331.2✓

DRAFT
REMEDIAL INVESTIGATION REPORT

APPENDICES
(VOLUME II)

OLD CORTLAND COUNTY LANDFILL
TOWN OF SOLON
CORTLAND COUNTY, NEW YORK

MARCH, 1998

PREPARED FOR:

CORTLAND COUNTY DEPT. OF SOLID WASTE
TOWN LINE ROAD
McGRAW, NEW YORK 13101

PREPARED BY:

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APPENDIX A

SUBSURFACE LOGS

B&L

BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-EB-1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

PROJECT No. 331.22

DRILL RIG: CME-55, Truck Mounted
CASING: 4¼" HSA
SOIL SAMPLER: 2" Split-Barrel
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches
ROCK SAMPLER: N/A
OTHER:

ELEVATION: 1928.2 feet DATUM: NGVD
LOC. (COORDS): 960017.9 N, 638978.7 E
START DATE: 7/18/97 FINISH DATE: 7/21/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
0						[No samples collected 0'-70', boring advanced through waste.]	Advanced 4¼" HSA to 60.0'.
5						Cuttings demonstrated mixed solid wastes with layers of periodic cover materials.	
60							End day @ 60'
65							7/21/97 0800HRS: WL @ 49.9' Continue auger advancement
70						69.9'	69.9': Auger refusal. Assumed bedrock.
75						Boring terminated at 69.9'.	
80						Installed 2" PVC monitoring well with 20.0' of 0.01-inch/slot screen at 69.0'.	
85						See Installation Detail for monitoring well construction dimensions.	
90							

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SUBSURFACE LOG

Boring No. RI-MW-1A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

PROJECT No. 331.22

DRILL RIG: CME-55, Truck Mounted
CASING: 4¼" HSA
SOIL SAMPLER: 2" Split-Barrel
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches
ROCK SAMPLER: N/A
OTHER:

ELEVATION: 1718.3 feet DATUM: NGVD
LOC. (COORDS): 958553.4 N, 638152.1 E
START DATE: 7/25/97 FINISH DATE: 7/25/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
0–16						[No samples collected 0'-16'. See subsurface log RI-MW-1B for details.]	Advanced 4¼" HSA to 31.5'.
	1	1.4	12-15 17-17	32		GLACIAL TILL Dark greenish-gray mottled gray SILT and CLAY, CLAY, some fine subangular gravel, little coarse to fine sand. Wet, stiff to very stiff very stiff.	
	2	1.4	8-15 50/.4	-			
	3	1.6	10-27 25-22	52			
	4	1.2	15-19 20-25	39			
	5	1.7	8-12 17-18	29			
	6	0.7	6-8 12-16	20			
	7	1.1	9-15 19-22	34			
	8	1.6	12-29 30-50/.2	59		(ML) 31.7'	
31.7–40						Boring terminated at 31.7'. Installed 2" PVC monitoring well with 15.0' of 0.01-inch/slot wire wrap screen at 31.0'. See Installation Detail for monitoring well construction dimensions.	

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BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-1B

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG:	CME-55, Truck Mounted	ELEVATION:	1718.8 feet DATUM: NGVD
CASING:	4¼" HSA	LOC. (COORDS):	958561.2 N, 638153.3 E
SOIL SAMPLER:	2" Split-Barrel	START DATE:	7/24/97 FINISH DATE: 7/25/97
SAMPLE HAMMER:	Wt: 140 lbs. Fall: 30 inches	CONTRACTOR:	North Star Drilling, Inc.
ROCK SAMPLER:	HQ wire line core barrel	DRILLER:	Jeff Thew
OTHER:		GEOLOGIST:	James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	MATERIAL DESCRIPTION	Remarks
0	1	1.8	10-14 17-20	31	FILL Dark brown coarse to fine SAND and GRAVEL, some silt and clay. Damp, medium dense. 1.0'	Advanced 4¼" HSA to 33'.
	2	0.1	50/.4	-	GLACIAL TILL Greenish-gray mottled gray SILT and CLAY, some fine subangular gravel, little coarse to fine sand. Damp, stiff to very stiff.	
5	3	1.8	15-15 16-22	31	4.0': Grades dark greenish-gray with occassional cobbles.	
	4	1.7	20-12 14-16	26		
	5	2.0	9-14 16-19	30	6.0': Becomes moist.	
10	6	1.4	4-16 15-19	31		
	7	1.8	12-16 26-37	42	12.0': Becomes wet.	Groundwater first encountered at 12'.
15	8	1.6	10-17 17-25	34		
	9	1.2	47-17 22-25	39		
	10	1.1	12-20 29-34	49		
20	11	0.8	14-21 24-32	45		
	12	1.0	10-31 25-54	56		
25	13	1.0	77-25 25-25	50		
	14	1.0	7-10 12-18	22		
	15	1.2	12-14 18-20	32		
30	16	0.8	8-15 25-50/.3	40	(ML) 31.5'	Removed augers and grouted 4" permanent steel casing at 33'.
	17	0.6	90-50/.2	-	ITHACA FORMATION Gray SHALE and SILTSTONE, medium to fine grained, slightly to moderately weathered, thinly to moderately bedded, occassional vertical fractures and fossil horizons.	7/25/97 0945 HRS: Start coring at 33'.
35	C-1	10.0		29%	33.0-35.0': Thinly bedded (1"-3"), bedding planes infilled with clayey silt, inter-layers of coarse and fine grained bedding. 35.0': Becomes moderately bedded (2"-6").	1100HRS: Coring completed at 53'.
40						

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SUBSURFACE LOG

Boring No. RI-MW-1B

PROJECT: Old Cortland County Landfill RI/FS

PROJECT No. 331.22

CLIENT: Cortland County Department of Solid Waste

LOCATION: Town line Road, Town of Solon, New York

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
40	C-1					39.0-40.8': silt infilled vertical fracture.	
						43.0': Becomes finer grained	
45	C-2	10.0		30%			
50						50.0': Becomes thinly bedded (1"-3") and vertically fractured with silt infilling.	
						52.6': Fossil bed horizon.	
						53.0'	
55						Boring terminated at 53.0'.	
						Installed 2" PVC monitoring well with 10.0' of 0.01-inch/slot wire wrap screen at 53.0'	
60						See Installaion Detail for monitoring well construction dimensions.	
65							
70							
75							
80							
85							
90							

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BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-2A

PROJECT: Old Cortland County Landfill RI/FS
PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG: CME-55, Truck Mounted
CASING: 4¼" HSA
SOIL SAMPLER: 2" Split-Barrel
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches
ROCK SAMPLER: N/A
OTHER:

ELEVATION: 1757.9 feet DATUM: NGVD
LOC. (COORDS): 959265.4 N, 639221.9 E
START DATE: 7/23/97 FINISH DATE: 7/23/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
0						[No samples collected 0'-4'. See subsurface log RI-MW-2B for details.]	Advanced 4¼" HSA to 10.5'.
						GLACIAL TILL Greenish-brown mottled gray SILT and CLAY, some medium to fine subrounded to subangular gravel, little coarse to fine sand. Moist, firm to very stiff. 6.0': Becomes saturated. (ML) 9.0'	Groundwater first encountered at 6'.
5	1	1.8	10-20 16-12	36			
	2	2.0	8-9 12-8	21			
	3	1.6	5-5 8-12	13			
10						ITHACA FORMATION Gray SHALE and SILTSTONE, highly weathered, thinly bedded. 10.5'	
						Boring terminated at 10.5'. Installed 2" PVC monitoring well with 5.0' of 0.01-inch/slot wire wrap screen at 10.3'. See Installation Detail for monitoring well construction dimensions.	
15							
20							
25							
30							
35							
40							

B&L BARTON & LOGUIDICE, P.C.	SUBSURFACE LOG	Boring No. RI-MW-2B Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG:	CME-55, Truck Mounted	ELEVATION:	1757.8 feet DATUM: NGVD
CASING:	4¼" HSA	LOC. (COORDS):	959270.4 N, 639217.8 E
SOIL SAMPLER:	2" Split-Barrel	START DATE:	7/22/97 FINISH DATE: 7/23/97
SAMPLE HAMMER:	Wt: 140 lbs. Fall: 30 inches	CONTRACTOR:	North Star Drilling, Inc.
ROCK SAMPLER:	HQ wire line core barrel	DRILLER:	Jeff Thew
OTHER:		GEOLOGIST:	James Gruppe

DEPTH IN FEET (0–40)

SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)
1	0.5	4-10 12-16	22
2	1.4	8-12 12-15	24
3	1.5	14-21 14-11	35
4	1.9	8-7 6-4	13
5	1.5	4-21 53/.4	-
C-1	10.0		23%
C-2	10.0		30%

MATERIAL DESCRIPTION

FILL
Dark brown coarse to fine SAND and GRAVEL, some silt and clay. Damp, medium dense.
2.0'

GLACIAL TILL
Greenish-brown SILT and CLAY, some medium to fine subrounded to subangular gravel, little coarse to fine sand. Dry, firm to very stiff.
4.0': Becomes mottled gray and moist.
6.0': Becomes saturated.
(ML) 9.0'

ITHACA FORMATION
Gray SHALE and SILTSTONE, medium to fine grained, slightly to moderately weathered, thinly to moderately bedded, occassional vertical fractures and fossil horizons.
9.0': highly weathered, thinly bedded.
11.0-13.5': Thinly bedded (½"-1½"), 30 degree angled fractures.
12.3': 2" thick highly weathered zone.
13.5-15.3': Coarser grained, moderately bedded (3"-7").
14.5': 3" thick bed of iron stained fossils.
15.3': Becomes moderately bedded (1½"-5"), with occassional 30 degree angled fractures. Coarsening downward to 19.1'.
19.1': Becomes fine grained, top of 1" thick fossil horizon.
21.0': Becomes iron stained.
28.5': Becomes thinly bedded (½"-2")
31.0'

Boring terminated at 31.0'.

Installed 2" PVC monitoring well with 10.0' of 0.01-inch/slot wire wrap screen at 31.0'.

See Installaion Detail for monitoring well construction dimensions.

Remarks

Advanced 4¼" HSA to 10.5'.

Groundwater first encountered at 6'.

With augers @ 10.5' WL @ 6.5'

Removed augers and grouted 4" permanent steel casing at 11'.

7/23/97
0830 HRS: Start coring at 11'.
1100HRS: Coring completed at 31'.

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SUBSURFACE LOG

Boring No. RI-MW-3A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

PROJECT No. 331.22

DRILL RIG: CME-55, Truck Mounted
CASING: 4" casing & 3⅞" TCRB
SOIL SAMPLER: NA
SAMPLE HAMMER: Wt: lbs. Fall: inches
ROCK SAMPLER:
OTHER:

ELEVATION: 1799.0 feet DATUM: NGVD
LOC. (COORDS): 959727.2 N, 639739.5 E
START DATE: 7/17/97 FINISH DATE: 7/17/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
0						[No samples collected 0'-20'. See subsurface log RI-MW-3B for details.]	Advanced 4" casing to 4'. Continue advancement using 3⅞" TCRB with water to 20.5'.
20.5						20.5'	
						Boring terminated at 20.5'. Installed 2" PVC monitoring well with 10.0' of 0.01-inch/slot wire wrap screen at 20.3'. See Installation Detail for monitoring well construction dimensions.	

Depth scale: 0, 5, 10, 15, 20, 25, 30, 35, 40

BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-3B

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG:	CME-55, Truck Mounted	ELEVATION:	1799.0 feet DATUM: NGVD
CASING:	4¼" HSA, 4" & 5" ID casing	LOC. (COORDS):	959736.6 N, 639740.6 E
SOIL SAMPLER:	NA	START DATE:	7/16/97 FINISH DATE: 7/18/97
SAMPLE HAMMER:	Wt: 140 lbs. Fall: 30 inches	CONTRACTOR:	North Star Drilling, Inc.
ROCK SAMPLER:	HQ wire line core barrel	DRILLER:	Jeff Thew
OTHER:		GEOLOGIST:	James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
0–4.0	—					ITHACA FORMATION Gray SHALE and SILTSTONE, highly weathered and decomposed, soft. 4.0'	Advanced 4¼" HSA to 4'. Remove augers and set 4" casing to 4'.
4.0–8.5	C-1	4.5		9%		Gray SHALE and SILTSTONE, medium to fine grained, slightly to moderately weathered, thinly to moderately bedded, occassional vertical and fossil horizons. 4.0': Thinly bedded (½"-4½") with iron staining.	Core from 4.0-26.5'. Remove 4" casing and set 5" casing to 4'. Ream borehole using 4¼" roller bit and water to 27'. Grouted 4" permanent steel casing at 26.5'.
8.5–16.5	C-2	8.0		31%		8.5': Becomes moderately bedded (3"-8").	
16.5–26.5	C-3	10.0		35%		16.5': Silt infilled bedding plane. 16.5-23.5': Thinly bedded (½"-6"). 24.5-26.5': Vertical fracture.	
27–36.5	C-4	9.5		87%		29.3-31.2': Vertical fracture.	7/18/97 0900 HRS: Start coring at 27'. 1100HRS: Coring completed at 42'.
36.5–40	C-5	5.7		55%		36.5-39.0': Thinly bedded (1"-3").	

B&L	SUBSURFACE LOG	Boring No. RI-MW-3B Sheet 2 of 2

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
40	C-5					39.0': Moderately bedded (6"-8").	
						42.2'	
						Boring terminated at 42.2'. Installed 2" PVC monitoring well with 10.0' of 0.01-inch/slot wire wrap screen at 42.2' See Installation Detail for monitoring well construction dimensions.	
45							
50							
55							
60							
65							
70							
75							
80							
85							
90							

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BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-4A

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG: CME-55, Truck Mounted
CASING: 4¼" HSA, 4" ID casing
SOIL SAMPLER: 2" Split-Barrel
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches
ROCK SAMPLER: HQ wire line core barrel
OTHER:

ELEVATION: 1826.8 feet DATUM: NGVD
LOC. (COORDS): 960407.0 N, 639610.8 E
START DATE: 7/14/97 FINISH DATE: 7/15/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)	Lith.	MATERIAL DESCRIPTION	Remarks
0–8.5	1	0.9	2-10 15-9	25		GLACIAL TILL Brown SILT and CLAY, some medium to fine subangular gravel, little coarse to fine sand. Dry, stiff to very stiff. 2.0': Grades damp. (ML) 8.5'	Advanced 4¼" HSA to 9.5. No ground-water observed.
	2	0.8	5-7 12-12	19			
	3	1.4	11-21 17-29	38			
	4	1.8	14-21 19-24	40			
	5	0.2	67/.4	-			
8.5–36.5	C-1	6.8		33%		ITHACA FORMATION Gray SHALE and SILTSTONE, medium to fine grained, slightly to moderately weathered, thinly to moderately bedded, occassional vertical fractures and fossil horizons. 9.5': Thinly bedded (.5"-3"). 11.7-12.5' & 14.2-15.1': Moderately bedded. 16.5': Becomes moderately bedded.	Removed augers and advanced 4" casing to 9.5'. 1530 HRS: Start coring at 9.5'. 1730HRS: Coring complete at 36.5'.
	C-2	10.0		50%		20.9-21.5': Vertical fracture. 24.5': 2" thick fossil horizon.	1740HRS: WL @ 14.2' Remove drilling fluid. 1745HRS: WL @ 23.5' 1748HRS: WL @ 22.6' 1830HRS: WL @ 14.4'
	C-3	10.0		66%		31.5': 2' thick bed. 36.5'	
36.5–40						Boring terminated at 36.5'. Installed 2" PVC monitoring well with 15.0' of 0.01-inch/slot wire wrap screen at 30.0'. See Installation Detail for monitoring well dimensions.	7/15/97 0830HRS: WL @ 5.7'

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BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-5A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG: CME-55, Truck Mounted	ELEVATION: 1856.5 feet DATUM: NGVD
CASING: 4" ID casing	LOC. (COORDS): 960869.8 N, 638573.9 E
SOIL SAMPLER: NA	START DATE: 7/15/97 FINISH DATE: 7/15/97
SAMPLE HAMMER: Wt: lbs. Fall: inches	CONTRACTOR: North Star Drilling, Inc.
ROCK SAMPLER: HQ wire line core barrel	DRILLER: Jeff Thew
OTHER:	GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)	MATERIAL DESCRIPTION	Remarks
0–1.5					GLACIAL TILL Brown SILT & CLAY, little medium to fine subangular gravel and coarse to fine sand. Damp, stiff. (ML) 1.5'	Advanced 4" casing to 1.5'. No ground-water observed.
1.5–36.0	C-1 (2–6)	4.0		30%	ITHACA FORMATION Gray SHALE and SILTSTONE, medium to fine grained, slightly to moderately weathered, thinly to moderately bedded, occassional vertical fractures and fossil horizons. 2.0': Thinly bedded (½"-5") 6.5': 30 degree angled fracture. 8.5-9.3': Vertical fracture. 10.0': Moderately bedded (2"-11") 10.0-11.0': Vertical fracture. 16.0': Thinly bedded (1"-6") 16.0-18.5': Occassional 45 degree angled fractures 28.8': Moderately bedded (6"-16"), becomes more coarse. 28.0-29.0': Several vertical and 45 degree angled fractures. 32.5': ¼" thick finer grained bed. 36.0'	1330HRS: Start coring at 2'. 1530HRS: Coring completed at 36'. Removed drilling fluid. 1613HRS: WL @ 24.2' 1614HRS: WL @ 23.9'
	C-2 (6–16)	9.6		44%		
	C-3 (16–26)	10.0		46%		
	C-4 (26–36)	10.0		74%		

Boring terminated at 36.0'.
Installed 2" PVC monitoring well with 15.0' of 0.01-inch/slot wire wrap screen at 30.0'
See Installation Detail for monitoring well construction dimensions.

B&L

BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-6A

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG: CME-55, Truck Mounted
CASING: 4¼" HSA
SOIL SAMPLER: 2" Split-Barrel
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches
ROCK SAMPLER: N/A
OTHER:

ELEVATION: 1796.2 feet DATUM: NGVD
LOC. (COORDS): 960009.6 N, 637908.7 E
START DATE: 7/22/97 FINISH DATE: 7/22/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)	MATERIAL DESCRIPTION	Remarks
0					[No samples collected 0'-7'. See subsurface log RI-MW-6B for details.]	Advanced 4¼" HSA to 17.0'.
					GLACIAL TILL Greenish-gray mottled gray SILT and CLAY, little medium to fine subangular gravel, little coarse to fine sand. Damp, very stiff.	
	1	1.8	56-16 20-24	36		
10	2	1.3	10-17 17-22	34		
	3	1.3	16-18 50/.3	-	12.0': Becomes wet.	Groundwater first encountered at 12'.
	4	1.5	19-14 15-50/.3	29		
15	5	1.7	48-21 49-51	70	15.0': Grades with interlayers of weathered shale. (ML) 17.0'	
					Boring terminated at 17.0'.	
20					Installed 2" PVC monitoring well with 10.0' of 0.01-inch/slot wire wrap screen at 16.5'.	
					See Installation Detail for monitoring well construction dimensions.	

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BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-6B

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG: CME-55, Truck Mounted
CASING: 4¼" HSA
SOIL SAMPLER: 2" Split-Barrel
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches
ROCK SAMPLER: HQ wire line core barrel
OTHER:

ELEVATION: 1796.5 feet DATUM: NGVD
LOC. (COORDS): 960018.8 N, 637909.2 E
START DATE: 7/21/97 FINISH DATE: 7/22/97
CONTRACTOR: North Star Drilling, Inc.
DRILLER: Jeff Thew
GEOLOGIST: James Gruppe

DEPTH IN FEET	SAMPLE	Rec. (ft)	Blows per 6" ins	N or RQD (%)	MATERIAL DESCRIPTION	Remarks
0	1	0.6	8-24 50/.3	-	FILL Light brown coarse to fine SAND, little medium to fine gravel. Damp, medium dense.	Advanced 4¼" HSA to 17.5
	2	0.5	14-50/.3	-	4.0'	
5	3	1.8	10-12 22-24	34	GLACIAL TILL Greenish-brown SILT and CLAY, little fine subangular gravel and coarse to fine sand. Dry, very stiff.	
	4	1.7	18-24 22-22	46	8.0': Grades damp.	
	5	1.7	12-12 14-16	26		
10	6	1.5	10-12 18-10	30		
	7	1.4	12-26 28-21	54	12.0': Becomes wet.	Groundwater first encountered at 12'.
15	8	1.8	29-40 41-54	81	15.0': Grades with interlayers of weathered shale.	1530 HRS: With HSA at 10', W.L. @ 11.4'.
	9	0.4	28-50/.3	-	(ML) 16.5'	Removed augers and grouted 4" permanent steel casing at 17.5
20	C-1	8.5		27%	ITHACA FORMATION Gray SHALE and SILTSTONE, medium to fine grained, slightly to moderately weathered, thinly to moderately bedded, occassional vertical fractures and fossil horizons. 17.5': Thinly bedded (½"-6") 21.0': 30 degree angled fracture. 25.8': 20 degree angled fracture.	7/22/97 0830 HRS: Start coring at 17.5'. 1000 HRS: Coring completed at 38'.
30	C-2	5.0		40%	29.5-31.0': Frequent vertical and 30 degree angled fractures with iron staining.	
35	C-3	7.0		34%	38.0'	Installed 2" PVC mon. well with 10.0' of 0.01-inch/slot wire wrap screen at 38.0'. See Installation Detail for monitoring well construction dimensions.
40					Boring terminated at 38.0'.	

B&L

BARTON & LOGUIDICE, P.C.

SUBSURFACE LOG

Boring No. RI-MW-7A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS — PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

DRILL RIG: CME-55, Truck Mounted	ELEVATION: 1745.0 feet DATUM: NGVD
CASING: 4¼" HSA	LOC. (COORDS): 959051.7 N, 638676.3 E
SOIL SAMPLER: 2 & 3" Split-Barrel	START DATE: 7/23/97 FINISH DATE: 7/24/97
SAMPLE HAMMER: Wt: 140 lbs. Fall: 30 inches	CONTRACTOR: North Star Drilling, Inc.
ROCK SAMPLER: NA	DRILLER: Jeff Thew
OTHER:	GEOLOGIST: James Gruppe

SAMPLE	Rec. (ft)	Blows per 6 ins	N or RQD (%)
1	0.8	5-9 9-11	18
2	1.3	10-19 21-19	40
3	1.3	15-45 40-25	85
4	1.2	8-33 25-19	58
5	NR	15-22 24-26	NA
6	1.8	12-20 22-36	NA
7	1.6	16-25 30-34	55
8	1.3	17-27 36-36	63
9	1.4	10-20 40-46	60
10	1.0	11-17 29-36	46
11	1.5	19-36 49-50/.4	85
12	1.3	17-28 50/.4	-
13	1.6	10-14 26-27	40

DEPTH IN FEET: 0, 5, 10, 15, 20, 25, 30, 35, 40

MATERIAL DESCRIPTION

GLACIAL TILL
Gray mottled yellowish orange SILT and CLAY, little medium to fine gravel and coarse to fine sand. Damp, stiff to very stiff.
3.0': Grades brown.
5.5': Becomes wet.
6.0': Grades with frequent shale fragments.
10.0': Grades grayish green.
13.0': Grades damp, very dense.
17.5': Grades gray.
22.0': Grades greenish gray mottled gray.
24.0': Grades greenish gray
26.0': Grades yellowish gray and moist.
(ML) 28.0'

Boring terminated at 28.0'.

Installed 2" PVC monitoring well with 15.0' of 0.01-inch/slot wire wrap screen at 20.4'

See Installation Detail for monitoring well construction dimensions.

Remarks

Advanced 4¼" HSA to 28.0

Groundwater first encountered at 5.5'.

Sample No.'s 5 & 6 collected using 3" split barrel sampler.

