Investigation of the Former Coal Gasification Site at Mechanicville, New York

Phase II Remedial Investigation Report and Work Plan for Phase IIA Supplemental Remedial Investigation and Feasibility Study

Volume II of II - Appendices

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ASEA BROWN BOVF

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Appendix A

Test Pit Logs and Field Observations

MECHANICVILLE SITE

Test Pit	Total Depth (ft)	Visual Appearance	Odor and PID Characterization	Samples Collected
TP-1	7.7	Brown fill with cobbles from 0 to 0.8 ft. and black ash with clinkers and cinders from 0.8 to 2.0 ft. Reddish brown fine sandy silt, small cobbles, large boulders, organic material, bricks and clinkers from 2.0 to 3.0 ft., and brown sandy silt with cobbles, clinkers, glass, wood, and bricks from 3.0 to 6.0 ft. From 6.0 to 7.7 ft., light brown clayey silt with dark stains in root channels and highly fractured shale fragments. Wet, oily sheen at 7.7 ft. No visible coal tar.	Slight odor in black ash layer from 0.8 to 2.0 ft. Slight odor in light brown clayey silt layer from 6.0 to 7.7 ft. PID-background levels.**	Sample TP-1/S-1 at 6.5 to 7.0 ft.*
TP-2	7.5	Brown to dark brown silty sand with sharp angular cobbles from 0 to 1.3 ft. Brown sandy fill with bricks from 1.3 to 2.6 ft. Angular cobbles and boulders from 2.6 to 5.5 ft. with less weathered angular rocks in sand matrix from 5.5 to 7.0 ft. Angular cobbles (>50%) with gray clayey silt and brown sandy silt lenses from 7.0 to 7.5 ft. No visual signs of coal tar wastes.	PID readings of background levels in ambient air. Readings of 10 ppm from sampled material.	Sample TP-2/S-1 at 7.0 to 7.5 ft.*

TEST PIT OBSERVATIONS (continued)

Test Pit	Total Depth (ft)	Visual Appearance	Odor and PID Characterization	Samples Collected
TP-3	3.0	Light brown sandy silt with cobbles from 0.2 to 1.0 ft., and dark brown silty fill with cobbles, bricks, concrete from 1.0 to 3.0 ft. Concrete obstruction at 3.0 ft. No visible signs of coal tar or other contamination encountered.	PID readings at background level in ambient air and for soil.	No samples collected due to concrete obstruction.
TP-4	5.5	Light brown sandy silt with cobbles from 0.1 to 0.3 ft. and dark brown sandy silt with cobbles from 0.3 to 1.0 ft. Bricks from 1.0 to 1.5 ft. Light brown sand from 1.5 to 3.0 ft. Angular shale saturated with coal tar from 3.0 to 4.5 ft. and larger angular shale fragments from 4.75 to 5.5 ft. (saturated with coal tar).	PID readings of 30-40 ppm near sampled soil (3 to 4 feet below ground surface).	TP-4/S-1 at 3.0 to 4.0 ft. *
TP-5	6.5	Light brown sandy silt with cobbles from 0 to 1.3 ft and dark brown sandy silt with angular cobbles from 1.3 to 3.0 ft. Highly fractured shale, silt and clay soil, wood chips, and coke fragments saturated with coal tar from 3.0 to 6.5 ft. At 6.5 ft., silt and fractured shale saturated with coal tar.	PID reading of 50 ppm over saturated soil.	TP-5/S-1 from 3.0 to 4.0 ft.* TP-5/S-2 from 4.0 to 6.0 ft.* Duplicate sample TP-5/S-1 Dup.*

* Samples analyzed by ERCO.

** Background PID levels represent ambient air levels obtained outside and upwind of the site boundaries. At the Mechanicville site, background levels were generally less than 5 ppm.

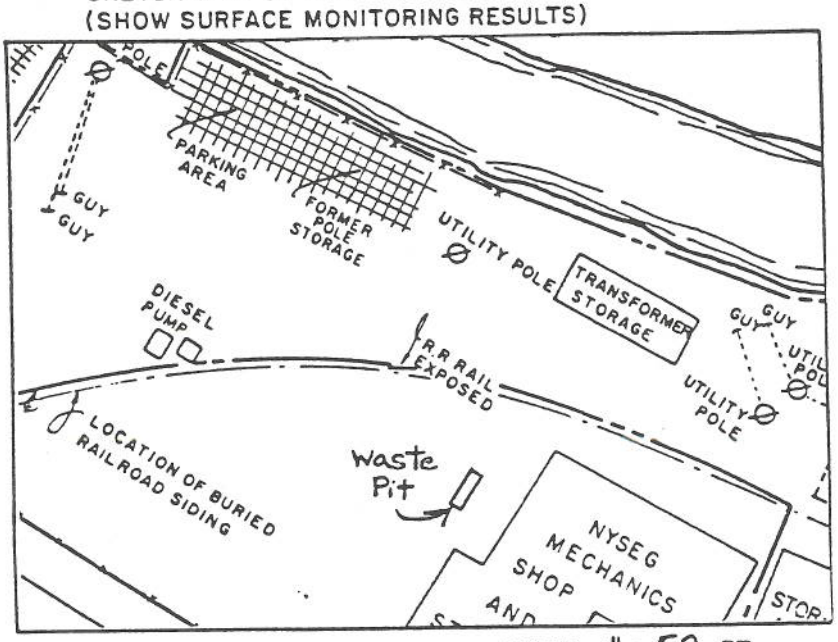
TEST PIT RECORD

SITE Mechanicville - NYSEG 4945-02

TEST PIT Waste Pit DATE 7/21/86 TIME ST. 1000 END 1030

COORDINATES N/A GRID ELEMENT N/A

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = 50 FT

CREW MEMBERS

1. S. Wibby
2. C. Moore
3. PT } Maloy (Empire)
4. RC }
5.
6.

MONITOR EQUIPMENT

PI METER	(Y)	N
EXPLOSIVE GAS	(Y)	N
AVAIL. OXYGEN	(Y)	N
OVA	Y	(N)

OTHER Radiation Meter

PHOTOGRAPHS, ROLL #1

EXPOSURE # 0

NOTES

0' – 0.3' Brown sandy fill with cobbles.

0.3' – 0.7' Asphalt

0.7' – 1.2' Brown sandy fill with cobbles

1.2' – 4.0' Brown to black sandy fill with clinkers, cobbles brick fragments, cobbles, and white/gray ash.

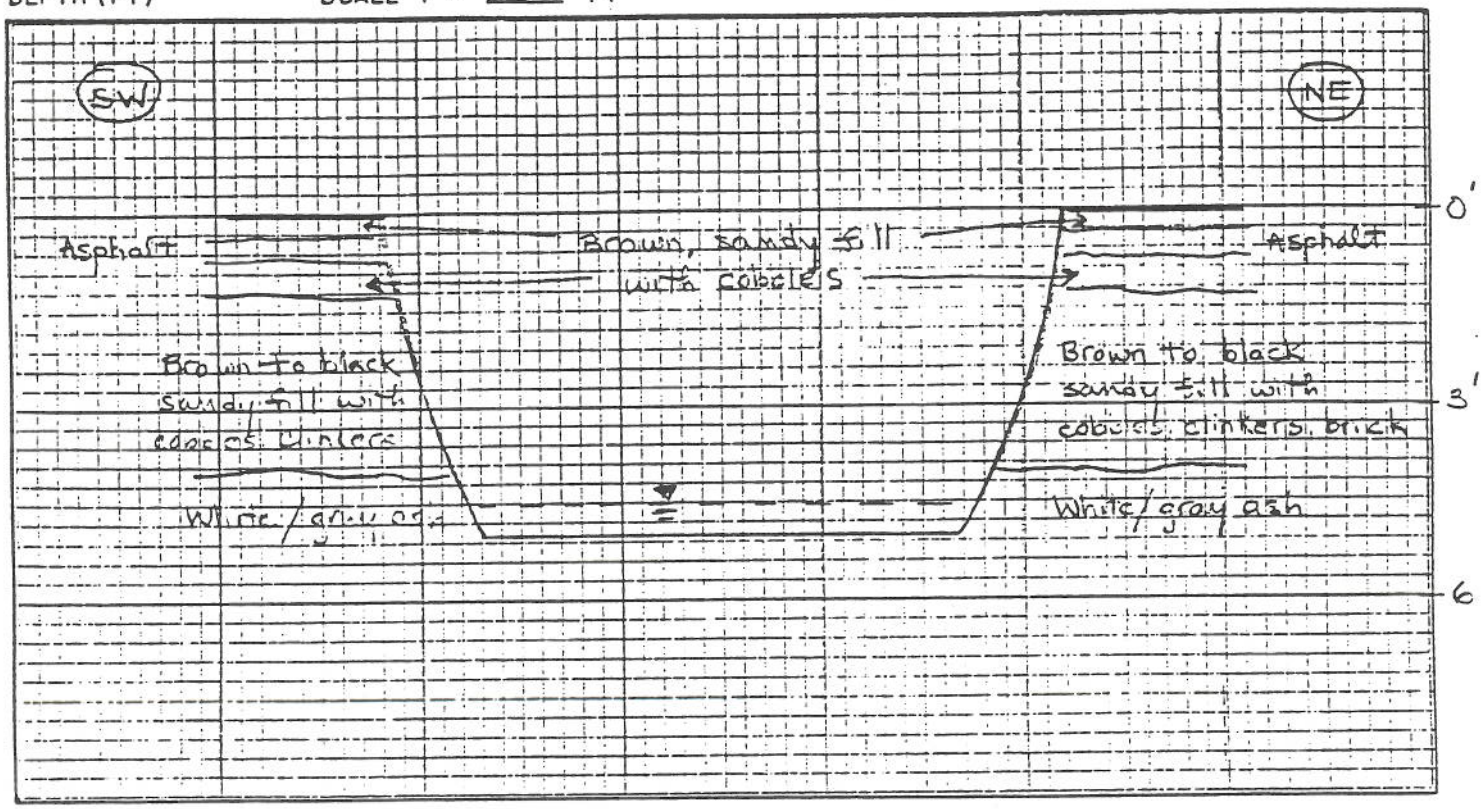
4.0' – 5.0' White/gray ash containing coke, clinkers, some wood, cobbles, and cinders grading back into cobbly brown fill.

∇ at 4.5'

TEST PIT RECORD
PROFILE ALONG TEST PIT– Waste Pit

SITE Mechanicville

DEPTH (FT) SCALE 1" = 3 FT



NOTES:

Test pit dimensions: W x L x D 2.5' x 10' x 5'

No visible coal tar but ash, coke and clinkers present.

PI readings at background level.

SAMPLES OBTAINED No Samples

NO.	DEPTH (FT)	INIT. SER. NO.	HD. SP. VOA PPM
S-1			
S-2			
S-3			
S-4			
S-5			
S-6			
S-7			
S-8			

REFERENCE: FIELD BOOK, PG. _____

ATTACHMENTS _____

Christina Moore

SIGNATURE

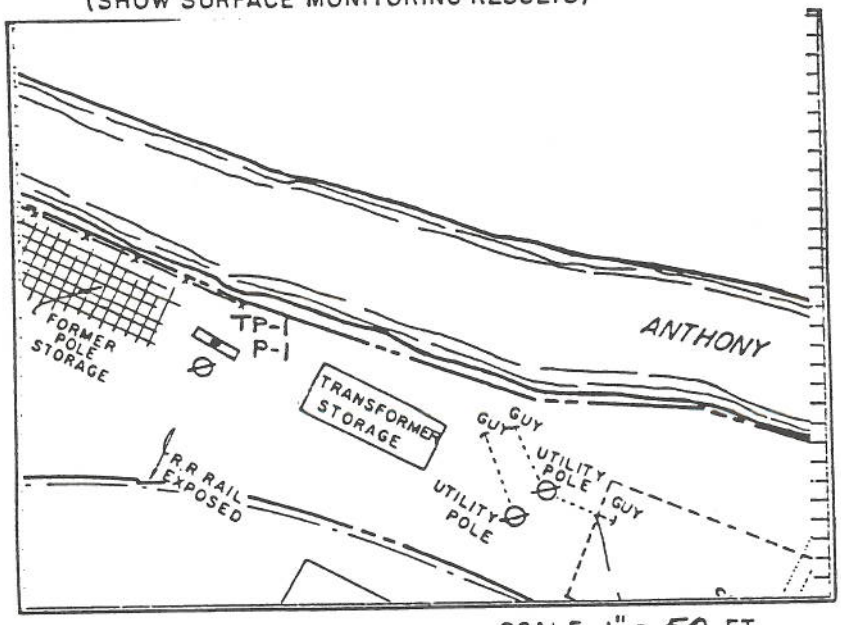
TEST PIT RECORD

SITE Mechanicville NYSEG 4945-02

TEST PIT TP-1 DATE 7/21/86 TIME ST. 10:50 END 11:30

COORDINATES N/A GRID ELEMENT N/A

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = 50 FT

CREW MEMBERS

1. S. Webby
2. C. Moore
3. P. Tierney } Maloy (Empire)
4. R. Ciccateri }
5.
6.

MONITOR EQUIPMENT

PI METER	(Y)	N
EXPLOSIVE GAS	(Y)	N
AVAIL. OXYGEN	(Y)	N
OVA	Y	(N)

OTHER Radiation meter

PHOTOGRAPHS, ROLL # 1

EXPOSURE 1

NOTES

FILL

0'-0.8' Brown sandy fill with cobbles Loose, dry

0.8'-2.0' Black ash with clinkers and cinders oxidized, loose, dry. Slight odor.

2.0'-3.0' Reddish brown fine sandy silt with small cobbles, large rounded boulders, organic material (roots), bricks and clinkers

3.0'-6.0' Brown sandy silt with cobbles, clinkers glass, wood bricks. Dry and loose.

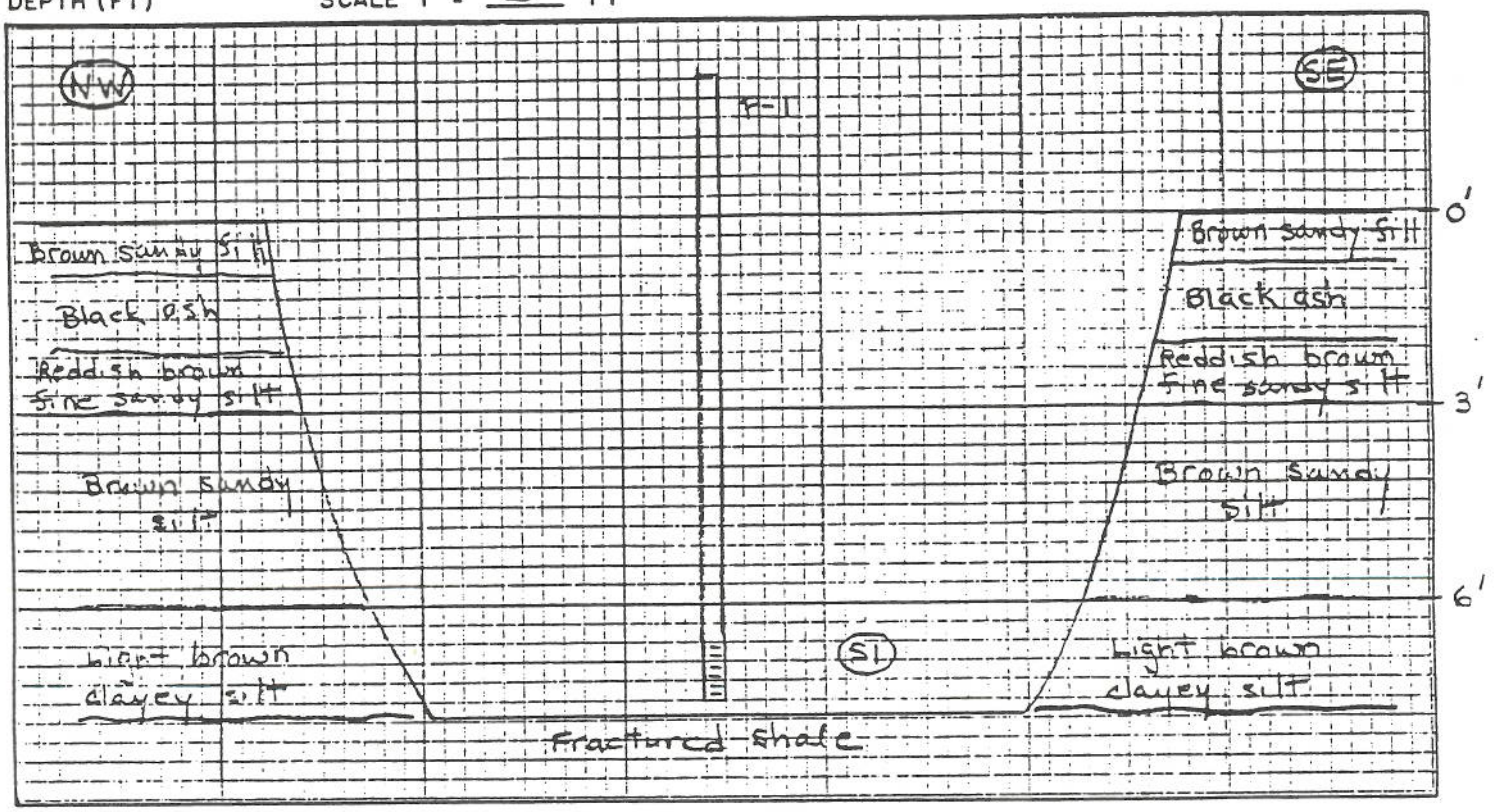
6.0'-7.7' Light brown clayey silt, cohesive, moist with mottling and slight odor. Dark stains in root channels.

7.7 Bedrock. Highly fractured shale, wet oil

TEST PIT RECORD
PROFILE ALONG TEST PIT- 1

SITE NYSEG Mechanicville

DEPTH (FT) SCALE 1" = 3 FT



NOTES:

Test pit dimensions (L x W x D)

14' x 1.5' x 7.7'

No groundwater seepage.

PI readings at background level.

No visible coal tar but ash & clinkers present.

Piezometer (P-1) installed behind utility pole - screened from 6.5' to 7.5'.

SAMPLES OBTAINED

NO.	DEPTH (FT)	INIT. SER. NO.	HD. SP. VOA PPM
S-1	6.5'-7.0'	MEEXTPXX01/11	
S-2			
S-3			
S-4			
S-5			
S-6			
S-7			
S-8			
	Collected soil for		
	lab permeability test.		

REFERENCE: FIELD BOOK, PG. _____

ATTACHMENTS _____

Christina Moore

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EC JORDAN CO

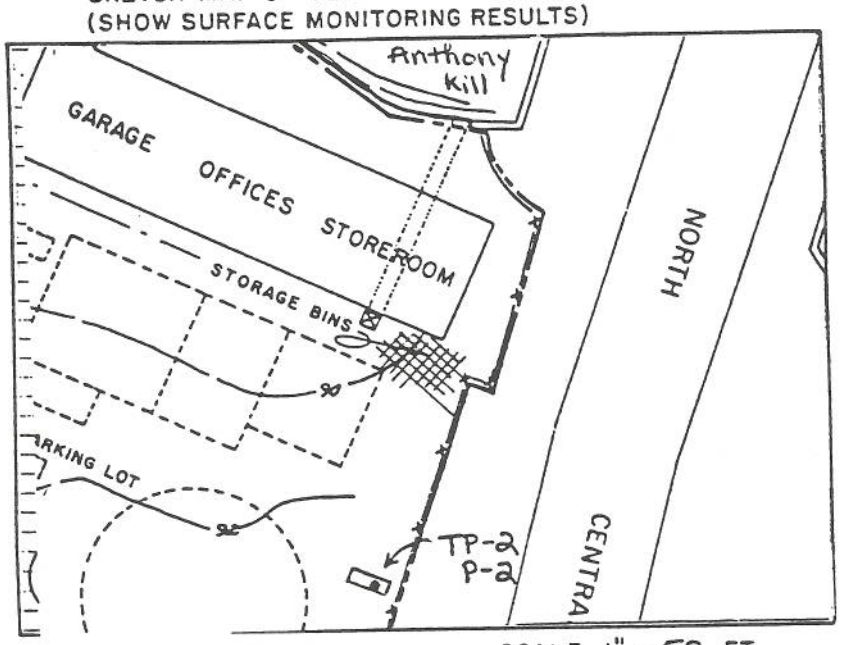
TEST PIT RECORD

SITE Mechanicville - NYSEG 4945-02

TEST PIT TP-2 DATE 7/21/86 TIME ST. 15:30 END 16:45

COORDINATES N/A GRID ELEMENT N/A

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = 50 FT

CREW MEMBERS

1. C.Moore
2. S.Wibby
3. PT } Malay (Empire)
4. RC }
5.
6.

MONITOR EQUIPMENT

PI METER	(Y)	N
EXPLOSIVE GAS	(Y)	N
AVAIL. OXYGEN	(Y)	N
OVA	Y	(N)

OTHER Radiation meter

PHOTOGRAPHS, ROLL #1

EXPOSURE #9, #10

NOTES 0'-1.3' Brown to dark brown silty sand with sharp angular cobbles (>50%)

1.3'-2.6' Brown sandy fill with bricks, oxidized

2.6'-5.5' angular cobbles and boulders with some sandy fill. Highly weathered. (75% rock material)

5.5'-7.0' angular rocks, less weathered with sand matrix

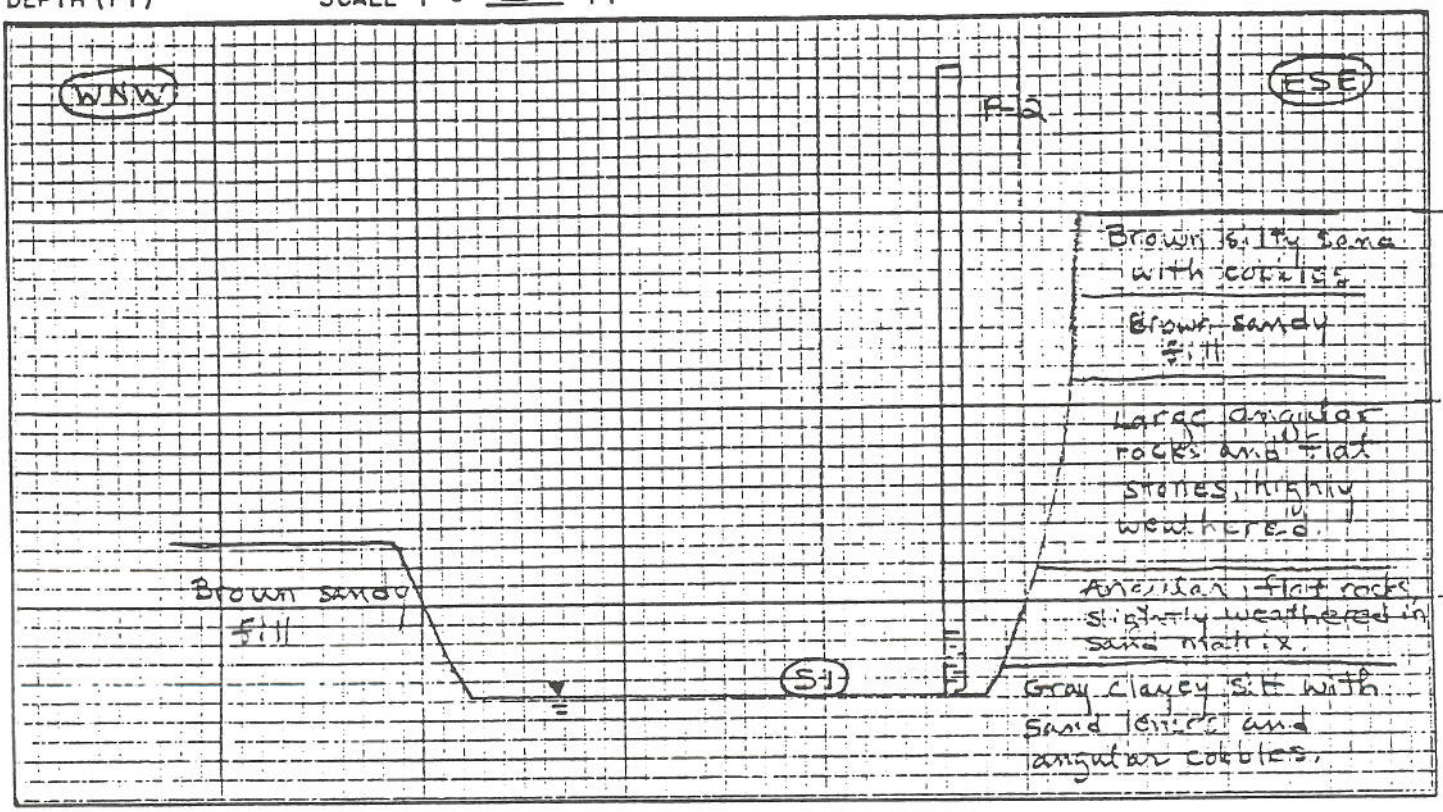
7.0'-7.5' & light gray clayey silt matrix with brown sandy silt lenses with angular cobbles (>50%). mottling

▽ 7.5'

TEST PIT RECORD
PROFILE ALONG TEST PIT- 2

SITE NYSEG Mechanicville

DEPTH (FT) SCALE 1" = 3 FT



NOTES:

Test pit dimensions (LxWxD):
11' x 2' x 7.5'

PI readings at background level in ambient air - 10 ppm from sampled material.

No visible coal tar.

Piezometer (P-2) installed on bank - screened from 6.5'-7.5'.

Test pit was dug into the bank.

SAMPLES OBTAINED

NO.	DEPTH (FT)	INIT. SER. NO.	HD. SP. VOA PPM
S-1	7.0'-7.5'	MEEXTPXX02/11	
S-2			
S-3			
S-4			
S-5			
S-6			
S-7			
S-8			

REFERENCE: FIELD BOOK, PG. _____
ATTACHMENTS _____

Christina Moore
SIGNATURE

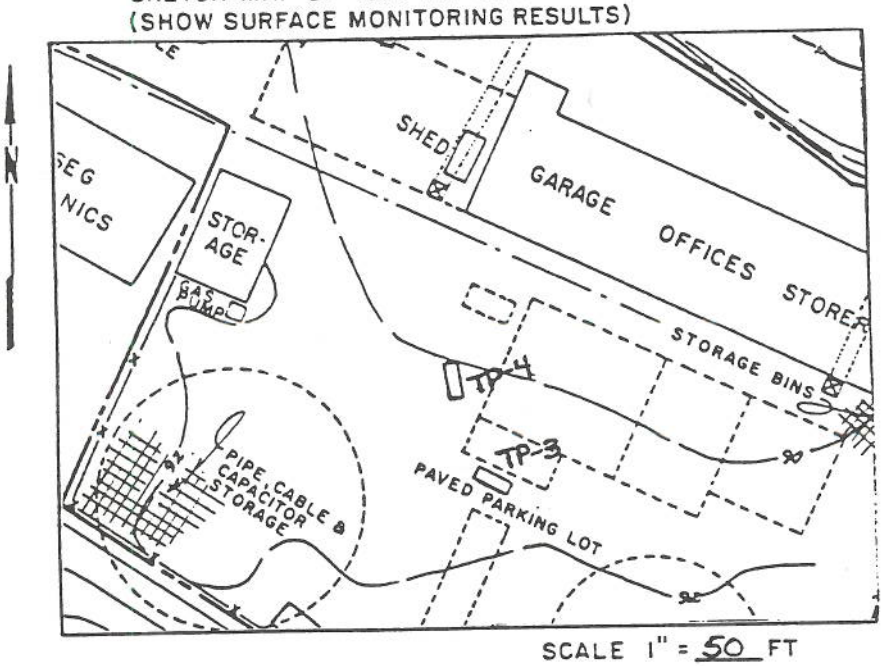
TEST PIT RECORD

SITE Mechanicville NYSEG 4945-02

TEST PIT TP-3 DATE 7/21 TIME ST. 14:15 END 14:30

COORDINATES N/A GRID ELEMENT N/A

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = 50 FT

CREW MEMBERS

1. CMoore
2. SWibby
3. PT } Maloy (Empire)
4. RC }
5.
6.

MONITOR EQUIPMENT

PI METER	(Y)	N Background
EXPLOSIVE GAS	(Y)	N
AVAIL. OXYGEN	(Y)	N
OVA	Y	(N)

OTHER Radiation meter

PHOTOGRAPHS, ROLL —

EXPOSURE —

NOTES 0.2'-1' Light brown sandy silt with cobbles loose, granular, dry.

1'-3' Dark brown silty fill with cobbles, bricks, and concrete. Loose, dry, and granular.

3' Concrete obstruction - refusal.

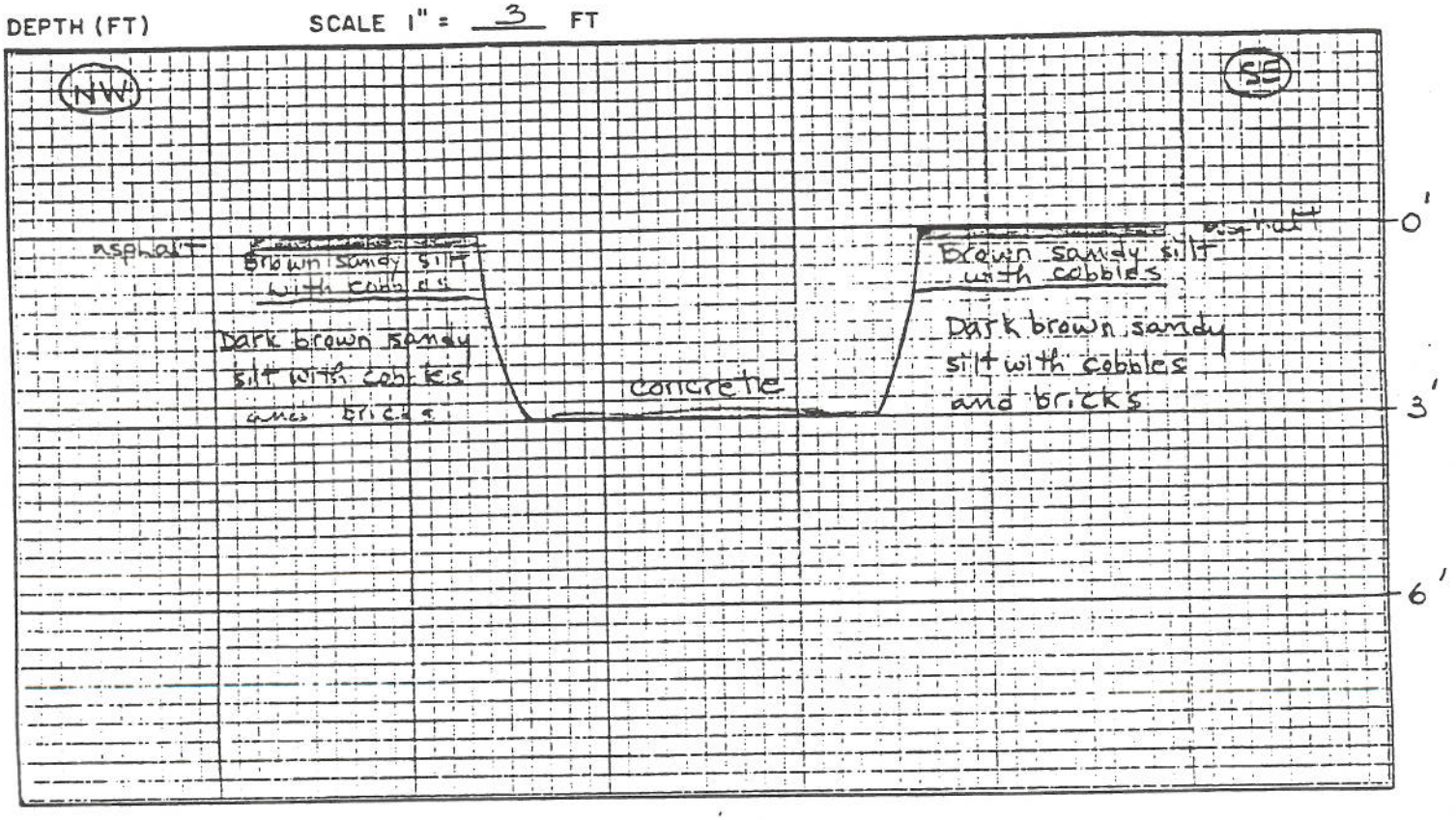
FILL

ENVIRONMENTAL

TEST PIT RECORD
PROFILE ALONG TEST PIT- 3

SITE NYSEG Mechanicville

DEPTH (FT) SCALE 1" = 3 FT



NOTES:

Test pit dimensions (L x W x D): 7' x 2' x 3'

PI meter readings at background in ambient air and at soil.

No visible signs of coal tar or other contamination.

Test pit was abandoned after numerous attempts to break through a concrete obstruction encountered at 3.0'.

No groundwater seepage

SAMPLES OBTAINED

NO.	DEPTH (FT)	INIT. SER. NO.	HD. SP. VOA PPM
S-1			
S-2			
S-3			
S-4		No Samples	
S-5			
S-6			
S-7			
S-8			

REFERENCE: FIELD BOOK, PG. _____
ATTACHMENTS _____

Christina Moore
SIGNATURE

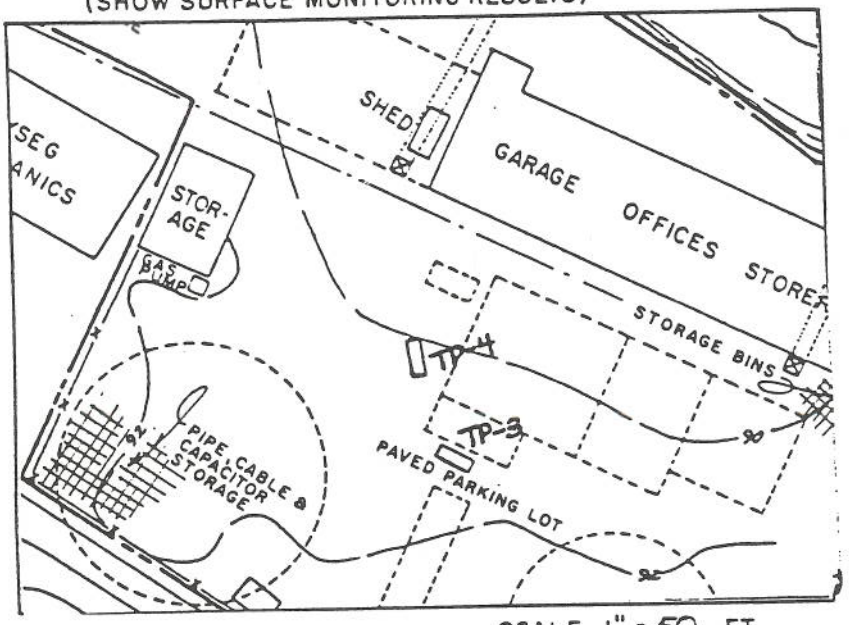
TEST PIT RECORD

SITE Mechanicville NYSEG

TEST PIT TP-4 DATE 7/21/86 TIME ST. 14:40 END 15:00

COORDINATES N/A GRID ELEMENT N/A

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = 50 FT

CREW MEMBERS

1. SWibby
2. CMoore
3. PT } Maloy (Empire)
4. RC }
5.
6.

MONITOR EQUIPMENT

PI METER	(Y)	N
EXPLOSIVE GAS	(Y)	N
AVAIL. OXYGEN	(Y)	N
OVA	Y	(N)

OTHER Radiation meter

PHOTOGRAPHS, ROLL #1

EXPOSURE #6, 7, 8

NOTES 0.1' – 0.3' Light brown sandy silt w/ cobbles
Loose and dry.

0.3' - 1.0' Dark brown/ sandysilt w/ cobbles.
Loose, dry.

1.0' - 1.5' Bricks

▽ 2.75' 1.5' - 3.0' Light brown sand, medium to fine

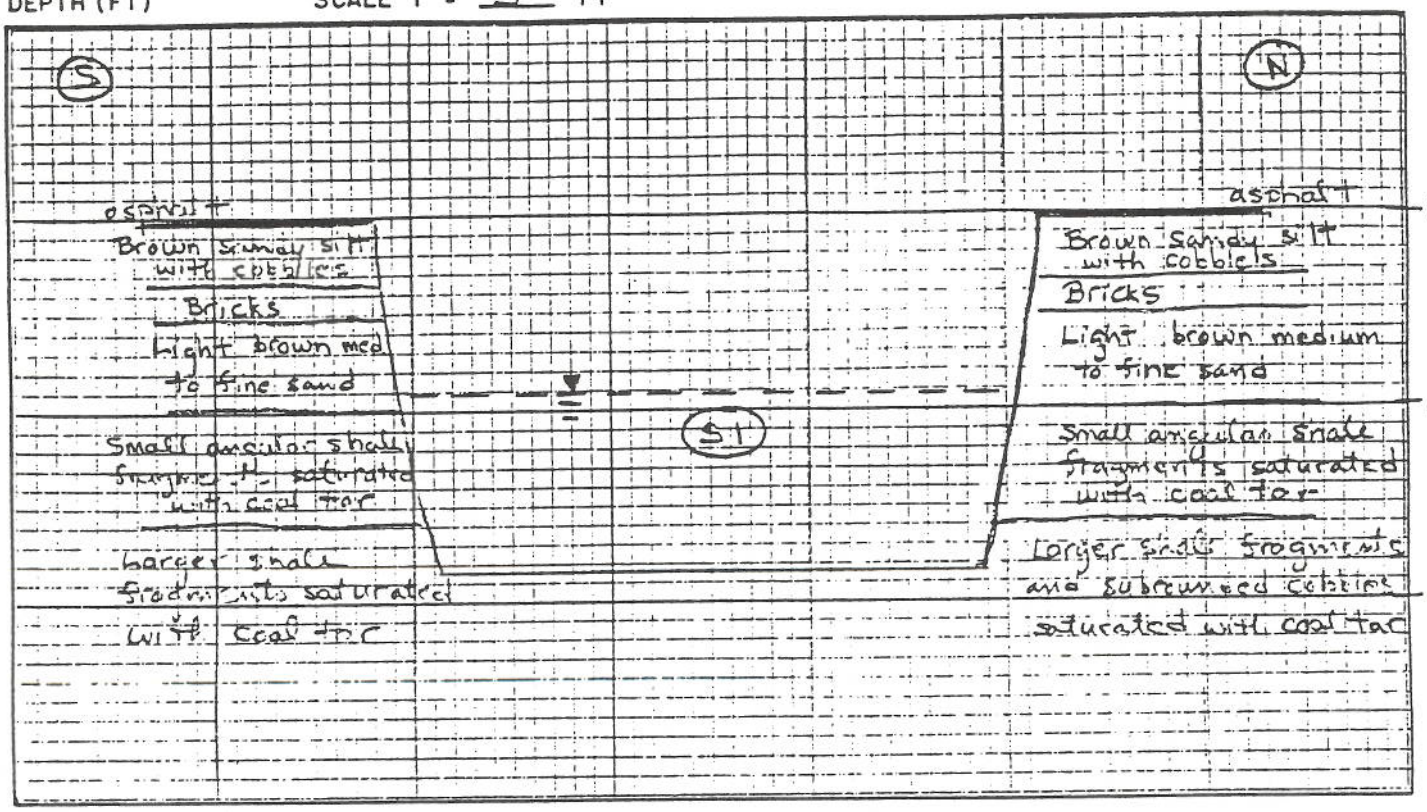
PI - 30 → 40ppm 3.0' - 4.75' angular shale rock fragments saturated with coal tar

4.75' - 5.6' Larger angular shale fragments and subrounded cobbles within clayey silt matrix. Saturated with coal tar

TEST PIT RECORD
PROFILE ALONG TEST PIT- 4

SITE NYSEG Mechanicville

DEPTH (FT) SCALE 1" = 3 FT



NOTES:

Test pit dimensions (LxWxD): 10' x 2' x 5.5'

PI meter readings of 30-40 ppm near sampled soil.

Coal tar observed from 3' to bottom of pit.

Water flowed rapidly into the pit from the SE corner

SAMPLES OBTAINED

NO.	DEPTH (FT)	INIT. SER. NO.	HD. SP. VOA PPM
S-1	3.0'-4.0'	MEEITPXX04/1	
S-2			
S-3			
S-4			
S-5			
S-6			
S-7			
S-8			

REFERENCE: FIELD BOOK, PG. _____

ATTACHMENTS _____

Christina Moore

SIGNATURE

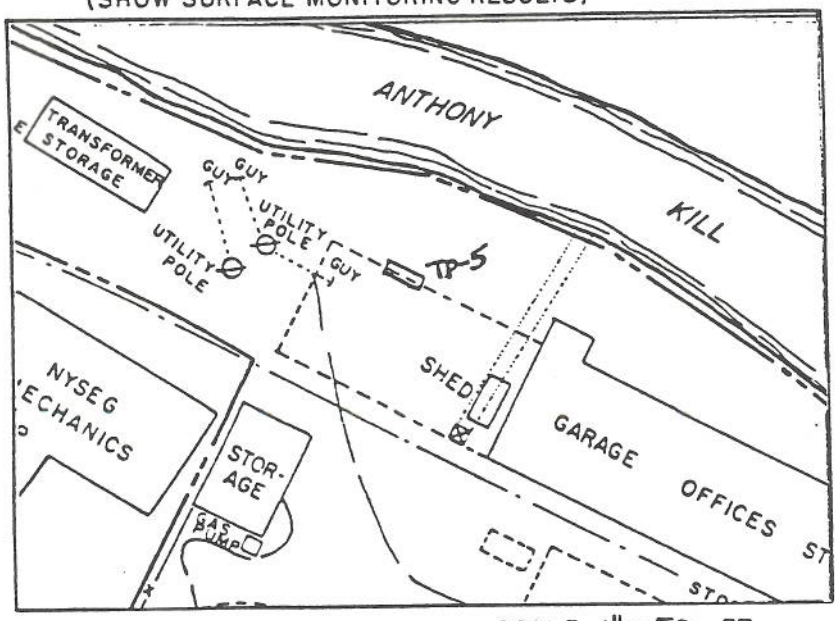
TEST PIT RECORD

SITE Mechanicville NYSEG 4945-02

TEST PIT TP-5 DATE 7/21/86 TIME ST. 12:50 END 13:45

COORDINATES N/A GRID ELEMENT N/A

SKETCH MAP OF TEST PIT SITE
(SHOW SURFACE MONITORING RESULTS)



SCALE 1" = 50 FT

CREW MEMBERS

1. SWibby
2. CMoore
3. PT } Maloy (Empire)
4. RC }
5.
6.

MONITOR EQUIPMENT

PI METER	(Y)	N
EXPLOSIVE GAS	(Y)	N
AVAIL. OXYGEN	(Y)	N
OVA	Y	(N)

OTHER Radiation meter

PHOTOGRAPHS, ROLL # 1

EXPOSURE #2, 3, 4, 5

NOTES 0'-1.3' Light brown sandy silt with cobbles

1.3'-3.0' Dark brown sandy silt with angular cobbles (Exposed tile drain at approx. 2')

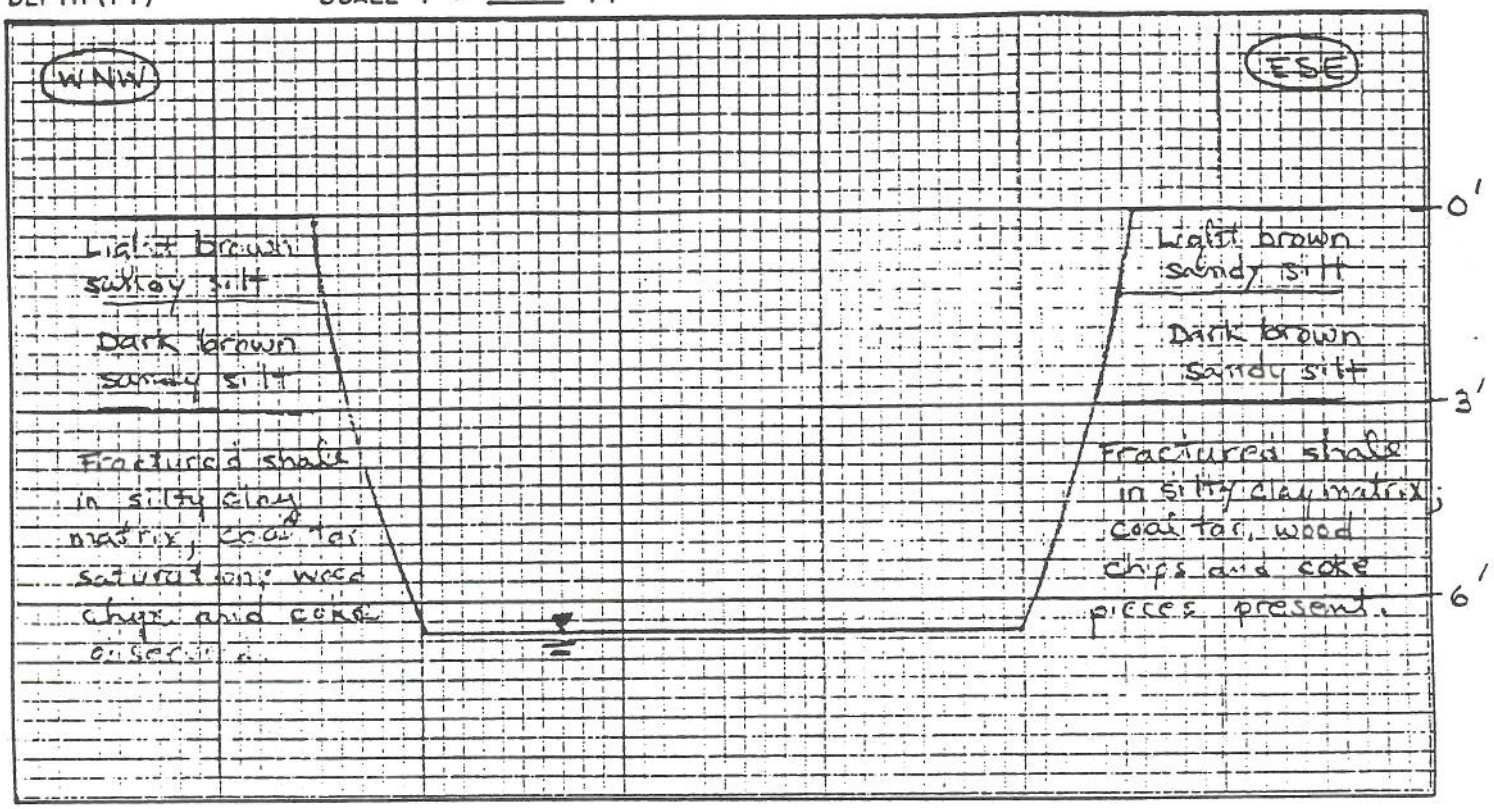
3.0-6.5' Highly fractured shale, weathered with silt and clay soil, loose. Wood chips and coke fragments present, saturated with coal tar.

▽ 6.5' Fractured bedrock surface; coal tar saturation; groundwater seepage.

TEST PIT RECORD
PROFILE ALONG TEST PIT- 5

SITE NYSEG Mechanicville

DEPTH (FT) SCALE 1" = 3 FT



NOTES:

Test pit dimensions (LxWxD): 12.5' x 2' x 6.5'

Coal tar saturation from 3' to bottom of pit.

PI meter reading of 50 ppm over saturated soil.

Groundwater seepage observed at bottom of pit.

Tile drain uncovered at approx. 2'.

SAMPLES OBTAINED

NO.	DEPTH (FT)	INIT. SER. NO.	HD. SP. VOA PPM
S-1	3.0'-4.0'	MEEXTPXX05/11	
S-2	4.0'-6.0'	MEEITPXX05/21	
S-3		(GC/MS)	
S-4			
S-5			
S-6			
S-7			
S-8			
Dup of S1	3.0'-4.0'	MEEXTPXX04/11	

REFERENCE: FIELD BOOK, PG. _____
ATTACHMENTS _____

Christina Moore
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Appendix B

B-1 Boring Logs and Field Observations

B-2 Monitoring Well Installation Diagrams

B-3 Permeability and Discharge Test Methods and Calculations

Appendix B-1

Boring Logs and Field Observations

DRILLING OBSERVATIONS
MECHANICVILLE SITE

Test Boring	Total Depth (ft)	Visual Appearance	Odor and PID Characterization	Samples Collected
B-1	20.2	Black coke ash up to 3mm diameter, from 3.5 to 4.0 ft. Brick fragments and glass encountered from surface to 8.0 ft. Dark gray shale bedrock at 12.2 ft.	No unusual odors. PID-background levels.[a]	Sample B-1/S-1 from 8.0 to 10.0 ft.[b]
B-2	16.2	Sandy to gravelly fill with shale fragments from 0.5 to 6.0 ft. Weathered shale bedrock at 9.4 feet. No visual signs of coal tar wastes encountered in boring.	No unusual odors. PID-headspace reading of 13 ppm on soil from 4.0 to 6.0 feet. Background levels elsewhere.	Sample B-2/S-1 from 8.0 to 9.5 ft.[b]
B-3	9.2	Black, stained wood chips from 2.0 to 4.0 ft. Trace coal tar-stained organics and fly ash from 4.0 to 6.0 ft., and coal tar staining in sandy silt and shale chips from 6.0 to 8.0 ft. Coal tar stains from 8.0 to 9.2 ft. on weathered bedrock with little silt and fine sand.	PID headspace readings of 270 ppm and 250 ppm from 4.0 to 6.0 ft. and 6.0 to 8.0 ft., respectively.	Sample B-3/S-1 from 4.0 to 6.0 ft.[b] Sample B-3/S-2 from 6.0 to 8.0
B-4	16.8	Brick chips from 4.0 to 6.0 ft. Coal tar staining noted from 6.0 to 14.0 ft. and 16 to 16.8 ft. Weathered bedrock and shale fragments predominant from 8 to 16 ft.	Coal tar odor from 4.0 - 6.0 ft. PID-ambient air readings of 10 ppm and 2 ppm at 6.0 to 8.0 ft. and 8.0 to 12.0 ft. PID-headspace readings of 10 to 70 ppm from depths of 4.0 to 12.0 ft.	Sample B-4/S-1 from 6.0 to 8.0 ft.[2]

5.88.10T
0001.0.0

DRILLING OBSERVATIONS (continued)
MECHANICVILLE SITE

Test Boring	Total Depth (ft)	Visual Appearance	Odor and PID Characterization	Samples Collected
B-5	19.4	Fill material with brick, coal clinkers, fly ash and shale chips from 6.0 to 8.0 ft. Predominantly sand and gravel with organics, coal clinkers, and wood chips from 8.0 to 9.6 ft. Coal tar sheen on brown silt with shale chips from 10.5 to 11.5 ft. Bedrock at 11.5 ft.	PID background levels for ambient air. PID headspace readings of 22 ppm and 175 ppm from 10.0 to 10.9 ft and 10.5 to 11.5 ft., respectively.	Sample B-5/S-1 from 10.0 to 10.9 ft.[b] Sample B-5/S-2 from 10.5 to 11.5 ft.
B-6	32.0	Casing driven to bedrock at 17 ft. Dark gray shale bedrock thinly laminated, hard, broken, and unweathered.	PID ambient air readings at background levels. 250 - 450 ppm off of augers at 1.5 to 2.5 ft. PID headspace readings of 300 ppm at 9.2 ft. and background levels from 17.0 to 22.0 ft.	No samples collected.
B-7	9.0	Casing spun through concrete pad (0 to 3.0 ft) and spoon pounded to 7.0 ft. Coarse sandy fill with pebbles and shale fragments from 7.0 to 9.0 ft.	No ambient air or headspace readings taken.	Sample B-7/S-1[b] from 7.0 to 9.0 ft.
B-8	17.4	Trace organics from 4.0 to 5.2 ft. Black stains on silt fill and shale fragments from 6 to 6.3 ft. Some coal tar visible on silt with cobbles from 9.5 to 13.5 ft. Extensive coal tar from 13.5 to 15.5 ft. on silty fill and shale fragments. Black, stained silty sand from 15.5 to 17.4 ft.	Slight odor from 4.0 to 6.3 ft. and 9.5 to 11.5 ft. PID ambient air readings of 1-2 ppm from 4.0 to 5.2 ft. PID headspace readings of 1-2 ppm, 20 ppm, and 30 ppm from 4.0 to 5.2 ft., 6 to 6.3 ft, and 7.5 to 9.5 ft, respectively.	Sample B-8/S-1 from 9.5 to 11.5 ft. Sample B-8/S-2 from 13.5 to 15.5 ft.[2] Sample B-8/S-3 from 15.5 to 17.5 ft.[2]

DRILLING OBSERVATIONS (continued)
MECHANICVILLE SITE

Test Boring	Total Depth (ft)	Visual Appearance	Odor and PID Characterization	Samples Collected
B-9	5.5	1½" of bituminous material over cobbley to gravelly silty sand (fill) to 4 ft; observable contamination at 2.7 ft, over thinly bedded and weathered rock.	PID headspace readings of 65 ppm from 4 to 5.5 ft; ambient air readings at low levels.	Sample B-9/S-1[c] from 4.0 to 5.5 ft.
B-10	19.7	Brown and black ash fill, cinders, coal, and glass, over tan to black silt (fill) to 9 feet. Observable contamination at 10 ft in gravelly silty sand; becomes less contaminated with depth. Oxidized rock begins near 18.5 ft.	PID headspace readings at background to 10 ft., increasing to 10 ppm and gradually diminishing to 6 ppm at 19 ft.	Sample B-10/S-1[c] from 16.0 to 18.0 ft.
B-11	18	Brown to olive brown silty sand to sandy silt (fill) to weathered rock at 3 ft. Hit solid rock near 6 ft.	No unusual odors. PID readings at background levels.	No analytical samples collected.
B-12	25.5	Black and yellow sand and silty sand over gray, brown and olive brown silty fine sand. Observable contamination below 14 ft.	Observable tar smell below 16 ft. PID headspace readings at background levels to 14 ft.; readings ranged from 9 ppm to 54 ppm down to 25.5 ft.	Samples B-12/S-1[c] from 16.0 to 18.0 ft.
B-13	55.5	See B-12 description. B-13 contains more gravel. Visible coal tar at 16 ft. Large cobble at 16.5 to 18.5 ft. Highly contaminated at 24 ft. Shale bedrock from 25.5 to 55.5 ft. Fracture at 55 ft. shows contamination on faces.	Coal tar odor at 16 ft. PID ranged from 10 to 50 ppm from 15 to 25.5 ft.	No analytical samples collected.

DRILLING OBSERVATIONS (continued)
MECHANICVILLE SITE

Test Boring	Total Depth (ft)	Visual Appearance	Odor and PID Characterization	Samples Collected
B-14	55	Brown, orange, and olive brown fine sands and silts. Weathered rock from 22 to 23.5 ft.	No unusual observations. PID readings at background levels.	Sample B-14/S-1 from 18.0 to 20.0 ft.[c]
B-15	39	Black cinder, ash, brick (fill) to bedrock at 9.0 ft.	No unusual odors but visual evidence of contamination. PID readings of 1.2 ppm at surface to 36 ppm at 6.0 to 8.0 ft.	Sample B-15/S-1 from 4.0 to 7.8 ft.[c] (Collected in a boring 6 ft. south of B-15).

[a] Background PID levels represent ambient air levels obtained outside and upwind of the site boundaries. At the Mechanicville site, background levels were generally less than 5 ppm.
[b] Samples analyzed by ERCO.
[c] Samples analyzed by NYSEG.

MECHANICVILLE BORING LOG

BORING NO. B-1

CLIENT NYSEG			PROJECT NO. 4945-02
CONTRACTOR EMPIRE SOILS	DATE STARTED 7/23/86		COMPLETED 7/24/86
METHOD HSA/NX CORE	CASING SIZE 4.25 I.D.	HNU (1.7) / 10.2	PROTECTION LEVEL D
GROUND EL. 96' MSL	SOIL DRILLED 11.0'	ROCK DRILLED 9.2'	TOTAL DEPTH 20.2'
LOGGED BY L. ESPY	CHECKED BY CM	DATE 9/22/86	▽ BELOW GROUND 8.65' 7-25-86

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLP	SAMPLE GC	OTHER HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD %
0	Bkgd.	D.J. S-1			Bkgd.	0-2.0' Light brown sandy FILL with trace clay, loose, dry. Some glass, moderate amount of roots, and organics. Iron staining on surface. Recovery: .5/2.0	FILL	3 6 7 10
2.5	Bkgd	D.J. S-2			Bkgd	2-3.5' Brown FILL same as above. 3.5-4.0' Black COKE ASH, up to 3mm diameter, loose, dry. Highly oxidized from 3.75' to 3.8'. .7/2.0	FILL	7 4 3 3
5.0	Bkgd.	D.J. S-3			Bkgd.	4-6.0' Dark brown to black silty FILL with up to 1" diameter gravel, some organics, brick fragments and glass, dense, moist, some iron staining. .6/2.0	FILL	4 3 2 3
7.5	Bkgd.	D.J. S-4			Bkgd.	6-8.0' Brown, silty FILL grading upwards to dark brown silty FILL, some gravel and glass, loose, very moist. .2/2.0	FILL	5 5 3 3
10	Bkgd.	ANYL S-1 D.J. S-5			Bkgd.	8-10.0' Brown, gravelly SAND, up to 4 mm diameter, somewhat dense, dry. 9.4-9.6' - Black, organic matter with grass 1.0/2.0	SAND	5 5 4 4
12.5		R-1			Bkgd.	10-11.9' Brown, gravelly SAND with dry shale fragments up to 1 inch throughout, dense to very dense, dry. 11-11.9' - weathered Shale with some silt, little oxidation, Refusal at 11.9' 1.5/2.0	SAND	12 32 77 100%/4
						BEDROCK AT 12.2'		
						R-1 12.2-13.6' 30B 12.2'. SPIN CASING TO 12.6'. Recovery = 0"/1.4' = 0%	SHALE	
15.0	Bkgd.	R-2			Bkgd.	R-2 13.6-17.2' Dark grey SHALE, laminated (1/5" bedding units), hard, very broken, weathering (staining) along bedding planes only. Bedding dips 30°. Primary fractures along bedding planes, secondary, hairline, fractures perpendicular to primary fractures and 1/2" in length. Recovery = 85% RQD = .7"/3.6" = 19%	SHALE	19%
17.5	Bkgd.	R-3			Bkgd.	R-3 17.0-20.2' (1.1 FT. CAVE-IN) Dark grey SHALE, same as above. Recovery = 95% RQD = 23%	SHALE	23%
20.0								

WELL DATA — CAVE-IN

* U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

MECHANICVILLE BORING LOG

BORING NO. B-1

CLIENT NYSEG			PROJECT NO. 4945-~~78~~
CONTRACTOR EMPIRE SOILS	DATE STARTED 7/23/86		COMPLETED 7/24/86
METHOD HSA/NX CORE	CASING SIZE 4.25 I.D.	HNU (LT) 10.2	PROTECTION LEVEL D
ROUND EL. 96' MSL	SOIL DRILLED 11.0'	ROCK DRILLED 9.2'	TOTAL DEPTH 20.2'
LOGGED BY L. ESPY	CHECKED BY CM	DATE 9/22/86	▽ BELOW GROUND 8.65' 7-25 86

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLR	GC	OTHER	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DIA.
20.0		R-3					R-3 Con't.	SHALE		CAVE-IN
							BOB 20.2 FT. CAVE-IN TO 18.9			
22.5										

*U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

FIELD LOG FOR BORING IN ROCK - A.

CONVENTIONAL ROCK DRILLING

PROJECT NO. 4945-02

BORING NO. B-1 (M)

PAGE 1 OF 1

LOGGED BY L. ESPY DATE 7/23/86 / 7/24/86

CHECKED BY JWP DATE 9/22/86

BIT USE
N - NEW
R - RESET
U - USED

DEPTH	SAMPLE TYPE AND NO.	TOP DEPTH FT.	TOP DEPTH IN.	LGTH. FT HH.	RECOVERY FT HH.	RECOVERY %	ROD IN.	ROD %	DRILLING BIT USE	DRILLING TIME MIN./FT.	DRILL WATER RETURN %	COMMENTS ON DRILLING AND SAMPLING
	R-1	12.2	'	1.4'	0	0	0	0	U	-	NA	1.4 FEET OF Granular material caved in. Washed out of R-2. Redrilled 12.2 - 13.6'.
	R-2	13.6	'	3.6'	3.06'	85%	.7'	19%	U	Approx. 6 min./ft.	NA	Return water muddy brown color.
				ROD FOR R-2 - 2				PIECES				
	R-3	17.2		3.0'	2.9'	95%	.7'	23%	U	6-7 min./FT.	NA	1.1 FT. CAVE-IN BEFORE SETTING 17.2.
				ROD FOR R-3 - 1				PIECE				
	EOB	20.2										

MECHANICVILLE BORING LOG

BORING NO. B-2

CLIENT NYSEG | PROJECT NO. 4945-

CONTRACTOR EMPIRE SOILS | DATE STARTED 8/1/86 | COMPLETED 8/1/86

METHOD HSA/NX CORE | CASING SIZE 4.25 I.D. | HNU (LT) 10.2 | PROTECTION LEVEL D

GROUND EL 90' MSL | SOIL DRILLED 9.5" | ROCK DRILLED 6.7' | TOTAL DEPTH 16.2

LOGGED BY L. ESPY | CHECKED BY CM | DATE 9/22/86 | ▽ BELOW GROUND 5.94' 8-1-86

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CL	SAMPLE GC	OTHER - WATER LEVEL HNU HEADSPACE (PPM)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DIAG.
0	Bkgd.	D.J. S-1			Bkgd.	0.5-2.0' Black, sandy to gravelly FILL, with rounded pebbles, Loose, dry.	FILL	12 | 14 | 8	
2.5	Bkgd.	D.J. S-2			Bkgd.	2-4' FILL, with 3 discrete layers: 2-3.4' Calcite, blocky (2" dia.) dry, angular chunks 3.4-3.9' Brown silty SAND, loose, dry 3.9-4.0' - Dark grey SHALE fragments in moist silty matrix. Very wet at 3.8'. REC. 55%	FILL	6 | 10 | 3 | 4	
5.0	Bkgd.	D.J. S-3			13 ppm	4-6' Sandy to gravelly FILL with 2" pebbles, subrounded to 5.7', 5.7-6.0'-Greenish-grey SILT to clayey SILT with some iron staining, trace organics, dense, moist. RECOVERY 35%	FILL / SILT	3 | 3 | 1 | 2	
7.5'	Bkgd.	D.J. S-4			Bkgd.	6-8' Orangish-grey clayey SILT with subrounded pebbles, dense, moist grading downwards to orangish grey silty coarse SAND with angular SHALE fragments, dense, damp. REC. 50%	SILT	3 | 12 | 6 | 14	
10.0	Bkgd.	D.J. S-5 ANVL S-1			Bkgd.	8-9.5' Dark grey silty coarse SAND, angular to 9.4' At 9.4' - Dark grey angular SHALE fragments, very thinly bedded, dry. REC. 45%	SAND	12 | 40 | 100/5	
12.5	Bkgd.	R-1			Bkgd.	Weathered BEDROCK AT 9.4' SET CASING AT 12.6 WASH OUT HOLE. BEGIN CORING R-1 9.5-13.5' Dark grey SHALE with 25% calcite in top 2/10 ft., V. thinly bedded (1/4-1"), hard, V. broken to broken, some weathering along bedding fractures (staining), calcite veins along bedding planes, bedding dips 30°. Recovery = 4.5/4.0' (CAVE-IN) RQD = 54%	SHALE		
15.0	Bkgd.	R-2			Bkgd.	R-2 13.5-16.2' Dark grey SHALE, massive, hard, unweathered, only 2 mechanical breaks which are along bedding planes. Recovery = 100% RQD = 100%	SHALE		
17.5						BOB 16.2'			
20.0'									

U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

FIELD LOG FOR BORING IN ROCK - A.

NYSEG Mechanicville, NY

PROJECT NO. 4945-02

BORING NO. B-2

PAGE 1 OF 1

LOGGED BY L. ESPY DATE 8/1/86

CHECKED BY JVP DATE 9/22/86

BIT USE
N - NEW
R - RESET
U - USED

DEPTH	FOR EACH RUN							DRILLING		DRILL WATER RETURN %	COMMENTS ON DRILLING AND SAMPLING
	SAMPLE TYPE AND NO.	TOP DEPTH FT. IN.	LGTH. FT. IN.	RECOVERY FT. IN.	RECOVERY %	ROD IN.	ROD %	BIT USE	TIME MIN./FT.		
9.5	R-1	9.5'	4'	4.5'	100+	NA	54%	U	6/Ft	NA	4' RUN.
	R-2	13.5'	2.7'	2.5	93%	NA	100%	U	6/FT	NA	2.7' Run
		16.2									

MECHANICVILLE BORING LOG

BORING NO. B-3

CLIENT HYSEG — PROJECT NO. 4945-02

CONTRACTOR EMPIRE SOILS — DATE STARTED 8/5/86 — COMPLETED 8/6/86

METHOD H.S. AUGER — CASING SIZE 4.25' ID — HNU (11.7)/10.2 — PROTECTION LEVEL C

GROUND EL. ~89' MSL — SOIL DRILLED 9.2' — ROCK DRILLED N/A — TOTAL DEPTH 9.2'

LOGGED BY JNW — CHECKED BY CM — DATE 9/22/86 — ▽ BELOW GROUND 2.5' 8/14/86

PI METER MALFUNCTIONING
INSPECT AMBIENT AIR DATA

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE	CLP	GC	OTHER	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DATA	ELEV. (FT)
0		D.J. S-1						0.5' Asphalt 0.5'-2.0' Black, fn-cs sand, some gravel and angular shale chips, grading to Sandy silt and shale chips; Dry; med. dense .75'/1.5	Fill	5 4 3		
		D.J. S-2						2.0'-4.0' Tan to gray silty Sand w/ angular shale chips; some black stained wood chips. loose; moist. 30% shale chips. Recovery .8Z/2.0'	Fill	5 4 3 3		
5		Anly. S-1					270 (8/11)	4.0'-6.0' Black silt (75%) w/ little angular shale chips grading to silt w/ some shale chips; trace coal tar stained org., wood and fly ash; loose; wet. 1.8'/2.0'	Fill	1 1 1 1		
		Anly S-2					250 (8/11)	6.0'-8.0' Black Sandy silt w/ shale chips and wood fragments; loose; wet; friable; Coal tar stained; dry very fractured shale in the end of the sample; iron stained; horiz. and vertical fractures (Rec. 1.3'/2.0')	Fill & wx Bdk			
								8.0-9.2' Weathered bedrock w/ little silt and fine sand; Horiz. and vert. fractures; platy and angular rock fragments; Coal tar stains, loose and wet at 8.0-8.3'; Tan, dry and dense at 8.3'-9.2'	wx Bdk	15 72 100/.2		
10								Bottom of boring at 9.2' Weathered bedrock at 8.0'-9.2' Bedrock at 9.2'				
15												
20												

▽ 8/14/86

* U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

EC JORDAN

MECHANICVILLE BORING LOG

BORING NO. B-4

CLIENT NYSEG				PROJECT NO. 4045-02
CONTRACTOR EMPIRE SOILS	DATE STARTED 7/29/86			COMPLETED 7/30/86
METHOD HSA/NX CORE	CASING SIZE 4.25 I.D.	HNU 11.8/10.2		PROTECTION LEVEL D/C
GROUND EL. 921 MSL	SOIL DRILLED 16.8	ROCK DRILLED NONE		TOTAL DEPTH 16.8
LOGGED BY SNW	CHECKED BY CM	DATE 9/22/86		▽ BELOW GROUND 3.2' (7-29-86)

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLP	SAMPLE GC	OTHER	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DATA	ELEV
	Bkgd						Auger through Pavement to .5				
	Bkgd	D.J. S-1				Bkgd	.5-2.0' Light Brown Sand Fill w/ angular to sub-rounded gravel. Ash, brick chips, Black staining at 1.2' below G.S. Loose and dry. .7/1.5	Fill	13 9 6		
2.5	Bkgd	N.R.				Bkgd.	2.0'-4.0' No Recovery Boulder was dug out by hand. 0/2.0	Fill	13 12 7 3	▽	
5.0	Bkgd	D.J. S-2				10	4.0'-6.0' Black to Dark Gray Sandy Silt Fill w/ sub rounded Fine gravel and brick chips. Coal tar odor. Loose and Friable. Dry 1.5/2.0	Fill	2 4 2 2		
7.5	10ppm	D.J. S-3 Anly GC Grab/MS				70+	6.0-8.0' Black to Brown Sandy Fill w/ small sub rounded to angular gravel, brick chips, loose - wet. grades into - Silty weathered bedrock w/ shale fragments, heavily coal tar stained and moderately oxidized. 1.5/2.0	Fill	4 8 11 14		
10.0	2	D.J. S-4				20+	8.0'-10.0' Black to Brown Silty Weathered Bedrock (50% silt), angular gravel (shale). grading into less silty clay weathered bedrock, coal tar present throughout - 85% Rock Material 2.0/2.0	Fill	14 19 21 31		
		C.J. S-5				70+	10-12' Clayey Silt weathered Bedrock, 75% angular gravel (shale), Coal tar stained loose, wet. 1.5/2.0	Fill	11 12 12 3		
12.5	Bkgd.	D.J. S-6				Bkgd.	12'-14' Gray Broken Shale Fragments w/ Silt, heavily stained w/ Coal tar. Loose. wet. 1.0/2.0	Fill	1 1 30 47		
15.0	Bkgd.	D.J. S-7				Bkgd.	14-16' Black Silt w/ angular shale chips gravel size. Loose. Wet 50% silt 50% Rck .2/2.0	Fill	2 1 0 2		
	Bkgd.	D.J. S-8				Bkgd.	16-16.8 Tan to Lgt Gray Silt Clay Till w/ small sub rounded pebbles & Fine gravel in the till matrix. Organics w/ Coal tar staining in root canals. Dry. Dessicated. Tight .6/1.1	Till	2 1 100/1.1		
20.0							Refusal @ 16.8' BOB - 16.8'				

* U = THIN WALL TUBE S = SPLIT SPOON = = ROCK

MECHANICVILLE BORING LOG

BORING NO. B-5

CLIENT NYSEG | PROJECT NO. 4945-02

CONTRACTOR EMPIRE SOILS | DATE STARTED 8/4/86 | COMPLETED 8/5/86

METHOD HSA/NX CORE | CASING SIZE 4.25 I.D. /NX HD | HNU 11.7/10.2 | PROTECTION LEVEL D/C

ROUND EL 89' MSL | SOIL DRILLED 11.5' | ROCK DRILLED 7.9' | TOTAL DEPTH 19.4

LOGGED BY SNW | CHECKED BY CM | DATE 9/22/86 | ▽ BELOW GROUND 10.0' 8/5/86

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE	CLP	GC	OTHER	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DATA	ELE
	Bkgd.	D.J. S-1					Bkgd	0-2.0 Dk. Brown Silty Sand Fill w/ angular gravel, organics, loose, moist. Rec. 1.6/2.0	Fill	3 6 6 4		
2.5	Bkgd.	D.J. S-2					Bkgd	2.0-4.0 Lgt Brown angular gravel Fill w/ sand and silt interbedded, oxidation staining on shale chips. Loose. Dry. 80% Rock Material. 1.0/2.0	Fill	3 3 3 2		
5.0	Bkgd	D.J. S-3					Bkgd	4.0-6.0 Dk. Brown to Brown Silty Gravel Fill w/ Fine sand w/ some Black Stained lenses. Loose. moist. 65% angular shale gravel. 1.2/2.0	Fill	4 2 2 3		
7.5	P.I. MALFUNCTIONING	D.J. S-4						6.0-8.0' Fill - Brick, Coal Clinkers, Brown Sandy silt, fly ash, shale chips. Mostly Brick (75%) 1.0/2.0	Fill	4 7 11 7		
		D.J S-5						8-9.6' Dk. Brown to Brown Sand Silt Fill w/ gravel, organics, coal clinkers, wood chips. predominately sand + gravel. .9/1.6	Fill	7 12 19 100/1.1		
10.0								Auger to 10'				
		Any S-1					22	10.0-10.9' Dk. Brown silt w/ Rock (shale) chips - gravel size organics, Mod. Loose, wet .5/.9	Silt	15 100/.4		
		Any S-2					175	10.5-11.5 Dk. Brown Silt w/ angular shale chips (gravel) Coal tar sheen, loose, wet .9/1.0	Silt	21 52 100%		
								Bedrock at 11.5				
12.5								R-1 10.6-11.6 Metasedimentary Erratic Boulder 11.6-12.9 - Void Space - Sediment, wood chips shale fragments 12.4-15.3 - Gray shale, thin darker laminations (1-2 mm thick spaced every ½" to 1", Hard, Massive Calcite inclusions. Unweathered to trace weathering, 30-40° Bedding planes. Fractures occur at ∢60° across bedding planes. Rec. 4.95/5.0 = 89%	Shale			
15.0								R-2 15.34-16.1 Gray Shale same as above No Natural Fractures Rec-76%	Shale	Not Determinable Due to Coring Problems		
17.5								R-3 16.1-19.5 Gray Shale same as above, No Natural Fractures. Rec. = 100% RQD = 86%	Shale			
20.0								BOB - 19.4				

U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

FIELD LOG FOR BORING IN ROCK - A.

BIT USE
N - NEW
R - RESET
U - USED

PROJECT NO. 494502
BORING NO. B-5
PAGE 1 OF 1
LOGGED BY SNW DATE 8/4/86 - 8/5/86
CHECKED BY TWD DATE 9/22/86

DEPTH	FOR EACH RUN							DRILLING		DRILL WATER RETURN %	COMMENTS ON DRILLING AND SAMPLING
	SAMPLE TYPE AND NO.	TOP DEPTH FT.	TOP DEPTH IN.	LGTH. IN.	RECOVERY IN.	RECOVERY %	RQD IN.	RQD %	BIT USE	TIME MIN./FT.		
	R-1	10	6	5.0	4.45	89%		89%	U	9/ft		
	R-2	15	34	1.3	1.0	76%		NA*	U	*		* Due to mechanical problems RQD cannot be accurately interpreted
	R-3	16	1	3.4	3.5	100%		86%	U	9/ft		

MECHANICVILLE BORING LOG

BORING NO. B-6

CLIENT NYSEG			PROJECT NO. 4945-02
CONTRACTOR EMPIRE SOILS	DATE STARTED 7/24/86		COMPLETED 7/29/86
METHOD HSA/NX CORE	CASING SIZE 4.25" I.D.	HNU (1.7) 10.2	PROTECTION LEVEL C/D
GROUND EL. 92' MSL	SOIL DRILLED 17'	ROCK DRILLED 15'	TOTAL DEPTH 32.0
LOGGED BY L. ESPY	CHECKED BY CM	DATE 9/22/86	▽ BELOW GROUND Unknown

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLP	SAMPLE GC	CASING BLOW COUNTS / FT.	HNU HEADSPACE (PPM)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DATA
0							DRIVING CASING TO BDRK. NO SAMPLING.			NO MONITORING WELL INSTALLATION
					47		AUGER TOP 0.5' ASPHALT & FILL			
	Bkgd				48	250-450 ppm off Augers	DIFFICULT TO KEEP CASING STRAIGHT.			
2.5'					49					
					30		3.5' Standing water			
5.0'							BLOWS NOT RECORDED			
	Bkgd									
7.5					11					
					12					
							BLOWS NOT RECORDED			
	Bkgd					300 ppm	9.2' - DRIVING DIFFICULT AT 9.2'. CASING KICKED OUT AT ANGLE, POSSIBLE COBBLE.			
10.0'					17					
					19					
					25					
12.5					43					
					18					
15.0'					35		14.3' CUTTINGS IN RINSEWATER LOOK LIKE WEATHERED ROCK.			
							16.4' DRIVING DIFFICULT. ROLLER-BIT FROM 16.4-17.0' TO REAM & WASH HOLE.			
17.5		R-1				Bkgd	R-1 17.0-22.0' Dark grey SHALE, very thinly bedded (30° dip), hard, broken, Unweathered except along bedding planes.			
	Bkgd						Recovery - 90%			
20.0'							RQD - 71%			

*U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

MECHANICVILLE BORING LOG

BORING NO. B-6

CLIENT NYSEG			PROJECT NO. 4945-72
CONTRACTOR EMPIRE SOILS	DATE STARTED 7/24/86		COMPLETED 7/29/86
METHOD HSA/NX CORE	CASING SIZE 4.25" I.D.	HNU (LL) 10.2	PROTECTION LEVEL C/D
GROUND EL 92' MSL	SOIL DRILLED 17'	ROCK DRILLED 15'	TOTAL DEPTH 32.0'
LOGGED BY L. ESPY	CHECKED BY CM	DATE 9/22/86	▽ BELOW GROUND Unknown

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLP	SAMPLE GC	OTHER	HNU HEADSPACE (PPM)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR ROD % (20 40 60 80 100)	WELL DIAG.
20.0		R-1 (con't)					R-1 (con't) See page 1 for description.	SHALE BDRY		
22.5	Bkgd	R-2				Bkgd.	R-2 22.0 - 27.0' Dark grey SHALE, thinly laminated (.03-.1"), hard, broken, unweathered. Iron oxidation staining in upper (17-18) fractures. Bedding laminae offset by vertical, discontinuous fractures and foldmy. Fractures occur along calcite (30-40°) inclusions. Minor amount of inclusions, concoidal in shape. Recovery - 102% RQD - 80%	SHALE 27.7		
25.0										
30.0	Bkgd.	R-3				Bkgd.	R-3 27.0-32.0' Dark grey SHALE, same as above except fewer inclusions than in R-2. Fractures perpendicular to bedding at 45-90°. Some evidence of deformation. Recovery = 100% RQD = 83%.	SHALE		
							BOB 32.0'			
35.0										

*U = THIN WALL TUBE S = SPLIT SPOON R = ROCK

FIELD LOG FOR BORING IN ROCK - A.

BIT USE
N - NEW
R - RESET
U - USED

PROJECT NO. 4945-02
BORING NO. B-6
PAGE 1 OF 1
LOGGED BY SNW/L.ESPY DATE 7/28/86 - 7/29/86
CHECKED BY JWP DATE 9/22/86

DEPTH	FOR EACH RUN								DRILLING		DRILL WATER RETURN %	COMMENTS ON DRILLING AND SAMPLING
	SAMPLE TYPE AND NO.	TOP DEPTH FT.	TOP DEPTH IN.	LGTH. IN.	RECOVERY IN.	RECOVERY %	ROD IN.	ROD %	BIT USE	TIME MIN./FT.		
17.0'	R-1	17.	0	5'	4.5'	90%	NA	71%	U	NA	NA	MANY MECHANICAL Breaks in Rock, Few Natural
22.0	R-2	22.	0	5'	5.0	102%	NA	80%	U	9/ft	NA	Mechanical breaks, fractures along calcite inclusions
32.0	R-3	32.	0	5'	5.0	100%	NA	83%	U	8/ft.	NA	Vertical to Near Vertical discontinuous fractures present.

