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Hazardous Materials Technical Center

NAVY ASSESSMENT AND CONTROL OF INSTALLATION POLLUTANTS
CONFIRMATION STUDY FOR SITES 2, 4, 6 AND 10
NAVAL WEAPONS SUPPORT CENTER
CRANE, INDIANA

VOLUME 2 of 3 - APPENDICES

June 1985

Prepared for

Crane Naval Weapons Support Center
Crane, Indiana

Prepared By

Hazardous Materials Technical Center
P.O. Box 8168
Rockville, Maryland 20856-8168

DYNAMAC CORPORATION
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APPENDIX A1

Detailed Logs of Sub-Surface Materials Encountered During Drilling, and the Drilling Techniques Employed at Each Well

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 26 Aug 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 738.66 Boring No. WES-2-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1A	26 Aug	0.0		0.0	0.5	0.0	0.92	3" Shelby Tube	0	Jar	Clay (CL): Brown in color, soft,
1				0.5	1.0	0.92	1.87		0	S.T.	low plasticity, & slight organic
				1.0	1.5				10		matter.
				1.5	2.0				30		Sample length: 1.97 ft
			6.0	2.0	2.5				100		
				0.0	5.0	--------		7" Folding Auger	------		Cleanout
2A	26 Aug	6.0	7.17	5.0	5.5	5.0	6.0	3" Fixed Piston Sampler	0	Jar	Sandy silt (SM) & sandstone frag-
2				5.5	6.0	6.0	6.95		20	S.T.	ments: brown in color, slightly
				6.0	6.5				380		sticky, & contains 25% weathered
				6.5	7.0				700		sandstone. Sandstone is light
				7.0	7.17				800		brown to grey in color, uniform,
											fine-grained, dry, & friable.
											Sample length: 1.95 ft

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Sheet 1 of 2 Sheets

NOTE: Extra jar sample made for NWSC

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-1-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	26 Aug	7.17	11.5	5.0	7.17	----	----	7" Folding Auger	----	----	Cleanout: weathered sandstone starts at 7.17 ft
	26 Aug	11.5	30.0	7.17	30.0	----	----	5-5/8" Rock Bit	----	----	Hard sandstone at 11.5 ft. Water at approximately 20 ft. Cleanout to 10 ft below water, blew hole dry of water & cuttings. Installed well screen.

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Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 26 Aug 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 725.46 Boring No. WES-2-2-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1	26 Aug	0.0		0.0	0.5	0.0	1.65	3" Shelby Tube	40	S.T.	Silt (ML): brown in color, soft,
1A				0.5	1.0	1.65	2.5		75	Jar	slightly sticky, dry, & contains
				1.0	1.5				140		organic matter.
				1.5	2.0				180		Sample length: 2.5 ft
			5.0	2.0	2.5				230		
				0.0	5.0	----	----	7" Folding Auger	----	----	Cleanout
2A	26 Aug	5.0		5.0	5.5	5.0	6.05	3" Fixed Piston Sampler	40	Jar	Silt (ML) & weathered sandstone:
				5.5	6.0				700		brown to brownish white in color
			6.05	6.0	6.05				800		& dry. Sandstone is fine-grained,
											uniform, & friable. Slight dry
											green film found on soil sample.
											Sample length: —
	26 Aug	6.05		5.0	6.1	----	----	5-5/8" Rock Bit	----	----	Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 8 Sheets

NOTE: Extra jar sample made for NWSC

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-2-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	26 Aug	6.05		6.1	6.7	----------	----------	3" Pitcher Sam.	200	--	Fragments of weathered sandstone
											Continued on Eng Form 1836, page 3.
											Will use 4x5-1/2 in. core barrel.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 8 Sheets

Hole No. WES-2-2-81

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION NWSC, Crane, Indiana	SHEET 2 OF 2 SHEETS

1. PROJECT NWSC Groundwater Study	10. SIZE AND TYPE OF BIT 4x5-1/2 in. diamond
2. LOCATION (Coordinates or Station) Rye Burial Grounds	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-2-2-81	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED two
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 26 August 81; COMPLETED 2 September 81
7. THICKNESS OF OVERBURDEN 6.1 ft	17. ELEVATION TOP OF HOLE 725.46 ft
8. DEPTH DRILLED INTO ROCK 48.4 ft	18. TOTAL CORE RECOVERY FOR BORING 87.5%
9. TOTAL DEPTH OF HOLE 54.5 ft	19. SIGNATURE OF INSPECTOR Sept. 13

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
725.46	0.0		See page one for over-burden information.			
724.46	1.0					
723.46	2.0					
722.46	3.0					
721.46	4.0					
720.46	5.0					
719.46	6.0					
718.46	7.0		No recovery— highly weathered sandstone			26 August 1981 Run 1 Begin 3:45 Rec 4.3' End 4:45 Loss 0.8' Time 60 min. Gain- Rest time 50 min Hyd press 100 psi Water press - RQD 70± Drl. Action Smooth Water Ret Brown Remarks
717.46	8.0		½" clay seam-soft			
716.46	9.0		½" clay seam-soft Sandstone	81.4%	--	
715.46	10.0					

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PROJECT | HOLE NO.

Hole No. [illegible]

DRILLING LOG	DIVISION	INSTALLATION	SHEET [illegible] OF [illegible] SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
715.46	10.0		Sandstone: see below			
714.46	11.0		Run 1			
713.46	12.0		closed break Sandstone interbedded with seams of clay, siltstone, limonite, lignite, and peat. Core ranges in color from shades of brown, orange and red to various shades of grey. Grain size is uniform and ranges from very fine to fine with quartz grains predominating. Material is dry, friable, and weathered. Bedding is distinct with thickness ranging from [illegible] in. to 8 in. maximum.			27 August 1981 WL - Run 2 Began 9:15 Rec 3.65' End 10:20 Loss - Time 65 min Gain - Drl time 40 min Hyd press 100-120 psi Water press - RPM 75± Drl Action Smooth Water rot Brown
712.46	13.0					
711.46	14.0					Bit blocked off.
710.46	15.0			100%	--	
			Run 2			
709.46	16.0		fractured			WL - Run 3 Began 10:40 Rec 4.15' End 11:10 Loss - Time 30 min Gain - Drl time 30 min Hyd press 100-200 psi Water press - RPM 75± Drl Action Smooth Water rot Brown Remarks -
708.46	17.0		Sandstone: same	100%	--	
707.46	18.0		closed break			
706.46	19.0					
			Run 3			
705.46	20.0		No recovery			

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PROJECT | HOLE NO.

Hole No. #55-2-2-51

DRILLING LOG	DIVISION	INSTALLATION	SHEET 5 OF 6 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED — COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
705.46	20.0		Run 4			WL - Run 4 Began 12:05 Rec 0.0' End 12:30 Loss 0.6' Time 25 min Gain - Drl time 25 min Hyd press 100-120 psi Water press - RPM 50 ± Drl Action Smooth Water ret -
704.46	21.0		No recovery			
703.46	22.0			62.0%	--	Remarks Bit blocked off.
			-fractured siltsone Siltstone: brown, dry, and breaks very easily.			
702.46	23.0					WL - Run 5 Began 12:50 Rec 3.1' End 1:45 Loss 1.9' Time 55 min Gain - Drl time 50 min Hyd press 100-200 psi Water press - RPM 50-75 ± Drl Action Semi-rough Water ret -
701.46	24.0		Sandstone with lignite: same			
700.46	25.0		Run 5			Remarks -
			-fractured Run 6	100.0%	--	
699.46	26.0		Limonite with pyrite and chalcopyrite: red, blue, black in color, very hard, and has high specific gravity.			WL - Run 6 Began 2:05 Rec ≈0.6' End 2:30 Loss - Time 25 min Gain - Drl time 20 min Hyd press 200 psi Water press - RPM 50 ± Drl Action Rough Water ret -
			No recovery	0.0%	--	
698.46	27.0		Run 7			Remarks -
697.46	28.0		fractured sandstone and clay	69.0%	--	WL - Run 7 Began 2:50 Rec 0.0' End 3:15 Loss 1.6' Time 25 min Gain - Drl time 15 min Hyd press 200 psi Water press - RPM 50 ± Drl Action Rough Water ret -
696.46	29.0		Sandstone: same			
695.46	30.0		Run 8			Remarks: Bit blocked off

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

Hole No. WES-2-2-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 6 OF 8 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED / COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
675.46	50.0		Shale(70%) with interbedded sandstone(30%)			WL- Run 14 Began 2:00 Rec 4.5' End 3:40 Loss 1.0' Time 90 min Gain - Drl time 90 min Hyd press 300 psi Water press - RPM 70 Drl Action Smooth Water retBrown Remarks-
674.46	51.0		0.15 ft dark grey shale			
			Shale: green in color, uniform, brittle, and soft.			
673.46	52.0			81.8%	--	
			Highly fractured - possibly mechanical/ machine fractured.			
672.46	53.0					
			Run 14 Recovered core to approximately 53.5 ft.			
671.46	54.0		End depth is 54.5 ft			
670.46	55.0		Blew hole dry of all water. Ran air for approximately one hour to remove water. Will monitor in morning to see if water is coming in. Water level rose to 43.0 ft overnight. Blew hole and installed well screen.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PROJECT HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 3 Sep 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 720.02 Boring No. WES-2-3-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1	3 Sep	0.0		0.0	0.5	0.0	1.15	3" Shelby Tube	0	S.T.	Clay (CL): Brown in color, dry,
1A				0.5	1.0	1.15	1.45		20	Jar	crumbles easily, & contains frag-
				1.0	1.5				150		ments of weathered sandstone.
				1.5	2.0				300		Sample length: 1.45 ft
			2.5	2.0	2.5				350		Tube damaged in push.
				0.0	5.0	----------		7" Folding Auger	----------		Cleanout: assumed change at 2.5'
2A	3 Sep	2.5	5.65	50.	5.65	5.0	5.65	3" Pitcher Sampler	700	Jar	Clayey sand (SC) & fragments of
											sandstone: brown in color, dry,
											friable, uniform, & very fine-grained.
	3 Sep			5.0	66.2	----------		5-5/8" Rock Bit	----------		Cleanout: possible moisture at
											19.4 ft. Drilling indicates 0.2
											to 0.4 ft cavity at this depth.
											Checked hole for water and negative
											results. Removed small root from rock bit.

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NOTE: Extra jar sample made for NWSC

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-3-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
		5.65	43.7								Sandstone: brown, fine-grained
		43.7	54.7								Shale: grey/green color
		54.7	64.2								Sandstone: red/purple, fine-grained
											Limestone: grey, very hard
		64.2	66.2								
											Water level overnight rose to
											55.8 ft. Suspect water coming in
											at 54.7 ft. Blew hole dry and in-
											stalled well screen.

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Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 4 Sep 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 716.66 Boring No. WES-2-4-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1	4 Sep	0.0		0.0	0.5	0.0	2.2	3" Shelby Tube	20	S.T.	Silt (ML): brown to grey, no
1A				0.5	1.0	2.2	2.5		20	Jar	cohesion, dry, very uniform in
				1.0	1.5				70		grain size, texture, & composition
				1.5	2.0				150		Sample length: 2.5 ft
			3.75	2.0	2.5				300		
				0.0	5.0	----------		7" Folding Auger	----	----	Cleanout
2A	4 Sep	3.75		5.0	5.5	5.0	5.65	3" Fixed Piston Samp.	150	Jar	Silt (ML) & fragments of sand-
			5.65	5.5	5.65				700		stone: silt is same as above.
											Sandstone is friable, fine-
											grained, light brown in color.
	4 Sep	5.65	41.5	5.0	31.0	----------		5-5/8" Rock Bit	----	----	Sandstone: brown & fine-grained
	5 Sep	41.5	43.0	31.0	50.5	----------		5-5/8" Rock Bit	----	----	Shale: green, soft & weathered
		43.0	50.5								Shale: green & hard

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Sheet 1 of 2 Sheets

NOTE: Extra jar sample made for NWSC

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-4-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
											Encountered water at 40.5 ft.
											Drilled 10.0 ft below water.
											Blew cuttings & water from hole.
											Installed well screen.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 5 Sep 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 739.24 Boring No. WES-2-5-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1	5 Sep	0.0		0.0	0.5	0.0	1.55	3" Shelby Tube	20	S.T.	Clay (CL): brown in color, soft,
1A				0.5	1.0	1.55	1.90		20	Jar	dry, moderately cohesive, & con-
				1.0	1.5				50		tains organic matter.
				1.5	2.0				150		Sample length: 1.9 ft
				2.0	2.5				300		
				0.0	5.0	----	----	7" Folding Auger	----	----	Cleanout
2	5 Sep			5.0	5.5	5.0	6.1	3" Fixed Piston Sam.	100	S.T.	Clay (CL) & sandstone: clay same
2A				5.5	6.0	6.1	6.45		350	Jar	as above. Sandstone is red in
			6.45	6.0	6.45				750		color, very friable, & fine-grained.
											Sample length: 1.45 ft
	5 Sep	6.45	28.0	5.0	68.8	----	----	5-5/8" Rock Bit	----	----	Sandstone: red to brown, fine-
		28.0	68.8								grained. Alternating small seams
											of sandstone, shale, & limestone.
											Slightly moist at 30 ft but no water.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED Sheet 1 of 2 Sheets

NOTE: Extra jar sample was made for NWSC

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-5-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
											Water level rose overnight to
											55.8 ft. Blew hole of water &
											cuttings. Installed well screen.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 23 Sep 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 736.58 Boring No. WES-2-6-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1	23 Sep	0.0		0.0	0.5	0.0	2.2	3" Shelby Tube	0	S.T.	Clay (CL) - brown to grey in color
1A				0.5	1.0	2.2	2.45		0	Jar	dry, little cohesion, material
				1.0	1.5				10		disturbed by dozer.
				1.5	2.0				100		Sample length: 2.45 ft
				2.0	2.5				140		
1B	23 Sep			0.0	5.0	0.0	5.0	7" Folding Auger	--	Jar	Cleanout: Sample for NWSC -
											material same as above
2	23 Sep			5.0	5.5	5.0	6.33	3" Fixed Piston Sam.	0	S.T.	Clay (CL): same as above.
2A				5.5	6.0	6.33	6.55		20	Jar	Sample length: 1.55 ft
				6.0	6.55				550		
2B	23 Sep		9.0	5.0	9.0	5.0	9.0	7" Folding Auger		Jar	Cleanout: Sample for NWSC -
											material same as above

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Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-6-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	23 Sep	9.0	64.0	9.0	50.0	----	----	5-5/8" Rock Bit	----	----	Sandstone & interbedded shale: weathered, brown & dark grey in color, soft spot at 37 ft.
											Monitored hole for water at 50 ft for 40 min. & negative results.
	23 Sep	64.0	70.63	50.0	70.63	----	----	5-5/8" Rock Bit	----	----	Continued drilling & between 55 & 60 ft encountered water. Shale: dark grey

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 24 Sep 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 728.73 Boring No. WES-2-7-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont	CLASSIFICATION AND REMARKS
1	24 Sep	0.0		0.0	0.5	0.0	2.0	3" Shelby Tube	0	S.T.	Sandy silt (SM): brown, dry, hard,
1A				0.5	1.0	2.0	2.15		0	Jar	& contains 5% very fine gravel.
				1.0	1.5				0		Possible dozer fill.
				1.5	2.0				20		Sample length: 2.15 ft
			4.0	2.0	2.5				100		
1B	24 Sep			0.0	5.0	0.0	5.0	7" Folding Auger		Jar	Cleanout: Material same as above.
											Sample for NWSC.
	24 Sep	4.0	9.0	5.0	40.0	----------	----------	5-5/8" Rock Bit	----------	----------	Sandstone: brown, weathered
		9.0	51.2								Sandstone & interbedded dark grey
											shale. Sandstone is brown, tan,
											grey & white, hardness varies from
											soft to very hard.
											Slight damp area at 31.3 ft. Drilled
											to 40 ft and monitored hole for
											60 min. with negative results.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-7-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
	24 Sep	51.2	57.3	40.0	57.3	----------		5-5/8" Rock Bit	-------		Water at approximately 46 ft.
											Material changes to dark grey
											shale with interbedded sandstone
											at 51.2 ft.
											Blew hole of water & cuttings.
											Installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 25 Sep 81
Location Dye Burial Grounds Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 730.29 Boring No. WES-2-8-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press.	Cont.	CLASSIFICATION AND REMARKS
1	25 Sep	0.0		0.0	0.5	0.0	2.25	3" Shelby Tube	0	S.T.	Silty clay (CL): light brown-brown
1A				0.5	1.0	2.25	2.45		0	Jar	in color, dry, moderate cohesion,
				1.0	1.5				0		uniform, slightly stiff.
				1.5	2.0				40		Sample length: 2.45 ft
				2.0	2.5				60		
1B	25 Sep			0.0	5.0	0.0	5.0	7" Folding Auger		Jar	Cleanout: Sample for NWSC -
											material same as above.
2	25 Sep			5.0	5.5	5.0	6.69	3" Fixed Piston Sam.	0	S.T.	Silty clay (CL): lt. brown to
2A				5.5	6.0	6.69	6.84		10	Jar	brown, dry, stiff, moderate co-
				6.0	6.5				180		hesion, uniform.
				6.5	6.84				800		Sample length: 1.84 ft
1B	25 Sep		6.84	5.0	6.84	5.0	6.84	7" Folding Auger		Jar	Cleanout: sample for NWSC -
											material same as above

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-2-8-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	25 Sep	6.84	58.0	6.84	40.0	----	----	5-5/8" Rock Bit	----	----	Sandstone & interbedded dark grey shale: sandstone varies from white, grey, brown to reddish brown. From 30 to 35.7 ft soft and slightly damp. Monitored for water at 40 ft for 40 min. & negative results.
	25 Sep	58.0	60.1	40.0	60.1	----	----	5-5/8" Rock Bit	----	----	Shale: dark grey

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 9 Sept. 1981
Location McComish Gorge Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 603.49 Boring No. WES-4-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	9 Sept	0.0		0.0	0.5	0.0	2.08	3" Shelby Tube	0	ST	Silt (ML): brown in color, slightly
1A				0.5	1.0	2.08	2.23		0	Jar	moist, little cohesion, slight
				1.0	1.5				0		gritty feal, and contains organic
				1.5	2.0				20		matter.
				2.0	2.5				120		Sample length; 2.23 ft
			5.0	0.0	5.0			7" Folding Auger			Cleanout
2	9 Sept	5.0		5.0	5.5	5.0	6.55	*3"Fixed Piston Sampler	0	ST	Silty sand (SM): reddish brown in
2A				5.5	6.0	6.55	6.75		0	Jar	color, very uniform, fine-grained,
				6.0	6.5				0		little cohesion, and dry.
				6.5	7.0				20		
				7.0	7.4				80		Sample length; 1.75 ft
				5.0	70.0			*7" Hollow-stem Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

*3" Fixed Piston Sampler = 3" F.P.S.
*7" Hollow Stem Auger = 7" H.S. Auger

Sheet 1 of 5 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3	9 Sept			10.0	10.5	10.0	10.3	3" F.P.S.	0	ST	Silty sand (SM): reddish brown in
3A				10.5	11.0	10.3	10.6		20	Jar	color, uniform, fine-grained (pre-
				11.0	11.5				40		dominately quartz), little cohesion,
				11.5	12.0				50		and dry.
				12.0	12.5				700		Sample length: 0.6 ft- Sample fell
											back into hole.
			14.0	70.0	15.0	—	—	7" H.S. Auger		—	Cleanout: assumed stratum change.
4	9 Sept	14.0		15.0	15.5	15.0	16.97	3" F.P.S.	0	ST	Gravelly sand (SP): reddish brown
4A				15.5	16.0	16.97	17.20		20	Jar	in color, fine to coarse-grained
				16.0	16.5				80		sand, very fine gravel, slightly
				16.5	17.0				120		moist, and no cohesion.
				17.0	17.5				140		Sample length: 2.2 ft
			19.0	15.0	20.0	—	—	7" H.S. Auger		—	Cleanout: assumed stratum change.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 5 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
5	9 Sept	19.0		20.0	20.5	20.0	22.05	3" F.P.S	0	ST	Sand (SP): brown in color, fine
5A				20.5	21.0	22.05	22.3		10	Jar	to medium grained, slight moisture,
				21.0	21.5				30		very little cohesion, and 80-90%
				21.5	22.0				60		quartz sand.
				22.0	22.5				90		Sample length: 2.3 ft
			24.0	20.0	25.0			7" H.S. Auger			Cleanout: assumed stratum change
6	9 Sept	24.0		25.0	25.5	25.0	27.08	3" F.P.S.	0	ST	Silty sand (SM): brown in color,
				25.5	26.0	27.08	27.3		50	Jar	fine-grained, slight moisture, little
				26.0	26.5				100		cohesion, and contains 30% silt.
				26.5	27.0				160		
				27.0	27.5				180		Sample length: 2.3 ft
			30.0	25.0	30.0			7" H.S. Auger			Cleanout: assumed stratum change

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 5 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
7A	9 Sept	30.0		30.0	30.5	30.0	30.3	3" F.P.S.	0	Jar	Recovered 0.3 ft of very moist
				30.5	31.0				10		sand/silt: brown in color, very
				31.0	31.5				20		fine-grained, and slight cohesion.
				31.5	32.0				50		Will attempt again at 32.5 ft.
				32.0	32.5				80		
				30.0	32.5			7" H.S. Auger			Cleanout
8	9 Sept			32.5	33.0	32.5	33.3	3" F.P.S.	0	ST	Silt (ML): very moist, brown in
8A				33.0	33.5	33.3	33.6'		20	Jar	color, moderately cohesive, and
				33.5	34.0				30		contains 1-2% very fine gravel.
				34.0	34.5				40		Sample length: 1.1 ft
				34.5	35.0				80		Lost 1.4 ft
			37.5	32.5	37.5			7" H.S. Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 4 of 5 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
9	9 Sept	37.5		37.5	38.0	37.5	39.55	3" F.P.S.	0		Clay silt: grey in color, moist
9A				38.0	38.5	39.55	39.8		40		and moderately cohesive.
				38.5	39.0				190		
				39.0	39.5				230		Sample length: 2.3 ft
				39.5	39.85				300		
				37.5	40.0			7" H.S. Auger			Cleanout
10	10Sept			40.3	40.8	40.3	42.48	3" F.P.S.	0	ST	Clay silt; same moist
10A				40.8	41.3	42.48	42.63		0	Jar	
				41.3	41.8				0		
				41.8	42.3				10		Sample length: 2.33 ft
			42.7	42.3	42.7				20		
	10Sept										Pulled auger and installed well
											screen.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 5 of 5 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 10 Sept. 1981
Location McComish Gorge Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 585.69 Boring No. WES-4-2-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	10Sept	0.0		0.0	0.5	0.0	1.27	3"Shelby Tube	280	ST	Gravelly sand (SP): brown in
1A				0.5	1.0	1.27	1.47		240	Jar	color, dry, fine to coarse
				1.0	1.5				300		grained with 20% fine to medium
				1.5	2.0				330		gravel, and no cohesion.
				2.0	2.5				350		Sample length: 1.47 ft
				0.0	5.0			7" Folding Auger			Cleanout
2	10Sept			*5.0	5.5	5.0	5.9	*3"Fixed Piston Sampler	0	ST	Gravelly sand (SP): brown in
2A				5.5	6.0	5.9	6.1		20	Jar	color, dry, fine to medium
				6.0	6.5				40		grained with 10% fine gravel and
				6.5	7.0				60		little cohesion.
											Sample length: 1.1 ft- suspect
											loss
			8.0	5.0	10.0			*7"Hollow Stem Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

*3" Fixed Piston Sampler = 3" F.P.S.
*7" Hollow Stem Auger = 7" H.S. Auger

Sheet 1 of 4 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-2-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3	10Sept	8.0		10.0	10.5	10.0	11.97	3" F.P.S.	12	ST	Silty sand (SM): brown in color
3A				10.5	11.0	11.97	12.23		20	Jar	slight moisture, and slight
				11.0	11.5				30		cohesion.
				11.5	12.0				90		Last foot is fine-grained,
				12.0	12.5				150		Sample length: 2.23 ft
				70.0	15.0			7" H.S. Auger			Cleanout
4	11Sept		15.0	15.0	15.5	15.0	16.60	3" F.P.S.	0	ST	Clay silt (ML): brown in color,
4A		15.0		15.5	16.0	16.60	16.85		20	Jar	moderately cohesive, and slight
				16.0	16.5				40		moisture. Lost last 0.4 ft
				16.5	17.0				100		Sample length: 1.85 ft
				17.0	17.5				180		
				15.0	20.0			7" H.S. Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 4 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-2-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
	11Sept			20.0	20.5	See below		3" F.P.S.	20		Lost sample.
				20.5	21.0				20		
				21.0	21.5				50		
				21.5	22.0				70		
				22.0	22.5				130		
5A	11Sept			20.0	21.5	20.0	21.5	Standard Splitspoon	—	Jar	Pushed splitspoon-clay silt (ML)
											brown in color, moderately
											cohesive, and moist. Water was
											visible in bottom of hole.
			22.0	20.0	25.0	—	—	7" H.S. Auger	—		Cleanout: stratum change assumed
6	11Sept	22.0		20.0	25.5	25.0	27.05	3" F.P.S.	0	ST	Silty sand (SM): grey in color,
6A				25.5	26.0	27.05	27.35		10	Jar	very fine-grained sand, uniform,
				26.0	26.5				50		moderately cohesive, and moist.
				26.5	27.0				100		Sample length: 2.35 ft

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

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BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No. _____
Boring No. WES-4-2-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
				27.0	27.4				160		
				25.0	30.0			7" H.S. Auger			Cleanout
7	11Sept			30.0	30.5	30.0	32.05	3" F.P.S.	10	ST	Silty sand (SM): brown in color,
7A				30.5	31.0	32.05	32.35		20	Jar	very fine-grained, moderate
				31.0	31.5				80		cohesion, and moist.
				31.5	32.0				120		Sample length: 2.35 ft
			32.4	32.0	32.4				170		
											Left hole open overnight to
											monitor water level. Water on
											12 Sept. 81, was at 19.9 ft.
											Installed well through auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 4 of 4 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 12 Sept, 1981
Location McComish Gorge Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 566.22 Boring No. WES-4-3-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press Wt. Kelly	Cont	CLASSIFICATION AND REMARKS
1	12Sept	0.0		0.0	0.5	0.0	2.08	3" Shelby Tube		ST	Silty sand (SM): brown in color,
1A				0.5	1.0	2.08	2.28		0	Jar	damp, fine-grained, and moderate
				1.0	1.5				20		cohesion. Sand equals 60 to 70%
				1.5	2.0				60		and silt equals 30 to 40%.
				2.0	2.5				120		Sample length: 2.28 ft
			4.5	0.0	5.0			7" Folding Auger			Cleanout
2	12Sept	4.5		5.0	5.5	5.0	7.13	*3"Fixed Piston Sampler	0	ST	Silty sand (SM): grey in color,
2A				5.5	6.0	7.13	7.38		10	Jar	damp to moist, fine-grained, and
				6.0	6.5				20		moderate cohesion. Sand equals
				6.5	7.0				20		60%-70% and silt equals 30%-40%.
				7.0	7.5				20		Believe water starts at 5.5 ft.
											Sample length: 2.38 ft
				5.0	10.0			*7" Hollow Stem Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

*3" Fixed Piston Sampler = 3" F.P.S.
*7" Hollow Stem Auger = 7" H.S. Auger

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-3-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3	12Sept			10.0	10.5	10.0	12.3	3" F.P.S	0	ST	Silty sand (SM): same as in no.2
3				10.5	11.0	11.83	12.13		10	Jar	except for more moisture.
				11.0	11.5				50		
				11.5	12.0				120		Sample length: 2.28 ft
				12.0	12.4				160		
			15.0	10.0	15.0	—	—	7" H.S, Auger		—	Cleanout
											When pulling weight out of hollow
											stem auger, acted as piston and
											sucked sand in behind. Cleaned
											out several times with same result.
											Used splitspoon to get sample of
											material and confirm if sample
											was wet.
4A	12Sept	15.00	17.0	15.0	17.0	15.0	17.0	*Splitspoon			Silty sand (SM): grey in color,
											saturated, and fine-grained.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED *Splitspoon = 1-7/8" I.D. x 2 1/2" O.D. Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-3-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
											Installed well through auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 28 Sept. 1981
Location McComish Gorge Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 593.14 Boring No. WES-4-4-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
1	28Sept	0.0		0.0	0.5	0.0	2.26	3" Shelby Tube	0	ST	Clay (CL): brown in color, dry,
1A				0.5	1.0	2.26	2.45		0	Jar	uniform, slightly stiff, with
				1.0	1.5				0		slight to moderate cohesion,
				1.5	2.0				0		Sample length: 2.45 ft
				2.0	2.5				10		
				0.0	5.0			7"Folding Auger			Cleanout
2	28Sept			5.0	5.5	5.0	6.64	*3"Fixed Piston Sampler	0	ST	Clay (CL): same as above.
				5.5	6.0	6.64	6.82		20	Jar	
				6.0	6.5				90		Sample length: 1.82 ft
				6.5	7.0				130		
				7.0	7.35				200		
			10.0	5.0	10.00			*7"Hollow Stem Auger			Cleanout: stratum change assumed

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

*3" Fixed Piston Sampler = 3" F.P.S.
*7" Hollow Stem Auger = 7" H.S. Auger

Sheet 1 of 4 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-4-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
3	28Sept	10.0		10.0	10.5	10.0	12.19	3" F.P.S	0	ST	Silt (ML): brown, uniform, dry,
3A				10.5	11.0	12.19	12.36		0	Jar	and slight cohesion.
				11.0	11.5				140		Sample length: 2.36 ft
				11.5	12.0				160		
				12.0	12.38				210		
			13.5	10.0	15.0			7" H.S. Auger			Cleanout
4	28Sept	13.5		15.0	15.5	15.0	16.7	3" F,P.S.	0	ST	Sand (SP): reddish brown in
				15.5	16.0	16.7	17.0		10	Jar	color, dry, fine-grained, and
				16.0	16.5				20		no cohesion.
				16.5	17.0				60		Sample length: 2.00 ft
				17.0	17.5				90		
				15.0	20.0			7" H.S. Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 4 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No. _____
Boring No. WES-4-4-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
5	28Sept			20.0	20.5	20.0	22.08	3" F.P.S.	0	ST	Sand (SP): brown in color, fine-
5A				20.5	21.0	22.08	22.4		0	Jar	grained, dry, and very uniform
				21.0	20.5				0		quartz sand.
				20.5	22.0				10		Sample length: 2.35 ft
				22.0	22.4				120		
				20.0	25.0			7" H.S. Auger			Cleanout
6				25.0	25.5	25.0	26.50	3" F.P.S.	0	ST	Sand (SP): brown in color, very
6A	28Sept			25.5	26.0	26.50	26.80		0	Jar	fine-grained, wet, and uniform.
				26.0	26.5				10		Water in hollow stem auger at
				26.5	27.0				30		26.89 ft.
				27.0	27.41				70		Sample length: 1.8 ft
				25.0	30.0			7" H.S. Auger			Cleanout: when pulling plug
											from auger, sand came in.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 4 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-4-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
7	28Sept			27.8	28.3	27.8	29.90	3" F.P.S.	0	ST	Sand (SP): brown, fine-grained,
				28.3	28.8	29.90	30.40		0	Jar	and wet.
				28.8	29.3				0		Sample length: 2.40 ft
				29.3	29.8				0		
				29.8	30.3				40		
				30.0	35.0			7" H.S. Auger			Cleanout
8	28Sept		36.25	35.0	35.5	35.0	37.05	3" F.P.S.	30	ST	Clay (CL): grey in color, soft,
8A		36.25		35.5	36.0	37.05	37.30		70	Jar	very uniform in texture, and
				36.0	36.5				100		uniform consistency.
				36.5	37.0				120		Sample length: 2.30 ft
			37.4	37.0	37.4				120		
											Installed well through auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 4 of 4 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 30 Sept. 1981
Location McComish Gorge Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 573.39 Boring No. WES-4-5-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	30Sept	0.0		0.0	0.5	0.0	1.8	3" Shelby Tube	0	ST	Sandy clay (CL): brown in color,
1A				0.5	1.0	1.8	1.95		0	Jar	moderate cohesion, soft, and
				1.0	1.5				0		contains 20-30% fine-grained sand.
				1.5	2.0				10		Sample length: 1.95 ft
				2.0	2.55				10		
				0.0	5.0			7" Folding Auger			Cleanout
2	30Sept			5.0	5.5	5.0	6.36	*3"Fixed Piston Sampler	0	ST	Sandy clay (CL): brown in color,
				5.5	6.0	6.36	6.56		0	Jar	moderate cohesion, soft, and con-
				6.0	6.5				0		tains 40% fine to coarse-grained
				6.5	7.0				0		sand.
				7.0	7.41				10		Sample length: 1.56 ft
			7.5	5.0	70.0			*7" Hollow Stem Auger			Cleanout

*3" Fixed Piston Sampler = 3" F.P.S.
*7" Hollow Stem Auger = 7" H.S. Auger

Sheet 1 of 3 Sheets

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-5-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3	30Sept	7.5		10.0	10.5	10.0	11.10	3" F.P.S.	0	ST	Silty sand (SM): dark grey to
3A				10.5	11.0	11.10	11.70		0	Jar	black in color, wet, slight cohesion,
				11.0	11.5				0		and trace of odor (organic/oily).
				11.5	12.0				10		Sample length: 2.21 ft
				12.0	12.42				10		Water at 9.5 ft after 30 min
			13.5	10.0	15.0			7" H.S. Auger			Cleanout: material came in when
											pulling plug from auger.
		13.5		14.3	14.8	14.3	16.0	3" F.P.S.	80	ST	Sandy gravel (GW): grey in color,
				14.8	15.3	16.0	16.35		110	Jar	wet, coarse sand (30%) and fine
				15.3	15.8				115		to medium angular to rounded,
				15.8	16.3				130		unsorted gravel.
			15.0	16.3	16.71				130		Sample length: 2.35 ft
				15.0	20.0			7" H.S. Auger			Cleanout: material came in when
											pulling plug from auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-5-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
5	30Sept	15.0		18.6	19.1	18.6	20.05	3" F.P.S.	70	ST	Silty sand (SM): grey in color,
5A				19.1	19.6	20.05	20.35		210	Jar	wet, no cohesion, and uniform.
				19.6	20.1				220		Sample length: 1.75 ft
				20.1	20.6				380		
			20.91	20.6	20.91				450		
											Installed well through auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 8 Oct. 1981
Location McComish Gorge Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 579.54 Boring No. WES-4-6-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	8 Oct	0.0		0.0	0.5	0.0	2.14	3" Shelby Tube	0	ST	Sand (SP): reddish brown in color,
1A				0.5	1.0	2.14	2.36		0	Jar	slight cohesion, dry, uniform, and
				1.0	1.5				0		fine-grained.
				1.5	2.0				50		Sample length: 2.36 ft
				2.0	2.5				140		
				0.0	5.0			7" Folding Auger			Cleanout
2	8 Oct			5.0	5.5	5.0	7.08	*3"Fixed Piston Sampler	0	ST	Sand (SP): brown in color, slight
2A				5.5	6.0	7.08	7.34		0	Jar	cohesion, dry, uniform, and fine
				6.0	6.5				0		to medium (10-15%) grained.
				6.5	7.0				0		Sample length: 2.34 ft
			10.0	7.0	7.4				0		
				5.0	10.0			*7" Hollow Stem Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

*3" Fixed Piston Sampler = 3" F.P.S.
*7" Hollow Stem Auger = 7" H.S. Auger

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-6-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3	8 Oct	10.0		10.0	10.5	10.0	11.71	3" F.P.S.	0	ST	Silty sand (SM): brown in color,
3A				10.5	11.0	11.71	12.31		0	Jar	very fine-grained, uniform, slightly
				11.0	11.5				0		damp, and little cohesion.
				11.5	12.0				0		Sample length: 2.31 ft
				12.0	12.4				0		
				10.0	15.0			7" H.S. Auger			Cleanout
4	8 Oct			15.0	15.5	15.0	17.17	3" F.P.S.	0	ST	Silty sand (SM): brown in color,
4A				15.5	16.0	17.17	17.38		0	Jar	very fine-grained, moist, uniform,
				16.0	16.5		Water	at 17.35	0		and slight cohesion,
				16.5	17.0				0		Sample length: 2.38 ft
				17.0	17.38				0		
				15.0	20.0			7" H.S. Auger			Cleanout: material came in when
											pulling plug from auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-4-6-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
5	8 Oct			19.5	20.0	19.5	20.35	3" F.P.S.	0	ST	Silty sand (SM): same as in pre-
5A				20.0	20.5	20.35	20.6		0	Jar	vious sample-moist.
				20.5	21.0				0		Sample length: 1.1 ft
				21.0	21.5				0		
				21.5	21.9				0		
				20.0	25.0			7" H.S. Auger			Cleanout: material came in when
											pulling plug from auger.
6	8 Oct			24.2	24.7	24.2	26.36	3" F.P.S.	0	ST	Silty sand (SM): brown to grey in
6A				24.7	25.2	26.36	26.56		20	Jar	color, fine-grained, slight cohesion,
				25.2	25.7				50		uniform, and damp.
				25.7	26.2				100		Sample length: 2.36 ft
			26.59	26.2	26.59				130		
											Installed well through auger.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 17 Sept, 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 682.63 Boring No. WES-6-1A-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	17Sept	0.0		0.0	0.5	0.0	2.17	3" Shelby Tube	0	ST	Clay (CL): brown to grey in color,
1A				0.5	1.0	2.17	2.32		0	Jar	dry, moderate, cohesion, and uniform
				1.0	1.5				80		organic matter first foot.
				1.5	2.0				250		
				2.0	2.5				480		Sample length: 2.32 ft
				0.0	5.0			7" Folding Auger			Cleanout
2	17Sept			5.0	5.5	5.0	6.21	3"Fixed Piston Sampler		ST	Clay (CL): orange brown in color,
2A				5.5	6.0	6.21	6.36			Jar	dry, stiff, hard, and contains
				6.0	6.5						5-10% very fine, angular to rounded
				6.5	7.0						gravel.
				7.0	7.5						Sample length: 1.36 ft
			8.3	5.0	8.30			7"Hollow Stem Auger			Cleanout: bedrock at 8.3 ft,
		8.3	19.0	8.30	19.0			5 5/8" Rock Bit			Sandstone: reddish color and fine-grained. Water around 9 ft.

Sheet 1 of 1 Sheets

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BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 6 Nov. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 683.27 Boring No. WES-6-1B-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	6 Nov	0.0		0.0	2.5	0.0	1.14	3" Shelby Tube		ST	Clay (CL): brown in color, very
1A						1.14	1.27			Jar	stiff, dry, and low plasticity.
											Sample length: 1.27 ft
				0.0	5.0			7" Solid Auger			Cleanout
2			7.0	5.0	7.0	5.0	6.14	3"Fixed Piston Sampler		ST	Sandy clay (CL): brown in color,
2A						6.14	6.29			Jar	very stiff, dry, and low plasticity.
											Sample length: 1.27 ft
	6 Nov	7.0	8.6	5.0	29.0			5 5/8" Rock Bit			Clay/shale: reddish brown
		8.6	12.6								Sandstone: light grey and hard
		12.6	13.2								Shale: brown
		13.2	14.0								Shale: grey
		14.0	15.2								Sandstone: reddish brown
		15.2	15.6								Shale: light grey
		15.6	16.3								Sandstone: light grey

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-1B-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		16.3	20.5								Shale: grey and hard
		20.5	24.5								Sandstone: light grey, very hard,
											and fine-grained.
		24.5	28.0								Sandstone: light grey and extremely
											hard.
		28.0	31.0								Shale: dark grey
	6 Nov			29.7	29.0	—	—	5 5/8" Rock	Bit	—	No water untill 29.3 ft (very slow).
											Drilled to 39.0 and will leave
											open overnight.
	7 Nov										Water at 8:05 a.m. 34.65 ft.
				39.0	44.7	—	—	5 5/8" Rock	Bit	—	Drilled 10 ft below water.
		31.0	44.7								Sandstone: brown and fine-grained.
											Installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 11 Nov. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 682.60 Boring No. WES-6-1C-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	11 Nov	0.0		0.0	0.5	0.0	1.34	3" Shelby Tube	0	ST	Sandy clay (CL): brown in color,
1A				0.5	1.0	1.34	1.51		40	Jar	dry, soft, and slight cohesion.
				1.0	1.5				140		
				1.5	2 0				280		Sample length: 1.51 ft
				2.0	2.5				320		
			4.0	0.0	5.0			7" Folding Auger			Cleanout: assumed stratum change
2	11 Nov	4.0		5.0	5.5	5.0	6.25	3"Fixed Piston Sampler	0	ST	Clay (CH): brown in color, dry,
2A				5.5	6.0	6.25	6.40		0	Jar	very stiff, hard, and high plasti-
				6.0	6.5				20		city.
				6.5	7.0				180		Sample length: 1.40 ft
			7.5	7.0	7.31				320		
		7.5	8.2	5.0	8.3			7" Folding Auger			Sand and weathered sandstone;
											brown and fine-grained
		8.2	8.3								Sand and weathered sandstone:

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Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-1C-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
											light grey and fine-grained.
	11 Nov	8.3	10.0	8.3	38.0	—	—	5 5/8" Rock	Bit	—	Sandstone: brown and fine-grained.
		10.0	12.3								Sandstone: grey with grey shale
											lenses
		12.3	12.5								Sandstone: dark brown
		12.5	15.1								Sandstone: brown
		15.1	17.2								Sandstone: brown with grey shale
											lenses
		17.2	23.7								Sandstone: soft, brown, and weathered
		23.7	27.8								Sandstone: hard and brown
		27.8	31.4								Shale and sandstone lenses
		31.4	35.7								Sandstone: brown and soft
		35.7	38.1								Sandstone: hard
	12 Nov										Water overnight at 9:20 a.m. at
											36.52 ft, water at 2:10 p.m. at
											36.20 ft. Blew wells 6-1A and

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No. _____
Boring No. WES-6-1C-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	18 Nov			0.0	38.1			1 3/4" Rock	Bit		6-1B with air to see if there was any communication between these borings and 6-1C. No communications was noticeable. Allowed hole to set untill 19 Nov. 1981, Jetted well several times and each time its making water.

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Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 18 Sept. 1981
Location Demolition Area Job No. 141-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 637.53 Boring No. WES-6-2-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
1	18Sept	0.0		0.0	0.5	0.0	1.58	3" Shelby Tube	0	ST	Clay (CL): brown in color, soft,
1A				0.5	1.0	1.58	1.78		0	Jar	little cohesion, uniform, slightly
				1.0	1.5				0		damp, and organic matter,
				1.5	2.0				0		Sample length: 1.78 ft
				2.0	2.5				20		
				0.0	5.0	—	—	7" Solid Auger		—	Cleanout
2A	18Sept		5.38	5.0	5.38			3"Fixed Piston Sampler	800	Jar	Clay (CL) and sandstone fragments:
											same as above
	19Sept			5.4	—			4 x 5-1/2"Core Barrel			See page two for log of core.

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Sheet 1 of 5 Sheets

Hole No. WES-6-2-81

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION Crane, IN	SHEET 2 OF 5 SHEETS

1. PROJECT NWSC Groundwater Study	10. SIZE AND TYPE OF BIT 4 x 5-1/2' Diamond bit
2. LOCATION (Coordinates or Station) Demolition Area	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-6-2-81	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED two
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 18 Sept. 81; COMPLETED 21 Sept. 81
7. THICKNESS OF OVERBURDEN 5.38 ft	17. ELEVATION TOP OF HOLE 657.53
8. DEPTH DRILLED INTO ROCK 33.62 ft	18. TOTAL CORE RECOVERY FOR BORING 93.4 %
9. TOTAL DEPTH OF HOLE 39.0 ft	19. SIGNATURE OF INSPECTOR Joseph B. Dunbar

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
632.53	5.0		See page one for overburden information.			
631.53	6.0		No recovery			
630.53	7.0					19 Sept.81 WL - Run 1 Began 8:10 Rec 2.8' End 9:05 Loss 2 2' Time 55 min Gain - Drl time 55 min Hyd press 150psi Water press - RPM 75 Drl Action Smooth Water ret -
629.53	8.0		Sandstone: brown, fine-grained, weathered, and friable. fractured			
628.53	9.0		Clay shale: grey and soft. closed			Remarks Used air
627.53	10.0		Shale: dark grey to brown, soft, and dry. Run 1	56%	-	
626.53	11.0		Shale: dark grey to black and highly organic			
625.53	12.0		Sandstone and interbedded Shale: sandstone is brown in color, fine-grained, moderately friable, and weathered. Shale averages around 20% of interval and thickness 1/16-1/4 in. with frequency increasing with depth.			WL - Run 2 Began 9:20 Rec 4.65' End 10:45 Loss - Time 25 min Gain - Drl time 25 min Hyd press 100-150psi Water press - RPM - Drl Action Smooth Water ret -
624.53	13.0		closed			Remarks -
623.53	14.0		Shale: dark grey in color, soft, organic, slightly moist, and weathered.			
622.53	15.0			100%	-	

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PROJECT | HOLE NO.

Hole No. WES-6-2-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
622.53	15.0		Run 2			
			Sandstone and interbedded shale: sandstone is grey to brown and moderately hard. Shale runs at 15% and is grey to dark grey in color.			
621.53	16.0					AL - Run 3 Began 11:05 Rec 4.8 End 11:50 Loss - Time 45 min Gain - Drl time 45 min Hyd press 150psi Water press - RPM 50-75 Drl Action Smooth Water ret - Remarks -
620.53	17.0		Shale: black and soft			
			closed			
619.53	18.0					
			Sandstone: light grey to brown, fine-grained, and moderately hard.			
618.53	19.0		recemented breaks-iron			
			Run 3	100%	-	
617.53	20.0					
616.53	21.0		1/4 in. black shale			
			1/4 in. black shale			AL - Run 4 Began 12:40 Rec 4.7 End 1:30 Loss - Time 50 min Gain - Drl time 50 min Hyd press 100-150psi Water press - RPM 50-75 Drl Action Smooth Water ret - Remarks -
			Sandstone: grey to brown, fine-grained, and moderately hard to hard. Run contains 1-5% shale. Oxidized from 21.5-22.0 and 23.5-24.1 ft.			
615.53	22.0					
614.53	23.0		1/4 in. black shale			
			Shale seams in fractured sandstone			
613.53	24.0					
			Run 4	100%	-	
612.53	25.0					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

Hole No. WES-6-2-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 4 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
612.53	25.0					
611.53	26.0		1/2 in. black shale 3/4 in. black shale			AL - Run 5 Began 1:50 Rec 4.8 End - 2:25 Loss - Time 35 min Gain - Drl time 35 min Hyd press 150psi Water press - RPM 50-75 Drl Action Smooth Water ret -
610.53	27.0		closed			
609.53	28.0		Sandstone: grey in color, fine-grained, moderately hard, and interbedded with 10-20% black shale ranging in thickness from 1/8-3/4 in.			Remarks Water in hole at 29 ft
608.53	29.0		Run 5	100%	-	
607.53	30.0					
606.53	31.0		Sandstone: same-oxidized from 29.3-30.5 ft 1/4 in. shale			AL - Run 6 Began 2.50 Rec 5.1 End 3:24 Loss - Time 34 min Gain - Drl time 34 min Hyd press 150psi Water press - RPM 50-75 Drl Action Smooth Water ret - Remarks -
605.53	32.0		1/4 in. shale			
604.53	33.0		ripple marks			
603.53	34.0		Run 6	100%	-	
602.53	35.0		Sandstone and shale: closed			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

Hole No. WES-6-2-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 5 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED — COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
602.53	35.0					
601.53	36.0		Sandstone (50%) and shale (50%): sandstone is fine-grained, grey to dark grey and hard; shale is black and contains sand. Thickness ranges from 1/8 to 1-1/2 in. and averages runs 1-in.			AL - Run 7 Began 3:50 Rec 4.6 End 4:50 Loss - Time 60 min Gain - Drl time 55 min Hyd press 150 Water press - RPM 50-75 Drl Action Smooth Water ret - Remarks -
600.53	37.0					
	38.0		Shale: black, soft, uniform and slakes on drying.			
	39.0		Run 7	100%	-	
			Installed well on 21 Sept. 81			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 21 Sept. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 659.77 Boring No. WES-6-3-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	21Sept	0.0		0.0	0.5	0.0	1.74	3" Shelby Tube	0	ST	Clay (CL): dark brown in color,
1A				0.5	1.0	1.74	1.94		10	Jar	uniform, slight cohesion, organic
				1.0	1.5				50		matter, and very slight moisture.
				1.5	2.0				120		Sample length: 1.94 ft
			4.0	2.0	2.5				150		
				0.0	5.0	—	—	7" Folding Auger	—		Cleanout
2	21Sept	4.0	5.3	5.0	5.3	5.0	5.3	3"Fixed Piston Sampler	800	Jar	Sandy clay (CL): light brown in
											color, very stiff, dry, and contains
											10-20% sand.
	21Sept	5.3	8.0	5.3	20.3	—	—	5 5/8" Rock Bit	—		Cleanout: at 8.0 ft rock is harder,
											less weathered. Moisture between
											10-11 ft
		8.0	18.0								Sandstone
		18.0	20.3								Shale

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-3-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
	21Sept										Water at 10.6 ft at 9:01 a.m.
											Blew hole and installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 1 Oct. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 632.89 Boring No. WES-6-4-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	1 Oct	0.0		0.0	0.5	0.0	1.46	3" Shelby Tube	40	ST	Gravelly clay (CL): brown in color,
1A				0.5	1.0	1.46	1.66		40	Jar	soft to slightly stiff, and dry.
				1.0	1.5				60		Gravel is fine-grained, friable
				1.5	2.0				80		sandstone.
				2.0	2.5				100		Sample length: 1.66 ft
			4.8	0.0	4.8	—	—	7" Solid Auger	—		Cleanout: bedrock at 4.8 ft
	2 Oct	4.8	6.5	4.8	30.0	—	—	5 5/8" Rock Bit	—		Weathered sandstone and clay: brown
		6.5	23.0								Sandstone and shale: light grey
											to green in color, and moderately
											hard
		23.0	26.0								Sandstone: greenish grey and hard
		26.0	27.8								Shale: hard and green
		27.8	30.0								Sandstone: hard and light grey
											Water at 19.5 ft

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 1 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 2 Oct. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 607.89 Boring No. WES-6-5-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	2 Oct	0.0		0.0	0.5	0.0	1.8	3" Shelby Tube	100	ST	Clay (CL): brown to reddish brown
1A				0.5	1.0	1.8	2.0		100	Jar	in color, soft to moderately stiff,
				1.0	1.5				160		dry, and contains 20-25% fine gravel.
				1.5	2.0				220		
				2.0	2.5				220		Sample length: 2.00 ft
			6.5	0.0	5.0	—	—	7" Solid Auger		—	Cleanout: assumed stratum change
2	3 Oct	6.5		5.0	5.5	5.0	6.85	3"Fixed Piston Sampler	160	ST	Clay shale: brown to grey, soft,
2A				5.5	6.0	6.85	7.05		220	Jar	and dry.
				6.0	6.5				240		
				6.5	7.0				260		Sample length: 2.05 ft
				7.0	7.5				300		
			11.5	7.5	27.0	—	—	5 5/8" Rock Bit		—	Clay shale: see above
		11.5	13.0								Shale: red in color
		13.0	27.0								Shale: grey in color and harder

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-5-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
											at 26 ft.
											Hole making water at fairly good
											rate between 16.5 and 17.0 ft.
											Blew hole and installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 13 Oct. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 672.06 Boring No. WES-6-6-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	13Oct	0.0		0.0	0.5	0.0	1.41	3" Shelby Tube	200	ST	Clay (CL): brown in color, very
1A				0.5	1.0	1.41	1.58		160	Jar	stiff, dry, variable composition,
				1.0	1.5			"	240		and thinly bedded.
				1.5	2.0			"	300		
				2.0	2.5				460		Sample length: 1.58 ft
				0.0	5.0	—	—	7" Solid Auger	—		Cleanout
2	13Oct			5.0	5.5	5.0	6.27	*3"Fixed Piston Sampler	-160	ST	Clay (CL): same as above except
2A				5.5	6.0	6.27	6.45		240	Jar	not as stiff.
				6.0	6.5				300		
				6.5	7.0				400		
				7.0	7.5				500		Sample length: 1.45 ft
			9.0	5.0	10.0	—	—	7" Solid Auger	—		Cleanout: assumed stratum change

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

*3" Fixed Piston Sampler = 3" F.P.S Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-6-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3	13Oct	9.0		10.0	10.5	10.0	11.30	3" F.P.S.	200	ST	Shale: brown and dark grey, dry,
3A				10.5	11.0	11.30	11.45		340	Jar	stiff, varied composition, and
			11.8	11.0	11.5				500		varied texture.
											Sample length: 1.45 ft
	13Oct	11.8	14.0	11.8	60.0			5 5/8" Rock	Bit		Shale: grey and medium hard
		14.0	15.2								Shale: brown and medium hard
		15.2	16.8								Shale: reddish brown and medium hard
		16.8	26.6								Shale: greyish brown and medium hard
		26.6	27.3								Coal: black and medium to hard
		27.3	36.0								Shale: grey and soft
		36.0	37.2								Shale: brown
		37.2	38.0								Shale: grey
		38.0	41.0								Sandstone: grey and hard
		41.0	42.2								Shale: grey and medium hard
		42.2	46.3								Sandstone: brown and medium hard

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-6-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
		46.3	48.7								Sandstone: grey and hard
		48.7	51.0								Sandstone: light grey-grey and
											medium hard
		51.0	62.3								Shale: grey
	14Oct			60.0	62.3			5 5/8" Rock	Bit	—	Water level rose to 50.5 ft over-
											night. M-scope wouldn't give
											reading, water level measured on
											drill rods and estimate 2 ft
											displacement. Set well after
											blowing hole.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 14 Oct. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator A. McNamara Surface El 660.92 Boring No. WES-6-7-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	14Oct	0.0		0.0	0.5	0.0	2.22	3" Shelby Tube	20	ST	Clay (CL): brown in color, soft
1A				0.5	1.0	2.22	2.40		100	Jar	to slightly stiff, dry, and low
				1.0	1.5				250		plasticity- fill material
				1.5	2.0				300		Sample length: 2.40 ft
			4.5	2.0	2.5				300		
				0.0	5.0	—	—	7" Folding Auger	—		Cleanout
2	14Oct	4.5		5.0	5.5	5.0	6.45	*3"Fixed Piston Sampler	0	ST	Sandy clay (CL): orange brown in
2A				5.5	6.0	6.45	6.65		80	Jar	color, dry, variable composition,
				6.0	6.5				500		and contains 10-20% fine-grained
				6.5	7.0				550		sand. Possible black powder
			7.5	7.0	7.38				—		intermixed in sample.
											Sample length: 1.65 ft- chucks
											slipped
		7.5	10.0	5.0	10.0	—	—	7" Folding Auger	—		Cleanout: clay and weathered sandstone.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED *3" Fixed Piston Sampler = 3"F.P.S. Sheet 1 of 4 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-7-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
3A	14Oct	10.0		10.0	10.5	10.0	10.5	3"F.P.S.	700	Jar	Sandstone: grey brown in color,
											dry, weathered, and very fine-
											grained.
				10.7	——			4 x 5-1/2"Core Barrel			See page 3 (Engineer Form 1836)
											for log of core.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 4 Sheets

Hole No. WES-6-7-81

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION Crane, IN	SHEET 3 OF 4 SHEETS

1. PROJECT NWSC Groundwater Study	10. SIZE AND TYPE OF BIT 4 x 5 1/2' Diamond bit
2. LOCATION (Coordinates or Station) Demolition Area	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-6-7-81	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED three; UNDISTURBED two
5. NAME OF DRILLER A. McNamara	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 14 Oct. 81; COMPLETED 15 Oct. 81
7. THICKNESS OF OVERBURDEN 10.0 ft	17. ELEVATION TOP OF HOLE 660.92
8. DEPTH DRILLED INTO ROCK 19.15 ft	18. TOTAL CORE RECOVERY FOR BORING 100%
9. TOTAL DEPTH OF HOLE 29.15 ft	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
650.92	10.0		See pages 1 and 2 for			
649.92	11.0		Sandstone: brown to orange brown in color, fine-grained quartz and miscellaneous sand, weathered, dry, thinly bedded, and friable.			14 Oct. 81 WL - Began 2:05 End 3:00 Time 55 min Drl time 55 min Hyd press 100psi Water press - RPM 50+ Drl Action Smooth ~~Water~~ rot Reddish brown and grey Remarks Cored with air Run 1 Rec 4.15' Loss - Gain -
648.92	12.0		~ fractured			
647.92	13.0		Shale: black, dry, soft, and uniform, except for small, irregular seams and lenses of yellow, dry, and earthy oxidation product or precipitate.			
			~ fractured			
646.92	14.0					
			Run 1	100%	-	
645.92	15.0		Shale: same as above			
644.92	16.0		~ closed			WL - Began 3:45 End 4:50 Time 65 min Drl time 65 min Hyd press - Water press RPM 50-60+ Drl Action Smooth ~~Water~~ rot Dark black/dark grey Remarks Cored with air. Water began bubbling in at bottom of run. Checked water level 15 Oct. 81, at 8:00 and read 15.56 ft. Run 2 Rec 4.75 Loss - Gain -
643.92	17.0			100%	-	
642.92	18.0		Coal: black in color, brilliant luster, brittle, soft, and jointed with irregular pattern. From 17.9-18.1 ft, slight, earthy, orange brown crust. From 18.6-19.0 ft, material is more shale like in nature and softer.			
641.92	19.0					
			Run 2			
640.92	20.0		Shaley sandstone			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

Hole No. WES-6-7-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 4 OF 4 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
2. LOCATION (Coordinates or Station)	12. MANUFACTURER'S DESIGNATION OF DRILL
3. DRILLING AGENCY	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
4. HOLE NO. (As shown on drawing title and file number)	14. TOTAL NUMBER CORE BOXES
5. NAME OF DRILLER	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
640.92	20.0		From 20-20.5 ft, soft, black shale.			15 Oct, 81
639.92	21.0		Shaley sandstone: light to dark grey in color, moderately hard, very fine-grained, and contains 30-40% interbedded dark grey shale. Sandstone and shale is interbedded in irregular seams, lenses, and thin beds.			WL - Run 3 Began 9:30 Rec 0.0' End 9:45 Loss 0.8' Time 15 min Gain - Drl time 15 min Hyd press 100psi Water press - RPM 50 Drl Action Smooth Water ret Black Remarks Blocked off
638.92	22.0					
637.92	23.0					
636.92	24.0		Run 4	118%	-	WL - Run 4 Began 10:08 Rec 4.55' End 11:33 Loss - Time 85 min Gain 0.8 Drl time 85 min Hyd press 100psi Water press - RPM 50-70 Drl Action Smooth Water ret Black-dark grey Remarks -
635.92	25.0					
634.92	26.0		coal (1/4-1/2 in.)			
			shale (1/2 in.)			
633.92	27.0					
632.92	28.0		Shaley sandstone and interbedded shale: 20-30% shale 70-80% sandstone			WL - Run 5 Began 12:18 Rec 5.05 End 2:00 Loss - Time 102 min Gain - Drl time 102 min Hyd press 100psi Water press - RPM 50 Drl Action Smooth Water ret Black Remarks -
631.92	29.0		Run 5	100%	-	
			Cleaned mud and cuttings from hole with water. Jetted hole of water and installed well screen.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 14 Oct, 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 638.72 Boring No. WES-6-8-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	14Oct	0.0		0.0	0.5	0.0	1.55	3" Shelby Tube	80	ST	Clay (CL): brown in color, soft,
1A				0.5	1.0	1.55	1.75		100	Jar	low plasticity, and uniform.
				1.0	1.5				120		Material is fill from dozer.
				1.5	2.0				120		Sample length: 1.75 ft
			4.2	2.0	2.5				140		
				0.0	5.0			7" Solid Auger			Cleanout
2	14Oct	4.2		5.0	5.5	5.0	5.99	3"Fixed Piston Sampler	700	ST	Sandstone: brown in color, weathered,
2A				5.5	6.0	5.99	6.19		400	Jar	very fine-grained, crumbles easily,
											and dry.
			6.3	6.0					700		Sample length: 1.19 ft
	14Oct	6.3	8.4	6.3	20.0			5 5/8" Rock Bit			Sandstone: weathered and brown
		8.4	9.2								Shale: reddish grey and soft
		9.2	11.4								Sandstone: grey
		11.4	17.3								Shale: grey and hard

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-8-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
	15Oct	17.3	27.5	20.0	27.5	—	—	5 5/8" Rock	Bit	—	Shale; dark grey and hard
											Encountered water around 17.5 ft.
											Drilled to 27.5 ft. Water came up
											overnight to depth of 8 ft (reading
											taken on 15 Oct. 81 at 8:10 a.m.
											Blew hole and installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 16 Oct, 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 631.04 Boring No. WES-6-9-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1A		0.0		0.0	0.5	0.0	1.7	3" Shelby Tube	260	Jar	Sand (SP) and sandstone fragments:
				0.5	1.0				500		brown in color, dry, fine-grained
				1.0	1.5				700		quartz sand, and uniform. Tube
			1.7	1.5	1.7				700		was damaged in push.
		1.7	3.2	0.0	39.7			5 5/8" Rock Bit			Sandstone: brown and weathered
		3.2	6.6								Clay shale: brown
		6.6	7.5								Shale: grey
		7.5	8.6								Sandstone
		8.6	17.9								Shale: changing often from brown,
											to red, and to grey.
		17.9	19.7								Sandstone: rust colored
		19.7	23.2								Shale: grey
		23.2	24.2								Sandstone: brown
		24.2	25.0								Shale: grey
		25.0	27.5								Sandstone: brown

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-9-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
		27.5	39.7								Shale: grey
											Water at 29 ft. Installed well
											after blowing hole.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 17 Oct. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator A. McNamara Surface El 659.10 Boring No. WES-6-10-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	17Oct	0.0		0.0	0.5	0.0	2.08	3" Shelby Tube	0	ST	Clay (CL): brown in color, dry,
1A				0.5	1.0	2.08	2.28		0	Jar	no cohesion, and organic matter.
				1.0	1.5				0		Material is fill from dozer.
				1.5	2.0				20		Sample length: 2.28 ft
			4.0	2.0	2.5				40		
				0.0	5.0	—	—	7" Folding Auger	—		Cleanout: fill ends at 4.0 ft
2	17Oct	4.0		5.0	5.5	5.0	6.99	3"Fixed Piston Sampler	40	ST	Clay (C): grey brown in color,
2A				5.5	6.0	6.99	7.14		100	Jar	uniform, stiff, dry, and high plas-
				6.0	6.5				150		ticity.
				6.5	7.0				250		Sample length: 2.14 ft
				7.0	7.35				400		
				5.0	10.0	—	—	7" Folding Auger	—		Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED 3" Fixed Piston Sampler = 3" F.P.S. Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-10-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
3	17 Oct			10.0	10.5	10.0	11.49	3" F.P.S.	0	ST	Clay (CH); dark grey brown in color,
3A				10.5	11.0	11.49	11.68		20	Jar	dry, stiff, uniform, and high plas-
				11.0	11.5				50		ticity.
				11.5	12.0				400		Sample length: 1.68 ft
				12.0	12.40				500		
			13.34	10.0	15.0			7" Folding Auger			Cleanout; assumed stratum change
4A	17 Oct	13.34	15.5	15.0	15.5	15.0	15.5	3" F.P.S.	700	Jar	Sandy shale: brownish dark grey
											in color, dry, and stiff to hard.
	17 Oct	15.5	20.0	15.0	32.7			5 5/8" Rock Bit			Shale: brown to dark grey
		20.0	22.0								Coal: black- water at 22 ft
		22.0	32.7								Shale and interbedded sandstone
											Blew hole dry and installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 17 Oct. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 657.43 Boring No. WES-6-11-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	17Oct	0.0		0.0	0.5	0.0	2.39	3" Shelby Tube	50	ST	Sandy silt (SM): brown in color,
1A				0.5	1.0	2.39	2.62		75	Jar	dry, no cohesion, and contains 5-10%
				1.0	1.5				120		sandstone and limonite gravel.
				1.5	2.0				140		
			3.5	2.0	2.62				160		Sample length: 2.62 ft
				0.0	5.0			7" Solid Auger			Cleanout
2	17Oct	3.5	6.0	5.0	5.5	5.0	5.71	3"Fixed Piston Sampler	100	ST	Clay (CL) and shale: brown in color,
2A				5.5	5.9	5.71	5.90		500	Jar	low plasticity, dry, and contains
											30% hard shale fragments.
	17Oct	6.0	7.8	5.0	30.5			5 5/8" Rock Bit			Shale: grey
		7.8	8.5								Coal: black
		8.5	10.5								Shale: brown and grey mixed
		10.5	15.3								Shale: light brown

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-11-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
		15.3	16.0								Limestone: light grey
		16.0	17.0								Shale: grey
		17.0	22.2								Shale: dark grey with water between
											20-20.5 ft
		22.2	23.0								Sandstone: brown and hard
		23.0	27.0								Shale: hard and grey
		27.0	27.8								Sandstone: hard
		27.8	30.5								Shale: grey
											Blew hole dry and installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 3 Nov. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 667.28 Boring No. WES-6-12-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
		0.0		0.0	1.1						Disturbed when setting up rig.
			1.5								Clay (CH): brown, soft, and slight
											moisture
1	3 Nov	1.5	2.8	1.1	3.6	1.10	2.20	3"Shelby Tube		ST	Clay (CH): brick red in color, dry,
1A						2.20	2.35			Jar	uniform, stiff, and high plasticity.
		2.8	3.1			Pressure gauge is broken					Sandy clay (CL): brown in color,
											dry, stiff, and brittle.
											Sample length: 1.25 ft
				0.0	5.0			7" Solid Auger			Cleanout
2	3 Nov	3.1	7.6	5.0	6.7	5.0	6.01	3"Fixed Piston Sampler		ST	Clay shale: brown to grey brown in
						6.01	6.15			Jar	color, dry, and stiff.
											Sample length: 1.15 ft

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-12-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	3 Nov	7.6	8.3	5.0	45.4			5 5/8" Rock	Bit		Coal; black
		8.3	12.0								Sandstone: light grey and medium
											hard
		12.0	16.3								Shale: dark grey
		16.3	26.0								Sandstone: light brown
		26.0	27.3								Shale: dark grey and hard
		27.3	28.5								Sandstone: brown
		28.5	31.8								Shale: dark grey
		31.8	34.5								Sandstone: grey and hard
		34.5	37.0								Shale: light grey
		37.0	41.8			Slight moisture at 37 ft					Sandstone: light grey
		41.8	51.7								Shale: grey
	4 Nov			45.4	51.7			5 5/8" Rock	Bit		Water came up to depth of 41.5 ft
											overnight. Drilled to 51.7 ft and
											set well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 5 Nov. 1981
Location Demolition Area Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator D. Taylor Surface El 660.41 Boring No. WES-6-13-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	5 Nov	0.0	3.7	0.0	2.5	0.0	1.29	3"Shelby Tube		ST	Clay (CL): reddish brown in color,
1A						1.29	1.44			Jar	slightly moist, stiff, and low
											plasticity.
											Sample length: 1.44 ft
2	5 Nov	3.7	5.7	0.0	5.0	3.7	5.0	7" Solid Auger		Jar	Clay shale: dark black in color,
											soft, dry, and highly organic.
		5.7	8.0	5.0	52.0	—	—	5 5/8" Rock Bit		—	Shale: mixture of grey and brown
		8.0	13.3								Shale: grey and soft
		13.3	14.4								Shale: brown and soft
		14.4	16.1								Sandstone: grey and hard
		16.1	18.2								Sandstone: brown
		18.2	23.7								Shale: grey and hard
		23.7	24.8								Sandstone: light grey
		24.8	27.7								Shale: grey and hard
		27.7	31.8								Sandstone: grey and hard

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-13-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
		31.8	32.3								Sandstone: brown
		32.3	35.7								Sandstone: grey and hard
		35.7	50.2								Shale: dark grey and hard
		50.2	52.0								Sandstone: light grey and hard
											Water at 40.5 ft coming in very
											slow. Installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 27 Oct. 1981
Location Old Rifle Range Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 505.06 Boring No. WES-6-14-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	27Oct	0.0		0.0	0.5	0.0	1.61	3" Shelby Tube	0	ST	Sandy clay (CL) and sandstone gravel:
1A				0.5	1.0	1.61	1.89		0	Jar	brown in color, moist, and low
				1.0	1.5				0		plasticity.
				1.5	2.0				0		
				2.0	2.5						Sample length: 1.89 ft
			3.44	0.0	5.0	—	—	7" Folding Auger	—		Cleanout: assumed stratum change
2	27Oct	3.44		5.0	5.5	5.0	7.06	3"Fixed Piston Sampler	0	ST	Sandy clay (CL): grey to brown in
2A				5.5	6.0	7.06	7.30		0	Jar	color, moist, and low plasticity.
				6.0	6.5				0		Water level at 4.0 ft, ten minutes
				6.5	7.0				0		later, water level at 3.4 ft.
				7.0	7.4				10		Sample length: 2.30 ft
				5.0	10.0	—	—	7" Folding Auger	—		Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED 3" Fixed Piston Sampler = 3" F.P.S. Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-14-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
3	27 Oct	11.8		10.0	10.5	10.0	11.67	3" F.P.S.	0	ST	Clay (CH): dark grey in color,
3A				10.5	11.0	11.67	11.89		0	Jar	uniform, soft, and high plasticity.
				11.0	11.5				10		
				11.5	12.0				30		
				12.0	12.4				70		Sample length: 1.89 ft
				10.0	15.0			7"Folding Auger			Cleanout
4	27 Oct			15.0	15.5	15.0	17.07	3" F.P.S.	0	ST	Clay (CH): same as above- water
4A				15.5	16.0	17.07	17.32		0	Jar	level rose to 2.6 ft after lunch.
				16.0	16.5				0		
				16.5	17.0				0		
				17.0	17.39				0		Sample length: 2.32 ft
			17.5	15.0	17.5			7" Folding Auger			Cleanout: installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 30 Oct, 1981
Location Old Rifle Range Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 510.42 Boring No. WES-6-15-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	30 Oct	0.0		0.0	0.5	0.0	1.35	3"Shelby Tube	0	ST	Sand (SP) and sandstone fragments,
1A				0.5	1.0	1.35	1.55		0	Jar	brown to orange brown in color, very
				1.0	1.5				50		fine to fine-grained, and dry.
				1.5	2.0				120		
			2.4	2.0	2.5				700		Sample length: 1.55 ft
				0.0	2.75			7" Folding Auger			Cleanout; bedrock starts at 2.4 ft
				0.0	2.8			5 5/8" Rock Bit			Cleanout
	31 Oct			2.8				4 x 5 1/2"Core Barrel			See page two for core log.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

Hole No. WES-6-15-81

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION Crane, IN	SHEET 2 OF 3 SHEETS

1. PROJECT NWSC Groundwater Study	10. SIZE AND TYPE OF BIT 4 x 5 1/2 in. Diamond bit
2. LOCATION (Coordinates or Station) Old Rifle Range	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-6-15-81	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED two
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 30 Oct. 81; COMPLETED 31 Oct. 81
7. THICKNESS OF OVERBURDEN 2.75 ft	17. ELEVATION TOP OF HOLE 510.42
8. DEPTH DRILLED INTO ROCK 14.50 ft	18. TOTAL CORE RECOVERY FOR BORING 95.2% %
9. TOTAL DEPTH OF HOLE 17.25 ft	19. SIGNATURE OF INSPECTOR Joseph R. Durham

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
510.42	0.0					
509.42	1.0					
			See page one for over-burden information.			
508.42	2.0					
						30 Oct. 81 WL - Run 1 Began 2:35 Rec 4.55' End 2:55 Loss - Time 20 min Gain - Drl time 20 min Hyd press 100psi Water press - RPM 50-75 Drl Action Smooth ~~Water~~ ret Brown Remarks Cored with air. Stuck core bbl-drilled 6" Cs around to break out.
507.42	3.0					
506.43	4.0					
			Sandstone: brown to rusty brown in color, uniform, fine-grained quartz sand, moderately hard, and oxidized. Bedding ranges from thinly bedded to around one foot maximum thickness and horizontal to sub-horizontal in attitude.			
505.42	5.0					
504.42	6.0					
			Solution cavity.			
						31 Oct. 81 WL - Run 2 Began 9:42 Rec 3.85 End 10:15 Loss - Time 33 min Gain - Drl time 33 min Hyd press 100psi Water press - RPM 50-75 Drl Action Smooth Water ret Slight return-brown Remarks Stuck core bbl-Drilled 6" Cs around to break out.
503.42	7.0		Water at end of run. Run 1	100%	-	
502.42	8.0					
501.42	9.0		Sandstone: same			
500.42	10.0					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

Hole No. WES-6-15-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 3 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED / COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
500.42	10.0					
499.42	11.0		Run 2			
498.42	12.0					AL - Run 3 Began 1:09 Rec 4.1' End 1:39 Loss - Time 30 min Gain - Drl time 30 min Hyd press 100psi Water press - RPM 50 Drl Action Smooth ~~Water~~ ret Slight-brown Remarks Water more pronounced after second run.
497.42	13.0		Sandstone: same	100%	-	
			small cavity-1/2 x 1/2 x 1 in.			
496.42	14.0					
495.42	15.0		Run 3			
494.42	16.0		Sandstone: same	64.1%	-	AL - Run 4 Began 2:00 Rec 1.25' End 2:30 Loss 0.70 Time 30 min Gain - Drl time 30 min Hyd press 100+ Water press - RPM 50 Drl Action Smooth ~~Water~~ ret Slight-brown Remarks -
			Recovered to 16.55 ft			
493.42	17.0		Hole rodded at 17.25 ft Run 4			
			Blew hole dry and installed well.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 2 Nov, 1981
Location Old Rifle Range Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 527.88 Boring No. WES-6-16-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	2 Nov	0.0		0.0	0.5	0.0	1.37	3" Shelby Tube	0	ST	Silt (ML): brown in color, uniform,
1A				0.5	1.0	1.37	1.52		0	Jar	dry, and stiff.
				1.0	1.5				200		
				1.5	2.0				480		
				2.0	2.5				620		Sample length: 1.52 ft
				0.0	3.0			7" Folding Auger			Cleanout: very hard
			4.5	3.0	5.0			5 5/8" Rock Bit			Cleanout: softer at 4.5 ft
2A	2 Nov	4.5	10.0	5.0	5.4	5.0	5.4	3"Fixed Piston Sampler	700	Jar	Sandy silt (ML): brown in color,
											dry, low plasticity, and contains
											5-10% fine to medium sand.
		10.0	27.0	5.0	45.15			5 5/8" Rock Bit			Clay shale: brown in color, very
											stiff to hard, weathered, and
											slightly moist in regions,

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No. _____
Boring No. WES-6-16-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		27.0	45.15								Sandstone: brown in color, medium
											hard, and fine-grained.
											Encountered water between 35 and 37ft.
											Meausred water level after 49
											minutes and it rose to 31.97 ft.
											Drilled to 45.15 ft and blew water
											from hole. Rinsed hole three times
											with clean water to remove mud.
											Installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 10 Nov, 1981
Location Old Rifle Range Job No. 441-G150,11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 510.73 Boring No. WES-6-17-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	10 Nov	0.0		0.0	0.5	0.0	1.39	3" Shelby Tube	0	ST	Clay (CL); brown in color, soft,
1A				0.5	1.0	1.39	1.57		0	Jar	slightly moist, and low plasticity.
				1.0	1.5				30		Sample length: 1.57 ft
			2.0	1.5	2.0				700		
	10 Nov	2.0		0.0	17.5	—	—	6 3/4" Rock	Bit	—	Sandstone; brown, fine-grained,
											and medium hard. Checked hole for
											water at 6.8 ft, 10.0 ft, and
											12.4 ft. Moisture at 12.4 ft.
											Water visible from 12.4 to 17.5 ft
											coming in from sidewalls.
	10 Nov		22.5	17.5	22.55	—	—	4 x 5 1/2" Core Barrel		—	Sandstone; see page two for log
											of core.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

Hole No. WES-6-17-81

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION Crane, IN	SHEET 2 OF 2 SHEETS

1. PROJECT NWSC Groundwater Study	10. SIZE AND TYPE OF BIT 4 x 5 1/2 in Diamond
2. LOCATION (Coordinates or Station) Old Rifle Range	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-6-17-81	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED one
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 10 Nov. 81; COMPLETED 10 Nov. 81
7. THICKNESS OF OVERBURDEN 2.0 ft	17. ELEVATION TOP OF HOLE 510.73
8. DEPTH DRILLED INTO ROCK 20.55 ft	18. TOTAL CORE RECOVERY FOR BORING 24.6% %
9. TOTAL DEPTH OF HOLE 22.55 ft	19. SIGNATURE OF INSPECTOR Joseph B. Kirnham

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
493.73	17.0					
492.73	18.0		From 17.5 to 18.0 ft, 1/4-3/4 in. alternating layers of rusty brown to dark brown sandstone.			10 Nov. 81 AL - Run 1 Began 1:13 Rec 5:05 End 1:56 Loss - Time 43 min Gain - Drl time 43 min Hyd press 100psi Water press - RPM 50-75 Drl Action Smooth Water ret Brown -
491.73	19.0		Sandstone: brown in color, uniform, fine-grained quartz sand, and medium hard. Pyrite crystals with oxidation rims from 21.65-21.9 ft and at 22.35 ft.			
490.73	20.0					
489.73	21.0					
488.73	22.0					
			Run 1	100%	-	
487.73	23.0		Reamed hole out with 6-3/4 in rock bit and rinsed hole with clean water. Water level came up overnight to 12.7 ft. Blew dry and installed well.			

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BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 13 Nov. 1981
Location Old Rifle Range Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 508.03 Boring No. WES-6-18-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	13 Nov	0.0		0.0	0.5	0.0	1.63	3" Shelby Tube	0	ST	Silty sand (SM): brown to rusty
1A				0.5	1.0	1.63	1.78		0	Jar	brown in color, fine-grained, and
				1.0	1.5				20		little cohesion.
				1.5	2.0				280		
			5.0	2.0	2.5				380		Sample length: 1.78 ft
				0.0	5.0			7" Folding Auger			Cleanout
2	13 Nov	5.0		5.0	5.5	5.0	6.58	3"Fixed Piston Sampler	0	ST	Sand (SP): brown in color, uniform,
2A				5.5	6.0	6.58	6.78		20	Jar	fine-grained quartz sand, and
				6.0	6.5				320		slightly damp.
			6.5	6.5	6.75				720		Sample length: 1.78 ft
		6.5	10.0	5.0	26.6			5 5/8" Rock Bit			Sandstone: brown, weathered, and
											fine-grained
		10.0	11.5								Sandstone with clay/shale lenses.
		11.5	14.4								Sandstone: brown, fine-grained,

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Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-18-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
											and soft.
		14.4	26.6								Sandstone: brown, fine-grained,
											and hard.
											Water at 16.6 ft.
											Jetted hole twice to clear water
											and installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 23 Nov, 1981
Location Old Rifle Range Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 503.42 Boring No. WES-6-19-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
		0.0		0.0	5.0			7" Folding Auger			Cleanout: 0.0 to 5.0 ft is disturbed
											from setting up. Had to dump load
			3.0								of gravel to firm up area.
1	23 Nov	3.0		5.0	5.5	5.0	6.88	*3"Fixed Piston Sampler	0	ST	Clay (CH): grey with streaks of
1A				5.5	6.0	6.88	7.13		0	Jar	brown, soft, and high plasticity.
				6.0	6.5				0		Water in hole after cleanout- 8 ft.
				6.5	7.0				0		Sample length: 2.13 ft
				7.0	7.5				10		
			11.75	5.0	10.0			7" Folding Auger			Cleanout: assumed stratum change
2	23 Nov	11.75		10.0	10.5	10.0	11.66	3" F.P.S.	0	ST	Sandy clay (CL): dark grey in color,
2A				10.5	11.0	11.66	11.96		0	Jar	soft, low to medium plasticity, and
				11.0	11.5				0		contains 20% very fine-grained sand.
				11.5	12.0				0		
				12.0	12.39				0		Sample length: 1.96 ft

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* 3" Fixed Piston Sampler = 3"F.P.S.

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-19-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
			16.75	10.0	15.0			7" Folding Auger			Cleanout: assumed stratum change
3	23 Nov	16.75		15.0	15.5	15.0	17.06	3" F.P.S.	0	ST	Gravelly clay (CL): brown to grey
3A				15.5	16.0	17.06	17.36		0	Jar	with traces of red and green, fine
				16.0	16.5				0		to medium sized gravel, soft, and
				16.5	17.0				0		low plasticity,
				17.0	17.40				0		Sample length: 2.36 ft
			20.0	15.0	20.0			7" Folding Auger			Went additional few ft to provide
											better seal at surface.

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Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 24 Nov, 1981
Location Old Rifle Range Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 515.68 Boring No. WES-6-20-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	24 Nov	0.0		0.0	0.5	0.0	1.78	3" Shelby Tube	0	ST	Silt (ML), brown in color, soft,
				0.5	1.0	1.78	1.95		0	Jar	low plasticity, and dry.
				1.0	1.5				25		
				1.5	2.0				75		Sample length: 1.95 ft
				2.0	2.5				380		
				0.0	5.0			7" Folding Auger			Cleanout
2	24 Nov			5.0	5.5	5.0	6.75	3"Fixed Piston Sampler	0	ST	Silt (ML): brown in color with
2A				5.5	6.0	6.75	6.95		0	Jar	traces of grey, soft, and low
				6.0	6.5				10		plasticity.
				6.5	7.0				230		Sample length: 1.95 ft- chucks slipped
				7.0	7.5				380		
	25 Nov		8.0	5.0	8.0			7" Folding Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-20-81

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
	25 Nov	8.0	30.5	8.0	30.5			5 5/8" Rock	Bit		Sandstone: brown in color, fine-grained, and weathered. Water encountered around 20.5 ft. Installed well.

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Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 16 July 1983
Location Old Rifle Range Job No. 441-C150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 575.27 Boring No. WES-6-21-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	16 July	0.0	7.6	0.0	18.1			5" Folding Auger			Clay(CL): brown, soft to stiff, dry, sandy.
		7.6	9.6								Gravelly clay: reddish brown, red sandy, gravelly (med. hard ferruginous gravel) stiff to very stiff, dry, massive.
		9.6	10.6								Clay(CH): brown, very stiff, dry, silty, very thinly bedded.
		10.6	11.6								Clay(CH): grey, very stiff, dry, silty, very thinly bedded.
		11.6	16.6								Clay(CH): brown, soft to stiff, silty, slightly damp, very thinly bedded.

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BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-6-21-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		16.6	17.0								Shale: grey, soft to stiff, slightly damp.
		17.0	17.6								Lignite: black, earthy, sandy, soft
	18July	17.6	38.5	18.1	48.0			6" Rock Bit			Siltstone: brownish grey, light to dark grey, soft, thinly bedded.
		38.5	39.0								Shale: grey, soft
		39.0	43.5								Limestone: grey, very fine-grained hard-water at 39 ft.
		43.5	48.0								Shale(?): no cuttings, soft
	18July										Installed well-rinsed boring several times to remove mud.

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BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 25 August 1983
Location Old Rifle Range Job No. 441-C150.13CR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 507.64 Boring No. WES-6-22-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	25Aug	0.0	4.6	0.0	4.6			5"Folding Auger			Clayey sand (SM) and sandstone gravel: brown, soft to stiff, very fine-grained sand (25%), sandstone gravel approximately 25%.
		4.6	26.0	4.6	26.0			5-5/8" Rock Bit			Sandstone: brown, reddish brown, uniform, very fine-grained, weathered soft, water at 14.6 ft
		26.0	--								Shale(?): possible change - no cuttings.
	25Aug										Rinsed boring with water to clear mud. Installed monitoring well.

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Sheet 1 of 1 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 30 September 1983
Location Old Rifle Range Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator B. Harried Surface El 506.41 Boring No. WES-6-23-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
-	30Sept	0.0	4.3	0.0	27.0			5-5/8"RockB	t		Sandy clay(CL): brown, soft to stiff, dry, sandy-very fine grained.
		4.3	27.0								Sandstone: light brown, brown and reddish brown, very fine-grained, uniform, quartz sandstone, soft and weathered to 24 ft water at 16 ft.
	30Sept										Installed well

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Sheet 1 of 1 Sheets

BORING LOG
FIELD DATA

Project NWSC Disposal Site Characterization Site Crane, IN Date 10 June 1983
Location Old Rifle Range Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 525.62 Boring No. EPA-L-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	HYD PRESS	CONT	CLASSIFICATION AND REMARKS
1	10 June	0.0		0.0	0.5	0.0	2.4	3"Fixed Pist	100	ST	Clay(CL): brown, soft, damp
1A				0.5	1.0	2.4	2.5		150	Jar	Slightly sandy (very fine-grained),
				1.0	1.5				200		soft
				1.5	2.0				400		
				2.0	2.5				400		Sample length: 2.5 ft
				0.0	5.0			5"Folding Auger			Cleanout
2	10 June			5.0	5.5	5.0	7.3	3"Fixed Pist	150	ST	Clay(CL): mottled brown and grey,
2A				5.5	6.0	7.3	7.4		200	Jar	damp, soft, stiff
				6.0	6.5				260		
				6.5	7.0				300		
				7.0	7.4				330		Sample length: 2.4 ft
				5.0	10.0			5"Folding Auger			Cleanout
3	10 June		10.5	10.0	10.5	10.0	10.5	3"Fixed Pist	750	Jar	Clay(CL): grey and brown, sandy

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Sheet 1 of 6 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-L-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	11 June	10.5		10.5	13.8	10.5	13.8	Core 300= 7x5-1/2"Barrel		Runl.	Sandstone and clay(CL): brown,tan
											and grey, very fine-grained, predom-
											inantly quartz sandstone interbedded
											with brown sandy clay. Recovered
											approximately 2 ft with sandstone
											fragments ranging from fine to coarse
											gravel. Recovered two core pieces
											approx. 0.4 ft long. Sandstone is
											weathered, gravel fragments very
											friable and larger fragments moderately
											friable, very fine-grained.
											Drill Time 49 min:

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Sheet 2 of 6 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-1-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	11 June			13.8	19.0	13.8	19.0	Core 4x51/2"Barre	100-300	Run2	Sandstone and clay(CL): 60% weathered sandstone interbedded with 40% sandy clay(CL); sandstone is brown, and reddish brown, very fine-grained, predominantly quartz sandstone, clay is brown and reddish brown. Sandstone fragments range from fine to coarse gravel.
											Recovered: approx. 2.0ft
											Loss: " 3.0ft
											Drill Time: 53 min.
	11 June		24.0	19.0	24.0	19.0	24.0	Core 4x51/2"Barre	100-300	Run3	Sandstone and clay(CL): No recovery except for several gravel sized sandstone fragments.
											Drill Time: 8 min.
											Water at 24 ft.

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Sheet 3 of 6 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No _____ Boring No. EPA-1-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	11 June	24.0		24.0	25.0	24.0	25.0	3" Pitcher Sampler	750		Sandstone: tan, brown, and reddish brown, very fine-grained uniform, quartz, very friable to moderately friable.
				—	25.0			5 5/8" Rock Bit			Cleanout
	11 June			25.0	29.8			4x51/2" Core Barrel		Run4	See Page 5
	11 June			29.8	32.3			" "		Run5	
	11 June		35.9	32.3	35.9			" "		Run6	
											Drilled last three runs with water. Left hole open to obtain water level measurements.

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Sheet 4 of 6 Sheets

Hole No. EPA-1-83

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION NWSC, Crane, IN	SHEET 1 OF 6 SHEETS

1. PROJECT: Disposal Site Characterization
2. LOCATION (Coordinates or Station): Old Rifle Range
3. DRILLING AGENCY: CEWES
4. HOLE NO. (As shown on drawing title and file number): EPA-1-83
5. NAME OF DRILLER: C. Drake
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED ____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: 24.0
8. DEPTH DRILLED INTO ROCK: 11.9
9. TOTAL DEPTH OF HOLE: 35.9
10. SIZE AND TYPE OF BIT: 4x5½" Diamond
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURER'S DESIGNATION OF DRILL: Failing 1500
13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED 0; UNDISTURBED Three
14. TOTAL NUMBER CORE BOXES: --
15. ELEVATION GROUND WATER:
16. DATE HOLE: STARTED 10 June 1983; COMPLETED 11 June 1983
17. ELEVATION TOP OF HOLE: 525.62
18. TOTAL CORE RECOVERY FOR BORING: 42.9%
19. SIGNATURE OF INSPECTOR: Joseph B. Drake

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
500.62	25		Sandstone: tan, reddish brown, oxidized, soft, very fine-grained, uniform, predominantly quartz, weathered, bedding is horizontal and very thinly bedded.	100%	--	WL -- Run 4 Began 2:44 Rec 4.8 End 3:00 Loss -- Time 16 min Gain -- Drl time 16 min Hyd press 100-300 PSI Water press -- RQD 75-100+ Drl Action Smooth Water ret Brown Remarks
499.62	26					
498.62	27					
497.62	28					
496.62	29					
			Run 4 RQD=72.9%			
495.62	30		Sandstone: see above and see remarks.	100%		WL -- Run 5 Began 3:27 Rec 2.5' End 3:37 Loss -- Time 10 min Gain -- Drl time 10 min Hyd press 100-200 PSI Water press -- RQD 75-100+ Drl Action Smooth Water ret Brown Blocked off fractured run.
494.64	31					
493.62	32					
			Run 5 RQD=0.0%			
492.62	33		Sandstone: see above	100%		WL -- Run 6 Began 4:03 Rec 3.6 End 4:18 Loss -- Time 15 min Gain -- Drl time 15 min Hyd press 200 PSI Water press -- RQD 75-100+ Drl Action Smooth Water ret Brown Remarks
491.62	34					
[illegible]	35					

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Hole No.

DRILLING LOG	DIVISION	INSTALLATION	SHEET 1 OF 1 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED / COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
490.62	35		Sandstone: see above	100%		
			Run 6 RQD=100%			
489.62	36					

ENG FORM 1836 PREVIOUS MAR 71

HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Disposal Site Characterization Site Crane, IN Date 13 June 1983
Location Old Rifle Range Job No. 441-C 150.13CR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 530.91 Boring No. EPA-2-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Pres	Cont	CLASSIFICATION AND REMARKS
1	13 June	0.0		0.0	0.5	0.0	2.10	3" Shelby tube	80	ST	Clay (CL): brown with streaks
1A				0.5	1.0	2.10	2.25		160	Jar	of grey, soft, damp, organic matter
				1.0	1.5				200		(roots).
				1.5	2.0				260		Sample length: 2.25 ft
			5.0	2.0	2.5				340		
				0.0	5.0			5" Folding Auger			Cleanout
2	13 June	5.0		5.0	5.5	5.0	6.35	3" Fixed Piston	160	ST	Gravelly clay (CL): reddish brown
2A				5.5	6.0	6.35	6.50		260	Jar	clay with decomposed sandstone rock,
				6.0	6.5				400		fine to coarse gravel sized rock
											fragments, clay is soft and slightly
											damp, rock, approx 30%
											Sample length: 1.50 ft
			8.5	5.0	10.0			5" Folding Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-2-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
3		8.5		10.0	12.5	10.0	11.35	Pitcher 3" Sampler	300	ST	Clayey Gravel(GC): reddish brown,
3A						11.35	11.50			Jar	sandstone from fine to coarse gravel,
											rock approximately 65%, clay approx-
											imately 35%. Sandstone is very
											fine-grained, weathered.
											Sample length 1.5 ft
				10.0	15.0			5 5/8 RockBit			Cleanout
4			19.5	15.0	16.1	15.0	15.95	Pitcher 3" Sampler	300	ST	Clayey Gravel(GC): same as above.
4A						15.95	16.1			Jar	Sample length: 1.1 ft
		19.5	20.2	15.0	38.5			5 5/8 RockBit			Sandstone: reddish brown, soft
		20.2	25.5								Clay: brown, damp water at 20.2 ft
		25.5	27.8								Clay: grey, soft
		27.8	28.5								Clay: brown, soft

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-2-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
				28.5	29.5						Clay: brown, soft.
				29.5	38.5						Sandstone: brown, reddish brown,
											fine-grained, soft
											Installed 2 ft. piece of casing
											to keep hole open to monitor water
											levels.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Disposal Site Characterization Site Crane, IN Date 14 June 1983
Location Old Rifle Range Job No. 441-G150. 13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 523.20 Boring No. EPA-3-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	14 June	0.0		0.0	0.5	0.0	2.25	3" Shelby Tube	80	ST	Clay (CL): brown and grey, soft,
1A				0.5	1.0	2.25	2.40		100	Jar	damp, slightly sandy (5%)
				1.0	1.5				170		
				1.5	2.0				220		
			6.0	2.0	2.5				500		Sample Length: 2.4 ft
				0.0	5.0			5" Folding Auger			Cleanout
2	14 June	6.0		5.0	5.5	5.0	6.08	3" Fixed Piston	280	ST	Clayey Gravel (GC): reddish brown,
2A				5.5	6.0	6.08	6.28		550	Jar	fine to medium gravel sized sand-
				6.0	6.5				610		stone fragments with soft, sandy
				6.5	7.0				620		clay.
			7.5	7.0	7.5				640		Sample length: 1.28 ft
				5.0	10.0			5" Folding Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-3-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
3	14 June	7.5		10.0	10.5	10.0	12.12	3" Fixed Piston	80	ST	Clay(CL and CH): grey and light
3A				10.5	11.0	12.12	12.27		120	Jar	brown, soft, damp, dense, grades
				11.0	11.5				130		from a CH to a CL between 10 and 11
				11.5	12.0				160		ft.
			16.5	12.0	12.45				160		Sample length: 2.27 ft
				10.0	15.0			5"Folding Auger			Cleanout
4		16.5	17.5	15.0	15.5	15.0	16.1	3" Fixed Piston	190	ST	Sandy Gravel: reddish brown, black
4A				15.5	16.0	16.1	16.3		320	Jar	weathered, very fine-grained
				16.0	16.5				600		sandstone.
				16.5	17.0				450		Sample length: 1.3 ft
				17.0	17.45				430		
		17.5	19.0	15.0	20.0			5"Folding Auger			Clay(CL): brown, reddish brown,
											damp, sandy, gravelly(fine), thinly bedded
		19.0	20.0								Sand(SM): brown, very fine-grained

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No _____
Boring No. EPA-3-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
											damp, silty, clayey(slight binder)
5A	4June			20.0	20.6	20.0	20.6	3" Fixed Piston	750	Jar	Sandy Gravel(GC): reddish brown, brown, dark grey, weathered, very fine-grained sandstone, damp.
		20.0	32.5	20.0	32.5			5-5/8"RockBit			Sandstone: brown, very fine-grained weathered, uniform quartz sandstone.
											Installed 2 ft. piece of casing to keep hole open to monitor water levels.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Disposal Site Characterization Site Crane, IN Date 14 June 1983
Location Old Rifle Range Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 521.89 Boring No. EPA-4-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	14 June	0.0		0.0	0.5	0.0	1.5	3" Shelby Tube	80	ST	Clay(CL): brown, soft, uniform,
1A				0.5	1.0	1.5	1.7		120	Jar	damp.
				1.0	1.5				160		
				1.5	2.0				180		Sample length: 1.7 ft
			3.5	2.0	2.5				170		
						0.0	5.0	3" Folding Auger			Cleanout
2A	14 June	3.5		5.0	5.5	5.0	5.95	3" Fixed Piston	280	Jar	Gravelly clay(CL): reddish brown,
				5.5	5.95				750t		dark brown, brittle, stiff, dry
											with 10 to 20% rock fragments
											(sandstone) ranging from coarse
											sand size to medium gravel, angular
			9.0								fragments.
				5.0	10.0			3" Folding Auger			Cleanout
3	14 June	9.0		10.0	10.5	10.0	12.18	3" Fixed Piston	100	ST	Clay(CL): brown with streaks of

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-4-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
3A	14June			10.5	11.0	12.18	12.38		220	Jar	grey, stiff, brittle, slightly moist
4A	14June			11.0	11.5	15.0	16.0		280	Jar	sandy, thinly bedded
				11.5	12.0				260		
			16.0	12.0	12.45				270		Sample length: 2.38 ft
				10.0	16.0	15.0	16.0	6"FoldingAuger			Cleanout- hard at 16 ft
5		16.0	18.0	16.0	18.5	16.0	18.35	3"Pitcher Sampler	700	ST	Sandstone: brown and black, very
5A						18.35	18.50			Jar	weathered, primarily gravel and
											coarse sand fragments.
		18.0	18.5								Shale: greenish grey, brittle dry
											soft, uniform - water in bottom
											of hole.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____

Location _____

Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No. _____

Boring No. EPA-4-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		18.5	21.0	16.0	30.0			5-5/8" Rock Bit			Sandstone: brown, weathered, soft
		21.0	30.0								Sandstone: tan, light grey, medium
											good rock, very fine-grained, quartz
											sandstone.
											Installed 3.0 ft casing and left
											hole open to monitor water levels.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Disposal Site Characterization Site Crane, IN Date 16 June 1983
Location Old Rifle Range Job No. 441-C150.13CR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 521.16 Boring No. EPA-5-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Con	CLASSIFICATION AND REMARKS
1	16 June	0.0		0.0	0.5	0.0	2.25	3" Shelby Tube	50	ST	Clay(CL): brown, soft, dry,
1A				0.5	1.0	2.25	2.40		60	Jar	sandy
				1.0	1.5				100		
				1.5	2.0				160		
				2.0	2.5				260		Sample length: 2.40 ft.
				0.0	5.0			5" Folding Auger			Cleanout
2	16 June			5.0	5.5	5.0	6.85	3" Fixed Piston	190	ST	Clay(CL): brown with streaks
2A				5.5	6.0	6.85	7.0		260	Jar	of grey, stiff, soft, damp,
				6.0	6.5				350		slightly sandy.
				6.5	7.0				380		
			9.0	7.0	7.38				400		Sample length: 2.0 ft.
				5.0	10.0			5" Folding Auger			Cleanout
3	16 June	9.0	14.2	10.0	10.5	10.0	11.22	3" Fixed Piston	130	ST	Gravelly clay(CL): reddish brown

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. EPA-5-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
3A	16June					10.0	12.0	5" Folding Auger	150	Jar	stiff, brittle, dry; gravel fragments
									320		are angular, fine to coarse sandstone
									520		Sample length: 1.32 ft - tube
									700		stopped and bent on gravel/cobble
				10.0	15.0			5"FoldingAuger			Cleanout
4	16June	14.2		15.0	15.5	15.0	17.15	3" Fixed Piston		ST	Clay(CL): brown and grey, soft,
4A				15.5	16.0	17.15	17.30			Jar	damp.
				16.0	16.5						
				16.5	17.0						
			18.5	17.0	17.45						Sample length: 2.3 ft.
5A		18.5	20.4	15.0	20.0	18.5	19.9	3"Folding Auger		Jar	Silty Sand(SM): brownish grey,
											moist, very fine-grained, uniform.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____
Drill Rig _____ Inspector _____ Operator _____ Surface El. _____ Job No. _____ Boring No. EPA-5-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
6A	16June			20.0	20.4	20.0	20.4	3" Pitcher Sampler	100	Jar	Silty sand(SM): greyish brown, wet, very fine-grained, uniform - hard at 20.4
		20.4	32.0	20.0	32.0			5 5/8" RockBit			Sandstone: light brown, light grey, very fine-grained, slightly weathered.
											Left hole open to obtain water level measurments.
											Installed 2 ft. piece of casing.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 20 Nov. 1981
Location Rockeye Site Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 617.80 Boring No. WES-10-1-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont.	CLASSIFICATION AND REMARKS
1	20Nov	0.0		0.0	0.5	0.0	1.84	3" Shelby Tube	0	ST	Gravelly sand (SN): brown in color,
1A				0.5	1.0	1.84	2.0		10	Jar	dry, fine to coarse sand, and fine
				1.0	1.5				10		to coarse, angular to rounded gravel.
				1.5	2.0				30		
			4.1	2.0	2.5				50		Sample length: 2.00 ft
				0.0	5.0	—	—	7"Folding Auger	—		Cleanout
2	20Nov	4.1		5.0	5.5	5.0	6.16	3"Fixed Piston Sampler	20	ST	Sand (SP): orange brown in color,
2A				5.5	6.0	6.16	6.41		20	Jar	fine-grained, moderate to little
				6.0	6.5				30		cohesion, and dry.
				6.5	7.0				200		
			7.19	7.0	7.19				460		Sample length: 1.41 ft
	20Nov	7.19	17.3	5.0	30.5	—	—	5 5/8" Rock Bit	—		Sandstone: reddish brown-brown and
											soft.
		17.3	19.0								Sandstone: brown and medium hard

Sheet 1 of 2 Sheets

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____

Location _____ Job No. _____

Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-1-81

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		19.0	20.5								Sandstone: brown and soft
		20.5	26.3								Sandstone: brown and soft to medium
		26.3	28.8								Sandstone: brown and hard
		28.8	29.5								Sandstone: red colored water.
		29.5	30.5								Limestone: grey colored water and
											hard drilling.
											Bailed and washed hole to remove
											mud and cuttings. Water began at
											20.5 ft and was red in color to
											indicated depth. Lost cuttings
											at 28.8 ft with slight water return.
											Installed well.

Sheet 2 of 2 Sheets

WES FORM 819 EDITION OF NOV 1971 MAY BE USED

BORING LOG
FIELD DATA

Project NWSC Groundwater Study Site Crane, IN Date 22 Nov. 1981
Location Rockeye Site Job No. 441-G150.11GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 618.51 Boring No. WES-10-2-81

SAMPLE NUMBER	DATE TAKEN 1981	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd. Press	Cont	CLASSIFICATION AND REMARKS
1	22Nov	0.0		0.0	0.5	0.0	1.29	3" Shelby Tube	0	ST	Silty sand (SM); dark brown in
1A				0.5	1.0	1.29	1.46		0	Jar	color, dry, soft, very fine-grained,
				1.0	1.5				0		and slight cohesion.
				1.5	2.0				0		Sample length: 1.46 ft
			4.4	2.0	2.5				0		
				0.0	4.4			7"Folding Auger			Cleanout
		4.4	7.1	4.4	9.6			4 x 5 1/2"Core Barrel			For core log see page 2.
		7.1	25.0	4.4	9.6			6 3/4" Rock Bit			
		25.0	25.8	9.6	15.8			4 x 5 1/2"Core Barrel			
				9.6	15.8			6 3/4" Rock Bit			
				15.8	20.8			4 x 5 1/2"Core Barrel			
				15.8	20.8			6 3/4" Rock Bit			
				20.8	25.8			4 x 5 1/2"Core Barrel			
				20.8	25.8			6 3/4" Rock Bit			

Sheet 1 of 4 Sheets

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Hole No. WES-10-2-81

DRILLING LOG	DIVISION U.S. Navy	INSTALLATION Crane, IN	SHEET 2 OF 4 SHEETS

1. PROJECT NWSC Groundwater Study	10. SIZE AND TYPE OF BIT 4 x 5-1/2 in. Diamond Bit
2. LOCATION (Coordinates or Station) Rockeye Site	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-10-2-81	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED one
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 22 Nov. 1981; COMPLETED 22 Nov. 1981
	17. ELEVATION TOP OF HOLE 618.51
7. THICKNESS OF OVERBURDEN 4.4 ft	18. TOTAL CORE RECOVERY FOR BORING 47.7 %
8. DEPTH DRILLED INTO ROCK 21.4 ft	19. SIGNATURE OF INSPECTOR
9. TOTAL DEPTH OF HOLE 25.8 ft	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
614.51	4.0					
613.51	5.0		Loose sandstone gravel: fine to coarse fragments, brown, and fine-grained.			WL - Run 1 Began 9:40 Rec 5.2' End 9:53 Loss - Time 13 min Gain - Drl time 13 min Hyd press 100psi Water press - RPM 70 ± Drl Action Smooth Water ret Brown Remarks Cored with air
			Gravelly clay: 60% brown, stiff clay and 40% fine to coarse, rounded gravel			
612.51	6.0		Loose sandstone gravel.			
			Sandstone: brown, very weathered, fine-grained, and friable.			
611.51	7.0		Limestone: grey with clay seam			
610.51	8.0					
			Sandstone: brown, very weathered, uniform, fine-grained quartz sand, and friable.			
609.51	9.0		fractured	100%	-	
			Run 1			
608.51	10.0					
607.51	11.0		closed break			Run 2 Rec 3.4' Loss 2.8' Gain - Drl time 13 min Hyd press 100psi Water press - RPM 50-100 Drl Action - Water ret Brown Remarks Water at end of run-15.8 ft
606.51	12.0		fractured	54.8%	-	
			Sandstone: same			
605.51	13.0		No recovery			
604.51	14.0					

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PROJECT HOLE NO.

Hole No. WES-10-2-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 4 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
2. LOCATION (Coordinates or Station)	12. MANUFACTURER'S DESIGNATION OF DRILL
3. DRILLING AGENCY	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
4. HOLE NO. (As shown on drawing title and file number)	14. TOTAL NUMBER CORE BOXES
5. NAME OF DRILLER	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	16. DATE HOLE: STARTED / COMPLETED
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR
9. TOTAL DEPTH OF HOLE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
604.51	14.0					
603.51	15.0		Run 2			
602.51	16.0					AL. - Run 3 Began 11:22 Rec 0.8' End 11:25 Loss 3.7' Time 3 min Gain - Drl time 3 min Hyd press 100psi Water press - RPM 100+ Drl Action Smooth ~~Water~~ rot Brown Remarks -
601.51	17.0		Sandstone	17.8%	-	
600.51	18.0		No recovery except for approximately 0.8 ft of weathered, brown, fine-grained quartz sandstone.			
599.15	19.0					
598.51	20.0		Run 3			
597.51	21.0		Sandstone			AL. - Run 4 Began 11:57 Rec 0.8' End 12:05 Loss 4.7' Time 8 min Gain - Drl time 8 min Hyd press 100psi Water press - RPM 100 Drl Action Smooth ~~Water~~ rot Brown Remarks -
596.51	22.0		No recovery	14.5%	-	
595.51	23.0					
594.51	24.0					

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PROJECT | HOLE NO.

Hole No. WES-10-2-81

DRILLING LOG	DIVISION	INSTALLATION	SHEET 4 OF 4 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
2. LOCATION (Coordinates or Station)	
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
594.51	24.0		No recovery			
593.51	25.0		Limestone: light grey, moderately hard, and fine-grained.			
			Bailed water from hole and set well. Boring fell in 0.9 ft.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT)

PROJECT | HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 1 July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 808.13 Boring No. WES-10-3-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	1July	0.0	5.0	0.0	0.5	0.0	1.90	3" Shelby Tube	60	ST	Clay(CL): brown, stiff, dry,
1A				0.5	1.0	1.90	2.05	"	120	Jar	sandy.
				1.0	1.5				180		
				1.5	2.0				290		
				2.0	2.5				380		Sample length: 2.05 ft.
				0.0	5.0			5"Folding Auger			Cleanout
2	1July	5.0	13.0	5.0	7.5	5.0	6.6	3" Pitcher Sampler	700	ST	Sandstone: brown, very fine-
											grained, damp, predominantly
											quartz sand.
											Sample length: 1.6 ft.
	1July	13.0	13.5	5.0	29.5			6" Rock Bit			Coal: block, soft.
		13.5	15.5								Sandstone: brown, very fine-
											grained, soft, predominantly

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-3-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
											quartz sand, weathered.
		15.5	19.5								Sandstone: light grey, dark grey, very fine-grained, soft to medium shaley, water at 19 ft.
		19.5	23.0								Sandstone: brown, very fine-grained, soft, predominantly quartz sand.
		23.0	29.5								Sandstone: light grey, dark grey, shaley, soft to medium, very fine-grained.
	2 July										Water overnight at 12.15 ft.
	5 July										Installed monitoring well

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 2July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 827.90 Boring No. WES-10-4-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
		0.0	0.2	0.0	0.2			5"Folding Auger			Cleanout-organic matter(grass)
1	2July	0.2		0.2	0.7	0.2	1.35	3" Shelby Tube	90	ST	Clay(CL): brownish grey, soft,
1A				0.7	1.2	1.35	1.A5		180	Jar	sandy.
				1.2	1.7				270		
				1.7	2.2				290		
				2.2	2.7				370		Sample length: 1.25 ft.
				0.0	5.0			5"Folding Auger			Cleanout
2	2July			5.0	5.5	5.0	7.25	3" Fixed Piston	120	ST	Clay(CL): greyish brown, soft,
2A				5.5	6.0	7.25	7.40		180	Jar	sandy, damp.
				6.0	6.5				200		
				6.5	7.0				260		
			11.5	7.0	7.4				280		Sample length: 2.4 ft.
				5.0	10.0			5"Folding Auger			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-4-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
3	2July	11.5	15.0	10.0	12.5	10.0	12.45	3" Pitcher	300	ST	Siltstone: white, light grey, brown very stiff, brittle, weathered, sandy.
		15.0	19.8	10.0	40.3			6" Rock Bit			Sandstone: brown, very fine-grained, soft
		19.8	22.5								Clay Shale: grey, sandy, soft
		22.5	25.8								Coal: black, soft (poor quality)
		25.8	34.5								Sandy Shale: grey, dark grey, soft, very fine-grained sand-water at 30 ft.
		34.5	36.0								Coal: black, soft (bituminous?)
		36.0	40.3								Sandy Shale: grey, dark grey, soft very fine-grained sand.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-4-83

SAMPLE NUMBER	DATE TAKEN	STRATUM		DRIVE		SAMPLE		TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		FROM	TO	FROM	TO	FROM	TO				
	4 July										Water level over night at 11.45.
	5 July										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground - water Study Site Crane, IN Date 2 July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 828.39 Boring No. WES-10-5-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
	2July	0.0		0.0	2.4			6" Rock Bit			Fill: cement and clay(CL)
			4.0	2.4	5.0			4x5-1/2" Core Barrel			Clay(CL) and fill gravel
1	2July	4.0		5.0	5.5	5.0	6.85	3" Fixed Piston	80	ST	Clay(CL): brown with grey streaks,
1A				5.5	6.0	6.85	6.95		170	Jar	stiff, damp
				6.0	6.5				260		
				6.5	7.0				340		
			10.5	7.0	7.38				480		Sample length: 1.95 ft.
				5.0	10.0			5"FoldingAuger			Cleanout
2	2July	10.5		10.0	10.5	10.0	11.1	3" Fixed Piston	160	ST	Shale: dark grey to black, soft,
2A				10.5	11.0	11.1	11.2		740	Jar	weathered.
			11.45	11.0	11.45				800		
	4July			10.0	11.45			6" Rock Bit			Cleanout

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 5 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-5-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS See boring log on page 3
	4July			11.45	15.1	11.45	15.1	4x5 1/2" Core Barrel			Run 1
	4July			15.1	17.8	11.45	15.1	4x5 1/2" Core Barrel			Run2
	4July			17.8	22.8	17.8	22.8	4x5 1/2" Core Barrel			Run3
	4July			22.8	27.2	22.8	27.2	4x5 1/2" Core Barrel			Run4 – water at 24.3 ft.
	4July			27.2	31.8	27.2	31.8	4x5 1/2" Core Barrel			Run5
	5July			31.8	35.8	31.8	35.1	4x5 1/2" Core Barrel			Run6
	5July										Installed monitoring well after blowing water from boring

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 5 Sheets

Hole No. WES-10-5-83

DRILLING LOG	DIVISION U. S. Navy	INSTALLATION Crane, IN	SHEET 3 OF 5 SHEETS

1. PROJECT NWSC Ground-water Study	10. SIZE AND TYPE OF BIT 4x5¼" Core Barrel
2. LOCATION (Coordinates or Station) Rockeye	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CENES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing
4. HOLE NO. (As shown on drawing title and file number) WES-10-5-83	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED two
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 2 July 83; COMPLETED 5 July 1983
7. THICKNESS OF OVERBURDEN 10.5 ft	17. ELEVATION TOP OF HOLE 828.39
8. DEPTH DRILLED INTO ROCK 24.6 ft	18. TOTAL CORE RECOVERY FOR BORING 100% %
9. TOTAL DEPTH OF HOLE 35.1 ft	19. SIGNATURE OF INSPECTOR [signature]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
817.39	11		See boring log page 1			
			fractured			
816.39	12		Siltstone: orange grey to light orange brown, highly weathered, thinly bedded, grading to approximately 10% very fine-grained sandstone, soft to medium with harder area reflecting iron (liminite) precipitation, oxidized.			WL -- Run 1 Began 7:39 Rec 3.65' End 7:51 Loss -- Time 12 min Gain -- Drl time 12 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret brown, grey Remarks
815.39	13					
			fractured			
814.39	14					
			fractured			
813.39	15		Run 1 RQD=32.9%	100%		
			fractured			WL -- Run 2 Begin 8:19 Rec 2.7' End 8:40 Loss -- Time 21 min Gain -- Drl time 21 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret brown, grey Remarks
812.39	16		Siltstone: dark orange brown, very weathered-primarily a soil with hard regions of ferruginous, oxidized, sandy siltstone, material is thinly bedded. Grades to light grey at 17.2 ft, yellow, soluble gossan or precipitate.			
811.39	17		fractured			
			Run 2 RQD=0.0%	100%		
810.39	18		fractured			WL -- Run 3 Began 9:25 Rec 5.0' End 9:44 Loss -- Time 19 min Gain -- Drl time 19 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret brown, grey Remarks
			Siltstone: highly weathered, light grey and orange brown, soft, thinly bedded.			
809.39	19					
			Clay shale: chocolate brown, black, soft, thinly bedded, moisture is present along break surfaces, oxidized, very weathered.			
808.39	20					
807.39	21					

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Hole No. WES-10-5-83

DRILLING LOG	DIVISION	INSTALLATION	SHEET 4 OF 5 SHEETS
1. PROJECT		10. SIZE AND TYPE OF BIT	
2. LOCATION (Coordinates or Station)		11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	
3. DRILLING AGENCY		12. MANUFACTURER'S DESIGNATION OF DRILL	
4. HOLE NO. (As shown on drawing title and file number)		13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN	DISTURBED / UNDISTURBED
5. NAME OF DRILLER		14. TOTAL NUMBER CORE BOXES	
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.		15. ELEVATION GROUND WATER	
		16. DATE HOLE	STARTED / COMPLETED
7. THICKNESS OF OVERBURDEN		17. ELEVATION TOP OF HOLE	
8. DEPTH DRILLED INTO ROCK		18. TOTAL CORE RECOVERY FOR BORING %	
9. TOTAL DEPTH OF HOLE		19. SIGNATURE OF INSPECTOR	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
807.39	21					
			Clay Shale: same			
806.39	22					
			Mechanical fracture			
			Run 3 RQD=27%	100%		
805.39	23		fractured			
			Clay Shale: same			
804.39	24		fractured			AL -- Run 4 Began 10:05 Rec 4.4' End 10:30 Loss -- Time 25 min Gain -- Drl time 25 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret Brown, dark brown Remarks Water at end of run-lost cuttings at 24.3 ft Will switch to water to drill.
			Lignite: black, soft earthy texture, wet.			
803.39	25		closed breaks: oxidized.			
			Sandstone: light grey, very fine-grained, oxidized moderately friable.			
802.39	26		Shale: light grey to greenish grey, very soft, very weathered, brittle, damp, sandy.			
801.39	27		Run 4 RQD=27.3%	100%		
			Shale: see above			
800.39	28					AL -- Run 5 Began 11:31 Rec 4.6' End 11:41 Loss -- Time 10 min. Gain -- Drl time 10 min. Hyd press 150 psi Water press - RPM 100 + Drl Action Smooth Water ret Black, dark grey Remarks
			closed, oxidized			
799.39	29		Sandstone light grey, very fine-grained, contains abundant quanity of fines with thinly bedded shale-clay lamina(10%) rock is soft, moderately friable, slightly weathered.			
798.39	30					
797.39	31					

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PROJECT HOLE NO.

Hole No. WFS-10-5-83

DRILLING LOG	DIVISION	INSTALLATION	SHEET 5 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
797.39	31		Sandstone: same Run 5 RQD=84%	100%		5 July 1983
796.39	32		Sandstone and shale: interbedded sandstone and shale, light grey to black, gradual grading toward a uniform shale, very thin horizontal bedding (1/6" to ½" maximum thickness), sandstone is very fine-grained, nonuniform.			WL -- Began 8:53 End 9:07 Time 9 min Drl time 9 min Hyd press 150 PSI Water press -- RPM 100± Drl Action Smooth Water ret Black, dark grey Run 6 Rec 3.3' Loss 0.7' Cair ---
795.39	33					
794.39	34					
793.39	35		Shale: black, soft, uniform, slakes on drying. Run 6 RQD=90.9%	100%		

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 6 July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 808.40 Boring No. WES-10-6-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	6July	0.0		0.0	0.5	0.0	0.95	3" Shelby Tube	140	ST	Gravelly clay(CL): brown, very
1A				0.5	1.0	0.95	1.10		480	Jar	stiff, dry, with very fine-grained
				1.0	1.5				460		quartz sandstone gravel-fine to med.
				1.5	2.0				340		
			6.0	2.0	2.5				310		Sample length: 1.1 ft
				0.0	5.0			5"FoldingAuger			Cleanout
2	6July	6.0		5.0	5.5	5.0	6.07	3" Fixed Piston	240	ST	Sandstone: brown, very friable,
2A				5.5	6.0	6.07	6.22		380	Jar	very fine-grained, weathered
				6.0	6.33				800		Sample length: 1.22 ft.
	6July		10.5	5.0	30.4			6" Rock Bit			Sandstone: brown, very fine-grained, soft.
		10.5	25.0								Sandstone: brown, very fine-grained,
											hard to very hard.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-6-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		25.0	26.0								Coal: black, soft,(bituminous).
		26.0	28.5								Sandstone: brown, light grey, very fine-grained, soft.
		28.5	30.4								Siltstone and shale: light grey, dark grey, thinly bedded, soft.
											Water between 15 and 18 ft.
	7 July										Water level overnight: 11.83 ft.
	7 July										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 12 July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 785.90 Boring No. WES-10-7-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1A	12July	0.0	2.5	0.0	0.5	0.0	0.4	Shelby 3" Tube	200	Jar	Clay(CL): brown, dark brown,
1B				0.5	1.0	0.4	0.6		800	Jar	sandy, soft, damp, organic, matter;
				1.0	1.5				200		tube damaged in push.
				1.5	2.0				180		
				2.0	2.5				400		Sample length: 0.6 ft.
		2.5	6.0	2.5	19.5			6" Rock Bit			Sandstone and clay: brown, very fine-grained sandstone, very weathered, damp, clay is soft.
		6.0	7.4								Coal or lignite: black, very soft water at 7.4 ft.
		7.4	14.0								Siltstone: light grey, soft, uniform.
		14.0	16.5								Shale: black, dark grey, soft.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-7-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		16.5	16.8								Lignite: black, very soft.
		16.8	19.5								Shale: dark grey, soft.
											Rinsed hole with fresh water several times and blew water from boring to remove mud.
	13July										Water level overnight: 2.10 ft
	13July										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 13 July 1983
Location Rockeye Job No. 441-G150.GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 787.14 Boring No. WES-10-8-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	13July	0.0	1.43	0.0	0.5	0.0	1.33	3" Shelby Tube	180	ST	Gravelly clay(CL): brown, soft,
1A				0.5	1.0	1.33	1.43		380	Jar	sandy, sandstone gravel, organic
				1.0	1.5				550		matter.
											Sample length: 1.43 ft.
		1.43	3.5	0.0	19.5			6" Rock Bit			Sandstone and clay: brown, soft,
											weathered, fine-grained sandstone,
											thinly bedded.
		3.5	6.7								Sandstone: light brown, very
											fine-grained, hard
		6.7	8.4								Coal: black, soft, water at
											6.7 ft.
		8.4	14.7								Siltstone: brown, light grey, soft

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-8-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		14.7	17.0								Shale: dark grey, black, soft
		17.0	17.4								Lignite: black, very soft
		17.4	19.5								Shale: dark grey, soft
	13July										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 14 July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 786.13 Boring No. WES-10-9-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	19July	0.0	2.5	0.0	0.5	0.0	2.05	3" Shelby Tube	100	ST	Sandy Clay (CL): brown, stiff to
1A				0.5	1.0	2.05	2.40		200	Jar	hard, dry, very fine- grained
				1.0	1.5				280		sand.
				1.5	2.0				400		
				2.0	2.5				600		Sample length: 2.40 ft.
	14July	2.5	4.5	0.0	35.0			6" Rock Bit			Sandstone and clay: brown
											thinly bedded, soft, fine-grained
		4.5	7.0								Sandstone: grey, hard, very fine-
											grained.
		7.0	9.5								Sandstone: brown, soft, very
											fine-grained.
		9.5	15.5								Shale: grey, dark grey, soft

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-9-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		15.5	16.8								Sandstone: light grey, soft.
		16.8	21.3								Siltstone: light grey to dark grey soft.
		21.3	22.5								Sandstone: light grey, very fine grained, soft.
		22.5	25.0								Coal: black, soft to medium, wet.
		25.0	35.0								Shale: light to dark grey, inter-bedded with siltstone, soft.
	15July										Water level overnight: 13.55 ft.
	15July										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 15July 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 781.86 Boring No. WES-10-10-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
	15July	0.0	1.5	0.0	1.5			5"Folding Auger			Cleanout: dozer fill - 6" Casing
1	15July	1.5	4.5	1.5	2.0	1.5	2.9	3" Shelby Tube	20	ST	Gravelly clay(CL): brown, damp
1A				2.0	2.5	2.9	3.1		40	Jar	soft, sandy, gravelly (fine to
				2.5	3.0				70		medium sandstone gravel).
				3.0	3.5				110		
				3.5	4.0				140		Sample length: 1.6 ft
	15July	4.5	7.0	1.5	27.5			6" Rock Bit			Sandstone and clay: brown, dark
											brown, soft, thinly bedded, very
											fine-grained sandstone.
		7.0	8.0								Clay Shale: grey, soft.
		8.0	9.3								Sandstone: brown, hard, very
											fine-grained.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-10-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		9.3	9.5								Lignite: black, very soft.
		9.5	12.0								Sandstone: brown, grey, very fine-grained, soft.
		12.0	14.5								Shale: brown, grey, soft.
		14.5	17.0								Sandstone: grey, very fine-grained, soft.
		17.0	18.0								Coal: black, very soft, wet.
		18.0	27.5								Siltstone: grey, soft, thinly bedded.
	15 July										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 29 August 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 804.66 Boring No. WES-10-11-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	29Aug	0.0	6.5	0.0	0.5	0.0	2.33	3"ShelbyTube	100	ST	Clay(CL): brown with streaks of
1A				0.5	1.0	2.33	2.48		150	Jar	grey, soft, damp sandy, organic
				1.0	1.5				190		matter (roots) - moist from
				1.5	2.0				250		4.5 ft.
				2.0	2.5				260		Sample length: 2.48 ft.
				0.0	5.0			5"FoldingAuger			Cleanout:
2	29Aug	6.5	8.0	5.0	5.5	5.0	6.49	3" Fixed Piston	100	ST	Gravelly clay (CL): grey with
2A				5.5	6.0	6.49	6.59		140	Jar	streaks of brown, soft, moist
				6.0	6.5				150		gravelly - angular, fine, very
				6.5	7.0				180		fine - grained sandstone.
				7.0	7.5				240		Sample length: 1.59 ft.
	30Aug	8.0	10.0	5.0	10.0			5"FoldingAuger			Clay(CH): grey, dark grey, soft,
											moist.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-11-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	30Aug	10.0	10.3	10.0	20.0			6"Rock Bit			Lignite: black, soft, dry, earthy
		10.3	13.0								Shale: dark grey, soft
		13.0	20.0								Sandstone: reddish brown, brown, and grey, very fine - grained, soft, weathered to 14.5 ft.
	30Aug										Blew water from hole and installed monitoring well.

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Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 30 August 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 822.35 Boring No. WES-10-12-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	30Aug	0.0	3.6	0.0	0.5	0.0	2.38	3" Shelby Tube	80	ST	Clay(CL): brown and grey,
1A				0.5	1.0	2.38	2.48		100	Jar	soft, dry, organic matter
				1.0	1.5				140		(roots).
				1.5	2.0				150		
				2.0	2.5				250		Sample length: 2.48 ft.
				0.0	3.6			5"FoldingAuger			Cleanout
	30Aug	3.6	9.0	3.6	35.0			6" Rock Bit			Sandstone and clay: brown, reddish
											brown, thinly bedded, oxidized,
											soft to hard, weathered, very
											fine-grained sandstone.
		9.0	18.5								Sandstone and Shale: light
											grey and brown, thinly bedded,
											soft, very fine-grained sandstone.

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Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-12-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		18.5	25.0								Sandstone and clay shale: brown, very fine - grained sandstone, soft shale - clay shale, thinly bedded, wet at 25 ft.
		25.0	31.0								Sandstone and shale: light and dark grey, thinly bedded, soft.
		31.0	35.0								Sandstone: brown, very fine-grained, hard.
	31Aug										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 31 August 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 813.17 Boring No. WES-10-13-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	31Aug	0.0	5.0	0.0	0.5	0.0	1.56	3" Shelby Tube	120	ST	Clay (CL): brown, stiff, hard
1A				0.5	1.0	1.56	1.66		180	Jar	brittle, organic matter (roots)
				1.0	1.5				250		
				1.5	2.0				400		
				2.0	2.5				550		Sample length: 1.66 ft.
				0.0	5.0			5"FoldingAuger			Cleanout
	31Aug	5.0	6.0	5.0	27.0			6" Rock Bit			Clay Shale: brown, stiff, hard
		6.0	14.8								Sandstone: brown, reddish brown, soft and weathered to 9 ft - medium to hard from 9 ft., very fine - grained.
		14.8	16.5								Sandstone: light grey, very fine-grained, soft, wet at 16.5 ft.

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Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Location _____ Site _____ Date _____

Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Job No. _____

Boring No. WES-10-13-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		16.5	27.0								Sandstone: brown, soft, very fine - grained.
	1 Sept										Installed monitoring well

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 1 September 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 812.92 Boring No. WES-10-14-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	1 Sept	0.0	1.6	0.0	0.5	0.0	1.85	3" Shelby Tube		ST	Clay(CL): brown, soft to stiff,
				0.5	1.0						contains sandstone fragments, very
				1.0	1.5						fine-grained.
				1.5	2.0						
				2.0	2.5						Sample length: 1.95 ft.
				0.0	3.0			5" Folding Auger			Cleanout
		1.6	21.5	3.0	43.1			6" Rock Bit			Sandstone: brown, light brown, very
											fine-grained, soft, weathered.
		21.5	23.5								Lignite and shale: dark grey and
											black, soft, thinly bedded.
		23.5	29.3								Shale: dark grey, soft, uniform.

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Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-14-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		29.3	29.7								Sandstone: light grey, very fine grained, poorly sorted.
		29.7	31.8								Shale: dark grey, soft
		31.8	32.8								Coal: black, soft, brittle (bituminous.)
		32.8	34.5								Sandstone: light grey, very fine-grained, soft, water at 33 ft.
		34.5	43.1								Sandstone: light grey, brown, thinly bedded with shale, very fine-grained sandstone.

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Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 21 September 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 812.21 Boring No. WES-10-14A-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	21Sept	0.0	1.5	0.0	30.0			6" Rock Bit			Clay(CL) and sandstone: brown, soft to stiff, sandy- very fine-grained, gravelly dry
		1.5	19.8								Sandstone: light brown to brown, very fine-grained, unifrom quartz sandstone, weathered.
		19.8	30.0								Shale and lignite: dark grey to black, thinly bedded, soft, slight amount of water at 20.0 ft.
	22Sept										Left boring open overnight- water at 28.4 ft. Installed well.

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Sheet 1 of 1 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 21 September 1983
Location Rockeye Job No A41-C150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 812.44 Boring No. WES-10-14B-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	21Sept	0.0	1.5	0.0	20.0			6" Rock Bit			Clay(CL) and sandstone: brown, soft to stiff, sandy-very fine-grained, gravelly
		1.5	20.0								Sandstone: light brown to brown, very fine-grained, uniform, quartz sandstone, weathered - water at 20 ft.
	22Sept										Left boring open overnight - water at 12.05 ft. Installed monitoring well.

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Sheet 1 of 1 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-15-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		10.5	16.8								Shale and sandstone: light to dark grey, soft, thinly bedded, very fine - grained sandstone.
		16.8	17.7								Sandstone: light grey, very fine-grained, hard.
		17.7	26.4								Shale: dark grey, soft
		26.4	28.4								Coal: black, soft, brittle (bituminous)- wet at 28.4 ft.
		28.4	36.0								Shale: dark grey, soft
		36.0	37.4								Coal: black, soft, brittle (bituminous)

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Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-15-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		37.4	38.8								Sandstone: light grey, soft, very fine-grained
	2 Sept										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 6 September 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 785.42 Boring No. WES-10-16-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
1	6Sept	0.0	2.50	0.0	2.5	0.0	1.95	3" Shelby Tube		ST	Fill(Gravelly Sand): brown,
1A						1.95	2.05			Jar	very fine-grained sand and sand-
											stone gravel, dry, soft to stiff,
											poorly sorted.
											Sample length: 2.05 ft.
				0.0	2.5			5" Folding Auger			Cleanout: weathered rock at 2.5ft.
				2.5	3.0			6" Rock Bit			Cleanout for core barrel.
				3.0	8.0	3.0	3.8	4x5 1/2" Core Barrel		Run 1	See boring log
	7 Sept			8.0	13.0	11.2	13.0	" "		Run 2	
				13.0	18.0	13.0	18.0	" "		Run 3	
				18.0	23.0	18.0	23.0	" "		Run 4	Water at 23 ft.
				23.0	27.5	23.0	27.5	" "		Run 5	
				27.5	32.75	27.5	32.75	" "		Run 6	
				32.75	34.2	32.75	34.2	" "		Run 7	

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Sheet 1 of 5 Sheets

Hole No. WES-10-16-83

DRILLING LOG	DIVISION U. S. Navy	INSTALLATION Crane, IN	SHEET 2 OF 5 SHEETS

1. PROJECT NWSC Ground-water Study	10. SIZE AND TYPE OF BIT 4x5½-in diamond
2. LOCATION (Coordinates or Station) Rockeye	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CEWES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-10-16-83	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED one; UNDISTURBED zero
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER --
	16. DATE HOLE: STARTED 6 September 83; COMPLETED 8 September 83
7. THICKNESS OF OVERBURDEN 2.5 ft	17. ELEVATION TOP OF HOLE 785.42 ft MSL
8. DEPTH DRILLED INTO ROCK 31.7 ft	18. TOTAL CORE RECOVERY FOR BORING 76.3%
9. TOTAL DEPTH OF HOLE 34.2 ft	19. SIGNATURE OF INSPECTOR [illegible]

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
782.42	3		—fractured			
781.42	4		Sandstone: brown, reddish brown, soft to stiff, weathered, very fine-grained, very friable, clayey, contains oxidized ferruginous concreations, thinly bedded- loss cause by air breaking up rock.			6 September 83
780.42	5					NL -- Run 1 Began 2:23 Roc 0.8' End 3:25 Loss 4.2' Time 57 min Gain -- Drl time 57 min Hyd press 100 PSI Water press -- RPM 50+ Drl Action Smooth Water ret Brown Remarks
779.42	6		Loss			
778.42	7					Reamed hole with 6 3/4" rock bit.
777.42	8		Run 1 RQD=0.0	16%	--	
776.42	9		Sandstone: see above			7 September 83
775.42	10			36%		NL Run 2 Began 9:51 Roc 1.8' End 10:28 Loss 3.2' Time 37 min Gain -- Drl time 37 min Hyd press 150+ Water press -- RPM 100 + Drl Action Smooth Water ret brown, grey Remarks
774.42	11		Sandstone(80%) and shale(20%): brown, reddish brown, and light grey sandstone thinly bedded with dark grey shale; sandstone is very fine-grained, weathered, and oxidized, shale is soft with breaks occuring in the shale, bedding ranges from 1/32" to 1" in thickness			
773.42	12					
772.42	13		-continued on next page-			

Hole No. NES-10-16-83

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED / UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE: STARTED / COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
772.42	13		-continued from previous page- and horizontal in attitude.			
771.42	14		Sandstone(95%) and shale(5%): light grey, uniform sandstone thinly bedded with very fine lamina of grey and dark grey shale; sandstone is very fine-grained and slightly weathered, bedding is horizontal in attitude.			NL Run 3 Began 10:45 Rec 5.0' End 11:11 Loss -- Time 26 min Gain -- Drl time 26 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret grey Remarks
770.42	15					
769.42	16					
768.42	17					
767.42	18		Run 3 RQD=74%	100%		
766.42	19		Sandstone(95%) and shale(5%): see above.			NL Run 4 Began 11:26 Rec 5.0' End 11:55 Loss -- Time 29 min Gain -- Drl time 29 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret grey Remarks Water at end of run.
765.42	20					
764.42	21					
763.42	22					
762.42	23		Run 4 RQD=88%	100%		

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Hole No. WES-10-16-83

DRILLING LOG	DIVISION	INSTALLATION	SHEET 4 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TUM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE — STARTED — COMPLETED
7. THICKNESS OF OVERBURDEN	17. ELEVATION TOP OF HOLE
8. DEPTH DRILLED INTO ROCK	18. TOTAL CORE RECOVERY FOR BORING %
9. TOTAL DEPTH OF HOLE	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
762.42	23		oxidized-light orange			
			Sandstone(95%) and shale(5%): see above			
761.42	24					
			fractured			
			oxidized- light orange			
760.42	25		cavity with clay filling			
			closed breaks			
759.42	26					
			cavity			
			oxidized-light orange			
758.41	27					
			Run 5 RQD=31.1%	100%		
			fractured			
757.42	28					
			fractured			
756.42	29		Sandstone(95%) and shale-lignite/coal(5 %): light grey, uniform, very fine-grained sandstone, thinly bedded with shale, coal, and lignite			
755.42	30		fractured			
			closed breaks			
754.42	31					
			cavity			
753.42	32		fractured			
			Run 6 RQD=48.6%	100%		
752.42	33					

Run 5
AL --
Began 1:48 Rec 4.5'
End 1:59 Loss --
Time 11 min Gain --
Drl time 11 min
Hyd press 150 PSI
Water press --
RPM 100+
Drl Action Smooth
Water ret
Grey
Remarks
Drilled with water.

Run 6
AL --
Began 2:25 Rec 5.25'
End 2:37 Loss --
Time 12 min Gain --
Drl time 12 min
Hyd press 150 PSI
Water press --
RPM 100+
Drl Action Smooth
Water ret
Grey
Remarks

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) HOLE NO.

Hole No. WES-10-16-83

DRILLING LOG	DIVISION	INSTALLATION	SHEET 5 OF 5 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TUM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
	15. ELEVATION GROUND WATER
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	16. DATE HOLE — STARTED — COMPLETED
	17. ELEVATION TOP OF HOLE
7. THICKNESS OF OVERBURDEN	18. TOTAL CORE RECOVERY FOR BORING %
8. DEPTH DRILLED INTO ROCK	19. SIGNATURE OF INSPECTOR
9. TOTAL DEPTH OF HOLE	

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
752.42	33		Sandstone(90%) and shale-lignite/coal(10%): see above			
751.42	34		Run 7 RQD=31%			NL -- Run 7 Began 2:57 Rec 1.45' End 3:01. Loss -- Time 4 min Gain -- Drl time 4 min Hyd press 100 PSI Water press -- RPM 100+ Drl Action Smooth Water ret Grey
			8 Sept 83 Installed well after blowing water from boring several times			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE. (TRANSLUCENT) PROJECT HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 9 September 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 776.60 Boring No. WES-10-17-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont.	CLASSIFICATION AND REMARKS
1	9 Sept	0.0	3.0	0.0	0.5	0.0	2.33	3" Shelby Tube	120	ST	Clayey Sand (SC): brown, reddish
1A				0.5	1.0	2.33	2.48		140	Jar	brown, soft to slightly stiff,
				1.0	1.5				180		slight cohesion, damp, contains
				1.5	2.0				240		very fine-grained sandstone gravel.
				2.0	2.5				460		Sample length: 2.48 ft.
				0.0	3.0			5" Folding Auger			Cleanout
	9 Sept	3.0	8.6	3.0	10.0			6" Rock Bit			Sandstone and clay: brown, very
											fine - grained, quartz, weathered
											sandstone thinly bedded with soft
											brown and grey clay.
	10 Sept	8.6	21.5	10.0	25.0			6" Rock Bit			Sandstone: light to dark brown,
											soft, weathered, very fine -
											grained, quartz sandstone, wet
											at 13 ft.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-17-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		21.5	25.0								Shale and sandstone: dark grey shale thinly bedded with light grey, very fine grained, soft sandstone.
	10Sept										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 10 September 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 774.09 Boring No. WES-10-18-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
1	10Sept	0.0	4.8	0.0	0.5	0.0	1.73	3" Shelby Tube	80	ST	Fill-sandy clay (CL): brown,
1A				0.5	1.0	1.73	1.83		90	Jar	soft, sandy, low plasticity.
				1.0	1.5				140		
				1.5	2.0				280		
				2.0	2.5				300		Sample length: 1.83 ft.
	10Sept			0.0	4.8			5"FoldingAuger			Cleanout
	10Sept	4.8	6.8	4.8	25.0			6" Rock Bit			Sandstone and clay: brown, reddish
											brown, very fine - grained
											predominantly quartz, weathered,
											sandstone thinly bedded with soft
											sandy clay.
		6.8	21.0								Sandstone: light grey, light brown,
											brown, weathered, oxidizied, very
											fine-grained, predominantly

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-18-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
											quartz sandstone, wet at 13 ft.
		21.0	24.5								Shale: dark grey, soft
		24.5	25.0								Sandstone: grey, very fine - grained, soft.
	10Sept										Installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 12September1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 783.60 Boring No. WES-10-19-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER	Hyd Press	Cont	CLASSIFICATION AND REMARKS
1	12Sept	0.0	4.0	0.0	0.5	0.0	2.24	3" Shelby Tube		ST	Sandy clay (CL): brown, soft,
1A				0.5	1.0	2.24	2.34			Jar	damp, sandy - very fine-grained,
				1.0	1.5						organic matter.
				1.5	2.0						
				2.0	2.5						Sample length: 2.34 ft.
				0.0	5.0			5"FoldingAuger			Cleanout
2A	12Sept	4.0	5.65	5.0	5.5	5.0	5.65	3" Fixed Piston		Jar	Sandy clay (CL) and sandstone
				5.5	5.65						gravel: brown and grey, soft
											clay mixed with very fine - grained
											sandstone gravel (fine - medium),
											moist - water at 5.65 ft.
	12Sept	5.65	7.6	5.0	22.0			6" Rock Bit			Sandstone and clay: brown, soft
											weathered, very fine - grained
											sandstone, thinly bedded.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-19-83

SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		7.6	9.2								Sandstone: brown, soft, weathered very fine - grained.
		9.2	9.6								Clay: grey, soft.
		9.6	12.0								Shale: dark grey, soft.
		12.0	12.6								Shale and coal: black and dark grey, thinly bedded, very soft.
		12.6	14.9								Shale: dark grey, soft
		14.9	15.5								Shale and sandstone: brown, grey, dark grey, thinly bedded, very fine - grained, soft.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 3 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-19-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
		15.5	22.0								Sandstone: brown, very fine - grained, soft.
	12Sept										Installed monitoring well

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 3 of 3 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground-water Study Site Crane, IN Date 13September1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 802.86 Boring No. WES-10-20-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	13Sept	0.0	8.2	0.0	0.7			5"FoldingAuger			Sandy clay (CL) and sandstone gravel: brown, soft to stiff; fine to coarse, very fine-grained weathered sandstone gravel, organic matter, damp-bent auger.
	13Sept	8.2	29.0	0.0	39.0			6" Rock Bit			Sandstone: brown, tan, reddish brown, pink, uniform very fine-grained quartz sandstone, soft, water at 29 ft.
		29.0	32.0								Shale: dark grey, soft
		32.0	34.0								Coal: black, soft, brittle, uniform (bituminous)
		34.0	39.0								Sandstone, Siltstone, and Shale:

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-20-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
											light to dark grey, very thinly bedded, soft
	13Sept										Installed monitoring well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 14September 1983
Location Rockeye Job No. 441-G150.13GR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 781.56 Boring No. WES-10-21-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	14Sept	0.0	3.0	0.0	5.0			6" Rock Bit			Sandy clay(CL): brown, soft to stiff, damp, sandy-very fine-grained.
	14Sept			5.0	7.6	5.0	7.6	4x5 1/2 Core Barrel		Run1	See boring log
				7.6	10.35	7.6	10.35	" "		Run2	
				10.35	14.95	10.35	14.95	" "		Run3	
	15Sept			14.95	16.5	14.95	16.5	" "		Run4	
				16.5	21.45	16.5	21.45	" "		Run5	
				21.45	24.7	21.45	24.7	" "		Run6	Bottom depth at 25 ft.
	15Sept										Installed monitoring well

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 3 Sheets

Hole No. WES-10-21-83

DRILLING LOG	DIVISION U. S. Navy	INSTALLATION Crane, IN	SHEET 2 OF 3 SHEETS

1. PROJECT NWSC Ground-water Study	10. SIZE AND TYPE OF BIT 4x5½" Diamond
2. LOCATION (Coordinates or Station) Rockeye	11. DATUM FOR ELEVATION SHOWN (TBM or MSL) MSL
3. DRILLING AGENCY CERES	12. MANUFACTURER'S DESIGNATION OF DRILL Failing 1500
4. HOLE NO. (As shown on drawing title and file number) WES-10-21-83	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN: DISTURBED zero; UNDISTURBED zero
5. NAME OF DRILLER C. Drake	14. TOTAL NUMBER CORE BOXES zero
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
	16. DATE HOLE: STARTED 14 September83; COMPLETED 15September83
7. THICKNESS OF OVERBURDEN 3.0 ft	17. ELEVATION TOP OF HOLE 781.56
8. DEPTH DRILLED INTO ROCK 22.5 ft	18. TOTAL CORE RECOVERY FOR BORING 100% %
9. TOTAL DEPTH OF HOLE 25.0 ft	19. SIGNATURE OF INSPECTOR Joseph B. Drake

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
776.56	5		Machine fractured			14 September 83
			closed break			WL -- Run 1
			sandy clay shale: brown, very weathered, sandy- 30-40% very fine-grained, stiff to very stiff, damp, thinly bedded.			Began 1:10 Rec 1.6' End 1:15 Loss -- Time 15 min Gain -- Drl time 15 min Hyd press 100 PSI Water press -- RPM 100+ Drl Action Smooth Water ret Brown Remarks
775.56	6		Run 1 RQD=87.5%	100%		
774.56	7		fractured			
			closed break			
			clay shale and sandstone: brown, light brown, thinly bedded, very weathered, stiff to hard, very fine- grained sandstone.			
773.56	8					
			Sandstone: brown-reddish brown, very weathered, very fine-grained, clayey, oxidized, hard.			WL -- Run 2 Began 1:47 Rec 3.75' End 2:15 Loss -- Time 28 min Gain -- Drl time 28 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret Brown and grey Remarks
772.56	9					
			Clay shale: brown, light brown, reddish brown, very thinly bedded, very weathered, soft to very stiff.			
771.56	10		Shale: black or dark grey, soft thinly bedded.			
			Run 2 RQD=85.3%	100%		
			Machine breaks			
770.56	11		Shale(90%) and sandstone(10%): dark grey, and light grey, thinly bedded.			
			highly weathered and oxidized-solution channeling and wet.			
			Shale(90%) and lignite/coal(10%): dark grey and black, thinly bedded.			WL -- Run 3 Began 2:34 Rec 4.6' End 2:53 Loss -- Time 19 min Gain -- Drl time 19 min Hyd press 150 PSI Water press -- RPM 100+ Drl Action Smooth Water ret grey Remarks Water at end of run reamed hole with 6 3/4-in bit to 8.0 ft and installed section of 6-in casing.
769.56	12					
			Slight weathering and oxidation.			
			Shale: black and dark grey, uniform, soft.			
768.56	13					
767.56	14					
			Machine break			
766.56	15		Run 3 RQD=84.8%	100%		

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) HOLE NO.

Hole No. WES-10-21-83

DRILLING LOG	DIVISION	INSTALLATION	SHEET 3 OF 3 SHEETS

1. PROJECT	10. SIZE AND TYPE OF BIT
2. LOCATION (Coordinates or Station)	11. DATUM FOR ELEVATION SHOWN (TBM or MSL)
3. DRILLING AGENCY	12. MANUFACTURER'S DESIGNATION OF DRILL
4. HOLE NO. (As shown on drawing title and file number)	13. TOTAL NO. OF OVER-BURDEN SAMPLES TAKEN — DISTURBED — UNDISTURBED
5. NAME OF DRILLER	14. TOTAL NUMBER CORE BOXES
6. DIRECTION OF HOLE ☐ VERTICAL ☐ INCLINED ____ DEG. FROM VERT.	15. ELEVATION GROUND WATER
7. THICKNESS OF OVERBURDEN	16. DATE HOLE — STARTED — COMPLETED
8. DEPTH DRILLED INTO ROCK	17. ELEVATION TOP OF HOLE
9. TOTAL DEPTH OF HOLE	18. TOTAL CORE RECOVERY FOR BORING %
	19. SIGNATURE OF INSPECTOR

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
776.56	15		Sandstone(60%) and shale(40%): light grey, very fine-grained sandstone thinly bedded with soft, dark grey to black shale, bedding ranges from 1/32-in to ½-in. in thickness and nearly horizontal in attitude.			15 September 83
775.56	16		Run 4 RQD=100%			AL-- Run 4 Began 9:51 Rec 1.55' End 9:59 Loss -- Time 8min Gain -- Drl time 8 min Hyd press 200 PSI Water press -- RPM 150± Drl Action Smooth Water ret Grey Remarks Drilled with water.
			Machine fractured			
774.56	17		Sandstone(60%) and shale(40%): see above			
773.56	18					
772.56	19		closed breaks			AL Run 5 Began 10:13 Rec 4.95' End 10:38 Loss -- Time 25 min Gain -- Drl time 25 min Hyd press 150 PSI Water press -- RPM 150± Drl Action Smooth Water ret Brown and grey Remarks
771.56	20		Shale: dark grey or black, soft, uniform.			
770.56	21		Sandstone(95%) and shale(5%): light brown, very fine-grained, uniform, thinly bedded with soft, grey shale, oxidized.			
			Run 5 RQD=85.9%	100%		
769.56	22		Sandstone and shale: see above.			
768.56	23		Sandstone(95%) and shale(5%): light grey, very fine-grained, uniform sandstone thinly bedded with 1/32-in to 1/16-in dark grey shale seams.			AL Run 6 Began 11:16 Rec 3.25' End 11.28 Loss -- Time 12 min Gain -- Drl time 12 min Hyd press 200 PSI Water press -- RPM 150± Drl Action Smooth Water ret Grey and brown Remarks
			breaks at shale seams			
767.56	24		Sandstone(95%) and shale(5%): see above.			
			Run 6 RQD=93.8%	100%		
766.56	25		Bottom of boring at 25 ft.			

ENG FORM 1836 MAR 71 PREVIOUS EDITIONS ARE OBSOLETE (TRANSLUCENT) PROJECT HOLE NO.

BORING LOG
FIELD DATA

Project NWSC Ground - Water Study Site Crane, IN Date 16September1983
Location Rockeye Job No. 441-C150-13CR21/22
Drill Rig Failing Inspector J. Dunbar Operator C. Drake Surface El 822.98 Boring No. WES-10-22-83

SAMPLE NUMBER	DATE TAKEN 1983	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
	16Sept	0.0	5.5	0.0	30.0			6" Rock Bit			Sandy clay(CL): brown, soft to stiff, damp, organic matter (roots), sandy-very fine-grained sand.
		5.5	6.0								Clay: light grey, soft, sandy.
		6.0	12.1								Sandstone: light brown, brown, light grey, very fine-grained, thinly bedded, soft.
		12.1	14.5								Sandstone, shale, and coal (slight): light to dark grey and black, very thinly bedded, soft, very fine-grained sandstone.
		14.5	18.4								Sandstone: light brown and light

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 1 of 2 Sheets

BORING LOG
FIELD DATA

Project _____ Site _____ Date _____
Location _____ Job No. _____
Drill Rig _____ Inspector _____ Operator _____ Surface El _____ Boring No. WES-10-22-83

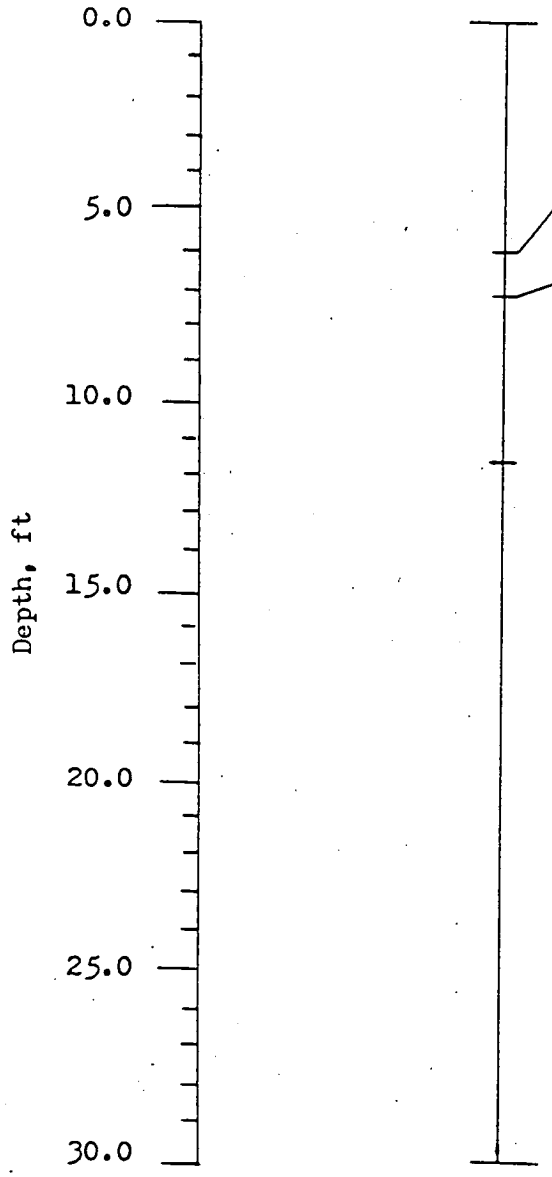
SAMPLE NUMBER	DATE TAKEN	STRATUM FROM	STRATUM TO	DRIVE FROM	DRIVE TO	SAMPLE FROM	SAMPLE TO	TYPE OF SAMPLER			CLASSIFICATION AND REMARKS
											grey or white, very hard, uniform, quartz sandstone.
		18.4	20.9								Shale: grey, soft, wet at 20 ft.
		20.9	24.2								Sandstone and shale: light to dark grey, soft, thinly bedded, very fine-grained sand.
		24.2	25.7								Sandstone: light grey, very fine-grained, soft.
		25.7	30.0								Sandstone and shale: light to dark grey, thinly bedded, soft, very fine-grained sandstone.
	20Sept										Installed well.

WES FORM JAN 74 819 EDITION OF NOV 1971 MAY BE USED

Sheet 2 of 2 Sheets

APPENDIX A2

Graphical Representations of the Lithologies at Each Monitoring Well



738.66' MSL

Clay (CL): brown in color, soft, low plasticity, and slight organic matter.

Silty sand (SM): brown in color, slight cohesion, and contains 25% weathered sandstone fragments.

Sandstone: light brown to grey in color, uniform, fine-grained, dry, friable, and weathered.

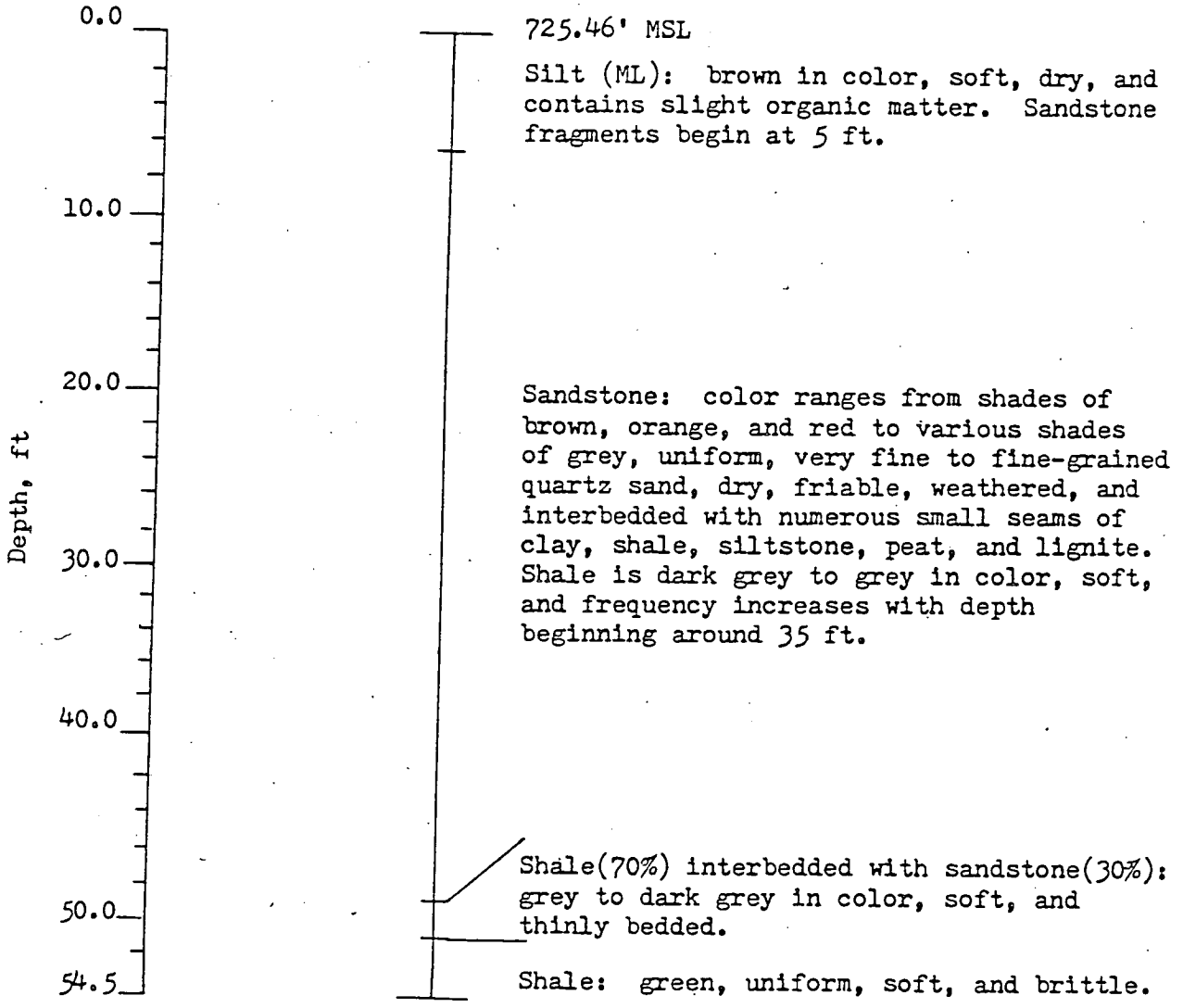
Sandstone: light brown to grey in color, fine-grained, and hard.

NWSC, Crane, Indiana

Dye Burial Grounds

Lithology

Boring Number: WES-2-1-81

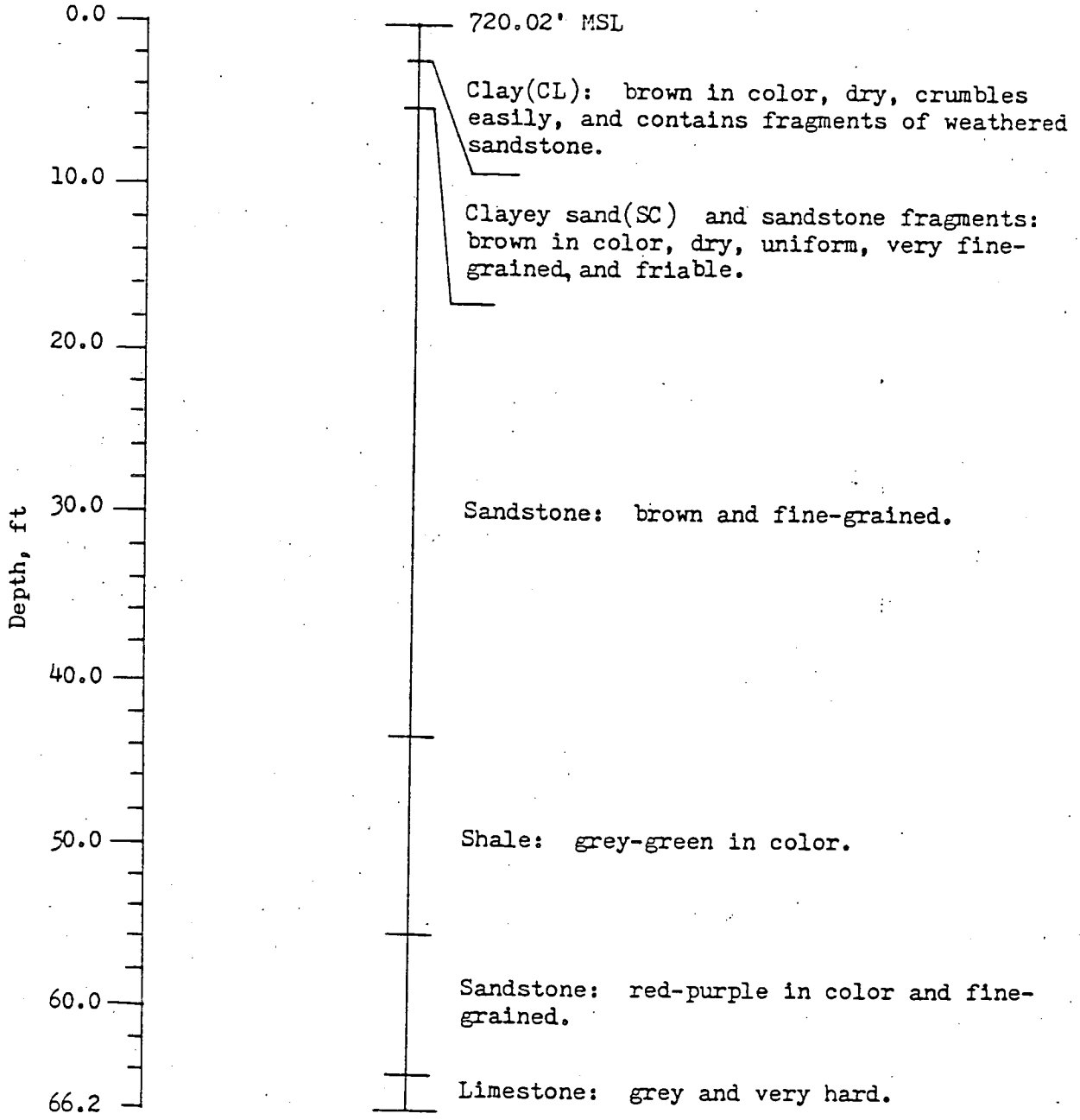


NWSC, Crane, Indiana

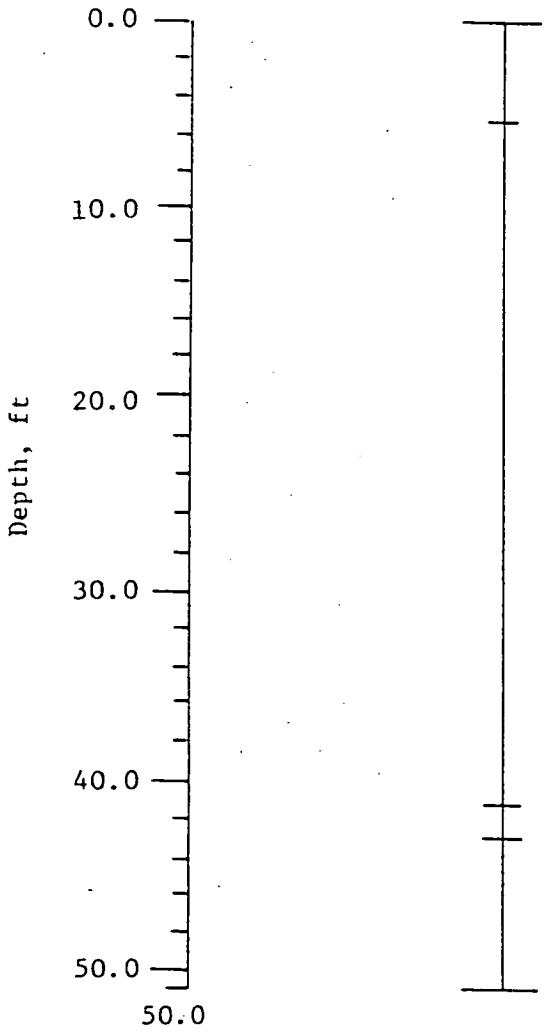
Dye Burial Grounds

Lithology

Boring Number: WES-2-2-81



NWSC, Crane, Indiana
Dye Burial Grounds
Lithology
Boring Number: WES-2-3-81



716.66' MSL

Silt (ML): brown to grey in color, no cohesion, dry, very uniform in grain size, texture, and composition. Sandstone fragments begin at 3.75 ft.

Sandstone: brown in color and fine-grained.

Shale: green and soft.

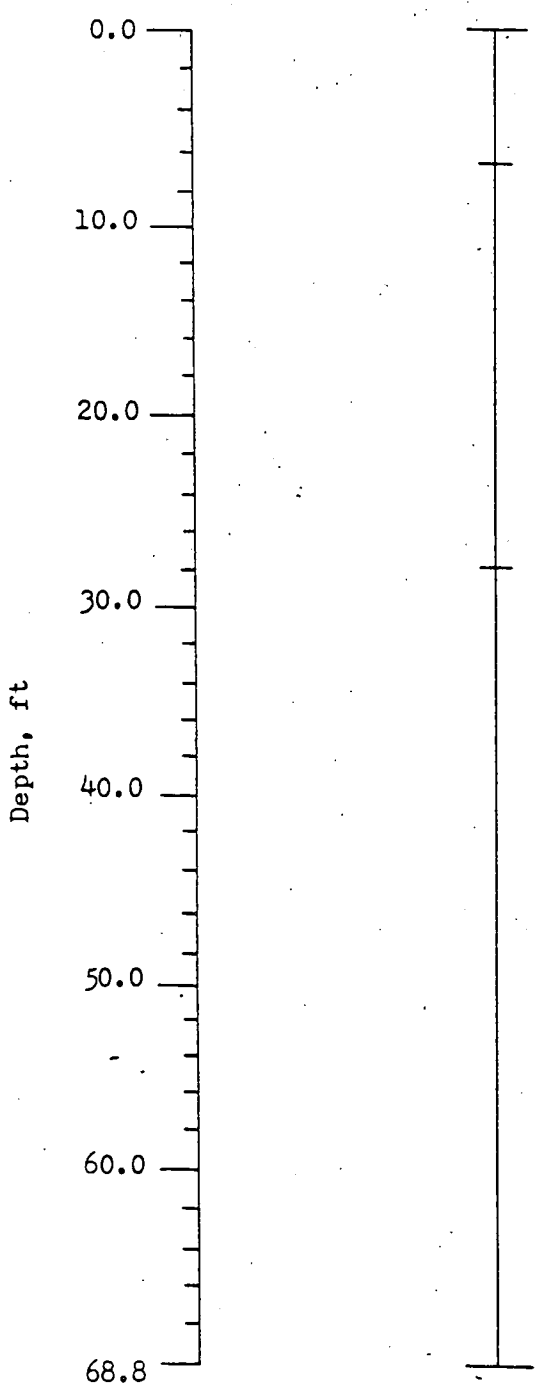
Shale: green and hard.

NWSC, Crane, Indiana

Dye Burial Grounds

Lithology

Boring Number: WES-2-4-81



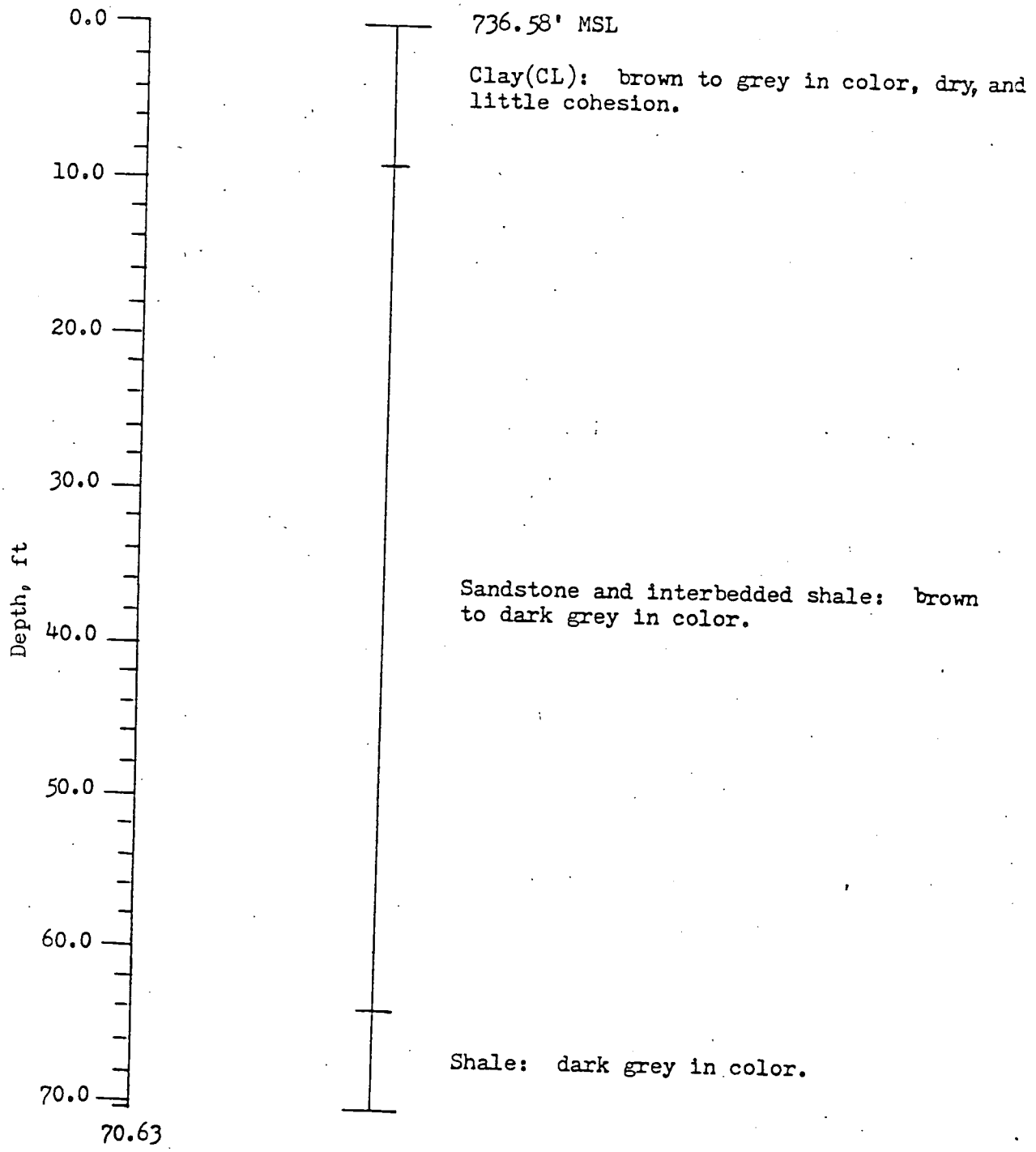
739.24' MSL

Clay (CL): brown in color, soft, dry, moderately cohesive, and slight organic matter. Sandstone fragments begin at 5 ft.

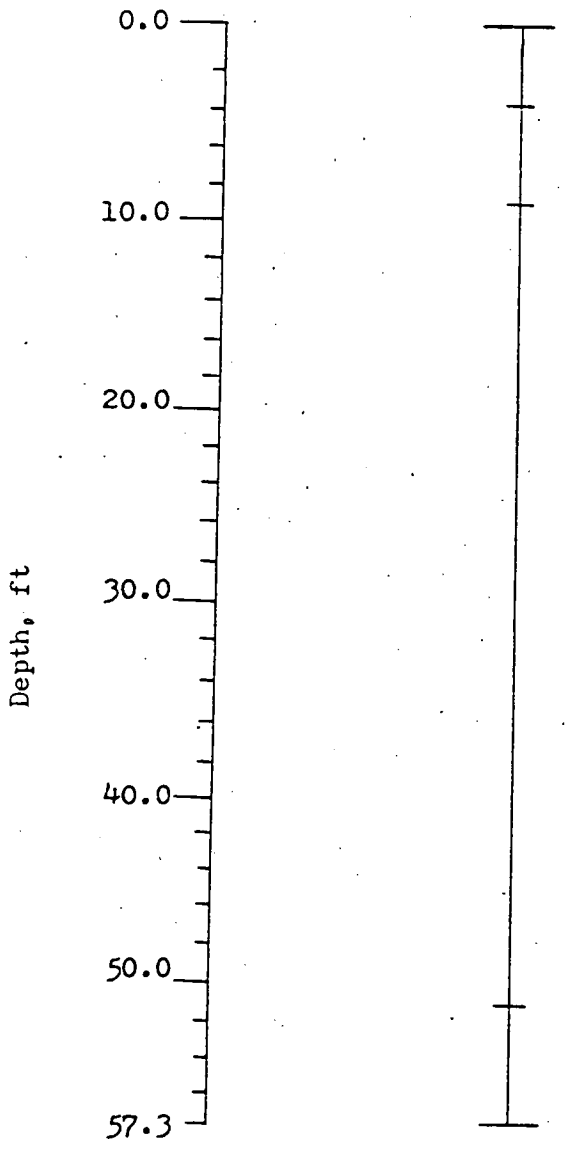
Sandstone: red to brown in color and fine-grained.

Interbedded sandstone, shale, and limestone.

NWSC, Crane, Indiana
Dye Burial Grounds
Lithology
Boring Number: WES-2-5-81



NWSC, Crane, Indiana
Dye Burial Grounds
Lithology
Boring Number: WES-2-6-81



728.73' MSL

Silty sand (SM): brown, dry, hard, and contains 5% very fine gravel.

Sandstone: brown in color and weathered.

Sandstone and interbedded dark grey shale: brown, tan, grey, and white in color, soft to very hard.

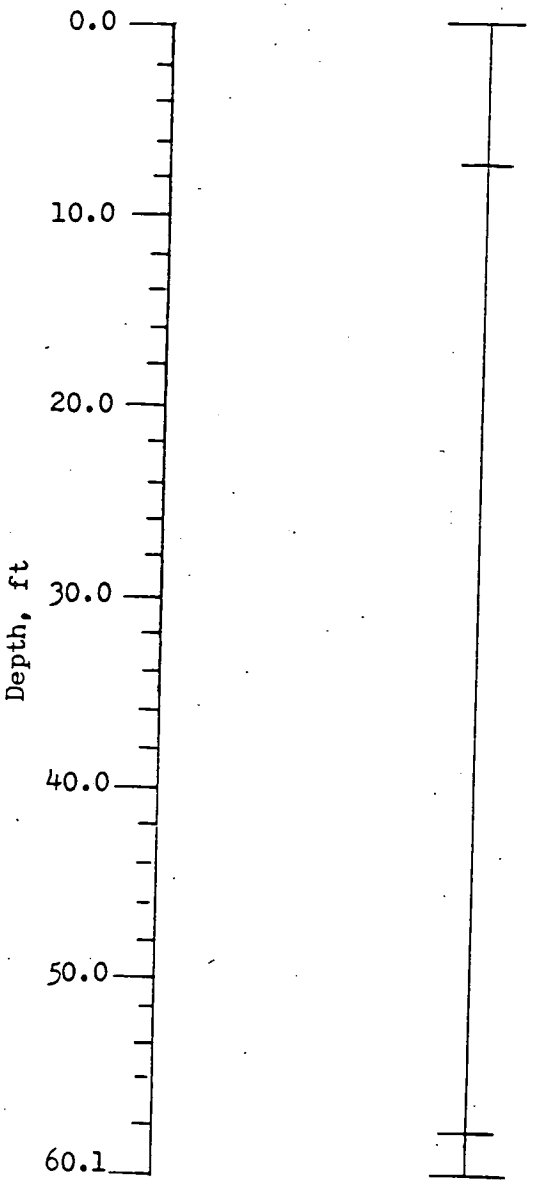
Shale and interbedded sandstone: dark grey in color.

NWSC, Crane, Indiana

Dye Burial Grounds

Lithology

Boring Number: WES-2-7-81



730.29' MSL

Silty clay(CL): light brown to brown, dry, moderate cohesion, uniform, and slightly stiff.

Sandstone and interbedded dark grey shale: color ranges from white, grey, brown, and reddish brown.

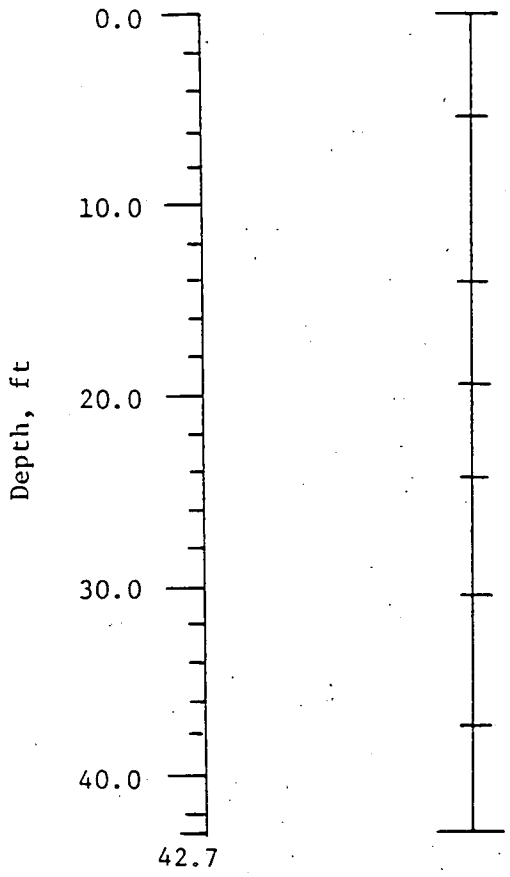
Shale: dark grey in color.

NWSC, Crane, Indiana

Dye Burial Grounds

Lithology

Boring Number: WES-2-8-81



603.49' MSL

Silt (ML): brown in color, slightly moist, little cohesion, slightly gritty, and contains organic matter.

Silty sand (SM): reddish brown in color, very uniform, fine-grained, little cohesion, and dry.

Gravelly sand (SP): reddish brown in color, fine to coarse-grained sand, very fine gravel, slightly moist, and no cohesion.

Sand (SP): brown in color, fine to medium quartz sand, slight moisture, and very little cohesion.

Silty sand (SM): brown in color, fine-grained quartz sand, slight moisture, little cohesion, and 30% silt.

Silt (ML): brown in color, very moist, moderately cohesive, and contains 1-2% very fine gravel.

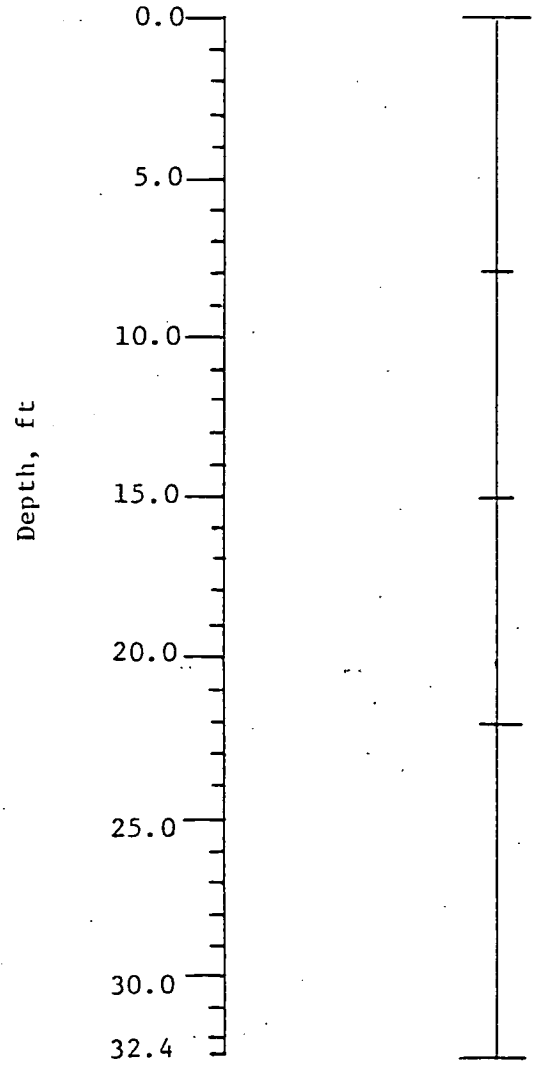
Clay silt (ML): grey in color, moist, and moderately cohesive.

NWSC, Crane, Indiana

McComish Gorge

Lithology

Boring Number: WES-4-1-81



585.69' MSL

Gravelly sand (SP): brown in color, dry, no cohesion, and fine to coarse-grained sand with 10-20% fine to medium gravel.

Silty sand (SM): brown in color, slight moisture, and slight cohesion.

Clay silt (ML): brown in color, moderately cohesive, and slight moisture. Material is very moist around 20 ft.

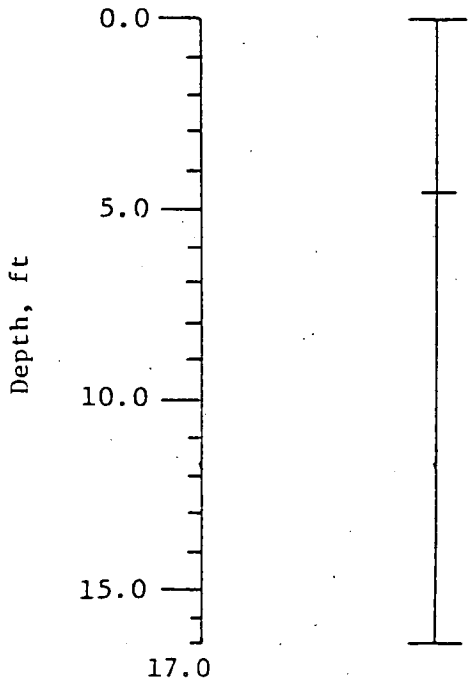
Silty sand (SM): grey in color, very fine-grained sand, uniform, moderately cohesive, and moist.

NWSC, Crane, Indiana

McComish Gorge

Lithology

Boring Number: WES-4-2-81



566.22' MSL

Silty sand (SM): brown in color, damp, fine-grained, moderate cohesion, and contains 30 to 40% silt.

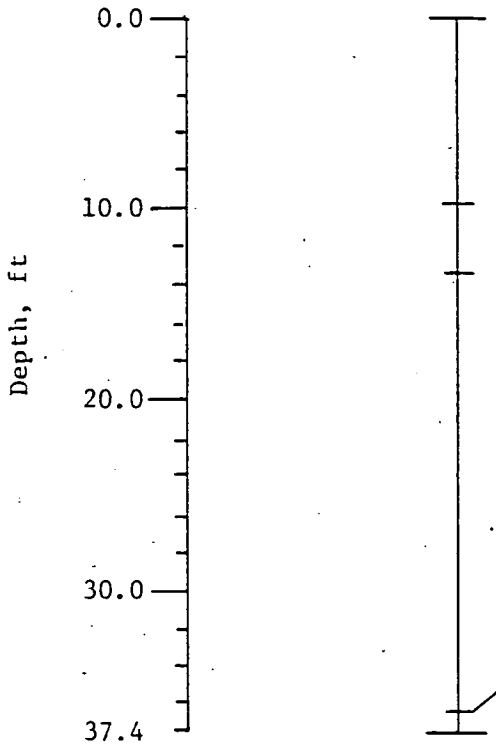
Silty sand (SM): grey in color, fine-grained, wet, moderate cohesion, and contains 30 to 40% silt.

NWSC, Crane, Indiana

McComish Gorge

Lithology

Boring Number: WES-4-3-81



593.14' MSL

Clay (CL): brown in color, dry, uniform, slightly stiff, and slight to moderate cohesion.

Silt (ML): brown in color, dry, uniform, and slight cohesion.

Sand (SP): reddish brown to brown in color, fine-grained quartz sand, uniform, and wet from 26.9 ft.

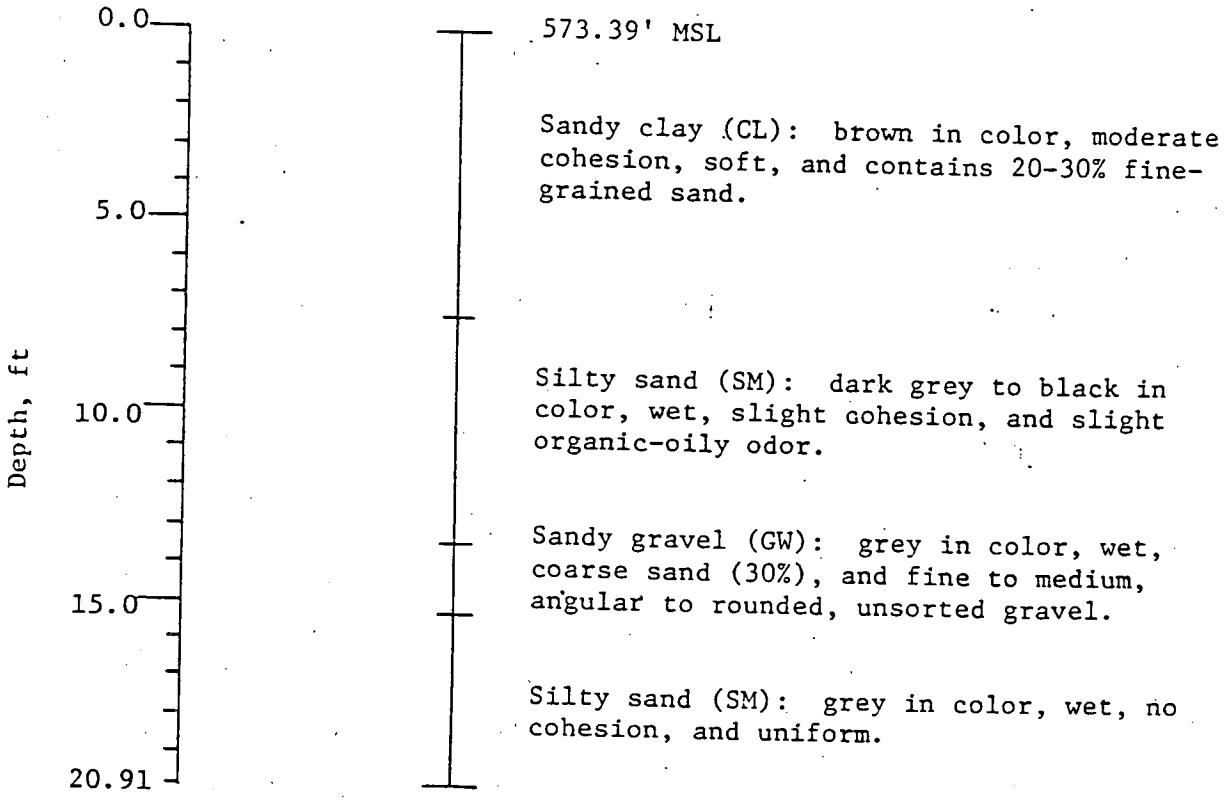
Clay (CL): grey in color, soft, very uniform texture, and uniform consistency.

NWSC, Crane, Indiana

McComish Gorge

Lithology

Boring Number: WES-4-4-81

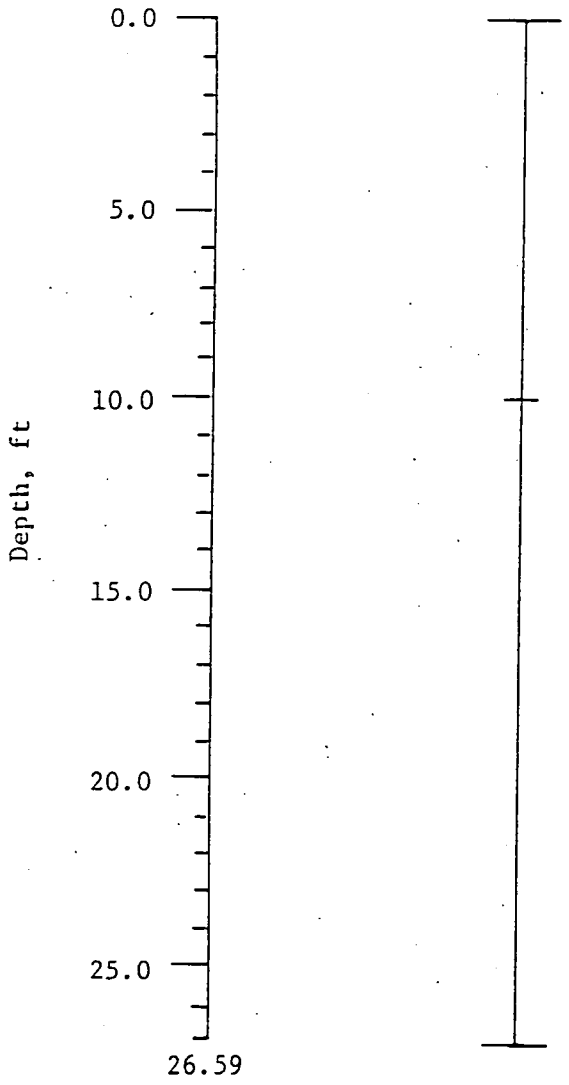


NWSC, Crane, Indiana

McComish Gorge

Lithology

Boring Number: WES-4-5-81



579.54' MSL

Sand (SP): reddish brown to brown in color, dry, uniform, slight cohesion, and fine to medium grained.

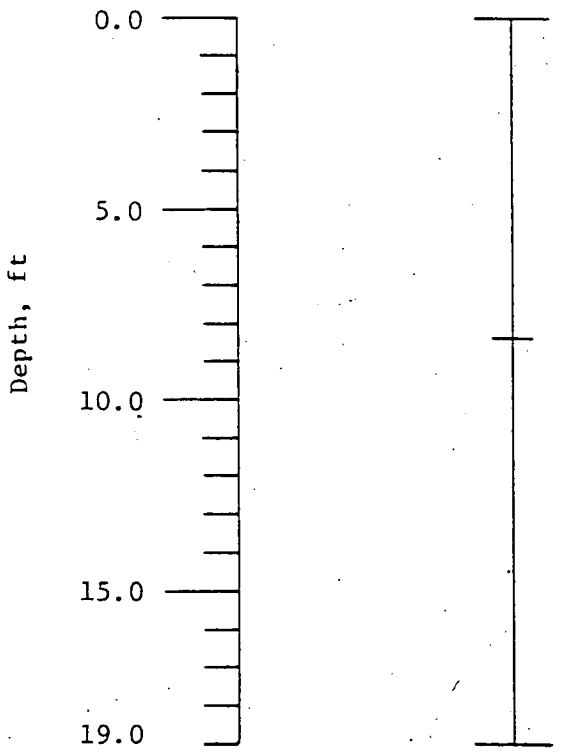
Silty sand (SM): brown in color, uniform, very fine-grained, slight cohesion, and wet from 17.35 ft. Material changes to grey color at 24.2 ft.

NWSC, Crane, Indiana

McComish Gorge

Lithology

Boring Number: WES-4-6-81



682.63' MSL

Clay (CL): brown to grey in color, dry, moderate cohesion, organic matter, and contains 5-10% very fine, angular to rounded gravel from 5 ft.

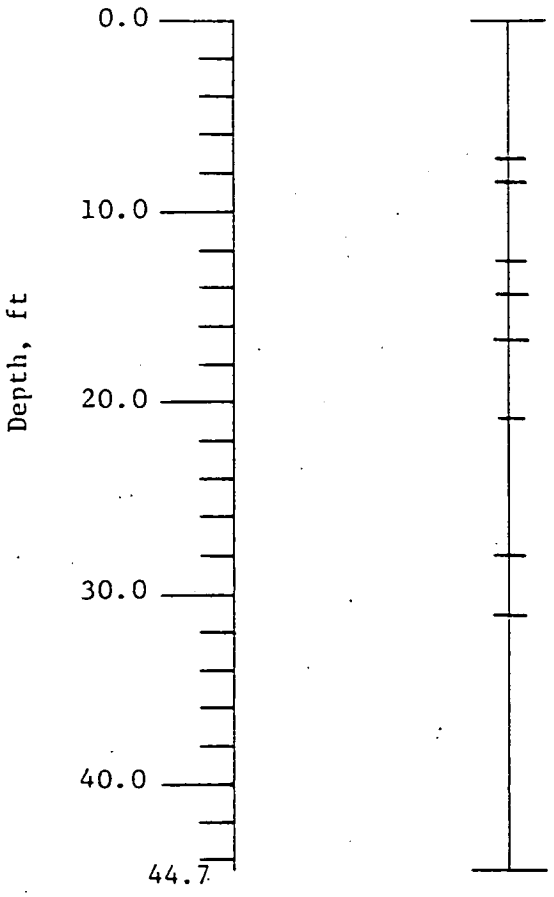
Sandstone: reddish brown in color and fine-grained.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-1A-81



683.27' MSL

Clay (CL): brown in color, very stiff, dry, and low plasticity.

Clay shale: reddish brown.

Sandstone: light grey and hard.

Shale: brown and grey.

Sandstone and shale: light grey.

Shale: grey and hard.

Sandstone: light grey, fine-grained, and very hard.

Shale: dark grey.