End day
Augers @ 26', WL dry

7/24/97
0930HRS: WL @ 4.5'

APPENDIX B

MONITORING WELL
INSTALLATION DETAILS

B&L

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-EB-1

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

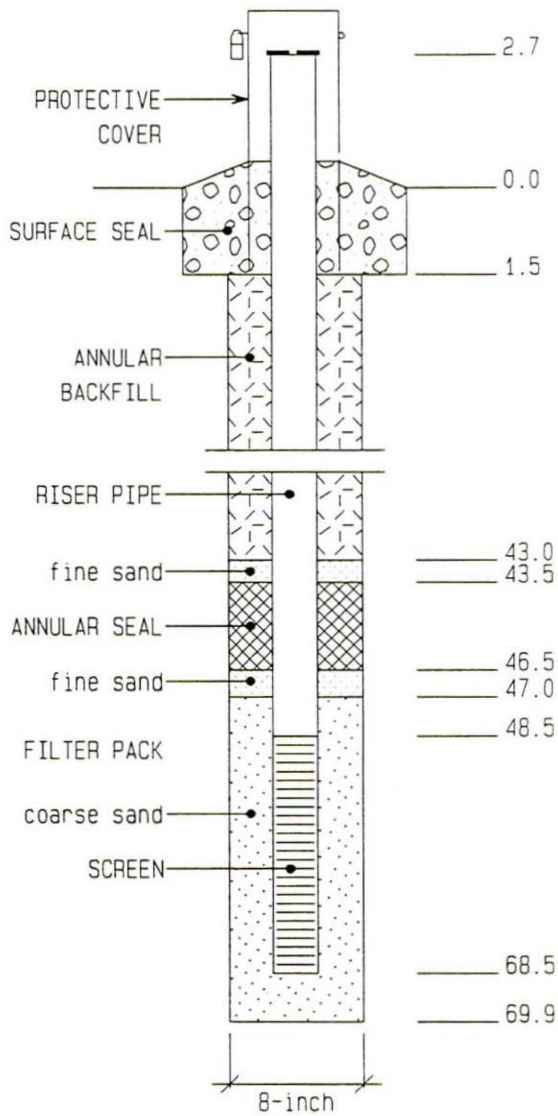
PROJECT No. 331.22

TOP OF RISER PIPE: 1930.9ft
GROUND ELEVATION: 1928.2ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-EB-1
DATE: 7/21/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 71.20ft below top of riser pipe
WATER LEVEL: 58.80ft DATE: 8/4/97

SCREEN
Material: PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 20.0ft
Stratigraphic unit: waste

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 51.20ft
Joint type: Flush-threaded
Standup: 2.70ft above ground level

FILTER PACK
Material: Sand size: #1 Morie Sand
Fine Sand: #00 Morie Sand
Total Length: 22.0ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 41.5ft
Placement Method: Tremie pipe

PROTECTIVE COVER
Material: Galvanized Steel
Diameter: 4-inch X 4-inch Length: 5.0ft
Standup: 2.70ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 8/4/97
Method: Bailer

NOTES: Bailed 7 gallons during development

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-1A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

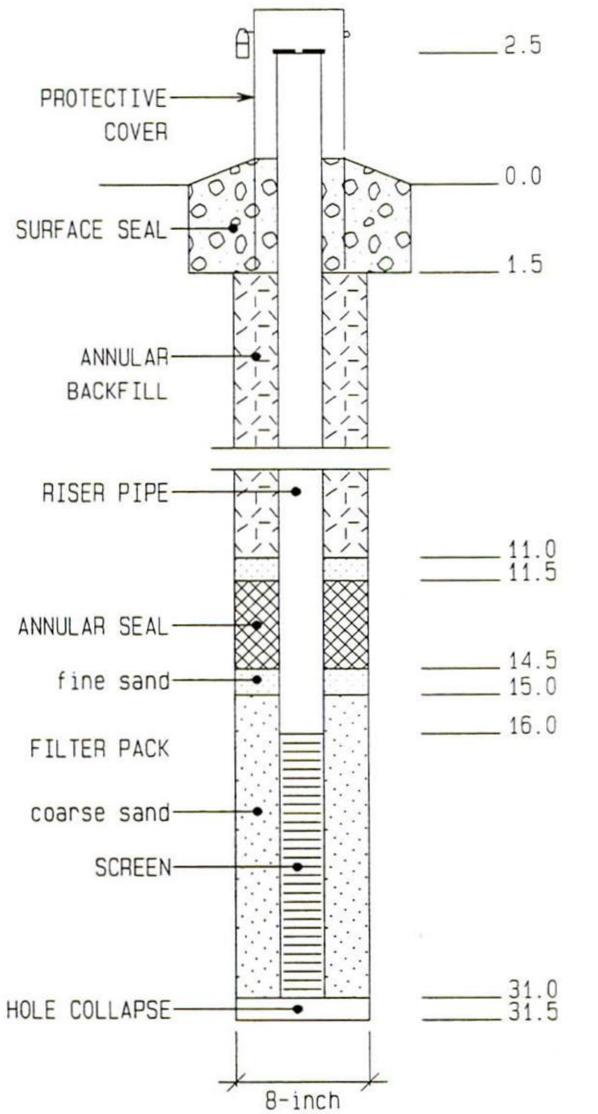
PROJECT No. 331.22

TOP OF RISER PIPE: 1720.78ft
GROUND ELEVATION: 1718.3ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-1A
DATE: 07/25/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 33.50ft below top of riser pipe
WATER LEVEL: 0.90ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 15.0ft
Stratigraphic unit: Glacial Till

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 18.5ft
Joint type: Flush-threaded
Standup: 2.48ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 16.5ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 10.0ft
Placement Method: Tremie pipe

PROTECTIVE COVER
Material: Galvanized Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.6ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated bailer

NOTES: Bailed dry after 20 gallons during development.

B&L

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-1B

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

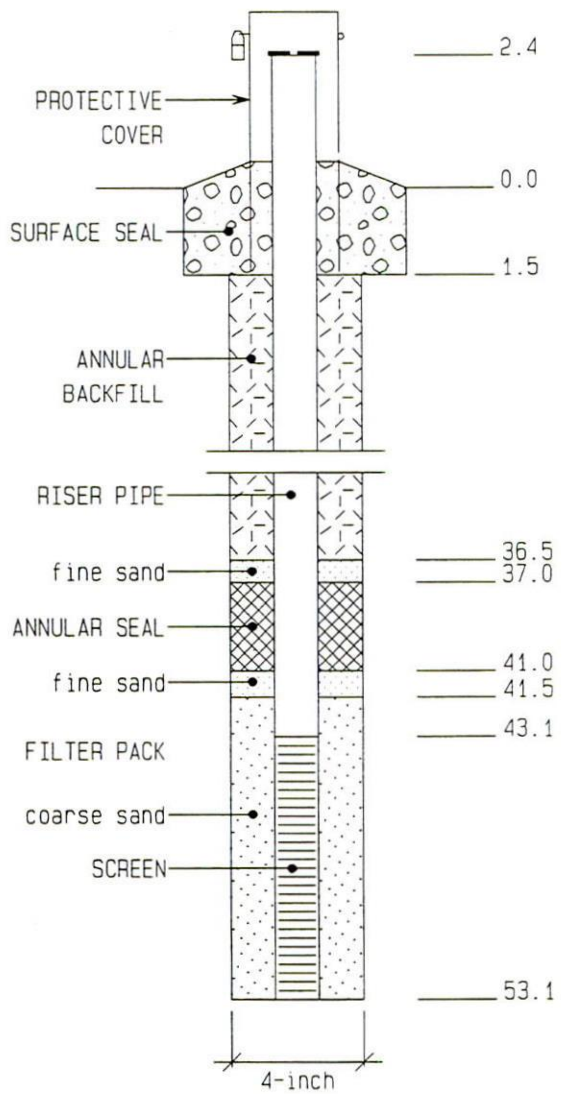
PROJECT No. 331.22

TOP OF RISER PIPE: 1721.23ft
GROUND ELEVATION: 1718.8ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-1B
DATE: 07/25/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 55.50ft below top of riser pipe
WATER LEVEL: 8.46ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 10.0ft
Stratigraphic unit: Ithaca Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 45.5ft
Joint type: Flush-threaded
Standup: 2.43ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 12.1ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 4.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 35.5ft
Placement Method: Tremie pipe

PROTECTIVE COVER
Material: Steel
Diameter: 6-inch Length: 5.0ft
Standup: 3.2ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated air lift pump

NOTES: Pumped dry after 20 gallons during development.

Permanent 4-inch steel casing installed to 36.5'.

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-2A

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

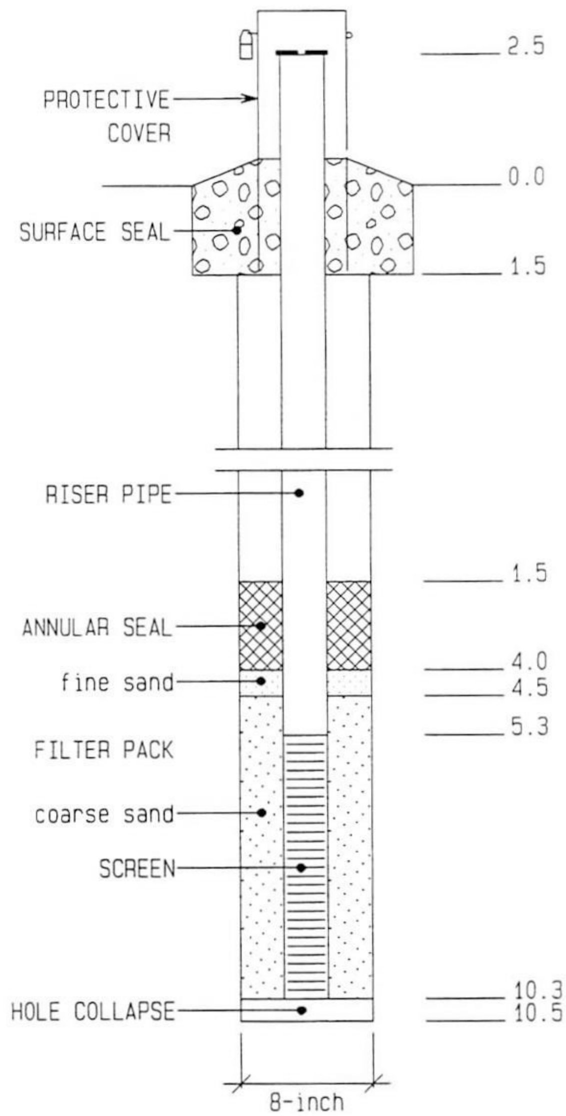
PROJECT No. 331.22

TOP OF RISER PIPE: 1760.38ft
GROUND ELEVATION: 1757.9ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-2A
DATE: 07/23/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 12.82ft below top of riser pipe
WATER LEVEL: 6.34ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 5.0ft
Stratigraphic unit: Glacial Till

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 7.82ft
Joint type: Flush-threaded
Standup: 2.48ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 6.5ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 2.5ft
Placement method: Gravity

ANNULAR BACKFILL
Material: -
Length: ft
Placement Method:

PROTECTIVE COVER
Material: Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.6ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated bailer

NOTES: Bailed dry after 20 gallons during development.

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-2B

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

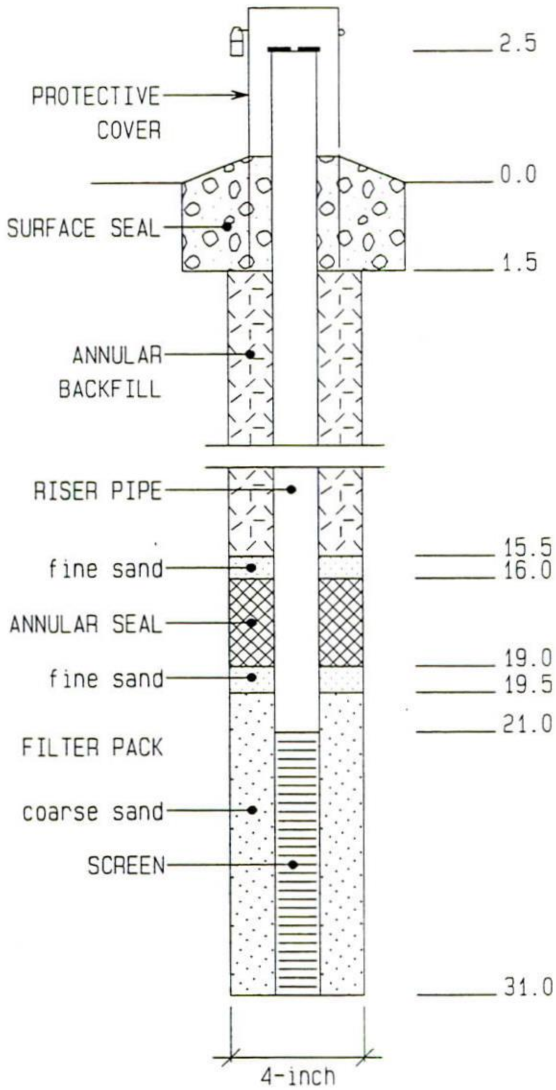
PROJECT No. 331.22

TOP OF RISER PIPE: 1760.32ft
GROUND ELEVATION: 1757.8ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-2B
DATE: 07/23/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 33.52ft below top of riser pipe
WATER LEVEL: 7.60ft DATE: 8/4/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 10.0ft
Stratigraphic unit: Ithaca Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 23.52ft
Joint type: Flush-threaded
Standup: 2.52ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 12.0ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 14.5ft
Placement Method: Tremie pipe

PROTECTIVE COVER
Material: Steel
Diameter: 6-inch Length: 5.0ft
Standup: 2.7ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/04/97
Method: Non-dedicated bailer

NOTES: Removed 12 gallons during development

Permanent 4-inch steel casing installed to 11.0'.

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-3A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

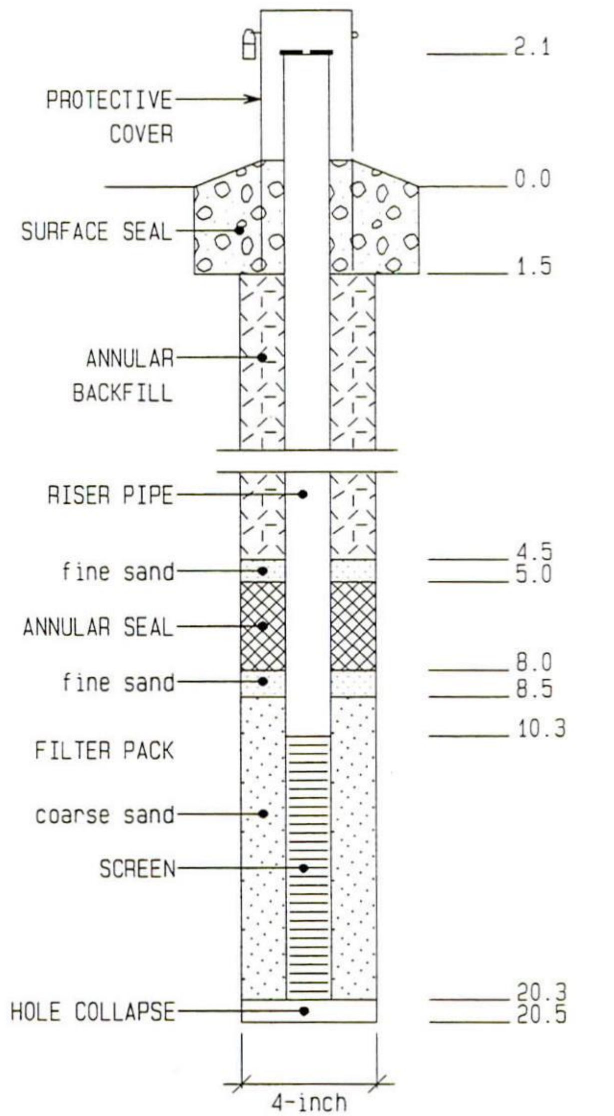
PROJECT No. 331.22

TOP OF RISER PIPE: 1801.07ft
GROUND ELEVATION: 1799.0ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-3A
DATE: 07/17/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 22.43ft below top of riser pipe
WATER LEVEL: 11.83ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 10.0ft
Stratigraphic unit: Ithica Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 12.43ft
Joint type: Flush-threaded
Standup: 2.07ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 12.5ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 3.5ft
Placement Method: Gravity

PROTECTIVE COVER
Material: Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.2ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated Bailer

NOTES: Bailed dry after 5 gal. during development.

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-3B

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

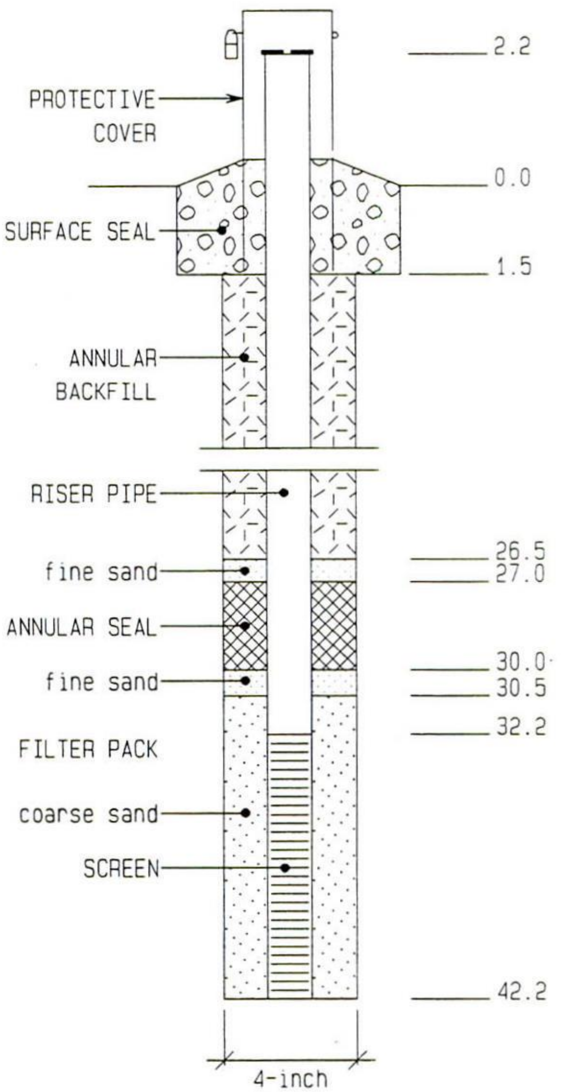
PROJECT No. 331.22

TOP OF RISER PIPE: 1801.23ft
GROUND ELEVATION: 1799.0ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-3B
DATE: 07/18/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 44.38ft below top of riser pipe
WATER LEVEL: 21.25ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 10.0ft
Stratigraphic unit: Ithaca Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 34.38ft
Joint type: Flush-threaded
Standup: 2.23ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 12.2ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 25.5ft
Placement Method: Tremie pipe

PROTECTIVE COVER
Material: Steel
Diameter: 6-inch Length: 5.0ft
Standup: 2.7ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated air lift pump

NOTES: Removed 5 gal. during development.

Permanent 4-inch steel casing installed to 26.5'.

B&L

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-4A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

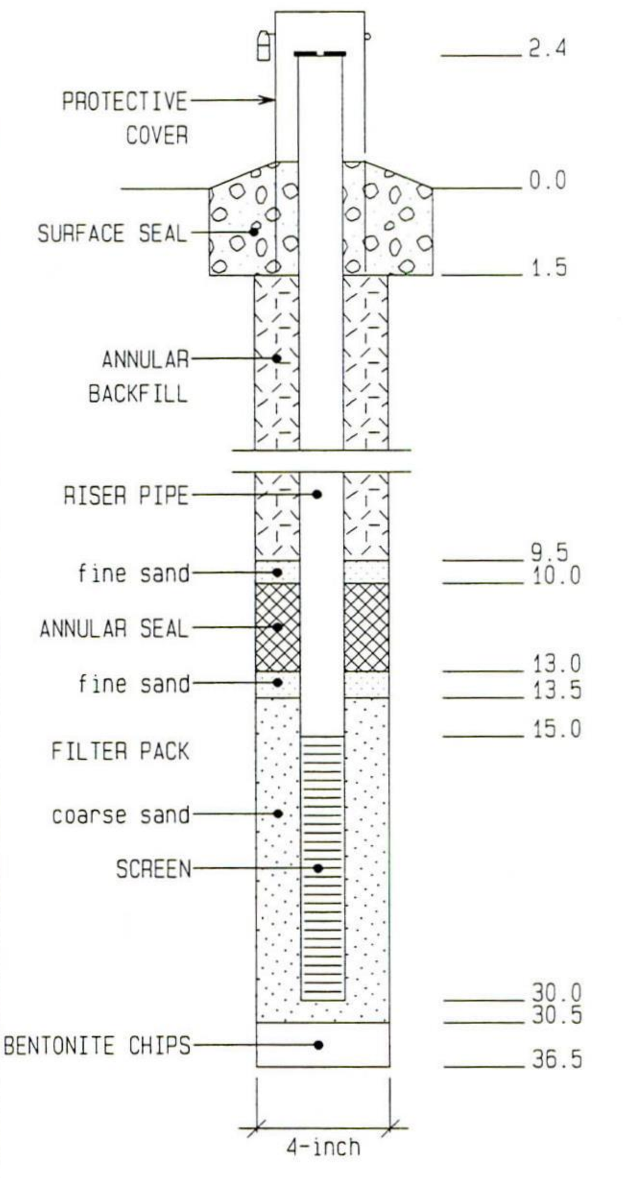
PROJECT No. 331.22

TOP OF RISER PIPE: 1829.17ft
GROUND ELEVATION: 1826.8ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-4A
DATE: 07/15/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 32.42ft below top of riser pipe
WATER LEVEL: 9.40ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 15.0ft
Stratigraphic unit: Ithaca Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 17.42ft
Joint type: Flush-threaded
Standup: 2.37ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 17.5ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 8.5ft
Placement Method: Gravity

PROTECTIVE COVER
Material: Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.5ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated air lift pump

NOTES: Pumped dry after 8 gal. during development

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-5A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

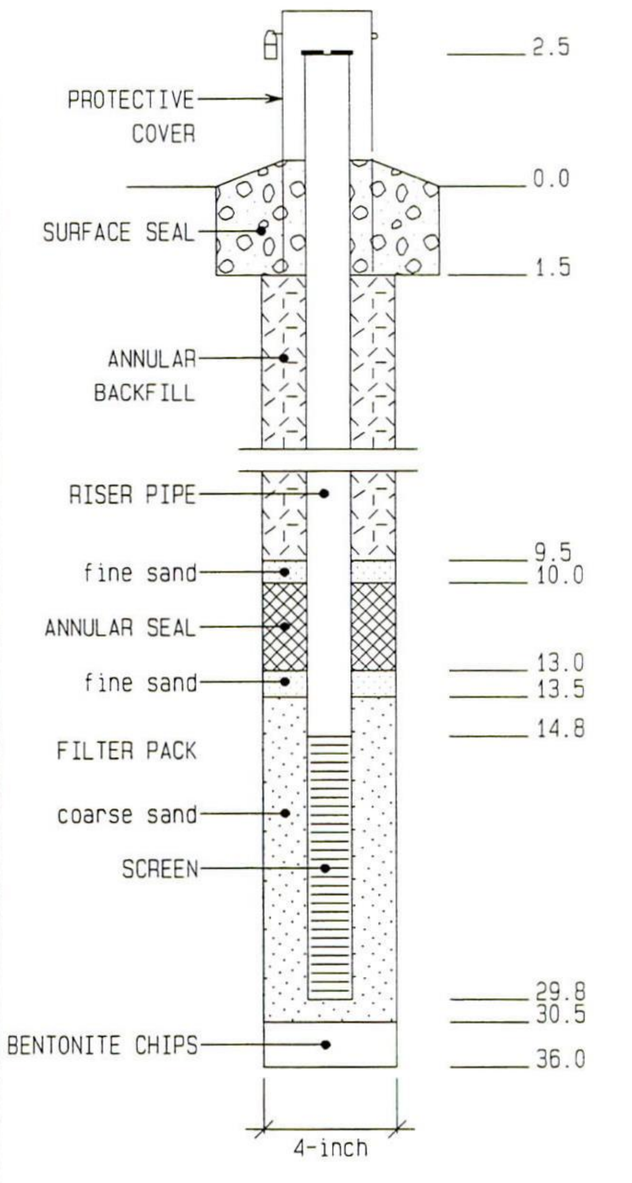
PROJECT No. 331.22

TOP OF RISER PIPE: 1859.03ft
GROUND ELEVATION: 1856.5ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-5A
DATE: 07/15/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 32.28ft below top of riser pipe
WATER LEVEL: 11.41ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 15.0ft
Stratigraphic unit: Ithaca Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 17.28ft
Joint type: Flush-threaded
Standup: 2.53ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 17.5ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 8.5ft
Placement Method: Gravity

PROTECTIVE COVER
Material: Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.7ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated air lift pump

NOTES: Pumped dry after 6 gal. during development

B&L

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-6A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

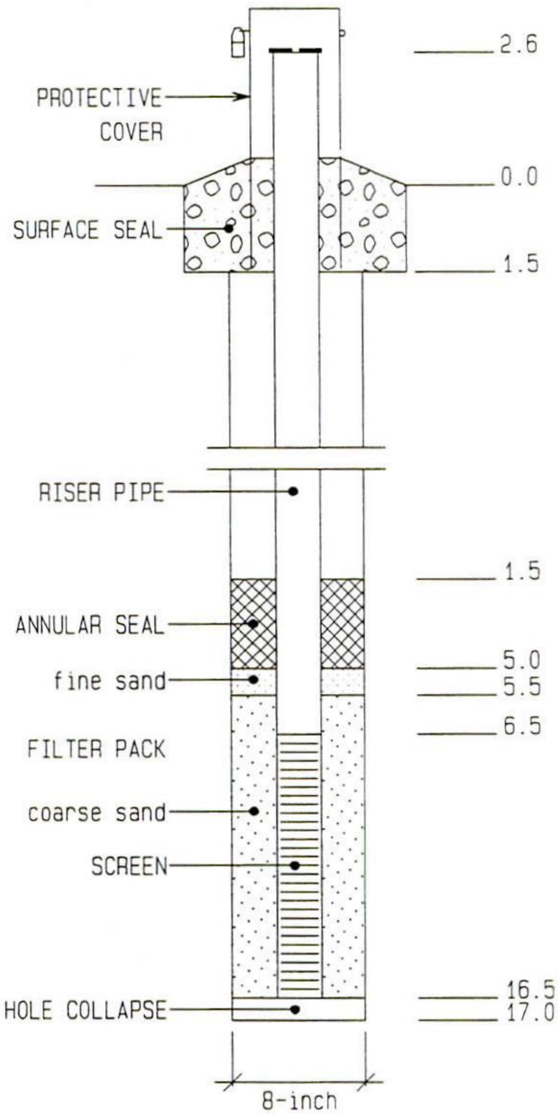
PROJECT No. 331.22

TOP OF RISER PIPE: 1798.79ft
GROUND ELEVATION: 1796.2ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-6A
DATE: 07/22/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 19.05ft below top of riser pipe
WATER LEVEL: 14.64ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 10.0ft
Stratigraphic unit: Glacial Till

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 9.05ft
Joint type: Flush-threaded
Standup: 2.59ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 12.0ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.5ft
Placement method: Gravity

ANNULAR BACKFILL
Material: -
Length: ft
Placement Method:

PROTECTIVE COVER
Material: Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.7ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated bailer

NOTES: Bailed 25 gal. during development

B&L

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-6B

Sheet 1 of 1

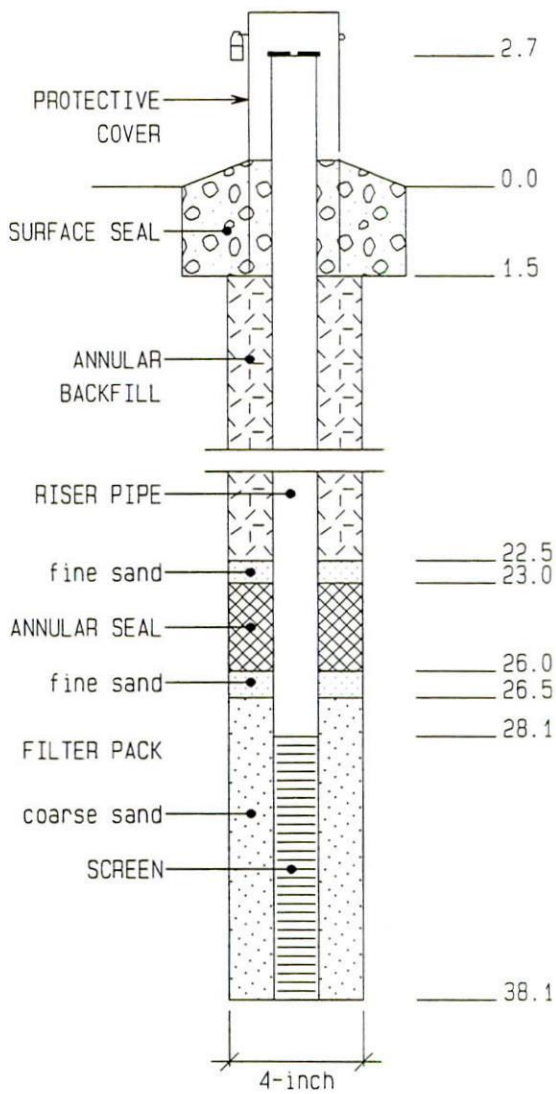
PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

PROJECT No. 331.22

TOP OF RISER PIPE: 1799.16ft
GROUND ELEVATION: 1796.5ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-6B
DATE: 07/22/97

NOT TO SCALE DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 40.75ft below top of riser pipe
WATER LEVEL: 14.41ft DATE: 8/1/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 10.0ft
Stratigraphic unit: Ithaca Formation

RISER PIPE
Material: PVC
Diameter: 2-inch Length: 30.75ft
Joint type: Flush-threaded
Standup: 2.66ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 12.1ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 3.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: Bentonite/Cement Grout
Length: 21.5ft
Placement Method: Tremie pipe

PROTECTIVE COVER
Material: Steel
Diameter: 6-inch Length: 5.0ft
Standup: 2.8ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/01/97
Method: Non-dedicated air lift pump

NOTES: Pumped dry after 8 gal. during development

Permanent 4-inch steel casing installed to 17.5'.