MECHANICVILLE BORING LOG

BORING NO. B-7

PROJECT NO. 1945-02

CLIENT NYSEG

CONTRACTOR EMPIRE SOILS | DATE STARTED 7/31/86 | COMPLETED 8/1/86

METHOD HSA/NX CORE | CASING SIZE 4.25" ID | HNU (LT) 10.2 | PROTECTION LEVEL D

GROUND EL. 92' MSL | SOIL DRILLED 8.8' | ROCK DRILLED NONE | TOTAL DEPTH 9.0

LOGGED BY L. ESPY | CHECKED BY CM | DATE 9/22/86 | ▽ BELOW GROUND 3.9

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLP	SAMPLE GC	OTHER - WATER LEVEL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR RQD % (20 40 60 80 100)	WELL DIAGRAM
0							SPIN CASING THRU. CONCRETE PAD.	ASPHALT		
							0-.3 - ASPHALT	CONCRETE		
							.3-1.2 CONCRETE PAD	VOID		
							1.2-2.1 VOID	FILL		
2.5					3.0 ▽		2.1-3.0 BOULDER FILL			
							3-5' Pound spoon. 0% Recovery	3.9 ▽	2 2 2 2	
5.0		NO RECOVERY					5-7' Pound spoon. Recovery 5% - all wash		8 5 3 3	
7.5		ANYL. S-1 DJ S-1					7-9' Dark grey coarse sandy FILL with some 1-2" pebbles, trace clay. Trace wood (may have fallen into hole), calcite piece (1" dia.), weathered shale fragments at 8.8-9'. Dark grey, thinly bedded 1" long.	FILL	7 15 53 85	CAVE-IN
10.2							BOB 9.0'	Rock		
15.0										
20.0										

T = THIN WALL TUBE S = SPLIT SPOON R = ROCK

MECHANICVILLE BORING LOG

BORING NO. B-8

CLIENT NYSEG | PROJECT NO. 4945-02

CONTRACTOR EMPIRE SOILS | DATE STARTED 8/6/86 | COMPLETED 8/6/86

METHOD HSA/NX CORE | CASING SIZE 4.25" I.D. | HNU (LT)/10.2 TIP-11.7 HNU-10.7 | PROTECTION LEVEL D/C

GROUND EL 92' MSL | SOIL DRILLED 17.4' | ROCK DRILLED NONE | TOTAL DEPTH / 17.4'

LOGGED BY SNW | CHECKED BY CM | DATE 9/22/86 | ▽ BELOW GROUND 7.5-13.5' (APPROX)

DEPTH (FT)	HNU AMBIENT AIR	SAMPLE NO. & TYPE NO.	SAMPLE CLP GC OTHER	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN OR ROD % (20 40 60 80 100)	WELL INSTALLATION
0					AUGER THRU ASPHALT TO 0.5'			
.5	Bkgd	D.J. S-1		Bkgd.	.5-2' Lgt. brown to brown Sandy FILL with cobbles and pebbles, platey to rounded, loose, dry, oxidized sediments. Broken rock Rec. 1.0/1.5	FILL	10 12 8	
2.5	Bkgd	D.J. S-2		Bkgd.	2-4' Lgt. brown to brown sandy SILT FILL w/ coal clinkers (oxidized) and trace subrounded brick and cobbles. Platey shale chips, loose to compact, dry. REC. 1.3/2.0	FILL	12 29 13 14	
5.0	1-2 ppm	D.J. S-3		1-2 ppm	4-5.2' Brown sandy FILL grading to silt Fill with depth, with concrete chips, dry, oxidized shale fragments, subrounded boulder pebbles at 4.7'. Trace organics. Compact, moist. Slight coal tar odor throuout. .9/1.2	FILL	10 20 100/2	
	Bkgd.	D.J. S-4		20 ppm (shoe)	6-6.3' Brown silt FILL w/ rounded cobbles, platey shale fragments, and brick shards. Coal tar odor and black stains. Loose and moist. Obstruction from 5.2-7.2. Augured thru. .3/.3	FILL	100/.3	
7.5	Bkgd.	D.J. S-5 NO REC.		30 ppm (shoe)	7.5-9.5' Brown silt on outside of spoon. No Recovery. 30 ppm off spoon, no staining. Rec. 0/2.0	UNK.	3 2 3 3	
10.0	Bkgd	ANYL. S-1 D.J. S-6		Bkgd	9.5-11.5' Brown silt w/ pebbles and cobbles, very loose, saturated. Slight coal tar odor, some coal tar present. REC. 2.0/2.0	SILT SILT	4 6 7 9	
12.5	Bkgd.	D.J. S-7 (wood) S-8 (soil)		Bkgd.	11.5-13.5' Brown silt w/ pebbles and cobbles, very loose, saturated. Coal tar present at 13.3-13.5'. Wood fibers at 13.0' REC. .9/2.0	SILT FILL	9 12 32 8	
15.0	Bkgd.	ANYL. S-2		Bkgd.	13.5-15.5' - Silty FILL w/ shale fragments and subrounded cobbles, loose, saturated. Extensive COAL TAR. REC. 1.2/2.0	FILL	6 2 2 3	
17.5	Bkgd.	GC/MS ANYL. S-3		50-100 ppm	15.5-17.4' Black stained silty SAND with subrounded cobbles, pebbles and shale chips, loose, saturated. REFUSAL AT 17.4'. REC. 1.3/2.0	SILT-SAND	3 3 2 100/.4	
20.0					BOB 17.4'			

NO MONITORING WELL INSTALLATION

T = THIN WALL TUBE S = SPLIT SPOON R = ROCK

MECHANICVILLE	TASK 3		BORING NO. B-9
CLIENT NYSEG			PROJECT NO. 4545-03
CONTRACTOR NORTH STAR DRILLING CO.		DATE STARTED 11-11-87	COMPLTD. 11-11-87
METHOD H.S.A.	CASING SIZE 4.25" ID	PID TIP #1	PROTECTION LEVEL D
GROUND EL 88.5 Rel.	SOIL DRILLED 5.5'	ROCK DRILLED NA	TOTAL DEPTH 5.5'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND
SCREEN NA (FT)	RISER NA (FT)	MATERIAL NA PVC SS TF	ID NA

PAGE 1 OF 1

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD% 20 40 60 80 100	WELL DATA	EL. (FT)
0	Bg.						AUGERED TO 4'					
							COAL TAR OBVIOUS AT 2.7'					
1							VERY GRAVELLY & COBBLY; SHAKES RIG					
							CUTTINGS ARE WET W/ COAL TAR.					
2							SURFACE IS 1 1/2" OF BITUMINOUS OVER COBBLY SILTY SAND - FILL					
3												
4		S-1		1.3	Y	65	BLACK SILTY SAND(?) W/ SLUDGE & COAL TAR, SATURATED OVER VARVED WEATHERED ROCK, OLIVE GRAY TO BLACK W/ UNWEATHERED ROCK FRAGMENTS & SILT	SM-GW		23 56 40		
5							B.O.B. @ 5.5'					

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

MECHANICVILLE	**TASK 3**		**BORING NO.** B-10
CLIENT **NYSEG**			PROJECT NO. 4945-03
CONTRACTOR **NORTH STAR DRILLING CO.**		DATE STARTED 11-12-87	COMPLTD. 11-12-87
METHOD H.S.A.	CASING SIZE 6" I.D.	PID TIP # 1	PROTECTION LEVEL D
GROUND EL 96.7 Rel.	SOIL DRILLED 19.2'	ROCK DRILLED .5'	TOTAL DEPTH 19.7'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND 10.2' 11-20-87
SCREEN 10.8 (FT)	RISER 8.7 (FT)	MATERIAL PVC (SS) TF	ID 2"	PAGE 1 OF 1

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD % (20 40 60 80 100)	WELL DATA	EL. (FT)
0	BKG	S-1		1.1		BKG	FILL Br TO BLK MOIST SANDY SILT W/ CINDERS for 1', OVER BLK TO Br ASH FILL W/ CINDERS, COAL PIECES, DRY TO MOIST		ML	10 16 26 16		
		S-2		1.2			4'			7 6 5 7		
5		S-3		.5			SILTY SAND (FILL) TAN TO Br TO DARK Br, SAND IS F TO M, TR TO LITTLE GRAVEL, MOIST W/ SOME ASH FILL; SAND IS SUGARY IN APPEARANCE.		SM	3 2 3 3		
		S-4		.7						2 1 2 1		
		S-5		1.0			4' SANDY SILT Br, F. SAND, TR. CLAY, MOIST, W/ BRIGHT ORANGE MOTTLES 10		ML	2 2 4 2		
10		S-6		.7		100	SILTY SAND Br TO RUSTY SILT & F TO M. SAND, LITTLE GRAVEL, SATURATED, CONTAMINATED			2 1 8 6		
		S-7		.7		99	Br TO DK. GRAY TO Br. F. TO M. SAND, TR. GRAVEL, WEATHERED Shale FRAGS.		SM	3 6 8 5		
15		S-8		1.0		26	below 15'			2 3 5 5		
		S-9		1.8	Y*	6	TAN TO YELLOW Br. V.F.S., WELL SORTED			6 2 5 3		
		S-10		1.3		6	WEATHERED ROCK 19' TO 19.3' 19.3' TOP OF ROCK AT 19.3'		GW/SM	WOR 50/0.0		
20							B. O. B. 19.7'					

* DUPLICATE SAMPLE

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND
WOR = WEIGHT OF RODS

* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

MECHANICVILLE	TASK 3		BORING NO. B-11
CLIENT NYSEG			PROJECT NO. 4945-03
CONTRACTOR NORTH STAR DRILLING CO.		DATE STARTED 11-12-87	COMPLTD. 11-13-87
METHOD H.S.A. & CORING	CASING SIZE 4 1/4" ID.	PID TIP #1	PROTECTION LEVEL D
GROUND EL 92.1 Rel.	SOIL DRILLED 5.5'	ROCK DRILLED 12.5	TOTAL DEPTH 18'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND 4.17 (11-24-87)
SCREEN (FT)	RISER (FT)	MATERIAL PVC SS TF	ID PAGE 1 OF 1

(FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD %	WELL DATA	EL. (FT)
0	BKG.	S-1		1.2		BKG	SILTY SAND (FILL) BROWN TO BLACK, TR. GRAVEL W/ COAL FRAGS, GLASS, CINDERS		SM	4 4 2 4		
		S-2		1.3		BKG	SANDY SILT — DUN BR TO ORANGE BR, LITTLE GRAVEL, MOIST		ML	4 3 6 10		
		S-3		1.2		BKG	WEATHERED ROCK — BR & BLK, LAYERED, FISSILE, HARD, DRY, LITTLE CLAY,		GW	12 36 40		
							6.0 BEDROCK SHALE FRAGS. COMMON, ONWARD					
		R-1		80 %			SHALE			0 %		
		R-2		80 %								
							B.O.B. @ 18'					

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND

* U= THIN WALL S= SPLIT SPOON R= ROCK

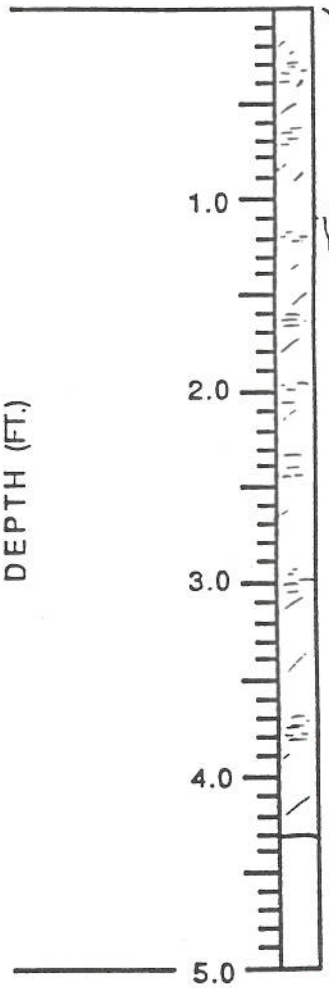
E.C. JORDAN CO.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 1 OF 2

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-12-87	CHK'D BY: CM 12/29/87
BORING NO.: B-11	SAMPLE: R-1	CORE DIA. (IN.): 2	DEPTH (FT.): 8 TO 13
CORE LENGTH (FT.): 5	CORE RECOVERY : 4.3 (FT.) 86 (%)	RQD: 0 (%)	ROCK QUALITY : V. POOR

ROCK DESCRIPTION AND IDENTIFICATION

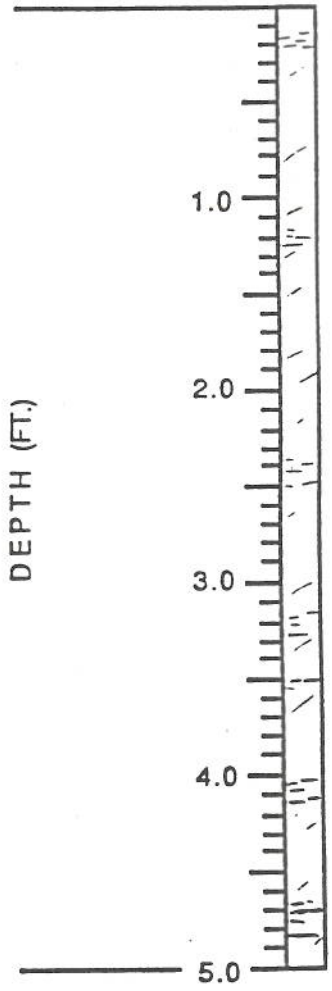


SHALE — DARK GRAY TO BLACK, THINLY BEDDED, W/ BEDS @ 35° TO 45° FROM HORIZONTAL. TOP 1' IS MODERATELY WEATHERED W/ MnO_2 & O_2 STAINING PROMINENT, BECOMES FRESH AT NEAR 11'. FRACTURE FACES AFTER 11' ARE FRESH & SHOW SLICKENSIDE FEATURES. BEDDING IS PARALLEL TO FRACTURES. NO PIECE IS AS LONG AS 3".

VISUAL IDENTIFICATION
ROCK CORES

SHEET 2 OF 2

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-12-87	CHK'D BY: CM 12/29/87
BORING NO.: B-11	SAMPLE: R-2	CORE DIA. (IN.): 2	DEPTH (FT.): 13 TO 18
CORE LENGTH (FT.): 5	CORE RECOVERY : 4 (FT.) 80 (%)	RQD: 80 (%)	ROCK QUALITY : V. GOOD



ROCK DESCRIPTION AND IDENTIFICATION

SHALE UNWEATHERED, COMPETENT, FRESH, W/ BEDDING 15° TO 20° FROM HORIZONTAL

15.'-15.4' NATURAL JOINT - NO WEATHERING

17' HEALED V. THIN FRACTURE W/ CALCITE FILLING

MECHANICVILLE — TASK 3		BORING NO. B-12
CLIENT NYSEG		PROJECT NO. 4945-03
CONTRACTOR NORTH STAR DRILLING CO.	DATE STARTED 11-18-87	COMPLTD. 11-18-87
METHOD H.S.A. / CASING SIZE 6" ID	PID TIP# 1	PROTECTION LEVEL D
GROUND EL 98.3 Rel. / SOIL DRILLED 25.5'	ROCK DRILLED NA	TOTAL DEPTH 25.5'
LOGGED BY T. LONGLEY / CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND 13.45' (11-20-87)
SCREEN 11 (FT) / RISER 14.5 (FT) / MATERIAL PVC (SS) TF	ID 2"	PAGE 1 OF 1

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD % (20 40 60 80 100)	WELL DATA	EL. (FT)
	BKG	S-1		1.6		BKG	SILTY SAND — BLACK, MOIST, FIRM IN PLACE w/ ASH FILL & CLINKERS over Br. SILTYS., TR. GRAVEL, SLIGHTLY PLASTIC		SM	5 6 5 5		
		S-2		1.2			2.5' SAND — YELLOW BROWN, FINE SAND, TR. TO LITTLE GRAVEL, MOIST		SP	3 3 3 3		
5		S-3		.2						3 2 3 3		
		S-4		.3			6' SILTY SAND — BROWN, MOIST, LITTLE GRAVEL, SLIGHTLY PLASTIC OVER BROWN WELL SORTED MED. SAND, LITTLE FINE SAND, TR. GRAVEL		SM	7 8 10 10		
		S-5		.6						27 10 17 20		
10		S-6		.9			10' SILTY FINE SAND — BROWN TO DULL YELLOW, TR. TO LITTLE GRAVEL, FIRM IN PLACE, MOIST; SATURATED W/ OBSERVABLE CONTAMINATION AFTER 15.5'			9 11 24 15		
		S-7		1.0						11 10 7 9		▽
		S-8		.6		45				7 7 7 5		
15		S-9		1.1		10	16' SANDY SILT 18' — BROWN TO OLIVE BROWN, TR. GRAVEL - GRADES TO WELL SORTED SAND & SILT		ML	3 4 2 3		
		S-10		.9		13	SILTY SAND & GRAVEL — BLACK, OLIVE BROWN & BROWN w/ ANGULAR COARSE FRAGMENTS (AS IN A TILL), SATURATED; CONTAMINATION DESTROYS LITHOLOGY			4 5 3 4		
20		S-11		.6		54	22'		SM	3 3 3 3		
		S-12		1.3	Y	12	SILTY FINE SAND — GRAY, BROWN, V. WELL SORTED, PERMEABLE, LOOSE			5 4 3 3		
25		S-13		0.4		9				2 5 10 50/0.9		
							B.O.B. @ 25.5'					

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND

* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

MECHANICVILLE	TASK 3		BORING NO. B-13
CLIENT NYSEG			PROJECT NO. 4945-03
CONTRACTOR NORTH STAR DRILLING CO.		DATE STARTED 11-10-87	COMPLTD. 11-18-87
METHOD H.S.A., CASING, CORING	CASING SIZE 4" I.D.	PID TIP #1	PROTECTION LEVEL D
GROUND EL 98.6 Rel.	SOIL DRILLED 25.5'	ROCK DRILLED 30'	TOTAL DEPTH 55.5'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND 15.67' (11-20-87)
SCREEN 10.8 (FT)	RISER 44.7 (FT)	MATERIAL PVC (SS) TF	ID 2" PAGE 1 OF 2

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD % (20 40 60 80 100)	WELL DATA	EL. (FT)
0	BKG											
5												
10												
15		S-1	X	.6		10	GRAVELLY SILTY SAND (FILL) BROWN, WET, WITH VISIBLE COAL TAR SHEEN & ODOR		SM	27 30 59/3		
20		S-2	X	1.2		50	SILTY SAND TAN, WET, TR. GRAVEL, W/ OBVIOUS COAL TAR CONTAMINATION			3 3 3 4		
		S-3	X	2.0		22	23' GRAVELLY SILTY SAND BRN. TO GRAY BRN C. SAND TR. GRAVEL & SILT OVER WELL SORTED F. SAND, OVER WEATHERED ROCK,		SM/GM	2 2 2 5		
25		S-4	X	1.0		10	25.5' BEDROCK LITTLE SLT, SAT., CONTAM.			4 5 9/0.2		
		R-1		97 %			SHALE BLACK, UNWEATHERED, HARD, THINLY LAMINATED					
30												
35												

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND

* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

MECHANICVILLE	TASK 3		BORING NO. B-13
CLIENT NYSEG			PROJECT NO. 4945-03
CONTRACTOR NORTH STAR DRILLING CO.		DATE STARTED 11-10-87	COMPLTD. 11-18-87
METHOD H.S.A., CASING, CORING	CASING SIZE 4" I.D.	PID TIP #1	PROTECTION LEVEL D
GROUND EL 98.6 Rel.	SOIL DRILLED 25.5'	ROCK DRILLED 30'	TOTAL DEPTH 55.5'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND
SCREEN 10.8 (FT)	RISER 44.7 (FT)	MATERIAL PVC (SS) TF	ID 2" PAGE 2 OF 2

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD % 20 40 60 80 100	WELL DATA	EL. (FT)
35							SHALE BLACK, FRESH UNWEATHERED					
							BEDDING ON MM SCALE					
40		R-2		100 %								
45												
		R-3		100 %								
50							FRACTURE AT 55' PRODUCED COLORS ON RETURN WATER - CORE SHOWED VISIBLE COAL TAR CONTAMINATION					
55							B.O.B. @ 55.5'					
60												

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

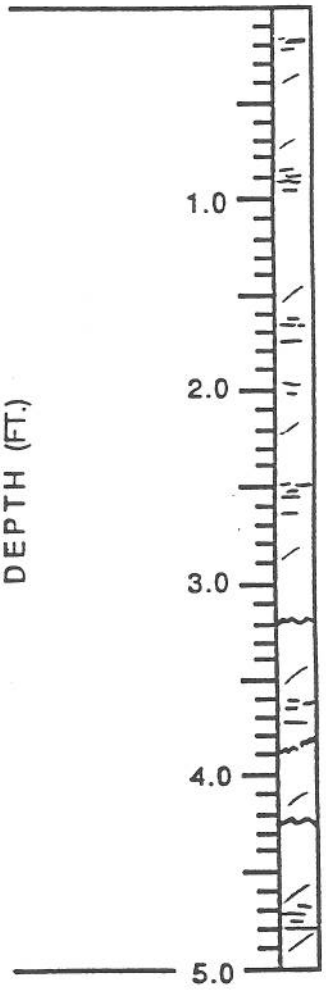
* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 1 OF 3

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-17-87	CHK'D BY: CM 12/29/87
BORING NO.: B-13	SAMPLE: R-1	CORE DIA. (IN.): 2	DEPTH (FT.): 25 TO 35.5
CORE LENGTH (FT.): 10	CORE RECOVERY: 9.7 (FT.) 97 (%)	RQD: 95 (%)	ROCK QUALITY: EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

SHALE BLACK, UNWEATHERED, HARD, THINLY LAMINATED,

BEDDING ∠'S FROM HORIZONTAL

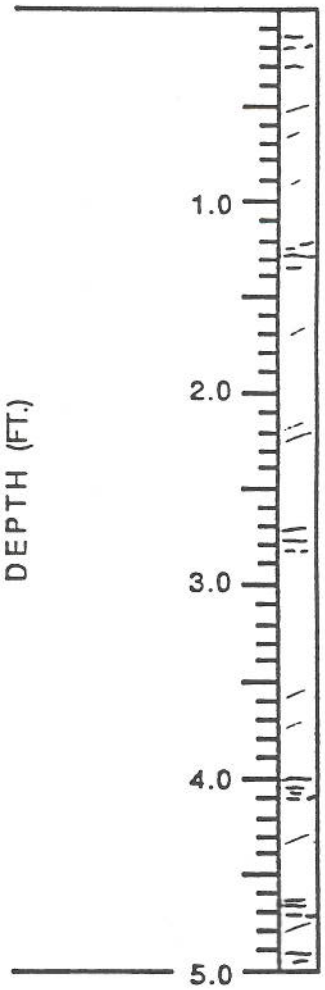
DEPTH	∠
26'	45-50°
28'	10°
30'	15°
32'	15°
34'	15°

AT : 33.4', 34', 31.7' HAVE V. SMALL JOINTING, REHEALED.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 2 OF 3

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-17-87	CHK'D BY: CM 12/29/87
BORING NO.: B-13	SAMPLE: R-2	CORE DIA. (IN.): 2	DEPTH (FT.): 35 TO 45
CORE LENGTH (FT.): 10	CORE RECOVERY: 10 (FT.) 100 (%)	RQD: 100 (%)	ROCK QUALITY: EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

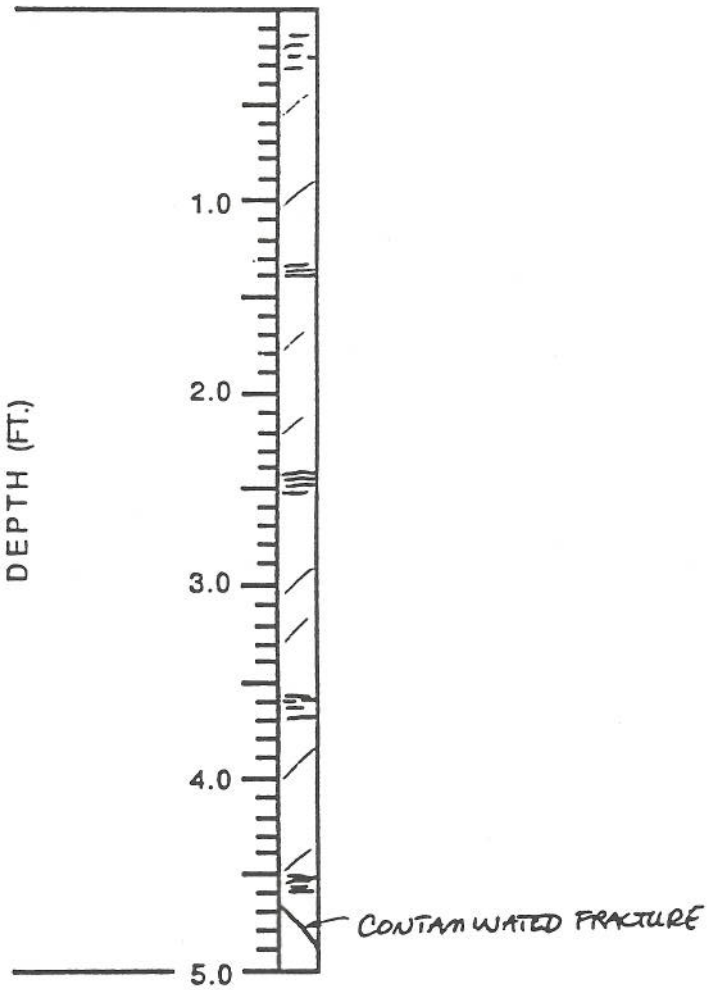
SHALE AS ABOVE
NO UNUSUAL FEATURES

BEDDING AT 15° TO HORIZONTAL

VISUAL IDENTIFICATION
ROCK CORES

SHEET 3 OF 3

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-18-87	CHK'D BY: CM 12/29/87
BORING NO.: B-13	SAMPLE: R-3	CORE DIA. (IN.): 2	DEPTH (FT.): 45.5 TO 55.5
CORE LENGTH (FT.): 10	CORE RECOVERY : 10 (FT.) 100 (%)	RQD: 98 (%)	ROCK QUALITY : EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

SHALE FRESH, UNWEATHERED, BLACK TO BLACKISH GRAY W/ THIN BEDDING ON MM SCALE

BEDDING AT 20° TO 25° FROM HORIZONTAL

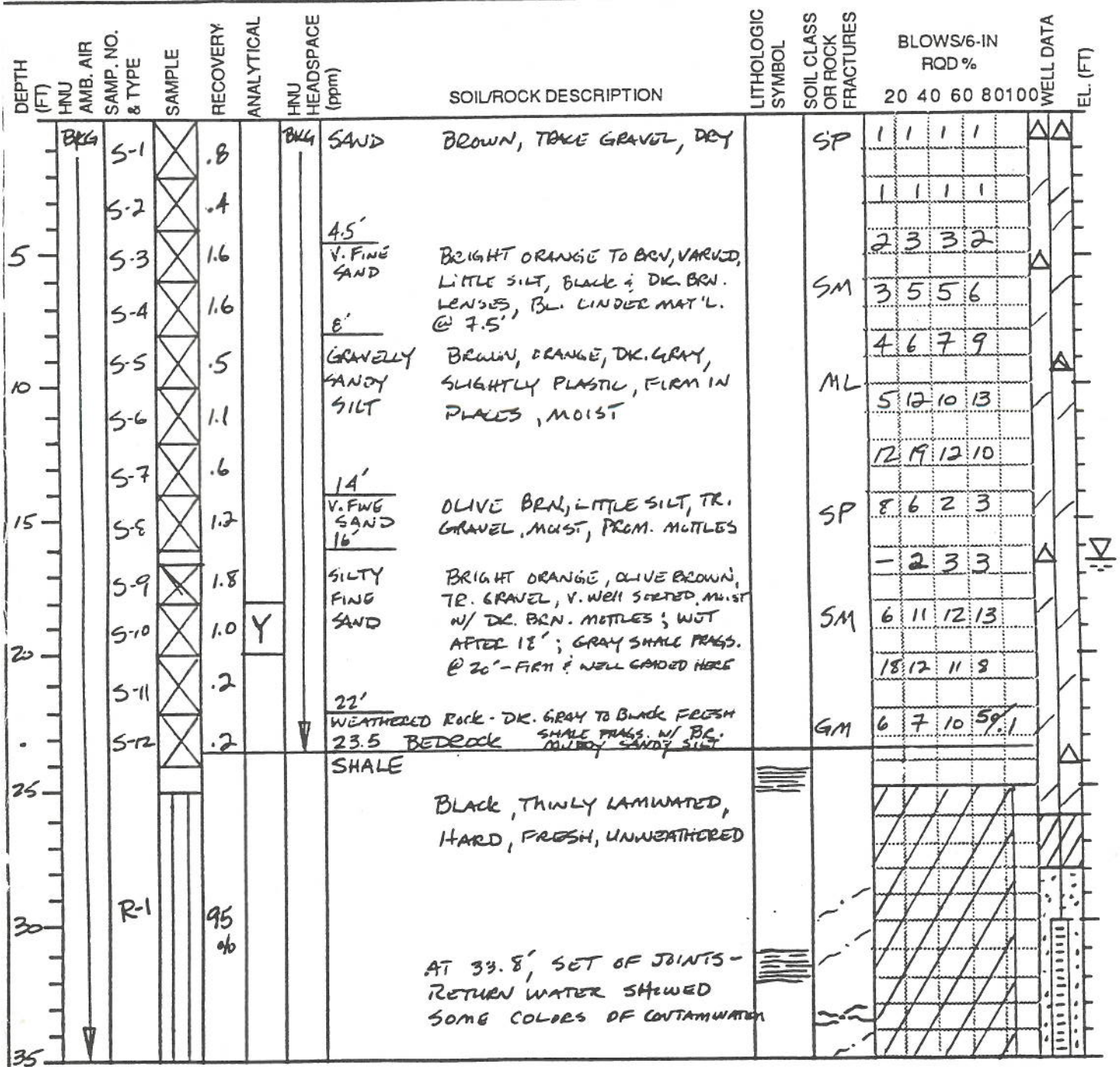
55' - FRACTURE (ZONE) W/ GRAVEL SIZE SHALE FRAGMENTS & CALCITE FRAGMENT HAS VISIBLE COAL TAR SMELL & SHEEN ON FRACTURE FACES (& RETURN WATER AS.

55.3' - 2 HEALED FRACTURES @ 62°

55.5' - BEDDING OF 20° TO HORIZONTAL W/ FRACTURE @ 62° FROM HORIZONTAL

E.C. JORDAN CO.

MECHANICVILLE	**TASK 3**	**BORING NO.** B-14
CLIENT **NYSEG**		PROJECT NO. 4945-03
CONTRACTOR **NORTH STAR DRILLING CO.**	DATE STARTED 11-9-87	COMPLTD. 11-19-87
METHOD H.S.A. & CORING / CASING SIZE 4" ID	PID TIP # 1	PROTECTION LEVEL D
GROUND EL 98.7 Rel. / SOIL DRILLED 23.5'	ROCK DRILLED 31.5'	TOTAL DEPTH 55'
LOGGED BY T. LONGLEY / CHECKED BY CN	DATE 12/29/87	▽ BELOW GROUND 16.45' (11-20-87)
SCREEN 11 (FT) / RISER 30 (FT) / MATERIAL PVC (SS) TF	ID 2"	PAGE 1 OF 2



PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND

* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

MECHANICVILLE	TASK 3		BORING NO. B-14
CLIENT NYSEG			PROJECT NO. 4945-03
CONTRACTOR NORTH STAR DRILLING CO.		DATE STARTED 11-9-87	COMPLTD. 11-19-87
METHOD H.S.A. & CORING	CASING SIZE 4"ID	PID TIP #1	PROTECTION LEVEL D
GROUND EL 98.7 Rel.	SOIL DRILLED 23.5'	ROCK DRILLED 31.5'	TOTAL DEPTH 55'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND
SCREEN 11 (FT)	RISER 30 (FT)	MATERIAL PVC/SS/TF	ID 2" PAGE 2 OF 2

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD% 20 40 60 80 100	WELL DATA	EL. (FT)
35	BKG						SHALE					
		R-2		97 %			SOME DRILLERS BREAKS IN AN OTHERWISE FRESH, UNWEATHERED BLACK, THINLY LAMINATED BLACK SHALE					
40												
		R-3		100 %								
45												
		R-4		100 %							CUTTINGS & SAND	
50												
55							BOB @ 55'					

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND

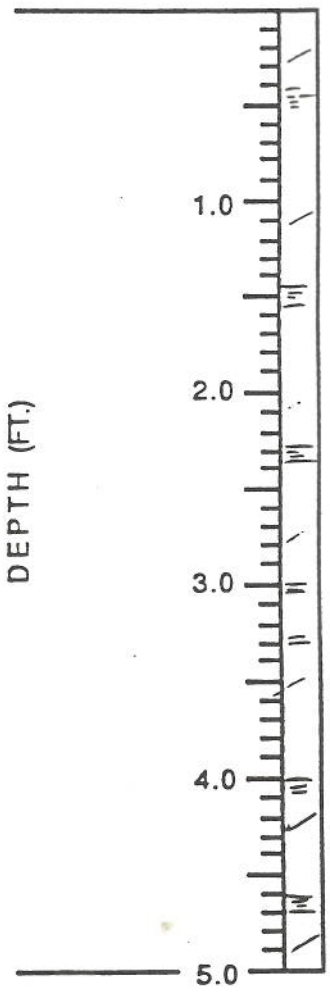
* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 1 OF 4

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-19-87	CHK'D BY: CM 12/29/87
BORING NO.: B-14	SAMPLE: R-1	CORE DIA. (IN.): 2	DEPTH (FT.): 25 TO 35
CORE LENGTH (FT.): 10	CORE RECOVERY: 9.5 (FT.) 95 (%)	RQD: 83 (%)	ROCK QUALITY: GOOD



ROCK DESCRIPTION AND IDENTIFICATION

SHALE BLACK THINLY LAMINATED, HARD, FRESH, UNWEATHERED

27.7'-28.4' } MICRO FRACTURES THAT
31.4'-32.4' } RETAIN WATER AS CORE DRIES

FROM 28' TO 35', NUMEROUS BREAKS - MOSTLY PARALLEL TO BEDDING

AT 33.8', HAVE A SET OF RANDOMLY ORIENTATED JOINTS; DURING DRILLING, THE RETURN WATER FROM THIS ZONE SHOWED A SHEEN; CORE GIVE NO TIP READINGS

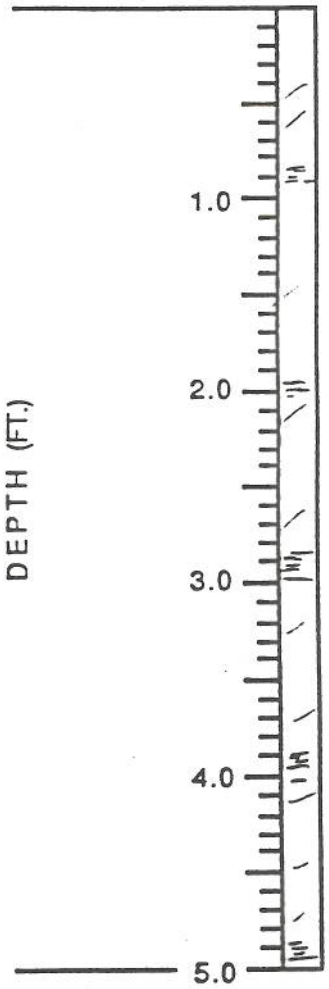
BEDDING	DEPTHS	ANGLES
	26'	25°
	31'	35°
	34'	20°

VISUAL IDENTIFICATION
ROCK CORES

SHEET 2 OF 4

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-19-87	CHK'D BY: CM 12/29/87
BORING NO.: B-14	SAMPLE: R-2	CORE DIA. (IN.): 2	DEPTH (FT.): 35 TO 42
CORE LENGTH (FT.): 7	CORE RECOVERY: 6.8 (FT.) 97 (%)	RQD: 91 (%)	ROCK QUALITY: EXCELLENT

ROCK DESCRIPTION AND IDENTIFICATION



SHALE AS ABOVE

38.7' TO 41' HIGH ANGLE FRACTURES 80° FROM HORIZONTAL- REHEALED & LINED W/ CALCITE- NO APPARENT WEATHERING- BROKE DUE TO DRILLING ACTION

VISUAL IDENTIFICATION
ROCK CORES

SHEET 3 OF 4

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-19-87	CHK'D BY: CM 12/29/87
BORING NO.: B-14	SAMPLE: R-3	CORE DIA. (IN.): 2	DEPTH (FT.): 42 TO 45
CORE LENGTH (FT.): 3	CORE RECOVERY : 3 (FT.)/100 (%)	RQD: 100 (%)	ROCK QUALITY : EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

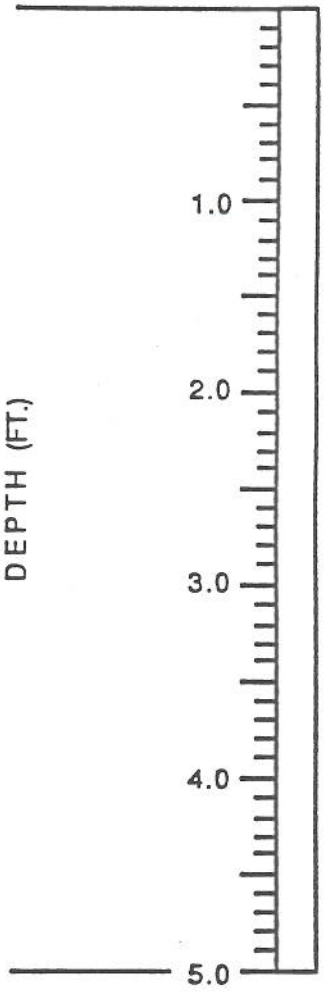
SHALE AS ABOVE

BEDDING	DEPTHS	ANGLES
	36'	20°
	40'	15°
	42'	15°

VISUAL IDENTIFICATION
ROCK CORES

SHEET 4 OF 4

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-19-87	CHK'D BY: CM 12/29/87
BORING NO.: B-14	SAMPLE: R-4	CORE DIA. (IN.): 2	DEPTH (FT.): 45 TO 55
CORE LENGTH (FT.): 10	CORE RECOVERY : 10 (FT.) 100 (%)	RQD: 98 (%)	ROCK QUALITY : EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

SHALE AS ABOVE
COMPETENT, FRESH, NO WEATHERING, HARD

SOME DRILLERS BREAKS

MECHANICVILLE	TASK 3		BORING NO. B-15
CLIENT NYSEG			PROJECT NO. 4945-03
CONTRACTOR NORTH STAR DRILLING CO.		DATE STARTED 11-13-87	COMPLTD. 11-17-87
METHOD H.S.A. & CORING	CASING SIZE 4" I.D.	PID TIP #1	PROTECTION LEVEL D
GROUND EL 88.5 Rel.	SOIL DRILLED 8.7'	ROCK DRILLED 30.3'	TOTAL DEPTH 39'
LOGGED BY T. LONGLEY	CHECKED BY CM	DATE 12/29/87	▽ BELOW GROUND 8.19' (11-20-87)
SCREEN 11 (FT)	RISER 13 (FT)	MATERIAL PVC (SS) TF	ID 2"

PAGE 1 OF 1

DEPTH (FT)	HNU AMB. AIR	SAMP. NO. & TYPE	SAMPLE	RECOVERY	ANALYTICAL	HNU HEADSPACE (ppm)	SOIL/ROCK DESCRIPTION	LITHOLOGIC SYMBOL	SOIL CLASS OR ROCK FRACTURES	BLOWS/6-IN RQD% 20 40 60 80 100	WELL DATA	EL. (FT)
0	BKG	S-1		1.2		BKG	FILL — BLACK CINDER & ASH FILL, TRACE COAL, SOME BRICK PIECES, etc., MOIST, LOOSE			2 8 5 1		
		S-2		0.0						1 2 3 3		
5		S-3		0.7		BKG				1 1 1 1		
		S-4		1.4		BKG	7.5' GRAVELLY SILTY SAND, BRN. TO DK BRN. MOIST. OVER HIGHLY WEATHERED ORIENTED SHARDS OF ROCK + SOIL			1 4 6 8		▽
		S-5		0.9		BKG	8.0 9.0'			16 45 50/0.2		
10							SHALE BEDROCK — BLACK TO GRAYISH BLACK, THINLY LAMINATED, FRESH, FEW DRILLERS BREAKS.					
15		R-1		82 %								
20												
25		R-2		99 %			BREAK AT 25.5'					
30		R-3		100 %								
35							B.O.B. @ 39'					

PROPORTION	(-)AMOUNT(+)
trace (tr)	0-10%
little (li)	10-20%
some (so)	20-35%
and	35-50%

ABBREVIATION	
f-fine	gr-gray
m-medium	br-brown
c-coarse	blk-black

BKG = BACKGROUND

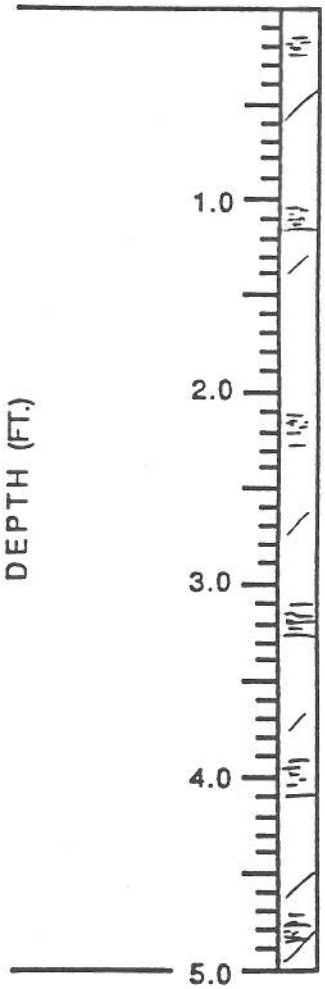
* U= THIN WALL S= SPLIT SPOON R= ROCK

E.C. JORDAN CO.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 1 OF 3

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-16-87	CHK'D BY: CM 12/29/87
BORING NO.: B-15	SAMPLE: R-1	CORE DIA. (IN.): 2	DEPTH (FT.): 11 TO 21
CORE LENGTH (FT.): 10	CORE RECOVERY : 10 (FT.)/100(%)	RQD: 100 (%)	ROCK QUALITY : EXCELLENT



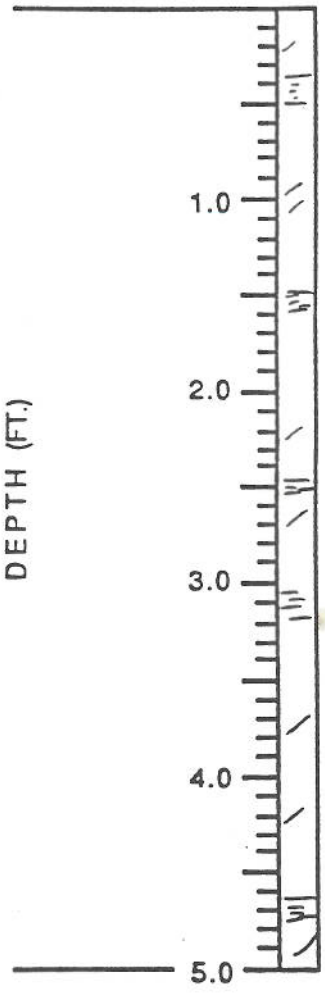
ROCK DESCRIPTION AND IDENTIFICATION

SHALE BLACK TO GRAYISH BLACK, THINLY LAMINATED, FRESH, BEDDING AT 50° TO HORIZONTAL, HARD CALCITE LAYERS IN MM SCALE PARALLEL TO BEDDING. A FEW DRILLERS BREAKS.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 2 OF 3

JOB NO.: **4945-03**	BY: NORTH STAR	DATE: 11-16-87	CHK'D BY: CN 12/29/87
BORING NO.: B-15	SAMPLE: R-2	CORE DIA. (IN.): 2	DEPTH (FT.): 21 TO 29.5
CORE LENGTH (FT.): 8.5	CORE RECOVERY : 8.4 (FT.) 99 (%)	RQD: 94 (%)	ROCK QUALITY : EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

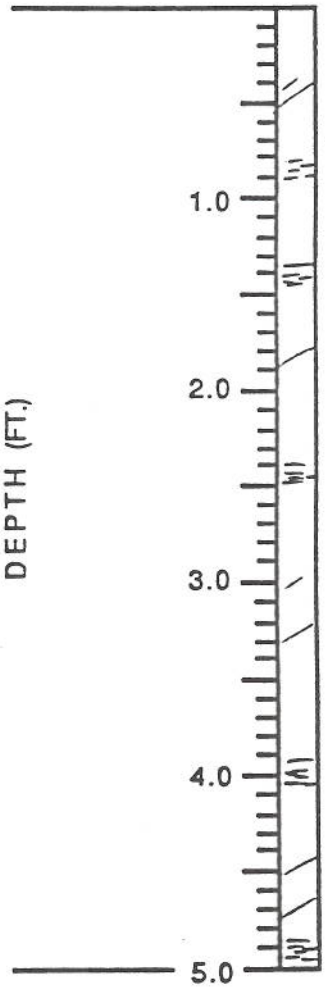
SHALE AS ABOVE; SOME DISSEMINATED PYRITE PRODUCED H_2S SMELL WHILE DRILLING

25.5' - NATURAL BREAK @ 40° FROM HORIZONTAL - IN REHEALED FRACTURE ZONE - SOME SERICITE HERE.

VISUAL IDENTIFICATION
ROCK CORES

SHEET 3 OF 3

JOB NO.: 4945-03	BY: NORTH STAR	DATE: 11-16-87	CHK'D BY: CM 12/29/87
BORING NO.: B-15	SAMPLE: R-3	CORE DIA. (IN.): 2	DEPTH (FT.): 29.5 TO 39
CORE LENGTH (FT.): 9.5	CORE RECOVERY : 9.5 (FT.) 100 (%)	RQD: 100 (%)	ROCK QUALITY : EXCELLENT



ROCK DESCRIPTION AND IDENTIFICATION

SHALE AS ABOVE

BEDDING DEPTHS	∠ FROM HORIZ.
30'	45°
34'	40°
37'	35°
39.5'	25°

AT 31.8', 35.6, & 36.4' HAVE FRACTURES BUT THEY ARE FRESH & UNWEATHERED

Appendix B-2

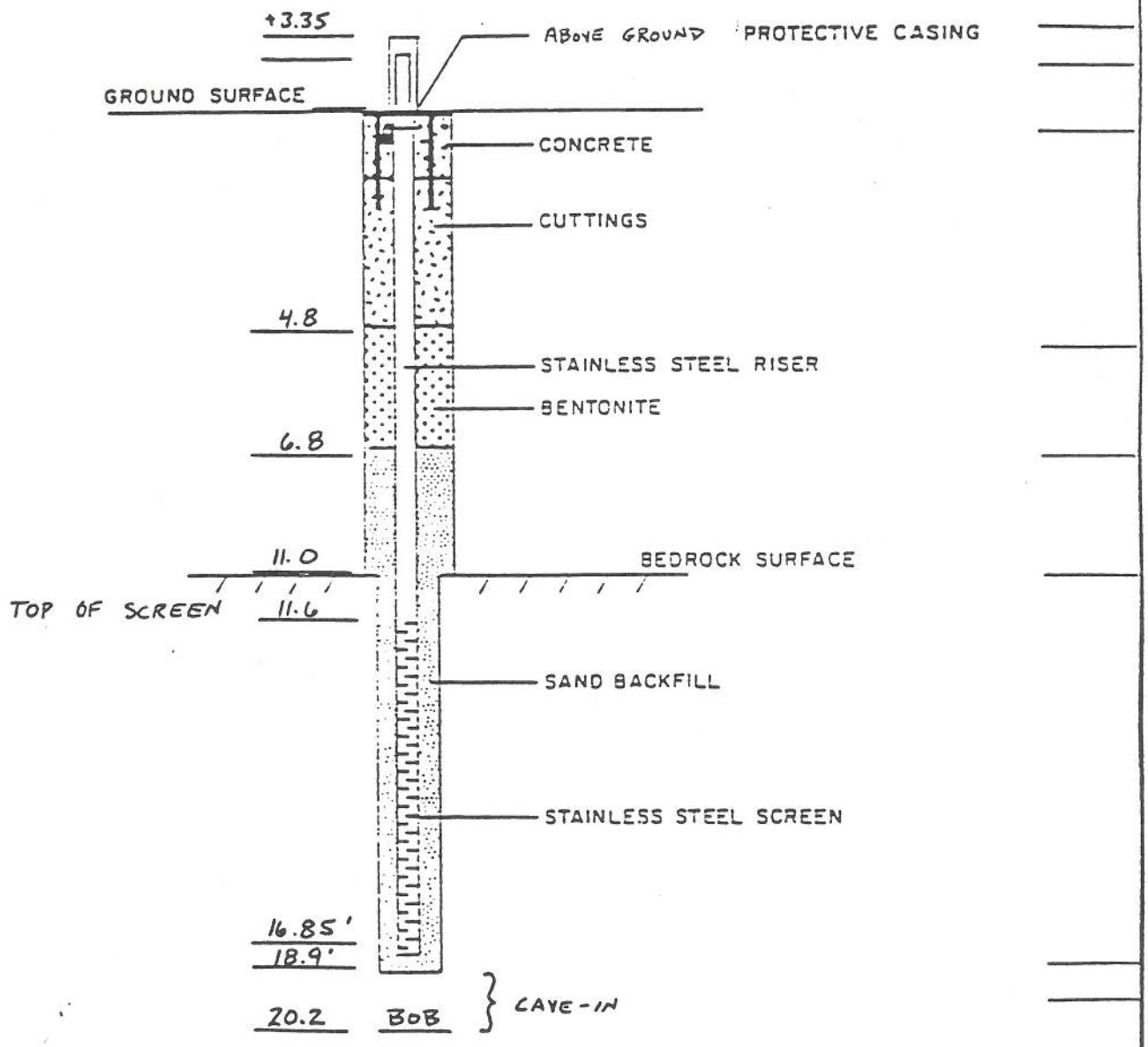
Monitoring Well Installation Diagrams

MONITORING WELL INSTALLATION DIAGRAM

ECT NO.	PROJECT NAME	WELL NO.
4945-02	NYSEG MECHANICVILLE	MW-1
LLED BY L. ESPY S. WIBBY	DATE INSTALLED 8/1/86	BORING DIAMETER 8.75"
DIAMETER 2.0"	WELL MATERIAL SS	BACKFILL MATERIAL #3 JERSEY SAND

, FT.

DEPTH, FT.

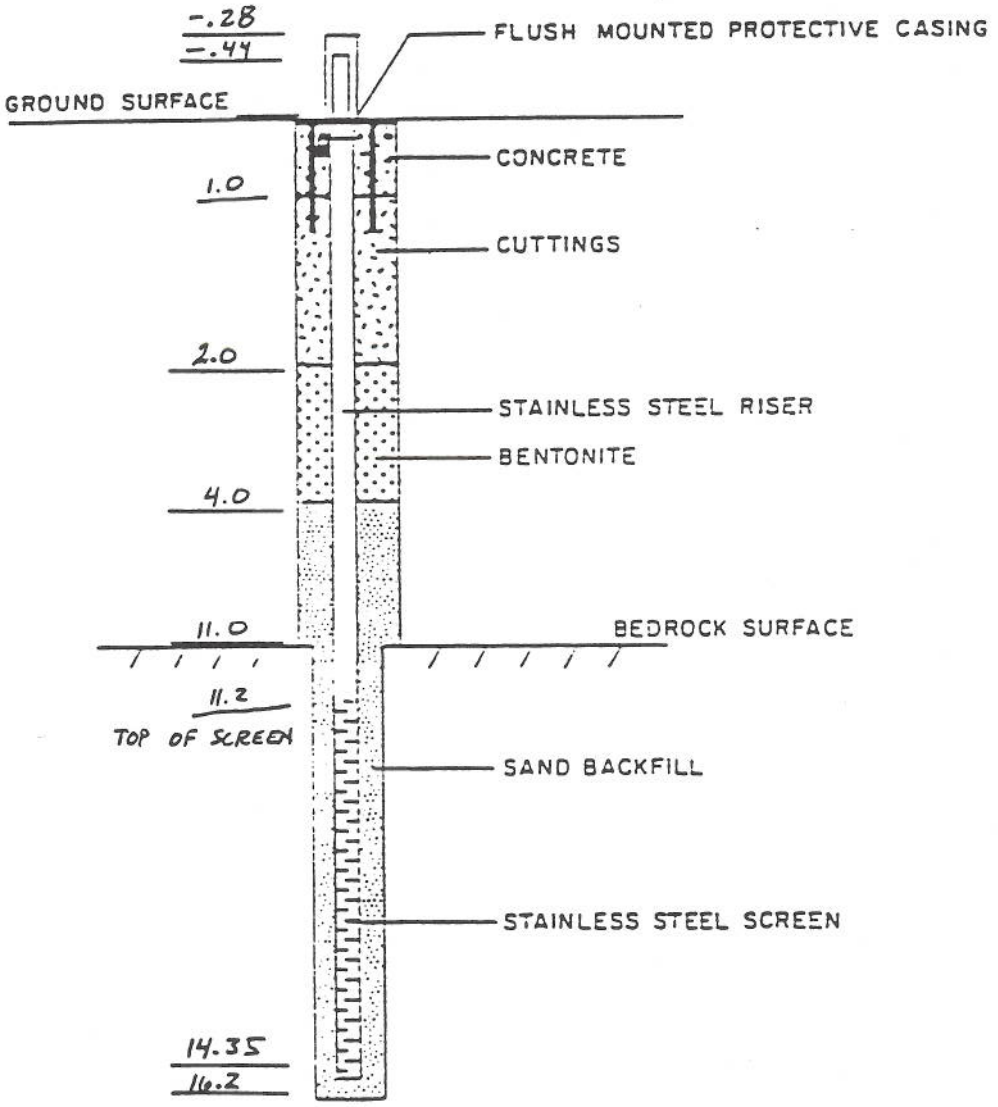


MONITORING WELL INSTALLATION DIAGRAM

OJECT NO.	PROJECT NAME	WELL NO.
4945-02	NYSEG MECHANICVILLE	MW-2
STALLED BY L. ESPY, S. WIBBY	DATE INSTALLED 8/1/86	BORING DIAMETER 8.75"
LL DIAMETER 2.0"	WELL MATERIAL SS	BACKFILL MATERIAL #3 JERSEY SAND

EV., FT.

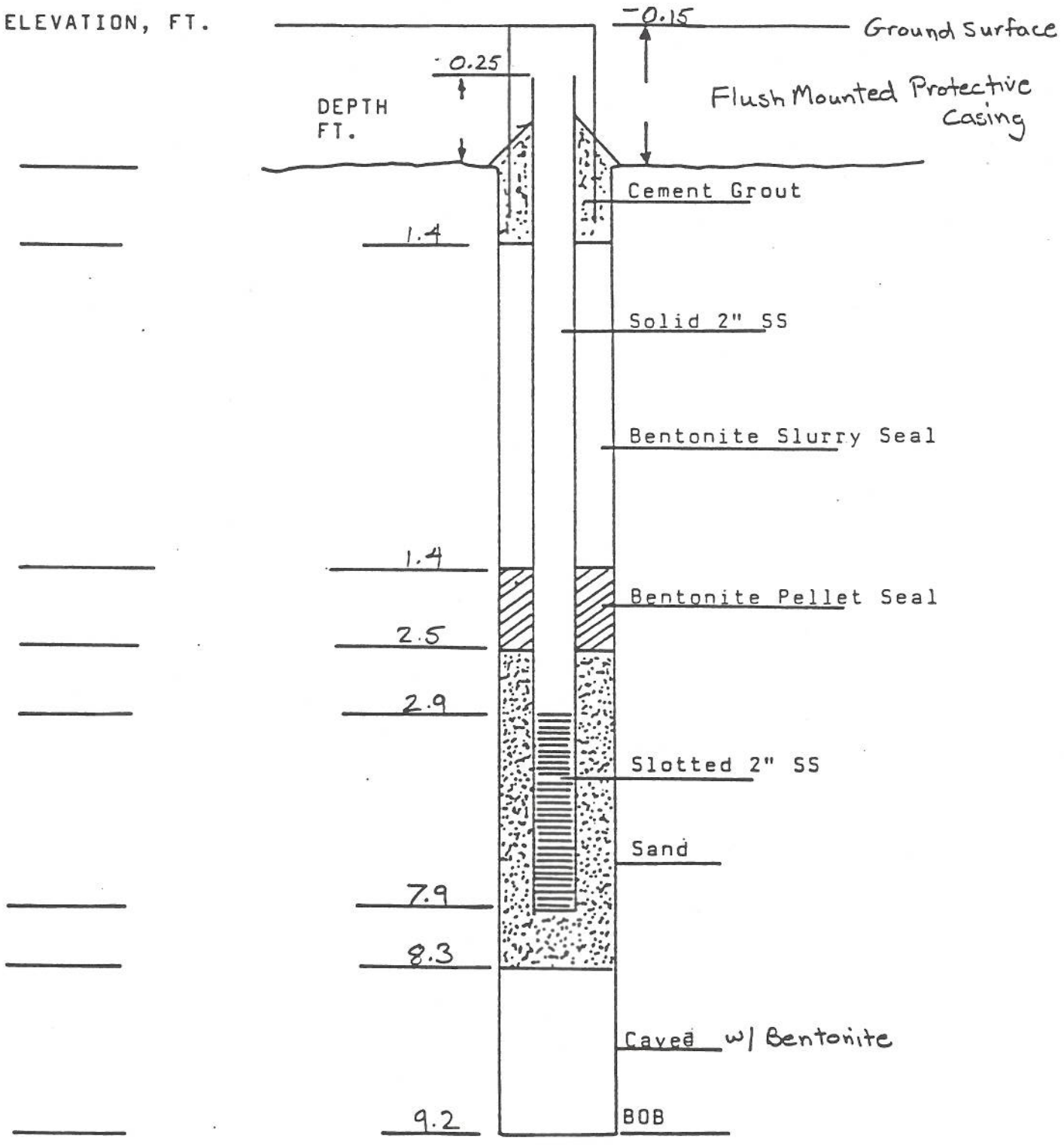
DEPTH, FT.



EC JORDAN CO

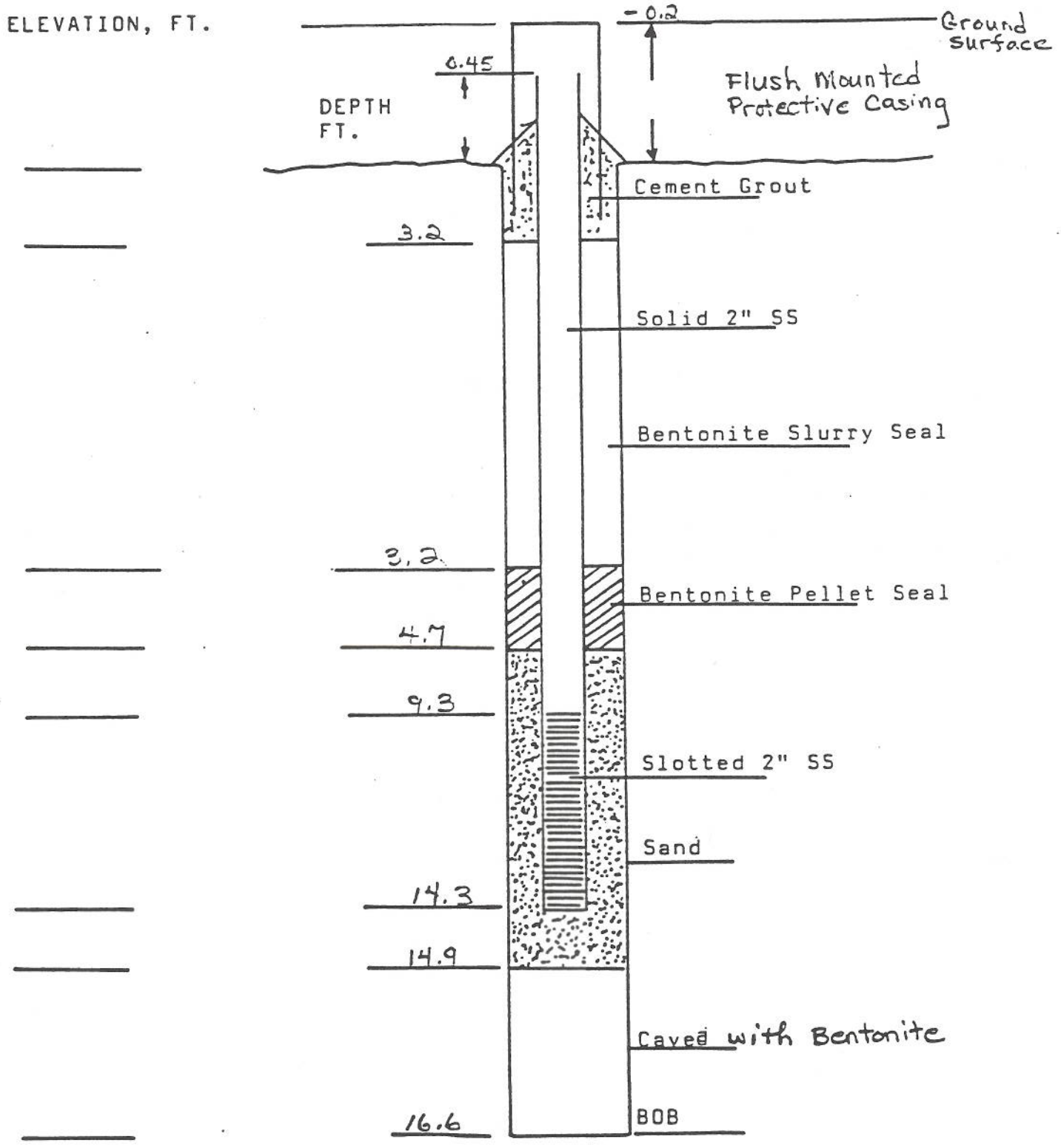
WELL INSTALLATION DETAILS

Project No. 4945-02	Project Name NYSEG MECHANICVILLE	Well No. MW-3
Installed By SNW/JWP	Date Installed 8/6/86	Boring Diameter 8.75"
Well Diameter 2"	Well Material SS	Backfill Material #3 Jersey Sand



WELL INSTALLATION DETAILS

Project No. 4945-02	Project Name NYSEG Mechanicville	Well No. MW-4
Installed By SNW, LWE, ICM	Date Installed 7/30/86	Boring Diameter 8.75"
Well Diameter 2"	Well Material Stainless Steel	Backfill Material #3 Jersey sand

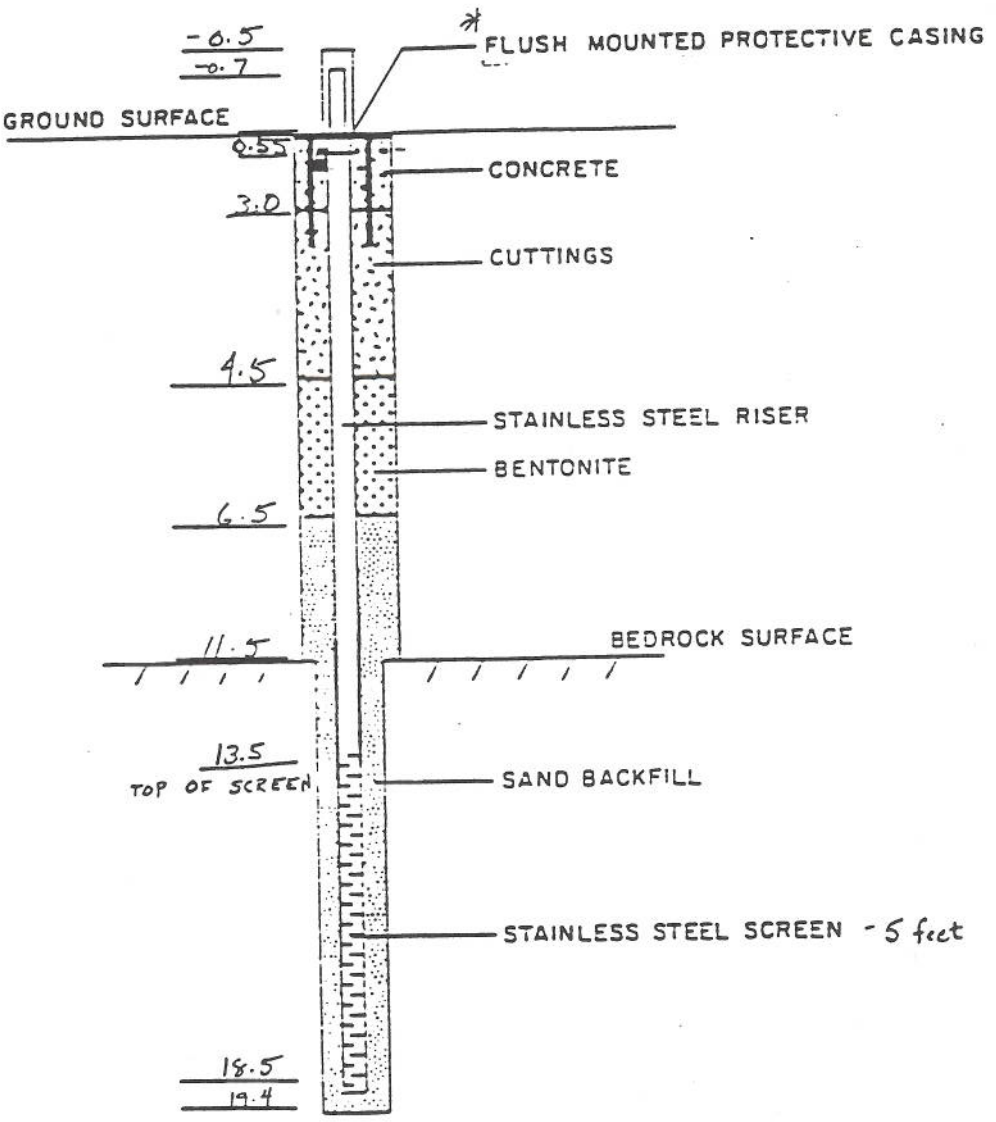


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MONITORING WELL INSTALLATION DIAGRAM

JECT NO. 4945-02	PROJECT NAME NYSEG MECHANICVILLE	WELL NO. MW-5
ALLED BY SNW; JWP	DATE INSTALLED 8/5/86	BORING DIAMETER 8.75"
L DIAMETER 2.0"	WELL MATERIAL SS	BACKFILL MATERIAL #3 Jersey Sand

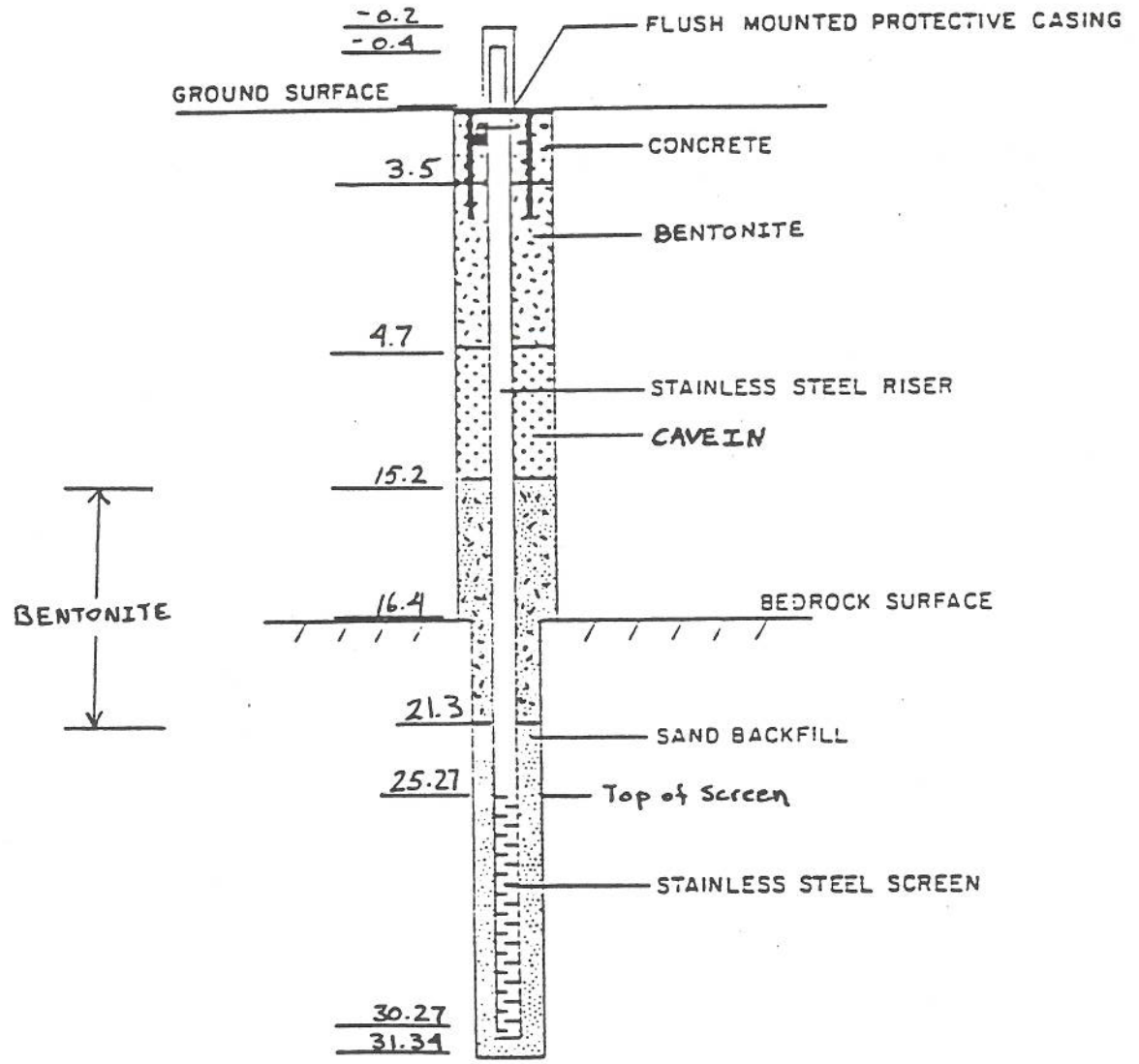
V., FT. DEPTH, FT.



MONITORING WELL INSTALLATION DIAGRAM

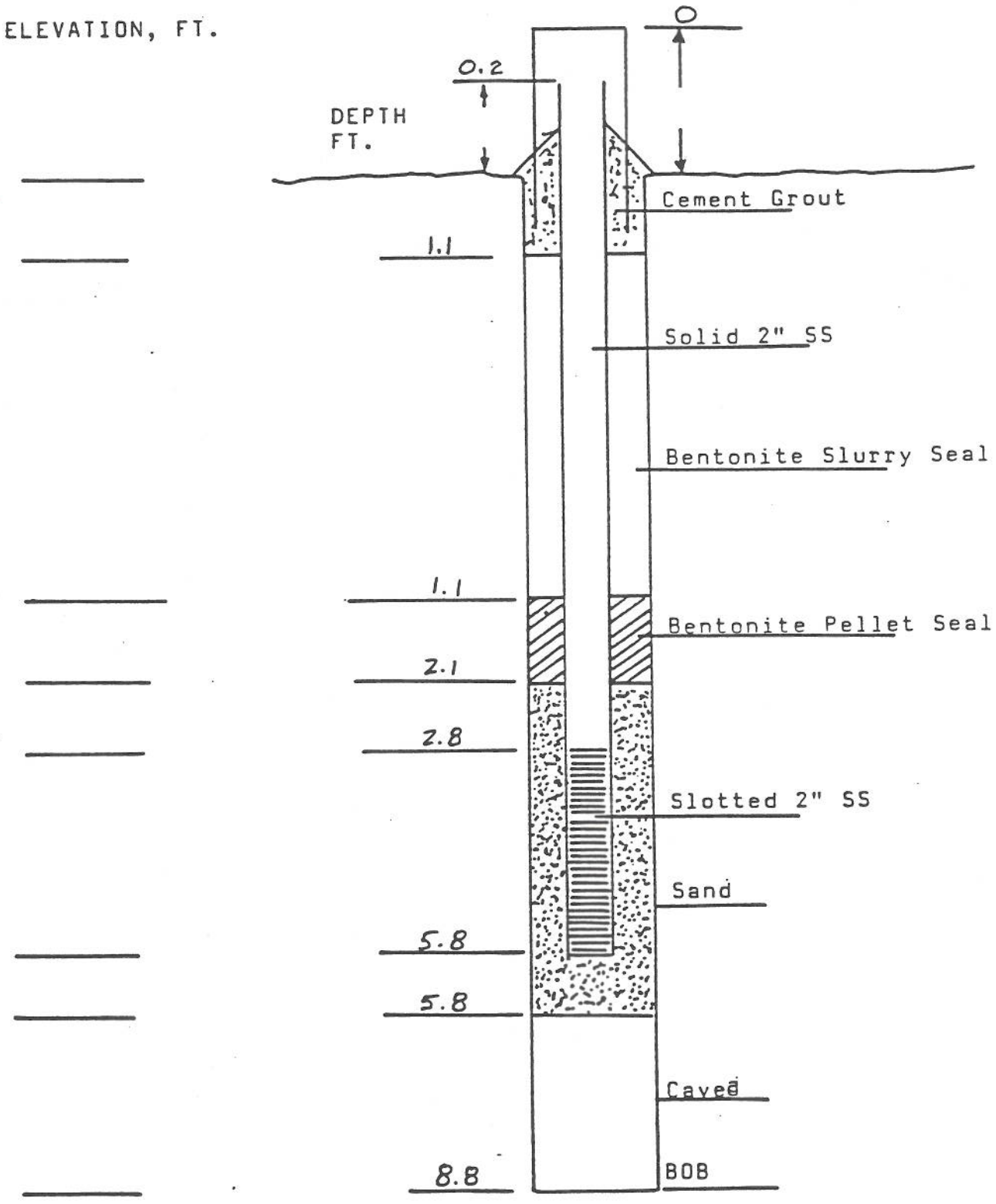
OJECT NO. 4945-02	PROJECT NAME NYSEG MECHANICVILLE	WELL NO. MW-6
ITALLED BY SNW	DATE INSTALLED 7-29-86	BORING DIAMETER 4.0"
LL DIAMETER 2.0"	WELL MATERIAL SS	BACKFILL MATERIAL #3 JERSEY SAND

EV., FT. DEPTH, FT.



