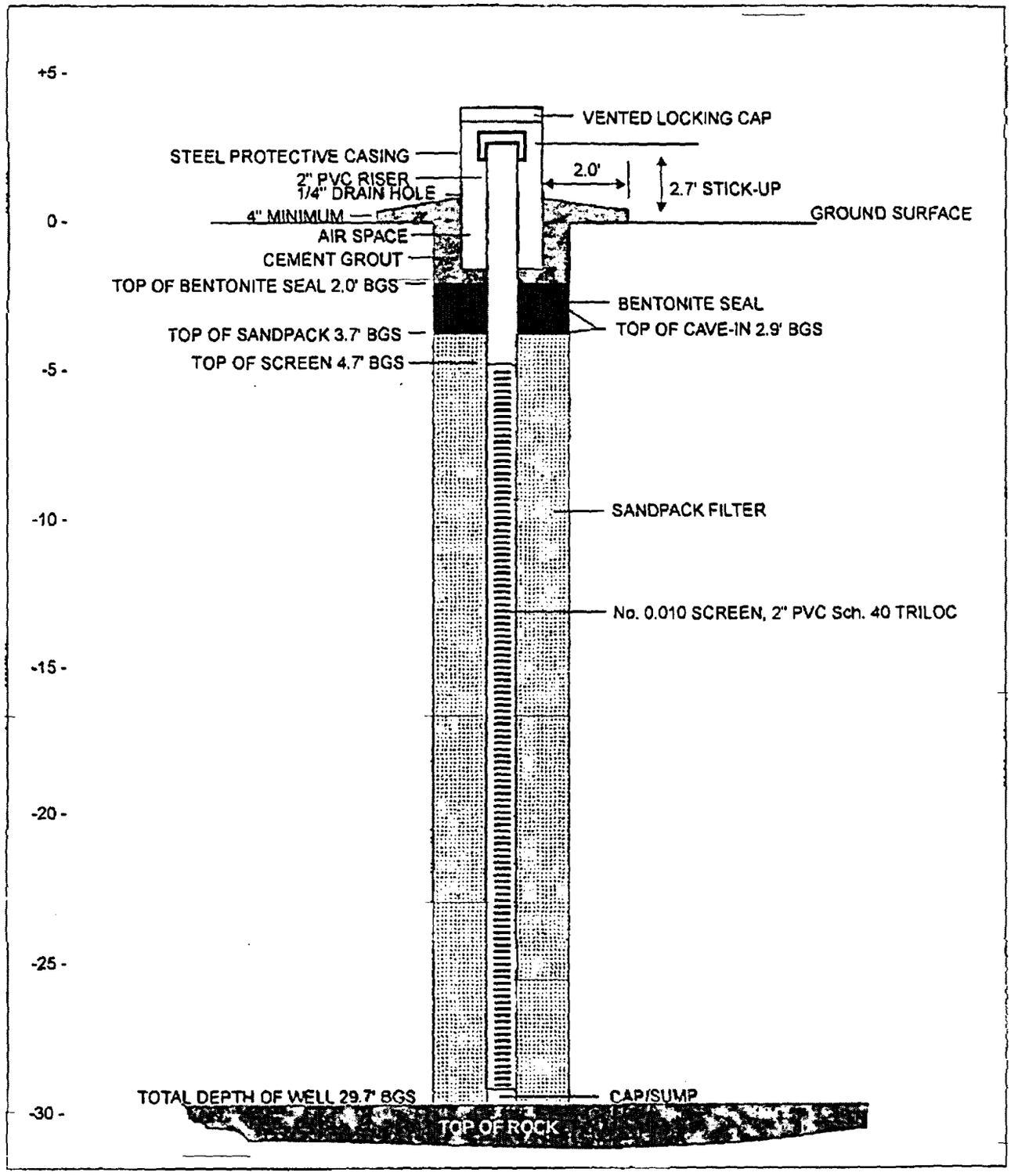
HOLE NO.

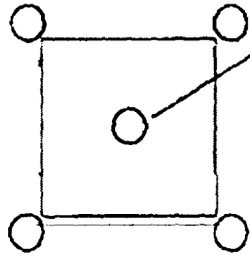
HTRW DRILLING LOG *original location INTC-MWS

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 1 OF 1 SHEETS 2

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE ZONE NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Dark Brown sand; well graded; dry	HNu=0 (Backgrnd)			Blow Count = 4,8,7,12
		gravel (limestone?), dry				Ran: 2'
	1					Rec: 1.5'
		Brownish yellow sand, well graded, dry				lost: 0.5'
	2	Brownish yellow well graded sand; dry	HNu=0 (Backgrnd)			Blow Count = 9,12,40, refusal
	3					Ran: 1.5'
						Rec: 1.3'
						lost: 0.2'
	4					refusal at 3.7'
	5					
	6					
	7					
	8					
	9					
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

TNTC-MW5
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

TNTC-MW06

HTRW DRILLING LOG

HOLE NUMBER: TNTC-MWG

SHEET 1 OF 3 SHEETS

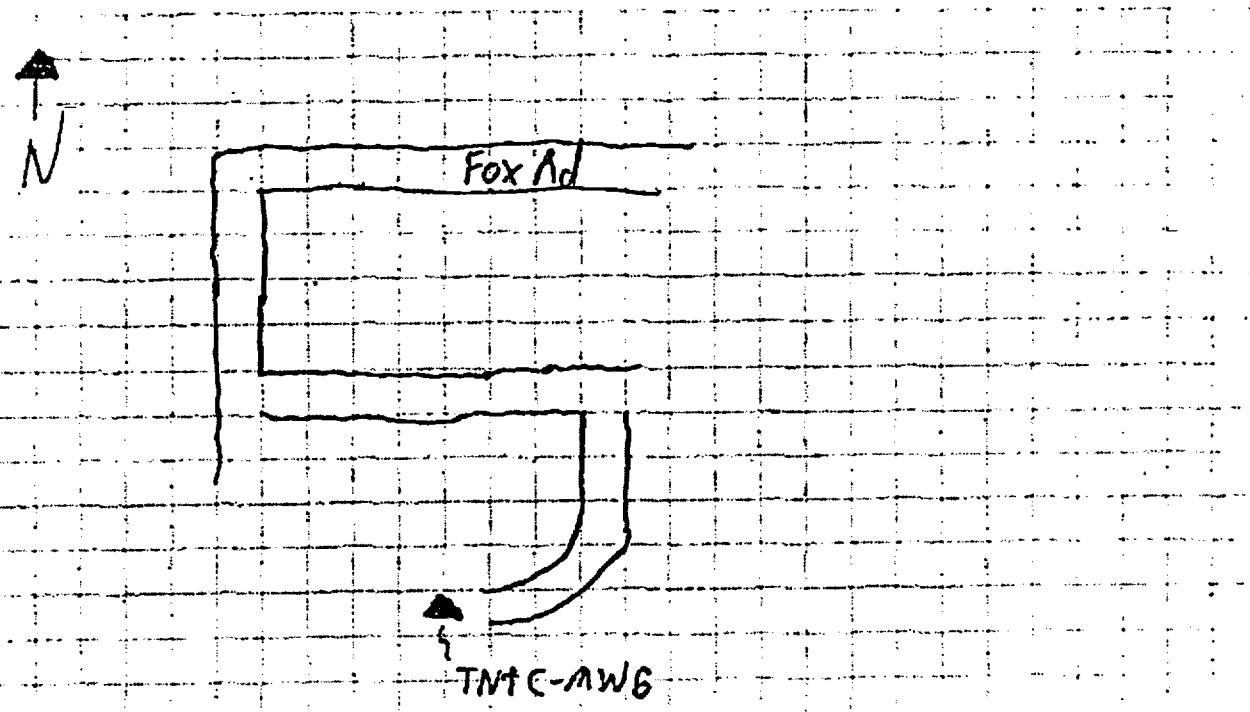
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services, Inc.
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 Diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" @ 5 ft long hollow stem auger; 24"; split spoon; 140 lb drop hammer	8. HOLE LOCATION: TNT Area C
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-16-94 / 11. DATE COMPLETED: 10-16-94
12. OVERBURDEN THICKNESS: 12.2 ft	15. DEPTH GROUNDWATER ENCOUNTERED: approx 3.5 feet
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 12.2 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: N/A
None	---		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: N/A

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Deatherage

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: TPC-MW6

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 2 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	1	Park Brown Sandy organic material; dry ~~Hard~~ weathered rock w/ hard gravel pieces Brown to Lt. Brown well graded sand; dry	Hnu=1 (Background)			Blow Count=4,19,7,7 Ran: 2.0' Rec: 2.0' Lost: 0
	2 3	Brownish yellow well graded sand; moist Dark gray well graded sand, wet, 1" strip of Black Sand.	Hnu=1 (Background)			Blow Count=4,5,6,6 Ran: 2.0 Rec: 1.5 Lost: 0.5
	4 5	Dark gray well graded Sand w/ black staining mixed in; wet; no significant odor.	Hnu=1 (Background)			Blow Count=2,1,1,1 Ran: 2.0 Rec: 1.4 Lost: 0.6
	6 7	Dark Gray well graded sand w/ black staining; wet. Gray, soft clay; wet, sandy	Hnu=1 (Background)			Blow Count=1,4,5,6 Ran=~~0.5'~~ 2.0' Rec=0.5' Lost=1.5'
	8 9 10	Gray sandy clay; very soft; wet Gray weathered shale; moist	Hnu=1 (Background)			Blow Count=4,7,9,10 Ran: 2.0 Rec: 1.2 Lost: 0.8

PROJECT: Plum Brook Ordnance Works | HOLE NO.

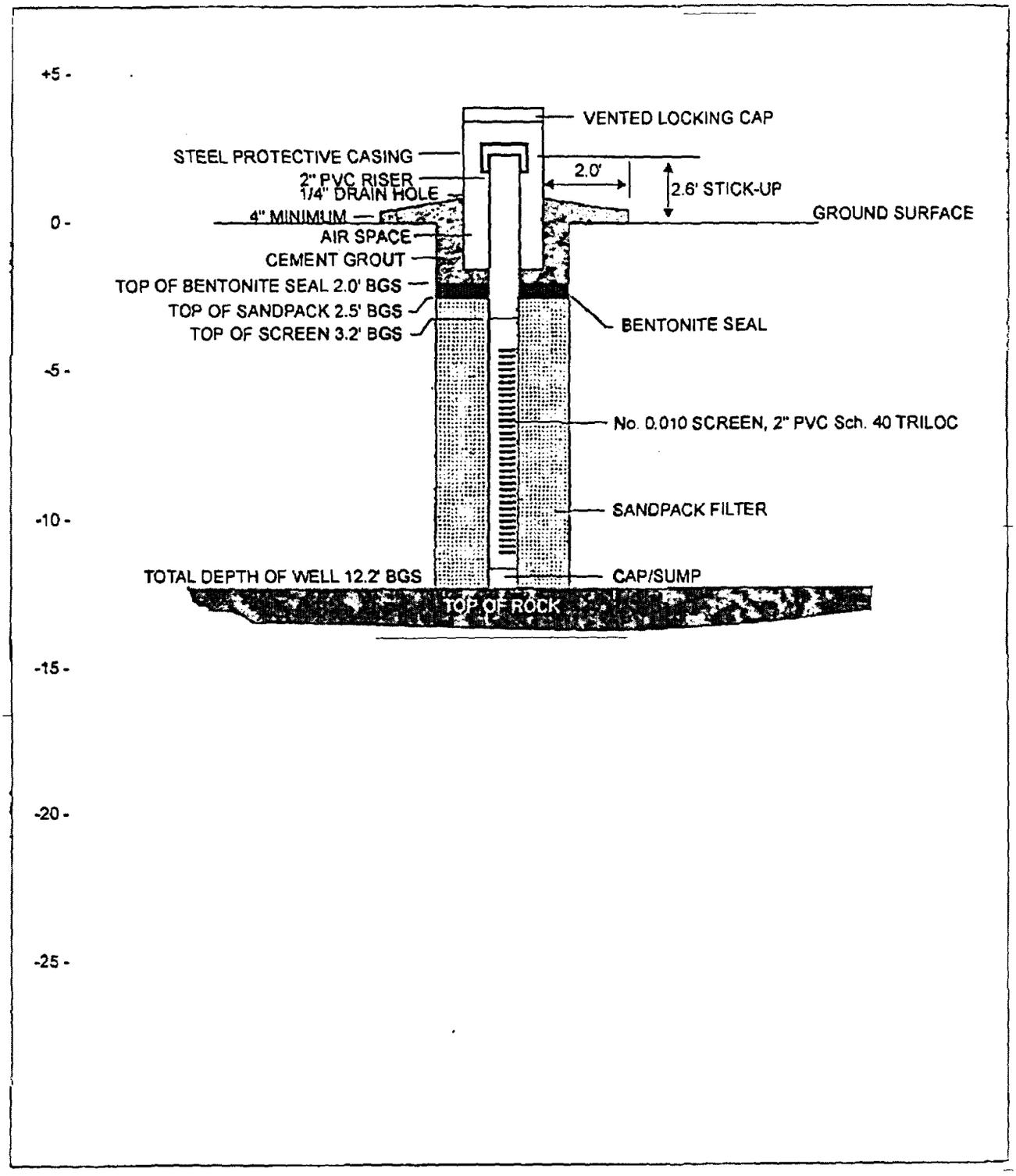
HTRW DRILLING LOG

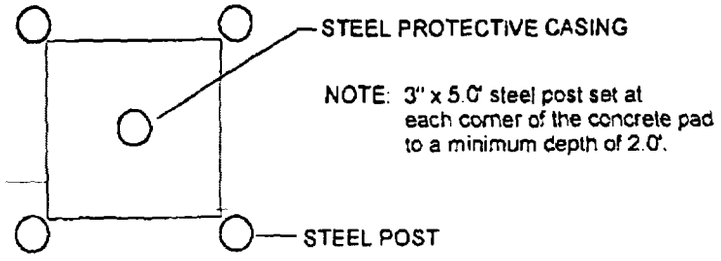
TNTC-MWG

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Dorthing | SHEET 3 OF 3 SHEETS

ELEV. (3)	DEPTH (5)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	10	Gray weathered Shale; moist	Hnu=1 (Background)			Blow Count: 4, 7, 13, 20 Ran: 2.0 Rec: 1.2 Lost: 0.8
	11					
	12	Gray weathered shale; moist.	Hnu=1 (Background)			Blow Count: 4, 50 over 2" Ran: 0-5 Rec: 0.5 Lost: 0
	13					
	14					End of Drilling. The well is ~~[illegible]~~ 12.2 ft deep.
	15					
	16					
	17					
	18					
	19					
	20					

PROJECT: Plum Brook Ordnance Works | HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

TNTC-MW6
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

WA-MW01

HTRW DRILLING LOG

HOLE NUMBER: PB-WA-MW1

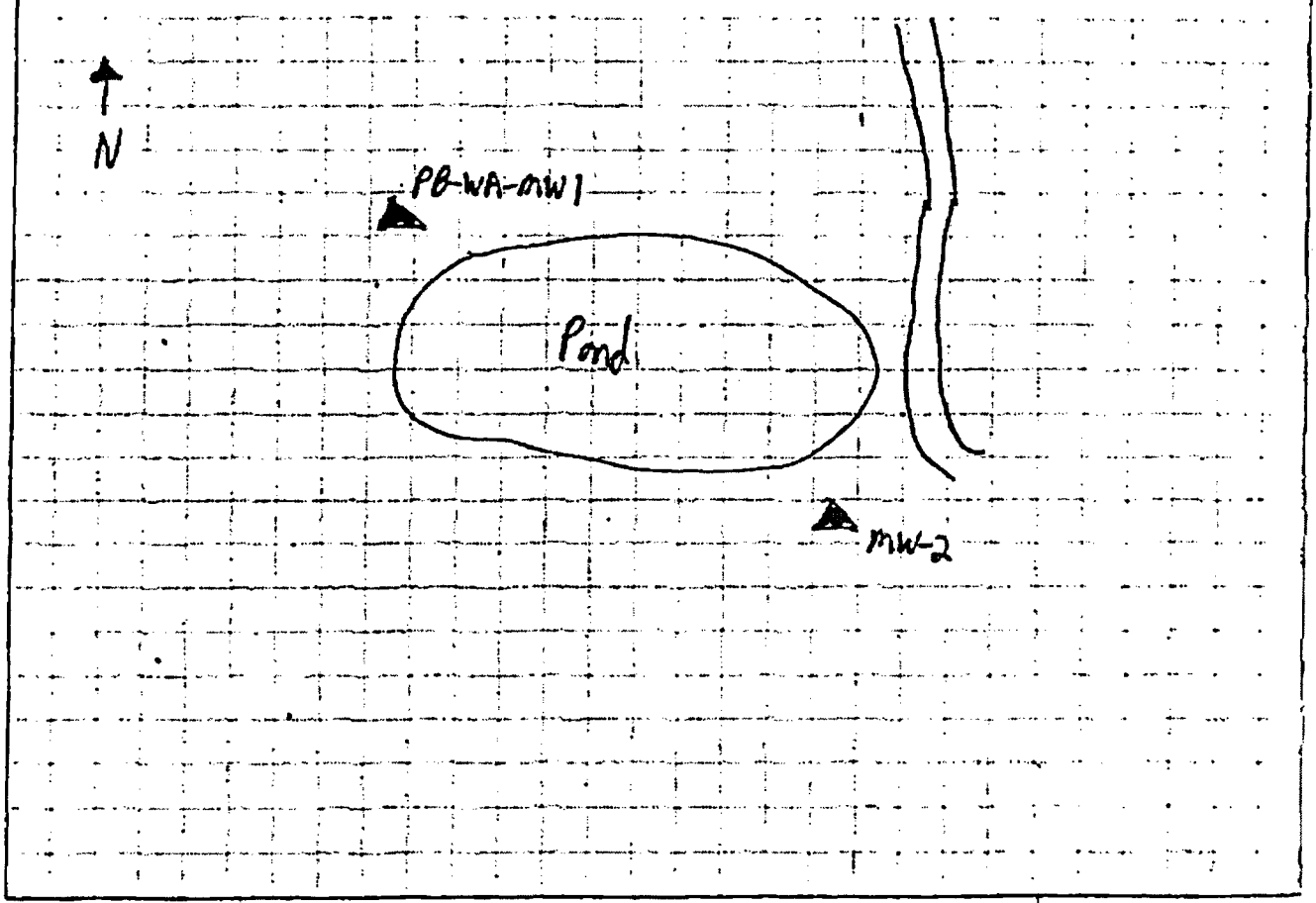
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services Inc.
SHEET 1 OF 4 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darryl	6. MANUFACTURER'S DESIGNATION OF DRILL: D-50 Diesel
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID SFI long hollow stem augers; 2" split spoon; 140 lb drop hammer	8. HOLE LOCATION: West Area Pond
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-17-94 / 11. DATE COMPLETED: 10-18-94
12. OVERBURDEN THICKNESS: 22.3 ft	15. DEPTH GROUNDWATER ENCOUNTERED: approx 17 feet
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 22.3 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Deatherage

LOCATION SKETCH/COMMENTS SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

PB-WA-MW

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deatherage | SHEET 2 OF 2 SHEETS 4

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
		Dark brown well graded sandy organic material; dry	Hnu=1 (Background)			Blow Count = 5,11,9,7 Ran: 2.0 Rec: 2.0 Lost: 0
	1	Brownish yellow well graded sand; dry				
	2	Yellowish red very sandy clay; well graded; ~~dry~~ moist	Hnu=1 (Background)			Blow Count: 5,9,11,15 Ran: 2.0 Rec: 1.4 Lost: 0.6
	3					
	4	Brownish yellow weathered shale; moist, well graded	Hnu=1 (Background)			Blow Count = 6,8,7,11 Ran: 2.0 Rec: 1.3 Lost: 0.7
	5					
	6	Brown to brownish yellow sandy weathered shale; moist	Hnu=1 (Background)			Blow Count: 3,9,13,14 Ran: 2.0 Rec: 1.9 Lost: 0.1
	7					
	8	Brownish yellow sandy weathered shale; moist	Hnu=1 (Background)			Blow Count: 2,3,3,4 Ran: 2.0 Rec: 2.0 Lost: 0
	9	Gray sandy clay; soft; moist; wet traces in spoon				
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

PB-WB-MW1

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deathrage | SHEET 3 OF 3 SHEETS 4

ELEV. (6)	DEPTH (5)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	10 11	Gray soft clay w/ weathered Shale; moist w/ traces of wetness in spoon	Hnu=1 (Background)			Blow Count: 2,2,3,3 Pen: 2.0 Rec: 1.8 Lost: 0.2
	12 13	Gray, soft, sandy clay w/ weathered Shale; moist w/ traces of wetness.	Hnu=1 (Background)			Blow Count: 2,2,3,2 Pen: 2.0 Rec: 2.0 Lost: 0
	14 15	Gray, soft sandy clay w/ weathered Shale; moist with traces of wetness	Hnu=1 (Background)			Blow Count: 3,3,3,3 Pen: 2.0 Rec: 1.9 Lost: 0.1
	16 17	Gray, very soft clay; moist to wet; high plasticity	Hnu=1 (Background)			Blow Count: 1,1,1,1 Pen: 2.0 Rec: 2.0 Lost: 0
	18 19 20	Gray very soft clay; wet; high plasticity	Hnu=1 (Background)			Blow Count: 1,1,3,2 Pen: 2.0 Rec: 2.0 Lost: 0

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

PR-WA-MW

PROJECT: Plum Brook Ordnance Works

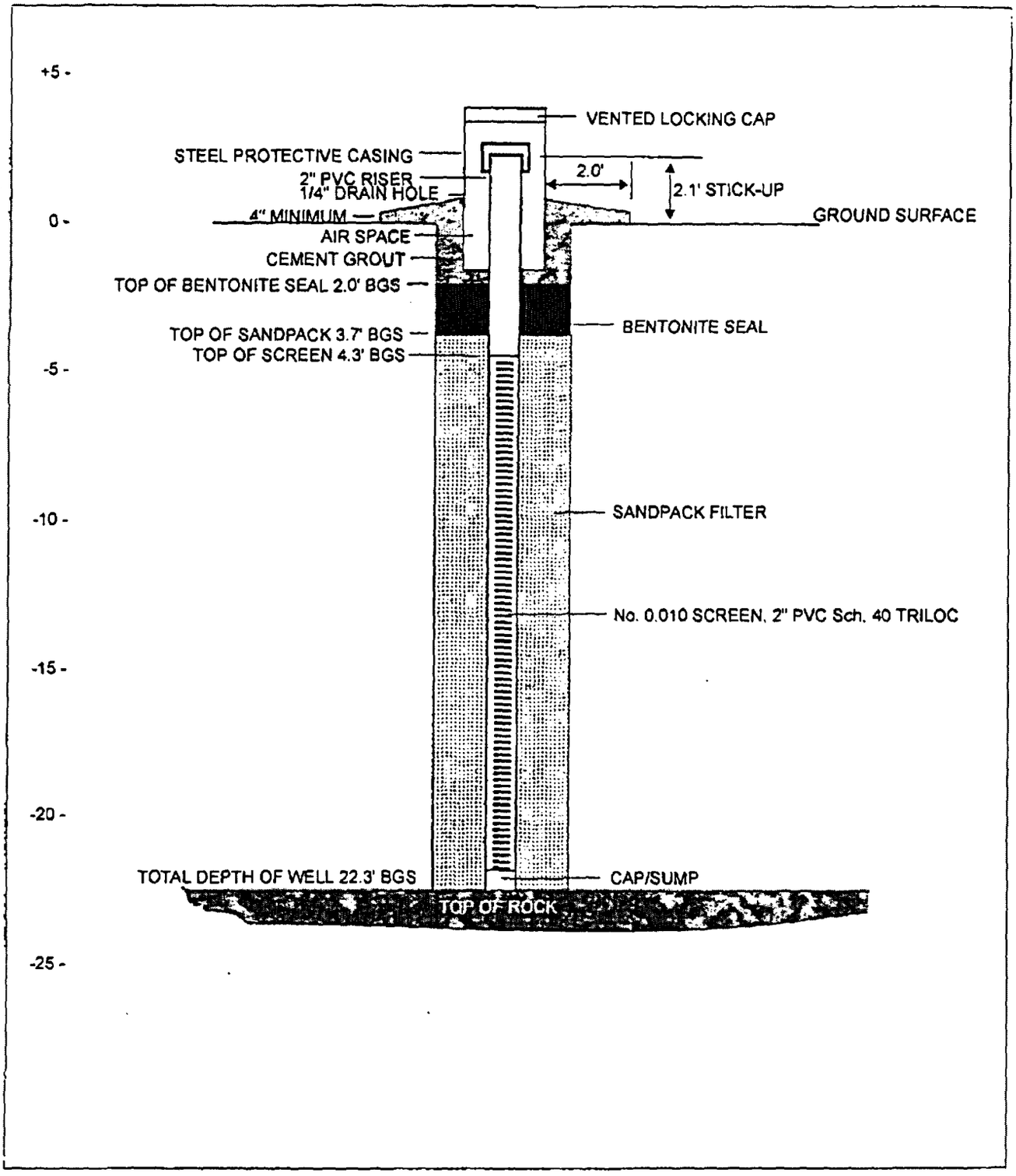
INSPECTOR: Joe Deatherage

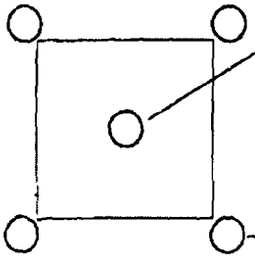
SHEET 4 OF 4 SHEETS

ELEV. (2)	DEPTH (1)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	20	Gray soft clay; moist to wet; high plasticity	Hnu=1 (Background)			Blow Count: 0, 1, 6, 12 Ran: 2.0 Rec: 1.5 Lost: 0.5
	21	Gray soft clay w/ weathered shale mix; moist to wet				
	22	Gray soft clay with limestone at base; moist to wet.	Hnu=1 (Background)			Blow Count = 7, 50 over 3" Ran: 0.7 Rec: 0.4 Lost: 0.3 * Refusal at 22.3' *
	23					
	24					

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-WA-MW1
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

WA-MW02

HTRW DRILLING LOG

HOLE NUMBER: PB-WA-MW2 + PB-WA-S10

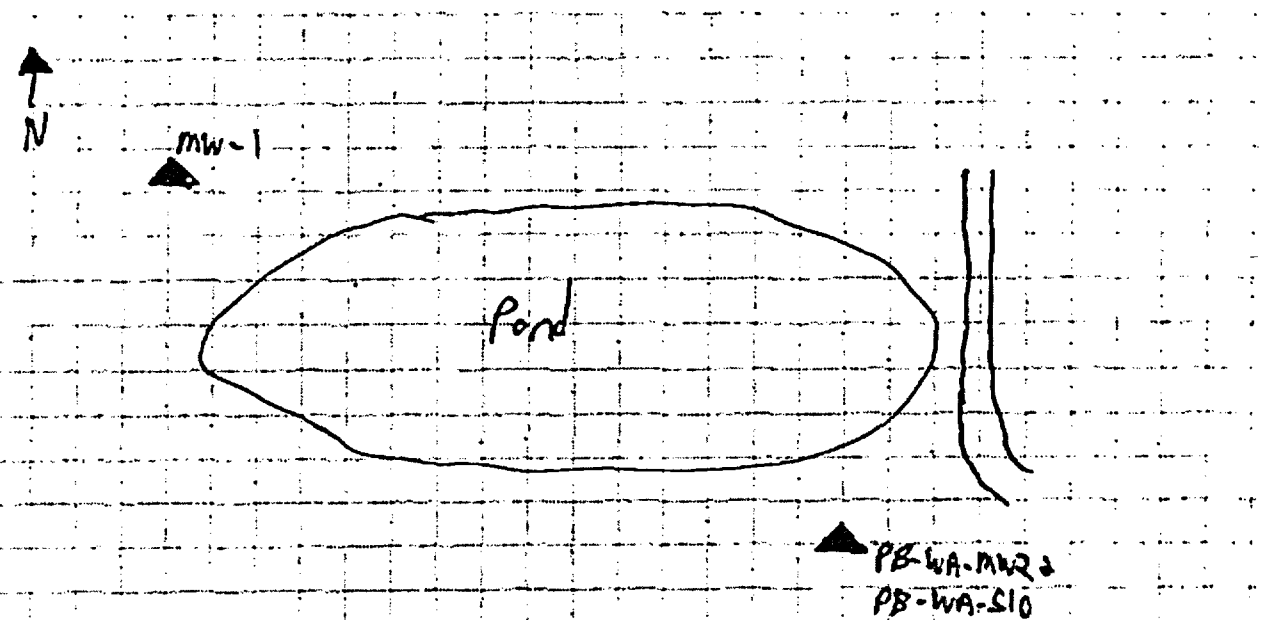
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belsco Drilling Services, Inc.
SHEET 1 OF 2 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Darry	6. MANUFACTURER'S DESIGNATION OF DRILL: CME 45 ATV
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 2½" split spoon; 140 lb drop hammer; stainless steel bowls & spoons	8. HOLE LOCATION: Red Water Pond area
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-27-94 / 11. DATE COMPLETED: 10-27-94
12. OVERBURDEN THICKNESS: 12.0 Ft	15. DEPTH GROUNDWATER ENCOUNTERED: approx 1.5 Ft
13. DEPTH DRILLED INTO ROCK: 0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED:
14. TOTAL DEPTH OF HOLE: 12.0 Ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): N/A

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		N/A

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	-					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Joe Deatherage

LOCATION SKETCH/COMMENTS — SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

PB-WA-MW 8

PROJECT: Plum Brook Ordnance Works | INSPECTOR: Joe Deathrage | PB-WA-S10 | SHEET 2 OF 2 SHEETS 3

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	0	Dark Brown Sandy organic material	Hnu=2 (Background =0)			Blow Count = 2,4,2,2 Ran: 2.0 Rec: 1.6 Lost: 0.4
	1.0	Brown well graded sand w/ some clay mix; wet at 1.5ft				
	2.0	Brown sandy, well graded, some clay mix and brownish yellow flakes; wet	Hnu=2 (Background =0)			Blow Counts 1,1,1,1 Ran: 2.0 Rec: 2.0 Lost: 0
	3.0					
	4.0	Brown to gray sandy clay; wet	Hnu=20 (Background =0)		PB-WA-S10- 3.0/5.0	Blow Count = 1,1,1,1 Ran: 2.0 Rec: 2.0 Lost: 0
	5.0	Gray clay; very soft; moderate plasticity; very moist				
	6.0	Gray clay with brownish yellow mottling; very soft; high plasticity; very moist	Hnu=50 (Background =0)		PB-WA-S10- 8.0/10.4	Blow Count: 0,1,1,1 Ran: 2.0 Rec: 2.0 Lost: 0
	7.0					
	8.0	Gray clay; very soft; high plasticity; moist to wet. Brownish yellow mottling	Hnu=50 (Background =0)			Blow Count: 1,2,6,7 Ran: Rec: Lost:
	9.0					
	10.0					

PROJECT: Plum Brook Ordnance Works | HOLE NO.

HTRW DRILLING LOG

PB-WA-5710

PROJECT: Plum Brook Ordnance Works

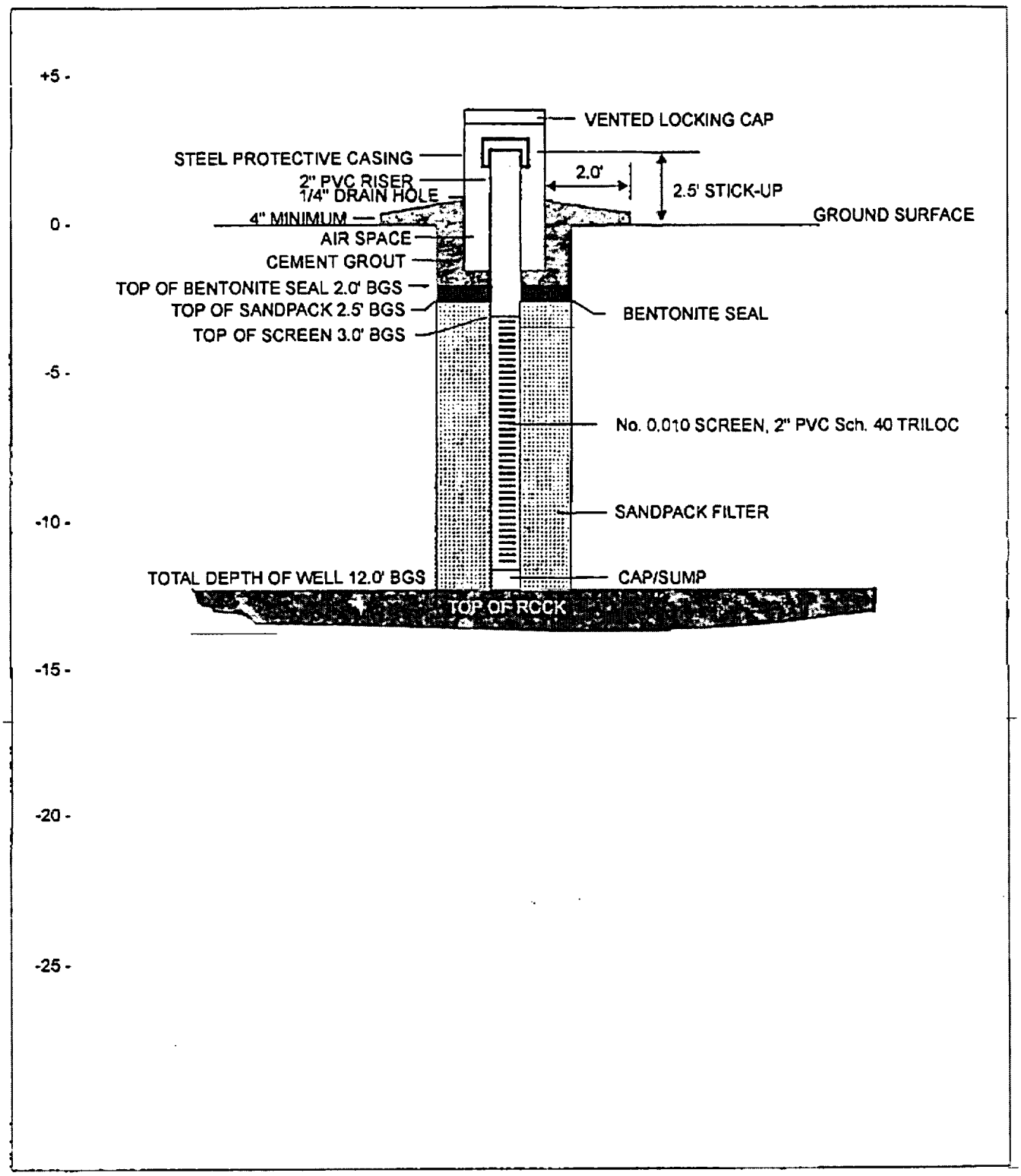
INSPECTOR: Joe Dentlinger

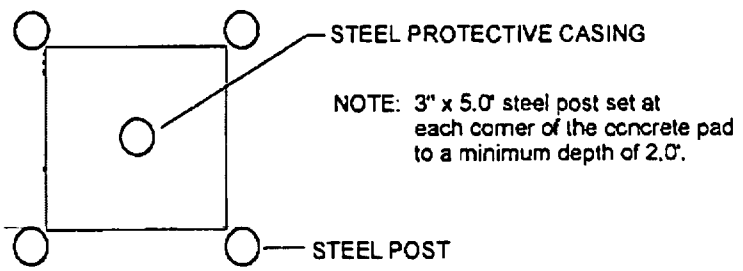
SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (m)	REMARKS (g)
	10	Gray Clay; very soft; high plasticity; wet; brown mottling	Hnu = 1 (Background = 0)			Blow Counts = 2, 19, 10, 50 over 5"
		Weathered Shale; gray				Run: 1.9'
	11					Rec: 1.0'
						Lost: 0.9'
	12					Boring terminated at 12.0 ft due to auger refusal
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-WA-MW2
OVERBURDEN WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

AA1-BEDGW-001

HTRW DRILLING LOG

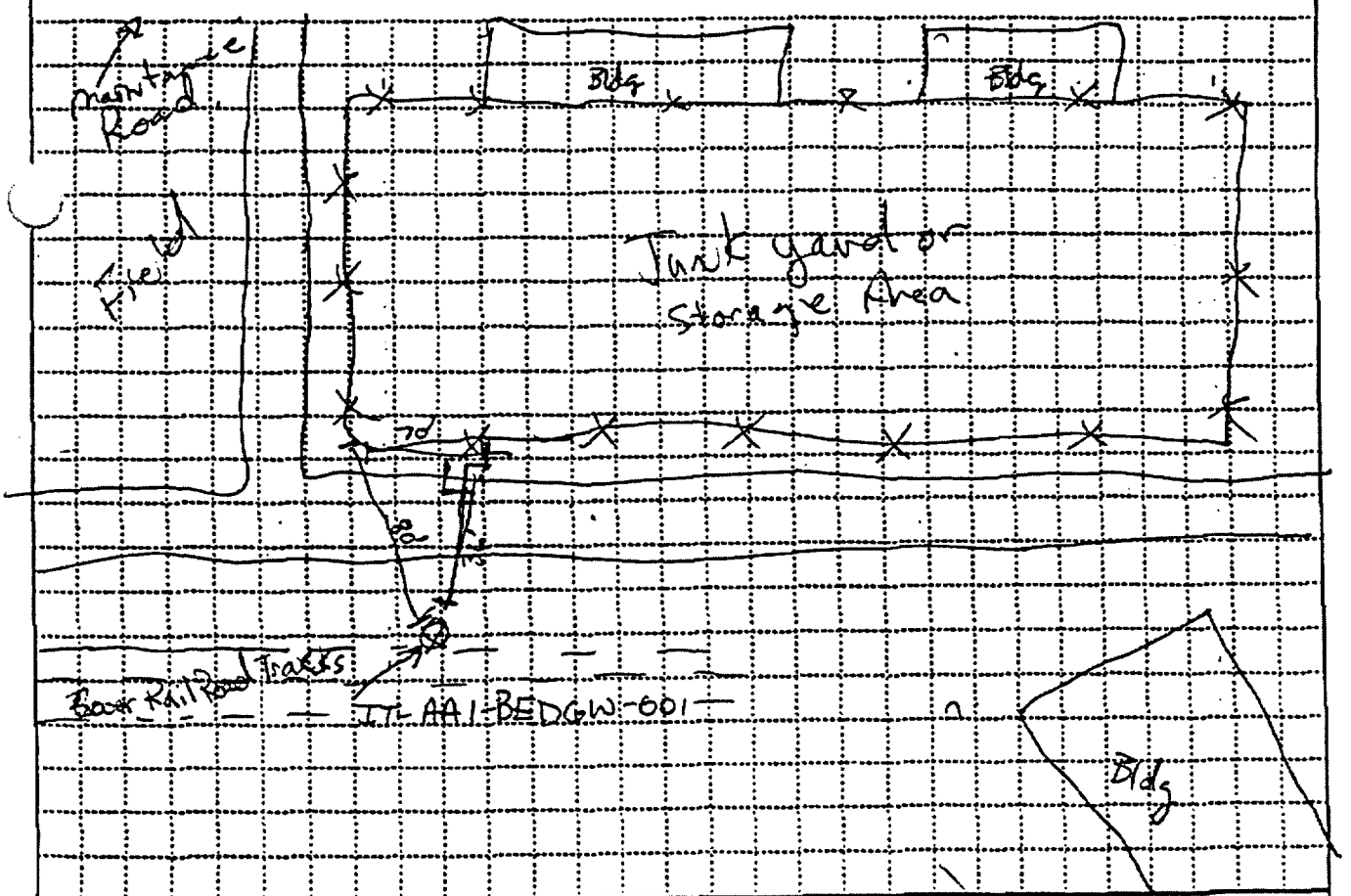
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-AA1-BEDGW-001
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF SHEETS 8
3. PROJECT: AA1 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D 120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich D 120, Both Rig; 12 1/4" TD HSA, 2 1/2" SS 3:1; 5000N, 140lb Hammer, 10" Roller Cone Bit; 3" x 10' Core Barrel, 375 Ingersoll Rand Air Compressor	8. HOLE LOCATION: N=623067.04, E=1977718.26 See sketch	
	9. SURFACE ELEVATION: 638.80 Ft. ~~647.00 (From Topo)~~ DKK	
	10. DATE STARTED: 9/8/97	11. DATE COMPLETED: 9/24/97
12. OVERBURDEN THICKNESS: 23.1	15. DEPTH GROUNDWATER ENCOUNTERED: 19.8' 1st encounter in Overburden / ~550	
13. DEPTH DRILLED INTO ROCK: 42.9	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 30.41 on 10-5-97	
14. TOTAL DEPTH OF HOLE: 66.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	X		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: AA1 / Plum Brook Ordnance Works | HOLE NO. IT-AA1-BEDGW-001

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

HOLE NUMBER: GW-001

PROJECT: AA1/Plum Brook Ordnance Works | INSPECTOR: G. Bickner | SHEET 2 OF 2 SHEETS

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	ANALYTICAL SAMPLE NO.	REMARKS
		Grassy Surface 0.2'	HNU			16:35
	1	SAND Silty (40%) Dark br. Very Fine grained Dry to slightly Damp. lo to V lo.	2.2 ppm		3/3 4/5	Sample Thru 4'/4 JD Augers, using 2'x2" Split Spoon (SS) Raw: 2.0' Rec 1.0' Loss 1.0'
	2	2.0' Becoming Orange Brown				Auger to 2.0' 2.0'
		3.0'			5/7 7/8	Raw 2.0' Rec 1.6', Loss 0.6'
	3	SILT Sdy (15%) Very F gra Black low Pl. lo	2.0 ppm			Has a Burn smell.
	4	4.0 Becoming Brown				Auger to 4.0' 4.0'
	5	5.2'	1.2 ppm		2/3 4/5	Raw 2.0' Rec 1.7 Loss 0.3
	6	SILT Clay (~30%) Slightly Damp mottled Orange Brown med Pl.		Geotech Sample		Auger to 6.0' 6.0'
	7	6.5' Decreasing Clay Content (10%)	0.8 ppm		2/2 2/3	Raw 2.0' Rec 1.2 Loss 0.8
	8	8.0'				Auger to 8.0' 8.0'
		Silt Sdy V F gra Orange Brown Gray to Slight Damp to Damp Low to Non Pl. 9.0'			3/5 6/7	Raw 2.0' Rec 2.0', Loss 0.0
	9	Silt Clay (20%) Low Pl. Gr Med.	0.2 ppm			
	10					Auger to 10.0' 10.0'

PROJECT: AA1/Plum Brook Ordnance Works | HOLE NO. IT-AA1-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: GW-001

PROJECT: AA1/Plum Brook Ordnance Works | INSPECTOR: G. Buckner | SHEET 3 OF 8 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		SILT Stg Low Pl. V F Grn	1.0 PPM	Geotech Sample Sample # IT-AA1-BEDGW-001 10'-12' 1650	Blow Counts 3/6 7/8	Raw 2.0' Rec 1.5 Loss 0.5
	12	12.2				Auger to 12.0' 12'
		Clay Stg Gr Mod to High Pl. Homogeneous	0.0 PPM		2/3 4/4	Raw 2.0' Rec 2.0' loss 0.0'
	14					Auger to 14.0' 14.0'
	15		0.5 PPM		2/3 3/4	Raw 2.0' Rec 2.0' loss 0.0'
	16					Auger to 16.0' 16.0'
	17		0.0 PPM		3/3 5/5	Raw 2.0 Rec 2.0' loss 0.0'
	18	18.5'		18.0		Auger to 18' 18.0'
	19	Clay Gvl (slm'e) Fgvl Mod to High Pl.	0.0 PPM	Geotech Sample Sample # IT-AA1-BEDGW-001 (8720) 19'-20'	2/2 4/8	Raw 2.0' Rec 2.0 loss 0.0
	20	19.8' Refusal		20.0		

PROJECT: AA1/Plum Brook Ordnance Works | HOLE NO. IT-AA1-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: GW-001

PROJECT: AA1/Plum Brook Ordnance Works

INSPECTOR: G. Buckner

SHEET: 4 OF 8

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	SPECIMEN SAMPLE NO. (ft)	REMARKS (ft)
		SILT Gravel Dry to Sligh Hy Damp. Stiff low Plasticity moist to wet	HNU		Blows Counts	
					6/8	Run 2.0' Rec 1.8' Loss 0.2'
	21		0.8 ppm		10/11	
		22.0'				Auger to 22.0' 22.0'
	22	Gravel Firm to Med.	0.5 ppm		5/38	Run 1.1' Rec 1.1' Loss 0.0' 1740
					50/inch	
	23	Spoon Refusal 23.1				
		Shale (Siltstone) gray, slightly weathered slightly damp soft – moderately hard	ppm 0.0			Continued by Ed Rankinen 80% recovery Start 0900 Finished 1000
	24					
	25					
	26					
	27					
	28					
	29					
	30					

HTRW DRILLING LOG

HOLE NUMBER: (GW) - DO1

PROJECT: PLum Brook Dedicance Work

INSPECTOR: E. Kanewsky

SHEET 3 OF 5 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	CENTER SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Shale (siltstone) weathered grey ~~[illegible]~~ damp soft to moderately hard	0 ppm			Start - 0900 Finished - 1000
	31					
	32					
	33					
	34					
	35	Shale (siltstone) slightly weathered grey soft to moderately ~~[illegible]~~ wet Interbedded w/clay medium plasticity grey ~~[illegible]~~ wet	0 ppm			70% recovery St 1030 Finished 1200 ~~[illegible]~~ Sample stick to the core barrel Water table @ 35'
	36					
	37					
	38					
	39					

PROJECT

HOLE NO. IT-AA1-BEDGW-001

HTRW DRILLING LOG

IT-A | HOLE NUMBER A1-BEDGW-001

PROJECT Plum Brook Ordnance Works | INSPECTOR | SHEET 6 OF 7 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Shaley LIMESTONE ~~State (siltstone)~~ w/foss. slightly weathered gray, moderately hard, dry				start 1500 stop 1800 100% recovery
	41	Interpretation of Shaley LIMESTONE made from description, cross-section, and representative rock sample.				
	42					
	43					
	44					
	45					
	46					
	47	LIMESTONE Shale ~~(siltstone)~~ DKGR slightly weathered moderately hard gray, dry				100% start 1510 Finished 1810 3 feet
	48					

PROJECT | HOLE NO. IT-AA1-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: AAI-BEDGW-001

PROJECT: Lure Brook Dedevance

INSPECTOR:

SHEET 7 OF 7 SHEETS 8

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS LIMESTONE	FIELD SCREENING RESULTS (ppm)	CERTECH SAMPLE OR CORE BOX NO. (no)	ANALYTICAL SAMPLE NO. (no)	REMARKS (ft)
		~~shale (siltstone)~~ DRK				0910 - started
		~~grey~~				1210 - Finished
		slightly weathered				100% recovery
		moderately hard				
	51	grey w/brown surface				strong petroleum
		~~clay~~ slightly damp				odor from
		petroleum odor				52½ to 54'
	52					Rainbow thin
						on surface
	53	SILTY LIMESTONE DRK				
		siltstone (sandstone)				
		slightly weathered				
		moderately hard				
	54	dry				
		brownish grey				
	55	SILTY LIMESTONE				
		siltstone (sandstone				
		slightly weathered				
	56	moderately hard				
		~~brown~~ - moist - wet				
		petroleum odor				
	57	brownish grey				
	58					
	59					

PROJECT

HOLE NO. IT-AAI-BEDGW-001

HTRW DRILLING LOG

PROJECT: Plum Brook Ordnance | INSPECTOR: | HOLE NUMBER: AAI-BEDGW-001 | SHEET 8 OF 8 SHEETS

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	CONTROL SAMPLE OR CORE BOX NO.	ANALYTICAL SAMPLE NO.	REMARKS
		LIMESTONE Siltstone ~~Sandstone~~ gr slightly weathered moderately hard brownish grey				1500 - started 1900 - finished 90% recovery petroleum odor WT - at 62'
	61	clay				
		LIMESTONE Siltstone ~~Sandstone~~ gr fiss. filiceous moderately weathered				
	62	grey, moderately hard saturated				
		LIMESTONE Siltstone ~~Sandstone~~ gr fossiliferous				
	63	slightly weathered moderately hard grey				
	64	saturated				
	65					
	66					
		BOH at 66'				
	67					
	68					
	69					

PROJECT | HOLE NO. IT-AAI-BEDGW-001

AA2-BEDGW-001

HTRW DRILLING LOG

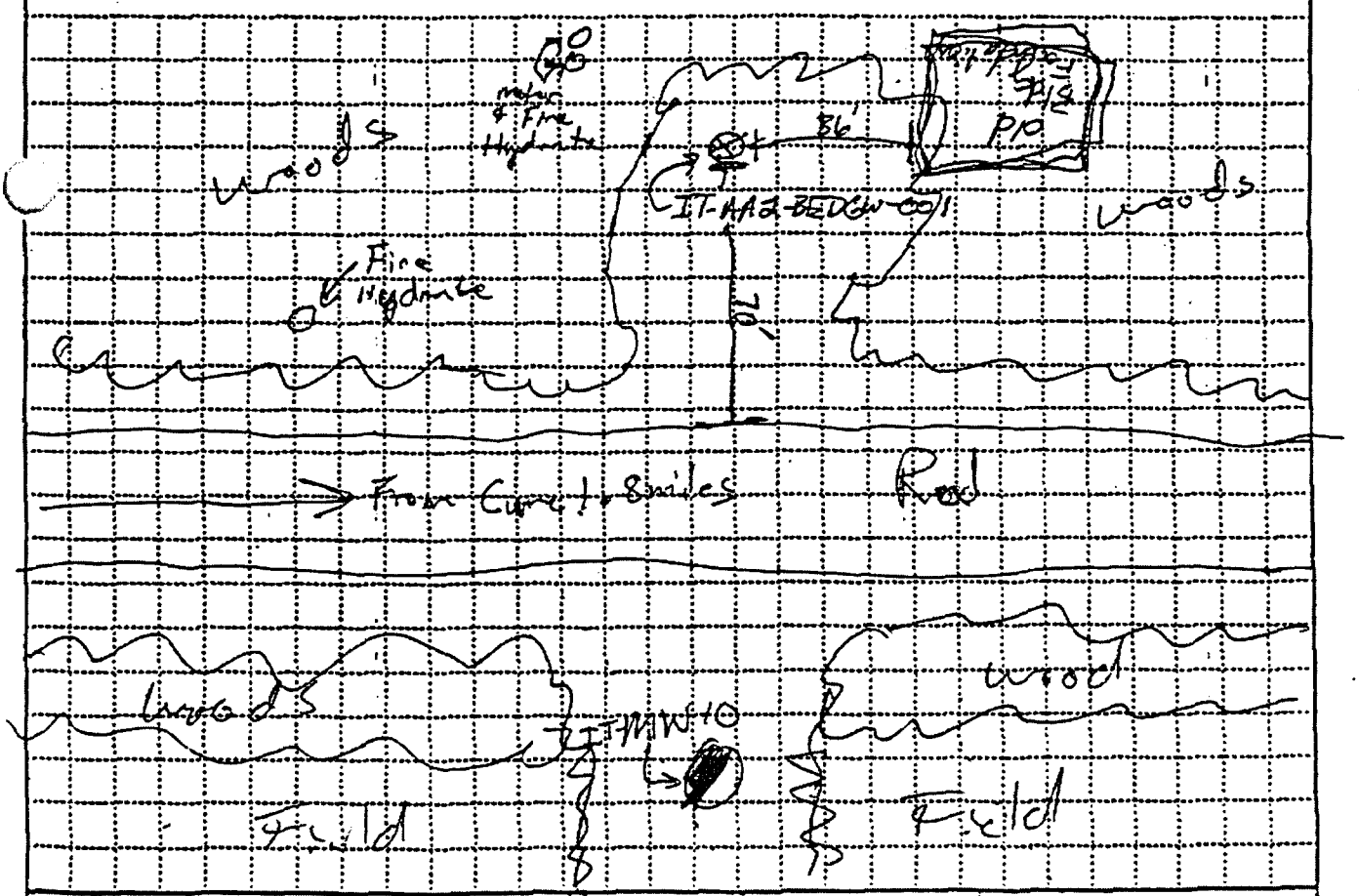
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-AA2-BEDGW-001
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 6 SHEETS
3. PROJECT: AA2 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich D-120 Drill Rig, 12¼ HSA ID, SS Split Spoon, 140lb Hammer, 10" Roller Cone Bit, 10" x 3' Core Barrel, 825 Ingersoll Rand Air Compressor.	8. HOLE LOCATION: N=623599.94 E=1904552.48 See Sketch	
	9. SURFACE ELEVATION: 641.60 Ft. ~~640.0~~ (From Topo) DKE	
	10. DATE STARTED: 9/6/97	11. DATE COMPLETED: 10/2/97
12. OVERBURDEN THICKNESS: 18.8'	15. DEPTH GROUNDWATER ENCOUNTERED: 34.0	
13. DEPTH DRILLED INTO ROCK: 25.2'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 12.48 on 10-5-97	
14. TOTAL DEPTH OF HOLE: 44.0'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	X		1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / [signature]

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: Plum Brook Ordnance Works | HOLE NO. IT-AA2-BEDGW-001

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

HOLE NUMBER GW-001

PROJECT AA2 / Plum Brook Ordnance Works INSPECTOR G. Dickner

SHEET 2 OF 6 SHEETS

ELEV. (m)	DEPTH (m)	DESCRIPTION OF MATERIALS (m)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (m)	ANALYTICAL SAMPLE NO. (m)	REMARKS (m)
		Leaves + organic 0.2'	HNu		Blow counts	Sample Thru 4'/4 ID HSA, using 2' x 2" SS split Spoon. 140 lb Hammer!
		SILT Sdy VF gra br + orangish br mottled 0.7 Becoming ~~Hard~~ stiff. lo low Pl. ML	6.0 ppm		2/9 9/10	RAN: 2.0' REC: 1.0' Loss: 1.0'
	1					
	2	2.2'				Auger to 2.0' 2.0'
		SILT Layering Present Mottled Brown + yellow br. Dry Sdy (Very Lithic) Dry lo Pl. med ML	0.0 ppm		6/6 9/8	RAN 2.0' REC 1.0' Loss 1.0'
	3					
	4	4.0' Becoming mottled + layered Orange br + gr				Auger to 4.0' 4.0'
	5	5.5' mst	4.6 ppm		5/6 7/10	Ran 2.0' Rec 1.8' Loss 0.2'
	6	6.0'				Auger to 6.0' 6.0'
		SILT Br Dry to mst lo Pl. med mL	1.0 ppm		5/13 11/9	Ran 2.0' Rec 2.0' Loss 0.0'
	7					
	8	7.8' Becoming mst to wet				Auger to 8.0' 8.0'
		8.5'			3/3	Ran 2.0'
	9	SILT wet med Gr low ~~med to~~ Pl. ~~GS~~ GS	2.2 ppm		2/3	Rec 2.0' Loss 0.0'
						Auger to 10' 10.0'
	10					

PROJECT AA-2 / Plum Brook Ordnance Works | IT-AA2-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: GW-001

PROJECT: AA2/Plum Brook Ordnance Works | INSPECTOR: G. Buck | SHEET 3 OF 6 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Silt Gr Homogeneous Wet to most low to Med Plast. ML 12.2	Hand 2.0 ppm	Geotech Sample Sample # IT-AA2-BEDGW-001 10'-12' 14:40	3/2 3/4	Ran 2.0' Rec 1.6' Loss 0.4' Auger to 12.0' 12.0'
	11					
	12					
		Silt Clay (30%) Homogeneous Firm Med Gray Damp Med. Pl. ML 13.5'	4.1 ppm		2/2 3/4	Ran 2.0' Rec 1.8' Loss 0.2' Auger to 14.0' 14'
	13					
		Silt Clay (30%) gravel (Shale) Fegra Gray Damp to most Med Pl. 14.0' No gravel Present.			2/3 5/5	Ran 2.0' Rec 1.7' Loss 0.3 Auger to 16.0' 16'
	14					
	15		4.0 ppm			
	16			Geotech Sample Sample # IT-AA2-BEDGW-001-16'-18' (15:00)	3/4 8/10	Ran 2.0' Rec 1.6 Loss 0.4
		17.0'				
	17	Clay Silty Gravel Present (Shale) Gr med to Dense Most to Dmp. 18.8'	3.8 ppm 10.2 ppm		8/50/4 inch	Auger to 18' 18.0' Spoon Refusal at 18.8' limestone in the End of Spoon (1510)
	18					
		Spoon & Auger Refusal				
	19					
	20					

HTRW DRILLING LOG

HOLE NUMBER: IT-AA2-BEDGW-001

PROJECT: Plum Brook Reservoir Wand

INSPECTOR: ED Kanevsky

SHEET 4 OF 6 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	CENTER SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Siltstone				start 1025
		slightly weathered				Finished 1105
		dry				90% recovery
	21	grey				
		soft-to moderately hard				
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					

PROJECT

HOLE NO. IT-AA2-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: IT-AA2-BED GW-001

PROJECT: Pueblo Depot Ordnance

INSPECTOR: ED KANESKY

SHEET 5 OF 6 SHEETS

ELEV. (10)	DEPTH (10)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (10)	GEOTECH SAMPLE OR CORE BOX NO. (10)	ANALYTICAL SAMPLE NO. (10)	REMARKS (10)
		~~siltstone~~ Limestone moderately weathered moderately hard damp				Start 1310 End 1400 100% recovery
	31	gray				
		~~siltstone~~ Limestone moderately weathered moderately hard moist gray				
	32					
	33					
	34	~~siltstone~~ Limestone moderately weathered moderately hard wet gray				
	35					
	36					
	37					
	38					
	39					

PROJECT

HOLE NO. ~~AA~~ IT-AA2-BED GW-001

HTRW DRILLING LOG

HOLE NUMBER: IT-AA2-PEDGW-001

PROJECT: Plumbrook Ordnance Works

INSPECTOR: ED KANERSKY

SHEET 6 OF 6 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	CONTROL SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Siltstone (Limestone?) Slightly weathered moderately hard moist grey				Start 1350 END 1530 100% recovery
	41					
	42					
	43	Limestone slightly weathered moist. grey moderately hard				
	44					
	45					
			BOH @ 45			
	46					
	47					
	48					
	49					

PROJECT

HOLE NO. IT-AA2-PEDGW-001

AA3-BEDGW-001

HTRW DRILLING LOG

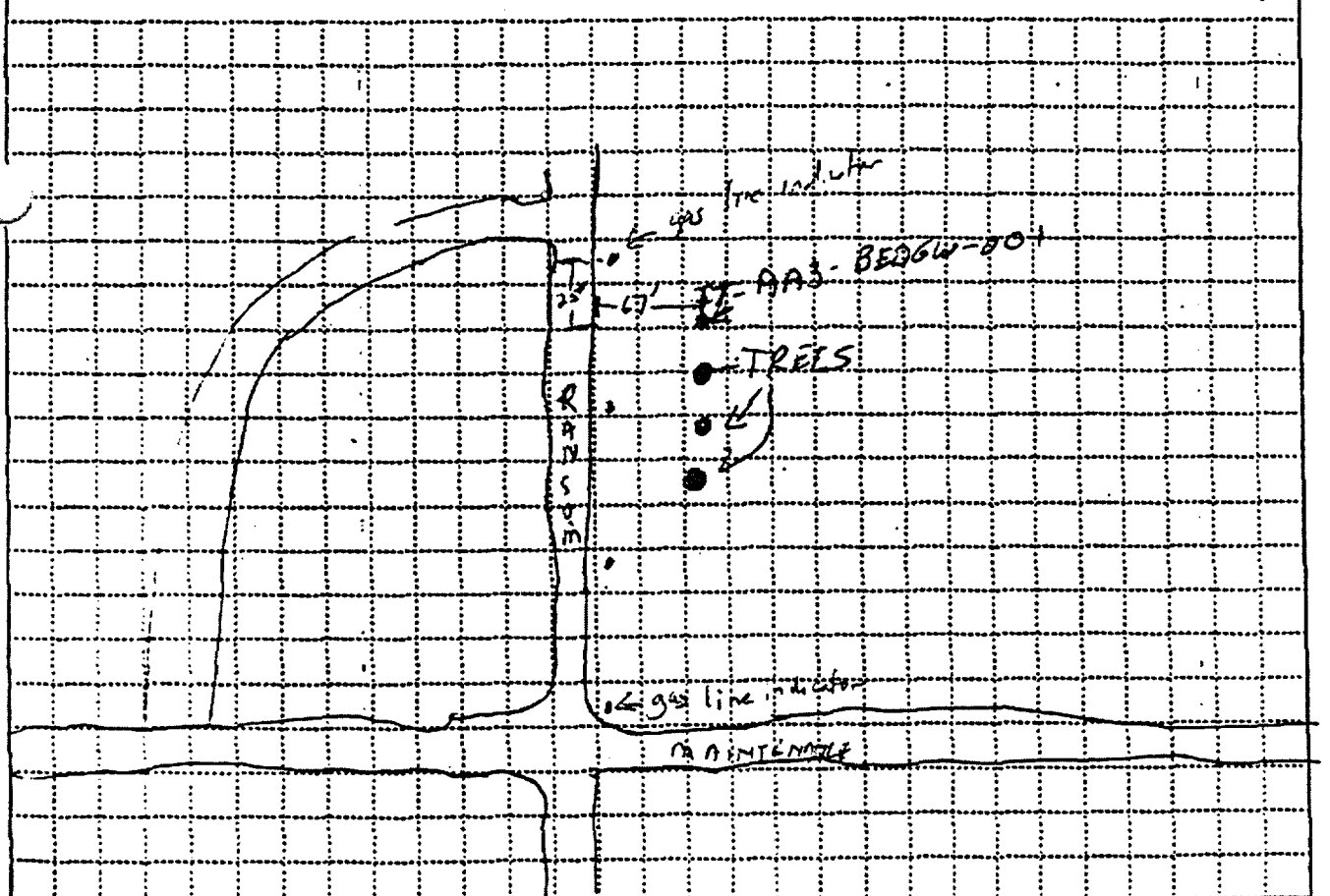
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-AA3-BEDGW-001
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 7
3. PROJECT: AA3 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich D-120 drilling; 12.25" ID HSA 3"x3' Split Spoon Sampler 140 lb hammer; 10" & 6" Roller Cone Bit 3" x 10' Core Barrel	8. HOLE LOCATION: N=625030.61, E=1914957.28 See Sketch	
	9. SURFACE ELEVATION: 634.10 Ft. ~~635.0 (From Top of)~~ DKK	
	10. DATE STARTED: 9/6/97	11. DATE COMPLETED: 10-5-97
12. OVERBURDEN THICKNESS: 25.9'	15. DEPTH GROUNDWATER ENCOUNTERED: 11.0' (Overburden) / w44.0 Bedrock	
13. DEPTH DRILLED INTO ROCK: 28.1	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 20.00 on 10-7-97	
14. TOTAL DEPTH OF HOLE: 54.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	X		1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / Ed Knovsky

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT	HOLE NO.
AA3 / Plum Brook Ordnance Works	IT-AA3-BEDGW-001

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

HOLE NUMBER: GW-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR: G. Buckner

SHEET 2 OF 7 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (USCS)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	634.9	Grassy Surface 0.35'	Hrm		Blow Count	Sample thru 4¼" ID augers using 2" ID split spoon. (0750)
634.0	1	Silt br-dk sl dmp low plasticity ML	PID 26ppm		1/3 3/3	Run 2.0 Rec 1.0 Loss 1.0
						Auger to 2' 2.0
	2					
		2.7'			3/4	Run 2.0
633.3		Gravel (ls) Float wea	PID		2/17	Rec 1.5
631.9	3	dry, wht-gr, sd GW 2.7	12ppm			Loss 0.5
		Cly-Silt (80%) br (orange-sh) + gr sl dmp mottled, low plasticity ML				
	4					Auger to 4' 4.0
	5		PID 14ppm		3/3 3/5	Run 2.0 Rec 1.3 Loss 0.7
		(Cl ~35%) 6.0' Becoming more clayey				Auger to 6'
629.0	6		PID 22ppm		2/2 3/3	Run 2.0 Rec 1.5 Loss 0.5
	7	ML				
		(Cl ~10%) 8.0 Decreasing cl content		8.0 Geotech Sample JAB sample # IT-AA3-BED GW-001 8'-10'		Auger to 8 8.0
627.0	8		PID 8ppm		2/3 3/7	Run 2.0 Rec 2.0 Loss 0.0
624.0	9	ML				
	10			10.0		Auger to 10' 10.0

PROJECT: AA3 / Plum Brook Ordnance Works

HOLE NO.: IT-AA3-BED01-001

HTRW DRILLING LOG

HOLE NUMBER: 6W-001

PROJECT: AA3 \ Plumbrook Ordnance Works

INSPECTOR: G. Buckner

SHEET 3 OF 3 SHEETS 2

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
6[illegible]		Cly-silt (85%) gr, homogeneous mst cl ~15% silt ML 11.0 Saturated	PID 0 ppm		2/3 2/2	Run 2.0 Rec 2.0 Loss 0.0
	11					
	12					Auger to 12' 12.0
			PID 6 ppm		2/3 2/2	Run 2.0 Rec 1.9 Loss 0.1
	13					
	14					Auger to 14' 14.0
620.6		14.5				
		Cly-silt gr, med plasticity clay ~25% soft ML	PID 2 ppm		0/1 2/3	Run 2.0 Rec 1.7 Loss 0.3
	15					
619.1		15.9				
	16	Cly-silt ~cl ~15% sl dmp soft gr, homogeneous ML			NA	Auger to 16' 16.0
						Run 2.0 Rec 0.0 Loss 2.0 missed 2' sample
	17					
	18					Auger to 18' 18.0
			PID 0 ppm		2/2 2/3	Run 2.0 Rec. 2.0 Loss 0.0
	19					
	20					Auger to 20 20.0

PROJECT: AA3 \ Plum Brook Ordnance Works

HOLE NO. IT-AA3-BED6W-001

HTRW DRILLING LOG

HOLE NUMBER: GW 001

PROJECT: PlumBrook Ordnance Works

INSPECTOR: G. Buckner

SHEET: 4 OF 7

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	ANALYTICAL SAMPLE NO.	REMARKS
614.4		Cly-Silt, soft cl ~ 15% gr, homogenous sl dmp 208 V soft	PID 0ppm		1/2 2/2	Run 2.0 Rec. 2.0 Loss 0.0
	21					
	22			W2		Auger to 22' 22.0
612.2		22.8		Geotech Sample ~~SAE~~ 2 sample # IT-AA3-BEDGW-001 22'-24'	2/3 2/10	Run 2.0 Rec 2.0 Loss 0.0
	23	Clay ~(90%) Silt ~(10%) Sl. lt gr, homogenous mod plasticity CL 24.0	PID 2ppm			
611.0	24			24.0		Auger to 24' 24.0
		Clay mod plasticity Very stiff CL sl dmp fine gravels (well rounded) present, s 25.5	PID 6ppm		2/23 26/50/5"	Run 1.9 Rec 1.9 Loss 0.1
604.5		Clay, mod plasticity, v st, sl dmp, gr, fine + coarse gravels present CL 25.9				
604.1	26	Spoon refusal on bedrock				Auger to 26' 26.0 Auger refusal at 26', (0958) - Begin Pulling 4 1/4" ID augers -
		Shale moderately shear bruised soft - to moderately hard damp grey				Continue by ED RAVENSCRAFT

PROJECT: AA3 \ PlumBrook Ordnance Works

HOLE NO.: IT-AA3-BEDGW-001

HTRW DRILLING LOG

PROJECT Plum Brook Ordnance | INSPECTOR ED Lawson | HOLE NUMBER IT-AA3-BEDGW-001 | SHEET 5 OF 7 SHEETS

ELEV. (m)	DEPTH (m)	DESCRIPTION OF MATERIALS (m)	FIELD SCREENING RESULTS (m)	CENTER SAMPLE OR CORE BOX NO. (m)	ANALYTICAL SAMPLE NO. (m)	REMARKS (m)
		SHALE				
		moderately weathered				
		soft- to moderately hard				
	31	GREY				
		damp				
	32					
	33					
		~~siltstone~~ limestone				
		moderately weathered				
		GREY, moderately hard				
	34	moist				
		~~Siltstone~~ Limestone				
		slightly weathered				
	35	soft- to moderately hard				
		GREY				
		dry				
	36					
	37					
	38					
	39					

PROJECT AA3 / Plum Brook Ordnance Works | HOLE NO. IT-AA3-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: II-AA3-BEDGW-001

PROJECT: Plum Brook Ordnance

INSPECTOR: ED RANEWSKY

SHEET 6 OF 6 SHEETS 2

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		~~Siltstone~~ Limestone moderately weathered soft to moderately hard				Start 1530. Finish 1720
	41	GREY dry				100% recovery
	42					
	43					
	44					
		~~Siltstone~~ Limestone slightly-moderately weathered				Start grey5 Finished 1000
	45	soft-moderately hard grey wet				100% recover
	46					
	47					
	48					
	49					

HTRW DRILLING LOG

HOLE NUMBER: IT-AA3-BEDGW-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR: Ed Kawcisky

SHEET 7 OF 7 SHEETS

ELEV. (FT)	DEPTH (FT)	DESCRIPTION OF MATERIALS (FT)	FIELD SCREENING RESULTS (FT)	GEOTECH SAMPLE OR CORE BOX NO. (FT)	ANALYTICAL SAMPLE NO. (FT)	REMARKS (FT)
		Siltstone Limestone moderately weathered ~~too~~ soft to moderately hard Grey wet				
	51					
	52					
	53					
	54	BOH @ 54				
	55					
	56					
	57					
	58					
	59					

PROJECT: AA3 / Plum Brook Ordnance Works

HOLE NO.: IT-AA3-BEDGW-001

ABG-BEDGW-001

HTRW DRILLING LOG

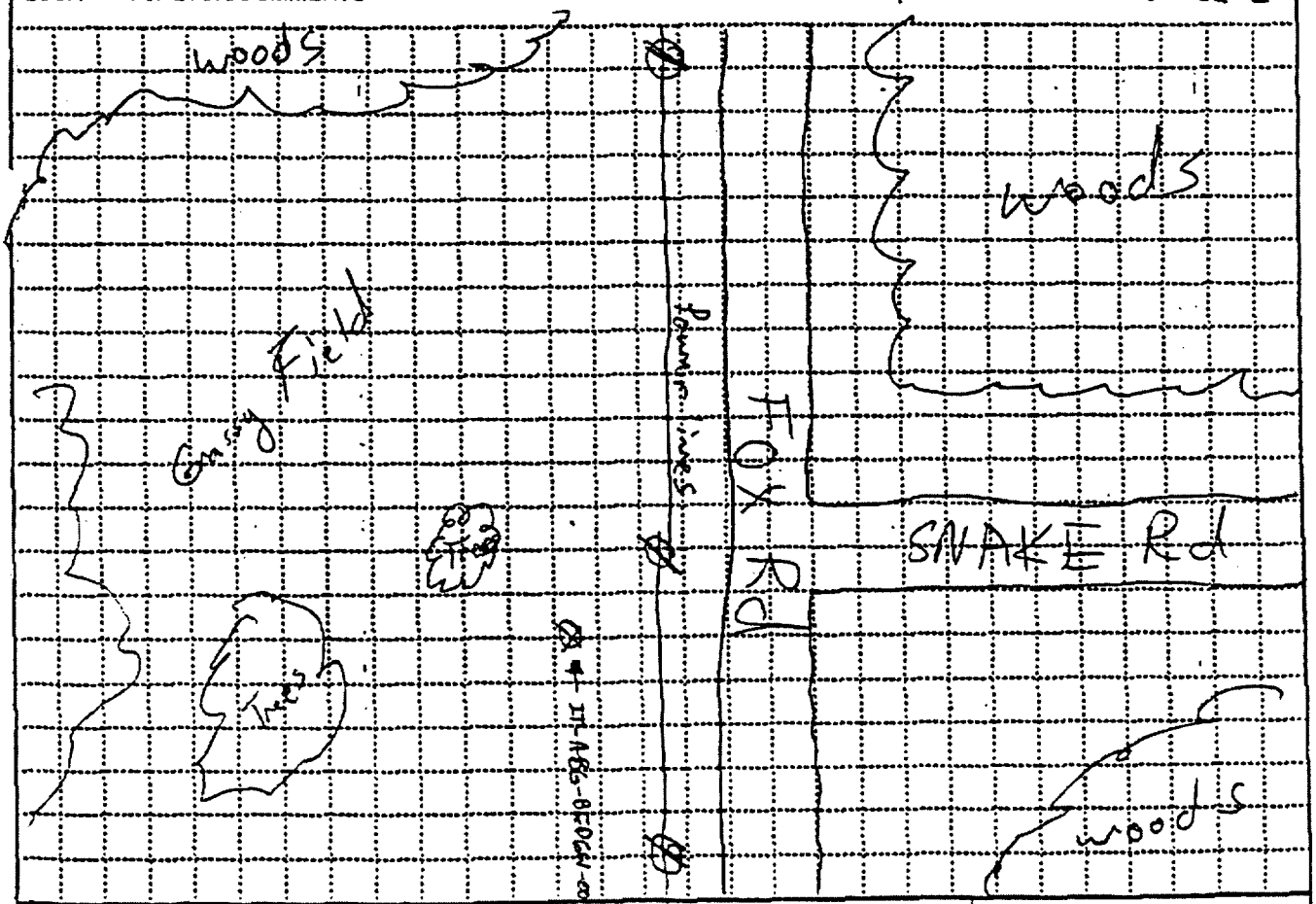
DISTRICT: USACE / Nashville			HOLE NUMBER: IT-ABG-BEDGW-001
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling		SHEET 1 OF SHEETS 4
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio		
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Dierich D-120		
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Dierich D-120 (Drill Rig) 12" ID HSA, 2"x3" SS Spl. + Spoon, 140 Hammer 10" & 6' Roller Cone 6+ 3 x 10' Core Barrel, 425 Ingersoll Rand Air Compressor	8. HOLE LOCATION: N=621579.50 E=1921506.02 See Sketch		
	9. SURFACE ELEVATION: 658.20 Ft. ~~658.00 (From Topo)~~ BLK		
	10. DATE STARTED: 9/4/97	11. DATE COMPLETED: 9/10/97	
12. OVERBURDEN THICKNESS: 6.0'	13. DEPTH GROUNDWATER ENCOUNTERED: 4.2 (Overburden) / 12.5'		
13. DEPTH DRILLED INTO ROCK: 15.5	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 5.51 on 10-4-97		
14. TOTAL DEPTH OF HOLE: 21.5	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA		

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	X		1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / E Kanovsky

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: Plum Brook Ordnance Works | HOLE NO. IT-ABG-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: IT-ABG-BED GW-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET: 2 OF 4

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	PENETRATION RESISTANCE (ft)	REMARKS (ft)
658.0		Grassy Surface 0.2	HNU		Blow counts	Sample thru 4 1/4" ID augers, split spoon 2' x 2".
		SILT Silty Moist Fgra gr (shale) lo			3/5 9/10	
657.0	1	1.0	9.0 ppm			Ran 2.0' Rec 1.8' Loss 0.2'
		SAND VFGra mst well sorted yel Br. lo				
	2	2.5'				Auger to 2'
655.5		Ash silty Bl Fgra Dry 2.4'			6/9 17/20	Ash smells like Burned material.
655.1	3	SAND gr VF gra well sorted mst lo	6.8 ppm	IT-ABG-BEDGW-001 2'-4' (1030)		Ran 2.0' Rec 1.4' loss 0.6'
	4	Saturated ~~at~~ 4.2'				Auger to 4'
	5		5.5 ppm	IT-ABG-BEDGW-001 4'-6' 10:35	6/10 50/4in	Ran 2.0' Rec 0.9' Loss 1.1
652.0	6	Spoon Refusal 6.0'				Auger to 6'
		Shale Fissel (can auger into it) weathered				
651.0	7	Auger Refusal 7.0'				ED KANEVSKY Continued logging
		shale, slightly weathered slightly damp Grey HARD	H2S 0.ppm			Water at 4' Rising Start 1540 End 1805 WL 6' from bottom
	8					
	9					

HTRW DRILLING LOG

HOLE NUMBER IT ABG-BEDCW-001

PROJECT Plumbrook Ordnance Works

INSPECTOR

SHEET 2 OF 3 SHEETS 4

ELEV. (m)	DEPTH (m)	DESCRIPTION OF MATERIALS (m)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (m)	ANALYTICAL SAMPLE NO. (m)	REMARKS (m)
						4'4 - cored W1 - 5' GS
	11					
	12	Shale slightly weathered DAMP Grey Hard	H_2S 0ppm			Start 0745 End 1130
	13	Shale highly weathered wet Gray Hard				
	14					
	15	Shale slightly weathered DAMP Brownish gray Hard				
	16					
	17					
	18					
	19					

HTRW DRILLING LOG

HOLE NUMBER: IT-ABG-BEDGW-001

PROJECT: Plum Brook Ordnance Wks

INSPECTOR:

SHEET 4 OF 4 SHEETS

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	ANALYTICAL SAMPLE NO.	REMARKS
	21					Could't recover 3' of bedrock 70% recovery w/ L-5'
	22	BOH at ~~[illegible]~~ 21.5				
	23					
	24					
	25					

PROJECT: Plum Brook Ordnance Works

HOLE NO. IT-ABG-BEDGW-001

BG8-BEDGW-001

HTRW DRILLING LOG

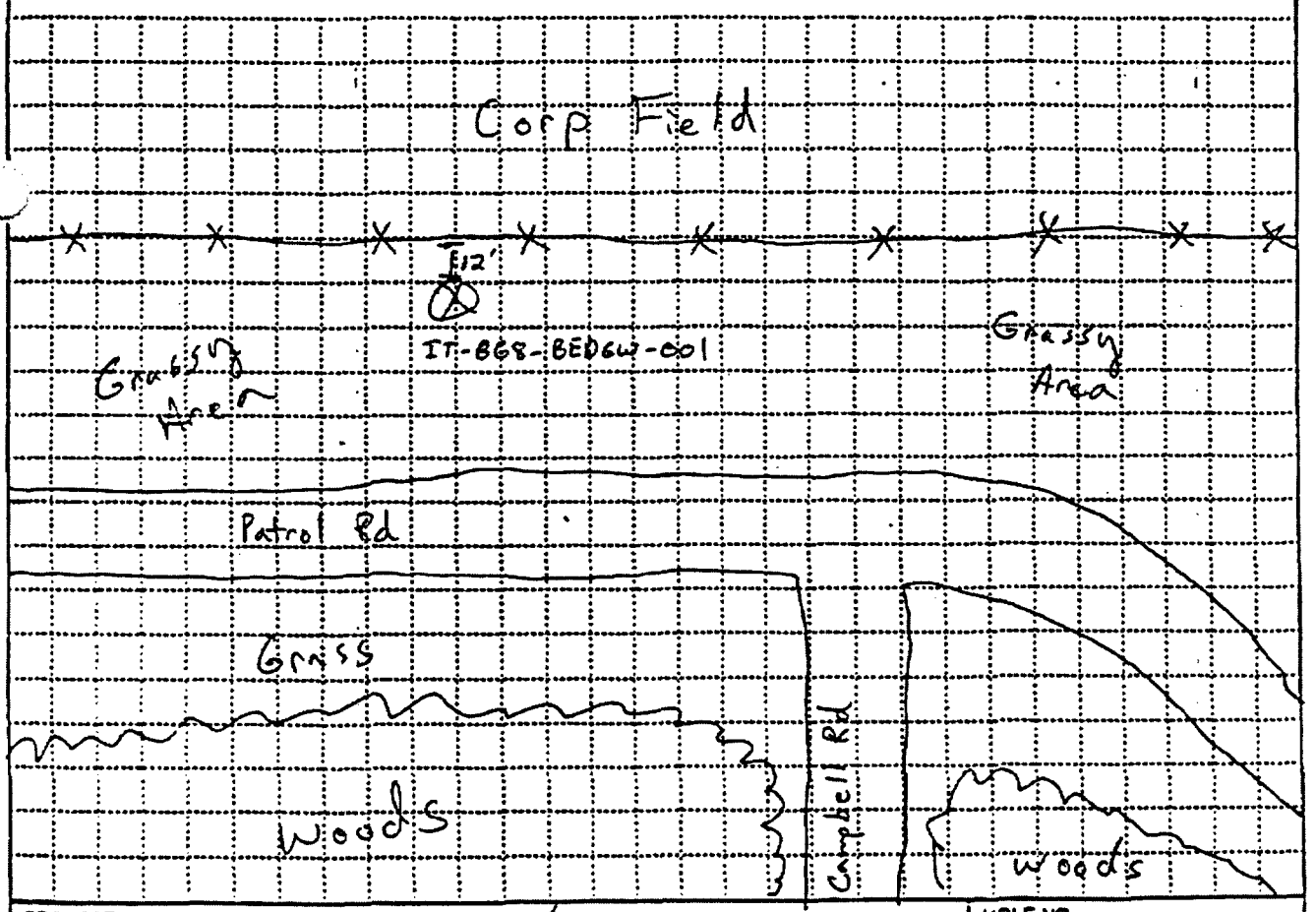
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-BG8-BEDGW-001
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 4 SHEETS
3. PROJECT: BG8 / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diamarich D-120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diamarich D-120 (Drill Rig) 12" ID HSA, 2" x 2" SS Split Spoon, 140 lb Hammer, 1" inch Roller Cone Bit, 3" x 1ft Core Barrel, SSS Ingersoll Rand Air Compressor	8. HOLE LOCATION: N=618635.28, E=1909856.87 See Sketch	
	9. SURFACE ELEVATION: 673.70 ft. ~~690~~ / (From Topo) DKC	
	10. DATE STARTED: 9/4/97	11. DATE COMPLETED: 9/20/97
12. OVERBURDEN THICKNESS: ~~3.5'~~ 3.0'	15. DEPTH GROUNDWATER ENCOUNTERED: 9-10' GS'	
13. DEPTH DRILLED INTO ROCK: 18.0	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 2.5' GS' - 12 hours	
14. TOTAL DEPTH OF HOLE: 21.0	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
1	X		1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
NA						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / [signature]

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: BG8 / Plum Brook Ordnance Works | HOLE NO. IT-BG8-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: MW001

PROJECT: Plum Brook Ordnance Work

INSPECTOR: G. Buckner

SHEET 2 OF 2 SHEETS 4

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	CLINTON SAMPLE OR CORE BOX NO. (ft)	BLOW COUNTS	REMARKS (ft)
690.0		Grassy Surface 0.2'	HNU			Single Thru 4 1/4" ID Augers using 2" ID & split spoon.
		SILT sdy br mst F gra well sorted 1.5'	2.0 ppm	0'-2' IT-868-BEDGW-001 (0930)	2/2 2/5	Run 2.0 Rec 1.0 Lost 1.0
688.5		clay sdy br mst F gra well sorted lean				Auger to 2'
687.0	2		1.0 ppm		4/50/5.5"	
		3.0' Top of Weathered Rock				
	3	Auger Refusal 3.5'				
685.5						CONTINUED BY ED KANEVSKY 9/19/97
	4	Drill thru no core collected				Log from Cuttings because ring barrel geton cored barrel
	5	~~[illegible]~~				~~[illegible]~~ rock is shallow
		Shale w/ ~~Quar~~ mineral intrusions				
	6	according to cuttings				
	7	Shale (siltstone) slightly weathered grey moderately hard moist				Water @ 7'-8' Begin casing
	8					
	9	Shale weathered grey moist				
	10	~~moist~~ Shale sandstone				

PROJECT: Plum Brook Ordnance Works

FILE NO. IT-868- BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: IT-BG8-BEDGW-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR: ES Kanevsky

SHEET 3 OF 3 SHEETS 11

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Slightly weathered grey, ~~[illegible]~~ moderately hard, moist ~~Sample broken~~				5' recovery
	11					50% water table ?
	12	No recovery ~~core~~				coring was very fast
	13					
	14					coring was very fast
	15					
	16					
	17	Shale (siltstone) weathered, moderately hard grey wet				100% recovery
	18					
	19					

HTRW DRILLING LOG

HOLE NUMBER: BE08-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR: Ed Kanicky

SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Shale (siltstone) slightly weathered moderately grey, fresh wet				
	21					
		BOH @ 21'				
	22					

PROJECT

HOLE NO. IT-B08-BEDGW-001

MNTA-BEDGW-001

HTRW DRILLING LOG

DISTRICT	USACE / Nashville
HOLE NUMBER	IT-MNTA-BED GW-001
1. COMPANY NAME	IT Corp
2. DRILL SUBCONTRACTOR	Belasco Drilling
SHEET / SHEETS	1 OF 8
3. PROJECT	MNTA / Plum Brook Ordnance Works
4. LOCATION	Sandusky, Ohio
5. NAME OF DRILLER	Allen Dudley
6. MANUFACTURER'S DESIGNATION OF DRILL	Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	Diedrich D-120 (Drill Rig) 17.25" ID HSA, 2"x2" SS Split Spoon, 140 lb Hammer, 10 inch Rollers Core Bit, 10" x 3" Core barrel, 825 Ingersol Rand Air Compressor
8. HOLE LOCATION	N = 623808.24 E = 918649.38 See Sketch
9. SURFACE ELEVATION	636.05 ft. 629.0 (From Topo) DKK
10. DATE STARTED	9/5/97
11. DATE COMPLETED	9/22/97
12. OVERBURDEN THICKNESS	24.8'
13. DEPTH GROUNDWATER ENCOUNTERED	1 overburden water (7.0') / 55.2'
14. DEPTH DRILLED INTO ROCK	39.0'
15. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	27.77 10-6-97
16. TOTAL DEPTH OF HOLE	65.0'
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

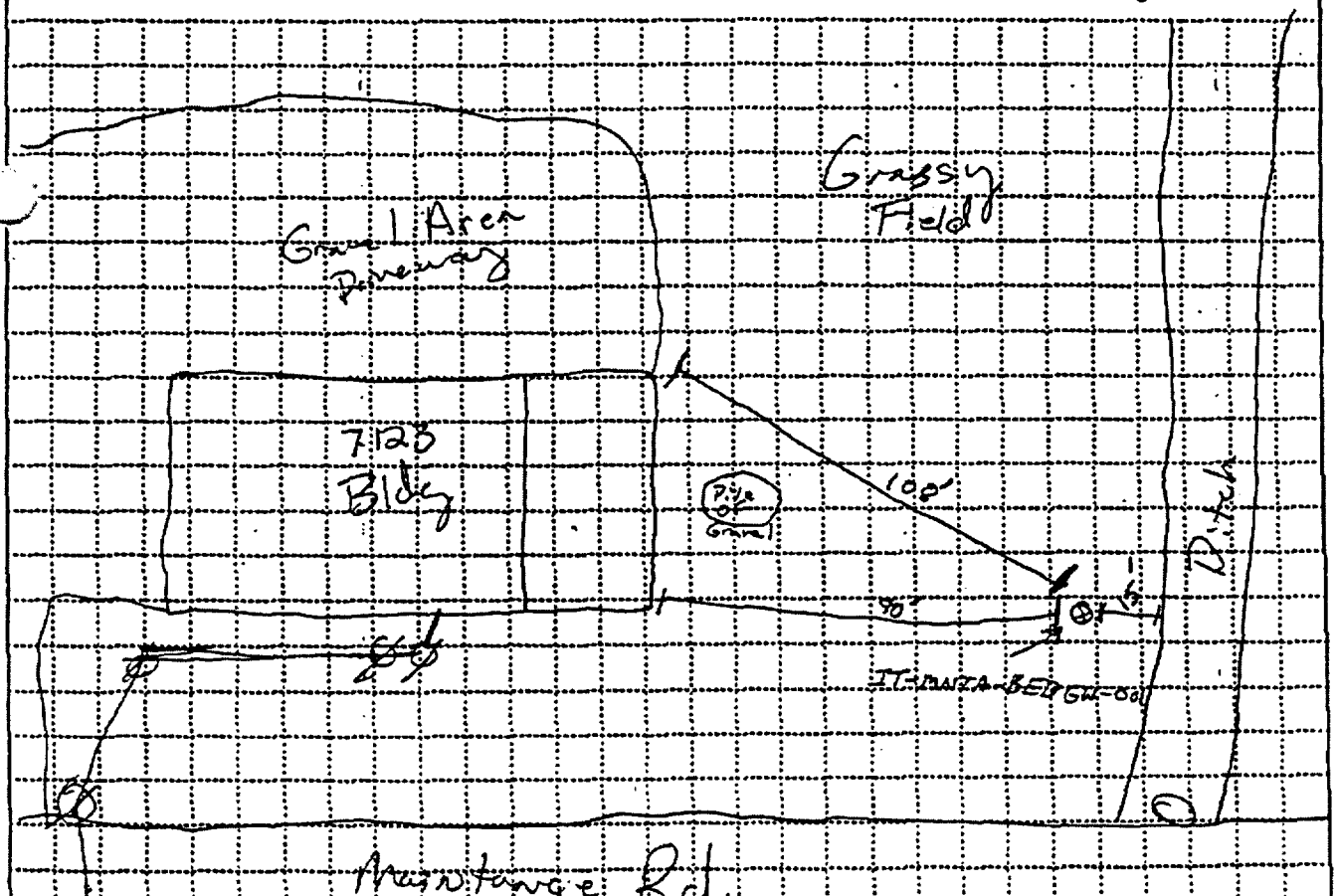
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
2	X		2

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / [signature]

LOCATION SKETCH/COMMENTS

SCALE: Not to Scale



PROJECT	HOLE NO.
MNTA / Plum Brook Ordnance Works	IT-MNTA-BED GW-001

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

IT - MNTA - BEDGW-001

PROJECT: MNTA/Plum Brook Ordnance Works

INSPECTOR: G. Buckner

HOLE NUMBER: BEDGW-001

SHEET 2 OF 8

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	BLOW COUNTS	REMARKS
	629.9	Grassy Surface 0.2'	HNU		Blow count	Sample thru 4 1/4 ID augers using 2" ID SS spoon (08:30)
	1	Silt br (Dark to m st) s+f Humic 0.6' loose 0.7' low pl mL	1.2 ppm		3/5 7/8	Raw 2.0' Rec 0.8' Loss 1.2' Auger to 2'
	2				4/7 9/8	Raw 2.0' Rec 1.4 Loss 0.6 Auger to 4'
	3	3.2'				
	4	Silt s+f br (orange-ish) gry (and mottled) gray low to mod pl mL 4.4'	9.0 ppm			
	5	Silt sdy F gra mst to Dry well sorted mL 5.2'			2/3 5/7	Raw 2.0' Rec 1.2' Loss 0.8' Auger to 6'
	6	Clay s+f Middle to High Pl Tan mottled (Br, Gray + orange-br) Homogeneous CH 6.5' wet 7.0' saturated	6.8 ppm			
	7		9.0 ppm		2/4 4/4	Raw 2.0' Rec 1.6 Loss 0.4 Auger to 8'
	8	8.2' Silt, many F gra, well sorted sdy to saturated. Br mL 8.3' Clay mst fat Br CH 8.8'				
	9	Silt, many F gra, well sorted sdy to saturated. mL 9.9 Clay mst fat Br CH	5.0 ppm		3/4 7/8	Raw 2.0' Rec 1.6' Loss 0.4' Auger to 10'
	10					

HTRW DRILLING LOG

HOLE NUMBER: IT-MNTA-BED GW-001

PROJECT: MNTA / Plum Brook Ordnance Works — INSPECTOR: G. Buckner — SHEET 3 OF 3 (with 8)

ELEV.	DEPTH	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS	GEOTECH SAMPLE OR CORE BOX NO.	BLOW COUNTS	REMARKS
	11	Clay, sig (10%) lean, stf, mst, mottled (Gray, br, orange-ish br). med. pl. CL 11.3'	HNU 2.8 ppm		3/6, 9/10	Raw 2.0', Rec 2.0', Loss 0.0'. Auger to 12'
	12–13	Clay, Fat (CH), mst to wet, Gray, med to high pl., stf., Homogeneous CH 16.4'	6.4 ppm	Geotech sample (0930) Sample # IT-MNTA-BEDGW-001 12'–14'	1/3, 6/6	Raw 2.0', Rec 1.8', Loss 0.2'. Auger to 14'
	14–15		9.0 ppm		1/3, 5/6	Raw 2.0', Rec 1.8', Loss 0.2'. Auger to 16'
	16–17	Clay, Shale fragments Present, Gray, Very stf., mst to wet, Fat CL 18.4'	9.0 ppm		5/7, 10/13	Raw 2.0', Rec 1.6', loss 0.4'. Auger to 18'
	18	18' Dry to moist				
	19	Clay, Shale fragments Present, Gray, Very stf., mst to wet, Fat. 19' stf (CH)	8.2 ppm	Geotech sample (0945) Sample # IT-MNTA-BEDGW-001 13'–20'	2/10, 11/13	09:10. Raw 2.0', Rec 1.7', Loss 0.3'. Auger to 20'
	20					