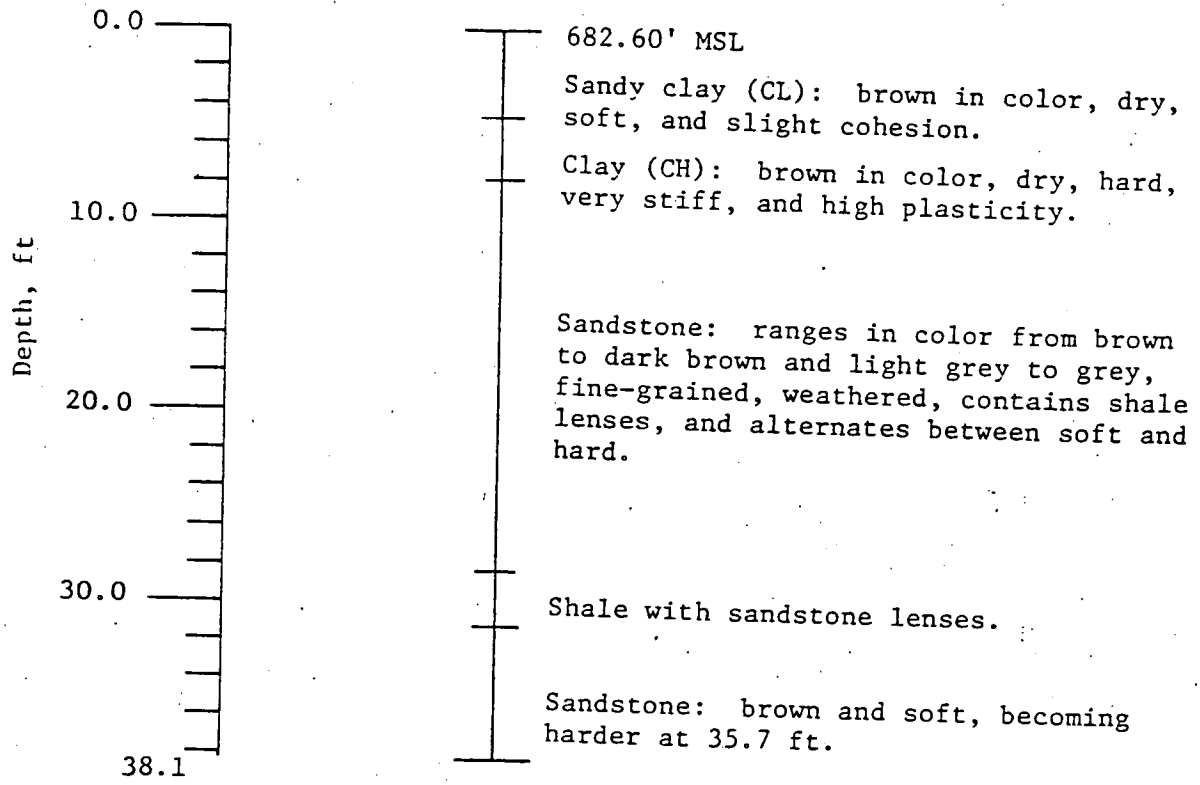
Sandstone: brown and fine-grained.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-1B-81

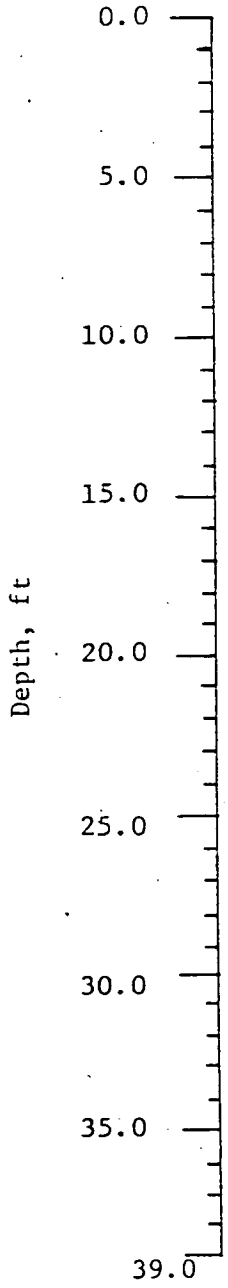


NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-1C-81



637.53' MSL

Clay (CL): brown in color, soft, little cohesion, uniform, slightly damp, and organic matter. Sandstone fragments start around 5 ft.

Sandstone: brown fine-grained, weathered, and friable.

Shale: brown, grey to dark grey, dry, and very soft to soft.

Sandstone and interbedded shale: sandstone is brown in color, fine-grained, moderately friable, and weathered. Shale averages around 20% of interval with thickness ranging from 1/16-1/4 in. and frequency increasing with depth.

Shale: dark grey in color, soft, organic matter, slightly moist, and weathered.

Sandstone and interbedded shale: sandstone ranges from brown to grey, to light grey, fine-grained, and moderately hard to hard. Shale is grey to dark grey in color, soft, and content is about 10-20% of interval.

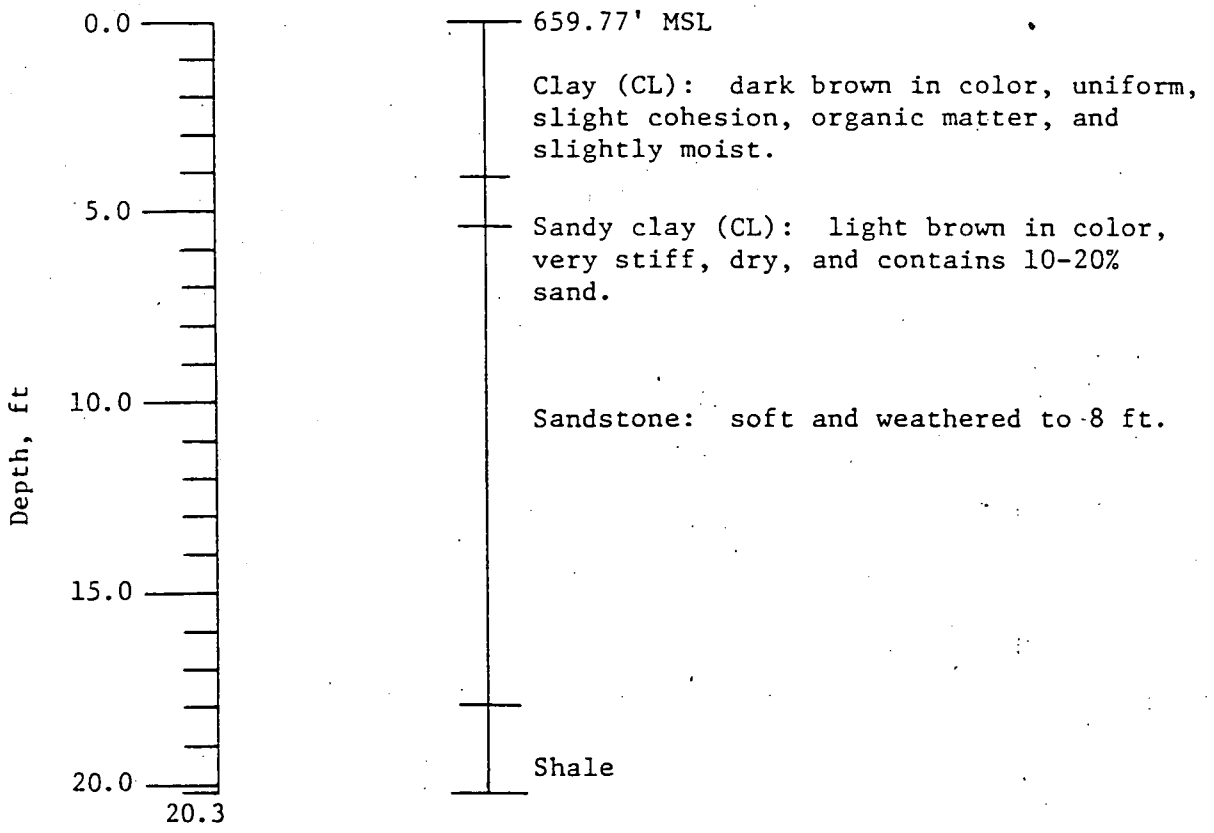
Sandstone (50%) and shale (50%): sandstone is fine-grained, grey to dark grey, and hard. Shale is black and contains sand. Bedding ranges from 1/8 to 1-1/2 in. with average at around 1 in.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-2-81

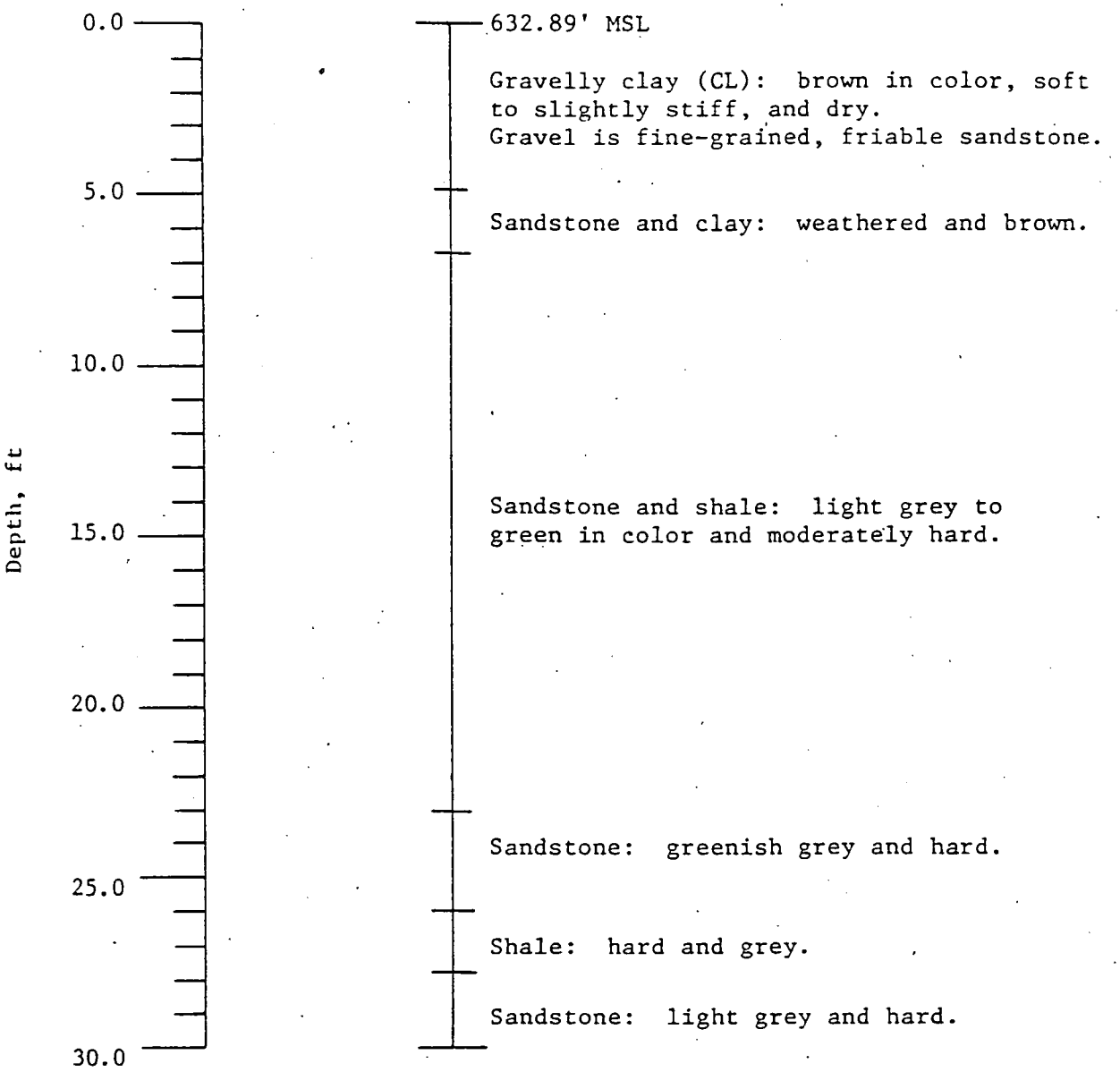


NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-3-81

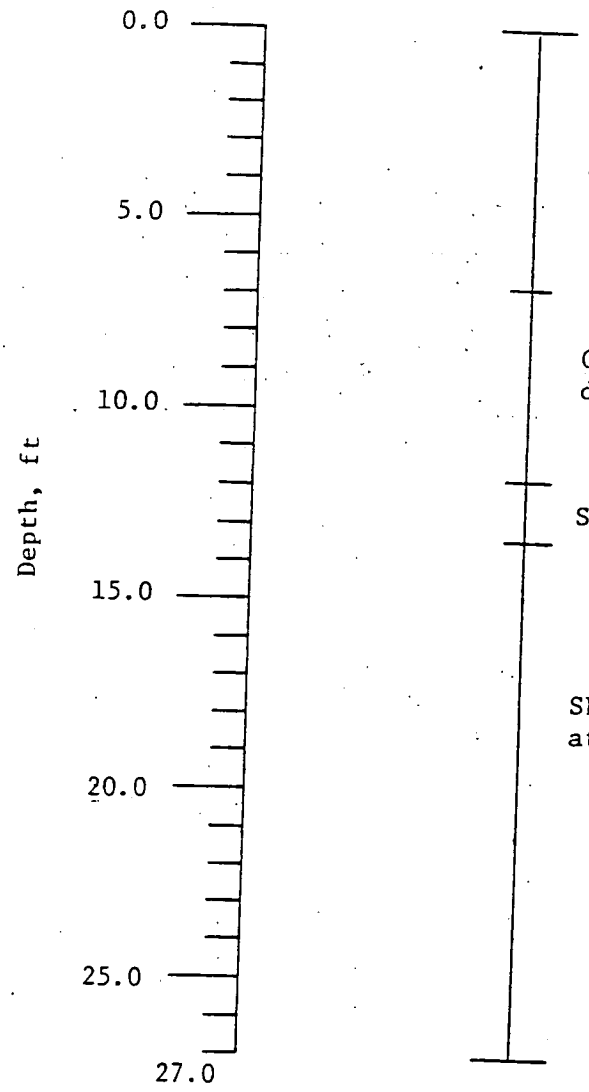


NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-4-81



607.89' MSL

Clay (CL): brown to reddish brown in color, soft to moderately stiff, dry, and contains 20-25% fine gravel.

Clay shale: brown to grey, soft, and dry.

Shale: red.

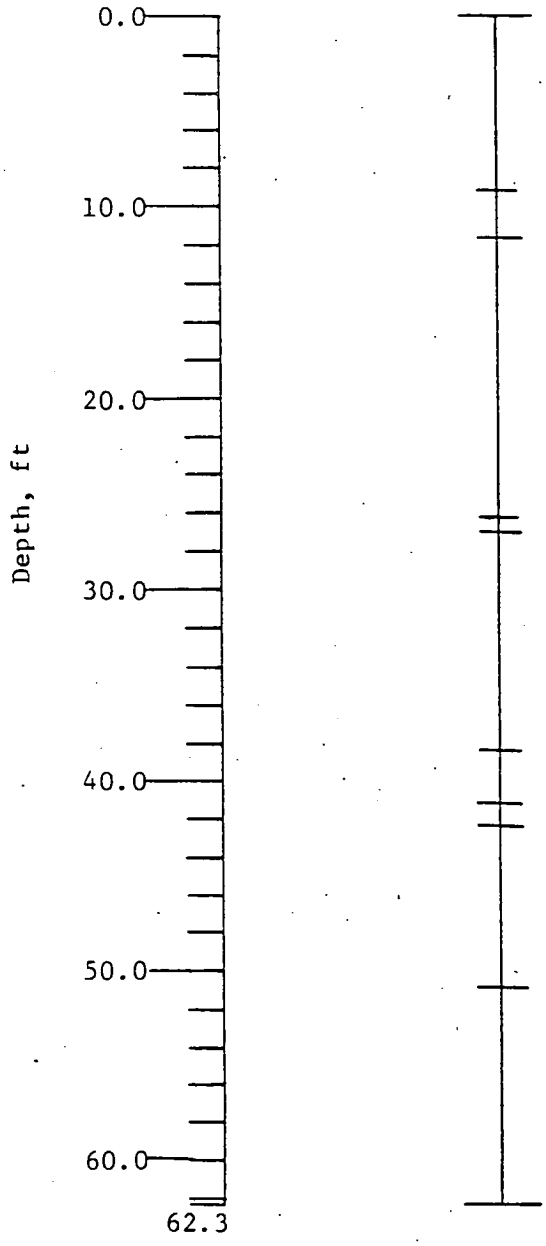
Shale: grey in color and becoming harder at 26 ft.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-5-81



672.06' MSL

Clay (CL): brown in color, stiff, thinly bedded, and dry.

Shale: brown and dark grey, dry, stiff, varied texture, and varied composition.

Shale: medium hard, grey, brown, and reddish brown in color.

Coal: black and medium hard.

Shale: grey to brown and soft.

Sandstone: grey and hard.

Shale: grey and medium hard.

Sandstone: brown to grey and medium hard to hard.

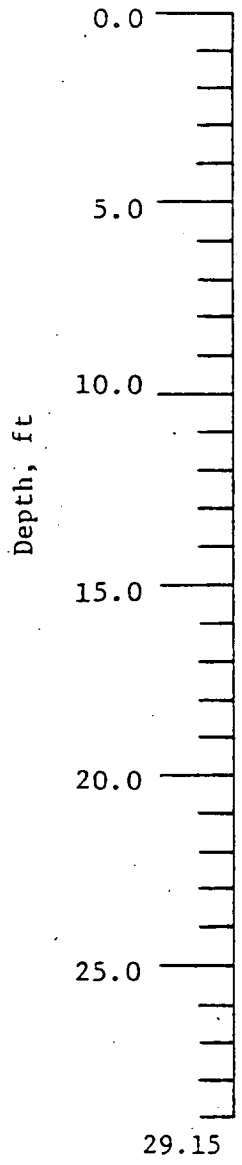
Shale: grey.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-6-81



660.92' MSL

Clay (CL): brown in color, soft to slightly stiff, dry, and low plasticity. Material is dozer fill.

Sandy clay (CL): orange brown in color, soft, dry, and contains 10-20% fine-grained sand.

Clay and weathered sandstone.

Sandstone: brown to orange brown, fine-grained quartz sand, weathered, dry, thinly bedded, and friable.

Shale: black, dry, soft, and uniform.

Coal: black, brilliant luster, brittle, soft, and jointed.

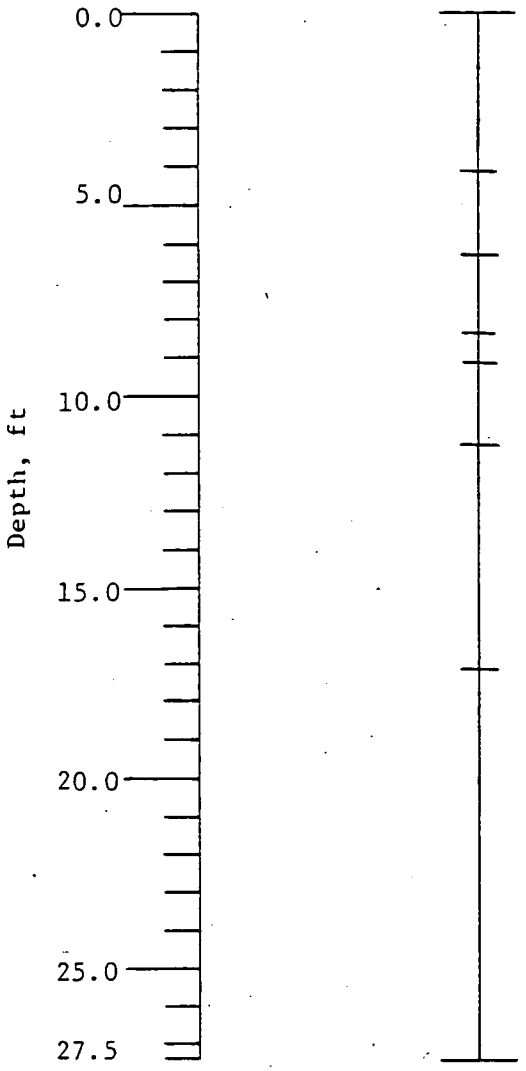
Shaley sandstone: light to dark grey, moderately hard, very fine-grained, and contains 30-40% interbedded dark grey shale. Sandstone and shale are interbedded in irregular seams, lenses, and thin beds.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-7-81



638.72' MSL

Clay (CL): brown in color, soft, low plasticity, and uniform. Material is dozer fill.

Sandstone: brown in color, weathered, very fine-grained, crumbles easily, and dry.

Sandstone: weathered and brown.

Shale: reddish grey and soft.

Sandstone: grey.

Shale: grey and hard.

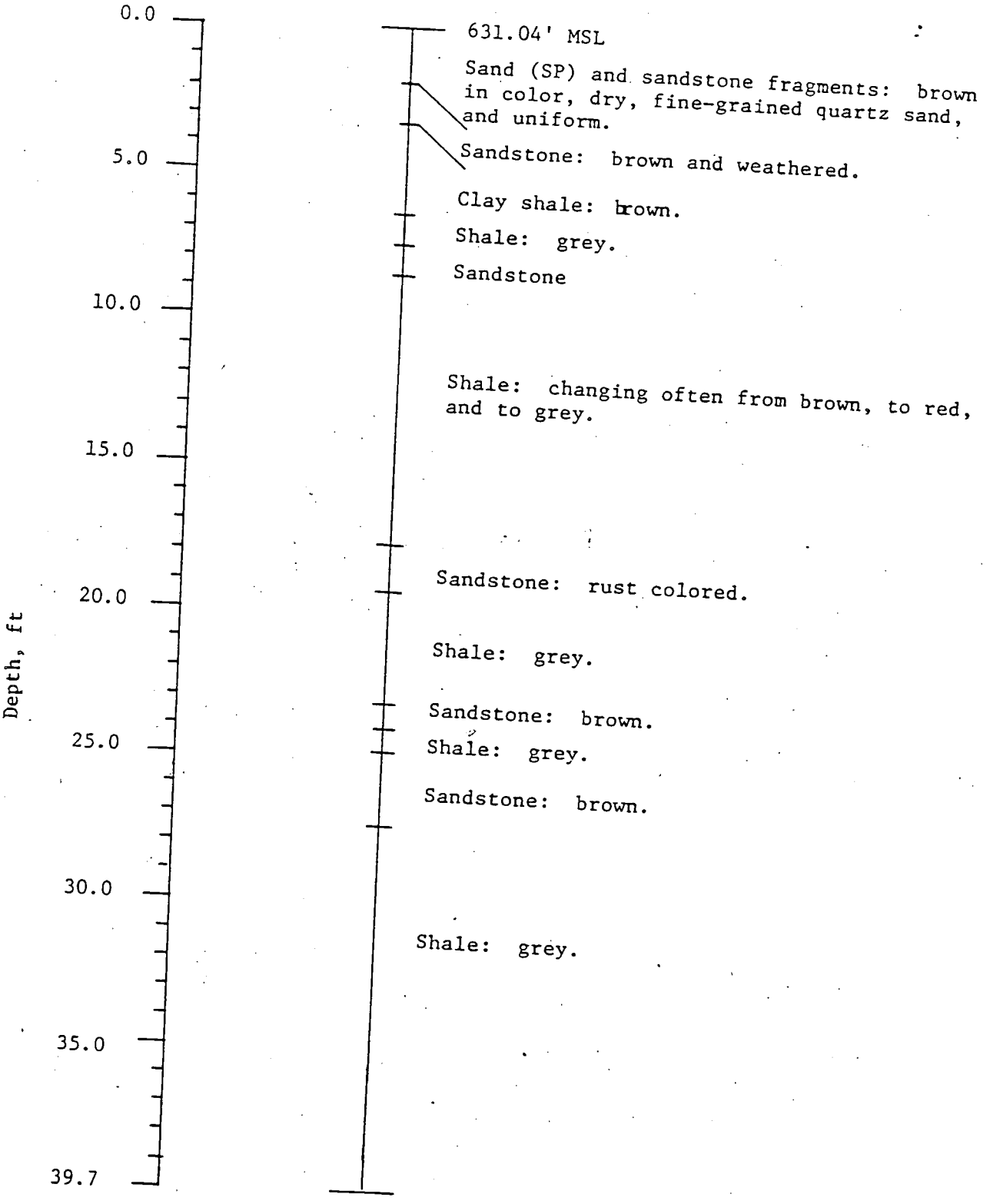
Shale: dark grey and hard.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-8-81

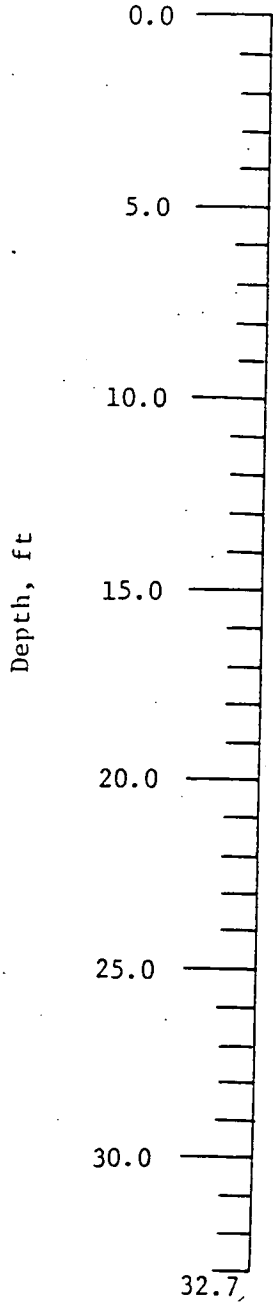


NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-9-81



659.10' MSL

Clay (CL): brown in color, dry, no cohesion, and organic matter. Material is dozer fill.

Clay (CH): grey brown in color, dry, stiff, uniform, and high plasticity.

Sandy shale: brownish dark grey in color, dry, and stiff to hard.

Shale: brown to dark grey.

Coal: black.

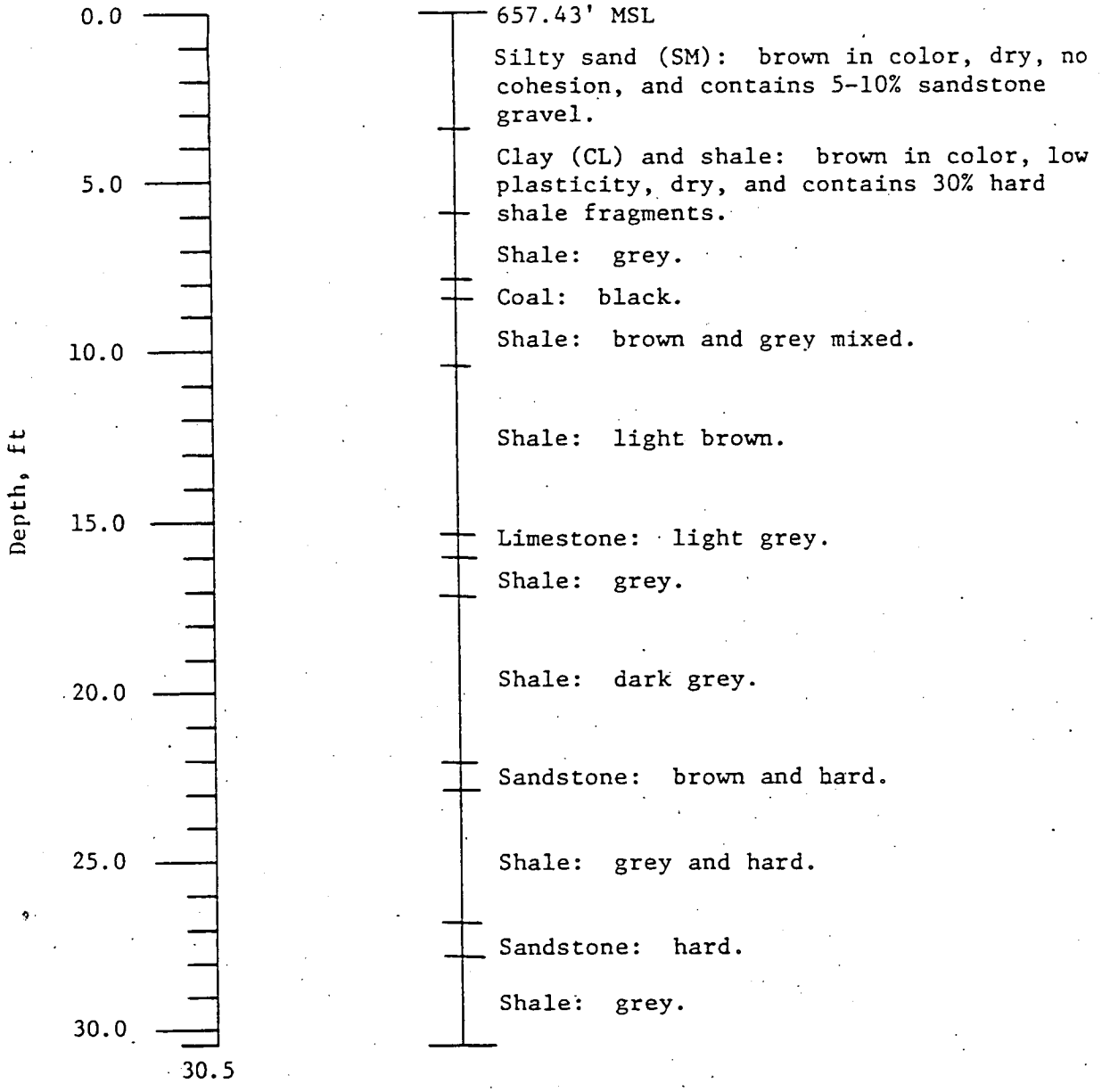
Shale and interbedded sandstone

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-10-81

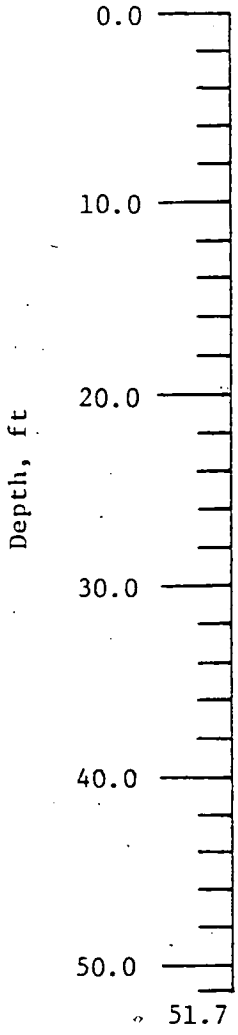


NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-11-81



667.28' MSL

Clay (CH): brown to red in color, slightly moist to dry, soft to stiff, and high plasticity.

Clay shale: brown to grey brown in color, dry, and stiff.

Coal: black.

Sandstone: light grey and medium hard.

Shale: dark grey.

Sandstone: light brown.

Shale: dark grey and hard.

Sandstone: brown.

Shale: dark grey.

Sandstone: grey and hard.

Shale: light grey.

Sandstone: light grey.

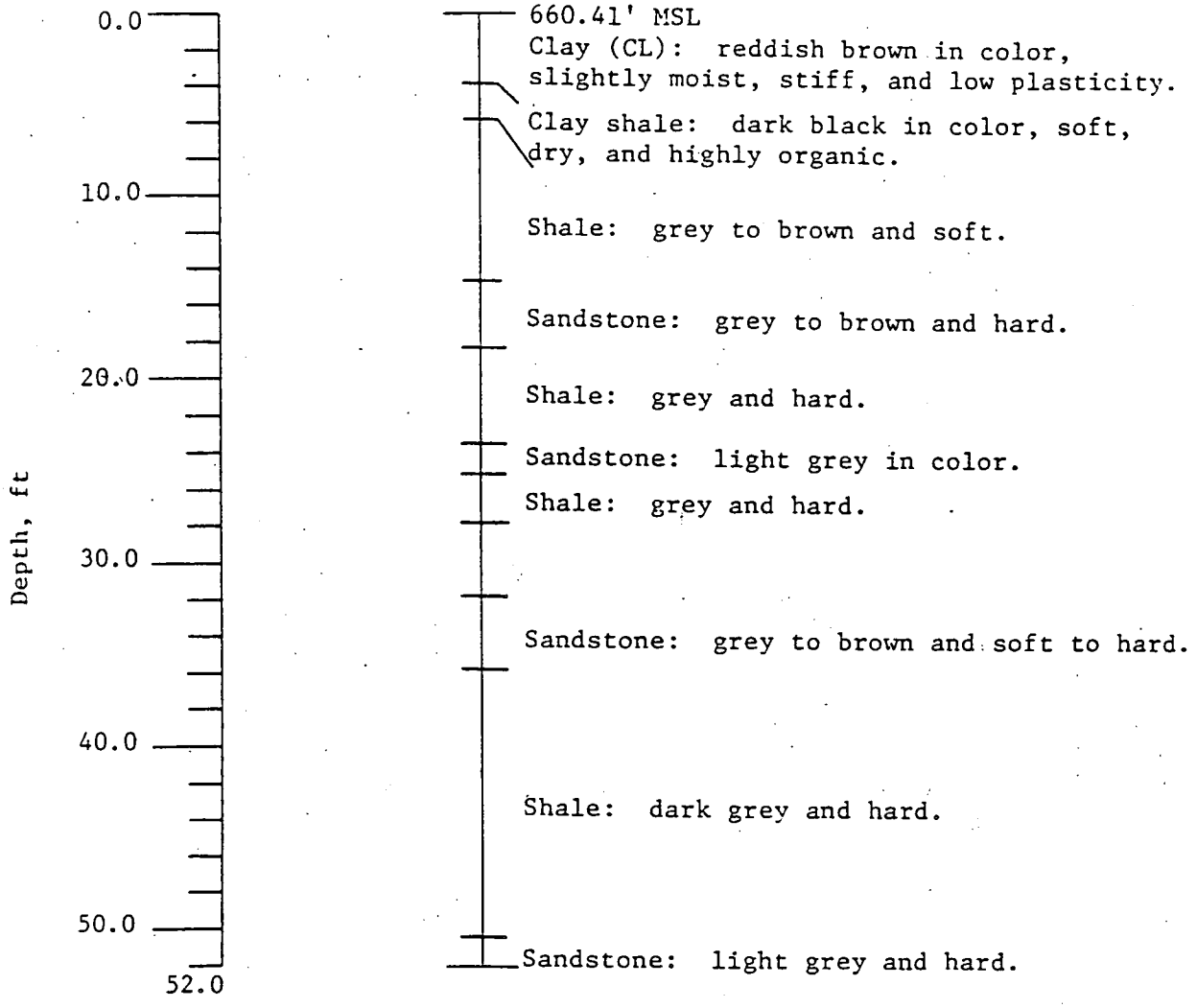
Shale: grey.

NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-12-81

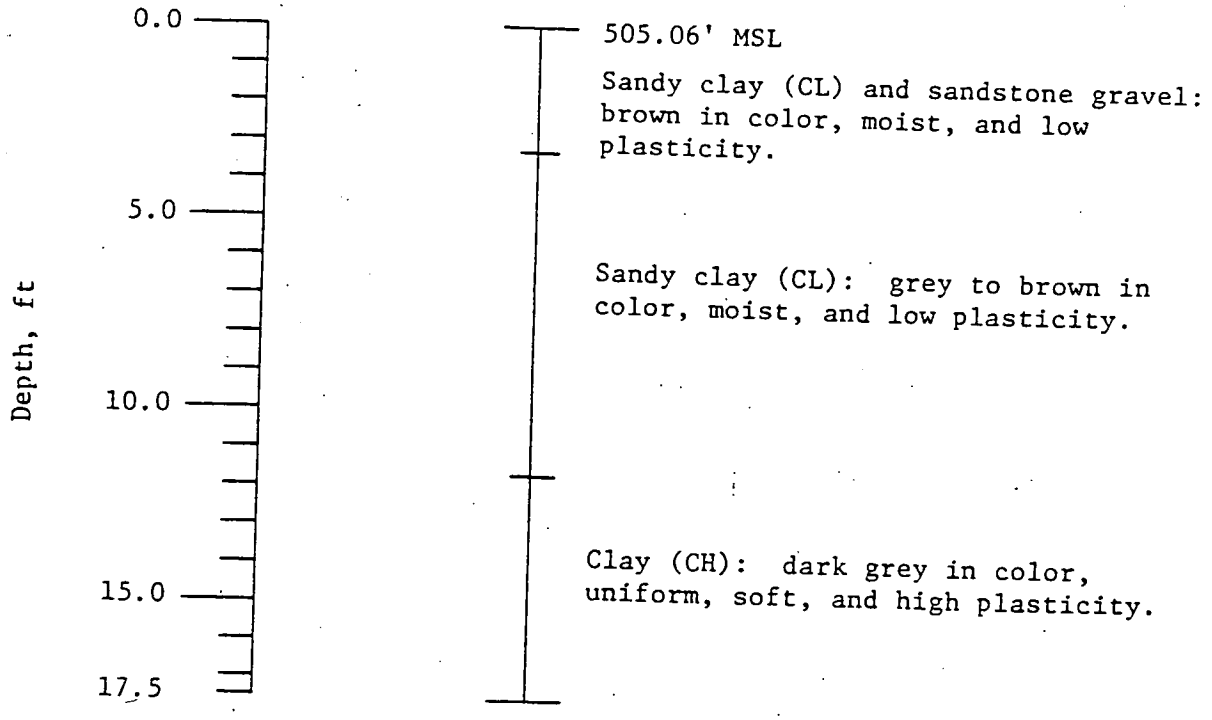


NWSC, Crane, Indiana

Demolition Area

Lithology

Boring Number: WES-6-13-81

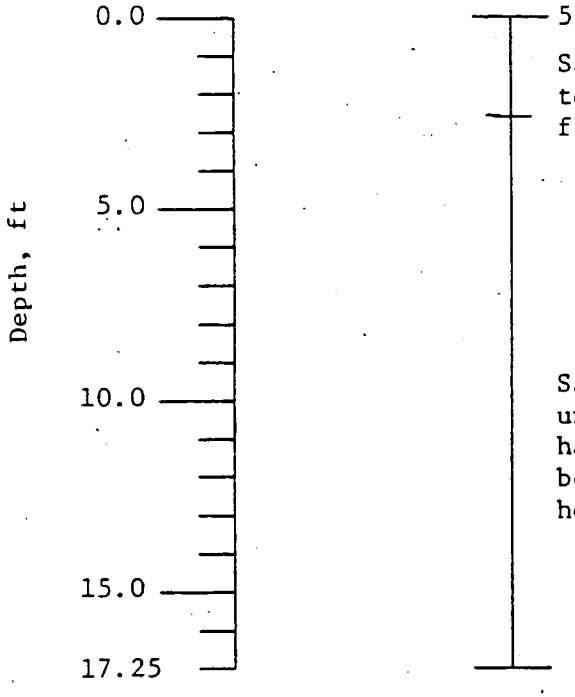


NWSC, Crane, Indiana

Old Rifle Range

Lithology

Boring Number: WES-6-14-81



510.42' MSL

Sand (SP) and sandstone fragments: brown to orange brown in color, very fine to fine-grained, and dry.

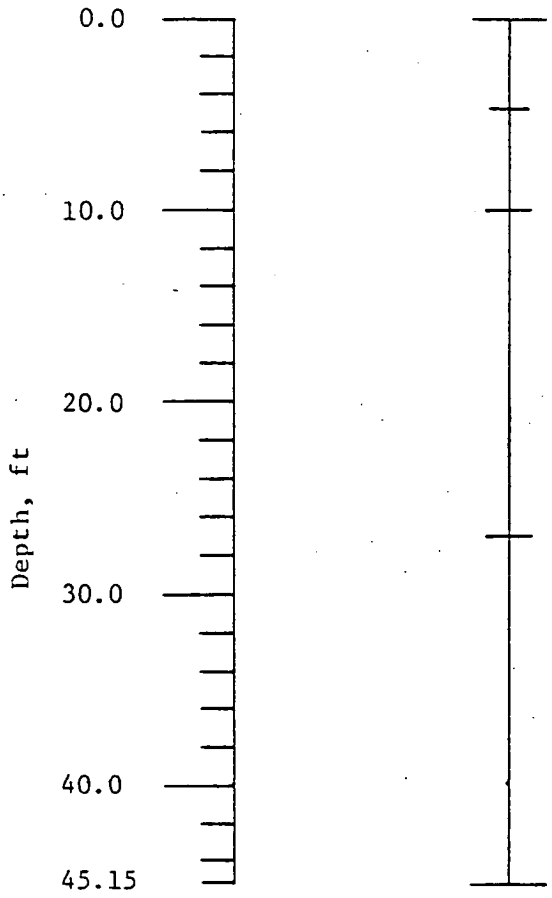
Sandstone: brown to rusty brown in color, uniform, fine-grained quartz sand, moderately hard and oxidized. Bedding ranges from thinly bedded to around one foot maximum and nearly horizontal in attitude.

NWSC, Crane, Indiana

Old Rifle Range

Lithology

Boring Number: WES-6-15-81



527.88' MSL

Silt (ML): brown in color, uniform, dry, and stiff.

Sandy silt (ML): brown in color, dry, and contains 5-10% fine to medium-grained sand.

Clay shale: brown in color, very stiff to hard, weathered, and slightly moist in regions.

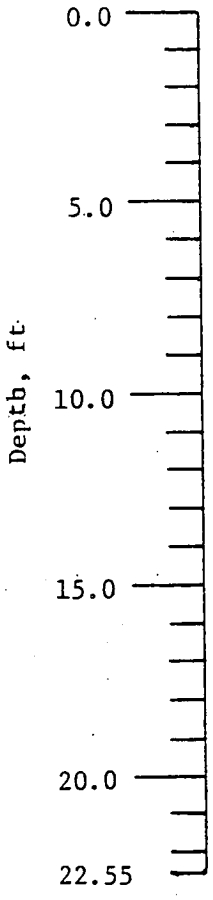
Sandstone: brown in color, medium hard, and fine-grained.

NWSC, Crane, Indiana

Old Rifle Range

Lithology

Boring Number: WES-6-16-81



510.73' MSL

Clay (CL): brown in color, soft, slightly moist, and low plasticity.

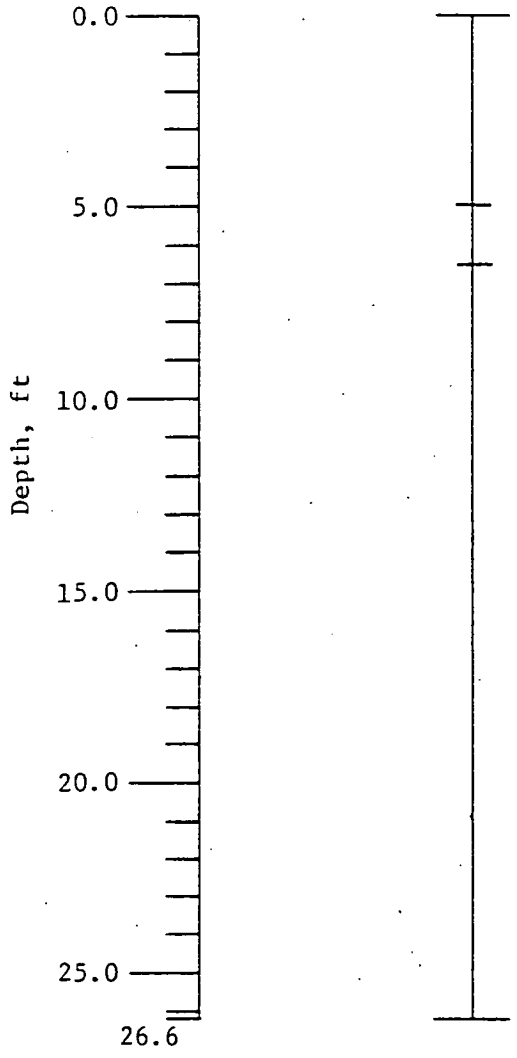
Sandstone: brown in color, uniform, fine-grained quartz sand, medium hard, and oxidized in regions.

NWSC, Crane, Indiana

Old Burning Grounds

Lithology

Boring Number: WES-6-17-81



508.03' MSL

Silty sand (SM): brown to rusty brown in color, fine-grained, and little cohesion.

Sand (SP): brown in color, uniform, fine-grained quartz sand, and slightly moist.

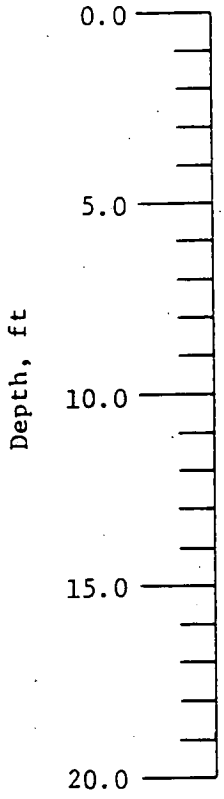
Sandstone: brown, weathered, fine-grained, medium hard to hard, and contains clay or shale lenses from 10 to 11.5 ft .

NWSC, Crane, Indiana

Old Rifle Range

Lithology

Boring Number: WES-6-18-81



503.42' MSL

Fill

Clay (CH): grey with streaks of brown, soft, and high plasticity.

Sandy clay (CL): dark grey in color, soft, low to medium plasticity, and contains 20% very fine-grained sand.

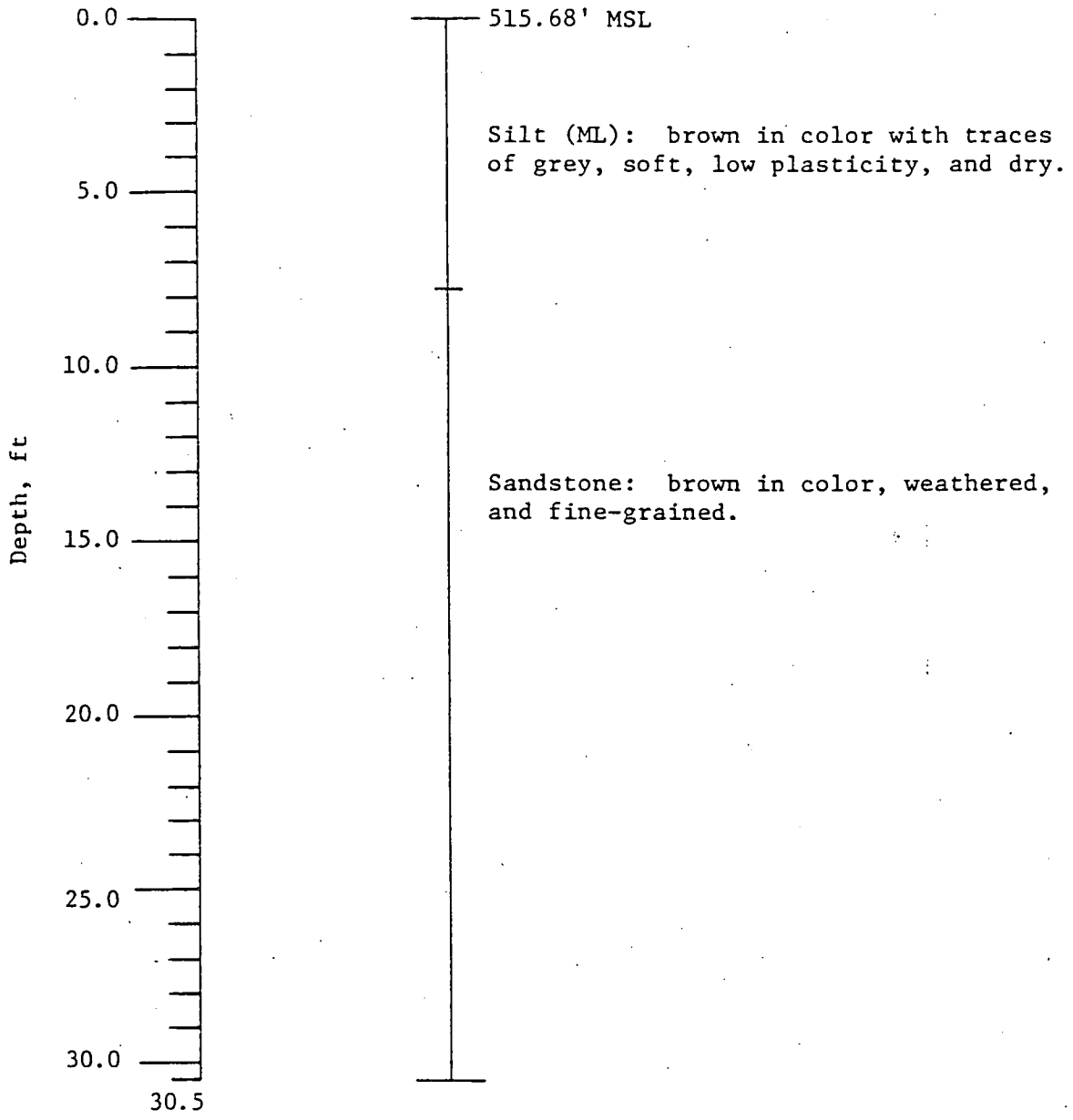
Gravelly clay (CL): brown to grey with traces of red and green, soft, low plasticity, and contains fine to medium sized gravel.

NWSC, Crane, Indiana

Old Burning Grounds

Lithology

Boring Number: WES-6-19-81

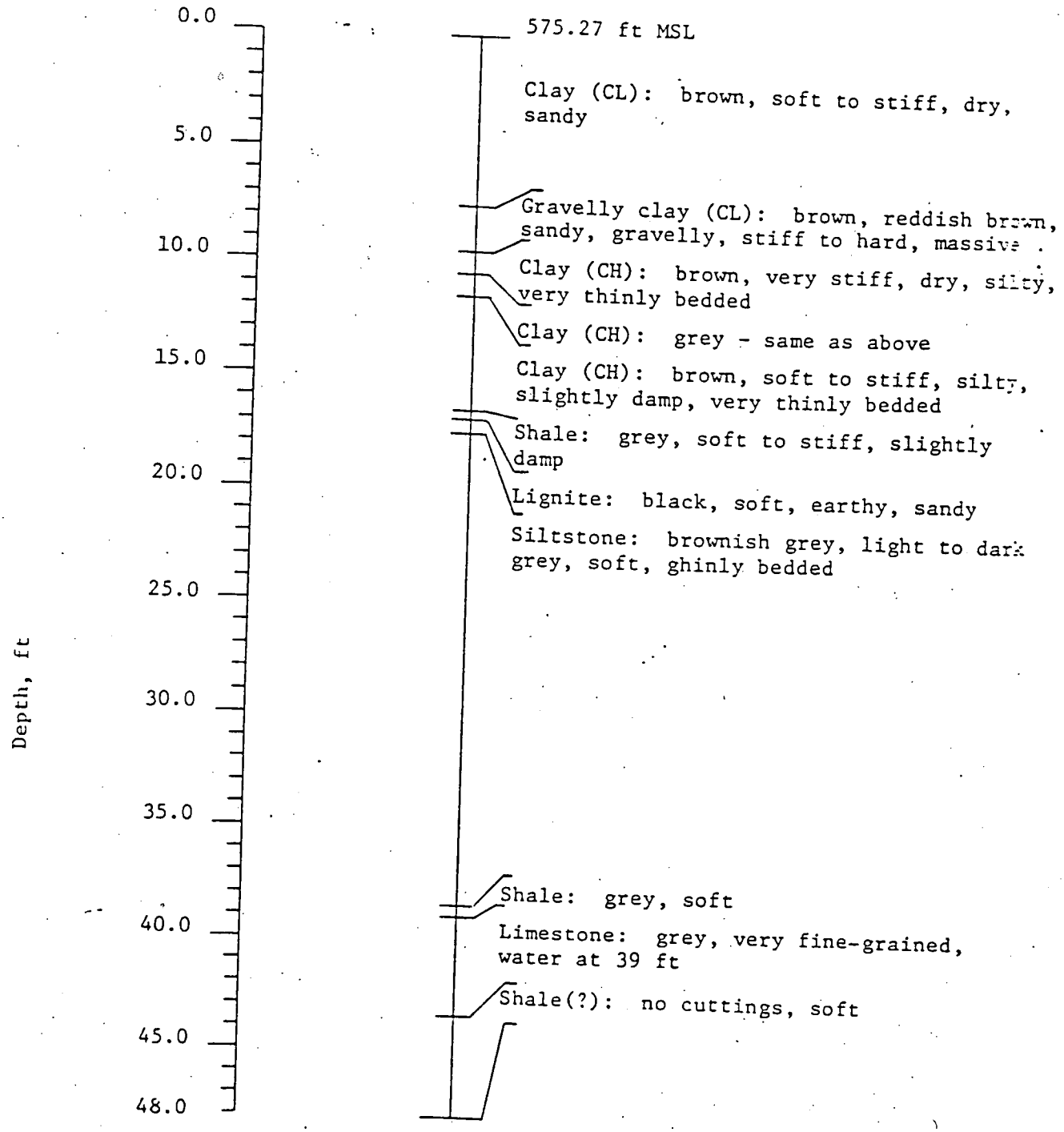


NWSC, Crane, Indiana

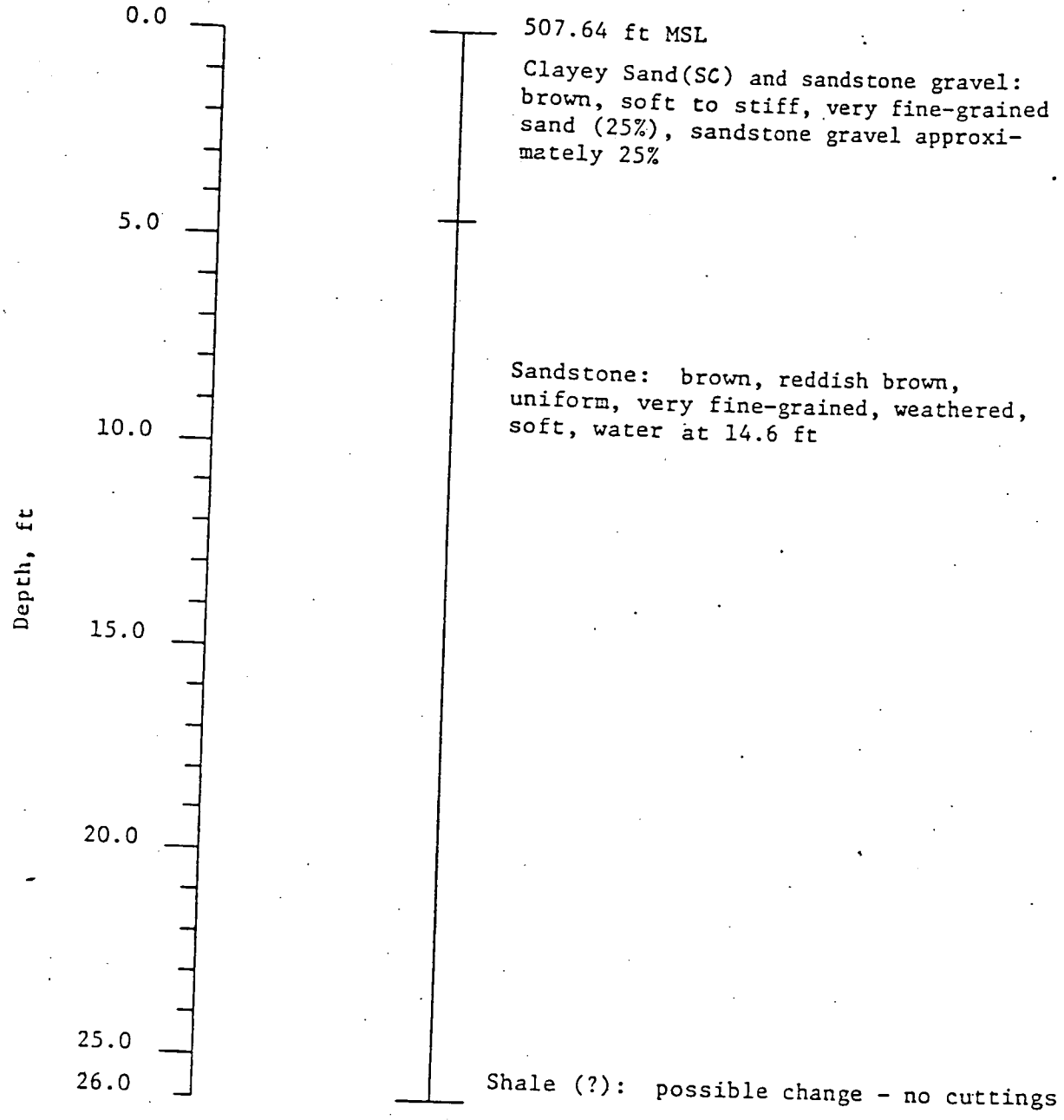
Old Rifle Range

Lithology

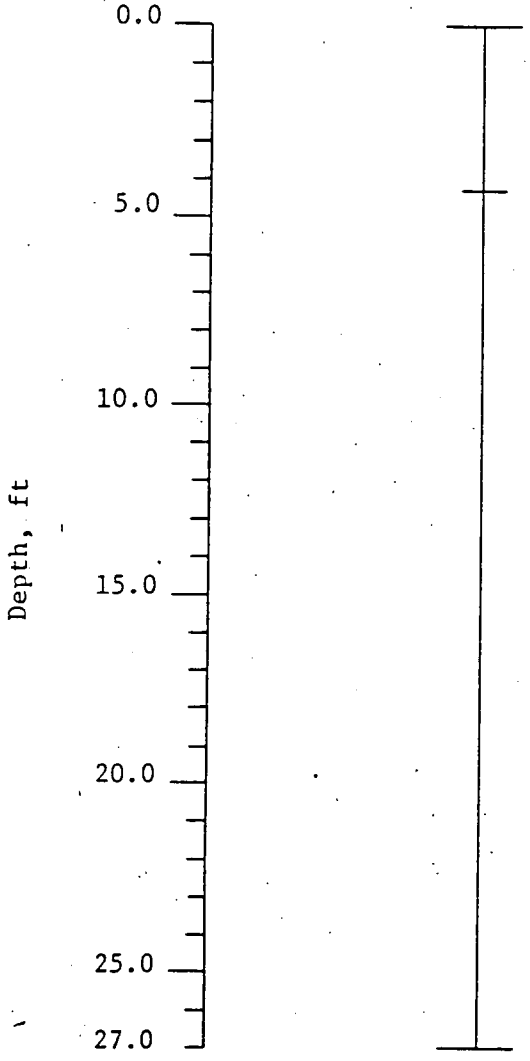
Boring Number: WES-6-20-81



NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring Number: WES-6-21-83



NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring Number: WES-6-22-83

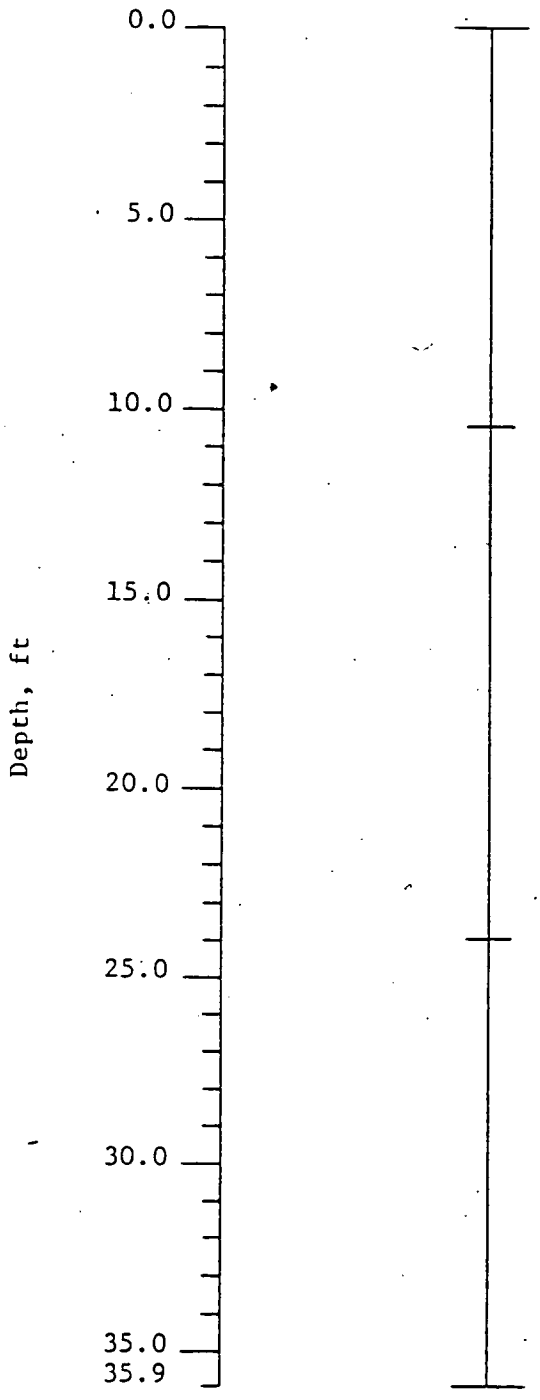


506.41 ft MSL

Sandy clay (CL): brown, soft to stiff, dry, sandy - very fine-grained

Sandstone: light brown, brown, and reddish brown, very fine-grained, uniform quartz sandstone, soft and weathered to 24 ft. Water at 16 ft

NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring Number: WES-6-23-83



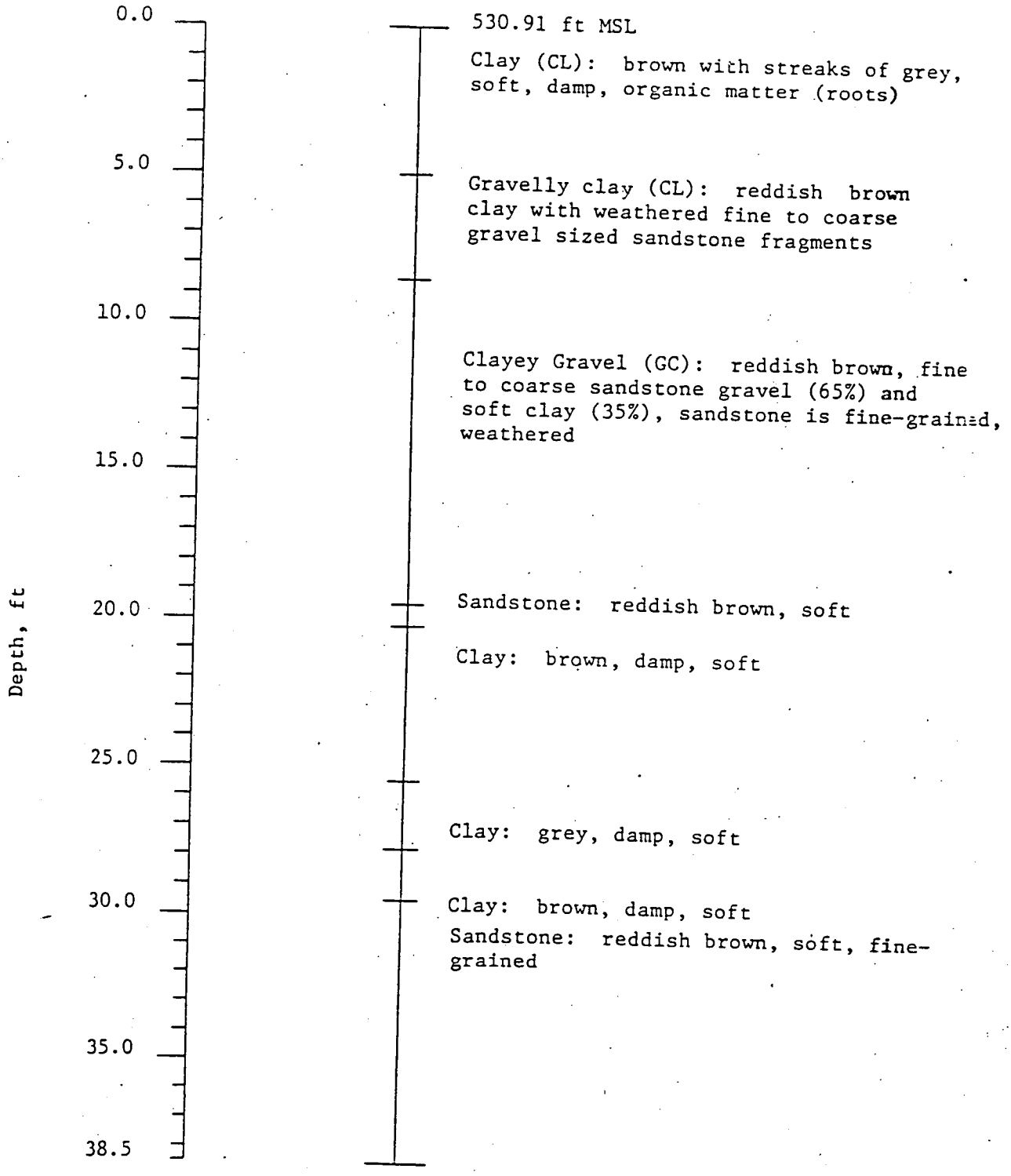
525.62 ft MSL

Clay (CL): brown and grey, soft to stiff, damp, uniform

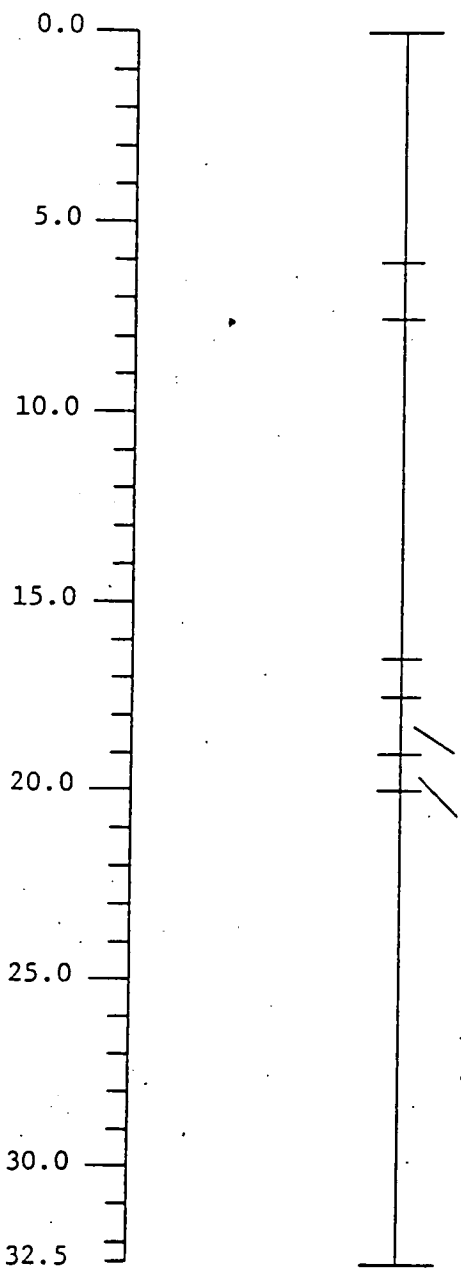
Sandstone and clay (CL): tan, brown, reddish brown, weathered sandstone interbedded with brown sandy clay; sandstone is very fine-grained, uniform, quartz sand, friable

Sandstone: tan, brown, reddish brown, weathered, very fine-grained, uniform, quartz sandstone, bedding is horizontal and very thinly bedded

NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring No.: EPA-1-83



NWSC. Crane, Indiana
Old Rifle Range
Lithology
Boring Number: EPA-2-83



523.20 ft MSL

Clay (CL): brown and grey, soft, damp, slightly sandy

Clayey gravel (GC): reddish brown, fine to medium gravel sized sandstone fragments with soft, sandy clay

Clay (CL and CH): grey and light brown, soft, damp, dense, grades from a CH to a CL between 10-11 ft

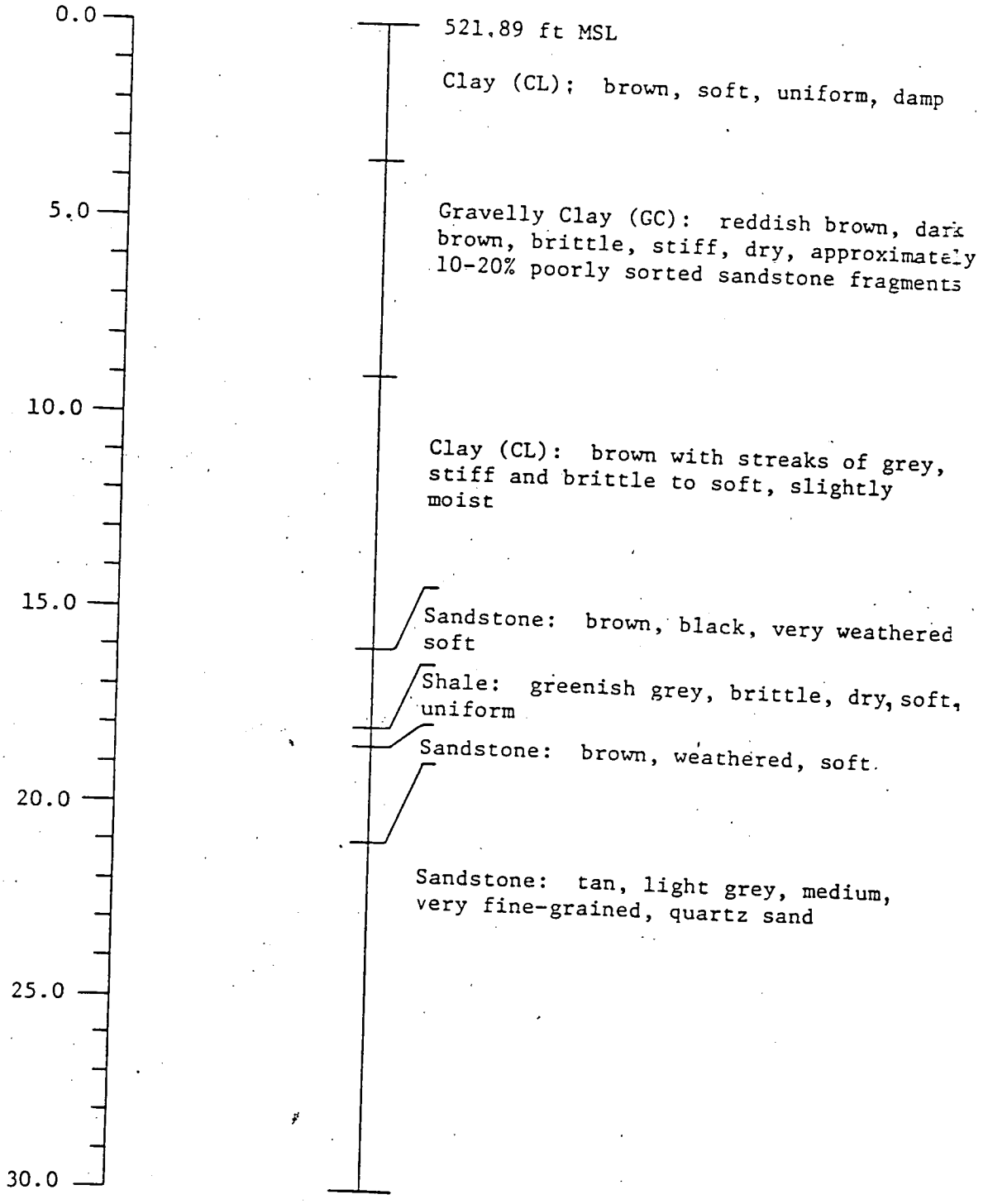
Sandy gravel (GW): reddish brown, black, weathered, very fine-grained sandstone

Clay (CL): brown, reddish brown, damp, sandy, gravelly (fine)

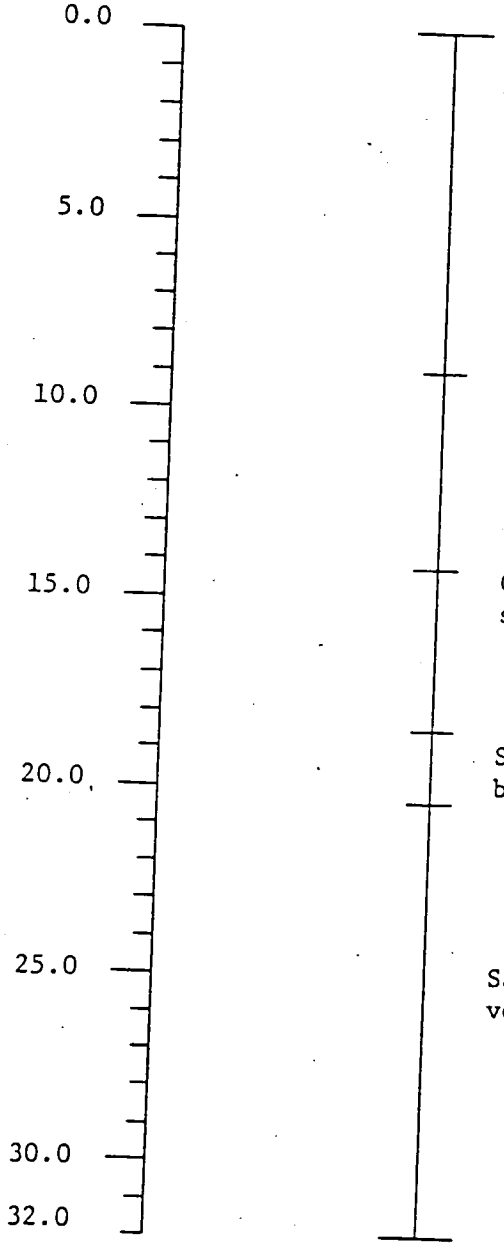
Sand (SM): brown very fine-grained, damp, silty/clayey (slight binder)

Sandstone: brown, uniform, weathered, very fine-grained, quartz sand. Water at 20 ft

NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring Number: EPA-3-83



NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring Number: EPA-4-83



521.16 ft MSL

Clay (CL): brown with streaks of gr
soft to stiff, sandy, slight cohesio

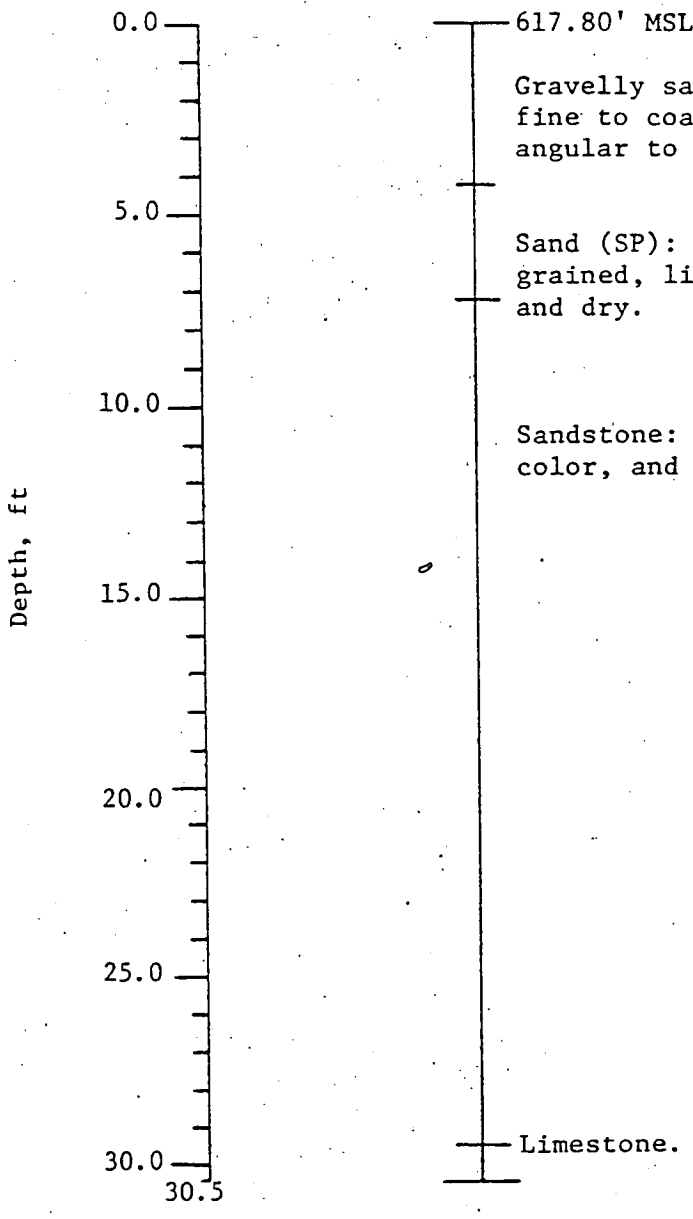
Gravelly Clay (CL): reddish brown, stiff, brittle, dry, gravel fragments angular, fine to coarse, sandstone predominant

Clay (CL): brown and grey, soft, dar
slight cohesion

Silty sand (SM): brownish grey to gr
brown; very fine-grained, uniform, we

Sandstone: light brown, light grey, very fine-grained, uniform

NWSC, Crane, Indiana
Old Rifle Range
Lithology
Boring Number: EPA-5-83

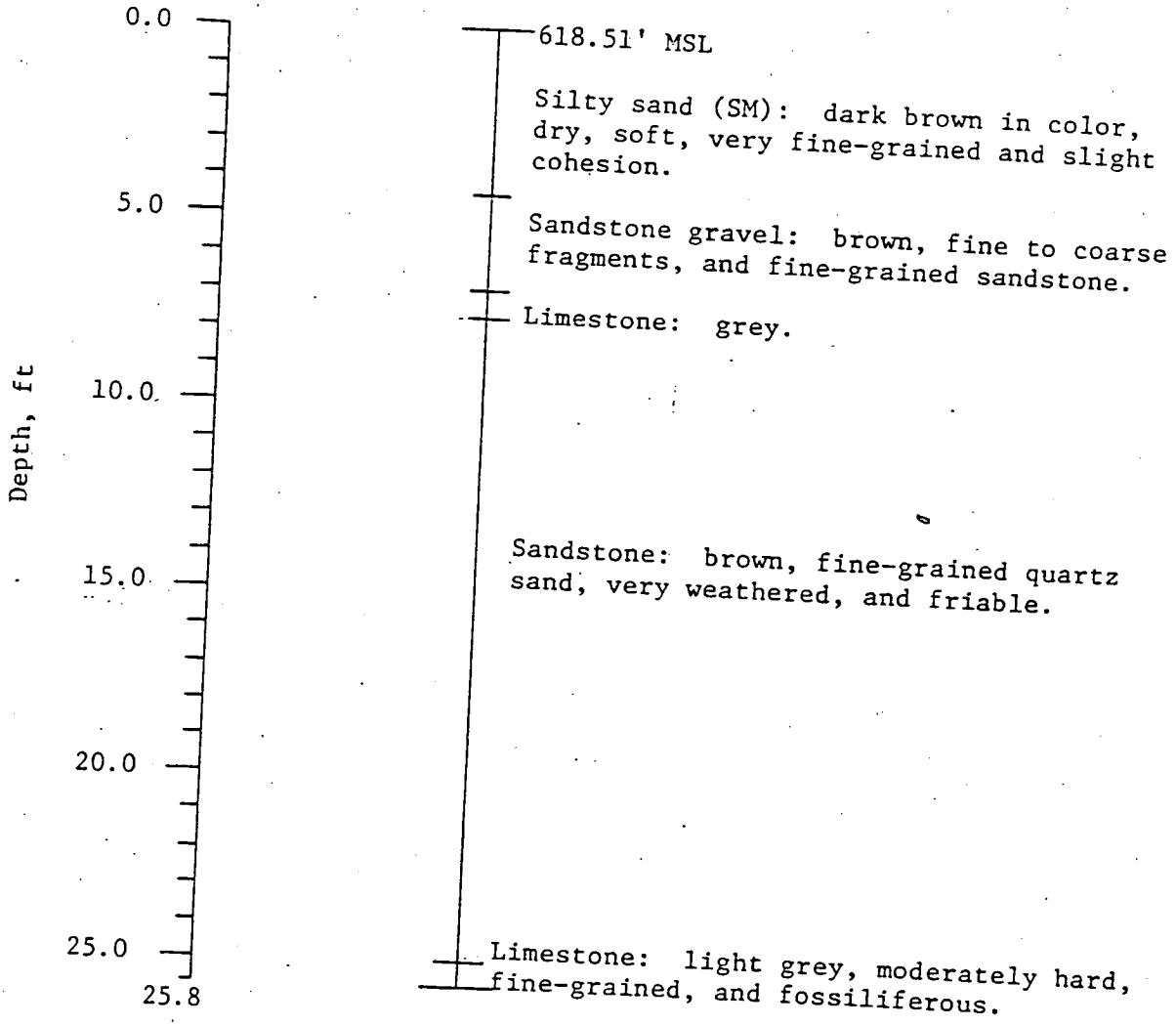


NWSC, Crane, Indiana

Rockeye Site

Lithology

Boring Number: WES-10-1-81

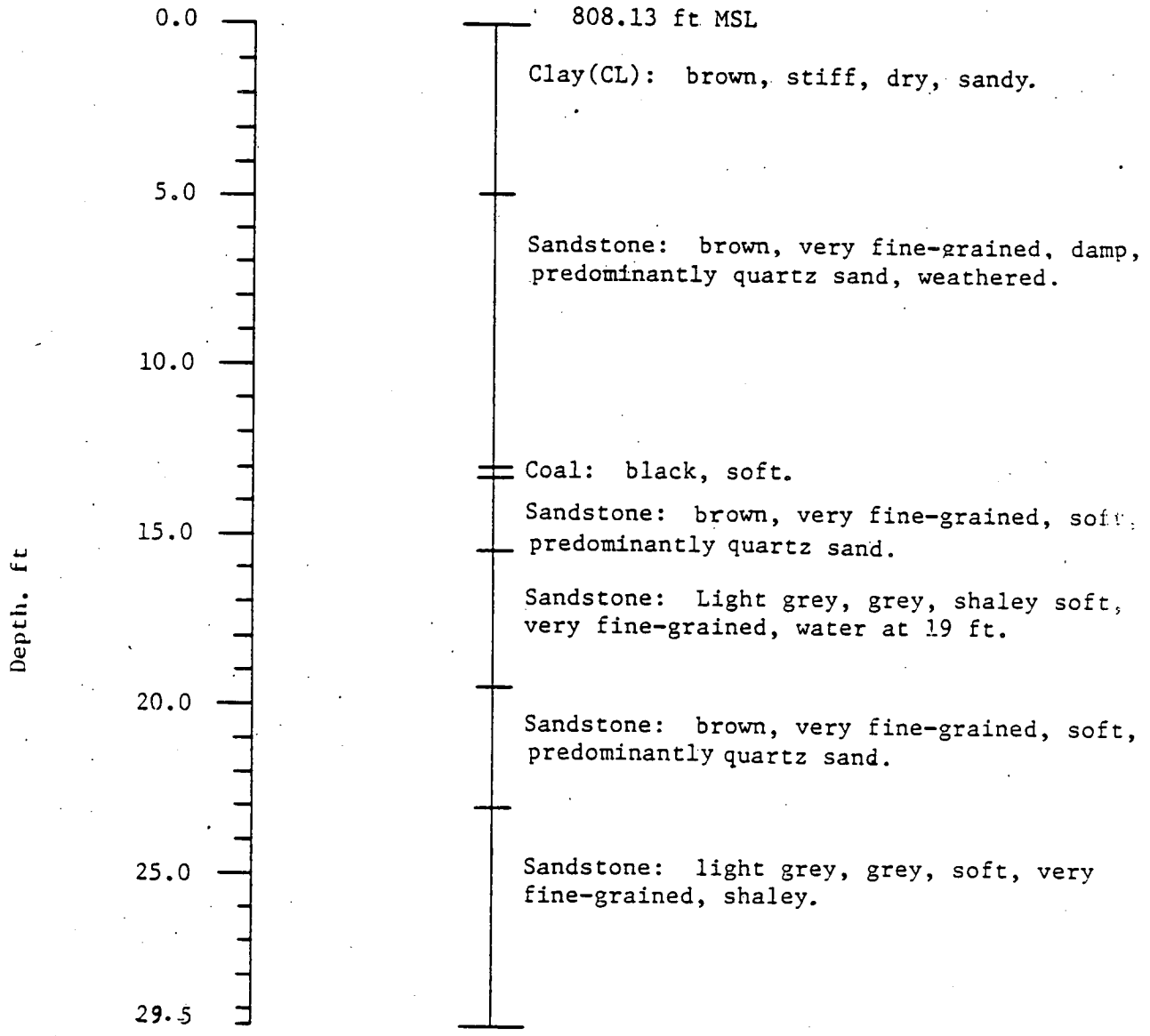


NWSC, Crane, Indiana

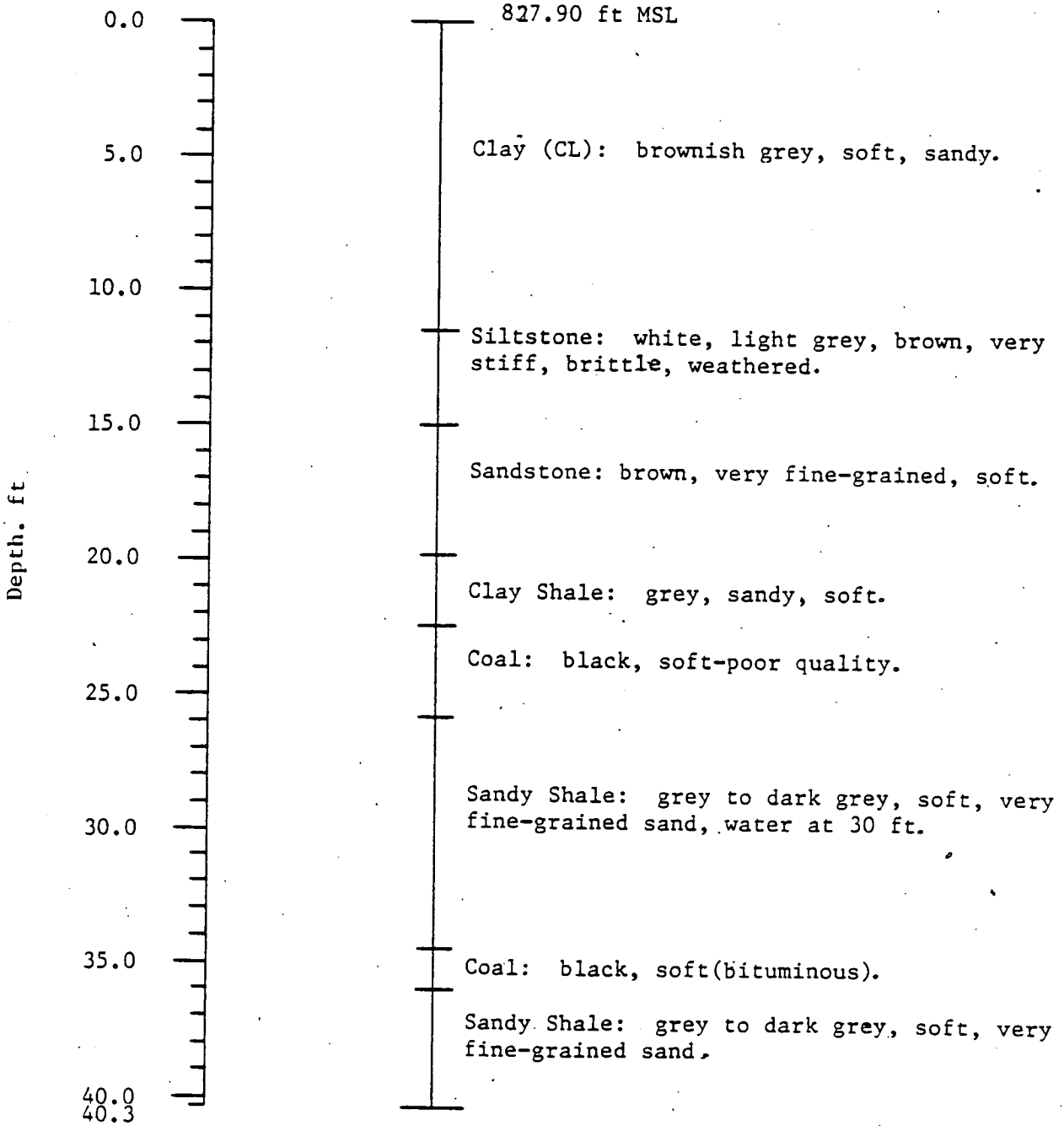
Rockeye Site

Lithology

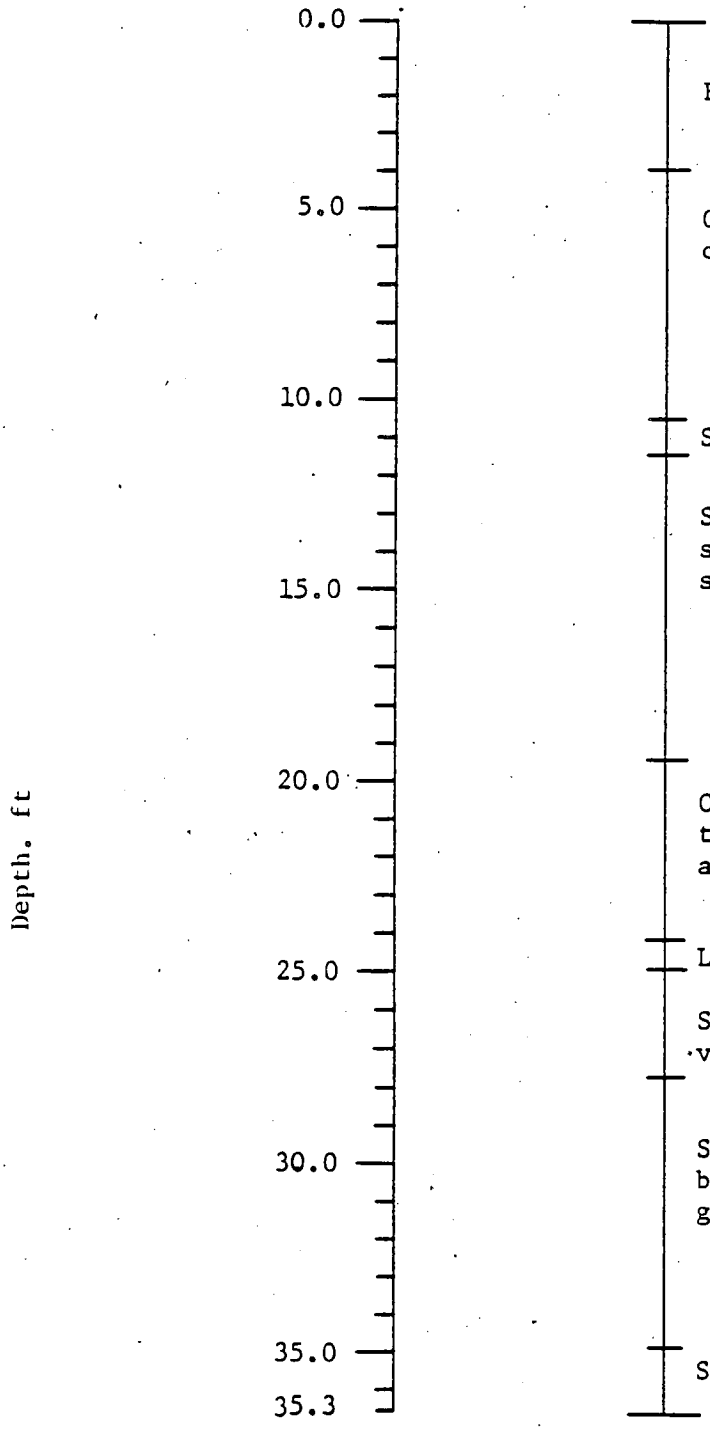
Boring Number: WES-10-2-81



NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-3-83



NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-4-83



828.39 ft MSL

Fill: cement and clay.

Clay (CL): brown with grey streaks, stiff, damp.

Shale: dark grey to black, soft, weathered.

Siltstone: orange grey to dark orange brown, sandy, weathered, oxidized, thinly bedded, soft to medium.

Clay Shale: chocolate brown, black, soft, thinly bedded, oxidized, weathered, moisture along breaks.

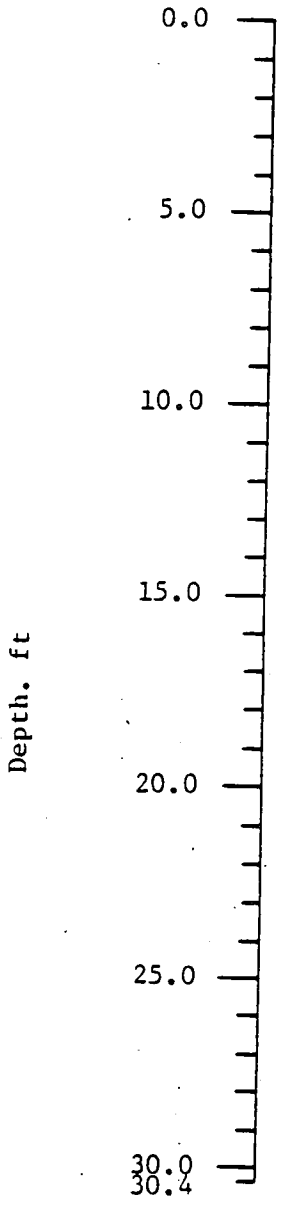
Lignite: black, soft, earthy, wet.

Shale: light grey to greenish grey, very soft very weathered, brittle, damp, sandy.

Sandstone and shale: light to dark grey and black, thinly bedded, slightly weathered, grades to a shale, soft.

Shale: black, soft, uniform.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-5-83



808.40 ft MSL

Gravelly clay (CL): brown, very stiff, dry, very fine-grained, quartz sandstone gravel.

Sandstone: brown, very friable, very fine-grained, weathered.

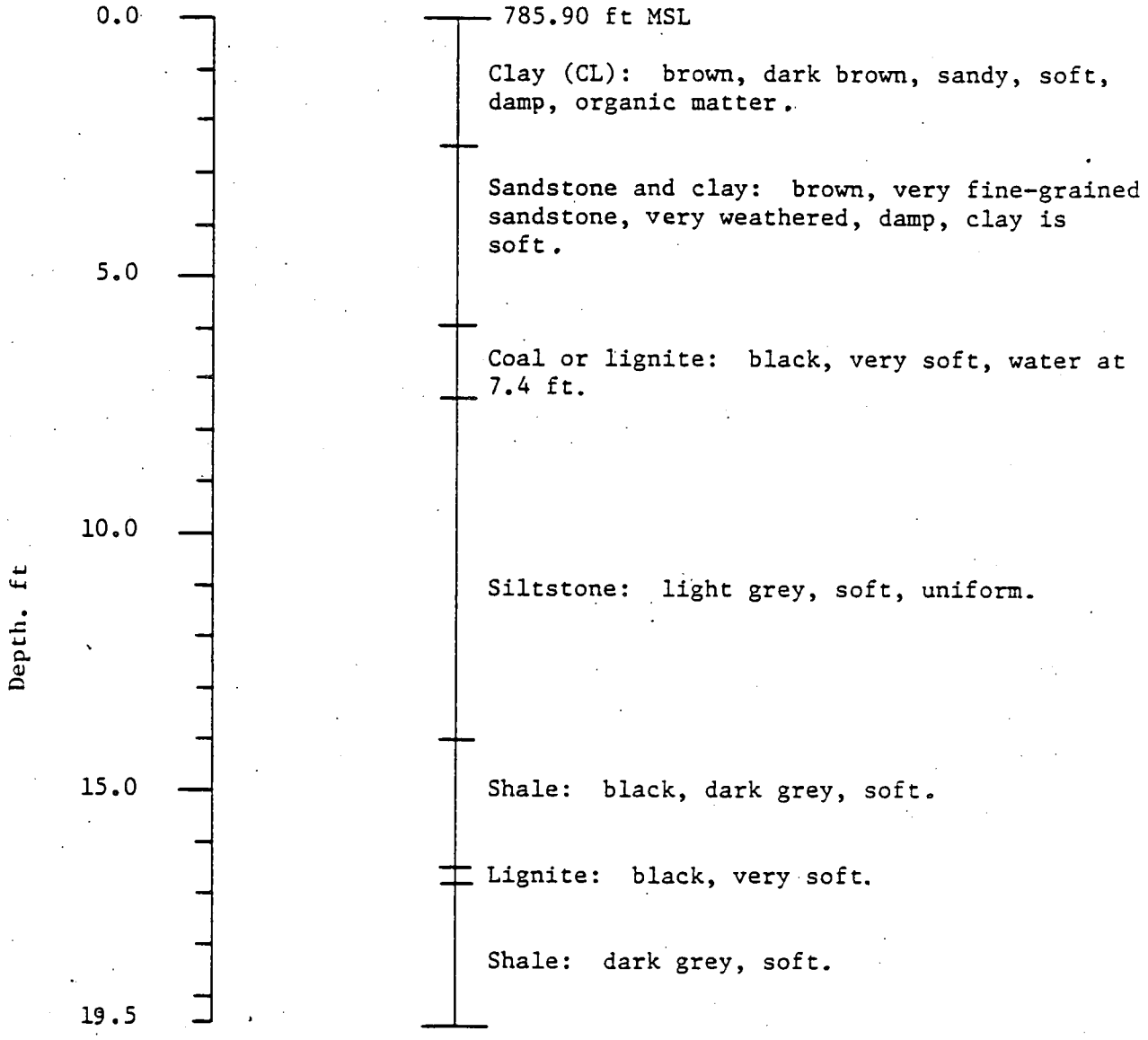
Sandstone: brown, very fine-grained, hard to very hard (iron) water between 15 and 18 ft.

Coal: black, soft (bituminous).

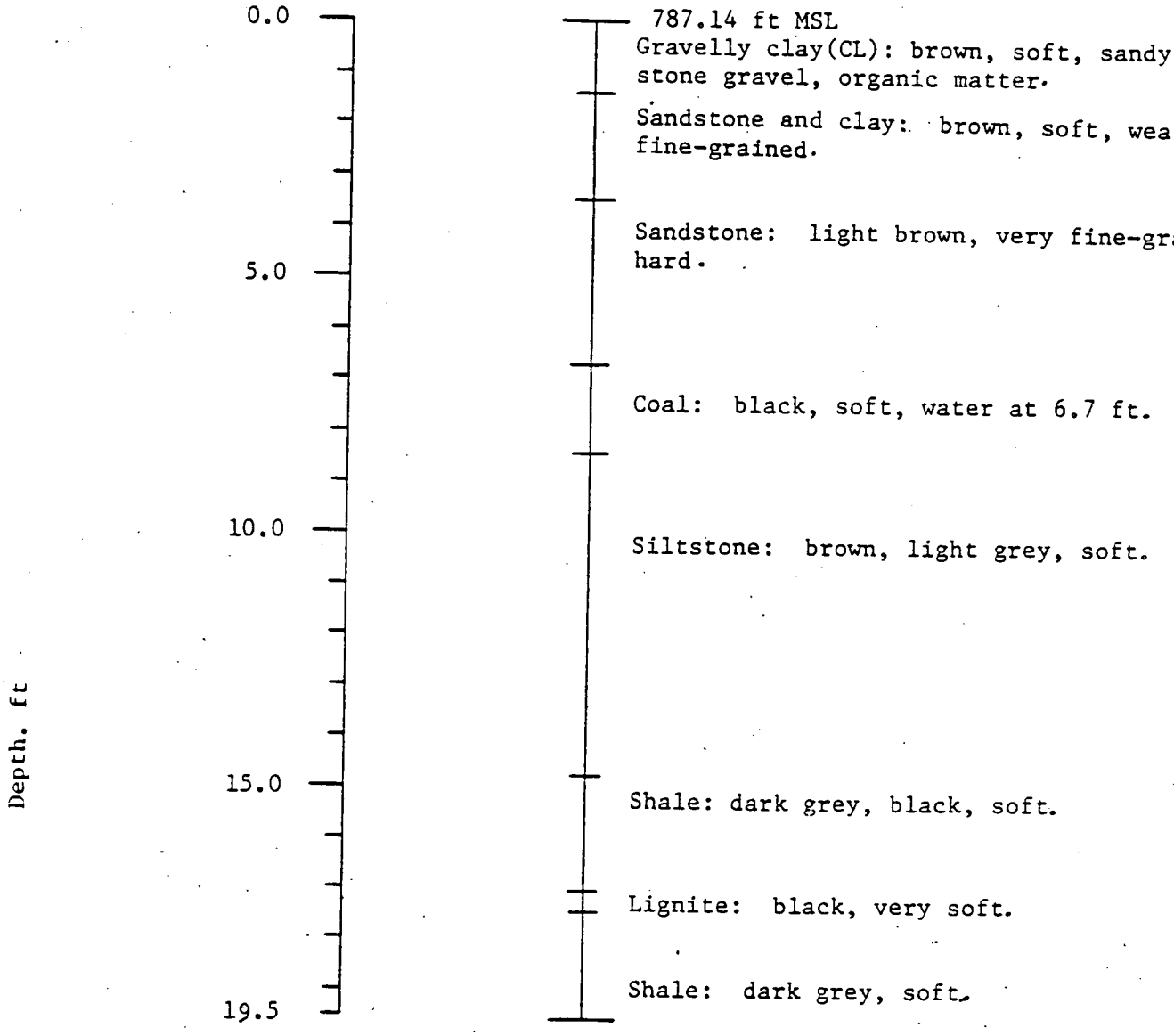
Sandstone: brown, light grey, very fine-grained, soft.

Siltstone and Shale: light grey to dark grey, thinly bedded, soft.

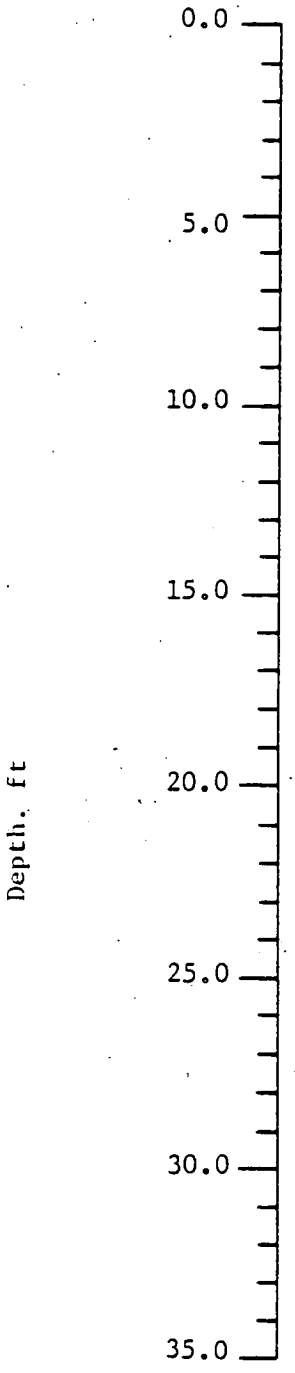
NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-6-83



NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-7-83



NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-8-83



786.13 ft MSL

Sandy clay (CL): brown, stiff to hard, very fine-grained.

Sandstone and clay: brown, thinly bedded, soft, fine-grained.

Sandstone: grey, very fine-grained, hard.

Sandstone: brown, soft, very fine-grained.

Shale: grey, dark grey, soft.

Sandstone: light grey, soft, very fine-grain

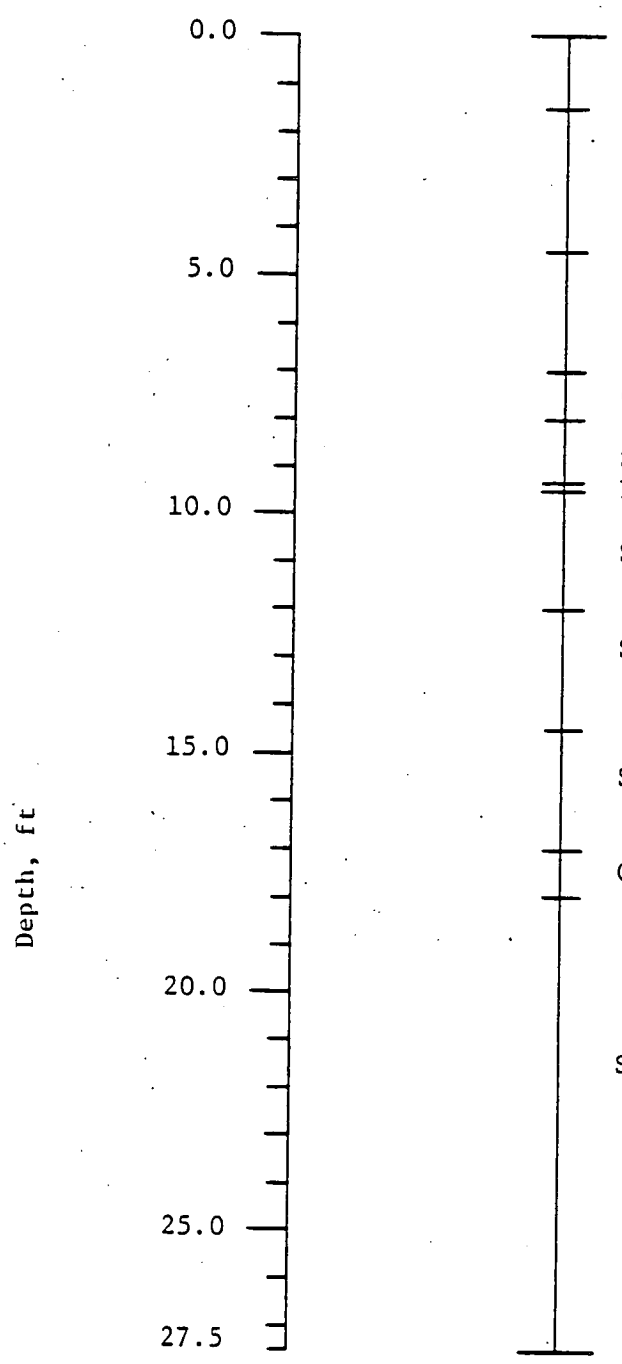
Siltstone: light grey to dark grey, soft.

Sandstone: light grey, soft, very fine-grain

Coal: black, soft to medium, water between 22.5 and 25.0.

Shale: Light grey to dark grey interbedded with siltstone, soft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-9-83



781.86

Dozer fill.

Gravelly clay (CL): brown, damp, soft, sandy gravelly (fine to medium sandstone gravely).

Sandstone and caly: brown, dark brown, soft thinly bedded, very fine-grained sandstone

Clay Shale: grey, soft.

Sandstone: brown, hard, very fine-grained

Lignite: black, very soft.

Sandstone: brown, grey, very fine-grained.

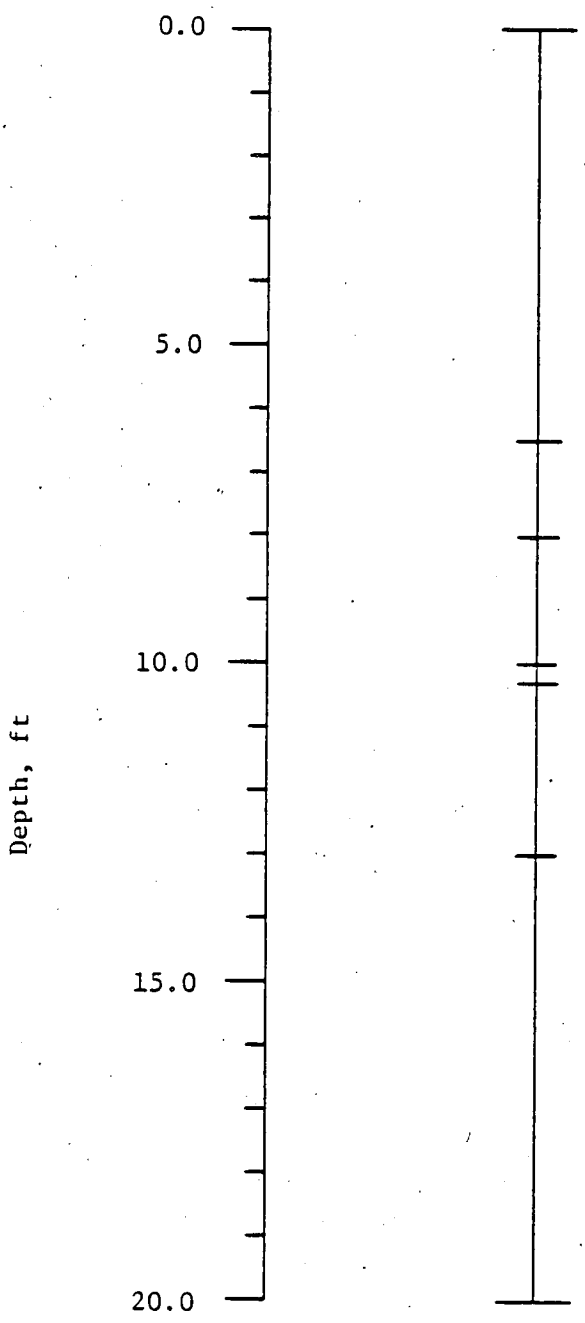
Shale: brown, grey, soft.

Sandstone: grey, very fine-grained, soft.

Coal: black, soft.

Siltstone: grey, soft, thinly bedded.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-10-83



804.66

Clay(CL): brown with streaks of grey, soi
damp, sandy, organic matter (roots), moist
at 3 ft.

Gravelly clay (CL): grey with streaks of brown, soft, moist, gravelly-angular, fine, very fine-grained sandstone.

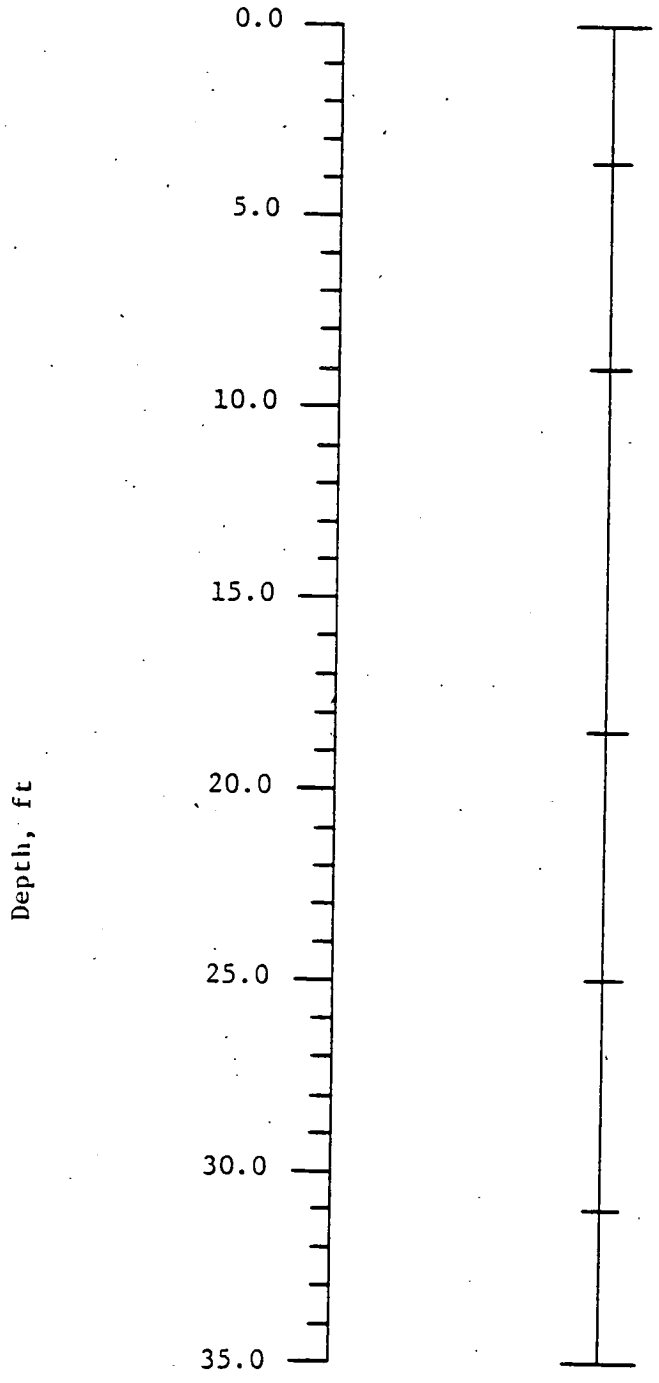
Clay (CL): grey, dark grey, soft, moist.

Lignite: black, soft, dry, earthy.

Shale: dark grey, soft.

Sandstone: reddish brown, brown, and grey, very fine-grained, soft, weatherd to 14.5 ft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-11-83



822.35 ft MSL

Clay (CL): brown and grey, soft, dry, organic matter (roots).

Sandstone and clay: brown, reddish brown thinly bedded , oxidized, weathered, soft to hard, very fine-grained.

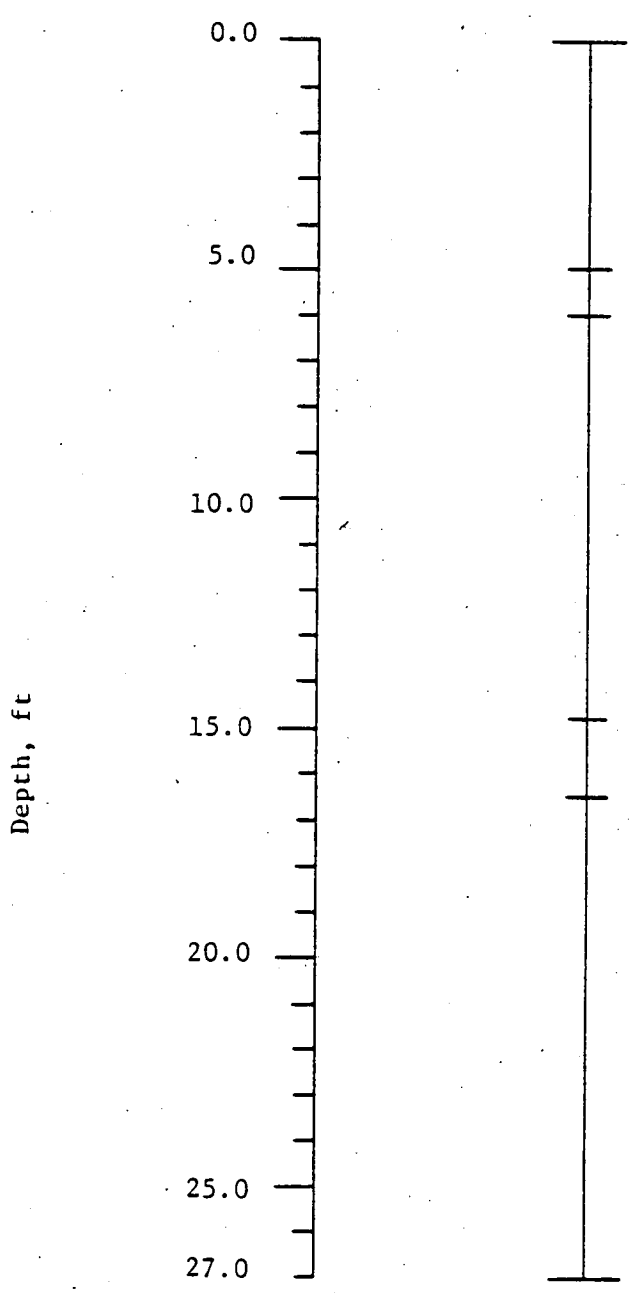
Sandstone and shale: light grey and brown, thinly bedded, soft, very fine-grained sandstone.

Sandstone and clay shale: brown, very fine grained sandstone, soft shale-clay shale, thinly bedded.

Sandstone and shale: light and dark grey, thinly bedded, soft.

Sandstone: brown, very fine-grained, hard.

NWSC, Crane, Indiana
Rockeye
Lighology
Boring Number: WES-10-12-83



813.17 ft MSL

Clay (CL): brown, stiff, hard, brittle, organic matter (roots).

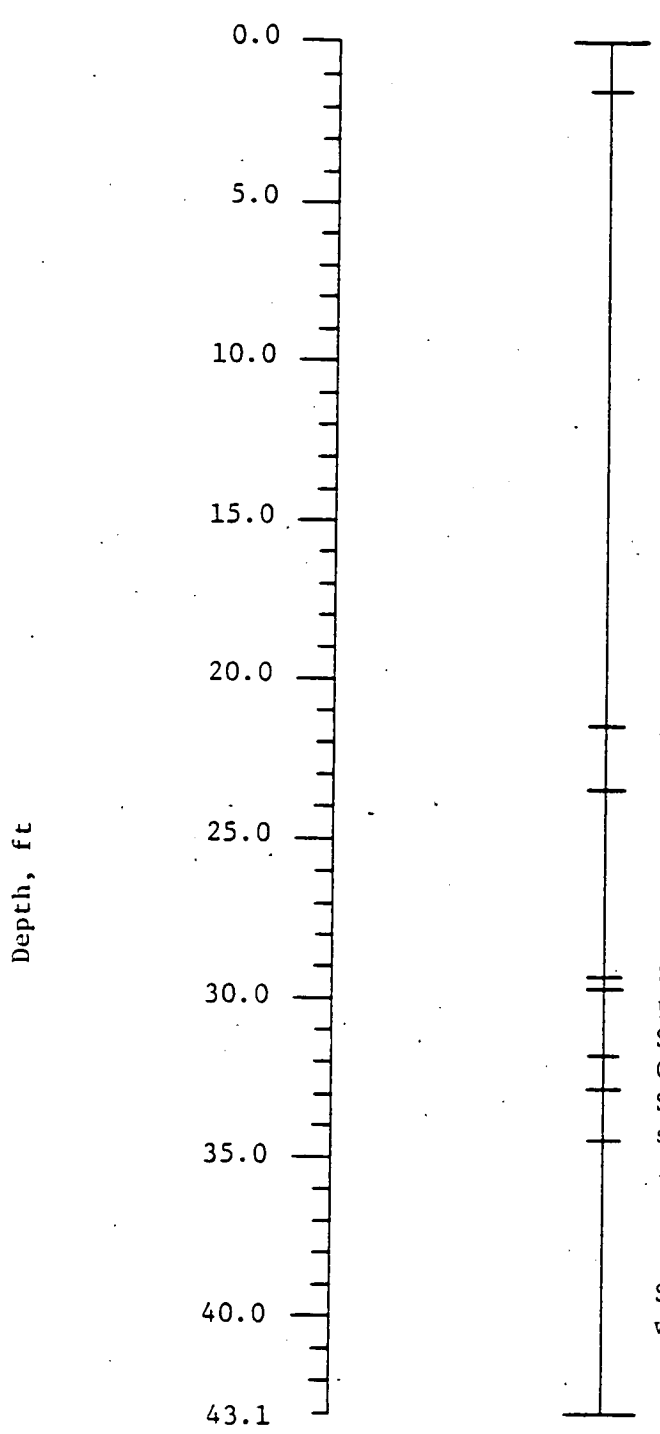
Clay Shale: brown, hard, stiff.

Sandstone: brown, reddish brown, soft and weathered to 9 ft, medium to hard from 9 ft very fine-grained.

Sandstone: light grey, very fine-grained, soft, wet at 16.5 ft.

Sandstone: brown, soft, very fine-grained.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-13-83



812.92 ft MSL

Clay (CL): brown, soft to stiff, contains sandstone gravel-very fine-grained.

Sandstone: brown, light brown, very fine-grained, soft, weathered.

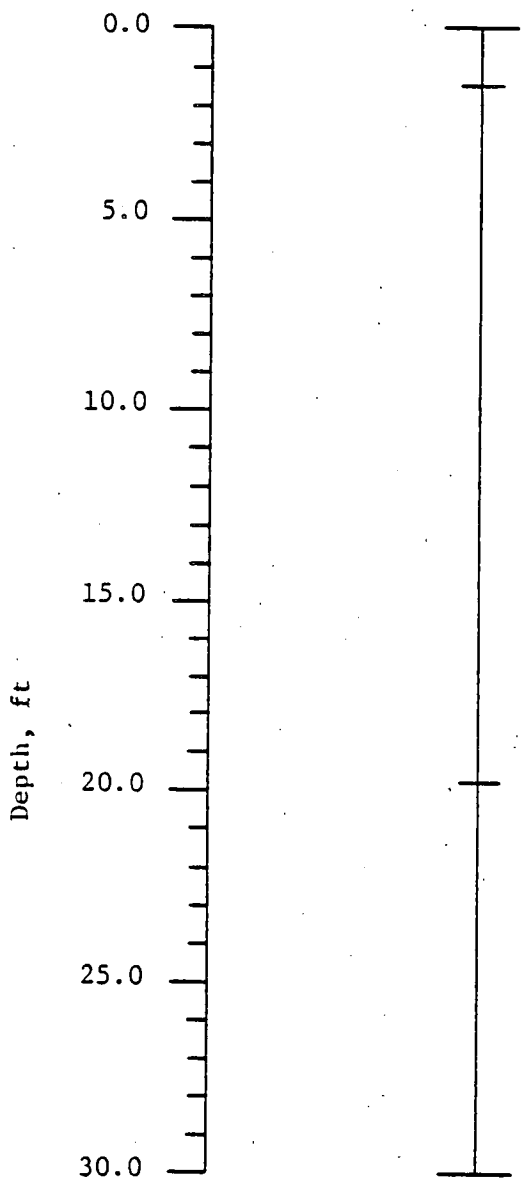
Lignite and shale: dark grey and black, soft thinly bedded.

Shale: dark grey, soft, uniform.

Sandstone: light grey, very fine-grained, poorly sorted.
Shale: dark grey, soft.
Coal: black, soft, brittle (bituminous).
Sandstone: light grey, very fine-grained, soft, water at 33 ft.

Sandstone: light grey, brown, thinly bedded with shale, very fine-grained sandstone.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-14-83



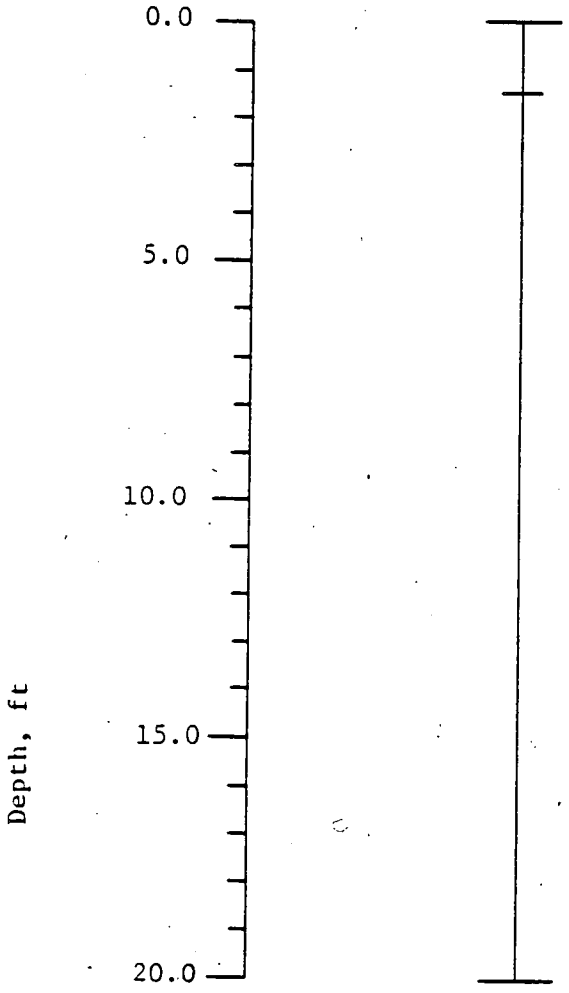
812.21 ft MSL

Clay (CL) and sandstone: brown, soft to st
sandy- very fine-grained, gravelly, dry.

Sandstone: light brown to brown, very fine-
grained, uniform, quartz sandstone weathere

Shale and lignite: dark grey to black,
thinly bedded, soft, water at 20 ft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-14A-83

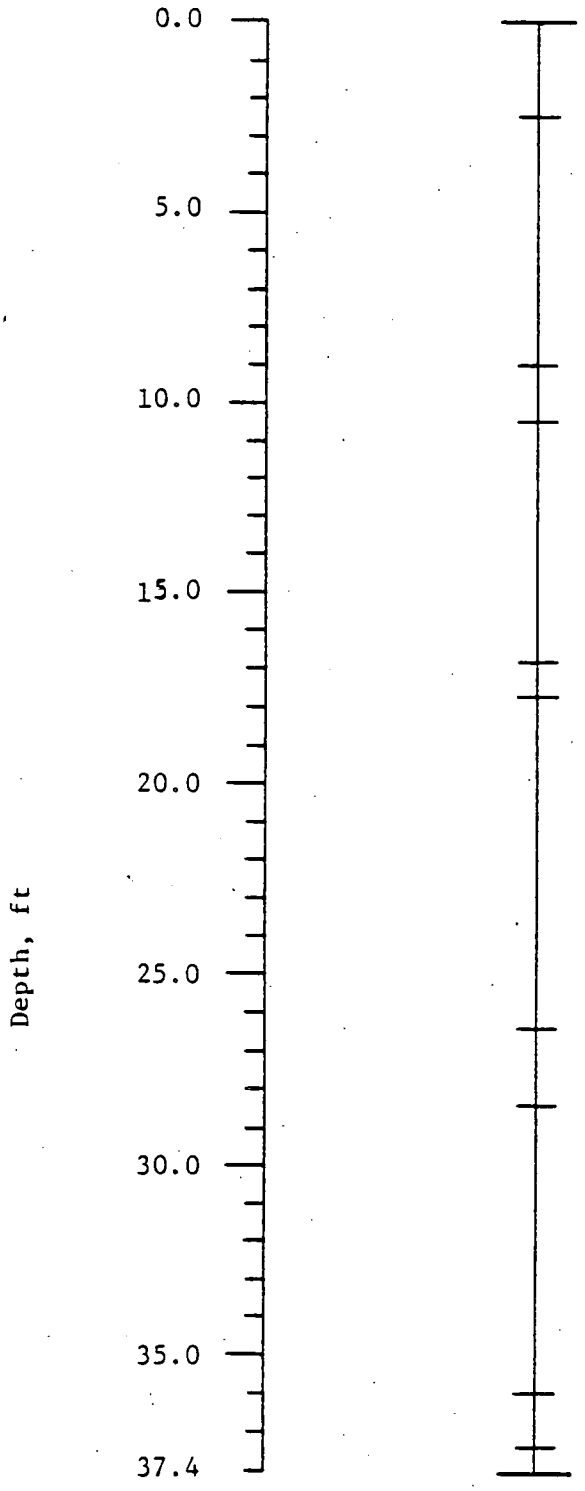


812.44 ft MSL

Clay (CL) and sandstone: brown soft to sti
sandy - very fine-grained, gravelly.

Sandstone: light brown to brown, very fine-
grained, uniform, quartz sandstone, weather
water at 20 ft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-14B-83



789.34 ft MSL

Clay(CL): brown, soft to stiff, slightly damp, fill to 1 ft, gravelly-very fine-grain sandstone gravel.

Sandstone and clay: brown, reddish brown, soft, weathered, thinly bedded, very fine-grained sandstone.

Sandstone and clay: light grey clay and brown, and grey sandstone, thinly bedded, very fine-grained sandstone.

Shale and sandstone: light to dark grey, soft, thinly bedded, very fine-grained sandstone.

Sandstone: light grey, very fine-grained, hard.

Shale: dark grey, soft.

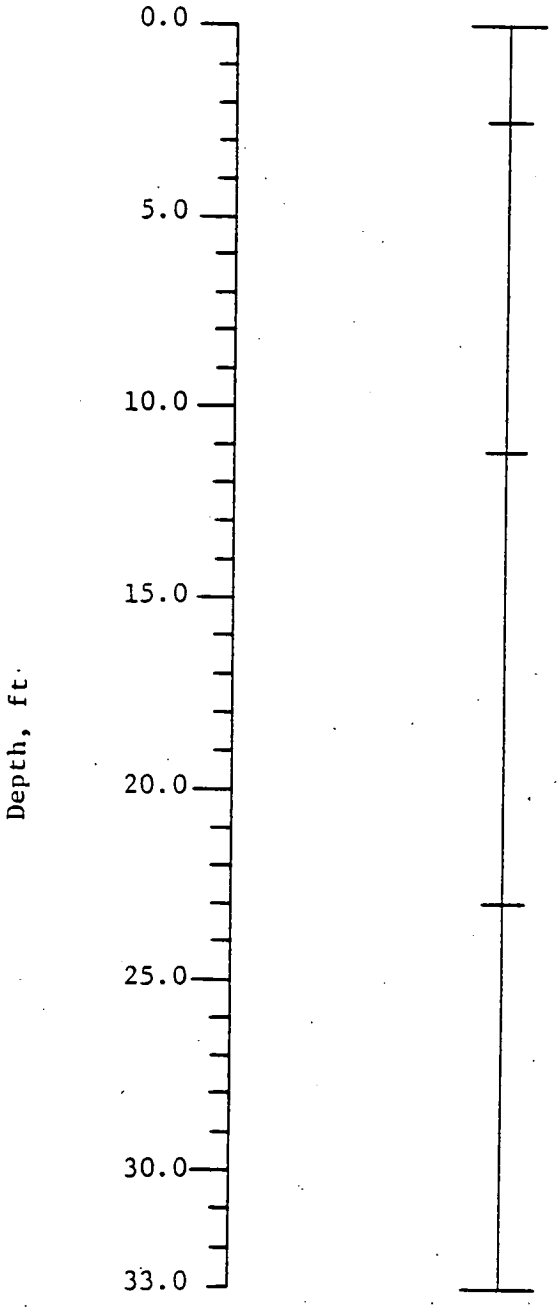
Coal: black, soft, brittle (bituminous), wet at 28 ft.

Shale: dark grey, soft.

Coal: black, soft, brittle (bituminous).

Sandstone: light grey, soft, very fine-grained.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-15-83



785.42 ft MSL

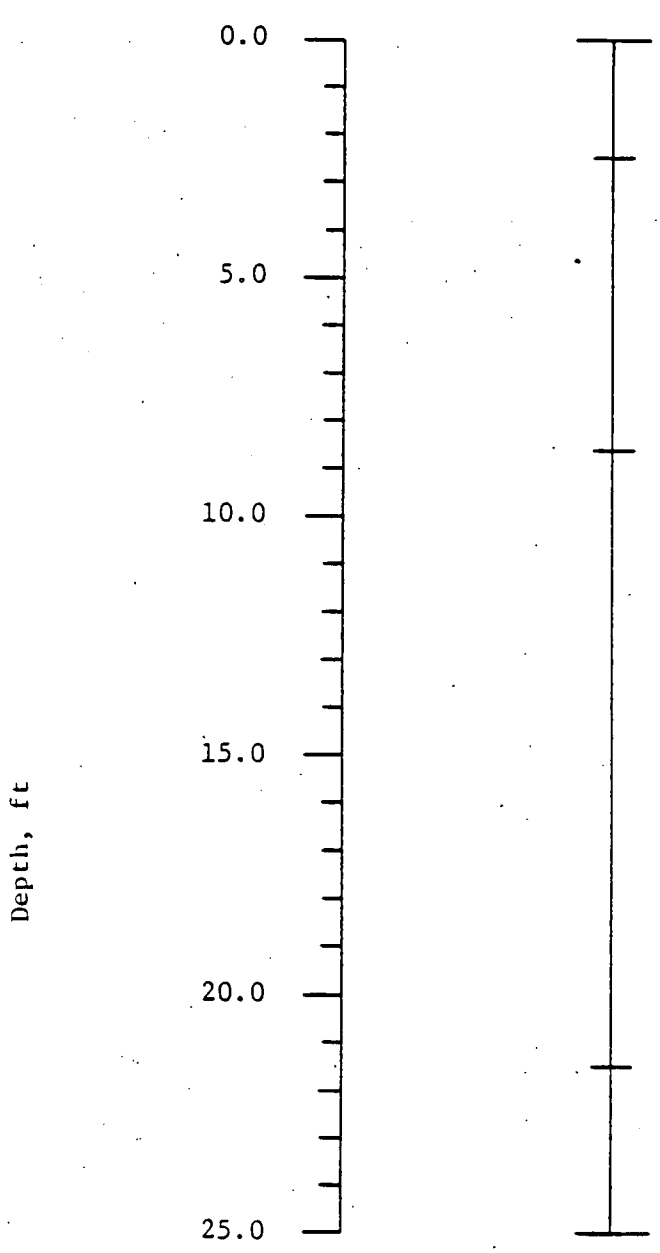
Fill (gravelly sand): brown, very fine-grained sand and sandstone gravel, dry, soft to stiff, poorly sorted.

Sandstone: brown, reddish brown, soft to stiff, very weathered, very fine-grained, friable, clayey, contains oxidized, ferruginous gravel, thinly bedded, partial recovery.

Sandstone (80%) and shale (20%): brown reddish brown, and light grey sandstone thinly bedded with dark grey, soft shale. Sandstone is very fine-grained, weathered, oxidized, breaks occur in shale, bedding ranges from 1/32 in 1-in thickness, horizon in attitude, water at 23 ft.

Sandstone (95%) and shale (50%): see above.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-16-83



776.60 ft MSL

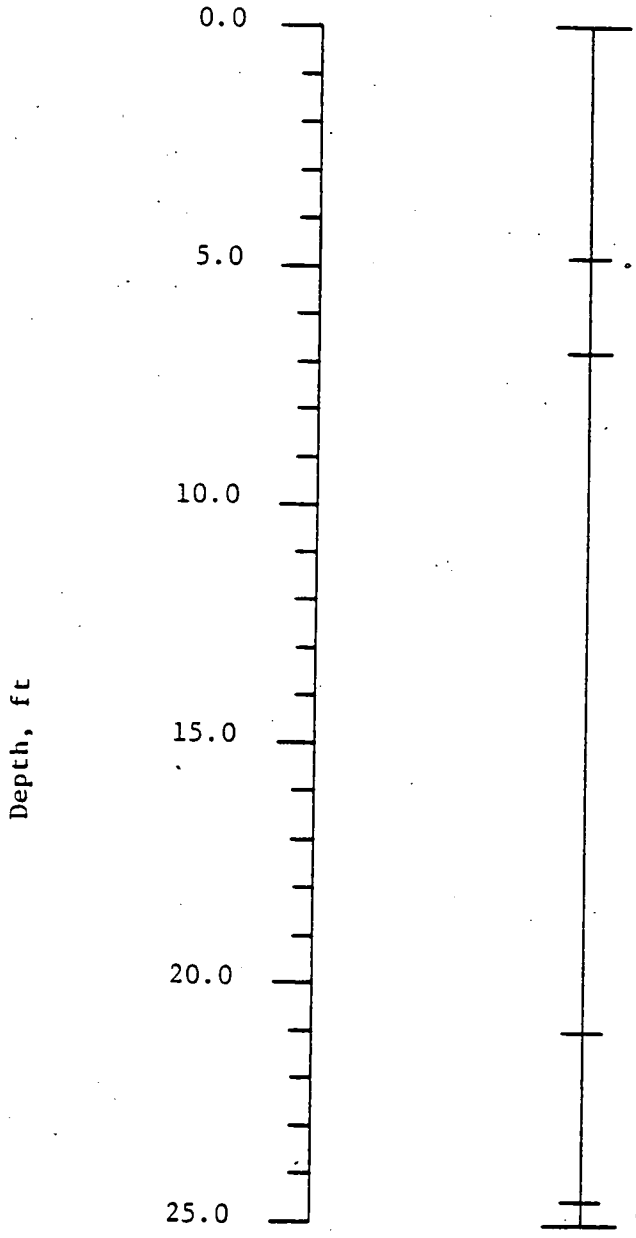
Clayey sand(CL): brown, reddish brown, soft to slightly stiff, slight cohesion, damp, contains very fine-grained sandstone gravel.

Sandstone and clay: brown, very fine-grained quartz sandstone thinly bedded with soft, brown and grey clay, weathered.

Sandstone: light to dark brown, soft, weathered, very fine-grained, quartz sandstone, wet at 13 ft.

Shale and sandstone: dark grey, soft shale thinly bedded with light grey very fine-grained, soft sandstone.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-17-83



774.09 ft MSL

Fill (sandy clay): brown, soft, sandy, low plasticity.

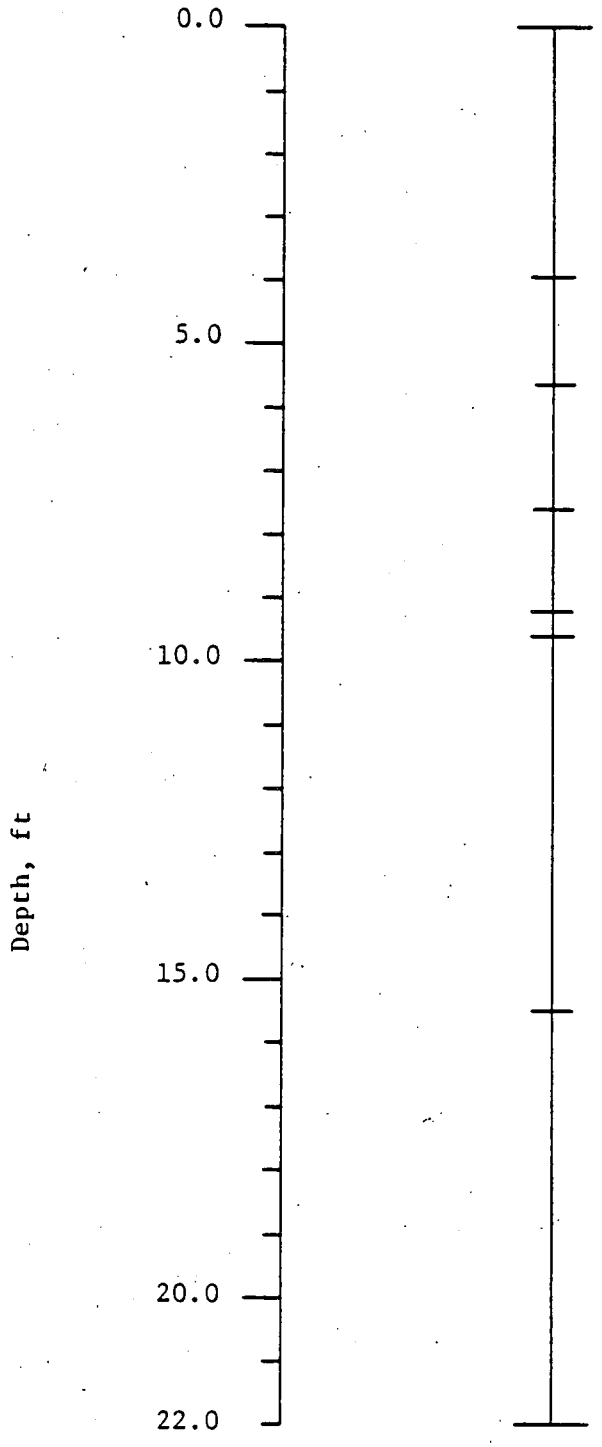
Sandstone and clay: brown, reddish brown, ve fine-grained, predominantly quartz sandstone thinly bedded with soft sandy clay, weathere

Sandstone: light grey, light brown, brown, weathered, oxidized, very fine-grained, predominantly quartz sandstone, wet at 13 ft.

Shale: dark grey, soft.

Sandstone: grey, very fine-grained, soft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-18-83



783.60 ft MSL

Sandy clay(CL): brown, soft, damp, sandy-very fine-grained, organic matter.

Sandy clay(CL) and sandstone gravel: brown and grey, soft clay mixed with very fine-grained sandstone gravel, wet at 5.65 ft.

Sandstone and clay: brown, soft, weathered, very fine-grained sandstone, thinly bedded

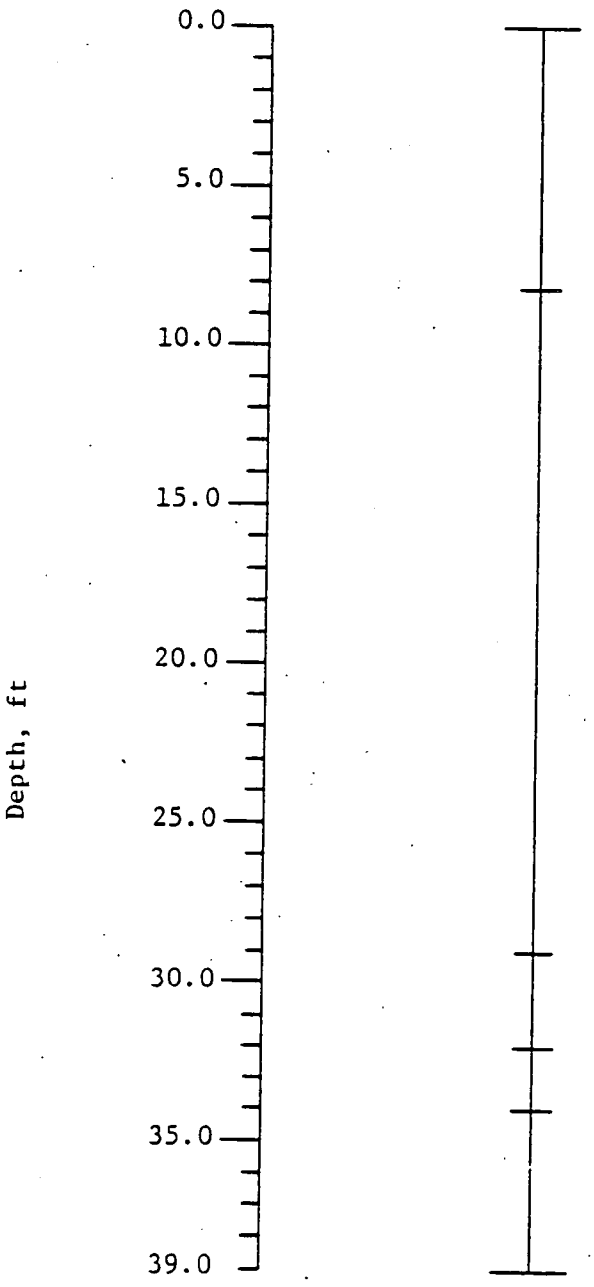
Sandstone: brown, soft, weathered, very fine-grained.

Clay: brown, soft.

Shale coal and sandstone: dark grey, black light grey, thinly bedded, soft.

Sandstone: brown, very fine-grained, soft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-19-83



802.86 ft MSL

Sandy clay and sandstone gravel: brown, so to stiff, fine to coarse, very fine-grained weathered, sandstone gravel, damp.

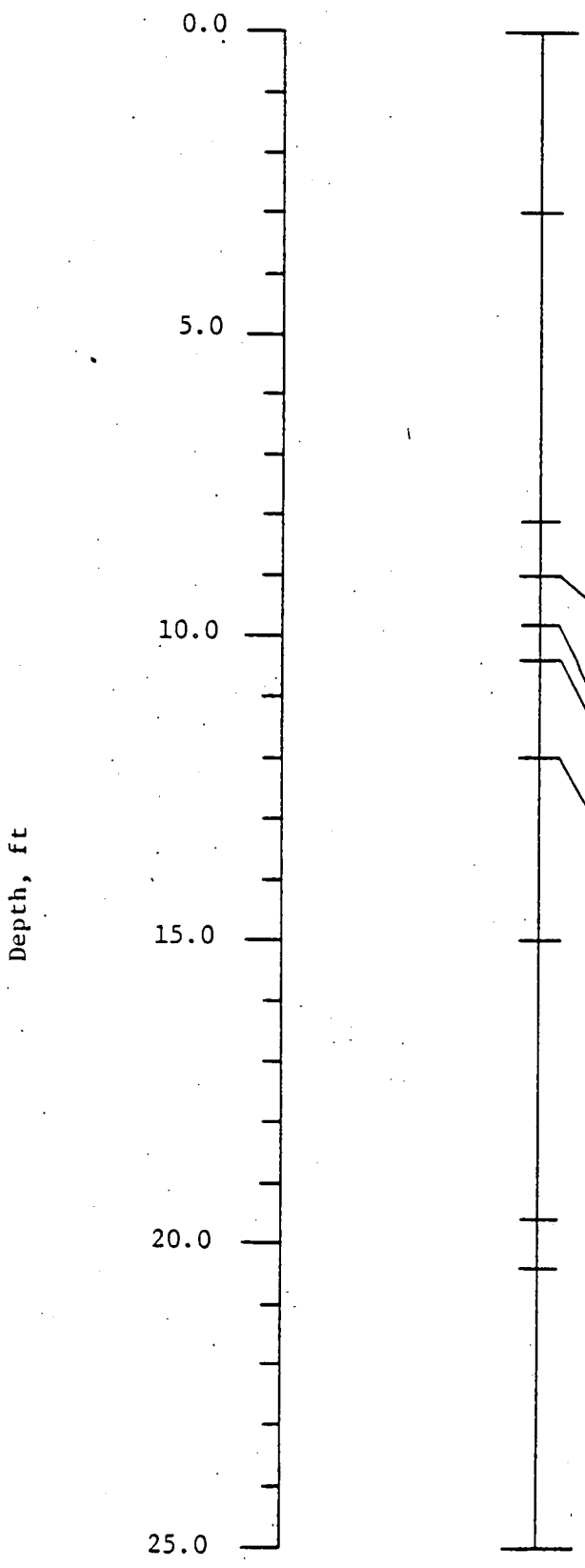
Sandstone: brown, tan, reddish brown, pink white, uniform, very fine-grained quartz sandstone, soft, water at 29 ft.

Shale: dark grey, soft.

Coal: black, brittle, soft, uniform (bitum ous).

Sandstone, siltstone, and shale: light to dark grey, very thinly bedded, soft.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-20-83



781.56 ft MSL

Sandy clay(CL): brown, soft to stiff, sandy very fine-grained sand, damp.

Sandy clay shale: brown, very weathered, sandy - 30 to 40% very fine-grained sand, st to very stiff, damp, thinly bedded.

Sandstone: brown to reddish brown, very weathered, very fine-grained, clayey oxidiz soft to hard.

Clay Shale: brown, light brown, reddish bro very weathered, very thinly bedded, soft to very stiff.

Shale: black or dark grey, soft, thinly bed

Shale(90%) and sandstone(10%) dark grey and light grey, thinly bedded, highly weathered and oxidized from 10.2 to 10.9 ft and wet.

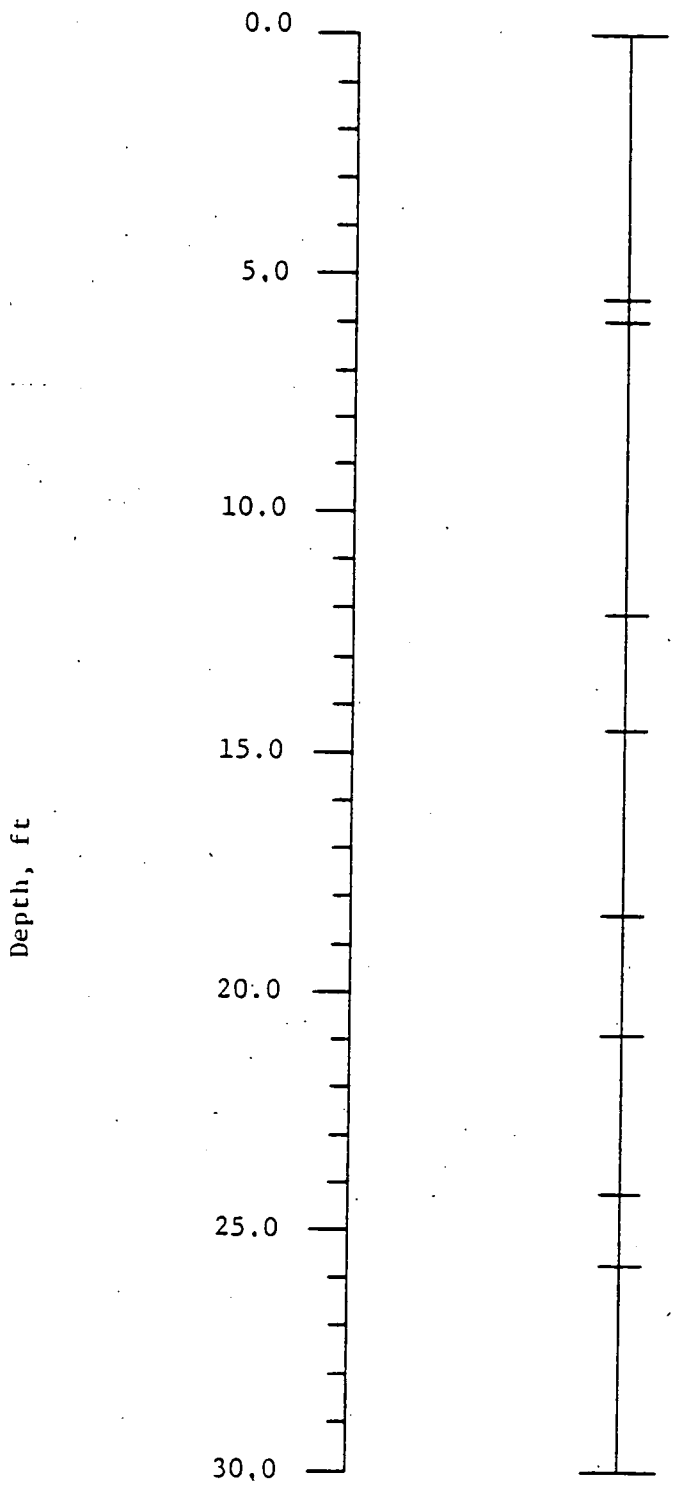
Shale: black and dark grey, uniform, soft.

Sandstone(60%) and shale (40%): light grey, very fine grained sandstone thinly bedded wi soft dark grey to black shale, bedding range from 1/32 to 1/4-in in thickness and rearly horizontal in attitude.

Shale: dark grey or black, soft, uniform.

Sandstone(95%) and shale (5%): light brown and light grey, oxidized in regions very fine grained uniform quartz sandstone thinl bedded with soft black shale ranging in thic ness from 1/32 to 1/16 in.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES-10-21-83



822.98 ft MSL

Sandy clay(CL): brown soft to stiff, damp. organic matter(roots), sandy- very fine-grained sand.

Clay: light grey, soft, sandy.

Sandstone: light brown, brown, light grey, very fine-grained, thinly bedded, soft.

Sandstone, shale, and coal(slight): light dark grey and black, very thinly bedded, so very fine-grained sandstone.

Sandstone: light brown and light grey or white, very hard, uniform, quartz sandstone.

Shale: grey, soft, wet at 20 ft.

Sandstone and shale: light to dark grey, sc thinly bedded, very fine-grained sand.

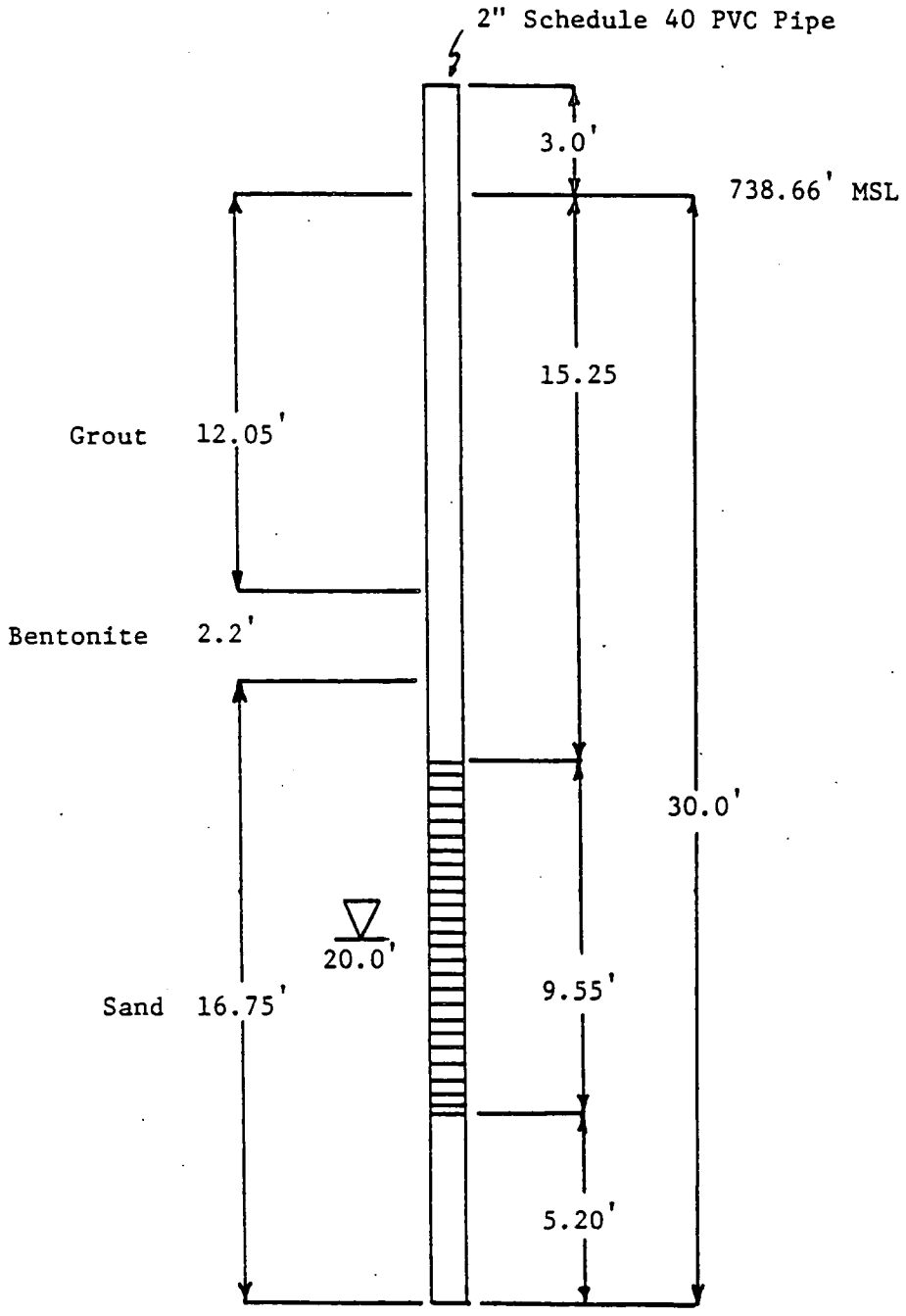
Sandstone: light grey, very fine-grained, soft

Sandstone and shale: light to dark grey, thinly bedded, soft, very fine-grained sandstone.

NWSC, Crane, Indiana
Rockeye
Lithology
Boring Number: WES 10-22-83

APPENDIX A3

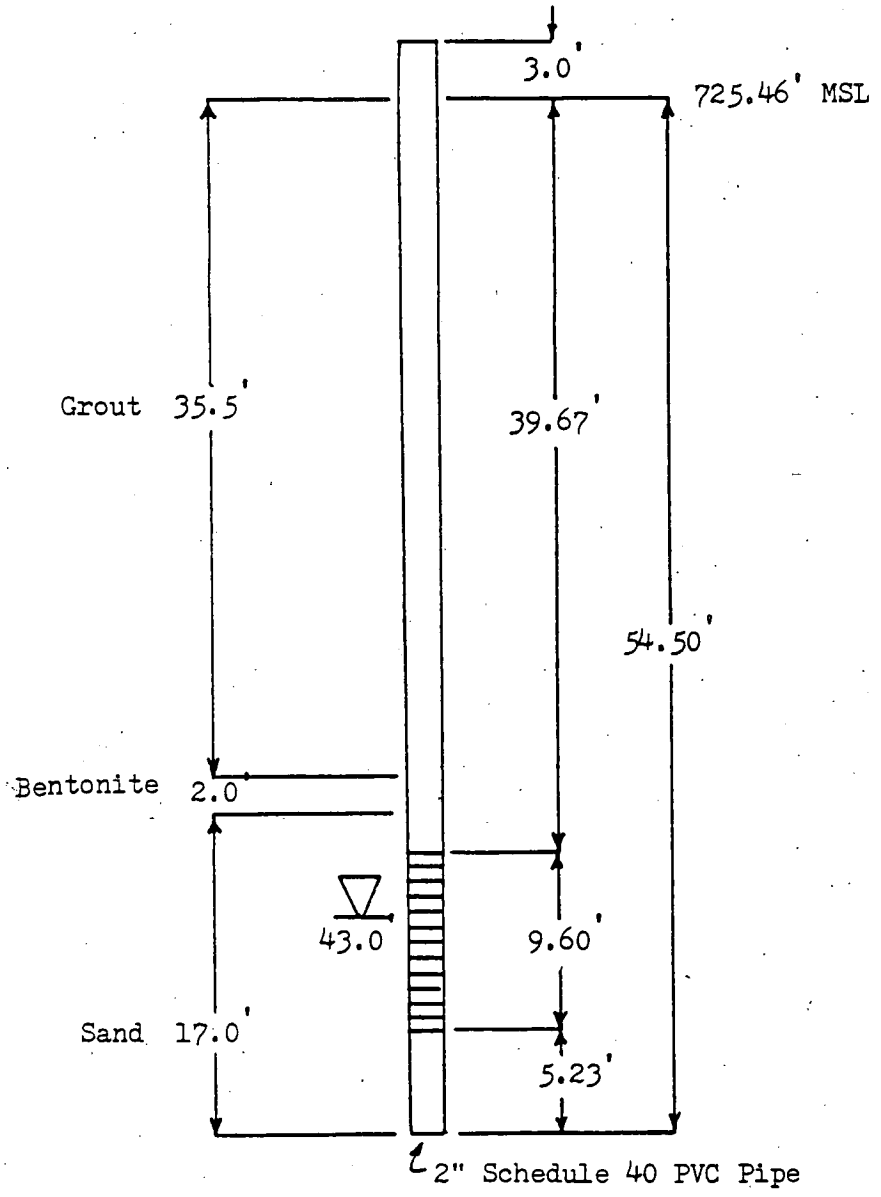
Graphical Representations of the Construction Details for Each Monitoring Well



Water depth at time of drilling

Well screen

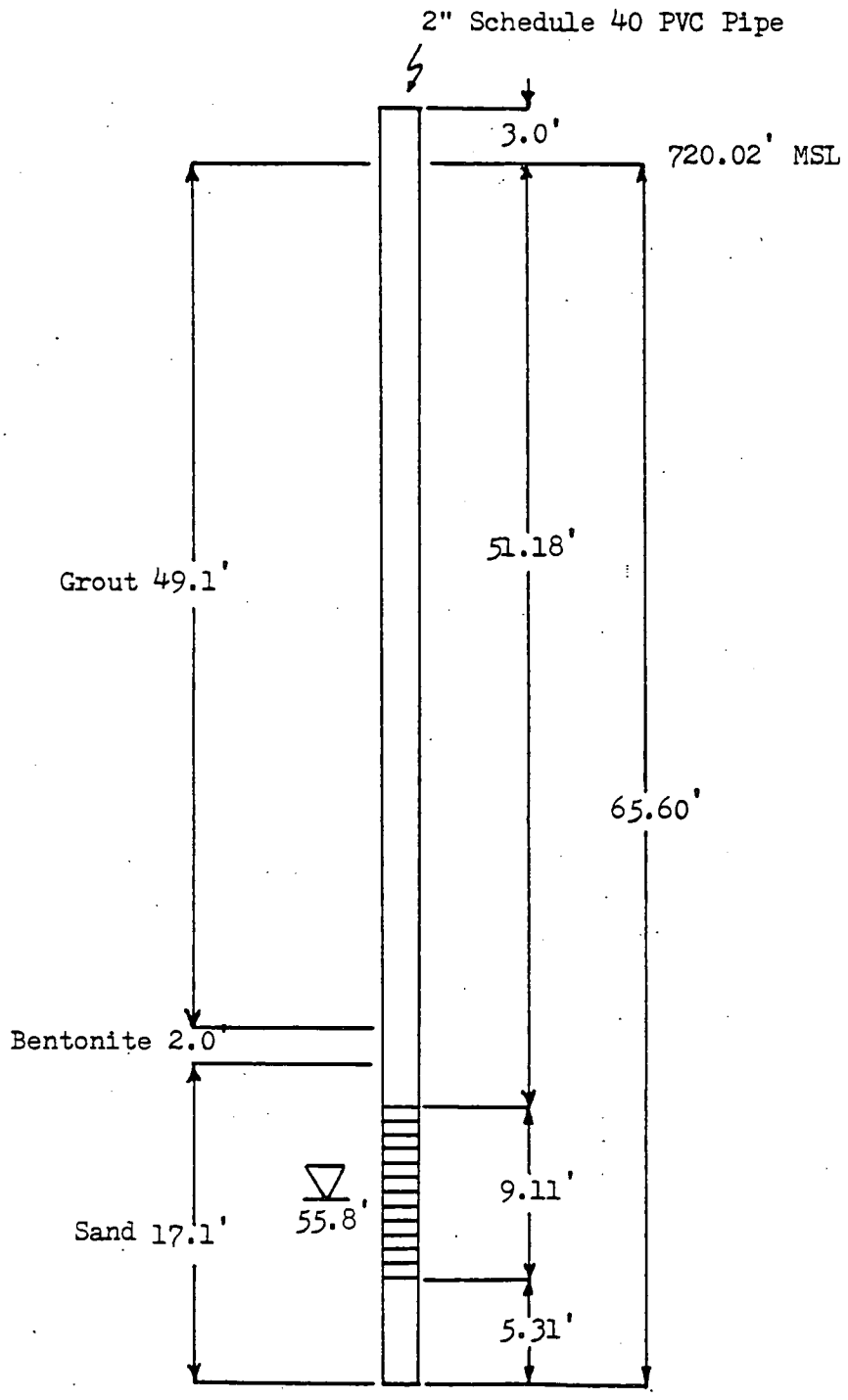
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-1-81



Water depth at time of drilling

Well screen

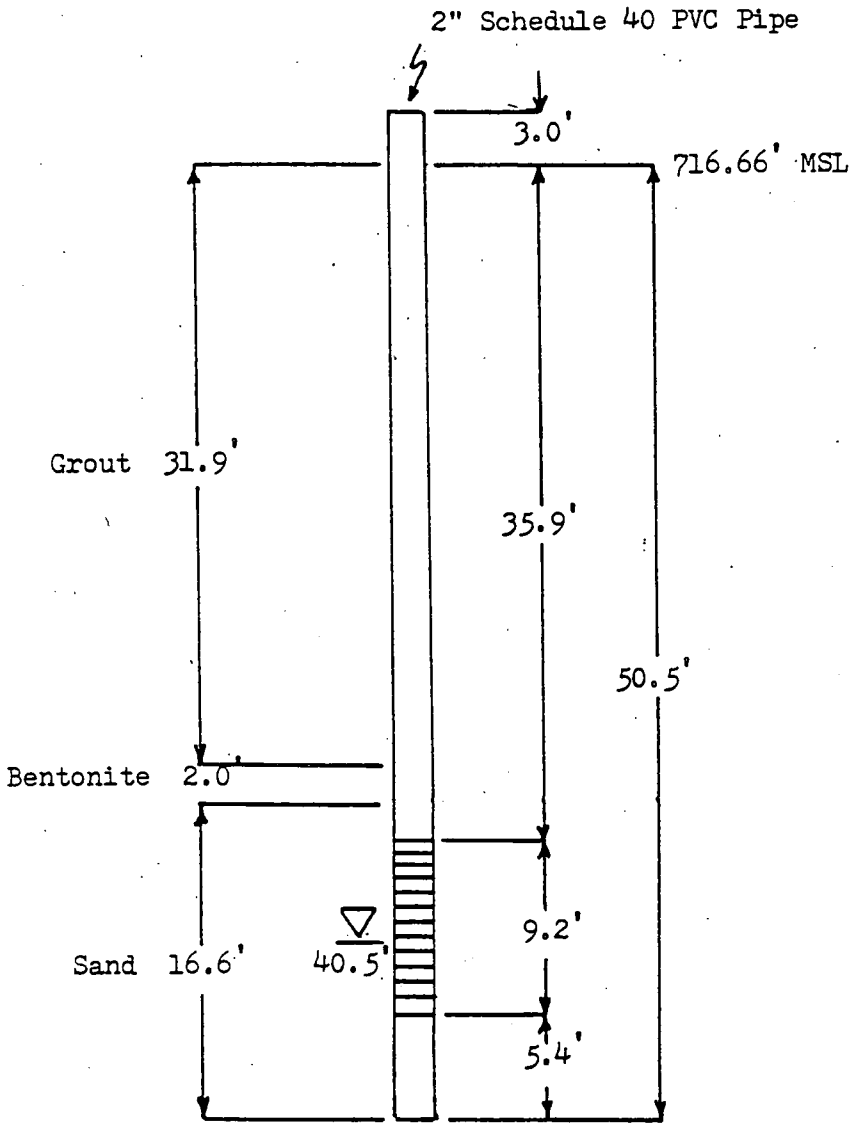
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-2-81



Water depth at time of drilling

Well screen

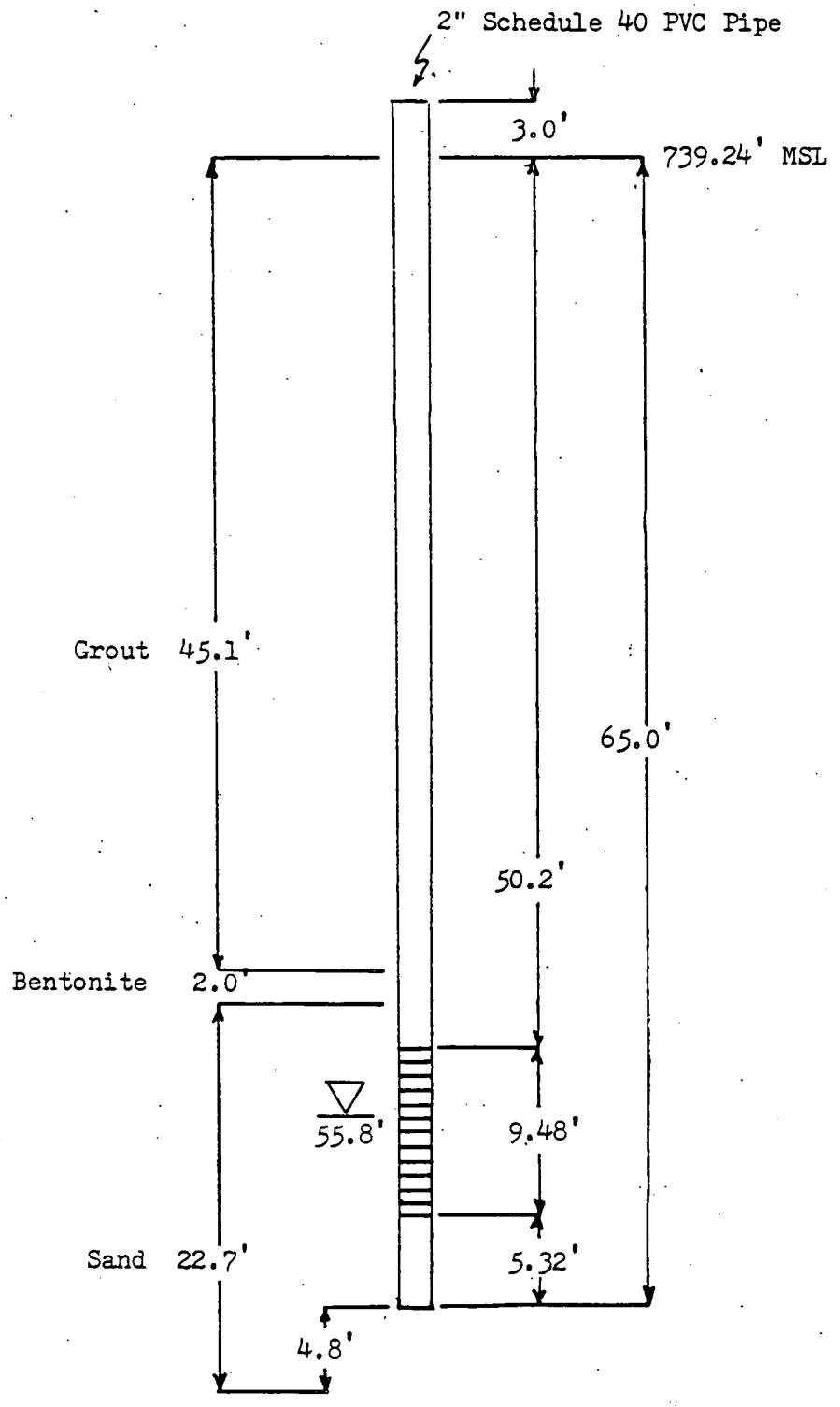
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-3-81



▽ Water depth at time of drilling

Well screen

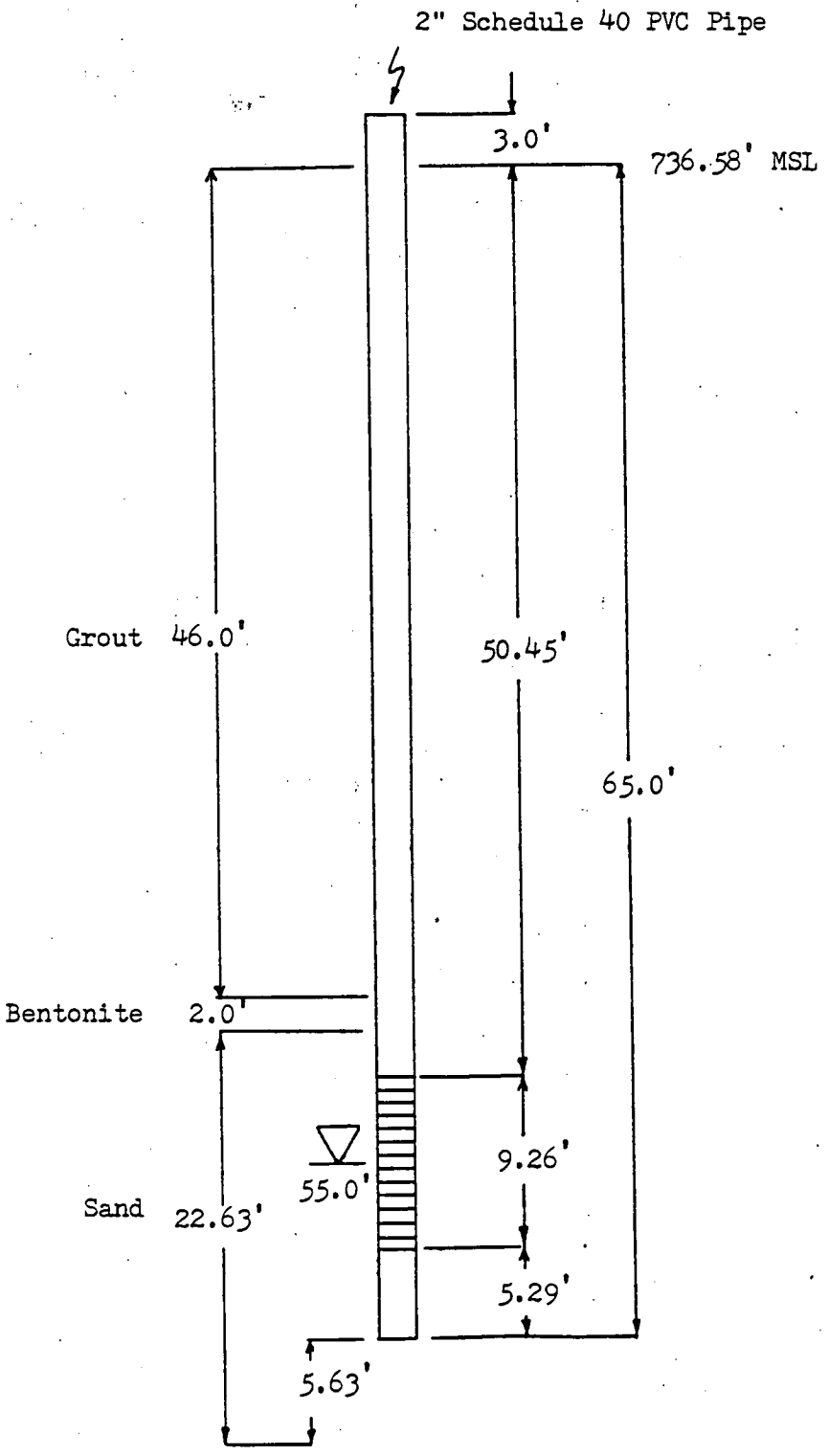
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-4-81



Water depth at time of drilling

Well screen

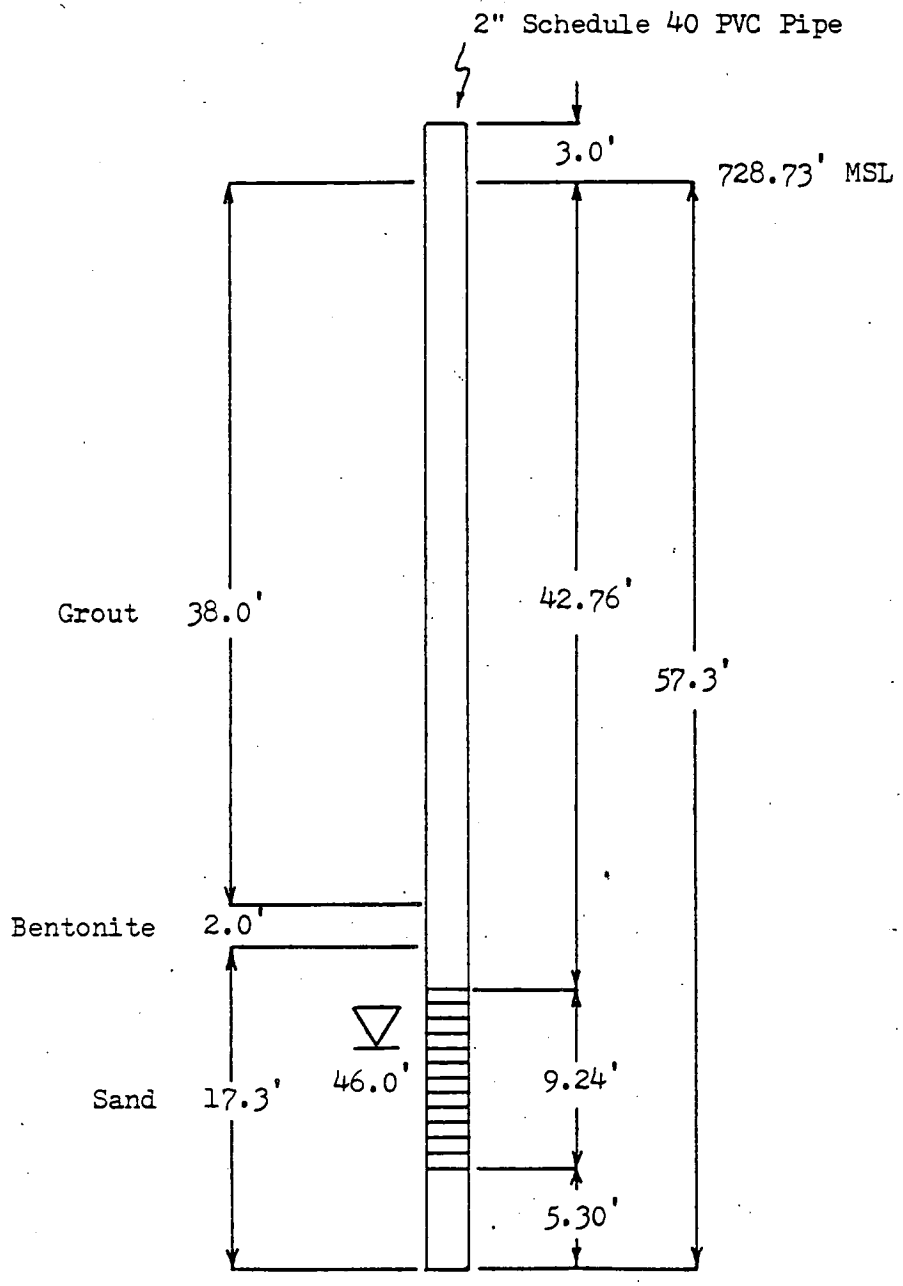
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-5-81



Water depth at time of drilling

Well screen

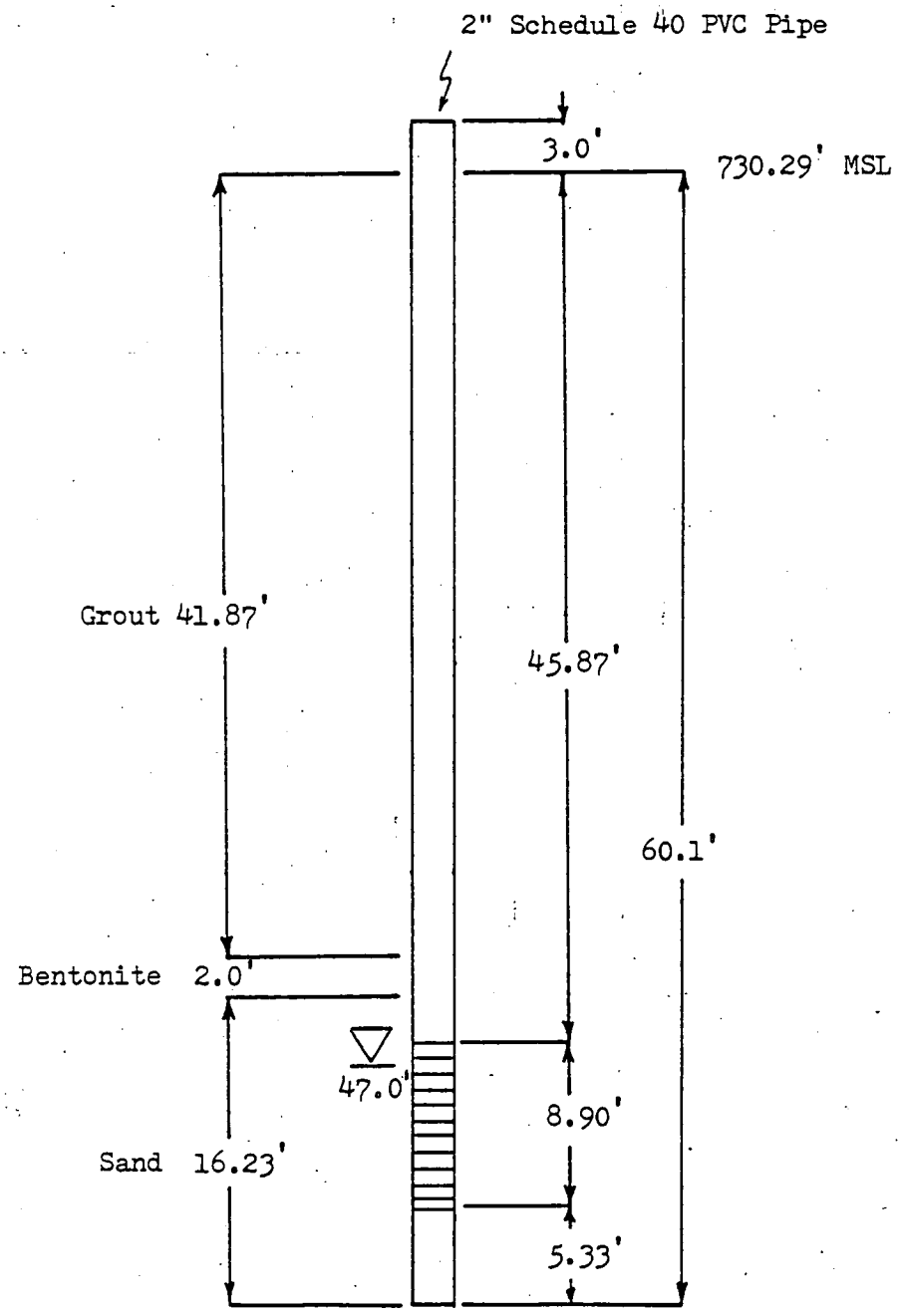
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-6-81



Water depth at time of drilling

Well screen

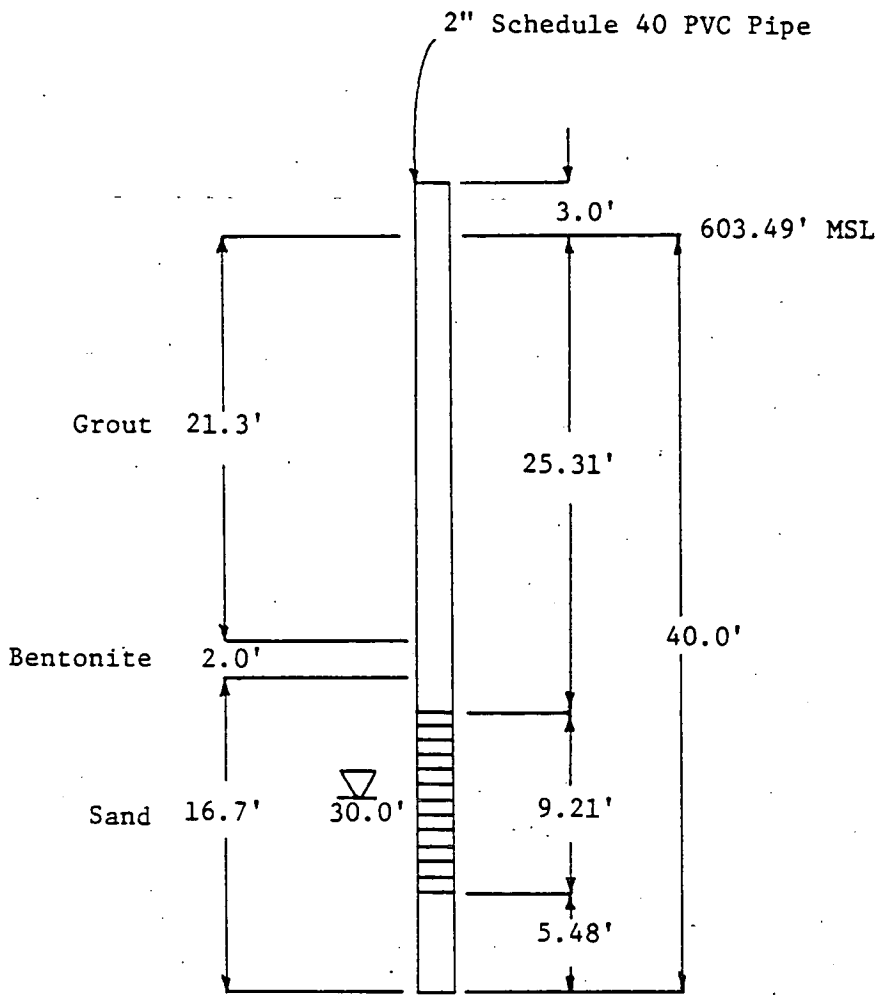
NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-7-81



Water depth at time of drilling

Well screen

NWSC, Crane, Indiana
Dye Burial Grounds
Well Completion
Boring Number: WES-2-8-81