BARTON & LOGUIDICE, P.C.

INSTALLATION DETAIL

Well No. RI-MW-7A

Sheet 1 of 1

PROJECT: Old Cortland County Landfill RI/FS
CLIENT: Cortland County Department of Solid Waste
LOCATION: Town line Road, Town of Solon, New York

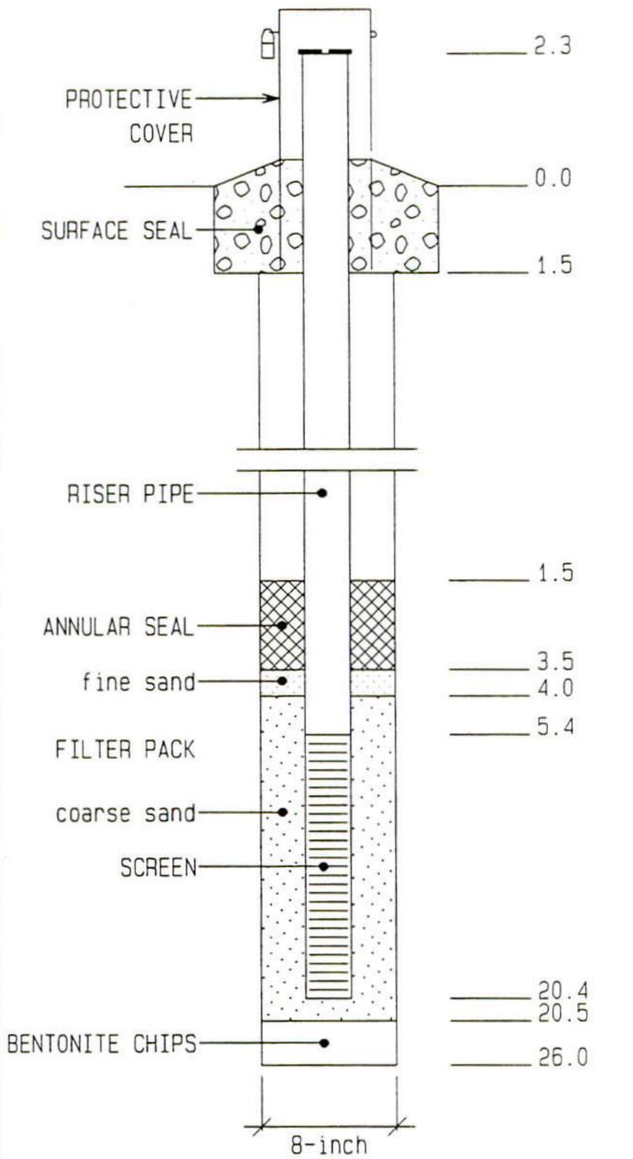
PROJECT No. 331.22

TOP OF RISER PIPE: 1747.30ft
GROUND ELEVATION: 1745.0ft
DATUM: NGVD

WELL TYPE: Groundwater Monitoring Well
INSTALLED AT: RI-MW-7A
DATE: 07/24/97

NOT TO SCALE

DEPTHS IN FEET



GEOLOGIST: James Gruppe
CONTRACTOR: North Star Drilling, Inc.

TOTAL WELL DEPTH: 22.65ft below top of riser pipe
WATER LEVEL: 6.22ft DATE: 8/4/97

SCREEN
Material: wire wrap PVC Slot size: 0.010-inch
Diameter: 2-inch Length: 15.0ft
Stratigraphic unit: Glacial Till

RISER PIPE
Material: PVC
Diameter: 2.0-inch Length: 7.65ft
Joint type: Flush-threaded
Standup: 2.30ft above ground level

FILTER PACK
Material: Sand size: #1 Morie
Fine Sand: #00 Morie
Total Length: 17.0ft
Placement Method: Gravity

ANNULAR SEAL
Material: Bentonite Chips
Length: 2.0ft
Placement method: Gravity

ANNULAR BACKFILL
Material: -
Length: ft
Placement Method:

PROTECTIVE COVER
Material: Steel
Diameter: 4-inch Length: 5.0ft
Standup: 2.8ft above ground level
Surface seal: Concrete

WELL DEVELOPMENT
Date: 08/04/97
Method: Non-dedicated air lift pump

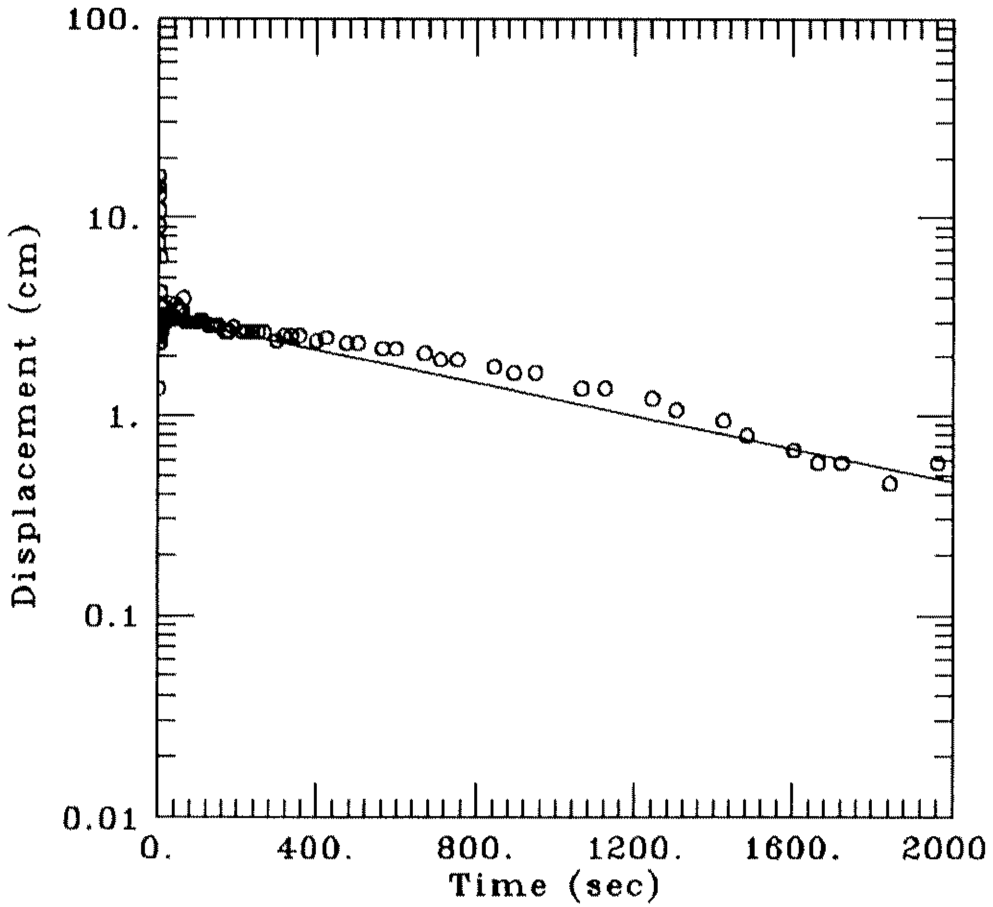
NOTES: Pumped dry after 14 gal. during development.

APPENDIX C

HYDRAULIC CONDUCTIVITY TEST RESULTS

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-1A Test 1 of 2 (falling head)



DATA SET:
mw1afh1.aqt
12/09/97

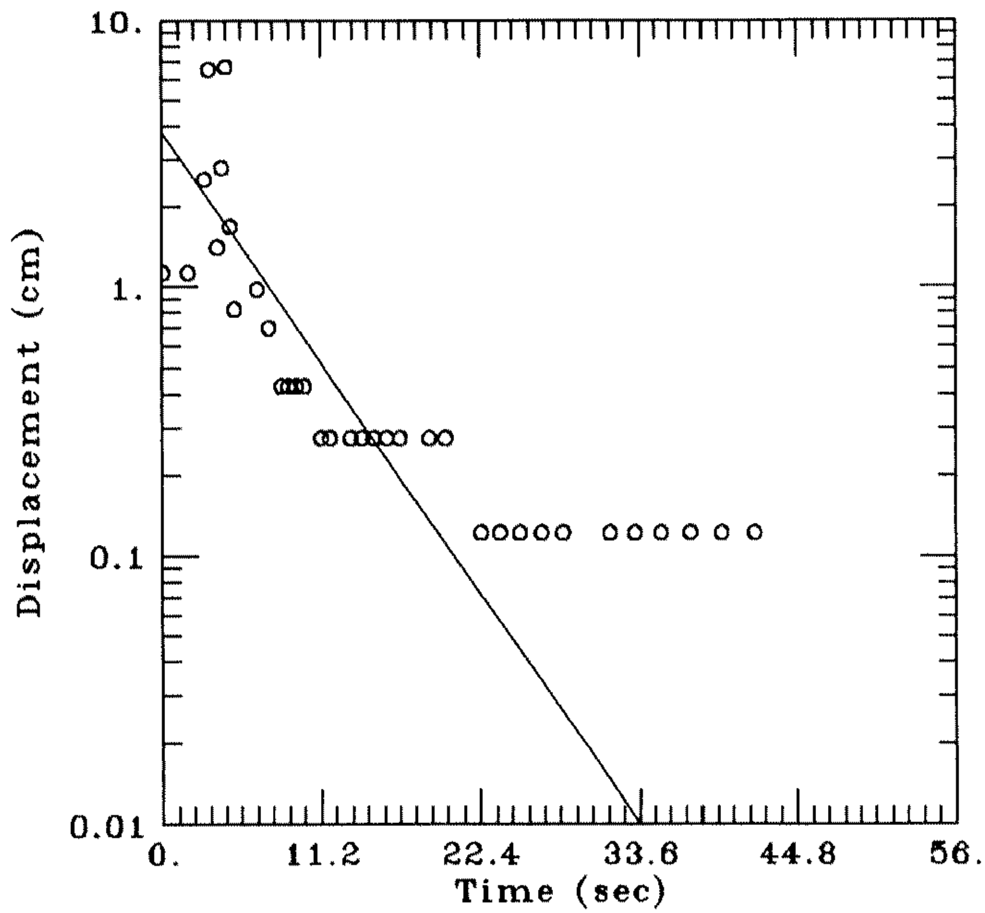
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-1a

ESTIMATED PARAMETERS:
K = 2.0009E-05 cm/sec
y0 = 3.199 cm

TEST DATA:
H0 = 15.97 cm
rc = 2.53 cm
rw = 10.15 cm
L = 502.9 cm
b = 757.4 cm
H = 757.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-1A Test 2 of 2 (rising head)



DATA SET:
mw1arh1.aqt
12/09/97

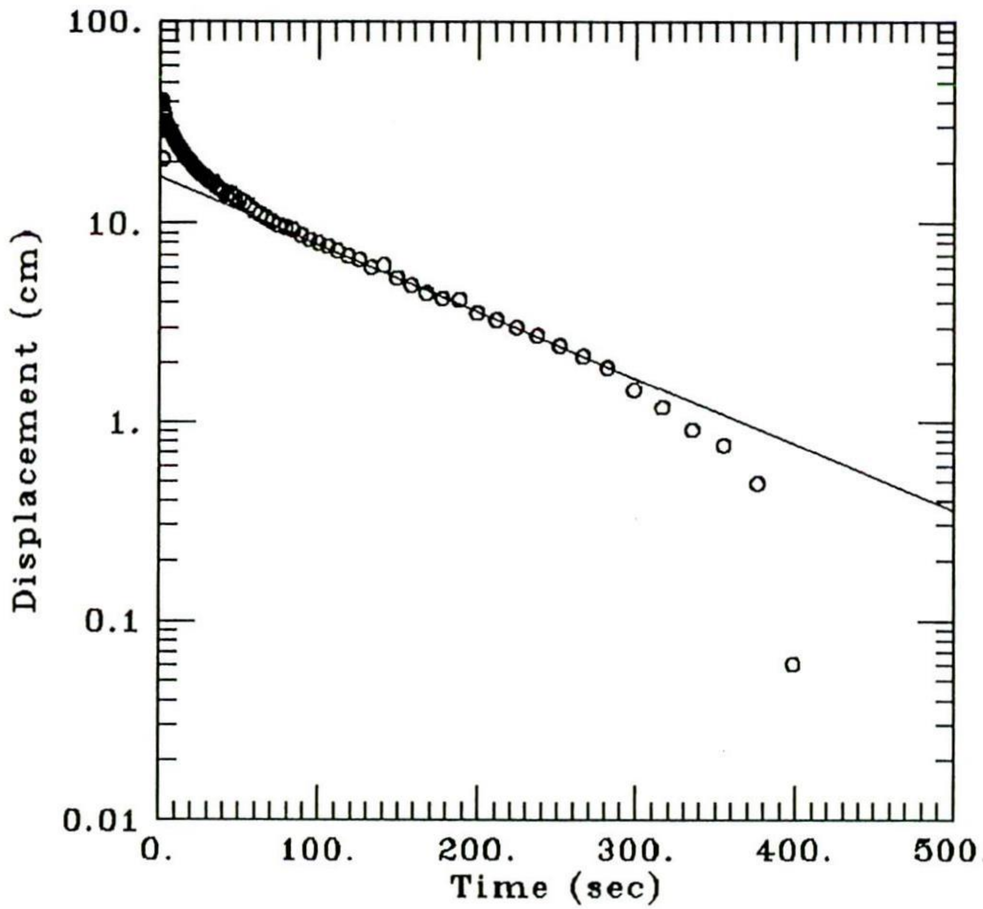
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-1a

ESTIMATED PARAMETERS:
K = 0.003659 cm/sec
y0 = 3.849 cm

TEST DATA:
H0 = 1.128 cm
rc = 2.53 cm
rw = 10.15 cm
L = 502.9 cm
b = 757.4 cm
H = 757.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-1B Test 1 of 4 (falling head)



DATA SET:
mw1bfh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined

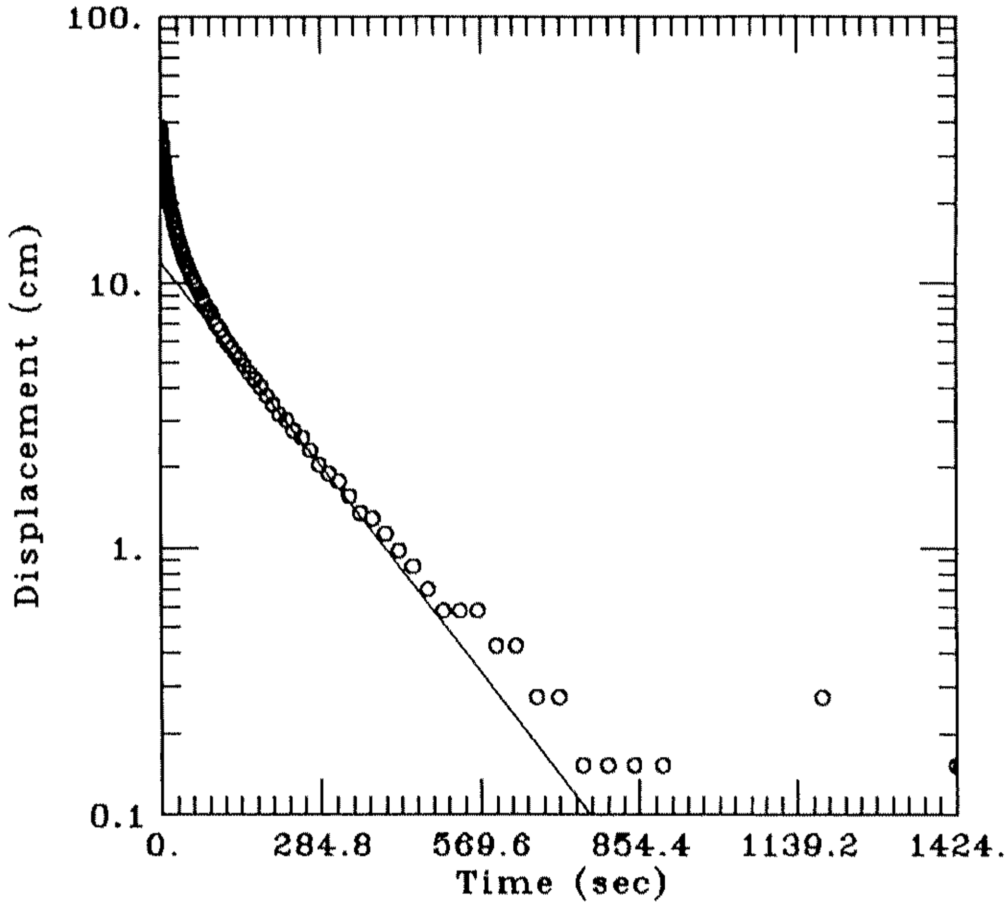
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0002794 cm/sec
y0 = 16.85 cm

TEST DATA:
H0 = 40.36 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 1448.7 cm
H = 1448.7 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-1B Test 2 of 4 (rising head)



DATA SET:
mw1brh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined

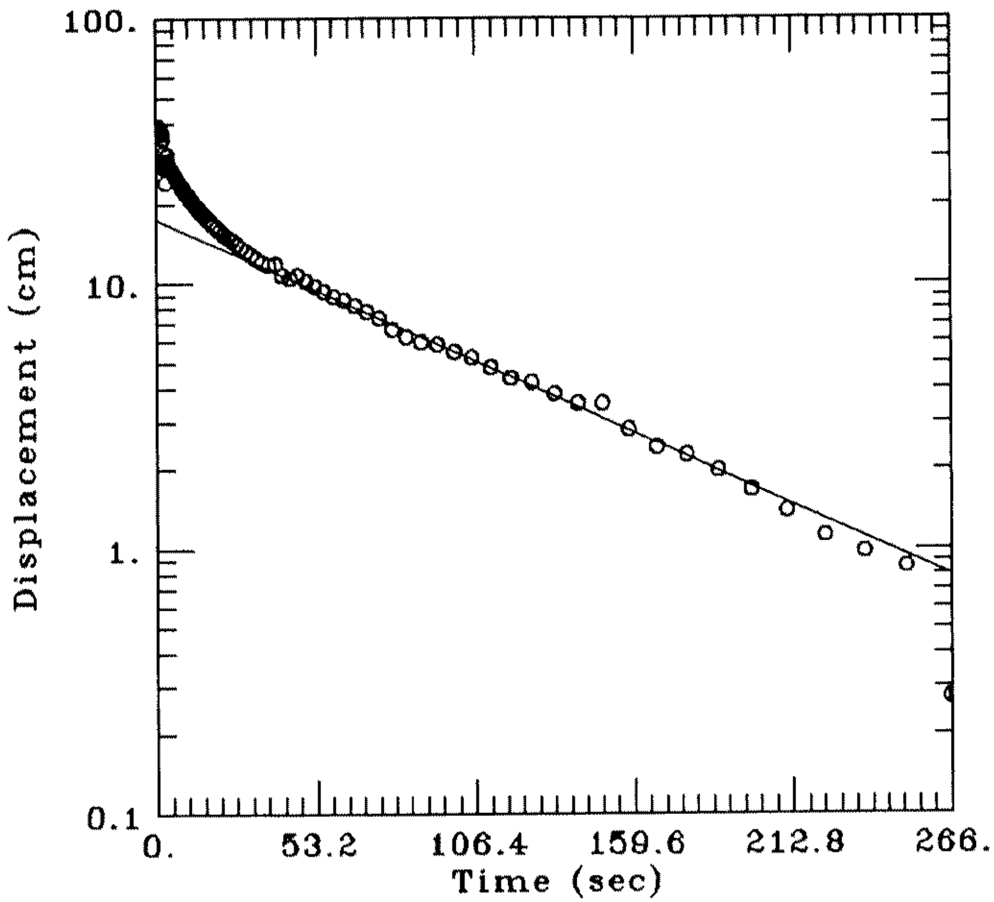
SOLUTION METHOD:
Bouwer-Rice

ESTIMATED PARAMETERS:
K = 0.0002267 cm/sec
y0 = 12.12 cm

TEST DATA:
H0 = 38.47 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 1448.7 cm
H = 1448.7 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-1B Test 3 of 4 (falling head)



DATA SET:
mw1bfh2.aqt
12/12/97

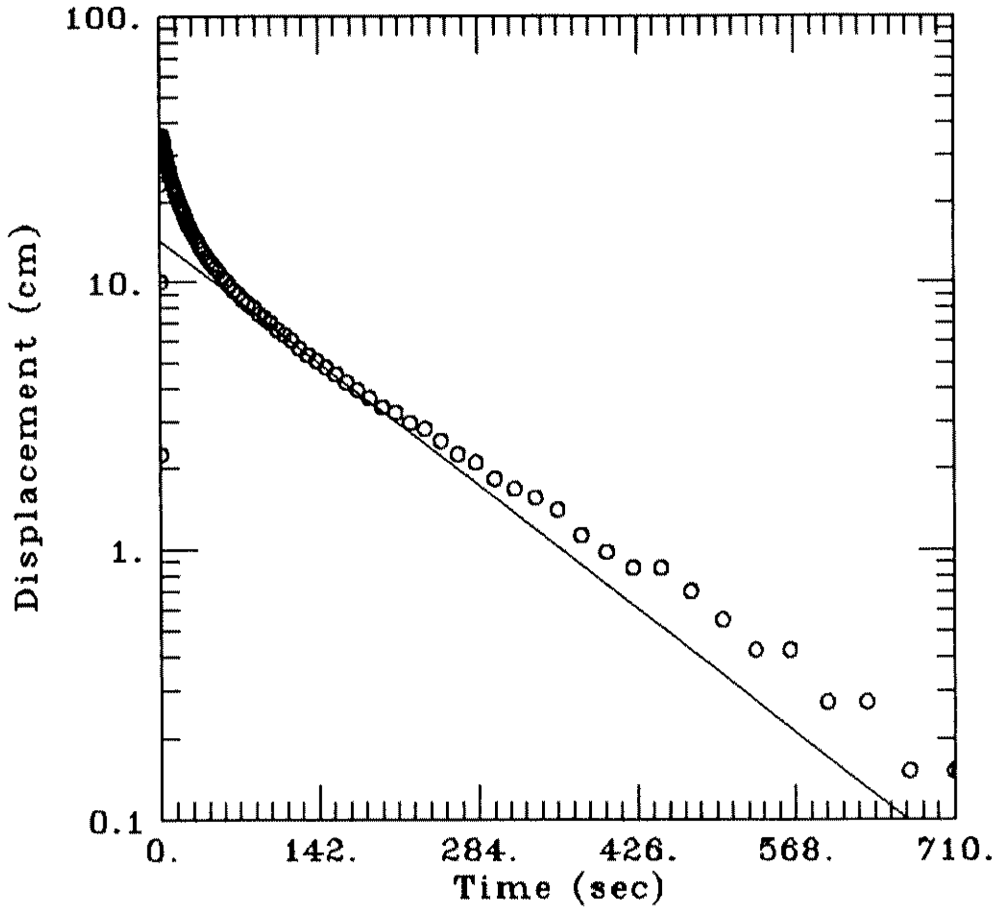
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-1b

ESTIMATED PARAMETERS:
K = 0.0004212 cm/sec
y0 = 17.52 cm

TEST DATA:
H0 = 39.32 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 1448.7 cm
H = 1448.7 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-1B Test 4 of 4 (rising head)



DATA SET:
mw1brh2.aqt
12/12/97

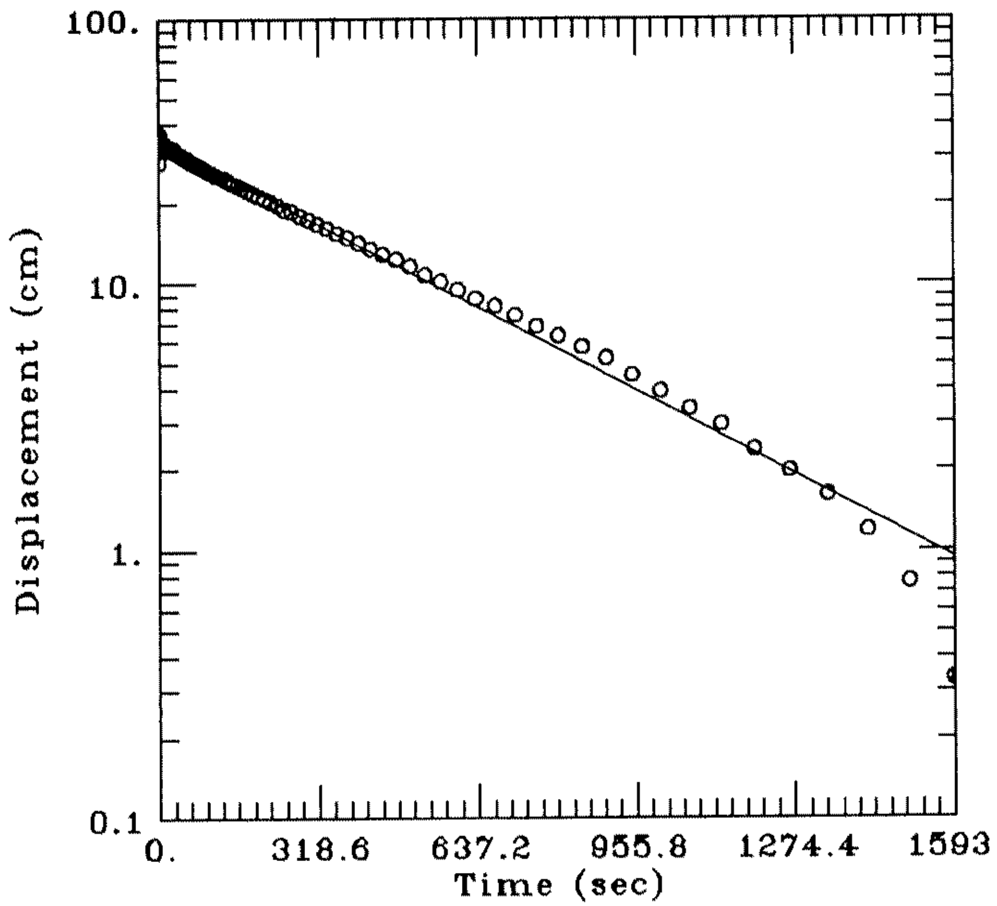
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-1b