HTRW DRILLING LOG

HOLE NUMBER: IT-MNTA-BEDGW-001

PROJECT: MNTA/Plum Brook Ordnance Work

INSPECTOR: G. Buckner

SHEET 4 OF 8 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	21	Clay Shale Frag. Present Gray stiff Dry to Moist med to high Plasticity Lean to Fat. CL 21.6'	9.6 ppm		7/14 19/24	Raw 2.0' Rec 2.0' Loss 0.0'
	22	Clay Silty Shale & limestone Frag. Present Lean to Fat Dry to Moist. F. Gra to V F Gra. well Sorted poor Rec. CL	1.8 ppm	GB ~~1/21~~ 9-5-97 ~~24/20~~	17/21 24/20	Auger to 22.0' Raw 2.0' Rec 0.2' Loss 1.8
	24	24.8'			6/12 50/5inch	Auger to 24.0
	25	Shale, weathered Gray Thinly Bedded Dry. spoon Refusal 25.9'	2.2 ppm			Raw 2.0' Rec 1.2 Loss 0.8 Auger to 26.0
	26	Shale weathered Gray Thinly Bedded. Dry.				Because of spoon refusal we will discontinue samples we will try to auger into weathered shale.
	27					
	28	28' Augers are very hard to turn. (4½.w) Bedrock becoming more competent.				
	29					GB ~~We will [illegible]~~ ~~Fresh shale~~ Auger to 30' then weathered (Fissil) Shale. Difficult it is starting to get hard.
	30					

PROJECT: MNTA/Plum Brook Ordnance Works

HOLE NO. IT-MNTA-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: IT-MNTA-BED GW-001

PROJECT: MNTA / Plum Brook Ordnance Works

INSPECTOR: G. Buckner

SHEET 5 OF 8 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Shale Gray Thinly Bedded Dry.				Logged from cuttings (10:50) Begin Pulling 4 1/4 inch Auger. Will Thus Boring with 12 1/4 inch Augers. 11:20 Complete Pulling Augers Begin Boring with 12 1/4. ~~9/A~~ Auger Begin Boring to ~~[illegible]~~ bounce down. Must Begin Complete Bedrock. Auger to 32.6'
	31					
	32	Shaley LIMESTONE DEPTH 31.6' ~~Shale~~ slightly weathered (siltstone) ~~[illegible]~~ moderately hard Grey dry	Start of LIMESTONE			Logging continued by ED RANEVSKY ~~[illegible]~~ start 1610 End 1705
	33					
	34					
	35					* Interpretation of shale to shaley LIMESTONE based upon description of rock, cross-section, and representative rock sample.
	36	Shaley LIMESTONE ~~Shale~~ slightly-moderately weathered (siltstone) moderately hard grey dry				
	37					
	38					
	39					
	40					

HTRW DRILLING LOG

IT-MNTA-BEDGW 001

PROJECT: Plum Brook Ordnance Work

INSPECTOR: E Kanevsky

SHEET 6 of 8

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (no)	ANALYTICAL SAMPLE NO. (no)	REMARKS (%)
		Shaly LIMESTONE				
		~~Shale~~ ?DKK, 11/16/55 slightly weathered (siltstone) Hard				Start 0800 End 1330
		Gray ~~[illegible]~~				
	41	dry				
	42					
	43					
	44	- - - - - - - - - - - -	← ~~Start of LIMESTONE~~ DKL			Start 11:30 9/12/94
						100% recovery
	45					
		- - - - LIMESTONE - - -				
	46	Shaly, slightly DKK weathered, moderately hard				*Interpretation of Shale to Shaly LIMESTONE based upon description of rock, cross-section, and representative rock sample.
		dry				
		w/ some intermixed of quartz (mineral) sandstone				
	47					
	48					
	49					

HTRW DRILLING LOG

HOLE NUMBER: IT-MNTA-BEDGW-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR: E. Kanevsky

SHEET 7 OF 7 SHEETS

ELEV. (m)	DEPTH (m)	DESCRIPTION OF MATERIALS (m)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (m)	ANALYTICAL SAMPLE NO. (m)	REMARKS (m)
		~~Slate~~ Shaley DKK LIMESTONE slightly weathered hard Grey, slightly damp w/ quartz intrusions (mineral) sandstone		H_2S 7 ppm		H_2S - odor from 4 - 10 ppm at wellhead
	51					
	52					
	53	~~Slate~~ Shaley DKK LIMESTONE slightly weathered CANDSTONE hard Grey				
	54	Grey				
		~~w/ quartz intrusion (mineral)~~ ~~Slate~~ DK LIMESTONE slightly weathered ~~Grey~~ Grey, moderately hard slightly damp				
	55	~~Slate~~ DKK LIMESTONE (shaley) slightly weathered / w fossils Grey, moderately hard wet		H_2S 68 ppm		
	56					
	57	Surface of the core covered w/ black H_2S reaction ~~Slate~~ Rotahow ~~Slate~~ Shin on the surface of the core				
	58					
	59					
	60					

PROJECT: P BOW

HOLE NO. IT-MNTA-BEDGW-001

HTRW DRILLING LOG

HOLE NUMBER: IT-MWTA-BEDGW-001

SHEET 8 OF 8

PROJECT: Plum Brook Ordnance Wks

INSPECTOR: E. Karansky

ELEV. (m)	DEPTH (m)	DESCRIPTION OF MATERIALS (m)	FIELD SCREENING RESULTS (m)	SENTRICK SAMPLE OR CORE BOX NO. (m)	ANALYTICAL SAMPLE NO. (m)	REMARKS (m)
		Shelby				
		~~SHALE~~ LIMESTONE				
		slightly weathered (siltstone)				
		grey w/black surfaces				
	61	(H2S reaction), moderately				
		hard				
		wet				
		some fossiles				
	62	strong petroleum				
		odor				
	63					
	64					
		BOH @ 64'				
	65	65' BOH.				
	66					
	67					
	68					
	69					
	70					

PROJECT: PBOW

HOLE NO. IT-MWTA-BEDGW-001

PB-BED-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

SHEET 1 OF 1 SHEETS

1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Balasco Drilling Services, Inc
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSA w/cont. sampling; 6¼" ID HSA, 2' Split Spoons; NX core Equipment, 6" Roller Cone	8. HOLE LOCATION: EPA Road
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-12-94 / 11. DATE COMPLETED: 11-8-94
12. OVERBURDEN THICKNESS: 40.7' BGS	15. DEPTH GROUNDWATER ENCOUNTERED: not encountered until coring commenced
13. DEPTH DRILLED INTO ROCK: 40.7' - 75.5' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 20.41' BTOC 24hrs
14. TOTAL DEPTH OF HOLE: 75.5' BGS, 78.10' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 43.01' 11-16-94

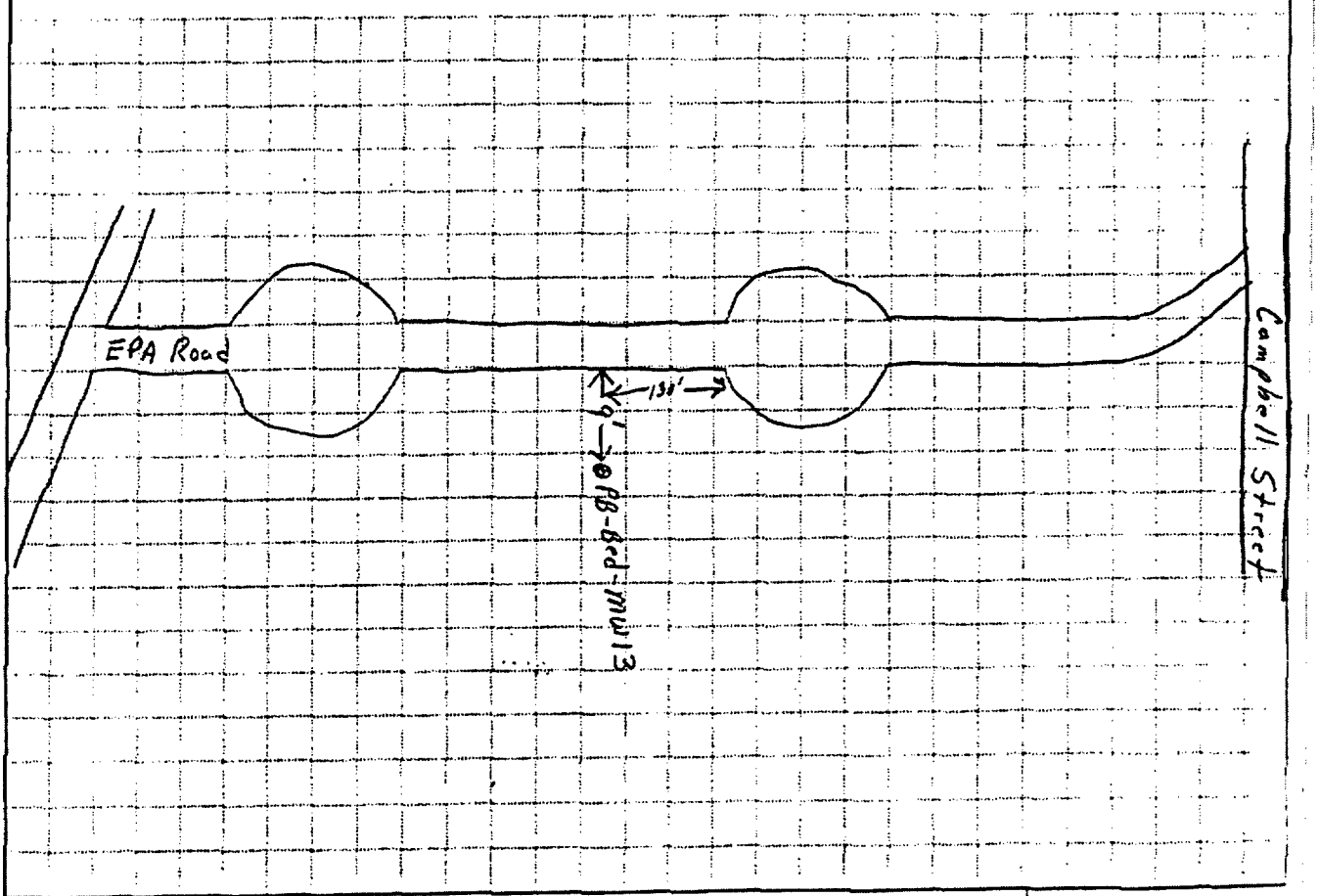
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES: 4
None	---		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 93%
None	-					

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charles Way

LOCATION SKETCH/COMMENTS

SCALE: Not to Scale



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	0	Dark Brown to Brownish Black Silty Fine Sand with organics		3		
				5		
		Yellow Brown to Reddish Brown Fine Sandy Silt to Silty Fine Sand Some root modeling present Dry		6		
				8		24" Recovery
	2			4		
				5		
				5		
		Tanish Brown and Gray Silty Clay moist		6		24" Recovery
	4	Same as above with a couple sand zones less than ½ inch in thickness - dry		3		
				3		
				6		
				7		22" Recovery
	6	Silty Clay Grades mainly Gray - layered in thin sheets		3		
				6		
				9		
				16		24" Recovery
	8	Gray Silty Clay with a 2" Brownish Yellow med sand zone at 9.0'		4		
				9		
				12		
				18		24" Recovery
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	10	Same as above, grading to very highly weathered shale layered and powdery		8		
				12		
				20		
				50/5		20" Recovery
	12			16		
				50/4		10" Recovery
				Straight Auger very Hard		13' Straight Auger, too hard to sample, not hard enough to core
	14					
	16					
	18					
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW 13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	20					Continue straight Augering
	22					
						Very Hard
	24					
	26					
						27' Picking up an odor from Borehole, appears to be due to augers cutting the very hard weathered shale cuttings very hot. HNu = occasionally 3 in Breathing zone. Burnt oil odor
	28					
	30					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	30					Straight Auger
	32					
	34					
	36					
	40					Auger Refusal 40'

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-mw13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 6 OF SHEETS

ELEV. (8)	DEPTH (7)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (9)	ANALYTICAL SAMPLE NO. (9)	REMARKS (9)
		Limestone				Auger Refusal 40.7
	Ti Break	Shale, medium Dark Gray (N4), very thinly laminated, slightly calcareous, with occasional bivalve fossils and very slight amount of pyrite, slight oil odor from shale				Run 1 40.7'-45.8' 250 psi Down pressure Initial core recovery of 14¾" Have to go back in to get remaining core
	Ti Break					
	Ti Break					
	Ti Break					
	42					
	Ti Break			Box 1		
	Ti Break					20 min/5 ft
	43					
	Ti Break					Core 61.5" Rec 61.5"
	44					
	Ti Break					
	45					
	Ti Break					End Run 1 at 45.8'
						Roller Cone
	46	Same as above with numerous bivalves, pyrite more numerous, occasional natural fractures				Begin Run 2 at 46.0' 4" casing set to 46.0'
4.6' Open Break						
	Ti Break					
	47					21 min/9.6 feet
	Ti Break			Box 1		
	Ti Break					Core 115" Rec 96" Lost 19"
	48					
	Ti Break					
	49					
	Ti Break					
	Ti Break					
	50					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-mw13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 7 OF 7 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	50					
		T. Break		Box 1		
	51	Ti Break				
		Grades to pale yellowish Brown (10YR 6/2) and Medium Dark Gray with petroleum odor				
	52	Ti Break Ti Break Spin				
		Ti Break				
	53	Spin		Box 2		
		Spin Broken up due to coring				
	54					
		Ti Break				
	55	Spin				
						End Run 2 at 55.6'
						Begin Run 3 at 55.6'
	56	Ti Break				
		Spin				
	57	Spin				20 min/10 ft
		Spin				H_2S reading 1 ppm after coring
	58	Spin				Hear gurgling sound in borehole
		Ti Break Ti Break				core 120" Rec 117" Lost 3"
	59					
		Ti Break				
		Spin				
	60					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW13

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 9 OF SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	60	Spin		Box 2		
		Ti Break				
	61	Ti Break				
		Ti Break				
	62	Ti Break		Box 3		
		Ti Break				
	63	Ti Break				
		Ti Break				
	64	Ti Break				
		Ti Break				
		Ti Break				
	65					
		Ti Break				End Run 3 at 65.5'
		Grades medium Dark Gray (N4) Spots of oil on Core				Begin Run 4 at 65.5'
	66	Ti Break				Lost approx 6' of core down hole, blocking borehole at 46', cant get it out, will have to roller cone it out with 3 3/4" roller cone next week.
		Ti Break				
	67					
		Ti Break				
	68	Ti Break				11-8-94 Cleared Blockage with roller cone, inserted core barrel, only able to recover 3.3' of remaining core.
		Ti Break				
		Ti Break				
		Ti Break				
	69					Core 120" Rec 75" Lost 45"
		Ti Break				
	70			Box 4		

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW13

PROJECT: Plum Brook Ordnance Works

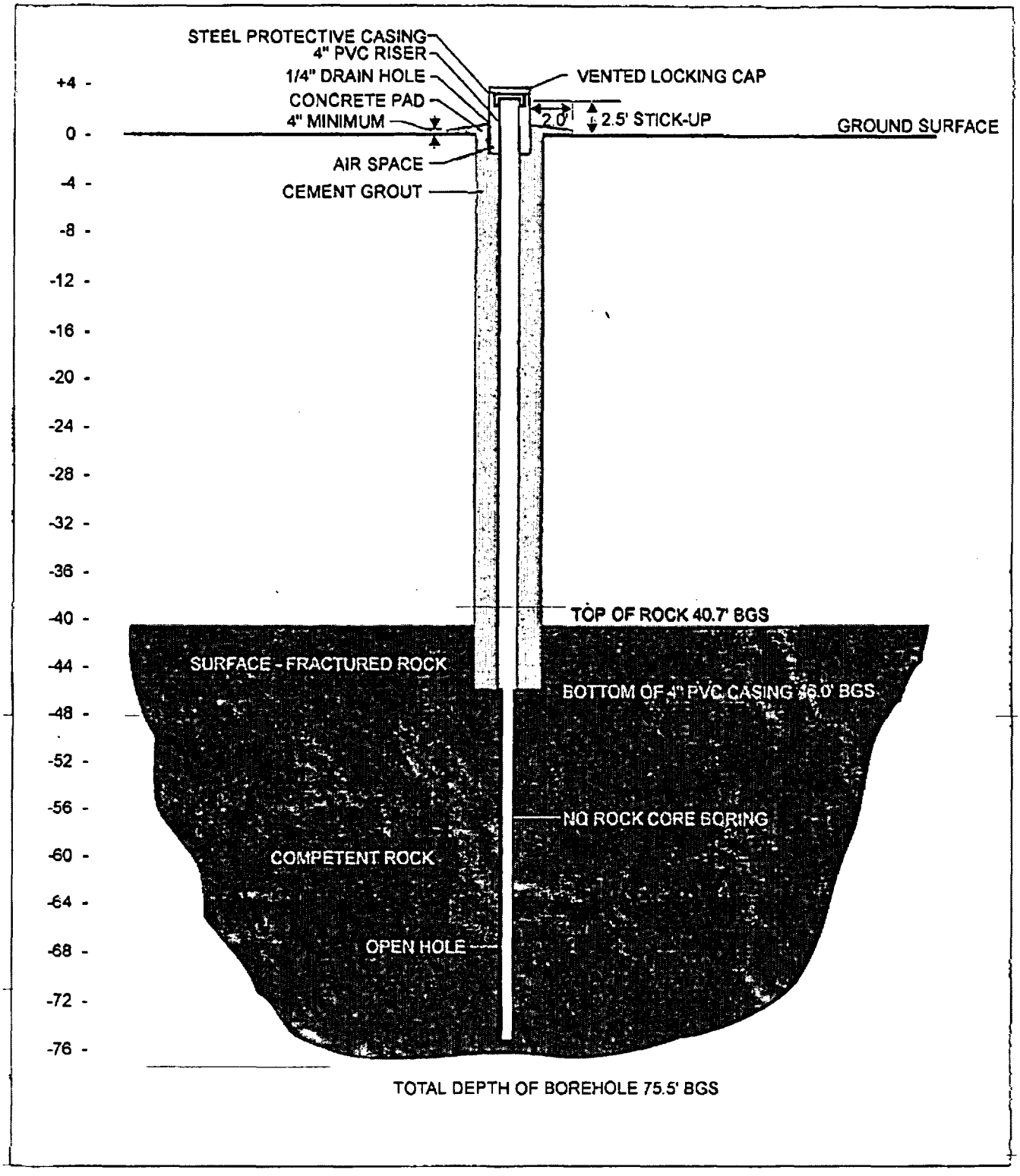
INSPECTOR:

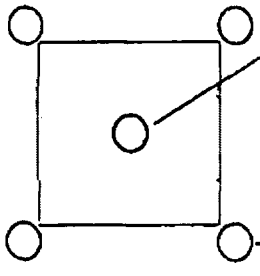
SHEET 9 OF SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (5)	ANALYTICAL SAMPLE NO. (6)	REMARKS (7)
	70	Broken up due to coring				
	71					
	72			Box 4		
	73					
	74					
	75					End Run 4 at 75.5'
	76					Borehole PB-Bed-MW13 Terminated at 75.5' on 11-8-94
	77					
	78					
	79					
	80					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW13





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-13
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW14

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW14

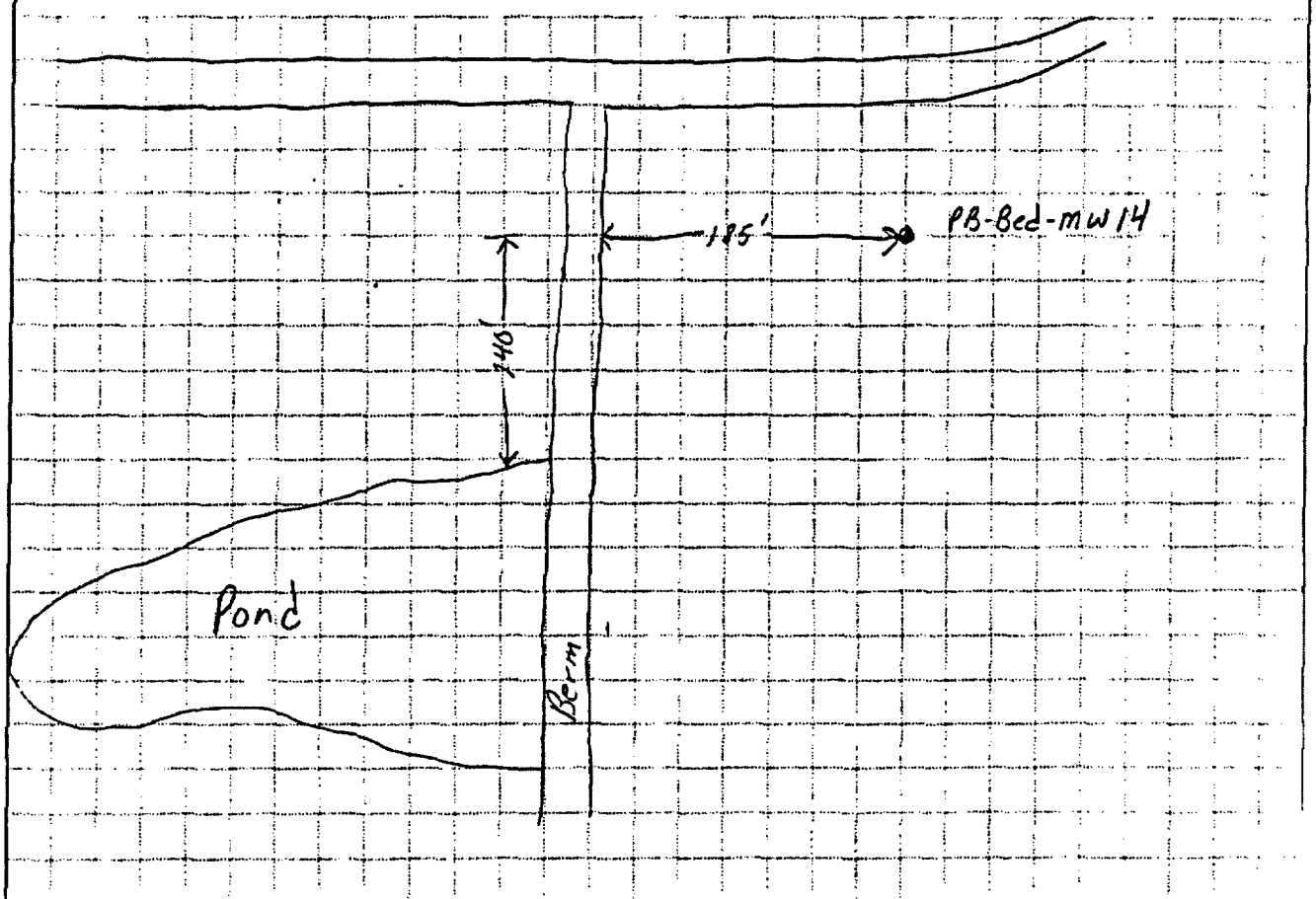
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services
SHEET 1 OF 1 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSA, 2' Split Spoons; 6¼" ID HSA; HQ Core Barrell, 6" Roller cone; NX Core Barrell	8. HOLE LOCATION: West Area Ponds
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-17-94 / 11. DATE COMPLETED: 11-12-94
12. OVERBURDEN THICKNESS: 24.5' BGS	15. DEPTH GROUNDWATER ENCOUNTERED: 18' BGS
13. DEPTH DRILLED INTO ROCK: 24.5' - 49.4' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 24.07' BTOC 48 hrs
14. TOTAL DEPTH OF HOLE: 52.2' BGS, 55.0' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 24.45' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		3

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY) Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 97%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charles Way

LOCATION SKETCH/COMMENTS — SCALE: Not to scale



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW14

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW14

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (D)	DEPTH (E)	DESCRIPTION OF MATERIALS (C)	FIELD SCREENING RESULTS (F)	GEOTECH SAMPLE OR CORE BOX NO. (G)	ANALYTICAL SAMPLE NO. (H)	REMARKS (I)
	0	Dark Brown Silty Fine Sand with roots - Dry	HNu 0	1 2	H	20" Recovery
	1	Grades to Yellow Brown		2 3		
	2	Grades with trace clay-dry	HNu 0	3 5		20" Recovery
	3			7 7		
	4	Brownish Gray + Brownish Orange Clayey Silty Fine Sand dry-horizontal layering	HNu 0	3 4		22" Recovery
	5			6 7		
	6	Grades with 1/4" Brownish Yellow Silty Fine Sand lenses about every 2 inches Dry	HNu 0	2 3		24" Recovery
	7			5 7		
	8	Brown + Brownish Yellow thinly layered silty Fine Sand	HNu 0	3 5		24" Recovery
	9			8 7		
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW14

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW14

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (10)	DEPTH (20)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (10)	GEOTECH SAMPLE OR CORE BOX NO. (10)	ANALYTICAL SAMPLE NO. (10)	REMARKS (10)
	10		HNu	3		24" Recovery
		Gray Clayey Silt - moist	0	3		
	11			3		
				4		
	12	Gray Silty Clay - moist		2		24" Recovery
				3		
	13			4		
				4		
	14	Same as above		2		24" Recovery
				2		
	15			3		
				3		
	16	Gray Fat Clay - moist		1		24" Recovery
				1		
	17			2		
				2		
	18	Same as above moist to wet		wt of Hammer		24" Recovery
				1		
	19			1		
				1		
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW14

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW14

PROJECT: Plum Brook Ordnance Works

INSPECTOR: Charles Way

SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	20	Same as above with fragments of weathered shale moist to wet	HNu 0	wt of Hammer 1 1 1		24" Recovery
	21					
	22	Same as above with lots of weathered shale	HNu 0	2 5 7 50/0		10" Recovery
	23					
	24					Auger Refusal at 24.5'
	25	Limestone, medium Dark Gray (N4) fine to medium crystalline, strong, fresh with occasional bivalve fossils				Begin Run 1 at 24.5' HQ Core Barrel
	26			Box 1		All breaks appear to be breaks from coring process Core 60" Rec 57" Lost 3"
	27					
	28					
	29					Set 4" casing to 29.0' End Run 1 at 29.3'
	30	Limestone, medium Dark Gray (N4), strong, fresh intermixed with zones of limy shale, Dark Gray (N3), weak, fresh to slightly weathered at open breaks, occasional fossils		Box 2		Begin Run 2 at 29.3' on 11-12-94 with NQ core barrell and clear water

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW14

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW14

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	30	Ti Break				
		Ti Break — Limy shale zone 30.4 to 31.6				
		Ti Break				
	31	Ti Break				Core 60" Rec 54" Lost 6"
		Ti Break				
		Ti Break				
	32	Open Break — Limy shale zone 32.1 to 32.5				23 min/5 ft Lost about 30 gals at open breaks
		Open Break				
	33	Ti Break — Limy shale zone 33.0-33.1				
	34			Box 2		End Run 2 at 34.3'
		Grades to Fossiliferous limestone, light Brownish Gray (5YR 6/1), finely crystalline, strong, fresh, with stylolitic surfaces, very slight petroleum odor				Begin Run 3 at 34.3'
	35	45° open Break				
						Core 112" Rec 112"
	36					35 min/9.3'
		Ti Break				
	37					
	38					
	39	Open Break				
	40					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW14

HTRW DRILLING LOG

HOLE NO. PB-Bed-MW14

PROJECT: Plum Brook Ordnance Works

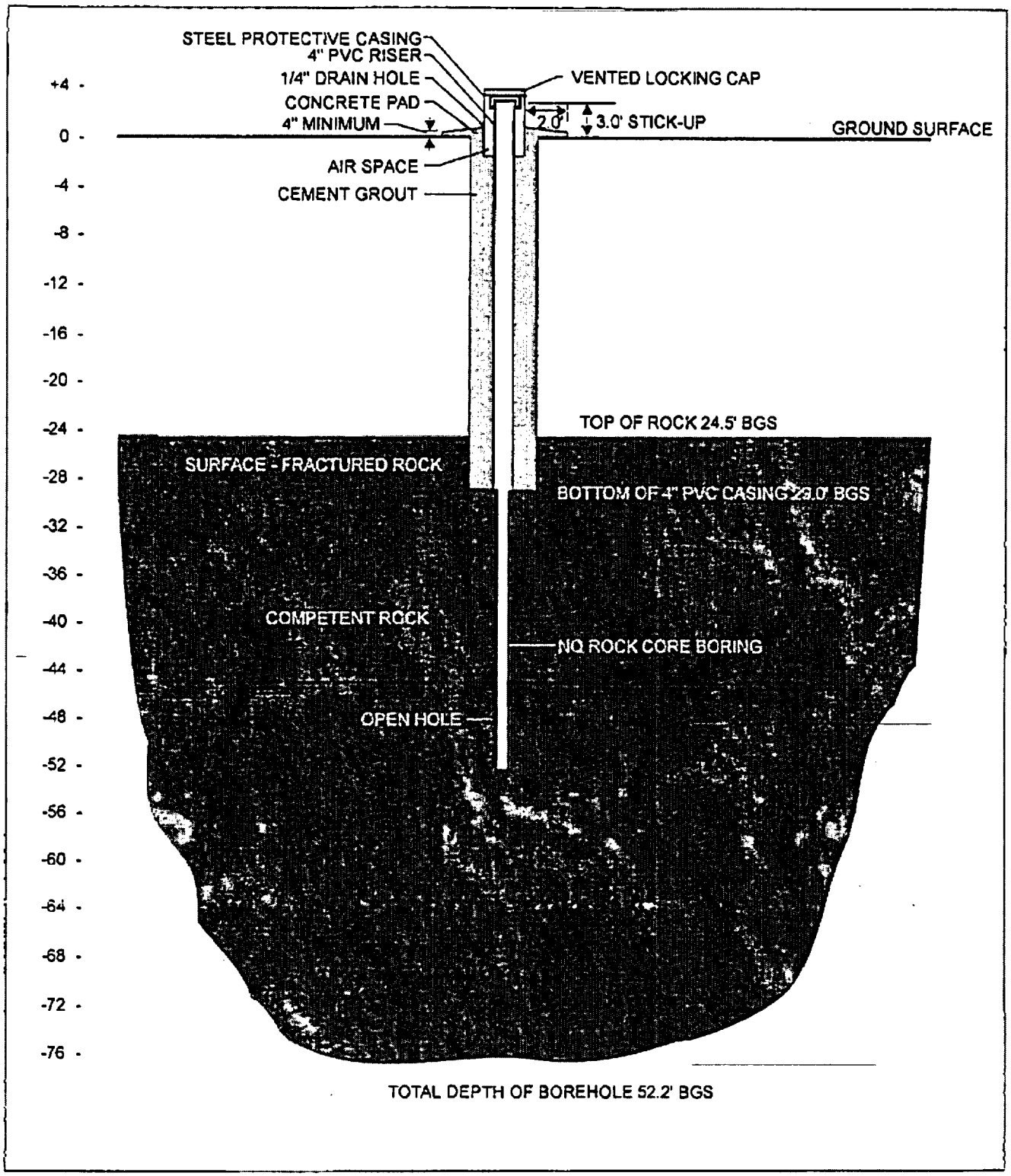
INSPECTOR:

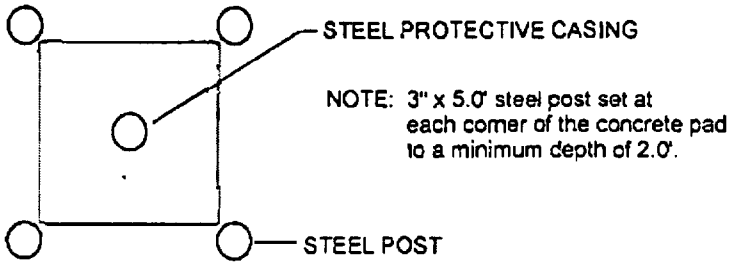
SHEET 6 OF 6 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	40					
		Ti Break				
	41					
	42			Box 2		
		Ti Break				
	43					End Run 3 at 43.6'
						Begin Run 4 at 43.6'
	44	Begin vertical, partially rehealed fracture				
	45					Core 70" Rec 70"
		End vertical, partially rehealed fracture				17 min / 5.7'
	46	Open Break		Box 3		
	47	Ti Break				
		Begin vertical, partially rehealed fracture				
	48					
		Ti Break - small oil sheen				
	49					End Run 4 at 49.4'
		Add 25' screen, remainder riser 2.75' stickup				Boring terminated at 49.4' on 11-12-94
	50					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW14





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-14
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW15

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW15

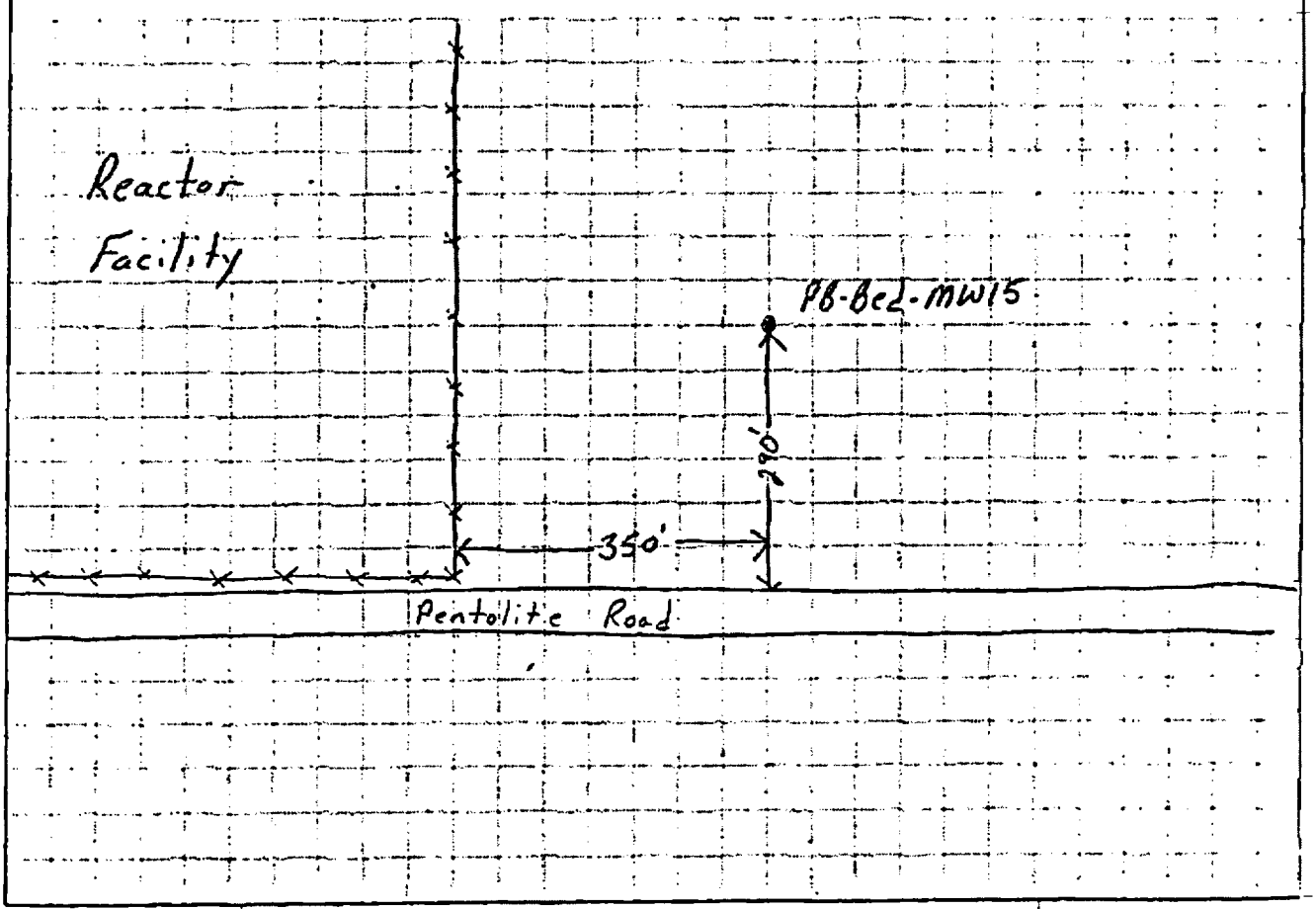
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services
SHEET 1 OF 1 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSAs, 6¼" ID HSAs; HQ Core Equipment; NX Core Equipment, 6" Roller Cone; 2' Split Spoons	8. HOLE LOCATION: Pentolite Road Ponds
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-18-94 / 11. DATE COMPLETED: 11-11-94
12. OVERBURDEN THICKNESS: 24.3' BGS	15. DEPTH GROUNDWATER ENCOUNTERED: 10.0' BGS
13. DEPTH DRILLED INTO ROCK: 24.3 - 74.4' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 25.89' BTOC 48 hrs
14. TOTAL DEPTH OF HOLE: 74.4' BGS, 77.0' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 37.41' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		4

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	-					99%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
-		X		Charles Way

LOCATION SKETCH/COMMENTS SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW15

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW15

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
		Brown + Grayish Brown Silty Fine Sand - Dry		3		20" Recovery
			HNu	4		
	1		0			
				7		
				6		
	2	Grades with Brownish Yellow - Dry		6		24" Recovery
			HNu			
			0	6		
	3			7		
				7		
	4			5		24" Recovery
			HNu			
		Gray + Brown Clayey Silt with small amount of fine	0	7		
	5	Sand - Dry		10		
				9		
	6			4		24" Recovery
			HNu			
			0	5		
	7	Gray Silty Clay - moist		5		
				7		
	8			2		24" Recovery
			HNu			
			0	3		
	9			4		
		Gray Clayey Silt - moist		6		
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW15

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW15

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (4)	DEPTH (5)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	10	Same as above moist to wet	HNu 0	3		24" Recovery
				2		
	11			3		
				4		
	12	Same as above moist to wet	HNu 0	1		24" Recovery
				2		
	13			2		
				4		
	14	Gray Silty Clay with fragments of weathered shale-moist	HNu 0	1		24" Recovery
				2		
	15			2		
				4		
	16	Same as above moist	HNu 0	1		20" Recovery
				2		
	17			3		
				4		
	18	Same as above few more shale fragments Becomes dryer	HNu 0	1		22" Recovery
				2		
	19			5		
				8		
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW15

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW15

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 4 OF 4 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	20	Same as above	HNu 0	4		24" Recovery
				7		
	21			7		
				13		
	22	Same as above, with larger shale fragments dryer	HNu 0	5		10" Recovery
				7		
	23			12		
				50/6		
	24					Auger Refusal at 24.3'
		Limestone, medium Dark Gray (N4), fine to medium crystalline, strong, Fresh with occasional bivalves				Begin Run 1 at 24.3'
	25		Rec	RQD		
			78.5/86	78.5/86		Core 86" Rec 78.5" Lost 7.5"
		Void 25.5'-26.0'				
	26			Box 1		
	27					
	28					
	29					
	30					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW15

HTRW DRILLING LOG

PB-Bed-MW15

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF SHEETS

ELEV. (8)	DEPTH (2)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (5)	ANALYTICAL SAMPLE NO. (6)	REMARKS (7)
	30					set and grouted 4" casing to 31.5'
	31					Left .2' in Btm hole End Run 1 at 31.5'
						Roller Cone
	32	~~Fossiliferous~~ Limestone, medium Dark Gray (N4), Fine to medium crystalline, strong, fresh, with occasional stylolite surfaces and bivalve fossil spin Slight Petroleum odor	Rec / Core	74" / Core		Begin Run 2 at 31.7 using 12'3" NQ core barrell and clear water 11-10-94
	33					
		Ti Break				Core 93" Rec 91" Lost 2"
	34	Ti Break	91" / 93"	91" / 93		
	35			Box 2		27min/7.7ft
	36	Ti Break				
	37					
		Ti Break				
	38					
	39	Ti Break, black staining at stylolite				End Run 2 at 39.4' Begin Run 3 at 39.4' 11-11-94
	40					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW15

HTRW DRILLING LOG

HOLE NO. PB-Bed-MW15

PROJECT Plum Brook Ordnance Works

INSPECTOR

SHEET 6 OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	40					
	41					
	42					
		Ti Break at stylolite, black stain				Core 120"
						Rec 122"
	43			Box 2		Gain 2"
	44					
		Ti Break				34min/10ft
	45	Open Break at shale seam				
	46	Ti Break at stylolite, black stain				
	47					
		Open Break - clay seam ½"				
	48			Box 3		
	49					End Run 3 at 49.4'
						Begin Run 4 at 49.4'
	50					

PROJECT Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW15

HTRW DRILLING LOG

HOLE NO. PB-Bed-MW15

PROJECT Plum Brook Ordnance Works

INSPECTOR

SHEET 7 OF 7 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	50					
	51					
		Ti Break				
	52					
						Core 120"
	53					Rec 120"
				Box 3		
	54					41 min/10 ft
		Ti Break				
		Ti Break				
	55					
		Ti Break				
	56					
	57					
	58					
	59					
						End Run 4 at 59.4'
						Begin Run 5 at 59.4'
		Partial rehealed vertical fracture begins				
	60					

PROJECT Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW15

HTRW DRILLING LOG

HOLE NO. PB-Bed-MW15

PROJECT Plum Brook Ordnance Works

INSPECTOR

SHEET 8 OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	60					
				Box 3		almost entire run had partial rehealed vertical fracture which seperated when rock was broken to fit in core box
	61					
	62					Core 120" Rec 120
	63					
	64	Ti Break				39 min/10 ft
				Box 4		
	65					
	66					
	67	Partial rehealed vertical fracture ends				
	68					
	69					End Run 5 at 69.4'
						Begin Run 6 at 69.4'
	70					

PROJECT Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW15

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW15

PROJECT: Plum Brook Ordnance Works

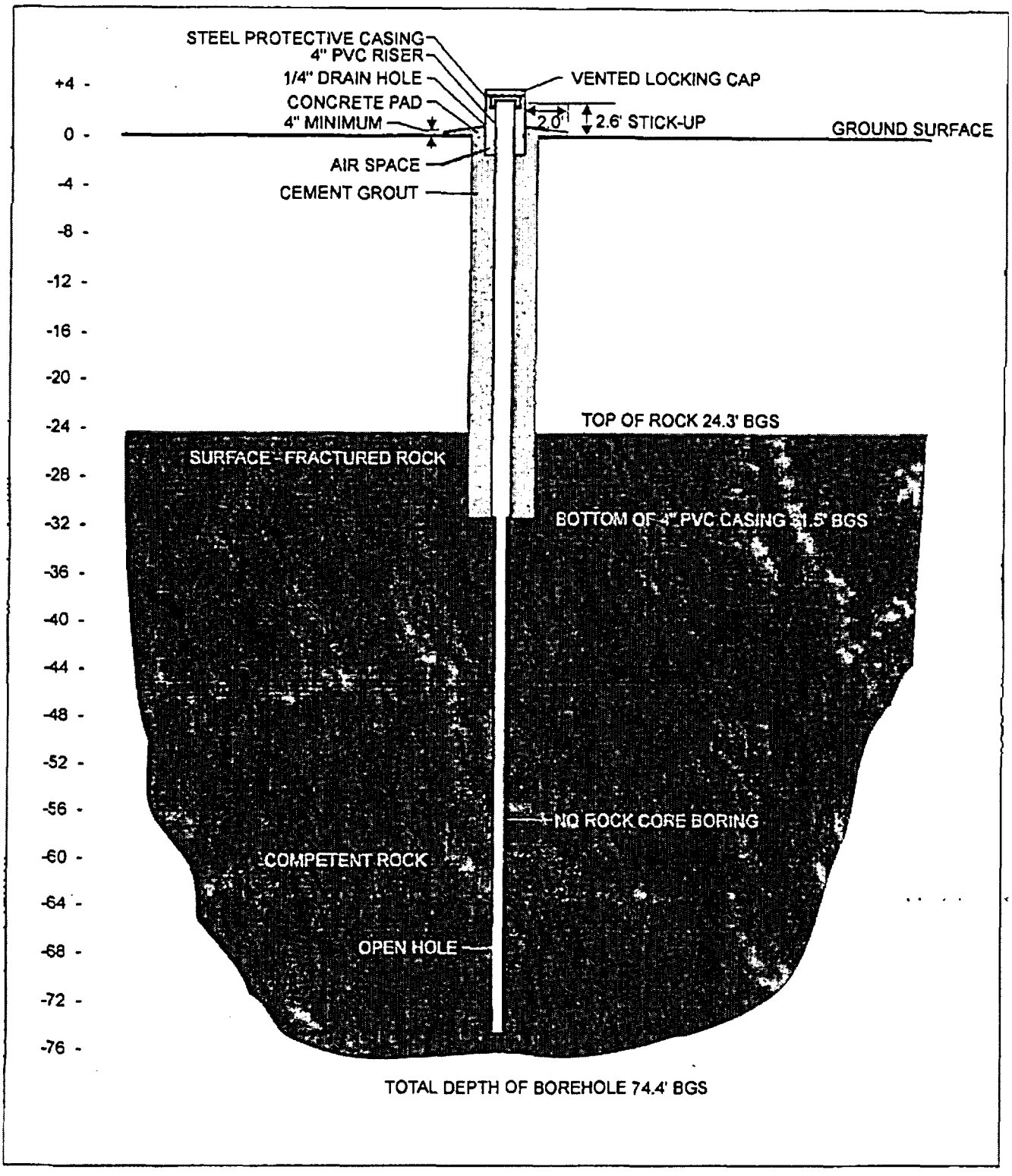
INSPECTOR:

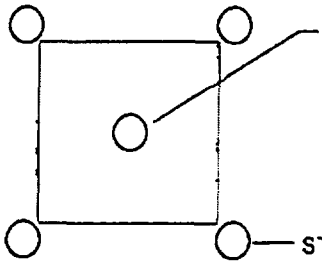
SHEET 9 OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	70					No Breaks
	71					Core 60" Rec 59" Lost 1"
				Box 4		
	72					25 min/5 ft
	73					
	74					End Run 6 at 74.4'
						Boring terminated at 74.4' on 11-11-94
	75					
	76					
	77					
	78					
	79					
	80					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW15





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-15
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW16

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW16

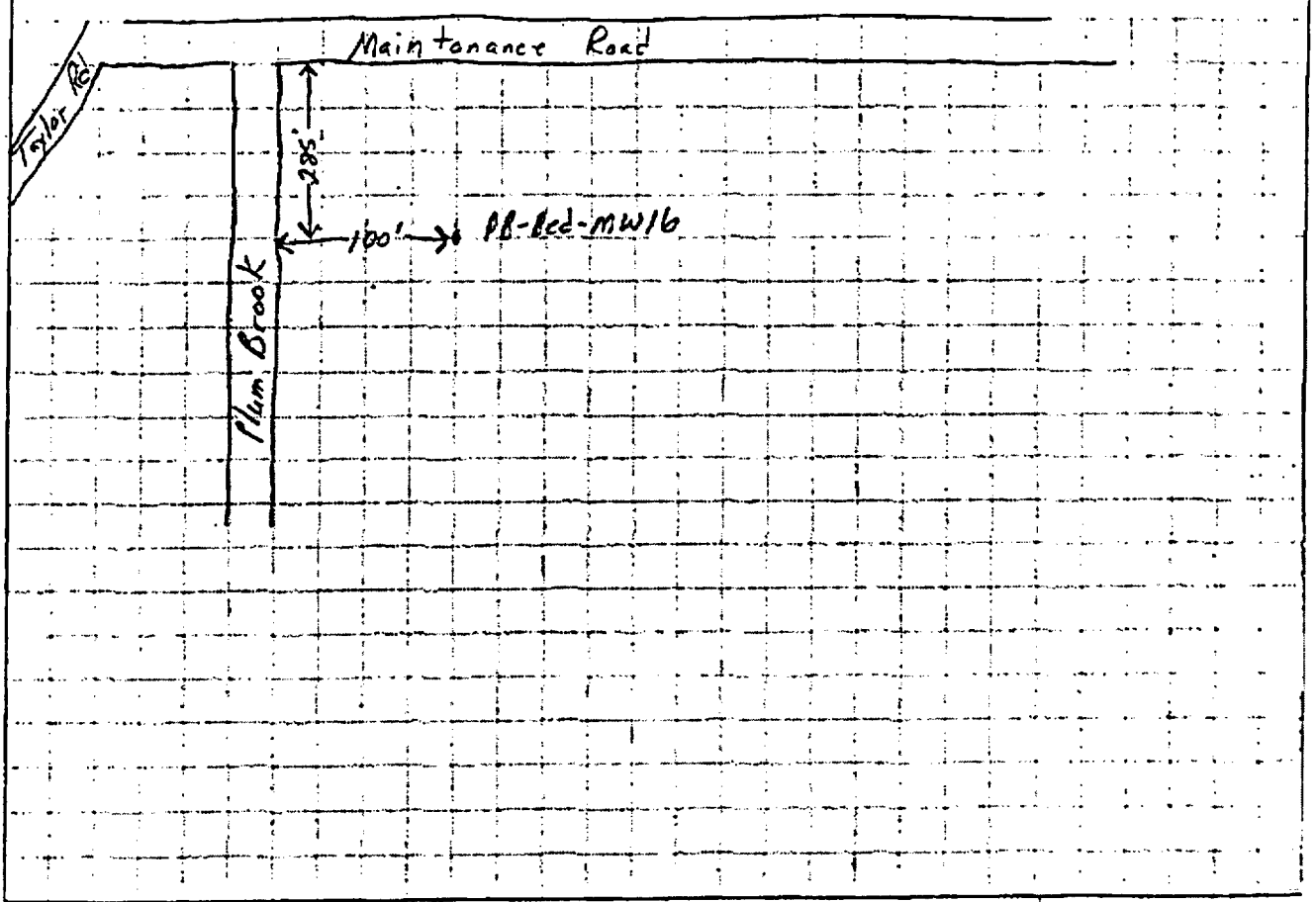
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services
SHEET — OF 1 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSA, 6¼" ID HSA; 6" Roller Cone; NX Core Equipment, 2' Split Spoons	8. HOLE LOCATION: Toluene Tanks
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-15-94 / 11. DATE COMPLETED: 10-30-94
12. OVERBURDEN THICKNESS: 44.2' BGS	15. DEPTH GROUNDWATER ENCOUNTERED: not encountered until coring commenced
13. DEPTH DRILLED INTO ROCK: 44.2' – 74.0' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 45.45' BTOC 15 hrs
14. TOTAL DEPTH OF HOLE: 74.0' BGS, 76.5' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 64.64' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		3

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 93%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charles Way

LOCATION SKETCH/COMMENTS — SCALE?



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW16

HTRW DRILLING LOG

PB-Bed-MW-16

PROJECT: Plum Brook Ordnance Works | INSPECTOR: | SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	0	Grayish Black + Brown Silty Fine sand with organics Dry		2		24" Recovery
			HNu 0	4		
				12		
				12		
	2			5		20" Recovery
			HNu 0	6		
		Mottled Brown + Gray Clayey Silt with roots - Dry		6		
				7		
	4		HNu 0	4		20" Recovery
				8		
				8		
		Grades to Mottled Brown + Gray Silty Clay - Dry		12		
	6		HNu 0	4		24" Recovery
		Mottled Grayish Brown + Brownish Yellow Silty Fine Sand		7		
				12		
				15		
	8		HNu 0	5		24" Recovery
		Gray Clayey Silt - Dry		6		
		Mottled Brownish Gray + Brownish Red (Iron Staining) Silty Fine Sand - Dry		9		
				12		
	10					

PROJECT: Plum Brook Ordnance Works | HOLE NO. PB-Bed-MW16

HTRW DRILLING LOG

HOLE NUMBER: PB-B-1-MW16

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	10	Gray + Brownish Yellow Silty Clay + Clayey Silt, moist in clayey zones, dry in silty zones	HNu 0	3 6 8 17		24" Recovery
	12	Gray Highly weathered, horizontally layered shale Dry-powdery	HNu 0	25 50/4		10" Recovery
	14	Same as above	HNu 0	27 50/4		10" Recovery Straight Auger from 15'
	16					
	18					
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW16

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW-16

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 4 OF SHEETS

ELEV. (3)	DEPTH (4)	DESCRIPTION OF MATERIALS (5)	FIELD SCREENING RESULTS (6)	GEOTECH SAMPLE OR CORE BOX NO. (7)	ANALYTICAL SAMPLE NO. (8)	REMARKS (9)
	20	Same as above, Gray highly weathered shale				Hard augering
	22					
	24					
	26					
	28					
	30					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW16

HTRW DRILLING LOG

PB-Bed-MW-16

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	30	Gray highly weathered shale				
	31					
	32					
	33					
	34					
	35					
	36					
	37					
	38					
	39					
	40					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW16

HTRW DRILLING LOG

PB-Bed-MW16

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 6 OF SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	40	Gray highly weathered Shale				Hard Augering
	41					
	42					
	43					
	44					Refusal at 44.2'
		Shaley Limestone, medium Dark Gray (N4) to Dark Gray (N3), finely crystalline, strong, Fresh with occasional fossils & pyritized fossils	core/rec	74"/rec		Run 1 44.2' with NX core barrel on 10-15-94
	45		36.5/60	36.5/60		Other two feet Left in hole, core catcher wont grab core
	46	Ti Break				
				Box 1		core 60" Rec 36.5" Lost 23.5"
	47					
	48					
	49					4" Casing set at 49.2' End Run 1 at 49.2'
						Begin Run 2 at 49.2' with NX core barrell on 10-30-94
		Ti Break				
	50					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW16

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW16

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 7 OF 7 SHEETS

ELEV. (1)	DEPTH (2)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (5)	ANALYTICAL SAMPLE NO. (6)	REMARKS (7)
	50	Fossiliferous Limestone, medium Dark Gray (N4) to Dark Gray (N3), finely crystalline fresh, strong with pyrite deposition at 51.8'				
	Ti Break					
	51		76/78	59/78		19min/6.5 ft
		Ti Break				
	52					Natural fractures at 50.3, 51.85, 52.4, 53.6 54.4, 54.6 and 55.4
		Ti Break				
				Box 1		
	53					Core 78" Rec 76" Lost 2"
		At 53.3 becomes slightly weathered to Light Brownish Gray (5YR 6/1) with numerous fossils				
	Ti Break					
	54					
		Ti Break				
		Ti Break				
	55					
		Ti Break				End Run 2 at 55.5'
		Same as above, with stylolites, petroleum smell + discoloration small amount of oil on rock core				Begin Run 3 at 55.5
	56					
		Ti Break	104/120	104/120		HNu reading 16 ppm off rock core
	57					
				Box 2		natural fractures at 56.6', 59.2', 61.2', 61.6, 63.0 and 64.1
	58					Left 16" in hole pick it up next run
	59	Ti Break				Core 120" Rec 104" Lost 16"
	60					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW16

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW16

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 8 OF 8 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	60					
	61	T: Break				
		T: Break				
	62			Box 2		
	63	T: Break				
	64	T: Break				
	65	T: Break T: Break				End Run 3 at 65.5' Begin Run 4 at 65.5
	66	Same as above, with large calcite concretions from 68.2-68.8 T: Break		Box 3		
	67					
	68					
	69					
	70	T: Break				

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW16

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW16

PROJECT: Plum Brook Ordnance Works

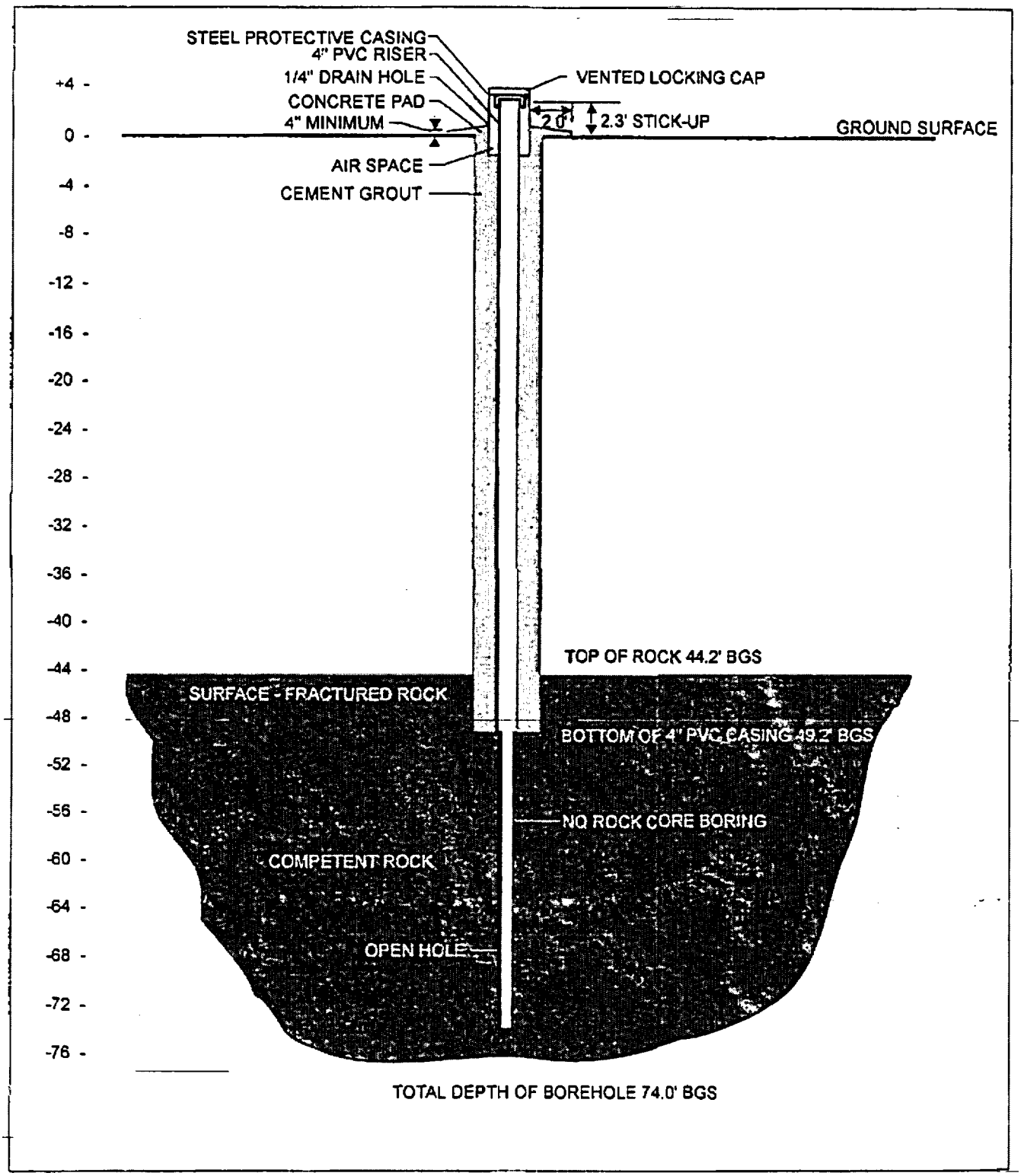
INSPECTOR:

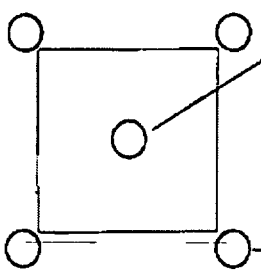
SHEET 9 OF 9 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (6)	FIELD SCREENING RESULTS (7)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (9)	REMARKS (10)
	70					
	71		117.5 / 102	106 / 102		picked up 16" from previous run
		Ti Break				natural fractures at 65.1, 65.2, 65.3, 66.75, 70.0, 71.45, 73.0 and 73.6
	72			Box 3		
						Core 102"
						Rec 117.5"
	73	Ti Break				Gain 15.5"
		Ti Break				
	74					End Run 4 at 74.0'
						Borehole PB-Bed-MW16 terminated at 74.0' on 10-30-94
	75					
	76					
	77					
	78					
	79					
	80					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW16





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-16
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW17

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW17

SHEET 1 OF 1 SHEETS

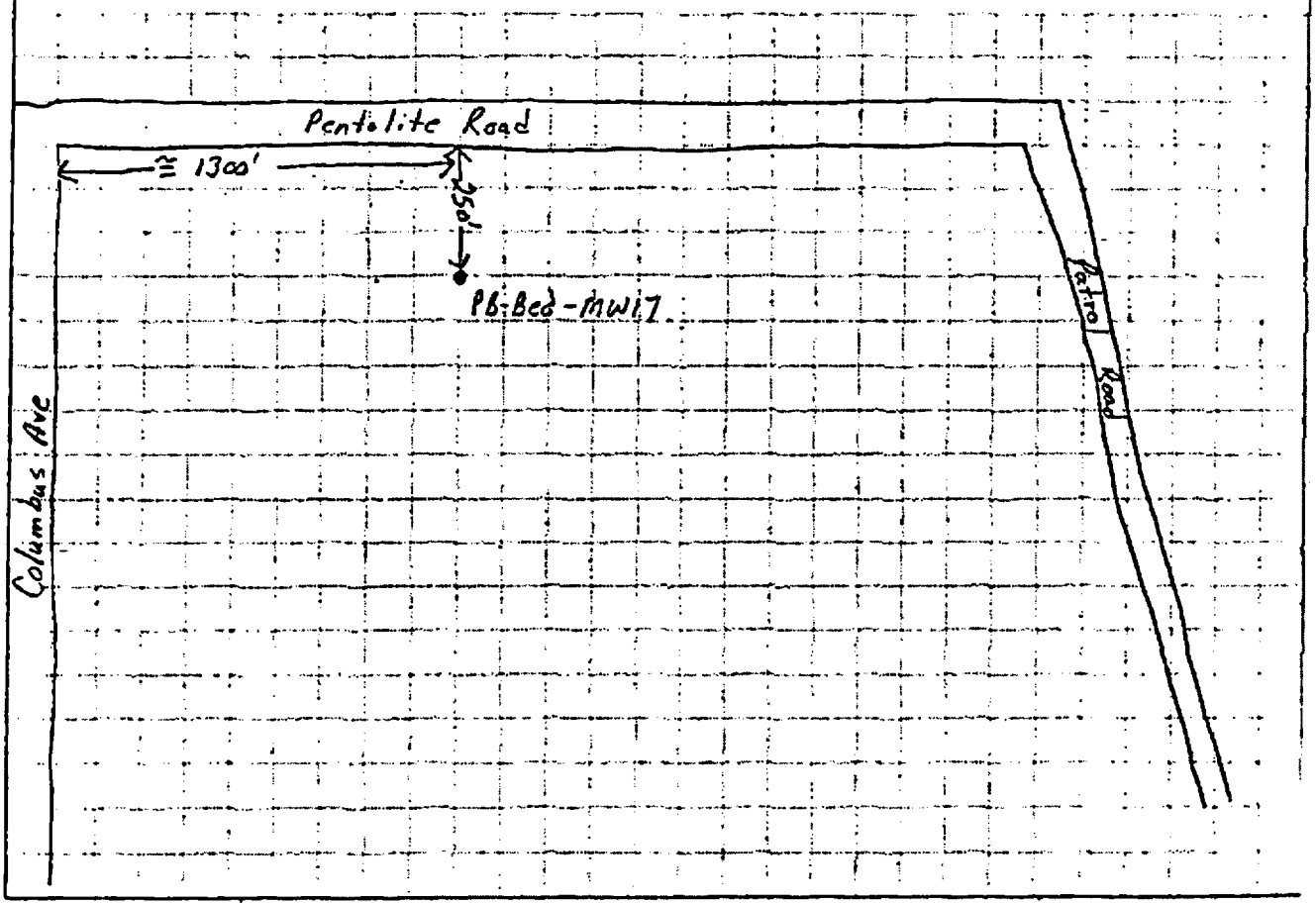
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSA, 6¼" ID HSA; 2' Split Spoons, 6" Roller Core; NX Core Equipment	8. HOLE LOCATION: Pentolite Road
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-26-94 / 11. DATE COMPLETED: 11-11-94
12. OVERBURDEN THICKNESS: 37.3' BGS	15. DEPTH GROUNDWATER ENCOUNTERED: Not encountered until coring commenced ...
13. DEPTH DRILLED INTO ROCK: 37.3' BGS - 64.4' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 28.23' BTOC 15 hrs
14. TOTAL DEPTH OF HOLE: 64.4' BGS, 67.0' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 26.88' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		3

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 99%
–						

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charles Way

LOCATION SKETCH/COMMENTS SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW17

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW17

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	0	Black to Dark Brown Silty Fine Sand - dry roots	HNu 0	3		22" Recovery
				4		
	1			5		
		Grades Brownish Yellow and Gray with trace Clay - dry		7		
	2	Brownish Yellow and Gray Clayey Silt with weathered shale fragments and cemented Sand fragments - dry	HNu 0	5		20" Recovery
				5		
	3			6		
				7		
	4	Grades with Brown, no cemented sand fragments Dry	HNu 0	4		24" Recovery
				6		
	5			10		
				15		
	6		HNu 0	4		24" Recovery
				12		
	7			15		
		Grades with olive gray, dry hard		20		
	8	Gray Silty Clay - dry	HNu 0	3		24" Recovery
				8		
	9			10		
				12		
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW17

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW17

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	10	Same as above -dry	HNu 0	6		22" Recovery
				10		
	11	Gray thinly laminated highly weathered shale Dry		34		
				50/4		
	12	Same as above -dry	HNu 0	24		10" Recovery
				50/3		
	13					Straight Auger
	14					
	15					
	16					
	17					
	18					
	19					
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW17

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-mw17

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 4 OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	20	Gray weathered shale				Straight Auger
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-mw17

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW17

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF 5 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	30					
	31					
	32					
	33					
	34					
	35					
	36					
	37					Auger Refusal 37.3'
	T. Break 38	Limestone, medium Dark Gray (N4) to Olive Gray (5Y 4/1), finely crystalline, strong, fresh with occasional bivalve fossils Hard	Rec/Core 59/59	74"/Core 51/59 Box 1		Begin Run 1 at 37.3' with NX core barrell on 10-26-94 Natural fracture at 37.75', 37.9', 37.97', 40.0', 40.4' Core 59" Rec 59"
	39					
	40	T. Break				

HOLE NO. PB-Bed-MW17

PROJECT: Plum Brook Ordnance Works

HTRW DRILLING LOG

PB-Bed-MW17

PROJECT: Plum Brook Ordnance Works | INSPECTOR | SHEET 6 OF 6 SHEETS

ELEV. (c)	DEPTH (ft)	DESCRIPTION OF MATERIALS (a)	FIELD SCREENING RESULTS (m)	GEOTECH SAMPLE OR CORE BOX NO. (n)	ANALYTICAL SAMPLE NO. (o)	REMARKS (p)
	40					
		Ti Break				
				Box 1		
	41					
	42					End Run 1 at 42.2'
						Begin Run 2 at 42.2' 10-27-94
			35/36	35/36		
	43					
				Box 1		35 min/3ft
						350 lbs/down pressure
						Core 36"
	44					Rec 35"
						Lost 1"
						44.8'-44.95' busted up with Hammer
	45					End Run 2 at 45.2'
						Roller Cone
		Fossiliferous Limestone, medium Dark Gray (N4), strong, Fresh, with numerous stylolites and a petroleum odor				Begin Run 3 at 45.3' with NQ core barrell and clear water on 11-11-94
		Ti Break Finely crystalline				
	46					
		T. Break		Box 2		
	47	Ti Break				Core 109"
						Rec 108.5"
	48					26 min/9.1 ft
		T. Break				
		Weathered Broken up zone & grades to yellowish gray (5Y 7/2)				
	49					
		Ti Break				
	50					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW17

HTRW DRILLING LOG

HOLE NUMBER PB-Bed-MW17

PROJECT Plum Brook Ordnance Works

INSPECTOR

SHEET 7 OF SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	50					
		30° Weathered Break with mineral decomposition				
	51					
		Ti Break		Box 2		
		Ti Break				
	52					
	53					
	54	Ti Break at stylolite				End Run 3 at 54.4'
						Begin Run 4 at 54.4'
	55					
		Ti Break				core 120"
						Rec 120.5"
	56					
						27.5 min/10ft
	57					
	58					
	59					
		Ti Break				
	60					

PROJECT Plum Brook Ordnance Works

HOLE NO.

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW17

PROJECT: Plum Brook Ordnance Works

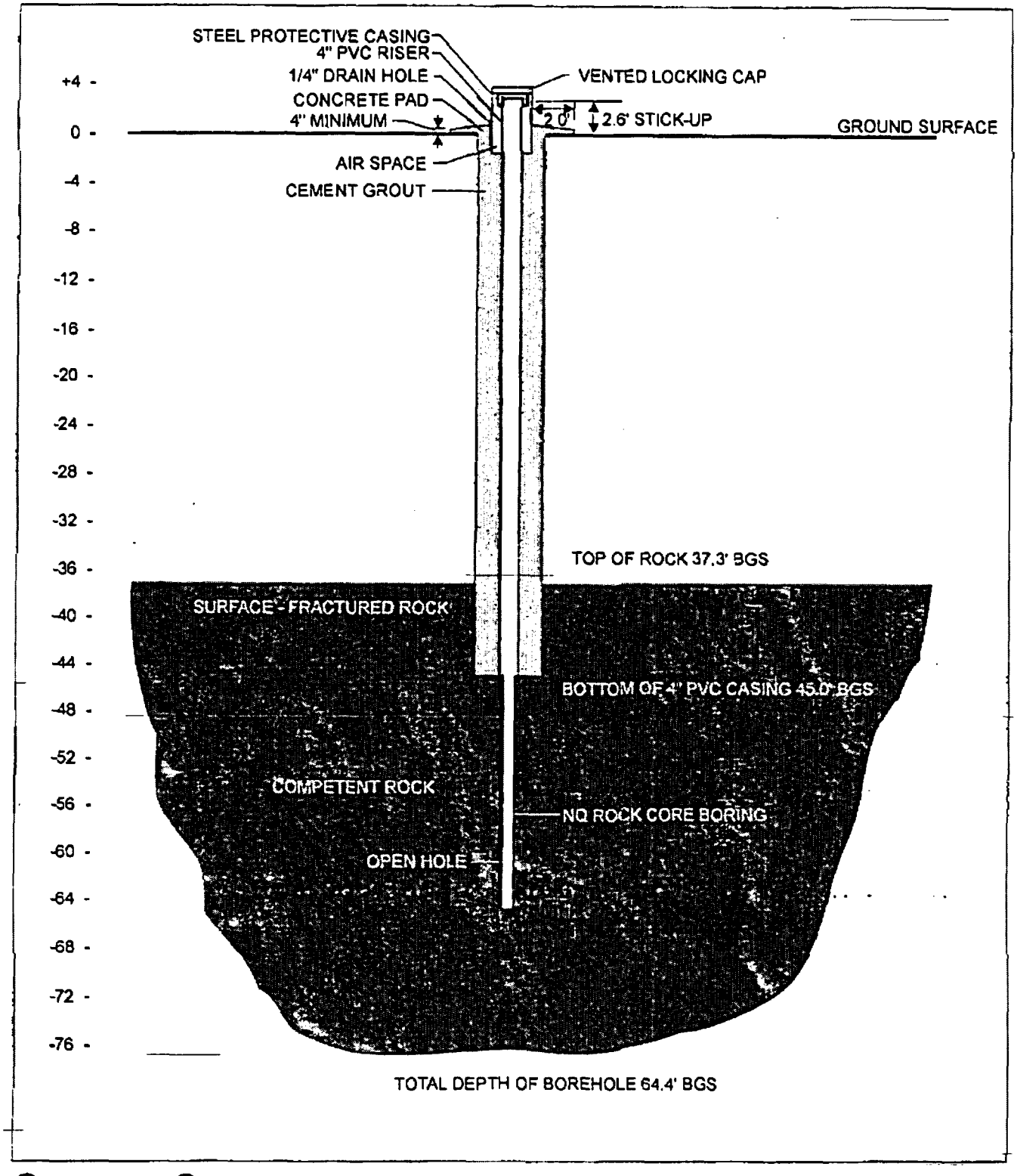
INSPECTOR:

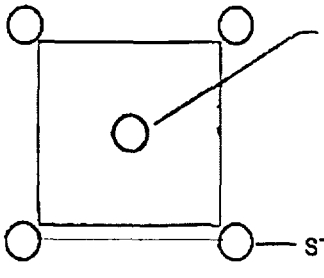
SHEET 8 OF SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	60			Box 2		
	61	Open Break, Black Stained				
	62			Box 3		Losing core water 30-40 gals
		Ti Break				
	63					
		Ti Break				
	64	Ti Break				End Run 4 at 64.4'
	65					Borehole terminated at 64.4' on 11-12-94
	66					
	67					
	68					
	69					
	70					

PROJECT: Plum Brook Ordnance Works

HOLE NO.





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-17
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-mw18

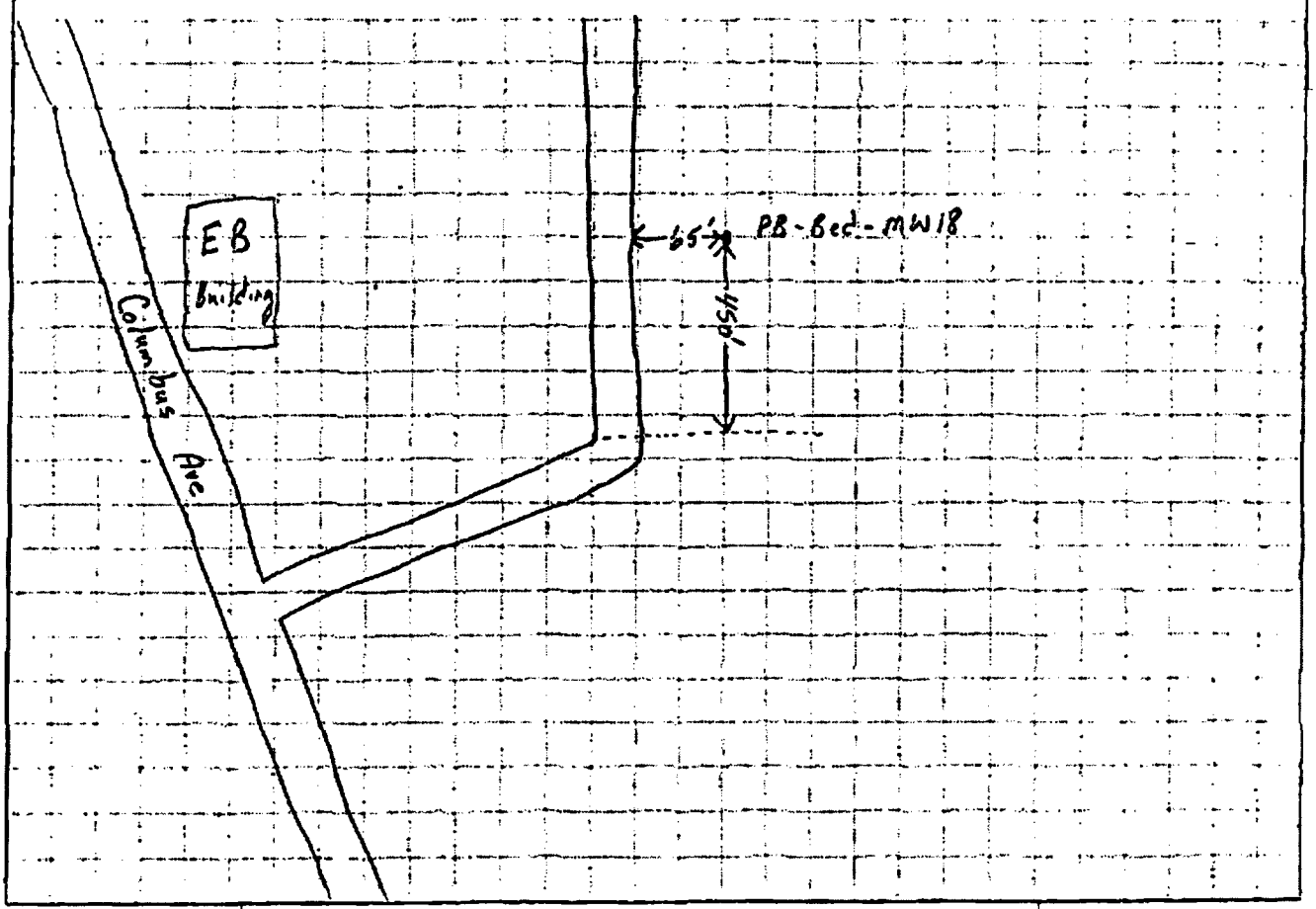
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services
SHEET 1 OF 1 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼ HSAs, 6¼ HSAs; 2" Split Spoons; NX Core Equipment, 6" Roller Cone	8. HOLE LOCATION: East of TNT Area A
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-24-94 / 11. DATE COMPLETED: 11-2-94
12. OVERBURDEN THICKNESS: 30.8' BGS (Below ground surface)	15. DEPTH GROUNDWATER ENCOUNTERED: 8.5'
13. DEPTH DRILLED INTO ROCK: 30.8' - 75.4' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 29.87' 24 hrs
14. TOTAL DEPTH OF HOLE: 75.4' BGS, 78.10' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 29.69' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	12. TOTAL NUMBER OF CORE BOXES
None	---		4

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 84%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charles Way

LOCATION SKETCH/COMMENTS SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-mw18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	0	Dark Brown Silty Fine Sand	HNu	1		20" Recovery
		Grades to Brownish Yellow	0	3		
	1			4		
		Grades back to Dark Brown with gravels		8		
	2	Dry	HNu	5		24" Recovery
			0	6		
	3	Grades brownish Yellow		5		
	4			5		
			HNu	3		20" Recovery
		Mottled Brown, Brownish Yellow and Gray Silty Sandy Clay with gravels - Dry	0	5		
	5			4		
				6		
	6		HNu	3		24" Recovery
			0	5		
	7	Grades to Brownish Yellow and Gray Silty Clay - Dry		7		
				12		
	8		HNu	4		20" Recovery
		Gray Gravelly Clay - weathered rock fragments - wet	0	22		
	9			37		
				50/5		
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	10	Weathered shale in shoe wet		23		1" Recovery
				39		
	11			39		
				50/4		
	12	Layered weathered shale & clay Hard Augering				Straight Auger
	13					
	14					
	15					
	16					
	17					
	18					
	19	Weathered shale becomes dry				
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW-18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 4 OF SHEETS

ELEV. (3)	DEPTH (2)	DESCRIPTION OF MATERIALS (4)	FIELD SCREENING RESULTS (5)	GEOTECH SAMPLE OR CORE BOX NO. (6)	ANALYTICAL SAMPLE NO. (7)	REMARKS (8)
	20	Weathered Shale dry				Straight Auger
	21					
	22					
	23					
	24					
	25					
	26					
	27					
	28					
	29					
	30					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW 18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	30					
	31	Shale, medium Dark Gray (N4) to dark gray (N3), highly weathered, slightly calcareous	Rec/core 55"/58"	74"/core 29"/58"		Begin Run 1 at 30.8' with NX core barrell on 10-24-94
						17.75 min/5ft
	32					250 lbs down pressure
	33					Core 58" Rec 55" Lost 3"
	34			Box 1		
	35					End Run 1 at 35.7'
						Begin Run 2 at 35.7'
	36		62"/60"	55/60		
	37					18.5 min/5ft
						250 lbs/down pressure
	38					Core 60" Rec 62" Gain 2"
	39					
	40					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 6 OF SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	40			Box 1		End Run 2 at 40.7'
						Begin Run 3 at 40.7'
	41		50.5/60	50.5/60		18.5 min/5ft
						250 lb down pressure
	42					Core 60"
						Rec 50.5"
	43					Lost 9.5"
	44			Box 2		
	45					End Run 3 at 45.7'
						Begin Run 4 at 45.7'
	46		64/60	60/60		24 min/5ft
						250 lb down pressure
	47					Core 60"
						Rec 64"
						Gain 4"
	48					
	49					
	50					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 7 OF 7 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	50			Box 2		End Run 4 at 50.7'
	51					Roller cone set 4" PVC casing to 51.0'
	52	Same as above	40/45	20/45		Begin Run 5 at 51.7' with NX core barrell on 11-1-94
	53			Box 3		Core 45" Rec 40" Lost 5"
	54					
	55					End Run 5 at 55.4'
	56					Begin Run 6 at 55.4'
	57		51/120	0/120		Low recovery in this weathered shale would suggest that rock was blocking bit causing rock to be ground up rather than going into barrel
	58					Core 120" Rec 51" Lost 69"
	59					
	60					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW18

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW18

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 8 OF 8 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	60					
	61					
	62					
	63			Box 3		
	64					
	65					End Run 6 at 65.4'
						Begin Run 7 at 65.4'
	66	65.9' becomes fresh to slightly weathered with pyrite present in small quantities a few bivalves present				
			114/120	95/120		38 min/10 ft
	67					Left 6" in borehole
						Core 120"
	68			Box 4		Rec 114"
						Lost 6"
		68.5 Shaley Limestone, medium Dark Gray (N4) to Dark Gray (N3), finely crystalline, fresh to slightly weathered with bivalve fossils and small amounts of pyrite				
	69					
	70					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW18

HTRW DRILLING LOG

PROJECT: Plum Brook Ordnance Works

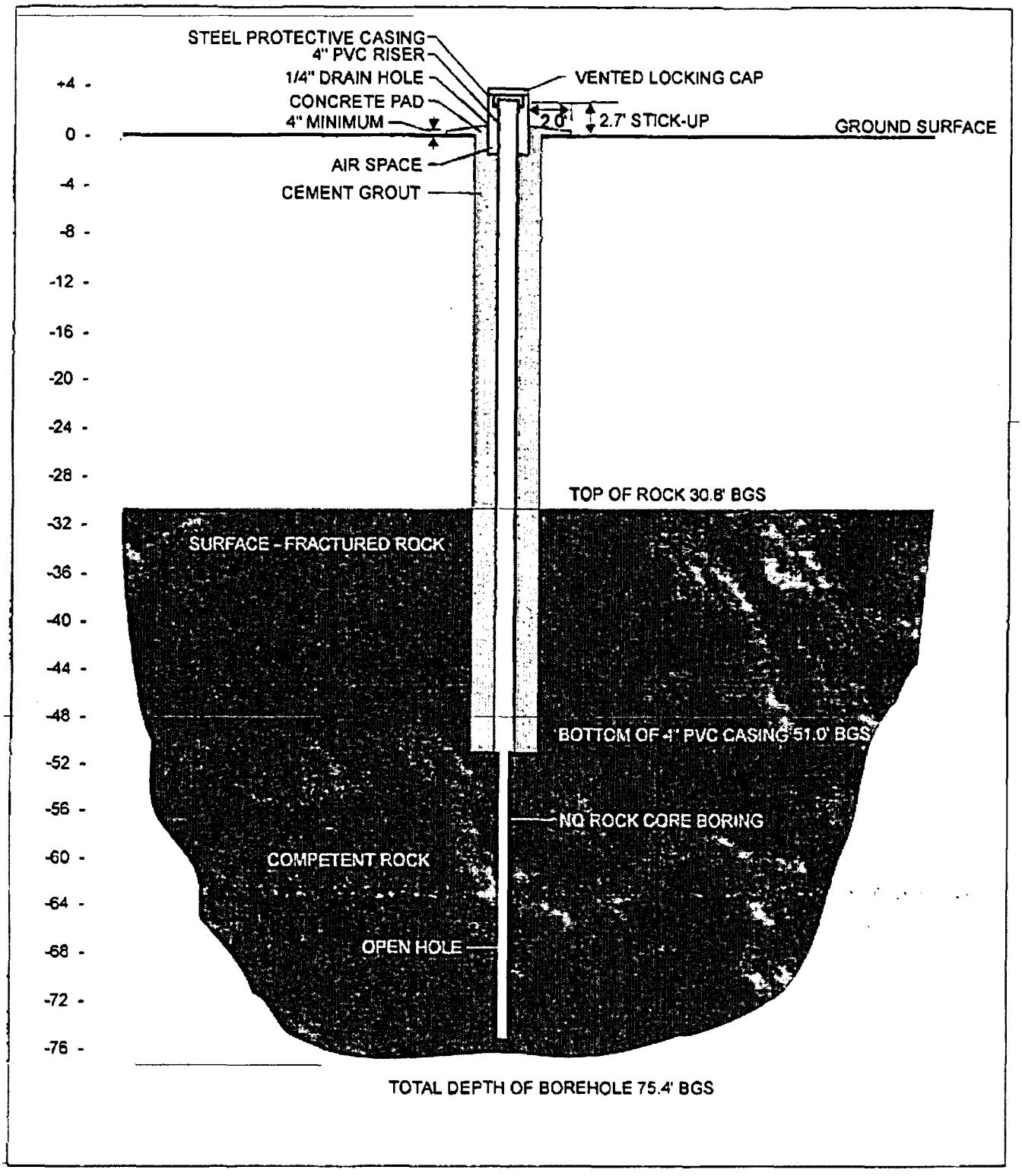
INSPECTOR:

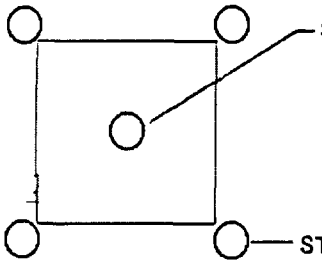
SHEET 9 OF SHEETS

ELEV. (8)	DEPTH (8)	DESCRIPTION OF MATERIALS (8)	FIELD SCREENING RESULTS (8)	GEOTECH SAMPLE OR CORE BOX NO. (8)	ANALYTICAL SAMPLE NO. (8)	REMARKS (8)
	70					
	71					
	72			Box 4		
	73					
	74					
	75					End Run 7 at 75.4'
	76					Boring terminated at 75.4' on 11-2-94 Install 30' screen in borehole with riser to insure hole does not collapse.
	77					
	78					
	79					
	80					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW18





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-18
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW19

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW19

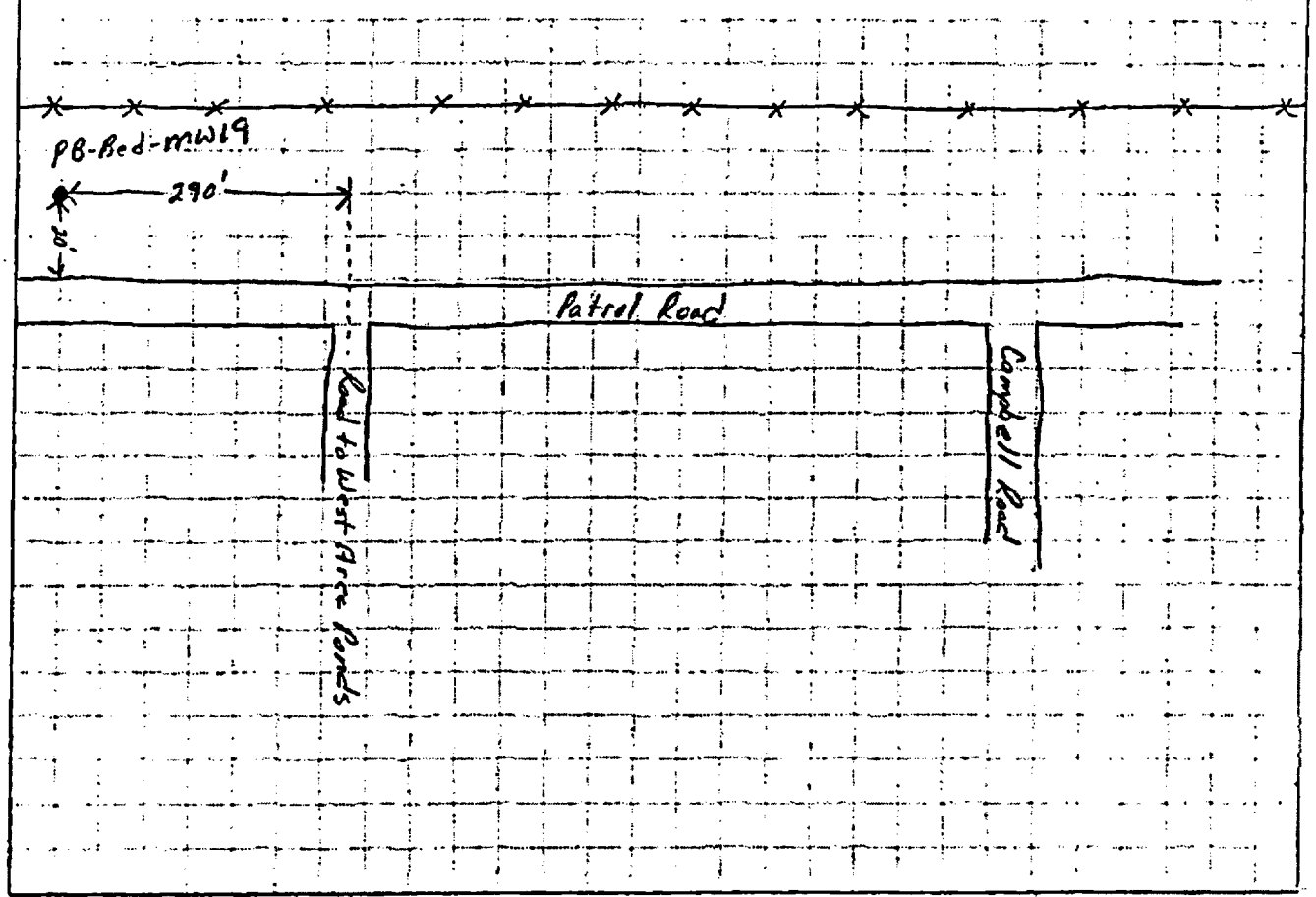
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Belasco Drilling Services
SHEET 1 OF 1 SHEETS	
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSA, 6¼" ID HSA, 2" Split Spoons, 6" Roller Core, NQ Core Equipment	8. HOLE LOCATION: North of West Area Ponds
	9. SURFACE ELEVATION:
	10. DATE STARTED: 11-8-94 / 11. DATE COMPLETED: 11-13-94
12. OVERBURDEN THICKNESS: 19.1'	15. DEPTH GROUNDWATER ENCOUNTERED: Not encountered until coring commenced
13. DEPTH DRILLED INTO ROCK: 19.1' BGS – 49.5' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 22.56' BTOC 15 hrs
14. TOTAL DEPTH OF HOLE: 49.5' BGS, 52.2' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 22.25' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		3

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 100%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charles Way

LOCATION SKETCH/COMMENTS — SCALE: Not to scale



PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW19

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW19

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	0	Dark Brownish Black Silty Fine Sand with roots	HNu 0	2		24" Recovery
				3		
	1	Grades to Brownish Yellow		4		
				6		
	2		HNu 0	3		20" Recovery
				3		
	3	Brownish Yellow and Gray Clayy Silt		5		
				6		
	4	Same as above	HNu 0	3		20" Recovery
				4		
	5			7		
				7		
	6	Grades mainly Brownish Yellow, some gray moist	HNu 0	2		24" Recovery
				4		
	7			5		
				7		
	8		HNu 0	3		24" Recovery
				3		
	9	Gray Silty Clay-moist		4		
				4		
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW19

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW19

PROJECT: Plum Brook Ordnance Works | INSPECTOR:

SHEET 3 OF 3 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	10	Same as above - moist	HNu 0	1 2 2 4		24" Recovery
	11					
	12	Same as above - moist Slight plasticity	HNu 0	2 2 2 3		24" Recovery
	13					
	14	Same as above with a few small fragments of weathered shale	HNu 0	1 1 2 2		24" Recovery
	15					
	16	Same with small fragments of weathered shale	HNu 0	1 2 2 4		24" Recovery
	17					
	18	Same as above	HNu 0	1 10		10" Recovery
	19	Weathered shale				Auger Refusal at 19.1'
		Limestone, medium Dark Gray (N4), finely crystalline, strong, fresh with occasional fossils		50/0 Box 1		Begin Run 1 at 19.1'
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW19

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW19

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 4 OF 4 SHEETS

ELEV. (1)	DEPTH (2)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (5)	ANALYTICAL SAMPLE NO. (6)	REMARKS (7)
	20					
	21	Open Break	Rec / Core	74" / Core		
	22					30 min/10 ft
	23	Grades to Fossiliferous limestone medium Dark Gray (N4), strong, fresh, with zones of weathered shale, Dark Gray (N3)	120" / 120"	106" / 120"		Core 120" Rec 120"
	24					Lost all return water
		Open Break				
	25					
		~~Open Break~~ Weathered shale ← Break				
	26	Fossiliferous limestone				
		Weathered shale Highly Broken up ↓				
	27	Fossiliferous limestone				
		Weathered shale with pyrite flakes				
		Fossiliferous limestone				
	28	Open Break				
	29					End Run 1 at 29.1'
						Roller cone ↓
	30					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW19

HTRW DRILLING LOG

PROJECT: Plum Brook Ordnance Works | INSPECTOR | SHEET 5 OF 5 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	30					Roller cone
	31	Ti Break		Box 1		Begin Run 2 at 30.5' core 15" Rec 15" End Run 2 at 31.75
	32					Roller cone set 4" PVC casing to 32.0'
	33	Fossiliferous limestone, medium Dark Gray (N4), finely crystalline, strong, Fresh, with numerous stylolites; Ti Break				Begin Run 3 at 32.4' on 11-13-94 with NQ core barrell and clear H_2O
	34	Open Break				Core 86" Rec 86"
	35	Open Break				
	36	T. Break - Black stained		Box 2		19 min/7.1 ft
	37	Ti Break				
	38	Open Break - Black stained				
	39	Ti Break				End Run 3 at 39.5' Begin Run 4 at 39.5'
	40					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW19