Water depth at time of drilling

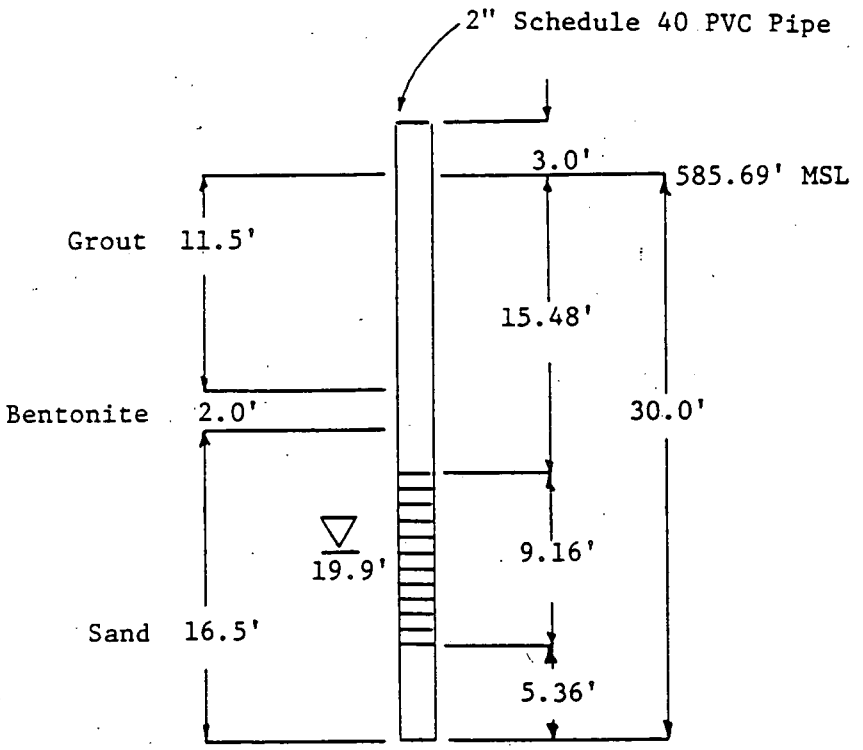
Well screen

NWSC, Crane, Indiana

McComish Gorge

Well Completion

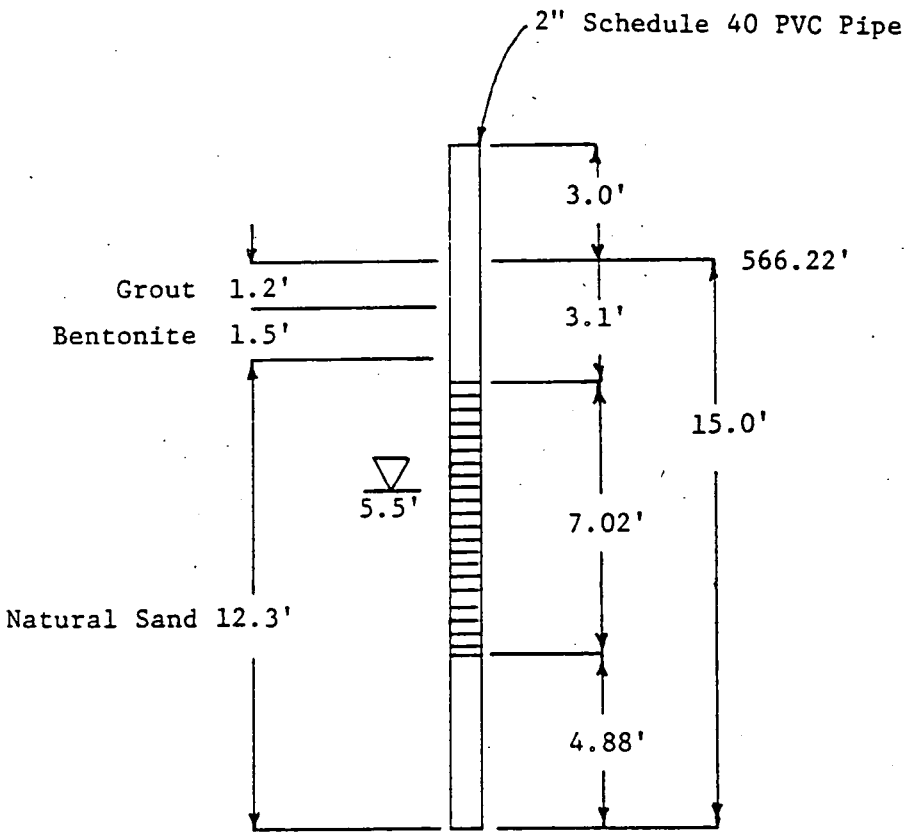
Boring Number: WES-4-1-81



Water depth at time of drilling

Well screen

NWSC, Crane, Indiana
McComish Gorge
Well Completion
Boring Number: WES-4-2-81



Water depth at time of drilling

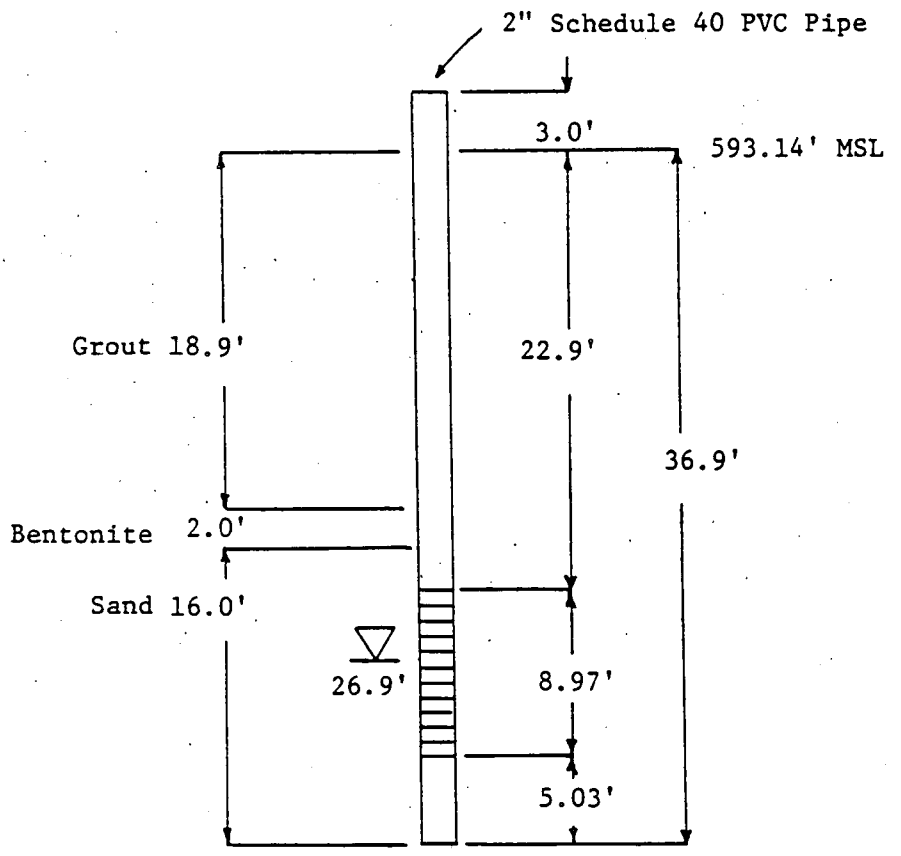
Well screen

NWSC, Crane, Indiana

McComish Gorge

Well Completion

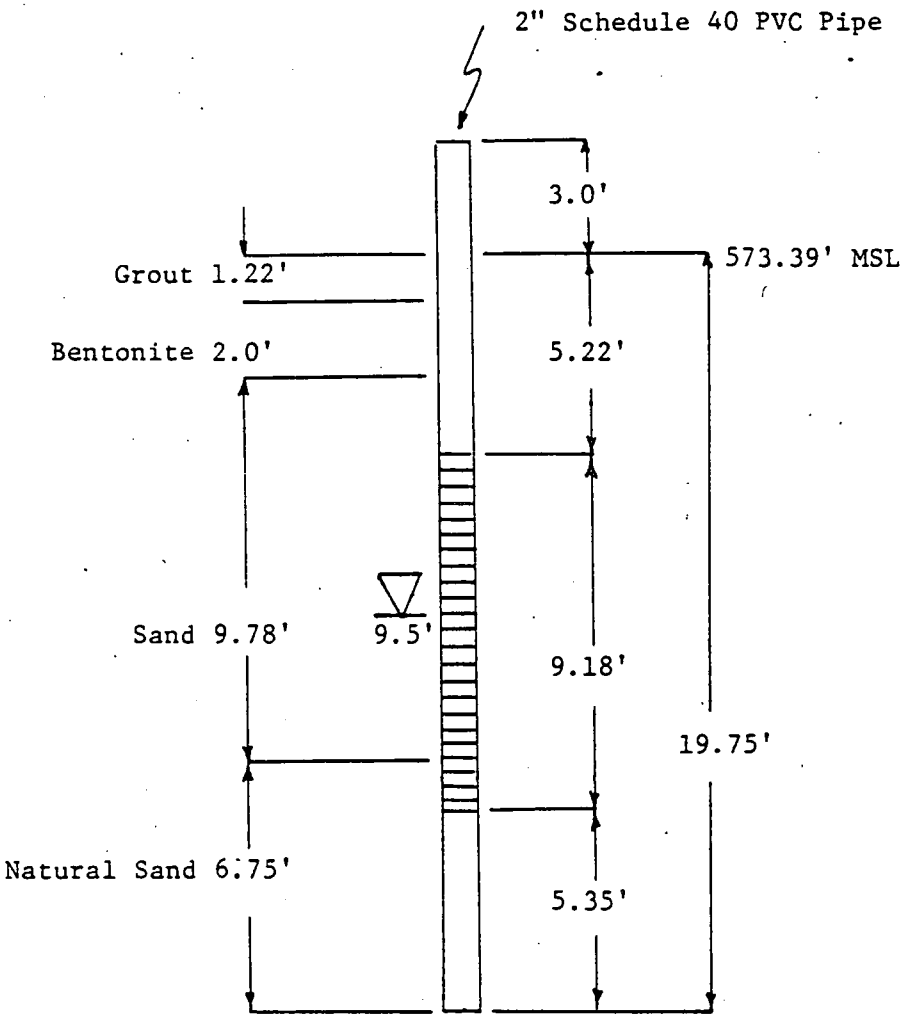
Boring Number: WES-4-3-81



Water depth at time of drilling

Well screen

NWSC, Crane, Indiana
McComish Gorge
Well Completion
Boring Number: WES-4-4-81



Water depth at time of drilling

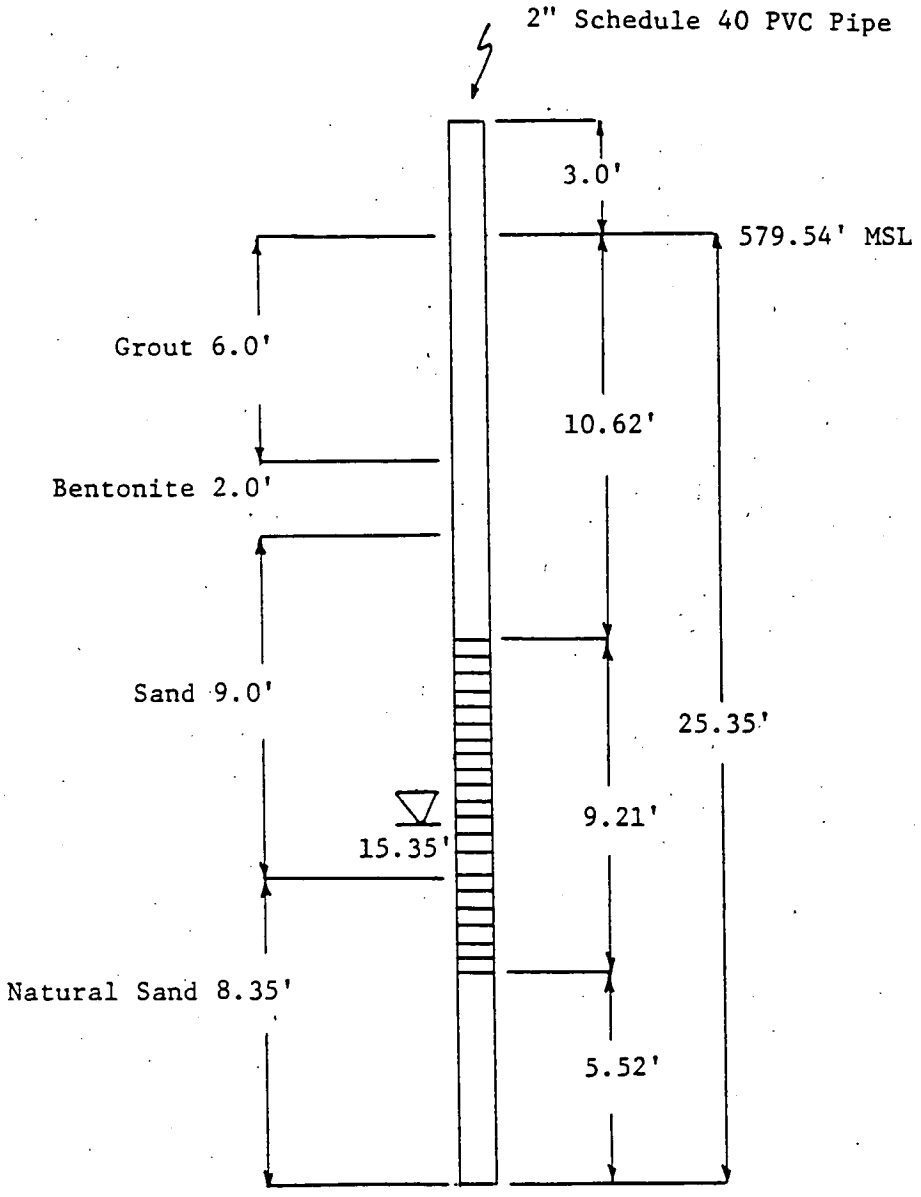
Well screen

NWSC, Crane, Indiana

McComish Gorge

Well Completion

Boring Number: WES-4-5-81



Water depth at time of drilling

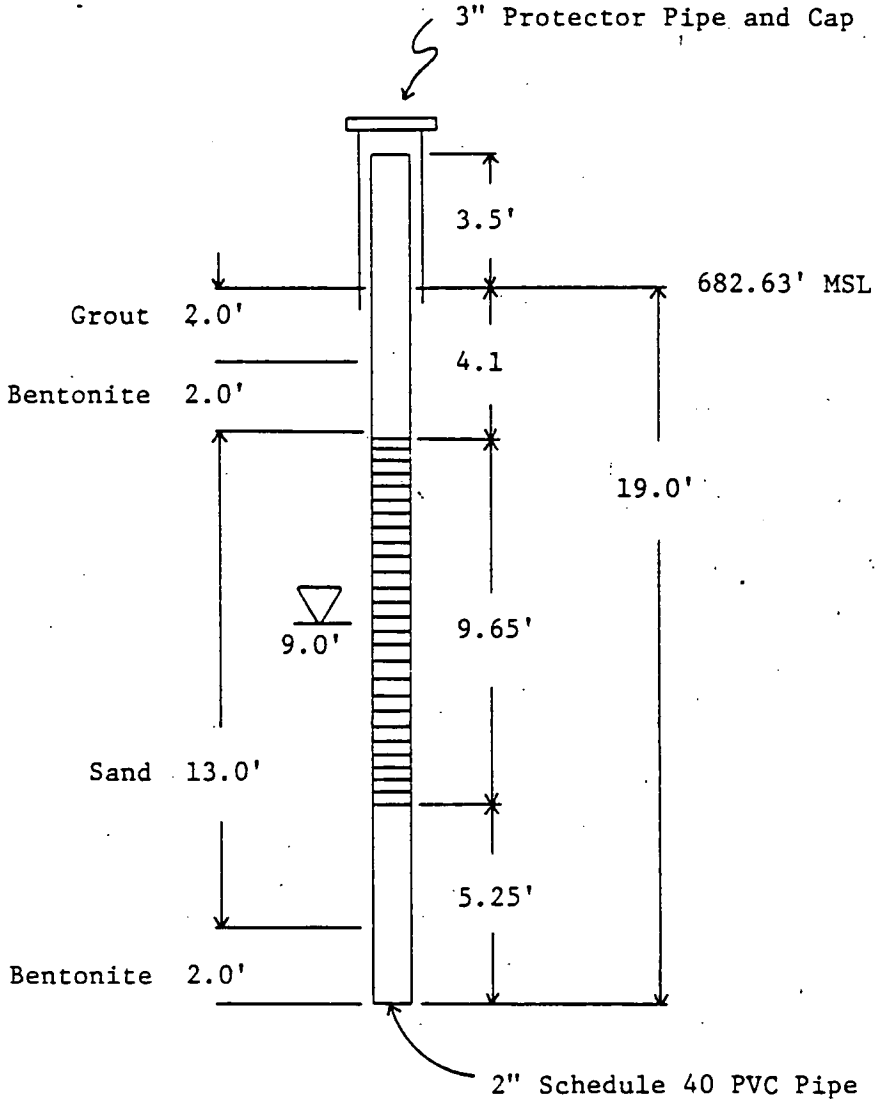
Well screen

NWSC, Crane, Indiana

McComish Gorge

Well Completion

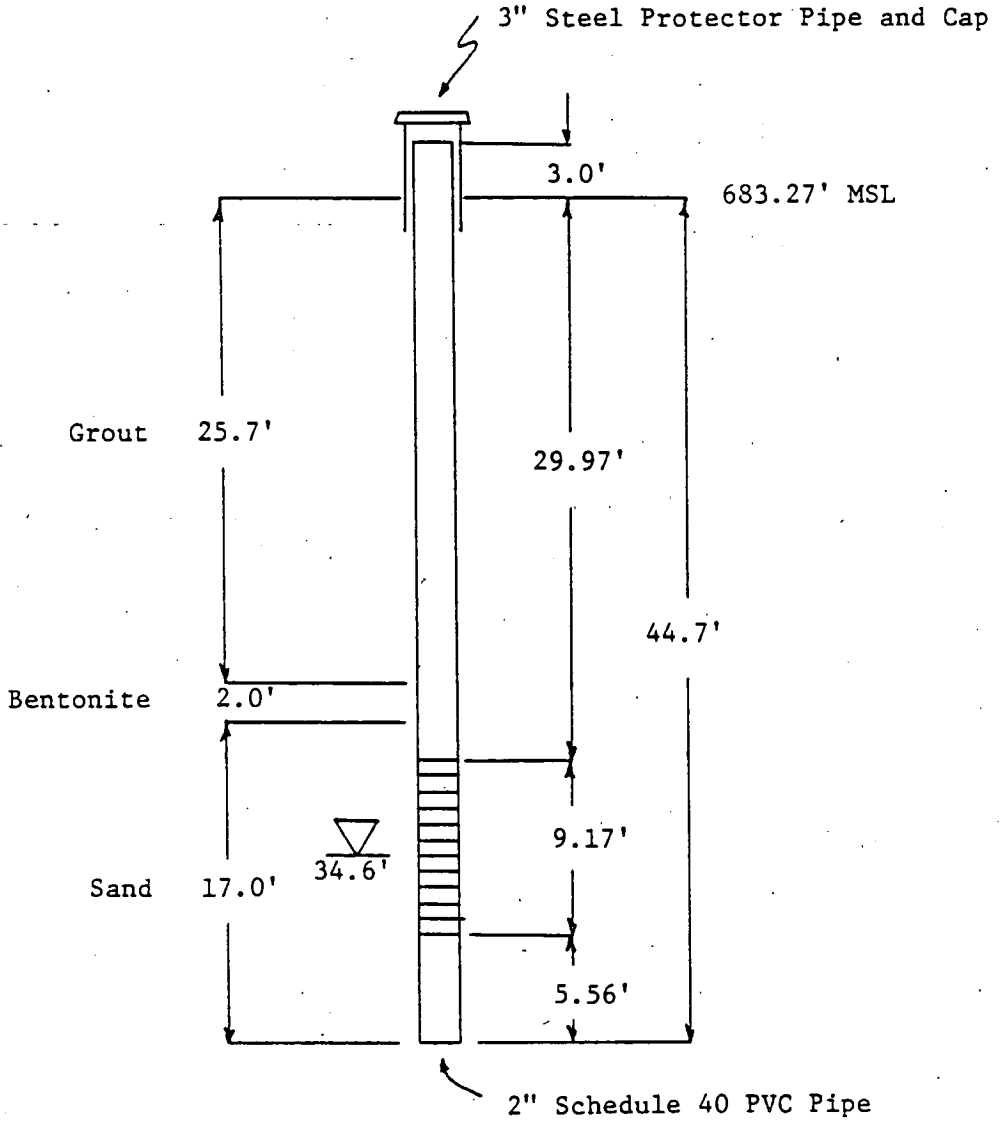
Boring Number: WES-4-6-81



Well screen

Water depth at time of drilling

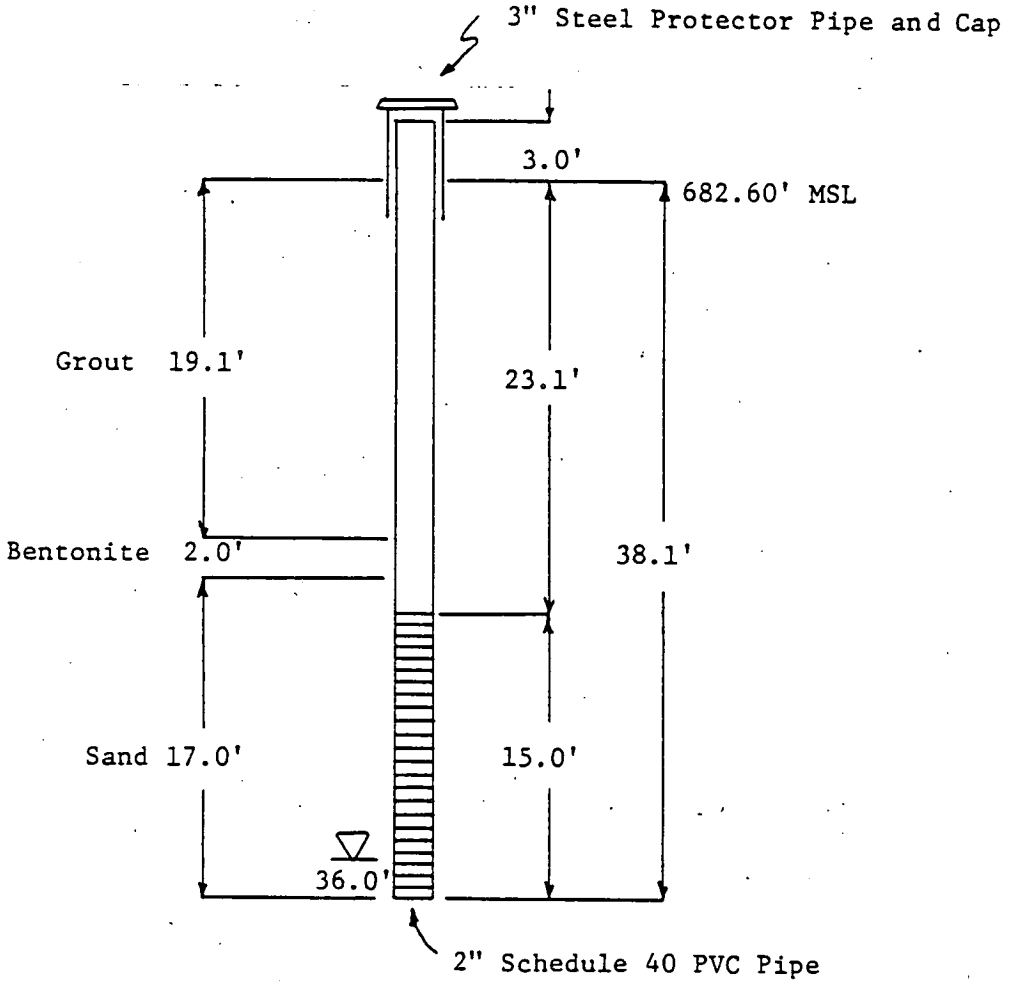
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-1A-81



Well screen

Water depth at time of drilling

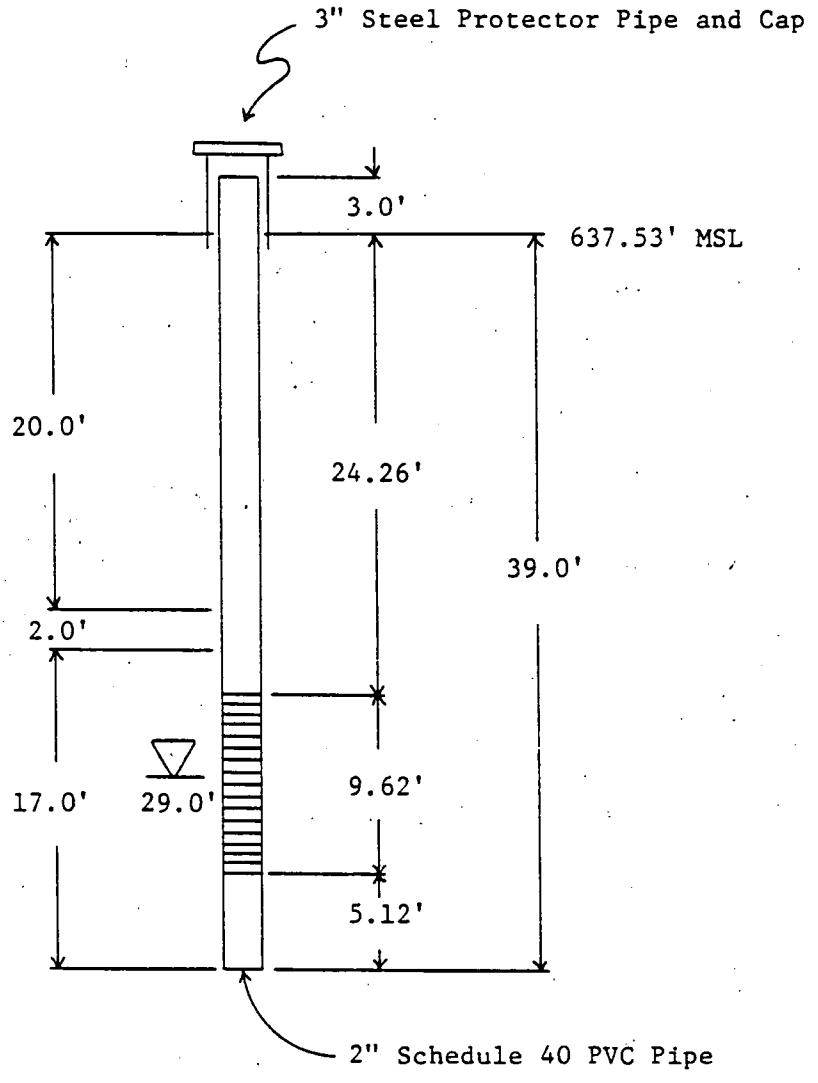
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-1B-81



Well screen

Water depth at time of drilling

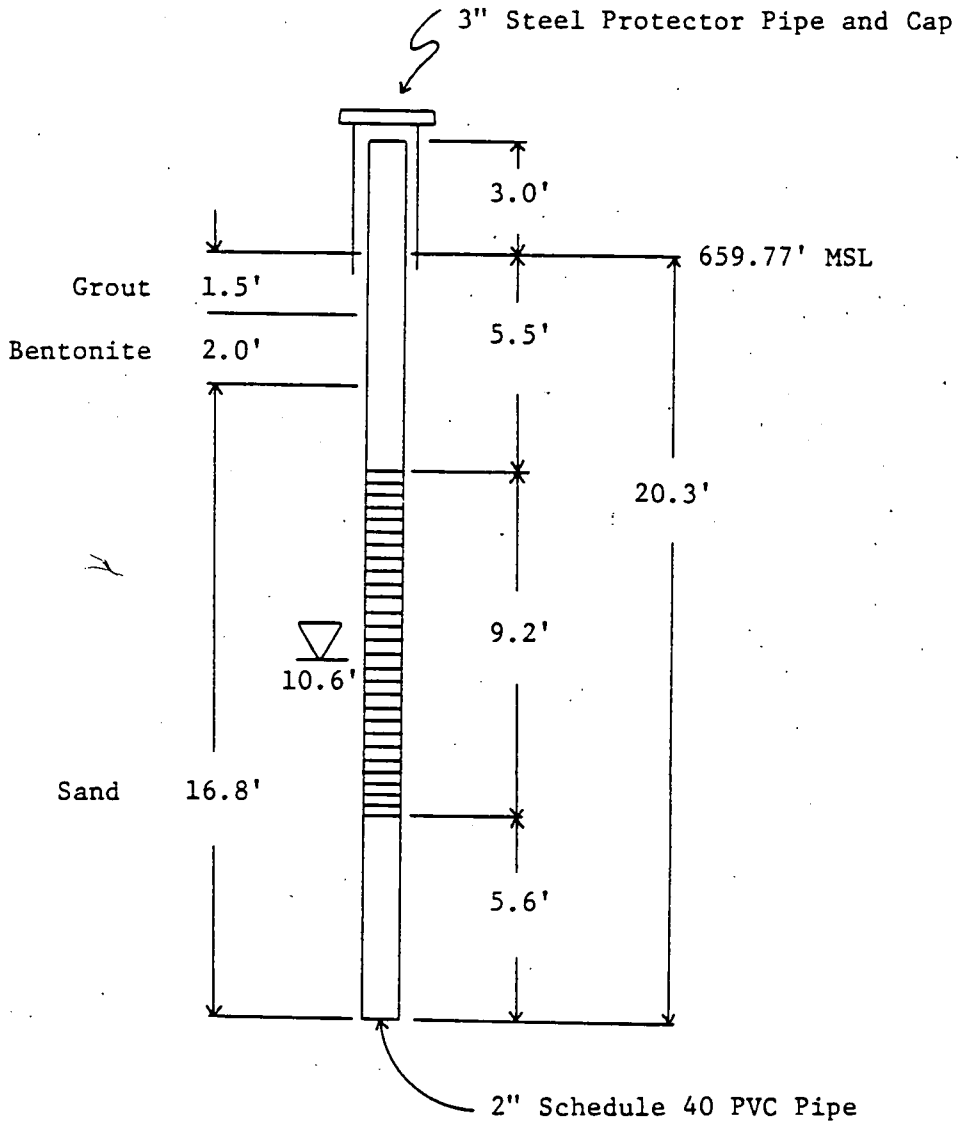
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-1C-81



Well screen

Water depth at time of drilling

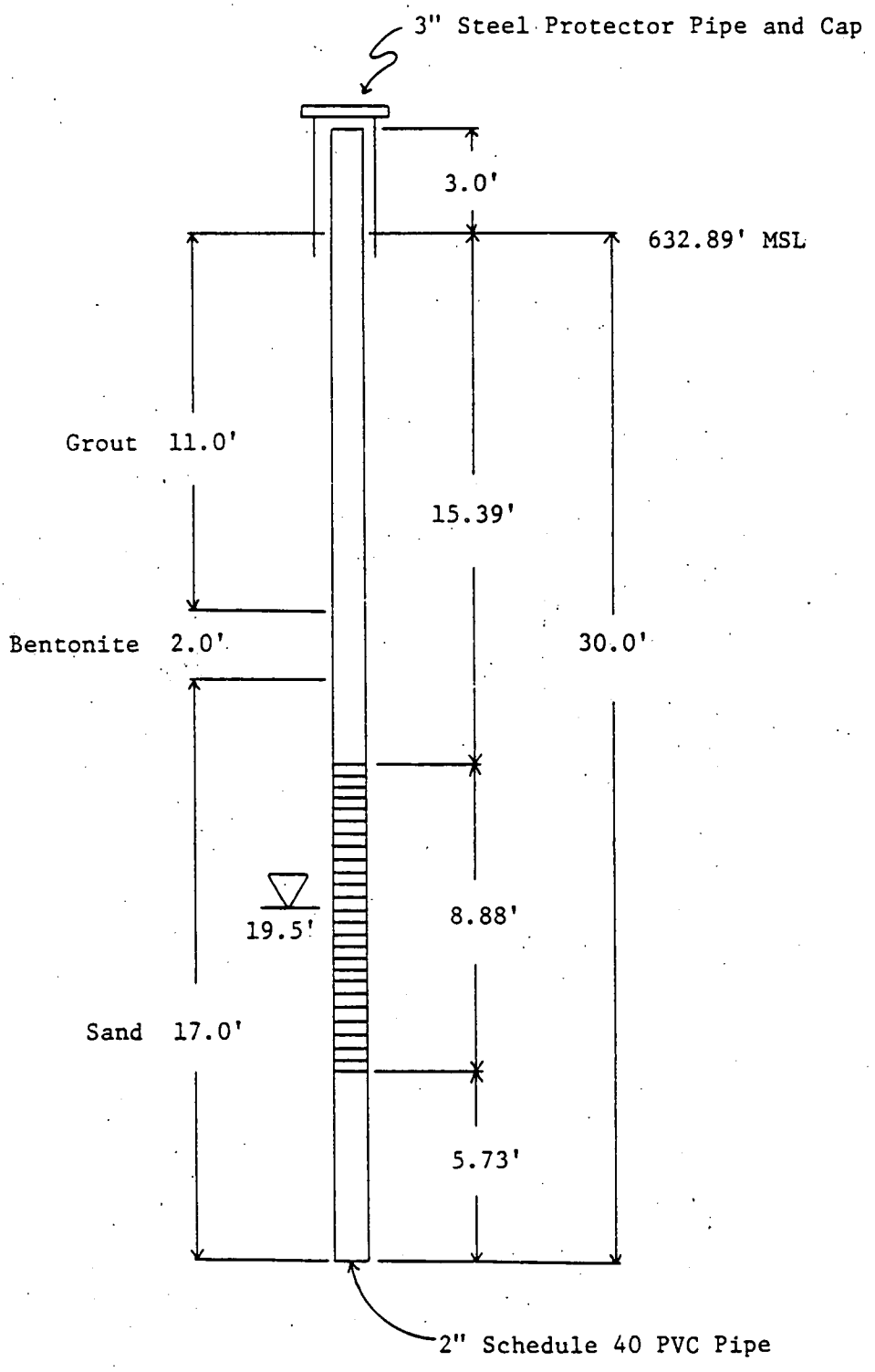
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-2-81



Well screen

Water depth at time of drilling

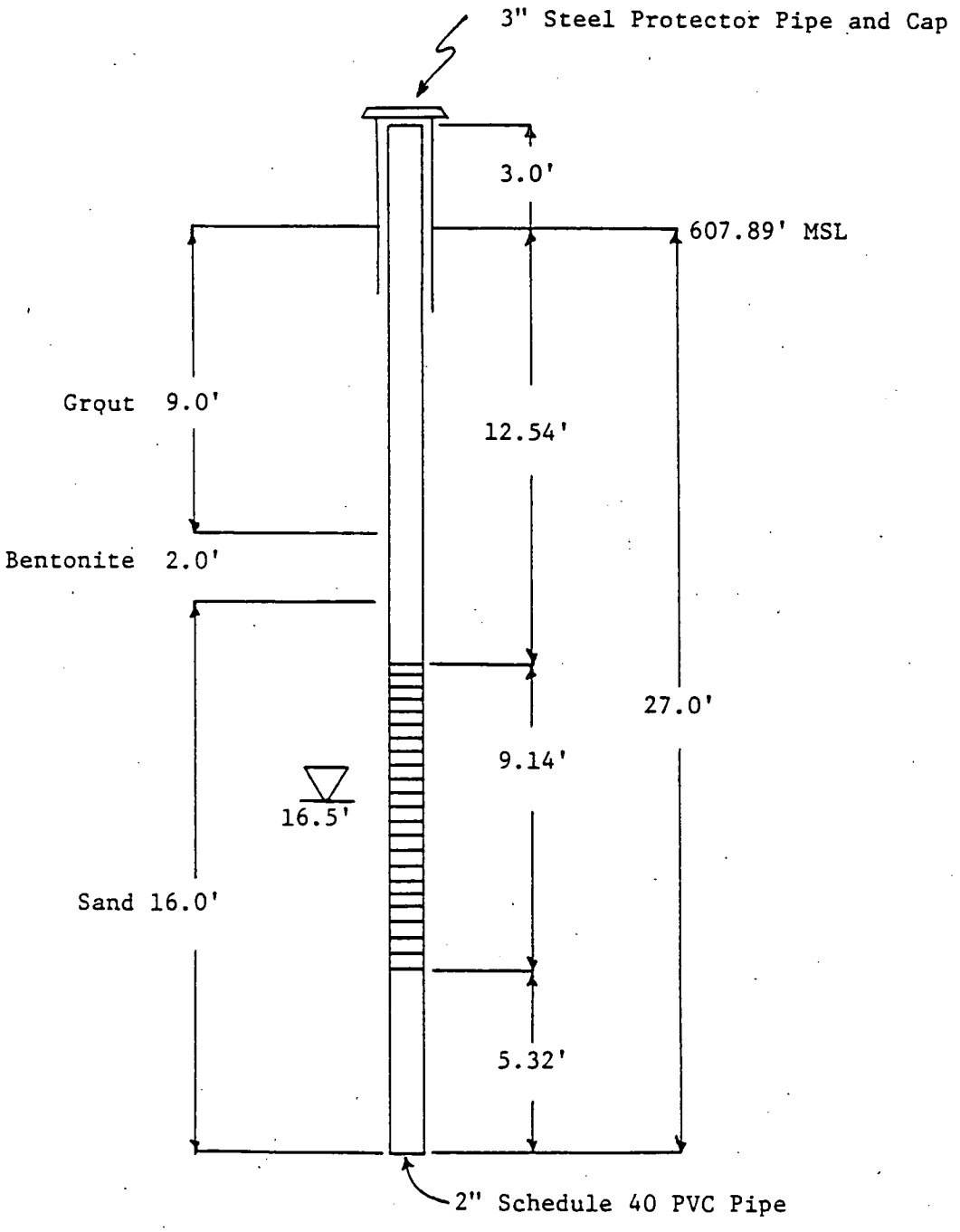
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-3-81



Well screen

Water depth at time of drilling

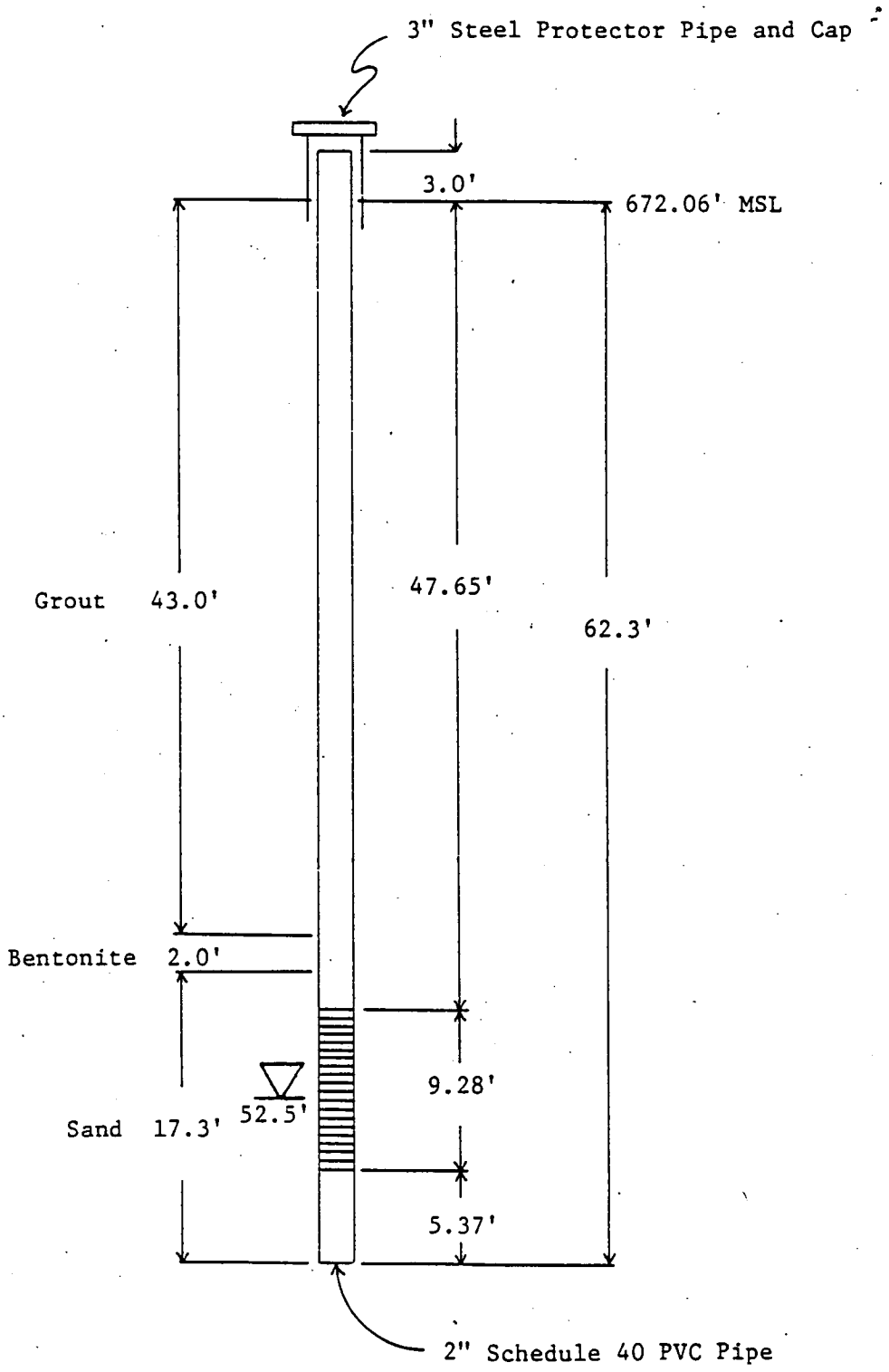
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-4-81



Well screen

Water depth at time of drilling

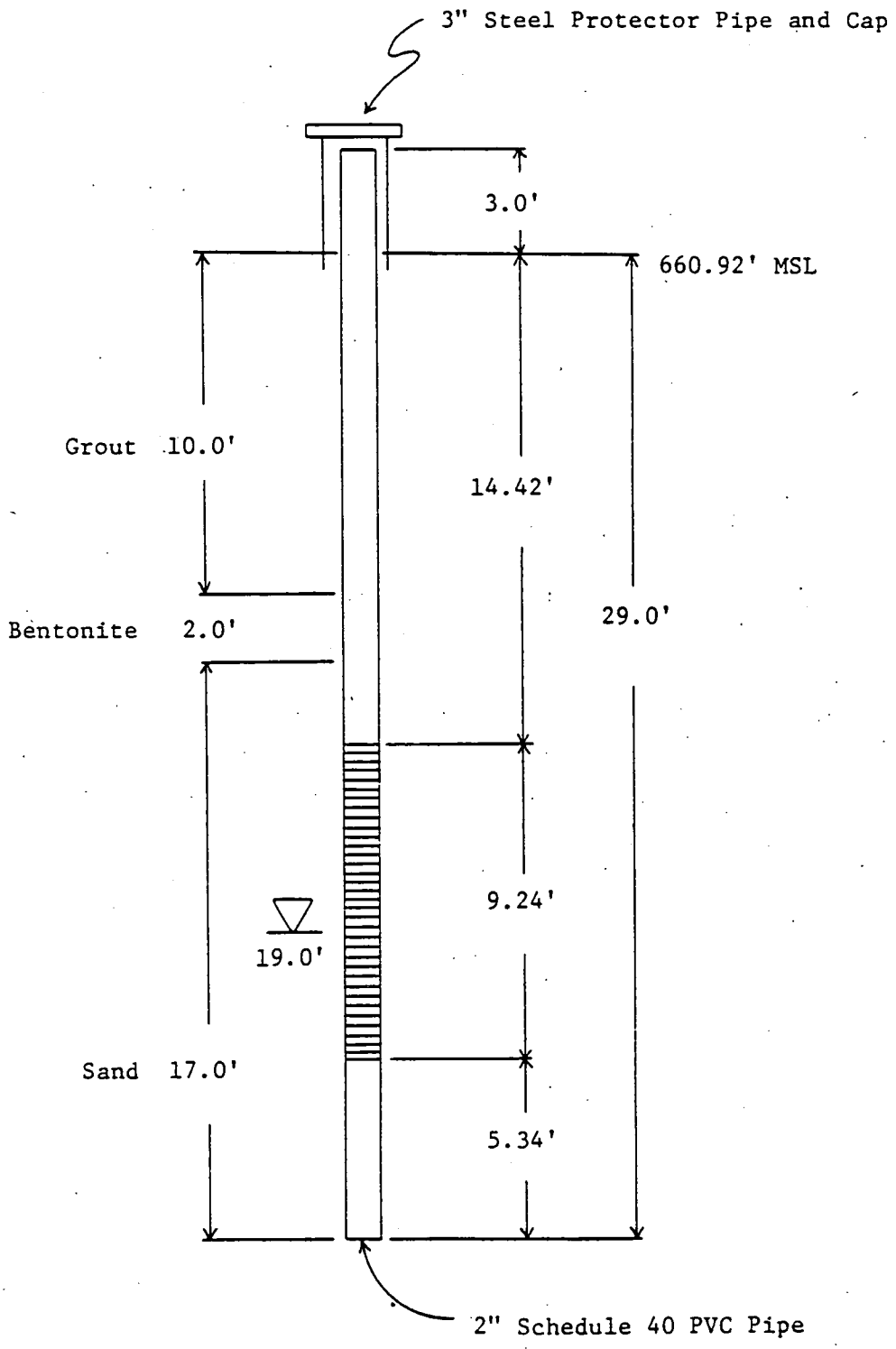
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-5-81



Well screen

Water depth at time of drilling

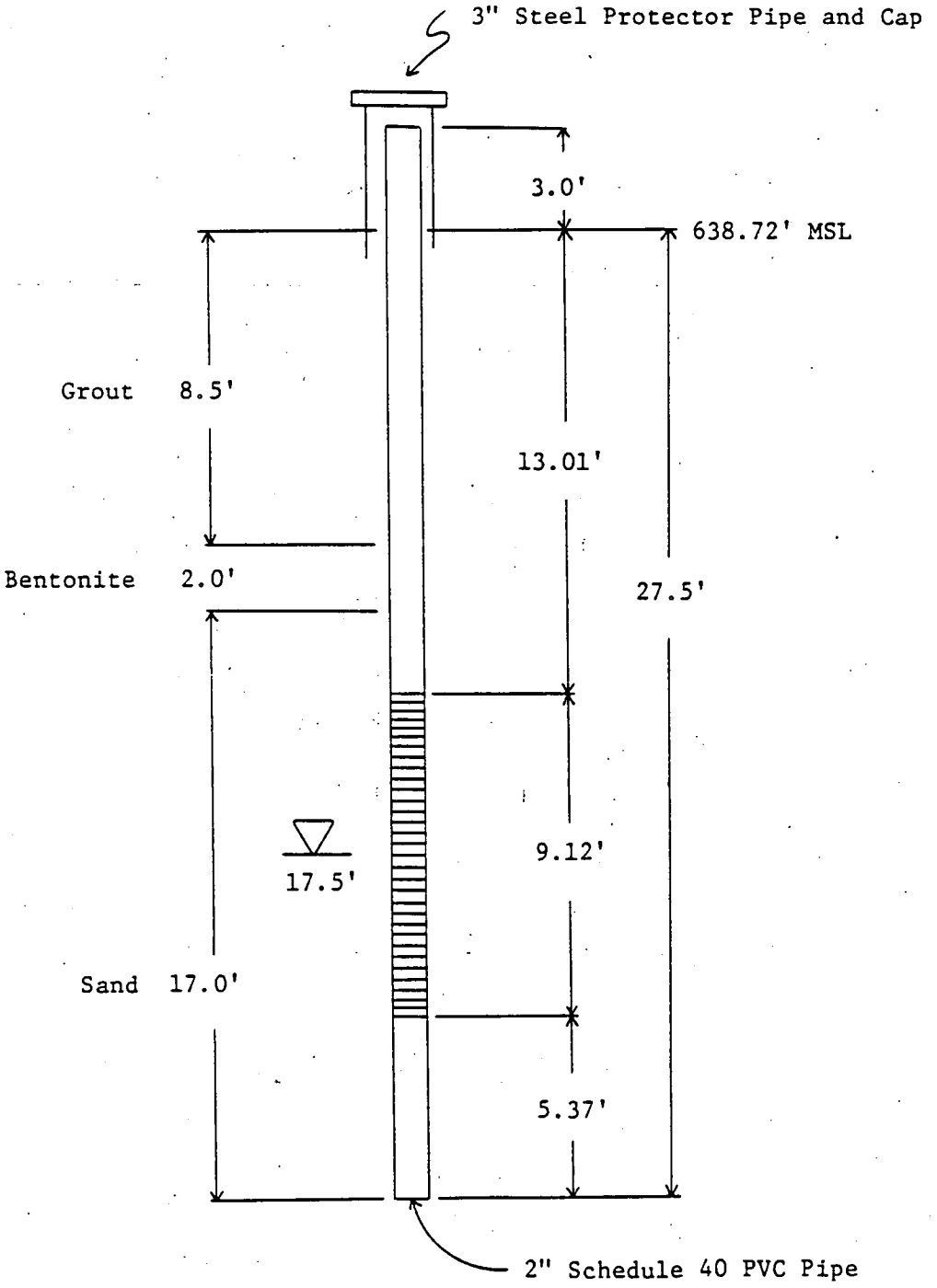
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-6-81



Well screen

Water depth at time of drilling

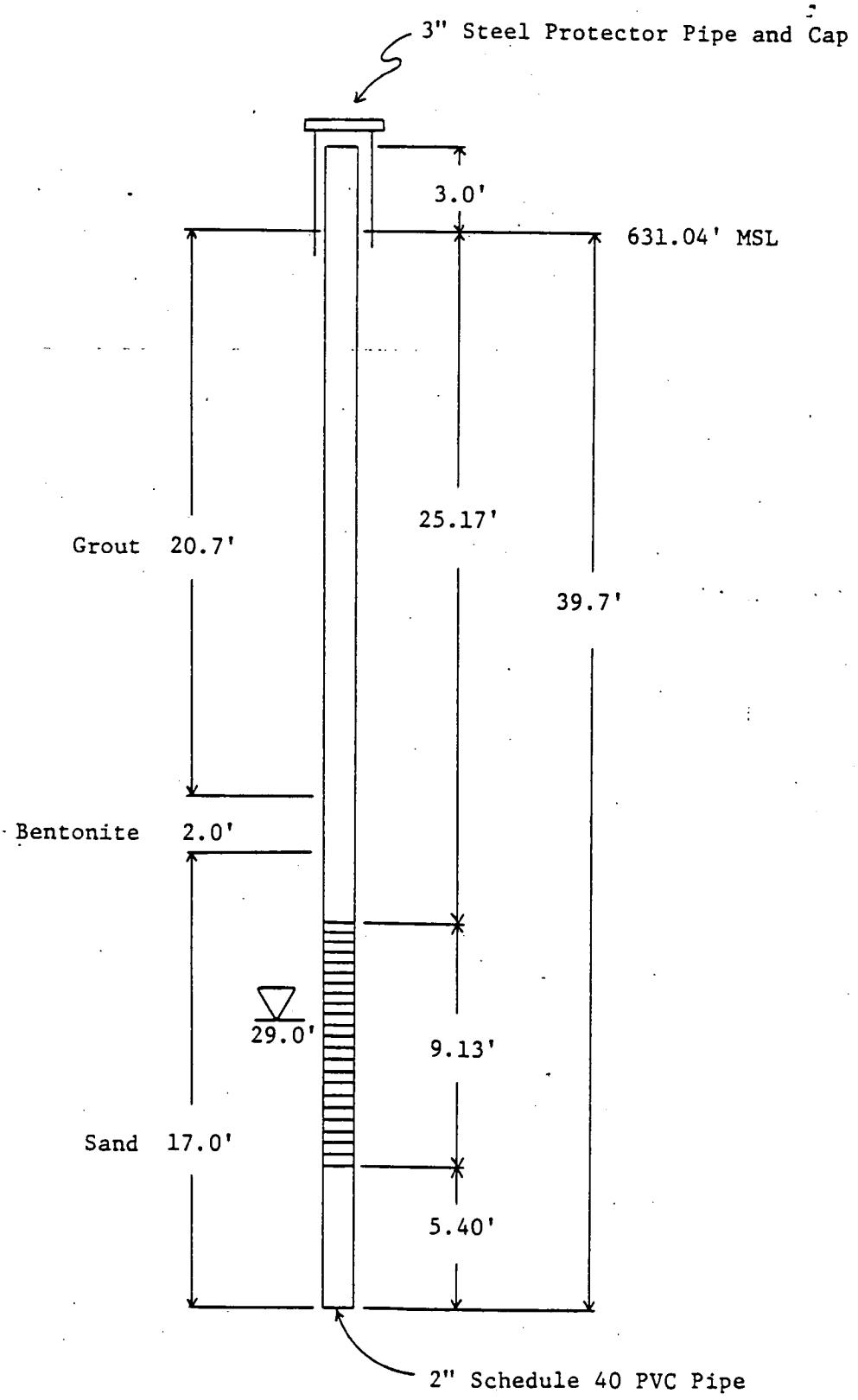
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-7-81



Well screen

Water depth at time of drilling

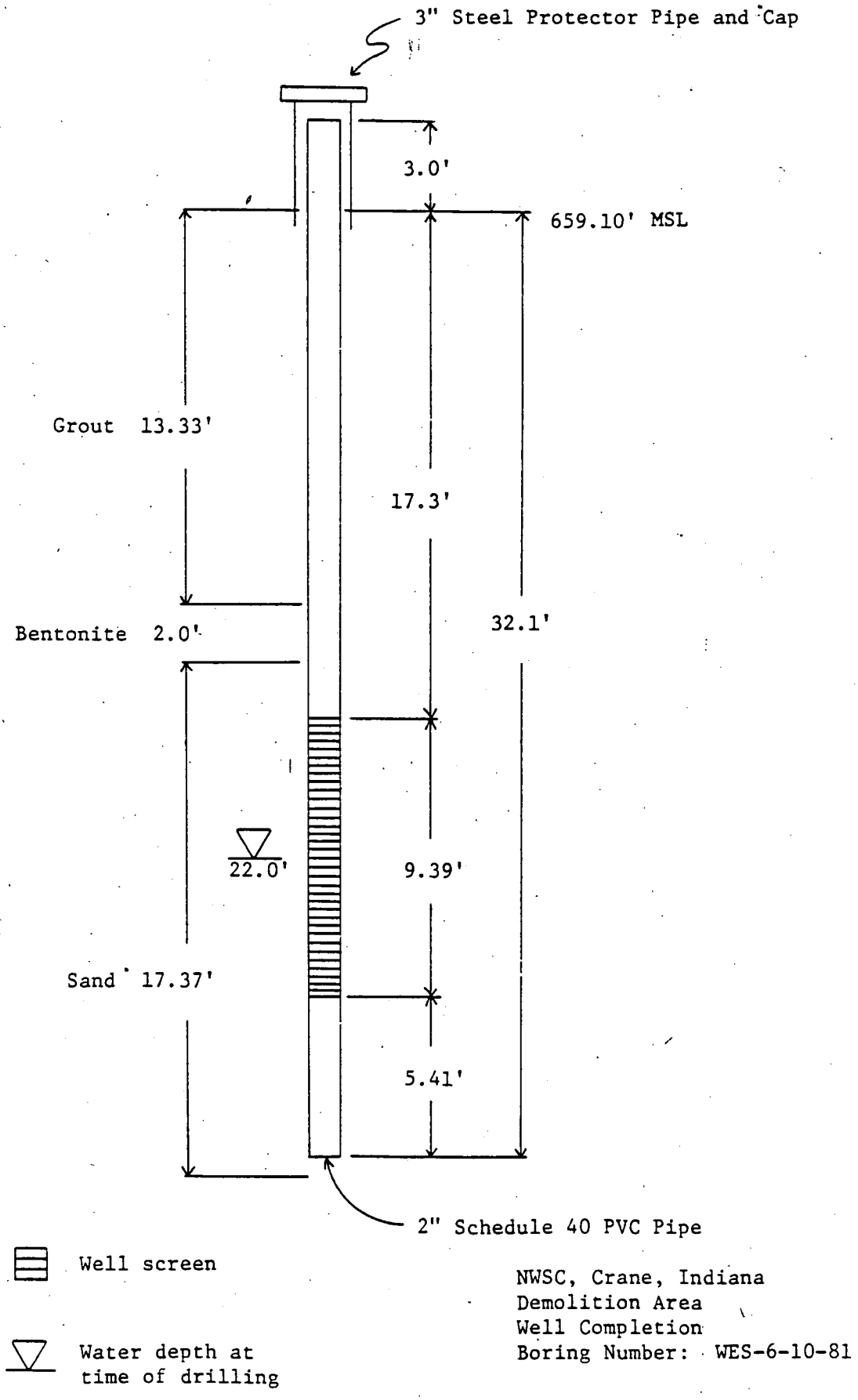
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-8-81

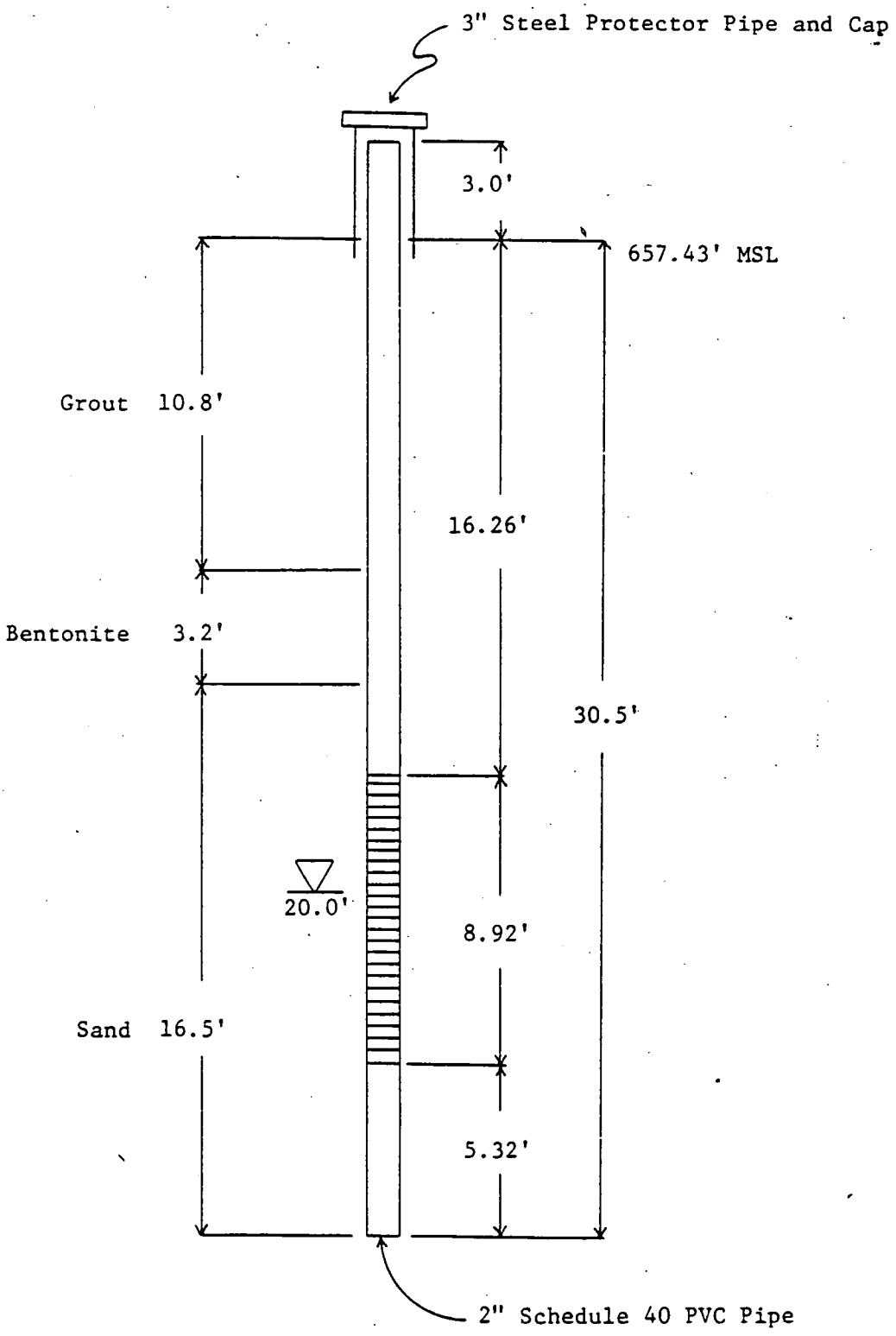


Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-9-81

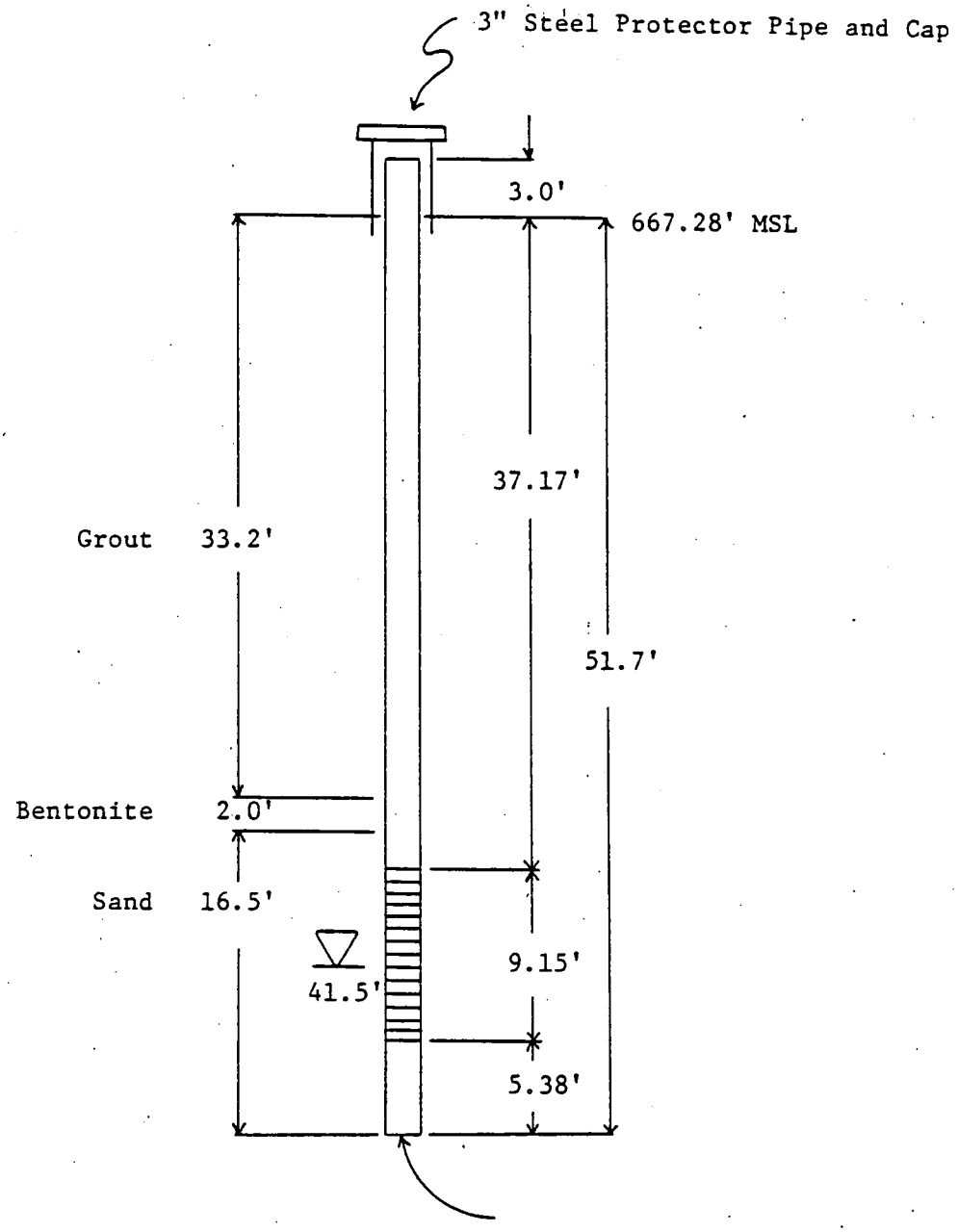

3" Steel Protector Pipe and Cap
3.0'
659.10' MSL
Grout 13.33'
17.3'
32.1'
Bentonite 2.0'
22.0'
9.39'
Sand 17.37'
5.41'
2" Schedule 40 PVC Pipe
Well screen
Water depth at time of drilling
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-10-81



Well screen

Water depth at time of drilling

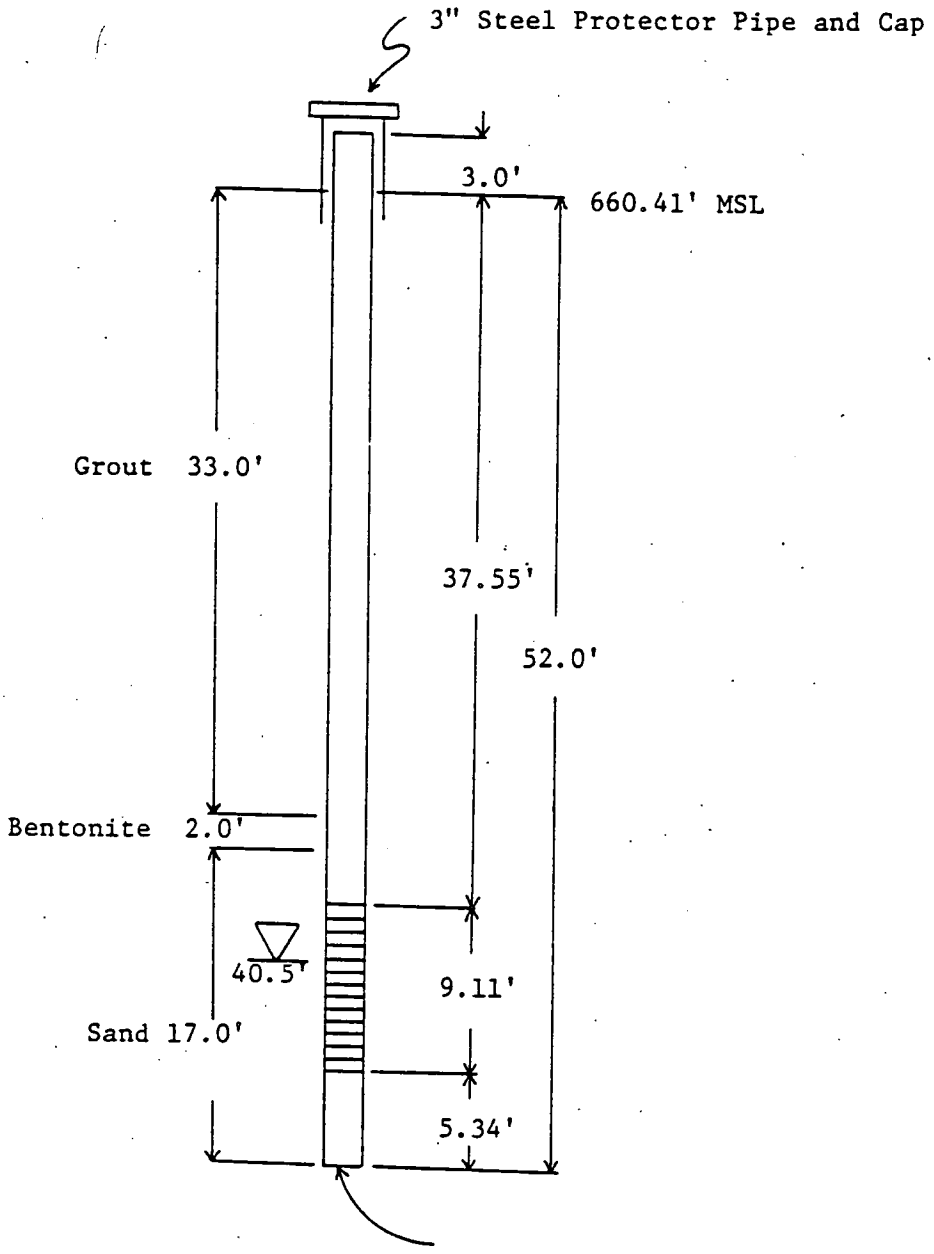
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-11-81



Well screen

Water depth at time of drilling

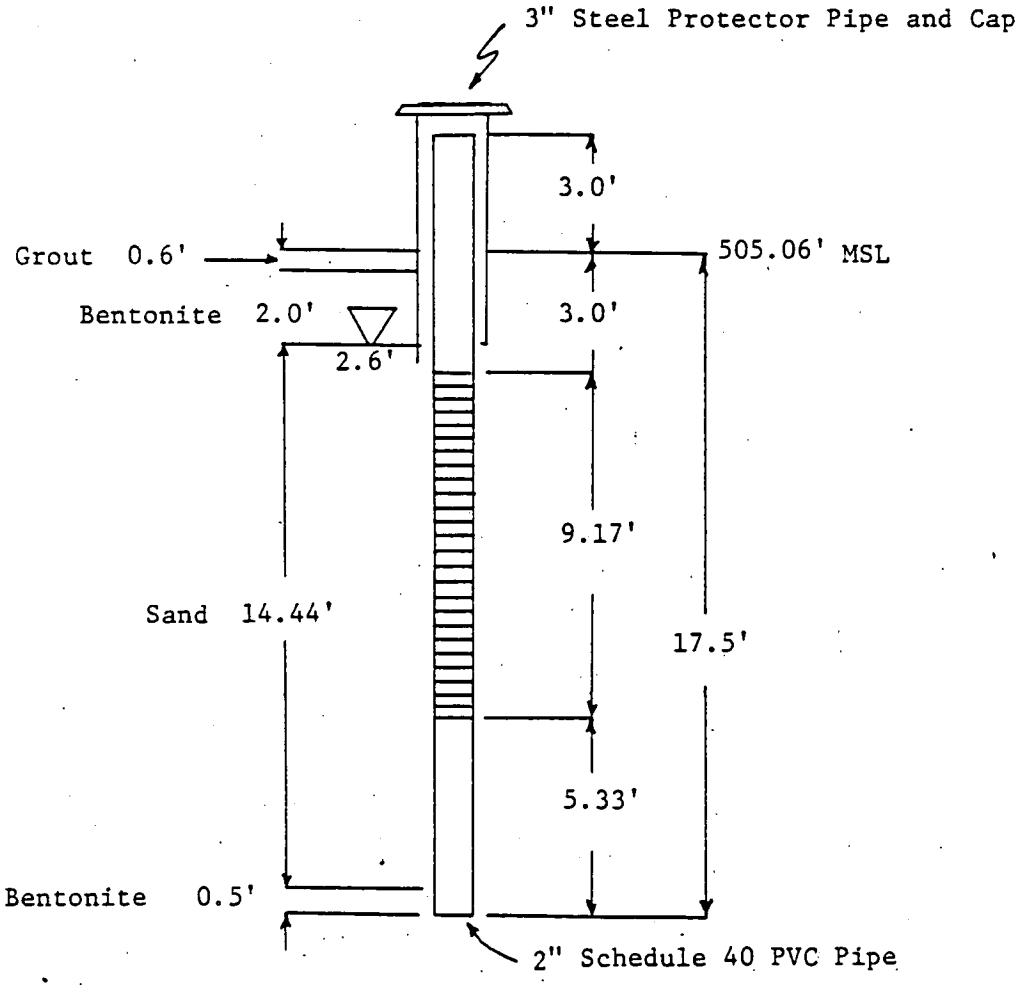
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-12-81



Well screen

Water depth at time of drilling

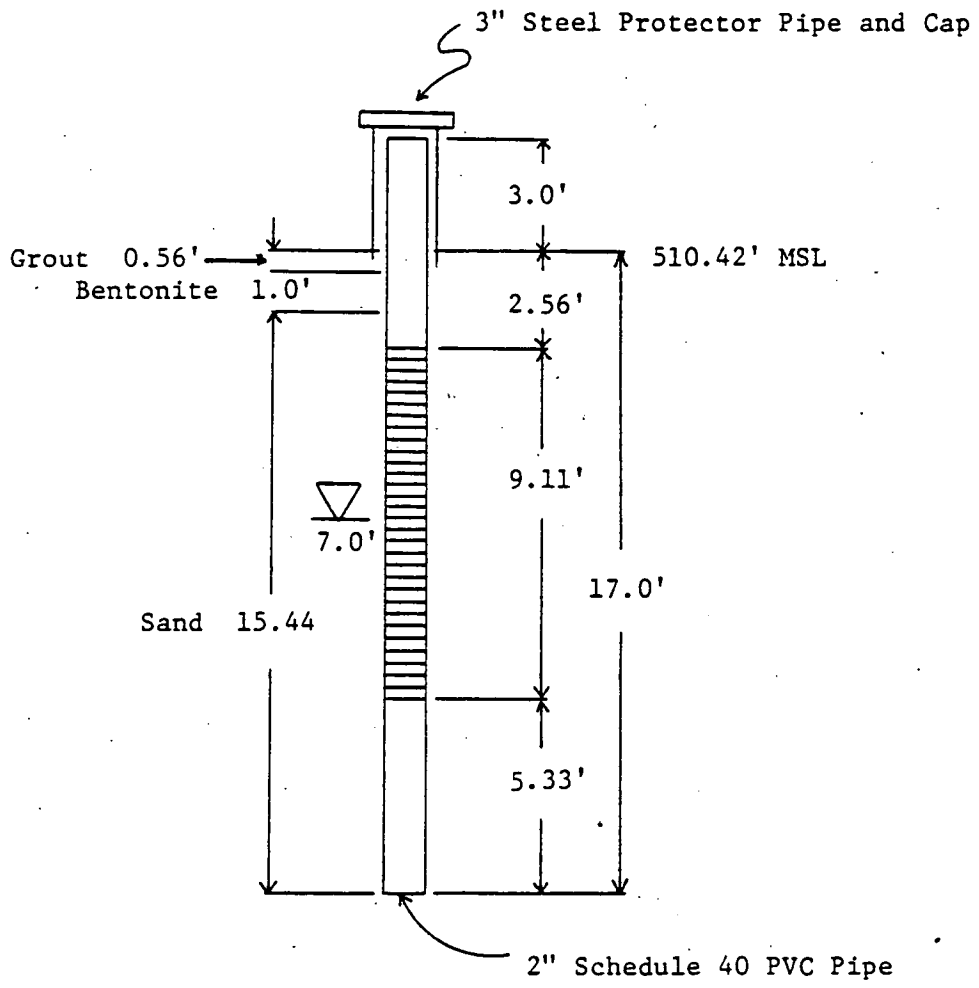
NWSC, Crane, Indiana
Demolition Area
Well Completion
Boring Number: WES-6-13-81



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Rifle Range
Well Completion
Boring Number: WES-6-14-81



Well screen

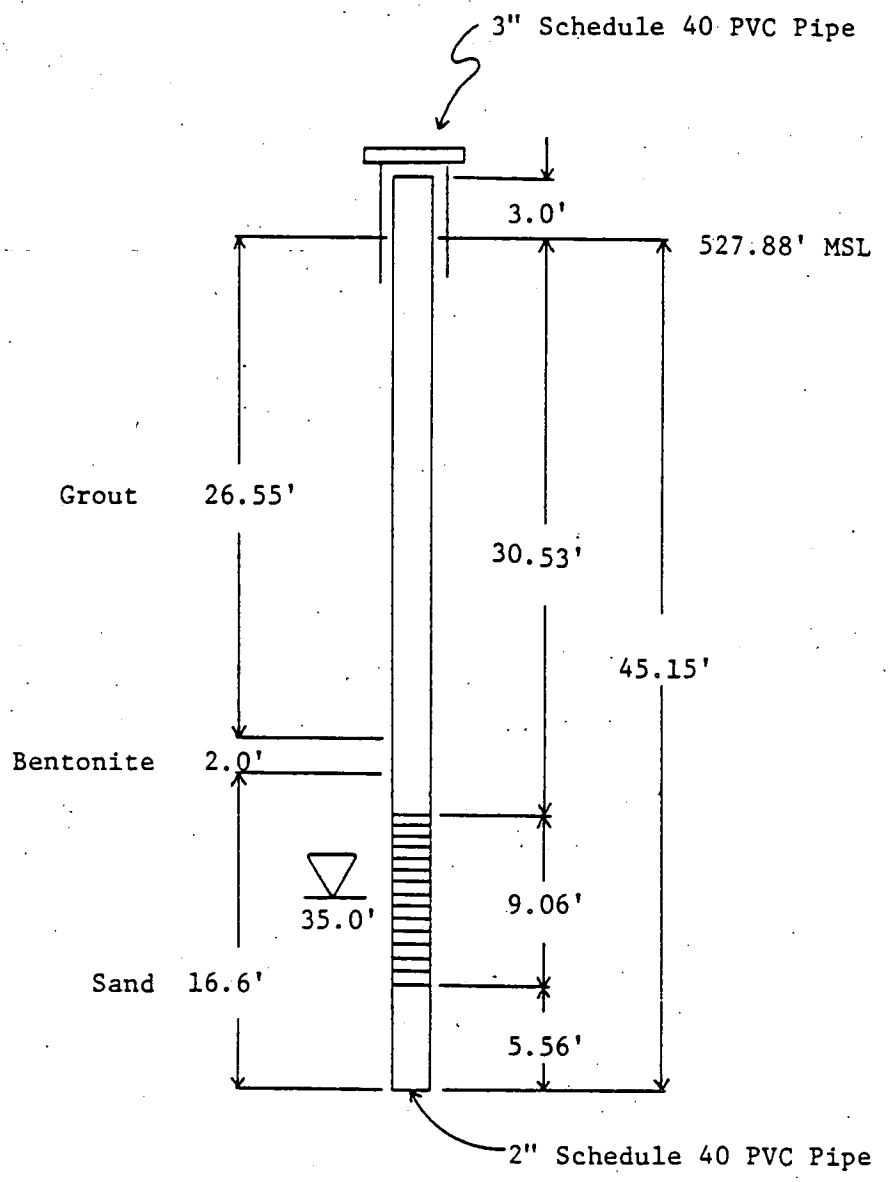
Water depth at time of drilling

NWSC, Crane, Indiana

Rifle Range

Well Completion

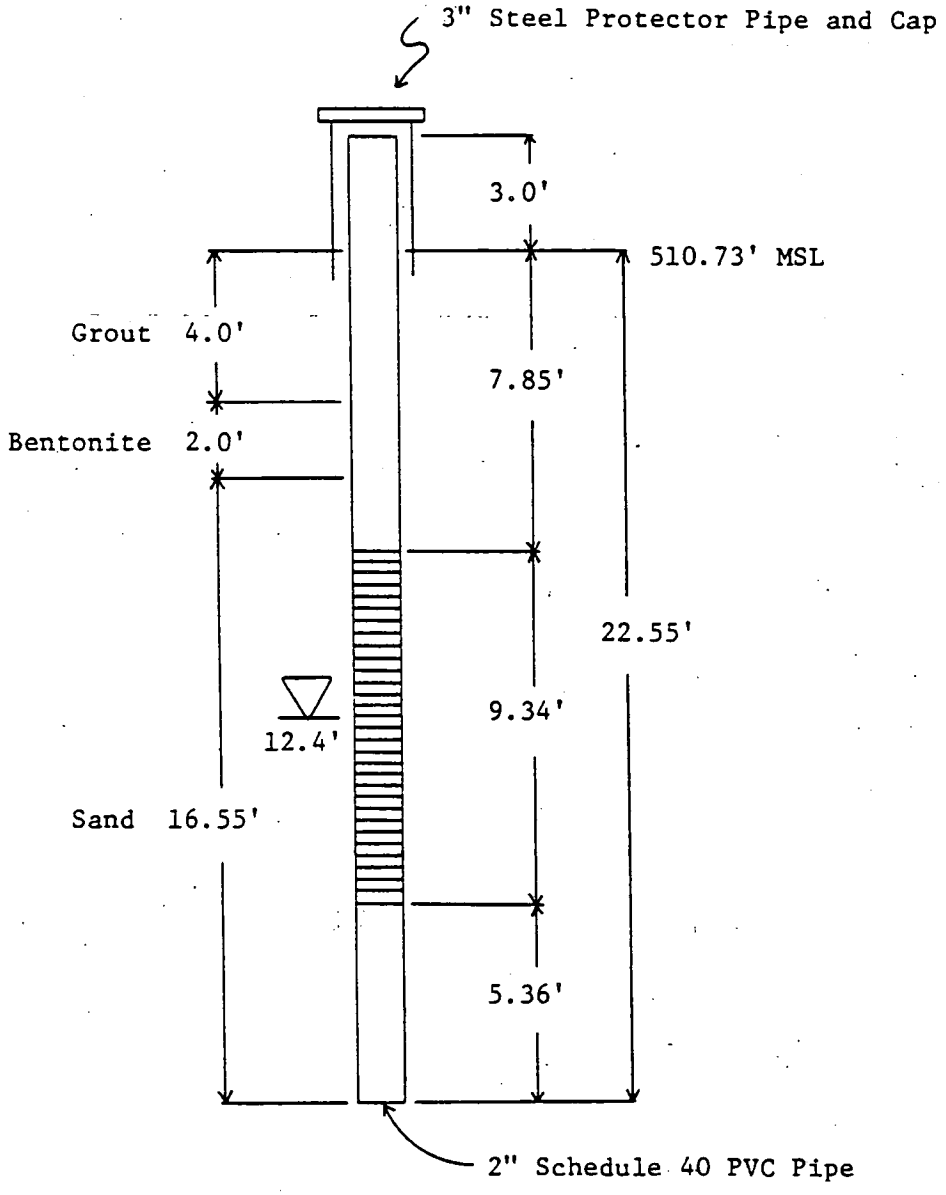
Boring Number: WES-6-15-81



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Rifle Range
Well Completion
Boring Number: WES-6-16-81



Well screen

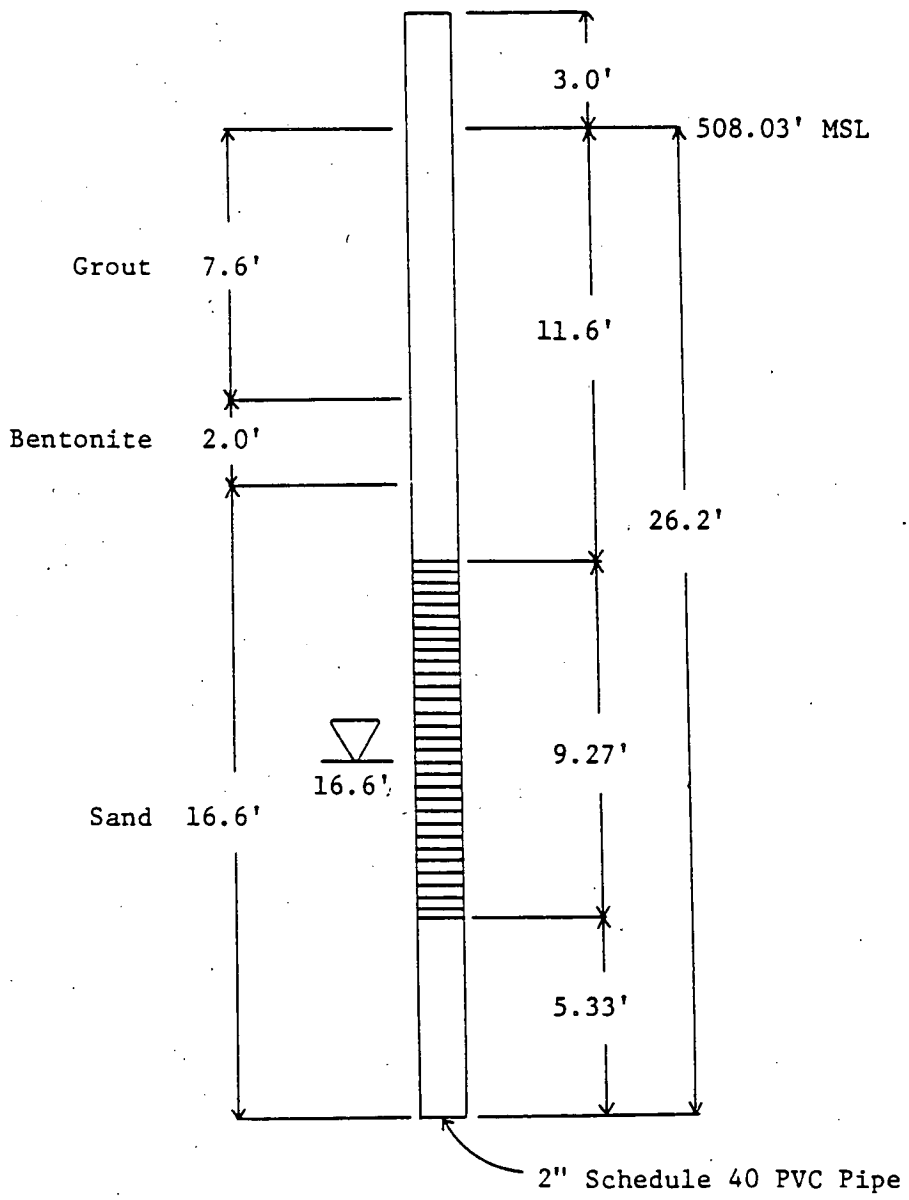
Water depth at time of drilling

NWSC, Crane, Indiana

Rifle Range

Well Completion

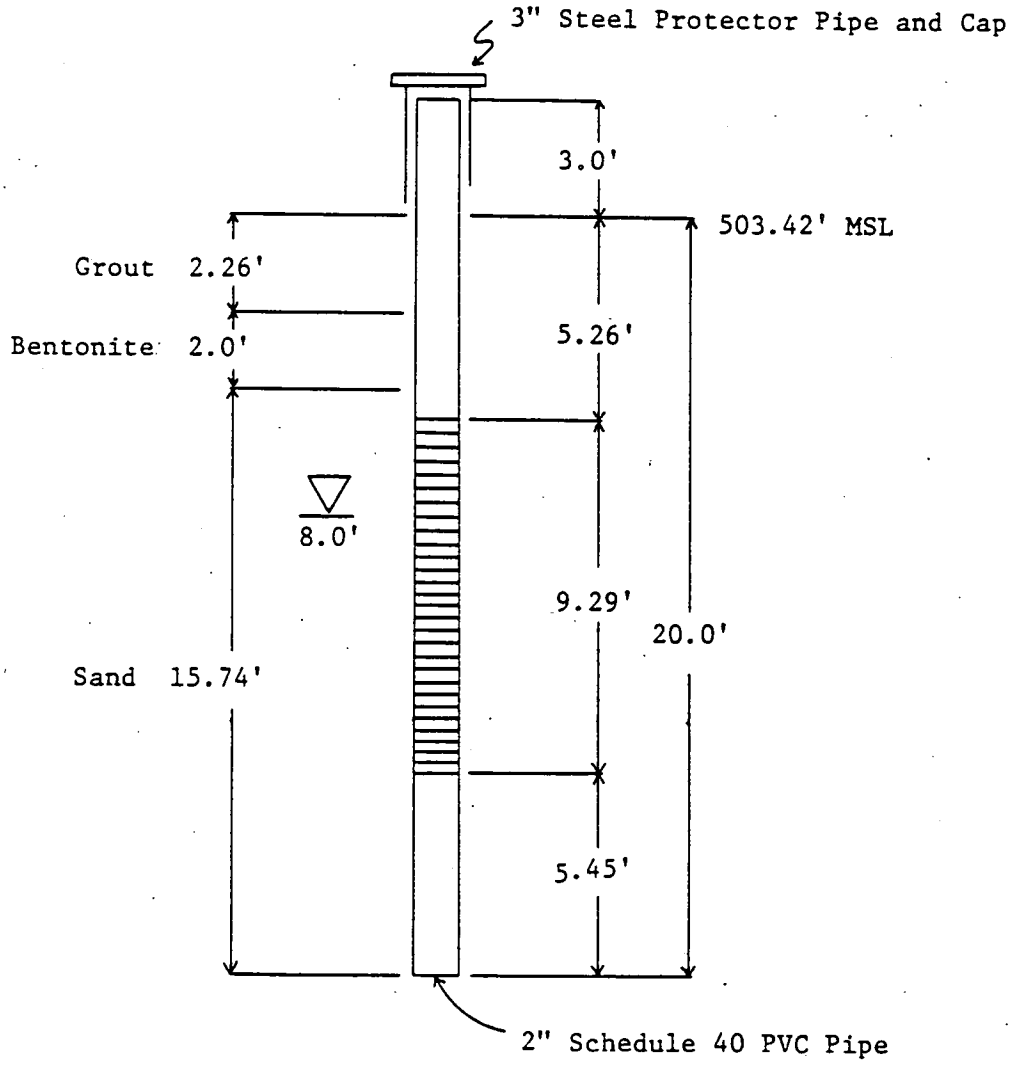
Boring Number: WES-6-17-81



Well screen

Water depth at time of drilling

NWSC, Crane, Indiana
Rifle Range
Well Completion
Boring Number: WES-6-18-81



Well screen

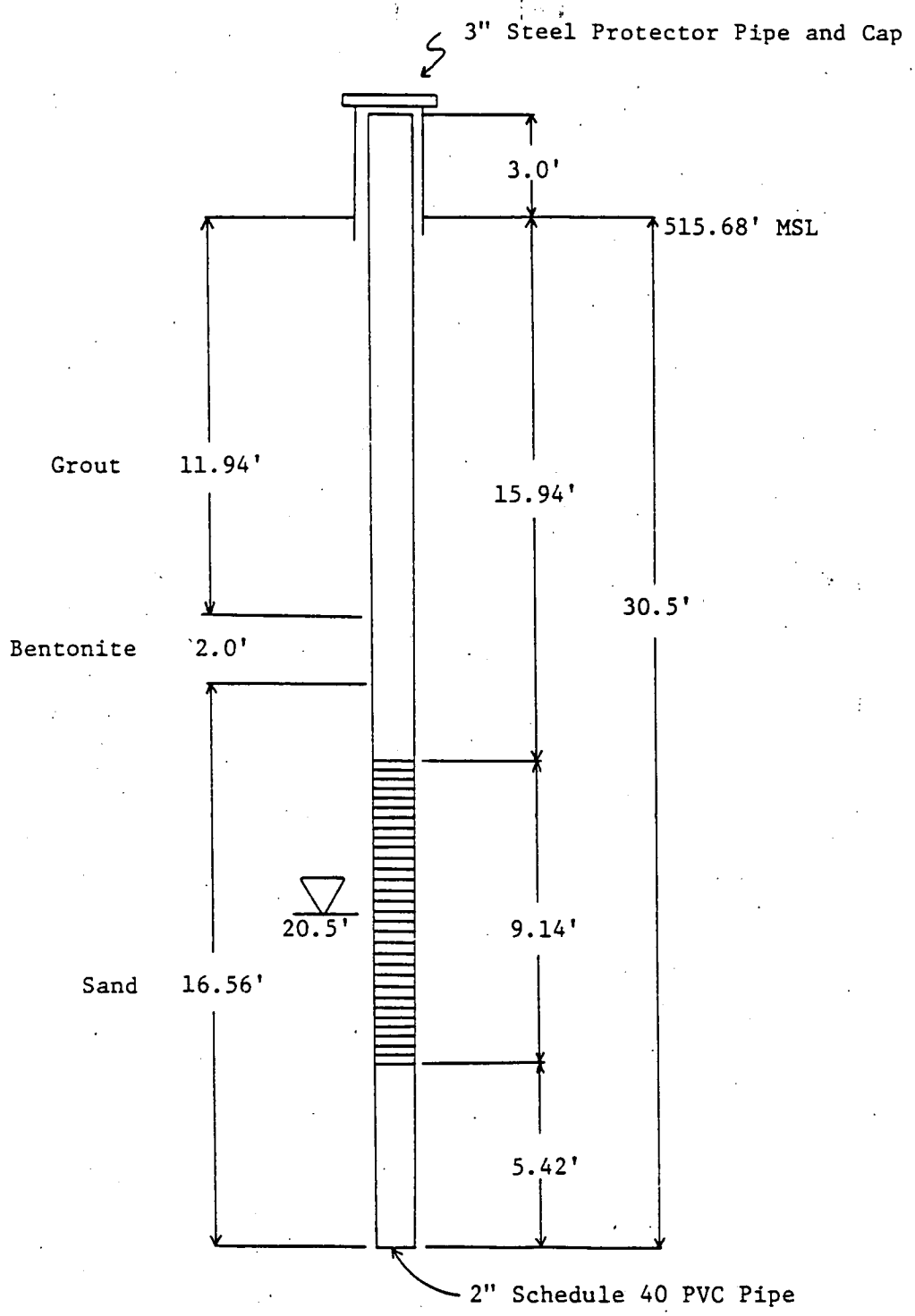
Water depth at time of drilling

NWSC, Crane, Indiana

Rifle Range

Well Completion

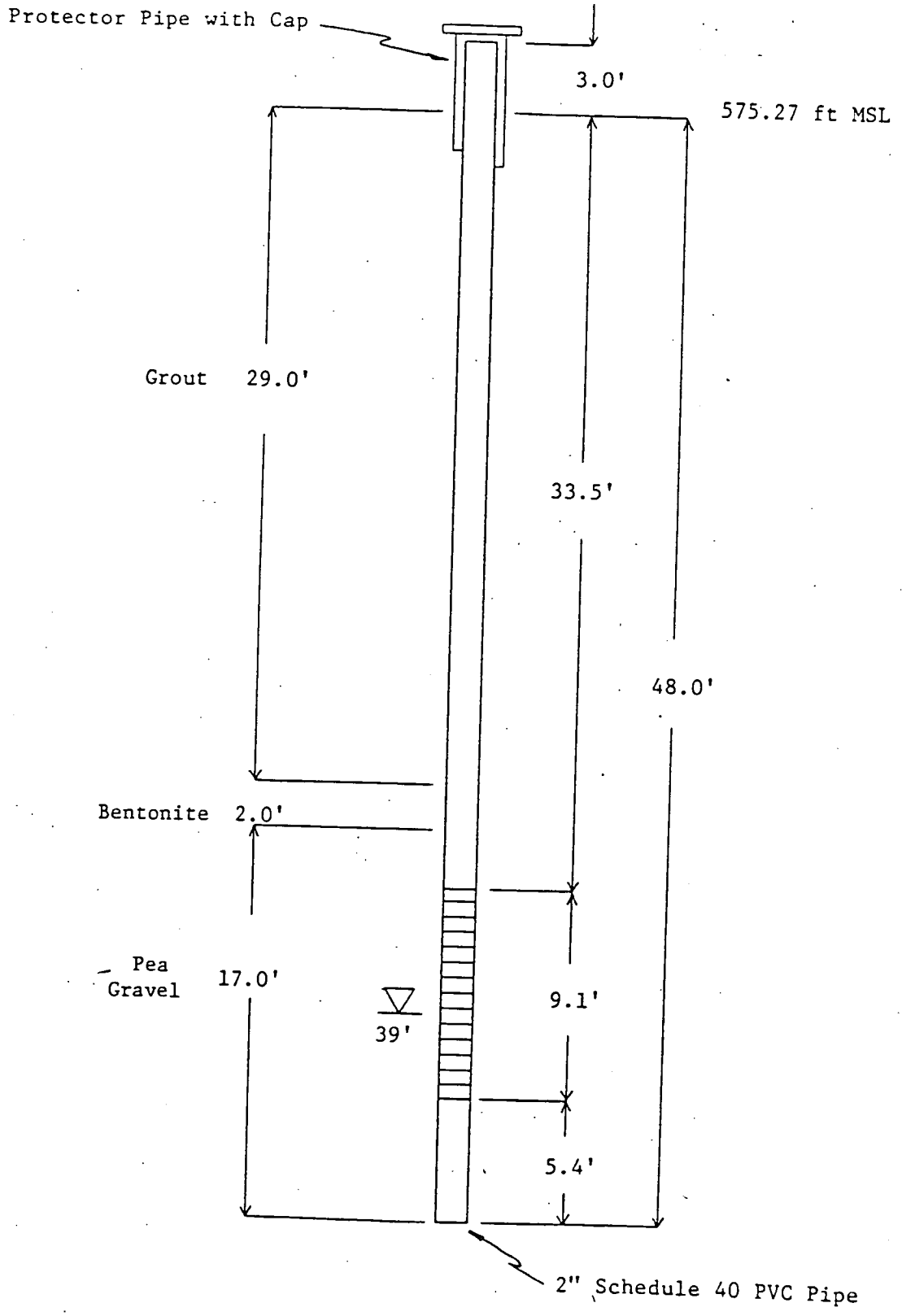
Boring Number: WES-6-19-81



Well screen

Water depth at time of drilling

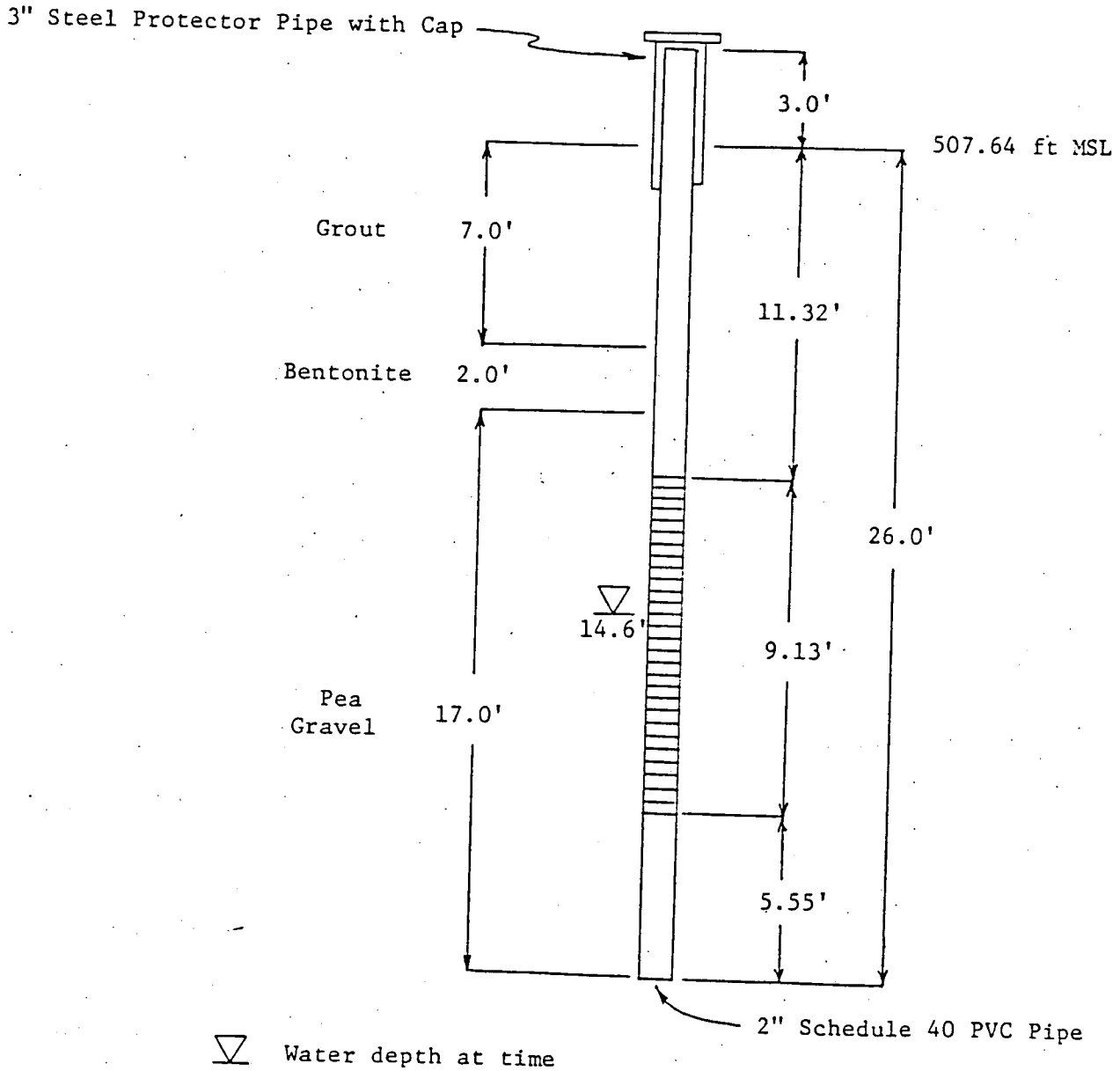
NWSC, Crane, Indiana
Rifle Range
Well Completion
Boring Number: WES-6-20-81



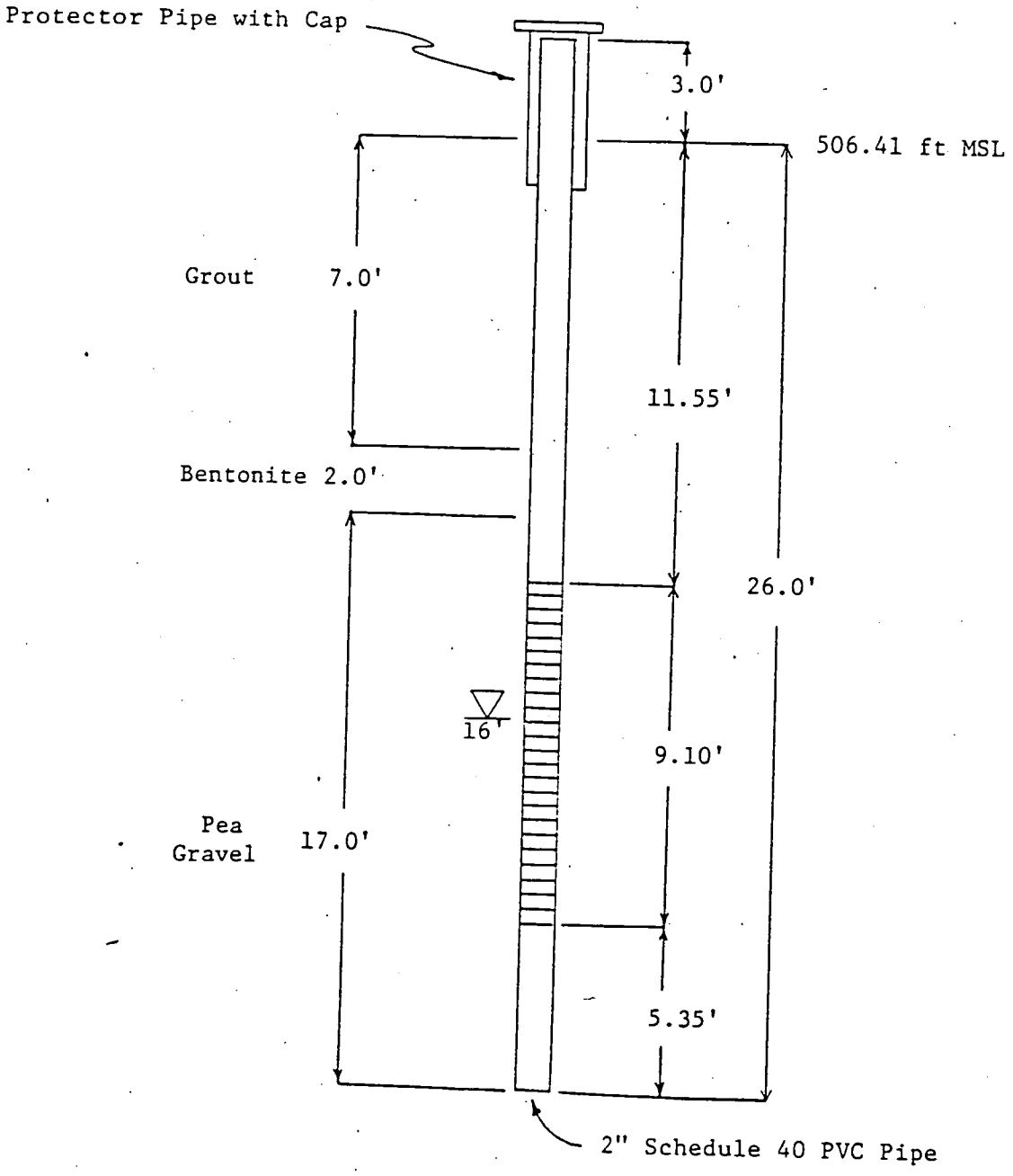
Water depth at time of drilling

Well Screen

NWSC, Crane, Indiana
Old Rifle Range
Well Completion
Boring Number: WES-6-21-83



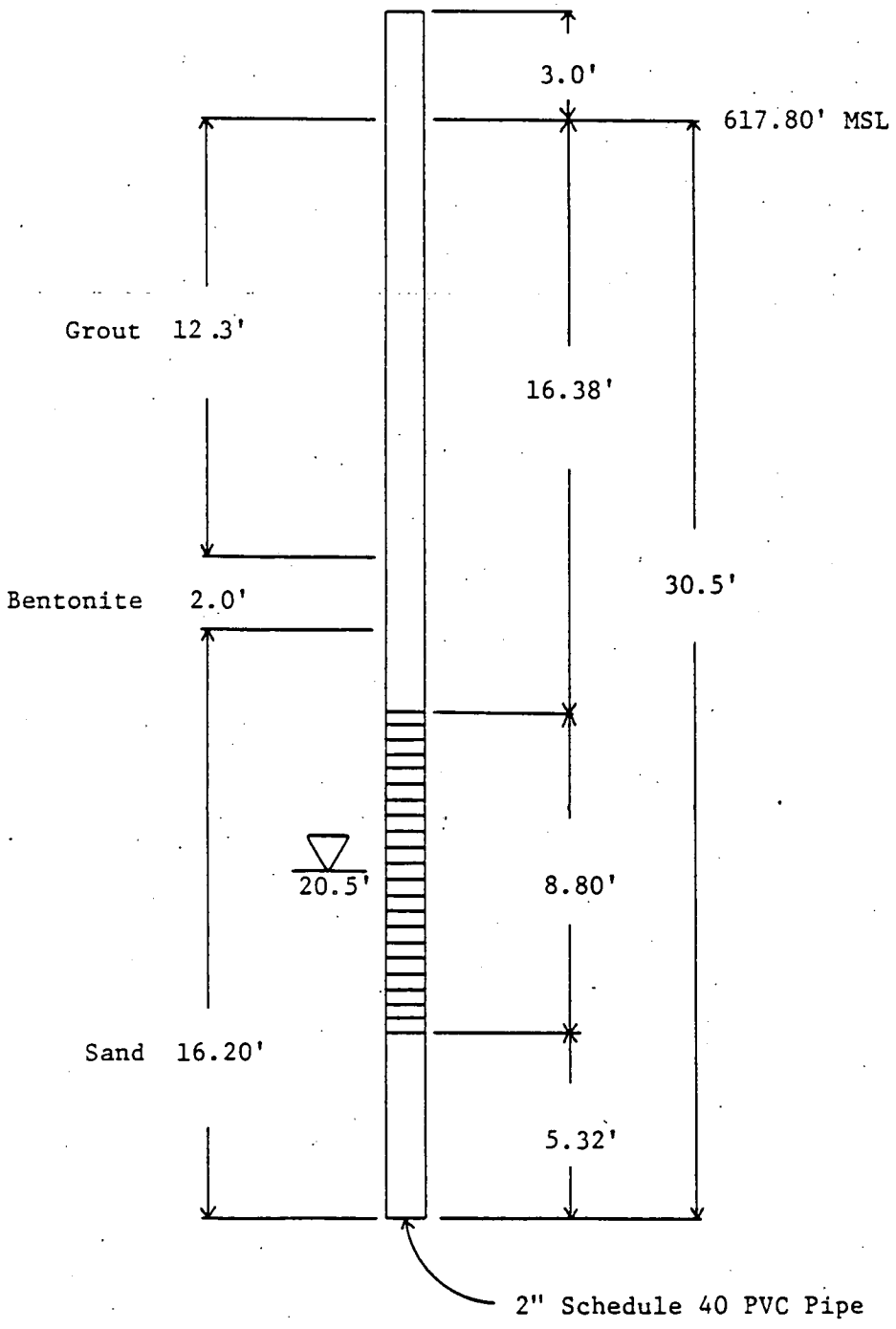
NWSC, Crane, Indiana
Old Rifle Range
Well Completion
Boring Number: WES-6-22-83



Water depth at time of drilling

Well Screen

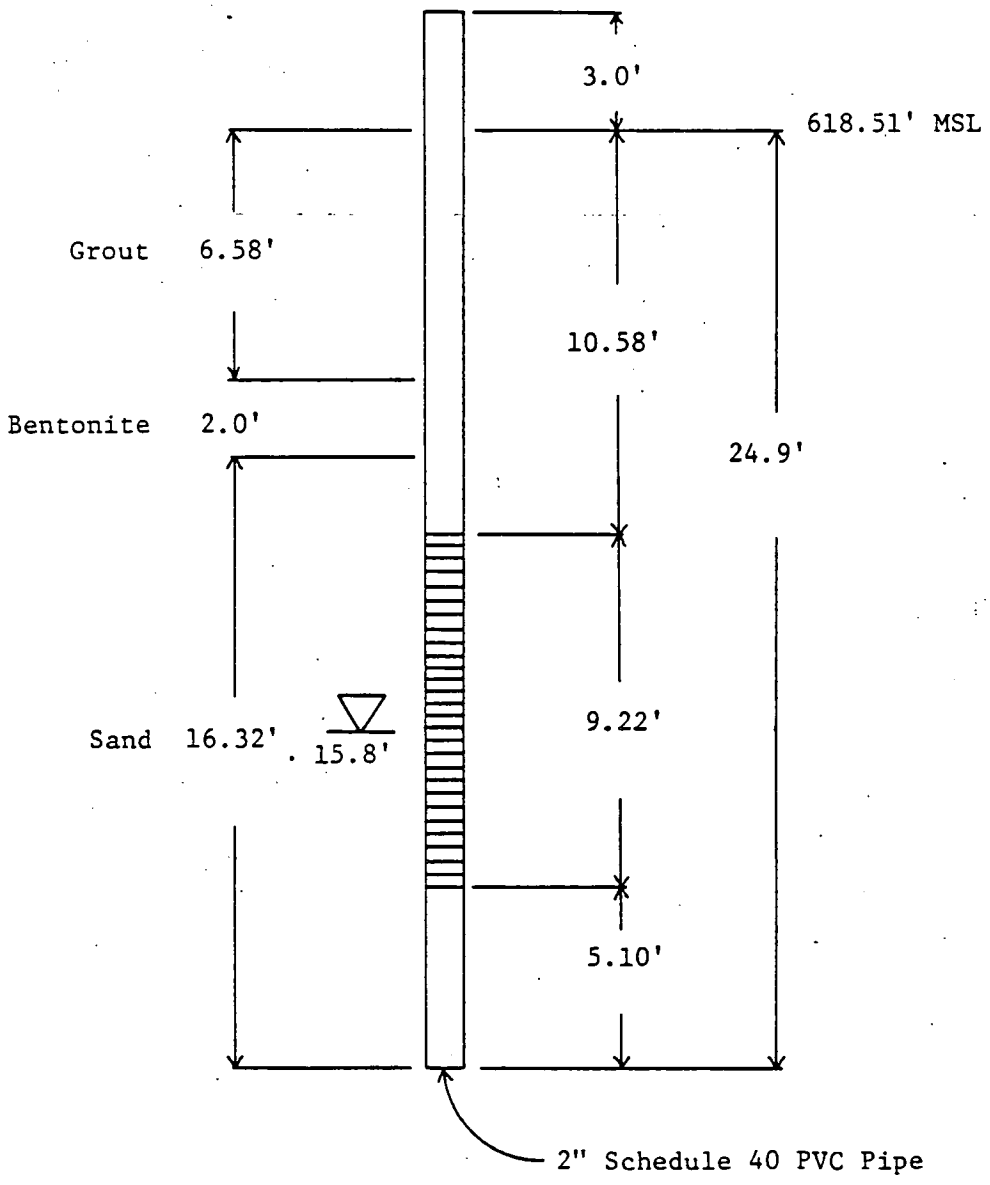
NWSC, Crane, Indiana
Old Rifle Range
Well Completion
Boring Number: WES-6-23-83



Well screen

Water depth at time of drilling

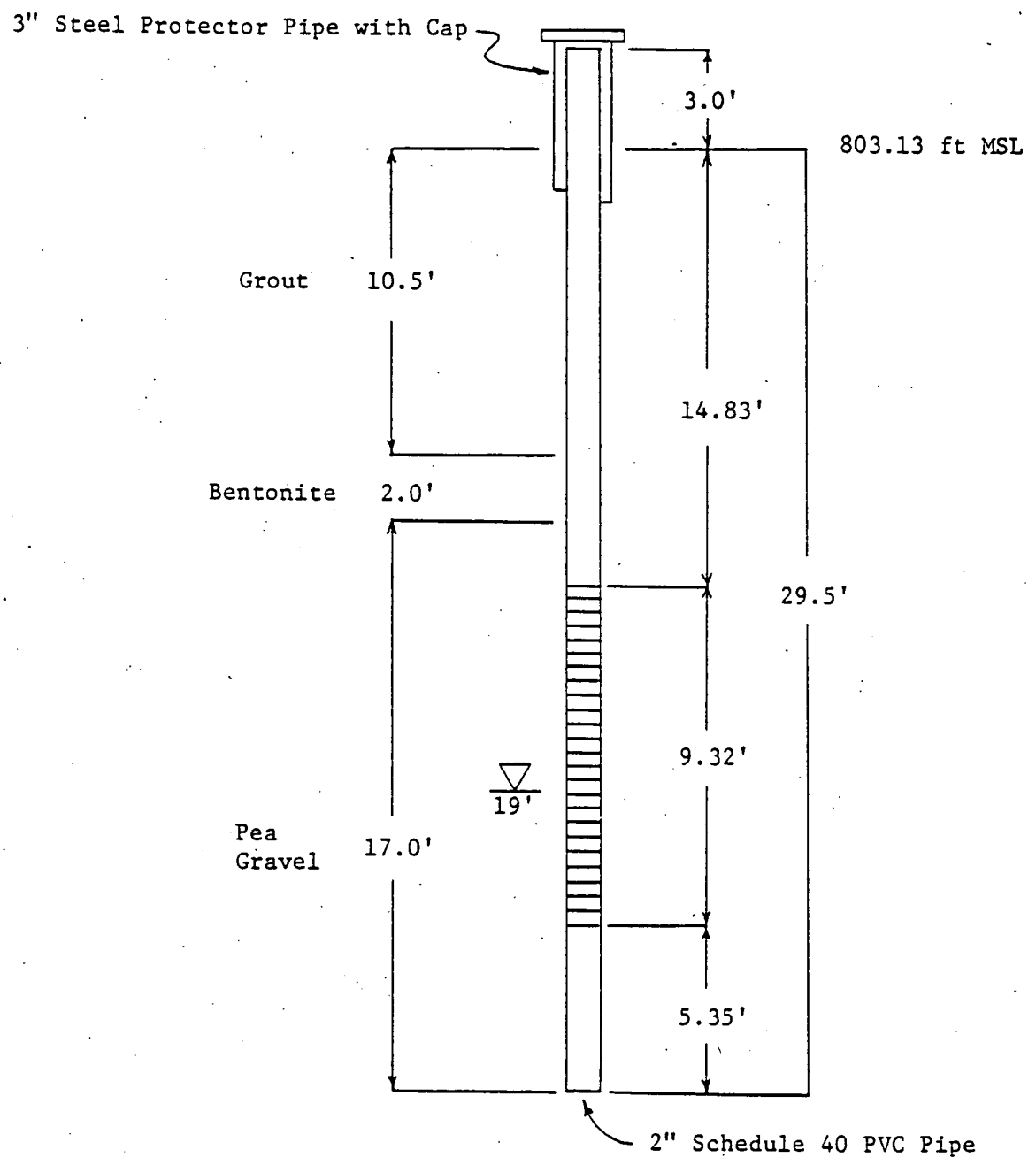
NWSC, Crane, Indiana
Rockeye Site
Well Completion
Boring Number: WES-10-1-81



Well screen

Water depth at time of drilling

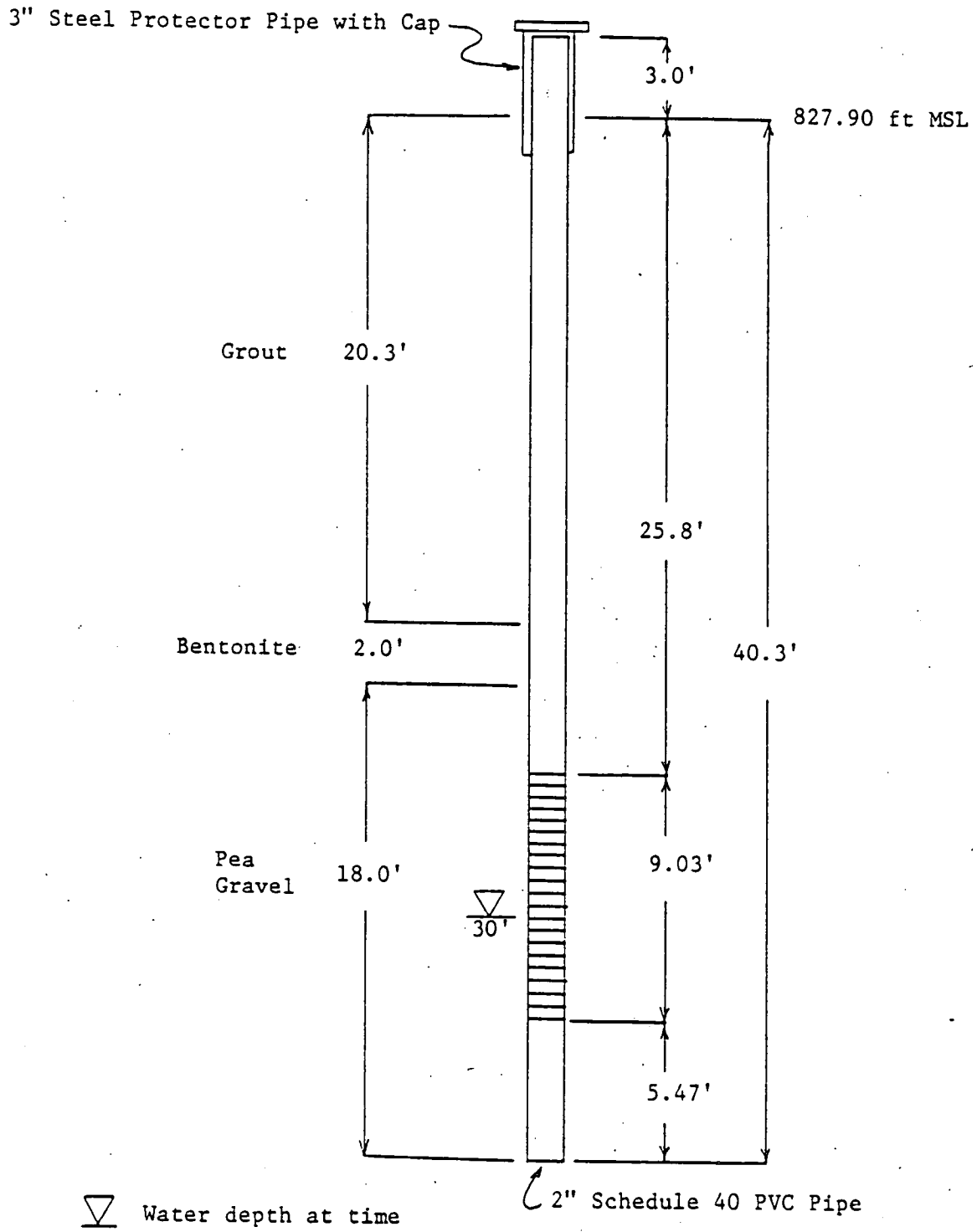
NWSC, Crane, Indiana
Rockeye Site
Well Completion
Boring Number: WES-10-2-81



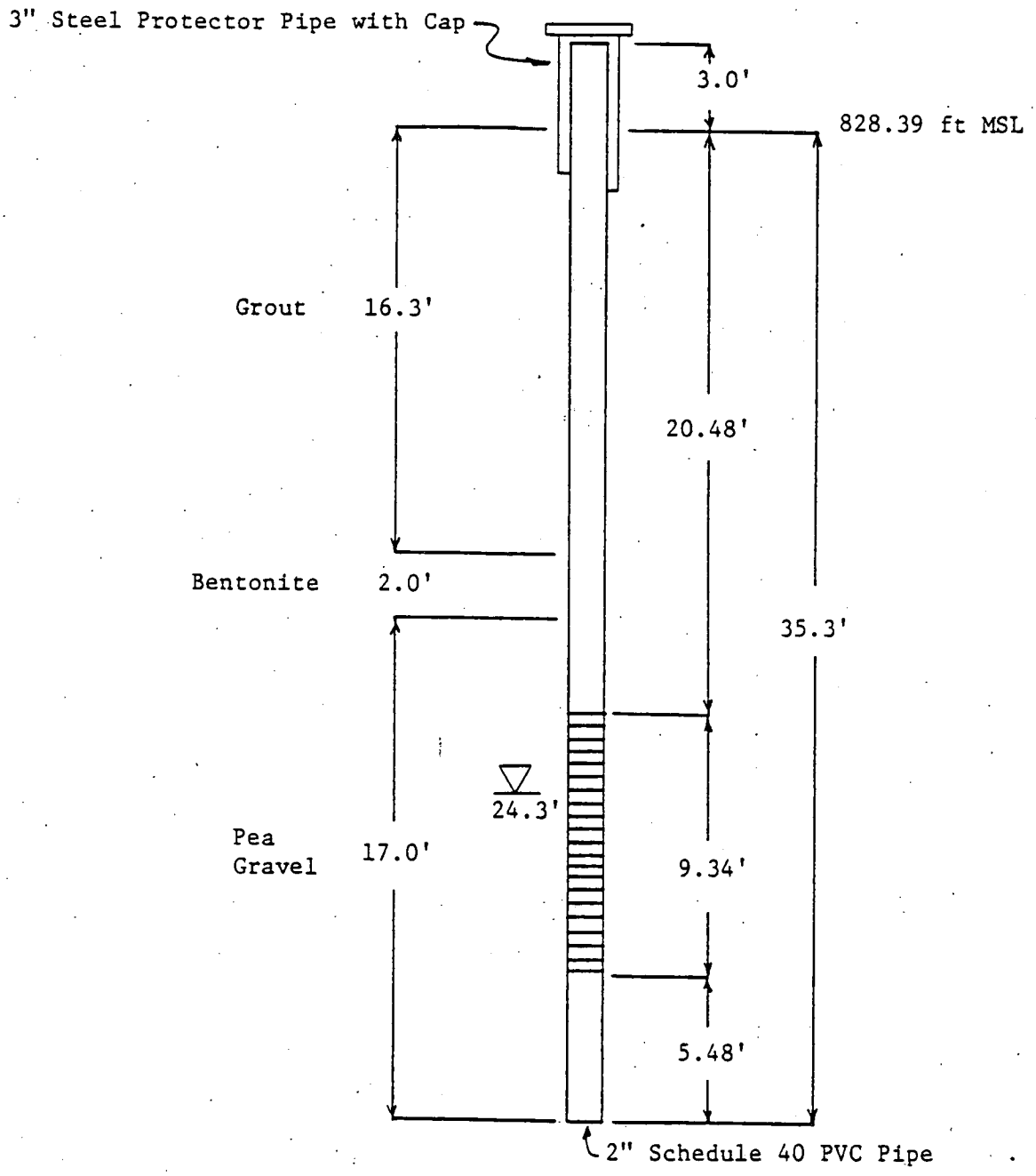
Water depth at time of drilling

Well Screen

NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-3-83



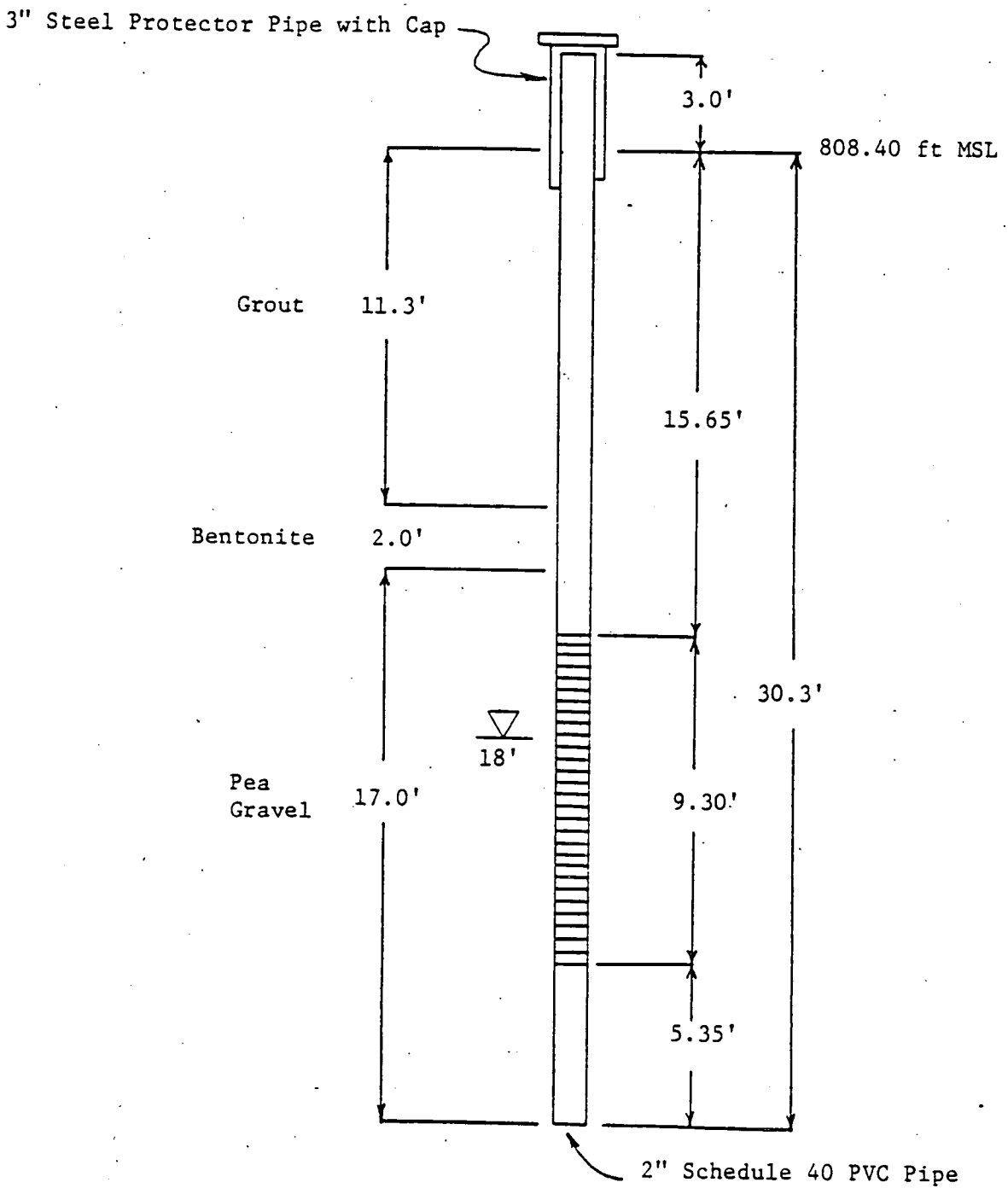
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-4-83



Water depth at time of drilling

Well Screen

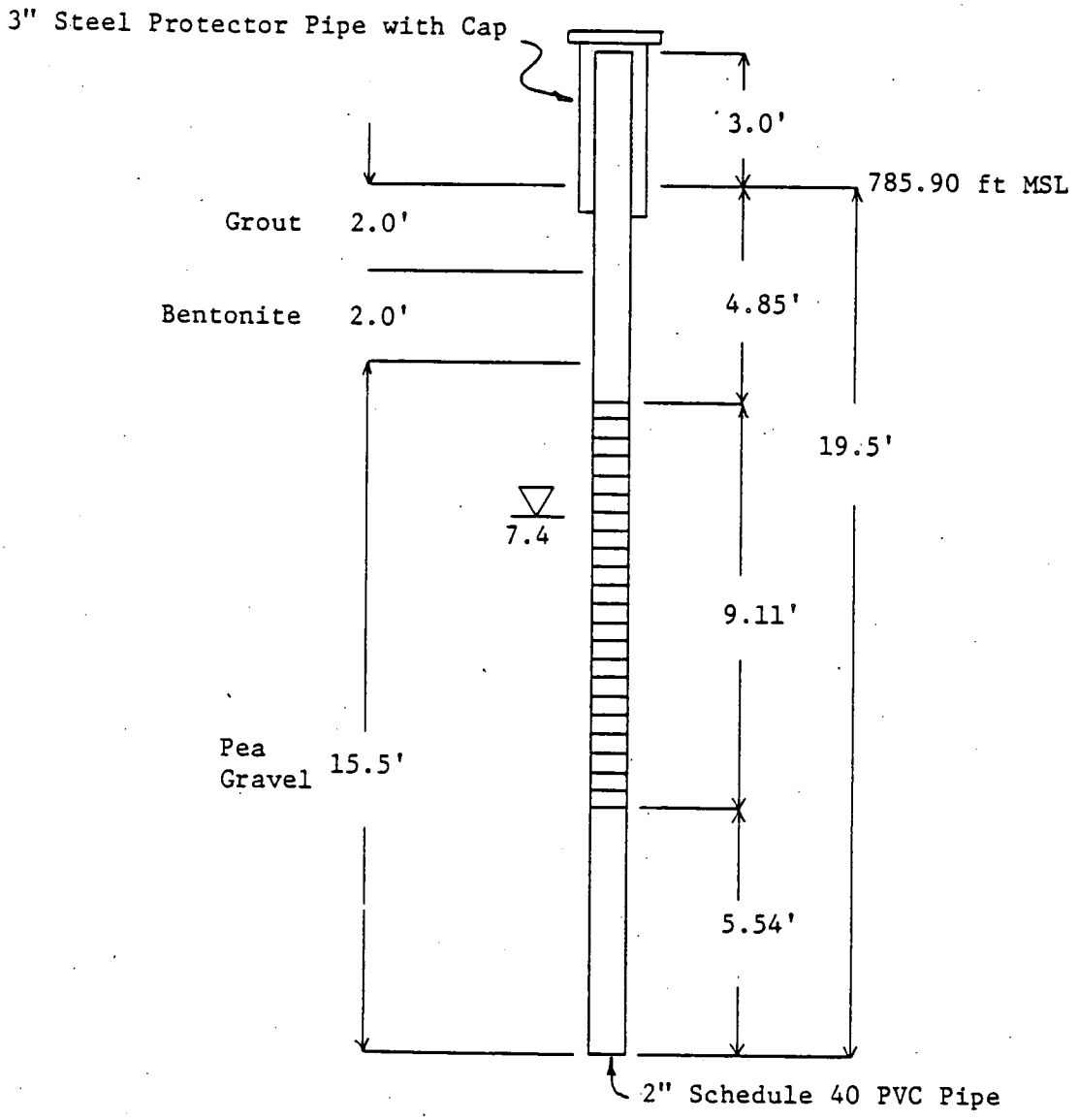
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-5-83



Water depth at time of drilling

Well Screen

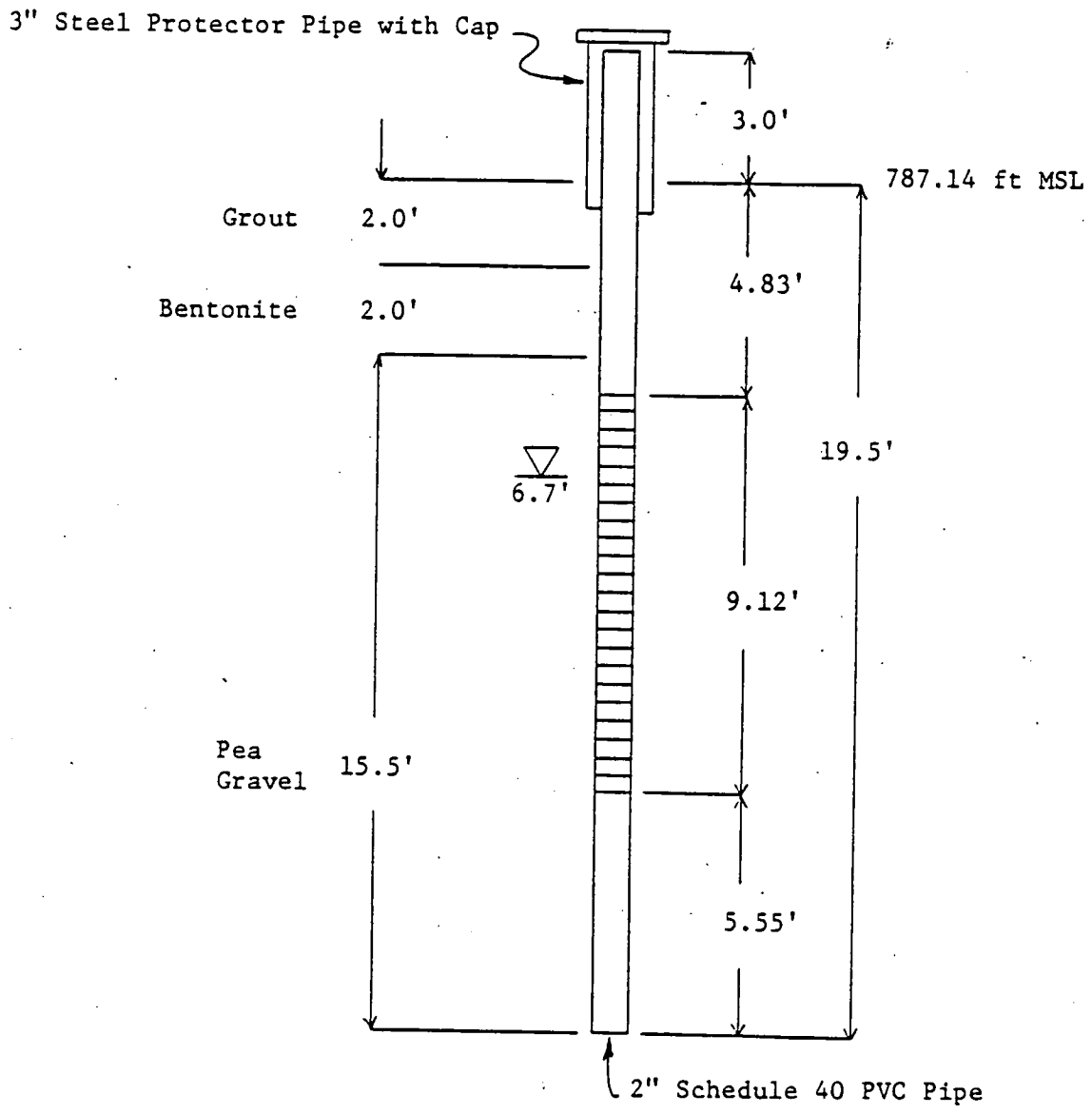
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-6-83



Water depth at time of drilling

Well Screen

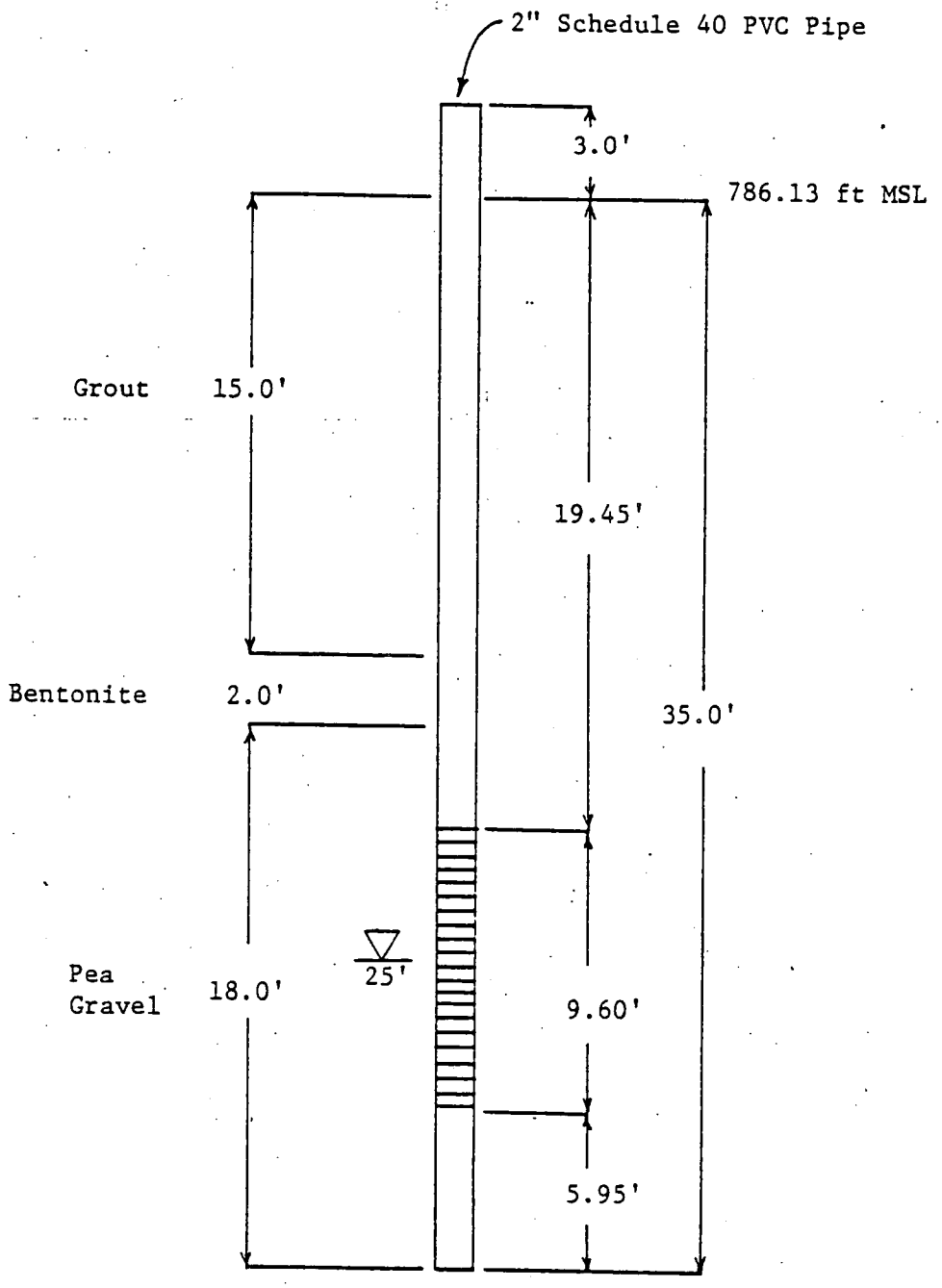
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-7-83



Water depth at time of drilling

Well Screen

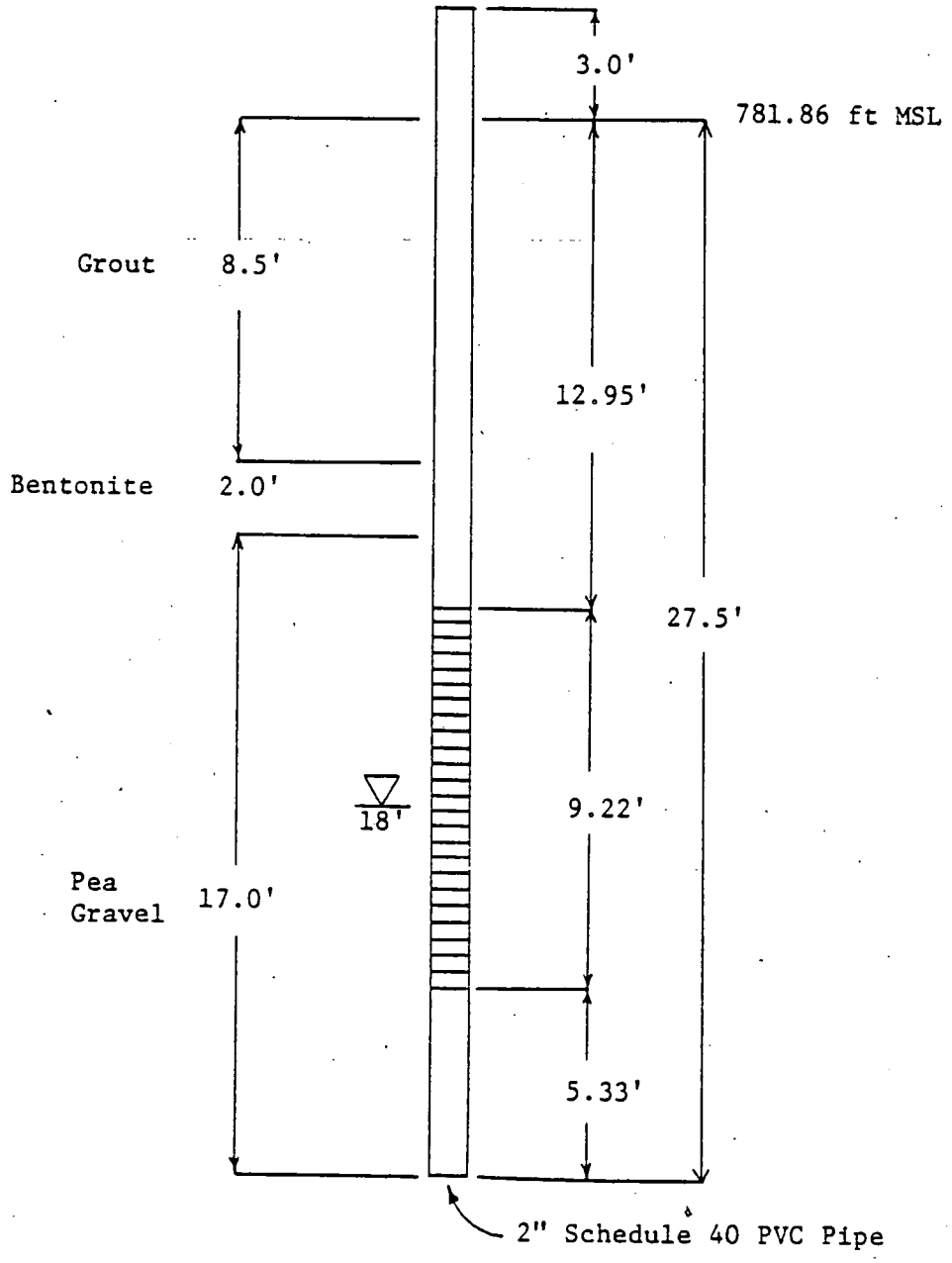
NWSC, Crane Indiana
Rockeye
Well Completion
Boring Number: WES-10-8-83



Water depth at time of drilling

Well Screen

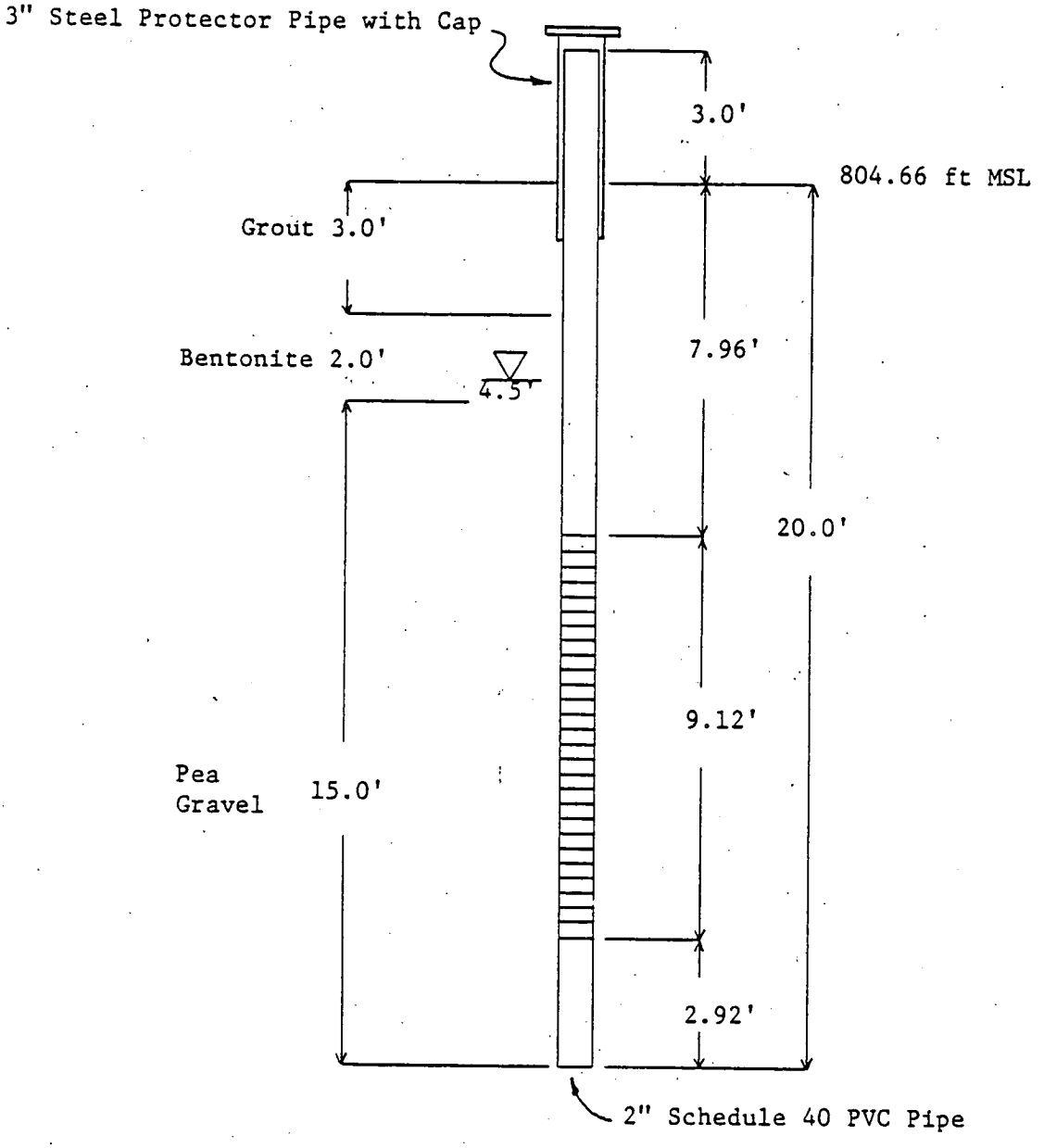
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-9-83



Water depth at time of drilling

Well Screen

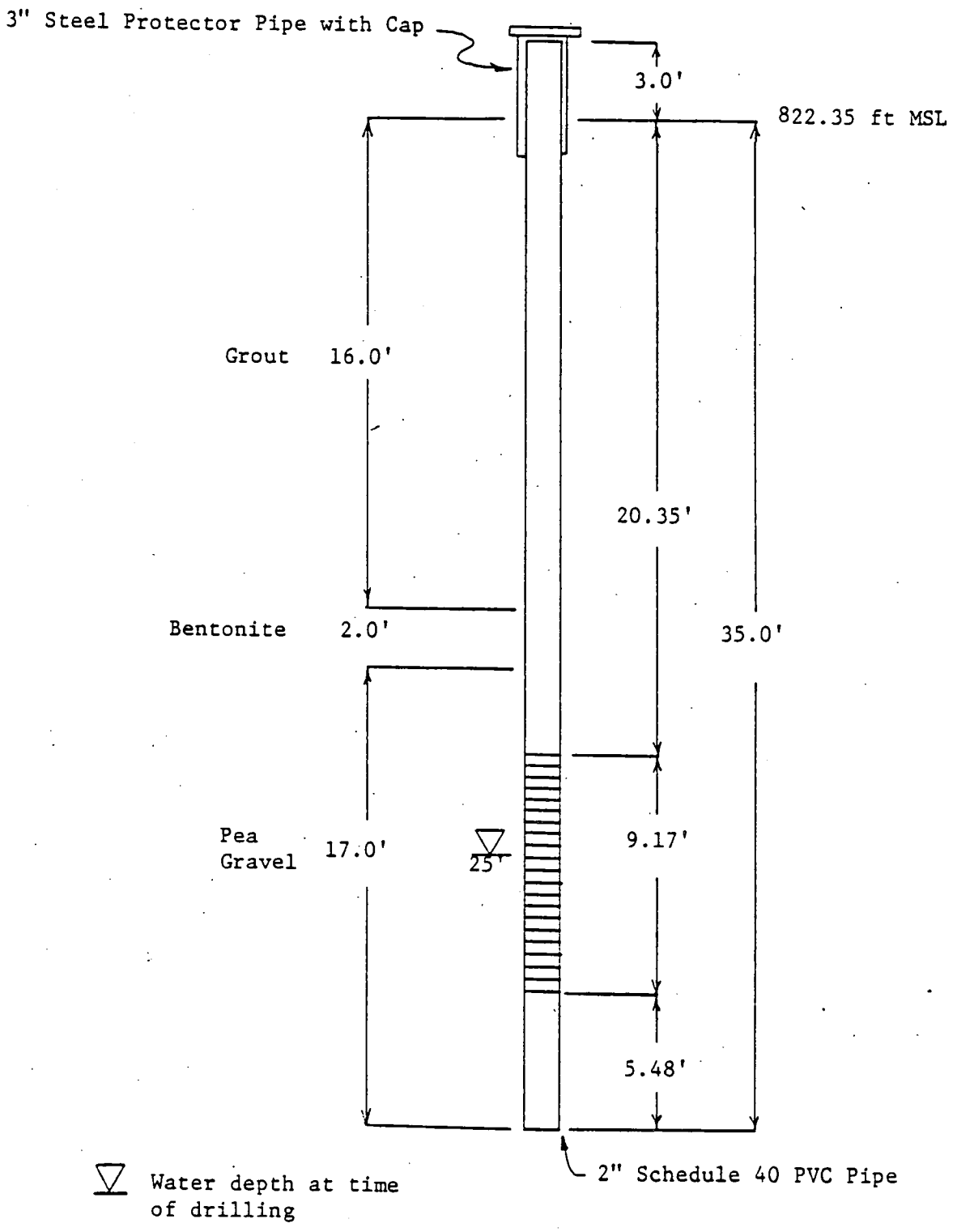
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-10-83



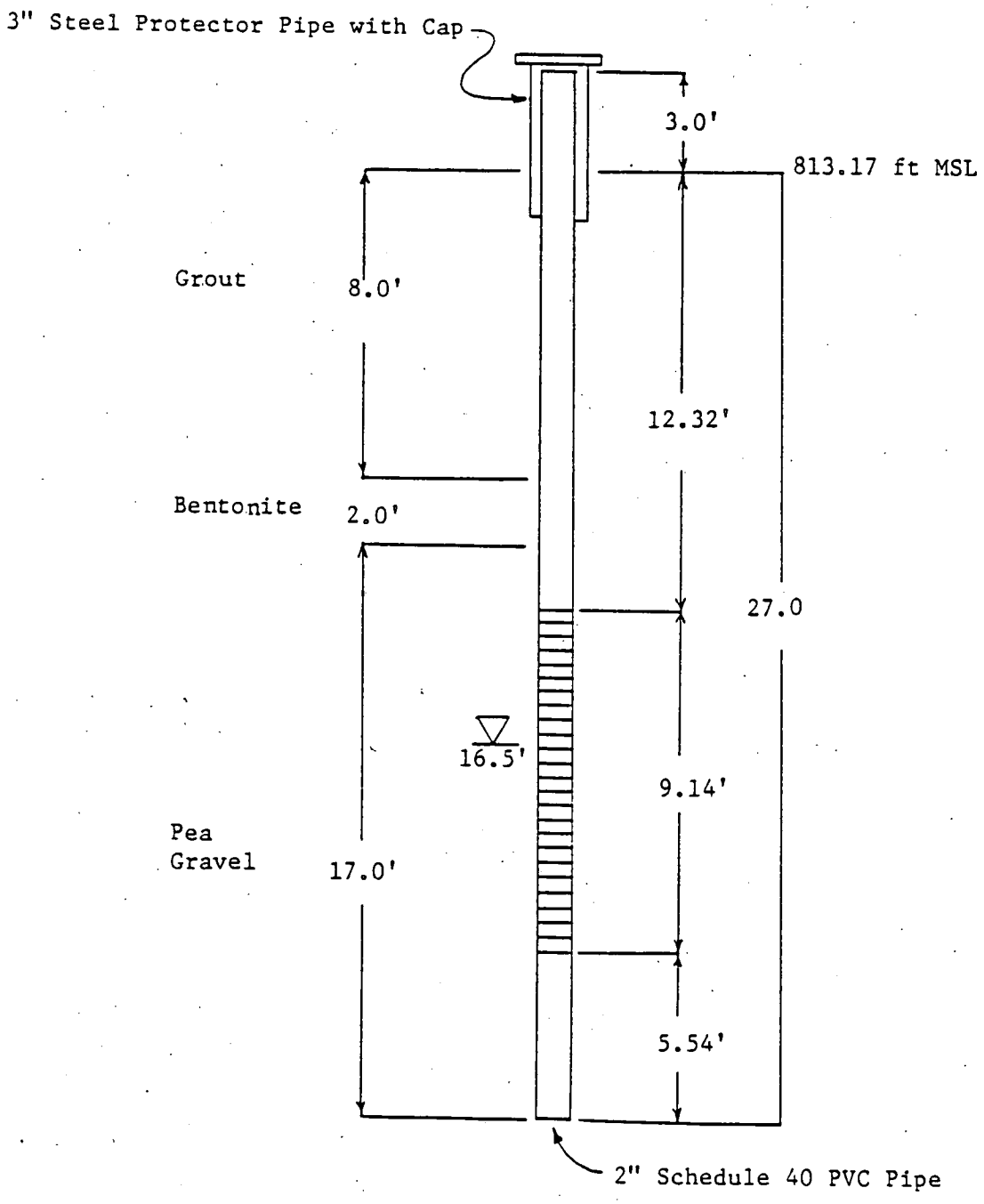
Water depth at time of drilling

Well Screen

NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-11-83



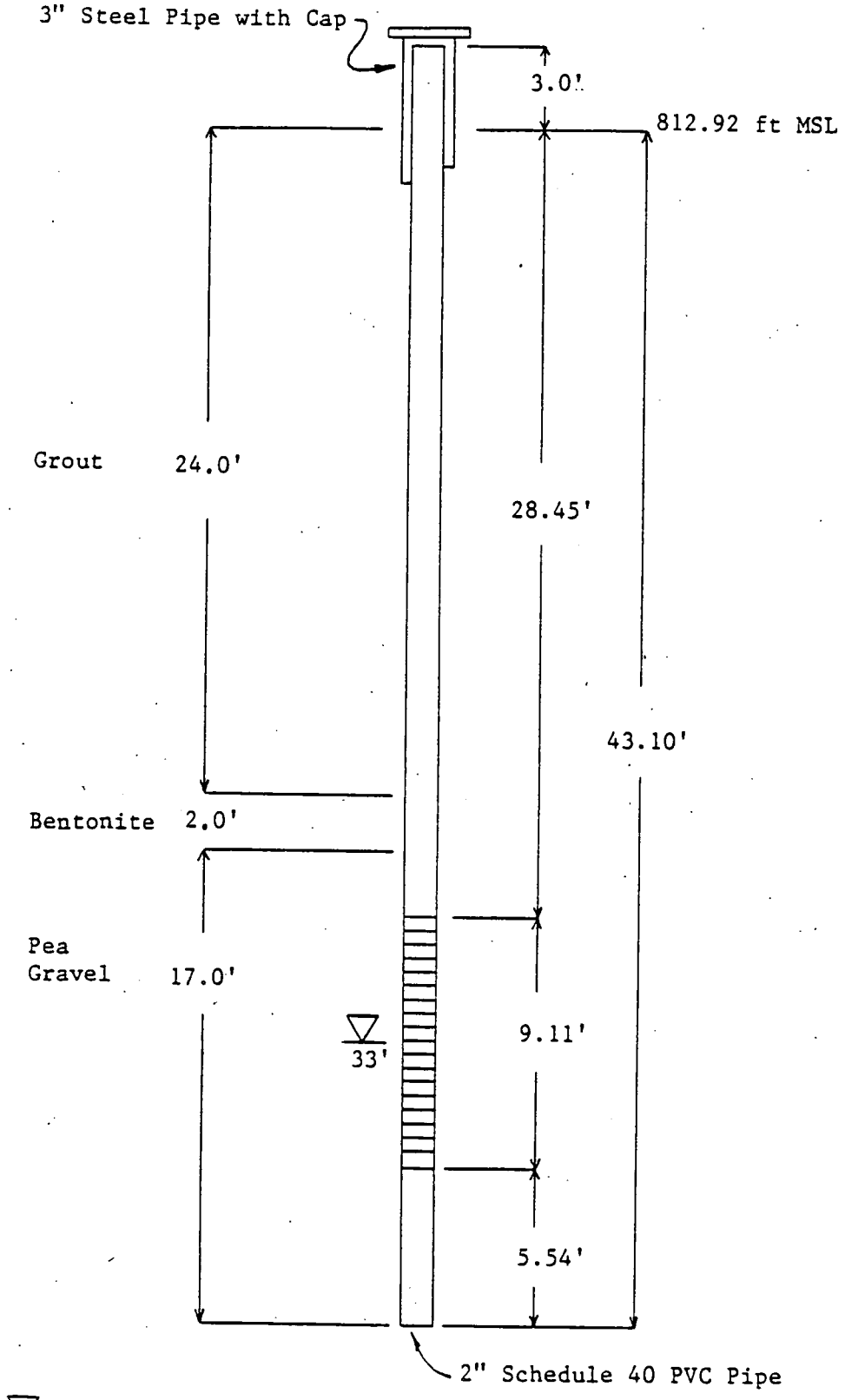
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-12-83



Water Depth at Time of Drilling

Well Screen

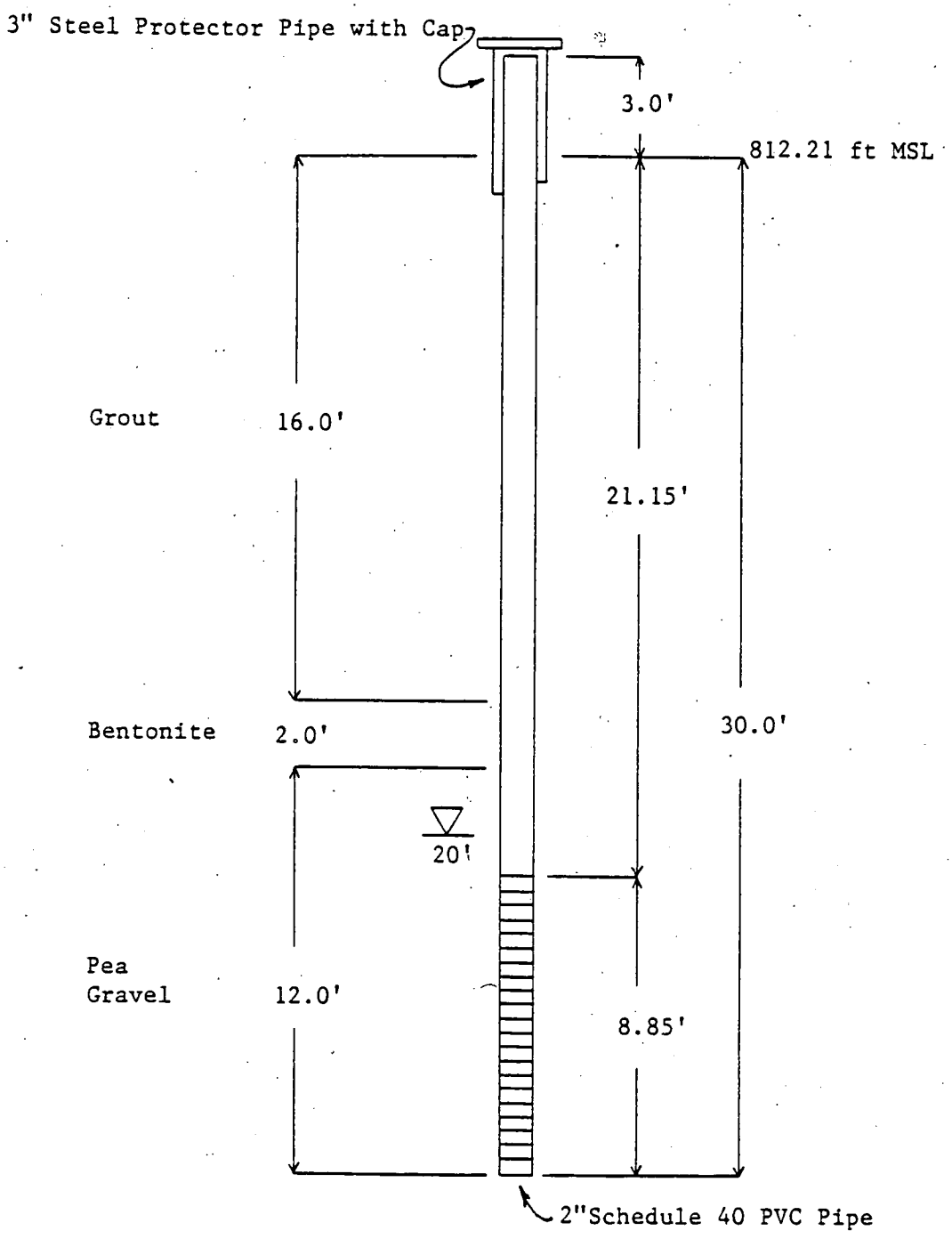
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-13-83



Water Depth at Time of Drilling

NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-14-83

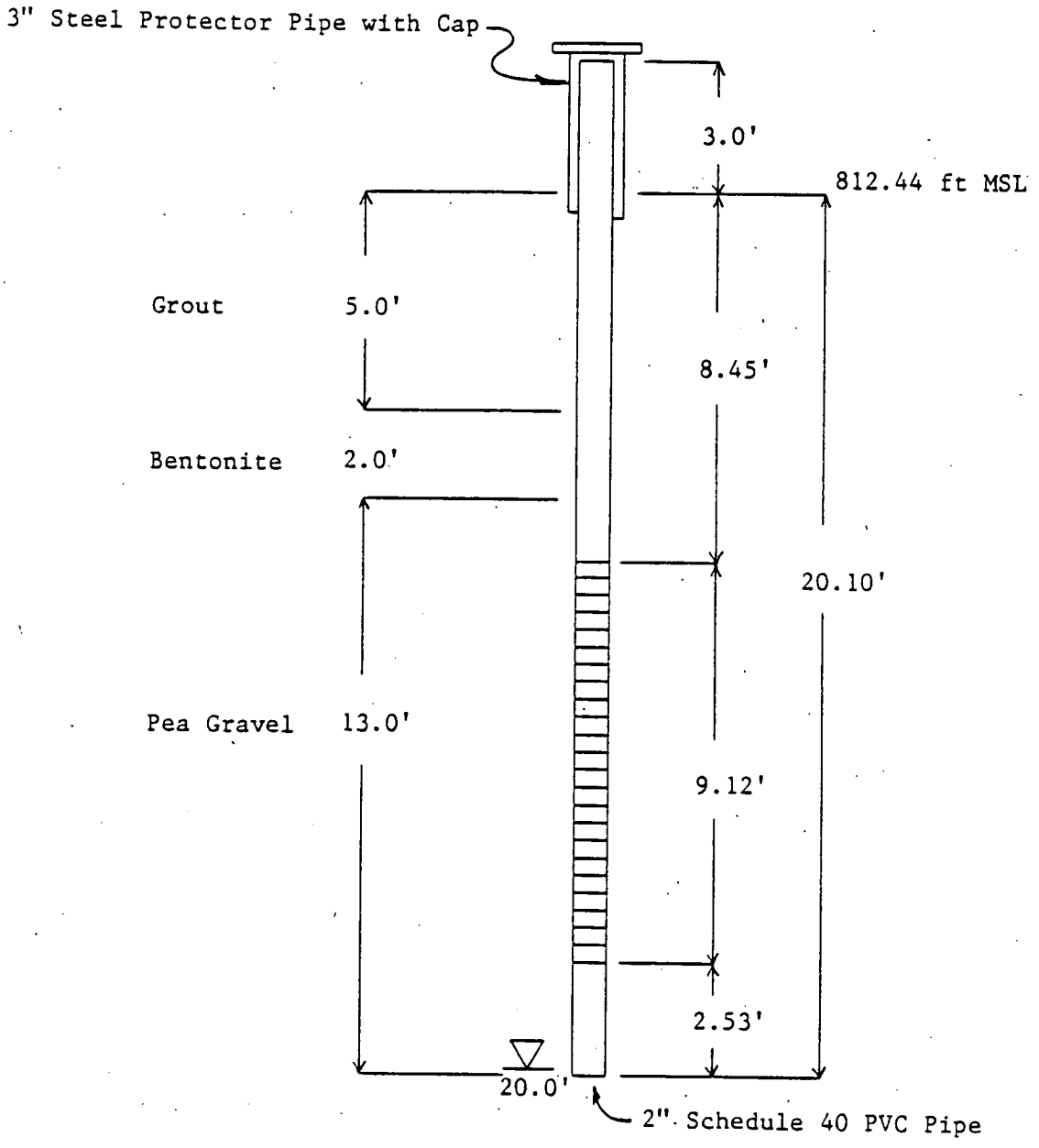
Well Screen



Water Depth at Time of Drilling

Well Screen

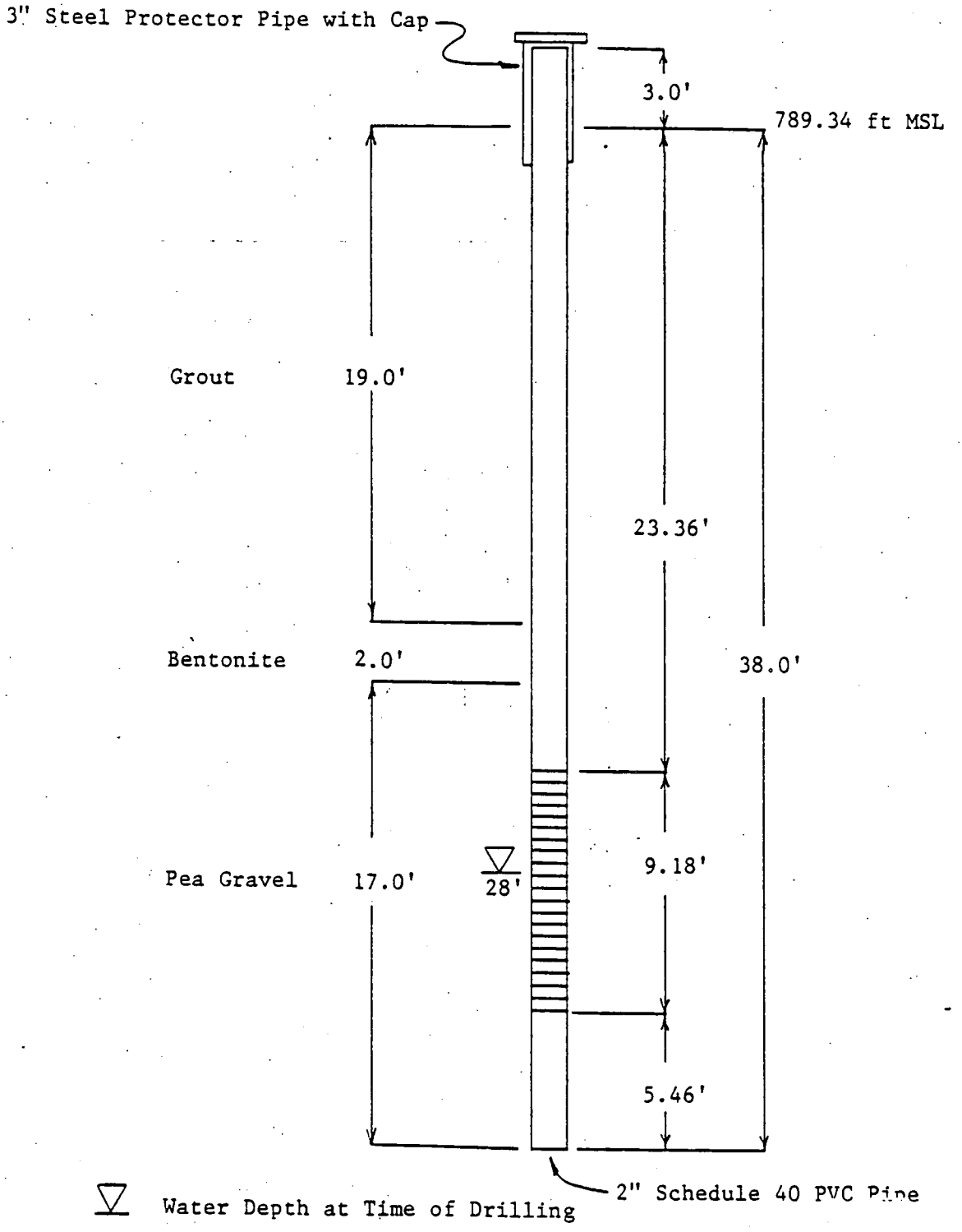
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-14A-83



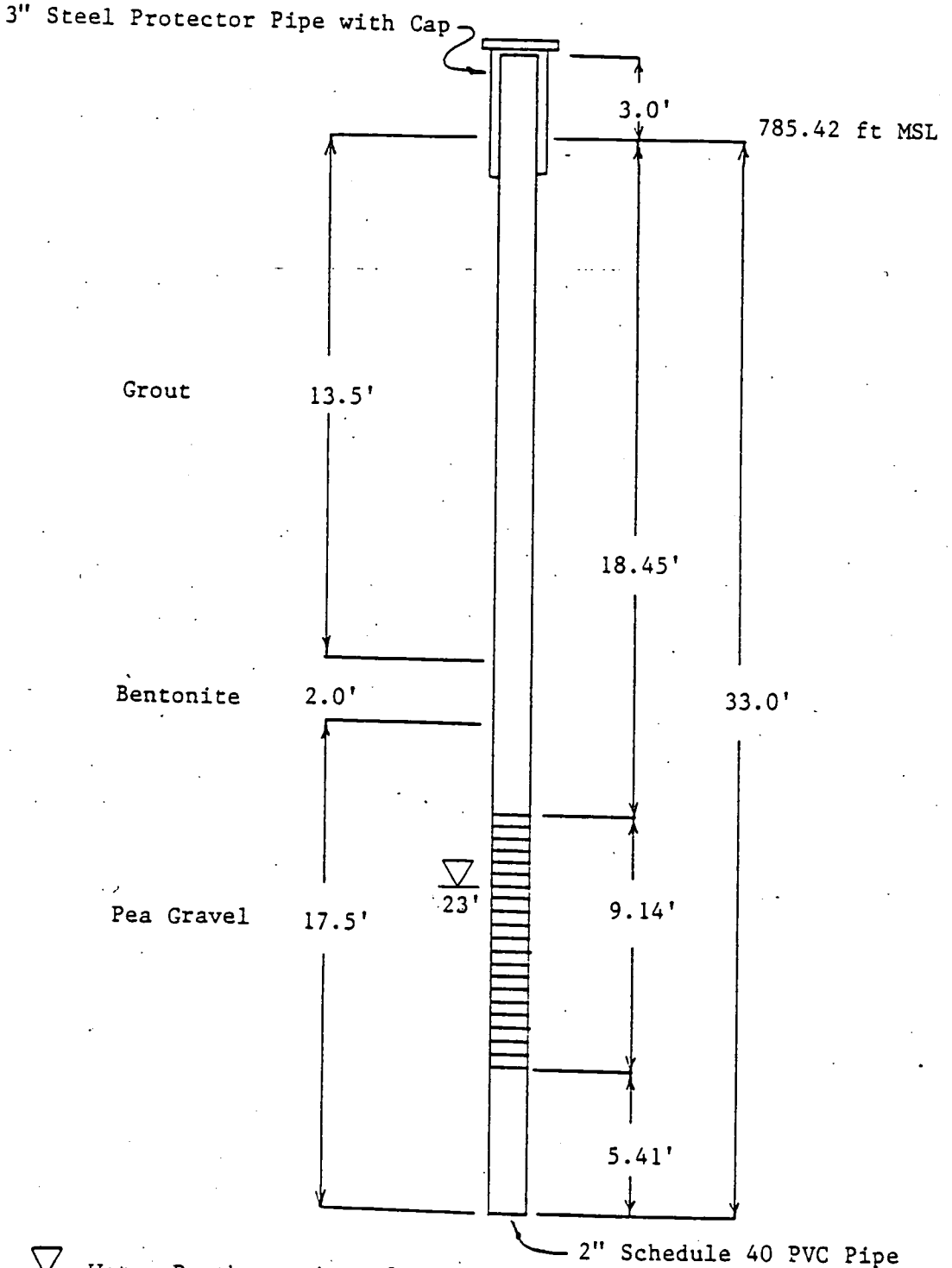
Water Depth at Time of Drilling

Well Screen

NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-14B-83



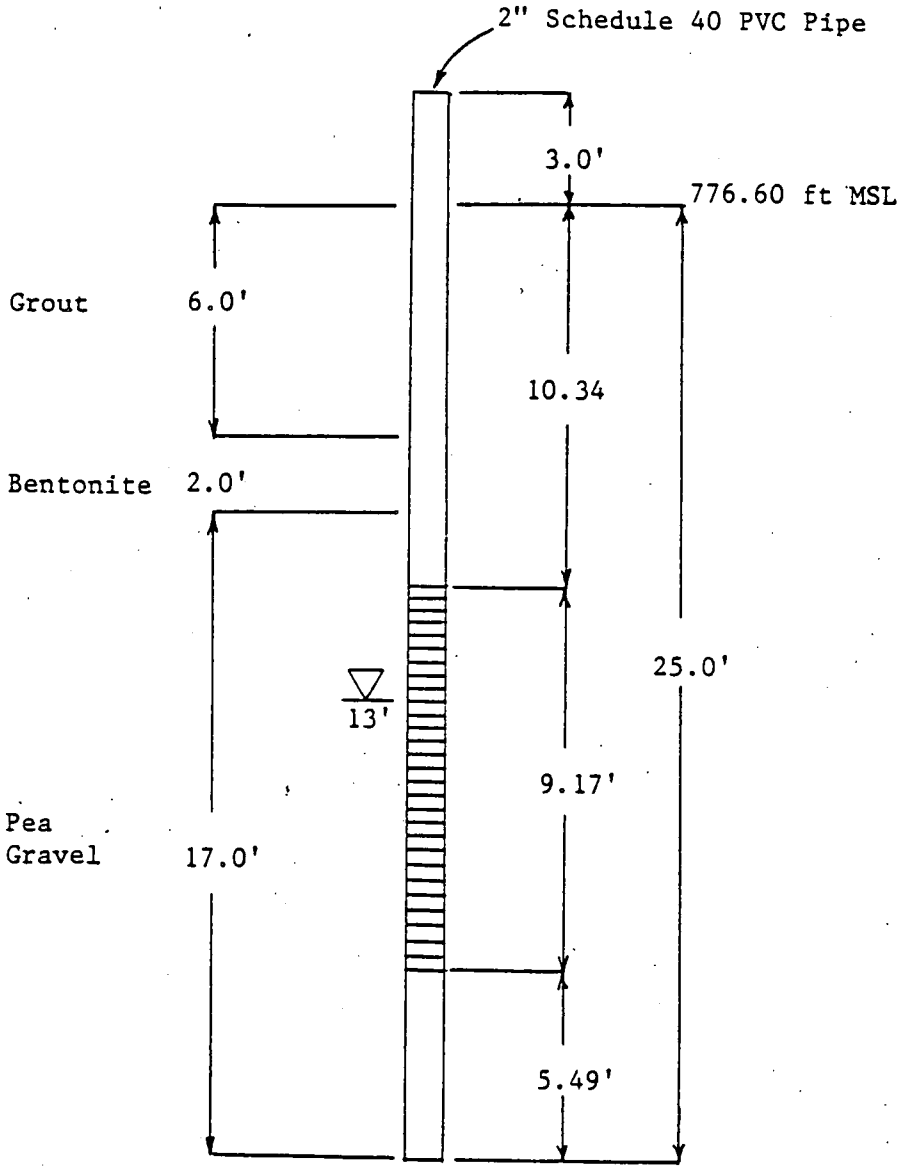
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-15-83



Water Depth at time of Drilling

Well Screen

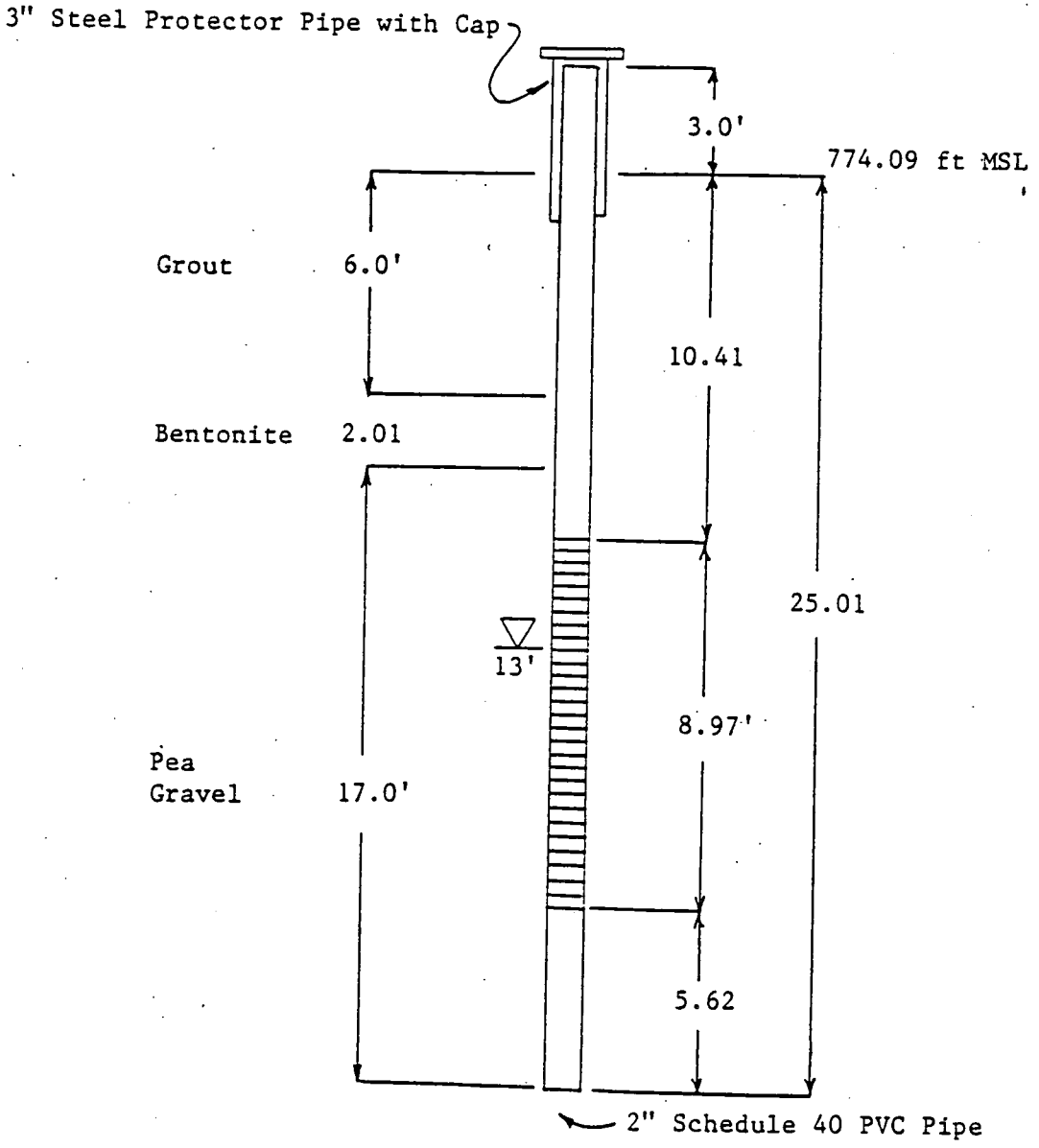
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-16-83



Water Depth at Time of Drilling

Well Screen

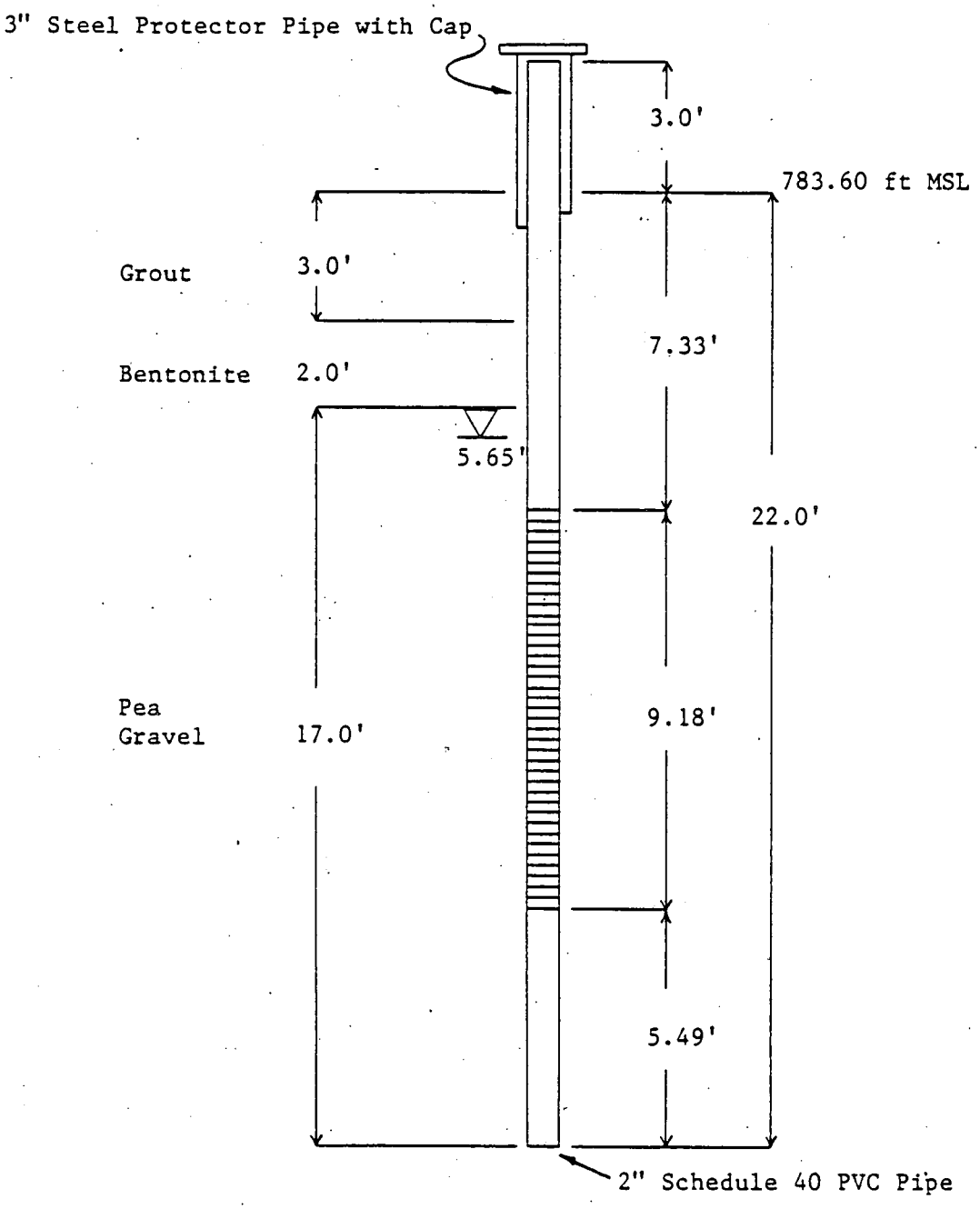
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-17-83



Water Depth at Time of Drilling

Well Screen

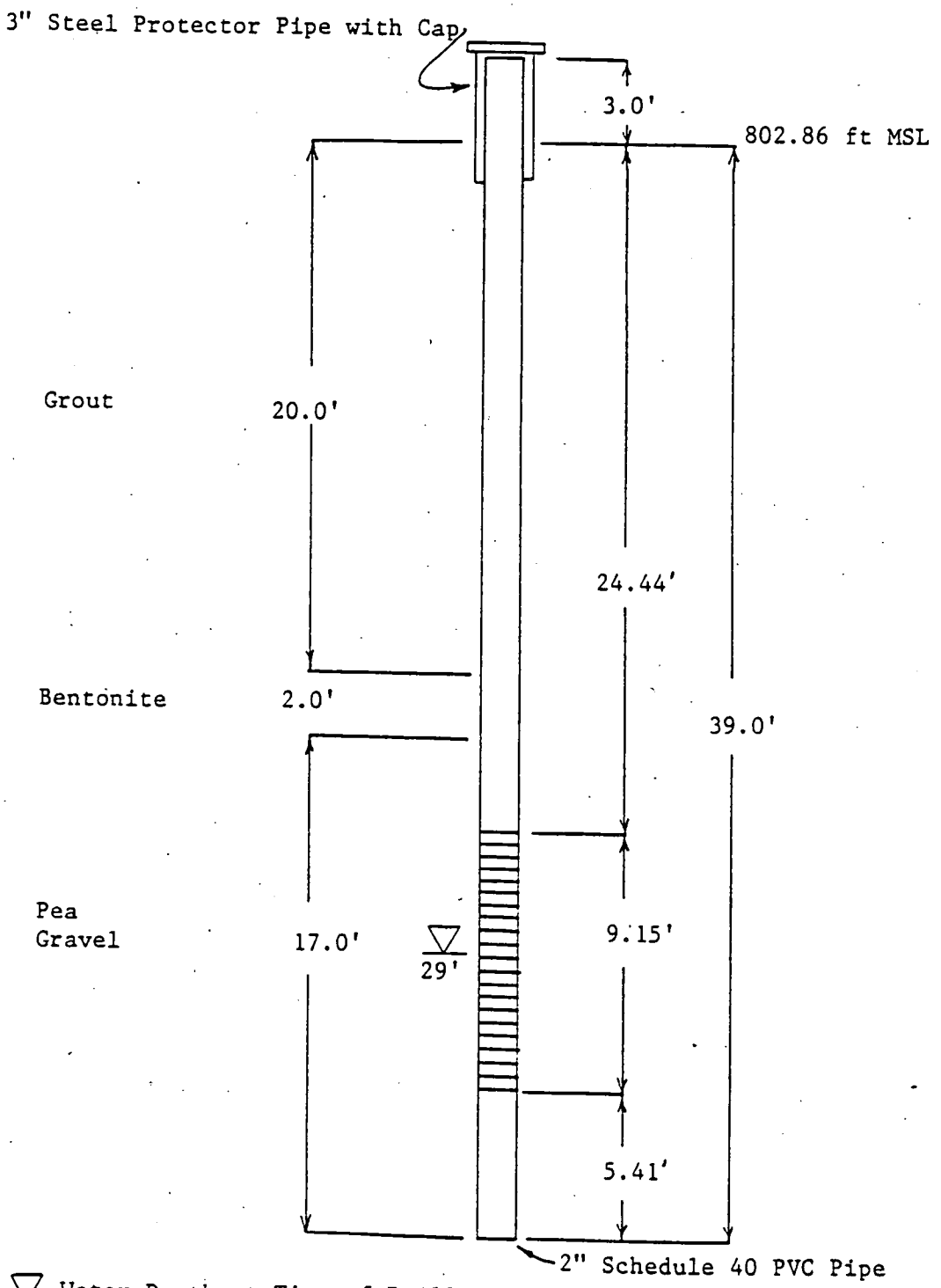
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-18-83



Water Depth at Time of Drilling

Well Screen

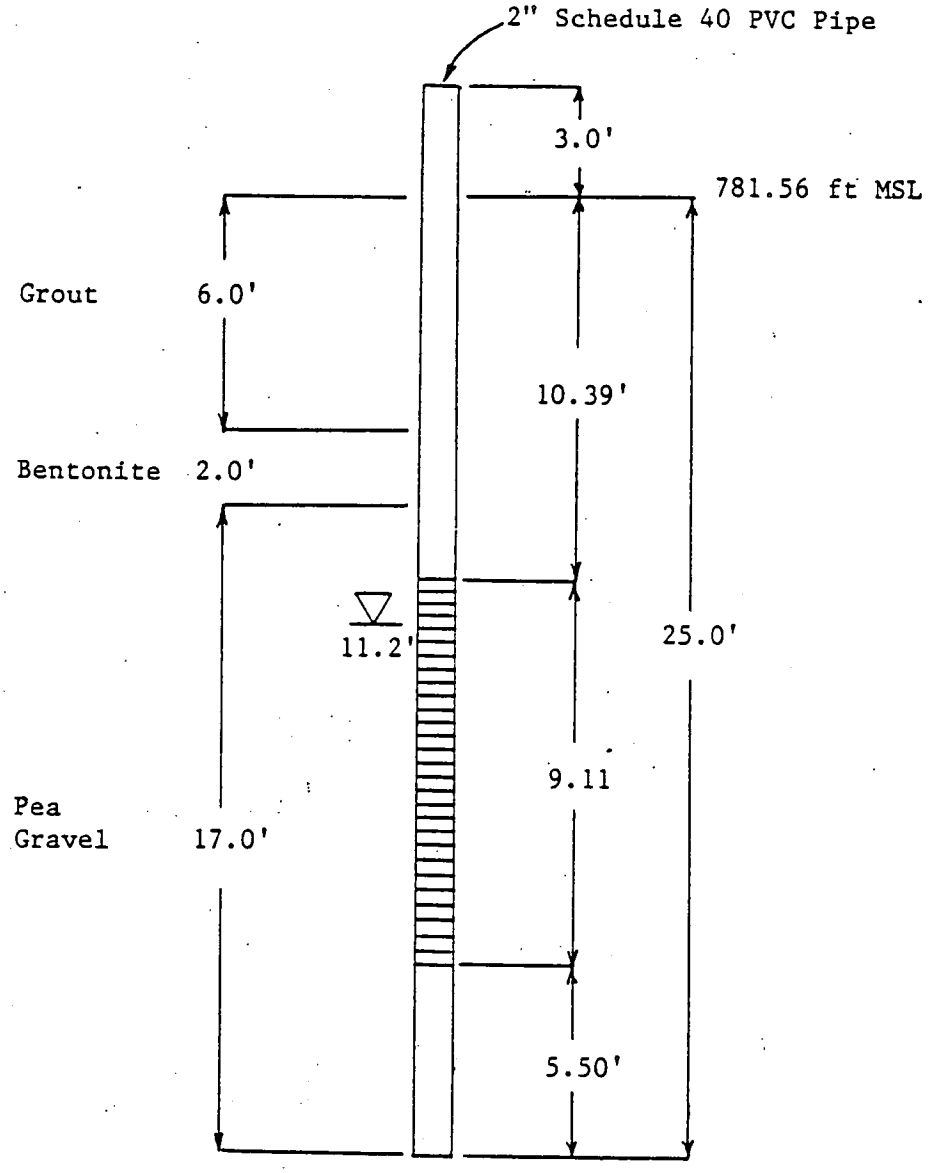
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-19-83



Water Depth at Time of Drilling

Well Screen

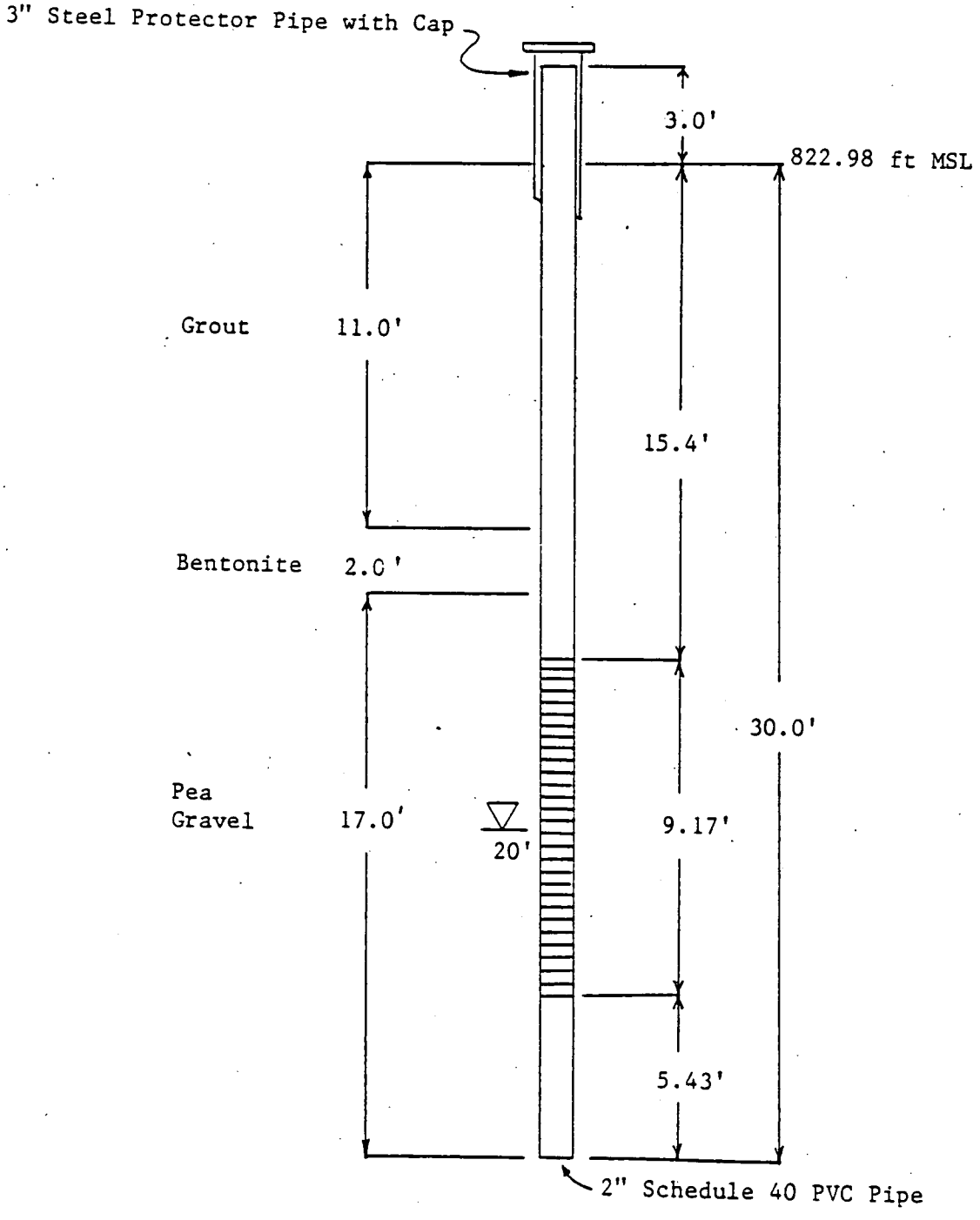
NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-20-83



Water Depth at Time of Drilling

Well Screen

NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-21-83



Water Depth at Time of Drilling

Well Screen

NWSC, Crane, Indiana
Rockeye
Well Completion
Boring Number: WES-10-22-83

APPENDIX A4

Summary of the Groundwater Elevations Observed in the Monitoring Wells During Their Installation

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-1-81

Top of Pipe Elevation: 741.66 ft MSL

Screen Interval: from 723.41 to 713.86 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
26 Aug 81	5:08	—	—	No water
27 Aug 81	9:02	22.99	718.67	
28 Aug 81	8:25	20.47	721.19	
29 Aug 81	8:37	19.80	721.86	
30 Aug 81	12:36	19.25	722.41	
31 Aug 81	9:45	19.24	722.42	
1 Sep 81	10:00	19.15	722.51	
2 Sep 81	7:50	19.00	722.66	
9 Sep 81	12:45	19.08	722.58	
16 Sep 81	8:20	18.87	722.79	
23 Sep 81	12:45	19.29	722.37	
30 Sep 81	8:28	19.29	722.37	
7 Oct 81	10:48	19.23	722.43	
14 Oct 81	10:41	19.20	722.46	
21 Oct 81	9:24	19.14	722.52	
28 Oct 81	12:55	19.08	722.58	
4 Nov 81	11:18	19.30	722.36	
11 Nov 81	1:51	19.53	722.13	
16 Nov 81	12:00	19.41	722.25	Blew dry
18 Nov 81	12:57	19.34	722.32	
25 Nov 81	3:56	19.27	722.39	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-2-81

Top of Pipe Elevation: 728.46 ft MSL

Screen Interval: from 685.79 to 676.19 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
4 Sep 81	8:35	45.65	682.81	
5 Sep 81	8:27	46.10	682.36	
6 Sep 81	12:30	46.22	682.24	
7 Sep 81	8:50	46.01	682.45	
8 Sep 81	12:13	46.01	682.45	
9 Sep 81	12:50	46.13	682.33	
10 Sep 81	3:00	46.09	682.37	
16 Sep 81	8:27	46.05	682.41	
23 Sep 81	12:50	46.70	681.76	
30 Sep 81	8:45	46.33	682.13	
7 Oct 81	9:59	46.66	681.86	
14 Oct 81	10:52	46.54	681.92	
21 Oct 81	9:12	46.50	681.96	
28 Oct 81	12:43	46.62	681.84	
4 Nov 81	11:05	46.47	681.99	
11 Nov 81	1:40	46.58	681.88	
16 Nov 81	3:59	46.09	682.37	Blew dry
18 Nov 81	12:31	46.33	682.13	
25 Nov 81	3:45	46.41	682.05	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-3-81

Top of Pipe Elevation: 723.02 ft MSL

Screen Interval: from 668.84 to 659.73 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
4 Sep 81	9:10	55.80	664.22	Open hole
5 Sep 81	8:14	52.53	667.49	Open hole
6 Sep 81	12:25	40.78	682.24	
7 Sep 81	9:08	41.31	681.71	
8 Sep 81	12:20	41.78	681.24	
9 Sep 81	12:55	42.28	680.74	
10 Sep 81	3:05	42.60	680.42	
11 Sep 81	9:10	42.81	680.21	
12 Sep 81	7:33	43.20	679.82	
16 Sep 81	8:33	43.75	679.27	
23 Sep 81	12:57	44.67	678.35	
30 Sep 81	8:40	44.89	678.13	
7 Oct 81	9:06	44.91	678.11	
14 Oct 81	10:54	45.19	677.83	
21 Oct 81	9:07	45.33	677.69	
28 Oct 81	12:47	45.32	677.70	
4 Nov 81	11:03	45.29	677.73	
11 Nov 81	1:36	45.26	677.76	
16 Nov 81	4:43	45.35	677.67	Blew dry
18 Nov 81	12:38	55.15	667.87	
25 Nov 81	3:43	51.60	671.42	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-4-81

Top of Pipe Elevation: 719.66 ft MSL

Screen Interval: from 680.76 to 671.56 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
6 Sep 81	12:21	38.84	680.82	
7 Sep 81	9:10	38.62	681.04	
8 Sep 81	12:25	38.67	680.99	
9 Sep 81	1:00	38.67	680.99	
10 Sep 81	3:07	38.50	681.16	
11 Sep 81	9:14	38.68	680.98	
12 Sep 81	7:29	38.73	680.93	
16 Sep 81	8:40	38.52	681.14	
23 Sep 81	12:59	39.06	680.60	
30 Sep 81	8:50	38.65	681.01	
7 Oct 81	9:04	38.75	680.91	
14 Oct 81	10:57	38.84	680.82	
21 Oct 81	8:50	38.89	680.77	
28 Oct 81	12:50	38.96	680.70	
4 Nov 81	10:55	38.88	680.78	
11 Nov 81	1:32	38.99	680.67	
16 Nov 81	5:01	38.60	681.06	Blew dry
18 Nov 81	12:43	38.72	680.94	
25 Nov 81	3:40	38.95	680.71	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-5-81

Top of Pipe Elevation: 742.24 ft MSL

Screen Interval: from 689.04 to 679.56 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
7 Sep 81	8:20	54.5-55.0	684.24	Open hole
8 Sep 81	12:08	57.66	684.58	
9 Sep 81	1:10	57.79	684.45	
10 Sep 81	3:14	57.60	684.64	
11 Sep 81	8:50	57.84	684.40	
12 Sep 81	7:15	57.83	684.41	
13 Sep 81	2:01	57.68	684.56	
14 Sep 81	3:40	57.52	684.72	
16 Sep 81	8:13	57.68	684.56	
23 Sep 81	3:59	58.01	684.23	
30 Sep 81	8:25	57.93	684.31	
7 Oct 81	9:45	57.90	684.34	
14 Oct 81	10:35	58.00	684.24	
21 Oct 81	9:27	58.11	684.13	
28 Oct 81	12:59	58.10	684.14	
4 Nov 81	11:20	58.00	684.24	
11 Nov 81	1:55	58.08	684.16	
16 Nov 81	11:13	57.95	684.29	Blew dry
18 Nov 81	1:00	57.87	684.37	
25 Nov 81	3:58	57.90	684.34	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-6-81

Top of Pipe Elevation: 739.58 ft MSL

Screen Interval: from 686.13 to 676.87 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
24 Sep 81	8:00	55.36	681.22	Open hole
25 Sep 81	3:55	54.74	684.74	
26 Sep 81	9:01	55.32	684.26	
27 Sep 81	3:25	55.40	684.18	
28 Sep 81	8:55	55.56	684.02	
29 Sep 81	11:34	55.64	683.94	
30 Sep 81	8:31	55.36	684.22	
1 Oct 81	11:55	55.30	684.28	
7 Oct 81	9:49	55.51	684.07	
14 Oct 81	10:44	55.54	684.04	
21 Oct 81	9:22	55.60	683.98	
28 Oct 81	12:35	55.74	683.84	
4 Nov 81	11:16	55.80	683.78	
11 Nov 81	1:49	55.65	683.93	
16 Nov 81	12:40	55.18	684.40	Blew dry
18 Nov 81	12:55	55.48	684.10	
25 Nov 81	3:53	55.69	683.89	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-7-81

Top of Pipe Elevation: 731.73 ft MSL

Screen Interval: from 685.97 to 676.73 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
25 Sep 81	9:01	45.34	683.39	Open hole
26 Sep 81	9:00	48.02	683.71	
27 Sep 81	3:25	48.34	683.39	
28 Sep 81	9:03	48.31	683.42	
29 Sep 81	11:39	48.24	683.49	
30 Sep 81	8:35	48.23	683.50	
1 Oct 81	11:59	47.85	683.88	
2 Oct 81	8:06	48.06	683.67	
7 Oct 81	9:50	48.20	683.53	
14 Oct 81	10:45	48.20	683.53	
21 Oct 81	9:19	48.27	683.46	
28 Oct 81	12:40	48.32	683.41	
4 Nov 81	11:09	48.31	683.42	
11 Nov 81	1:43	48.29	683.44	
16 Nov 81	1:20	47.84	683.89	Blew dry
18 Nov 81	12:52	48.01	683.72	
25 Nov 81	3:50	48.00	683.73	

