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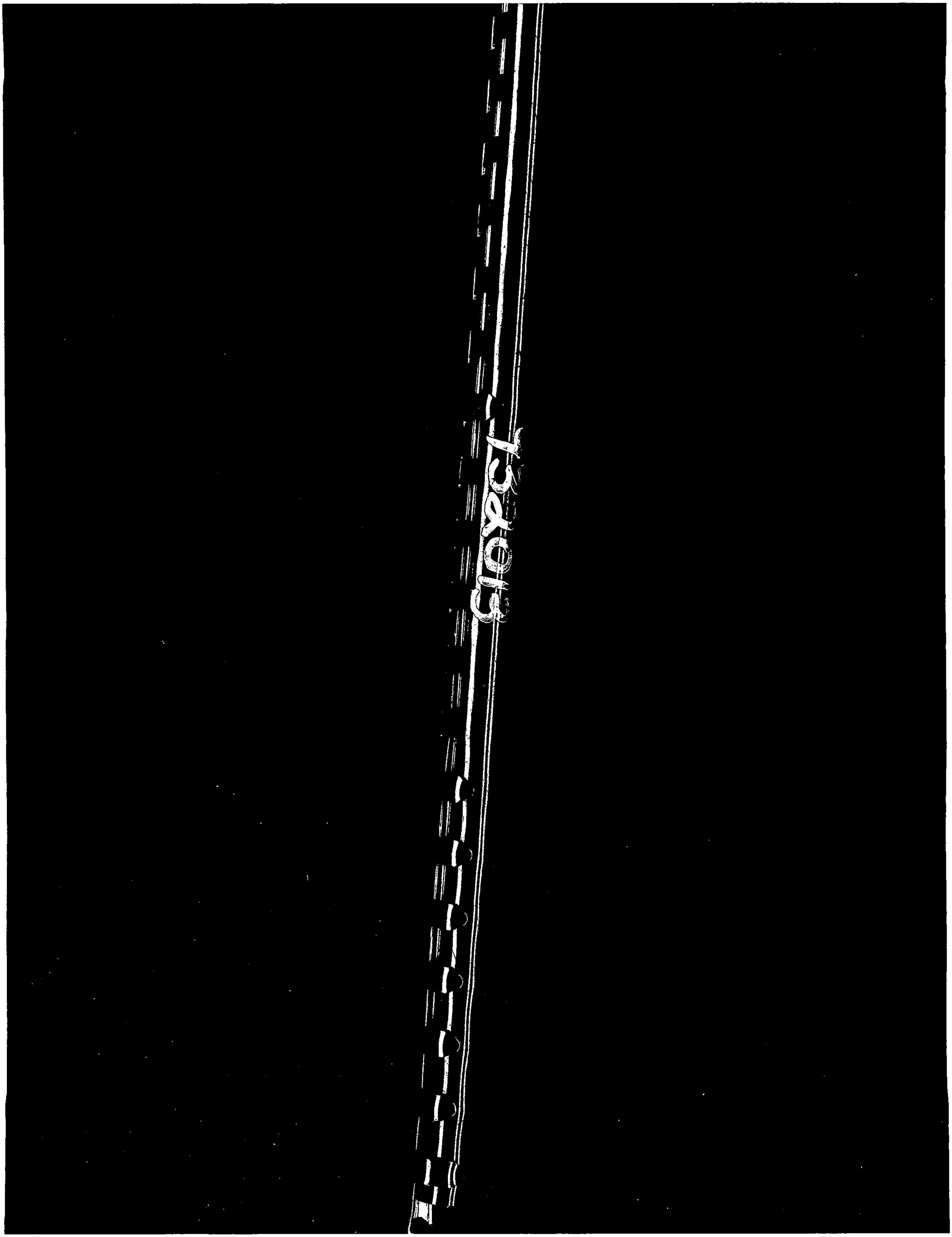
EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE REPORT
OFF-SHORE INVESTIGATION
GILL CREEK REMEDIATION
DUPONT CHEMICALS
NIAGARA FALLS, NEW YORK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EMPIRE
SOILS INVESTIGATIONS INC. S-5167 SOUTH PARK AVENUE • HAMBURG, NY 14075-1503 • 716/649-8110 FAX 716/649-8051

SUBSURFACE REPORT
OFF-SHORE INVESTIGATION
GILL CREEK REMEDIATION
DUPONT CHEMICALS
NIAGARA FALLS, NEW YORK

Prepared for:

DuPont Chemicals
Buffalo Avenue and Chemical Road
Niagara Falls, New York 14302

Attention: Mr. Joe Clark

BTA-92-073
MAY 4, 1992

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SUBSURFACE REPORT
OFF-SHORE INVESTIGATION
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NIAGARA FALLS, NEW YORK

INTRODUCTION

Empire Soils Investigations, Inc. (Empire) was requested and authorized by Mr. Joe Clark of DuPont Chemicals (DuPont) to collect and compile subsurface data for Gill Creek Remediation project at DuPont's facility located on Buffalo Avenue in Niagara Falls, New York. The purpose of this investigation is to obtain geotechnical data with respect to the proposed cofferdam at the creek.

This project was completed in accordance with a work plan provided by DuPont titled "DuPont Chemicals, Niagara Falls Plant - Sampling and Testing Scope of Work on the Robert Moses Parkway and in the Niagara River for Relocating 006/007 Outfalls to the Niagara River Project and Gill Creek Remediation Project". This document included a general layout plan and Figure 4-4 which show the proposed locations of three (3) test borings, TH-3 through TH-5, located in Niagara River. The number and locations of the test borings were selected by others. Empire was furnished with a drawing entitled "Map Showing Site of Proposed Cofferdam for Gill Creek Remediation Project" dated March 23, 1992. A partial copy of these drawings is included in Appendix A.

Empire coordinated the subsurface investigation program with DuPont representatives and Woodward-Clyde Consultants, civil engineers for DuPont. The test borings were drilled by Empire using a Failing F-10 drill rig on a barge. Neal R. Klettke, L.S., contracted by DuPont, directed Empire crew at site to position the rig at the test boring locations in the river. The test borings were logged in the field by an Empire Environmental Geologist. The Empire geologist

monitored air quality and excavated soils with an organic vapor analyzer (OVA) during the field work for health and safety purposes. The test boring logs are enclosed in Appendix B. Empire conducted packer permeability testing within the rock strata in test borings. The results of these tests are included in Appendix C.

Empire performed a gradation (sieve) analysis on a composite sample of overburden material recovered from borings TH-3 and TH-5 as directed by Woodward-Clyde. The results of the gradation analysis are enclosed in Appendix D.