HTRW DRILLING LOG

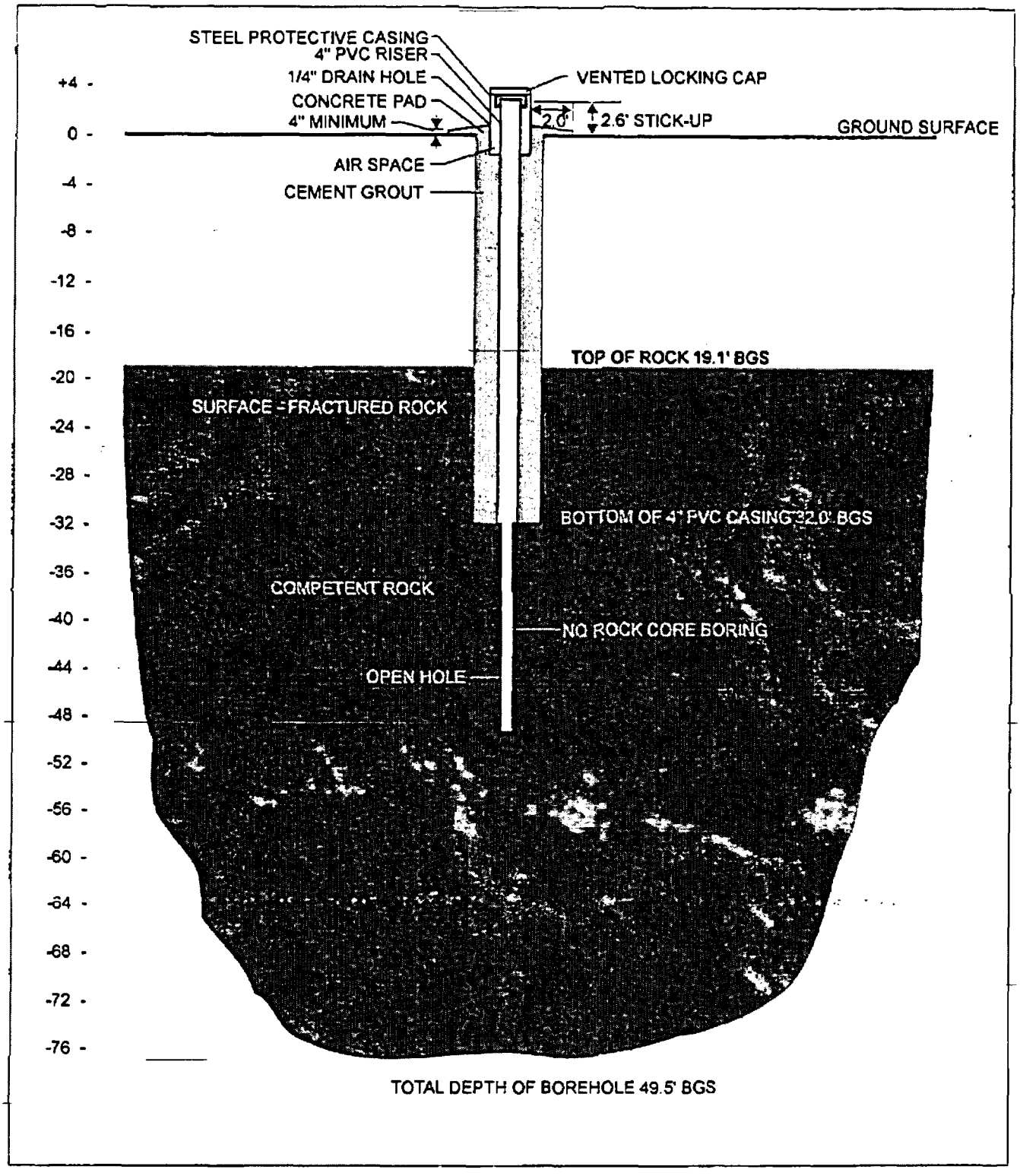
HOLE/WELL NO. PB-Bed-MW19

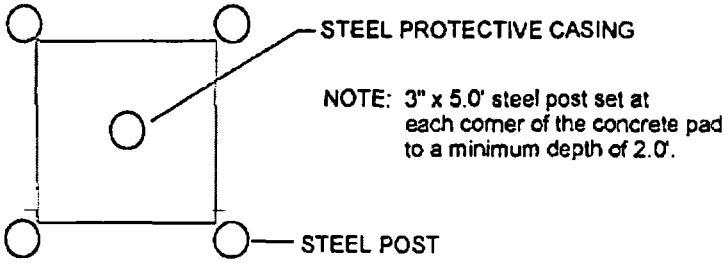
PROJECT Plum Brook Ordnance Works | INSPECTOR | SHEET 6 OF 6 SHEETS

ELEV. (1)	DEPTH (2)	DESCRIPTION OF MATERIALS (3)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (5)	ANALYTICAL SAMPLE NO. (6)	REMARKS (7)
	40					
	41					
						Core 120" Rec 120"
	42					
		Ti Break				
	43			Box 2		
		Ti Break				34 min/10 ft
	44					
		Ti Break				
	45					
		Open Break				
	46					
	47					
	48			Box 3		
		Ti Break				H_2S odor after Run 4 completed, borehole bubbling
	49	Ti Break				End Run 4 at 49.5'
						Borehole Terminated at 49.5' on 11-13-94. Set 25' screen remainder riser
	50					

PROJECT Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW19





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-19
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW20

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW20

SHEET 1 OF 1 SHEETS

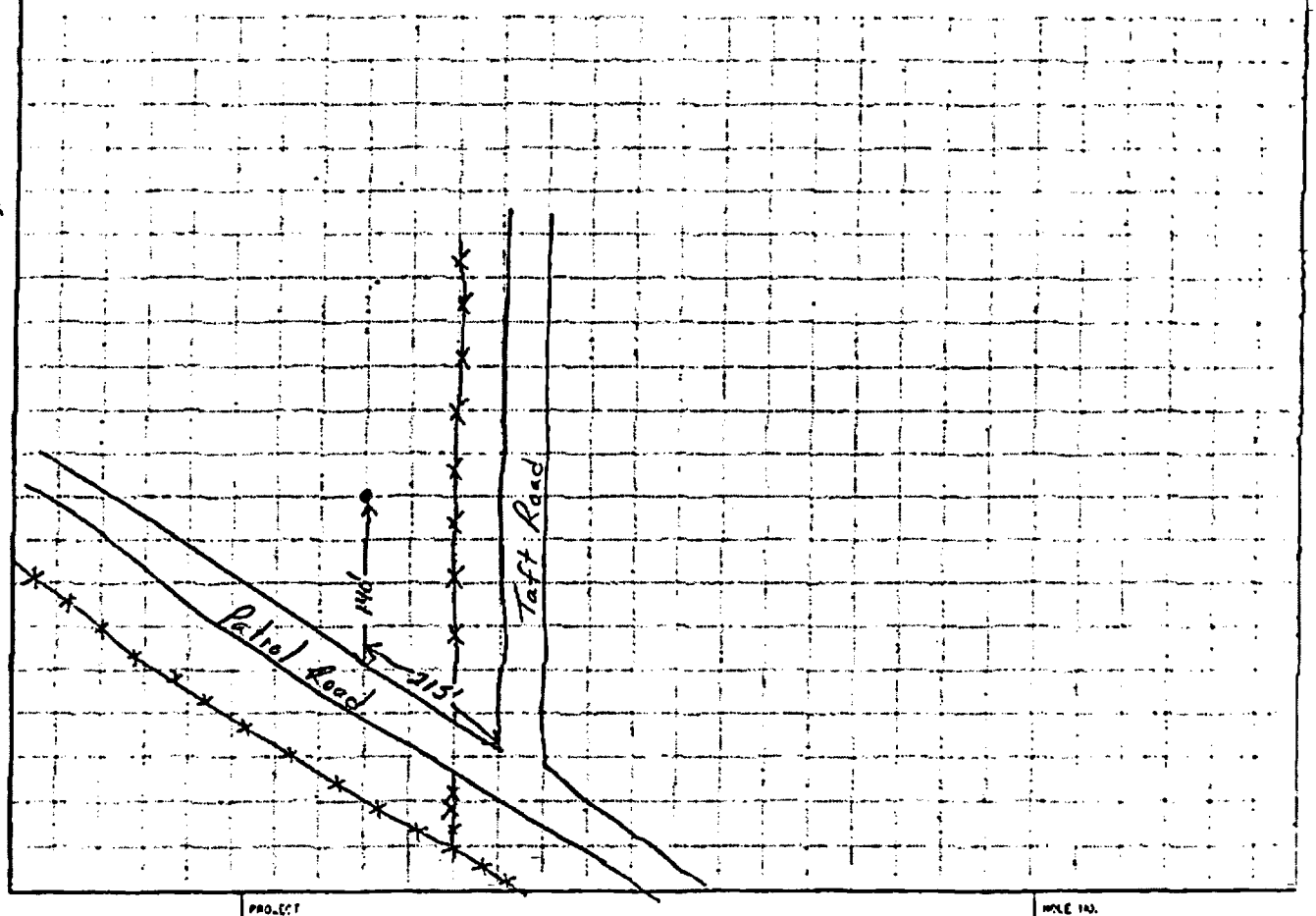
1. COMPANY NAME: Dames & Moore	2. DRILLING SUBCONTRACTOR: Bekasco Drilling Services
3. PROJECT: Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio
5. NAME OF DRILLER: Al Dadley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID HSA, 6¼" ID HSA; 2" Split spoons, 6" Roller cone; NX core equipment	8. HOLE LOCATION: South Patrol Road - Background
	9. SURFACE ELEVATION:
	10. DATE STARTED: 10-28-94 / 11. DATE COMPLETED: 11-13-94
12. OVERBURDEN THICKNESS: 21.5'	15. DEPTH GROUNDWATER ENCOUNTERED: Not encountered until coring commenced
13. DEPTH DRILLED INTO ROCK: 21.5' BGS - 49.5' BGS	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 17.17' BTOC 24 hrs
14. TOTAL DEPTH OF HOLE: 49.5' BGS, 52.3' BTOC	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): 18.69' BTOC 11-16-94

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
None	---		

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY): Explosives	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY: 93%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Charlie Way

LOCATION SKETCH/COMMENTS SCALE:



PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-MW20

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW20

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 2 OF 2 SHEETS

ELEV. (8)	DEPTH (7)	DESCRIPTION OF MATERIALS (2)	FIELD SCREENING RESULTS (4)	GEOTECH SAMPLE OR CORE BOX NO. (6)	ANALYTICAL SAMPLE NO. (5)	REMARKS (9)
	0	Brownish Yellow and Gray Silty Clay with trace fine sand and roots. - dry	HNu 0	3		20" recovery
				5		
	1			8		
				12		
	2	Brownish Yellow and Tanish Gray. Silty Fine Sand with trace clay	HNu 0	4		22" Recovery
				7		
	3			10		
				14		
	4		HNu 0	6		24" Recovery
				8		
	5	Grades Yellow Brown and Gray - moist, without clay		6		
				9		
	6			22		
		Blackish Gray weathered shale		50/2		Straight Auger
	7					
	8					
	9					
	10					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW20

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW20

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 3 OF SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	10	Grades to Gray weathed shale				Straight Auger
	11					
	12					
	13					
	14					
	15					
	16					
	17					
	18					
	19					
	20					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW20

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW20

PROJECT: Plum Brook Ordnance Works | INSPECTOR | SHEET 4 OF 4 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	20					
	21					Auger Refusal at 21.5'
	22	Shale, Dark Gray (N3) slightly weathered to Fresh non calcareous, with occasional zones of shale, Dark greenish gray (5GY 4/1) intermixed	Rec/Core	74"/core		Begin Run 1 at 21.5'
			16/52"	0/52"		Core 52" Rec 16"
	23	Breaks to numerous to put of log				Lost 36"
				Box 1		
	24					
	25					End Run 1 at 25'10"
	26	Same as above				Begin Run 2 at 25'10"
		Breaks to numerous to put on Log	88"/58	71/58		30" from core Run 1
	27			Box 1		core 58" Rec 88" Gain 30"
	28					
	29					
	30	Becomes weathered				

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW20

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-mw20

PROJECT: Plum Brook Ordnance Works

INSPECTOR:

SHEET 5 OF 5 SHEETS

ELEV. (8)	DEPTH (9)	DESCRIPTION OF MATERIALS (10)	FIELD SCREENING RESULTS (11)	GEOTECH SAMPLE OR CORE BOX NO. (12)	ANALYTICAL SAMPLE NO. (13)	REMARKS (14)
	30					
		Becomes Fresh		Box 1		End Run 2 at 30.7'
		Same as above, with zones of pyrite deposition				Begin Run 3 at 30.7'
	31		51/57	51/57		
						Left 6" in hole
	32	Ti Break				Core 57" Rec 51" Lost 6"
	33	Ti Break		Box 2		
	34					
		Ti Break				
	35					Set 4" PVC casing to 35.0'
		Ti Break				End Run 3 at 35.5' Roller Cone
	36	Ti Break Shale, Dark Gray (N3), non calcareous, strong, Fresh with occasional zones of shale, Dark greenish gray (5GY 4/1) intermixed				Begin Run 4 at 36.0' on 11/13-94 with NQ core barrel and clear water
	37					Core 102" Rec 84" Lost 18"
	38	38.25-38.3 Pyrite deposition				31 min/8.5'
	39					
	40					

PROJECT: Plum Brook Ordnance Works

HOLE NO. PB-Bed-mw20

HTRW DRILLING LOG

HOLE NUMBER: PB-Bed-MW20

PROJECT: Plum Brook Ordnance Works

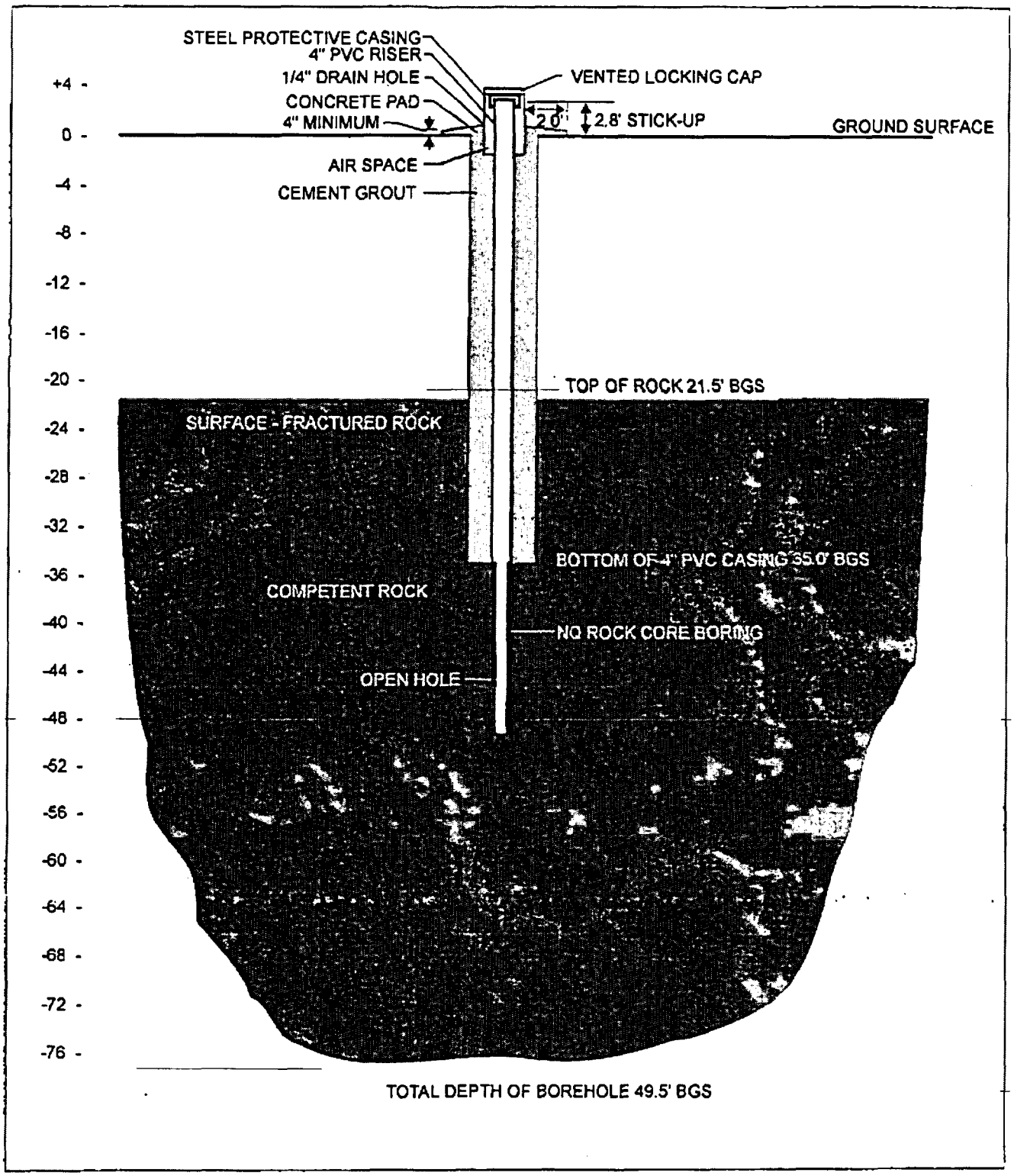
INSPECTOR:

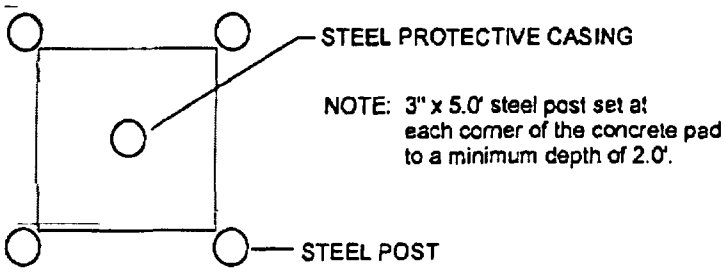
SHEET 6 OF 6 SHEETS

ELEV. (a)	DEPTH (b)	DESCRIPTION OF MATERIALS (c)	FIELD SCREENING RESULTS (d)	GEOTECH SAMPLE OR CORE BOX NO. (e)	ANALYTICAL SAMPLE NO. (f)	REMARKS (g)
	40					
	41					
		Thin pyrite zone				
	42					
	43	Ti Break Becomes fissile, slightly weathered				
						Loss of 20-30 gals water
	44					
		Open Break				End Run 4 at 44.5'
						Begin Run 5 at 44.5'
	45					
						Core 60" Rec 67" Gain 7"
	46					
						22.5 min/5 ft
	47					measure H_2O at 26.42' at 11:30, take lunch, at 12:40 H_2O at 27.28'
		Open Break, black stained				Can hear bubbling in well
	48					
						Left 1' of core in borehole making Total depth 48.6'
						Install 20' screen, rest riser. 2.75' stickup
	49					
						End Run 5 at 49.5'
	50					

PROJECT: Plum Brook Ordnance Works

HOLE NO.: PB-Bed-MW20





NOTE: 3" x 5.0' steel post set at each corner of the concrete pad to a minimum depth of 2.0'.

PB-Bed-MW-20
BEDROCK WELL DETAILS

Plum Brook Ordnance Works
Sandusky, Ohio

DAMES & MOORE

PB-BED-MW24

HTRW DRILLING LOG

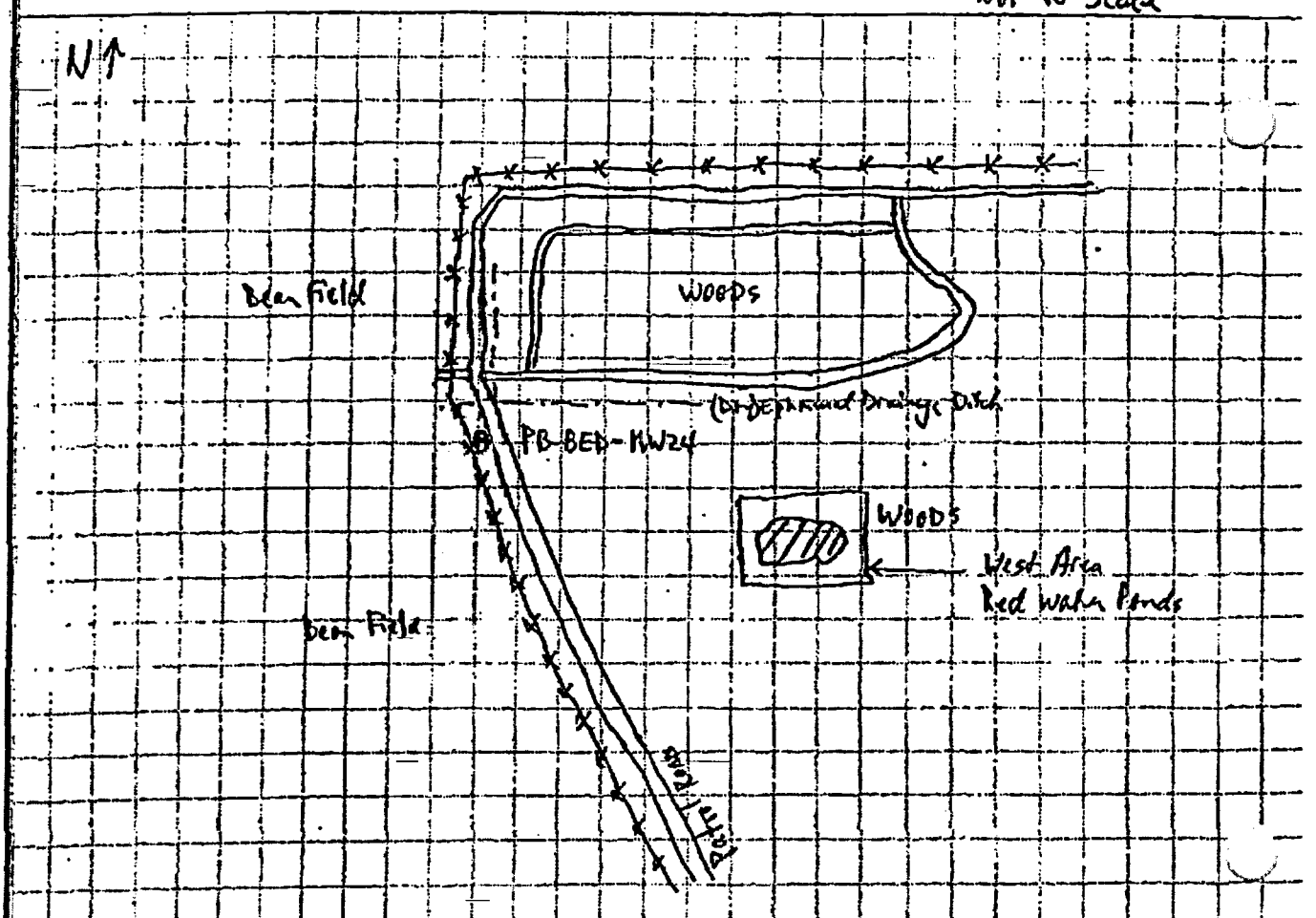
DISTRICT: Nashville, TN		HOLE NUMBER: PB-BED-MW2
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Boart Longyear	SHEET 1 OF 6
3. PROJECT: PBOW	4. LOCATION: NASA Plum Brook Station, Sandusky,	
5. NAME OF DRILLER: Paul Dickinson	6. MANUFACTURER'S DESIGNATION OF DRILL: BK81	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 6" OD. Installed 2" PVC monitoring well.	8. HOLE LOCATION: See Sketch	
	9. SURFACE ELEVATION: 644.20 Ft	
	10. DATE STARTED: 8/26/01	11. DATE COMPLETED: 9/13/01
12. OVERBURDEN THICKNESS: 17.3 Ft	15. DEPTH GROUNDWATER ENCOUNTERED: 7.0 Ft (overburden), Bedrock unknown	
13. DEPTH DRILLED INTO ROCK: 24.2 Ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 26.5 Ft @ 1 hr	
14. TOTAL DEPTH OF HOLE: 41.5 Ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	6

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kesch

LOCATION SKETCH/COMMENTS — SCALE: Not To Scale



PROJECT: PBOW | HOLE NO. PB-BED-MW24

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW24

Project: PBOW | Contractor: D. Kessler | Sheet 2 of 6

Elev (ft)	Depth (ft) bgs	Description of Materials	Unified Class	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
		Grass						
		Stiff, (10YR 3/2) very dark grayish br. homogeneous, sandy SILT (30% sand), organics (roots), dry 0.8	ML	0.0	NA	3/4/ 6/10	1.5/ 2.0	Began drilling 8/26/01 0910
	1	Stiff, (10YR 5/6) yellowish brown, mottled (30%-gray), vfg, sandy SILT, very well sorted, organics (roots), dry	ML			0910		Breathing Air/ Background PID = 0.0 ppm
	2				NA			VRAE: CO = 0 ppm LEL = 0% H_2S = 0 ppm O_2 = 20.7%
	3	As above (no organics) 4.2		0-0		6/8/ 10/7	1.4/ 2.0	
	4					0915		
		Stiff, (2.5Y 5/2) gray brown, mottled (50%-dark yellow), ~~vfg~~, high plasticity, SILT, little clay (10%), trace vfg sand, even-parallel bedding planes, moist		0-0	NA	8/7/ 8/9	2.0/ 2.0	
	6					0920		
	7	As above		0.0	NA	4/3/ 7/10	2.0/ 2.0	▽ Encountered (overburden) groundwater at 7.0 ft
	8					0925		
	9	Very stiff, (2.5Y 5/3) light olive br, mottled (20%), SILT, trace clay, even-parallel bedding, wet		0.0	NA	5/7/ 12/14	2.0/ 2.0	Mottling along vertical fractures
	10					0927		

Project: PBOW | Hole Number: PB-BED-MW24

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW24

Project: PBOW | Contractor: D. Kessler | Sheet 3 of 6 sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	Unified Soil	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	10	Stiff, (2.5Y 4/1) dark gray, homogeneous, high plasticity, SILT, trace clay, rounded pebbles (light gray), 1-5mm, wet		~~NM~~ NM	NA	3/5/ 6/8 0930	2.0/ 2.0	Brown staining along horizontal fractures
	12	As above, granules/pebbles increase 10%, 1-10 mm		NM	NA	3/4/ 5/5 0935	2.0/ 2.0	
	14	As above		NM	NA	3/5/ 6/8 0938	2.0/ 2.0	
	16	As above, granules/pebbles 30%		NM	NA	7/8 50 for 3" 0945	1.3/ 1.3	Limestone pebble in shoe, 20x15mm. Bottom of 12" DD Bucket
	17.3	Spoon refusal @ 17.3 ft. LIMESTONE, gray, calcareous, fossils, fine grained, very fine grain pyrite <5%, trace calcite, clear quartz "spot" 5x5 mm.	NA	NM	NA	NA	NA	Began cutting with 8" rotary bit. Faint H_2S odor. Breathing Air: PID=0.0 ppm, CO=0 ppm, LEL=0%, H_2S=0 ppm, O_2=20.8%
	20							

Project: PBOW | Hole Number: PB-BED-MW24

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW24

Project: PBOW | Geologist: D. Kessler | Sheet 4 of 6

Elev (ft)	Depth (ft)	Description of Materials	USCS Symbol	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (%)	Remarks
	20	LIMESTONE, gray, average to hard	NA	NM	NA	NA	NA	Hardness based on cutting speed.
	21	21.5						Bottom of 8" OD Borehole at 21.5 ft
		LIMESTONE, gray, hard, massive bedding, slightly weathered, calcareous, slightly fractured, fossils (brachs)				Fracs		Bottom of 6 5/8" OD Steel casing at 21.5' Began coring 9/13/01 0925
	22				21.7 Limey shale	21.9 - 22.0		C-1 (21.5-26.5') End: 0933 Start: 0925.
	23	Limey shale layer 21.9-22.0 ft soft,			Box # 1			5 Ft Run
		Large coal 23.6-23.9' (0.3' x 0.3') wide						5 Ft Recovery
	24			0.4		24.6		0
	25				25.2			Breathing Air/Bckgrd PID: 0.0 ppm VRAE: CO: 0 ppm LEL: 0% H_2S: 0 ppm O_2: 20.9%
					Box # 2	25.6		
	26					26.5		
	27	As above, massive, slightly fractured,						C-2 (26.5-31.5') End: 0955 Start: 0944
	28				28.5			HC odor drilling
					Box # 3			5 Ft Run
	29					29.3		5 Ft Recovery
								0 Loss
	30							HC odor

Project: PBOW | Hole Number: PB-BED-MW24

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW24

Project: PBOW

Geologist: D. Kessler

Sheet 5 of 6 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	30							C-2 (cont)
					Box #3	30.8		
	31							
		LIMESTONE, gray, hard to very hard, massive bedding, slight to fresh weathering, calcareous, slightly fractured, fossils (brachs/stromatites) corals				31.5		31.5
	32				32.4			C-3 (31.5-36.7')
	33				Box #4			End: – Start: –
								5 Ft Run
	34			32.7				5.2 Ft Recovery
								0.2 Ft GAIN
	35					35.0 white shale filled		HC staining on core Strong odor
	36				36.3			Can hear water gurgling after pumping gas
					Box #5			36.7
	37	As above						C-4 (36.7-41.5')
						37.7		
	38					38.2		End: 1052 Start: 1031
								5 Ft Run
	39					39.		4.8 Ft Recovery
								0.2 Ft Loss
						39.6		
	40							

Project: PBOW

Hole Number: PB-BED-MW24

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW24

Project: PBow

Geologist: D. Kessler

Sheet 6 of 6 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (%)	Remarks
	40	LIMESTONE, gray, very hard, massive, fresh weathering, calcareous. fossils (brach/stromatites corals)		20.1	40.6 Box # 6			C-4 (cont'd) ¢C staining on core.
	41					41.5		
		Total Depth - 41.5 ft						Pumped borehole 207 1160 1162 } 3.5' } 4.5'
	42							
	43							Can hear water gurgling during recharge.
	44							
	45							
	46							
	47							
	48							
	49							
	50							

Project: PBow

Hole Number: PB-BED-MW24

INTERNATIONAL TECHNOLOGY CORPORATION

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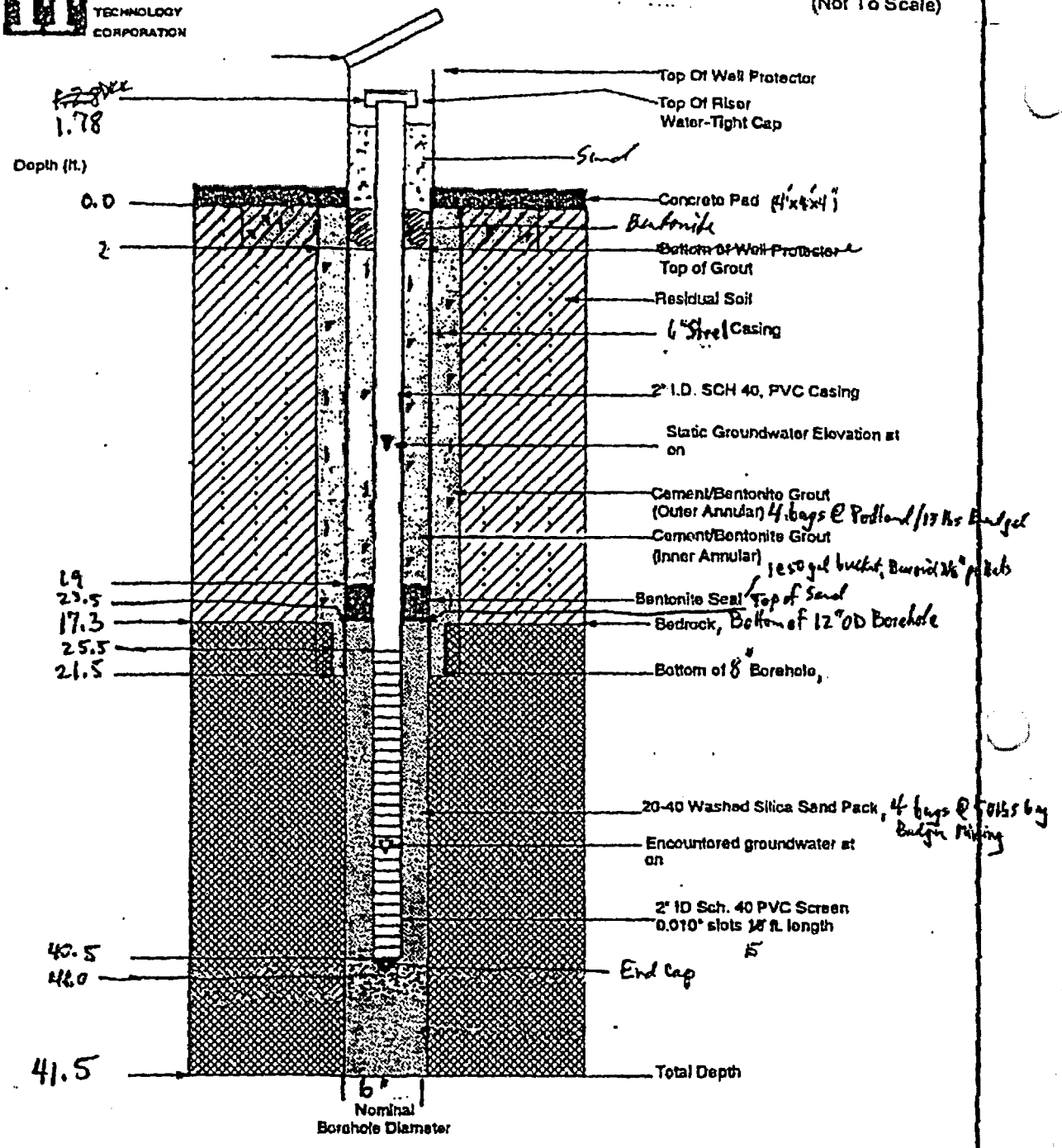


Notes:

Well No.: PB-BED-MW24
Date Installed: 9/13/01
Elevation Top of Casing: 645.98 ft

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OH 10

BWMWA20CWC.DRW

PB-BED-MW25

HTRW DRILLING LOG

DISTRICT	Nashville, TN
HOLE NUMBER	PB-BED-MW25
SHEET / OF SHEET	1 of 5
1. COMPANY NAME	IT Corporation
2. DRILL SUBCONTRACTOR	Boart Longyear
3. PROJECT	PBOW
4. LOCATION	NASA Plum Brook Station, Sandusky, OH
5. NAME OF DRILLER	Paul Dickinson
6. MANUFACTURER'S DESIGNATION OF DRILL	BK81
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4¼" ID/8" OD HSA with 1.4" ID Stain-less Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 6" OD. Installed 2" PVC monitoring well.
8. HOLE LOCATION	See Sketch
9. SURFACE ELEVATION	681.99 Ft
10. DATE STARTED	8/26/01
11. DATE COMPLETED	9/11/01
12. OVERBURDEN THICKNESS	8.8 Ft
13. DEPTH GROUNDWATER ENCOUNTERED	4.8 Ft (overburden)
13. DEPTH DRILLED INTO ROCK	29.7 Ft
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
14. TOTAL DEPTH OF HOLE	38.5 Ft
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

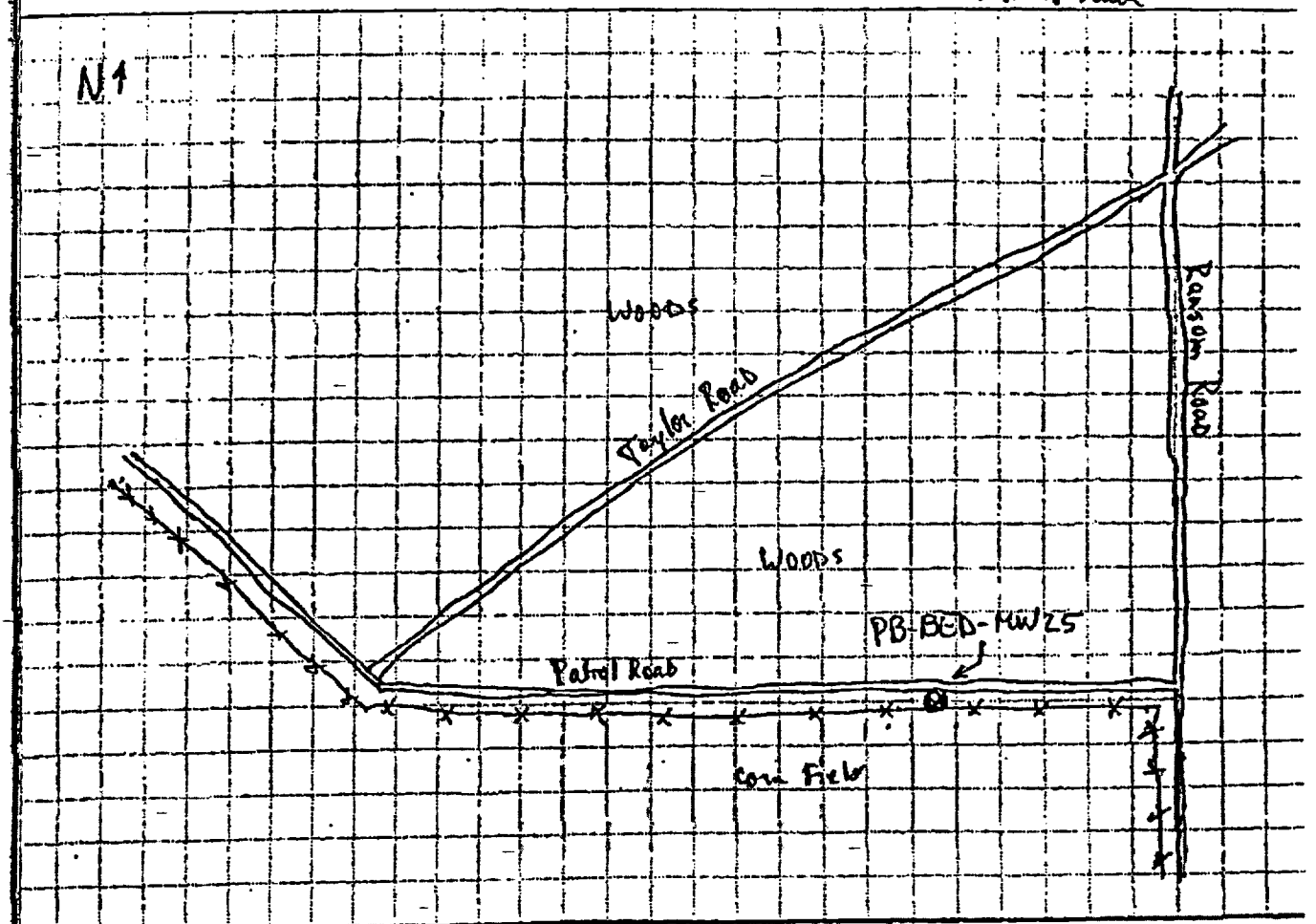
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	4

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Keesh

LOCATION SKETCH/COMMENTS

SCALE: Not To Scale



PROJECT PBOW

HOLE NO. PB-BED-MW25

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW25

Project: PBOW | Geologist: D. Kessler | Sheet 2 of 5 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
		Grass/Weeds						
		FILL: (Very loose, (10YR 3/3) dark brown, mottled (light brown), silty SAND, organics (roots) dry) 0.6	Sm		NA	1/1	1.4/	Began Drilling 8/26/01 1455
	1	FILL: (Loose, (10YR 4/6) brownish yellow, homogeneous, vfg, SAND, very well sorted, dry)	SP	0		4/7	2.0	With 4¼"ID/8"OD augers Borehole reamed w/ 12"OD augers to 10 ft Background/Breathing PID = 0.0 ppm
	2					1455		VRAE: CO = 0 ppm LEL = 0% H_2O = 0.0 ppm O_2 = 20.9% (strong breeze)
		As above		0	NA	2/6/	1.8/	
	3		SP			4/4	2.0	
						1458		
	4	As above, color changing to (10YR 4/4) dark yellowish brown silt content in SAND 5% at 4.8 Ft	SP	0	NA	3/5/	2.0/	▽ Encountered overburden groundwater at 4.8 Ft
	5					6/4	2.0	
						1459		
	6	As above 4.6 Ft interval		0	NA	2/1/	2.0/	
	7					1/12	2.0	
		7.3						
		Medium dense, (10YR 3/2) very dark grayish brown, homogeneous, vfg, SAND, some silt (25%), very well sorted, wet, black shale fragments 7.7-8.0 Ft (10%), trace gravel, very coarse to 8.3	Sm	0	NA	1504		
	8					5/7/	1.6/	
	9	Weathered SHALE, dark brown, very soft, thinly laminated		0		8/50 for 6"	2.0	Black coal (sh?) lamination (2) 9.1 and 9.4 Ft
	10	spoon refusal @ 10.0 Ft				1512		

Project: PBOW | Hole Number: PB-BED-MW25

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW25

Project: PBOW

Geologist: D. Kessler

Sheet 3 of 5 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. BEMW5	Recovery (ft)	Remarks
	10	SHALE, highly weathered, dark brown, thinly laminated, soft	NA	0	NA	NA	NA	Bottom of 12"OD augers at 10 ft Description from cuttings
	11							
	12							
	13							
	14	Dry						Shale from bottom of augers - dry 4 1/4" ID/8" OD augers refusal
	15	8"OD Auger Refusal @ 15 ft SHALE, soft, dark brown,						
	16							
	17							
	18							More competent w/ depth.
	19							Detected solid competent shale cuttings at ~20 ft
	20							

Project: PBOW

Hole Number: PB-BED-MW25

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW25

Project: PBOW

Geologist: D. Kesslur

Sheet 4 of 5 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	20	SHALE, dark brown, average hardness	NA	NM	NA	NA	NA	
	21	21.5						Began drilling 8/27/01 to 23.3 ft w/ 8" roller bit
		LIMESTONE						
	22							Drilled to 23.3 ft w/ 8" roller bit. 6" steel casing at 23.3 ft
	23							
		LIMESTONE, light gray, hard, massive bedding, slightly weathered, calcareous, moderately fractured.				Fracs		Began drilling 9/4/01
	24					24.2 24.3		C-1 (23.3-28.3')
	25	25.1-25.7 ft; many crystals white nodules		0.0	Box # 1	24.7 (iron stained edges)		End: — Start: —
	26					26		5 ft Run
					rounded	26.3 26.35		5 ft Recovery
					highly weathered			0 Loss
	27	27.3-28.3; pitted 30%, highly weathered zone 27.3-27.6'			27.3	27.3 rounded edges		
	28				Box # 2	28		
		LIMESTONE, as above				28.5		C-2 (28.3-33.5')
	29					29.3 (rounded edges)		End: 1020 Start: 1000
	30							

Project: PBOW

Hole Number: PB-BED-MW25

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW25

Project: PBOW

Geologist: D. Kressler

Sheet 5 of 5 Sheets

Elev (ft)	Depth (ft)	Description of Materials	USCS Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Frecs	Recovery (ft)	Remarks
	30	LIMESTONE, light gray, hard, massive bedding, slightly weathered, calcareous, moderately fractured, fossils				30.2 (rough)		5 Ft Run
	31				31			5.2 Ft Recovery
		31.5			Box #3	31.5		0.2 Ft Gain
	32	SHALE, very dark gray, soft, thinly bedded, highly weathered, pyrite vugs(2) 31.5-31.9; decomposed 32.4-32.5; clay/silt filled		NM		32.4		Breathing Air/Background PID = 0.0 ppm CO = 0 ppm LEL = 0 ppm H_2S = 0 ppm O_2 = 21.0%
	33					32.8		
	33	Limey SHALE, very dark gray, moderately hard, thinly bedded, moderately weathered, fossils (brachs/corals), calcareous, moderately to highly fractured pyrite vug 35.6 Ft						C-3 (33.5-38.5')
	34				34.8			End: 1048 Start: 1035
	35					34.9		
					Box # 4	35.3		HC odor
						35.7		5 Ft Run
	36					36.2		5 Ft Recovery
						36.3		
						36.4 (clay filled, crushed vugs)		0 Loss
						36.75		
	37	37						
	37	LIMESTONE, light gray, hard, massive, slightly weathered, fossils (brachs/corals), calcareous, moderate to slightly fractured.				37.5		
	38							
		Total Depth = 38.5 Ft						
	39							
	40							

Project: PBOW

Hole Number: PB-BED-MW25

INTERNATIONAL TECHNOLOGY CORPORATION

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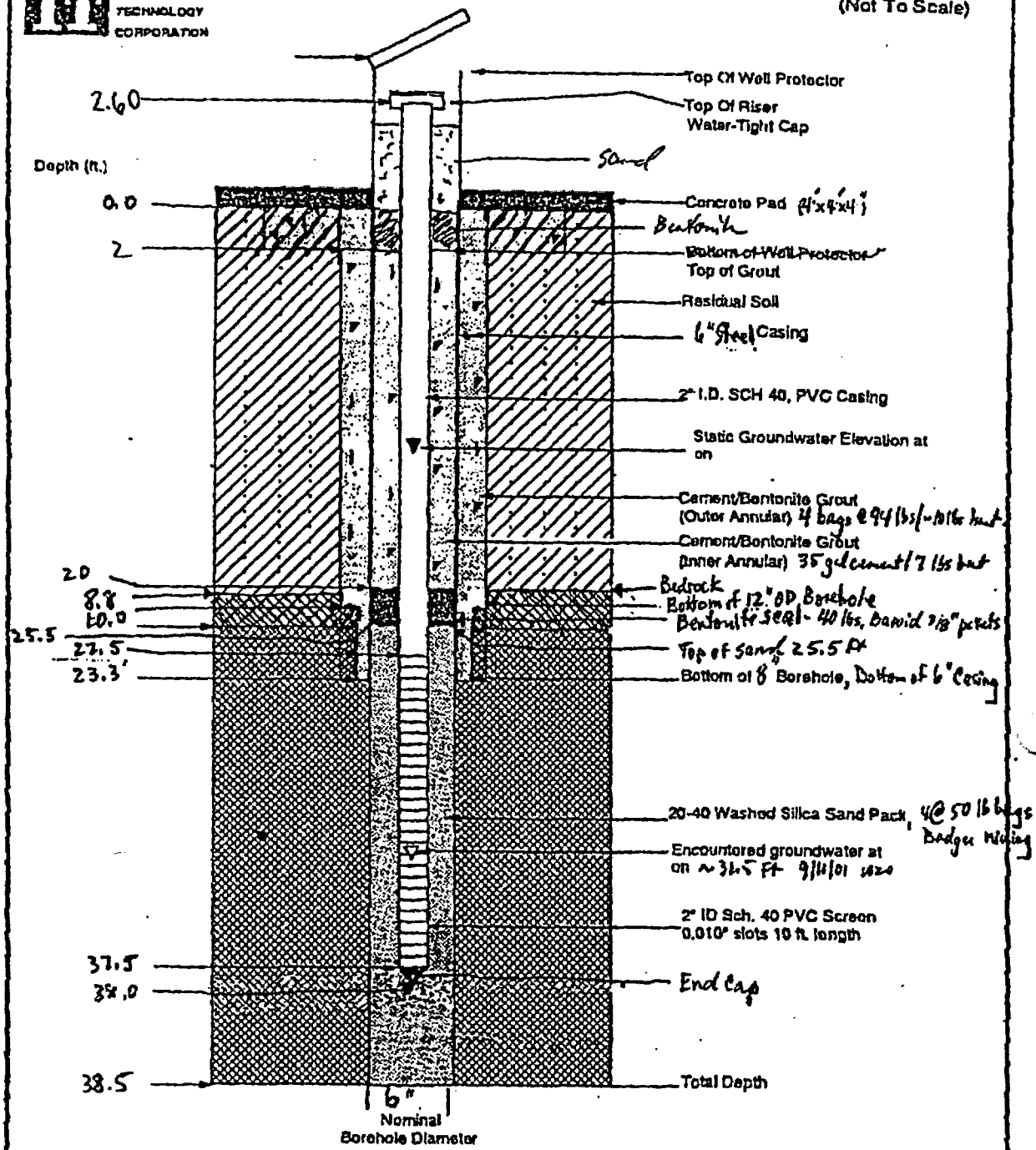


Notes:

Well No.: PB-BED-MW25

Date Installed: ~~9/4/01~~ 9/12/01

Elevation Top of Casing: 684.59 ft.

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

BWMWA2IOWC.DRW

PB-BED-MW26

HTRW DRILLING LOG

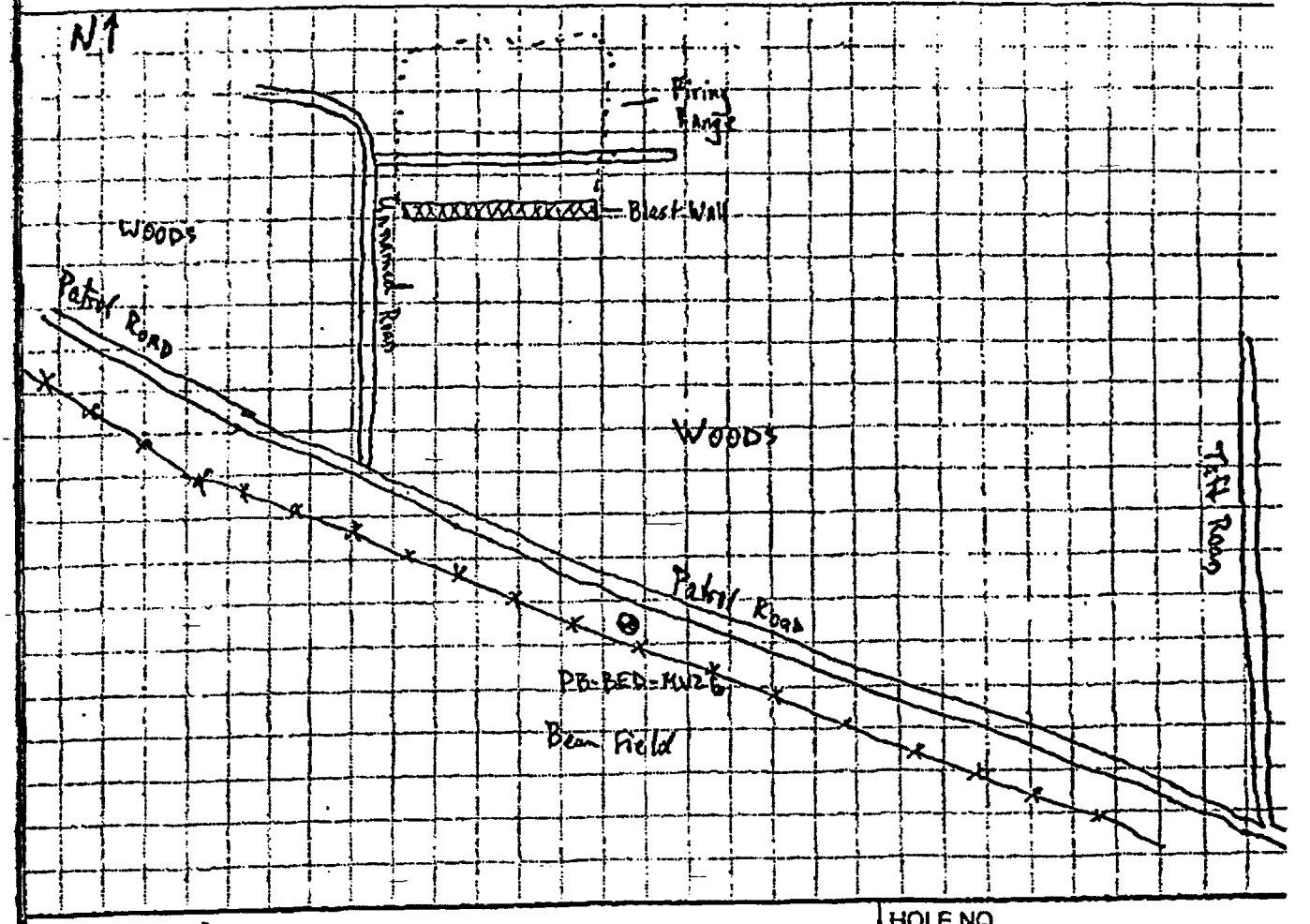
DISTRICT	Nashville, TN
HOLE NUMBER	PB-BED-MW26
1. COMPANY NAME	IT Corporation
2. DRILL SUBCONTRACTOR	Boart Longyear
SHEET / OF SHEET	1 OF 7
3. PROJECT	PBOW
4. LOCATION	NASA Plum Brook Station, Sandusky, OH
5. NAME OF DRILLER	Paul Dickinson
6. MANUFACTURER'S DESIGNATION OF DRILL	BK81
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6 5/8" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 6" OD. Installed 2" PVC monitoring well.
8. HOLE LOCATION	See Sketch
9. SURFACE ELEVATION	674.61 Ft
10. DATE STARTED	8/27/01
11. DATE COMPLETED	9/10/01
12. OVERBURDEN THICKNESS	6.5 Ft
13. DEPTH DRILLED INTO ROCK	52.0 Ft
14. TOTAL DEPTH OF HOLE	58.5 Ft
15. DEPTH GROUNDWATER ENCOUNTERED	Not encountered (overburden). Bedrock ~ ~~47.0~~ 47.0 Ft
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	9

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kosch

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT PBOW — HOLE NO. PB-BED-MW26

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW26

Project: PBOW | Geologist: D. Kessler | Sheet 2 of 7 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Line	Field Screening Results (ppm)	Geotech Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
		Grass/Weeds						
		Medium stiff, (10YR 2/1) black, homogeneous, medium plasticity, ~~stiff~~ SILT, organics (roots) vfg sand (15%), moist 0.7		0.0	NA	3/4/	1.3/	Began driving 8/27/01 1140
	1	Stiff, (10YR 4/6) dark yellowish brown, mottled (50%) (light brown/gray), clayey SILT, vfg sand (20%), dry shale fragments 5%	ml			5/7	2.0	Breathing Air/Background PID = 0.0 ppm CO = 0 ppm LEL = 0% H_2S = 0 ppm O_2 = 20.9%
	2					1142		
		As above 2.5		0.0	NA	2/4/	1.7/	
	3	Medium dense, (10YR 5/3) brown, mottled (gray, dark brown) (10%), vfg, SAND, silt (20%), dry 3.8	sm			6/7	2.0	
		Medium stiff, (10YR 5/6) yellowish br, mottled (5% gray), platy bedding, silty CLAY, shale fragments, black oxidized specks (15%), moist medium plasticity.				1146		
	4			0.0	NA	2/2/	1.9/	
	5		cl			5/7	2.0	
						1148		
	6	As above, moist 0.5		0.0	NA	5/7/	2.0/	Bedrock
	7	SHALE, very severe (decomposed) weathering, (2 GLEY 5 PB 6/1) bluish gray, relic bedding, thinly bedded, soft, dry	NA			12/48	2.0	Rock crumbles in hand
						1154		
	8			NM	NA	NA	NA	Discontinued split-spoon sampling
	9							
	10							Bottom of 12" borehole

Project: PBOW | Hole Number: PB-BED-MW26

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW26

Project: PBOW

Geologist: D. Krssler

Sheet 3 of 7 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	Water Level	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	10	SHALE, dark brown, thinly bedded, severely (highly) weathered dry	NA	~~NM~~ NM	NA	NA	NA	Described from cuttings w/ 8" OD augers. Color change ~10 ft
	11							
	12							
	13							
	14							
	15							
	16							
	17							▽ Water encountered ~17 ft
	18							
	19							
	20							

Project: PBOW

Hole Number: PB-BED-MW26

HTRW DRILLING LOG (continuation sheet)

Hole Number: PB-BED-MW26

Project: PBOW | Geologist: D. Kessler | Sheet 4 of 7 sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	20	SHALE, dark brown	NA	NM	NA	NA	NA	
	21							Cuttings ~~begins~~ became dry ~~dry~~ at ~ 21 Ft
	22							
	23							Strange, sweet organic odor from cuttings PID = 0.0 ppm Borehole 0.0 ppm
	24	SHALE, bluish gray, hard, micro-laminated, slightly broken, fresh weathering						Description from rock core knocked out of auger (24.3-24.5')
		8" OD Auger Refusal @ 24.5 Ft						
	25	SHALE, hard, competent						PID = 0.0 ppm H_2S = 0.0 ppm (Still strange odor) Natural HC
	26							
	27							Drilled to 27.5 Ft w/ 8" rotary bit. Set 6 5/8" steel casing at 27.5 Ft.
	28	SHALE, very dark brown, moderately hard, thinly laminated, slight weathering, pyrite vug at 30.1 Ft, wavy limestone layers 28.2-28.3', 29.4-29.5', 29.7-29.75', ~~29~~ 30.3-30.4', 30.65-30.75',		0.0	Box # 1 photo	Fracs 28.8 29.1 29.8		Began coring 9/8/01 1700 C-1 (27.5-32.5) Breathing Air: PID = 0.0 ppm CO = 0 ppm O_2 = 21.1% LEL = 0% H_2S = 0 ppm
	29							
	30							

Project: PBOW | Hole Number: PB-BED-MW26

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW26

Project: PBOW

Geologist: D. Kessler

Sheet 5 of 7 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	Unit/Zone	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample or Frac	Recovery (ft)	Remarks
	30	SHALE, very dark brown, moderately hard, thinnly laminated, slight weathering, Lm layers wavy, continuous 30.95-31', 32.35-32.45'.			Box #1	-30.1 (clay filled)		End: 1715 Start: 1702
					30.8	-30.8 (clay filled)		5 Ft Run 5.1 Ft Recovery 0.1 Ft Fain.
	31				Box #2 photo	-31.4 (clay filled) -32.2		
	32				32.6			32.5 32.6
		As above, unbroken, pyrite in vugs. wavy Lm layer at 32.5-32.6'						C-2 (32.6-37.5') End: 1745 Start: 1735
	33				Box #3 photo			HC odor while drilling
	34							5 Ft Run 5 Ft Recovery 0 Loss
	35				36.4	36.4		
	36				Box #4	Vertical Frac (Not water bearing)		
	37					37.5		37.5
		As above, unbroken (except from pieces of vertical frac			Box #4 photo	Vertical fracture		C-3 (37.5-43.0') End: 1816 Start: 1804
	38				39.5			
	39							
	40							

Project: PBOW

Hole Number: PB-BED-MW26

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW26

Project: PBOW

Geologist: D. Kessler

Sheet 6 of 7 Sheets

Elev (ft)	Depth (ft)	Description of Materials	USCS Class	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	40	SHALE, very dark brown,				Fracs		Drilled (C-3 cont)
						40.2 ft clay filled vertical		5.5 Ft Run
				NM		40.6		5.5 Ft Recovery
	41					40.7 (clay filled)		
					Box #5			0 Loss
		41.5						
		LIMESTONE, gray, hard, massive, slightly weathered, 1 vug, calcareous						HC odor
	42				photo	42.1 horizontal 42.3 vertical		
					43.0			
	43							Began drilling 9/10/01 0838
						Frac 43.1		C-4
						43.55-43.6		(43-48.4')
	44	As above 43.55-43.6' frac rounded edges		NM				
		44.0 – 45.6'; pitted LM (30%) 5% vugs 45.1-45.3 - Honeycombed			Box # 6			5 Ft Run
								5.4 Ft Recovery
	45	46.3-47'; pitted, vugs				45.3		0.4 Ft Gain
					photo			
	46				46.4			
	47	47			Box # 7	47		▽ Possible Bedrock water at 47'
		SHALE, dark gray, soft, thinly laminated, highly weathered, intensely fractured (kelly apart) (decomposed).			photo			
	48							
						Fracs		48.4
								C-5
	49	As above						(48.4-53.4')
		49.5						
		Limy SHALE, highly weathered				pyrite		End 1103 start 1048
	50							

Project: PBOW

Hole Number: PB-BED-MW26

HTRW DRILLING LOG

(continuation sheet)

Hole Number: PB-BED-MW26

Project: PBOW

Geologist: D. Kessler

Sheet 7 of 7 Sheets

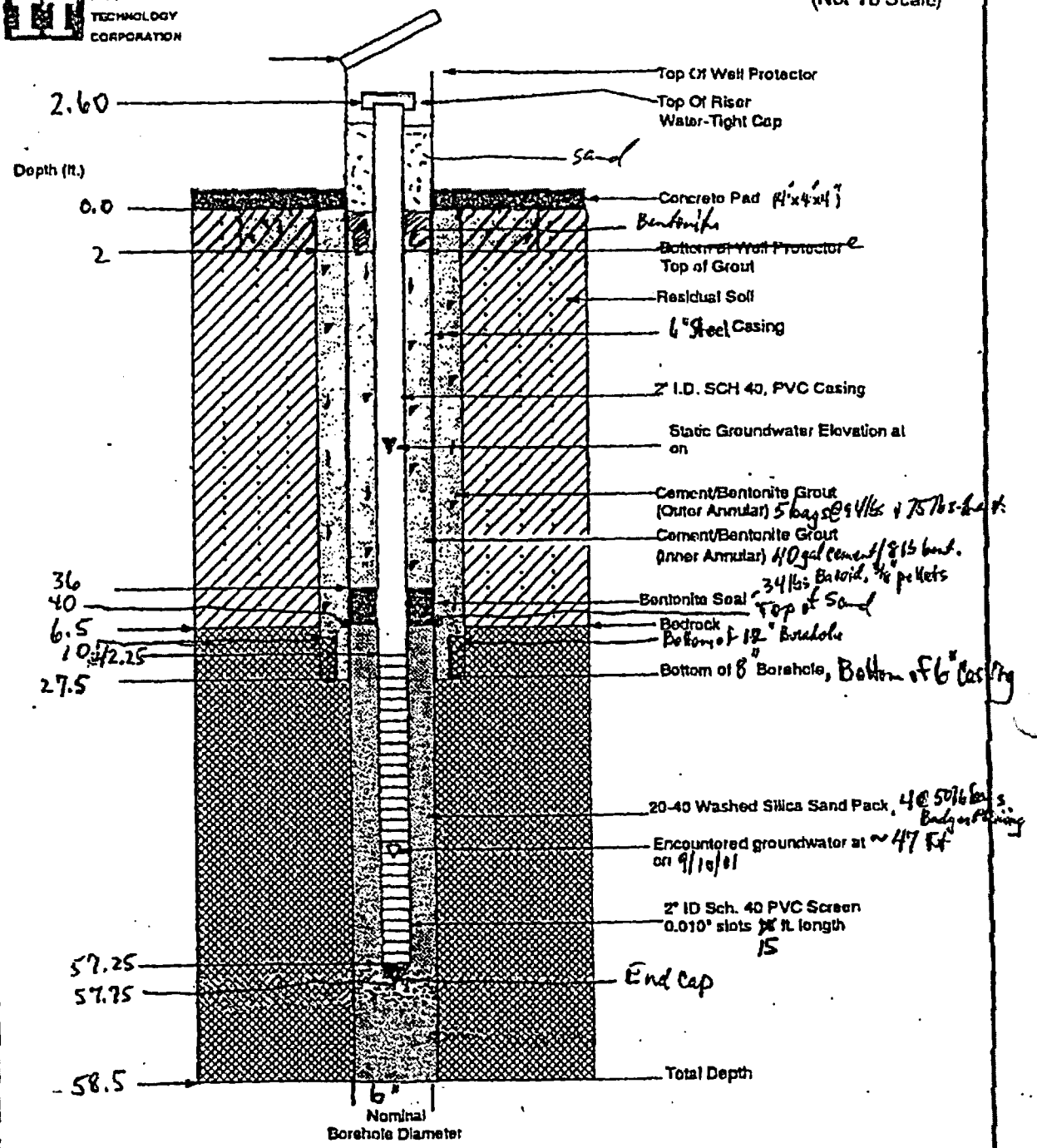
Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	50	Limey SHALE, dark gray, moderately hard, thinly bedded, moderately weathered, Fossils (bracks, corals), calcareous moderate to highly fractured (not yet broken)			50.5 Box # 8 photo	FRACS 51 Pyrite		HC odor 5 Ft Run 5.2 Ft Recovery 0.2 ft Gain Pumped well Recharge: 1225 @ 3 min = 0.1' 1228 @ 3 min = 0.1' 1231 @ 3 min = 0.1' 1245 @ 14 min = 0.1' 1256 @ 14 min = 0.1' 1312 @ 16 min = 0.1'
	51			NM				
	52							
	53	Weathering zone Limey SHALE Shaly LIMESTONE, dark gray, soft to moderately hard, ~~thinly bedded~~ massive, moderately weathered fossils, (bracks, corals, crinoids), 2 pyrite filled vugs, unbroken			53.6 Box # 9 photo	54.3 (rounded edges)		C-6 (53.6 – 58.5) End: 1408 Start: 1355 4.9 ~~5~~ Ft Run 4.85 Ft Recovery 0.05 Ft Loss
	54							
	55			MM				
	56							
	57							
	58							
	59	Total Depth = 58.5 Ft						
	60							

Project: PBOW

Hole Number: PB-BED-MW26

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Notes:

Well No.: PB-BED-MW26
Date Installed: 9/10/01
Elevation Top of Casing: 677.21 ft

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

DWUMWA2DWC.DRW

TNTA-BEDGW-001

HTRW DRILLING LOG

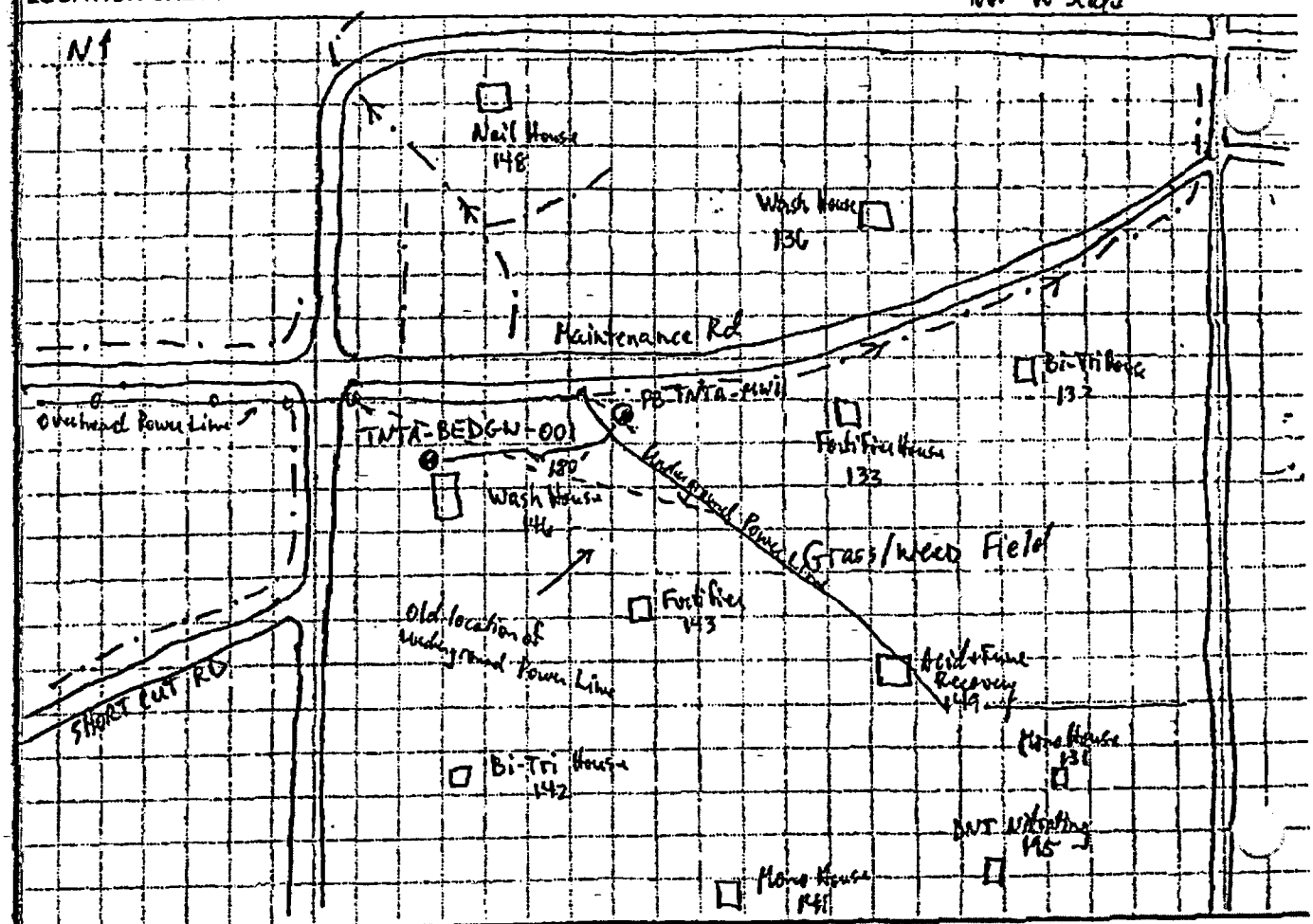
DISTRICT: Nashville, TN		HOLE NUMBER: TNTA-BEDGW-001
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Boart Longyear	SHEET: 1 OF 10
3. PROJECT: PBOW	4. LOCATION: NASA Plum Brook Station, Sandusky, OH	
5. NAME OF DRILLER: Paul Dickinson / Tod Schmelfelds	6. MANUFACTURER'S DESIGNATION OF DRILL: BK81 / Centura C2-25U	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 6" OD. Installed 2" PVC monitoring well.	8. HOLE LOCATION: See Sketch	
	9. SURFACE ELEVATION: 636.99 Ft	
	10. DATE STARTED: 9/24/01	11. DATE COMPLETED: 9/13/01
12. OVERBURDEN THICKNESS: 8.5 Ft	15. DEPTH GROUNDWATER ENCOUNTERED: Groundwater not encountered (overburden)	
13. DEPTH DRILLED INTO ROCK: 77.5 Ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 86 ft.	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	9

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kessler / [illegible]

LOCATION SKETCH/COMMENTS — SCALE: Not To Scale



PROJECT: PBOW | HOLE NO.: TNTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 2 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Weeds						
		Loose, (10YR 3/2) very dark grayish brown SAND, trace silt, organics weed(root), dry 0.4			NA	5/5	1.4	Began drilling 8/4/01 1429
		Fill: (Loose, 10YR 5/4) yellowish brown, homogeneous, very fine gray, SAND, very well sorted, organics (roots), dry) 1.0	SP	0.0		5/5	2.0	
	1	Fill: (Loose, whitish gray, sandy GRAVEL, very fine grain, 30% sand, very fine grain to 20 mm gravel pebbles, dry)	Gm			1630		Old Road bed, parking area
	2	Fill: (Loose, (10YR 3/3) dark brown, mottled (brownish yellow, black), very fine grain, SAND, very well sorted 1", 2", 4" black ash layers, moist ~~very~~ dry)	SP	0.0	NA	4/4	1.7	Background Breathing Air: PID = 0.0 ppm
	3	1/4" dark gray, clay layers (wavy) in black sand ~~3.5-4.0 ft~~ 3.3-3.7				5/5	2.0	Black sand (ash) ~~so~~ is carbon from burning
	4	4.4				1632		VRAE:
		Stiff, (10YR 4/1) dark gray, homogeneous, silty CLAY, low plasticity, blocky bedding, dry		0.0	NA	1/3		CO = 0 ppm
	5					7/12	1.8	LEL = 0%
							2.0	H_2S = 0 ppm
								O_2 = 21.3%
	6					1634		
		Consistency increasing w/ depth	CL		NA	4/8		
		As above. Shale bedding (laminations) visible at 8.5 ft.		0.0		12/20	2.0	
	7						2.0	
						1642		Wet pockets w/in bedding
	8	As above, 8.5			NA	3/20	1.7	Bedrock 8.5'
		SHALE, dark gray, soft, very thinly laminated, severely weathered, dry	NA	0.0		23/50 for 4"	1.7	Almost clay
	9					1647		
	10							

Project: PBOW

Hole Number: TNTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TMTA-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 3 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	Unit Symbol	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	10	SHALE, severely weathered, very soft, very thin laminations, dry	NA	0.0	NA	25/ 50 for 5"	0.9/ 0.9	10
	11	Spoon Refusal @ 10.9	NA	NA	NA	NA	NA	10.9 Began with 4¼" ID augers
	12	SHALE, gray, dry						
	13							
	14							
	15							Bottom of 12" OD Borehole at 15 Ft 15
	16							
	17							
	18							
	19							
	20							

Project: PBOW

Hole Number: TMTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA-BEDGW-001

Project: PBOW

Sheet 4 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (%)	Remarks
	20	SHALE, gray, dry	NA	0.0	NA	NA	NA	
	21							
	22							
	23							
	24							
	25	4¼" ID Auger Refusal @ 25 ft	NA		NA	NA	NA	Began drilling 9/5/01 0930 w/ 8" OD Rotary bit
	26	SHALE, gray, soft						
	27			1.5				Breathing Air / Background: PID: 0.0 ppm VRAE: CO = 0 ppm LEL = 0% H_2S = 0 ppm O_2 = 20.7%
	28							
	29							
	30							

Project: PBOW

Hole Number: TNTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 5 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	30	SHALE, gray, soft	N/A		NA	NA	NA	Background/ Breathing Air: PID: 0.0 ppm
	31			0.6				VRAE: CO: 0 ppm LEL: 1% H_2S: 0 ppm O_2: 20.8%
	32							
	33							
	34							
	35							Using water to circulate cuttings from borehole. No water loss.
	36							
	37							Strange, sweet organic odor 1.6 ppm
	38							Clay Slug attempt to wash out. (2-3 ft length)
	39							
	40							

Project: PBOW

Hole Number: TNTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 6 of 10

Elev (ft)	Depth (ft) bgs	Description of Materials	Inches/Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	40	SHALE, gray, soft	NA		NA	NA	NA	Large 2 Ft Slug of silty CLAY with pebbles surges to top of ~~well~~ borehole. pebbles subrounded gray, brown
	41							
	42							
	43							Drill Rod begins chatter at 43.5'
	44							Chattering stops at 44 Ft
	45							
	46							SHALE ?
	47	SHALE, gray, soft						
	48							still no coreable bedrock. No rock cuttings, only silty clay nodules gathered from water.
	49							
	50							

Project: PBOW

Hole Number: TNTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 7 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	50	SHALE, gray, soft		NM	NA	NA	NA	
	51	shaley LIMESTONE, average hardness, dark gray, moderately weathered, pyrite, fossils						Described from cuttings
	52							
	53							
	54							Bottom of 8" Borehole, Bottom of 6" Steel casing @ 55 ft
	55					FTBCS		9/13/01 coring
						56.8		Run 55-60 wet
								Run 5' 60'
								Recov 4'
								Start 10 Am
								End 10 40
	56					56.6		
	57	v. hard, massive, gray, limestone		NM	Box 1 55-58	Run 1 ~~57.8~~ 58 ~~58.6~~		~~55-60~~
	58							
	59							
	60					60		

Project: PBOW

Hole Number: TNTA-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA-BED GW001

Project: PBOW

Contractor: RPodar.c

Sheet 8 of 10

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Use	Field Screening Results (ppm)	Geotech Sample or Core Box No.	Analytical Sample No. FRACS	Recovery (ft)	Remarks
	60	LIMESTONE, gray, very hard, massive bedding			60.3	Run 2		Run 60-65
					60.7			
					61			
	61				61.5			
					61.4			
					62			
	62	as above				Run 2		Run 60-65
								Recov 5'
					62.9	Box 2		Recov 5'
	63			NM				PID 0.0
					63.5	58-62		
	64				64			
	65	as above				Run 3		Run 65-70
								Run 5'
						Box 3		Recov 5'
	66			NM	66.2	Box 4		Box 3
								62-65
	67				67.5			
								Box 4
								65-69
	68				68.3			
	69							
	70							

Project: PBOW

Hole Number: TNTA-SEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole number: INTA BED GW001

Project: PBOW

Geologist: R Roberts

Sheet 9 of 10 sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Frocs	Recovery (%)	Remarks
	70	as above			Run 4			Run 70-75 Start 1145 Run 5' Recov 5'
	71	LIMESTONE, gray, very hard, massive bedding			Box 5 69-72			PID 0.0
	72				71.4 71.9			
	73			NM	~~72.8~~ ~~72.9~~			
	74				73.8 73.7			
	75							
					Run 5			Run 75-80 Start 1200 Run 5' Recov 5'
	76			NM	Box 6 ~~72-76~~ Box 7 76-79.5	76.2 76.8		Box 6 72-76'
	77					77.5		
	78					78.2		
	79					79		
	80							

Project: PBOW

Hole Number: INTA BED GW001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTA6ED (W001)

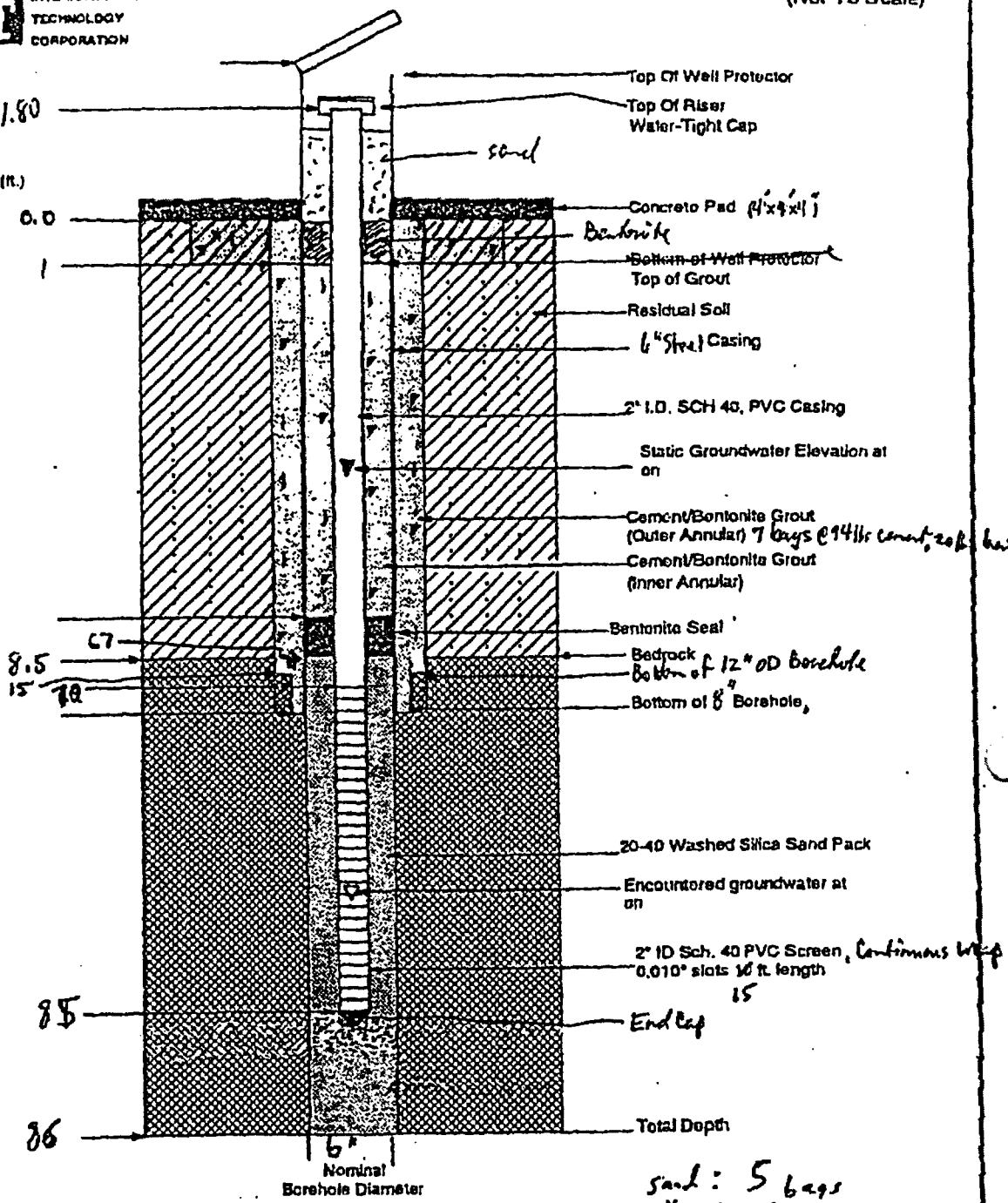
Project: PBOW | Contractor: R Robin's | Sheet 10 of 10

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech Sample or Core Box No.	Analytical Sample No. FTCS	Recovery (ft)	Remarks
	80				Run 6			Run 8-85 Run 5' Recov 5'
	81	as above		80.8	80.8			
		LIMESTONE, gray, very hard, massive bedding		81.5	79.5			Box 8 79.5-83
	82			NM	82.7			
	83				83.1			
					83.6			
	84				84.1			Box 9 83-85
	85							85
								set at 85 85' sump ~~[illegible]~~ 85-90'
	86	Total Depth = 86 ft						
	87							
	88							
	89							
	90							

Project: PBOW | Hole Number: TNTA-BED(W001)

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



sand: 5 bags
pellets: 1 bucket

Notes:

Well No.: TNTA-BEDGW-001
Date Installed: 9/13/01
Elevation Top of Casing: 638.79 ft

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

BWMWA2DWC.DRW

TNTB-BEDGW-001

HTRW DRILLING LOG

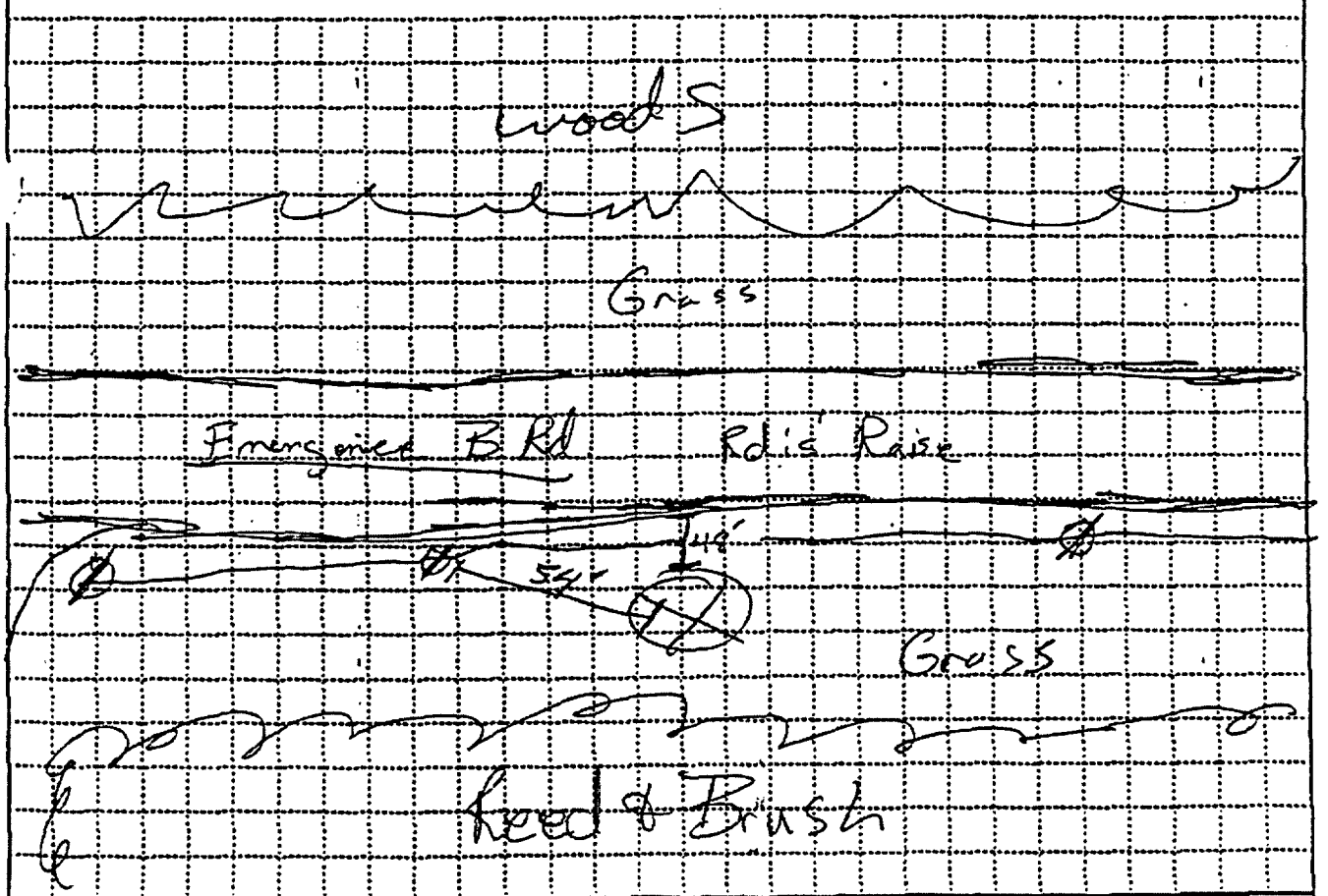
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-TNTB-BEDGW-001
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 4 SHEETS
3. PROJECT: TNTB / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich-D-120	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich-D-120 (Drill Rig) 12 1/4 in ID HSA, 2 x 24" SS split Spoon 140lb Hammer, 10 inch Roller Cone Bit, 3" x 10' Core barrel, 825 Ingersoll Rand Air Compressor	8. HOLE LOCATION: N = 618737.55, E = 1417218.02 See Sketch	
	9. SURFACE ELEVATION: 659.80 Ft. ~~646.0' (From Topo)~~ DKS	
	10. DATE STARTED: 9/6/97	11. DATE COMPLETED: 10/1/97
12. OVERBURDEN THICKNESS: ~1.0'	15. DEPTH GROUNDWATER ENCOUNTERED: Not encountered in overburden / ~13.0	
13. DEPTH DRILLED INTO ROCK: 24'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 4.95 on 10-4-97	
14. TOTAL DEPTH OF HOLE: 25'	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
1	X		1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / Ed Kamrosky

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT: TNTB / Plum Brook Ordnance Works — HOLE NO. IT-TNTB-BEDGW-001

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

IT- HOLE NUMBER TNTB-BEDGW-001

PROJECT TNTB Plum Brook Ordnance Works INSPECTOR G. Buettner

SHEET 2 OF 2 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	PENETRATION RESISTANCE (ft)	REMARKS (ft)
		Grassy Surface 0.2	HNU	Geotech Sample	3 Blow Count	Sample Thru 4¾" HSA using 2'x2" S.S. Split Spoon. (1250)
		SILT Dark br, Dry, organics (Rootlets)				
	1	SILT 0.5 gr. (Shale Black), mottled Br & Orange mottle, Dry, low lamed Pl. 1.0'	ppm 19.0'	IT-TNTB-BEDGW-001 0-2'	3/3 7/41	Run 2.0' Rec 1.7 Loss 0.3
		Shale (Black) Dry Thinly Bedded				
	2		45.0 ppm			Auger to 2' 2.0' Spoon Refusal
	3				50/4"	Logs from cuttings until we hit competent Bedrock. (1330) Pack up & demobilize
	4	Auger Refusal 4.5'				use 10" Roller cone bit to set casing.
		Shale/silt Stone Clogged from cuttings				
	5					
	6					
	7					
	8					
	9	9.0' Shale/silt stone. Mod. Hard, Slightly Damp, Sl. Medium gray, no odor.			P-1	Begin Coring w/ HQ 3" ID Core barrel, 9-25-97 End 15:30 Start 12:00 Time 3:30. Core barrel is broken. Core 0.5 50% Rec

HTRW DRILLING LOG

IT-TNTB-BEDGW-001

PROJECT: Plum Brook Ordnance Works

INSPECTOR: G. Bruckner

SHEET 3 OF 3 SHEETS 4

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ppm)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Shale, slightly weathered soft- to moderate hard grey moist		P-2		Begin Coring at 10' using 2" 10' core barrel 0920 9-31-97
	11					W/ @ 11.5'
						End 1020 Start 09:20 Time
	12					Run 8.5' Rec. loss 1 Air Pressure: 120 PSI
	13	Shale, wheathered soft- moderate hard grey wet				
	14	Shale slightly weathered soft- moderate hard grey moist				
	15					
	16					
		Shale, wheathered soft to moderate hard grey wet				
	17					
	18					
	19					
	20					

HTRW DRILLING LOG

HOLE NUMBER: IT-TNTB-BEDGW-C01

PROJECT: Plum Brook Ordnance Works | INSPECTOR: B. Ranesky | SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	CONTROL SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
		Shale weathered to moderately weathered soft to moderately hard	H_2S			End 1138
	21	grey	1 ppm at well head	-		80% recovery
		saturated	0 ppm BZ			
	22					
	23					
	24					
	25					
		BOH @ 25'				

PROJECT: Plum Brook Ordnance Works | HOLE NO. IT-TNTB-BEDGW-C01

TNTB-BEDGW-002

HTRW DRILLING LOG

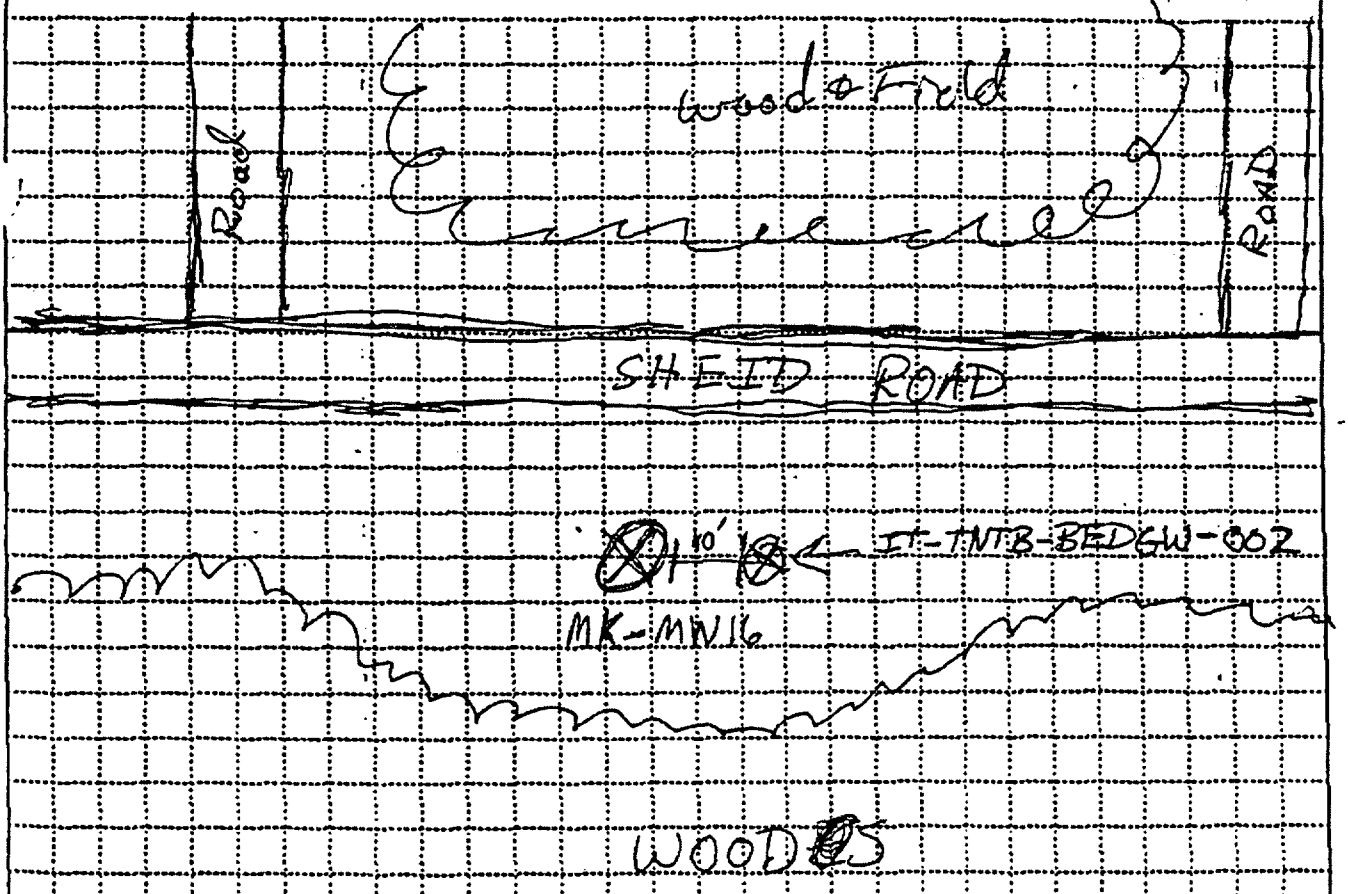
DISTRICT: USACE / Nashville		HOLE NUMBER: IT-TNTB-BEDGW-002
1. COMPANY NAME: IT Corp	2. DRILL SUBCONTRACTOR: Belasco Drilling	SHEET 1 OF 4 SHEETS
3. PROJECT: TNTB / Plum Brook Ordnance Works	4. LOCATION: Sandusky, Ohio	
5. NAME OF DRILLER: Allen Dudley	6. MANUFACTURER'S DESIGNATION OF DRILL: Diedrich D-120 &	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: Diedrich D-120 (Drill Rig) 12 1/4 inch ID HSA, 2" x 2" SS split spoon, 140 lb. Hammer, 2" x 10" Core Barrel 10" + 6" Roller Cone Bit, 875 Ingersoll Rand Air Compressor	8. HOLE LOCATION: N=616835.18 E=1918020.88 See Sketch	
	9. SURFACE ELEVATION: 670.10 Ft ~~670.0~~ / (From Topo) DKK	
	10. DATE STARTED: 9/5/97	11. DATE COMPLETED: 9/24/97
12. OVERBURDEN THICKNESS: ~~4.0~~ 2.8'	15. DEPTH GROUNDWATER ENCOUNTERED: ~11.0	
13. DEPTH DRILLED INTO ROCK: 22.4'	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: 6.50 on 11-4-97	
14. TOTAL DEPTH OF HOLE: 25.2	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
1	X		1

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
						%

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
		X		Greg Buckner / [signature]

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT	HOLE NO.
TNTB / Plum Brook Ordnance Works	IT-TNTB-BEDGW-002

ENG FORM 5056-R, AUG 94 (Proponent: CECW-EG)