WELL INSTALLATION DETAILS

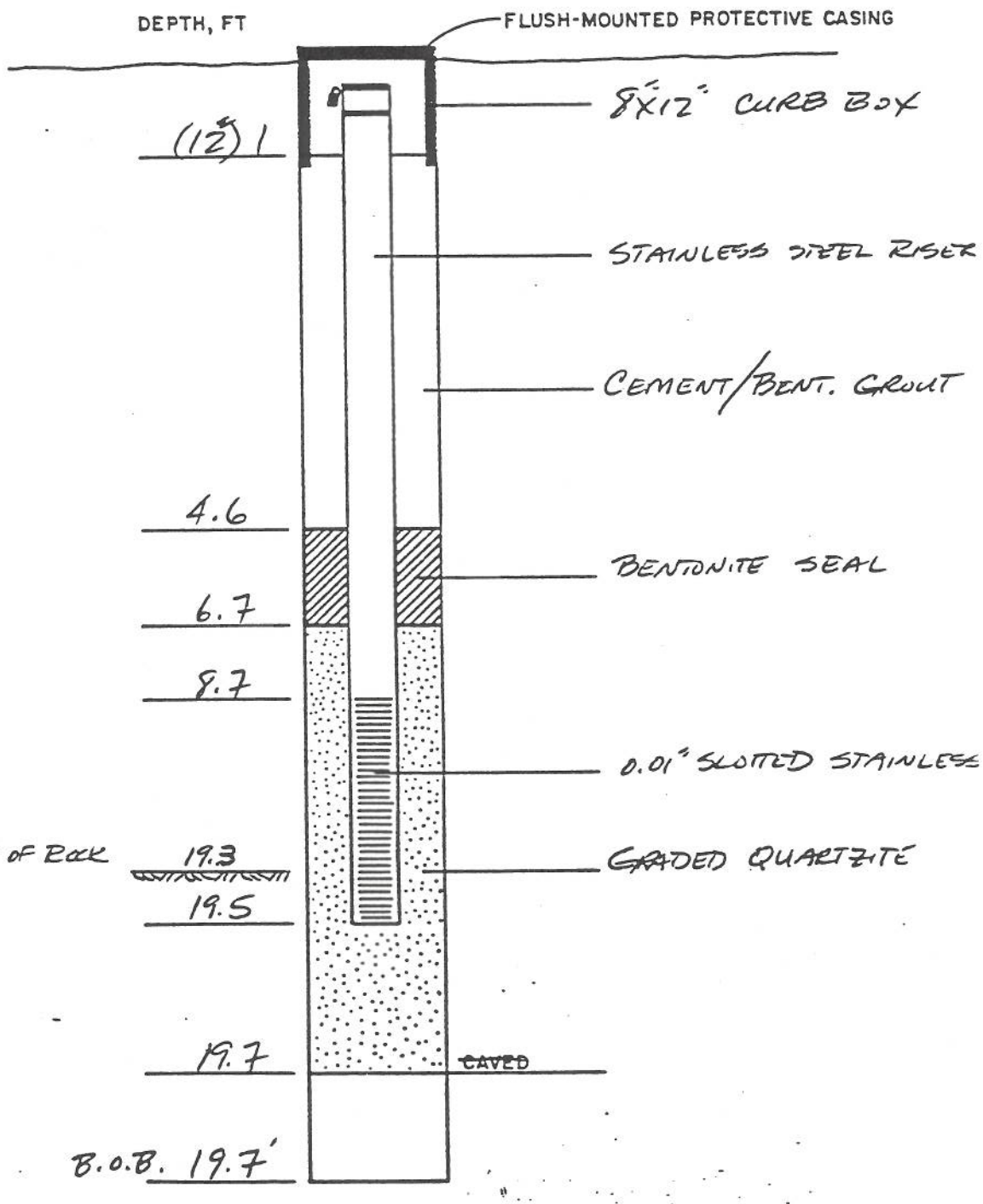
Project No. 4945 - 02	Project Name NYSEG MECHANICVILLE	Well No. Piezometer P-7
Installed By S. Wibby L. Espy	Date Installed 7-31-86	Boring Diameter 8.75"
Well Diameter 2.0"	Well Material PVC	Backfill Material #3 JERSEY SAND



EC JORDAN CO

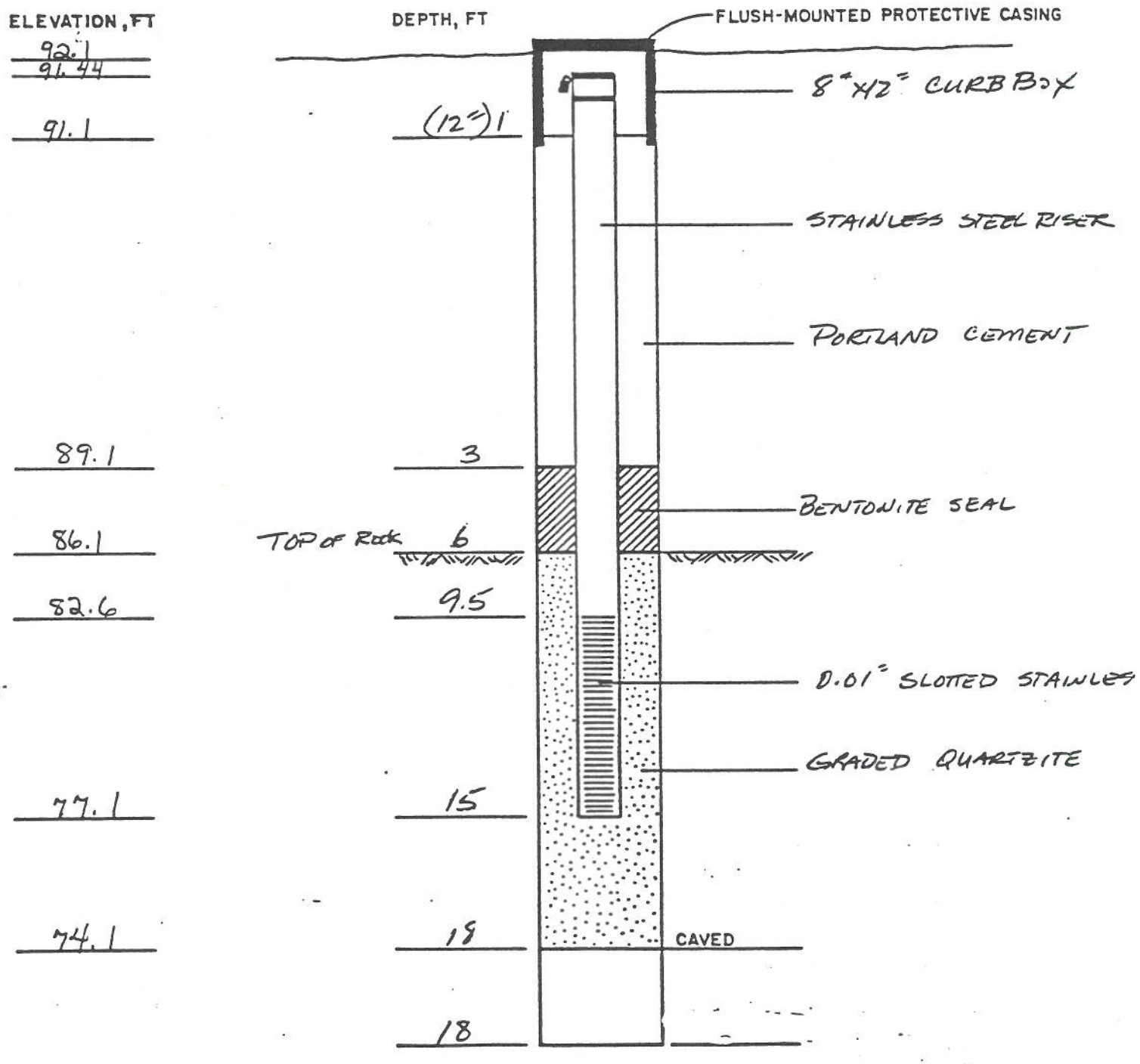
WELL INSTALLATION DETAILS

PROJECT NO. 4945-03	PROJECT NAME NYSEG MECHANICVILLE TASK3	WELL NO. MW-10
INSTALLED BY NORTH STAR DRILLING	DATE INSTALLED 11-12-87	BORING DIAMETER 6"
WELL DIAMETER 2"	WELL MATERIAL SCHEDULE 40 304 STAINLESS STEEL	BACKFILL MATERIAL #4 Q-Rok GRADED QUARTZITE



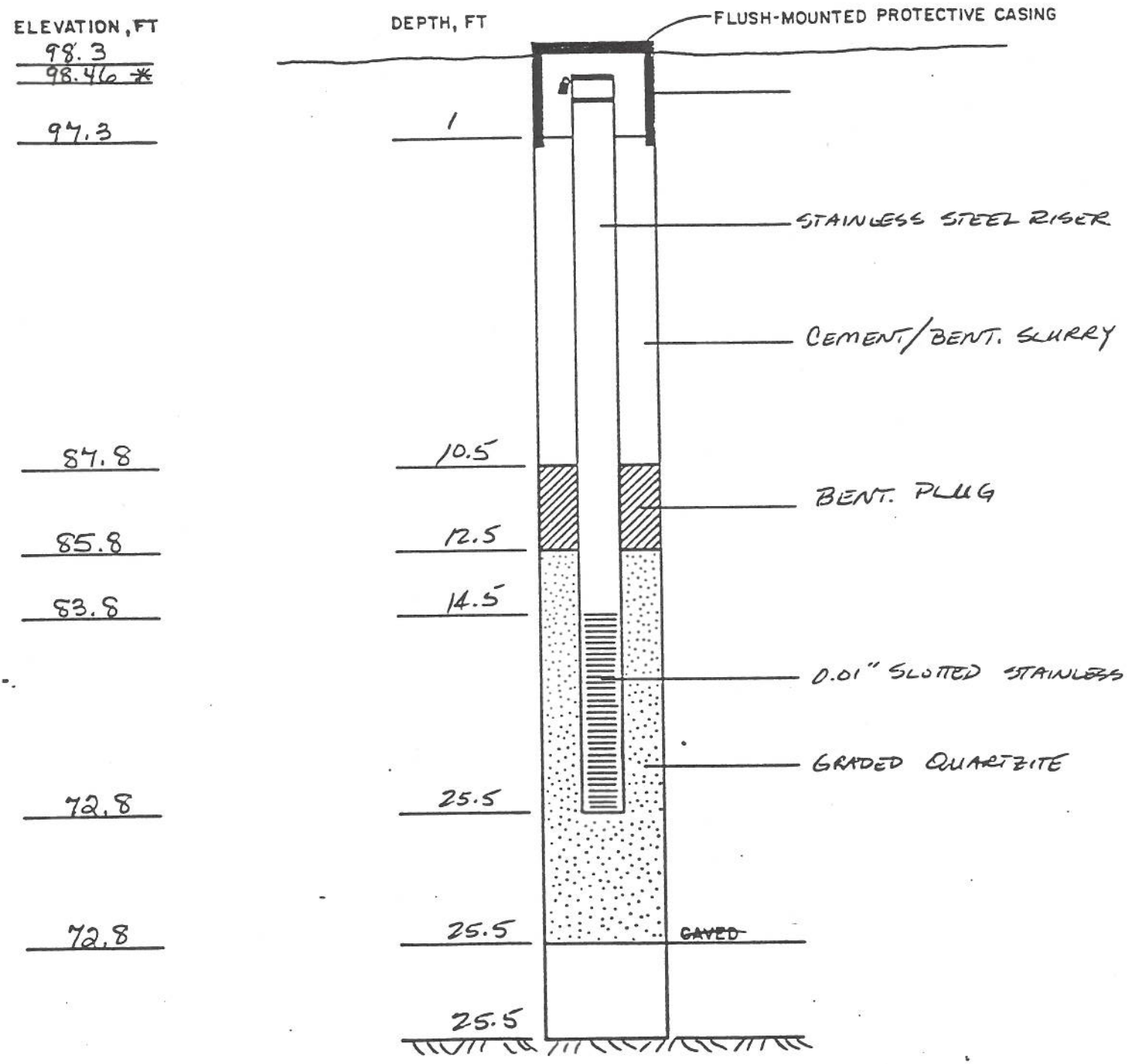
WELL INSTALLATION DETAILS

PROJECT NO. 4945-03	PROJECT NAME NYSEG MECHANICVILLE TASK 3	WELL NO. MW-11
INSTALLED BY NORTH STAR DRILLING	DATE INSTALLED 11-13-87	BORING DIAMETER 6"
WELL DIAMETER 2"	WELL MATERIAL SCH. 40, 304 STAINLESS STEEL	BACKFILL MATERIAL GRADED QUARTZITE



WELL INSTALLATION DETAILS

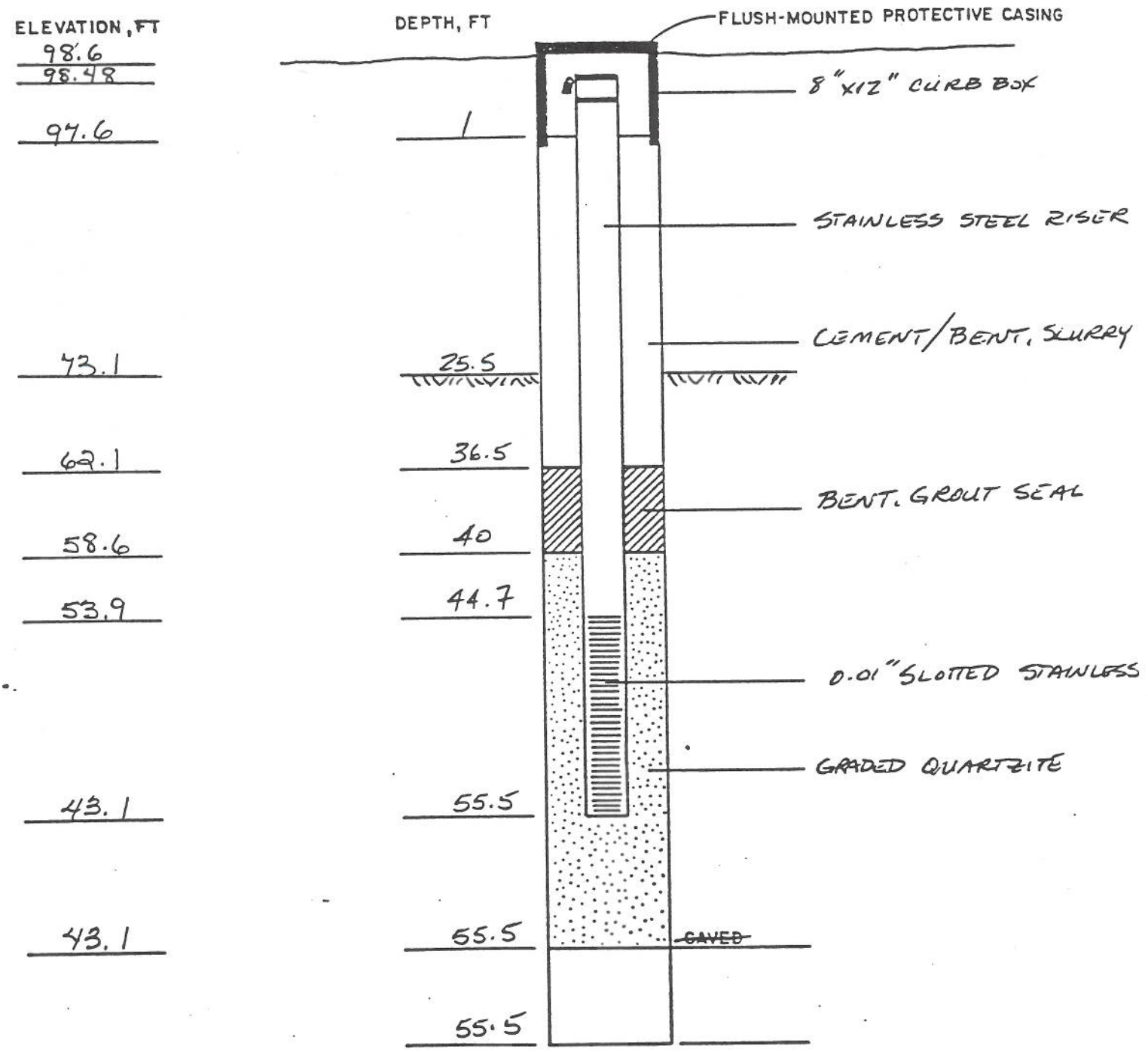
PROJECT NO. 4945-03	PROJECT NAME NYSEG MECHANICVILLE TASK 3	WELL NO. MW-12
INSTALLED BY NORTH STAR DRILLING	DATE INSTALLED 11-18-87	BORING DIAMETER 6"
WELL DIAMETER 2"	WELL MATERIAL SCH 40, 304 STAINLESS STEEL	BACKFILL MATERIAL GRADED QUARTZITE



* Riser is slightly above the ground surface

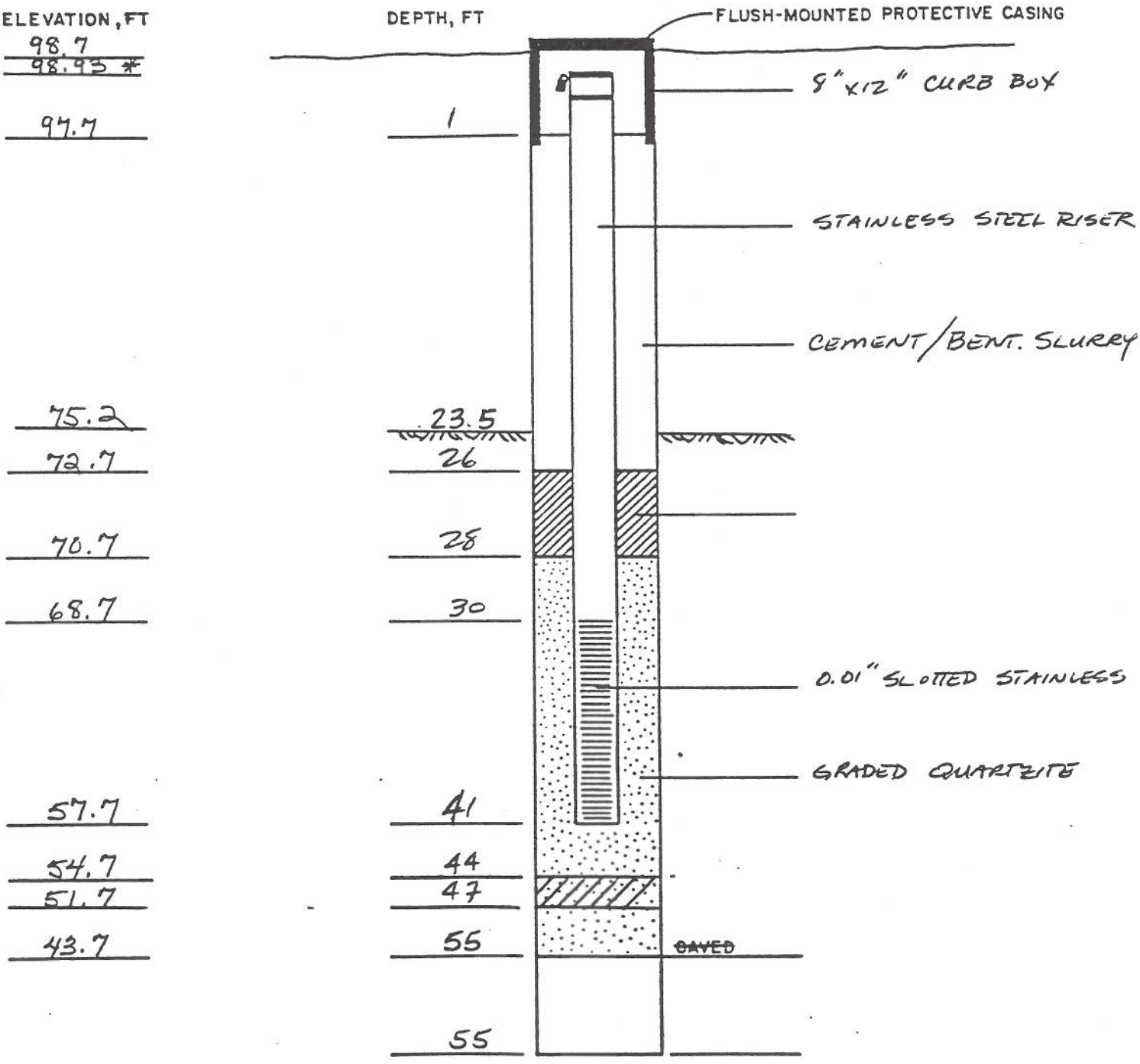
WELL INSTALLATION DETAILS

PROJECT NO. 4945-03	PROJECT NAME NYSEG MECHANICVILLE TASK 3	WELL NO. MW-13
INSTALLED BY NORTH STAR DRILLING	DATE INSTALLED 11-18-87	BORING DIAMETER 10" Soil / 4" & 3" IN Rock
WELL DIAMETER 2"	WELL MATERIAL Sch. 40, 304 STAINLESS STEEL	BACKFILL MATERIAL GRADED QUARTZITE



WELL INSTALLATION DETAILS

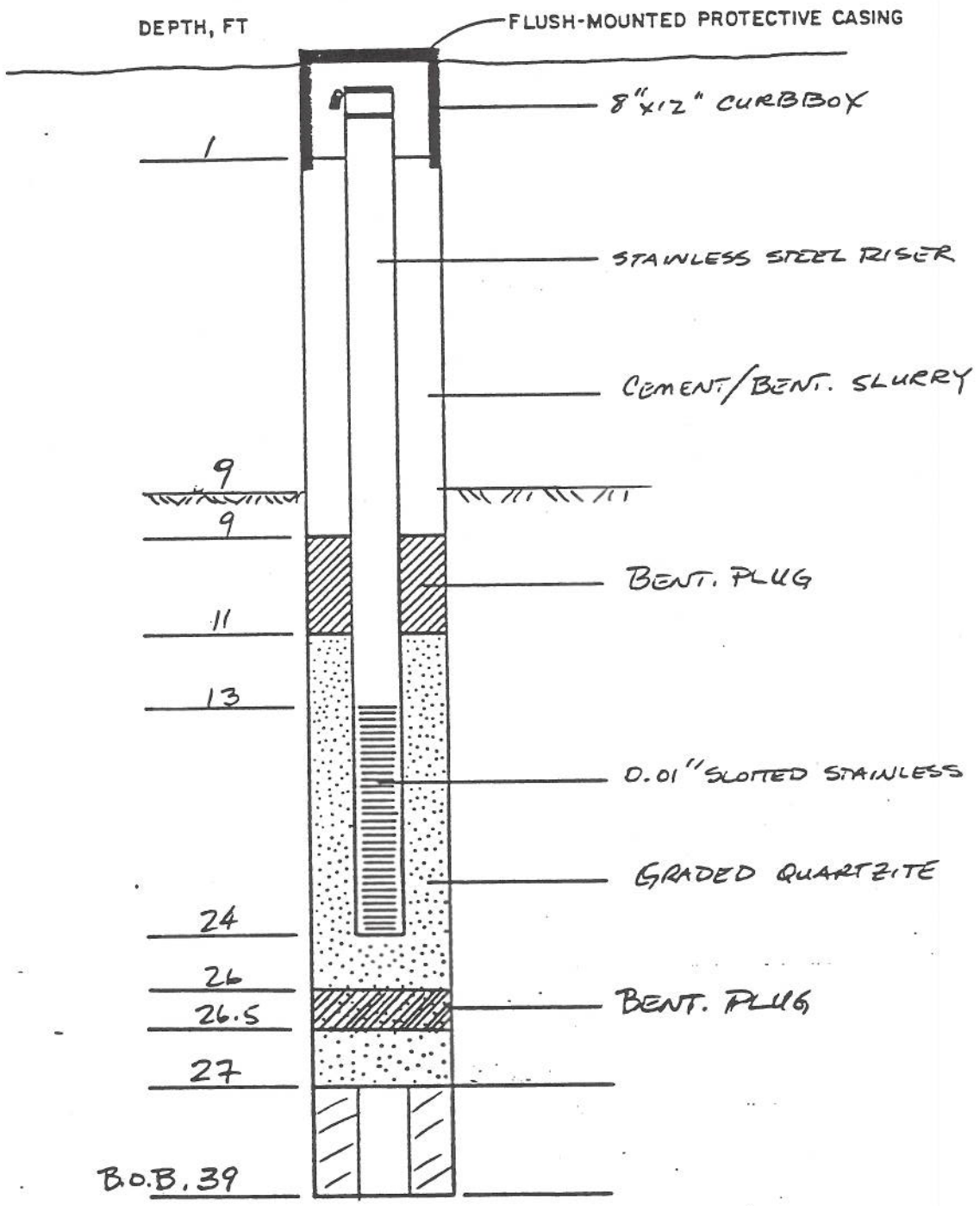
PROJECT NO. 4945-03	PROJECT NAME NYSEG MECHANICVILLE TASK 3	WELL NO. MW-14
INSTALLED BY NORTH STAR DRILLING	DATE INSTALLED 11-19-87	BORING DIAMETER 11" SOIL 4" & 3" IN ROCK
WELL DIAMETER 2"	WELL MATERIAL SCH 40, 304 STAINLESS STEEL	BACKFILL MATERIAL GRADED QUARTZITE



* Riser is slightly higher than the ground surface.

WELL INSTALLATION DETAILS

PROJECT NO. 4945-03	PROJECT NAME NYSEG MECHANICVILLE TASK 3	WELL NO. MW-15
INSTALLED BY NORTH STAR DRILLING	DATE INSTALLED 11-17-87	BORING DIAMETER 10" Soil / 4" ⌀ 3" in Rock
WELL DIAMETER 2"	WELL MATERIAL SCH 40, 304 STAINLESS STEEL	BACKFILL MATERIAL GRADED QUARTZITE



EC JORDAN CO

Appendix B-3

Permeability and Discharge Test Methods and Calculations

PERMEABILITY TEST METHODS

FALLING HEAD METHOD

In this method, an excess head is created in the monitoring well/piezometer by adding a volume of water which is then allowed to seep into the soil. Measurements are made of the water level in the monitoring well/piezometer over a given period of time. These measurements are continued until the rate of decrease or excess head becomes small.

RISING HEAD METHOD

In this method, water is removed from the monitoring well/piezometer and the rate of rise of the water level is observed until the rate of rise in water level becomes small.

PACKER TEST METHOD

This method is used to test the permeability of bedrock. Water is introduced under pressure to the borehole through tubing that discharges the water into a subsurface interval isolated by inflatable plugs. This allows water to seep only into the bedrock zone of interest. A flow meter was used to make measurements of the amount of water that the formation accepts.

PERMEABILITY DATA SHEET
EXAMPLE CALCULATION - FALLING HEAD TEST
MECHANICVILLE SITE

TYPE OF TEST: Falling head

Equation: $$K_h = \frac{(d^2)\ \ell n\ \frac{2mL}{D}}{8L\ (t_2 - t_1)} \times \ell n\ \frac{H_1}{H_2}$$ For uniform soil conditions

Test Data for MW-1:

m	=	Transformation Ratio = 1
L	=	Length of monitored zone = 12.1 feet = 368.8 cm
D	=	Diameter of borehole = 7.5 inches = 19.05 cm
d	=	Diameter of well pipe = 2 inches = 5.08 cm
t_1	=	Time when flow rate begins to stabilize = 50 seconds
H_1	=	Head at t_1 = 0.61 feet
t_2	=	Time when flow rate stabilization drops = 180 seconds
H_2	=	Head at t_2 = 0.03 feet

PERMEABILITY DATA SHEET
EXAMPLE CALCULATION - RISING HEAD TEST
MECHANICVILLE SITE

TYPE OF TEST: Rising head

Equation: $K_h = \frac{(d^2)\ \ell n\ \frac{2mL}{D}}{8L\ (t_2 - t_1)} \times \ell n\ \frac{H_1}{H_2}$ For uniform soil conditions

Test Data for MW-11:

m = Transformation Ratio = 1
L = Length of monitored zone = 5.5 feet = 167.64 cm
D = Diameter of borehole = 6 inches = 15.24 cm
d = Diameter of well pipe = 2 inches = 5.08 cm
t_1 = Time when flow rate begins to stabilize = 100 seconds
H_1 = Head at t_1 = 1.49 feet = 45.42 cm
t_2 = Time when flow rate stabilization drops = 390 seconds
H_2 = Head at t_2 = 0.61 feet = 18.59 cm

PERMEABILITY DATA SHEET
EXAMPLE CALCULATION - PACKER TEST
MECHANICVILLE SITE

TYPE OF TEST: Packer Test

Equation: $K_h = \frac{Q}{2\Pi\ L\ H}\ \ell n\ \frac{L}{r}$ $\quad L \geq 10r$

Test Data for MW-13:

Q = Constant rate of flow into the borehole = 7.4 gal/min = 481 cm^3/sec
L = Length of test section = 13 feet = 396.24 cm
H = Differential head on test section = 1,597.2 cm
r = Radius of the borehole = 2 inches = 5.08 cm

PERMEABILITY TEST RESULTS
MECHANICVILLE SITE

STRATA TESTED	APPROXIMATE DEPTH OF TEST INTERVAL[1]	TEST LOCATION	TYPE TEST	HYDRAULIC CONDUCTIVITY cm/sec	HYDRAULIC CONDUCTIVITY ft/day	REMARKS
Task 2 Wells						
Fill, Natural Soil, Weathered & Unweathered Rock	7'-19'	MW-1	In Situ	9.5×10^{-4}	2.7	Falling Head
Fill, Natural Soil, Weathered & Unweathered Rock	4'-16'	MW-2	In Situ	1.1×10^{-3}	3.1	Falling Head
Fill, Weathered Rock	2.5'-9'	MW-3	In Situ	1.6×10^{-4}	0.45	Falling Head
Fill, Weathered & Unweathered Rock	5'-16.5'	MW-4	In Situ	1.9×10^{-4}	0.54	Falling Head
Fill, Natural Soil, Weathered & Unweathered Rock	6.5'-19.5'	MW-5	In Situ	5.4×10^{-4}	1.5	Falling Head
Weathered & Unweathered Rock	21.5'-31.5'	MW-6	In Situ	7.5×10^{-5}	0.21	Falling Head
Unweathered Rock	25'-30'	MW-6	In Situ	1.8×10^{-4}	0.51	Packer Test (15 psi)
Unweathered Rock	25'-30'	MW-6	In Situ	2.0×10^{-4}	0.57	Packer Test (30 psi)
Task 3 Wells						
Natural Soil, Weathered Rock	7'-20'	MW-10	In Situ	2.2×10^{-5}	0.06	Rising Head
Unweathered Rock	6'-18'	MW-11	In Situ	2.0×10^{-4}	0.57	Rising Head
Natural Soil	12.5'-25.5'	MW-12	In Situ	4.0×10^{-4}	1.10	Rising Head
Unweathered Rock	40'-55.5'	MW-13	In Situ	3.0×10^{-4}	0.72	Rising Head
Unweathered Rock	28'-55'	MW-14	In Situ	2.0×10^{-4}	0.57	Rising Head

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PERMEABILITY TEST RESULTS
MECHANICVILLE SITE
(continued)

STRATA TESTED	APPROXIMATE DEPTH OF TEST INTERVAL[1]	TEST LOCATION	TYPE TEST	HYDRAULIC CONDUCTIVITY cm/sec	HYDRAULIC CONDUCTIVITY ft/day	REMARKS
Unweathered Rock	11'-39'	MW-15	In Situ	1.0×10^{-4}	0.28	Rising Head
Unweathered Rock	32.5'-45.5'	MW-13	In Situ	5.0×10^{-4}	1.4	Packer Test (15 psi)
Unweathered Rock	32.5'-45.5'	MW-13	In Situ	9.0×10^{-4}	2.6	Packer Test (30 psi)
Unweathered Rock	27'-35'	MW-14	In Situ	9.0×10^{-4}	2.6	Packer Test (10 psi)
Unweathered Rock	27'-35'	MW-14	In Situ	4.0×10^{-4}	1.1	Packer Test (20 psi)
Unweathered Rock	35'-45'	MW-14	In Situ	2.0×10^{-4}	0.57	Packer Test (15 psi)
Unweathered Rock	35'-45'	MW-14	In Situ	2.0×10^{-4}	0.57	Packer Test (30 psi)
Unweathered Rock	13'-21'	MW-15	In Situ	4.0×10^{-4}	1.1	Packer Test (10 psi)
Unweathered Rock	13'-21'	MW-15	In Situ	4.0×10^{-4}	1.1	Packer Test (20 psi)
Unweathered Rock	21'-29.5'	MW-15	In Situ	1.0×10^{-4}	0.28	Packer Test (15 psi)
Unweathered Rock	21'-29.5'	MW-15	In Situ	1.0×10^{-4}	0.28	Packer Test (30 psi)
Unweathered Rock	29.5'-39'	MW-15	In Situ	2.6×10^{-5}	0.07	Packer Test (15 psi)
Unweathered Rock	29.5'-39'	MW-15	In Situ	1.4×10^{-5}	0.04	Packer Test (30 psi)

[1] For rising and falling head tests, interval defined from bottom of borehole to bottom of well seal; zone of influence may be larger or smaller due to hydraulic characteristics of formation.

EXAMPLE CALCULATION
SITE GROUNDWATER DISCHARGE TO THE ANTHONY KILL
MECHANICVILLE SITE

$Q = KiA$

For Mechanicville Site:

Q = groundwater discharge, ft^3/day

K = geometric mean hydraulic conductivity = 0.28 ft/day (silty shale) and 1.1 ft/day (shallow bedrock)

i = groundwater gradient = 0.06 ft/ft

A = aquifer cross sectional area = 200 ft^2 (site length = 200 ft; saturated aquifer thickness = 10 ft)

Q (silty shale) = 33.6 ft^3/day or 0.0004 cfs

Q (shallow bedrock) = 132 ft^3/day or 0.002 cfs

Calculated site groundwater discharge to the Anthony Kill is less than 0.003 cfs.

Appendix C

C-1 Groundwater Level Data

C-2 Monitoring Well Sampling Procedures

Appendix C-1

Groundwater Level Data

GROUNDWATER LEVEL DATA
MECHANICVILLE SITE

LOCATION	GROUND ELEVATION (Ft.-Relative[1])	RISER ELEVATION (Ft.-Relative[1])	WATER ELEVATION (Ft. Relative[1]) 8/5/86	9/9/86	12/2/86	3/10/87	6/2/87	12/22/87	3/29/88
MW-1	95.9	98.6	87.3	87.3	87.6	88.4	87.4	87.5	87.4
MW-2	91.6	91.3	88.1	88.9	89.0	89.0	88.4	88.8	88.8
MW-3	87.4	87.3	NA	84.6	85.1	85.7	83.6	85.1	85.6
MW-4	91.0	90.6	86.8	87.1	88.1	88.1	87.6	NM[2]	87.9
MW-5	88.4	87.9	78.4	78.2	78.9	NM	79.9	NM	79.1
MW-6	91.0	90.7	86.8	86.9	86.9	87.7	87.2	87.7	87.6
P-1	92.5	95.0	85.7	85.5	86.7	86.40	85.5	85.8	86.2
P-2	95.2	98.8	87.1	86.9	87.6	89.70	86.9	87.2	87.4
P-3	91.8	91.8	88.6	89.7	91.8	89.30	88.5	NM	89.0
MW-10	96.7	96.5						85.9	85.4
MW-11	92.1	91.4						87.5	87.6
MW-12	98.3	98.5						84.7	84.4
MW-13	98.6	98.5						82.6	82.8
MW-14	98.7	98.9						82.5	82.4
MW-15	88.5	88.2						80.3	81.0
Bridge[3]		86.3						77.7	78.8

NOTES:

[1] Elevation is relative to the assumed datum used to prepare the survey (see Appendix A-7).
[2] NM = Not measured due to well inaccessibility or heavy contamination.
[3] Surface water elevation of Anthony Kill at bridge.

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Appendix C-2

Monitoring Well Sampling Procedures

MONITORING OF GROUNDWATER WELLS

1. Check the well for proper identification and location.

2. Measure and record the height of protective casing.

3. After unlocking the well and removing any well caps, measure and record the ambient and well-mouth organic vapor levels using the photoionization meter. If organic vapor levels at breathing height reach 5 ppm, the sampler shall utilize the appropriate safety equipment as described in the Health and Safety Plan.

4. Using the electronic water level meter, measure and record the static water level in the well to the nearest 0.01 foot. Measure also the depth to the well bottom from a constant reference point on the top of the well riser. Upon removing the water level wire, rinse it with laboratory-grade isopropanol or ethanol and then distilled water.

5. Calculate the volume of stagnant water in the well casing. Volume in liters equals 0.154 times the square of the inside diameter of the casing (in inches) times the depth of water (in feet).

SAMPLING OF GROUNDWATER MONITORING WELLS

Following the measurements and calculations described above, sampling will commence in the sequence below:

1. Lower the submersible pump or peristaltic pump intake into the well. For shallow groundwater situations, the intake of the suction tubing or of the submersible pump will be lowered to the top of the well screen and the well purged three to five times the calculated volume. Alternatives to this procedure may be necessary if one of the following conditions exist:

   a. If the well screen is very large, making pumping from the top impractical, the suction line or submersible pump should be lowered to the approximate mid-point of the screened portion of the well.

   b. If the well is situated in tight formations such as tills, clays or rock, the purging of the well should be performed from very near the bottom of the well screen. This will facilitate complete removal of standing well water.

2. Connect the instrumentation header to the pump discharge and begin flushing the well. Monitor the in situ parameters (pH, Eh, temperature, and specific conductivity) and measure the volume of groundwater being pumped. Alternately, in situ parameters may be monitored in a beaker filled from the pump discharge. Purging of the standing well water is considered complete when one of the following is achieved:

   a. at least three well volumes have been purged and in situ parameters stabilized, or

b. five well volumes have been purged, or

c. the well has been pumped dry.

3. Record the in situ parameters.

4. After purging, lower the pump intake or bailer, as appropriate for the parameters of concern (i.e. bailer for volatiles; and bailer, peristaltic or submersible pump for all other parameters) to the middle of the screened interval. If the analysis to be performed is for lighter-than-water chemical species, then the pump or bailer should be lowered to the top of the water column for sample collection.

5. Collect the sample(s).

   Volatile and semi-volatile samples are filled directly from the bailer with as little agitation as possible.

   Other samples will be placed directly into the appropriate container from the discharge tubing of the pump or bailer. Where filtration is required, an in-line filter should be used, if possible. Vacuum filtration is an alternative to an in-line device (see attached Table).

6. Remove the pump from the well and decontaminate the pump and tubing by flushing with isopropanol; up to one gallon of the solvent is used as needed. Rinse the pump and tubing with one liter of distilled water for every 40 feet of tubing.

7. Complete sample data records after each well is sampled.

8. Secure the well cap and lock.

STANDARD FIELD FILTRATION PROCEDURES

A. IN-LINE FILTRATION

EQUIPMENT

1. A portable 102-mm acrylic backflushing filter unit
2. 102-mm diameter filter papers, 0.45 µm membrane filters
3. Reagent rinse water (ASTM Type II or better)
4. 20% v/v nitric acid rinse solution

PROCEDURES

1. Attach in-line filter assembly, after assembling filter paper into filter holder, to discharge line of sampling pump. Open by-pass valve completely.
2. Turn sampling pump on, slowly turn by-pass valve closed, allowing flow into the filter. Remove trapped air through the filter bleed valve, if necessary.
3. Discard the initial 100 mℓ ± of filtrate. Collect subsequent filtrate into sample bottle.
4. Rinse barrel and filter holder assembly between samples with three rinses of reagent water. The rinse sequence when elemental parameters will be analyzed is: reagent water - 20% v/v nitric acid - reagent water.

B. VACUUM FILTRATION

EQUIPMENT

1. Two sets of either glass funnel type or self-contained polysulfone filters with sintered glass discs or polysulfone filter plates
2. 47-mm diameter filter papers, 0.45 µm membrane filters
3. Vacuum pump or ISCO peristaltic pump with silicone tubing
4. Reagent rinse water (ASTM Type II or better)
5. 20% v/v nitric acid rinse solution

PROCEDURES

1. Thoroughly rinse sintered glass disc, filter funnel, and stem or polysulfone filter units with reagent water.
2. On the basis of visual clarity of sample, prefiltering with larger pore filters may be required. If sample has a heavy clay content, organics, or suspended matter, prefiltration through a 3.0- or 5.0-µm membrane filter may be necessary.
3. Place membrane filter on filter holder with minimum handling.
4. Attach filter holder with filter to filter funnel and receiver.
5. Swirl and slowly pour sample bottle into filter funnel.
6. Attach suction tubing to filter flask and vacuum pump (or ISCO pump). Pump is turned on in the vacuum mode.
7. Filter a small portion of the sample and discard filtrate after rinsing flask with sample filtrate.
8. If prefiltering was required, pass sample through a 0.45-µm membrane filter using another filtering apparatus.
9. Transfer filtered sample to appropriate bottles.
10. Rinse filtration equipment between samples with at least three rinses of reagent water. The rinse sequence, when elemental parameters are to be analyzed, is: reagent water - 20% v/v nitric acid - reagent water.

C. PRESSURE FILTRATION

EQUIPMENT

1. Pressure filter apparatus consisting of 1 liter barrel filter, filter holder and pressure hose connectors
2. Source of pressurized gas, i.e., tank of nitrogen, argon, etc.
3. 147 mm filter papers, 0.45 µm membrane filter
4. Reagent rinse water (ASTM Type II or better)
5. 20% v/v nitric acid rinse solution

PROCEDURES

1. If filter barrel has sample valve, assemble filter assembly with 0.45 µm membrane filter and attach pressure hose.
2. If filter barrel does not have a sample valve, assemble filter paper on filter holder.
3. Turn barrel upside down and pour sample into barrel.
4. Place filter holder and filter onto barrel assembly, making sure to align O-ring for a positive seal.
5. Attach swing-away bolts and tighten hand-tight.
6. Turn over filter assembly and attach pressure hose assembly.
7. Slowly turn on pressurized gas and increase pressure regulator to a maximum of 20 psi.
8. Collect filtrate from bottom of barrel assembly.
9. Rinse barrel and filter holder assembly between samples with three rinses of reagent water. The rinse sequence when elemental parameters will be determined is: reagent water - 20% v/v nitric acid - reagent water.

Appendix D

D-1 Analytical Methods and Representative Waste Characterization

D-2 Analytical Data for Quality Assurance Samples

D-3 Analytical Data for Laboratory Quality Control Samples

D-4 Minimum Detection Limits for Task 2 and Task 3 Laboratory Data

D-5 Task 4 Surface Soil Data Laboratory Results

Appendix D-1

Analytical Methods and Representative Waste Characterization

TABLE D-1-1

ANALYTICAL METHODS[1]
TASK 2
MECHANICVILLE SITE

Analytical Parameter	Soils and Sediments	Groundwater and Surface Water
Volatile Organic Compounds	Method 8020 with confirmatory analysis of 2 soil samples and one round of sediments using Method 8240	Method 602 for Round 1 samples; Method 624 for subsequent sampling rounds
Semi-Volatile Organic Compounds	Method 8310 with confirmatory analysis of 2 soil samples and one round of sediments using Method 8270	Method 610 for Round 1 samples; Method 625 for subsequent sampling rounds
Cyanide - Total and Ferro-Ferricyanide	Method 9010	Method 335.2
Total Organic Carbon	Method 9060	Method 415.1
Total Phenolics	Method 420.1	Method 420.1
Iron and Zinc	Method 200.7 with 3050	Method 200.7

[1] Method numbers refer to USEPA methods (USEPA, 1983) unless otherwise noted.

TABLE D-1-2

ANALYTICAL METHODS[1]
TASK 3
MECHANICVILLE SITE

Analytical Parameter	Soil and Sediment	Groundwater and Surface Water
Volatile Organic Compounds	Method 8240	Method 624
Semi-Volatile Organic Compounds	Method 8270	Method 625
Cyanide - Total	Method 9010	Method 335.2
Total Organic Carbon	Method 9060	Method 415.1
Total Phenolics	Method 420.1	Method 420.1
Iron and Zinc	Method 200.7 with 3050	Method 200.7

[1] Method numbers refer to USEPA methods unless otherwise noted (USEPA, 1983).

ORGANIC COMPOUNDS IN COAL TAR STORAGE VESSELS
ITHACA-COURT STREET SITE

	Coal Tar Samples		Aqueous Sample
	Vessel A[1]	Vessel B[2]	Vessel B
Volatile Organics	(mg/kg)	(mg/kg)	(mg/ℓ)
Minimum Detection Limit (MDL)	(10)	(48)	(0.002)
Volatile Aromatics			
Benzene	1,900	1,800	80.0
Toluene	2,200	2,600	33.0
Ethylbenzene	120	140	ND[3]
Total Xylene	2,200	1,900	5.6
Styrene	910	1,100	4.2
Total Volatiles	7,330	7,540	122.8
Semivolatile Organics			
Minimum Detection Limit (MDL)	(1,500)	(2,800)	(1.6)
PAH			
Acenaphthene	T[4]	T	ND
Acenaphthylene	10,000	33,000	T
Anthracene	7,800	16,000	ND
Benzo(a)anthracene	4,200	5,600	ND
Benzo(a)pyrene	4,000	5,200	ND
Benzo(g,h,i)perylene	T	T	ND
Benzo(k)fluoranthene) coeluted Benzo(b)fluoranthene)	5,200	4,900	ND
Chrysene	4,300	6,300	ND
Dibenzo(a,h)anthracene	T	T	ND
Fluoranthene	12,000	16,000	ND
Fluorene	5,400	15,000	ND
Indeno(1,2,3-cd)pyrene	T	T	ND
Naphthalene	55,000	180,000	ND
Phenanthrene	24,000	40,000	ND
Pyrene	12,000	10,000	ND
Other			
Phenol	2,700	T	48.0
2,4-Dimethylphenol	ND	ND	2.6
2,4-Dichlorophenol	T	ND	ND
Total Semivolatiles	146,600	332,000	50.6

[1] Vessel A is located adjacent to Markles Flats.
[2] Vessel B is located next to the swimming pool.
[3] ND = Not Detected
[4] T = Detected in trace concentrations at or below the MDL.

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METALS, TOTAL ORGANIC HALIDES, AND IGNITABILITY
RESULTS FOR COAL TAR STORAGE VESSEL SAMPLES
ITHACA-COURT STREET SITE

	Coal Tar Samples		Aqueous Sample
	Vessel A[1]	Vessel B[2]	Vessel B
EP Toxicity Metals[3]	(mg/ℓ)	(mg/ℓ)	(mg/ℓ)
Ag	ND	ND	0.0033
As	0.39[4]	2.1[4]	0.014
Ba	ND	ND	0.140
Cd	ND	ND	ND
Cr	ND	ND	0.015
Hg	ND	ND	0.0002
Pb	ND	3.7[4]	0.028
Se	ND	ND	ND
Other Metals			
Cu	ND	ND	0.023
Ni	ND	ND	0.011
Ti	1.7[4]	1.8[4]	ND
Zn	0.31[4]	1.4[4]	0.065
Total Organic Halides	(mg/kg)	(mg/kg)	(mg/ℓ)
TOX, as Chlorine	830	870	0.39
Ignitability	(°F)	(°F)	
Flash Point	99	81	NA[2]

[1] ND = Not Detected
[2] NA = Not Analyzed
[3] Metals in coal tar samples were analyzed following extraction procedure (EP).
[4] EP toxicity limits for the detected metals are: As and Pb, 5 mg/ℓ; Ti and Zn, none specified.

AN ANALYSIS OF SPENT OXIDE WASTES[1]

Component	Percent
Free sulfur	44.70
Moisture	17.88
Ferric monohydrate	5.26
Ferrous monohydrate	6.25
Basic ferric sulfate	1.25
Ferric ammonium ferrocyanide	3.80
Ferrosoferric ammonium ferrocyanide	2.50
Ferric pyridic ferrocyanide	1.20
Organic matter peat fiber	4.68
Tar	1.21
Silica	1.05
Naphthalene	0.72
Pyridine sulfate	0.77
Ammonium sulfate	2.06
Calcium sulfate	0.12
Ferrous sulfate	0.02
Ammonium thiocyanate	1.30
Sulfur otherwise combined	1.33
Ogranic matter soluble in alkalies (humus)	1.54
Combined water and loss (by difference)	2.36
	100.00

[1] Utility Solid Waste Activities Group (USWAG), 1984. Handbook on Manufactured Gas Plant Sites. Prepared by Environmental Research and Technology, Inc. and Koppers Co., Inc., for the USWAG Superfund Committee, Washington, D.C. p. 3-46.

Appendix D-2

Analytical Data for Quality Assurance Samples

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TABLE D-2-1
CHEMICALS FOUND IN TASK 2 QUALITY ASSURANCE SAMPLES
MECHANICVILLE SITE

SITE IDENTIFIER	SAMPLER BLANK				TRIP BLANK				FILTRATION BLANK			
SAMPLE IDENTIFIER	SB-101	SB-201	SB-301	SB-401	TB-101	TB-201	TB-301	TB-401	FB-101	FB-201	FB-301	FB-401
ORGANICS ANALYSIS (1)	HPLC	GC/MS	GC/MS	GC/MS	HPLC	GC/MS	GC/MS	GC/MS	HPLC	HPLC	HPLC	HPLC
DATE OF SAMPLE COLLECTION	9/9/86	12/2/86	3/10/87	6/2/87	9/9/86	12/2/86	3/10/87	6/2/87	9/9/86	12/2/86	3/10/87	6/2/87
VOLATILE ORGANICS (MG/L)												
-VOLATILE AROMATICS-												
BENZENE	ND (2)	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
TOLUENE	ND	ND	ND	ND	ND	0.006	ND	ND	--	--	--	--
ETHYLBENZENE	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
STYRENE	ND	ND	ND	ND	ND	ND	ND	ND	--	--	--	--
TOTAL XYLENE	-- (3)	ND	ND	ND	--	ND	ND	ND	--	--	--	--
o - XYLENE	ND	--	--	--	ND	--	--	--	--	--	--	--
o - XYLENE	ND	--	--	--	ND	--	--	--	--	--	--	--
p - XYLENE	ND	--	--	--	ND	--	--	--	--	--	--	--
TRIMETHYLBENZENE	ND	--	--	--	ND	--	--	--	--	--	--	--
-OTHER-												
ACETONE	--	0.0438	ND	ND	--	ND	0.0242	ND	--	--	--	--
METHYLENE CHLORIDE	--	ND	ND	0.006	--	(4)	0.0095	ND	--	--	--	--
TOTAL VOLATILE AROMATICS	ND	ND	ND	ND	ND	0.006	ND	ND	--	--	--	--
SEMIVOLATILE ORGANICS (MG/L)												
-PAH-												
ACENAPHTHENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
ACENAPHTHYLENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
ANTHRACENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
BENZO(b)FLUORANTHENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
BENZO(k)FLUORANTHENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
BENZO(g,h,i)PERYLENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
BENZO(a)ANTHRACENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
BENZO(a)PYRENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
CHRYSENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
DIBENZO(a,h)ANTHRACENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
FLUORANTHENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
FLUORENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
INDENO(1,2,3,-cd)PYRENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
NAPHTHALENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
PHENANTHRENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
PYRENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
-OTHER-												
BIS(2-ETHYLHEXYL)PHTHALATE	--	--	0.015	0.006	--	--	--	--	--	--	--	--
2-METHYLNAPTHALENE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
TOTAL PAH	ND	ND	ND	ND	--	--	--	--	--	--	--	--

TABLE D-2-1 (continued)

CHEMICALS FOUND IN TASK 2 QUALITY ASSURANCE SAMPLES
MECHANICVILLE SITE

SITE IDENTIFIER	SAMPLER BLANK				TRIP BLANK				FILTRATION BLANK			
SAMPLE IDENTIFIER	SB-101	SB-201	SB-301	SB-401	TB-101	TB-201	TB-301	TB-401	FB-101	FB-201	FB-301	FB-401
ORGANICS ANALYSIS (1)	HPLC	GC/MS	GC/MS	GC/MS	HPLC	GC/MS	GC/MS	GC/MS	HPLC	HPLC	HPLC	HPLC
DATE OF SAMPLE COLLECTION	9/9/86	12/2/86	3/10/87	6/2/87	9/9/86	12/2/86	3/10/87	6/2/87	9/9/86	12/2/86	3/10/87	6/2/87
OTHER CHEMICALS (MG/L)												
-METALS-												
IRON	ND	ND	0.09	ND	--	--	--	--	ND	ND	ND	ND
ZINC	ND	0.012	ND	ND	--	--	--	--	ND	0.014	ND	ND
-CYANIDE-												
TOTAL CYANIDE	ND	ND	ND	ND	--	--	--	--	--	--	4	--
AMENAPLE CYANIDE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
FERRO-FERRI CYANIDE	ND	ND	ND	ND	--	--	--	--	--	--	--	--
-OTHER-												
TOTAL RECOVERABLE PHENOLICS	0.012	--	--	ND	--	--	--	--	--	--	--	--
TOTAL ORGANIC CARBON	ND	1	2.3	1.0	--	--	--	--	ND	1	4.1	2.8
SULFATE	--	4.0	--	--	--	--	--	--	--	4.0	--	--

NOTES:
(1) INDICATES WHETHER SAMPLE VALUES WERE OBTAINED BY GC/MS OR HPLC METHODS.
(2) ND = NOT DETECTED (SEE APPENDIX B-4 FOR MINIMUM DETECTION LIMITS).
(3) -- = NOT ANALYZED
(4) TRACE CONCENTRATIONS DETECTED BELOW THE QUANTIFIABLE REPORTING LIMIT.

TABLE D-2-2

Chemicals Detected in Task 3 Quality Assurance Samples
Mechanicville Site

SAMPLE TYPE:	------FILTRATION BLANK------		------SAMPLER BLANK------	
SAMPLE IDENTIFIER:	FB-01	FB-01	SB-01	SB-01
DATE OF SAMPLE COLLECTION:	12/22/87	3/29/88	12/22/87	3/29/88
**** Volatile Organics (mg/l) ****				
-VOLATILE AROMATICS-	NR	NR	ND	ND
-OTHER-				
Acetone	NR	NR	0.16	ND
Chlorobenzene	NR	NR	ND	ND
Total Volatile Aromatics	NR	NR	ND	ND
Total Volatile Organics	NR	NR	0.16	ND
**** Semi-Volatile Organics (mg/l) ****				
-PAH-	NR	NR	ND	ND
-OTHER-				
Phenol	NR	NR	ND	ND
bis (2-Ethylhexyl) Phthalate	NR	NR	ND	ND
Total PAH	NR	NR	ND	ND
Total Semi-Volatile Organics	NR	NR	ND	ND
**** Other Chemicals (mg/l) ****				
-METALS-				
Iron	ND	ND	0.24	ND
Zinc	ND	0.02	ND	ND
-CYANIDE-	NR	NR	ND	ND
-OTHER-				
Total Recoverable Phenolics	NR	NR	ND	0.009
Total Organic Carbon	3.8	4.9	2.1	1.2

NOTES:

(1) Trace concentrations detected below the quantifiable reporting limit.
ND = Not Detected.
NR = Not Requested.

TABLE D-2-2 (continued)

Chemicals Detected in Task 3 Quality Assurance Samples
Mechanicville Site

SAMPLE TYPE:	------TRIP BLANK------	
SAMPLE IDENTIFIER:	TB-01	TB-01
DATE OF SAMPLE COLLECTION:	12/22/87	3/29/88
** Volatile Organics (mg/l) **		
-VOLATILE AROMATICS-	ND	ND
-OTHER-		
Acetone	ND	
Chlorobenzene	ND	(1)
Total Volatile Aromatics	ND	ND
Total Volatile Organics	ND	ND
** Semi-Volatile Organics (mg/l) **		
-PAH-	NR	NR
-OTHER-		
Phenol	NR	NR
bis (2-Ethylhexyl) Phthalate	NR	NR
Total PAH	NR	NR
Total Semi-Volatile Organics	NR	NR
** Other Chemicals (mg/l) **		
-METALS-		
Iron	NR	NR
Zinc	NR	NR
-CYANIDE-	NR	NR
-OTHER-		
Total Recoverable Phenolics	NR	NR
Total Organic Carbon	NR	NR

NOTES:

(1) Trace concentrations detected below the quantifiable reporting limit.
ND = Not Detected.
NR = Not Requested.

Appendix D-3

Analytical Data for Laboratory Quality Control Samples
(To be Provided Under Separate Cover)

Appendix D-4

Minimum Detection Limits for Task 2 and Task 3 Laboratory Data

01/19/88

TABLE D-4-1
MINIMUM DETECTION LIMITS
MECHANICVILLE SITE

#TEST PITS (MG/KG)#

SAMPLE IDENTIFIER	TP-1/S-1	TP-2/S-1	TP-4/S-1	TP-5/S-1	TP-5/S-1 DUP	TP-5/S-1 GC/MS
VOLATILE AROMATICS	0.022	0.051	0.024	0.099	0.094	0.096
ACETONE	-- (2)	--	--	--	--	2.4
METHYLENE CHLORIDE	--	--	--	--	--	0.2
CARBON DISULFIDE	--	--	--	--	--	0.4
SEMIVOLATILE ORGANICS	0.043	11.0	5.7	78.0	93.0	13.0
IRON	10.0	10.0	10.0	10.0	10.0	--
ZINC	2.0	2.0	2.0	2.0	2.0	--
CYANIDE (1)	0.3	0.3	0.3	0.3	0.3	--
TOTAL RECOVERABLE PHENOLICS	0.2	0.2	0.2	0.2	0.2	--
TOTAL ORGANIC CARBON	100	100	100	100	100	--

#BORINGS (MG/KG)#

SAMPLE IDENTIFIER	B-1/S-1	B-2/S-1	B-3/S-1	B-4/S-1	B-5/S-1	B-7/S-1	B-8/S-1	B-8/S-1 GC/MS
VOLATILE AROMATICS	0.043	0.052	0.56	0.028	0.54	0.052	10.0	3.6
ACETONE	--	--	--	--	--	--	--	90.0
METHYLENE CHLORIDE	--	--	--	--	--	--	--	9.0
CARBON DISULFIDE	--	--	--	--	--	--	--	3.6
SEMIVOLATILE ORGANICS	5	0.55	170	24	54	0.65	61	130
IRON	10	10	10	10	10	10	10	--
ZINC	2	2	2	2	2	2	2	--
CYANIDE (1)	1	1	1	1	1	1	1	--
TOTAL RECOVERABLE PHENOLICS	1	1	1	1	1	1	1	--
TOTAL ORGANIC CARBON	1000	1000	1000	1000	1000	1000	1000	--

GROUNDWATER (MG/L)

SAMPLE IDENTIFIER ORGANICS ANALYSIS	MW-101 HPLC	MW-101 GC/MS	MW-201 GC/MS	MW-301 GC/MS	MW-401 GC/MS	MW-102 HPLC	MW-202 GC/MS	MW-202 GC/MS DUP	MW-302 GC/MS	MW-402 GC/MS	MW-103 HPLC	MW-103 GC/MS	MW-203 GC/MS	MW-303 GC/MS	MW-403 GC/MS
VOLATILE AROMATICS	0.001	0.002	0.005	0.010	0.005	0.001	0.005	0.005	0.010	0.005	0.050	0.020	0.250	0.010	0.050
ACETONE	--	0.010	0.010	0.010	0.010	--	0.010	0.010	0.010	0.010	--	0.500	0.500	0.010	0.100
METHYLENE CHLORIDE	--	0.050	0.050	0.010	0.005	--	0.050	0.050	0.010	0.005	--	0.050	0.250	0.010	0.050
SEMIVOLATILE ORGANICS	0.020	0.020	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.050	0.200	0.200	0.010	0.010	0.100
IRON	0.1	--	0.03	0.1	0.1	0.1	0.03	0.03	0.1	0.1	0.1	--	0.03	0.1	0.1
ZINC	0.01	--	0.005	0.02	0.020	0.01	0.005	0.005	0.02	0.02	0.01	--	0.005	0.02	0.02
CYANIDE (1)	0.01	--	0.01	0.02	0.010	0.01	0.01	0.01	0.02	0.01	0.01	--	0.01	0.02	0.01
TOTAL RECOVERABLE PHENOLICS	0.01	--	--	--	0.005	0.01	--	--	--	0.005	0.01	--	--	--	0.005
TOTAL ORGANIC CARBON	0.5	--	5	5	5	0.5	5	5	5	5	0.5	5	5	5	5
SULFATE	--	--	1	--	1	--	1	1	--	1	--	--	1	--	1

(1) TOTAL CYANIDE

TABLE D-4-1 (continued)

MINIMUM DETECTION LIMITS (1) (CONT'D)
MECHANICVILLE SITE

$GROUNDWATER (MG/L)$

SAMPLE IDENTIFIER ORGANICS ANALYSIS	MW-104 HPLC	MW-204 GC/MS	MW-304 GC/MS	MW-404 GC/MS	MW-105 HPLC	MW-205 GC/MS	MW-405 GC/MS	MW-405 GC/MS DUP	MW-106 HPLC	MW-106 HPLC DUP	MW-206 GC/MS	MW-306 GC/MS	MW-306 GC/MS DUP	MW-406 GC/MS
VOLATILE AROMATICS	0.050	0.050	0.010	0.050	0.010	0.100	0.050	0.050	0.050	0.050	0.250	0.010	0.010	0.050
ACETONE	--	0.100	0.010	0.100	--	0.200	0.100	0.100	--	--	0.500	0.010	0.010	0.100
METHYLENE CHLORIDE	--	0.050	0.010	0.050	--	0.100	8.500	8.500	--	--	0.250	0.010	0.010	0.050
SEMIVOLATILE ORGANICS	0.200	0.010	0.010	0.100	0.200	0.010	0.100	0.100	4.000	4.000	0.010	0.010	0.010	0.500
IRON	0.1	0.03	0.1	0.1	0.1	0.03	0.1	0.1	0.1	0.1	0.03	0.1	0.1	0.1
ZINC	0.01	0.005	0.02	0.02	0.01	0.005	0.02	0.02	0.01	0.01	0.005	0.02	0.02	0.02
CYANIDE (3)	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.01
TOTAL RECOVERABLE PHENOLICS	0.01	--	--	0.005	0.01	--	0.005	0.005	0.01	0.01	--	--	--	0.005
TOTAL ORGANIC CARBON	0.5	5	5	5	0.5	5	5	5	0.5	0.5	5	5	5	5
SULFATE	--	1	1	1	--	1	1	1	--	--	1	--	--	1

$SURFACE WATER (MG/L)$

SAMPLE IDENTIFIER ORGANICS ANALYSIS	SW-101 HPLC	SW-201 GC/MS	SW-301 GC/MS	SW-301 GC/MS DUP	SW-401 GC/MS	SW-102 HPLC	SW-202 GC/MS	SW-202 GC/MS DUP	SW-302 GC/MS	SW-402 GC/MS	SW-402 GC/MS DUP	SW-103 HPLC	SW-203 GC/MS	SW-303 GC/MS	SW-403 GC/MS
VOLATILE AROMATICS	0.001	0.005	0.010	0.010	0.005	0.001	0.005	0.005	0.010	0.005	0.005	0.001	0.005	0.010	0.005
ACETONE	--	0.010	0.010	0.010	0.010	--	0.010	0.010	0.010	0.010	0.010	--	0.010	0.010	0.010
METHYLENE CHLORIDE	--	0.005	0.010	0.010	0.005	--	0.005	0.005	0.010	0.005	0.005	--	0.005	0.010	0.005
SEMIVOLATILE ORGANICS	0.020	0.010	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.010	0.010	0.020	0.010	0.010	0.010
IRON	0.1	0.03	0.1	0.1	0.1	0.1	0.03	0.03	0.1	0.1	0.1	0.1	0.03	0.1	0.1
ZINC	0.01	0.005	0.02	0.02	0.02	0.01	0.005	0.005	0.02	0.02	0.02	0.01	0.005	0.02	0.02
CYANIDE (3)	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
TOTAL RECOVERABLE PHENOLICS	0.01	--	--	--	0.005	0.01	--	--	--	0.005	0.005	0.01	--	--	0.005
TOTAL ORGANIC CARBON	0.5	5	5	5	5	0.5	5	5	5	5	5	0.5	5	5	5
SULFATE	--	1	--	--	--	--	1	1	--	--	--	--	1	--	--

$SEDIMENTS (MG/KG)$

SAMPLE IDENTIFIER	SED-101	SED-201	SED-301 GC/MS	SED-301 DUP	SED-401 GC/MS	SED-102	SED-202	SED-202 DUP	SED-302 GC/MS	SED-402 GC/MS	SED-402 DUP	SED-103	SED-103 DUP	SED-203	SED-303 GC/MS	SED-403 GC/MS
VOLATILE AROMATICS	0.024	0.025	0.080	0.062	1.000	0.025	0.028	0.025	0.070	1.000	1.000	0.025	0.024	0.027	0.066	1.000
ACETONE	--	--	2.000	1.600	1.000	--	--	--	1.700	1.000	1.000	--	--	--	1.700	1.000
SEMIVOLATILE ORGANICS	0.420	0.360	1.100	1.100	0.600	0.410	0.510	0.900	0.940	0.600	0.600	0.500	0.520	0.310	0.990	0.600
IRON	0.1	9200	5	5	2	0.1	19000	16000	5	2	2	0.1	0.1	20000	5	2
ZINC	0.01	36	5	5	0.5	0.01	69	100	5	0.5	0.5	0.01	0.01	88	5	0.5
CYANIDE (3)	0.01	0.1	0.01	0.01	0.3	0.01	0.1	0.1	0.01	0.3	0.3	0.01	0.01	0.1	0.01	0.3
TOTAL RECOVERABLE PHENOLICS	0.01	0.01	0.01	0.01	0.2	0.01	0.01	0.01	0.01	0.2	0.2	0.01	0.01	0.01	0.01	0.2
TOTAL ORGANIC CARBON	0.5	4600	100	100	100	0.5	3500	7600	200	100	100	0.5	0.5	4600	100	100
SULFATE	--	32	--	--	--	--	32	32	5	--	--	--	--	32	--	--

(1) NOMINAL DETECTION LIMITS WERE USED WHEN MDLs WERE NOT REPORTED BY THE LABORATORY.
(2) -- NOT ANALYZED
(3) TOTAL CYANIDE

01/19/88

TABLE D-4-2
QUALITY ASSURANCE SAMPLES
MINIMUM DETECTION LIMITS (1)
MECHANICVILLE SITE

SITE IDENTIFIER	SAMPLER BLANK				TRIP BLANK				FILTRATION BLANK			
DATE OF SAMPLE COLLECTION	9/9/86	12/2/86	3/11/87	6/2/87	9/9/86	12/2/86	3/11/87	6/2/87	9/9/86	12/2/86	3/11/87	6/2/87
VOLATILE AROMATICS	0.001	0.005	0.010	0.005	0.001	0.005	0.010	0.005	-- (2)	--	--	--
ACETONE	0.002	0.010	0.010	0.010	0.002	0.010	0.010	0.010	--	--	--	--
METHYLENE CHLORIDE	0.001	0.005	0.010	0.005	0.001	0.005	0.010	0.005	--	--	--	--
SEMIVOLATILE ORGANICS	0.02	0.010	0.010	0.010	--	--	--	--	--	--	--	--
IRON	0.10	0.03	0.05	0.100	--	--	--	--	0.10	0.03	0.05	0.100
ZINC	0.010	0.005	0.01	0.020	--	--	--	--	0.010	0.005	0.01	0.020
TOTAL CYANIDE	0.010	0.01	0.01	0.01	--	--	--	--	--	--	--	--
TOTAL ORGANIC CARBON	0.50	5	5	5	--	--	--	--	0.50	5	5	5
TOTAL RECOVERABLE PHENOLICS	0.01	--	--	0.005	--	--	--	--	--	--	--	--
SULFATE	--	1	--	--	--	--	--	--	--	1	--	--

(1) NOMINAL DETECTION LIMITS WERE USED WHERE MDLs WERE NOT REPORTED BY THE LABORATORY.
(2) -- NOT ANALYZED

TABLE D-4-3

EXPLANATION OF TERMS AND ABBREVIATIONS
USED IN LABORATORY REPORTS

Term or Abbreviation	Explanation
Flagged Data Table	Presents analytical results corrected for errors and for method blank analysis as required.
RL	Reporting Limit. Indicates concentration at which laboratory can obtain accurate and repeatable results. Commonly referred to as the "Detection Limit."
J	Compound concentration estimated. Detected, but at a concentration below the Reporting Limit.
B	Compound detected in method blank.
U	Analysis performed for compound, but compound not detected.
D	Concentration determined by sample dilution.
R	Concentration value rejected because compound concentration in blank was greater than five times the Reporting Limit.
NA	Sample not analyzed for this compound.
NR	Sample analysis not requested.

Appendix D-5

Task 4 Surface Soil Data Laboratory Results

MECHANICVILLE SOILS PCB RESULTS

SAMPLE LOCATION	PCB	% MOISTURE
MEEIXX8901	< 6 PPB	0.0
MEEIXX8902	< 6 PPB	27.3
MEEIXX8903	< 6 PPB	13.3
MEEIXX8903A	< 6 PPB	6.7
MEEIXX8904	< 6 PPB	12.5
MEEIXX8905	< 6 PPB	11.8
MEEIXX8906	< 6 PPB	7.1
MEEIXX8906A	< 6 PPB	14.3
MEEIXX8907	< 6 PPB	13.3
MEEIXX8907A	< 6 PPB	20.0
MEEIXX8908	< 6 PPB	3.3
MEEIXX8908A	< 6 PPB	23.5
MEEIXX8909	< 6 PPB	6.7
MEEIXX8910		0.0

Sample location MEEIXX8910 = a trip blank

Analysis Results
Report Number 092089024
Date: September 20, 1989

JAL

ENT I.D. EG	ULI I.D.	Amenable Cyanide	Total Cyanide (distilled)	Total Cyanide (un-distilled)	
HANICSVILLE:					
S-1 MEEIXX8901 8/29/89	24389090	1.8	1.8	<1.0	
S-2 MEEIXX8902 8/29/89	24389091	<1.0	<1.0	<1.0	
S-3 MEEIXX8903 8/29/89	24389092	<1.0	<1.0	<1.0	
S-3A MEEIXX8903A 8/29/89	24389093	1.9	1.9	<1.0	
S-4 MEEIXX8904 8/29/89	24389094	<1.0	<1.0	<1.0	
S-5 MEEIXX8905 8/29/89	24389095	<1.0	<1.0	<1.0	
S-10 MEEIXX8910 8/29/89	24389097	9.9	9.9	<1.0	

ll results are expressed as ppm as received.
ampled by client.

pproved: _____ 9/20/89

ote: See disclaimer on cover letter.

SOIL MATRIX
METHOD 8270 -- HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE)	
	MEEI Blank (9/1/89)	MEEIXX8910 (9/1/89)
Acenaphthene	<0.33	<0.33
Acenaphthylene	<0.33	<0.33
Anthracene	<0.33	<0.33
Benzo(a)anthracene	<0.33	<0.33
Benzo(a)pyrene	<0.33	<0.33
Benzo(b)fluoranthene	<0.33	<0.33
Benzo(g,h,i)perylene	<0.33	<0.33
Benzo(k)fluoranthene	<0.33	<0.33
Benzoic acid	<0.33	<0.33
Benzyl alcohol	<0.33	<0.33
Bis(2-chloroethoxy)methane	<0.33	<0.33
Bis(2-chloroethyl)ether	<0.33	<0.33
Bis(2-chloroisopropyl)ether	<0.33	<0.33
Bis(2-ethylhexyl)phthalate	<0.33	0.41
4-Bromophenylphenylether	<0.33	<0.33
Butylbenzylphthalate	<0.33	<0.33
4-Chloroaniline	<0.33	<0.33
2-Chloronaphthalene	<0.33	<0.33
4-Chlorophenylphenylether	<0.33	<0.33
Chrysene	<0.33	<0.33
Dibenzo(a,h)anthracene	<0.33	<0.33
Dibenzofuran	<0.33	<0.33
1,2-Dichlorobenzene	<0.33	<0.33
1,3-Dichlorobenzene	<0.33	<0.33
1,4-Dichlorobenzene	<0.33	<0.33
3,3'-Dichlorobenzidine	<0.66	<0.66
Diethylphthalate	<0.33	<0.33
Dimethylphthalate	<0.33	<0.33
Di-n-butylphthalate	0.68	0.86
2,6-Dinitrotoluene	<0.33	<0.33
2,4-Dinitrotoluene	<0.33	<0.33
Di-n-octylphthalate	<0.33	6.6
Fluoranthene	<0.33	<0.33
Fluorene	<0.33	<0.33
Hexachlorobenzene	<0.33	<0.33
Hexachlorobutadiene	<0.33	<0.33
Hexachlorocylopentadiene	<0.33	<0.33
Hexachloroethane	<0.33	<0.33
Indeno(1,2,3-cd)pyrene	<0.33	<0.33
Isophorone	<0.33	<0.33

(Continued)

SOIL MATRIX
METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE)	
	MEEI Blank (9/1/89)	MEEIXX8910 (9/1/89)
2-Methylnaphthalene	<0.33	<0.33
Naphthalene	<0.33	<0.33
2-Nitroaniline	<1.6	<1.6
3-Nitroaniline	<1.6	<1.6
4-Nitroaniline	<1.6	<1.6
Nitrobenzene	<0.33	<0.33
N-nitrosodi-n-propylamine	<0.33	<0.33
N-nitrosodiphenylamine	<0.33	<0.33
Phenanthrene	<0.33	<0.33
Pyrene	<0.33	<0.33
1,2,4-Trichlorobenzene	<0.33	<0.33
2-Chlorophenol	<0.33	<0.33
2,4-Dichlorophenol	<0.33	<0.33
2,4-Dimethylphenol	<0.33	<0.33
4,6-Dinitro-o-cresol	<1.6	<1.6
2,4-Dinitrophenol	<1.6	<1.6
2-Methylphenol	<0.33	<0.33
4-Methylphenol	<0.33	<0.33
2-Nitrophenol	<0.33	<0.33
4-Nitrophenol	<1.6	<1.6
p-Chloro-m-cresol	<0.33	<0.33
Pentachlorophenol	<1.6	<1.6
Phenol	<0.33	<0.33
2,4,5-Trichlorophenol	<1.6	<1.6
2,4,6-Trichlorophenol	<0.33	<0.33
Extraction Date	9/1/89	9/1/89
Analysis Date	10/21/89	10/21/89
Internal Standards		
Level Added = 2.0 ug/g		
(% Recovery)		
Phenanthrene-D_{10}	122	111
Surrogates		
(% Recovery)		
2-Fluorophenol	70	83
Phenol-D_5	88	89
2,4,6-Tribromophenol	44	56
Nitrobenzene-D_5	94	87
2-Fluorobiphenyl	71	78
Terphenyl-D_{14}	93	98

SOIL MATRIX
METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE)	
	MEEIXX8901 * (9/1/89)	MEEIXX8902 * (9/1/89)
Acenaphthene	<0.66	<0.66
Acenaphthylene	2.1	5.2
Anthracene	1.1	2.8
Benzo(a)anthracene	4.5	5.4
Benzo(a)pyrene	3.4	4.9
Benzo(b)fluoranthene	2.7	8.7
Benzo(g,h,i)perylene	1.6	2.9
Benzo(k)fluoranthene	4.3	7.1
Benzoic acid	<0.66	<0.66
Benzyl alcohol	<0.66	<0.66
Bis(2-chloroethoxy)methane	<0.66	<0.66
Bis(2-chloroethyl)ether	<0.66	<0.66
Bis(2-chloroisopropyl)ether	<0.66	<0.66
Bis(2-ethylhexyl)phthalate	3.7	<0.66
4-Bromophenylphenylether	<0.66	<0.66
Butylbenzylphthalate	<0.66	<0.66
4-Chloroaniline	<0.66	<0.66
2-Chloronaphthalene	<0.66	<0.66
4-Chlorophenylphenylether	<0.66	<0.66
Chrysene	6.2	9.6
Dibenzo(a,h)anthracene	<0.66	<0.66
Dibenzofuran	<0.66	<0.66
1,2-Dichlorobenzene	<0.66	<0.66
1,3-Dichlorobenzene	<0.66	<0.66
1,4-Dichlorobenzene	<0.66	<0.66
3,3'-Dichlorobenzidine	<1.3	<1.3
Diethylphthalate	<0.66	<0.66
Dimethylphthalate	<0.66	<0.66
Di-n-butylphthalate	<0.66	0.99
2,6-Dinitrotoluene	<0.66	<0.66
2,4-Dinitrotoluene	<0.66	<0.66
Di-n-octylphthalate	<0.66	<0.66
Fluoranthene	7.4	5.3
Fluorene	0.71	<0.66
Hexachlorobenzene	<0.66	<0.66
Hexachlorobutadiene	<0.66	<0.66
Hexachlorocylopentadiene	<0.66	<0.66
Hexachloroethane	<0.66	<0.66
Indeno(1,2,3-cd)pyrene	1.4	2.5
Isophorone	<0.66	<0.66
CPAH	22.5	38.7

(Continued)

* Elevated detection limits are the result of a dilution necessitated by sample matrix.

I.D. #89-1665

SOIL MATRIX
METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE) MEEIXX8901 * (9/1/89)	MEEIXX8902 * (9/1/89)
2-Methylnaphthalene	<0.66	<0.66
Naphthalene	<0.66	<0.66
2-Nitroaniline	<3.2	<3.2
3-Nitroaniline	<3.2	<3.2
4-Nitroaniline	<3.2	<3.2
Nitrobenzene	<0.66	<0.66
N-nitrosodi-n-propylamine	<0.66	<0.66
N-nitrosodiphenylamine	<0.66	<0.66
Phenanthrene	8.5	2.6
Pyrene	16	14
1,2,4-Trichlorobenzene	<0.66	<0.66
2-Chlorophenol	<0.66	<0.66
2,4-Dichlorophenol	<0.66	<0.66
2,4-Dimethylphenol	<0.66	<0.66
4,6-Dinitro-o-cresol	<3.2	<3.2
2,4-Dinitrophenol	<3.2	<3.2
2-Methylphenol	<0.66	<0.66
4-Methylphenol	<0.66	<0.66
2-Nitrophenol	<0.66	<0.66
4-Nitrophenol	<3.2	<3.2
p-Chloro-m-cresol	<0.66	<0.66
Pentachlorophenol	<3.2	<3.2
Phenol	<0.66	<0.66
2,4,5-Trichlorophenol	<3.2	<3.2
2,4,6-Trichlorophenol	<0.66	<0.66
Extraction Date	9/1/89	9/1/89
Analysis Date	10/21/89	10/21/89
Internal Standards		
Level Added = 2.0 ug/g		
(% Recovery)		
Phenanthrene-D_{10}	143	154
Surrogates		
(% Recovery)		
2-Fluorophenol	76	78
Phenol-D_5	73	74
2,4,6-Tribromophenol	53	58
Nitrobenzene-D_5	72	70
2-Fluorobiphenyl	69	68
Terphenyl-D_{14}	95	95

* Elevated detection limits are the result of a dilution necessitated by sample matrix.

I.D. #89-1665

SOIL MATRIX

METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE)	
	MEEIXX8903 * (9/1/89)	MEEIXX8903A * (9/1/89)
Acenaphthene	1.5	1.7
Acenaphthylene	<0.66	<0.66
Anthracene	1.3	1.1
Benzo(a)anthracene	2.8	2.5
Benzo(a)pyrene	1.8	1.9
Benzo(b)fluoranthene	2.3	1.9
Benzo(g,h,i)perylene	<0.66	0.69
Benzo(k)fluoranthene	2.1	2.4
Benzoic acid	<0.66	<0.66
Benzyl alcohol	<0.66	<0.66
Bis(2-chloroethoxy)methane	<0.66	<0.66
Bis(2-chloroethyl)ether	<0.66	<0.66
Bis(2-chloroisopropyl)ether	<0.66	<0.66
Bis(2-ethylhexyl)phthalate	1.1	0.92
4-Bromophenylphenylether	<0.66	<0.66
Butylbenzylphthalate	<0.66	<0.66
4-Chloroaniline	<0.66	<0.66
2-Chloronaphthalene	<0.66	<0.66
4-Chlorophenylphenylether	<0.66	<0.66
Chrysene	3.4	3.1
Dibenzo(a,h)anthracene	<0.66	<0.66
Dibenzofuran	<0.66	<0.66
1,2-Dichlorobenzene	<0.66	<0.66
1,3-Dichlorobenzene	<0.66	<0.66
1,4-Dichlorobenzene	<0.66	<0.66
3,3'-Dichlorobenzidine	<1.3	<1.3
Diethylphthalate	<0.66	<0.66
Dimethylphthalate	<0.66	<0.66
Di-n-butylphthalate	1.1	0.93
2,6-Dinitrotoluene	<0.66	<0.66
2,4-Dinitrotoluene	<0.66	<0.66
Di-n-octylphthalate	<0.66	<0.66
Fluoranthene	6.0	4.7
Fluorene	<0.66	<0.66
Hexachlorobenzene	<0.66	<0.66
Hexachlorobutadiene	<0.66	<0.66
Hexachlorocylopentadiene	<0.66	<0.66
Hexachloroethane	<0.66	<0.66
Indeno(1,2,3-cd)pyrene	<0.66	<0.66
Isophorone	<0.66	<0.66

CPAH 9.0 8.7

(Continued)

* Elevated detection limits are the result of a dilution necessitated by sample matrix.

I.D. #89-1665

SOIL MATRIX
METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE) MEEIXX8903 * (9/1/89)	MEEIXX8903A * (9/1/89)
2-Methylnaphthalene	<0.66	<0.66
Naphthalene	<0.66	<0.66
2-Nitroaniline	<3.2	<3.2
3-Nitroaniline	<3.2	<3.2
4-Nitroaniline	<3.2	<3.2
Nitrobenzene	<0.66	<0.66
N-nitrosodi-n-propylamine	<0.66	<0.66
N-nitrosodiphenylamine	<0.66	<0.66
Phenanthrene	6.6	4.1
Pyrene	13	11
1,2,4-Trichlorobenzene	<0.66	<0.66
2-Chlorophenol	<0.66	<0.66
2,4-Dichlorophenol	<0.66	<0.66
2,4-Dimethylphenol	<0.66	<0.66
4,6-Dinitro-o-cresol	<3.2	<3.2
2,4-Dinitrophenol	<3.2	<3.2
2-Methylphenol	<0.66	<0.66
4-Methylphenol	<0.66	<0.66
2-Nitrophenol	<0.66	<0.66
4-Nitrophenol	<3.2	<3.2
p-Chloro-m-cresol	<0.66	<0.66
Pentachlorophenol	<3.2	<3.2
Phenol	<0.66	<0.66
2,4,5-Trichlorophenol	<3.2	<3.2
2,4,6-Trichlorophenol	<0.66	<0.66
Extraction Date	9/1/89	9/1/89
Analysis Date	10/21/89	10/21/89
Internal Standards		
Level Added = 2.0 ug/g		
(% Recovery)		
Phenanthrene-D_{10}	169	171
Surrogates		
(% Recovery)		
2-Fluorophenol	75	74
Phenol-D_5	77	75
2,4,6-Tribromophenol	40	49
Nitrobenzene-D_5	76	70
2-Fluorobiphenyl	64	74
Terphenyl-D_{14}	98	102

* Elevated detection limits are the result of a dilution necessitated by sample matrix.

I.D. #89-1665

SOIL MATRIX

METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE)	
	MEEIXX8904 * (9/1/89)	MEEIXX8905 * (9/1/89)
Acenaphthene	<0.66	<0.66
Acenaphthylene	<0.66	<0.66
Anthracene	<0.66	<0.66
Benzo(a)anthracene	1.3	<0.66
Benzo(a)pyrene	0.86	<0.66
Benzo(b)fluoranthene	1.4	<0.66
Benzo(g,h,i)perylene	<0.66	<0.66
Benzo(k)fluoranthene	1.3	<0.66
Benzoic acid	<0.66	<0.66
Benzyl alcohol	<0.66	<0.66
Bis(2-chloroethoxy)methane	<0.66	<0.66
Bis(2-chloroethyl)ether	<0.66	<0.66
Bis(2-chloroisopropyl)ether	<0.66	<0.66
Bis(2-ethylhexyl)phthalate	<0.66	<0.66
4-Bromophenylphenylether	<0.66	<0.66
Butylbenzylphthalate	<0.66	<0.66
4-Chloroaniline	<0.66	<0.66
2-Chloronaphthalene	<0.66	<0.66
4-Chlorophenylphenylether	<0.66	<0.66
Chrysene	2.3	<0.66
Dibenzo(a,h)anthracene	<0.66	<0.66
Dibenzofuran	<0.66	<0.66
1,2-Dichlorobenzene	<0.66	<0.66
1,3-Dichlorobenzene	<0.66	<0.66
1,4-Dichlorobenzene	<0.66	<0.66
3,3'-Dichlorobenzidine	<1.3	<1.3
Diethylphthalate	<0.66	<0.66
Dimethylphthalate	<0.66	<0.66
Di-n-butylphthalate	0.87	0.67
2,6-Dinitrotoluene	<0.66	<0.66
2,4-Dinitrotoluene	<0.66	<0.66
Di-n-octylphthalate	11	<0.66
Fluoranthene	0.70	<0.66
Fluorene	<0.66	<0.66
Hexachlorobenzene	<0.66	<0.66
Hexachlorobutadiene	<0.66	<0.66
Hexachlorocylopentadiene	<0.66	<0.66
Hexachloroethane	<0.66	<0.66
Indeno(1,2,3-cd)pyrene	<0.66	<0.66
Isophorone	<0.66	<0.66

CPAH 7.16 ND

(Continued)

* Elevated detection limits are the result of a dilution necessitated by sample matrix.

I.D. #89-1665

SOIL MATRIX
METHOD 8270 - HAZARDOUS SUBSTANCE LIST BASE/NEUTRAL/ACID EXTRACTABLES

COMPOUND (Units of Measure = ug/g dry)	SAMPLE IDENTIFICATION (DATE) MEEIXX8904 * (9/1/89)	MEEIXX8905 * (9/1/89)
2-Methylnaphthalene	<0.66	<0.66
Naphthalene	<0.66	<0.66
2-Nitroaniline	<3.2	<3.2
3-Nitroaniline	<3.2	<3.2
4-Nitroaniline	<3.2	<3.2
Nitrobenzene	<0.66	<0.66
N-nitrosodi-n-propylamine	<0.66	<0.66
N-nitrosodiphenylamine	<0.66	<0.66
Phenanthrene	<0.66	<0.66
Pyrene	1.2	<0.66
1,2,4-Trichlorobenzene	<0.66	<0.66
2-Chlorophenol	<0.66	<0.66
2,4-Dichlorophenol	<0.66	<0.66
2,4-Dimethylphenol	<0.66	<0.66
4,6-Dinitro-o-cresol	<3.2	<3.2
2,4-Dinitrophenol	<3.2	<3.2
2-Methylphenol	<0.66	<0.66
4-Methylphenol	<0.66	<0.66
2-Nitrophenol	<0.66	<0.66
4-Nitrophenol	<3.2	<3.2
p-Chloro-m-cresol	<0.66	<0.66
Pentachlorophenol	<3.2	<3.2
Phenol	<0.66	<0.66
2,4,5-Trichlorophenol	<3.2	<3.2
2,4,6-Trichlorophenol	<0.66	<0.66
Extraction Date	9/1/89	9/1/89
Analysis Date	10/21/89	10/21/89
Internal Standards		
Level Added = 2.0 ug/g		
(% Recovery)		
Phenanthrene-D_{10}	143	133
Surrogates		
(% Recovery)		
2-Fluorophenol	75	74
Phenol-D_5	77	70
2,4,6-Tribromophenol	47	43
Nitrobenzene-D_5	64	62
2-Fluorobiphenyl	70	67
Terphenyl-D_{14}	102	94

* Elevated detection limits are the result of a dilution necessitated by sample matrix.