Our interpretation of the subsurface conditions is based on the soil and rock sampled at the test boring locations. Variations from inferred soil characterization and ground water observations should be expected. The subsurface logs should be referred to for a detailed description of the subsurface conditions at each test location. The lines designating the interfaces between various strata on the logs are approximate. The transition between strata may actually be gradual.

SUBSURFACE MATERIALS

Test borings TH-3 through TH-5 were completed by Empire between April 14-16, 1992. Borings TH-3, TH-4 and TH-5 were located on the western, central and eastern, respectively, sections of the proposed cofferdam. The borings were advanced generally per ASTM D-1586 in overburden and ASTM D-2113 in rock. The river water was approximately 13.1 to 13.3 feet deep during our drilling program. Drilling deck was situated 5.0 feet (TH-3 and TH-5) or 5.2 feet (TH-4) above the river water level.

The test borings revealed an approximately 0.6 to 0.7 feet thick layer of overburden material consisting of gravel with little sand and trace silt over bedrock. Rock coring was performed to depths of 50.4, 50.5 and 50.8 feet below the deck level in TH-3, TH-4 and TH-5, respectively. The rock is gray dolomitic limestone. The rock is relatively highly fractured

and/or weathered to depths (below the deck level) of approximately 28 feet in TH-3, 33.6 feet in TH-4 and 32.5 feet in TH-5.

The Empire geologist scanned the recovered soil and rock samples in the field with a Photoionization Detector (PID) for the presence of volatile organic compounds. The background PID readings were 0.2 to 0.8 parts per million (ppm) within the overburden. The fractured rock zone between 25.0 and 30.4 feet within TH-3 had PID readings approximately 200-300 ppm and exhibited a chemical odor.

PACKER PERMEABILITY TESTS

Empire conducted packer tests in rock strata to estimate rock permeability in general accordance with Section 118 of the Design of Small Dams (Department of the Interior, Bureau of Reclamation, 1977, pp 193-196). Detailed results of these tests are provided in Appendix C.

The tests were performed between 30.4-50.4 feet in boring TH-3, 30.5-50.5 feet in TH-4 and 29.0-50.8 feet in TH-5. The test results indicate a permeability ranging from 2.56×10^{-5} feet per second to 0.025×10^{-5} feet per second.

REMARKS

This report is intended for use by the client and its designated professionals to make site evaluations and to advance the design of the project. Use of this report for other purposes is not permitted without the written authorization of Empire Soils Investigations, Inc.

This report has been prepared in accordance with generally accepted geotechnical engineering practices. No warranty or guarantee, either expressed or implied, is made.

We appreciate the opportunity of service on this project. If there are any questions regarding the report, please contact us.

Respectfully Submitted,
EMPIRE SOILS INVESTIGATIONS, INC.