HTRW DRILLING LOG

HOLE NUMBER: IT-TNTB-BEDGW-002

PROJECT: TNTB / Plum Brook Ordnance Works

INSPECTOR: G. Buckner

SHEET 2 OF 2 SHEETS 4/

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	SAMPLE NO. / BLOW COUNT (ft)	REMARKS (ft)
		~~SILT~~ Gravel ~~gul (shale)~~ sily br & gray (mottled) lo Org. GM 0.8'	HNU		4/7 6/5	Sample thru 4 1/4" ID auger using 2" ID SS split spoon
	1	SILT gul (shale) Br & gray (mottled) odd Low Pl. ML 2.8'	30.0 ppm	2.0'		Raw 2.0' Rec 1.2' Loss 0.8' Auger to 2.0' 2.0'
	2			Geotech sample sphit IT-TNTB-BEDGW-002 2'-4' 9-5-97 4.0'	3/13 30/59 Air	
	3	Shale wea dk gr bdd Spoon Refusal 3.9'	18.0 ppm			Raw 2.0' Rec 1.6' Loss 0.4' Auger to 4.0' 4.0'
	4	Shale highly weathered Gray				Use 12" roller cone bit to set 10' casing 5' into bedrock. Logged from Cuttings
	5					
	6					
	7					
	8	Shale MOD. weathered, gray 8.0'		8.0' Box 1		8.0' Bottom of casing. Casing will not go any deeper shale is fallin into hole. shale is competent. 9-24-97 09:30 Begin Coring at IT-TNTB-BEDGW-002 - Begin at 8' using 13.5' core bbl and Air.
	9					
	10					

HTRW DRILLING LOG

HOLE NUMBER: IT-TNTB-BEDGW-002

PROJECT: Plum Brook Ordnance Works | INSPECTOR: G. Bretzer | SHEET 2 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (ft)	FIELD SCREENING RESULTS (ft)	GEOTECH SAMPLE OR CORE BOX NO. (ft)	ANALYTICAL SAMPLE NO. (ft)	REMARKS (ft)
	11	shale, stonecutting, fg-vfg nodules, gray, mod. hard, wet/saturated thinly bedded.				P-1 End 13:50 ~~Lunch~~ Start 10:50 Time ~~3:00~~ 2:40 Run ~~10.0'~~ 8.0' Rec 8.0 Loss ~~2.0~~ 0.0' Air Pressure 140psi - 120psi WL - 14:00
	12					
	13					
	14					
	15					
	16		Slight H_2S odor after pulling bowl could hear boiling in the hole. ~~Stg~~ Sl. 11 0 0ppm			P-2 End 16:35 Start 14:35 Time 2:00 Run = ~~10.0'~~ 9.0' Rec - 8.0 Loss 1.0 Air Pressure 120psi WL. 25.2'
	17					
	18					
		spin				
	19					
	20					

HIRW DRILLING LOG

HOLE NUMBER: IT-TNTB-BEDGW-002

PROJECT: Plum Brook Ordnance Works/TNTB

INSPECTOR: G. Buckner

SHEET 4 OF 4 SHEETS

ELEV. (ft)	DEPTH (ft)	DESCRIPTION OF MATERIALS (col)	FIELD SCREENING RESULTS (col)	GEOTECH SAMPLE OR CORE BOX NO. (col)	ANALYTICAL SAMPLE NO. (col)	REMARKS (col)
		Shale, slightly weathered, pyrite nodules, gray mod. hard, wet, thinly bedded				
	21					
	22					
	23		H_2S 0.0 ppm			
	24					
	25	Spin 25.0 Limestone, hard, gray to light gray				
		25.2' Bottom of Hole				16:40 Begin Reaming hole w. 4½ 6" Roller cone bit.
	26					
	27					
	28					
	29					
	30					

TNTB-BEDGW-003

HTRW DRILLING LOG

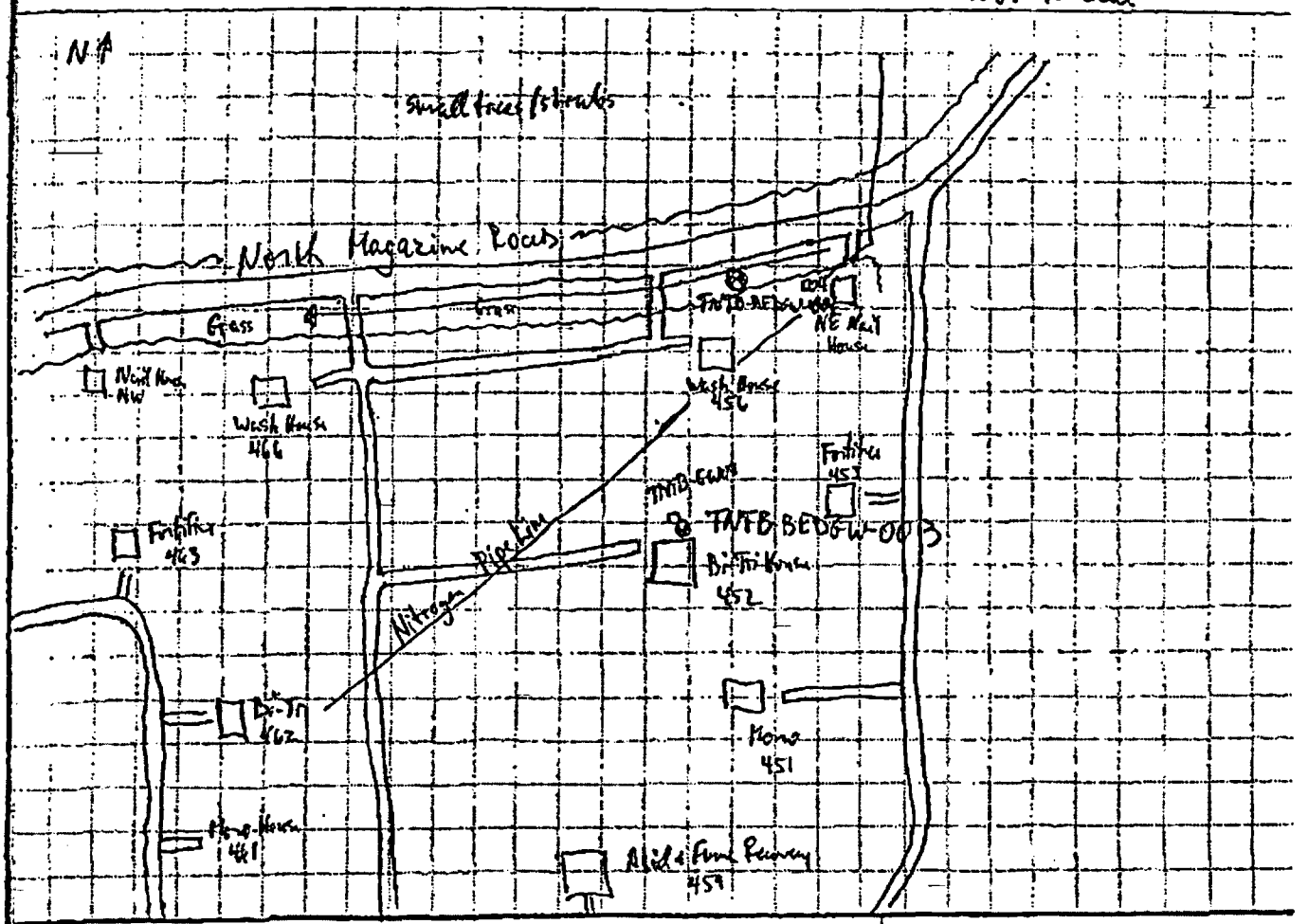
DISTRICT	Nashville, TN
HOLE NUMBER	TNTB-BEDGW-00
SHEET / SHEET	1 of 6
1. COMPANY NAME	IT Corporation
2. DRILL SUBCONTRACTOR	Beant Longyear
3. PROJECT	PBOW
4. LOCATION	NASA Plum Brook Station, Sandusky, OH
5. NAME OF DRILLER	Paul Dickinson
6. MANUFACTURER'S DESIGNATION OF DRILL	BK81
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole [illegible] OD. Installed 2" PVC monitoring well.
8. HOLE LOCATION	See Sketch
9. SURFACE ELEVATION	681.34 Ft
10. DATE STARTED	8/30/01
11. DATE COMPLETED	9/8/01
12. OVERBURDEN THICKNESS	~~14.8 Ft~~ Dry 4.3 Ft
13. DEPTH DRILLED INTO ROCK	28.5 Ft
14. TOTAL DEPTH OF HOLE	43.3 Ft
15. DEPTH GROUNDWATER ENCOUNTERED	11.3 Ft (overburden), Bedrock gw suspended at 40.9 Ft
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	NA
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	NA

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	5

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kesch

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT PBOW

HOLE NO. TNTB-BEDGW-003

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTB-BEDGW-003

Project: PBOW

Geologist: D. Kessler

Sheet 2 of 6

Elev (ft)	Depth (ft) Bgs	Description of Materials	USCS/Lithology	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Weeds						
		Fill: Black, silty SAND, dry 0.1						Began drilling 8/30/01 1135 with 4¼" ID HSA
	1	Fill: (Loose, 10YR 2/4/6) dark yellowish brown, homogeneous, SAND, very fine grain, very well sorted, dry)	SP	0.0	NA	2/2/ 3/3 1140	1.5/ 2.0	Background/Breathing PID=0.0ppm CO=0ppm LEL=1% H_2S=0 ppm O_2=21.0%
	2	As above	SP	0.0	NA	2/2/ 1/2 1142	1.0/ 2.0	
	4	4.3						
	5	Loose, (10YR 2/2) very dark brown, mottled (50% - black, yellow, rust), very fine grain, shaley SAND, little silt (20%), 30% shale, broken, thinly laminated, severely weathered, dry	SM	0.0	NA	stop ~~2/3/~~ DKH 3/4 ~~6/6/~~ ~~7/5~~ 1144	0.5/ 2.0	Began very weathered decomposed shale
	7	As above	SM	0.0	NA	~~5/9/~~ DKH ~~14/17~~ 6/6/ 7/5 1152	1.4/ 2.0	
	9	As above Moist at 9 ft	SM	0.0	NA	stop ~~5/9/~~ ~~14/17~~ ~~9/11~~ ~~7/7~~ 1155	2.0/ 2.0	

Project: PBOW

Hole Number: TNTB-BEDGW-003

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTB-BEDGW-003

Project: PBOW

Geologist: D. Kessler

Sheet 3 of 6 sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	10	Medium dense, (10YR 2/2) very dark brown, mottled (black, yellow, rust), 50% mottled, very fine grain, shaley SAND, 40% shale, trace sand 10%, moist 11	Sm	0.0	NA	9/4/ 7/7	1.5/ 2.0	
	11	Medium dense, (10YR 3/1) very dark gray, very fine grain, SAND, trace silt (<5%) shale 40%, black shale, broken, wet				1158		▽ Encountered overburden groundwater at 11.3 ft
	12	As above, silt content increases with depth. 14	SP	NM	NA	5/12/ 13/17 1200	1.8/ 2.0	
	14	~~As above,~~ As above, silt 20%, shale 30%, SAND 50%, wet 14.8	Sm	NM	NA	9/12/ 26/40 1204	1.6/ 2.0	
	15	SHALE, black, broken, thinly laminated (5Y 5/6) olive, 1% pocket of silt, friable, wet	NA					Bedrock Bottom of 12" borehole at 15 ft
	16			NM	NA	50 for 5" 1234	0.4/ 0.4	
	17	Spoon Refusal @ 16.4 ft SHALE	NA	NA	NA	NA	NA	
	18	4¼" ID Auger Refusal @ 18 ft SHALE	NA	NA	NA	NA	NA	Fractured (Dry) at 18.5'
	19							
	20							

Project: PBOW

Hole Number: TNTB-BEDGW-003

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TMTB-BEDGW-003

Project: PBOW | Contractor: D. Kessler | Sheet 4 of 6 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	20	SHALE, black/dark brown, moderately weathered, moderately hard chips, 10% stained, thinly laminated	NA	NM	NA	NA	NA	
	21							
	22							
	23							Bottom of 8" OD Borehole. Bottom of 6" Steel Casing @ 23 Ft
	24				~~Box #1~~ NK	Fracs		C-1 (23-28') End: 1619 Start: 1548
	25			NM				5 Ft Run 0 Ft Recovery
	26							Borehole open to 28 Ft. Core washed away. Coreborrel lined w/ very dark brown, SILT
	27							No water lost
	28	SHALE, black/very dark brown, moderately hard, thinly bedded, slightly broken, moderately weathered, pyrite in lamination 28.2; pyrite vugs 7mm to 25mm		0.0	Box #1	28.5 28.6 28.65 28.9 28.4 29.45		C-2 (28-33') End: 1700 Start 1645
	29							5 Ft Run 4 Ft Recovery
	30							

Project: PBOW | Hole Number: TMTB-BEDGW-003

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTB-BEDGW-003

Project: PBOW

Geologist: D. Kessler

Sheet 5 of 6

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Soil	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. FTRCS	Recovery %	Remarks
	30	SHALE, black/very dark brown, moderately hard, thinly bedded, slightly broken, moderately weathered, pyrite in vugs				30		(C-2 cont)
	31				Box # 1	30.7 30.6		5 Ft Run 4 Ft Recovery 1 Ft Loss
	32				photo 27			Obtained portion of lost broken bar
				NM				
	33	SHALE, as above 33-33.9 Ft, Intensely fractured				33 Intrusive 33.9		C-3 (33-38') End: 1815 Start: 1759
	34				Box # 2	34.1 Vertical also 34.8		
	35	35.1						5 Ft Run 5 Ft Recovery 0 Loss
		LIMESTONE, gray, hard, massive, slightly weathered, fossils (brachs, corals), 5% vugs (quartz filled), unbroken			photo 26	35.9		
	36				Box # 3	36		
	37	37-38 Ft; pitted, highly weathered			photo 25	37.5		
	38	As above, intensely pitted 38-38.5'.			38	38.2 38.6		Began Casing 9/8/01 0857 C-4 (38-43)
	39	39-39.4'; wavy, continuous, shale laminations			Box # 4	39 39.4		End: 0911 Start: 0857
	40				photo 24			

Project: PBOW

Hole Number: TNTB-BEDGW-003

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TMTB-BEDGW-003

Project: PBOW

Geologist: D. Kessler

Sheet 6 of 6 Sheets

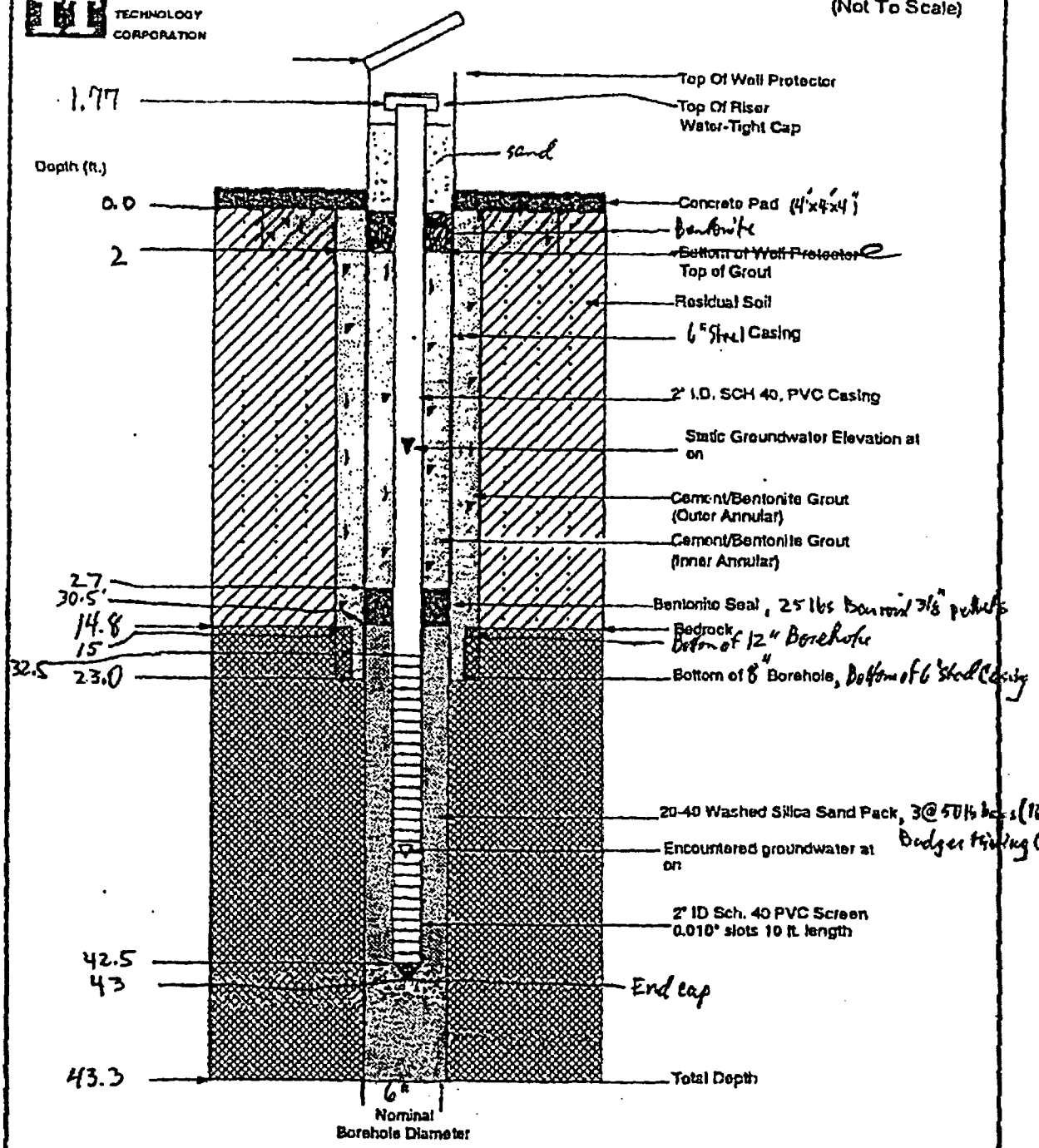
Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Frags	Recovery (ft)	Remarks
	40	LIMESTONE		-40.1		-40.1		C-4 (cont'd) (38-43.3')
		40.9		NM	Box # 4	-41.0, -41.3 } Intense		53 Ft Run
	41	SHALE, gray, highly weathered/decomposed, thinly laminated, very soft, 42.5 pyrite vugs (8)				-41.6		53 Ft Recovery
		40.9–42.7 highly weathered/decomposed			41.8	-41.8, -42 } Intense		0 Loss
	42	Moderately hard ~~clay~~ SHALE 42.6-42.9			Box # 5	-42.4		pumped borehole
					photo 23	-42.97 } Intense		
	43				43.3	-43.3		
		Total Depth = 43.3 Ft						
	44							
	45							
	46							
	47							
	48							
	49							
	50							

Project: PBOW

Hole Number: TMTB-BEDGW-003

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Notes:

Well No.: TNTB-BEDGW-003
Date Installed: 9/8/01
Elevation Top of Casing: 683.11 ft

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

BWAMWA23DWC.DRW/8/5-16-03

TNTB-BEDGW-004

HTRW DRILLING LOG

DISTRICT	Nashville, TN
HOLE NUMBER	TNTB-BEDGW-004
SHEET / SHEETS	1 of 4
1. COMPANY NAME	IT Corporation
2. DRILL SUBCONTRACTOR	Boart Longyear
3. PROJECT	PBOW
4. LOCATION	NASA Plum Brook Station, Sandusky, O
5. NAME OF DRILLER	Paul Dickinson
6. MANUFACTURER'S DESIGNATION OF DRILL	BK81
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT	4 1/4" ID/8" OD HSA with 1.4" ID Stain-less Steel split-spoons. Borehole reamed with 8 1/4" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6 5/8" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 8" OD. Installed 2" PVC monitoring well.
8. HOLE LOCATION	See Sketch
9. SURFACE ELEVATION	666.78 Ft
10. DATE STARTED	8/28/01
11. DATE COMPLETED	9/7/01
12. OVERBURDEN THICKNESS	4.9 Ft
13. DEPTH DRILLED INTO ROCK	21.2 Ft
14. TOTAL DEPTH OF HOLE	26.1 Ft
15. DEPTH GROUNDWATER ENCOUNTERED	Overburden groundwater not encountered/Bedrock unknown
16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED	4.8 Ft BGS 9/7/01 0855
17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY)	9.69 btw

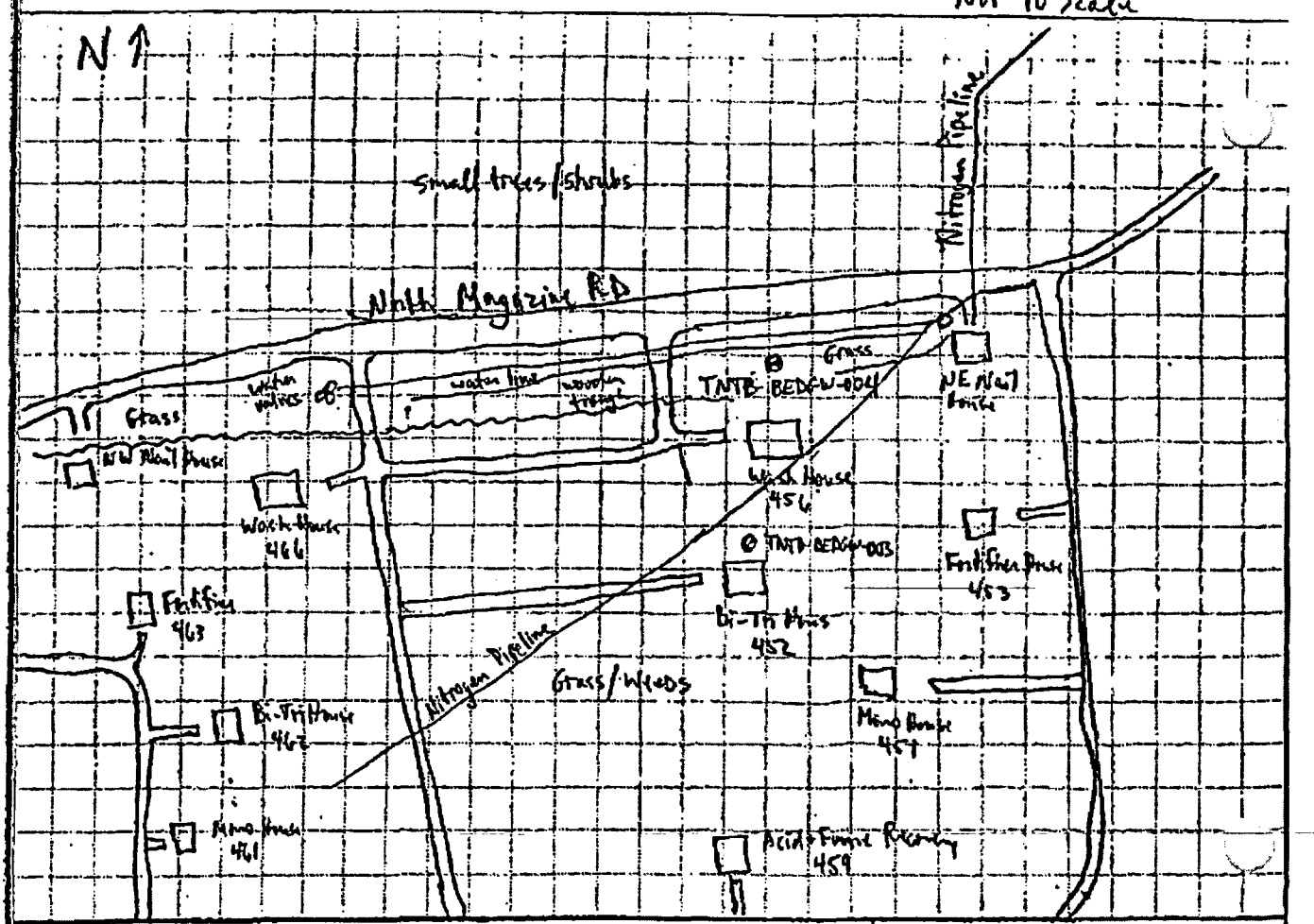
18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	4

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kessler

LOCATION SKETCH/COMMENTS

SCALE: Not To Scale



PROJECT PBOW

HOLE NO. TNTB-BEDGW-004

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTB-BEDGW-004

Project: PBOW

Geologist: D. Kessler

Sheet 2 of 4

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
		Grass						
		Fill: Stiff. (10YR 2/1) black, mottled (3%- brown), clayey SILT, some sand (20%), organics (roots) trace pebbles, dry	ml	0.0	NA	3/4/ 5/7	1.4/ 2.0	Began drilling 8/29/01 1245 w/4¼" ID augers
	1	Fill: (Stiff, (10YR 5/2) grayish brown, mottled (yellowish brown)-50%), clay SILT, some sand (20%), vfg, very well sorted, low plasticity, dry)				1746		
	2		ml	0.0	NA	4/4/ 5/7	1.8/ 2.0	thinly laminated, very weathered decomposed, former Shale
	3	As above						
	4					1752		
	5	SHALE, dark gray, broken, thinly laminated 4.9 5.2		0.0	NA	8/27/ 50 for 2" 1757	1.2/ 1.2	Began drilling 8/30/01 0745 Advanced 12" Borehole to 4.9 Ft
		Spoon Refusal @ 5.2 Ft						Continued drilling with augers.
	6	SHALE						
		4¼" ID Auger Refusal @ 6.3 Ft		0.0	NA	100 for 7" 1809	0.7/ 0.7	Attempted spoon
		SHALE, dark gray, broken, thin lam, dry						
		Spoon Refusal @ 6.2 Ft						Breathing Air/ Background
	7							PID = 0.0 ppm
	8	SHALE, very dark brown/black, slightly weathered, average hardness						VRAE: CO = 0 ppm LEL = 0% H2S = 0 ppm O2 = 20.9%
	9							Organic odor in borehole PID = 30.8 ppm
	10							

Project: PBOW

Hole Number: TNTB-BEDGW-004

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTB-BEDGW-004

Project: PBOW

Geologist: D. Kessler

Sheet 3 of 4 Sheets

Elev (ft)	Depth (ft) Depth	Description of Materials	USCS Class	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		SHALE, very dark brown/black, slight weathering, average hardness	NM	NM	NA	NA	NA	Bottom of 8" OD Borehole. Bottom of 6" steel Casing
	11					Fracs		Cut w/ 6" roller bit during clean-out.
	12	SHALE, very dark brown, moderately hard, thin lamination, moderate weathering, pyrite in pits/laminations (2%), highly fractured			Pyrite	Fracs 11.8 12.1 12.1 12.4		Began coring w/ PQ bit 9/6/97 1705 C-1 11.5-16.5' End Time: 1712 Start Time: 1705
	13					12.9 13.1 13.2 (1")		
	14			0.0	Box #1	13.7 13.9 (1/4")		5 Ft Run 4.5 Ft Recovery 0.5 Ft Loss
						14.3		
	15	Large vug filled w/ pyrite 14.4-14.5 Ft			15.3	15.3 15.9 vertical		Breathing Air PID: 0.0 ppm CO: 0 ppm LEL: 0% H_2S: 0 ppm O_2: 21.7%
	16				Box #2	16.3		
		16.8			16.5			
	17	LIMESTONE, greenish gray, hard, massive, slightly weathered, fossils (brachs/corals) in pits/vugs (10%), moderately fractured			Box #2	16.9 (mech) 16.7 17.1' (mech) 17.5 (mech)		C-2 16.5-21.5 Ft End: 1749 Start: 1740
	18					17.7 (mech) Frac 18		5 Ft Run 5.3 Ft Recovery 0.3 Ft Gain
	19				Box #3	18.2 (mech) 18.6 Frac		
	20							

Project: PBOW

Hole Number: TNTB-BEDGW-004

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTB-BEDGW-004

Project: PBOW

Geologist: D. Kessler

Sheet 4 of 4 Sheets

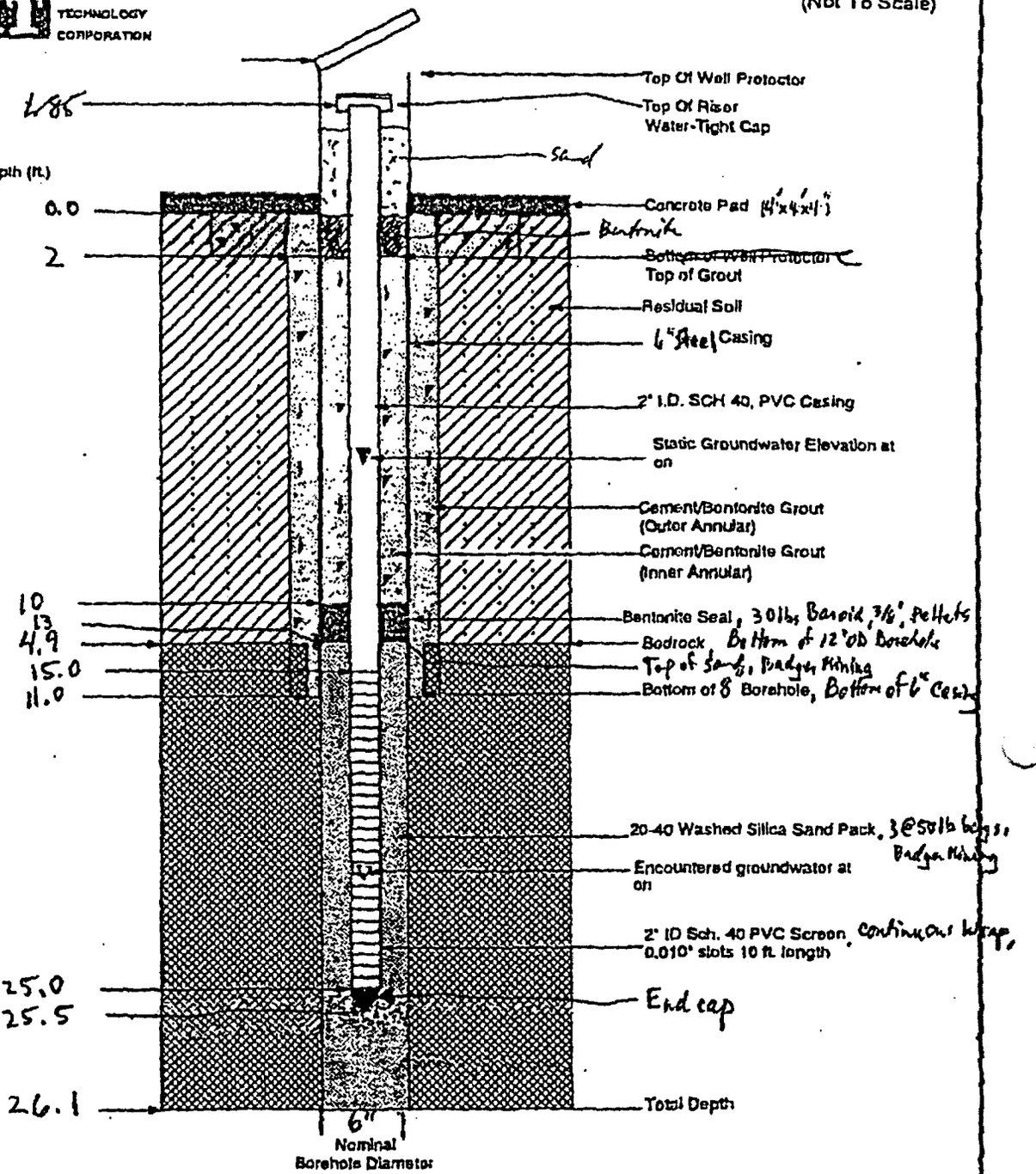
Elev (ft)	Depth (ft) bgs	Description of Materials	USCS Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Fracs	Recovery (ft)	Remarks
	20	LIMESTONE, greenish gray, hard, massive, slightly weathered, fossils (brachs, corals) in pits/vugs (10%)				20.2		(C-2 cont)
	21			0.5	Box #3	20.8 filled w/shale; 21.3 (Mech)		
								21.5
						21.7		C-3 21.5-26.1 Ft
	22							
						22.7		End 1817 start 1808
	23	23.2				23.2		
		SHALE, gray, soft, very thinly laminated, highly weathered				23.6; 23.6 Frac; 24 (mech)		4.6' Run 4.6' Recovery 0 Loss
	24				Box #4			
	25					25.1; 25.4		
		25.7				25.7		
		LIMESTONE, gray, hard 26						
	26	SHALE				26.0		
		Total Depth = 26.1 Ft						
	27							
	28							
	29							
	30							

Project: PBOW

Hole Number: TNTB-BEDGW-004

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Notes:

Well No.: TNTB-BEDGW-004
Date Installed: 9/7/01
Elevation Top of Casing: 668.63 ft

Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, Ohio

26.1
13
13.1

TNTC-BEDGW-001

HTRW DRILLING LOG

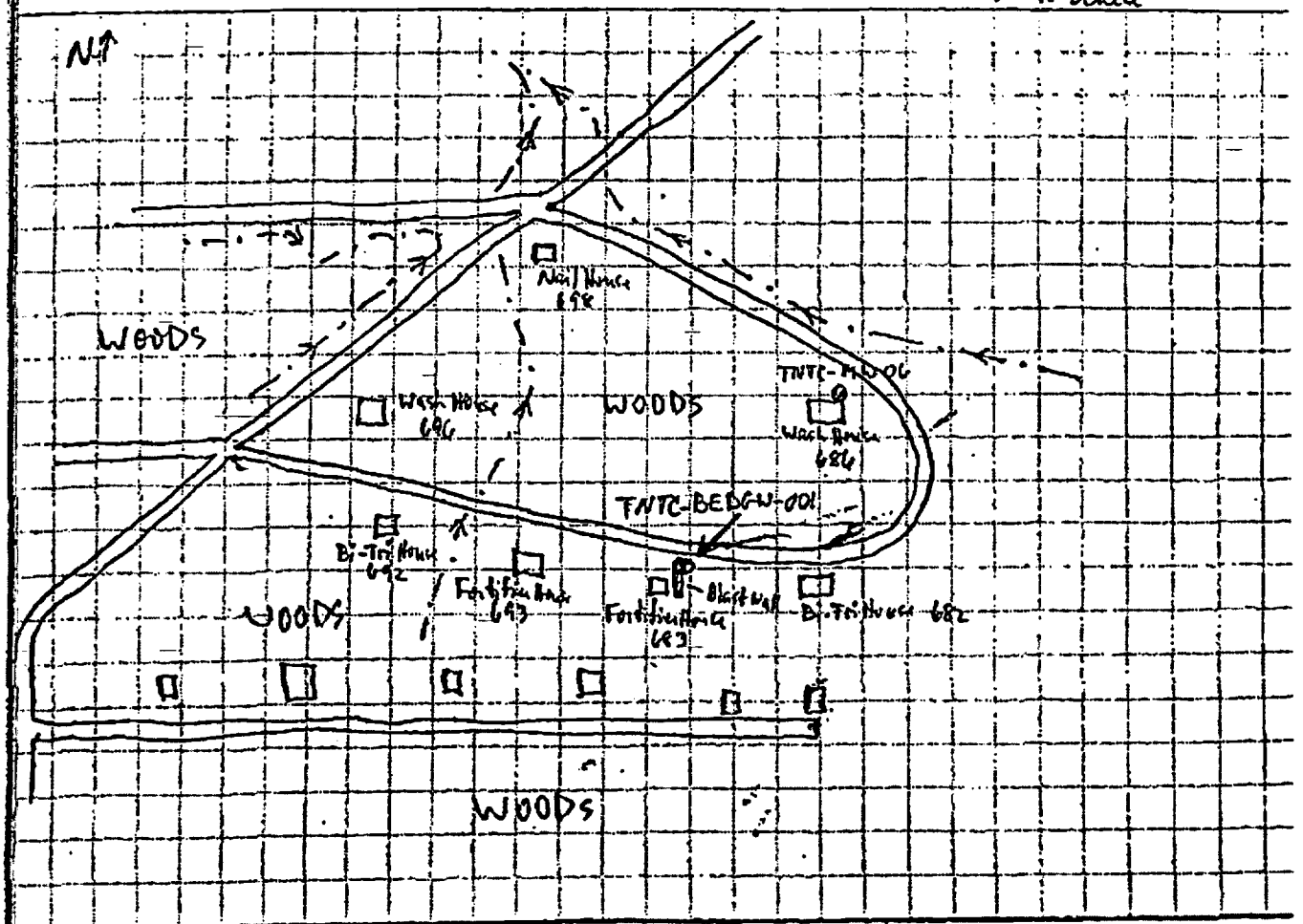
DISTRICT: Nashville, TN	HOLE NUMBER: TNTC-BEDGW-00	SHEET 1 OF 10
1. COMPANY NAME: IT Corporation	2. DRILL SUBCONTRACTOR: Boart Longyear	
3. PROJECT: PBOW	4. LOCATION: NASA Plum Brook Station, Sandusky, OH	
5. NAME OF DRILLER: Paul Dickinson / Todd Schmalt	6. MANUFACTURER'S DESIGNATION OF DRILL: BK81 for overburden Centera C2-250 for coring	
7. SIZES AND TYPES OF DRILLING AND SAMPLING EQUIPMENT: 4¼" ID/8" OD HSA with 1.4" ID Stainless Steel split-spoons. Borehole reamed with 8¼" ID/12" OD HSA. Bedrock cut with 8" OD tricone rotary bit. Installed 6" ID/6⅝" OD black steel casing. Bedrock cored with PQ bit. Cores 3" OD, borehole 6" OD. Installed 2" PVC monitoring well.	8. HOLE LOCATION: See Sketch	
	9. SURFACE ELEVATION: 664.04 Ft	
	10. DATE STARTED: 8/28/01	11. DATE COMPLETED: 9/12/01
12. OVERBURDEN THICKNESS: 14.5 Ft	15. DEPTH GROUNDWATER ENCOUNTERED: 8.8 Ft (overburden)	
13. DEPTH DRILLED INTO ROCK: ~~86 Ft~~ 71.5 Ft	16. DEPTH TO WATER AND ELAPSED TIME AFTER DRILLING COMPLETED: NA	
14. TOTAL DEPTH OF HOLE: 86 ft	17. OTHER WATER LEVEL MEASUREMENTS (SPECIFY): NA	

18. GEOTECHNICAL SAMPLES	DISTURBED	UNDISTURBED	19. TOTAL NUMBER OF CORE BOXES
	NA	NA	9

20. SAMPLES FOR CHEMICAL ANALYSIS	VOC	METALS	OTHER (SPECIFY)	OTHER (SPECIFY)	OTHER (SPECIFY)	21. TOTAL CORE RECOVERY
	NA	NA	NA	NA	NA	100 %

22. DISPOSITION OF HOLE	BACKFILLED	MONITORING WELL	OTHER (SPECIFY)	23. SIGNATURE OF INSPECTOR
	NA	X	NA	David Kusch / Reed Roberts

LOCATION SKETCH/COMMENTS — SCALE: Not to Scale



PROJECT	HOLE NO.
PBOW	TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDGW-001

Project: PBOW | Geologist: D. Kessler | Sheet 2 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unc	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
		Weeds						
	1	Fill: Loose, (10YR 4/3) brown, homogeneous, SAND, trace silt, organics (roots), vfg, very well sorted, dry 0.5	SP	0.0	NA	2/2 5/4 1640	1.4 2.0	Began drilling 8/28/01 1640 with 4¼" ID augers
	2	Fill: (color grading to yellowish brown (10YR 5/6)) No SILT						Background/ Breathing Air: PID = 0.0 ppm
	3	As above	SP	0.0	NA	2/4 5/5 1644	1.6 2.0	VRAE: CO = 0 ppm LEL = 0% H_2S = 0 ppm O_2 = 21.1 %
	4							
	5	As above Fill: (color grading to (10YR 5/8) yellowish brown)	SP	0.0	NA	3/5 5/5	2.0 2.0	
	6							
	7	At 7.6 Ft; color changing to (10YR 4/3) brown, moist	SP	0.0	NA	4/3 5/5	2.0 2.0	
	8							
	9	At 9.5-10 Ft; color changing to (5Y 4/2) olive gray, dark red/ blackish red nodules at 9.6 Ft; trace silt begins	SP	0.0	NA	5/4 5/5	2.0 2.0	▽ Encountered overburden groundwater at 8.8 Ft PID = 0.0 ppm of nodules
	10							

Project: PBOW | Hole Number: TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDGW-001

Project: PBOW | Geologist: D. Kessler | Sheet 3 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Other	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	10	Medium dense, (5Y 4/2) olive gray, homogeneous, SAND, trace silt, very fine grain, very well sorted, wet, 11.3	sp	NM	NA	5/8/17/29	2.0/2.0	
	11	Medium dense, (2.5Y 4/1) dark gray homogeneous, very fine grain SAND and GRAVEL, coarse grain to 30 mm size, limestone, wet 13	gm	NM	NA	8/17/9/32	2.0/2.0	
	12	Very stiff, (10YR 5/1) gray, homogeneous, low plasticity, silty CLAY, coarse grain shale fragments (35%), wet 14.5	cl	NM	NA	10/11/12/30	1.5/2.0	Bedrock Z. Decomposed severely weathered SHALE
	13	Very stiff, (10GY 5/N) gray, homogeneous, high plasticity, silty CLAY, irregular bedding, dry	ch	NM	NA	8/12/29/32	2.0/2.0	
	14	As above		NM	NA	17/29/33/42	1.5/2.0	
	15	As above						
	16							
	17							
	18							
	19							
	20							

Project: PBOW | Hole Number: TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 4 of 10

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample Jar: Blows	Recovery (ft)	Remarks
	21	Very hard, (1GLEY 5/N) gray, homogeneous high plasticity, silty CLAY. occasional laminated bedding planes, dry, 20% shale fragments	ch	NM	NA	10/16/ 50 for 3" 1729	1.3/ 1.3	Decomposed shale. Very hard clay in shoe tip.
	22	Spoon Retrieved @ 21.3 Ft		NM	NA	NA	NA	Began advancing only 4¼" ID augers.
	23		ch					
	24							
	25	Very hard, (1GLEY 5/N), gray, homogeneous high plasticity, silty CLAY, ~~wet~~ dry		NM	NA	16/50 for 3" 1745	0.9/ 0.9	Augers turning/ advancing fairly easily attempted spoon. End of Day
	25.8	Spoon Retrieved @ 25.8 Ft		NM	NA	NA	NA	Began drilling 8/29/01 0730 with 9¼" ID augers. 8¼" ID / 12" OD augers drilled to 25 Ft
	27	Very hard, (1GLEY 5/N) gray, homogeneous, high plasticity, silty CLAY, dry	ch					Decomposed shale
	28							
	29							
	30							

Project: PBOW

Hole Number: TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 5 of 10 Sheets

Elev (ft)	Depth (ft) Bgs	Description of Materials	USCS Line	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample or Nat. Frac.	Recovery (ft)	Remarks
	30	Very hard, (10GLEY 5/N) gray, homogeneous, high plasticity, silty CLAY, thinnly laminated bedding, dry	ch	NM	NA	100 Gm 0.4"	0.8/ 0.4	30.4
	31							Augers advancing easily.
	32							Decomposed, (severely weathered) shale
	33							
	34							
	35	As above	ch	NM	NA	50 Gm 3"	1.3/ 0.3	35 / 35.3
	36							
	37							
	38							
	39							Sweet, organic odor 0.8 ppm = PID
	40							

Project: PBOW

Hole Number: TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDFW-001

Project: PBOW

Geologist: D. Kessler

Sheet 6 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	Unified Uns	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Blows	Recovery (ft)	Remarks
	40	Weyhard, (10LE4 5/N) gray, homogeneous, high plasticity, silty CLAY, very thinly laminated bedding, dry, friable, 80% shale silt	ch	0.8	NA	100 for 6"	0.5/0.5	40.5
	41							Could not core material with wet or dry coring method.
	42							
	43							
	44							Augers cut easily
	45	As above	ch	2.2	NA	100 for 4" 0831	0.3/0.3	45.3 Strong organic odor
	46							
	47							
	48							
	49							
	50							

Project: PBOW

Hole Number: TNTC-BEDFW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDGW-001

Project: PBOW

Geologist: D. Kessler

Sheet 7 of 10 sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. / Blows	Recovery (ft)	Remarks
	50	Very hard, light gray, homogeneous, very thinly laminated bedding. SHALE, very friable, dry limestone pebble (20x20x30 mm)	NA	1.8	NA	100 for 7" 0847	0.7/ 0.7	50.6
	51							Augers difficulty cutting 51-51.5 ft
	52							
	53							
	54							
	55	As above, limestone pebble (18x20x28 mm)		NM	NA	100 for 7" 0510	0.7 / 0.7	Layers of limestone shale. Shale layers much thicker. Will stop 4¾" ID auger drilling. Shale completed. 55.2
	56							
	57					Run #		Bottom of 8" OD Bucket at 57.2' Bottom of Isolation casing at 57.2
	58	~~massive, very hard gray~~ ~~limestone~~ grey, weathered limey shale from 57-58.0 then 59 massive very hard limestone		SH / ~~ess~~ / LS		1 Fracs / 58.5 / 58.8 / 59.3 / 59.6		Run 1 Begin coring 9/11/01 57-62 Run 5' Recov 4'
	60							

Project: PBOW

Hole Number: TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BEDGW-001

Project: PBOW

Contractor: R Poderis

Sheet 8 of 10 Sheets

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/Units	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. Times	Recovery (%)	Remarks
	60							Box 1 57-62
	61					61.0		Start 900 end 510
						61		
						61.5		
	62	Massive very hard limestone				Run 2		Run 62-67 Run 5' Rec 5'
	63					63		
						63.7		Box 2 62-65
	64					64.5		Box 3 65-67
						64.8		Start 510 end 530
	65							
						66.5		
	67							67
						Run 3 9-11-01		67-72 Run 5' Rec 5'
						67.4		
	68					67.8		
						68.1		Box 4 67-69.5
	69							Box 5 69.5-
						69.5		
						69.6		Start 830 end 840
						69.5		
	70							

Project: PBOW

Hole Number: TNTC-BEDGW-001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-BED GW001

Project: PBOW

Geologist: R. Paolini

Sheet 9 of 10

Elev (ft)	Depth (ft) bgs	Description of Materials	USCS/ Unit	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No. FTCCS	Recovery (ft)	Remarks
	70							
	71					70.8		Box 5 69-74
	72	Massive very hard gray limestone			Run 4	72.4		72-77
					Box 6 74-76	72.8		5' recov 5' run point 905
	73					73.8		
						73.9		
	74					74.5		Box 6 74-76
						[illegible]		
	75					75.5		
						76		
	76					[illegible]		
						76.4		
						76.6		
	77							
					Box 7 76-78.5			Began Coring 9/12/01 Box 7 76-78.5
	78				Box 8 78.5-82	76		
						76.5		Box 8 78.5-82
	79					78		Run 77-82
						78.5		
	80							

Project: PBOW

Hole Number: TNTC-BEDGW001

HTRW DRILLING LOG

(continuation sheet)

Hole Number: TNTC-GW001

Project: PBOW

Contractor: Roulon's

Sheet 10 of 10 Sheets

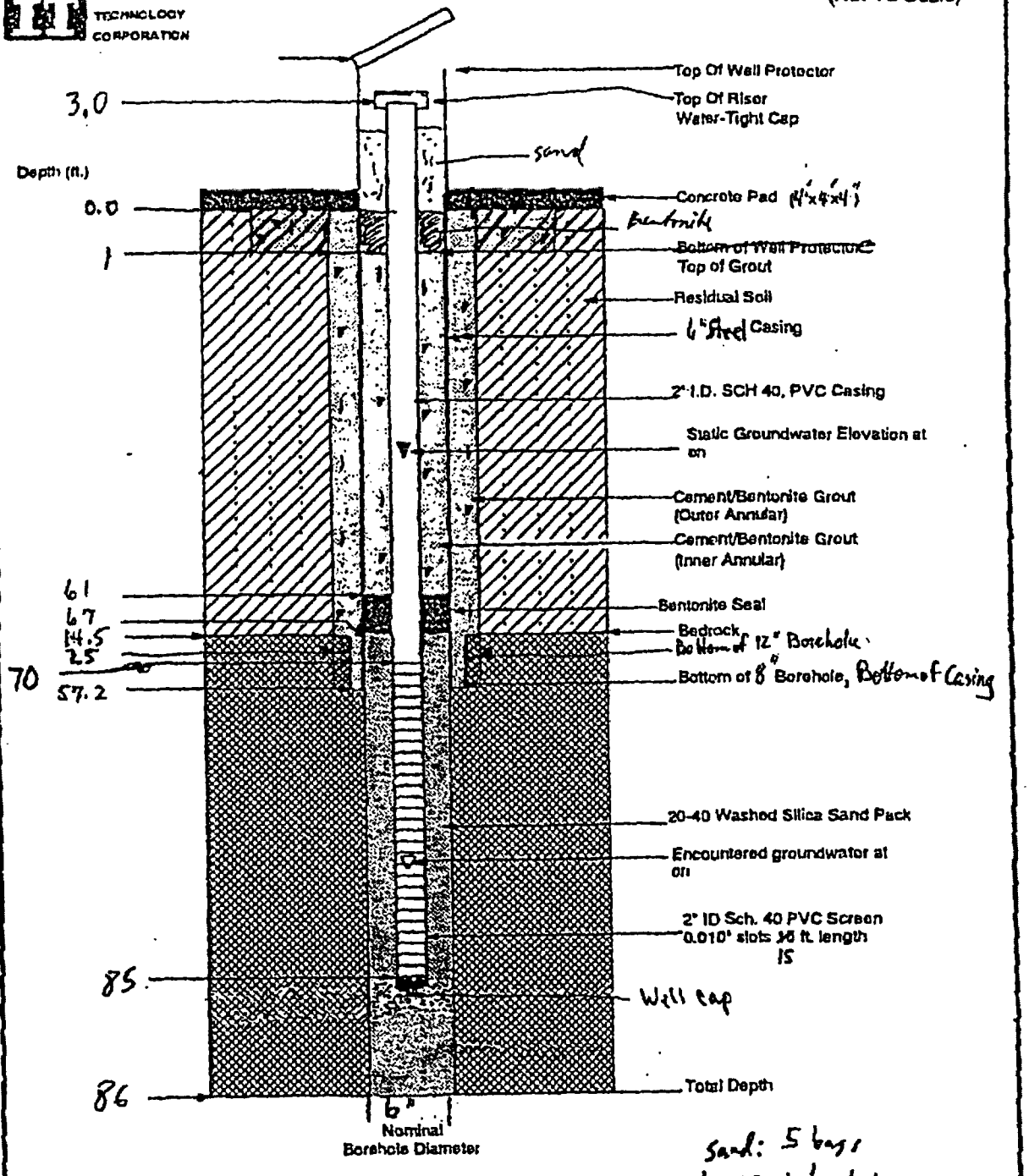
Elev (ft)	Depth (ft) Bgs	Description of Materials	USCS/USDA	Field Screening Results (ppm)	Geotech. Sample or Core Box No.	Analytical Sample No.	Recovery (ft)	Remarks
	80							
	1					81.5		
	2							~~[illegible]~~ 82
		massive gray limestone, very hard with vertical calcite deposits in fractures.						82-86
	3					83		
	4				Box 9 82-86	84		vertical fracture
						84.7		Box 9 82-86
	5							Clean
	6	Total Depth - 86 Ft						86
	7							Sealed with 85, 1' sand
	8							
	9							
	10							

Project: PBOW

Hole Number: TNTC-BCDGW001

INTERNATIONAL TECHNOLOGY CORPORATION

(Not To Scale)



Sand: 5 bags
bent: 1 bucket

Notes:

Well No.: TNTC-BEDGW-001
Date Installed: 9/12/01
Elevation Top of Casing: 667.04 ft

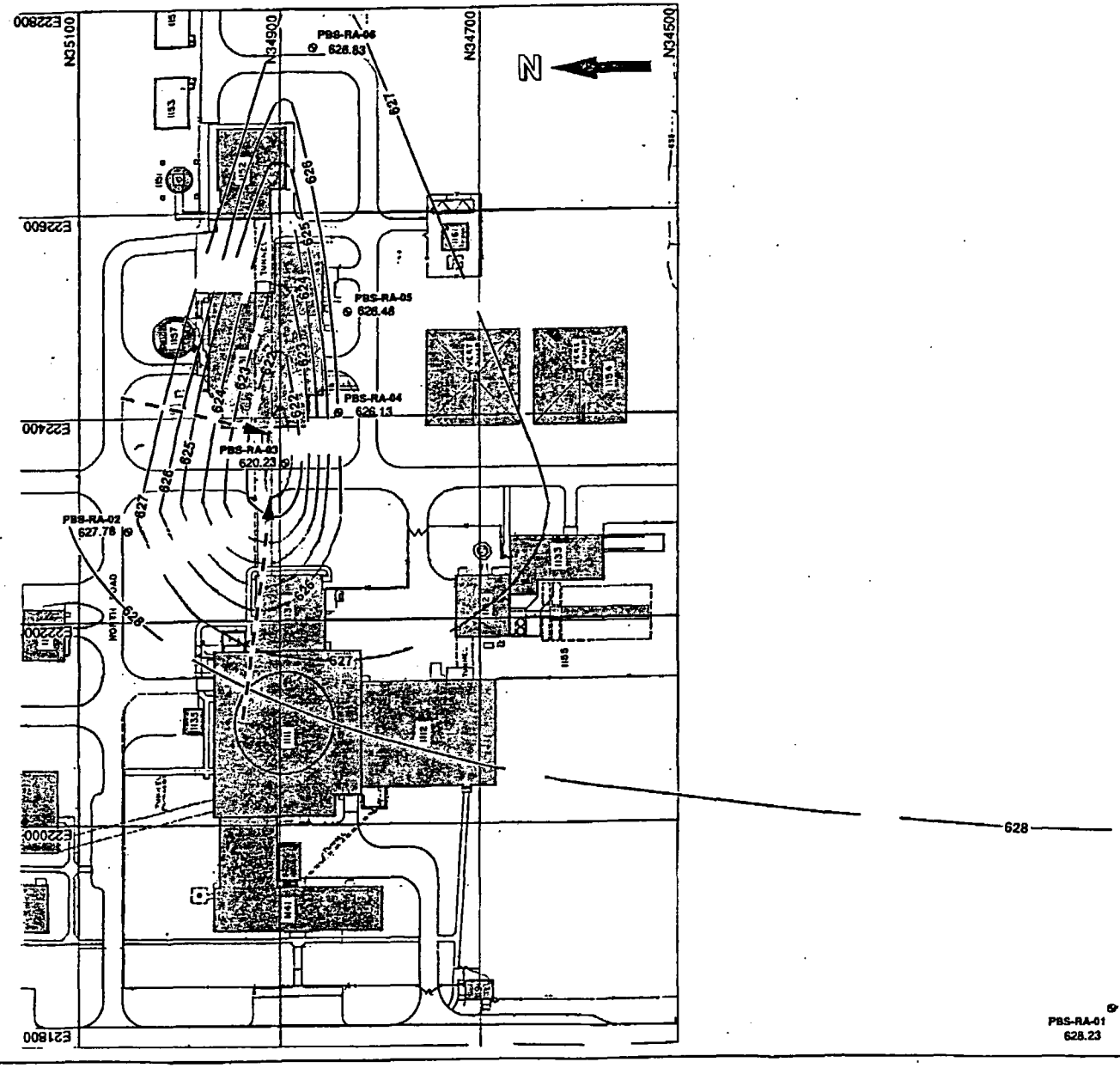
Well Construction Diagram
prepared for:
Plum Brook Ordnance Works
Sandusky, OHIO

BW\MWAZIOWC.DRW

APPENDIX C

GROUNDWATER FLOW MAPS

1991 Ebasco



LEGEND

◐	PBS-RA-01 628.23	Ground Water Monitoring Well Ground Water Elevation
———	—628—	Ground Water Elevation Contour
– – – – – – ➤		Direction of Ground Water Flow

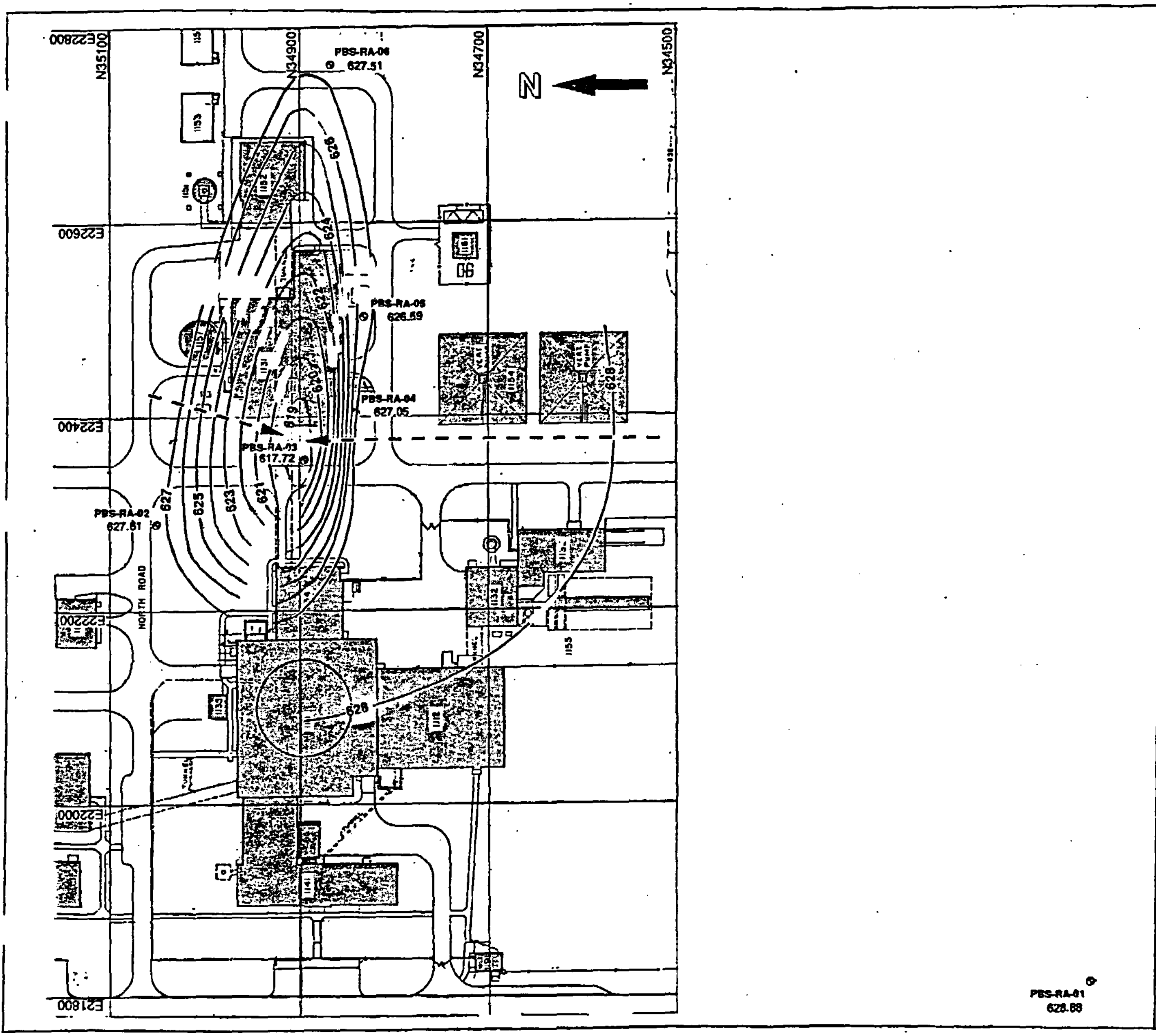
NASA PLUM BROOK STATION

UNDERGROUND STORAGE TANK CORRECTIVE ACTIONS REMEDIAL INVESTIGATIONS/FEASIBILITY STUDY: PHASE I

Ground Water Elevation Contours for 05/09/91

REACTOR AREA

EBASCO ENVIRONMENTAL	SCALE: 1"=100'
FROM NASA DWG. NO. PF-65156	**FIGURE 3-41**



LEGEND

◉	PBS-RA-01 628.88	Ground Water Monitoring Well Ground Water Elevation
——	628	Ground Water Elevation Contour
– – – – ➜		Direction of Ground Water Flow

NASA PLUM BROOK STATION
UNDERGROUND STORAGE TANK
CORRECTIVE ACTIONS REMEDIAL
INVESTIGATIONS/FEASIBILITY STUDY:
PHASE I

Ground Water Elevation Contours for 01/10/91

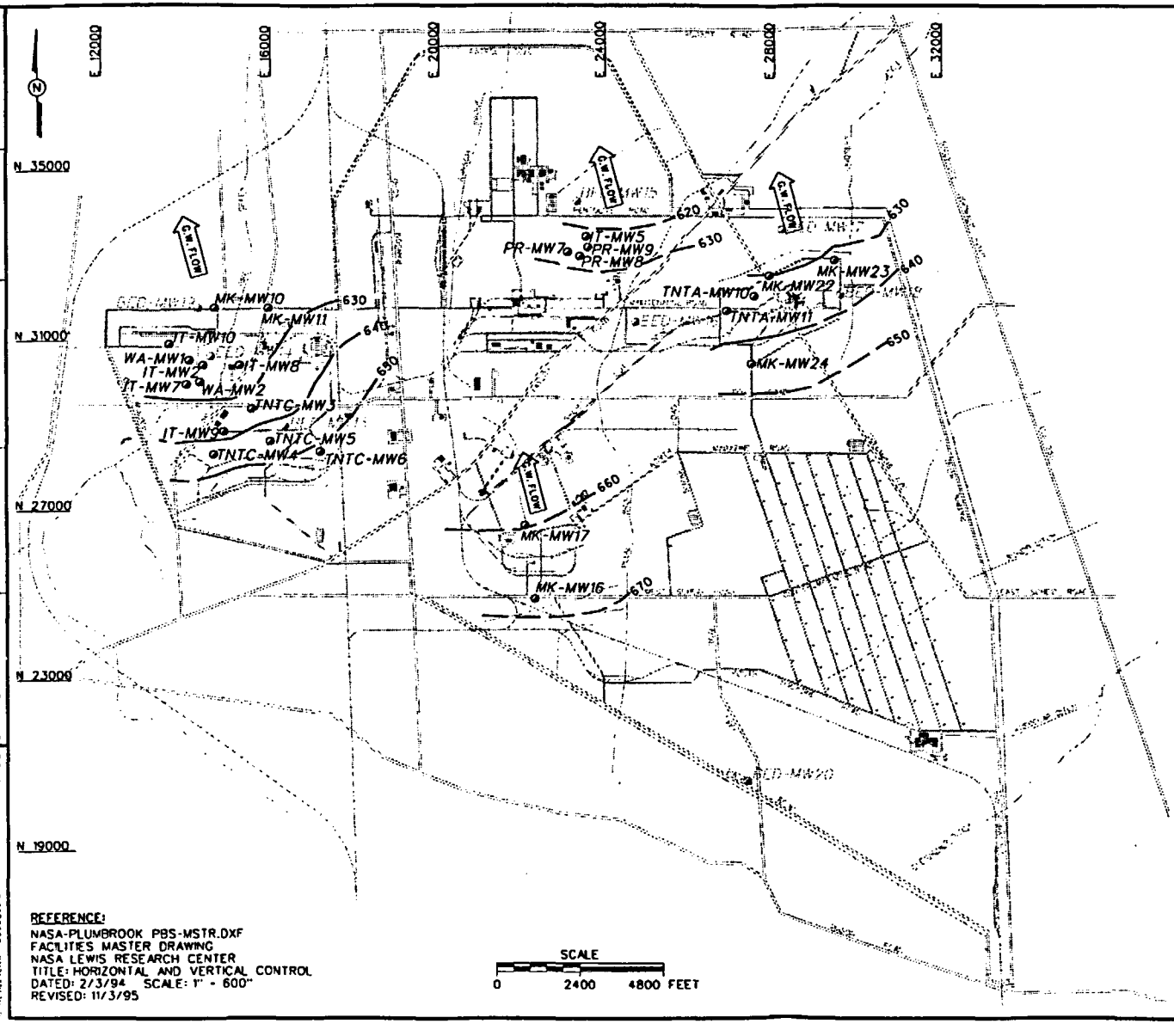
REACTOR AREA

EBASCO ENVIRONMENTAL SCALE: 1"=100'

FROM NASA DWG. NO. PF-65156

FIGURE 3-40

1997 IT



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- EXISTING WELL
- INTERPRETED GROUNDWATER FLOW DIRECTION (G.W. FLOW)
- GROUNDWATER ELEVATION CONTOUR ELEVATION LINE (DASHED WHERE INFERED)

NOTES:

CONTOUR INTERVAL IS 10 FEET

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

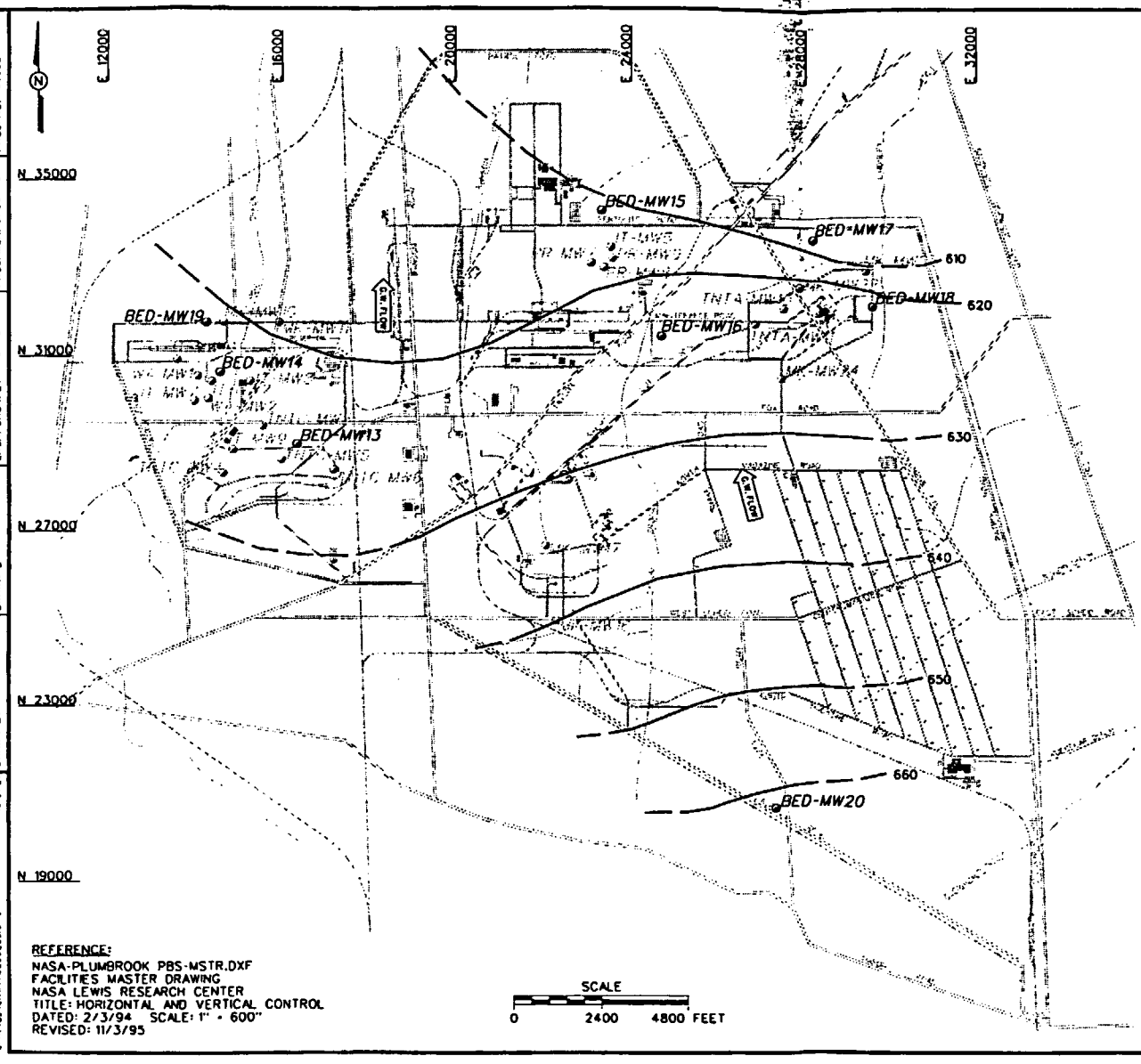
SCALE
0 2400 4800 FEET

FIGURE 5-1
GROUNDWATER ELEVATION CONTOUR MAP OVERBURDEN WATER BEARING ZONE (OCTOBER, 1996)

PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

INTERNATIONAL TECHNOLOGY CORPORATION

STARTING DATE: 4/24/97	DATE LAST REV:	DRAFT. CHCK. BY: R. KNIGHT	INITIATOR: G. YU
DRAWN BY: R. KNIGHT	DRAWN BY:	ENGR. CHCK. BY: G. YU	PROJ. MGR.: D. BURTON
23 SEP 97	16:02:31	DWG. NO.:	PROJ. NO.: 766952



LEGEND:

- BUILDINGS
- FENCE (PBOW BOUNDARY)
- RAILROAD
- DITCH
- SURFACE POND
- EXISTING WELL
- GROUNDWATER FLOW DIRECTION
- WATER LEVEL ELEVATION CONTOUR LINE (DASHED WHERE INFERED)

NOTES:

CONTOUR INTERVAL IS 10 FEET

REFERENCE:
NASA-PLUMBROOK PBS-MSTR.DXF
FACILITIES MASTER DRAWING
NASA LEWIS RESEARCH CENTER
TITLE: HORIZONTAL AND VERTICAL CONTROL
DATED: 2/3/94 SCALE: 1" = 600"
REVISED: 11/3/95

SCALE
0 2400 4800 FEET

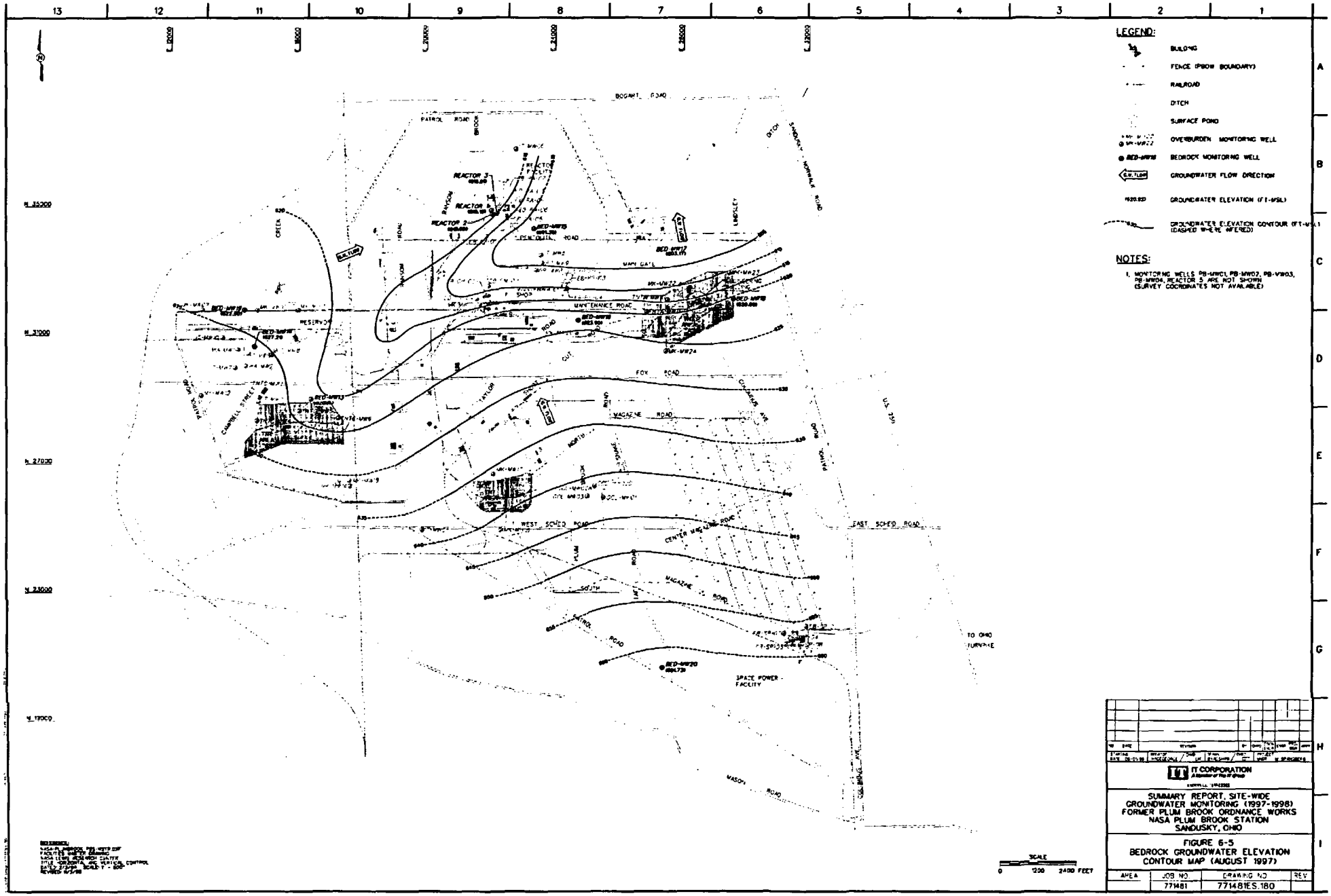
FIGURE 5-2
BEDROCK GROUNDWATER ELEVATION CONTOUR MAP (OCTOBER, 1996)

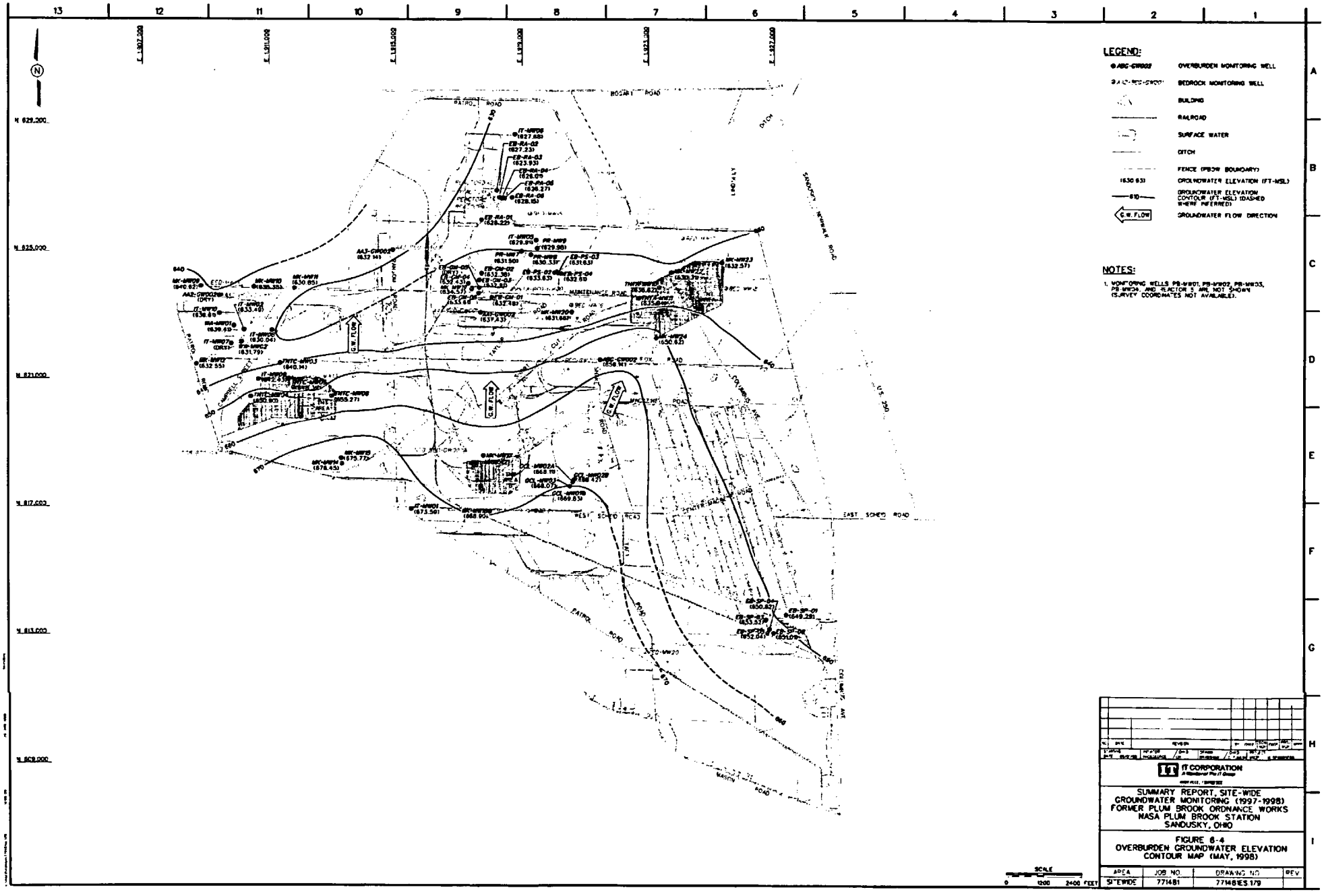
PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

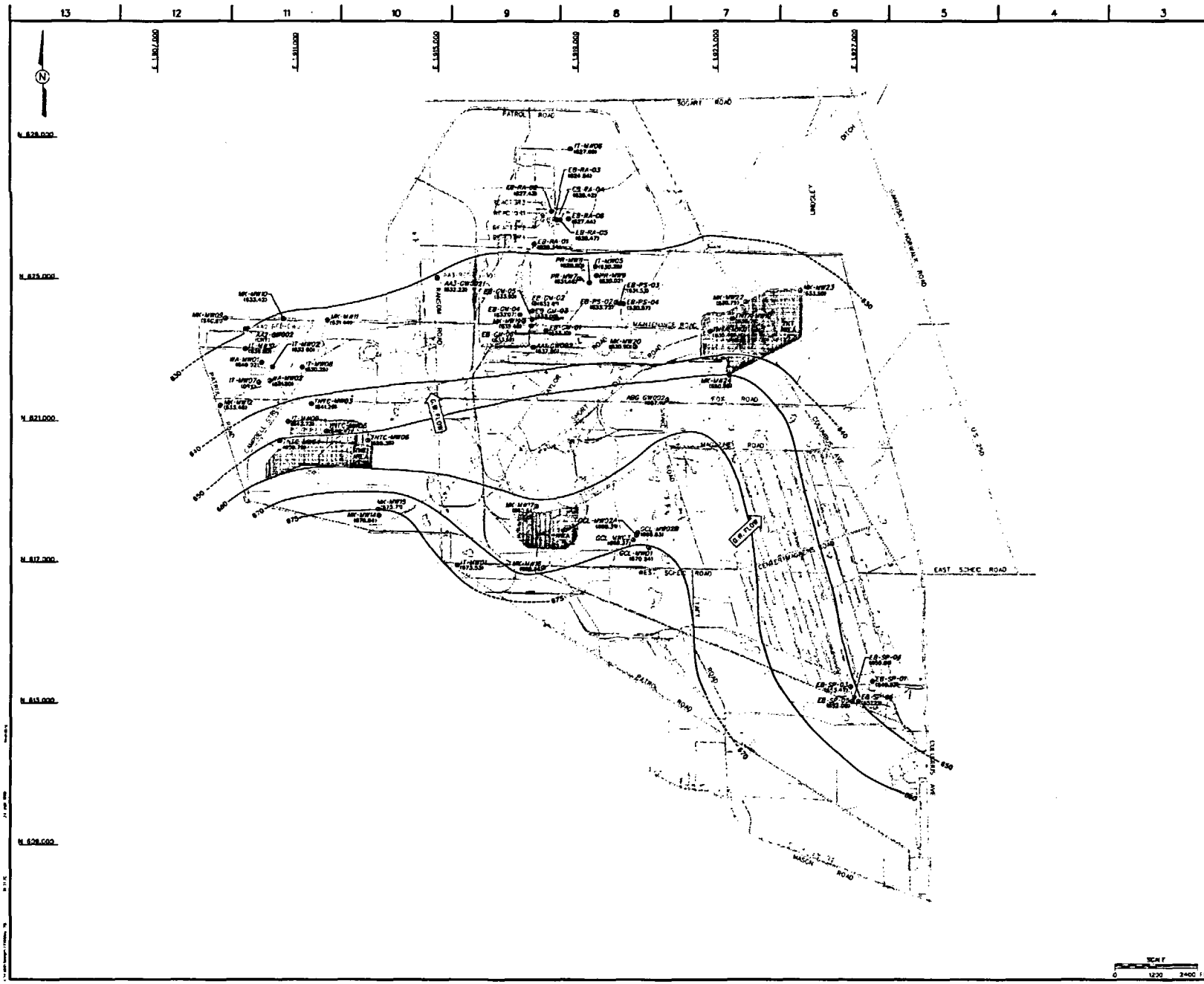
INTERNATIONAL TECHNOLOGY CORPORATION

23 SEP 97 | STARTING DATE 4/24/97 | DATE LAST REV | DRAFT. CHCK. BY: R. KNIGHT | INITIATOR: G. YU | DWG. NO.:
16:01:21 | DRAWN BY: R. KNIGHT | DRAWN BY: | ENGR. CHCK. BY: G. YU | PROJ. MGR. D. BURTON | PROJ. NO.: 766952

1999 IT


LEGEND:
BUILDING
FENCE (PBOW BOUNDARY)
RAILROAD
DITCH
SURFACE POND
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
GROUNDWATER FLOW DIRECTION
GROUNDWATER ELEVATION (FT-MSL)
GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE)
BOGART ROAD
PATROL ROAD
REACTOR 3
REACTOR 1
REACTOR 2
MAIN GATE
MAINTENANCE ROAD
FOX ROAD
MAGAZINE ROAD
WEST SCHED ROAD
EAST SCHED ROAD
CENTER MAGAZINE ROAD
SOUTH MAGAZINE ROAD
SPACE POWER FACILITY
TO OHIO TURNPIKE
MASON ROAD
SANDUSKY - MORNALE ROAD
U.S. 250
SCALE
0 1200 2400 FEET
IT CORPORATION
SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998) FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO
FIGURE 6-5
BEDROCK GROUNDWATER ELEVATION CONTOUR MAP (AUGUST 1997)
AREA
JOB NO. 771481
DRAWING NO. 771481ES.180
REV.


LEGEND:
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
BUILDING
RAILROAD
SURFACE WATER
DITCH
FENCE (PBOW BOUNDARY)
(630.63) GROUNDWATER ELEVATION (FT-MSL)
610 GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
G.W. FLOW GROUNDWATER FLOW DIRECTION
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
N 829,000
N 825,000
N 821,000
N 817,000
N 813,000
N 809,000
E 1,907,000
E 1,911,000
E 1,915,000
E 1,919,000
E 1,923,000
E 1,927,000
PATROL ROAD
BOSART ROAD
MAINTENANCE ROAD
WEST SCHED ROAD
EAST SCHED ROAD
SANDUSKY - NORWALK ROAD
U.S. 250
SCALE
0 1200 2400 FEET
IT CORPORATION
SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
FIGURE 6-4
OVERBURDEN GROUNDWATER ELEVATION CONTOUR MAP (MAY, 1998)
AREA SITEWIDE
JOB NO. 771481
DRAWING NO. 771481ES179
REV



LEGEND:

- MK-MW08 — OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- 633.00 — GROUNDWATER ELEVATION (FT-MSL)
- G.W. FLOW — GROUNDWATER FLOW DIRECTION
- 630 — GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
- BUILDING
- RAILROAD
- SURFACE WATER
- DITCH
- FENCE (PBOW BOUNDARY)

NOTES:

1. MONITORING WELLS PB MW01, PB MW02, PB MW03, PB MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE)

SCALE: 0 1200 2400 FEET

NO.	DATE	REVISION	BY	CHKD	DRAWN	PROJ. ENGR	PROJ. MGR.	APPR
0-X	05/15/98	ISSUED FOR REVIEW	CHKD	DRAWN	CHKD	PROJ. ENGR	PROJ. MGR.	APPR

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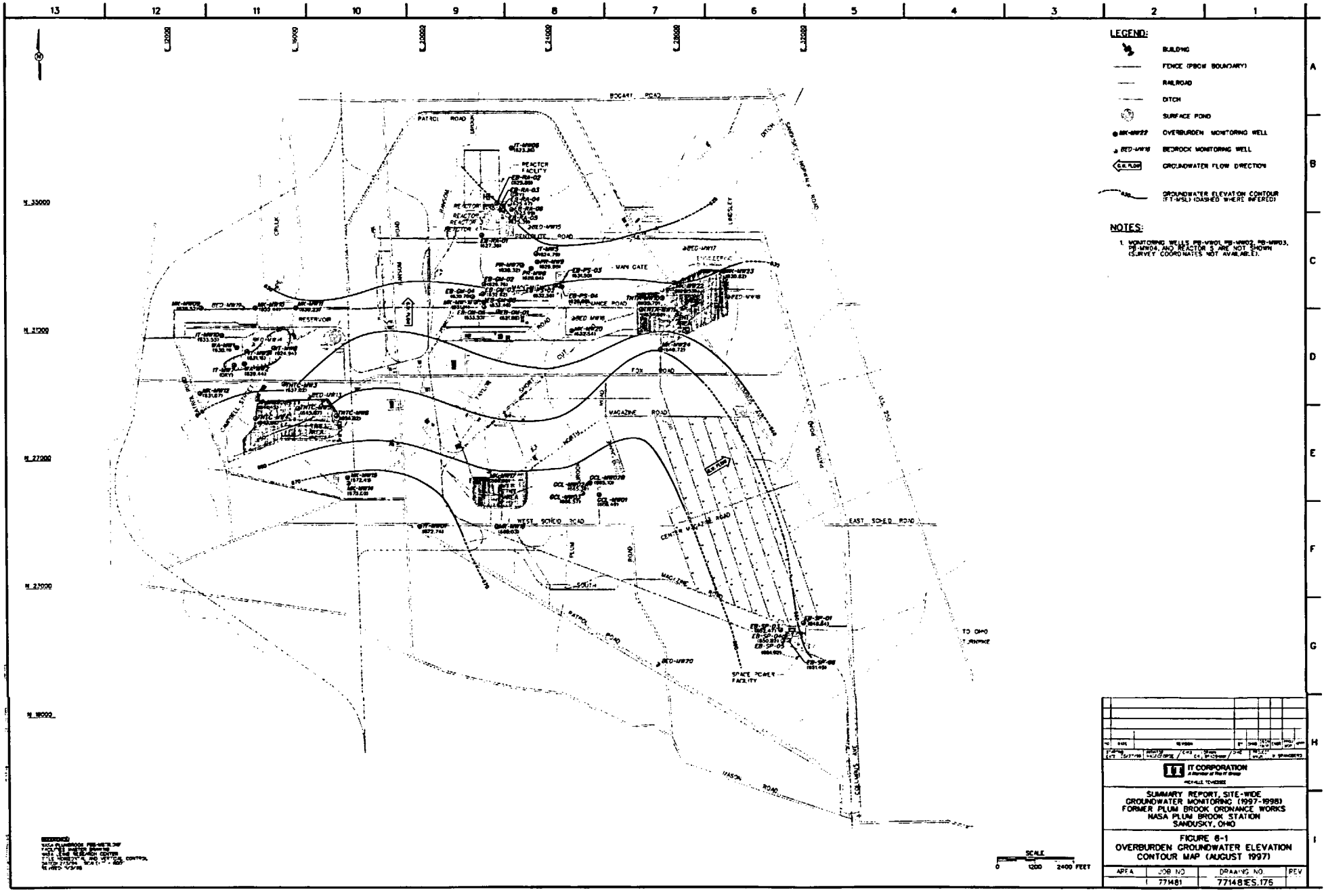
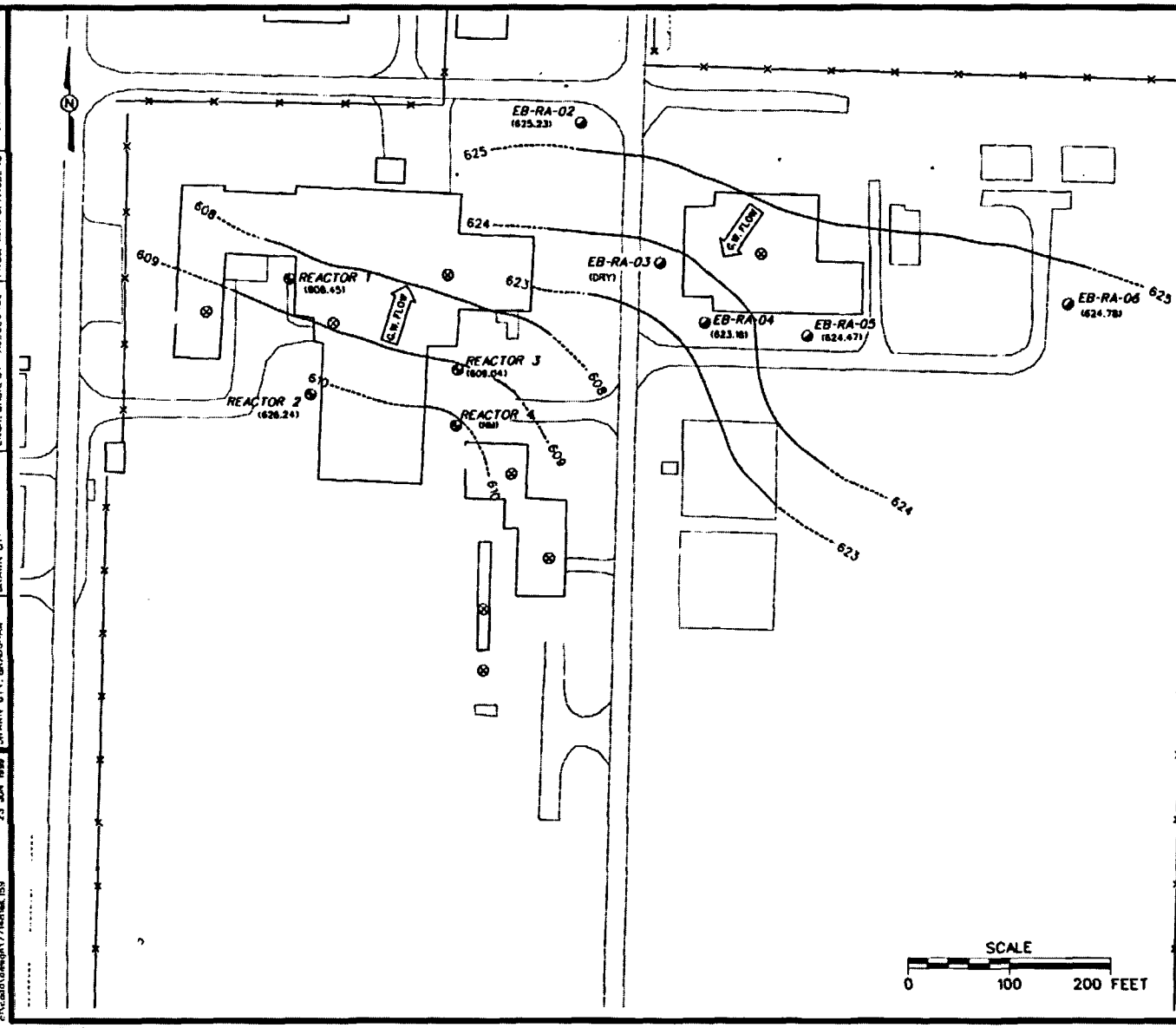
SUMMARY REPORT, SITE-WIDE
GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-3
OVERBURDEN GROUNDWATER ELEVATION
CONTOUR MAP (FEBRUARY 1998)

AREA	JOB NO.	DRAWING NO.	REV.
SITEWIDE	771481	771481ES.178	


LEGEND:
BUILDING
FENCE (PBOW BOUNDARY)
RAILROAD
DITCH
SURFACE POND
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
GROUNDWATER FLOW DIRECTION
GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERED)
NOTES:
1. MONITORING WELLS PB-VW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
BOCART ROAD
PATROL ROAD
REACTOR FACILITY
FENCE SITE ROAD
MAIN GATE
RESERVOIR
FOX ROAD
MAGAZINE ROAD
WEST SCHED ROAD
EAST SCHED ROAD
CENTER MAGAZINE ROAD
SOUTH MAGAZINE ROAD
SPACE POWER FACILITY
TO OHIO TURNPIKE
U.S. 250
N 35000
N 31000
N 27000
N 23000
N 19000
SCALE
0 1200 2400 FEET
IT CORPORATION
NASHVILLE TENNESSEE
SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
FIGURE 6-1
OVERBURDEN GROUNDWATER ELEVATION CONTOUR MAP (AUGUST 1997)
AREA
JOB NO
771481
DRAWING NO.
771481ES.175
REV



LEGEND:

EB-RA-06	OVERBURDEN MONITORING WELL LOCATION
REACTOR 1	BEDROCK MONITORING WELL LOCATION
⊗	SUMP WELL
(608.45)	GROUNDWATER ELEVATION (FT-MSL) IN BEDROCK MONITORING WELLS
610	GROUNDWATER ELEVATION CONTOUR IN BEDROCK MONITORING WELLS
(NM)	NOT MEASURED
(628.18)	GROUNDWATER ELEVATION IN OVERBURDEN MONITORING WELLS (FT-MSL)
623	GROUNDWATER ELEVATION CONTOUR IN OVERBURDEN MONITORING WELLS (FT-MSL)
G.W. FLOW	GROUNDWATER FLOW
	BUILDINGS
	FENCE

NOTES:

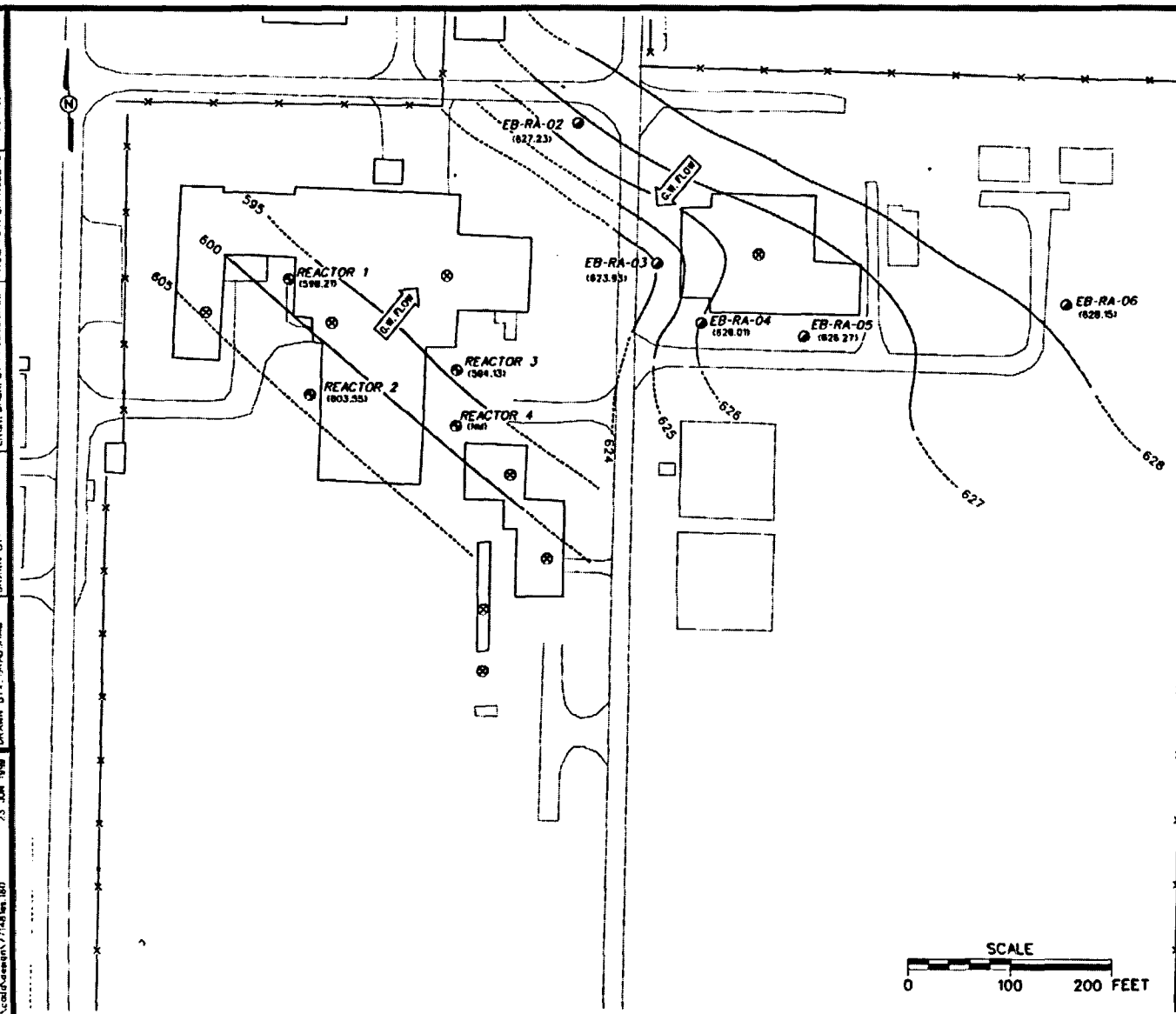
1. LOCATIONS OF SUMP WELLS ARE APPROXIMATE. SUMP WELLS HAVE NOT BEEN SURVEYED.
2. GROUNDWATER ELEVATION 626.24 FT OF REACTOR WELL NO. 2 NOT USED DURING CONTOURING.