I.D. #89-1665

Sample Number
BLANK96

ORGANICS ANALYSIS DATA SHEET

(Page 1)

Laboratory Name: NYSEG-CORP-LAB
Lab Sample ID No: BLANK96
Sample Matrix: SOIL
Data Release Authorized By:

Case No: ME82969
QC Report No:
Contract No:
Date Sample Received: 09/06/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared:
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 0.0

CAS Number		UG/KG	
74-87-3	Chloromethane	1300	U
74-83-9	Bromomethane	1300	U
75-01-4	Vinyl Chloride	1300	U
75-00-3	Chloroethane	1300	U
75-09-2	Methylene Chloride	630	U
67-64-1	Acetone	1300	U
75-15-0	Carbon Disulfide	630	U
75-35-4	1,1-Dichloroethene	630	U
75-35-3	1,1-Dichloroethane	630	U
156-60-5	Trans-1,2-Dichloroethene	630	U
67-66-3	Chloroform	630	U
107-06-2	1,2-Dichloroethane	630	U
78-93-3	2-Butanone	1300	U
71-55-6	1,1,1-Trichloroethane	630	U
56-23-5	Carbon Tetrachloride	630	U
108-05-4	Vinyl Acetate	1300	U
75-27-4	Bromodichloromethane	630	U

CAS Number		UG/KG	
78-87-5	1,2-Dichloropropane	630	U
10061-02-6	Trans-1,3-Dichloropropene	630	U
79-01-6	Trichloroethene	630	U
124-48-1	Dibromochloromethane	630	U
79-00-5	1,1,2-Trichloroethane	630	U
71-43-2	Benzene	630	U
10061-01-5	cis-1,3-Dichloropropene	630	U
110-75-8	2-Chloroethylvinylether	1300	U
75-25-2	Bromoform	630	U
108-10-1	4-Methyl-2-Pentanone	1300	U
591-78-6	2-Hexanone	1300	U
127-18-4	Tetrachloroethene	630	U
79-34-5	1,1,2,2-Tetrachloroethane	1300	U
108-88-3	Toluene	630	U
108-90-7	Chlorobenzene	630	U
100-41-4	Ethylbenzene	630	U
100-42-5	Styrene	630	U
	Total Xylenes	630	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

MEEIXX8901

ORGANICS ANALYSIS DATA SHEET
(Page 1)

Laboratory Name: NYSEG-COFF-LAB
Lab Sample ID No: ME0196
Sample Matrix: SOIL
Data Release Authorized By:

Case No: ME82989
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/06/89
Date Analyzed: 09/05/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 0.0

CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1300	U	78-87-5	1,2-Dichloropropane	630	U
74-83-9	Bromomethane	1300	U	10061-02-6	Trans-1,3-Dichloropropene	630	U
75-01-4	Vinyl Chloride	1300	U	79-01-6	Trichloroethene	630	U
75-00-3	Chloroethane	1300	U	124-48-1	Dibromochloromethane	630	U
75-09-2	Methylene Chloride	630	U	79-00-5	1,1,2-Trichloroethane	630	U
67-64-1	Acetone	1300	U	71-43-2	Benzene	630	U
75-15-0	Carbon Disulfide	630	U	10061-01-5	cis-1,3-Dichloropropene	630	U
75-35-4	1,1-Dichloroethene	630	U	110-75-8	2-Chloroethylvinylether	1300	U
75-34-3	1,1-Dichloroethane	630	U	75-25-2	Bromoform	630	U
156-60-5	Trans-1,2-Dichloroethene	630	U	108-10-1	4-Methyl-2-Pentanone	1300	U
67-66-3	Chloroform	630	U	591-78-6	2-Hexanone	1300	U
107-06-2	1,2-Dichloroethane	630	U	127-18-4	Tetrachloroethene	630	U
78-93-3	2-Butanone	1300	U	79-34-5	1,1,2,2-Tetrachloroethane	1300	U
71-55-6	1,1,1-Trichloroethane	630	U	108-88-3	Toluene	630	U
56-23-5	Carbon Tetrachloride	630	U	108-90-7	Chlorobenzene	630	U
108-05-4	Vinyl Acetate	1300	U	100-41-4	Ethylbenzene	630	U
75-27-4	Bromodichloromethane	630	U	100-42-5	Styrene	630	U
					Total Xylenes	630	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

MEEIXX8902

ORGANICS ANALYSIS DATA SHEET

(Page 1)

Laboratory Name: NYSEG-CORP-LAB
Lab Sample ID No: ME0296
Sample Matrix: SOIL
Data Release Authorized By:

Case No: ME82989
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/05/89
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 27.0

CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1700	U	78-87-5	1,2-Dichloropropane	860	U
74-83-9	Bromomethane	1700	U	10061-02-6	Trans-1,3-Dichloropropene	860	U
75-01-4	Vinyl Chloride	1700	U	79-01-6	Trichloroethene	860	U
75-00-3	Chloroethane	1700	U	124-48-1	Dibromochloromethane	860	U
75-09-2	Methylene Chloride	860	U	79-00-5	1,1,2-Trichloroethane	860	U
67-64-1	Acetone	1700	U	71-43-2	Benzene	860	U
75-15-0	Carbon Disulfide	860	U	10061-01-5	cis-1,3-Dichloropropene	860	U
75-35-4	1,1-Dichloroethene	860	U	110-75-8	2-Chloroethylvinylether	1700	U
75-34-3	1,1-Dichloroethane	860	U	75-25-2	Bromoform	860	U
156-60-5	Trans-1,2-Dichloroethene	860	U	108-10-1	4-Methyl-2-Pentanone	1700	U
67-66-3	Chloroform	860	U	591-78-6	2-Hexanone	1700	U
107-06-2	1,2-Dichloroethane	860	U	127-18-4	Tetrachloroethene	860	U
78-93-3	2-Butanone	1700	U	79-34-5	1,1,2,2-Tetrachloroethane	1700	U
71-55-6	1,1,1-Trichloroethane	860	U	108-88-3	Toluene	860	U
56-23-5	Carbon Tetrachloride	860	U	108-90-7	Chlorobenzene	860	U
108-05-4	Vinyl Acetate	1700	U	100-41-4	Ethylbenzene	860	U
75-27-4	Bromodichloromethane	860	U	100-42-5	Styrene	860	U
					Total Xylenes	860	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

MEEIXX8903

ORGANICS ANALYSIS DATA SHEET
(Page 1)

Laboratory Name: NYSEG-CORP-LAB
Lab Sample ID No: ME0396
Sample Matrix: SOIL
Data Release Authorized By:

Case No: ME82989
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/06/89
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 13.0

CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1400	U	78-87-5	1,2-Dichloropropane	720	U
74-83-9	Bromomethane	300	J	10061-02-6	Trans-1,3-Dichloropropene	720	U
75-01-4	Vinyl Chloride	1400	U	79-01-6	Trichloroethene	720	U
75-00-3	Chloroethane	1400	U	124-48-1	Dibromochloromethane	720	U
75-09-2	Methylene Chloride	720	U	79-00-5	1,1,2-Trichloroethane	720	U
67-64-1	Acetone	1400	U	71-43-2	Benzene	720	U
75-15-0	Carbon Disulfide	720	U	10061-01-5	cis-1,3-Dichloropropene	720	U
75-35-4	1,1-Dichloroethene	720	U	110-75-8	2-Chloroethylvinylether	1400	U
75-34-3	1,1-Dichloroethane	720	U	75-25-2	Bromoform	720	U
156-60-5	Trans-1,2-Dichloroethene	720	U	108-10-1	4-Methyl-2-Pentanone	1400	U
67-66-3	Chloroform	720	U	591-78-6	2-Hexanone	1400	U
107-06-2	1,2-Dichloroethane	720	U	127-18-4	Tetrachloroethene	720	U
78-93-3	2-Butanone	1400	U	79-34-5	1,1,2,2-Tetrachloroethane	1400	U
71-55-6	1,1,1-Trichloroethane	720	U	108-88-3	Toluene	720	U
56-23-5	Carbon Tetrachloride	720	U	108-90-7	Chlorobenzene	720	U
108-05-4	Vinyl Acetate	1400	U	100-41-4	Ethylbenzene	720	U
75-27-4	Bromodichloromethane	720	U	100-42-5	Styrene	720	U
					Total Xylenes	720	U

J - Reported value is less than the detection limit.
U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

| Sample Number
| MEEIXX8903A

ORGANICS ANALYSIS DATA SHEET

(Page 1)

Laboratory Name: NYSEG-CORP-LAB
Lab Sample ID No: ME3A96
Sample Matrix: SOIL
Data Release Authorized By:

Case No: ME82989
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/06/89
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 7.0

CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1300	U	78-87-5	1,2-Dichloropropane	670	U
74-83-9	Bromomethane	1300	U	10061-02-6	Trans-1,3-Dichloropropene	670	U
75-01-4	Vinyl Chloride	1300	U	79-01-6	Trichloroethene	670	U
75-00-3	Chloroethane	1300	U	124-48-1	Dibromochloromethane	670	U
75-09-2	Methylene Chloride	670	U	79-00-5	1,1,2-Trichloroethane	670	U
67-64-1	Acetone	1300	U	71-43-2	Benzene	670	U
75-15-0	Carbon Disulfide	670	U	10061-01-5	cis-1,3-Dichloropropene	670	U
75-35-4	1,1-Dichloroethene	670	U	110-75-8	2-Chloroethylvinylether	1300	U
75-34-3	1,1-Dichloroethane	670	U	75-25-2	Bromoform	670	U
156-60-5	Trans-1,2-Dichloroethene	670	U	108-10-1	4-Methyl-2-Pentanone	1300	U
67-66-3	Chloroform	670	U	591-78-6	2-Hexanone	1300	U
107-06-2	1,2-Dichloroethane	670	U	127-18-4	Tetrachloroethene	670	U
78-93-3	2-Butanone	1300	U	79-34-5	1,1,2,2-Tetrachloroethane	1300	U
71-55-6	1,1,1-Trichloroethane	670	U	108-88-3	Toluene	670	U
56-23-5	Carbon Tetrachloride	670	U	108-90-7	Chlorobenzene	670	U
108-05-4	Vinyl Acetate	1300	U	100-41-4	Ethylbenzene	670	U
75-27-4	Bromodichloromethane	670	U	100-42-5	Styrene	670	U
					Total Xylenes	670	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

ORGANICS ANALYSIS DATA SHEET

(Page 1)

Laboratory Name: NYSDEC-OFF-LAB
Lab Sample ID No: ME045
Sample Matrix: SOIL
Data Release Authorized By:

Case No: MS02099
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/05/89
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 12.0

CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1400	U	78-87-5	1,2-Dichloropropane	710	U
74-83-9	Bromomethane	1400	U	10061-02-6	Trans-1,3-Dichloropropene	710	U
75-01-4	Vinyl Chloride	1400	U	79-01-6	Trichloroethene	710	U
75-00-3	Chloroethane	1400	U	124-48-1	Dibromochloromethane	710	U
75-09-2	Methylene Chloride	710	U	79-00-5	1,1,2-Trichloroethane	710	U
67-64-1	Acetone	1400	U	71-43-2	Benzene	710	U
75-15-0	Carbon Disulfide	710	U	10061-01-5	cis-1,3-Dichloropropene	710	U
75-35-4	1,1-Dichloroethene	710	U	110-75-8	2-Chloroethylvinylether	1400	U
75-34-3	1,1-Dichloroethane	710	U	75-25-2	Bromoform	710	U
156-60-5	Trans-1,2-Dichloroethene	710	U	108-10-1	4-Methyl-2-Pentanone	1400	U
67-66-3	Chloroform	710	U	591-78-6	2-Hexanone	1400	U
107-06-2	1,2-Dichloroethane	710	U	127-18-4	Tetrachloroethene	710	U
78-93-3	2-Butanone	1400	U	79-34-5	1,1,2,2-Tetrachloroethane	1400	U
71-55-6	1,1,1-Trichloroethane	710	U	108-88-3	Toluene	710	U
56-23-5	Carbon Tetrachloride	710	U	108-90-7	Chlorobenzene	710	U
108-05-4	Vinyl Acetate	1400	U	100-41-4	Ethylbenzene	710	U
75-27-4	Bromodichloromethane	710	U	100-42-5	Styrene	710	U
					Total Xylenes	710	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

MEEIXX3905

ORGANICS ANALYSIS DATA SHEET
(Page 1)

Laboratory Name: NYSEG-CORP-LAB
Lab Sample ID No: ME0596
Sample Matrix: SOIL
Data Release Authorized By:

Case No: ME82589
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/06/89
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 12.0

CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1400	U	78-87-5	1,2-Dichloropropane	710	U
74-83-9	Bromomethane	1400	U	10061-02-6	Trans-1,3-Dichloropropene	710	U
75-01-4	Vinyl Chloride	1400	U	79-01-6	Trichloroethene	710	U
75-00-3	Chloroethane	1400	U	124-48-1	Dibromochloromethane	710	U
75-09-2	Methylene Chloride	710	U	79-00-5	1,1,2-Trichloroethane	710	U
67-64-1	Acetone	1400	U	71-43-2	Benzene	710	U
75-15-0	Carbon Disulfide	710	U	10061-01-5	cis-1,3-Dichloropropene	710	U
75-35-4	1,1-Dichloroethene	710	U	110-75-8	2-Chloroethylvinylether	1400	U
75-34-3	1,1-Dichloroethane	710	U	75-25-2	Bromoform	710	U
156-60-5	Trans-1,2-Dichloroethene	710	U	108-10-1	4-Methyl-2-Pentanone	1400	U
67-66-3	Chloroform	710	U	591-78-6	2-Hexanone	1400	U
107-06-2	1,2-Dichloroethane	710	U	127-18-4	Tetrachloroethene	710	U
78-93-3	2-Butanone	1400	U	79-34-5	1,1,2,2-Tetrachloroethane	1400	U
71-55-6	1,1,1-Trichloroethane	710	U	108-88-3	Toluene	710	U
56-23-5	Carbon Tetrachloride	710	U	108-90-7	Chlorobenzene	710	U
108-05-4	Vinyl Acetate	1400	U	100-41-4	Ethylbenzene	710	U
75-27-4	Bromodichloromethane	710	U	100-42-5	Styrene	710	U
					Total Xylenes	710	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

Sample Number
MEEIXXS910

ORGANICS ANALYSIS DATA SHEET

(Page 1)

Laboratory Name: NYSEG-CORP-LAB
Lab Sample ID No: ME1096
Sample Matrix: SOIL
Data Release Authorized By:

Case No: MEB2987
QC Report No:
Contract No:
Date Sample Received: 08/30/89

VOLATILE COMPOUNDS

Concentration: MED
Date Extracted/Prepared: 09/06/89
Date Analyzed: 09/06/89
Dil Factor: 125 pH
Percent Moisture: (Not Decanted) 0.0

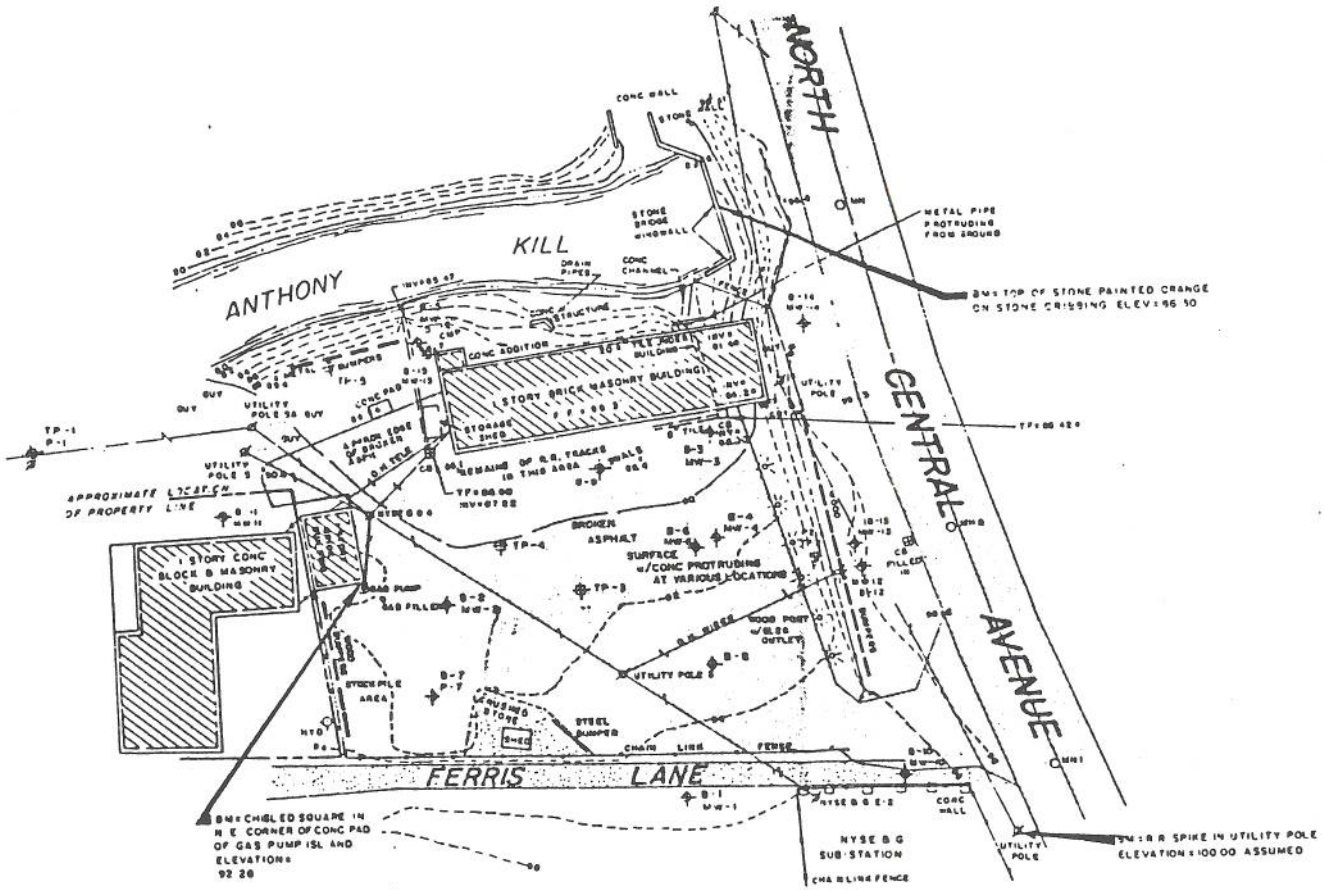
CAS Number		UG/KG		CAS Number		UG/KG	
74-87-3	Chloromethane	1300	U	78-87-5	1,2-Dichloropropane	630	U
74-83-9	Bromomethane	1300	U	10061-02-6	Trans-1,3-Dichloropropene	630	U
75-01-4	Vinyl Chloride	1300	U	79-01-6	Trichloroethene	630	U
75-00-3	Chloroethane	1300	U	124-48-1	Dibromochloromethane	630	U
75-09-2	Methylene Chloride	630	U	79-00-5	1,1,2-Trichloroethane	630	U
67-64-1	Acetone	1300	U	71-43-2	Benzene	630	U
75-15-0	Carbon Disulfide	630	U	10061-01-5	cis-1,3-Dichloropropene	630	U
75-35-4	1,1-Dichloroethene	630	U	110-75-8	2-Chloroethylvinylether	1300	U
75-34-3	1,1-Dichloroethane	630	U	75-25-2	Bromoform	630	U
156-60-5	Trans-1,2-Dichloroethene	630	U	108-10-1	4-Methyl-2-Pentanone	1300	U
67-66-3	Chloroform	630	U	591-78-6	2-Hexanone	1300	U
107-06-2	1,2-Dichloroethane	630	U	127-18-4	Tetrachloroethene	630	U
78-93-3	2-Butanone	1300	U	79-34-5	1,1,2,2-Tetrachloroethane	1300	U
71-55-6	1,1,1-Trichloroethane	630	U	108-88-3	Toluene	630	U
56-23-5	Carbon Tetrachloride	630	U	108-90-7	Chlorobenzene	630	U
108-05-4	Vinyl Acetate	1300	U	100-41-4	Ethylbenzene	630	U
75-27-4	Bromodichloromethane	630	U	100-42-5	Styrene	630	U
					Total Xylenes	630	U

U - Compound analyzed for but not detected. The reported value is the minimum attainable detection limit for the sample.

See page 1A for complete definitions of the data reporting qualifiers.

Appendix E

Site Survey Map



RECORD OF WORK	DATE		
	6-26-86	PREPARED FOR E C JORDAN CO.	D A F
	10 7 86	MONITORING LOCATIONS & DATA ADDED E C. JORDAN	D A F
	12 4 87	" " , BORING & GEOPHYSICAL	
		SIGHTS ADDED - E C JORDAN	D. A. F
	12 10 87	ELEVATIONS AT GEOPHYSICAL SURVEY POINTS	
		ADDED	D A F

TOPOGRAPHIC SURVEY
PORTION OF LANDS OF
NEW YORK STATE ELECTRIC & GAS CORP.
(MECHANICVILLE SITE)

TOWN OF MECHANICVILLE	COUNTY: SARATOGA, N.Y.
SCALE: 1" = 50'	DATE: JUNE 26, 1986

DAVID A. FLANDERS ASSOCIATES
6 MORNINGSIDE DRIVE
BALLSTON LAKE, NEW YORK

MAP BY: DAVID A FLANDERS — LIC. NO: 49,134

86-72-S

MONITORING DEVICE			ELEVATION
MONITORING WELL		#1	98.56
"	"	#2	91.31
"	"	#3	87.31
"	"	#4	90.61
"	"	#5	87.89
"	"	#6	90.65
"	"	#10	96.49
"	"	#11	91.44
"	"	#12	98.46
"	"	#13	98.48
"	"	#14	98.93
"	"	#15	88.17
BORING	#1	GROUND	95.9
"	#2	"	91.6
"	#3	"	87.4
"	#4	"	91.0
"	#5	"	88.4
"	#6	"	91.0
"	#7	"	91.8
"	#8	"	93.2
"	#9	"	88.5
"	#10	"	96.7
"	#11	"	92.1
"	#12	"	98.3
"	#13	"	98.6
"	#14	"	98.7
"	#15	"	88.5
PIEZOMETER		#1	95.02
"		#2	98.83
"		#7	91.76
TEST PIT		#1	92.5
"	"	#2	95.2
"	"	#3	91.4
"	"	#4	90.3
"	"	#5	89.1

NOTE: ELEVATION OF MONITORING WELLS AND PIEZOMETERS TAKEN AT TOP OF EXISTING NOTCH CUT IN TOP OF P.V.C. PIPE.

NOTES:

A. TOPOGRAPHIC INFORMATION SHOWN HEREON HAS BEEN COMPILED UTILIZING STANDARD FIELD SURVEY PROCEDURES. NO ATTEMPT HAS BEEN MADE TO SHOW THE SIZE AND LOCATION OF ANY UNDERGROUND UTILITIES OF SUBSURFACE FEATURES WHICH MAY EXIST.

B. ELEVATION DATUM USED IN CONNECTION WITH THE PREPARATION OF SURVEY IS FROM AN ASSUMED DATUM.

C. THE LIMITS OF OWNERSHIP OF LANDS OF NEW YORK STATE ELECTRIC AND GAS CORP., WHERE NOT READILY APPARENT AT THE TIME OF THIS TOPOGRAPHIC SURVEY. FOR LOCATION OF PERTINENT PROPERTY LINES A BOUNDARY SURVEY IS RECOMMENDED.

Appendix F

Solubility Data

SOLUBILITIES OF PAHs IN WATER (mg/ℓ)[1]

Compound	Verschueren[2]	EPA Treatability Manual[3]
cenaphthene	--	3.42
cenaphthylene	3.93	3.93
nthracene	1.29	0.073
enzo(a)anthracene	0.044 at 24°C	0.014
enzo(a)pyrene	0.003 at 20°C	0.0038
enzo(b)fluoranthene	--	NA[4]
enzo(k)fluoranthene	--	0.00055
enzo(g,h,i)perylene	0.00026	0.00026
hrysene	0.006	0.002
ibenzo(a,h)anthracene	--	0.0005
luoranthene	0.120 at 24°C	0.26
luorene	1.9	1.98
ndeno(1,2,3-cd)pyrene	--	0.62
aphthalene	30.0 at 20°C	34.4
henanthrene	0.816 at 21°C	1.29
yrene	0.032 at 24°C	0.14

All values are calculated at 25°C unless otherwise noted.

Verschueren, K. Handbook of Environmental Data on Organic Chemicals, Van Nostrand Reinhold Company, New York, New York 1977.

USEPA, Treatability Manual Volume I: Treatability Data, Office of Research and Development, Washington, DC EPA-600/2-82-001a. September 1981 (Revised).

NA - Not available.

Appendix G

G-1 Dose Response Assessment

G-2 Toxicological Profiles

G-3 Risk Templates

G-4 Air Modeling Method and Results

Appendix G-1

Dose Response Assessment

POLYNUCLEAR AROMATIC HYDROCARBONS

In this section, various issues relating to the incremental excess cancer risk from exposure to PAHs are discussed. These issues include a discussion of PAH mixtures and how they are treated in a risk assessment, and reviews of the studies used by USEPA to derive the cancer potency factors.

Polynuclear Aromatic Hydrocarbon Mixtures

Many PAH-containing mixtures are carcinogenic in humans and animals. Some pure PAH components have been tested in animals and found to have carcinogenic activity, while others have been repeatedly tested and found to have no carcinogenic activity. Quantitative dose/response data exist only for a few well-studied PAHS. Benzo(a)Pyrene (B(a)P) is well-studied and is often used as a surrogate for PAHs as a class. USEPA and ICF-Clement Associates cancer potency factors have been derived for B(a)P for both the oral and inhalation routes.

PAHs are routine analytes at former coal gasification sites. Several are carcinogenic, while several are not considered by USEPA or the International Agency for Research on Cancer (IARC) to be carcinogenic. There are three possible approaches for performing quantitative risk assessment of this subset of PAHs for which there are analytical data:

- Total all the PAHs and apply the cancer potency factor for B(a)P.

- Total all the PAHs considered carcinogenic and apply the cancer potency factor for B(a)P.

- Use a comparative potency approach whereby each PAH is converted into B(a)P equivalents based on its potency relative to B(a)P in a mouse skin assay.

The first approach is not routinely used because it is believed by many that the actual risks to human health are overestimated by the method. The approach routinely adopted by USEPA as a basis of risk assessment is the second approach. The cancer potency factors calculated from assays on B(a)P are applied to the subclass of carcinogenic PAHs within the mixture that is to be assessed. Therefore, the B(a)P cancer potency factor is applied to all carcinogenic PAHs regardless of the extent of evidence of their carcinogenicity.

The merits of this approach are (1) it is very easy to accomplish and (2) a margin of safety is incorporated by assigning the cancer potency factor for B(a)P to all carcinogenic PAHs. This margin of safety is needed because hazardous waste samples that contain PAHs are likely to have many more PAHs than the 16 routine analytes.

However, there are critics of the current USEPA approach. Proponents of the comparative potency approach argue that B(a)P is known to be more potent in the mouse skin assay than several other common PAHs. The first and second approaches therefore overestimate the human carcinogenic risk from exposure to

an environmental mixture of PAHs by assuming that other PAHs are equal in potency to B(a)P. The comparative potency approach (ICF-Clement Associates, 1987a; Chu and Chen, 1984) has merit for assessing the risks of a specific PAH mixture of known composition. An important criticism of the comparative potency approach such as that proposed by ICF-Clement Associates is that it ignores the myriad of other carcinogenic PAHs normally found in PAH-contaminated samples. Table B-2 shows a list of some individual PAHs that have been identified in coal tar and related products and that have been found to be carcinogenic. Many of these compounds are present in hazardous waste samples for which risk assessment must be performed. When samples of these wastes are sent to Contract Laboratory Program laboratories for analysis, however, data on only 14 PAHs will be collected. Only six of these are considered by USEPA to be probable human carcinogens. The comparative potency approach totally ignores these compounds. The USEPA approach of totaling the carcinogenic PAHs does not explicitly consider these other probable contaminants. However, the application of the B(a)P factor to the subset of the carcinogenic PAHs may provide an appropriate margin of safety, given that not all carcinogenic PAHs are as potent as B(a)P.

TABLE G-1-1

PAH ANALYTES AT HAZARDOUS WASTE SITES

PAHS ON USEPA'S HSL (TCL)	PAHS CONSIDERED CARCINOGENIC BY USEPA	PAHS FOR WHICH ICF-DERIVED COMPARATIVE POTENCY FACTOR EXISTS
Benzo(a)pyrene	x	x
Indeno(1,2,3-cd)pyrene	x	x
Dibenzo(a,h)anthracene	x	
Benzo(a)anthracene	x	x
Chrysene	x	x
Benzo(b)fluoranthene	x	x
Benzo(k)fluoranthene		x
Benzo(g,h,i)perylene		x
Fluorene		
Acenaphthene		
Phenanthrene		
Anthracene		
Fluoranthene		
Pyrene		

TABLE G-1-2

COAL-TAR CONSTITUENTS OF INTEREST
THAT ARE NOT ROUTINE ANALYTES
AT HAZARDOUS WASTE SITES

CARCINOGENIC PAHS	
Carbazole	(USEPA category B2 carcinogen)
Quinoline	
Dibenzocarbazoles	
2-aminopyrene	
Benzo(c)acridine	(USEPA category C; IARC-limited animal data)
Benzo(e)pyrene	(IARC-limited short-term data)
Benzo(j)fluoranthene	(IARC-sufficient animal data)
Benzo(a)fluoranthene	(IARC-sufficient animal data)
Dibenz(a,h)anthracene	(IARC-limited animal data)
Dibenz(a,c)anthracene	(IARC-limited animal data)
Dibenz(a,i)pyrene	(IARC-sufficient animal data)
5,6-benzoquinoline	
Methyl pyrene	
Dibenzo(a,h)pyrene	
Dibenzo(c,g)carbazole	
Cyclopenta(c,d)pyrene	(IARC-limited animal data)
Benzo(c)phenanthrene	

Scientific reviewers of the ICF-Clement Associates approach, while applauding the authors' theoretical treatment of the topic, also pointed out the limitations of using such a method for complex environmental samples. For example, Dr. Roy Albert (ICF-Clement Associates, 1987b) made the following comment:

> The section that tests the comparative potency method using a synthetic mixture of PAHs is fine but needs to include a mixture found in real life such as products of combustion, extracts of shale tar, or cigarette smoke condensate. USEPA's use of B(a)P as a surrogate could cover unknown carcinogenic constituents in such mixtures, so may have some validity. Some realistic complex mixtures should be examined to see if the comparative potency method works. It is not necessary to include such an examination as part of this effort, but it should be done at some point.

In a similar vein, Dr. Jeffrey Harris (ICF-Clement Associates, 1987b) of Massachusetts Institute of Technology made the following comment:

> I am concerned that a great many environmental mixtures (e.g., smoke from fossil fuel combustion, leachates from hazardous waste sites) will not consist purely of PAHs. In such cases, I am not sure that the proposed methodology will address the central problem of evaluating the potency of the overall mixture. If, as suggested by the current report, most PAHs are of equal or lesser potency than B(a)P, then the real uncertainties will arise not from the PAHs but from the remaining compounds, either alone or in combination with PAHs. Suppose that a mixture contains PAHs,

which are known tumor initiators and also dioxins and PCBs, which are known tumor promoters. Refined analysis of PAH potencies will still not address the initiator-promoter interactions between PAHs and the other compounds. To take a simple example, would one expect to predict the carcinogenic potency of tobacco smoke from the PAH dose-additive model, when such smoke contains nitrosamines, metals, radioisotopes, etc.? The above objection can be rebutted, at least to some extent, if the authors can show that many relevant environmental mixtures consist of pure PAHs.

Another criticism of the comparative potency approach concerns the potential for synergistic effects when individual components are administered together. Dr. Norton Nelson (ICF-Clement Associates, 1987b) of New York University made the following comment upon reviewing the ICF-Clement Associates document:

> There are, of course, the usual concerns about cross-species extrapolation; the presence of inhibitory, enhancing as well as additive and neutral factors in the media in which the several agents are found; the uncertainty as to the sequence in which the biological action takes place in the several species and so forth and so forth [sic]. Most of these are, of course, covered in the discussion.
>
> It may be noted that published work has shown that in some instances when several carcinogenic agents, which are independently active, when administered together can produce either addition or inhibition and, perhaps, in some cases, synergistic action. This, of course, relates to the underlying premise of the additive nature of carcinogens which is a

prime assumption built into the whole process.

The ICF-Clement Associates report clearly states that their approach does not address the issue of antagonism or synergism, but such effects have been documented and can have important implications for risk assessment when complex environmental mixtures are involved. The following paragraphs summarize several selected reports of synergism found in a cursory review of the scientific literature.

In the IARC report on coal tars and derived products (IARC, 1985), there is a report on the co-carcinogenic properties on a noncarcinogenic fraction of creosote. A basic fraction of creosote was tested in mice by Sall and Shear (IARC, 1985) for modifying effects of B(a)P-induced tumorigenesis. A group of 100 female strain A mice was divided into five subgroups and painted three times a week (124 to 145 times) with a 1 percent solution of the basic fraction in benzene, 0.2 or 0.05 percent B(a)P in benzene, or 0.05-percent B(a)P in benzene containing 1 percent of the basic creosote fraction alone. Tumors were not produced in any of the mice receiving the basic creosote fraction alone. However, the latent period for tumor appearance was shorter in the groups receiving B(a)P and the basic fraction of creosote as compared with that for mice receiving B(a)P alone, suggesting that the basic fraction of creosote decreased the latency of the tumorigenic effects of B(a)P.

In addition, many studies on co-carcinogenesis have been concerned with the identification of tumor-accelerating substances present in cigarette smoke. These compounds are generally tested for co-carcinogenic activity by repeated

application to mouse skin together with low doses of B(a)P. A positive response would be obtained in cases where the tumor yield of the combination exceeds that produced by either agent alone at the same doses. Van Duuren and co-workers (USEPA, 1979) established that a pronounced co-carcinogenic effect could be obtained with catechol and the noncarcinogens pyrene, benzo(e)pyrene, B(e)P, and benzo(g,h,i)perylene. Doses of 2,000, 12, 15, and 21 ug of catechol, pyrene, B(e)P, and benzo(g,h,i) perylene, respectively, were applied three times a week for 52 weeks to female ICR/Ha Swiss mice. Each animal also received 5 ug of B(a)P in 0.1 ml acetone with each dose of test substance. Fluoranthene has also been shown to possess co-carcinogenic activity. The application of a comparative potency approach to assessing the risks of PAHs would totally ignore the co-carcinogenic properties of some of the noncarcinogenic compounds.

Summary

Jordan reviewed the toxicologic data on the tumorigenesis of B(a)P and mixtures of PAH compounds, and concluded that (1) use of the cancer potency factors for B(a)P derived by USEPA and ICF-Clement Associates for the oral and inhalation routes is appropriate, and (2) these values should be used to assess the risks of the total concentration of carcinogenic PAHs. Jordan recognizes that there are some technical limitations to this approach; however, the limitations are not serious enough to justify selecting another approach.

Although using the cancer potency factor from assays on B(a)P for the seven

carcinogenic PAHs detected at the site may overestimate actual risk, Jordan considers it the most suitable alternative for assessing risks of exposure to a mixture of PAHs. While not used to quantitatively assess carcinogenic risks in this report, Jordan will refer to the comparative potency approach developed by ICF-Clement Associates in a qualitative manner, when discussing the results of the risk assessment and interpreting their significance. Drawbacks to the use of the USEPA cancer potency factors are briefly summarized in the following paragraphs.

Derivation of the Oral Cancer Potency Factor

The current cancer potency factor (oral) for B(a)P is based on a quantitative analysis of the dose-response data presented in a study by Neal and Rigdon (1967). In this study, male and female mice (CFW strain) were repeatedly fed B(a)P in their diet. The carcinogenic endpoint was forestomach tumors.

Numerous other studies similarly demonstrate that orally administered B(a)P can cause gastric tumors in several strains of mice (Collins et al., 1943; Peacock and Kirby, 1944; Nau et. al. 1958; Rigdon and Neal, 1966; Federenko and Yanysheva, 1966). Previous studies, however, did not utilize large numbers of animals or multiple doses. Therefore, the study by Neal and Rigdon (1967), which used 608 mice and 10 dose levels, was chosen by USEPA for quantitative dose/response assessment. In this study, mice were dosed for varying periods of time with B(a)P incorporated into laboratory chow. The exact manner of preparing the diet was not reported. Animals were allowed to eat ad libitum. Dosimetry was not quantitatively performed by measuring food

consumption. The amount of B(a)P consumed was estimated assuming that each mouse consumed 4 g of food daily. This lack of quantitative dosimetry introduces uncertainty into the value of the cancer potency factor.

Stomach tissues were examined macroscopically and histologically. The frequency of papillomas and squamous cell carcinomas in the squamous portion of the stomach (forestomach) were recorded. Tumors did not occur in other parts of the GI tract. Other tissues were not examined. The authors concluded that the development of gastric tumors in CFW mice fed B(a)P is influenced by (1) the concentration of B(a)P per gram of food; (2) the number of days it is fed; and (3) the total amount of B(a)P ingested per day.

There are several aspects of the Neal and Rigdon study (1967), as well as USEPA's approach to deriving an oral cancer potency factor, which have been criticized in the scientific literature. These criticisms are presented to highlight some of the toxicological uncertainties associated with the use of the B(a)P potency factor for quantifying incremental excess cancer risk. Jordan considers these criticisms insufficient to warrant not using the potency values.

Critical comments on the Neal and Rigdon study (1967) are twofold. First, the mice were fed diets dosed with B(a)P, but actual food intake per animal was not measured. An average food intake was assumed. Second, the dosing period was not consistent across exposure groups.

A deficiency of the Neal and Rigdon study (1967) for derivation of a cancer

potency factor is that the maximum period of the experiment was only 110 days for most dosage groups, and 70 to 197 days for several dosage groups. It is likely that the dose required to produce the observed effects would have been lower had the experimental dosing period been longer (USEPA, 1982). This assumption has basis in the study itself. Other animals were dosed for shorter periods of time and were observed to have reduced effects in proportion to the dosing time. Other experimental factors that are atypical of standard bioassay protocols include variable age of first exposure and an observation period that lasted on-fifth of a lifetime.

USEPA corrected for several of these experimental deficiencies in calculating its cancer potency factor. First, USEPA restricted its analysis of the data set to that subgroup of the experimental population that had been exposed continuously for the length of the experiment. Second, USEPA adjusted the experimental dose by averaging the actual daily dose for the dosing period over the entire experiment period.

$$\text{Adjusted dose} = \text{Actual daily dose} \times \frac{110 \text{ days}}{183 \text{ days}}$$

Lastly, the unadjusted cancer potency factor from the study was translated into a human potency value. First, the risk must be adjusted to account for constant exposure throughout one's entire lifetime. It was assumed that a normal mouse lifetime was 630 days. USEPA's standard procedures for less than full lifetime follow-up yield an adjustment factor of $(630/183)^3 = 40.8$.

Second, it is standard practice to calculate species-equivalent exposure units

on a unit mass/unit surface area basis. To convert the estimate to these units, it is multiplied by the additional adjustment factor of $(70/0.034)^{1/3}$ = 12.72, where 70 and 0.034 kg are the weights of an average human and CFW mouse, respectively. After making these two adjustments, the human cancer potency factor was estimated to be 11.53 $(mg/kg/day)^{-1}$.

In fitting the linearized model, no adjustments were made for the variable ages of the animals at first dosing or the ages attained at the end of the observation period. Using the standard USEPA approach, data on animals exposed to 50 ppm B(a)P or more were discarded because of "lack of fit." USEPA obtained a 95 percent upperbound estimate on the chemical's potency to humans of 11.53 $(mg/kg/day)^{-1}$. This number represents an upperbound on the slope of the cancer dose-response curve for this chemical.

USEPA is currently considering lowering the oral potency factor to 4.3 $(mg/kg/day)^{-1}$ based on a reanalysis of the available dose-response data regarding oral exposures to B(a)P. However, at this time, there is no way to predict either the likelihood that the cancer potency factor will, in fact, be changed or the scheduled date at which any potential agency changes would be finalized.

Other toxicological issues have been raised. One issue focuses on the relevance of the tumor endpoint between animals and humans, which is related to physiological differences of the target organs in animals and humans. When applying the current USEPA oral cancer potency factor to human risk assessment, it is important to question the relevance of the tumor endpoint

from the animal study to humans. The relevance of rodent forestomach tumors to humans has been examined (USEPA, 1982). While apparently relevant with respect to route of administration, the site of tumor production and probable underlying mechanism are possibly unique to laboratory rodents because of the anatomy of the rodent stomach. The forestomach in both rat and mouse is nonglandular and has a stratified squamous epithelium with a cornified covering. The fundus portion of the human stomach (homologous to the forestomach in rodents) is glandular and has a columnar epithelium. The similarities between the epithelium of rodents and that of skin suggest that the induction of forestomach tumors in mice may be analogous to the induction of skin tumors in skin-painting bioassays. This possibility calls into question the relevance of forestomach tumors in mice to the potential for human cancer from B(a)P ingestion.

B(a)P has been shown to cause distant site tumors where administered orally. This is consistent with the wide tissue distribution that has been observed in rodents following GI absorption. Rigdon and Neal observed pulmonary adenomas, thymomas, lymphomas, and leukemia in CFW mice fed B(a)P (Rigdon and Neal, 1966; Rigdon et al., 1967). Ingestion of B(a)P caused mammary tumors in Lewis rats (USEPA, 1979) and Sprague/Dawley rats (USEPA, 1982). Ovarian, lymphoid, mammary, and heptic tumors have also been observed in mice after oral administration of a related PAH (i.e., dimethylbenzanthracene).

For human risk assessment, an oral cancer potency factor based on gastric tumors and/or distant site tumors in a species anatomically more similar to humans than rodents would be desirable. In its absence, the current USEPA

cancer potency factor may be used for oral exposures to humans. Although there is no information of cancers in humans following oral exposures to PAHs, members of this class of compounds have been shown to cause skin, lung, and perhaps bladder tumors in humans when administered by other routes of exposure (IARC, 1985; USEPA, 1982; USEPA, 1979).

Therefore, PAHs can be metabolically activated both at the site of entry (e.g., skin or lungs) and possibly at distant sites (e.g., bladder). Use of the oral cancer potency factor should be accompanied by a consideration of its limitations:

(1) The short duration of the experiment results is an unquantifiable uncertainty in the cancer potency factor.

(2) The possible oversensitivity of the mouse forestomach may overestimate the risk to humans of gastric tumors due to anatomical differences.

(3) The effect of the relative sensitivity of mouse and human stomachs regarding PAH metabolism and tumorigenesis has an unknown effect of the relative sensitivities of mice and humans to the formation of distant site tumors following oral exposures.

(4) The use of only gastric tumors in mice to derive the cancer potency factor and not the total of local and distant tumors introduces uncertainty in the estimates of total carcinogenic risks to humans

following oral exposure B(a)P.

The application of the USEPA oral cancer potency factor to dermal exposures in humans may be an appropriate use of the dose/response data. In the animals and in humans, the major anticipated site of action is the skin tissue itself. Both human and rodent skin exhibit the PAH-metabolizing activity required for tumorigenesis.

For over 200 years, it has been recognized that skin cancers are associated with occupational exposure to tars and pitches related to the destructive distillation of coal. Scrotal lesions represent a large fraction of the skin cancers reported in numerous studies. IARC (1985) has concluded that there is sufficient evidence that occupational exposures to coal tar, as they occur during the destructive distillation of coal, give rise to skin cancer in humans. In addition, there is sufficient evidence that coal tar pitches are carcinogens in humans, and limited evidence that coal tar-derived creosotes are carcinogenic in humans. These data are corroborated by the animal data. There is sufficient evidence for the carcinogenicity in experimental animals of coal tars, creosotes, creosote oils, anthracene oils, and coal tar pitches (IARC, 1985).

Little information exists on the potential for distant site tumors following dermal administration of PAHs to animals. In general, there has been inadequate reporting of the possible effects on internal organs of application to the skin of the text substances. The mouse skin assay, for instance, is restricted to observation of skin tumors.

In conclusion, it is reasonable to presume, based on the available information, that the major target organ of PAHs following dermal exposure by animals and humans is the skin itself. Because the oral cancer potency factor for B(a)P is based on gastric tumors that did not require systematic uptake of the B(a)P and because the anatomy of the rodent forestomach is similar to rodent skin, the cross-route application of a cancer potency factor is reasonable in this case. The uncertainty in the public health risk assessment process cannot be quantified. To have optimal accuracy, the risk assessor may wish to use an appropriately derived toxicokinetic factor to consider the differences in the local uptake into human skin versus uptake into the membranes of the GI tract of the CFW mouse.

The use of an oral cancer potency factor for assessing the risks due to dermal exposures to PAHs has several limitations that have unknown effects on the resulting estimates of carcinogenic risks.

Regarding the ability of a mouse oral cancer potency factor to estimate mouse skin responses, many scientists argue that the oral potency factor underestimates the potency of B(a)P as a mouse skin carcinogen. There is evidence in the literature that PAHs are more potent carcinogens in mouse skin under the experimental conditions than in the mouse GI tract (Grimmer, 1985). Jordan has performed some preliminary calculations to demonstrate this fact.

In a summary of four skin-painting experiments with C57BL/6J female mice (USEPA, 1979), doses of 0.025 umoles and higher (to 0.4 umoles) resulted in 7 to 100 percent of the animals developing tumors. The animals were treated

with B(a)P once every two weeks for 60 weeks by topical application to the shaved skin of the back. Therefore, total doses of as little as 0.19 mg per animal over 60 weeks produced significant carcinogenic responses. A similar result is observed when reviewing the results of a mouse skin study by Bingham and Falk (1969). A dose of 6.25 ug per animal given 3 times a week for 50 weeks caused 35 percent of the test animals to develop skin tumors. B(a)P was administered topically to the backs of C3H/He mice. The total dose of 0.94 mg resulted in a significant carcinogenic response. Habs et al. (1980) also showed that low doses of B(a)P can cause mouse skin tumors. B(a)P was topically applied to the backs of female NMRI mice for their lifetimes at a dose of 1.7 ug/animal, twice a week. It is not known what the lifetime of these animals was, but even assuming a full two years, the total dose per animal that caused a tumor incidence of 24 percent was only 0.35 mg per animal.

These total dermal doses of 0.2 to 0.9 mg per animal to produce a significant carcinogenic response are two orders of magnitude lower than the total orally administered dose of B(a)P that Neal and Rigdon (1967) gave over 100 days to produce a significant carcinogenic response. In that study of B(a)P in the diet, at 40 to 250 ppm, total doses of 13 to 165 mg per animal caused tumor incidences of 2.5 to 90 percent (gastric tumors).

It would appear that the application of the B(a)P oral cancer potency factor would underestimate the risk to mice dosed dermally with B(a)P.

The relevance of this finding to risk assessment is, however, questionable.

Some scientists arguethat potencies for these two dosing situations that vary drastically in their experimental details cannot be directly compared. In the oral experiment, food is consumed for a fraction of each day for the duration of the experiment; whereas, in skin-painting experiments, animals are exposed continuously to the agent. In addition, solvents are often used as vehicles in skin-painting experiments. These solvents may either injure the skin, causing modifications in uptake, or facilitate uptake directly. On the other hand, lipophilic contaminants are generally more efficiently absorbed through the membranes of the GI tract than through intact skin.

The more serious uncertainty involved in interpreting these data concerns the possible differences in sensitivity of mouse and human skin towards PAH carcinogenesis. The uncertainties involved in estimating human risks posed by dermal contact with PAHs using the mouse oral potency factor cannot be quantified.

Several studies have been reported that document the occurrence of tumors other than at the site of entry. However, studies (either for distant-site tumors or for dermal application) are not of a quality that permits the derivation of a potency factor. Because there is no cancer potency factor for dermal absorption, Jordan has used the oral potency factor.

When deriving an appropriate toxicokinetic factor to use for dermal risk assessment with PAHs, the risk assessor needs to be concerned with the local uptake into the skin and the membranes of the gastrointenstinal tract, but not the uptake and absorption into the system circulation. The oral cancer

potency factor for benzo(a)pyrene (B(a)P) is based on local site-of-entry tumors in the gastrointestinal tract of rodents. These tissues are metabolically active and can cause PAH metabolism (EPA, 1979). Some studies have correlated tumorigenesis with arylhydrocarbon hydroxylase activity (EPA, 1979) in mouse gastric mucosa. Thus, systemic uptake and hepatic metabolism is not required for PAHs to cause gastric tumors in mice.

For the skin, where the risk assessor wishes to apply an orally derived dose/response value, the situation is similar. The expected carcinogenic endpoint is primarily cancer of the skin. Skin is also metabolically active, and systemic absorption is not required for skin tumorigenesis. B(a)P has been shown to cause distant site tumors when administered orally. Rigdon and Neal observed pulmonary adenomas, thymomas, and leukemia in mice fed B(a)P (Rigdon and Neal, 1966; Rigdon, et al., 1967). The current EPA cancer potency factor, however, does not consider distant site tumors. Thus, when making the direct comparison of dermal dosing situation to the EPA cancer potency factor, only local uptake into the tissues at the site of entry needs to be considered.

An appropriate dermal toxicokinetic factor would consider the comparative rates of uptake into the tissue, the rates of both toxifying and detoxifying metabolism, and the rates of systemic uptake of the parent compound and/or metabolites between the mouse gastrointestinal tract (diet) and the human skin (soil). Another issue to consider is the residence time of contact of the xenobiotic and the biological membrane. Quantitative information is not available to accurately derive a toxicokinetic factor at this time. It is

reasonable, however, to assume that local uptake of B(a)P into the gastrointestinal tract of mice exceeds the local uptake into the skin from PAH-contaminated soils. The skin is designed as a barrier, whereas the membranes of the gastrointestinal tract are designed to allow, if not facilitate, uptake of substances. It is common for risk assessments to use dermal toxicokinetic factors of 1-10 percent when qualtitatively assessing the risks due to dermal exposures to B(a)P and using its oral cancer potency factor. Thus, it is assumed that the net rate of local uptake of B(a)P into the skin of humans is 1-10 percent of the net rate of local uptake of B(a)P into the gastric mucosa of the mouse. In the absence of data to the contrary, these estimates are reasonable.

For carcinogenic PAHs, Jordan recommends that 0.5-1.0 be assumed as an oral TKF. The Neal and Rigdon study (1967) from which the EPA oral potency factor for B(a)P was derived was a dietary study in mice. B(a)P was administered as an ingredient in standard laboratory chow. No data are available on the effects of soils versus laboratory chow as vehicles. Likewise, no data exist on the comparative uptake or metabolism of B(a)P in membranes of gastrointestinal tracts of mice versus those of humans. Since there is no a priori reason to assume great differences, it is appropriate to use a toxicokinetic factor of 0.5-1.0 for B(a)P.

Basis of the USEPA Inhalation Cancer Potency Factor for B(a)P

A cancer potency factor for humans was derived by USEPA from the study of Thyssen et al. (1981). In this experiment, Syrian golden hamsters were exposed throughout their lives to B(a)P in a sodium chloride aerosol 4.5 hours/day, 7 days/week for 10 weeks, and then 3 hours/day thereafter. Respiratory tract tumors were induced in the nasal cavity, larynx, and trachea. The incidences of respiratory tumors were zero occurrences in a sample of 27 (0/27) for controls, 0/27 for the low-dose group, 9/26 for the mid-dose group, and 13/25 for the high-dose group. The highest exposure level had an adverse impact on survival time. Due to early mortality in the highest dose group, these data were excluded from the derivation of the cancer potency factor. Based on the respiratory tumor response of male hamsters and using the linearized multi-stage model, USEPA derived a potency factor from the study of 0.73 $(mg/kg/day)^{-1}$ (USEPA, 1984a). The cancer potency factor was translated into a human cancer potency factor by multiplying this value by the cube root of the body-weight ratio. This approach is empirically accepted to adjust for species-to-species extrapolation. The factor of $(70/0.12)^{1/3}$ was used to derive the human cancer potency factor of 6.11 $(mg/kg/day)^{-1}$.

USEPA is currently considering lowering the inhalation potency factor to 0.45 $(mg/kg/day)^{-1}$ based on a reanalysis of the available dose/response data regarding inhalation exposures to B(a)P. However, at this time there is no way to predict either the likelihood that the cancer potency factor will, in fact, be changed, or the scheduled date at which any potential agency changes would be finalized.

BENZENE

Benzene has been classified by USEPA as a Class A known human carcinogen based on several studies showing increased incidence of nonlymphocytic leukemia from occupational exposure. These studies have also shown increased incidence of neoplasia in rats and mice exposed by gavage and inhalation.

Derivation of the Oral and Inhalation Cancer Potency Factors

The oral and inhalation cancer potency factors for benzene have been set by USEPA at 2.9×10^{-2} $(mg/kg/day)^{-1}$; they were derived from the human data for inhalation exposure.

The unit risk estimate is the geometric mean of four maximum likelihood point estimates using pooled data from two occupational studies (Rinsky and Young, 1981; Ott, 1978), which were then adjusted for the results of the Wong et al. (1983) study. The pooled cohorts were significantly large and were followed for an adequate period of time. Increases in leukemias were statistically significant and related to dose in one of these studies. The risk estimates derived from considering the Rinsky and Ott studies were very close in value to the risk factor based on Infante et al. (1977), Ott (1978), and Aksoy (1974).

In a retrospective cohort mortality study, Rinsky and Young (1981) observed seven deaths from leukemia among 748 workers exposed to benzene and followed for at least 24 years (17,020 person-years). This increased incidence was statistically significant; the standard mortality ratio (SMR) was 560. (An SMR

is the ratio of the number of deaths observed in the study population to the number of deaths expected if it had the same rate structure as the chosen standard population.) For the five leukemia deaths that occurred among workers with more than 5 years exposure, the SMR was 2,100. Exposures ranged from 10 to 100 ppm (8-hour TWA).

Ott (1978) observed three deaths from leukemia among 594 workers followed for at least 23 years in a retrospective cohort mortality study, but the increase was not statistically significant. Exposures ranged from less than 2 to more than 25 ppm (8-hours TWA).

Wong et al. (1983) reported on the mortality of 3,036 male chemical workers who had been exposed to benzene for at least 3 days/week for 6 months during the years 1946 through 1975. The control subjects held jobs at the same plants for at least 6 months but were never subject to benzene exposure. Dose-dependent increases were seen in leukemia and lymphatic and hematopoietic cancer. The incidence of leukemia was responsible for the majority of the increase. It was noted that the significance of the increase was due largely to a less-than-expected incidence of neoplasia in the unexposed subjects.

TOLUENE

The evaluation of toluene for evidence of human carcinogenic potential is in progress. The dose/response assessment for toluene therefore is based on noncarcinogenic health endpoints.

Derivation of the Oral Risk Reference Dose

The oral RfD is 0.3 mg/kg/day where an uncertainty factor of 100 was applied (10 for sensitive individuals and 10 for interspecies extrapolation). The principal study from which the oral RfD was derived was that of the Chemical Industry Institute of Toxicology (CIIT, 1980). This was a 24-month inhalation toxicology study of Fischer-344 rats exposed to atmospheric toluene and is the only chronic toxicity study of toluene. The concentration levels of 30, 100, or 300 ppm (113, 377, and 1,130 mg/m^3) were administered to 120 male and 120 female rats 6 hours/day for 5 days/week. Equal numbers of each sex were used as controls. After 18 and 24 months, clinical chemistry, hematology, and urinalysis testing was performed. A No-Observed-Adverse-Effect Level (NOAEL) of 300 ppm was based on the finding that all measured parameters at the end of the study were normal except for a dose-related decrease in hematocrit value in females at 100- and 300-ppm exposure levels.

The oral RfD was derived by route-to-route extrapolation and expanding the exposure from 6 hours/day, 5 days/week to continuous exposure, and multiplying by 20 m^3/day for a human breathing rate, dividing by 70-kg human weight, and assuming a 0.5 absorption factor. This absorption factor is not used for all chemicals due to inconsistency in the development methods for RfDs.

An oral study by Wolf et al. (1956) reported no subchronic adverse effects of toluene at the maximum tested dose (590 mg/kg/day). Other subchronic inhalation and oral studies in rats and mice support the NOAEL. Although confidence in the principal study for the oral RfD is rated high due to the large sample size and number of measurements, the confidence of the oral RfD is only medium because it was based on an inhalation study.

Derivation of the Inhalation Risk Reference Dose

The AIC for inhalation has recently changed from 1.5 mg/kg/day to 1.0 mg/kg/day (USEPP, 1987). This is a reevaluation of the Chemical Industry Institute of Toxicology (CIIT) (1980) study, as mentioned in the discussion of the oral RfD. The derivation of this number is not known.

ETHYL BENZENE

Ethyl benzene has not yet been evaluated by USEPA for its human carcinogenic potential. Therefore, an RfD is calculated which assumes the health effect of concern is noncarcinogenic.

Derivation of the Oral Risk Reference Dose

The oral RfD for ethyl benzene is listed in IRIS as 0.1 mg/kg/day. It is based on a rat oral bioassay by Wolf et al. (1956) which showed liver and kidney toxicity. In the selected study, four groups of 10 albino female rats were administered doses of 13.6, 136, 408, or 680 mg/kg/day respectively of ethyl benzene in an olive oil gavage over 182 days. There were 20 rat controls.

The No-Observed-Effect Level (NOEL) of 136 mg/kg/day, from which the RfD is derived, is associated with histopathological changes seen in the liver and kidney. Other health endpoints examined in the study included: growth, mortality, appearance and behavior, hematological measurements, terminal concentration of urea nitrogen in the blood, final average organ and body weights, and bone marrow counts.

The RfD was derived from the NOEL by multiplying by 5 days/7 days to extrapolate to continuous exposure. No absorption factor was applied.

The chosen study is given a low confidence rating because only one sex was included in the study and because it was not a chronic duration study. In

addition, other supporting studies of oral toxicity are not known.

STYRENE

The evaluation of the human carcinogenic potential for styrene is under review by a USEPA inter-office agency work group. Although it is currently classified by USEPA as a probable human carcinogen (i.e., Class B2), there is no USEPA cancer potency factor. Therefore, in this analysis noncarcinogenic risks are estimated. In IRIS, the RfD is calculated for noncarcinogenic endpoints for oral exposure only.

Derivation of the Oral Risk Reference Dose

The styrene oral RfD is 0.2 mg/kg/day, which is principally based on the subchronic oral study in dogs by Quast et al. (1979). This study showed evidence of a NOAEL of 200 mg/kg/day for red blood cell and liver effects. There are other supporting studies cited. There is no dose conversion factor applied to the NOAEL of 200 mg/kg/day from the Quast et al. (1979) study to obtain the RfD.

The chosen study exposed four female and four male beagle dogs to doses of zero, 200, 400, or 600 mg styrene/kg body weight/day by peanut oil gavage for 560 days. No adverse effects were noted in the dogs gavaged with doses of 200 mg/kg/day. The effects observed at the higher dose categories were increased numbers of Heinz bodies in the red blood cells and liver, and increased iron deposits. There were noteworthy differences in the variations of blood cell parameters in individual animals at the same dose level.

The supporting chronic study of Ponomarkov and Jomatis (1978) dosed rats once

per week for 120 weeks with 500 mg/kg styrene. Mice were once dosed per week for the same duration with 300 mg/kg styrene. The rats showed no significant effects. This study was deemed inappropriate for risk assessment of chronic toxicity due to the weekly dosing schedule.

Another study by Wolf et al. (1956) gave oral daily doses to rats over 185 days, which is not considered a chronic duration. While the rats receiving an oral dose of 95 mg/kg body weight/day showed no adverse effects, the rats receiving oral doses of 285 and 475 mg/kg/day showed reduced growth and increased liver and kidney weights.

Other subchronic studies in rats with orally administered doses reported Lowest-Observed-Effect Levels (LOELs) at 350 to 500 mg/kg/day and NOELs at 100 to 400 mg/kg/day.

The confidence rating for the styrene oral RfD is medium because the critical study, although well performed, used such a small number of animals. In addition, none of the studies supporting the RfD value are considered as chronic in duration.

XYLENE(S)

The carcinogenic assessment of xylene by USEPA is awaiting the review of an inter-office agency work group. The toxicity of xylene is assessed for non-carcinogenic endpoints based on an RfD.

Derivation of the Oral Risk Reference Dose

The oral RfD listed in IRIS is 2 mg/kg/day; this value is based on a NOAEL of 250 mg/kg/day, reported by the NTP (1986b) in a study of chronic health effects on gavaged rats. This was selected as the primary study because it used a chronic exposure in two species by a relevant route of administration, and comprehensive histology was conducted. The critical effects noted by the NTP were hyperactivity, decreased body weight, and increased mortality. Xylene gavage doses of zero, 250, or 500 mg/kg/day were given to groups of 50 male and 50 female Fischer-344 rats for 5 days/week for 103 weeks. During the same time, groups of 50 male and 50 female B6C3F1 mice were gavaged with zero, 500, or 1,000 mg/kg/day.

Gross necropsy and comprehensive historical examinations were performed on all animals that died or were sacrificed. There were no compound-related histopathologic lesions in any of the exposed rats or mice. Therefore, the low dose of 250 mg/kg/day was set as the NOAEL. There was increased dose-related mortality in male rats that was significantly higher in the high-dose group compared with the controls; however, this effect was not significant in the low-dose group. The authors noted that the behavioral changes associated with xylene exposure may have caused rats to resist gavage.

Two other subchronic studies, although not cited as specific supporting studies for the RfD, provide evidence of xylene's toxic effects. A rat dietary study by Bowers et al. (1982) reported a NOAEL of 10 mg/kg/day with an uncertainty factor of 1,000. An inhalation study by Jenkins et. al. (1970) on rats, guinea pigs, monkeys, and dogs was used by USEPA in 1985 to calculate an RfD of 0.06 mg/kg/day, where the effects seen at the high dose were deaths in rats and monkeys and tremors in dogs.

The only adjustment made to the NOAEL of 250 mg/kg/day to obtain the RfD of 2 mg/kg/day was to adjust the dose from 5 days/week to continuous. The uncertainty factor of 100 was chosen to give a factor of 10 for species-to-species extrapolation and 10 to protect sensitive individuals.

The oral xylene RfD is given a medium confidence level because the NTP study was considered adequate in size, duration of study, and comprehensiveness of histological examinations, but did not include clinical chemistries, analysis of blood enzymes, and urinalysis. In addition, no LOEL has yet been reported for chronic oral exposure to xylene for comparison with the NOAEL.

Derivation of the Inhalation Risk Reference Dose

The inhalation RfD is taken as the value listed in the Superfund Public Health Evaluation Manual. This value is 0.4 mg/kg/day based on a subchronic rat study (Carpenter et al., 1975 NTP; 1986b). A dose of 3,500 mg/m^3 was administered 6 hrs/day, 5 days/wk for 13 weeks. No effects were seen at this dose. Derivation of the RfD from this study is not known. An uncertainty factor of 1,000 was used.

NAPHTHALENE

The dose/response value for naphthalene is used to evaluate the potential hazards of noncarcinogenic PAHs. Currently, there is inadequate evidence that naphthalene is carcinogenic. Its dose response value is an AIC as listed in the USEPA Health Effects Assessment (HEA) Quarterly Update (9/88) and the SPHEM update (8/88). The AIC is determined for noncarcinogenic adverse health effect for naphthalene.

Derivation of Oral Risk Reference Dose

The AIC for naphthalene is 0.4 mg/kg/day, which was derived from a study by Schmahl (1955). In this study rats (strain not specified) were exposed in the in their diet to a dose that ranged from 10-20 mg/day. The rats were dosed 6 days/week for 700 days. The equivalent lifetime dose for the rats was 41 mg/kg/day. The observed toxicological effects were ocular and internal lesions.

The NOEL for the Schmahl study was 41 mg/kg/day. The AIC was derived from this NOEL by applying an uncertainty factor of 100 (for inter and intraspecies extrapolation), resulting in an oral AIC for humans of 0.4 mg/kg/day.

CYANIDE

The USEPA-verified RfD for cyanides was derived from a NOAEL observed in an animal study conducted by Howard and Hanzel (1955). In this study, groups of 10 male and 10 female albino rats were maintained for 104 weeks on diets that had been fumigated with HCN. The food was analyzed by steam distillation into sodium hydroxide solution with subsequent titration of the resulting CN-ion. Because the HCN vaporized from the food, the diet was analyzed initially and after two days. The authors determined that fresh food needed to be prepared and fed on alternate days to maintain the HCN level within specified ranges.

The average measured HCN concentrations in the diet were 76 mg/kg of food for the low-dose level and 190 mg/kg of food for the high-dose level. A similar group of rats fed the basal diet were maintained as controls. The diets provided cyanide doses of zero, 3.2, and 7.8 mg/kg/day for males; and zero, 4.3, and 10.8 mg/kg/day for females. These doses were calculated from food consumption and body weight data provided by the authors. During the two years of study, the growth curves for all groups did not vary as a result of treatment. Food consumption, hematological values, and survival were also similar in all groups during the study. Except for changes associated with aging, pathological changes in the Central Nervous System (CNS) or other organ systems were not observed.

The highest NOAEL (10.8 mg/kg/day for female rats) is the basis of the USEPA RfD (USEPA, 1989a). According to USEPA guidelines, an uncertainty factor of 100 was used to derive the RfD (10 for species extrapolation; 10 for sensitive

populations). A modifying factor of 5 was used to account for the apparent tolerance to cyanide when it is ingested with food rather than when it is administered by gavage or drinking water. The RfD is, therefore, 2×10^{-2} mg/kg/day (USEPA, 1989a). USEPA's confidence in the Howard and Hanzel (1955) study is medium. Adequate records of food consumption and body weight were maintained, and animals of both sexes were tested at two doses for two years. The data base was rated medium because a small but sufficient number of studies support the chosen study. Therefore, USEPA has medium confidence in the RfD (USEPA, 1989a).

Upon first examination of other cyanide toxicity data, it might appear that the RfD is not adequately protective of public health. Jordan reviewed supporting toxicity information on cyanides, however, and has determined that the USEPA RfD is technically sound. According to ATSDR (1988), observed oral lethal doses for humans and rats are lower than 11 mg/kg. In addition, a Lowest-Observed-Adverse-Effect Level (LOAEL) for dogs based on neurotoxic effects has been defined by a study by Hertting et al. (1960). Both USEPA and ATSDR have determined that it is inappropriate to base the derivation of an RfD on the Hertting study for several reasons. Animals dosed at 0.27 mg/kg/day exhibited degenerative changes in Central Nervous System (CNS) cells. However, these animals were given bolus doses of NaCN by gavage (capsule). It is well- documented that animals can tolerate higher doses of cyanide when administered in the diet or drinking water over long periods of exposure (USEPA, 1985d). This fact also explains the observation of oral lethal doses in mammals at levels below the rat NOAEL. In a study by Hayes (1967), rats tolerated 25 daily doses of 4 mg cyanide/kg when the chemical was

mixed in the diet. Each dose was equal to an acute oral LD50. In addition, rats tolerated higher doses of KCN when administered in drinking water than when administered in bolus by gavage with water as the vehicle (USEPA, 1985d).

USEPA has also determined that the dog is not a good model for cyanide toxicity in humans. Dogs have been shown to be the most sensitive of the usual laboratory animals to cyanide's effects (ATSDR, 1988). This is due to the low level of cyanide metabolic capacity of the dog liver. Total rhodanese activity in all other species tested is higher than in dogs. Rhodanese is the enzyme that detoxifies cyanide. This is another reason that the low LOAEL for dogs in the Hertting study is not inconsistent with the cyanide toxicological data base.

In another study, Philbrick et al. (1979) identified a LOAEL in rats at doses of 30 mg/kg/day. Myelin degeneration was observed in spinal cords of rats fed this dose level. In addition, depressed thyroid function was observed. The NOAEL defined by the Howard and Hanzel study (1955) is not inconsistent with the LOAEL defined by the Philbrick study.

Application of the Oral Cyanide Risk Reference Dose to Inhalation Exposures

USEPA has not derived an RfD or an AIC level for inhalation exposure to cyanides. Animal studies pertaining to the chronic toxicity of inhaled cyanide were not located in the scientific literature. To assess quantitatively the human health risks due to inhalation of particulate cyanide compounds, Jordan therefore evaluated the suitability of using the oral RfD.

It is well known that inhalation of HCN gas is much more toxic than ingestion of bolus doses of cyanide salts or ingestion of cyanide salts as dietary or drinking water constituents (USEPA, 1984b; ATSDR, 1988). This is due both to the efficient pulmonary uptake of HCN and to the decreased first-pass metabolic identification of cyanide when inhaled compared to ingestion. It is inappropriate to assess the risks of inhalation of HCN gas by use of the USEPA oral RfD. On the other hand, the oral RfD can be used to assess risks due to inhalation of cyanide-containing particulates if an appropriate toxicokinetic factor is applied.

There is no information available on the uptake of cyanide salts by the lungs. All available inhalation toxicology studies use cyanide in the form of HCN. It is reasonable to anticipate that particular cyanide salts are absorbed in the lungs, but to a lesser degree than HCN. This conclusion is based on the knowledge that cyanide salts are absorbed through the skin. Cyanides are moderately lipid-soluble, which allows them to rapidly penetrate the epidermis. In addition, some cyanide compounds (e.g., potassium cyanide) have a corrosive effect on the skin that increases the rate of dermal absorption (ATSDR, 1988). It is expected that particulate cyanide salts would be absorbed more efficiently through pulmonary membranes that are constantly bathed with aqueous physiological solutions than through intact skin.

In addition, it has been reported that sodium cyanide and potassium cyanide are extremely toxic when inhaled (Sax and Lewis, 1986). Jordan is unaware of any studies that described the degree of uptake of cyanide salts when inhaled; nor is there any quantitative information available concerning the relative

detoxification of cyanide when ingested versus when inhaled. To properly utilize the oral RfD in assessing inhalation risks, the effects of these competing processes need to be estimated. Jordan has defined an inhalation toxicokinetic factor to evaluate these two processes.

Jordan assumes that the degree of pulmonary adsorption of cyanide particles retained in the lungs is the same as the degree of GI absorption in the Howard and Hanzel study (1955), and that pulmonary retention of 10 um particles is 75 percent of the inhaled particles. Further, Jordan assumes that the detoxifying hepatic metabolism after ingestion is 10 times that following inhalation. Therefore, the toxicokinetic factor is 7.5 relative to GI exposure in the study from which the RfD was derived.

The toxicokinetic factor is consistent with the available information about the toxicity of HCN gas. If it is assumed that the adsorption following inhalation of HCN gas is 10 times the absorption following ingestion of cyanide salts in the gut, and that metabolism following ingestion is 10 times that following inhalation exposure, then it could be predicted that inhaled HCN is 100 times more toxic than ingested cyanide ion. This prediction is consistent with the observed human lethal doses. The oral lethal dose in humans has been reported to be approximately 1 mg/kg, whereas the inhalation lethal dose for HCN is approximately 0.02 mg/kg (ATSDR, 1988). This increase in toxicity is due partly to the high pulmonary uptake of the agent and the decreased metabolism.

Application of the Cyanide Risk Reference Dose to Dermal Exposure

Because cyanides are known to be readily absorbed through skin, it is appropriate to use the RfD to assess the risks posed by dermal contact with cyanide containing soil. As with inhalation exposures, it is expected that the metabolic detoxification is 10 times more efficient for ingestion exposure compared to dermal exposure. No information is available on the efficiency of uptake of cyanide from contaminated soil. Jordan also assumes that the dermal uptake of cyanide from cyanide-containing soil is 10 percent as efficient as uptake of cyanide from HCN-treated food in the study from which the RfD was derived. Therefore, the relevant toxicokinetic factor is one.

Application of the Cyanide Risk Reference Dose to Oral Exposures

As discussed previously, the toxicity of cyanide when given as a dietary constituent is less than when given as a pure compound by gavage. There is no information available regarding the efficiency of adsorption when soil or diet is the vehicle. A conservative approach is to assume that the uptake is the same. Therefore, Jordan recommends that a toxicokinetic factor of one be used in assessing the risks to human health posed by ingestion of contaminated soil.

Cyanide Speciation

Jordan recommends that the USEPA oral RfD for cyanides only be applied to free cyanides. These would consist of HCN and cyanide salts, which result in the free cyanide ion being released in solution. Iron-complexed cyanides (e.g., ferro- and ferricyanide) are forms of cyanide in which the cyanide ion is not dissociable. Potassium ferrocyanide, for instance, has been shown to be fatal

to rats only at very high doses (1,600 mg/kg) after oral dosing (NIOSH, 1985). The lethal dose for 50 percent of rats tested (LD50) ranges from 1,600 to 3,200 mg/kg (Clayton and Clayton, 1982). It has also been reported that dogs, which are the most sensitive of the known laboratory animals, tolerated 2,626 mg/kg of ferrocyanide given intravenously. The complex was rapidly excreted in the urine (Clayton and Clayton, 1982). No reports of adverse effects in humans from the ferro- or ferricyanide could be found in the literature surveyed. Use of the USEPA RfD to estimate the human health risks posed by exposure to iron-complexed cyanide would therefore greatly overestimate the actual risks.

TRIMETHYLBENZENE

Trimethylbenzene has not been evaluated by the USEPA for its toxicity; however, it is believed to be comparable to other compounds of the alkybenzene class, such as xylene, tolune, and ethylbenzene. Because xylene is most closely structurally related to tremethylbenzene, the oral and inhalationn RFds for xylene of 2.0 and 0.4 mg/kg/day, respectively were also used for trimethylbenzene.

Although the ACGIH TLV is lower for trimethylbenzene than for xylene, the reasoning behind this is unclear. No other study seems to indicate that the toxicity of trimethylbenzene is higher than that of xylene. The LD50s (lethal dose - 50; the dose at which 50% of the dosed animals die) for the guinea pig are 2,000 mg/kg for xylene and 1,303 mg/kg for trimethylbenzene. The oral rat LD50s are 4,300 mg/kg and 8,970 mg/kg for xylenes and trimethylbenzenes, respectively. Thus, there is no significant difference in acute toxicity between the two compounds. Klaasen et al., (1986) describes the acute toxicity of all alkylbenzenes as Central Nervous System (CNS) depressant and toxic at levels that are relatively similar. They also conclude that all alkylbenzenes are relatively nontoxic except in acute exposures to high doses, and are metabolized to less toxic compounds via a nonsaturable pathway. Thus, the possibility of trimethylbenzene or any alkylated benzenes forming toxic reactive intermediate compounds is very slim.

Jordan feels that until more information is gained on trimethylbenzenes, the assumption of a similar toxicity to xylene is conservative and applicable in this risk assessment.

Appendix G-2

Toxicological Profiles

POLYNUCLEAR AROMATIC HYDROCARBONS

Polynuclear aromatic hydrocarbons (PAHs) are a class of several hundred compounds, all of which consist of annelated benzene rings. While each compound has specific chemical properties, their fate in the environment can be summarized broadly.

Several of the PAHs are volatile enough to exist as vapors in the atmosphere, including naphthalene, phenanthrene, anthracene, fluoranthene, and pyrene. These compounds are subject to photochemical degradation and are expected to have an atmospheric half-life of less than one day. PAHs with low vapor pressure exist in the atmosphere adsorbed to particulate matter. The half-life of these compounds may be from less than one day to several weeks, depending on the composition of the particulate matter and extent of PAH degradation from ozonolysis reactions (USEPA, 1984a). Studies have indicated that particles less than 3.0 um have the highest PAH sorption (Pucknat, 1981).

The half-life of PAHs in the soil is highly variable and can range from less than one day to several decades. Because PAHs have low water solubility and adsorb to soil particles, they are not expected to be highly mobile in soils. No significant leaching of PAHs into the groundwater is expected, particularly if the soils have high organic carbon content (USEPA, 1984a).

PAHs are ubiquitous in the environment and most are formed during the combustion of organic compounds. Major sources of PAHs include incomplete combustion of fuels for heat and manufacturing; burning of coal, gasoline, and

diesel fuel; and burning of municipal and agricultural wastes. PAHs are associated with manufactured process gas residuals (Atlantic Environmental Services, 1988). Cigarette smoke also contains PAHs. To a limited extent, these compounds also occur naturally (i.e., plants and bacteria synthesize PAHs during growth, and naturally-caused brush and forest fires produce PAHs).

The carcinogenic properties of individual PAHs have been known for over 50 years, but not all PAHs are carcinogenic. Most carcinogenic PAHs are derived from the benzo(a)anthracene structure. Benzo(a)anthracene is weakly carcinogenic; however, the addition of benzene rings to specific positions substantially increases the carcinogenicity of the new compound. The substitution of methyl groups to specific carbons of the benzene ring also increases the carcinogenicity (Klaassen et al., 1986). Of the sixteen PAHs detected at this site, six are classified as potential human carcinogens (Carcinogen Assessment Group [CAG] B2 classification).

There are numerous animal studies of the carcinogenic potential of individual PAHs; however, limited information is available on the effects of complex mixtures of PAHs in the environment. It is not certain what effect interactions of carcinogenic and noncarcinogenic PAHs have on the carcinogenic potential of the mixture. Complex mixture information is largely derived from mouse skin-painting experiments with extracts of coal tar products and gasoline or diesel exhaust. Carcinogenic responses have been reported; however, problems with study design and reporting limit the interpretation of these findings.

PAHs are lipophilic and are absorbed from the gastrointestinal (GI) tract, lungs, and across the dermal membrane. Studies of benzo(a)pyrene (B(a)P) have found that it readily crosses the membranes of the GI tract, and tissue accumulation is exponential as B(a)P concentrations increase. B(a)P has also been found to be readily absorbed from the lungs (Kotin et al., 1969; Vaino et al., 1976; Mitchell and Tu, 1979).

Once PAHs have been absorbed, metabolic activation is required to convert PAHs to the reactive electrophilic species which are responsible for tumorigenesis. PAHs are metabolized by the cytochrome P-450 system to epoxides, which are subject to epoxide hydrolases, and form stereoisomeric diols. Diol epoxides bind to DNA (Klaassen et al., 1986).

PAHs are excreted via the bile and GI tract into the feces. Animal studies of injected PAHs found trace amounts of PAHs in the urine and expired air, but the majority was excreted in the feces (Heidelberger and Jones, 1948; Heidelberger and Weiss, 1951).

The carcinogenicity of PAHs has been demonstrated in both human and animal studies. Occupational studies involving worker exposure to PAHs from emissions of coke ovens, foundry processes, coal gas production, roofing tar, and coal combustion have reported increased risk of lung and other-site cancer mortality. While not proven, PAH exposures are believed to be the cause of the increased risk. Varying degrees of increased risk have been noted among different occupations and may be attributed to different durations and

intensities of exposures, the presence of other compounds, and different PAH mixtures to which the workers were exposed.

Epidemiologic studies of community populations are confounded by many factors (e.g., exposure to other chemicals, residence time in the community, varying levels of air pollution over time, and cigarette-smoking behavior). However, when cigarette smoking was controlled for, a study of urban residents found a two-fold increase in the risk of lung cancer when compared to rural residents. This increased risk may be attributed to the higher level of PAHs in city air (USEPA, 1979).

Numerous animal studies have reported tumorigenesis resulting from inhalation, oral, dermal/skin-painting, and injection exposures to PAHs. Lung, liver, mammary gland and digestive tract tumors, and leukemia have been reported. These studies involved exposures to separate PAHs, while the human studies involved exposures to mixtures. The animal studies were also high-dose exposures with a limited number of animals. Estimation of carcinogenesis from low-dose exposure is subject to considerable uncertainty, which is compounded when the exposure is to a mixture of PAHs rather than a single compound.

Noncarcinogenic effects of PAH exposure have also been reported in animal studies. These effects include weight loss, kidney and liver function changes, bronchitis, and serum enzyme changes (Knobloch et al., 1969). Animal studies have found PAHs to cross the placenta, and teratogenic effects have been reported (Pucknat, 1981).

Because the effects of PAH exposure are dependent on metabolism of the PAHs, exposure to any compound which either inhibits or induces the enzyme systems associated with PAH metabolism may potentially magnify or reduce the effects of the exposure. People who have altered metabolism or are exposed to compounds in the environment or dietary elements that may affect the cytochrome P-450 system may have increased health risks from PAH exposure.

Occupational standards have been established for PAH exposure associated with coal tar pitch volatiles. The following PAHs found at this site have been classified as probable human carcinogens (CAG B2 classification): benzo-(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, chrysene, dibenzo-(a,h)anthracene, indeno(1,2,3-cd)pyrene. In addition, the State of New York considers benzo(k)fluoranthene to be a probable human carcinogen.

BENZENE

Benzene is a highly flammable volatile aromatic hydrocarbon that is used both as a gasoline additive and a chemical intermediate in the production of many compounds (e.g., styrene and phenol). Benzene is associated with manufactured gas process residuals (Atlantic Environmental Services, 1988). Volatilization appears to be the major transport process of benzene from surface waters and soils to the ambient air, and atmospheric transport of benzene occurs readily (USEPA, 1979). Data indicate that it may be photo-oxidized rapidly in the atmosphere. The atmospheric destruction of benzene is probably the most likely fate process. Values for benzene's log octanol/water partition coefficient (K_{ow}) indicate that adsorption onto organic material may be significant. Sorption processes are likely removal mechanisms in both surface water and groundwater. Gradual biodegradation by a variety of microorganisms probably occurs. The rate of benzene biodegradation may be enhanced by the presence of other hydrocarbons.