Groundwater Elevations

Dye Burial Grounds

Boring Number: WES-2-8-81

Top of Pipe Elevation: 733.29 ft MSL

Screen Interval: from 684.42 to 675.52 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
26 Sep 81	8:50	47.0	683.29	Open hole
27 Sep 81	3:29	49.75	683.54	
28 Sep 81	9:07	49.94	683.35	
29 Sep 81	11:43	49.89	683.40	
30 Sep 81	8:38	49.78	683.51	
1 Oct 81	12:03	49.52	683.77	
2 Oct 81	8:10	49.68	683.61	
3 Oct 81	8:15	49.85	683.44	
7 Oct 81	9:55	49.83	683.46	
14 Oct 81	10:49	49.88	683.41	
21 Oct 81	9:15	49.92	683.37	
28 Oct 81	12:30	50.00	683.29	
4 Nov 81	11:13	49.95	683.34	
11 Nov 81	1:46	49.97	683.32	
16 Nov 81	2:13	49.52	683.77	Blew dry
18 Nov 81	12:46	49.76	683.53	
25 Nov 81	3:47	49.76	683.53	

Groundwater Elevations

McComish Gorge

Boring Number: WES-4-1-81

Top of Pipe Elevation: 606.49 ft MSL

Screen Interval: from 578.18 to 568.97 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Sep 81	7:55	31.82	574.67	
12 Sep 81	9:02	31.83	574.66	
13 Sep 81	2:20	31.79	574.70	
14 Sep 81	8:15	31.89	574.60	
15 Sep 81	5:55	31.81	574.68	
16 Sep 81	9:15	31.94	574.55	
17 Sep 81	11:02	31.89	574.60	
24 Sep 81	12:50	32.05	574.44	
1 Oct 81	8:20	32.05	574.44	
8 Oct 81	2:50	32.05	574.44	
15 Oct 81	5:10	32.11	574.38	
22 Oct 81	8:34	32.26	574.23	
29 Oct 81	2:11	32.31	574.18	
5 Nov 81	9:15	32.55	573.94	
12 Nov 81	4:31	32.43	574.06	
19 Nov 81	10:58	32.42	574.07	
26 Nov 81	9:54	32.44	574.05	
29 Nov 81	1:45	32.57	573.92	

Groundwater Elevations

McComish Gorge

Boring Number: WES-4-2-81

Top of Pipe Elevation: 588.69 ft MSL

Screen Interval: from 570.21 to 561.05 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
12 Sep 81	8:35	19.9	565.79	Open hole
13 Sep 81	2:24	21.71	566.98	
14 Sep 81	8:24	21.71	566.98	
15 Sep 81	5:55	21.68	567.01	
16 Sep 81	9:21	21.81	566.88	
17 Sep 81	11:05	21.79	566.90	
18 Sep 81	11:01	21.73	566.96	
19 Sep 81	7:23	21.74	566.95	
24 Sep 81	12:53	21.75	566.94	
1 Oct 81	8:26	22.02	566.67	
8 Oct 81	2:53	22.13	566.56	
15 Oct 81	5:12	22.00	566.69	
22 Oct 81	8:37	22.08	566.61	
29 Oct 81	2:15	22.08	566.61	
5 Nov 81	9:21	22.15	566.54	
12 Nov 81	4:34	22.30	566.39	
19 Nov 81	10:59	22.17	566.52	
26 Nov 81	9:57	22.11	566.58	
29 Nov 81	1:46	22.14	566.55	

Groundwater Elevations

McComish Gorge

Boring Number: WES-4-3-81

Top of Pipe Elevation: 569.22 ft MSL

Screen Interval: from 563.12 to 556.10 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
13 Sep 81	2:29	6.65	562.57	
14 Sep 81	8:30	6.80	562.42	
15 Sep 81	6:00	6.57	562.65	
16 Sep 81	9:25	6.70	562.52	
17 Sep 81	11:14	6.48	562.74	
18 Sep 81	11:06	6.61	562.61	
19 Sep 81	7:28	6.54	562.68	
24 Sep 81	12:58	6.70	562.52	
1 Oct 81	8:36	6.59	562.63	
8 Oct 81	3:00	6.59	562.63	
15 Oct 81	5:20	6.74	562.48	
22 Oct 81	8:44	6.64	562.58	
29 Oct 81	2:23	6.48	562.74	
5 Nov 81	9:31	6.60	562.62	
12 Nov 81	4:45	6.49	562.73	
19 Nov 81	11:06	6.52	562.70	
26 Nov 81	10:06	6.40	562.82	
29 Nov 81	1:53	6.32	562.90	

Groundwater Elevations

McComish Gorge

Boring Number: WES-4-4-81

Top of Pipe Elevation: 596.14 ft MSL

Screen Interval: from 570.24 to 561.27 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
29 Sep 81	2:00	28.79	567.35	
30 Sep 81	9:40	28.75	567.39	
1 Oct 81	8:30	28.88	567.26	
2 Oct 81	3:15	28.64	567.50	
3 Oct 81	2:20	28.77	567.37	
4 Oct 81	11:53	28.77	567.37	
5 Oct 81	8:01	28.78	567.36	
8 Oct 81	2:55	28.82	567.32	
15 Oct 81	5:19	28.86	567.28	
22 Oct 81	8:42	28.94	567.20	
29 Oct 81	2:20	28.95	567.19	
5 Nov 81	9:27	29.09	567.05	
12 Nov 81	4:39	29.20	566.94	
19 Nov 81	11:05	29.25	566.89	
26 Nov 81	10:02	29.25	566.89	
29 Nov 81	1:50	29.27	566.87	

Groundwater Elevations

McComish Gorge

Boring Number: WES-4-5-81

Top of Pipe Elevation: 576.39 ft MSL

Screen Interval: from 568.17 to 558.99 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
1 Oct 81	8:33	11.15	565.24	
2 Oct 81	3:18	11.33	565.06	
3 Oct 81	2:25	11.41	564.98	
4 Oct 81	11:56	11.35	565.04	
5 Oct 81	8:09	11.54	564.85	
6 Oct 81	11:35	11.43	564.96	
7 Oct 81	8:58	11.47	564.92	
8 Oct 81	2:58	11.79	564.60	
15 Oct 81	5:22	12.04	564.35	
22 Oct 81	8:46	12.43	563.96	
29 Oct 81	2:25	12.58	563.81	
5 Nov 81	9:33	12.50	563.89	
12 Nov 81	4:43	12.57	563.82	
19 Nov 81	11:09	12.59	563.80	
26 Nov 81	10:05	12.11	564.28	
29 Nov 81	1:54	11.87	564.52	

Groundwater Elevations

McComish Gorge

Boring Number: WES-4-6-81

Top of Pipe Elevation: 582.54 ft MSL

Screen Interval: from 568.92 to 559.71 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
9 Oct 81	4:35	18.01	564.53	
10 Oct 81	4:30	18.06	564.48	
11 Oct 81	1:04	18.04	564.50	
12 Oct 81	8:55	18.15	564.39	
13 Oct 81	9:08	18.30	564.24	
14 Oct 81	9:44	18.03	564.51	
15 Oct 81	5:16	18.09	564.45	
22 Oct 81	8:39	18.08	564.46	
29 Oct 81	2:17	18.00	564.54	
5 Nov 81	9:23	18.01	564.53	
12 Nov 81	4:36	18.10	564.44	
19 Nov 81	11:02	17.96	564.58	
26 Nov 81	9:59	17.97	564.57	
29 Nov 81	1:49	17.88	564.66	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-1A-81

Top of Pipe Elevation: 686.13 ft MSL

Screen Interval: from 678.53 to 668.88 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
18 Sep 81	8:05	11.35	671.28	Open hole
19 Sep 81	4:00	14.60	671.53	
20 Sep 81	9:50	14.00	672.13	
21 Sep 81	12:35	12.59	673.54	
22 Sep 81	10:26	12.08	674.05	
23 Sep 81	3:30	12.09	674.04	
24 Sep 81	1:50	11.87	674.26	
25 Sep 81	7:20	11.76	674.37	
2 Oct 81	8:43	11.26	674.87	
9 Oct 81	12:08	11.42	674.70	
16 Oct 81	12:25	11.66	674.47	
23 Oct 81	3:45	17.60*	668.53	
30 Oct 81	10:01	17.42*	668.71	
6 Nov 81	2:20	17.39*	668.74	
12 Nov 81				Blew hole and rinsed
13 Nov 81	8:50	—	—	No water
16 Nov 81	8:40	—	—	No water
20 Nov 81	3:30	—	—	No water
27 Nov 81	9:02	17.02*	669.11	

* Water level below screen

Groundwater Elevations

Demolition Area

Boring Number: WES-6-1B-81

Top of Pipe Elevation: 686.27 ft MSL

Screen Interval: from 653.30 to 644.13 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
8 Nov 81	—	—	—	No water
9 Nov 81	5:25	—	—	" "
10 Nov 81	11:20	—	—	" "
11 Nov 81	2:30	—	—	" "
12 Nov 81	10:30	—	—	" "
13 Nov 81	9:00	—	—	" "
16 Nov 81	8:50	—	—	" "
20 Nov 81	8:35	—	—	" "
27 Nov 81	8:57	—	—	" "

Groundwater Elevations

Demolition Area

Boring Number: WES-6-1C-81

Top of Pipe Elevation: 685.60 ft MSL

Screen Interval: from 659.50 to 644.50 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
16 Nov 81	7:34	29.95	652.65	Open hole
17 Nov 81				Open hole - jetted dry
18 Nov 81	11:24	32.38	650.22	Open hole - jetted dry
19 Nov 81	10:00	33.52	652.08	
20 Nov 81	8:31	33.57	652.03	
22 Nov 81	9:04	35.42	650.18	
23 Nov 81	10:35	35.13	650.47	
24 Nov 81	10:14	34.26	651.34	
25 Nov 81	3:20	35.35	650.25	
27 Nov 81	9:00	35.27	650.33	
30 Nov 81	10:48	36.25	649.35	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-2-81

Top of Pipe Elevation: 640.53 ft MSL

Screen Interval: from 613.27 to 603.65 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
21 Sep 81	1:55	24.40	613.13	Open hole
22 Sep 81	10:30	27.31	613.22	
23 Sep 81	3:35	27.55	612.98	
24 Sep 81	2:50	27.64	612.89	
25 Sep 81	7:25	27.69	612.84	
26 Sep 81	7:00	27.49	613.04	
27 Sep 81	2:10	27.49	613.04	
2 Oct 81	8:50	27.65	612.88	
9 Oct 81	12:45	27.55	612.98	
16 Oct 81	11:50	27.95	612.58	
23 Oct 81	3:02	28.11	612.42	
30 Oct 81	10:31	28.29	612.24	
6 Nov 81	3:05	28.15	612.38	
13 Nov 81	9:39	28.54	611.99	
15 Nov 81	8:21	28.36	612.17	Blew dry
16 Nov 81	7:29	28.21	612.32	
20 Nov 81	4:14	28.30	612.23	
27 Nov 81	8:52	28.51	612.02	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-3-81

Top of Pipe Elevation: 662.77 ft MSL

Screen Interval: from 654.27 to 645.07 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
22 Sep 81	9:01	10.6	649.17	Open hole
23 Sep 81	3:40	13.57	649.20	
24 Sep 81	2:50	13.58	649.19	
25 Sep 81	7:30	13.42	649.35	
26 Sep 81	7:05	13.42	649.35	
27 Sep 81	2:20	13.50	649.27	
28 Sep 81	5:05	13.66	649.11	
2 Oct 81	8:55	13.63	649.14	
9 Oct 81	12:29	13.61	649.16	
16 Oct 81	12:59	13.83	648.94	
23 Oct 81	3:39	14.31	648.46	
30 Oct 81	10:09	14.39	648.38	
6 Nov 81	2:25	14.22	648.55	
13 Nov 81	5:11	14.50	648.27	
15 Nov 81	7:46	14.43	648.34	Blew dry
16 Nov 81	7:15	14.12	648.65	
20 Nov 81	3:40	14.58	648.19	
27 Nov 81	8:21	14.76	648.01	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-4-81

Top of Pipe Elevation: 635.89 ft MSL

Screen Interval: from 617.50 to 608.62 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
2 Oct 81	8:50	19.50	613.39	Open hole
3 Oct 81	9:45	23.45	612.44	
4 Oct 81	11:01	23.45	612.44	
5 Oct 81	9:20	23.59	612.30	
6 Oct 81	12:00	23.52	612.37	
7 Oct 81	4:45	23.67	612.22	
8 Oct 81	11:30	23.72	612.17	
9 Oct 81	12:40	23.54	612.35	
16 Oct 81	12:05	23.90	611.99	
23 Oct 81	3:33	24.25	611.64	
30 Oct 81	10:19	24.40	611.49	
6 Nov 81	2:30	24.30	611.59	
13 Nov 81	5:22	24.45	611.44	
15 Nov 81	7:56	24.30	611.59	Blew dry
20 Nov 81	3:48	24.35	611.59	
27 Nov 81	8:27	24.48	611.41	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-5-81

Top of Pipe Elevation: 610.89 ft MSL

Screen Interval: from 595.35 to 586.21 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
3 Oct 81	1:15	19.90	590.99	
4 Oct 81	11:08	17.54	593.35	
5 Oct 81	9:31	17.45	593.44	
6 Oct 81	12:06	17.25	593.64	
7 Oct 81	4:50	17.09	593.80	
8 Oct 81	11:35	17.02	593.87	
9 Oct 81	12:56	17.02	593.87	
16 Oct 81	11:55	17.00	593.89	
23 Oct 81	3:10	17.15	593.74	
30 Oct 81	10:32	17.25	593.64	
6 Nov 81	3:02	17.18	593.71	
13 Nov 81	5:44	17.17	593.72	
15 Nov 81	8:15	17.14	593.75	Blew dry
16 Nov 81	7:27	17.24	593.65	
20 Nov 81	4:10	17.28	593.61	
27 Nov 81	8:47	16.81	594.08	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-6-81

Top of Pipe Elevation: 675.06 ft MSL

Screen Interval: from 624.41 to 615.13 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
15 Oct 81	12:36	46.56	628.50	
16 Oct 81	12:25	46.10	628.96	
17 Oct 81	3:44	46.60	628.46	
18 Oct 81	3:38	45.54	629.52	
19 Oct 81	9:59	45.14	629.92	
20 Oct 81	9:44	45.79	629.27	
21 Oct 81	10:12	45.74	629.32	
23 Oct 81	3:53	45.76	629.30	
30 Oct 81	10:45	45.61	629.45	
6 Nov 81	3:15	45.48	629.58	
13 Nov 81	5:52	45.52	629.54	
15 Nov 81	8:41	45.24	629.82	Blew dry
16 Nov 81	8:10	45.42	629.64	
20 Nov 81	5:29	45.37	629.69	
27 Nov 81	9:07	45.26	629.80	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-7-81

Top of Pipe Elevation: 663.92 ft MSL

Screen Interval: from 646.50 to 637.26 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
15 Oct 81	12:35	18.10	645.82	
17 Oct 81	3:49	18.15	645.77	
18 Oct 81	3:45	18.73	645.19	
19 Oct 81	10:01	18.43	645.49	
20 Oct 81	9:50	18.44	645.48	
21 Oct 81	10:20	18.36	645.56	
22 Oct 81	12:59	18.36	645.56	
23 Oct 81	3:56	18.54	645.38	
30 Oct 81	10:50	18.81	645.11	
6 Nov 81	3:31	18.55	645.37	
13 Nov 81	6:04	18.60	645.32	
15 Nov 81	9:25	18.45	645.47	Blew dry
16 Nov 81	8:20	18.45	645.47	
20 Nov 81	5:43	18.42	645.50	
27 Nov 81	9:34	18.36	645.56	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-8-81

Top of Pipe Elevation: 641.72 ft MSL

Screen Interval: from 625.71 to 616.59 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
16 Oct 81	12:31	11.10	630.62	
17 Oct 81	3:52	11.79	629.93	
18 Oct 81	3:55	11.60	630.12	
19 Oct 81	10:07	11.23	630.49	
20 Oct 81	9:46	11.22	630.50	
21 Oct 81	10:15	11.18	630.54	
22 Oct 81	1:01	11.21	630.51	
23 Oct 81	3:59	11.31	630.41	
30 Oct 81	10:47	11.02	630.70	
6 Nov 81	3:23	10.90	630.82	
13 Nov 81	6:01	10.40	631.32	
15 Nov 81	9:08	10.34	631.38	Blew dry
16 Nov 81	8:31	10.12	631.60	
20 Nov 81	5:37	10.18	631.54	
27 Nov 81	9:39	9.66	632.06	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-9-81

Top of Pipe Elevation: 634.04 ft MSL

Screen Interval: from 605.87 to 596.74 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
17 Oct 81	3:33	25.71	608.33	
18 Oct 81	3:32	25.62	608.42	
19 Oct 81	9:49	25.79	608.25	
20 Oct 81	9:39	26.06	607.98	
21 Oct 81	10:04	25.94	608.10	
22 Oct 81	12:54	26.00	608.04	
23 Oct 81	3:14	25.98	608.06	
30 Oct 81	10:30	26.00	608.04	
6 Nov 81	2:58	26.05	607.99	
13 Nov 81	5:34	26.34	607.70	
15 Nov 81	8:05	26.16	607.88	Blew dry
16 Nov 81	7:24	26.19	607.85	
20 Nov 81	4:05	26.10	607.94	
27 Nov 81	8:44	26.25	607.79	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-10-81

Top of Pipe Elevation: 662.10 ft MSL

Screen Interval: from 641.80 to 632.41 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
20 Oct 81	9:31	22.19	639.91	
21 Oct 81	9:58	22.20	639.90	
22 Oct 81	12:45	22.26	639.84	
23 Oct 81	3:19	22.25	639.85	
24 Oct 81	11:04	22.24	639.86	
25 Oct 81	4:45	22.26	639.84	
26 Oct 81	8:10	22.28	639.82	
30 Oct 81	10:26	22.35	639.75	
6 Nov 81	2:53	22.70	639.40	
13 Nov 81	5:28	22.63	639.47	
15 Nov 81	8:03	22.59	639.51	Blew dry
16 Nov 81	7:22	22.56	639.54	
20 Nov 81	4:02	22.61	639.49	
27 Nov 81	8:40	22.72	639.38	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-11-81

Top of Pipe Elevation: 660.43 ft MSL

Screen Interval: from 641.17 to 632.25 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
18 Oct 81	3:20	14.18	646.25	
19 Oct 81	9:45	14.14	646.29	
20 Oct 81	9:36	14.12	646.31	
21 Oct 81	9:59	14.18	646.25	
22 Oct 81	12:48	14.06	646.37	
23 Oct 81	3:23	14.11	646.32	
24 Oct 81	11:07	14.15	646.28	
30 Oct 81	10:24	14.12	646.31	
6 Nov 81	2:55	14.05	646.38	
13 Nov 81	5:21	14.14	646.29	
15 Nov 81	7:59	14.10	646.33	Blew dry
16 Nov 81	7:18	16.26	644.17	
20 Nov 81	3:58	14.40	646.03	
27 Nov 81	8:34	14.41	646.02	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-12-81

Top of Pipe Elevation: 670.28 ft MSL

Screen Interval: from 630.11 to 620.96 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
5 Nov 81	12:55	39.65	630.63	
6 Nov 81	3:17	39.36	630.92	
7 Nov 81	8:20	39.60	630.68	
8 Nov 81	12:07	39.38	630.90	
9 Nov 81	5:05	39.62	630.66	
10 Nov 81	11:10	39.67	630.61	
11 Nov 81	2:17	39.50	630.78	
13 Nov 81	5:55	39.45	630.83	
15 Nov 81	8:59	39.20	631.08	Blew dry
16 Nov 81	8:23	39.12	631.16	
20 Nov 81	5:32	39.25	631.03	
27 Nov 81	9:10	39.25	631.03	

Groundwater Elevations

Demolition Area

Boring Number: WES-6-13-81

Top of Pipe Elevation: 663.41 ft MSL

Screen Interval: from 622.86 to 613.75 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
6 Nov 81	3:21	54.93	605.48	No water
7 Nov 81	8:25	47.44	612.97	
8 Nov 81	12:11	40.76	619.65	
9 Nov 81	5:10	35.90	624.51	
10 Nov 81	11:17	34.64	625.77	
11 Nov 81	2:20	34.53	625.88	
12 Nov 81	3:30	32.95	627.46	
13 Nov 81	5:57	32.18	628.23	
15 Nov 81	9:20	31.40	632.01	Blew dry
16 Nov 81	8:28	39.12	621.29	
20 Nov 81	5:35	32.65	630.76	
27 Nov 81	9:13	30.72	632.69	
30 Nov 81	10:56	30.50	632.91	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-14-81

Top of Pipe Elevation: 508.06 ft MSL

Screen Interval: from 502.06 to 492.89 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
28 Oct 81	4:35	5.57	502.49	
29 Oct 81	9:21	5.60	502.46	
30 Oct 81	4:10	5.64	502.42	
31 Oct 81	7:40	5.70	502.36	
1 Nov 81	10:30	5.75	502.31	
2 Nov 81	10:59	5.78	502.28	
3 Nov 81	1:49	5.85	502.21	
6 Nov 81	10:44	5.90	502.16	
13 Nov 81	1:31	5.19	502.87	
15 Nov 81	3:34	5.35	502.71	Blew dry
16 Nov 81	10:53	5.30	502.76	
20 Nov 81	10:34	3.54	504.52	
27 Nov 81	10:07	3.65	504.41	

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-14-81

Top of Pipe Elevation: 508.06 ft MSL

Screen Interval Elevation: from 502.06 to 492.89 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	8:03	2.48	505.58	
20 Jun 83	8:41	2.73	505.33	
30 Jun 83	4:50	4.65	503.41	
7 Jul 83	1:08	4.25	503.81	
15 Jul 83	9:08	4.97	503.09	Bentonite in well
18 Jul 83				Blew well-screen is broken
2 Aug 83	3:40	4.50	503.56	
8 Aug 83	2:16	4.73	503.33	
9 Aug 83	8:14	4.76	503.30	
10 Aug 83	1:15	4.80	503.26	
11 Aug 83	2:46	5:00	503.06	
12 Aug 83	9:17	5.09	502.97	
13 Aug 83	9:56	5.12	502.94	
16 Aug 83	8:30	5.48	502.58	
23 Aug 83	9:30	6.03	502.03	
30 Aug 83	10:10	6.38	501.68	
6 Sep 83	2:03	6.75	501.31	
13 Sep 83	4:42	6.89	501.17	
20 Sep 83	8:21	7.07	500.99	
28 Sep 83				Removed well and grouted

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-14A-83

Top of Pipe Elevation: 508.87 ft MSL

Screen Interval Elevation: from 499.58 to 490.48 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
8 Aug 83	2:15	5.00	503.87	
9 Aug 83	8:14	5.11	503.76	
10 Aug 83	1:14	5.37	503.50	
11 Aug 83	2:46	5.34	503.53	
12 Aug 83	9:18	5.48	503.39	
13 Aug 83	9:57	5.56	503.31	
16 Aug 83	8:30	5.93	502.94	
23 Aug 83	9:29	6.54	502.33	
30 Aug 83	10:11	6.72	502.15	
6 Sep 83	2:02	7.00	501.87	
13 Sep 83	4:42	7.25	501.62	
20 Sep 83	8:21	7.83	501.04	
6 Oct 83	11:34	6.58	502.29	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-15-81

Top of Pipe Elevation: 513.42 ft MSL

Screen Interval: from 507.86 to 498.75 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
1 Nov 81	10:35	14.40	499.02	
2 Nov 81	11:25	14.30	499.12	
3 Nov 81	1:45	14.69*	498.73	
4 Nov 81	10:31	14.77*	498.65	
5 Nov 81	10:12	14.73*	498.69	
6 Nov 81	10:55	14.74*	498.68	
7 Nov 81	10:58	14.74*	498.68	
9 Nov 81				Blew well and rinsed with clean water
10 Nov 81	11:33	—	—	No water
13 Nov 81	4:31	—	—	" "
15 Nov 81	2:35	—	—	" "
17 Nov 81	5:15	—	—	" "
20 Nov 81	10:22	15.50*	497.92	
27 Nov 81	10:26	13.51	499.91	

* Water level below screen

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-15-81

Top of Pipe Elevation: 513.42 ft MSL

Screen Interval Elevation: from 507.86 to 498.75 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	7:51	9.28	504.14	
20 Jun 83	8:49	9.85	503.57	
30 Jun 83	4:40	10.35	503.07	
7 Jul 83	1:21	11.30	502.12	
15 Jul 83	8:53	11.75	501.67	
2 Aug 83	3:10	12.78	500.64	ERG Purged well
9 Aug 83	8:25	12.34	501.08	
16 Aug 83	8:44	13.00	500.42	
23 Aug 83	8:43	13.28	500.14	
30 Aug 81	10:28	13.49	499.93	
6 Sep 83	2:16	13.58	499.84	
13 Sep 83	4:51	13.70	499.72	
20 Sep 83	8:40	14.74	498.68	
6 Oct 83	11:41	13.75	499.67	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-16-81

Top of Pipe Elevation: 530.88 ft MSL

Screen Interval: from 497.35 to 488.29 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
4 Nov 81	10:43	29.74	498.14	Open hole
5 Nov 81	10:07	32.76	498.12	
6 Nov 81	10:47	32.80	498.08	
7 Nov 81	11:02	32.95	497.93	
8 Nov 81	11:58	32.70	498.18	
9 Nov 81	2:42	32.84	498.04	
10 Nov 81	11:30	32.75	498.13	
11 Nov 81	2:45	32.80	498.08	
13 Nov 81	1:36	32.60	498.28	
15 Nov 81	3:30	32.51	498.37	Blew dry
16 Nov 81	10:45	32.20	498.68	
20 Nov 81	10:27	32.11	498.77	
27 Nov 81	10:16	31.60	499.28	

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-16-81

Top of Pipe Elevation: 530.88 ft MSL

Screen Interval Elevation: from 497.35 to 488.29 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	7:45	24.20	506.68	
20 Jun 83	8:15	26.25	504.63	
30 Jun 83	4:56	27.55	503.33	
7 Jul 83	1:01	28.76	502.12	
15 Jul 83	8:56	29.00	501.88	
2 Aug 83	2:56	29.85	501.03	ERG Purged well
9 Aug 83	8:10	29.98	500.90	
16 Aug 83	8:26	30.54	500.34	
23 Aug 83	9:26	31.00	499.88	
30 Aug 83	10:06	31.18	499.70	
6 Sep 83	2:00	31.28	499.60	
13 Sep 83	4:39	31.62	499.26	
20 Sep 83	8:17	31.89	498.99	
6 Oct 83	11:32	32.52	498.36	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-17-81

Top of Pipe Elevation: 513.73 ft MSL

Screen Interval: from 502.88 to 493.54 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
12 Nov 81	3:39	15.44	498.29	
13 Nov 81	1:35	15.49	498.24	
15 Nov 81	2:33	15.12	498.61	Blew dry
16 Nov 81	10:30	15.00	498.73	
17 Nov 81	5:19	15.15	498.58	
18 Nov 81	11:35	15.22	498.51	
19 Nov 81	2:35	14.80	498.93	
20 Nov 81	10:21	15.02	498.71	
24 Nov 81	10:21	14.27	499.46	
27 Nov 81	10:23	14.12	499.61	
29 Nov 81	11:25	13.96	499.77	

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-17-81

Top of Pipe Elevation: 513.73 ft MSL

Screen Interval Elevation: from 502.88 to 493.54 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	7:49	9.73	504.00	
20 Jun 83	8:49	10.20	503.53	
30 Jun 83	4:39	10.55	503.18	
7 Jul 83	1:21	11.70	502.03	
15 Jul 83	8:51	12.20	501.53	
2 Aug 83	3:10	13.40	500.33	ERG Purged well
9 Aug 83	8:24	12.73	501.00	
16 Aug 83	8:43	13.58	500.15	
23 Aug 83	8:42	13.68	500.05	
30 Aug 83	10:27	13.89	499.84	
6 Sep 83	2:15	14.25	499.48	
13 Sep 83	4:52	15.00	498.73	
20 Sep 83	8:39	14.92	498.81	
6 Oct 83	11:42	15.46	498.27	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-18-81

Top of Pipe Elevation: 511.03 ft MSL

Screen Interval: from 496.43 to 487.16 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
18 Nov 81	11:38	14.22	496.88	
19 Nov 81	2:38	14.00	497.03	
20 Nov 81	10:31	13.88	497.15	
22 Nov 81	9:13	13.66	497.37	
23 Nov 81	9:09	13.59	497.44	
24 Nov 81	10:24	13.38	497.65	
25 Nov 81	11:07	13.41	497.62	
27 Nov 81	10:13	13.42	497.61	
29 Nov 81	11:22	13.30	497.73	
6 Dec 81	9:20	12.75	498.28	Readings by NWSC

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-18-81

Top of Pipe Elevation: 511.03 ft MSL

Screen Interval Elevation: from 496.43 to 487.16 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	7:57	9.78	501.25	
20 Jun 83	8:36	10.35	500.68	
30 Jun 83	4:46	10.96	500.07	
7 Jul 83	1:15	11.61	499.42	
15 Jul 83	9:00	11.86	499.17	
2 Aug 83	3:34	12.72	498.31	ERG Purged Well
9 Aug 83	8:19	12.42	498.61	
16 Aug 83	8:38	12.76	498.27	
23 Aug 83	9:36	13.30	497.73	
30 Aug 83	10:16	13.42	497.61	
6 Sep 83	2:09	13.63	497.40	
13 Sep 83	4:46	13.90	497.13	
20 Sep 83	8:24	14.10	496.93	
6 Oct 83	11:39	14.51	496.52	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-19-81

Top of Pipe Elevation: 506.42 ft MSL

Screen Interval: from 498.16 to 488.87 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
25 Nov 81	11:00	8.28	498.14	
26 Nov 81	3:59	7.94	498.48	
27 Nov 81	10:10	8.11	498.31	
29 Nov 81	11:20	7.85	498.57	
30 Nov 81	10:40	7.99	498.43	
6 Dec 81	9:25	8.08	498.34	Readings by NWSC
3 Jan 82	10:30	6.80	499.62	Readings by NWSC
1 Mar 82	10:00	6.50	499.92	Readings by NWSC

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-19-81

Top of Pipe Elevation: 506.42 ft MSL

Screen Interval Elevation: from 498.16 to 488.87 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	8:00	4.51	501.91	
20 Jun 83	8:38	3.22	503.20	
30 Jun 83	4:48	5.65	500.77	
7 Jul 83	1:12	6.57	499.85	
15 Jul 83	9:02	6.75	499.67	
2 Aug 83	3:36	10.65	495.77	ERG Purged Well
9 Aug 83	8:16	7.42	499.00	
16 Aug 83	8:34	7.96	498.46	
23 Aug 83	9:33	8.35	498.07	
30 Aug 83	10:33	8.77	497.65	
6 Sep 83	2:07	8.77	497.65	
13 Sep 83	4:45	9.14	497.28	
20 Sep 83	8:27	9.32	497.10	
6 Oct 83	11:36	9.88	496.54	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-20-81

Top of Pipe Elevation: 518.68 ft MSL

Screen Interval: from 499.74 to 490.60 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
26 Nov 81	4:02	19.85	498.83	
27 Nov 81	10:20	20.29	498.39	
29 Nov 81	11:23	20.12	498.56	
30 Nov 81	10:37	19.91	498.77	
6 Dec 81	9:30	19.67	499.01	Readings by NWSC
3 Jan 82	9:55	18.10	500.58	Readings by NWSC
1 Mar 82	8:15	17.0	501.68	Readings by NWSC

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-20-81

Top of Pipe Elevation: 518.68 ft MSL

Screen Interval Elevation: from 499.74 to 490.60 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
11 Jun 83	7:54	16.23	502.45	
20 Jun 83	8:33	16.85	501.83	
30 Jun 83	4:43	17.34	501.34	
7 Jul 83	1:18	17.97	500.71	
15 Jul 83	8:58	18.00	500.68	
2 Aug 83	3:31	19.40	499.28	ERG Purged Well
9 Aug 83	8:21	18.95	499.73	
16 Aug 83	8:40	19.58	499.10	
23 Aug 83	9:39	19.76	498.92	
30 Aug 83	10:19	19.92	498.76	
6 Sep 83	2:11	20.24	498.44	
13 Sep 83	4:48	20.63	498.05	
20 Sep 83	8:32	20.80	497.88	
6 Oct 83	11:45	21.22	497.46	

Groundwater Elevations

Old Rifle Range

Boring Number: WES-6-21-83

Top of Pipe Elevation: 578.27 ft MSL

Screen Interval Elevation: from 541.77 to 532.67 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
18 Jul 83	10:00	33.28	544.99	
20 Jul 83	9:21	33.42	544.85	
21 Jul 83	3:44	33.50	544.77	
22 Jul 83	3:33	33.51	544.76	
23 Jul 83	12:04	33.52	544.75	
25 Jul 83	10:24	33.62	544.65	
26 Jul 83	11:01	33.65	544.62	
2 Aug 83	2:52	34.08	544.19	
9 Aug 83	8:07	34.23	544.04	
16 Aug 83	8:23	34.34	543.93	
23 Aug 83	9:20	34.71	543.56	
30 Aug 83	10:03	34.90	543.37	
6 Sep 83	1:57	34.98	543.29	
13 Sep 83	4:36	35.22	543.05	
20 Sep 83	8:14	35.39	542.88	
6 Oct 83	11:29	35.70	542.57	

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-22-83

Top of Pipe Elevation: 510.64 ft MSL

Screen Interval Elevation: from 496.32 to 487.19 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
26 Aug 83	7:47	11.22	499.42	
29 Aug 83	12:24	12.34	498.30	
30 Aug 83	10:21	12.44	498.20	
31 Aug 83	2:24	12.40	498.24	
1 Sep 83	11:32	12.34	498.30	
2 Sep 83	8:37	12.56	498.08	
3 Sep 83	10:07	12.52	498.12	
6 Sep 83	2:13	12.56	498.08	
13 Sep 83	4:49	12.91	497.73	
20 Sep 83	8:35	13.03	497.61	
6 Oct 83	11:47	13.53	497.11	

Ground-Water Elevations

Old Rifle Range

Boring Number: WES-6-23-83

Top of Pipe Elevation: 509.41 ft MSL

Screen Interval Elevation: from 494.86 to 485.76 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
1 Oct 83	7:21	12.30	497.11	
3 Oct 83	1:22	12.33	497.08	
4 Oct 83	4:06	12.34	497.07	
5 Oct 83	3:54	12.30	497.11	
6 Oct 83	11:51	12.64	496.77	
10 Oct 83	7:43	12.43	496.98	

Ground-Water Elevations

Old Rifle Range

Boring Number: EPA-1-83

Ground Elevation: 525.62 ft MSL

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
13 Jun 83	10:34	14.3	511.32	
14 Jun 83	1:05	14.6	511.02	
15 Jun 83	1:45	15.2	510.42	
16 Jun 83	11:41	15.50	510.12	
17 Jun 83	10:38	15.68	509.94	
20 Jun 83	8:21	16.72	508.90	
22 Jun 83				Caved In
30 Jul 83				Grouted Boring

Ground-Water Elevations

Old Rifle Range

Boring Number: EPA-2-83

Ground Elevation: 530.91 ft MSL

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
14 Jun 83	1:08	21.70	509.21	
15 Jun 83	1:48	21.74	509.17	
16 Jun 83	11:39	22.14	508.77	
17 Jun 83	10:28	22.30	508.61	
20 Jun 83	8:19	22.85	508.06	
22 Jun 83	11:40	23.15	507.76	
25 Jun 83	1:35	23.32	507.59	
30 Jun 83	4:32	24.05	506.86	
7 Jul 83	12:50	24.75	506.16	
15 Jul 83				Caved In
23 Jul 83				Grouted Boring

Ground-Water Elevations

Old Rifle Range

Boring Number: EPA-3-83

Ground Elevation: 523.20 ft MSL

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
15 Jun 83	1:50	16.0	507.30	
16 Jun 83	11:36	16.34	506.86	
17 Jun 83	10:25	16.70	506.50	
20 Jun 83	8:13	17.37	505.83	
22 Jun 83	11:38	17.70	505.50	
25 Jun 83	1:47	18.08	505.12	
30 Jun 83	4:31	18.80	504.40	
7 Jul 83	12:58	19.60	503.60	
15 Jul 83	8:31	20.70	503.50	
30 Jul 83	8:00	22.00	501.00	
30 Jul 83				Grouted Boring

Ground-Water Elevations

Old Rifle Range

Boring Number: EPA-4-83

Ground Elevation: 521.89 ft MSL

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
16 Jun 83	11:47	14.70	507.19	
17 Jun 83	10:33	14.80	507.09	
20 Jun 83	8:25	16.43	505.46	
22 Jun 83	11:42	15.70	506.19	
25 Jun 83	1:39	15.72	506.17	
30 Jun 83	4:34	16.42	505.47	
7 Jul 83	12:54	18.65	503.24	
15 Jul 83	8:35	17.95	503.94	
23 Jul 83				Grouted Boring

Ground-Water Elevations

Old Rifle Range

Boring Number: EPA-5-83

Ground Elevation: 521.16 ft MSL

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
17 Jun 83	10:35	16.50	504.66	
20 Jun 83	8:29	16.80	504.36	
22 Jun 83	11:45	16.50	504.66	
25 Jun 83	1:42	17.05	504.11	
30 Jun 83	4:37	18.35	502.81	
7 Jul 83				Caved In
30 Jul 83				Grouted Boring

Groundwater Elevations

Rockeye Site

Boring Number: WES-10-1-81

Top of Pipe Elevation: 620.80 ft MSL

Screen Interval: 601.42 to 592.60 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
22 Nov 81	10:45	17.69	603.11	
23 Nov 81	3:05	18.00	602.80	
24 Nov 81	9:58	14.94	605.86	
25 Nov 81	4:15	18.07	602.73	
26 Nov 81	4:32	17.70	603.10	
27 Nov 81	3:17	17.66	603.14	
29 Nov 81	1:12	17.95	602.85	

Groundwater Elevations

Rockeye Site

Boring Number: WES-10-2-81

Top of Pipe Elevation: 621.51 ft MSL

Screen Interval: 607.93 to 598.71 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
23 Nov 81	3:10	19.46	602.05	
24 Nov 81	9:55	14.94	606.57	
25 Nov 81	4:12	19.85	601.66	
26 Nov 81	4:30	19.83	601.68	
27 Nov 81	3:14	19.85	601.66	
29 Nov 81	1:14	20.16	601.35	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-3-83

Top of Pipe Elevation: 811.13 ft MSL

Screen Interval Elevation: from 793.30 to 783.98 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
2 Jul 83	7:50	12.15	795.98	Open hole
4 Jul 83	8:40	11.95	796.18	Open hole
5 Jul 83	11:11	12.00	796.13	Open hole
6 Jul 83	8:57	15.30	795.83	
7 Jul 83	3:23	15.32	795.81	
8 Jul 83	11:29	15.42	795.71	
9 Jul 83	7:16	15.21	795.92	
11 Jul 83	4:00	15.20	795.93	
12 Jul 83	10:52	15.22	795.91	Sampled well
13 Jul 83	8:07	15.38	795.75	
20 Jul 83	3:04	15.33	795.80	
27 Jul 83	9:36	15.55	795.58	
3 Aug 83	7:39	15.65	795.48	
10 Aug 83	9:42	15.53	795.60	
17 Aug 83	8:22	15.53	795.60	
24 Aug 83	9:55	15.86	795.27	
31 Aug 83	12:32	15.59	795.54	
6 Sep 83	11:27	15.55	795.58	
14 Sep 83	1:55	15.03	796.10	
21 Sep 83	12:01	16.11	795.02	
28 Sep 83	2:22	16.13	795.00	
6 Oct 83	9:21	16.28	794.85	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-4-83

Top of Pipe Elevation: 830.90 ft MSL

Screen Interval Elevation: from 802.10 to 793.07 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
4 Jul 83	8:45	11.45	816.45	Open hole
5 Jul 83	10:47	11.34	816.56	Open hole
6 Jul 83	8:45	14.52	816.38	
7 Jul 83	3:28	15.40	815.50	Purged well
8 Jul 83	11:16	14.67	816.23	
9 Jul 83	7:21	14.61	816.29	
11 Jul 83	3:56	14.38	816.52	
12 Jul 83	10:33	14.71	816.19	Sampled well
13 Jul 83	8:12	14.50	816.40	
20 Jul 83	3:14	14.53	816.37	
27 Jul 83	9:32	14.46	816.44	
3 Aug 83	8:20	14.50	816.40	
10 Aug 83	9:53	14.39	816.51	
17 Aug 83	8:32	14.55	816.35	
24 Aug 83	10:05	14.58	816.32	
1 Sep 83	8:23	14.43	816.47	
6 Sep 83	11:43	14.38	816.52	
14 Sep 83	1:38	14.88	816.02	
21 Sep 83	12:51	14.90	816.00	
28 Sep 83	2:46	15.00	815.90	
6 Oct 83	9:04	15.00	815.90	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-5-83

Top of Pipe Elevation: 831.39 ft MSL

Screen Interval Elevation: from 807.91 to 798.57 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
6 Jul 83	2:09	16.82	814.57	
7 Jul 83	3:37	17.42	813.97	Purged well
8 Jul 83	11:00	17.40	813.99	
9 Jul 83	7:25	17.25	814.14	
11 Jul 83	3:52	17.55	813.84	
12 Jul 83	11:52	17.58	813.81	Sampled well
13 Jul 83	8:14	17.68	813.71	
20 Jul 83	3:17	18.32	813.07	
27 Jul 83	9:29	18.52	812.87	
3 Aug 83	8:23	18.43	812.96	
10 Aug 83	9:55	18.41	812.98	
17 Aug 83	8:36	18.47	812.92	
24 Aug 83	10:09	18.84	812.55	
1 Sep 83	2:03	18.72	812.67	
6 Sep 83	11:46	18.81	812.58	
14 Sep 83	1:35	19.21	812.18	
21 Sep 83	10:30	19.43	811.96	
28 Sep 83	1:39	19.57	811.82	
6 Oct 83	9:37	19.65	811.74	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-6-83

Top of Pipe Elevation: 811.40 ft MSL

Screen Interval Elevation: from 792.75 to 783.45 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
7 Jul 83	3:36	13.55	797.85	
8 Jul 83	11:20	13.35	798.05	
9 Jul 83	7:28	13.24	798.16	
11 Jul 83	3:46	13.35	798.05	
12 Jul 83	12:12	13.26	798.14	Sampled well
13 Jul 83	8:25	13.53	797.87	
20 Jul 83	3:25	13.41	797.99	
27 Jul 83	9:12	13.66	797.74	
3 Aug 83	8:30	13.66	797.74	
10 Aug 83	10:01	13.72	797.68	
17 Aug 83	8:42	13.79	797.61	
24 Aug 83	10:15	14.03	797.37	
31 Aug 83	9:16	13.74	797.66	
6 Sep 83	11:57	14.00	797.40	
14 Sep 83	1:13	14.40	797.00	
21 Sep 83	10:51	14.35	797.05	
28 Sep 83	2:04	14.48	796.92	
6 Oct 83	9:51	14.58	796.82	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-7-83

Top of Pipe Elevation: 788.90 ft MSL

Screen Interval Elevation: from 781.05 to 771.94 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
13 Jul 83	8:27	2.10	783.80	Open hole
14 Jul 83	3:31	5.40	783.50	
15 Jul 83	7:22	4.30	784.60	
16 Jul 83	5:05	4.62	784.28	
18 Jul 83	9:15	4.50	784.40	
19 Jul 83	3:20	4.60	784.30	
20 Jul 83	3:23	4.58	784.32	
21 Jul 83	9:54	4.69	784.21	
22 Jul 83	3:50	4.21	784.69	
27 Jul 83	9:05	4.68	784.22	Sample well
3 Aug 83	8:27	3.22	785.68	
10 Aug 83	9:59	4.02	784.88	
17 Aug 83	8:40	4.72	784.18	
24 Aug 83	10:11	4.00	784.90	
31 Aug 83	9:20	3.94	784.96	
6 Sep 83	11:54	5.00	783.90	Sampled well
14 Sep 83	1:24	4.04	784.86	
21 Sep 83	10:40	3.65	785.25	
28 Sep 83	1:53	5.29	783.61	
6 Oct 83	9:47	3.34	785.56	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-8-83

Top of Pipe Elevation: 790.14 ft MSL

Screen Interval Elevation: from 782.31 to 773.19 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
14 Jul 83	3:34	5.83	784.31	
15 Jul 83	9:20	5.85	784.29	
16 Jul 83	5:06	6.01	784.13	
18 Jul 83	9:14	6.18	783.96	
19 Jul 83	3:20	6.15	783.99	
20 Jul 83	3:21	6.21	783.93	
21 Jul 83	9:53	6.30	783.84	
22 Jul 83	3:49	5.83	784.31	
27 Jul 83	9:06	6.35	783.79	Sampled well
3 Aug 83	8:26	4.55	785.59	
10 Aug 83	9:58	5.55	784.59	
17 Aug 83	8:39	6.29	783.85	
24 Aug 83	10:12	5.56	784.58	
31 Aug 83	9:21	5.60	784.54	
6 Sep 83	11:55	7.30	782.84	Sampled well
14 Sep 83	1:25	5.46	784.68	
21 Sep 83	10:39	5.10	785.04	
28 Sep 83	1:51	6.79	783.35	
6 Oct 83	9:48	4.68	785.46	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-9-83

Top of Pipe Elevation: 789.13 ft MSL

Screen Interval Elevation: from 766.68 to 757.08 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
15 Jul 83	9:36	13.55	772.58	Open hole
16 Jul 83	4:48	16.57	772.56	
18 Jul 83	9:35	16.64	772.49	
19 Jul 83	3:25	16.78	772.35	
20 Jul 83	3:09	16.74	772.39	
21 Jul 83	9:46	16.68	772.45	
22 Jul 83	3:44	16.75	772.38	
23 Jul 83	7:02	16.75	772.38	
27 Jul 83	9:41	16.88	772.25	Sampled well
3 Aug 83	8:16	17.03	772.10	
10 Aug 83	9:47	17.18	771.95	
17 Aug 83	8:28	17.27	771.86	
24 Aug 83	10:00	17.47	771.66	
31 Aug 83	2:36	17.46	771.67	
6 Sep 83	11:36	17.57	771.56	Sampled well
14 Sep 83	1:45	17.93	771.20	
21 Sep 83	1:03	17.94	771.19	
28 Sep 83	2:39	18.03	771.10	
6 Oct 83	9:08	18.07	771.06	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-10-83

Top of Pipe Elevation: 784.86 ft MSL

Screen Interval Elevation: from 768.91 to 759.69 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
16 Jul 83	4:50	12.00	772.86	
18 Jul 83	9:36	12.08	772.78	
19 Jul 83	3:25	12.19	772.67	
20 Jul 83	3:10	11.98	772.88	
21 Jul 83	9:47	12.13	772.73	
22 Jul 83	3:45	12.08	772.78	
23 Jul 83	7:06	12.31	772.55	
27 Jul 83	9:42	12.64	772.22	Sampled well
3 Aug 83	8:12	12.36	772.50	
10 Aug 83	9:48	12.61	772.25	
17 Aug 83	8:28	12.73	772.13	
24 Aug 83	10:01	12.86	772.00	
31 Aug 83	12:37	12.83	772.03	
6 Sep 83	11:38	13.03	771.83	Sampled well
14 Sep 83	1:44	13.32	771.54	
21 Sep 83	1:02	13.35	771.51	
28 Sep 83	2:39	13.60	771.26	
6 Oct 83	9:11	13.50	771.36	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-11-83

Top of Pipe Elevation: 807.66 ft MSL

Screen Interval Elevation: from 796.70 to 787.58 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
31 Aug 83	8:54	5.95	801.71	
1 Sep 83	2:06	6.00	801.66	
2 Sep 83	9:15	6.12	801.54	
3 Sep 83	10:57	6.15	801.51	
5 Sep 83	8:20	6.30	801.36	
6 Sep 83	11:49	6.33	801.33	
7 Sep 83	8:25	6.20	801.46	Sampled well
14 Sep 83	1:33	6.20	801.46	
21 Sep 83	10:32	6.22	801.44	
28 Sep 83	1:41	6.62	801.04	
6 Oct 83	9:38	5.86	801.80	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-12-83

Top of Pipe Elevation: 825.35 ft MSL

Screen Interval Elevation: from 802.00 to 792.83 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
31 Aug 83	8:35	30.1	795.25	
1 Sep 83	2:16	25.00	800.35	
2 Sep 83	9:13	24.75	800.60	
3 Sep 83	11:02	24.64	800.71	
5 Sep 83	8:24	24.58	800.77	
6 Sep 83	11:51	24.68	800.67	
7 Sep 83	8:27	24.81	800.54	Sampled well
14 Sep 83	1:31	24.95	800.40	
21 Sep 83	10:34	25.11	800.24	
28 Sep 83	1:48	25.42	799.93	
6 Oct 83	9:42	25.40	799.95	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-13-83

Top of Pipe Elevation: 816.17 ft MSL

Screen Interval Elevation: from 800.85 to 791.71 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
1 Sep 83	10:38	14.43	801.74	
2 Sep 83	9:20	15.48	800.69	
3 Sep 83	10:53	15.44	800.73	
5 Sep 83	8:16	15.34	800.83	
6 Sep 83	11:32	15.30	800.87	
7 Sep 83	8:22	15.58	800.59	Sampled well
8 Sep 83	8:13	15.77	800.40	
14 Sep 83	1:48	16.06	800.11	
21 Sep 83	12:58	15.77	800.40	
28 Sep 83	2:35	15.83	800.34	
6 Oct 83	9:14	16.00	800.17	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-14-83

Top of Pipe Elevation: 815.92 ft MSL

Screen Interval Elevation: from 784.47 to 775.36 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
2 Sep 83	9:31	34.17	781.75	
3 Sep 83	10:33	39.60	776.32	
5 Sep 83	8:04	39.87	776.05	
6 Sep 83	11:19	39.74	776.18	
7 Sep 83	8:15	39.68	776.24	Sampled well
8 Sep 83	8:03	44.45	771.47	
9 Sep 83	11:42	44.38	771.54	Dry well
10 Sep 83	1:19	44.34	771.58	
13 Sep 83	10:52	45.00	770.92	
15 Sep 83				Blew well with air for approximately 2 hrs
20 Sep 83	2:30	46.10	769.82	

NOTE: See data for well WES-10-14A-83 and WES-10-14B-83

Ground-Water Elevations

Rockeye

Boring Number: WES-10-14A-83

Top of Pipe Elevation: 815.21 ft MSL

Screen Interval Elevation: from 791.06 to 782.21 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
22 Sep 83	9:15	28.40	783.81	Open hole - blew water from boring
23 Sep 83	9:25	31.65	783.56	
24 Sep 83	11:35	31.78	783.43	
26 Sep 83	10:00	31.92	783.29	
27 Sep 83	9:10	31.80	783.41	
28 Sep 83	2:13	31.68	783.53	
6 Oct 83	9:28	31.58	783.63	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-14B-83

Top of Pipe Elevation: 815.44 ft MSL

Screen Interval Elevation: from 803.99 to 794.87 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
22 Sep 83	9:11	12.01	800.43	Open hole - blew water from boring
23 Sep 83	9:29	19.65	795.79	
24 Sep 83	11:38	14.78	800.66	
26 Sep 83	10:02	14.53	800.91	
27 Sep 83	9:11	14.52	800.92	
28 Sep 83	2:14	14.50	800.94	
6 Oct 83	9:29	14.75	800.69	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-15-83

Top of Pipe Elevation: 792.34 ft MSL

Screen Interval Elevation: from 765.98 to 756.80 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
3 Aug 83	10:42	19.85	772.49	
5 Aug 83	8:11	19.83	772.51	
6 Sep 83	11:24	19.88	772.46	
7 Sep 83	8:18	19.95	772.39	Sampled well
8 Sep 83	8:08	19.91	772.43	
9 Sep 83	11:46	19.92	772.42	
10 Sep 83	1:23	19.92	772.42	
14 Sep 83	1:53	20.00	772.34	
21 Sep 83	12:02	20.15	772.19	
28 Sep 83	2:19	20.29	772.05	
6 Oct 83	9:23	20.25	772.09	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-16-83

Top of Pipe Elevation: 788.42 ft MSL

Screen Interval Elevation: from 766.97 to 757.83 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
9 Sep 83	11:37	18.52	769.90	
10 Sep 83	1:12	18.75	769.67	
12 Sep 83	3:38	18.74	769.68	
13 Sep 83	10:47	18.98	769.44	
14 Sep 83	1:20	19.13	769.29	
15 Sep 83	1:57	19.10	769.32	
21 Sep 83	10:57	19.44	768.98	Sampled well
28 Sep 83	2:08	19.53	768.89	
6 Oct 83	9:55	19.25	769.17	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-17-83

Top of Pipe Elevation: 779.60 ft MSL

Screen Interval Elevation: from 766.26 to 757.09 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
12 Sep 83	3:30	12.05	767.55	
13 Sep 83	11:08	12.18	767.42	
14 Sep 83	1:01	12.33	767.22	
15 Sep 83	1:51	12.22	767.38	
16 Sep 83	2:37	12.08	767.52	
17 Sep 83	6:50	12.33	767.27	
19 Sep 83	9:17	12.40	767.20	
21 Sep 83	10:46	12.49	767.11	Sampled well
28 Sep 83	1:58	12.70	766.90	
6 Oct 83	10:09	12.88	766.72	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-18-83

Top of Pipe Elevation: 777.09 ft MSL

Screen Interval Elevation: from 763.68 to 754.71 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
12 Sep 83	3:29	9.30	767.79	
13 Sep 83	11:05	9.58	767.51	
14 Sep 83	12:56	9.58	767.51	
15 Sep 83	1:49	9.60	767.49	
16 Sep 83	2:35	9.32	767.77	
17 Sep 83	6:47	9.58	767.51	
19 Sep 83	9:15	9.70	767.39	
21 Sep 83	10:45	9.73	767.36	Sampled well
28 Sep 83	1:56	10.03	767.06	
6 Oct 83	10:10	10.00	767.09	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-19-83

Top of Pipe Elevation: 786.60 ft MSL

Screen Interval Elevation: from 776.27 to 767.09 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
13 Sep 83	11:01	10.20	776.40	
14 Sep 83	1:06	11.78	774.82	
15 Sep 83	1:53	11.95	774.65	
16 Sep 83	2:34	12.15	774.45	
17 Sep 83	6:55	12.50	774.10	
19 Sep 83	9:21	12.96	773.64	
20 Sep 83	1:24	13.12	773.48	
21 Sep 83	10:49	13.06	773.54	Sampled well
28 Sep 83	2:02	13.25	773.35	
6 Oct 83	9:57	6.38	780.22	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-20-83

Top of Pipe Elevation: 805.86 ft MSL

Screen Interval Elevation: from 778.42 to 769.27 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
14 Sep 83	1:28	32.58	773.28	
15 Sep 83	2:59	32.34	773.52	
16 Sep 83	2:32	32.22	773.64	
17 Sep 83	6:58	32.37	773.49	
19 Sep 83	9:25	32.50	773.36	
20 Sep 83	1:21	32.21	773.65	
21 Sep 83	10:37	32.49	773.37	Sampled well
28 Sep 83	1:50	32.94	772.92	
6 Oct 83	9:45	32.77	773.09	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-21-83

Top of Pipe Elevation: 784.56 ft MSL

Screen Interval Elevation: from 771.17 to 762.06 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
16 Sep 83	2:41	13.78	770.78	
17 Sep 83	6:53	14.25	770.31	
19 Sep 83	9:19	14.77	769.79	
20 Sep 83	1:26	14.91	769.65	
21 Sep 83	10:43	15.15	769.41	Sampled well
23 Sep 83	9:40	15.59	768.97	
24 Sep 83	11:42	15.87	768.69	
28 Sep 83	2:00	15.55	769.01	
6 Oct 83	10:13	16.26	768.30	

Ground-Water Elevations

Rockeye

Boring Number: WES-10-22-83

Top of Pipe Elevation: 825.98 ft MSL

Screen Interval Elevation: from 807.58 to 798.41 ft MSL

Grid Coordinates:

Date	Time	Depth to Water, ft	Water Elevation, ft MSL	Remarks
17 Sep 83	12:50	30.0	795.98	Open hole - dry
20 Sep 83	11:28	7.57	815.41	Open hole
21 Sep 83	12:55	8.87	817.11	
22 Sep 83	8:46	9.95	816.03	Purged well
23 Sep 83	9:36	11.54	814.44	
24 Sep 83	11:47	10.63	815.35	
26 Sep 83	10:10	10.11	815.87	
27 Sep 83	9:16	10.00	815.98	
28 Sep 83	2:43	10.05	815.93	
6 Oct 83	10:03	9.64	816.34	

APPENDIX A5

Laboratory Test Results for Samples of the
Unconsolidated Overburden Collected
from Selected Monitoring Wells

Physical Soil Test Procedures and Results

Standard soil test procedures as specified by Engineer Manual 1110-2-1906, "Laboratory Soil Testing," were followed during testing.

Unified Soil Classification System

Classification of soils according to the USCS depends upon grain-size distribution and the Atterberg limits. Grain-size distribution is determined with sieves and the liquidity and plasticity limits (Atterberg limits) are determined with standard devices. The liquid and plastic limits are the water contents at the boundaries between the semiliquid and plastic state and the plastic and semisolid state, respectively.

Water content and density

Water content and soil density are important engineering relationships and are useful correlations among samples for which a full suite of physical test data are not available. Water content is the amount of free water in a soil and is determined by the following formula:

$$W = \frac{W_w}{W_s}$$

where

W = water content

W_w = weight of water

W_s = dry weight of soil

Density or dry unit weight is determined according to the following formula:

$$D = \frac{W_s}{V}$$

where

D = density

W_s = dry weight of soil

V = volume of soil

Permeability

Permeability is a measure of a soil's ability to transmit a fluid; in the current study the fluid is water. The flow of water through a soil is governed by Darcy's law:

$$q = KiA$$

where

q = rate of discharge through a soil of cross-sectional area A

K = coefficient of permeability

i = hydraulic gradient (the loss of hydraulic head per unit distance of flow)

A = sample area perpendicular to flow

For coarse-grained materials, permeability tests are usually conducted in a constant head apparatus. In this equipment, an overflowing reservoir maintains a constant head on a soil sample of specified dimensions and the amount of water passing through the soil in a specified time is collected and measured. The permeability is then calculated according to the formula:

$$K_{20} = \frac{QLR_t}{hAt}$$

where

K_{20} = coefficient of permeability, cm/sec at 20°

Q = quantity of flow, cc

L = length of specimen over which head loss is measured, cm. If piezometer taps are used, L is equal to the distance between piezometer taps.

R_t = temperature correction factor for viscosity of water

h = head loss across sample or between piezometer taps, cm

Chemical Test

Cation Exchange Capacity

Cation Exchange Capacity (CEC) test procedures as specified by Technical Report EPA/CE 81-1, "Procedures for Handling and Chemical Analysis of Sediment and Water Samples," were followed during testing. The CEC of a soil is a measure of the cations reversibility capacity from the surface of the crystalline matrix of a mineral. The CEC is expressed in millequivalents per 100 grams and is calculated from the following formula:

$$CEC/100g = \frac{(X\ mg/\ell)\ (.05)\ (100)}{(18\ mg/meq)\ (g)\ (\%\ S)}$$

where

X = ammonia concentration in NaCl leachate, mg/ℓ

.05 = volume of NaCl leachate, ℓ

18 = millequivalent weight of ammonium ion, mg/meq

g = weight of sediment sample, g

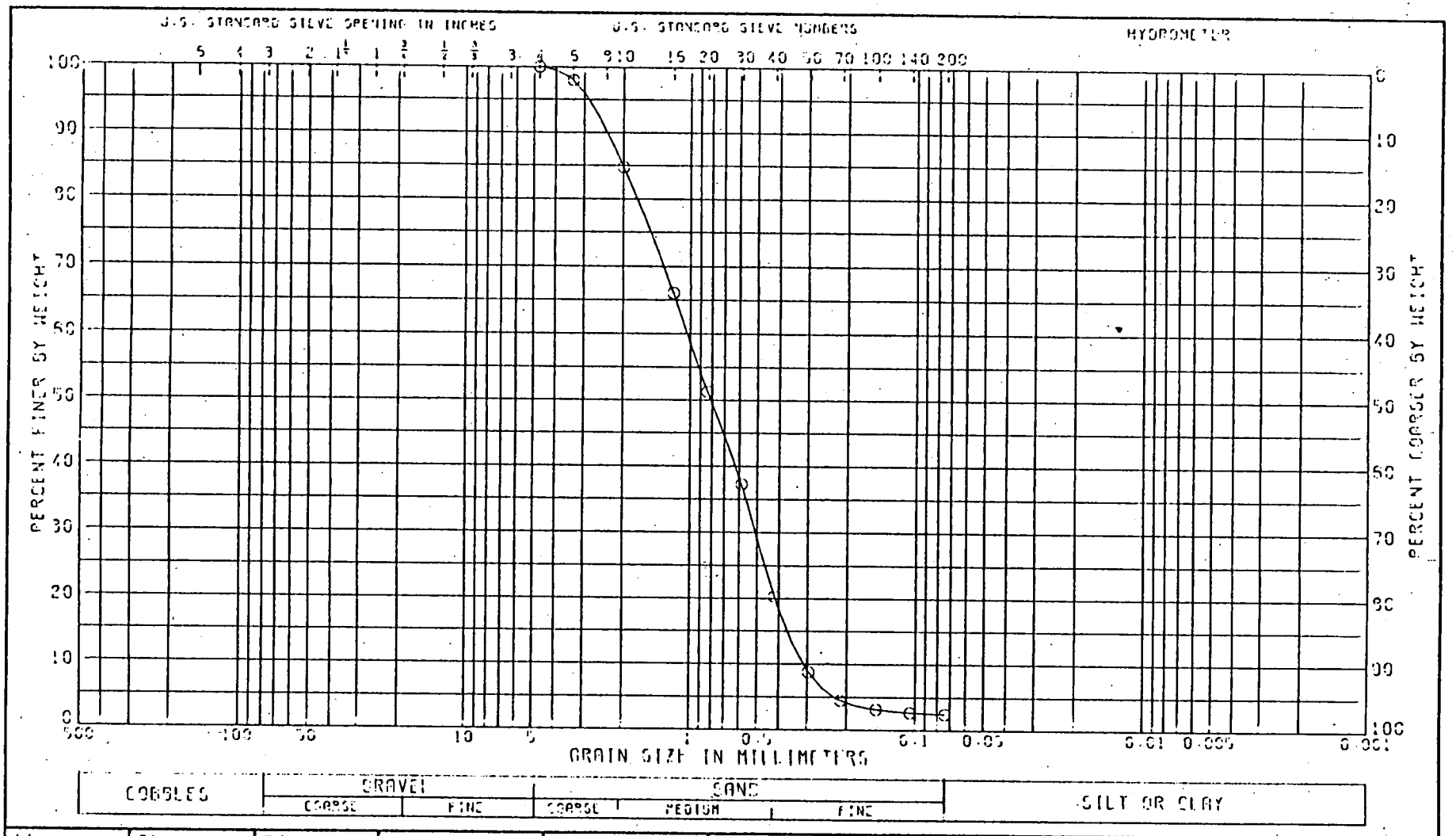
% S = percent solids in sediment sample (as decimal fraction)

Laboratory Soil Test Results

Dye Burial Grounds

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
2-1-81	1	0.92-1.87	101.0	21.9	38	19	19	CL		7.83
2-1-81	2	6.0-6.95	125.1	11.1	25	14	11	CL		
2-2-81	1	0.0-1.65	93.3	21.2	46	21	25	CL	2.97×10^{-7}	2.54
2-3-81	1	0.0-1.15	108.9	18.4	44	23	21	CL		4.49
2-3-81	2A*	5.0-5.65	--	14.3	38	14	24	CL		
2-4-81	1	0.0-2.2	91.4	18.5	42	21	21	CL		2.81
2-5-81	1	0.0-1.55	93.8	18.0	44	23	21	CL		4.51
2-5-81	2	5.0-6.1	117.0	8.8	25	14	11	CL		
2-6-81	1	0.0-2.2	82.7	15.8	31	17	14	CL		
2-6-81	2	5.0-6.33	106.3	15.4	38	15	23	CL	3.86×10^{-5}	0.49
2-7-81	1	0.0-2.0	105.5	9.2	34	15	19	CL		5.06
2-8-81	1	0.0-2.25	84.8	17.1	39	18	21	CL		
2-8-81	2	5.0-6.69	117.0	13.4	39	16	23	CL	5.98×10^{-8}	6.38

* Jar sample
** See Figure E-1



LL	PL	PI	CS	NAT W.Y	

CLASSIFICATION

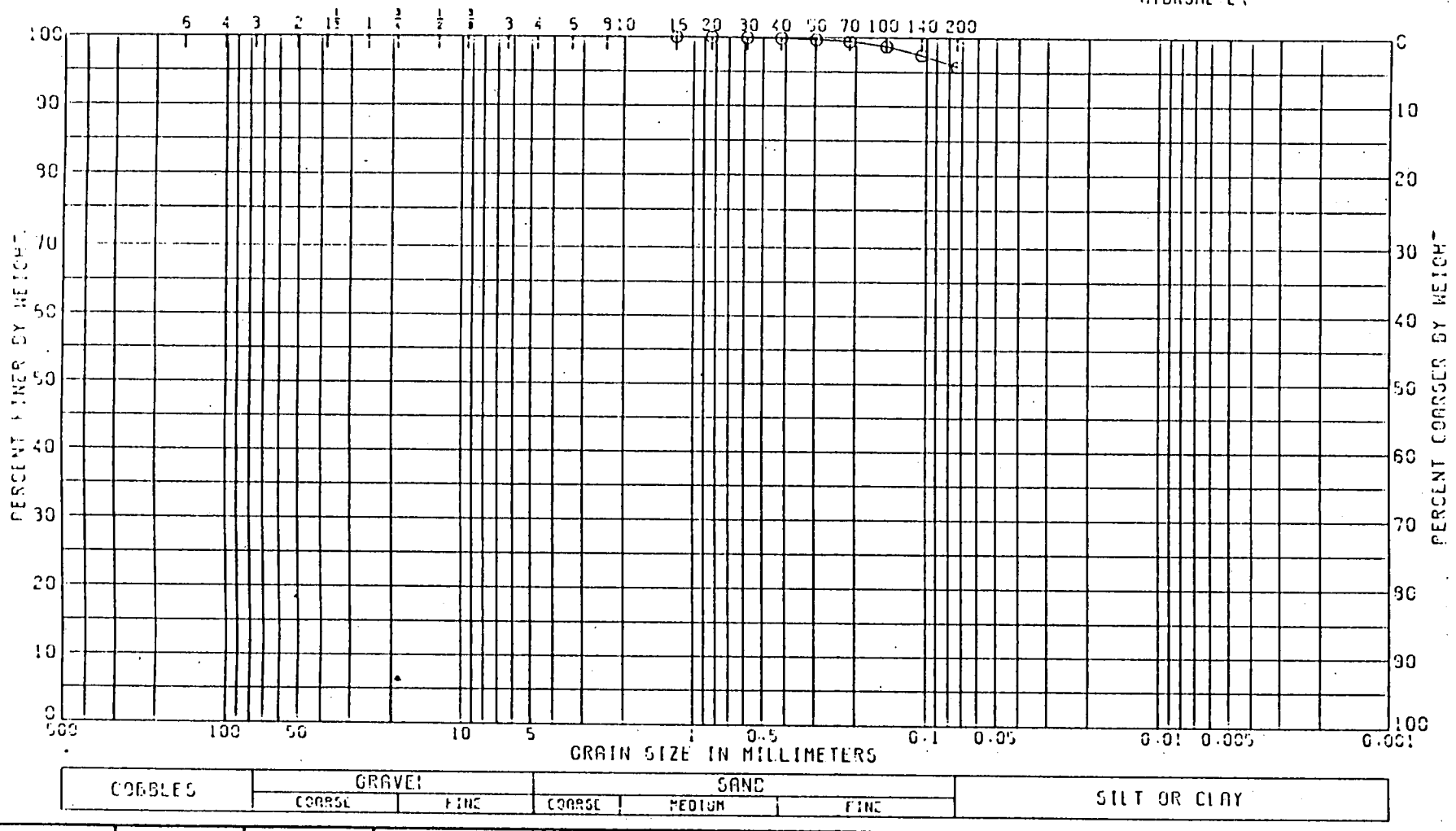
SAND (SP), GRAYISH BROWN

GRADATION CURVE

PROJECT CRANE NWSC SCREEN SAND

BORING NO. 0 SAMPLE NO. 0

DEPTH/ELEV 0 DATE 14 APR 92



LL	PL	PI	CS	NAT W.%
39	19	19		21.9

CLASSIFICATION

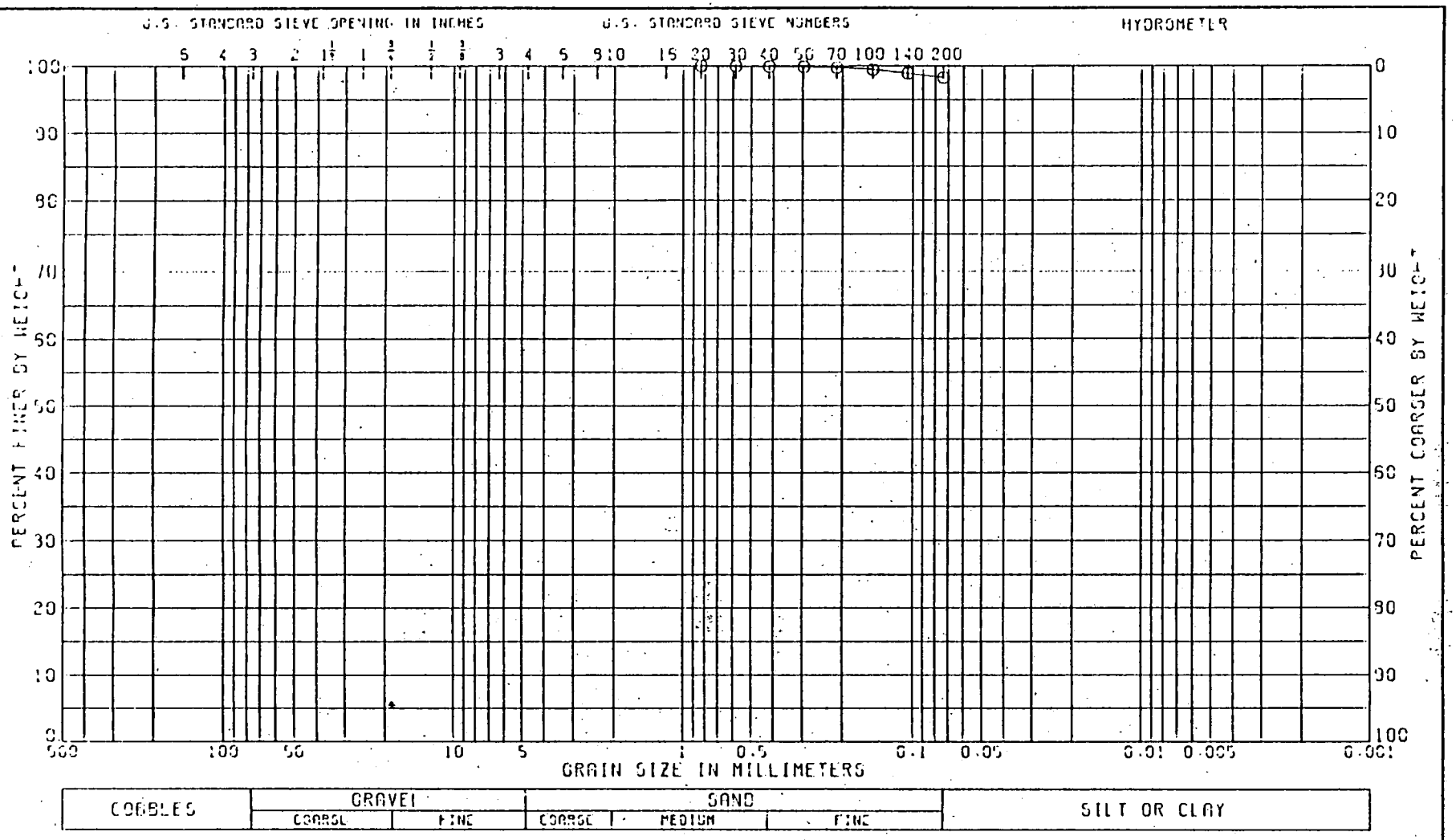
CLAY (CL), BROWN: TRACE OF SAND

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-1-81 SAMPLE NO. 1

DEPTH/ELEV 0.92-1.87 DATE 30 MAR 92



LL 46	PL 21	PI 25	CS	NAT W.% 21.2	

CLASSIFICATION

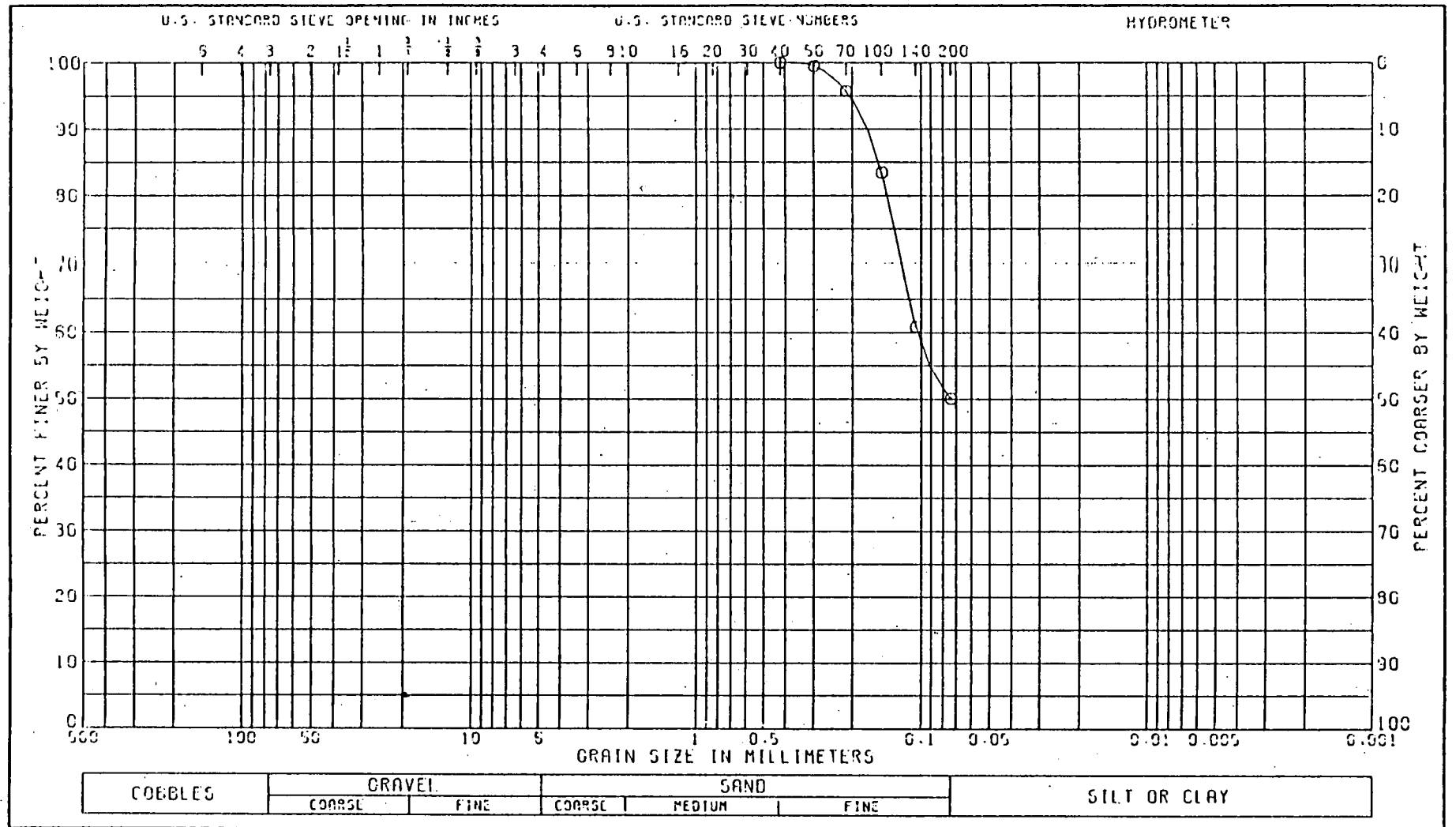
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-2-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.65 DATE 30 MAR 82



LL 39	PL 14	PI 24	GS	NAT W.% 14.3	

CLASSIFICATION

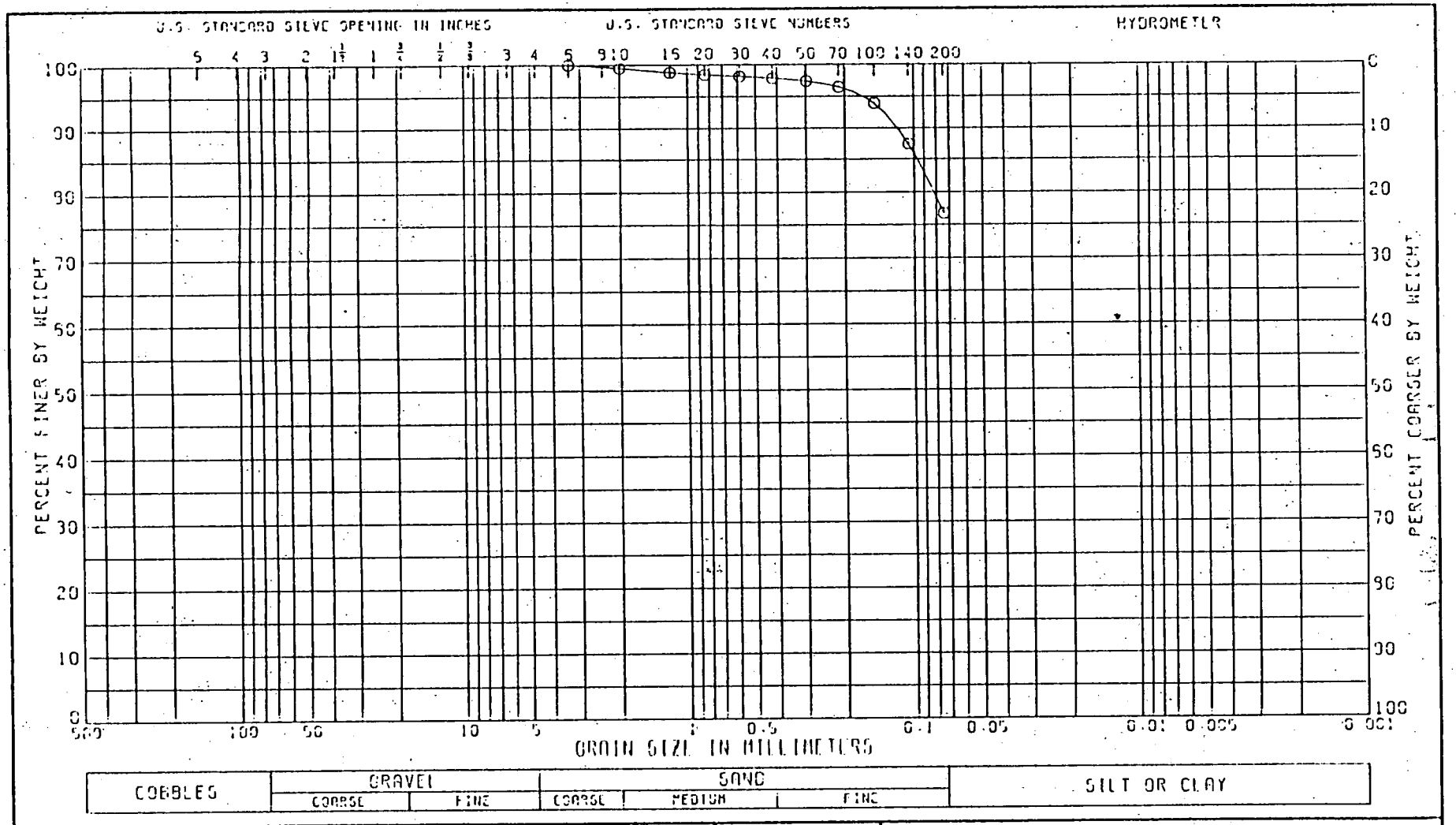
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-3-81 SAMPLE NO. 2A

DEPTH/ELEV 5.0-5.65 DATE 30 MAR 82



LL 25	PL 14	PI 11	CS	NAT W.% 11.1	

CLASSIFICATION

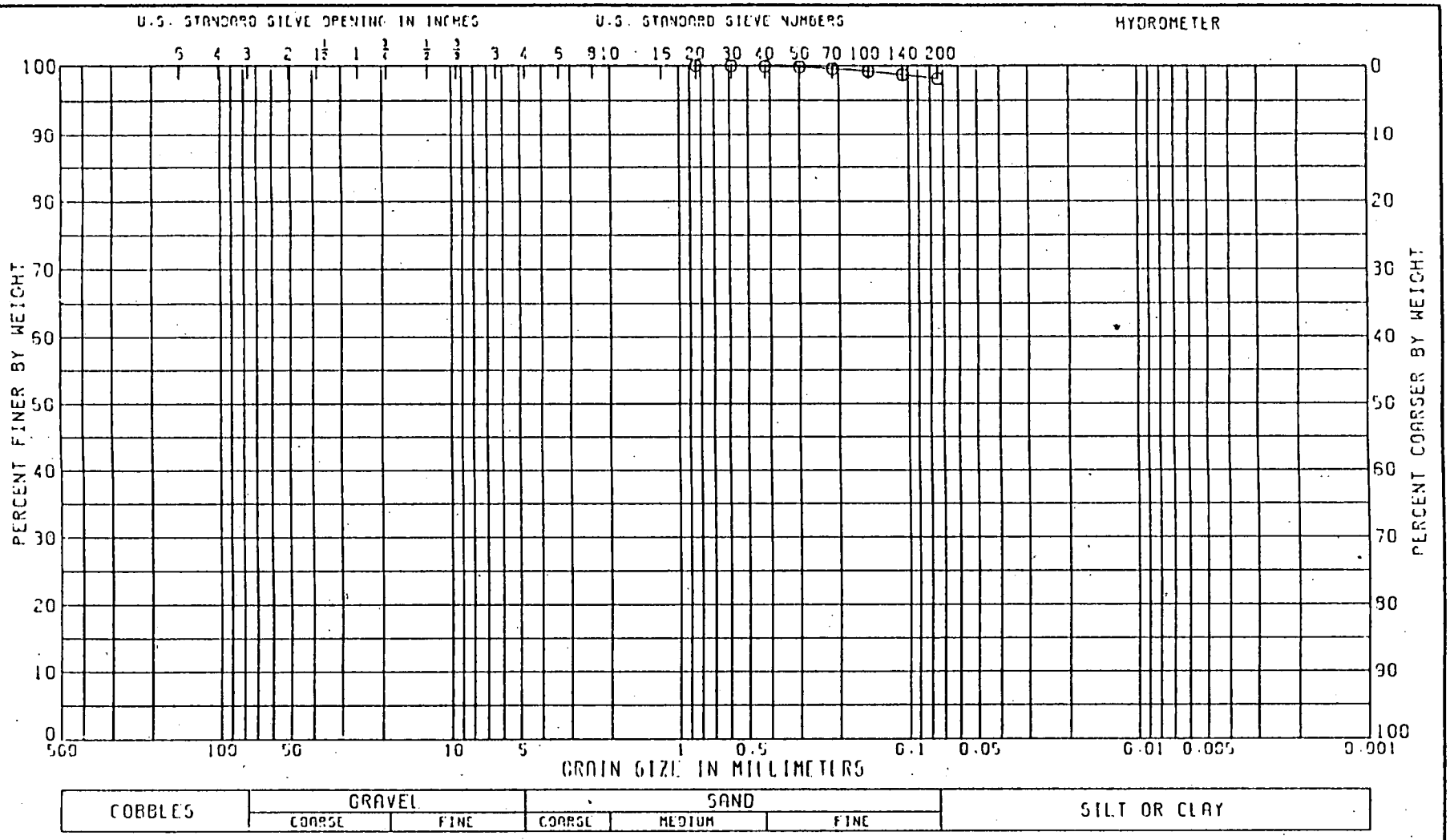
SANDY CLAY (CL), LIGHT BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-1-91 SAMPLE NO 2

DEPTH/ELEV 6.0-6.95 DATE 30 MAR 92



LL 44	PL 23	PI 21	CS	NAT W.% 18.4

CLASSIFICATION

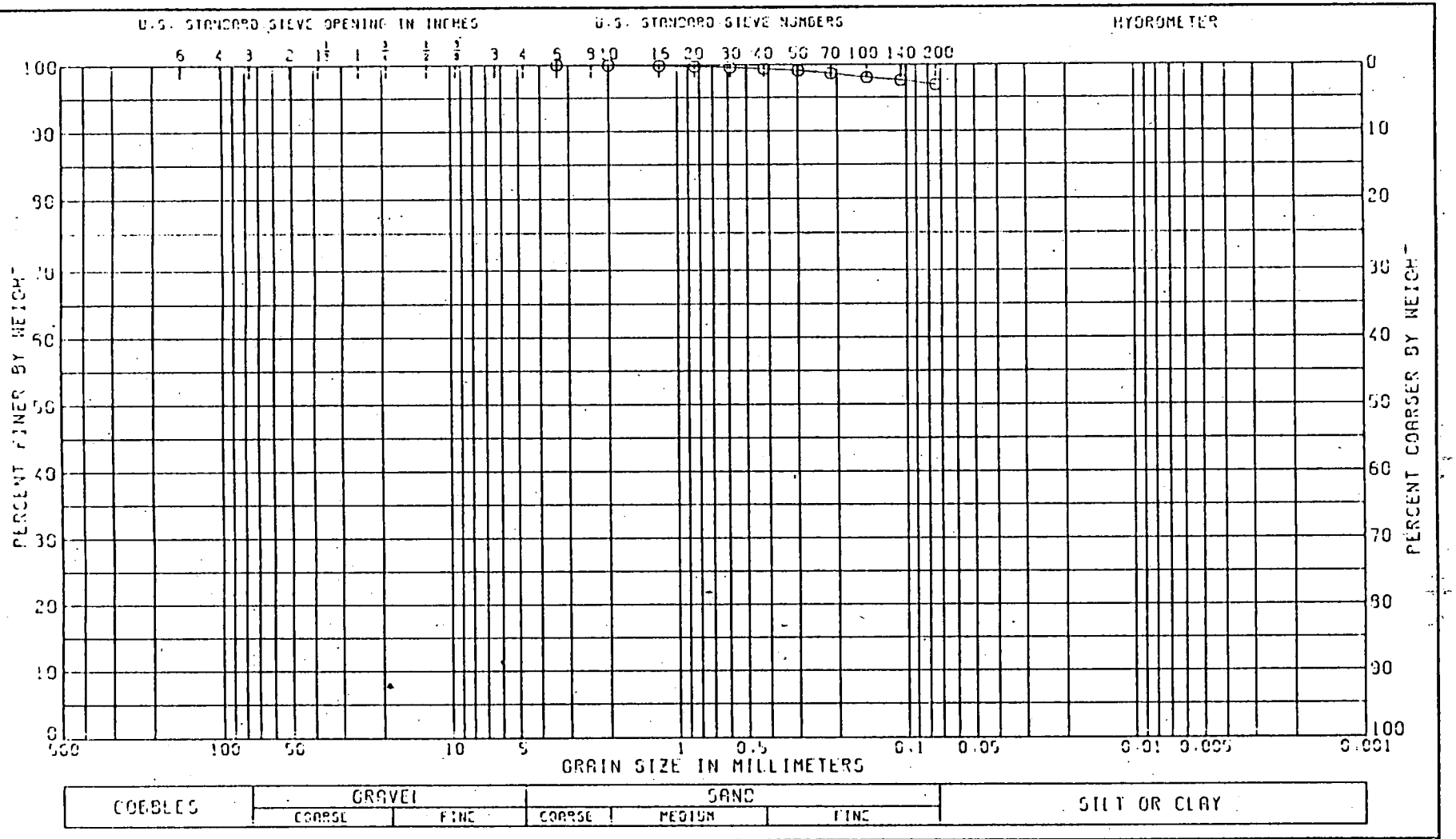
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-3-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.15 DATE 30 MAR 82



LL	PL	PI	GS	NAT W.%
44	23	21		18.0

CLASSIFICATION

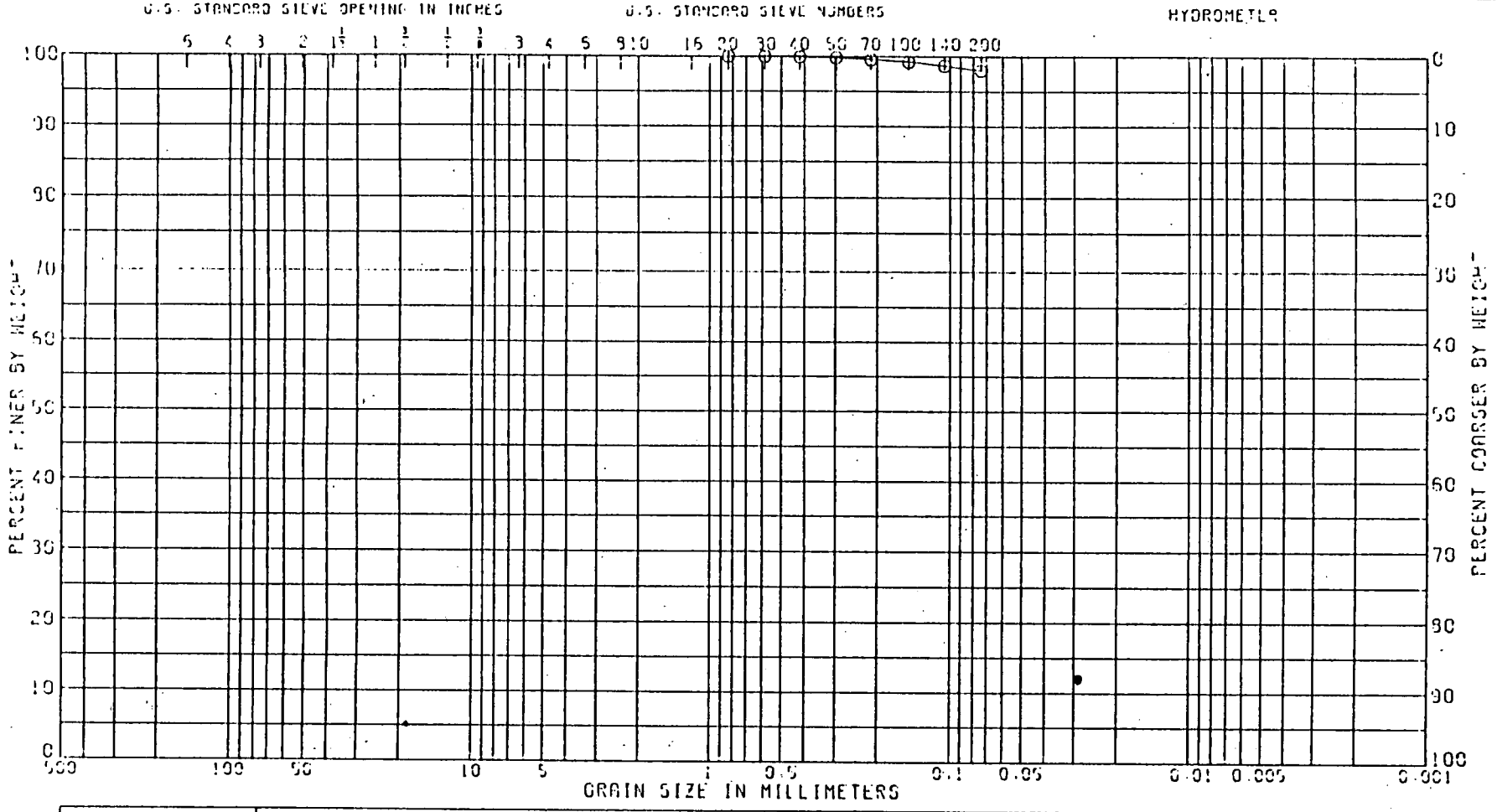
CLAY (CL), DARK TAN: TRACE OF SAND

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-5-81 SAMPLE NO 1

DEPTH/ELEV 0.0-1.55 DATE 30 MAR 82



LL	PL	PI	CS	NAT W.%
42	21	21		18.5

CLASSIFICATION

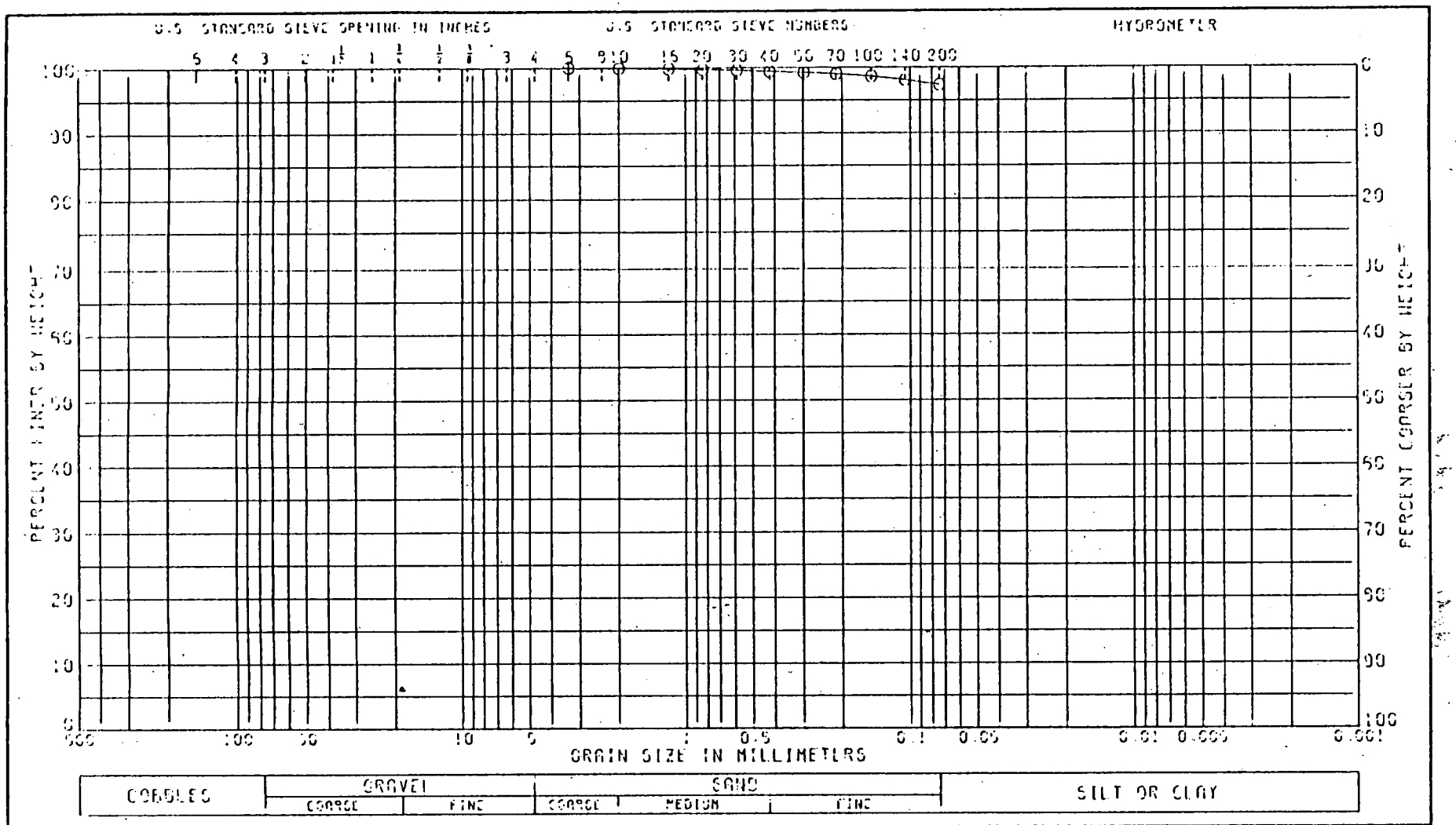
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-4-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.2 DATE 30 MAR 82



LL 31	PL 17	PI 14	CS	NAT W.% 15.8	

CLASSIFICATION

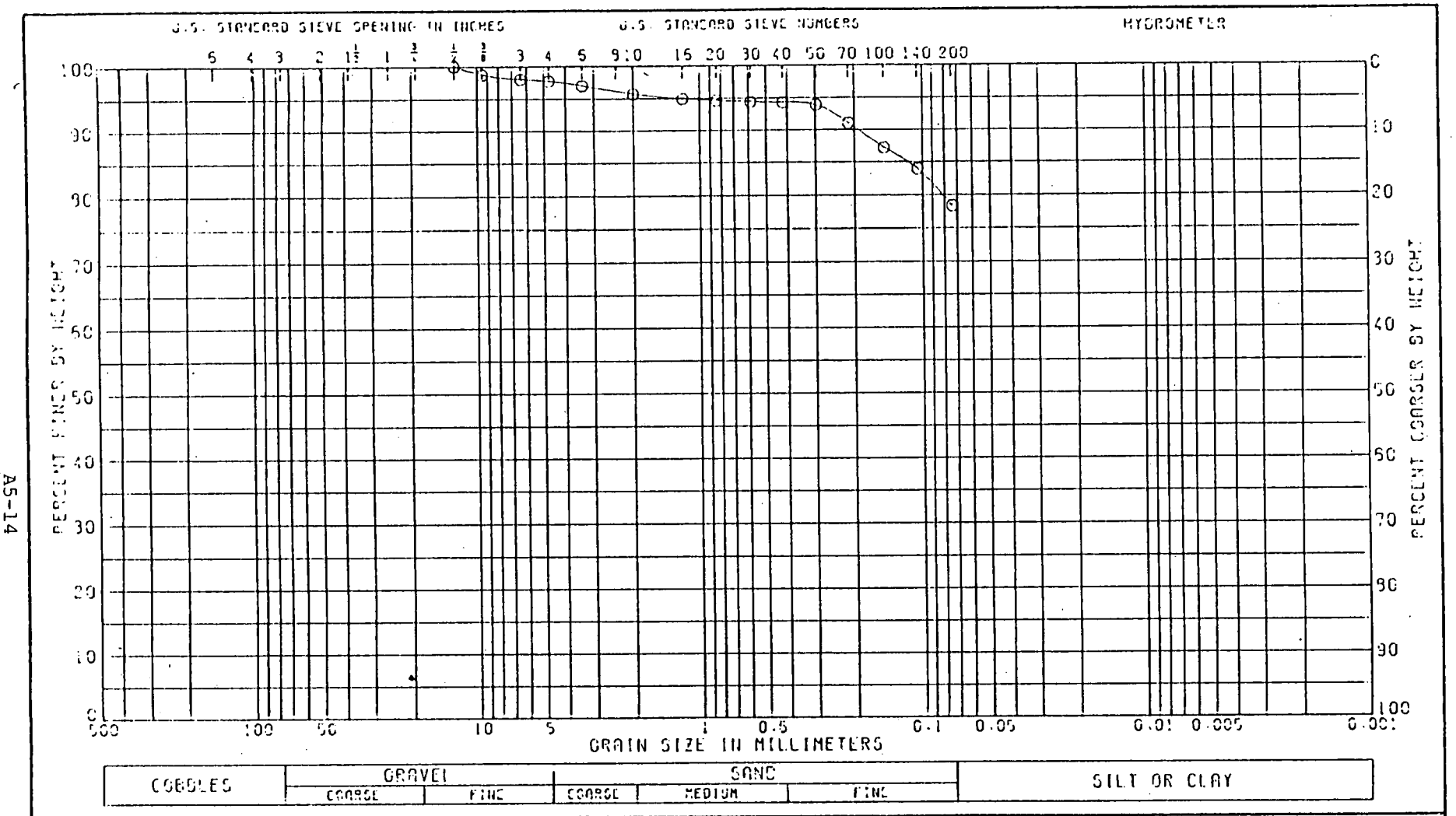
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO 2-6-81 SAMPLE NO 1

DEPTH/ELEV 0.0-2.2 DATE 26 FEB 92



LL	PL	PI	OS	NAT W.%
25	14	11		8.8

CLASSIFICATION

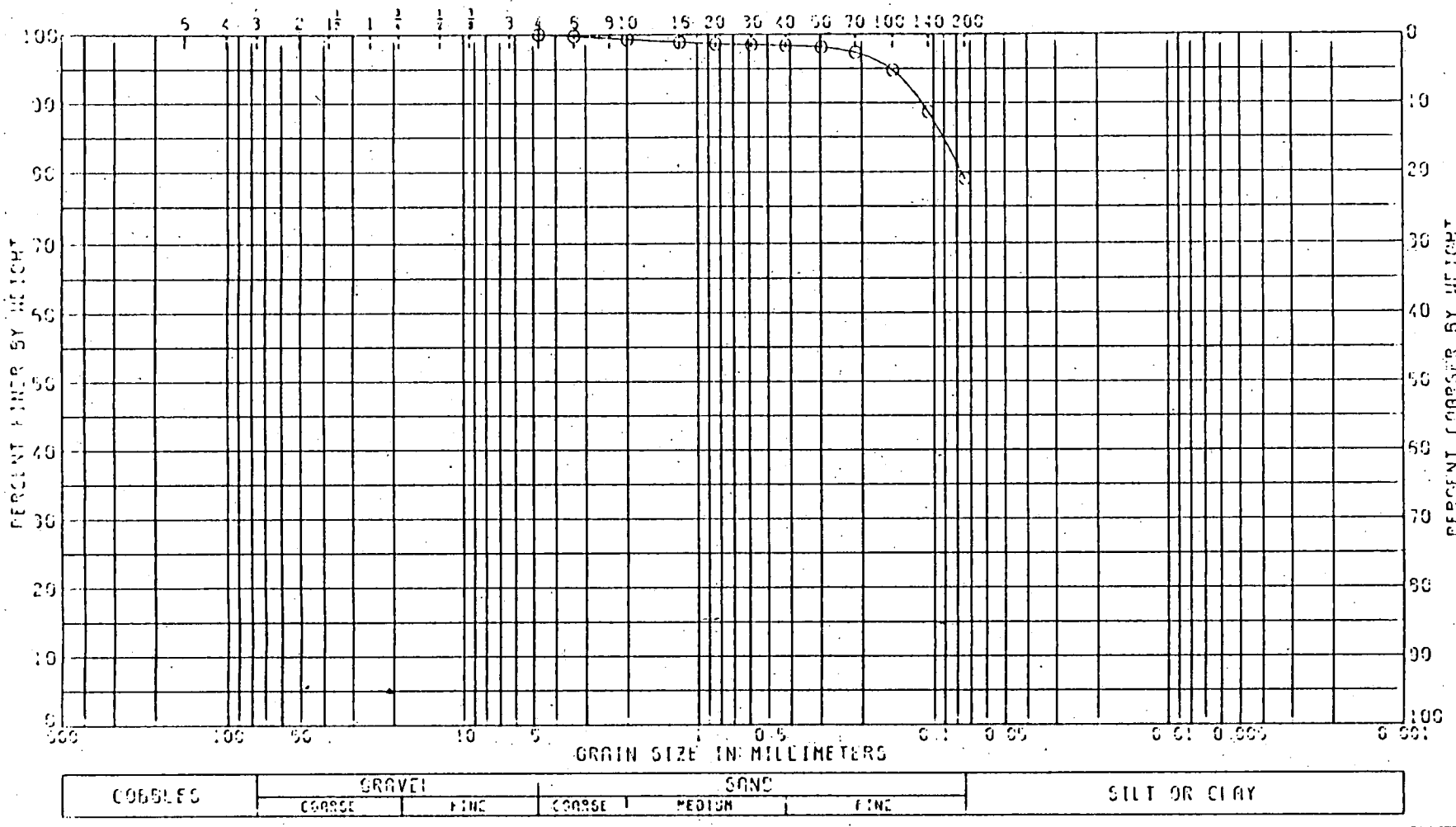
SANDY CLAY (CL), TAN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-5-91 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.1 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%	
34	15	19		9.2	

CLASSIFICATION

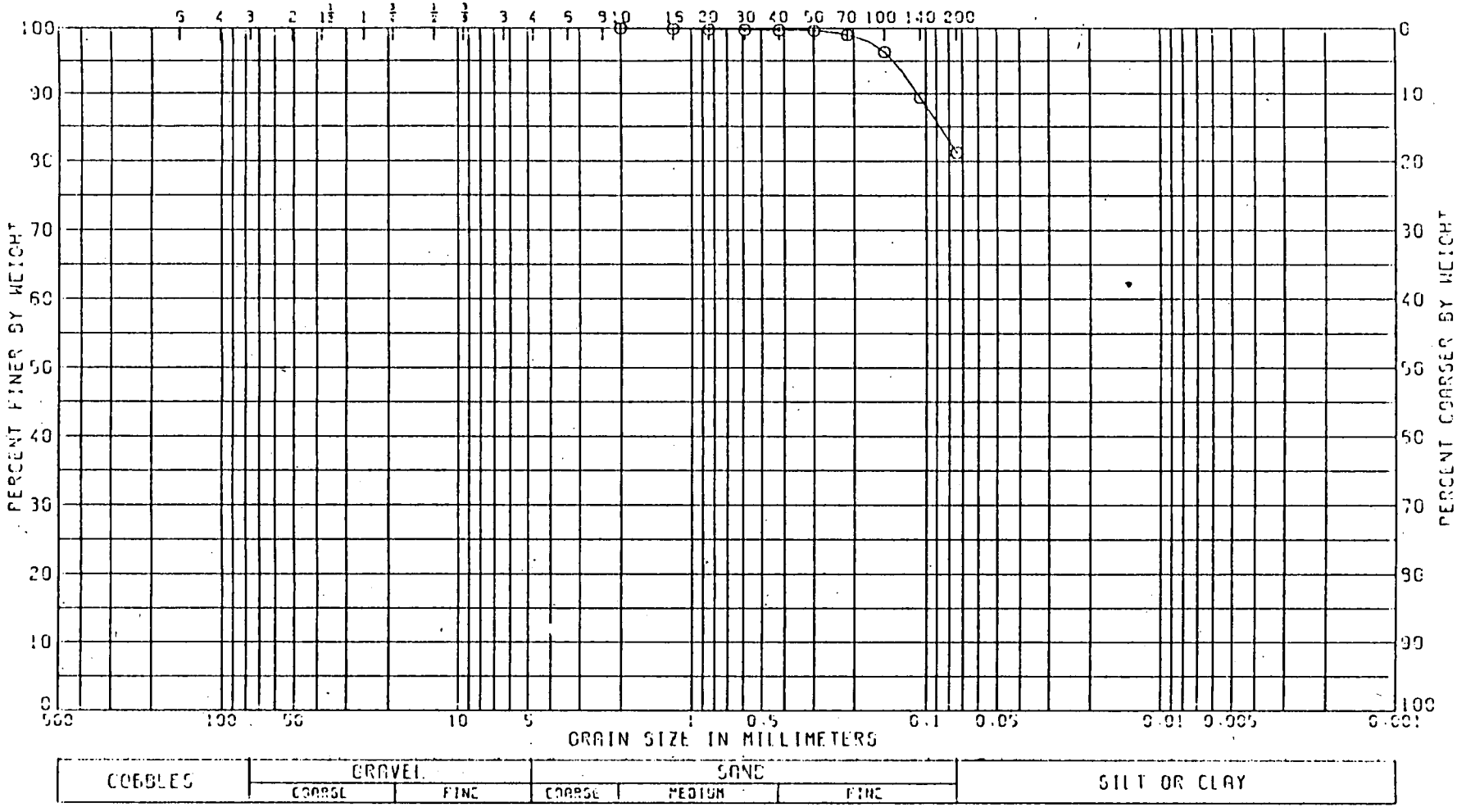
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO 2-7-81 SAMPLE NO 1

DEPTH/ELEV 0.0-2.0 DATE 26 FEB 82



LL 39	PL 16	PI 23	GS	NAT W.% 15.4

CLASSIFICATION

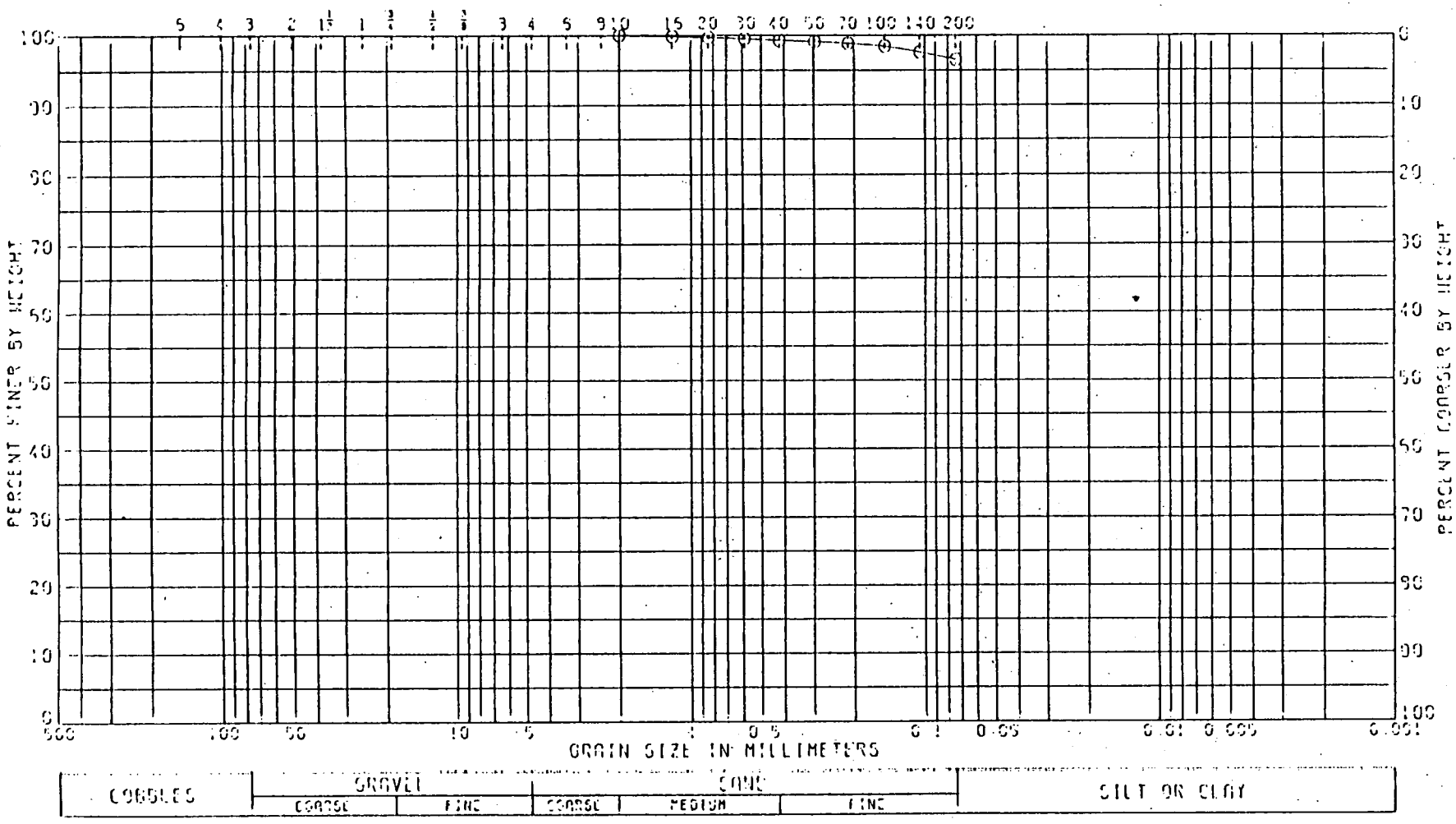
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-6-91 SAMPLE NO 2

DEPTH/ELEV 5.0-6.33 DATE 30 MAR 92



LL 39	PL 18	PI 21	CC	NAT W.% 17.1	

CLASSIFICATION

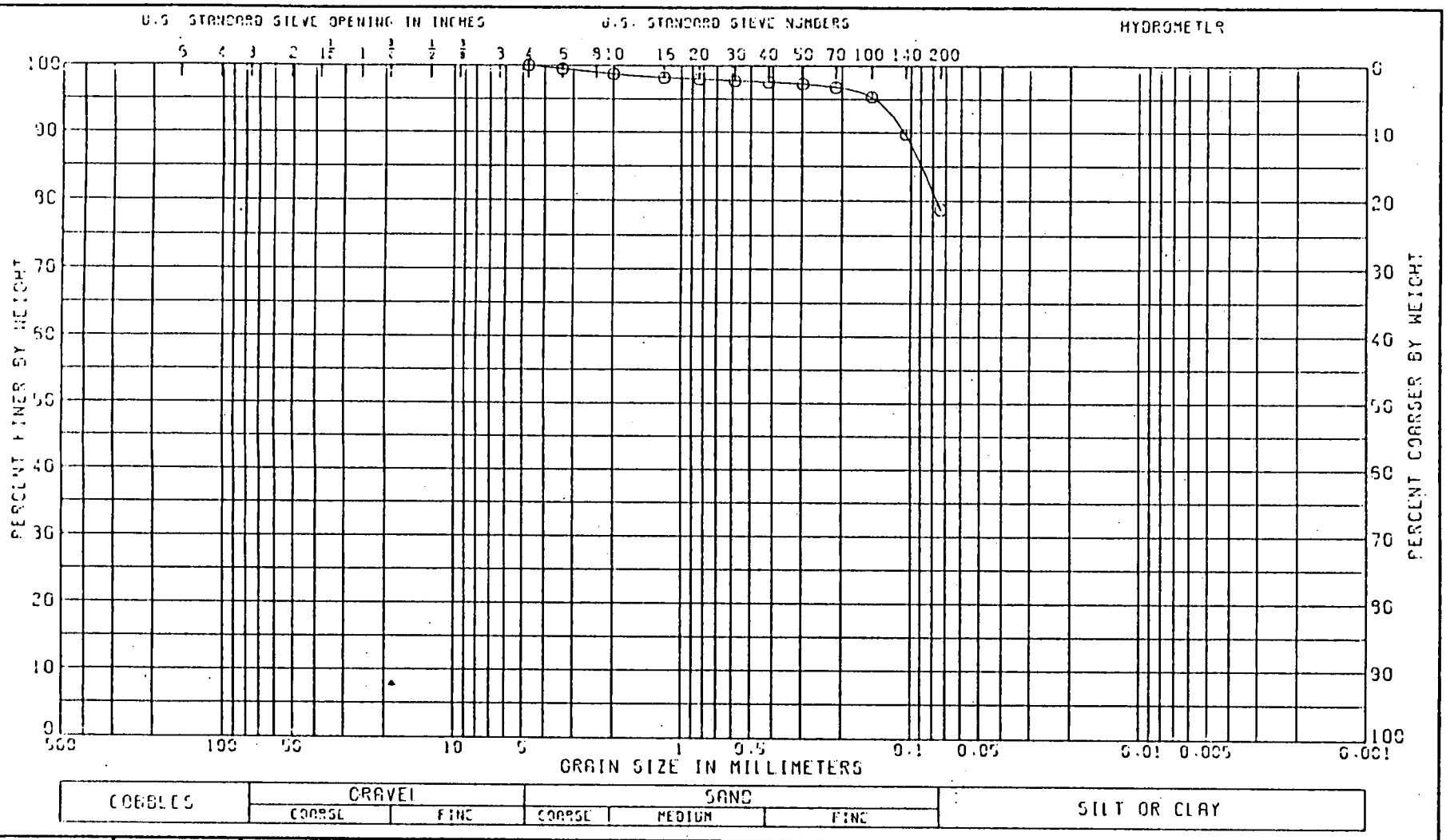
CLAY (CL), BROWN: TRACE OF SAND

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO 2-9-81 SAMPLE NO 1

DEPTH/ELEV 0.0-2.25 DATE 25 FEB 82



LL 39	PL 16	PI 23	CS	NAT W.% 13.4	

CLASSIFICATION

SANDY CLAY (CL), TAN

GRADATION CURVE

PROJECT CRANE NWSC DYE BURIAL

BORING NO. 2-8-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.69 DATE 30 MAR 92

Laboratory Soil Test Results

McComish Gorge

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
4-1-81	1	0.0-2.08	115.1	15.0	29	15	14	CL		4.28
4-1-81	2	5.0-6.55	110.8	17.8	27	16	11	SC		
4-1-81	3	10.0-10.3	86.6	10.3	19	12	7	SP-SC		
4-1-81	4	15.0-16.97	100.0	15.0	28	17	11	SC		
4-1-81	5	20.0-22.05	87.8	11.3	NP+	NP	NP	SP-SM		
4-1-81	6	25.0-27.08	95.6	15.5	NP	NP	NP	SM		
4-1-81	7A*	30.0-30.3	--	21.5	NP	NP	NP	--		
4-1-81	8	32.5-33.3	97.1	19.1	25	18	7	CL		
4-1-81	9	37.5-39.55	102.4	23.1	26	18	8	CL		
4-1-81	10	40.3-42.48	104.4	17.2	NP	NP	NP	ML		
4-2-81	1	0.0-1.27	118.8	10.6	22	13	9	SC		
4-2-81	2	5.0-5.9	116.7	12.6	27	12	15	SC		
4-2-81	3	10.0-11.97	96.9	13.9	24	16	8	SC		
4-2-81	4	15.0-16.60	101.1	22.9	29	24	5	ML		
4-2-81	5A*	20.0-21.5	--	30.0	21	16	5	CL-ML		
4-2-81	6	25.0-27.05	100.5	13.6	NP	NP	NP	SM		2.87
4-2-81	7	30.0-32.05	99.7	14.6	NP	NP	NP	SM		
4-3-81	1	0.0-2.08	105.8	14.1	25	13	12	SC		
4-3-81	2	5.0-7.13	64.3	49.7	NP	NP	NP	ML		2.93
4-3-81	3	10.0-11.83	97.4	4.9	NP	NP	NP	SM		
4-3-81	4A*	15.0-17.0	--	24.3	NP	NP	NP	SP-SM		

(Continued)

\+ Not plastic
* Jar sample
** See Figure E-1

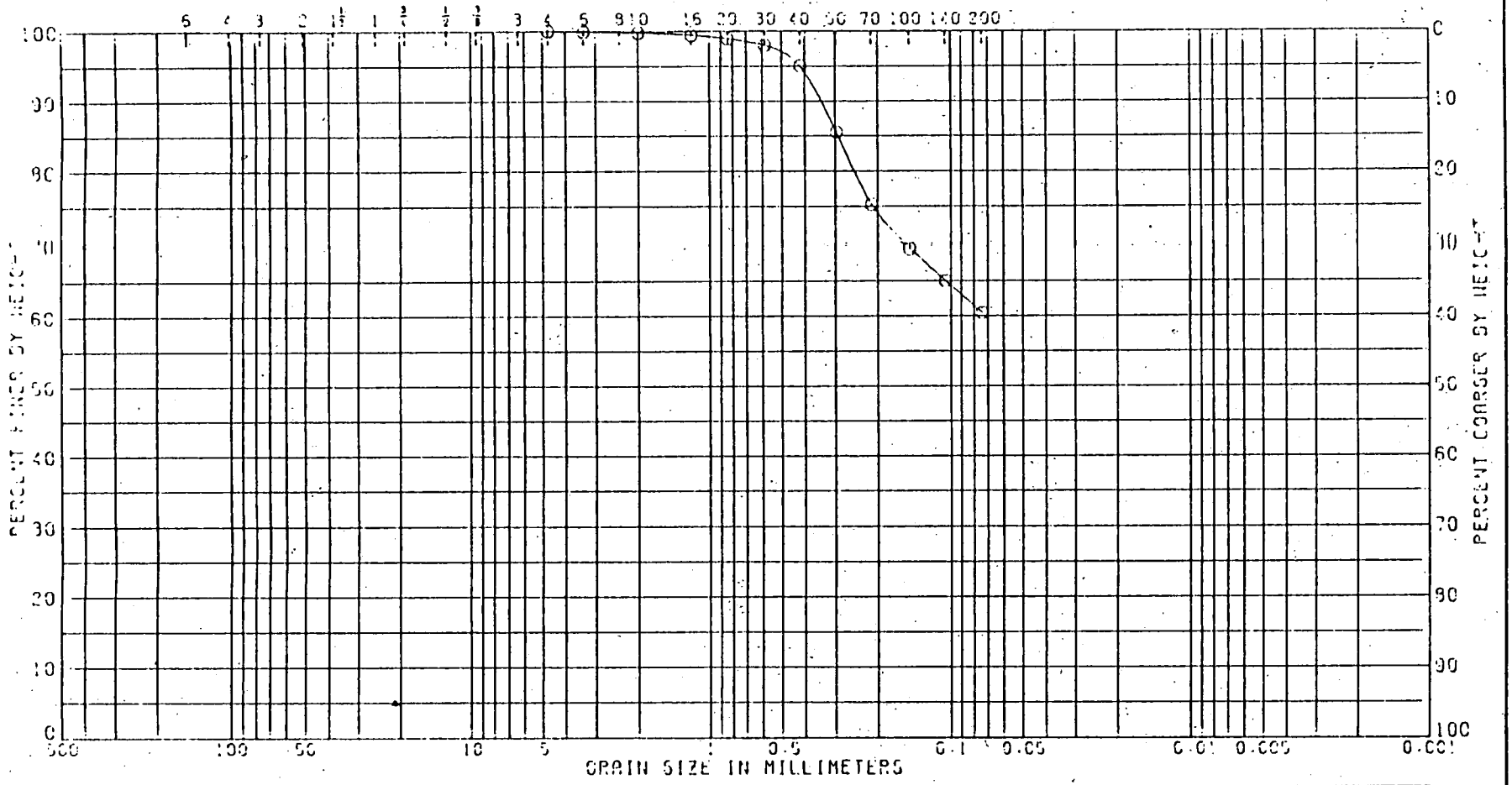
Laboratory Soil Test Results

McComish Gorge (Concluded)

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
4-4-81	1	0.0-2.26	99.0	20.7	39	18	21	CL		6.58
4-4-81	2	5.0-6.64	103.8	21.8	45	20	25	CL		
4-4-81	3	10.0-12.19	98.8	12.0	35	19	16	CL		
4-4-81	4	15.0-16.7	87.7	9.9	32	14	18	SC		
4-4-81	5	20.0-22.08	91.1	5.8	NP	NP	NP	SP-SM		
4-4-81	6	25.0-26.50	93.7	18.4	NP	NP	NP	SP-SM		
4-4-81	7	27.8-29.90	98.4	23.9	NP	NP	NP	SM	3.99×10^{-5}	
4-4-81	8	35.0-37.05	89.8	33.6	31	16	15	CL		
4-5-81	1	0.0-1.8	100.5	23.6	35	16	19	CL		
4-5-81	2	5.0-6.36	102.5	21.1	38	18	20	CL		
4-5-81	3	10.0-11.10	91.8	22.9	30	17	13	SC		3.36
4-5-81	4	14.3-16.0	96.7	14.7	NP	NP	NP	SP		
4-5-81	5	18.6-20.05	89.8	22.4	NP	NP	NP	SM		
4-6-81	1	0.0-2.14	115.0	12.4	NP	NP	NP	SM		2.74
4-6-81	2	5.0-7.08	93.3	10.2	NP	NP	NP	SM		
4-6-81	3	10.0-11.71	83.4	19.2	NP	NP	NP	ML		
4-6-81	4	15.0-17.17	92.3	27.4	NP	NP	NP	SM		
4-6-81	5	19.5-20.35	103.1	18.4	NP	NP	NP	SM		
4-6-81	6	24.2-26.36	101.9	23.1	20	17	3	SM		

* Jar sample

** See Figure E-1



LL	PL	PI	GS	NAT W.%	
29	15	14		15.0	

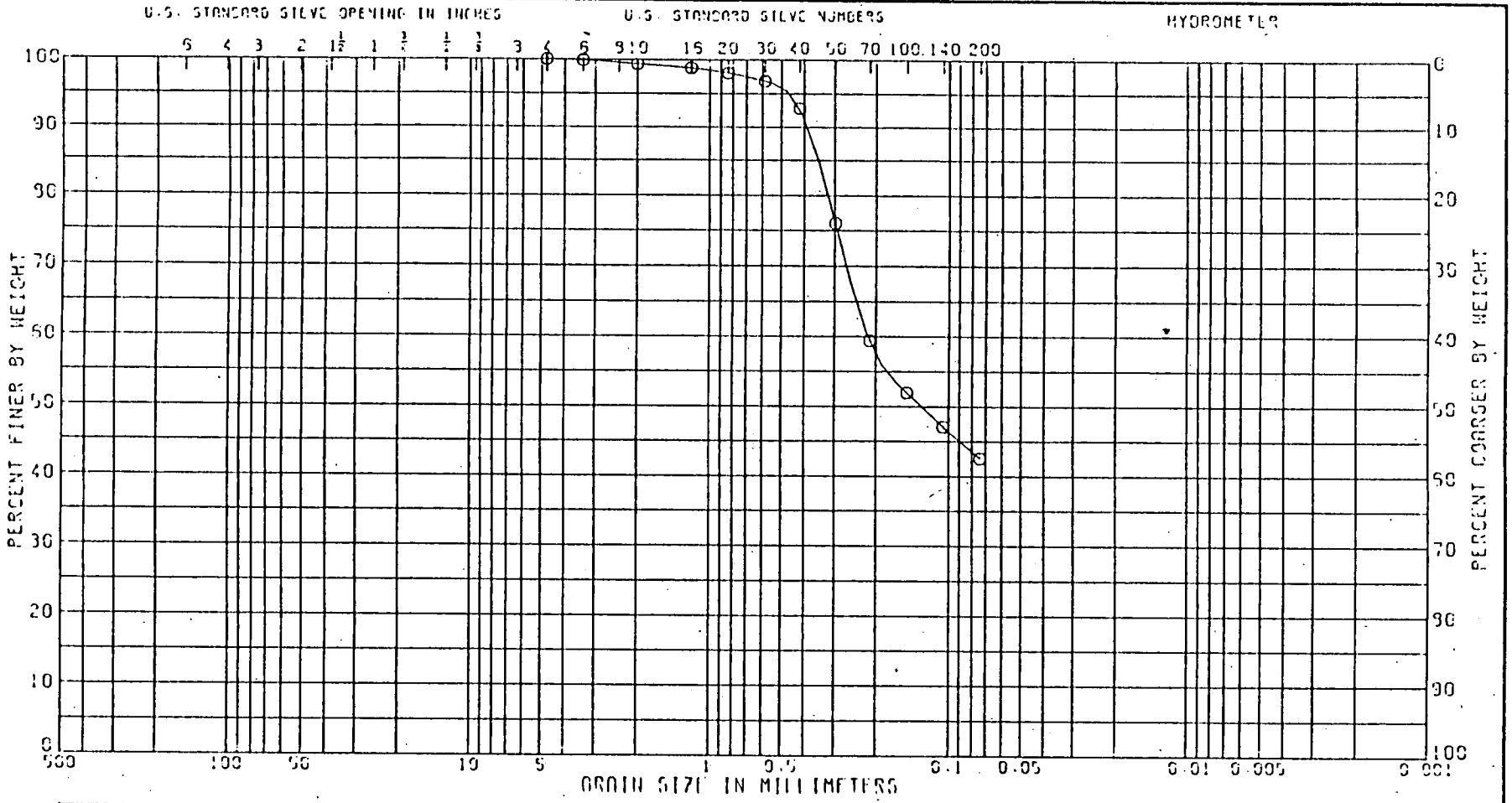
CLASSIFICATION
SANDY CLAY (CL), TAN

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO 4-1-81 SAMPLE NO 1

DEPTH/ELEV 0.0-2.08 DATE 00 MAR 82



LL	PL	PI	GS	NAT W.%
27	16	11		17.8

CLASSIFICATION

CLAYEY SAND (SC), TAN

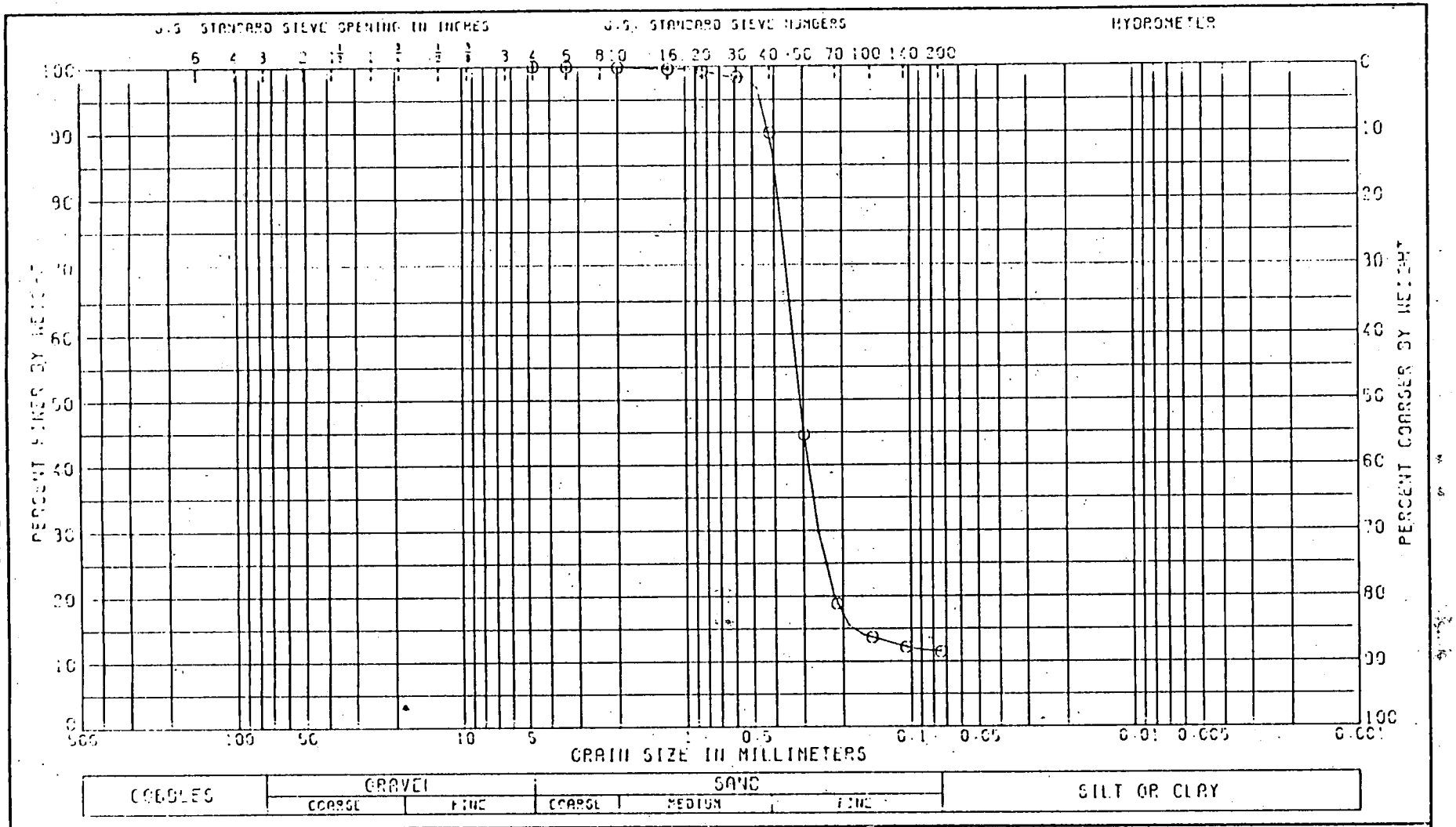
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-1-81 SAMPLE NO. 2

DEPTH/ELEV. 5.0-6.55 DATE 30 MAR 82



LL 19	PL 12	PI 7	GS	NAT W.% 10.3	

CLASSIFICATION

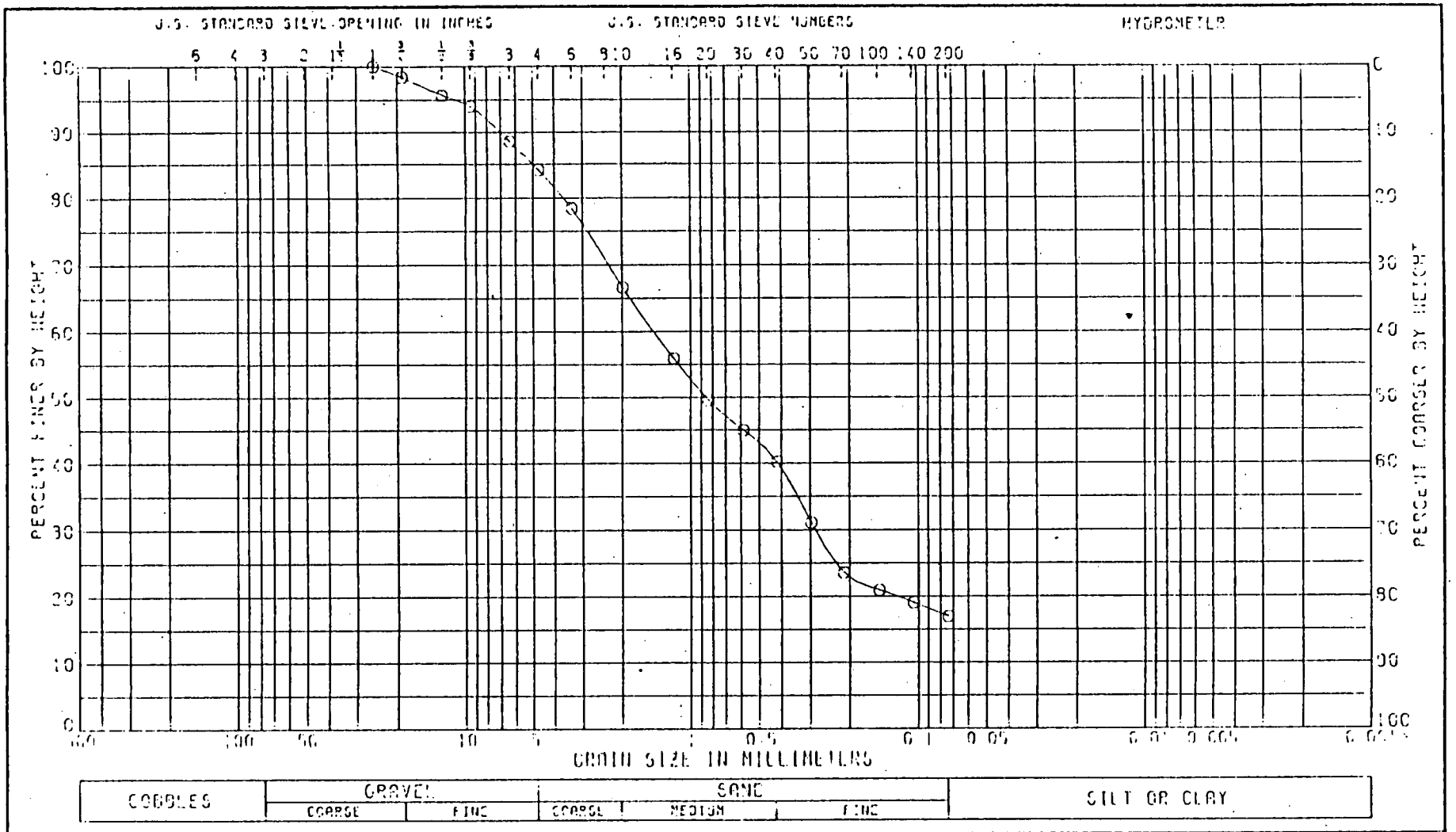
CLAYEY SAND (SP-SC), REDDISH BROWN

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO. 4-1-81 SAMPLE NO 3

DEPTH/ELEV 10.0-10.3 DATE 09 MAR 82



LL	PL	PI	GS	NAT W.%	
28	17	11		15.0	

CLASSIFICATION

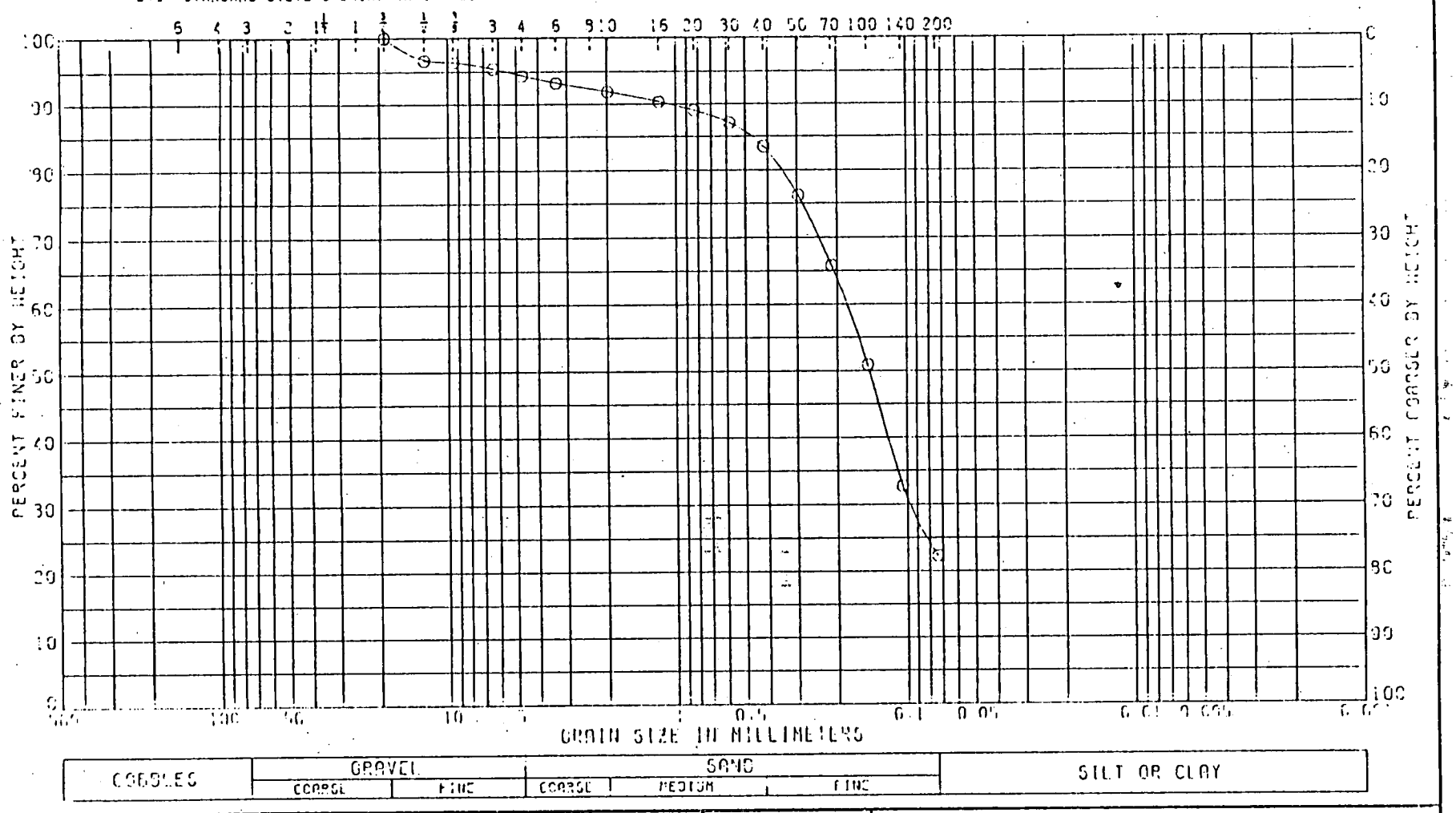
GRAVELLY CLAYEY SAND (SC), BROWN

GRADATION CURVE

PROJECT CRANE NESC
MCCOMISH GORGE

BORING NO. 4-1-81 SAMPLE NO. 4

DEPTH/ELEV 15.0-16.0? DATE 09 MAR 82



LL	PL	PI	GS	NAT W.% 15.5	

CLASSIFICATION

SILTY SAND (SM) BROWN: WITH GRAVEL

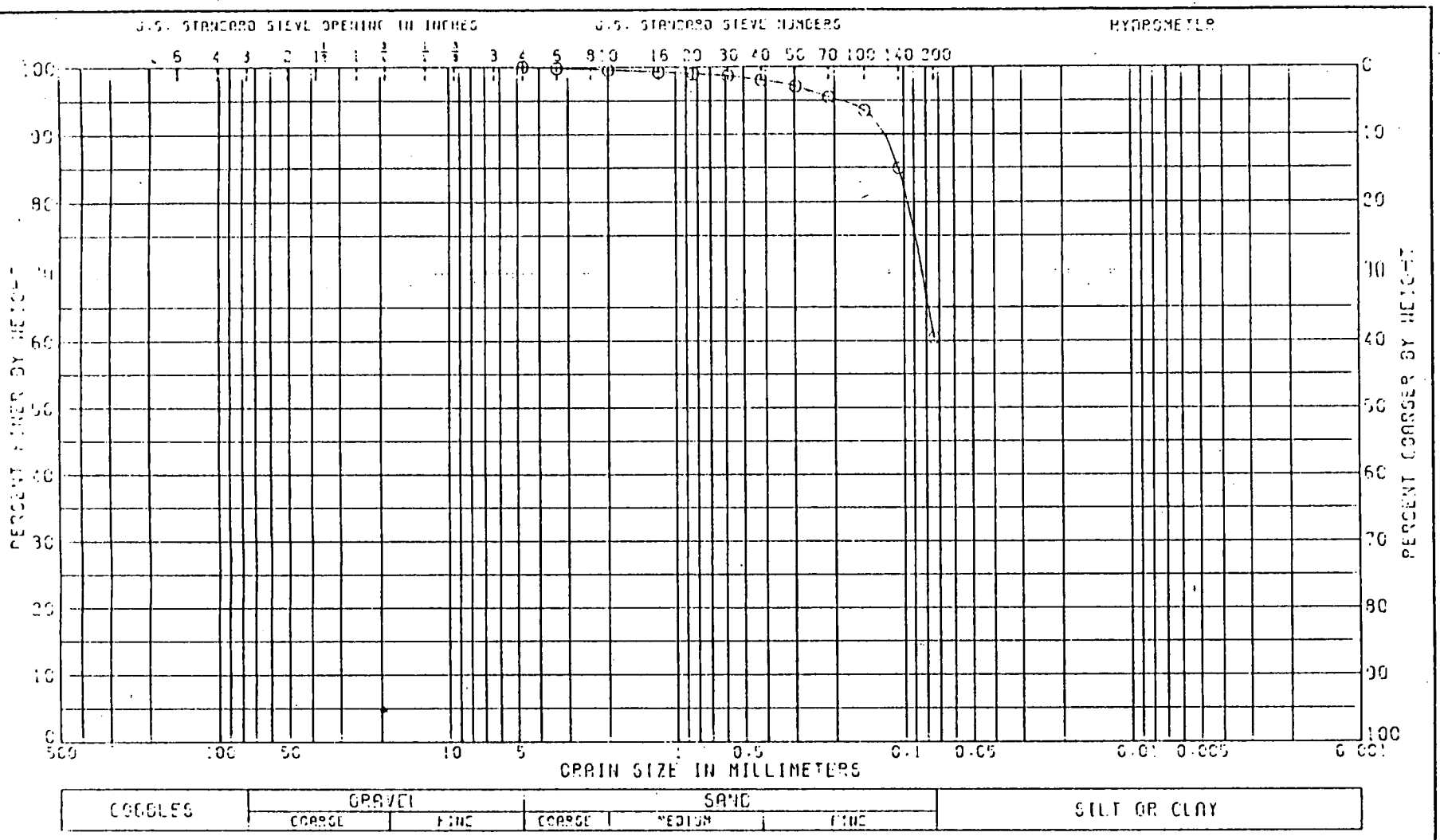
GRADATION CURVE

PROJECT CRANE MLSC

MCCONNISH GORGE

BORING NO 4--1-81 SAMPLE NO 6

DEPTH/ELEV 25.0-27.0 DATE 00 MAR 82



LL 25	PL 19	PI 7	GS	NAT W.% 19.1	

CLASSIFICATION

SANDY CLAY (CL), BROWN

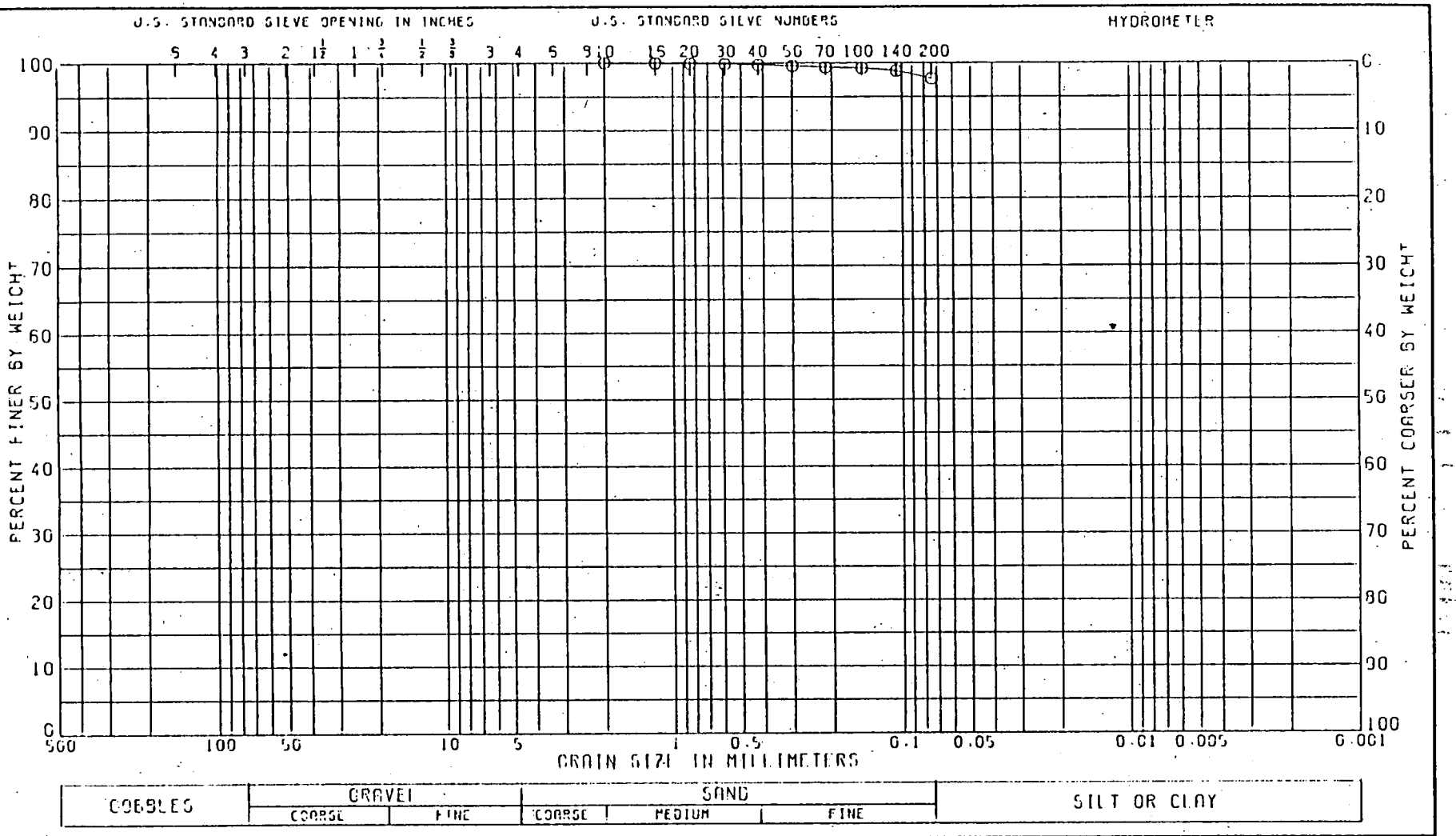
GRADATION CURVE

PROJECT CRANE NESC

MCCOMISH GORGE

BORING NO. 4-1-81 SAMPLE NO 8

DEPTH/ELEV 32.5-33.3 DATE 03 MAR 82



LL 26	PL 18	PI 8	GS	NAT W.% 23.1	

CLASSIFICATION

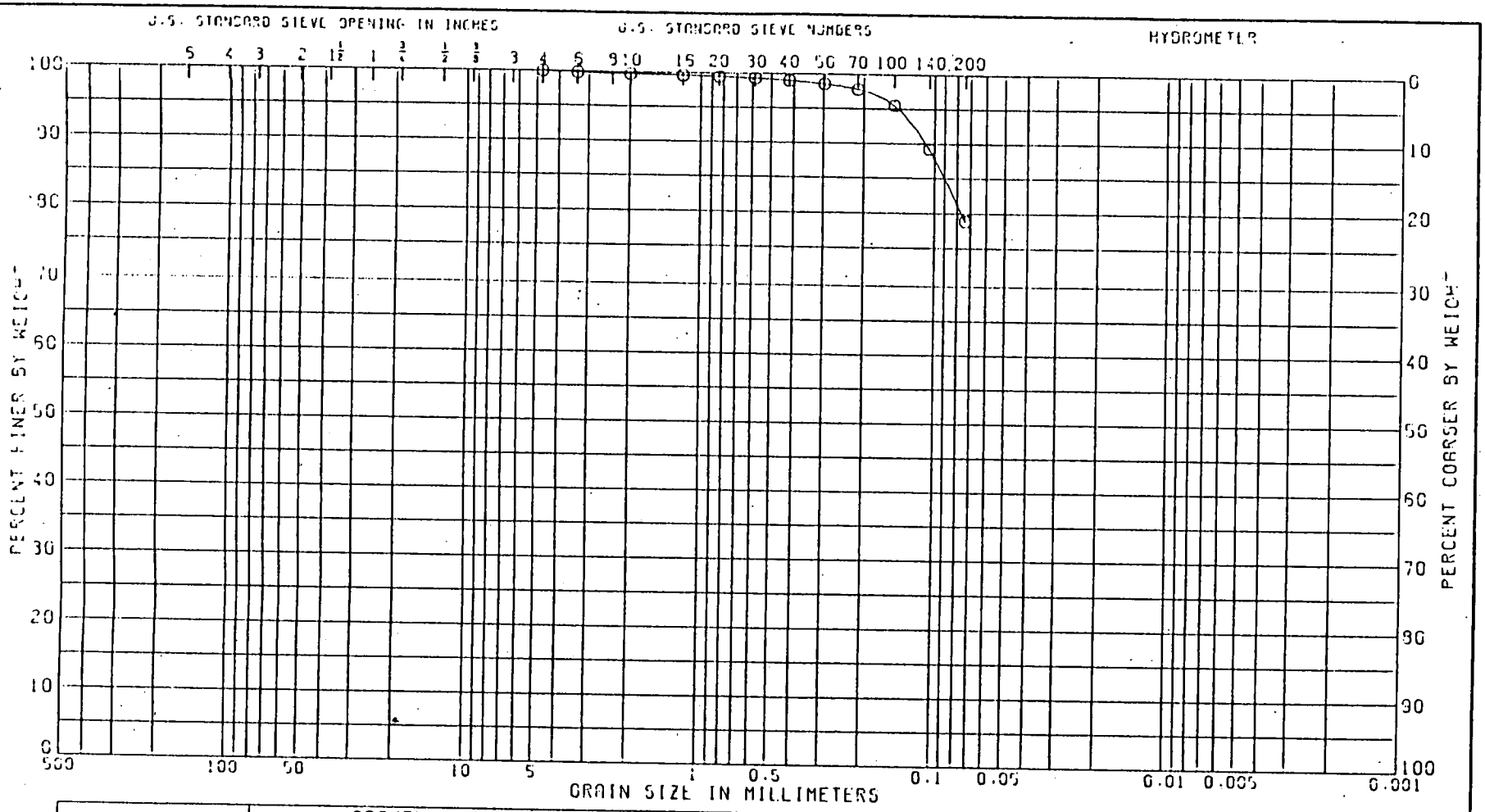
CLAY (CL), GRAY

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO. 4-1-81 SAMPLE NO. 9

DEPTH/ELEV 37.5-39.55 DATE 30 MAR 82



LL	PL	PI	CS	NAT W.%	
NP				17.2	

CLASSIFICATION

SANDY SILT (ML), GRAY

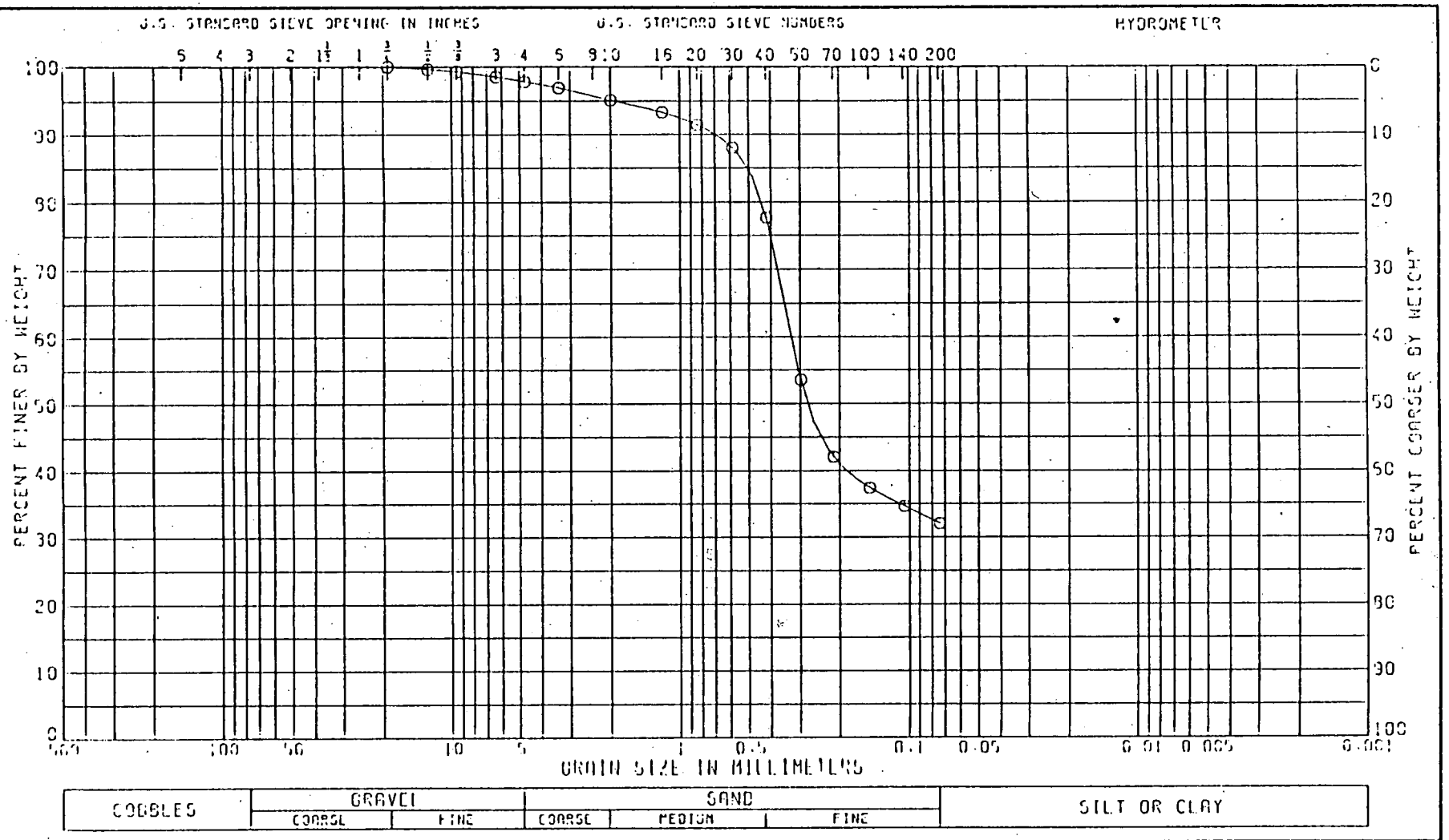
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-1-81 SAMPLE NO. 10

DEPTH/ELEV 40.3-42.48 DATE 30 MAR 82



LL	PL	PI	CS	NAT W.%	
22	13	9		10.6	

CLASSIFICATION

CLAYEY SAND (SC), BROWN

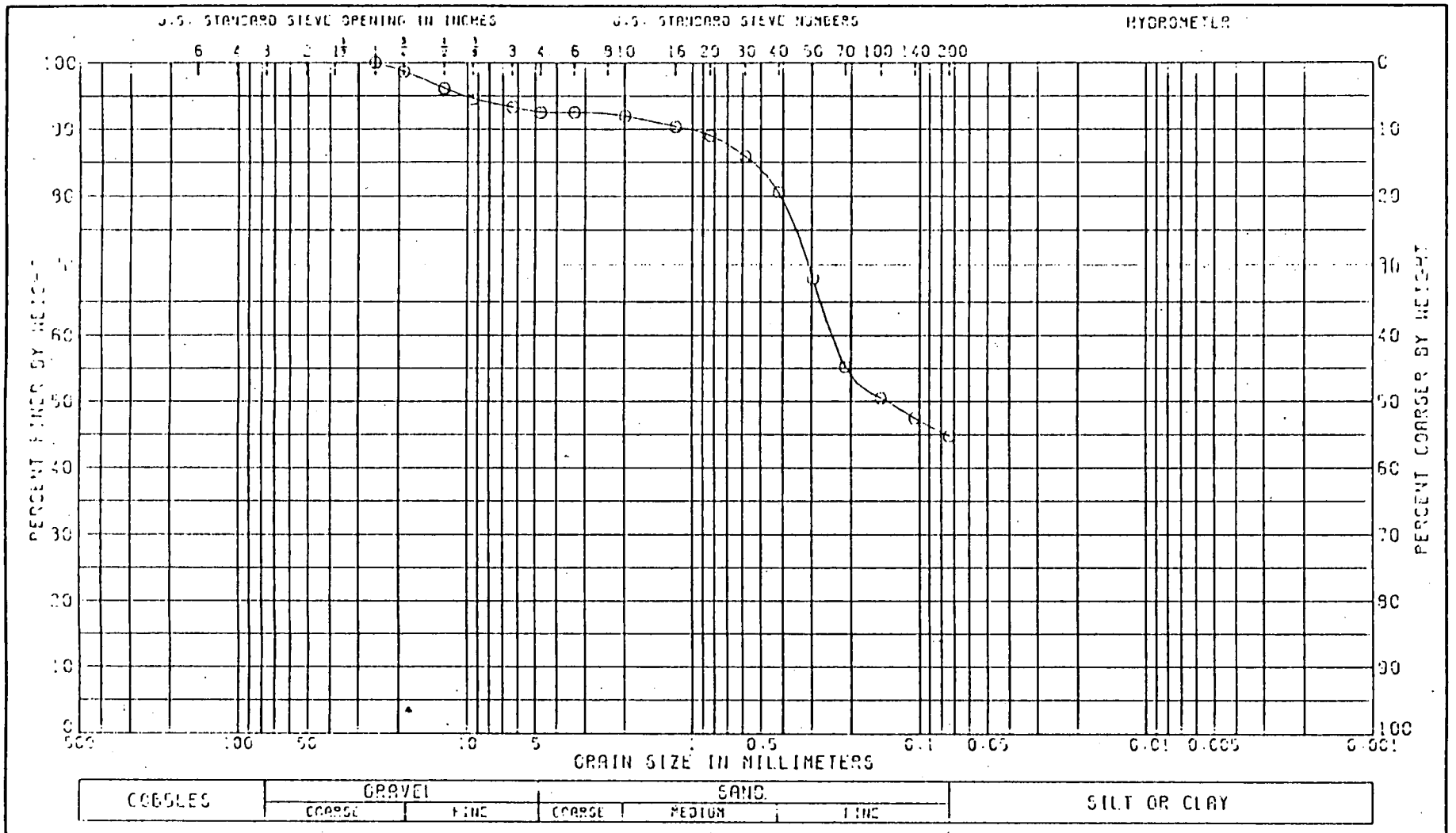
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-2-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.27 DATE 30 MAR 82



LL	PL	PI	GS	NAT W.%
27	12	15		12.6

CLASSIFICATION

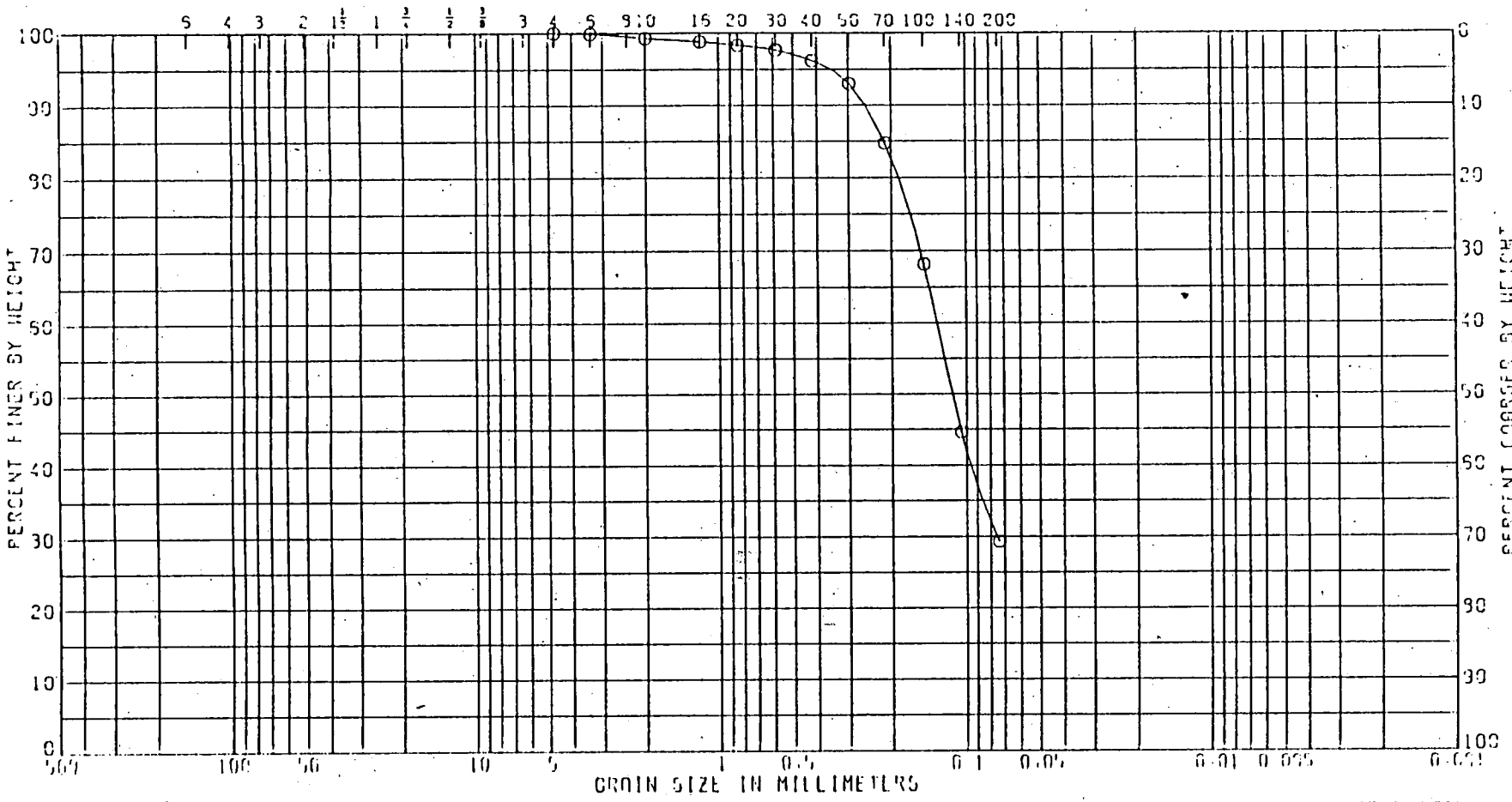
CLAYEY SAND (SC), REDDISH BROWN: WITH GRAVEL
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO 4-2-81 SAMPLE NO 2

DEPTH/ELEV 5.0-5.0 DATE 09 MAR 82



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL 24	PL 15	PI 9	GS	NAT W.% 13.9	

CLASSIFICATION

CLAYEY SAND (SC), BROWN

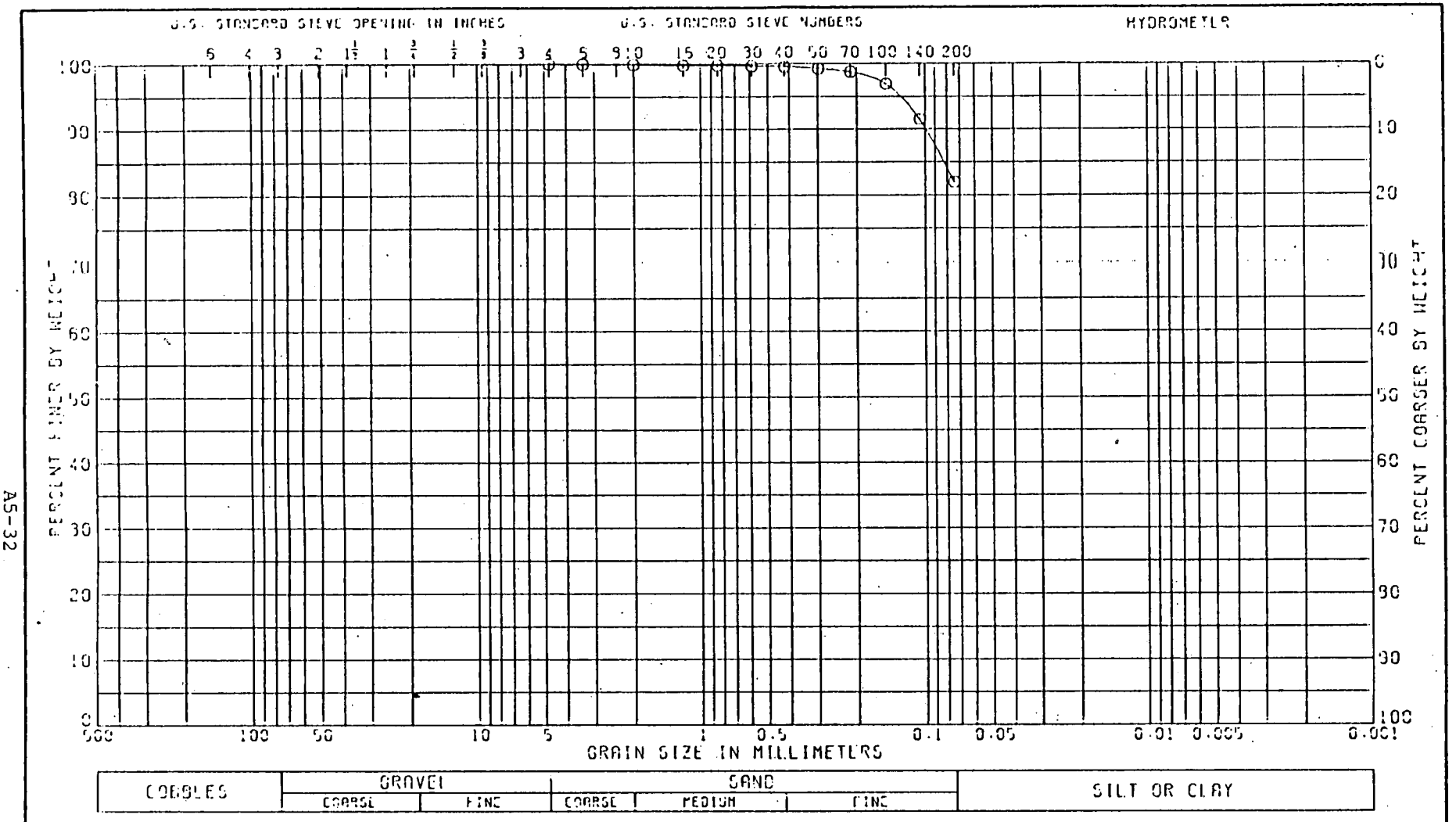
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-2-81 SAMPLE NO 3

DEPTH/ELEV 10.0-11.97 DATE 30 MAR 82



LL	PL	PI	GS	NAT W.%	
29	24	5		22.9	

CLASSIFICATION

SANDY SILT (ML), BROWN

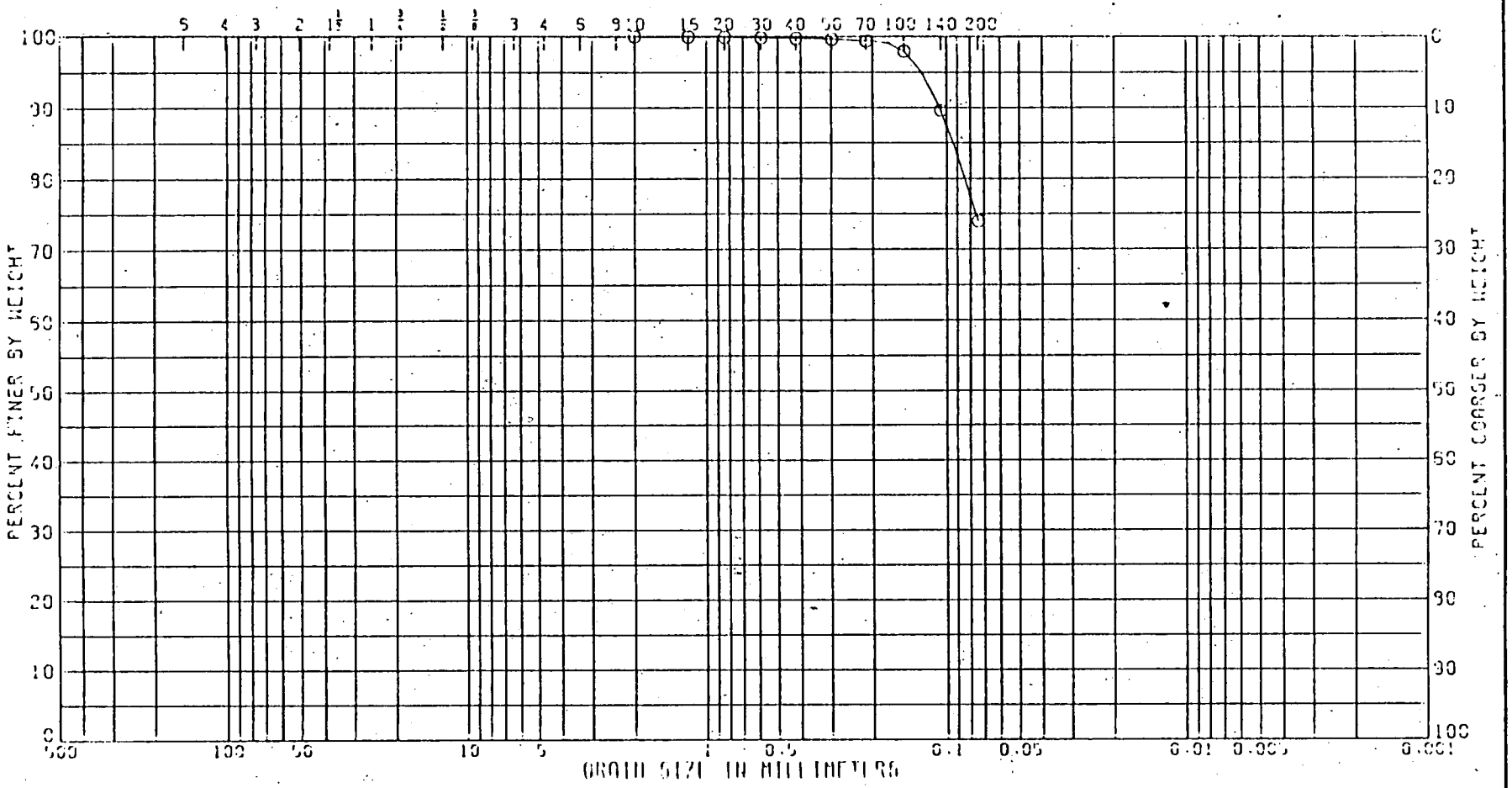
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-2-91 SAMPLE NO. 4

DEPTH/ELEV 15.0-16.60 DATE 30 MAR 92



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	CS	NAT W.%	
21	16	5		30.0	

CLASSIFICATION

SANDY CLAYEY SILT (ML-CL), BROWN

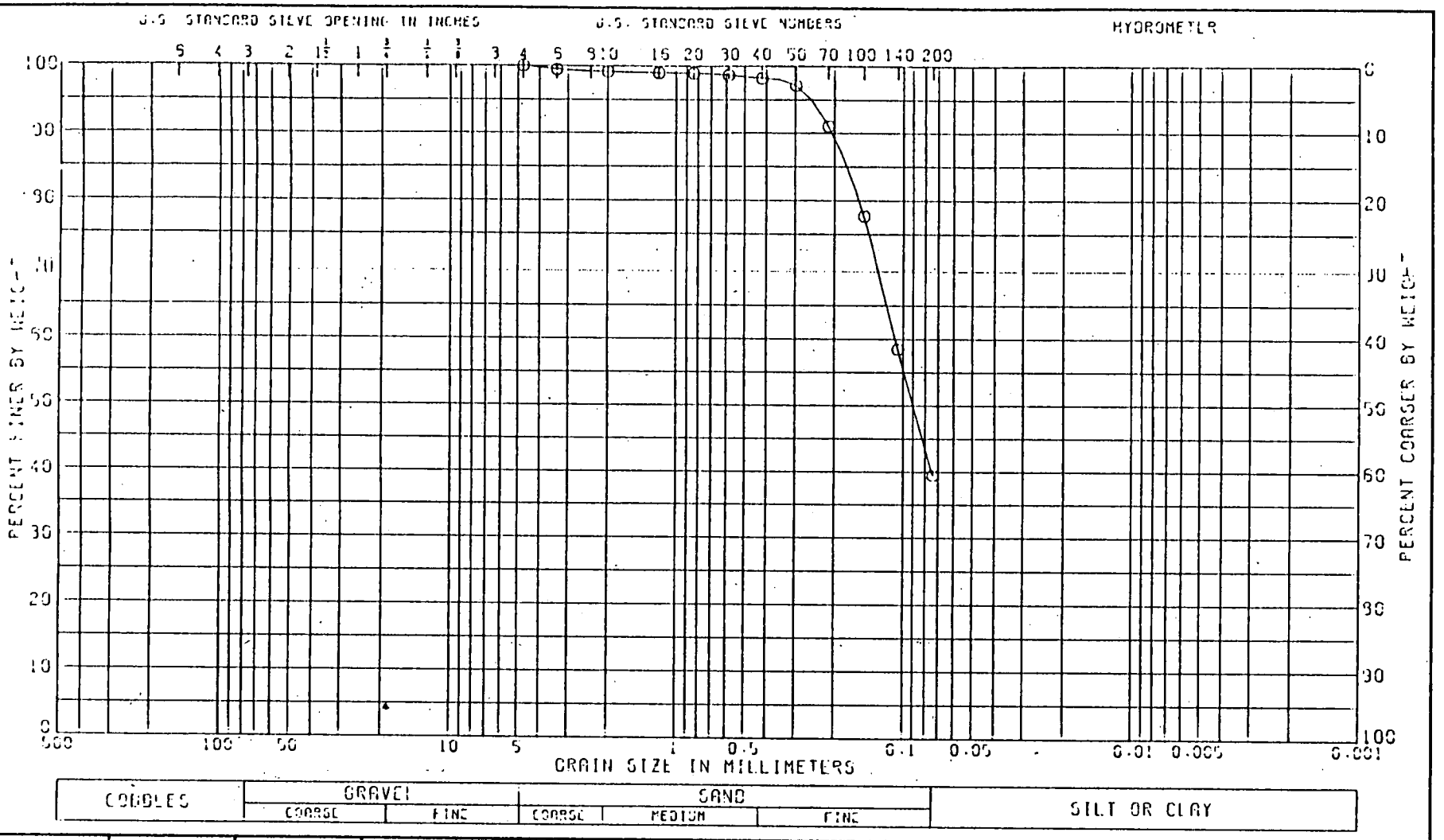
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-2-91 SAMPLE NO 5G

DEPTH/ELEV 20.0-21.5 DATE 30 MAR 92



LL NP	PL	PI	CS	NAT W.% 13.6	

CLASSIFICATION

SILTY SAND (SM), GRAYISH BROWN

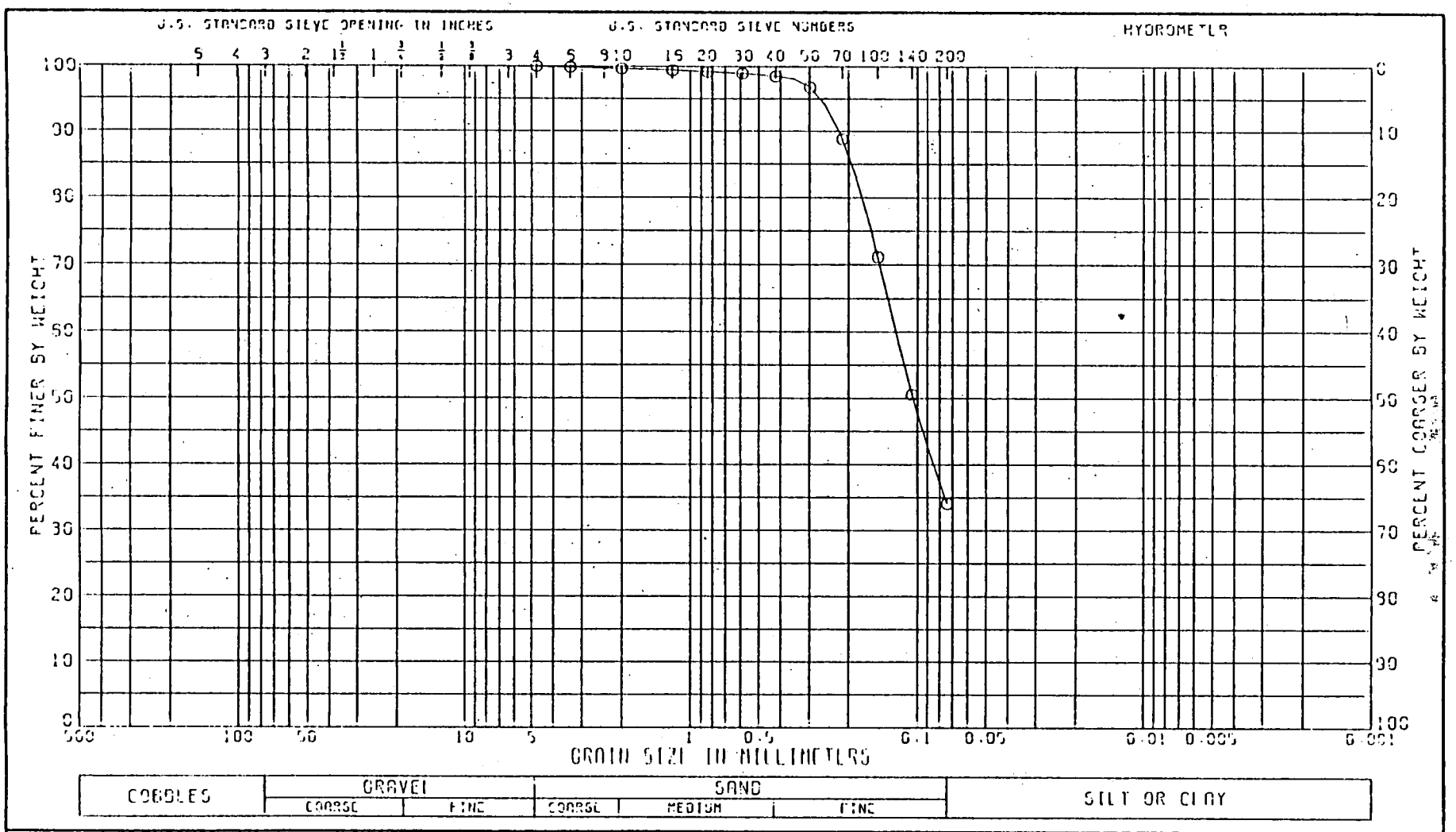
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-2-81 SAMPLE NO. 6

DEPTH/ELEV 25.0-27.05 DATE 30 MAR 82



LL	PL	PI	CS	NAT W.%	
NP				14.6	

CLASSIFICATION

SILTY SAND (SM), BROWN

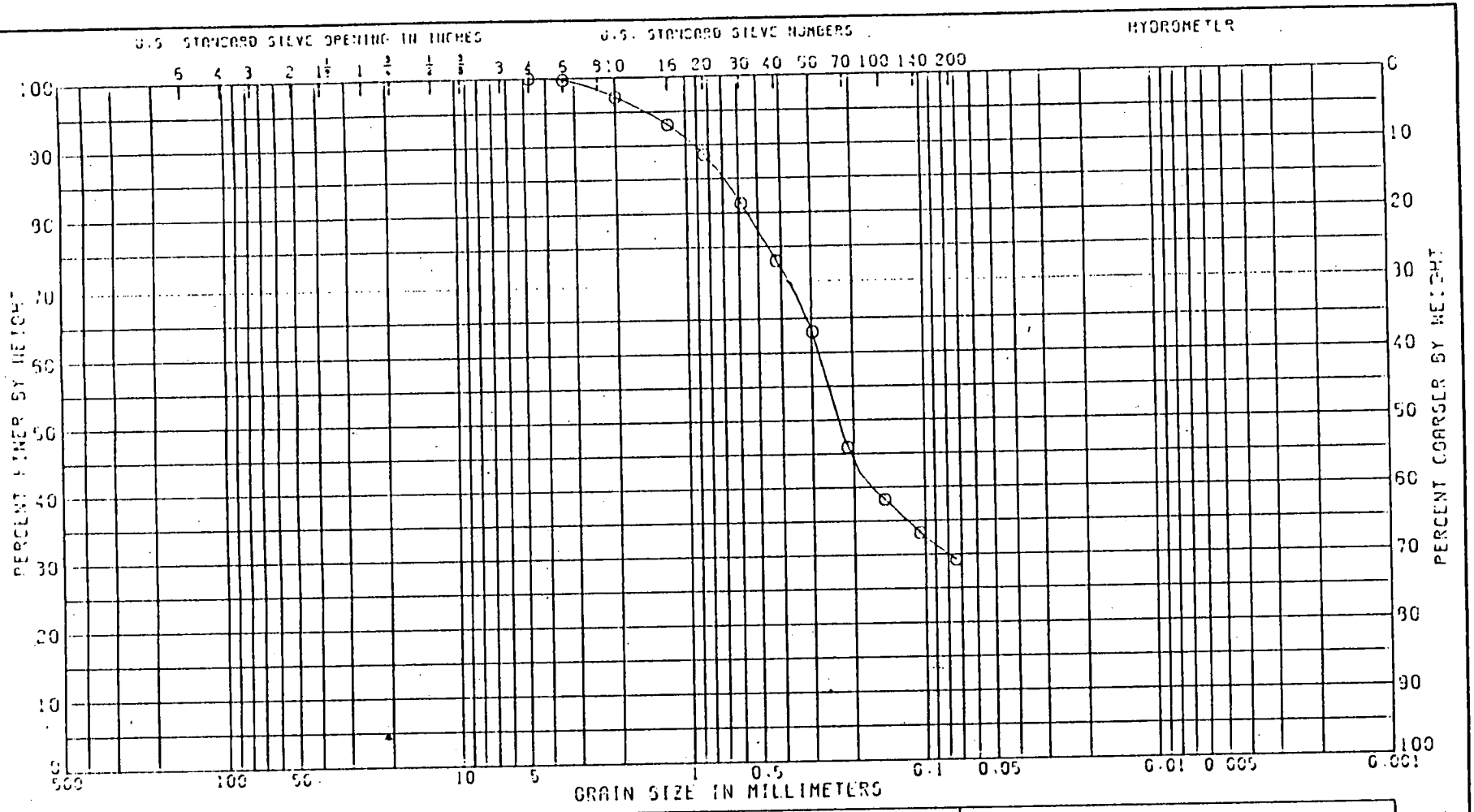
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO: 4-2-91 SAMPLE NO: 7

DEPTH/ELEV 30.0-32.05 DATE 30 MAR 92



LL 25	PL 13	PI 12	GS	NAT W.% 14.1	

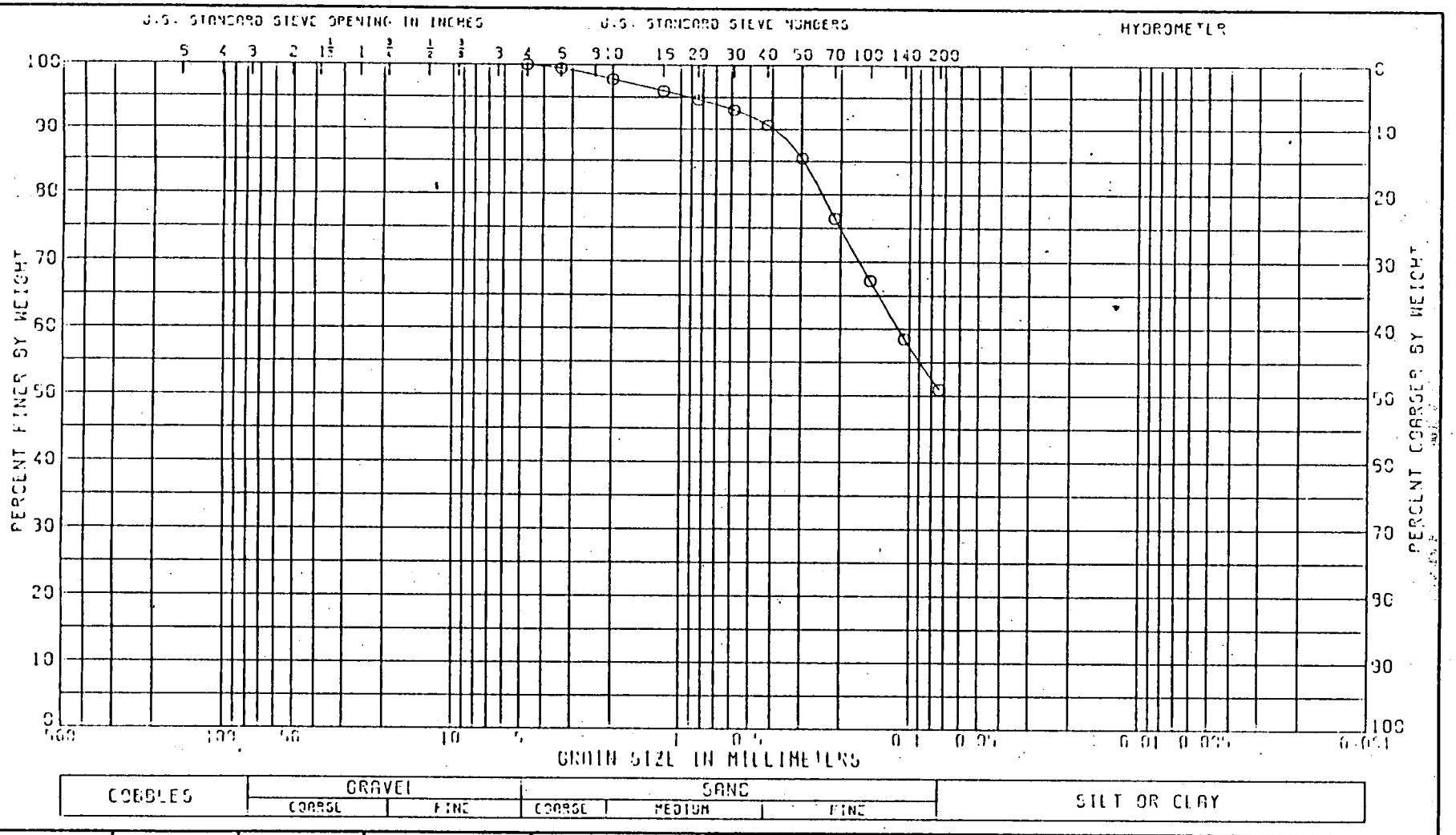
CLASSIFICATION
CLAYEY SAND (SC), BROWN

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-3-91 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.09 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%	
NP				49.7	

CLASSIFICATION

SANDY SILT (ML), GRAYISH BROWN

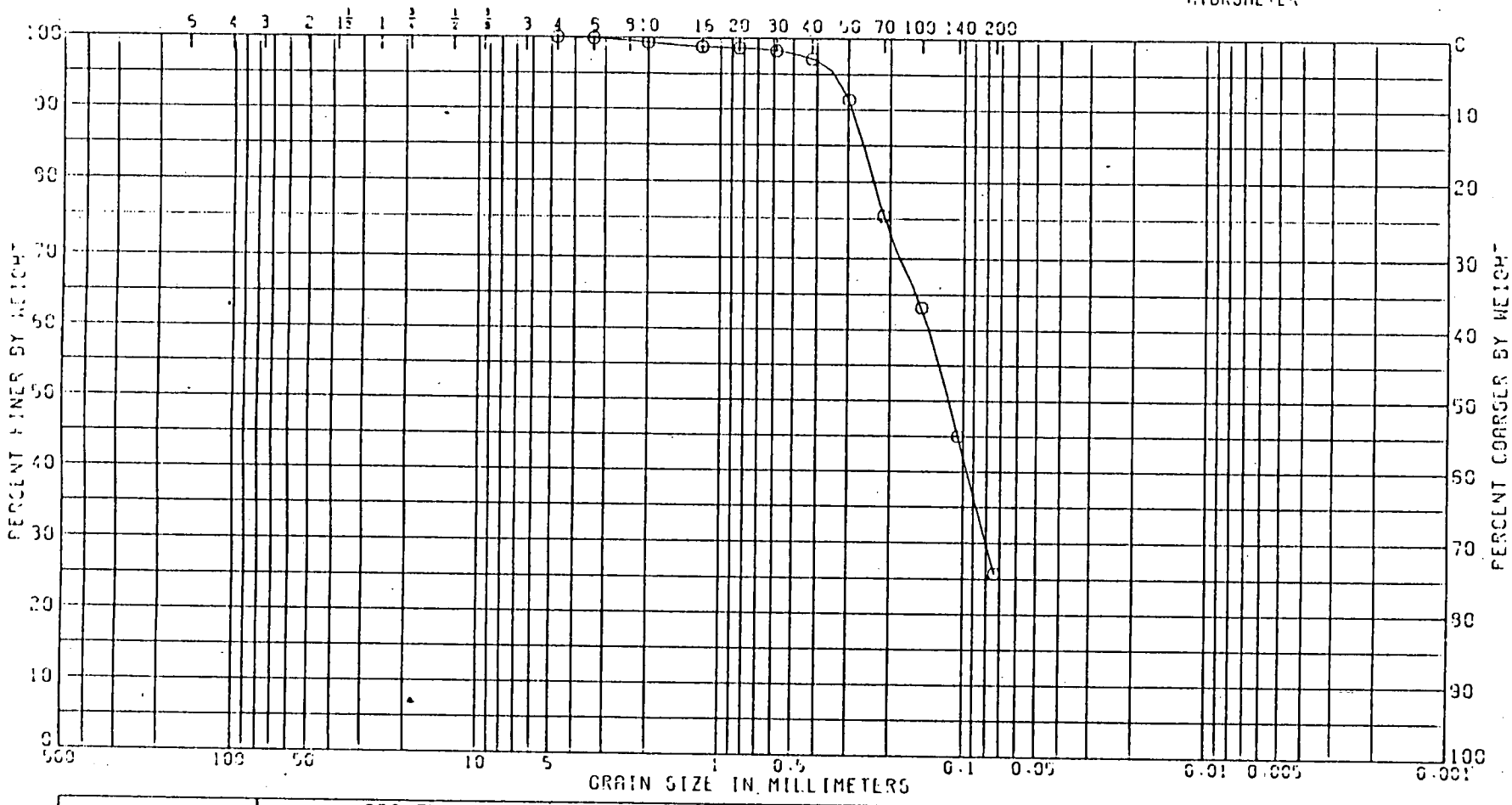
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-3-81 SAMPLE NO 2