FIGURE 6-9
GROUNDWATER ELEVATION CONTOUR MAP, REACTOR FACILITY AREA (NOVEMBER 1997)

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 05/26/99 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: HAGELGIORGI | DWG. NO.: 77145fig.159
DRAWN BY: BRADSHAW | DRAWN BY: | ENGR. CHCK. BY: HAGELGIORGI | PROJ. MGR.: SPANGBERG | PROJ. NO.: 77491
23 JUN 1999 11:39:31
brandberg
c:\cadd\design\77145fig.159



LEGEND:

EB-RA-06	OVERBURDEN MONITORING WELL LOCATION
REACTOR 1	BEDROCK MONITORING WELL LOCATION
⊗	SUMP WELL
(598.21)	GROUNDWATER ELEVATION (FT-MSL) IN BEDROCK MONITORING WELLS
600	GROUNDWATER ELEVATION CONTOUR IN BEDROCK MONITORING WELLS
(NM)	NOT MEASURED
(628.15)	GROUNDWATER ELEVATION IN OVERBURDEN MONITORING WELLS (FT-MSL)
628	GROUNDWATER ELEVATION CONTOUR IN OVERBURDEN MONITORING WELLS (FT-MSL)
G.W. FLOW	GROUNDWATER FLOW
	BUILDINGS
	FENCE

NOTES:

LOCATIONS OF SUMP WELLS ARE APPROXIMATE. SUMP WELLS HAVE NOT BEEN SURVEYED.

FIGURE 6-10
GROUNDWATER ELEVATION CONTOUR MAP, REACTOR FACILITY AREA (MAY 1998)

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
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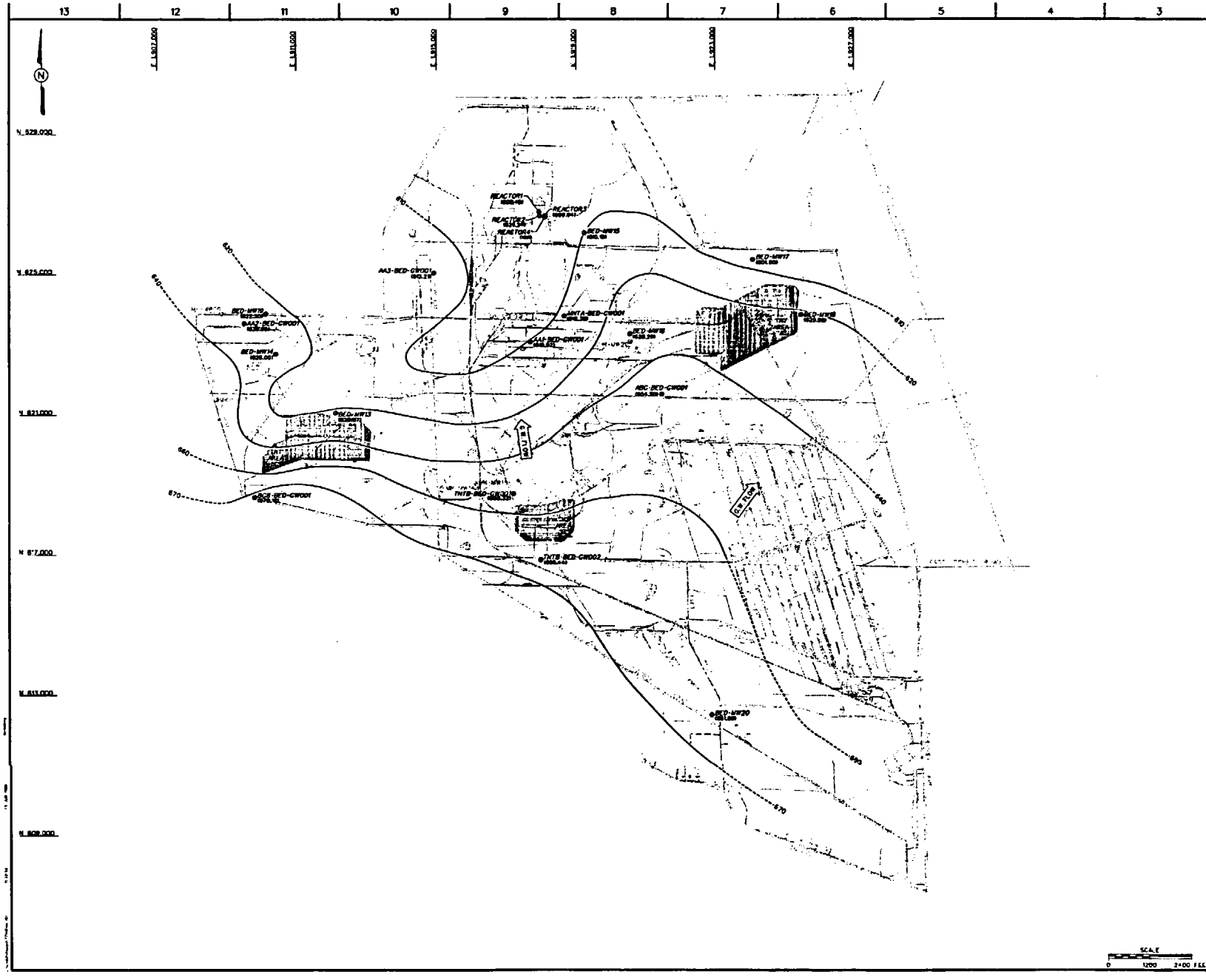
STARTING DATE: 05/28/99 | DATE LAST REV.: | DRAFT. CHECK. BY: C. TUMLIN | INITIATOR: HADI GORGE | DWG. NO.: 127148 fig. 160
DRAWN BY: SPADSHAM | DRAWN BY: | ENGR. CHECK. BY: HACECEORGE | PROJ. MGR.: SPANGBERG | PROJ. NO.: 77148
23 JUN 1999



LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- GROUNDWATER ELEVATION (FT-MSL)
- NOT MEASURED
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
- BUILDING
- RAILROAD
- SURFACE WATER
- DITCH
- FENCE (PBOW BOUNDARY)

NOTES:

1. MONITORING WELLS PB-VW01, PB-VW02, PB-VW03, PB-VW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. GROUNDWATER ELEVATION 626.24 FT OF REACTOR WELL NO. 2 NOT USED DURING CONTOURING.

SCALE
0 1200 2400 FEET

NO	DATE	REVISION	BY	CHK'D	CHK'D & APP'D	SUPERV	DATE

STARTING DATE 12-11-98	REVISION VERIFIED	BY	CHKD	BY	DATE	/ CHK'D	BY	DATE	REV BY

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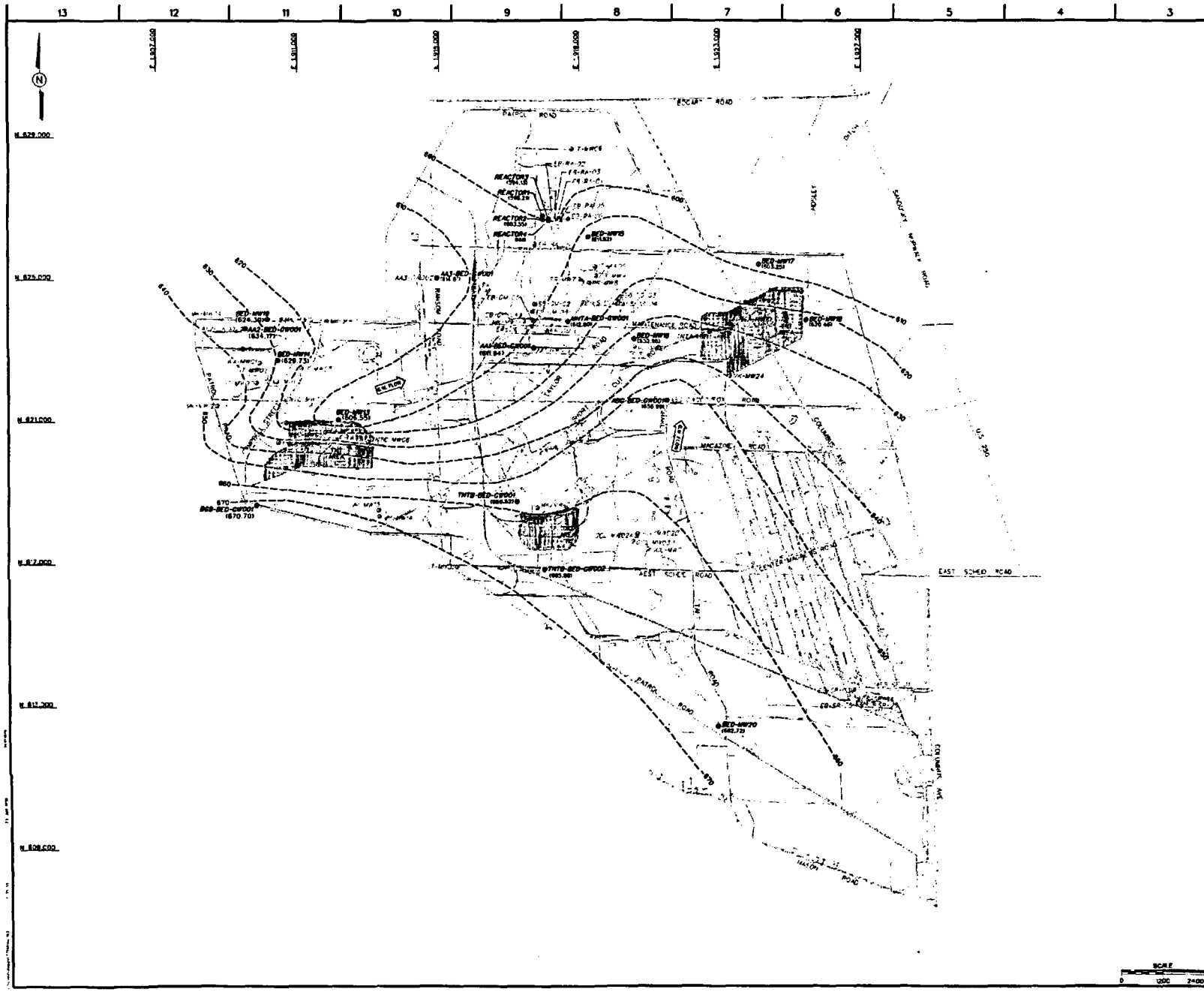
KNOXVILLE, TENNESSEE

SUMMARY REPORT, SITE-WIDE
GROUNDWATER MONITORING (1997-1998)
PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-6
BEDROCK GROUNDWATER ELEVATION
CONTOUR MAP (NOVEMBER 1997)

AREA	JOB NO	DRAWING NO	REV
SITEWIDE	771481	771481E5.181	



LEGEND:

● ABG-BED-GW001	MONITORING WELL LOCATION
● MW-MW09	OVERSURDEN WELL LOCATION
	BUILDING
	RAILROAD
	SURFACE WATER
	DITCH
	FENCE (PBOW BOUNDARY)
(634.77)	GROUNDWATER ELEVATION (FT-MSL)
(NM)	NOT MEASURED
——610——	GROUNDWATER ELEVATION CONTOUR
G.W. FLOW	INTERPRETED GROUNDWATER FLOW DIRECTION

NOTES:

1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).

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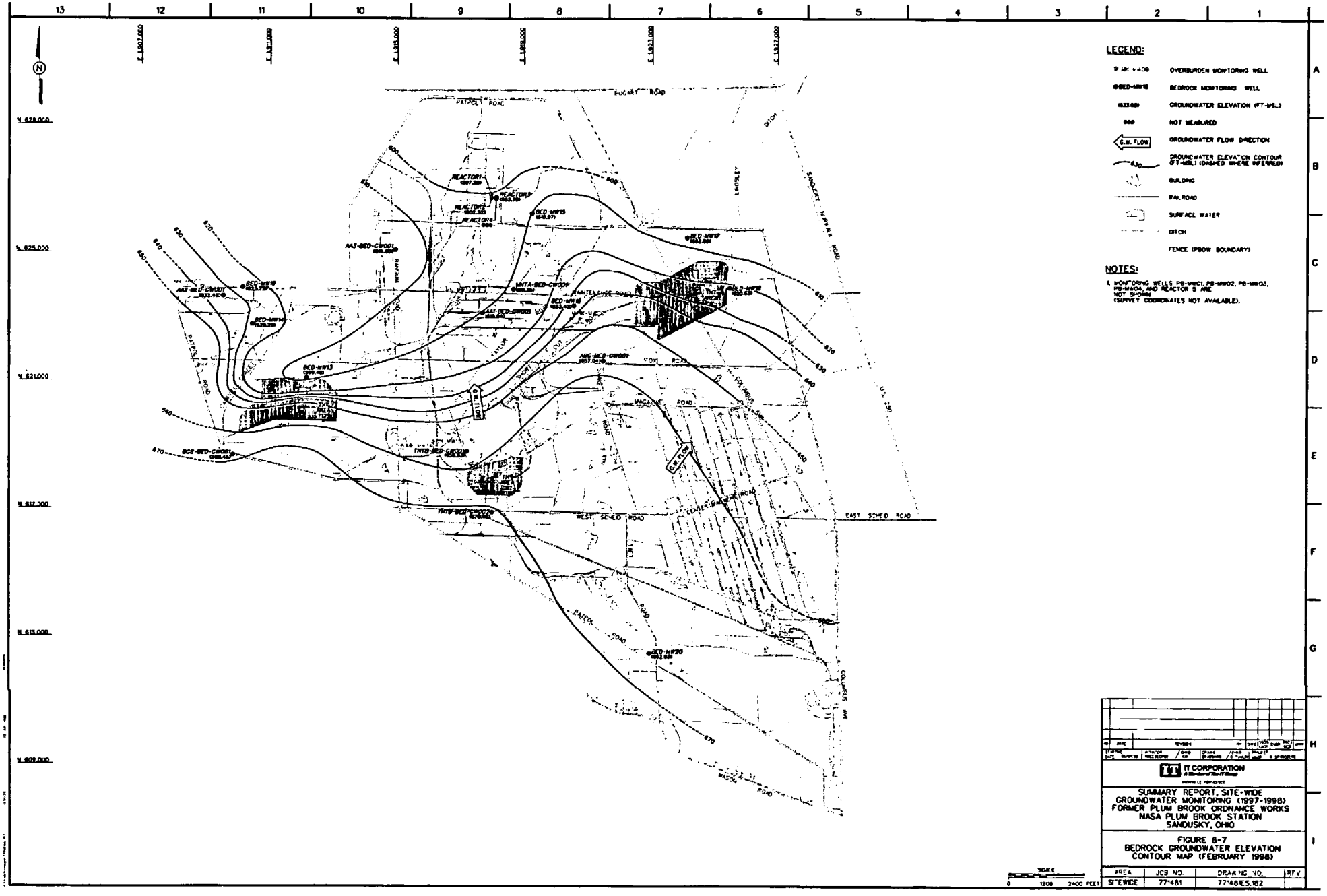
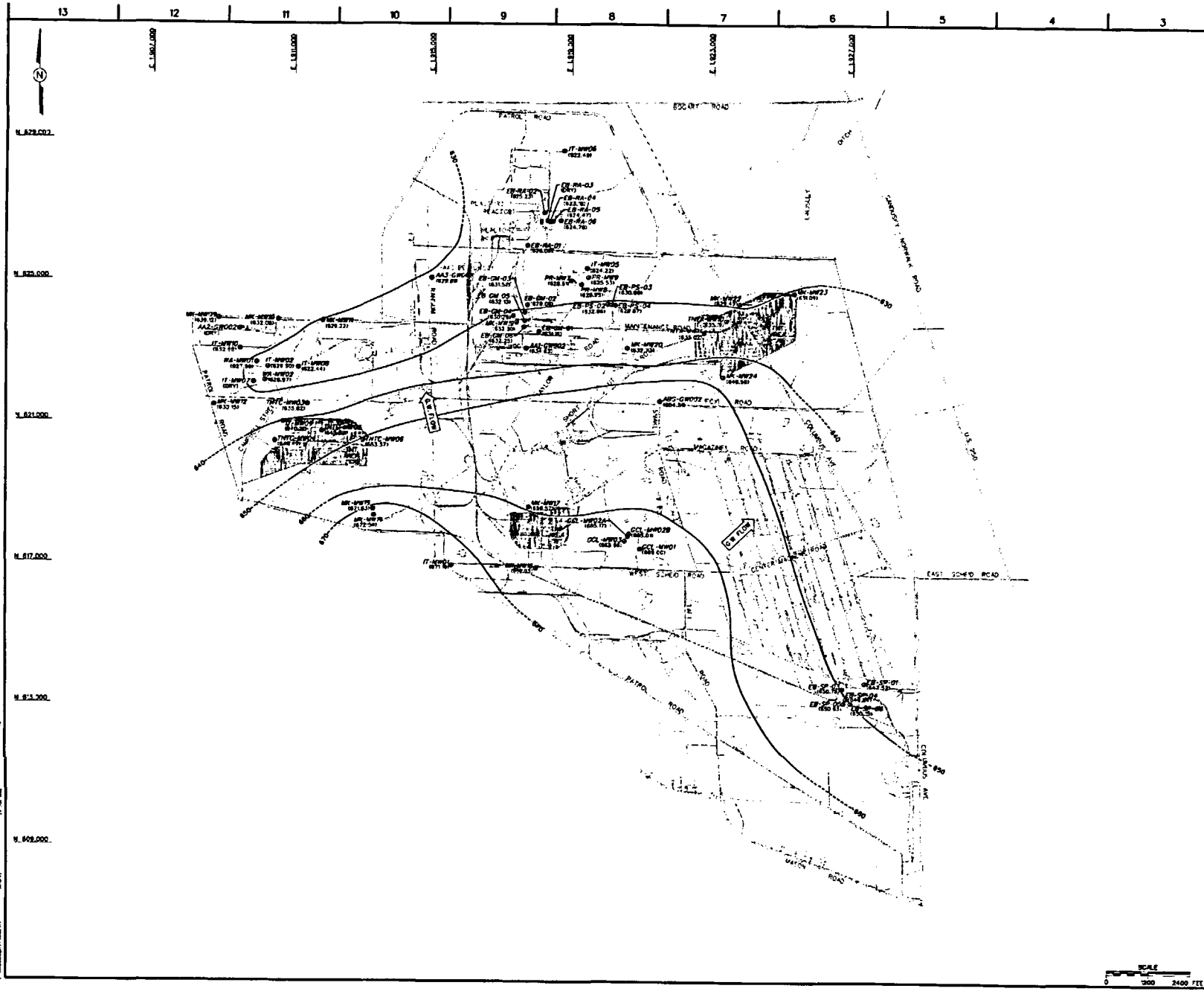
SUMMARY REPORT, SITE-WIDE
GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-8
BEDROCK GROUNDWATER
ELEVATION CONTOUR MAP
(MAY 1998)

AREA	JOB NO.	DRAWING NO.	REV
SITEWIDE	771481	771481ES.183	


LEGEND:
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
GROUNDWATER ELEVATION (FT-MSL)
NOT MEASURED
GROUNDWATER FLOW DIRECTION
GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
BUILDING
RAILROAD
SURFACE WATER
DITCH
FENCE (PBOW BOUNDARY)
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
SCALE
0 1200 2400 FEET
IT CORPORATION
SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998) FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO
FIGURE 6-7
BEDROCK GROUNDWATER ELEVATION CONTOUR MAP (FEBRUARY 1998)
AREA
SITEWIDE
JOB NO.
771481
DRAWING NO.
771481ES.182
REV



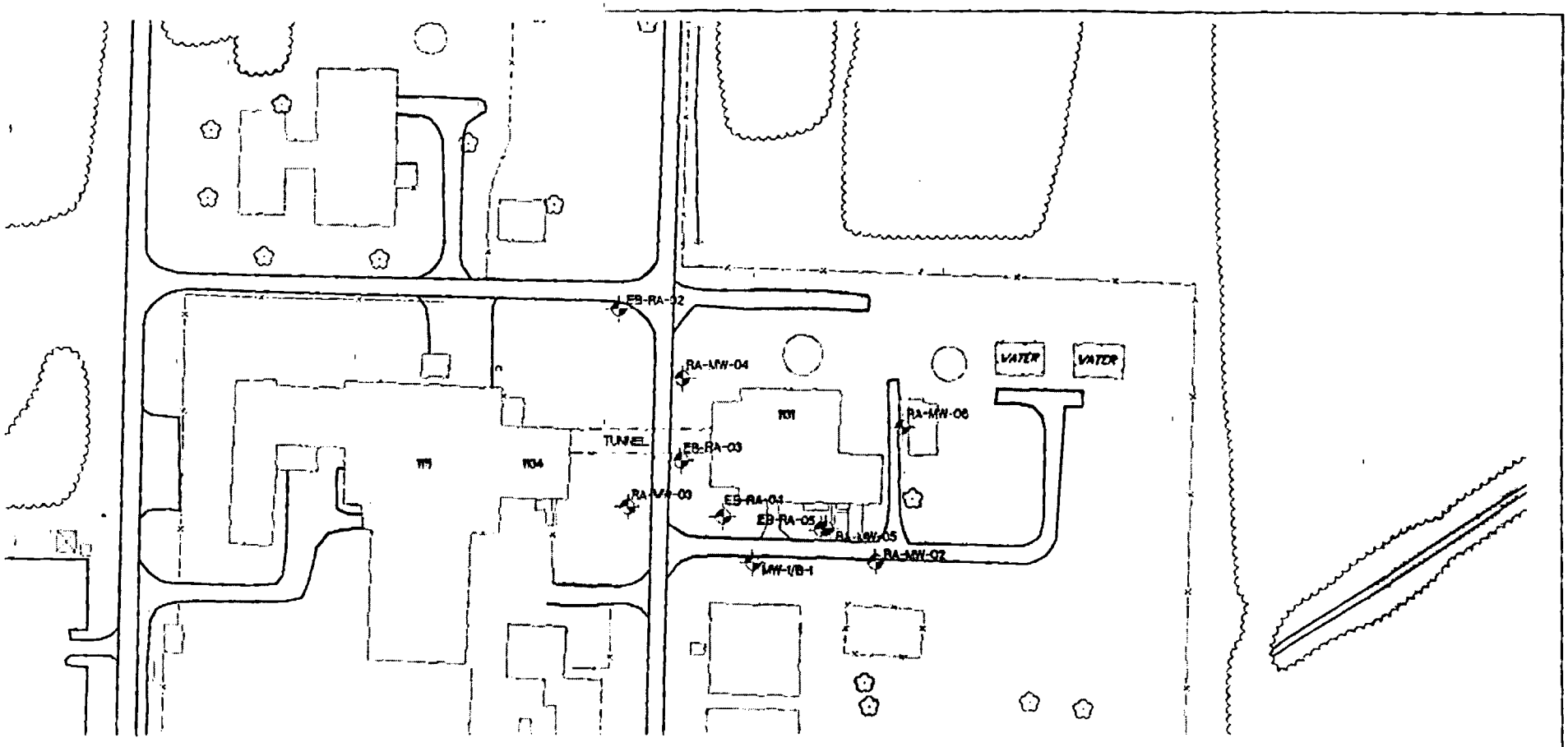
IT CORPORATION

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998) FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

FIGURE 6-2
OVERBURDEN GROUNDWATER ELEVATION CONTOUR MAP (NOVEMBER 1997)

AREA	JOB NO	DRAWING NO.	REV
SITEWIDE	771481	771481ES.177	

2000 Amended Closure Plan



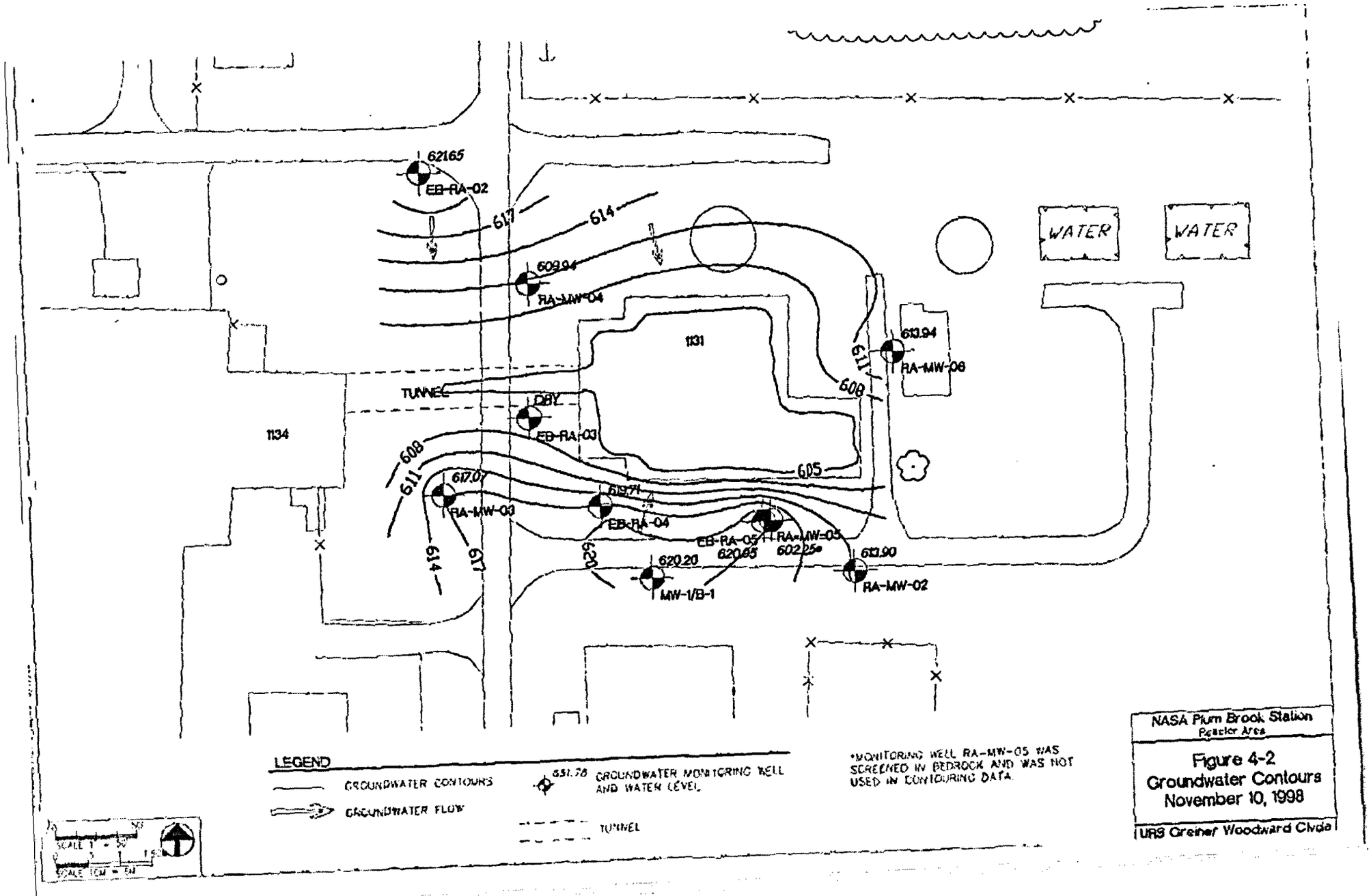
LEGEND

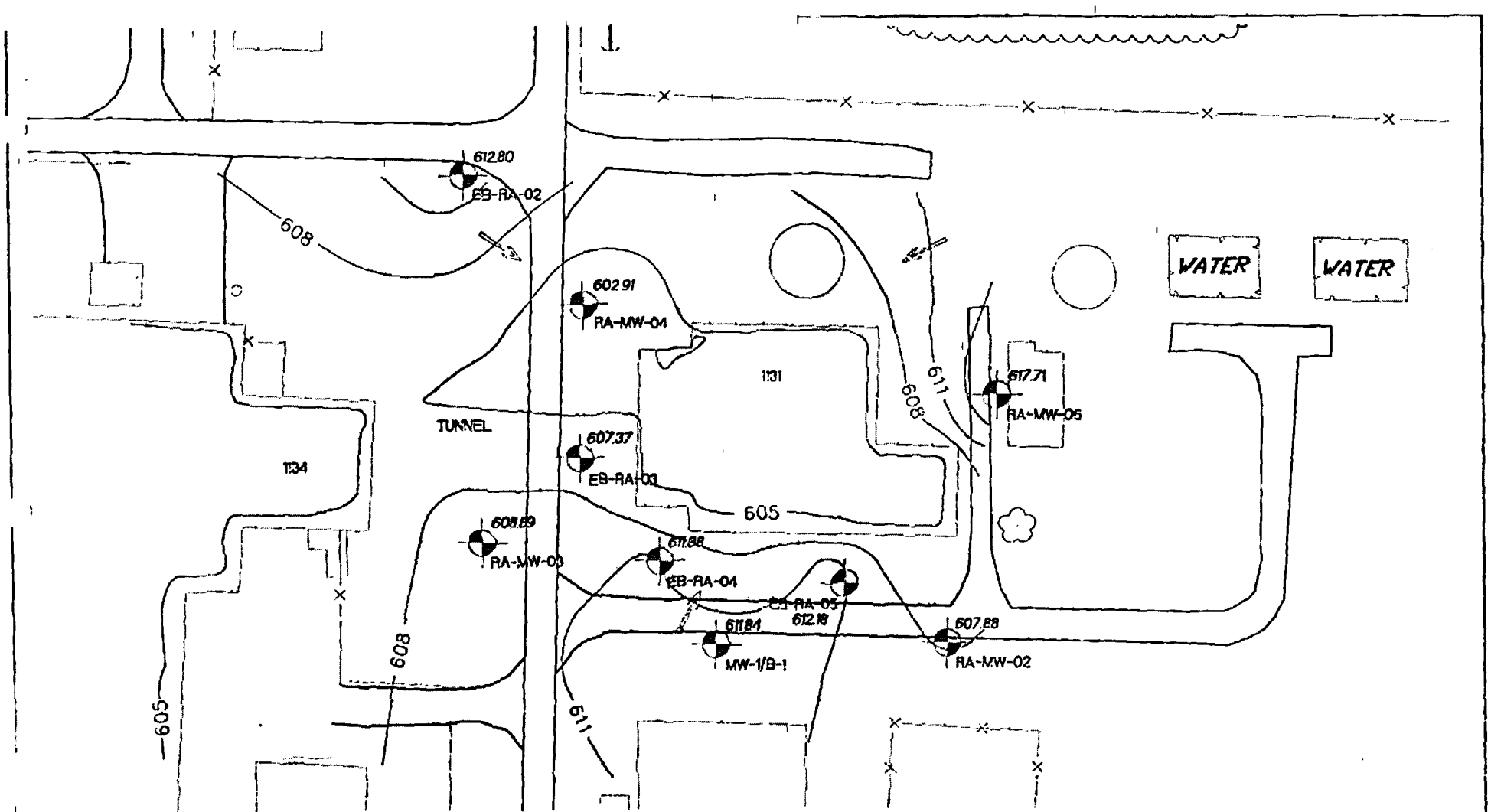
GROUNDWATER MONITORING WELL

TUNNEL

NASA Plum Brook Station
Reactor Area

Figure 4-1
Monitoring Well
Locations


621.65
EB-RA-02
617
614
609.94
RA-MW-04
1131
613.94
RA-MW-06
611
608
WATER
WATER
TUNNEL
DBY
EB-RA-03
1134
608
611
617.07
RA-MW-03
619.71
EB-RA-04
605
614
617
620
EB-RA-05
620.65
RA-MW-05
602.25*
620.20
MW-1/B-1
613.90
RA-MW-02
LEGEND
GROUNDWATER CONTOURS
GROUNDWATER FLOW
631.78 GROUNDWATER MONITORING WELL AND WATER LEVEL
TUNNEL
*MONITORING WELL RA-MW-05 WAS SCREENED IN BEDROCK AND WAS NOT USED IN CONTOURING DATA
NASA Plum Brook Station
Reactor Area
Figure 4-2
Groundwater Contours
November 10, 1998
URS Greiner Woodward Clyde



LEGEND

GROUNDWATER CONTOURS

GROUNDWATER FLOW

651.78 GROUNDWATER MONITORING WELL AND WATER LEVEL
RA-MW-06

TUNNEL

*MONITORING WELL RA-MW-05 WAS SCREENED IN BEDROCK AND WAS NOT USED IN CONTOURING DATA.

NASA Plum Brook Station
Reactor Area

Figure 4-5
Groundwater Contours
August 23, 1999

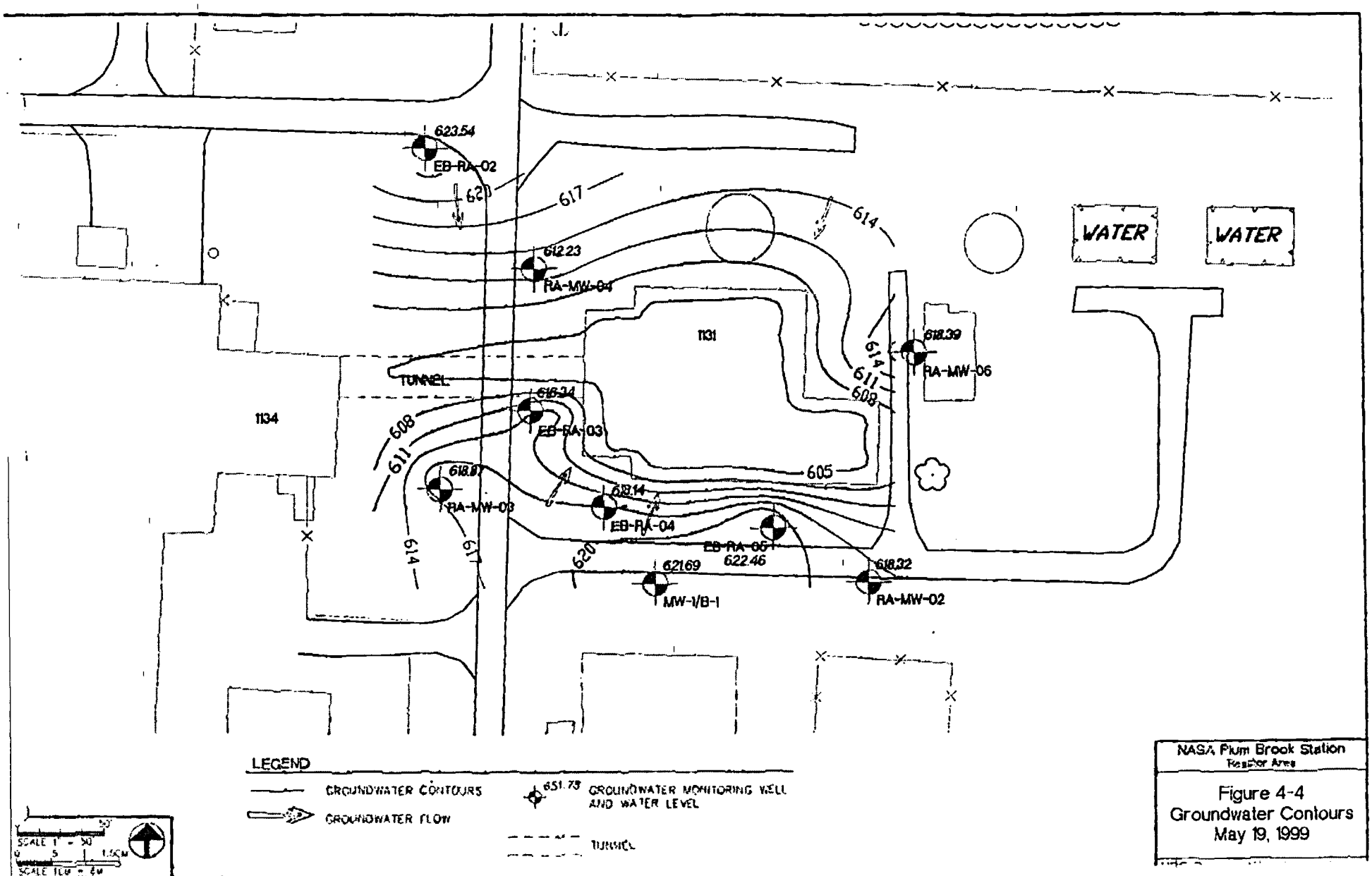
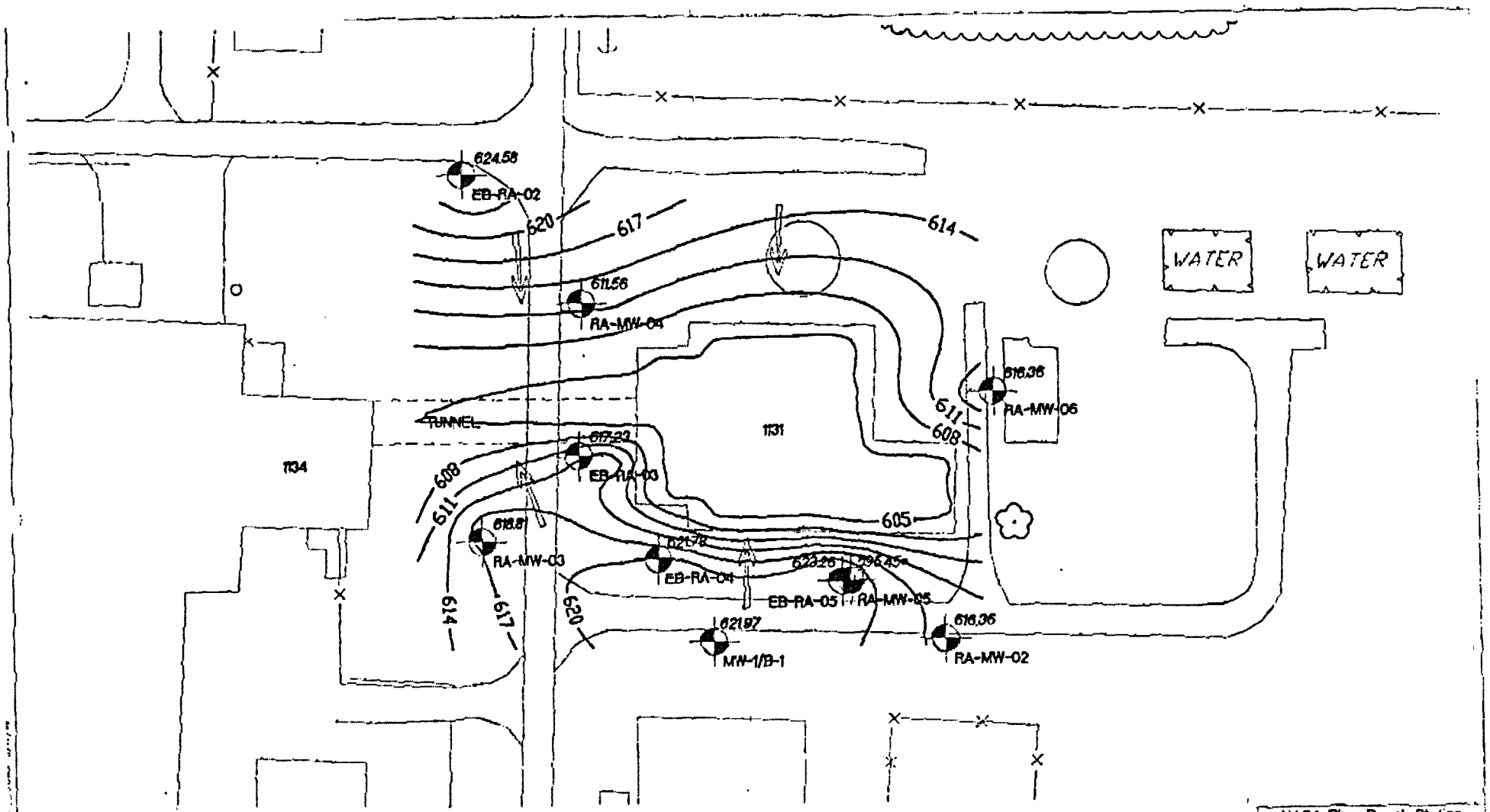


Figure 4-4
Groundwater Contours
May 19, 1999



LEGEND

GROUNDWATER CONTOURS

GROUNDWATER FLOW

651.78 GROUNDWATER MONITORING WELL AND WATER LEVEL

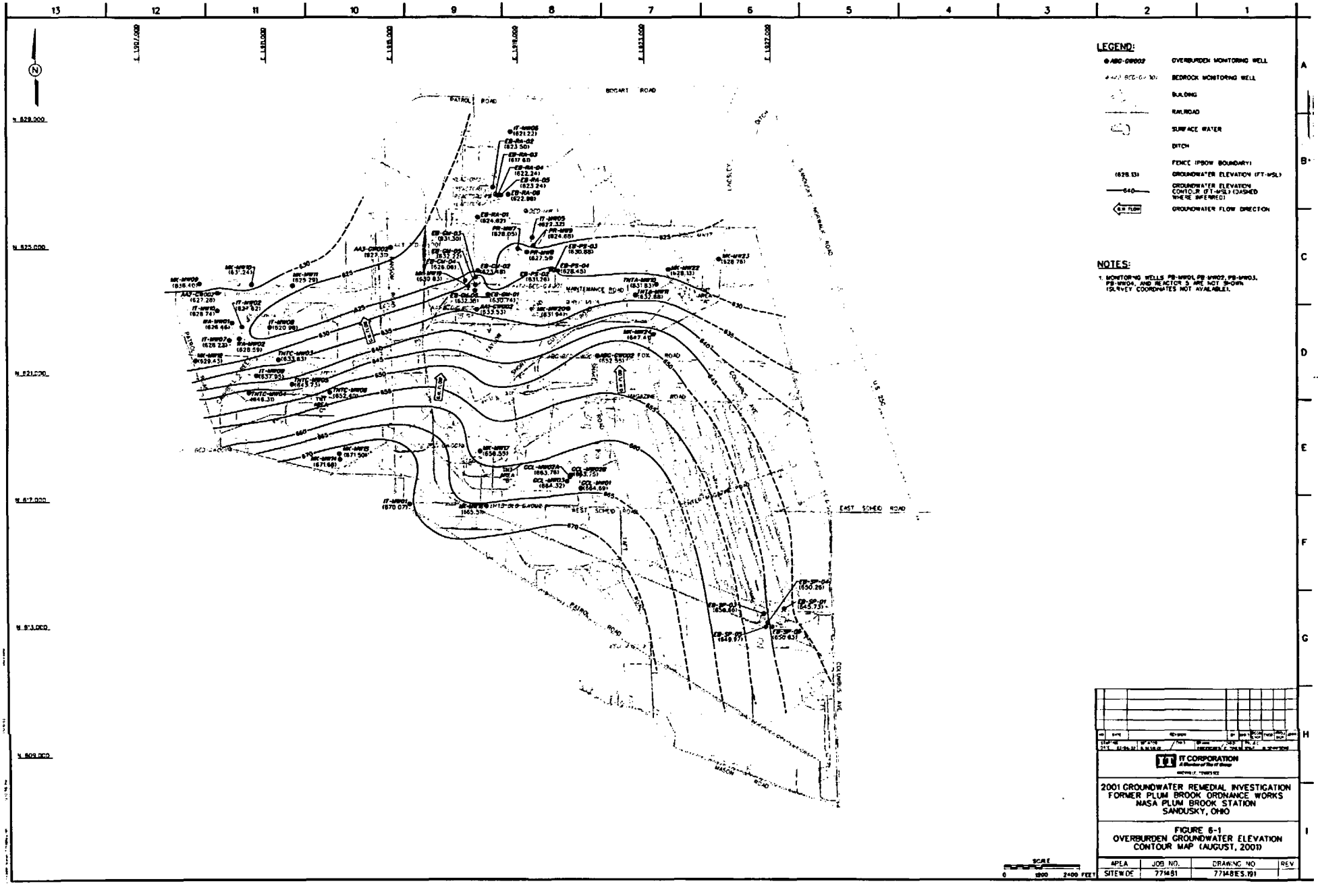
TUNNEL

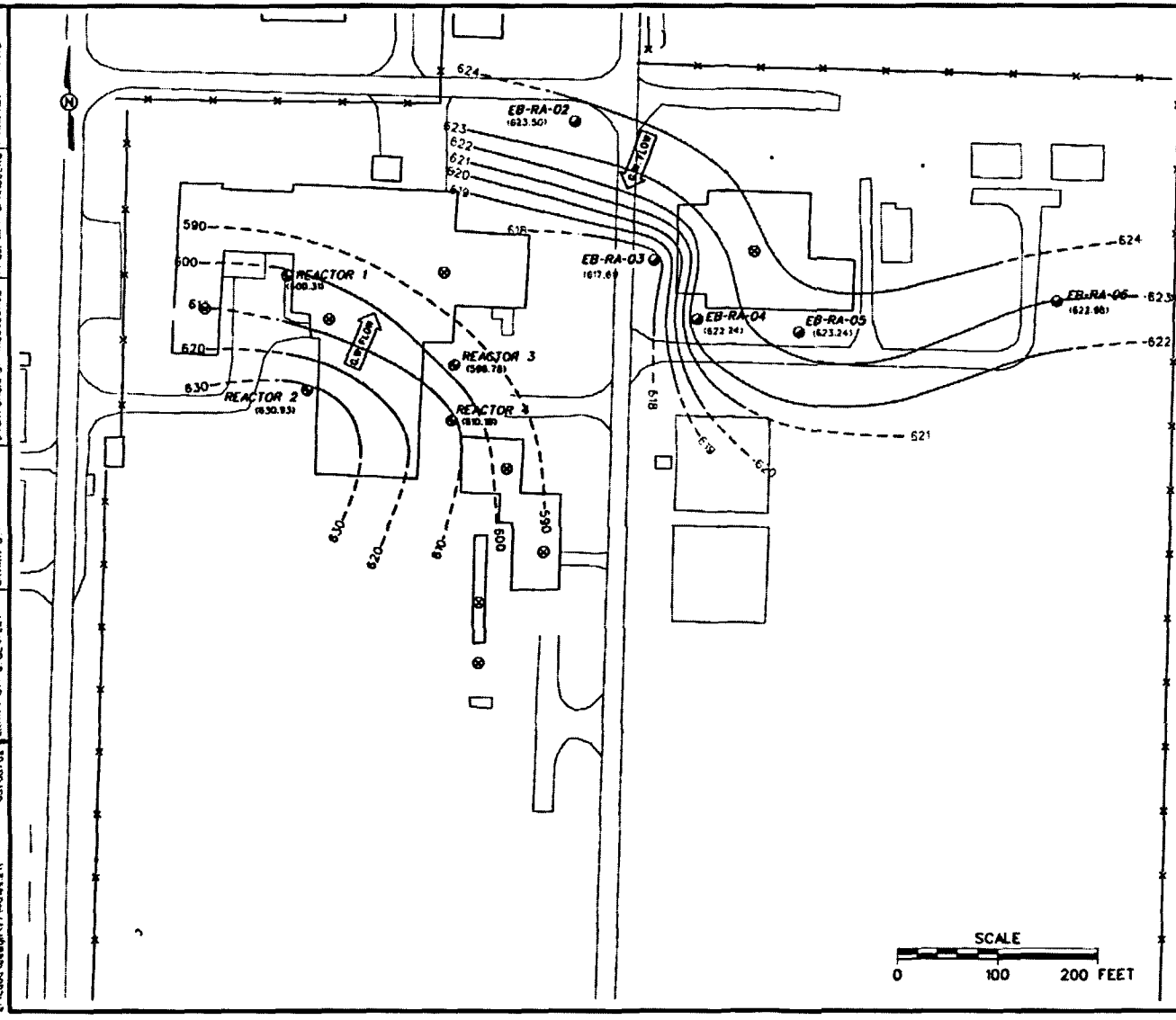
*MONITORING WELL RA-MW-05 WAS SCREENED IN BEDROCK AND WAS NOT USED IN CONTOURING DATA.

NASA Plum Brook Station
Reactor Area

Figure 4-3
Groundwater Contours
February 17, 1999

2002 IT


LEGEND:
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
BUILDING
RAILROAD
SURFACE WATER
DITCH
FENCE (PBOW BOUNDARY)
(628.13) GROUNDWATER ELEVATION (FT-MSL)
640 GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
GROUNDWATER FLOW DIRECTION
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
BOGART ROAD
PATROL ROAD
MAINTENANCE ROAD
FOX ROAD
MAGAZINE ROAD
WEST SCHEED ROAD
EAST SCHEED ROAD
COLUMBUS AVE
MASON ROAD
SCALE
0 1200 2400 FEET
IT CORPORATION
2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
FIGURE 6-1
OVERBURDEN GROUNDWATER ELEVATION
CONTOUR MAP (AUGUST, 2001)
AREA
SITEWIDE
JOB NO.
771481
DRAWING NO
771481E5.191
REV



LEGEND:

EB-RA-06	OVERBURDEN MONITORING WELL LOCATION
REACTOR 1	BEDROCK MONITORING WELL LOCATION
	SUMP WELL
(600.39)	GROUNDWATER ELEVATION (FT-MSL) IN BEDROCK MONITORING WELLS
610	GROUNDWATER ELEVATION CONTOUR IN BEDROCK MONITORING WELLS
(622.98)	GROUNDWATER ELEVATION IN OVERBURDEN MONITORING WELLS (FT-MSL)
623	GROUNDWATER ELEVATION CONTOUR IN OVERBURDEN MONITORING WELLS (FT-MSL)
G.W. FLOW	GROUNDWATER FLOW
	BUILDINGS
	FENCE

NOTES:

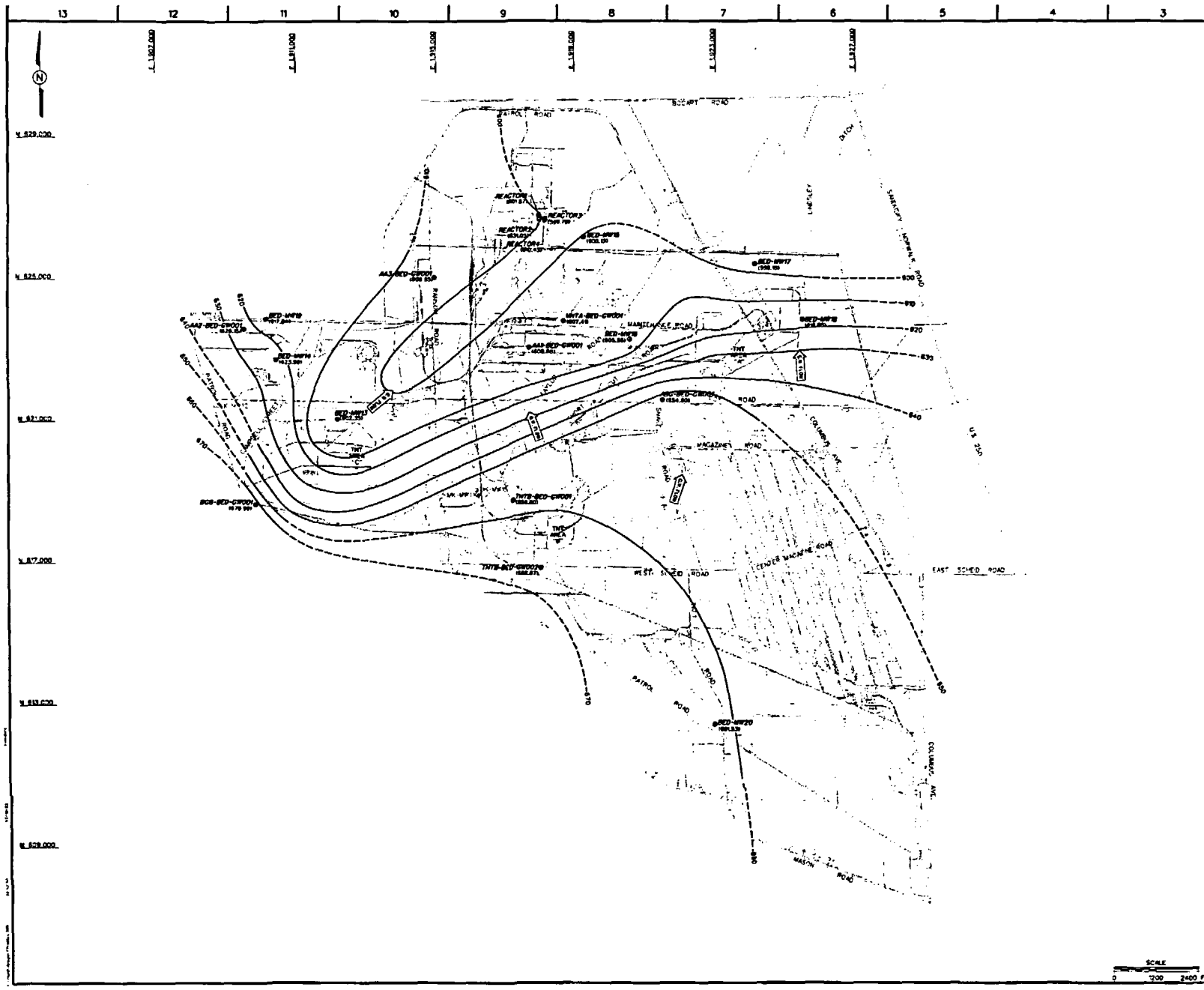
1. LOCATIONS OF SUMP WELLS ARE APPROXIMATE. SUMP WELLS HAVE NOT BEEN SURVEYED.

FIGURE 6-5
GROUNDWATER ELEVATION CONTOUR MAP, REACTOR FACILITY AREA (AUGUST 2001)

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 03/08/02 | DATE LAST REV.: | DRAFT CHCK. BY: C. TUALIN | INITIATOR: D. KESSLER | DWG NO.: 777148\ws 21
DRAWN BY: C. BENTLEY | DRAWN BY: | ENGR. CHCK. BY: HAGEGEORGE | PROJ. MGR: SPANGBERG | PROJ. NO.: 777481
02:04 21 03/08/02 | bvendorg | e:\cad\design\777148\ws 21



LEGEND:

● MK-MW07	OVERBURDEN MONITORING WELL
● BED-MW16	BEDROCK MONITORING WELL
(633.86)	GROUNDWATER ELEVATION (FT-MSL)
	NOT MEASURED
G.W. FLOW	GROUNDWATER FLOW DIRECTION
630	GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
	BUILDING
	RAILROAD
	SURFACE WATER
	DITCH
	FENCE (PBOW BOUNDARY)

NOTES:

1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. GROUNDWATER ELEVATION OF REACTOR #2 AND REACTOR #4 NOT USED IN CONTOURING.

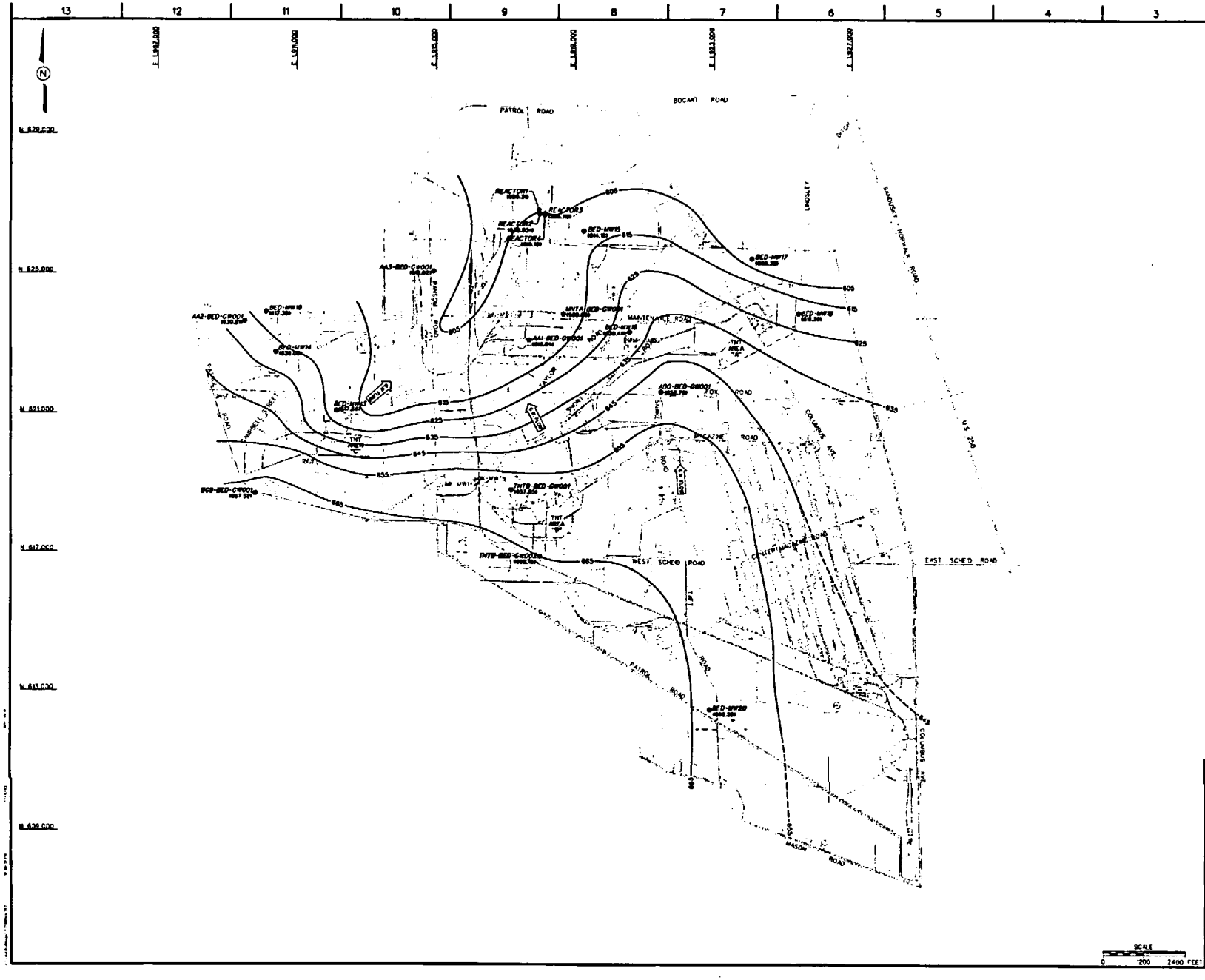
SCALE
0 1200 2400 FEET

IT CORPORATION
A Member of The IT Group
KNOXVILLE, TENNESSEE

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-4
BEDROCK GROUNDWATER ELEVATION
CONTOUR MAP (NOVEMBER 2001)

AREA	JOB NO	DRAWING NO.	REV
SITEWIDE	771481	771481ES.209	



LEGEND:

- OVERBURDEN MONITORING WELL
- BEDROCK MONITORING WELL
- GROUNDWATER ELEVATION (FT-MSL)
- NOT MEASURED
- GROUNDWATER FLOW DIRECTION
- GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
- BUILDING
- RAILROAD
- SURFACE WATER
- DITCH
- FENCE (PROW BOUNDARY)

NOTES:

1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. GROUNDWATER ELEVATION OF REACTOR #2 AND REACTOR #4 NOT USED IN CONTOURING.

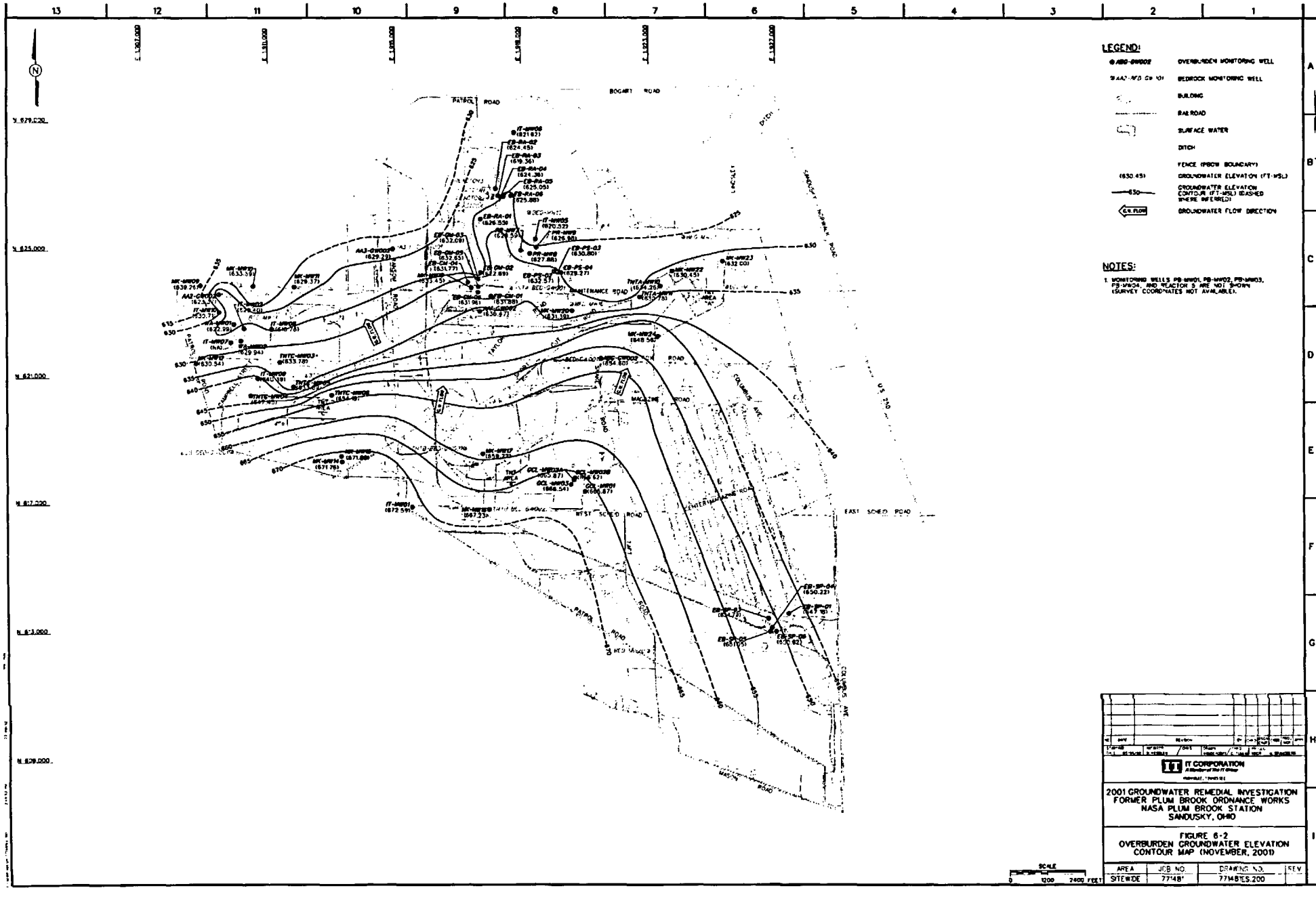
SCALE
0 200 2400 FEET

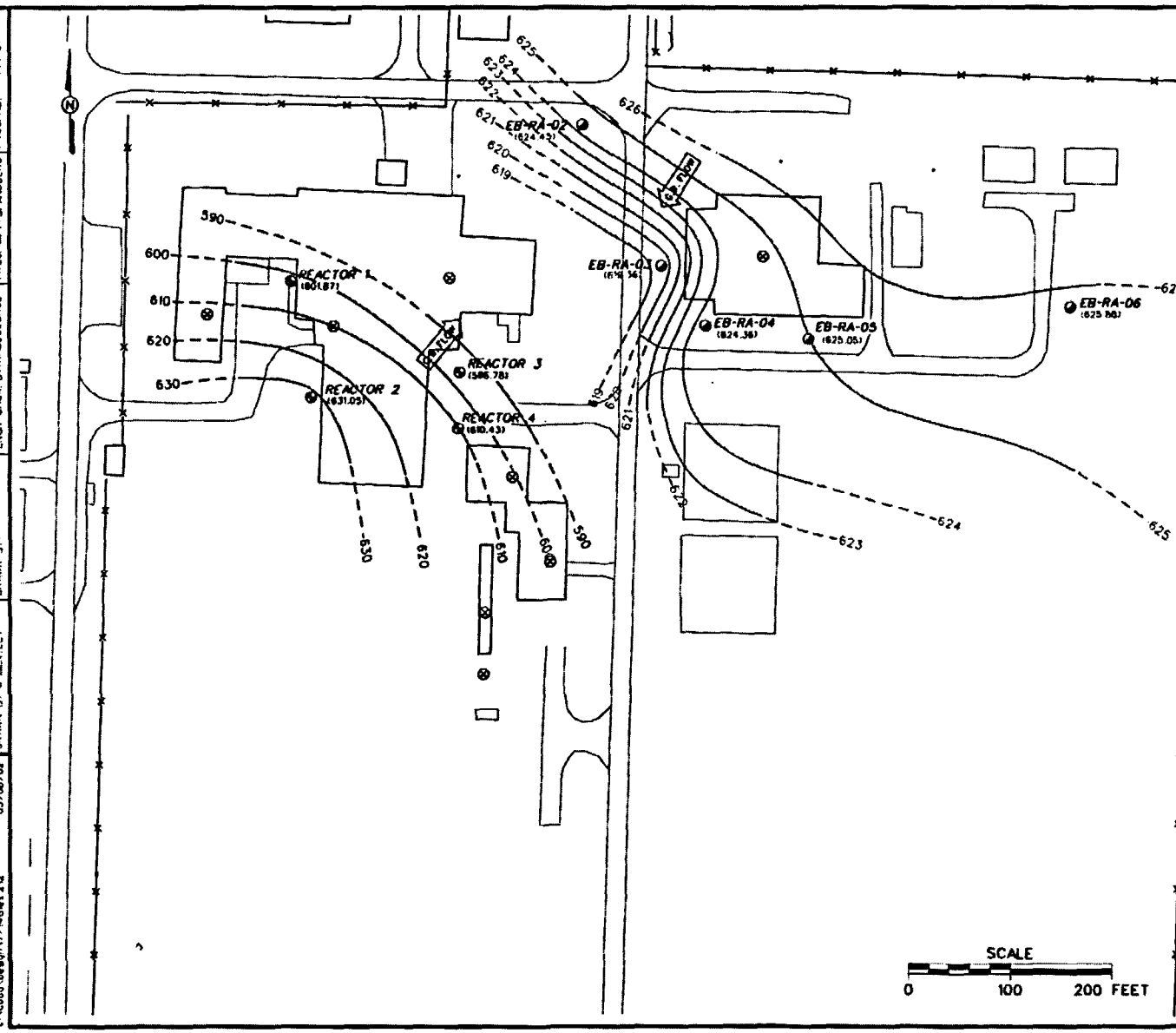
IT CORPORATION
A Subsidiary of The IT Group
NORWALK, PENNSYLVANIA

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-3
BEDROCK GROUNDWATER ELEVATION
CONTOUR MAP (AUGUST 2001)

AREA	JOB NO.	DRAWING NO.	REV
SITEWIDE	771481	771481ES.192	


LEGEND:
OVERBURDEN MONITORING WELL
BEDROCK MONITORING WELL
BUILDING
RAILROAD
SURFACE WATER
DITCH
FENCE (PBOW BOUNDARY)
(630.45) GROUNDWATER ELEVATION (FT-MSL)
630 GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
GW FLOW GROUNDWATER FLOW DIRECTION
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
BOGART ROAD
PATROL ROAD
MAGAZINE ROAD
EAST SCHED ROAD
WEST SCHED ROAD
COLUMBUS AVE
SANDUSKY NORWALK ROAD
US 250
N 629,020
N 625,000
N 621,000
N 617,020
N 613,000
N 609,000
E 1,907,000
E 1,910,000
E 1,915,000
E 1,918,000
E 1,923,000
E 1,927,000
SCALE
0 1200 2400 FEET
IT CORPORATION
2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
FIGURE 6-2
OVERBURDEN GROUNDWATER ELEVATION
CONTOUR MAP (NOVEMBER, 2001)
AREA SITEWIDE
JOB NO. 771481
DRAWING NO. 771481ES.200
REV.



LEGEND:

- EB-RA-06 — OVERBURDEN MONITORING WELL LOCATION
- REACTOR 1 — BEDROCK MONITORING WELL LOCATION
- SUMP WELL
- (631.05) — GROUNDWATER ELEVATION (FT-MSL) IN BEDROCK MONITORING WELLS
- 600 — GROUNDWATER ELEVATION CONTOUR IN BEDROCK MONITORING WELLS
- (625.86) — GROUNDWATER ELEVATION IN OVERBURDEN MONITORING WELLS (FT-MSL)
- 624 — GROUNDWATER ELEVATION CONTOUR IN OVERBURDEN MONITORING WELLS (FT-MSL)
- GW FLOW — GROUNDWATER FLOW
- BUILDINGS
- FENCE

NOTES:

1. LOCATIONS OF SUMP WELLS ARE APPROXIMATE. SUMP WELLS HAVE NOT BEEN SURVEYED.

SCALE

0 100 200 FEET

FIGURE 6-6
GROUNDWATER ELEVATION CONTOUR MAP, REACTOR FACILITY AREA (NOVEMBER 2001)

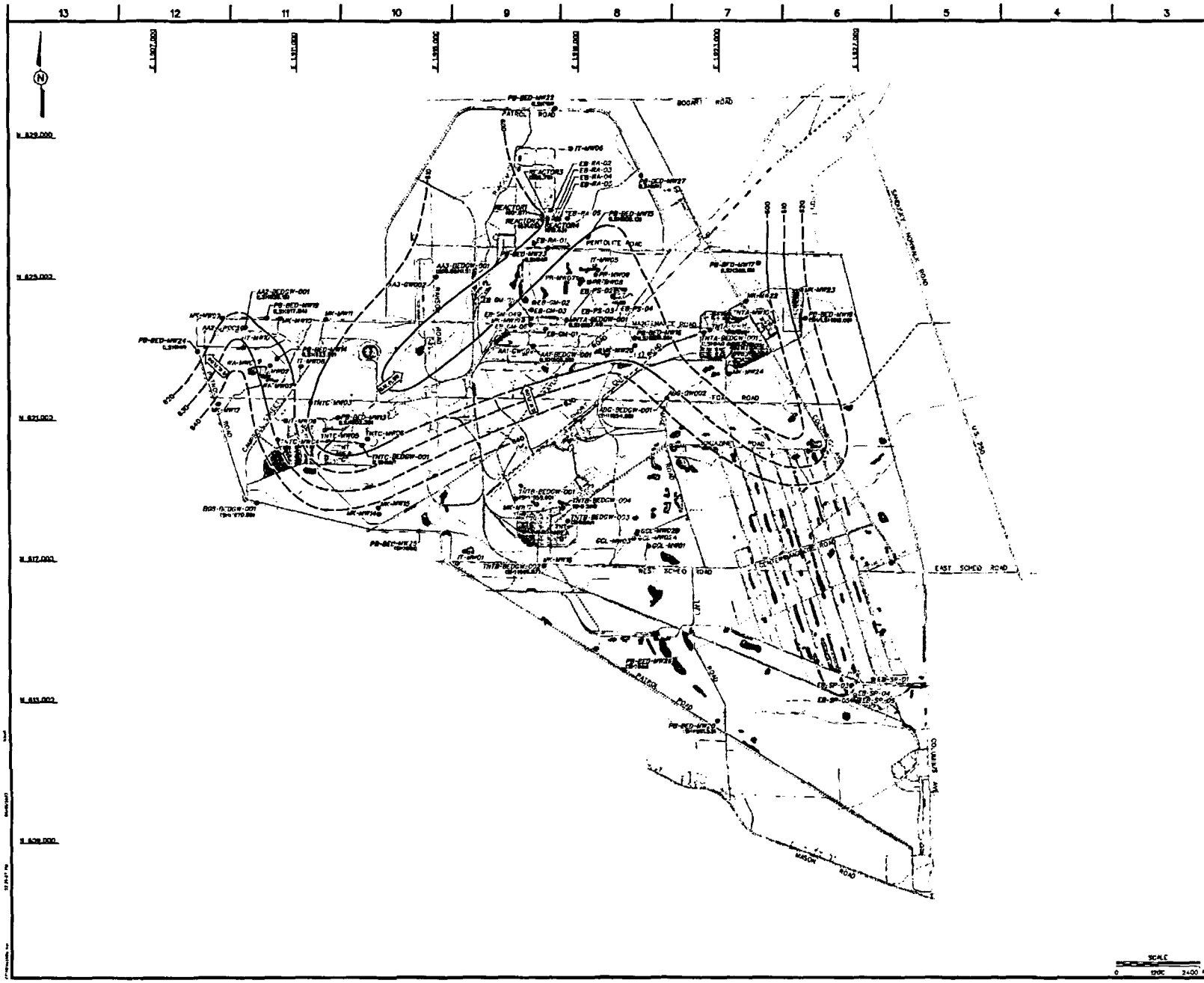
2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 03/08/02	DATE LAST REV:	DRAFT CHCK BY: C. TUMLIN	INITIATOR: D. HESSLER	DWG. NO. ...\77148ws212	
DRAWN BY: C. BENTLEY	DRAWN BY:	ENGR CHCK. BY: HAGEGEORGE	PROJ. MGR. SPANGBERG	PROJ. NO.: 77148	

02-05-08 03/08/02 brandarg e:\cadd\design\77148ws212

2003 IT



LEGEND:

●ABC-GW007	OVERBURDEN MONITORING WELL
●TNTC-BEDGW-001 (LS)	BEDROCK MONITORING WELL SCREENED IN LIMESTONE
●ABC-BEDGW-001 (SH)	BEDROCK MONITORING WELL SCREENED IN SHALE
	BUILDING
	RAILROAD
	SURFACE WATER
	DITCH
	FENCE (PBOW BOUNDARY)
(830.45)	GROUNDWATER ELEVATION (FT-MSL)
——830——	GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
	GROUNDWATER FLOW DIRECTION
(NM)	NOT MEASURED

NOTES:

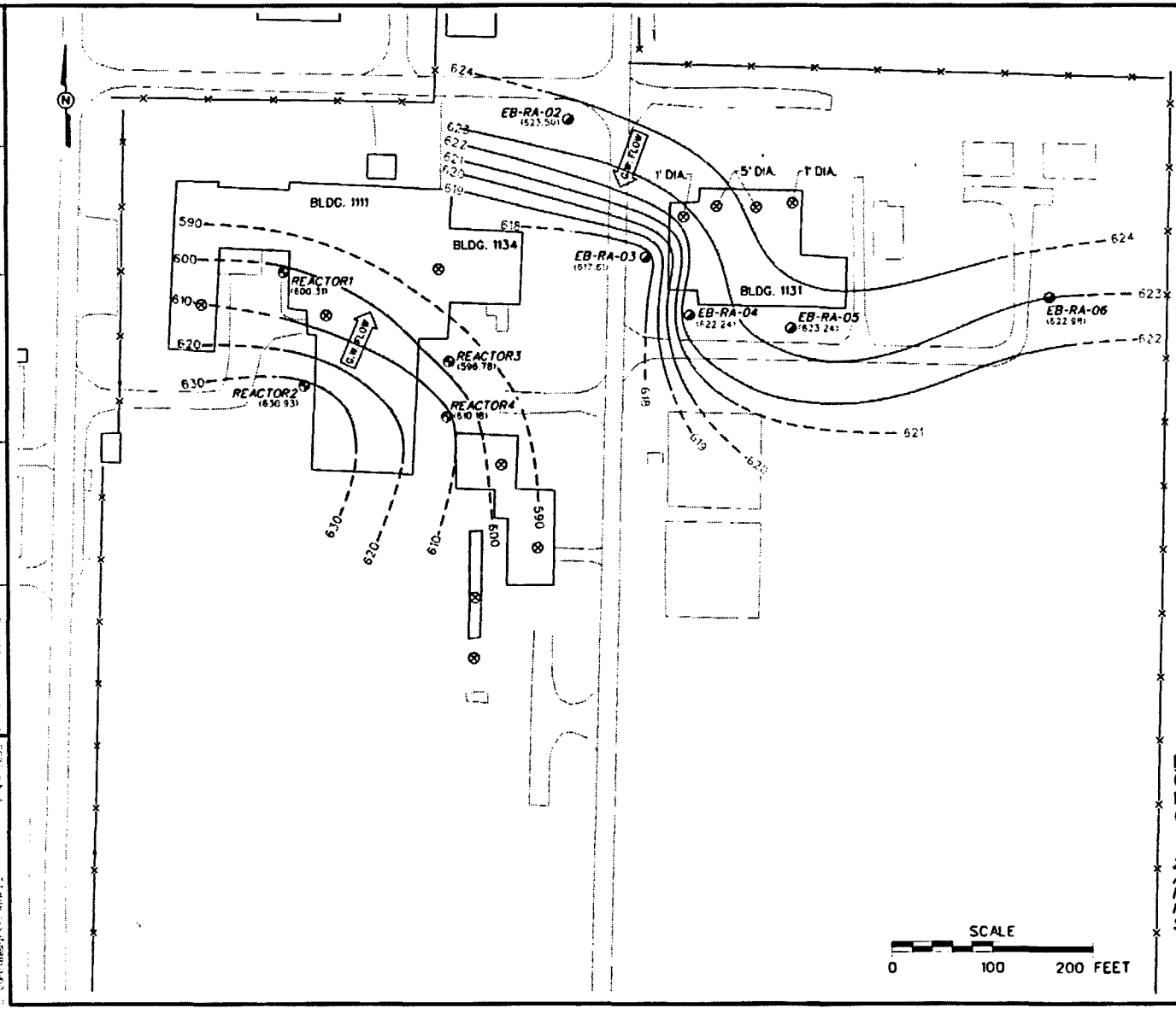
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. MONITORING WELLS REACTOR 2 AND REACTOR 4 WERE NOT USED FOR GROUNDWATER ELEVATION CONTOURING.
3. TYPE OF BEDROCK MONITORING WELLS ARE SCREENED IN IS INDICATED BY (SH) - SHALE AND (LS) - LIMESTONE.
4. MONITORING WELLS WITH (SH) DESIGNATION NOT INCLUDED IN CONTOURING.
5. DASHED LINES INDICATE UNCERTAIN GROUNDWATER LEVEL ELEVATION
6. GROUNDWATER LEVEL ELEVATIONS FROM BEDROCK MONITORING WELLS TNTA-BEDGW-001, TNTC-BEDGW-001, PB-BED-MW22, PB-BED-MW23, PB-BED-MW24, AND PB-BED-MW27 INFERRED FROM MAY 2002 DATA.

Shaw Environmental, Inc

2002 GROUNDWATER DATA SUMMARY
AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-3
DELAWARE LIMESTONE GROUNDWATER
ELEVATION CONTOUR MAP (NOVEMBER 2001)

AREA	JOB NO.	DRAWING NO.	REV
SITEWIDE	771481	771481ES209A.DGN	



LEGEND:

EB-RA-06	OVERBURDEN MONITORING WELL LOCATION
REACTOR1	BEDROCK MONITORING WELL LOCATION
⊗	SUMP WELL
(600.31)	GROUNDWATER ELEVATION (FT-MSL) IN BEDROCK MONITORING WELLS
610	GROUNDWATER ELEVATION CONTOUR IN BEDROCK MONITORING WELLS
(622.95)	GROUNDWATER ELEVATION IN OVERBURDEN MONITORING WELLS (FT-MSL)
623	GROUNDWATER ELEVATION CONTOUR IN OVERBURDEN MONITORING WELLS (FT-MSL)
G.W. FLOW	GROUNDWATER FLOW
	BUILDINGS
	FENCE

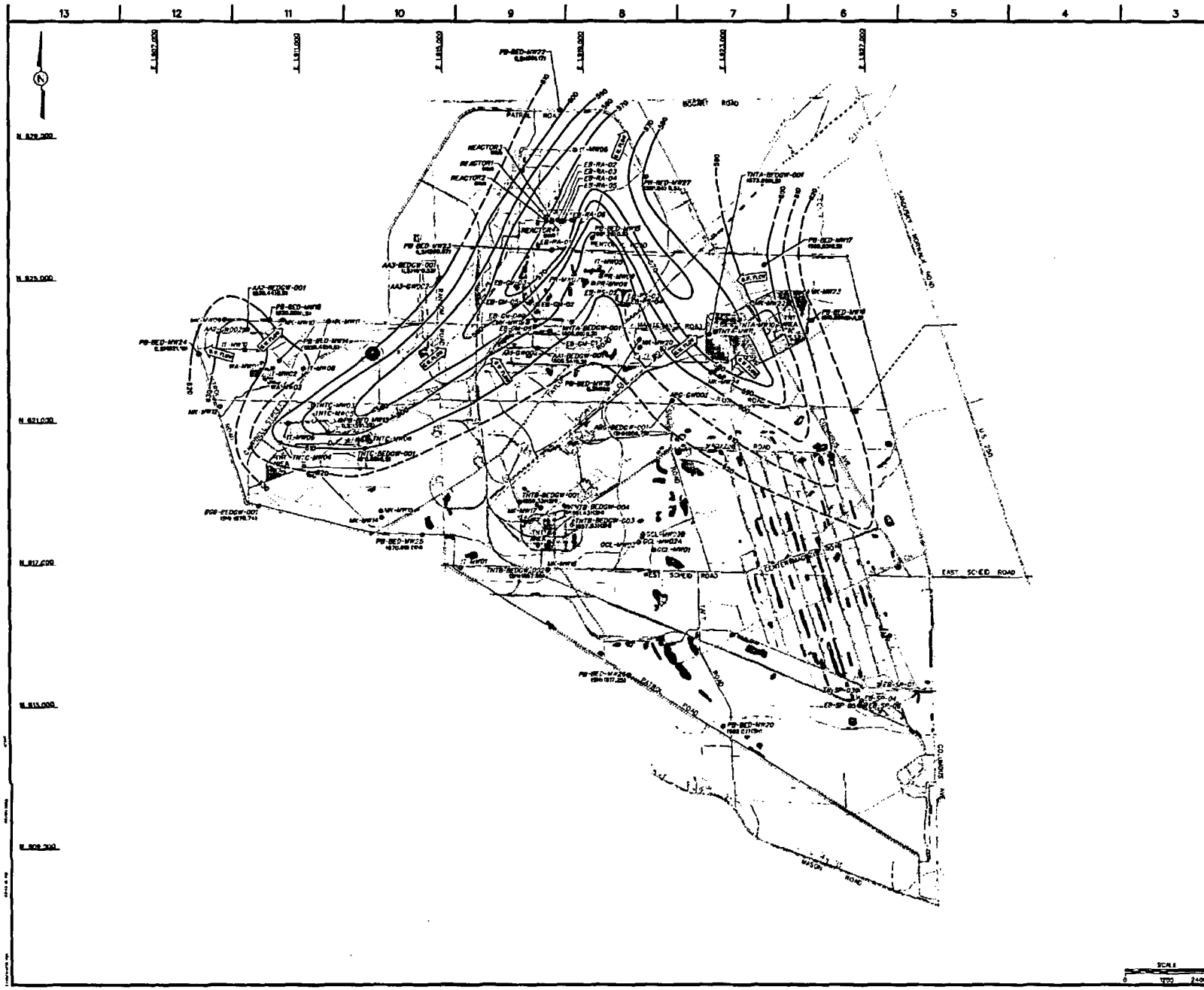
NOTES:

1. LOCATIONS OF SUMP WELLS ARE APPROXIMATE. SUMP WELLS HAVE NOT BEEN SURVEYED.

FIGURE 6-5
GROUNDWATER ELEVATION CONTOUR MAP, REACTOR FACILITY AREA (AUGUST 2001)

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Shaw Environmental, Inc.



LEGEND:

ABC-GW002	OVERBURDEN MONITORING WELL
TNTC-BEDGW-001 (LS)	BEDROCK MONITORING WELL SCREENED IN LIMESTONE
AZ2-BEDGW-001 (SH)	BEDROCK MONITORING WELL SCREENED IN SHALE
	BUILDING
	RAILROAD
	SURFACE WATER
	DITCH
	FENCE (PBOW BOUNDARY)
(630.45)	GROUNDWATER ELEVATION (FT-MSL)
630	GROUNDWATER ELEVATION CONTOUR (FT-MSL) (DASHED WHERE INFERRED)
S.W. FLOW	GROUNDWATER FLOW DIRECTION
(NM)	NOT MEASURED

NOTES:

1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. MONITORING WELLS REACTOR 1, REACTOR 2, REACTOR 3, AND REACTOR 4 WERE NOT USED FOR GROUNDWATER ELEVATION CONTOURING.
3. TYPE OF BEDROCK MONITORING WELLS ARE SCREENED IN IS INDICATED BY (SH) - SHALE AND (LS) - LIMESTONE.
4. MONITORING WELLS WITH (SH) DESIGNATION NOT INCLUDED IN CONTOURING.
5. DASHED LINES INDICATE UNCERTAIN GROUNDWATER LEVEL ELEVATION.

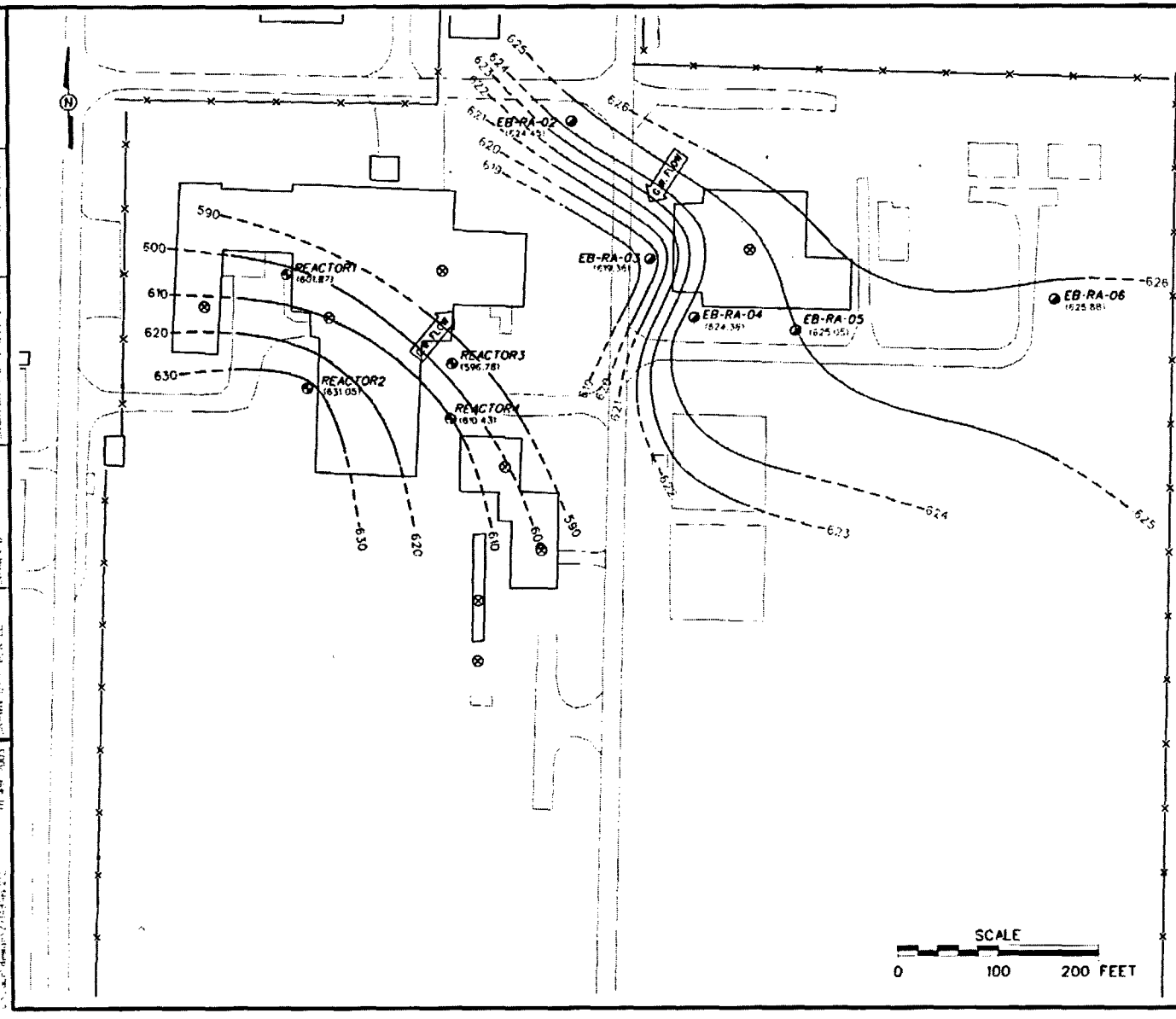
NO.	DATE	REVISION	BY	CHKD	DWN	CHKD	PROJ ENGR	PROJ MGR

Shaw Environmental, Inc.
CINCINNATI, OHIO

2002 GROUNDWATER DATA SUMMARY
AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 6-4
DELAWARE LIMESTONE GROUNDWATER
ELEVATION CONTOUR MAP (MAY 2002)

AREA	JOB NO.	DRAWING NO.	REV.
SITEWIDE	77481	77148ES2'8.DGN	



LEGEND:

EB-RA-06	OVERBURDEN MONITORING WELL LOCATION
REACTOR1	BEDROCK MONITORING WELL LOCATION
⊗	SUMP WELL
(631.05)	GROUNDWATER ELEVATION (FT-MSL) IN BEDROCK MONITORING WELLS
600	GROUNDWATER ELEVATION CONTOUR IN BEDROCK MONITORING WELLS
(625.88)	GROUNDWATER ELEVATION IN OVERBURDEN MONITORING WELLS (FT-MSL)
624	GROUNDWATER ELEVATION CONTOUR IN OVERBURDEN MONITORING WELLS (FT-MSL)
GW FLOW	GROUNDWATER FLOW
	BUILDINGS
	FENCE

NOTES:

1. LOCATIONS OF SUMP WELLS ARE APPROXIMATE. SUMP WELLS HAVE NOT BEEN SURVEYED.

FIGURE 6-6
GROUNDWATER ELEVATION CONTOUR MAP, REACTOR FACILITY AREA (NOVEMBER 2001)

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Shaw Environmental, Inc.