ESTIMATED PARAMETERS:
K = 0.0002687 cm/sec
y0 = 14.37 cm

TEST DATA:
H0 = 35.78 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 1448.7 cm
H = 1448.7 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-2B Test 1 of 1 (falling head)



DATA SET:
mw2bfh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/3/97

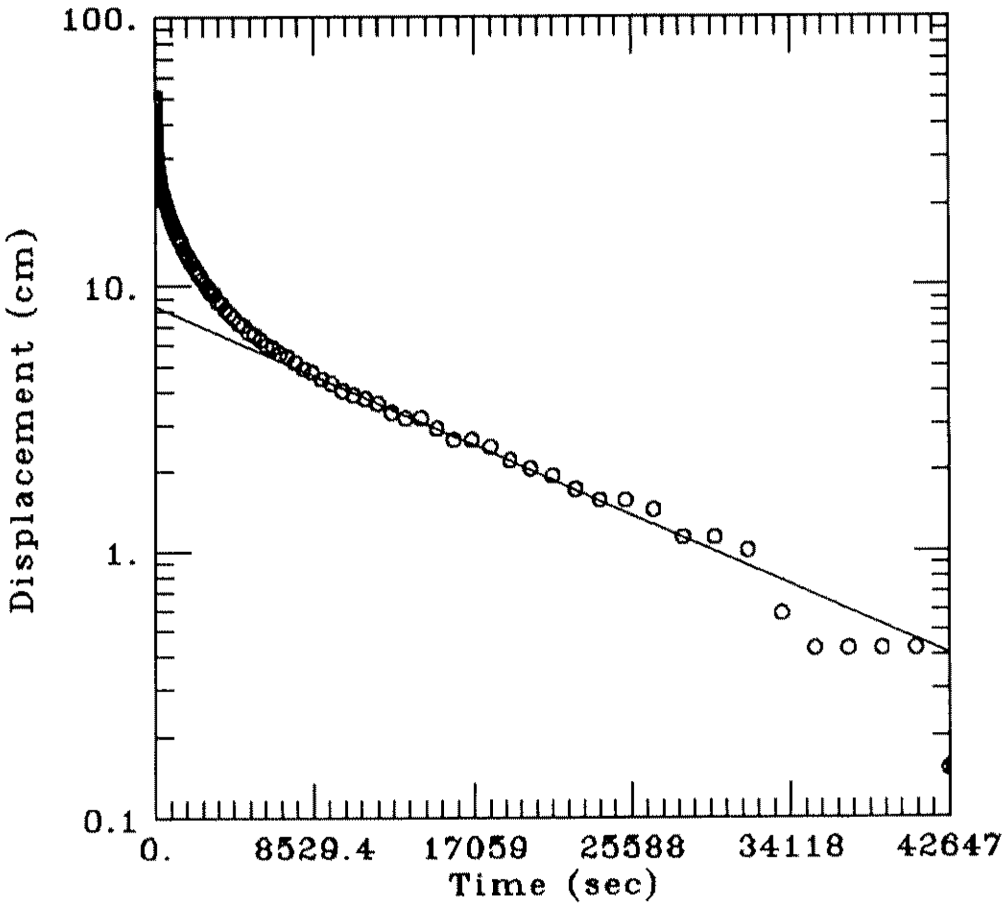
TEST WELL:
ri-mw-2b

ESTIMATED PARAMETERS:
K = 7.5454E-05 cm/sec
y0 = 34.26 cm

TEST DATA:
H0 = 36.64 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 841.6 cm
H = 841.6 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-3A Test 1 of 2 (falling head)



DATA SET:
mw3afh1.aqt
12/12/97

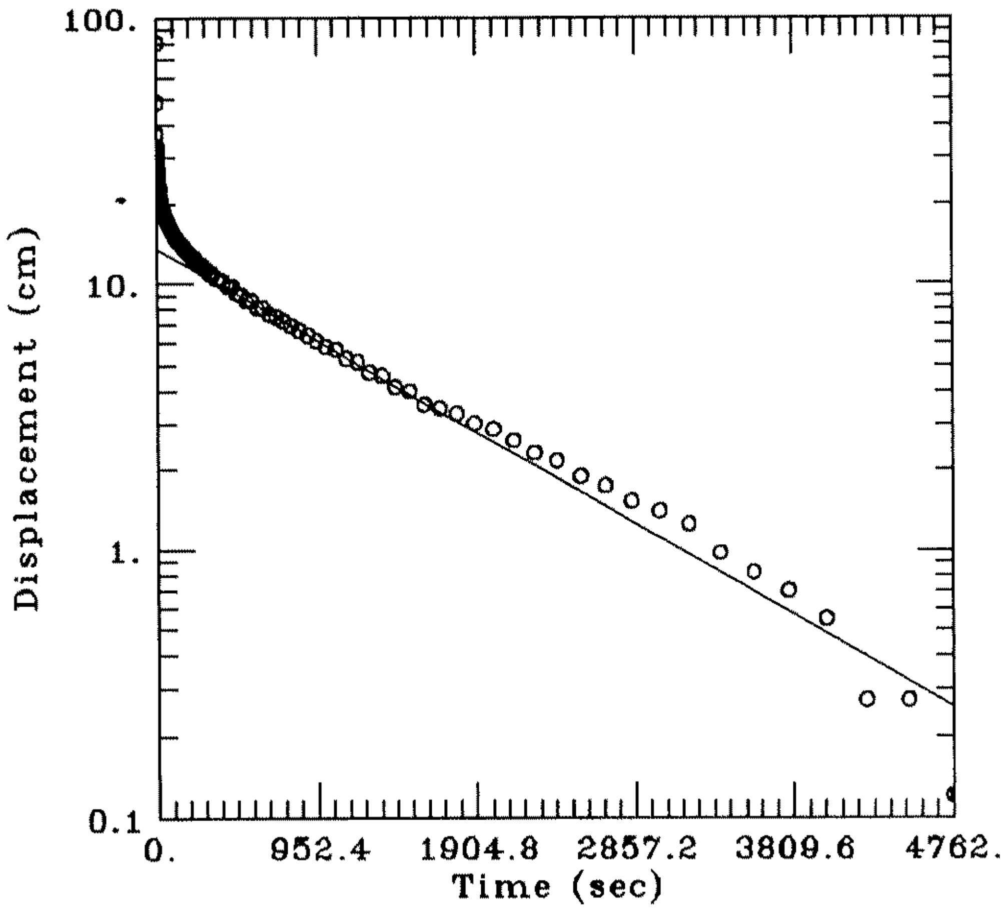
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/2/97
TEST WELL:
ri-mw-3a

ESTIMATED PARAMETERS:
K = 2.0092E-06 cm/sec
y0 = 8.388 cm

TEST DATA:
H0 = 50.78 cm
rc = 2.53 cm
rw = 5.09 cm
L = 374.9 cm
b = 380.1 cm
H = 380.1 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-3A Test 2 of 2 (rising head)



DATA SET:
mw3arh1.aqt
12/12/97

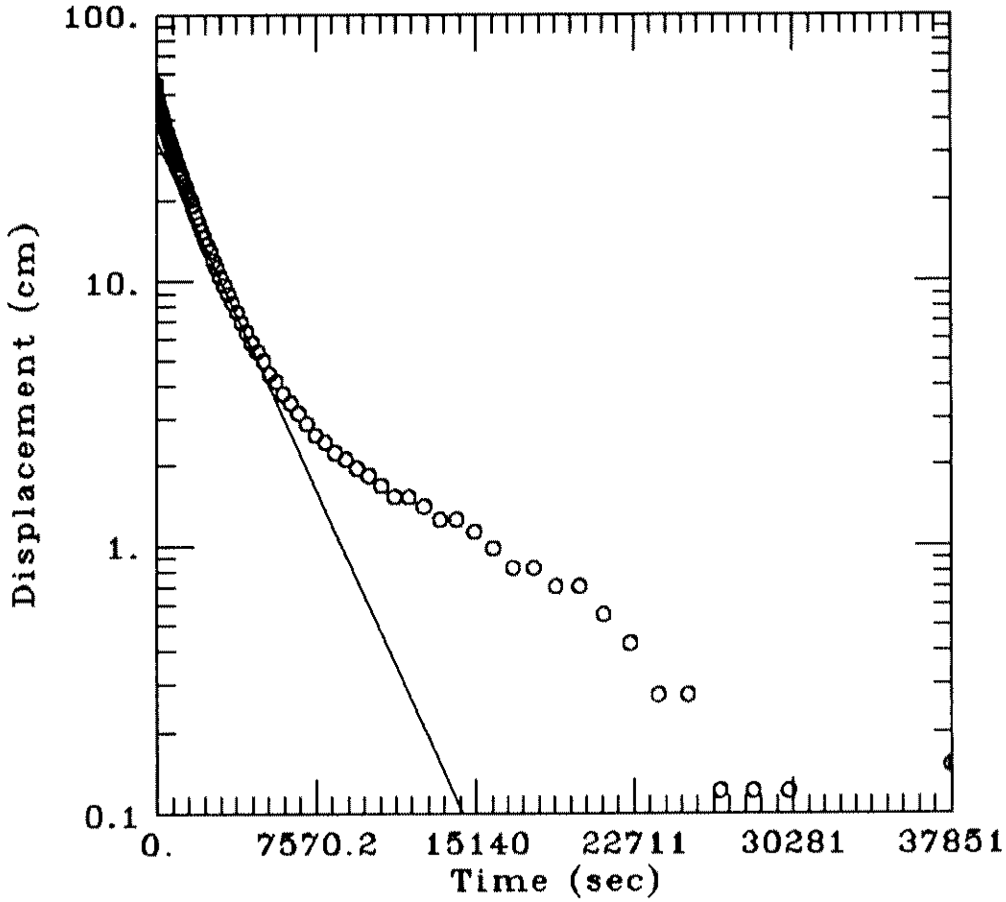
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-3a

ESTIMATED PARAMETERS:
K = 2.3509E-05 cm/sec
y0 = 13.5 cm

TEST DATA:
H0 = 80.83 cm
rc = 2.53 cm
rw = 5.09 cm
L = 374.9 cm
b = 380.1 cm
H = 380.1 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-3B Test 1 of 2 (falling head)



DATA SET:
mw3bfh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/2/97

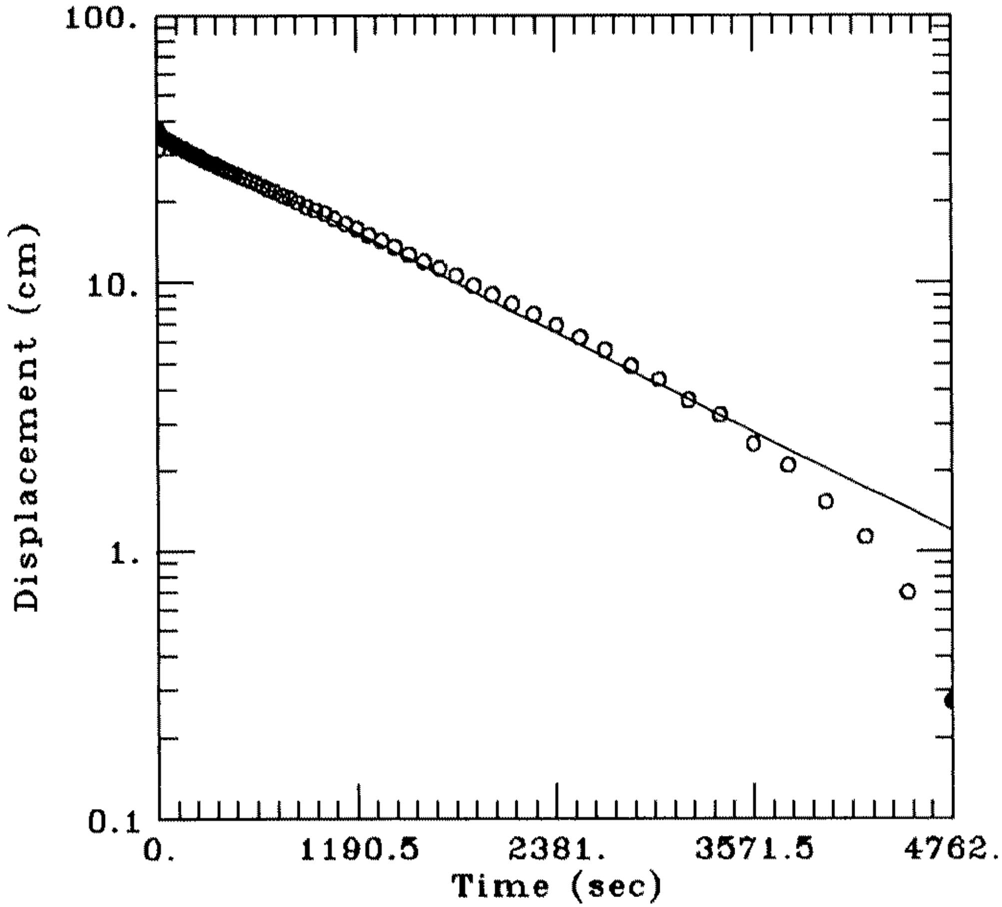
TEST WELL:
ri-mw-3b

ESTIMATED PARAMETERS:
K = 1.3325E-05 cm/sec
y0 = 34.04 cm

TEST DATA:
H0 = 54.68 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 832.1 cm
H = 832.1 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-3B Test 2 of 2 (rising head)



DATA SET:
mw3brh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/3/97

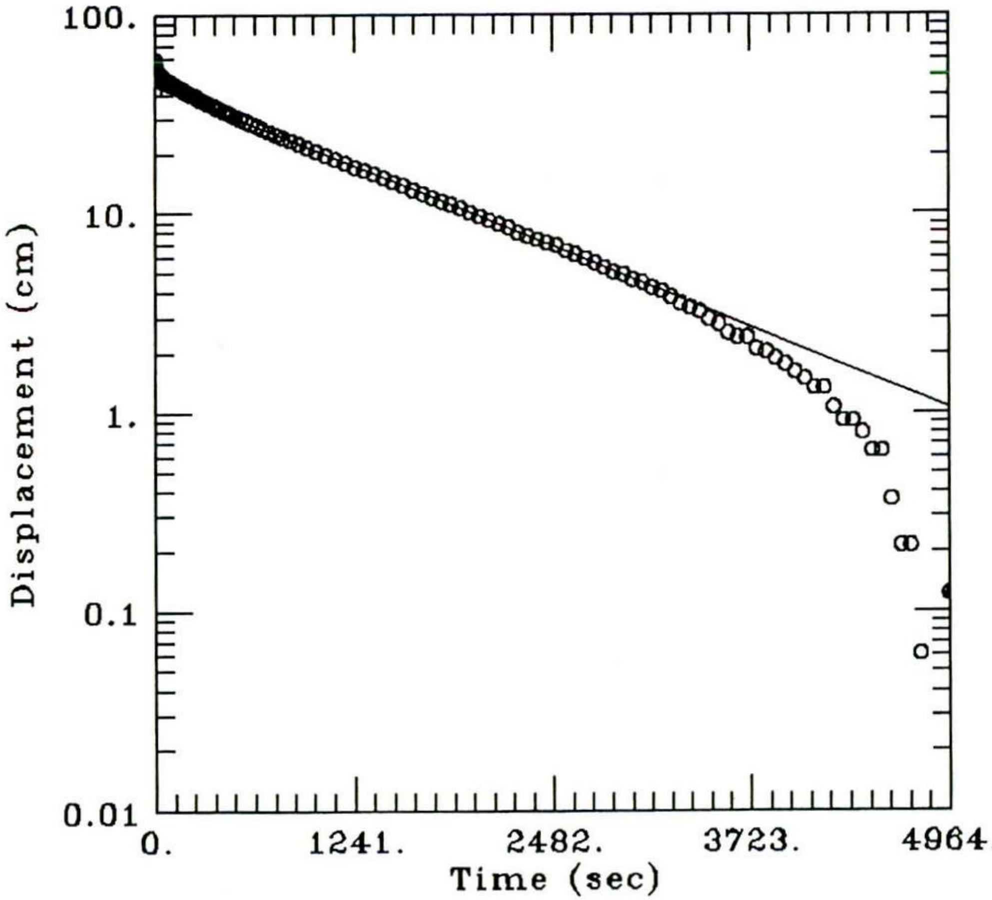
TEST WELL:
ri-mw-3b

ESTIMATED PARAMETERS:
K = 2.38E-05 cm/sec
y0 = 35.98 cm

TEST DATA:
H0 = 37.46 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 832.1 cm
H = 832.1 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-4A Test 1 of 3 (falling head)



DATA SET:
mw4afh1.aqt
12/16/97

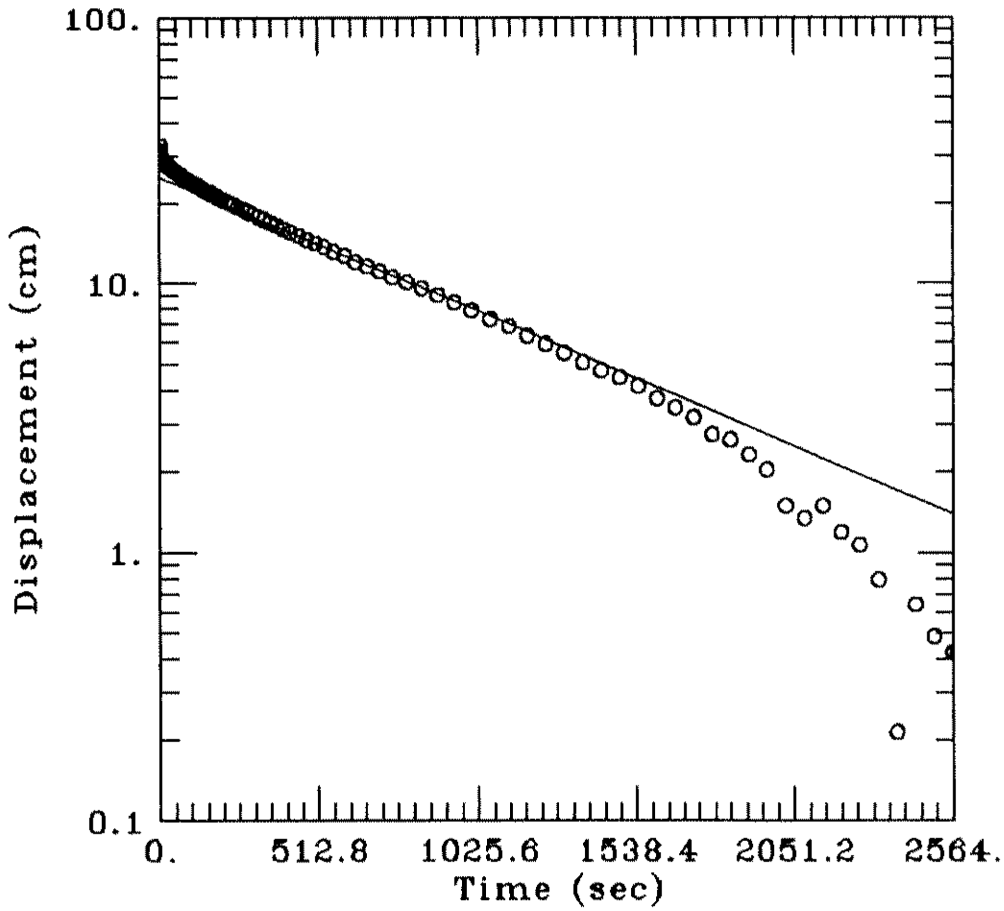
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/2/97
TEST WELL:
ri-mw-4a

ESTIMATED PARAMETERS:
K = 1.7538E-05 cm/sec
y0 = 44.51 cm

TEST DATA:
H0 = 59.19 cm
rc = 2.53 cm
rw = 5.09 cm
L = 518.2 cm
b = 715.7 cm
H = 715.7 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-4A Test 2 of 3 (rising head)



DATA SET:
mw4arh1.aqt
12/16/97

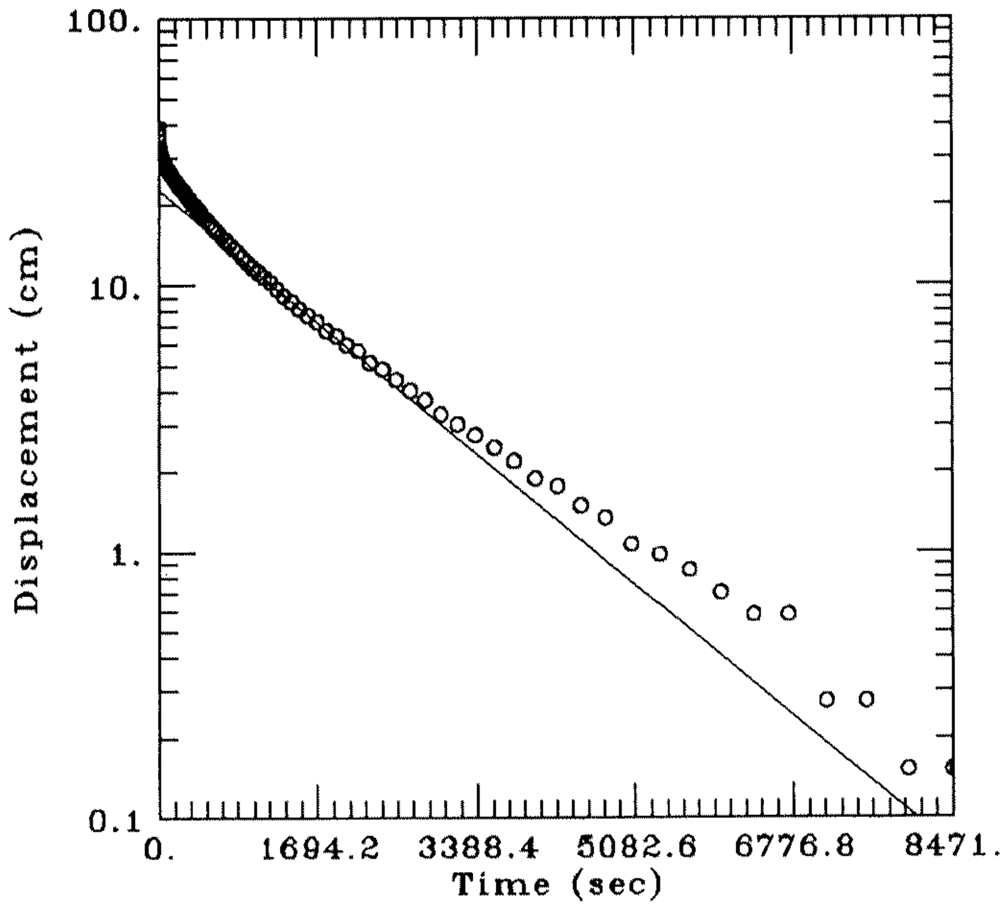
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/2/97
TEST WELL:
ri-mw-4a

ESTIMATED PARAMETERS:
K = 2.6151E-05 cm/sec
y0 = 24.89 cm

TEST DATA:
H0 = 31.21 cm
rc = 2.53 cm
rw = 5.09 cm
L = 518.2 cm
b = 715.7 cm
H = 715.7 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-4A Test 3 of 3 (falling head)



DATA SET:
mw4afh2.aqt
12/16/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/2/97

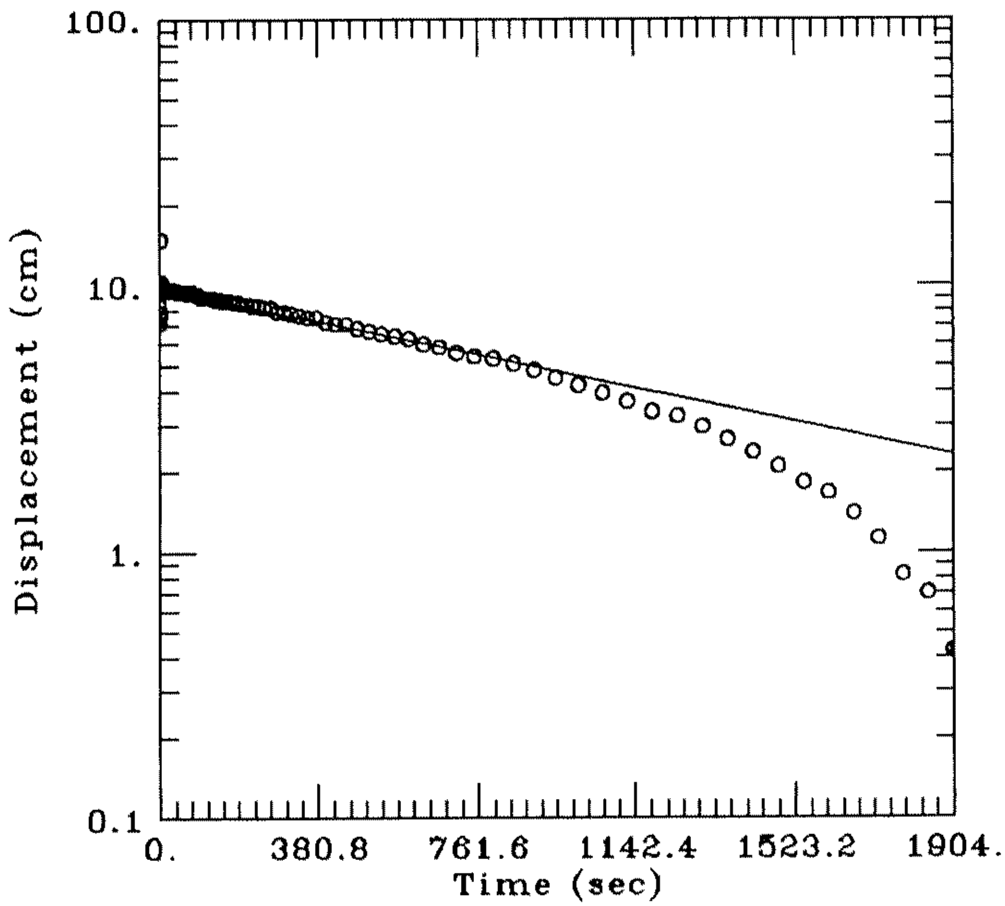
TEST WELL:
ri-mw-4a

ESTIMATED PARAMETERS:
K = 1.5605E-05 cm/sec
y0 = 22.61 cm

TEST DATA:
H0 = 38.95 cm
rc = 2.53 cm
rw = 5.09 cm
L = 518.2 cm
b = 715.7 cm
H = 715.7 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-5A Test 1 of 3 (falling head)