DEPTH/ELEV 5.0-7.13 DATE 30 MAR 82



LL	PL	PI	GS	NAT W.%	
NP				4.9	

CLASSIFICATION

SILTY SAND (SM), BROWN

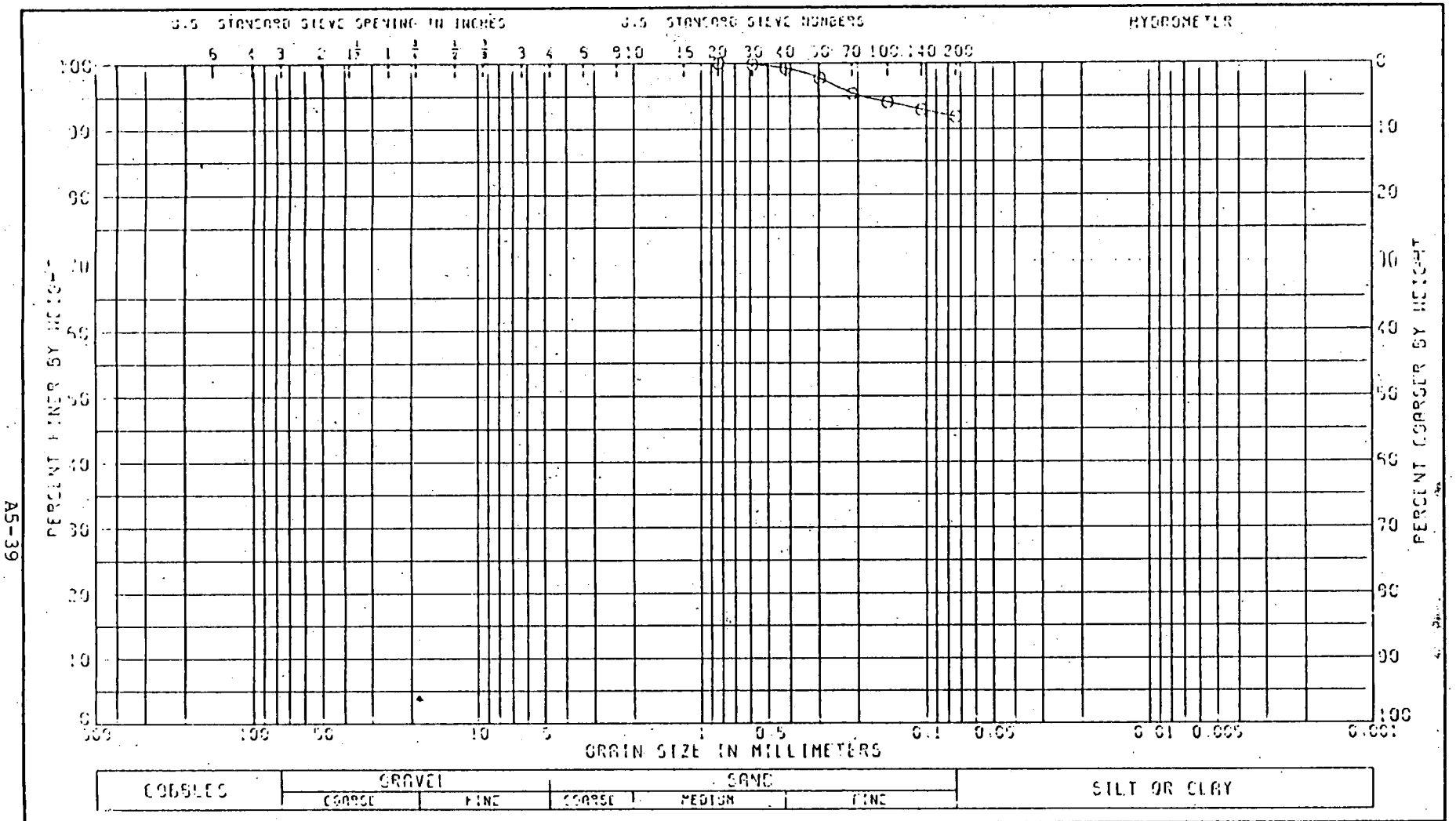
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-3-81 SAMPLE NO. 3

DEPTH/ELEV 10.0-11.83 DATE 30 MAR 82



LL 39	PL 18	PI 21	CS	NAT W.% 20.7	

CLASSIFICATION

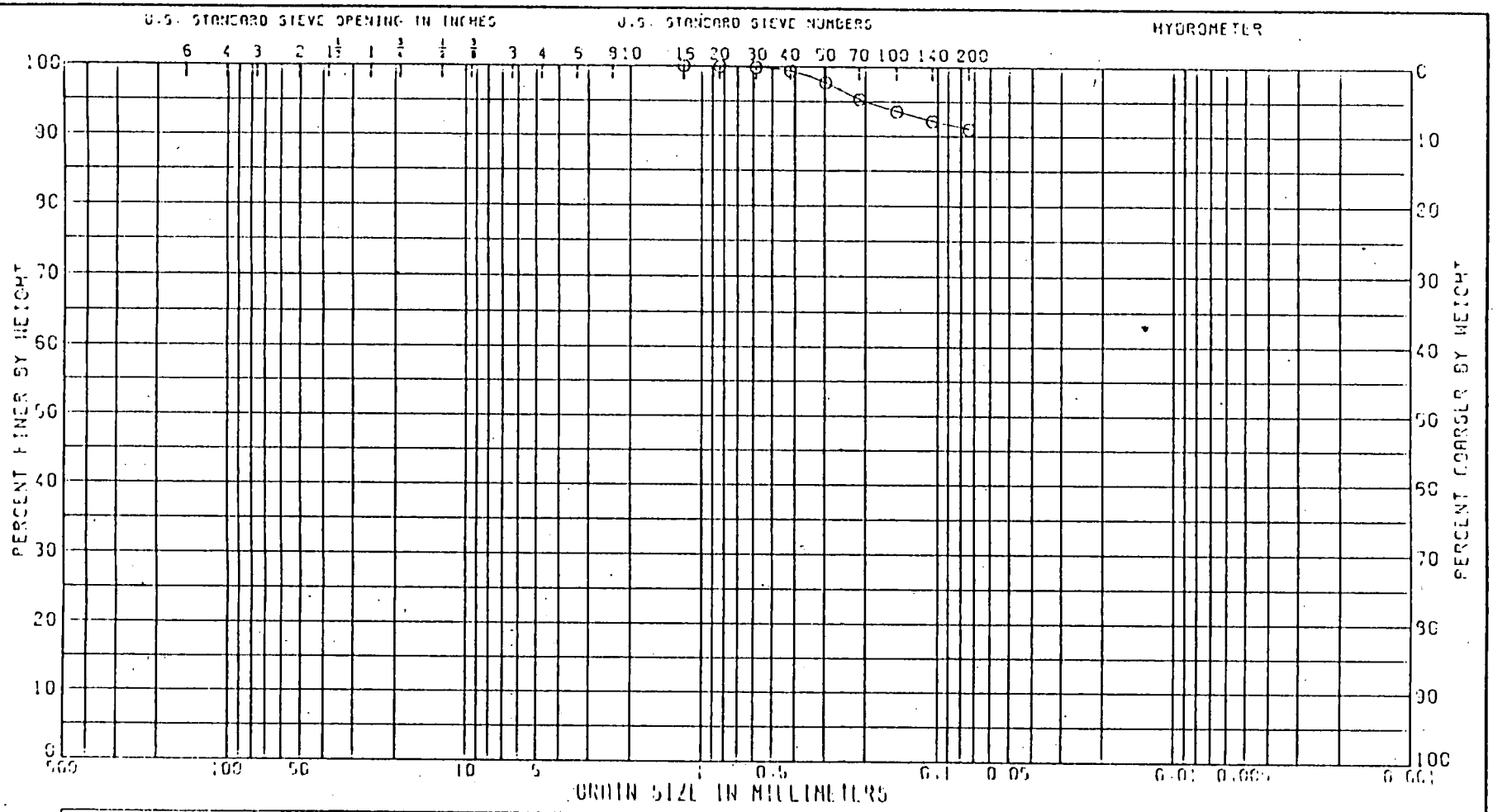
CLAY (CL), REDDISH BROWN; WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO 4-4-81 SAMPLE NO 1

DEPTH/ELEV 0.0-2.26 DATE 26 FEB 82



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%	
45	20	25		21.8	

CLASSIFICATION

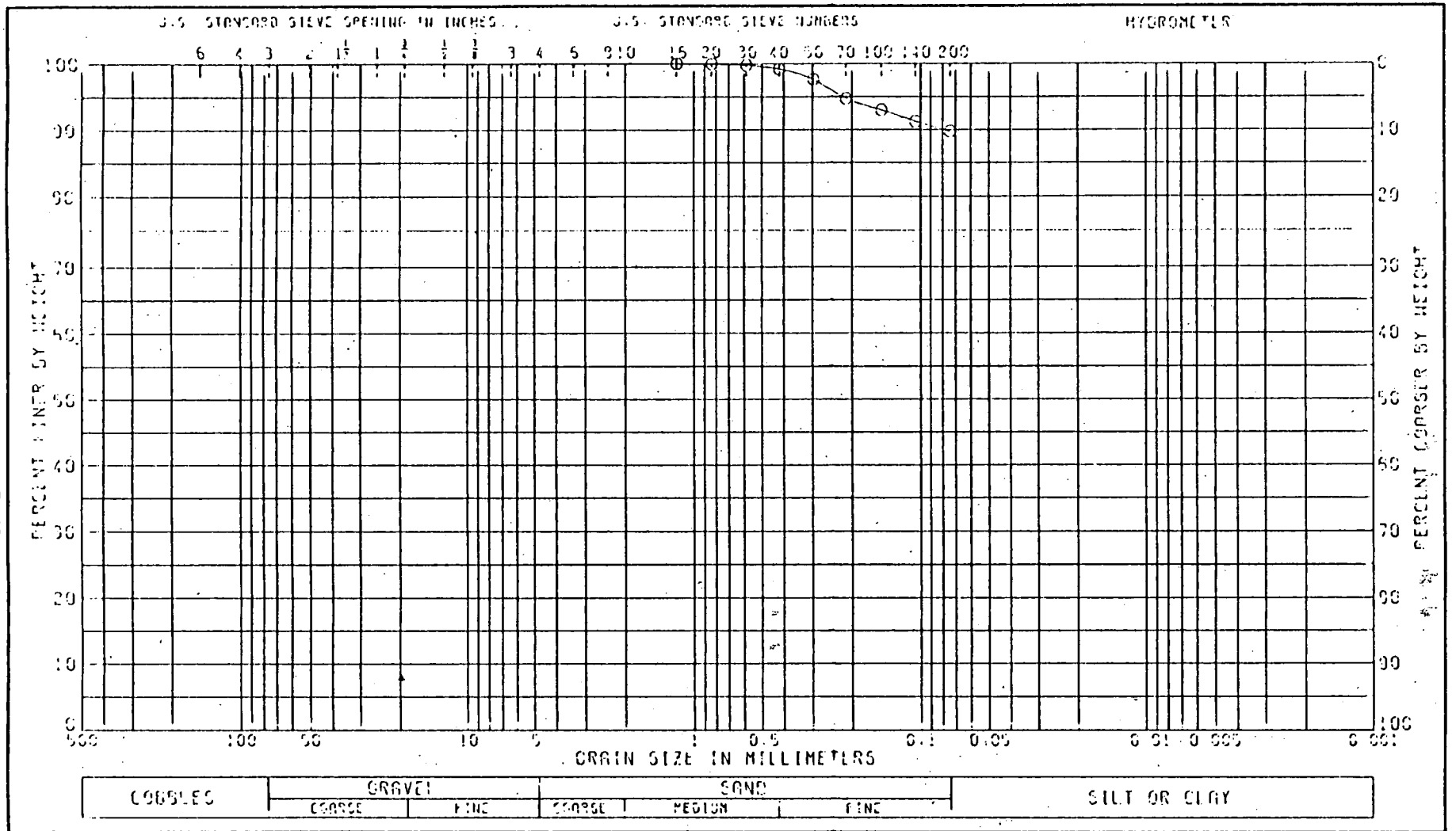
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-4-81 SAMPLE NO 2

DEPTH/ELEV 5.0-6.64 DATE 11 FEB 82



LL 35	PL 19	PI 16	GS	NAT W.% 12.0	

CLASSIFICATION

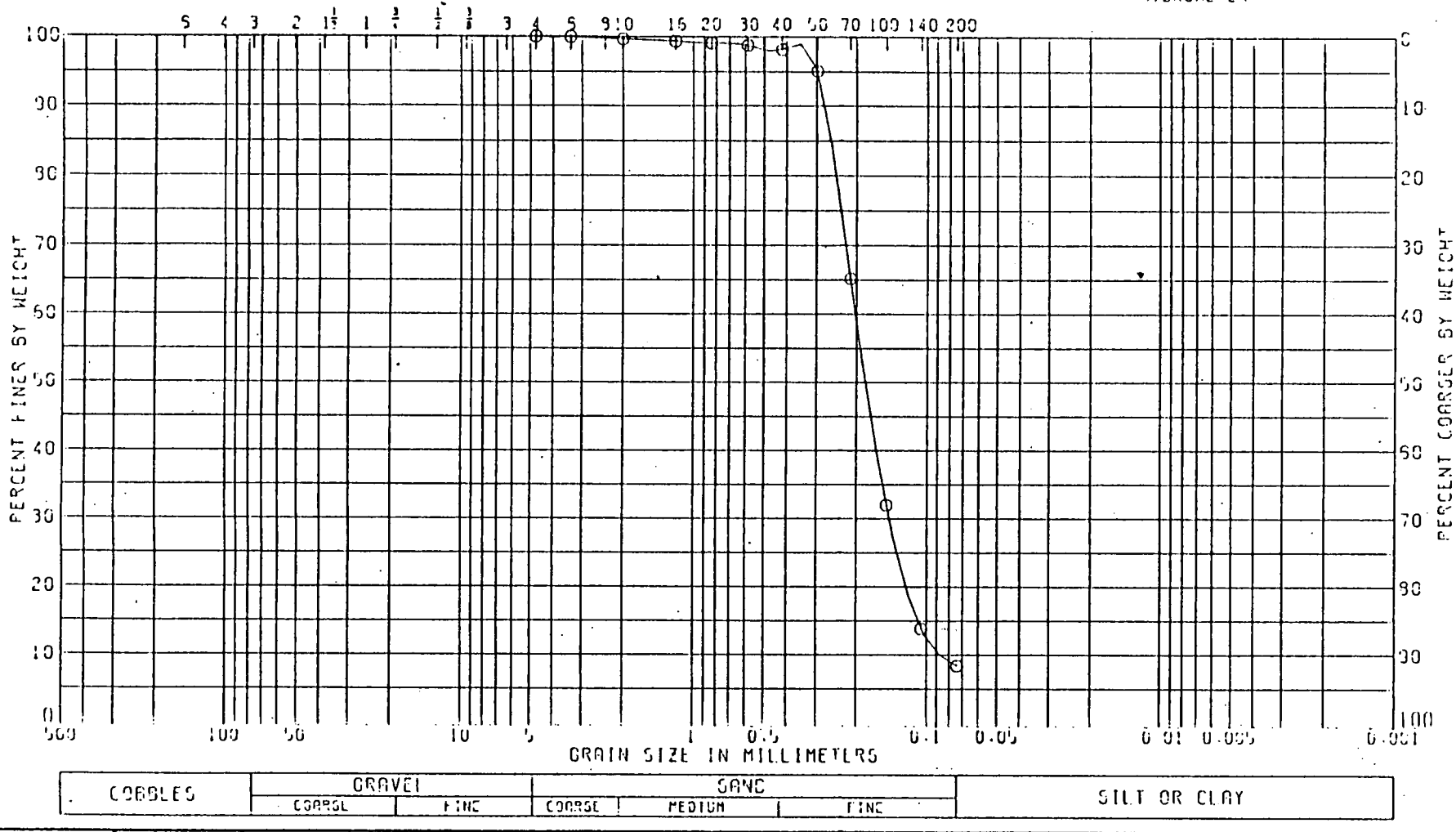
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO 4-1-81 SAMPLE NO 3

DEPTH/ELEV 10.0-12.10 DATE 25 FEB 82



LL NP	PL	PI	GS	NAT W.% 24.3

CLASSIFICATION

SILTY SAND (SP-SM), GRAY

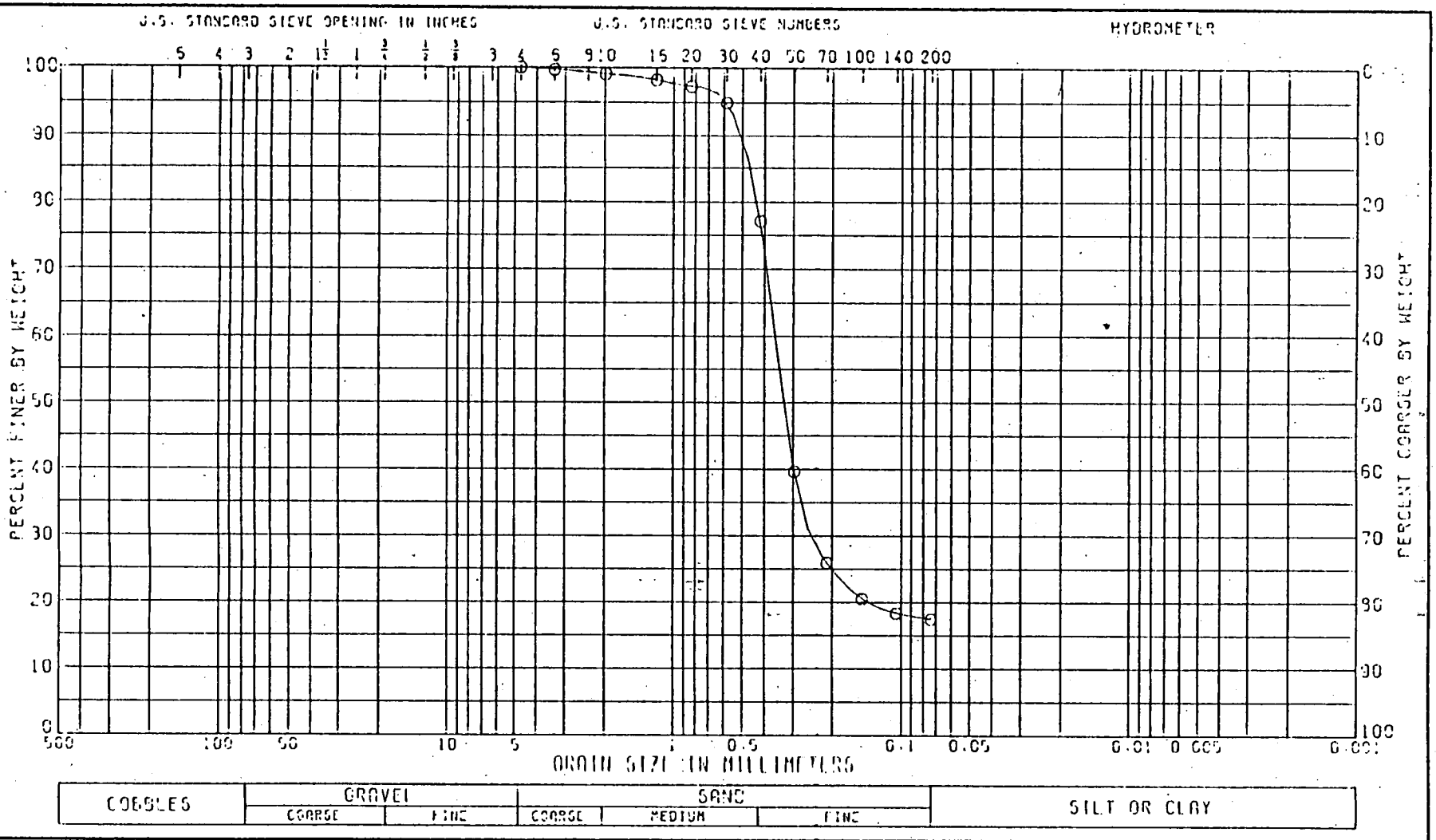
GRADATION CURVE

PROJECT CRANE NWSC

MCCOMISH GORGE

BORING NO. 4-3-81 SAMPLE NO. 4G

DEPTH/ELEV 15.0-17.0 DATE 30 MAR 92



LL	PL	PI	CS	NAT W.%	
32	14	18		9.9	

CLASSIFICATION

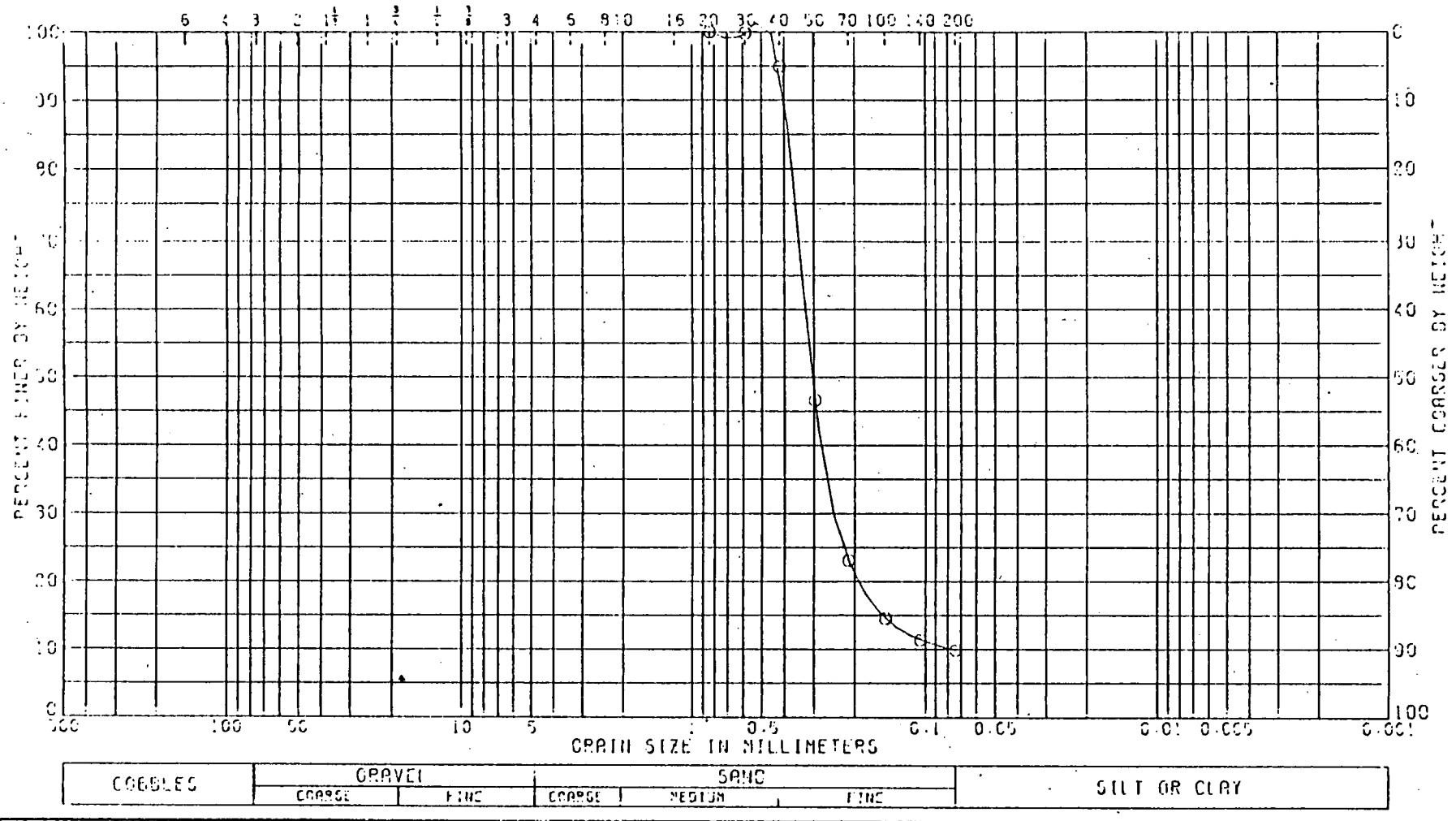
CLAYEY SAND (SC), BROWN

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-4-91 SAMPLE NO. 4

DEPTH/ELEV 15.0-16.97 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%	
NP				5.8	

CLASSIFICATION

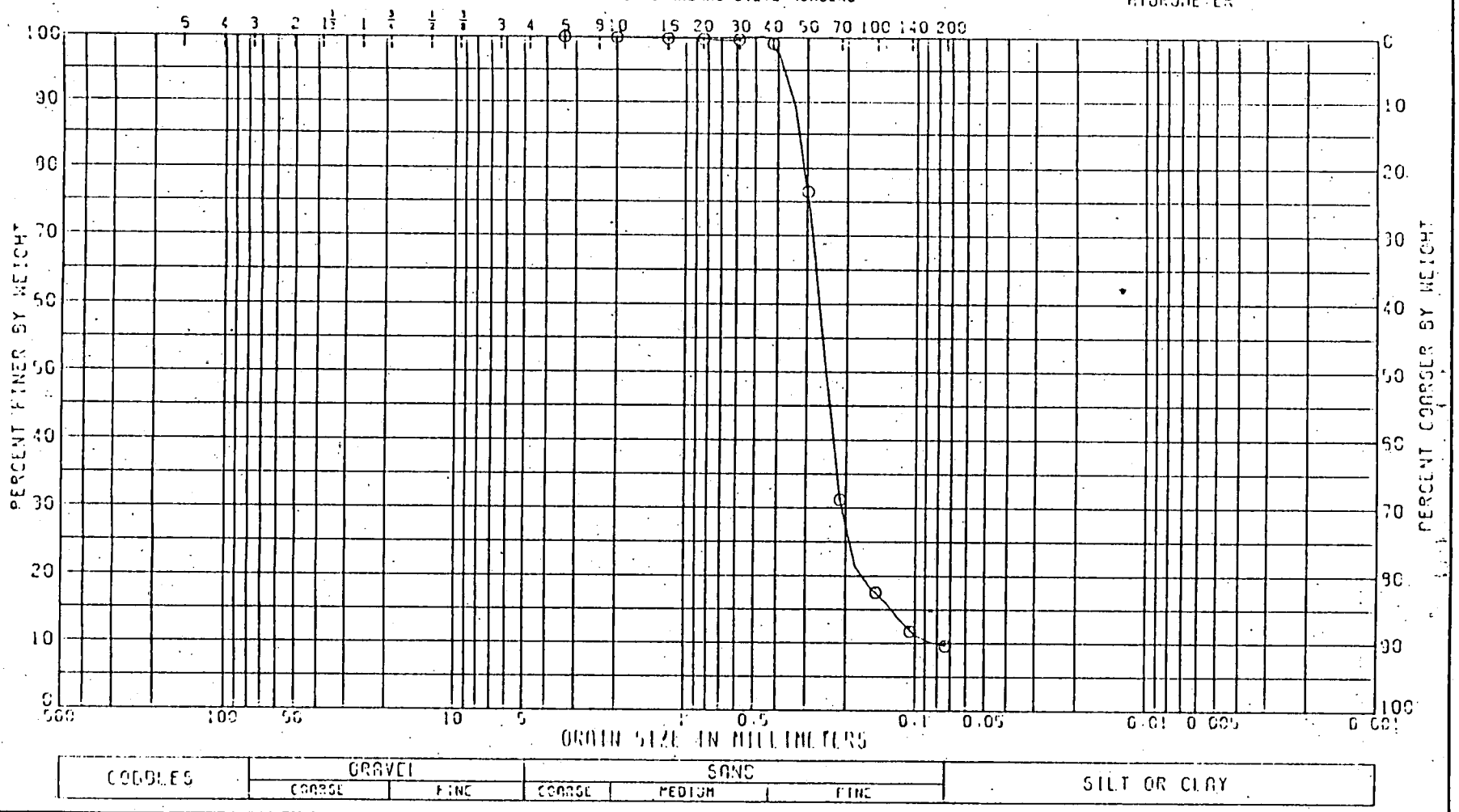
SILTY SAND (SP-SM), BROWN

GRADATION CURVE

PROJECT CRANE NESC
MCCOMISH GORGE

BORING NO. 4-4-81 SAMPLE NO. 5

DEPTH/ELEV 20.0-22.08 DATE 09 MAR 82



LL NP	PL	PI	GS	NAT W.% 18.4	

CLASSIFICATION

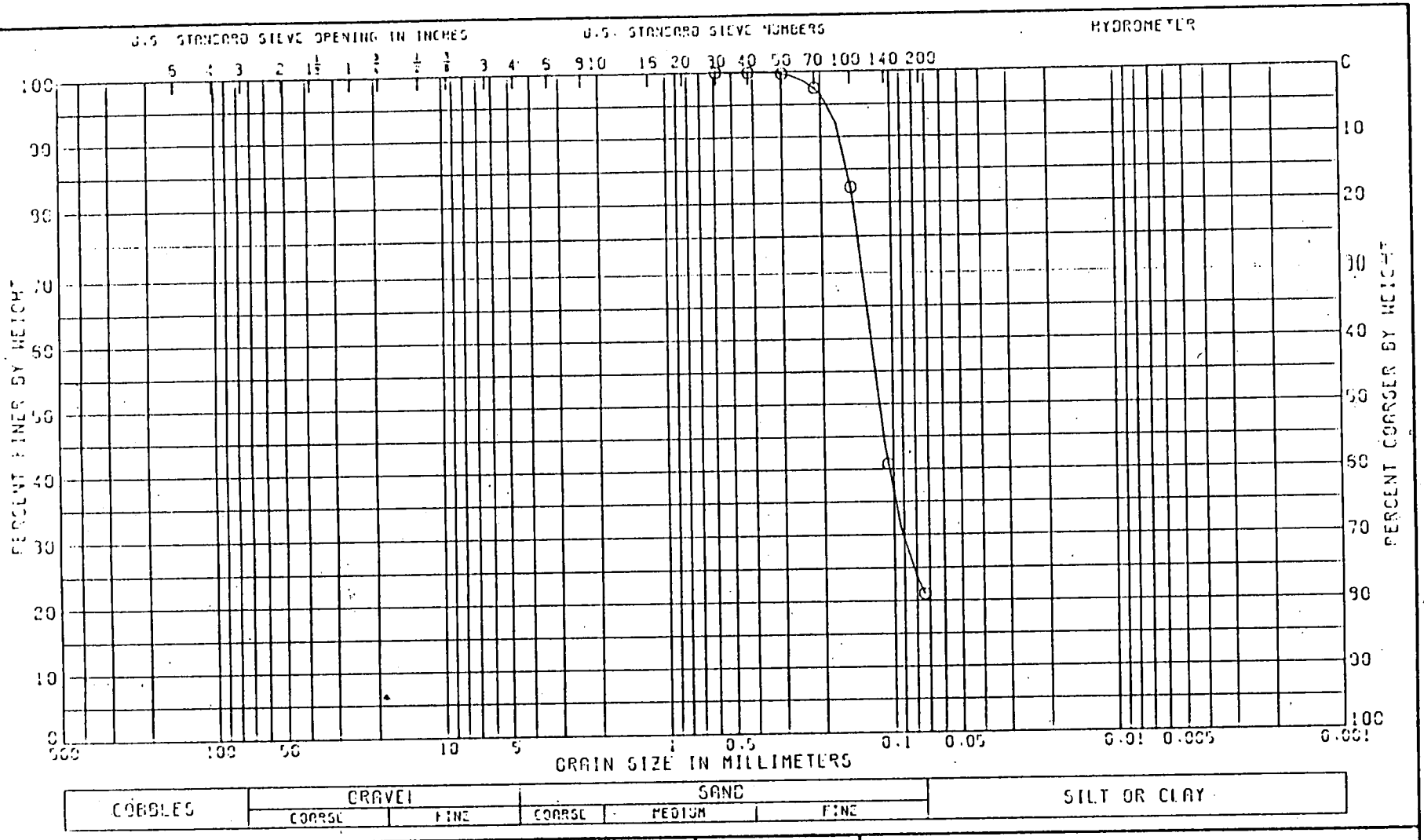
SILTY SAND (SP-SM), REDDISH BROWN

GRADATION CURVE

PROJECT CRANE NWSC MCCORMISH GORGE

BORING NO. 4-4-91 SAMPLE NO S

DEPTH/ELEV 25.0-26.50 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%
NP				23.9

CLASSIFICATION

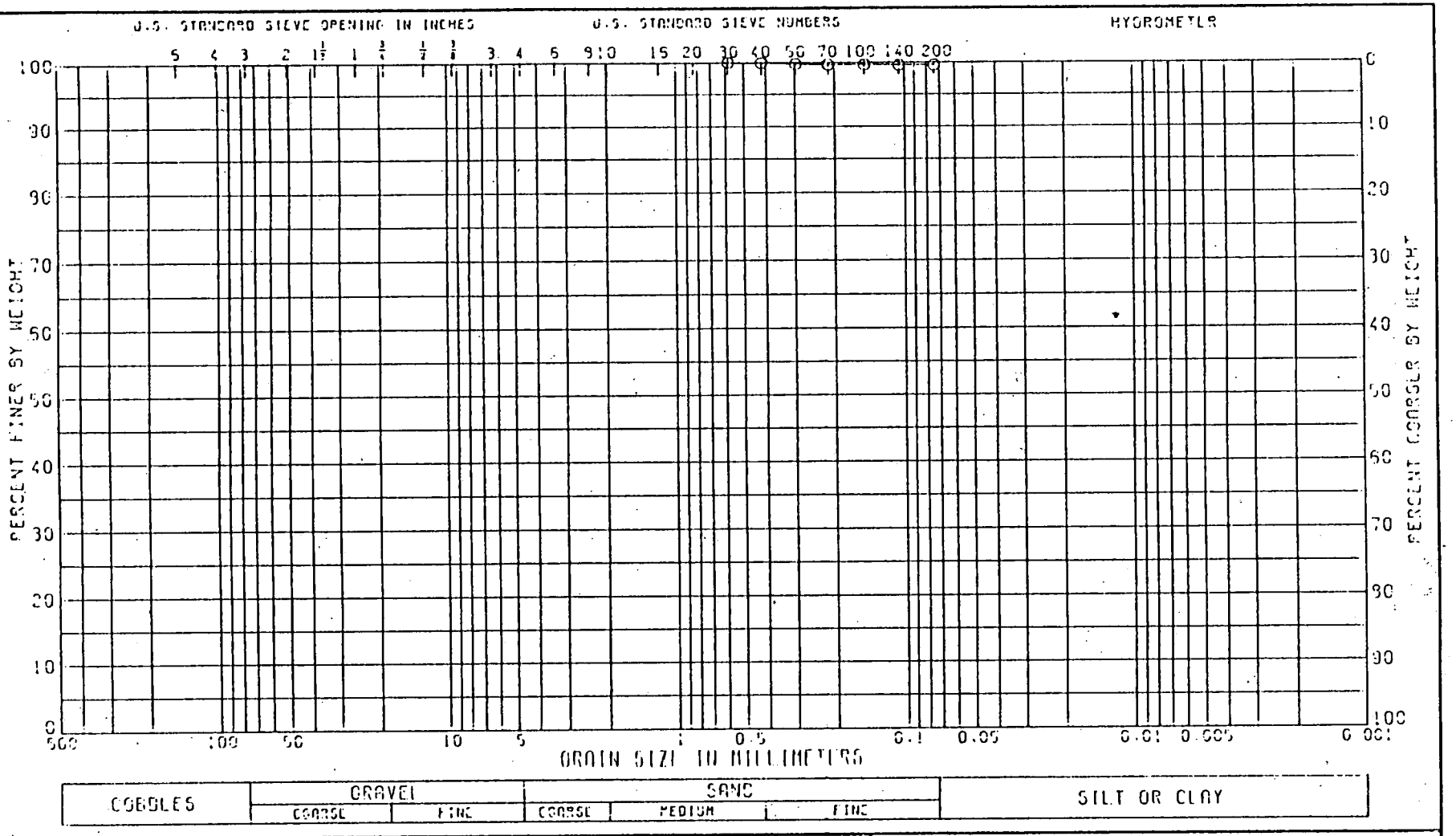
SILTY SAND (SM), REDDISH BROWN

GRADATION CURVE

PROJECT CRANE NWSC
MCCOMISH GORGE

BORING NO. 4-4-91 SAMPLE NO. 7

DEPTH/ELEV 27.8-29.00 DATE 30 MAR 92



LL	PL	PI	GS	NAT W.%
31	16	15		33.6

CLASSIFICATION

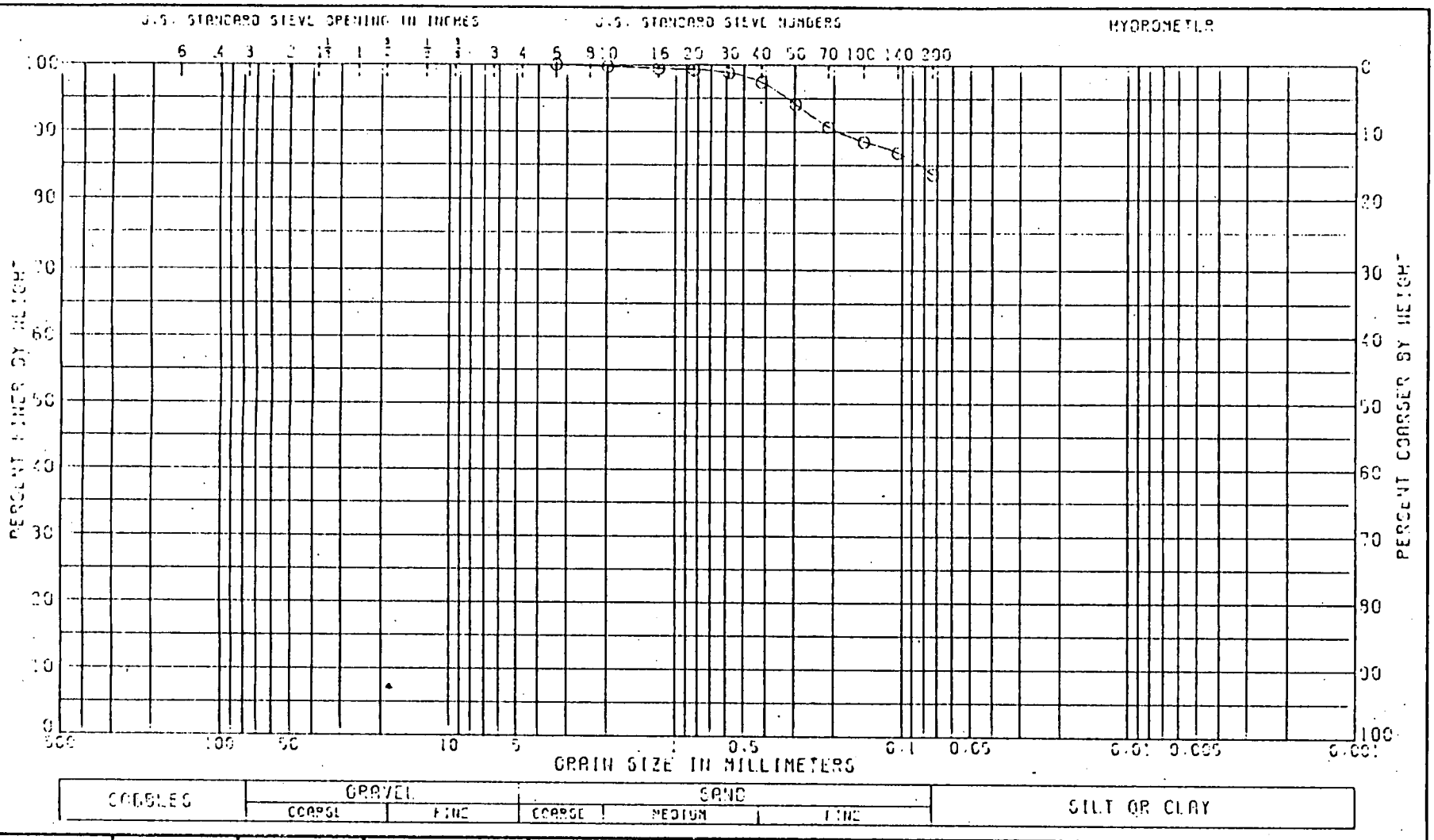
CLAY (CL), GRAY

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-4-91 SAMPLE NO 8

DEPTH/ELEV 35.0-37.05 DATE 11 FEB 92



LL 35	PL 16	PI 19	GS	NAT W.% 23.6	

CLASSIFICATION

SANDY CLAY (CL), TAN

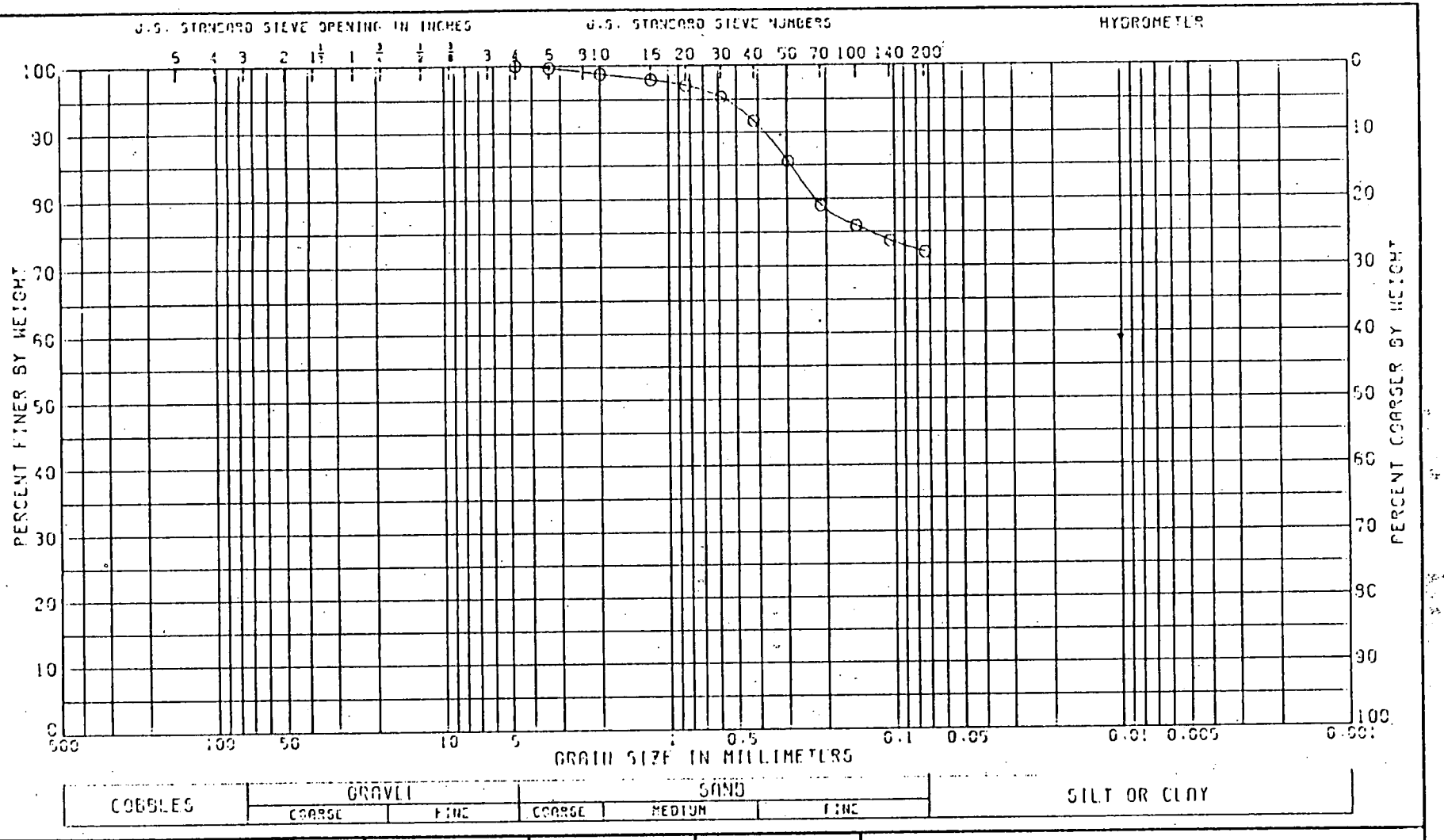
GRADATION CURVE

PROJECT CRANE NESC

MCCOMISH GORGE

BORING NO. 4--5--81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.8 DATE 03 MAR 82



LL 38	PL 18	PI 20	GS	NAT W.% 21.1

CLASSIFICATION

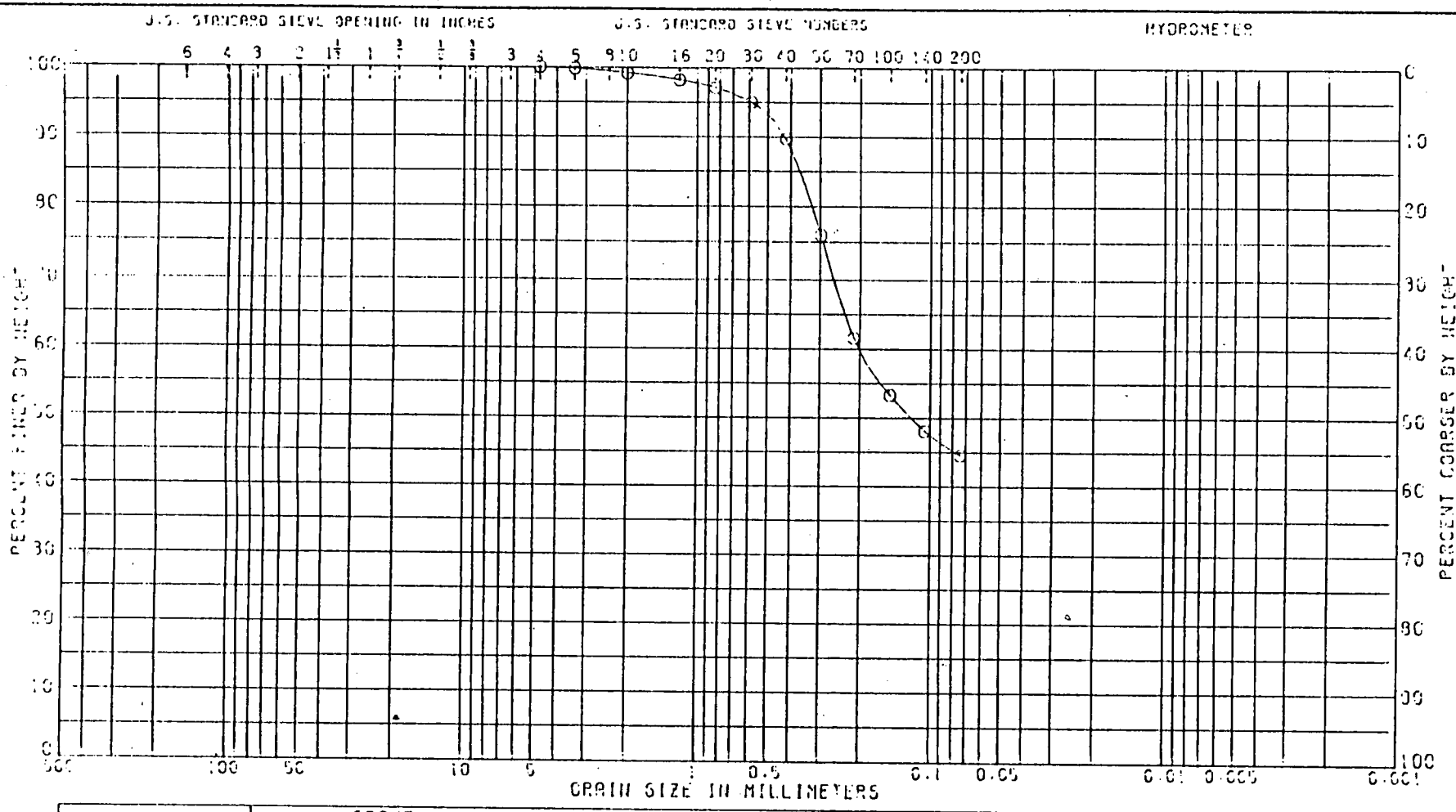
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-5-91 SAMPLE NO 2

DEPTH/ELEV 5.0-6.36 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%
30	17	13		22.9

CLASSIFICATION

CLAYEY SAND (SC), DARK BROWN

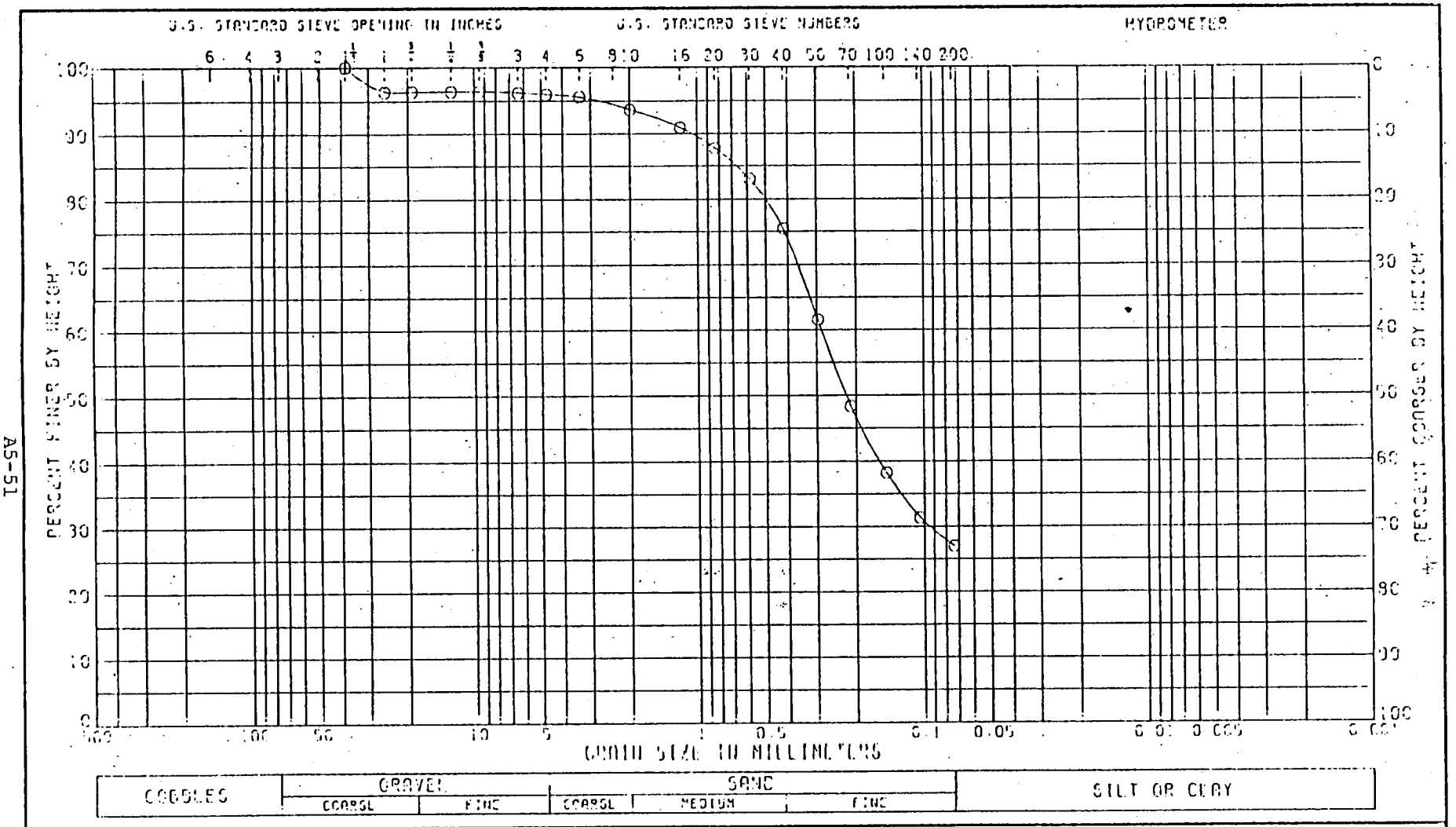
GRADATION CURVE

PROJECT CRANE MUSC

MCCOMISH GORGE

BORING NO. 4-5-81 SAMPLE NO 3

DEPTH/ELEV 10.0-11.10 DATE 09 MAR 82



LL NP	PL	PI	GS	NAT W.% 12.4

CLASSIFICATION

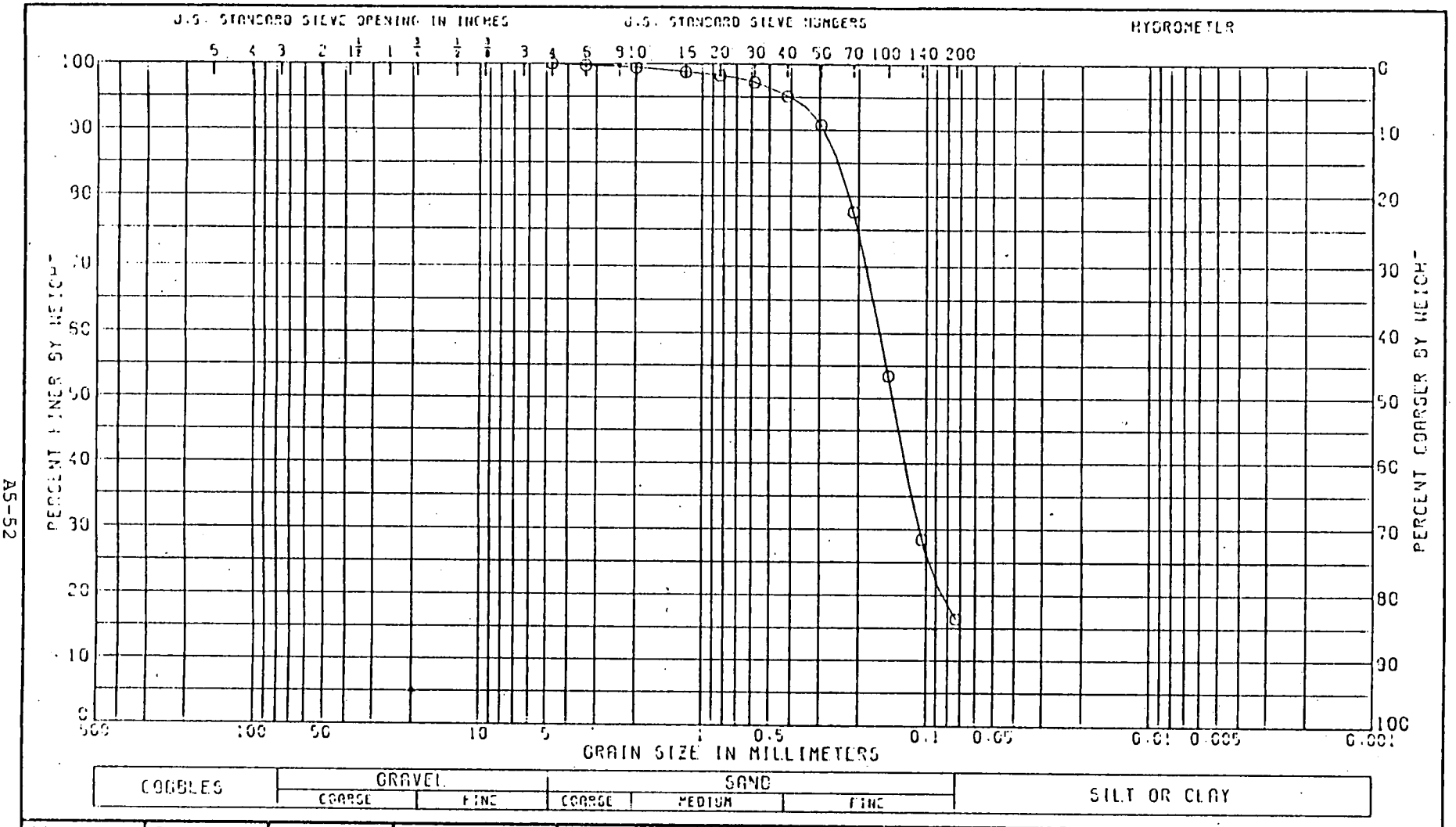
SILTY SAND (SM), LIGHT BROWN: TRACE OF GRAVEL
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE MUSC
MCCOMISH GORGE

BORING NO 4-6-81 SAMPLE NO 1

DEPTH/ELEV 0.0-2.14 DATE 09 MAR 82



LL	PL	PI	GS	NAT W.%	
NP				10.2	

CLASSIFICATION

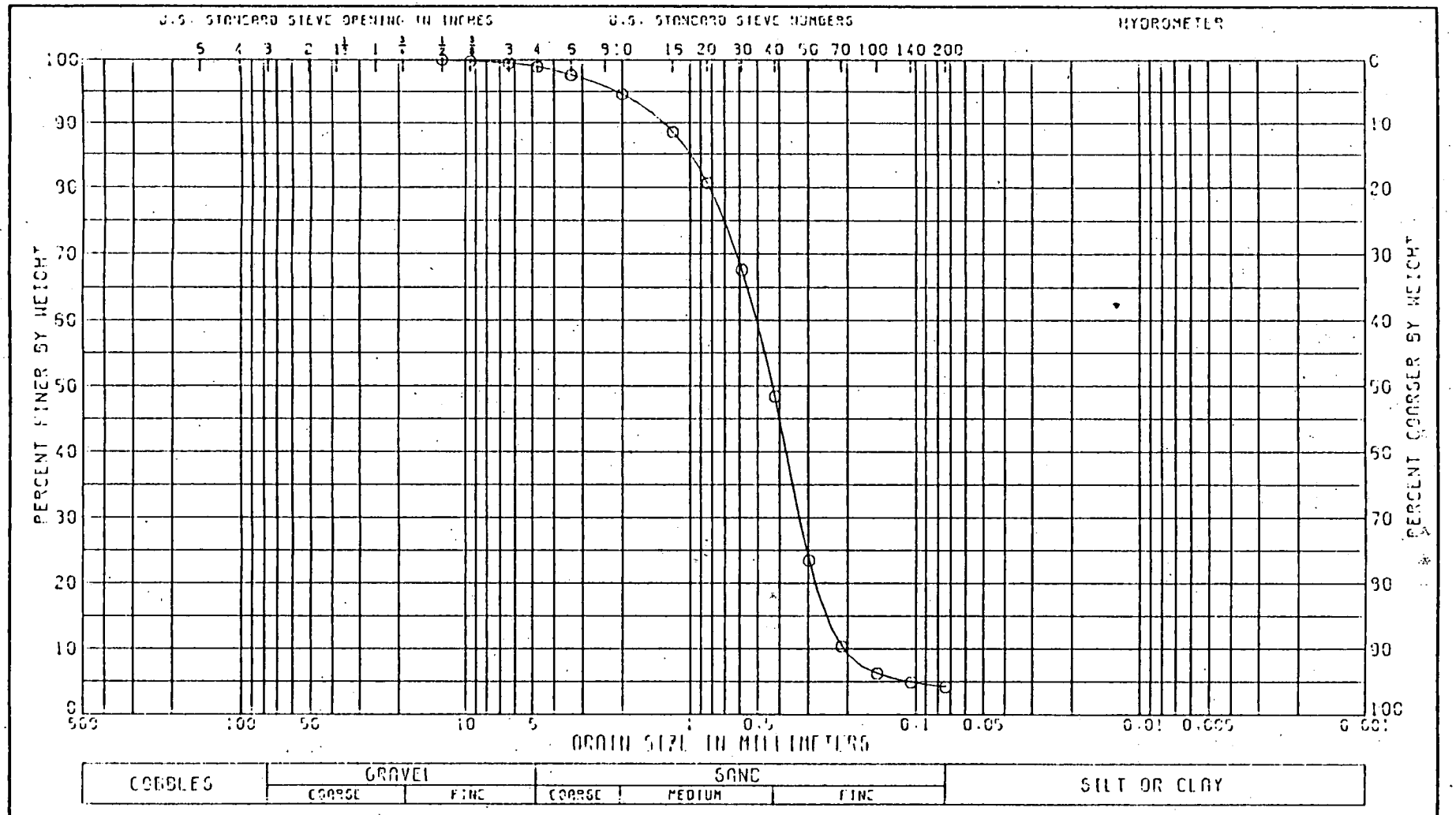
SILTY SAND (SM), DARK BROWN

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-6-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-7.0 DATE 11 FEB 82



LL	PL	PI	CS	NAT W.%	
NP				14.7	

CLASSIFICATION

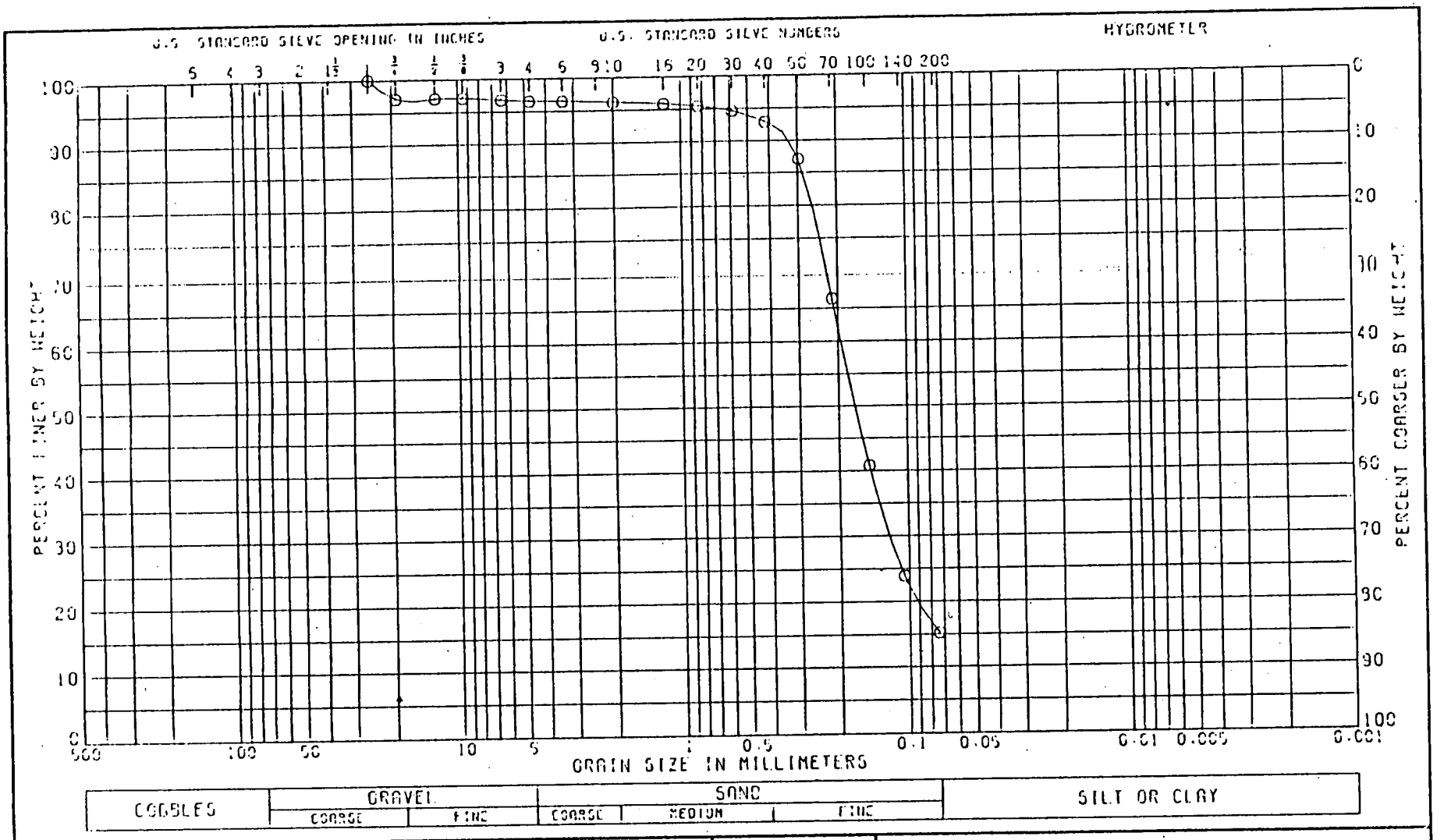
SAND (SP), GRAY

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-5-91 SAMPLE NO. 4

DEPTH/ELEV 14.3-16.0 DATE 11 FEB 92



LL	PP	PL	PI	GS	NAT W.% 22.4

CLASSIFICATION

SILTY SAND (SM), BROWN: TRACE OF GRAVEL

GRADATION CURVE

PROJECT CRANE NWSC MCCOMISH GORGE

BORING NO. 4-5-81 SAMPLE NO. 5

DEPTH/ELEV 18.6-20.05 DATE 11 FEB 82

Laboratory Soil Test Results

Demolition Area

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
6-1A-81	1	0.0-2.17	102.6	21.0	42	18	24	CL		
6-1A-81	2	5.0-6.21	115.2	18.6	63	20	43	CH		
6-1B-81	1	0.0-1.14	120.2	15.0	34	18	16	CL		
6-1B-81	2	5.0-6.14	114.1	17.9	48	16	32	CL		11.0
6-1C-81	1	0.0-1.34	111.9	17.8	49	19	30	CL		20.0
6-1C-81	2	5.0-6.25	116.6	17.7	57	19	38	CH		
6-2-81	1	0.0-1.58	98.8	22.8	35	20	15	CL		8.60
6-3-81	1	0.0-1.74	81.0	26.8	35	19	16	CL		4.60
6-3-81	2A*	5.0-5.3	--	15.6	44	18	26	CL		
6-4-81	1	0.0-1.46	103.5	19.3	33	20	13	CL		4.79
6-5-81	1	0.0-1.8	110.9	9.1	35	17	18	CL		5.73
6-5-81	2	5.0-6.85	118.5	16.0	44	22	22	CL		
6-6-81	1	0.0-1.41	110.8	14.1	40	16	24	CL	0	
6-6-81	2	5.0-6.27	119.3	14.5	43	17	26	CL		5.60
6-6-81	3	10.0-11.30	120.4	14.9	45	22	23	CL		
6-7-81	1	0.0-2.22	111.3	16.3	46	16	30	CL		5.67
6-7-81	2	5.0-6.45	118.7	17.0	42	20	22	CL		
6-8-81	1	0.0-1.55	103.8	21.5	36	21	15	CL		7.72
6-8-81	2	5.0-5.99	122.8	10.8	25	15	10	CL		

(Continued)

* Jar sample
** See Figure E-1

Laboratory Soil Test Results

Demolition Area (Concluded)

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
6-9-81	1A*	0.0-1.7	--	7.4	30	13	17	SC		
6-10-81	1	0.0-2.08	81.6	14.8	41	19	22	CL		
6-10-81	2	5.0-6.99	109.7	17.4	45	19	26	CL	3.01×10^{-8}	35.8
6-10-81	3	10.0-11.49	110.0	20.8	47	25	22	CL		
6-11-81	1	0.0-2.39	98.5	13.0	32	18	14	CL		7.19
6-11-81	2	5.0-5.71	101.1	22.0	36	19	17	CL		
6-12-81	1	1.10-2.20	108.4	20.8	57	18	39	CH		3.53
6-12-81	2	5.0-6.01	132.9	7.9	26	12	14	CL		
6-13-81	1	0.0-1.29	113.2	17.3	50	17	33	CH		10.7

* Jar sample
** See Figure E-1

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
6-14-81	1	0.0-1.61	115.6	15.8	27	16	11	SC		
6-14-81	2	5.0-7.06	98.8	24.0	28	19	9	CL	2.77×10^{-6}	5.65
6-14-81	3	10.0-11.67	101.1	23.5	33	18	15	CL		
6-14-81	4	15.0-17.07	87.0	33.3	61	24	37	CH		
6-15-81	1	0.0-1.35	111.5	16.5	27	17	10	CL		
6-16-81	1	0.0-1.37	102.4	13.8	37	20	17	CL		11.2
6-16-81	2A*	5.0-5.4	--	10.7	29	15	14	CL		
6-17-81	1	0.0-1.39	101.0	22.7	28	17	11	CL		3.71
6-18-81	1	0.0-1.63	117.4	15.0	35	18	17	CL		
6-18-81	2	5.0-6.58	112.9	13.9	24	14	10	SC		
6-19-81	1	5.0-6.88	103.6	23.2	42	18	24	CL		10.2
6-19-81	2	10.0-11.66	99.7	25.2	44	17	27	CL		
6-20-81	1	0.0-1.78	110.8	19.1	27	15	12	CL		4.65
6-20-81	2	5.0-6.75	109.9	18.9	35	14	21	CL		

* Jar sample
** Unified Soils Classification System

Laboratory Soil Test Results

Old Rifle Range

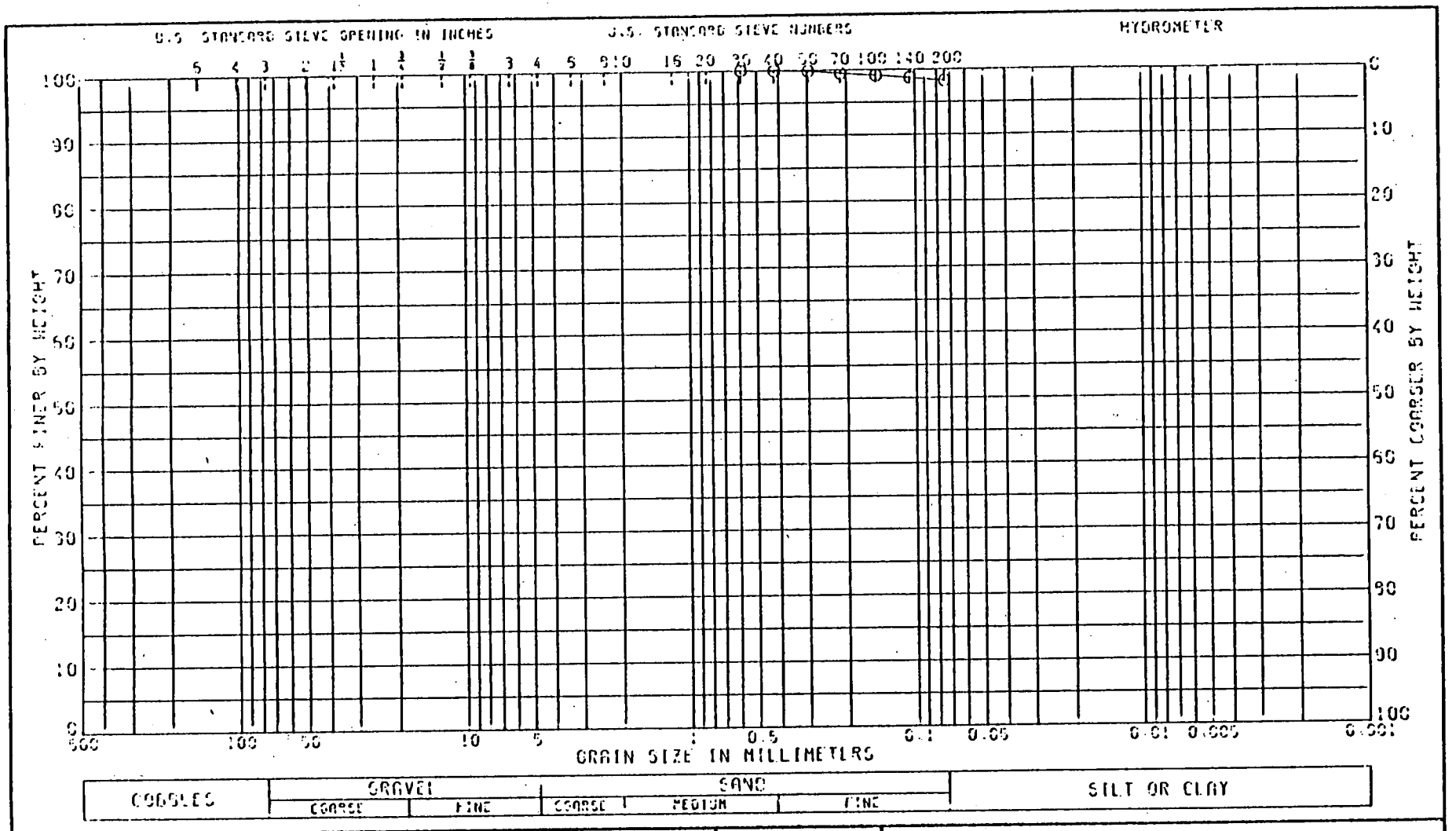
Boring Number	Sample Number	Depth (ft)	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
EPA-1-83	1	0.0-2.4	110.7	18.6	34	14	20	CL	$3.3X10^{-7}$	15.7
EPA-1-83	2	5.0-7.3	115.4	15.5	24	13	11	CL		
EPA-2-83	1	0.0-2.1	115.1	16.3	24	15	9	CL		12.8
EPA-2-83	2	5.0-6.35	114.0	16.8	32	14	18	CL		
EPA-2-83	3	10.0-11.35	115.4	13.6	29	13	16	CL		
EPA-2-83	4	15.0-15.95	114.9	9.6	35	16	19	CL		
EPA-3-83	1	0.0-2.25	108.5	19.2	34	15	19	CL		18.4
EPA-3-83	2	5.0-6.08	120.6	13.6	38	18	20	CL		
EPA-3-83	3	10.0-12.12	106.2	20.7	36	14	22	CL	$2.13X10^{-6}$	
EPA-3-83	4	15.0-16.1	123.7	14.0	35	19	16	CL		
EPA-4-83	1	0.0-1.5	105.0	20.4	33	22	11	CL		16.8
EPA-4-83	3	10.0-12.18	109.1	20.2	44	16	28	CL		
EPA-4-83	5	16.0-18.35	113.5	11.2	31	17	14	CL		
EPA-5-83	1	0.0-2.25	106.7	18.9	32	13	19	CL		20.5
EPA-5-83	2	5.0-6.85	109.2	19.1	33	14	19	CL		
EPA-5-83	3	10.0-11.22	110.0	15.6	23	14	9	CL	$9.21X10^{-6}$	
EPA-5-83	4	15.0-17.15	107.6	20.3	38	18	20	CL		
EPD-1-83	1*	BP***	-	-	35	12	23	CL		
EPD-1-83	2*	BP	-	-	32	13	19	CL		
EPD-1-83	3*	BP	-	-	38	16	22	CL		
EPD-2-83	1*	BP	-	-	31	15	16	CL		

Laboratory Soil Test Results

Old Rifle Range (Continued)

Boring Number	Sample Number	Depth (ft)	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
EPD-2-81	2*	BP	-	-	31	14	17	CL		
EPD-2-83	3	BP	-	-	35	16	19	CL		

* - Jar Sample - #1 (South end of pit), #2 (Center of pit, #3 (North end of pit)
** - Unified Soils Classification System
*** - Bottom of Pit - N end of 1 = 512.20 ft msl; S end of 1 = 510.90 ft msl
N end of 2 = 511.70 ft msl; S end of 2 = 513.10 ft msl



LL 42	PL 18	PI 24	CS	NAT W.% 21.0	

CLASSIFICATION

CLAY (CL), BROWN

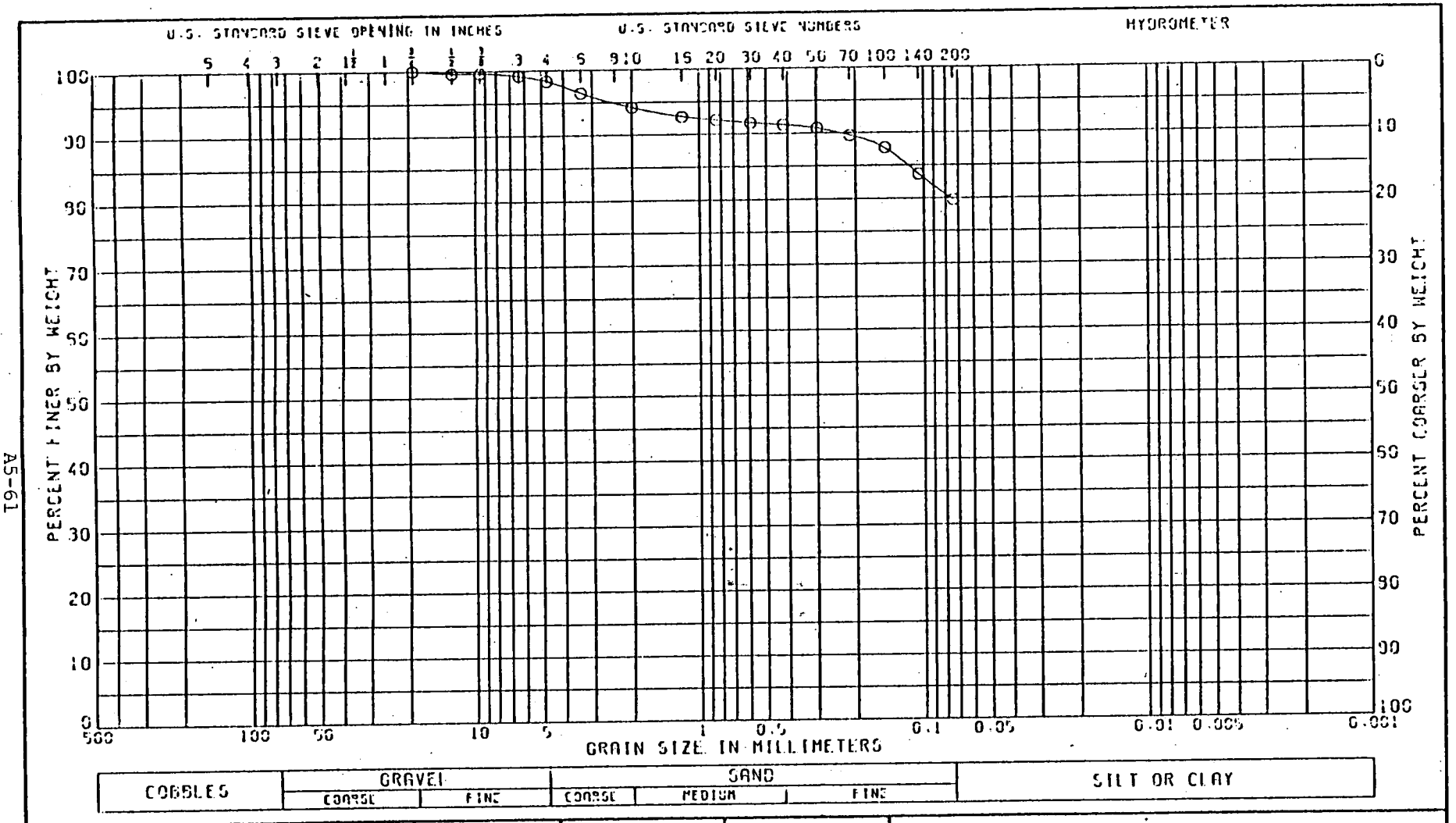
GRADATION CURVE

PROJECT CRANE NESC

OLD BURNING GROUND

BORING NO 6-18-01 SAMPLE NO 1

DEPTH/ELEV 0.0-2.17 DATE 26 FEB 82



LL 63	PL 20	PI 43	CC	NAT W.% 18.6	

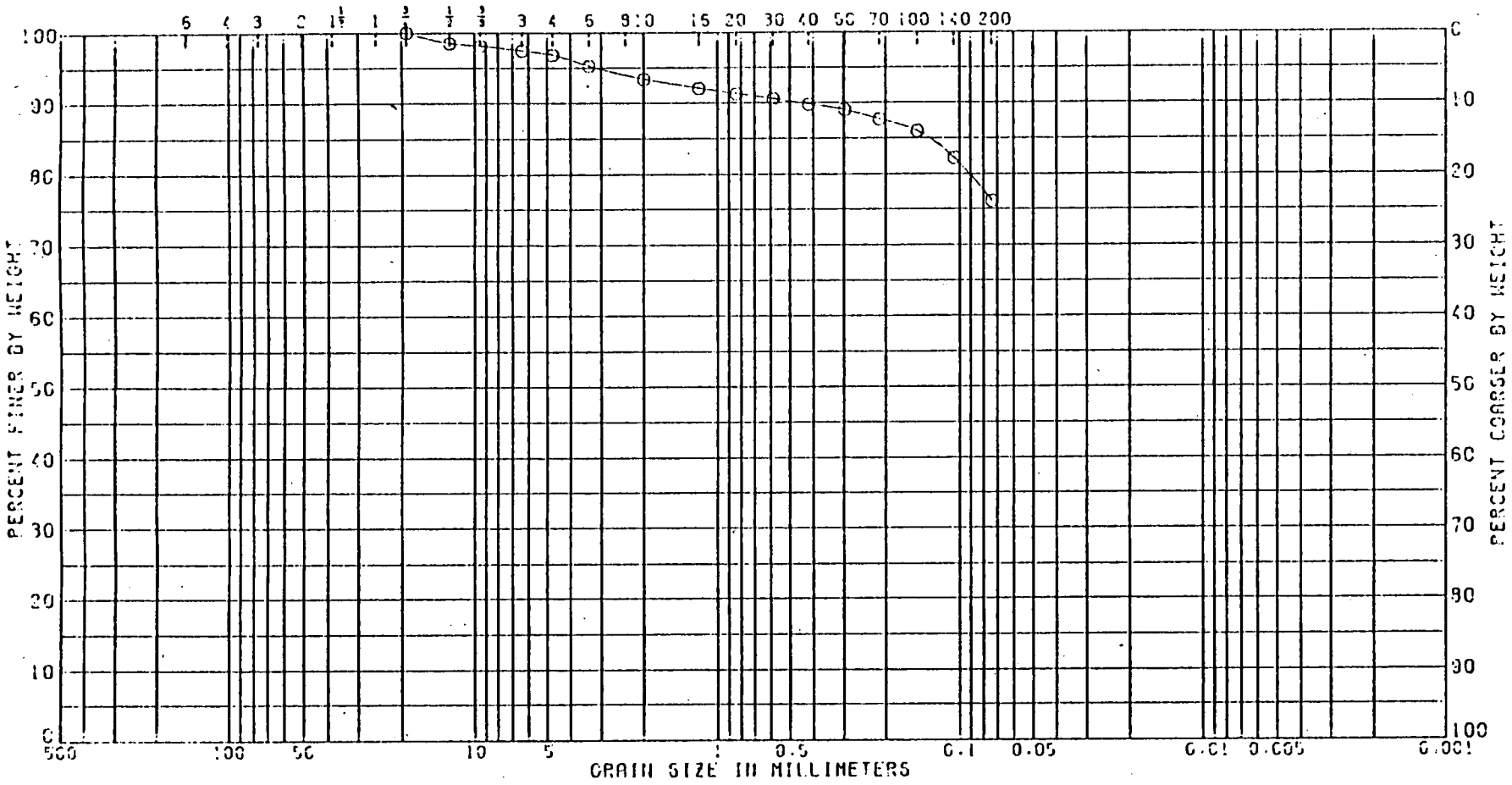
CLASSIFICATION
SANDY CLAY (CH), TAN

GRADATION CURVE

PROJECT CRANE NWSC
DEMOLITION AREA

BORING NO. 6-1A-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.21 DATE 31 MAR 92



LL	PL	PI	GS	NAT W.%
34	18	16		15.0

CLASSIFICATION

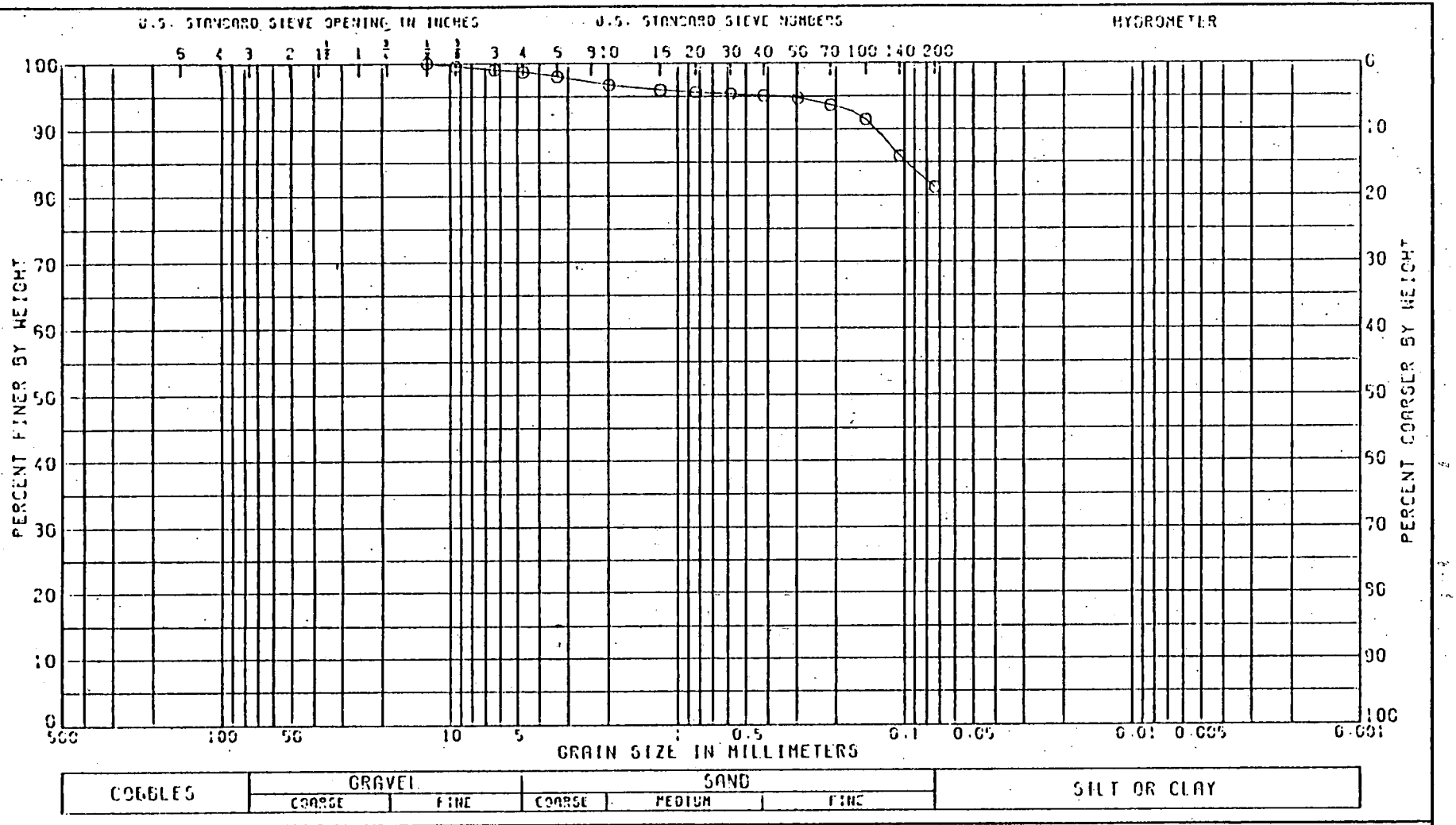
SANDY CLAY (CL), BROWN: TRACE OF GRAVEL

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-16-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.14 DATE 12 MAR 82



LL 48	PL 16	PI 32	GS	NAT W.% 17.9	

CLASSIFICATION

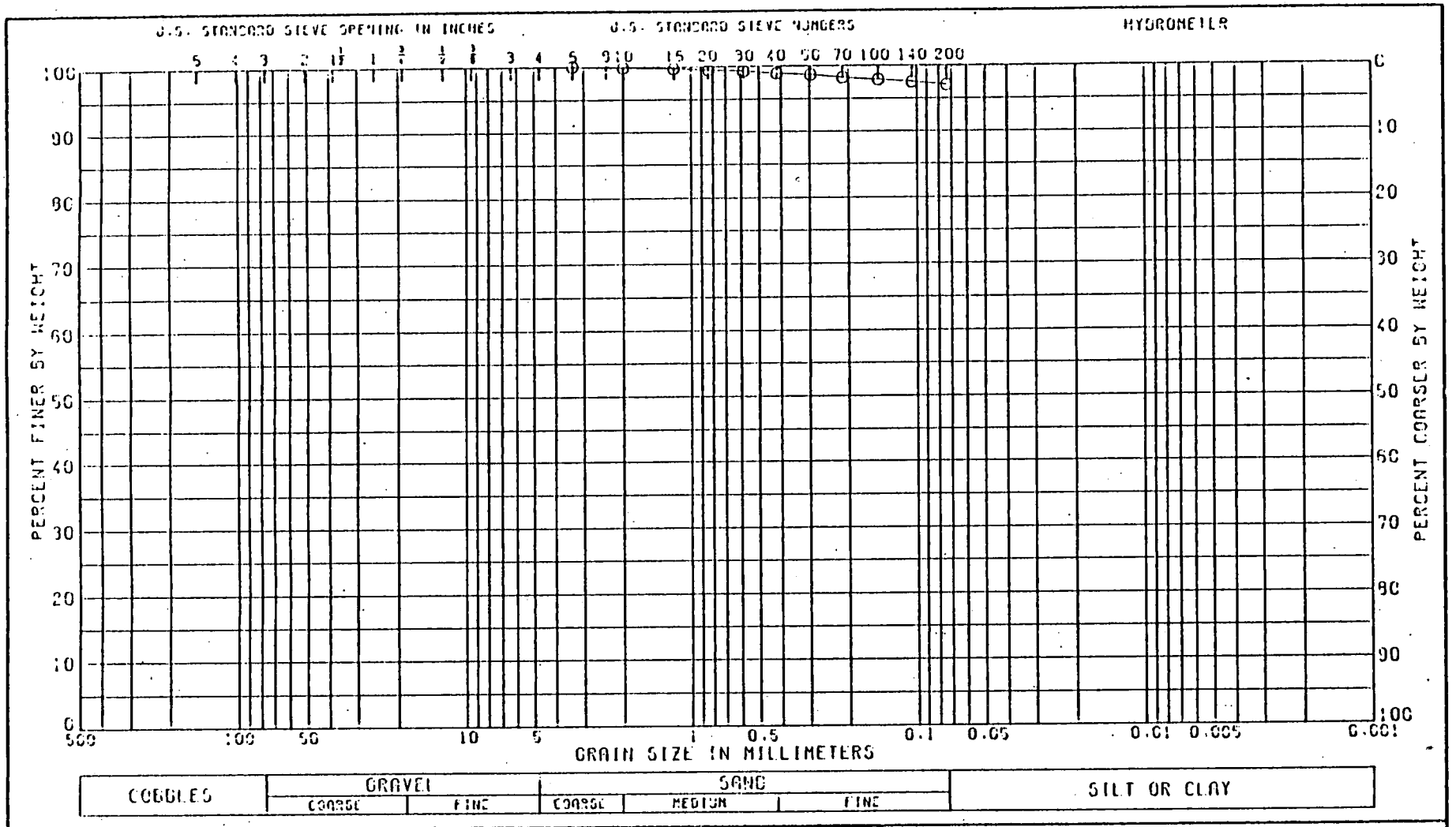
SANDY CLAY (CL), TAN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-16-01 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.14 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%
49	19	30		17.8

CLASSIFICATION

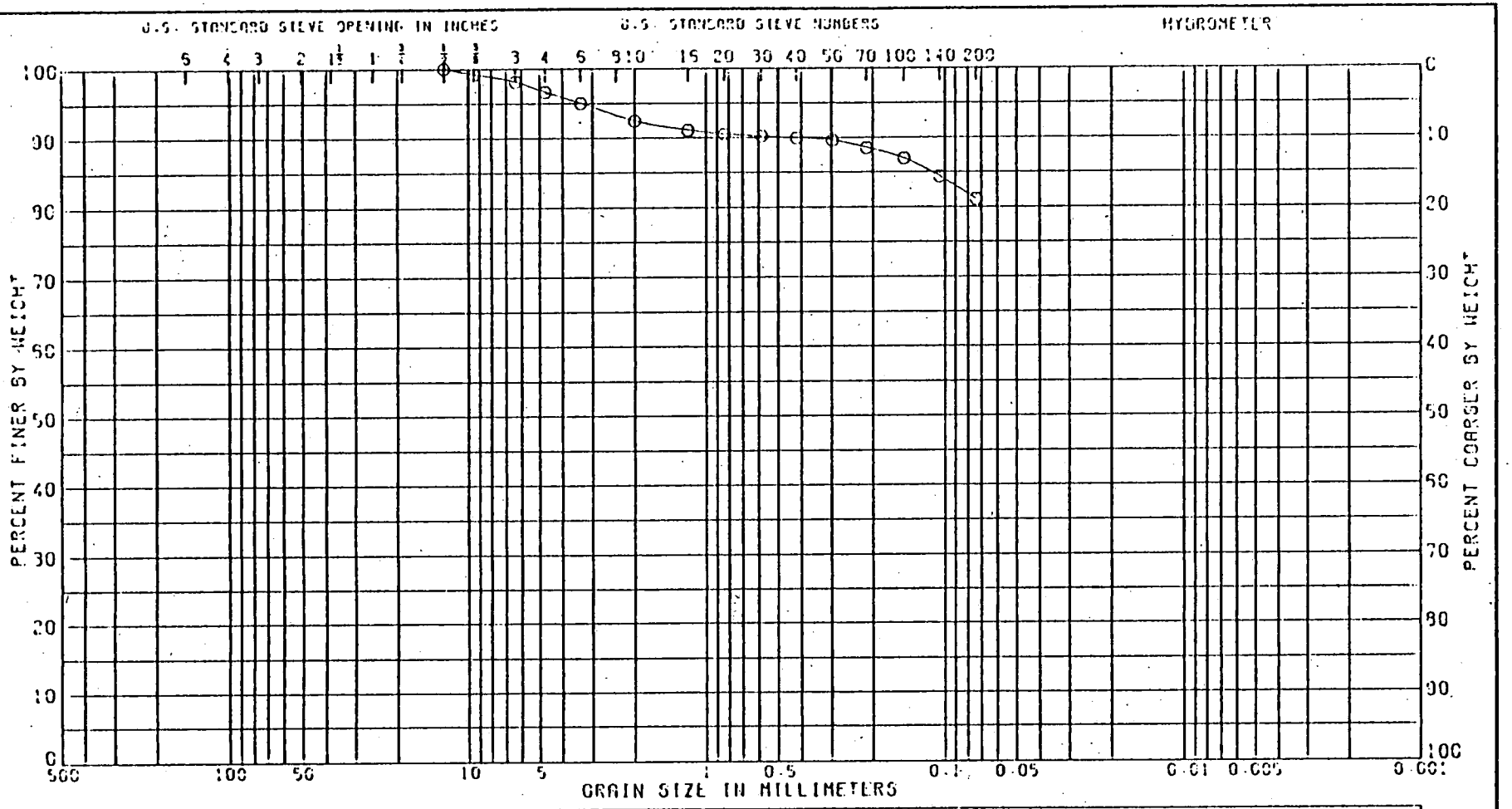
CLAY (CL), BROWN: TRACE OF SAND

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-1C-01 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.34 DATE 11 FEB 82



LL 57	PL 19	PI 38	GS	NAT W.% 17.7	

CLASSIFICATION

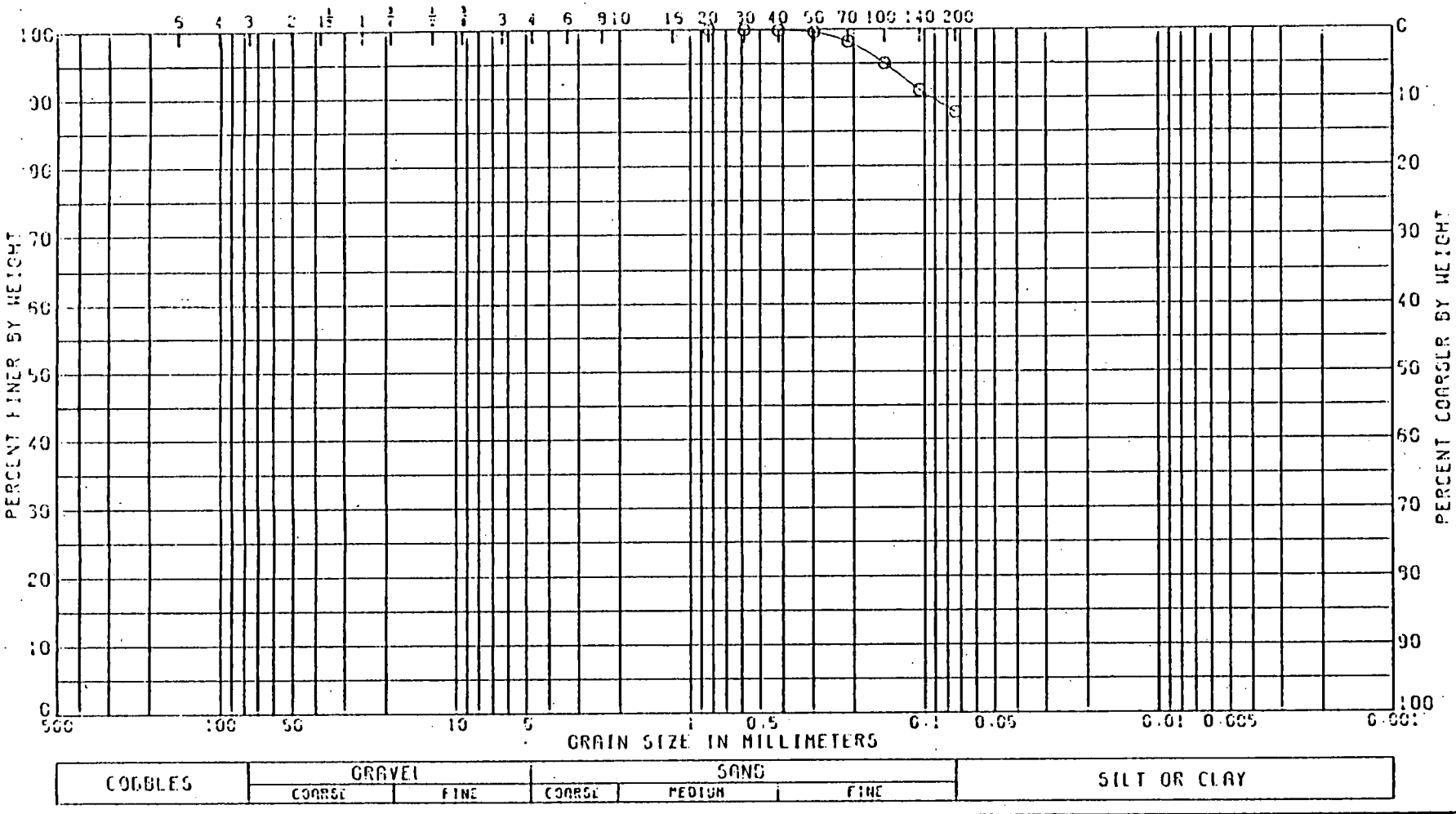
SANDY CLAY (CH), TAN: TRACE OF GRAVEL

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-1C-91 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.25 DATE 11 FEB 92



LL	PL	PI	GS	NAT W.%
35	20	15		22.8

CLASSIFICATION

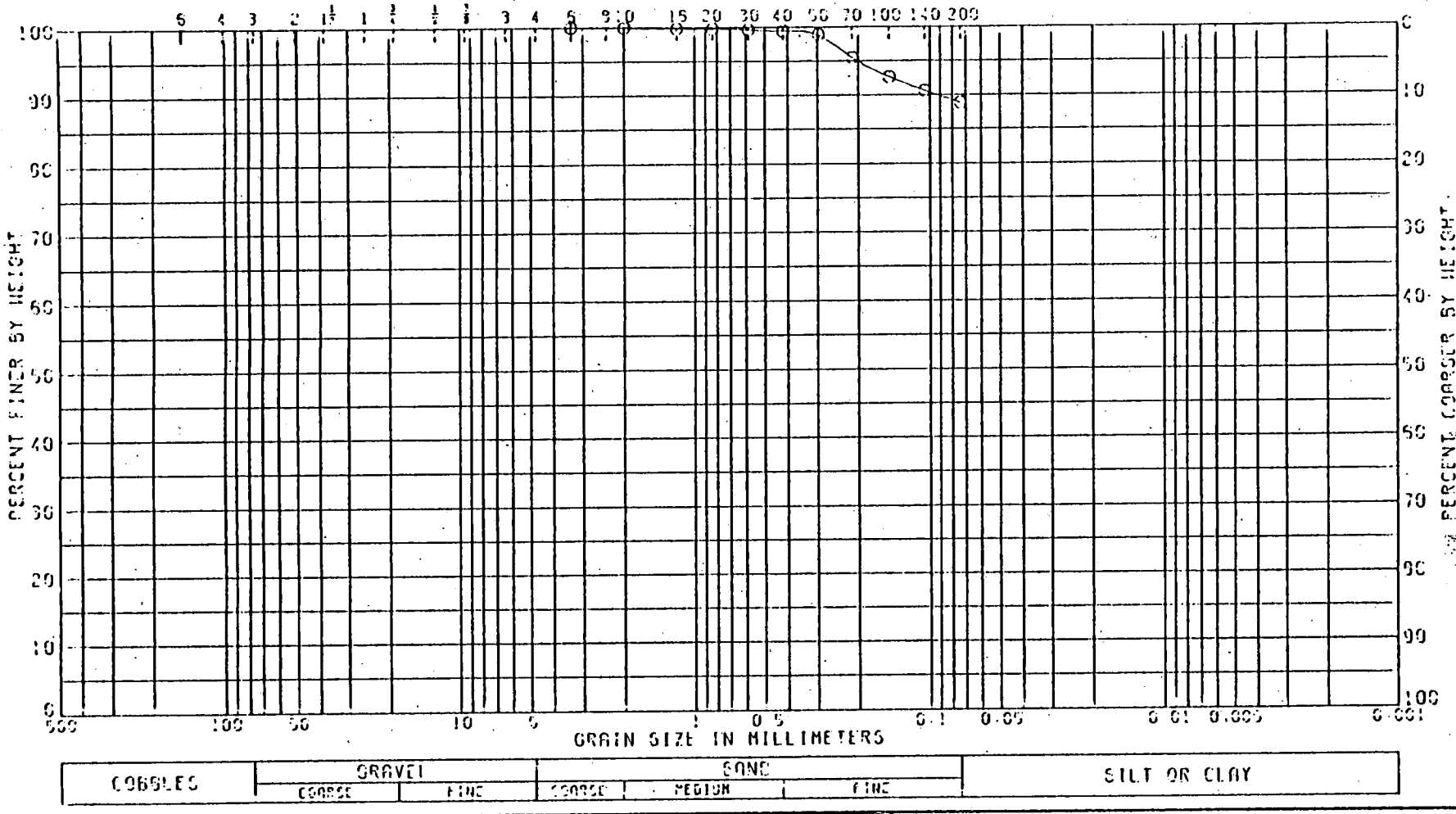
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-2-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.50 DATE 11 FEB 82



LL	PL	PI	CC	NAT W.%	
35	19	16		26.8	

CLASSIFICATION

CLAY (CL), BROWN: WITH SAND

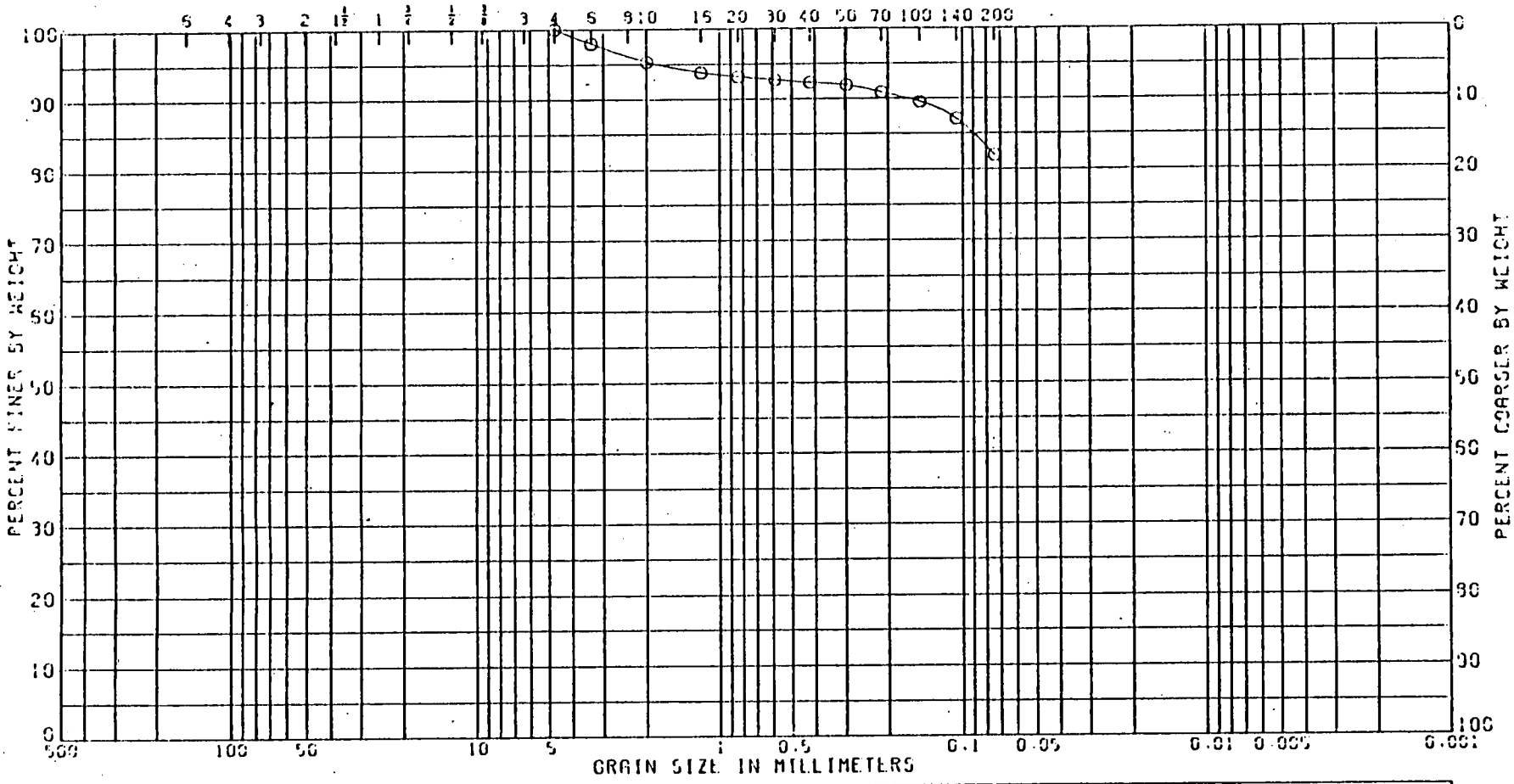
GRADATION CURVE

PROJECT CRANE NWSC

OLD BURNING GROUND

BORING NO 6-3--81 SAMPLE NO 1

DEPTH/ELEV 0.0-1.74 DATE 26 FEB 82



LL	PL	PI	CS	NAT W.%
44	18	26		15.6

CLASSIFICATION

SANDY CLAY (CL), BROWN

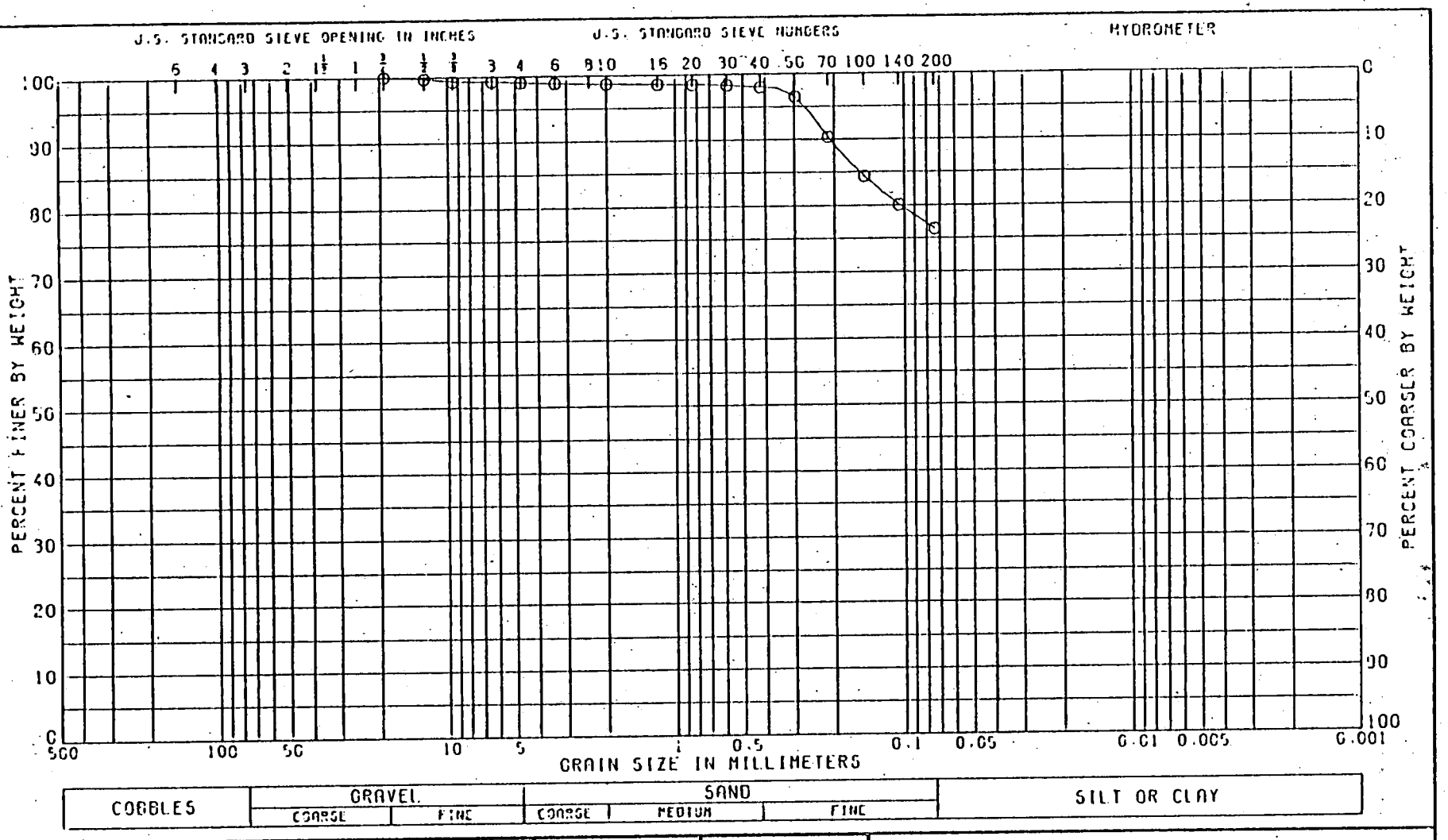
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-3-91 SAMPLE NO. 2A

DEPTH/ELEV 5.0-5.3 DATE 31 MAR 92



LL	PL	PI	CS	NAT W.%
33	20	13		19.3

CLASSIFICATION

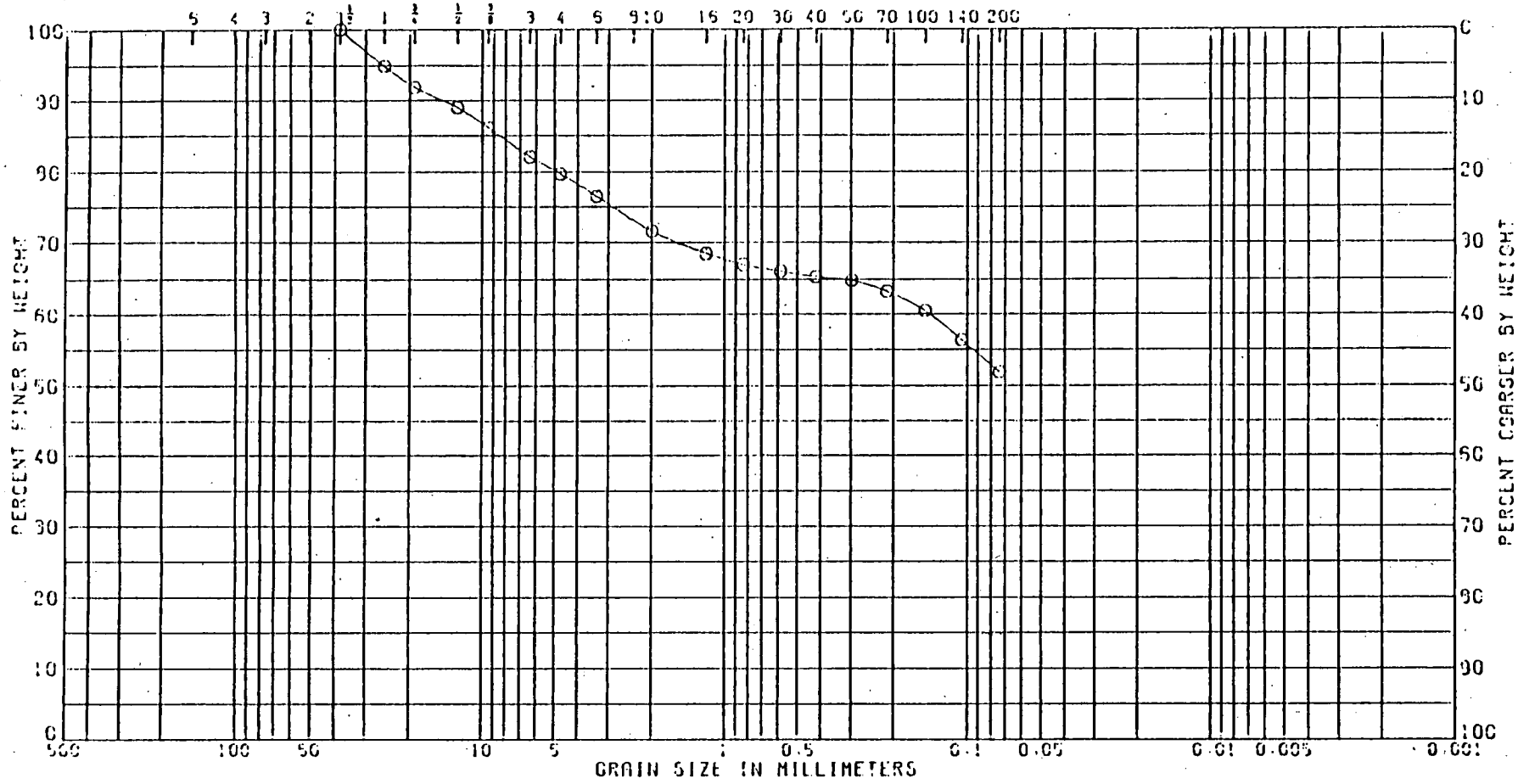
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-4-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.46 DATE 12 MAR 82



LL 35	PL 17	PI 18	CS	NAT W.% 9.1	

CLASSIFICATION

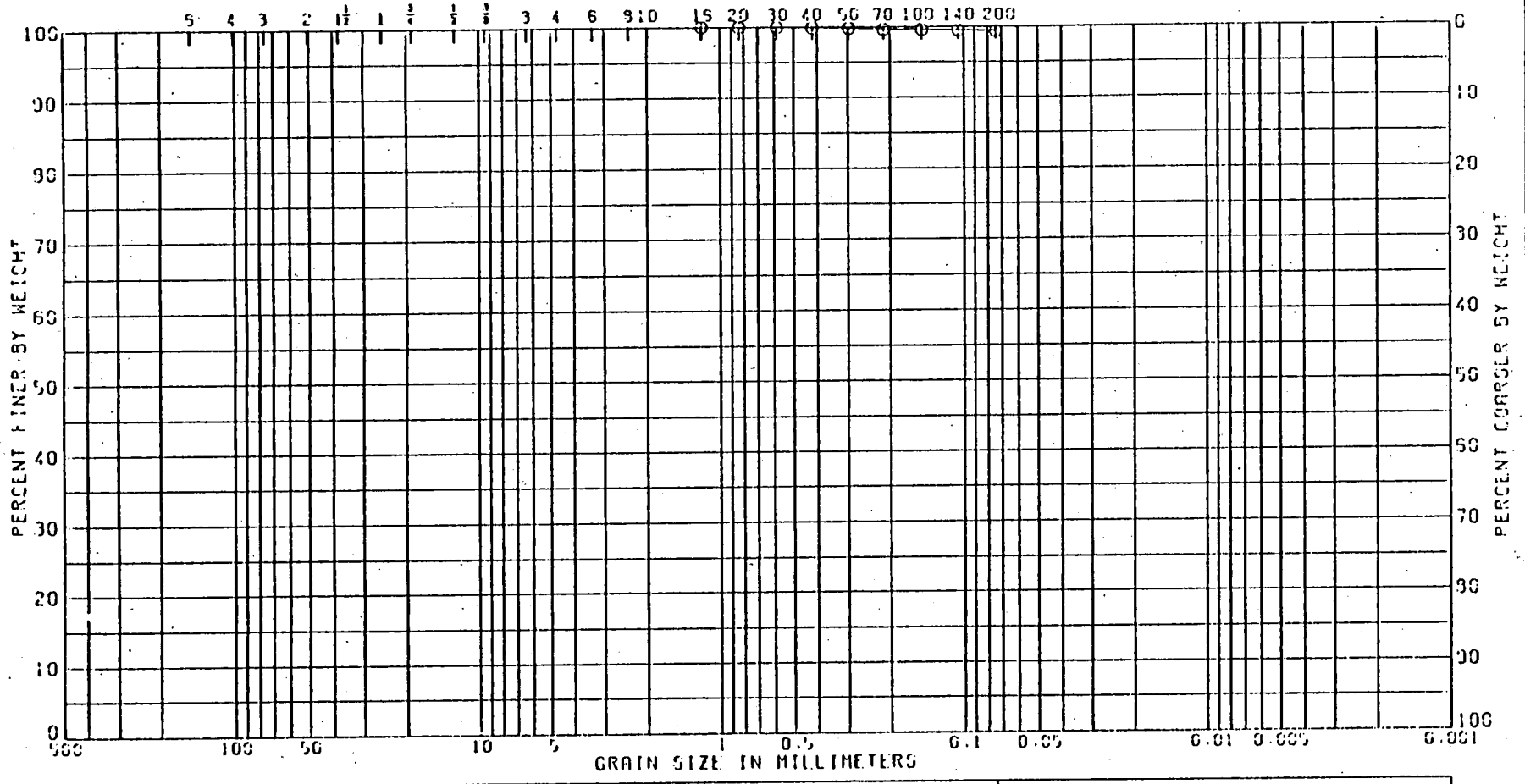
GRAVELLY SANDY CLAY (CL), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-5-91 SAMPLE NO 1

DEPTH/ELEV 0.0-1.0 DATE 11 FEB 92



LL 44	PL 22	PI 22	CS	NAT W.% 16.0	

CLASSIFICATION

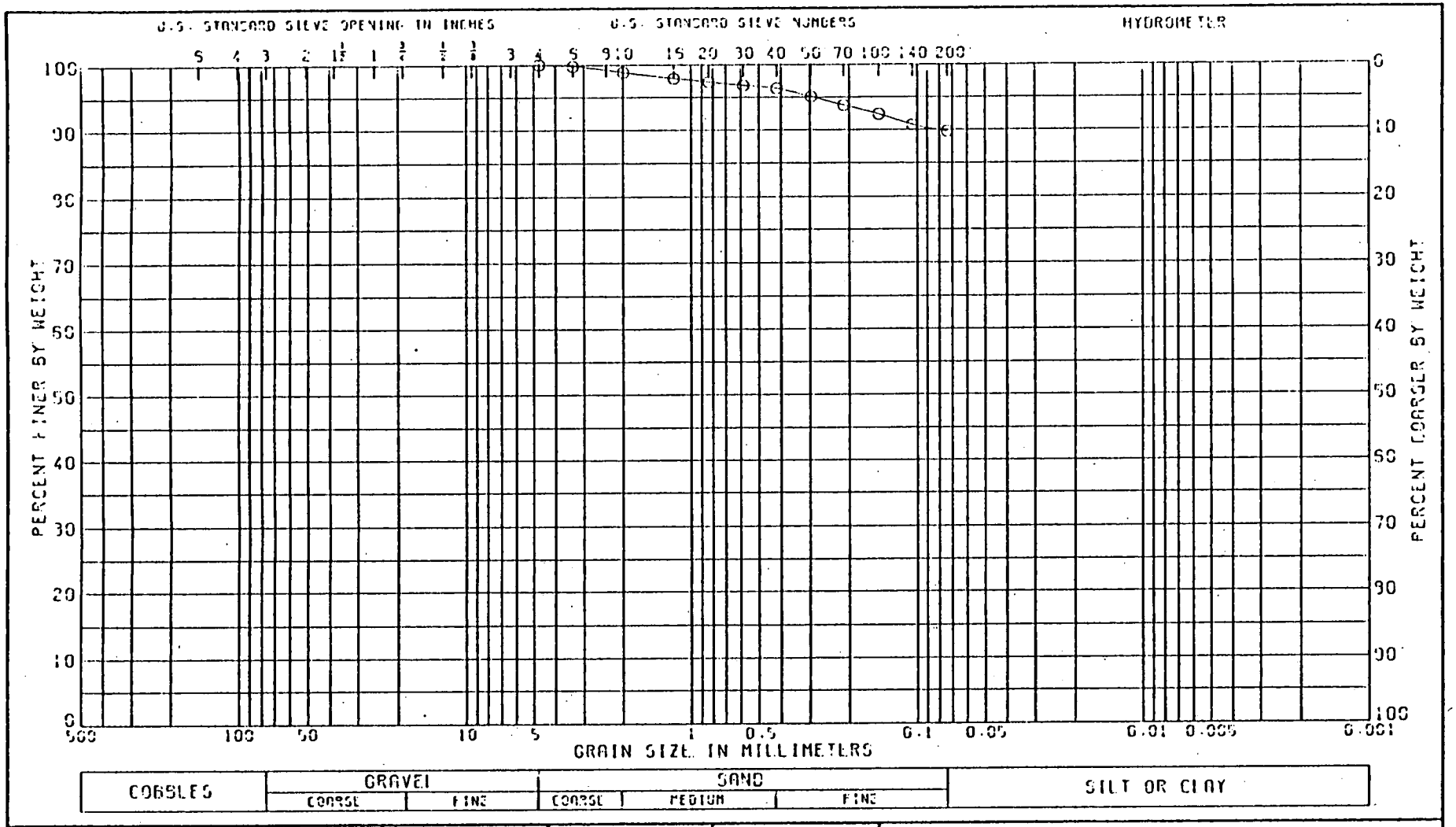
CLAY (CL), GRAY

GRADATION CURVE

PROJECT CRANE NWSC
DEMOLITION AREA

BORING NO. 6-5-91 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.95 DATE 31 MAR 92



LL	PL	PI	CS	NAT W.%
40	16	24		14.1

CLASSIFICATION

CLAY (CL), BROWN: WITH SAND

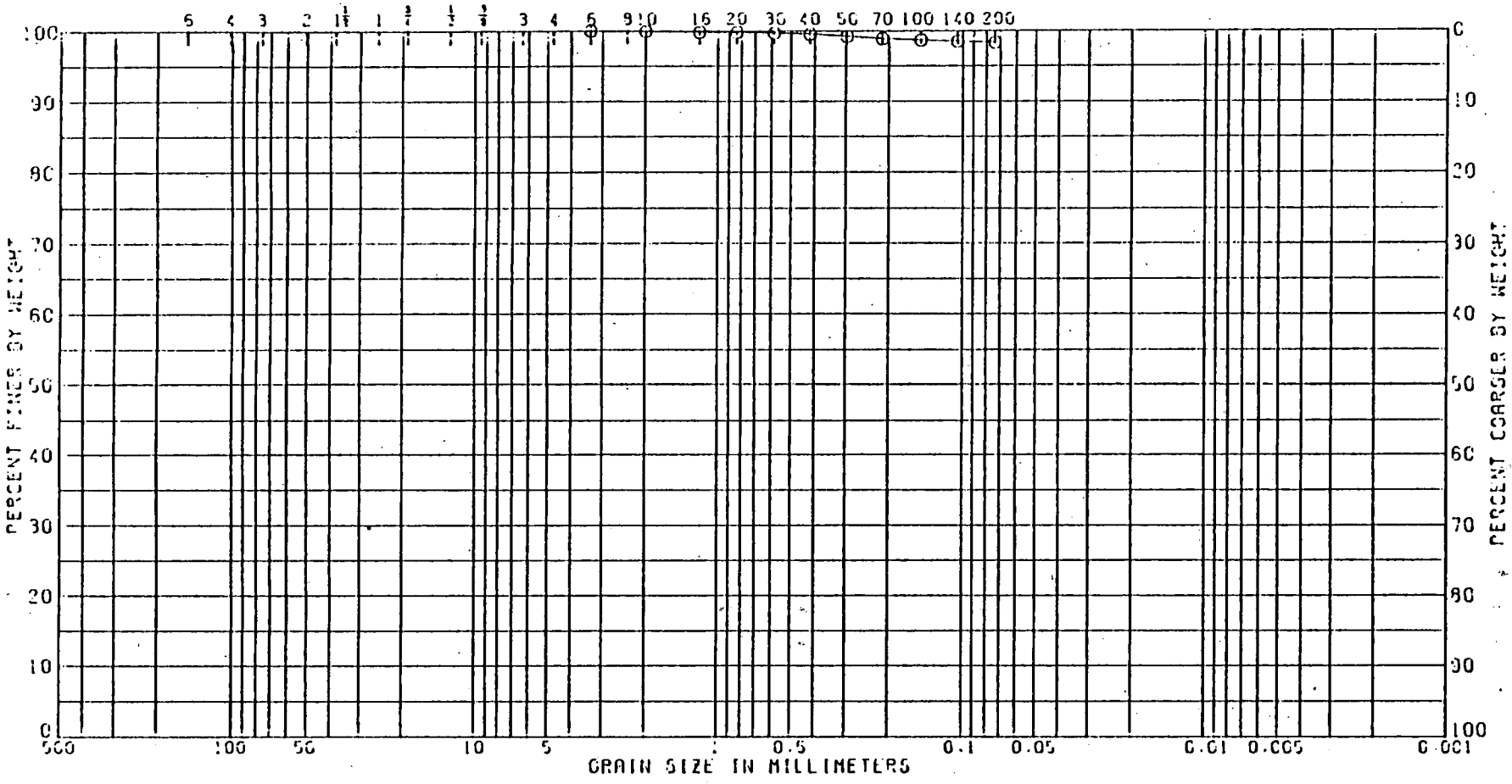
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-6-91 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.41 DATE 31 MAR 92



LL	PL	PI	GS	NAT W.%
43	17	26		14.5

CLASSIFICATION

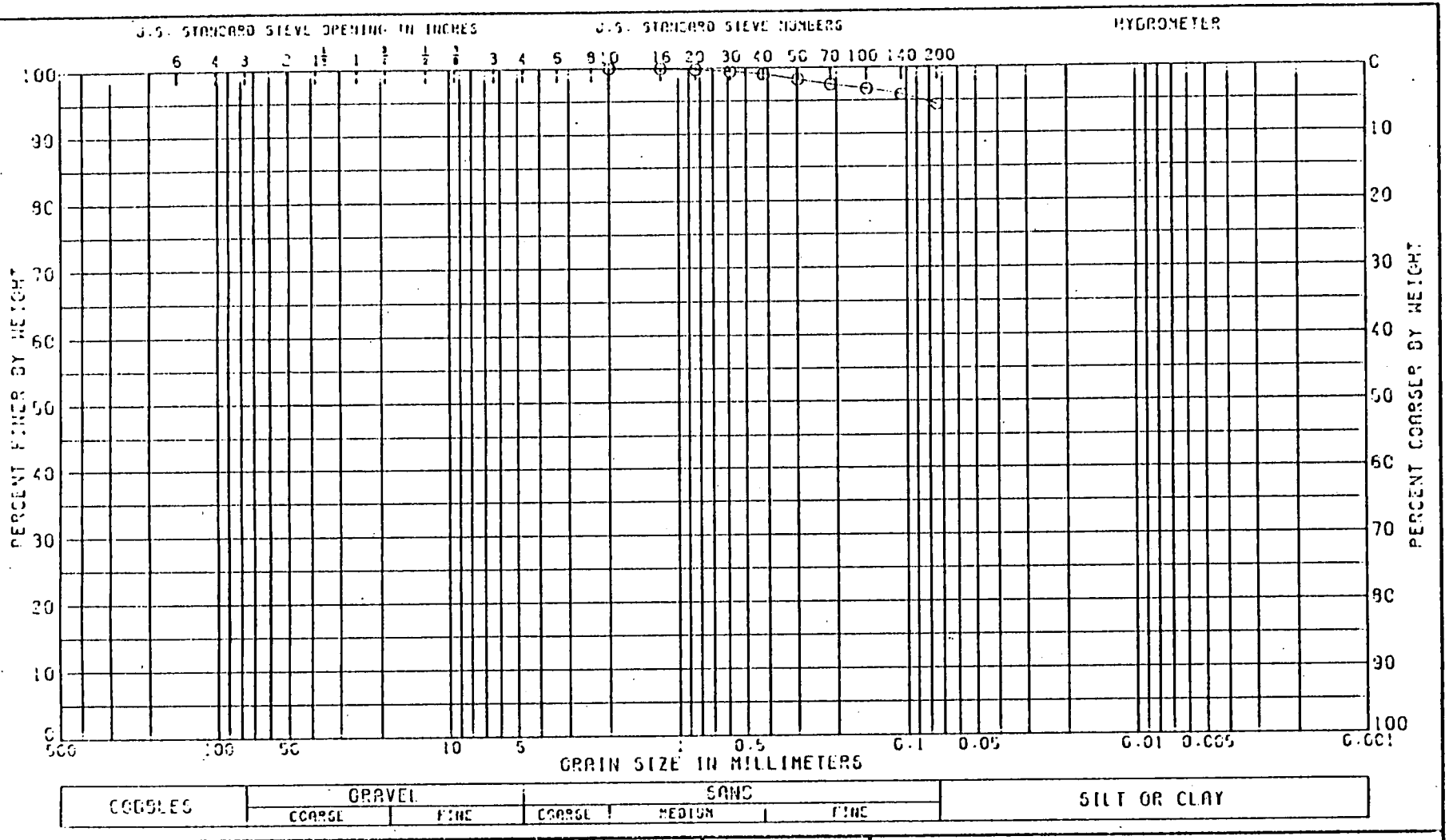
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NESC DEMOLITION AREA

BORING NO. 6-6-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.27 DATE 12 MAR 82



LL	PL	PI	GS	NAT W.%
45	22	23		14.9

CLASSIFICATION

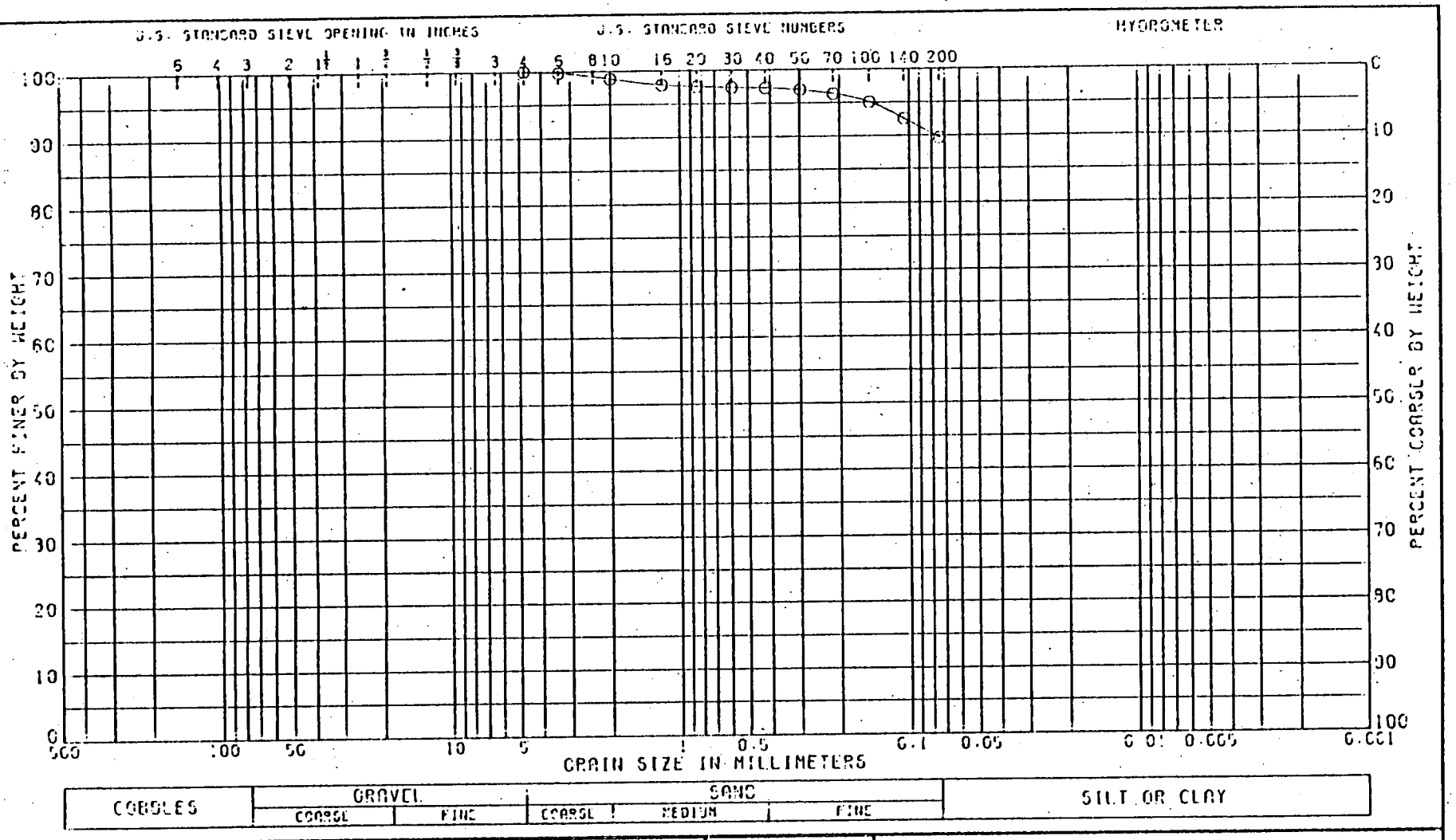
CLAY (CL), GRAYISH BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-6-81 SAMPLE NO. 3

DEPTH/ELEV 10.0-11.30 DATE 12 MAR 82



LL 46	PL 16	PI 30	GS	NAT W.% 16.3

CLASSIFICATION

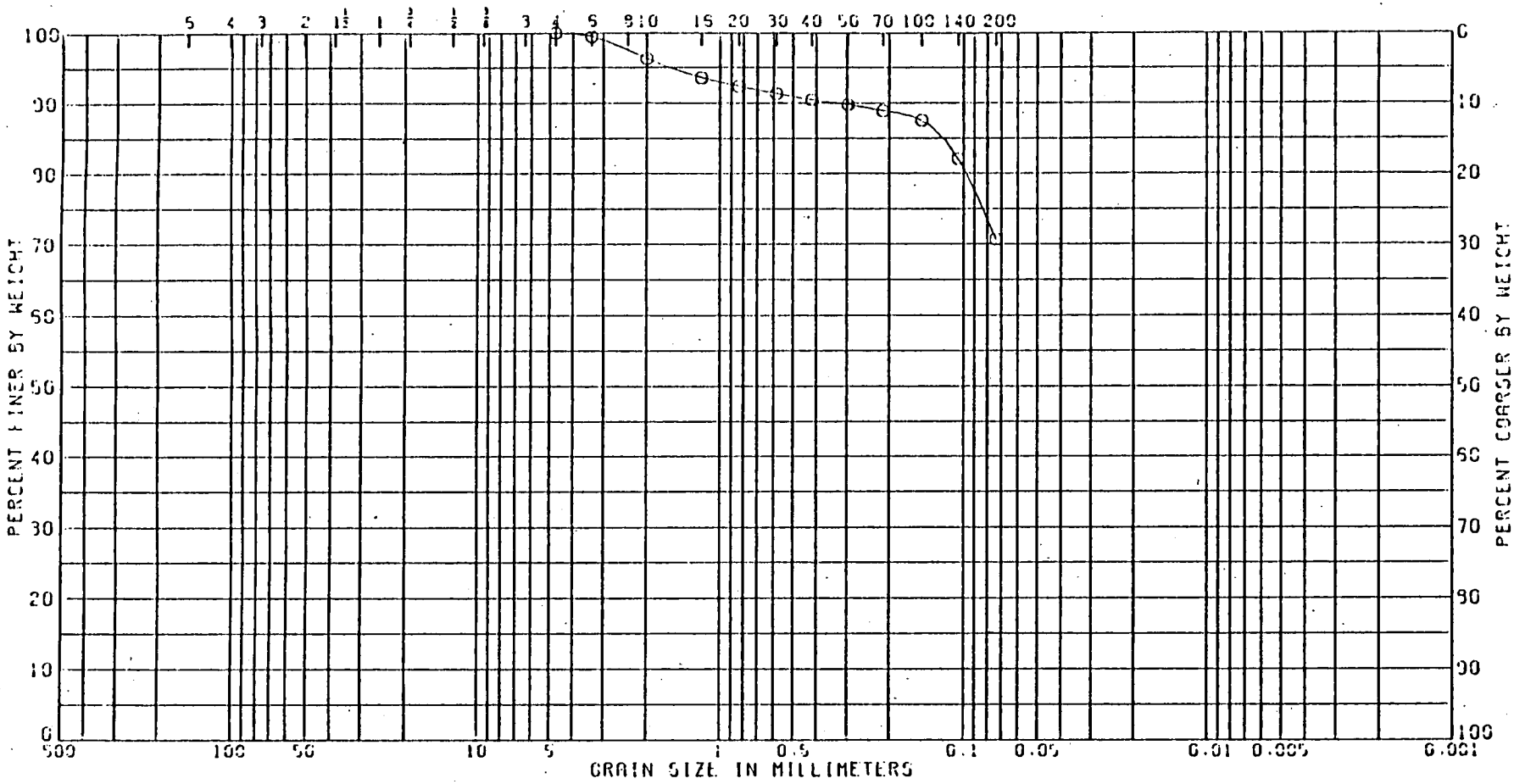
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NUSC DEMOLITION AREA

BORING NO. 6-7-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.22 DATE 12 MAR 82



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	CS	NAT W.%	
42	20	22		17.0	

CLASSIFICATION

SANDY CLAY (CL), TAN

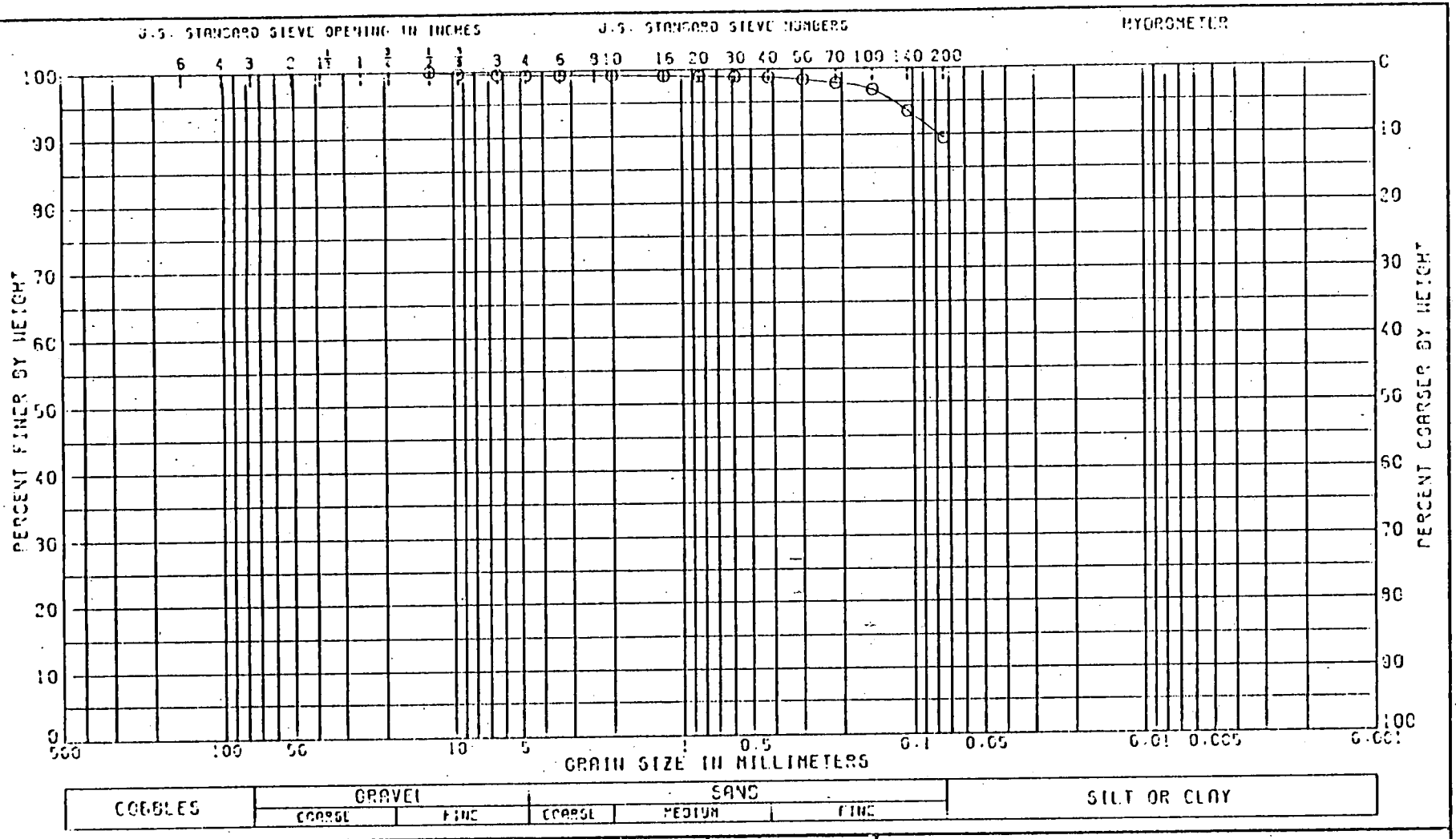
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-7-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.45 DATE 31 MAR 82



LL	PL	PI	GS	NAT W.%
36	21	15		21.5

CLASSIFICATION

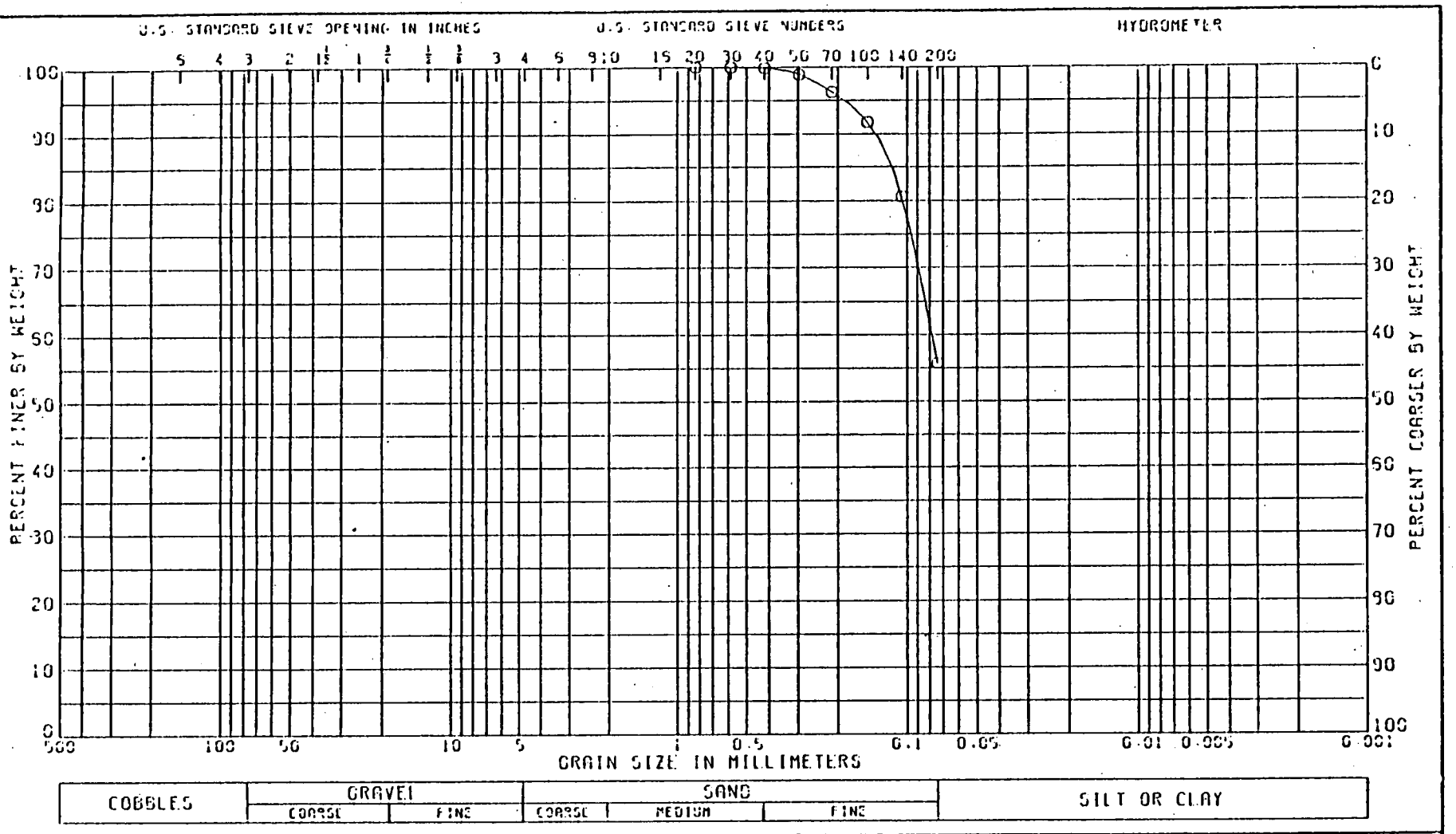
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-B-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.55 DATE 12 MAR 82



LL 25	PL 15	PI 10	CS	NAT W.% 10.8	

CLASSIFICATION

SANDY CLAY (CL), BROWN

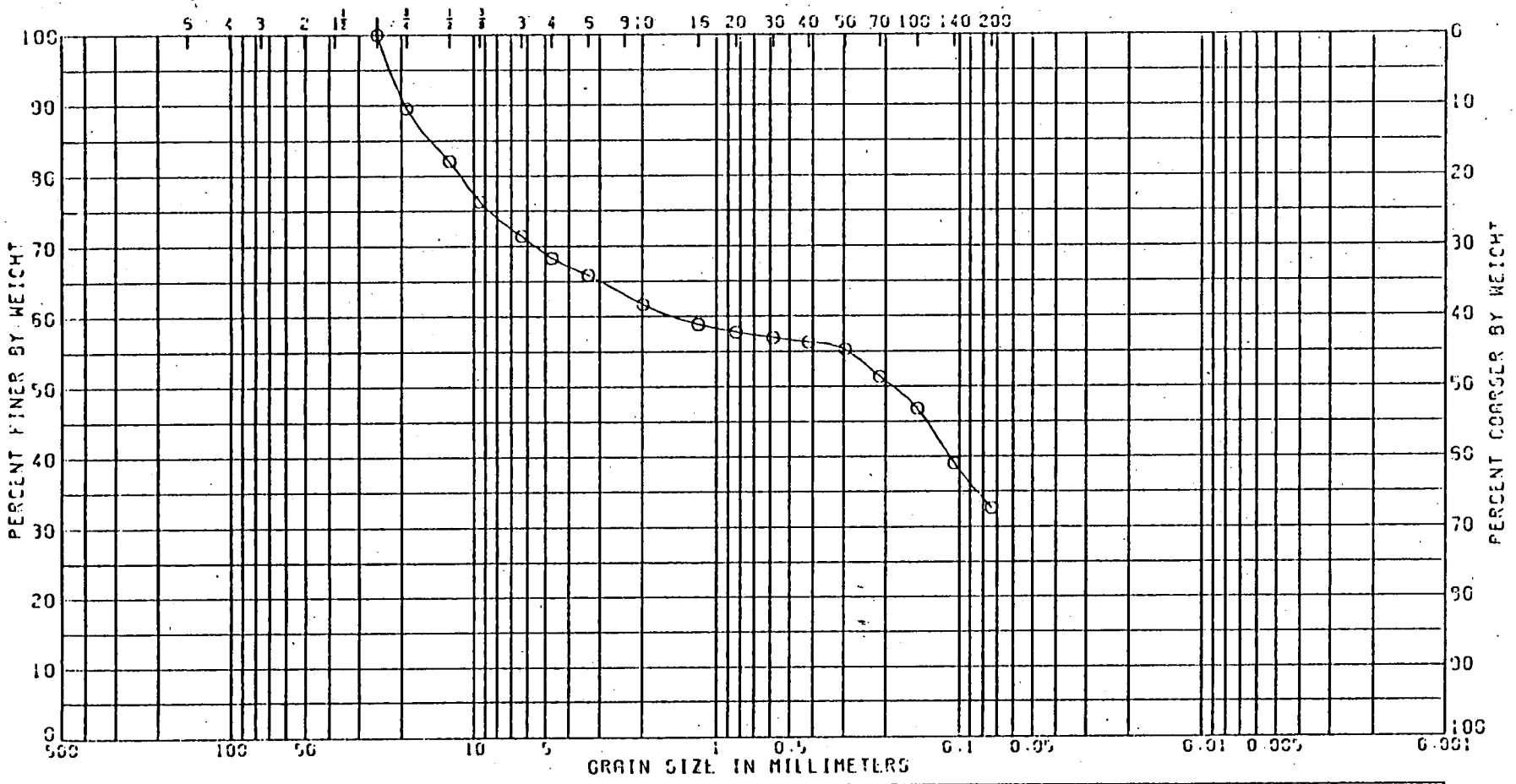
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-B-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-5.99 DATE 31 MAR 82



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	CS	NAT W.%
30	13	17		7.4

CLASSIFICATION

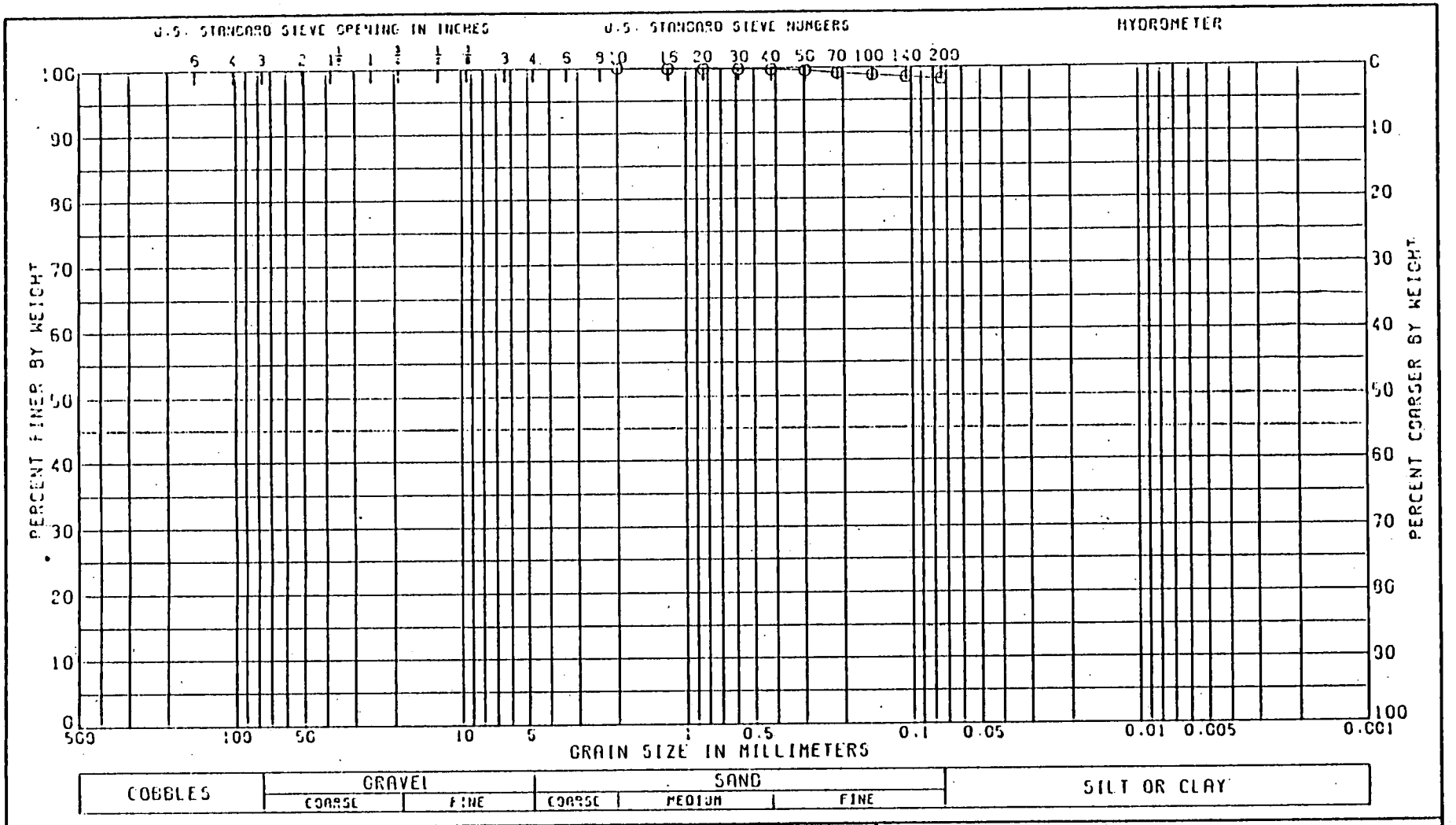
GRAVELLY CLAYEY SAND (SC), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC
DEMOLITION AREA

BORING NO. 6-D-01 SAMPLE NO. 1A

DEPTH/ELEV 0.0-1.7 DATE 31 MAR 92



LL 41	PL 19	PI 22	CS	NAT W.% 14.8	

CLASSIFICATION

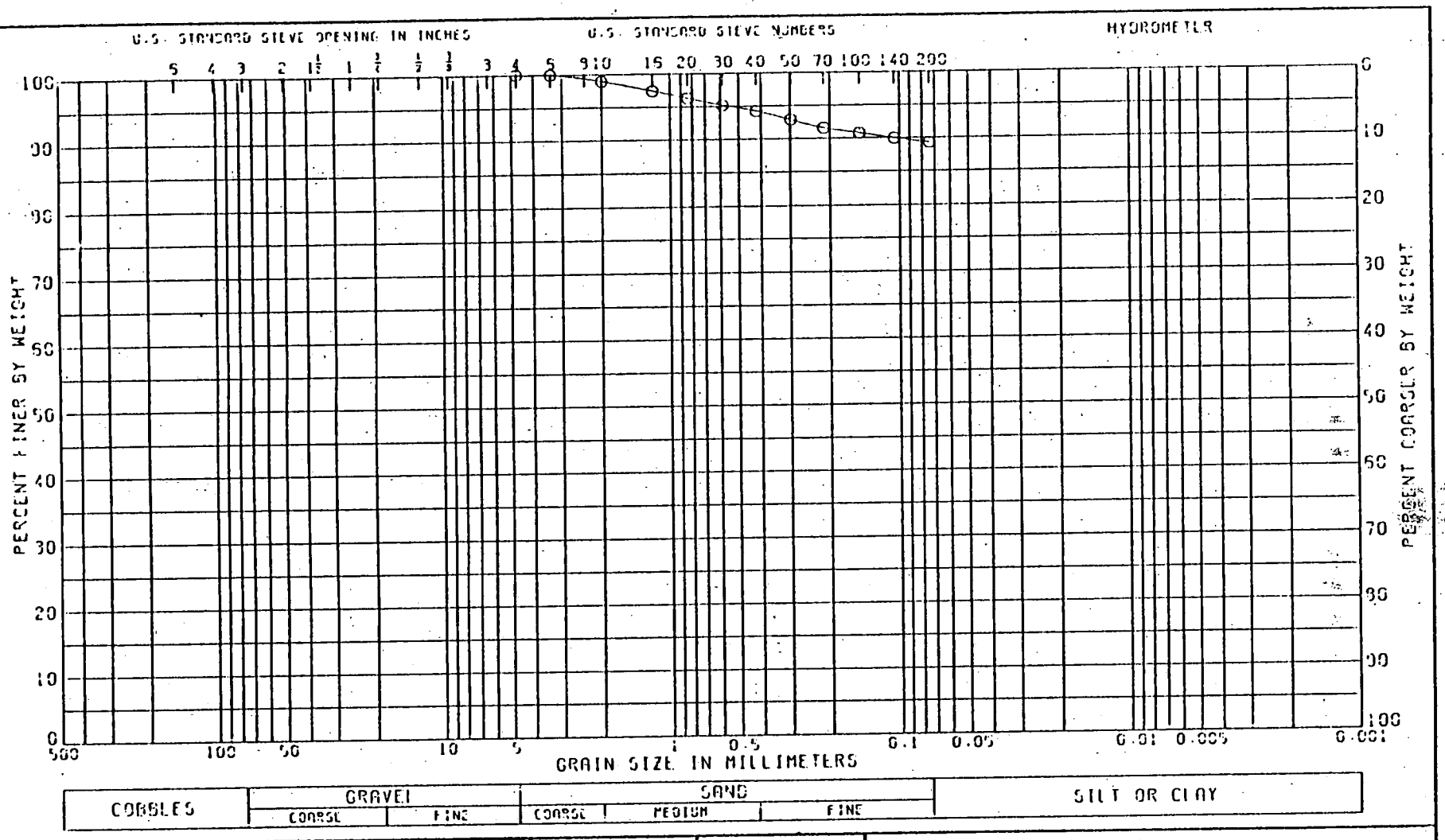
CLAY (CL) BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-10-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.08 DATE 12 MAR 82



LL	PL	PI	CS	NAT W.%
45	19	26		17.4

CLASSIFICATION

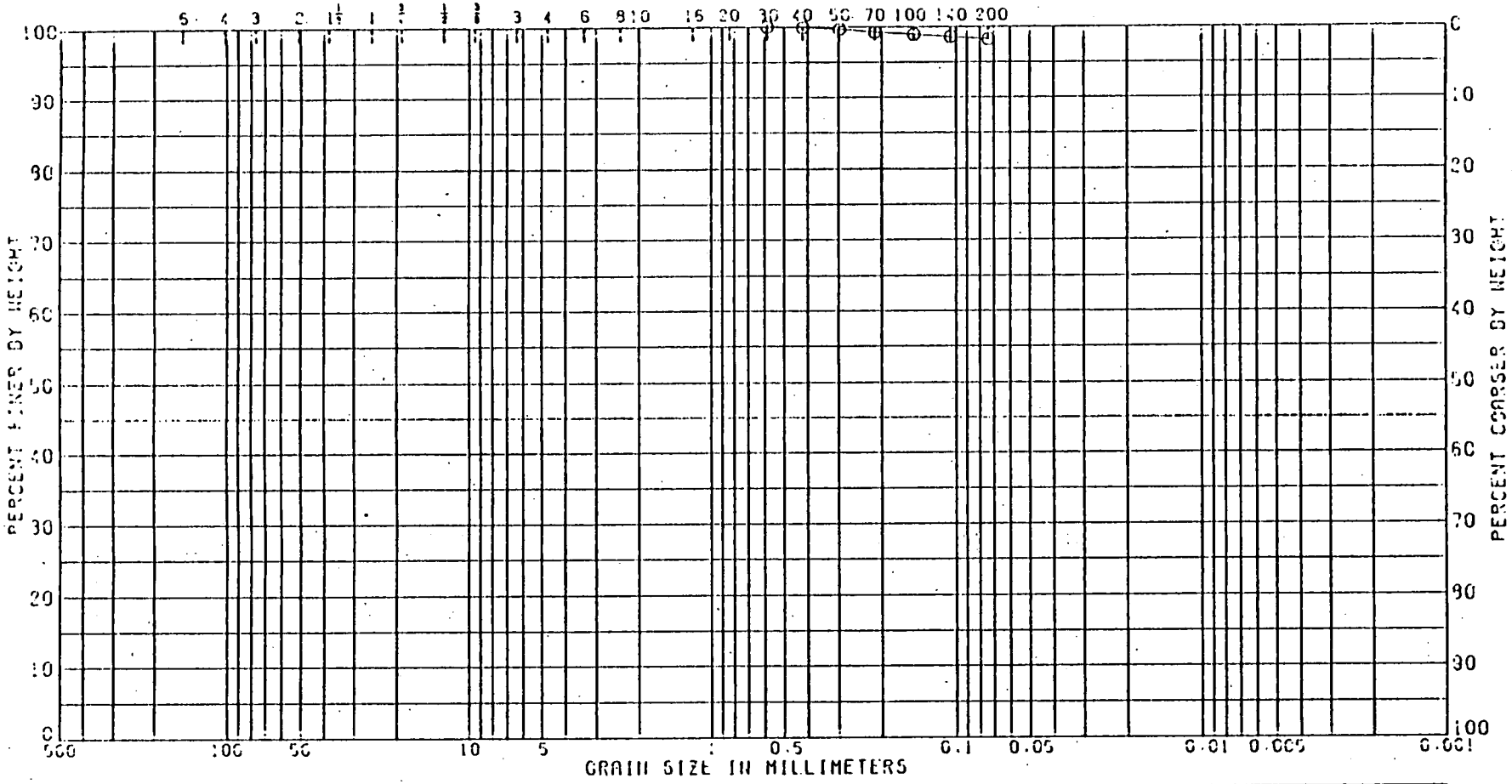
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC
DEMOLITION AREA

BORING NO. 6-10-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.00 DATE 31 MAR 82



LL	PL	PI	GS	NAT W.C.
47	25	22		20.8

CLASSIFICATION

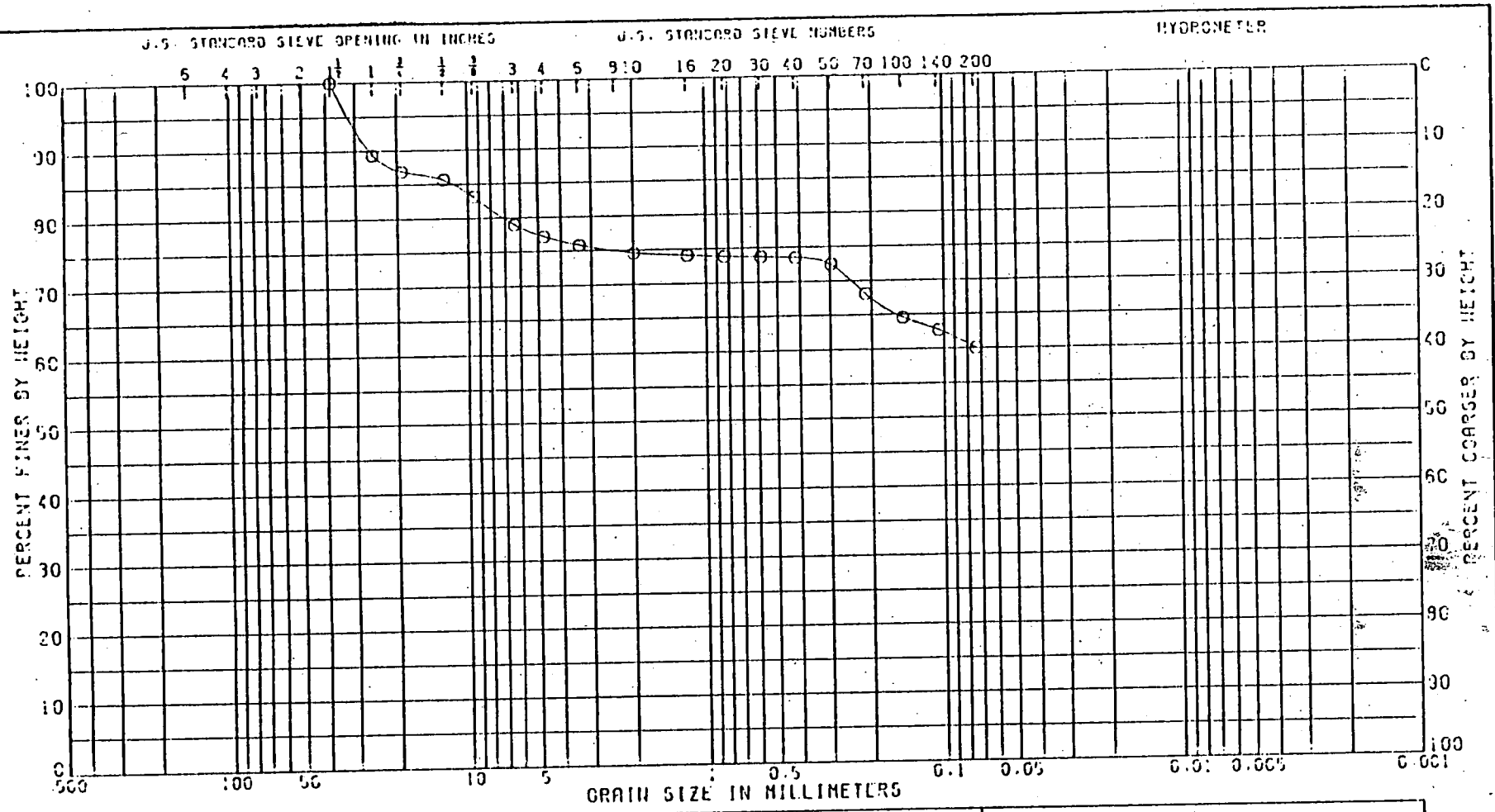
CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-10-81 SAMPLE NO. 3

DEPTH/ELEV 10.0-11.40 DATE 12 MAR 82



LL	PL	PI	GS	NAT W.%
32	18	14		13.0

CLASSIFICATION

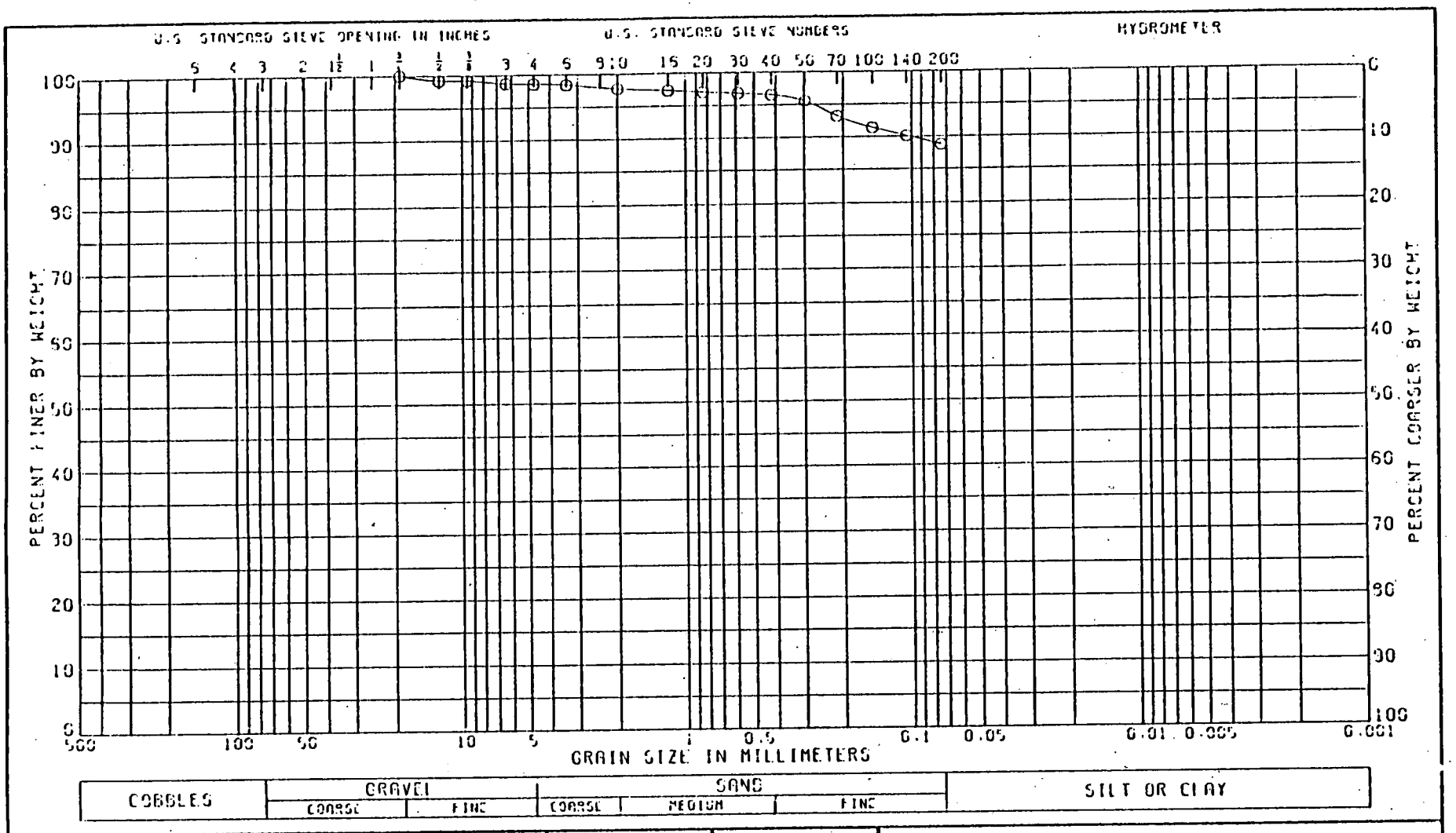
GRAVELLY SANDY CLAY (CL), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-11-91 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.30 DATE 12 MAR 92



LL	PL	PI	CS	NAT W.%	
36	19	17		22.0	

CLASSIFICATION

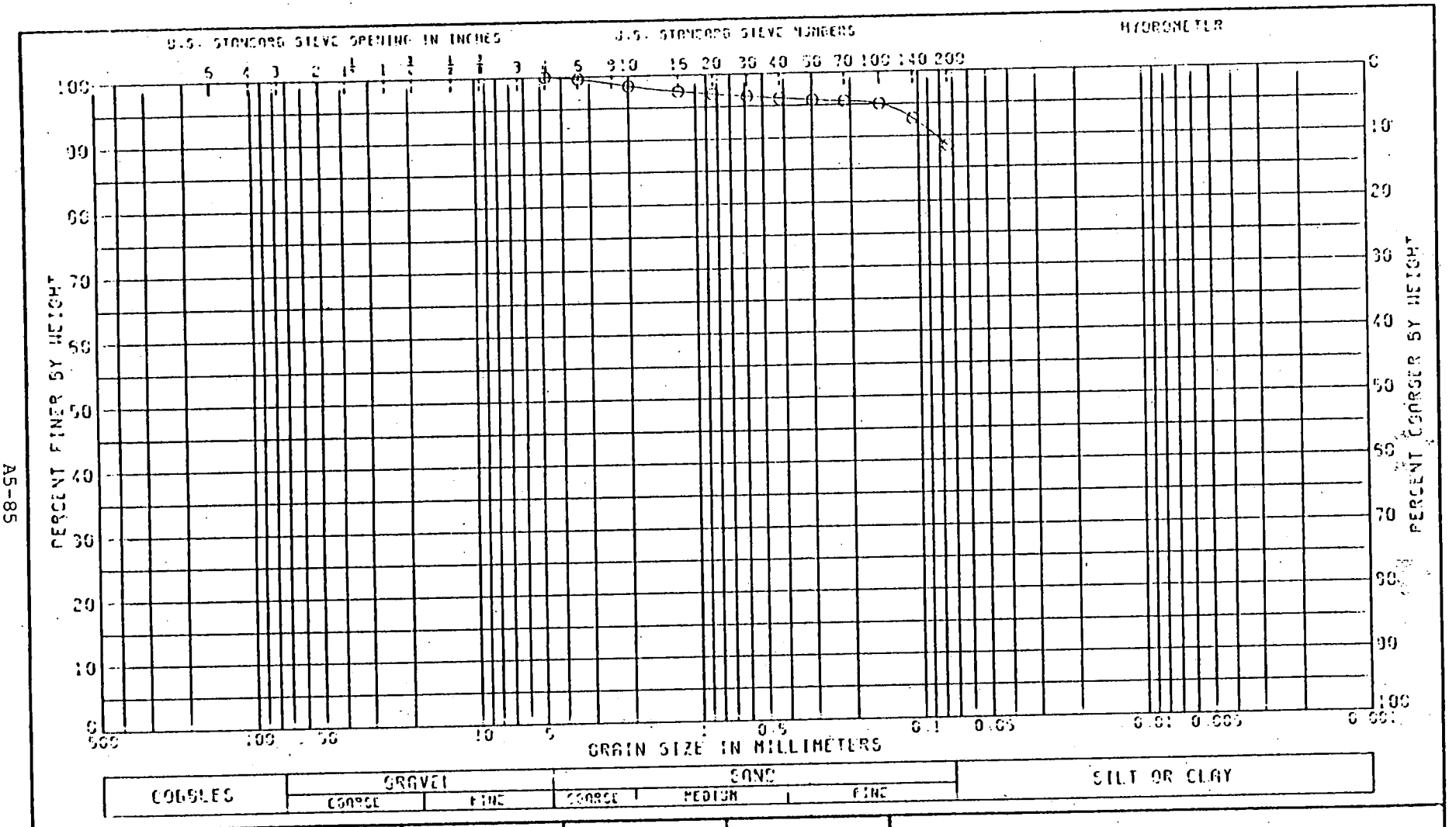
CLAY (CL), LIGHT BROWN: WITH SAND
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC
DEMOLITION AREA

BORING NO. 6-11-91 SAMPLE NO. 2

DEPTH/ELEV 5.0-5.71 DATE 31 MAR 92



LL	PL	PI	CC	NAT W.%	
57	18	39		20.8	

CLASSIFICATION

CLAY (CH), REDDISH BROWN: WITH SAND

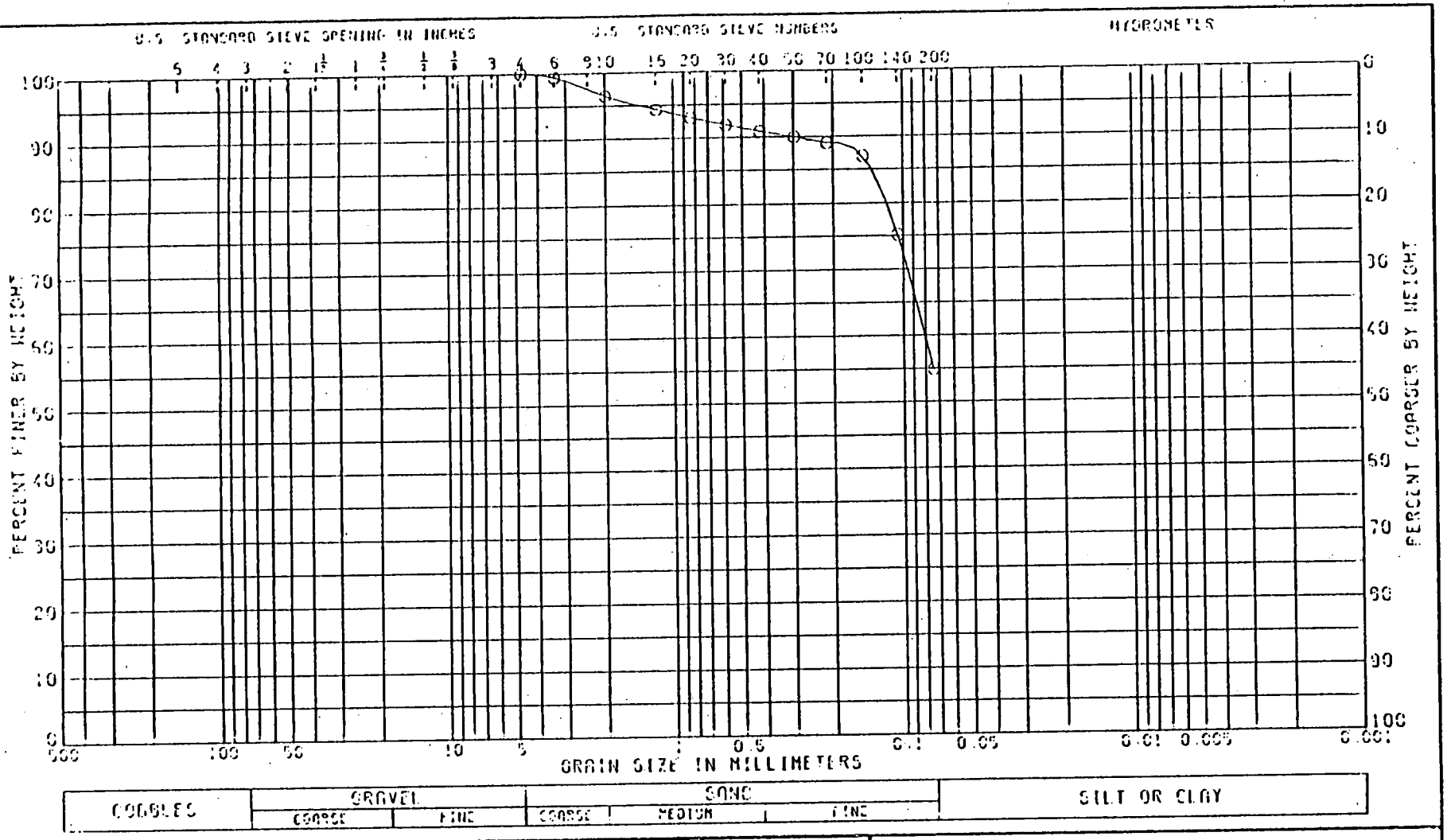
GRADATION CURVE

PROJECT CRANE NWSC

OLD BURNING GROUND

BORING NO 6-12-91 SAMPLE NO 1

DEPTH/ELEV 1.10-2.20 DATE 26 FEB 92



LL 26	PL 12	PI 14	GS	NAT W.% 7.9	

CLASSIFICATION

SANDY CLAY (CL), GRAY

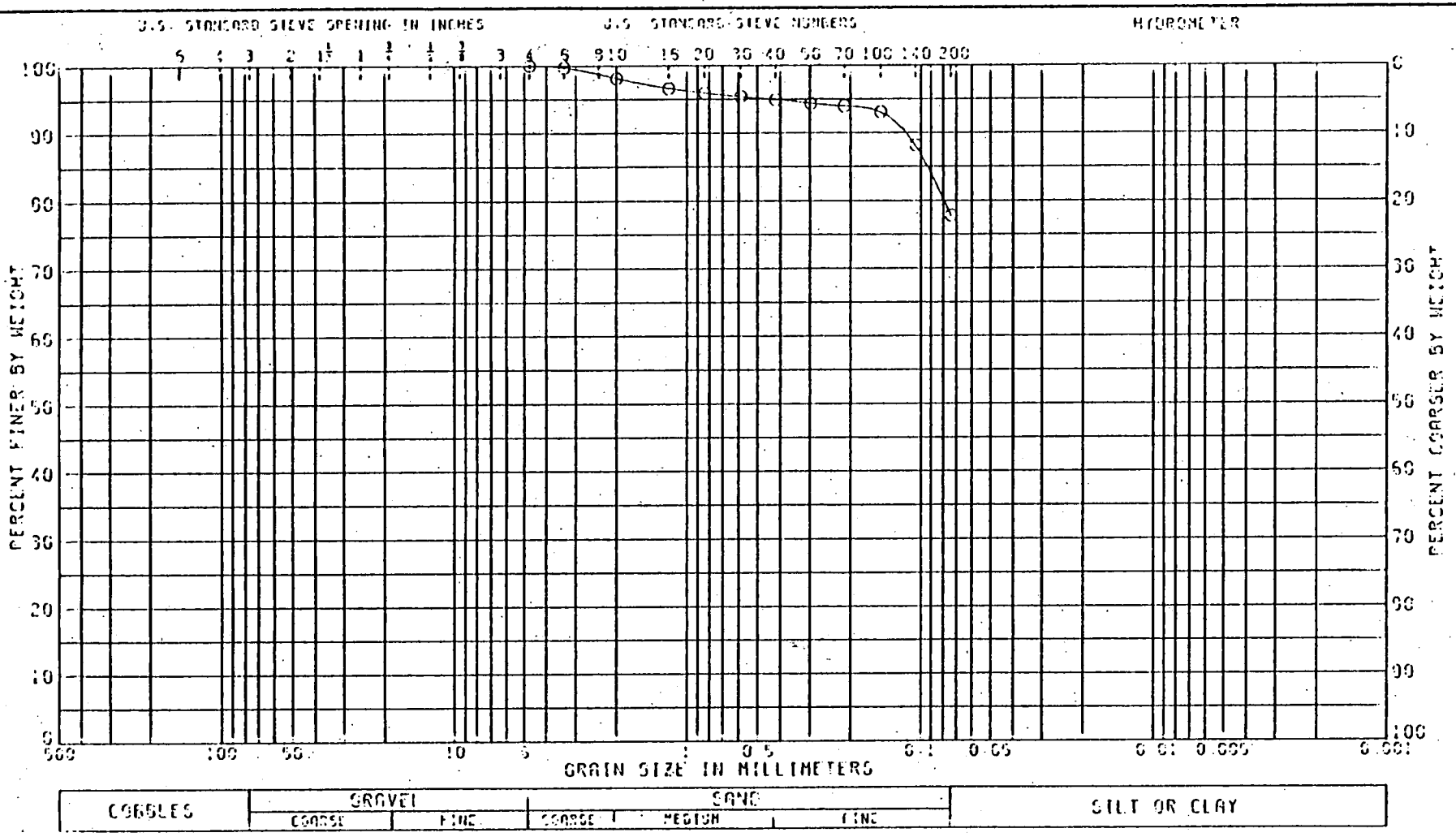
GRADATION CURVE

PROJECT CRANE NWSC

OLD BURNING GROUND

BORING NO. 6-12-91 SAMPLE NO 2

DEPTH/ELEV 5.0-6.14 DATE 26 FEB 92



LL	PL	PI	GS	NAT W.%
50	17	33		17.3

CLASSIFICATION

SANDY CLAY (CH) BROWN

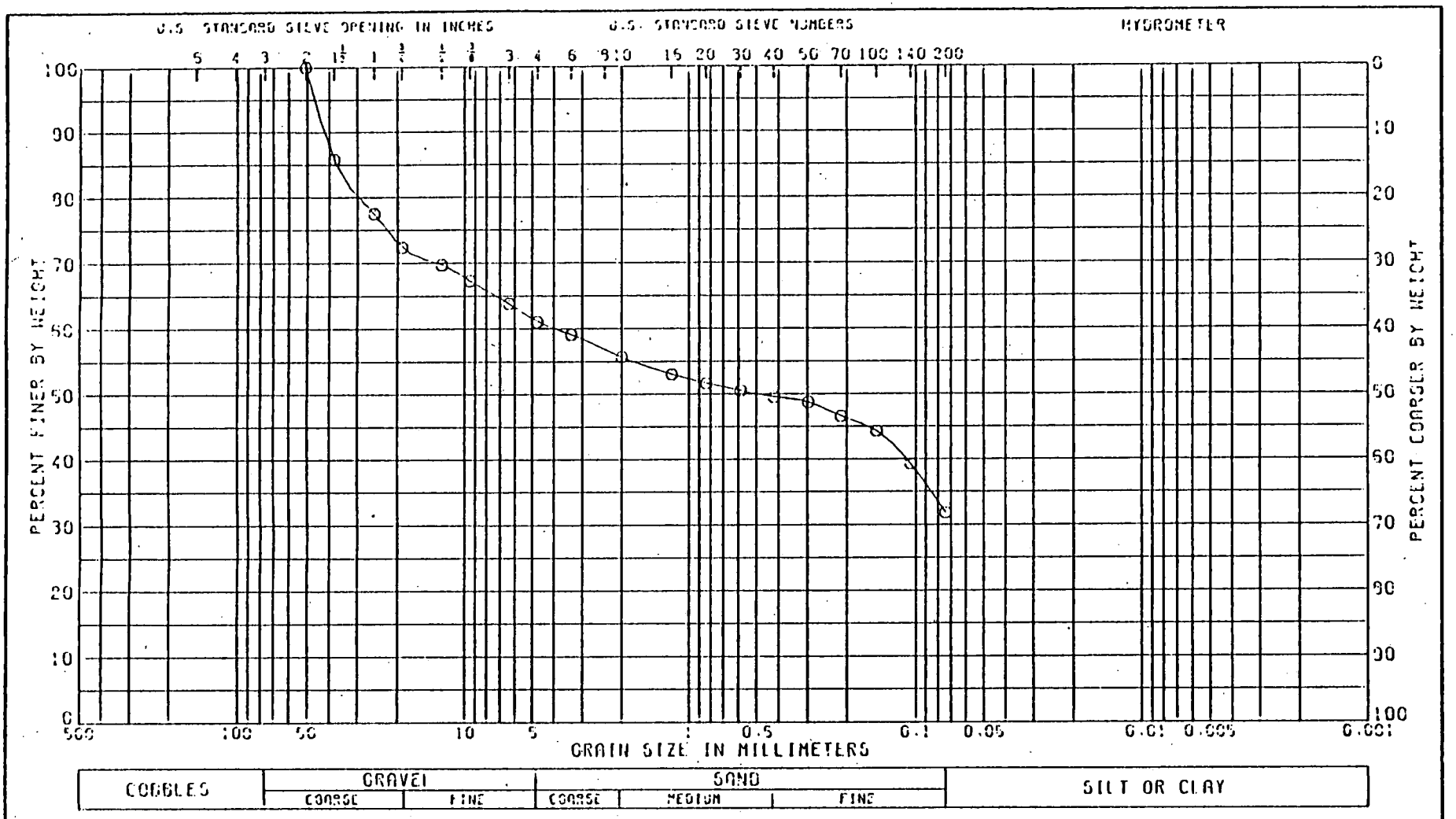
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO 6-13-01 SAMPLE NO 1

DEPTH/ELEV 0.0-1.20 DATE 26 FEB 92



LL 27	PL 16	PI 11	GS	NAT W.% 15.8	

CLASSIFICATION

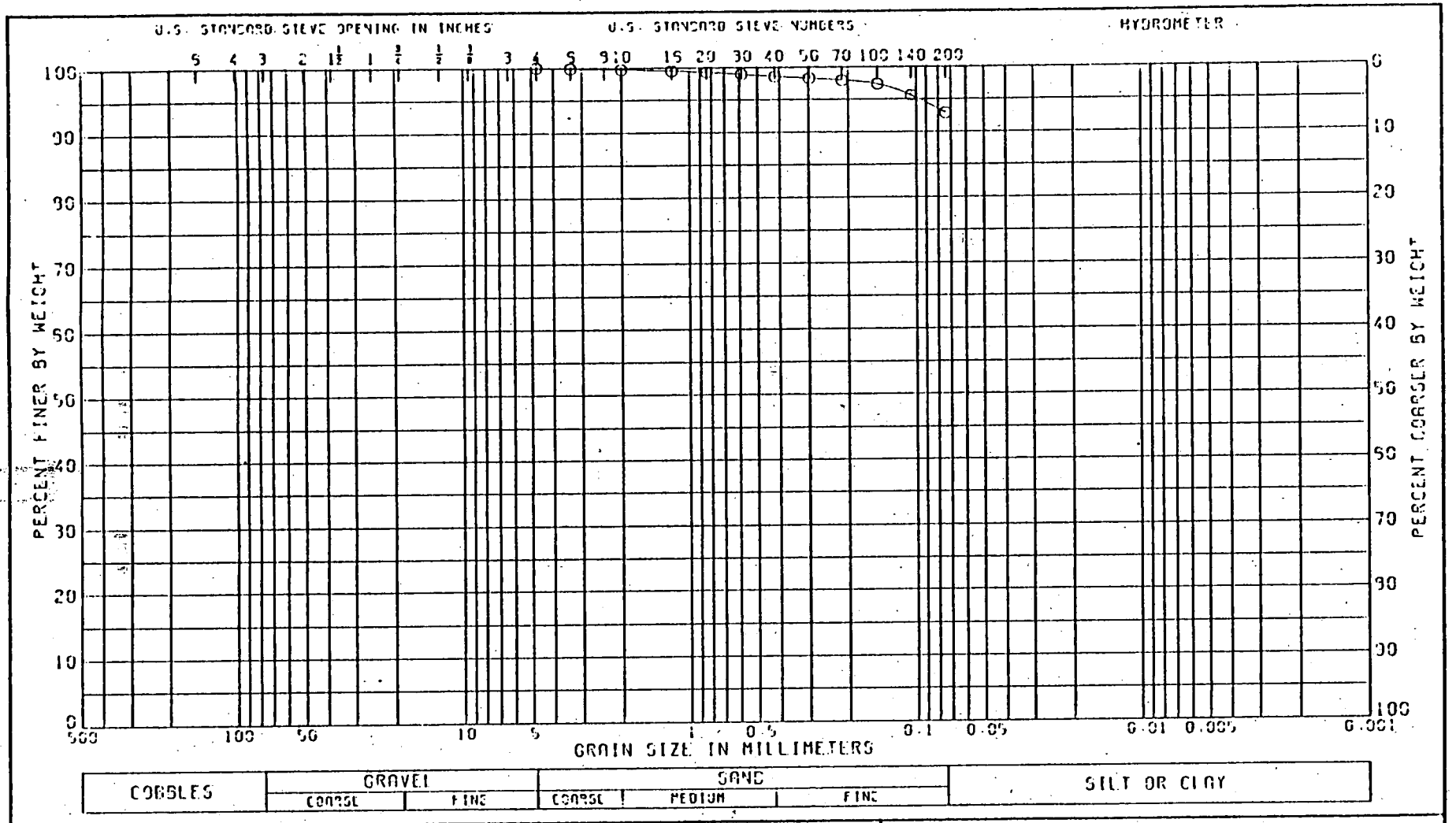
GRAVELLY CLAYEY SAND (SC), REDDISH BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-14-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.61 DATE 11 FEB 82