APPENDIX D

GROUNDWATER LEVEL MEASUREMENTS

1997 IT

Table 2-5

Groundwater Level Elevations
Groundwater Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	TOC Elevation (feet, msl)	Ground Elevation (feet, msl)	Water Level Elevation Dec-94 (feet, msl)	Water Level Elevation Mar-95 (feet, msl)	Water Level Elevation Oct-96 (feet, msl)	Water Level Change since Mar. 95 (feet)	Notes
PB-TNTA-MW10	640.18	637.5	633.71	637.04	635.62	-1.42	
PB-TNTA-MW11	640.50	637.86	630.56	632.82	633.56	0.74	
PB-TNTC-MW3	645.41	642.57	Dry, <628.57	639.2	635.01	-4.19	
PB-TNTC-MW4	654.43	651.89	634.87	651.07	648.51	-2.56	
PB-TNTC-MW5	651.81	649.07	628.01	647.62	643.28	-4.34	
PB-TNTC-MW6	659.40	656.82	651.93	655.2	654.56	-0.64	
PB-WA-MW1	644.43	642.32	619.85	619.45	624.99	5.54	
PB-WA-MW2	633.65	631.16	629.59	631.91	628.75	-3.16	
PB-PR-MW7	633.99	631.5	626.32	631.65	629.64	-2.01	
PB-PR-MW8	635.02	632.5	624.55	629.98	627.56	-2.42	
PB-PR-MW9	633.70	630.7	622.92	630.12	626.57	-3.55	
PB-BED-MW13	648.27	645.81	607.85	619.29	621.79	2.5	
PB-BED-MW14	646.04	643.05	621.76	624.39	625.23	0.84	
PB-BED-MW15	631.64	629.08	603.54	598.91	610.22	11.31	
PB-BED-MW16	636.02	633.68	571.38	633.68	630.17	-3.51	
PB-BED-MW17	629.97	627.34	602.57	602.9	602.76	-0.14	
PB-BED-MW18	651.50	648.83	625.05	620.39	621.68	1.29	
PB-BED-MW19	643.07	640.5	621.07	623.52	622.92	-0.6	
PB-BED-MW20	676.33	673.57	661.35	661.28	661.98	0.7	
MK-MW10	640.89	638.06	626.66	Not Measured	632.23	--	
MK-MW11	637.69	634.71	625.22	631.36	628.89	-2.47	
MK-MW16	674.32	671.33	667.14	669.36	668.42	-0.94	
MK-MW17	664.64	660.97	659.58	661.1	660.56	-0.54	
MK-MW22	638.05	635.58	628.85	631.55	630.07	-1.48	
MK-MW23	639.07	636.95	620.88	628.12	632.14	4.02	
MK-MW24	657.12	654.44	648.31	650.77	649.61	-1.16	
IT-MW002	639.63	636.69	627.32	633.75	629.33	-4.42	
IT-MW005	634.99	631.91	620.19	629.62	623.36	-6.26	
IT-MW07	635.03	632.3	-	-	dry, < 627.3	--	piezometer
IT-MW08	633.16	630.6	-	-	619.96	--	new well/survey data
IT-MW09	647.45	645.4	-	-	dry, < 632	--	new well/survey data
IT-MW010	644.80	642.2	-	-	626.41	--	new well/survey data

Note: TOC and ground surface elevations were reported in Table 5-2 of Dames & Moore Site-Wide Groundwater Investigation report (Dames & Moore, 1996) unless otherwise indicated.

1999 IT

Table 6-2

Summary of Groundwater Elevation Measurements
Former Plum Brook Ordnance Works, Sandusky, Ohio

(Page 1 of 3)

Well Identification	Coordinates (Ohio Plane)[a] Easting x	Northing y	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/1994[b]	03/1995[c]	10/1996[d]	8/27	8/27/1997[e]	11/12	11/12/1997[f]	2/24	02/24/1998[g]	5/5	05/05/1998[h]
IT-AA1-BEDGW-001	1917718	623069	641.04	638.8	--[i]	--	--	--	--	30.52	610.52	30.50	610.54	29.1	611.94
IT-AA1-GW002	1917728	623068	640.85	638.6	--	--	--	--	--	6.22	634.63	3.05	637.80	3.42	637.43
IT-AA2-BEDGW-001	1909553	623600	644.06	641.6	--	--	--	--	--	13.11	630.95	11.58	632.48	9.89	634.17
IT-AA2-GW-002[j]	1909481	623589	643.95	641.5	--	--	--	--	--	--	dry[k]	--	dry	--	dry
IT-AA3-BEDGW-001	1914957	625037	636.43	634.1	--	--	--	--	--	23.22	613.21	21.53	614.90	21.62	614.81
IT-AA3-GW-002	1914956	625028	636.11	634.1	--	--	--	--	--	6.30	629.81	3.88	632.23	3.97	632.14
IT-ABG-BEDGW-001	1921506	621580	660.59	658.2	--	--	--	--	--	6.09	654.50	3.55	657.04	5.60	654.99
IT-ABG-GW-002	1921516	621579	661.06	658.2	--	--	--	--	--	6.55	654.51	3.95	657.11	4.92	656.14
PB-BED-MW13	1912175	621044	647.95	645.49	607.85	619.29	621.79	27.80	620.15	27.08	620.87	48.47	599.48	41.40	606.55
PB-BED-MW14	1910457	622720	645.72	642.73	621.76	624.39	625.23	18.51	627.21	19.72	626.00	16.44	629.28	15.99	629.73
PB-BED-MW15	1919283	626179	631.31	628.76	603.54	598.91	610.22	29.95	601.36	21.12	610.19	20.34	610.97	19.79	611.52
PB-BED-MW16	1920594	623299	635.70	633.36	571.38	633.68	630.17	11.80	623.90	7.41	628.29	2.28	633.42	2.74	632.96
PB-BED-MW17	1924121	625417	629.65	627.02	602.57	602.90	602.76	26.48	603.17	27.75	601.90	26.85	602.80	26.40	603.25
PB-BED-MW18	1925483	623849	651.18	648.51	625.05	620.39	621.68	30.58	620.60	30.22	620.96	30.55	620.63	30.72	620.46
PB-BED-MW19	1910174	623869	642.75	640.19	621.07	623.52	622.92	19.85	622.90	20.55	622.20	19.00	623.75	18.45	624.30
PB-BED-MW20	1922952	612423	676.01	673.25	661.35	661.28	661.98	14.28	661.73	14.42	661.59	13.98	662.03	13.29	662.72
IT-BG8-BEDGW-001	1909857	616635	676.56	673.7	--	--	--	--	--	6.38	670.18	6.11	668.45	5.86	670.70
EB-GM-01	1918339	623563	640.45	637.70	--	--	--	8.77	631.68	9.29	631.16	7.35	633.10	7.97	632.48
EB-GM-02	1917822	624435	637.52	634.90	--	--	--	10.76	626.76	9.46	628.06	4.91	632.61	5.14	632.38
EB-GM-03	1917775	624131	638.90	636.20	--	--	--	6.28	632.62	7.38	631.52	5.81	633.09	5.99	632.91
EB-GM-04	1917442	624052	636.34	633.60	--	--	--	5.56	630.78	5.55	630.79	3.27	633.07	3.91	632.43
EB-GM-05	1917802	623872	639.70	637.00	--	--	--	6.24	633.46	7.57	632.13	5.80	633.90	dry	dry
EB-GM-06	1917799	623723	639.61	637.00	--	--	--	6.08	633.53	7.36	632.25	5.92	633.69	6.00	633.61
EB-PS-02	1920061	624344	638.53	635.70	--	--	--	5.97	632.56	5.87	632.66	4.81	633.72	4.90	633.63
EB-PS-03	1920187	624324	637.15	634.40	--	--	--	5.65	631.50	6.35	630.80	5.62	631.53	5.52	631.63
EB-PS-04	1920259	624298	637.87	635.30	--	--	--	8.87	629.00	9.00	628.87	7.30	630.57	5.26	632.61
EB-RA-01	1917783	625964	633.97	631.40	--	--	--	6.61	627.36	7.88	626.09	5.63	628.34	5.75	628.22
EB-RA-02	1918282	626944	633.95	631.30	--	--	--	8.10	625.85	8.72	625.43	6.52	627.43	6.72	627.23
EB-RA-03	1918346	626788	633.63	630.90	--	--	--	--	dry	--	dry	9.09	624.54	9.70	623.93
EB-RA-04	1918389	626731	633.54	630.70	--	--	--	8.07	625.47	10.36	623.18	7.12	626.42	7.53	626.01
EB-RA-05	1918492	626717	633.34	630.60	--	--	--	7.95	625.39	8.87	624.47	6.87	626.47	7.07	626.27
EB-RA-06	1918750	626748	632.64	630.10	--	--	--	8.65	623.99	7.86	624.78	5.20	627.44	4.49	628.15
EB-SP-01	1927550	613598	655.07	652.30	--	--	--	6.43	648.64	7.55	647.52	5.54	649.53	5.78	649.29
EB-SP-03	1926836	613398	657.73	655.10	--	--	--	5.26	652.47	6.94	650.79	4.26	653.47	4.21	653.52

Table 6-2

Summary of Groundwater Elevation Measurements
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting x	Northing y	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/1994[b]	03/1995[c]	10/1996[d]	8/27	8/27/1997[e]	11/12	11/12/1997[f]	2/24	02/24/1998[g]	5/5	05/05/1998[h]
EB-SP-04	1926937	613162	658.02	655.25	--	--	--	7.20	650.82	8.18	649.84	4.21	653.81	7.20	650.82
EB-SP-05	1926897	613051	657.00	654.50	--	--	--	5.08	651.92	6.17	650.83	4.92	652.08	4.96	652.04
EB-SP-06	1927074	613056	658.25	655.40	--	--	--	6.80	651.45	8.10	650.15	7.04	651.21	7.24	651.01
GCL-MW01	1921255	617560	674.81	671.40	--	--	--	8.32	666.49	8.81	666.00	4.57	670.24	4.98	669.83
GCL-MW02A	1920961	617937	672.96	669.70	--	--	--	7.57	665.39	7.79	665.17	4.65	668.31	4.85	668.11
GCL-MW02B	1920984	617941	673.42	669.60	--	--	--	8.32	665.10	8.41	665.01	4.59	668.83	5.00	668.42
GCL-MW03	1920777	617641	672.57	669.55	--	--	--	6.00	666.57	6.61	665.96	4.20	668.37	4.50	668.07
IT-MW01	1915525	616901	678.19	674.50	--	--	--	5.45	672.74	7.00	671.19	4.66	673.53	4.60	673.59
IT-MW02	1910265	622512	639.28	636.37	627.32	633.75	629.33	8.09	631.19	9.78	629.50	5.68	633.60	5.79	633.49
IT-MW05	1919475	625346	634.67	631.59	620.19	629.62	623.36	9.88	624.79	10.45	624.22	4.42	630.25	4.76	629.91
IT-MW06	1918768	628642	631.70	628.50	--	--	--	8.34	623.36	9.21	622.49	4.01	627.69	4.02	627.68
IT-MW07[i]	1909862	622076	635.03	632.30	--	--	--	--	dry	--	dry	--	dry	--	dry
IT-MW08	1911132	622498	633.16	630.60	--	--	619.96	8.22	624.94	10.72	622.44	2.91	630.25	3.12	630.04
IT-MW09	1910699	620956	647.45	645.40	--	--	dry	6.00	641.45	7.24	640.21	4.72	642.73	5.02	642.43
IT-MW10	1919485	623027	644.80	642.52	--	--	626.41	11.25	633.55	12.12	632.68	8.20	636.60	8.19	636.61
MK-MW09	1908872	623901	645.61	642.95	--	--	--	6.09	639.52	6.49	639.12	5.00	640.61	4.99	640.62
MK-MW10	1910564	623860	640.57	637.74	626.66	--	632.23	7.13	633.44	8.49	632.08	7.15	633.42	5.22	635.35
MK-MW11	1910564	623860	637.36	634.39	625.22	631.36	628.89	7.13	630.23	8.14	629.22	5.92	631.44	6.51	630.85
MK-MW12	1908764	621233	640.93	638.10	--	--	--	9.86	631.07	10.78	630.15	7.45	633.48	8.38	632.55
MK-MW14	1913325	618311	681.26	678.50	--	--	--	8.17	673.09	8.72	672.54	4.62	676.64	4.81	676.45
MK-MW15	1913304	618488	680.63	677.80	--	--	--	8.22	672.41	8.80	671.83	4.92	675.71	4.86	675.77
MK-MW16	1918011	616834	674.00	671.01	667.14	669.36	668.42	5.97	668.03	7.75	666.25	5.14	668.86	5.10	668.90
MK-MW17	1917613	618572	664.32	660.65	659.58	661.10	660.56	4.32	660.00	4.75	659.57	3.68	660.64	3.90	660.42
MK-MW19	1917535	623871	639.13	636.20	--	--	--	7.99	631.14	6.83	632.30	3.67	635.46	4.56	634.57
MK-MW20	1920539	622912	637.51	634.30	--	--	--	4.97	632.54	4.78	632.73	6.61	630.90	5.85	631.66
MK-MW22	1923776	624339	637.73	635.24	628.65	631.55	630.07	8.20	629.53	8.24	629.49	6.94	630.79	7.42	630.31
MK-MW23	1925354	624657	639.11	636.63	620.88	628.12	632.14	8.49	630.62	8.02	631.09	5.61	633.50	6.54	632.57
MK-MW24	1923302	622264	656.80	654.12	648.31	650.77	649.61	7.08	649.72	7.22	649.58	6.25	650.55	6.18	650.62
IT-MNTA-BEDGW-001	1918699	623808	638.40	636.05	--	--	--	--	--	28.04	610.36	27.05	611.35	25.60	612.80
PB-PR-MW07	1919021	624996	633.67	631.18	626.32	631.65	629.64	5.35	628.32	5.06	628.61	2.21	631.46	2.17	631.50
PB-PR-MW08	1919309	624889	634.70	632.18	624.55	629.98	627.56	6.66	626.04	7.72	626.98	4.90	629.80	4.37	630.33
PB-PR-MW09	1919510	625092	633.38	630.38	622.92	630.12	626.57	6.50	626.88	7.85	625.53	3.36	630.02	3.40	629.98
REACTOR1	1917983	626773	630.51	630.45	--	--	--	15.32	615.19	22.06	608.45	33.25	597.26	32.30	598.21
REACTOR2	1918003	626661	631.05	631.00	614.71	601.89	--	15.40	615.65	4.81	626.24	28.53	602.52	27.50	603.55

Table 6-2

Summary of Groundwater Elevation Measurements
Former Plum Brook Ordnance Works, Sandusky, Ohio

(Page 3 of 3)

Well Identification	Coordinates (Ohio Plane)[a] Easting x	Northing y	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/1994[b]	03/1995[c]	10/1996[d]	8/27	8/27/1997[e]	11/12	11/12/1997[f]	2/24	02/24/1998[g]	5/5	05/05/1998[h]
REACTOR3	1918148	626685	631.21	631.10	--	--	--	14.60	616.61	22.17	609.04	37.45	593.76	37.08	594.13
PB-TNTA-MW10	1923399	623864	639.86	637.18	633.71	637.04	635.62	4.16	635.70	4.67	635.19	3.10	636.76	3.24	636.62
PB-TNTA-MW11	1922744	623518	640.18	637.54	630.50	632.82	633.58	5.49	634.69	5.16	635.02	4.78	635.40	4.34	635.84
IT-TNTB-BEDGW-001	1917218	618738	662.43	659.8	--	--	--	--	--	4.11	658.32	5.60	656.83	2.91	659.52
IT-TNTB-BEDGW-002	1918021	616835	673.35	670.1	--	--	--	--	--	6.91	666.44	2.89	670.46	7.67	665.68
PB-TNTC-MW03	1911391	621465	645.09	642.25	dry	639.20	635.01	8.07	637.02	9.27	635.82	3.80	641.29	4.95	640.14
PB-TNTC-MW04	1910470	620413	654.11	651.57	634.87	651.07	648.51	6.15	647.96	7.62	646.49	3.32	650.79	3.21	659.90
PB-TNTC-MW05	1911811	620692	651.49	648.75	628.01	647.62	643.28	5.62	645.87	5.60	645.89	3.02	648.47	3.10	648.39
PB-TNTC-MW06	1913006	620429	659.08	656.50	651.93	655.20	654.56	4.46	654.62	5.71	653.37	3.72	655.36	3.81	655.27
PB-WA-MW01	1909948	622641	644.11	642.00	--	--	--	14.00	630.11	16.15	627.96	4.09	640.02	4.70	639.41
PB-WA-MW02	1910176	622124	633.33	630.84	--	--	--	3.89	629.44	4.46	628.87	1.53	631.80	1.54	631.79

[a] Survey data are scaled to the Ohio State Plane Coordinate System (North Zone)

[b] Data from Dames & Moore, Sitewide Groundwater Investigation Final Report (4/97).

[c] Data from Dames & Moore, Sitewide Groundwater Investigation Final Report (4/97).

[d] Data from IT Corporation, Site-Wide Groundwater Investigation Report (9/97).

[e] Data from IT Corporation, 1st Quarterly Water Level Measurement Event Report (10/97).

[f] Data from IT Corporation, 2nd Quarterly Water Level Measurement and 1st Semi-Annual Groundwater Sampling Event Report (5/98).

[g] Data from IT Corporation, 3rd Quarterly Water Level Measurement Event Report (6/97).

[h] Data from IT Corporation, 4th Quarterly Water Level Measurement and 2nd Semi-Annual Groundwater Sampling Event Report (this volume).

[i] Symbol denotes data are not available.

[j] Temporary piezometer.

[k] Well was dry at the time of the measurement.

IT 2002

Table 6-1

Summary of Groundwater Elevation Measurements
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/1994[b]	0319/95[c]	10/1996[d]	8/27	8/27/1997[e]	11/12	11/12/1997[f]	2/24	02/24/1998[g]
IT-AA1-BEDGW-001	1917719	623069	641.04	638.80	--	--	--	--	--	30.52	610.52	30.50	610.54
IT-AA1-GW002	1917728	623068	640.85	638.60	--	--	--	--	--	6.22	634.63	3.05	637.80
IT-AA2-BEDGW-001	1909552	623600	644.06	641.60	--	--	--	--	--	13.11	630.95	11.58	632.48
IT-AA2-GW-002	1909481	623589	643.95	641.50	--	--	--	--	--	--	dry	--	dry
IT-AA3-BEDGW-001	1914957	625037	636.43	634.10	--	--	--	--	--	23.22	613.21	21.53	614.90
IT-AA3-GW-002	1914956	625028	636.11	634.10	--	--	--	--	--	6.30	629.81	3.88	632.23
IT-ABG-BEDGW-001	1921506	621580	660.59	658.20	--	--	--	--	--	6.09	654.50	3.55	657.04
IT-ABG-GW-002	1921516	621579	661.06	658.20	--	--	--	--	--	6.55	654.51	3.95	657.11
PB-BED-MW13	1912175	621044	647.95	645.49	607.85	619.29	621.79	27.80	620.15	27.08	620.87	48.47	599.48
PB-BED-MW14	1910457	622720	645.72	642.73	621.76	624.39	625.23	18.51	627.21	19.72	626.00	16.44	629.28
PB-BED-MW15	1919283	626179	631.31	628.76	603.54	598.91	610.22	29.95	601.36	21.12	610.19	20.34	610.97
PB-BED-MW16	1920594	623299	635.70	633.36	571.38	633.68	630.17	11.80	623.90	7.41	628.29	2.28	633.42
PB-BED-MW17	1924121	625417	629.65	627.02	602.57	602.90	602.76	26.48	603.17	27.75	601.90	26.85	602.80
PB-BED-MW18	1925483	623849	651.18	648.51	625.05	620.39	621.68	30.58	620.60	30.22	620.96	30.55	620.63
PB-BED-MW19	1910174	623869	642.75	640.19	621.07	623.52	622.92	19.85	622.90	20.55	622.20	19.00	623.75
PB-BED-MW20	1922952	612423	676.01	673.25	661.35	661.28	661.98	14.28	661.73	14.42	661.59	13.98	662.03
PB-BED-MW22	1918367	629778	629.67	627.22	--	--	--	--	--	--	--	--	--
PB-BED-MW23	1918150	625838	633.71	631.11	--	--	--	--	--	--	--	--	--
PB-BED-MW24	1908168	622916	645.98	644.20	--	--	--	--	--	--	--	--	--
PB-BED-MW25	1914458	617821	684.59	681.99	--	--	--	--	--	--	--	--	--
PB-BED-MW26	1920274	613878	677.21	674.61	--	--	--	--	--	--	--	--	--
PB-BED-MW27	1920791	627896	627.14	625.24	--	--	--	--	--	--	--	--	--
IT-BG8-BEDGW-001	1909857	618635	676.56	673.70	--	--	--	--	--	6.38	670.18	8.11	668.45
EB-GM-01	1918339	623563	640.45	637.70	--	--	--	8.77	631.68	9.29	631.16	7.35	633.10
EB-GM-02	1917822	624435	637.52	634.90	--	--	--	10.76	626.76	9.46	628.06	4.91	632.61
EB-GM-03	1917775	624131	638.90	636.20	--	--	--	6.28	632.62	7.38	631.52	5.81	633.09
EB-GM-04	1917442	624052	636.34	633.60	--	--	--	5.56	630.78	5.55	630.79	3.27	633.07
EB-GM-05	1917802	623872	639.70	637.00	--	--	--	8.24	633.48	7.57	632.13	5.80	633.90
EB-GM-06	1917799	623723	639.61	637.00	--	--	--	6.08	633.53	7.36	632.25	5.92	633.69
EB-PS-02	1920061	624344	638.53	635.70	--	--	--	5.97	632.56	5.87	632.66	4.81	633.72
EB-PS-03	1920187	624324	637.15	634.40	--	--	--	5.65	631.50	6.35	630.80	5.62	631.53
EB-PS-04	1920259	624298	637.87	635.30	--	--	--	8.87	629.00	9.00	628.87	7.30	630.57
EB-RA-01	1917783	625964	633.97	631.40	--	--	--	6.61	627.36	7.88	626.09	5.63	628.34
EB-RA-02	1918282	626944	633.95	631.30	--	--	--	8.10	625.85	8.72	625.43	6.52	627.43
EB-RA-03	1918346	626788	633.63	630.90	--	--	--	--	dry	--	dry	9.09	624.54
EB-RA-04	1918389	626731	633.54	630.70	--	--	--	8.07	625.47	10.36	623.18	7.12	626.42

Table 6-1

Summary of Groundwater Elevation Measurements
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/1994[b]	0319/95[c]	10/1996[d]	8/27	8/27/1997[e]	11/12	11/12/1997[f]	2/24	02/24/1998[g]
EB-RA-05	1918492	626717	633.34	630.60	--	--	--	7.95	625.39	8.87	624.47	6.87	626.47
EB-RA-06	1918750	626748	632.64	630.10	--	--	--	8.65	623.99	7.86	624.78	5.20	627.44
EB-SP-01	1927550	613598	655.07	652.30	--	--	--	6.43	648.64	7.55	647.52	5.54	649.53
EB-SP-03	1928836	613398	657.73	655.10	--	--	--	5.26	652.47	6.94	650.79	4.26	653.47
EB-SP-04	1926937	613162	658.02	655.25	--	--	--	7.20	650.82	8.18	649.84	4.21	653.81
EB-SP-05	1926897	613051	657.00	654.50	--	--	--	5.08	651.92	6.17	650.83	4.92	652.08
EB-SP-06	1927074	613056	658.25	655.40	--	--	--	6.80	651.45	8.10	650.15	7.04	651.21
GCL-MW01	1921255	617560	674.81	671.40	--	--	--	8.32	666.49	8.81	666.00	4.57	670.24
GCL-MW02A	1920961	617937	672.96	669.70	--	--	--	7.57	665.39	7.79	665.17	4.65	668.31
GCL-MW02B	1920984	617941	673.42	669.60	--	--	--	8.32	665.10	8.41	665.01	4.59	668.83
GCL-MW03	1920777	617641	672.57	669.55	--	--	--	6.00	666.57	6.61	665.96	4.20	668.37
IT-MW01	1915525	616901	678.19	674.50	--	--	--	5.45	672.74	7.00	671.19	4.66	673.53
IT-MW02	1910265	622512	639.28	636.37	627.32	633.75	629.33	8.09	631.19	9.78	629.50	5.68	633.60
IT-MW05	1919475	625346	634.67	631.59	620.19	629.62	623.36	9.88	624.79	10.45	624.22	4.42	630.25
IT-MW06	1918768	628642	631.70	628.50	--	--	--	8.34	623.36	9.21	622.49	4.01	627.69
IT-MW07[i]	1909882	622076	635.03	632.30	--	--	--	--	dry	--	dry	--	dry
IT-MW08	1911132	622498	633.16	630.60	--	--	619.96	8.22	624.94	10.72	622.44	2.91	630.25
IT-MW09	1910699	620956	647.45	645.40	--	--	dry	6.00	641.45	7.24	640.21	4.72	642.73
IT-MW10	1909485	623027	644.80	642.20	--	--	626.41	11.25	633.55	12.12	632.68	8.20	636.60
MK-MW09	1908872	623901	645.61	642.95	--	--	--	6.09	639.52	6.49	639.12	5.00	640.61
MK-MW10	1910564	623860	640.57	637.74	626.66	--	632.23	7.13	633.44	8.49	632.08	7.15	633.42
MK-MW11	1910564	623860	637.36	634.39	625.22	631.36	628.89	7.13	630.23	8.14	629.22	5.92	631.44
MK-MW12	1908764	621233	640.93	638.10	--	--	--	9.86	631.07	10.78	630.15	7.45	633.48
MK-MW14	1913325	618311	681.26	678.50	--	--	--	8.17	673.09	8.72	672.54	4.62	676.64
MK-MW15	1913304	618488	680.63	677.80	--	--	--	8.22	672.41	8.80	671.83	4.92	675.71
MK-MW16	1918011	616834	674.00	671.01	667.14	669.36	668.42	5.97	668.03	7.75	666.25	5.14	668.86
MK-MW17	1917813	618572	664.32	660.65	659.58	661.10	660.56	4.32	660.00	4.75	659.57	3.68	660.64
MK-MW19	1917535	623871	639.13	636.20	--	--	--	7.99	631.14	6.83	632.30	3.67	635.46
MK-MW20	1920539	622912	637.51	634.30	--	--	--	4.97	632.54	4.78	632.73	6.61	630.90
MK-MW22	1923776	624339	637.73	635.24	628.85	631.55	630.07	8.20	629.53	8.24	629.49	6.94	630.79
MK-MW23	1925354	624657	639.11	636.63	620.88	628.12	632.14	8.49	630.62	8.02	631.09	5.61	633.50
MK-MW24	1923302	622264	656.80	654.12	648.31	650.77	649.61	7.08	649.72	7.22	649.58	6.25	650.55

Table 6-1

Summary of Groundwater Elevation Measurements
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/1994[b]	0319/95[c]	10/1996[d]	8/27	8/27/1997[e]	11/12	11/12/1997[f]	2/24	02/24/1998[g]
IT-MNTA-BEDGW-001	1918699	623808	638.40	636.05	--	--	--	--	--	28.04	610.36	27.05	611.35
PB-PR-MW07	1919021	624996	633.67	631.18	626.32	631.65	629.64	5.35	628 32	5.06	628.61	2.21	631.46
PB-PR-MW08	1919309	624889	634.70	632.18	624.55	629.98	627.56	6.86	628.04	7.72	626.98	4.90	629 80
PB-PR-MW09	1919510	625092	633.38	630.38	622.92	630.12	626.57	6.50	626.88	7.85	625.53	3.36	630.02
REACTOR1	1917983	626773	630.51	630.45	--	--	--	15.32	615.19	22.06	608.45	33.25	597.26
REACTOR2	1918003	626661	631.05	631.00	614.71	601.89	--	15.40	615.65	4.81	626.24	28.53	602.52
REACTOR3	1918148	626685	631.21	631.10	--	--	--	14.60	616.61	22.17	609.04	37.45	593.76
REACTOR4	1918147	626630	630.83	630.44	--	--	--	--	--	--	--	--	--
PB-TNTA-MW10	1923399	623864	639.86	637.18	633.71	637.04	635.62	4.16	635.70	4.67	635.19	3.10	636.76
PB-TNTA-MW11	1922744	623518	640.18	637.54	630.50	632.82	633.56	5.49	634.69	5.16	635.02	4.78	635.40
IT-TNTA-BEDGW-001	1922580	623447	638.79	636.99	--	--	--	--	--	--	--	--	--
IT-TNTB-BEDGW-001	1917218	618738	662.43	659.80	--	--	--	--	--	4.11	658.32	5.60	656.83
IT-TNTB-BEDGW-002	1918021	616835	673.35	670.10	--	--	--	--	--	6.91	666.44	2.69	670.46
IT-TNTB-BEDGW-003	1918710	618103	683.11	681.34	--	--	--	--	--	--	--	--	--
IT-TNTB-BEDGW-004	1918572	618469	668.63	666.78	--	--	--	--	--	--	--	--	--
IT-TNTC-BEDGW-001	1912853	620254	667.04	664.04	--	--	--	--	--	--	--	--	--
PB-TNTC-MW03	1911391	621465	645.09	642.25	dry	639.20	635.01	8.07	637.02	9.27	635.82	3.80	641.29
PB-TNTC-MW04	1910470	620413	654.11	651.57	634.87	651.07	648.51	6.15	647.96	7.62	646.49	3.32	650.79
PB-TNTC-MW05	1911811	620692	651.49	648.75	628.01	647.62	643.28	5.62	645.87	5.60	645.89	3.02	648.47
PB-TNTC-MW06	1913006	620429	659.08	656.50	651.93	655.20	654 58	4.46	654.62	5.71	653.37	3.72	655.36
PB-WA-MW01	1909948	622641	644.11	642.00	--	--	--	14.00	630.11	16.15	627.96	4.09	640.02
PB-WA-MW02	1910176	622124	633.33	630.84	--	--	--	3.89	629 44	4 46	628.87	1.53	631.80

Table 6-1

Summary of Groundwater Elevation Measurements
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Groundwater Elevation Measurements (feet above mean sea level (msl))									
	5/5	05/05/1998[b]	9/20[1]	09/20/00	1/17[1]	01/17/01	8/15[1]	08/15/01	11/15[1]	11/15/01
IT-AA1-BEDGW-001	29.1	611.94	14.30	626.74	--	--	31.00	610.04	32.16	608.88
IT-AA1-GW002	3.42	637.43	4.20	636.65	3.60	637.25	7.32	633.53	4.38	636.47
IT-AA2-BEDGW-001	9.89	634.17	14.30	629.76	--	--	13.25	630.81	15.91	628.15
IT-AA2-GW-002	--	dry	13.20	630.75	7.50	636.45	16.57	627.38	20.58	623.37
IT-AA3-BEDGW-001	21.62	614.81	25.20	611.23	24.90	611.53	25.61	610.82	27.58	608.85
IT-AA3-GW-002	3.97	632.14	5.10	631.01	4.00	632.11	8.80	627.31	6.82	629.29
IT-ABG-BEDGW-001	5.60	654.99	5.80	654.79	4.20	656.39	7.80	652.79	5.99	654.60
IT-ABG-GW-002	4.92	656.14	5.80	655.26	4.60	656.46	8.51	652.55	6.46	654.60
PB-BED-MW13	*41.40*	*606.55*	*27.90*	*620.05*	*28.40*	*619.55*	*30.31*	*617.64*	*45.60*	*602.35*
PB-BED-MW14	15.99	629.73	18.80	626.92	17.90	627.82	19.63	626.09	21.73	623.99
PB-BED-MW15	19.79	611.52	20.40	610.91	18.80	612.51	17.13	614.18	31.18	600.13
PB-BED-MW16	2.74	632.96	5.00	630.70	--	--	5.29	630.41	30.14	605.56
PB-BED-MW17	26.40	603.25	29.80	599.85	0.00	629.65	29.33	600.32	31.50	598.15
PB-BED-MW18	30.72	620.46	30.90	620.28	31.80	619.38	31.79	619.39	33.10	618.08
PB-BED-MW19	18.45	624.30	21.20	621.55	21.90	620.85	25.38	617.38	24.91	617.84
PB-BED-MW20	13.29	662.72	13.80	662.21	13.80	662.21	13.75	662.26	14.48	661.53
PB-BED-MW22	--	--	--	--	--	--	--	--	--	--
PB-BED-MW23	--	--	--	--	--	--	--	--	--	--
PB-BED-MW24	--	--	--	--	--	--	--	--	--	--
PB-BED-MW25	--	--	--	--	--	--	--	--	--	--
PB-BED-MW26	--	--	--	--	--	--	--	--	--	--
PB-BED-MW27	--	--	--	--	--	--	--	--	--	--
IT-BG8-BEDGW-001	5.86	670.70	5.40	671.16	6.00	670.56	9.04	667.52	5.57	670.99
EB-GM-01	7.97	632.48	8.40	632.05	8.60	631.85	9.71	630.74	8.57	631.88
EB-GM-02	5.14	632.38	7.80	629.72	5.10	632.42	14.04	623.48	14.83	622.69
EB-GM-03	5.99	632.91	6.00	632.90	6.40	632.50	7.60	631.30	6.81	632.09
EB-GM-04	3.91	632.43	4.60	631.74	3.90	632.44	10.28	626.06	4.57	631.77
EB-GM-05	dry	dry	6.40	633.30	6.90	632.80	7.48	632.22	7.05	632.65
EB-GM-06	6.00	633.61	6.30	633.31	6.80	632.81	7.23	632.38	7.65	631.96
EB-PS-02	4.90	633.63	5.70	632.83	4.50	634.03	7.27	631.26	5.96	632.57
EB-PS-03	5.52	631.63	5.70	631.45	6.30	630.85	6.27	630.88	6.35	630.80
EB-PS-04	5.26	632.61	8.40	629.47	8.60	629.27	9.43	628.45	8.60	629.27
EB-RA-01	5.75	628.22	6.40	627.57	5.90	628.07	9.35	624.62	7.42	626.55
EB-RA-02	6.72	627.23	7.10	626.85	7.30	626.65	10.45	623.50	9.50	624.45
EB-RA-03	9.70	623.93	12.60	621.03	15.70	617.93	16.03	617.61	14.27	619.36
EB-RA-04	*7.53*	*626.01*	*8.60*	*624.94*	*9.80*	*623.74*	*11.30*	*622.24*	*9.18*	*624.36*

Table 6-1

Summary of Groundwater Elevation Measurements
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Groundwater Elevation Measurements (feet above mean sea level (msl))									
	6/5	05/05/1998[b]	9/20[c]	09/20/00	1/17[d]	01/17/01	8/15[e]	08/15/01	11/15[f]	11/15/01
EB-RA-05	7.07	626.27	7.10	626.24	7.40	625.94	10.10	623.24	8.29	625.05
EB-RA-06	4.49	628.15	6.10	626.54	5.20	627.44	9.66	622.98	6.76	625.88
EB-SP-01	5.78	649.29	7.40	647.67	6.50	648.57	9.34	645.73	7.89	647.18
EB-SP-03	4.21	653.52	4.80	652.93	--	--	7.07	650.66	5.94	651.79
EB-SP-04	7.20	650.82	7.40	650.62	--	--	7.76	650.26	7.80	650.22
EB-SP-05	4.96	652.04	5.40	651.60	--	--	7.03	649.97	5.95	651.05
EB-SP-06	7.24	651.01	6.40	651.85	--	--	7.63	650.63	7.63	650.62
GCL-MW01	4.98	669.83	6.80	668.01	6.90	667.91	10.12	664.69	8.94	665.87
GCL-MW02A	4.85	668.11	5.60	667.36	4.90	668.06	9.20	663.76	6.34	666.62
GCL-MW02B	5.00	668.42	6.10	667.32	5.20	668.22	9.67	663.75	6.88	666.54
GCL-MW03	4.50	668.07	5.30	667.27	4.60	667.97	8.25	664.32	5.60	666.97
IT-MW01	4.60	673.59	5.30	672.89	4.80	673.39	8.12	670.07	5.60	672.59
IT-MW02	5.79	633.49	6.95	632.33	5.80	633.48	11.66	627.62	9.88	629.40
IT-MW05	4.76	629.91	8.80	625.87	6.40	628.27	12.35	622.32	14.15	620.52
IT-MW06	4.02	627.68	--	--	--	--	10.48	621.22	10.08	621.62
IT-MW07[i]	--	dry	3.90	631.13	2.70	632.33	6.81	628.22	--	--
IT-MW08	3.12	630.04	6.60	626.56	5.20	627.96	12.18	620.98	14.38	618.78
IT-MW09	5.02	642.43	8.30	639.15	6.80	640.65	9.50	637.95	7.06	640.39
IT-MW10	8.19	636.61	10.30	634.50	9.50	635.30	16.06	628.74	14.09	630.71
MK-MW09	4.99	640.62	5.80	639.81	5.60	640.01	9.21	636.40	6.35	639.26
MK-MW10	5.22	635.35	5.60	634.97	5.20	635.37	9.33	631.24	6.98	633.59
MK-MW11	6.51	630.85	6.80	630.56	6.50	630.86	12.07	625.29	7.99	629.37
MK-MW12	8.38	632.55	--	--	9.40	631.53	11.50	629.43	10.39	630.54
MK-MW14	4.81	678.45	7.50	673.76	6.00	675.26	9.58	671.68	9.50	671.76
MK-MW15	4.86	675.77	7.40	673.23	6.80	673.83	9.13	671.50	8.75	671.88
MK-MW16	5.10	668.90	5.90	668.10	6.10	667.90	8.49	665.51	6.77	667.23
MK-MW17	3.90	660.42	5.10	659.22	4.90	659.42	5.78	658.55	5.10	659.22
MK-MW19	4.56	634.57	4.90	634.23	4.80	634.33	8.30	630.83	5.68	633.45
MK-MW20	5.85	631.66	5.50	632.01	--	--	5.57	631.94	6.12	631.39
MK-MW22	7.42	630.31	7.80	629.93	6.90	630.83	9.60	628.13	7.28	630.45
MK-MW23	6.54	632.57	7.40	631.71	7.30	631.81	10.35	628.76	7.11	632.00
MK-MW24	6.18	650.62	7.50	649.30	6.10	650.70	9.39	647.41	8.24	648.56

Table 6-1

Summary of Groundwater Elevation Measurements
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Groundwater Elevation Measurements (feet above mean sea level [msl])									
	5/5	05/05/1998[b]	9/20[f]	09/20/00	1/17[j]	01/17/01	8/15[i]	08/15/01	11/15[i]	11/15/01
IT-MNTA-BEDGW-001	25.60	612.80	--	--	--	--	29.40	609.00	30.99	607.41
PB-PR-MW07	2.17	631.50	--	--	--	--	5.63	628.05	5.08	628.59
PB-PR-MW08	4.37	630.33	--	--	--	--	7.19	627.51	6.82	627.88
PB-PR-MW09	3.40	629.98	--	--	--	--	6.70	624.68	6.40	626.98
REACTOR1	32.30	598.21	25.50	605.01	31.80	598.71	30.20	600.31	28.64	601.87
REACTOR2	27.50	603.55	27.40	603.65	27.10	603.95	0.13	630.93	0.00	631.05
REACTOR3	37.08	594.13	35.60	595.61	35.20	596.01	34.43	596.78	34.43	596.78
REACTOR4	--	--	20.40	610.43	20.30	610.53	20.65	610.18	20.40	610.43
PB-TNTA-MW10	3.24	636.62	4.80	635.06	2.90	636.96	8.03	631.83	5.60	634.26
PB-TNTA-MW11	4.34	635.84	6.20	633.98	3.10	637.08	7.30	632.88	9.40	630.78
IT-TNTA-BEDGW-001	--	--	--	--	--	--	--	--	--	--
IT-TNTB-BEDGW-001	2.91	659.52	3.60	658.83	3.60	658.83	4.78	657.65	3.83	658.60
IT-TNTB-BEDGW-002	7.67	665.68	6.20	667.15	5.60	667.75	8.20	665.15	6.48	666.87
IT-TNTB-BEDGW-003	--	--	--	--	--	--	--	--	--	--
IT-TNTB-BEDGW-004	--	--	--	--	--	--	--	--	--	--
IT-TNTC-BEDGW-001	--	--	--	--	--	--	--	--	--	--
PB-TNTC-MW03	4.95	640.14	6.80	638.29	4.20	640.89	11.46	633.63	11.31	633.78
PB-TNTC-MW04	3.21	659.90	6.80	647.31	4.00	650.11	7.80	646.31	6.66	647.45
PB-TNTC-MW05	3.10	648.39	5.20	646.29	3.60	647.89	7.76	643.73	17.60	633.89
PB-TNTC-MW06	3.81	655.27	4.90	654.18	4.10	654.98	6.68	652.40	4.89	654.19
PB-WA-MW01	4.70	639.41	14.20	629.91	9.20	634.91	17.65	626.46	21.12	622.99
PB-WA-MW02	1.54	631.79	3.90	629.43	1.90	631.43	4.74	628.59	3.39	629.94

[a] Northings and Eastings are scaled to the Ohio State Plane Coordinate System (North Zone), NAD 1983. Vertical datum to NGVD 1929.

[b] Data from Dames & Moore, Sitewide Groundwater Investigation Final Report (4/97).

[c] Data from Dames & Moore, Sitewide Groundwater Investigation Final Report (4/97)

[d] Data from IT Corporation, Site-Wide Groundwater Investigation Report (9/97).

[e] Data from IT Corporation, 1st Quarterly Water Level Measurement Event Report (10/97).

[f] Data from IT Corporation, 2nd Quarterly Water Level Measurement and 1st Semi-Annual Groundwater Sampling Event Report (5/98).

[g] Data from IT Corporation, 3rd Quarterly Water Level Measurement Event Report (6/97)

[h] Data from IT Corporation, 4th Quarterly Water Level Measurement and 2nd Semi-Annual Groundwater Sampling Event Report (6/99).

[i] Data received from ICI field measurements (2/02).

[j] Symbol denotes data are not available.

[m] Product in well No measurement recorded.

[n] Temporary piezometer.

Shaw 2003

Table 6-1

Summary of Groundwater Elevation Measurements
2002 Groundwater Data Summary and Evaluation Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/94	12/1994[a]	3/19	03/19/95[a]	10/96	10/1996[a]	8/27	8/27/1997[a]	11/12	11/12/1997	2/24	02/24/1998[a]
Overburden Monitoring Wells																
AA1-GW-002	1917728	623058	640.85	638.60	--	--	--	--	--	--	--	--	8.22	634.63	3.05	637.80
AA2-GW-002	1909481	623569	643.95	641.50	--	--	--	--	--	--	--	--	--	dry	--	dry
AA3-GW-002	1914956	625028	636.11	634.10	--	--	--	--	--	--	--	--	8.30	629.81	3.88	632.23
ABG-GW-002	1921516	621579	661.06	658.20	--	--	--	--	--	--	--	--	6.55	654.51	3.95	657.11
EB-GM-01	1918339	623563	640.45	637.70	--	--	--	--	--	--	8.77	631.68	9.29	631.16	7.35	633.10
EB-GM-02	1917822	624438	637.52	634.90	--	--	--	--	--	--	10.76	626.76	9.46	628.06	4.91	632.61
EB-GM-03	1917775	624131	638.90	636.20	--	--	--	--	--	--	6.28	632.62	7.38	631.52	5.81	633.09
EB-GM-04	1917442	624052	636.34	633.60	--	--	--	--	--	--	5.98	630.78	5.55	630.79	3.27	633.07
EB-GM-05	1917802	623872	639.70	637.00	--	--	--	--	--	--	6.24	633.46	7.57	632.13	5.80	633.90
EB-GM-06	1917799	623723	639.61	637.00	--	--	--	--	--	--	6.08	633.53	7.36	632.25	5.92	633.69
EB-PS-02	1920061	624344	638.53	635.70	--	--	--	--	--	--	5.97	632.56	5.87	632.66	4.81	633.72
EB-PS-03	1920187	624324	637.15	634.40	--	--	--	--	--	--	5.65	631.50	6.35	630.80	5.62	631.53
EB-PS-04	1920259	624296	637.87	635.30	--	--	--	--	--	--	8.87	629.00	9.00	628.87	7.30	630.57
EB-RA-01	1917783	625964	633.97	631.40	--	--	--	--	--	--	6.61	627.36	7.88	626.09	5.63	628.34
EB-RA-02	1918282	626944	633.95	631.30	--	--	--	--	--	--	8.10	625.85	8.72	625.43	6.52	627.43
EB-RA-03	1918346	626788	633.63	630.90	--	--	--	--	--	--	--	dry	--	dry	9.09	624.54
EB-RA-04	1918389	626731	633.54	630.70	--	--	--	--	--	--	8.07	625.47	10.36	623.18	7.12	626.42
EB-RA-05	1918492	626717	633.34	630.60	--	--	--	--	--	--	7.95	625.39	8.87	624.47	6.87	626.47
EB-RA-06	1918750	626748	632.64	630.10	--	--	--	--	--	--	8.65	623.99	7.86	624.78	5.20	627.44
EB-SP-01	1927650	613598	655.07	652.30	--	--	--	--	--	--	6.43	648.64	7.55	647.52	5.54	649.53
EB-SP-03	1926836	613398	657.73	655.10	--	--	--	--	--	--	5.26	652.47	6.94	650.79	4.26	653.47
EB-SP-04	1926937	613162	656.02	655.25	--	--	--	--	--	--	7.20	650.82	8.18	649.84	4.21	653.81
EB-SP-05	1926897	613051	657.00	654.50	--	--	--	--	--	--	5.08	651.92	6.17	650.83	4.92	652.08
EB-SP-06	1927074	613056	658.25	655.40	--	--	--	--	--	--	6.80	651.45	8.10	650.15	7.04	651.21
GCL-MW01	1921255	617560	674.81	671.40	--	--	--	--	--	--	8.32	666.49	8.81	666.00	4.57	670.24
GCL-MW02A	1920861	617937	672.96	669.70	--	--	--	--	--	--	7.57	665.39	7.79	665.17	4.65	668.31
GCL-MW02B	1920964	617941	673.42	669.60	--	--	--	--	--	--	8.32	665.10	8.41	665.01	4.59	668.83
GCL-MW03	1920777	617641	672.57	669.55	--	--	--	--	--	--	6.00	666.57	6.61	665.96	4.20	668.37
IT-MW01	1915525	616901	678.19	674.50	--	--	--	--	--	--	5.45	672.74	7.00	671.19	4.66	673.53
IT-MW02	1910265	622512	639.26	636.37	11.99	627.32	5.53	633.75	9.95	629.33	8.09	631.19	9.78	629.50	5.88	633.60
IT-MW05	1919475	625346	634.67	631.59	14.48	620.19	6.05	629.62	11.31	623.36	9.86	624.79	10.45	624.22	4.42	630.25
IT-MW06	1918768	626642	631.70	628.50	--	--	--	--	--	--	8.34	623.36	9.21	622.49	4.01	627.69
IT-MW07[a]	1909862	622076	635.03	632.30	--	--	--	--	--	--	--	dry	--	dry	--	dry
IT-MW08	1911132	622496	633.16	630.60	--	--	--	--	13.20	619.96	8.22	624.94	10.72	622.44	2.91	630.25
IT-MW09	1910599	620956	647.45	645.40	--	--	--	--	dry	--	6.00	641.45	7.24	640.21	4.72	642.73
IT-MW10	1909485	623027	644.80	642.20	--	--	--	--	18.39	626.41	11.25	633.55	12.12	632.68	8.20	636.60
MK-MW09	1908672	623901	645.61	642.95	--	--	--	--	--	--	6.09	639.52	6.49	639.12	5.00	640.61
MK-MW10	1910564	623861	640.57	637.74	13.91	626.66	--	--	8.34	632.23	7.13	633.44	8.49	632.08	7.15	633.42
MK-MW11	1911843	623829	637.36	634.39	12.14	625.22	6.00	631.36	8.47	628.89	7.13	630.23	8.14	629.22	5.92	631.44
MK-MW12	1908764	621233	640.93	638.10	--	--	--	--	--	--	9.86	631.07	10.78	630.15	7.45	633.48
MK-MW14	1913325	618311	681.26	678.50	--	--	--	--	--	--	8.17	673.09	8.72	672.54	4.62	676.64
MK-MW15	1913304	618468	680.63	677.80	--	--	--	--	--	--	8.22	672.41	8.80	671.83	4.92	675.71

Table 6-1

Summary of Groundwater Elevation Measurements
2002 Groundwater Data Summary and Evaluation Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 5/5	05/05/1998[a]	9/20[f]	09/20/00	1/17[f]	01/17/01	8/15[f]	08/15/01	11/15[f]	11/15/01	2/27/28[f]	02/27/02	5/4[f]	05/04/02
Overburden Monitoring Wells																		
AA1-GW-002	1917728	623068	640.86	638.60	3.42	637.43	4.20	636.65	3.60	637.25	7.32	633.53	4.38	636.47	3.39	637.46	3.32	637.53
AA2-GW-002	1909481	623589	643.95	641.50	--	dry	13.20	630.75	7.50	638.45	16.57	627.38	20.58	623.37	10.63	633.32	4.85	639.10
AA3-GW-002	1914958	625028	636.11	634.10	3.97	632.14	5.10	631.01	4.00	632.11	8.80	627.31	8.82	629.29	4.50	631.61	4.22	631.89
ABG-GW-002	1921516	621579	661.06	658.20	4.92	656.14	5.80	655.26	4.60	656.46	8.51	652.55	6.46	654.60	4.18	656.88	4.06	657.00
EB-GM-01	1918339	623563	640.45	637.70	7.97	632.48	8.40	632.05	8.60	631.85	9.71	630.74	8.57	631.88	8.10	632.35	8.15	632.30
EB-GM-02	1917822	624435	637.52	634.90	5.14	632.38	7.80	629.72	5.10	632.42	14.04	623.48	14.83	622.69	4.72	632.80	5.15	632.37
EB-GM-03	1917775	624131	638.90	636.20	5.99	632.91	6.00	632.90	6.40	632.50	7.60	631.30	6.81	632.09	5.96	632.94	6.17	632.73
EB-GM-04	1917442	624052	636.34	633.60	3.91	632.43	4.60	631.74	3.90	632.44	10.28	626.06	4.57	631.77	3.47	632.87	3.94	632.40
EB-GM-05	1917802	623872	639.70	637.00	dry	dry	6.40	633.30	6.90	632.80	7.48	632.22	7.05	632.65	6.25	633.45	6.40	633.30
EB-GM-06	1917799	623723	639.61	637.00	6.00	633.61	6.30	633.31	6.80	632.81	7.23	632.38	7.65	631.96	6.28	633.33	6.24	633.27
EB-PS-02	1920061	624344	638.53	635.70	4.90	633.63	5.70	632.83	4.50	634.03	7.27	631.26	5.96	632.57	4.70	633.83	5.19	633.34
EB-PS-03	1920187	624324	637.16	634.40	5.52	631.63	5.70	631.45	6.30	630.85	6.27	630.88	6.35	630.80	5.96	631.19	5.98	631.17
EB-PS-04	1920259	624298	637.87	635.30	5.26	632.61	6.40	629.47	6.60	629.27	9.43	628.45	8.60	629.27	8.00	629.87	8.16	629.71
EB-RA-01	1917783	626964	633.97	631.40	5.75	628.22	6.40	627.57	5.90	628.07	9.35	624.62	7.42	626.55	5.85	628.12	6.25	627.72
EB-RA-02	1918282	626944	633.95	631.30	6.72	627.23	7.10	626.85	7.30	626.65	10.45	623.50	9.50	624.45	NM	--	--	--
EB-RA-03	1918346	626788	633.63	630.90	9.70	623.93	12.60	621.03	15.70	617.93	16.03	617.61	14.27	619.36	NM	--	--	--
EB-RA-04	1918389	626731	633.54	630.70	7.53	626.01	8.60	624.94	9.80	623.74	11.30	622.24	9.18	624.36	NM	--	--	--
EB-RA-05	1918492	626717	633.34	630.60	7.07	626.27	7.10	626.24	7.40	625.94	10.10	623.24	8.29	625.05	NM	--	--	--
EB-RA-06	1918750	626748	632.64	630.10	4.49	628.15	6.10	626.54	5.20	627.44	9.66	622.98	6.76	625.88	NM	--	--	--
EB-SP-01	1927550	613598	655.07	652.30	5.78	649.29	7.40	647.67	6.50	648.57	9.34	645.73	7.89	647.18	6.10	648.97	6.20	648.87
EB-SP-03	1926836	613398	657.73	655.10	4.21	653.52	4.80	652.93	--	--	7.07	650.66	5.94	651.79	4.19	653.54	4.76	652.97
EB-SP-04	1926937	613162	656.02	655.25	7.20	650.82	7.40	650.62	--	--	7.76	650.26	7.80	650.22	7.30	650.72	7.44	650.58
EB-SP-05	1926897	613051	657.00	654.50	4.98	652.04	5.40	651.60	--	--	7.03	649.97	5.95	651.05	4.96	652.04	5.27	651.73
EB-SP-06	1927074	613056	658.25	655.40	7.24	651.01	8.40	651.85	--	--	7.63	650.63	7.63	650.62	4.18	654.07	7.25	651.00
GCL-MW01	1921255	617560	674.81	671.40	4.98	669.83	6.80	668.01	6.90	667.91	10.12	664.69	8.94	665.87	5.10	669.71	5.22	669.59
GCL-MW02A	1920961	617937	672.96	669.70	4.85	668.11	5.80	667.36	4.90	668.06	9.20	663.76	6.34	666.62	4.75	668.21	5.25	667.71
GCL-MW02B	1920984	617941	673.42	669.60	5.00	668.42	6.10	667.32	5.20	668.22	9.67	663.75	6.86	666.54	4.84	668.58	5.02	668.40
GCL-MW03	1920777	617641	672.57	669.55	4.50	668.07	5.30	667.27	4.60	667.97	8.25	664.32	5.60	666.97	4.30	668.27	4.52	668.05
IT-MW01	1915525	616901	678.19	674.50	4.60	673.59	5.30	672.89	4.80	673.39	6.12	670.07	5.60	672.59	4.66	673.53	4.85	673.34
IT-MW02	1910265	622512	639.28	636.37	5.79	633.49	6.95	632.33	5.80	633.48	11.66	627.62	9.88	629.40	5.82	633.46	6.03	633.25
IT-MW05	1919475	625346	634.67	631.59	4.76	629.91	6.80	625.87	6.40	628.27	12.35	622.32	14.15	620.52	5.17	629.50	4.80	629.87
IT-MW06	1918768	628642	631.70	628.50	4.02	627.68	--	--	--	--	10.48	621.22	10.08	621.62	5.84	625.86	4.11	627.59
IT-MW07[b]	1909862	622076	635.03	632.30	--	dry	3.90	631.13	2.70	632.33	6.81	628.22	NM	--	NM	--	--	--
IT-MW08	1911132	622498	633.16	630.60	3.12	630.04	6.60	626.56	5.20	627.96	12.18	620.98	14.38	618.78	4.19	628.97	5.30	627.86
IT-MW09	1910699	620956	647.45	645.40	5.02	642.43	8.30	639.15	6.80	640.65	9.50	637.95	7.06	640.39	6.42	641.03	7.18	640.27
IT-MW10	1909485	623027	644.80	642.20	8.19	636.61	10.30	634.50	9.50	635.30	18.06	628.74	14.09	630.71	8.77	636.03	8.25	636.55
MK-MW09	1908872	623901	645.61	642.95	4.99	640.62	5.80	639.81	5.60	640.01	9.21	636.40	8.35	639.26	5.51	640.10	5.41	640.20
MK-MW10	1910564	623861	640.57	637.74	5.22	635.35	5.60	634.97	5.20	635.37	9.33	631.24	6.98	633.59	5.02	635.55	5.56	635.01
MK-MW11	1911843	623829	637.36	634.39	6.51	630.85	6.80	630.56	6.50	630.86	12.07	625.29	7.99	629.37	3.92	633.44	6.91	630.45
MK-MW12	1908764	621233	640.93	638.10	8.38	632.55	--	--	9.40	631.53	11.50	629.43	10.39	630.54	8.30	632.63	8.50	632.43
MK-MW14	1913325	618311	681.26	678.50	4.81	676.45	7.50	673.76	6.00	675.26	9.58	671.68	9.50	671.76	5.88	675.38	5.12	676.14
MK-MW15	1913304	618488	680.63	677.80	4.86	675.77	7.40	673.23	6.80	673.83	9.13	671.50	8.75	671.88	5.29	675.34	5.27	675.36

Table 6-1

Summary of Groundwater Elevation Measurements
2002 Groundwater Data Summary and Evaluation Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/94	12/1994[e]	3/19	03/19/95[e]	10/96	10/1996[e]	8/27	8/27/1997[e]	11/12	11/12/1997	2/24	02/24/1998[e]
MK-MW16	1918011	616834	674.00	671.01	6.86	667.14	4.64	669.36	5.56	668.42	5.97	668.03	7.75	666.25	5.14	668.86
MK-MW17	1917813	618572	664.32	660.65	4.74	659.58	3.22	661.10	3.76	660.56	4.32	660.00	4.75	659.57	3.68	660.64
MK-MW19	1917535	623871	639.13	636.20	--	--	--	--	--	--	7.99	631.14	6.83	632.30	3.67	635.46
MK-MW20	1920539	622912	637.51	634.30	--	--	--	--	--	--	4.97	632.54	4.78	632.73	6.61	630.90
MK-MW22	1923776	624339	637.73	635.24	8.86	628.85	6.18	631.55	7.66	630.07	8.20	629.53	8.24	629.49	6.94	630.79
MK-MW23	1925354	624657	639.11	636.63	18.23	620.88	10.99	628.12	6.97	632.14	8.49	630.62	8.02	631.09	5.61	633.50
MK-MW24	1923302	622264	656.80	654.12	8.49	648.31	6.03	650.77	7.19	649.61	7.06	649.72	7.22	649.56	6.25	650.55
PR-MW07	1919021	624996	633.67	631.18	7.35	626.32	2.02	631.65	4.03	629.64	5.35	628.32	5.06	628.61	2.21	631.46
PR-MW08	1919309	624889	634.70	632.18	10.15	624.55	4.72	629.98	7.14	627.56	8.66	626.04	7.72	626.98	4.90	629.80
PR-MW09	1919510	625092	633.36	630.36	10.46	622.92	3.26	630.12	6.81	626.57	6.50	626.86	7.85	625.53	3.36	630.02
TNTA-MW10	1923399	623864	639.86	637.18	6.15	633.71	2.82	637.04	4.24	635.62	4.16	635.70	4.67	635.19	3.10	636.76
TNTA-MW11	1922744	623518	640.18	637.54	9.68	630.50	7.36	632.82	6.62	633.56	5.49	634.69	5.16	635.02	4.78	635.40
TNTC-MW03	1911391	621465	645.09	642.25	dry	--	5.89	639.20	10.06	635.01	8.07	637.02	9.27	635.82	3.80	641.29
TNTC-MW04	1910470	620413	654.11	651.57	19.24	634.87	3.04	651.07	5.60	648.51	6.15	647.96	7.62	646.49	3.32	650.79
TNTC-MW05	1911811	620692	651.49	648.75	23.48	628.01	3.87	647.62	8.21	643.28	5.62	645.87	5.60	645.89	3.02	648.47
TNTC-MW06	1913006	620429	659.06	656.50	7.15	651.93	3.86	655.20	4.52	654.56	4.46	654.62	5.71	653.37	3.72	655.36
WA-MW01	1909948	622641	644.11	642.00	--	--	--	--	--	--	14.00	630.11	16.15	627.96	4.09	640.02
WA-MW02	1910176	622124	633.33	630.84	--	--	--	--	--	--	3.89	629.44	4.46	628.87	1.53	631.80
Bedrock Monitoring Wells																
AA1-BEDGW-001	1917719	623069	641.04	638.80	J	--	--	--	--	--	--	--	30.52	610.52	30.50	610.54
AA2-BEDGW-001	1909552	623600	644.06	641.60	--	--	--	--	--	--	--	--	13.11	630.95	11.56	632.49
AA3-BEDGW-001	1914957	625037	636.43	634.10	--	--	--	--	--	--	--	--	23.22	613.21	21.53	614.90
ABG-BEDGW-001	1921506	621580	660.59	658.20	--	--	--	--	--	--	--	--	6.09	654.50	3.55	657.04
BG8-BEDGW-001	1909857	618635	676.56	673.70	--	--	--	--	--	--	--	--	6.36	670.18	8.11	668.45
MNTA-BEDGW-001	1918699	623808	636.40	636.05	--	--	--	--	--	--	--	--	26.04	610.36	27.05	611.35
PB-BED-MW13	1912176	621044	647.95	645.49	40.10	607.85	26.86	619.29	26.16	621.79	27.80	620.15	27.08	620.87	45.47	599.48
PB-BED-MW14	1910457	622720	645.72	642.73	23.96	621.76	21.33	624.39	20.49	625.23	18.51	627.21	19.72	626.00	16.44	629.28
PB-BED-MW15	1919283	626179	631.31	628.76	27.77	603.54	32.40	598.91	21.09	610.22	29.95	601.36	21.12	610.19	20.34	610.97
PB-BED-MW16	1920594	623299	635.70	633.36	64.32	571.38	2.02	633.68	6.53	630.17	11.80	623.90	7.41	628.29	2.28	633.42
PB-BED-MW17	1924121	625417	629.65	627.02	27.08	602.57	26.75	602.90	26.89	602.76	26.48	603.17	27.75	601.90	26.85	602.80
PB-BED-MW18	1925463	623849	651.18	648.51	26.13	625.05	30.79	620.39	29.50	621.68	30.56	620.60	30.22	620.96	30.55	620.63
PB-BED-MW19	1910174	623869	642.75	640.19	21.68	621.07	19.23	623.52	19.83	622.92	19.85	622.90	20.55	622.20	19.00	623.75
PB-BED-MW20	1922952	612423	676.01	673.25	14.66	661.35	14.73	661.28	14.03	661.98	14.28	661.73	14.42	661.59	13.98	662.03
PB-BED-MW22	1918367	629778	629.67	627.22	--	--	--	--	--	--	--	--	--	--	--	--
PB-BED-MW23	1918150	625838	633.71	631.11	--	--	--	--	--	--	--	--	--	--	--	--
PB-BED-MW24	1908168	622916	645.96	644.20	--	--	--	--	--	--	--	--	--	--	--	--
PB-BED-MW25	1914456	617821	684.59	681.99	--	--	--	--	--	--	--	--	--	--	--	--
PB-BED-MW26	1920274	613878	677.21	674.61	--	--	--	--	--	--	--	--	--	--	--	--
PB-BED-MW27[m]	1920791	627896	627.14	625.24	--	--	--	--	--	--	--	--	--	--	--	--
TNTA-BEDGW-001	1922580	623447	639.79	636.99	--	--	--	--	--	--	--	--	--	--	--	--
TNTB-BEDGW-001	1917218	618738	662.43	659.80	--	--	--	--	--	--	--	--	4.11	658.32	5.60	656.83
TNTB-BEDGW-002	1918021	616835	673.35	670.10	--	--	--	--	--	--	--	--	6.91	666.44	2.89	670.46
TNTB-BEDGW-003	1918710	618103	683.11	681.34	--	--	--	--	--	--	--	--	--	--	--	--

Table 6-1

Summary of Groundwater Elevation Measurements
2002 Groundwater Data Summary and Evaluation Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[b] (ft msl)	Ground Elevation[c] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level (msl)) 5/5	05/05/1996[h]	9/20[i]	09/20/00	1/17[j]	01/17/01	8/15[i]	08/15/01	11/15[i]	11/15/01	2/27/02[i]	02/27/02	5/4[i]	05/04/02
MK-MW16	1918011	616834	674.00	671.01	5.10	668.90	5.90	668.10	6.10	667.90	8.49	665.51	6.77	667.23	5.36	668.64	5.34	668.66
MK-MW17	1917813	618572	664.32	660.65	3.90	660.42	6.10	659.22	4.90	659.42	5.78	658.55	5.10	659.22	4.46	659.86	4.40	659.92
MK-MW19	1917535	623671	639.13	636.20	4.56	634.57	4.90	634.23	4.80	634.33	6.30	630.83	5.68	633.45	4.27	634.86	4.80	634.33
MK-MW20	1920539	622912	637.51	634.30	5.85	631.66	5.50	632.01	--	--	5.57	631.94	6.12	631.39	NM[d]	--	--	--
MK-MW22	1923776	624339	637.73	635.24	7.42	630.31	7.80	629.93	6.90	630.83	9.60	628.13	7.28	630.45	8.69	631.04	7.35	630.38
MK-MW23	1925354	624657	639.11	636.63	6.54	632.57	7.40	631.71	7.30	631.81	10.35	628.76	7.11	632.00	5.96	633.15	6.43	632.68
MK-MW24	1923302	622264	656.80	654.12	6.18	650.62	7.50	649.30	6.10	650.70	9.39	647.41	8.24	648.56	6.15	650.65	6.18	650.62
PR-MW07	1919021	624998	633.67	631.18	2.17	631.50	--	--	--	--	5.63	628.05	5.08	628.59	2.46	631.21	2.28	631.39
PR-MW08	1919309	624889	634.70	632.18	4.37	630.33	--	--	--	--	7.19	627.51	6.62	627.88	5.08	629.62	4.46	630.24
PR-MW09	1919510	625092	633.38	630.38	3.40	629.98	--	--	--	--	8.70	624.68	6.40	626.98	3.49	629.89	3.42	629.96
TNTA-MW10	1923399	623864	639.86	637.18	3.24	636.62	4.80	635.06	2.90	636.96	8.03	631.83	5.60	634.26	3.20	636.66	3.18	636.68
TNTA-MW11	1922744	623518	640.18	637.54	4.34	635.84	6.20	633.98	3.10	637.08	7.30	632.88	9.40	630.78	4.30	635.88	4.41	635.77
TNTC-MW03	1911391	621465	645.09	642.25	4.95	640.14	6.80	638.29	4.20	640.89	11.46	633.63	11.31	633.78	4.55	640.54	5.21	639.88
TNTC-MW04	1910470	620413	654.11	651.57	3.21	650.90	6.80	647.31	4.00	650.11	7.80	646.31	6.66	647.45	3.65	650.26	4.29	649.82
TNTC-MW05	1911811	620692	651.49	648.75	3.10	648.39	5.20	646.29	3.60	647.89	7.76	643.73	17.60	633.89	3.07	648.42	3.30	648.19
TNTC-MW06	1913006	620429	659.08	656.50	3.81	655.27	4.90	654.18	4.10	654.98	6.68	652.40	4.89	654.19	3.74	655.34	4.40	654.68
WA-MW01	1909948	622641	644.11	642.00	4.70	639.41	14.20	629.91	9.20	634.91	17.65	626.46	21.12	622.99	18.38	625.73	5.29	638.82
WA-MW02	1910176	622124	633.33	630.84	1.54	631.79	3.90	629.43	1.90	631.43	4.74	628.59	3.39	629.94	1.27	632.06	1.22	632.11
Bedrock Monitoring Wells																		
AA1-BEDGW-001	1917719	623069	641.04	638.80	29.1	611.94	14.30	626.74	--	--	31.00	610.04	32.16	608.88	30.93	610.11	32.50	608.54
AA2-BEDGW-001	1909552	623600	644.08	641.80	9.89	634.17	14.30	629.76	--	--	13.26	630.81	15.91	628.15	15.08	628.98	13.62	630.44
AA3-BEDGW-001	1914957	625037	636.43	634.10	21.62	614.81	25.20	611.23	24.90	611.53	25.61	610.82	27.58	608.85	20.66	615.77	25.90	610.53
ABG-BEDGW-001	1921506	621580	660.59	658.20	5.60	654.99	5.80	654.79	4.20	656.39	7.80	652.79	5.99	654.60	3.62	656.77	3.81	656.78
BG8-BEDGW-001	1909857	618635	676.56	673.70	5.86	670.70	5.40	671.16	6.00	670.56	9.04	667.52	5.57	670.99	5.68	670.88	5.82	670.74
MNTA-BEDGW-001	1918699	623808	638.40	636.05	25.60	612.80	--	--	--	--	29.40	609.00	30.99	607.41	30.19	608.21	31.50	606.90
PB-BED-MW13	1912175	621044	647.95	645.49	41.40	606.55	27.90	620.05	28.40	619.55	30.31	617.64	45.60	602.35	37.50	610.45	56.67	591.28
PB-BED-MW14	1910457	622720	645.72	642.73	15.99	629.73	18.80	626.92	17.90	627.82	19.63	626.09	21.73	623.99	18.59	627.13	17.30	628.42
PB-BED-MW15	1919283	626179	631.31	628.76	19.79	611.52	20.40	610.91	18.80	612.51	17.13	614.18	31.18	600.13	23.96	607.35	30.05	601.26
PB-BED-MW16	1920594	623298	635.70	633.36	2.74	632.96	5.00	630.70	--	--	5.29	630.41	30.14	605.56	NM[d]	--	--	--
PB-BED-MW17	1924121	625417	629.85	627.02	28.40	603.25	29.80	599.85	0.00	629.65	29.33	600.32	31.50	598.15	29.65	600.00	31.62	598.03
PB-BED-MW18	1925453	623849	651.18	648.51	30.72	620.46	30.90	620.28	31.80	619.38	31.79	619.39	33.10	618.08	32.43	618.75	32.59	618.59
PB-BED-MW19	1910174	623869	642.75	640.19	18.45	624.30	21.20	621.55	21.90	620.85	25.38	617.38	24.91	617.84	23.27	619.48	22.75	620.00
PB-BED-MW20	1922952	612423	676.01	673.25	13.29	662.72	13.80	662.21	13.80	662.21	13.75	662.26	14.48	661.53	13.81	662.20	13.94	662.07
PB-BED-MW22	1918367	629778	629.67	627.22	--	--	--	--	--	--	--	--	--	--	29.76	599.91	28.50	601.17
PB-BED-MW23	1918150	625838	633.71	631.11	--	--	--	--	--	--	--	--	--	--	60.80	572.91	73.04	560.67
PB-BED-MW24	1908168	622916	645.98	644.20	--	--	--	--	--	--	--	--	--	--	25.80	620.18	24.80	621.18
PB-BED-MW25	1914458	617821	684.59	681.99	--	--	--	--	--	--	--	--	--	--	14.05	670.54	13.90	670.69
PB-BED-MW26	1920274	613878	677.21	674.61	--	--	--	--	--	--	--	--	--	--	59.63	617.58	59.96	617.25
PB-BED-MW27[m]	1920791	627896	627.14	625.24	--	--	--	--	--	--	--	--	--	--	44.60	582.54	46.10	581.04
TNTA-BEDGW-001	1922580	623447	638.79	636.99	--	--	--	--	--	--	--	--	--	--	75.36	*576.23	77.70	*573.89
TNTB-BEDGW-001	1917218	618738	662.43	659.80	2.91	659.52	3.60	658.83	3.60	658.83	4.78	657.65	3.83	658.60	3.16	659.27	3.10	659.33
TNTB-BEDGW-002	1918021	616835	673.35	670.10	7.67	665.68	6.20	667.15	5.60	667.75	8.20	665.15	6.48	666.87	5.72	667.63	5.80	667.55
TNTB-BEDGW-003	1918710	618103	683.11	681.34	--	--	--	--	--	--	--	--	--	--	19.38	663.73	25.28	657.83

Table 6-1

Summary of Groundwater Elevation Measurements
2002 Groundwater Data Summary and Evaluation Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 12/94	12/1994[a]	3/19	03/19/95[a]	10/95	10/1995[a]	8/27	8/27/1997[a]	11/12	11/12/1997	2/24	2/24/1998
TNTB-BEDGW-004	1918572	618469	668.63	666.78	--	--	--	--	--	--	--	--	--	--	--	--
TNTC-BEDGW-001	1912853	620254	667.04	664.04	--	--	--	--	--	--	--	--	--	--	--	--
REACTOR1	1917983	626773	630.51	630.45	--	--	--	--	--	--	15.32	615.19	22.06	608.45	33.25	597.26
REACTOR2	1918003	626661	631.05	631.00	16.34	614.71	29.16	601.89	--	--	15.40	615.65	4.81	626.24	28.53	602.52
REACTOR3	1918148	626685	631.21	631.10	--	--	--	--	--	--	14.60	616.61	22.17	609.04	37.45	593.76
REACTOR4	1918147	626630	630.83	630.44	--	--	--	--	--	--	--	--	--	--	--	--

Table 6-1

Summary of Groundwater Elevation Measurements
2002 Groundwater Data Summary and Evaluation Report
Former Plum Brook Ordnance Works, Sandusky, Ohio

Well Identification	Coordinates (Ohio Plane)[a] Easting (x)	Northing (y)	Top of Casing Elevation[a] (ft msl)	Ground Elevation[a] (ft msl)	Groundwater Elevation Measurements (feet above mean sea level [msl]) 5/5	05/05/1996[b]	9/20[c]	09/20/00	1/17[d]	01/17/01	8/15[e]	08/15/01	11/15[f]	11/15/01	2/27[g]	02/27/02	5/4[h]	05/04/02
TNTB-BEDGW-004	1918572	618469	668.83	666.78	--	--	--	--	--	--	--	--	--	--	7.31	661.32	7.20	661.43
TNTC-BEDGW-001	1912653	620254	667.04	664.04	--	--	--	--	--	--	--	--	--	--	57.64	609.40	56.98	610.06
REACTOR1	1917983	626773	630.51	630.45	32.30	598.21	25.50	605.01	31.80	598.71	30.20	600.31	28.64	601.87	NM	--	--	--
REACTOR2	1918003	626661	631.05	631.00	27.50	603.55	27.40	603.65	27.10	603.95	0.13	630.93	0.00	631.05	NM	--	--	--
REACTOR3	1918148	626685	631.21	631.10	37.08	594.13	35.60	595.61	35.20	596.01	34.43	596.78	34.43	596.78	NM	--	--	--
REACTOR4	1918147	626630	630.83	630.44	--	--	20.40	610.43	20.30	610.53	20.65	610.18	20.40	610.43	NM	--	--	--

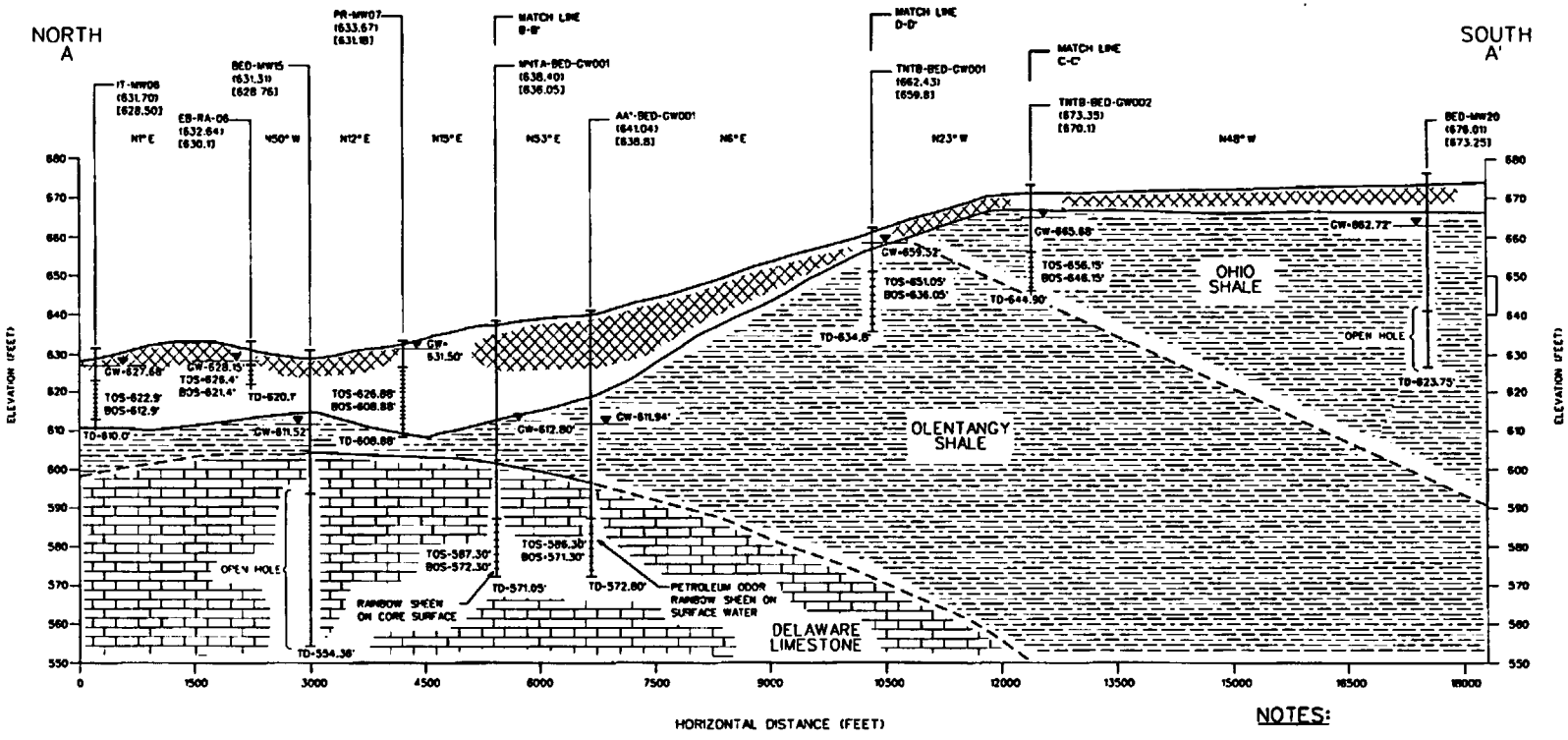
[a] Northings and Eastings are scaled to the Ohio State Plane Coordinate System (North Zone), NAD 1983. Vertical datum to NGVD 1929.
[b] Data from Dames & Moore, Sitewide Groundwater Investigation Final Report (4/97).
[c] Data from Dames & Moore, Sitewide Groundwater Investigation Final Report (4/97).
[d] Data from IT Corporation, Site-Wide Groundwater Investigation Report (9/97).
[e] Data from IT Corporation, 1st Quarterly Water Level Measurement Event Report (10/97).
[f] Data from IT Corporation, 2nd Quarterly Water Level Measurement and 1st Semi-Annual Groundwater Sampling Event Report (5/98).
[g] Data from IT Corporation, 3rd Quarterly Water Level Measurement Event Report (6/97).
[h] Data from IT Corporation, 4th Quarterly Water Level Measurement and 2nd Semi-Annual Groundwater Sampling Event Report (6/99).
[i] Data received from ICI field measurements.
[j] Symbol denotes data are not available.
[k] Temporary piezometer (removed 4/14/02).
[l] Hydrocarbon product in well. No measurement recorded.
[m] Monitoring well PB-BED-MW27 was abandoned at the publics request in January 2003 due to "nuisance" (hydrogen sulfide) odors.
[n] Groundwater elevation corrected for hydrocarbon product in well. TOC elevation - (depth to groundwater - [product thickness x 0.8]).

APPENDIX E

GEOLOGIC CROSS SECTIONS PREPARED BY IT

Section 1: IT (1999)
Section 2: IT (2002)
Section 3: Shaw (2003)

Section 1: IT (1999)



CROSS SECTION A-A'

LEGEND:

OVERBURDEN	GW-627.68'	GROUNDWATER ELEVATION (MAY 5, 1998)
SHALE	BED-MW15	WELL ID
	(631.31)	CASING ELEVATION
LIMESTONE	[628.76]	GROUND SURFACE ELEVATION
	TD-610.80'	TOTAL DEPTH OF BOREHOLE
CONTACT AREA UNCERTAIN	TOS	TOP OF SCREEN
	BOS	BOTTOM OF SCREEN
	N15°E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE:
0 1500 3000 FEET

VERTICAL SCALE:
0 30 60 FEET

NOTES:

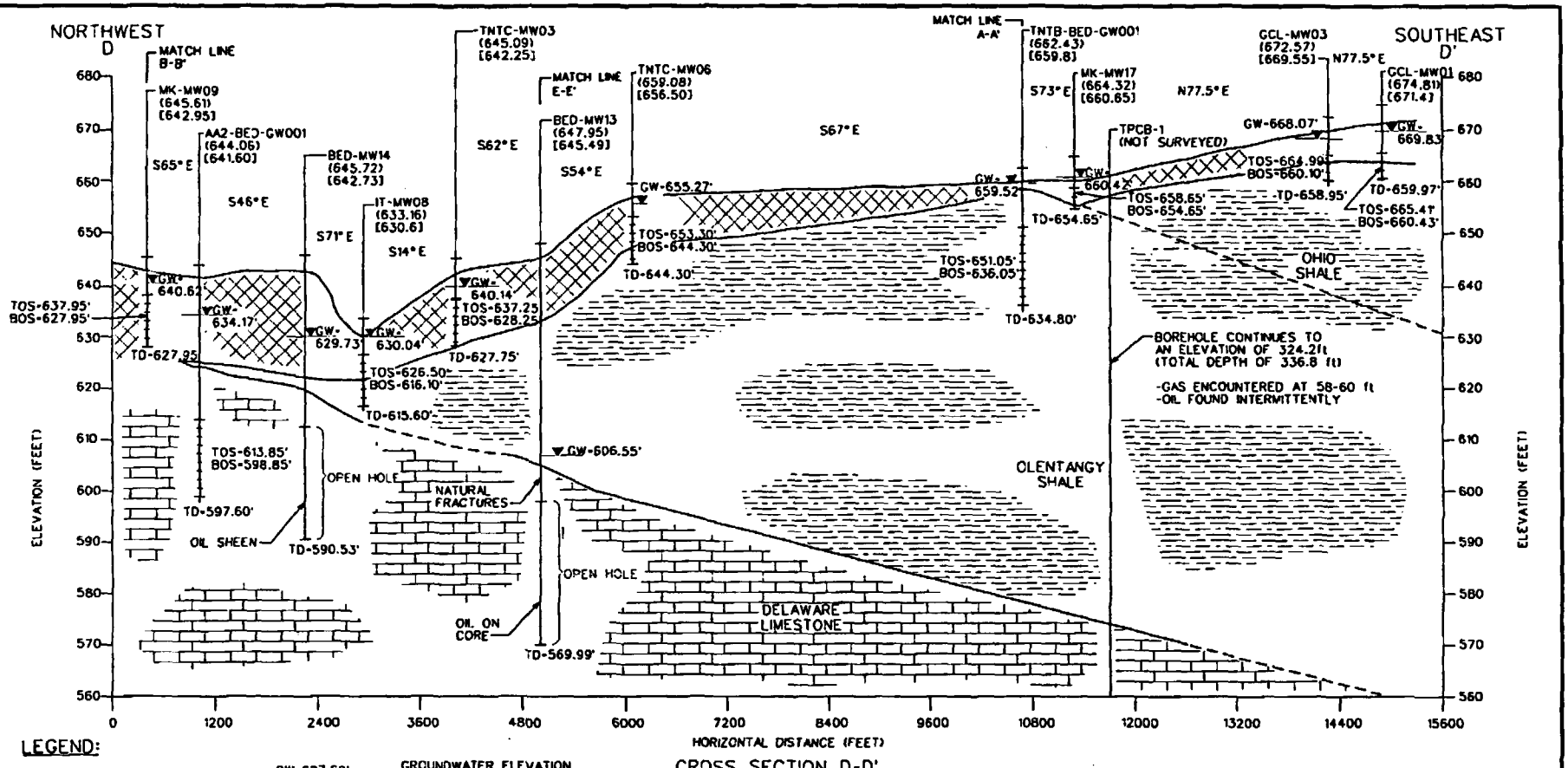
1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

FIGURE 2-3
GEOLOGIC CROSS-SECTION A-A'

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 1/4/99 | DATE LAST REV.: | DRAFT. CHCK. BY: C. TUMLIN | INITIATOR: D. KESSLER | DWG. NO.: 77148leg 154
DRAWN BY: R. SPRES | DRAWN BY: | ENGR. CHCK. BY: D. KESSLER | PROJ. MGR.: SPANGBERG | PROJ. NO.: 77148
10-27-99 | 23 JUN 1999



LEGEND:

- OVERBURDEN
- SHALE
- LIMESTONE
- CONTACT AREA UNCERTAIN

GW-627.68'	GROUNDWATER ELEVATION (MAY 5, 1998)
BED-MW15	WELL ID
(631.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD-610.80'	TOTAL DEPTH OF BOREHOLE
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15°E	BEARING OF CROSS-SECTION SEGMENT

CROSS SECTION D-D'

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

HORIZONTAL SCALE:

0 1200 2400 FEET

VERTICAL SCALE:

0 20 40 FEET

FIGURE 2-6
GEOLOGIC CROSS-SECTION D-D'

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 05/25/93 | DATE LAST REV.: | DRAFT CHCK BY: C. TUALIN | INITIATOR: HAGEGEORGE | DWG. NO.: 1-7714-8 rev 157
DRAWN BY: T. BRADSHAW | DRAWN BY: | ENGR. CHCK BY: HAGEGEORGE | PROJ. MGR.: SPANGBERG | PROJ. NO.: 7714-8
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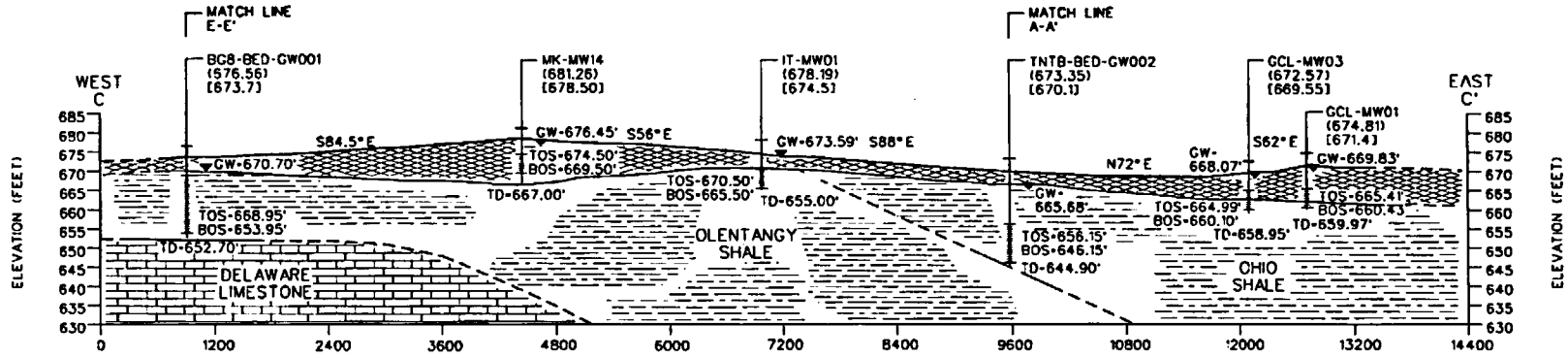

HORIZONTAL DISTANCE (FEET)

CROSS SECTION C-C'

LEGEND:

OVERBURDEN	GW-627.68'▼	GROUNDWATER ELEVATION (MAY 5, 1998)
	BED-MW15	WELL ID
SHALE	(631.31)	CASING ELEVATION
	[628.76]	GROUND SURFACE ELEVATION
LIMESTONE	TD-610.80'	TOTAL DEPTH OF BOREHOLE
	TOS	TOP OF SCREEN
CONTACT AREA UNCERTAIN	BOS	BOTTOM OF SCREEN
	N15°E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE:

0 1200 2400 FEET

VERTICAL SCALE:

0 30 60 FEET

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-03DG

FIGURE 2-5
GEOLOGIC CROSS-SECTION C-C'

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998) FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 05/26/99 | DATE LAST REV: | DRAFT CHCK BY: C. TUNLIN | INITIATOR: K. KESSLER | DWG NO.: 771481ea.56
DRAWN BY: R. SPRES | DRAWN ON: | ENGR CHCK. BY: D. KESSLER | PROJ. MGR: SPANGBERG | PROJ. NO. 771481
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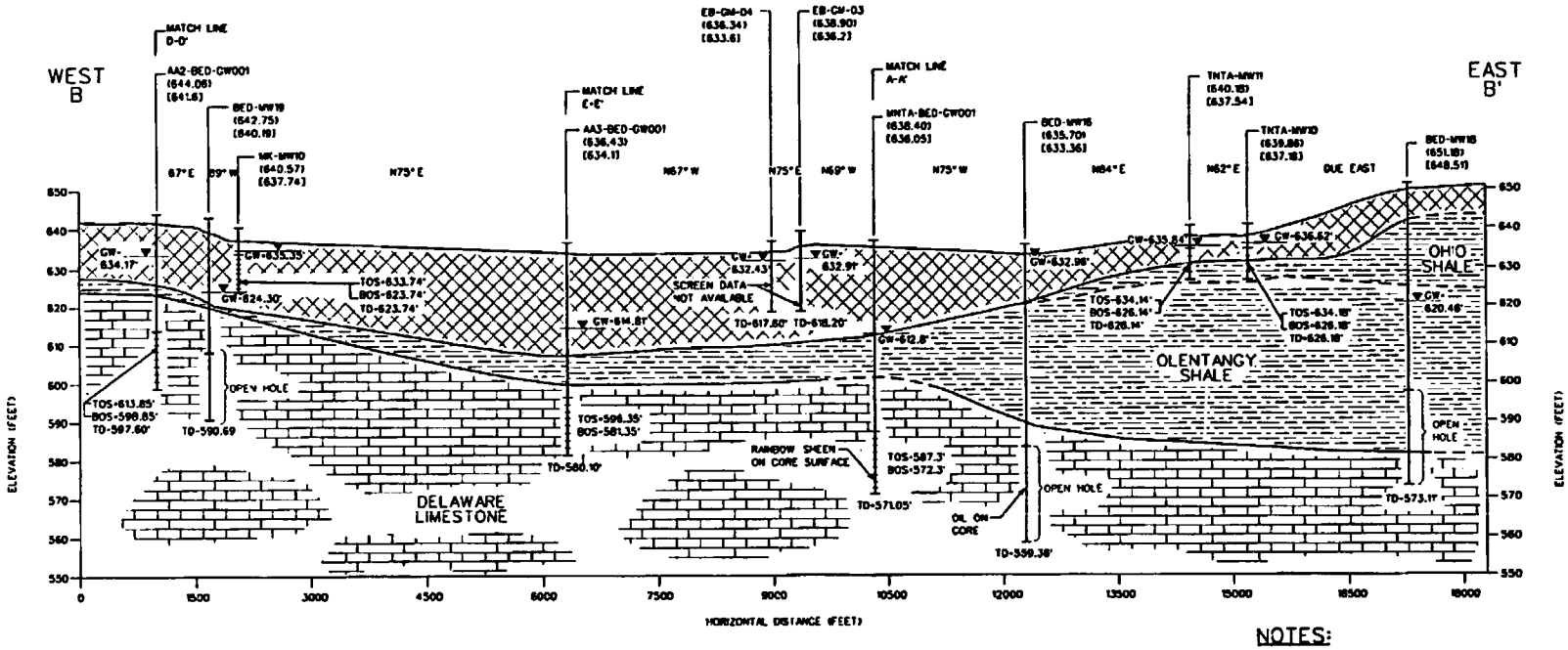

CROSS SECTION B-B'

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

LEGEND:

OVERBURDEN	GW-627.68'	GROUNDWATER ELEVATION (MAY 5, 1998)
SHALE	BED-MW15	WELL ID
	(631.31)	CASING ELEVATION
LIMESTONE	[628.76]	GROUND SURFACE ELEVATION
	TD-610.80'	TOTAL DEPTH OF BOREHOLE
	TOS	TOP OF SCREEN
CONTACT AREA UNCERTAIN	BOS	BOTTOM OF SCREEN
	N15° E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE:
0 1500 3000 FEET

VERTICAL SCALE:
0 30 60 FEET

FIGURE 2-4
GEOLOGIC CROSS-SECTION B-B'

SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998)
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 1/4/99 | DATE LAST REV: | DRAFT. CHECK BY: C. TUMLIN | MITATOR: 40SS.FR | DWG. NO.: 377-48ss '55
DRAWN BY: R. SPIRES | DRAWN BY: | ENGR. CHECK BY: D. KESSLER | PROJ. MGR.: SPANGBERG | PROJ. NO.: 771481
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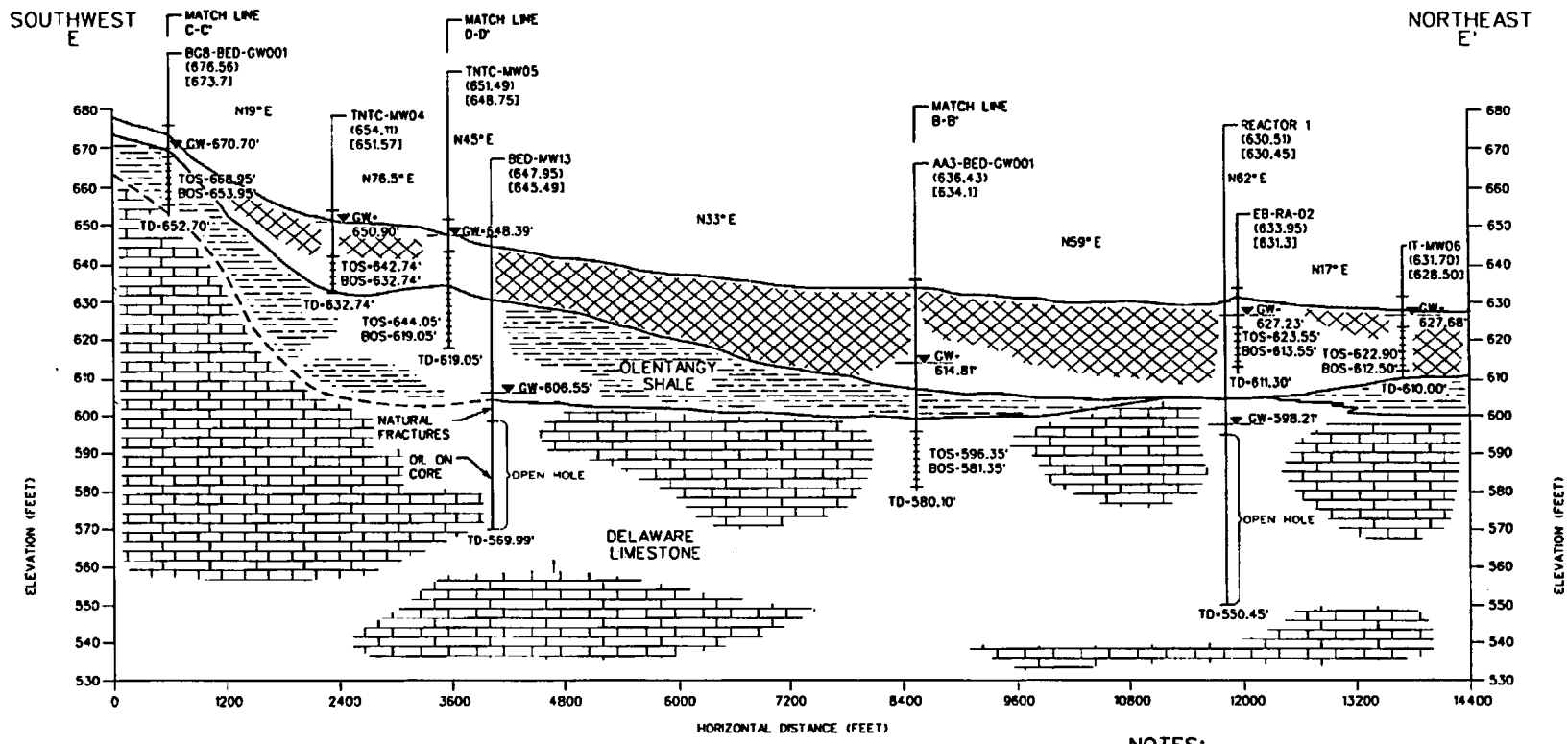


CROSS SECTION E-E'

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D30G

LEGEND:

- OVERBURDEN
- SHALE
- LIMESTONE
- CONTACT AREA UNCERTAIN

GW-627.68'	GROUNDWATER ELEVATION (MAY 5, 1998)
BED-MW15	WELL ID
(631.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD-6'0.80'	TOTAL DEPTH OF BOREHOLE
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15°E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE: 0 1200 2400 FEET

VERTICAL SCALE: 0 30 60 FEET

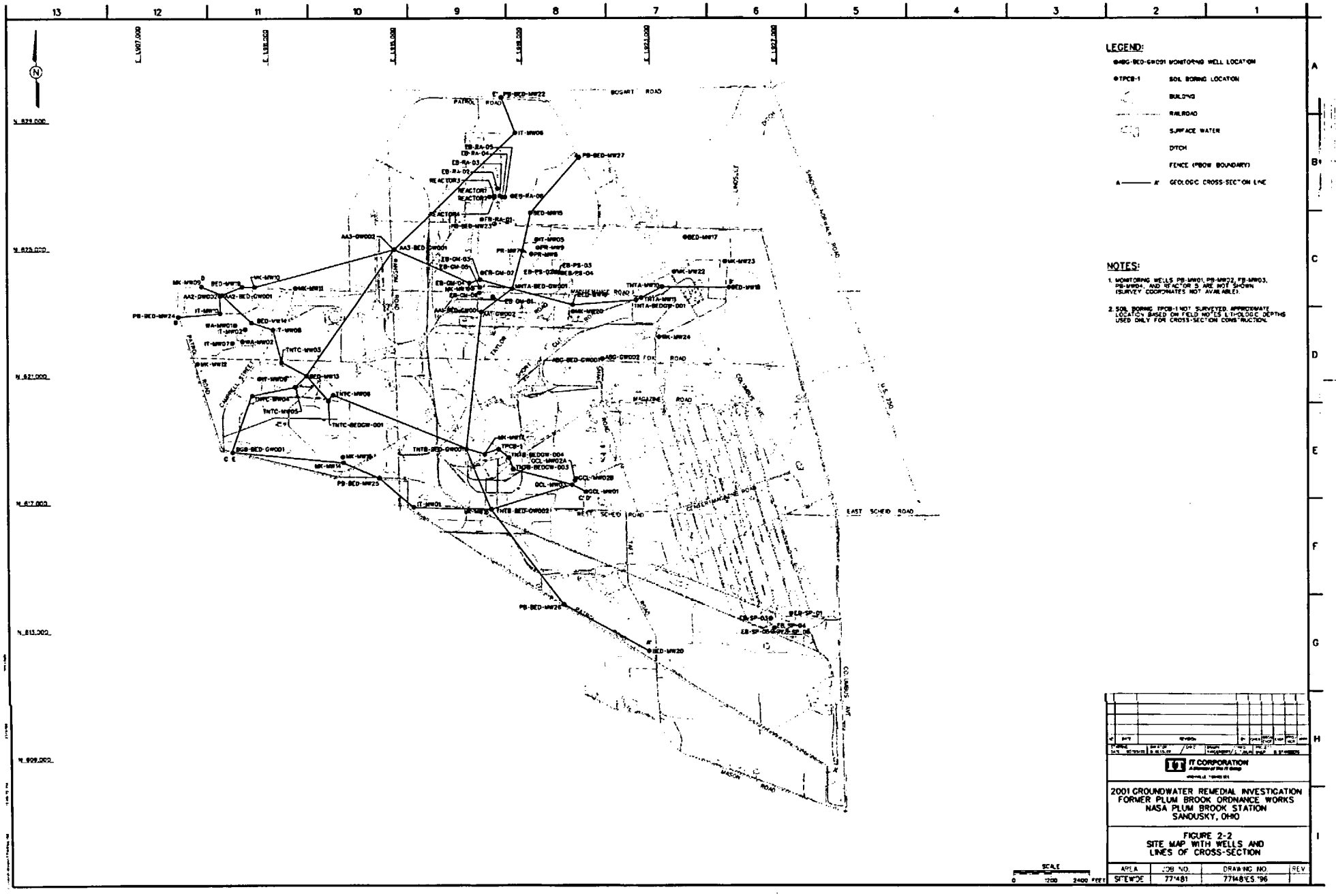
FIGURE 2-7
GEOLOGIC CROSS-SECTION E-E'

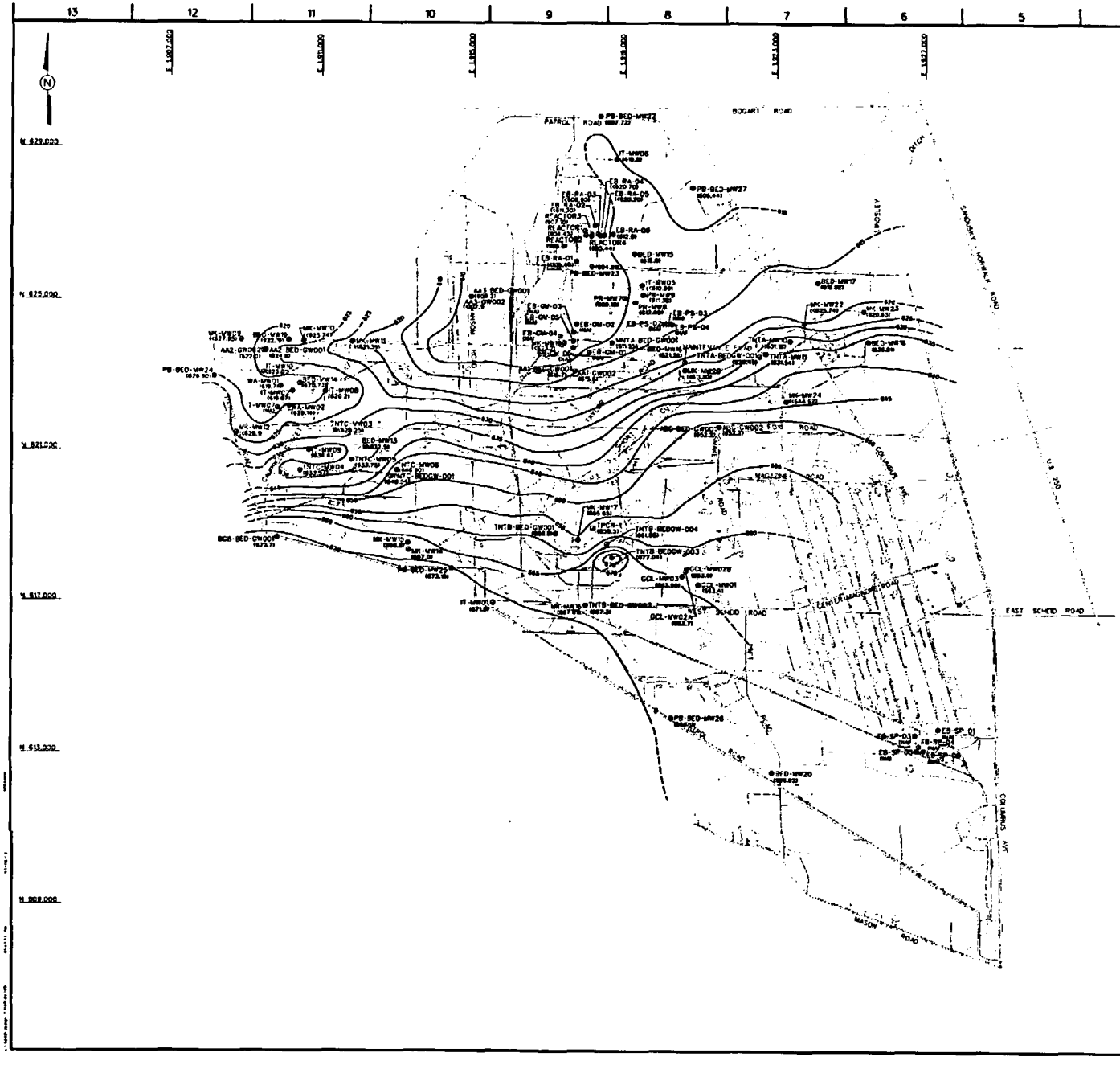
SUMMARY REPORT, SITE-WIDE GROUNDWATER MONITORING (1997-1998) FORMER PLUM BROOK ORDNANCE WORKS NASA PLUM BROOK STATION SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE 05/26/99 | DATE LAST REV: | DRAFT. CHCK BY: C. TUNLIN | INITIATOR: HAGEGEORGE | DWG. NO. 771481es158
DRAWN BY: T. BRADSHAW | DRAWN BY: | ENGR. CHCK. BY: HAGEGEORGE | PROJ. MGR: SPANGBERG | PROJ. NO: 771481
10:42:35 23 JUN 1999

Section 2: IT (2002)


LEGEND:
MW-BED-GW001 MONITORING WELL LOCATION
TPCB-1 SOIL BORING LOCATION
BUILDING
RAILROAD
SURFACE WATER
DITCH
FENCE (PBOW BOUNDARY)
A——A' GEOLOGIC CROSS-SECTION LINE
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. SOIL BORING TPCB-1 NOT SURVEYED. APPROXIMATE LOCATION BASED ON FIELD NOTES LITHOLOGIC DEPTHS USED ONLY FOR CROSS-SECTION CONSTRUCTION.
BOGART ROAD
EAST SCHEID ROAD
WEST SCHEID ROAD
MAGAZINE ROAD
SANDUSKY NORWALK ROAD
U.S. 250
COLUMBUS AVE
MASON ROAD
N 829,000
N 825,000
N 821,000
N 817,000
N 813,000
N 809,000
E 1,907,000
E 1,915,000
E 1,919,000
E 1,923,000
E 1,927,000
SCALE
0 1200 2400 FEET
IT CORPORATION
2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
FIGURE 2-2
SITE MAP WITH WELLS AND
LINES OF CROSS-SECTION
AREA SITEWIDE
JOB NO. 771481
DRAWING NO. 771481ES.196
REV



LEGEND:

- MWBG-BED-GW001 — MONITORING WELL LOCATION
- TPCB-1 — SOIL BORING LOCATION
- BUILDING
- RAILROAD
- SURFACE WATER
- DITCH
- FENCE (PBOW BOUNDARY)
- 1021.381 — BEDROCK ELEVTION (FT-MSL)
- 870 — BEDROCK ELEVATION CONTOUR (FT-MSL)
- (1010.000) — LESS THAN ELEVATION INDICATED BORING DID NOT ENCOUNTER BEDROCK.
- DRILL LOG NOT AVAILABLE

NOTES:

1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 5 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. SOIL BORING TPCB-1 NOT SURVEYED. APPROXIMATE LOCATION BASED ON STD NOTES. LITHOLOGIC DEPTHS USED ONLY FOR CROSS-SECTION CONSTRUCTION.
3. TOP OF BEDROCK ELEVATION MAP BASED ON LITHOLOGY ENCOUNTERED DURING MONITORING WELL INSTALLATION ONLY.