David R. Steiner
Senior Environmental Geologist

Sunil K. Mital, P.E.
Geotechnical Engineer

Dr. Mohamed M. Yasin, P.E.
Senior Environmental Engineer

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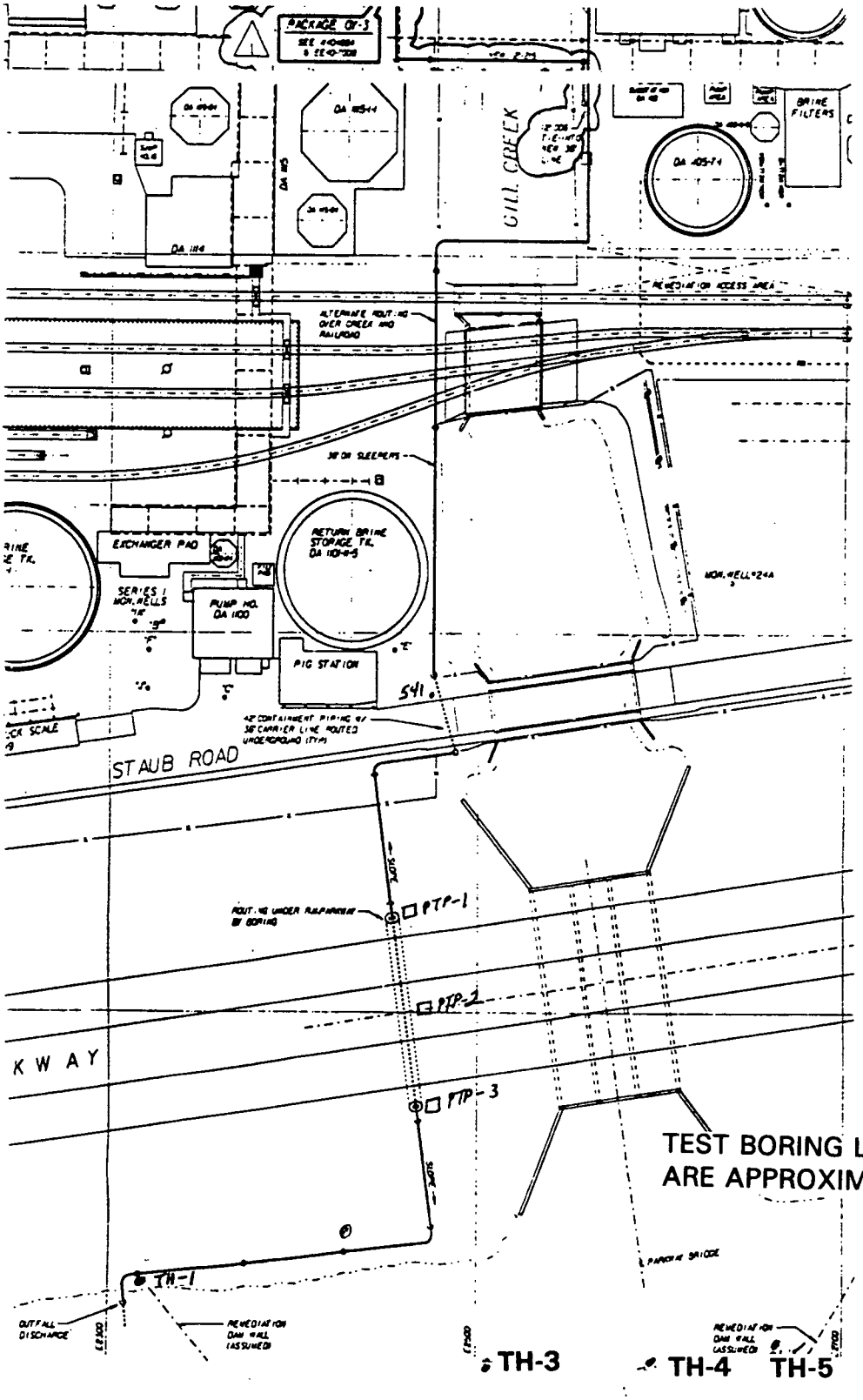
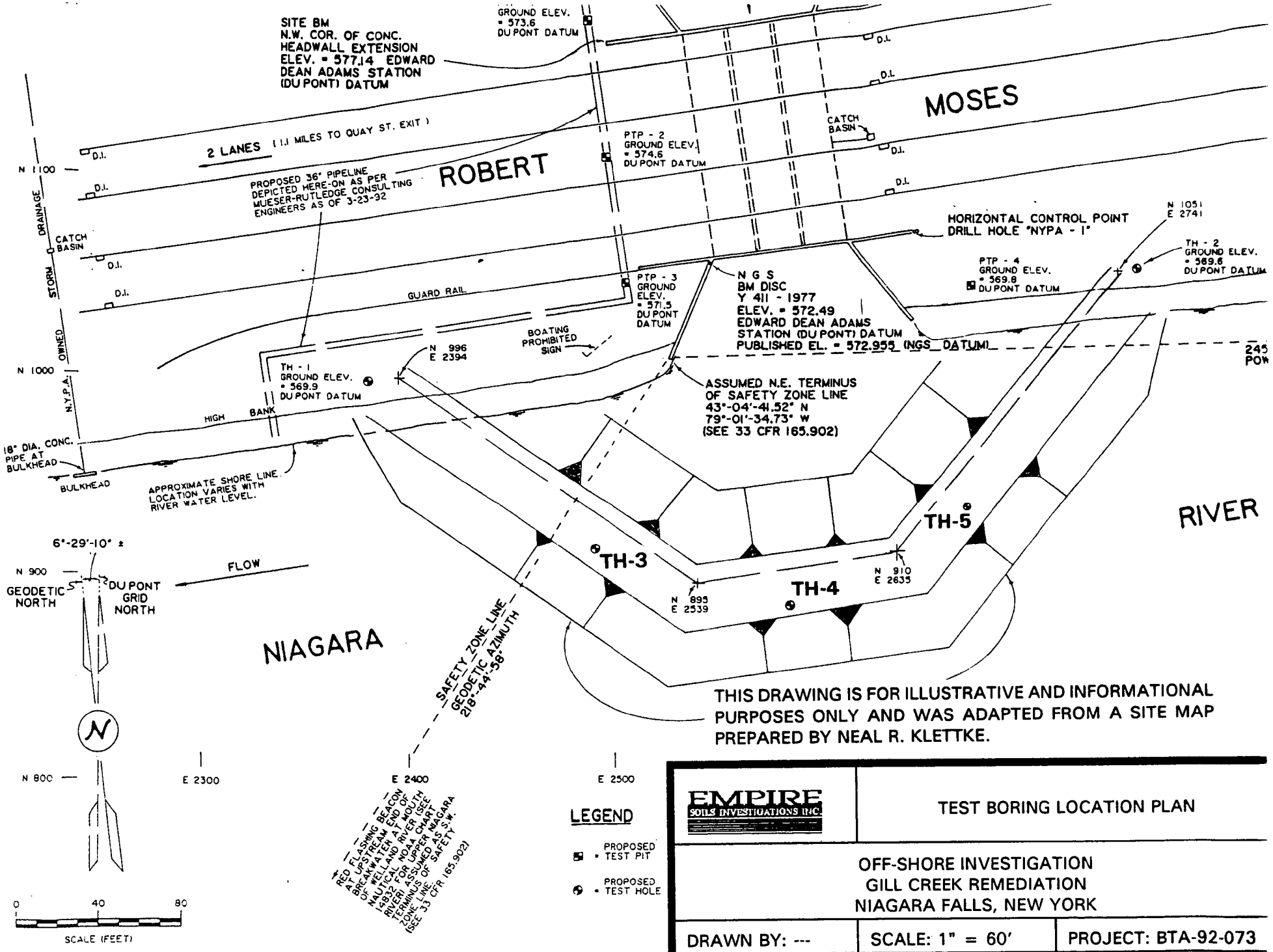
SOILS INVESTIGATIONS INC.

APPENDIX A



EMPIRE SOILS INVESTIGATIONS INC.	SITE LOCATION MAP	
OFF-SHORE INVESTIGATION GILL CREEK REMEDIATION NIAGARA FALLS, NEW YORK		
DRAWN BY: ---	SCALE: N.T.S.	PROJECT: BTA-92-073
CHECKED BY: ---	DATE: MAY 1992	DRAWING NO: A



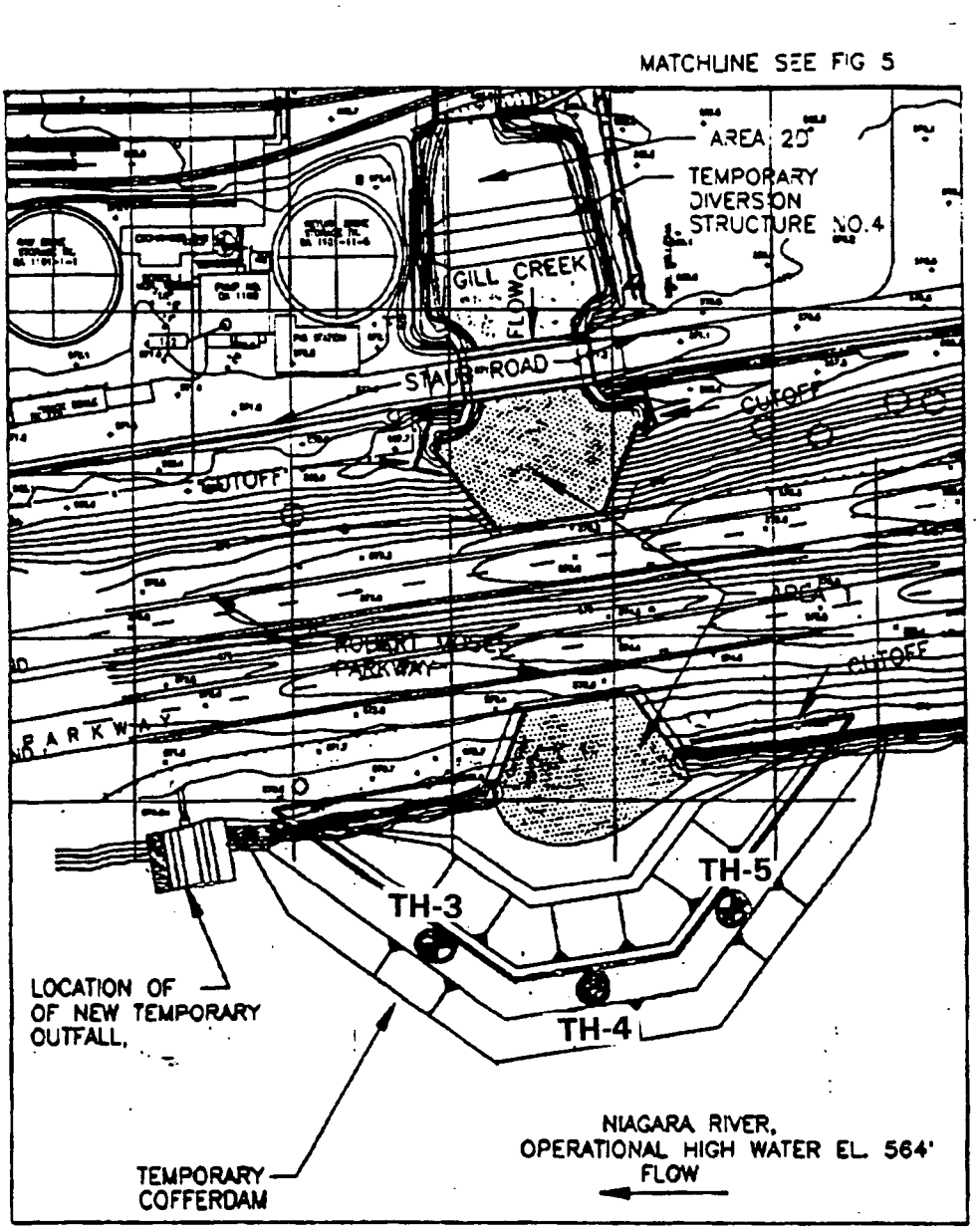
THIS DRAWING IS FOR ILLUSTRATIVE AND INFORMATIONAL PURPOSES ONLY AND WAS ADAPTED FROM A SITE MAP PREPARED BY NEAL R. KLETTKE.