LL	PL	PI	CS	NAT W.%	
28	19	9		24.0	

CLASSIFICATION

CLAY (CL) , BROWN: WITH SAND

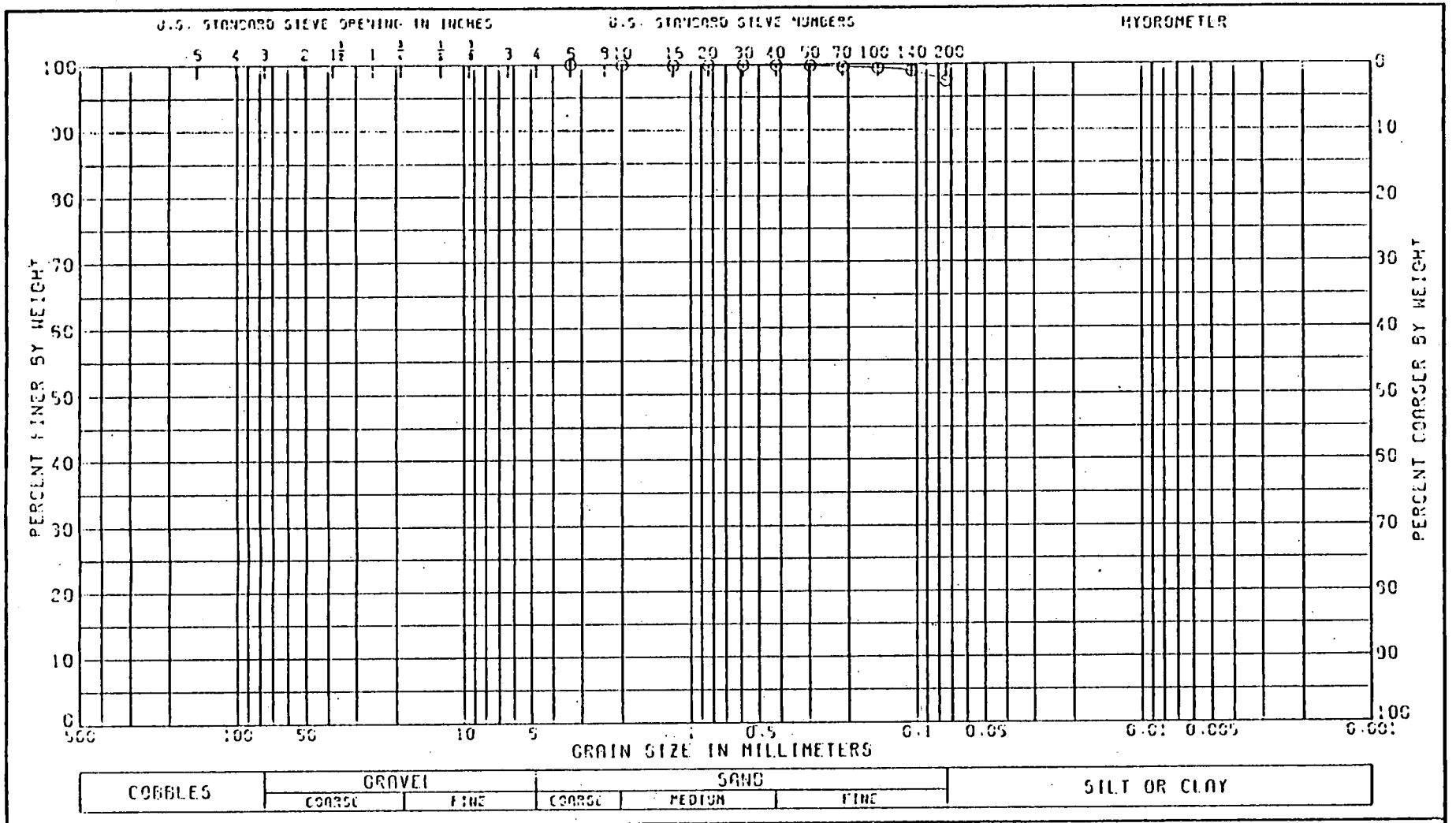
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-14-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-7.05 DATE 31 MAR 92



LL 33	PL 18	PI 15	GS	NAT W.% 23.5	

CLASSIFICATION

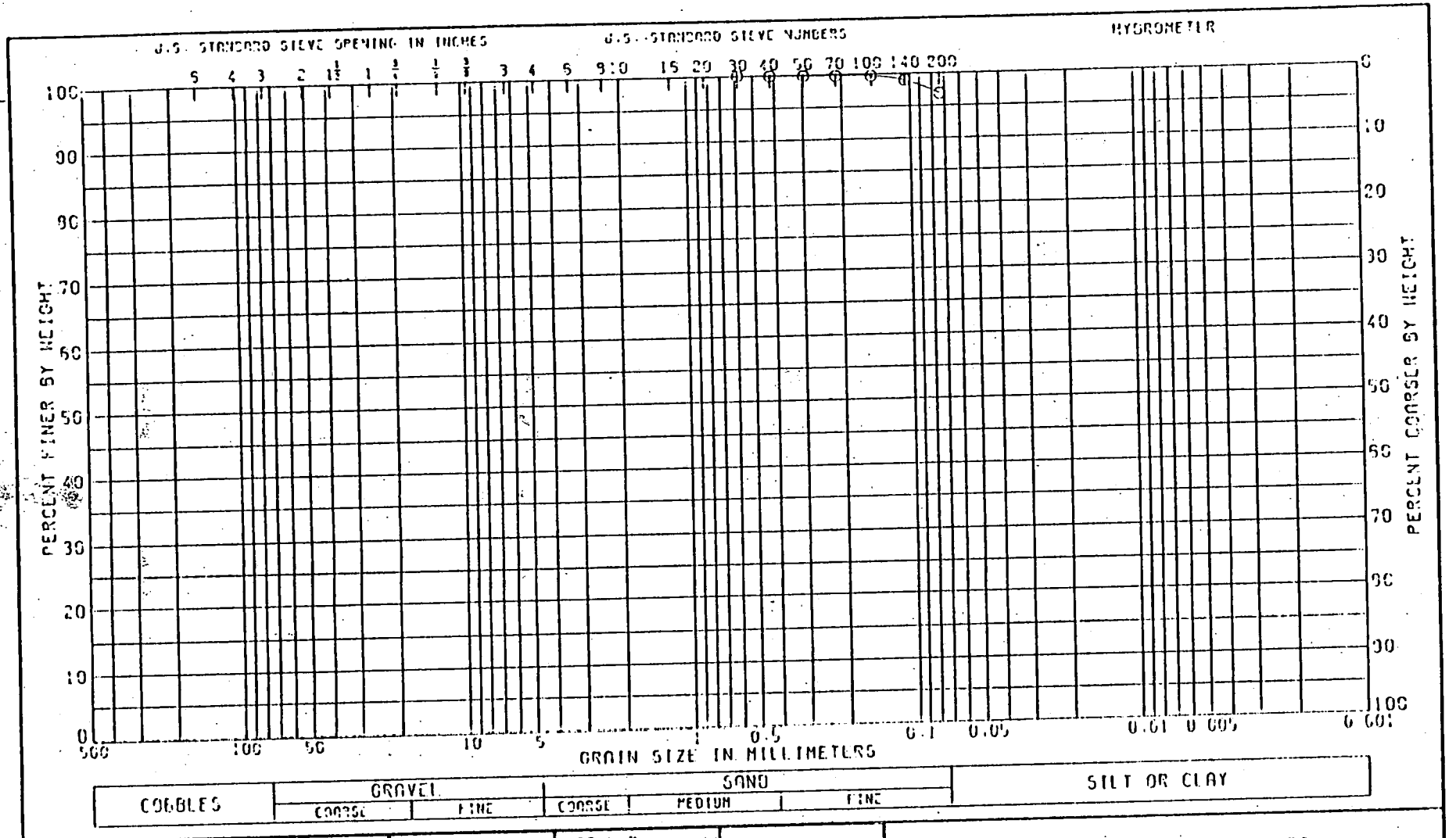
CLAY (CL), GRAY

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-14-81 SAMPLE NO 3

DEPTH/ELEV 10.0-11.67 DATE 11 FEB 92



LL 61	PL 24	PI 37	GS	NAT W.% 33.3	

CLASSIFICATION

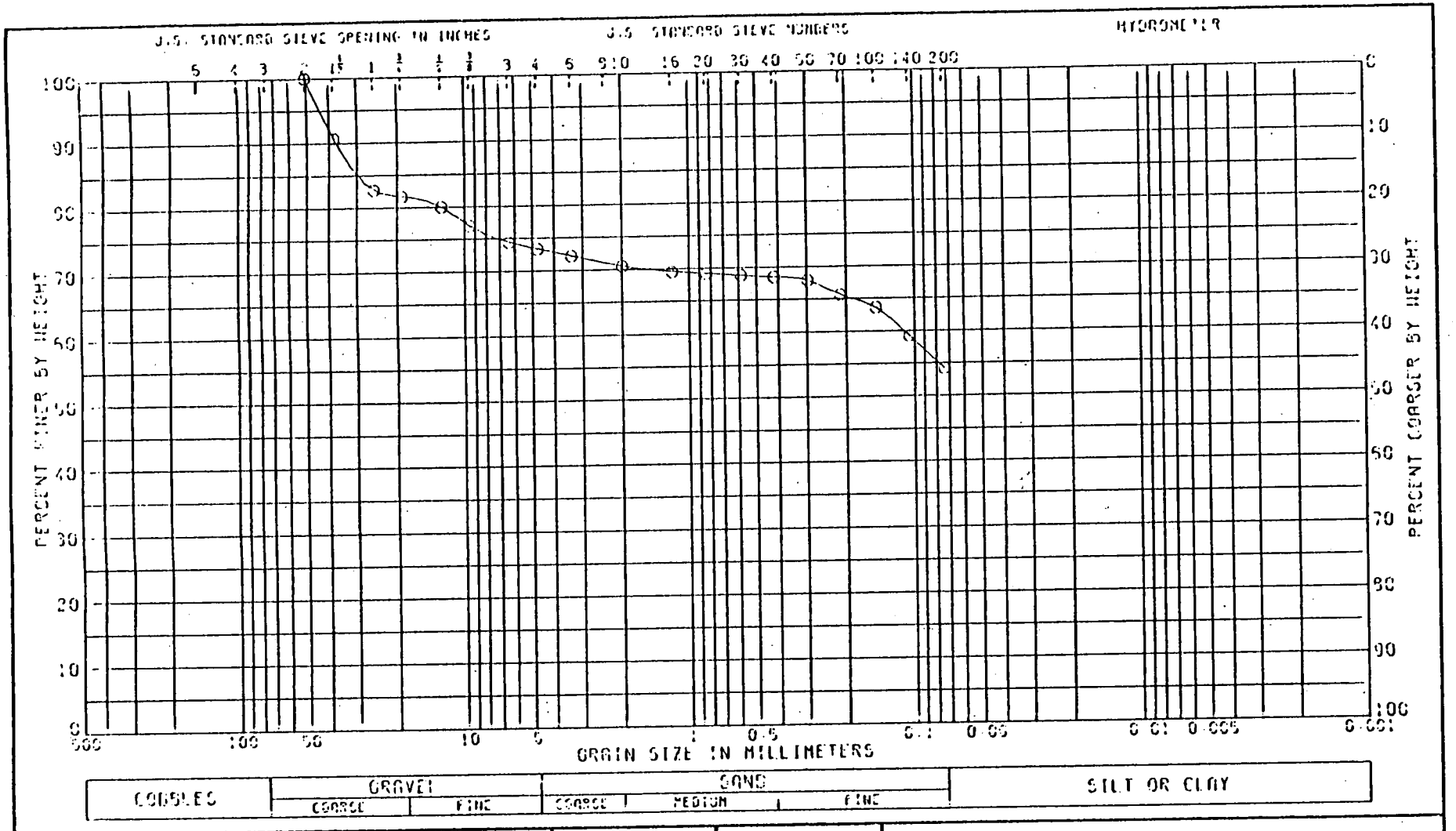
CLAY (CH), DARK BROWN

PROJECT CRANE NESC DEMOLITION AREA

BORING NO. S-14-01 SAMPLE NO. 4

DEPTH/ELEV 15.0-17.07 DATE 11 FEB 92

GRADATION CURVE



LL 27	PL 17	PI 10	CS	NAT W.% 16.5	

CLASSIFICATION

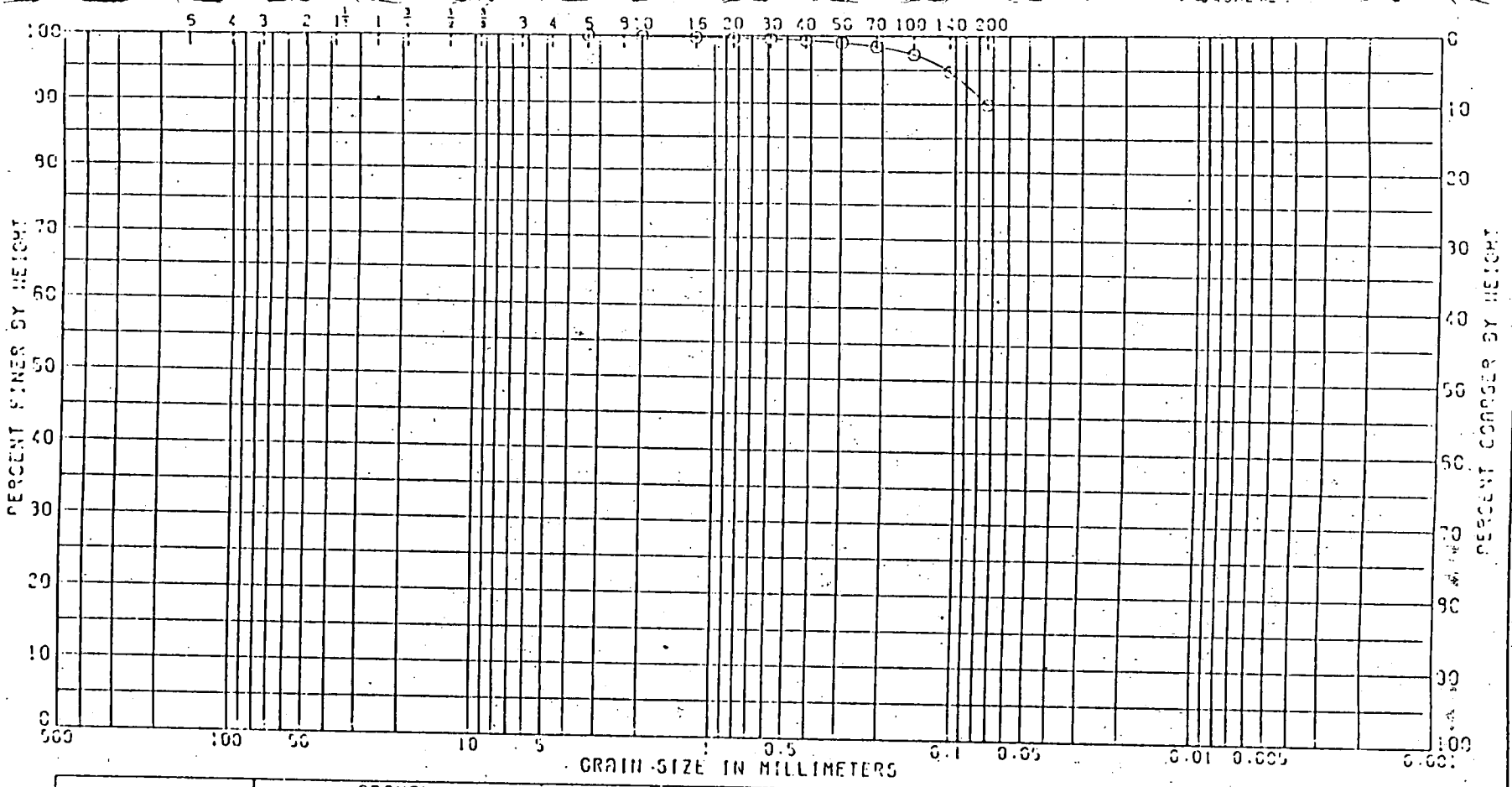
GRAVELLY SANDY CLAY (CL), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC
OLD BURNING GROUND

BORING NO 6-15-91 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.35 DATE 26 FEB 82



LL	PL	PI	GS	NAT W.%	
37	20	17		13.8	

CLASSIFICATION

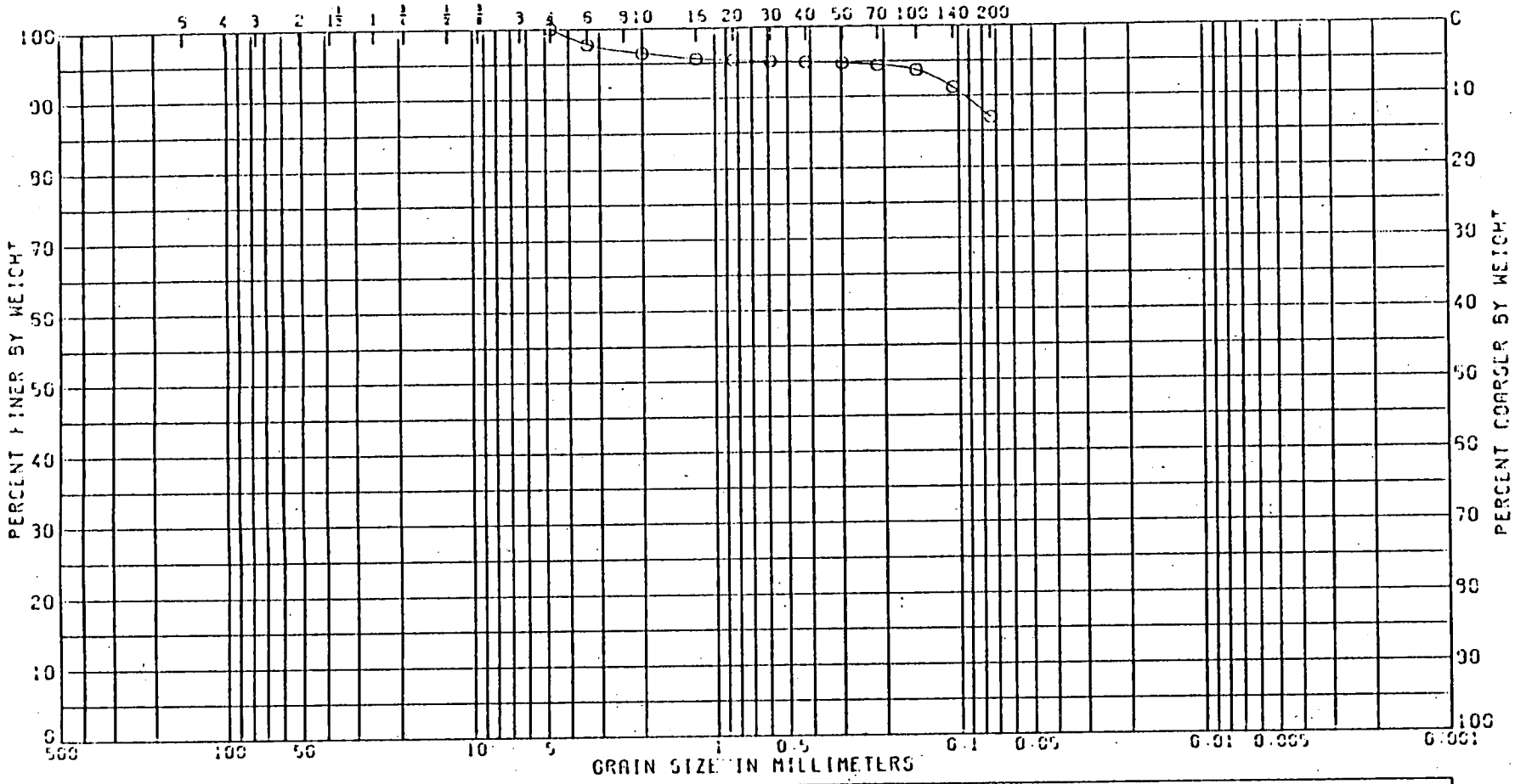
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT: CRANE NWSC DEMOLITION AREA

BORING NO. 6-18-91 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.37 DATE 12 MAR 92



LL	PL	PI	CS	NAT W.%
29	15	14		10.7

CLASSIFICATION

SANDY CLAY (CL), BROWN

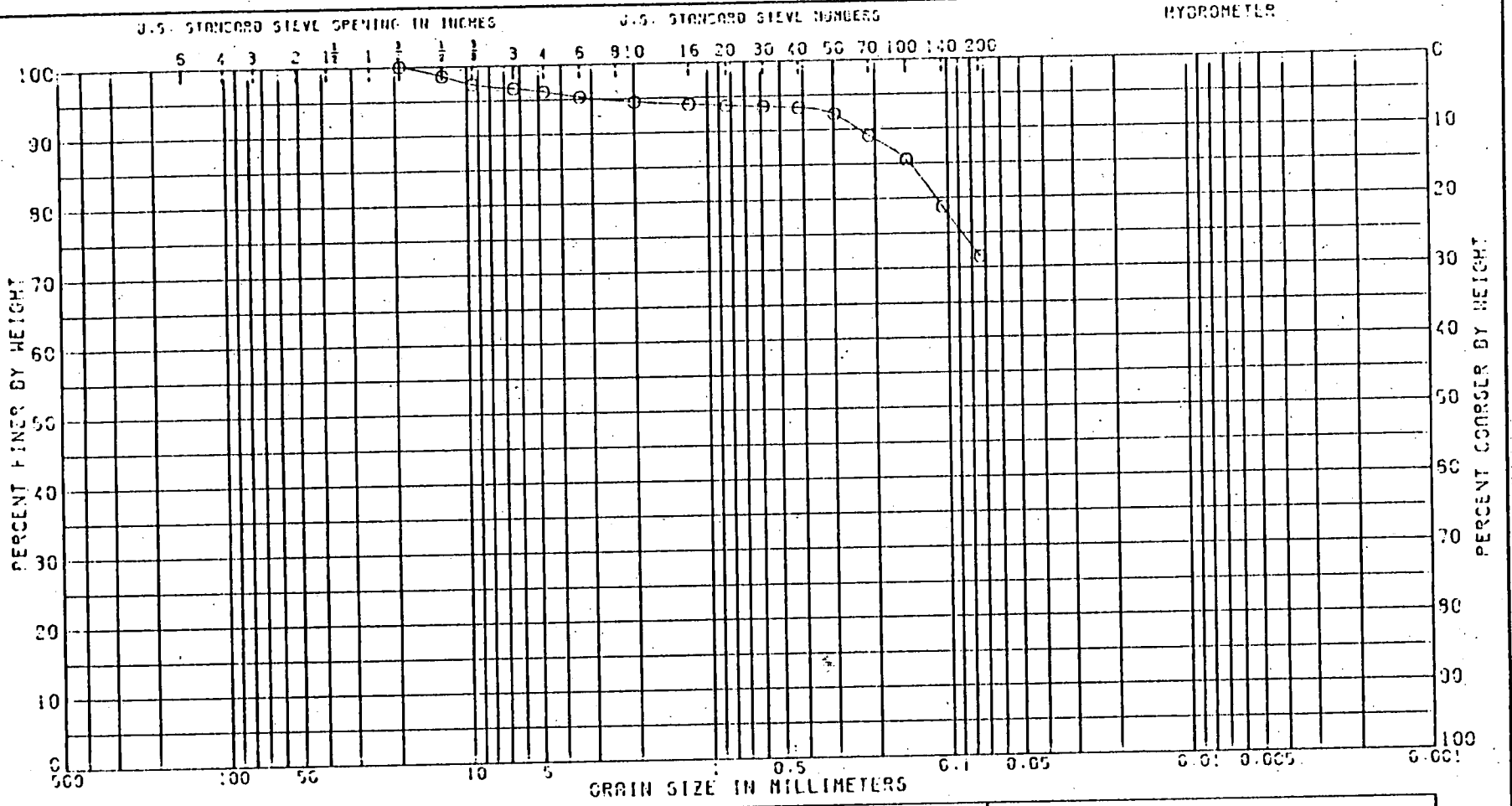
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-16-81 SAMPLE NO. 2A

DEPTH/ELEV 5.0-5.4 DATE 31 MAR 82



LL	PL	PI	GS	NAT W.%
28	17	11		22.7

CLASSIFICATION

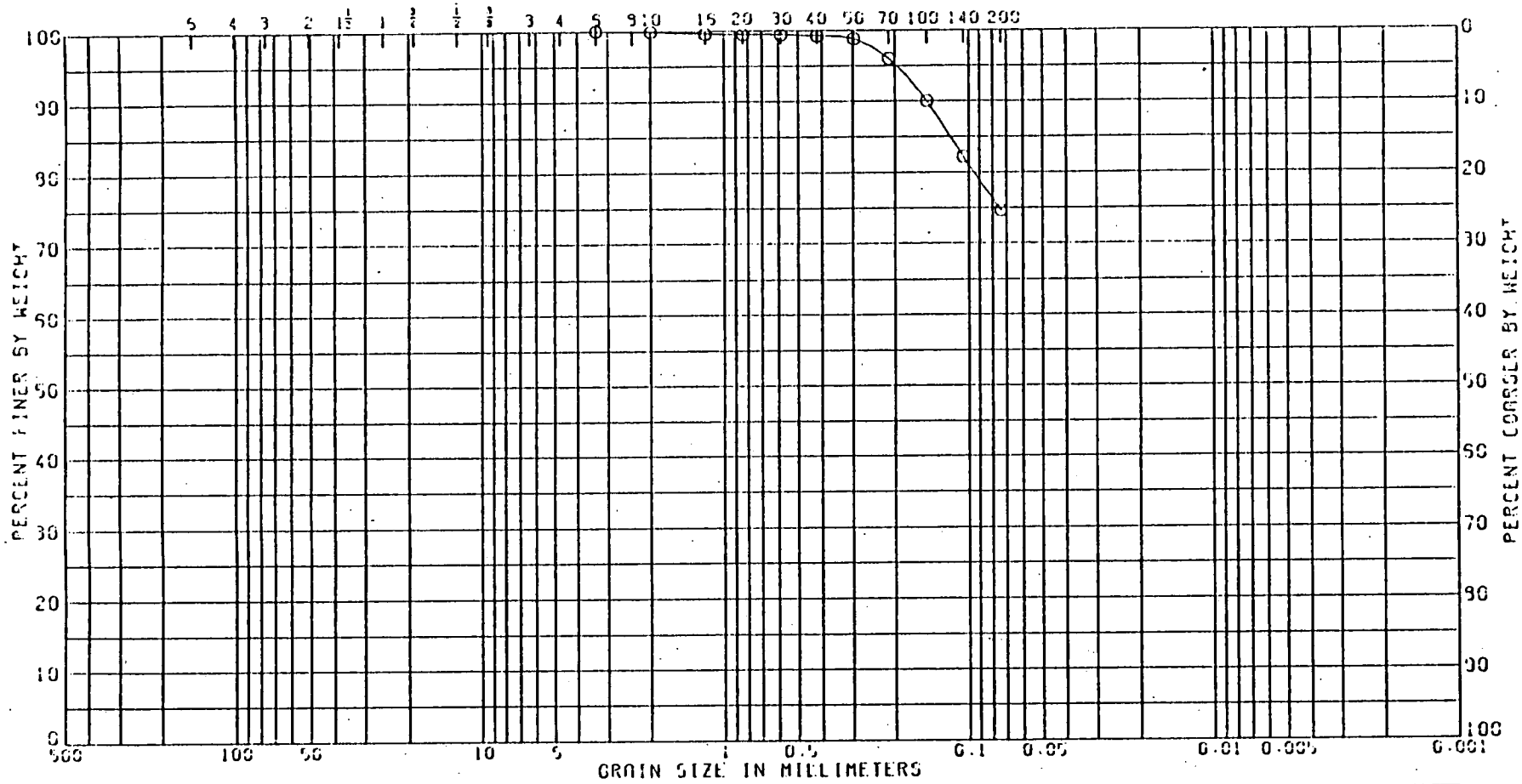
SANDY CLAY (CL), BROWN TRACE OF GRAVEL

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-17-81 SAMPLE NO 1

DEPTH/ELEV 0.0-1.30 DATE 12 MAR 82



LL 35	PL 18	PI 17	CS	NAT W.% 15.0	

CLASSIFICATION

SANDY CLAY (CL), TAN

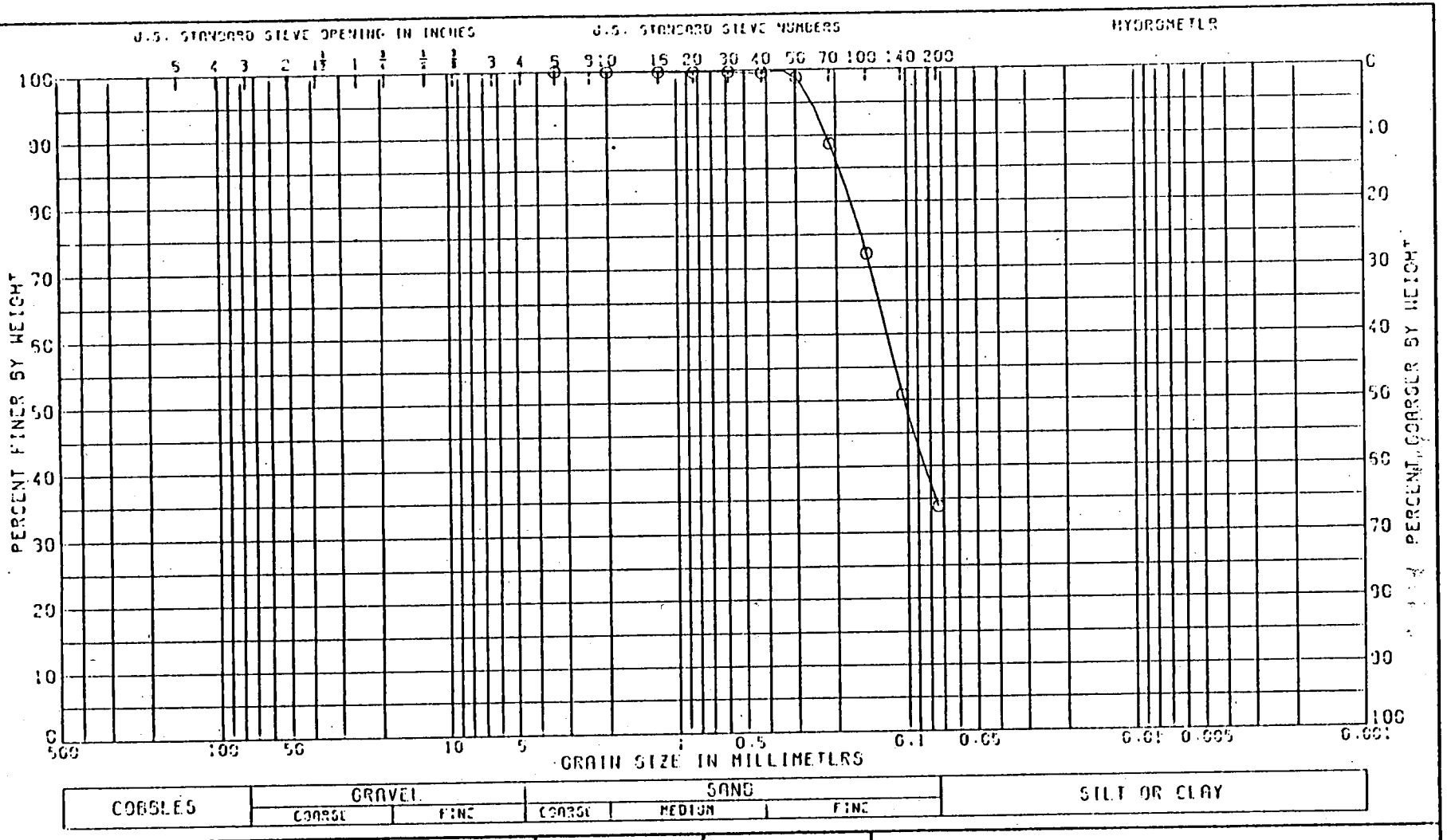
GRADATION CURVE

PROJECT CRANE NWSC

DEMOLITION AREA

BORING NO. 6-18-91 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.63 DATE 31 MAR 92



LL	PL	PI	GS	NAT W.%
24	14	10		13.9

CLASSIFICATION

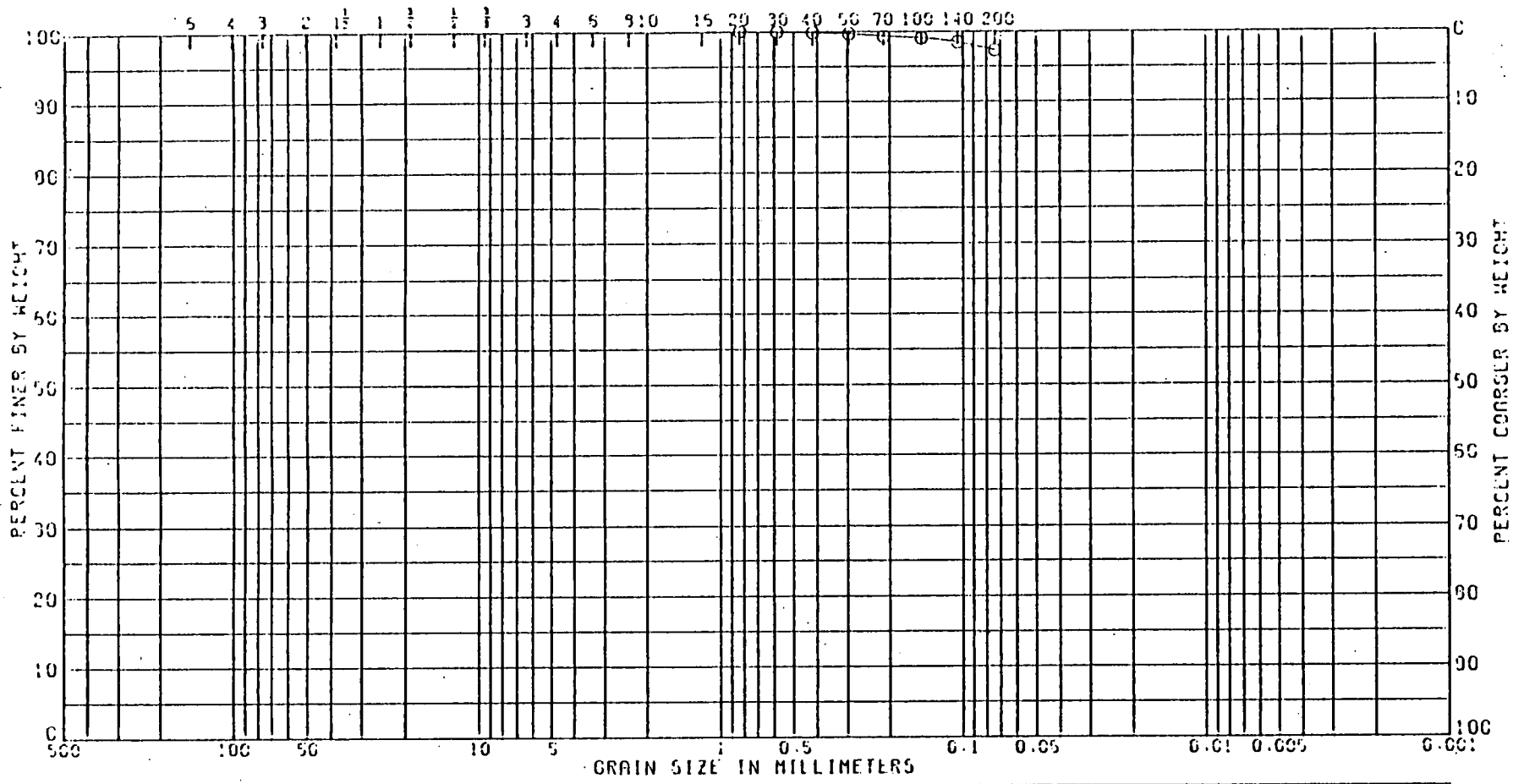
CLAYEY SAND (SC), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-18-91 SAMPLE NO 2

DEPTH/ELEV 5.0-6.50 DATE 11 FEB 92



LL 42	PL 18	PI 24	CS	NAT W.% 23.2	

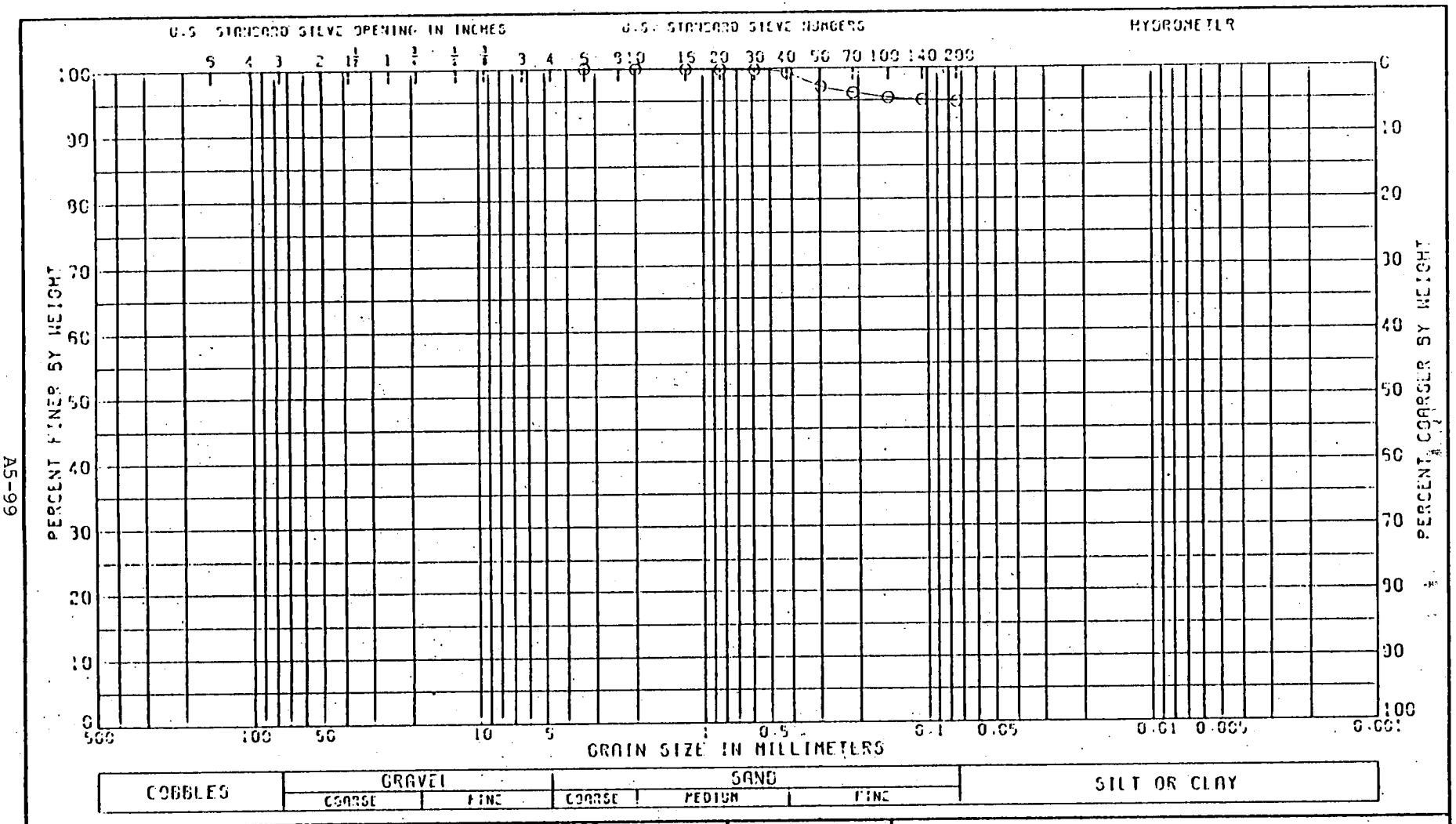
CLASSIFICATION
CLAY (CL), LIGHT BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-10-81 SAMPLE NO. 1

DEPTH/ELEV 5.0-6.00 DATE 11 FEB 82



LL 44	PL 17	PI 27	CS	NAT. W.% 25.2	

CLASSIFICATION

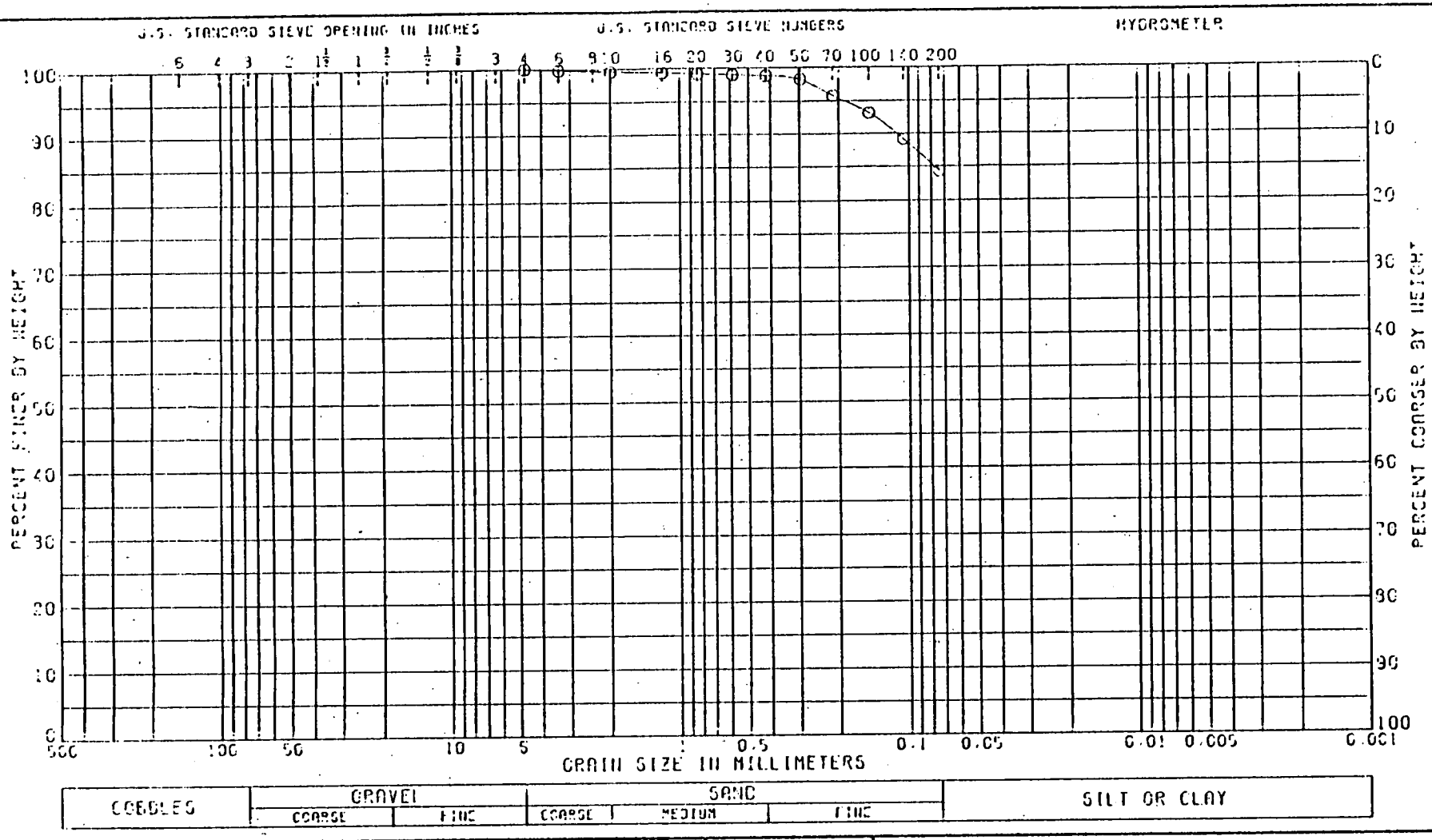
CLAY (CL), BROWNISH GRAY: WITH SAND

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. S-19-91 SAMPLE NO. 2

DEPTH/ELEV 10.0-11.56 DATE 11 FEB 92



LL 27	PL 15	PI 12	GS	NAT W.% 19.1	

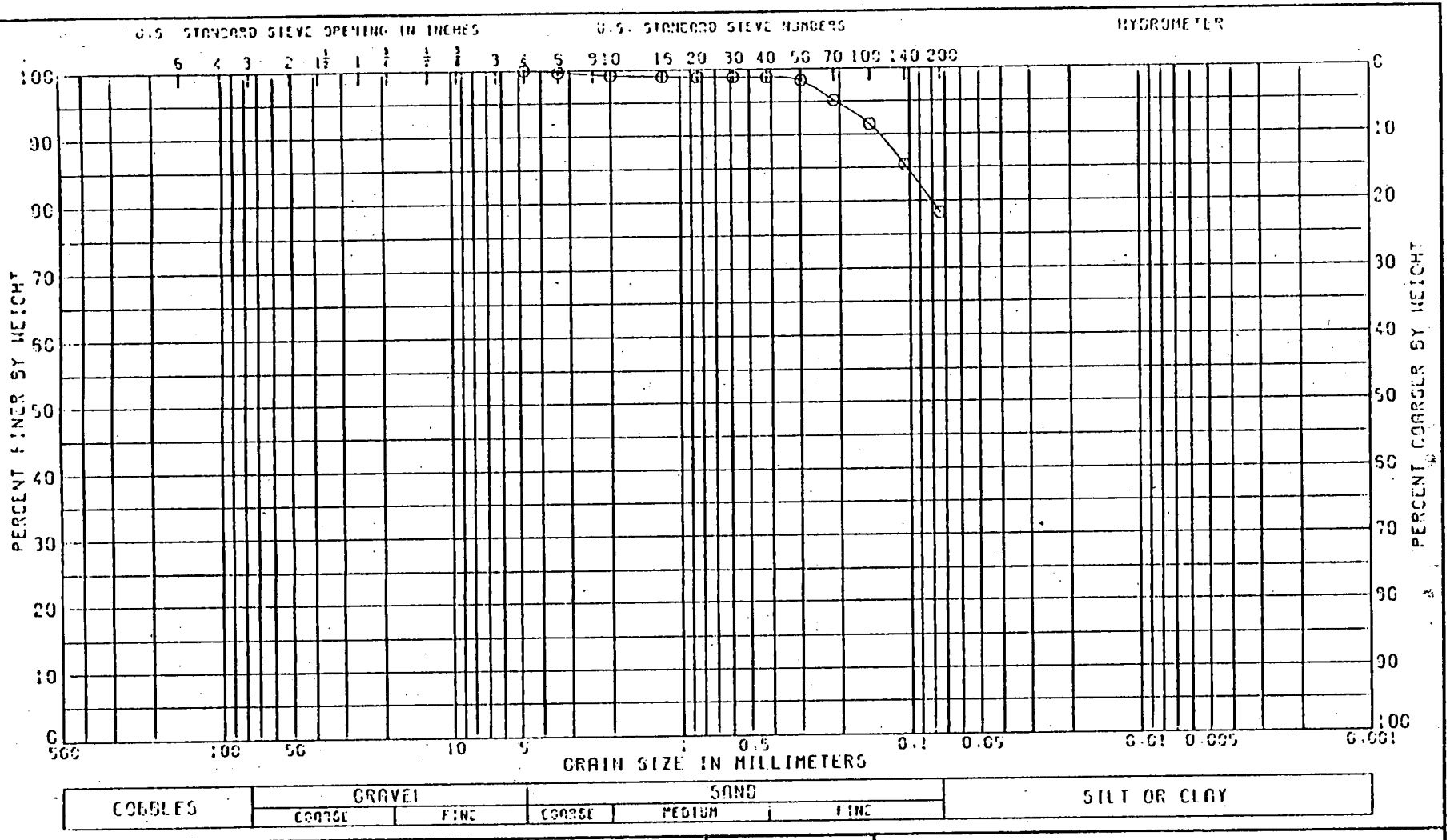
CLASSIFICATION
SANDY CLAY (CL), REDDISH BROWN

GRADATION CURVE

PROJECT CRANE NESC DEMOLITION AREA

BORING NO. 6-20-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.78 DATE 05 FEB 82



LL	PL	PI	GS	NAT W.%	
35	14	21		18.9	

CLASSIFICATION

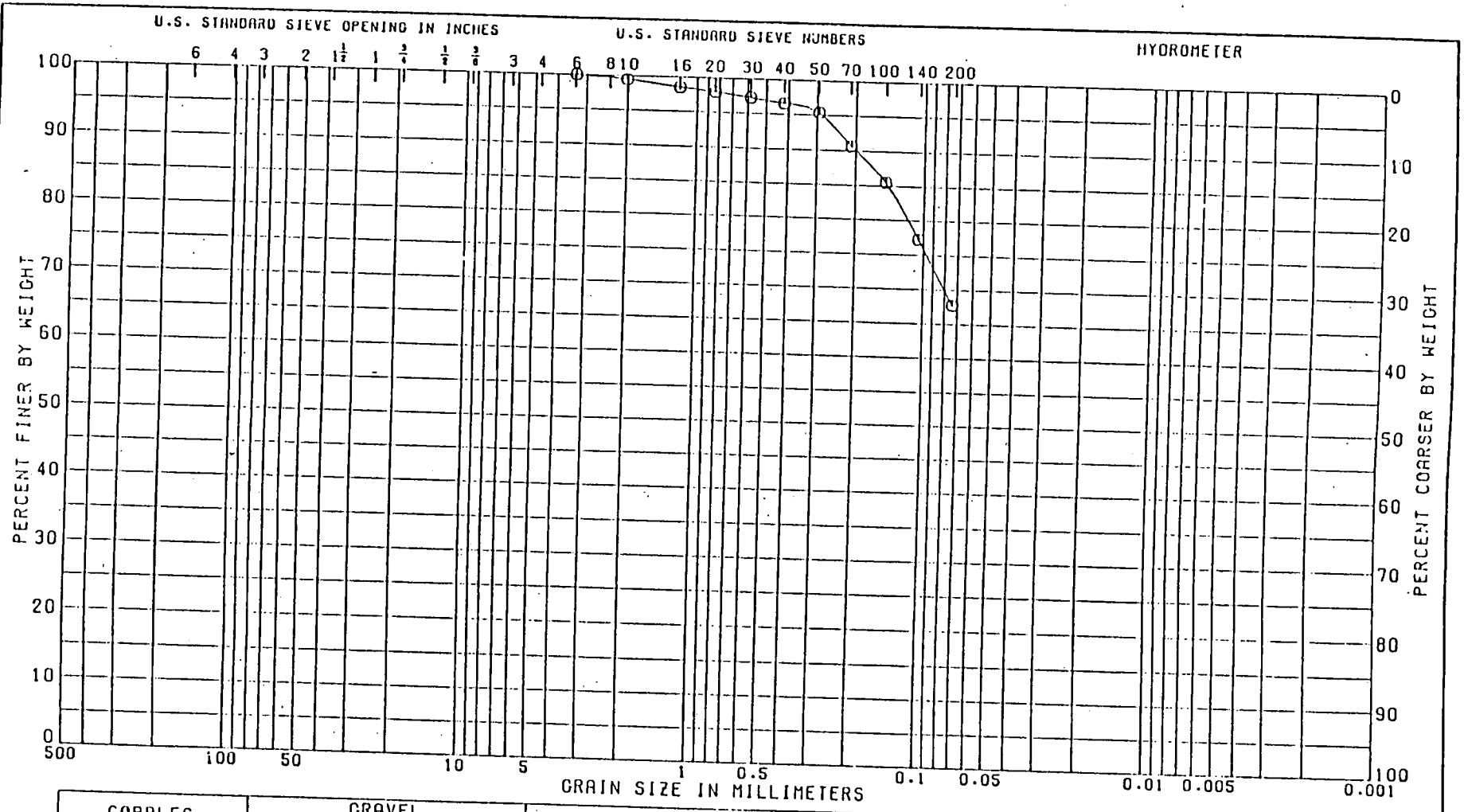
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NWSC DEMOLITION AREA

BORING NO. 6-20-01 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.75 DATE 11 FEB 92



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W,%
34	14	20		

CLASSIFICATION

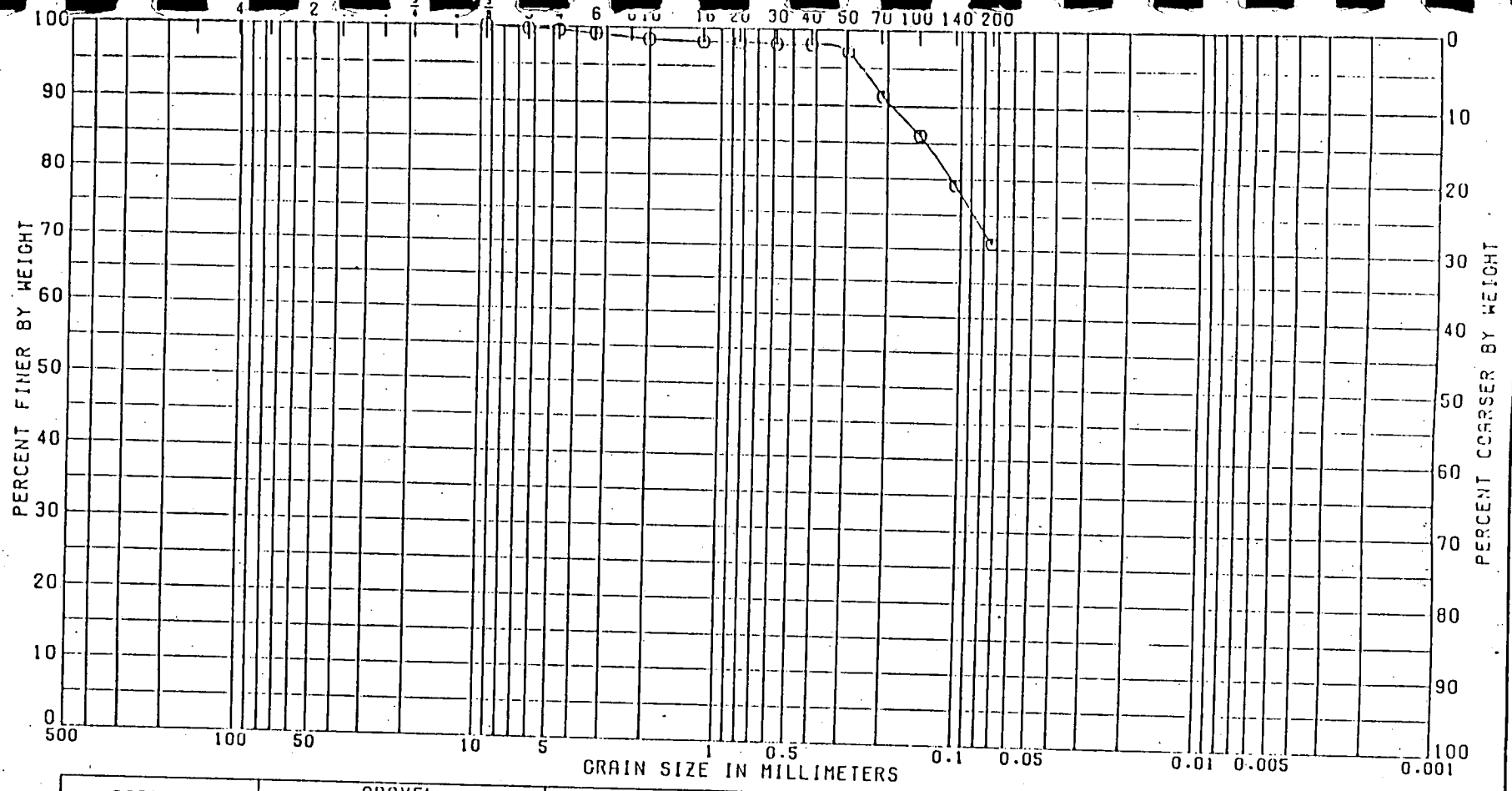
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-1-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.4 DATE 08 NOV 83



LL	PL	PI	CS	NAT W.%
24	13	11		

CLASSIFICATION

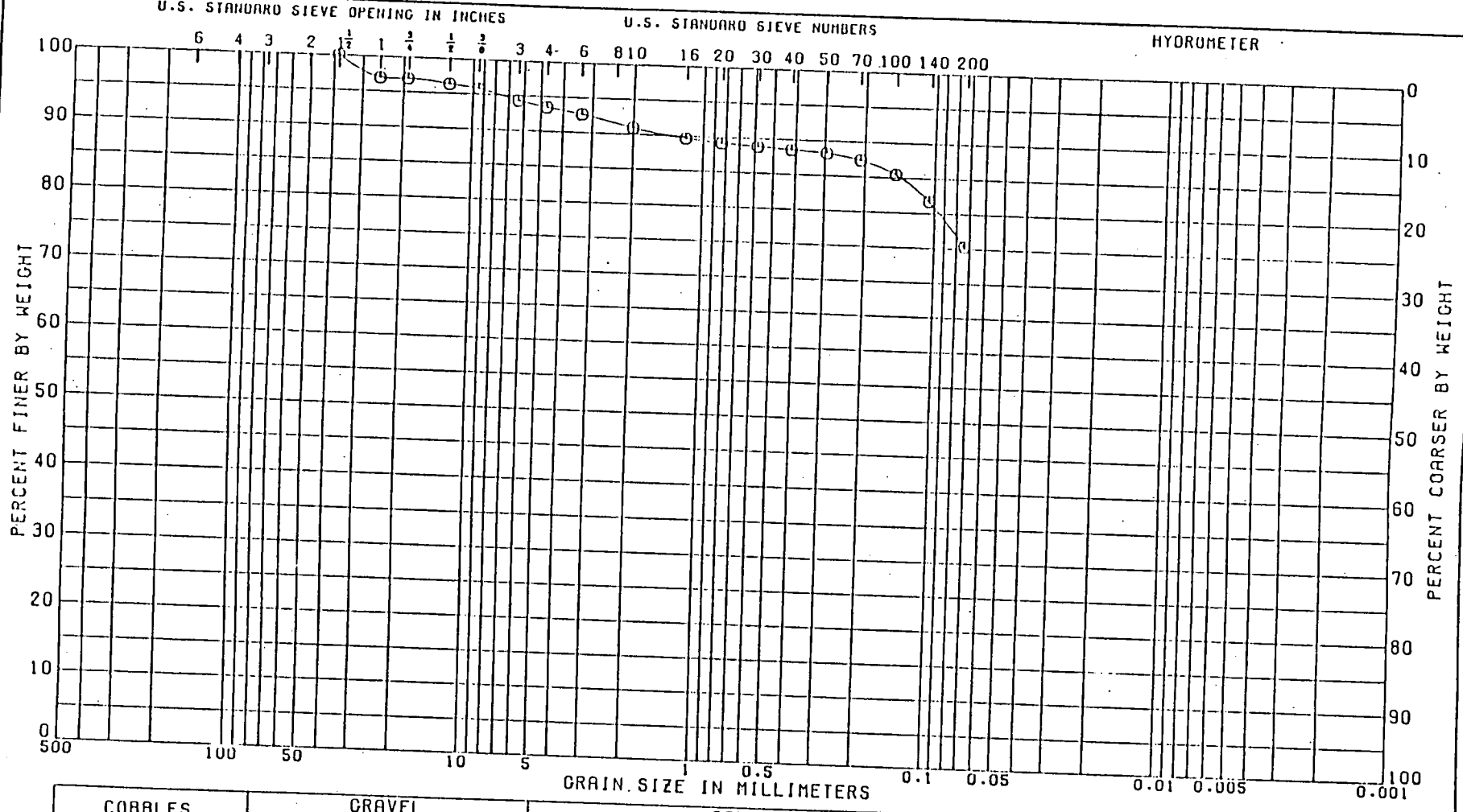
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-1-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-7.3 DATE 08 NOV 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
24	15	9		

CLASSIFICATION

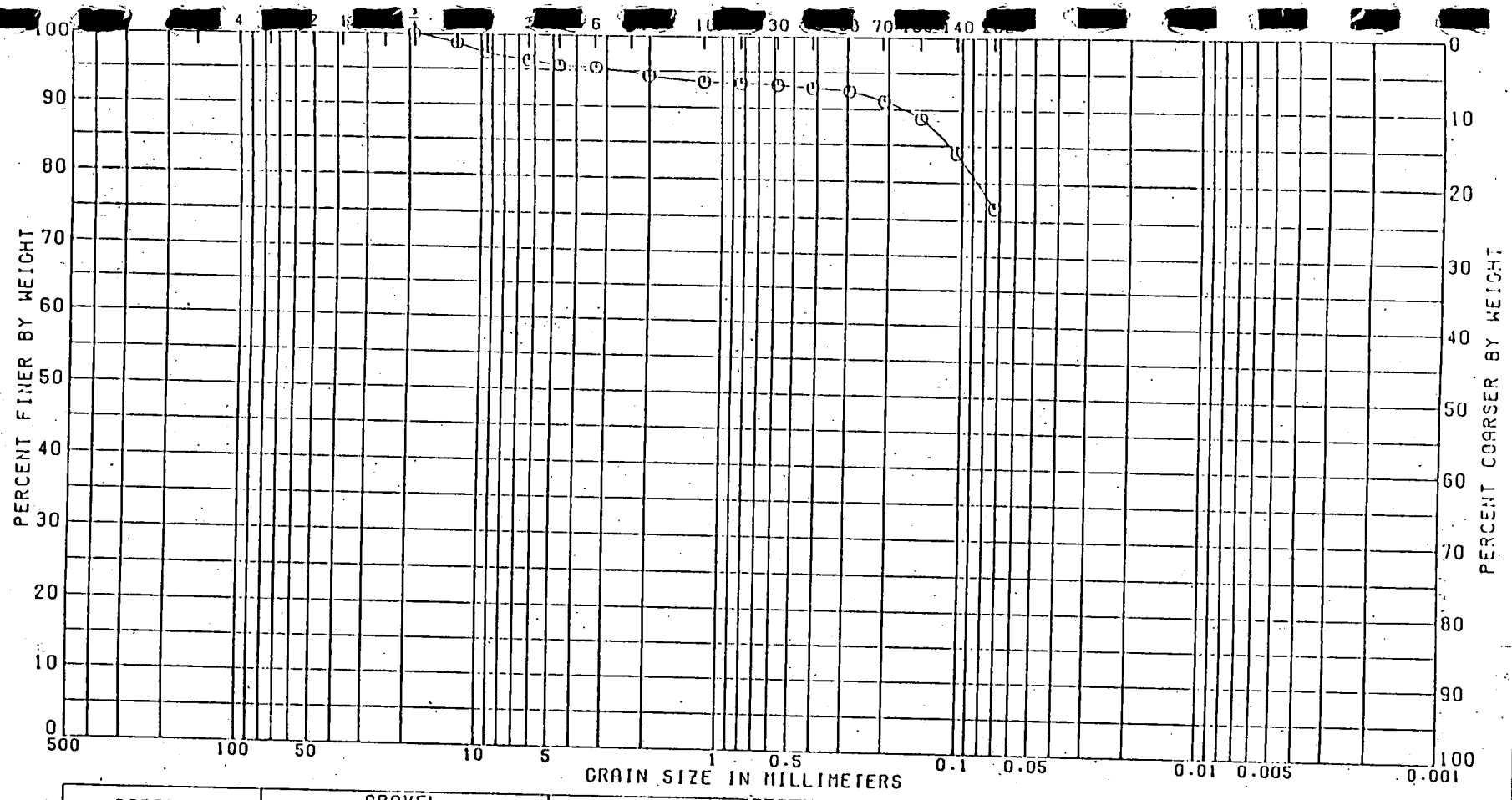
SANDY CLAY (CL), TAN: WITH GRAVEL
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-2-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.10 DATE 08 NOV 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
32	14	18		

CLASSIFICATION

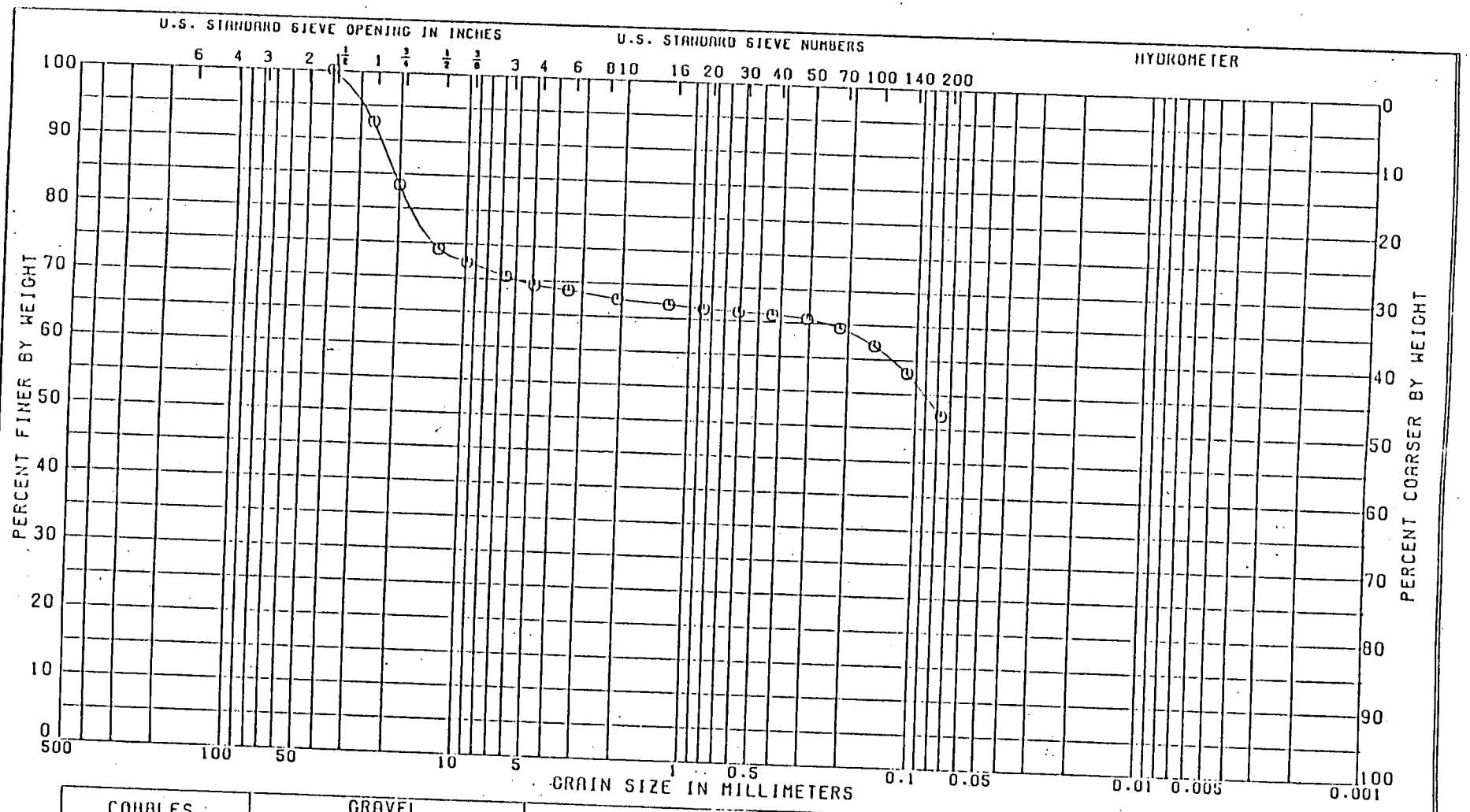
SANDY CLAY (CL), BROWN: TRACE OF GRAVEL
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-2-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.35 DATE 08 NOV 83



LL 29	PL 13	PI 16	GS	NAT W.%	

CLASSIFICATION

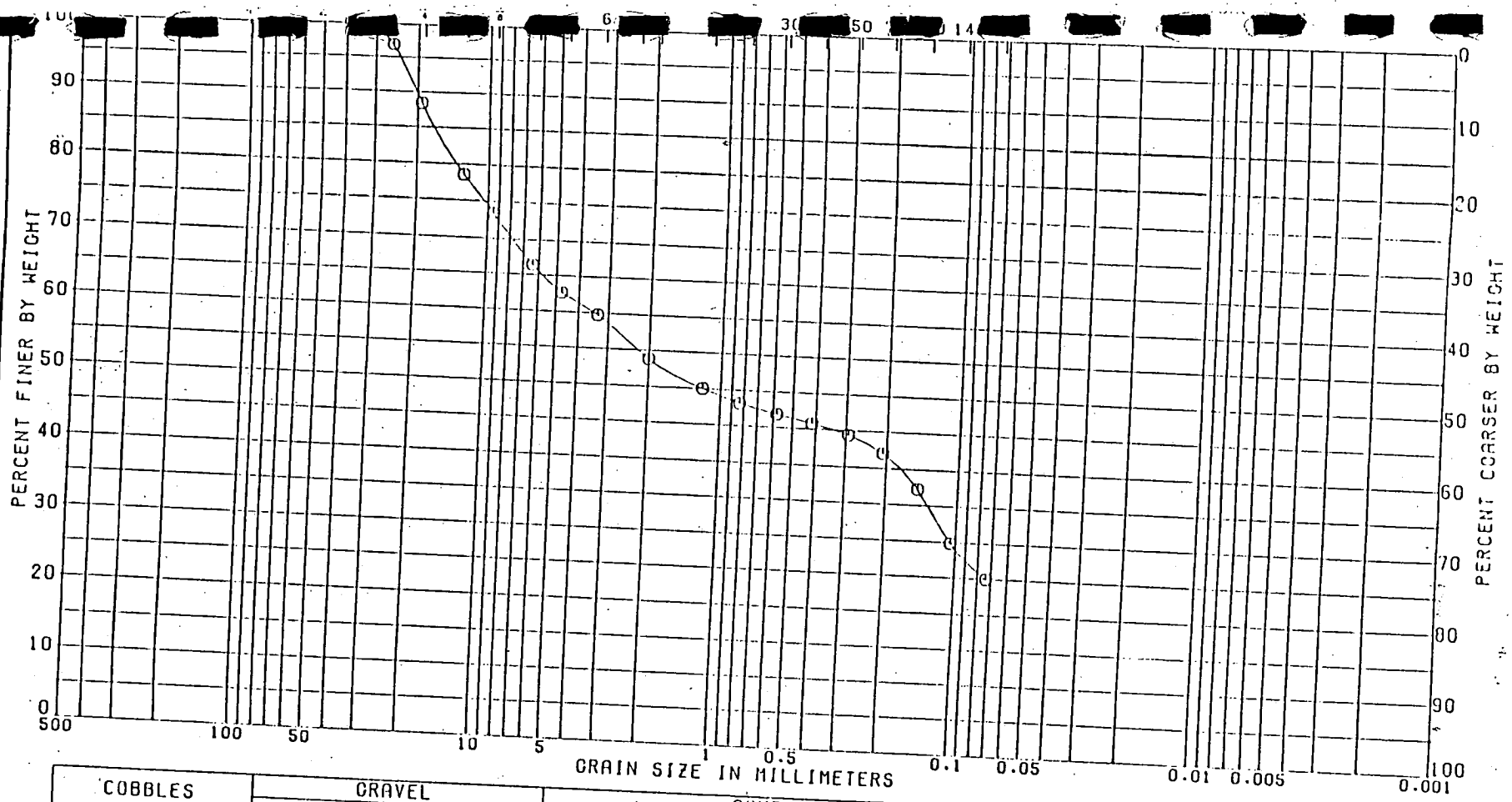
SANDY GRAVELLY CLAY (CL) TAN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-2-83 SAMPLE NO. 3

DEPTH/ELEV 10.0-11.35 DATE 08 NOV 83



LL 35	PL 16	PI 19	CS	NAT W.%	

CLASSIFICATION

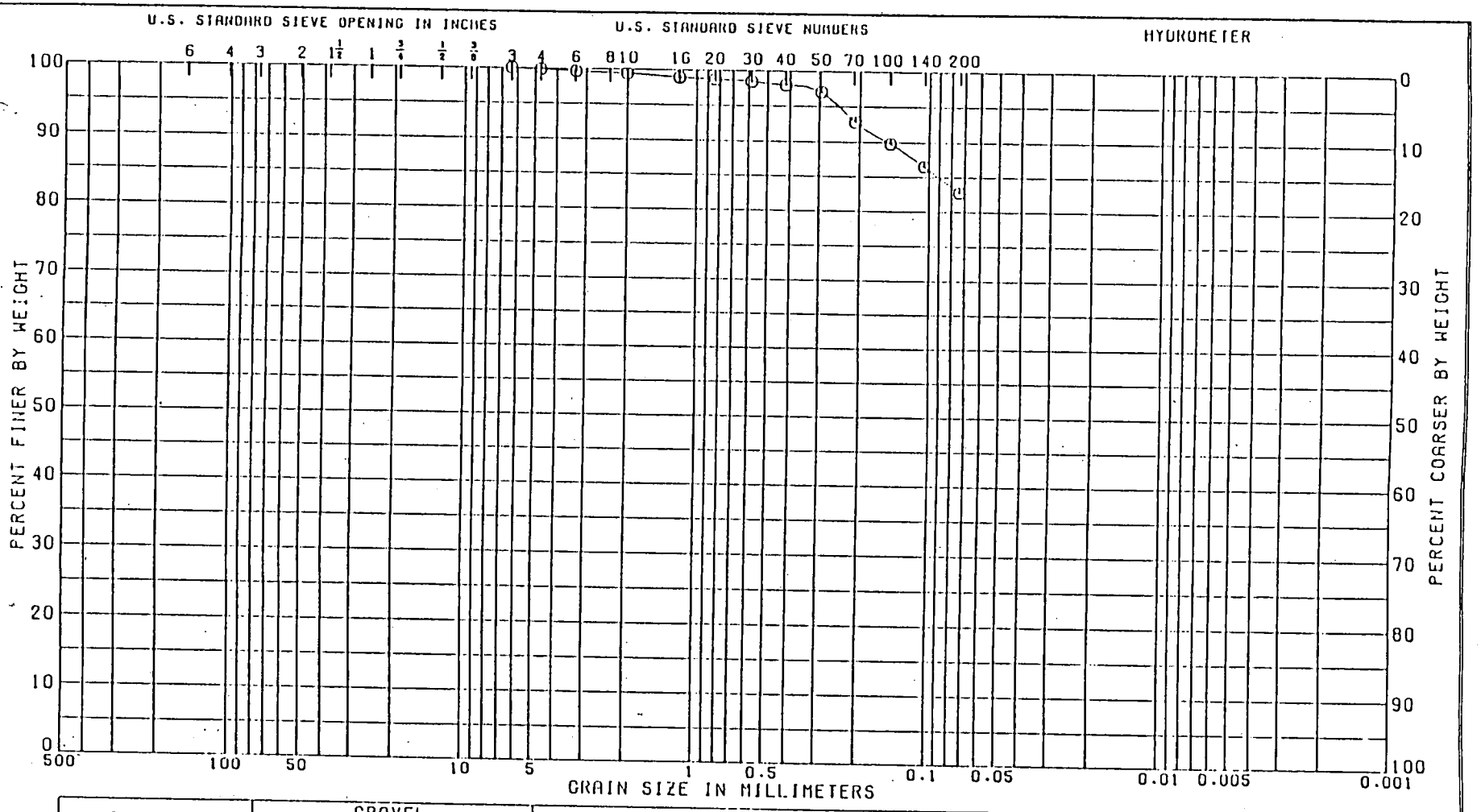
GRAVELLY CLAYEY SAND (SC), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-2-83 SAMPLE NO. 4

DEPTH/ELEV 15.0-15.95 DATE 08 NOV 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
34	15	19		

CLASSIFICATION

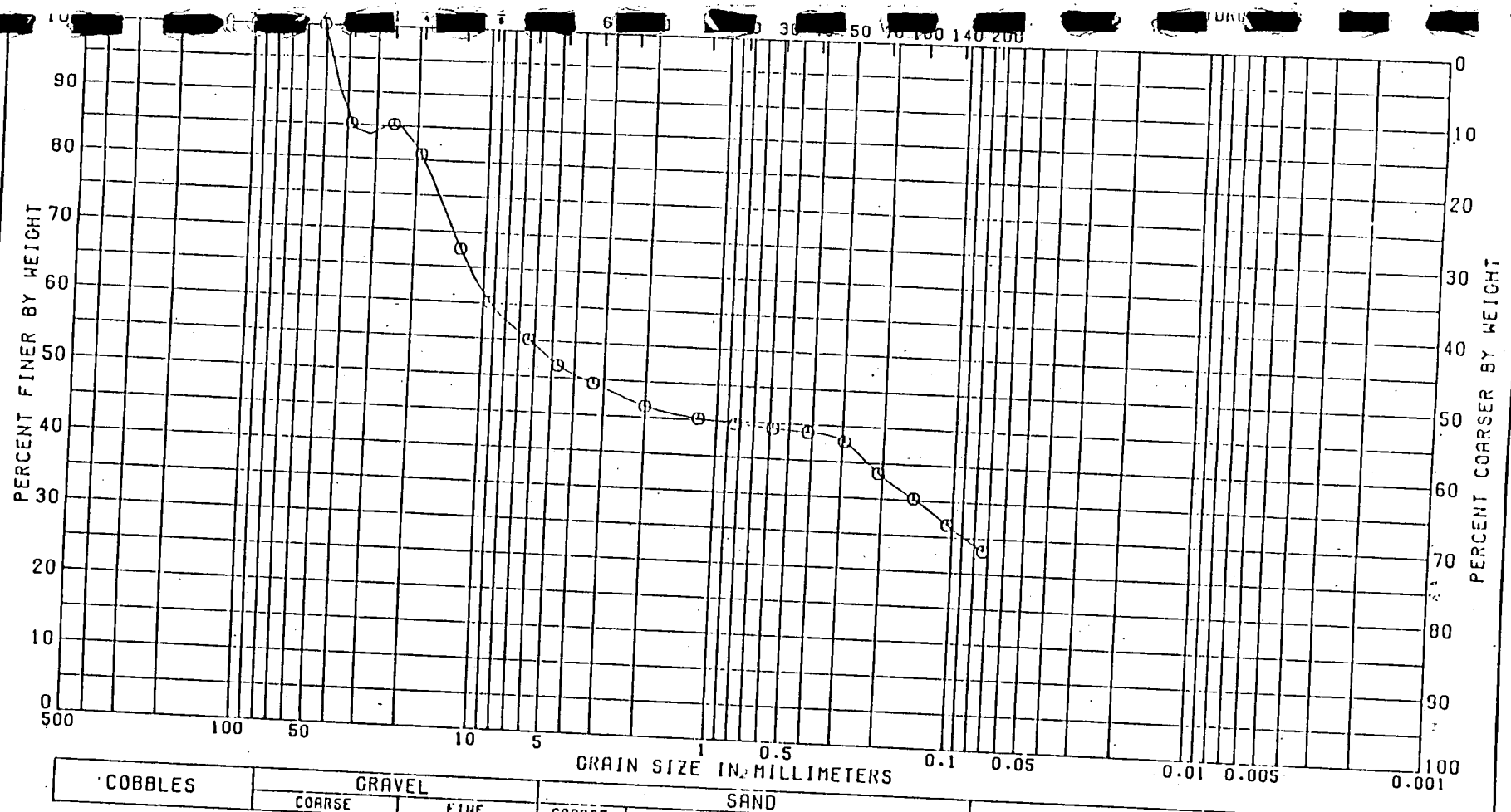
SANDY CLAY (CL), BROWN

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-3-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.25 DATE 08 NOV 83

GRADATION CURVE



LL 38	PL 18	PI 20	GS	NAT W.%	

CLASSIFICATION

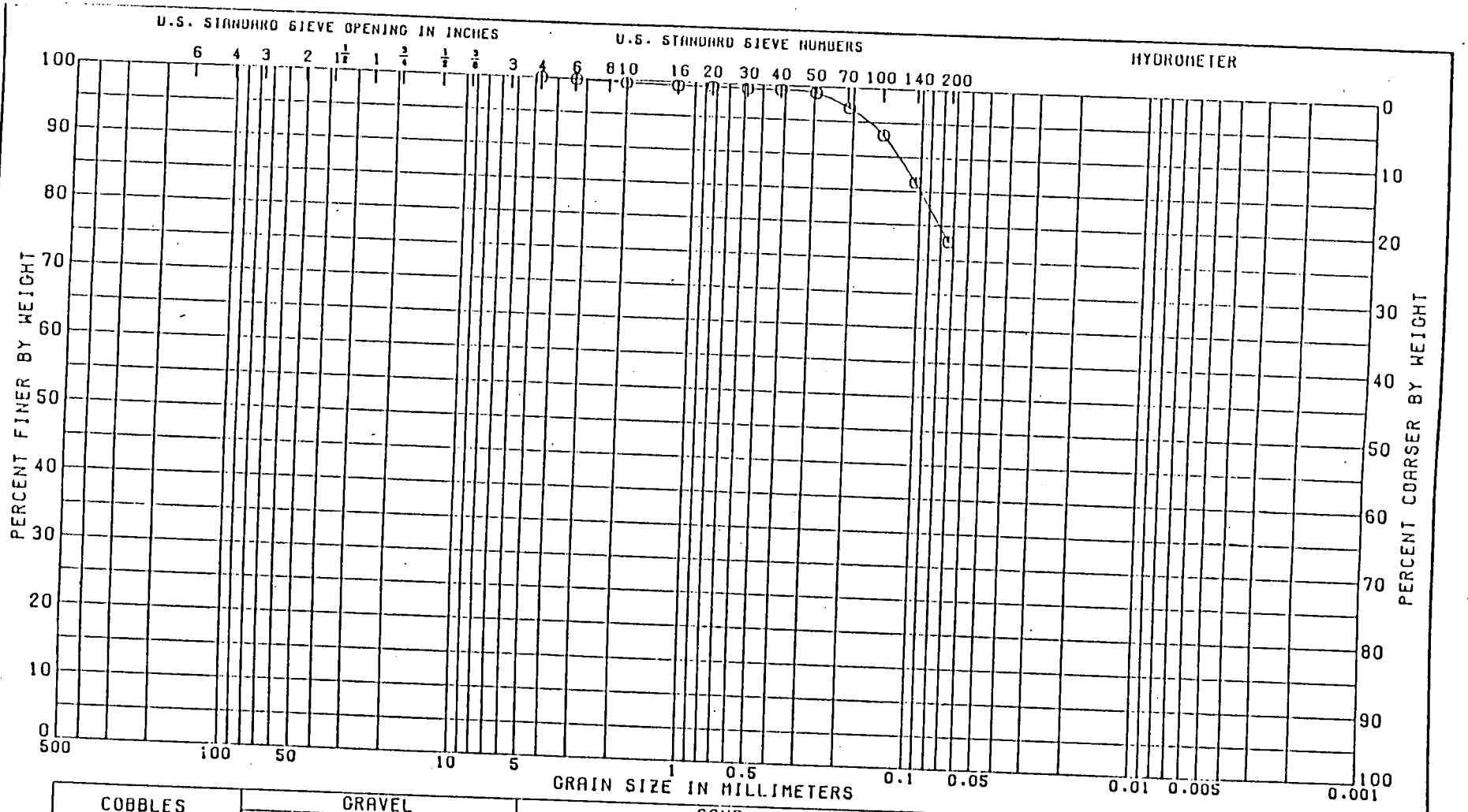
SANDY CLAYEY GRAVEL (GC), REDDISH BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-3-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.08 DATE 08 NOV 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
36	14	22		

CLASSIFICATION

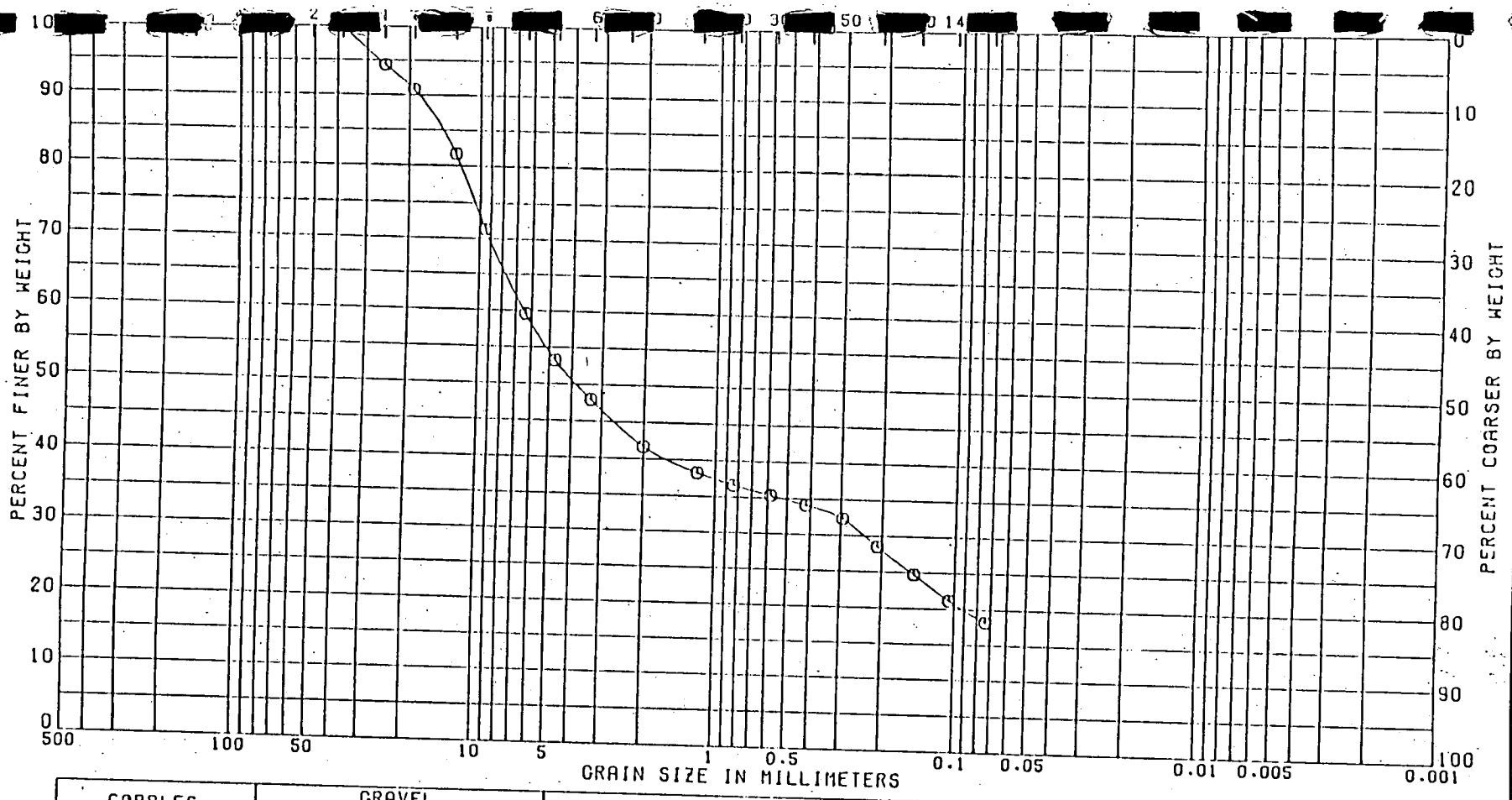
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-3-83 SAMPLE NO. 3

DEPTH/ELEV 10.0-12.12 DATE 08 NOV 83



LL	PL	PI	GS	NAT W.%
35	19	16		

CLASSIFICATION

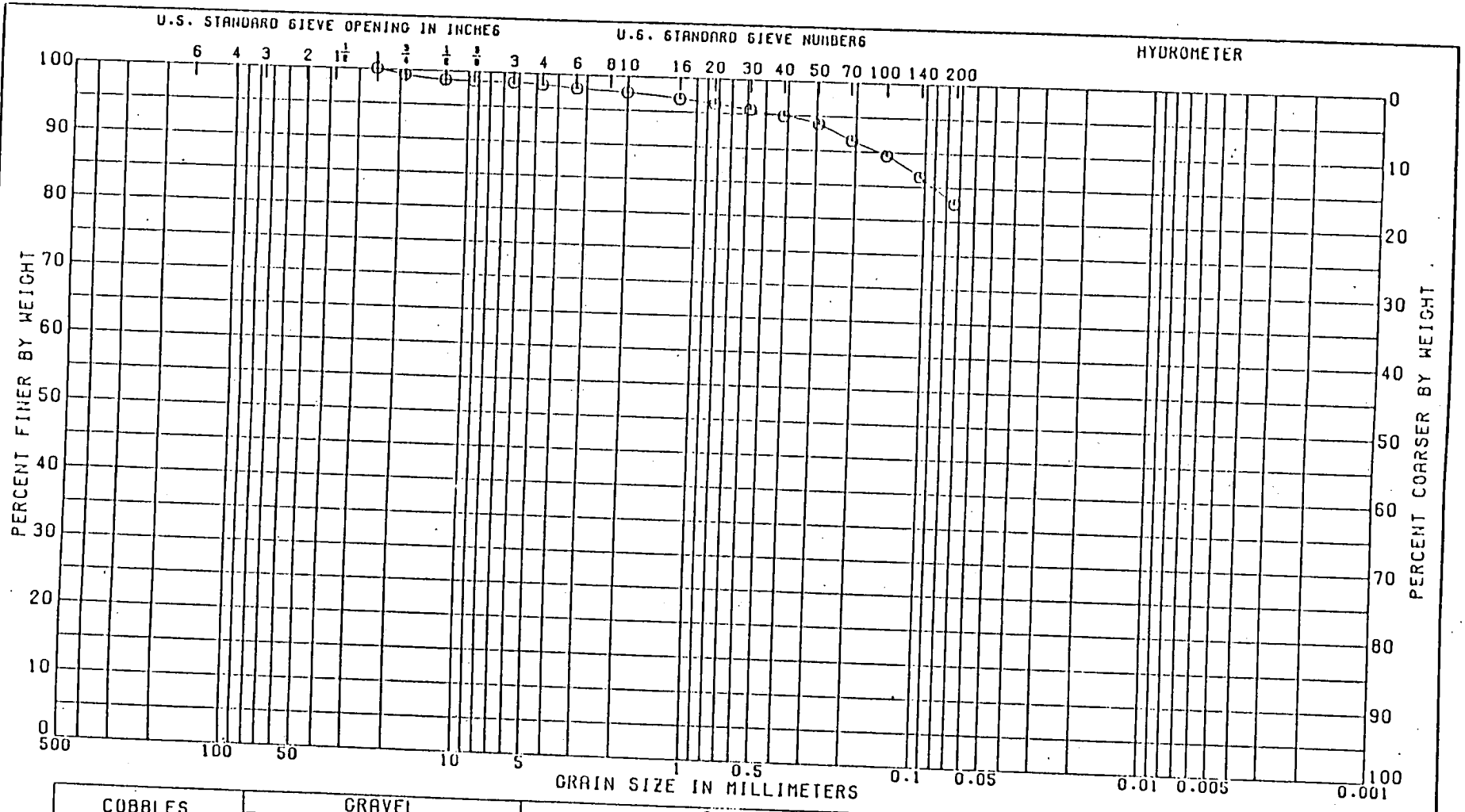
SANDY CLAYEY GRAVEL (GC), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-3-83 SAMPLE NO. 4

DEPTH/ELEV 15.0-16.1 DATE 08 NOV 83



LL 33	PL 22	PI 11	GS	NAT W.%	

CLASSIFICATION

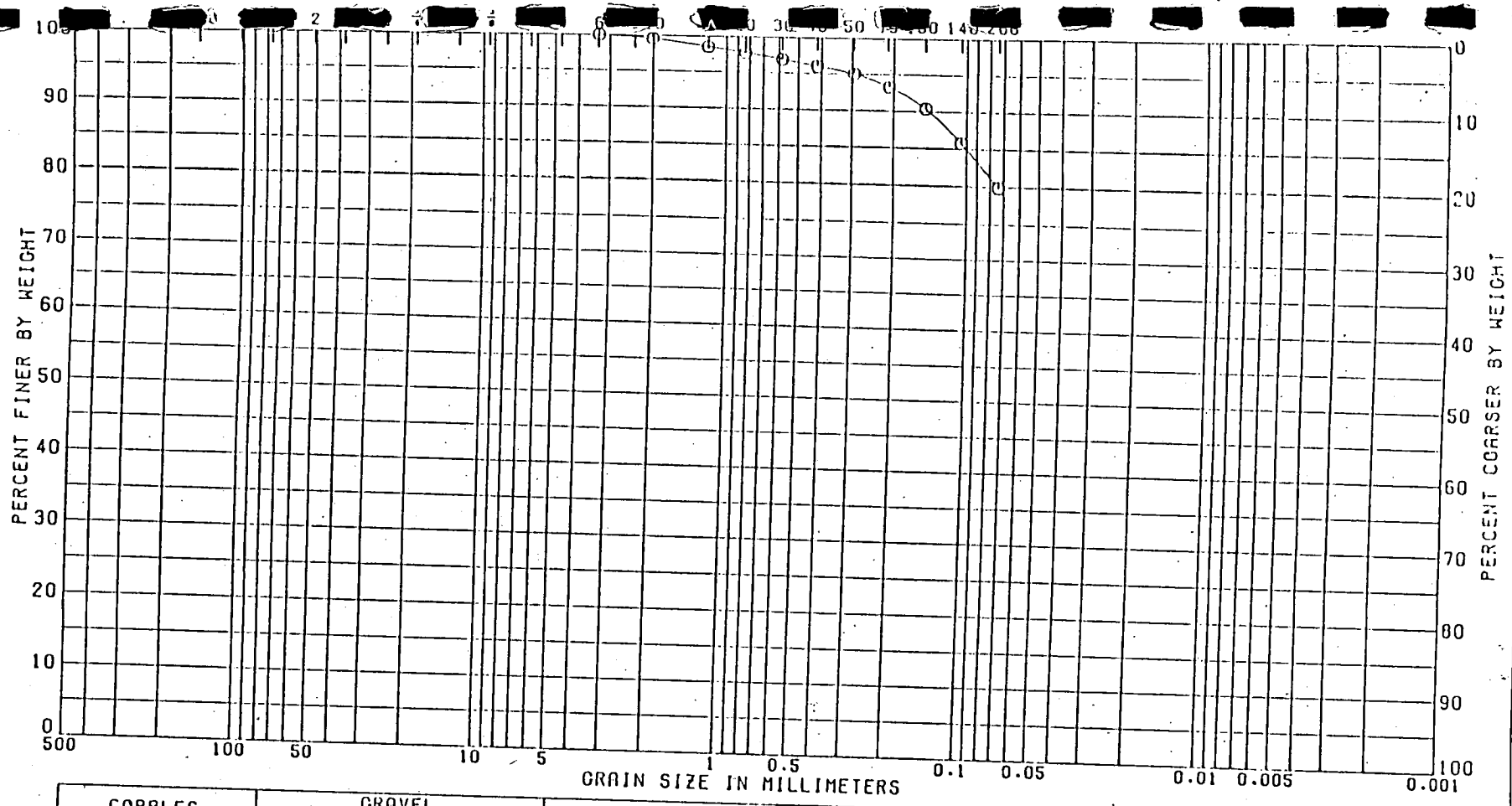
SANDY CLAY (CL), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-4-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.5 DATE 08 NOV 83



LL 44	PL 16	PI 28	GS	NAT W.%	

CLASSIFICATION

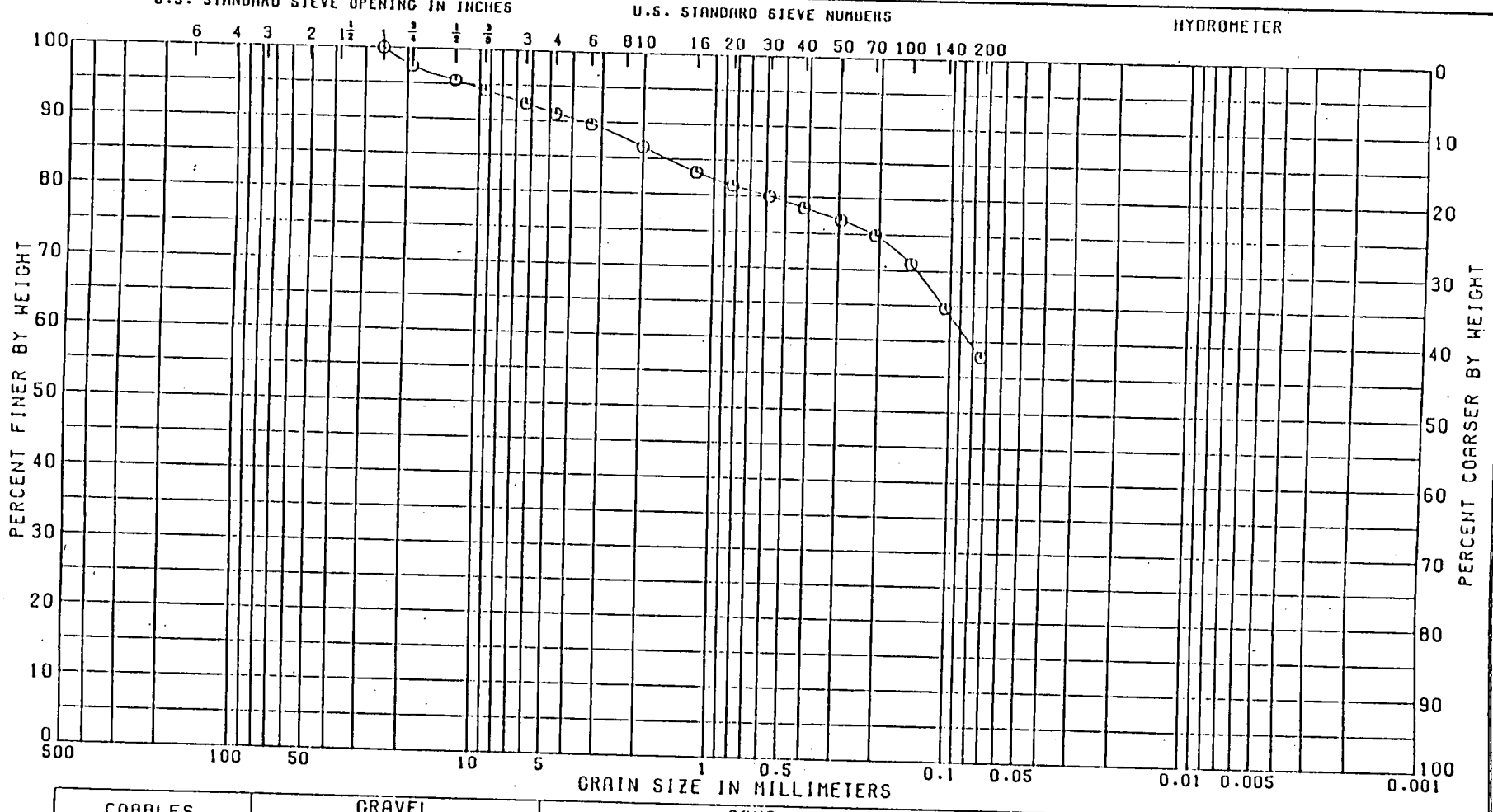
SANDY CLAY (CL), REDDISH TAN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-4-83 SAMPLE NO. 3

DEPTH/ELEV 10.0-12.18 DATE 08 NOV 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	CS	NAT W.%
31	17	14		

CLASSIFICATION

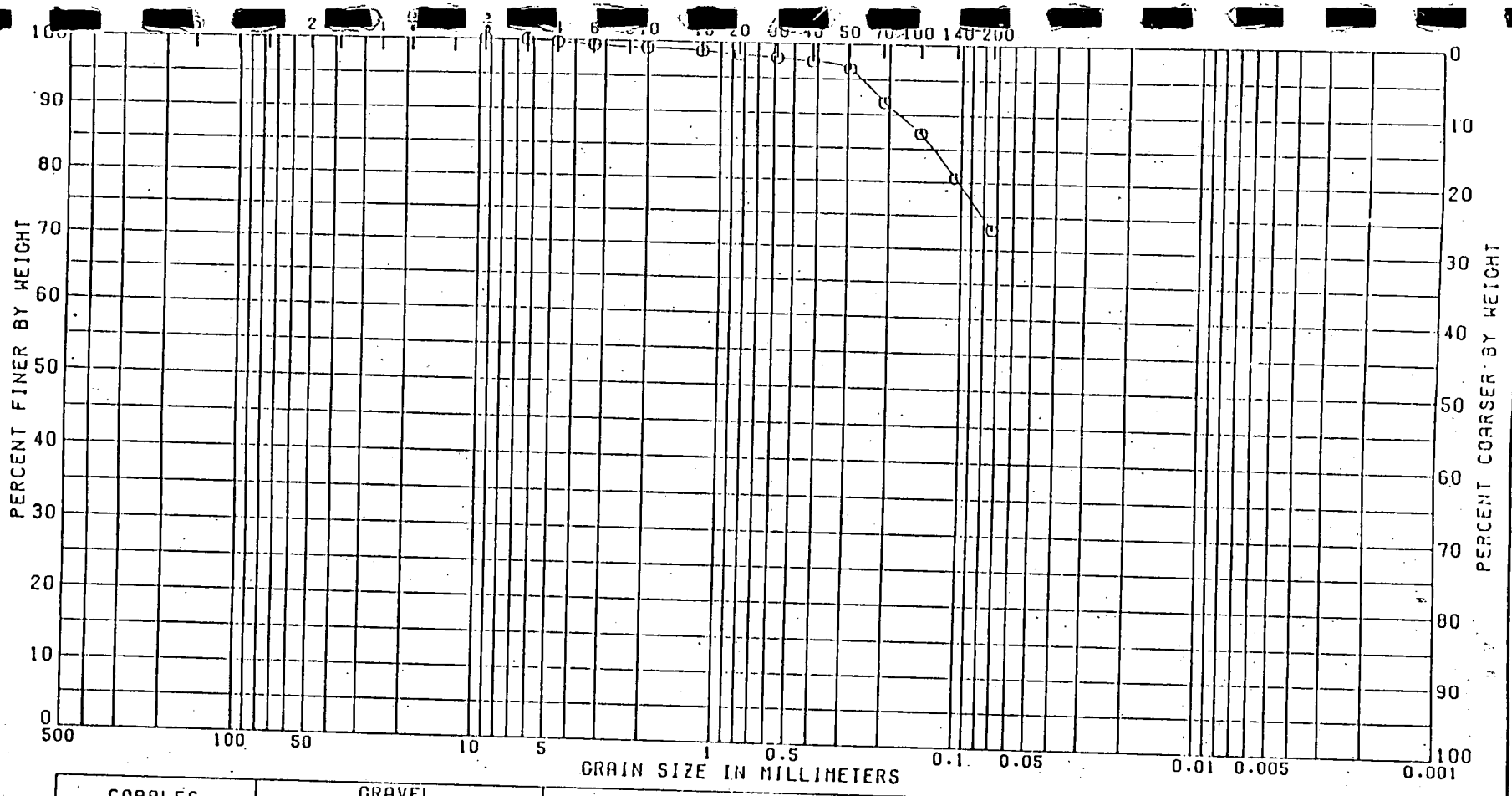
SANDY CLAY (CL), TAN: WITH GRAVEL
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-4-83 SAMPLE NO. 5

DEPTH/ELEV 16.0-18.35 DATE 08 NOV 83



LL 32	PL 13	PI 19	CS	NAT W.%	

CLASSIFICATION

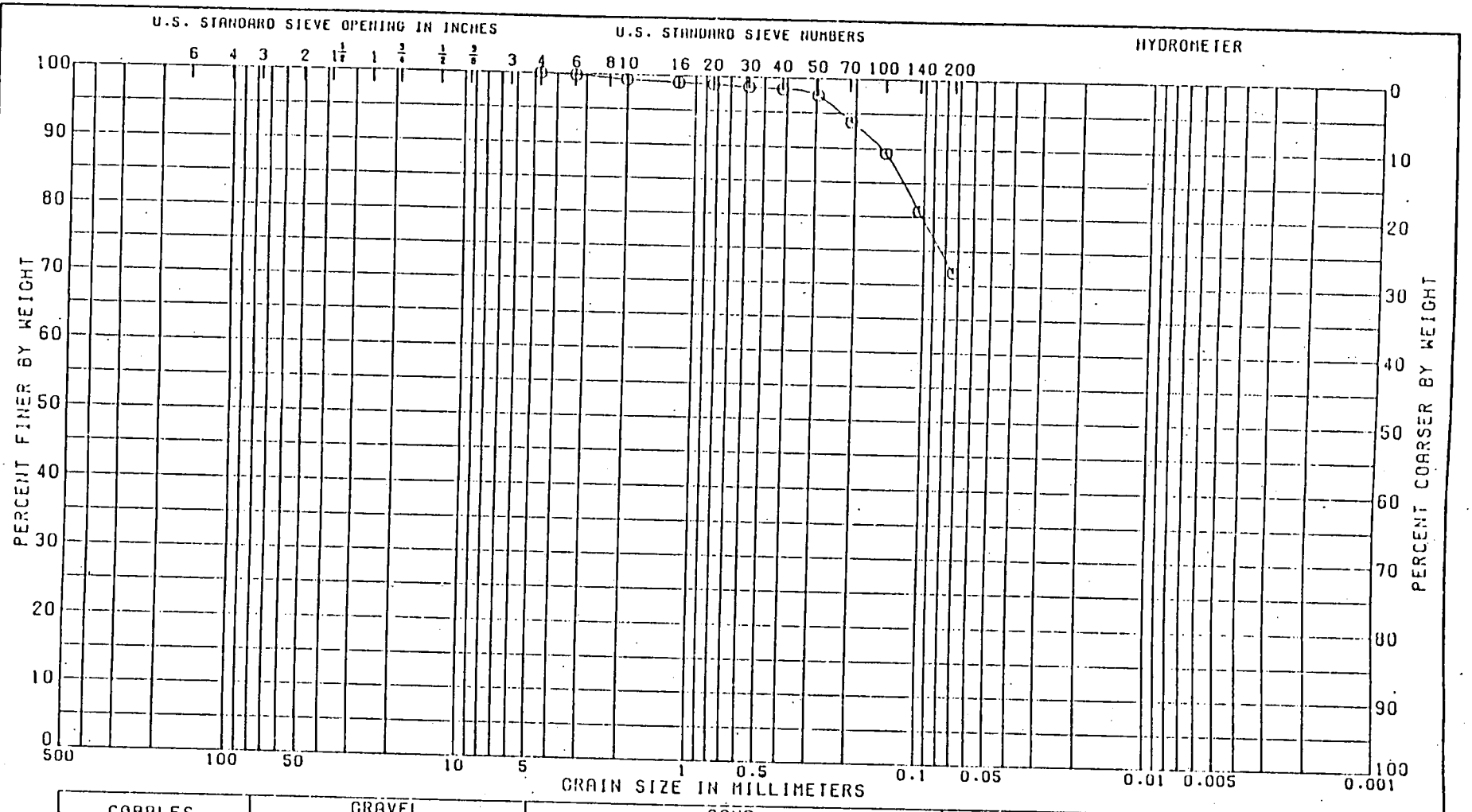
SANDY CLAY (CL), TAN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-5-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.25 DATE 08 NOV 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
33	14	19		

CLASSIFICATION

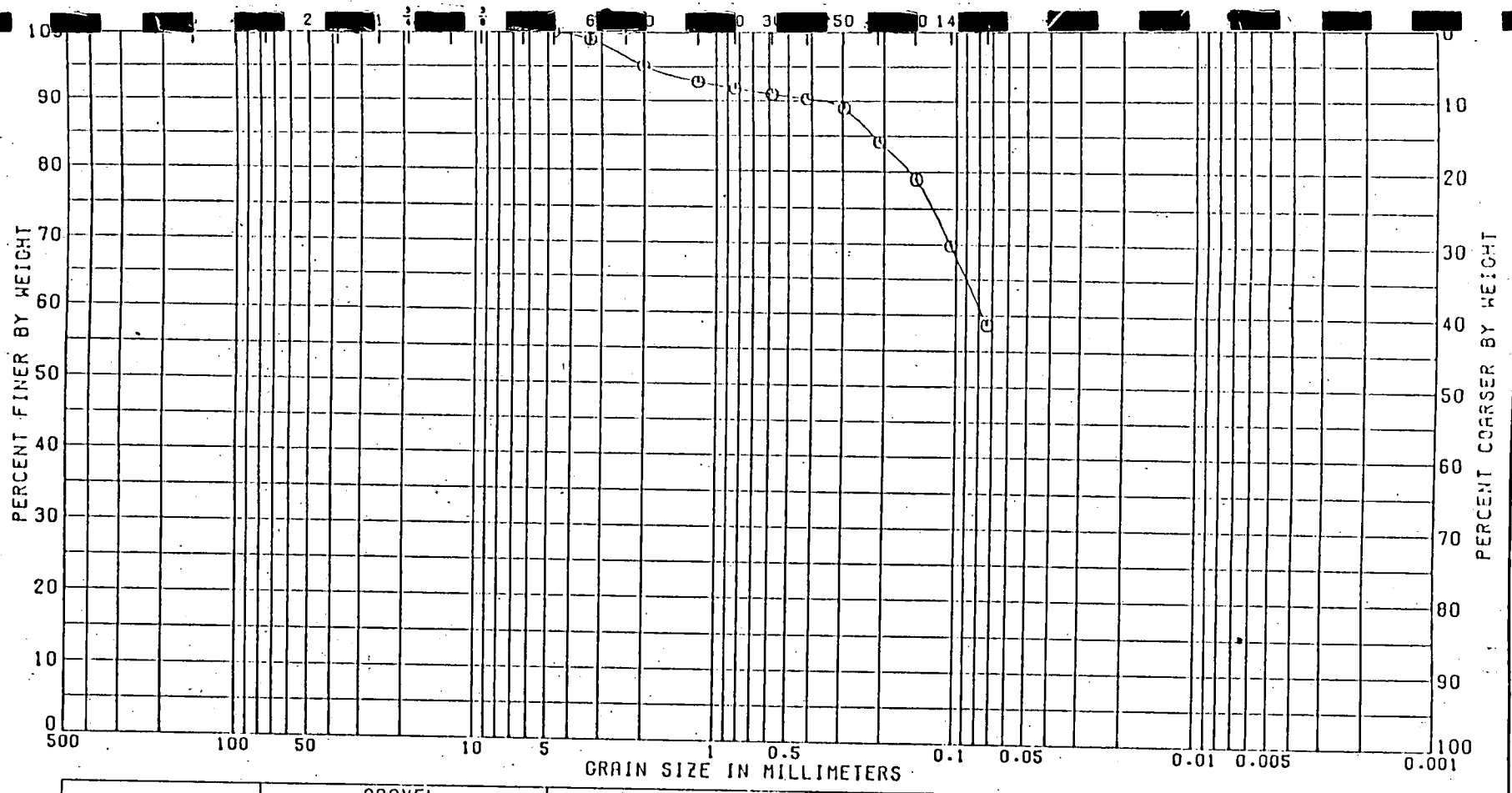
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-5-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.85 DATE 15 DEC 83



LL	PL	PI	GS	NAT W.%
23	14	9		

CLASSIFICATION

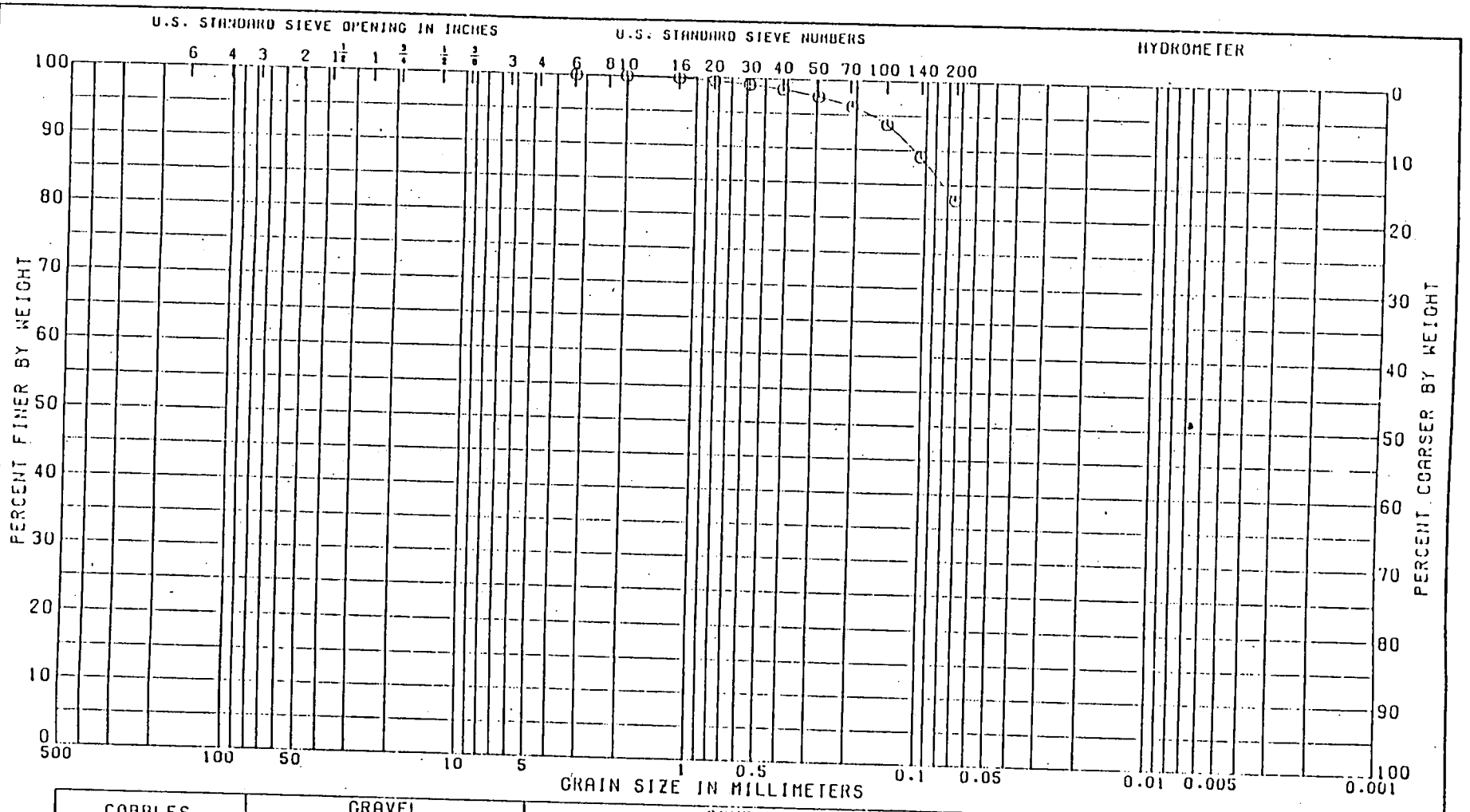
SANDY CLAY (CL), REDDISH BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-5-83 SAMPLE NO. 3

DEPTH/ELEV 10.0-11.22 DATE 08 NOV 83



LL	PL	PI	CS	NAT W.%	
38	18	20			

CLASSIFICATION

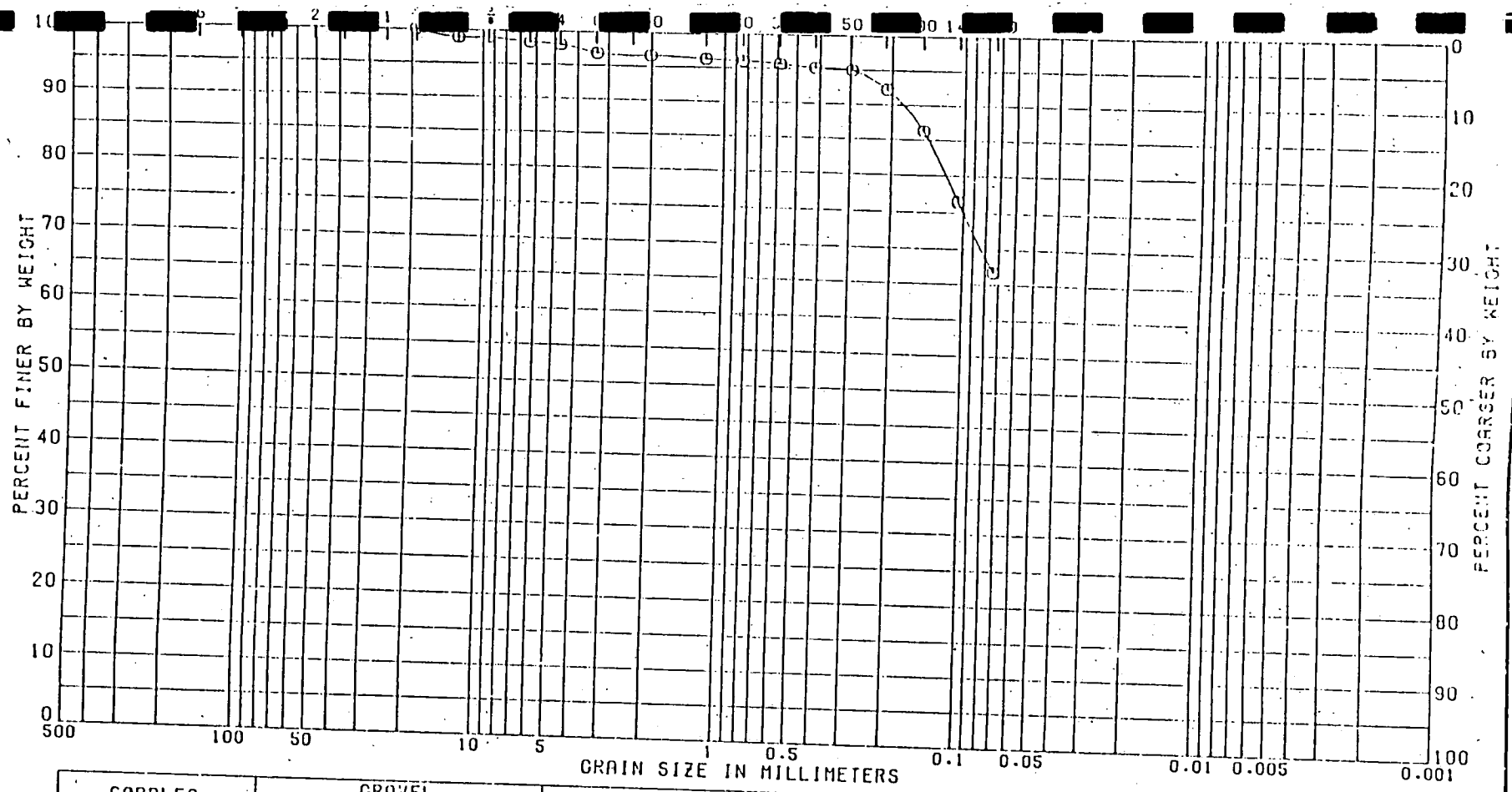
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. EPA-5-83 SAMPLE NO. 4

DEPTH/ELEV 15.0-17.15 DATE 15 DEC 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%	
35	12	23			

CLASSIFICATION

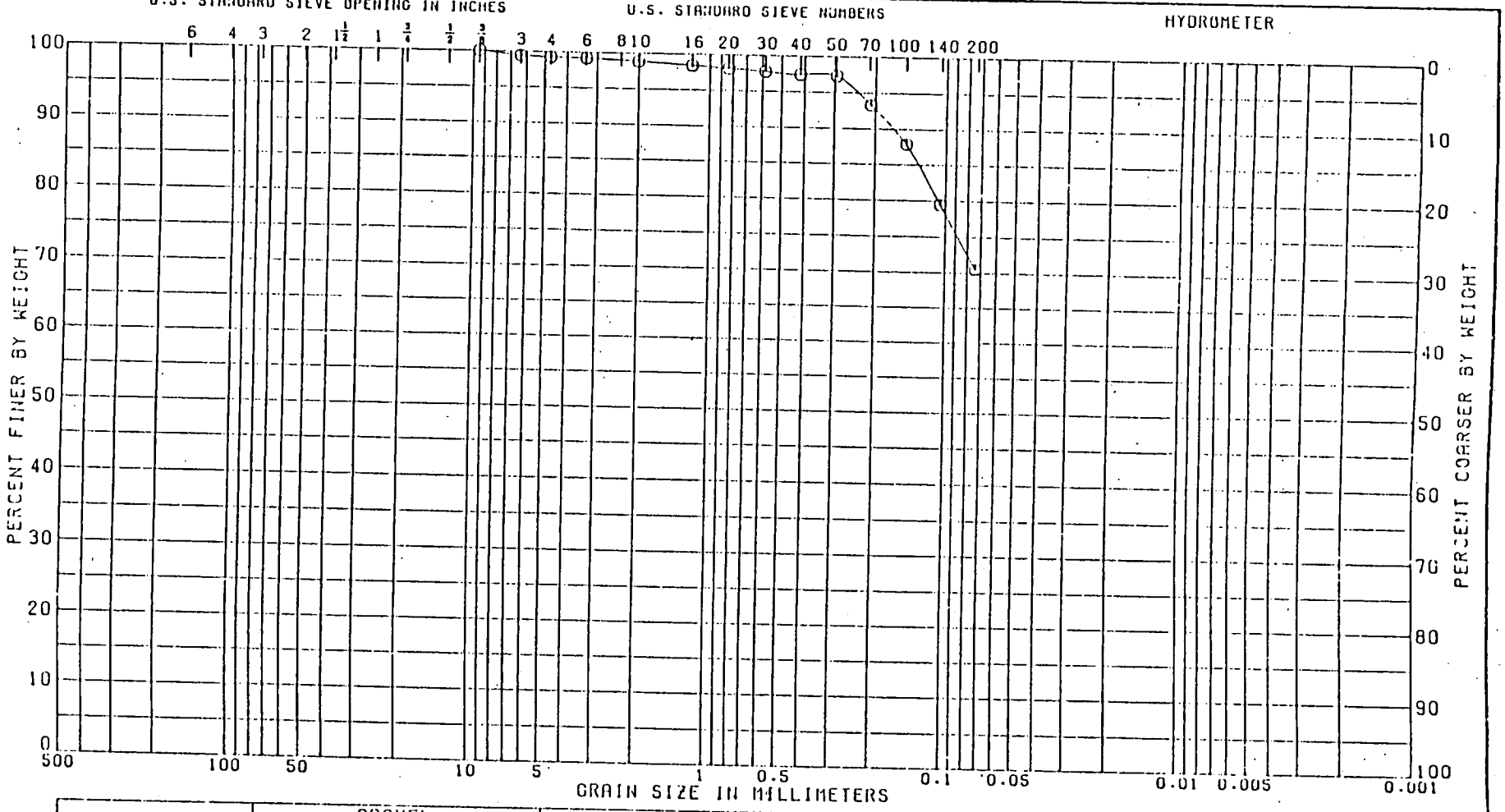
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. EPD-1 SAMPLE NO. 1

DEPTH/ELEV BOTTOM-PIT DATE 31 OCT 83



LL	PL	PI	GS	NAT W.%
32	13	19		

CLASSIFICATION

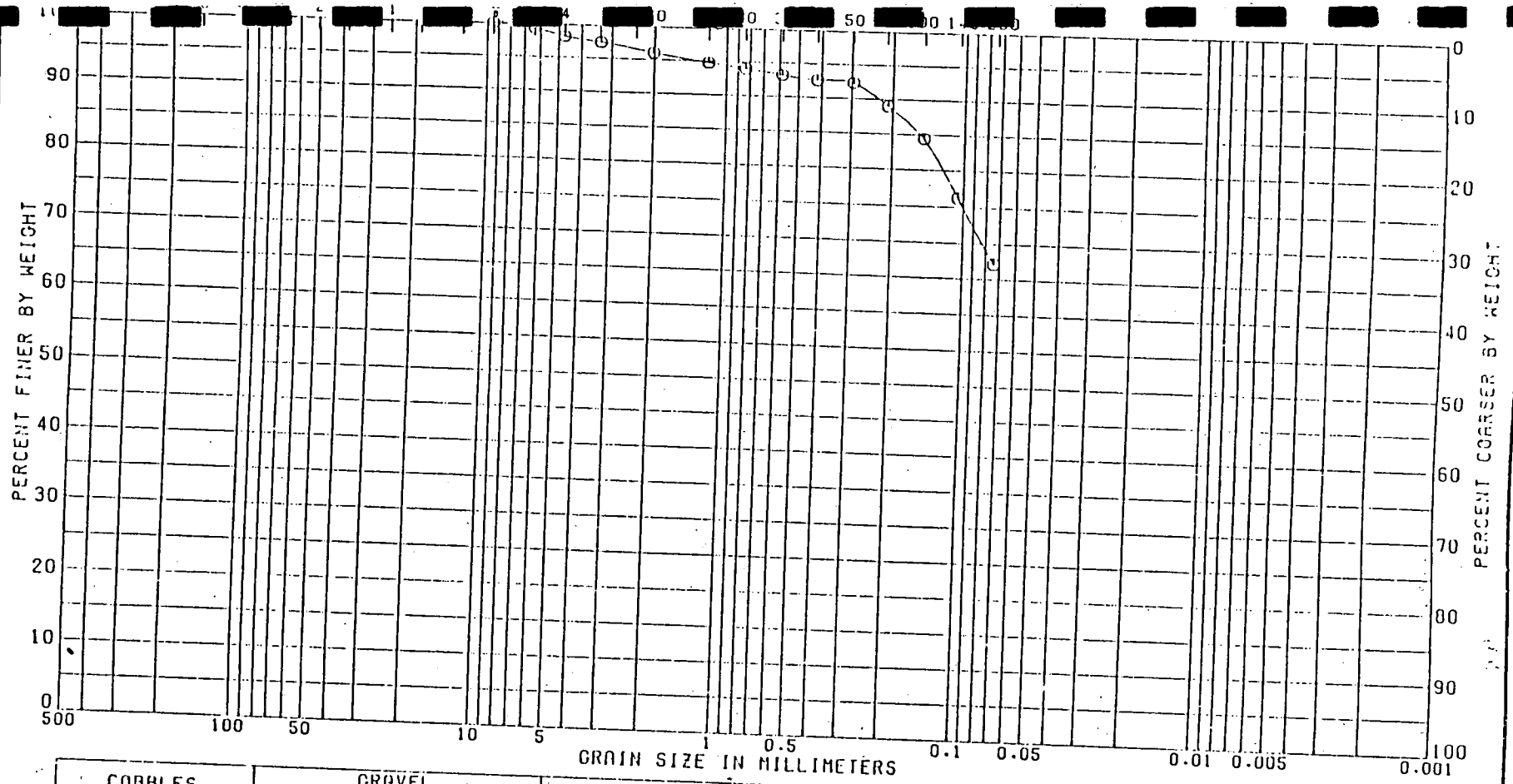
SANDY CLAY (CL), LIGHT BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. EPD-1 SAMPLE NO. 2

DEPTH/ELEV BOTTOM-PIT DATE 31 OCT 83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL 38	PL 16	PI 22	GS	NAT W.%	

CLASSIFICATION

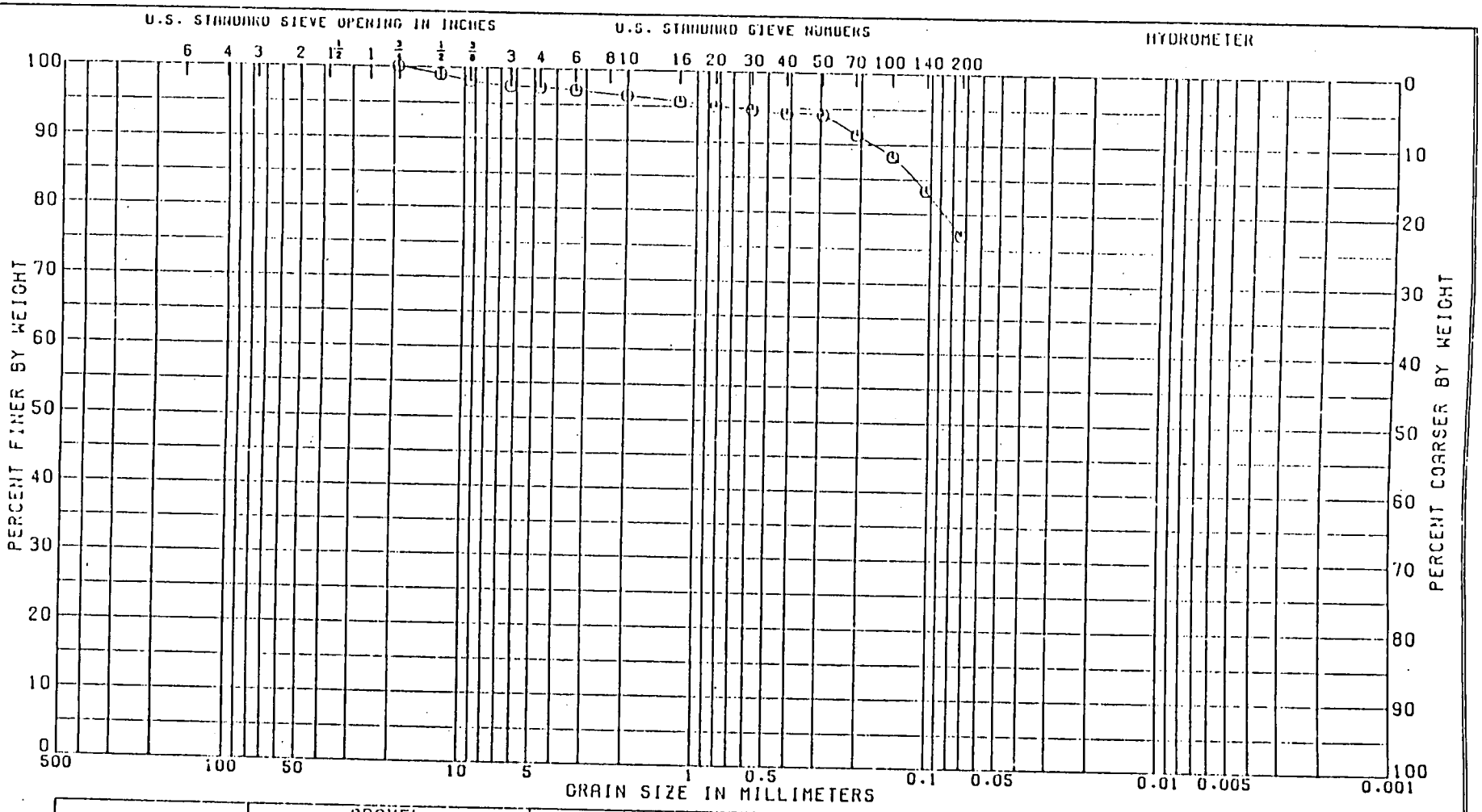
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. EPD-1 SAMPLE NO. 3

DEPTH/ELEV BOTTOM-PIT DATE 31 OCT 83



LL	PL	PI	GS	NAT W.%
31	15	16		

CLASSIFICATION

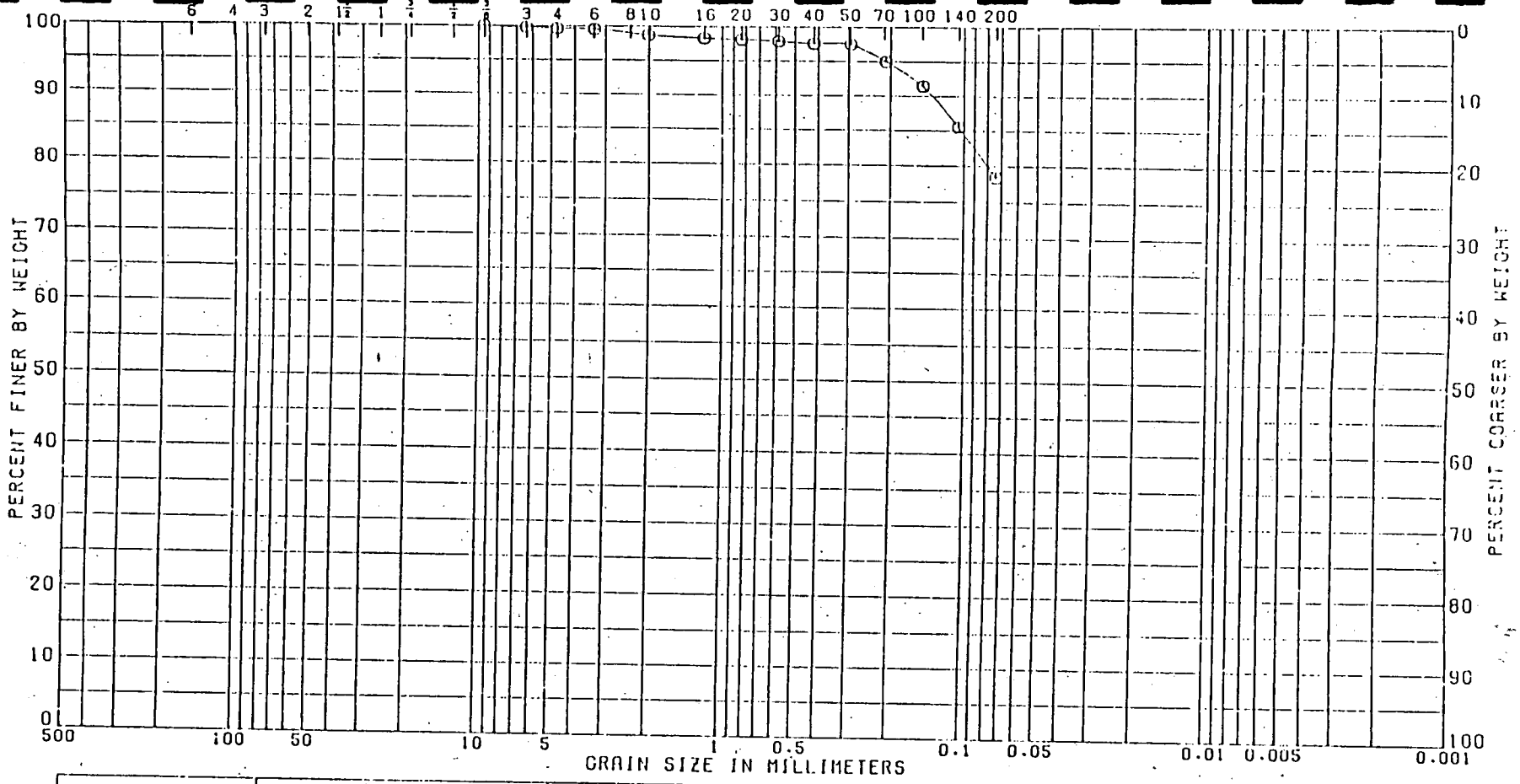
SANDY CLAY (CL), LIGHT BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. EPD-2 SAMPLE NO. 1

DEPTH/ELEV BOTTOM-PIT DATE 31 OCT 83



LL	PL	PI	GS	NAT W.%
31	14	17		

CLASSIFICATION

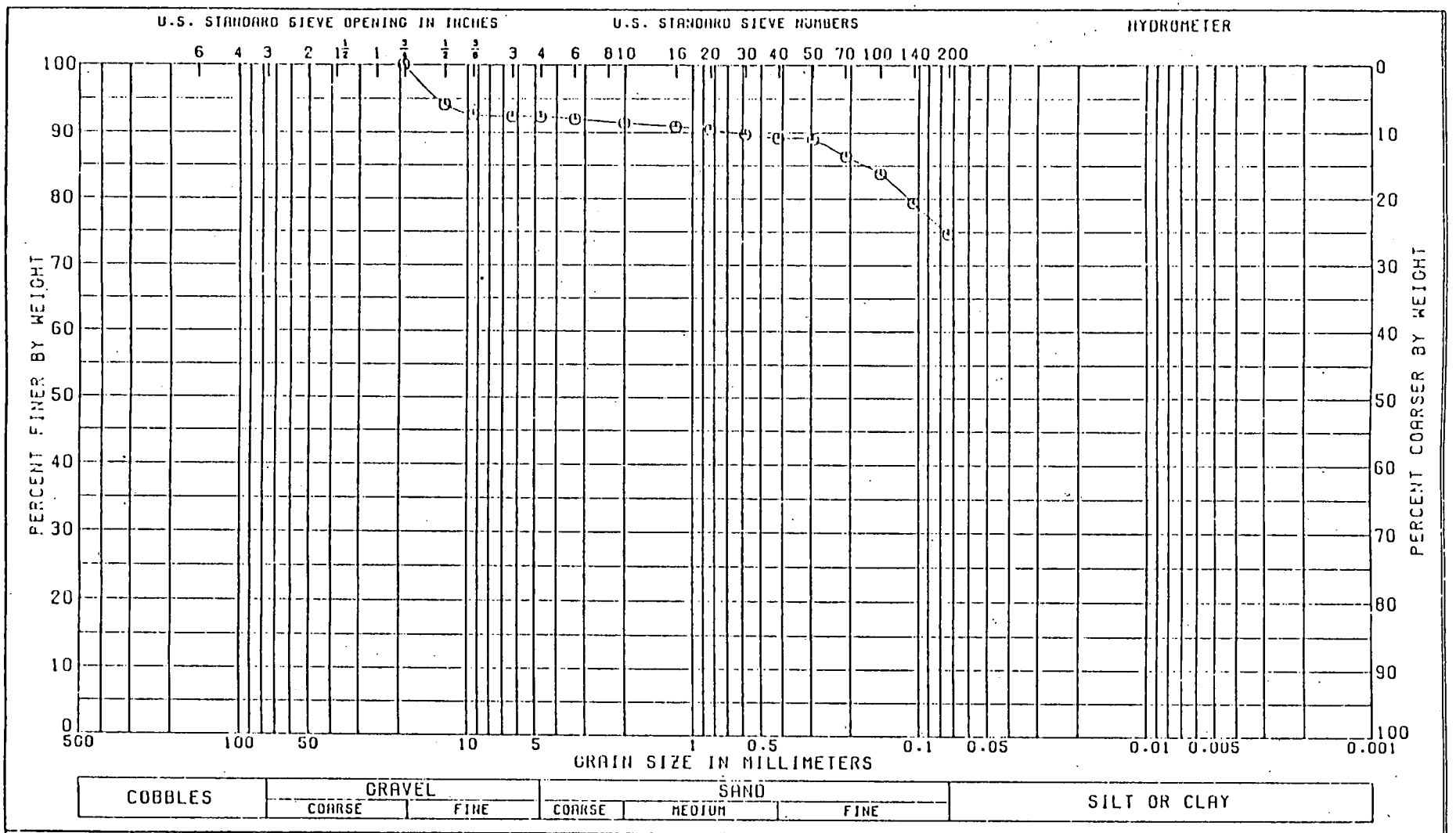
SANDY CLAY (CL), LIGHT BROWN -

GRADATION CURVE

PROJECT NWSC

BORING NO. EPD-2 SAMPLE NO. 2

DEPTH/ELEV BOTTOM-PIT DATE 31 OCT 83



LL	PL	PI	GS	NAT W.%
35	16	19		

CLASSIFICATION

SANDY CLAY (CL), LIGHT BROWN: WITH GRAVEL

GRADATION CURVE

PROJECT NWSC

BORING NO. EPD-2 SAMPLE NO. 3

DEPTH/ELEV BOTTOM-PIT DATE 31 OCT 83

Laboratory Soil Test Results

Rockeye Site

Boring Number	Sample Number	Depth ft	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
10-1-81	1	0.0-1.84	116.2	9.6	NP+	NP	NP	SM		
10-1-81	2	5.0-6.16	118.0	9.6	24	15	9	GC		1.76
10-2-81	1	0.0-1.29	101.4	18.2	33	20	13	CL	5.20×10^{-6}	5.98

\+ Not plastic
** See Figure E-1

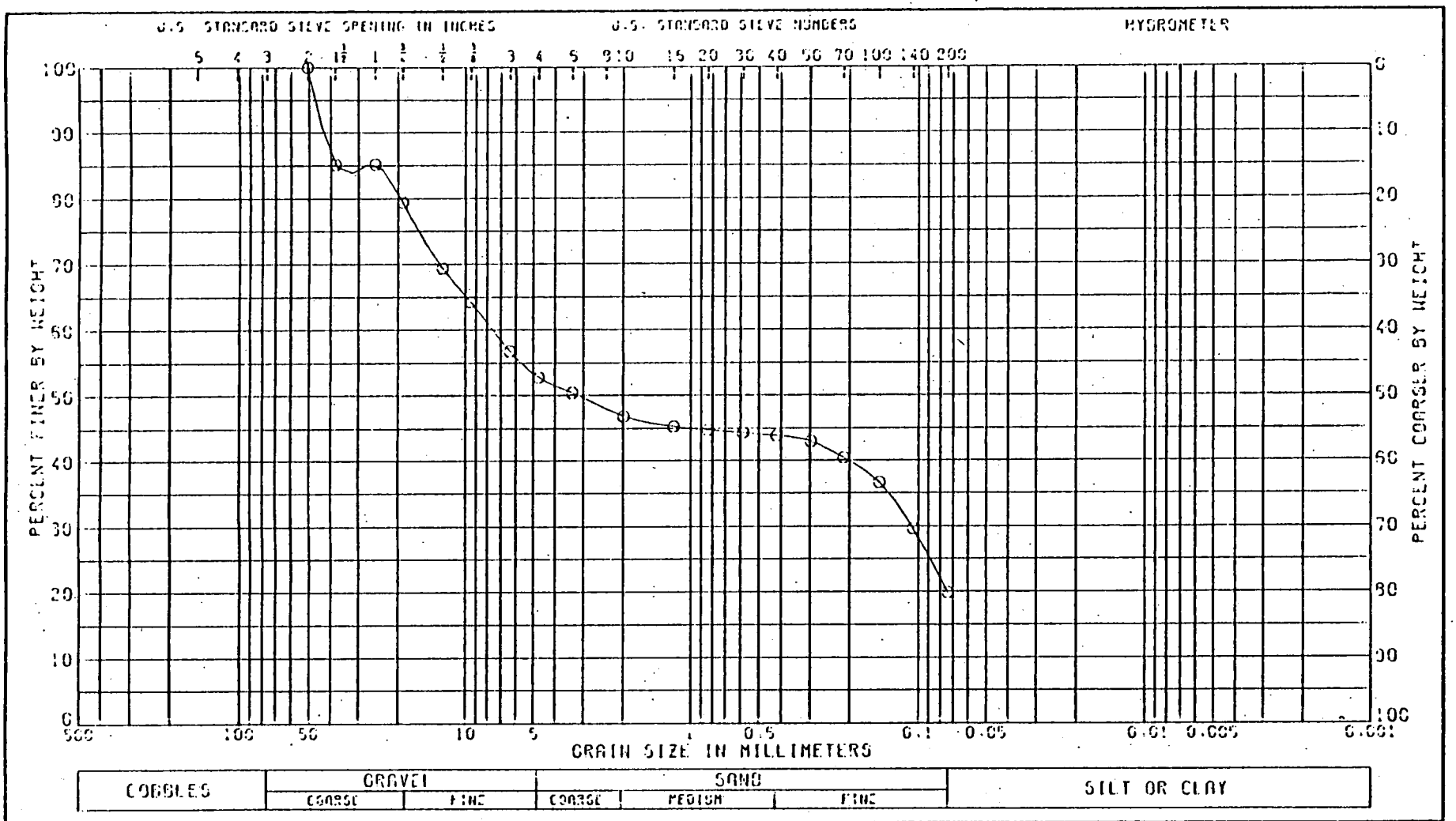
Laboratory Soil Test Results

Rockeye Munitions Facility

Boring Number	Sample Number	Depth (ft)	Dry Density lbs/cu ft	Water Content Percent	Liquid Limit Percent	Plastic Limit Percent	Plasticity Index Percent	USCS**	Permeability cm/sec	Cation Exchange Capacity meq/100 g
WES-10-3-83	1	0.0-1.90	100.8	21.6	45	20	25	CL		19.0
WES-10-4-83	1	0.2-1.35	102.9	17.3	38	20	18	CL		16.3
WES-10-4-83	2	5.0-7.25	108.3	19.9	34	15	19	CL	2.3×10^{-7}	
WES-10-4-83	3	10.0-12.5	122.4	8.3	25	16	9	CL		
WES-10-5-83	1	5.0-6.85	113.7	17.4	30	17	13	CL		17.9
WES-10-6-83	1	0.0-0.95	106.8	9.6	25	15	10	CL		14.0
WES-10-6-83	2	5.0-6.07	114.3	15.2	24	16	8	CL		
WES-10-7-83	1*	0.0-0.4	--	--	35	20	15	CL		19.1
WES-10-8-83	1	0.0-1.33	102.0	9.24	31	17	14	CL		321.0
WES-10-9-83	1	0.0-2.05	107.8	9.5	34	17	17	CL		401.0
WES-10-10-83	1	1.5-2.9	100.6	19.6	29	17	12	CL		333.0
WES-10-11-83	1	0.0-2.33	89.1	12.7	32	18	14	CL		6.4
WES-10-11-83	2	5.0-6.49	107.2	20.7	48	22	26	CL		
WES-10-12-83	1	0.0-2.38	87.6	15.7	41	21	20	CL		14.4
WES-10-13-83	1	0.0-1.56	97.6	11.5	49	19	30	CL		13.4
WES-10-14-83	1	0.0-1.85	115.7	6.7	34	15	19	CL		
WES-10-15-83	1	0.0-2.25	100.7	10.3	16	12	4	SM-SC		19.7
WES-10-16-83	1	0.0-1.95	---------- Fill Material ----------							
WES-10-17-83	1	0.0-2.33	107.1	14.3	40	17	23	CL	3.20×10^{-5}	9.7
WES-10-18-83	1	0.0-1.73	---------- Fill Material ----------							
WES-10-19-83	1	0.0-2.24	100.2	8.5	27	16	11	CL		4.9

* Jar sample

** Unified Soil Classification System



LL	PL	PI	CS	NAT W.%	
NP				9.6	

CLASSIFICATION

SANDY SILTY GRAVEL (GM), BROWN

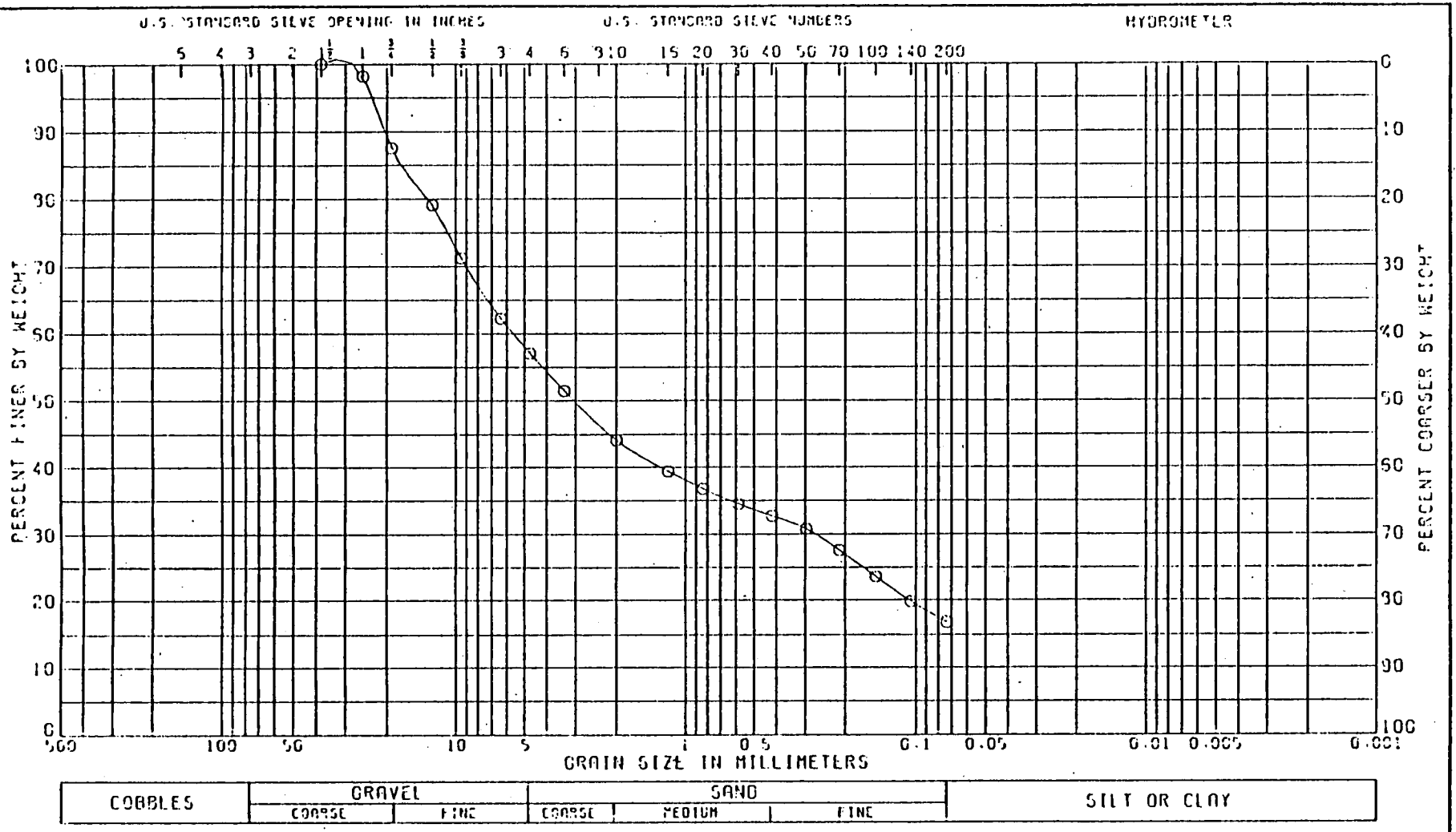
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC ROCKEYE NORTH DISCHARGE

BORING NO. 10-1-81 SAMPLE NO 1

DEPTH/ELEV 0.0-1.84 DATE 11 FEB 82



LL	PL	PI	CS	NAT W.%	
24	15	9		9.6	

CLASSIFICATION

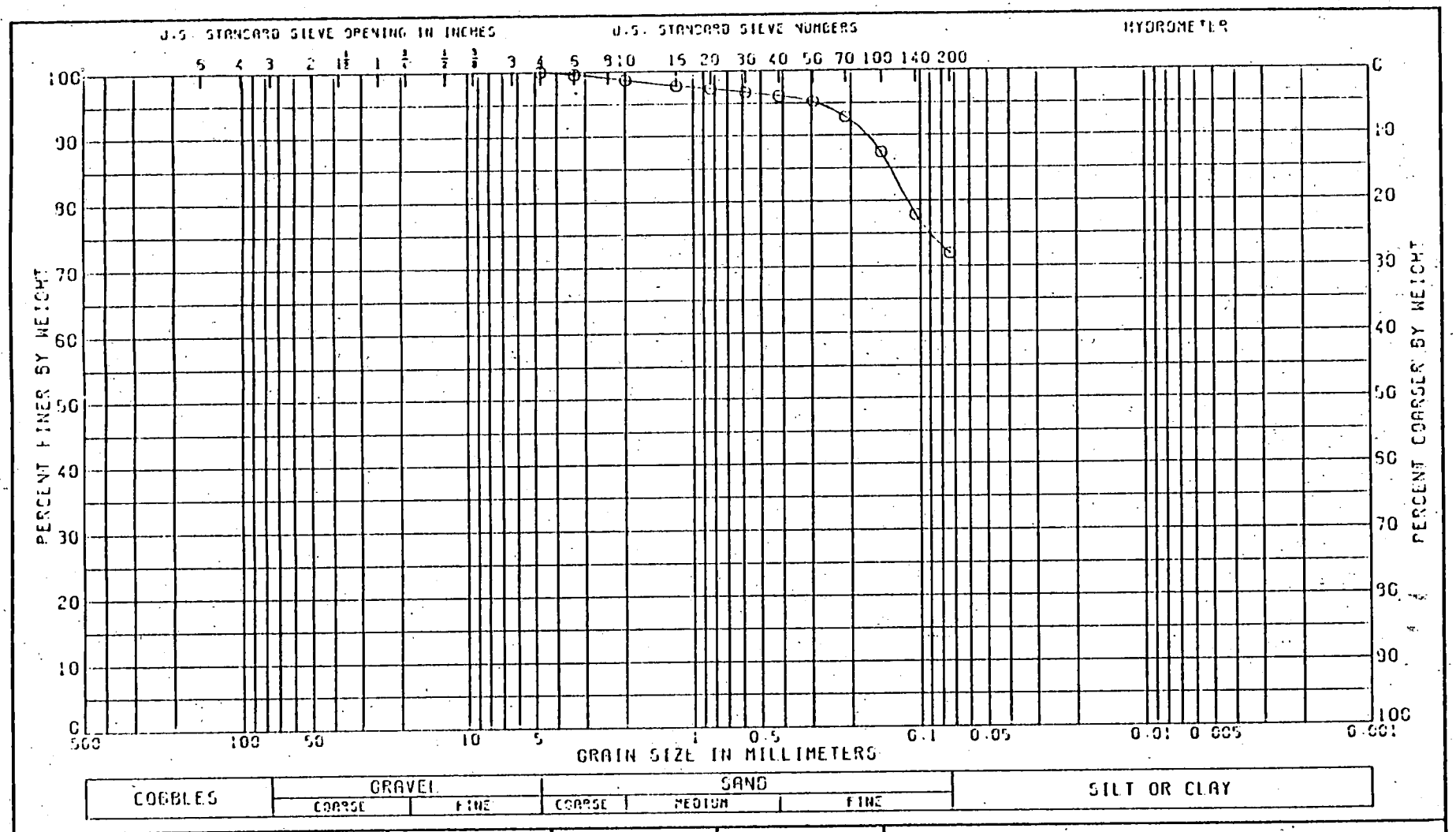
SANDY CLAYEY GRAVEL (GC), BROWN
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT CRANE NWSC ROCKEYE NORTH DISCHARGE

BORING NO. 10-1-81 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.15 DATE 31 MAR 82



LL	PL	PI	CS	NAT W.%	
33	20	13		18.2	

CLASSIFICATION

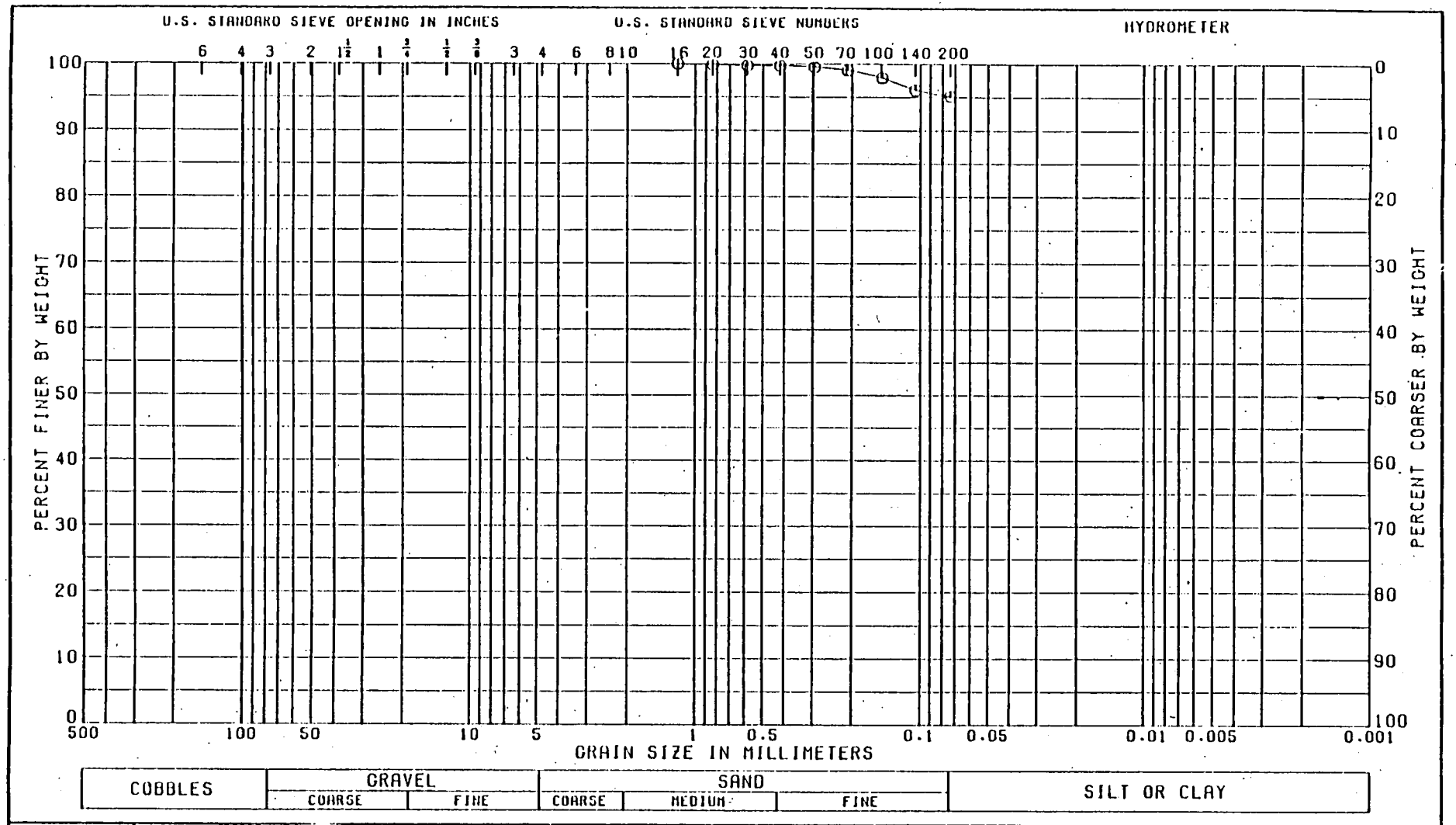
SANDY CLAY (CL), BROWN.

GRADATION CURVE

PROJECT CRANE NWSC ROCKEYE NORTH DISCHARGE

BORING NO. 10-2-81 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.29 DATE 31 MAR 82



LL	PL	PI	GS	NAT W.%	
45	20	25			

CLASSIFICATION

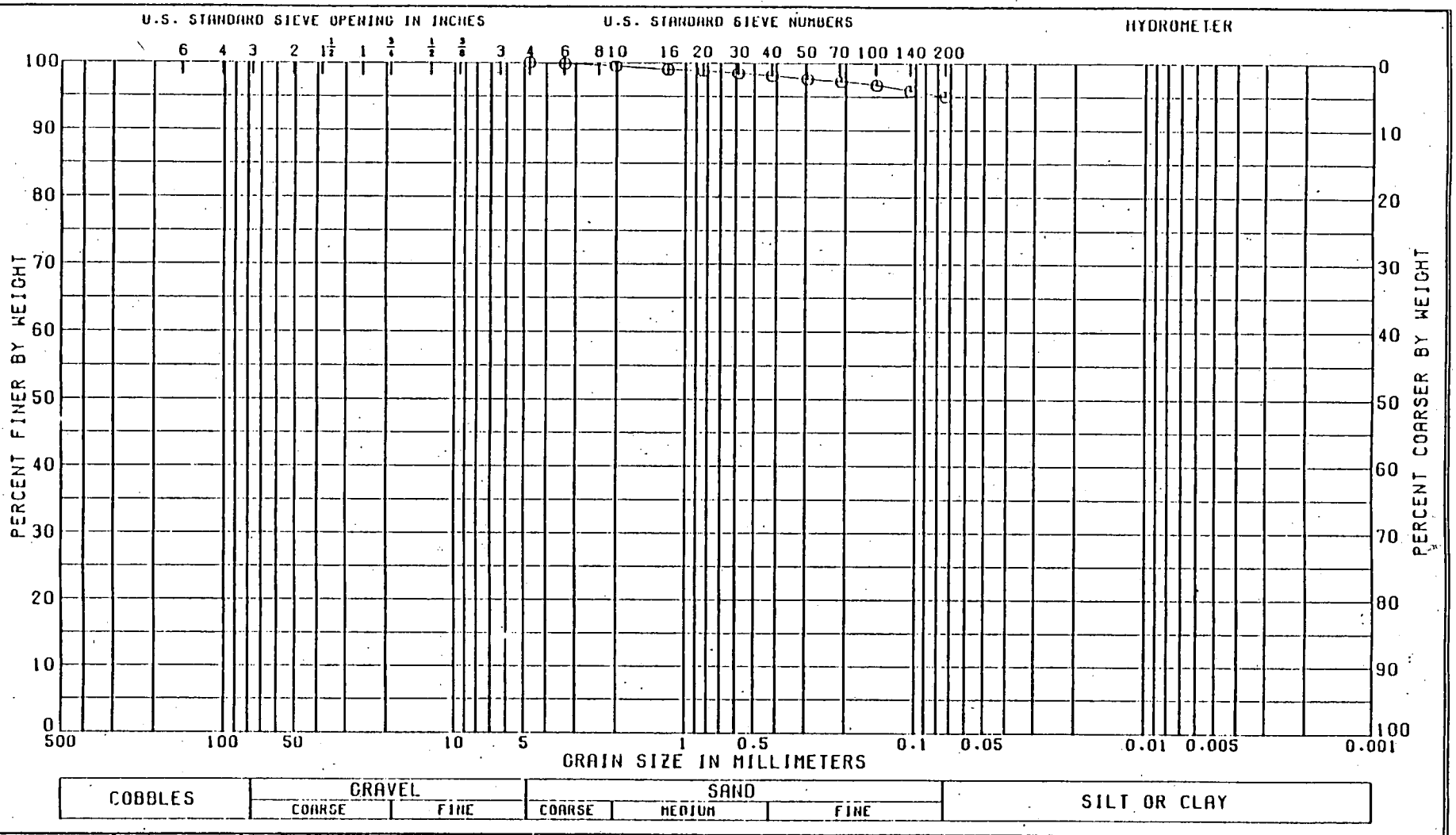
CLAY (CL), BROWN: TRACE OF SAND

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-3-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.90 DATE 30 NOV 83



LL 38	PL 20	PI 18	CS	NAT. W.%	

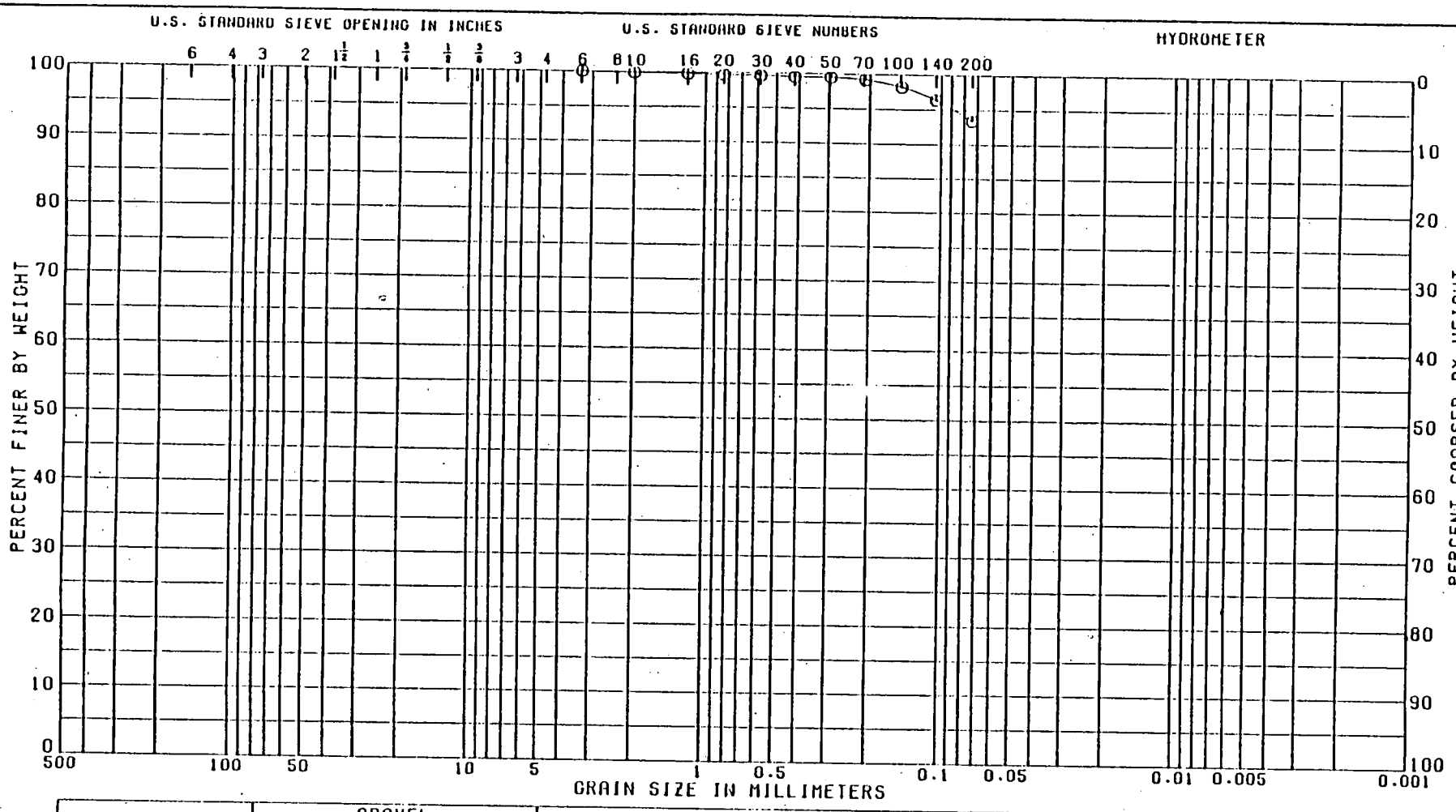
CLASSIFICATION
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-4-83 SAMPLE NO. 1

DEPTH/ELEV 0.1-1.35 DATE 30 NOV 83



LL	PL	PI	GS	NAT W.%	
34	15	19			

CLASSIFICATION

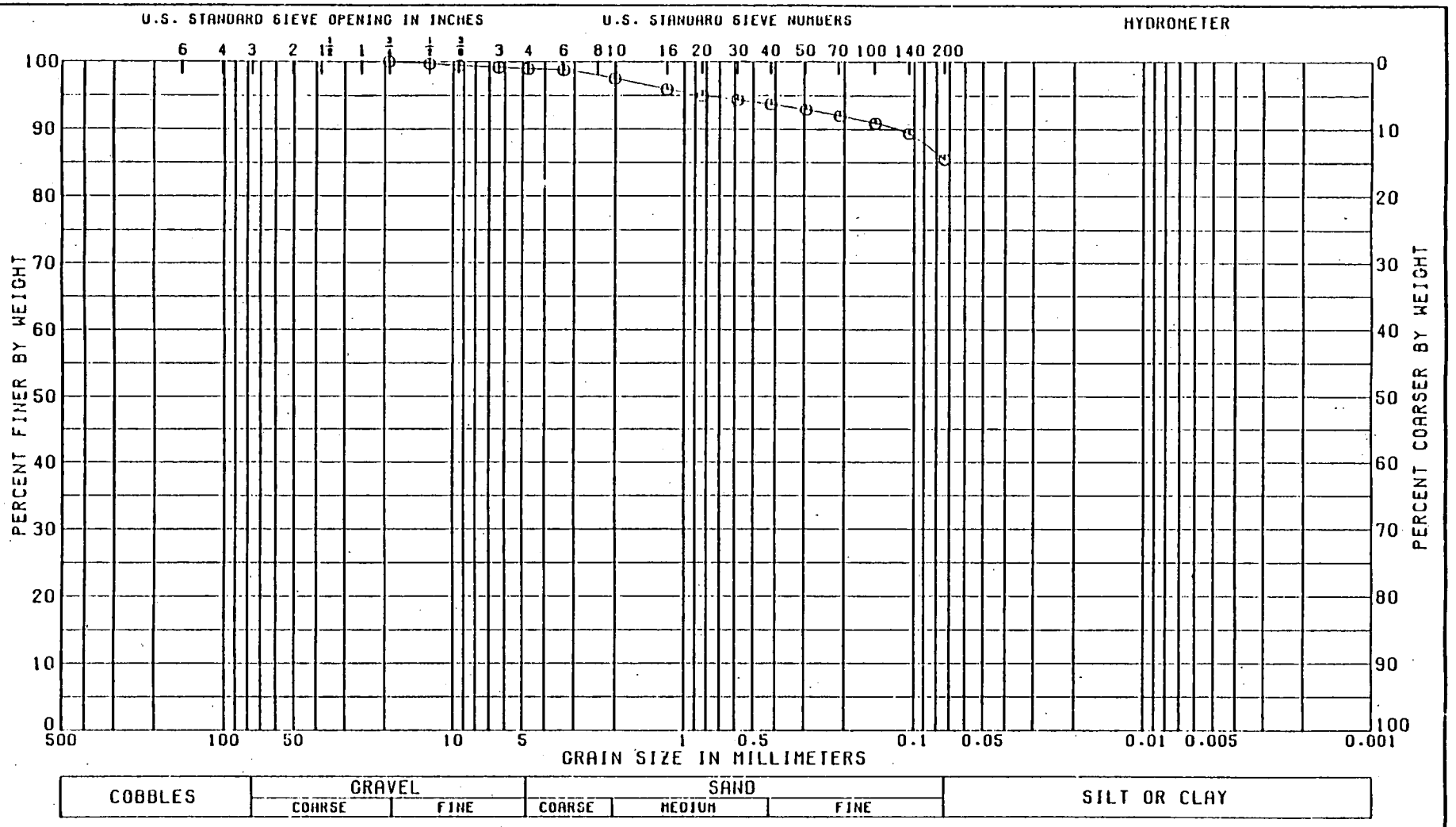
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-4-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-7.25 DATE 30 NOV 83



LL	PL	PI	GS	NAT W.%
25	16	9		

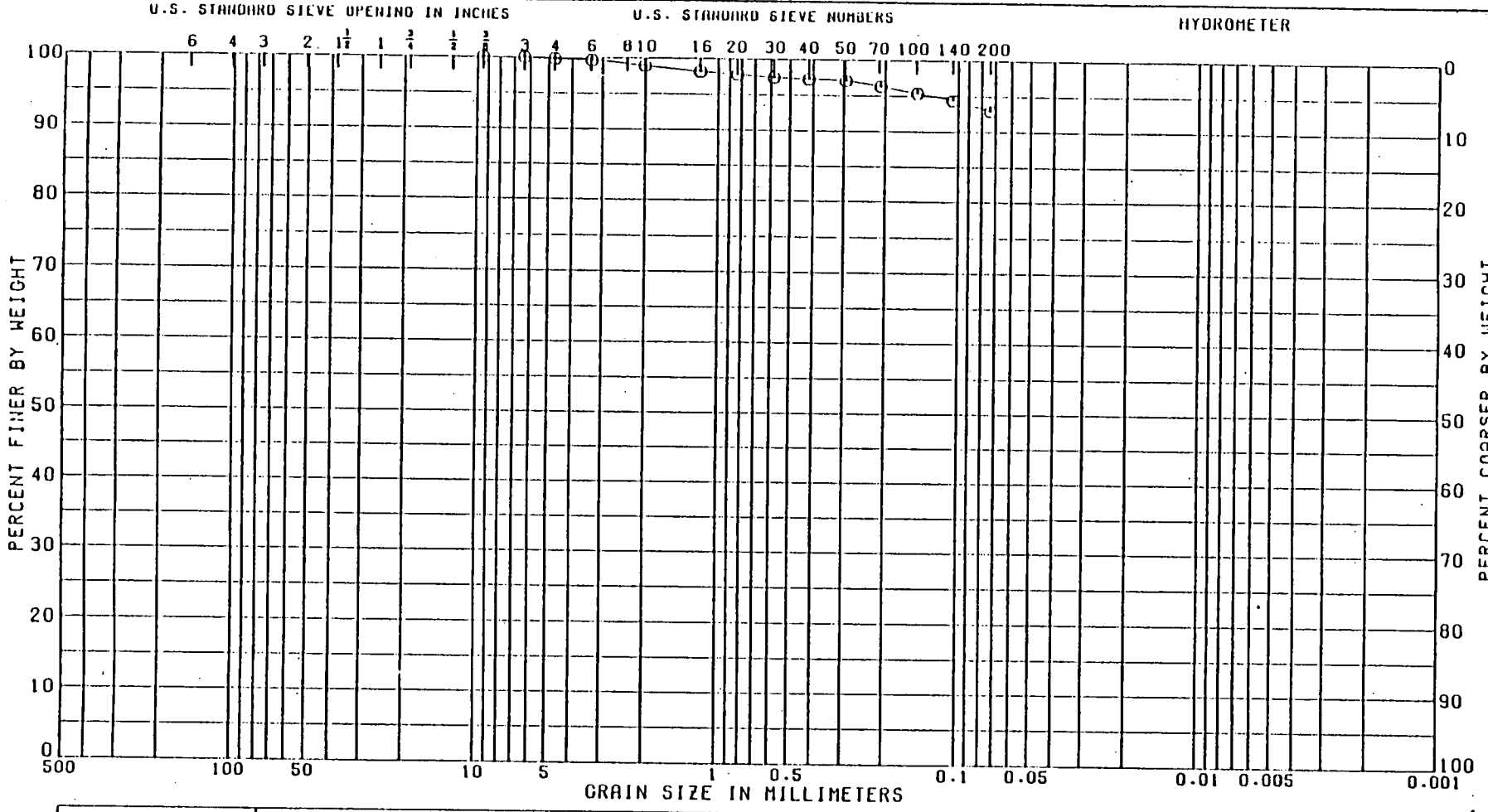
CLASSIFICATION
SANDY CLAY (CL), GRAY

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-4-83 SAMPLE NO. 3

DEPTH/ELEV 10.0-12.5 DATE 30 NOV 83



LL	PL	PI	GS	NAT W.%	
30	17	13			

CLASSIFICATION

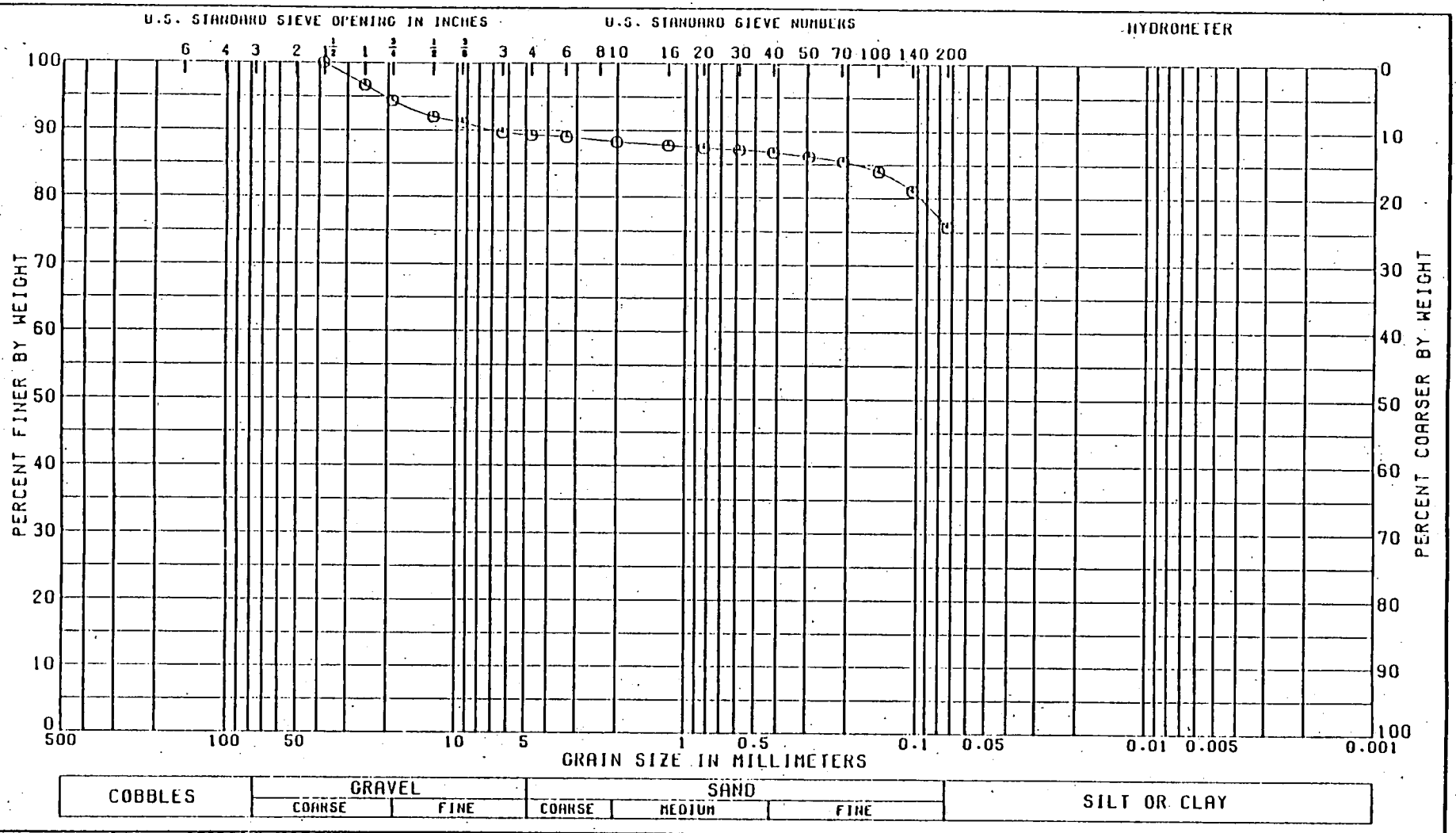
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-5-83 SAMPLE NO. 1

DEPTH/ELEV 5.0-6.85 DATE 30 NOV 83



LL	PL	PI	GS	NAT W.%
25	15	10		

CLASSIFICATION

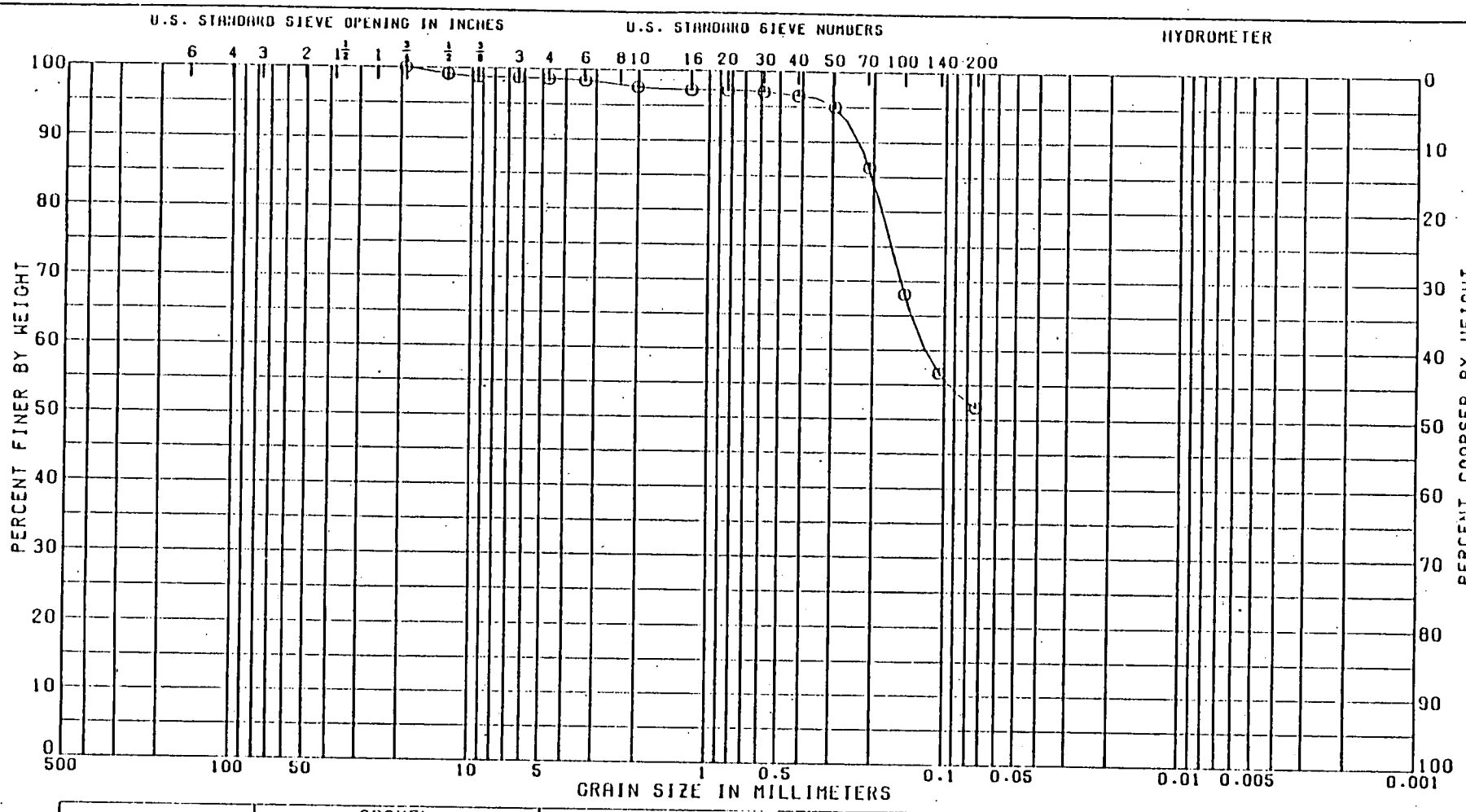
SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-6-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-0.95 DATE 30 NOV 83



LL	PL	PI	GS	NAT W.%
24	16	8		

CLASSIFICATION

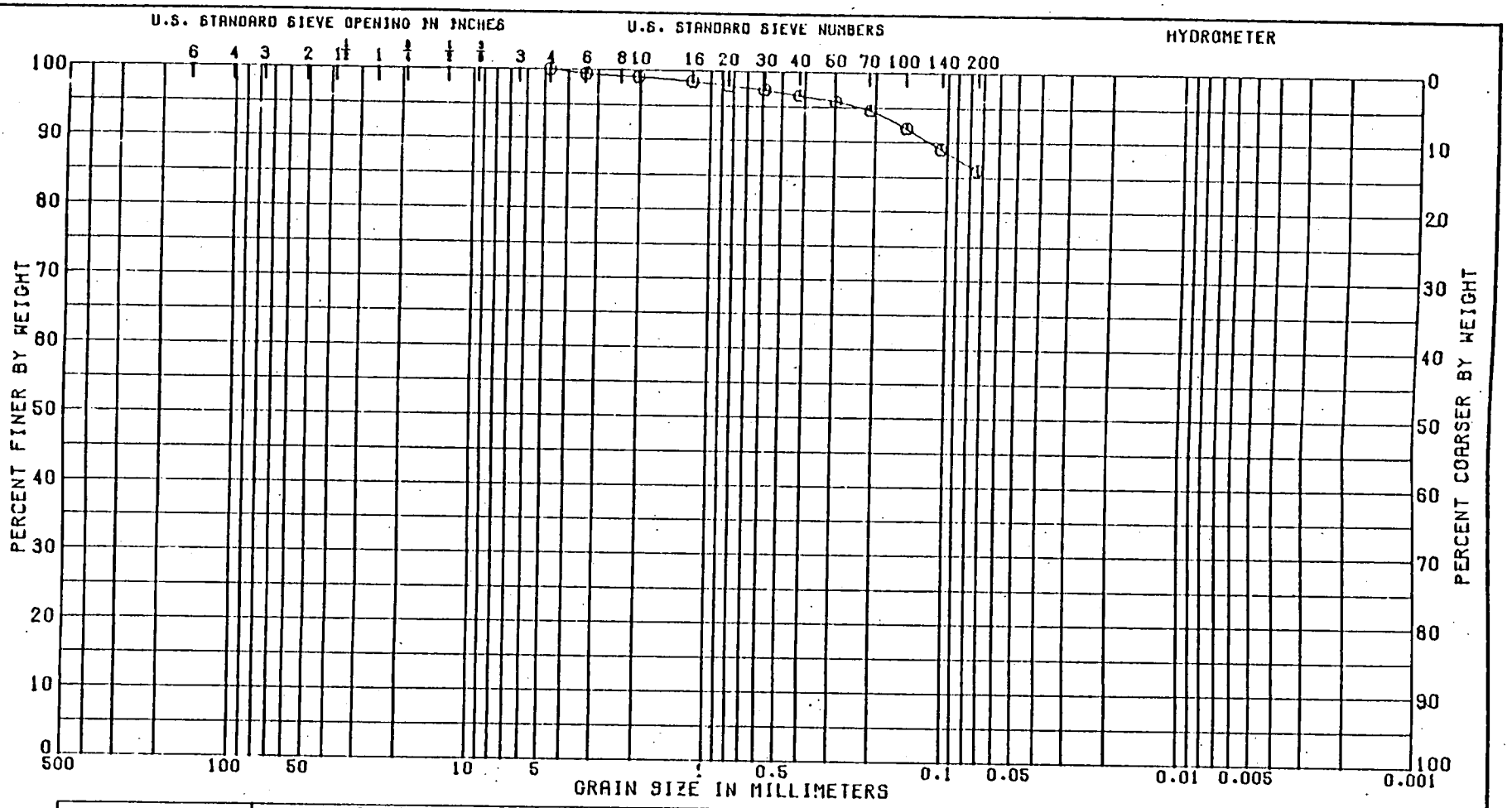
SANDY CLAY (CL), LIGHT BROWN

GRADATION CURVE

PROJECT CRANE NAVAL WEAPONS SUPPORT CENTER

BORING NO. WES-10-6-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.07 DATE 30 NOV 83



LL	PL	PI	GS	NAT W.%
35	20	15		

CLASSIFICATION

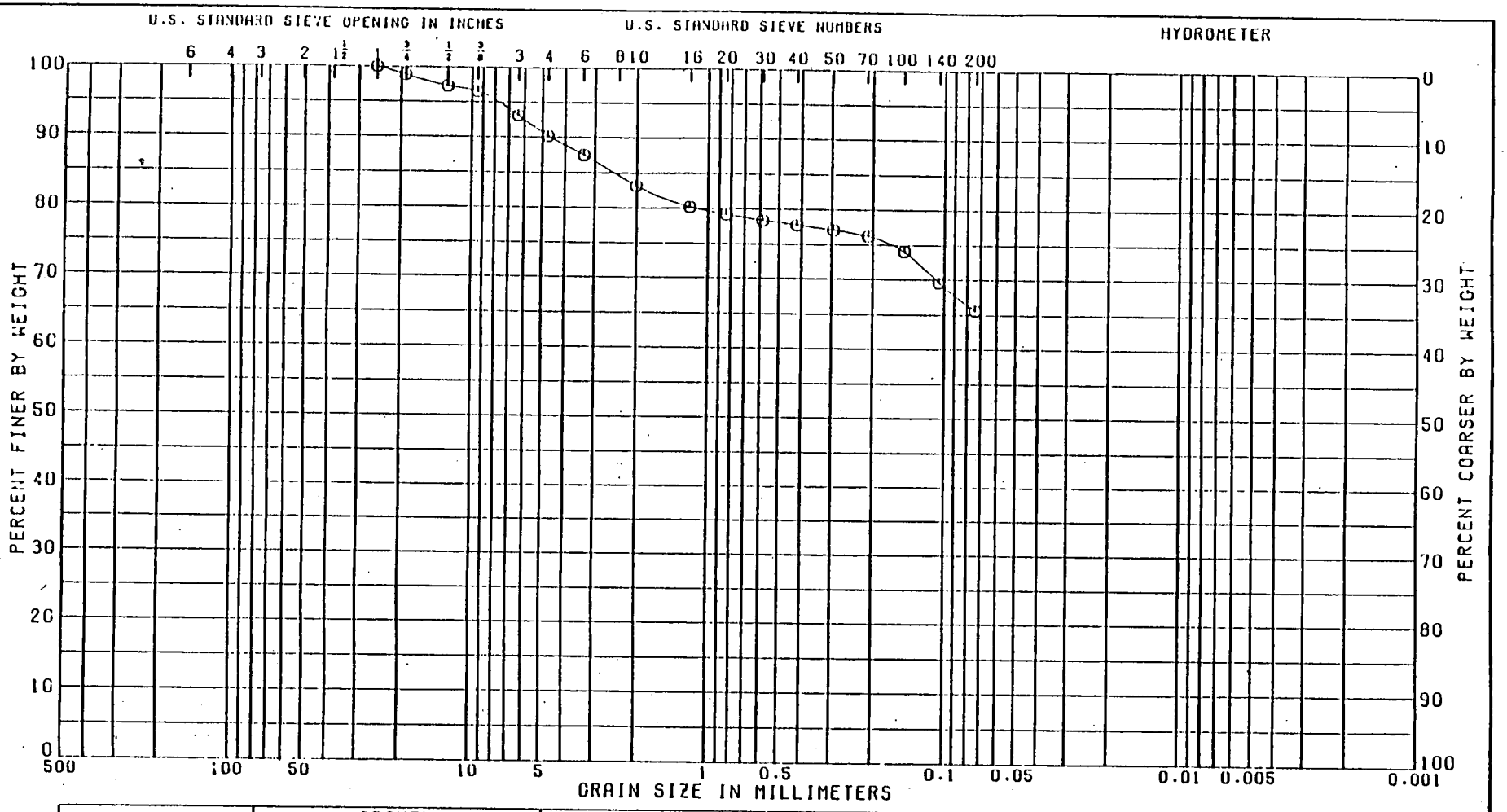
SANDY CLAY (CL), DARK BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-7-83 SAMPLE NO. 1A

DEPTH/ELEV 0-0.4 DATE 05 MAR 84



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
31	17	14		

CLASSIFICATION

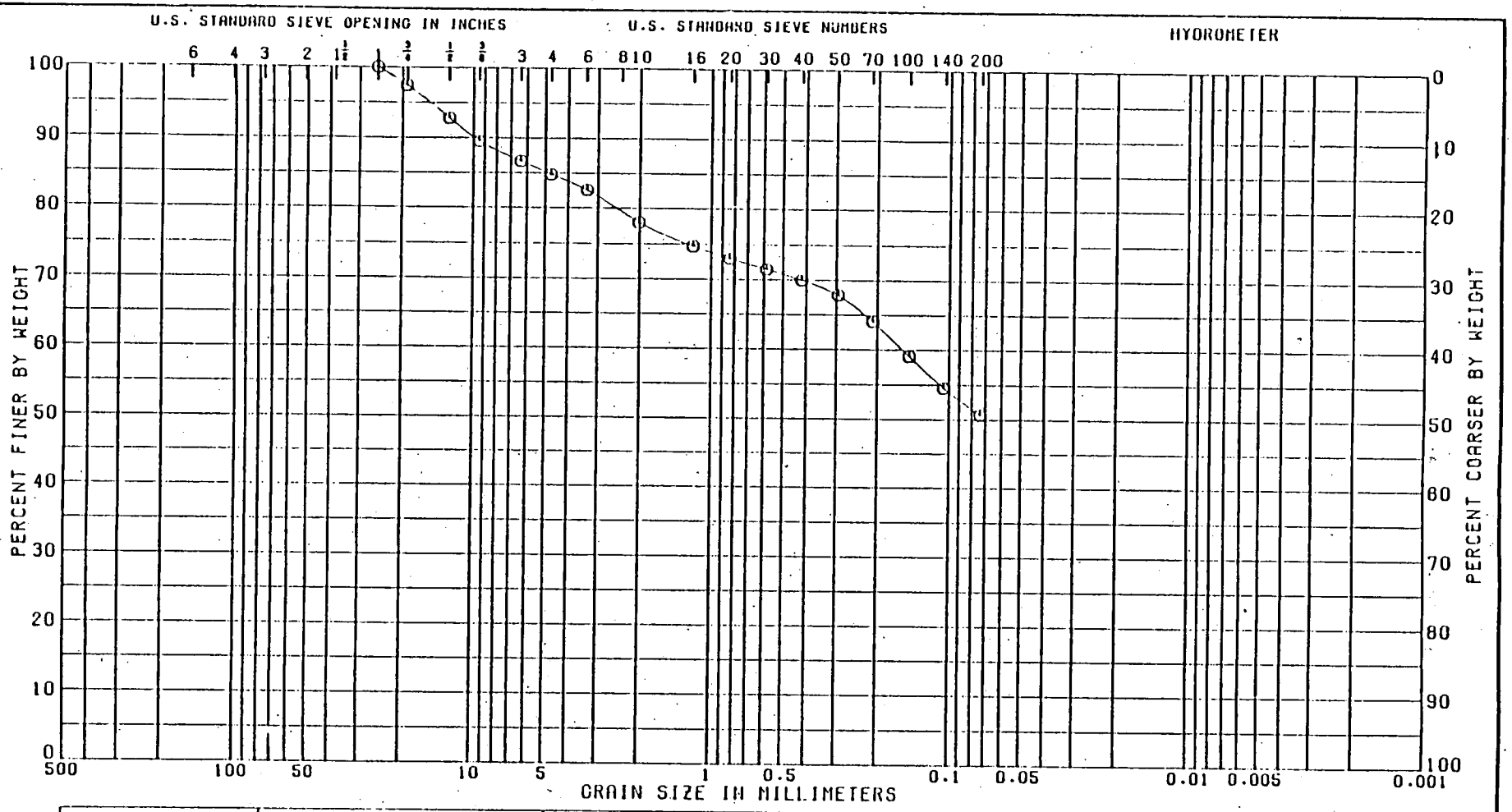
SANDY CLAY (CL), BROWN; WITH GRAVEL
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-8-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.33 DATE 16 FEB 84