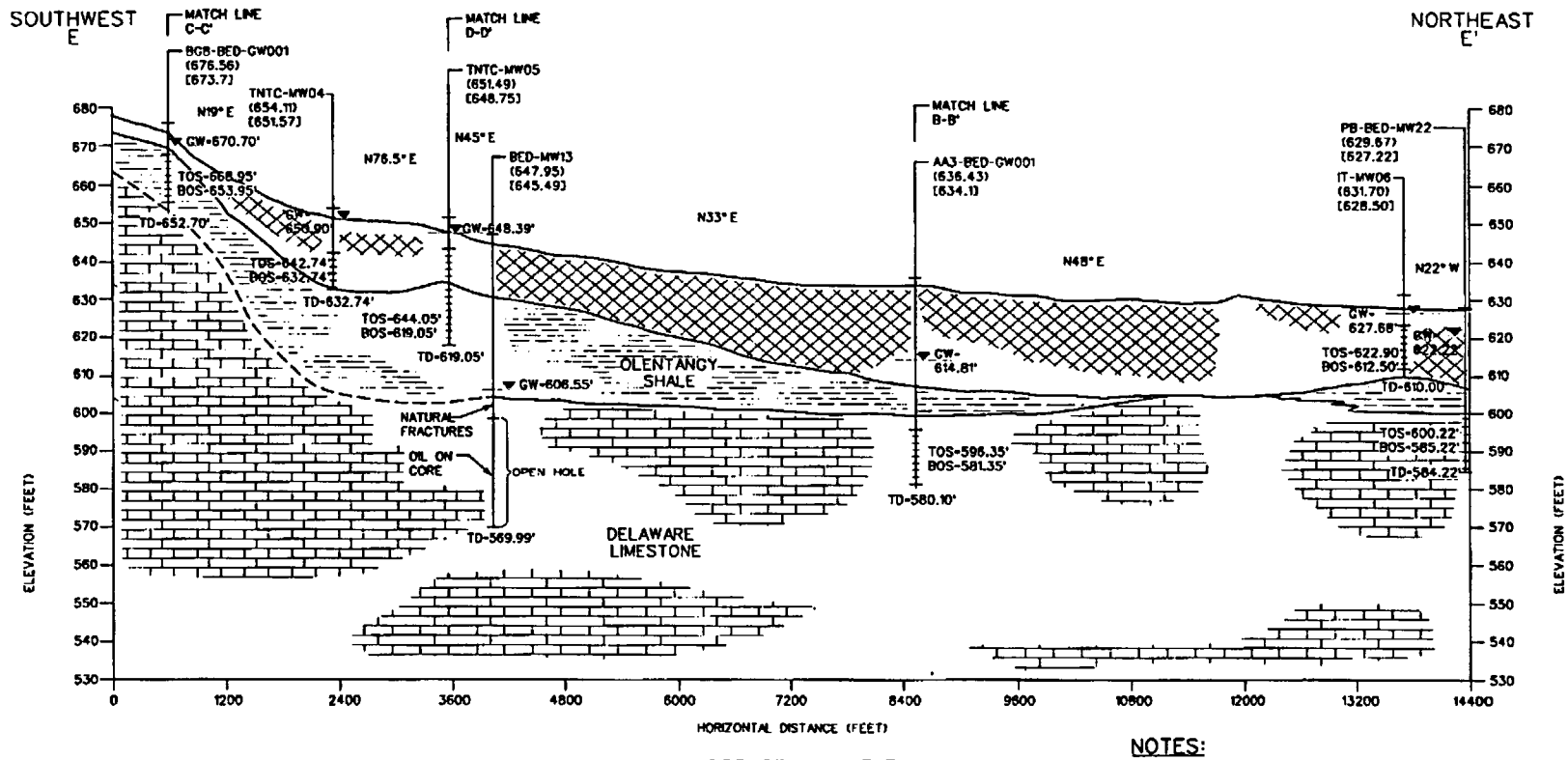
SCALE: 0 1200 2400 FEET

IT CORPORATION
A Subsidiary of The IT Group

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

FIGURE 2-8
TOP OF BEDROCK ELEVATION CONTOUR MAP

AREA	JOB NO	DRAWING NO.	REV
SITEWIDE	771481	77148E.S.'95	



CROSS SECTION E-E'

LEGEND:

OVERBURDEN	
SHALE	
LIMESTONE	
CONTACT AREA UNCERTAIN	

GW-627.68'	GROUNDWATER ELEVATION (NOVEMBER 2001)
BED-MW15	WELL ID
(631.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD-610.80'	TOTAL DEPTH OF BOREHOLE
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15° E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE:
0 1200 2400 FEET

VERTICAL SCALE:
0 30 60 FEET

NOTES:

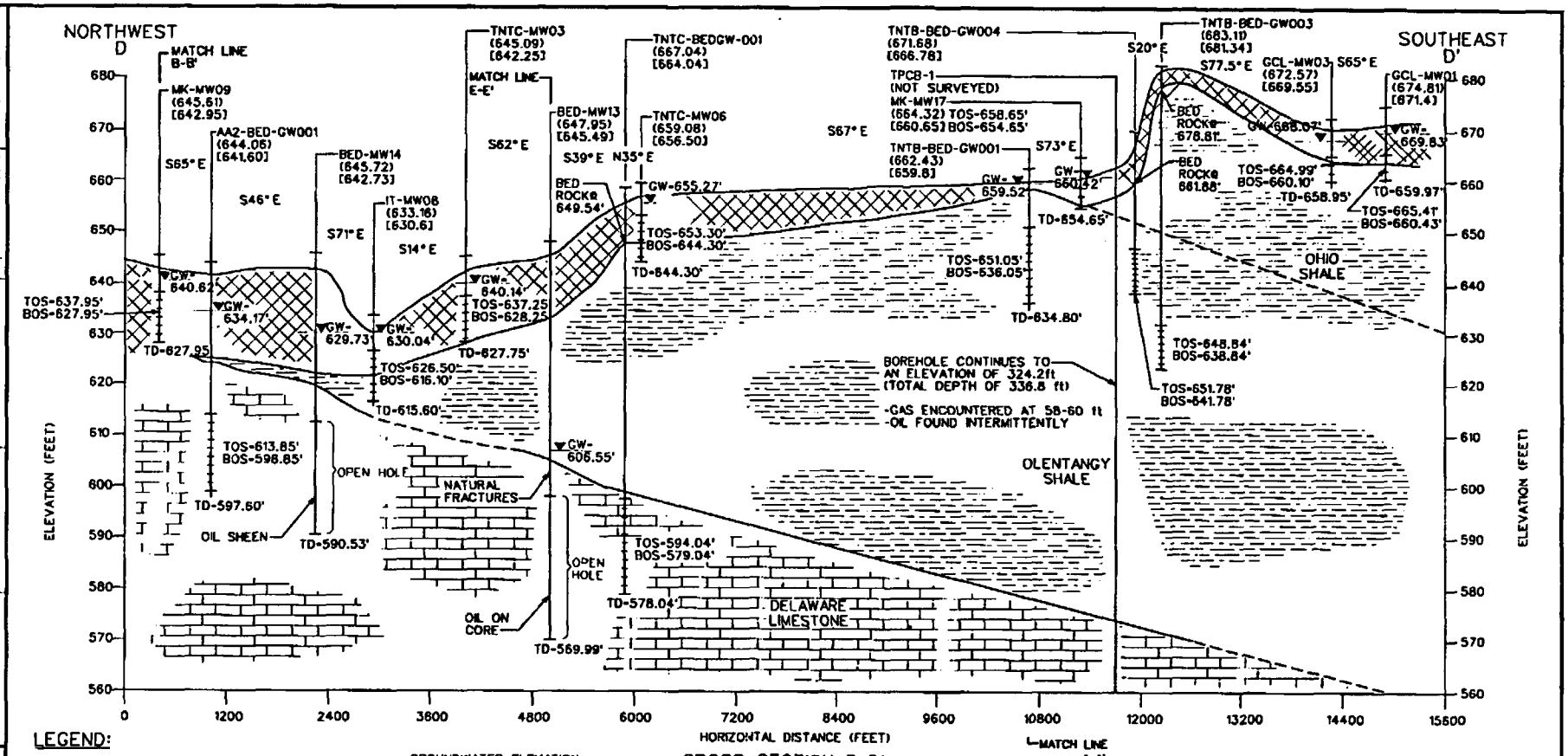
1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

FIGURE 2-7
GEOLOGIC CROSS-SECTION E-E'

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE 05/26/99 | DATE LAST REV. | CRAFT. CHCK BY: C. TUVLIN | INITIATOR: HAGEGEORGE | DWG. NO.: \77148es158
DRAWN BY: T. BRADSHAW | DRAWN BY: | ENGR. CHCK BY: HAGEGEORGE | PROJ. MGR. P. THOMPSON | PROJ. NO.: 77148
02-18-18 03/13/02 bvandberg c:\cad\designs\77148es158



LEGEND:

OVERBURDEN	
SHALE	
LIMESTONE	
CONTACT AREA UNCERTAIN	

GW-627.68'	GROUNDWATER ELEVATION (NOVEMBER 2001)
BED-MW15	WELL ID
(631.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD-610.80'	TOTAL DEPTH OF BOREHOLE
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15° E	BEARING OF CROSS-SECTION SEGMENT

CROSS SECTION D-D'

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-03DG

HORIZONTAL SCALE:

0 1200 2400 FEET

VERTICAL SCALE:

0 20 40 FEET

FIGURE 2-6
GEOLOGIC CROSS-SECTION D-D'

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE 05/25/99 | DATE LAST REV. | DRAFT CHCK. BY: C. TUMLIN | INITIATOR: HAGEGEORGE | CNG. NO.: \77148\es157
DRAWN BY: T. BRADSHAW | DRAWN BY: | ENGR. CHCK. BY: HAGEGEORGE | PROJ. MGR.: SPANGBERG | PROJ. NO.: 77148
03/13/02 07:28:42 AM
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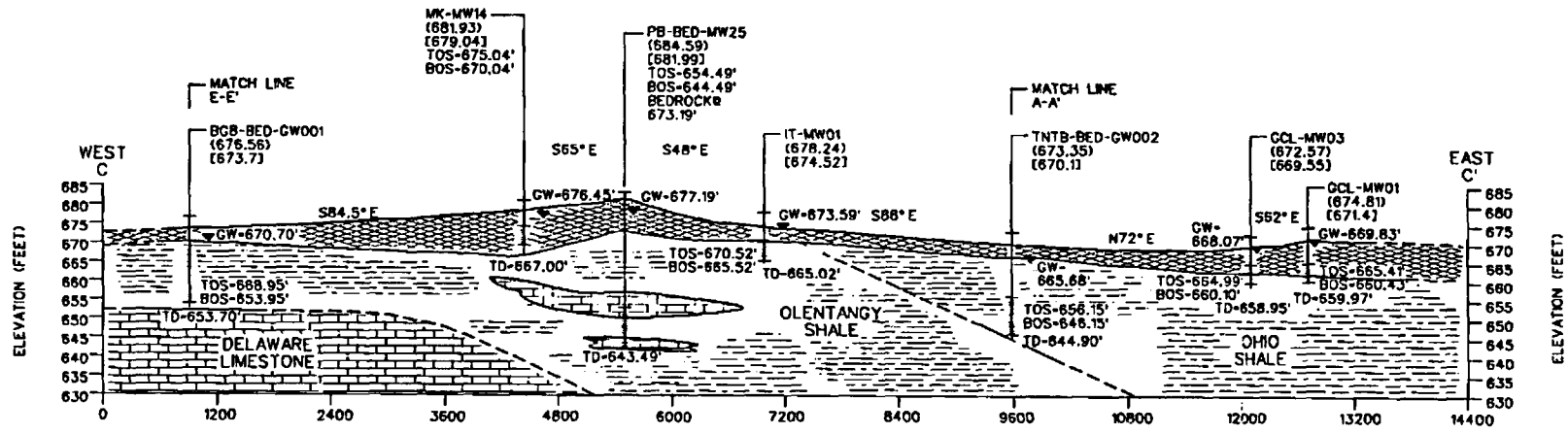


HORIZONTAL DISTANCE (FEET)

CROSS SECTION C-C'

HORIZONTAL SCALE:

0 1200 2400 FEET

VERTICAL SCALE:

0 30 60 FEET

LEGEND:

OVERBURDEN	GW-627.68'	GROUNDWATER ELEVATION (NOVEMBER 2001)
SHALE	BED-MW15	WELL ID
	(631.31)	CASING ELEVATION
LIMESTONE	[628.76]	GROUND SURFACE ELEVATION
	TD-610.80'	TOTAL DEPTH OF BOREHOLE
	TOS	TOP OF SCREEN
CONTACT AREA UNCERTAIN	BOS	BOTTOM OF SCREEN
	N15°E	BEARING OF CROSS-SECTION SEGMENT

NOTES:

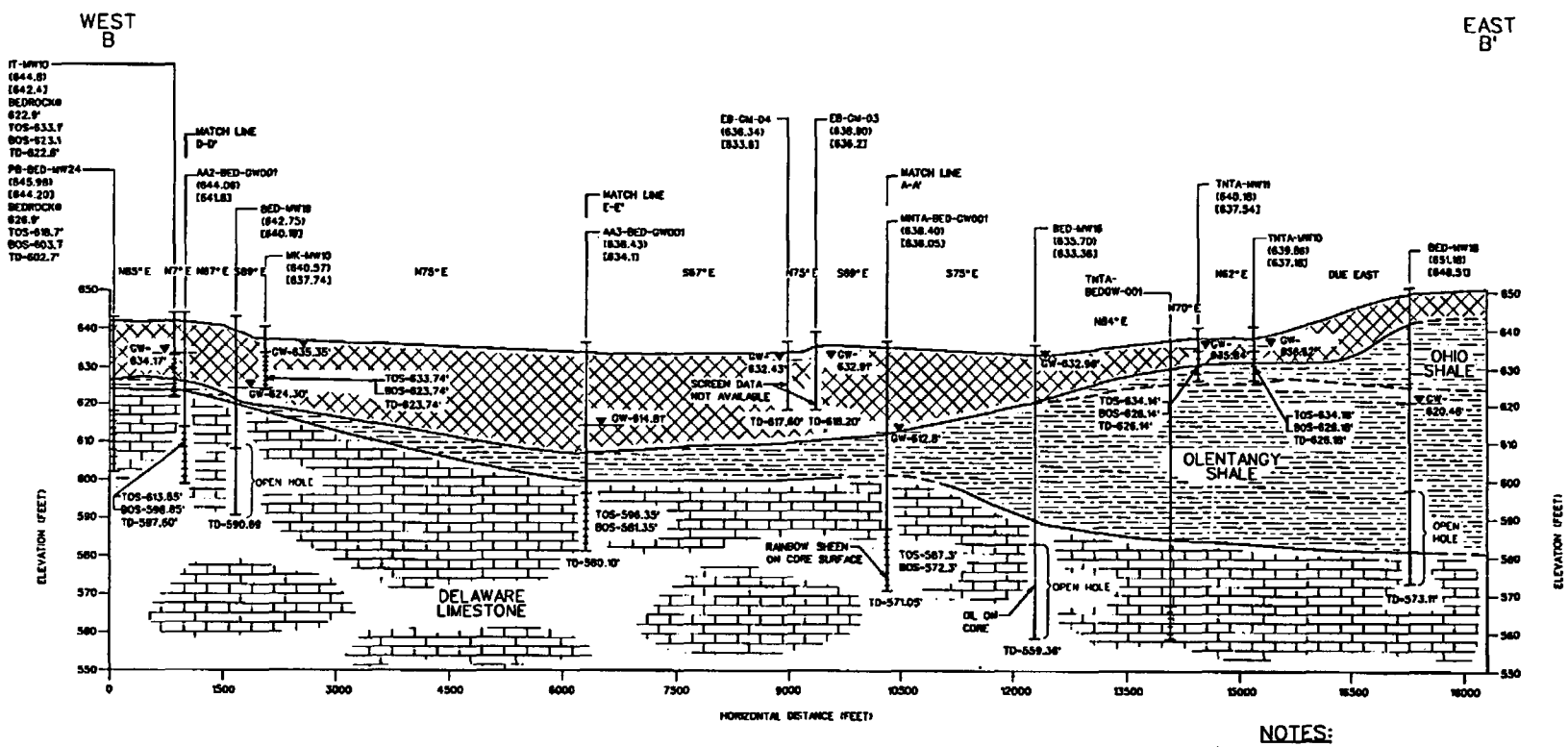
1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

FIGURE 2-5
GEOLOGIC CROSS-SECTION C-C'

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 05/26/99 | DATE LAST REV. | DRAFT CHCK. BY: C. TUMLIN | INITIAL CHK'D. KESSLER | CWG. NO.: \77148\ss156
DRAWN BY: R. SPRES | DRAWN BY: | ENGR. CHCK. BY: D. KESSLER | PROJ. MGR.: P. THOMPSON | PROJ. NO.: 77148
03/13/02 01:53:56 PM
cbentley c:\acad\design\77148\ss156



CROSS SECTION B-B'

LEGEND:

OVERBURDEN	GW-627.68'	GROUNDWATER ELEVATION (NOVEMBER 2001)
SHALE	BED-MW15	WELL ID
	(631.31)	CASING ELEVATION
LIMESTONE	[628.76]	GROUND SURFACE ELEVATION
	TD-610.80'	TOTAL DEPTH OF BOREHOLE
	TOS	TOP OF SCREEN
CONTACT AREA UNCERTAIN	BOS	BOTTOM OF SCREEN
	N15° E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE:
0 1500 3000 FEET

VERTICAL SCALE:
0 30 60 FEET

NOTES:

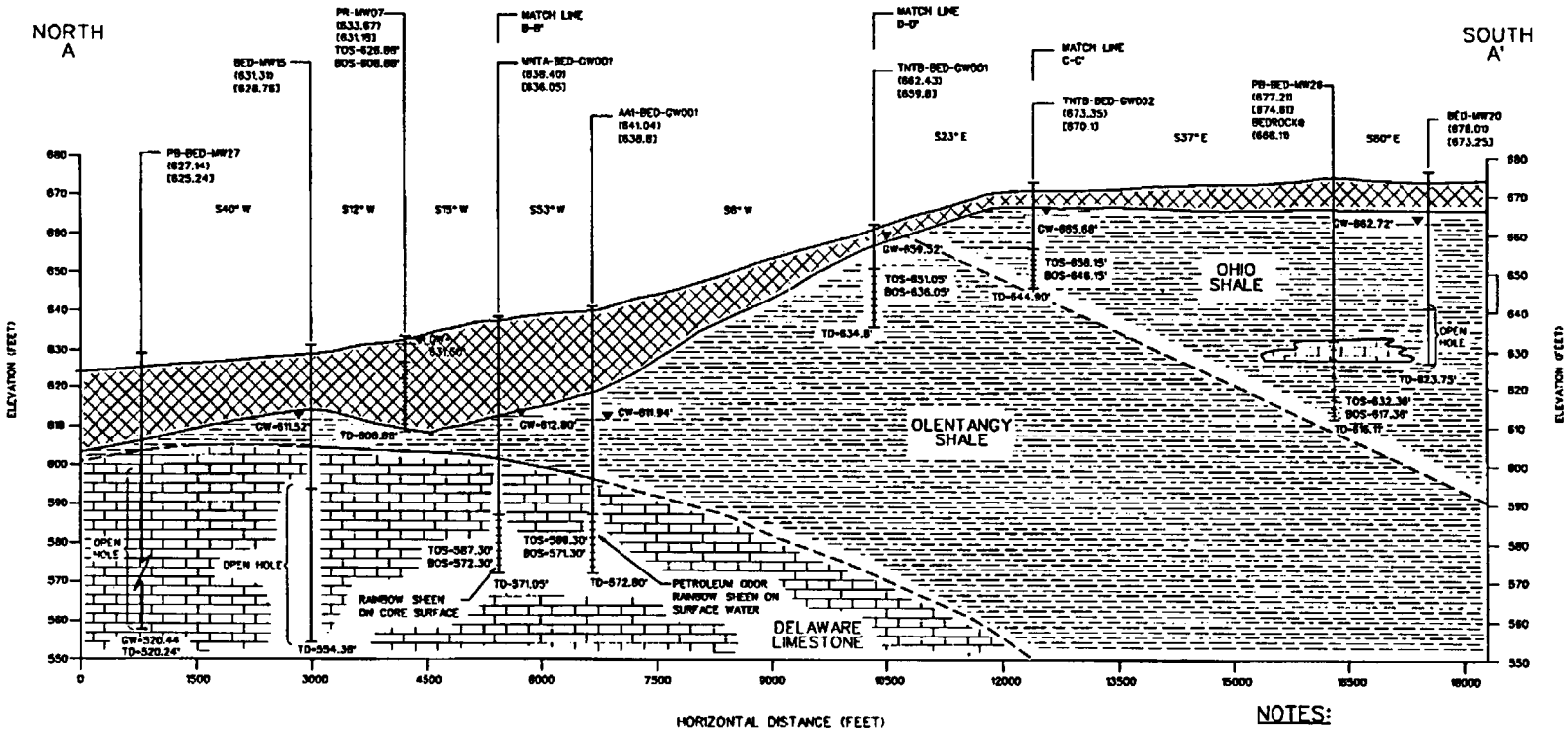
1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D30G

FIGURE 2-4
GEOLOGIC CROSS-SECTION B-B'

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 1/4/99 | DATE LAST REV.: | DRAFT CHCK. BY: C. TUMLA | INITIATOR D. KESSLER | DWG. NO.: 77148les.155
DRAWN BY: R. SPRES | DRAWN BY: | ENGR CHCK. BY: D. KESSLER | PROJ. NO.: 77148



CROSS SECTION A-A'

LEGEND:

OVERBURDEN	GW-627.68'	GROUNDWATER ELEVATION (NOVEMBER 5, 2001)
SHALE	BED-MW15	WELL ID
LIMESTONE	(631.31)	CASING ELEVATION
CONTACT AREA UNCERTAIN	(628.76)	GROUND SURFACE ELEVATION
	TD-610.80'	TOTAL DEPTH OF BOREHOLE
	TOS	TOP OF SCREEN
	BOS	BOTTOM OF SCREEN
	N15° E	BEARING OF CROSS-SECTION SEGMENT

HORIZONTAL SCALE:
0 1500 3000 FEET

VERTICAL SCALE:
0 30 60 FEET

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NORTH AMERICAN VERTICAL DATUM (1983).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D30G

FIGURE 2-3
GEOLOGIC CROSS-SECTION A-A'

2001 GROUNDWATER REMEDIAL INVESTIGATION
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

IT CORPORATION
A Member of The IT Group

STARTING DATE: 1/4/99 | DATE LAST REV: | DRAFT CHCK. BY: C. TUMLIN | INITIATOR: D. KESSLER | DWG. NO.: \77148\es154
DRAWN BY: R. SPIRES | DRAWN BY: | ENGR CHCK. BY: D. KESSLER | PROJ. MGR.: B. THOMPSON | PROJ. NO.: 77148
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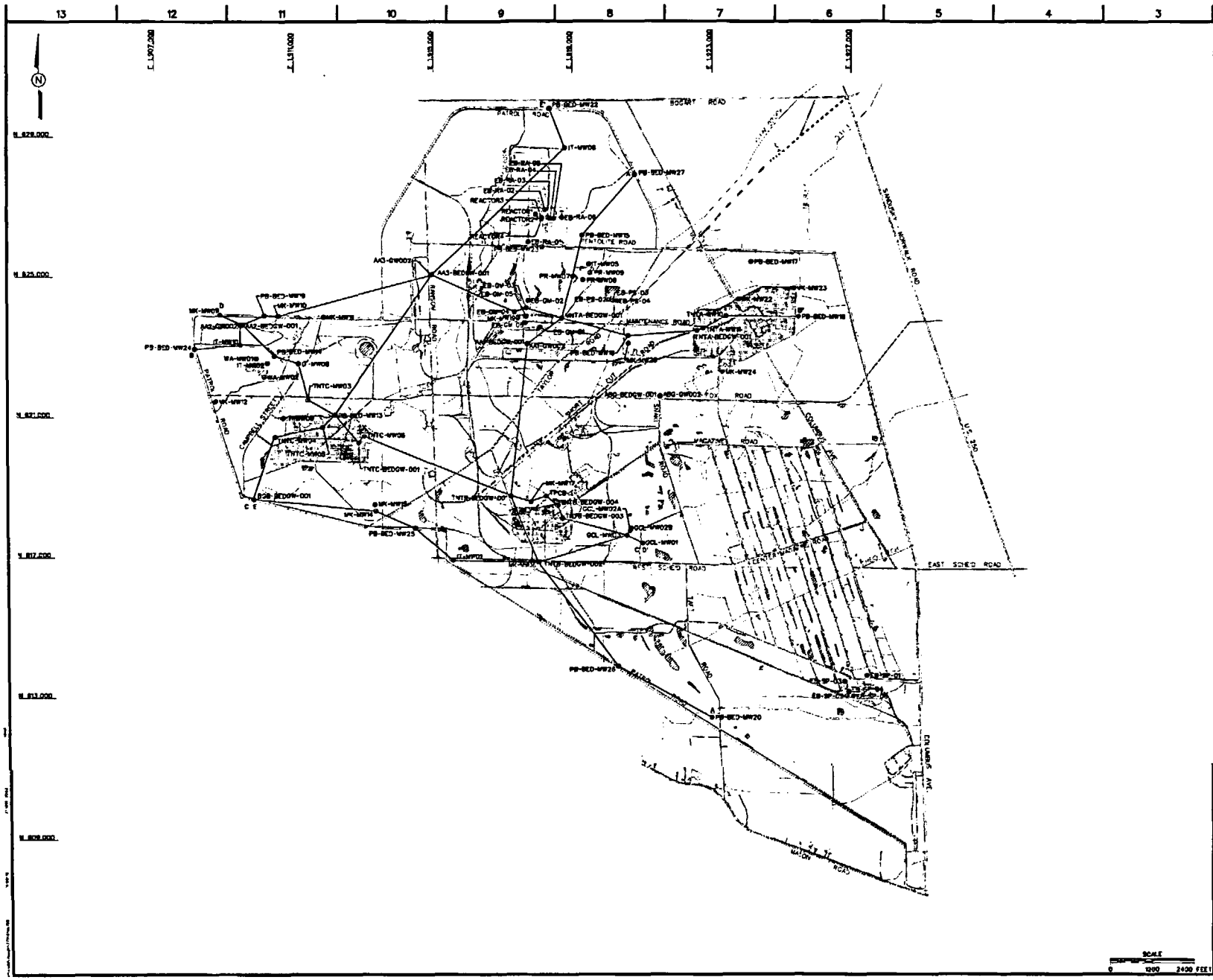
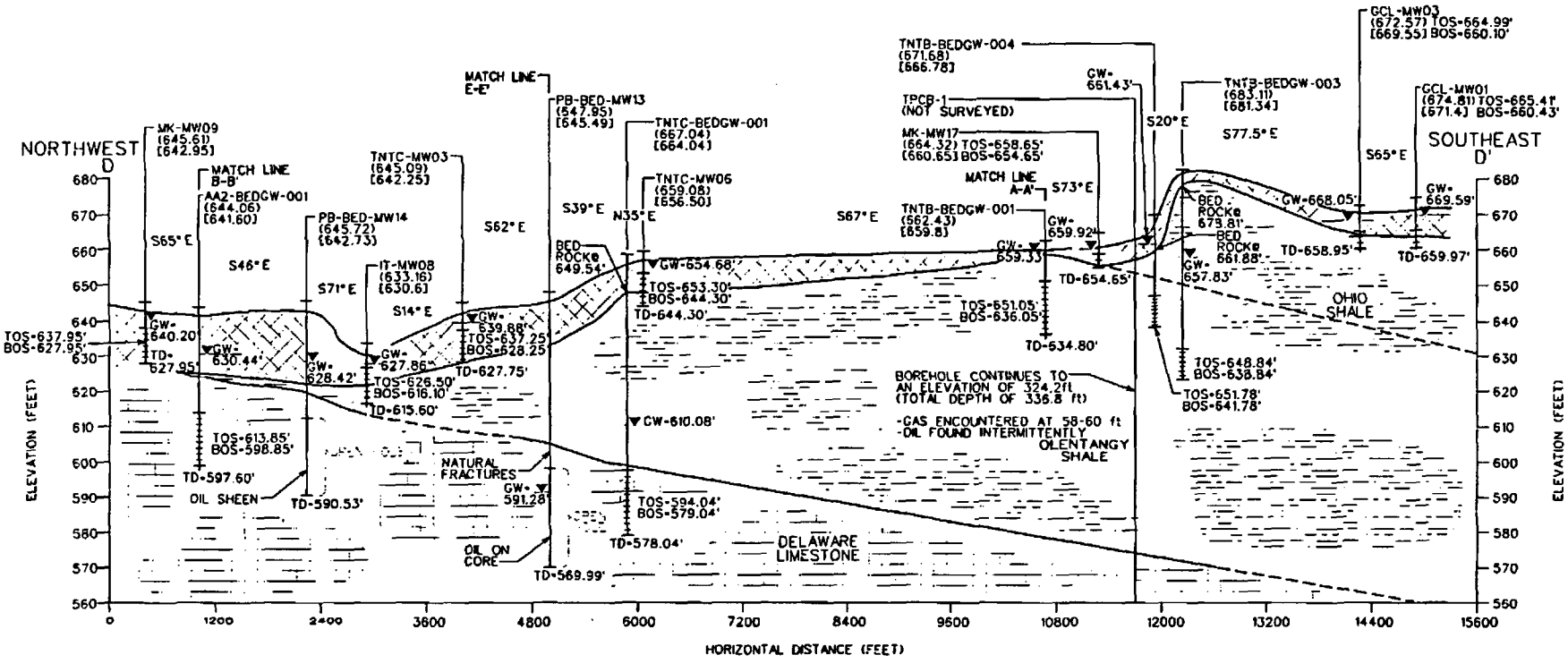
Section 3: Shaw (2003)


LEGEND:
MBG-BED-GW001 MONITORING WELL LOCATION
TPCB-1 SOIL BORING LOCATION
BUILDING
RAILROAD
SURFACE WATER
DITCH
FENCE (PBOW BOUNDARY)
A——A' GEOLOGIC CROSS-SECTION LINE
NOTES:
1. MONITORING WELLS PB-MW01, PB-MW02, PB-MW03, PB-MW04, AND REACTOR 3 ARE NOT SHOWN (SURVEY COORDINATES NOT AVAILABLE).
2. SOIL BORING TPCB-1 NOT SURVEYED APPROXIMATE LOCATION BASED ON FIELD NOTES. LITHOLOGIC DEPTHS USED ONLY FOR CROSS-SECTION CONSTRUCTION.
SCALE
0 1200 2400 FEET
Shaw Environmental, Inc.
2002 GROUNDWATER DATA SUMMARY
AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO
FIGURE 2-2
SITE MAP WITH WELLS AND
LINES OF CROSS-SECTION
AREA
STEWIDE
JOB NO.
771481
DRAWING NO.
REV.



CROSS SECTION D-D'

LEGEND:

	OVERBURDEN	BED-MW15	WELL ID
	SHALE	(631.31)	CASING ELEVATION
		[628.76]	GROUND SURFACE ELEVATION
	LIMESTONE	TD-610.80'	BOTTOM OF BOREHOLE ELEVATION
		TOS	TOP OF SCREEN
		BOS	BOTTOM OF SCREEN
— — —	CONTACT AREA UNCERTAIN	N15° E	BEARING OF CROSS-SECTION SEGMENT
GW-627.68'	GROUNDWATER ELEVATION (MAY 4, 2002)		WELL SCREEN INTERVAL

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NATIONAL GEODETIC VERTICAL DATUM (1929).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

HORIZONTAL SCALE:

0 1200 2400 FEET

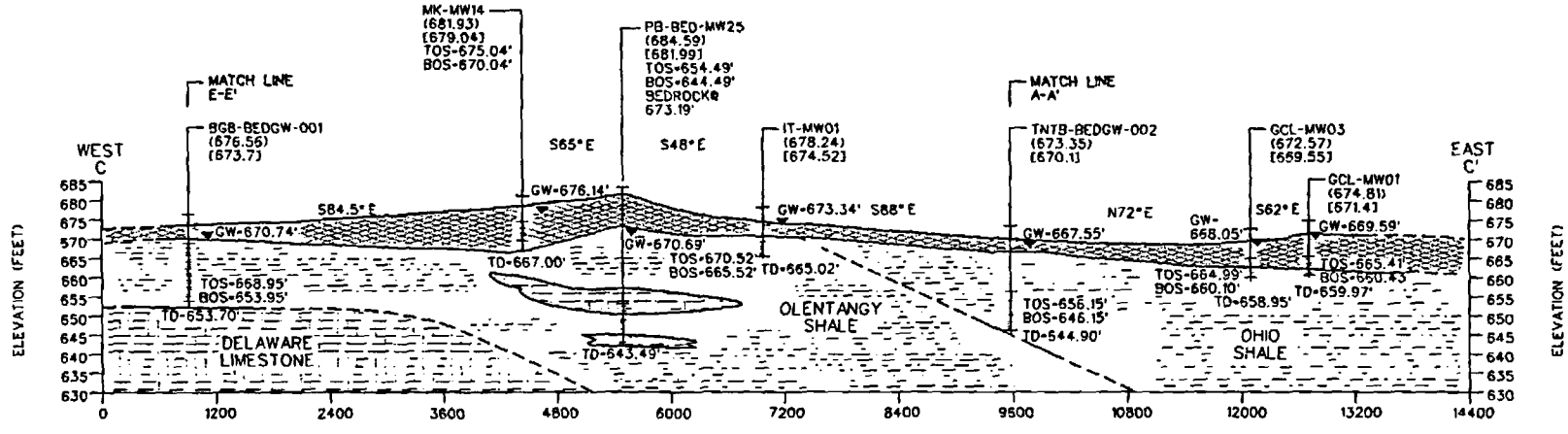
VERTICAL SCALE:

0 30 60 FEET

FIGURE 2-6
GEOLOGIC CROSS-SECTION D-D'

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Shaw Environmental, Inc.



CROSS SECTION C-C'

LEGEND:

OVERBURDEN	
SHALE	
LIMESTONE	
CONTACT AREA UNCERTAIN	
GW=627.68'▼	GROUNDWATER ELEVATION (MAY 4, 2002)
BED-MW15	WELL ID
(831.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD=610.80'	BOTTOM OF BOREHOLE ELEVATION
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15°E	BEARING OF CROSS-SECTION SEGMENT
	WELL SCREEN INTERVAL

HORIZONTAL SCALE:
0 1200 2400 FEET

VERTICAL SCALE:
0 30 60 FEET

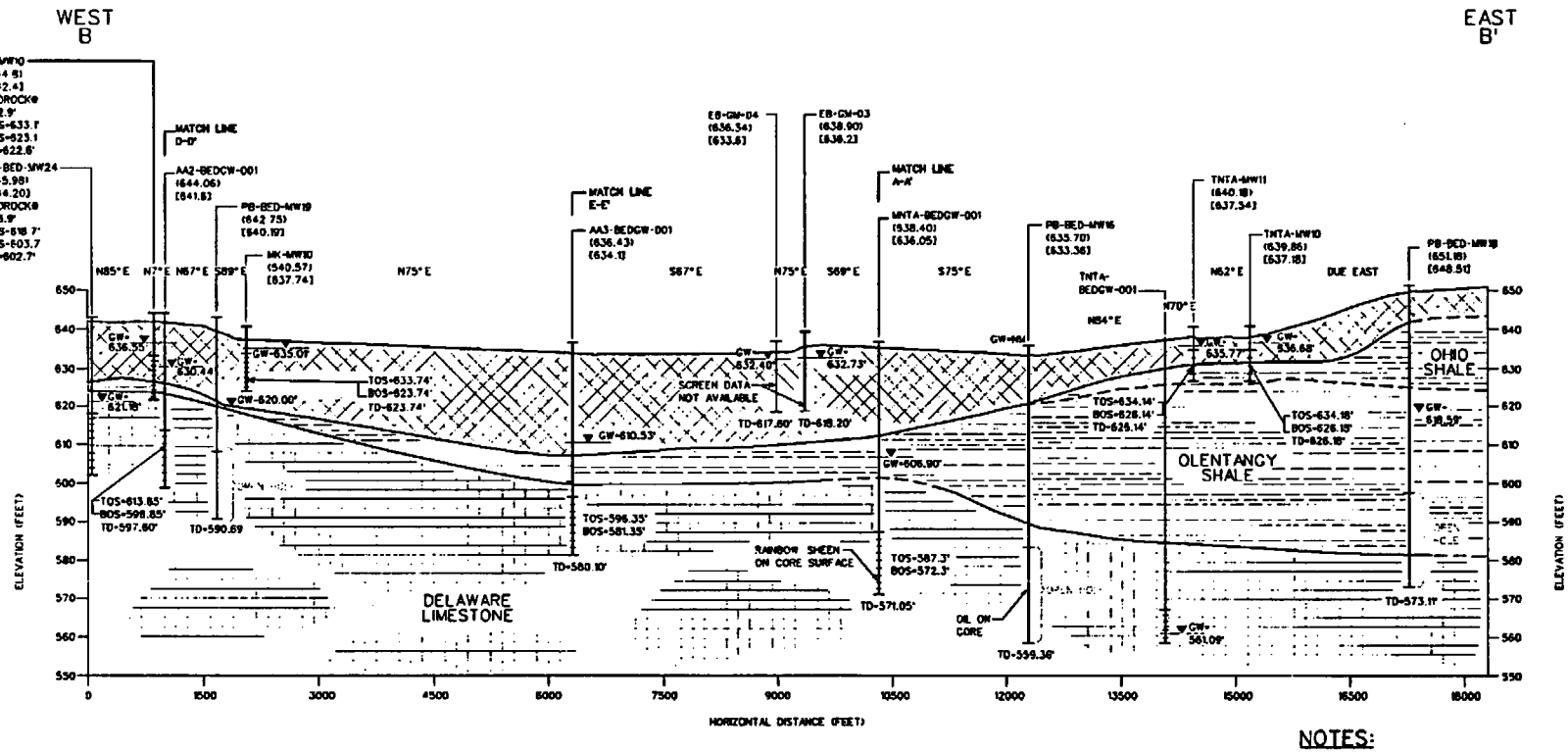
NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NATIONAL GEODETIC VERTICAL DATUM (1929).
2. REFERENCE- PRELIMINARY OHIO DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

FIGURE 2-5
GEOLOGIC CROSS-SECTION C-C'

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw® Shaw Environmental, Inc.



CROSS SECTION B-B'

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NATIONAL GEODETIC VERTICAL DATUM (1929).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

LEGEND:

OVERBURDEN	
SHALE	
LIMESTONE	
CONTACT AREA UNCERTAIN	
GW-627.68'	GROUNDWATER ELEVATION (MAY 4, 2002)

BED-MW15	WELL ID
(631.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD-610.80'	BOTTOM OF BOREHOLE ELEVATION
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15°E	BEARING OF CROSS-SECTION SEGMENT
	WELL SCREEN INTERVAL

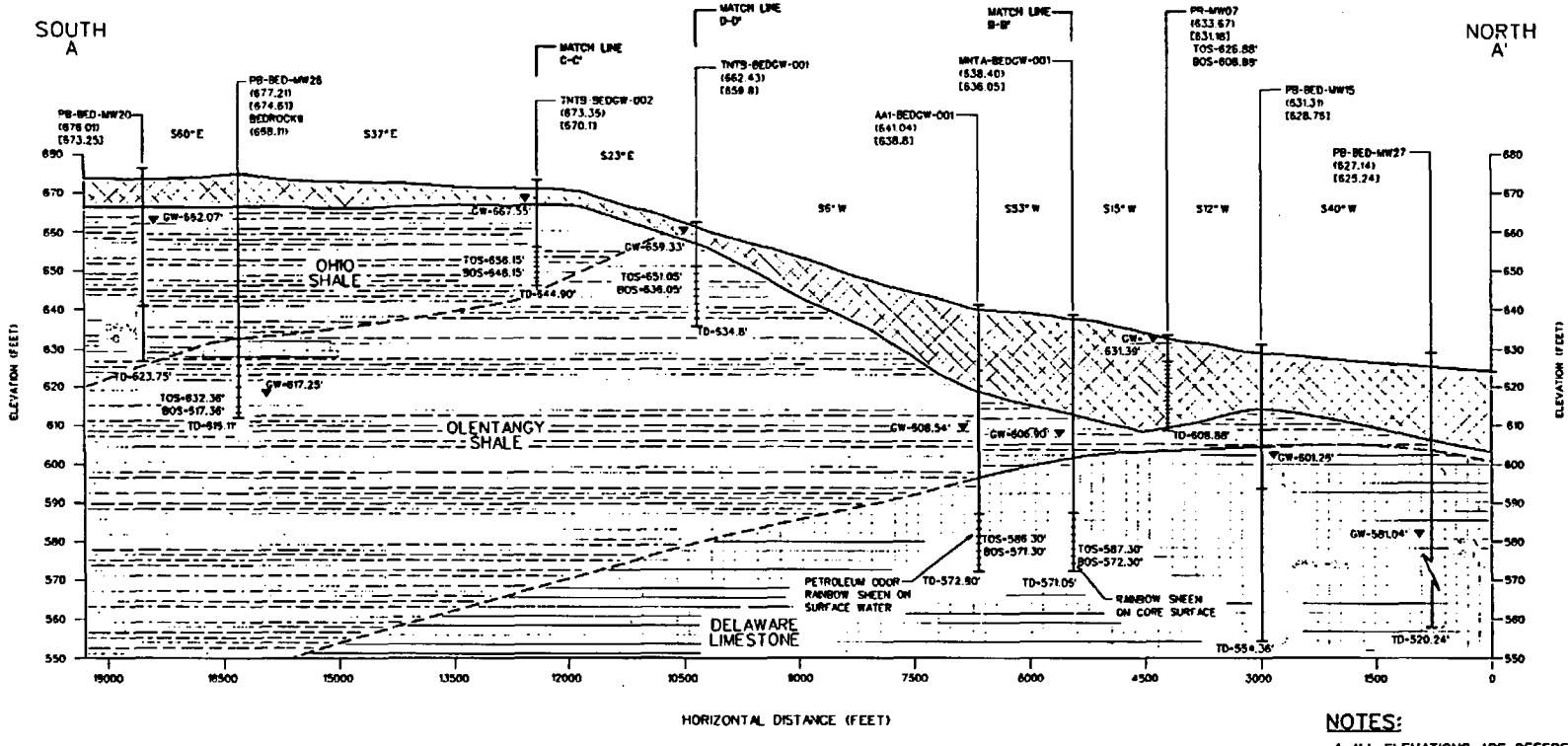
HORIZONTAL SCALE: 0 1500 3000 FEET

VERTICAL SCALE: 0 30 60 FEET

FIGURE 2-4
GEOLOGIC CROSS-SECTION B-B'

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Shaw Environmental, Inc.



CROSS SECTION A-A'

LEGEND:

OVERBURDEN	BED-MW15	WELL ID
	(631.31)	CASING ELEVATION
SHALE	[628.76]	GROUND SURFACE ELEVATION
	TD=610.80'	BOTTOM OF BOREHOLE ELEVATION
LIMESTONE	TOS	TOP OF SCREEN
	BOS	BOTTOM OF SCREEN
CONTACT AREA UNCERTAIN	N15°E	BEARING OF CROSS-SECTION SEGMENT
GW=627.58' GROUNDWATER ELEVATION (MAY 4, 2002)		WELL SCREEN INTERVAL

HORIZONTAL SCALE:
0 1500 3000 FEET

VERTICAL SCALE:
0 30 60 FEET

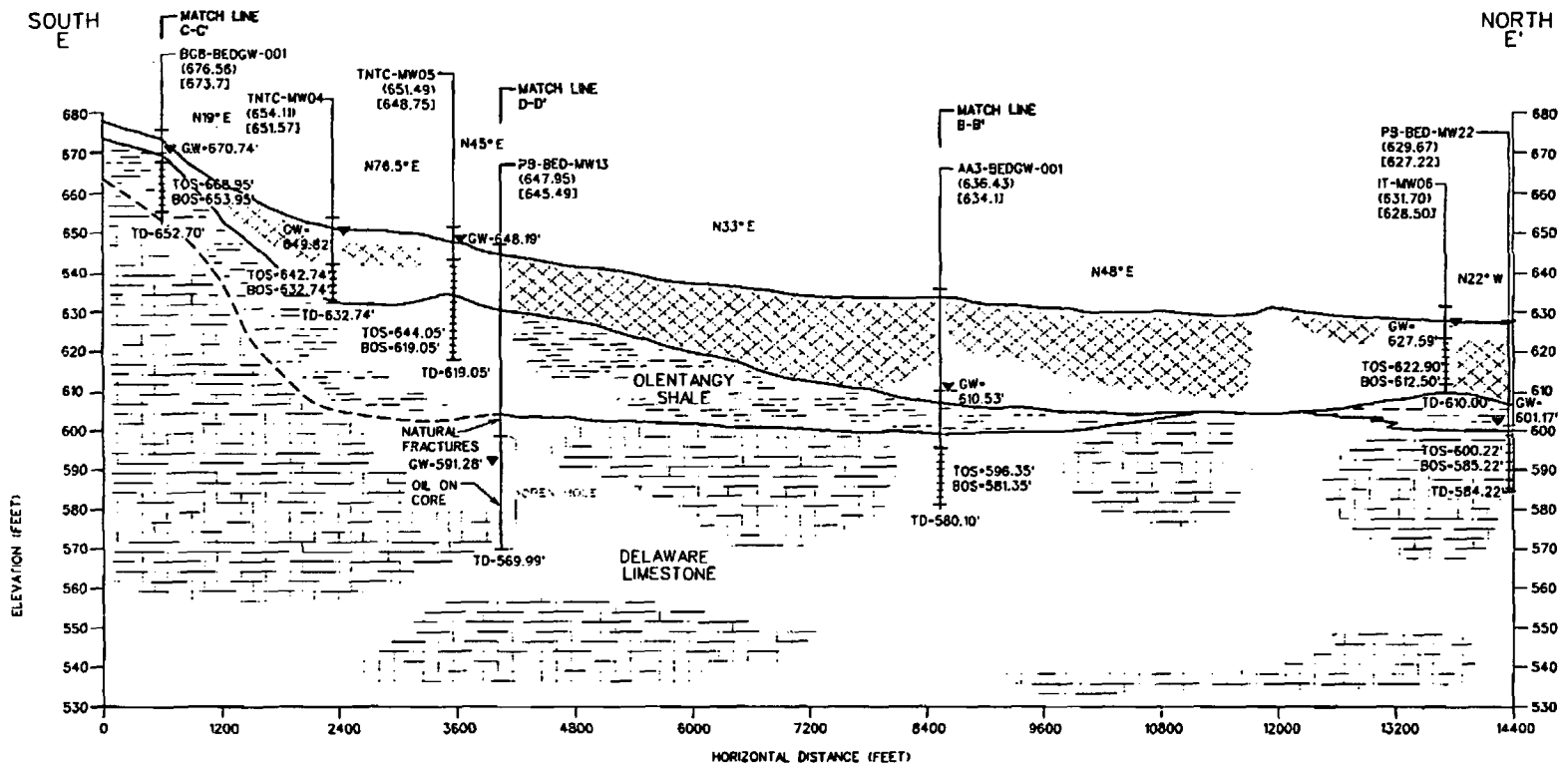
NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NATIONAL GEODETIC VERTICAL DATUM (1929).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

FIGURE 2-3
GEOLOGIC CROSS-SECTION A-A'

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

Shaw Shaw Environmental, Inc.



CROSS SECTION E-E'

NOTES:

1. ALL ELEVATIONS ARE REFERENCED TO NATIONAL GEODETIC VERTICAL DATUM (1929).
2. REFERENCE- PRELIMINARY OHIO, DEPARTMENT OF NATURAL RESOURCES, DIVISION OF GEOLOGICAL SERVICES, OPEN FILE MAP BG-D3DG

LEGEND:

OVERBURDEN	
SHALE	
LIMESTONE	
CONTACT AREA UNCERTAIN	
GW=627.68'	GROUNDWATER ELEVATION (MAY 4, 2002)
BED-MW15	WELL ID
(631.31)	CASING ELEVATION
[628.76]	GROUND SURFACE ELEVATION
TD=610.80'	BOTTOM OF BOREHOLE ELEVATION
TOS	TOP OF SCREEN
BOS	BOTTOM OF SCREEN
N15° E	BEARING OF CROSS-SECTION SEGMENT
	WELL SCREEN INTERVAL

HORIZONTAL SCALE: 0 1200 2400 FEET

VERTICAL SCALE: 0 30 60 FEET

FIGURE 2-7
GEOLOGIC CROSS-SECTION E-E'

2002 GROUNDWATER DATA SUMMARY AND EVALUATION REPORT
FORMER PLUM BROOK ORDNANCE WORKS
NASA PLUM BROOK STATION
SANDUSKY, OHIO

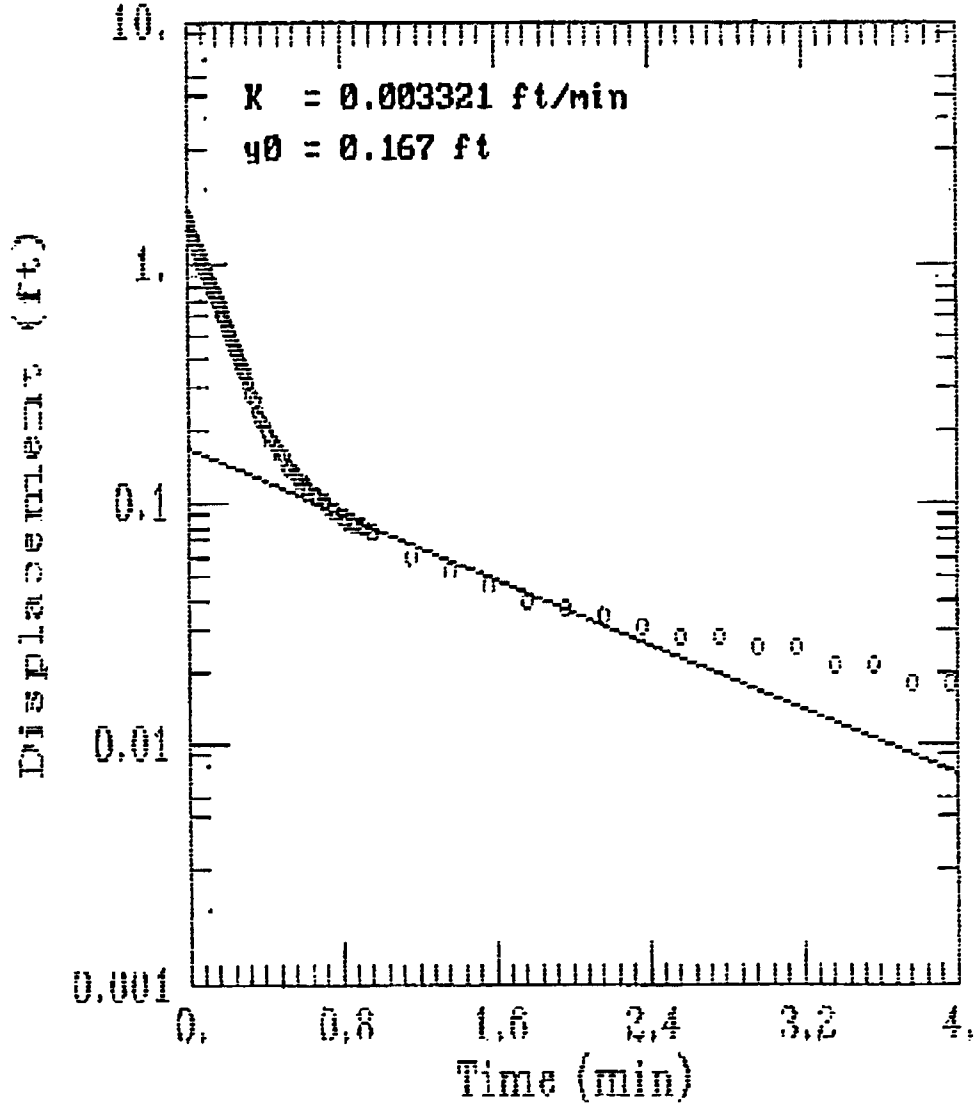
Shaw Shaw Environmental, Inc.

APPENDIX F

IN-SITU HYDRAULIC CONDUCTIVITY TESTS

IT (1997)

PBOW IT-MW08 Rising Test 1



IT-MW08 Slug Test 1
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0	1.547
0.0033	1.472
0.0066	1.456
0.01	1.406
0.0133	1.413
0.0166	1.366
0.02	1.366
0.0233	1.341
0.0266	1.315
0.03	1.294
0.0333	1.268
0.0366	1.24
0.04	1.237
0.0433	1.212
0.0466	1.221
0.05	1.171
0.0533	1.162
0.0566	1.153
0.06	1.124
0.0633	1.112
0.0666	1.077
0.07	1.052
0.0733	1.055
0.0766	1.037
0.08	1.024
0.0833	1.008
0.0866	0.993
0.09	0.977
0.0933	0.961
0.0966	0.949
0.1	0.921
0.1033	0.918
0.1066	0.877
0.11	0.889
0.1133	0.867
0.1166	0.855
0.12	0.842
0.1233	0.833
0.1266	0.82
0.13	0.808
0.1333	0.792
0.1366	0.78
0.14	0.767
0.1433	0.755
0.1466	0.742
0.15	0.733
0.1533	0.72
0.1566	0.708
0.16	0.698

IT-MW08 Slug Test 1
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0.1633	0.686
0.1666	0.683
0.17	0.676
0.1733	0.667
0.1766	0.664
0.18	0.632
0.1833	0.62
0.1866	0.61
0.19	0.601
0.1933	0.592
0.1966	0.582
0.2	0.573
0.2033	0.564
0.2066	0.554
0.21	0.545
0.2133	0.535
0.2166	0.526
0.22	0.517
0.2233	0.51
0.2266	0.482
0.23	0.491
0.2333	0.482
0.2366	0.476
0.24	0.466
0.2433	0.46
0.2466	0.451
0.25	0.444
0.2533	0.438
0.2566	0.429
0.26	0.423
0.2633	0.416
0.2666	0.407
0.27	0.401
0.2733	0.394
0.2766	0.388
0.28	0.382
0.2833	0.375
0.2866	0.369
0.29	0.363
0.2933	0.357
0.2966	0.35
0.3	0.344
0.3033	0.338
0.32	0.31
0.3366	0.285
0.3533	0.263
0.37	0.241
0.3866	0.225
0.4033	0.209

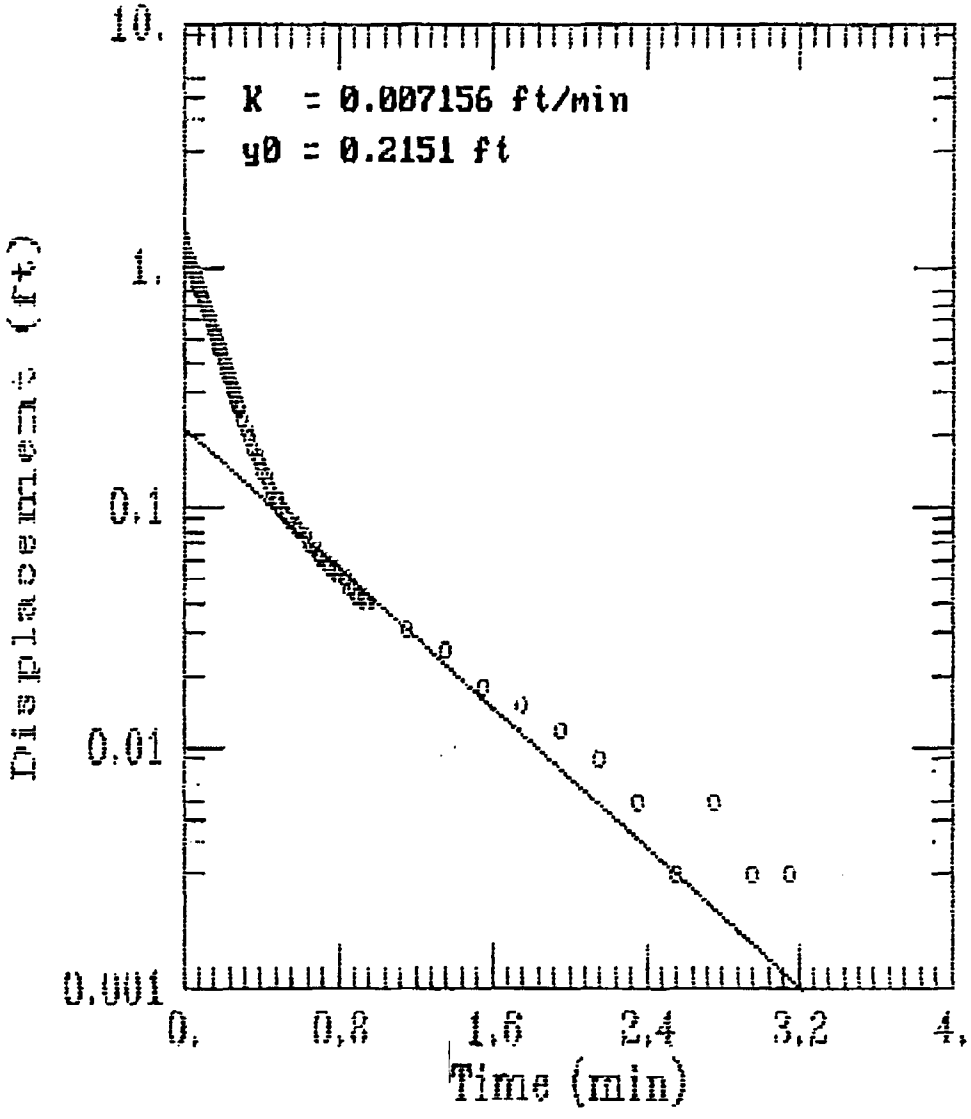
IT-MW08 Slug Test 1
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0.42	0.197
0.4366	0.184
0.4533	0.175
0.47	0.166
0.4866	0.156
0.5033	0.15
0.52	0.144
0.5366	0.137
0.5533	0.134
0.57	0.128
0.5866	0.122
0.6033	0.119
0.62	0.115
0.6366	0.112
0.6533	0.109
0.67	0.106
0.6866	0.103
0.7033	0.1
0.72	0.1
0.7366	0.097
0.7533	0.094
0.77	0.094
0.7866	0.09
0.8033	0.087
0.82	0.087
0.8366	0.084
0.8533	0.084
0.87	0.081
0.8866	0.081
0.9033	0.081
0.92	0.078
0.9366	0.078
0.9533	0.075
0.97	0.075
1.17	0.059
1.37	0.053
1.57	0.046
1.77	0.04
1.97	0.037
2.17	0.034
2.37	0.031
2.57	0.028
2.77	0.028
2.97	0.025
3.17	0.025
3.37	0.021
3.57	0.021
3.77	0.018
3.97	0.018

IT-MW08 Slug Test 1
PBOW, Groundwater Investigation

Elapsed Time	Input 1
4.17	0.015
4.37	0.018
4.57	0.015
4.77	0.015
4.97	0.015
5.17	0.012
5.37	0.012
5.57	0.012
5.77	0.012
5.97	0.012
6.17	0.009
6.37	0.012
6.57	0.009
6.77	0.009
6.97	0.009
7.17	0.009
7.37	0.009
7.57	0.009
7.77	0.009
7.97	0.006
8.17	0.006
8.37	0.006
8.57	0.006
8.77	0.006
8.97	0.006
9.17	0.006
9.37	0.006
9.57	0.006
9.77	0.006
9.97	0.003

PBOW IT-MW08 Rising Test 2



IT-MW08 Slug Test 2
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0	1.3
0.0033	1.272
0.0066	1.225
0.01	1.209
0.0133	1.178
0.0166	1.159
0.02	1.14
0.0233	1.124
0.0266	1.068
0.03	1.096
0.0333	1.068
0.0366	1.049
0.04	1.046
0.0433	1.012
0.0466	0.98
0.05	0.958
0.0533	0.98
0.0566	0.933
0.06	0.933
0.0633	0.918
0.0666	0.892
0.07	0.877
0.0733	0.858
0.0766	0.811
0.08	0.833
0.0833	0.82
0.0866	0.808
0.09	0.792
0.0933	0.78
0.0966	0.764
0.1	0.752
0.1033	0.739
0.1066	0.73
0.11	0.714
0.1133	0.701
0.1166	0.692
0.12	0.676
0.1233	0.664
0.1266	0.651
0.13	0.642
0.1333	0.629
0.1366	0.617
0.14	0.607
0.1433	0.595
0.1466	0.585
0.15	0.573
0.1533	0.564
0.1566	0.554
0.16	0.542

IT-MW08 Slug Test 2
PBOW, Groundwater Investigation

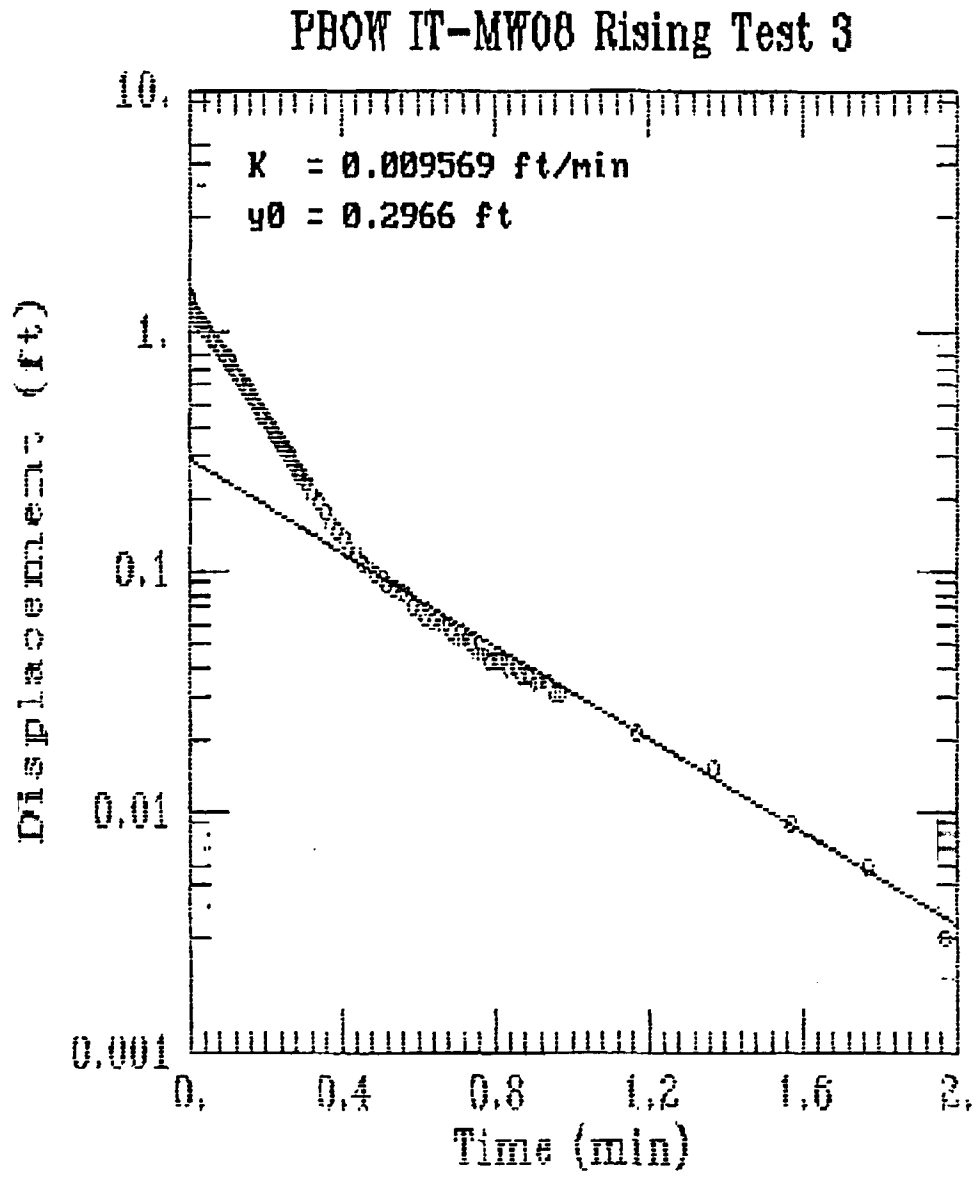
Elapsed Time	Input 1
0.1633	0.532
0.1666	0.523
0.17	0.513
0.1733	0.504
0.1766	0.495
0.18	0.485
0.1833	0.476
0.1866	0.466
0.19	0.457
0.1933	0.448
0.1966	0.441
0.2	0.432
0.2033	0.426
0.2066	0.416
0.21	0.41
0.2133	0.401
0.2166	0.394
0.22	0.385
0.2233	0.379
0.2266	0.372
0.23	0.363
0.2333	0.357
0.2366	0.35
0.24	0.344
0.2433	0.335
0.2466	0.332
0.25	0.322
0.2533	0.316
0.2566	0.31
0.26	0.307
0.2633	0.3
0.2666	0.294
0.27	0.288
0.2733	0.285
0.2766	0.278
0.28	0.272
0.2833	0.269
0.2866	0.263
0.29	0.256
0.2933	0.253
0.31	0.231
0.3266	0.209
0.3433	0.191
0.36	0.175
0.3766	0.162
0.3933	0.15
0.41	0.14
0.4266	0.131
0.4433	0.125
0.46	0.115

IT-MW08 Slug Test 2
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0.4766	0.109
0.4933	0.106
0.51	0.1
0.5266	0.094
0.5433	0.09
0.56	0.087
0.5766	0.084
0.5933	0.081
0.61	0.078
0.6266	0.075
0.6433	0.072
0.66	0.068
0.6766	0.068
0.6933	0.065
0.71	0.062
0.7266	0.059
0.7433	0.059
0.76	0.056
0.7766	0.056
0.7933	0.053
0.81	0.053
0.8266	0.05
0.8433	0.05
0.86	0.046
0.8766	0.046
0.8933	0.043
0.91	0.043
0.9266	0.043
0.9433	0.04
0.96	0.04
1.16	0.031
1.36	0.025
1.56	0.018
1.76	0.015
1.96	0.012
2.16	0.009
2.36	0.006
2.56	0.003
2.76	0.006
2.96	0.003
3.16	0.003
3.36	0
3.56	0
3.76	0
3.96	-0.003
4.16	-0.003
4.36	-0.003
4.56	-0.003
4.76	-0.003
4.96	-0.003

IT-MW08 Slug Test 2
PBOW, Groundwater Investigation

Elapsed Time	Input 1
5.16	-0.006
5.36	-0.006
5.56	-0.006
5.76	-0.006
5.96	-0.006
6.16	-0.006
6.36	-0.009
6.56	-0.009
6.76	-0.009
6.96	-0.009
7.16	-0.009
7.36	-0.009
7.56	-0.009
7.76	-0.009
7.96	-0.009
8.16	-0.012
8.36	-0.012
8.56	-0.009
8.76	-0.012
8.96	-0.012
9.16	-0.012
9.36	-0.012
9.56	-0.012
9.76	-0.012
9.96	-0.012


PBOW IT-MW08 Rising Test 3
K = 0.009569 ft/min
y0 = 0.2966 ft
10.
1.
0.1
0.01
0.001
Displacement (ft)
0.
0.4
0.8
1.2
1.6
2.
Time (min)

IT-MW08 Slug Test 3
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0	1.375
0.0034	1.353
0.0067	1.237
0.01	1.228
0.0134	1.2
0.0167	1.178
0.02	1.153
0.0234	1.165
0.0267	1.102
0.03	1.102
0.0334	1.08
0.0367	1.062
0.04	1.055
0.0434	1.018
0.0467	1.024
0.05	0.987
0.0534	0.974
0.0567	0.958
0.06	0.93
0.0634	0.927
0.0667	0.905
0.07	0.886
0.0734	0.871
0.0767	0.864
0.08	0.846
0.0834	0.833
0.0867	0.814
0.09	0.802
0.0934	0.786
0.0967	0.78
0.1	0.761
0.1034	0.748
0.1067	0.733
0.11	0.72
0.1134	0.704
0.1167	0.695
0.12	0.683
0.1234	0.67
0.1267	0.657
0.13	0.648
0.1334	0.636
0.1367	0.623
0.14	0.614
0.1434	0.601
0.1467	0.589
0.15	0.579
0.1534	0.57
0.1567	0.557
0.16	0.548

IT-MW08 Slug Test 3
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0.1634	0.535
0.1667	0.526
0.17	0.517
0.1734	0.507
0.1767	0.498
0.18	0.488
0.1834	0.479
0.1867	0.469
0.19	0.46
0.1934	0.451
0.1967	0.444
0.2	0.435
0.2034	0.426
0.2067	0.419
0.21	0.41
0.2134	0.401
0.2167	0.394
0.22	0.388
0.2234	0.379
0.2267	0.372
0.23	0.363
0.2334	0.357
0.2367	0.35
0.24	0.344
0.2434	0.338
0.2467	0.329
0.25	0.325
0.2534	0.316
0.2567	0.31
0.26	0.307
0.2634	0.3
0.2667	0.294
0.27	0.288
0.2734	0.281
0.2767	0.275
0.28	0.272
0.2834	0.266
0.2867	0.26
0.29	0.256
0.2934	0.25
0.2967	0.244
0.3	0.241
0.3034	0.235
0.3067	0.231
0.3234	0.209
0.34	0.191
0.3567	0.172
0.3734	0.159
0.39	0.147
0.4067	0.137

IT-MW08 Slug Test 3
PBOW, Groundwater Investigation

Elapsed Time	Input 1
0.4234	0.125
0.44	0.119
0.4567	0.109
0.4734	0.103
0.49	0.097
0.5067	0.094
0.5234	0.087
0.54	0.084
0.5567	0.081
0.5734	0.078
0.59	0.072
0.6067	0.068
0.6234	0.065
0.64	0.062
0.6567	0.059
0.6734	0.059
0.69	0.056
0.7067	0.053
0.7234	0.053
0.74	0.05
0.7567	0.046
0.7734	0.046
0.79	0.043
0.8067	0.043
0.8234	0.043
0.84	0.04
0.8567	0.04
0.8734	0.037
0.89	0.037
0.9067	0.034
0.9234	0.034
0.94	0.034
0.9567	0.031
0.9734	0.031
1.1734	0.021
1.3734	0.015
1.5734	0.009
1.7734	0.006
1.9734	0.003
2.1734	0
2.3734	0
2.5734	-0.006
2.7734	-0.006
2.9734	-0.006
3.1734	-0.009
3.3734	-0.009
3.5734	-0.009
3.7734	-0.012
3.9734	-0.012
4.1734	-0.012

IT-MW08 Slug Test 3
PBOW, Groundwater Investigation

Elapsed Time	Input 1
4.3734	-0.012
4.5734	-0.015
4.7734	-0.015
4.9734	-0.015
5.1734	-0.015
5.3734	-0.015
5.5734	-0.018
5.7734	-0.015
5.9734	-0.018
6.1734	-0.018
6.3734	-0.018
6.5734	-0.018
6.7734	-0.018
6.9734	-0.018
7.1734	-0.018
7.3734	-0.021
7.5734	-0.021
7.7734	-0.021
7.9734	-0.021
8.1734	-0.021
8.3734	-0.021
8.5734	-0.021
8.7734	-0.021
8.9734	-0.021
9.1734	-0.021
9.3734	-0.025
9.5734	-0.021
9.7734	-0.025
9.9734	-0.021

IT (2002)

Aquifer Test Results

Plum Brook Ordnance Works
Sandusky, OH
Project Number 825635

1.0 Purpose

This aquifer test in the form of slug testing was conducted to estimate the hydraulic conductivity of geologic materials in the vicinity of eight monitoring wells at the Plum Brook Ordnance works, Sandusky, Ohio. Newly installed during the 2001 Site-Wide Groundwater Remedial Investigation, the following wells were tested:

- PB-BED-MW22 (Bedrock)
- PB-BED-MW23 (Bedrock)
- PB-BED-MW24 (Bedrock)
- PB-BED-MW25 (Bedrock)
- PB-BED-MW27 (Bedrock)
- TNTB-BEDGW-003 (Bedrock)
- TNTB-BEDGW-004 (Bedrock)
- TNTC-BEDGW-001 (Bedrock)

2.0 Method

The methods of Bouwer and Rice (1976), as implemented through the computer program AQTESOLV® for Windows (HydroSOLVE, Inc. 1989), was used to calculate the hydraulic conductivity near a well. The calculation was based on the rate of water level change after adding a slug of known volume to the well (Falling Test) or sudden removal of a volume of water (Rising Test).

3.0 Theory

The Bouwer and Rice (1976) method for unconfined aquifers is based on the following equation:

$$Q = 2\pi KL_e \frac{y}{ln(R_e / r_w)}. \qquad 1$$

where:

Q is the flux to the well (length^3/time), K is the hydraulic conductivity of the aquifer (length/time), L_e is the length of screen contributing water to the well (length), y is the difference between the water level in the well and the equilibrium water table (length), R_e is the aquifer radius over which water level changes are dissipated (length) and r_w is the boring radius (length).

The instantaneous change in water level in the well, dy/dt, is given by:

$$dy/dt = -Q/\pi r_c^2 \qquad 2$$

Where $\pi r_c^2 1$ is the cross sectional area of the well.

Combining equations (1) and (2) yields:

$$\frac{1}{y} dy = -\frac{2KL_e}{r_c^2 ln(R_e/r_w)} dt \qquad 3$$

Integration of (3) between y_o at time t = 0 and y_t at time t and solving for K yields:

$$K = \left[\frac{r_c^2 ln(R_e/r_w)}{2L_e}\right]\frac{1}{t} ln\frac{y_o}{y_t} \qquad 4$$

K and the factor in square brackets are constants. Therefore, field data plotted as $ln(y_t)$ versus t should lie on a straight line with slope,

$$-\frac{2KL_e}{r_c^2 ln(R_e/r_w)}. \qquad 5$$

The factor $ln(R_e/r_w)$ in (4) is an empirical function of aquifer and well geometry. For partially penetrating wells:

$$ln\frac{R_e}{r_w} = \left[\frac{1.1}{ln(L_w/r_w)} + \frac{A + B\,ln[(H - L_w)/r_w]}{L_e/r_w}\right]^{-1}, \qquad 6$$

where $ln\,[(H-L_w)/r_w] \leq 6$.

For fully penetrating wells:

$$ln\frac{R_e}{r_w} = \left(\frac{1.1}{ln(L_w/r_w)} + \frac{C}{L_e/r_w}\right)^{-1}. \qquad 7$$

The dimensionless parameters A, B, and C are empirical functions of well geometry as determined by electric analog modeling (Bouwer and Rice, 1976).

Hydraulic conductivity is calculated from (4) using the slope and y-intercept of a line fit to the field data and $ln(R_e/r_w)$ from (6) or (7).

4.0 Assumptions

The Bouwer and Rice (1976) method for unconfined aquifers is based on the assumptions that:

- The aquifer is homogeneous, isotropic and unconfined.
- Drawdown is negligible compared to aquifer thickness.
- Vadose zone flow is negligible.
- Well losses are negligible.

5.0 Procedure

The following steps were followed in estimating the aquifer hydraulic conductivity:

a) Define the aquifer and well geometry using the following parameters (Table 1):

H	Aquifer saturated thickness (assumed)
L_e	Length of saturated well screen
L_w	Static height of water in well
r_c	Radius of well casing
r_w	Radius of boring
Φ	Porosity of filter pack (Assumed to be 30 percent. Porosity of unconsolidated sand ranges from 25 to 50 percent [Freeze and Cherry, 1979])
y_o	Initial change in water level

b) Using the field data to determine whether water level fluctuations occurred within the screened interval of the well.

When $L_w = L_e$. Water level fluctuations occurred in the screened section of the well. Modify r_c to account for filter pack storage according to:

$$r_c^* = \left[r_c^2 + \phi(r_w^2 - r_c^2)\right]^{1/2} \qquad 8$$

When $L_w > L_e$. Water level fluctuations occurred above the screened portion of the well. Note that the filter pack porosity in this case does not affect subsequent calculations, therefore, r_c is used in calculation.

c) Input geometric parameters listed above and time versus drawdown data.

d) Perform hydraulic conductivity calculations. Hydraulic conductivity is calculated interactively using AQTESOLV® for Windows. AQTESOLV® is used to display field data, which is then visually matched with a best-fit line. AQTESOLV® then calculates the hydraulic conductivity from the input geometric data and slope and y-intercept of the best-fit line.

6.0 Results

The slug tests were performed from November 13 through 15, 2001. Both falling and rising tests were conducted in PB-BED-MW22, PB-BED-MW23, TNTB-BEDGE-003, TNTB-BEDGE-004, and TNTC-BEDGE-001 while only rising test was conducted in PB-BED-MW22, PB-BED-MW23, and PB-BED-MW27 because the water level prior to the test was below the top of the screen. Two monitoring wells were originally planned for slug testing but were not tested. PB-BED-MW-26 had an insufficient water column (about 2 ft) for a meaning test and was therefore not tested. Another well TNTA-BEDGW-001 exhibited an erratic water level fluctuation between August 2001 and November. The depth to water measurement at this location was 11.18 ft below ground surface in August and was 158.8 ft prior to the test, indicating that this location was not suitable for aquifer testing purpose.

Table 1 summarizes the depth to groundwater, the total well depth, and the geometric data of each well tested. Values of calculated hydraulic conductivity (K) and transmissivity (T) are summarized in Table 2. The hydraulic conductivity values of the tested well are range from 0.00231 ft/day (PB-BED-MW27) to 5.48 ft/day (PB-BED-MW25) with a geometric mean of 0.358 ft/day. The transmissivity (T) was also calculated for each test using an assumed aquifer saturated thickness for each location. T values are summarized in Table 2.

7.0 References

Bouwer, H. and R. C. Rice, 1976, "A Slug Test Method for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells," ***Water Resources Research***, Vol. 12, No. 3, pp. 423-428.

Cooper, H. H., J. D. Bredehoeft, and I. S. Papadopulos, 1967, "Response of a Finite Diameter Well to an Instantaneous Change of Water," ***Water Resources Research***, Vol. 3, No. 1, pp. 263-269.

Freeze, R. A., and J. A. Cherry, 1979, ***Groundwater***, Prentice-Hall, Englewood Cliffs, New Jersey, 604 p.

Geraghty and Miller Environmental Services, 1989, AQTESOLV, Aquifer Test Design and Analysis Software, Version 1.1.