Benzene is a recognized human carcinogen (IARC, 1982). Several epidemiological studies provide sufficient evidence of a causal relationship between benzene exposure and leukemia in humans. Several occupational studies since 1969 on exposures to low benzene concentrations (i.e., less than 9 ppm) conducted 1969 have shown no excess leukemias among workers and no mortality findings directly attributable to benzene exposures. Benzene is a known inducer of aplastic anemia in humans, with a latency period of up to 10 years. It reduces the number of white blood cells and other blood components, which may progress to a reduction in all blood cell types. Similar adverse effects

on the blood-cell-producing system occur in animals exposed to benzene. In both humans and animals, benzene exposure is associated with chromosomal damage, although it has not been shown to be mutagenic. Benzene has been shown to be fetotoxic and to cause embryolethality in experimental animals.

Exposure to high concentrations of benzene in the air causes central nervous system (CNS) depression and cardiovascular effects. Benzene has been reported to cause subjective symptoms (e.g., headaches and nausea) with chronic exposure to as little as 100 parts per million (ppm). Acute exposures of 50 to 150 ppm for 5 hours or 500 ppm for 1 hour will cause headaches, lassitude, and fatigue. An hour-long exposure at 1,500 ppm can cause illness, and 5 to 10 minutes at 20,000 ppm may be lethal for humans (Clayton and Clayton, 1981). No data could be found on subjective symptoms caused by benzene exposures closer to the National Institute for Occupational Safety and Health (NIOSH) recommended workplace time-weighted average (TWA) standard of 1 ppm, or the American Conference of Governmental and Industrial Hygienists (ACGIH) threshold limit value (TLV) of 10 ppm, which are designed to prevent leukemia and other chronic health effects in worker populations.

Acute occupational exposures have occurred. Browning (1965) reported that severe exposures, such as would occur when working in a storage tank, cause convulsions, paralysis, unconsciousness, and death. Deaths from cardiac sensitization and cardiac arrhythmias have also been reported after relatively large exposures. Milder exposure produced giddiness, headache, and nausea, followed by unconsciousness.

Early workplace practices produced chronic exposures to benzene at levels of 500 to 1,000 ppm. These exposures caused headaches and other clinical signs of benzene poisoning. Helmer (1944) reported that 60 of 184 workers in one plant exhibited headaches, fatigue, and blood disorders. Benzene levels were measured at 140 to 220 ppm after changes in work practices and ventilation equipment was installed; initial concentrations had been estimated at more than 5,000 ppm. Greenburg et al. (1939) reported on chronic benzene poisoning in three rotogravure printing plants. Benzene concentrations ranged from 11 to 1,060 ppm, and workers were exposed for 4 to 7 days/week. Symptoms reported for the 286 of 332 workers with varying degrees of benzene poisoning included fatigue, dryness of mucous membranes, nausea or vomiting, and lethargy for medium-level exposures; and the same symptoms plus weakness, nose bleeds, loss of appetite, shortness of breath, dizziness, and lethargy for the highest concentration level.

TOLUENE

Toluene is an aromatic hydrocarbon that is flammable, practically insoluble in water, and fully miscible with many organic liquids. Toluene is produced primarily from petroleum sources. It is used to produce benzene and phenol. Also, toluene is used as a solvent and an intermediate in production of explosives and specialty organic chemicals. Toluene is associated with manufactured gas process residuals (Atlantic Environmental Services, 1988).

Almost all toluene discharged to the environment by industry is in the form of atmospheric emissions. Photo-oxidation is the primary atmospheric degradation process for toluene, and benzaldehyde is reported to be the principal organic by-product. Direct photolytic cleavage of toluene is energetically improbable in the atmosphere, and oxidation and hydrolysis are probably not important as aquatic fates.

Toluene is known to be degraded by microorganisms and can be detoxified and excreted by mammals. However, the available data do not allow estimation of the relative importance of biodegradation/biotransformation processes.

Acute and chronic inhalation exposures to 200 ppm or greater concentrations of toluene vapor cause eye irritation, headaches, nausea, and other Central Nervous System (CNS) effects in humans. In humans, acute exposures to very high concentrations can cause narcosis, but exposures to quantities sufficient to produce unconsciousness fail to produce organ damage.

Acute toluene exposure can cause subjective CNS symptoms (e.g., nausea, headache, and fatigue) as well as eye irritation, at levels equal to or exceeding 200 ppm. In a study of three subjects who were exposed for eight hours to various toluene levels, one subject reported a mild headache at levels of 50 or 100 ppm in the air. At 200 ppm the majority reported fatigue, muscular weakness, repeated headache, nausea, impaired coordination, eye irritation, and after-effects (including fatigue, general confusion, and moderate insomnia) (Von Oettigan et al., 1942). As the toluene concentration was increased, the severity of these effects increased. At 800 ppm, volunteers reported severe fatigue, pronounced nausea, mental confusion, uncoordination, and severe after-effects. In a similar experiment, two subjects exposed for eight hours reported slight exhilaration at 200 ppm, lassitude and nausea at 400 to 600 ppm, and headache, nausea, and severe lassitude at 800 ppm (Carpenter et al, 1944). In studies of 10 people, the majority of the subjects reported eye and throat irritation after a 3 to 5 minute exposure to 300 ppm toluene. The subjects considered 200 ppm to be acceptable for an 8-hour exposure (Nelson et al., 1943). Others reported that a single 7-hour exposure to 200 ppm caused CNS effects such as decreased coordination, prolonged reaction time, decrease in pulse, and decrease in systolic blood pressure (Ogata et al., 1970).

Chronic exposure to toluene was also reported to cause CNS disturbances. In 100 workers exposed to toluene for one to three weeks, and who sought medical attention, 30 percent were exposed to 200 to 500 ppm and complained of headache, nausea, anorexia, lassitude, impairment of coordination, and loss of memory (Wilson, 1942). The workers exposed to 500 to 1,500 ppm complained of

nausea, headache, dizziness, anorexia, extreme weakness, and pronounced impairment of coordination and reaction time. It was unclear whether toluene levels below 200 ppm caused adverse effects.

Other CNS alterations have been observed in workers. Parmeggiani and Sassi (1954) reported that six of 11 workers exposed to 200 to 800 ppm toluene for many years exhibited signs of nervous hyperexcitability. In another setting, one worker exposed for many years to 210 to 300 ppm showed symptoms of stupor, nervousness, and insomnia. However, in 17 other workers exposed to 80 to 160 ppm, no CNS effects were noted (Capellini and Alessio, 1971). Chronic occupational exposure to 300 to 430 ppm toluene was also reported to cause behavioral changes.

The most noted effect of toluene in animals is CNS depression following high-level exposure. Vapor levels at or below 1,000 ppm appear to have little effect on gross parameters, although more sensitive indicators (e.g., electroencephalogram [EEG] changes) were noted in rats. Several studies indicate that toluene exerts no adverse effects on the blood-forming organs in rats and dogs. However, leukocytosis, impaired leukopoiesis, and chromosomal damage in the bone marrow were reported by several other researchers for rats and mice. Most inhalation and ingestion studies produced no evidence of liver damage, but effects suggestive of liver damage were noted at higher inhalation exposures (i.e., 2,000 ppm) in rats and various animals dosed intraperitoneally. Several studies reported renal injury to rats, dogs, and guinea pigs after subchronic inhalation of toluene in excess of 600 ppm. Lung irritation effects were observed in some studies with dogs, guinea pigs, and

rats. The acute oral LD50 for rats ranges from 6 to 7.5 g/kg. Inhalation LD50 values range from 500 to 700 ppm for mice and 4,000 ppm for rats (USEPA, 1983a).

There is no conclusive evidence that toluene is carcinogenic or mutagenic in animals or humans (USEPA, 1980a). The National Toxicology Program (NTP) is currently conducting an inhalation carcinogenicity bioassay with rats and mice. Researchers have reported that toluene is embryotoxic but not teratogenic in laboratory animals. There are no accounts of teratogenic effects in humans after exposure to toluene.

ACGIH recommends a TLV of 100 ppm (375 mg/m^3) toluene. This value appears to be appropriate for the prevention of headache and nausea, as well as other CNS effects. A short-term exposure limit of 150 ppm (560 mg/m^3) has been recommended for exposures of less than 15-minute duration in an 8-hour day.

ETHYL BENZENE

Ethyl benzene is a volatile aromatic compound with a high log K_{ow}, indicating that it adsorbs onto organic particles in the soil, slowing its transport to groundwater and surface water. Small amounts of ethyl benzene can leach into groundwater from soil (especially sandy soil) and may biodegrade in subsurface soils. The half-life of ethyl benzene in air is 35 hours. The primary loss mechanisms from the soil surface is expected to be evaporation. Ethyl benzene is a chemical which is associated with manufactured gas process residuals (Atlantic Environmental Services, 1988).

To date, ethyl benzene has not been evaluated by USEPA for human carcinogenicity potential. The target organs for health impacts from acute exposures are the eyes, upper respiratory system, skin, and CNS. No data on teratogenicity or mutagenicity of ethyl benzene were located by USEPA (1980b).

Human toxicity of ethyl benzene is characterized by its irritancy to the skin, and less markedly, to the mucous membranes (ACGIH, 1986). The TLV for ethyl benzene of 100 ppm was set to protect against its irritant effects. At this concentration, no systemic effects of ethyl benzene are expected to be produced (ACGIH, 1986).

Bardodej and Bardodejava (1970) reported no toxic effects in volunteers after inhalation exposure to 100 ppm ethyl benzene for 8 hours. Their exposure to an increased concentration of ethyl benzene resulted in fatigue, headache, and mild eye and respiratory irritation.

STYRENE

Styrene is a volatile aromatic compound produced primarily from the dehydrogenation of ethyl benzene. Styrene is used to produce polystyrene, which is a thermoplastic with excellent electrical properties and thermal stability.

The target organs for toxic effects are the CNS, the respiratory system, and the eyes and skin. There is some epidemiologic evidence of greater sensitivity of the human fetus than the adult to the systemic toxic effects of styrene. These studies are described in the following paragraphs.

The frequency of spontaneous abortions among Finnish chemical workers was analyzed by Hemminki et al (1980). Information on spontaneous abortions (15,482 cases), induced abortions (71,235 cases), and births (193,897 cases) for 1973 through 1976 was obtained from the Hospital Discharge Registry of the Finnish National Board of Health. The information was linked by social security number to the membership of the Finnish Union of Chemical Workers (approximately 900 female members). The rates of spontaneous abortion were 8.5 percent (N = 52) and 15.0 percent (N = 6) among the female union members and a subgroup in the styrene industry, respectively. These rates were significantly higher ($p < 0.01$) than the rate among all Finnish women (5.5 percent, N = 15, 482).

The information on the work histories of 43 Finnish mothers of children born with CNS defects from June 1, 1976, to March 1, 1977, were obtained through

personal interviews (Holmberg, 1977). Two mothers had been employed in the reinforced plastics industry with regular exposure to styrene, polyester resin, organic peroxides, and acetone. The defects in their two children were anencephaly and congenital hydrocephaly. The overall rates of anencephaly and congenital hydrocephaly were reported to be 0.2 and 0.3 respectively, per 1,000 live births in Finland. Based on these estimates, there appeared to be more than a 300-fold increased rate of these malformations in the reinforced plastics industry during the 9-month study period, compared to the general population (2/12 versus 0.5/1,000).

Retrospective cohort mortality and case-control studies were conducted on workers exposed to styrene in the styrene-polystyrene manufacturing industry and in the styrene-butadiene synthetic rubber industry (McMichael et al., 1976; Smith and Ellis, 1977; Meinhardt et al., 1978). Inadequate data are available at present to indicate that styrene is a human carcinogen. However, an elevated incidence of tumors of the hematopoietic and lymphatic tissues have been observed. Available studies are limited because of relatively small cohort sizes or multiple chemical exposures of workers (including exposure to benzene).

Styrene is classified by USEPA as a possible human carcinogen (Group C), meaning there are no human data and limited evidence of carcinogenicity from animal studies.

XYLENE(s)

Xylenes are volatile aromatic compounds used as a solvent for prints, ink, and adhesives. There are three isomeric forms of xylene: meta-xylene, ortho-xylene, and para-xylene. Xylenes are components of detergents and other household and industrial products. Xylene is associated with manufactured gas process residuals (Atlantic Environmental Services, 1988).

Xylenes readily volatilize from surface water and surface soil. Volatilization and subsequent photo-oxidation by reaction with hydroxyl radicals in the atmosphere are probably important transport and degradation processes for xylenes in the upper layer of soil and in aquatic environments. Xylenes bind to sediment in water and to organics in soils and undergo microbial degradation. Biodegradation is probably the most degradation fate process in both soils and the aquatic environment. Xylenes have been shown to persist for up to six months in soil. Because of their low water solubility and rapid biodegradation, xylenes are unlikely to leach into groundwater in high concentrations.

Short-term exposure can cause eye, nose, and throat irritation at 200 ppm. There is some evidence that chronic exposures to less than 50 ppm can cause headaches and other CNS effects. Xylene has not been shown to be carcinogenic when administered orally to rats or mice. Xylene was found to be mutagenic in a battery of short-term assays. Xylene is not teratogenic but has caused fetotoxicity in rats and mice.

Occupational exposure to xylene has been reported to cause headache, fatigue, lassitude, irritability, and GI disturbances (e.g., nausea, anorexia, and flatulence). Other researchers have also reported neurological disturbances and injury to the heart, kidney, and CNS among xylene workers.

Short-term exposures to xylene vapors have not been demonstrated to cause noticeable subjective effects at levels less than 200 ppm. When 10 volunteers were exposed for 3 to 5 minutes to xylene at 200 ppm, the majority reported eye, nose, and throat irritation (Nelson et al., 1943). At 100 ppm, the majority reported no symptoms and indicated that an 8-hour daily exposure at this level would be satisfactory. In another study, one of six people exposed for 15 minutes to 233 ppm experienced eye irritation, and four of six reported eye irritation at 460 ppm (Carpenter et al., 1975). Activities reported to cause eye and upper respiratory tract irritation from uncharacterized xylene levels include furniture polishing and demolition of epoxy resin concrete. Unconsciousness and death have been reported to result from xylene exposure in excess of 10,000 ppm (Morley et al., 1970). The workers who died had evidence of pulmonary edema and brain hemorrhage. The survivors suffered from amnesia, renal impairment, and hepatic dysfunction.

Long-term exposure to xylene may result in subjective symptoms at levels lower than 200 ppm. One-third of 45 xylene production workers exposed daily to 10 to 45 ppm reported headaches, irritability, insomnia, rapid heartbeat, and indigestion (Sukhanova et al., 1969). Intermittent exposure over 2 months to 270 to 350 ppm xylene caused acute vomiting, giddiness, and loss of appetite in one worker (Glass, 1961).

ACGIH believes the irritant effects of xylene are minimal at 100 ppm with no significant degree of narcosis or chronic injury from exposures at that level; consequently, they recommended a TLV of 100 ppm (435 mg/m^3). A short-term exposure limit of 150 ppm has been recommended by ACGIH for exposures of less than 15 minutes in an 8-hour work day.

NAPHTHALENE

Naphthalene is a white solid, also called naphthalin, naphthene, moth flake, tar camphor, or white tar, which exhibits the characteristic mothball odor. Chemically, it is composed of two fused benzene rings (Sandmeyer, 1981). Naphthalene occurs naturally in the roots of Radix and Herba ononids (Hesse et al. 1977). It is formed in cigarette smoke by pyrolysis (Johnstone, 1963) and is a photodecomposition produce of carbaryl, a naphthylcarbamate insecticide (Addison et al., 1975). Naphthalene also occurs in crude oil, cracked petroleum products, coke oven emissions, and high temperature carbonization of bituminous coal (American Petroleum Institute, 1959). Naphthalene is associated with manufactured gas process residuals (Atlantic Environmental Services, 1988).In both solid and liquid form, naphthalene is flammable. The vapor or dust can make an explosive mixture with air. Molten naphthalene, in contact with water, may result in violent foaming or the formation of explosive mixtures (Manufacturing Chemists Association, 1956).

Ingestion of naphthalene, in the form of mothballs, has resulted in no adverse effects in a number of the cases described. The ingested material was excreted in the feces in unchanged form. The co-ingestion of fats facilitates the absorption and other systemic events (Moeschlin, 1965). In severe cases, ingestion caused gastroenteric distress, tremors and convulsions. Within 2 to 7 days, moderate to severe anemia may develop, hemoglobin damage occurs, and the serum takes on a yellowish brown color. In some cases, this leads to disruption of renal function and even death due to respiratory failure (Deichman and Gerade, 1969).

Naphthalene is acutely irritating to the eye. With skin contact, it is a primary irritant. Since naphthalene may volatilize and sublime at room temperature, inhalation is a primary exposure route. The signs and symptoms of toxicity due to inhalation of naphthalene vapors resemble those observed from oral or dermal exposure. Naphthalene vapors may cause eye and respiratory irritation, headache, nausea, and perfuse perspiration.

Chronic effects of oral administration of a naphthalene-isopropanol mixture resembled ethanol intoxication but subsided after a few days (Gadsden, 1958). The effects on the eye were more severe. Corneal ulceration and cataracts have been observed (Adams, 1930) as well as general opacities which were observed after 5 years of exposure. Repeated inhalation of naphthalene vapors may produce malaise, headache, and vomiting.

Daily oral administration of naphthalene to rabbits at 1 g/kg produced effects in the eye that were slightly visible after only three doses and definitely exhibited after 20 days. A dose of 1.5 g/kg day produced white spots in the rabbit eye periphery but were distributed over the whole retina of young animals (Shimotori, 1972). Naphthalene is rapidly metabolized in adults to alpha- and beta-naphthol and alpha- and beta-naphthoquinone. The most active metabolite is probably naphthalene-1,2-oxide (Juchau and Namkung, 1974).

Usually organic compounds that readily form epoxides are suspected mutagens or carcinogens. Although naphthalene has low DNA and RNA binding capacities (Brooks and Lawley, 1964) and previous studies have failed to show evidence of carcinogenic activity by naphthalene (Horning et al., 1976; Searle, 1976;

Skjaeggestad, 1964), NTP has recently tested naphthalene for carcinogenic activity in mice. The results of the study have not yet been published.

EPA (1982) determined that the dose at which acute effects have been observed in humans is three to five orders of magnitude higher than the exposure levels to specific subpopulations associated with mothball use and cigarette smoking. EPA, therefore, concluded that there appears to be little acute risk to humans from environmental exposure to naphthalene; however, severe adverse effects are possible from accidental ingestion of substantial quantities of naphthalene.

CYANIDE

Cyanide is a compound that may exist as a gas (e.g., hydrogen cyanide [HCN]), a salt (e.g., potassium cyanide [KCN] or sodium cyanide [NaCN]) a metal cyanide (ferro/ferri-cyanide), or as free cyanide. At coal gasification sites, cyanide is expected to be present mostly as ferro/ferri-cyanide, and to a lesser extent, as free or amenable cyanide. Most cyanides, with the exception of several metallocyanides, are relatively soluble in water. However, their environmental fate in water varies considerably by compound. The alkali metal cyanides (e.g., KCN and NaCN) readily dissociate upon release to the water and may form HCN or bond with metals present in the water. Ferro- and ferricyanides are relatively stable metallocyanides and may undergo photodissociation to the cyanide ion (CN-) and form HCN. The insoluble cyanides (i.e., copper and silver cyanide) are not expected to dissociate. They may become adsorbed to sediment, bioaccumulate in aquatic organisms, or biodegrade (ATSDR, 1988).

In both water and soils, volatilization is expected to be an important fate process. At a pH of less than 9.2, most of the free cyanide in water and soil is expected to exist as HCN (ATSDR, 1988). HCN has a vapor pressure of 264.3 mm mercury (mmHg) (0°C); however, volatilization is expected to vary with soil and water characteristics. A number of microorganisms biodegrade cyanide at low concentrations. HCN is expected to be highly mobile in soils and may leach into the groundwater when present in concentrations that may exceed the biodegradation capacity of the microorganisms.

Most atmospheric cyanide is HCN. It is expected to be resistant to photodecomposition and has a half-life of approximately 334 days (ATSDR, 1988). At coal gasification sites that have been inactive for decades, HCN would not be a major concern. Both cyanide gases and salts are used in industrial processes. HCN is manufactured at 14 sites in the U.S. and is used as an intermediate in the production of nylon and other compounds. Minor uses of HCN include insecticides and rodenticides for fumigating enclosed spaces (e.g., grain storage areas). Cyanide salts are used mainly in the electroplating and metal-finishing industries. Minor applications of the salts include the manufacture of dyes and pigments, as well as use as insecticides and rodenticides.

Cyanides also occur naturally in several foods and plants and are produced by certain bacteria, fungi, and algae. Cyanocobalamin, a form of vitamin B12, is a dietary requirement. However, most of the cyanide found in the environment is from industrial processes.

The exposure routes of concern for cyanide at this site are ingestion of cyanide-contaminated soils and inhalation of fugitive dust where cyanide has been adsorbed to the particles. There are no studies in the available literature that evaluate toxicity following these specific exposures. All the inhalation studies are of the effects of exposure to HCN; oral studies are generally on the effects of HCN, NaCN, or KCN exposure.

Epidemiological studies have also been undertaken in tropical climates where the cyanide-containing vegetable, cassava, is a dietary staple. Neurologic,

cardiovascular/respiratory, and/or thyroid effects were found following these exposures. However, care should be exercised when assuming the same effects will result from the defined routes of exposure at this site and from exposure to other cyanide compounds.

The fatal effects of exposure to high doses of cyanide over short periods of time are well known. Inhalation of 100 ppm HCN for 0.5 to 1 hour has been fatal to humans. The LD50 in humans for ingestion exposure has been reported to be 1.5 mg/kg/day of CN-. A lower fatal dose in humans has been reported at 0.6 mg/kg/day CN- (ATSDR, 1988).

Brief exposure to lower levels of cyanide has resulted in rapid, deep breathing, shortness of breath, convulsions, and loss of consciousness. Because cyanide is not sequestered in the body, these effects are reversible over time. However, longer-term exposure to these low levels has resulted in CNS, thyroid gland, and cardiovascular effects.

Cyanide is readily absorbed following inhalation and oral exposure. Human studies have reported 58 to 77 percent of inhaled HCN is retained in the lungs (Landahl & Hermann, 1950). Human and animal studies indicate cyanide is rapidly distributed by the blood following both inhalation and oral exposure.

The major metabolic pathway of cyanide is conversion to thiocyanate by either rhodanese or 3-mercaptopyruvate. There are also three minor metabolic pathways: conversion to 2-aminothiazoline-4-barboylic acid; incorporation into a 1-carbon metabolic pool; or combination with hydroxycobalamin to form

cyanocobalamin (B12) (ATSDR, 1988). Cyanide metabolites are primarily excreted in the urine. Small amounts are excreted in the expired air.

Inhalation Toxicity

Numerous occupational exposures to cyanide have been reported; however, no levels of exposure are available. Exposure to HCN resulted in palpitations, shortness of breath, pain over the heart, vertigo, and involuntary eye movements (Carmelo, 1955), cyanosis, headache, altered EEG, and left-sided blindness (Sandberg, 1967). A photographic laboratory worker was exposed to potassium cyanide when a bag of the compound burst in his face. He developed abdominal pain, pallor, and collapse, but recovered after treatment (Thomas and Brooks, 1970).

While many of the available animal studies involved inhalation of fatal doses of cyanide, several studies are available that demonstrate effects from exposure to lower doses.

When monkeys were exposed to 87 to 196 ppm HCN, severe disruptive changes in respiration and unconsciousness were noted (Purser et al., 1984). Tremors, convulsions, loss of equilibrium, dyspnea, nausea, exaggerated intestinal peristalsis, and diarrhea were noted in dogs exposed to 45 ppm HCN for varying durations (Valade, 1952).

All available human and animal studies involved exposure to HCN and not particulate matter. Acute exposure to inhaled HCN at high concentrations resulted in hyperventilation, unconsciousness, and death. The cardiovascular

effects are believed to be secondary to the CNS effects (ATSDR, 1988). A worker exposed to HCN by both inhalation and dermal routes developed left-sided blindness (Sandberg, 1967). HCN fumigators also exposed by inhalation and dermal contact developed palpitations, shortness of breath, pain over the heart, vertigo, and involuntary eye movements (Carmelo, 1955).

When rats were exposed to inhalation of HCN at low concentrations, cardiac enzyme changes resulted (O'Flaherty and Thomas, 1982). The previously cited Purser study of monkeys exposed to 87 to 196 ppm HCN from pyrolyzed polyacrylonitrile also found cardiovascular effects, including rapid induction of a semiconscious state and severe disruptive changes in respiration.

Several occupational studies of workers exposed to HCN produced thyroid abnormalities. In a case-control study of electroplating workers exposed to 6.4 to 10.4 ppm HCN for 5 to 15 years, 56 percent of the exposed group had enlarged thyroid glands and significantly elevated hemoglobin levels and lymphocyte counts. It should be noted that these workers were also exposed to volatiles, exposure levels varied, and unmatched controls were used (El Ghawabi et al., 1975).

Workers in a silver-reclaiming factory exposed an average of 10.5 months to a TWA of 16.6 mg/m^3 HCN developed headache, dizziness, and mild thyroid abnormalities (Blanc et al., 1985).

No studies of developmental effects in humans resulting form inhalation of cyanide are available.

The only available animal study is of hamsters exposed to acetonitrile, which has cyanide as a metabolic by-product. The hamsters were dosed with zero, 1,800, 3,800, 5,000, and 8,000 ppm for 60 minutes. Dose-related increases in maternal mortality, fetal resorptions, and malformations were found (Willhite, 1981).

Oral Toxicity

The risk assessment at this site quantitatively evaluates effects from ingestion of soil particles to which cyanide is adsorbed. There are a number of studies of CN- administered in the diet or by gavage; however, no studies in which soil was the vehicle are available.

Male rats were fed 30 mg/kg/day cyanide for 11.5 months and developed vacuolization and myelin degeneration of the spinal cord (Philbrick et al., 1979). No CNS effects were reported by Howard and Hanzell (1955) for rats fed up to 10.8 mg/kg/day of CN- in HCN-fumigated feed for two years.

Dogs fed 0.27 and 0.53 mg/kg/day cyanide in capsules for 16 weeks developed degenerative changes in the CNS ganglion cells, reduced ribonucleic acid (RNA) content, and inflammation (Hertting et al., 1960).

No studies describing cardiovascular or respiratory effects in humans or animals following long-term, low-dose oral exposure were found in the available literature. However, it is important to note that respiratory failure and death have resulted following continuous exposure to single, high doses of cyanide.

Qualitative surveys of African communities where people are exposed to cyanide from consumption of cassava have found a strong correlation between cassava consumption and endemic goiter and cretinism. Dietary deficiencies may have compounded this association (ATSDR, 1988).

In a 14-day study, male rats were fed the equivalent of 40 mg/kg/day CN- as potassium cyanide added to the diet. The diets varied by the amount of protein. Increased thyroid weights and increased plasma thyroid stimulating hormone levels were noted only in the low-protein diet group. These effects were not observed when protein levels were increased or when iodine was added to the drinking water of rats fed the low-protein diet (Kreutler et al., 1978).

Rats were fed the equivalent of 30 mg/kg/day CN- for 11.5 months. At the end of four months, the rats exhibited decreased plasma thyroxine and thyroxine secretion rates. At the end of the 11.5 months, these same effects were found, plus increased relative thyroid weight (Philbrick et al., 1979).

Epidemiologic studies were conducted in Zaire where cassava is a staple food. Congenital hypothyroidism was found in 15 percent of the newborns. This incidence is approximately 500 times that of industrialized countries. In addition to cassava consumption, iodine deficiencies may have contributed to this condition (ATSDR, 1988).

Numerous studies of orally exposed pregnant animals have found maternal toxicities and developmental abnormalities in the offspring. Pregnant

hamsters exposed to cyanide as D,L-amygdalin (a component of laetrile) exhibited maternal toxicity at 250 mg/kg and greater. Fetuses were examined at 15-days gestation, and dose-related abnormalities were observed in this group (Willhite, 1982).

Female rats were fed a basal casava diet containing 12 mg/kg HCN and a basal diet with 1.25 gm KCN per kg diet prior to mating, during gestation, and through lactation. The weanlings were subsequently fed these same diets. Those weanlings exposed to higher levels of cyanide in utero and during the post-weaning period had significantly decreased protein-efficiency ratios. Both the dams and weanlings fed the potassium cyanide-enhanced diet had significantly increased serum thiocyanate levels (Tewe and Maner, 1981).

Pregnant pigs were fed cassava diets with added cyanide. In the group with the highest exposure (520.7 mg/kg CN-), serum thiocyanate levels were increased in dams and fetuses. Reduced thyroid activity was found in the dams. Both the high and low groups (276 mg/kg CN-) had proliferation of glomerular cells in the kidneys.

Other Effects. No data on reproductive toxicity from cyanide exposure by any route are available in the literature. Cyanide has tested negative for mutagenic effects. There are no data available indicating that cyanide has any carcinogenic effects.

High Risk Populations. High-risk populations include those persons with a metabolic disturbance in the conversion of cyanide to thiocyanate and those

with dietary deficiencies (e.g., iodine, protein, vitamin B12, or riboflavin), as well as those nutritionally deprived.

TRIMETHYLBENZENE

Trimethylbenzenes are alkylated benzenes. This group of compounds, which include xylenes, toluene, and ethylbenzene, is a by-product of petroleum distillation and found in coke oven effluents. Trimethylbenzenes are primarily used in industry as solvents, paint thinners, and motor fuel components. One of the three trimethylbenzene isomers has been identified as an insect attractant (Clayton and Clayton, 1981). Trimethylbenzene is associated with manufactured gas process residuals (Atlantic Environmental Services, 1988).

Trimethylbenzene, as with most alkylated benzenes, seems to be relatively nontoxic except during acute exposures at very high concentrations (Klaasen et al., 1986). This is probably because alkylated benzenes are metabolized to compounds of lower toxicity, and there is no evidence that these metabolic pathways can be saturated, leading to the formation of toxic reactive intermediates. Trimethylbenzene is absorbed through the lungs and the GI tract; dermal absorption does not lead to systemic toxicity. The primary toxicologic effects seen at acute exposure to high concentration are CNS depressive effects such as nervousness, anxiety, fatigue, nausea, and irritation of the eyes, nose and throat. Skin irritation and chemical pneumonitis can occur at the site of contact (e.g., where deposition in lungs occurs). Workers exposed to trimethylbenzene in a solvent at concentrations of 10-60 ppm for many years have shown hypochromic anemia and some deviation from normal coagulation (ACGIH, 1986).

Little experimental work has been carried out on trimethylbenzene. Most studies are acute or subacute in duration, and the results were mostly CNS depressive effects with some incidence of thrombocytosis, thrombosenis, and inhibition of phagocytical activity in leukocytes.

There are no drinking water or OSHA standards for trimethylbenzene; however, the ACGIH recommends a threshold limit value of 25 ppm (125 mg/m^3) in air.

APPENDIX G-1/2

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Appendix G-3

Risk Templates

SEDC-HP

16-Jan-90

TABLE G-3-1
Direct Contact with and/or Ingestion of Sediment
Most Probable Case - Children
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
noncarcinogenic PAHs	12.84	2.5	0.050	0.01	0.50	45	1	1.95E-08	1.94E-08	4.00E-01	9.74E-08
ethylbenzene	0.0174	2.5	0.050	0.05	0.10	45	1	5.30E-12	1.32E-10	1.00E-01	1.37E-09
cyanide (total)	0.4330	2.5	0.050	1.00	0.50	45	1	6.59E-10	6.55E-08	2.00E-02	3.31E-06
									SUMMARY HAZARD INDEX		3.41E-06

Note: TK - Toxicokinetic Factor

TABLE G-3-2
Direct Contact with and/or Ingestion of Sediment
Most Probable Case - Children
Carcinogenic effects
Mechanicville Site

DC-MP
25-Jul-90

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{years}} \times \frac{\text{No. of years exposed}}{70 \text{ years}} \times \frac{1 \text{ mg}}{1000 \text{ ug}} \times \frac{1 \text{ yr}}{365 \text{ days}}$$

$$\text{Incremental Risk} = \text{Body Dose (mg/kg/day)} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Benzene	0.0330	2.5	0.050	0.05	0.10	45	1	5.0	7.18E-13	1.78E-11	2.90E-02	5.38E-13
Carc. PAHs - USEPA	3.7600	2.5	0.050	0.01	0.50	45	1	5.0	4.09E-10	4.06E-10	1.15E+01	9.37E-09
Carc. PAHs - ICF	3.7600	2.5	0.050	0.01	0.50	45	1	5.0	4.09E-10	4.06E-10	3.20E+00	2.61E-09

SUMMARY CARCINOGENIC RISK	
USEPA	9.37E-09
ICF	2.61E-09

Note: TK - Toxicokinetic Factor

SEDC-BW

16-Jan-90

TABLE G-3-3
Direct Contact with and/or Ingestion of Sediment
Realistic Worst Case - Children
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
noncarcinogenic PAHs	42.67	9.1	0.1	0.10	1.00	45	2	5.20E-07	4.75E-06	4.00E-01	1.32E-05
ethylbenzene	0.087	9.1	0.1	0.25	0.50	45	2	5.30E-10	2.42E-08	1.00E-01	2.47E-07
cyanide (total)	1.30	9.1	0.1	2.50	1.00	45	2	1.58E-08	3.62E-06	2.00E-02	1.82E-04
									SUMMARY HAZARD INDEX		1.95E-04

Note: TK - Toxicokinetic Factor

TABLE G-3-4
Direct Contact with and/or Ingestion of Sediment
DC-RW
Realistic Worst Case - Children
25-Jul-90
Carcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose}\ (\text{mg/kg/day}) = \text{Soil Concentration}\ (\text{ug/g}) \times [(\text{Amount Contacted}\ (\text{g/event}) \times \text{Dermal TK Factor}) + (\text{Amount Ingested}\ (\text{g/event}) \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{years}} \times \frac{\text{No. of years exposed}}{70\ \text{years}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Incremental Risk} = \text{Body Dose}\ \text{mg/kg/day} \times \text{CAG Potency Factor}\ (\text{mg/kg/day})^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
enzene	0.0950	9.1	0.1	0.25	0.50	45	2	10.0	8.26E-11	3.78E-09	2.90E-02	1.12E-10
arc. PAHs - USEPA	10.2000	9.1	0.1	0.10	1.00	45	2	10.0	1.77E-08	1.62E-07	1.15E+01	2.07E-06
arc. PAHs - ICF	10.2000	9.1	0.1	0.10	1.00	45	2	10.0	1.77E-08	1.62E-07	3.20E+00	5.76E-07

SUMMARY CARCINOGENIC RISK	
USEPA	2.07E-06
ICF	5.76E-07

Note: TK - Toxicokinetic Factor

SEDWK-HP
16-Jan-90

TABLE G-3-5
Direct Contact with and/or Ingestion of Sediment
Most Probable Case - Workers
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
noncarcinogenic PAHs	12.84	1.2	0.050	0.01	0.50	70	5	6.28E-08	2.89E-08	4.00E-01	2.29E-07
ethylbenzene	0.0174	1.2	0.050	0.05	0.10	70	5	1.70E-11	1.96E-10	1.00E-01	2.13E-09
cyanide (total)	0.43	1.2	0.050	1.00	0.50	70	5	2.12E-09	9.74E-08	2.00E-02	4.98E-06
									SUMMARY HAZARD INDEX		5.21E-06

Note: TK - Toxicokinetic Factor

TABLE G-3-6

WK-MP

25-Jul-90

Direct Contact with and/or Ingestion of Sediment
Most Probable Case - Workers
Carcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times$$

$$\frac{1}{\text{Body Weight (kg)}} \times \text{No. Events (years)} \times \text{No. of years exposed (70 years)} \times \frac{1\text{mg}}{1000\text{ ug}} \times \frac{1\text{ yr}}{365\text{ days}}$$

$$\text{Incremental Risk} = \text{Body Dose mg/kg/day} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Benzene	0.0330	1.2	0.050	0.05	0.10	70	5	3.0	1.38E-12	1.59E-11	2.90E-02	5.02E-13
Carc. PAHs - USEPA	3.7600	1.2	0.050	0.01	0.50	70	5	3.0	7.88E-10	3.63E-10	1.15E+01	1.32E-08
Carc. PAHs - ICF	3.7600	1.2	0.050	0.01	0.50	70	5	3.0	7.88E-10	3.63E-10	3.20E+00	3.68E-09

SUMMARY CARCINOGENIC RISK	
USEPA	1.32E-08
ICF	3.68E-09

Note: TK - Toxicokinetic Factor

SKDWK-BW
16-Jan-90

TABLE G-3-7
Direct Contact with and/or Ingestion of Sediment
Realistic Worst Case - Workers
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
noncarcinogenic PAHs	42.67	4.2	0.1	0.10	1.00	70	10	1.67E-06	7.09E-06	4.00E-01	2.19E-05
ethylbenzene	0.087	4.2	0.1	0.25	0.50	70	10	1.70E-09	3.61E-08	1.00E-01	3.78E-07
cyanide (total)	1.30	4.2	0.1	2.50	1.00	70	10	5.09E-08	5.40E-06	2.00E-02	2.73E-04
									SUMMARY HAZARD INDEX		2.95E-04

Note: TK - Toxicokinetic Factor

TABLE G-3-8
Direct Contact with and/or Ingestion of Sediment
DWK-RW
Realistic Worst Case - Workers
25-Jul-90
Carcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times \left[(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})\right] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{years}} \times \frac{\text{No. of years exposed}}{70 \text{ years}} \times \frac{1 \text{ mg}}{1000 \text{ ug}} \times \frac{1 \text{ yr}}{365 \text{ days}}$$

$$\text{Incremental Risk} = \text{Body Dose (mg/kg/day)} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Benzene	0.0950	4.2	0.1	0.25	0.50	70	10	10.0	2.66E-10	5.64E-09	2.90E-02	1.71E-10
Carc. PAHs - USEPA	10.2000	4.2	0.1	0.10	1.00	70	10	10.0	5.70E-08	2.42E-07	1.15E+01	3.44E-06
Carc. PAHs - ICF	10.2000	4.2	0.1	0.10	1.00	70	10	10.0	5.70E-08	2.42E-07	3.20E+00	9.57E-07

SUMMARY CARCINOGENIC RISK	
USEPA	3.44E-06
ICF	9.57E-07

Note: TK - Toxicokinetic Factor

SOILWKMP
16-Jan-90

TABLE G-3-9
Direct Contact with and/or Ingestion of Soil
Most Probable Case - Workers
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
toluene	151.00	1.2	0.050	0.025	0.05	70	1	1.48E-08	1.70E-07	3.00E-01	6.16E-07
xylene	306.00	1.2	0.050	0.05	0.10	70	1	5.99E-08	6.89E-07	2.00E+00	3.74E-07
ethyl benzene	82.10	1.2	0.050	0.05	0.10	70	1	1.61E-08	1.85E-07	1.00E-01	2.01E-06
cyanide (amenable)	0.525	1.2	0.050	1.00	0.50	70	1	5.14E-10	2.36E-08	2.00E-02	1.21E-06
noncarcinogenic PAHs	2785.00	1.2	0.050	0.01	0.50	70	1	2.73E-06	1.25E-06	4.00E-01	9.95E-06
styrene	150.00	1.2	0.050	0.05	0.10	70	1	2.94E-08	3.38E-07	2.00E-01	1.83E-06
trimethylbenzene	26.70	1.2	0.050	0.05	0.10	70	1	5.23E-09	6.01E-08	2.00E+00	3.27E-08
									SUMMARY HAZARD INDEX		1.60E-05

Note: TK - Toxicokinetic Factor

TABLE G-3-10
Direct Contact with and/or Ingestion of Soil
TLWKMP Most Probable Case - Workers
25-Jul-90 Carcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times$$

$$\frac{1}{\text{Body Weight (kg)}} \times \text{No. Events (years)} \times \frac{\text{No. of years exposed}}{70 \text{ years}} \times \frac{1\text{mg}}{1000 \text{ ug}} \times \frac{1 \text{ yr}}{365 \text{ days}}$$

$$\text{Incremental Risk} = \text{Body Dose mg/kg/day} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Benzene	104.00	1.2	0.050	0.05	0.10	70	1	2.0	5.81E-10	6.69E-09	2.90E-02	2.11E-10
Carc. PAHs - USEPA	271.00	1.2	0.050	0.01	0.50	70	1	2.0	7.58E-09	3.49E-09	1.15E+01	1.27E-07
Carc. PAHs - ICF	271.00	1.2	0.050	0.01	0.50	70	1	2.0	7.58E-09	3.49E-09	3.20E+00	3.56E-08

SUMMARY CARCINOGENIC RISK	
USEPA	1.27E-07
ICF	3.56E-08

Note: TK - Toxicokinetic Factor

SOILWKRW
16-Jan-90

TABLE G-3-11
Direct Contact with and/or Ingestion of Soil
Realistic Worst Case - Workers
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
toluene	840.00	4.2	0.1	0.125	0.25	70	2	1.64E-06	3.49E-05	3.00E-01	1.22E-04
xylene	1400.00	4.2	0.1	0.25	0.50	70	2	5.48E-06	1.16E-04	2.00E+00	6.09E-05
ethyl benzene	440.00	4.2	0.1	0.25	0.50	70	2	1.72E-06	3.66E-05	1.00E-01	3.83E-04
cyanide (amenable)	3.20	4.2	0.1	2.50	1.00	70	2	2.50E-08	2.66E-06	2.00E-02	1.34E-04
noncarcinogenic PAHs	10851.00	4.2	0.1	0.10	1.00	70	2	8.49E-05	3.61E-04	4.00E-01	1.11E-03
styrene	780.00	4.2	0.1	0.250	0.50	70	2	3.05E-06	6.48E-05	2.00E-01	3.39E-04
trimethylbenzene	170.00	4.2	0.1	0.25	0.50	70	2	6.65E-07	1.41E-05	2.00E+00	7.39E-06
									SUMMARY HAZARD INDEX		2.16E-03

Note: TK - Toxicokinetic Factor

TABLE G-3-12

Direct Contact with and/or Ingestion of Soil
Realistic Worst Case - Workers
Carcinogenic Effects
Mechanicville Site

MILWKRW
25-Jul-90

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times \left[(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})\right] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{years}} \times \frac{\text{No. of years exposed}}{70 \text{ years}} \times \frac{1 \text{ mg}}{1000 \text{ ug}} \times \frac{1 \text{ yr}}{365 \text{ days}}$$

$$\text{Incremental Risk} = \text{Body Dose mg/kg/day} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Benzene	640.0000	4.2	0.1	0.25	0.50	70	2	4.0	1.43E-07	3.04E-06	2.90E-02	9.23E-08
Carc. PAHs - USEPA	1305.0000	4.2	0.1	0.10	1.00	70	2	4.0	5.84E-07	2.48E-06	1.15E+01	3.52E-05
Carc. PAHs - ICF	1305.0000	4.2	0.1	0.10	1.00	70	2	4.0	5.84E-07	2.48E-06	3.20E+00	9.80E-06

SUMMARY CARCINOGENIC RISK	
USEPA	3.53E-05
ICF	9.89E-06

Note: TK - Toxicokinetic Factor

INHALATION RISK SCENARIOS

DISK: INHALATION
FILE: INH-MECH.WK1

DATE: 25-Jul-90

SITE: Mechanicville SUMMARY TABLE: TABLE G-3-13

Variables	Child
Body Weight (kilograms)	21
Duration of Total Exposure Period (years)	6

Noncarcinogenic Compound(s)	Toxicokinetic Factor (unitless)	Standard or Guideline (mg/kg/day)
Cyanide	7.50	2.00E-02
Ethylbenzene	1.00	1.00E-01
Noncarcinogenic PAHs	0.75	4.00E-01
Styrene	1.00	2.00E-01
Toluene	1.00	1.00E+00
Trimethylbenzene	1.00	4.00E-01
Total Xylenes	1.00	4.00E-01

Carcinogenic Compound(s)	Toxicokinetic Factor (unitless)	CAG Potency Factor (mg/kg/day)^-1
Benzene	1.00	2.90E-02
Bis(2-ethylhexyl)phthalate	0.75	1.40E-02
Methylene Cloride	1.00	1.40E-02
Carcinogenic PAHs - USEPA	1.00	6.10E+00
Carcinogenic PAHs - ICF	1.00	4.53E-01

Zone 1 School, 750 ft Noncarcinogenic Compound(s)	MOST PROBABLE CASE Concentration (mg/m^3)	MOST PROBABLE CASE Duration of Exposure (hrs/event)	MOST PROBABLE CASE Number of Exposure Events (events/yr)	REALISTIC WORST CASE Concentration (mg/m^3)	REALISTIC WORST CASE Duration of Exposure (hrs/event)	REALISTIC WORST CASE Number of Exposure Events (events/yr)
Cyanide	3.58E-09	8	20	2.45E-07	8	25
Ethylbenzene	5.52E-05	8	20	2.16E-03	8	25
Noncarcinogenic PAHs	1.43E-05	8	20	9.80E-04	8	25
Styrene	1.02E-04	8	20	3.93E-03	8	25
Toluene	1.02E-04	8	20	3.97E-03	8	25
Trimethylbenzene	1.81E-05	8	20	6.99E-04	8	25
Total Xylenes	2.07E-04	8	20	8.04E-03	8	25

Zone 2 Home, 100 ft (playing) Noncarcinogenic Compound(s)	MOST PROBABLE CASE Concentration (mg/m^3)	MOST PROBABLE CASE Duration of Exposure (hrs/event)	MOST PROBABLE CASE Number of Exposure Events (events/yr)	REALISTIC WORST CASE Concentration (mg/m^3)	REALISTIC WORST CASE Duration of Exposure (hrs/event)	REALISTIC WORST CASE Number of Exposure Events (events/yr)
Cyanide	2.09E-08	6	20	9.42E-07	6	25
Ethylbenzene	2.41E-04	6	20	1.01E-02	6	25
Noncarcinogenic PAHs	8.35E-05	6	20	3.77E-03	6	25
Styrene	4.42E-04	6	20	1.84E-02	6	25
Toluene	4.44E-04	6	20	1.86E-02	6	25
Trimethylbenzene	7.86E-05	6	20	3.28E-03	6	25
Total Xylenes	9.01E-04	6	20	3.77E-02	6	25

Zone 3 Home, 100 ft (sleeping) Noncarcinogenic Compound(s)	MOST PROBABLE CASE Concentration (mg/m^3)	MOST PROBABLE CASE Duration of Exposure (hrs/event)	MOST PROBABLE CASE Number of Exposure Events (events/yr)	REALISTIC WORST CASE Concentration (mg/m^3)	REALISTIC WORST CASE Duration of Exposure (hrs/event)	REALISTIC WORST CASE Number of Exposure Events (events/yr)
Cyanide	2.09E-08	10	20	9.42E-07	10	25
Ethylbenzene	2.41E-04	10	20	1.01E-02	10	25
Noncarcinogenic PAHs	8.35E-05	10	20	3.77E-03	10	25
Styrene	4.42E-04	10	20	1.84E-02	10	25
Toluene	4.44E-04	10	20	1.86E-02	10	25
Trimethylbenzene	7.86E-05	10	20	3.28E-03	10	25
Total Xylenes	9.01E-04	10	20	3.77E-02	10	25

TABLE G-3-13 (continued)

Zone 1 School, 750 ft Carcinogenic Compound(s)	MOST PROBABLE CASE Concentration (mg/m^3)	MOST PROBABLE CASE Duration of Exposure (hrs/event)	MOST PROBABLE CASE Number of Exposure Events (events/yr)	REALISTIC WORST CASE Concentration (mg/m^3)	REALISTIC WORST CASE Duration of Exposure (hrs/event)	REALISTIC WORST CASE Number of Exposure Events (events/yr)
Benzene	7.03E-05	8	20	2.73E-03	8	25
Bis(2-ethylhexyl)phthalate	0.00E+00	8	20	0.00E+00	8	25
Methylene Cloride	0.00E+00	8	20	1.31E-05	8	25
Carcinogenic PAHs - USEPA	1.41E-06	8	20	9.65E-05	8	25
Carcinogenic PAHs - ICF	1.41E-06	8	20	9.65E-05	8	25

Zone 2 Home, 100 ft (playing) Carcinogenic Compound(s)	MOST PROBABLE CASE Concentration (mg/m^3)	MOST PROBABLE CASE Duration of Exposure (hrs/event)	MOST PROBABLE CASE Number of Exposure Events (events/yr)	REALISTIC WORST CASE Concentration (mg/m^3)	REALISTIC WORST CASE Duration of Exposure (hrs/event)	REALISTIC WORST CASE Number of Exposure Events (events/yr)
Benzene	3.06E-04	6	20	1.28E-02	6	25
Bis(2-ethylhexyl)phthalate	0.00E+00	6	20	0.00E+00	6	25
Methylene Cloride	1.48E-06	6	20	6.15E-05	6	25
Carcinogenic PAHs - USEPA	8.20E-06	6	20	3.70E-04	6	25
Carcinogenic PAHs - ICF	8.20E-06	6	20	3.70E-04	6	25

Zone 3 Home, 100 ft (sleeping) Carcinogenic Compound(s)	MOST PROBABLE CASE Concentration (mg/m^3)	MOST PROBABLE CASE Duration of Exposure (hrs/event)	MOST PROBABLE CASE Number of Exposure Events (events/yr)	REALISTIC WORST CASE Concentration (mg/m^3)	REALISTIC WORST CASE Duration of Exposure (hrs/event)	REALISTIC WORST CASE Number of Exposure Events (events/yr)
Benzene	3.06E-04	10	20	1.28E-02	10	25
Bis(2-ethylhexyl)phthalate	0.00E+00	10	20	0.00E+00	10	25
Methylene Cloride	1.48E-06	10	20	6.15E-05	10	25
Carcinogenic PAHs - USEPA	8.20E-06	10	20	3.70E-04	10	25
Carcinogenic PAHs - ICF	8.20E-06	10	20	3.70E-04	10	25

Terminology
Inhalation
Most Probable Case
Realistic Worst Case
Young Child
Adult
Carcinogen
Noncarcinogen

Inhalation Rate (m^3/hr)
Child

	Zone 1	Zone 2	Zone 3
Most Probable	0.8	2.0	0.4
Realistic Worst	0.8	2.0	0.4

TABLE G-3-13 (continued)

Mechanicville
Inhalation Most Probable Case
Young Child Noncarcinogen

Noncarcinogenic Compound(s)	Body Weight (kilograms)	Zone 1 Concentration (mg/m^3)	Zone 1 Duration of Exposure (hrs/event)	Zone 1 Number of Exposure Events (events/yr)	Zone 1 Inhalation Rate (m^3/hr)	Zone 1 Exposure (mg/kg/day)	Zone 2 Concentration (mg/m^3)	Zone 2 Duration of Exposure (hrs/event)	Zone 2 Number of Exposure Events (events/yr)	Zone 2 Inhalation Rate (m^3/hr)	Zone 2 Exposure (mg/kg/day)
Cyanide	21	3.58E-09	8	20	0.8	5.98E-11	2.09E-08	6	20	2.0	6.54E-10
Ethylbenzene	21	5.52E-05	8	20	0.8	9.22E-07	2.41E-04	6	20	2.0	7.55E-06
Noncarcinogenic PAHs	21	1.43E-05	8	20	0.8	2.39E-07	8.35E-05	6	20	2.0	2.61E-06
Styrene	21	1.02E-04	8	20	0.8	1.70E-06	4.42E-04	6	20	2.0	1.38E-05
Toluene	21	1.02E-04	8	20	0.8	1.70E-06	4.44E-04	6	20	2.0	1.39E-05
Trimethylbenzene	21	1.81E-05	8	20	0.8	3.02E-07	7.86E-05	6	20	2.0	2.46E-06
Total Xylenes	21	2.07E-04	8	20	0.8	3.46E-06	9.01E-04	6	20	2.0	2.82E-05

Noncarcinogenic Compound(s)	Zone 3 Concentration (mg/m^3)	Zone 3 Duration of Exposure (hrs/event)	Zone 3 Number of Exposure Events (events/yr)	Zone 3 Inhalation Rate (m^3/hr)	Zone 3 Exposure (mg/kg/day)	Summary Exposure (mg/kg/day)	Toxicokinetic Factor (unitless)	Standard or Guideline (mg/kg/day)	Hazard Ratio
Cyanide	2.09E-08	10	20	0.4	2.18E-10	9.32E-10	7.5	2.00E-02	3.50E-07
Ethylbenzene	2.41E-04	10	20	0.4	2.52E-06	1.10E-05	1.0	1.00E-01	1.10E-04
Noncarcinogenic PAHs	8.35E-05	10	20	0.4	8.71E-07	3.72E-06	0.8	4.00E-01	6.98E-06
Styrene	4.42E-04	10	20	0.4	4.61E-06	2.02E-05	1.0	2.00E-01	1.01E-04
Toluene	4.44E-04	10	20	0.4	4.63E-06	2.02E-05	1.0	1.00E+00	2.02E-05
Trimethylbenzene	7.86E-05	10	20	0.4	8.20E-07	3.58E-06	1.0	4.00E-01	8.96E-06
Total Xylenes	9.01E-04	10	20	0.4	9.40E-06	4.11E-05	1.0	4.00E-01	1.03E-04

SUMMARY HAZARD INDEX	3.50E-04

TABLE G-3-13 (continued)

Mechanicville
Inhalation Realistic Worst Case
Young Child Noncarcinogen

Noncarcinogenic Compound(s)	Body Weight (kilograms)	Zone 1 Concentration (mg/m^3)	Zone 1 Duration of Exposure (hrs/event)	Zone 1 Number of Exposure Events (events/yr)	Zone 1 Inhalation Rate (m^3/hr)	Zone 1 Exposure (mg/kg/day)	Zone 2 Concentration (mg/m^3)	Zone 2 Duration of Exposure (hrs/event)	Zone 2 Number of Exposure Events (events/yr)	Zone 2 Inhalation Rate (m^3/hr)	Zone 2 Exposure (mg/kg/day)
Cyanide	21	2.45E-07	8	25	0.8	5.11E-09	9.42E-07	6	25	2.0	3.69E-08
Ethylbenzene	21	2.16E-03	8	25	0.8	4.51E-05	1.01E-02	6	25	2.0	3.95E-04
Noncarcinogenic PAHs	21	9.80E-04	8	25	0.8	2.04E-05	3.77E-03	6	25	2.0	1.47E-04
Styrene	21	3.93E-03	8	25	0.8	8.20E-05	1.84E-02	6	25	2.0	7.20E-04
Toluene	21	3.97E-03	8	25	0.8	8.29E-05	1.86E-02	6	25	2.0	7.28E-04
Trimethylbenzene	21	6.99E-04	8	25	0.8	1.46E-05	3.28E-03	6	25	2.0	1.28E-04
Total Xylenes	21	8.04E-03	8	25	0.8	1.68E-04	3.77E-02	6	25	2.0	1.48E-03

Noncarcinogenic Compound(s)	Zone 3 Concentration (mg/m^3)	Zone 3 Duration of Exposure (hrs/event)	Zone 3 Number of Exposure Events (events/yr)	Zone 3 Inhalation Rate (m^3/hr)	Zone 3 Exposure (mg/kg/day)	Summary Exposure (mg/kg/day)	Toxicokinetic Factor (unitless)	Standard or Guideline (mg/kg/day)	Hazard Ratio
Cyanide	9.42E-07	10	25	0.4	1.23E-08	5.43E-08	7.5	2.00E-02	2.04E-05
Ethylbenzene	1.01E-02	10	25	0.4	1.32E-04	5.72E-04	1.0	1.00E-01	5.72E-03
Noncarcinogenic PAHs	3.77E-03	10	25	0.4	4.91E-05	2.17E-04	0.8	4.00E-01	4.07E-04
Styrene	1.84E-02	10	25	0.4	2.40E-04	1.04E-03	1.0	2.00E-01	5.21E-03
Toluene	1.86E-02	10	25	0.4	2.43E-04	1.05E-03	1.0	1.00E+00	1.05E-03
Trimethylbenzene	3.28E-03	10	25	0.4	4.28E-05	1.86E-04	1.0	4.00E-01	4.64E-04
Total Xylenes	3.77E-02	10	25	0.4	4.92E-04	2.14E-03	1.0	4.00E-01	5.34E-03

SUMMARY HAZARD INDEX	1.82E-02

TABLE G-3-13 (continued)

Mechanicville
Inhalation Most Probable Case
Young Child Carcinogen

Carcinogenic Compound(s)	Zone 1 Body Weight (kilograms)	Zone 1 Concentration (mg/m^3)	Zone 1 Duration of Exposure (hrs/event)	Zone 1 Number of Exposure Events (events/yr)	Zone 1 Inhalation Rate (m^3/hr)	Zone 1 Exposure (mg/kg/day)
Benzene	21	7.03E-05	8.0	20	0.8	1.01E-07
Bis(2-ethylhexyl)phthalate	21	0.00E+00	8.0	20	0.8	0.00E+00
Methylene Cloride	21	0.00E+00	8.0	20	0.8	0.00E+00
Carcinogenic PAHs - USEPA	21	1.41E-06	8.0	20	0.8	2.02E-09
Carcinogenic PAHs - ICF	21	1.41E-06	8.0	20	0.8	2.02E-09

Zone 2 Concentration (mg/m^3)	Zone 2 Duration of Exposure (hrs/event)	Zone 2 Number of Exposure Events (events/yr)	Zone 2 Inhalation Rate (m^3/hr)	Zone 2 Exposure (mg/kg/day)
3.06E-04	6	20	2.0	8.21E-07
0.00E+00	6	20	2.0	0.00E+00
1.48E-06	6	20	2.0	3.97E-09
8.20E-06	6	20	2.0	2.20E-08
8.20E-06	6	20	2.0	2.20E-08

Carcinogenic Compound(s)	Zone 3 Concentration (mg/m^3)	Zone 3 Duration of Exposure (hrs/event)	Zone 3 Number of Exposure Events (events/yr)	Zone 3 Inhalation Rate (m^3/hr)	Zone 3 Exposure (mg/kg/day)
Benzene	3.06E-04	10.0	20	0.4	2.74E-07
Bis(2-ethylhexyl)phthalate	0.00E+00	10.0	20	0.4	0.00E+00
Methylene Cloride	1.48E-06	10.0	20	0.4	1.32E-09
Carcinogenic PAHs - USEPA	8.20E-06	10.0	20	0.4	7.34E-09
Carcinogenic PAHs - ICF	8.20E-06	10.0	20	0.4	7.34E-09

Summary Exposure (mg/kg/day)	Toxicokinetic Factor (unitless)	CAG Potency Factor (mg/kg/day)^-1	Incremental Cancer Risk
1.20E-06	1.0	2.90E-02	3.47E-08
0.00E+00	0.8	1.40E-02	0.00E+00
5.30E-09	1.0	1.40E-02	7.41E-11
3.14E-08	1.0	6.10E+00	1.91E-07
3.14E-08	1.0	4.53E-01	1.42E-08

SUMMARY INCREMENTAL CANCER RISK	USEPA	2.26E-07
	ICF	4.90E-08

TABLE G-3-13 (continued)

Mechanicville
Inhalation Realistic Worst Case
Young Child Carcinogen

Carcinogenic Compound(s)	Zone 1 Body Weight (kilograms)	Zone 1 Concentration (mg/m^3)	Zone 1 Duration of Exposure (hrs/event)	Zone 1 Number of Exposure Events (events/yr)	Zone 1 Inhalation Rate (m^3/hr)	Zone 1 Exposure (mg/kg/day)
Benzene	21	2.73E-03	8	25	0.8	4.88E-06
Bis(2-ethylhexyl)phthalate	21	0.00E+00	8	25	0.8	0.00E+00
Methylene Cloride	21	1.31E-05	8	25	0.8	2.34E-08
Carcinogenic PAHs - USEPA	21	9.65E-05	8	25	0.8	1.73E-07
Carcinogenic PAHs - ICF	21	9.65E-05	8	25	0.8	1.73E-07

Carcinogenic Compound(s)	Zone 2 Concentration (mg/m^3)	Zone 2 Duration of Exposure (hrs/event)	Zone 2 Number of Exposure Events (events/yr)	Zone 2 Inhalation Rate (m^3/hr)	Zone 2 Exposure (mg/kg/day)
Benzene	1.28E-02	6.0	25	2.0	4.29E-05
Bis(2-ethylhexyl)phthalate	0.00E+00	6.0	25	2.0	0.00E+00
Methylene Cloride	6.15E-05	6.0	25	2.0	2.06E-07
Carcinogenic PAHs - USEPA	3.70E-04	6.0	25	2.0	1.24E-06
Carcinogenic PAHs - ICF	3.70E-04	6.0	25	2.0	1.24E-06

Carcinogenic Compound(s)	Zone 3 Concentration (mg/m^3)	Zone 3 Duration of Exposure (hrs/event)	Zone 3 Number of Exposure Events (events/yr)	Zone 3 Inhalation Rate (m^3/hr)	Zone 3 Exposure (mg/kg/day)
Benzene	1.28E-02	10.0	25	0.4	1.43E-05
Bis(2-ethylhexyl)phthalate	0.00E+00	10.0	25	0.4	0.00E+00
Methylene Cloride	6.15E-05	10.0	25	0.4	6.88E-08
Carcinogenic PAHs - USEPA	3.70E-04	10.0	25	0.4	4.14E-07
Carcinogenic PAHs - ICF	3.70E-04	10.0	25	0.4	4.14E-07

Carcinogenic Compound(s)	Summary Exposure (mg/kg/day)	Toxicokinetic Factor (unitless)	CAG Potency Factor (mg/kg/day)^-1	Incremental Cancer Risk
Benzene	6.21E-05	1.0	2.90E-02	1.80E-06
Bis(2-ethylhexyl)phthalate	0.00E+00	0.8	1.40E-02	0.00E+00
Methylene Cloride	2.99E-07	1.0	1.40E-02	4.18E-09
Carcinogenic PAHs - USEPA	1.83E-06	1.0	6.10E+00	1.11E-05
Carcinogenic PAHs - ICF	1.83E-06	1.0	4.53E-01	8.28E-07
SUMMARY INCREMENTAL CANCER RISK			USEPA	1.30E-05
			ICF	2.63E-06

TABLE G-3-13 (continued)

RISK CALCULATION SUMMARY
Mechanicville Site
Inhalation
Noncarcinogen

Compounds	Most Probable Case Child	Percent Total Risk	Realistic Worst Case Child	Percent Total Risk
Cyanide	3.50E-07	0.1%	2.04E-05	0.1%
Ethylbenzene	1.10E-04	31.4%	5.72E-03	31.4%
Noncarcinogenic PAHs	6.98E-06	2.0%	4.07E-04	2.2%
Styrene	1.01E-04	28.8%	5.21E-03	28.6%
Toluene	2.02E-05	5.8%	1.05E-03	5.8%
Trimethylbenzene	8.96E-06	2.6%	4.64E-04	2.5%
Total Xylenes	1.03E-04	29.4%	5.34E-03	29.3%
SUMMARY HAZARD INDEX	3.50E-04		1.82E-02	

Inhalation
Carcinogen

Compounds	Most Probable Case Child	Percent Risk-USEPA	Percent Risk-ICF	Realistic Worst Case Child	Percent Risk-USEPA	Percent Risk-ICF
Benzene	3.47E-08	15.3%	70.8%	1.80E-06	13.9%	68.4%
Bis(2-ethylhexyl)phthalate	0.00E+00	0.0%	0.0%	0.00E+00	0.0%	0.0%
Methylene Cloride	7.41E-11	0.0%	0.2%	4.18E-09	0.0%	0.2%
Carcinogenic PAHs - USEPA	1.91E-07	84.6%		1.11E-05	86.1%	
Carcinogenic PAHs - ICF	1.42E-08		29.0%	8.28E-07		31.4%
SUMMARY INCREMENTAL CANCER RISK						
USEPA	2.26E-07			1.30E-05		
ICF	4.90E-08			2.63E-06		

SSLC-MP
16-Jan-90

TABLE G-3-14
Direct Contact with and/or Ingestion of Soil
Most Probable Case - Teenagers
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices.

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
noncarcinogenic PAHs	24.00	9.1	0.1	0.05	0.10	45	5	7.31E-08	3.34E-06	4.00E-01	8.53E-06
Cyanide (amenable)	0.69	9.1	0.1	1.00	0.50	45	5	1.05E-08	1.92E-06	2.00E-02	9.66E-05
									SUMMARY HAZARD INDEX		1.05E-04

Note: TK - Toxicokinetic Factor

noncar PAHs
car PAHs

TABLE G-3-15
Direct Contact with and/or Ingestion of Soil
Most Probable Case - Teenagers
Carcinogenic Effects
Mechanicville Site

EC-MP
25-Jul-90

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times \left[(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})\right] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{years}} \times \frac{\text{No. of years exposed}}{70 \text{ years}} \times \frac{1 \text{ mg}}{1000 \text{ ug}} \times \frac{1 \text{ yr}}{365 \text{ days}} \times \frac{1}{1000 \text{ ug}}$$

$$\text{Incremental Risk} = \text{Body Dose mg/kg/day} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Carc. PAHs - USEPA	20.00	9.1	0.1	0.05	0.1	45	5	5.0	4.35E-09	1.99E-07	1.15E+01	2.34E-06
Carc. PAHs - ICF	20.00	9.1	0.1	0.05	0.1	45	5	5.0	4.35E-09	1.99E-07	3.20E+00	6.50E-07

SUMMARY CARCINOGENIC RISK	
USEPA	2.34E-06
ICF	6.50E-07

Note: TK - Toxicokinetic Factor

SSLC-BW
16-Jan-90

TABLE G-3-16
Direct Contact with and/or Ingestion of Soil
Realistic Worst Case - Teenagers
Noncarcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and hazard indices.

The equations to calculate body dose level and hazard indices are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times \left[\left(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}\right) + \left(\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor}\right)\right] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{year}} \times \frac{1\ \text{mg}}{1000\ \text{ug}} \times \frac{1\ \text{yr}}{365\ \text{days}}$$

$$\text{Hazard Index} = \frac{\text{Body Dose (mg/kg/day)}}{\text{Standard or Guideline (mg/kg/day)}}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	Standard/ Guideline (mg/kg/day)	Hazard Index
noncarcinogenic PAHs	37.41	9.1	0.1	0.05	0.10	45	10	2.28E-07	1.04E-05	4.00E-01	2.66E-05
Cyanide (amenable)	1.80	9.1	0.1	2.50	1.00	45	10	1.10E-07	2.51E-05	2.00E-02	1.26E-03
									SUMMARY HAZARD INDEX		1.28E-03

Note: TK - Toxicokinetic Factor

TSLC-RW

25-Jul-90

TABLE G-3-17
Direct Contact with and/or Ingestion of Soil
Realistic Worst Case - Teenagers
Carcinogenic Effects
Mechanicville Site

This table calculates estimated body doses and incremental carcinogenic risks.

The equations to calculate body dose level and incremental carcinogenic risks are:

$$\text{Body Dose (mg/kg/day)} = \text{Soil Concentration (ug/g)} \times [(\text{Amount Contacted (g/event)} \times \text{Dermal TK Factor}) + (\text{Amount Ingested (g/event)} \times \text{Ingestion TK Factor})] \times \frac{1}{\text{Body Weight (kg)}} \times \frac{\text{No. Events}}{\text{years}} \times \frac{\text{No. of years exposed}}{70 \text{ years}} \times \frac{1 \text{ mg}}{1000 \text{ ug}} \times \frac{1 \text{ yr}}{365 \text{ days}} \times \frac{1}{1000 \text{ ug}}$$

$$\text{Incremental Risk} = \text{Body Dose mg/kg/day} \times \text{CAG Potency Factor (mg/kg/day)}^{-1}$$

Compound	Concentration (ug/g)	Amount of Soil Contacted (g/event)	Amount of Soil Ingested (g/event)	Dermal TK Factor	Ingestion TK Factor	Body Weight (kg)	No. of Events per year	No. of Years Exposed	Ingestion Body Dose (mg/kg/day)	Direct Contact Body Dose (mg/kg/day)	CAG Potency Factor (mg/kg/day)^-1	Incremental Risk
Carc. PAHs - USEPA	38.20	9.1	0.1	0.05	0.1	45.0	10	10.0	3.32E-08	1.52E-06	1.15E+01	1.79E-05
Carc. PAHs - ICF	38.20	9.1	0.1	0.05	0.1	45.0	10	10.0	3.32E-08	1.52E-06	3.20E+00	4.97E-06

SUMMARY CARCINOGENIC RISK	
USEPA	1.79E-05
ICF	4.97E-06

Note: TK - Toxicokinetic Factor

Appendix G-4

Air Modeling Method and Results

D.1 AIR QUALITY MODELING OF FUGITIVE AIR EMISSIONS

Emissions of contaminants are predicted for future hypothetical construction activities at the Mechanicville site. Both particle and volatile emissions are estimated.

D.1.1 Fugitive Dust Emissions

The fugitive dust emission equations used for this analysis are based on empirical studies of surface mines and storage piles for various materials (Cowherd, 1985). These equations can be used to estimate the emissions of contaminants based on the measured chemical concentrations in the surface soil at the Mechanicville site.

The emissions predicted from these equations are for inhalable particles (PM_{10}) that have an aerodynamic diameter smaller than or equal to 10um. Inhalable particles can be retained by the body upon inhalation and contribute to inhalation exposure.

Contaminant emission rates were estimated from PM_{10} emission factors, the mass fraction of contaminant in the Mechanicville site soil, and the hypothetical exposed surface area of the contaminated soil. The contaminant emission rate (Q_{10}; g/sec) of particles 10 um and smaller was determined by the following equation:

$$Q_{10}\ (g/sec) = [\ f \times E_{10} \times A_c\ ] \times 10^{-6} \qquad (D\text{-}1)$$

where:

Q_{10} = contaminant PM_{10} emission rate (g/sec)

f = mass fraction of contaminant in PM_{10} emissions (mg contaminant/kg PM_{10})

E_{10} = PM_{10} emission rate (g PM_{10}/m^2-sec)

A_c = contaminated surface area (m^2)

10^{-6} = conversion factor for (mg contaminant/kg PM_{10}) to (g contaminant/g PM_{10})

The first step in estimating the emission rate (Q_{10}) from the contaminated surface area is to evaluate the sources of the particle emissions. For the Mechanicville site, the main source of particle emissions is wind erosion.

For estimating emissions from wind erosion for surface areas not covered by vegetation, two emission factor equations have been recommended by Cowherd et al. (1985). Selection of an equation depends on whether the contaminated site's surface material is classified as having a "limited reservoir" or an "unlimited reservoir" of erodible surface particles. Nonhomogeneous exposed surfaces that are crusted and include nonerodible elements are characterized as having a "limited reservoir" of erodible particles and require high threshold wind speeds for wind erosion. Exposed surfaces with "unlimited" erosion potential are those that do not form a crust and consist of finely divided particles (e.g., sandy agricultural soil). For the "unlimited reservoir" category, a lower threshold wind speed is necessary to entrain the contaminated soil. Based on field studies, a threshold friction velocity of 75 cm/sec is considered as the dividing line between the two classes of wind erosion.

Based on a relationship derived by Gillette (1980), the threshold friction velocity for wind erosion can be estimated from the mode of the grain-size distribution for soil samples from the site. Based on representative soil samples from the Mechanicville site, a threshold friction velocity less than 75.0 cm/sec was determined using the Gillette curve as presented in Cowherd et al. (1985). Therefore, the "unlimited reservoir" emission equation was used for the Mechanicville site.

For the utility repair scenario described in Section 5.0, Jordan calculated a conservative estimate of the PM_{10} emission rate (E_{10}) for the contaminated surface with "unlimited" erosion potential; an emission factor derived by Gillette (1981) based on field measurements of highly erodible soil was used. Cowherd (1985) presents a simplified form of this equation to represent the worst-case (short-term) emission rates. This equation is:

$$E_{10}\ (g/m^2\text{-sec}) = (1.0 \times 10^{-5})\ (1 - V)[U_{6\text{-hour}}]^3 \qquad \text{(D-2)}$$

where: V = fraction of contaminated surface with vegetative cover (equal to 0.0 for bare soil)

$[\ U_{6\text{-hour}}\ ]$ = expected maximum 6-hour mean wind speed (m/sec)

Based on local climatological data presented in Cowherd et al. (1985), the fastest mile [U^*] and mean wind speed [U] recorded for Albany, New York, are 21.4 m/sec and 4.0 m/sec, respectively. Because the Mechanicville site is located approximately 15 miles north of Albany, the Albany meteorological data were assumed to be representative of the Mechanicville site. As proposed by the World

Meteorological Organization to account for different averaging periods, the expected maximum 6-hour mean wind speed during the year can be estimated by the following equation:

$$[U_{6\text{-hour}}]\ (\text{m/sec}) = [U^*]\text{-}2.0 \qquad \text{(D-3)}$$

For the Mechanicville site, with all of the uncovered contaminated soil assumed to be bare (V = 0.0), worst-case hourly emission rates (E_{10}) due to soil erosion were calculated for the following two wind speed conditions:

Maximum Hourly Wind Speed: 19.4 m/sec

Most Probable Hourly Wind Speed: 4.0 m/sec

The particulate emission rates (E_{10}), per unit surface area, for the two wind speed cases were calculated to be:

Maximum 6-hour Wind Speed: $E_{10} = 7.30 \times 10^{-2}$ g/m^2-sec

Most Probable Wind Speed: $E_{10} = 6.40 \times 10^{-4}$ g/m^2-sec

A summary of the assumptions and input parameters used to estimate the fugitive dust emission rates due to unlimited soil erosion are given in Table D-1.

TABLE G-4-1

ASSUMPTIONS AND INPUT PARAMETERS
USED IN FUGITIVE DUST EMISSION RATE CALCULATIONS
MECHANICVILLE SITE

Wind Erosion Emissions

Erosion Potential:	Unlimited
Volume of Contaminated Soil Removed:	
Utility Repair Excavation: (Realistic Worst Case)	4,800 cubic feet
Utility Repair Excavation Case: (Most Probable Case)	1,200 cubic feet
Fraction of Contaminated Surface (V) with Vegetative Cover	0.00
Roughness Height (Zo):	5.0 cm

Wind Speed Range	Wind Speed [m/s]	E_{10c} [g/m^2 -s]
High Wind Speed:	19.4	8.00×10^{-5}
Mean Wind Speed:	4.0	9.73×10^{-7}

The surface area of contaminated soil was assumed to equal that of the soil pile. The volume of contaminated soil brought to the surface and piled at the site was estimated for the following two scenarios:

Utility Repair Excavation - Realistic Worst Case: 4,800 cubic feet

Utility Repair Excavation - Most Probable Case: 1,200 cubic feet

The exposed surface areas of the soil piles were estimated based on the assumption that the storage piles were shaped similar to a solid cone.

The actual contaminant emission rates (Q_{10}), in grams per second, were obtained by Equation D-1 for the two wind speed cases.

D.1.2 Volatilization Rates from Soils

The volatilization of contaminants through the soil is a complex process involving the mass transfer of volatiles from the soil particles into the air pores in the soil, mass transfer through the soil pore spaces, and mass transfer from the soil surface into the ambient air. Before estimating the volatilization rates of organic chemicals from the contaminated soil, several empirical models were evaluated. For each model, values for several input parameters were not directly available for Mechanicville and would have had to be estimated. The volatilization rates calculated by the different models for specific contaminants ranged over several orders of magnitude. Because of the

uncertainty of the applicability of these models for the Mechanicville site, it was decided that a more simplified but conservative approach would be used.

Based on the mean contaminant soil concentration measured at the Mechanicville site, the mass of the contaminant (grams) in the soil for the two soil volume cases previously discussed was determined. The contaminant emission rates due to volatilization from the surface soils were calculated for the following two cases:

Most Probable: 10 percent of VOC mass emitted over 20-day period

Realistic Worst: 100 percent of VOC mass emitted over 30-day period

For the two cases, the emission rates due to volatilization from the exposed soil are assumed to remain constant. For the contaminants measured in the Mechanicville soil, Table D-2 provides the mean soil concentration (mg/kg) and the 20-day and 30-day average emission rates (g/sec).

D.2 AIR QUALITY DISPERSION MODELS

Once contaminant emission rates for the different scenarios have been estimated, air quality modeling is used to estimate ambient air concentrations at selected distances from the Mechanicville site. Jordan modeled the emissions from the exposed soil surface area as area sources. Jordan assumed that no plume rise will occur, and that the contaminant emissions are mixed uniformly over a height equal to the height of the soil pile.

TABLE G-4-2

SOIL CONCENTRATIONS AND EMISSION RATES
FOR VOLATILIZATION FROM SURFACE SOILS
MECHANICVILLE SITE

ASSUMPTIONS:

MOST PROBABLE: 10% OF VOC MASS EMITTED OVER 20 DAYS
WORST CASE: 100% OF VOC MASS EMITTED OVER 30 DAYS

SOIL DENSITY: 1440 KG/M^3
SOIL VOLUME: MOST PROBABLE: 1200 CU. FT. WORST CASE: 4800 CU. FT.

		MOST PROBABLE		WORST CASE	
CONTAMINANT COMPOUND	MEAN SOIL CONC. (MG/KG)	MASS OF CONTAMINANT IN SOIL[a] (G)	20 DAY AVG. E[b] (G/S)	MASS OF CONTAMINANT IN SOIL (G)	30 DAY AVG. E (G/S)
Benzene	104	5.09E+03	2.94E-04	2.03E+04	7.85E-03
Toluene	151	7.38E+03	4.27E-04	2.95E+04	1.14E-02
Ethylbenzene	82.1	4.01E+03	2.32E-04	1.61E+04	6.20E-03
Styrene	150	7.34E+03	4.25E-04	2.93E+04	1.13E-02
Total Xylenes	306	1.50E+04	8.66E-04	5.99E+04	2.31E-02
Trimethylbenzene	26.7	1.31E+03	7.56E-05	5.22E+03	2.01E-03
Methylene Chloride	0.5	2.45E+01	1.42E-06	9.78E+01	3.77E-05

[a] Mass of contaminant in soil (g) = mean soil concentration $\left(\frac{\text{mg contaminant}}{\text{kg soil}}\right)$ x soil density $\left(\frac{\text{kg soil}}{\text{m}^3}\right)$ x soil volume (m^3)

[b] Average E(g/s) = $\frac{\text{mass of contaminant in soil (g)}}{20 \text{ days}} \times \frac{1 \text{ day}}{24 \text{ hour}} \times \frac{1 \text{ hour}}{60 \text{ min.}} \times \frac{1 \text{ min}}{60 \text{ sec.}}$

Jordan evaluated two air dispersion modeling approaches to determine which modeling approach was appropriate for the Mechanicville site. The first modeling approach involves a simple box model to estimate ambient concentrations due to emissions from an area source. The box model is based on conservation of mass equations, requires steady-state conditions, and is widely used in exposure studies where the receptors are on-site or very close to the exposed surface area. The box itself encloses the area of interest, bounded by the ground, with a height estimated by an assumed mixing layer. Mixing within the box is assumed to be complete. The width of the box is set equal to the width of the exposed soil area. The box is oriented so that its length lies in the direction of the wind. The box model is limited in its application to area sources with a surface width much larger than the distance to the receptor of interest.

For the Mechanicville site, predicted concentrations are of interest at receptors located on-site or within 750 feet of the exposed contaminated area. The size of the exposed contaminated soil piles for the Mechanicville site are relatively small, with the largest pile estimated to have a diameter of only 31 feet. Because the distance to the receptors of interest is greater than the width of the soil pile, the box model is not appropriate for the Mechanicville site. Therefore, another modeling approach was considered for determining the ambient contaminant concentrations due to fugitive emissions.

The second modeling approach follows the basic modeling procedures described in D. B. Turner's Workbook of Atmospheric Dispersion Estimates (Turner, 1970). These procedures are based on the basic Gaussian plume equation. For a ground-level source with no effective plume rise, the Gaussian equation reduces to a

simplified form that has been widely used in screening assessments. For the Mechanicville site, the emissions from the soil piles are assumed to be spread over the area of the pile. Following Turner's recommendations, Jordan modeled the area source emissions from the soil pile as if they originated from a virtual point source. The virtual point source approach creates a point source located at an appropriate distance upwind such that the horizontal dispersion at the soil pile is equal to the soil pile width. The horizontal dispersion downwind of the facility can then be simulated as if all the soil pile emissions were being emitted from the virtual point source. The distance used in the calculation of ambient concentrations is the total distance from the virtual point to the receptor.