DATA SET:
mw5afh1.aqt
01/06/98

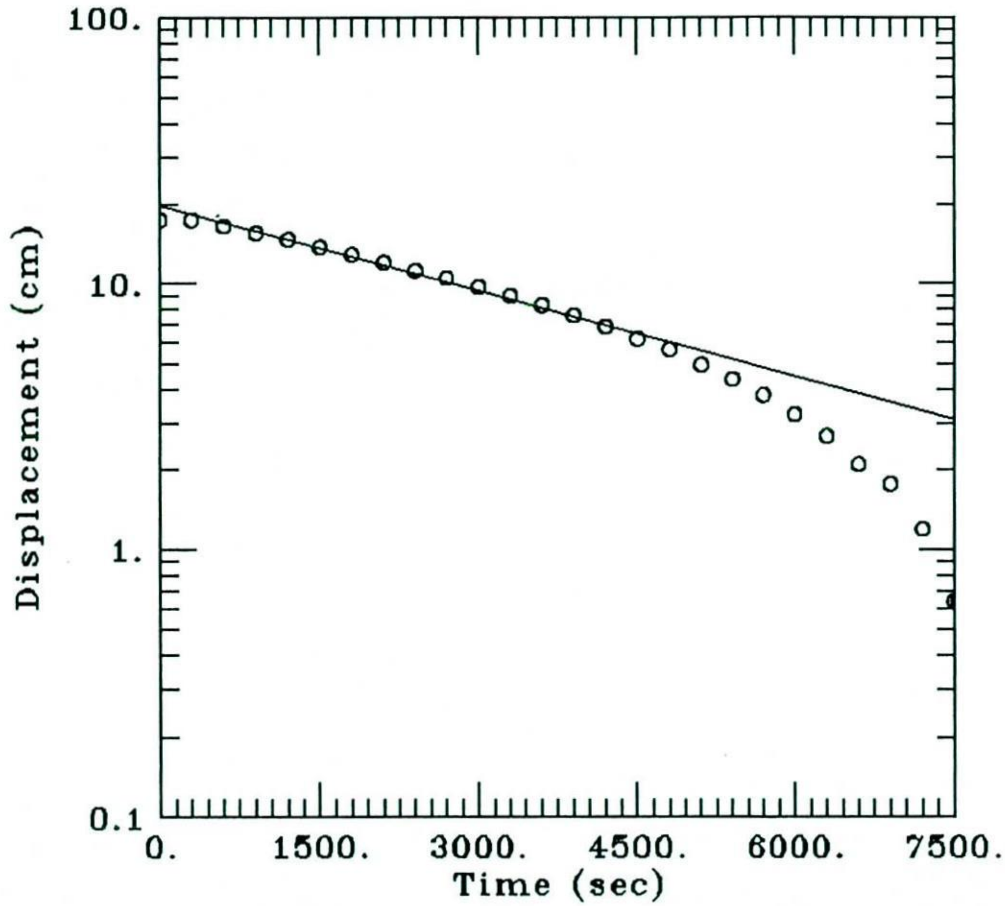
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/2/97
TEST WELL:
ri-mw-5a

ESTIMATED PARAMETERS:
K = 1.7998E-05 cm/sec
y0 = 9.664 cm

TEST DATA:
H0 = 14.9 cm
rc = 2.53 cm
rw = 5.09 cm
L = 512.1 cm
b = 796.4 cm
H = 796.4 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-5A Test 2 of 3 (falling head)



DATA SET:
mw5afh1a.aqt
01/06/98

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/2/97

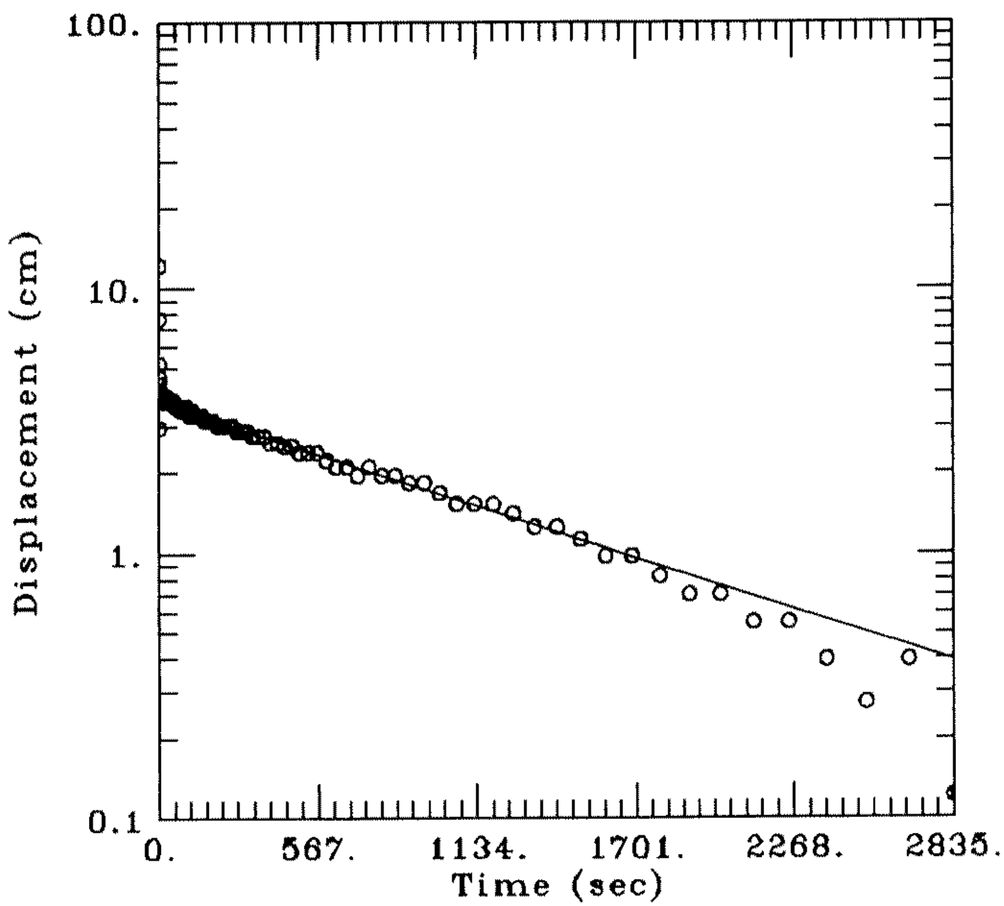
TEST WELL:
ri-mw-5a

ESTIMATED PARAMETERS:
K = 5.931E-06 cm/sec
y0 = 19.81 cm

TEST DATA:
H0 = 17.43 cm
rc = 2.53 cm
rw = 5.09 cm
L = 512.1 cm
b = 796.4 cm
H = 796.4 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-5A Test 3 of 3 (rising head)



DATA SET:
mw5arh1.aqt
12/16/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/2/97

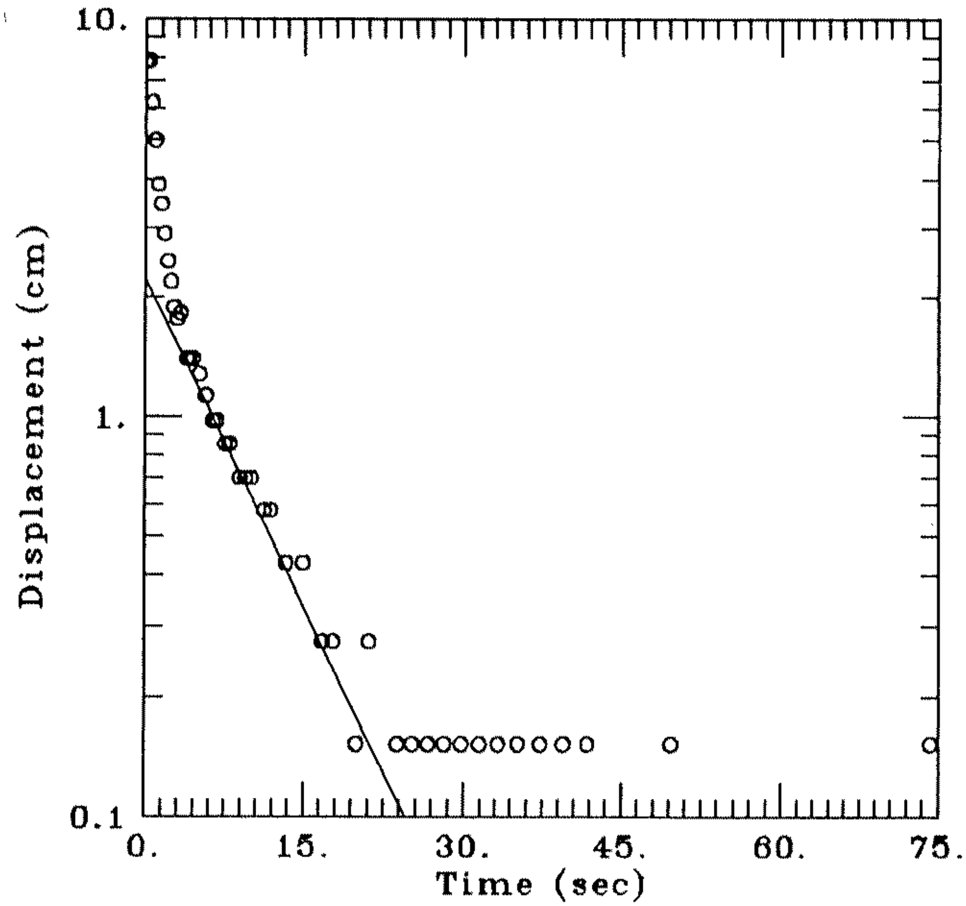
TEST WELL:
ri-mw-5a

ESTIMATED PARAMETERS:
K = 1.8777E-05 cm/sec
y0 = 3.638 cm

TEST DATA:
H0 = 12.16 cm
rc = 2.53 cm
rw = 5.09 cm
L = 512.1 cm
b = 796.4 cm
H = 796.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-6A Test 2 of 4 (rising head)



DATA SET:
mw6arh1.aqt
12/12/97

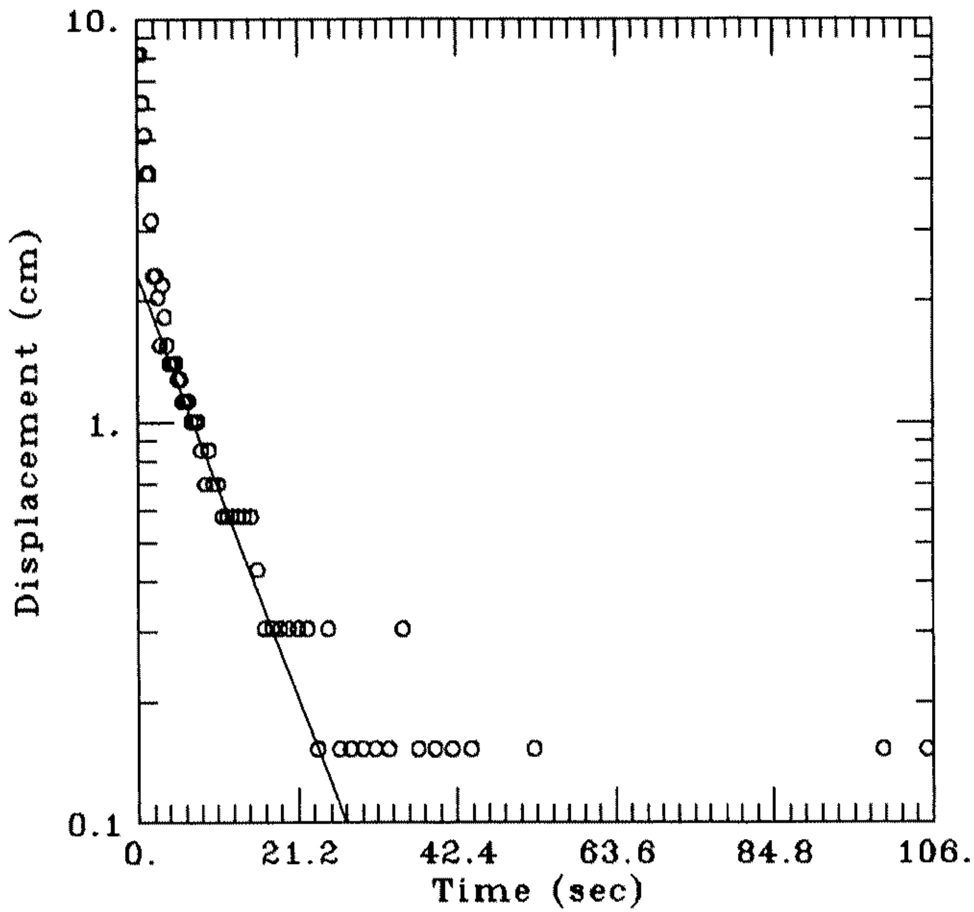
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-6a

ESTIMATED PARAMETERS:
K = 0.002047 cm/sec
y0 = 2.239 cm

TEST DATA:
H0 = 7.864 cm
rc = 2.53 cm
rw = 10.15 cm
L = 457.2 cm
b = 186.5 cm
H = 186.5 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-6A Test 4 of 4 (rising head)



DATA SET:
mw6arh2.aqt
12/12/97

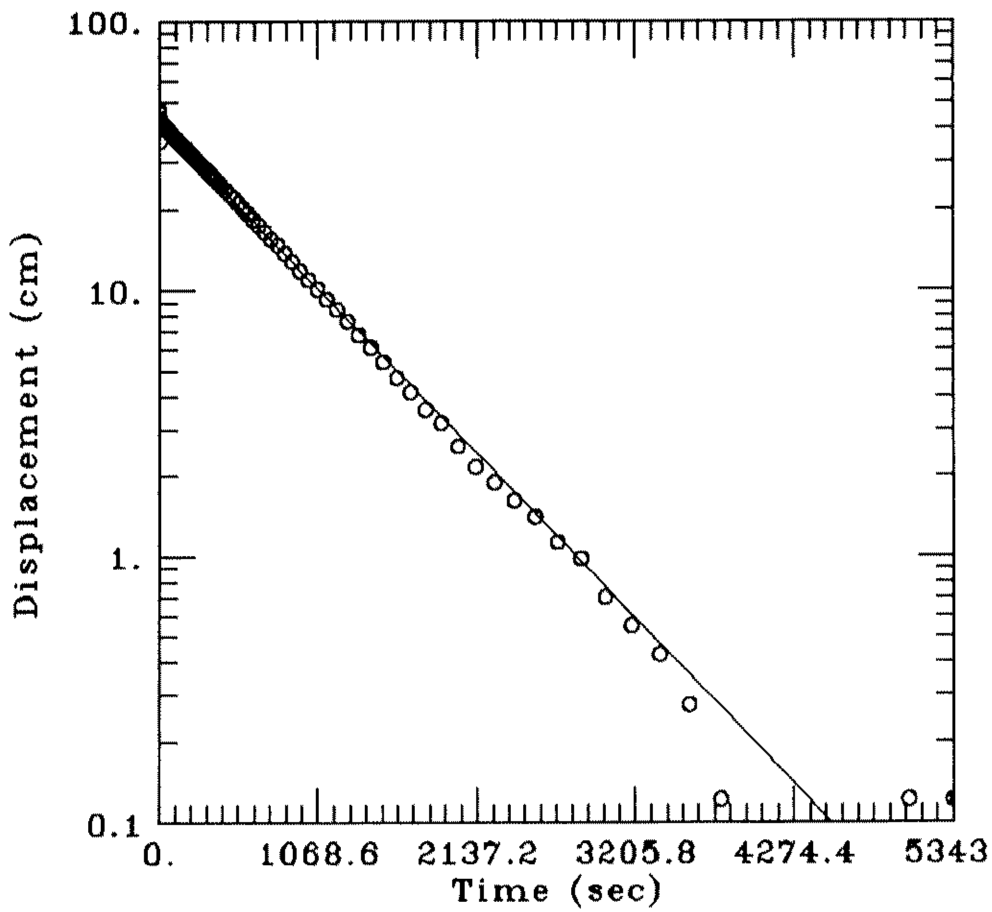
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-6a

ESTIMATED PARAMETERS:
K = 0.001853 cm/sec
y0 = 2.329 cm

TEST DATA:
H0 = 8.169 cm
rc = 2.53 cm
rw = 10.15 cm
L = 457.2 cm
b = 186.5 cm
H = 186.5 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-6B Test 1 of 2 (falling head)



DATA SET:
mw6bfh1.aqt
12/16/97

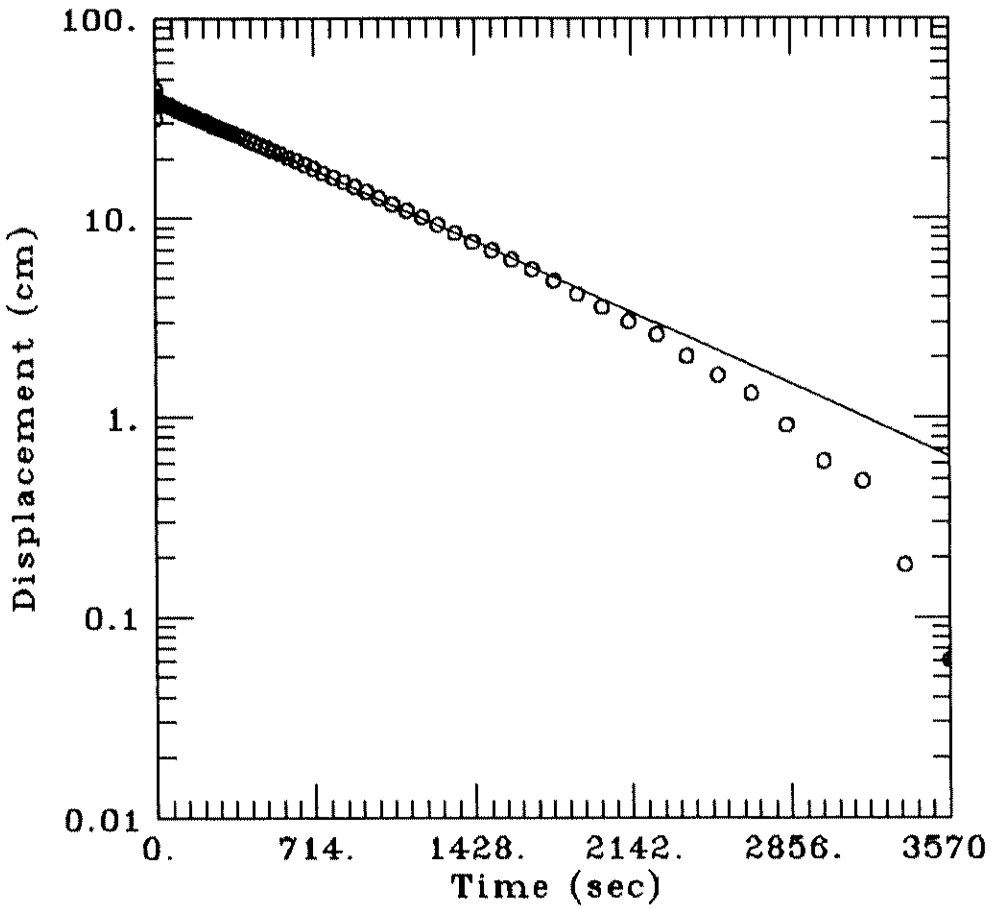
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-6b

ESTIMATED PARAMETERS:
K = 4.4556E-05 cm/sec
y0 = 42.65 cm

TEST DATA:
H0 = 45.96 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 844.3 cm
H = 844.3 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-6B Test 2 of 2 (rising head)



DATA SET:
mw6brh1.aqt
12/16/97

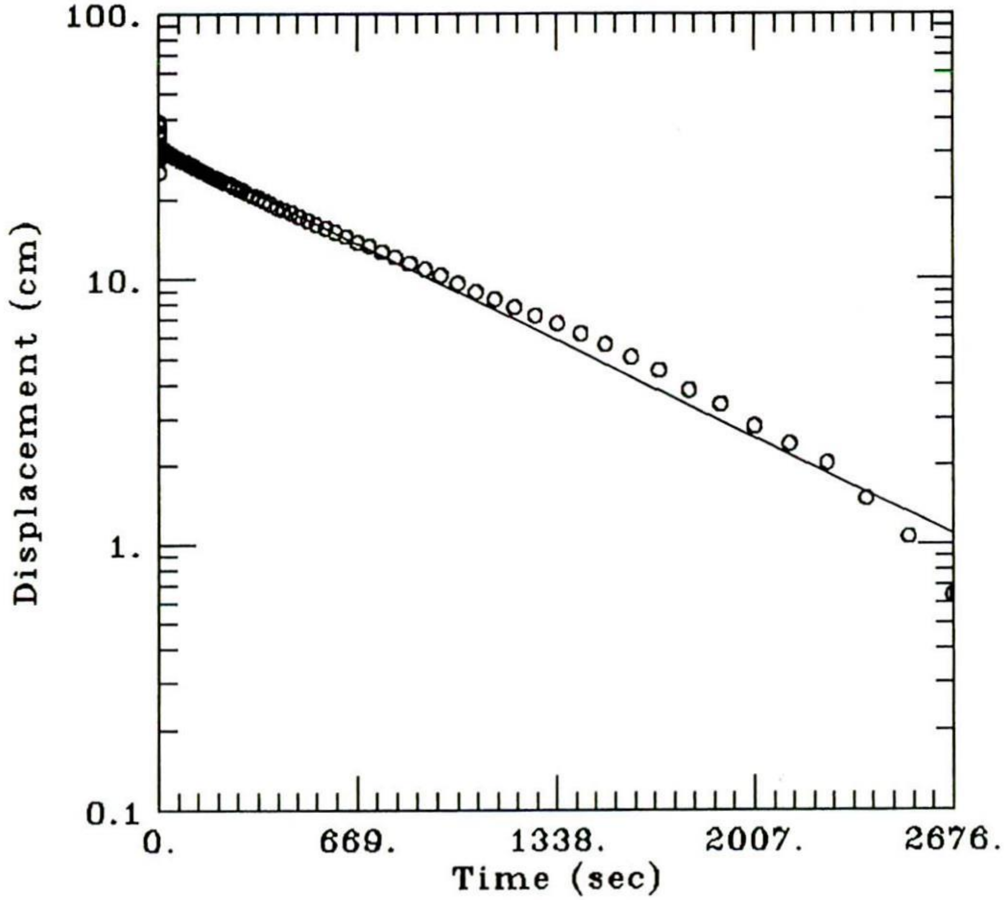
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-6b

ESTIMATED PARAMETERS:
K = 3.8441E-05 cm/sec
y0 = 39.58 cm

TEST DATA:
H0 = 44.14 cm
rc = 2.53 cm
rw = 5.09 cm
L = 365.8 cm
b = 844.3 cm
H = 844.3 cm

Barton & Loguidice, P.C.	Client: **Cortland County**
Project No.: **331.22**	Location: **Old Cortland County Landfill**

RI-MW-7A Test 1 of 2 (falling head)



DATA SET:
mw7afh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/3/97

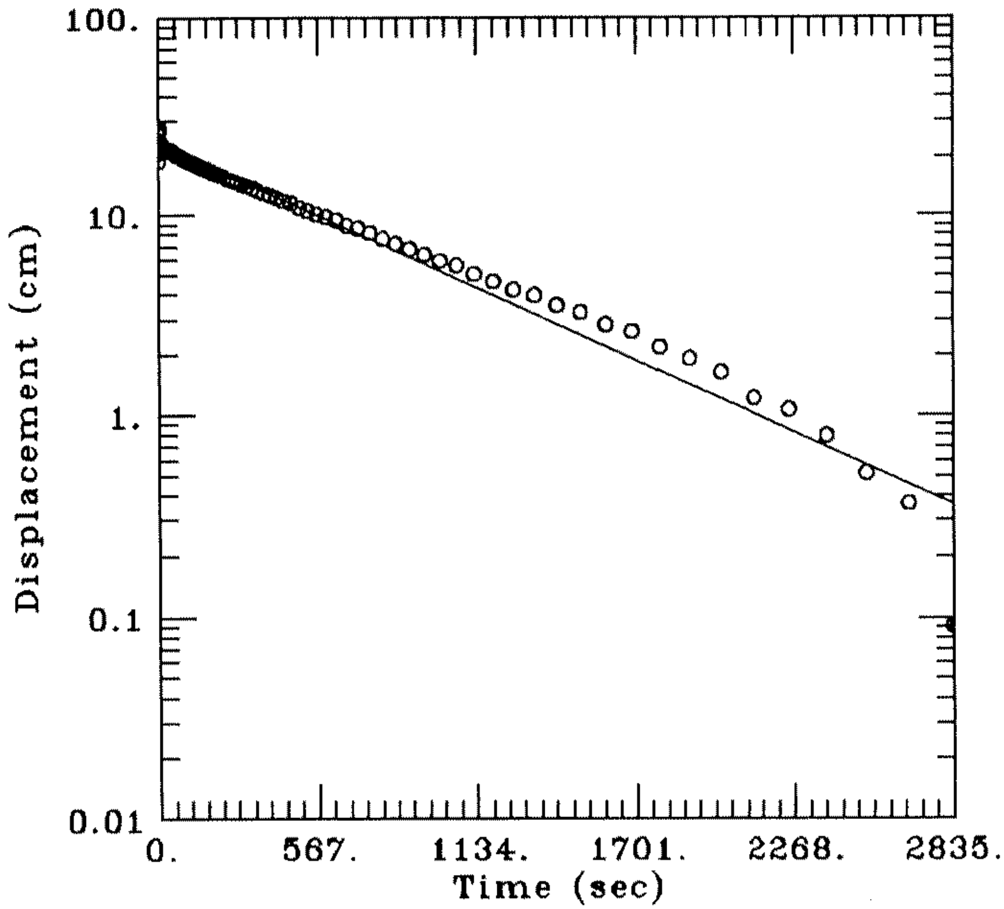
TEST WELL:
ri-mw7a

ESTIMATED PARAMETERS:
K = 2.4147E-05 cm/sec
y0 = 31.61 cm

TEST DATA:
H0 = 39.01 cm
rc = 2.53 cm
rw = 10.15 cm
L = 515.1 cm
b = 585.8 cm
H = 585.8 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