LL 34	PL 17	PI 17	GS	NAT W.%	

CLASSIFICATION

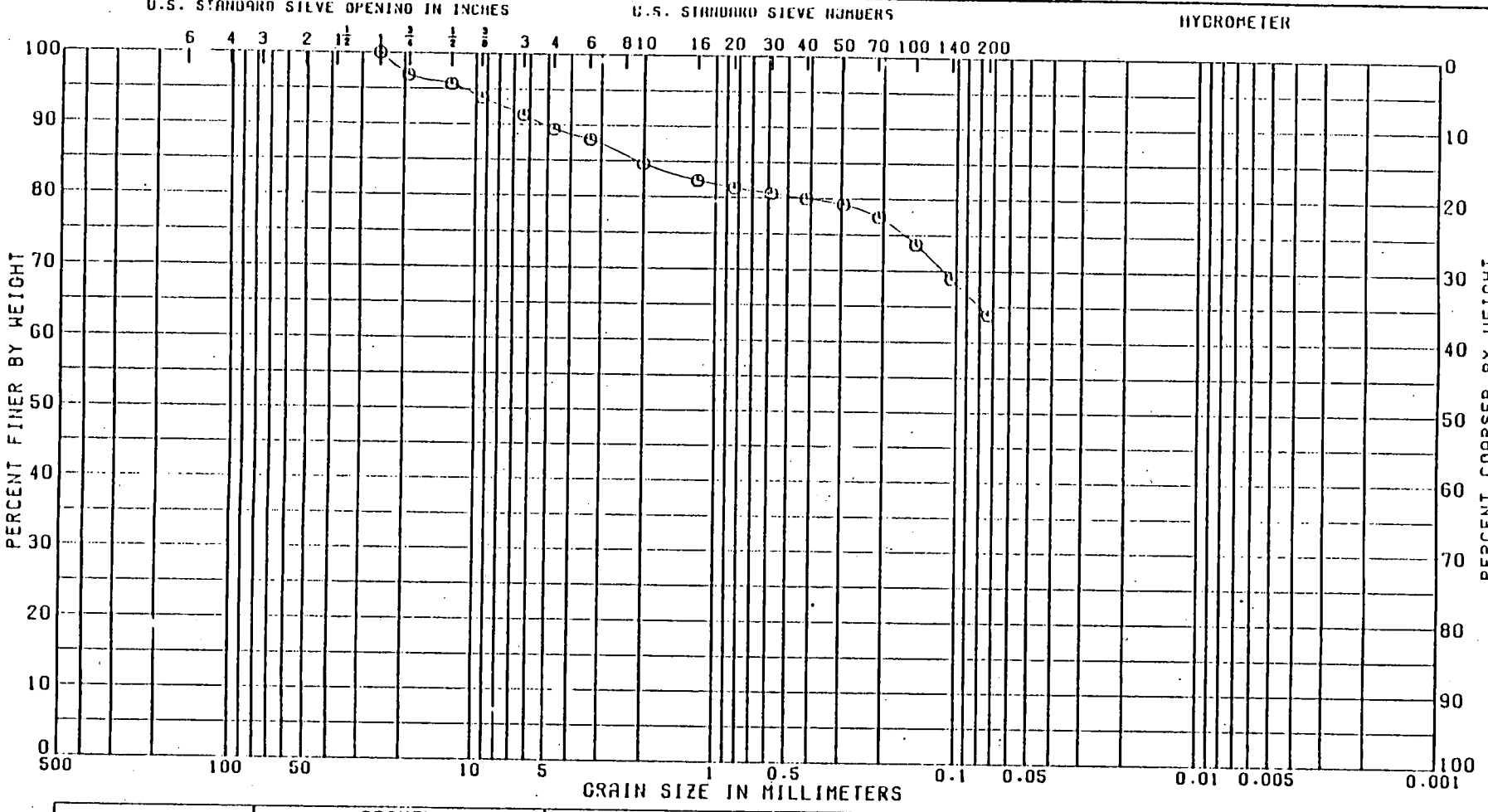
GRAVELLY SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-9-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.05 DATE 30 JAN 84



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
29	17	12		

CLASSIFICATION

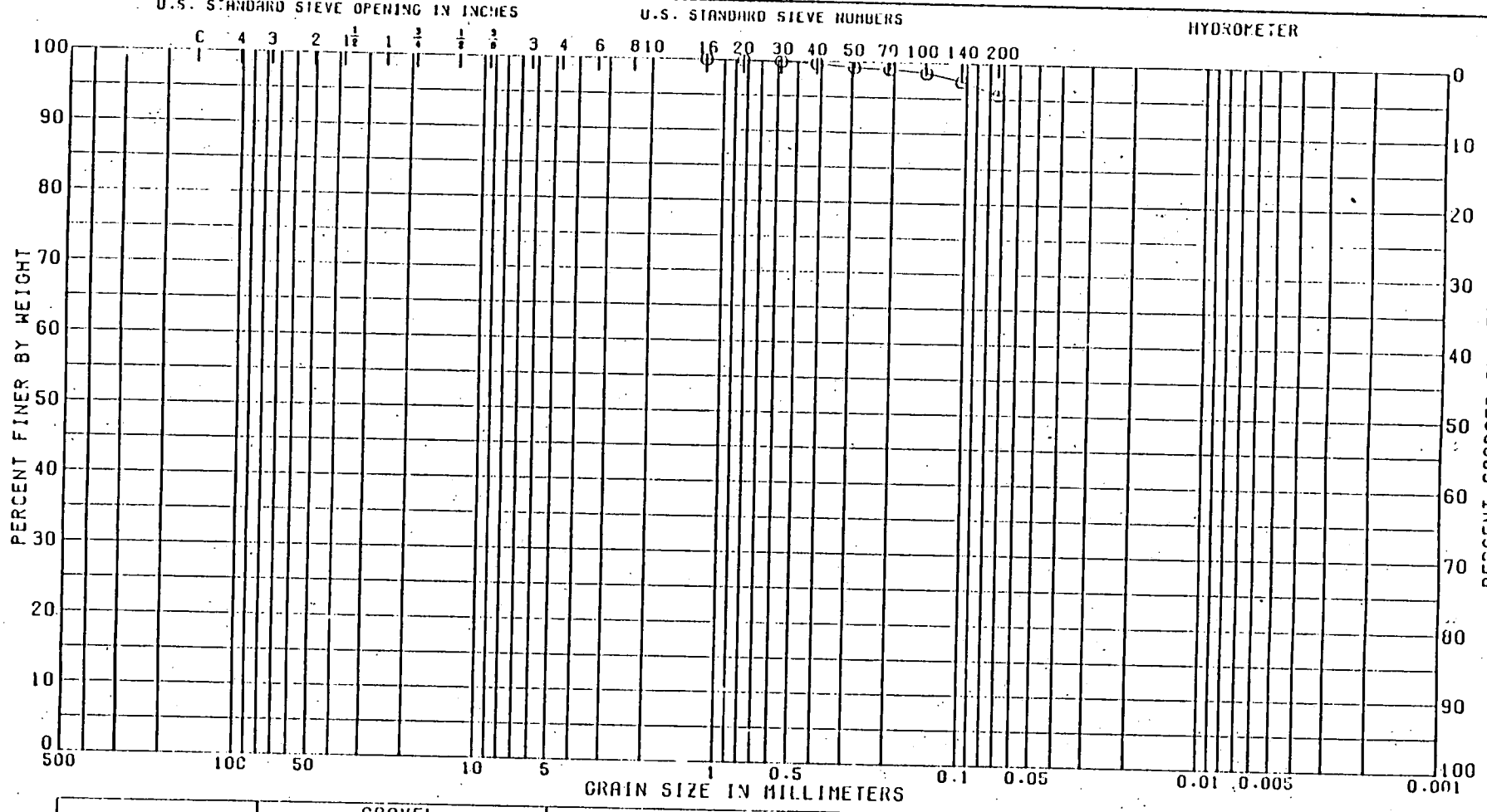
SANDY CLAY (CL), BROWN: WITH GRAVEL

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-10-03 SAMPLE NO. 1

DEPTH/ELEV 1.5-2.9 DATE 30 JAN 84



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

LL	PL	PI	GS	NAT W.%
32	18	14		

CLASSIFICATION

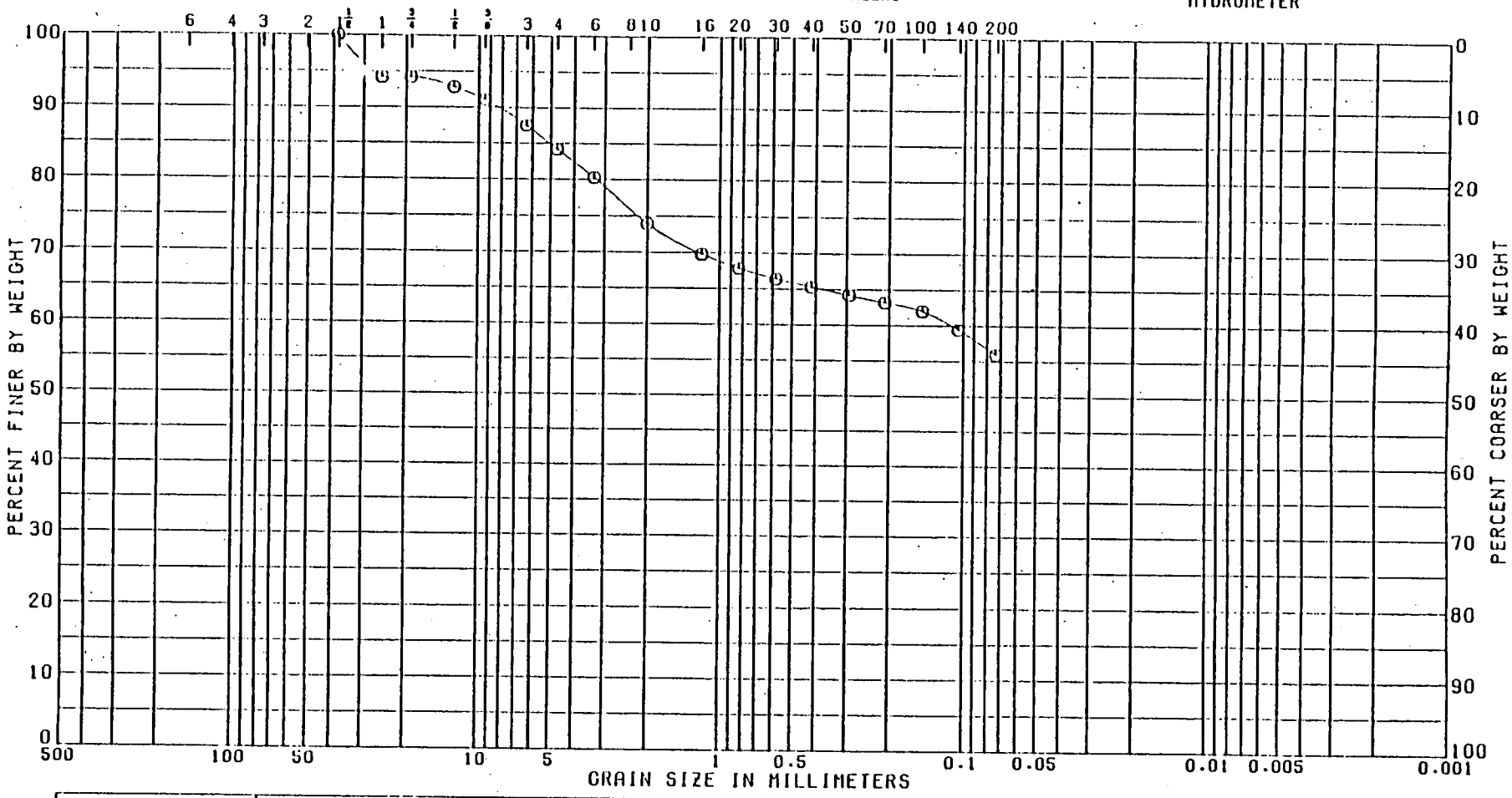
CLAY (CL), LIGHT BROWN: TRACE OF SAND

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-11-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.33 DATE 30 JAN 84



LL	PL	PI	CS	NAT W.%	
48	22	26			

CLASSIFICATION

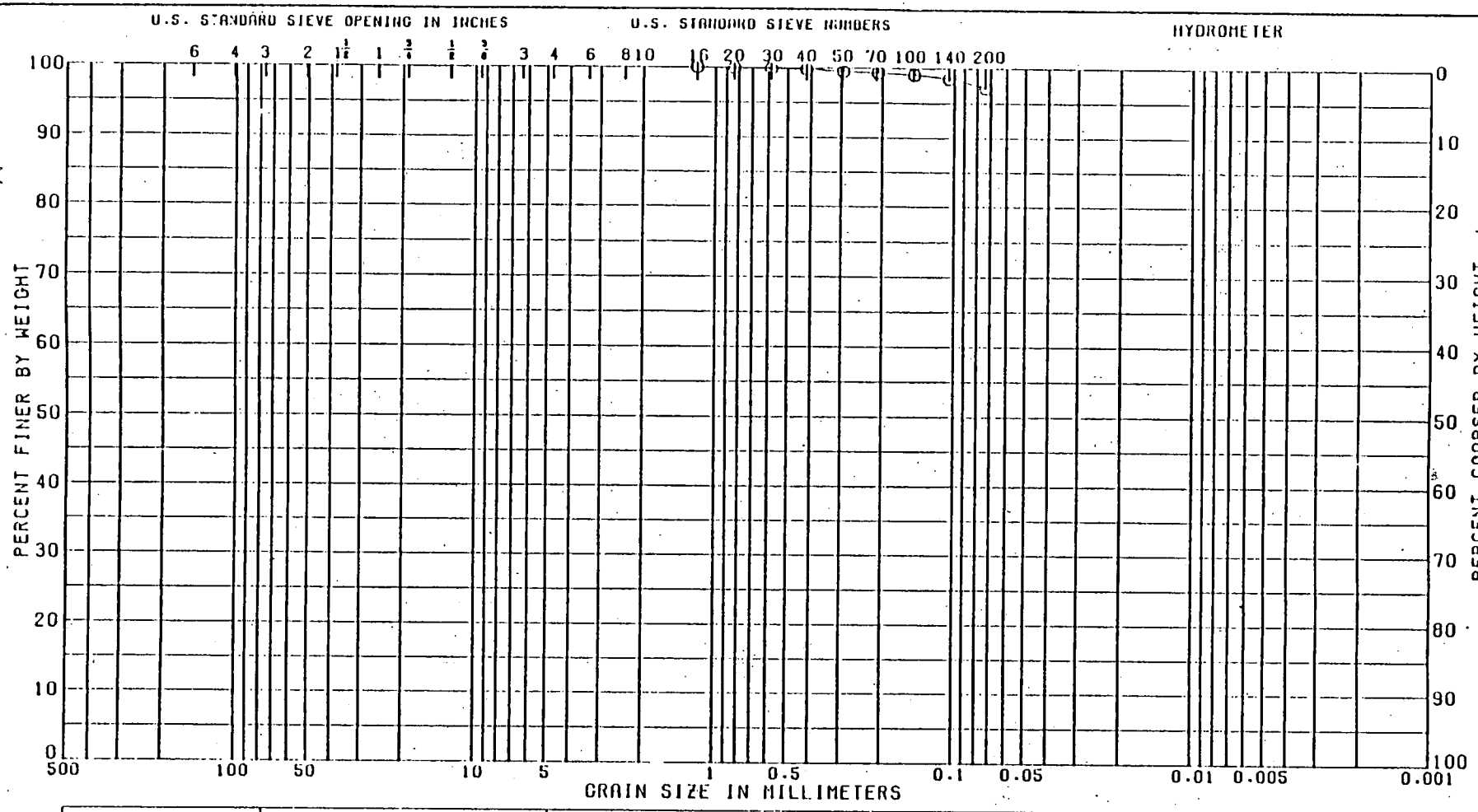
GRAVELLY SANDY CLAY (CL), BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-11-83 SAMPLE NO. 2

DEPTH/ELEV 5.0-6.49 DATE 30 JAN 84



LL	PL	PI	GS	NAT W.%	
41	21	20			

CLASSIFICATION

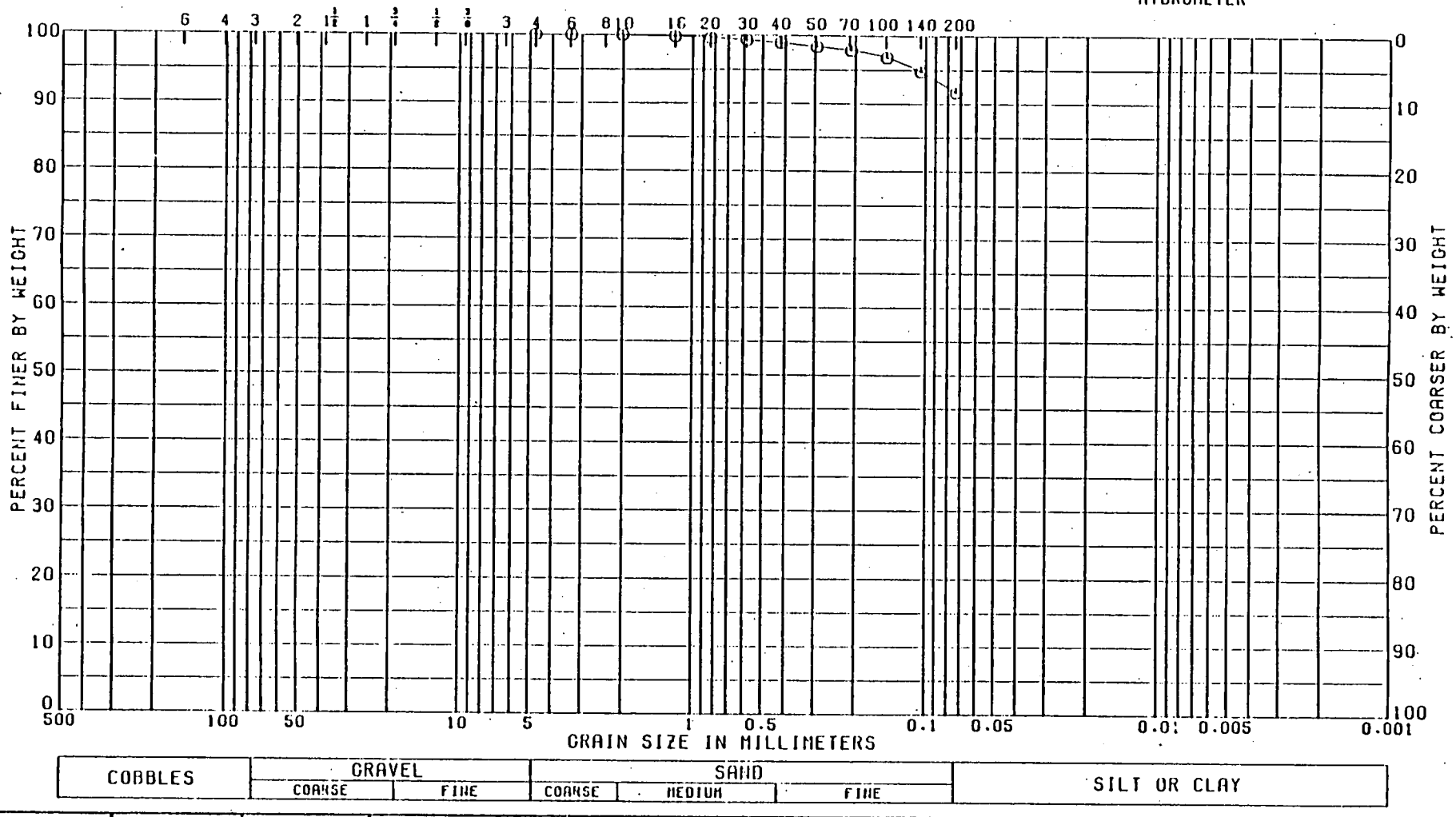
CLAY (CL), BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-12-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.38 DATE 30 JAN 84



LL	PL	PI	GS	NAT W.%	
49	19	30			

CLASSIFICATION

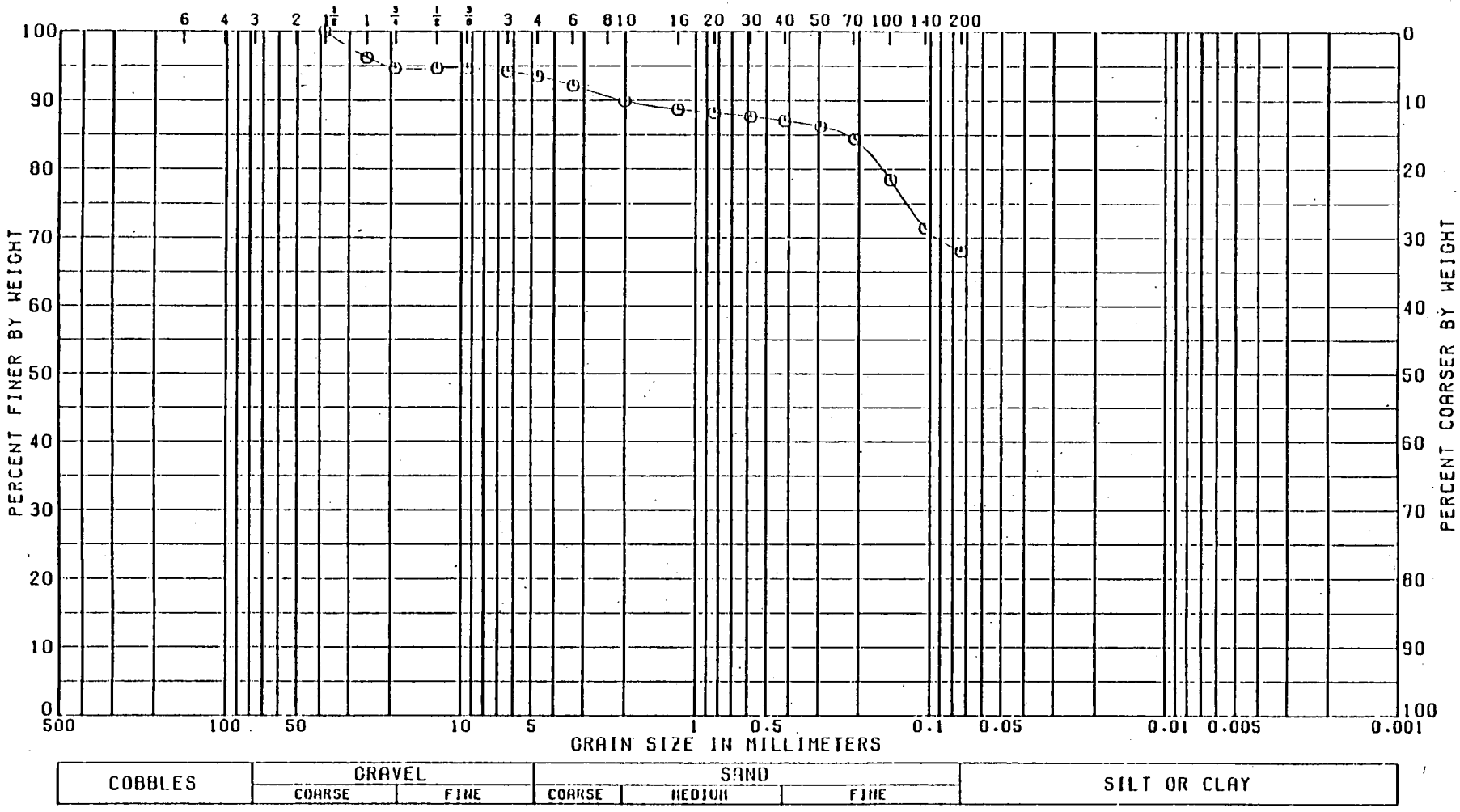
CLAY (CL), BROWN: WITH SAND

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-13-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.56 DATE 30 JAN 84



LL	PL	PI	GS	NAT W.%	
34	15	19			

CLASSIFICATION

SANDY CLAY (CL), LT. BROWN: WITH GRAVEL

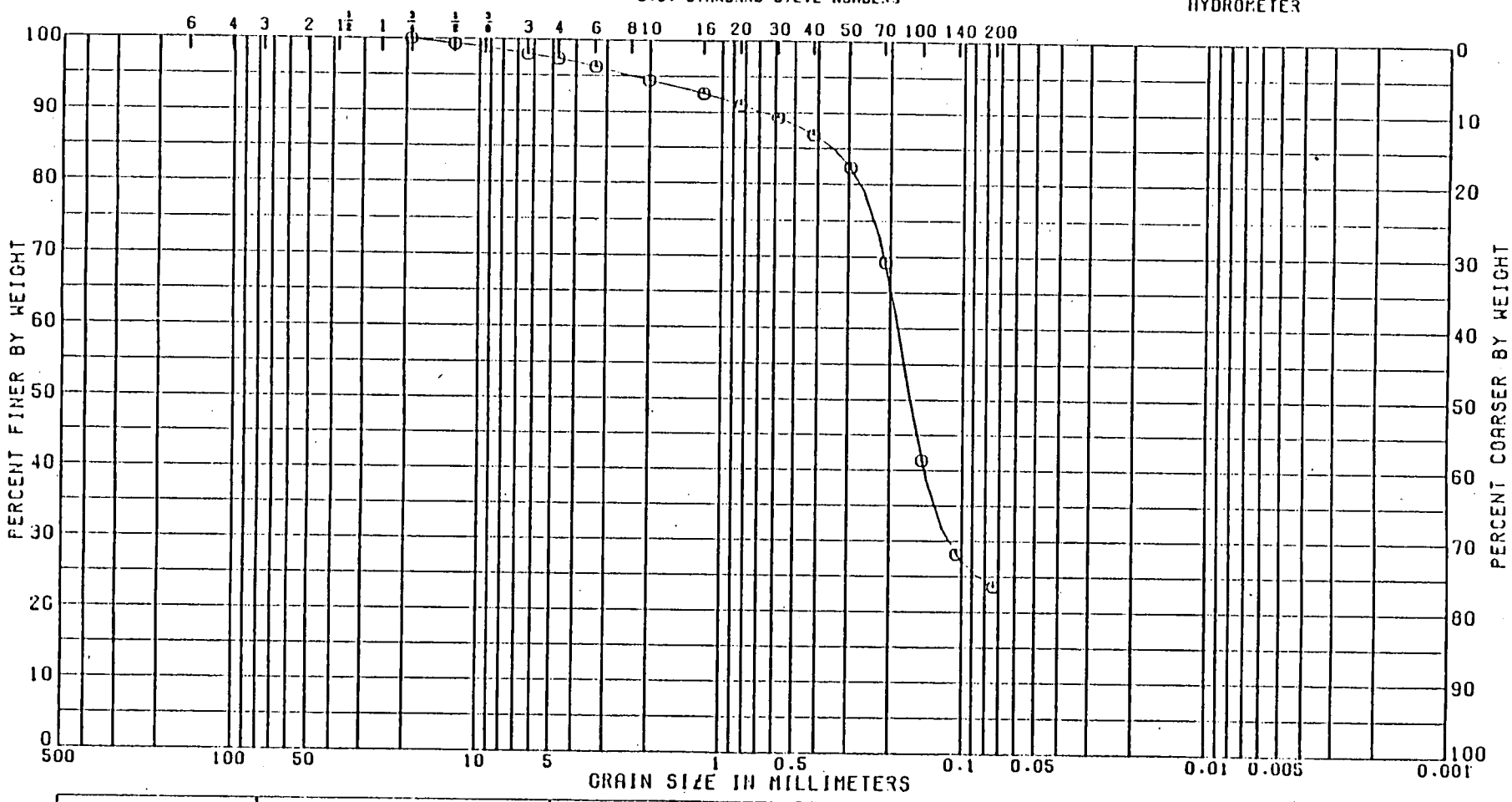
INSUFFICIENT SAMPLE FOR ACCURATE GRADATION

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-14-03 SAMPLE NO. 1

DEPTH/ELEV 0.0-1.85 DATE 30 JAN 84



LL	PL	PI	GS	NAT W.%
16	12	4		

CLASSIFICATION

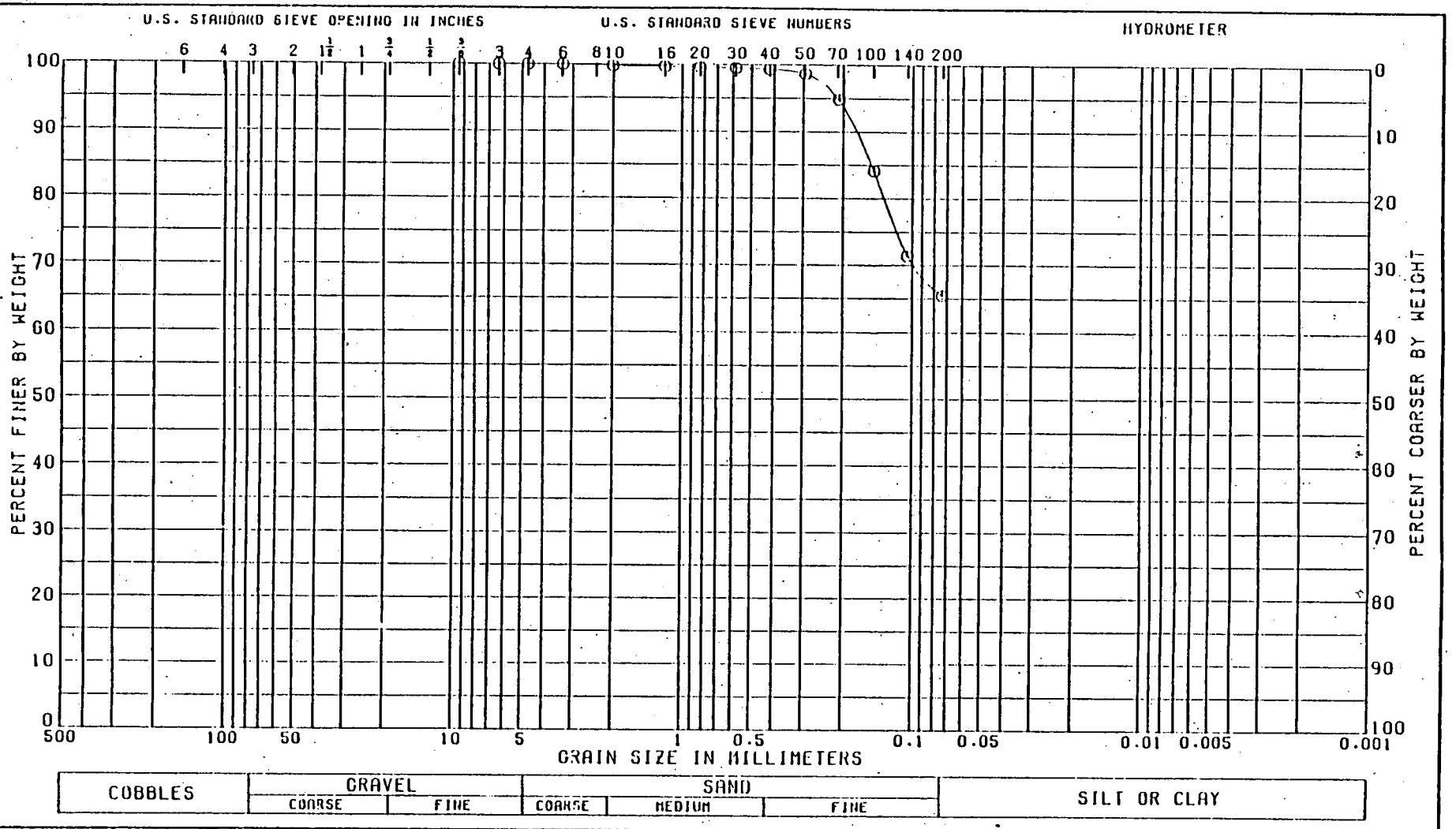
SILTY SAND (SM-SC), BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-15-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.25 DATE 30 JAN 84



LL	PL	PI	GS	NAT W.%	
40	17	23			

CLASSIFICATION

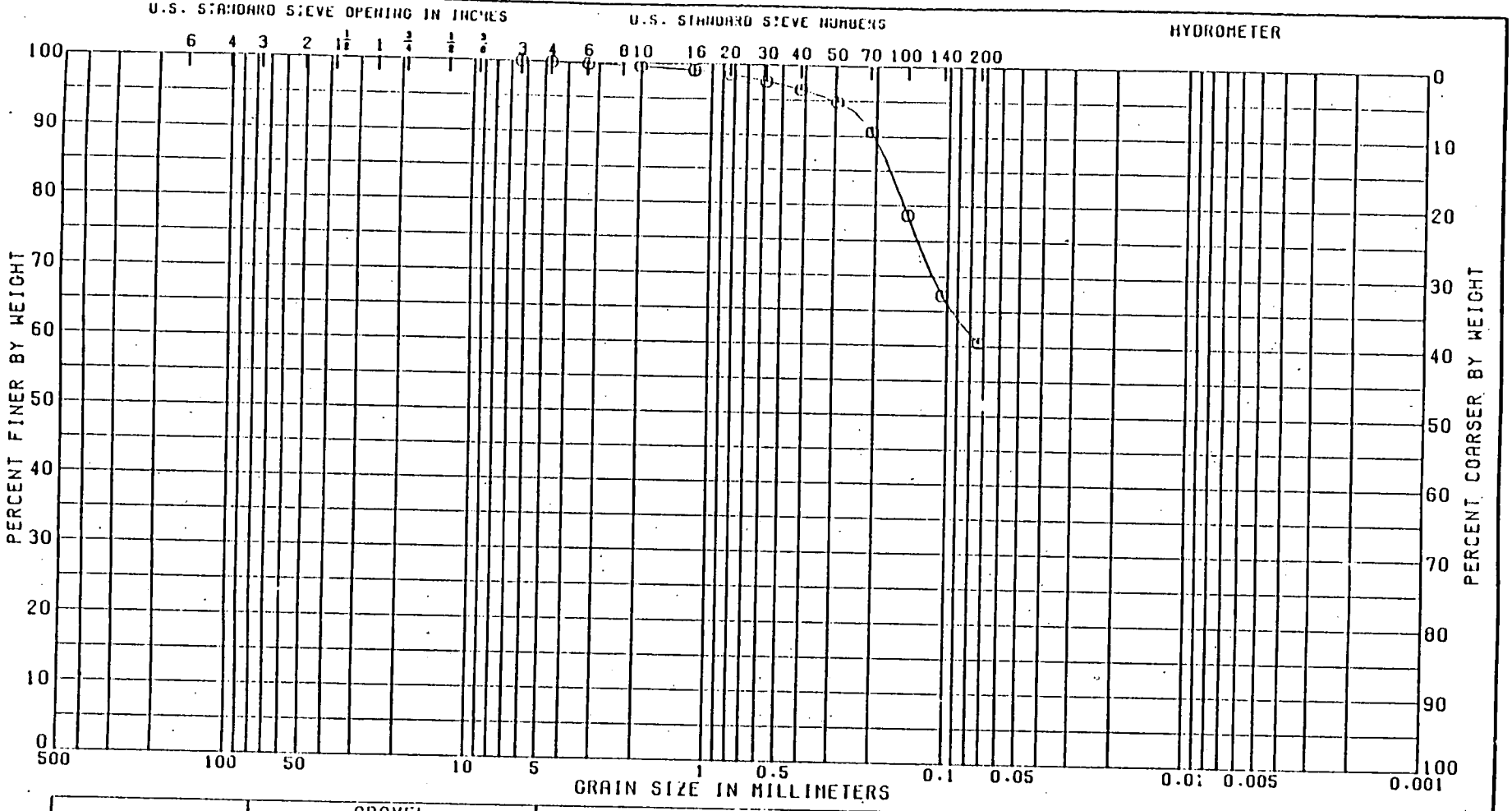
SANDY CLAY (CL), LIGHT BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-17-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.33 DATE 30 JAN 84



LL	PL	PI	GS	NAT W.%	
27	16	11			

CLASSIFICATION

SANDY CLAY (CL), DK. BROWN

GRADATION CURVE

PROJECT NWSC

BORING NO. WES-10-19-83 SAMPLE NO. 1

DEPTH/ELEV 0.0-2.24 DATE 30 JAN 84

APPENDIX A6

Results of First-Year Quarterly Analysis of Groundwater Samples for Background Parameters

FIRST QUARTER

Monitoring Results for the First Year

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
WATER LEVELS A	13 DEC 81		FT	718.66	679.24	679.58	679.73	678.29	677.48	667.02
ARSENIC	30 NOV 81	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	30 NOV 81	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	30 NOV 81	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	30 NOV 81	.010	MGL	ND	.020	.020	.040	.020	ND	.020
FLUORIDE	30 NOV 81	.10	MGL	.27	.15	.14	.16	.14	.23	.43
LEAD	30 NOV 81	.010	MGL	ND	ND	ND	ND	ND	ND	ND
MERCURY	30 NOV 81	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	30 NOV 81	.05	MGL	.35	ND	ND	ND	ND	ND	ND
SELENIUM	30 NOV 81	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	30 NOV 81	.01	MGL	ND	ND	ND	ND	ND	.01	ND
ENDRIN	30 NOV 81	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	30 NOV 81	.08	UGL	ND	ND	ND	ND	ND	.11C	ND
TOXAPHENE	30 NOV 81	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	30 NOV 81	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	30 NOV 81	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVER	30 NOV 81	.5	UGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	30 NOV 81	2.77	PCL	ND	ND	ND	ND	ND	ND	ND
GROSS BETA	30 NOV 81	1.30	PCL	3.30	8.17	6.65	6.02	4.54	3.66	6.40
TOTCOLBACT	01 DEC 81	1.	PHM	23.*	52.*	TNTC *	420.*	12.*	ND	35.*
CHLORIDE	30 NOV 81	1.0	MGL	21.3	90.4	156.0	67.3	57.1	21.9	23.8
IRON	30 NOV 81	.03	MGL	.11	.30	.35 *	.62 *	.26	.23	.24
MANGANESE	30 NOV 81	.01	MGL	.03	10.70 *	2.60 *	4.50 *	2.40 *	7.20 *	7.00 *
PHENOL	30 NOV 81	.01	MGL	ND	.02	ND	ND	ND	ND	.01
SODIUM	30 NOV 81	1.	MGL	208.	91.	79.	47.	60.	37.	37.
SULFATE	30 NOV 81	5.0	MGL	845.0 *	1380.0 *	2420.0 *	1380.0 *	1070.0 *	712.0 *	740.0 *
PH(FIELD)	30 NOV 81		PH	7.0	7.3	6.9	6.9	6.7	6.7	7.3
PH(FIELD)	30 NOV 81		PH	7.0	7.1	6.8	7.0	6.6	6.8	7.2
PH(FIELD)	30 NOV 81		PH	7.0	7.3	6.8	6.9	6.7	6.8	7.3
PH(FIELD)	30 NOV 81		PH	6.9	7.2	6.8	6.8	6.7	6.8	7.3
SPEC COND	30 NOV 81	1.	UMC	2480.	2850.	4180.	2720.	2500.	1700.	1550.
SPEC COND	30 NOV 81	1.	UMC	2500.	2850.	4100.	2710.	2490.	1700.	1540.
SPEC COND	30 NOV 81	1.	UMC	2490.	2850.	4200.	2730.	2490.	1700.	1550.
SPEC COND	30 NOV 81	1.	UMC	2500.	2850.	4150.	2700.	2500.	1700.	1550.
TOC	30 NOV 81	1.0	MGL	9.8	16.4	5.2	6.0	5.2	11.7	16.0
TOC	30 NOV 81	1.0	MGL	9.5	16.5	5.0	6.2	5.2	11.9	15.6
TOC	30 NOV 81	1.0	MGL	9.6	16.1	5.3	6.3	5.3	12.3	15.5
TOC	30 NOV 81	1.0	MGL	9.5	16.3	5.2	6.3	5.2	12.3	16.1

25 Mar 82

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
TOX	30 NOV 81	10.	UGL	106.C	70.C	42.C	ND	27.C	59.C	28.C
TOX	30 NOV 81	10.	UGL	109.C	66.C	58.C	57.C	92.C	44.C	39.C
TOX	30 NOV 81	10.	UGL	105.C	36.C	47.C	55.C	79.C	53.C	42.C
TOX	30 NOV 81	10.	UGL	110.C	85.C	19.C	60.C	73.C	58.C	44.C

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES; TRAILING ZEROES DO NOT ALWAYS INDICATE SIGNIFICANCE, BUT ARE THE RESULTS OF COMPUTER FORMATTING.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	2-4
WATER				
LEVEL'S A	13 DEC 81		FT	676.66
ARSENIC	30 NOV 81	.010	MGL	ND
BARIUM	30 NOV 81	.1	MGL	ND
CADMIUM	30 NOV 81	.005	MGL	ND
CHROMIUM	30 NOV 81	.010	MGL	.020
FLUORIDE	30 NOV 81	.10	MGL	1.50
LEAD	30 NOV 81	.010	MGL	ND
MERCURY	30 NOV 81	.2	UGL	ND
NO2+NO3 AS N	30 NOV 81	.05	MGL	.05
SELENIUM	30 NOV 81	.005	MGL	ND
SILVER	30 NOV 81	.01	MGL	ND
ENDRIN	30 NOV 81	.04	UGL	ND
LINDANE	30 NOV 81	.08	UGL	ND
TOXAPHENE	30 NOV 81	1.6	UGL	ND
METHOXYCHLOR	30 NOV 81	1.6	UGL	ND
2,4-D	30 NOV 81	3.8	UGL	ND
SILVEX	30 NOV 81	.5	UGL	ND
GROSS ALPHA	30 NOV 81	4.60	PCL	ND
GROSS BETA	30 NOV 81	1.30	PCL	4.03
TOTCOLBACT	01 DEC 81	1.	PHM	4.*
CHLORIDE	30 NOV 81	1.0	MGL	62.1
IRON	30 NOV 81	.03	MGL	.35 *
MANGANESE	30 NOV 81	.01	MGL	4.00 *
PHENOL	30 NOV 81	.01	MGL	ND
SODIUM	30 NOV 81	1.	MGL	53.
SULFATE	30 NOV 81	5.0	MGL	827.0 *
PH(FIELD)	30 NOV 81		PH	6.7
PH(FIELD)	30 NOV 81		PH	6.7
PH(FIELD)	30 NOV 81		PH	6.7
PH(FIELD)	30 NOV 81		PH	6.7
SPEC COND	30 NOV 81	1.	UMC	2500.
SPEC COND	30 NOV 81	1.	UMC	2500.
SPEC COND	30 NOV 81	1.	UMC	2500.
SPEC COND	30 NOV 81	1.	UMC	2500.
TOC	30 NOV 81	1.0	MGL	4.5
TOC	30 NOV 81	1.0	MGL	4.5
TOC	30 NOV 81	1.0	MGL	4.5
TOC	30 NOV 81	1.0	MGL	4.4

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	2-4
TOX	30 NOV 81	10.	UGL	61.C
TOX	30 NOV 81	10.	UGL	32.C
TOX	30 NOV 81	10.	UGL	53.C
TOX	30 NOV 81	10.	UGL	73.C

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES; TRAILING ZEROES DO NOT ALWAYS INDICATE SIGNIFICANCE, BUT ARE THE RESULTS OF COMPUTER FORMATTING.
A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: MCCOMISH GORGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 4-1	4-2	4-4	4-3	4-5	4-6
WATER LEVELS A	13 DEC 81		FT	573.59	566.39	566.74	562.52	564.89	564.44
ARSENIC	07 DEC 81	.010	MGL	.010	ND	ND	ND	ND	ND
BARIUM	07 DEC 81	.1	MGL	ND	ND	ND	ND	ND	ND
CADMIUM	07 DEC 81	.005	MGL	ND	ND	ND	ND	ND	ND
CHROMIUM	07 DEC 81	.010	MGL	ND	ND	ND	ND	.010	.010
FLUORIDE	07 DEC 81	.10	MGL	.13	.13	ND	.14	ND	.14
LEAD	07 DEC 81	.010	MGL	ND	ND	ND	ND	ND	ND
MERCURY	07 DEC 81	.2	UGL	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	07 DEC 81	.05	MGL	.38	1.10	.19	ND	.07	.58
SELENIUM	07 DEC 81	.005	MGL	ND	ND	ND	ND	ND	ND
SILVER	07 DEC 81	.01	MGL	ND	ND	ND	ND	ND	ND
ENDRIN	07 DEC 81	.04	UGL	ND	ND	ND	ND	ND	ND
LINDANE	07 DEC 81	.08	UGL	ND	ND	ND	.19C	ND	ND
TOXAPHENE	07 DEC 81	1.6	UGL	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	07 DEC 81	1.6	UGL	ND	ND	ND	ND	ND	ND
2,4-D	07 DEC 81	3.8	UGL	ND	ND	ND	ND	ND	ND
SILVEX	07 DEC 81	.5	UGL	ND	ND	ND	ND	ND	ND
GROSS ALPHA	07 DEC 81	1.96	PCL	ND	ND	ND	ND	ND	ND
GROSS BETA	07 DEC 81	1.30	PCL	1.65	2.42	3.55	2.25	2.19	1.17
TOTCOLIBACT	08 DEC 81	1.	PHM	ND	ND	TNTC *	ND	45.*	ND
CHLORIDE	07 DEC 81	1.0	MGL	1.7	3.0	41.0	7.6	12.4	7.2
IRON	07 DEC 81	.03	MGL	.80 *	.59 *	.15	1.15 *	20.60 *	.20
MANGANESE	07 DEC 81	.01	MGL	.82 *	.38 *	10.30 *	1.06 *	7.30 *	.65 *
PHENOL	07 DEC 81	.01	MGL	ND	ND	ND	ND	ND	ND
SODIUM	07 DEC 81	1.	MGL	9.	5.	21.	33.	20.	10.
SULFATE	07 DEC 81	5.0	MGL	7.7	37.0	11.8	28.5	20.4	38.9
PH(FIELD)	07 DEC 81		PH	6.9	7.1	6.6	6.7	6.3 *	6.9
PH(FIELD)	07 DEC 81		PH	7.0	7.0	6.6	6.7	6.3 *	6.9
PH(FIELD)	07 DEC 81		PH	7.0	7.1	6.6	6.7	6.3 *	6.8
PH(FIELD)	07 DEC 81		PH	7.0	7.1	6.6	6.7	6.3 *	6.9
SPEC COND	07 DEC 81	1.	UMC	330.	540.	880.	530.	630.	550.
SPEC COND	07 DEC 81	1.	UMC	330.	550.	870.	520.	630.	550.
SPEC COND	07 DEC 81	1.	UMC	330.	540.	880.	530.	640.	550.
SPEC COND	07 DEC 81	1.	UMC	340.	540.	880.	530.	630.	550.
TOC	07 DEC 81	1.0	MGL	7.0	15.0	33.0	19.0	7.0	18.0
TOC	07 DEC 81	1.0	MGL	8.0	14.0	33.0	19.0	7.0	18.0
TOC	07 DEC 81	1.0	MGL	7.0	15.0	33.0	19.0	7.0	18.0
TOC	07 DEC 81	1.0	MGL	7.0	14.0	33.0	19.0	7.0	18.0

25 MAR 82

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: MCCOMISH GORGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 4-1	4-2	4-4	4-3	4-5	4-6
TOX	07 DEC 81	10.	UGL	18.C	ND	112.C	72.C	47.C	ND
TOX	07 DEC 81	10.	UGL	25.C	ND	111.C	90.C	37.C	ND
TOX	07 DEC 81	10.	UGL	36.C	ND	68.C	103.C	38.C	16.C
TOX	07 DEC 81	10.	UGL	12.C	55.C	117.C	56.C	33.C	37.C

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES; TRAILING ZEROES DO NOT ALWAYS INDICATE SIGNIFICANCE, BUT ARE THE RESULTS OF COMPUTER FORMATTING.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
WATER										
LEVELS A	13 DEC 81		FT			647.80	648.37	612.13	611.59	593.79
ARSENIC	16 NOV 81	.010	MGL				.043	.013	ND	ND
BARIUM	16 NOV 81	.1	MGL				ND	ND	ND	ND
CADMIUM	16 NOV 81	.005	MGL				ND	ND	ND	ND
CHROMIUM	16 NOV 81	.010	MGL				ND	ND	ND	ND
FLUORIDE	16 NOV 81	.10	MGL				.25	.52	.18	.19
LEAD	16 NOV 81	.010	MGL				ND	ND	ND	ND
MERCURY	16 NOV 81	.2	UGL				ND	ND	ND	ND
NO2+NO3 AS N	16 NOV 81	.05	MGL				.40	.06	.09	.07
SELENIUM	16 NOV 81	.005	MGL				ND	ND	ND	ND
SILVER	16 NOV 81	.01	MGL				ND	ND	ND	ND
ENDRIN	16 NOV 81	.04	UGL				ND	ND	ND	ND
LINDANE	16 NOV 81	.08	UGL				ND	ND	ND	ND
TOXAPHENE	16 NOV 81	1.6	UGL				ND	ND	ND	ND
METHOXYCHLOR	16 NOV 81	1.6	UGL				ND	ND	ND	ND
2,4-D	16 NOV 81	3.8	UGL				ND	ND	ND	ND
SILVEX	16 NOV 81	.5	UGL				1.0C	ND	ND	ND
GROSS ALPHA	16 NOV 81	1.66	PCL				ND	ND	ND	ND
GROSS BETA	16 NOV 81	1.30	PCL				5.70	3.50	2.85	3.27
TOTCOLIBACT	17 NOV 81	1.	PHM				ND	13.*	ND	ND
CHLORIDE	16 NOV 81	1.0	MGL				8.0	12.1	6.1	11.0
IRON	16 NOV 81	.03	MGL				.15	.11	.12	.57 *
MANGANESE	16 NOV 81	.01	MGL				4.30 *	2.00 *	.03	2.00 *
PHENOL	16 NOV 81	.01	MGL				ND	ND	.02	ND
SODIUM	16 NOV 81	1.	MGL				26.	42.	27.	8.
SULFATE	16 NOV 81	5.0	MGL				756.0 *	871.0 *	305.0 *	120.0
PH(FIELD)	16 NOV 81		PH				7.8	7.5	6.8	7.2
PH(FIELD)	16 NOV 81		PH				7.8	7.4	6.8	7.3
PH(FIELD)	16 NOV 81		PH				7.8	7.4	6.8	7.1
PH(FIELD)	16 NOV 81		PH				7.8	7.4	6.8	7.3
SPEC COND	16 NOV 81	1.	UMC				1550.	1710.		600.
SPEC COND	16 NOV 81	1.	UMC				1550.	1700.		605.
SPEC COND	16 NOV 81	1.	UMC				1570.	1720.		600.
SPEC COND	16 NOV 81	1.	UMC				1560.	1720.		610.
TOC	16 NOV 81	1.0	MGL				14.1	26.4	12.0	5.2
TOC	16 NOV 81	1.0	MGL				14.3	25.6	12.0	4.9
TOC	16 NOV 81	1.0	MGL				14.6	26.4	12.3	5.4
TOC	16 NOV 81	1.0	MGL				14.7	26.0	12.0	5.2

25 MAR 82

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
TOX	16 NOV 81	10.	UGL				17.C	41.C	25.C	14.C
TOX	16 NOV 81	10.	UGL				ND	34.C	26.C	12.C
TOX	16 NOV 81	10.	UGL				11.C	33.C	28.C	18.C
TOX	16 NOV 81	10.	UGL				ND	32.C	33.C	18.C

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES; TRAILING ZEROES DO NOT ALWAYS INDICATE SIGNIFICANCE, BUT ARE THE RESULTS OF COMPUTER FORMATTING.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
WATER										
LEVELS A	13 DEC 81		FT	607.84	639.50	646.33	645.42	631.42	629.88	631.08
ARSENIC	16 NOV 81	.010	MGL	ND	ND	ND	.010	ND	ND	ND
BARIUM	16 NOV 81	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	16 NOV 81	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	16 NOV 81	.010	MGL	ND	ND	ND	.010	ND	ND	ND
FLUORIDE	16 NOV 81	.10	MGL	.40	.42	.13	3.50 *	.28	.50	.22
LEAD	16 NOV 81	.010	MGL	ND	.010	ND	.010	.010	.010	.010
MERCURY	16 NOV 81	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	16 NOV 81	.05	MGL	.43	.08	ND	.09	.71	.10	.80
SELENIUM	16 NOV 81	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	16 NOV 81	.01	MGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	16 NOV 81	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	16 NOV 81	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	16 NOV 81	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	16 NOV 81	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	16 NOV 81	3.8	UGL	ND	3.9C	5.4C	ND	ND	ND	ND
SILVEX	16 NOV 81	.5	UGL	ND	.5C	2.9C	ND	.6C	ND	ND
GROSS ALPHA	16 NOV 81	2.12	PCL	3.82	ND	ND	8.32	ND	ND	ND
GROSS ALPHA	04 JAN 82	14.70	PCL				ND			
GROSS BETA	16 NOV 81	1.30	PCL	1.55	3.37	6.37	4.01	2.82	8.30	10.40
GROSS BETA	04 JAN 82	1.30	PCL				3.68			
TOTCOLBACT	17 NOV 81	1.	PHM	ND	4. *	ND	ND	ND	ND	ND
TOTCOLBACT	04 JAN 82	1.	PHM		ND					
CHLORIDE	16 NOV 81	1.0	MGL	10.7	10.6	8.7	30.2	6.8	24.2	19.6
IRON	16 NOV 81	.03	MGL	.22	14.70 *	1.50 *	53.00 *	.15	.08	.49 *
MANGANESE	16 NOV 81	.01	MGL	3.40 *	10.00 *	22.00 *	30.00 *	1.34 *	45.00 *	16.00 *
PHENOL	16 NOV 81	.01	MGL	ND	ND	ND	ND	ND	.03	ND
SODIUM	16 NOV 81	1.	MGL	14.	30.	52.	84.	42.	79.	45.
SULFATE	16 NOV 81	5.0	MGL	294.0 *	629.0 *	815.0 *	3180.0 *	248.0 *	3120.0 *	2720.0 *
PH(FIELD)	16 NOV 81		PH	6.4 *	6.3 *	6.4 *	4.7 *	6.5	7.0	6.3 *
PH(FIELD)	16 NOV 81		PH		6.4 *	6.4 *	4.7 *	6.7	7.0	
PH(FIELD)	16 NOV 81		PH		6.4 *	6.4 *	4.7 *	6.6	7.0	
PH(FIELD)	16 NOV 81		PH		6.4 *	6.4 *	4.7 *	6.7	7.0	
PH(FIELD)	04 JAN 82		PH				4.4 *			
PH(FIELD)	04 JAN 82		PH				4.4 *			
PH(FIELD)	04 JAN 82		PH				4.4 *			
PH(FIELD)	04 JAN 82		PH				4.4 *			
SPEC COND	16 NOV 81	1.	UMC	920.	1300.	1790.	3850.	740.	4010.	3700.
SPEC COND	16 NOV 81	1.	UMC	920.	1300.	1780.	3850.	750.	4000.	3700.
SPEC COND	16 NOV 81	1.	UMC	920.	1300.	1790.	3840.	750.	4050.	3690.
SPEC COND	16 NOV 81	1.	UMC	910.	1310.	1790.	3860.	750.	4000.	3690.
TOC	16 NOV 81	1.0	MGL	8.0	3.8	4.8	7.0	5.3	9.7	12.0
TOC	16 NOV 81	1.0	MGL	8.3	4.0	4.9	7.3	5.7	10.9	12.0
TOC	16 NOV 81	1.0	MGL	8.3	3.6	4.4	7.2	5.3	10.2	12.3
TOC	16 NOV 81	1.0	MGL	8.3	3.8	4.9	7.1	5.0	10.1	12.4

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
TOX	16 NOV 81	10.	UGL	19.C	28.C	65.C	15.C	13.C	32.C	32.C
TOX	16 NOV 81	10.	UGL	23.C	27.C	40.C	ND	25.C	38.C	29.C
TOX	16 NOV 81	10.	UGL	41.C	17.C	44.C	16.C	23.C	28.C	37.C
TOX	16 NOV 81	10.	UGL	31.C	28.C	41.C	ND	ND	33.C	39.C

LEGEND

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A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 02

INSTALLATION: CRANE AAA, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-13
WATER				
LEVELS A	13 DEC 81		FT	632.01
ARSENIC	16 NOV 81	.010	MGL	ND
BARIUM	16 NOV 81	.1	MGL	ND
CADMIUM	16 NOV 81	.005	MGL	ND
CHROMIUM	16 NOV 81	.010	MGL	.010
FLUORIDE	16 NOV 81	.10	MGL	.12
LEAD	16 NOV 81	.010	MGL	.010
MERCURY	16 NOV 81	.2	UGL	ND
NO2+NO3 AS N	16 NOV 81	.05	MGL	1.10
SELENIUM	16 NOV 81	.005	MGL	ND
SILVER	16 NOV 81	.01	MGL	ND
ENDRIN	16 NOV 81	.04	UGL	ND
LINDANE	16 NOV 81	.08	UGL	ND
TOXAPHENE	16 NOV 81	1.6	UGL	ND
METHOXYCHLOR	16 NOV 81	1.6	UGL	ND
2,4-D	16 NOV 81	3.8	UGL	ND
SILVEX	16 NOV 81	.5	UGL	1.2C
GROSS ALPHA	16 NOV 81	5.39	PCL	ND
GROSS ALPHA	04 JAN 82	17.00	PCL	ND
GROSS BETA	16 NOV 81	1.30	PCL	11.20
GROSS BETA	04 JAN 82	1.30	PCL	11,20
URANIUM	04 JAN 82	0.	PCL	1.
TOTCOLBACT	17 NOV 81	1.	PHM	ND
CHLORIDE	16 NOV 81	1.0	MGL	14.7
IRON	16 NOV 81	.03	MGL	.26
MANGANESE	16 NOV 81	.01	MGL	27.00 *
PHENOL	16 NOV 81	.01	MGL	ND
SODIUM	16 NOV 81	1.	MGL	330. *
SULFATE	16 NOV 81	5.0	MGL	3500.0 *
PH(FIELD)	16 NOV 81		PH	6.5
PH(FIELD)	16 NOV 81		PH	6.5
PH(FIELD)	16 NOV 81		PH	6.5
PH(FIELD)	16 NOV 81		PH	6.5
PH(FIELD)	04 JAN 82		PH	6.4
PH(FIELD)	04 JAN 82		PH	6.6
PH(FIELD)	04 JAN 82		PH	6.6
PH(FIELD)	04 JAN 82		PH	6.5
SPEC COND	16 NOV 81	1.	UMC	5000.
SPEC COND	16 NOV 81	1.	UMC	5010.
SPEC COND	16 NOV 81	1.	UMC	5000.
SPEC COND	16 NOV 81	1.	UMC	5050.
TOC	16 NOV 81	1.0	MGL	12.3
TOC	16 NOV 81	1.0	MGL	12.3
TOC	16 NOV 81	1.0	MGL	12.3
TOC	16 NOV 81	1.0	MGL	12.8

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-13
TOX	16 NOV 81	10.	UGL	28.C
TOX	16 NOV 81	10.	UGL	30.C
TOX	16 NOV 81	10.	UGL	33.C
TOX	16 NOV 81	10.	UGL	59.C

LEGEND
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A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: RIFLE RANGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-16	6-14	6-15	6-17	6-18	6-19	6-20
WATER LEVELS A	13 DEC 81		FT	498.38	502.66	510.42	498.63	499.93	499.82	500.58
ARSENIC	16 NOV 81	.010	MGL	ND	ND		ND			
ARSENIC	04 JAN 82	.010	MGL					ND	ND	ND
BARIUM	16 NOV 81	.1	MGL	ND	ND		ND			
BARIUM	04 JAN 82	.1	MGL					.2	ND	ND
CADMIUM	16 NOV 81	.005	MGL	ND	ND		ND			
CADMIUM	04 JAN 82	.005	MGL					ND	ND	ND
CHROMIUM	16 NOV 81	.010	MGL	ND	ND		ND			
CHROMIUM	04 JAN 82	.010	MGL					ND	ND	ND
FLUORIDE	16 NOV 81	.10	MGL	.11	.11		ND			
FLUORIDE	04 JAN 82	.10	MGL					ND	.16	ND
LEAD	16 NOV 81	.010	MGL	ND	ND		ND			
LEAD	04 JAN 82	.010	MGL					ND	ND	ND
MERCURY	16 NOV 81	.2	UGL	ND	ND		ND			
MERCURY	04 JAN 82	.2	UGL					ND	ND	ND
NO2+NO3 AS N	16 NOV 81	.05	MGL	ND	.11		1.40			
NO2+NO3 AS N	04 JAN 82	.05	MGL					16.10 *	.34	4.00
SELENIUM	16 NOV 81	.005	MGL	ND	ND		ND			
SELENIUM	04 JAN 82	.005	MGL					ND	ND	ND
SILVER	16 NOV 81	.01	MGL	ND	ND		ND			
SILVER	04 JAN 82	.01	MGL					ND	ND	ND
ENDRIN	16 NOV 81	.04	UGL	ND	ND		ND			
ENDRIN	04 JAN 82	.04	UGL					ND	ND	ND
LINDANE	16 NOV 81	.08	UGL	ND	ND		ND			
LINDANE	04 JAN 82	.08	UGL					ND	ND	ND
TOXAPHENE	16 NOV 81	1.6	UGL	ND	ND		ND			
TOXAPHENE	04 JAN 82	1.6	UGL					ND	ND	ND
METHOXYCHLOR	16 NOV 81	1.6	UGL	ND	ND		ND			
METHOXYCHLOR	04 JAN 82	1.6	UGL					ND	ND	ND
2,4-D	16 NOV 81	3.8	UGL	ND	ND		3.8C			
2,4-D	04 JAN 82	3.8	UGL					ND	ND	ND
SILVEX	16 NOV 81	.5	UGL	1.8C	ND		ND			
SILVEX	04 JAN 82	.5	UGL					ND	ND	ND
GROSS ALPHA	16 NOV 81	1.30	PCL	ND	ND		ND			
GROSS ALPHA	04 JAN 82	1.82	PCL					ND	ND	ND
GROSS BETA	16 NOV 81	1.30	PCL	1.23	1.56		2.20			
GROSS BETA	04 JAN 82	1.61	PCL					1.33	3.98	ND
TOTCOLBACT	17 NOV 81	1.	PHM	ND	ND		ND			
TOTCOLBACT	04 JAN 82	1.	PHM					ND	42.*	ND
CHLORIDE	16 NOV 81	1.0	MGL	9.1	6.3		2.1			
CHLORIDE	04 JAN 82	1.0	MGL					4.7	4.7	3.3
IRON	16 NOV 81	.03	MGL	.11	.32 *		.34 *			

25 MAR 82

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: RIFLE RANGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-16	6-14	6-15	6-17	6-18	6-19	6-20
IRON	04 JAN 82	.03	MGL					ND	1.83 *	.08
MANGANESE	16 NOV 81	.01	MGL	.08 *	.18 *		.04			
MANGANESE	04 JAN 82	.01	MGL					ND	2.24 *	ND
PHENOL	16 NOV 81	.01	MGL	ND	ND		ND			
PHENOL	04 JAN 82	.01	MGL					ND	ND	ND
SODIUM	16 NOV 81	1.	MGL	24.	11.		5.			
SODIUM	04 JAN 82	1.	MGL					15.	74.	24.
SULFATE	16 NOV 81	5.0	MGL	30.0	53.8		28.1			
SULFATE	04 JAN 82	5.0	MGL					8.0	90.9	10.5
PH(FIELD)	16 NOV 81		PH	6.8	6.6		6.7			
PH(FIELD)	16 NOV 81		PH	6.9			6.7			
PH(FIELD)	16 NOV 81		PH	6.9			6.7			
PH(FIELD)	16 NOV 81		PH	6.9			6.7			
PH(FIELD)	04 JAN 82		PH					6.6	6.8	7.0
PH(FIELD)	04 JAN 82		PH					6.6	6.8	6.9
PH(FIELD)	04 JAN 82		PH					6.5	6.8	7.0
PH(FIELD)	04 JAN 82		PH					6.6	6.8	7.0
SPEC COND	16 NOV 81	1.	UMC	410.	500.		520.			
SPEC COND	16 NOV 81	1.	UMC	410.	500.		520.			
SPEC COND	16 NOV 81	1.	UMC	400.	500.		520.			
SPEC COND	16 NOV 81	1.	UMC	400.	500.		530.			
SPEC COND	04 JAN 82	1.	UMC					468.	780.	315.
SPEC COND	04 JAN 82	1.	UMC					470.	790.	315.
SPEC COND	04 JAN 82	1.	UMC					468.	780.	314.
SPEC COND	04 JAN 82	1.	UMC					465.	790.	315.
TOC	16 NOV 81	1.0	MGL	20.3	3.3		2.0			
TOC	16 NOV 81	1.0	MGL	18.7	3.3		2.2			
TOC	16 NOV 81	1.0	MGL	18.2	3.3		2.0			
TOC	16 NOV 81	1.0	MGL	19.5	3.3		2.0			
TOC	04 JAN 82	1.0	MGL					2.0	5.0	3.0
TOC	04 JAN 82	1.0	MGL					2.0	5.0	3.0
TOC	04 JAN 82	1.0	MGL					2.0	5.0	3.0
TOC	04 JAN 82	1.0	MGL					2.0	5.0	3.0
TOX	16 NOV 81	10.	UGL	24.C	19.C		ND			
TOX	16 NOV 81	10.	UGL	33.C	28.C		ND			
TOX	16 NOV 81	10.	UGL	17.C	25.C		ND			
TOX	16 NOV 81	10.	UGL	24.C	20.C		ND			

RUN DATE: 05 MAR 82

INSTALLATION: CRANE AAA, IN

FACILITY: RIFLE RANGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-16	6-14	6-15	6-17	6-18	6-19	6-20
TOX	04 JAN 82	10.	UGL					21.C	29.C	ND
TOX	04 JAN 82	10.	UGL					20.C	25.C	15.C
TOX	04 JAN 82	10.	UGL					20.C	31.C	25.C
TOX	04 JAN 82	10.	UGL					22.C	30.C	13.C

LEGEND

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A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

SECOND QUARTER

Monitoring Results for the First Year

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
WATER LEVELS (A)	09 MAR 82		FT	719.7	684.7	682.6	684.7	683.3	682.0	677.0
ARSENIC	09 MAR 82	.010	MGL	ND	ND	.011	ND	ND	ND	ND
BARIUM	09 MAR 82	.1	MGL	ND	ND	.3	ND	.1	ND	ND
CADMIUM	09 MAR 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	09 MAR 82	.010	MGL	.010	ND	.020	ND	ND	ND	ND
FLUORIDE	09 MAR 82	.10	MGL	.29	.14	.30	.17	.19	.28	.31
LEAD	09 MAR 82	.010	MGL	ND	ND	.010	ND	ND	ND	ND
MERCURY	09 MAR 82	.2	UGL	.6	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	09 MAR 82	.05	MGL	.36	ND	.08	ND	ND	ND	ND
SELENIUM	09 MAR 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	09 MAR 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	09 MAR 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	09 MAR 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	09 MAR 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	09 MAR 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	09 MAR 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	09 MAR 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	09 MAR 82	13.20	PCL	<7.36	<8.89	<13.20	<7.97	<7.45	<6.66	<4.78
RADIUM-226	09 MAR 82	.05	PCL		.42	.29	.17	.19	.42	
GROSS BETA	09 MAR 82	1.30	PCL	3.89	8.19	7.43	4.45	5.65	4.79	5.11
STRONTIUM-90	01 MAR 82	1.0	PCL		1.9					
CHLORIDE	09 MAR 82	1.0	MGL	205.0	82.8	171.0	61.6	63.6	25.3	15.7
IRON	09 MAR 82	.03	MGL	.25	.07	.06	.05	.08	.27	.04
MANGANESE	09 MAR 82	.01	MGL	.12#	17.90#	6.50#	6.30#	4.70#	7.50#	1.83#
PHENOL	09 MAR 82	.01	MGL	ND	ND	.02	.01	.01	ND	ND
SODIUM	09 MAR 82	1.	MGL	196.	78.	66.	44.	54.	34.	28.
SULFATE	09 MAR 82	5.0	MGL	920.0#	1220.0#	2560.0#	1230.0#	570.0#	930.0#	500.0#
PH(FIELD)	09 MAR 82		PH	6.5	6.4#	6.3#	6.3#	6.2#	6.5	6.6
PH(FIELD)	09 MAR 82		PH	6.5	6.4#	6.3#	6.3#	6.3#	6.5	6.6
PH(FIELD)	09 MAR 82		PH	6.4#	6.3#	6.2#	6.3#	6.3#	6.5	6.6
PH(FIELD)	09 MAR 82		PH	6.5	6.4#	6.3#	6.3#	6.3#	6.5	6.5
SPEC COND	09 MAR 82	1.	UMC	2045.	2949.	3001.	2598.	2450.	1840.	1359.
SPEC COND	09 MAR 82	1.	UMC	2043.	2950.	3000.	2599.	2450.	1840.	1360.
SPEC COND	09 MAR 82	1.	UMC	2044.	2959.	2999.	2597.	2450.	1840.	1360.
SPEC COND	09 MAR 82	1.	UMC	2044.	2950.	3000.	2598.	2452.	1835.	1360.
TOC	09 MAR 82	1.0	MGL	8.0	10.0	4.0	3.0	3.0	5.0	5.0
TOC	09 MAR 82	1.0	MGL	8.0	10.0	4.0	3.0	3.0	5.0	5.0
TOC	09 MAR 82	1.0	MGL	8.0	11.0	5.0	3.0	3.0	5.0	5.0
TOC	09 MAR 82	1.0	MGL	8.0	10.0	4.0	3.0	3.0	5.0	5.0
TOX	09 MAR 82	.010	MGL	.140 C	.160 C	.065 C	.028 C	.045 C	.087 C	.099 C
TOX	09 MAR 82	.010	MGL	.120 C	.120 C	.067 C	.038 C	.049 C	.120 C	.088 C
TOX	09 MAR 82	.010	MGL	.170 C	.150 C	.055 C	.077 C	.061 C	.130 C	.086 C
TOX	09 MAR 82	.010	MGL	.150 C	.150 C	.068 C	.053 C	.031 C	.130 C	.068 C

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 2-4	
WATER					
LEVELS (A)	09 MAR 82		FT	680.7	
ARSENIC	09 MAR 82	.010	MGL	ND	
BARIUM	09 MAR 82	.1	MGL	ND	
CADMIUM	09 MAR 82	.005	MGL	ND	
CHROMIUM	09 MAR 82	.010	MGL	ND	
FLUORIDE	09 MAR 82	.10	MGL	2.00*	
LEAD	09 MAR 82	.010	MGL	ND	
MERCURY	09 MAR 82	.2	UGL	ND	
NO2+NO3 AS N	09 MAR 82	.05	MGL	.09	
SELENIUM	09 MAR 82	.005	MGL	ND	
SILVER	09 MAR 82	.01	MGL	ND	
ENDRIN	09 MAR 82	.04	UGL	ND	
LINDANE	09 MAR 82	.08	UGL	ND	
TOXAPHENE	09 MAR 82	1.6	UGL	ND	
METHOXYCHLOR	09 MAR 82	1.6	UGL	ND	
2,4-D	09 MAR 82	3.8	UGL	ND	
SILVEX	09 MAR 82	.5	UGL	ND	
GROSS ALPHA	09 MAR 82	8.13	PCL	<8.13	
RADIUM-226	09 MAR 82	.05	PCL	.14	
GROSS BETA	09 MAR 82	1.30	PCL	3.84	
CHLORIDE	09 MAR 82	1.0	MGL	63.3	
IRON	09 MAR 82	.03	MGL	ND	
MANGANESE	09 MAR 82	.01	MGL	5.30#	
PHENOL	09 MAR 82	.01	MGL	ND	
SODIUM	09 MAR 82	1.	MGL	44.	
SULFATE	09 MAR 82	5.0	MGL	1770.0#	
PH(FIELD)	09 MAR 82		PH	6.2#	
PH(FIELD)	09 MAR 82		PH	6.2#	
PH(FIELD)	09 MAR 82		PH	6.2#	
PH(FIELD)	09 MAR 82		PH	6.2#	
SPEC COND	09 MAR 82	1.	UMC	2425.	
SPEC COND	09 MAR 82	1.	UMC	2424.	
SPEC COND	09 MAR 82	1.	UMC	2426.	
SPEC COND	09 MAR 82	1.	UMC	2424.	
TOC	09 MAR 82	1.0	MGL	3.0	
TOC	09 MAR 82	1.0	MGL	3.0	
TOC	09 MAR 82	1.0	MGL	3.0	
TOC	09 MAR 82	1.0	MGL	3.0	
TOX	09 MAR 82	.010	MGL	.065	C
TOX	09 MAR 82	.010	MGL	.064	C
TOX	09 MAR 82	.010	MGL	.077	C
TOX	09 MAR 82	.010	MGL	.090	C

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN FACILITY: DYE BURIAL SITE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER REGULATION STANDARD
# VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: MCCOMISH GORGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 4-1	4-2	4-4	4-3	4-5	4-6
WATER LEVELS (A)	23 MAR 82		FT	575.5	571.2	568.1	564.2	567.9	566.7
ARSENIC	23 MAR 82	.010	MGL	ND	ND	ND	ND	ND	ND
BARIUM	23 MAR 82	.1	MGL	ND	ND	ND	ND	ND	ND
CADMIUM	23 MAR 82	.005	MGL	ND	ND	ND	ND	ND	ND
CHROMIUM	23 MAR 82	.010	MGL	ND	ND	ND	ND	ND	ND
FLUORIDE	23 MAR 82	.10	MGL	.14	.11	.11	.12	ND	.10
LEAD	23 MAR 82	.010	MGL	ND	ND	ND	ND	ND	ND
MERCURY	23 MAR 82	.2	UGL	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	23 MAR 82	.05	MGL	.38	.17	.70	ND	.06	.51
SELENIUM	23 MAR 82	.005	MGL	ND	ND	ND	ND	ND	ND
SILVER	23 MAR 82	.01	MGL	ND	ND	ND	.01	ND	ND
ENDRIN	23 MAR 82	.04	UGL	ND	ND	ND	ND	ND	ND
LINDANE	23 MAR 82	.08	UGL	ND	ND	ND	ND	ND	ND
TOXAPHENE	23 MAR 82	1.6	UGL	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	23 MAR 82	1.6	UGL	ND	ND	ND	ND	ND	ND
2,4-D	23 MAR 82	3.8	UGL	ND	ND	ND	ND	ND	ND
SILVEX	23 MAR 82	.5	UGL	ND	ND	ND	ND	ND	ND
GROSS ALPHA	23 MAR 82	4.92	PCL	ND	ND	ND	ND	ND	ND
GROSS BETA	23 MAR 82	1.56	PCL	1.55	1.27	1.95	1.71	ND	1.15
CHLORIDE	23 MAR 82	1.0	MGL	3.0	4.0	9.0	10.0	9.0	3.0
IRON	23 MAR 82	.03	MGL	.78#	.30	.76#	6.30#	6.40#	.25
MANGANESE	23 MAR 82	.01	MGL	.12#	.02	.95#	1.90#	4.50#	.01
PHENOL	23 MAR 82	.01	MGL	ND	ND	ND	ND	ND	ND
SODIUM	23 MAR 82	1.	MGL	37.	4.	15.	30.	17.	7.
SULFATE	23 MAR 82	5.0	MGL	74.0	29.0	15.0	33.0	24.0	24.0
PH(FIELD)	23 MAR 82		PH	6.5	6.6	6.3#	6.1#	5.7#	6.6
PH(FIELD)	23 MAR 82		PH	6.5	6.7	6.5	6.1#	5.8#	6.8
PH(FIELD)	23 MAR 82		PH	6.4#	6.6	6.5	6.1#	5.8#	6.5
PH(FIELD)	23 MAR 82		PH	6.5	6.7	6.4#	6.1#	5.8#	6.6
SPEC COND	23 MAR 82	1.	UMC	380.	470.	748.	501.	521.	529.
SPEC COND	23 MAR 82	1.	UMC	383.	470.	745.	500.	520.	530.
SPEC COND	23 MAR 82	1.	UMC	383.	470.	745.	500.	520.	531.
SPEC COND	23 MAR 82	1.	UMC	383.	470.	744.	501.	521.	530.
TOC	23 MAR 82	1.0	MGL	2.0	2.0	3.0	4.0	3.0	2.0
TOC	23 MAR 82	1.0	MGL	2.0	2.0	4.0	3.0	4.0	2.0
TOC	23 MAR 82	1.0	MGL	2.0	2.0	4.0	3.0	4.0	2.0
TOC	23 MAR 82	1.0	MGL	2.0	2.0	4.0	4.0	3.0	2.0
TOX	23 MAR 82	.010	MGL	ND	ND	.031 C	.010 C	.017 C	ND
TOX	23 MAR 82	.010	MGL	.014 C	ND	.028 C	ND	.018 C	ND
TOX	23 MAR 82	.010	MGL	.012 C	ND	.028 C	.015 C	.016 C	ND
TOX	23 MAR 82	.010	MGL	.015 C	ND	.029 C	.012 C	.015 C	.011 C

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: MCCOMISH GORGE

LEGEND

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PHM - PER 100 MILLILITERS

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
WATER LEVELS (A)	22 FEB 82		FT			D	640.8	613.5	611.1	599.9
ARSENIC	22 FEB 82	.010	MGL				ND	ND	ND	ND
BARIUM	22 FEB 82	.1	MGL				ND	ND	ND	ND
CADMIUM	22 FEB 82	.005	MGL				ND	.006	ND	ND
CHROMIUM	22 FEB 82	.010	MGL				ND	.010	ND	ND
FLUORIDE	22 FEB 82	.10	MGL				.46	.86	.20	.22
LEAD	22 FEB 82	.010	MGL				ND	ND	ND	ND
MERCURY	22 FEB 82	.2	UGL				ND	ND	ND	ND
NO2+NO3 AS N	22 FEB 82	.05	MGL				1.40	2.00	ND	.62
SELENIUM	22 FEB 82	.005	MGL				ND	ND	ND	ND
SILVER	22 FEB 82	.01	MGL				ND	ND	ND	ND
ENDRIN	22 FEB 82	.04	UGL				ND	ND	ND	ND
LINDANE	22 FEB 82	.08	UGL				ND	ND	ND	ND
TOXAPHENE	22 FEB 82	1.6	UGL				ND	ND	ND	ND
METHOXYCHLOR	22 FEB 82	1.6	UGL				ND	ND	ND	ND
2,4-D	22 FEB 82	3.8	UGL				ND	ND	ND	ND
SILVEX	22 FEB 82	.5	UGL				ND	ND	ND	ND
GROSS ALPHA	22 FEB 82	9.23	PCL				<6.47	<9.23	<5.90	<3.40
RADIUM-226	22 FEB 82	1.30	PCL						ND	
GROSS BETA	22 FEB 82	1.76	PCL				ND	3.41	ND	2.89
CHLORIDE	22 FEB 82	1.0	MGL				4.0	11.5	10.0	11.3
IRON	22 FEB 82	.03	MGL				.05	.12	.43#	.03
MANGANESE	22 FEB 82	.01	MGL				.97#	1.60#	.32#	1.82#
PHENOL	22 FEB 82	.01	MGL				ND	ND	ND	ND
SODIUM	22 FEB 82	1	MGL				18.	43.	32.	10.
SULFATE	22 FEB 82	5.0	MGL				640.0#	630.0#	450.0#	100.0
PH(FIELD)	22 FEB 82		PH				6.5	6.3#	6.1#	6.5
PH(FIELD)	22 FEB 82		PH				6.5	6.3#	6.1#	6.4#
PH(FIELD)	22 FEB 82		PH				6.4#	6.3#	6.1#	6.5
PH(FIELD)	22 FEB 82		PH				6.5	6.2#	6.1#	6.5
SPEC COND	22 FEB 82	1.	UMC				1480.	2003.	1241.	578.
SPEC COND	22 FEB 82	1.	UMC				1480.	2003.	1240.	577.
SPEC COND	22 FEB 82	1.	UMC				1480.	2002.	1240.	578.
SPEC COND	22 FEB 82	1.	UMC				1479.	2003.	1241.	577.
TOC	22 FEB 82	1.0	MGL				5.0	4.0	2.0	3.0
TOC	22 FEB 82	1.0	MGL				5.0	4.0	2.0	3.0
TOC	22 FEB 82	1.0	MGL				5.0	4.0	2.0	3.0
TOC	22 FEB 82	1.0	MGL				5.0	4.0	2.0	3.0
TOX	22 FEB 82	.010	MGL				.013 C	ND	.027 C	.043 C
TOX	22 FEB 82	.010	MGL				.013 C	ND	.021 C	.099 C
TOX	22 FEB 82	.010	MGL				.015 C	ND	.026 C	.072 C
TOX	22 FEB 82	.010	MGL				.013 C	.011 C	.026 C	.072 C

A6-21

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
WATER										
LEVELS (A)	22 FEB 82		FT	612.5	642.3	628.4				
LEVELS (A)	01 MAR 82		FT				646.9	632.2	628.8	629.3
ARSENIC	22 FEB 82	.010	MGL	ND	ND	ND				
ARSENIC	01 MAR 82	.010	MGL				.062*	ND	ND	ND
BARIUM	22 FEB 82	.1	MGL	ND	ND	ND				
BARIUM	01 MAR 82	.1	MGL				ND	ND	ND	ND
CADMIUM	22 FEB 82	.005	MGL	ND	.005	ND				
CADMIUM	01 MAR 82	.005	MGL				.025*	ND	ND	ND
CHROMIUM	22 FEB 82	.010	MGL	ND	ND	ND				
CHROMIUM	01 MAR 82	.010	MGL				.030	ND	.010	.010
FLUORIDE	22 FEB 82	.10	MGL	.37	.54	.14				
FLUORIDE	01 MAR 82	.10	MGL				2.00*	.58	.60	.30
LEAD	22 FEB 82	.010	MGL	ND	ND	ND				
LEAD	01 MAR 82	.010	MGL				.014	ND	.020	.020
MERCURY	22 FEB 82	.2	UGL	ND	ND	ND				
MERCURY	01 MAR 82	.2	UGL				ND	ND	ND	.2
NO2+NO3 AS N	22 FEB 82	.05	MGL	.36	ND	ND				
NO2+NO3 AS N	01 MAR 82	.05	MGL				ND	.78	ND	.09
SELENIUM	22 FEB 82	.005	MGL	ND	ND	ND				
SELENIUM	01 MAR 82	.005	MGL				ND	ND	ND	ND
SILVER	22 FEB 82	.01	MGL	ND	ND	ND				
SILVER	01 MAR 82	.01	MGL				ND	ND	ND	ND
ENDRIN	22 FEB 82	.04	UGL	ND	ND	ND				
ENDRIN	01 MAR 82	.04	UGL				ND	ND	ND	ND
LINDANE	22 FEB 82	.08	UGL	ND	ND	ND				
LINDANE	01 MAR 82	.08	UGL				ND	ND	ND	ND
TOXAPHENE	22 FEB 82	1.6	UGL	ND	ND	ND				
TOXAPHENE	01 MAR 82	1.6	UGL				ND	ND	ND	ND
METHOXYCHLOR	22 FEB 82	1.6	UGL	ND	ND	ND				
METHOXYCHLOR	01 MAR 82	1.6	UGL				ND	ND	ND	ND
2,4-D	22 FEB 82	3.8	UGL	ND	ND	ND				
2,4-D	01 MAR 82	3.8	UGL				ND	ND	ND	ND
SILVEX	22 FEB 82	.5	UGL	ND	ND	ND				
SILVEX	01 MAR 82	.5	UGL				ND	ND	ND	ND
GROSS ALPHA	22 FEB 82	7.47	PCL	<3.48	<6.16	<7.47				
GROSS ALPHA	01 MAR 82	17.60	PCL				<17.60	<3.43	<15.20	<16.20
RADIUM-226	22 FEB 82	1.30	PCL		ND					
RADIUM-226	01 MAR 82	.05	PCL				.78		.37	
GROSS BETA	22 FEB 82	1.30	PCL	ND	2.13	3.56				
GROSS BETA	01 MAR 82	1.30	PCL				5.32	2.40	9.68	9.69

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-9	6-10	6-11	6-7	6-8	6-6	6-12
STRONTIUM-90	01 MAR 82	1.3	PCL						ND	
STRONTIUM-90	23 MAR 82	1.0	PCL							ND
URANIUM	01 MAR 82	0.	PCL				1.			1.
CHLORIDE	22 FEB 82	1.0	MGL	10.0	10.0	8.0				
CHLORIDE	01 MAR 82	1.0	MGL				26.8	6.0	19.7	17.2
IRON	22 FEB 82	.03	MGL	ND	22.40#	21.70#				
IRON	01 MAR 82	.03	MGL				63.60#	.04	1.33#	.08
MANGANESE	22 FEB 82	.01	MGL	2.20#	8.70#	16.80#				
MANGANESE	01 MAR 82	.01	MGL				22.00#	2.50#	43.00#	26.50#
PHENOL	22 FEB 82	.01	MGL	ND	ND	ND				
PHENOL	01 MAR 82	.01	MGL				ND	ND	ND	ND
SODIUM	22 FEB 82	1.	MGL	12.	24.	31.				
SODIUM	01 MAR 82	1.	MGL				80.	21.	64.	47.
SULFATE	22 FEB 82	5.0	MGL	230.0	580.0#	740.0#				
SULFATE	01 MAR 82	5.0	MGL				3390.0#	740.0#	3150.0#	3110.0#
PH(FIELD)	22 FEB 82		PH	6.5	6.1#	6.0#				
PH(FIELD)	22 FEB 82		PH	6.5	6.0#	6.0#				
PH(FIELD)	22 FEB 82		PH	6.5	6.1#	6.0#				
PH(FIELD)	22 FEB 82		PH	6.4#	6.0#	6.0#				
PH(FIELD)	01 MAR 82		PH				4.0#	6.3#	6.0#	6.2#
PH(FIELD)	01 MAR 82		PH				4.1#	6.3#	6.0#	6.2#
PH(FIELD)	01 MAR 82		PH				4.1#	6.3#	6.0#	6.2#
PH(FIELD)	01 MAR 82		PH				4.1#	6.3#	6.0#	6.2#
SPEC COND	22 FEB 82	1.	UMC	750.	1280.	1670.				
SPEC COND	22 FEB 82	1.	UMC	750.	1280.	1670.				
SPEC COND	22 FEB 82	1.	UMC	750.	1280.	1660.				
SPEC COND	22 FEB 82	1.	UMC	750.	1280.	1668.				
SPEC COND	01 MAR 82	1.	UMC				4000.	918.	3800.	3700.
SPEC COND	01 MAR 82	1.	UMC				4000.	920.	3800.	3700.
SPEC COND	01 MAR 82	1.	UMC				4000.	920.	3800.	3700.
SPEC COND	01 MAR 82	1.	UMC				4000.	918.	3800.	3710.
TOC	22 FEB 82	1.0	MGL	5.0	5.0	4.0				
TOC	22 FEB 82	1.0	MGL	5.0	5.0	4.0				
TOC	22 FEB 82	1.0	MGL	5.0	5.0	4.0				
TOC	22 FEB 82	1.0	MGL	5.0	5.0	4.0				
TOC	01 MAR 82	1.0	MGL				5.0	2.0	4.0	6.0
TOC	01 MAR 82	1.0	MGL				5.0	2.0	4.0	6.0
TOC	01 MAR 82	1.0	MGL				5.0	2.0	4.0	6.0
TOC	01 MAR 82	1.0	MGL				5.0	2.0	4.0	6.0
TOX	22 FEB 82	.010	MGL	.051 C	.055 C					
TOX	22 FEB 82	.010	MGL	.063 C	.040 C					

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-9	6-10	6-11	6-7	6-8	6-6	6-12
TOX	22 FEB 82	.010	MGL	.058 C	.044 C					
TOX	22 FEB 82	.010	MGL	.055 C	.041 C					
TOX	01 MAR 82	.010	MGL				.030 C	.022 C	.035 C	.110 C
TOX	01 MAR 82	.010	MGL				.013 C	.046 C	.018 C	.100 C
TOX	01 MAR 82	.010	MGL				.030 C	.046 C	.045 C	.120 C
TOX	01 MAR 82	.010	MGL				.018 C	.053 C	.035 C	.120 C

A6-24

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-13	
WATER					
LEVELS (A)	01 MAR 82		FT	631.9	
ARSENIC	01 MAR 82	.010	MGL	ND	
BARIUM	01 MAR 82	.1	MGL	ND	
CADMIUM	01 MAR 82	.005	MGL	ND	
CHROMIUM	01 MAR 82	.010	MGL	ND	
FLUORIDE	01 MAR 82	.10	MGL	.17	
LEAD	01 MAR 82	.010	MGL	.010	
MERCURY	01 MAR 82	.2	UGL	.2	
NO2+NO3 AS N	01 MAR 82	.05	MGL	ND	
SELENIUM	01 MAR 82	.005	MGL	ND	
SILVER	01 MAR 82	.01	MGL	ND	
ENDRIN	01 MAR 82	.04	UGL	ND	
LINDANE	01 MAR 82	.08	UGL	ND	
TOXAPHENE	01 MAR 82	1.6	UGL	ND	
METHOXYCHLOR	01 MAR 82	1.6	UGL	ND	
2,4-D	01 MAR 82	3.8	UGL	ND	
SILVEX	01 MAR 82	.5	UGL	ND	
GROSS ALPHA	01 MAR 82	17.90	PCL	<17.90	
GROSS BETA	01 MAR 82	1.30	PCL	13.30	
CHLORIDE	01 MAR 82	1.0	MGL	12.9	
IRON	01 MAR 82	.03	MGL	.06	
MANGANESE	01 MAR 82	.01	MGL	9.00#	
PHENOL	01 MAR 82	.01	MGL	ND	
SODIUM	01 MAR 82	1.	MGL	334.	
SULFATE	01 MAR 82	5.0	MGL	3500.0#	
PH(FIELD)	01 MAR 82		PH	6.4#	
PH(FIELD)	01 MAR 82		PH	6.5	
PH(FIELD)	01 MAR 82		PH	6.5	
PH(FIELD)	01 MAR 82		PH	6.5	
SPEC COND	01 MAR 82	1.	UMC	4650.	
SPEC COND	01 MAR 82	1.	UMC	4650.	
SPEC COND	01 MAR 82	1.	UMC	4650.	
SPEC COND	01 MAR 82	1.	UMC	4650.	
TOC	01 MAR 82	1.0	MGL	8.0	
TOC	01 MAR 82	1.0	MGL	8.0	
TOC	01 MAR 82	1.0	MGL	8.0	
TOC	01 MAR 82	1.0	MGL	8.0	
TOX	01 MAR 82	.010	MGL	.150	C
TOX	01 MAR 82	.010	MGL	.160	C
TOX	01 MAR 82	.010	MGL	.140	C
TOX	01 MAR 82	.010	MGL	.170	C

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN FACILITY: DEMOLITION GROUNDS

LEGEND

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C RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER REGULATION STANDARD
# VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA
D - WELL WAS DRY

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

A6-26

RUN DATE: 18 JUN 82

INSTALLATION: CRANE NWSC, IN

FACILITY: RIFLE RANGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-16	6-14	6-15	6-17	6-18	6-19	6-20
WATER LEVELS (A)	01 MAR 82		FT	499.9	505.1		467.2	499.0	499.9	501.7
ARSENIC	01 MAR 82	.010	MGL	ND	ND		ND	ND	ND	ND
BARIUM	01 MAR 82	.1	MGL	ND	ND		ND	ND	ND	ND
CADMIUM	01 MAR 82	.005	MGL	ND	ND		ND	ND	ND	ND
CHROMIUM	01 MAR 82	.010	MGL	ND	ND		ND	ND	ND	ND
FLUORIDE	01 MAR 82	.10	MGL	ND	ND		ND	ND	.15	ND
LEAD	01 MAR 82	.010	MGL	ND	ND		ND	ND	ND	ND
MERCURY	01 MAR 82	.2	UGL	ND	ND		ND	ND	ND	ND
NO2+NO3 AS N	01 MAR 82	.05	MGL	ND	.31		.94	14.70*	.09	5.20
SELENIUM	01 MAR 82	.005	MGL	ND	ND		ND	ND	ND	ND
SILVER	01 MAR 82	.01	MGL	ND	ND		ND	ND	ND	ND
ENDRIN	01 MAR 82	.04	UGL	ND	ND		ND	ND	ND	ND
LINDANE	01 MAR 82	.08	UGL	ND	ND		ND	ND	ND	ND
TOXAPHENE	01 MAR 82	1.6	UGL	ND	ND		ND	ND	ND	ND
METHOXYCHLOR	01 MAR 82	1.6	UGL	ND	ND		ND	ND	ND	ND
2,4-D	01 MAR 82	3.8	UGL	ND	ND		ND	ND	ND	ND
SILVEX	01 MAR 82	.5	UGL	ND	ND		ND	ND	ND	ND
GROSS ALPHA	01 MAR 82	3.63	PCL	ND	ND		ND	ND	ND	ND
GROSS BETA	01 MAR 82	1.64	PCL	1.37	2.08		2.25	ND	2.28	ND
CHLORIDE	01 MAR 82	1.0	MGL	4.0	1.0		ND	4.0	3.0	2.0
IRON	01 MAR 82	.03	MGL	.16	.30		.05	.25	.87#	.35#
MANGANESE	01 MAR 82	.01	MGL	.02	.03		.07#	ND	1.05#	ND
PHENOL	01 MAR 82	.01	MGL	ND	ND		ND	ND	ND	ND
SODIUM	01 MAR 82	1.	MGL	11.	4.		4.	25.	62.	14.
SULFATE	01 MAR 82	5.0	MGL	11.1	580.0#		26.8	ND	36.4	ND
PH(FIELD)	01 MAR 82		PH	6.3#	6.2#		6.3#	6.4#	6.3#	6.4#
PH(FIELD)	01 MAR 82		PH	6.3#	6.2#		6.3#	6.4#	6.3#	6.3#
PH(FIELD)	01 MAR 82		PH	6.3#	6.2#		6.3#	6.4#	6.3#	6.3#
PH(FIELD)	01 MAR 82		PH	6.3#	6.2#		6.3#	6.4#	6.3#	6.3#
SPEC COND	01 MAR 82	1.	UMC	351.	380.		450.	430.	699.	290.
SPEC COND	01 MAR 82	1.	UMC	351.	380.		449.	430.	699.	291.
SPEC COND	01 MAR 82	1.	UMC	350.	380.		449.	430.	690.	291.
SPEC COND	01 MAR 82	1.	UMC	350.	380.		449.	430.	699.	291.
TOC	01 MAR 82	1.0	MGL	10.0	1.0		1.0	2.0	4.0	3.0
TOC	01 MAR 82	1.0	MGL	10.0	1.0		2.0	2.0	4.0	4.0
TOC	01 MAR 82	1.0	MGL	10.0	1.0		2.0	2.0	4.0	3.0
TOC	01 MAR 82	1.0	MGL	10.0	1.0		1.0	2.0	4.0	3.0
TOX	01 MAR 82	.010	MGL	.120 C	.190 C		.087 C	.130 C	.110 C	.116 C
TOX	01 MAR 82	.010	MGL	.120 C	.170 C		.120 C	.085 C	.150 C	.150 C
TOX	01 MAR 82	.010	MGL	.120 C	.170 C		.110 C	.130 C	.140 C	.082 C
TOX	01 MAR 82	.010	MGL	.110 C	.230 C		.110 C	.110 C	.130 C	.150 C

RUN DATE: 10 JUN 82

INSTALLATION: CRANE NWSC, IN FACILITY: RIFLE RANGE

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

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CU - COLOR UNITS
PHM - PER 100 MILLILITERS

THIRD QUARTER

Monitoring Results for the First Year

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
WATER										
LEVELS (A)	06 JUN 82		FT	721.7	687.2	684.1	684.1	683.7	682.5	678.0
ARSENIC	08 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	08 JUN 82	.1	MGL	ND	ND	ND	ND	ND	ND	ND
CADMIUM	08 JUN 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	08 JUN 82	.010	MGL	.070*	.040	ND	ND	ND	.020	.020
FLUORIDE	08 JUN 82	.10	MGL	.27	.15	.86	.20	.22	.29	.23
LEAD	08 JUN 82	.010	MGL	ND	ND	.010	ND	ND	ND	ND
MERCURY	08 JUN 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	08 JUN 82	.05	MGL	.40	ND	.32	ND	.07	ND	.10
SELENIUM	08 JUN 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	08 JUN 82	.01	MGL	ND	ND	ND	ND	.01	ND	ND
ENDRIN	08 JUN 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	08 JUN 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	08 JUN 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	08 JUN 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	08 JUN 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	08 JUN 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	08 JUN 82	25.70	PCL	<6.87	<17.00	<25.70	<15.70	<15.70	<6.33	<4.56
RADIUM-226	08 JUN 82	.20	PCL	ND				.59	.14	
GROSS BETA	08 JUN 82	1.30	PCL	1.76	5.84	3.38	4.07	3.96	4.59	4.62
URANIUM	08 JUN 82	0.	PCL		1.	1.	1.	1.		
CHLORIDE	08 JUN 82	1.0	MGL	220.0	80.0	200.0	66.0	61.0	30.0	14.0
IRON	08 JUN 82	.03	MGL	.29	ND	.16	.07	ND	.55#	ND
MANGANESE	08 JUN 82	.01	MGL	.06#	12.80#	6.10#	6.20#	2.90#	5.60#	.63#
PHENOL	08 JUN 82	.01	MGL	.05	.01	.01	.01	.01	.03	.01
SODIUM	08 JUN 82	1.	MGL	242.	98.	90.	34.	38.	30.	24.
SULFATE	08 JUN 82	5.0	MGL	770.0#	1430.0#	2760.0#	1250.0#	1010.0#	830.0#	420.0#
PH(FIELD)	08 JUN 82		PH	6.6	6.4#	6.5	6.6	6.3#	6.5	6.7
PH(FIELD)	08 JUN 82		PH	6.6	6.5	6.5	6.6	6.2#	6.4#	6.5
PH(FIELD)	08 JUN 82		PH	6.6	6.5	6.5	6.7	6.3#	6.5	6.7
PH(FIELD)	08 JUN 82		PH	6.6	6.4#	6.4#	6.7	6.2#	6.5	6.6
SPEC COND	08 JUN 82	1.	UMC	2450.	3000.	4500.	2600.	2500.	1925.	1320.
SPEC COND	08 JUN 82	1.	UMC	2450.	3000.	4500.	2600.	2500.	1925.	1320.
SPEC COND	08 JUN 82	1.	UMC	2450.	3000.	4500.	2600.	2500.	1925.	1320.
SPEC COND	08 JUN 82	1.	UMC	2450.	3000.	4500.	2600.	2500.	1925.	1320.
TOC	08 JUN 82	1.0	MGL	50.0	87.0	78.0	69.0	91.0	54.0	53.0
TOC	08 JUN 82	1.0	MGL	49.0	87.0	77.0	68.0	90.0	56.0	54.0
TOC	08 JUN 82	1.0	MGL	50.0	89.0	77.0	69.0	91.0	56.0	54.0
TOC	08 JUN 82	1.0	MGL	49.0	88.0	79.0	69.0	90.0	55.0	55.0
TOX	08 JUN 82	.010	MGL	.060 C	.047 C	.023 C	.019 C	.018 C	.011 C	.019 C
TOX	08 JUN 82	.010	MGL	.062 C	.044 C	.029 C	.016 C	.016 C	ND	ND
TOX	08 JUN 82	.010	MGL	.053 C	.021 C	.019 C	.024 C	.018 C	.014 C	ND
TOX	08 JUN 82	.010	MGL	.055 C	.024 C	.024 C	.021 C	.016 C	ND	ND

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	2-4	
WATER					
LEVELS (A)	08 JUN 82		FT	680.7	
ARSENIC	08 JUN 82	.010	MGL	ND	
BARIUM	08 JUN 82	.1	MGL	ND	
CADMIUM	08 JUN 82	.005	MGL	ND	
CHROMIUM	08 JUN 82	.010	MGL	.020	
FLUORIDE	08 JUN 82	.10	MGL	2.00*	
LEAD	08 JUN 82	.010	MGL	ND	
MERCURY	08 JUN 82	.2	UGL	ND	
NO2+NO3 AS N	08 JUN 82	.05	MGL	.11	
SELENIUM	08 JUN 82	.005	MGL	ND	
SILVER	08 JUN 82	.01	MGL	ND	
ENDRIN	08 JUN 82	.04	UGL	ND	
LINDANE	08 JUN 82	.08	UGL	ND	
TOXAPHENE	08 JUN 82	1.6	UGL	ND	
METHOXYCHLOR	08 JUN 82	1.6	UGL	ND	
2,4-D	08 JUN 82	3.8	UGL	ND	
SILVEX	08 JUN 82	.5	UGL	ND	
GROSS ALPHA	08 JUN 82	13.20	PCL	<13.20	
RADIUM-226	08 JUN 82	.27	PCL	ND	
GROSS BETA	08 JUN 82	1.30	PCL	3.46	
CHLORIDE	08 JUN 82	1.0	MGL	860.0#	
IRON	08 JUN 82	.03	MGL	ND	
MANGANESE	08 JUN 82	.01	MGL	5.20#	
PHENOL	08 JUN 82	.01	MGL	ND	
SODIUM	08 JUN 82	1.	MGL	35.	
SULFATE	08 JUN 82	5.0	MGL	1270.0#	
PH(FIELD)	08 JUN 82		PH	6.2#	
PH(FIELD)	08 JUN 82		PH	6.2#	
PH(FIELD)	08 JUN 82		PH	6.2#	
PH(FIELD)	08 JUN 82		PH	6.2#	
SPEC COND	08 JUN 82	1.	UMC	2510.	
SPEC COND	08 JUN 82	1.	UMC	2510.	
SPEC COND	08 JUN 82	1.	UMC	2510.	
SPEC COND	08 JUN 82	1.	UMC	2510.	
TOC	08 JUN 82	1.0	MGL	49.0	
TOC	08 JUN 82	1.0	MGL	48.0	
TOC	08 JUN 82	1.0	MGL	49.0	
TOC	08 JUN 82	1.0	MGL	49.0	
TOX	08 JUN 82	.010	MGL	.012	C
TOX	08 JUN 82	.010	MGL	ND	
TOX	08 JUN 82	.010	MGL	ND	
TOX	08 JUN 82	.010	MGL	ND	

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN FACILITY: DYE BURIAL SITE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

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MGL - MILLIGRAMS/LITER
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PHM - PER 100 MILLILITERS

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: MCCOMISH GORGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 4-1	4-2	4-4	4-3	4-5	4-6
WATER									
LEVELS (A)	21 JUN 82		FT	575.5	567.9	568.6	563.2	565.4	565.5
ARSENIC	22 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND
BARIUM	22 JUN 82	.1	MGL	ND	ND	.1	ND	.2	ND
CADMIUM	22 JUN 82	.005	MGL	ND	ND	ND	ND	ND	ND
CHROMIUM	22 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND
FLUORIDE	22 JUN 82	.10	MGL	.15	.10	.10	.10	ND	.11
LEAD	22 JUN 82	.010	MGL	ND	ND	ND	ND	ND	ND
MERCURY	22 JUN 82	.2	UGL	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	22 JUN 82	.05	MGL	.06	ND	.17	ND	ND	.08
SELENIUM	22 JUN 82	.005	MGL	ND	ND	ND	ND	ND	ND
SILVER	22 JUN 82	.01	MGL	ND	ND	ND	.02	ND	ND
ENDRIN	22 JUN 82	.04	UGL	ND	ND	ND	ND	ND	ND
LINDANE	22 JUN 82	.08	UGL	ND	ND	ND	ND	ND	ND
TOXAPHENE	22 JUN 82	1.6	UGL	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	22 JUN 82	1.6	UGL	ND	ND	ND	ND	ND	ND
2,4-D	22 JUN 82	3.8	UGL	ND	ND	ND	ND	ND	ND
SILVEX	22 JUN 82	.5	UGL	ND	ND	ND	ND	ND	ND
GROSS ALPHA	22 JUN 82	5.03	PCL	<1.30	<4.07	<4.34	<4.01	<5.08	<3.63
GROSS BETA	22 JUN 82	1.64	PCL	ND	ND	1.51	2.48	ND	ND
CHLORIDE	22 JUN 82	1.0	MGL	4.0	4.0	5.0	11.0	13.0	13.0
IRON	22 JUN 82	.03	MGL	2.10#	.06	.78#	18.90#	13.50#	.12
MANGANESE	22 JUN 82	.01	MGL	.17#	ND	.38#	2.16#	5.90#	ND
PHENOL	22 JUN 82	.01	MGL	.10	.04	.02	.08	.01	.05
SODIUM	22 JUN 82	1.	MGL	15.	7.	10.	35.	20.	6.
SULFATE	22 JUN 82	5.0	MGL	12.0	23.0	6.0	16.0	25.0	36.0
PH(FIELD)	22 JUN 82		PH	6.8	6.8	6.7	6.2#	6.1#	6.7
PH(FIELD)	22 JUN 82		PH	6.8	6.8	6.7	6.2#	6.1#	6.7
PH(FIELD)	22 JUN 82		PH	6.8	6.8	6.7	6.2#	6.1#	6.7
PH(FIELD)	22 JUN 82		PH	6.8	6.8	6.7	6.2#	6.0#	6.7
SPEC COND	22 JUN 82	1.	UMC	420.	500.	490.	580.	740.	545.
SPEC COND	22 JUN 82	1.	UMC	420.	500.	490.	580.	740.	545.
SPEC COND	22 JUN 82	1.	UMC	420.	500.	490.	580.	740.	545.
SPEC COND	22 JUN 82	1.	UMC	420.	500.	490.	580.	740.	550.
TOC	22 JUN 82	1.0	MGL	60.0	55.0	52.0	65.0	88.0	53.0
TOC	22 JUN 82	1.0	MGL	62.0	55.0	53.0	65.0	87.0	53.0
TOC	22 JUN 82	1.0	MGL	63.0	54.0	52.0	65.0	88.0	53.0
TOC	22 JUN 82	1.0	MGL	62.0	53.0	53.0	65.0	88.0	53.0
TOX	22 JUN 82	.010	MGL	ND	.014 C	ND	ND	.011 C	ND
TOX	22 JUN 82	.010	MGL	ND	.014 C	ND	ND	.018 C	ND
TOX	22 JUN 82	.010	MGL	.014 C	.011 C	ND	.016 C	.014 C	ND
TOX	22 JUN 82	.010	MGL	.011 C	.012 C	ND	ND	.016 C	ND

RUN DATE: 00 NOV 82

INSTALLATION: CRANE NWSC, IN FACILITY: MCCOMISH GORGE

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

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UGL - MICROGRAMS/LITER
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TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN FACILITY: AMMUNITION BURNING GROUND

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

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PHM - PER 100 MILLILITERS

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
WATER										
LEVELS (A)	11 JUL 82		FT			649.6	648.8	613.0	611.1	595.4
ARSENIC	12 JUL 82	.010	MGL			ND	ND	ND	ND	ND
BARIUM	12 JUL 82	.1	MGL			ND	ND	ND	ND	ND
CADMIUM	12 JUL 82	.005	MGL			ND	ND	ND	ND	ND
CHROMIUM	12 JUL 82	.010	MGL			ND	ND	ND	.010	ND
FLUORIDE	12 JUL 82	.10	MGL			.12	.56	1.00	.21	.21
LEAD	12 JUL 82	.010	MGL			ND	ND	ND	ND	ND
MERCURY	12 JUL 82	.2	UGL			ND	ND	ND	ND	ND
NO2+NO3 AS N	12 JUL 82	.05	MGL			.28	.67	1.00	.18	.52
SELENIUM	12 JUL 82	.005	MGL			ND	ND	ND	ND	ND
SILVER	12 JUL 82	.01	MGL			ND	ND	ND	ND	ND
ENDRIN	12 JUL 82	.04	UGL			ND	ND	ND	ND	ND
LINDANE	12 JUL 82	.08	UGL			ND	ND	ND	ND	ND
TOXAPHENE	12 JUL 82	1.6	UGL			ND	ND	ND	ND	ND
METHOXYCHLOR	12 JUL 82	1.6	UGL			ND	ND	ND	ND	ND
2,4-D	12 JUL 82	3.8	UGL			ND	ND	ND	ND	ND
SILVEX	12 JUL 82	.5	UGL			ND	ND	ND	ND	ND
GROSS ALPHA	12 JUL 82	7.57	PCL			<2.49	<7.57	<6.02	<6.02	<3.18
GROSS BETA	12 JUL 82	1.81	PCL			2.39	ND	2.33	2.29	2.69
CHLORIDE	12 JUL 82	1.0	MGL			110.0	30.0	36.0	29.0	30.0
IRON	12 JUL 82	.03	MGL			ND	ND	.13	ND	.10
MANGANESE	12 JUL 82	.01	MGL			ND	.78#	1.45#	.15#	2.31#
PHENOL	12 JUL 82	.01	MGL			.02	.06	.04	.01	.02
SODIUM	12 JUL 82	1.	MGL			82.	16.	48.	33.	8.
SULFATE	12 JUL 82	5.0	MGL			480.0#	660.0#	1000.0#	420.0#	97.0
PH(FIELD)	12 JUL 82		PH			6.4#	6.7	6.5	6.8	6.5
PH(FIELD)	12 JUL 82		PH			6.5	6.7	6.6	6.8	6.4#
PH(FIELD)	12 JUL 82		PH			6.5	6.6	6.5	6.7	6.5
PH(FIELD)	12 JUL 82		PH			6.5	6.7	6.5	6.7	6.5
SPEC COND	12 JUL 82	1.	UMC			1720.	1410.	1940.	1110.	615.
SPEC COND	12 JUL 82	1.	UMC			1700.	1420.	1930.	1120.	620.
SPEC COND	12 JUL 82	1.	UMC			1730.	1420.	1945.	1110.	628.
SPEC COND	12 JUL 82	1.	UMC			1700.	1420.	1930.	1110.	615.
TOC	12 JUL 82	1.0	MGL			80.0	26.0	64.0	63.0	52.0
TOC	12 JUL 82	1.0	MGL			82.0	25.0	65.0	63.0	53.0
TOC	12 JUL 82	1.0	MGL			81.0	29.0	64.0	62.0	50.0
TOC	12 JUL 82	1.0	MGL			80.0	27.0	65.0	63.0	52.0
TOX	12 JUL 82	.010	MGL			.064 C	ND	.018 C	ND	.028 C
TOX	12 JUL 82	.010	MGL			.036 C	ND	.011 C	ND	.052 C
TOX	12 JUL 82	.010	MGL			.043 C	.017 C	.029 C	ND	.055 C
TOX	12 JUL 82	.010	MGL			.037 C	ND	ND	ND	.059 C

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
WATER LEVELS (A)	11 JUL 82		FT	611.0	642.1	646.7	646.9	629.7	629.4	630.3
ARSENIC	12 JUL 82	.010	MGL	ND	.010	ND	.063*	ND	ND	ND
BARIUM	12 JUL 82	.1	MGL	.3	ND	ND	ND	ND	ND	ND
CADMIUM	12 JUL 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	12 JUL 82	.010	MGL	ND	ND	ND	.020	ND	ND	.020
FLUORIDE	12 JUL 82	.10	MGL	.47	.70	.16	3.00*	.50	.52	.31
LEAD	12 JUL 82	.010	MGL	ND	ND	ND	.010	ND	.010	ND
MERCURY	12 JUL 82	.2	UGL	ND	ND	ND	ND	ND	ND	ND
NO2+NO3 AS N	12 JUL 82	.05	MGL	.46	ND	.05	.21	.75	ND	.06
SELENIUM	12 JUL 82	.005	MGL	ND	ND	ND	.017*	ND	.017*	.009
SILVER	12 JUL 82	.01	MGL	ND	ND	ND	.02	ND	ND	ND
ENDRIN	12 JUL 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	12 JUL 82	.09	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	12 JUL 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	12 JUL 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	12 JUL 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	12 JUL 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
GROSS ALPHA	12 JUL 82	15.40	PCL	4.56	3.40	<5.92	<14.70	<15.40	<3.20	<14.80
GROSS BETA	12 JUL 82	2.24	PCL	3.50	3.07	4.10	3.70	ND	5.10	8.58
CHLORIDE	12 JUL 82	1.0	MGL	12.0	24.0	22.0	38.0	24.0	35.0	26.0
IRON	12 JUL 82	.03	MGL	.14	25.40#	33.40#	67.00#	ND	.98#	.26
MANGANESE	12 JUL 82	.01	MGL	9.60#	8.90#	12.90#	24.00#	1.18#	44.00#	40.00#
PHENOL	12 JUL 82	.01	MGL	.01	.04	.03	.09	.01	.02	.07
SODIUM	12 JUL 82	1.	MGL	16.	27.	20.	118.	22.	64.	47.
SULFATE	12 JUL 82	5.0	MGL	380.0#	560.0#	710.0#	3200.0#	200.0	2710.0#	2850.0#
PH(FIELD)	12 JUL 82		PH	5.2#	6.3#	6.4#	4.1#	6.6	6.5	6.4#
PH(FIELD)	12 JUL 82		PH	5.2#	6.3#	6.4#	4.0#	6.5	6.4#	6.4#
PH(FIELD)	12 JUL 82		PH	5.3#	6.3#	6.5	4.0#	6.6	6.4#	6.3#
PH(FIELD)	12 JUL 82		PH	5.2#	6.3#	6.4#	4.0#	6.6	6.4#	6.3#
SPEC COND	12 JUL 82	1.	UMC	750.	1080.	1550.	3750.	790.	3600.	3630.
SPEC COND	12 JUL 82	1.	UMC	745.	1085.	1540.	3750.	790.	3650.	3700.
SPEC COND	12 JUL 82	1.	UMC	740.	1085.	1540.	3730.	785.	3580.	3680.
SPEC COND	12 JUL 82	1.	UMC	740.	1080.	1550.	3720.	795.	3580.	3680.
TOC	12 JUL 82	1.0	MGL	34.0	50.0	68.0	57.0	47.0	63.0	65.0
TOC	12 JUL 82	1.0	MGL	36.0	50.0	67.0	58.0	48.0	64.0	65.0
TOC	12 JUL 82	1.0	MGL	35.0	50.0	68.0	58.0	47.0	64.0	65.0
TOC	12 JUL 82	1.0	MGL	36.0	50.0	67.0	57.0	47.0	64.0	66.0
TOX	12 JUL 82	.010	MGL	.035 C	.014 C	ND	.012 C	.021 C	.016 C	ND
TOX	12 JUL 82	.010	MGL	.022 C	ND	ND	.012 C	.023 C	.012 C	ND
TOX	12 JUL 82	.010	MGL	.023 C	.015 C	ND	ND	.022 C	.026 C	ND
TOX	12 JUL 82	.010	MGL	.020 C	ND	ND	.011 C	.017 C	.021 C	ND

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-13
WATER LEVELS (A)	11 JUL 82		FT	632.2
ARSENIC	12 JUL 82	.010	MGL	.010
BARIUM	12 JUL 82	.1	MGL	ND
CADMIUM	12 JUL 82	.005	MGL	ND
CHROMIUM	12 JUL 82	.010	MGL	.010
FLUORIDE	12 JUL 82	.10	MGL	.15
LEAD	12 JUL 82	.010	MGL	ND
MERCURY	12 JUL 82	.2	UGL	ND
NO2+NO3 AS N	12 JUL 82	.05	MGL	ND
SELENIUM	12 JUL 82	.005	MGL	.018*
SILVER	12 JUL 82	.01	MGL	ND
ENDRIN	12 JUL 82	.04	UGL	ND
LINDANE	12 JUL 82	.08	UGL	ND
TOXAPHENE	12 JUL 82	1.6	UGL	ND
METHOXYCHLOR	12 JUL 82	1.6	UGL	ND
2,4-D	12 JUL 82	3.6	UGL	ND
SILVEX	12 JUL 82	.5	UGL	ND
GROSS ALPHA	12 JUL 82	1.30	PCL	22.60
GROSS BETA	12 JUL 82	1.30	PCL	9.62
CHLORIDE	12 JUL 82	1.0	MGL	21.0
IRON	12 JUL 82	.03	MGL	.27
MANGANESE	12 JUL 82	.01	MGL	9.10#
PHENOL	12 JUL 82	.01	MGL	.09
SODIUM	12 JUL 82	1.	MGL	256.
SULFATE	12 JUL 82	5.0	MGL	2800.0#
PH(FIELD)	12 JUL 82		PH	6.6
PH(FIELD)	12 JUL 82		PH	6.6
PH(FIELD)	12 JUL 82		PH	6.6
PH(FIELD)	12 JUL 82		PH	6.6
SPEC COND	12 JUL 82	1.	UMC	3830.
SPEC COND	12 JUL 82	1.	UMC	3650.
SPEC COND	12 JUL 82	1.	UMC	3830.
SPEC COND	12 JUL 82	1.	UMC	3800.
TOC	12 JUL 82	1.0	MGL	74.0
TOC	12 JUL 82	1.0	MGL	73.0
TOC	12 JUL 82	1.0	MGL	74.0
TOC	12 JUL 82	1.0	MGL	73.0
TOX	12 JUL 82	.010	MGL	ND
TOX	12 JUL 82	.010	MGL	ND
TOX	12 JUL 82	.010	MGL	ND
TOX	12 JUL 82	.010	MGL	ND

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN FACILITY: DEMOLITION GROUNDS

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER RECULATION STANDARD
# VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: RIFLE RANGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-16	6-14	6-15	6-17	6-13	6-19	6-20
WATER										
LEVELS (A)	27 JUN 82		FT	501.4	503.1		501.3	498.7	500.4	499.7
ARSENIC	28 JUN 82	.010	MGL	ND	ND		ND	ND	ND	ND
BARIUM	28 JUN 82	.1	MGL	ND	ND		ND	ND	ND	ND
CADMIUM	28 JUN 82	.005	MGL	ND	ND		ND	ND	ND	ND
CHROMIUM	28 JUN 82	.010	MGL	ND	ND		ND	ND	ND	ND
FLUORIDE	28 JUN 82	.10	MGL	ND	ND		ND	ND	.13	ND
LEAD	28 JUN 82	.010	MGL	ND	ND		ND	ND	ND	ND
MERCURY	28 JUN 82	.2	UGL	ND	ND		ND	ND	ND	ND
NO2+NO3 AS N	28 JUN 82	.05	MGL	.14	.20		1.00	13.00*	.13	6.00
SELENIUM	28 JUN 82	.005	MGL	ND	ND		ND	ND	ND	ND
SILVER	28 JUN 82	.01	MGL	ND	ND		ND	ND	ND	ND
ENDRIN	28 JUN 82	.01	UGL	ND	ND		ND	ND	ND	ND
LINDANE	28 JUN 82	.08	UGL	ND	ND		ND	ND	ND	ND
TOXAPHENE	28 JUN 82	1.6	UGL	ND	ND		ND	ND	ND	ND
METHOXYCHLOR	28 JUN 82	1.6	UGL	ND	ND		ND	ND	ND	ND
2,4-D	28 JUN 82	3.8	UGL	ND	ND		ND	ND	ND	ND
SILVEX	28 JUN 82	.5	UGL	ND	ND		ND	ND	ND	ND
GROSS ALPHA	28 JUN 82	3.30	PCL	ND	6.30		3.18	ND	5.14	ND
GROSS BETA	28 JUN 82	1.66	PCL	ND	2.49		2.43	ND	3.11	ND
CHLORIDE	28 JUN 82	1.0	MGL	5.0	8.0		3.0	5.0	5.0	4.0
IRON	28 JUN 82	.03	MGL	.11	1.19#		.11	.77#	1.52#	.81#
MANGANESE	28 JUN 82	.01	MGL	.01	.08#		ND	.02	1.78#	.02
PHENOL	28 JUN 82	.01	MGL	.03	ND		ND	ND	.02	ND
SODIUM	28 JUN 82	1.	MGL	8.	4.		4.	21.	43.	15.
SULFATE	28 JUN 82	5.0	MGL	10.0	43.0		27.0	4.0	42.0	7.0
PH(FIELD)	28 JUN 82		PH	6.6	6.4#		5.9#	6.7	6.5	6.8
PH(FIELD)	28 JUN 82		PH	6.6	6.5		6.1#	6.7	6.5	6.8
PH(FIELD)	28 JUN 82		PH	6.6	6.4#		5.8#	6.6	6.4#	6.9
PH(FIELD)	28 JUN 82		PH	6.6	6.4#		6.2#	6.6	6.4#	6.3#
SPEC COND	28 JUN 82	1.	UMC	360.	380.		450.	430.	645.	330.
SPEC COND	28 JUN 82	1.	UMC	360.	360.		450.	430.	643.	330.
SPEC COND	28 JUN 82	1.	UMC	360.	370.		450.	430.	643.	330.
SPEC COND	28 JUN 82	1.	UMC	360.	350.		450.	430.	645.	330.
TOC	28 JUN 82	1.0	MGL	32.0	26.0		31.0	16.0	32.0	22.0
TOC	28 JUN 82	1.0	MGL	31.0	26.0		32.0	17.0	32.0	22.0
TOC	28 JUN 82	1.0	MGL	31.0	27.0		32.0	17.0	30.0	22.0
TOC	28 JUN 82	1.0	MGL	31.0	27.0		31.0	17.0	30.0	21.0
TOX	28 JUN 82	.010	MGL	.033 C	.120 C		.036 C	.012 C	ND	ND
TOX	28 JUN 82	.010	MGL	.042 C	.120 C		ND	.016 C	.012 C	ND
TOX	28 JUN 82	.010	MGL	.041 C	.130 C		ND	.032 C	ND	ND
TOX	28 JUN 82	.010	MGL	.039 C	.110 C		.012 C	.025 C	ND	ND

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN FACILITY: RIFLE RANGE

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

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MGL - MILLIGRAMS/LITER
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CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
GROSS ALPHA	16 NOV 81	3.66	PCL				ND	ND	ND	ND
GROSS ALPHA	22 FEB 82	9.23	PCL				ND	ND	ND	ND
GROSS ALPHA	12 JUL 82	7.57	PCL			<2.49	<7.57	<6.02	<6.02	<3.18
RADIUM-226	22 FEB 82	1.30	PCL						ND	
GROSS BETA	16 NOV 81	1.30	PCL				5.70	3.50	2.85	3.27
GROSS BETA	22 FEB 82	1.76	PCL				ND	3.41	ND	2.89
GROSS BETA	12 JUL 82	1.81	PCL			2.39	ND	2.33	2.29	2.69

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
GROSS ALPHA	16 NOV 81	4.88	PCL	3.82	ND	ND	8.32	ND	ND	ND
GROSS ALPHA	04 JAN 82	14.70	PCL				ND			
GROSS ALPHA	22 FEB 82	7.47	PCL	<3.48	<6.16	<7.47				
GROSS ALPHA	01 MAR 82	17.60	PCL				<17.60	<3.43	<15.20	<16.20
GROSS ALPHA	12 JUL 82	15.40	PCL	4.56	3.40	<5.92	<14.70	<15.40	<3.20	<14.80
RADIUM-226	04 JAN 82	.05	PCL				2.67			
RADIUM-226	22 FEB 82	1.30	PCL		ND					
RADIUM-226	01 MAR 82	.05	PCL				.78		.37	
GROSS BETA	16 NOV 81	1.30	PCL	1.55	3.37	6.37	4.01	2.82	8.30	10.40
GROSS BETA	04 JAN 82	1.30	PCL				3.68			
GROSS BETA	22 FEB 82	1.30	PCL	ND	2.13	3.56				
GROSS BETA	01 MAR 82	1.30	PCL				5.32	2.40	9.68	9.69
GROSS BETA	12 JUL 82	2.24	PCL	3.50	3.07	4.10	3.70	ND	5.10	8.58
STRONTIUM-90	01 MAR 82	1.3	PCL						ND	
STRONTIUM-90	23 MAR 82	1.0	PCL							ND
URANIUM	01 MAR 82		PCL				1.			1.

RUN DATE: 08 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-13
GROSS ALPHA	16 NOV 81	5.39	PCL	ND
GROSS ALPHA	04 JAN 82	17.00	PCL	ND
GROSS ALPHA	01 MAR 82	17.90	PCL	ND
GROSS ALPHA	12 JUL 82	1.30	PCL	22.60
GROSS BETA	16 NOV 81	1.30	PCL	11.20
GROSS BETA	04 JAN 82	1.30	PCL	11.20
GROSS BETA	01 MAR 82	1.30	PCL	13.30
GROSS BETA	12 JUL 82	1.30	PCL	9.62
STRONTIUM-90	04 JAN 82	1.0	PCL	ND
URANIUM	04 JAN 82		PCL	1.

RUN DATE: 09 NOV 82

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
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TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

FOURTH QUARTER

Monitoring Results for the First Year

RUN DATE: 19 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
WATER LEVELS (A)	18 OCT 82		FT	722.2	685.2	683.6	682.7	683.3	681.5	677.0
ARSENIC	19 OCT 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
BARIUM	19 OCT 82	.1	MGL	ND	ND	.2	ND	ND	ND	ND
CADMIUM	19 OCT 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
CHROMIUM	19 OCT 82	.010	MGL	ND	ND	ND	ND	ND	ND	ND
FLUORIDE	19 OCT 82	.10	MGL	.27	.13	1.00	.19	.18	.25	.19
LEAD	19 OCT 82	.010	MGL	ND	ND	.013	ND	ND	ND	ND
MERCURY	19 OCT 82	.2	UGL	.4	.5	ND	.5	ND	ND	.9
NO2+NO3 AS N	19 OCT 82	.05	MGL	.45	.08	.42	.29	.25	.26	.12
SELENIUM	19 OCT 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	19 OCT 82	.01	MGL	ND	ND	.01	ND	ND	ND	ND
ENDRIN	19 OCT 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	19 OCT 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	19 OCT 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	19 OCT 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	19 OCT 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	19 OCT 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
CHLORIDE	19 OCT 82	1.0	MGL	220.0	81.0	190.0	65.0	59.0	30.0	18.0
IRON	19 OCT 82	.03	MGL	.08	.03	.07	.22	.19	.67#	ND
MANGANESE	19 OCT 82	.01	MGL	.06#	12.70#	7.40#	6.70#	5.10#	8.20#	.87#
PHENOL	19 OCT 82	.01	MGL	.01	.02	ND	ND	ND	ND	ND
SODIUM	19 OCT 82	1.	MGL	224.	62.	66.	38.	47.	30.	22.
SULFATE	19 OCT 82	5.0	MGL	800.0#	1420.0#	2460.0#	1090.0#	950.0#	816.0#	340.0#
PH(FIELD)	19 OCT 82		PH	6.9	6.3#	6.5	6.6	6.4#	6.5	6.9
PH(FIELD)	19 OCT 82		PH	6.8	6.3#	6.6	6.6	6.4#	6.5	6.9
PH(FIELD)	19 OCT 82		PH	6.9	6.4#	6.6	6.5	6.4#	6.6	7.0
PH(FIELD)	19 OCT 82		PH	6.8	6.4#	6.6	6.6	6.4#	6.6	7.0
SPEC COND	19 OCT 82	1.	UMC	1560.	1880.	2630.	2300.	1500.	1200.	1190.
SPEC COND	19 OCT 82	1.	UMC	1560.	1880.	2630.	2300.	1500.	1180.	1200.
SPEC COND	19 OCT 82	1.	UMC	1560.	1880.	2650.	2300.	1500.	1180.	1200.
SPEC COND	19 OCT 82	1.	UMC	1560.	1880.	2650.	2280.	1500.	1180.	1200.
TOC	19 OCT 82	1.0	MGL	41.0	42.0	35.0	24.0	51.0	32.0	31.0
TOC	19 OCT 82	1.0	MGL	41.0	44.0	36.0	24.0	49.0	33.0	32.0
TOC	19 OCT 82	1.0	MGL	42.0	42.0	36.0	25.0	49.0	33.0	32.0
TOC	19 OCT 82	1.0	MGL	41.0	44.0	34.0	24.0	49.0	32.0	33.0
TOX	19 OCT 82	.010	MGL	.140 C	ND	.031 C	ND	ND	.150 C	.160 C
TOX	19 OCT 82	.010	MGL	.092 C	.019 C	.016 C	ND	ND	.150 C	.160 C
TOX	19 OCT 82	.010	MGL	.140 C	ND	.010 C	ND	.012 C	.150 C	.160 C
TOX	19 OCT 82	.010	MGL	.150 C	.015 C	ND	ND	ND	.170 C	.140 C

RUN DATE: 19 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	2-4
WATER				
LEVELS (A)	18 OCT 82		FT	680.7
ARSENIC	19 OCT 82	.010	MGL	ND
BARIUM	19 OCT 82	.1	MGL	ND
CADMIUM	19 OCT 82	.005	MGL	ND
CHROMIUM	19 OCT 82	.010	MGL	ND
FLUORIDE	19 OCT 82	.10	MGL	2.00*
LEAD	19 OCT 82	.010	MGL	ND
MERCURY	19 OCT 82	.2	UGL	ND
NO2+NO3 AS N	19 OCT 82	.05	MGL	.06
SELENIUM	19 OCT 82	.005	MGL	ND
SILVER	19 OCT 82	.01	MGL	ND
ENDRIN	19 OCT 82	.04	UGL	ND
LINDANE	19 OCT 82	.08	UGL	ND
TOXAPHENE	19 OCT 82	1.6	UGL	ND
METHOXYCHLOR	19 OCT 82	1.6	UGL	ND
2,4-D	19 OCT 82	3.8	UGL	ND
SILVEX	19 OCT 82	.5	UGL	ND
CHLORIDE	19 OCT 82	1.0	MGL	81.0
IRON	19 OCT 82	.03	MGL	.05
MANGANESE	19 OCT 82	.01	MGL	4.90#
PHENOL	19 OCT 82	.01	MGL	ND
SODIUM	19 OCT 82	1.	MGL	43.
SULFATE	19 OCT 82	5.0	MGL	1190.0#
PH(FIELD)	19 OCT 82		PH	6.5
PH(FIELD)	19 OCT 82		PH	6.5
PH(FIELD)	19 OCT 82		PH	6.4#
PH(FIELD)	19 OCT 82		PH	6.6
SPEC COND	19 OCT 82	1.	UMC	2180.
SPEC COND	19 OCT 82	1.	UMC	2200.
SPEC COND	19 OCT 82	1.	UMC	2180.
SPEC COND	19 OCT 82	1.	UMC	2200.
TOC	19 OCT 82	1.0	MGL	21.0
TOC	19 OCT 82	1.0	MGL	20.0
TOC	19 OCT 82	1.0	MGL	19.0
TOC	19 OCT 82	1.0	MGL	21.0
TOX	19 OCT 82	.010	MGL	.016 C
TOX	19 OCT 82	.010	MGL	ND
TOX	19 OCT 82	.010	MGL	ND
TOX	19 OCT 82	.010	MGL	ND

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
GROSS ALPHA	30 NOV 81	7.40	PCL	<4.11	<5.47	<7.40	<5.28	<2.77	<3.29	<3.12
GROSS ALPHA	09 MAR 82	13.20	PCL	<7.36	<8.89	<13.20	<7.97	<7.45	<6.66	<4.78
GROSS ALPHA	08 JUN 82	25.70	PCL	<6.87	<17.00	<25.70	<15.70	<15.70	<6.33	<4.56
RADIUM-226	09 MAR 82	.05	PCL		.42	.29	.17	.19	.42	
RADIUM-226	08 JUN 82	.20	PCL	ND	.30		.12	.59	.14	
GROSS BETA	30 NOV 81	1.30	PCL	3.30	8.17	6.65	6.02	4.54	3.66	6.40
GROSS BETA	09 MAR 82	1.30	PCL	3.89	8.19	7.43	4.45	5.65	4.79	5.11
GROSS BETA	08 JUN 82	1.30	PCL	1.78	5.84	3.38	4.07	3.98	4.59	4.62
STRONTIUM-90	01 MAR 82	1.0	PCL		1.9					
URANIUM	08 JUN 82	0.	PCL		1.	1.	1.	1.		

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	2-4
GROSS ALPHA	30 NOV 81	4.60	PCL	ND
GROSS ALPHA	09 MAR 82	8.13	PCL	ND
GROSS ALPHA	08 JUN 82	13.20	PCL	ND
RADIUM-226	09 MAR 82	.05	PCL	.14
RADIUM-226	08 JUN 82	.27	PCL	ND
GROSS BETA	30 NOV 81	1.30	PCL	4.03
GROSS BETA	09 MAR 82	1.30	PCL	3.84
GROSS BETA	08 JUN 82	1.30	PCL	3.46

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 19 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DYE BURIAL SITE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER REGULATION STANDARD
# VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
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TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: MCCOMISH GORGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	8 4-1	4-2	4-4	4-3	4-5	4-6
WATER LEVELS (A)	04 OCT 82		FT	575.0	567.2	D	561.7	563.9	565.0
ARSENIC	05 OCT 82	.010	MGL	ND	ND		ND	ND	ND
BARIUM	05 OCT 82	.1	MGL	ND	ND		ND	.2	ND
CADMIUM	05 OCT 82	.005	MGL	ND	ND		ND	ND	ND
CHROMIUM	05 OCT 82	.010	MGL	ND	ND		ND	.100*	ND
FLUORIDE	05 OCT 82	.10	MGL	.15	.11		.11	.10	.11
LEAD	05 OCT 82	.010	MGL	ND	ND		ND	ND	ND
MERCURY	05 OCT 82	.2	UGL	77.0*	.8		.9	.5	1.8
NO2+NO3 AS N	05 OCT 82	.05	MGL	.16	.11		.08	.12	.11
SELENIUM	05 OCT 82	.005	MGL	ND	ND		ND	ND	ND
SILVER	05 OCT 82	.01	MGL	ND	ND		ND	ND	ND
ENDRIN	05 OCT 82	.04	UGL	ND	ND		ND	ND	ND
LINDANE	05 OCT 82	.08	UGL	ND	ND		ND	ND	ND
TOXAPHENE	05 OCT 82	1.6	UGL	ND	ND		ND	ND	ND
METHOXYCHLOR	05 OCT 82	1.6	UGL	ND	ND		ND	ND	ND
2,4-D	05 OCT 82	3.8	UGL	ND	ND		ND	ND	ND
SILVEX	05 OCT 82	.5	UGL	ND	ND		ND	ND	ND
GROSS ALPHA	05 OCT 82	3.25	PCL	ND	ND		2.98	ND	ND
GROSS BETA	05 OCT 82	1.30	PCL	1.67	2.06		1.63	2.96	ND
CHLORIDE	05 OCT 82	1.0	MGL	ND	ND		ND	5.0	1.0
IRON	05 OCT 82	.03	MGL	1.83#	ND		2.83#	32.20#	ND
MANGANESE	05 OCT 82	.01	MGL	.39#	.01		1.09#	6.70#	.08#
PHENOL	05 OCT 82	.01	MGL	.01	.01		ND	ND	ND
SODIUM	05 OCT 82	1.	MGL	11.	4.		11.	15.	6.
SULFATE	05 OCT 82	5.0	MGL	ND	18.0		ND	9.0	30.0
PH(FIELD)	05 OCT 82		PH	7.0	6.9		6.6	6.1#	6.8
PH(FIELD)	05 OCT 82		PH	7.1	6.9		6.7	6.1#	6.8
PH(FIELD)	05 OCT 82		PH	7.0	7.0		6.8	6.2#	6.8
PH(FIELD)	05 OCT 82		PH	7.0	7.0		6.8	6.1#	6.8
SPEC COND	05 OCT 82	1.	UMC	396.	475.		440.	670.	540.
SPEC COND	05 OCT 82	1.	UMC	400.	475.		440.	670.	540.
SPEC COND	05 OCT 82	1.	UMC	400.	475.		440.	670.	540.
SPEC COND	05 OCT 82	1.	UMC	400.	475.		440.	670.	540.
TOC	05 OCT 82	1.0	MGL	27.0	29.0		18.0	75.0	24.0
TOC	05 OCT 82	1.0	MGL	27.0	30.0		17.0	72.0	23.0
TOC	05 OCT 82	1.0	MGL	26.0	28.0		16.0	73.0	23.0
TOC	05 OCT 82	1.0	MGL	27.0	29.0		16.0	72.0	23.0
TOX	05 OCT 82	.010	MGL	.021 C	ND		ND	.036 C	.069 C
TOX	05 OCT 82	.010	MGL	.030 C	ND		ND	.066 C	.034 C
TOX	05 OCT 82	.010	MGL	.033 C	ND		ND	.057 C	.048 C
TOX	05 OCT 82	.010	MGL	.028 C	ND		ND	.069 C	.045 C

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: MCCOMISH GORGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 4-1	4-2	4-4	4-3	4-5	4-6
GROSS ALPHA	07 DEC 81	2.71	PCL	ND	ND	ND	ND	ND	ND
GROSS ALPHA	23 MAR 82	4.92	PCL	ND	ND	ND	ND	ND	ND
GROSS ALPHA	22 JUN 82	5.08	PCL	<1.30	<4.07	<4.34	<4.01	<5.08	<3.63
GROSS ALPHA	05 OCT 82	3.25	PCL	ND	ND		2.98	ND	ND
GROSS BETA	07 DEC 81	1.30	PCL	1.65	2.42	3.55	2.25	2.19	1.17
GROSS BETA	23 MAR 82	1.56	PCL	1.55	1.27	1.95	1.71	ND	1.15
GROSS BETA	22 JUN 82	1.64	PCL	ND	ND	1.51	2.48	ND	ND
GROSS BETA	05 OCT 82	1.30	PCL	1.67	2.06		1.63	2.96	ND

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN FACILITY: MCCOMISH GORGE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER REGULATION STANDARD
# VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA
D - WELL WAS DRY

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
WATER LEVELS (A)	31 OCT 82						648.8	611.5	611.4	593.9
ARSENIC	01 NOV 82	.010	MGL				ND	ND	ND	ND
BARIUM	01 NOV 82	.1	MGL				ND	ND	ND	ND
CADMIUM	01 NOV 82	.005	MGL				ND	ND	ND	ND
CHROMIUM	01 NOV 82	.010	MGL				.020	.010	.040	ND
FLUORIDE	01 NOV 82	.10	MGL				.48	.91	.28	.22
LEAD	01 NOV 82	.010	MGL				ND	ND	ND	ND
MERCURY	01 NOV 82	.2	UGL				ND	.6	.2	.9
NO2+NO3 AS N	01 NOV 82	.05	MGL				.23	1.00	1.00	.22
SELENIUM	01 NOV 82	.005	MGL				ND	ND	ND	ND
SILVER	01 NOV 82	.01	MGL				ND	.01	ND	.01
ENDRIN	01 NOV 82	.04	UGL				ND	ND	ND	ND
LINDANE	01 NOV 82	.08	UGL				ND	ND	ND	ND
TOXAPHENE	01 NOV 82	1.6	UGL				ND	ND	ND	ND
METHOXYCHLOR	01 NOV 82	1.6	UGL				ND	ND	ND	ND
2,4-D	01 NOV 82	3.8	UGL				ND	ND	ND	ND
SILVEX	01 NOV 82	.5	UGL				ND	ND	ND	ND
CHLORIDE	01 NOV 82	1.0	MGL				1.1	28.0	5.5	5.5
IRON	01 NOV 82	.03	MGL				.25	.48#	.27	.29
MANGANESE	01 NOV 82	.01	MGL				1.61#	1.94#	ND	2.03#
PHENOL	01 NOV 82	.01	MGL				ND	ND	ND	ND
SODIUM	01 NOV 82	1.	MGL				36.	108.	66.	17.
SULFATE	01 NOV 82	5.0	MGL				730.0#	1200.0#	430.0#	98.0
PH(FIELD)	01 NOV 82		PH				6.6	6.6	6.7	6.6
PH(FIELD)	01 NOV 82		PH				6.8	6.6	6.8	6.6
PH(FIELD)	01 NOV 82		PH				6.6	6.6	6.8	6.6
PH(FIELD)	01 NOV 82		PH				6.6	6.6	6.8	6.7
SPEC COND	01 NOV 82	1.	UMC				1480.	2050.	1180.	600.
SPEC COND	01 NOV 82	1.	UMC				1480.	2050.	1170.	600.
SPEC COND	01 NOV 82	1.	UMC				1480.	2050.	1180.	600.
SPEC COND	01 NOV 82	1.	UMC				1480.	2050.	1170.	600.
TOC	01 NOV 82	1.0	MGL				45.0	40.0	51.0	31.0
TOC	01 NOV 82	1.0	MGL				45.0	40.0	51.0	33.0
TOC	01 NOV 82	1.0	MGL				46.0	40.0	50.0	31.0
TOC	01 NOV 82	1.0	MGL				45.0	40.0	51.0	32.0
TOX	01 NOV 82	.010	MGL				.077 C	.020 C	ND	.048 C
TOX	01 NOV 82	.010	MGL				.070 C	ND	ND	.048 C
TOX	01 NOV 82	.010	MGL				.079 C	.018 C	ND	.056 C
TOX	01 NOV 82	.010	MGL				.070 C	ND	ND	.079 C

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
WATER										
LEVELS (A)	31 OCT 82			609.0	640.1	646.4	644.9	630.7	629.6	630.3
ARSENIC	01 NOV 82	.010	MGL	ND	.013	ND	.050	ND	ND	ND
BARIUM	01 NOV 82	.1	MGL	ND	ND	ND	ND	ND	.1	.1
CADMIUM	01 NOV 82	.005	MGL	ND	ND	ND	.023*	ND	.005	ND
CHROMIUM	01 NOV 82	.010	MGL	ND	.010	ND	.070*	ND	.040	ND
FLUORIDE	01 NOV 82	.10	MGL	.32	.84	.17	2.00*	.44	.89	.29
LEAD	01 NOV 82	.010	MGL	ND	ND	ND	.010	ND	.016	.010
MERCURY	01 NOV 82	.2	UGL	ND	.3	ND	.4	ND	ND	ND
NO2+NO3 AS N	01 NOV 82	.05	MGL	.52	.63	.32	.17	.84	.15	.52
SELENIUM	01 NOV 82	.005	MGL	ND	ND	ND	ND	ND	ND	ND
SILVER	01 NOV 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
ENDRIN	01 NOV 82	.04	UGL	ND	ND	ND	ND	ND	ND	ND
LINDANE	01 NOV 82	.08	UGL	ND	ND	ND	ND	ND	ND	ND
TOXAPHENE	01 NOV 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
METHOXYCHLOR	01 NOV 82	1.6	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-D	01 NOV 82	3.8	UGL	ND	ND	ND	ND	ND	ND	ND
SILVEX	01 NOV 82	.5	UGL	ND	ND	ND	ND	ND	ND	ND
CHLORIDE	01 NOV 82	1.0	MGL	4.0	3.0	2.0	25.0	ND	34.0	14.0
IRON	01 NOV 82	.03	MGL	.18	34.70#	24.70#	8.50#	.21	3.46#	.27
MANGANESE	01 NOV 82	.01	MGL	7.50#	8.70#	12.20#	32.00#	1.01#	67.00#	47.00#
PHENOL	01 NOV 82	.01	MGL	ND	ND	ND	ND	ND	ND	ND
SODIUM	01 NOV 82	1.	MGL	31.	50.	44.	194.	42.	192.	94.
SULFATE	01 NOV 82	5.0	MGL	310.0#	610.0#	750.0#	3100.0#	186.0	3300.0#	2720.0#
PH(FIELD)	01 NOV 82		PH	6.4#	5.7#	6.3#	3.9#	6.2#	6.2#	6.5
PH(FIELD)	01 NOV 82		PH	6.5	5.8#	6.3#	4.0#	6.2#	6.2#	6.5
PH(FIELD)	01 NOV 82		PH	6.3#	5.7#	6.3#	3.9#	6.2#	6.3#	6.5
PH(FIELD)	01 NOV 82		PH	6.3#	5.7#	6.3#	4.1#	6.3#	6.1#	6.5
SPEC COND	01 NOV 82	1.	UMC	750.	1280.	1680.	3550.	790.	4000.	3600.
SPEC COND	01 NOV 82	1.	UMC	750.	1280.	1680.	3550.	790.	4000.	3600.
SPEC COND	01 NOV 82	1.	UMC	750.	1280.	1680.	3550.	790.	4000.	3600.
SPEC COND	01 NOV 82	1.	UMC	750.	1280.	1680.	3550.	790.	4000.	3600.
TOC	01 NOV 82	1.0	MGL	26.0	24.0	47.0	36.0	23.0	8.0	52.0
TOC	01 NOV 82	1.0	MGL	27.0	25.0	46.0	37.0	22.0	7.0	53.0
TOC	01 NOV 82	1.0	MGL	27.0	25.0	46.0	36.0	22.0	8.0	53.0
TOC	01 NOV 82	1.0	MGL	26.0	25.0	46.0	35.0	22.0	7.0	52.0
TOX	01 NOV 82	.010	MGL	.039 C	ND	ND	.020 C	.025 C	.023 C	ND
TOX	01 NOV 82	.010	MGL	.011 C	ND	ND	.022 C	.027 C	ND	ND
TOX	01 NOV 82	.010	MGL	.029 C	ND	ND	ND	.029 C	.030 C	ND
TOX	01 NOV 82	.010	MGL	.045 C	ND	ND	.019 C	.015 C	.030 C	ND

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-13
WATER LEVELS (A)	31 OCT 82			619.4
ARSENIC	01 NOV 82	.010	MGL	ND
BARIUM	01 NOV 82	.1	MGL	.1
CADMIUM	01 NOV 82	.005	MGL	ND
CHROMIUM	01 NOV 82	.010	MGL	ND
FLUORIDE	01 NOV 82	.10	MGL	.14
LEAD	01 NOV 82	.010	MGL	ND
MERCURY	01 NOV 82	.2	UGL	.3
NO2+NO3 AS N	01 NOV 82	.05	MGL	.31
SELENIUM	01 NOV 82	.005	MGL	ND
SILVER	01 NOV 82	.01	MGL	ND
ENDRIN	01 NOV 82	.04	UGL	ND
LINDANE	01 NOV 82	.08	UGL	ND
TOXAPHENE	01 NOV 82	1.6	UGL	ND
METHOXYCHLOR	01 NOV 82	1.6	UGL	ND
2,4-D	01 NOV 82	3.8	UGL	ND
SILVEX	01 NOV 82	.5	UGL	ND
CHLORIDE	01 NOV 82	1.0	MGL	3.0
IRON	01 NOV 82	.03	MGL	.15
MANGANESE	01 NOV 82	.01	MGL	9.00#
PHENOL	01 NOV 82	.01	MGL	ND
SODIUM	01 NOV 82	1.	MGL	398.
SULFATE	01 NOV 82	5.0	MGL	2480.0#
SPEC COND	01 NOV 82	1.	UMC	3600.
SPEC COND	01 NOV 82	1.	UMC	3600.
SPEC COND	01 NOV 82	1.	UMC	3600.
SPEC COND	01 NOV 82	1.	UMC	3600.
TOC	01 NOV 82	1.0	MGL	10.0
TOC	01 NOV 82	1.0	MGL	10.0
TOC	01 NOV 82	1.0	MGL	11.0
TOC	01 NOV 82	1.0	MGL	9.0
TOX	01 NOV 82	.010	MGL	ND
TOX	01 NOV 82	.010	MGL	ND
TOX	01 NOV 82	.010	MGL	ND
TOX	01 NOV 82	.010	MGL	ND

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: RIFLE RANGE

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-16	6-14	6-15	6-17	6-18	6-19	6-20
WATER LEVELS (A)	19 SEP 82		FT	501.9	504.1	D	502.2	498.7	499.4	499.4
ARSENIC	20 SEP 82	.010	MGL	ND			ND	ND	ND	ND
BARIUM	20 SEP 82	.1	MGL	ND			ND	ND	.4	.2
CADMIUM	20 SEP 82	.005	MGL	ND			ND	ND	ND	ND
CHROMIUM	20 SEP 82	.010	MGL	ND			ND	ND	ND	ND
FLUORIDE	20 SEP 82	.10	MGL	ND	.10		ND	ND	.14	ND
LEAD	20 SEP 82	.010	MGL	ND			ND	ND	ND	ND
MERCURY	20 SEP 82	.2	UGL	ND			ND	ND	ND	ND
NO2+NO3 AS N	20 SEP 82	.05	MGL	.29	.41		1.00	11.90*	.22	7.00
SELENIUM	20 SEP 82	.005	MGL	ND			ND	ND	ND	ND
SILVER	20 SEP 82	.01	MGL	ND			ND	ND	ND	ND
ENDRIN	20 SEP 82	.04	UGL	ND	ND		ND	ND	ND	ND
LINDANE	20 SEP 82	.08	UGL	ND	ND		ND	ND	ND	ND
TOXAPHENE	20 SEP 82	1.6	UGL	ND	ND		ND	ND	ND	ND
METHOXYCHLOR	20 SEP 82	1.6	UGL	ND	ND		ND	ND	ND	ND
2,4-D	20 SEP 82	3.8	UGL	ND	ND		ND	ND	ND	ND
SILVEX	20 SEP 82	.5	UGL	ND	ND		ND	ND	ND	ND
GROSS ALPHA	20 SEP 82	3.57	PCL	ND			ND	2.26	ND	ND
GROSS BETA	20 SEP 82	1.67	PCL	ND			2.53	ND	2.48	ND
CHLORIDE	20 SEP 82	1.0	MGL	4.0	7.0		2.0	3.6	3.0	3.0
IRON	20 SEP 82	.03	MGL	ND			ND	.07	.16	.30
MANGANESE	20 SEP 82	.01	MGL	ND			.02	.02	2.90#	ND
PHENOL	20 SEP 82	.01	MGL	ND			ND	ND	ND	ND
SODIUM	20 SEP 82	1.	MGL	9.			3.	15.	32.	15.
SULFATE	20 SEP 82	5.0	MGL	22.0	64.0		32.0	10.9	44.0	16.0
PH(FIELD)	20 SEP 82		PH	6.9			6.4#	6.7	6.5	6.9
PH(FIELD)	20 SEP 82		PH	6.9			6.5	6.7	6.6	6.9
PH(FIELD)	20 SEP 82		PH	6.9			6.5	6.8	6.8	6.9
PH(FIELD)	20 SEP 82		PH	6.8			6.7	6.8	6.6	6.9
SPEC COND	20 SEP 82	1.	UMC	380.	535.		460.	460.	630.	350.
SPEC COND	20 SEP 82	1.	UMC	380.	530.		460.	450.	630.	350.
SPEC COND	20 SEP 82	1.	UMC	380.	535.		460.	450.	630.	350.
SPEC COND	20 SEP 82	1.	UMC	380.	530.		460.	460.	630.	350.
TOC	20 SEP 82	1.0	MGL	14.0			11.0	ND	29.0	8.0
TOC	20 SEP 82	1.0	MGL	13.0			11.0	ND	29.0	8.0
TOC	20 SEP 82	1.0	MGL	13.0			11.0	2.0	30.0	8.0
TOC	20 SEP 82	1.0	MGL	13.0			11.0	2.0	31.0	8.0
TOX	20 SEP 82	.010	MGL	ND	.021 C		ND	ND	.029 C	.051 C
TOX	20 SEP 82	.010	MGL	ND	.054 C		ND	.038 C	.021 C	.076 C
TOX	20 SEP 82	.010	MGL	.021 C	.050 C		ND	.013 C	ND	.061 C
TOX	20 SEP 82	.010	MGL	.050 C	.051 C		ND	ND	.010 C	.058 C

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
GROSS ALPHA	16 NOV 81	3.66	PCL				ND	ND	ND	ND
GROSS ALPHA	22 FEB 82	9.23	PCL				<6.47	<9.23	<5.90	<3.90
GROSS ALPHA	12 JUL 82	7.57	PCL			<2.49	<7.57	<6.02	<6.02	<3.18
RADIUM-226	22 FEB 82	1.30	PCL						ND	
RADIUM-226	12 JUL 82	.24	PCL				ND	.58	.43	
GROSS BETA	16 NOV 81	1.30	PCL				5.70	3.50	2.85	3.27
GROSS BETA	22 FEB 82	1.76	PCL				ND	3.41	ND	2.89
GROSS BETA	12 JUL 82	1.81	PCL			2.39	ND	2.33	2.29	2.69

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-8	6-12
GROSS ALPHA	16 NOV 81	4.88	PCL	3.82	ND	ND	8.32	ND	ND	ND
GROSS ALPHA	04 JAN 82	14.70	PCL				ND			
GROSS ALPHA	22 FEB 82	7.47	PCL	<3.48	<6.16	<7.47				
GROSS ALPHA	01 MAR 82	17.60	PCL				<17.60	<3.43	<15.20	<16.20
GROSS ALPHA	12 JUL 82	15.40	PCL	4.56	3.40	<5.92	<14.70	<15.40	<3.20	<14.80
RADIUM-226	04 JAN 82	.05	PCL				2.67			
RADIUM-226	22 FEB 82	1.30	PCL		ND					
RADIUM-226	01 MAR 82	.05	PCL				.78		.37	
RADIUM-226	12 JUL 82	.05	PCL			.45	.39	.26		.32
GROSS BETA	16 NOV 81	1.30	PCL	1.55	3.37	6.37	4.01	2.82	8.30	10.40
GROSS BETA	04 JAN 82	1.30	PCL				3.68			
GROSS BETA	22 FEB 82	1.30	PCL	ND	2.13	3.56				
GROSS BETA	01 MAR 82	1.30	PCL				5.32	2.40	9.68	9.69
GROSS BETA	12 JUL 82	2.24	PCL	3.50	3.07	4.10	3.70	ND	5.10	8.58
STRONTIUM-90	01 MAR 82	1.3	PCL						ND	
STRONTIUM-90	23 MAR 82	1.0	PCL							ND
URANIUM	01 MAR 82	0.	PCL				1.			1.

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: DEMOLITION GROUNDS

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-13
GROSS ALPHA	16 NOV 81	5.39	PCL	ND
GROSS ALPHA	04 JAN 82	17.00	PCL	ND
GROSS ALPHA	01 MAR 82	17.90	PCL	ND
GROSS ALPHA	12 JUL 82	1.30	PCL	22.60*
GROSS BETA	16 NOV 81	1.30	PCL	11.20
GROSS BETA	04 JAN 82	1.30	PCL	11.20
GROSS BETA	01 MAR 82	1.30	PCL	13.30
GROSS BETA	12 JUL 82	1.30	PCL	9.62
STRONTIUM-90	04 JAN 82	1.0	PCL	ND
URANIUM	04 JAN 82	0.	PCL	1.

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: RIFLE RANGE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
* VALUE EXCEEDS A NATIONAL INTERIM PRIMARY DRINKING WATER REGULATION STANDARD
# VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA
D - WELL WAS DRY

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN

FACILITY: RIFLE RANGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-16	6-14	6-15	6-17	6-18	6-19	6-20
GROSS ALPHA	16 NOV 81	1.30	PCL	ND	ND		ND			
GROSS ALPHA	04 JAN 82	3.67	PCL					ND	ND	ND
GROSS ALPHA	01 MAR 82	3.63	PCL	ND	ND		ND	ND	ND	ND
GROSS ALPHA	28 JUN 82	3.30	PCL	ND	6.30		3.18	ND	5.14	ND
GROSS ALPHA	20 SEP 82	3.57	PCL	ND			ND	2.26	ND	ND
RADIUM-226	28 JUN 82	.26	PCL		ND					
GROSS BETA	16 NOV 81	1.30	PCL	1.23	1.56		2.20			
GROSS BETA	04 JAN 82	1.61	PCL					1.33	3.96	ND
GROSS BETA	01 MAR 82	1.64	PCL	1.37	2.08		2.25	ND	2.28	ND
GROSS BETA	28 JUN 82	1.66	PCL	ND	2.49		2.43	ND	3.11	ND
GROSS BETA	20 SEP 82	1.67	PCL	ND			2.53	ND	2.48	ND

RUN DATE: 14 JAN 83

INSTALLATION: CRANE NWSC, IN FACILITY: RIFLE RANGE

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMETAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

APPENDIX A7

Dye and Heavy Metal Analytical Results for Soil Samples From Wells at the Dye Burial Grounds

TEST DATA

Sample ID	Metals							
	Ag	Cr	As	Cd	Pb	Se	Ba	Hg
1-1A	.0016	.0163	.054	<.005	.0176	.0206	<.10	4.62×10^{-5}
1-2A	<.001	.0392	.048	<.005	<.001	.0074	<.10	1.62×10^{-5}
2-1A	<.001	.0230	.069	<.005	<.001	.0072	<.10	2.14×10^{-5}
2-2A	<.001	.0131	.055	<.005	<.001	.0122	<.10	1.11×10^{-5}
3-1A	<.001	.0234	<.010	<.005	<.001	.0105	<.10	4.25×10^{-5}
3-2A	<.001	.0355	<.010	<.005	<.001	<.002	<.10	7.97×10^{-5}
4-1A	<.001	.0326	.029	<.005	<.001	.080	<.10	3.65×10^{-5}
4-2A	<.001	.0318	<.010	<.005	<.001	<.002	<.10	1.56×10^{-5}
5-1A	<.001	.0274	.032	<.005	<.001	.0187	<.10	1.67×10^{-5}
5-2A	<.001	.0340	.018	<.005	.0158	<.002	<.10	1.29×10^{-5}
2-6-1B	<.001	.0270	<.010	<.005	.004	<.002	<.10	19.5×10^{-5}
2-6-2B	<.001	.0200	<.010	<.005	.008	<.002	<.10	14.0×10^{-5}
2-7-18	<.001	.0130	<.010	<.005	.003	<.002	<.10	36.7×10^{-5}
2-8-1B	<.001	.0210	<.010	<.005	.016	<.002	<.10	43.1×10^{-5}
2-8-2B	<.001	.0320	<.010	<.005	.005	<.002	<.10	24.9×10^{-5}
2-YD-1A	.001	1.08	<.010	<.005	5.49	.010	<.10	28.1×10^{-5}

1. Test data based on 1 gram soil sample digested and diluted to 100 ml for analysis.

2. All values are reported as percent metal content in the soil submitted for analysis.

Enclosure (1)

APPENDIX A8a

Results of Second-Year Analysis of Groundwater Samples for Group II and III Parameters and Explosives at the RS

2nd Year - First Semi-annual

RUN DATE: 01 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 4-1	4-2	4-4	4-3	4-5	4-6
WATER LEVELS (A)	25 FEB 83		FT		568.8	568.2	563.5	566.3	566.1
CHLORIDE	01 MAR 83	1.0	MGL		ND	ND	5.0	4.0	3.0
IRON	01 MAR 83	.03	MGL		ND	ND	18.00#	16.70#	ND
MANGANESE	01 MAR 83	.01	MGL		.01	.65#	2.60#	5.70#	ND
PHENOL	01 MAR 83	.01	MGL		ND	ND	ND	ND	ND
SODIUM	01 MAR 83	1.	MGL		3.	10.	22.	14.	7.
SULFATE	01 MAR 83	5.0	MGL		11.0	ND	19.0	15.0	36.0
PH(FIELD)	01 MAR 83		PH		7.0		6.2#	6.2#	7.1
PH(FIELD)	01 MAR 83		PH		7.0		6.2#	6.2#	7.1
PH(FIELD)	01 MAR 83		PH		6.9		6.2#	6.2#	7.1
PH(FIELD)	01 MAR 83		PH		7.0		6.2#	6.2#	7.1
SPEC COND	01 MAR 83	1.	UMC		455.	625.	375.	430.	445.
SPEC COND	01 MAR 83	1.	UMC		455.	620.	375.	428.	446.
SPEC COND	01 MAR 83	1.	UMC		460.	620.	375.	430.	445.
SPEC COND	01 MAR 83	1.	UMC		460.	623.	373.	428.	445.
TOC	01 MAR 83	1.0	MGL		31.0	44.0	40.0	50.0	23.0
TOC	01 MAR 83	1.0	MGL		30.0	44.0	41.0	50.0	22.0
TOC	01 MAR 83	1.0	MGL		30.0	45.0	41.0	50.0	22.0
TOC	01 MAR 83	1.0	MGL		31.0	44.0	42.0	50.0	22.0
TOX	01 MAR 83	.010	MGL		ND	ND	ND	.010 C	ND
TOX	01 MAR 83	.010	MGL		ND	.014 C	ND	.011 C	ND
TOX	01 MAR 83	.010	MGL		ND	.017 C	ND	.015 C	ND
TOX	01 MAR 83	.010	MGL		ND	.011 C	ND	ND	ND

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-16	6-14	6-15	6-17	6-18	6-19	6-20
WATER										
LEVELS (A)	01 MAR 83		FT	503.7			502.3	499.6	500.5	500.6
CHLORIDE	01 MAR 83	1.0	MGL	4.0			2.0	4.0	2.0	3.0
IRON	01 MAR 83	.03	MGL	ND			ND	ND	ND	ND
MANGANESE	01 MAR 83	.01	MGL	.03			ND	.01	.29#	.01
PHENOL	01 MAR 83	.01	MGL	ND			ND	ND	ND	ND
SODIUM	01 MAR 83	1.	MGL	10.			3.	19.	14.	13.
SULFATE	01 MAR 83	5.0	MGL	ND			29.0	ND	44.0	ND
PH(FIELD)	01 MAR 83		PH	6.7			6.0#	6.7	6.9	6.9
PH(FIELD)	01 MAR 83		PH	6.8			6.0#	6.8	6.8	6.9
PH(FIELD)	01 MAR 83		PH	6.8			6.0#	6.8	6.8	6.9
PH(FIELD)	01 MAR 83		PH	6.8			6.0#	6.8	6.8	6.7
SPEC COND	01 MAR 83	1.	UMC	380.			266.	410.	600.	281.
SPEC COND	01 MAR 83	1.	UMC	380.			265.	410.	595.	281.
SPEC COND	01 MAR 83	1.	UMC	380.			267.	415.	600.	280.
SPEC COND	01 MAR 83	1.	UMC	378.			267.	415.	600.	280.
TOC	01 MAR 83	1.0	MGL	19.0			15.0	18.0	5.0	9.0
TOC	01 MAR 83	1.0	MGL	19.0			14.0	17.0	5.0	9.0
TOC	01 MAR 83	1.0	MGL	20.0			14.0	17.0	5.0	9.0
TOC	01 MAR 83	1.0	MGL	19.0			14.0	17.0	5.0	9.0
TOX	01 MAR 83	.010	MGL	.049	C		.026 C	.058 C	.034 C	.058 C
TOX	01 MAR 83	.010	MGL	.038	C		.020 C	.051 C	.040 C	.067 C
TOX	01 MAR 83	.010	MGL	.017	C		.019 C	.050 C	.035 C	.052 C
TOX	01 MAR 83	.010	MGL	.040	C		.024 C	.017 C	.040 C	.020 C
2,4,6-TNT	01 MAR 83	100.	UGL	ND			ND	ND	ND	ND
2,4-DNT	01 MAR 83	100.	UGL	ND			ND	ND	ND	ND
2,6-DNT	01 MAR 83	100.	UGL	ND			ND	ND	ND	ND
RDX	01 MAR 83	100.	UGL	ND			ND	ND	ND	ND
HMX	01 MAR 83	100.	UGL	ND			ND	ND	ND	ND
TETRYL	01 MAR 83	100.	UGL	ND			ND	ND	ND	ND

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
WATER LEVELS (A)	23 FEB 83		FT	721.9	685.2	685.1	684.1	684.4	682.8	678.3
CHLORIDE	23 FEB 83	1.0	MGL	216.0	67.0	200.0	58.0	59.0	22.0	11.0
CHLORIDE	28 FEB 83	1.0	MGL							
IRON	23 FEB 83	.03	MGL	ND	.49#	.07	.05	.08	.08	ND
IRON	28 FEB 83	.03	MGL							
MANGANESE	23 FEB 83	.01	MGL	.06#	14.10#	1.61#	6.00#	3.90#	5.70#	.28#
MANGANESE	28 FEB 83	.01	MGL							
PHENOL	23 FEB 83	.01	MGL	ND	ND	ND	ND	ND	.01	.01
PHENOL	28 FEB 83	.01	MGL							
SODIUM	23 FEB 83	1.	MGL	238.	61.	96.	40.	49.	29.	18.
SODIUM	28 FEB 83	1.	MGL							
SULFATE	23 FEB 83	5.0	MGL	810.0#	1440.0#	2810.0#	1110.0#	1360.0#	940.0#	750.0#
SULFATE	28 FEB 83	5.0	MGL							
PH(FIELD)	23 FEB 83		PH	6.8	6.4#	6.3#	6.4#	6.2#		
PH(FIELD)	23 FEB 83		PH	6.8	6.4#	6.4#	6.4#	6.2#		
PH(FIELD)	23 FEB 83		PH	6.8	6.4#	6.4#	6.4#	6.2#		
PH(FIELD)	23 FEB 83		PH	6.8	6.4#	6.4#	6.4#	6.2#		
PH(FIELD)	28 FEB 83		PH						6.2#	6.9
PH(FIELD)	28 FEB 83		PH						6.2#	6.9
PH(FIELD)	28 FEB 83		PH						6.2#	6.9
PH(FIELD)	28 FEB 83		PH						6.2#	7.0
SPEC COND	23 FEB 83	1.	UMC	2500.	2900.	4650.	2500.	2400.		
SPEC COND	23 FEB 83	1.	UMC	2480.	2950.	4680.	2500.	2380.		
SPEC COND	23 FEB 83	1.	UMC	2500.	2900.	4650.	2500.	2400.		
SPEC COND	23 FEB 83	1.	UMC	2520.	2900.	4680.	2500.	2400.		
SPEC COND	28 FEB 83	1.	UMC						1790.	1110.
SPEC COND	28 FEB 83	1.	UMC						1780.	1100.
SPEC COND	28 FEB 83	1.	UMC						1780.	1100.
SPEC COND	28 FEB 83	1.	UMC						1800.	1120.
TOC	23 FEB 83	1.0	MGL	34.0	98.0	95.0	60.0	40.0		
TOC	23 FEB 83	1.0	MGL	34.0	98.0	94.0	62.0	41.0		
TOC	23 FEB 83	1.0	MGL	34.0	99.0	97.0	62.0	41.0		
TOC	23 FEB 83	1.0	MGL	34.0	100.0	97.0	61.0	42.0		
TOC	28 FEB 83	1.0	MGL						74.0	66.0
TOC	28 FEB 83	1.0	MGL						75.0	65.0
TOC	28 FEB 83	1.0	MGL						74.0	65.0
TOC	28 FEB 83	1.0	MGL						74.0	65.0
TOX	23 FEB 83	.010	MGL	.060 C	.110 C	.076 C	.032 C	.021 C		
TOX	23 FEB 83	.010	MGL	.064 C	.110 C	.070 C	.019 C	.024 C		
TOX	23 FEB 83	.010	MGL	.062 C	.110 C	.074 C	.042 C	.026 C		

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
TOX	23 FEB 83	.010	MGL	.074 C	.110 C	.074 C	.037 C	.019 C		
TOX	28 FEB 83	.010	MGL						.012 C	ND
TOX	28 FEB 83	.010	MGL						.019 C	.012 C
TOX	28 FEB 83	.010	MGL						.035 C	ND
TOX	28 FEB 83	.010	MGL						.011 C	ND

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 2-4	
WATER LEVELS (A)	23 FEB 83		FT	681.7	
CHLORIDE	23 FEB 83	1.0	MGL	74.0	
IRON	23 FEB 83	.03	MGL	.17	
MANGANESE	23 FEB 83	.01	MGL	6.40#	
PHENOL	23 FEB 83	.01	MGL	ND	
SODIUM	23 FEB 83	1.	MGL	46.	
SULFATE	23 FEB 83	5.0	MGL	1300.0#	
PH(FIELD)	23 FEB 83		PH	6.4#	
PH(FIELD)	23 FEB 83		PH	6.4#	
PH(FIELD)	23 FEB 83		PH	6.4#	
PH(FIELD)	23 FEB 83		PH	6.4#	
SPEC COND	23 FEB 83	1.	UMC	2320.	
SPEC COND	23 FEB 83	1.	UMC	2320.	
SPEC COND	23 FEB 83	1.	UMC	2300.	
SPEC COND	23 FEB 83	1.	UMC	2300.	
TOC	23 FEB 83	1.0	MGL	42.0	
TOC	23 FEB 83	1.0	MGL	42.0	
TOC	23 FEB 83	1.0	MGL	42.0	
TOC	23 FEB 83	1.0	MGL	42.0	
TOX	23 FEB 83	.010	MGL	.017	C
TOX	23 FEB 83	.010	MGL	.024	C
TOX	23 FEB 83	.010	MGL	.016	C
TOX	23 FEB 83	.010	MGL	.018	C

RUN DATE: 21 JUN 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE
VALUE EXCEEDS A NATIONAL SECONDARY DRINKING WATER REGULATION CRITERIA

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

2nd Year - Second Semi-annual

HSHB-ES-G/WP
SUBJECT: Ground-water Monitoring Results for Naval Weapons Support Center (NWSC), Crane, IN

Incl 2

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-1	2-5	2-6	2-7	2-8	2-2	2-3
WATER LEVELS (A)	27 JUL 83		FT	722.6	685.3	684.9	684.0	685.2	680.5	678.4
PH(FIELD)	27 JUL 83		PH	6.6	6.5	6.5	6.6	6.5	6.6	
PH(FIELD)	27 JUL 83		PH	6.8	6.5	6.5	6.5	6.4	6.6	
PH(FIELD)	27 JUL 83		PH	6.7	6.5	6.4	6.5	6.4	6.5	
PH(FIELD)	27 JUL 83		PH	6.8	6.5	6.5	6.6	6.4	6.5	
PH(FIELD)	30 JUL 83		PH							6.3
PH(FIELD)	30 JUL 83		PH							6.3
PH(FIELD)	30 JUL 83		PH							6.3
PH(FIELD)	30 JUL 83		PH							6.3
SPEC COND	27 JUL 83	1.	UMC	2400.	3100.	4500.	3000.	2600.	2200.	
SPEC COND	27 JUL 83	1.	UMC	2400.	3100.	4600.	3050.	2600.	2200.	
SPEC COND	27 JUL 83	1.	UMC	2400.	3100.	4600.	3050.	2600.	2200.	
SPEC COND	27 JUL 83	1.	UMC	2400.	3050.	4600.	3000.	2650.	2200.	
SPEC COND	30 JUL 83	1.	UMC							1200.
SPEC COND	30 JUL 83	1.	UMC							1210.
SPEC COND	30 JUL 83	1.	UMC							1200.
SPEC COND	30 JUL 83	1.	UMC							1200.
TOC	27 JUL 83	1.0	MGL	57.0	86.0	65.0	71.0	99.0	57.0	
TOC	27 JUL 83	1.0	MGL	59.0	86.0	64.0	70.0	98.0	57.0	
TOC	27 JUL 83	1.0	MGL	59.0	88.0	64.0	71.0	99.0	58.0	
TOC	27 JUL 83	1.0	MGL	57.0	89.0	66.0	71.0	98.0	58.0	
TOC	30 JUL 83	1.0	MGL							49.0
TOC	30 JUL 83	1.0	MGL							48.0
TOC	30 JUL 83	1.0	MGL							49.0
TOC	30 JUL 83	1.0	MGL							50.0
TOX	27 JUL 83	.010	MGL	.069 C	ND	.060 C	ND	ND	.033 C	
TOX	27 JUL 83	.010	MGL	.092 C	ND	.047 C	ND	ND	.036 C	
TOX	27 JUL 83	.010	MGL	.070 C	ND	.030 C	ND	ND	.020 C	
TOX	27 JUL 83	.010	MGL	.056 C	ND	.046 C	ND	ND	.047 C	
TOX	30 JUL 83	.010	MGL							.027
TOX	30 JUL 83	.010	MGL							.027
TOX	30 JUL 83	.010	MGL							.027
TOX	30 JUL 83	.010	MGL							.022

2-2

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 2-4	
WATER LEVELS (A)	27 JUL 83		FT	681.5	
PH(FIELD)	27 JUL 83		PH	5.9	
PH(FIELD)	27 JUL 83		PH	6.0	
PH(FIELD)	27 JUL 83		PH	6.0	
PH(FIELD)	27 JUL 83		PH	6.1	
SPEC COND	27 JUL 83	1.	UMC	1800.	
SPEC COND	27 JUL 83	1.	UMC	1800.	
SPEC COND	27 JUL 83	1.	UMC	1800.	
SPEC COND	27 JUL 83	1.	UMC	1800.	
TOC	27 JUL 83	1.0	MGL	32.0	
TOC	27 JUL 83	1.0	MGL	32.0	
TOC	27 JUL 83	1.0	MGL	34.0	
TOC	27 JUL 83	1.0	MGL	33.0	
TOX	27 JUL 83	.010	MGL	.082	C
TOX	27 JUL 83	.010	MGL	.088	C
TOX	27 JUL 83	.010	MGL	.070	C
TOX	27 JUL 83	.010	MGL	.066	C

RUN DATE: 24 OCT 93

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

LEGEND

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MGL - MILLIGRAMS/LITER
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PHM - PER 100 MILLILITERS

HSHB-ES-G/WP
SUBJECT: Ground-water Monitoring Results for Naval Weapons Support Center (NWSC), Crane, IN

Incl 4

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS B 4-1	4-2	4-4	4-3	4-5	4-6
WATER LEVELS (A)	29 JUL 83		FT	576.1	567.9	567.8	562.9	564.9	565.2
PH(FIELD)	29 JUL 83		PH		7.0	6.3	6.3	6.0	7.0
PH(FIELD)	29 JUL 83		PH		6.9	6.3	6.2	5.9	7.0
PH(FIELD)	29 JUL 83		PH		6.9	6.3	6.3	6.0	7.0
PH(FIELD)	29 JUL 83		PH		6.8	6.3	6.3	5.9	7.0
PH(FIELD)	02 AUG 83		PH	7.0					
PH(FIELD)	02 AUG 83		PH	7.0					
PH(FIELD)	02 AUG 83		PH	6.9					
PH(FIELD)	02 AUG 83		PH	7.0					
SPEC COND	29 JUL 83	1.	UMC		500.	410.	510.	540.	560.
SPEC COND	29 JUL 83	1.	UMC		490.	420.	510.	550.	560.
SPEC COND	29 JUL 83	1.	UMC		495.	420.	510.	550.	560.
SPEC COND	29 JUL 83	1.	UMC		500.	420.	510.	540.	560.
SPEC COND	02 AUG 83	1.	UMC	390.					
SPEC COND	02 AUG 83	1.	UMC	390.					
SPEC COND	02 AUG 83	1.	UMC	390.					
SPEC COND	02 AUG 83	1.	UMC	395.					
TOC	29 JUL 83	1.0	MGL		33.0	29.0	38.0	65.0	30.0
TOC	29 JUL 83	1.0	MGL		32.0	29.0	37.0	64.0	30.0
TOC	29 JUL 83	1.0	MGL		32.0	30.0	37.0	65.0	30.0
TOC	29 JUL 83	1.0	MGL		33.0	30.0	37.0	65.0	29.0
TOC	02 AUG 83	1.0	MGL	22.0					
TOC	02 AUG 83	1.0	MGL	22.0					
TOC	02 AUG 83	1.0	MGL	23.0					
TOC	02 AUG 83	1.0	MGL	22.0					
TOX	29 JUL 83	.010	MGL		.012 C	.037 C	.036 C	.043 C	.021 C
TOX	29 JUL 83	.010	MGL		.014 C	.015 C	.041 C	.050 C	.017 C
TOX	29 JUL 83	.010	MGL		.013 C	.030 C	.047 C	.045 C	.017 C
TOX	29 JUL 83	.010	MGL		ND	.020 C	.058 C	.048 C	ND
TOX	02 AUG 83	.010	MGL	.043 C					
TOX	02 AUG 83	.010	MGL	.040 C					
TOX	02 AUG 83	.010	MGL	.054 C					
TOX	02 AUG 83	.010	MGL	.018 C					

HSHB-ES-G/WP
SUBJECT: Ground-water Monitoring Results for Naval Weapons Support Center (NWSC), Crane, IN

2-2

Incl 6

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: DEMOLITION GROUNDS

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 6-1A	B 6-1B	B 6-1C	B 6-3	6-2	6-4	6-5
WATER LEVELS (A)	01 AUG 83		FT	674.4	644.1		650.4	611.3	612.2	
PH(FIELD)	02 AUG 83		PH	6.8			6.2	6.2	6.5	
PH(FIELD)	02 AUG 83		PH	6.8			6.2	6.1	6.6	
PH(FIELD)	02 AUG 83		PH	6.9			6.2	6.2	6.6	
PH(FIELD)	02 AUG 83		PH	6.9			6.2	6.1	6.5	
SPEC COND	02 AUG 83	1.	UMC	2000.			1470.	2350.	1360.	
SPEC COND	02 AUG 83	1.	UMC	1950.			1470.	2400.	1350.	
SPEC COND	02 AUG 83	1.	UMC	2000.			1480.	2400.	1350.	
SPEC COND	02 AUG 83	1.	UMC	1950.			1470.	2400.	1360.	
TOC	02 AUG 83	1.0	MGL	30.0			18.0	28.0	33.0	
TOC	02 AUG 83	1.0	MGL	29.0			18.0	27.0	32.0	
TOC	02 AUG 83	1.0	MGL	30.0			17.0	27.0	31.0	
TOC	02 AUG 83	1.0	MGL	30.0			18.0	26.0	32.0	
TOX	02 AUG 83	.010	MGL	.039 C			.014 C	.012 C	.032 C	
TOX	02 AUG 83	.010	MGL	.029 C			.013 C	.040 C	.019 C	
TOX	02 AUG 83	.010	MGL	.022 C			ND	.017 C	.030 C	
TOX	02 AUG 83	.010	MGL	.036 C			.012 C	.014 C	.017 C	
2,4,6-TNT	02 AUG 83	100.	UGL	ND			ND	ND	ND	
2,4-DNT	02 AUG 83	100.	UGL	ND			ND	ND	ND	
2,6-DNT	02 AUG 83	100.	UGL	ND			ND	ND	ND	
RDX	02 AUG 83	100.	UGL	ND			ND	ND	ND	
HMX	02 AUG 83	100.	UGL	ND			ND	ND	ND	
TETRYL	02 AUG 83	100.	UGL	ND			ND	ND	ND	

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-9	6-10	6-11	6-7	6-8	6-6	6-12
WATER LEVELS (A)	01 AUG 83		FT	609.7	640.9	646.9	646.3	631.7	629.9	630.7
PH(FIELD)	02 AUG 83		PH	4.1	5.1	5.8	3.9	6.7	6.1	6.3
PH(FIELD)	02 AUG 83		PH	4.1	5.0	5.7	4.0	6.7	6.2	6.3
PH(FIELD)	02 AUG 83		PH	4.0	5.2	5.7	3.9	6.7	6.1	6.4
PH(FIELD)	02 AUG 83		PH	4.0	5.1	5.7	3.9	6.7	6.1	6.4
SPEC COND	02 AUG 83	1.	UMC	970.	1360.	1650.	3800.	1000.	3900.	4200.
SPEC COND	02 AUG 83	1.	UMC	970.	1350.	1650.	3800.	1050.	3900.	4100.
SPEC COND	02 AUG 83	1.	UMC	970.	1370.	1650.	3800.	1000.	3900.	4200.
SPEC COND	02 AUG 83	1.	UMC	960.	1360.	1650.	3800.	1000.	3900.	4300.
TOC	02 AUG 83	1.0	MGL	14.0	12.0	9.0	22.0	24.0	19.0	32.0
TOC	02 AUG 83	1.0	MGL	14.0	13.0	9.0	23.0	24.0	19.0	32.0
TOC	02 AUG 83	1.0	MGL	13.0	13.0	9.0	22.0	24.0	19.0	31.0
TOC	02 AUG 83	1.0	MGL	13.0	13.0	9.0	22.0	24.0	20.0	32.0
TOX	02 AUG 83	.010	MGL	.025 C	.013 C	.079 C	.012 C	ND	.024 C	.094 C
TOX	02 AUG 83	.010	MGL	.028 C	.017 C	.087 C	ND	ND	.026 C	.094 C
TOX	02 AUG 83	.010	MGL	.022 C	.015 C	.074 C	ND	ND	.038 C	.120 C
TOX	02 AUG 83	.010	MGL	.023 C	.021 C	.078 C	ND	.014 C	.022 C	.110 C
2,4,6-TNT	02 AUG 83	100.	UGL	ND	ND	ND	ND	ND	ND	ND
2,4-DNT	02 AUG 83	100.	UGL	ND	ND	ND	ND	ND	ND	ND
2,6-DNT	02 AUG 83	100.	UGL	ND	ND	ND	ND	ND	ND	ND
RDX	02 AUG 83	100.	UGL	ND	ND	ND	ND	ND	ND	ND
HMX	02 AUG 83	100.	UGL	ND	ND	ND	ND	ND	ND	ND
TETRYL	02 AUG 83	100.	UGL	ND	ND	ND	ND	ND	ND	ND

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: DEMOLITION GROUNDS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 6-13	
WATER LEVELS (A)	01 AUG 83		FT	632.7	
PH(FIELD)	02 AUG 83		PH	6.5	
PH(FIELD)	02 AUG 83		PH	6.5	
PH(FIELD)	02 AUG 83		PH	6.5	
PH(FIELD)	02 AUG 83		PH	6.5	
SPEC COND	02 AUG 83	1.	UMC	4600.	
SPEC COND	02 AUG 83	1.	UMC	4600.	
SPEC COND	02 AUG 83	1.	UMC	4600.	
SPEC COND	02 AUG 83	1.	UMC	4500.	
TOC	02 AUG 83	1.0	MGL	34.0	
TOC	02 AUG 83	1.0	MGL	34.0	
TOC	02 AUG 83	1.0	MGL	35.0	
TOC	02 AUG 83	1.0	MGL	35.0	
TOX	02 AUG 83	.010	MGL	.073	C
TOX	02 AUG 83	.010	MGL	.070	C
TOX	02 AUG 83	.010	MGL	.068	C
TOX	02 AUG 83	.010	MGL	.059	C
2,4,6-TNT	02 AUG 83	100.	UGL	ND	
2,4-DNT	02 AUG 83	100.	UGL	ND	
2,6-DNT	02 AUG 83	100.	UGL	ND	
RDX	02 AUG 83	100.	UGL	ND	
HMX	02 AUG 83	100.	UGL	ND	
TETRYL	02 AUG 83	100.	UGL	ND	

HSHB-ES-G/WP
SUBJECT: Ground-water Monitoring Results for Naval Weapons Support Center (NWSC), Crane, IN

Incl 7

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

SAMPLING SITES RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	6-16	6-14	6-15	6-17	6-18	6-19	6-20
WATER LEVELS (A)	02 AUG 83		FT	500.1	502.6		499.3	497.5	498.5	498.7
PH(FIELD)	02 AUG 83		PH	6.8	6.2		6.1	7.1	7.1	6.7
PH(FIELD)	02 AUG 83		PH	6.8	6.2		6.1	7.1	7.1	6.7
PH(FIELD)	02 AUG 83		PH	6.8	6.2		6.1	7.1	7.1	6.8
PH(FIELD)	02 AUG 83		PH	6.8	6.1		6.1	7.1	7.2	6.7
SPEC COND	02 AUG 83	1.	UMC	460.	440.		350.	500.	690.	400.
SPEC COND	02 AUG 83	1.	UMC	470.	440.		350.	500.	690.	400.
SPEC COND	02 AUG 83	1.	UMC	470.	440.		360.	490.	690.	400.
SPEC COND	02 AUG 83	1.	UMC	470.	450.		350.	495.	700.	400.
TOC	02 AUG 83	1.0	MGL	22.0	22.0		13.0	22.0	43.0	13.0
TOC	02 AUG 83	1.0	MGL	22.0	23.0		13.0	21.0	43.0	13.0
TOC	02 AUG 83	1.0	MGL	23.0	22.0		14.0	21.0	43.0	14.0
TOC	02 AUG 83	1.0	MGL	23.0	22.0		13.0	22.0	42.0	13.0
TOX	02 AUG 83	.010	MGL	ND	ND		ND	.027 C	.025 C	.025 C
TOX	02 AUG 83	.010	MGL	ND	ND		.015 C	.023 C	.049 C	.023 C
TOX	02 AUG 83	.010	MGL	ND	ND		ND	.024 C	.054 C	.027 C
TOX	02 AUG 83	.010	MGL	.014 C	ND		ND	.025 C	.040 C	.028 C
2,4,6-TNT	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
2,4-DNT	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
2,6-DNT	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
RDX	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
HMX	02 AUG 83	100.	UGL	100.	ND		ND	ND	ND	ND
TETRYL	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: DEMOLITION GROUNDS

LEGEND

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A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

HSHB-ES-G/WP
SUBJECT: Ground-water Monitoring Results for Naval Weapons Support Center (NWSC), Crane, IN

Incl 11

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: SITE 10

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 10-1	10-2
WATER LEVELS (A)	02 MAR 83		FT	602.3	601.2
PH(FIELD)	02 MAR 83		PH	7.2	6.2
PH(FIELD)	02 MAR 83		PH	7.2	6.1
PH(FIELD)	02 MAR 83		PH	7.1	6.1
PH(FIELD)	02 MAR 83		PH	7.1	6.0
2,4,6-TNT	02 MAR 83	100.	UGL	ND	ND
2,4-DNT	02 MAR 83	100.	UGL	ND	ND
2,6-DNT	02 MAR 83	100.	UGL	ND	ND
RDX	02 MAR 83	100.	UGL	ND	ND
HMX	02 MAR 83	100.	UGL	ND	ND
TETRYL	02 MAR 83	100.	UGL	ND	ND

HSHB-ES-G/WP
SUBJECT: Ground-water Monitoring Results for Naval Weapons Support Center (NWSC), Crane, IN

Incl 10

RUN DATE: 24 OCT 83

INSTALLATION: CRANE NWSC, IN

SITE: SITE 10

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 10-1	10-2
WATER LEVELS (A)	02 AUG 83		FT	602.6	602.2
PH(FIELD)	02 AUG 83		PH	7.0	6.5
PH(FIELD)	02 AUG 83		PH	6.9	6.5
PH(FIELD)	02 AUG 83		PH	6.9	6.5
PH(FIELD)	02 AUG 83		PH	7.0	6.5
2,4,6-TNT	02 AUG 83	100.	UGL	ND	ND
2,4-DNT	02 AUG 83	100.	UGL	ND	ND
2,6-DNT	02 AUG 83	100.	UGL	ND	ND
RDX	02 AUG 83	100.	UGL	ND	255.
HMX	02 AUG 83	100.	UGL	ND	ND
TETRYL	02 AUG 83	100.	UGL	ND	ND

APPENDIX A8b

Results of the 3rd Semi-annual
Sampling Episode

Area 2 - CERCLA

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT [illegible] - COMMANDER 04-30-84

CLIENT I.D. [illegible]
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED 01-31-84

PARAMETER	RESULTS	UNITS
ORGANIC NITROGEN	0.005	mg/L
NITROGEN, TOTAL [illegible]	ND (0)	mg/L
CONDUCTANCE, SPECIFIC	2200	umho/cm
pH, FIELD	8.8	S.U.
CHLORIDE	66	mg/L
IRON, TOTAL	0.18	mg/L
MANGANESE, TOTAL	4.1	mg/L
PHENOLS	0.004	mg/L
SODIUM, TOTAL	45	mg/L
SULFATE	1500	mg/L

CLIENT I.D. [illegible]
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED 01-31-84

PARAMETER	RESULTS	UNITS
NITROGEN, [illegible]		
ORGANIC NITROGEN	0.06	mg/L
ORGANIC NITROGEN	ND (0.002)	mg/L
ORGANIC CARBON	0.002	mg/L
CARBON, TOTAL ORGANIC	37	mg/L
CONDUCTANCE, SPECIFIC	910	umho/cm
pH, FIELD	8.3	S.U.
CHLORINE	130	mg/L
IRON, TOTAL	0.06	mg/L
MANGANESE, TOTAL	4.6	mg/L
PHENOLS	0.005	mg/L
SODIUM, TOTAL	80	mg/L
SULFATE	3000	mg/L

CLIENT I.D. [illegible]
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED 01-31-84

PARAMETER	RESULTS	UNITS
NITROGEN, [illegible]		
ORGANIC NITROGEN	0.10	mg/L
ORGANIC NITROGEN	0.003	mg/L
ORGANIC CARBON	0.029	mg/L

NOTE: SEE NEXT PAGE FOR EXPLANATION OF SYMBOLS

CONTINUED

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

[illegible] SUMMARY [illegible]

CLIENT [illegible]
ERG SAMPLE NO. [illegible]
MATRIX [illegible] WATER
DATE COLLECTED [illegible]

PARAMETER	RESULTS	UNITS
[illegible]	ND [illegible]	mg/L
[illegible]	[illegible]	umho/cm
FIELD	[illegible]	S.U.
[illegible]ORIDE	180	mg/L
[illegible]	[illegible]	mg/L
[illegible] TOTAL	[illegible]	mg/L
[illegible]	[illegible]	mg/L
[illegible] TOTAL	[illegible]	mg/L
[illegible]	[illegible]	mg/L
SULFATE	1400	mg/L

CLIENT I.D. 789 B-8 (A)
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED: 01-31-84

PARAMETER	RESULTS	UNITS
[illegible]	ND (0.01)	mg/L
[illegible]	ND (0.0001)	mg/L
[illegible]	0.015	mg/L
[illegible] TOTAL [illegible]	ND (8)	mg/L
[illegible]	2700	umho/cm
FIELD	8.4	S.U.
CHLORIDE	88	mg/L
[illegible]	0.15	mg/L
[illegible] TOTAL	2.4	mg/L
[illegible] TOTAL	<0.004	mg/L
[illegible]	93	mg/L
[illegible]	1300	mg/L

CLIENT I.D. 789 B-1 (A)
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED: 02-01-84

PARAMETER	RESULTS	UNITS
[illegible]	0.06	mg/L
[illegible]	0.03	mg/L
[illegible]	0.076	mg/L
[illegible] TOTAL ORGANIC	14	mg/L

CONTINUED

[illegible] SEE LAST PAGE FOR EXPLANATION OF SYMBOLS

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

[illegible] 04-30-94

CLIENT [illegible]
ERG SAMPLE [illegible]
MATRIX [illegible] WATER
DATE COLLECTED [illegible]

PARAMETER	RESULTS	UNITS
CONDUCTANCE, SPECIFIC	1300	umho/c
pH (FIELD)	6.6	S.U.
CHLORIDE	190	mg/L
IRON, TOTAL	1.81	mg/L
MANGANESE, TOTAL	0.009	mg/L
PHENOLS	(0.004)	mg/L
SODIUM, TOTAL	210	mg/L
SULFATE	880	mg/L

CLIENT I.D. [illegible] (A)
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED 02-01-94

PARAMETER	RESULTS	UNITS
HALOGEN, TOTAL ORGANIC		
ORGANIC CHLORIDE	0.07	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	0.020	mg/L
CARBON, TOTAL ORGANIC	14	mg/L
CONDUCTANCE, SPECIFIC	1200	umho/cm
pH (FIELD)	6.6	S.U.
CHLORIDE	19	mg/L
IRON, TOTAL	0.05	mg/L
MANGANESE, TOTAL	7.1	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	82	mg/L
SULFATE	880	mg/L

CLIENT I.D. [illegible] (A)
ERG SAMPLE NO. [illegible]
MATRIX NATURAL WATER
DATE COLLECTED 02-01-94

PARAMETER	RESULTS	UNITS
HALOGEN, TOTAL		
ORGANIC CHLORIDE	0.05	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	0.003	mg/L
CARBON, TOTAL ORGANIC	8	mg/L
CONDUCTANCE, SPECIFIC	1300	umho/cm

PAGE [illegible] SEE LAST PAGE FOR EXPLANATION OF SYMBOLS

CONTINUED

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

[illegible] 04-30-92

CLIENT I.D. [illegible]
ERG SAMPLE ID [illegible]
MATRIX NATURAL WATER
DATE COLLECTED [illegible]

PARAMETER	RESULTS	UNITS
[illegible] FIELD	[illegible]	S.U.
CHLORIDE	[illegible]	mg/L
[illegible] TOTAL	[illegible]	mg/L
MANGANESE, TOTAL	[illegible]	mg/L
PHENOLS	[illegible]	mg/L
SODIUM, TOTAL	[illegible]	mg/L
SULFATE	[illegible]	mg/L

CLIENT I.D. [illegible]
ERG SAMPLE ID [illegible]
MATRIX NATURAL WATER
DATE COLLECTED [illegible]

PARAMETER	RESULTS	UNITS
[illegible]	[illegible]	mg/L
[illegible]	[illegible]	mg/L
[illegible]	[illegible]	mg/L
[illegible]	[illegible]	mg/L
[illegible] FIELD	[illegible]	umho/cm
[illegible]	[illegible]	S.U.
CHLORIDE	[illegible]	mg/L
[illegible]	[illegible]	mg/L
MANGANESE, TOTAL	[illegible]	mg/L
PHENOLS	[illegible]	mg/L
[illegible]	[illegible]	mg/L
SULFATE	[illegible]	mg/L

CLIENT I.D. [illegible]
ERG SAMPLE ID [illegible]
MATRIX NATURAL WATER
DATE COLLECTED 01-31-92

PARAMETER	RESULTS	UNITS
[illegible]	[illegible]	
[illegible] CYANIDE	0.03	mg/L
[illegible]	ND (0.002)	mg/L

[illegible] SEE LAST PAGE FOR EXPLANATION OF SYMBOLS

CONTINUED

Area 6-CERCLA

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT NO. V6998.1 - COMMANDER 04-30-84

CLIENT I.D. D-6-1A (A)
ERG SAMPLE NO: 02/102824
MATRIX: NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	0.02	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	0.011	mg/L
CARBON, TOTAL ORGANIC,	3	mg/L
CONDUCTANCE, SPECIFIC	1700	umho/cm
pH, FIELD	6.8	S.U.
RDX (BY HPLC)	ND (20)	ug/L
COMMENTS: HIGHER DETECTION LIMIT DUE TO REDUCED AMOUNT EXTRACTED.		
HMX (BY HPLC)	ND (20)	ug/L
COMMENTS: HIGHER DETECTION LIMIT DUE TO REDUCED AMOUNT EXTRACTED.		
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	21	mg/L
IRON, TOTAL	0.02	mg/L
MANGANESE, TOTAL	<0.005	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	99	mg/L
SULFATE	590	mg/L

CONTINUED

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT NO V6448.1 - COMMANDER 04-30-84

CLIENT I.D. R-6-13 (A)
ERG SAMPLE NO: 02/102828
MATRIX: NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	0.04	mg/L
ORGANIC BROMIDE	0.008	mg/L
ORGANIC IODINE	0.028	mg/L
CARBON, TOTAL ORGANIC,	12	mg/L
CONDUCTANCE, SPECIFIC	3800	umho/cm
pH, FIELD,	6.6	S.U.
RDX (BY HPLC)	ND (10)	ug/L
HMX (BY HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	8	mg/L
IRON, TOTAL	0.02	mg/L
MANGANESE, TOTAL	0.84	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	110	mg/L
SULFATE	2700	mg/L

CLIENT I.D. R-6-14A (A)
ERG SAMPLE NO: 02/102832
MATRIX: NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	ND (0.01)	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	0.003	mg/L
CARBON, TOTAL ORGANIC,	3	mg/L
CONDUCTANCE, SPECIFIC	370	umho/cm
pH, FIELD	6.4	S.U.
RDX (BY HPLC)	ND (10)	ug/L
HMX (BY HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	9	mg/L
IRON, TOTAL	0.02	mg/L
MANGANESE, TOTAL	0.34	mg/L
PHENOLS	0.034	mg/L
SODIUM, TOTAL	7.4	mg/L
SULFATE	44	mg/L

CONTINUED

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT NO. 16998 1 - COMMANDER 04-30-84

CLIENT I.D. R-sample (A)
ERG SAMPLE NO: 02/102836
MATRIX NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	ND (0.01)	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	0.018	mg/L
CARBON, TOTAL ORGANIC	ND (2)	mg/L
CONDUCTANCE, SPECIFIC	310	umho/cm
pH, FIELD	6.8	S.U.
RDX (8Y HPLC)	ND (10)	ug/L
HMX (8Y HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	3	mg/L
IRON, TOTAL	ND (0.01)	mg/L
MANGANESE, TOTAL	<0.005	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	7.3	mg/L
SULFATE	6	mg/L

CLIENT I.D. R-6-17 (A)
ERG SAMPLE NO: 02/102840
MATRIX NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	0.15	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	ND (0.002)	mg/L
CARBON, TOTAL ORGANIC	ND (2)	mg/L
CONDUCTANCE, SPECIFIC	150	umho/cm
pH, FIELD	6.1	S.U.
RDX (8Y HPLC)	ND (10)	ug/L
HMX (8Y HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	1	mg/L
IRON, TOTAL	ND (0.01)	mg/L
MANGANESE, TOTAL	0.004	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	2.0	mg/L
SULFATE	22	mg/L

CONTINUED

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT NO. V6998.1 - COMMANDER 04-30-84

CLIENT I.D.: A-6-18 (A)
ERG SAMPLE NO: 02/102844
MATRIX: NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	ND (0.01)	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	ND (0.002)	mg/L
CARBON, TOTAL ORGANIC	ND (2)	mg/L
CONDUCTANCE, SPECIFIC	360	umho/cm
pH, FIELD	6.8	S.U.
RDX (BY HPLC)	10	ug/L
HMX (BY HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	2	mg/L
IRON, TOTAL	ND (0.01)	mg/L
MANGANESE, TOTAL	0.005	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	19	mg/L
SULFATE	41	mg/L

CLIENT I.D.: A-6-19 (A)
ERG SAMPLE NO: 02/102848
MATRIX: NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	ND (0.01)	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	ND (0.002)	mg/L
CARBON, TOTAL ORGANIC	14	mg/L
CONDUCTANCE, SPECIFIC	570	umho/cm
pH, FIELD	6.9	S.U.
RDX (BY HPLC)	ND (10)	ug/L
HMX (BY HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	7	mg/L
IRON, TOTAL	<0.01	mg/L
MANGANESE, TOTAL	1.6	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	36	mg/L
SULFATE	43	mg/L

CONTINUED

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT NO. V6998.1 - COMMANDER 04-30-84

CLIENT I.D. 8--20 (A)
ERG SAMPLE NO: 02/102852
MATRIX: NATURAL WATER
DATE COLLECTED: 02-07-84

PARAMETER	RESULTS	UNITS
HALOSCAN - T		
ORGANIC CHLORIDE	ND (0.01)	mg/L
ORGANIC BROMIDE	0.007	mg/L
ORGANIC IODINE	0.009	mg/L
CARBON, TOTAL ORGANIC	ND (2)	mg/L
CONDUCTANCE, SPECIFIC	300	umho/cm
pH, FIELD	7.2	S.U.
RDX (BY HPLC)	ND (10)	ug/L
HMX (BY HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L
CHLORIDE	3	mg/L
IRON, TOTAL	<0.01	mg/L
MANGANESE, TOTAL	0.005	mg/L
PHENOLS	ND (0.004)	mg/L
SODIUM, TOTAL	12	mg/L
SULFATE	4	mg/L

SFR - SEE FIELD REPORT FOR RESULT
NA - NOT APPLICABLE TO TEST REQUESTED
ND - NONDETECTED, DETECTION LIMIT IN ()
SD - SAMPLE DAMAGED
SR - SEE ATTACHED REPORT FOR RESULT
U - POSITIVE RESULT BUT AT UNQUANTIFIABLE CONCENTRATION BELOW INDICATED LEVEL

THANK YOU FOR YOUR BUSINESS !