The calculation of the ambient concentrations due to emissions from the soil piles is simplified by using the virtual source approximation. Further simplification is possible by assuming that the emissions due to soil erosion and volatilization are initially spread over the height of the soil pile. Having calculated the contaminant emission rate of particles 10 um and smaller (Q_{10c}), the ambient contaminant concentration can be estimated by the following equation:

$$C10 = Q_{10c} / [\ pi * \text{sigma}_y * (\text{sigma}_z + H_p) * U\ ] \qquad (D\text{-}6)$$

where:

C10 = Contaminant air concentration (g/m^3)

Q_{10c} = Contaminated emission rate (g/sec)

sigma_y = Horizontal dispersion coefficient (m) at distance X + Xv

sigma_z = Vertical dispersion coefficient (m) at distance X

H_p = Height of soil pile (m)

U = Average wind speed (m/sec)

X_v = Virtual source distance (m)

X = Distance from edge of soil pile to receptor (m)

For the Mechanicville site evaluation, downwind receptors were placed 10, 100, and 750 feet from the edge of the soil pile. The initial virtual horizontal dispersion coefficient is estimated by dividing the width of the soil surface pile by 4.3. From extrapolation of the horizontal dispersion coefficient curve in Turner's workbook for D atmospheric stability class, the virtual source distance (X_v) was determined for two different soil volume cases:

Case Description	Exposed Soil Volume
Utility Repair Excavation - Realistic Worst	4,800 cubic feet
Utility Repair Excavation - Most Probable	1,200 cubic feet

Different wind speeds were used with Equation D-6 to represent realistic worst and most probable conditions at the Mechanicville site. To represent the most probable conditions, a wind speed of 4.0 m/sec with a D atmospheric stability class was assumed. To represent the worst case conditions, two wind speed values were assumed. To simulate realistic worst conditions from emissions due to the volatilization of contaminants in the soil pile, a wind speed of 2.0 m/sec was selected. Because fugitive emissions due to unlimited soil erosion increase with wind speed, a wind speed of 19.4 m/sec was selected to represent worst case particulate emissions.

Based on the assumptions used in this analysis, the ambient air quality concentrations calculated using Equation D-6 predict hourly values of contaminant concentrations. To relate these predictions to longer averaging time periods, conservative scaling factors recommended by USEPA (1977) were used to estimate longer duration exposure concentrations. The 1-hour average box model predictions were multiplied by 0.40 to obtain 24-hour average off-site concentrations, and by 0.70 to obtain 8-hour average on-site concentrations.

Table D-3 presents the ambient air concentrations due to fugitive dust emissions from soil erosion for the realistic worst case utility repair scenario. Table D-4 presents the contaminant ambient air concentrations for the analogous most probable case.

Based on the emission rates for volatilization from surface soil given in Table D-2, Table D-5 provides the chemical-specific average concentrations for the two contaminated soil volume cases (i.e., two utility repair scenarios). The ambient 1-hour average concentrations were calculated based on an assumed D atmospheric stability class and wind speed values of 2.0 and 4.0 m/sec. From the predicted 1-hour average concentrations, 8-hour and 24-hour average concentrations were calculated using the scaling factors given previously.

4945D-3

TABLE G-4-3

AMBIENT AIR CONCENTRATIONS
FOR NONVOLATILE CONTAMINANTS:
REALISTIC WORST CASE
UTILITY REPAIR SCENERIO
MECHANICVILLE

ASSUMPTIONS:

	Wind Speed (m/sec)	Soil Surface Area (sq. meters)
For Unlimited Wind Erosion:	19.4	135.9

(Stability Class = D for all cases)

COMPOUND	DOWNWIND DISTANCE (feet)	REALISTIC WORST CASE AMBIENT AIR CONCENTRATIONS (ug/cu.m) WIND EROSION 1-hour	8-hour	24-hour
Acenaphthene	10	1.18E+00	8.26E-01	4.72E-01
	100	4.41E-01	3.09E-01	1.76E-01
	750	1.15E-01	8.04E-02	4.59E-02
Acenaphthylene	10	3.35E+00	2.34E+00	1.34E+00
	100	1.25E+00	8.75E-01	5.00E-01
	750	3.26E-01	2.28E-01	1.30E-01
Anthracene	10	1.67E+00	1.17E+00	6.69E-01
	100	6.25E-01	4.38E-01	2.50E-01
	750	1.63E-01	1.14E-01	6.51E-02
Carcinogenic PAHs	10	2.48E+00	1.73E+00	9.91E-01
	100	9.26E-01	6.48E-01	3.70E-01
	750	2.41E-01	1.69E-01	9.65E-02
Fluoranthene	10	2.61E+00	1.82E+00	1.04E+00
	100	9.74E-01	6.82E-01	3.90E-01
	750	2.54E-01	1.78E-01	1.01E-01
Fluorene	10	4.70E+00	3.29E+00	1.88E+00
	100	1.76E+00	1.23E+00	7.02E-01
	750	4.57E-01	3.20E-01	1.83E-01
Naphthalene	10	4.99E+00	3.49E+00	2.00E+00
	100	1.87E+00	1.31E+00	7.46E-01
	750	4.86E-01	3.40E-01	1.94E-01
Phenanthrene	10	2.94E+00	2.05E+00	1.17E+00
	100	1.10E+00	7.68E-01	4.39E-01
	750	2.86E-01	2.00E-01	1.14E-01
Pyrene	10	3.65E+00	2.55E+00	1.46E+00
	100	1.36E+00	9.54E-01	5.45E-01
	750	3.55E-01	2.49E-01	1.42E-01
2-Methylnaphthalene	10	1.19E-01	8.32E-02	4.75E-02
	100	4.44E-02	3.11E-02	1.78E-02
	750	1.16E-02	8.10E-03	4.63E-03
Total Cyanide	10	6.30E-03	4.41E-03	2.52E-03
	100	2.35E-03	1.65E-03	9.42E-04
	750	6.13E-04	4.29E-04	2.45E-04

4945d-4

TABLE G-4-4

AMBIENT AIR CONCENTRATIONS
FOR NONVOLATILE CONTAMINANTS:
MOST PROBABLE CASE
UTILITY REPAIR SCENERIO
MECHANICVILLE

ASSUMPTIONS:

	Wind Speed (m/sec)	Soil Surface Area (sq. meters)
For Unlimited Wind Erosion:	4.0	34

(Stability Class = D for all cases)

COMPOUND	DOWNWIND DISTANCE (feet)	MOST PROBABLE CASE AMBIENT AIR CONCENTRATIONS (ug/cu.m) WIND EROSION 1-hour	8-hour	24-hour
Acenaphthene	10	3.72E-02	2.60E-02	1.49E-02
	100	9.76E-03	6.83E-03	3.91E-03
	750	1.68E-03	1.17E-03	6.71E-04
Acenaphthylene	10	1.05E-01	7.38E-02	4.22E-02
	100	2.77E-02	1.94E-02	1.11E-02
	750	4.76E-03	3.33E-03	1.90E-03
Anthracene	10	5.27E-02	3.69E-02	2.11E-02
	100	1.38E-02	9.69E-03	5.54E-03
	750	2.38E-03	1.67E-03	9.52E-04
Carcinogenic PAHs	10	7.80E-02	5.46E-02	3.12E-02
	100	2.05E-02	1.44E-02	8.20E-03
	750	3.52E-03	2.47E-03	1.41E-03
Fluoranthene	10	8.21E-02	5.75E-02	3.28E-02
	100	2.16E-02	1.51E-02	8.63E-03
	750	3.71E-03	2.59E-03	1.48E-03
Fluorene	10	1.48E-01	1.04E-01	5.92E-02
	100	3.89E-02	2.72E-02	1.56E-02
	750	6.68E-03	4.68E-03	2.67E-03
Naphthalene	10	1.57E-01	1.10E-01	6.29E-02
	100	4.13E-02	2.89E-02	1.65E-02
	750	7.10E-03	4.97E-03	2.84E-03
Phenanthrene	10	9.24E-02	6.47E-02	3.70E-02
	100	2.43E-02	1.70E-02	9.72E-03
	750	4.17E-03	2.92E-03	1.67E-03
Pyrene	10	1.15E-01	8.04E-02	4.60E-02
	100	3.02E-02	2.11E-02	1.21E-02
	750	5.19E-03	3.63E-03	2.07E-03
2-Methylnaphthalene	10	3.74E-03	2.62E-03	1.50E-03
	100	9.84E-04	6.89E-04	3.94E-04
	750	1.69E-04	1.18E-04	6.76E-05
Total Cyanide	10	1.98E-04	1.39E-04	7.94E-05
	100	5.21E-05	3.65E-05	2.09E-05
	750	8.96E-06	6.27E-06	3.58E-06

4945d-5

TABLE G-4-5

AMBIENT AIR CONCENTRATIONS
FOR VOLATILE CONTAMINANTS:
UTILITY REPAIR SCENERIO
MECHANICVILLE

ASSUMPTIONS:

	Soil Pile Volume (cu. ft.)	Wind Speed (m/sec)
Most Probable Case:	1200	4.0
Realistic Worst Case:	4800	2.0

(Stability Class = D for all cases)

COMPOUND	DOWNWIND DISTANCE (feet)	AMBIENT AIR CONCENTRATIONS (ug/cu.m.)					
		MOST PROBABLE			REALISTIC WORST CASE		
		1-hour	8-hour	24-hour	1-hour	8-hour	24-hour
Benzene	10	2.84E+00	1.99E+00	1.13E+00	8.56E+01	5.99E+01	3.42E+01
	100	7.64E-01	5.35E-01	3.06E-01	3.20E+01	2.24E+01	1.28E+01
	750	1.76E-01	1.23E-01	7.03E-02	6.83E+00	4.78E+00	2.73E+00
Toluene	10	4.12E+00	2.88E+00	1.65E+00	1.24E+02	8.70E+01	4.97E+01
	100	1.11E+00	7.77E-01	4.44E-01	4.65E+01	3.25E+01	1.86E+01
	750	2.55E-01	1.79E-01	1.02E-01	9.92E+00	6.94E+00	3.97E+00
Ethylbenzene	10	2.24E+00	1.57E+00	8.96E-01	6.76E+01	4.73E+01	2.70E+01
	100	6.03E-01	4.22E-01	2.41E-01	2.53E+01	1.77E+01	1.01E+01
	750	1.39E-01	9.70E-02	5.54E-02	5.39E+00	3.78E+00	2.16E+00
Styrene	10	4.10E+00	2.87E+00	1.64E+00	1.23E+02	8.62E+01	4.93E+01
	100	1.11E+00	7.74E-01	4.42E-01	4.60E+01	3.22E+01	1.84E+01
	750	2.54E-01	1.78E-01	1.02E-01	9.83E+00	6.88E+00	3.93E+00
Total Xylenes	10	8.36E+00	5.85E+00	3.34E+00	2.52E+02	1.76E+02	1.01E+02
	100	2.25E+00	1.58E+00	9.01E-01	9.41E+01	6.59E+01	3.77E+01
	750	5.17E-01	3.62E-01	2.07E-01	2.01E+01	1.41E+01	8.04E+00
Trimethylbenzene	10	7.30E-01	5.11E-01	2.92E-01	2.19E+01	1.53E+01	8.76E+00
	100	1.97E-01	1.38E-01	7.86E-02	8.19E+00	5.73E+00	3.28E+00
	750	4.52E-02	3.16E-02	1.81E-02	1.75E+00	1.22E+00	6.99E-01

APPENDIX G-4

REFERENCES

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Turner, D.B., 1970. Workbook of Atmospheric Dispersion Estimates; U.S. Department of Health, Education, and Welfare; National Air Pollution Administration; Cincinnati, Ohio.

U.S. Environmental Protection Agency (USEPA), 1977. Guideline for Air Quality Maintenance Planning and Analysis (Volume 10 - Revised): Procedures for Evaluating Air Quality Impact of New Stationary Sources; USEPA-450/4-77-001; prepared for USEPA Office of Air Quality Planning and Standards; Research Triangle Park, North Carolina.

U.S. Environmental Protection Agency (USEPA), 1983 Reference from the GRADIENT Report (Management of Manufactured Gas Plant Site - Section 1.3.2.1) giving the emission rate (PM10) equation for bulldozers.

MECHANICVILLE SITE-SPECIFIC HEALTH AND SAFETY PLAN

INVESTIGATION OF FORMER COAL GASIFICATION SITES

MECHANICVILLE SITE
MECHANICVILLE, NEW YORK

HEALTH AND SAFETY PLAN

Prepared for:

New York State Electric and Gas Corporation
4500 Vestal Parkway East
Binghamton, New York 13903-1082

Prepared by:

ABB Environmental Services, Inc.
Portland, Maine

FEBRUARY 1992

SITE INVESTIGATION TEAM
SITE SAFETY PLAN

A. GENERAL INFORMATION

SITE: Mechanicville

LOCATION: Mechanicville, New York

PLAN PREPARED BY: T. Plante DATE: 2/20/92

APPROVED BY: Mig MacLeod DATE: 2/25/92

OBJECTIVE(S): To maintain health and safety while collecting environmental characterization samples (soil/water) from a former coal gasification plant site. This plan covers activities to be performed under Task 5: Phase IIA Supplemental Remedial Investigations.

PROPOSED DATE OF INVESTIGATION: May 1992 through November 1992

BACKGROUND REVIEW: Complete: X Preliminary: _____

OVERALL HAZARD: Serious: ___ Moderate: X Low: X Unknown: ___

1.1 Scope and Purpose

This Health and Safety Plan (HASP) was prepared in conformance with the ABB Environmental Services, Inc. (ABB-ES) Health and Safety Program, and is intended to meet the requirements found in 29 CFR 1910.120. As such, the HASP addresses all activities associated with field operations at the NYSEG, Mechanicville site. Compliance with this HASP is required of all ABB-ES personnel, contractor personnel, or third parties entering the site.

SUMMARY OF INVESTIGATION

The objective of the Phase IIA Supplemental Remedial Investigation is to gain a greater understanding of the site which will address comments and recommendations offered by the New York State Department of Environmental Conservation (NYSDEC). The work plan specifically focuses on assessing site soils for PCB contamination, further investigation west of the site to assess soil and groundwater quality, and installation of soil borings, monitoring wells, piezometers and seepage meters downgradient of the site to assess off-site migration of site-related contaminants. The investigation includes the following activities:

- geophysical survey of the area directly east of the site to delineate the bedrock surface and locate the bedrock trough;
- installation of one upgradient shallow monitoring well;
- installation of one shallow and one bedrock monitoring well pair downgradient of the site;
- possible installation of one to two additional monitoring wells downgradient if visible evidence of contamination is found in the first pair;
- collection of subsurface boring soil samples inside and outside the boundary of the site;
- possible installation of additional soil borings if initial downgradient borings show soil contamination;
- shallow subsurface soil sampling within the site boundary;
- installation of piezometers along the Anthony Kill adjacent to and downgradient of the site;
- sediment sampling and UV/IR screening of samples;
- installation of seepage meters along the banks of the Anthony Kill adjacent to and downstream of the site;

- measurement of water levels in wells, piezometers, and surface water; and
- collection of groundwater and seep water samples for analyses.

B. SITE/WASTE CHARACTERISTICS

WASTE TYPES(S): Liquid _X_ Solid _X_ Sludge ___ Gas ___

CHARACTERISTICS(S): Corrosive ___ Ignitable _?_ Radioactive ___

Volatile _X_ Toxic _X_ Reactive _?_ Unknown _X_ Other (Name) ___

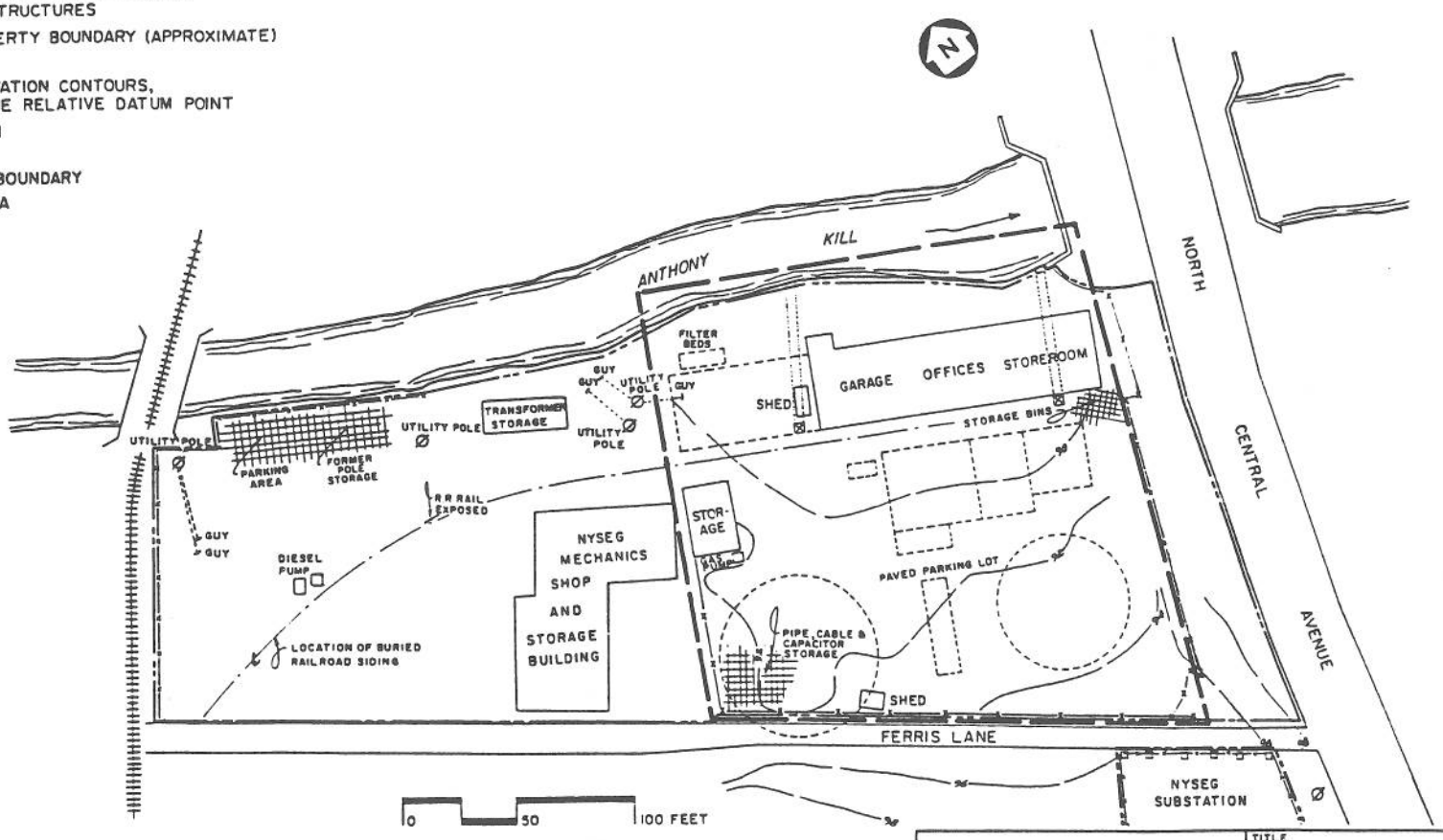
FACILITY DESCRIPTION:

The former Mechanicville manufactured gas plant (MGP) site is located in Mechanicville, New York along the Anthony Kill (a small tributary of the Hudson River). The site is a quarter-mile upstream of the Hudson River, on the western side of North Central Avenue. The site is bounded by the Anthony Kill on the north, North Central Avenue on the east, Ferris Lane on the south, and a lot presently owned by NYSEG on the west. A gas manufacturing plant was operated at the site by New York State Electric and Gas Corporation (NYSEG) and its predecessor companies from 1901 until 1955. Most of the structures utilized in the coal gas manufacturing operation were cleaned out and demolished at the time of closure in 1955. Two of the original gas plant structures are still standing on the site. These are: (1) a large building formerly used as a boiler house and a substation; and (2) a small building formerly used as an office. Between 1955 and 1990, NYSEG operated natural gas and electric service center. The site is currently unoccupied and is surrounded by a 6-foot high chain link fence on three sides and the Anthony Kill to the north. The site is being investigated because it was formerly used for coal gas manufacturing.

The present layout of the facility is shown in Figure 1. A more detailed facility description and site history is contained in Section 1.0 of the Phase II Remedial Investigation Report.

LEGEND

- APPROXIMATE LOCATION OF FORMER GAS PLANT STRUCTURES
- NYSEG PROPERTY BOUNDARY (APPROXIMATE)
- FENCE
- GROUND ELEVATION CONTOURS, IN FEET ABOVE RELATIVE DATUM POINT
- STORM DRAIN
- CULVERT
- STUDY AREA BOUNDARY
- STORAGE AREA



BASE MAP SOURCE:

TOPOGRAPHIC SURVEY PREPARED BY DAVID A. FLANDERS ASSOCIATES, 6 MORNINGSIDE DRIVE, BALLSTON LAKE, NEW YORK, DATED 6/26/86 (86-72-S). REVISED 12/87.

ELEVATIONS BASED ON ASSUMED DATUM OF 100.00' AT RR SPIKE IN UTILITY POLE LOCATED 25' SOUTH OF FERRIS LANE AND NORTH CENTRAL AVENUE.

E.C. JORDAN CO.
CONSULTING ENGINEERS

CLIENT
NEW YORK STATE ELECTRIC AND GAS CORP.
BINGHAMTON, NEW YORK

TITLE
MECHANICVILLE SITE PLAN - 1987
MECHANICVILLE, NEW YORK

INVESTIGATION OF FORMER COAL GASIFICATION SITES

PROJECT NO. 4945-04

FIGURE 1

C. HAZARD EVALUATION

The wastes that may have been generated and deposited at the Mechanicville site are (1) ash and condensate from the gas house; (2) wood chips and spent oxide wastes from the purifying house; and (3) coal tar and oil sludges. Coal tar residues are present in the base of the relief gas holder. In November of 1981, NYSEG employees collected a soil sample from the relief holder at a depth of 3 to 5 feet. Petroleum odors and coal tar residues were observed. A sample of the tar contained 40 mg/ℓ of total phenols. Results of further chemical analysis done on samples taken during Tasks 1 through 4 indicate the presence of several chemicals associated with coal tar. The chemicals of concern identified in the Task 4 Risk Assessment are shown in Table 1.

The general hazards apparent for investigations of former coal gasification sites are both dermal and respiratory. Contact with the wastes is to be carefully avoided. Respiratory hazards result both from volatile components of the waste and possible inhalation of the dusts contaminated with the non-volatile constituents. Several of the constituents are know carcinogens and others (especially phenol) will cause severe dermal irritation. More specific information is provided in Tables 2 and 3.

PCBs which may have been present in transformers stored on-site may be in the soil in the former electrical equipment storage areas. PCBs are suspected carcinogens and are toxic by direct contact and ingestion. Since PCBs are possible severe dermal irritants, contact should be avoided.

Cold stress is a potential problem at the site if operations are conducted during the winter months. Cold Weather Operations is discussed in Appendix A of this HASP

TABLE 1

CONTAMINANTS OF CONCERN
MECHANICVILLE SITE

CARCINOGENS	MEDIUM IN WHICH DETECTED
Carcinogenic PAHs[1]	Soil, Sediment
Benzene	Soil, Sediment, Indoor Air
NONCARCINOGENS	
Toluene	Soil, Indoor Air
Xylene	Soil
Ethyl Benzene	Soil, Sediment
Styrene	Soil
Noncarcinogenic PAHs[2]	Soil, Sediment
Cyanide	Soil, Sediment
Trimethylbenzene	Soil

Notes:

1 Include benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)anthracene, benzo(a)pyrene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

2 Include acenaphthene, acenaphthylene, anthracene, benzo(g,h,i)perylene, fluoranthene, fluorene, naphthalene, phenanthrene, pyrene, and 2-methylnaphthalene (sediment only).

TOXICOLOGICAL PROPERTIES OF COMPOUNDS IDENTIFIED
IN VARIOUS MEDIA
MECHANICVILLE SITE

COMPOUND CLASS	MEDIA IDENTIFIED IN	SPECIFIC COMPOUNDS	TOXICOLOGICAL PROPERTIES[1]
Volatile Organic Compounds	Groundwater	Toluene, benzene, xylenes, ethylbenzene, trimethylbenzene, styrene	These aromatic compounds are absorbed readily through the respiratory and gastrointestinal (GI) tracts and can also be absorbed through the skin. Benzene has the potential to cause cancer. Depending on the dose received, the other compounds can exert toxic effects on the liver and kidneys; they can also act as central nervous system (CNS) depressants and respiratory irritants.
	Subsurface Soil	All of the above plus n-propylbenzene	
	Sediment	Toluene, benzene	
	Air	Toluene, benzene	
Semivolatile Compounds			
• PAHs	Groundwater	Acenaphthene, acenaphthylene, anthracene, benzofluoranthenes, benzo(g,h,i)perylene, benzo(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, pyrene	PAHs are a diverse group of compounds of varying toxicity. They are highly lipid-soluble and are absorbed through the GI and respiratory tracts, and to a lesser degree, through the skin. Many PAHs have been shown to be potentially carcinogenic. Other PAHs are thought to be noncarcinogenic; these include fluorene, anthracene, pyrene, naphthalene, phenanthrene, and fluoranthene. The acute toxicity and chronic toxicity of low level exposures are not well understood.
	Subsurface soil Sediment	All of the above plus dibenzo(a,h)anthracene	
• Phenolic compounds	Groundwater Subsurface soil Surface water	Total recoverable phenolics	Depending on the dose, these compounds can produce liver and kidney toxicity and CNS effects. They can act as respiratory and skin irritants.
Inorganic Compounds	Groundwater	Iron, zinc, cyanide, sulfate	Iron and zinc are essential nutrients. However, they can produce objectionable effects such as staining, bad taste, and GI irritation at high levels. Bioavailable cyanide can exert toxic effects on the liver, kidneys, CNS, and cardiovascular system at high levels. Sulfate is a natural constituents of groundwater which affects taste in high concentration (500 mg/ℓ).
	Subsurface soil	Iron, zinc, cyanide	
	Surface water	Iron, cyanide, sulfate	
	Sediment	Iron, zinc, sulfate	

1 In assessing the risks to public health and the environment posed by these chemicals, not only toxicological properties but also potential receptors and probable exposure conditions must be considered.

CHEMICAL TOXICITY OF COAL TAR CONSTITUENTS

CHEMICAL	APPROXIMATE ODOR THRESHOLD (PPM)	TLV (PPM)	PHYSICAL CHARACTERISTICS	DERMAL TOXICITY	REMARKS
Benzene	0.16	10	Aromatic odor	Local + + Systemic + + +	Poisoning occurs most commonly through inhalation; also penetrates through skin. Carcinogen.
Toluene	1	100 (skin)	Aromatic odor	Local + Systemic +	Penetrates through skin.
Xylenes	0.1-1	100	Aromatic odor		Moderate toxicity via inhalation and oral routes. Low dermal toxicity.
Naphthalene	0.01	10	Mothball odor	Local + + Systemic + +	Poisoning may occur through ingestion of large doses, inhalation, or skin absorption.
Phenolics	1	5 (skin)	Sweet, tarry odor		High toxicity via oral, dermal, and inhalation routes. Absorption from spilling phenolic solutions on the skin may be very rapid, and death results from collapse within 30 minutes to several hours.
Cresol	0.01	5	Sweet, tarry odor		Moderately toxic via inhalation and oral routes. Acts similarly to phenols, but less severe. Produces severe chemical burns and dermatitis.
Phenanthrene/Anthracene					A skin irritant, and an allergen. Known carcinogen.
Ethylbenzene	0.1	100	Aromatic odor	Local + + Systemic + +	Skin irritant.
Pyridine	0.1	5 (skin)	Penetrating, sickening odor	Local + + Systemic +	A mild irritant to the skin. Mildly toxic via oral and inhalation routes.
Ammonia	1	25	Pungent, suffocating odor	Local + + +	Skin and eye irritant. Highly toxic via inhalation and oral routes.
Chrysene					Carcinogenic agent.
Benzo(a)pyrene					Suspected carcinogen. Toxic by inhalation.
Cyanide compounds		5 (skin)	Faint almond odor		Cyanide compounds of sodium and potassium can affect the body if inhaled or in contact with eyes and skin or ingested. Sufficient cyanide may be absorbed through the skin to cause fatal poisoning.
Sulfide compounds Hydrogen sulfide		10	Rotten-egg odor		Cause softening and irritation of the skin. Hydrogen sulfide is extremely toxic.

TABLE 3

CHEMICAL TOXICITY OF COAL TAR CONSTITUENTS

CHEMICAL	APPROXIMATE ODOR THRESHOLD (PPM)	TLV (PPM)	PHYSICAL CHARACTERISTICS	DERMAL TOXICITY	REMARKS
Coal Tar Pitch Volatiles		0.2 mg/m^3	Penetrating, sickening odor		
Arsenic and compounds		0.2 mg/m^3		Local +++ Systemic +++	
Polychlorinated biphenyl: PCB Arochlor 1242 $C_{12}H_7CL_3$ (approx.)	1	2	Colorless to dark brown liquid with mild hydrocarbon odor	Local ++ Systemic	Poisoning occurred most commonly through investigation or penetration of skin.
Archlor 1254 $C_6H_2C1_3C_6H_3C1_2$	0.5	1		Local ++	Symptoms: irritates eyes (discharge), skin acne-form, dermatitis, jaundice, dark urine. Target organ: liver, eyes, skin. First Aid: Swallow: Ipecac, vomit. Skin: soap wash (immed) Incompatibles: strong oxidizers.

Notes:

TLV - Threshold Limit Value
\+ - Slight Hazard
++ - Moderate Hazard
+++ - Extreme Hazard

D. SITE SAFETY WORK PLAN

PERIMETER ESTABLISHMENT:

Map/Sketch Attached? Yes Site Secured? Partially
(6' perimeter fence)
Perimeter Identified? Yes Zone(s) of Contamination Identified? Some

PERSONNEL PROTECTION:

Level of Protection: A ___ B ___ C X D X - Modified

Anything above background in the breathing zone on the PID, monitor for benzene using the 0.5/a Draeger tube. If benzene levels exceed 1.0 ppm (note: using 1.0 instead of 0.5 ppm because tube also reads toluene and xylene), upgrade to Level C. If benzene levels are below 1.0 ppm, continue working at modified Level D until PID levels reach 25 ppm then upgrade to Level C. If PID levels near 50 ppm, monitor with benzene 5/b tube. If benzene levels exceed 50 ppm, upgrade to Level B. Otherwise, continue working at Level C until PID readings read over 100 ppm.

Level B required if:

- PID ≥ 1000, or
- Benzene ≥ 50 ppm

Level C required if:

- PID between 25 and 1000 ppm, and/or
- Benzene between 1 and 50 ppm

Modified Level D ok if:

- PID < 25 ppm, and
- Benzene < 1 ppm

SURVEILLANCE EQUIPMENT AND MATERIALS:

To the extent feasible, the presence of airborne contaminants will be evaluated through the use of direct-reading instrumentation. Information gathered will be used to ensure the adequacy of the levels of protection being employed at the site, and may be used as the basis for upgrading or downgrading levels of protection, at the discretion of the site HSO.

- ISD Dual Detector. This meter monitors for combustible gases and oxygen. It can be used to determine (1) if an area contains concentrations of combustible gases with readings in percentage of the lower explosive limit; and (2) the percentage of oxygen. This equipment will be calibrated in accordance with the manufacturer's instructions.

- HNU IS101 and Photovac TIP Photoionization Detector (PID). Like the OVA, the PID operates on the basis of ionization of the contaminant, which results in a meter deflection proportional to the concentration of the contaminant. In the PID, ionization is caused by a UV light source. The strength of the UV (measured in electron volts [eV]) determines which contaminants can be ionized. The HNU can use three different strength UV sources, including 9.6, 10.2, and 11.7 eV. Only the 10.2- and 11.7-eV probes are currently available for field use. The TIP operates using a UV light source of 10.6 eV. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

- Detector Tubes (MSA and Draeger). A colorimetric detector tube is a direct-reading instrument that consists of a glass tube impregnated with an indicating chemical, which is connected to a piston cylinder or bellows-type pump. A known volume of air is drawn through the glass tube. The contaminant in the air reacts with the indicator chemical, producing a stain the length of which is proportional to the contaminant's concentration. Care must be taken when using the detector tubes because reliability of the results depends on proper calibration, the degree of stability of the reacting chemical, and the ambient temperature. Interfering gases or vapors can also positively or negatively affect measured results. Calibration and maintenance will be performed in accordance with the manufacturer's instructions.

DECONTAMINATION PROCEDURES:

Equipment to be decontaminated during the project may include (1) drill rig, (2) tools, (3) monitoring equipment, (4) sample containers, and (5) truck or trailer. Drilling equipment will be steam-cleaned prior to arrival at the Mechanicville site, followed by on-site steam-cleaning with approved water upon site arrival and between boring/well sites. Prior to use on-site, all casings, augers, recirculation and water tanks, etc., will be devoid both inside and out of any asphaltic, bituminous, or other encrusting or coating materials, grease, grout, soil, etc.

To the extent practical, all steam cleaning shall be performed in an area that is on-site. All decontamination will be done by personnel in protective gear appropriate for the level of decontamination, as determined by the Health and Safety Officer. Decontamination areas will be lined with plastic. If heavy coal tar is present, equipment will be decontaminated in a lined, bermed pit, and decontamination fluids will be collected and drummed. All other decontamination fluids will be disposed of via percolation on-site.

The split-spoon sampler utilized during the subsurface soil sampling procedures will be decontaminated using a TSP/water rinse followed by a distilled water rinse. Loose material will be removed using a brush, prior to the split-spoon washing procedure.

Heavy coal tar material that cannot be removed from sampling equipment will be cleaned with kerosene, then a TSP/water rinse, followed by a distilled water rinse. Large drilling equipment (i.e., augers) will be cleaned with kerosene, then steam-cleaned.

Spoils from the borehole operation, to the extent possible, shall be placed back in the borehole directly above the bentonite grout seal. If a larger than expected quantity of concentrated wastes is encountered, NYSEG will be notified and the wastes will be separated and drummed for later disposal.

SITE ENTRY PROCEDURES:

The site itself will normally be divided into three zones: the majority of the work area will be considered the Exclusion Zone, with limited areas serving as the Support

Zone, and an area for decontamination called the Contamination Reduction Zone (CRZ).

Exclusion Zone

The Exclusion Zone isolates the area of contaminant generation and restricts (to the extent possible) the spread of contamination from active areas of the site to support areas and off-site locations. The Exclusion Zone is demarcated by the Hot Line (i.e., a tape line or physical barrier). Personnel entering the Exclusion Zone must (1) enter through the CRZ; (2) wear the prescribed level of protection (see Section 4.3.1); and (3) be otherwise authorized to enter the Exclusion Zone (see Section 1.3, 1.4, and 9.1). Any personnel, equipment, or materials exiting the Exclusion Zone will be considered contaminated. Personnel will be subject to decontamination; equipment and materials will either be subject to decontamination or containerized in uncontaminated devices.

Within the Exclusion Zone, specific locations or restricted areas (clearly marked or identified) will be established as necessary for particular locations or around specific site operations. In the case of well drilling or excavation operations, a restricted area will be established that includes a minimum 30-foot radius from the drill rig or excavation operation. Other restricted areas may include drum areas, active site areas, sources of combustible gases or air contaminants, or other dangerous areas as they are identified. Specific access for emergency services to areas of specific site operations will be established.

Contamination Reduction Zone

Moving out from the Exclusion Zone, starting at the Hot Line and continuing to the Contamination Control Line, is the CRZ. The CRZ is a transition zone between contaminated and uncontaminated areas of the site. When "hot" or contaminated personnel, equipment, or materials cross the Hot Line, they are assumed to be as "hot" or contaminated as they are going to be from site operations. Being subjected to the decontamination process, they become less contaminated; when they reach the Contamination Control Line, they are clean and can exit this zone without spreading contamination.

Within the CRZ is the Contamination Reduction Corridor (CRC), where materials necessary for full personnel and portable equipment decontamination are kept. A

separate facility will be established for heavy equipment decontamination. In addition, certain safety equipment (e.g., emergency eye wash, fire extinguisher, stretcher, and first aid kit) are staged in this zone.

Support Zone

The Support Zone is the outermost zone of the site, separated from the CRZ by the Contamination Control Line; it is considered a clean area. Movement of personnel and materials from this zone into the CRZ is generally unrestricted, except as required through access points controlled for administrative purposes. However, only uncontaminated/decontaminated personnel or materials may enter this zone from the CRZ.

The Support Zone contains the necessary support facilities (including personal hygiene facilities) for site operations. It also serves as the communications center and source of emergency assistance for operations in the Exclusion Zone and CRZ. A log of all persons entering the site will be maintained by the HSO, the field operations leader, or the site designee.

COMMUNICATIONS:

When radio communication is not used, the following air horn signals will be employed:

HELP	three short blasts	(. . .)
EVACUATION	three long blasts	(_ _ _)
ALL CLEAR	alternating long and short blasts	(_ . _ .)

ENGINEERING CONTROLS, WORK PRACTICES, AND PERSONAL PROTECTIVE EQUIPMENT

ENGINEERING CONTROLS:

No special engineering controls can be used at the Mechanicville site.

WORK PRACTICES:

Workers are expected to adhere to established safe work practices for their respective specialties (e.g., drilling, sampling collection, laboratory analysis, or construction). The need to exercise caution in the performance of specific work tasks is made more acute due to (1) weather conditions; (2) restricted mobility and reduced peripheral vision caused by the protective gear itself; (3) the need to maintain the integrity of the protective gear; and (4) the increased difficulty in communicating caused by respirators. Work at the site will be conducted according to established protocols and guidelines for the safety and health of all involved. Among the most important of these principles for working at a hazardous waste site are the following:

- In any unknown situation, always assume the worst conditions and plan responses accordingly.

- Use the buddy system. Under no conditions will any person be permitted to enter the Exclusion Zone alone. Establish and maintain communication. In addition to radio communications, it is advisable to develop a set of hand signals, because conditions may greatly impair verbal communications.

- Because no personal protective equipment is 100-percent effective, all personnel must minimize contact with excavated or contaminated materials. Plan work areas, decontamination areas, and procedures accordingly. Do not place equipment on drums or the ground. Do not sit on drums or other materials. Do not sit or kneel on the ground in the Exclusion Zone or CRZ. Avoid standing in or walking through puddles or stained soil.

- Smoking, eating, or drinking in the work area and before decontamination will not be allowed. Oral ingestion of contaminants is the second most likely means of introducing toxic substances into the body (inhalation is the first).

- Avoid heat and other work stresses related to wearing protective gear. Work breaks should be planned to prevent stress-related accidents or fatigue.

- To the extent feasible, handling of contaminated materials should be done remotely, particularly when drummed or other containerized hazardous waste materials are found on-site. Every effort should be made to identify the contents of containers found on-site before they are subject to material-handling applications.

- Personnel must be observant of not only one's own immediate surroundings, but also those of others. Everyone will be working under constraints; therefore, a team effort is needed to notice and warn of impending dangerous situations. Extra precautions are necessary when working near heavy equipment and while utilizing personal protective gear because vision, hearing, and communication can be restricted.

- Contact lenses are not allowed to be worn on-site; if corrosive or lachrymose substances enter the eyes, proper flushing is impeded.

- All facial hair that interferes with the face piece fit, must be removed prior to donning a respirator at all sites requiring Level C or B protection.

- Rigorous contingency planning and dissemination of plans to all personnel minimizes the impact of rapidly changing safety protocols in response to changing site conditions.

- Personnel must be aware that chemical contaminants may mimic or enhance symptoms of other illnesses or intoxication. Avoid excess use of alcohol or working while ill during field investigation assignments.

- The site leader, HSO, and sampling personnel will maintain project records in a bound notebook (e.g., daily activities, meetings, incidents, and data). Notebooks will remain on-site for the duration of the project so that replacement personnel may add information, thereby maintaining continuity. These notebooks and daily records will become part of the permanent project file.

Team Member	Responsibility
Dan Ostrye	Project Manager
Tom Plante+*	Site Manager
Bob Burger	Sampling Supervisor
Rick Allen	Geophysical Supervisor
Nathan Hagelin+*	Site Hydrogeologist
Nathan Hagelin+*	Site Health and Safety Officer

* First Aid Certified + CPR Certified

WORK LIMITATION: (Time of day, etc.)

Work will be conducted only during daylight hours. Sampling work undertaken during the winter will continue until winter conditions make efforts unproductive or inefficient, or the provisions of the cold weather operations plan are invoked.

TRAINING

Training is defined under the ABB Environmental Health and Safety Program, and all personnel entering potentially contaminated areas of this site must meet the requirements of 29 CFR 1910.120. Personnel without the required training will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange).

MEDICAL SURVEILLANCE

All personnel entering potentially contaminated areas of this site will be medically qualified for site assignment through a medical surveillance program outlined in the ABB Environmental Health and Safety Program. Personnel who have not received

medical clearance will not be permitted in any area with potential for exposure to toxic substances or harmful physical agents (i.e., downrange).

E. EMERGENCY INFORMATION

LOCAL RESOURCES

Ambulance	John A. Ahearn Rescue Squad	(518) 664-8354
Hospital Emergency Room	Leonard Hospital, Troy, New York	235-0310
Poison Control Center	Albany Medical Center	445-3125
Police	City of Mechanicville	664-7383
Fire Department	City of Mechanicville	664-7383
Airport	Albany County	(800) 343-8828
Explosives Unit	N/A	
EPA Contact		

SITE RESOURCES

Water Supply Yes, in NYSEG office building

Telephone Yes, NYSEG Office (518) 664-7371 ext. 30 or 34

Radio No

Other

EMERGENCY CONTACTS

1.	Environmental Medicine Resources	(404) 455-0818
2.	National Poison Control Center	(808) 492-2414
3.	National Response Center (USEPA)	(800) 424-8802
4.	Chemical Manufacturers Association Chemical Regional Center	(800) 262-8200
5.	Site HSO: Nathan Hagelin	(207) 775-5401 X2725
6.	Site Manager: Tom Plante	(207) 775-5401 X2720
7.	Regional HSS: Meg MacLeod	(207) 775-5401 X2112
8.	HSM: Cindy Sundquist	(207) 775-5401 X2111
9.	Project Manager: Dan Ostrye	(207) 775-5401 X2703
10.	Tom O'Meara (NYSEG - Binghamton)	(607) 762-4036

EMERGENCY/CONTINGENCY PLAN

This section identifies the emergency contingency planning undertaken for operations at this site. Other sections provide further information to be used under emergency conditions.

PERSONNEL ROLES, LINES OF AUTHORITY, AND COMMUNICATION:

The site HSO is the primary authority for directing site operations under emergency conditions. All communications both on- and off-site will be directed through the HSO.

EVACUATION:

Withdrawal Upwind

The work party will continually note general wind directions while on-site. (A windsock may be set up near the work site for visual determinations.) When conditions warrant moving away from the work site, the crew will relocate upwind a distance of approximately 100 feet or farther, as indicated by site monitoring instruments. Donning an SCBA and a safety harness and line, the HSO and a member of the crew (the buddy system must be used) may return to the work site to determine if the condition noted was transient or persistent. If persistent, an alarm should be raised to notify on-site personnel of the situation and the need to leave the site or don an SCBA. An attempt to decrease emissions should be made only if greater respiratory protection is donned. The HSS and client will be notified of conditions. When site access is restricted, thus hindering escape, the crew may be instructed to evacuate the site rather than move upwind, especially if withdrawal upwind moves the crew away from escape routes.

Site Evacuation

When conditions warrant site evacuation, the work party will proceed upwind of the work site and notify the security force, HSO, and field office of site conditions. If the decontamination area is upwind and greater than 500 feet from the work site, the

crew will pass quickly through decontamination to remove contaminated outer suits. If the hazard is toxic gas, respirators will be retained. The crew will proceed to the field office to assess the situation. If instrumentation indicates an acceptable condition, respirators may be removed. As more information is received from the field crew, it will be relayed to the appropriate agencies. The advisability and type of further response action will be coordinated and carried out by the HSO.

Evacuation of Surrounding Area

When the HSO determines that conditions warrant evacuation of downwind residences and commercial operations, local agencies will be notified and assistance requested. Designated on-site personnel will initiate evacuation of the immediate off-site area without delay.

EMERGENCY MEDICAL TREATMENT/FIRST AID:

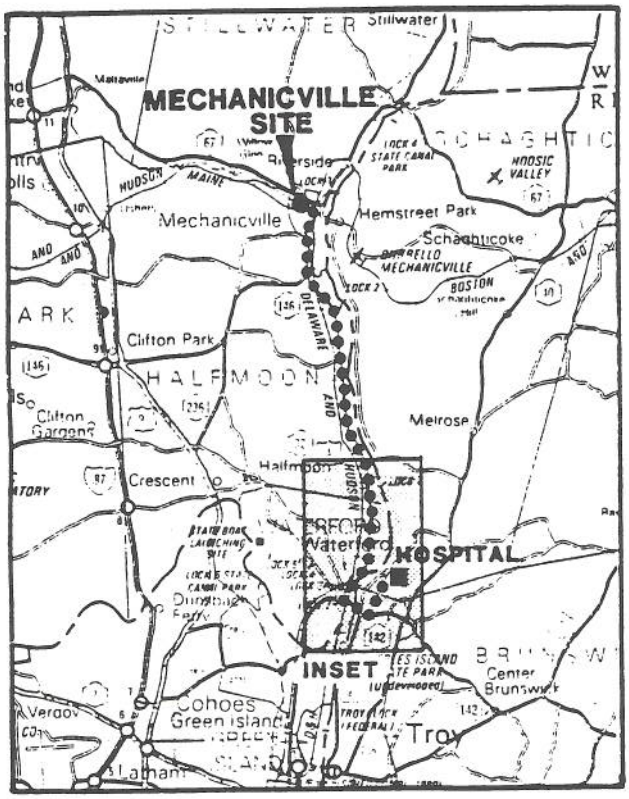
First aid will be rendered to any person injured on-site, as appropriate. The injured person will then be transported to medical personnel for further examination and/or treatment. The preferred transport method is a professional emergency transportation service; however, when this is not readily available or would result in excessive delay, other transport is authorized. Under no circumstances will injured persons transport themselves to a medical facility for emergency treatment.

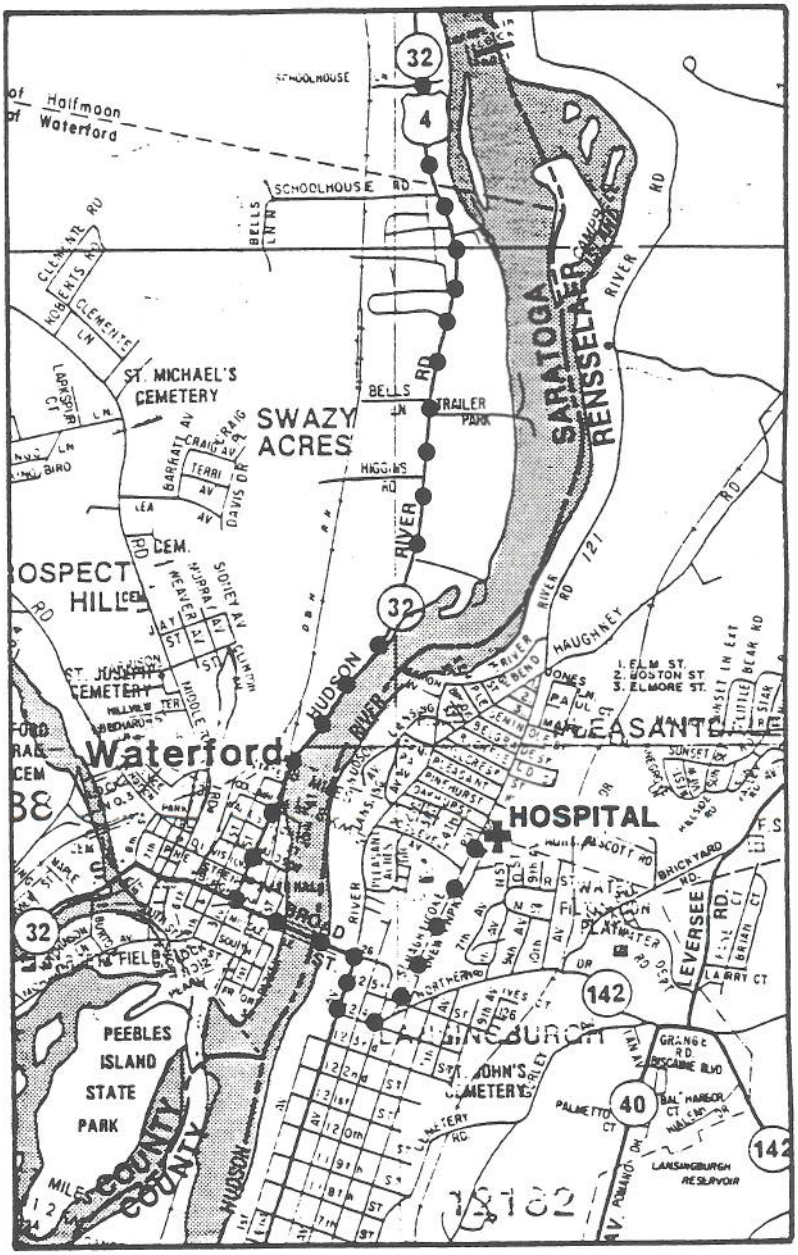
When an injury occurs in a downrange position, provisions for decontamination of the victim will be made. However, life-threatening conditions may preclude normal decontamination procedures. In such cases, arrangements will be made with the medical facility and transporter to provide for the situation.

F. EMERGENCY ROUTES

(Give road or other directions; attach map)

HOSPITAL: Exit site - Proceed south on North Central Avenue (Route 4). Follow Route 4 to Waterford, New York. Turn left onto the Waterford Bridge at 2nd Avenue (Broad St.). Bear right upon crossing the Hudson River and continue on 2nd Avenue. At the first light turn left onto 124th St. which runs into New Turnpike Road. Proceed east approximately one mile on New Turnpike Road and Leonard Hospital is on the right. (See Figure 2).





E.C. JORDAN CO. CONSULTING ENGINEERS	MECHANICVILLE TRANSPORT ROUTE TO HOSPITAL
NEW YORK STATE ELECTRIC AND GAS BINGHAMTON, NEW YORK	INVESTIGATION OF COAL GASIFICATION
	JOB NO. 4945-01 FIGURE 2

FIELD TEAM REVIEW

I have read and reviewed the health and safety information in the HASP. I understand the information and will comply with the requirements of the HASP.

NAME: _____

DATE: _____

SITE/PROJECT: _____

MEDICAL DATA SHEET

This Medical Data Sheet will be completed by all on-site personnel and kept in the Support Zone during site operations. It is not a substitute for the Medical Surveillance Program requirements consistent with the ABB Environmental Corporate Health and Safety Program for Hazardous Waste Sites. This data sheet will accompany any personnel when medical assistance or transport to hospital facilities is required. If more space is required, use the back of this sheet.

PROJECT: _____

NAME: _____

ADDRESS: _____

HOME TELEPHONE: AREA CODE ( ) _____

AGE: _____ HEIGHT: _____ WEIGHT: _____

IN CASE OF EMERGENCY, CONTACT: _____

ADDRESS: _____

TELEPHONE: AREA CODE ( ) _____

DO YOU WEAR CONTACT LENSES? YES ( ) NO ( )

ALLERGIES: _____

LIST MEDICATION(S) TAKEN REGULARLY: _____

PARTICULAR SENSITIVITIES: _____

PREVIOUS/CURRENT MEDICAL CONDITIONS OR EXPOSURES TO HAZARDOUS CHEMICALS: _____

NAME OF PERSONAL PHYSICIAN: _____

TELEPHONE: AREA CODE ( ) _____

MATERIALS LISTS

TABLE A-1
PERSONNEL SAFETY EQUIPMENT CHECK LIST

QUANTITY REQUIRED	PROTECTIVE AND SAFETY EQUIPMENT	MODEL OR MATERIAL
	SCBA	MSA 401
	Spare Cylinders	
1pp	Escape Mask	ELSA
1pp	Full Face	
2ppd	Cartridge	
1pp	Hardhat w/Face Shield	
1pp	*Safety Glasses	
	Ear Protection	
2ppd	*Gloves, inner	surgical
2pp	*Gloves, outer	nitrile
	Chem Resist Coveralls	
2ppd	Disposable Coveralls	Coated Tyvek
	Splash Aprons	Vinyl
1pp	*Boots: Safety Boots	
2ppd	Boot Covers	
	Fully Encapsulated Suits	
	Dosimeters	TLD
1	First Aid Equipment *Utility first aid kit Industrial first aid kit	
	Stretcher	
	Oxygen	
2	*Eye Wash Station	Portable
	Emergency Shower	
2	*Fire Extinguisher	CO_2
	Safety Harness	
	Safety Harness	
	Emergency Tools	
	Other duct tape (rolls)	

* - Mandatory
pp - per person
ppd - per person per day

TABLE A-2

DECONTAMINATION EQUIPMENT/MATERIALS

QUANTITY	TYPE	REMARKS
4	wash tubs	
1	high pressure water sprayer hot	
1	steam sprayer	
4	scrub brushes	
2 bags/day	containers contaminated disposables	
1 box	detergent	
5 gal/day	methanol/acetone/ isopropanol	
5 gal	kerosene	
10. gal/day	deionized water	
1 box/day	disposable wipes	
	plastic wrap	
	Ziploc bags	

CHRIS DATA SHEETS/MSDSs

NER CODE A-111

MONSANTO PRODUCT NAME

TRISODIUM PHOSPHATE CRYSTALLINE

MONSANTO COMPANY
800 N. LINDBERGH BLVD.
ST. LOUIS, MO 63167

Emergency Phone No.
(Call Collect)
314-694-1000

PRODUCT IDENTIFICATION

Synonyms:	TSP/C; Trisodium orthophosphate; Sodium phosphate, tribasic; Phosphoric acid, trisodium salt; Trisodium phosphate dodecahydrate
Chemical Formula:	$Na_3PO_4 \cdot 12H_2O \cdot 1/4\ NaOH$ (approximately)
CAS No.:	10101-89-0*
DOT Proper Shipping Name:	Sodium Phosphate, Tribasic (see NOTE below)
DOT Hazard Class/ I.D. No.:	ORM-E/NA9148
DOT Label(s):	Not Applicable
Hazardous Substance(s)/ RQ(s):	Yes/5,000 lbs.
U.S. Surface Freight Classification:	Trisodium Phosphate

Note: Bagged material is not regulated.

*Since hydrated materials could not be reported on the ~~TSCA Initial Inventory~~ List, Trisodium Phosphate Crystalline was reported as anhydrous with the CAS No. 7601-54-9.

WARNING STATEMENTS

DANGER!
CAUSES EYE BURNS
CAUSES SKIN IRRITATION

PRECAUTIONARY MEASURES

Do not get in eyes, on skin, on clothing.
Avoid breathing dust.
Keep container closed.
Use with adequate ventilation.
Wash thoroughly after handling.

EMERGENCY AND FIRST AID PROCEDURES

FIRST AID: IF IN EYES, immediately flush with plenty of water for at least 15 minutes. Call a physician.

IF ON SKIN, immediately flush with plenty of water. Remove contaminated clothing. Wash clothing before reuse.

OCCUPATIONAL CONTROL PROCEDURES

Eye Protection: Wear chemical safety goggles to prevent eye contact. Have eye baths immediatey available where eye contact can occur.

Skin Protection: Wear appropriate impervious gloves and protective clothing to prevent skin contact. Launder contaminated clothing and clean protective equipment before reuse.

Respiratory Protection: Use NIOSH approved equipment suitable for nuisance dust when airborne exposure is excessive. Consult respirator manufacturer to determine appropriate type equipment for given application.

Ventilation: Provide ventilation to minimize exposure. Local exhaust ventilation preferred.

Airborne Exposure Limits: Product: Trisodium phosphate dodecahydrate

Although no specific exposure limit has been established for this material, OSHA and ACGIH have established limits for nuisance dusts:

OSHA PEL/TWA: Total 15 mg/m^3; Respirable 5 mg/m^3
ACGIH TLV/TWA: Total 10 mg/m^3; Respirable 5 mg/m^3

Keep exposure below these limits.

FIRE PROTECTION INFORMATION

This material is not combustible.

REACTIVITY DATA

Materials to Avoid: Trisodium Phosphate Crystalline could be corrosive to aluminum surfaces because of high pH. Sealed containers should be kept free of water because of its corrosivity when wet.

Hazardous Decomposition Products: None.

Hazardous Polymerization: Does not occur..

PHYSIOLOGICAL EFFECTS SUMMARY

Oral LD_{50} (Rat): 6,500 mg/kg, Practically Nontoxic
Dermal LD_{50} (Rabbit): 7,940 mg/kg, Practically Nontoxic
Eye Irritation (Rabbit): (FHSA) Corrosive
Skin Irritation (Rabbit): (FHSA) 3.3 on a scale of 8.0, Moderately Irritating

PHYSICAL DATA

Appearance and Odor: White, crystalline, free-flowing granules or powder; odorless

pH (1% solution @ 25°C): 12.0

Bulk Density (lbs./cu. ft.): Powder 61-65
Granular 58-64

Solubility (g/100 g H_2O) (Anhydrous Salt Basis):
11.6 @ 25°C
17.5 @ 40°C
35.3 @ 60°C
61.3 @ 80°C
84.5 @ 100°C

Note: These physical data are typical values based on material tested but may vary from

SPILL, LEAK & DISPOSAL INFORMATION

Waste Disposal: Dispose of in a landfill in accordance with all local, state and federal regulations.

Spill or Leakage Procedures: Sodium phosphate, tribasic, as currently defined, is *a hazardous substance* in the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (Superfund) and in the current federal regulations 40 CFR, Part 116 (Section 311, Clean Water Act) with a reportable quantity of 5,000 pounds when released to the environment. Since federal, state and local laws may vary, consult your attorney or appropriate regulatory officials for information relating to spill reporting.

Sweep, scoop or vacuum up all spilled material, contaminated soil and other contaminated material and place in containers. If possible, complete cleanup on a dry basis. After all practical dry cleanup has been done, residual contamination can be flushed with plenty of water.

ADDITIONAL COMMENTS

Environmental Toxicity Information:

96-hr LC_{50} (Bluegill) : 440 mg/l, Practically Nontoxic
96-hr LC_{50} (Trout) : 260 mg/l, Practically Nontoxic

DATE: 8/1/83 **REVISED:** X **SUPERSEDES:** 5/78
MSDS NO.: 010101890

FOR ADDITIONAL NON-EMERGENCY INFORMATION, CONTACT:

Product Acceptability Coordinator
Detergent Materials
Monsanto Industrial Chemicals Co.
314-694-2096
(A Unit of Monsanto Company)

MATERIAL SAFETY DATA — *ANHYDROUS PHOSPHATE CRYSTALLINE*

Although the information and recommendations set forth herein (hereinafter "information") are presented in good faith and believed to be correct as of the date hereof, Monsanto Company makes no representations as to the completeness or accuracy thereof. Information is supplied upon the condition that the persons receiving same will make their own determination as to its suitability for their purposes prior to use. In no event will Monsanto Company be responsible for damages of any nature whatsoever resulting from the use of or reliance upon information. NO REPRESENTATIONS OR WARRANTIES, EITHER EXPRESS OR IMPLIED, OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR OF ANY OTHER NATURE ARE MADE HEREUNDER WITH RESPECT TO INFORMATION OR THE PRODUCT TO WHICH INFORMATION REFERS.

OILS, FUEL: NO. 1

OON

Common Synonyms	Watery liquid	Colorless	Kerosene odor
Kerosene Kerosene Range oil JP-1	Floats on water.		

Stop discharge if possible
Call fire department
Avoid contact with liquid
Isolate and remove discharged material
Notify local health and pollution control agencies

Fire

Combustible
Extinguish with dry chemical, foam or carbon dioxide
Water may be ineffective on fire
Cool exposed containers with water

Exposure

CALL FOR MEDICAL AID.
LIQUID
Irritating to skin and eyes.
Harmful if swallowed
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water
IF IN EYES, hold eyelids open and flush with plenty of water
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Miscellaneous Hydrocarbon Mixtures
3.2 Formula: Not applicable
3.3 IMO/UN Designation: 3.3/1223
3.4 DOT ID No.: 1223
3.5 CAS Registry No.: Data not available

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless to light brown
4.3 Odor: Characteristic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Protective gloves; goggles or face shield.
5.2 Symptoms Following Exposure: INGESTION causes irritation of gastrointestinal tract; pulmonary tract irritation secondary to exhalation of vapors. ASPIRATION causes severe lung irritation with coughing, gagging, dyspnea, substernal distress, and rapidly developing pulmonary edema, signs of bronchopneumonia and pneumonitis appear later; minimal central nervous system depression.
5.3 Treatment of Exposure: INGESTION: do NOT lavage or induce vomiting; call physician. ASPIRATION: enforce bed rest; administer oxygen; call physician. EYES: wash with plenty of water. SKIN: wipe off and wash with soap and water.
5.4 Threshold Limit Value: Data not available
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 1; LD_{50} = 5-15 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 1 ppm
5.11 IDLH Value: Data not available

6. FIRE HAZARDS

6.1 Flash Point: 100°F C.C.
6.2 Flammable Limits in Air: 0.7%-5%
6.3 Fire Extinguishing Agents: Dry chemical, foam, carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: 444°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 4 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 33

8. WATER POLLUTION

8.1 Aquatic Toxicity: 2990 ppm/24 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 53%, 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Light hydrocarbon distillate: 100%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10 HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Combustible liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	2
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	1
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	0
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	0
Flammability (Red)	2
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: 380 560°F = 193—293°C = 466—566°K
12.4 Freezing Point: —45 to —55°F = —43 to —48°C = 230 to 225°K
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: (liquid) 0.81 0.85 at 15°C
12.8 Liquid Surface Tension: 23 32 dynes/cm = 0.023—0.032 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 47—49 dynes/cm = 0.047 0.049 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: 110 Btu/lb = 60 cal/g = 2.5 X 10^4 J/kg
12.13 Heat of Combustion: —18,540 Btu/lb = —10,300 cal/g = —431.24 X 10^3 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

BENZENE

BNZ

Common Synonyms

Benzol
Benzole

Watery liquid Colorless Gasoline-like odor

Floats on water. Flammable. Irritating vapor is produced. Freezing point is 42°F.

Avoid contact with liquid and vapor. Keep people away.
Wear goggles and self-contained breathing apparatus.
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability.
Restrict access.

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** C_6H_6
3.3 **IMO/UN Designation:** 3.2/1114
3.4 **DOT ID No.:** 1114
3.5 **CAS Registry No.:** 71-43-2

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Aromatic; rather pleasant aromatic odor, characteristic odor

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Hydrocarbon vapor canister, supplied air or a hose mask, hydrocarbon-insoluble rubber or plastic gloves, chemical goggles or face splash shield, hydrocarbon-insoluble apron such as neoprene.
5.2 **Symptoms Following Exposure:** Dizziness, excitation, pallor, followed by flushing, weakness, headache, breathlessness, chest constriction. Coma and possible death.
5.3 **Treatment of Exposure:** SKIN: flush with water followed by soap and water; remove contaminated clothing and wash skin. EYES: flush with plenty of water until irritation subsides. INHALATION: remove from exposure immediately. Call a physician. IF breathing is irregular or stopped, start resuscitation, administer oxygen.
5.4 **Threshold Limit Value:** 10 ppm 1 ppm
5.5 **Short Term Inhalation Limits:** 75 ppm for 30 min
5.6 **Toxicity by Ingestion:** Grade 3: LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Leukemia
5.8 **Vapor (Gas) Irritant Characteristics:** If present in high concentrations, vapors may cause irritation of eyes or respiratory system. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 4.68 ppm
5.11 **IDLH Value:** 2,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 12°F C.C.
6.2 **Flammable Limits in Air:** 1.3%-7.9%
6.3 **Fire Extinguishing Agents:** Dry chemical, foam, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back
6.7 **Ignition Temperature:** 1097°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 6.0 mm/min
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 5 ppm/6 hr/minnow/lethal/distilled water
20 ppm/24 hr/sunfish/TL_m/tap water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 1.2 lb/lb, 10 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:**
Industrial pure .....99+%
Thiophene-free .....99+%
Nitration .....99+%
Industrial 90% .....85+%
Reagent .....99+%
9.2 **Storage Temperature:** Open
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Pressure-vacuum

10 HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-V-W

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor irritant	1
Liquid or Solid Irritant	1
Poisons	3
Water Pollution	
Human Toxicity	3
Aquatic Toxicity	1
Aesthetic Effect	3
Reactivity	
Other Chemicals	2
Water	1
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 78.11
12.3 **Boiling Point at 1 atm:** 176°F = 80.1°C = 353.3°K
12.4 **Freezing Point:** 42.0°F = 5.5°C = 278.7°K
12.5 **Critical Temperature:** 552.0°F = 288.9°C = 562.1°K
12.6 **Critical Pressure:** 710 psia = 48.3 atm = 4.89 MN/m²
12.7 **Specific Gravity:** 0.879 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 28.9 dynes/cm = 0.0289 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 35.0 dynes/cm = 0.035 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** 2.7
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.061
12.12 **Latent Heat of Vaporization:** 169 Btu/lb = 94.1 cal/g = 3.94 X 10⁵ J/kg
12.13 **Heat of Combustion:** −17,460 Btu/lb = −9698 cal/g = −406.0 X 10⁵ J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 30.45 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 3.22 psia

NOTES

ETHYLBENZENE

ETB

Common Synonyms	Liquid	Colorless	Sweet gasoline-like odor
Phenylethane EB	Floats on water. Flammable; irritating vapor is produced		

Avoid contact with liquid and vapor. Keep people away.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Shut off ignition sources and call fire department.
Stop discharge if possible.
Stay upwind and use water spray to "knock down" vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles, self-contained breathing apparatus, and rubber overclothing (including gloves).
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or difficult breathing.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic hydrocarbon
3.2 Formula: $C_6H_5CH_2CH_3$
3.3 IMO/UN Designation: 3.3/1175
3.4 DOT ID No.: 1175
3.5 CAS Registry No.: 100-41-4

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Self-contained breathing apparatus; safety goggles.
5.2 Symptoms Following Exposure: Inhalation may cause irritation of nose, dizziness, depression. Moderate irritation of eye with corneal injury possible. Irritates skin and may cause blisters.
5.3 Treatment of Exposure: INHALATION: if ill effects occur, remove victim to fresh air, keep him warm and quiet, and get medical help promptly; if breathing stops, give artificial respiration. INGESTION: induce vomiting only upon physician's approval; material in lung may cause chemical pneumonia. SKIN AND EYES: promptly flush with plenty of water (15 min. for eyes) and get medical attention; remove and wash contaminated clothing before reuse.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 200 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg (rat)
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 Odor Threshold: 140 ppm
5.11 IDLH Value: 2,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 80°F O.C., 59°F C.C.
6.2 Flammable Limits in Air: 1.0%-6.7%
6.3 Fire Extinguishing Agents: Foam (most effective); water fog; carbon dioxide or dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating vapors are generated when heated
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to the source of ignition and flash back.
6.7 Ignition Temperature: 860°F
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: 5.8 mm/min
6.10 Adiabatic Flame Temperature: Data Not Available

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data Not Available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 29 ppm/96 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 2.8% (theor.), 5 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research grade: 99.98%; pure grade: 99.5%; technical grade: 99.0%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.17
12.3 Boiling Point at 1 atm: 277.2°F = 136.2°C = 409.4°K
12.4 Freezing Point: −139°F = −95°C = 178°K
12.5 Critical Temperature: 651.0°F = 343.9°C = 617.1°K
12.6 Critical Pressure: 523 psia = 35.6 atm = 3.61 MN/m²
12.7 Specific Gravity: 0.867 at 20°C (liquid)
12.8 Liquid Surface Tension: 29.2 dynes/cm = 0.0292 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.071
12.12 Latent Heat of Vaporization: 144 Btu/lb = 80.1 cal/g = 3.35×10^5 J/kg
12.13 Heat of Combustion: −17,780 Btu/lb = −9877 cal/g = -413.5×10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data Not Available
12.26 Limiting Value: Data Not Available
12.27 Reid Vapor Pressure: 0.4 psia

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data Not Available
6.12 Flame Temperature: Data Not Available

STYRENE

STY

Common Synonyms	Watery liquid	Colorless to light yellow	Sweet pleasant odor
Styrol Vinylbenzene Phenylethylene Styrolene	Floats on water. Flammable, irritating vapor is produced.		

Avoid contact with liquid and vapor. Keep people away.
Wear chemical protective suit with self-contained breathing apparatus.
Stop discharge if possible.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
CONTAINERS MAY EXPLODE IN FIRE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear chemical protective suit with self-contained breathing apparatus.
Combat fires from safe distance or protected location.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Will burn skin and eyes.
Harmful if swallowed.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-air contaminant
Mechanical containment
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Olefin
3.2 Formula: $C_6H_5CH=CH_2$
3.3 IMO/UN Designation: 3.3/2055
3.4 DOT ID No.: 2055
3.5 CAS Registry No.: 100-42-5

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Sweet at low concentrations; characteristic pungent; sharp; disagreeable

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Air-supplied mask or approved canister; rubber or plastic gloves; boots; goggles or face shield.
5.2 Symptoms Following Exposure: Moderate irritation of eyes and skin. High vapor concentrations cause dizziness, drunkenness, and anesthesia.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; keep warm and quiet; use artificial respiration if needed. INGESTION: do NOT induce vomiting; call physician; no known antidote. SKIN OR EYE CONTACT: flush with plenty of water; for eyes get medical attention.
5.4 Threshold Limit Value: 50 ppm
5.5 Short Term Inhalation Limits: 100 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 Late Toxicity: Data not available
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause moderate irritation such that personnel will find high concentrations unpleasant. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Causes smarting of the skin and first-degree burns on short exposure; may cause secondary burns on long exposure.
5.10 Odor Threshold: 0.148 ppm
5.11 IDLH Value: 5,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 93°F O.C., 88°F C.C.
6.2 Flammable Limits in Air: 1.1%-6.1%
6.3 Fire Extinguishing Agents: Water fog, foam, carbon dioxide, or dry chemical
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back. At elevated temperatures such as in fire conditions, polymerization may take place which may lead to container explosion.
6.7 Ignition Temperature: 914°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.2 mm/min
6.10 Adiabatic Flame Temperature: Data not available

(Continued)

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: May occur if heated above 150°F. Can cause rupture of container. Metal salts, peroxides, and strong acids may also cause polymerization.
7.6 Inhibitor of Polymerization: Tertiary-butylcatechol, 10-15 ppm
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 30

8. WATER POLLUTION

8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 18% (theor.), 412 days
8.4 Food Chain Concentration Potential: None

9. SHIPPING INFORMATION

9.1 Grades of Purity: 99.5+%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester)

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

A-T-U-Z

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	2
Liquid or Solid Irritant	2
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	2
Water	0
Self Reaction	3

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	2

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 104.15
12.3 Boiling Point at 1 atm: 293.4°F = 145.2°C = 418.4°K
12.4 Freezing Point: −23.1°F = −30.6°C = 242.6°K
12.5 Critical Temperature: 703°F = 373°C = 646°K
12.6 Critical Pressure: 580 psa = 39.48 atm = 4.00 MN/m²
12.7 Specific Gravity: 0.906 at 20°C (liquid)
12.8 Liquid Surface Tension: 32.14 dynes/cm = 0.03214 N/m at 19°C
12.9 Liquid Water Interfacial Tension: 35.48 dynes/cm = 0.03548 N/m at 19°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.074
12.12 Latent Heat of Vaporization: 156 Btu/lb = 86.8 cal/g = 3.63 X 10^5 J/kg
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: −277 Btu/lb = −154 cal/g = −6.45 X 10^5 J/kg
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.27 psa

6. FIRE HAZARDS (Continued)

6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

TOLUENE

TOL

Common Synonyms
Toluol
Methylbenzene
Methylbenzol

Watery liquid Colorless Pleasant odor

Floats on water. Flammable, irritating vapor is produced.

Stop discharge if possible. Keep people away.
Shut off ignition sources and call fire department.
Stay upwind and use water spray to "knock down" vapor.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear goggles and self-contained breathing apparatus.
Extinguish with dry chemical, foam, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause nausea, vomiting, headache, dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability.
Evacuate area.

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** $C_6H_5CH_3$
3.3 **IMO/UN Designation:** 3.2/1294
3.4 **DOT ID No.:** 1294
3.5 **CAS Registry No.:** 108-88-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Pungent, aromatic, benzene-like; distinct, pleasant

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Air-supplied mask; goggles or face shield; plastic gloves.
5.2 **Symptoms Following Exposure:** Vapors irritate eyes and upper respiratory tract; cause dizziness, headache, anesthesia, respiratory arrest. Liquid irritates eyes and causes drying of skin. If aspirated, causes coughing, gagging, distress, and rapidly developing pulmonary edema. If ingested causes vomiting, griping, diarrhea, depressed respiration.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air, give artificial respiration and oxygen if needed; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 600 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 2; LD_{50} = 0.5 to 5 g/kg
5.7 **Late Toxicity:** Kidney and liver damage may follow ingestion.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.17 ppm
5.11 **IDLH Value:** 2,000 ppm

6 FIRE HAZARDS

6.1 **Flash Point:** 40°F C.C., 55°F O.C.
6.2 **Flammable Limits in Air:** 1.27%-7%
6.3 **Fire Extinguishing Agents:** Carbon dioxide or dry chemical for small fires, ordinary foam for large fires.
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent.
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel a considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 997°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.7 mm/min
6.10 **Adiabatic Flame Temperature:** Data not available.

(Continued)

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 1180 mg/l/96 hr/sunfish/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0%, 5 days; 38% (theor), 8 days
8.4 **Food Chain Concentration Potential:** None

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research, reagent, nitration-all 99.8 + %; industrial: contains 94 + %, with 5% xylene and small amounts of benzene and nonaromatic hydrocarbons; 90/120: less pure than industrial.
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10 HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 92.14
12.3 **Boiling Point at 1 atm:** 231.1°F = 110.6°C = 383.8°K
12.4 **Freezing Point:** −139°F = −95.0°C = 178.2°K
12.5 **Critical Temperature:** 605.4°F = 318.6°C = 591.8°K
12.6 **Critical Pressure:** 596.1 psa = 40.55 atm = 4.106 MN/m^2
12.7 **Specific Gravity:** 0.867 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 29.0 dynes/cm = 0.0290 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 36.1 dynes/cm = 0.0361 N/m at 25°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.089
12.12 **Latent Heat of Vaporization:** 155 Btu/lb = 86.1 cal/g = 3.61×10^5 J/kg
12.13 **Heat of Combustion:** −17,430 Btu/lb = −9686 cal/g = -405.5×10^5 J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 17.17 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 1.1 psa

6. FIRE HAZARDS (Continued)

6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

m-XYLENE

XLM

Common Synonyms	Watery liquid	Colorless	Sweet odor
1,3-Dimethylbenzene Xylol	Floats on water. Flammable, irritating vapor is produced		

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE.
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID.

VAPOR
Irritating to eyes, nose, and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: m-$C_6H_4(CH_3)_2$
3.3 IMO/UN Designation: 3.2/1307
3.4 DOT ID No.: 1307
3.5 CAS Registry No.: 108-38-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Like benzene; characteristic aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma; can be fatal. Kidney and liver damage can occur.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 g/kg
5.7 Late Toxicity: Kidney and liver damage.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 84°F C.C.
6.2 Flammable Limits in Air: 1.1%-6.4%
6.3 Fire Extinguishing Agents: Foam, dry chemical or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 986°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.8 mm/min
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 0% (theor.), 8 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research: 99.99%; Pure: 99.0%; Technical: 98.2%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

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11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health:	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.16
12.3 Boiling Point at 1 atm: 269.4°F = 131.9°C = 405.1°K
12.4 Freezing Point: −54.2°F = −47.9°C = 225.3°K
12.5 Critical Temperature: 650.8°F = 343.8°C = 617.0°K
12.6 Critical Pressure: 513.6 atm = 34.95 psia = 3.540 MN/m²
12.7 Specific Gravity: 0.864 at 20°C (liquid)
12.8 Liquid Surface Tension: 28.6 dynes/cm = 0.0286 N/m at 20°C
12.9 Liquid Water Interfacial Tension: 36.4 dynes/cm = 0.0364 N/m at 30°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.071
12.12 Latent Heat of Vaporization: 147 Btu/lb = 81.9 cal/g = 3.43 X 10^5 J/kg
12.13 Heat of Combustion: −17,554 Btu/lb = −9752.4 cal/g = −408.31 X 10^5 J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 26.01 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.34 psia

NOTES

o-XYLENE

XLO

Common Synonyms
1, 2-Dimethylbenzene
Xylol

Watery liquid Colorless Sweet odor

Floats on water. Flammable, irritating vapor is produced.

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause headache, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, or loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

Dangerous to aquatic life in high concentrations.
Fouling to shoreline.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: Flammable liquid
2.2 Class: 3

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Aromatic Hydrocarbon
3.2 Formula: $o\text{-}C_6H_4(CH_3)_2$
3.3 IMO/UN Designation: 3.2/1307
3.4 DOT ID No.: 1307
3.5 CAS Registry No.: 95-47-6

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid
4.2 Color: Colorless
4.3 Odor: Benzene-like; characteristic aromatic

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 Symptoms Following Exposure: Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 Treatment of Exposure: INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 Threshold Limit Value: 100 ppm
5.5 Short Term Inhalation Limits: 300 ppm for 30 min.
5.6 Toxicity by Ingestion: Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 Late Toxicity: Kidney and liver damage.
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 Liquid or Solid Irritant Characteristics: Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 Odor Threshold: 0.05 ppm
5.11 IDLH Value: 10,000 ppm

6. FIRE HAZARDS

6.1 Flash Point: 63°F C.C.; 75°F O.C.
6.2 Flammable Limits in Air: 1.1%-7.0%
6.3 Fire Extinguishing Agents: Foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Water may be ineffective.
6.5 Special Hazards of Combustion Products: Not pertinent
6.6 Behavior in Fire: Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 Ignition Temperature: 869°F
6.8 Electrical Hazard: Class I, Group D
6.9 Burning Rate: 5.8 mm/min.
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: 32

8. WATER POLLUTION

8.1 Aquatic Toxicity: >100 mg/l/96 hr/D. magna/TL_m/fresh water
8.2 Waterfowl Toxicity: Data not available
8.3 Biological Oxygen Demand (BOD): 0 lb/lb, 5 days; 2.5% (theor.), 5 days
8.4 Food Chain Concentration Potential: Data not available

9. SHIPPING INFORMATION

9.1 Grades of Purity: Research: 99.99%; Pure: 99.7%; Commercial: 95+%
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No reaction
9.4 Venting: Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

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11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: Flammable liquid
11.2 NAS Hazard Rating for Bulk Water Transportation:

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 NFPA Hazard Classification:

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Liquid
12.2 Molecular Weight: 106.16
12.3 Boiling Point at 1 atm: 291.9°F = 144.4°C = 417.6°K
12.4 Freezing Point: −13.3°F = −25.2°C = 248.0°K
12.5 Critical Temperature: 674.8°F = 357.1°C = 630.3°K
12.6 Critical Pressure: 541.5 atm = 36.84 psa = 3.732 MN/m²
12.7 Specific Gravity: 0.880 at 20°C (liquid)
12.8 Liquid Surface Tension: 30.53 dynes/cm = 0.03053 N/m at 15.5°C
12.9 Liquid Water Interfacial Tension: 36.06 dynes/cm = 0.03606 N/m at 20°C
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): 1.068
12.12 Latent Heat of Vaporization: 149 Btu/lb = 82.9 cal/g = 3.47 X 10⁵ J/kg
12.13 Heat of Combustion: −17,556 Btu/lb = −9754.7 cal/g = −408.41 X 10⁵ J/kg
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: 30.64 cal/g
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: 0.26 psa

NOTES

p-XYLENE

XLP

Common Synonyms
1, 4-Dimethylbenzene
Xylol

Watery liquid Colorless Sweet odor

Floats on water. Flammable, irritating vapor is produced.
Freezing point is 56°F.

Stop discharge if possible. Keep people away.
Call fire department.
Avoid contact with liquid and vapor
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

FLAMMABLE
Flashback along vapor trail may occur.
Vapor may explode if ignited in an enclosed area.
Wear self-contained breathing apparatus.
Extinguish with foam, dry chemical, or carbon dioxide.
Water may be ineffective on fire.
Cool exposed containers with water.

Exposure

CALL FOR MEDICAL AID

VAPOR
Irritating to eyes, nose and throat.
If inhaled, will cause dizziness, difficult breathing, or loss of consciousness.
Move to fresh air.
If breathing has stopped, give artificial respiration.
If breathing is difficult, give oxygen.