Table 1

Summary of Monitoring Well Geometry Data
PBOW, Sandusky, OH

Well No.	Water Level (TOC) (ft)	Total Depth (TOC) (ft)	H (Assumed)	r_c (ft)	r_w (ft)	L_e (ft)	L_w (ft)
PB-BED-MW22	30.24	44.45	14.21	0.08	0.25	15	14.21
PB-BED-MW23	67.33	75.6	8.27	0.08	0.25	20	8.27
PB-BED-MW24	27.46	42.78	15.32	0.08	0.25	15	15.32
PB-BED-MW25	15.05	40.6	25.55	0.08	0.25	10	25.55
PB-BED-MW26	58.02	60.15	2.13	0.08	0.25	15	2.13
PB-BED-MW27	48.44	107.7	59.26	0.08	0.25	78.5	59.26
TNTA-BEDGW-001	80.2	85.45	5.25	0.08	0.25	15	5.25
TNTB-BEDGW-003	29.55	41.23	11.68	0.08	0.25	10	11.68
TNTB-BEDGW-004	8.39	26.75	18.36	0.08	0.25	10	18.36
TNTC-BEDGW-001	59.03	87.62	28.59	0.08	0.25	15	28.59

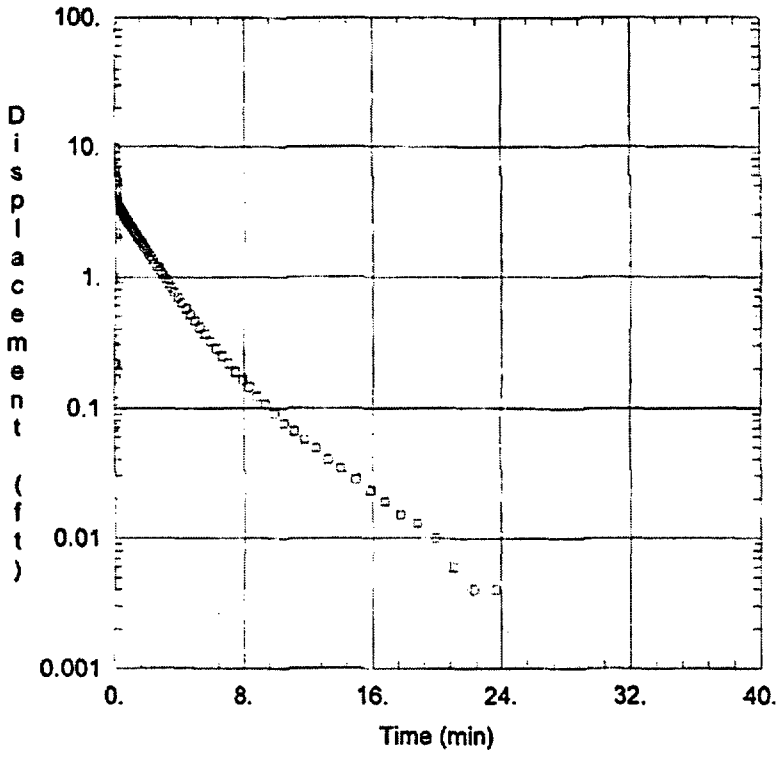
Note: H — Aquifer saturated thickness (assumed)
r_c — Radius of well casing
r_w — Radius of boring
L_e — Length of saturated well screen
L_w — Static height of water in well
Φ — Porosity of filter pack (Assumed to be 30 percent. Porosities of unconsolidated sand range from 25 to 50 percent [Freeze and Cherry, 1979])

Table 2

Summary of Hydraulic Conductivities
PBOW, Sandusky, OH

Well No.	Date Tested	Aquifer Response	Saturated Aquifer Thickness (Assumed)	Test Type	Transmisivities T (ft^2/day)	Hydraulic Conductivities K (ft/min)	Hydraulic Conductivities K (cm/sec)	Hydraulic Conductivities K (ft/day)
PB-BED-MW22	11/13/01	Unconfined	14.21	Rising	3.69E+00	1.80E-04	9.16E-05	2.59E-01
PB-BED-MW23	11/14/01	Unconfined	8.27	Rising	5.41E-01	4.54E-05	2.31E-05	6.54E-02
PB-BED-MW24	11/13/01	Unconfined	15.32	Falling	2.35E+01	1.07E-03	5.42E-04	1.54E+00
				Rising	2.81E+01	1.28E-03	6.48E-04	1.84E+00
PB-BED-MW25	11/14/01	Unconfined	25.55	Falling	1.40E+02	3.81E-03	1.94E-03	5.48E+00
				Rising	1.23E+02	3.33E-03	1.69E-03	4.80E+00
PB-BED-MW26	slug test was not performed due to low water column in the well							
PB-BED-MW27	11/14/01	Unconfined	59.26	Rising	1.37E-01	1.61E-06	8.16E-07	2.31E-03
TNTA-BEDGW-001	slug test was not performed due to low water column in the well							
TNTB-BEDGW-003	11/13/01	Unconfined	11.68	Falling	insufficient data			
				Rising	2.82E-02	1.68E-06	8.52E-07	2.41E-03
TNTB-BEDGW-004	11/13/01	Unconfined	18.36	Falling	4.03E+01	1.53E-03	7.75E-04	2.20E+00
				Rising	8.51E+01	3.22E-03	1.64E-03	4.63E+00
TNTC-BEDGW-001	11/14/01	Unconfined	28.59	Falling	9.36E+00	2.27E-04	1.16E-04	3.27E-01
				Rising	5.46E+00	1.33E-04	6.74E-05	1.91E-01
Maximum					***1.40E+02***	***3.81E-03***	***1.94E-03***	***5.48E+00***
Minimum					***2.82E-02***	***1.61E-06***	***8.16E-07***	***2.31E-03***
Geometric Mean					***7.06E+00***	***2.49E-04***	***1.26E-04***	***3.58E-01***

Time Versus Drawdown Data



FALLING TEST ANALYSIS

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Date: 02/21/02 Time: 15:26:24

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: TNTC-BEDGW-001
Test Date: 11/14/01

AQUIFER DATA

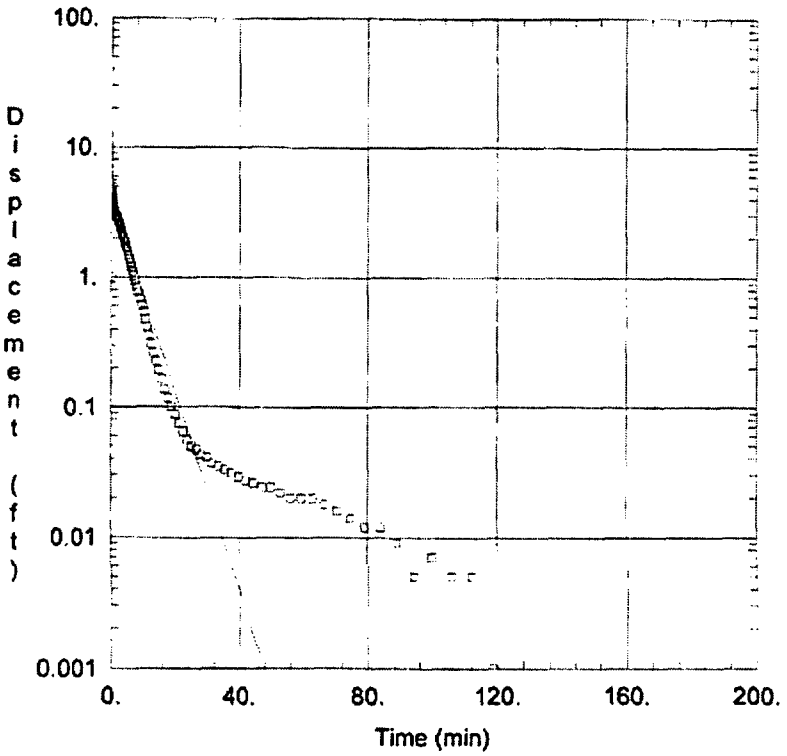
Saturated Thickness: 28.59 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (CGW-001)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 15. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 28.59 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0002274 ft/min
y0 = 2.852 ft



RISING TEST ANALYSIS

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Date: 02/21/02 Time: 14:11:12

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: TNTC-BEDGW-001
Test Date: 11/14/01

AQUIFER DATA

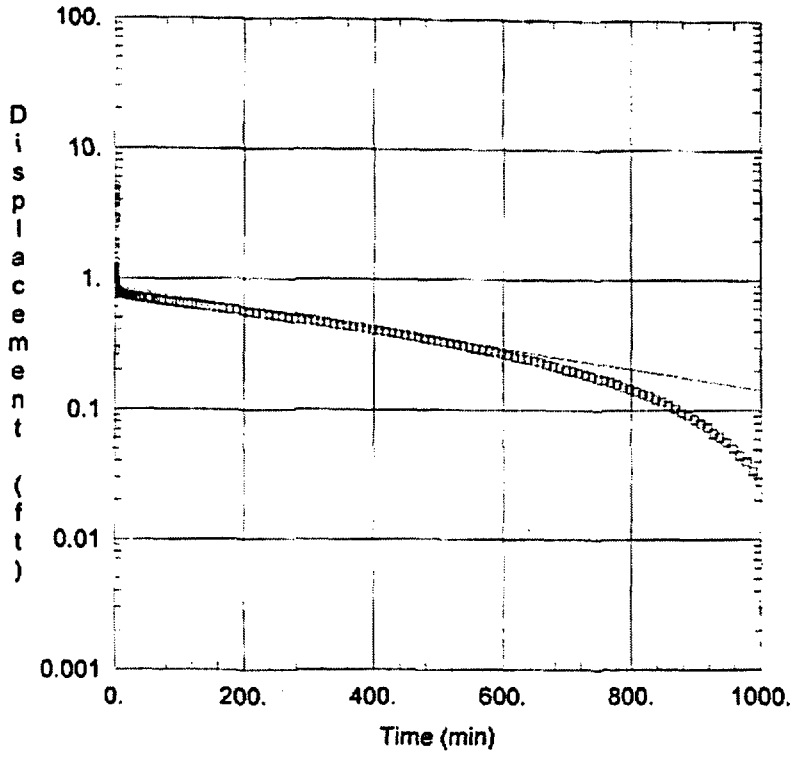
Saturated Thickness: 28.59 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (CGW-001)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 15. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 28.59 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.0001326 ft/min
y0 = 4.318 ft



RISING TEST ANALYSIS

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Date: 02/21/02 Time: 14:13:53

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: TNTB-BEDGW-003
Test Date: 11/13/01

AQUIFER DATA

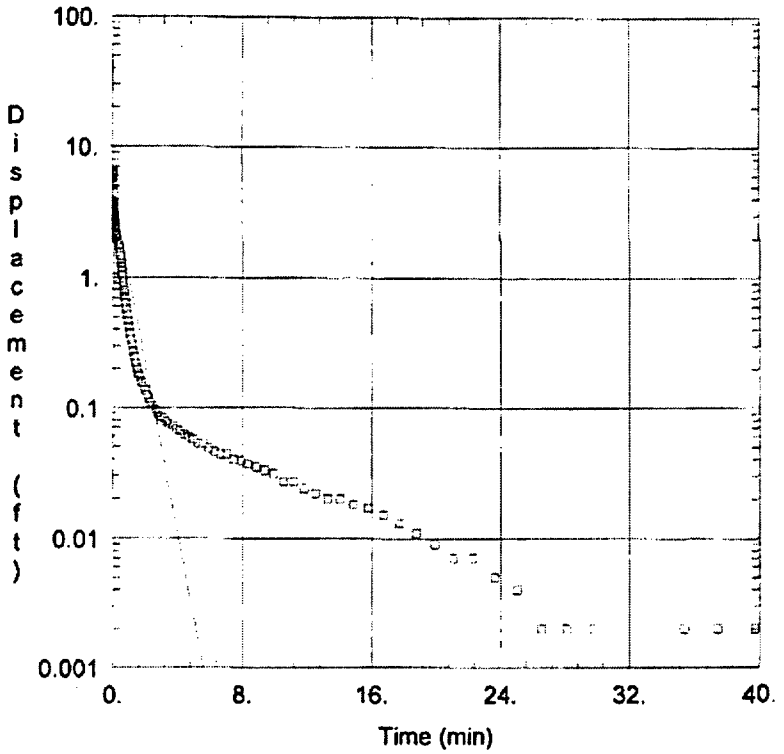
Saturated Thickness: 11.68 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW-003)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 11.68 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.676E-06 ft/min
y0 = 0.8637 ft



FALLING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\gw4f.aqt
Date: 02/21/02 Time: 14:15:07

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: TNTB-BEDGW-004
Test Date: 11/13/01

AQUIFER DATA

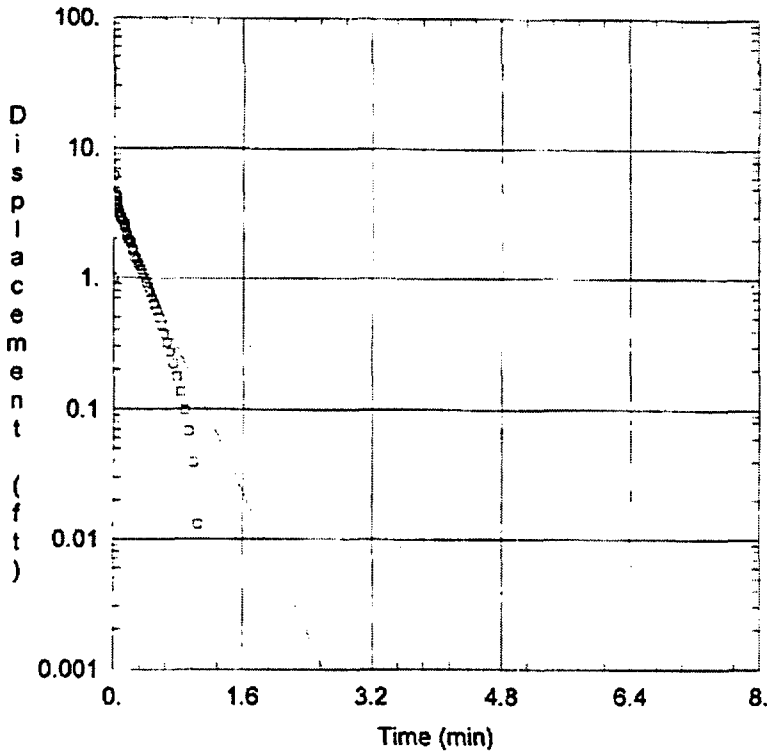
Saturated Thickness: 18.36 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW-004)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 18.36 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001525 ft/min
y0 = 4.318 ft



RISING TEST ANALYSIS

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Date: 02/21/02 Time: 14:15:30

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: TNTB-BEDGW-004
Test Date: 11/13/01

AQUIFER DATA

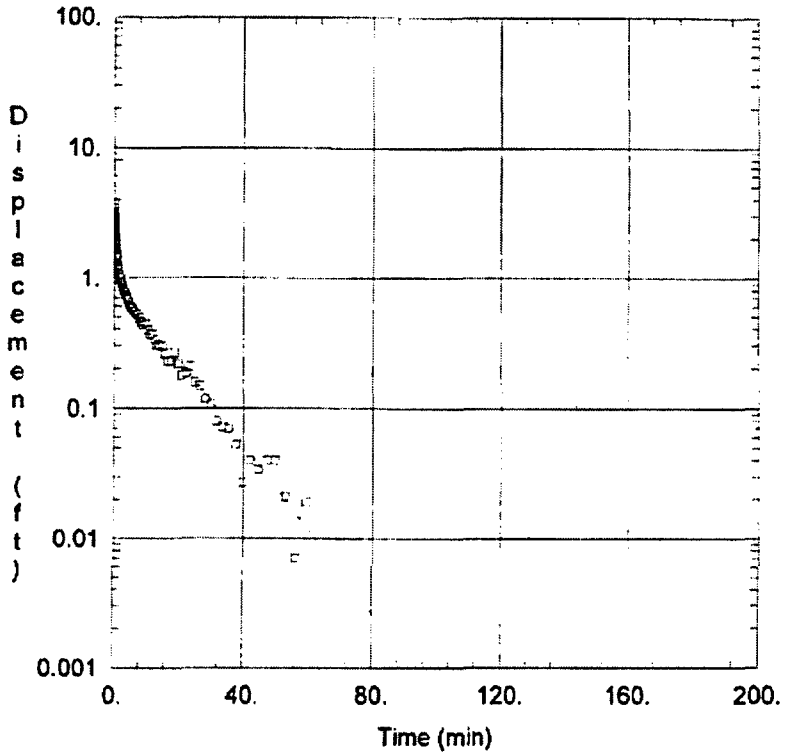
Saturated Thickness: 18.36 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (GW-004)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 18.36 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.003218 ft/min
y0 = 3.554 ft



RISING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw22r.aqt
Date: 02/21/02 Time: 14:16:02

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW22
Test Date: 11/13/01

AQUIFER DATA

Saturated Thickness: 14.21 ft
Anisotropy Ratio (Kz/Kr): 1.

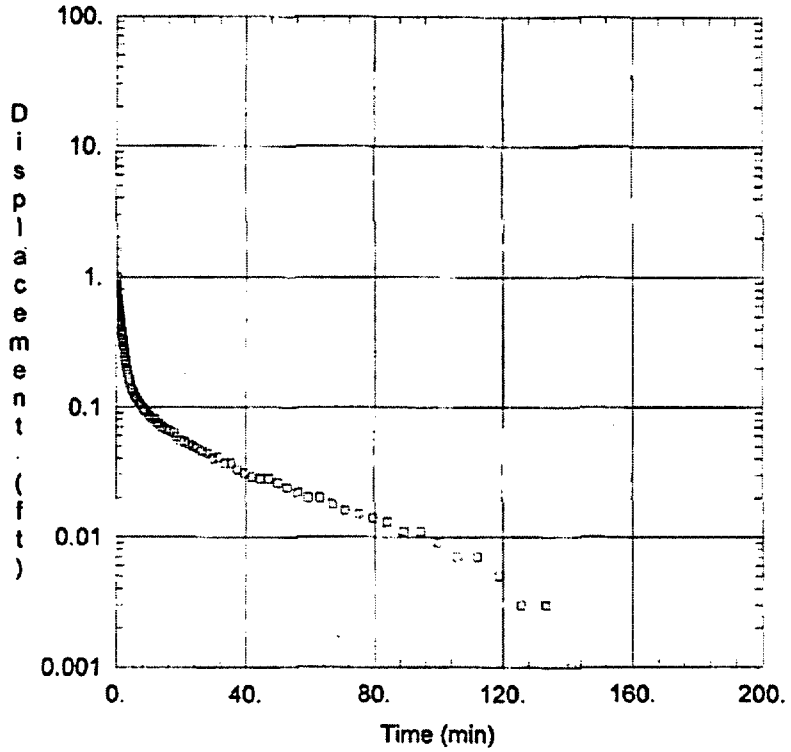
WELL DATA (MW-22)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 15. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 14.21 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.0001802 ft/min
y0 = 1.054 ft



RISING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw23r.aqt
Date: 02/21/02 Time: 14:16:30

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW23
Test Date: 11/14/01

AQUIFER DATA

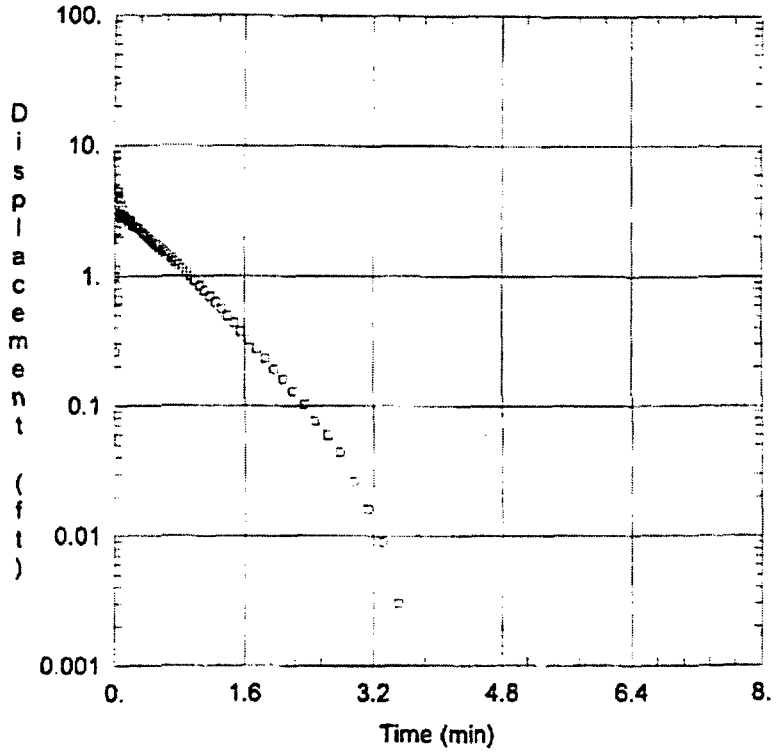
Saturated Thickness: 8.27 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 20. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 8.27 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 4.542E-05 ft/min
y0 = 0.1244 ft



FALLING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw24f.aqt
Date: 02/21/02 Time: 14:16:52

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW24
Test Date: 11/13/01

AQUIFER DATA

Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 1.

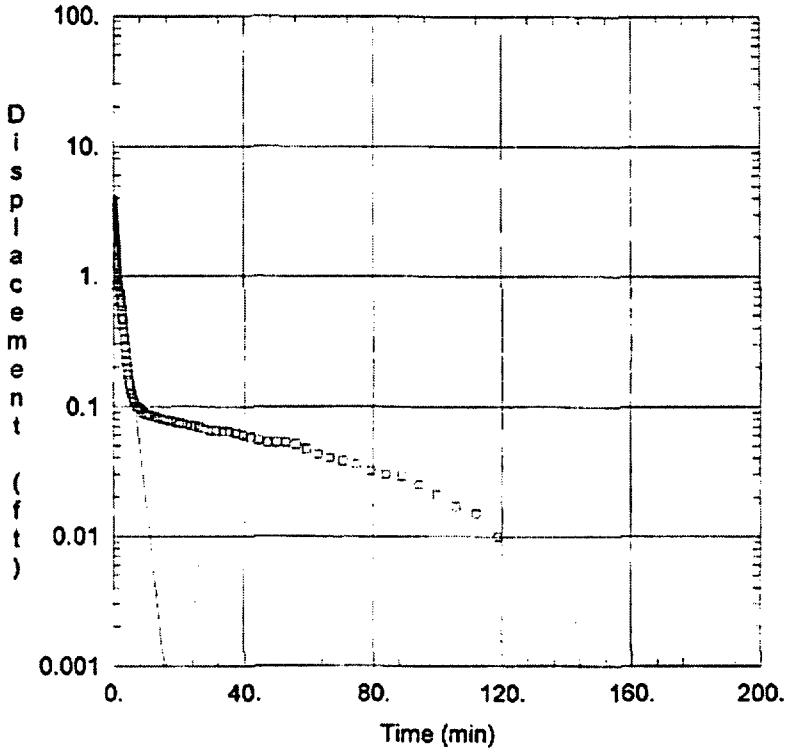
WELL DATA (MW-24)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 15. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 15.32 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.001067 ft/min
y0 = 3.94 ft



RISING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw24r.aqt
Date: 02/21/02 Time: 14:18:08

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW23
Test Date: 11/13/01

AQUIFER DATA

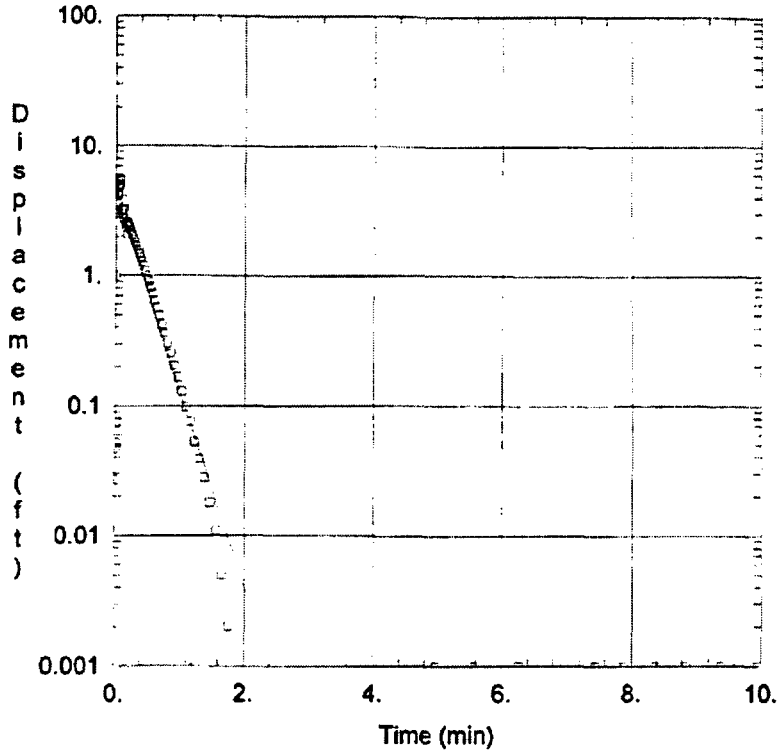
Saturated Thickness: 15.32 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-23)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 15. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 15.32 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 0.001275 ft/min
y0 = 3.18 ft



FALLING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw25f.aqt
Date: 02/21/02 Time: 14:19:18

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW25
Test Date: 11/13/01

AQUIFER DATA

Saturated Thickness: 25.55 ft
Anisotropy Ratio (Kz/Kr): 1.

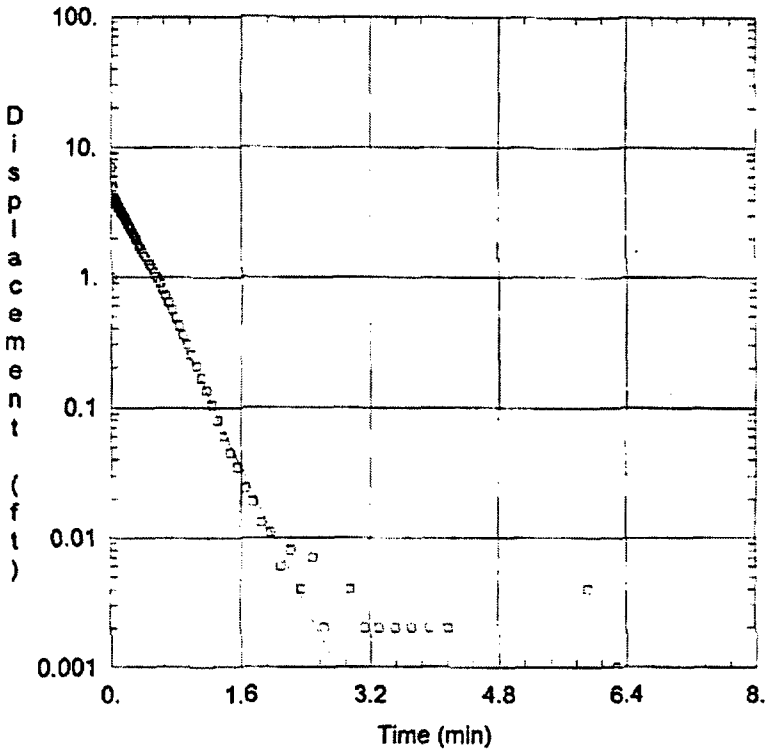
WELL DATA (MW-25)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 25.55 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.003808 ft/min
y0 = 4.458 ft



RISING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw25r.aqt
Date: 02/21/02 Time: 14:19:52

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW25
Test Date: 11/13/01

AQUIFER DATA

Saturated Thickness: 25.55 ft
Anisotropy Ratio (Kz/Kr): 1.

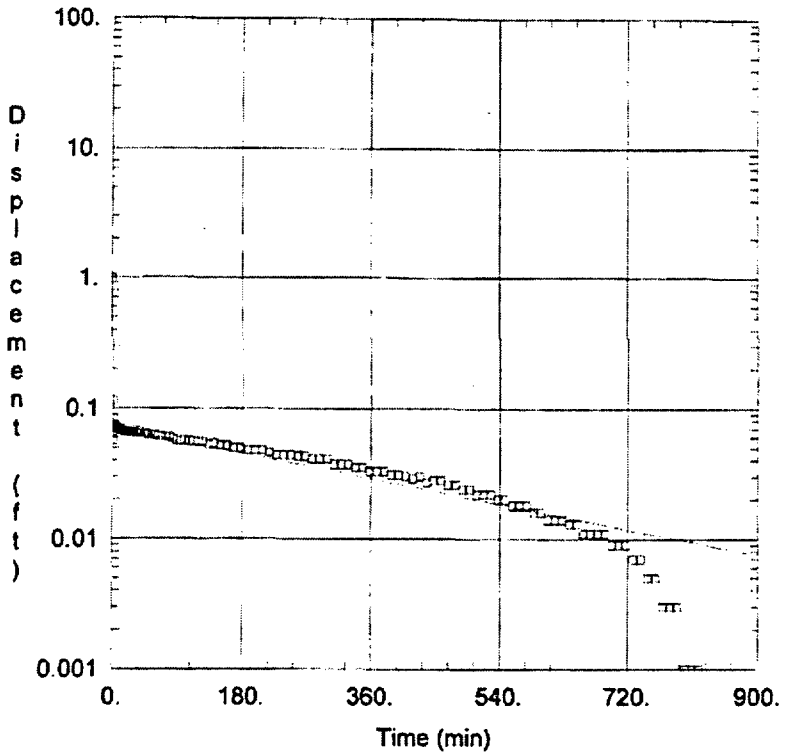
WELL DATA (MW-25)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 10. ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 25.55 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice

K = 0.003333 ft/min
y0 = 4.729 ft



RISING TEST ANALYSIS

Data Set: C:\Documents and Settings\jli\My Documents\Projects\PBOW\mw27r.aqt
Date: 02/21/02 Time: 14:20:11

PROJECT INFORMATION

Company: IT
Client: USACE
Project: 825635 04000000
Test Location: PBOW, Sandusky, OH
Test Well: PB-BED-MW27
Test Date: 11/14/01

AQUIFER DATA

Saturated Thickness: 59.26 ft
Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-27)

Initial Displacement: 1. ft
Wellbore Radius: 0.25 ft
Screen Length: 78.5 ft
Gravel Pack Porosity: 0.3
Casing Radius: 0.08 ft
Well Skin Radius: 0.25 ft
Total Well Penetration Depth: 59.26 ft

SOLUTION

Aquifer Model: Unconfined
Solution Method: Bouwer-Rice
K = 1.606E-06 ft/min
y0 = 0.07082 ft

APPENDIX G

VERTICAL HYDRAULIC GRADIENTS

IT (1999)

Table 6-4

Well Pair Vertical Hydraulic Gradients
Former Plum Brook Ordnance Works, Sandusky, Ohio

	Well Name	Unit Monitored (ft below ground)	Well TD (ft below ground)	Depth of Monitored Zone (ft below ground)	Elevation of Ground Surface (ft)	Elevation of Center of Monitored Zone (ft)	Groundwater Elevation				Average Vertical Gradient (ft/ft)
							8/27/97	11/12/97	2/24/98	5/5/98	
Pair 1	IT-AA1-GW002	OB/OS	22	6.8-21.9	638.6	624.25	NA	634.63	637.80	637.43	
	IT-AA1-BED-GW001	DL	65.0	49.8-64	638.8	581.90	NA	610.52	610.54	611.94	
	Distance Between Center of Monitored Zones					42.35					
	Vertical Gradient						NA	0.563	0.637	0.596	0.599
Pair 2	IT-AA2-GW-002	OB/OLS	18.5	8.3-18.3	641.5	628.20	NA	DRY	DRY	643.95	
	IT-AA2-BED-GW001	DL	54	27.8-42.8	641.6	606.30	NA	630.95	632.48	634.17	
	Distance Between Center of Monitored Zones					21.90					
	Vertical Gradient						NA	NA	NA	0.447	0.447
Pair 3	AA3-GW002	OB	16	5.8-15.8	634.1	623.30	NA	629.81	632.23	622.14	
	AA3-BED-GW001	DL	53	37.8-52.8	634.1	588.80	NA	613.21	614.90	614.81	
	Distance Between Center of Monitored Zones					34.5					
	Vertical Gradient						NA	0.481	0.502	0.212	0.398
Pair 4	ABG-GW002	OB	6.8	2.5-6.5	658.2	653.70	NA	654.51	657.11	657.06	
	ABG-BED-GW001	OS	21	10.8-20.8	658.2	642.40	NA	654.50	657.04	656.99	
	Distance Between Center of Monitored Zones					11.30					
	Vertical Gradient	OB/OS					NA	0.001	0.006	0.006	0.004
Pair 5	MK-MW16	OB/OS	8	2-7	671.01	666.51	668.35	666.25	669.18	669.22	
	TNTB-BED-GW002	OS	24.2	14-24	670.10	651.10	NA	666.44	670.46	665.68	
	Distance Between Center of Monitored Zones					15.41					
	Vertical Gradient						NA	-0.012	-.081	0.223	0.044

OB - Overburden.
OS - Ohio Shale.
OLS - Olentangy Shale.
DL - Delaware Limestone.

IT (2002)

Table 6-4

Well Pair Vertical Hydraulic Gradients
2001 Groundwater Remedial Investigation
Former Plum Brook Ordnance Works, Sandusky, Ohio

	Well Name	Unit Monitored (ft bgs)	Well TD (ft bgs)	Depth of Monitored Zone (ft bgs)	Elevation of Ground Surface (ft)	Elevation of Center of Monitored Zone (ft)	Groundwater Elevation				Average Vertical Gradient (ft/ft)
							8/27/97	11/12/97	2/24/98	5/5/98	
Pair 1	IT-AA1-GW002	OB/OS	22	6.8-21.9	638.6	624.25	NA	634.63	637.80	637.43	
	IT-AA1-BED-GW001	DL	65.0	49.8-64	638.8	581.90	NA	610.52	610.54	611.94	
	Distance between Center of Monitored Zones										
	Vertical Gradient						NA	0.563	0.637	0.596	0.599
Pair 2	IT-AA2-GW-002	OB/OLS	18.5	8.3-18.3	641.5	628.20	NA	DRY	DRY	643.95	
	IT-AA2-BED-GW001	DL	54	27.8-42.8	641.6	606.30	NA	630.95	632.48	634.17	
	Distance between Center of Monitored Zones					21.90					
	Vertical Gradient						NA	NA	NA	0.447	0.447
Pair 3	AA3-GW002	OB	16	5.8-15.8	634.1	623.30	NA	629.81	632.23	622.14	
	AA3-BED-GW001	DL	53	37.8-52.8	634.1	588.80	NA	613.21	614.9	614.81	
	Distance between Center of Monitored Zones					34.50					
	Vertical Gradient						NA	0.481	0.502	0.212	0.398
Pair 4	ABG-GW002	OB	6.8	2.5-6.5	658.2	653.70	NA	654.51	657.11	657.06	
	ABG-BED-GW001	OS	21	10.8-20.8	658.2	642.40	NA	654.5	657.04	656.99	
	Distance between Center of Monitored Zones					11.30					
	Vertical Gradient	OB/OS					NA	0.001	0.006	0.006	0.004
Pair 5	MK-MW16	OB/OS	8	2-7	671.01	666.51	NA	666.25	669.18	669.22	
	TNTB-BED-GW002	OS	24.2	14-24	670.10	651.10	NA	666.44	670.46	665.68	
	Distance between Center of Monitored Zones					15.41					
	Vertical Gradient						NA	-0.012	-0.81	0.223	0.044

OB - Overburden.
OS - Ohio State.
OLS - Olentangy shale.
DL - Delaware limestone.

APPENDIX H

SURVEY DATA

Dames & Moore (1999)

[illegible]: [illegible]TNTA.[illegible]

POINT	NORTHING	EASTING	ELEVATION	NOTE
1000	32580.1577	27844.9668	638.0465	MK-MW22 CAS
1001	32580.3630	27844.3376	635.5575	MK-MW22 GND
1002	32935.1711	29414.2443	639.4729	MK-MW23 CAS
1003	32934.0916	29414.5169	636.9500	MK-MW23 GND
1004	30493.6231	27420.8660	657.1164	MK-MW24 CAS
1005	30494.7073	27420.4812	654.4446	MK-MW24 GND
1006	32095.2811	27479.5229	640.1783	PB-TNTA-MW10 CAS
1007	32093.1214	27478.6611	637.5025	PB-TNTA-MW10 GND
1008	31733.6648	26832.7054	640.4990	PB-TNTA-MW11 CAS
1009	31731.5058	26832.6482	637.8648	PB-TNTA-MW11 GND

File: [illegible].CRD

POINT	NORTHING	EASTING	ELEVATION	NOTE
2000	24937.4730	22260.6698	674.3227	MK-MW16 CAS
2001	24938.5128	22260.1230	671.3271	MK-MW16 GND
2002	26671.1286	22021.0026	664.6425	MK-MW17 CAS
2003	26670.7095	22019.8256	660.9672	MK-MW17 GND

POINT	NORTHING	EASTING	ELEVATION	NOTE
3000	29408.6978	15531.0263	645.4149	PB-TNTC-MW3 CAS
3001	29408.8887	15532.7451	642.5686	PB-TNTC-MW3 GND
3002	28334.5197	14635.8790	654.4254	PB-TNTC-MW4 CAS
3003	28332.1101	14634.9910	651.8891	PB-TNTC-MW4 GND
3004	28645.6081	15969.9882	651.8103	PB-TNTC-MW5 CAS
3005	28645.9387	15970.1375	649.0699	PB-TNTC-MW5 GND
3006	28411.4613	17171.1652	659.4018	PB-TNTC-MW6 CAS
3007	28413.0296	17169.5598	656.8196	PB-TNTC-MW6 GND

File: [illegible]

POINT	NORTHING	EASTING	ELEVATION	NOTE
4000	30428.4220	14380.0948	639.5980	IT-MW002 CASING
4001	30428.0835	14379.8083	636.6895	IT-MW002 GND
4002	30428.3357	14379.9481	639.6292	IT-MW002 MEAS PT
4003	31783.0116	14647.2616	640.8941	MK-MW10 CAS
4004	31784.0924	14646.6469	638.0600	MK-MW10 GND
4005	31782.0442	15925.8393	637.6858	MK-MW11 CAS
4006	31782.6482	15926.8071	634.7066	MK-MW11 GND
4007	30549.5032	14060.0756	644.4319	PB-WA-MW-1 CASING
4008	30549.4006	14060.5771	642.3200	PB-WA-MW-1 GND
4009	30038.2737	14301.1933	633.6505	PB-WA-MW-2 CASING
4010	30038.9137	14301.2543	631.1569	PB-WA-MW-2 GND

L.A: C:BEN-WELL.TRT

POINT	NORTHING	EASTING	ELEVATION	NOTE
5000	33122.3541	23074.6346	633.9861	PB-PR-MW7 CAS
5001	33122.1380	23074.6900	631.5000	PB-PR-MW7 GND
5002	33022.0426	23365.0504	635.0205	PB-PR-MW8 CAS
5003	33022.1700	23364.7000	632.5000	PB-PR-MW8 GND
5004	33229.7381	23561.4850	633.6999	PB-PR-MW9 CAS
5005	33227.1940	23564.6760	630.7000	PB-PR-MW9 GND
5006	33482.7542	23520.4311	634.9943	IT-MW05 CAS
5007	33481.1410	23518.7250	631.9147	IT-MW05 GND

[illegible] MISCWELL.PRN

POINT	NORTHING	EASTING	ELEVATION	NOTE
6000	29006.7777	16324.7729	648.2731	PB-BED-MW13 CAS
6001	29004.7448	16324.8381	645.8093	PB-BED-MW13 GND
6002	30640.9823	14567.4105	646.0366	PB-BED-MW14 CAS
6003	30640.6739	14564.9269	643.0537	PB-BED-MW14 GND
6004	34311.2880	23307.8310	631.6394	PB-BED-MW15 CAS
6005	34311.2752	23310.1041	629.0737	PB-BED-MW15 GND
6006	31463.0050	24687.7929	636.0173	PB-BED-MW16 CAS
6007	31461.0305	24688.0338	633.6826	PB-BED-MW16 GND
6008	33666.0038	28164.0776	629.0697	PB-BED-MW17 CAS
6009	33667.9151	28164.7514	627.3369	PB-BED-MW17 GND
6010	32130.3503	29563.1857	651.5041	PB-BED-MW18 CAS
6011	32128.0488	29563.0032	648.8318	PB-BED-MW18 GND
6012	31782.9542	14256.5847	643.0705	PB-BED-MW19 CAS
6013	31780.9102	14256.3225	640.5050	PB-BED-MW19 GND
6014	20646.7145	27306.6374	676.3317	PB-BED-MW20 CAS
6015	20645.1156	27305.6314	673.5732	PB-BED-MW20 GND
6016	34874.6151	21994.7173	630.1175	REACTOR1 CAS
6017	34874.7528	21994.7061	630.2061	REACTOR1 GND
6018	34762.4651	22017.2722	630.6801	REACTOR2 CAS
6019	34762.6821	22017.2191	630.7188	REACTOR2 GND
6020	34790.0313	22161.7567	630.8760	REACTOR3 CAS
6021	34790.0394	22161.8532	630.7346	REACTOR3 GND
6022	34735.1486	22161.2091	631.1532	REACTOR4 CAS
6023	34735.1918	22161.2332	630.7567	REACTOR4 GND

File: C:WA-SOIL.CRS

NT	NORTHING	EASTING	ELEVATION	NOTE
7000	30006.1890	14404.1956	631.8186	PB-WA-S1
7001	29954.2200	14345.3691	624.3863	PB-WA-S2
7002	29932.7040	14250.8353	626.0317	PB-WA-S3
7003	30183.0401	14061.7649	633.3041	PB-WA-S4
7004	30159.2497	14065.3231	633.0988	PB-WA-S5
7005	30147.6119	13844.2866	633.3705	PB-WA-S6
7006	30184.1411	13751.1463	635.3703	PB-WA-S7
7007	30354.5831	13748.0405	637.7745	PB-WA-S8
7008	30441.3753	14085.3392	639.3238	PB-WA-S9
7009	30331.5225	14694.5146	632.1665	PB-WA-S11
7010	30166.2900	14696.1580	627.5275	PB-WA-S12
7011	30066.0276	14455.5353	631.5901	PB-WA-S13
7012	30058.3731	14678.7106	629.1723	PB-WA-S14
7013	30531.8066	14752.4694	632.8720	PB-WA-S15
7014	30433.0133	14278.0708	638.2466	PB-WA-S16
7015	30334.9682	14416.1808	633.1152	PB-WA-S17
7016	30192.6733	14442.4040	631.5738	PB-WA-S18
7017	30442.8399	14461.8418	632.3120	PB-WA-S19
7018	30092.2223	14361.9554	631.3624	PB-WA-S20
7019	30105.3354	14387.2320	630.8781	E POND H2O ELEV
7020	30091.9365	14312.4992	634.9013	W POND H2O ELEV
7021	30411.8869	14299.0826	0.0000	GRID A,0
22	30312.0487	14304.8151	0.0000	GRID 2
023	30362.2829	14301.7802	0.0000	GRID 1
7024	30263.3419	14307.5367	0.0000	GRID 3
7025	30214.0439	14310.2108	0.0000	GRID 4
7026	30164.6824	14313.1814	0.0000	GRID 5
7027	30115.9103	14315.8810	0.0000	GRID 6
7028	30089.5931	14317.2538	0.0000	GRID 7
7029	30080.1290	14267.4196	0.0000	GRID B'
7030	30084.4724	14220.4027	0.0000	GRID C'
7031	30088.0436	14168.2477	0.0000	GRID D'
7032	30106.6105	14145 6197	0.0000	GRID 6'
7033	30156.6212	14143.6142	0.0000	GRID 5'
7034	30205.4939	14112.9276	0.0000	GRID E'
7035	30202.9630	14063.6400	0.0000	GRID F'
7036	30203.0170	14014.3307	0.0000	GRID G'
7037	30203.0974	13964.5085	0.0000	GRID H'
7038	30202.7904	13915.0375	0.0000	GRID I'
7039	30197.5543	13867.1776	0.0000	GRID J'
7040	30196.9283	13817.7907	0.0000	GRID K'
7041	30201.5060	13768.7801	636.6574	GRID L' BOB
7042	30200.3900	13771.3730	0.0000	GRID 3'
7043	30200.8029	13768.3270	0.0000	GRID 2'
7044	30205.9562	13765.6018	636.8894	GRID 1' BOB
7045	30380.2308	13764.6497	0.0000	GRID 0'
7046	30410.8059	13751.3223	0.0000	GRID L
7047	30413.6969	13801.2278	0.0000	GRID K
48	30415.0030	13851.4200	0.0000	GRID J
049	30416.6121	13902.1923	0.0000	GRID I
7050	30418.5878	13950.5057	0.0000	GRID H
7051	30417.3195	14001.1511	0.0000	GRID G
7052	30416.4089	14050.5135	0.0000	GRID F
7053	30415.9302	14101.0651	0.0000	GRID E
7054	30415.1270	14150.6190	0.0000	GRID D
7055	30411.1949	14200.1267	0.0000	GRID C

POINT	NORTHING	EASTING	ELEVATION	NOTE
7056	30412.9637	14249.8965	0.0000	GRID B
7057	30411.3433	14231.3303	635.9779	BOB (BOT OF BANK
7058	30415.9536	14232.9379	639.3188	TOB (TOP OF BANK)
7059	30387.0836	14301.1532	637.6700	TOB
7060	30374.3088	14301.9589	634.8275	BOB
7061	30368.4182	14314.1056	635.1599	BOB
7062	30358.6547	14336.7958	637.5027	BERM
7063	30226.2309	14339.8016	638.1550	BERM
7064	30227.7183	14321.0614	635.4249	BOB
7065	30074.9673	14323.4755	638.4649	BERM
7066	30085.9520	14318.9367	636.1066	BOB
7067	30067.9813	14230.8525	637.9243	BERM
7068	30075.3576	14224.2036	635.9106	BOB
7069	30073.5948	14142.1937	638.5194	BERM
7070	30085.1195	14144.8041	636.3330	BOB
7071	30129.2379	14126.9881	637.7410	BERM
7072	30132.4814	14132.5218	635.9668	BOB
7073	30190.0450	14110.7680	638.1967	BERM
7074	30199.0133	14115.1351	635.3406	BOB
7075	30193.9837	14063.9819	636.1324	BREECH
7076	30189.3128	13957.6800	638.1029	BERM
7077	30194.4934	13956.8308	635.9451	BOB
7078	30195.9626	13763.0785	638.0533	BERM
7079	30255.0272	13748.0461	637.4130	EDGE LOW AREA
7080	30266.2094	13754.2036	636.0354	BOB
7081	30323.5849	13754.0661	637.2612	EDGE LOW AREA
7082	30360.1172	13798.4222	637.7170	TOB
7083	30356.4426	13802.7049	635.9964	BOB
7084	30384.3376	13851.3515	635.9836	BOB
7085	30388.2027	13847.7164	638.6041	TOB
7086	30416.7064	13937.8832	637.8301	TOB
7087	30409.4718	13943.9074	635.4179	BOB
7088	30434.4388	14035.9950	635.9225	BOB
7089	30442.5649	14040.6405	636.8063	BOB
7090	30428.0000	14047.0726	639.2780	TOB
7091	30421.8045	14046.8447	635.6744	BOB
7092	30412.0179	14130.6031	635.3740	BOB
7093	30418.6284	14129.3554	638.0894	TOB

File: C:PEN-SOIL.CRS

POINT	NORTHING	EASTING	ELEVATION	NOTE
8000	33227.1240	22964.6760	633.5100	P-BH1
8001	33022.1240	22964.7000	633.0200	P-BH2
8002	32922.1240	22964.7120	633.0800	P-BH3
8003	33122.1380	23074.6900	631.4900	P-MW4
8004	32922.1670	23074.7120	631.2100	P-BH5
8005	33227.1470	23164.6770	631.3200	P-BH6
8006	33022.1470	23164.7000	631.1100	P-BH7
8007	33517.1580	23264.6430	633.6700	P-BH8
8008	33322.1580	23264.6650	631.1200	P-BH9
8009	33122.1590	23264.6880	631.1000	P-BH10
8010	32922.1610	23284.7120	632.2900	P-MW11
8011	33422.1700	23364.6540	630.4200	P-BH12
8012	33227.1700	23364.6760	632.8100	P-BH13
8013	33022.1700	23364.7000	632.4800	P-MW14
8014	33322.1830	23464.6670	633.0200	P-BH15
8015	33122.1820	23464.6880	634.5400	P-BH16
8016	32922.1820	23464.7120	631.1900	P-BH17
8017	33422.1920	23564.6540	629.8300	P-BH18
8018	33227.1940	23564.6760	630.7300	P-MW19
8019	33122.1940	23564.6880	631.6100	P-BH20
8020	33110.0910	23177.0110	630.5700	PB-PR-S21
8021	33162.1750	23394.6850	634.6300	P-BH21A
22	33275.8650	23282.9030	630.3200	PB-PR-S22
23	33369.6920	23353.9460	629.8300	PB-PR-S23
8024	33373.7880	23447.8330	629.9700	PB-PR-S24

IT (1999)

NEW MONITORING WELLS (NASA PBS COORDINATES)

PT #	Y	X	ELEV	WELL #
252	29982.500	13987.892	632.640	MW7GND
251	29982.504	13987.790	635.350	MW7CAS
227	30437.005	15248.293	630.920	MW8GND
228	30435.170	15247.906	633.480	MW8CAS
233	28884.946	14852.186	645.720	MW9GND
234	28882.831	14852.220	647.770	MW9CAS
248	30926.420	13587.695	642.510	MW10GND
246	30924.244	13587.828	645.120	MW10CAS

NEW MONITORING WELLS (OHIO STATE COORDINATES)

PT #	Y	X	ELEVATION (ground)	ELEVATION (casing)	WELL #
251	622075.676	1909861.839	632.300	635.030	IT-MW7*
225	622497.939	1911132.383	630.600	633.160	IT-MW8
231	620955.600	1910699.468	645.400	647.450	IT-MW9
245	623026.644	1909484.655	642.200	644.800	IT-MW10

* - temporary piezometer

:XISTING MONITORING WELLS (OHIO STATE COORDINATES)

PT #	Y	X	ELEVATION	WELL	POSITION
1100	624339.440	1923776.407	637.730	MK-MW22	CAS
1101	624339.661	1923775.783	635.240	MK-MW22	GND
1102	624656.620	1925353.648	639.110	MK-MW23	CAS
1103	624655.534	1925353.894	636.630	MK-MW23	GND
1104	622263.851	1923302.327	656.800	MK-MW24	CAS
1105	622264.944	1923301.968	654.120	MK-MW24	GND
1106	623863.520	1923399.445	639.860	PB-TNTA-MW10	CAS
1107	623861.382	1923398.533	637.180	PB-TNTA-MW10	GND
1108	623517.575	1922744.173	640.180	PB-TNTA-MW11	CAS
1109	623515.418	1922744.065	937.540	PB-TNTA-MW11	GND
1200	616833.696	1918010.497	674.000	MK-MW16	CAS
1201	616834.747	1918009.976	671.010	MK-MW16	GND
1202	618572.482	1917812.572	664.320	MK-MW17	CAS
1203	618572.092	1917811.385	660.650	MK-MW17	GND
1300	621464.997	1911390.720	645.090	PB-TNTC-MW3	CAS
1301	621465.147	1911392.442	642.250	PB-TNTC-MW3	GND
1302	620412.716	1910470.087	654.110	PB-TNTC-MW4	CAS
1303	620410.329	1910469.141	651.570	PB-TNTC-MW4	GND
1304	620691.637	1911811.188	651.490	PB-TNTC-MW5	CAS
1305	620691.916	1911813.344	648.750	PB-TNTC-MW5	GND
1306	620428.714	1913006.304	659.080	PB-TNTC-MW6	CAS
1307	620430.320	1913004.737	656.500	PB-TNTC-MW6	GND
1400	622512.007	1910264.705	639.280	IT-MW002	CAS
1401	622511.675	1910264.431	636.370	IT-MW002	GND
1402	622511.924	1910264.557	639.310	IT-MW002	MEASU.
1403	623859.687	1910564.322	640.570	MK-MW10	CAS
1404	623860.782	1910563.734	637.740	MK-MW10	GND
1405	623859.687	1910564.322	637.360	MK-MW11	CAS
1406	623828.580	1911843.397	634.390	MK-MW11	GND
1407	622640.734	1909947.711	644.110	PB-WA-MW-1	CAS
1408	622640.619	1909948.210	642.000	PB-WA-MW-1	GND
1409	622123.895	1910176.458	633.330	PB-WA-MW-2	CAS
1410	622124.533	1910176.535	630.840	PB-WA-MW-2	GND
1500	624996.059	1919020.828	633.670	PB-PR-MW7	CAS
1501	624995.842	1919020.879	631.180	PB-PR-MW7	GND
1502	624888.805	1919308.729	634.700	PB-PR-MW8	CAS
1503	624888.942	1919308.382	632.180	PB-PR-MW8	GND
1504	625091.706	1919510.083	633.380	PB-PR-MW9	CAS
1505	625089.087	1919513.212	630.380	PB-PR-MW9	GND
1506	625345.617	1919475.123	634.670	IT-MW05	CAS
1507	625344.046	1919473.379	631.590	IT-MW05	GND
1600	621044.151	1912174.521	647.950	PB-BED-MW13	CAS
1601	621042.117	1912174.539	645.490	PB-BED-MW13	GND

1602	622719.990	1910457.060	645.720	PB-BED-MW14	CAS
1603	622719.740	1910454.570	642.730	PB-BED-MW14	GND
1604	626178.959	1919282.558	631.310	PB-BED-MW15	CAS
1605	626178.892	1919284.779	628.760	PB-BED-MW15	GND
1606	623298.550	1920593.533	635.700	PB-BED-MW16	CAS
1607	623296.570	1920593.727	633.360	PB-BED-MW16	GND
1608	625417.226	1924121.493	629.650	PB-BED-MW17	CAS
1609	625419.121	1924122.212	627.020	PB-BED-MW17	GND
1610	623848.512	1925483.197	651.180	PB-BED-MW18	CAS
1611	623846.215	1925482.960	648.510	PB-BED-MW18	GND
1612	623869.017	1910173.785	642.750	PB-BED-MW19	CAS
1613	623866.980	1910173.474	640.190	PB-BED-MW19	GND
1614	612423.248	1922951.545	676.010	PB-BED-MW20	CAS
1615	612421.674	1922950.501	673.250	PB-BED-MW20	GND
1616	626773.634	1917983.404	629.800	REACTOR1	CAS
1617	626773.771	1917983.396	631.890	REACTOR1	GND
1618	626660.982	1918003.256	630.360	REACTOR2	CAS
1619	626661.200	1918003.208	630.400	REACTOR2	GND
1620	626685.067	1918148.350	630.560	REACTOR3	CAS
1621	626685.072	1918148.453	630.410	REACTOR3	GND
1622	626630.217	1918146.484	630.830	REACTOR4	CAS
1623	626630.259	1918146.510	630.440	REACTOR4	GND

EXISTING MONITORING WELLS (NASA PBS COORDINATES)

PT #	Y	X	ELEVATION	WELL	POSITION
1000	32580.157	27844.966	638.050	MK-MW22	CAS
1001	32580.363	27844.337	635.560	MK-MW22	GND
1002	32935.171	29414.244	639.430	MK-MW23	CAS
1003	32934.091	29414.516	636.950	MK-MW23	GND
1004	30493.623	27420.866	657.120	MK-MW24	CAS
1005	30494.707	27420.481	654.440	MK-MW24	GND
1006	32095.231	27479.522	640.180	PB-TNTA-MW10	CAS
1007	32093.121	27478.661	637.500	PB-TNTA-MW10	GND
1008	31733.664	26832.705	640.500	PB-TNTA-MW11	CAS
1009	31731.505	26832.648	937.860	PB-TNTA-MW11	GND
2000	24937.473	22260.669	674.320	MK-MW16	CAS
2001	24938.512	22260.123	671.330	MK-MW16	GND
2002	26671.128	22021.002	664.640	MK-MW17	CAS
2003	26670.709	22019.825	660.970	MK-MW17	GND
3000	29408.697	15531.026	645.410	PB-TNTC-MW3	CAS
3001	29408.888	15532.745	642.570	PB-TNTC-MW3	GND
3002	28334.519	14635.879	654.430	PB-TNTC-MW4	CAS
3003	28332.110	14634.991	651.890	PB-TNTC-MW4	GND
3004	28645.608	15969.988	651.810	PB-TNTC-MW5	CAS
3005	28645.938	15972.137	649.070	PB-TNTC-MW5	GND
3006	28411.461	17171.165	659.400	PB-TNTC-MW6	CAS
3007	28413.029	17169.559	656.820	PB-TNTC-MW6	GND

4000	30428.422	14380.094	639.600	IT-MW002	CAS
4001	30428.083	14379.828	636.690	IT-MW002	GND
4002	30428.335	14379.948	639.630	IT-MW002	MEASU.P
4003	31783.011	14647.261	640.890	MK-MW10	CAS
4004	31784.092	14646.646	638.060	MK-MW10	GND
4005	31783.011	14647.261	637.680	MK-MW11	CAS
4006	31782.648	15926.807	634.710	MK-MW11	GND
4007	30549.503	14060.075	644.430	PB-WA-MW-1	CAS
4008	30549.400	14060.577	642.320	PB-WA-MW-1	GND
4009	30038.273	14301.193	633.650	PB-WA-MW-2	CAS
4010	30038.913	14301.254	631.160	PB-WA-MW-2	GND
5000	33122.354	23074.634	633.990	PB-PR-MW7	CAS
5001	33122.138	23074.690	631.500	PB-PR-MW7	GND
5002	33022.042	23365.050	635.020	PB-PR-MW8	CAS
5003	33022.170	23364.700	632.500	PB-PR-MW8	GND
5004	33229.738	23561.485	633.700	PB-PR-MW9	CAS
5005	33227.194	23564.676	630.700	PB-PR-MW9	GND
5006	33482.754	23520.431	634.990	IT-MW05	CAS
5007	33481.141	23518.725	631.910	IT-MW05	GND
6000	29006.777	16324.772	648.270	PB-BED-MW13	CAS
6001	29004.744	16324.838	645.810	PB-BED-MW13	GND
6002	30640.982	14567.410	646.040	PB-BED-MW14	CAS
6003	30640.673	14564.926	643.050	PB-BED-MW14	GND
6004	34311.288	23307.881	631.630	PB-BED-MW15	CAS
6005	34311.275	23310.104	629.080	PB-BED-MW15	GND
6006	31463.005	24687.792	636.020	PB-BED-MW16	CAS
6007	31461.030	24688.033	633.680	PB-BED-MW16	GND
6008	33666.003	28164.077	629.970	PB-BED-MW17	CAS
6009	33667.915	28164.751	627.340	PB-BED-MW17	GND
6010	32130.350	29563.185	651.500	PB-BED-MW18	CAS
6011	32123.048	29563.003	648.830	PB-BED-MW18	GND
6012	31782.954	14256.584	643.070	PB-BED-MW19	CAS
6013	31780.910	14256.322	640.510	PB-BED-MW19	GND
6014	20646.714	27306.637	676.330	PB-BED-MW20	CAS
6015	20645.115	27305.631	673.570	PB-BED-MW20	GND
6016	34874.615	21994.717	630.120	REACTOR1	CAS
6017	34874.752	21994.706	632.210	REACTOR1	GND
6018	34762.465	22017.272	630.680	REACTOR2	CAS
6019	34762.682	22017.219	630.720	REACTOR2	GND
6020	34790.031	22161.756	630.880	REACTOR3	CAS
6021	34790.039	22161.859	630.730	REACTOR3	GND
6022	34735.148	22161.209	631.150	REACTOR4	CAS
6023	34735.191	22161.233	630.760	REACTOR4	GND

IT (2002)

2001 - PBOW Survey Data
Monitoring Wells, Temporary Piezometers, and Soil Borings

M&S ID#	N (y)	E (x)	Riser Elevation	*Ground Elevation	I.T. DESIGNATION
PMW22	629778.465	1918366.518	629.67	627.22	PB-BED-MW22
PMW23	625837.856	1918150.334	633.71	631.11	PB-BED-MW23
MW24	622916.444	1908168.033	645.98	644.2	PB-BED-MW24
MW25	617820.942	1914457.628	684.59	681.99	PB-BED-MW25
PMW26	613878.45	1920274.330	677.21	674.61	PB-BED-MW26
PMW21	627896.268	1920791.393	627.14**	625.24	PB-BED-MW27
1421	623446.555	1922580.206	638.79	636.99	TNTA-BEDGW-001
GW003	618102.551	1918710.111	683.11	681.34	TNTB-BEDGW-003
GW04a	618468.655	1918572.329	668.63	666.78	TNTB-BEDGW-004
GW02a	620253.524	1912852.629	667.04	664.04	TNTC-BEDGW-001

Elevation of the well indicated by the double asterisk (**), is reported to the lip of the metal casing, the lip being further defined as the rim of the un-hinged portion of the casing when the well is open.

Temporary Piezometer Locations: TNT AREA "A"

M&S ID#	N (y)	E (x)	Ground Elevation	I.T. DESIGNATION
AGW11	622927.387	1923122.509	660.78	PBOW-TNTA-GW11
AGW14	623190.957	1922681.123	651.03	PBOW-TNTA-GW14
AGW17	623355.606	1923280.926	657.67	PBOW-TNTA-GW17
AGW18	623615.678	1922615.978	635.99	PBOW-TNTA-GW18
AGW19	623612.675	1923052.195	640.78	PBOW-TNTA-GW19
AGW20	623518.063	1923277.547	650.07	PBOW-TNTA-GW20
AGW21	623536.519	1923487.366	653.45	PBOW-TNTA-GW21
AGW22	623786.499	1923374.405	636.96	PBOW-TNTA-GW22
AGW23	624594.636	1923848.627	630.05	PBOW-TNTA-GW23
AGW24	624626.183	1924076.124	630.71	PBOW-TNTA-GW24
AGW25	624216.2087	1924365.209	647.27	PBOW-TNTA-GW25
AGW26	624710.322	1925228.323	635.59	PBOW-TNTA-GW26
AGW29	624060.502	1925148.986	651.70	PBOW-TNTA-GW29

Temporary Piezometer Locations: TNT AREA "B"

M&S ID#	N (y)	E (x)	Ground Elevation	I.T. DESIGNATION
GW01	618367.591	1918624.926	666.70	PBOW-TNTB-GW01
GW02a	618188.481	1918855.644	675.42	PBOW-TNTB-GW02
GW003	618102.551	1918710.111	680.81	PBOW-TNTB-GW03
BGW04	617135.012	1918389.937	671.48	PBOW-TNTB-GW04
GW05a	618217.994	1918058.619	668.41	PBOW-TNTB-GW05

Temporary Piezometer Locations: TNT AREA "C"

M&S ID#	N (y)	E (x)	Ground Elevation	I.T. DESIGNATION
CGW11	620331.710	1910550.710	653.83	PBOW-TNTC-GW11
CGW12	620146.522	1910611.696	662.05	PBOW-TNTC-GW12
CGW13	620758.676	1911179.138	646.45	PBOW-TNTC-GW13
CGW14	620274.222	1911096.543	665.86	PBOW-TNTC-GW14
CGW15	620356.049	1911289.110	663.64	PBOW-TNTC-GW15
CGW16	620580.093	1911620.405	652.40	PBOW-TNTC-GW16
CGW17	620595.298	1911806.326	654.39	PBOW-TNTC-GW17
1422	620512.153	1912367.605	656.21	PBOW-TNTC-GW18
1424	620501.150	1912567.123	653.19	PBOW-TNTC-GW19
1427	620516.741	1912868.095	650.61	PBOW-TNTC-GW20
CGW22	620004.907	1910543.651	667.56	PBOW-TNTC-GW22
CGW24	619961.510	1910900.212	673.99	PBOW-TNTC-GW24
CGW29	619944.630	1912604.500	675.09	PBOW-TNTC-GW29
CGW31	619846.540	1913163.050	673.35	PBOW-TNTC-GW31

Soil Borings

M&S ID#	N (y)	E (x)	I.T. DESIGNATION
575	625038.03	1919102.57	PBOW-PRWP-DP03A
583	624840.68	1919354.54	PBOW-PRWP-DP11A
587	625028.14	1919381.06	PBOW-PWRP-DP10A
600	622543.21	1910216.51	PBOW-WRWP-DP13A
619	622546.61	1909995.23	PBOW-WRWP-DP09A
621	622425.11	1910395.07	PBOW-WRWP-DP16A
1069	618043.21	1918673.57	PBOW-TNTB-SS375A
1080	618323.00	1918833.09	PBOW-TNTB-SS295A

M & S CONTROL POINTS USED:

M&S ID#	N (y)	E (x)	ELEV.
68	620384.34	1912011.51	662.63
1137	623519.65	1922494.73	638.67
1139	623137.9	1922479.99	652.75
1305	620363.23	1912296.61	662.99
1310	620524.21	1912187.81	653.25
1423	620366.89	1912542.66	662.89
1425	620319.01	1912809.24	662.82
6	621515.91	1921536 94	
10	620366.08	1921493.74	
55	622733.16	1910235.74	
59	622538.8	1910286.75	
94	624985.39	1919003.31	
95	624663.49	1919144.88	
597	622610.14	1910150.91	
1428	622395.48	1910271.94	
1429	618585.17	1919007.83	

Notes:

[4]Ground Elevation not provided by survey crew. Elevation obtained by subtracting riser height from TOC elevation.

A) SAMPLE STAKES AT NINE PREVIOUS SAMPLE LOCATIONS WERE RECOVERED AND/OR REPLACED BY CONVENTIONAL LAND SURVEYING TECHNIQUES. A TOPCON GTS-303 ELECTRONIC TOTAL STATION WAS USED TO MEASURE ANGLES AND DISTANCES FROM CONTROL POINTS PREVIOUSLY ESTABLISHED BY MURPHY AND SACKS SURVEYORS. WHERE AN EXISTING SAMPLE STAKE WAS NOT RECOVERED, STAKES WERE RESET AT A HORIZONTAL TOLERANCE OF 0.10' +/-.

B) WHERE POSSIBLE, NEW SAMPLE POINTS WERE COLLECTED BY DIRECT STATIC DIFFERENTIAL GPS OBSERVATION USING THREE LEICA SR-261 RECEIVERS. GPS VECTORS WERE ADJUSTED HOLDING FIXED STATION "CLARK" USING LEICA SKI SOFTWARE (VERSION 2.30), PRODUCING A LEAST SQUARES ADJUSTMENTS OF THE WGS 84 POSITIONS. A LOOP OF 5,409 METERS USING THE UNADJUSTED VECTORS PASSING THE FIXED AND DERIVED CONTROL YIELDS A LOOP PRECISION OF 1 PART IN 177,490. COORDINATE VALUES ARE REPORTED IN OHIO STATE PLANE SYSTEM, NORTH ZONE (NAD 1983.) A COMBINED SCALE FACTOR OF 0.9999270034 WAS USED IN THIS CALCULATION. VERTICAL DATUM IS NGVD 1929. VALUES OBTAINED ARE WITHIN THE HORIZONTAL TOLERANCE OF 0.10' +/- AND THE VERTICAL TOLERANCE OF 0.01' +/-.

C) WHEN DIRECT GPS OBSERVATION PROVED IMPOSSIBLE NEW SAMPLE LOCATIONS (M&S ID# 1421, 1422, 1424, 1427) WERE LOCATED BY CONVENTIONAL SURVEY TECHNIQUES AS DESCRIBED IN SECTION "A", ABOVE. VALUES OBTAINED ARE WITHIN THE HORIZONTAL TOLERANCE OF 0.10' +/- AND THE VERTICAL TOLERANCE OF 0.01' +/- .

GPS CONTROL:

MONUMENT "CLARK" WAS ESTABLISHED BY M&S IN 1996 AS A PERMANANT, ON-SITE GPS CONTROL STATION. HORIZONTAL VALUES WERE DERIVED FROM NGS MONUMENT "SKYWAY RM 2" AND VERTICAL VALUES FROM FIRST ORDER CONTROL BENCHMARK J 318 USING A CLOSED, ADJUSTED GPS TRAVERSE. VALUES FOR MONUMENT "CLARK" ARE:

NORTHING (y) 191,029.0899m
EASTING (x) 585,910.9777m
COORDINATE REFERENCE SYSTEM IS NAD 83 (OHIO STATE PLANE NORTH ZONE)
ELLIPSOID ELEVATION 190.6255m (NGVD 29)
REFERENCE ELLIPSOID IS WGS 1984
GEOID HEIGHT -35.1900m
EPOCH IS GEOID 93

APPENDIX I

FRACTURE TRACE ANALYSIS

(Dames & Moore, April 1997b)

J.0 FRACTURE TRACE ANALYSIS

A preliminary fracture trace analysis was performed at the PBS to try to identify optimal locations for installation of wells in the limestone and shale bedrock underlying the site. The geology of the subsurface at the PBS is similar to other locations where fracture trace analysis has been useful in evaluating the occurrence and movement of groundwater. Fracture trace analysis was also felt to be useful in locating zones of preferential flow beneath PBS, and therefore aid in locating future monitoring wells.

J.1 APPLICABILITY OF FRACTURE TRACE ANALYSIS TO PBS SITE

Lattman (1958) defined a fracture trace as follows:

> *A photogeologic fracture trace is a natural linear feature consisting of topographic (including straight stream segments), vegetation, or soil tonal alignments, visible primarily on aerial photographs, and expressed continuously for less than one mile. Only natural linear features not obviously related to the outcrop pattern of tilted beds, lineation and foliation, and stratigraphic contacts are classified as fracture traces.*

The importance of fracture traces to groundwater hydrogeology comes from the observation that these features are often underlain by zones of closely-spaced fractures or faults in the bedrock. These zones are capable of transmitting larger quantities of water than the adjacent less-fractured bedrock, and of localizing groundwater flow.

In typical sedimentary rocks and unconsolidated sediments, groundwater is contained in pore spaces between individual grains. Groundwater movement is controlled by the movement of water within and between pore spaces. Within individual units, aquifers are often considered somewhat homogeneous and isotropic. In carbonates and shales like those that underlie PBS, groundwater occurs along joints, bedding planes, faults or other fracture zones. Groundwater movement is controlled by the distribution, interconnectivity and orientation of the joints, faults, bedding planes and fracture

zones. These fractured aquifers are, therefore, strongly non-homogeneous and anisotropic. Groundwater flow rates along zones of fracture concentration are typically orders of magnitude higher than flow in the surrounding rock. Therefore, the locations of the zones of fracture concentration must be considered when locating monitoring wells and interpreting groundwater flow patterns for a particular region.

Fracture traces are considered to be surface expressions of vertical or near-vertical zones of fracture concentration. They are straight, cut across topography, and often independent of regional structural trends. Typical thicknesses range from 6 to 70 feet (Gold and Parizek, 1976).

The fracture trace technique is basically a method for locating narrow zones of highly fractured rock. It has been very successful in geological settings where solutioned limestones are exposed or have a thin soil mantle. It can also be used in areas of glacial cover, as bedrock fractures tend to be propagated upward through the overburden by means of a complex combination of drainage enhancement, differential settling, and erosion. Fracture trace analysis for water well location is not foolproof. The fracture trace technique is simply a means to maximize the chances of obtaining well yields in the upper end of the range possible for a particular geological and hydrological setting.

The geology in the vicinity of PBS consists of gently dipping carbonate and shale bedrock units overlain by a thin veneer of glacial sediments. Carbonates underlie the northern and western portion of the site, and shales underlie the south and eastern portion of the site. Karst topography has been observed in carbonate bedrock in northern and western Erie county, north and west of PBS. The depth to bedrock ranges from zero to 25 feet.

Groundwater flow in the carbonate and shale bedrock units is probably influenced by joints, faults, bedding planes and other zones of fracture concentration. Identifying these zones of fracture concentration is important in understanding the groundwater flow patterns in the vicinity of the site, and for locating monitoring wells.

The thinness of the glacial covering lends itself to fracture trace analysis. The zones of fracture concentration in the bedrock can be propagated through the thin glacial covering as described above. Fracture trace analysis is both relevant and applicable for the PBS.

J.2 AERIAL PHOTO INTERPRETATION

J.2.1 Aerial Photos Interpreted

Aerial photos at three different scales at PBS have been interpreted for fracture traces. The scales range from the largest scale of 1:6000 to the smallest scale of 1:20400. These photos generally overlap enough so that stereoscope analysis is possible. Table J-1 lists the essential details for three photo sets. The photo sets are named based on their identification numbers printed on each photo in the set.

The recommended scale of aerial photography for fracture trace analysis is 1:20000 (Meiser and Earl, 1982). The aerial photography available for PBS ranges from scales smaller to scales larger than the recommended scale. The photography available also ranges from 1950 to 1988, providing coverage during most of the period of time that PBS was actively in use. The 3823 photo set has significant snow cover in all photos. This snow cover makes photo interpretation for fracture trace analysis more difficult.

J.2.2 Photo Interpretation Methods

Fracture trace analysis was performed for each set of photographs. The procedure used for fracture trace analysis is described below.

1. The photographs were fit together into a photomosaic of the site. A clear plastic overlay was prepared to overlay the photomosaic. A few major road features were transferred to the photomosaic, so the overlay could be oriented over any individual photograph.

TABLE J-1

PBS AERIAL PHOTOGRAPHS

Photo Set	Scale	Date of Photos	Number of Photos	Coverage
PW Set	1:20400 (1" = 1700 ft)	October, 1950	8	All except SE corner
733 Set	1:8400 (1" = 700 ft)	??	7	Only NE portion
3823 Set	1:6000 (1" = 500 ft)	??	61	Entire site

2. The photomosaic was dismantled, and fracture trace analysis was performed using multiple methods. These methods include:

   - Stereoscope Viewing: Most of the fracture traces were identified using a stereoscope. Two photos at a time were used for stereoscopic viewing. The stereoscope was moved over the appropriate portion of the photos, and the linear features noted.

   - Non-stereoscope Viewing: Each photo was also examined individually, without the benefit of the stereoscope. This method was particularly successful in the large scale photographs, because the linear features were generally larger than the field of view of the stereoscope in these photographs. The photographs were examined using both high and low angles, and the photograph was rotated to check all possible orientations.

   - Alternate light sources: For both stereoscope and non-stereoscope viewing, several different light sources were used. Incandescent lighting and daylight were both used for reflected light viewing. Various positions for the light sources were also used. Transmitted light was also used during the non-stereoscope viewing. In some cases, the transmitted light highlighted fracture traces that were difficult to discern using reflected light.

3. For all of the viewing methods, the photographs were directly viewed without the clear overlay. After each fracture trace was identified, the clear plastic overlay was placed on the photo and the linear feature recorded on the overlay. The overlay was then removed, and the search for more linear features continued. This procedure was used to record the location of the linear features without marking or in any other way biasing the photographs. This procedure also allowed all of the linear features for each set of photographs to be recorded on a single integrated overlay. The overlay was used for all photos in the set. For mapping the entire PBS site, this procedure was easier and resulted in less bias than the traditional method of marking the ends of the linear features.

4. For all scales of photographs, only those linear features which had apparently non-human origins were recorded. Mapped linear features included topographic lows, straight segments of streams, vegetation alignments, and soil tonal alignments. No roads, power lines, plow lines, or other clearly man-made features were recorded. In some cases, it was difficult to assess whether some of the features were the result of human activities. In many areas, lines of trees exist, and the origin of these lines are not clearly apparent.

5. In order to synthesize the fracture trace information, the observed fracture traces at the various photo scales were plotted on a common scale. The fracture traces interpreted from each set of aerial photos were transferred to a clear overlay of a USGS quadrangle map of the PBS site (USGS Sandusky and Kimball Quadrangles), at a 1:24000 scale. In order to transfer the fracture traces to the map overlay, the fracture traces were numbered and described. Then the approximate location of each fracture trace was plotted on the map overlay. This process was performed for each set of fracture traces. The locations of the fracture traces plotted on the map overlays are approximate, since many features have changed over time, and several features from the aerial photos are difficult to locate exactly on the map.

J.2.3 Results of Air Photo Interpretation

The PW photo set (1:20400) covers most of the PBS site, except for the extreme southeast portion. This photo set is the closest to the recommended scale for aerial photo analysis. Seventy fracture traces were mapped in and near the PBS site on the PW photo set. Figure J-1 shows the USGS map overlay of the fracture traces mapped in the PW photo set, and Table J-2 lists the corresponding fracture traces. This photo set was taken in October of 1950, and the mapped linear features were identified based on soil tonal alignment, vegetation alignment, and observed depressions. Some linear features were mapped based on straight stream segments.

TABLE J-2

LISTING OF FRACTURE TRACES IN PW AERIAL PHOTO SET

Fracture Trace Number	Approximate Orientation	Photo Evidence	Equivalent Fracture Traces in other Photo	Ground Truth Area	Ground Truth Evidence
PW-1	NE	aqueduct?			
PW-2	NNE	aqueduct?			
PW-3	NE	dark soil tonal alignment	733-1		
PW-4	NW	light soil tonal alignment	733-16	TNTA	man-made
PW-5	NE	dark soil tonal alignment	733-17;3823-4	TNTA	slight depression
PW-6	NW	depression and vegetation alignment		TNTA	no evidence- too wooded
PW-7	NE	soil tonal alignment	733-8	TNTA	no evidence- too wooded
PW-8	NNW	soil tonal alignment	733-7		
PW-9	NNW	light soil tonal alignment	733-10	TNTA	man made
PW-10	E	vegetation alignment	733-9	TNTA	man-made
PW-11	NE	light soil tonal alignment			
PW-12	NE	ditch and soil line			
PW-13	N	vegetation alignment	3823-44		
PW-14	E	vegetation alignment		SRBP	slight depression
PW-15	N	vegetation alignment	3823-38		
PW-16	NE	depression and vegetation alignme	3823-42		
PW-17	NE	soil tonal alignment	3823-36	BW	boundary of plowed field
PW-18	NNW	vegetation alignment			
PW-19	N	light soil tonal alignment			
PW-20	N	light soil tonal alignment			
PW-21	NW	soil tonal alignment		SRBP	slight depression
PW-22	N	light soil tonal alignment		SRBP	no evidence
PW-23	N	vegetation alignment		SRBP	no evidence
PW-24	NE	ditch and soil alignment		TNTB	man made ditch
PW-25	N	vegetation alignment		TNTB	no evidence
PW-26	N	vegetation alignment		TNTB	no evidence
PW-27	NNE	vegetation alignment		TNTB	no evidence
PW-28	NNE	light soil tonal alignment		TNTB	no evidence
PW-29	NW	dark soil tonal alignment	733-26; 3823-15		
PW-30	NEE	vegetation alignment		BW	man made
PW-31	N	dark soil tonal alignment		MTT	no evidence
PW-32	E	vegetation alignment	3823-33		
PW-33	N	soil tonal alignment		MTT	broad depression
PW-34	NE	straight stream segment	733-21; 3823-12		
PW-35	NE	aqueduct?		PR RWP	aqueduct
PW-36	NE	straight stream and light soil align	733-28	PR RWP	aligned ditches
PW-37	NNW	depression		PR RWP	man made
PW-38	E	depression		SA	no evidence
PW-39	NE	soil tonal alignment		PR RWP	good depression
PW-40	N	vegetation alignment		PR RWP	no evidence
PW-41	NE	straight stream segment	733-41		

TABLE J-2

LISTING OF FRACTURE TRACES IN PW AERIAL PHOTO SET

Fracture Trace Number	Approximate Orientation	Photo Evidence	Equivalent Fracture Traces in other Photo	Ground Truth Area	Ground Truth Evidence
PW-42	NNE	straight stream segment			
PW-43	NE	dark soil tonal alignment			
PW-44	NEE	dark soil tonal alignment			
PW-45	NEE	dark soil tonal alignment			
PW-46	NEE	dark soil tonal alignment			
PW-47	NE	dark soil tonal alignment			
PW-48	NNE	dark soil tonal alignment			
PW-49	N	vegetation alignment			
PW-50	E	straight stream segment		WA RWP	man made ditch
PW-51	N	vegetation alignment		TNTC	man made?
PW-52	NW	vegetation alignment		TNTC	man made?
PW-53	NE	vegetation alignment		TNTC	man made?
PW-54	NNE	straight stream segment	3823-53	WA RWP	straight stream
PW-55	NE	soil tonal alignment		WA RWP	broad depression
PW-56	NE	vegetation alignment	3823-55	WP RWP	very slight topography
PW-57	NE	soil tonal alignment			
PW-58	N	soil and vegetation alignment		TNTC	man made?
PW-59	NNW	vegetation alignment and depression		TNTC	man made?
PW-60	NNW	soil tonal alignment		TNTC	man made?
PW-61	NNW	soil tonal alignment		TNTC	no evidence - overgrown
PW-62	N	vegetation alignment			
PW-63	NE	light soil tonal alignment			
PW-64	NW	light soil tonal alignment		TRBP	no evidence
PW-65	NNW	straight stream segment	3823-43	TRBP	no evidence
PW-66	NW	light soil tonal alignment and depression		STT	no evidence
PW-67	NNW	soil tonal alignment		STT	slight depression
PW-68	N	soil tonal alignment	3823-59	STT	no evidence
PW-69	NWW	soil tonal alignment		STT	slight depression
PW-70	NE	soil tonal alignment			

The 733 photo set (1:8400) covers only the northeast portion of the site. Thirty-one fracture traces were mapped in the region covered by the 733 photo set. Table J-3 lists the corresponding fracture traces, as well at their approximate orientations and identifying evidence. The mapped linear features were mainly due to soil tonal and vegetative alignments, as well as straight stream segments.

The 3823 photo set (1:6000) covers the entire site at a large scale using 61 photos. However, significant snow cover exists in the photos. This snow cover prevents mapping fracture traces based on soil tonal alignment, and makes it more difficult to map vegetative alignment. Also, the snow cover makes it much more difficult to evaluate whether the straight line segments are due to human activities. The mapped fracture traces are mainly due to depressions in the snow surface or alignment of large vegetation. Sixty-one fracture traces were mapped. Table J-4 lists the corresponding fracture traces, as well at their approximate orientations and identifying evidence.

Many of the fracture traces mapped in one photo set are different from fracture traces mapped in other photo sets. This phenomenon is expected, since the photos cover different seasons and cover a range of nearly 40 years. Fracture traces that are mapped in more than one set of photos may be a result of strong expression of zones of fracture concentration, or a result of human activities. Table J-5 shows the number of mapped fracture traces that are common between various photo sets. The tables listing the fracture traces for each photo set also contain a column listing the common fracture traces between photo sets.

J.3 FIELD CHECKING OF PHOTO FEATURES

In order to locate wells using the fracture trace technique, it is important to field check the photo evidence. This process is made difficult because there are often several clues of different types which define a fracture trace, and some of the linear features may be due to human activity. The most common land features seen on the ground are topographic lows or depressions, stream alignments, vegetation alignments, and soil tones.

TABLE J-3

LISTING OF FRACTURE TRACES IN 733 AERIAL PHOTO SET

Fracture Trace Number	Approximate Orientation	Photo Evidence	Equivalent Fracture Traces in other Photo	Ground Truth Area	Ground Truth Evidence
733-1	NE	aqueduct?	PW-3		
733-2	NE	soil tone alignment			
733-3	NW	vegetation alignment			
733-4	NE	soil tone alignment			
733-5	NNW	light soil tonal alignment			
733-6	NW	vegetation and dark soil tone			
733-7	NNW	soil tone alignment	PW-8		
733-8	NE	soil tone alignment	PW-7		
733-9	E	soil tonal alignment	PW-10		
733-10	NNW	light tonal alignment	PW-9		
733-11	NE	vegetation alignment			
733-12	NW	light soil tonal alignment	3823-7		
733-13	NE	dark soil tonal alignment			
733-14	NNW	light soil tonal alignment			
733-15	NE	depression and dark soil tone			
733-16	NW	light soil tonal alignment	PW-4		
733-17	NE	light soil tonal alignment	PW-5	TNTA	slight depression
733-18	NE	vegetation and dark soil tone		TNTA	no evidence
733-19	NE	vegetation alignment		TNTA	man-made ditch
733-20	NW	vegetation and dark soil tone		TNTA	broad low depression
733-21	NE	straight stream segment	PW-34		
733-22	NNE	dark soil tonal alignment			
733-23	N	depression			
733-24	NE	straight stream segment	PW-41		
733-25	E	soil tonal alignment			
733-26	NE	dark soil tonal alignment	PW-29		
733-27	NE	aqueduct?	3823-17	PR RWP	aqueduct
733-28	NE	straight stream segment	PW-36		
733-29	ME	aqueduct?	PW-29		
733-30	NNE	topographic line		PR RWP	near power line - no evidence
733-31	NE	vegetation alignment		SA	wide, slight depression

TABLE J-4

LISTING OF FRACTURE TRACES IN 3823 PHOTO SET

Fracture Trace Number	Approximate Orientation	Photo Evidence	Equivalent Fracture Traces in other Photo Sets	Ground Truth Area	Ground Truth Evidence
3823-1	NE	snow tone - depression			
3823-2	NNE	snow tone - depression			
3823-3	NE	high snow mound			
3823-4	NW	vegetation and depression	PW-5		
3823-5	NE	vegetation alignment		TNTA	partially man made, partly natural
3823-6	NW	depression		TNTA	man made ditch
3823-7	NE	dark tree line and depression	733-12		
3823-8	NNW	depression			
3823-9	NNW	tree line		TNTA	no evidence - too wooded
3823-10	E	vegetation and snow tone alignment			
3823-11	NE	snow tone - depression			
3823-12	NE	straight stream segment	PW-34		
3823-13	N	vegetation alignment		PR RWP	tree alignment, no depression
3823-14	E	vegetation alignment			
3823-15	N	vegetation alignment	PW-29		
3823-16	NE	depression and vegetation alignment			
3823-17	NE	snow tone - depression	733-27	SA	aqueduct
3823-18	NNW	depression and vegetation alignment		PWWDB	sharp and marshy depression
3823-19	N	vegetation alignment		PWWDB	shallow depression and marsh
3823-20	N	vegetation alignment			
3823-21	NW	topographic alignment	PW-44		
3823-22	N	topographic alignment			
3823-23	N	depression			
3823-24	NE	depression			
3823-25	N	depression			
3823-26	N	topographic alignment			
3823-27	NNE	topographic alignment			
3823-28	NNE	topographic alignment			
3823-29	NW	depression			
3823-30	NEE	straight stream segment		MTT	man made
3823-31	N	vegetation and topographic alignment			
3823-32	E	depression			
3823-33	N	tree line	PW-32		
3823-34	NE	depression			
3823-35	NE	depression and vegetation alignment			
3823-36	NE	depression and vegetation alignment	PW-17	BW	no evidence - overgrown
3823-37	NNW	tree alignment		BW	man made - old road
3823-38	E	vegetation alignment	PW-15		
3823-39	NE	vegetation alignment			
3823-40	N	depression and snow tone			
3823-41	NE	snow tone			
3823-42	NNE	snow tone line	PW-16		
3823-43	NE	vegetation and topographic alignment	PW-65		

TABLE J-4

LISTING OF FRACTURE TRACES IN 3823 PHOTO SET

Fracture Trace Number	Approximate Orientation	Photo Evidence	Equivalent Fracture Traces in other Photo Sets	Ground Truth Area	Ground Truth Evidence
3823-44	NEE	vegetation alignment	PW-13		
3823-45	NEE	vegetation alignment			
3823-46	NEE	vegetation alignment			
3823-47	NE	depression			
3823-48	NNE	depression and vegetation alignment			
3823-49	N	depression and vegetation alignment		TNTB	broad shallow depression
3823-50	E	vegetation and straight stream segment		TNTB	man made ditch
3823-51	N	depression		TRBP	depression and grass alignment
3823-52	NW	vegetation alignment			
3823-53	NE	straight stream segment	PW-54	WA RWP	straight stream
3823-54	NNE	straight stream segment and depression		WA RWP	segment of Plum Brook- man made?
3823-55	NE	vegetation alignment	PW-56	WA RWP	very slight high and low topography
3823-56	NE	topographic alignment			
3823-57	NE	topographic alignment		TNTC	sharp topographic line, man made ?
3823-58	N	vegetation alignment		G-8 BGA	no evidence-too wooded
3823-59	NNW	vegetation alignment	PW-68		
3823-60	NNW	topographic alignment			
3823-61	NNW	topographic alignment			

TABLE J-5

FRACTURE TRACES COMMON AMONG PHOTO SETS

	PW Set	733 Set	3823 Set
PW Set	70	11	13
733 Set		31	2
3823 Set			61

Since zones of closely spaced fractures are more easily weathered and eroded than surrounding rock, the most common form of ground truth is a linear sag, swale or valley along the fracture zone. Abrupt changes in the courses of streams are often related to region joint sets in bedrock. In carbonate bedrock, it is common to find sinkholes and closed depressions aligned along a zone of fracture concentration.

Vegetation alignments form because the deeper weathering along a fracture zone results in deeper root development along fracture traces. Vegetation along a fracture trace may be larger or more dense than neighboring vegetation. This evidence is often difficult to see at the ground level.

Soil tonal alignments are often easy to see in aerial photos, but much more difficult to discern on the ground. The field of view on the ground is very limited. The amount of sunlight, plant cover, and time since the last rainfall can all effect the usefulness of soil tonal alignments as a tool for ground checking.

At the PBS site, ground checking of the fracture traces was performed on March 13 and 14, 1995. No snow cover was present at the site during the ground checking. Not every fracture trace observed in the aerial photos was checked on the ground. Only those fracture traces situated in areas of the site where monitoring wells are likely to be located were checked. Fracture traces were checked on the ground in 13 general areas. These areas and the corresponding fracture traces that were checked in each area are listed in Table J-6.

The results of field checking of these fracture traces are also included in Tables J-2, J-3, and J-4. If a fracture trace was field checked, the general area in which it is located is listed in the appropriate table. The ground evidence for the fracture trace is also provided. In general, the ground evidence for fracture traces fell into several categories: (1) human activity, (2) no evidence, (3) slight to strong depressions or other evidence. Many of the fracture traces observed in the aerial photos were the result of human activities, and field checking allowed man made features to be easily identified. Twenty of the fracture traces which were field checked were thought to be a result of human activities.

TABLE J-6

FRACTURE TRACES FIELD CHECKED

General Area	Fracture Traces Field Checked
Snake Road Burn Pit (SRBP)	PW-14,21,22,23
Taylor Road Burn Pit (TRBP)	PW-63,64; 3823-51
South Toluene Tank (STT)	PW-66,67,68,70
G-8 Burn Ground Area (G8BG)	3823-57
Sellite Area (SA)	PW-38; 733-27,31; 3823-17
TNT Area A (TNTA)	PW-4,5,6,7,9,10, 29,30; 733-17,18,19,20; 3823-5,6,9
TNT Area B (TNTB)	PW-24,25,26,27,28; 3823-49,50
TNT Area C (TNTC)	PW-51,52,53,58,59,60,61; 3823-57
Middle Toluene Tanks (MTT)	PW-31,33; 3823-30
Pentolite Road Red Water Ponds (PR RWP)	PW-35,36,37,39,40; 733-27,30; 3823-13
Pentolite Waste Water Disposal Basin (PWWDB)	3823-18,19
West Area Red Water Ponds (WARWP)	PW-50,54,55,56; 3823-53,54,55
Background Well Area (BW)	PW-17,30; 3823-36,37,51

For many of the fracture traces observed in the photos, no ground evidence could be found. Many times, the photo evidence was a result of soil tonal alignments, and this evidence could not be seen on the ground. However, a lack of ground confirmation does not rule out the possibility that these fracture traces exist. Soil tonal alignments are very difficult to see on the ground, yet may overly significant zones of fracture concentration. In other cases, the vegetative cover was simply too thick or too wooded to see any evidence of fracture traces. The photos may have been taken when the vegetation was much smaller, and subsequent growth has hidden all ground evidence of these fracture traces.

Depression were observed on the ground for a number of the fracture traces. These features range from very slight depressions of less than a few inches to depressions greater than a foot. The width of the depressions range from several feet to over 20 feet. Some of the depressions were aligned with vegetative evidence. No sinkholes or other evidence of karst topography was observed.

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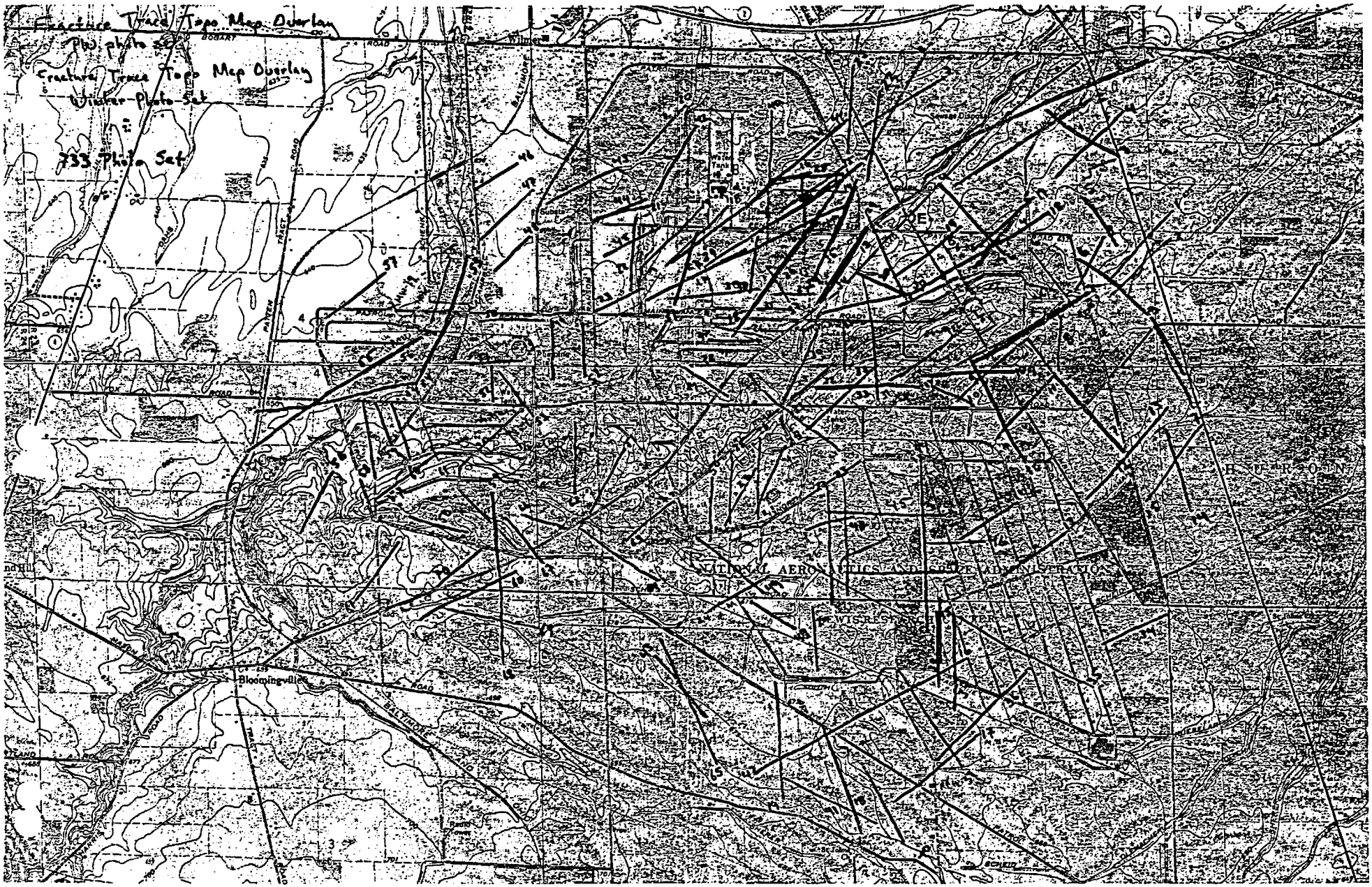
Fracture Trace Topo Map Overlay
PW photo set
Fracture Trace Topo Map Overlay
Wicker Photo Set
733 Photo Set
Bloomingville
BALTIMORE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
WISTRESTANCE TERRA