EMPIRE SOILS INVESTIGATIONS INC.

TEST BORING LOCATION PLAN

OFF-SHORE INVESTIGATION
GILL CREEK REMEDIATION
NIAGARA FALLS, NEW YORK

DRAWN BY: ---	SCALE: 1" = 60'	PROJECT: BTA-92-073
CHECKED BY: ---	DATE: MAY 1992	DRAWING NO: B



SCALE: 1" = 100'

E.I. duPONT deNEMOURS & CO OLIN CORPORATION	Job No. : 22915 Prepared by : LDF Date : 2/14/92	PLAN VIEW OF TEMP. DIVERSION STR. NO. 4 & TEMP. COFFERDAM FIG. 4-4

TEST BORING LOCATIONS ARE APPROXIMATE

EMPIRE SOILS INVESTIGATIONS INC

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APPENDIX B

GENERAL INFORMATION & KEY TO SUBSURFACE LOGS

The Subsurface Logs attached to this report present the observations and mechanical data collected by the driller at the site, supplemented by classification of the material removed from the borings as determined through visual identification by technicians in the laboratory. It is cautioned that the materials removed from the borings represent only a fraction of the total volume of the deposits at the site and may not necessarily be representative of the subsurface conditions between adjacent borings or between the sampled intervals. The data presented on the Subsurface Logs together with the recovered samples will provide a basis for evaluating the character of the significance relative to each other. Often analyses of standard boring data indicate the need for additional testing or sampling procedures to more accurately evaluate the subsurface conditions. Any evaluation of the contents of this report and the recovered samples must be performed by Professionals. The information presented in the following defines some of the procedures and terms used on the Subsurface Logs to describe the conditions encountered.

1. The figures in the Depth column defines the scale of the Subsurface Log.

2. The sample column shows, graphically, the depth range from which a sample was recovered. See Table 1 for a description of the symbols used to signify the various types of samples.

3. The Sample No. is used for identification on sample containers and/or Laboratory Test Reports.

4. Blows on Sampler - shows the results of the "Penetration Test", recording the number of blows required to drive a split spoon sampler into the soil. The number of blows required for each six inches of penetration is recorded. The first 6 inches of penetration is considered to be a seating drive. The number of blows required for the second and third 6 inches of penetration is termed the penetration resistance, N. The outside diameter of the sampler, the hammer weight and the length of drop are noted at the bottom of the Subsurface Log.

5. PID - Organic vapor measurements taken with a Photoionization Detector (PID). Measurements recorded in parts per million (ppm).

6. Symbol - Material symbol which indicates the type of soil that was encountered during classification of the recovered soil at the approximate depth. The symbol indicated represents an approximate boundary between soil types and the transition may be gradual.

7. All recovered soil samples are reviewed in the laboratory by an engineering technician, geologist, or geotechnical engineer, unless note otherwise. The visual descriptions are made on the basis of a combination of the driller's field descriptions and observations and the sample as received in the laboratory. The method of visual classification is based primarily on the United Soil Classification (ASTM D 2487-83) with regard to the particle size and plasticity. (See Table No. II) Additionally, the relative portion, by weight, of two or more soil types is Burmister, ASTM Special Technical Publication 479, June 1970. (See Table III) The description of the relative soil density or consistency is based upon the penetration records as defined on Table No. IV. The description of the soil moisture is based upon the relative wetness of the soils as recovered and is described as dry, moist, wet and saturated. Water introduced in the boring either naturally or during drilling may have affected the moisture condition of the recovered sample. Special terms are used as required to describe materials in greater detail; several such terms are listed in Table V. When sampling gravelly oils with a standard two inch diameter split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter. The presence of boulders and large gravel is sometimes, but not necessarily detected by an evaluation of the casing and samplers blows or through the "action" of the drill rig as reported by the driller.

8. The description of the rock shown is based on the recovered rock core and the driller's observations. The terms frequently used in the description are included in Table VI.

9. The stratification lines represent the approximate boundary between soil types and the transition may be gradual. Solid stratification lines are based on the driller's field observations.

10. Miscellaneous observations and procedures noted by the driller are shown in this column, including water level observations. It is important to realize the reliability of the water level observations depends upon the soil type (water does not readily stabilize in a hole through fine grained soils), and that drill water used to advance the boring may have influenced the observations. The ground water level typically will fluctuate seasonally. One or more perched or trapped water levels may exist in the ground seasonally. All the available readings should be evaluated. If definite conclusions cannot be made, it is often prudent to examine the conditions more thoroughly through test pit excavations or water observations wells.

11. The length of core run is defined as the length of penetration of the core barrel. Core recovery is the length of core recovered divided by the core run. The RQD (Rock Quality Designation) is the total pieces of NX core exceeding 4 inches in length divided by the core run. The size core barrel used is also noted.