LIQUID
Irritating to skin and eyes.
If swallowed, will cause nausea, vomiting, loss of consciousness.
Remove contaminated clothing and shoes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.
IF SWALLOWED and victim is CONSCIOUS, have victim drink water or milk.
DO NOT INDUCE VOMITING.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
Fouling to shorelines.
May be dangerous if it enters water intakes.
Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)
Issue warning-high flammability
Evacuate area
Should be removed
Chemical and physical treatment

2. LABEL

2.1 **Category:** Flammable liquid
2.2 **Class:** 3

3. CHEMICAL DESIGNATIONS

3.1 **CG Compatibility Class:** Aromatic Hydrocarbon
3.2 **Formula:** $p\text{-}C_6H_4(CH_3)_2$
3.3 **IMO/UN Designation:** 3.2/1307
3.4 **DOT ID No.:** 1307
3.5 **CAS Registry No.:** 106-42-3

4. OBSERVABLE CHARACTERISTICS

4.1 **Physical State (as shipped):** Liquid
4.2 **Color:** Colorless
4.3 **Odor:** Like benzene; characteristic aromatic

5. HEALTH HAZARDS

5.1 **Personal Protective Equipment:** Approved canister or air-supplied mask; goggles or face shield; plastic gloves and boots.
5.2 **Symptoms Following Exposure:** Vapors cause headache and dizziness. Liquid irritates eyes and skin. If taken into lungs, causes severe coughing, distress, and rapidly developing pulmonary edema. If ingested, causes nausea, vomiting, cramps, headache, and coma. Can be fatal. Kidney and liver damage can occur.
5.3 **Treatment of Exposure:** INHALATION: remove to fresh air; administer artificial respiration and oxygen if required; call a doctor. INGESTION: do NOT induce vomiting; call a doctor. EYES: flush with water for at least 15 min. SKIN: wipe off, wash with soap and water.
5.4 **Threshold Limit Value:** 100 ppm
5.5 **Short Term Inhalation Limits:** 300 ppm for 30 min.
5.6 **Toxicity by Ingestion:** Grade 3; LD_{50} = 50 to 500 mg/kg
5.7 **Late Toxicity:** Kidney and liver damage.
5.8 **Vapor (Gas) Irritant Characteristics:** Vapors cause a slight smarting of the eyes or respiratory system if present in high concentrations. The effect is temporary.
5.9 **Liquid or Solid Irritant Characteristics:** Minimum hazard. If spilled on clothing and allowed to remain, may cause smarting and reddening of the skin.
5.10 **Odor Threshold:** 0.05 ppm
5.11 **IDLH Value:** 10,000 ppm

6. FIRE HAZARDS

6.1 **Flash Point:** 81°F C.C.
6.2 **Flammable Limits in Air:** 1.1%-6.6%
6.3 **Fire Extinguishing Agents:** Foam, dry chemical, or carbon dioxide
6.4 **Fire Extinguishing Agents Not to be Used:** Water may be ineffective.
6.5 **Special Hazards of Combustion Products:** Not pertinent
6.6 **Behavior in Fire:** Vapor is heavier than air and may travel considerable distance to a source of ignition and flash back.
6.7 **Ignition Temperature:** 870°F
6.8 **Electrical Hazard:** Class I, Group D
6.9 **Burning Rate:** 5.8 mm/min.
6.10 **Adiabatic Flame Temperature:** Data not available
6.11 **Stoichiometric Air to Fuel Ratio:** Data not available
6.12 **Flame Temperature:** Data not available

7. CHEMICAL REACTIVITY

7.1 **Reactivity With Water:** No reaction
7.2 **Reactivity with Common Materials:** No reaction
7.3 **Stability During Transport:** Stable
7.4 **Neutralizing Agents for Acids and Caustics:** Not pertinent
7.5 **Polymerization:** Not pertinent
7.6 **Inhibitor of Polymerization:** Not pertinent
7.7 **Molar Ratio (Reactant to Product):** Data not available
7.8 **Reactivity Group:** 32

8. WATER POLLUTION

8.1 **Aquatic Toxicity:** 22 ppm/96 hr/bluegill/TL_m/fresh water
8.2 **Waterfowl Toxicity:** Data not available
8.3 **Biological Oxygen Demand (BOD):** 0 lb/lb in 5 days
8.4 **Food Chain Concentration Potential:** Data not available

9. SHIPPING INFORMATION

9.1 **Grades of Purity:** Research: 99.99%; Pure: 99.8%; Technical: 99.0%
9.2 **Storage Temperature:** Ambient
9.3 **Inert Atmosphere:** No requirement
9.4 **Venting:** Open (flame arrester) or pressure-vacuum

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)
A-T-U

11. HAZARD CLASSIFICATIONS

11.1 **Code of Federal Regulations:** Flammable liquid
11.2 **NAS Hazard Rating for Bulk Water Transportation:**

Category	Rating
Fire	3
Health	
Vapor Irritant	1
Liquid or Solid Irritant	1
Poisons	2
Water Pollution	
Human Toxicity	1
Aquatic Toxicity	3
Aesthetic Effect	2
Reactivity	
Other Chemicals	1
Water	0
Self Reaction	0

11.3 **NFPA Hazard Classification:**

Category	Classification
Health Hazard (Blue)	2
Flammability (Red)	3
Reactivity (Yellow)	0

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 **Physical State at 15°C and 1 atm:** Liquid
12.2 **Molecular Weight:** 106.16
12.3 **Boiling Point at 1 atm:** 280.9°F = 138.3°C = 411.5°K
12.4 **Freezing Point:** 55.9°F = 13.3°C = 286.5°K
12.5 **Critical Temperature:** 649.4°F = 343.0°C = 616.2°K
12.6 **Critical Pressure:** 509.4 atm = 34.65 psia = 3.510 MN/m²
12.7 **Specific Gravity:** 0.861 at 20°C (liquid)
12.8 **Liquid Surface Tension:** 28.3 dynes/cm = 0.0283 N/m at 20°C
12.9 **Liquid Water Interfacial Tension:** 37.8 dynes/cm = 0.0378 N/m at 20°C
12.10 **Vapor (Gas) Specific Gravity:** Not pertinent
12.11 **Ratio of Specific Heats of Vapor (Gas):** 1.071
12.12 **Latent Heat of Vaporization:** 150 Btu/lb = 81 cal/g = 3.4×10^4 J/kg
12.13 **Heat of Combustion:** −17,559 Btu/lb = −9754.7 cal/g = −408.41 $\times 10^4$ J/kg
12.14 **Heat of Decomposition:** Not pertinent
12.15 **Heat of Solution:** Not pertinent
12.16 **Heat of Polymerization:** Not pertinent
12.25 **Heat of Fusion:** 37.83 cal/g
12.26 **Limiting Value:** Data not available
12.27 **Reid Vapor Pressure:** 0.34 psia

NOTES

POLYCHLORINATED BIPHENYL

PCB

Common Synonyms	Oily liquid to solid powder	Light yellow liquid, or white powder	Weak odor
PCB Chlorinated biphenyl Arochlor Halogenated waxes Polychloropolyphenyls	Sinks in water.		

Stop discharge if possible. Keep people away.
Avoid contact with liquid and solid.
Call fire department.
Isolate and remove discharged material.
Notify local health and pollution control agencies.

Fire

Combustible.
Extinguish with water, foam, dry chemical, or carbon dioxide.

Exposure

CALL FOR MEDICAL AID.

LIQUID OR SOLID
Irritating to skin and eyes.
Flush affected areas with plenty of water.
IF IN EYES, hold eyelids open and flush with plenty of water.

Water Pollution

HARMFUL TO AQUATIC LIFE IN VERY LOW CONCENTRATIONS.
May be dangerous if it enters water intakes.

Notify local health and wildlife officials.
Notify operators of nearby water intakes.

1. RESPONSE TO DISCHARGE

(See Response Methods Handbook)

Issue warning-water contaminant
Should be removed
Chemical and physical treatment

2. LABEL

2.1 Category: None
2.2 Class: Not pertinent

3. CHEMICAL DESIGNATIONS

3.1 CG Compatibility Class: Not listed
3.2 Formula: $(C_{12}H_{10-n}Cl_n$
3.3 IMO/UN Designation: Not listed
3.4 DOT ID No.: 2315
3.5 CAS Registry No.: 1336-36-3

4. OBSERVABLE CHARACTERISTICS

4.1 Physical State (as shipped): Liquid or solid
4.2 Color: Pale yellow (liquid); colorless (solid)
4.3 Odor: Practically odorless

5. HEALTH HAZARDS

5.1 Personal Protective Equipment: Gloves and protective garments.
5.2 Symptoms Following Exposure: Acne from skin contact.
5.3 Treatment of Exposure: SKIN: wash with soap and water.
5.4 Threshold Limit Value: 0.5 to 1.0 mg/m³
5.5 Short Term Inhalation Limits: Data not available
5.6 Toxicity by Ingestion: Grade 2; oral rat LD_{50} = 3980 mg/kg
5.7 Late Toxicity: Causes chromosomal abnormalities in rats, birth defects in birds
5.8 Vapor (Gas) Irritant Characteristics: Vapors cause severe irritation of eyes and throat and cause eye and lung injury. They cannot be tolerated even at low concentrations.
5.9 Liquid or Solid Irritant Characteristics: Contact with skin may cause irritation.
5.10 Odor Threshold: Data not available
5.11 IDLH Value: 5 to 10 mg/m³

6. FIRE HAZARDS

6.1 Flash Point: >286°F
6.2 Flammable Limits in Air: Data not available
6.3 Fire Extinguishing Agents: Water, foam, dry chemical, or carbon dioxide
6.4 Fire Extinguishing Agents Not to be Used: Not pertinent
6.5 Special Hazards of Combustion Products: Irritating gases are generated in fires.
6.6 Behavior in Fire: Not pertinent
6.7 Ignition Temperature: Data not available
6.8 Electrical Hazard: Not pertinent
6.9 Burning Rate: Data not available
6.10 Adiabatic Flame Temperature: Data not available
6.11 Stoichiometric Air to Fuel Ratio: Data not available
6.12 Flame Temperature: Data not available

7. CHEMICAL REACTIVITY

7.1 Reactivity With Water: No reaction
7.2 Reactivity with Common Materials: No reaction
7.3 Stability During Transport: Stable
7.4 Neutralizing Agents for Acids and Caustics: Not pertinent
7.5 Polymerization: Not pertinent
7.6 Inhibitor of Polymerization: Not pertinent
7.7 Molar Ratio (Reactant to Product): Data not available
7.8 Reactivity Group: Data not available

8. WATER POLLUTION

8.1 Aquatic Toxicity:
0.278 ppm/96 hr/bluegill/TL_m/fresh water
0.005 ppm/336-1080 hr/pinfish/TL_m/salt water
8.2 Waterfowl Toxicity: LD_{50} 2000 ppm (mallard duck)
8.3 Biological Oxygen Demand (BOD): Very low
8.4 Food Chain Concentration Potential: High

9. SHIPPING INFORMATION

9.1 Grades of Purity: 11 grades (some liquid, some solids) which differ primarily in their chlorine content (20%-68% by weight)
9.2 Storage Temperature: Ambient
9.3 Inert Atmosphere: No requirement
9.4 Venting: Open

10. HAZARD ASSESSMENT CODE

(See Hazard Assessment Handbook)

II

11. HAZARD CLASSIFICATIONS

11.1 Code of Federal Regulations: ORM-E
11.2 NAS Hazard Rating for Bulk Water Transportation: Not listed
11.3 NFPA Hazard Classification: Not listed

12. PHYSICAL AND CHEMICAL PROPERTIES

12.1 Physical State at 15°C and 1 atm: Solid
12.2 Molecular Weight: Not pertinent
12.3 Boiling Point at 1 atm: Very high
12.4 Freezing Point: Not pertinent
12.5 Critical Temperature: Not pertinent
12.6 Critical Pressure: Not pertinent
12.7 Specific Gravity: 1.3—1.8 at 20°C (liquid)
12.8 Liquid Surface Tension: Not pertinent
12.9 Liquid Water Interfacial Tension: Not pertinent
12.10 Vapor (Gas) Specific Gravity: Not pertinent
12.11 Ratio of Specific Heats of Vapor (Gas): Not pertinent
12.12 Latent Heat of Vaporization: Not pertinent
12.13 Heat of Combustion: Not pertinent
12.14 Heat of Decomposition: Not pertinent
12.15 Heat of Solution: Not pertinent
12.16 Heat of Polymerization: Not pertinent
12.25 Heat of Fusion: Data not available
12.26 Limiting Value: Data not available
12.27 Reid Vapor Pressure: Data not available

NOTES

COAL TAR PITCH VOLATILES

CAS: 8007-45-2

TLV-TWA, 0.2 mg/m³, as Benzene Soluble Fraction
Appendix A1a — Recognized Human Carcinogen

The pitch of coal tar is the black or dark brown amorphous residue that remains after the redistillation process. The volatiles contain a large quantity of lower molecular weight polycyclic hydrocarbons.[1] As these hydrocarbons (naphthalene, fluorene, anthracene, acridine, phenanthrene) sublime into the air and there is an increase of benzo(a)pyrene (BaP or 3,4-benzpyrene) and other higher weight polycyclic hydrocarbons in the tar and in the fumes. Polycyclic hydrocarbons, known to be carcinogenic, are of this large molecular type.

Coal tar is used as a base for coatings and paints, for roofing and paving, and as a binder for carbon electrodes.

Doll[4] found that deaths from cancer of the lungs and pleura of retired gas-workers is approximately two times the expected rate.

Coal tar pitch polluted air is characterized by large amounts of phenanthrene, anthracene, pyrene, and carbazole. Coal tar pitch contains approximately 10% polycyclic hydrocarbons, and three different samples analyzed by Sawicki *et al*[1] gave a concentration of 1.4% BaP alone.

Samples collected in urban and nonurban sites[5,6] contained a range of 2.4–410 μg BaP/g of particulate (38-2600 μg BaP/g of benzene fraction or 0.11-61 μg/1000 m³ of air) in the former locations and 0.15-51 μg BaP/g of particulate (9.3-730 μg BaP/g of benzene soluble fraction or 0.01-1.9 μg BaP/1000 m³ of air) in the latter[5] during a three-month period, January through March.

Falk *et al*[7,10] pointed out that the amount of BaP in the air was greater than one would expect on the basis of comparative quantitative emissions of other hydrocarbons. The composition of the hydrocarbons varies with time and distance, suggesting differences in stability of the compounds. The authors conclude that chrysene, 1,12-benzperylene, coronene, and BaP are stable, and phenanthrene, an "unidentified hydrocarbon" and anthranthrene are most readily destroyed, usually within 48 hours. Intermediate stability is demonstrated by pyrene (58% recovery in 48 hours) and fluoranthrene (80% recovery in 48 hours).

Stability of polycyclic hydrocarbons was also studied by Commins and Lawther.[11] They point out that the temperature applied to sinter the filter used to collect the sample altered the apparent stability for BaP. They concluded that the filter should never be subjected to temperatures above 100°C; no loss of BaP was found after heating 100 μg BaP on a sintered disc in a sealed tube at 100°C for seven hours.

In further experiments, Kotin *et al*[8] painted the interscapular area of C57 black mice three times weekly with benzene extracts of natural smog. First tumors appeared 465 days following the initial application.

Fairhall[12] stated that fumes of dust from native asphalt do not present a substantial health hazard in comparison with coal tar fume or dust, citing the work of Hueper[13] and Davies.[14] Hueper[15] also pointed out that, as a rule, a minimal time of exposure of one to five years is required to develop occupational cancer. Similarly, occupational cancers often develop many years after exposure to carcinogens has ceased. Simmers[16] concluded that the degree of change noted in the lungs of rats breathing air contaminated with aromatic polycyclic hydrocarbons is dose-dependent.

In its criteria document for coal tar products, NIOSH cites papers dealing primarily with coke oven and aluminum potroom workers.[17] A study of aluminum industry potroom workers[18] showed an increase in lung cancer mortality. A paper on this industry in the Soviet Union associates such an increase with concentrations of tarry substances between 27 and 2130 mg/m³, while the BaP levels were between 0.6 and 56 μg/m³.[19] High respiratory mortality among coke oven workers in Great Britain was reported.[20] Kidney as well as lung cancer was relatively prevalent among American coke-oven workers exposed 5 years or more.[21]

Animal studies indicating that lung and kidney tumors were caused by exposure to coal tar aerosols were also cited.

The occupational exposure standard recommended by NIOSH was 0.1 mg/m³ for the cyclohexane extractable fraction.[17] A 1977 summary, however, gives 0.2 mg/m³ as the NIOSH recommendation for coal tar pitch volatiles.[22]

In the absence of more definitive information on the identity of the components of coal tar pitch aerosols responsible for carcinogenic effects, a TLV based on the benzene (or other suitable solvent) soluble fraction appears to be the most practical compromise. If the concentration of aerosols from coal tar, on this basis, is maintained below 0.2 mg/m³, any increase in the incidence of lung and other tumors, due to occupational exposure, should be minimal.

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OSHA POSTER

JOB SAFETY & HEALTH PROTECTION

The Occupational Safety and Health Act of 1970 provides job safety and health protection for workers by promoting safe and healthful working conditions throughout the Nation. Requirements of the Act include the following:

Employers

All employers must furnish to employees employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious harm to employees. Employers must comply with occupational safety and health standards issued under the Act.

Employees

Employees must comply with all occupational safety and health standards, rules, regulations and orders issued under the Act that apply to their own actions and conduct on the job.

The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor has the primary responsibility for administering the Act. OSHA issues occupational safety and health standards, and its Compliance Safety and Health Officers conduct jobsite inspections to help ensure compliance with the Act.

Inspection

The Act requires that a representative of the employer and a representative authorized by the employees be given an opportunity to accompany the OSHA inspector for the purpose of aiding the inspection.

Where there is no authorized employee representative, the OSHA Compliance Officer must consult with a reasonable number of employees concerning safety and health conditions in the workplace.

Complaint

Employees or their representatives have the right to file a complaint with the nearest OSHA office requesting an inspection if they believe unsafe or unhealthful conditions exist in their workplace. OSHA will withhold, on request, names of employees complaining.

The Act provides that employees may not be discharged or discriminated against in any way for filing safety and health complaints or for otherwise exercising their rights under the Act.

Employees who believe they have been discriminated against may file a complaint with their nearest OSHA office within 30 days of the alleged discrimination.

Citation

If upon inspection OSHA believes an employer has violated the Act, a citation alleging such violations will be issued to the employer. Each citation will specify a time period within which the alleged violation must be corrected.

The OSHA citation must be prominently displayed at or near the place of alleged violation for three days, or until it is corrected, whichever is later, to warn employees of dangers that may exist there.

Proposed Penalty

The Act provides for mandatory penalties against employers of up to $1,000 for each serious violation and for optional penalties of up to $1,000 for each nonserious violation. Penalties of up to $1,000 per day may be proposed for failure to correct violations within the proposed time period. Also, any employer who willfully or repeatedly violates the Act may be assessed penalties of up to $10,000 for each such violation.

Criminal penalties are also provided for in the Act. Any willful violation resulting in death of an employee, upon conviction, is punishable by a fine of not more than $10,000, or by imprisonment for not more than six months, or by both. Conviction of an employer after a first conviction doubles these maximum penalties.

Voluntary Activity

While providing penalties for violations, the Act also encourages efforts by labor and management, before an OSHA inspection, to reduce workplace hazards voluntarily and to develop and improve safety and health programs in all workplaces and industries. OSHA's Voluntary Protection Programs recognize outstanding efforts of this nature.

Such voluntary action should initially focus on the identification and elimination of hazards that could cause death, injury, or illness to employees and supervisors. There are many public and private organizations that can provide information and assistance in this effort, if requested. Also, your local OSHA office can provide considerable help and advice on solving safety and health problems or can refer you to other sources for help such as training.

Consultation

Free consultative assistance, without citation or penalty, is available to employers, on request, through OSHA supported programs in most State departments of labor or health.

[illegible] OFFICE

More Information

Additional information and copies of the Act, specific OSHA safety and health standards, and other applicable regulations may be obtained from your employer or from the nearest OSHA Regional Office in the following cities:

Atlanta, Georgia
Boston, Massachusetts
Chicago, Illinois
Dallas, Texas
Denver, Colorado
Kansas City, Missouri
New York, New York
Philadelphia, Pennsylvania
San Francisco, California

Telephone numbers for these offices, and additional area office locations, are listed in the telephone directory under the United States Department of Labor in the United States Government listing.

Washington, D.C.
1985
OSHA 2203

William E. Brock, Secretary of Labor

U.S. Department of Labor

COLD WEATHER OPERATIONS

COLD WEATHER OPERATIONS

I. INTRODUCTION

Cold weather often causes problems for personnel working outside. There are several types of cold weather injuries which can occur, even at temperatures above freezing. As temperatures drop below freezing, the potential for these injuries increases dramatically, as does the potential for equipment failure. Because of the considerable danger to personnel, outdoor work should be suspended if the ambient temperature drops below O° F (-18° C) or if the windchill factor drops below -29° F (-34° C). This level represents a guideline which should be used as an action level unless the HSO determines and documents otherwise.

Snow and ice add additional risks to personnel and operations. Reduced visibility, increased potential for falling injuries, reduced on-site mobility, and the increase in time required to access the site (or off-site support services) are some of the problems posed by snow and ice.

In view of the above, it is critical that the Site Safety Officer establish site specific safety and operating protocols, and that all on-site personnel be made aware of the risks from the recognition of, and the treatment of cold weather injuries.

II. COLD WEATHER INJURIES

There are two basic categories of cold weather injuries; local and systemic.

A. Local Cold Injuries

Local cold injuries are those injuries which affect specific areas of the body (e.g., fingers, ear, toes) and include the more commonly recognized cold weather injuries described below.

1. Chilblains is a condition that can result from prolonged exposure of bare skin to temperatures in the low sixties (°F) or below. This condition generally occurs in the extremities, and is a chronic injury of the skin and peripheral

capillary circulation. Covering and protecting the skin from prolonged exposure to the cold is the best method of preventing and treating chilblains.

2. Frostbite is the freezing of some part of the body as a result of exposure to very low temperatures. Frostbite can affect hands, feet, ears, and exposed parts of the face. It occurs when ice crystals form in the fluid in cells of the skin and tissue. As long as blood circulation remains good, frostbite will not occur. Frostbite is a constant hazard in sub- zero weather, especially where there are strong winds.

There are three stages of frostbite. Classification depends upon the amount of tissue damage. Severity can range from incipient frostbite (frostnip), which affects the skin, to superficial frostbite, which involves the skin and the tissues immediately beneath it, to deep frostbite, a much more serious injury with damage that may affect deeper tissue and even bone.

a. Symptoms

Symptoms for each of the three stages of frostbite include:

Frostnip
Skin first turns red, later becomes pale or waxy white.
May be tingling, stinging, or aching or uncomfortable sensation of coldness, followed by numbness, or it may be unnoticed by person.

Superficial Frostbite
Skin is white or gray-white and waxy in appearance.
Skin is firm to touch, does not move easily.
Tissue beneath the skin is soft and resilient.
Lack of sensation in the area.

Deep Frostbite
Tissues are pale, cold, solid.
Usually affects hands and feet.
Blisters and swelling may occur.

b. Emergency Treatment of Frostbite

Frostnip is easily reversed in the field by the application of body heat. Apply body heat before the affected area becomes numb. Thaw frozen spots immediately. Do not rub affected areas.

If frostnip affects your fingers and hands, place them against the skin of your chest or in your armpits. To warm your face, hold a mitten or scarf over the lower part of your face and breathe into it.

Superficial Frostbite usually responds to the application of body heat. If it does not or if it resembles the early stages of deep frostbite, treat the condition as though it were.

Deep Frostbite
If possible remove person to a heated shelter to avoid further frostbite.

Remove all constricting items (boots, gloves, socks) from area of injury if it can be done without danger of further frostbite.

RAPID REWARMING WILL MINIMIZE TISSUE LOSS.

Warm extremities in a carefully-controlled warm water bath (104°F to 106°F) until tips of the fingers or toes turn pink and feeling is restored.

If a water bath is not available, use ALTERNATE METHODS;

Apply wet packs (100°F to 112°F) to the person's body.

Gently wrap frostbitten area in blankets or other warm material.

DO NOT attempt to thaw by exercising the affected parts or heating them in front of an open fire, heat lamps, radiator or a stove. The person may have lost sensation in the parts and may receive a heat injury as a result.

DO NOT use snow to thaw frostbite.

DO NOT rub, massage or use pressure on the affected areas.

Watch to see if CPR is necessary.

Continue Care:

Keep frostbitten parts elevated if possible.

Give victim warm drinks such as tea, coffee, or soup.

DO NOT GIVE ALCOHOLIC BEVERAGES.

Have victim exercise fingers or toes as soon as they are warmed.

Do NOT allow a person with frostbitten feet to walk. It may cause additional damage.

c. Medical Treatment of Frostbite

Frostnip usually does not require medical care.

Superficial Frostbite. Blisters may require medical care.

Deep Frostbite. EARLY MEDICAL TREATMENT IS URGENT! Get the victim to medical care at once.

d. Prevention of Frostbite

It is far easier to prevent or to stop frostbite in earlier stages than to thaw and take care of badly frozen flesh:

Wear enough clothing to protect yourself against cold and wind.

Wear warm gloves and boots.

Pull a scarf or jacket flap over the lower part of your face or a hood tightly around your face.

Dry your feet as soon as possible if they get wet. Warm them with your hands. Use foot powder and put on dry socks.

If you cannot change wet boots and socks, exercise your feet frequently by wriggling your toes and moving your ankles. Never wear tight boots.

B. Systemic Cold Injuries

Systemic injuries are those that affect the entire body system. Severe general body cooling is known as systemic hypothermia, and can occur at temperatures well above freezing. Hypothermia is the progressive lowering of body temperature accompanied by rapid, progressive mental and physical collapse. Subnormal temperature within the central body can be fatal. A large percentage of wilderness deaths are the result of hypothermia.

Hypothermia is caused by exposure to cold and it is aggravated by moisture, cold winds, fatigue, hunger, and inadequate clothing or shelter. Excessive perspiration from strenuous exercise followed by too rapid cooling can lead to hypothermia.

Hypothermia usually occurs between the temperatures of 30-50°F, temperatures which most people believe are not dangerous. Crew members should be alert for symptoms of hypothermia, especially when temperatures are dropping rapidly or when they must work in rain, snow or ice.

Hypothermia may occur on land or following submersion in even moderately cold water, 65°F or below. Death in cold water may seem to be from drowning but it is usually the result of hypothermia.

On land, hypothermia may take up to a full day or more of exposure to develop. If the cold conditions are extremely severe, however, death may occur within a few hours of the first symptoms.

In water, skin and nearby tissues chill very fast. Within even 10 to 15 minutes, the temperature of the heart and brain may drop. When core (internal body) temperature reaches 90°F, unconsciousness may occur. In water, when the body temperature

drops to 80°F, heart failure is the usual cause of death. A person may drown as a result of losing the use of arms and legs or by becoming unconscious.

a. Symptoms

In the early stages of hypothermia, the body begins to lose heat faster than it can produce it and makes efforts to stay warm by shivering. When the body can no longer generate heat fast enough to overcome heat loss and the energy reserves of the body are becoming exhausted, a second stage begins; the body temperature begins to drop. This affects the ability of the brain to make judgments and also results in loss of muscular control.

As the body temperature drops, hypothermia symptoms become increasingly severe:

SYMPTOMS OF HYPOTHERMIA	APPROX. CORE TEMPS.
Person is conscious, alert. May have shivering that becomes uncontrollable as core temperature nears 95°F. Respirations increase at first.	Above 95°F
Person is conscious but disoriented, apathetic. Shivering present but diminishes as temperature drops. Below 92°F respiratory rate gradually diminishes, pupils begin to dilate.	95-90°F
Person is semi-conscious. Shivering replaced by muscular rigidity. Pupils fully dilated at about 86°F.	90-86°F
Unconscious, diminished respirations.	Below 86°F
Barely detectable or nondetectable respirations.	Below 80°F

b. Emergency Treatment of Hypothermia

In very mild cases of hypothermia, dry clothing and shelter may be all that is needed.

Move victim to shelter and warmth as rapidly as possible.

Gently remove all wet clothing (so victim does not expend energy warming and drying wet clothing) and replace it with dry.

Give the person something warm to drink. Do not give alcoholic beverages.

ALL OTHER CASES SHOULD BE CONSIDERED MEDICAL EMERGENCIES.

PROVIDE EXTERNAL HEAT ANY WAY POSSIBLE!

A WARM BATH with the water kept between 105°F and 110°F is the most effective way of warming a victim of hypothermia. (NEVER put an UNCONSCIOUS VICTIM in a bathtub.)

If it is not possible to give the person a warm bath, use an ALTERNATIVE METHOD:

Wrap warm moist towels (or other fabric) around the victim's head, neck, sides, groin. As the packs cool, rewarm them by adding warm water (about 105°F). (Check the temperature of the water with your elbow or the inside of your arm. Water should be warm but not hot).

Or, if you are at an remote outdoor location and cannot use any of the other methods:

Make a "human sandwich" by placing the unclothed victim in a sleeping bag (or between blankets) with two other undressed persons to provide body-to-body heat transfer. THIS WILL SAVE LIVES. Additional sleeping bags or blankets can be placed over and under the sleeping bag.

Do NOT wrap a hypothermia victim in a blanket without an auxiliary source of heat unless it is to protect against any further heat loss before treatment can begin.

Do NOT leave the person in a sleeping bag without extra heat in order to go for help unless there is no other alternative.

Continue treatment:

Give warm liquids and nourishing food if the person is conscious.

Check the person for symptoms of frostbite and if necessary, give treatment for frostbite.

Handle the patient gently and do not allow him to walk. Exertion can circulate cold stagnant blood from extremities to the central body and cause "after-drop", in which the patient's core temperature may drop below the level which will sustain life. (Alcohol also contributes to after-drop.)

c. Medical Care for Hypothermia

HYPOTHERMIA IS A SEVERE EMERGENCY. GET MEDICAL TREATMENT AS SOON AS POSSIBLE. Even persons with mild hypothermia should see a doctor.

d. Prevention of Hypothermia

Never go into the field in cold weather without wearing adequate clothing and taking a complete change of warm clothes and one or two pairs of extra socks (in plastic bags).

Wear or carry a windproof, water-resistant outer jacket. In rain or snow, wear adequate rain gear.

Stay dry. If your clothing becomes wet from perspiration, rain, snow or immersion in water, change it as soon as possible.

If you start to shiver in a prolonged or violent way, seek shelter at once. Shivering produces heat but uses up energy. Shivering violently may be an early sign of hypothermia.

Avoid accidental immersion in water. Practice boat safety and learn cold water survival techniques if your field work involves activities where you could fall into the water.

If you do fall into water (and are not very close to shore), remain quiet with your head out of water or climb onto the boat or any other object that will support you and keep you up out of the water.

C. Safety/First Aid Equipment

In view of the causes, results, and appropriate treatment of cold weather injuries discussed above, the following items should be included as safety equipment during cold weather operations.

Extra clothing for all personnel
Blankets/sleeping bag
High energy food, and drinking water supply
Toboggan
Tow ropes

In extreme cold conditions, the following safety items should also be included:

Electric blanket
Portable emergency generator (with fuel, oil, and cords)
Space heater and fuel

III. GENERAL WINTER OPERATIONS

Cold weather conditions can severely affect winter operations. The Site Manager and Site Safety Officer must plan work schedules and project tasks accordingly.

A. Preliminary Assessment

If you will be working outdoors in cold weather, assess the local weather conditions through the news media (radio, television, newspapers) in order to know the amount of preparation you will need to make. Carefully consider such questions as:

What are the typical wind and weather conditions for the period in which you will be sampling?

Are the areas in which you will work sheltered or open to the wind?

Is there a place nearby for periodic warming breaks? Can you obtain or heat warm food and beverages there? Is there a source of drinking water?

Are there ways to minimize the length of time that crew members will have to work outdoors in the cold?

If you use a vehicle for a warming area or will use a heater in a closed room, how can you insure there is adequate ventilation to prevent carbon monoxide poisoning?

B. Scheduling

Try to schedule work in the least severe weather.

Plan to rotate crew members to keep cold exposures short.

Allow sufficient time for frequent warming breaks.

Remember that workers in heavy clothing may need more time to complete tasks and may become fatigued more easily.

Be aware that you may have to discontinue operations if winds increase or the temperature drops.

Remember that winter days are short. Scheduling should allow time for taking care of equipment and supplies before nightfall when it is more difficult to gauge terrain and when temperatures are likely to drop.

C. Site Access

Snow and ice could make travel on site access roads impossible, or treacherous at best. Personnel should not be allowed to work on-site if conditions severely hamper the arrival or departure of emergency vehicles. An otherwise minor injury could

result in a major medical emergency if the route to off-site medical facilities is blocked by snow, ice, etc.

If conditions warrant, the following provisions should be made:

1. Snow removal/plowing services for site access roads should be secured.

2. A dependable four wheel drive vehicle should be immediately available on-site to transport injured to off-site medical facilities.

3. Sleeping bags, blankets, food supply, and water should be kept on-site in the event a sudden storm requires personnel to remain on-site overnight.

The HSO must decide when weather conditions make site access unsafe, and must stop work until conditions improve.

D. Equipment and Supplies

You should obtain equipment and supplies that will help prevent cold stress and that will help in the treatment of cold stress disorders.

Take a reliable ambient temperature thermometer, a wind gauge and a wind chill chart.

If the site is very windy, try to provide means of shielding workers from the wind.

If you are working at a distance from stores, carry extra food and water since hunger and dehydration contribute to cold stress. Try to take a means of providing hot food and beverages if one is not available nearby.

Provide emergency communication equipment for use between ground crews and those working in the cold, at heights, or in remote locations.

Very close attention must be paid to the effects of cold weather on field equipment. Many types of batteries can be severely affected by cold resulting in disabled radios, air monitoring equipment, sampling pumps, and vehicles. A supply of fresh batteries, sufficient number of charging units, and a set of automotive jumper cables should be maintained on-site.

The electronics in many field instruments such as PI meters, LEL meters and oxygen meters can also be adversely affected by the cold. Manufacturers literature must be consulted for operating ranges.

If at all possible, monitoring well sampling tasks should not be scheduled during cold weather. These tasks generally require the use of (relatively delicate) pumps; long, uninsulated stretches of tubing; and significant quantities of decontamination solutions. Unless considerable effort is expended to prevent pumps, hoses, decontamination solutions, and sample containers from freezing, attempting to sample monitoring wells in cold weather may be counter-productive. Portable shelters should be considered if cold weather sampling is necessary.

IV. CONCLUSIONS

Safe cold weather operations require considerable planning on the part of the Site Manager and Site Safety Officer.

Weather conditions and forecasts must be watched closely, and on-site activities and procedures modified accordingly.

On-site personnel must be made aware of the hazards of cold weather, and the symptoms and treatment of cold weather injuries.

A sufficient number of warm-up breaks must be provided to on-site personnel.

Enclosed, heated decontamination facilities may be required.

Additional time must be allotted in the morning to check out and warm-up field equipment. Additional time must also be allotted for the end of the day to drain hoses and pumps, pack and secure equipment, and plan the next day's activities based upon up-to-date weather forecasts.

MECHANICVILLE SITE-SPECIFIC QUALITY ASSURANCE PROJECT PLAN

INVESTIGATION OF THE FORMER COAL GASIFICATION SITE

AT

MECHANICVILLE, NEW YORK

QUALITY ASSURANCE PROJECT PLAN ADDENDUM

Prepared for:

New York State Electric and Gas Corporation
4500 Vestal Parkway East
Binghamton, New York 13903-1082

Prepared by:

ABB Environmental Services, Inc.
(Formerly E.C. Jordan Co.)
P.O. Box 7050, DTS
Portland, Maine 04112

Revised
May 1992

INVESTIGATION OF FORMER COAL GASIFICATION SITES
QAPP ADDENDUM

Client: NYSEG
Project No.: 4945-06
Task No.: 5

Prepared by: T. Plante 2/92
Reviewed & Approved by: D. Ostrye 2/92
Revised: 5/92

SITE DESCRIPTION

Site: Mechanicville Site ID: ME

Street: Corner of North Central Avenue and Ferris Lane.

City: Mechanicville County: Saratoga State: New York

Site Owners: New York State Electric and Gas Corp. (NYSEG)

Phone No: (518) 664-7371

Address: Park Plaza, Mechanicville, New York 12118

Purpose of Study: To expand our understanding of the nature and distribution of environmental contamination resulting from past use of the site for coal gasification and electrical equipment storage. Also, to gather hydrogeologic data to further define site hydrogeology and chemical migration pathways. This is the fifth phase of a phased investigation.

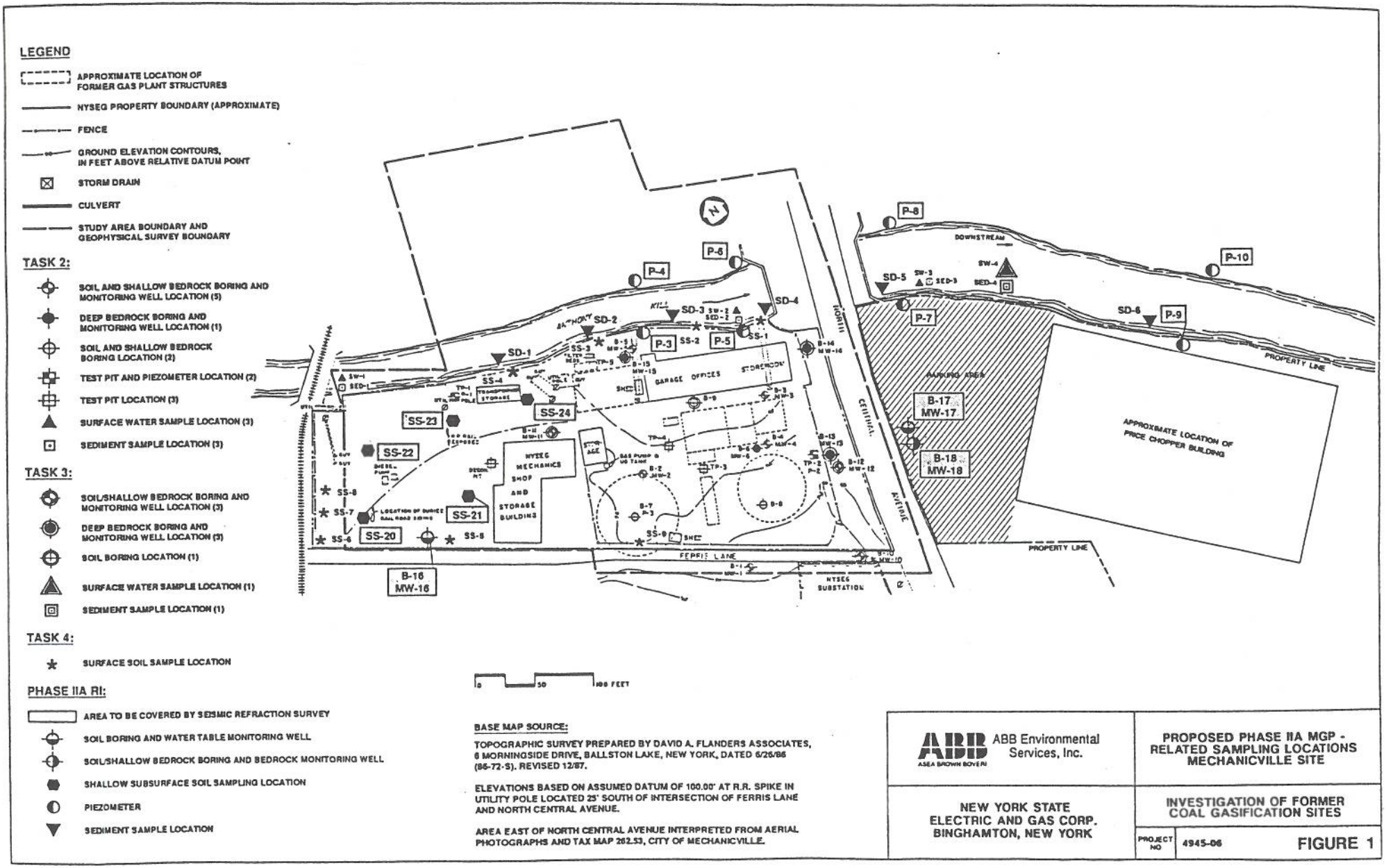
SUMMARY OF INVESTIGATION

The objective of this Phase IIA Supplemental Remedial Investigation is to gain a greater understanding of the site which will address comments and recommendations offered by the New York State Department of Environmental Conservation (NYSDEC). The work plan specifically focuses on assessing site soils for PCB contamination, further investigation west of the site to assess soil and groundwater quality, and installation of soil borings, monitoring wells, piezometers and seepage

meters downgradient of the site to assess off-site migration of site-related contaminants. The investigation includes the following activities:

- geophysical survey of the area directly east of the site to delineate the bedrock surface and locate the bedrock trough;
- installation of one upgradient shallow monitoring well;
- installation of one shallow and one bedrock monitoring well pair downgradient of the site;
- possible installation of one to two additional monitoring wells downgradient if visible evidence of contamination is found in the first pair;
- collection of subsurface boring soil samples inside and outside the boundary of the site;
- possible installation of additional soil borings if initial downgradient borings show visible evidence of soil contamination;
- shallow subsurface soil sampling within the site boundary;
- installation of piezometers along the Anthony Kill adjacent to and downgradient of the site;
- sediment sampling and UV/IR screening of samples;
- installation of seepage meters along the banks of the Anthony Kill adjacent to and downstream of the site;
- measurement of water levels in wells, piezometers, and surface water; and
- collection of groundwater and seep water samples for analyses.

The Phase IIA Supplemental Remedial Investigation is summarized below and sampling locations are shown in Figures 1 and 2. Detailed sampling procedures and



BASE MAP SOURCE:

TOPOGRAPHIC SURVEY PREPARED BY DAVID A. FLANDERS ASSOCIATES, 6 MORNINGSIDE DRIVE, BALLSTON LAKE, NEW YORK, DATED 6/26/86 (86-72-S). REVISED 12/87.

ELEVATIONS BASED ON ASSUMED DATUM OF 100.00' AT R.R. SPIKE IN UTILITY POLE LOCATED 25' SOUTH OF INTERSECTION OF FERRIS LANE AND NORTH CENTRAL AVENUE.

AREA EAST OF NORTH CENTRAL AVENUE INTERPRETED FROM AERIAL PHOTOGRAPHS AND TAX MAP 262.53, CITY OF MECHANICVILLE.

ABB Environmental Services, Inc.

NEW YORK STATE ELECTRIC AND GAS CORP. BINGHAMTON, NEW YORK

PROPOSED PHASE IIA MGP - RELATED SAMPLING LOCATIONS MECHANICVILLE SITE

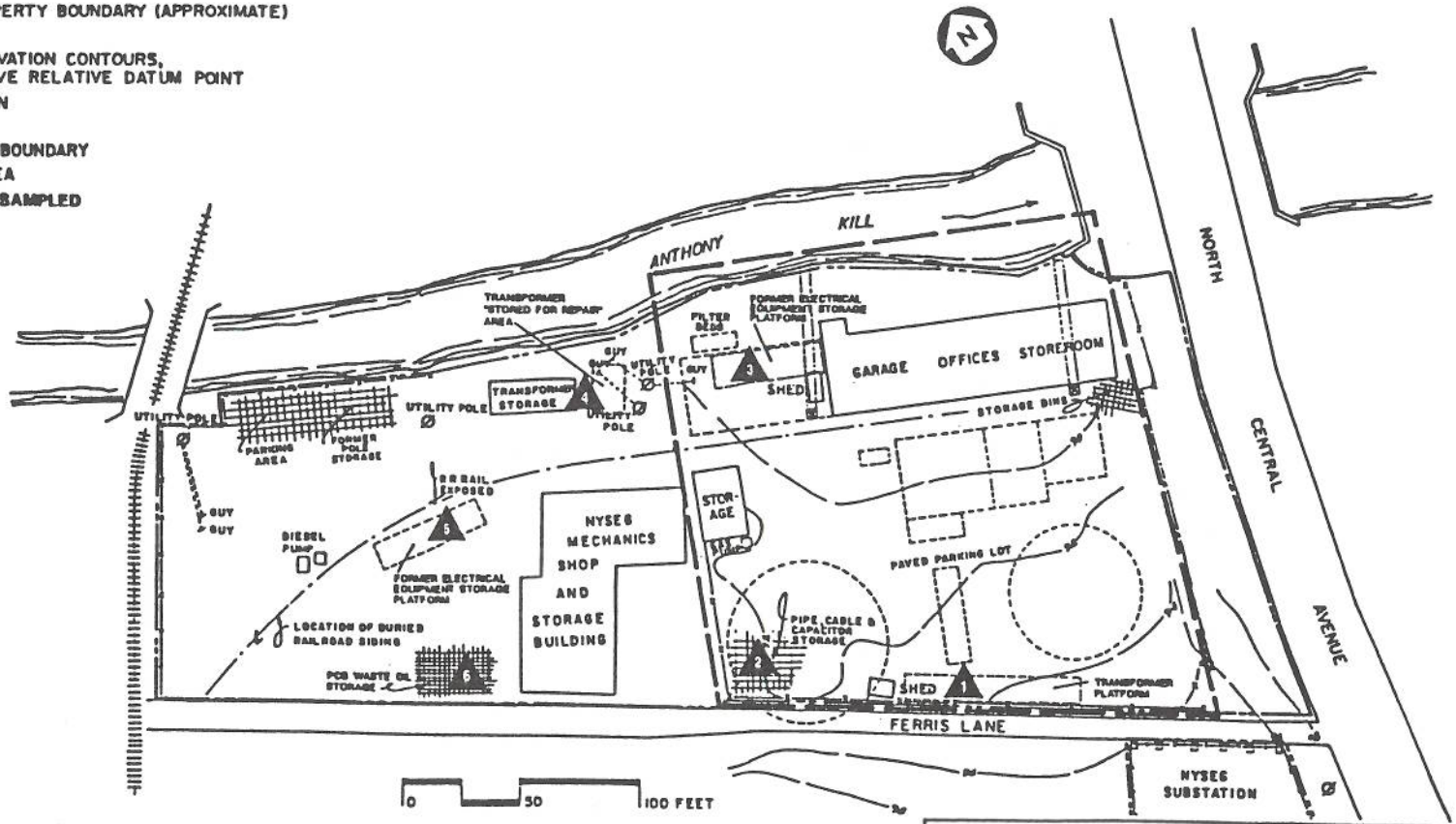
INVESTIGATION OF FORMER COAL GASIFICATION SITES

PROJECT NO 4945-06

FIGURE 1

LEGEND

- APPROXIMATE LOCATION OF FORMER GAS PLANT STRUCTURES
- NYSEG PROPERTY BOUNDARY (APPROXIMATE)
- FENCE
- GROUND ELEVATION CONTOURS, IN FEET ABOVE RELATIVE DATUM POINT
- STORM DRAIN
- CULVERT
- STUDY AREA BOUNDARY
- STORAGE AREA
- AREA TO BE SAMPLED FOR PCBs



BASE MAP SOURCE:

TOPOGRAPHIC SURVEY PREPARED BY DAVID A. FLANDERS ASSOCIATES, 6 MORNINGSIDE DRIVE, BALLSTON LAKE, NEW YORK, DATED 6/26/86 (86-72-S). REVISED 12/87.

ELEVATIONS BASED ON ASSUMED DATUM OF 100.00' AT RR SPIKE IN UTILITY POLE LOCATED 25' SOUTH OF FERRIS LANE AND NORTH CENTRAL AVENUE.

ABB Environmental Services, Inc.

CLIENT: NEW YORK STATE ELECTRIC AND GAS CORP. BINGHAMTON, NEW YORK

TITLE: PROPOSED PHASE II PCB SAMPLING AREAS MECHANICVILLE SITE

INVESTIGATION OF FORMER COAL GASIFICATION SITES

PROJECT NO. 4945-86

FIGURE 2

quality assurance objectives are for the activities to be undertaken during this field investigation are contained in the NYSEG contract QAPP (Jordan, 1986). A summary of these activities and any changes or additions are noted below.

1.0 GEOPHYSICAL INVESTIGATION

The seismic refraction survey will be conducted on the property occupied by a Price Chopper Supermarket east of the site, directly across North Central Avenue. The area to be covered by the seismic refraction survey is shown in Figure 1. The seismic refraction profiling method is an indirect means of determining the thickness and velocity values of the various seismic layers underlying a site. There is often a direct correlation between geologic strata and the layers defined during a seismic refraction investigation. For the Mechanicville site, the focus of seismic refraction will be to characterize the bedrock surface.

Interpretation of data is based on the measurement of the time required for elastic waves, generated at a point source, to travel to a series of sensitive listening devices called geophones, or seismometers. Geophones are placed at known intervals along a straight line on the ground surface and connected by special multi-conductor cables to the 24-channel seismograph. The cables are known as seismic spread cables and the array of geophones and cables is called a seismic spread. The seismograph is the device which records the elastic wave arrivals from the energy source along the seismic spread, acquiring separate data for each geophone position.

The seismic waves detected in a seismic refraction survey and used for depth calculations and the identification of materials is call a "P" (compressional) wave. This wave is transmitted through earth materials as a series of compressions and rarefactions. Just as sunlight is bent when it passes through a prism (refraction), so sound waves are also bent as they travel deeper into the earth through the various layers of soil and rock. Because they are bent, they eventually return to the surface as refracted seismic waves. If one carefully measures the transit times between the energy source and each geophone, one can interpret subsurface structure. The thickness and velocity values of various soil and rock layers can be computed. In the same manner, seismologists have learned about the interior of the earth by carefully measuring the arrival of seismic waves generated by distant earthquakes.

Field Procedure For Data Acquisition

Seismic spread cables, which have been fabricated with pre-measured shotpoint and geophone locations, are positioned along the lines of investigation. Geophones, which have been fitted with a spiked base so as to provide good ground contact, are positioned at their measured locations. Seismic energy is generated with either a

weight impact (sledge hammer) or small buried charges of explosives. If explosives are used, shotholes are usually prepared with a driven rod (not excavated) so as to insure good ground coupling. Th explosives are tightly tamped and the depths and amount of explosives used are noted.

Seismograms are obtained using a portable signal enhancement seismograph which records the wave arrivals from the energy source along the seismic spread, acquiring separate data for each geophone position. Timing lines are provided across the entire recording allowing direct reading of wave arrivals to an accuracy of one millisecond. The signal enhancement capability refers to the ability of the instrument to record the seismic waves from several impacts (or explosions), add them electronically,a nd retain this data in its internal digital memory for later processing and interpretation. The enhanced signal improves data quality and greatly facilitates interpretation.

Generally, several recordings are obtained along each seismic spread; seismograms are generated with the energy source at each end, and others may be obtained by energy generation in the middle, and at other positions along an individual seismic spread as necessary.

Continuous profiling is accomplished by having an end shotpoint of one seismic spread coincident with an end or intermediate position shot point of the succeeding spread. The length of each spread is determined by the required depth of penetration. Seismic spreads of varying lengths can be used in a study; the deeper the required penetration, the longer the spread must be.

Interpretation

The data are interpreted by first accurately measuring the individual transit times at each geophone position, then constructing a graph of these times versus their distance from the energy source. The geophysicist then determines by inspection of the time-distance graphs the number of subsurface seismic layers present. Straight line segments of best fit are drawn onto the graph, each layer being represented by a line of different slope. The inverse of the slope of each line is the (apparent) velocity value for each layer. The distance from the origin (or energy source) of the "crossover point" between two layers is proportional to the thickness of the overlying layer.

The identification of various materials can be made with a knowledge of seismic velocity values based on other engineering studies, and on correlations with various test borings taken near seismic lines. The results of seismic refractions will be used to place the downgradient borings/monitoring wells in the bedrock trough and/or the interpreted groundwater migration pathway (if different then any bedrock trough identified) and will be included in the Phase IIA Supplemental RI Report.

2.0 SUBSURFACE EXPLORATIONS

The Phase IIA Supplemental RI drilling program will consist of a minimum of three borings with an additional five optional borings depending on if visible evidence of contamination is found in the initial downgradient borings. Boring B-16 will be drilled to approximately 10 feet bgs (to bedrock), B-17 and B-18 will be advanced to bedrock (approximately 30 feet bgs). Boring B-18 will be advanced an additional 15 feet into bedrock. Monitoring wells will be installed in these borings and two of the optional borings downgradient of the site (if borings are completed). Split-spoon samples will be screened for coal tar residues by visual observation and odor, and for volatile compounds by use of a portable HNU or Photovac TIP photoionization detector. All borings not completed as monitoring wells will be grouted to the surface.

All borings completed to the bedrock surface (except B-18) will be drilled by using 4.25-inch inner diameter (ID) hollow-stem augers with continuous 3-inch outer diameter (OD) split-spoon sampling. B-18 will not be sampled since it is adjacent to B-17. Boring B-18 will be advanced 15 feet into bedrock by NX-coring. Core samples will be taken continuously. For boring B-18, the double-cased drilling technique will be used since it is anticipated that a confining silty-sand layer potentially overlain by coal tar will be encountered 1 to 2 feet above the bedrock surface as observed in borings B-12 and B-13 completed during Task 3. Potable water will be used for drilling and will be analyzed for volatile organic analytes (VOAs), semivolatile organic analytes (SVOAs), inorganics and total cyanide. Drilling methods are described in the NYSEG contract QAPP (Jordan, 1986c).

A minimum of one soil sample will be collected from each boring, preferably from the screened interval, and submitted to the NYSEG laboratory for analyses. These soil samples will be analyzed for VOAs, SVOAs, reactive cyanide and reactive sulfide, and inorganics. Analyses are summarized in Table 1, and documentation and

TABLE 1
NYSEG MECHANICVILLE SITE

PHASE IIA REMEDIAL INVESTIGATION
SAMPLE ANALYSIS PLAN

TYPE OF INVESTIGATION	MEDIUM	TOTAL EXPECTED NO. OF SAMPLES	VOAs NYSDEC ASP 91-1	VOAs NYSDEC ASP 91-4	SVOAs NYSDEC ASP 91-2	INORGANICS (SEE NOTES 2 AND 3) FILTERED	INORGANICS (SEE NOTES 2 AND 3) TOTAL	REACTIVE CYANIDE USEPA METHOD 9010	REACTIVE SULFIDE USEPA METHOD 9030	PCBs (9) USEPA METHOD 8080	TURBIDITY	MATRIX SPIKE	MATRIX SPIKE DUPLICATE	LEVEL OF DATA QUALITY(5)
Borings (1)	Soil	2 samples 1 duplicate 3 total (1)	3		3		3	3	3			1	1	IV
Shallow Subsurface Soil Sampling	Soil	5 samples 1 duplicate 6 total						6	6			1	1	IV
		24 samples 3 duplicates 27 total								27		2	2	III
Sediment	Soil	6 samples 1 duplicates 7 total	7		7		7	7	7			1	1	IV
Monitoring Wells: (6, 8)	Water	15 samples 2 duplicate 17 total	14	3	17	17	17				17	1	1	IV
Seep Meters or Surface Water (7)	Water	5 samples 1 duplicate 6 total		6	6	6	6				6	1	1	IV

Notes:

1. A minimum of one sample from each boring sampled will be submitted for laboratory analysis from the contaminated area or the well screen depth or both if different.
2. Analytes include Fe, Zn, Al, Cd, Sb, Co, Cu, Mn, Ni, Pb, Cr, and total amenable, and ferro-ferric cyanide. ASP Superfund CLP analytical methods will be used.
3. Filtered/unfiltered applicable to groundwater samples for metals.
4. ASP denotes NYSDEC Analytical Services Protocol, December 1991 revision.
5. All data validation performed according to USEPA protocol. 10% of samples will be subject to full validation, 90% to blank validation.
6. Samples from MW-22 and MW-23 behind Price Chopper will only be collected if these wells are deemed necessary and installed. Therefore, they are not included in this table.
7. Five seep meter/surface water samples will be collected. Surface water samples will be taken inplace of seepage meter samples where seepage meters prove ineffective.
8. All existing monitoring wells are to utilize NYSDEC ASP 91-1 for VOAs. All proposed wells (i.e., MW-16, MW-17, MW-18, MW-22 and MW-23) are to utilize NYSDEC ASP 91-4.
9. All PCB analyses will be performed using USEPA Method 8080 by NYSEG laboratories or NYSDOH ELAP-CLP certified laboratories.

W0029235.T80\1

data quality levels are also indicated in Table 1. All samples will be submitted to, and analyzed by a laboratory certified by NYSDOH for ELAP-CLP category. Information from split-spoon samples will be logged according to procedures outlined in the NYSEG contract QAPP (Jordan, 1986).

Maintaining proper records is an important aspect of soil sample taking. At the time samples are obtained, the following must be recorded by the sampler:

- sample site location (e.g., grid coordinates baseline station and offset, or the location plotted on a map or aerial photograph)
- sample type and depth
- soil description
- date and time of sampling
- project and sample designations
- sampler identification
- analyses requested

For laboratory samples, the sampler must initiate chain-of-custody (COC) procedures and describe the sample site in adequate detail to allow the analytical results to be properly interpreted and, if necessary, to allow collection of additional samples form the same sample location. Jordan uses standardized record forms to expedite this process and ensure uniformity of records. The sampling protocols and recordkeeping requirements for the types of samples described in the following pages vary according to the sampling techniques. Additional requirements may also be established on a site-specific basis.

The entire soil sampling process is designed and conducted in a manner that provides properly documented samples suitable for the intended analyses.

3.0 SHALLOW SUBSURFACE EXPLORATION

A total of six (five plus one duplicate) shallow subsurface soil samples will be collected west of the site (SS-20 through SS-24) as shown in Figure 1. The rationale for these samples is to evaluate whether chemicals from reported disposal of spent oxide wastes and wood chips are present on this area of the NYSEG property and to assess their impact. Samples will be collected with a stainless steel trowel or spoon or a spade from 0 to 12 inches below the pavement (or bgs if unpaved) and composited. Samples will be submitted to NYSEG for laboratory analysis of reactive cyanide and reactive sulfide.

A total of 27 shallow subsurface samples (SS-25 through SS-48 plus three duplicates) will be collected from the six electrical equipment storage areas shown on Figure 2. Each storage area will be subdivided into four equal-sized areas. Four samples will be collected from each sub-area from the 3- to 12-inch depth interval and composited, resulting in four composite samples for PCB analysis from each storage area. The sample grid spacing is illustrated in Table 2. Additional samples will be collected at locations other than the six storage areas if visible evidence of oil stains is encountered. Samples will be collected with a stainless steel trowel or spoon or a spade. Samples will be submitted to the NYSEG laboratory for PCB analysis (NYSDEC ASP 91-3).

Information from shallow subsurface soil samples will be logged according to procedures outlined in the NYSEG contract QAPP (Jordan, 1986). Soil sample recordkeeping described in the previous section also applies here. Figure 3 is an example surface soil sampling record.

4.0 MONITORING WELL/PIEZOMETER INSTALLATION

This program will further characterize the distribution of the groundwater chemical plume downgradient of the site (MW-17, MW-18, and possibly MW-21 and MW-22) and to provide additional upgradient groundwater quality information (MW-16). The monitoring wells will be constructed of 2-inch OD stainless steel construction. The final location of the downgradient wells will be based on a review of current on-site groundwater level measurements, the seismic refraction survey, and property access. These wells will also serve to better define the groundwater flow direction downgradient of the site. The monitoring well pair, MW-17/MW-18, will also be

TABLE 2

SAMPLE GRID SPACING

PCB SAMPLES

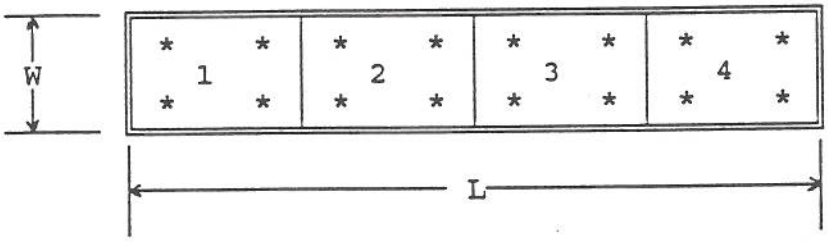
$$\text{Spacing}(x) = x / [2 * N(x)]$$

$$\text{1st Loc}(x) = \text{Space}(x) / 2$$

Were:

- x = L or W
- N(x) = # of composite samples in the L or W direction.
- Spacing(x) = spacing (distance between collection points) in the L or W direction.
- 1st Loc(x) = location of the corner collection points along L or W relative to edge of the suspect area.

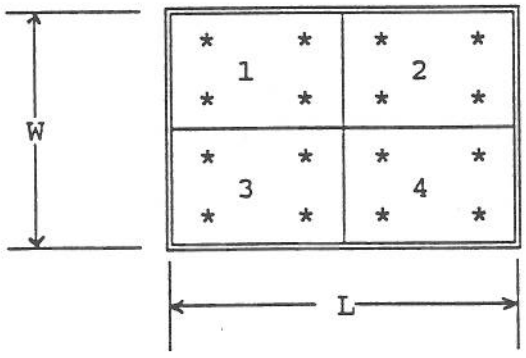
Example # 1



N(W)=1 N(l)=4

Space(W)= W/2
1st Loc(W)= W/4
Space(L)= L/8
1st Loc(L)= L/16

Example # 2



N(W) = N(L) = 2

Space(W)= W/4
1st Loc(W)= W/8

Space(L)= L/4
1st Loc(L)= L/8

LEGEND:

- * = sample collection point
- 1 = composite sample #
- W = width
- L = length
- ═══ = perimeter of suspect area
- —— = boundary of composite sample coverage

useful in determining the presence of vertical gradients between the bedrock and the overburden. Proposed locations of the wells are shown in Figure 1. Permission from private property owners will be necessary to install all off-site wells and piezometers as they are currently located.

In addition to the monitoring well installations, eight 1-inch PVC piezometers (P-3 through P-10) will be installed with a hand auger or hand driven into the ground to a depth of no greater than five feet along both banks of the Anthony Kill as shown in Figure 1. Well point piezometers will serve as groundwater level measurement points to be incorporated into the shallow groundwater flow contour maps for the Mechanicville site and, in conjunction with measured surface water elevations, used to indicate discharging or recharging conditions. This will enable better evaluation of shallow groundwater flow directions, gradients, and velocities from the site to these areas. These piezometers, in conjunction with water level data from the overburden/bedrock monitoring well pair MW-15/MW-5, will also indicate determine the presence of vertical gradients along the Anthony Kill, adjacent to the site.

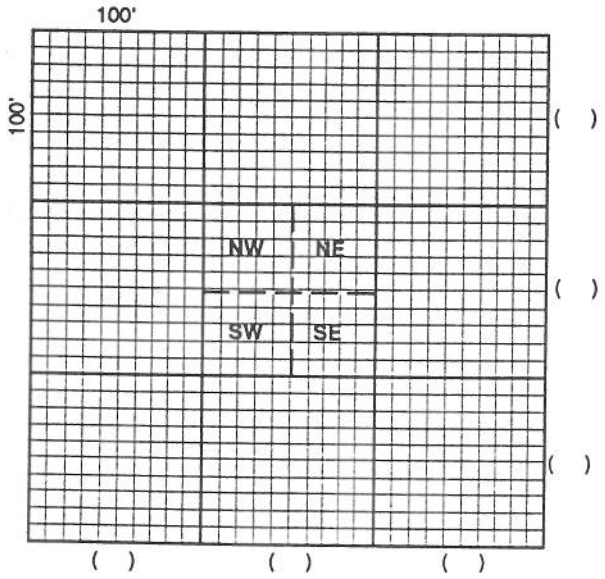
In general, monitoring wells and piezometers will be installed according to NYSEG procedures for monitoring wells and piezometers at former coal gasification plant sites (NYSEG, 1989). All substitutions, alterations and/or deviations from these procedures will require NYSDEC approval in advance. Based on previous site information, it is anticipated that well screens will be stainless steel, 10-slot (0.010 inch screen), with silica sand filter pack. The sand will be No. 0 Morie sand, with the uppermost six inches of the sand pack being No. 00 Morie sand, a finer material. A monitoring well installation report, including individual well construction details, will be prepared. In the shallow wells, the well screen and sand pack will be positioned to monitor the upper 10 feet of groundwater. The deep well will monitor the zone approximately 20 to 30 feet below the ground surface. Monitoring well installation details for the shallow and deep wells are shown in Figures 3 and 4, respectively. The borehole above (and below as necessary, including any sediment trap) the screened zone is sealed with dry bentonite pellets to preclude preferential vertical groundwater flow along the well annulus. The space between the bentonite seal and the surface seal will be filled with cement/bentonite grout (94 lbs cement per 3 to 5 lbs bentonite) regardless of whether or not contamination is encountered in the fill soil. Any deviations from the installation details specified in this QAPP must be approved by both NYSEG and NYSDEC.

SURFACE SOIL SAMPLING RECORD

Site _____

Grid Element; _____ Date; _____ Time: _____ St., _____ End. _____

Sketch Map of Grid Element



Samples Obtained

Composite Samples

Depth (Ft)	Quadrants	Init. Ser No.	Hd. Sp. PPM
S	NE NW SE SW		
1'	NE NW SE SW		
1.5'	NE NW SE SW		
2'	NE NW SE SW		

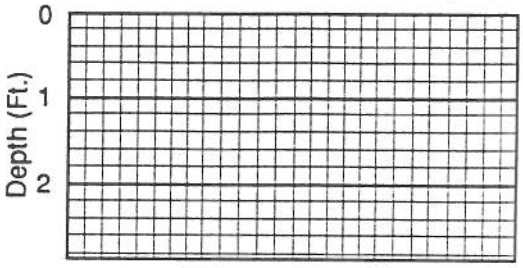
Grab Samples

	NE NW SE SW		
	NE NW SE SW		
	NE NW SE SW		
	NE NW SE SW		

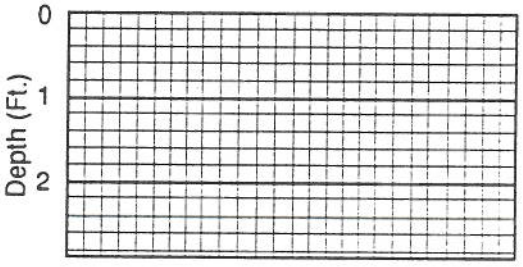
Sample Component Loss

-Description- -Monitoring- -PPM-

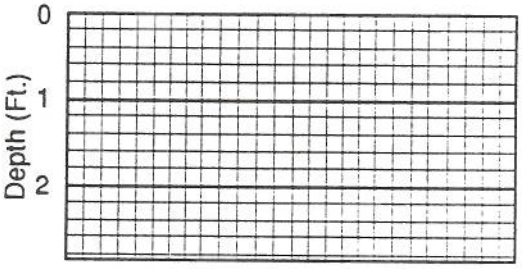
NE Surface PPM, Spoils PPM



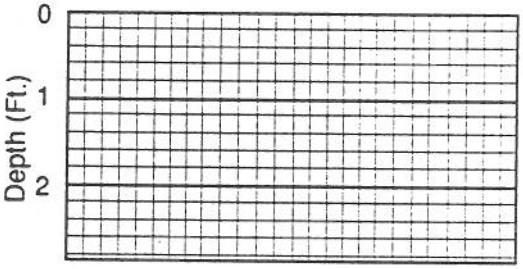
NW Surface PPM, Spoils PPM



NW Surface PPM, Spoils PPM



SE Surface PPM, Spoils PPM



Notes: _____ Photographers Roll: _____

_____ Exposures: _____

_____

_____

_____ Reference: Field Book, Page _____

Attachments, No. _____

_____
Signed

FIGURE 3
SURFACE SOIL SAMPLING RECORD
PROGRAM QUALITY ASSURANCE PROJECT PLAN

The preferred well development technique will be the surge (or surge-block) technique. During this development technique, in-situ well water is forced out, and pulled into, the well screen. This technique will draw silt-sized material entrained within the sand filter pack during well installation into the well. The accumulated silt within the well can then be periodically removed by bailing or pumping the well. The advantage of this development technique is that it will generate less water than continuous pumping development or air-lift development and it effectively removes fine-grained sediments surrounding the well screen. If this technique is not effective, the pumping or air-lift methods will be used as alternates. The development water generated will be pumped into closed-top 55-gallon drums and transported to the site. The development water will be allowed to infiltrate into an on-site groundwater recharge pit. The area as a recharge pit will be covered with clean soil when it is no longer needed in accordance with NYSDEC TAGM "Disposal of Contaminated Groundwater Generated During Remedial Investigations".

As part of this task, rising-head permeability tests will be conducted on all new wells to determine the horizontal hydraulic conductivities of the geologic strata being monitored. Rising-head tests will be performed by temporarily depressing the water level in the wells, using compressed air or a slug, and recording time and water level recovery using an in-situ Hermit data logger and pressure transducer or water level indicator.

5.0 Water Level Measurements

Water level measurements will be taken at all monitoring wells and piezometers associated with the site with an electronic water level meter using the top of the riser pipe as the reference datum. Elevations of top of risers will be surveyed subsequent to installation. Surface water elevations will be established in reference to adjacent piezometers. Water level measurement procedures are outlined in the NYSEG contract QAPP (Jordan, 1986). Duplicate keys for all wells will be provided to NYSDEC at the completion of the field investigation.

6.0 Groundwater Sampling and Analysis

The well installation program will be followed by one round of groundwater sampling of all wells. Dedicated stainless steel bailers will be installed in all existing site monitoring wells, and monitoring wells will be sampled according to the procedures

outlined in the NYSEG contract QAPP (Jordan, 1986), with the exception of the volume of water to be purged to reach turbidity goals.

Prior to obtaining a groundwater sample from a well, at least four to ten bore volumes of water must be pumped or bailed from a well of high yielding formation. Conversely, if the yield is low, the well may be purged of all its water, then sampling commenced as soon as the well recovers. The bore is the hole in which the stainless steel pipe stands, and volume is calculated from $(pi)(d^2)(h)/4$, where pi = 3.14,d = diameter of borehole, and h = height of water column from the bottom of the well to the surface of water in the well. Four to ten volumes are required to minimize turbidity and to obtain a representative sample; the turbidity goal is 50 NTUs or less. This holds for high yielding wells. For wells that can be totally evacuated by the four to ten (or less) bore volumes one total evacuation of the well will be sufficient.

Wells should be pumped or bailed dry. If this cannot be accomplished, the water level in the well should be monitored while pumping or bailing until the level has "stabilized". When this occurs, most if not all of the water being removed is coming from the aquifer. Temperature, specific conductance, and pH of the water should be monitored; when these factors "stabilize", it is probable that little or no water is coming from casing storage.

Purge water from monitoring will be drummed and transported to the site. Here it will be passed through granular activated carbon canisters and discharged in an on-site groundwater recharge pit.

In developing and extracting samples wells, the Division will require that dedicated tubes, hoses (rubber or tygon is unacceptable), and bailers, including line and other sampling equipment, must be provided for each well. Groundwater elevation equipment and other non-dedicated equipment will be decontaminated. Decontamination procedures are described in Section 9.0.

Groundwater sample analyses and data quality objectives are summarized in Table 1; all samples from monitoring rounds will be submitted to NYSEG laboratories, and may be subcontracted to the following New York State certified laboratories: Galson Laboratories in Syracuse, New York; Friend Laboratories in Waverly, Pennsylvania; and UPSTATE in Syracuse, New York. Any laboratory used to NYSEG must be certified by NYSDOH for ELAP-CLP category.

Groundwater samples will be analyzed in the field for turbidity temperature, pH, and conductivity and sent to a laboratory for analysis of volatile organics (NYSDEC ASP 91-1), semivolatile organics (NYSDEC ASP 91-2), inorganics, and turbidity. Table 1 details the sample analysis parameters. Groundwater sample collected-data will be recorded on a data record such as Figure 4.

7.0 SEDIMENT SAMPLING/SCREENING

The sediment sampling and screening will be conducted on samples collected from the southern bank of the Anthony Kill, adjacent to and downstream of the site. Sample locations will be determined in the field through visual observation of the stream bank conditions (i.e., stained sediments, flowing seeps, stressed vegetation) and evaluation of the hydrogeology of the site incorporating the additional wells and piezometers. A minimum of seven sediment samples (SD-1 through SD-6 plus one duplicate) will be collected for laboratory analysis of volatile organics (NYSDEC ASP 91-1), semivolatile organics (NYSDEC ASP 91-2), inorganics, total organic carbon, reactive cyanide (USEPA Method 9010) and reactive sulfide (USEPA Method 9030). Approximate locations are shown in Figure 1. Sediment sampling and field screening will be used to locate seepage meter investigation areas by identifying areas of the stream bank containing site-related chemicals. The sediment sampling rationale is contained in Table 8-2.

Sediment samples will be collected using stainless steel spoons or trowels, teflon or glass coring tubes in shallow surface water, and gravity cores in deeper waters as outlined in the NYSEG contract QAPP (Jordan, 1986). Samples will be collected at two to three depth intervals at each location (where sediment depth is sufficient) to profile potential discharge zones. If no sediment deposits are available, sampling will be collected from the submersed interface of the bedrock and the streambank overburden. Sediment sample data will be recorded on data sheets such as Figure 5.

All sediment samples will be examined in the field for visual signs of contamination and screened using a PID meter. Sediment samples collected will also be screened for the presence of PAH and TPH using the UV fluorescence and IR spectroscopy screening methods.

The UV fluorescence screening procedure involves the extraction of a soil sample in an organic solvent and comparison of the fluorescence of the extract to the

GROUNDWATER FIELD SAMPLE DATA RECORD

Project: _____ Site: _____

Project Number: _____ Date: _____

Sample Location ID: _____ Signature of Sampler: _____

Time: Start: _____ End: _____

Water Level/Well Data

Well Depth _____ Ft. ___ Measured ___ Historical

___ Top of Well ___ Top of Protective Casing ___ _____

Well Riser Stick-up _____ Ft. (from ground)

Protective _____ Ft. Casing/Well Difference

Protective _____ Ft. Casing

Depth to Water _____ Ft.

Well Material: ___ PVC ___ SS _____

Well Locked?: ___ Yes ___ No

Well Dia. ___ 2 inch ___ 4 inch ___ 6 inch ___ _____

Water Level Equip. Used: ___ Elect. Cond. Probe ___ Float Activated ___ Press. Transducer ___ _____

Height of Water Column _____ Ft. X ___ .16 Gal/Ft. (2 in.) ___ .65 Gal/Ft. (4 in.) ___ 1.5 Gal/Ft. (6 in.) ___ ___ Gal/Ft. (___ in.) = [_____ Gal/Vol _____ Total Gal Purged]

Well Integrity:	Yes	No
Prot. Casing Secure	___	___
Concrete Collar Intact	___	___
Other _____	___	___

Equipment Documentation

Purging/Sampling Equipment Used:

(✓ If Used For) Purging	Sampling		Equipment ID
___	___	Peristaltic Pump	_____
___	___	Bailer	_____
___	___	PVC/Silicon Tubing	_____
___	___	Teflon/Silicon Tubing	_____
___	___	Airlift	_____
___	___	Hand Pump	_____
___	___	In-line Filter	_____
___	___	Press/Vac Filter	_____
___	___	Submersible Pump	_____
___	___		_____

Decontamination Fluids Used:

(✓ All That Apply at Location)

___ Methanol (100%)
___ 25% Methanol/75% ASTM Type II water
___ Deionized Water
___ Liquinox Solution
___ Hexane
___ HNO_3/D.I. Water Solution
___ Potable Water
___ None
___ _____
___ _____

Field Analysis Data

Ambient Air VOC _____ ppm Well Mouth _____ ppm Field Data Collected ___ In-line ___ In Container

Sample Observations: ___ Turbid ___ Clear ___ Cloudy ___ Colored ___ Odor

Purge Data	@ _____ Gal.	@ _____ Gal.	@ _____ Gal.	@ _____ Gal.	@ _____ Gal.
Temperature, Deg. C					
pH, units					
Specific Conductivity (umhos/cm. @ 25 Deg. C.)					
Oxidation - Reduction, +/- mv					
Dissolved Oxygen, ppm					
Turbidity (NTU's)					

Sample Collection Requirements

(✓ If Required at this Location)

Analytical Parameter	✓ If Field Filtered	Preservation Method	Volume Required	✓ If Sample Collected	Sample Bottle IDs
					___/___/___/___
					___/___/___/___
					___/___/___/___
					___/___/___/___
					___/___/___/___
					___/___/___/___
					___/___/___/___
					___/___/___/___

Notes: _____

FIGURE 4
GROUNDWATER SAMPLE DATA RECORD
PROGRAM QUALITY ASSURANCE PROJECT PLAN

9202081D (a)

SURFACE WATER AND SEDIMENT FIELD SAMPLE DATA RECORD

Project: _____ Site: _____

Project Number: _____ Date: _____

Sample Location ID: _____

Time: Start: _____ End: _____ Signature of Sampler: _____

SURFACE WATER INFORMATION

TYPE OF SURFACE WATER:
[ ] STREAM [ ] RIVER
[ ] POND/LAKE [ ] SEEP

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

WATER DEPTH AND SAMPLE LOCATION _____ (ft)

DEPTH OF SAMPLE
FROM TOP OF WATER _____ (ft)

EQUIPMENT USED FOR COLLECTION:
[ ] NONE, GRAB INTO BOTTLE
[ ] BOMB SAMPLER
[ ] PUMP _____

VELOCITY MEASUREMENTS OBTAINED? [ ] YES, SEE FLOW MEASUREMENT DATA RECORD _____

TEMPERATURE _____ Deg. C. SPEC. COND. _____ µmhos/cm pH _____ Units DISS. O_2 _____ ppm

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID _____

SAMPLE LOCATION SKETCH:
[ ] YES
[ ] NO

METHOD USED:
[ ] WINKLER
[ ] PROBE

SEDIMENT INFORMATION

DEPTH OF SEDIMENT SAMPLE _____ (ft)

EQUIPMENT USED FOR COLLECTION:
[ ] GRAVITY CORER
[ ] S.S. SPLIT SPOON
[ ] DREDGE
[ ] HAND SPOON
[ ] ALUMINUM PANS
[ ] SS BUCKET
[ ] _____

TYPE OF SAMPLE COLLECTED:
[ ] DISCRETE
[ ] COMPOSITE

SAMPLE OBSERVATIONS:
[ ] ODOR _____
[ ] COLOR _____
[ ] _____

DECONTAMINATION FLUIDS USED:
✓ ALL USED
[ ] ETHYL ALCOHOL
[ ] 25% METHANOL/ 75% ASTM TYPE II WATER
[ ] DEIONIZED WATER
[ ] LIQUINOX SOLUTION
[ ] HEXANE
[ ] HNO_3 SOLUTION
[ ] POTABLE WATER
[ ] NONE

SEDIMENT TYPE:
[ ] CLAY
[ ] SAND
[ ] ORGANIC
[ ] GRAVEL

FIELD GC DATA: [ ] FIELD DUPLICATE COLLECTED
DUPLICATE ID _____

SAMPLES COLLECTED

✓ IF REQUIRED AT THIS LOCATION	MATRIX: SURFACE WATER	MATRIX: SEDIMENT	✓ IF PRESERVED WITH ACID-BASE	VOLUME REQUIRED	✓ IF SAMPLE COLLECTED	SAMPLE BOTTLE IDS
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____
[ ]	[ ]	[ ]	[ ]	_____	[ ]	_____/_____/_____/_____

NOTES/SKETCH

FIGURE 5
SURFACE WATER/SEDIMENT SAMPLE DATA RECORD
PROGRAM QUALITY ASSURANCE PROJECT PLAN

fluorescence of a known standard which can be either a specific PAH or a mixture of PAH. Since many other extractable organics, including naturally occurring compounds, also fluoresce; this screening can produce false positive results. However, the absence of fluorescent matter in a sample generally confirms the absence of medium to high levels of manufactured gas plant contaminants. The degree to which false positives are encountered is related to subsequent site uses, presence of natural lignite in soils, and vegetation.

The IR screening procedure is an adaptation of the laboratory procedure for measuring TPH. The adaptations are primarily related to sample volumes and extraction protocols which result in reduced analytical times. The results of TPH screening are more variable than laboratory results but provide useful data, especially where elevated levels (i.e., greater than 250 parts per million) are encountered.

These screening results will be used to select which sediment samples will be submitted for laboratory analysis.

8.0 Seepage Meter Installation/Sampling

The purpose of the seepage meter investigation is to empirically measure seepage rates of site-derived groundwater into the Anthony Kill and determine the chemical quality of seep water both adjacent to and downgradient of the site. Discharge rates determined through the seepage meters will be compared against Darcy's Law calculated estimates.

Seepage meters will be installed at approximately three locations adjacent to and two locations downstream of the site. The exact location and number of seepage meters actually installed will be determined by visual observation of the stream bank for stained sediments or flowing seeps and field screening of sediment samples for TPHs and PAHs.

Design specifications and interpretative methods for the data collected from the seepage meters are contained in Appendix A of this QAPP. A brief description of seepage meter construction follows.

Seepage meters are constructed of 55-gallon, steel drums, cut in half along the horizontal plane. A 3/8-inch ID section of threaded pipe is fitted through the end

of the drum with rubber washers and two nuts on either side of the drum end. The nuts are tightened to create a water-tight seal around the pipe, and each drum is checked for leaks.

A rubber hose is then fitted to the pipe, the other end of which is connected to a plastic bladder bag obtained from a medical supplier. The bag is equipped with a one-way valve on the drum end of the bag, and a flip valve for emptying tat the other end of the bag. The drum and bag are then fully submersed in water and pressed firmly into the stream bottom. Because the drums have neutral buoyancy, they must be anchored. To ensure no disturbance or movement, a wooden stake is driven adjacent to each drum, and a 3-inch-thick cinder block is slipped over the stake, to rest on top of and secure the drum. The bag is then submersed under water with a sinker. This completes the seepage meter installation; each stake is marked to identify the meter.