RI-MW-7A Test 2 of 2 (rising head)



DATA SET:
mw7arh1.aqt
12/12/97

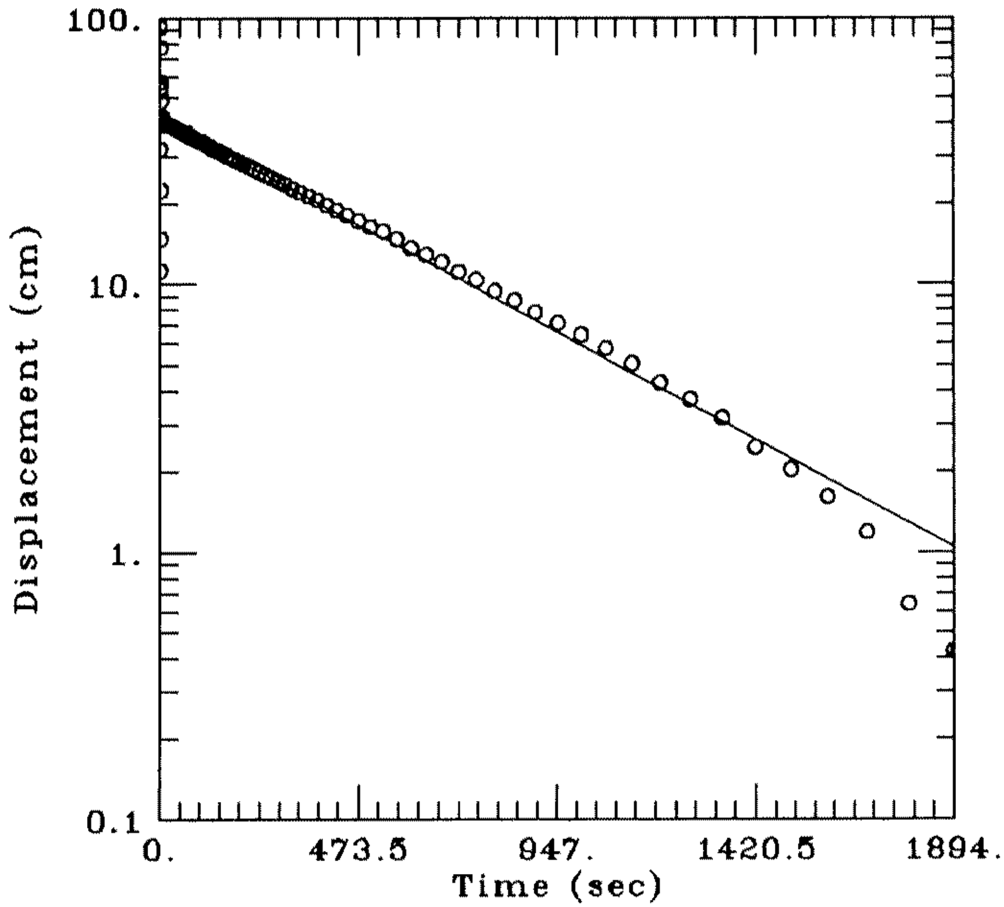
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
ri-mw-7a

ESTIMATED PARAMETERS:
K = 2.8188E-05 cm/sec
y0 = 23.01 cm

TEST DATA:
H0 = 27.71 cm
rc = 2.53 cm
rw = 10.15 cm
L = 515.1 cm
b = 585.8 cm
H = 585.8 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

CD-1 Test 1 of 2 (falling head)



DATA SET:
cd1fh1.aqt
12/16/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/3/97

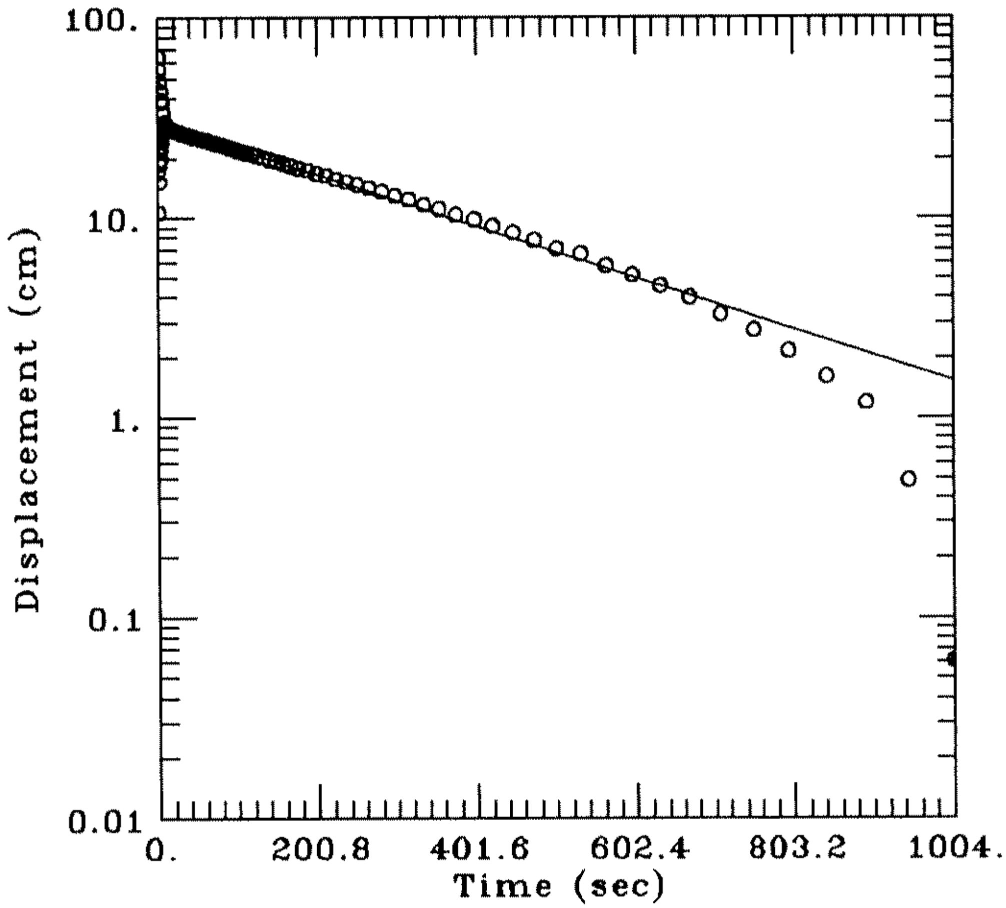
TEST WELL:
cd-1

ESTIMATED PARAMETERS:
K = 6.4325E-05 cm/sec
y0 = 42.09 cm

TEST DATA:
H0 = 92.38 cm
rc = 2.53 cm
rw = 5.09 cm
L = 335.3 cm
b = 487.4 cm
H = 487.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

CD-1 Test 2 of 2 (rising head)



DATA SET:
cd1rh1.aqt
12/16/97

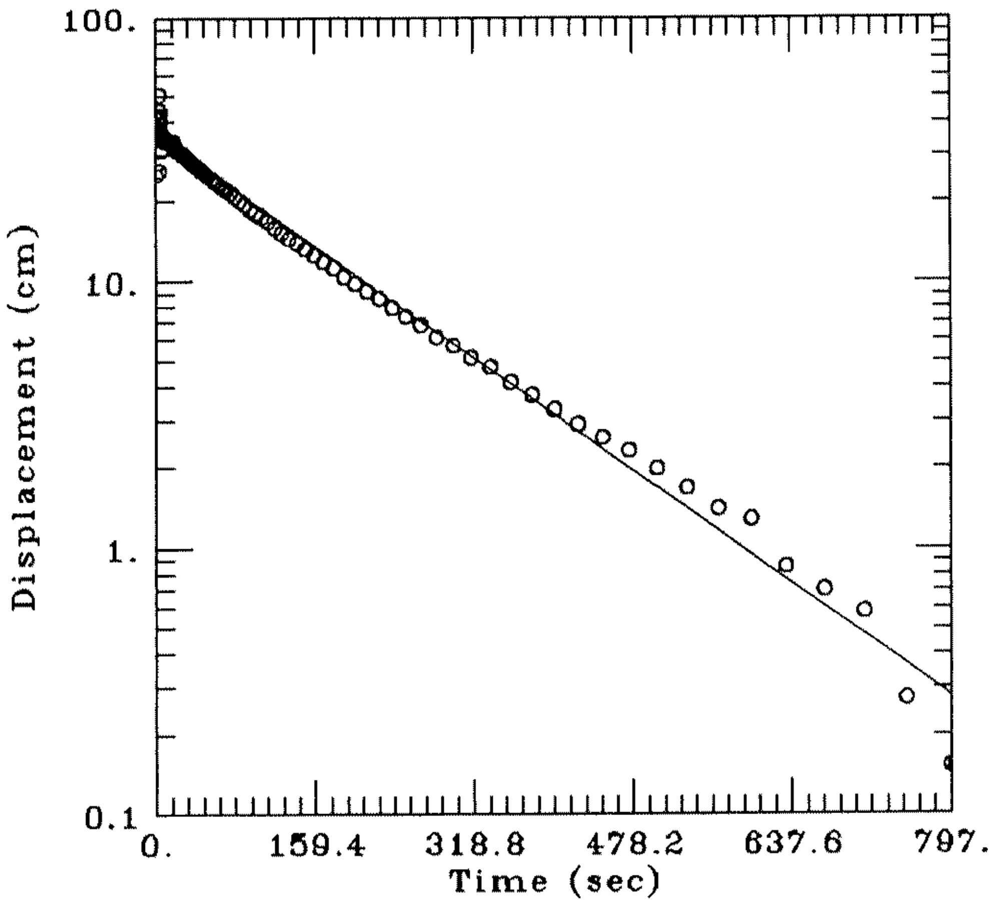
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
cd-1

ESTIMATED PARAMETERS:
K = 9.7612E-05 cm/sec
y0 = 29.89 cm

TEST DATA:
H0 = 64.47 cm
rc = 2.53 cm
rw = 5.09 cm
L = 335.3 cm
b = 487.4 cm
H = 487.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

CD-1RA Test 1 of 2 (falling head)



DATA SET:
cd1rafh1.aqt
01/06/98

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/2/97

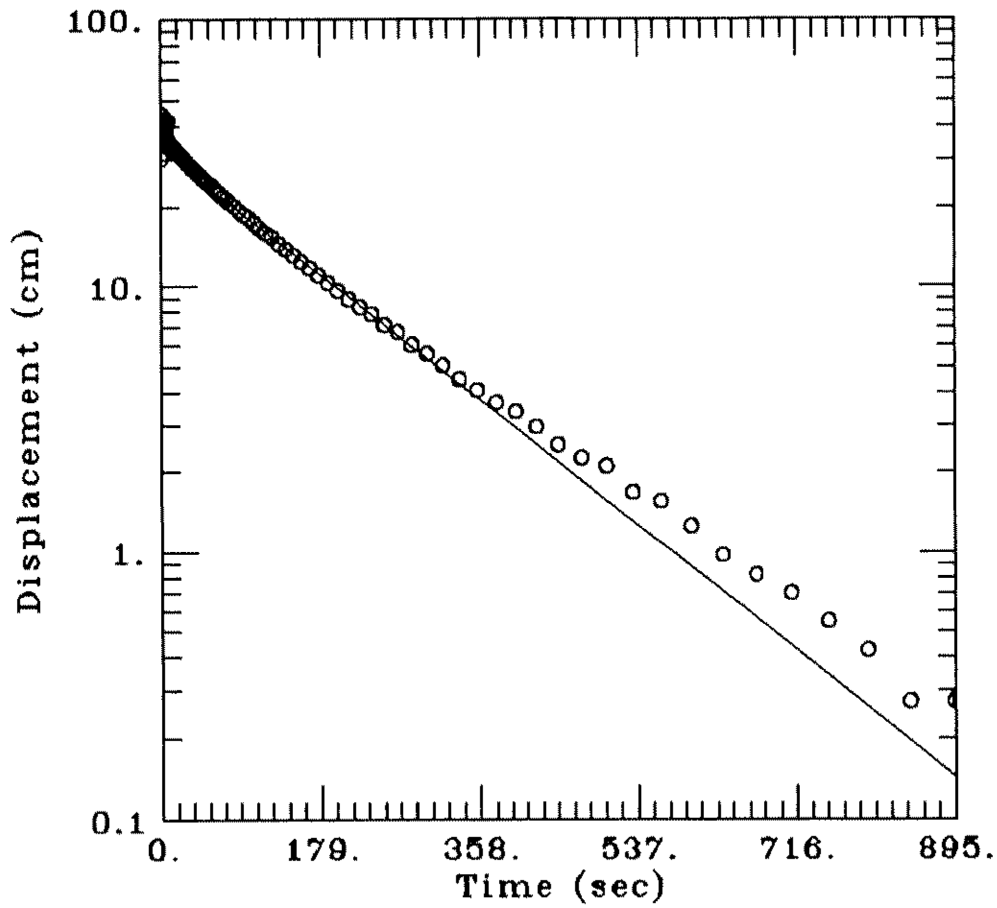
TEST WELL:
cd-1ra

ESTIMATED PARAMETERS:
K = 0.0001281 cm/sec
y0 = 35.78 cm

TEST DATA:
H0 = 37.55 cm
rc = 2.53 cm
rw = 5.09 cm
L = 640.1 cm
b = 1336.6 cm
H = 1336.6 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

CD-1RA Test 2 of 2 (rising head)



DATA SET:
cd1rarh1.aqt
01/06/98

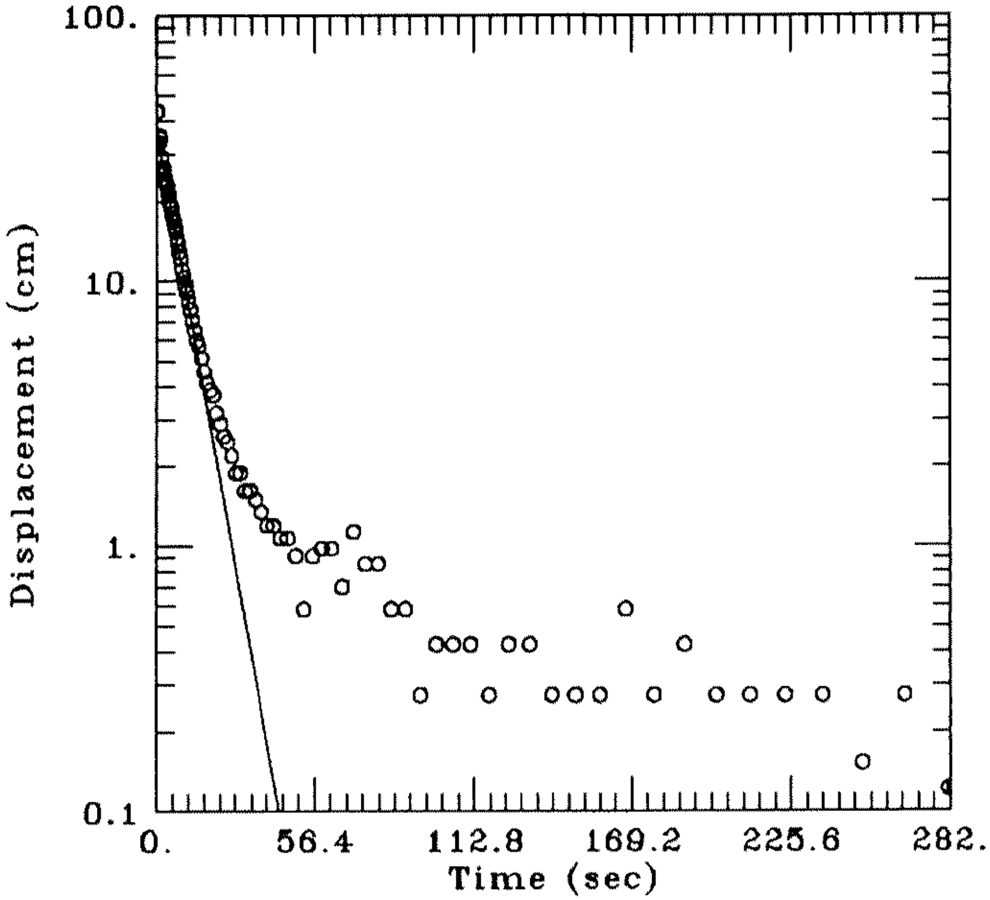
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/2/97
TEST WELL:
cd-1ra

ESTIMATED PARAMETERS:
K = 0.0001276 cm/sec
y0 = 32.99 cm

TEST DATA:
H0 = 44.5 cm
rc = 2.53 cm
rw = 5.09 cm
L = 640.1 cm
b = 1336.6 cm
H = 1336.6 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

D-1 Test 1 of 2 (falling head)



DATA SET:
d1fh1.aqt
12/16/97

AQUIFER TYPE:
Unconfined

SOLUTION METHOD:
Bouwer-Rice

TEST DATE:
10/3/97

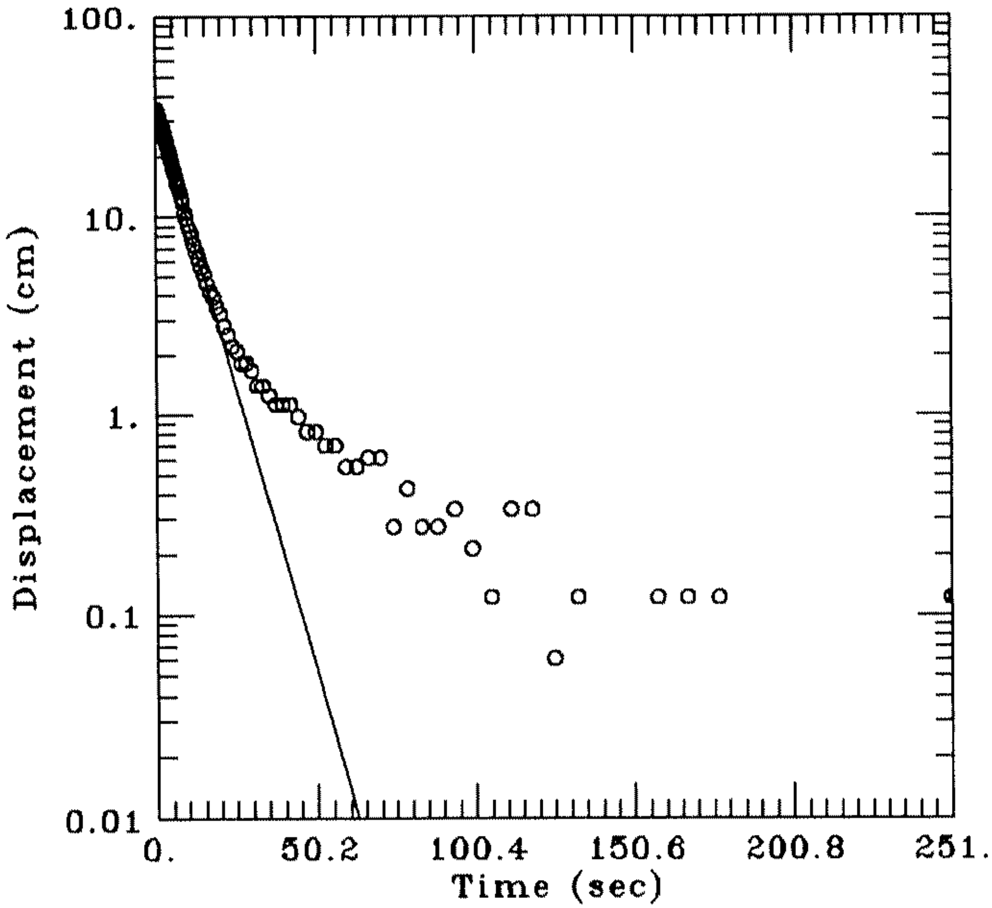
TEST WELL:
d-1

ESTIMATED PARAMETERS:
K = 0.003483 cm/sec
y0 = 38.14 cm

TEST DATA:
H0 = 43.74 cm
rc = 2.53 cm
rw = 5.09 cm
L = 624.8 cm
b = 5208.4 cm
H = 5208.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

D-1 Test 2 of 2 (rising head)



DATA SET:
d1rh1.aqt
12/16/97

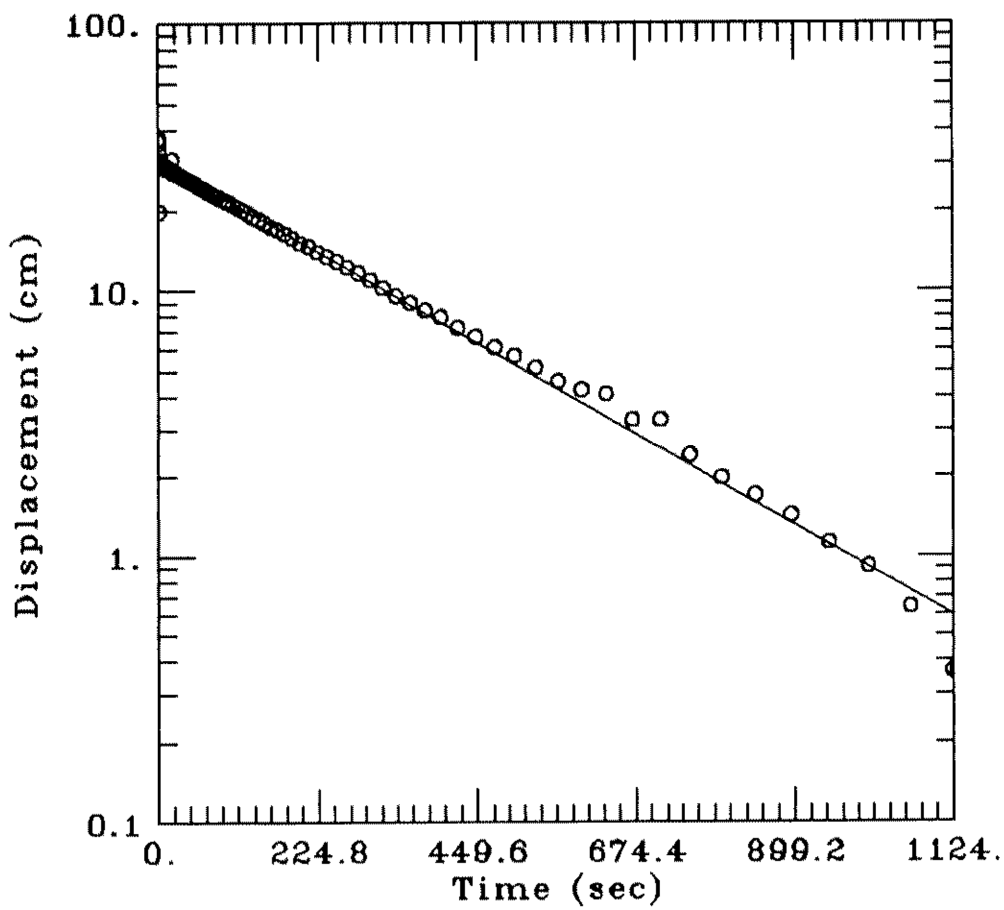
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
d-1

ESTIMATED PARAMETERS:
K = 0.003338 cm/sec
y0 = 35.76 cm

TEST DATA:
H0 = 34.17 cm
rc = 2.53 cm
rw = 5.09 cm
L = 624.8 cm
b = 5208.4 cm
H = 5208.4 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

D0-2 Test 1 of 2 (falling head)



DATA SET:
do2fh1.aqt
12/12/97

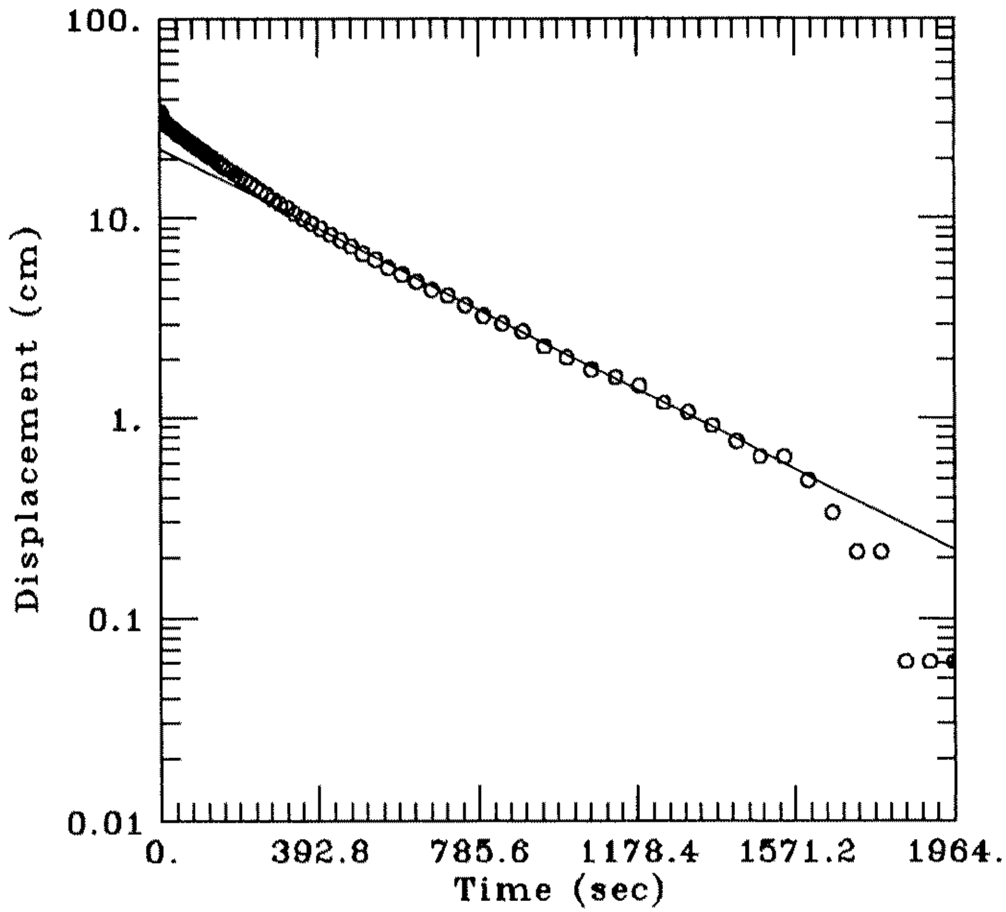
AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
do-2