DATE
STARTED: 5-7-91
FINISHED: 5-7-91

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BORING NO.: B-1
SURF. ELEV.: 100.0 ±
SHEET 1 OF 1

PROJECT: SAMPLE SUBSURFACE LOG
LOCATION: _____
PROJECT NO: _____
CLIENT: _____

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	P.I.D.	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
0		1	2	4	6	6	10	1		FILL	
		2						1		WELL GRADED GRAVELS, GW	
										POORLY GRADED GRAVELS, GP	
5										SILTY GRAVELS, GM	Water encountered at 4.8 feet.
										CLAYEY GRAVELS, GC	
10										WELL GRADED SANDS, SW	
										POORLY GRADED SANDS, SP	
										SILTY SAND, SM	
15										CLAYEY SAND, SC	
										INORG. SILT AND VERY F. SAND, CLAYEY SILT WITH LOW PLASTICITY, ML	
20										INORG CLAYS, GRAVELLY CLAY, SANDY CLAY, SILTY CLAY, LEAN CLAY, CL	
										ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY, OL	
25										INORGANIC SILTS, MH	
										INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS, CH	
										ORGANIC CLAYS OF MED TO HIGH PLASTICITY, OH	
30										PEAT, Pt	
										SHALE	RUN: 32.0'-40.0' REC: 88% RQD: 66%
35										SANDSTONE	
										SILTSTONE	
40										LIMESTONE	

(1) (2) (3) (4) (5) (6) (7) (8) (9) (10) (11)

DRILLER: _____
DRILL RIG: CME - 45
METHOD OF INVESTIGATION: ASTM D-1586 Using Hollow Stem Augers
WEATHER: Sunny, 70 F
CLASSIFIED BY: By Geologist

TABLE I


Split Spoon Sample


Shelby Tube Sample


Auger or Test Pit Sample


Rock Core

TABLE III

The following terms are used in classifying soils consisting of mixtuers of two or more soil types. The estimate is based on weight of total sample.

Term	Percent of Total Sample
"and"	35 - 50 %
"some"	20 - 35 %
"little"	10 - 20 %
"trace"	less than 10 %

(When sampling gravelly soils with a standard split spoon, the true percentage of gravel is often not recovered due to the relatively small sampler diameter.)

TABLE V

Varved	-	Horizontal uniform layers or seams of soil(s).
Layer	-	Soil deposit more than 6" thick.
Seam	-	Soil deposit less than 6" thick.
Parting	-	Soil deposit less than 1/8" thick.
Laminated	-	Irregular, horizontal and angled seams and parings of soil(s).

TABLE II

Identification of soil types is made on basis of an estimate of particle sizes, and in the case of fine grained soils also on basis of plasticity.

Soil Type	Soil Particle Size	
Boulder	> 12"	Course Grained (Granular)
Cobble	3" - 12"	
Gravel-Coarse	3" - ¾"	
-Fine	¾" - #4	
Sand-Coarse	#4 - #10	
-Medium	#10 - #40	
-Fine	#40 - #200	
Silt: Non-Plastic (Granular)	< #200	Fine Grained
Clay: Plastic (Cohesive)		

TABLE IV

The relative compactness or consistency is described in accord wth the following terms.

Granular Soils		Cohesive Soils	
Term	Blows per Foot, N	Term	Blows per Foot, N
Loose	< 11	Very Soft	< 3
Firm	11 - 30	Soft	3 - 5
Compact	31 - 50	Medium	6 - 15
Very Compact	> 50	Stiff	16 - 25
		Hard	> 25

(Large particles in the soils will often significantly influence the blows per foot recorded during the Penetration Test.)

TABLE VI

Rock Classification Terms		Meaning
Hardness:	Soft	Scratched by fingernail.
	Medium Hard	Scratched easily by penknife.
	Hard	Scratched with difficulty by penknife.
	Very Hard	Cannot be scratched by penknife.
Weathering:	Very Weathered	Judged from the relative amounts of disintegration iron staining, core recovery, clay seams, etc.
	Weathered	
	Sound	
Bedding:	Laminated	Natural Breaks in Rock Layers (< 1")
	Thin Bedded	(1" - 4")
	Bedded	(4" - 12")
	Thick Bedded	(12" - 36")
	Massive	(> 36")

(Fracturing refers to natural breaks in the rock oriented at some angle to the rock layers.)

DATE
STARTED: 4-16-92
FINISHED: 4-16-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-3
SURF. ELEV.: ±
SHEET 1 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.

LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N						SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
0										DECK OF BARGE	Drilling Deck is 5.0' above River water level
5										TOP OF WATER (RIVER) AT 5.0'	
10										WATER	
15											Split Spoon refusal at 19.0'
		1	57	50/0.2'			REF	BG		TOP OF OVERBURDEN AT 18.3'	Installed 3" diameter Flush Joint (F.J.) Casing to 20.0'
20										Gray and brn. f-c GRAVEL, little f-c Sand, tr. silt (wet, GW)	

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX ROCK CORE
WEATHER: RAIN, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 4-16-92
FINISHED: 4-16-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-3
SURF. ELEV.: ±
SHEET 2 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.
LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
20					Gray Dolomite LIMESTONE Rock, weathered to sound, hard, frequent horizontal fractures, occasional styolites	Clean out inside of casing with 2-7/8" Roller Bit to 20.4'
					More frequent horizontal fractures 23.5'-25.0'	
25					Vertical fracture 24.5'-24.6'	RUN #1 = 20.4'-25.0' (Core Block) REC = 4.5'/4.6' RQD = 1.3'/4.6' Lost Drilling Water at ~22.0' PID on Rock Core = BG
					Fractured and weathered Rock, possible Core loss 27.5'-28.1 Rock becomes sound at 28.1' Contains Gypsum-filled zones at 28.1'-29.7'	
30						RUN #2 = 25.0'-30.4' REC = 5.1'/5.4' RQD = 3.5'/5.4' PID on Fractured Zone = 200-300 ppm Chemical Odor
						Core Block at start of Run #3
35						RUN #3 = 30.4'-40.4' REC = 99% RQD = 93% PID on Rock Core = 5-20 ppm
					Contains Gypsum-filled zones at 38.5'-39.2'	
40					Contains horizontal fractures 38.9'-39.5'	

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX ROCK CORE
WEATHER: RAIN, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 4-16-92
FINISHED: 4-16-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-3
SURF. ELEV.: ±
SHEET 3 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.
LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
40					Contains sound bedrock	RUN #4 = 40.4'-50.4' REC = 100% RQD = 100%
45						
50					Boring Complete at 50.4'	Tremie Grouted Borehole at Completion
55						
60						

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX ROCK CORE
WEATHER: RAIN, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 4-15-92
FINISHED: 4-15-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG
BTA-92-073

BORING NO.: TH-4
SURF. ELEV.: ±
SHEET 1 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.
LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N		SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
0										DECK OF BARGE	Drilling Deck is 5.2' above River water level
5										TOP OF WATER (RIVER) AT 5.2'	
										WATER	
10											
15											
18.3		1	7	50/	0.2		REF	BG		TOP OF OVERBURDEN AT 18.3'	
										Gray medium GRAVEL, little f-c Sand, tr. silt (wet, GP)	S-1 Poor recovery
20											

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX Rock Core
WEATHER: CLOUDY, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 4-15-92
FINISHED: 4-15-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-4
SURF. ELEV.: ±
SHEET 2 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.

LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
20					Gray Dolomite LIMESTONE Rock, hard, slightly weathered to sound, occasional horizontal fractures, occasional styolites Horizontal Fractures: 20.5-20.9' 22.4-22.5' 22.8-22.9' 24.5-24.6' 25.1-25.4'	Advanced 3" F.J. Casing to 19.5' Advanced 2-7/8" Roller Bit to 20.5' NX CORE RUN #1 20.5'-30.5' REC=100% RQD=91% PID=BG on Rock Core ~5% Drilling water return while Coring from 20.5'-22.0' Apparent "softer" rock at 22.0' No drilling water return below 22.0'
25						
30					Contains zone of vugs and fractures 31.1'-31.4', possible core loss Contains horizontal and sub-horizontal fractures 32.6'-33.6'	RUN #2=30.5'-40.5' REC=98% RQD=84%
35						
40					Contains seam-filled with Calcite and Gypsum at 39.0'	

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX Rock Core
WEATHER: CLOUDY, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 4-15-92
FINISHED: 4-15-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-4
SURF. ELEV.: ±
SHEET 3 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.

LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
40					Vertical Fracture: 43.0-43.8'	RUN #3=40.5'-50.5' REC=100% RQD=99% PID=BG on rock core
45						
50					Fractured Rock: 49.5-49.6'	
					Boring Complete at 50.5'	Tremie Grouted Borehole at Completion
55						
60						

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX Rock Core
WEATHER: CLOUDY, 30's
CLASSIFIED BY: D.R. Steiner

DATE
STARTED: 4-14-92
FINISHED: 4-14-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-5
SURF. ELEV.: ±
SHEET 1 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.

LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6	6/12	12/18	18/24	N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
0									DECK OF BARGE	Drilling deck is 5.0' above River water level
										PID = Photoionization Detector readings (ppm) Background (BG) PID = 0.2-0.8 ppm
5									TOP OF WATER (RIVER) AT 5.0'	
									WATER	
10										
15										
		1	35	50/	0.1		REF	BG	Top of OVERBURDEN at 18.2'	
									Brn. f-c GRAVEL, little f-c Sand, tr. silt, tr. shells (wet, GP-GW)	
20									Sample Spoon refusal at 18.8'	

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX ROCK CORE
WEATHER: CLOUDY, 30's
CLASSIFIED BY: D. R. Steiner

DATE
STARTED: 4-14-92
FINISHED: 4-14-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-5
SURF. ELEV.: ±
SHEET 2 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.

LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
20					Gray Dolomite LIMESTONE Rock, hard, weathered to sound, occasional Styolites, occasional fractured zones, occasional vuggy zones Zones of Weathered and fractured Rock: 19.8'-20.0' 20.3'-20.6' (Possible Core loss) Fractured Rock: 20.8'-21.2' 23.0'-23.4' 24.1'-24.2' 25.4'-25.6' Vertical Fracture: 24.3'-24.9' All Rock recovered from RUN #3 was highly weathered and fractured, except one piece, 0.25' long. White , soft material (possible Gypsum) was recovered near the end of the run. Hole open to 28.4' after coring to 29.0' Fractured Rock 29.0-29.3' Rock becomes sound @ 29.3' Fractured and vuggy @ 31.9'-32.5' PID on Rock Core from 31.9'-32.5'= 200-300 ppm	3"Flush Joint (F.J.) casing (temporary) is 22.4' long Advanced F.J. Casing to 19.8.' Clean out inside of casing with 2-7/8" Roller Bit. RUN #1=19.8'-20.8' REC=80% RQD=30% RUN #2=20.8'-27.3' (Core Block) REC=5.7/6.5' (may have broken off high) RQD=3.7/6.5' RUN #3=27.3'-29.0' REC=80-90% (estimate) RQD=0% RUN #4=29.0'-30.8' REC=100% RQD=1.5'/1.8' PID on Rock Core=BG from 19.8'-29.0' PID on Rock Core=BG-1.5 ppm from 29.0'-30.8' RUN #5=30.8'-40.8' REC=10.0'/10.0' RQD=90%
25						
30						
35						
40						

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX ROCK CORE
WEATHER: CLOUDY, 30's
CLASSIFIED BY: D. R. Steiner

DATE
STARTED: 4-14-92
FINISHED: 4-14-92

EMPIRE
SOILS INVESTIGATIONS INC.

SUBSURFACE LOG

BTA-92-073

BORING NO.: TH-5
SURF. ELEV.: ±
SHEET 3 OF 3

PROJECT: Dupont-Gill Creek Remediation
CLIENT: E. I. Dupont DeNemours & Co.
LOCATION: Offshore-Mouth of Gill Creek
Niagara Falls, NY

DEPTH-FT.	SAMPLES	SAMPLE NO	BLOWS ON SAMPLER 0/6 6/12 12/18 18/24 N	SYMBOL	SOIL OR ROCK CLASSIFICATION	NOTES
40						RUN #6=40.8'-50.8' REC=82% RQD=82% (left 1.8' of Core in Hole)
45						
50					Boring Complete @ 50.8'	Tremie Grouted Borehole at Completion
55						
60						

DRILLER: J. Lamm
DRILL RIG: Failing F-10
METHOD OF INVESTIGATION: NX ROCK CORE
WEATHER: CLOUDY, 30's
CLASSIFIED BY: D. R. Steiner

EMPIRE
SOILS INVESTIGATIONS INC.