Flow into the meter through the stream bed is measured by closing the flip valve on the bag and allowing the bag to fill for several hours or days. The volume of seepage water collected in the bag over a measured time interval provides a groundwater seepage rate into the Anthony Kill for the area covered by the seepage meter. Seepage water will also collected and submitted for laboratory chemical analyses for volatile organics (NYSDEC ASP 91-4), semivolatile organics (NYSDEC ASP 91-2), and inorganics (see Table 1).

9.0 DECONTAMINATION PROCEDURES

Equipment to be decontaminated during the project may include (1) drill rig and drilling equipment; (2) truck or trailer; (3) tools; (4) monitoring equipment; and (5) sample containers. The drill rig and drilling equipment will be steam cleaned prior to arrival at the Mechanicville site, followed by on-site steam cleaning with water upon arrival, between boring/well sites, and after all work is complete at the site. The truck and trailer and assorted tools (i.e., pipe wrenches for breaking drill rods) will also be steam cleaned prior to leaving the site. Prior to use on-site, all casings, augers, recirculation and water tanks, etc., will be devoid, both inside and out, of any asphaltic, bituminous, or other encrusting or coating materials, grease, grout, soil, etc.

To the extent practical, all steam cleaning shall be performed in an area that is on-site. All decontamination will be performed by personnel in protective gear appropriate for the level of contamination, as determined by the Health and Safety Officer. All decontamination fluids will be disposed of via on-site percolation.

The split-spoon sampler(s) used during the subsurface soil sampling procedures will be decontaminated between samples and after final use, using a Liquinox/water rinse followed by a distilled water rinse. Loose material will be removed using a brush, prior to the split-spoon washing procedure.

Heavy coal tar material that cannot be removed from sampling equipment (i.e., hand/power augers for shallow subsurface samplers, may be cleaned with hexane, then a Liquinox/water rinse, followed by a distilled water rinse. Large equipment coated with heavy coal tar material (i.e., drilling augers) will be steam-cleaned.

Soil cuttings from the soil borings and monitoring well installation will be placed into 55-gallon drums, labeled, covered, and stored within the site property boundaries pending subsequent testing for hazardous waste characteristics and disposal by NYSEG in accordance with NYSEG TAGM "Disposal of Drill Cuttings". Wash water generated by the double-cased drilling method will be transported to the site, and after settling of solids, the supernate will be allowed to infiltrate into an on-site groundwater recharge pit. The area as a recharge pit will be covered with clean soil when it is no longer needed in accordance with NYSEC TAGM "Disposal of Contaminated Groundwater Generated During Remedial Investigations".

10.0 Data Quality Objectives (DQOs)

DQOs are based on the premise that different data uses require different quality data. Data quality refers to a degree of certainty with respect to precision, accuracy, reproducibility, completeness, and comparability. DQOs are qualitative and quantitative statements specifying the quality of data required to support RI/FS activities, such as including site screening, site characterization, and risk assessment, and to support engineering alterative evaluation and selection decisions.

Two levels of data quality, USEPA Level III and Level IV (USEPA, 1988; USEPA, 1989), are needed for the soil and groundwater samples submitted for analyses. These data quality objective levels are in accordance with the NYSDEC ASP. The

specific DQO levels for each individual sample are shown in Table 1. All samples undergoing ASP analyses will have Level IV data quality; all other samples will have Level III data quality. Level III allows the use of non-contract laboratory program (CLP) methods, but requires that the analytical methods be accepted by USEPA; the data is typically used for risk assessment, site characterization, alternative evaluation, and engineering design. This level of data quality is considered sufficient for the majority of the soil and water samples collected from this site; these samples are being used primarily to further characterize and define the limits of coal gasification process-related contaminants, to select and implement a remedial action.

Level IV requires CLP methods and CLP data packages; the data is used for risk assessment, alternative evaluation and engineering design for sites that are near heavily populated areas, or are likely to undergo litigation. Samples analyzed and documented to this level of data quality are being used primarily to confirm the presence of contaminants in sensitive areas (i.e., upgradient and downgradient, off-site monitoring wells) with a high degree of precision and accuracy. For Level IV validation, 10% of the samples will undergo full validation and 90% will undergo blank validation only.

The analytical laboratory (i.e., NYSEG or NYSEG subcontractor) must analyze matrix spikes (MS) and matrix spike duplicates (MSD) sufficient for determining analytical precision and accuracy for specified methods and requested levels of data quality. Frequency of MS and MSD analyses will be five percent for each matrix. Field, sampler, and trip blanks and field duplicates will be collected as described in the NYSEG contract QAPP (Jordan, 1986).

ABB Environmental will provide third-party validation and review of analytical results, in accordance with NYSDEC and USEPA protocol. The validation of analytical measurements consists of a systematic process of reviewing data to provide assurance that the data are adequate for their intended use.

Performance verification will be done for all data. During performance verification, the Chain-of-Custody and Analytical Request Forms (ARFs) are reviewed for completeness and accuracy. Method blank corrections will also be made to the data based on field, sampler, trip, and laboratory blank results.

In addition to the activities associated with Level III data validation, Level IV data validation requires more thorough quality control (QC) review of analytical methods

and laboratory Quality Assurance/Quality Control (QA/QC) documentation. Full validation Level IV will be performed for 10% sample and includes reviewing measurement system calibration and calibration verification, quality control activities, field sample data records and chain-of-custody, and intermediate calculations, as well as certifying the process.

INVESTIGATION OF FORMER COAL GASIFICATION SITES
QAPP ADDENDUM (continued)

Site Mechanicville Site I.D. ME

MANPOWER

Field Personnel

Team Leaders: Pending

Team Member(s): Pending

PROJECT COORDINATION

ABB Environmental Site Manger:	Thomas R. Plante	Phone No:	(207) 775-5401
ABB Environmental Project Manger:	Daniel P. Ostrye	Phone No:	(207) 775-5401
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ABB Environmental Project QA Officer:	Steven Turner	Phone No:	(207) 775-5401
ABB Environmental Data Validator	Maryanne Kosciewicz	Phone No:	(207) 775-5401

PROJECT SCHEDULE (see Figure 8-3 in Phase II RI Report)

	Event	Start	Duration
1.	Exploratory Borings/Monitoring Well Installations	Pending	
2.	Elevation Survey	Pending	
3.	Permeability Survey	Pending	
4.	Sampling Groundwater	Pending	
5.	Surface/Subsurface Soil Sampling	Pending	

INVESTIGATION OF FORMER COAL GASIFICATION SITES
QAPP ADDENDUM (continued)

Site Mechanicville

Site I.D. ME

SAMPLING REQUIREMENTS

Analytical Samples		QA Samples	10
Water Samples:		Duplicate samples: (Groundwater, Surface Water, Soil, Sediment, Air)	9
Groundwater:	17		
Surface Water:	0		
Seeps:	6		
Soil Samples:	45	Trip Blank: water (VOA)	1
Sediment Samples:	7	Air Blank: sorbent	0
Air Samples:	0	Filtration Blank (1/15 samples)	3
Other (Specify)	—	Sampler Blank Monitoring Well-Groundwater (VOA, SVOA, inorganics)	1
		Matrix Spike (5% per matrix)	7
		Matrix Spike Duplicate (5% per matrix)	7

See Table 1 for Sample Analysis Plan.

SAMPLE IDENTIFICATION

The standard method for sample identification used by ABB-ES for NYSEG former coal gasification plant sites includes the following codes:

Type of Sample	Code
Monitoring Well	MW
Groundwater Seep	GS
Surface Water	SW
Borehole	B
Test Pit	TP
Sediment	SD
Air	A
Duplicate	DUP
Trip Blank	TB
Filtration Blank	FB
Sampler Blank	SB
Tar Well	TW

The digits following the sample type code denote the number of the sample round (if more than one set of samples will be collected) and the number assigned to the sample point. For example, the groundwater sample collected from monitoring well Number 1 on the first sampling round would be MW-101 and the sample collected from that well on the second round would be MW-201. When more than one sample will be collected at the same point, as with boreholes, sample numbers are also assigned. The first sample from Boring 1 would be B-1(S1), the second sample B-1(S2), and so on. Sampling round numbers are not needed for boring samples because they are collected only once.

For this project, ABB will also use a sample identification code developed by NYSEG for direct use with NYSEG's computerized data recording system. Each sample will be assigned a thirteen-digit alpha-numeric code comprised of the following elements:

Element	Number of Digits
Site	2
Source of sample	1
Relative location (x)	1
Location of sample	2

Year of well installation (applies to groundwater samples only)	2
Sample point	2
Slash	1
Sample number	1
Round number	1
	13

The specific codes to be used in this investigation for each element are presented in the attached table. This table contains only a small portion of the coding system developed by NYSEG.

NYSEG SAMPLE IDENTIFICATION CODES

SITE	
Cortland/Homer	CH
Ithaca First Street	IF
Ithaca Court Street	IC
Ithaca Cayuga Inlet	II
Mechanicville	ME
Mechanicville/Coons Crossing	MC
Owego	OW

SOURCE OF SAMPLE	
Soil	E
Groundwater	G
Surface water	S
Air	A
Solid waste	W
Sediment	T

RELATIVE LOCATION	
Downgradient	D
In fill or in source	I
Upgradient	U
Not Applicable	X

LOCATION OF SAMPLE	
Air sampler	AS
Boring	B-
Monitoring well	MW
Tar well (pit, sump)	TW
Stream	SS
Test pit	TP
Shallow soil	SH
Deep soil	D-
Seep	EE

YEAR OF WELL INSTALLATION	
1985 well	85
1986 well	86
1990 well	90
Samples other than groundwater samples	XX

SAMPLE POINT		
First point		01
Second point		02
nth point		n
Duplicate		DU
Trip blank		TB
Filtration blank		FB
Sampler blank		SB

SEPARATOR	
Slash	/

SAMPLER NUMBER	
First sample of round at sample point	1
Second sample of round at sample point	2
nth sample of round at at sample point	n

ROUND NUMBER	
First round of sampling	1
Second round of sampling	2
nth round of sampling	n

INVESTIGATION OF FORMER COAL GASIFICATION SITES
MECHANICVILLE

EXAMPLE SAMPLE IDENTIFICATION NUMBERS

ABB-ES	NYSEG
Monitoring Wells - Round 1	
MW-101	MEGUMW8601/14
MW-102	MEGDMW8602/14
MW-103	MEGDMW8603/14
MW-104	MEGDMW8604/14
MW-105	MEGDMW8605/14
MW-106	MEGDMW8606/14
MW-107	MEGDMW9007/11
MW-108	MEGDMW9008/11
MW-19A	MEGDMW909A/11
MW-19B	MEGDMW909B/11
Monitoring Wells - Round 2	
MW-201	MEGUMW8601/15
MW-202	MEGDMW8602/15
MW-203	MEGDMW8603/15
MW-204	MEGDMW8604/15
MW-205	MEGDMW8605/15
MW-206	MEGDMW8606/15
MW-207	MEGDMW9007/12
MW-208	MEGDMW9008/12
MW-29A	MEGDMW909A/12
MW-29B	MEGDMW909B/12
Borings	
B-7	MEEDB-XX07/11
B-8	MEEDB-XX08/11
B-9A	MEEDB-XX9A/11
B-9B	MEEDB-XX9B/11

INVESTIGATION OF FORMER COAL GASIFICATION SITES
MECHANICVILLE

EXAMPLE SAMPLE IDENTIFICATION NUMBERS
continued

ABB-ES		NYSEG
QA Samples - Round 1		
DUP-107	(soil)	MEEXB-XXDU/11
DUP-103	(groundwater)	MEGXM290DU/11
DUP-108	(soil)	MEEXSHXXDU/11
TB-101	(water)	MEGXMW90TB/11
FB-101	(water)	MEGXMW90FB/11
SB-101	(water)	MEGXMW90SB/11
Surface/Shallow Subsurface Soil		
SS-21	(soil)	MEEISHXX21/11
SS-22	(soil)	MEEISHXX22/11
SS-23	(soil)	MEEISHXX23/11
SS-24	(soil)	MEEISHXX24/11
SS-25	(soil)	MEEISHXX25/11
SS-26	(soil)	MEEISHXX26/11
SS-27	(soil)	MEEISHXX27/11
SS-28	(soil)	MEEISHXX28/11
SS-29	(soil)	MEEISHXX29/11
SS-30	(soil)	MEEISHXX30/11
SS-31	(soil)	MEEISHXX31/11
SS-32	(soil)	MEEISHXX32/11
SS-33	(soil)	MEEISHXX33/11
SS-34	(soil)	MEEISHXX34/11
SS-35	(soil)	MEEISHXX35/11
SS-36	(soil)	MEEISHXX36/11
SS-37	(soil)	MEEISHXX37/11
SS-38	(soil)	MEEISHXX38/11
SS-39	(soil)	MEEISHXX39/11

E.C. Jordan Co., 1986. Quality Assurance Project Plan - *Investigation of Former Coal Gasification Sites in New York States*; Prepared for New York State Electric and Gas Corporation, Binghamton, New York; April 1986.

NYSEG, 1989. *Installation Procedures for Monitoring Wells and Piezometers at Former Coal Gasification Sites*; Prepared for the New York State Electric and Gas Corporation, Binghamton, New York, by their Environmental Matters Group; June 1989.

SEEPAGE STUDY REFERENCES

A Field Exercise on Groundwater Flow Using Seepage Meters and Mini-piezometers*

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Abstract

Basic principles of physical hydrogeology and the nature of the hydrologic interactions between groundwater and surface water can be convincingly demonstrated in the field using two inexpensive and easily-constructed devices known as the miniature piezometer and the seepage meter. These instruments have been successfully used during a hydrogeology field course at the University of Waterloo and have been adopted as a routine teaching aid. Seepage meters and miniature piezometers are inserted in the sediment of shallow areas in lakes, estuaries, or streams. In a matter of a few hours, the devices can be installed, monitored, and removed. Information on the direction and rate of groundwater flow can be obtained. Hydraulic conductivity can be measured using several types of tests. Samples of the groundwater can be collected and, with field measurements of parameters such as specific conductance, dissolved oxygen, pH, and chloride, comparisons between groundwater and surface water quality can be made. Student investigations can include the identification of groundwater inflow or outflow areas in lakes, streams, or estuaries, measurement of the spatial and temporal variations in seepage flux through bottom sediments, and identification of zones of subsurface pollutant migration into surface waters. A day of equipment preparation and a preliminary site visit are prerequisites to the student field activities. Materials for a seepage meter and a miniature piezometer can be acquired for less than 25 dollars.

Key Words: education, hydrogeology, groundwater, limnology, hydrology, water quality, contaminant, seepage, field exercise, lake, stream, estuary.

Introduction

This paper describes the use of two simple inexpensive devices that enable students to measure the flow of groundwater and to demonstrate for themselves some of the basic principles of hydrogeology. A half-day field trip to a shallow body of surface water, preferably with a sandy bottom, makes it possible for students to acquire data that can serve as an impressive indication of the dynamic nature of groundwater flow in a natural setting. The methods are rapid and direct and provide information that cannot otherwise be obtained even if expensive drilling equipment is available. The exercise involves the use of seepage meters to measure groundwater flow rates and the use of manually-installed miniature piezometers to measure hydraulic head (groundwater potential) and hydraulic conductivity. These methods have been used during field experiments in a groundwater hydrology course at the University of Waterloo and as a means of investigating groundwater-flow conditions in lake- and streambeds. The devices are also being used in current research projects, including thesis studies by undergraduate and graduate students.

The basic elements of groundwater flow are related through the Darcy equation,

$$Q = A \frac{dh}{dl} K.$$

Q is the flux of groundwater (volume/unit time), A is the area through which flow occurs, dh/dl is the hydraulic gradient (the change in hydraulic head over a distance along the line of flow (unitless)) and K is the hydraulic conductivity of the material (usually expressed as cm/s). Hydraulic head is a measure of the energy per unit weight of the groundwater. Textbooks on hydrogeology such as Todd (1959), Davis and De Weist (1966) and Domenico (1972) present more detailed discussions of the Darcy equation and its significance in groundwater studies.

Figure 1 shows schematic illustrations of groundwater flow near lakes, in lake bottoms, and in stream bottoms. The flow systems are represented by isopotential lines (contour lines of hydraulic head) and arrows showing the direction of groundwater flow. In lake bottoms and streambeds groundwater flow is upward, downward, or horizontal but is rarely non-existent. The direction and rate of flow is dependant on the physiography, texture and stratigraphy of the subsurface materials. Locally, the flow in streambeds and lake bottoms can vary dramatically, thus providing a variety of observational conditions within a single study area.

The two devices described below provide information on the flow net and on the flux and velocity of water moving along the flow lines at and near the interface. The seepage meter and the minipiezometer also provide a means of sampling the water that is either leaving or entering the groundwater zone beneath the lake or stream. This can often serve to demonstrate the influence

*This work was sponsored in part by a research agreement with Environment Canada

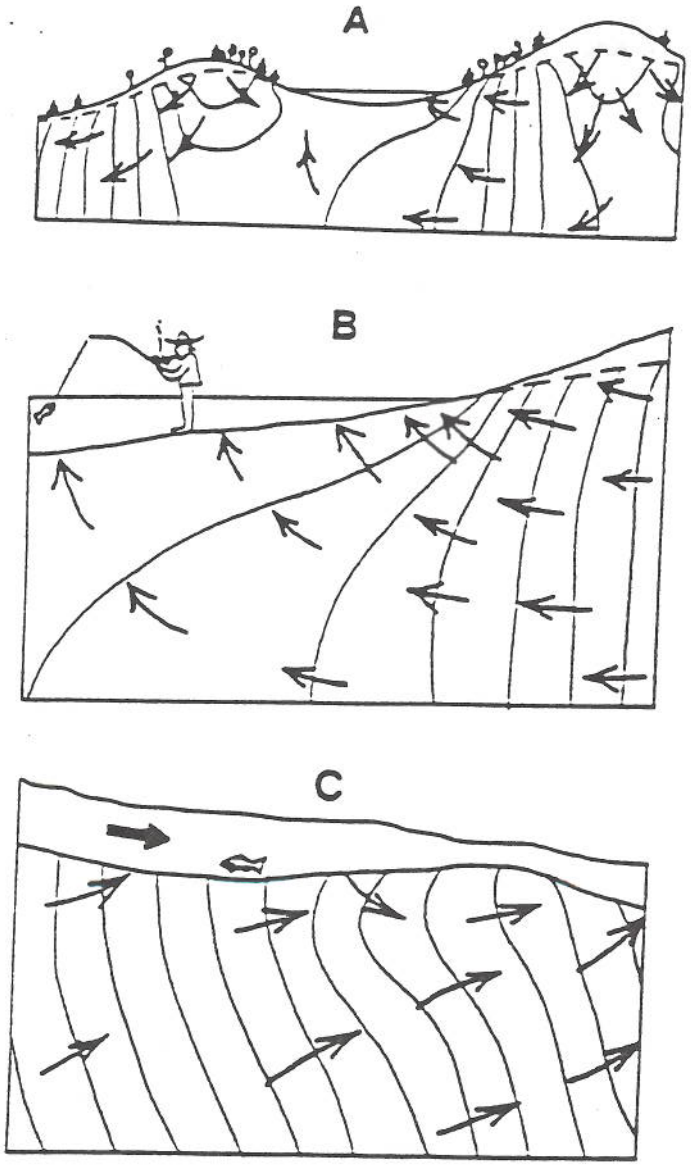


Fig. 1. — Idealized sections showing groundwater flow near bodies of surface water. A, topographic highs are recharge zones and the topographic lows (often occupied by lakes or streams) are discharge zones; B, pattern of groundwater discharge into a lake or estuary; C, longitudinal section of a streambed indicating flow into the sediment where the streambed is concave. (A modified from Winter, 1976; B modified from Lee, 1977; C modified from Vaux, 1968)

of groundwater on surface-water quality. In some cases it is possible to demonstrate that pollutants are fed to lakes or streams by groundwater seepage.

Miniature Piezometers

Piezometers are used to measure the hydraulic head in geologic materials that are saturated under positive pressure. They consist of pipes with slotted tips or well points on the end. Piezometers are normally installed in boreholes drilled by power auger, wash-boring, rotary drill or cable-tool equipment. Piezometers installed at depths between several meters and many tens of meters below ground surface have been used routinely by hydrogeologists and soil engineers for several decades. The miniature piezometer (mini-piezometer) is a similar device but is smaller in size and is installed manually.

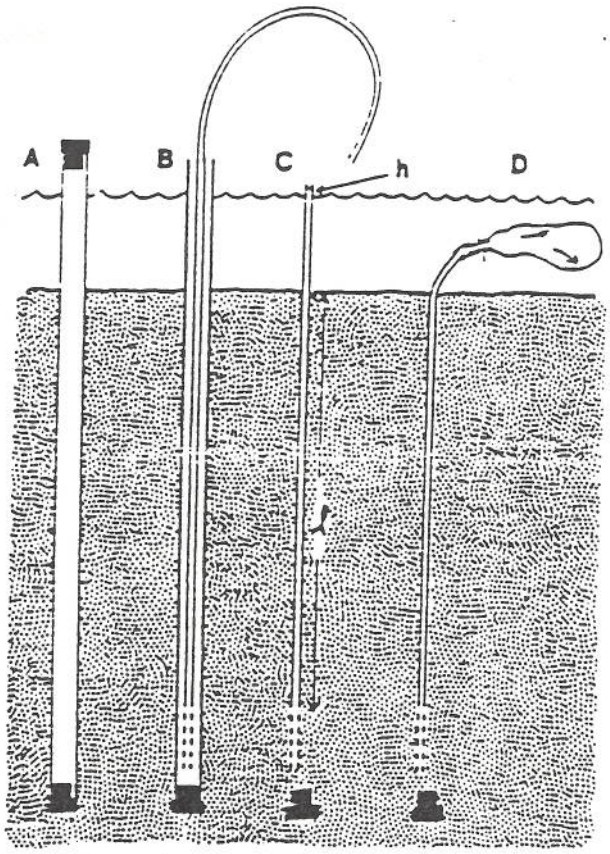


Fig. 2. — General features and method of installation of a mini-piezometer. A, casing driven into the sediment; B, plastic tube with screened tip inserted in the casing; C, plastic tube is a piezometer and indicates differential head (h) with respect to the surface water; D, plastic bag attached to the piezometer collects sediment-porewater. (See text for details)

Figure 2 shows the general features and method of installation of the mini-piezometer. The piezometer consists of a 0.31 cm ID translucent polyethylene tube (approximately $0.12/m) with a perforated tip wrapped with 0.2 mm nylon mesh netting or fiberglass cloth. The netting protects the tip from influx of sediment. The piezometer is installed using a 1.7 cm ID steel pipe that is driven into the bed by hammer or vibrator. The casing pipe is loosely fitted with 1.4 cm (5/8 inch) lag bolts at each end. When the steel pipe is driven to the desired depth the plastic tube is inserted and held in place as the pipe is pulled out. The bottom lag bolt remains in the sediment near the piezometer tip. Raised above the water level, the translucent tube shows the head differential with respect to the surface water.

Small differences in hydraulic head relative to the surface water are measured using a manometer that overcomes the difficulties of observing head differences that are slightly above or below the level of the surface water. The principle of the apparatus is indicated in figure 3A which shows how the difference in head between the piezometer and the surface water may be elevated and measured accurately. The equipment needed to measure this differential head in mini-piezometers is shown in figure 3B. The meter stick is attached to a rod and installed vertically next to the piezometer. The apparatus is prepared for use by blowing water out of the tygon tube using a rubber suction bulb. The bulb is squeezed and released slowly allowing water to rise to a static level. The

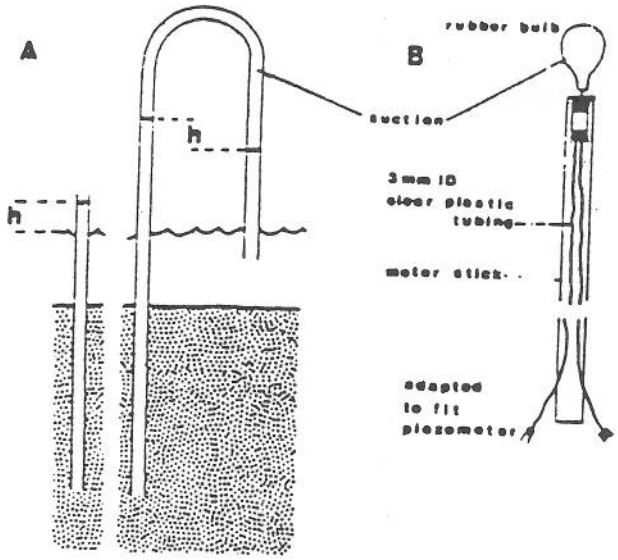


Fig. 3. — The manometer used to measure differential heads in minipiezometers. A, principle of operation; B, the field apparatus.

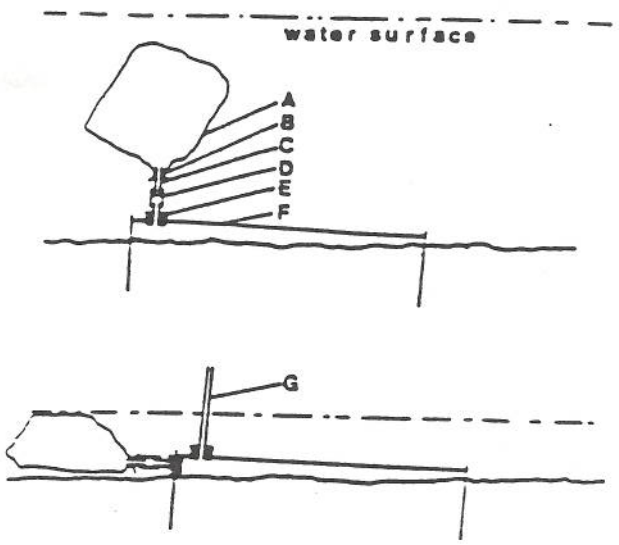


Fig. 4 — Full section view of seepage meter showing proper placement in the sediment. A, 4 liter, 0.017 mm membrane plastic Baggies Alligator bag (open end was heat sealed); B, rubber-band wrap; C, 0.64 cm inside diameter, 5 cm long polyethylene tube; D, 0.79 cm inside diameter, 4.5 cm long, amber-latex tube; E, 15 cm x 57 cm diameter epoxy-coated cylinder (end-section of a steel drum); G, 0.64 cm inside diameter, polyethylene tube long enough to reach above the surface water.

levels in the two tubes are compared to be sure no bubbles of air are causing different heads in the two tubes. One end of the tube is then attached to the piezometer tube and the other is left in the overlying water. When the water levels in the two tubes reach static levels, the differential head, Δh, is read on the meter stick. The vertical hydraulic gradient is $\Delta h/\Delta 1$, where $\Delta 1$ is the depth of the piezometer screen below the sediment-water interface.

To measure the hydraulic conductivity of the sediment adjacent to the piezometer tip, two types of tests can be conducted, a falling head test and a constant head test. For the falling head test the piezometer tube is extended vertically above the surface-water level and then filled with water to a condition of overflow. The overflow condition is discontinued at a time that is recorded as t initial. The rate at which the water level in the tube declines is then recorded. This can be facilitated by taking stop-watch readings of times at which the water level passes marked intervals on the tube. If the hydraulic conductivity is very high, the rate of water-level fall will be very rapid. Increased accuracy can be obtained if the fall distance is lengthened by extending the tube a couple meters above the surface-water level or by feeding water to the piezometer from a larger diameter reservoir with marked intervals. A constant head test can be performed by placing a known volume of water in a plastic bag attached to the submerged tube. The hydraulic head in the submerged bag is the level of the stream or lake level. The change in volume of water in the bag over a recorded time interval is measured. Example results and calculation procedures are summarized in Table 1. The derivations of the equations used in this analysis were first presented by Hvorslev (1951) and have been summarized by Lambe and Whitman (1969). The constant head and falling head formulas are based on significantly different assumptions. Comparison of hydraulic conductivities determined by these two methods can be an interesting endeavor.

Where the hydraulic gradient is downward, groundwater from the piezometer can be collected using a suction bulb or hand-operated vacuum pump connected to a bottle. Where the gradient is upward samples can be obtained by simply letting water discharge from the piezometer tube. Where the gradient is weak or the material poorly conductive, the screened area of the piezometer tip must be increased and suction must be applied to obtain water samples.

Seepage Meters

Seepage flux between the groundwater and the overlying surface water can be measured directly by covering an area of sediment with an open-bottomed container and then measuring the time and change of water volume in a bag connected to the container (Lee 1977). Two of these devices, known as seepage meters (Fig. 4), can be made by cutting 15-cm-long, end-sections from a 0.208 m^3 (55 gallon) metal drum. Seepage meters can detect flux as low as 0.001 cm^3/m^2 s (about 0.1 mm/day) if the bag is left connected for a day or longer. In water over 20 cm deep, a single tube through the top of the seepage meter serves both as a vent for any gas released from the sediment and as a connection for the measuring bag. In shallow water an additional outlet tube on the side of the seepage meter permits the bag to be submerged as it must be to maintain the same piezometric head in the seepage meter and in the surface water.

In use, the seepage meter is pushed slowly into the sediment and tilted slightly so that the vent will function properly (Fig. 4). Unless the sediment surface is soft or irregular, it is often unnecessary to push the seepage meter more than 8 cm into the sediment to obtain an adequate seal. The stopper with tube is then twisted into cylinder hole. Where flow is upward, it is unnecessary to

Piezometer observations

Piezometer number: P1 Depth of screen below sediment: 1 m

Time	Δh,mm	Gradient Δh/1	Elapsed time, min	Volume change, cm³
1630	35	.035	—	—
1650	33	.033	—	—
1739	36	.036	—	—
1705-1723	—	—	18	+12

Hydraulic conductivity calculation: Assuming a case G screen (Hvorslev 1951),

$$K_h = \frac{q \ln [(mL/D) + (1+(mL/D)^2]^{-.5}}{2\pi L H_c}$$

, where

D = diameter, intake, sample (cm)
L = length, inake, sample (cm)
H_c = constant piezometric head (cm)
q = flow of water (cm³/s)
t = time (s)
m = transformation ratio, $(K_h/K_v)^{-.5}$ assumed to equal 1*
ln = 2.3 $\log_{10}$.

Therefore K_h =

$$\frac{12 \text{ cm}^3/1080 \text{ s}) \text{ LN } [(10 \text{ cm}/.31 \text{ cm}) + (1+(10 \text{ cm}/.31 \text{ cm})^2)^{-.5}]}{2\pi (10 \text{ cm})(3.5 \text{ cm})}$$

$= 2.1 \times 10^{-4}$ cm/s

Seepage meter observations

Seepage meter number: SM 1
Depth of water: 0.2m
Sediment type: sand and organic matter

Time	Volume change, cm³	Elapsed time, min	Seepage flux, μm/s	Hydraulic conductivity, cm/s
1630-1648	+126	18	+.450	1.3×10^{-3}
1650-1736	+355	46	+.496	1.5×10^{-3}
1739-1752	+ 94	13	+.465	1.2×10^{-3}

Seepage flux calculation:

$$Q, \mu m/s = \frac{\text{(volume change, cm}^3\text{) } 0.0643}{\text{(elapsed time, min)}}$$

$$= \frac{(126)\ 0.0643}{18} = 0.450 \ \mu m/s$$

Hydraulic conductivity calculation:
From the Darcy equation K = v/S, where
v = Darcy velocity
S = hydraulic gradient, Δh/Δ1
K = hydraulic conductivity

Therefore $K = \frac{0.450 \ \mu m/s}{0.035} = 1.3 \times 10^{-3}$ cm/s

* The effect of this assumption is small (e.g. If m = 10, K_h = 2.7×10^{-4} cm/s; If m = 1000, K_h = 3.9×10^{-4} cm/s.

before connecting it to the seepage meter.

The Darcy velocity, v, (volume per unit area per unit time) is calculated from the relation 0.0643V ÷ t = v, where V is the volume of water (cm³) entering or leaving the bag, and t is the elapsed time (min). The Darcy velocity is expressed as micrometers per second (1 μm/s = 8.64 cm/day). The factor 0.0643 converts units of time, volume, anc area covered by a seepage meter (0.255 m²) to equivalent units of velocity (μm/s) or seepage flux (cm³/m² s). The average linear interstitial velocity is equal to the Darcy velocity divided by the porosity of the sediment. For most sandy sediments, porosities are in the range of 0.3 to 0.4 (expressed as a fraction).

Student Activities

Students from the University of Waterloc used these techniques to investigate the migration of tritium-contaminatec groundwater to a small lake and stream in an experimental watershed at the Chalk River Nuclear Laboratories in eastern Ontario. To minimize the number of pieces of equipment required, this exercise was combined with stream-flow metering so the students could rotate from one activity to the other. Each student installed a piezometer and a seepage meter and measured piezometric head during seepage-measurement intervals ranging from 10 to 45 minutes. Because of the difficulty of removing deeper casings by hand, most students elected to emplace their piezometer 0.6 to 1 m into the sediment. Each student conducted a constant head test to determine the hydraulic conductivity of material near the piezometer screen, and then removed the seepage meter so that subsequent students could install the equipment themselves.

The study sites met the following selection criteria:
Wave height less than 0.3 m;
Current speed less than 0.2 m/s;
Firm sanc with very little gravel and cobble; and
Water depth 0.1 to 0.6 m.

Preliminary measurements were made to be sure the students couic install the equipment and find seepage rates high enough to complete the exercise in 2 to 3 hours. Because seepage rates are generally highest near the shore, as illustrated in figure 1B, and because shoreline areas were accessible by wading, students worked within 10 m of the shoreline.

Data collected by one student and some sample calculations are shown in Table 1. Piezometric head and seepage rate generally decreased with distance from the lakeshore but seepage rates were quite variable in the streambec. Current effects probably accounted for the variability of replicate seepage measurements in the stream. Streambed heterogeneity probably caused variability between points. No zones of downward seepage were found in either the lake or the stream.

Direct measurements of seepage flux, made by the students, showed that groundwater flowed into the lake along the northern shore. A pore-water constituent (in this case tritiated water) indicated that this seepage water is contaminated by tritium, contained in waste waters pumped into disposal pits locatec about 800 m north of the lakeshore. The use of seepage meters and mini-piezometers thus enabled the students within a very short time to draw conclusions with regard to the occurrence and source of contaminants entering the lake. Analysis of water from mini-piezometers in the nearby streambed

showed no tritium contamination despite the presence of considerable tritium in the stream itself.

The dynamic nature of the groundwater regime was demonstrated in a visibly impressive manner by filling of the measuring bag attached to the seepage meter. All but 2 of 14 piezometers functioned properly as indicated by raising and lowering the piezometer tube and watching the water level fall or rise to a static level and by the constant-head response tests. Failure to obtain responsive piezometers was due to lifting of the piezometer tube while pulling the casing out of the sediment and consequent loss of the nylon-mesh screen.

We anticipate that a similar approach could be used by others to teach general principles of hydrogeology. This exercise could be included as a part of an introductory course in hydrogeology. It could also be used in hydrology, limnology, geomorphology or sedimentology courses. It could serve as a springboard for student projects designed to determine the importance of the groundwater component to the water budget of a lake or pond, to identify contaminant migration from groundwater to surface waters, to study the effects of seepage flux on sediment chemistry, or to study the role of groundwater in fluvial erosion and deposition. Because these topics have only recently begun to receive research attention, this work offers an opportunity and a freshness which is attractive to students.

Planning the Field Exercise

Sandy shores of gravel-quarry ponds, lakes, reservoirs, and estuaries are ideal sites for these exercises, but the importance of making preliminary measurements to identify suitable sites cannot be overemphasized. Seepage rates must be high enough so that volume changes of at least 50 cm^3 can occur in the measuring bag in 1-2 hours. The sediment should not contain rocks which will bend piezometer drive-casings. Strong wave action and currents interfere with accurate measurements of seepage, although piezometers would probably not be affected adversely. Mud bottoms may not have sufficient flow to permit flux measurement in 1-2 hours.

In estuaries, where tidal fluctuations induce seepage flux through sediment, it may be helpful to consult tide tables before planning a field exercise. At low tide, the highest rates of upward seepage and the strongest upward gradients occur (Lee 1977), and it is easier to install seepage meters at this time. Estimates of net seepage flux will require measurement through an entire tidal cycle.

In streams where surface-water velocity is low and especially in sandy areas, these methods can be used successfully. In other stream environments, however, it may be difficult to find suitable demonstration sites. Downward seepage in streams may be induced where permeability or depth of gravel increases in the direction of streamflow or where the longitudinal bed profile is concave (Vaux 1968). These factors, heterogeneity and current, make data from streambeds more difficult to interpret than comparable data from quieter waters.

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NOTES

A device for measuring seepage flux in lakes and estuaries[1]

Abstract—Seepage flux can be measured and samples of groundwater flowing into lakes and estuaries collected by enclosing an area of bottom with a cylinder vented to a plastic bag. The method has the advantage of not requiring measurements of permeability of bottom sediments. Seepage velocities from −0.1–2.58 $\mu m\ s^{-1}$ were measured in Minnesota and Wisconsin lakes and in Nova Scotia and North Carolina estuaries.

Where seepage inflow was rapid (0.4–0.8 $\mu m\ s^{-1}$), water collected with the seepage meter was chemically similar to water from wells on the same flow path, and the distribution and chemistry of the seepage concurred with a theoretical flow net. The rate and direction of seepage flux were correlated with water surface elevation during a tidal cycle.

This paper describes a simple, inexpensive instrument that has been used successfully to make direct measurements of seepage flux in lakes and estuaries (Table 1). The technique has the advantage of *not* requiring measurements of the permeability of sediments. The method yields a sample of water suitable for chemical analysis, and the equipment involved is relatively inexpensive.

Evaluation and management of lakes and estuaries often require specific information on water and chemical budgets. All of the inflow-outflow components must be measured or estimated, and almost invariably the greatest uncertainty involves the groundwater component. Rarely are direct measurements attempted, presumably because the investigators believe that this would require excessive investments of time and equipment. There is a severe lack of methodology for site-specific study of nutrient input to lakes via groundwater (Uttormark et al. 1974), and ground-

[1] Work was sponsored in part by a grant from the Pelican River Watershed, Detroit Lakes, Minnesota, to J. K. Neel, Department of Biology, University of North Dakota, Grand Forks.

Table 1. Seepage measurements using seepage meter at various locations.

Location	Seepage velocity ($\mu m\ s^{-1}$)	No. measurements	Bottom type	Water depth (m)	Comments
Lake Sallie, MN (46°46'N, 95°54'W)	0.01–2.58	494	sand, gravel	0.2–2.0	measurements made around entire perimeter of the lake, 1970–71
Lake Movil, MN (47°33'N, 95°08'W)	1.0	3	gravel	1.0	south shore, 8 Aug 1973
Lake Mendota, WI (43°07'N, 38°25'W)	0.32–0.46	2	sand	0.7	Mendota Park on ne shore, 10 Aug 1973
Minas Basin, NS (44°55'N, 64°08')	0.5–1.4	6	sand, silt	1.5–2.0	measurements made during falling tide on upper third of beach, 25 Jun 1975
Bogue Sound, NC (34°42'N, 76°45'W)	0.32	1	sand	0.9	measurements made during falling tide about 0.1 m below MLW, 16 May 1975
Duke Marine Lab, NC (34°42'N, 76°49'W)	−0.1–0.8	44	sand,	0.1–1.5	measurements made during falling and rising tide 0.1 m below MLW; 9 May 1974, 15–16 May 1975

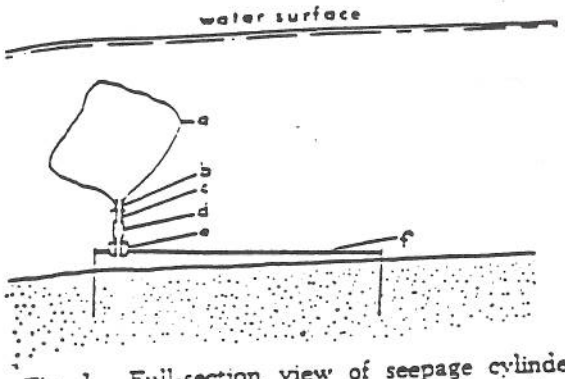


Fig. 1. Full-section view of seepage cylinder showing proper placement in sediment. a—4-liter, 0.017-mm-membrane, plastic Baggies Alligator bag (open end heat-sealed); b—rubber-band wrap; c—0.64-cm-ID, 6 cm long, polyethylene tube; d—0.79-cm-ID, 4.5 cm long, amber-latex tube; e—No. 5½ one-hole rubber stopper with polyethylene tube; f—15- × 57-cm-diameter epoxy-coated cylinder (end-section of a steel drum).

water flow systems around lakes (Born et al. 1974) and estuaries are poorly documented.

The usual approach for obtaining estimates of groundwater-surface water interaction is to install observation wells on land near the shore or in the water basin. The wells are then used to obtain measurements of the distribution of the hydraulic head and estimates of permeability. This is generally unsatisfactory because it is seldom feasible to estimate permeability by less than an order of magnitude and because surface-groundwater interaction is often controlled at or very near the sediment–water interface.

I thank J. K. Neel for guidance in the initial phases of this work. J. K. Neel, Q. L. Gehle, J. A. Cherry, and L. S. Clayton provided comments. Work space and equipment were provided by the staff of the Lake Sallie Fisheries Station, Minnesota Department of Conservation, and by the Department of Geology, Virginia Polytechnic Institute and State University. Part of this work appeared in my M.S. thesis (University of North Dakota).

Groundwater seeping into standing surface waters can be collected by covering an area of lakebed with a bottomless cylinder vented to a deflated plastic bag (Fig. 1). The cylinder is turned slowly (≈1 cm s^{-1}), open-end down, into the sediment until its top is about 2 cm above the sediment surface. The vent hole is elevated slightly so that any gas from the sediment may freely escape. The cylinder is marked and left for several days to allow benthic organisms to escape (although preliminary measurements can be started immediately). Then a stopper with tube is inserted into the cylinder hole.

To collect a sample, a deflated plastic bag is connected to the tube and left for a specified time or until it contains 0.5–3 liters. Where surface water seeps *into* the sediment, the plastic bag is filled with a known amount of water before it is connected to the tube. Macroscopic seepage velocity is determined as

$$v = \frac{1.075\ V}{t},$$

where V is liters of water entering (+ value) or leaving (− value) the bag, t is hours of elapsed time, and v is seepage velocity (+ is upward, − is downward) expressed as micrometers per second. The factor 1.075 converts units of volume, time, and area covered by the cylinder (0.255 m^2) to equivalent units of velocity ($\mu m\ s^{-1}$) or seepage flux (ml $m^{-2}\ s^{-1}$). The macroscopic seepage velocity should not be confused with the average interstitial velocity, which is equal to 100 times the seepage velocity divided by the percent porosity of the sediment.

Most problems in measuring seepage are due to improper placement of the cylinder. If the cylinder is not positioned with its hole near the highest point, gas from the sediment accumulates and reduces seepage. Measurements are also reduced if the cylinder lid presses against the lakebed. If the cylinder is pushed too rapidly into the sediment, blowouts can cause erratic results. In areas where sediment accumulates, the vent hole should be extended with a short length of pipe. Plugging from algal growth may necessitate periodic examination and cleaning of the vent tube. About 5 ml of water unavoidably enter the plastic bag during

connection. A lightweight, steel fence-picket, notched to hook the lower edge of the cylinder, helps in removal of the cylinder. It is easier to find the cylinders if the tops are painted white. Material for constructing each seepage meter costs $4 to $9 (in 1976) if two cylinders are cut from one 55-gallon (208 liter) drum.

The method will probably find its greatest application where surface waters lie in high to moderately permeable material. Without modifications, it is not designed for use in the turbulent water of the surf zone or in rapidly flowing rivers. In fine, low permeability sediments, groundwater velocity may be too low to measure with this technique, or flow may be restricted to discrete springs or leaks.

The principle of the method described here was first used to measure water losses from irrigation canals (Israelsen and Reeve 1944). Other methods (Bower and Rice 1968; Warnick 1951; Zuber 1970) have also been suggested to measure flow into or away from surface waters, but all involve substantial cost and none is appropriate for sample collection.

Laboratory-scale tests were designed to see if the seepage meter gave an accurate measure of groundwater flow over the velocity range encountered in the field. A rectangular test tank 1.3 m deep and 1.26 × 2.66 m in area held a bed of sand (0.5–0.125-mm-diameter granules, 4% silt and clay) 0.76 m deep. A permeable plate supported the sand 10 cm above the bottom of the tank. Upward or downward seepage through the sandbed was controlled with a variable-head tank connected to the water beneath the permeable plate. An overflow pipe kept 0.40 m of water over the sandbed. The seepage flux through the sand was controlled by the difference in the piezometric head measured by two tubes, one open to the water beneath the permeable plate and one open to the water above the sand. Measurements of seepage flux were made at several hydraulic gradients ranging from −0.071 to 0.097.

Reproducibility of velocity measurements was evaluated at Lake Sallie, Minnesota. Two seepage meters were placed 0.15 m apart. Simultaneous measurements were made during 3 consecutive days and at longer intervals over 2 months. The water surface elevations were recorded for Lake Sallie and nearby Muskrat Lake, 50 m away and 1.6 m higher.

A site near the Duke Marine Lab (Beaufort, North Carolina) was selected for additional tests because there was a recording tide gauge operated by the National Oceanic and Atmospheric Administration. About 20 m southwest of the tide gauge, three seepage meters were placed 0.65 m apart on a line perpendicular to shore in water about 0.4 m deep at mean low tide. The sediment was composed of sand and pieces of shells. Seepage flux was measured during 53–79-min intervals over a complete tidal cycle. When the tide was above mean sea level, measurements were started with 1 liter of water in the bag to permit detection of seepage into the sediment.

For evaluation of the seepage meter as a groundwater collection device, a site was selected in an area of fairly uniform groundwater discharge at Lake Sallie. Wells were installed to intercept water before it reached the lake, and seepage meters were placed in the lake adjacent to these wells to collect entering seepage (Fig. 2). Wells, driven 1.72 to 2.11 m into the water table, were sampled 8 times during 108 days. Only small amounts of water (0.6 liter) and soil (20 to 30 g) were removed at each sampling.

Water samples were either frozen and analyzed several weeks later or stored at 0° to 5°C and analyzed within 48 h. Ammonia, nitrite, and nitrate nitrogen, and soluble orthophosphate were determined according to *Standard methods* (Am. Public Health Assoc. 1965, 1971). Specific conductivity was measured at 20°C with a conductivity bridge. Chloride was determined with a specific-ion electrode. Samples were analyzed for total phosphate by a persulfate procedure (Dominick 1971). Filtration through medium-grade filter

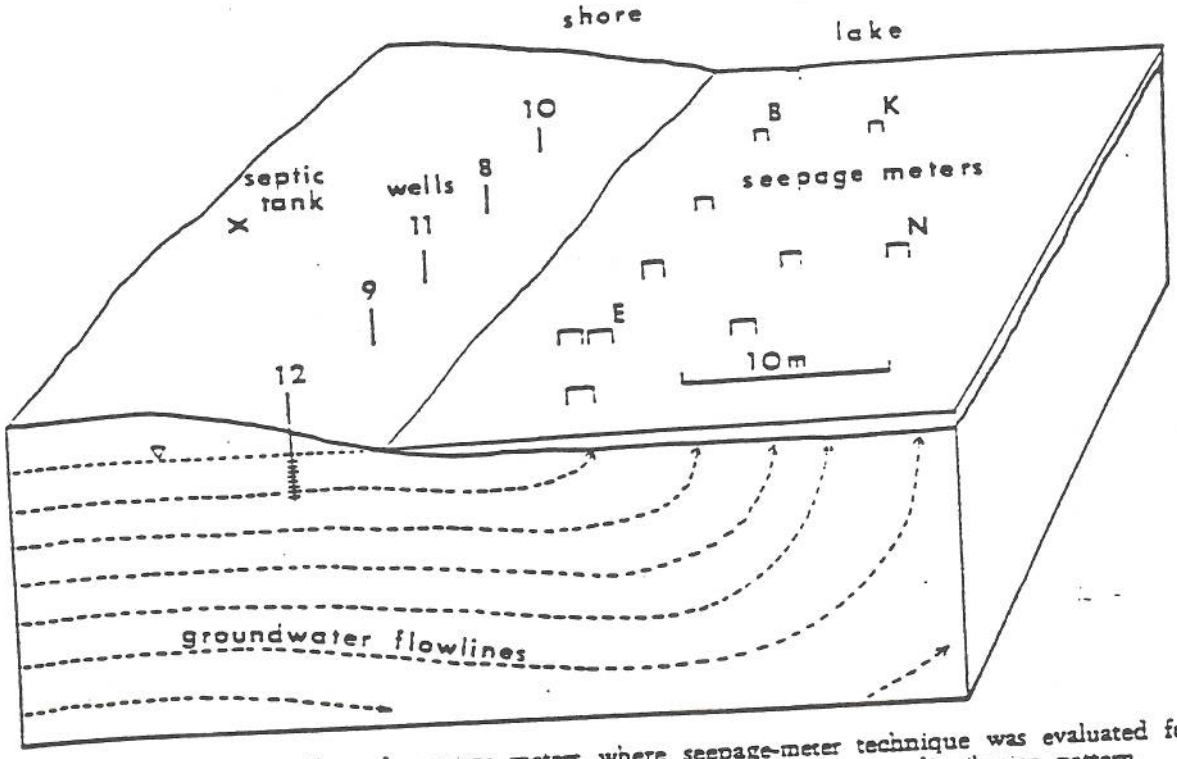


Fig. 2. Position of wells and seepage meters where seepage-meter technique was evaluated for collection of groundwater for chemical analysis. Flow lines show seepage distribution pattern.

paper (Sargent 501 or equivalent) preceded analyses for orthophosphate, nitrite, and nitrate.

Regression coefficients for the relation of velocity and hydraulic gradient in the experimental tank ranged from 0.998 to 0.994. Results for a representative seepage meter are shown in Fig. 3. Slopes for the regression lines for seepage at different locations in the test tank differed slightly (16 to 22 for upward seepage and 9.1 to 20 for downward seepage) probably due to heterogeneity in the test tank. However for any particular location in the tank, the slopes of the regression lines were significantly higher (at $p = 0.05$) for upward than for downward seepage. A 2–3-mm layer of fine clay particles accumulated at the surface of the sediment and these particles may have controlled permeability by impeding downward seepage more than upward seepage.

Results of the experiments on simultaneous measurement of seepage velocity showed that velocity for the two seepage meters always differed by about 0.1 μm s^{-1} and ranged from 0.596–0.854 μm s^{-1} over the 2-month period (Fig. 4). Variation in seepage velocity over time was not significantly correlated with changes in the relative elevation of nearby Muskrat Lake and Lake Sallie (Fig. 4). Changes in atmospheric pressure may have caused variations in velocity by changing the permeability of the sediment (Christiansen 1944; Peck 1960). Small variations in velocity were reproduced with closely placed seepage meters.

Measurements of velocity and water surface elevation during a tidal cycle at Beaufort, North Carolina, are presented in Fig. 5. Seepage velocity, measured with three seepage meters, was significantly correlated with water surface elevation ($R = 0.853$, $n = 32$). Seepage *into* the sediment (groundwater recharge) was detected in only 2 of 32 measurements. The close agreement of the three seepage meters over the tidal cycle showed that the technique gave reproducible results.

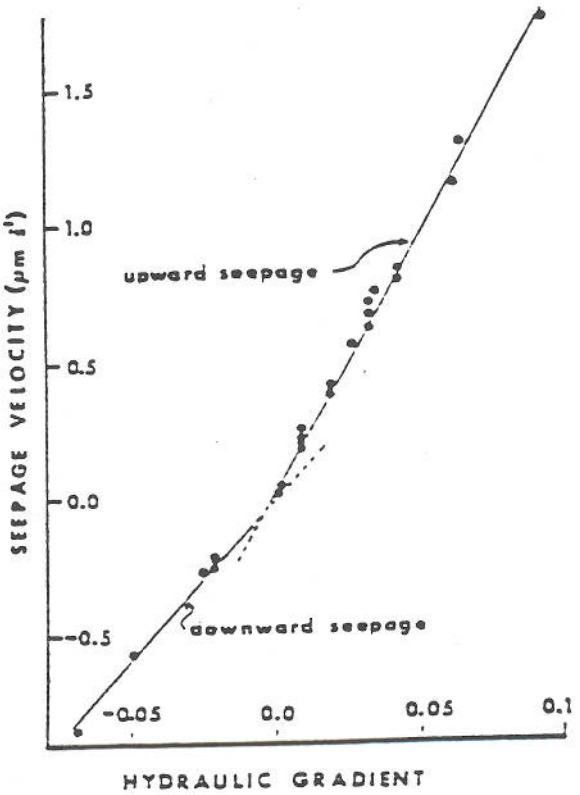


Fig. 3. Relation of hydraulic gradient and velocity measured with seepage meter in experimental tank. For upward seepage: velocity = (19.07 ± 0.22) gradient + (0.0220 ± 0.0012), R = 0.996, n = 29. For downward seepage: velocity = −(11.68 ± 0.94) gradient − (0.0028 ± 0.0110), R = 0.984, n = 7.

Along an 800-m segment of Lake Sallie shoreline, seepage measurements were made 5–160 m from shore. Near the midpoint of this section of shoreline, a site was selected for evaluation of the seepage meter as a groundwater collection device. At this site there was about 10 m of clean sand and gravel below the water table; the sand and gravel was underlain by a thick, relatively impermeable, clay layer (USGS well records, M.S. McBride personal communication).

A flow net (Fig. 6) was drawn assuming isotropic-homogeneous conditions, relatively low permeability of the underlying clay compared to the sand and gravel, and predominantly horizontal flow in the sand and gravel around the lake. The flow net showed that seepage velocity decreased exponentially with distance from shore and

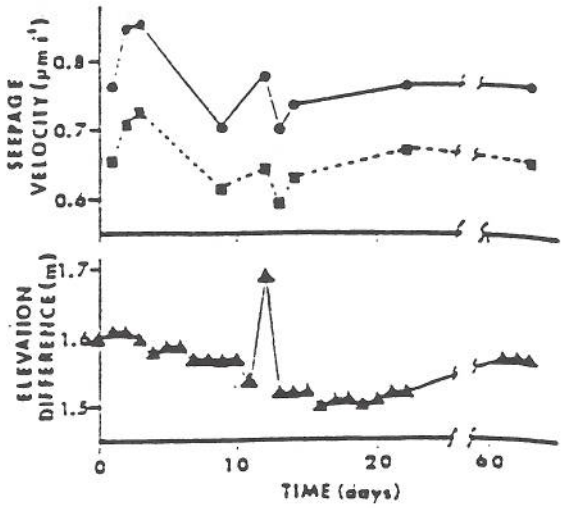


Fig. 4. Seepage velocity measurements from two seepage meters set 0.15 m apart, and relative elevations of lakes Sallie and Muskrat.

that shallow groundwater was discharged nearshore, deeper groundwater farther from shore.

Seepage measurements along the shoreline showed that nearshore discharge was rapid (0.3–0.8 μm s^{-1}) and that velocity did decline approximately exponentially

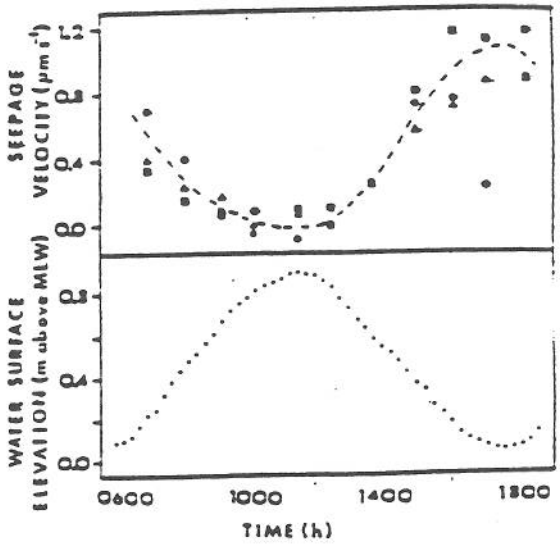


Fig. 5. Seepage velocity and water surface elevation during tidal cycle at Beaufort, North Carolina, 16 May 1975. Symbols (▲, ●, ■) denote different seepage meters. Water surface elevation data was obtained from NOAA tide gauge located at study site.

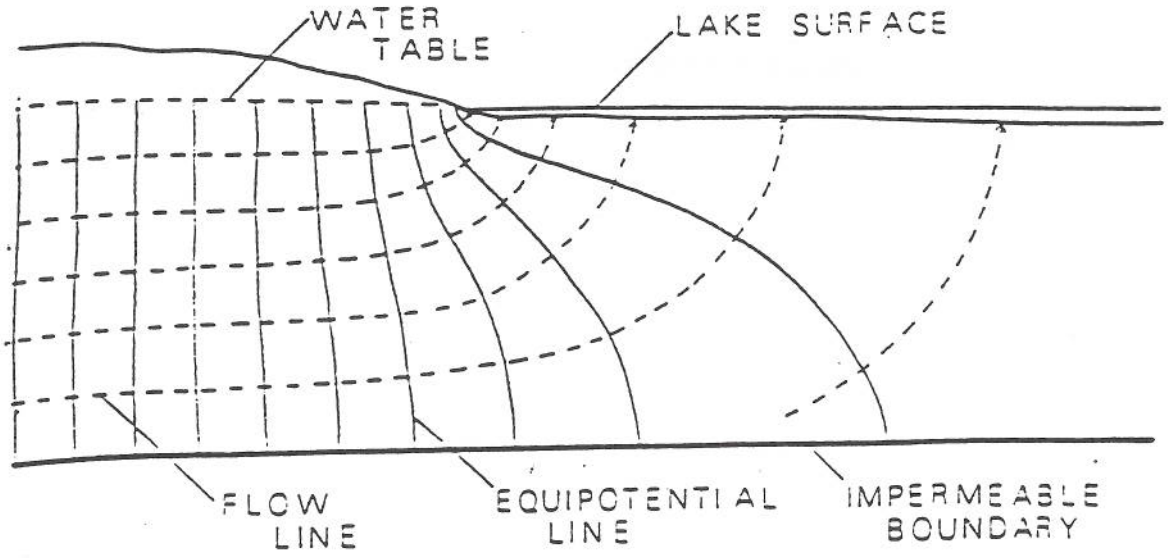


Fig. 6. Theoretical flow net showing distribution of groundwater discharge into Lake Sallie.

with distance from shore (Fig. 7). Substantial seepage influx occurred 60–80 m from shore, whereas the flow net showed high rates of flow to only about 15 m from shore. Seepage distribution would be skewed lakeward in this way if the horizontal to vertical permeability ratio were about 1 : 18 (Cedergren 1968), a common feature of glacial outwash terrain (Weeks 1969). McBride and Pfannkuch (1975) have also discussed the distribution of groundwater flow into lakes.

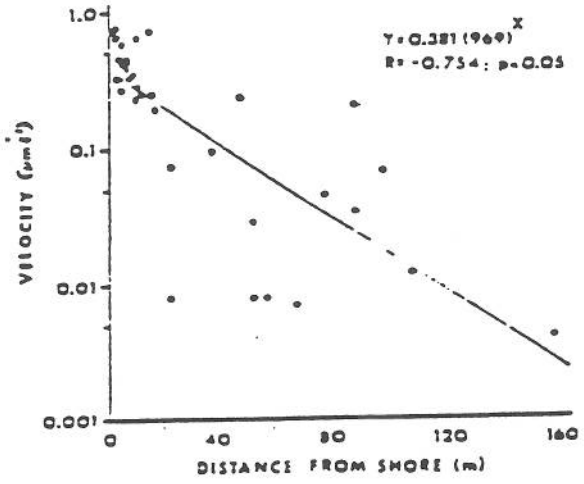


Fig. 7. Relation of seepage velocity and distance from shore along an 800-m shoreline segment at Lake Sallie.

Seepage influx at the site adjacent to the wells ranged from 0.4–0.8 μm s^{-1}. Water collected from the seepage meters initially contained high and varying concentrations of orthophosphate (0.21–1.15 mg liter^{-1}) which eventually stabilized in the range 0.02–0.30 mg liter^{-1}, the average concentration being 0.15 (Fig. 8). Ammonia concentrations in the water collected from the seepage meters were also high initially, but there was a steady decline over a 2-month period. Ammonia levels dropped below 0.25 mg liter^{-1} after 900 liters of groundwater passed through the seepage meters. An exception, seepage meter E, consistently yielded water containing over

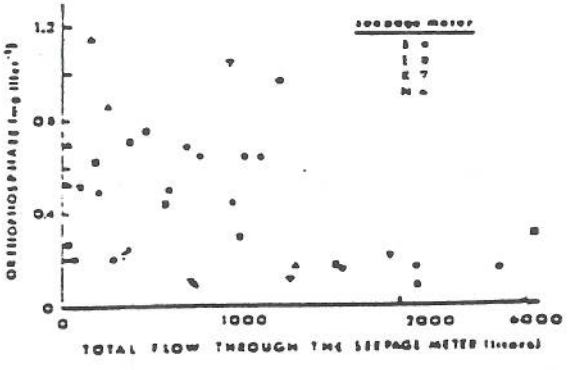


Fig. 8. Phosphate concentration and total groundwater discharged through four seepage meters over 4-month period.

Table 2. Chemical features of well water, lake water, and velocity and chemical features of seepage at a Lake Sallie experimental site, 1971.

Well no.		Ortho-PO_4	Total PO_4	NH_3-N	NO_3-N	Sp. cond. (umhos cm^{-1})	Chloride
8	Summary of	0.30 (±0.17)	4.49 (±1.64)	1.35 (±1.03)	12.4 (±6.4)	614 (±101)	30.1 (±39.2)
9	eight samples	0.45 (±0.25)	2.96 (±1.40)	0.46 (±0.29)	24.3 (±11.1)	782 (±208)	56.6 (±50.3)
10	collected	0.25 (±0.12)	4.05 (±2.65)	0.68 (±0.24)	11.0 (±1.6)	493 (±41)	8.73 (±1.86)
11	semimonthly	0.40 (±0.13)	2.84 (±1.91)	3.42 (±0.64)	31.8 (±5.1)	1160 (±103)	65.0 (±17.6)
12	Aug–Nov	0.15 (±0.10)	2.79 (±1.86)	0.36 (±0.19)	8.78 (±1.8)	423 (±42)	9.56 (±2.3)
Lake	23 Oct	0.20	0.40	0.02	0.026	363	21.1
	27 Nov	0.07	0.14	0.03	0.004	384	26.1
	30 Dec	0.09	0.28	0.16	3.92	-	-

Seepage meter		Liters through meter*	Velocity (um s^{-1})					
B	23 Oct	1,510	0.623	0.15	0.54	0.13	10.0	460	-
B	27 Nov	1,930	0.276	0.16	0.20	0.08	12.3	459	4.95
B	30 Dec	2,380	0.543	0.14	0.32	0.00	8.8	-	-
E	27 Nov	1,460	0.764	0.17	0.22	2.09	13.2	490	10.3
E	30 Dec	1,940	0.487	0.08	0.32	3.4	14	-	-
E	26 May	4,050+	1.03	0.30	0.30	2.48	16.0	-	-
K	27 Nov	1,240	0.492	0.11	0.20	0.17	0.003	530	6.37
K	30 Dec	1,780	0.743	0.21	0.32	0.20	0.003	-	-
N	27 Nov	1,270	0.747	0.17	0.28	0.11	0.002	480	5.5
N	30 Dec	1,830	0.650	0.02	0.28	0.16	0.004	-	-

* This column shows the volume of water which flowed through the seepage meter before the sample was collected. The average flow during the preceding months was used to calculate this number.

+ This number, for a sample collected in 1972, was calculated using the autumn flow rate.

2.0 mg $liter^{-1}$ NH_3-N even after 4,000 liters of groundwater and 9 months had passed. However, the phosphate concentration in seepage meter E was not higher than that of the other meters at this site (Table 2). Wells 9 and 11 (Fig. 2), located lakeward of a septic tank, had the highest specific conductivity and the highest concentration of orthophosphate, nitrate nitrogen, and chloride (Table 2). Average orthophosphate concentration of water from the other wells (8, 10, and 12) was in the same range as the orthophosphate concentration of water from the seepage meters.

Some evidence indicated that a high nitrate zone capped the water table. The seepage inflow 7 m from shore (B and E, Fig. 2) contained from 8.8–16 mg $liter^{-1}$ NO_3-N, but in groundwater discharged 12 m and 17 m from shore, nitrate concentrations were <0.005 mg $liter^{-1}$ N. Average nitrate concentrations in the shallow wells near the lakeshore ranged from 8.78–31.8 mg $liter^{-1}$ N (Table 2). Monthly samples from a well 57 m from the edge of the lake contained 1.57–0.34 mg $liter^{-1}$ NO_3-N at the surface of the water table, but when the well was driven 0.5 m deeper, nitrate levels fell to <0.012. It is not uncommon to find high nitrate concentrations in shallow groundwater near the water table (Behnke 1975).

Lake water contained less phosphate, less inorganic nitrogen, lower conductivity, and higher chloride than the seepage water (Table 2). Seepage water contained about the same amount of orthophosphate and about the same conductivity as the well water not affected by the septic tank.

The inexpensive seepage meter was used on moderately permeable sediment of lakes and estuaries to measure seepage velocities ranging from −0.1–2.58 $\mu m\ s^{-1}$. Where seepage is upward, the seepage meter yields a sample of water which can be used for chemical analysis.

For the velocity range encountered in the field, a linear relation was observed between measured seepage velocity and an experimentally controlled hydraulic gradient. Changes in the rate and direction of seepage flux during a tidal cycle were correlated with changes in the water surface elevation of an estuary. Closely placed seepage meters gave reproducible results.

Velocity and chemistry of seepage inflow to Lake Sallie thus concurred with results predicted by the theoretical flow net: shallow groundwater discharged nearshore contained high concentrations of nitrate, whereas deeper groundwater, discharged farther from shore, contained very little nitrate; nearshore seepage was rapid and declined with distance from shore. Where groundwater discharge was relatively rapid (0.4–0.8 $\mu m\ s^{-1}$), water collected with the seepage meter became chemically consistent after about 4 months and was chemically similar to water from wells located along the same flow path.

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Accepted: 5 August 1976

CITIZEN PARTICIPATION PLAN

CITIZEN PARTICIPATION PLAN

1.0 Introduction to the Plan

The New York State Electric and Gas Corporation (NYSEG) is committed to a citizen participation program as part of its responsibilities for the clean-up of the Mechanicville Central Avenue former manufactured gas plant (MGP) site. Citizen participation promotes public understanding of the remedial investigation process, and proposed remedial activities that are planned for the site. This plan provides an opportunity for the public to express their concerns and have input into the investigation and remedial actions that are being planned for the site.

2.0 Basic Site Information

Former MGP sites are being investigated by NYSEG because by-products of the gas production process may be present on site. These by-products, predominantly coal tars, have the potential to adversely effect human health and/or the environment.

The Mechanicville Central Avenue former manufactured gas plant produced coal gas, a predecessor to natural gas, from 1901 to 1955. Coal gas was produced by heating coal under low oxygen conditions in brick ovens. The gas was then cooled and cleaned for impurities. Coal tars, coal ash, and gas purifier waste were by-products generated on-site. The majority of coal tar generated on-site was collected and sold to tar refineries. However, previous investigations of the site identified that coal tars are present on the site in the subsurface soils. These coal tars have the potential to migrate and impact groundwater.

The site is currently listed on the New York Registry of Inactive Hazardous Waste Sites. The site is classified by the New York Department of Environmental Conservation (NYSDEC) as Classification 2; a site posing a significant threat to the public health or the environment--action required. NYSEG disagrees with NYSDEC's determination as no health or environmental threat has been identified in previous studies. However, NYSEG does agree that remedial actions are necessary for the site because coal tars and impacted groundwater are migrating into the Anthony Kill adjacent to the site.

3.0 Project Description

In 1986, NYSEG contracted an independent environmental consultant, E.C. Jordan Co. (Jordan) to conduct a multi-phase environmental investigation of the site. NYSEG conducted this investigation on a voluntary basis. The investigation included performing testpits, soil and bedrock borings, monitoring well installation, sampling and chemical analysis of soil, groundwater, Anthony Kill surface water and sediments, and indoor air. All analytical work was performed using generally accepted sampling protocols at New York State certified laboratories. Coal tars were found in several subsurface structures and also found in the subsurface soils. In 1990, Jordan concluded that the coal tar was impacting the quality of the local groundwater and seeping into the Anthony Kill. The impacted groundwater was also discharging into the Anthony Kill.

Jordan's Risk Assessment of the site concluded that the site did not pose a significant risk to public health nor was there a significant environmental risk to the Anthony Kill. These conclusions were based on the surface water and sediment samples taken from the Anthony Kill, and modeling of the discharges to the Anthony Kill. Although no significant risks were identified, NYSEG proposed plans to conduct a feasibility study to eliminate the discharge of coal tars to the Anthony Kill. These plans were proposed to the NYSDEC in the Fall of 1991. NYSDEC Region 5 staff responded to NYSEG's proposal by requesting NYSEG to resubmit the site investigation reports in a format that is consistent with NYSDEC guidelines. NYSDEC also identified several areas where additional study were warranted.

To address NYSDECs concerns, NYSEG contracted ABB Environmental Services, Inc. (ABB-ES) formerly the E.C. Jordan Co., to conduct a Phase IIA supplemental investigation. The Phase IIA Work Plan focuses on assessing surface soils for PCB oil contamination and installing additional soil borings and monitoring wells, and piezometers downgradient of the site. Additional groundwater samples will be collected from the new and existing monitoring wells. Seep samples and additional sediment samples will also be taken from the Anthony Kill. Several locations have been identified where NYSEG had historically stored electrical equipment. These areas will undergo soil sampling for PCB contamination.

Upon analysis of the samples from the Phase IIA investigation sampling points, a Feasibility Study will be performed to identify remedial actions that will address

the discharge of coal tar, and coal tar constituents, into the Anthony Kill. In the event that PCBs are detected in shallow subsurface soil samples, the need for remediation will be evaluated based on state and federal requirements.

NYSEG anticipates conducting the Phase IIA field investigation activities in May of 1992. A Draft Final Report will be available for public review in November 1992. This schedule is dependent on NYSDEC approval of the Phase IIA Work Plan by March 27, 1992.

4.0 Identification of Affected/Interested Public (Contact List)

Public Officials

Patrick Hildreth, Mayor
City of Mechanicville
36 North Main Street
Mechanicville, New York 12118
(518) 664-8331

Commissioner of Health & Safety
Dan Golden
City of Mechanicville
36 North Main Street
Mechanicville, New York 12118
(518) 664-5651

NYS Department of Health, Distribution Office
Brian Fear, P.E.
282 Glen Street
Glen Falls, New York 12801
(518) 793-3893

Mr. Robert Hathaway, Chair
Saratoga County Board of Supervisors
40 McMaster Road
Ballston Spa, New York 12020

Honorable Joseph Bruno
NYS Senate
LOB Room 915
Albany, New York 12247

Honorable Robert D'Andrea
NYS Assembly
LOB Room 320
Albany, NY 12248

John Sheehan
Bureau of Env. Exposure Investigations
NYS Department of Health
2 University Place
Albany, NY 12203

Sue Collamer
Health Liaison
NYS Department of Health
2 University Place
Albany, NY 12203

State Superfund Board Members:

Mr. James Buhrmaster
President J.H. Buhrmaster, Inc.
P.O. Box 2120
Scotia, NY 12302

Mr. Richard D. Morse
Legislative Program and Council Staff
NYS Assembly
Room 520, State Capital
Albany, NY 12248

Mr. Jim Ransom
Akwesasne Mohawk Reservation
Council Building
Hoganburg, NY 13655

Judy Enck
NY Public Interest Research Group
184 Washington Avenue
Albany, NY 12210

Adjacent Land Owners:

Northerly - Izzo's
12 South Central Avenue
Mechanicville, New York 12118
(518) 664-7391

Southerly - Thomas J. Fiacco
139 North Second Street
Mechanicville, New York 12118
(518) 664-5539

Abutters on Easterly Side of Central Avenue

Clark Trading Corp.
501 Duanesburg Road
Schenectady, New York 12306

Frank Cocozzo & Bruce Brown
c/o Getty Petroleum
49 Riverside Drive
Rensselaer, New York 12144

No organizations Working on the Site

Media:

1) Daily Newspapers:

Albany Times-Union
Timothy O. White, Editor
News Plaza, P.O. Box 15000
Albany, New York 12212
(518) 454-5694

The Daily Gazette
50 North Main Street
Mechanicville, New York 12118
(518) 664-2508

The Saratogian
Barbara Lombardo
20 Lake Avenue
Saratoga Springs, NY 12866

2) Radio:

WMVI
Chris Martin, General Manager
38 North Main Street
Mechanicville, New York 12118

3) Television:

TV Channel 10
Don Desker, News Director
341 Northern Boulevard
Albany, New York 12204
(518) 436-0771

WRGB
Gary Whittaker, News Director
1400 Balltown Road
Schenectady, New York 12309
(518) 381-4988

Others:

Anne Rabe
Citizens Environmental Coalition
33 Central Avenue
Albany, NY 12210

George Hodgson
Environmental Management Council
50 West High Street
Balston Spa, New York 12020
Phone: (518) 885-5381

5.0 Identification of Department Contacts

NYSDEC Contacts:

Site Manager

James McClain
Assistant Sanitary Engineer
Department of Environmental Conservation
Route 66
Raybrook, New York 12977
(518) 891-1370

Public Information

Betsy Lowe
Department of Environmental Conservation
Route 86
Raybrook, New York 12977
(518) 891-1370

6.0 Identification of Document Repository

Mechanicville District Public Library
15 South Main Street
Mechanicville, New York 12118
(518) 664-4646

7.0 Description of Specific Citizen Participation Activities

Upon NYSDEC review, notice of development of the Phase IIA Workplan will be made to all contacts listed in Section 4.0 A copy of the final work plan will be kept at the designated repository. The workplan will be presented at a public meeting after final approval by NYSDEC. A minimum two week advance notice of the public meeting will be provided to the contact list. Site RI/FS updates will be submitted to the contact list every six to twelve months until the Phase IIA work is complete. When the Phase IIA work is completed, the final draft report will be submitted to NYSDEC and two copies will be forwarded to the repository identified in Section 6.0.

Although utility work adjacent to the site and sediment exposure was considered in the health assessment, to address NYSDEC concerns over possible exposure to site related chemicals at adjacent facilities, NYSEG will contact all abutters and public utilities which may conduct intrusive work adjacent to the site. For any planned intrusive activities, NYSEG will provide an assessment of the potential exposure risk and provide guidance on developing health and safety procedures.

It is anticipated that a Proposed Remedial Action Plan (PRAP) will be written after the approval of the Phase IIA report. The PRAP identifies the problems and the recommended remedial actions that are necessary for the site. The PRAP also identifies all the options that were evaluated to remediate the site and provides justification for the remedial action that was chosen. NYSEG staff will take the lead to setup a public meeting to present the results of the Phase IIA report and the PRAP with a two week minimum advance notice. A 30-day public review period will follow and NYSEG will address issues and concerns raised during the public review process. The final Remedial Action Plan (RAP) will include response to any issues raised during the review period. The two copies of the final version of the RAP will be sent to the repository.

8.0 Glossary of Key Terms and Major Program Elements

NOTE: The first eight definitions represent major elements of the remedial process. They are presented in the order in which they occur, rather than in alphabetical order, to provide a context to aid in their definition.

Site Placed on Registry of Inactive Hazardous Waste Sites - Each inactive site known or suspected of containing hazardous waste must be included in the Registry. Therefore, all sites which state or county environmental or public health agencies identify as known or suspected to have received hazardous waste should be listed in the Registry as they are identified. When possible, the Department carries out an initial evaluation of the site before listing.

Phase I Site Investigation - Preliminary characterizations of hazardous substances present at a site; estimates pathways by which pollutants might be migrating away from the original site of disposal; identifies population or resources which might be affected by pollutants from a site; observes how the disposal area was used or operated; and gathers information regarding who might be responsible for wastes at a site. Involves a search of records from all agencies known to be involved with a site, interviews with site owners, employees and local residents to gather pertinent information about a site. Information gathered is summarized in a Phase I report.

After a Phase I investigation, DEC may choose to initiate an emergency response; to nominate the site for the National Priorities List; or, where additional information is needed to determine site significance, to conduct further (Phase II) investigation.

Phase II Site Investigation - Ordered by DEC when additional information is still needed after completion of Phase I to properly classify the site. A Phase II investigation is not sufficiently detailed to determine the full extent of the contamination, to evaluate remedial alternatives, or to prepare a conceptual design for construction. Information gathered is summarized in a Phase II report and is used to arrive at a final hazard ranking score and to classify the site.

Remedial Investigation (RI) - A process to determine the nature and extent of contamination by collecting data and analyzing the site. It includes sampling and monitoring, as necessary, and includes the gathering of sufficient information to determine the necessity for, and proposed extent of, a remedial program for the site.

Feasibility Study (FS) - A process for developing, evaluating and selecting remedial actions, using data gathered during the remedial investigation to: define the objectives of the remedial program for the site and broadly develop remedial action alternatives; perform an initial screening of these alternatives; and perform a detailed analysis of a limited number of alternative which remain after the initial screening stage.

Remedial Design - Once a remedial action has been selected, technical drawings and specifications for remedial construction at a site are developed as specified in the final RI/FS report. Design documents are used to bid and construct the chosen remedial actions. Remedial design is prepared by consulting engineers with experience in inactive hazardous waste disposal site remedial actions.

Construction - DEC selects contractors and supervises construction work to carry out the designed remedial alternative. Construction may be as straightforward as excavation of contaminated soil with disposal at a permitted hazardous waste facility. On the other hand, it may involve drum sampling and identification, complete encapsulation, leachate collection, storage and treatment, groundwater management, or other technologies. Construction costs may vary from several thousand dollars to many millions of dollars, depending on the size of the site, the soil, groundwater and other conditions and the nature of the wastes.

Monitoring/Maintenance - Denotes post-closure activities to insure continued effectiveness of the remedial actions. Typical monitoring/maintenance activities include quarterly inspection by an engineering technician; measurement of level of water in monitoring wells; or collection of ground water and surface water samples and analysis for factors showing the condition of water, presence of toxic substances, or other indicators of possible pollution from the site. Monitoring/maintenance may be required indefinitely at many sites.

Consent Order - A legal and enforceable negotiated agreement between the Department and responsible parties where responsible parties agree to undertake investigation and cleanup or pay for the costs of investigation and cleanup work at a site. The order includes a description of the remedial actions to be undertaken at the site and a schedule for implemented.

Contract - A legal document signed by a contractor and the Department to carry out specific site remediation projects.

Contractor - A person or firm hired to furnish materials or perform services especially in construction projects.

Delisting - Removal of a site from the state Registry based on study which shows the site does not contain hazardous wastes.

Potentially Responsible Party Lead Site - An inactive hazardous waste site at which those legally liable for the site have accepted responsibility for investigating problems at the site, and for developing and implementing the site's remedial program. PRP's include: those who owned the site during the time wastes were placed, current owners, past and present operators of the site, and those who generated the wastes placed at the site. Remedial programs developed and implemented by PRP's generally result from an enforcement action taken by the State and the costs of the remedial program are generally borne by the PRP.

Ranking System - The United States Environmental Protection Agency uses a hazard ranking system (HRS) to assign numerical scores to each inactive hazardous waste site. The scores express the relative risk or danger from the site.

Responsible Parties - Individuals, companies (e.g., site owners, operators, transporters or generators of hazardous waste) responsible for or contributed to the contamination problems at a hazardous waste site. PRP is a potential responsible party.

Site Classification - The Department assigns sites to classifications established by state law, as follows:

- Classification 1 - A site causing or presenting an imminent danger of causing irreversible or irreparable damage to the pubic health or environment--immediate action required.

- Classification 2 - A site posing a significant threat to the public health or environment--action required.

- Classification 2a - A temporary classification for a site known or suspected to contain hazardous waste. Most likely the site will require a Phase I and Phase II investigation to obtain more information. Based on the results, the site then would be reclassified or removed from the state Registry if found not to contain hazardous wastes.

- Classification 3 - A site which has hazardous waste confirmed, but not a significant threat to the public health or environment--action may be deferred.

- Classification 4 - A site which has been properly closed--requires continued management.

- Classification 5 - A site which has been properly closed, with no evidence of present or potential adverse impact--no further action required.

State-Lead Site - An inactive hazardous waste site at which the Department has responsibility for investigating problems at the site and for developing and implementing the site's remedial program. The Department uses money available from the State Superfund and the Environmental Quality bond Act of 1986 to pay for these activities. The Department has direct control and responsibility for the remedial program.