ESTIMATED PARAMETERS:
K = 0.0001525 cm/sec
y0 = 30.69 cm

TEST DATA:
H0 = 37.34 cm
rc = 2.53 cm
rw = 10.15 cm
L = 213.4 cm
b = 645.9 cm
H = 645.9 cm

Barton & Loguidice, P.C.	Client: Cortland County
Project No.: 331.22	Location: Old Cortland County Landfill

DO-2 Test 2 of 2 (rising head)



DATA SET:
do2rh1.aqt
12/12/97

AQUIFER TYPE:
Unconfined
SOLUTION METHOD:
Bouwer-Rice
TEST DATE:
10/3/97
TEST WELL:
do-2

ESTIMATED PARAMETERS:
K = 0.0001026 cm/sec
y0 = 22.55 cm

TEST DATA:
H0 = 34.23 cm
rc = 2.53 cm
rw = 10.15 cm
L = 213.4 cm
b = 645.9 cm
H = 645.9 cm

APPENDIX D

GEOTECHNICAL TEST RESULTS

parratt wolff inc

October 15, 1997

L-97104
Laboratory Testing
Old Cortland County Landfill
Job # 331.22

NATURAL MOISTURE CONTENT
ASTM D2216

Lab I.D. #	Sample	Depth (feet)	Moisture Content as a Percent of Dry Weight
10227	R1-MW-1	20.0 - 30.0	8.3
10228	R1-MW-2	6.0 - 7.0	10.1
10229	R1-MW-6	7.0 - 17.0	8.5
10230	R1-MW-7	10.0 -12.0	8.6

parratt wolff inc

SIEVE ANALYSIS OF
SOIL / AGGREGATE

Laboratory Testing - Old Cortland County Landfill
Job No. 331.22

PROJECT # L-97104

TEST METHOD ASTM D422 & D1140

REPORT # 1

REPORT DATE October 15, 1997

			Sieve Size - Percent Passing Sieve												
Lab I.D. #	Location	Depth (feet)	1 1/2"	1"	3/4"	1/2"	3/8"	1/4"	#4	#10	#30	#40	#60	#100	#200
10227	R1-MW-1	20.0 - 30.0	100	98.8	96.2	94.2	91.4	87.2	84.7	77.2	68.4	66.5	64.1	62.3	58.8
10228	R1-MW-2	6.0 - 7.0	100	96.4	91.8	89.2	86.1	81.3	78.1	68.5	59.4	57.8	55.7	54.3	50.7
10229	R1-MW-6	7.0 - 17.0	100	91.4	90.9	85.0	81.5	75.6	72.1	62.0	52.5	50.7	48.5	46.9	44.1
10230	R1-MW-7	10.0 - 12.0	100	98.9	95.6	90.2	86.5	82.5	79.5	71.2	62.3	60.5	58.1	56.4	52.9

Sample mass, as received, meets minimum requirements of test method: Yes ____ No X

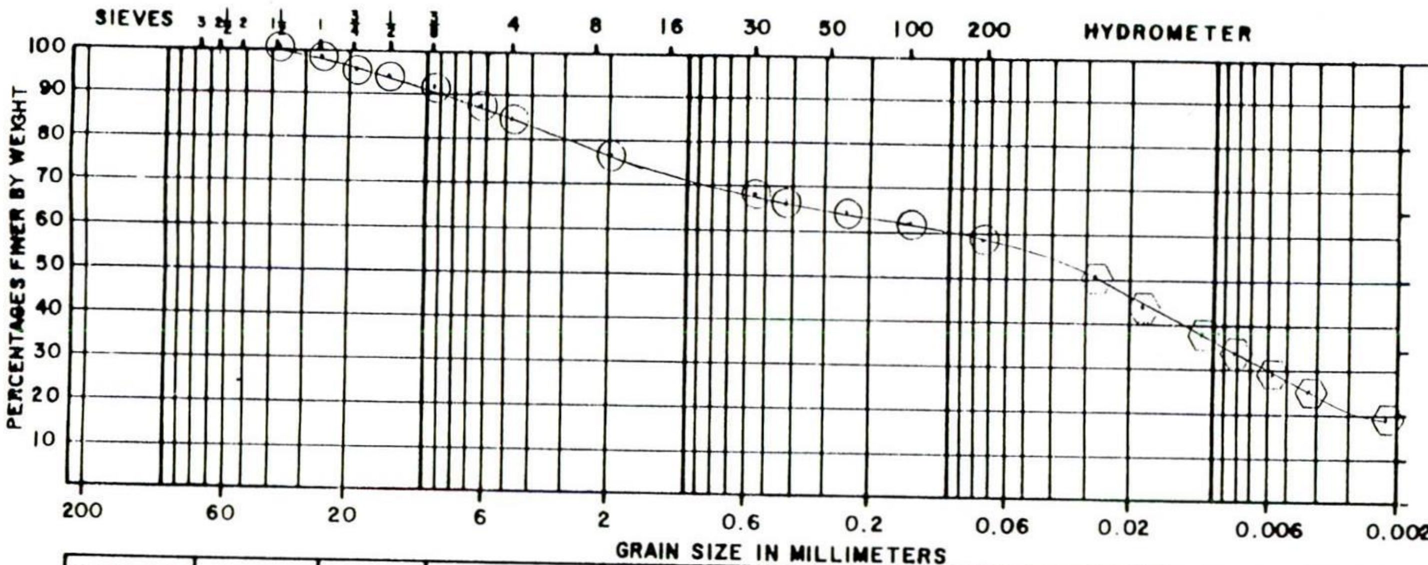
Prewashed: X No ____

Remarks:

Performed By TP, BSW

Checked By: V.J. Thoma

GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 | 76.2 | 25.4 | 9.52 | 2.0 | 0.59 | 0.25 | 0.074 MM. OPENING

9 in. | 3 in. | 1 in. | 3/8 in. | Nos. 10 | 30 | 60 | 200 SIEVE

L-97104	Lab I.D. # 10227
Laboratory Testing	Sample : R1-MW-1
Old Cortland County Landfill	Depth : 20.0' - 30.0'
Job #: 331.22	

⊙ Sieve Analysis ASTM D422 & D1140

⬡ Hydrometer Analysis ASTM D422

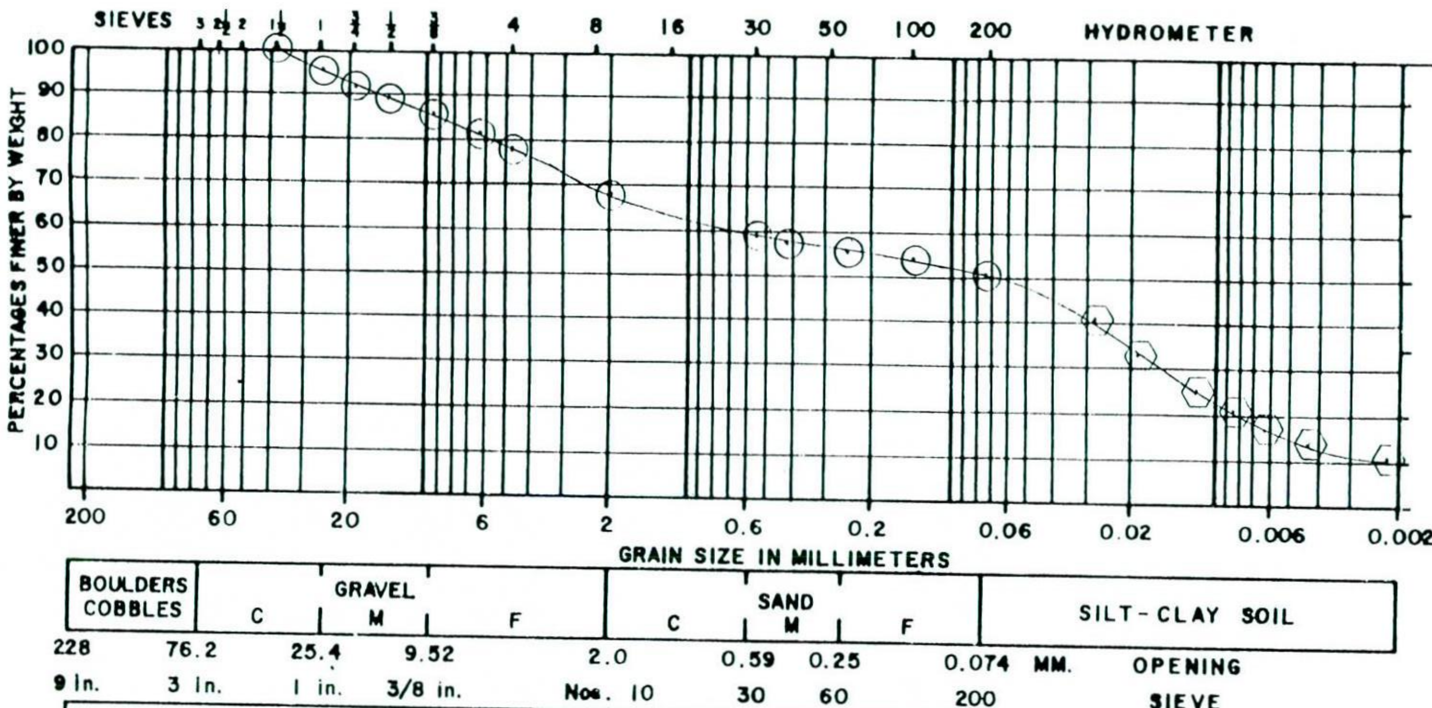
parratt wolff inc
FISHER RD. EAST SYRACUSE N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-97104
REPORT NO. 1
October 15, 1997

parratt wolff inc
FISHER RD. EAST SYRACUSE N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-97104
REPORT NO. 2
October 15, 1997

GRAIN SIZE ANALYSIS



L-97104	Lab I.D. # 10228
Laboratory Testing	Sample : R1-MW-2
Old Cortland County Landfill	Depth : 6.0' - 7.0'
Job #: 331.22	

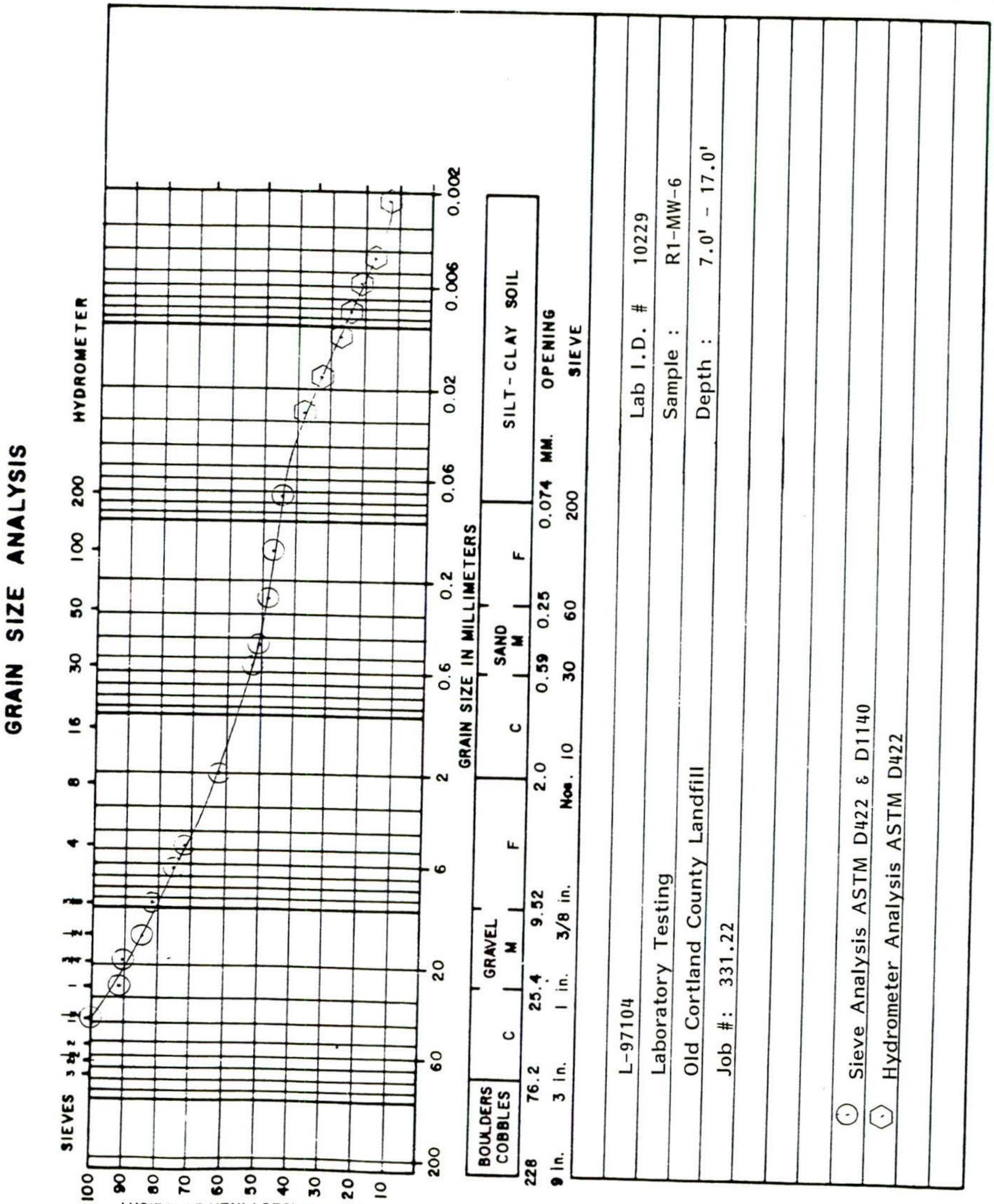
⊙ Sieve Analysis ASTM D422 & D1140

⬡ Hydrometer Analysis ASTM D422

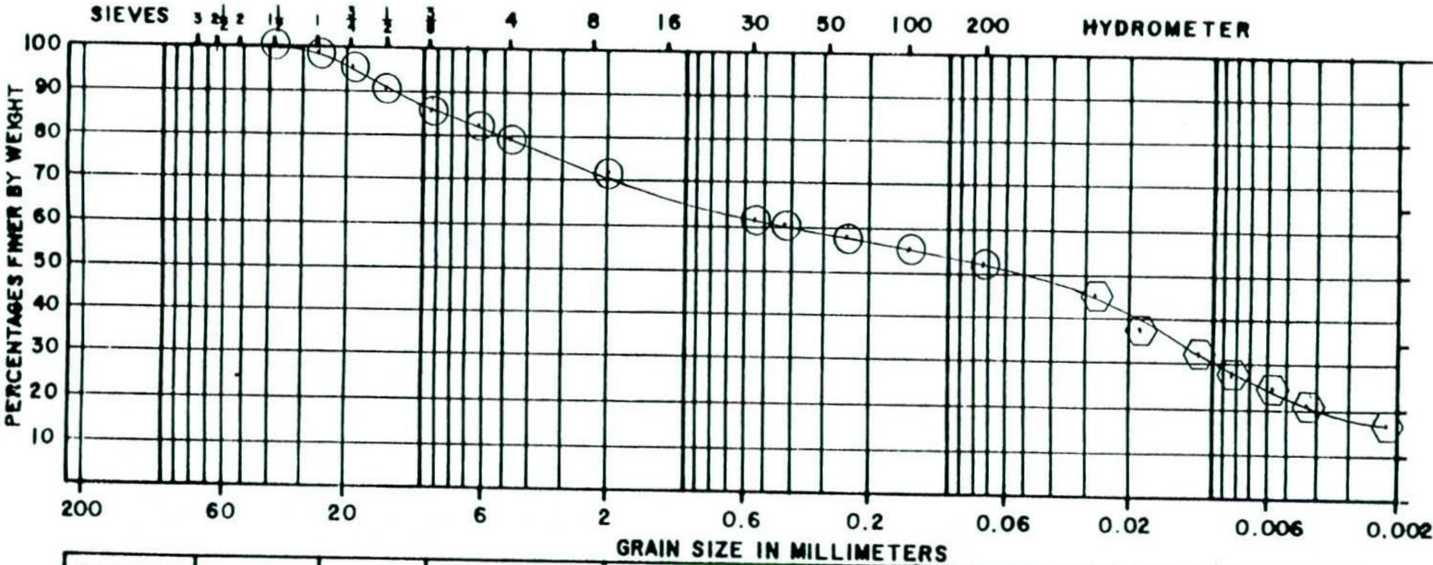
parratt wolff inc
FISHER RD. EAST SYRACUSE N.Y. 13057
TELEPHONE AREA CODE 315/437-1429

JOB NO. L-97104
REPORT NO. 3
October 15, 1997

GRAIN SIZE ANALYSIS



GRAIN SIZE ANALYSIS



BOULDERS COBBLES	GRAVEL C	GRAVEL M	GRAVEL F	SAND C	SAND M	SAND F	SILT-CLAY SOIL

228 76.2 25.4 9.52 2.0 0.59 0.25 0.074 MM. OPENING

9 In. 3 In. 1 in. 3/8 in. Nos. 10 30 60 200 SIEVE

L-97104

Laboratory Testing

Old Cortland County Landfill

Job #: 331.22

Lab I.D. # 10230

Sample : R1-MW-7

Depth : 10.0' - 12.0'

⊙ Sieve Analysis ASTM D422 & D1140

⬡ Hydrometer Analysis ASTM D422

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TELEPHONE AREA CODE 315/437 1429

JOB NO. L-97104

REPORT NO. 4

October 15, 1997

October 15, 1997

L-97104
Laboratory Testing
Old Cortland County Landfill
Job No. 331.22

ATTERBERG LIMITS
ASTM D4318

Lab ID#	Sample	Depth (feet)	Plastic Limit	Liquid Limit	Plasticity Index
10227	R1-MW-1	20.0 - 30.0	17	26	9
10228	R1-MW-2	6.0 - 7.0	17	23	6
10229	R1-MW-6	7.0 - 17.0	17	25	8
10230	R1-MW-7	10.0 -12.0	17	25	8

October 15, 1997

L-97104
Laboratory Testing
Old Cortland County Landfill
Job # 331.22

SPECIFIC GRAVITY OF SOILS ASTM D854

Lab ID#	Sample	Depth (feet)	Specific Gravity of Solids(G)
10227	R1-MW-1	20.0 - 30.0	2.73
10228	R1-MW-2	6.0 - 7.0	2.72
10229	R1-MW-6	7.0 - 17.0	2.77
10230	R1-MW-7	10.0 -12.0	2.74

October 15, 1997

L-97104
Laboratory Testing
Old Cortland County Landfill
Job # 331.22

BULK (NATURAL) SOIL DENSITY
CORPS OF ENGINEERS EM-1110-2-1906 APPENDIX II,
DISPLACEMENT METHOD

Lab I.D. #	Sample I.D.	Depth (feet)	Bulk (Natural) Soil Density(PCF) Dry Density	Moist Density
10227	R1-MW-1	20.0 - 30.0	137.3	148.4
10228	R1-MW-2	6.0 - 7.0	124.6	133.1 (1)
10229	R1-MW-6	7.0 - 17.0	129.6	143.7 (1)
10230	R1-MW-7	10.0 - 12.0	125.8	139.6 (1)

(1) Average of two determinations.

Report Date: October 15, 1997

Test Start Date 10/1/97

Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter ASTM D5084

Project No: L-97104 / Project Title: Laboratory Testing, Old Cortland County Landfill

ST No: -- / Lab ID#: 10228 Job # 331.22 / Test Sample Location: R1-MW-2

Depth/Lift/Elev.: 6'-7' / Type of Sample: Undisturbed X Remolded --

Method of Compaction: -- / Percent Compaction: --

Dry Unit Weight (PCF): Maximum: -- Initial: 130.5 / Moisture Content (% of Dry Weight): Optimum: -- Initial: 6.8

Initial Height (cm): 13.25 / Initial Diameter (cm): 6.30 / Initial Gradient: 26.5

Initial Degree of Saturation (B Value)(%): 98 / Permeant Liquid Used: Deaired Deionized H_2O

Confining Pressure (PSI): 71.0 / Test (head) Pressure (PSI): 68.0 / Tail (back) Pressure (PSI): 63.0

Final Degree Of Saturation (B Value)(%): 100 / Final Dry Unit Weight (PCF): 134.8 / Final Gradient: 26.6

Final Height (cm): 13.22 / Final Diameter (cm): 6.20 / Final Moisture Content (% of Dry Weight): 12.5

Final Four Determinations k (cm/sec)

3.76×10^{-7}	3.77×10^{-7}	3.77×10^{-7}	3.78×10^{-7}

Mean Value of Final Four Consecutive Determinations:

Coefficient of Permeability k (cm/sec): 3.77×10^{-7} Project Specifications: --

Notes:

Report
Date: October 15, 1997

Test Start
Date 10/1/97

Measurement of Hydraulic Conductivity
of Saturated Porous Materials
Using a Flexible Wall Permeameter
ASTM D5084

Project No: L-97104 / Project Title: Laboratory Testing, Old Cortland County Landfill Job # 331.22

ST No: -- / Lab ID#: 10230 / Test Sample Location: R1-MW-7

Depth/Lift/Elev.: 10'-12' / Type of Sample: Undisturbed X Remolded --

Method of Compaction: -- / Percent Compaction: --

Dry Unit Weight (PCF):
Maximum: -- Initial: 137.3 / Moisture Content (% of Dry Weight):
Optimum: -- Initial: 11.0

Initial Height (cm): 13.30 / Initial Diameter (cm): 5.63 / Initial Gradient: 26.4

Initial Degree of Saturation (B Value)(%): 100 / Permeant Liquid Used: Deaired Deionized H_2O

Confining Pressure (PSI): 71.0 / Test (head) Pressure (PSI): 68.0 / Tail (back) Pressure (PSI): 63.0

Final Degree Of Saturation (B Value)(%): 100 / Final Dry Unit Weight (PCF): 143.0 / Final Gradient: 26.6

Final Height (cm): 13.22 / Final Diameter (cm): 5.53 / Final Moisture Content (% of Dry Weight): 9.3

Final Four Determinations k (cm/sec)

7.97×10^{-8} 7.98×10^{-8} 7.99×10^{-8} 8.00×10^{-8}

Mean Value of Final Four Consecutive Determinations:

Coefficient of Permeability k (cm/sec): 7.98×10^{-8} Project Specifications: --

Notes:

APPENDIX E

CATION/ANION DISTRIBUTION PIPER TRI-LINEAR DIAGRAM (August and October, 1997 Data)

B&L

BARTON & LOGUIDICE, P.C.