APPENDIX C

EMPIRE
SOILS INVESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by WSM/DRS Ground Elevation (OFFSHORE)

Hole No. TH-3 Date Started 4-16-92 Rock Elevation

Location 30.4' - 40.4' Date Completed 4-16-92 Water Depth During Test 5.0

Single Packer Test

Test No.	Depth: To Bottom of Borehole (ft.) 1	Depth: To Bottom of Top Packer (ft.) 2	Length of Interval Tested (1-2) (ft.) A	Radius of Test Hole (ft.) R	A/R	Gauge Pressure x 2.31 (ft.) h_2	Vertical Distance from Gauge to Water Table (ft.) h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ (ft.) H	Water Loss (ft^3)	Elapsed Time (min.)	Rate of Flow ft^3/sec Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(C_s + 4)(R)(H)}$ ($\times 10^{-5}$ ft/sec) K
1	40.4	30.4	10.0	0.125	80	13.86	9.7		23.54	0.762	3	0.0042		105	1.31
2	↓	↓	↓	↓		30.03	↓		39.70	1.99	3	0.011		↓	2.03
3						43.89			53.59	2.53	3	0.014			1.92
4						57.75			67.45	3.61	3	0.020			2.18
5						43.89			53.59	2.94	3	0.016			2.19
6						30.03			39.70	1.56	3	0.0087			1.61
7						13.86			23.54	0.047	3	0.00026			0.081

NOTE: This form is for pressure permeability test performed below the water table.

EMPIRE SOILS INVESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by WSM/DRS Ground Elevation (OFFSHORE)
Hole No. TH-3 Date Started 4-16-92 Rock Elevation
Location 40.4' - 50.4' Date Completed 4-16-92 Water Depth During Test 5.0

Single Packer Test

Test No.	Depth: To Bottom of Borehole (Ft.) 1	Depth: To Bottom of Top Packer (Ft.) 2	Length of Interval Tested (1-2) (Ft.) A	Radius of Test Hole (Ft.) R	A/R	Gauge Pressure x 2.31 (Ft.) h_2	Vertical Distance from Gauge to Water Table (Ft.) h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ H	Water Loss (ft^3)	Elapsed Time (min.)	Rate of Flow ft^3/sec Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$K = \frac{Q}{(C_s + 4)(R)(H)}$ ($\times 10^{-7}$ ft/sec)
1	50.4	40.4	10.0	0.125	80	20.79	10.0		30.79	0	3	0		105	—
2						36.96			46.96	0.080	3	0.00045			7.03
3						60.06			70.06	0.067	3	0.00037			3.88
4						78.54			88.54	0.053	3	0.00030			2.49
5						60.06			70.06	0.053	3	0.00030			3.14
6						36.96			46.96	0.087	3	0.00048			7.50
7	↓	↓	↓	↓		20.79	↓		30.79	0.154	3	0.00085		↓	20.3

NOTE: This form is for pressure permeability test performed below the water table.

EMPIRE SOILS INVESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by DRS Ground Elevation (OFFSHORE)

Hole No. TH-4 Date Started 4-15-92 Rock Elevation

Location 30.5'-40.5' Date Completed 4-15-92 Water Depth During Test 5.0'

Single Packer Test

Test No.	Depth: To Bottom of Borehole (ft.) 1	Depth: To Bottom of Top Packer (ft.) 2	Length of Interval Tested (1-2) (ft.) A	Radius of Test Hole (ft.) R	A/R	Gauge Pressure x 2.31 (ft.) h_2	Vertical Distance from Gauge to Water Table (ft.) h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ (ft.) H	Water Loss (ft^3)	Elapsed Time (min.)	Rate of Flow ft^3/sec Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(Cs + 4)(R)(H)}$ ($\times 10^{-5}$ ft/sec.) K
1	40.5	30.5	10.0	0.125	80	13.86	9.0		22.86	0.481	3	0.0027		105	0.867
2						30.03			39.03	2.447	3	0.0136			2.56
3						43.89			52.89	3.316	3	0.0184			2.55
4						60.06			69.06	4.305	3	0.0239			2.54
5						43.89			52.89	3.289	3	0.0183			2.54
6						30.03			39.03	2.906	3	0.0134			2.52
7	↓	↓	↓	↓		13.86	↓		22.86	0.254	3	0.0014		↓	0.449

NOTE: This form is for pressure permeability test performed below the water table.

EMPIRE
SOILS INVESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by DRS Ground Elevation (OFFSHORE)

Hole No. TH-4 Date Started 4-15-92 Rock Elevation

Location 40.5' - 50.5' Date Completed 4-15-92 Water Depth During Test 5.0

Single Packer Test

Test No.	Depth: To Bottom of Borehole (ft.) 1	Depth: To Bottom of Top Packer (ft.) 2	Length of Interval Tested (1-2) (ft.) A	Radius of Test Hole (ft.) R	A/R	Gauge Pressure x 2.31 (ft.) h_2	Vertical Distance from Gauge to Water Table (ft.) h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ (ft.) H	Water Loss (ft^3)	Elapsed Time (min.)	Rate of Flow ft^3/sec Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$K = \frac{Q}{(Cs + 4)(R)(H)} \times 10^{-6}$ ft/sec
1	50.5	40.5	10.0	0.125	80	20.79	9.0		29.79	0.428	3	0.0024		105	5.91
2						41.58			50.58	0.281	3	0.0016			2.32
3						62.37			71.37	0.401	3	0.0022			2.26
4						83.16			92.16	0.495	3	0.0028			2.23
5						62.37			71.37	0.441	3	0.0025			2.57
6						41.58			50.58	0.334	3	0.0019			2.76
7	↓	↓	↓	↓		20.79	↓		29.79	0.201	3	0.0011		↓	2.71

NOTE: This form is for pressure permeability test performed below the water table.

EMPIRE SOILS INVESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by WSM/DRS Ground Elevation (OFFSHORE)

Hole No. TH-5 Date Started 4-14-92 Rock Elevation

Location 29.0'-40.8' Date Completed 4-14-92 Water Depth During Test 5.0'

Single Packer Test

Test No.	Depth To Bottom of Borehole (Ft.) 1	Depth To Bottom of Top Packer (Ft.) 2	Length of Interval Tested (1-2) (Ft.) A	Radius of Test Hole (Ft.) R	A/R	Gauge Pressure x 2.31 (Ft.) h_2	Vertical Distance from Gauge to Water Table (Ft.) h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ (Ft.) H	Water Loss (ft^3)	Elapsed Time (min.)	Rate of Flow ft^3/sec Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(Cs+4)(R)(H)} (\times 10^{-6}$ Ft/sec) K
1	40.8	29.0	11.8	0.125	94.4	11.55	9.0		20.55	0.388	3	0.0022		125	6.64
2						18.48			27.48	0.334	3	0.0019			4.29
3						30.03			39.03	1.417	3	0.0079			12.6
4						41.58			50.58	1.765	3	0.0098			12.0
5						30.03			39.03	0.896	3	0.0050			7.94
6						18.48			27.48	0.321	3	0.0018			4.06
7	↓	↓	↓	↓	↓	11.55	↓		20.55	0.187	3	0.0010		↓	3.02

NOTE: This form is for pressure permeability test performed below the water table.