PAGE 10 LAST PAGE

APPENDIX A8c

Results of the 4th Semi-annual
Sampling Episode

Area 10 - CERCLA

ANALYTICAL REPORT

ENVIRONMENTAL RESEARCH GROUP, INC.

ERG PROJECT NO. V7479 - COMMANDER 07-24-84

CLIENT I.D.: RW 10-1
ERG SAMPLE NO: 06/110447
MATRIX: GROUND WATER
DATE COLLECTED: 06-14-84

PARAMETER	RESULTS	UNITS
CARBON, TOTAL ORGANIC,	<2	mg/L
HALOSCAN - T		
ORGANIC CHLORIDE	0.02	mg/L
ORGANIC BROMIDE	ND (0.002)	mg/L
ORGANIC IODINE	ND (0.002)	mg/L
CONDUCTANCE, SPECIFIC	230	umho/cm
pH, FIELD,	7.6	S.U.
RDX (BY HPLC)	31	ug/L
HMX (BY HPLC)	ND (10)	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L

CLIENT I.D.: RW 10-2
ERG SAMPLE NO: 06/110448
MATRIX: GROUND WATER
DATE COLLECTED: 06-14-84

PARAMETER	RESULTS	UNITS
pH, FIELD,	7.2	S.U.
RDX (BY HPLC)	92	ug/L
HMX (BY HPLC)	14	ug/L
TNT (TRINITROTOLUENE)	ND (10)	ug/L

CLIENT I.D.: RW 10-2
ERG SAMPLE NO: 06/110448
MATRIX: GROUND WATER
DATE COLLECTED: 06-14-84

PARAMETER	RESULTS	UNITS
CARBON, TOTAL ORGANIC,	5	mg/L
HALOSCAN - T		
ORGANIC CHLORIDE	ND (0.01)	mg/L
ORGANIC BROMIDE	0.007	mg/L
ORGANIC IODINE	ND (0.002)	mg/L
CONDUCTANCE, SPECIFIC	290	umho/cm

CONTINUED

APPENDIX A8d

Results of the 5th Semi-annual
Sampling Episode

Area 2-CERCLA

Table III. Crane Naval Weapons Support Center. January 1985
Groundwater Sampling Project. Area 2-CERCLA

ATEC Lab No.	206-85	207-85	208-85	209-85
Well No.	2-1	2-2	2-3	2-4
Date Sampled	1/9/85	1/8/85	1/8/85	1/8/85
pH, Field	6.5	6.3	7.6	6.9
Cond. Field	2900	2280	1200	3000
Chloride, mg/l	<1	<1	<1	<1
Iron, ug/l	40	420	<20	200
Manganese, ug/l	130	4080	90	5650
Phenols, ug/l	<50	<50	100	50
Sodium, mg/l	204	15	18	31
Sulfate, mg/l	840	920	360	1340
TOC, mg/l	12.6	3.7	9.4	10.8
TOX, ug/l	52	8.9	13	17
Arsenic, ug/l	<4	<4	<4	<4
Barium, ug/l	80	50	70	80
Cadmium, ug/l	<0.4	<0.4	<0.4	<0.4
Chromium, ug/l	<20	<20	<20	<20
Lead, ug/l	<5	<5	<5	<5
Mercury, ug/l	<0.3	<0.3	<0.3	<0.3
Selenium, ug/l	8	<4	<4	<4
Silver, ug/l	10	<10	<10	<10

ATEC Lab No.	210-85	211-85	212-85	213-85
Well No.	2-5	2-6	2-7	2-8
Date Sampled	1/9/85	1/9/85	1/8/85	1/8/85
pH, Field	6.5	5.5	6.3	6.4
Cond. Field	3780	5160	2320	3400
Chloride, mg/l	<1	<1	<1	<1
Iron, ug/l	760	1280	<20	40
Manganese, ug/l	8490	5780	160	1490
Phenols, ug/l	<50	<50	<50	<50
Sodium, mg/l	49	46	45	38
Sulfate, mg/l	1650	1890	1380	1240
TOC, mg/l	4.5	6.5	5.9	9.2
TOX, ug/l	13	13	32	15
Arsenic, ug/l	<4	<4	<4	<4
Barium, ug/l	60	<50	<50	<50
Cadmium, ug/l	<0.4	1.0	<0.8	<0.4
Chromium, ug/l	20	<20	20	<20
Lead, ug/l	<5	<5	<5	<5
Mercury, ug/l	<0.3	<0.3	<0.3	<0.3
Selenium, ug/l	<4	<4	<4	<4
Silver, ug/l	<10	10	<10	<10

Area 4-CERCLA

Table VII. Crane Naval Weapons Support Center. January 1985
Groundwater Sampling Project. Area 4-CERCLA.

ATEC Lab No.	214-85	215-85	216-85
Well No.	4-1	4-2	4-3
Date Sampled	1/9/85	1/9/85	1/9/85
pH, Field, S.U.	6.3	6.5	6.5
Cond., Field, umho	610	450	450
Chloride, mg/l	<1	<1	<1
Iron, ug/l	30	<20	3160
Manganese, ug/l	270	10	1230
Phenols, ug/l	<50	<50	<50
Sodium, mg/l	4.3	8.8	19
Sulfate, mg/l	220	150	160
TOC, mg/l	4.8	6.4	7.7
TOX, ug/l	28	<5.0	9.5

ATEC Lab No.	217-85	218-85	219-85
Well No.	4-4	4-5	4-6
Date Sampled	1/9/85	1/9/85	1/9/85
pH, Field, S.U.	6.0	5.9	6.3
Cond., Field, umho	610	450	540
Chloride, mg/l	<1	<1	<1
Iron, ug/l	<20	800	<20
Manganese, ug/l	960	1960	130
Phenols, ug/l	<50	<50	<50
Sodium, mg/l	9.8	9.6	5.1
Sulfate, mg/l	25	54	50
TOC, mg/l	7.8	4.1	0.6
TOX, ug/l	45	10	5.6

Area 6-CERCLA

Table X. Crane Naval Weapons Support Center. January 1985
Groundwater Sampling Project. Area 6-CERCLA

ATEC Lab No.	482-85	483-85	484-85
Well No.	6-1A	6-2	6-3
Date Sampled	1/28/85	1/28/85	1/28/85
Arsenic, ug/l	<4	<8	<4
Barium, ug/l	<50	230	140
Cadmium, ug/l	<0.4	0.7	<0.4
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<5
Mercury, ug/l	<0.3	<0.3	0.3
Selenium, ug/l	<4	<4	<4
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

ATEC Lab No.	485-85	486-85	487-85
Well No.	6-4	6-6	6-7
Date Sampled	1/28/85	1/28/85	1/28/85
Arsenic, ug/l	<4	<4	55
Barium, ug/l	<50	230	<50
Cadmium, ug/l	<0.4	0.8	5
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<10
Mercury, ug/l	<0.3	<0.3	<0.3
Selenium, ug/l	<4	<8	<16
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	<0.005	<0.005
HMX, mg/l	<0.01	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

Table X. Crane Naval Weapons Support Center. January 1985
(Cont'd.) Groundwater Sampling Project. Area 6-CERCLA

ATEC Lab No.	488-85	489-85	490-85
Well No.	6-8	6-9	6-10
Date Sampled	1/28/85	1/28/85	1/29/85
Arsenic, ug/l	<4	4	20
Barium, ug/l	120	160	90
Cadmium, ug/l	<0.4	<0.4	1.7
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<5
Mercury, ug/l	<0.3	<0.3	<0.3
Selenium, ug/l	<4	<4	<4
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

ATEC Lab No.	491-85	492-85	493-85
Well No.	6-11	6-12	6-13
Date Sampled	1/28/85	1/28/85	1/28/85
Arsenic, ug/l	<4	<4	<8
Barium, ug/l	90	<50	50
Cadmium, ug/l	<0.4	<0.4	<0.4
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<5
Mercury, ug/l	<0.3	0.4	<0.3
Selenium, ug/l	<4	<4	<8
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

Table X. (Cont'd.) Crane Naval Weapons Support Center. January 1985 Groundwater Sampling Project. Area 6-CERCLA

ATEC Lab No.	494-85	495-85	496-85
Well No.	6-14A	6-15	6-16
Date Sampled	1/28/85	1/28/85	1/28/85
Arsenic, ug/l	<4	5	<4
Barium, ug/l	170	100	95
Cadmium, ug/l	<0.4	<0.4	<0.4
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<5
Mercury, ug/l	0.4	0.3	<0.3
Selenium, ug/l	<4	<4	<4
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

ATEC Lab No.	497-85	498-85	499-85
Well No.	6-17	6-18	6-19
Date Sampled	1/28/85	1/28/85	1/28/85
Arsenic, ug/l	<4	<4	<4
Barium, ug/l	200	80	330
Cadmium, ug/l	<0.4	<0.4	<0.4
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<5
Mercury, ug/l	<0.3	<0.3	<0.3
Selenium, ug/l	<4	<4	<4
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	0.012	<0.005
HMX, mg/l	<0.05	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

Table X. Crane Naval Weapons Support Center. January 1985
(Cont'd.) Groundwater Sampling Project. Area 6-CERCLA

ATEC Lab No.	500-85	501-85	502-85
Well No.	6-20	6-21	6-22
Date Sampled	1/28/85	1/28/85	1/28/85
Arsenic, ug/l	<4	<4	<4
Barium, ug/l	110	60	110
Cadmium, ug/l	<0.4	<0.4	<0.4
Chromium, ug/l	<20	<20	<20
Lead, ug/l	<5	<5	<5
Mercury, ug/l	<0.3	<0.3	0.3
Selenium, ug/l	<4	<4	<4
Silver, ug/l	<10	<10	<10
TNT, mg/l	<0.005	<0.005	0.107
HMX, mg/l	<0.05	<0.05	<0.05
RDX, mg/l	<0.01	<0.01	<0.01

ATEC Lab No.	503-85
Well No.	6-23
Date Sampled	1/28/85
Arsenic, ug/l	<4
Barium, ug/l	<50
Cadmium, ug/l	<0.4
Chromium, ug/l	<20
Lead, ug/l	<5
Mercury, ug/l	<0.3
Selenium, ug/l	<4
Silver, ug/l	<10
TNT, mg/l	<0.005
HMX, mg/l	<0.05
RDX, mg/l	<0.01

Area 10-CERCLA

Table XV. Crane Naval Weapons Support Center. January 1985
Groundwater Sampling Project. Area 10-CERCLA

ATEC Lab No.	319-85	320-85	512-85	321-85
Well No.	10-1	10-2	10-3	10-4
Date Sampled	1/16/85	1/16/85	1/16/85	1/16/85
TNT, mg/l	<0.005	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05	<0.05
RDX, mg/l	0.024	0.070	<0.01	<0.01

ATEC Lab No.	322-85	513-85	514-85	515-85
Well No.	10-5	10-6	10-7	10-8
Date Sampled	1/16/85	1/30/85	1/30/85	1/30/85
TNT, mg/l	<0.005	<0.005	0.023	0.029
HMX, mg/l	<0.05	<0.05	0.104	<0.05
RDX, mg/l	<0.01	<0.010	0.072	0.113

ATEC Lab No.	324-85	517-85	518-85	326-85
Well No.	10-10	10-11	10-12	10-13
Date Sampled	1/16/85	1/30/85	1/30/85	1/16/85
TNT, mg/l	<0.005	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05	<0.05
RDX, mg/l	<0.010	<0.010	<0.010	<0.010

Table XV. (Cont'd.) Crane Naval Weapons Support Center. January 1985 Groundwater Sampling Project. Area 10-CERCLA

ATEC Lab No.	520-85	521-85	522-85	523-85
Well No.	10-15	10-16	10-17	10-18
Date Sampled	1/30/85	1/30/85	1/30/85	1/30/85
TNT, mg/l	<0.005	<0.005	0.005	4.85
HMX, mg/l	<0.05	<0.05	<0.05	0.765
RDX, mg/l	<0.010	<0.010	0.014	6.19

ATEC Lab No.	524-85	525-85	526-85	326-85
Well No.	10-19	10-20	10-21	10-22
Date Sampled	1/30/85	1/30/85	1/30/85	1/16/85
TNT, mg/l	<0.005	<0.005	<0.005	<0.005
HMX, mg/l	<0.05	<0.05	<0.05	<0.05
RDX, mg/l	0.026	<0.010	<0.010	<0.010

APPENDIX A9

Summary of Sampling and Analytical Procedures

US ARMY GROUND-WATER MONITORING
AND ASSESSMENT PROGRAM

INSTRUCTIONS

FOR

COLLECTION,

PREPARATION AND SHIPMENT

OF SAMPLES

US ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD
SEPTEMBER 1981

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Instr for Collection, Prep and Shpmt of Samples

I. PURPOSE. This document is written to provide guidance to personnel at US Army installations who will be sampling ground-water monitoring wells. It has been prepared primarily to assist those installations which are being provided support by the US Army Environmental Hygiene Agency (USAEHA) in meeting monitoring requirements at sanitary landfills and hazardous waste landfills and surface impoundments.

II. GENERAL. Sections III through VI and Section VIII of this document provide instructions on collection and preparation of samples and data reporting. Section VII provides information on chemical analysis methods. The contents of this document may be used by installations monitoring hazardous waste landfills and surface impoundments to prepare the Sampling and Analysis Plan required by regulation (40 CFR 265.92).

Questions concerning these instructions or sampling and sample preparation should be referred to Mr. Gary Nemeth, Geotechnical Engineering Services Branch, Waste Disposal Engineering Division, this Agency, AV 584-2024 or (301) 671-2024.

III. SAMPLE CONTAINERS. The USAEHA will provide all sample containers to be used for shipment of samples. The only sample containers to be provided by the installation are the 1-gallon plastic jugs to be used to hold the samples prior to filtering. The number of sample containers needed for each well sample will depend on the number of parameters and filtering and preservation requirements. Inclosure 1 identifies the parameters and the eight separate containers which will be used when samples are taken from hazardous waste site monitoring wells. Inclosure 2 lists containers which will normally be provided for parameter groups which may be required at sanitary landfills or at hazardous waste sites with special parameter requirements. Only containers provided by USAEHA should be used. These containers will be properly cleaned and prelabeled with installation name, site identification, parameters and preservation information. The containers will normally be shipped by USAEHA with all those required for sampling one well in one box. The boxes should be kept by the installation because some will be used as shipping boxes for samples. Under some circumstances containers of a different size than those shown in Inclosures 1 and 2 will be used. These substitutions will be made because volume requirements will depend upon the number of parameters to be measured.

IV. SAMPLING AND FIELD OBSERVATIONS.

A. Water Level Measurement. Prior to sampling a well the water level must be measured and recorded on the field data log sheet. When the field crew visits the well they should have information available concerning well depth, depth to top of screen, and screen length. Water levels are most commonly measured with a clean steel tape. The tape should be lowered into the well until the end is a couple feet below the water surface. The wetted

length is measured when the tape is removed; and this measurement is subtracted from the length lowered into the well. This depth to water from the top of casing should be recorded. The length of casing above the ground surface should then be subtracted to obtain the desired value of depth to water from ground surface. The same value for length of casing above ground should be used each time water level is measured in the well, unless the casing length is modified. The depth measurements should be to the nearest tenth of a foot. If the portion of the tape which has been wetted is difficult to determine, chalk may be placed on the tape to make reading easier. Inks should not be used on the tape. If the tape must be weighted, a material such as stainless steel should be used. An electric water level probe may be used instead of a steel tape. Its advantages are convenience and not having to know prior to measurement the approximate depth to water. If the well is found to be dry, this should be noted on the log sheet. If the depth to water is found to be below the bottom of the screened interval, the well should also be considered dry and not sampled. This situation may occur in wells where the bottom portion of the well is not screened and holds water after water table levels drop below the screened interval. The steel tape, or electric probe, should be rinsed thoroughly with fresh tap water or distilled water prior to use in another well. A tape or probe which has been in contact with soil at the well site should not be lowered into a well until it has been rinsed clean. If contamination by oil or grease is evident, soapy water or acetone should be used for cleaning, followed by tap water rinsing.

B. Well Purging. All monitoring wells must be pumped or bailed prior to sampling to insure that samples are representative of the ground water and do not contain water which has been standing in the casing. For this monitoring program at least five volumes of water in the well casing should be removed. However, for a low yield well which does not quickly recharge as it is pumped, the well should be pumped or bailed dry and the sample then obtained as soon as the well recharges. When calculating the amount of water which must be purged, subtract depth to water (from ground surface) from the total depth of the well and then multiply by 0.16 for a 2-inch well, 0.37 for a 3-inch well, or 0.65 for a 4-inch well to obtain the volume of standing water in the well. The amount pumped prior to sampling should be recorded on the field data log sheet (Inclosures 3 and 4). The depth at which the pump should be set when purging a well will depend upon well construction details, water depth in the well, and well recharge rate. For a well which does not recharge as it is pumped, the pump intake should be as deep as possible in the well, but not so deep as to pick up the sediment which has accumulated in the well bottom. In wells which recharge as they are pumped, the pump intake should be about 5 feet below the surface of the water in the well. The pump will have to be lowered if the water level in the well drops during pumping. Pumping in this manner will insure that the water which has been standing in the well will be efficiently removed and a representative sample taken. The only exception to these pumping depth instructions will be those few

situations where the monitoring wells have more than one screened interval or a sediment trap.[1] When a well contains a sediment trap the final portion of purged water should be pumped from within the sediment trap section (do not lower pump into sediment in the bottom of the trap). When a well is constructed with more than one screen, the purged water should be pumped from the unscreened sections, beginning with the uppermost. Manufacturer's literature should be consulted to obtain specific instructions concerning the operation of sampling pumps. Questions may also be referred to the Geotechnical Engineering Services Branch, Waste Disposal Engineering Division, US Army Environmental Hygiene Agency, AUTOVON 584-2024. When pumping or sampling a well great care must be exercised to insure that contaminants are not introduced into the well or a sample. A sampler or sample tubing, or a bailer or bailer cable must not be allowed to contact the ground or a dirty surface in a vehicle or sampling equipment box. Plastic sheeting may be used to rest hoses, lines, and samplers upon. New sheeting should be used for each well sampled. Sampling equipment must be thoroughly cleaned before it is placed in its storage case. In those situations when there is windblown dust at the sampling site, it will be impossible to obtain a good sample. Sampling should be postponed until a more favorable time.

C. Sampling.

1. The sample containers in which unfiltered water is to be shipped should be filled first (see Inclosures 1 and 2). These containers should be rinsed several times with a small amount of water pumped from the well prior to filling (except for samples for grease and oil analysis). All of these containers (except grease and oil) must be filled to overflowing so that no headspace remains. Samples should be protected from light and kept cool from the time they are collected. Sample container labels should be completed using a waterproof pen before they are filled when the container is dry. The portion of the sample which must be filtered should be collected in polyethylene gallon bottles. For hazardous waste site wells monitored during 1981 and 1982 two of these gallon containers should be filled. The number required at sanitary landfill wells depends upon the parameters (see Inclosure 2). These containers should also be rinsed and filled to overflowing. Containers should be labeled with a waterproof pen. Sample containers should be filled in a manner which does not agitate or aerate the sample. This is important to prevent loss of volatile contaminants, and to prevent chemistry changes due to either CO_2 loss with pH increase or oxygenation of the sample. Containers are filled to overflowing for the same reasons. Some wells which do not recharge while they are pumped may not

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[1] A sediment trap is an unscreened section at the bottom of the well.

produce enough sample at one time. This situation will occur most frequently for hazardous waste site wells because more sample is required than at most sanitary landfills. The needed water should be obtained as soon as the well recharges.

2. Samples should be taken to the place where they will be filtered and preserved as soon as possible after sampling; and definitely within an hour or two.

3. Sampling equipment must be thoroughly cleaned between sampling at each well. This may normally be accomplished by rinsing thoroughly with tap water. At least 2-3 gallons of water should be pumped through the tubing and pump with each rinsing. If a bailer is used, it should be rinsed three times with tap water and then rinsed three times with distilled water. In those cases where a sampler becomes contaminated by pumping oily or greasy water, it should be rinsed first with soapy water and then rinsed thoroughly with clean water. It may be necessary to disassemble a pump to effectively clean it of oil and grease. Acetone rinsing is an effective method of removing oil and grease contamination, but should not be used unless it is certain that the materials used to construct the pump or bailer will not be affected. The USAEHA will advise an installation when special solvent cleaning of sampling equipment is considered necessary.

4. Deviations from the procedures specified above should be noted on the field data log sheet. Observations concerning the condition of the well, odor and color of the water should also be noted. Note if the well was found uncapped and also note the condition of the grout seal around the well.

D. Sampling Schedule and Sequence. Because of shipping and laboratory restrictions, all sampling and shipment of samples must be accomplished on either a Monday or Tuesday of the week. Those installations with many sites to be monitored may have to conduct sampling over a period of several weeks. However, all wells at each site to be monitored must be sampled the same day. When sampling wells at a site, the upgradient (and presumably uncontaminated) well or wells should be sampled first followed by the downgradient wells (or wells potentially contaminated).

V. SAMPLE PREPARATION.

A. Work Area Requirements. The work area, preferably a laboratory, must be cleaned and must be an area where there has not been any large-scale chemical usage. Pesticide mix areas or areas used to handle explosives are not acceptable. Specific requirements for the work area include:

1. 110-volt electricity,

2. minimum of 10 linear feet of working bench space,

3. complete sample filtration system,

4. pH meter with accessories (if pH measurement required),

5. distilled water,

6. cleaning supplies including nitric acid and acetone,

7. chemical preservative ampules (provided by USAEHA), and

8. Sample kits containing appropriate containers (provided by USAEHA).

B. Sample Storage. Samples should be placed in a cool, dark place (preferably a refrigerator) until ready for shipment. Those containers filled in the field should be placed into such storage as soon as they are brought to the work area. The polyethylene gallon containers should also be kept in cool and dark storage when not being used. When containers are received from sample collectors they should be checked for proper labeling.

C. pH Measurement. The sample pH should be measured as soon as possible after the sample is taken. When a sample is exposed to the air the pH level may change. This change is primarily due to loss of dissolved CO_2 from the sample. A pH measurement taken at the work area soon after the sample is taken will normally be more accurate than a field measurement as long as a significant pH change has not occurred. Visible evidence of precipitate forming in the sample between the time of sample collection and the time of pH measurement at the work area would indicate that the pH has changed and that an accurate measurement would have to be taken in the field as soon as the sample is taken. To be sure that accurate measurements are being obtained, it is recommended that pH measurements also be taken in the field with a portable meter during the initial sampling periods. For those sites where pH is not a required parameter (some sanitary landfills), it is recommended that pH be measured if an installation has a meter. For hazardous waste sites, pH measurement of four portions of the same sample are required. Sanitary landfill samples will only require one measurement. The following instructions should be followed when measuring pH.

1. Initially calibrate the pH meter in accordance with the manufacturers' specifications. The internal filling solution should cover the internal reference element in the combination electrode.

2. Standardize the meter with two buffer solutions, either pH 4.00 and 7.00, or 7.00 and 9.00. If samples are expected to be acidic, the lower range should be used. The buffer solutions should be placed into 150-mL beakers for measurement, and enough should be used so that the electrode is submerged at least 1 inch. The buffer and sample temperatures should be nearly the same when measurements are made. Ground water temperatures are

normally about 10°C. Therefore, the buffer solutions should be cooled to approximately this temperature before use. If pH measurements of the buffer solutions do not agree with the known values, either some instrument adjustment is necessary, or the buffer solution is contaminated and should be replaced. In this situation, follow the instructions in the instrument manual. When making measurements on samples or buffer solutions, the liquid in the beaker should be stirred slightly using a magnetic stirrer and stirring bar.

3. Pour a portion of the unfiltered sample from the gallon polyethylene jug into a clean 150-mL beaker. Measure and record the temperature on the field data logsheet. Adjust the temperature compensation setting on the meter to the temperature of the sample in accordance with the instrument manual. Measure and record the pH. The measurement should be to the nearest 0.1 pH unit. For hazardous waste sites, portions of the sample should be placed into four beakers and measurements recorded for each. If any of the four replicate measurements differ from the others by more than 0.3 pH units, perform the measurements again using new sample portions in different beakers. If pH measurements are made in the field, stirring with a magnetic stirrer and cooling the buffer solutions will not be practical and the meter may not be adjustable for temperature. Simply standardize the meter using the buffer solutions, measure and record sample temperature and pH.

4. Rinse the electrode with distilled water from a squeeze bottle every time the electrode is removed from the solution and blot dry before dipping into the next solution. After an oily sample is measured, rinse the electrode with acetone from a squeeze bottle and then rinse with distilled water.

5. Known and unknown control samples will be periodically sent by USAEHA to the installation for pH measurement. Measure a known control sample after every 20 sample measurements, or more often, and note results on the reverse side of the field data logsheet upon which the previous sample pH measurement was recorded. If the measured value is not within 10 percent of the known value, an instrument buffer or contamination problem is likely. This problem must be resolved before any further pH measurements are taken. Also repeat all sample measurements back to the last control sample or since the last standardization measurement. Unknown control samples should be measured when they are received and results reported to USAEHA.

6. Cleaning of beakers prior to use should be performed in accordance with instructions in Section V.F.

D. Filtering. Filtering may be performed by any one of three procedures. The first one being described is the most common type utilizing a standard vacuum pump and an all glass system. It consists of the pump, 1-liter filtering flask, ground glass base, 300-mL funnel, spring clamp,

forcep, prefilters, and membrane filters. The order for assembling the filtering system is as indicated below:

1. The tubulated ground glass base is fitted over the 1-liter flask.

2. A membrane filter is carefully placed over the fritted glass area of the base and then overlaid by a prefilter. The prefilter and membrane filter shall be handled with forceps.

3. The funnel is placed on top of the prefilter and fastened to the base by the spring clamp.

4. Vacuum tubing is connected from the vacuum pump to the side arm nipple of the base.

5. The pump is turned on and sample is gently poured into the funnel. The filtration rate is dependent on the nature of the sample. It may be necessary to replace the filters if they are fairly well clogged or if the filtration rate is extremely slow. If this is done, great care must be exercised so as not to contaminate the sample and not allow any suspended matter to enter the already filtered portion.

The second filtration procedure which may be used is performed with the "Millipore Hazardous Waste Filtration System." It uses compressed nitrogen instead of a vacuum pump. Large volumes can be filtered in a relatively short time period with this system. If this system is purchased, a detailed manual will be provided by the company. If, however, problems arise with the system, USAEHA will assist in resolving them. This system also uses the membrane filters and prefilters, only they are much larger than those with the vacuum system because of the larger filtration surface area. The third filtration procedure is also based on compressing a liquid sample through a membrane filter using nitrogen gas. Also with this procedure large volumes can be filtered in a relatively short time period. The procedure is known as the Barrel Pressure Filtering Apparatus and is manufactured by Leonard Mold and Die Works. The instructions are fairly simple and are inclosed with the purchased equipment. The USAEHA will assist if any problems develop with the equipment. The membrane filters must be soaked in distilled water for 24 hours prior to using. They should also be handled only with the purchased forceps, never with one's fingers. Care must be exercised when handling the membrane filter to avoid making any tears or pin holes. Before a sample bottle is filled with a filtered sample, it should be rinsed once with a small amount of the filtered sample and then that portion discarded. Sample bottles should not be rinsed or cleaned in any other manner because they will have been appropriately cleaned by USAEHA prior to shipment. Smaller containers should be filled before the large 1-gallon cubitaner for radiochemistry parameters. All containers should be filled to nearly full, but not overflowing because perservative must be added to some. The samples

for each site being monitored should be filtered beginning with the upgradient well(s) to minimize the possibility of cross contamination problems. The filtering apparatus should be cleaned between samples as instructed in Section V.F.

E. Sample Preservation.

1. The sample should be preserved with the chemicals listed in Inclosures 1 and 2. The acid ampules and sodium hydroxide tablets will be provided by USAEHA as required.

2. Care must be exercised when breaking and emptying the ampules so as to minimize contamination and alleviate chemical spillage on the sampler's hands and clothes. Disposable gloves shall be worn to help protect the hands. It is imperative that no mixup among the chemical ampules occurs and that they are separated from each other when being opened. The broken ampules must be properly discarded. Ampules will be color coded for identification.

3. Sample preservation requirements will also be stated on the container labels to minimize error. The chemical preservative, filtering and cooling requirements will be identified on the appropriate container labels. All containers, including those to which preservative has not been added, should be checked to insure that they have been dated and initialed. The dates placed on the containers and field data log sheets must be Julian dates consisting of five digits. These can be taken from many calenders. The Julian date consists of two digits to identify the year and three digits to identify the day of the year. Example: 81292 is the Julian date for 19 Oct 81.

4. The time from sampling until filtering and preservation is complete must be kept as short as possible. If the sampling rate is faster than samples can be filtered and preserved, sampling should be paced so that samples do not set more than an hour awaiting preparation.

5. If many wells are to be sampled, it will probably be best to have two persons taking samples and two persons preparing samples simultaneously. If only a few wells are to be sampled, two persons could take the samples and then return to the work area and prepare them.

F. Glassware and Equipment Cleaning.

1. Proper cleaning of glassware and equipment is essential to obtaining accurate ground-water quality analytical results. Beakers and the filtration system must be rinsed thoroughly with tap water and then rinsed three times with distilled water between each sample. If any glassware or equipment becomes coated with an oily residue it should be rinsed with acetone using a

500-mL squeeze bottle and then washed thoroughly with hot detergent water prior to the tap water and distilled water rinsings. It is imperative that no acetone or detergent remain on the apparatus after the water rinsings.

2. In addition to the above rinsings, all parts of the filtration system (except prefilters and membrane filters) shall be rinsed with a 50 percent nitric acid solution between samples from different facilities. If only one facility is being monitored, the acid rinse should precede the first sample. After the 50 percent nitric acid rinsing, the apparatus must be thoroughly rinsed with tap water and then rinsed three times with distilled water. All traces of the nitric acid must be removed. The 50 percent nitric acid solution (nitric acid mixed with distilled water on a one to one basis) should be made up in the rigid, leakproof, 1-gallon size, polyproplene jug purchased by the installation. The disposable rubber gloves should be worn when making up this solution. First fill the jug half-way with distilled water. To it, carefully add concentrated nitric acid to near the top. Cap and mix gently. The solution will become hot, but the jug will withstand the thermal shock. This solution should be labeled and protected from all sampling bottles. Rubber gloves should also be worn when rinsing the filtering system.

3. More frequent 50 percent nitric acid solution rinsings are not desired because they are time consuming and because of the risk of acid residue affecting nitrate analysis results. In some situations USAEHA may direct that the acid rinsing be performed between all samples (such as for sites with heavy metal ground-water contamination).

4. These instructions do not include procedures to be used to protect against cross contamination with organic compounds because these sample portions are not going to be filtered (pesticides, herbicides, total organic halogen). In those special cases where samples for organics analysis will be filtered, special cleaning instructions will be provided by USAEHA. This cleaning will normally involve cleaning with acetone or other organic solvents.

VI. SAMPLE SHIPMENT.

A. Packaging. All glass sample containers must be enclosed in their styrofoam packing and this packing wrapped with tape. Insulated coolers must be used as shipping containers for those sample portions which must be kept cool (see Inclosures 1 and 2). To maintain a low temperature during shipping, several reuseable ice packs should be placed in the cooler with the samples. Those sample portions which do not require cooling (metals and radiochemistry parameters) may be shipped to the lab in the cardboard shipping containers used to ship the containers to the installation. Those installations with only a few wells and no radiochemistry analysis requirements may find it as convenient and no more costly to ship all sample containers in the coolers.

B. Shipping Times.

1. Those sample portions which must be kept cool shall normally be shipped such that they are delivered to the laboratory within 2 days of shipment. The exception is those few sample portions which have parameters with very short holding times. These must be shipped so that they are delivered to the laboratory within 24 hours and are identified in Inclosure 2. The routine hazardous waste site monitoring does not require 24 hour shipping. However, such shipping may be required if analysis for special parameters is required or if 2 day shipping is found to be unsatisfactory for some parameter. The cardboard shipping containers with metals and radiochemistry analysis samples may be shipped in any manner which will insure delivery within 7 days. If any samples arrive at the laboratory late and holding times can not be met, the samples will be discarded and the installation instructed to resample. If these instructions are followed, holding times specified in 40 CFR Part 136, 18 December 1979 Federal Register, pages 75028-75052, will be complied with.

2. All samples taken during any one day and which require cooling must be prepared, packaged, and shipped the same day. The metals and radiochemistry samples may be shipped the following day if it is more convenient. Because of laboratory scheduling restrictions, all samples shipped in coolers must arrive not later than Thursday. This means that coolers must be shipped on Monday or Tuesday, or Wednesday if 24-hour shipping is used. If samples arrive at the laboratory on a Friday or Saturday, and analysis can not be performed soon enough to meet holding times, the samples will be discarded and resampling will be necessary.

3. The cost for shipping of samples to the laboratory and for return shipment of empty coolers with the reuseable ice packs must be paid by the installation. Paperwork for return shipment must be inclosed in the coolers when they are shipped to the laboratory. Because there are no time restrictions, the return of coolers by expensive "special" shipment is not necessary.

4. During the first year of this monitoring program, most analyses will be performed by Century Environmental Testing Laboratories, Thorofare, NJ (near Camden). Shipping to that laboratory should be considered when preparing shipping cost estimates.

C. Chain of Custody Control. Regulations require that sample chain of custody records be maintained. Inclosure 5 is the record form which will be used and Inclosure 6 is a sample of a completed form. Four copies (including original) of the form must be completed for each shipping container. Either carbon paper or a copier machine may be used. One copy should be held while the original and two copies are enclosed in the shipping container with the samples. The forms should be placed in a plastic protector to keep them from

getting wet. When the laboratory custodian receives the samples, that individual will sign all copies of the form. The original will be returned to the installation where it must be held on file. A second copy will be sent to Commander, US Army Environmental Hygiene Agency, ATTN: HSE-ES-S/Gary Nemeth, Aberdeen Proving Ground, MD 21010. The remaining copy will be held by the laboratory custodian.

VII. CHEMICAL ANALYSIS.

A. Analytical Procedures. The analytical procedures to be employed during this monitoring program are listed in inclosure 7. The methods of analysis for specific hazardous wastes will be identified as necessary in assessment plans prepared by USAEHA.

B. Quality Control. A quality control program will be strictly followed by the laboratory to insure the validity of all results. The USAEHA will maintain quality control data records.

C. Bacterial Analysis. Coliform bacteria analysis will be performed onsite by US Army Health Services Command medical activities or centers. The MEDDACs/MEDCENs will attempt to schedule their visit such that they are onsite when sampling for other parameters is performed. Sampling equipment must be made available for their use.

VIII. SCHEDULING AND DATA REPORTING.

A. Scheduling. To insure a reasonably uniform flow of samples into the laboratory, USAEHA will schedule sampling by installations. This schedule will be established in coordination with installation personnel, and there will be some flexibility to meet installation specific requirements. Approximately 3-4 weeks prior to sampling, USAEHA will formally notify the installation environmental coordinator of the scheduled sampling by mailing a listing similar to Inclosure 8. This listing will identify the installation, the facilities to be monitored, the wells to be sampled, the analytical parameters, the installation address, the laboratory address to which samples are to be shipped and the USAEHA address to which log sheets are to be sent. The parameters listed on the notification will be grouped by common sample container. Sample containers will be shipped to the installation environmental coordinator about 2-3 weeks prior to the scheduled sampling date. The scheduled date will always be a Monday or a Tuesday and will identify the week when samples are to be taken. If is necessary for the installation to postpone sampling, telephone notification should be given to Mr. Gary Nemeth, AV 584-2024, USAEHA. Similarly, USAEHA will notify the installation if laboratory scheduling problems require postponement of sampling.

B. Field Data Log Sheets. Notify USAEHA of sample shipment the day following shipment. Copies of field data log sheets should also be mailed to USAEHA immediately after shipment of samples. USAEHA will provide blank chain of custody forms and field data logsheets.

C. Data Reporting. The USAEHA will mail a tabulation of chemical analysis results, with interpretation, to the major command and installation 1-2 weeks after receipt of raw data from the laboratory. With an expected laboratory turn-around time of 4 weeks, data will normally be received by the major command/installation about 7 weeks after sampling. If the data indicates a serious problem requiring some type of action by the installation, or if an assessment is required, the major command and installation will be notified telephonically. Installation personnel are responsible for reporting data to regulatory authorities. In many situations a copy of the data tabulation provided by USAEHA may be forwarded to meet requirements. However, some states have developed special forms for data reporting.

D. Resampling. Resampling may be necessary for a variety of reasons. Resampling will normally be directed by USAEHA through telephone contact with the installation's environmental coordinator. In those situations where resampling is desired because of indicated ground-water contamination problems the major command will also be notified.

Preparation of Ground-Water Samples from Wells Around Hazardous Waste Sites

Parameter Group	Container Size & Type	Field Preparation	Chemical Preservation	Refrigeration at 4°C using Metal Cooler and 2-3 ice packs	Special Shipment Requiring 24 hour Delivery Time
Radiochemistry	1-gallon cubitaner, enclosed in a cardboard box	Filtered	Add 10 ml Nitric Acid Use the large red color-coded ampule	NO	NO
Pesticides Herbicides	1-quart glass bottle narrow neck w/teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	NO
Total Organic Halogen	Completely filled in a 1-quart glass bottle, narrow neck w/teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	NO
Metals	16-ounce wide mouth polyethylene bottle	Filtered	Add 2.5 ml Nitric Acid Use the small red color-coded ampule	NO	NO
Specific Conductance	16-ounce wide mouth polyethylene bottle	Unfiltered	NONE	YES	NO
Nitrate/Nitrite Phenol Total Organic Carbon	16-ounce glass bottle, narrow neck w/teflon-lined cap enclosed in a styrofoam pack	Filtered	Add 2 ml Sulfuric Acid Use the yellow color-coded ampule	YES	NO
Mercury	4-ounce wide mouth polyethylene bottle, enclosed in a qt cubitaner box *	Filtered	Add Nitric Acid-Dichromate Solution Use the ampule marked Nitric Acid-Dichromate	NO	NO
Fluoride Sulfate Chloride	4-ounce wide mouth polyethylene bottle, enclosed in a qt. cubitaner box *	Filtered	NONE	YES	NO

* 4/4-ounce bottles will fit in the provided qt. cubitaner box.

Inclosure 1

Preparation of Ground Water Samples from Wells Around Sanitary Landfill Sites

A. For Most Commonly Required Parameter Groupings

Parameter Group	Container Size & Type	Field Preparation	Chemical Preservation	Refrigeration at 4 °C (with metal cooler & 2-3 ice packs	Special Shipment Requiring 24 hour Delivery Time
Metals (individually listed) and/or Hardness	16-oz wide mouth polyethylene bottle	Filtered	Add 2.5 ml Nitric Acid Use the small red color-coded ampule	NO	NO
Any or all of the following: TDS, TS, TSS pH[1], Turbidity Specific Conductance, Alkalinity, and Acidity	32-ounce wide mouth polyethylene bottle	Unfiltered	NONE	YES	YES, if pH and Turbidity are required
Any or all of the following: Chloride, Sulfate, Fluoride and Color	16-ounce wide mouth polyethylene bottle	Filtered	NONE	YES	YES, if Color is required
If any of the additional parameters are required: Surfactants, Nitrate, Nitrite, and Orthophosphate	Substitute a 32-ounce wide mouth polyethylene bottle for the 16-ounce one				
Any or all of the following: Phenol, COD, and TOC	16-ounce glass bottle, narrow neck, with teflon-lined cap, enclosed in a styrofoam pack	Filtered	Add 2 ml Sulfuric Acid Use the yellow color-coded ampule	YES	NO

B. Less Commonly Required Parameter Groupings

Mercury	4-ounce wide mouth polyethylene bottle, enclosed in a qt. cubitaner box[2]	Filtered	Add Nitric Acid-Dichromate Solution Use the ampule marked Nitric Acid-Dichromate	NO	NO
Radiochemistry	1-gallon cubitaner enclosed in a cardboard box	Filtered	Add 10 ml Nitric Acid Use the large red color-coded ampule	NO	NO
DCO	1-quart glass bottle, narrow neck with teflon-lined cap, enclosed in a styrofoam pack	Filtered	NONE	YES	YES

1 - a field pH may also be required

Inclosure 2

Parameter Group	Container size and type	Field Preparation	Chemical Preservation	Refrigeration at 4°C using metal cooler & 2-3 ice packs	Special shipment Requiring 24 hour Delivery time
Cyanide	4-ounce wide mouth polyethylene bottle enclosed in a qt. cubitaner box [2]	Filtered	Add 1 pellet of Sodium Hydroxide	YES	NO
Any or all of the following: Nitrate/Nitrite, Ammonia, TKN, and Total Phosphate	16-ounce wide mouth polyethylene bottle	Filtered	Add 2 ml Sulfuric Acid Use the yellow color-coded ampule	YES	NO
Pesticides, Herbicides	1-quart glass bottle, narrow neck, with teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	NO
Special Organics	1-amber glass gallon jug & two 40 ml vials completely filled	Unfiltered	NONE	YES	NO
Oil and Grease	32-ounce wide mouth glass bottle with teflon-lined cap, enclosed is a styrofoam pack	Unfiltered	Add 2 ml Sulfuric Acid Use the yellow colored-coded ampule	YES	NO
Odor and/or Taste	1-quart glass bottle, narrow neck, with teflon-lined cap, enclosed in a styrofoam pack	Unfiltered	NONE	YES	YES
Hexavalent Chromium	8-ounce wide mouth polyethylene bottle	Filtered	NONE	YES	YES
Sulfide	4-ounce wide mouth polyethylene bottle enclosed in a qt. cubitaner box	Filtered	0.5 ml. zinc Acetate solution	YES	NO

[2] 4/4-ounce bottles will fit in the provided qt. cubitaner box

Inclosure 2 (cntd.)

GROUND-WATER MONITORING
FIELD DATA LOGSHEET

INSTALLATION: _____ WELL ID: _ _ _ _ _

DATE: __ __ __ __ __ __ __ __ __ __ __ __
day month year Julian

DEPTH TO WATER FROM TOP OF CASING: _ _ _ . _ FT

LENGTH OF CASING ABOVE GROUND SURFACE: _ _ . _ FT

DEPTH TO WATER FROM GROUND SURFACE: _ _ _ . _ FT

TIME OF MEASUREMENT: _ _ _ _ HRS

METHOD OF MEASUREMENT:

INSIDE DIAMETER OF CASING: _ _ . _ INCHES

PUMPING/SAMPLING METHOD:

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: _ _ _ GALLONS

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:

TIME OF SAMPLING: _ _ _ _ HRS

DEPTH TO WATER PRIOR TO SAMPLING: (FROM TOP OF CASING) _ _ _ . _ FT

AMOUNT OF SAMPLE COLLECTED (LIST CONTAINERS FILLED):

FIELD MEASUREMENTS(IF PERFORMED):

_ _ _ °C °F temperature

pH: _ _ . _ _ _ . _ _ _ . _ _ _ . _ 4 REPLICATE pH MEASUREMENTS IF A HAZARDOUS WASTE SITE

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFIED SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:

SAMPLE COLLECTOR'S NAME:

WORK AREA MEASUREMENTS(IF PERFORMED): _ _ _ °C °F temperature

pH: _ _ . _ _ _ . _ _ _ . _ _ _ . _ 4 REPLICATE pH MEASUREMENTS IF A HAZARDOUS WASTE SITE

pH METER TYPE AND MODEL:

FILTERING METHOD:

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: _ _ _ _ HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDURES:

COMMENTS AND OBSERVATIONS(CONTINUE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):

SAMPLE PREPARER'S NAME:

GROUND-WATER MONITORING
FIELD DATA LOGSHEET

INSTALLATION: Big Valley Army Depot

WELL ID: L F 4 _ _

DATE: 19 (day) OCT (month) 81 (year) 81292 (Julian)

DEPTH TO WATER FROM TOP OF CASING: 25.1 FT

LENGTH OF CASING ABOVE GROUND SURFACE: 2.2 FT

DEPTH TO WATER FROM GROUND SURFACE: 22.9 FT

TIME OF MEASUREMENT: 1310 HRS

METHOD OF MEASUREMENT: steel tape

INSIDE DIAMETER OF CASING: 2.0 INCHES

PUMPING/SAMPLING METHOD: geofilter pump

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: 17 GALLONS

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:

TIME OF SAMPLING: ____ HRS

DEPTH TO WATER PRIOR TO SAMPLING: ____ FT
(FROM TOP OF CASING)

AMOUNT OF SAMPLE COLLECTED
(LIST CONTAINERS FILLED):

1 qt part/hard
1 qt TOX
2 one gal containers
16 oz spec cond

FIELD MEASUREMENTS (IF PERFORMED):

temperature ___ °C °F

pH: ___ . ___
___ . ___
___ . ___
___ . ___

4 REPLICATE pH MEASUREMENTS IF A HAZARDOUS WASTE SITE

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFIED SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:

organic solvent odor, no unusual color

SAMPLE COLLECTOR'S NAME: Joe Jackson

WORK AREA MEASUREMENTS (IF PERFORMED):

temperature 12 °C °F

pH: 6.7
6.7
6.7
6.8

4 REPLICATE pH MEASUREMENTS IF A HAZARDOUS WASTE SITE

pH METER TYPE AND MODEL: nonportable; Fisher Accumet

FILTERING METHOD: Vacuum

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: 1500 HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDURES:

none

COMMENTS AND OBSERVATIONS (CONTINUE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):

solvent odor apparent in sample, possibly TCE.

SAMPLE PREPARER'S NAME: John Brown

GROUND-WATER MONITORING
FIELD DATA LOGSHEET

INSTALLATION: Big Bend AAP

DATE: 20 (day) Oct (month) 81 (year) 81293 (Julian)

WELL ID: RW6 __

DEPTH TO WATER FROM TOP OF CASING: __7.2 FT

LENGTH OF CASING ABOVE GROUND SURFACE: __1.9 FT

DEPTH TO WATER FROM GROUND SURFACE: __5.3 FT

TIME OF MEASUREMENT: 1420 HRS

METHOD OF MEASUREMENT: steel tape

INSIDE DIAMETER OF CASING: __3.0 INCHES

PUMPING/SAMPLING METHOD: PVC bailer

AMOUNT OF WATER PUMPED PRIOR TO SAMPLING: __2 GALLONS bailed dry

IF TIME ALLOWED FOR WELL TO RECHARGE BEFORE SAMPLING:

TIME OF SAMPLING: 0730 HRS 21 Oct 81

DEPTH TO WATER PRIOR TO SAMPLING: __7.4 FT
(FROM TOP OF CASING)

AMOUNT OF SAMPLE COLLECTED
(LIST CONTAINERS FILLED):
1 qt poly/bark
1 qt TOX
16 oz cond
1 gal jug filled, 2nd one third filled

FIELD MEASUREMENTS (IF PERFORMED):

___ °C °F temperature

pH: __.__ 4 REPLICATE pH MEASUREMENTS IF A HAZARDOUS WASTE SITE
__.__
__.__
__.__

pH METER TYPE AND MODEL:

NOTES CONCERNING CONDITION OF WELL, ODOR AND COLOR OF WATER, DEVIATIONS FROM SPECIFIED SAMPLING PROCEDURES, AND OTHER OBSERVATIONS:
Returned to well at 1700 hrs 20 Oct; well had not recharged - DTW = 15.2
Water has a yellow color and an organic odor. Grout seal around well is cracked and well casing is loose in hole.

SAMPLE COLLECTOR'S NAME: Charlie Brown

WORK AREA MEASUREMENTS (IF PERFORMED):

10 °C °F temperature

pH: 5.9 4 REPLICATE pH MEASUREMENTS IF A HAZARDOUS WASTE SITE
5.9
5.9
5.9

pH METER TYPE AND MODEL: portable; Beckman 3500

FILTERING METHOD: Vacuum

TIME WHEN FILTERING AND PRESERVATION IS COMPLETED: 0950 HRS

NOTES CONCERNING USE OF ANY SPECIAL PROCEDURES OR DEVIATIONS FROM SPECIFIED PROCEDURES:
Insufficient sample to fill radiochemistry containers initially. Sampler obtained another gallon jug full late morning 21 Oct 81. Filtered and preserved by 1300 hrs.

COMMENTS AND OBSERVATIONS (CONTINUE ON REVERSE SIDE IF ADDITIONAL SPACE IS NEEDED):
Organic odor and bright yellow color in filtered sample

SAMPLE PREPARER'S NAME: Jenny Smith
Incl HG

pH audit sample results on reverse

Sample No.	Measured pH	Date
QC617	5.9	21 Oct 81
QC708	8.0	"

JS

US ARMY GROUND-WATER MONITORING AND ASSESSMENT PROGRAM

CHAIN OF CUSTODY RECORD

CONTAINER LISTING

SAMPLING DATE	WELL ID	CONTAINER (PARAMETERS)

	SIGNATURE	DATE/TIME	ORGANIZATION
SAMPLE COLLECTOR			
SAMPLE PREPARER			
LABORATORY CUSTODIAN			

METHOD OF SHIPMENT:

COMMENTS:

US ARMY GROUND-WATER MONITORING AND ASSESSMENT PROGRAM

CHAIN OF CUSTODY RECORD

CONTAINER LISTING

SAMPLING DATE	WELL ID	CONTAINER (PARAMETERS)
21 Oct 81	RW6	pest/herb
	"	TOH
	"	Cond
	"	NO_3/NO_2, Phenol, TOC
	"	F, Cl, SO_4
	~~RW3~~ RW4, RW3	TOH
	" "	pest/herb
	" "	Cond
	" "	NO_3/NO_2, Phenol, TOC
	" "	F, Cl, SO_4
	RW1, RW2 RW3, RW4, RW6	Hg

	SIGNATURE	DATE/TIME	ORGANIZATION
SAMPLE COLLECTOR	Charlie Brown	21 Oct 81/0830 hrs	BIG BANG AAP
SAMPLE PREPARER	Jerry Smith	21 Oct 81/0930 hrs	"
LABORATORY CUSTODIAN			

METHOD OF SHIPMENT: UPS Blue Label

COMMENTS:

PARAMETER		PRIMARY METHODOLOGY	ALTERNATE METHODOLOGY[1]
Barium	EPA[2]	200.0, 208.1	
Sodium		200.0, 273.1	
Copper		200.0, 220.1	
Zinc		200.0, 289.1	
Manganese		200.0, 243.1	
Silver		200.0, 272.1	
Iron		200.0, 236.1	200.0, 236.2
Potassium		200.0, 258.1	
Magnesium		200.0, 242.1	
Calcium		200.0, 215.1	
Chromium		200.0, 218.2	200.0, 218.1
Cadmium		200.0, 213.2	200.0, 213.1
Lead		200.0, 239.2	
Arsenic		200.0, 206.2	200.0, 206.3
Selenium		200.0, 270.2	200.0, 270.3
Mercury		200.0, 245.1	200.0, 245.2
Specific Conductance		120.1	
Total Organic Carbon		415.1	
Total Organic Halogen		450.1	
Fluoride		340.2	340.3
Nitrate/Nitrite		353.2	353.1
Nitrite		353.2 (without Reduction Steps)	353.1
Ammonia		350.1, 350.2	350.1
Total Kjeldahl Nitrogen		351.2	351.3
Phenols		420.2	
Total Phosphate		365.4	365.2
Ortho Phosphate		365.4 (without Digestion)	365.2

PARAMETER	PRIMARY METHODOLOGY	ALTERNATE METHODOLOGY
Acidity	305.1	
Alkalinity	310.1	
Hardness EDTA	130.2	
Total Solids	160.3	
Total Suspended Solids	160.2	
Total Dissolved Solids	160.1	
Chloride	325.2	325.3
Sulfate	375.2	375.1
Surfactants	425.1	
Chemical Oxygen Demand	410.4	Ampule Method [3]
Turbidity	180.1	
Color	110.2	
Endrin	Methods for Organochlorine[4]	
Lindane	Methods for Organochlorine	
Toxaphene	Methods for Organochlorine	
Methoxychlor	Methods for Organochlorine	
2, 4-D	Methods for Organochlorine	
2, 4, 5, T-P (Silvex)	Methods for Organochlorine	
Oil & Grease	413.2	
Biochemical Oxygen Demand	405.1	
Gross Alpha	SM[5] 703	
Radium-226	SM 706	
Radium-228	SM 705	
Gross Beta	SM 703	
Strontium-90	SM 704	
Tritium	SM 707	

PARAMETER	PRIMARY METHODOLOGY	ALTERNATE METHODOLOGY
Uranium	Laser[6]	
Taste	SM 211A	
Acid Extractable Organics	FR[7] 625	FR 604
Base/Neutral Extractable Organics	FR 625	
Pesticide & PCB Extractable Organics	FR 625	
Volatile Organics	FR 624	FR 601
pH	150.1	
Odor	SM[8] (Quality)	140.1
Nitrate	353.2 (with and without Reduction Steps)	353.1
Cyanide	335.3	
Sulfide	376.2	
Nickel	200.0, 249.1	
Vanadium	200.0, 286.2	
Antimony	200.0, 204.2	
Beryllium	200.0, 210.1	
Thallium	200.0, 279.1	
Hexavalent Chromium	218.4	

1 - The selected alternate methods will be on an infrequent basis only if a need arises.

2 - Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, US Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Cincinnati, OH 45268, March 1979. All the methods listed are from this methods manual except for those individually marked with preletters.

3 - "Ampule Method", Chemical Oxygen Demand, Oceanography International Corporation, College Station, TX 77840, April 1978.

4 - "Methods for Organochlorine Pesticides and Chlorophenoxy Acid Herbicides in Drinking Water and Raw Source Water", available from ORD Publications, CERI, EPA, Cincinnati, OH 45268, July 1978.

5 - Standard Methods for the Examination of Water and Wastewater, 14th ed., American Public Health Association, American Water Works Association, Water Pollution Control Federation, Washington, DC 20036, 1975.

6 - "Laser Induced Phosphorescence Procedure for Uranium", Radiation Management Corp, Philadelphia, PA, 19104, 1981.

7 - EPA methods listed in Federal Register, Vol. 44, No. 233, Guidelines Establishing Test Procedures for the Analysis of Pollutants; Proposed Regulations, Monday, December 3, 1979.

8 - Standard Methods for the Examination of Water, Sewage, and Industrial Wastes, 10th ed., American Public Health Association, American Water Works Association, Federation of Sewage & Industrial Wastes Associations, New York 19 NY, 1955.

..... EXAMPLE .....

SCHEDULED SAMPLING AND ANALYSIS

Big Bang AAP
Red Water Lagoon
Sludge Basin
Landfill

Scheduled Sampling: 19 Oct 81

16 Wells: RW1, RW2, RW3, RW4, RW6, SB1, SB2, SB3, SB4, SB5, LF1, LF2, LF3, LF4, LF5, LF6

Ba	Endrin	TOX(4)	Gross Alpha
As	Lindane		Gross Beta
Cd	Toxaphene		
Cr	Methoxychlor		
Pb	2,4-D		
Se	Silvex		
Ag			
Na			
Mn			
Fe			
NO_2/NO_3	Spec Cond(4)	F	Hg
Phenol		Cl	
TOC(4)		SO_4	

Commander
Big Bang AAP
Attn: SARES-FE-E
Westwood, USA

Century Environmental Testing Laboratories, Inc.
1501 Grandview Avenue
MidAtlantic Park
Thorofare, NJ 08086

Commander
US Army Environmental Hygiene Agency
Attn: HSE-ES-S/Gary Nereth
Aberdeen Proving Ground, MD 21010
AV 584-2024, (301) 671-2024

SUPPLEMENT 1

TO

US ARMY GROUND-WATER MONITORING
AND ASSESSMENT PROGRAM

INSTRUCTIONS
FOR
COLLECTION
PREPARATION AND SHIPMENT
OF SAMPLES

US ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MD
APRIL 1982

Paragraph V.E.

6. Ground-water samples requiring analysis for any or all of the following explosives: 2,4,6-TNT, 2,4-DNT, 2,6-DNT, RDX, HMX, and Tetryl should be filtered (0.45 micron membrane filter) and then transferred to a clean 16-ounce glass bottle (narrow neck w/teflon-lined cap enclosed in a styrofoam pack). After transferring the sample to the bottle, add 10% sulfuric acid (H_2SO_4) drop-wise to obtain a sample pH of 4-5. If the sample already has a pH in the 3-6 range, don't add any acid to it. A commercial pH paper roll having an expanded scale range from about pH 3 to 7 can be used for this measurement. It is inoperative not to overacidify the sample. The H_2SO_4 should be prepared from a reagent grade or "more pure" grade concentrated H_2SO_4; a 10% concentration is achieved by adding 10 parts H_2SO_4 to 90 parts distilled or deionized water. In most cases, a full bottle of sample is not necessary. If difficulty results in obtaining a fairly full bottle, 100-200 milliliters of sample will be sufficient for explosive analysis.

7. Ground-water samples requiring analysis for volatile organic compounds, whether they are halogenated organics or purgeable non-halogenated aromatic or aliphatic compounds, must be collected in the specially designed and cleaned 40 ml glass vials equipped with a teflon-faced silicone septum and screw cap. These samples must be collected right at the sampling well immediately after extracting the samples from the well. Special care must be taken to insure completely filled vials, so that no bubbles or head space occurs. Also, the teflon-lined side of the septum must face the sample. It is imperative that these vials not be used for any other purpose, and if a vial is accidently soiled, it should not be used. A sample blank vial containing the installation's organic free water should accompany every batch of volatile organic samples.

8. The filled sample containers for explosives, volatile organics, pesticides/herbicides, and any other samples for organics analysis must be kept cold and protected from light.

Paragraph V.F.

5. The filtering apparatus used for filtering samples for the explosive parameters should be rinsed with reagent grade acetone or equivalent and then thoroughly rinsed with distilled or deionized water between each sample filtering. It is important that no acetone be left on the apparatus as it may come in contact with the membrane filter and dissolve it.

Paragraph VI.B.

5. Samples for explosives or volatile organics analysis must be shipped as soon as possible after sampling (within 24 hours) and a 24 hour delivery service must be used. These samples will be analyzed either by USAEHA or the contract laboratory on a case by case basis.

APPENDIX A10

Brief Descriptions of Surface Water, Climate, Topography, and Soils at NWSC

Climate

The NWSC is located in a warm temperate climate zone. In general, summers are warm and humid while winters are mild with cold periods of short duration. Temperature ranges from an average maximum July temperature of 89°F to an average minimum January temperature of 26°F. Precipitation is nearly evenly distributed throughout the year with maximum precipitation occurring during spring and early summer. The NWSC averages 44 inches of precipitation yearly with 42 inches of rain and 15 inches of snow. Average humidity ranges from 40 to 90 percent in summer and 60 to 90 percent in winter.

Topography

Surface relief at the NWSC consists of gently rolling hills and steep sided ridges which are dissected by numerous well-defined drainageways. Elevations at the NWSC are higher in the east and decline towards the west. The highest elevation occurs in the extreme eastern portion with an elevation of 860 feet (ft) mean sea level (MSL) while the lowest elevation of 491 ft MSL occurs in the southwestern portion of the installation.

Soils

The United States Department of Agriculture identifies three-fourths of Martin County which contains the major portion of the NWSC as belonging to the Zanesville and Muskingum soil series. These series are identified as a dark brown organic silt loam at the surface, underlain by 48 inches of mottled tan, grey, and yellow clay with varying percentages of sand and silt. Occasionally, a clay hardpan occurs between 25 and 32 inches below surface. WES borings encountered soil thickness at the NWSC from less than 1 ft to an excess of 40 ft. These borings identified a surficial organic layer underlain by clay, silt, or sand.

Surface Water

The surface drainage at the NWSC has formed a dense dendritic pattern throughout the installation that flows in a general southerly or southwesterly direction. Seven creeks in five drainage basins carry surface water off the installation where it eventually drains into the East Fork of the White River. Figure 1. shows the basins and drainages of the NWSC. Drainage Basin IV consists of Boggs and Turkey Creeks which are the primary drainageways for the installation and drain the majority of the area. The north and northwest section (Basin I) is drained by Furst Creek, the eastern portion (Basin III) is drained by the Sulphur Creek Complex, the extreme eastern portion (Basin II) is drained by Indiana Creek, and the southwestern section (Basin V) is drained by Seed Tick Creek. Also located within the installation are several small ponds and Lake Greenwood, an 800 acre spring-fed lake in the northwestern portion of the installation.

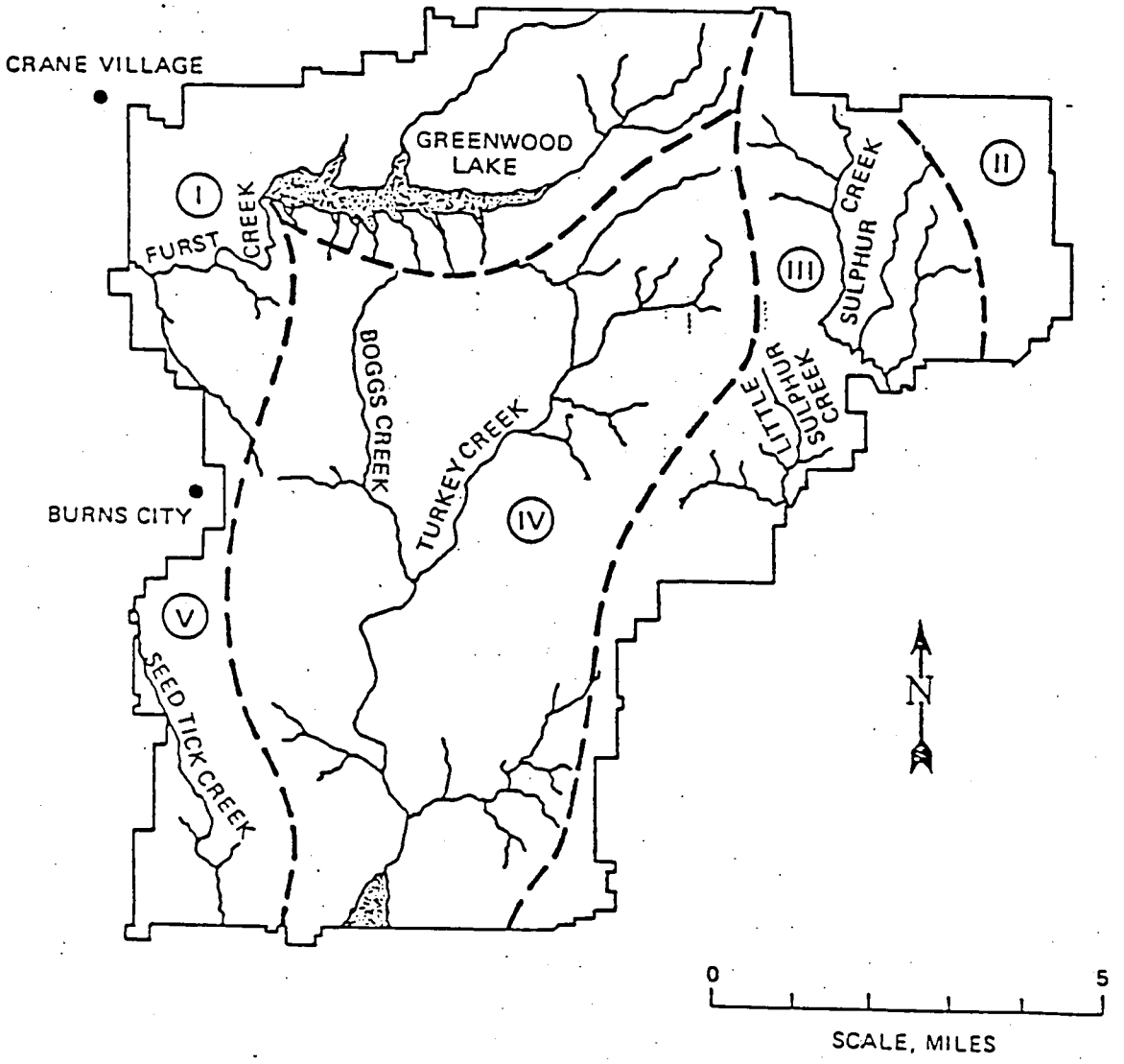


Figure 1. Surface Drainage at the NWSC.

APPENDIX A11

Summary of Well Drilling and Sampling Methods

Field Exploration Procedures Followed at the Present Study Sites

Field procedure

The installation of a monitoring network around each site was conducted in two phases. Phase one was concerned with determining depth to groundwater and the direction of groundwater flow by installing three monitoring wells around each disposal area. Well locations were based on the site topography and estimated water table gradient, and wells were located 25 to 75 ft from the site perimeter. When installed, the wells formed an approximate equilateral triangle around each area with one well up gradient and the remaining two wells down gradient of each disposal site. Water level measurements were recorded daily for seven days and weekly thereafter following each well installation (water levels were measured with an M-scope, a device similar to a volt-ohm meter). The NWSC surveyed all well locations and riser pipe elevations prior to implementation of the second phase. Croundwater elevations from the three initial wells were used to determine the direction of flow and the plane of the water table for each disposal site.

Phase two consisted of installing a sufficient number of wells to obtain a minimum of three monitoring wells along the down gradient perimeter of each disposal site. These wells were located 25 to 75 ft from the site perimeter and equally spaced along the down gradient length to insure optimum subsurface coverage. Additional monitoring wells were installed where more than one direction of flow was encountered or where the down gradient perimeter was large. Prior to drilling the down gradient wells, a surveyed ground elevation was obtained where possible, if not, an estimate of the ground elevation was made to predict the depth where groundwater would be encountered. If the water table was as predicted, the remaining down gradient wells were installed. If the water table was not at the predicted depth, the completed well was given time to stabilize and the new three point problems solved with the next well located accordingly.

Soil sampling procedure

Undisturbed and disturbed soil samples were obtained using two truck-mounted Failing 1500 drilling rigs. An undisturbed soil sample is defined as a sample of minimal disturbance suitable for laboratory testing. The primary method used in obtaining undisturbed soil samples was with a 3-inch (in.) -diameter (diam), fixed piston sampler or Hvorslev sampler (Figure 1). A 3-in. Shelby tube, mounted to the sampler head, was pushed with hydraulic pressure into the stratum being sampled. The sampler was retrieved from its position and the tube removed from the sampler head. Approximately 3 inches of the soil sample was removed from the bottom of the tube for field classification and then sealed into a jar and labeled. Field classification consisted of identifying soil type, color, consistency, water content, and any other visible physical characteristics. Packers were inserted in each end of the sample tube and the sample tube labeled for storage at the NWSC for later shipment to WES for physical testing.

Additional undisturbed sampling methods were employed using a Pitcher sampler (Figure 2) or Dennison barrel. Both sample techniques use an inner sample tube and outer barrel with bit which is drilled into the sample interval. These methods were primarily used with hard soils or weathered rock and very coarse soils where the Hvorslev sampler was not effective.

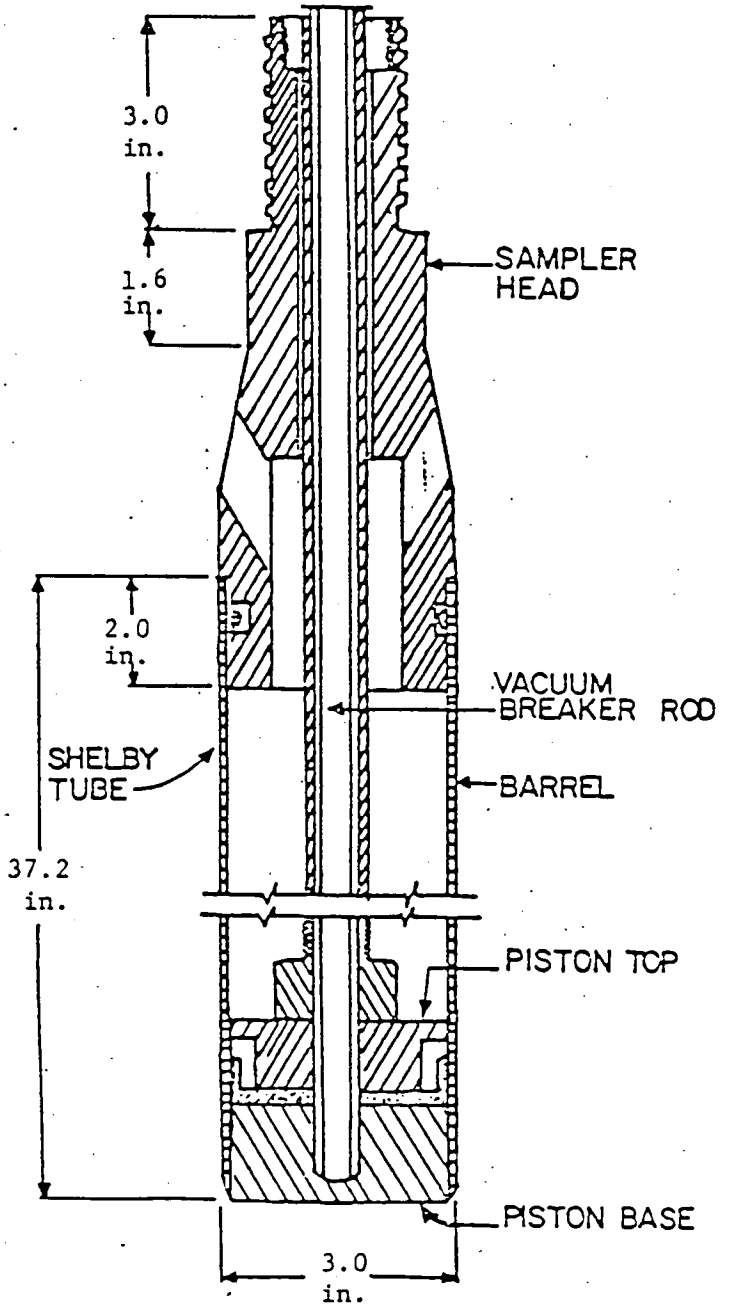


Figure 1. Sketch of Hvorslev Sampler or 3-in. Fixed Piston Sampler

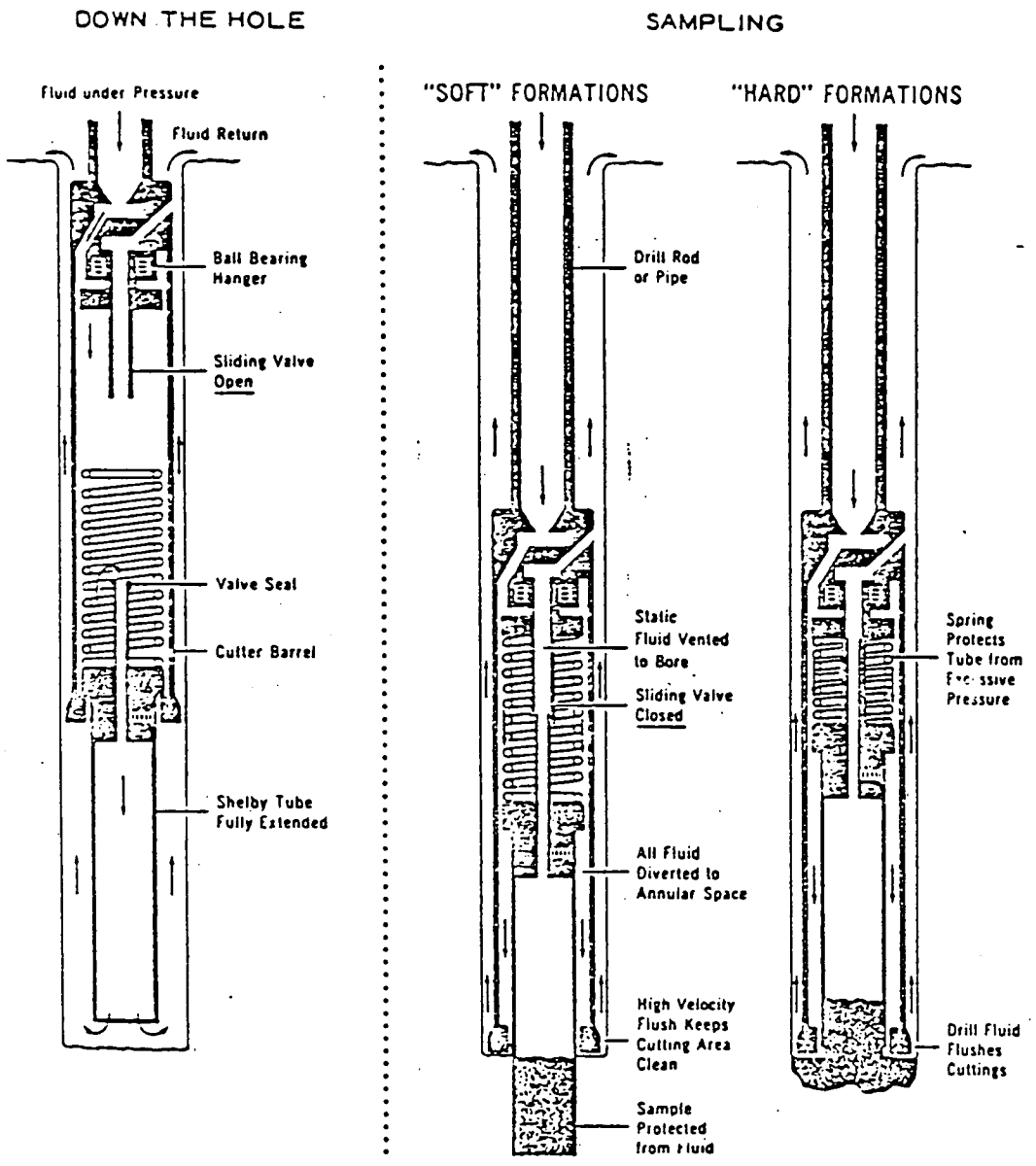


Figure 2. Sketch and Operation of Pitcher Sampler.

Disturbed soil samples were obtained with a split-spoon sampler (Figure 3). A disturbed soil sample contains all the constituents of a particular stratum, but the original structure has been altered. The split-spoon sampler was pushed with hydraulic pressure into the same interval where the Hvorslev sampler failed to obtain a sample. This sample loss generally occurred in very moist or wet sands. The split-spoon sampler was retrieved from its position, disassembled, and the sample removed from the barrel portion where it was classified, sealed into a jar, and labeled for later shipment to WES for laboratory testing.

Additional disturbed soil samples were requested by the NWSC from the Dye Burial Grounds and an ash pile at the Ammunition Burning Grounds. These soil samples were obtained with a folding auger and composite jar samples were made for every 5 ft of material sampled. The NWSC required these samples to conduct chemical analysis on the soil and ash from these areas.

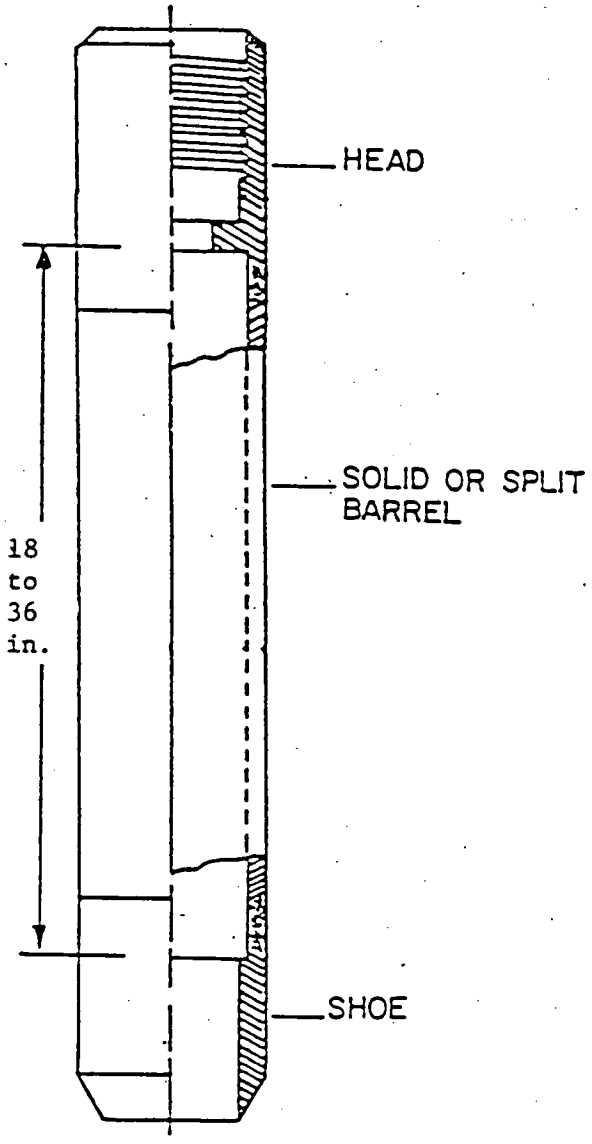
Sampling frequency

The sampling program called for 3-in. fixed piston undisturbed soil samples to be taken at 5-ft intervals - 0, 5, 10 ... ft - until either the water table or rock was encountered. If water was encountered in the overburden, two additional soil samples were taken at 5-ft and 10-ft below the depth where water was first encountered. If bedrock was encountered, boring advance was changed to rock drilling.

Boring advance between sample intervals was made with either a hollow stem auger or folding-solid auger. The hollow stem auger is a combination casing and auger which is used in soils where the boring will collapse when not supported. The folding or solid auger was used primarily in boring advance where soil borings tended to remain open. The hollow stem auger was used only at McComish Gorge and the Old Burning Pit where soils were predominantly coarser-grained.

Drilling

Drilling was initiated where rock was encountered. Rock drilling at the NWSC was done either with a 5-5/8-in. rock bit or 4-in. inside diameter (I.D.) x 5½-in. outside diameter (O.D.) core barrel with diamond bit (Figure 4). At least one boring per site was drilled with the core barrel



O.D. 2 in., 2.5 in., 3 in., 3.5 in.
I.D. 1.5 in., 2 in., 2.5 in., 3 in.

Figure 3. Sketch of Split-Spoon Sampler.

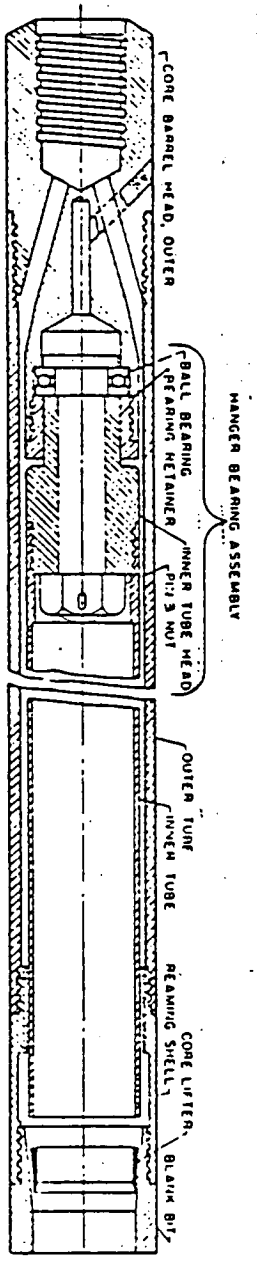


Figure 4. Sketch of 4-in. I.D. x 5-1/2-in. O.D. Core Barrel.

to provide detailed lithologic information and the remaining borings were drilled with a rock bit. Boring advance was ended when the boring was 10 ft below the water table.

Air was used as a medium during rock drilling. A 650 cubic feet per minute air compressor furnished the necessary pressure to remove cuttings from the boring and lubricate the rock bit. During the coring operation it was occasionally necessary for water to be used as a drilling medium instead of air. This occurred when the boring was too deep for cuttings to be efficiently removed by air or the water table prevented the cuttings from reaching the surface. The preferred medium was air because water could mask the water table.

Samples from core borings were not saved, but detailed lithological logs and photographs were made from rock samples. Lithological classification from rock bit borings was made on drill cuttings which identified type, color, grain-size, water content, and drilling resistance of the material. Appendix A contains the field boring logs and Appendix B graphically summarizes the information from the field boring logs.

Well installation

Well installation for each boring was dependent on the site geology. If the water table was encountered in the overburden, one of three situations could occur which was easily determined during the soil sampling operation by pushing two undisturbed soil samples below the depth where water was encountered. Where the saturated zone was found to equal or exceed 12.5 ft, well installation would correspond to Figure 5 and where the saturated zone was less than 12.5 ft, well installation would correspond to Figure 6. The third type of overburden well installation is illustrated in Figure 7 and occurs where the saturated zone is less than 12.5 ft and overlies rock. Figure 8 illustrates installation where the water table is in rock which represents the majority of wells installed at the NWSC.

A well string was made from 2-in. schedule 40 PVC pipe after the depth of the monitoring well was determined. All well strings consisted of a bottom capped silt trap, a slotted section of PVC screen (preconstructed 10-ft

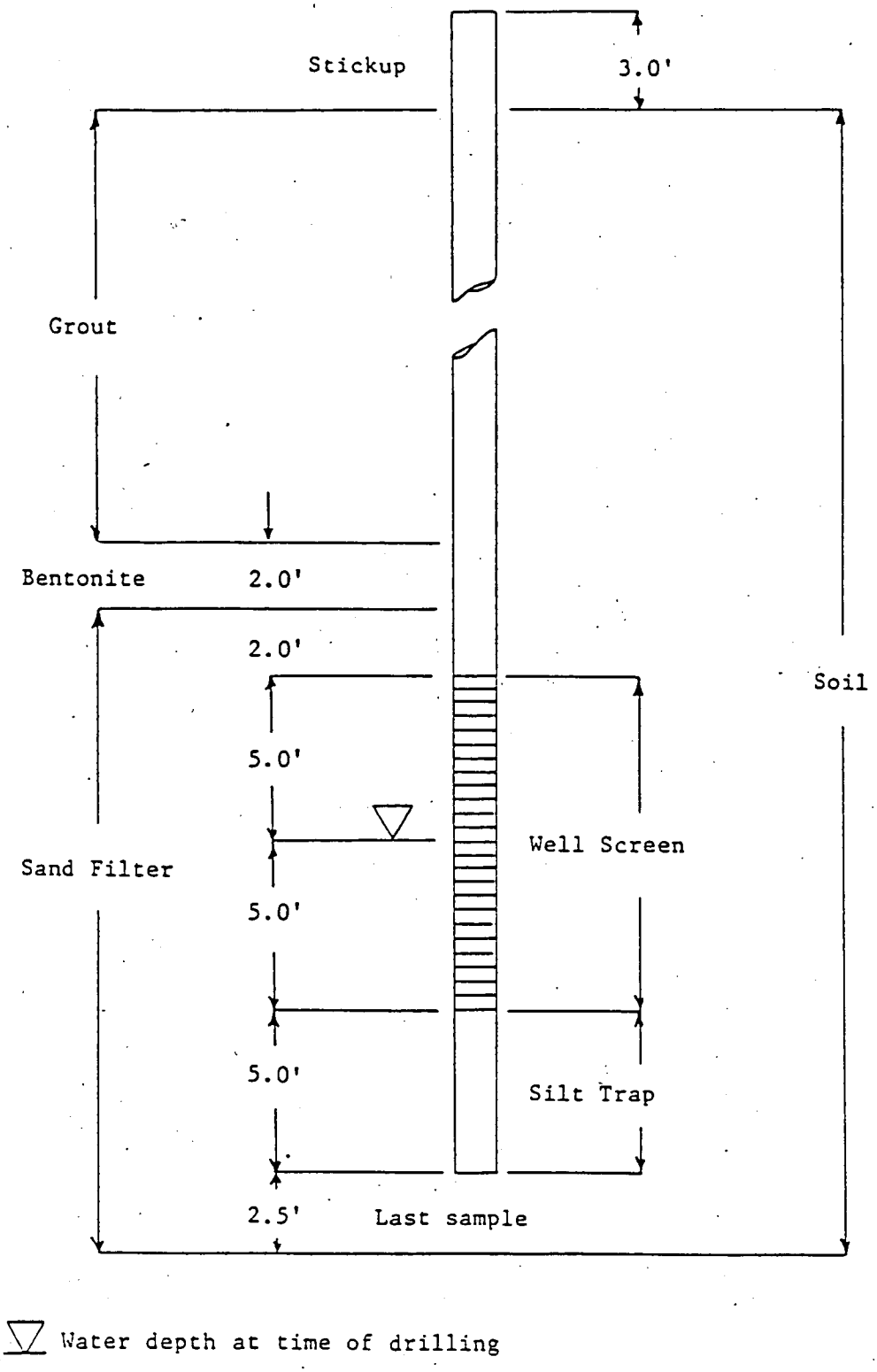


Figure 5. Monitoring Well When Saturated Zone Equals or Exceeds 12.5 ft.

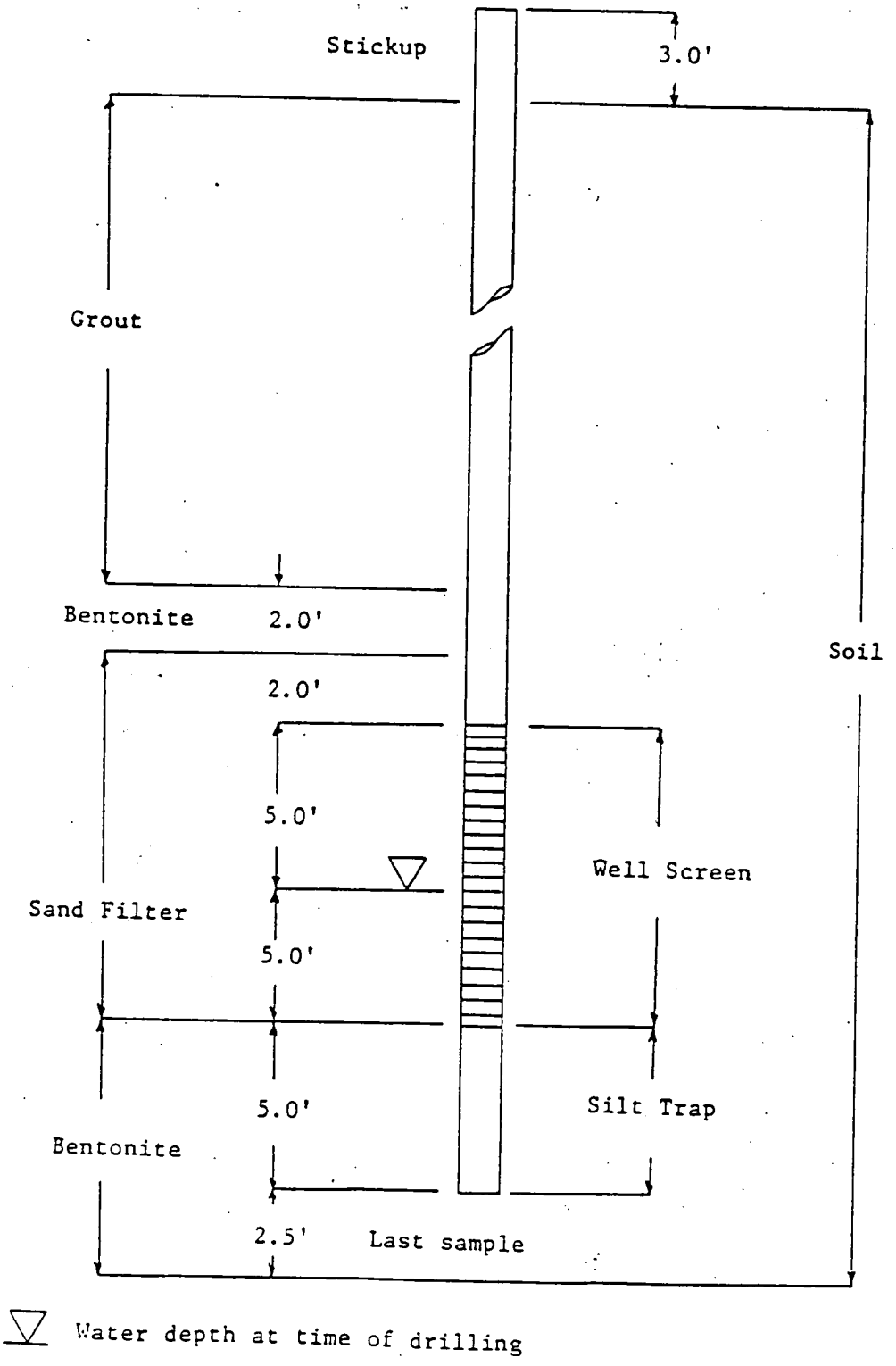


Figure 6. Monitoring Well When Saturated Zone is Less Than 12.5 ft Thick and Overlies Dry Soil.

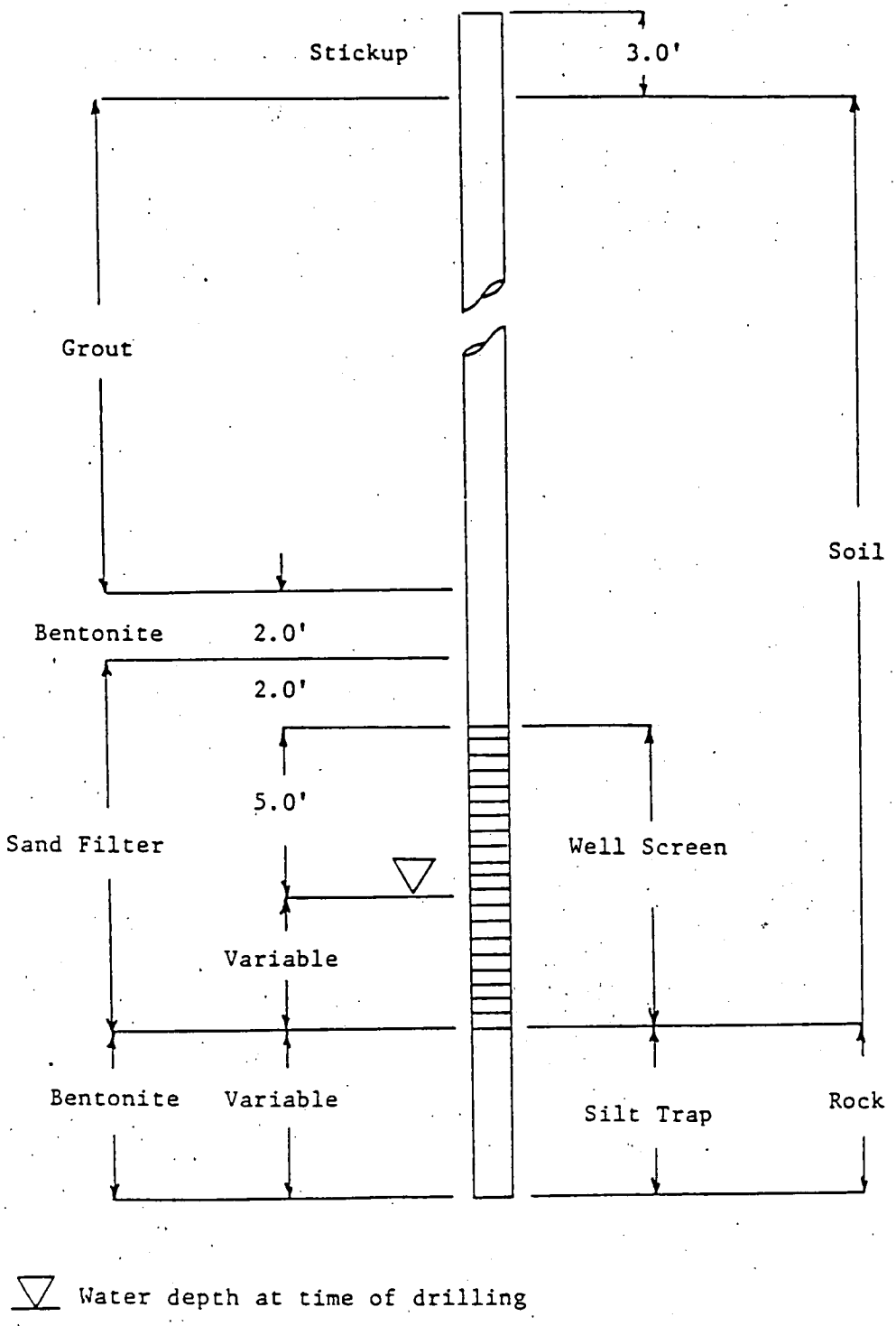


Figure 7. Monitoring Well When Saturated Zone is Less Than 12.5 ft Thick and Overlies Rock.

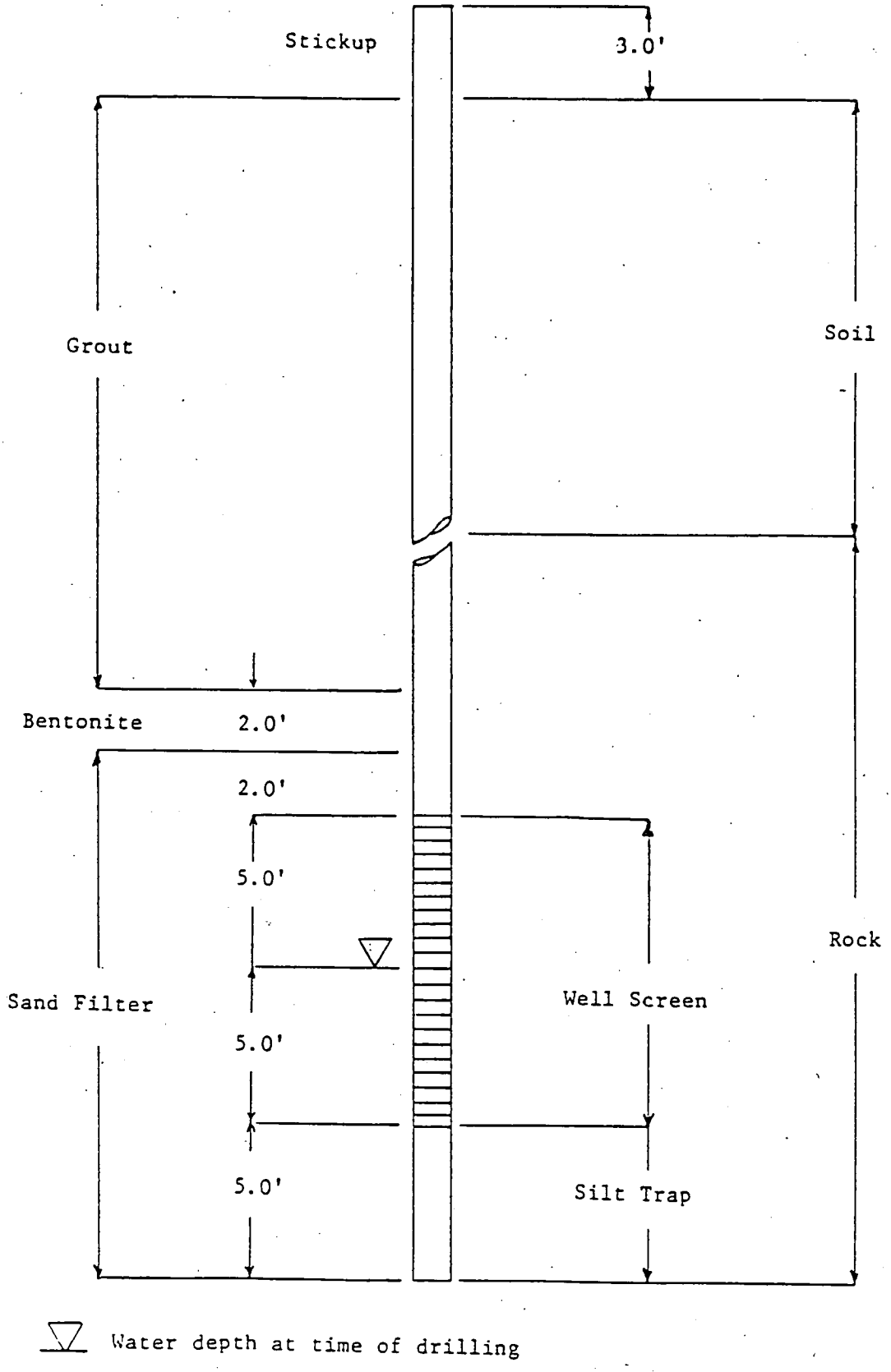


Figure 8. Monitoring Well with Water Table in Rock.

sections with slot width opening of 0.020 in.) and a solid riser pipe extending 3 ft above ground surface. All joints were sealed with PVC cement to prevent leakage and a small vent was sawed into the riser pipe cap to allow equalization of pressure. In shallow borings the well string was lowered as a complete unit while in deeper borings it was necessary to glue the well string in sections when lowering to the desired depth. If the hollow stem auger was used in boring advance (McComish Gorge and Old Burning Pit), the well string was lowered through the hollow stem auger and the hollow stem auger removed.

Well completion was dependent on the applicable geological condition in Figures 5 through 8. If the saturated zone was less than 12.5 ft and was underlain by soil (Figure 6) or bedrock (Figure 7), a bentonite seal was placed around the silt trap to prevent possible contamination of the underlying material from the water table. If the saturated zone was greater than 12.5 ft (Figure 5) or the water table was found in bedrock (Figure 8), a washed filter sand was placed around the silt trap. In all constructions, the annulus between the well screen and boring wall was filled with a washed filter sand (laboratory test results on the filter sand are contained in Appendix 5) to a level approximately 2 ft above the top of the screen, followed by approximately 2 ft of bentonite. The remaining annulus was grouted using a water, cement, and bentonite mixture. The bentonite was added to the grout to prevent shrinking and cracking during the curing process. Surface depressions caused by settling of the grout mixtures were later filled with a similar mixture.

In certain locations additional protection to the well was supplied by a 3-in.-diam, steel pipe with screw cap. All wells in the Demolition Area and the Old Rifle Range were fitted with protector pipes. Those locations where the possibility of damage might result from snow removal or high vehicle trafficked areas were also fitted with protector pipes. These protector pipes were cemented 2 ft below ground surface, vented in the cap, and contained a drain hole at the base. The drain hole prevented trapped water from freezing during the colder months and possible damage to the inner PVC riser pipe. Each monitoring well was labeled and Appendix 3 contains diagrams of all wells installed.

Physical Test and Cation Exchange Capacity

Physical test

Standard soil test procedures as specified by Engineering Manual 1110-2-1906 "Laboratory Soil Testing" were followed during testing. Classification tests (Atterberg limits and grain size distribution of soils), water content, and density tests were performed on all tube samples. Classification tests and water content were performed on all jar samples where no tube samples existed. Permeability tests were performed on selected samples from each site. Detailed testing procedures are presented in Appendix 5 with laboratory soil test data.

Classification of soils was made according to the Unified Soil Classification System (USCS) which depends on the grain size distribution and Atterberg limits. Grain size distribution was determined with standard sieves and the Atterberg limits (liquid and plastic limits) were determined with standard devices. The liquid and plastic limits are the water contents at the boundaries between the semiliquid and plastic state and the plastic and semisolid state, respectively.

Water content and soil density are important engineering relationships and are useful correlations among samples for which a full suite of test data are not available. Water content is the amount of free water in a soil and soil density is the dry weight per soil volume.

Permeability tests were performed on one to three representative samples from each site to evaluate the hydrogeological conditions at each disposal site. The samples above bedrock and the water table furnished an approximate measure of possible migration of contaminants.

Cation exchange capacity

Cation Exchange Capacity (CEC) test procedures as specified by Technical Report EPA/CE 81-1 "Procedures for Handling and Chemical Analysis of Sediment and Water Samples" were followed during testing. The CEC of a soil is a measure of the cations (positive charged ions) reversibility capacity from the surface of the crystalline matrix of a mineral. These cations may be released into the water table under appropriate conditions. CEC tests were generally performed on the jar sample from the first sample tube in each boring.

APPENDIX A12

Summary of the T-Test Used to Identify
Statistically Significant Differences Between
Observed and Background Groundwater Analytical Measurements

DEPARTMENT OF THE ARMY
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY
ABERDEEN PROVING GROUND, MARYLAND 21010

Mr. Nemeth/eam/AUTOVON
584-2927

REPLY TO
ATTENTION OF
HSE-EP-L

MEMORANDUM FOR RECORD

SUBJECT: Statistical Testing Under 40 CFR Part 260.93

1. Use of the Student's t-test is required by the subject regulation to detect significant increases (or pH decreases) of indicator parameters during ground water monitoring at hazardous waste impoundments, landfills, and land treatment facilities. This memorandum is written to serve as a guide for those who must evaluate monitoring data, but are not familiar with hypothesis testing. Clarification of questionable areas in the regulation has been provided by Mr. Barry Stoll of EPA, Commercial 202-755-9116.

382-4495

2. The regulation requires testing of monitoring data against a baseline established during the first year of monitoring. The equations and discussion of their use follows.

$$H: \mu_x = \mu_y \qquad (1)$$

$$t = \frac{\bar{X} - \bar{Y}}{\sqrt{\frac{1}{N_x} + \frac{1}{N_y}} \sqrt{\frac{\sum_{i=1}^{N_x} (X_i - \bar{X})^2 + \sum_{i=1}^{N_y} (Y_i - \bar{Y})^2}{N_x + N_y - 2}}} \qquad (2)$$

$$= \frac{\bar{X} - \bar{Y}}{\sqrt{\frac{1}{N_x} + \frac{1}{N_y}} \sqrt{\frac{(N_x - 1) S_x^2 + (N_y - 1) S_y^2}{N_x + N_y - 2}}} \qquad (3)$$

N_x, N_y Sample Size

S_x, S_y Sample Standard Deviation

$\bar{X}$, $\bar{Y}$ Sample Mean

$\bar{Y}$ and S_y are calculated from data gathered during the first year of monitoring. Samples are taken quarterly and each quarter 4 replicates are analyzed for each parameter. Although these 4 replicates are not independent samples, it is EPA, intent that they be considered as samples for the t-test analysis. The sample size, N_y, for the baseline period is therefore 16. After the first year of monitoring, the indicator parameters will be analyzed at least semi-annually with 4 replicate samples being analyzed for each parameter. The sample size, N_x, during the indicator evaluation program is then 4. Equation (3) is rewritten for N_x=4 and N_y=16:

$$t = \frac{\bar{X} - \bar{Y}}{0.228\sqrt{S_x^2 + 5S_y^2}}$$

The sample standard deviations may be calculated using the formula

$$S_x = \sqrt{\frac{\sum_{i=1}^{N_x}(X_i - \bar{X})^2}{N_x - 1}}$$

$$S_y = \sqrt{\frac{\sum_{i=1}^{N_y}(Y_i - \bar{Y})^2}{N_y - 1}}$$

The sample means are determined using

$$\bar{X} = \frac{\sum_{i=1}^{N_x} X_i}{N_x}$$

$$\bar{Y} = \frac{\sum_{i=1}^{N_y} Y_i}{N_y}$$

The t value is calculated using the above formula. For the parameters specific conductance, total organic carbon (TOC) and total organic halogen (TOH), the hypothesis $\mu_x = \mu_y$ (ground water quality unchanged) is rejected if $t > t_{\alpha; n_x+n_y-2}$. From t distribution tables, $t_{0.01;18}$ is 2.552. If the calculated t for a downgradient well parameter is greater than 2.552, resampling is required by regulation. For pH, because both an increase and a decrease indicate possible ground water contamination, a two-sided test is performed. The t value is

calculated as above and compared to $\pm \alpha/2;\ N_x+N_y-2$, which from t tables is $\pm 0.005;\ 18 = 2.878$. If the absolute value of the calculated t is greater than this value, resampling is again required by regulation.

3. The baseline values of $\bar{Y}$, S_y, and N_y are always calculated for the up-gradient (background) well(s) and are for only the first year of monitoring. Reasonable revisions of the baseline $\bar{Y}$ and S_y may be negotiated on a case-by-case basis after water quality assessments are performed. The t-test must be performed with monitoring data from each well individually (both upgradient and down gradient wells).

4. When resampling is required, (295.93(c)(2)), the samples are split and four replicates are run on each portion.

Gary Nemeth

GARY R. NEMETH
Environmental Engineer
APAP Spt Div

Example - pH

Baseline

6.2, 6.2, 6.2, 6.3

5.9, 5.9, 5.9, 5.9

6.9, 6.9, 6.9, 7.0

6.4, 6.5, 6.5, 6.5

$\bar{Y} = 6.38$

$S_y = 0.389$

$n_y = 16$

a) 6.0, 6.0, 6.0, 6.0

$\bar{X} = 6.0$

$S_x = 0$

$n_x = 4$

calculated $t = -1.916$

$|t| < 2.878$

$\therefore$ accept $H: \mu_x = \mu_y$

b) With this baseline rejection would be required at pH value of 5.8 or 7.0

Example - TOC

Baseline

9, 10, 10, 11

17, 18, 18, 19

7, 7, 8, 9

13, 15, 15, 16

$\bar{Y} = 12.625$

$S_y = 4.225$

$n_y = 16$

a) 18, 19, 19, 19

$\bar{X} = 18.75$

$S_x = 0.5$

$n_x = 4$

Calculated $t = 2.84$

$2.84 > 2.552$

$\therefore$ reject $H: \mu_x = \mu_y$

Assessment required

Example – Specific Conductance

Baseline

190, 200, 200, 200

700, 700, 710, 710

400, 410, 410, 410

250, 250, 250, 250

$\bar{Y} = 390$

$S_y = 204.1$

$n_y = 16$

a) 600, 600, 600, 610

$\bar{X} = 602.5$

$S_x = 5.0$

$n_x = 4$

calculated $t = 2.0$

$2.04 < 2.552$

$\therefore$ accept $H: \mu_x = \mu_y$

b) 700, 700, 700, 700

$\bar{X} = 700$

$S_x = 0$

$n_x = 4$

calculated $t = 2.98$

$2.98 > 2.552$

$\therefore$ reject $H: \mu_x = \mu_y$

Assessment required

APPENDIX A13

Results of the Statistical Analysis of the First and Second - year Analytical Results for Sites 2, 4, and 6

28 DEC 83

CALCULATED MEANS AND STANDARD DEVIATIONS OF INDICATOR PARAMETERS FOR BACKGROUND MONITORING WELLS

418173 CRANE NWSC, IN

DEMO GROUNDS-EAST RIDGE
UPGRADIENT WELLS: 6-7

	MEAN	STD DEV	N	UNITS
PH	4.235	.287	20	PH
COND	3784.375	169.822	16	UMC
TOC	26.412	22.442	16	MGL
TOX	.015	.008	16	MGL

DEMO GROUNDS-WEST RIDGE
UPGRADIENT WELLS: 6-3

	MEAN	STD DEV	N	UNITS
PH	6.887	.550	16	PH
COND	1483.687	51.500	16	UMC
TOC	22.856	15.569	16	MGL
TOX	.026	.029	16	MGL

DYE BURIAL SITE
UPGRADIENT WELLS: 2-5

	MEAN	STD DEV	N	UNITS
PH	6.600	.379	16	PH
COND	2670.500	474.676	16	UMC
TOC	39.331	31.558	16	MGL
TOX	.064	.054	16	MGL

MCCOMISH GORGE
UPGRADIENT WELLS: 4-1

	MEAN	STD DEV	N	UNITS
PH	6.819	.226	16	PH
COND	383.437	33.460	16	UMC
TOC	24.437	24.210	16	MGL
TOX	.018	.010	16	MGL

Incl 1

CALCULATED MEANS AND STANDARD DEVIATIONS OF INDICATOR PARAMETERS FOR BACKGROUND MONITORING WELLS

418173 CRANE NWSC, IN

RIFLE RANGE

UPGRADIENT WELLS: 6-16

	MEAN	STD DEV	N	UNITS
PH	6.662	.247	16	PH
COND	373.875	21.728	16	UMC
TOC	18.419	8.388	16	MGL
TOX	.050	.042	16	MGL

28 DEC 83

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 6-16	6-14	6-15	6-17	6-18	6-19	6-20
WATER										
LEVELS (A)	02 AUG 83		FT	500.1	502.6		499.3	497.5	498.5	498.7
PH(FIELD)	02 AUG 83		PH	6.8	6.2		6.1	7.1	7.1	6.7
PH(FIELD)	02 AUG 83		PH	6.8	6.1		6.1	7.1	7.2	6.7
PH(FIELD)	02 AUG 83		PH	6.8	6.2		6.1	7.1	7.1	6.7
PH(FIELD)	02 AUG 83		PH	6.8	6.2		6.1	7.1	7.1	6.8
SPEC COND	02 AUG 83	1.	UMC	470.	450.		350.	500.	690.	400.
SPEC COND	02 AUG 83	1.	UMC	460.	440.		350.	495.	690.	400.
SPEC COND	02 AUG 83	1.	UMC	470.	440.		350.	490.	700.	400.
SPEC COND	02 AUG 83	1.	UMC	470.	440.		360.	500.	690.	400.
TOC	02 AUG 83	1.0	MGL	23.0	22.0		13.0	22.0	42.0	13.0
TOC	02 AUG 83	1.0	MGL	22.0	22.0		13.0	22.0	43.0	13.0
TOC	02 AUG 83	1.0	MGL	22.0	23.0		13.0	21.0	43.0	13.0
TOC	02 AUG 83	1.0	MGL	23.0	22.0		14.0	21.0	43.0	14.0
TOX	02 AUG 83	.010	MGL	.014 C	ND		ND	.025 C	.040 C	.025 C
TOX	02 AUG 83	.010	MGL	ND	ND		ND	.024 C	.054 C	.023 C
TOX	02 AUG 83	.010	MGL	ND	ND		.015 C	.023 C	.049 C	.028 C
TOX	02 AUG 83	.010	MGL	ND	ND		ND	.027 C	.025 C	.027 C
2,4,6-TNT	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
2,4-DNT	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
2,6-DNT	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
RDX	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND
HMX	02 AUG 83	100.	UGL	100.	ND		ND	ND	ND	ND
TETRYL	02 AUG 83	100.	UGL	ND	ND		ND	ND	ND	ND

Incl 11

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM

B UPGRADIENT SITE

C RESULTS ARE FOR UNFILTERED SAMPLE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: RIFLE RANGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 6-14

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.662	373.875	18.419	.050
BACKGROUND STANDARD DEV	.247	21.728	8.388	.042
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.175	442.500	22.250	.005
CALCULATED STANDARD DEV	.050	5.000	.500	.000
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	3.848	6.157	.895	-2.100
ACCEPT TEST?	REJECT	REJECT	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL G-16 (BACKGROUND WELL)

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.662	373.875	18.419	.050
BACKGROUND STANDARD DEV	.247	21.728	8.388	.042
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.800	467.500	22.500	.007
CALCULATED STANDARD DEV	.000	5.000	.577	.004
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	1.095	8.399	.953	-1.992
ACCEPT TEST?	OK	REJECT	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: RIFLE RANGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 6-17

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.662	373.875	18.419	.050
BACKGROUND STANDARD DEV	.247	21.728	8.388	.042
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.100	352.500	13.250	.007
CALCULATED STANDARD DEV	.000	5.000	.500	.005
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	4.459	-1.918	-1.207	-1.980
ACCEPT TEST?	REJECT	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83 .

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL G-18

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.662	373.875	18.419	.050
BACKGROUND STANDARD DEV	.247	21.728	8.388	.042
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	7.100	496.250	21.500	.025
CALCULATED STANDARD DEV	.000	4.787	.577	.002
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	3.475	10.983	.719	-1.178
ACCEPT TEST?	REJECT	REJECT	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: RIFLE RANGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 6-19

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.662	373.875	18.419	.050
BACKGROUND STANDARD DEV	.247	21.728	8.388	.042
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	7.125	692.500	42.750	.042
CALCULATED STANDARD DEV	.050	5.000	.500	.013
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	3.658	28.585	5.682	-.370
ACCEPT TEST?	REJECT	REJECT	REJECT	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: RIFLE RANGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 6-20

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.662	373.875	18.419	.050
BACKGROUND STANDARD DEV	.247	21.728	8.388	.042
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.725	400.000	13.250	.026
CALCULATED STANDARD DEV	.050	.000	.500	.002
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.498	2.356	-1.207	-1.131
ACCEPT TEST?	OK	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

28 DEC 83

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 4-1	4-2	4-4	4-3	4-5	4-6
WATER LEVELS (A)	29 JUL 83		FT	576.1	567.9	567.8	562.9	564.9	565.2
PH(FIELD)	29 JUL 83		PH		6.8	6.3	6.3	6.0	7.0
PH(FIELD)	29 JUL 83		PH		7.0	6.3	6.3	5.9	7.0
PH(FIELD)	29 JUL 83		PH		6.9	6.3	6.2	5.9	7.0
PH(FIELD)	29 JUL 83		PH		6.9	6.3	6.3	6.0	7.0
PH(FIELD)	02 AUG 83		PH	7.0					
PH(FIELD)	02 AUG 83		PH	6.9					
PH(FIELD)	02 AUG 83		PH	7.0					
PH(FIELD)	02 AUG 83		PH	7.0					
SPEC COND	29 JUL 83	1.	UMC		500.	410.	510.	540.	560.
SPEC COND	29 JUL 83	1.	UMC		490.	420.	510.	550.	560.
SPEC COND	29 JUL 83	1.	UMC		495.	420.	510.	550.	560.
SPEC COND	29 JUL 83	1.	UMC		500.	420.	510.	540.	560.
SPEC COND	02 AUG 83	1.	UMC	390.					
SPEC COND	02 AUG 83	1.	UMC	390.					
SPEC COND	02 AUG 83	1.	UMC	390.					
SPEC COND	02 AUG 83	1.	UMC	395.					
TOC	29 JUL 83	1.0	MGL		33.0	30.0	37.0	65.0	29.0
TOC	29 JUL 83	1.0	MGL		33.0	29.0	38.0	65.0	30.0
TOC	29 JUL 83	1.0	MGL		32.0	29.0	37.0	64.0	30.0
TOC	29 JUL 83	1.0	MGL		32.0	30.0	37.0	65.0	30.0
TOC	02 AUG 83	1.0	MGL	22.0					
TOC	02 AUG 83	1.0	MGL	22.0					
TOC	02 AUG 83	1.0	MGL	23.0					
TOC	02 AUG 83	1.0	MGL	22.0					
TOX	29 JUL 83	.010	MGL		.012 C	.020 C	.058 C	.048 C	.021 C
TOX	29 JUL 83	.010	MGL		ND	.030 C	.036 C	.045 C	.017 C
TOX	29 JUL 83	.010	MGL		.014 C	.015 C	.047 C	.050 C	ND
TOX	29 JUL 83	.010	MGL		.013 C	.037 C	.041 C	.043 C	.017 C
TOX	02 AUG 83	.010	MGL	.054 C					
TOX	02 AUG 83	.010	MGL	.043 C					
TOX	02 AUG 83	.010	MGL	.040 C					
TOX	02 AUG 83	.010	MGL	.018 C					

T.O.I. #

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: MCCOMISH GORGE

LEGEND

NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.

A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
E RESULTS ARE FOR UNFILTERED SAMPLE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: MCCOMISH GORGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 4-1 (BACKGROUND WELL)

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.819	383.437	24.437	.018
BACKGROUND STANDARD DEV	.226	33.460	24.210	.010
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.975	391.250	22.250	.039
CALCULATED STANDARD DEV	.050	2.500	.500	.015
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	1.346	.457	-.177	3.371
ACCEPT TEST?	OK	OK	OK	REJECT

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 4-2

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.819	383.437	24.437	.018
BACKGROUND STANDARD DEV	.226	33.460	24.210	.010
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.900	496.250	32.500	.011
CALCULATED STANDARD DEV	.082	4.787	.577	.004
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.693	6.593	.653	-1.349
ACCEPT TEST?	OK	REJECT	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: MCCOMISH GORGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 4-3

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.819	383.437	24.437	.018
BACKGROUND STANDARD DEV	.226	33.460	24.210	.010
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.275	510.000	37.250	.045
CALCULATED STANDARD DEV	.050	.000	.500	.009
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	4.694	7.412	1.037	4.962
ACCEPT TEST?	REJECT	REJECT	OK	REJECT

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83 .

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

GROUND-WATER MONITORING STATISTICAL ANA YSIS

WELL 4-4

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.819	383.437	24.437	.018
BACKGROUND STANDARD DEV	.226	33.460	24.210	.010
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.300	417.500	29.500	.025
CALCULATED STANDARD DEV	.000	5.000	.577	.010
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	4.500	1.990	.410	1.344
ACCEPT TEST?	REJECT	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: MCCOMISH GORGE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 4-5

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.819	383.437	24.437	.018
BACKGROUND STANDARD DEV	.226	33.460	24.210	.010
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	5.950	545.000	64.750	.046
CALCULATED STANDARD DEV	.058	5.774	.500	.003
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	7.486	9.434	3.263	5.532
ACCEPT TEST?	REJECT	REJECT	REJECT	REJECT

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: MCCOMISH GORGE

GROUND-WATER MONITORING STATISTICAL AN' YSIS

WELL 4-6

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.819	383.437	24.437	.018
BACKGROUND STANDARD DEV	.226	33.460	24.210	.010
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	7.000	560.000	29.750	.015
CALCULATED STANDARD DEV	.000	.000	.500	.007
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	1.569	10.340	.430	-.562
ACCEPT TEST?	OK	REJECT	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

28 DEC 83

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

SAMPLING SITES
RESULTS

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	B 2-5	2-1	2-6	2-7	2-8	2-2	2-3
WATER LEVELS (A)	27 JUL 83		FT	685.3	722.6	684.9	684.0	685.2	680.5	678.4
PH(FIELD)	27 JUL 83		PH	6.5	6.8	6.5	6.6	6.5	6.6	
PH(FIELD)	27 JUL 83		PH	6.5	6.6	6.5	6.6	6.4	6.5	
PH(FIELD)	27 JUL 83		PH	6.5	6.8	6.5	6.5	6.4	6.6	
PH(FIELD)	27 JUL 83		PH	6.5	6.7	6.4	6.5	6.4	6.5	
PH(FIELD)	30 JUL 83		PH							6.3
PH(FIELD)	30 JUL 83		PH							6.3
PH(FIELD)	30 JUL 83		PH							6.3
PH(FIELD)	30 JUL 83		PH							6.3
SPEC COND	27 JUL 83	1.	UMC	3100.	2400.	4500.	3000.	2650.	2200.	
SPEC COND	27 JUL 83	1.	UMC	3050.	2400.	4600.	3050.	2600.	2200.	
SPEC COND	27 JUL 83	1.	UMC	3100.	2400.	4600.	3050.	2600.	2200.	
SPEC COND	27 JUL 83	1.	UMC	3100.	2400.	4600.	3000.	2600.	2200.	
SPEC COND	30 JUL 83	1.	UMC							1200.
SPEC COND	30 JUL 83	1.	UMC							1200.
SPEC COND	30 JUL 83	1.	UMC							1200.
SPEC COND	30 JUL 83	1.	UMC							1210.
TOC	27 JUL 83	1.0	MGL	89.0	57.0	66.0	71.0	98.0	58.0	
TOC	27 JUL 83	1.0	MGL	86.0	57.0	65.0	71.0	99.0	57.0	
TOC	27 JUL 83	1.0	MGL	86.0	59.0	64.0	70.0	98.0	57.0	
TOC	27 JUL 83	1.0	MGL	88.0	59.0	64.0	71.0	99.0	58.0	
TOC	30 JUL 83	1.0	MGL							49.0
TOC	30 JUL 83	1.0	MGL							48.0
TOC	30 JUL 83	1.0	MGL							49.0
TOC	30 JUL 83	1.0	MGL							50.0
TOX	27 JUL 83	.010	MGL	ND	.069 C	.060 C	ND	ND	.036 C	
TOX	27 JUL 83	.010	MGL	ND	.092 C	.047 C	ND	ND	.033 C	
TOX	27 JUL 83	.010	MGL	ND	.070 C	.030 C	ND	ND	.047 C	
TOX	27 JUL 83	.010	MGL	ND	.056 C	.046 C	ND	ND	.020 C	
TOX	30 JUL 83	.010	MGL							.022 C
TOX	30 JUL 83	.010	MGL							.027 C
TOX	30 JUL 83	.010	MGL							.027 C
TOX	30 JUL 83	.010	MGL							.027 C

T-01 6

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

PARAMETER	SAMPLING DATE	DETECTION LIMIT	UNITS	SAMPLING SITES RESULTS 2-4	
WATER LEVELS (A)	27 JUL 83		FT	681.5	
PH(FIELD)	27 JUL 83		PH	6.1	
PH(FIELD)	27 JUL 83		PH	5.9	
PH(FIELD)	27 JUL 83		PH	6.0	
PH(FIELD)	27 JUL 83		PH	6.0	
SPEC COND	27 JUL 83	1.	UMC	1800.	
SPEC COND	27 JUL 83	1.	UMC	1800.	
SPEC COND	27 JUL 83	1.	UMC	1800.	
SPEC COND	27 JUL 83	1.	UMC	1800.	
TOC	27 JUL 83	1.0	MGL	33.0	
TOC	27 JUL 83	1.0	MGL	32.0	
TOC	27 JUL 83	1.0	MGL	32.0	
TOC	27 JUL 83	1.0	MGL	34.0	
TOX	27 JUL 83	.010	MGL	.070	C
TOX	27 JUL 83	.010	MGL	.066	C
TOX	27 JUL 83	.010	MGL	.088	C
TOX	27 JUL 83	.010	MGL	.082	C

RUN DATE: 07 NOV 83

INSTALLATION: CRANE NWSC, IN SITE: DYE BURIAL SITE

LEGEND
NOTES: ALL METALS AND OTHER PARAMETERS WHERE APPROPRIATE ARE ON A DISSOLVED (FILTERED) BASIS UNLESS OTHERWISE NOTED. DETECTION LIMITS SHOWN ARE NORMAL LEVELS; ACTUAL LIMITS MAY VARY IN ENVIRONMENTAL SAMPLES. ANALYTICAL RESULTS ARE ACCURATE TO EITHER 2 OR 3 SIGNIFICANT FIGURES.
A VALUES SHOWN ARE FOR WATER LEVEL ELEVATION ABOVE A REFERENCE DATUM
B UPGRADIENT SITE
C RESULTS ARE FOR UNFILTERED SAMPLE

MGL - MILLIGRAMS/LITER
UGL - MICROGRAMS/LITER
PCL - PICOCURIES/LITER
UMC - MICROMHOS/CENTIMETER
NTU - NEPHELOMETRIC TURBIDITY UNITS
TON - THRESHOLD ODOR NUMBER
TDN - TASTE DILUTION INDEX NUMBER
CU - COLOR UNITS
PHM - PER 100 MILLILITERS

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-1

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.725	2400.000	58.000	.072
CALCULATED STANDARD DEV	.096	.000	1.155	.015
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.642	-1.117	1.159	.279
ACCEPT TEST?	OK	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-2

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.550	2200.000	57.500	.034
CALCULATED STANDARD DEV	.058	.000	.577	.011
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.258	-1.942	1.128	-1.084
ACCEPT TEST?	OK	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-3

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.300	1202.500	49.000	.026
CALCULATED STANDARD DEV	.000	5.000	.816	.002
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	1.551	-6.060	.600	-1.388
ACCEPT TEST?	OK	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83 .

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-4

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.000	1800.000	32.750	.076
CALCULATED STANDARD DEV	.082	.000	.957	.010
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	3.088	-3.594	-.409	.452
ACCEPT TEST?	REJECT	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-5 (BACKGROUND WELL)

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.500	3087.500	87.250	.005
CALCULATED STANDARD DEV	.000	25.000	1.500	.000
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.517	1.721	2.975	-2.141
ACCEPT TEST?	OK	OK	REJECT	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-6

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.475	4575.000	64.750	.046
CALCULATED STANDARD DEV	.050	50.000	.957	.012
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.645	7.854	1.578	-.659
ACCEPT TEST?	OK	REJECT	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-7

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.550	3025.000	70.750	.005
CALCULATED STANDARD DEV	.058	28.868	.500	.000
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.258	1.463	1.951	-2.141
ACCEPT TEST?	OK	OK	OK	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

RUN DATE 07 NOV 83

INSTALLATION: CRANE NWSC, IN

SITE: DYE BURIAL SITE

GROUND-WATER MONITORING STATISTICAL ANALYSIS

WELL 2-8

	PH	SPEC COND	TOC	TOX
UNITS		UMC	MGL	MGL
BACKGROUND MEAN	6.600	2670.500	39.331	.064
BACKGROUND STANDARD DEV	.379	474.676	31.558	.054
BACKGROUND SAMPLE SIZE	16	16	16	16
CALCULATED MEAN	6.425	2612.500	98.500	.005
CALCULATED STANDARD DEV	.050	25.000	.577	.000
SAMPLE SIZE	4	4	4	4
DEGREES OF FREEDOM	18	18	18	18
REFERENCE/BOOK T-VALUE	2.878	2.552	2.552	2.552
CALCULATED T-VALUE	.903	-.239	3.674	-2.141
ACCEPT TEST?	OK	OK	REJECT	OK

THIS STUDENT'S T-TEST AT THE 0.01 LEVEL OF SIGNIFICANCE IS A TWO-TAILED TEST FOR PH AND A SINGLE-TAILED TEST FOR THE OTHER INDICATOR PARAMETERS. A CALCULATED T-VALUE GREATER THAN THE REFERENCE T-VALUE INDICATES A STATISTICALLY SIGNIFICANT CHANGE OF THE CONCENTRATION OR VALUE OF THE INDICATOR PARAMETER FROM BACKGROUND. THIS TEST IS FOR DATA WITH SAMPLING DATES FROM 09 JUL 83 TO 31 DEC 83

APPENDIX A14

Paper Published by Lord, et.al. which Critiques
Ten Popular Geophysical Survey Techniques

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THE IDENTIFICATION AND LOCATION OF BURIED CONTAINERS VIA NON-DESTRUCTIVE TESTING METHODS

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(Received June 2, 1981; accepted in revised form October 5, 1981)

Summary

The problem of identifying and locating containers of hazardous materials located beneath the ground surface or under water can be solved by either some form of excavation or by a suitable non-destructive testing method. In this latter category are techniques which include standard geophysical methods, as well as a number of newer methods adopted from other technologies. This paper reviews these methods giving examples of each as it pertains to the buried container problem.

The conclusions section gives recommendations as to where each method is most applicable, as well as a comparison of each method on the basis of cost, deployment, interpretation, results and maximum depth of penetration.

Introduction

The investigation of sub-surface objects (either buried beneath the ground surface or underwater) can be approached in two very different ways. The first type that generally comes to mind is by use of a suitable destructive test method. In this category are the following:

- test pits
- excavation trenches
- auger holes
- core borings
- observation wells

While one does indeed "see" the subsurface materials as they are excavated for ease of examination or subsequent testing, such methods are not without drawbacks in identifying and locating buried containers. Some disadvantages of destructive test methods for this purpose are:

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- The information obtained is discontinuous over the area investigated.
- Permission to enter the properties in question (and excavate therein) may be troublesome or impossible to obtain.
- Access for excavation equipment may not be available at the site in question.
- Costs are generally high, e.g., small amounts of excavation can easily be $200/cu. yd and boring costs of $10/ft are not uncommon.
- There is a danger to personnel from containers containing hazardous, toxic or radioactive materials which have been inadvertently ruptured or pierced by the excavations or borings.
- There is a danger to the environment due to such materials emptying out of the containers if they have been ruptured or pierced.

The second type of approach to identifying and locating buried containers is by use of a suitable non-destructive testing (NDT) method. Within this category are the following methods which have been used or seem to have applicability:

- seismic reflection
- seismic refraction
- electrical resistivity
- low frequency electromagnetic (conductivity)
- induced polarization
- eddy current (metal detector)
- magnetometer
- continuous microwave (CW)
- pulsed radio frequency (ground penetrating radar)
- infrared radiation
- sonar (pulse echo acoustics)

All of the above methods are not equally suited for identifying and locating buried containers, but many are, and the interest in these NDT approaches to the problem seems to be increasing. The major disadvantage at this time seems to be one of non-familiarity, a feature which this paper is aimed at overcoming.

The structure of the paper will be to present a brief survey of those NDT methods which have been used to date in identifying and locating buried containers, and then to present a few case histories showing the type of output each method generates. An extension into related problems, e.g., location of buried land mines and utilities, will also be included. Our conclusions will present an assessment of the current and potential advantages and disadvantages of each method for the identification and location of buried containers.

Current NDT methods used to detect buried containers

This section presents the basis of our findings on the subject of the identification and location of buried containers via NDT methods. As mentioned in the introduction there are indeed a wide variety of available NDT methods. So as not to bias the paper with any particular method, this section has been

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(a) Ground prob

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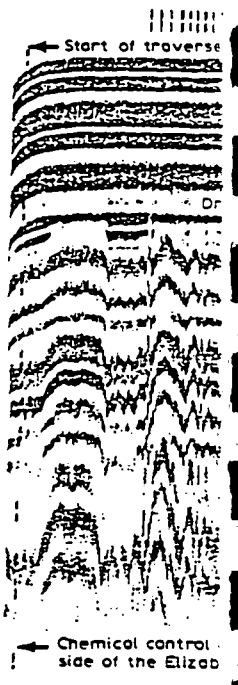

Fig. 1. Ground pene
to Chemical Control

arranged in the order of the most widely used NDT method first, down to those methods which have been used only once. An example of each method accompanies the technical background material. Additional detail on fundamentals is given in Ref. [1] and on case histories in Ref. [2].

(a) Ground probing radar (GPR)

A short (~ 10^{-8} sec long) pulse of electromagnetic energy of "carrier" frequency about 300 MHz is sent into the ground. A reflection occurs when a medium of different dielectric constant is encountered, e.g., a buried metal drum or a very distinct water surface. The time it takes for the pulse to travel down and back gives an indication of the spatial extent of the sub-surface objects. Several systems are commercially available and surveys to a depth of about 10 feet (deeper in dry soils and shallower in saturated soils) can be made rather quickly over relatively large areas. The usual output gives the strength of the return echo as a degree of blackening on an Alden-type recorder, examples of which follow.

In connection with the recent fire and series of explosions at the Chemical Control Corporation's site in Elizabeth, New Jersey, Roy Weston Associates [3] was contracted by the U.S. Coast Guard to determine the location of 55

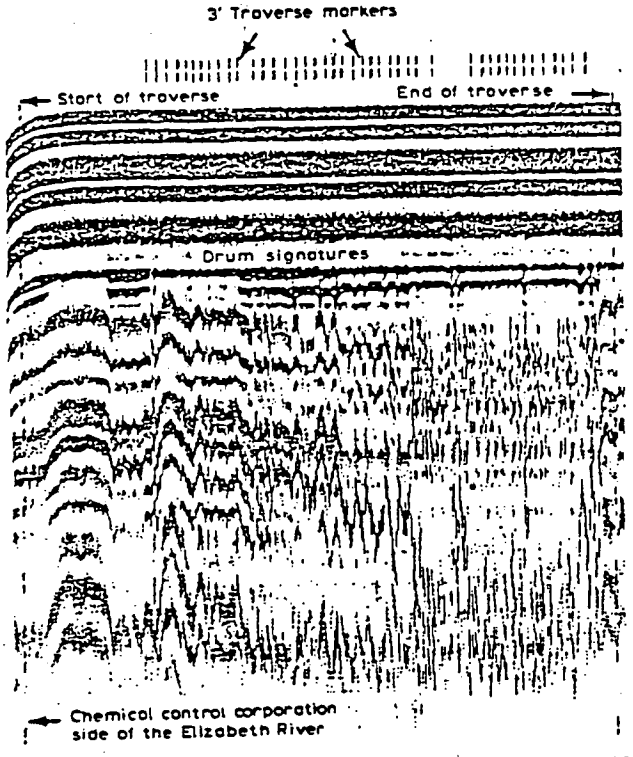

Fig. 1. Ground penetrating radar printout for traverse No. 39 in Elizabeth River, adjacent to Chemical Control Corporation Site, Elizabeth, New Jersey.

gal. steel drums suspected of being hurled into the adjacent Elizabeth River. A commercially available GPR system was adapted for river work by placing the antenna in a raft and pulling it by a small boat with the readout equipment on board. They performed 123 perpendicular traverses of the river at 10′ intervals and an additional 11 traverses at 10′ intervals parallel to the river flow. The object was to locate the drums which were on the river bottom, or embedded in the soft river silts and clays. The soft bottom sediment was estimated at 3′ to 5′ thick. The river depth ranged from 9′ to 13′.

The GPR traces showed a number of clear, unmistakable drum reflections, see Fig. 1. The carefully planned and executed GPR mapping of the site enabled the pinpointing of the location of many, or all, of the drums. Unfortunately, clean-up has not been initiated, so that "ground truth" has not been established.

Drexel University [4] is conducting ongoing research for EPA where steel drums are buried at known depths in various soil types (three sites; one a sand, one a river silt, and the third a silty clay) to determine the limitations of commercially available GPR equipment. The antenna used has a center frequency of 300 MHz and traverses are made at approximately one month intervals over the complete range of climatic conditions. To date, it has been found that:

- Traverses perpendicular to the drum axes are much more definitive than those parallel to the drum.
- Dry sand conditions show the best reflections.
- With soil at a high moisture content, as in a capillary zone, the reflections are very poor.
- When the water table is at the level of the top of the drum, the drum reflection is almost completely masked.
- Snow cover, or frozen ground, does not influence the readings.
- High moisture content of the upper soil (as immediately after a rain) limits the depth of the return signal.
- Ground vegetation limits the depth of the return signal.

Some examples of metal drums buried in sand at different depths traversed perpendicular to the axis and parallel to the axis are shown in Figs. 2 and 3, respectively.

(b) Metal detector (also called inductive or eddy current) method

This NDT method utilizes a search coil with an alternating current (a.c.) in it. It thereby produces an a.c. magnetic field which induces eddy currents in a nearby metallic object. These eddy currents produce a magnetic moment in the metal which then interacts back (via mutual inductance) on the search coil. The size of this mutual inductance is read out and gives an indication of the presence and size of the metallic object. This is the principle on which most metal detectors work. There are a wide variety of these relatively inexpensive metal detectors commercially available and they have been quite successful in detecting buried objects at relatively shallow depths. Penetration depth is obviously dependent upon the size of the buried object.

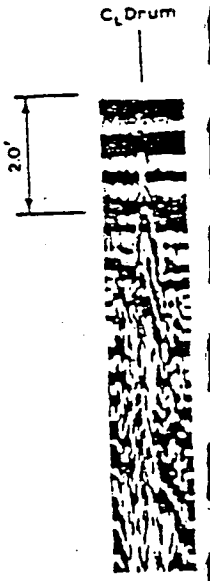

Fig. 2. Pulsed rad
by GPR traverse

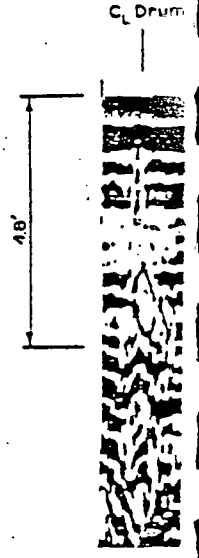

Fig. 3. Pulsed ra
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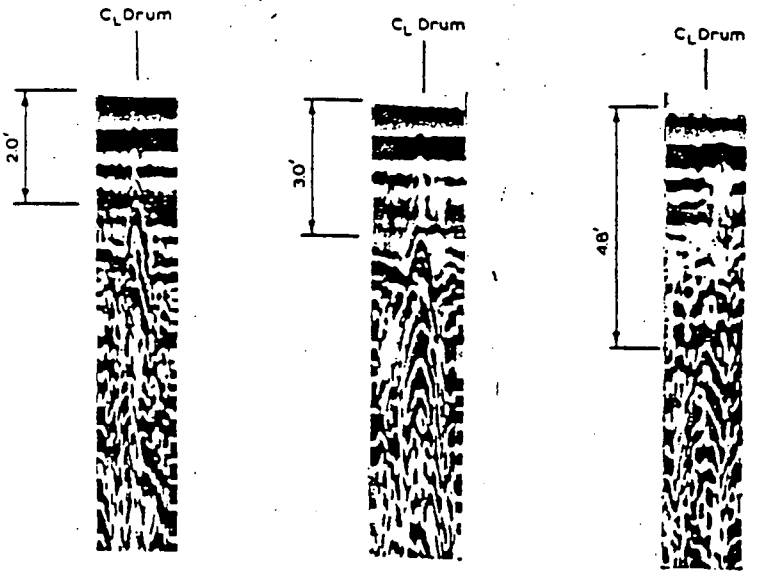

Fig. 2. Pulsed radar survey of buried metal drums in sandy soil at Wharton Site, surveyed by GPR traversed perpendicular to drum axis.

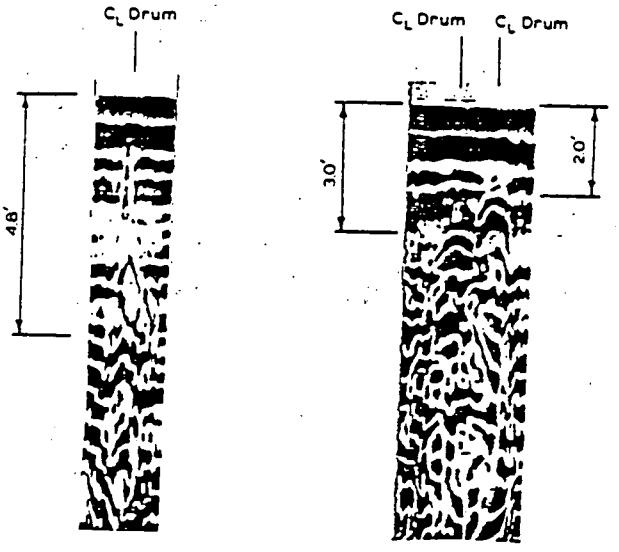

Fig. 3. Pulsed radar survey of buried metal drums in sandy soil at Wharton Site, surveyed by GPR traversed parallel to drum axis.

In conducting a survey over the location of a cluster of buried steel drums, Benson and Glaccum [5] show a clear metal detector reflection for the entirety of the 5 meter (≈ 15′) wide area, see Fig. 4. The return signal rises sharply above background on one side of the location of the drums, stays high, and

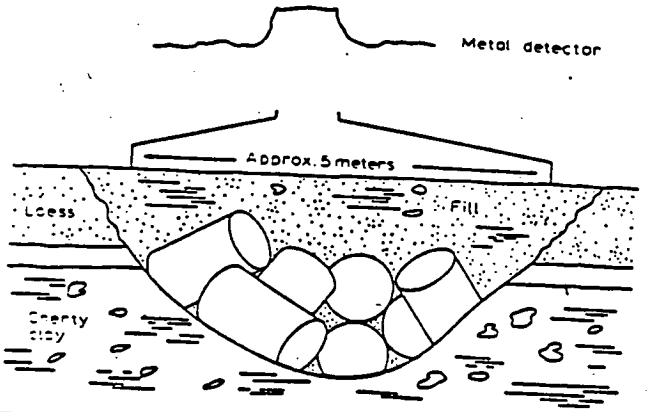

Fig. 4. Results of metal detector survey over buried container area [5].

then abruptly falls off as the traverse leaves the vicinity. The topmost portion of the drums were covered with about two feet of soil, which is apparently shallow enough so that changes in conductivity can be easily sensed by the metal detector. The authors state that in comparison to other NDT methods used at this site, "the metal detector provides a sharper response at the edge of the trench, resulting in better spatial definition of the drum boundaries".

(c) Magnetometer

A magnetometer is a device which measures very minute changes in the earth's magnetic field. Any magnetic object, e.g., an iron ore deposit, buried steel object, etc., will alter the earth's magnetic field locally and thus can potentially be detected. The most common magnetometer today uses proton nuclear magnetic resonance, called proton precession, while another type uses cesium vapor. The nuclear spin of the proton can be made to flip in a radio frequency (r.f.) field. When the frequency of the r.f. field and the d.c. magnetic field have appropriate values, there is a maximum flip rate and hence maximum energy absorption.

The proton magnetometer has the frequency set in such a way that maximum absorption is occurring under the normal magnetic field of the earth. If a magnetic object is encountered, the frequency goes out-of-tune and the frequency change one needs to bring it back into tune is a very precise measure of the change in magnetic field due to the magnetic object. A new, very sensitive magnetometer based on the superconducting Josephson effect, and called SQUID, is now commercially available.

Recognizing that the magnetometer detects only ferrous materials, but to a greater depth than metal detectors, Sandness et al. [6] developed a vehicle mounted cesium vapor magnetometer which was digitally interfaced to a microprocessor for data acquisition purposes. For the particular survey described, however, they used a commercially available proton precession magnetometer. Using three spherical steel sources (drums?) in the Hanford, Washington area

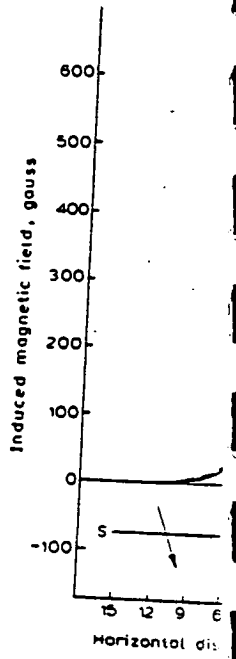

Fig. 5. Induced magn

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- The amplitud part.
- The anomaly dimensions.

Magnetometers great deal in geoph proton precession of a magnetometer zones of converging located.

(d) Electrical resisti

This geophysical and depends, for its conductivity alters t the distribution of e potential measured

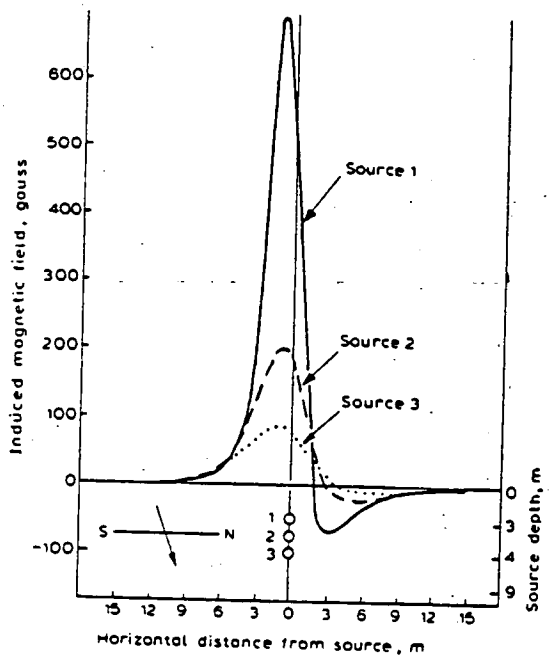

Fig. 5. Induced magnetic field from three buried containers at varying depths [6].

at depths of 3.0, 4.5 and 6.0 m, they found the response shown in Fig. 5 and drew the following conclusions.

- The earth's gravitational field pulled the maximum anomaly south of the source.
- The width of the anomaly is related to the source depth.
- The amplitude of the negative part of the anomaly is 10% of the positive part.
- The anomaly is small at burial depths greater than three times the source dimensions.

Magnetometers of several types are commercially available and are used a great deal in geophysical prospecting. An example of typical output using a proton precession magnetometer is shown in Fig. 6 which presents the results of a magnetometer field survey from a burial site consisting of dry soil. The zones of converging magnetic anomalies show where the buried objects are located.

(d) Electrical resistivity

This geophysical method applies current to the ground through electrodes and depends, for its operation, on the fact that any subsurface variation in conductivity alters the form of the current flow within the earth. Therefore, the distribution of electric potential is affected. The degree to which the potential measured at the surface is affected depends on the size, shape, loca-

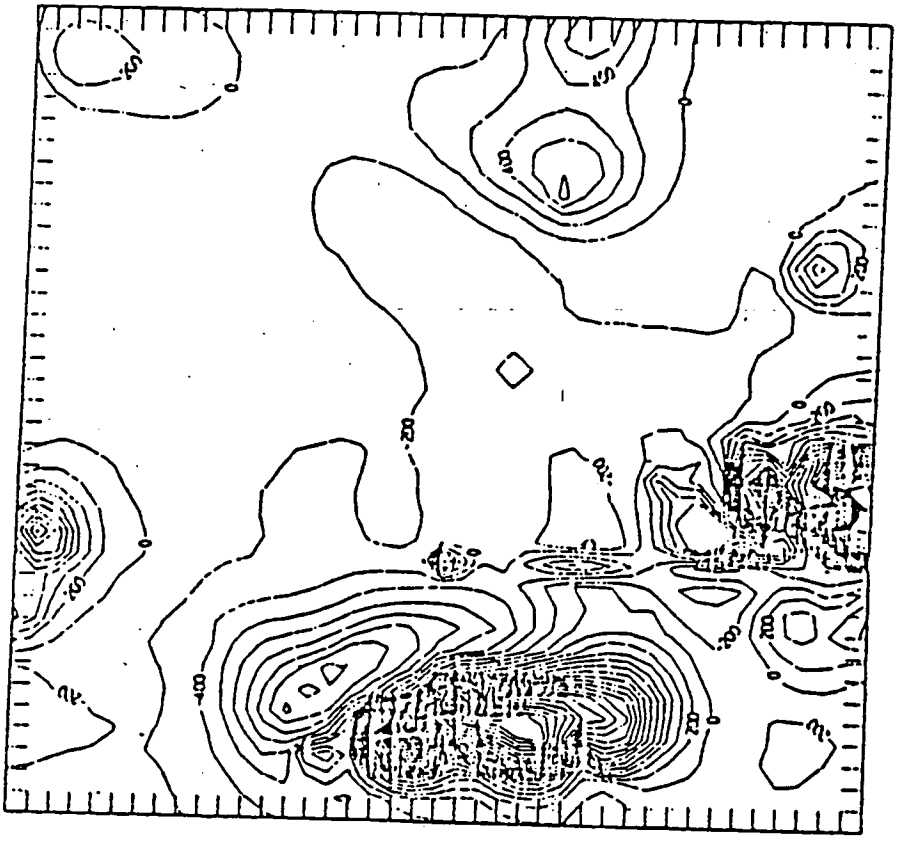

Fig. 6. Contour plot of magnetometer field survey data from a dry burial area.

tion and electrical resistivity of the sub-surface mass. It is therefore possible to obtain information about the sub-surface distribution of various bodies or the tracing of sub-surface seepage plumes from potential measurements made at the surface. This method is used extensively in the oil and mineral prospecting area, but has not been widely used in shallow monitoring for small buried objects. It has seen some use for tracing sub-surface liquids. There are many commercial sources of equipment to choose from.

At the Coventry, Rhode Island, site, the Mitre Corporation [7] used electrical resistivity as a seepage plume detection method. As various traverses were made, the area of buried drums was encountered and resistivity measurements were made. The high drum concentration was probably responsible for the extremely low resistivity values; see Fig. 7 which shows the results of a number of resistivity traverses in which the fourth was made in the vicinity of the buried drums. The high density of drums probably resulted in a large volume of highly conductive chemicals which would result in a strong effect on resistivity measurements. It should be mentioned, however, that the Mitre report does not dwell on the use of electrical resistivity to locate buried drums.

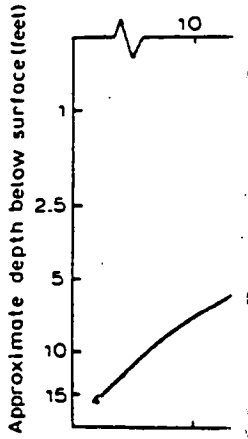

Fig. 7. Apparent resi

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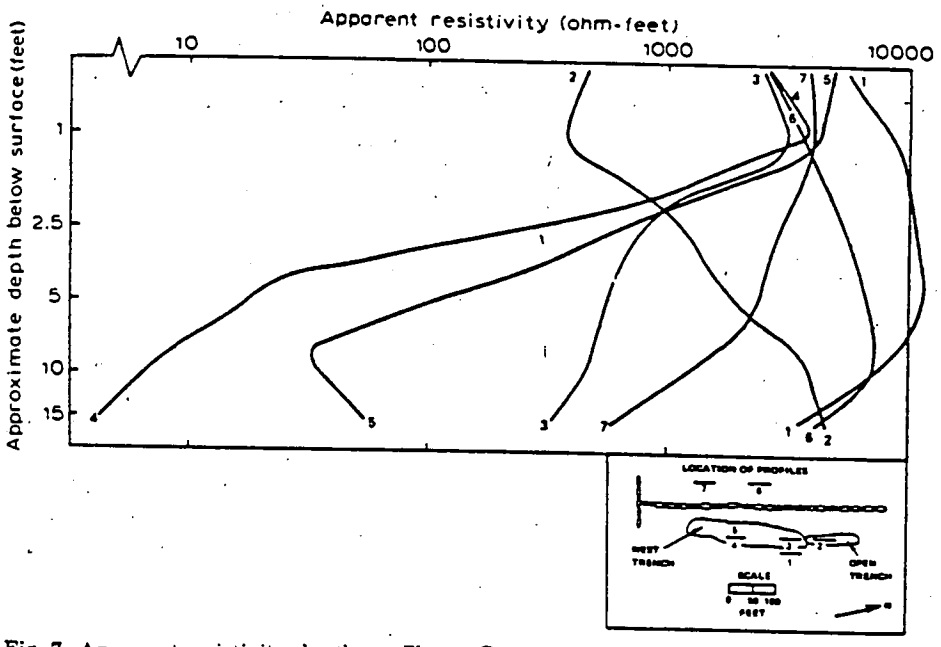

Fig. 7. Apparent resistivity depth profiles at Coventry, Rhode Island [7].

(e) Low frequency (VLF) electromagnetic

Electromagnetic methods utilize the measurement of secondary electromagnetic fields generated by induction in sub-surface conductors. The primary energy sources are electromagnetic fields generated by U.S. Navy VLF transmitting stations or fields generated during the study from a separate coil or line. That is, the transmitted waves induce currents in sub-surface conductors as the waves pass through them. The currents are formed in accordance with the laws of EM induction and conduction. The currents are then sources of new waves which radiate from the conductors and are detected at the surface. Inhomogeneities in the electromagnetic field observed at the surface indicate variations in conductivity of sub-surface features which are picked up with the receiver at the surface. This method is probably the most recently employed of those mentioned in this paper. Thus, its use in detecting small buried objects is largely unknown.

Benson and Glaccum [5] used the VLF—EM method to locate buried drums under approximately 2 feet of soil and were quite successful in doing so. The trench where the drums were buried was about 5 meters (15 feet) wide and the method showed the trench boundaries quite well, see Fig. 8. The general response from a number of parallel traverses made over the site is shown as a composite diagram in the corner of Fig. 8. Note that individual drum locations within the soil mass cannot be distinguished, but general boundaries are quite easily seen. Since the VLF—EM method responds to the conductivity of the drums, the high density of metal apparently eliminates resolution of individual behavior.

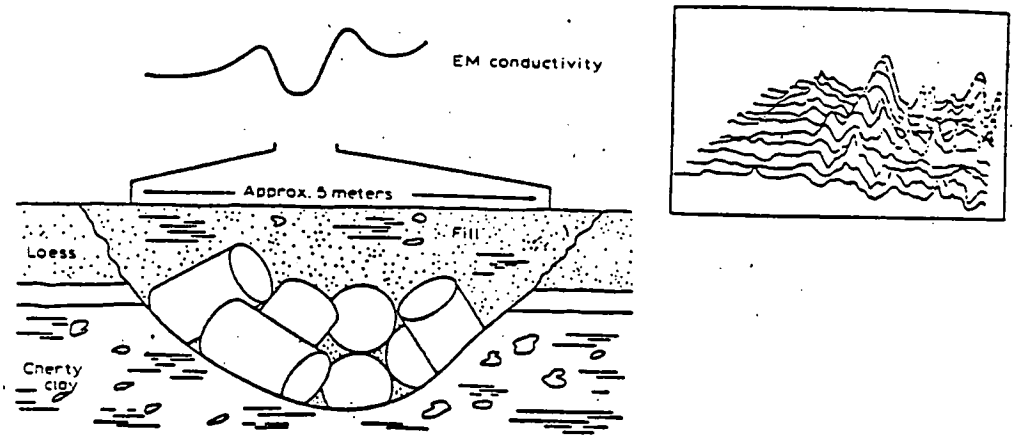

Fig. 8. Results of a VLF—EM survey of a buried container site showing one traverse and a series of parallel traverses over an area of fractures in soluble rock [5]. Eleven continuous and parallel EM conductivity lines clearly reveal size, location and periodicity of fracture trends in soluble rock to a depth of 6 meters. Line length is approx. 800 meters and line spacing is 15 meters.

(f) Seismic refraction [2]

In this well-established geophysical method, a seismic impulse (a hammer blow or explosive charge) is applied to the ground and the time to reach a transducer is measured for varying distances between the impulse and the transducer. The time is plotted as a function of distance and, if there is a well-defined layer beneath the surface, a characteristic break in the curve is found from which the depth to the layer can be determined. This method has not been used to detect small objects, but is widely used in the oil and mineral prospecting area, and can be used to determine generalized topography at a dump site.

(g) Sonar (pulse echo) acoustics [2]

This method is in principle similar to ground probing radar (GPR). A pulse of acoustic energy of a few kHz carrier frequency is beamed from a water surrounded source into the soil. A reflection occurs when the wave encounters a medium of different acoustic impedance (e.g., an air void or a metal plate). The time it takes for the echo to return gives an idea of the depth of the reflecting object. Lateral surveying will indicate the extent of the object. The trade off between resolution (high frequencies) and low loss (low frequencies) involves frequencies such that the usefulness of the technique is at most a few feet of probing into the soil. Coupling of the transducers to the soil presents a real problem. A somewhat higher frequency (12 kHz) unit has been used to probe the bottom of water bodies.

(h) Infrared radio

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(h) Infrared radiometry [2]

The method utilizes thermal radiation from a surface which is measured by an infrared radiometer. The heating can be either active or ambient. The radiation pattern reveals heat generation and heat flow anomalies caused by variations in the materials being investigated. The method is a highly refined NDT method. Much commercial equipment is available and has been used to determine water flow profiles (in dams), heat escaping from uninsulated houses, heat from vegetation, etc. Its use in picking up buried drums and related problems has not been reported. A major drawback of the technique is the cost of the equipment ($10,000 to $20,000 for a two-dimensional scanning unit).

(i) Nuclear (high energy particles) method [2]

There has been an effort to detect land mines with high energy particles. High energy particles (x-rays, neutrons, etc.) are beamed into the ground and if a metal mine is present more of the particles are back-scattered to the detector. The range of travel of the particles is very limited in soil.

(j) Continuous wave (CW) microwaves [2, 8]

This method is similar to ground probing radar except that a continuous wave (CW) is used. The CW is swept in frequency and the wave from the ground surface and the wave from a subsurface reflection interfere with each other. The spacing (in frequency) between interference maxima (or minima) as the frequency is swept gives the depth of the reflecting surface. Some systems of this type are in an advanced research stage; however, they are not available commercially as far as the authors are aware.

Conclusions

In assessing the current status of identification and location of buried containers using NDT methods, it is seen that a variety of techniques has been attempted. By categories these vary from traditional geophysical methods:

- seismic refraction
- electrical resistivity
- magnetometry

to more recent NDT methods (adapted from various technologies studying close-range problems):

- ground probing radar
- metal detector
- VLF (electromagnetic)
- sonar (pulsed echo acoustics)
- infrared
- nuclear — high energy
- continuous wave microwave

Threaded throughout the review of the literature and our personal experiences

TABLE 1

Assessment of most widely used NDT techniques for identification and location of buried containers

Method	Equipment cost	Field deployment	Data inter-pretation	Container detail	Maximum penetration depth (approx.)
Ground probing radar	$35,000	moderate	moderate	excellent	4′—15′
Metal detector	500	easy	simple	poor	2′—5′
Magnetometer	4,000	easy	moderate	poor	4′—30′
Resistivity	2,000	moderate	difficult	poor	2′—50′
VLF (EM)	7,000	moderate	moderate	poor	2′—20′
Refraction	5,000	moderate	moderate	poor	2′—100′
Sonar (pulse echo acous.)	10,000	difficult	moderate	good	1′—3′
Infrared	15,000	moderate	moderate	moderate	1′—5′
Nuclear—high energy	30,000	difficult	moderate	moderate	1′—2′
CW microwave	10,000	moderate	moderate	moderate	2′—12′

was an underlying theme that the geophysical methods (with the possible exception of magnetometry) were not sensitive enough to detect containers buried at shallow depths of the type generally encountered. We are in general agreement with this conclusion.

In order to rate, and compare, the remaining methods to one another, Table 1 has been assembled. Upon reviewing this information, we feel confident in making the following conclusions:

(1) Metal detectors should be the first method used for exploratory work. Since the majority of containers are steel and buried under from a few inches to a few feet of soil, one would be remiss in not first attempting to use this method. It is simple to use, gives straightforward results and is the least expensive of all NDT equipment to purchase and maintain.

(2) If the drums are shallow, but not of steel, we feel that the sonar—pulse echo acoustics method is best for soils of high saturation (> 50%) and the continuous wave microwave method is best for dry or partially saturated (< 50%) soils. However, both of these methods are still in a development stage and further research is necessary.

(3) For drums buried deeper than 5′ and in soils of high saturation (> 50%), the magnetometer seems best suited although individual drum definition is not particularly clear. The equipment is of moderate cost and many consulting firms have such services available.

(4) For drums buried deeper than 5′ in dry or partially saturated (< 50%) soils, GPR seems well suited. Here, more than other techniques, the individual containers can be identified and quantified. The equipment, however, is quite expensive and therefore only a limited number of consultants have such a service available.

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References

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2 R.M. Koerner a
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3 Weston Consult
Final Report to
4 R.M. Koerner a
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8 R.M. Koerner, A
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(5) The other NDT techniques noted in the literature require much more field (and laboratory) development before they can be recommended for routine field investigation. For most of them, "ground truth" experiments under a wide variety of field conditions seem justified.

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APPENDIX A15

Discharge Summaries for Streams Near NWSC
Which Were Used to Estimate Discharge Rates
for Streams at NWSC

03371520 BACK CREEK AT LEESVILLE, IN

LOCATION.—Lat 38°50'48", long 86°18'06", in SW¼SE¼ sec.21, T.5 N., R.2 E., Lawrence County, Hydrologic Unit 05120208, on left bank at downstream side of county road bridge, 0.9 mile (1.4 km) west of Leesville, 2.5 miles (4.0 km) upstream from Jones Defeat Hollow, and 7 miles (11 km) above mouth.

DRAINAGE AREA.—24.1 mi² (62.4 km²).

PERIOD OF RECORD.—October 1970 to current year.

REVISED RECORDS.—WDR IN-72-1: 1971.

GAGE.—Water-stage recorder. Datum of gage is 575.00 ft (175.260 m) National Geodetic Vertical Datum of 1929.

REMARKS.—Records fair.

AVERAGE DISCHARGE.—12 years, 34.4 ft³/s (0.974 m³/s), 19.38 in/yr (492 mm/yr).

EXTREMES FOR PERIOD OF RECORD.—Maximum discharge, 15,300 ft³/s (433 m³/s) July 21, 1973, gage height, 14.0 ft (4.27 m), from floodmarks, from rating extended above 550 ft³/s (15.6 m³/s) on basis of step-backwater analysis and contracted-opening and flow-over-road measurement of peak flow; no flow at times during 1971, 1975, 1976 and 1981.

EXTREMES OUTSIDE PERIOD OF RECORD.—Flood in 1913 reached a stage of 18.1 ft (5.52 m) from information by local resident.

EXTREMES FOR CURRENT YEAR.—Peak discharges above base of 1,000 ft³/s (28.3 m³/s) and maximum (*):

Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)	Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)
Jan. 4	0100	1060	30.0	5.23	1.594	Feb. 16	0400	2420	68.5	6.96	2.121
Jan. 22	2330	2300	65.1	ice jam		May 31	2145	1250	35.4	5.52	1.682
Jan. 31	0100	3630	103	8.08	2.463	Aug. 30	1700	*4370	124	*8.67	2.643

Minimum daily discharge, 0.10 ft³/s (0.003 m³/s) Aug, 4, 5, 22-24.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.80	1.2	33	38	193	16	63	6.8	112	6.3	.30	36
2	.68	1.2	19	36	147	14	52	5.9	33	4.7	.22	28
3	.68	1.1	14	102	169	18	198	4.7	17	42	.16	12
4	.68	.93	12	299	60	44	95	3.9	11	11	.10	6.9
5	.68	.93	10	85	43	45	72	3.3	8.9	6.3	.10	4.5
6	.93	.93	8.9	59	32	35	59	2.6	6.3	4.7	.80	3.0
7	1.1	.80	8.3	45	26	30	44	10	5.4	3.6	1.1	2.2
8	.93	.80	7.3	33	23	25	41	18	7.8	3.3	.58	1.6
9	.80	1.6	6.3	24	21	22	49	9.4	11	3.3	.30	1.2
10	.80	2.9	5.9	17	20	21	44	6.8	10	2.9	.22	.88
11	.80	2.9	5.4	14	19	38	40	5.4	6.3	5.9	.93	.71
12	.68	2.1	5.4	11	18	45	35	4.7	5.0	3.3	1.6	.63
13	.68	1.9	5.0	10	17	117	30	3.9	4.3	2.4	.80	.52
14	.68	1.6	5.0	8.4	17	85	24	3.6	3.6	1.9	.58	.54
15	.68	1.4	5.0	7.6	20	253	21	2.9	3.9	1.6	.40	.48
16	.80	1.4	4.4	7.0	935	167	24	2.6	8.9	1.2	.30	.36
17	.93	1.2	4.4	6.4	231	106	72	2.1	8.3	1.1	.22	.27
18	1.2	1.2	4.3	6.7	133	76	53	2.1	5.0	.93	.22	.34
19	1.1	3.6	4.0	6.9	101	231	45	2.1	3.9	3.9	.16	.26
20	.93	11	3.5	7.0	71	231	36	1.9	3.6	11	.16	.22
21	.80	5.9	4.0	8.0	50	137	29	2.6	2.9	3.3	.16	.22
22	.93	4.7	40	400	40	87	24	5.0	2.4	2.1	.10	.22
23	1.1	4.3	226	665	39	65	20	2.4	1.9	1.6	.10	.20
24	1.2	6.8	72	108	34	49	16	1.9	1.6	1.4	.10	.27
25	1.1	7.3	46	59	26	44	16	1.4	1.4	1.1	.16	.45
26	1.6	7.3	36	42	22	38	14	1.2	1.2	.93	.22	.42
27	3.3	10	101	34	21	30	12	1.9	68	.80	.40	.50
28	2.9	8.9	68	24	17	24	9.4	1.4	85	.68	.48	.55
29	2.1	7.8	50	23	----	22	8.3	3.9	11	.58	.48	.42
30	1.6	8.9	39	622	----	20	7.8	8.3	10	.48	544	.32
31	1.4	------	35	1760	----	119	------	127	----	.40	47	------
TOTAL	34.59	112.59	888.1	4568.0	2545	2254	1253.5	259.7	460.6	134.70	602.45	104.18
MEAN	1.12	3.75	28.6	147	90.9	72.7	41.8	8.38	15.4	4.35	19.4	3.47
MAX	3.3	11	226	1760	935	253	198	127	112	42	544	36
MIN	.68	.80	3.5	6.4	17	14	7.8	1.2	1.2	.40	.10	.20
CFSM	.05	.16	1.19	6.10	3.77	3.02	1.73	.35	.64	.18	.81	.14
IN.	.05	.17	1.37	7.05	3.93	3.48	1.93	.40	.71	.21	.93	.16

CAL YR 1981 TOTAL 8257.62 MEAN 22.6 MAX 457 MIN .40 CFSM .94 IN 12.75
WTR YR 1982 TOTAL 13217.41 MEAN 36.2 MAX 1760 MIN .10 CFSM 1.50 IN 20.40

03373700 LOST RIVER NEAR WEST BADEN SPRINGS, IN

LOCATION.—Lat 38°35'10", long 86°38'03", in SW¼SE¼ sec.21, T.2 N., R.2 W., Orange County, Hydrologic Unit 05120208, on left bank 20 ft (6 m) downstream from bridge on U.S. Highway 150, 1.7 miles (2.7 km) northwest of West Baden Springs, 3.8 miles (6.1 km) downstream from Lick Creek, and at mile 34.8 (56.0 km).

DRAINAGE AREA.—287 mi² (743 km²).

PERIOD OF RECORD.—December 1964 to current year. Prior to October 1965, published as Lost River near West Baden.

GAGE.—Water-stage recorder. Datum of gage is 457.92 ft (139.574 m) National Geodetic Vertical Datum of 1929 (levels by State of Indiana, Department of Natural Resources).

REMARKS.—Records good.

AVERAGE DISCHARGE.—17 years, 365 ft³/s (10.34 m³/s), 17.27 in/yr (439 mm/yr).

EXTREMES FOR PERIOD OF RECORD.—Maximum discharge, 7,540 ft³/s (214 m³/s) July 27, 1979, gage height, 25.71 ft (7.826 m); minimum daily, 7.5 ft³/s (0.21 m³/s) Oct. 8, 1966.

EXTREMES OUTSIDE PERIOD OF RECORD.—Flood in March 1964 reached a stage of 28.1 ft (8.56 m), from floodmarks, discharge, 14,500 ft³/s (411 m³/s).

EXTREMES FOR CURRENT YEAR.—Peak discharge above base of 2,000 ft³/s (56.6 m³/s) and maximum (*):

Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)	Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)
Jan. 23	1600	*6800	193	*25.30	7.711	Mar. 16	1300	2160	61.2	20.42	6.224
Jan. 31	2100	6650	188	25.21	7.684	Mar. 21	1100	2450	69.4	21.39	6.520

Minimum daily discharge, 24.0 ft³/s (0.68 m³/s) Oct. 4, 5, 14, 15, Aug. 19, 20, 26.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	25	38	548	330	5730	317	482	171	1100	274	40	1060
2	25	35	564	305	3450	303	418	163	1000	183	38	1770
3	25	33	361	476	2300	309	1440	160	540	158	36	1470
4	24	32	256	1460	2000	404	1780	150	372	176	35	754
5	24	31	195	1560	1720	614	1350	145	298	130	34	350
6	38	31	158	1100	1360	553	925	140	239	116	82	240
7	46	31	140	692	1060	464	680	140	197	105	94	180
8	38	30	127	496	879	405	569	320	213	246	51	140
9	31	34	113	407	791	371	545	430	360	492	39	120
10	28	66	101	339	698	350	511	300	263	289	35	100
11	26	80	92	272	634	401	449	250	185	316	36	90
12	25	64	84	240	586	743	409	210	153	252	36	76
13	25	54	80	220	548	1070	376	190	138	147	35	72
14	24	48	77	199	517	1230	342	170	124	114	31	74
15	24	45	74	182	544	1790	314	160	114	95	28	72
16	26	44	71	165	1040	2130	313	150	256	81	26	70
17	28	42	69	143	1560	2040	850	135	378	73	25	62
18	39	41	68	132	1410	1540	920	130	287	68	25	54
19	44	73	61	130	1080	1700	646	125	192	67	24	52
20	41	407	58	125	813	2110	496	120	152	116	24	48
21	34	273	57	128	710	2370	402	120	130	275	33	44
22	31	150	107	670	628	2080	341	170	115	173	39	42
23	32	111	1350	5460	547	1680	300	180	104	106	31	40
24	30	146	1330	5290	498	1210	277	175	95	81	27	40
25	31	183	786	3040	445	826	256	150	88	69	25	41
26	39	157	502	2050	397	643	242	130	83	62	24	44
27	72	183	546	1520	361	541	225	130	79	57	29	58
28	93	194	648	1050	337	471	207	150	145	51	34	74
29	64	150	552	752	——	424	191	160	579	48	32	46
30	47	130	435	1110	——	389	181	1900	466	45	150	40
31	41	——	360	4760	——	431	——	1300	——	43	962	——
TOTAL	1120	2936	9970	34803	32643	29909	16437	8324	8445	4508	2160	7323
MEAN	36.1	97.9	322	1123	1166	965	548	269	282	145	69.7	244
MAX	93	407	1350	5460	5730	2370	1780	1900	1100	492	962	1770
MIN	24	30	57	125	337	303	181	120	79	43	24	40
CFSM	.13	.34	1.12	3.91	4.06	3.36	1.91	.94	.98	.51	.24	.85
IN.	.15	.38	1.29	4.51	4.23	3.88	2.13	1.08	1.09	.58	.28	.95

CAL YR 1981 TOTAL 67863.1 MEAN 186 MAX 1850 MIN 9.0 CFSM .65 IN 8.80
WTR YR 1982 TOTAL 158578.0 MEAN 434 MAX 5730 MIN 24 CFSM 1.51 IN 20.55

03376260 FLAT CREEK NEAR OTWELL, IN

LOCATION.—Lat 38°26'12", long 87°07'52", in SE¼SE¼ sec.12, T.1 S., R.7 W., Pike County, Hydrologic Unit 05120209, on right bank at upstream side of bridge on State Highway 56, 2.2 miles (3.5 km) west of intersection of State Highways 56 and 257, 2.5 miles (4.0 km) southeast of Otwell, 6.2 miles (10.0 km) east of intersection of State Highways 56 and 61, and at mile 10.9 (17.5 km).

DRAINAGE AREA.—21.3 mi² (55.2 km²).

PERIOD OF RECORD.—October 1964 to April 1982 (discontinued).

REVISED RECORDS.—WSP 2109: Drainage area.

GAGE.—Water-stage recorder. Datum of gage is 448.00 ft (136.550 m) National Geodetic Vertical Datum of 1929.

REMARKS.—Records poor.

AVERAGE DISCHARGE.—17 years, (1965-81), 22.8 ft³/s (0.646 m³/s), 14.54 in/yr (369 mm/yr).

EXTREMES FOR PERIOD OF RECORD.—Maximum discharge, 1,680 ft³/s (47.6 m³/s) May 12, 1978, gage height, 12.34 ft (3.761 m); no flow at times most years.

EXTREMES OUTSIDE PERIOD OF RECORD.—Flood in March 1964 reached a stage of 12.58 ft (3.834 m).

EXTREMES FOR CURRENT YEAR.—Peak discharge above base of 800 ft³/s (22.7 m³/s) and maximum (*):

Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)
Jan. 23	0100	*1110	31.4	*12.22	3.725
Jan. 31	0700	1110	31.4	12.21	3.722

Minimum daily discharge, 1.0 ft³/s (0.028 m³/s) Oct. 14.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	1.2	1.5	42	25	118	14	15					
2	1.2	1.6	15	29	75	14	14					
3	1.2	1.6	8.0	117	54	19	49					
4	1.2	1.6	6.0	198	45	47	28					
5	1.2	1.7	5.0	50	30	31	23					
6	16	1.7	4.5	37	21	25	29					
7	2.1	1.5	5.4	15	17	23	18					
8	1.6	1.5	4.0	8.0	14	18	16					
9	1.3	2.5	3.7	6.0	13	17	---					
10	1.2	2.9	3.1	5.0	12	18	---					
11	1.1	1.7	3.3	4.5	11	74	---					
12	1.1	1.6	3.3	4.3	10	57	---					
13	1.2	1.5	2.7	4.0	9.5	113	---					
14	1.0	1.5	2.9	3.8	9.0	68	---					
15	1.2	1.7	3.0	3.7	15	256	---					
16	1.4	2.0	2.2	3.5	208	73	---					
17	2.8	2.5	2.9	3.4	125	45	---					
18	5.8	2.0	2.3	3.3	75	33	---					
19	2.5	39	1.8	3.2	55	207	---					
20	1.5	22	1.5	3.2	50	156	---					
21	1.3	4.0	1.9	4.0	49	148	---					
22	1.2	2.0	102	306	36	53	---					
23	2.2	3.0	199	618	31	37	---					
24	1.7	12	62	50	26	29	---					
25	1.4	3.3	28	30	19	25	---					
26	3.6	3.3	25	20	16	25	---					
27	6.9	16	84	15	16	18	---					
28	2.2	3.4	54	12	15	14	---					
29	1.8	1.7	43	9.5	------	14	---					
30	1.5	8.2	24	394	------	14	---					
31	1.4	-----	21	862	------	20	---					
TOTAL	73.0	150.5	766.5	2847.4	1174.5	1705	---					
MEAN	2.35	5.02	24.7	91.9	41.9	55.0	---					
MAX	16	39	199	862	208	256	---					
MIN	1.0	1.5	1.5	3.2	9.0	14	---					
CFSM	.11	.24	1.16	4.32	1.97	2.58	---					
IN.	.13	.26	1.34	4.97	2.05	2.98	---					

CAL YR 1981 TOTAL 6246.36 MEAN 17.1 MAX 687 MIN .77 CFSM .80 IN 10.91

03376350 SOUTH FORK PATOKA RIVER NEAR SPURGEON, IN

LOCATION.--Lat 38°17'50", long 87°15'39", in SE¼NE¼ sec.35, T.2 S., R.8 W., Pike County, Hydrologic Unit 05120209, on right bank at downstream side of bridge on State Highway 61, 0.5 mile (0.8 km) north of Enos Corner, 3.1 miles (5.0 km) north of Spurgeon, and at mile 8.0 (12.9 km).

DRAINAGE AREA.--42.8 mi^2 (110.9 km^2).

PERIOD OF RECORD.--October 1964 to current year.

REVISED RECORDS.--WSP 2109: Drainage area. WDR IN-75-1: 1965-74(P).

GAGE.--Water-stage recorder. Datum of gage is 420.88 ft (128.284 m) National Geodetic Vertical Datum of 1929.

REMARKS.--Records good. Regulation by coal-washing operation and strip-mining above gage.

AVERAGE DISCHARGE.--18 years, 50.0 ft^3/s (1.416 m^3/s), 15.86 in/yr (403 mm/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 5,900 ft^3/s (167 m^3/s) June 9, 1979, gage height, 15.07 ft (4.593 m) from rating curve extended above 3,300 ft^3/s (93.5 m^3/s) on basis of contracted-opening and flow over-the-road measurements at gage height of 15.07 ft (4.593 m); no flow Jan. 20-31, 1977.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in March 1964 reached a stage of 13.09 ft (3.99 m), from floodmarks, discharge, 4,000 ft^3/s (113 m^3/s).

EXTREMES FOR CURRENT YEAR.--Peak discharge above base of 1,000 ft^3/s (28.32 m^3/s) and maximum (*):

Date	Time	Discharge (ft^3/s)	Discharge (m^3/s)	Gage height (ft)	Gage height (m)	Date	Time	Discharge (ft^3/s)	Discharge (m^3/s)	Gage height (ft)	Gage height (m)
Jan. 23	0200	2600	73.6	11.97	3.648	June 8	1700	2000	56.6	11.21	3.417
Jan. 31	0500	2970	84.1	12.38	3.773	Sept. 13	2100	*3040	86.1	*12.45	3.795
Mar. 15	0400	1350	38.2	10.00	3.048						

Minimum daily discharge, 4.0 ft^3/s (0.113 m^3/s) Oct. 3, 4, 21, 24, 25.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.9	4.9	104	22	259	39	52	24	83	12	8.1	246
2	4.6	5.6	37	37	156	35	55	23	26	12	6.0	285
3	4.0	5.3	26	145	139	35	189	23	17	19	7.6	62
4	4.0	5.3	23	288	118	66	77	21	16	13	8.1	27
5	4.6	5.3	19	67	95	57	72	20	17	11	6.8	21
6	9.4	5.6	19	48	74	44	66	20	16	10	9.0	15
7	8.0	5.6	21	33	56	46	52	90	14	10	8.5	13
8	7.0	6.8	18	27	47	39	58	50	537	23	10	11
9	6.2	10	15	23	39	33	58	29	158	12	9.5	11
10	6.0	7.2	14	20	33	33	48	23	61	12	6.8	10
11	5.6	5.6	12	18	29	105	48	23	36	25	12	9.0
12	5.3	6.0	11	16	26	94	43	21	28	12	6.0	8.5
13	5.6	5.6	10	14	25	171	38	18	24	10	6.4	640
14	5.6	6.0	9.6	13	24	149	35	16	19	8.9	6.4	396
15	6.0	6.8	9.1	12	30	588	33	17	17	8.3	5.6	94
16	6.4	15	8.6	11	342	160	80	17	95	7.2	13	44
17	12	16	9.0	11	259	101	247	16	33	10	7.2	27
18	21	6.8	8.4	10	151	81	85	16	21	14	6.4	27
19	6.0	68	7.7	10	105	258	60	23	18	11	6.4	22
20	4.3	26	7.1	10	90	156	52	19	15	10	7.2	19
21	4.0	11	8.6	13	86	200	40	32	13	9.5	10	19
22	4.6	7.6	143	929	66	98	35	60	14	8.5	8.1	14
23	6.0	14	212	1080	57	81	32	23	13	8.5	14	13
24	4.0	23	62	160	52	67	31	18	12	8.1	12	20
25	4.0	12	34	80	44	62	32	16	11	9.5	7.2	43
26	12	17	28	67	39	60	33	16	12	8.5	6.0	22
27	15	31	87	50	36	52	31	17	11	6.8	51	19
28	6.8	13	48	41	39	50	26	15	43	8.1	9.5	17
29	10	9.5	32	36	----	47	23	35	26	9.0	8.5	14
30	7.2	24	21	742	----	47	25	26	16	7.2	10	12
31	5.3	----	20	1730	----	70	----	95	----	8.1	205	----
TOTAL	215.4	385.5	1084.1	5763	2516	3124	1756	862	1422	342.2	498.3	2180.5
MEAN	6.95	12.9	35.0	186	89.9	101	58.5	27.8	47.4	11.0	16.1	72.7
MAX	21	68	212	1730	342	588	247	95	537	25	205	640
MIN	4.0	4.9	7.1	10	24	33	23	15	11	6.8	5.6	8.5
CFSM	.16	.30	.82	4.35	2.10	2.36	1.37	.65	1.11	.26	.38	1.70
IN.	.19	.34	.94	5.01	2.19	2.72	1.53	.75	1.24	.30	.43	1.90

CAL YR 1981 TOTAL 10010.2 MEAN 27.4 MAX 502 MIN 4.0 CFSM .64 IN 8.70
WTR YR 1982 TOTAL 20149.0 MEAN 55.2 MAX 1730 MIN 4.0 CFSM 1.29 IN 17.51

03375800 HALL CREEK NEAR ST. ANTHONY, IN

LOCATION.--Lat 38°21'45", long 86°49'43", in NW¼NW¼ sec.11, T.2 S., R.4 W., Dubois County, Hydrologic Unit 05120209, on downstream side of right pier of bridge on County Road 125 South, 0.7 mile (1.1 km) upstream from Grassy Fork, 3.3 miles (5.3 km) north of St. Anthony, and at mile 4.1 (6.6 km).

DRAINAGE AREA.--21.8 mi² (56.5 km²).

PERIOD OF RECORD.--October 1970 to current year.

REVISED RECORDS.--WDR IN-75-1: 1971-74.

GAGE.--Water-stage recorder. Datum of gage is 459.22 ft (139.969 m) National Geodetic Vertical Datum of 1929 (levels by State of Indiana, Department of Natural Resources).

REMARKS.--Records fair.

AVERAGE DISCHARGE.--12 years, 33.4 ft³/s (0.946 m³/s), 20.81 in/yr (529 mm/yr).

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 11,500 ft³/s (326 m³/s) July 26, 1979, gage height, 15.30 ft (4.663 m) from contracted-opening and flow-over-the road measurements at gage height of 15.30 ft (4.663 m); no flow for many days in most years.

EXTREMES FOR CURRENT YEAR.--Peak discharge above base of 950 ft³/s (26.9 m³/s) and maximum (*):

Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)	Date	Time	Discharge (ft³/s)	Discharge (m³/s)	Gage height (ft)	Gage height (m)
Jan. 22	2000	*2960	83.8	*11.87	3.618	Apr. 3	0600	992	28.1	10.48	3.194
Jan. 31	0400	1760	49.8	11.27	3.435	Sept. 1	1900	1920	54.4	11.37	3.466
Mar. 15	0500	1290	36.5	10.92	3.328						

Minimum daily discharge, 0.30 ft³/s (0.008 m³/s) Aug. 26.

DISCHARGE, IN CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1981 TO SEPTEMBER 1982
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.73	1.4	106	19	95	10	14	5.2	62	3.1	1.1	758
2	.70	1.3	34	46	49	9.8	15	4.7	14	2.5	.94	147
3	.68	1.2	18	122	66	12	380	4.4	7.8	2.9	.85	33
4	.66	1.1	14	286	49	45	78	3.9	6.2	2.5	.78	13
5	.70	1.2	10	60	34	31	54	3.6	5.4	1.8	.72	7.1
6	1.7	1.3	8.4	42	24	25	44	3.5	4.2	1.4	.76	4.7
7	1.5	1.1	7.8	27	22	21	31	7.6	3.6	1.4	.93	3.6
8	1.4	1.1	6.4	19	21	17	29	6.0	10	5.4	1.9	2.9
9	1.3	1.3	5.6	17	19	15	34	4.4	7.8	2.9	1.6	2.5
10	1.2	1.6	5.0	14	16	14	29	3.8	5.6	2.4	1.4	2.2
11	1.1	1.3	4.7	12	14	34	24	3.3	3.9	26	2.2	2.0
12	1.0	1.2	4.8	10	13	45	20	3.1	3.8	3.2	1.6	1.9
13	.96	1.2	4.7	9.2	12	188	17	2.7	3.8	2.4	1.2	190
14	.92	1.1	4.2	8.6	11	109	15	2.5	3.1	1.9	.98	148
15	.98	1.1	4.1	8.2	51	610	13	2.3	2.9	1.7	.81	66
16	1.4	1.4	3.5	7.7	216	123	12	2.3	37	1.6	.67	21
17	2.4	2.2	5.6	7.0	112	70	158	2.2	9.2	4.8	.57	12
18	3.5	1.6	4.2	6.6	60	51	57	3.1	5.2	10	.49	14
19	1.5	40	3.6	6.3	41	155	34	3.1	4.1	3.5	.43	8.6
20	1.3	15	3.1	6.7	35	81	24	3.6	3.3	175	.64	6.4
21	1.1	4.8	4.0	8.2	33	72	17	2.7	2.9	13	.70	5.2
22	1.0	3.6	179	1100	23	48	13	13	2.5	19	.56	4.7
23	.97	4.8	238	1110	20	36	11	8.9	2.3	4.8	.45	4.1
24	.93	14	58	71	18	26	9.8	4.5	2.0	3.2	.38	7.3
25	.86	5.8	35	35	14	21	9.5	3.8	1.9	2.4	.34	18
26	4.3	20	28	20	13	18	8.9	4.8	1.8	2.0	.30	8.6
27	6.6	34	66	15	12	15	7.3	8.9	1.8	1.7	13	6.6
28	2.4	10	43	9.8	11	13	6.2	4.4	55	1.6	1.3	5.0
29	1.8	6.9	28	8.1	----	13	5.8	21	11	1.4	1.0	4.2
30	1.5	89	19	577	----	13	5.6	27	4.4	1.4	1.0	3.6
31	1.4	----	18	1080	----	23	------	59	----	1.2	2.7	------
TOTAL	48.49	271.6	973.7	4768.4	1104	1963.8	1176.1	233.3	288.5	308.1	42.30	1511.2
MEAN	1.56	9.05	31.4	154	39.4	63.3	39.2	7.53	9.62	9.94	1.36	50.4
MAX	6.6	89	238	1110	216	610	380	59	62	175	13	758
MIN	.66	1.1	3.1	6.3	11	9.8	5.6	2.2	1.8	1.2	.30	1.9
CFSM	.07	.42	1.44	7.06	1.81	2.90	1.80	.35	.44	.46	.06	2.31
IN	.08	.46	1.66	8.14	1.88	3.35	2.01	.40	.49	.53	.07	2.58

CAL YR 1981 TOTAL 5430.24 MEAN 14.9 MAX 424 MIN .09 CFSM .68 IN 9.27
WTR YR 1982 TOTAL 12689.49 MEAN 34.8 MAX 1110 MIN .30 CFSM 1.60 IN 21.65