EMPIRE SOILS INVESTIGATIONS INC

REPORT OF PRESSURE PERMEABILITY TESTS IN STABLE ROCK

Project BTA-92-073 Logged by WSM/DRS Ground Elevation (OFFSHORE)

Hole No. TH-5 Date Started 4-14-92 Rock Elevation _____

Location 40.8'-50.8' Date Completed 4-14-92 Water Depth During Test 5.0'

Single Packer Test

Test No.	Depth: To Bottom of Borehole (ft.) 1	Depth: To Bottom of Top Packer (ft.) 2	Length of Interval Tested (1-2) (ft.) A	Radius of Test Hole (ft.) R	A/R	Gauge Pressure x 2.31 (ft.) h_2	Vertical Distance from Gauge to Water Table (ft.) h_1	Head Loss in Pipe Length From Gauge to Top Packer L	$(h_1 + h_2 - L)$ (ft.) H	Water Loss (ft^3)	Elapsed Time (min.)	Rate of Flow ft^3/sec Q	Thickness of Saturated Layer S	Conductivity Coefficient Cs	$\frac{Q}{(C_s + 4)(R)(H)} (\times 10^{-6}$ ft/sec) K
1	50.8	40.8	10.0	0.125	80	13.86	9.6		23.46	0	3	0		105	—
2						32.31			41.94	0.174	3	0.00097			1.70
3						43.89			53.49	0.201	3	0.0011			1.51
4						57.75			67.35	0.160	3	0.00089			0.970
5						39.27			48.87	0.267	3	0.0015			2.25
6	↓	↓	↓	↓	↓	20.79	↓		30.39	0.120	3	0.00067		↓	1.62

NOTE: This form is for pressure permeability test performed below the water table.

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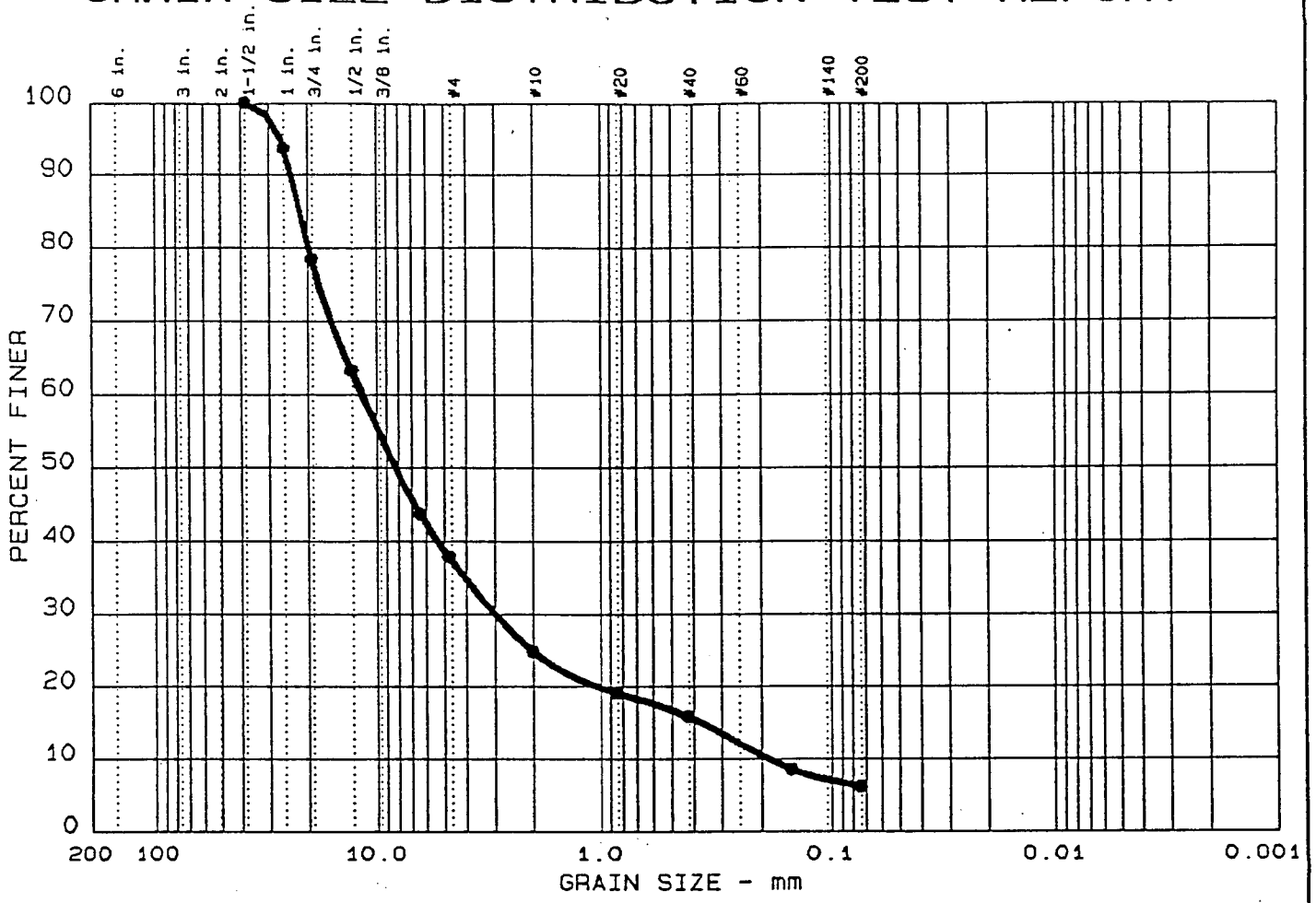
SOILS INVESTIGATIONS INC.

APPENDIX D

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	%+75mm	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	62.2	31.7	6.1	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			21.38	11.42	8.15	2.958	0.3639	0.1866	4.11	61.2

MATERIAL DESCRIPTION	USCS	AASHTO
● Gravel some sand trace silt or clay.	GP-GM	A-1-a

Project No.: BTA-92-073
Project: Dupont - Gill Creek Remediation
● Location: Offshore Test Borings

Date: 4/28/92

Remarks:
Composite sample :
TH-3, S-1 / TH-5, S-1

GRAIN SIZE DISTRIBUTION TEST REPORT

EMPIRE SOILS INVESTIGATIONS, INC.

Figure No. L-1