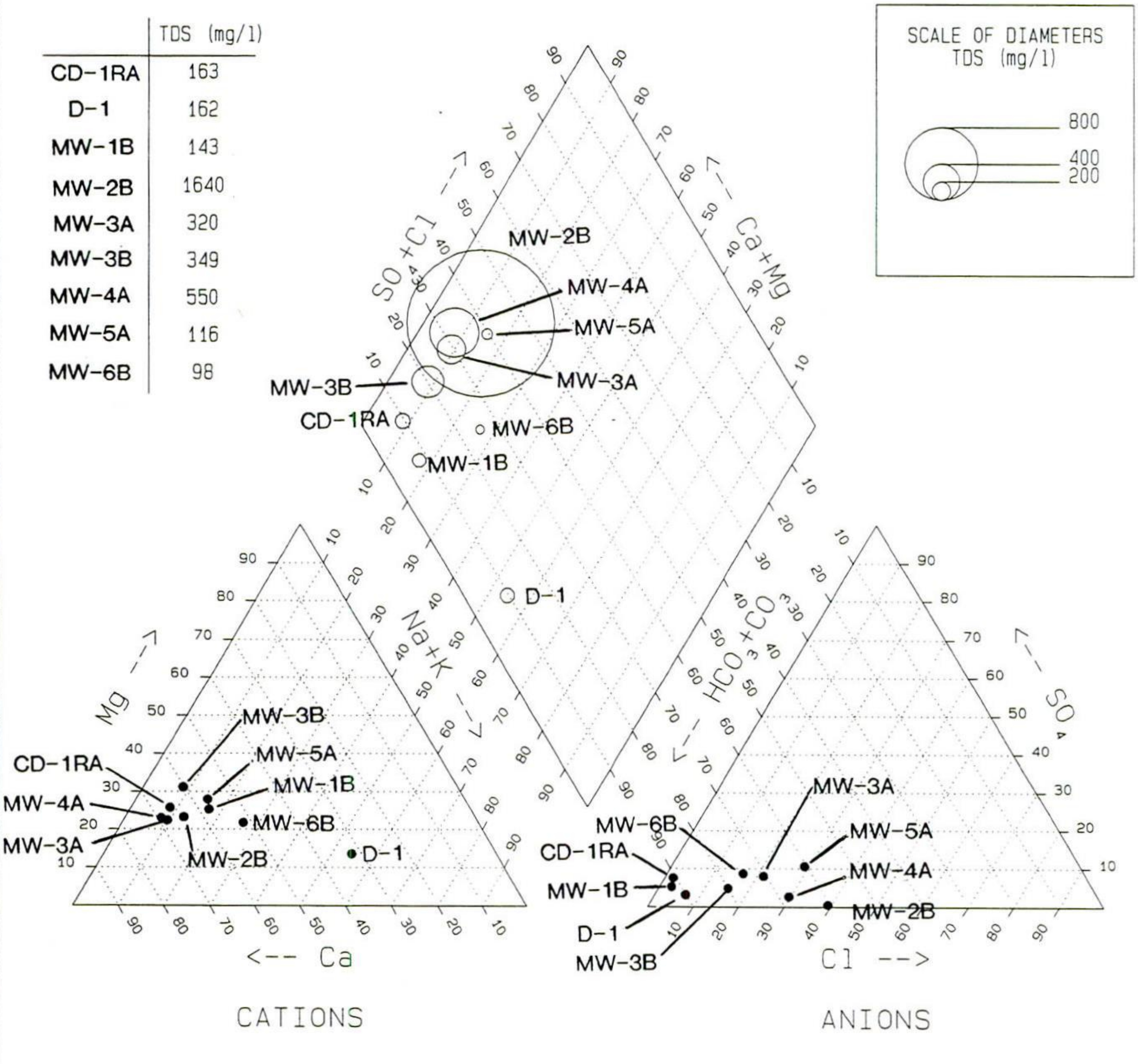
CATION/ANION DISTRIBUTION PIPER TRILINEAR DIAGRAM

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

	TDS (mg/l)
CD-1RA	163
D-1	162
MW-1B	143
MW-2B	1640
MW-3A	320
MW-3B	349
MW-4A	550
MW-5A	116
MW-6B	98



BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

CD-1RA

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	40.7	0.04990	2.03	65.8%
Diss. Mg	9.65	0.08224	0.79	25.7%
Diss. Na	5.5	0.04350	0.23	7.7%
Diss. K	.911	0.02558	0.02	0.8%
		Totals:	3.09	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2	0.02820	0.05	1.9%
SO_4	10.8	0.02082	0.22	7.6%
CO_3	1.6	0.03333	0.05	1.8%
HCO_3	160	0.01639	2.63	88.7%
		Totals:	2.96	100.0%

Cation/Anion Balance Error: 2.09%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 134 mg/l $CaCO_3$
pH: 8.3 SU
$[H^+]$: $10^{-8.3}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

D-1

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data – Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	21.5	0.04990	1.07	31.9%
Diss. Mg	5.57	0.08224	0.45	13.6%
Diss. Na	41	0.04350	1.78	53.0%
Diss. K	2.07	0.02558	0.05	1.6%
		Totals:	3.37	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	7.8	0.02820	0.22	6.8%
SO_4	5	0.02082	0.10	3.2%
CO_3	5.2	0.03333	0.17	5.4%
HCO_3	168	0.01639	2.75	84.7%
		Totals:	3.24	100.0%

Cation/Anion Balance Error: 1.87%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 146 mg/l $CaCO_3$
pH: 8.8 SU
$[H^+]$: $10^{-8.8}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW−1B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data − Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	24.8	0.04990	1.24	57.5%
Diss. Mg	6.62	0.08224	0.54	25.3%
Diss. Na	7.53	0.04350	0.32	15.2%
Diss. K	1.63	0.02558	0.04	1.9%
		Totals:	2.15	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2	0.02820	0.05	2.7%
SO_4	5.2	0.02082	0.10	5.3%
CO_3	0.36	0.03333	0.01	0.6%
HCO_3	115	0.01639	1.88	91.4%
		Totals:	2.06	100.0%

Cation/Anion Balance Error: 2.16%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 94.8 mg/l $CaCO_3$

pH: 7.8 SU

$[H^+]$: $10^{-7.8}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-2B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	281	0.04990	14.02	64.1%
Diss. Mg	61.7	0.08224	5.07	23.2%
Diss. Na	62.5	0.04350	2.72	12.4%
Diss. K	2.8	0.02558	0.07	0.3%
		Totals:	21.89	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	267	0.02820	7.53	39.3%
SO_4	5	0.02082	0.10	0.5%
CO_3	0.17	0.03333	0.005	0.03%
HCO_3	704	0.01639	11.53	60.2%
		Totals:	19.17	100.0%

Cation/Anion Balance Error: 6.61%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times 10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 577 mg/l $CaCO_3$
pH: 6.7 SU
$[H^+]$: $10^{-6.7}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-3A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	54.6	0.04990	2.72	68.0%
Diss. Mg	10.9	0.08224	0.89	22.4%
Diss. Na	7.98	0.04350	0.34	8.7%
Diss. K	1.42	0.02558	0.03	0.9%
		Totals:	4.00	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	31.4	0.02820	0.88	21.5%
SO_4	16	0.02082	0.33	8.1%
CO_3	0.55	0.03333	0.01	0.4%
HCO_3	176	0.01639	2.88	70.0%
		Totals:	4.12	100.0%

Cation/Anion Balance Error: 1.40%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 145 mg/l $CaCO_3$
pH: 7.8 SU
$[H^+]$: $10^{-7.8}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-3B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	73.2	0.04990	3.65	60.2%
Diss. Mg	23	0.08224	1.89	31.2%
Diss. Na	11.1	0.04350	0.48	8.0%
Diss. K	1.62	0.02558	0.04	0.7%
		Totals:	6.07	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	32	0.02820	0.90	15.3%
SO_4	13.8	0.02082	0.28	4.9%
CO_3	0.70	0.03333	0.02	0.4%
HCO_3	285	0.01639	4.68	79.4%
		Totals:	5.89	100.0%

Cation/Anion Balance Error: 1.50%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 235 mg/l $CaCO_3$

pH: 7.7 SU

$[H^+]$: $10^{-7.7}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-4A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	129	0.04990	6.44	69.0%
Diss. Mg	26.1	0.08224	2.15	23.0%
Diss. Na	16.1	0.04350	0.70	7.5%
Diss. K	1.93	0.02558	0.04	0.5%
		Totals:	9.33	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	79.1	0.02820	2.23	29.8%
SO_4	9.8	0.02082	0.20	2.7%
CO_3	0.95	0.03333	0.03	0.4%
HCO_3	307	0.01639	5.03	67.1%
		Totals:	7.49	100.0%

Cation/Anion Balance Error: 10.93%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 253 mg/l $CaCO_3$

pH: 7.8 SU

$[H^+]$: $10^{-7.8}$

B&L

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-5A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	34.1	0.04990	1.70	56.5%
Diss. Mg	10.2	0.08224	0.83	27.9%
Diss. Na	10.3	0.04350	0.44	14.9%
Diss. K	.84	0.02558	0.02	0.7%
		Totals:	3.01	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	44.5	0.02820	1.25	29.1%
SO_4	22	0.02082	0.45	10.6%
CO_3	0.97	0.03333	0.03	0.8%
HCO_3	157	0.01639	2.57	59.5%
		Totals:	4.31	100.0%

Cation/Anion Balance Error: 17.79%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2 \times 10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 130 mg/l $CaCO_3$
pH: 8.1 SU
$[H^+]$: $10^{-8.1}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-6B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	67.7	0.04990	3.38	51.7%
Diss. Mg	17.3	0.08224	1.42	21.8%
Diss. Na	38.2	0.04350	1.66	25.4%
Diss. K	2.97	0.02558	0.07	1.2%
		Totals:	6.54	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	38.2	0.02820	1.08	16.7%
SO_4	27.1	0.02082	0.56	8.8%
CO_3	0.18	0.03333	0.006	0.09%
HCO_3	292	0.01639	4.79	74.4%
		Totals:	6.44	100.0%

Cation/Anion Balance Error: .76%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 240 mg/l $CaCO_3$

pH: 7.1 SU

$[H^+]$: $10^{-7.1}$

BARTON & LOGUIDICE, P.C.

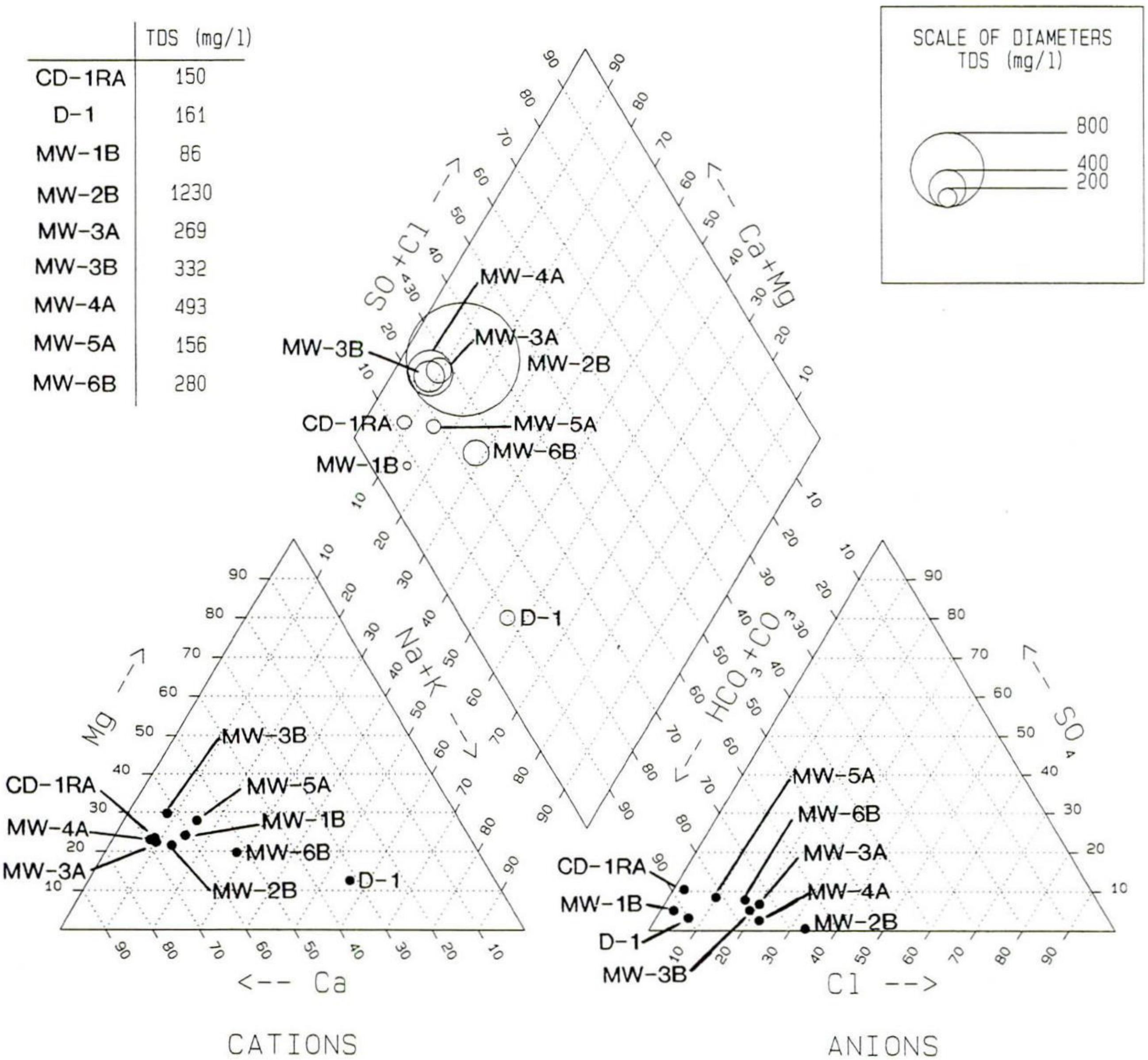
CATION/ANION DISTRIBUTION
PIPER TRILINEAR DIAGRAM

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

	TDS (mg/l)
CD-1RA	150
D-1	161
MW-1B	86
MW-2B	1230
MW-3A	269
MW-3B	332
MW-4A	493
MW-5A	156
MW-6B	280



B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	CD-1RA Sheet 2 of 10

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	39.5	0.04990	1.97	67.8%
Diss. Mg	8.3	0.08224	0.68	23.5%
Diss. Na	5.29	0.04350	0.23	7.9%
Diss. K	.951	0.02558	0.02	0.8%
		Totals:	2.91	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2.5	0.02820	0.07	2.3%
SO_4	15.3	0.02082	0.31	10.5%
CO_3	3.8	0.03333	0.12	4.2%
HCO_3	153	0.01639	2.51	83.0%
		Totals:	3.03	100.0%

Cation/Anion Balance Error: 2.03%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 132 mg/l $CaCO_3$
pH: 8.7 SU
$[H^+]$: $10^{-8.7}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

D-1

Sheet 3 of 10

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	19.1	0.04990	0.95	31.4%
Diss. Mg	4.63	0.08224	0.38	12.6%
Diss. Na	38.1	0.04350	1.66	54.7%
Diss. K	1.6	0.02558	0.04	1.3%
		Totals:	3.03	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	7.8	0.02820	0.22	6.8%
SO_4	5	0.02082	0.10	3.2%
CO_3	5.2	0.03333	0.17	5.4%
HCO_3	166	0.01639	2.73	84.6%
		Totals:	3.22	100.0%

Cation/Anion Balance Error: 3.06%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 145 mg/l $CaCO_3$
pH: 8.8 SU
$[H^+]$: $10^{-8.8}$

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BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-1B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	24.5	0.04990	1.22	60.9%
Diss. Mg	5.88	0.08224	0.48	24.1%
Diss. Na	6.59	0.04350	0.28	14.3%
Diss. K	.514	0.02558	0.01	0.7%
		Totals:	2.01	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2	0.02820	0.05	2.8%
SO_4	5	0.02082	0.10	5.1%
CO_3	3.3	0.03333	0.11	5.5%
HCO_3	107	0.01639	1.76	86.6%
		Totals:	2.03	100.0%

Cation/Anion Balance Error: .65%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 93.6 mg/l $CaCO_3$

pH: 8.8 SU

$[H^+]$: $10^{-8.8}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-2B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	274	0.04990	13.67	65.1%
Diss. Mg	55	0.08224	4.52	21.6%
Diss. Na	62.8	0.04350	2.73	13.0%
Diss. K	2.34	0.02558	0.06	0.3%
		Totals:	20.99	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	238	0.02820	6.71	33.1%
SO_4	5	0.02082	0.10	0.5%
CO_3	2.0	0.03333	0.06	0.3%
HCO_3	817	0.01639	13.39	66.0%
		Totals:	20.27	100.0%

Cation/Anion Balance Error: 1.73%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 673 mg/l $CaCO_3$
pH: 7.7 SU
$[H^+]$: $10^{-7.7}$

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BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-3A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data – Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	54.6	0.04990	2.72	68.0%
Diss. Mg	10.9	0.08224	0.89	22.4%
Diss. Na	7.98	0.04350	0.34	8.7%
Diss. K	1.42	0.02558	0.03	0.9%
		Totals:	4.00	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	28.7	0.02820	0.80	20.2%
SO_4	13	0.02082	0.27	6.8%
CO_3	4.2	0.03333	0.14	3.5%
HCO_3	170	0.01639	2.78	69.5%
		Totals:	4.00	100.0%

Cation/Anion Balance Error: .06%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 146 mg/l $CaCO_3$
pH: 8.7 SU
$[H^+]$: $10^{-8.7}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-3B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	71.9	0.04990	3.59	62.0%
Diss. Mg	20.9	0.08224	1.72	29.7%
Diss. Na	10.2	0.04350	0.44	7.7%
Diss. K	1.27	0.02558	0.03	0.6%
		Totals:	5.78	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	33.6	0.02820	0.94	18.9%
SO_4	12.4	0.02082	0.25	5.2%
CO_3	4.4	0.03333	0.14	2.9%
HCO_3	223	0.01639	3.65	73.0%
		Totals:	5.00	100.0%

Cation/Anion Balance Error: 7.21%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 190 mg/l $CaCO_3$
pH: 8.6 SU
$[H^+]$: $10^{-8.6}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-4A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	129	0.04990	6.44	69.0%
Diss. Mg	26.1	0.08224	2.15	23.0%
Diss. Na	16.1	0.04350	0.70	7.5%
Diss. K	1.93	0.02558	0.04	0.5%
		Totals:	9.33	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	74.6	0.02820	2.10	22.3%
SO_4	11.5	0.02082	0.23	2.5%
CO_3	1.3	0.03333	0.04	0.5%
HCO_3	430	0.01639	7.05	74.7%
		Totals:	9.44	100.0%

Cation/Anion Balance Error: .58%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 355 mg/l $CaCO_3$

pH: 7.8 SU

$[H^+]$: $10^{-7.8}$

B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	MW-5A Sheet 9 of 10

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	34.1	0.04990	1.70	56.5%
Diss. Mg	10.2	0.08224	0.83	27.9%
Diss. Na	10.3	0.04350	0.44	14.9%
Diss. K	.84	0.02558	0.02	0.7%
		Totals:	3.01	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	10.1	0.02820	0.28	10.1%
SO_4	11.5	0.02082	0.23	8.5%
CO_3	1.7	0.03333	0.05	2.0%
HCO_3	137	0.01639	2.24	79.4%
		Totals:	2.82	100.0%

Cation/Anion Balance Error: 3.19%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 115 mg/l $CaCO_3$
pH: 8.4 SU
$[H^+]$: $10^{-8.4}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-6B

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Bedrock Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	56.3	0.04990	2.81	52.1%
Diss. Mg	12.9	0.08224	1.06	19.7%
Diss. Na	33.3	0.04350	1.45	26.9%
Diss. K	2.77	0.02558	0.07	1.3%
		Totals:	5.39	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	35	0.02820	0.98	16.6%
SO_4	22.2	0.02082	0.46	7.8%
CO_3	1.1	0.03333	0.03	0.6%
HCO_3	271	0.01639	4.44	75.0%
		Totals:	5.93	100.0%

Cation/Anion Balance Error: 4.76%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 224 mg/l $CaCO_3$

pH: 7.9 SU

$[H^+]$: $10^{-7.9}$

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BARTON & LOGUIDICE, P.C.

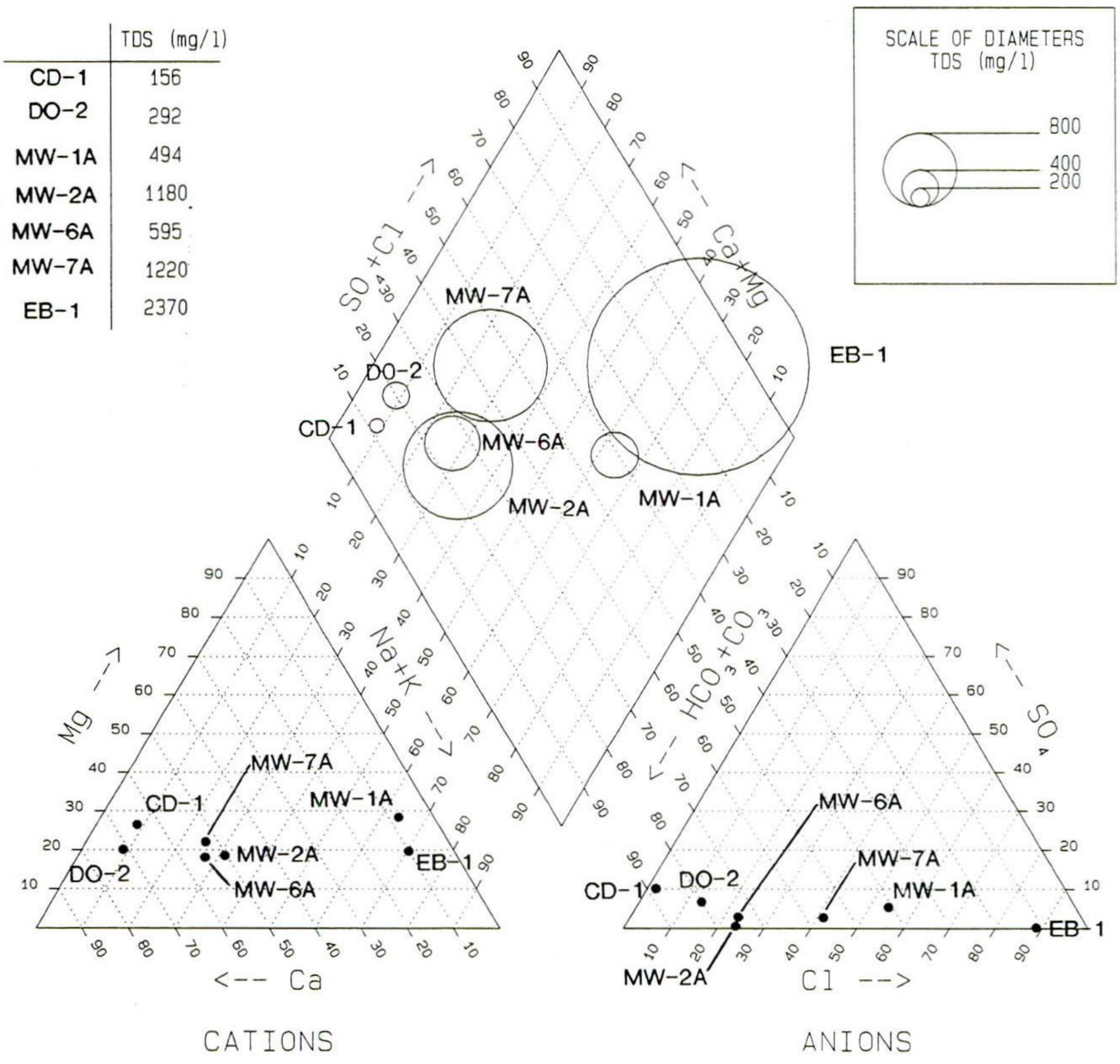
CATION/ANION DISTRIBUTION PIPER TRILINEAR DIAGRAM

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Overburden Monitoring Wells

	TDS (mg/l)
CD-1	156
DO-2	292
MW-1A	494
MW-2A	1180
MW-6A	595
MW-7A	1220
EB-1	2370



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CATION/ANION DISTRIBUTION

CD-1

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data – Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	40.5	0.04990	2.02	64.9%
Diss. Mg	10	0.08224	0.82	26.4%
Diss. Na	5.44	0.04350	0.23	7.6%
Diss. K	1.37	0.02558	0.03	1.1%
		Totals:	3.12	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2	0.02820	0.05	1.9%
SO_4	14.6	0.02082	0.30	10.1%
CO_3	1.2	0.03333	0.04	1.4%
HCO_3	159	0.01639	2.60	86.6%
		Totals:	3.00	100.0%

Cation/Anion Balance Error: 1.88%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 132 mg/l $CaCO_3$
pH: 8.2 SU
$[H^+]$: $10^{-8.2}$

B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	DO-2 Sheet 3 of 8

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data – Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	74.6	0.04990	3.72	71.0%
Diss. Mg	12.8	0.08224	1.05	20.1%
Diss. Na	10.2	0.04350	0.44	8.5%
Diss. K	1.02	0.02558	0.02	0.5%
		Totals:	5.25	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	23.3	0.02820	0.65	13.3%
SO_4	16	0.02082	0.33	6.8%
CO_3	1.5	0.03333	0.04	
HCO_3	237	0.01639	3.89	78.9%
		Totals:	4.93	100.0%

Cation/Anion Balance Error: 3.10%

Alkalinity conversion (from mg/l $CaCO_3$):

$$mg/l\ HCO_3 = \frac{Alkalinity}{(1 + 2x10^{-10.3} / [H^+]) \times 50} \times 61$$

$$mg/l\ CO_3 = \frac{Alkalinity}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 197 mg/l $CaCO_3$

pH: 8.1 SU

$[H^+]$: $10^{-8.1}$

BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	MW-1A Sheet 4 of 8

PROJECT: Remedial Investigation PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

August 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	6.76	0.04990	0.33	7.6%
Diss. Mg	15.4	0.08224	1.27	28.4%
Diss. Na	59.3	0.04350	2.58	57.9%
Diss. K	10.6	0.02558	0.27	6.1%
		Totals:	4.45	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	152	0.02820	4.29	54.2%
SO_4	20.6	0.02082	0.42	5.4%
CO_3	0.60	0.03333	0.02	0.3%
HCO_3	194	0.01639	3.18	40.2%
		Totals:	7.91	100.0%

Cation/Anion Balance Error: 27.97%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 160 mg/l $CaCO_3$
pH: 7.8 SU
$[H^+]$: $10^{-7.8}$

B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	MW−2A Sheet 5 of 8

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data – Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	183	0.04990	9.13	50.1%
Diss. Mg	41	0.08224	3.37	18.5%
Diss. Na	121	0.04350	5.26	28.9%
Diss. K	17.5	0.02558	0.44	2.5%
		Totals:	18.21	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	156	0.02820	4.40	23.7%
SO_4	5	0.02082	0.10	0.6%
CO_3	0.08	0.03333	0.002	0.02%
HCO_3	856	0.01639	14.03	75.7%
		Totals:	18.54	100.0%

Cation/Anion Balance Error: .89%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 702 mg/l $CaCO_3$
pH: 6.3 SU
$[H^+]$: $10^{-6.3}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-6A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	104	0.04990	5.19	54.5%
Diss. Mg	21	0.08224	1.73	18.1%
Diss. Na	55.4	0.04350	2.41	25.3%
Diss. K	7.64	0.02558	0.19	2.1%
		Totals:	9.52	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	79.1	0.02820	2.23	23.1%
SO_4	13.8	0.02082	0.28	3.0%
CO_3	0.09	0.03333	0.002	0.03%
HCO_3	435	0.01639	7.14	73.9%
		Totals:	9.66	100.0%

Cation/Anion Balance Error: .70%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 357 mg/l $CaCO_3$

pH: 6.6 SU

$[H^+]$: $10^{-6.6}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-7A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	220	0.04990	10.98	52.4%
Diss. Mg	56.2	0.08224	4.62	22.1%
Diss. Na	120	0.04350	5.22	24.9%
Diss. K	5.28	0.02558	0.13	0.6%
		Totals:	20.95	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	300	0.02820	8.46	41.5%
SO_4	27.4	0.02082	0.57	2.8%
CO_3	0.43	0.03333	0.01	0.07%
HCO_3	693	0.01639	11.36	55.7%
		Totals:	20.41	100.0%

Cation/Anion Balance Error: 1.32%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 569 mg/l $CaCO_3$
pH: 7.1 SU
$[H^+]$: $10^{-7.1}$

B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	EB-1 Sheet 8 of 8

PROJECT: Remedial Investigation PROJECT No. 331.22
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

August 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	138	0.04990	6.89	9.8%
Diss. Mg	168	0.08224	13.82	19.7%
Diss. Na	911	0.04350	39.63	56.5%
Diss. K	382	0.02558	9.77	13.9%
		Totals:	70.10	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	1220	0.02820	34.40	88.7%
SO_4	5	0.02082	0.10	0.3%
CO_3	0.08	0.03333	0.002	0.007%
HCO_3	261	0.01639	4.28	11.0%
		Totals:	38.79	100.0%

Cation/Anion Balance Error: 28.76%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 214 mg/l $CaCO_3$
pH: 6.8 SU
$[H^+]$: $10^{-6.8}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION
PIPER TRILINEAR DIAGRAM

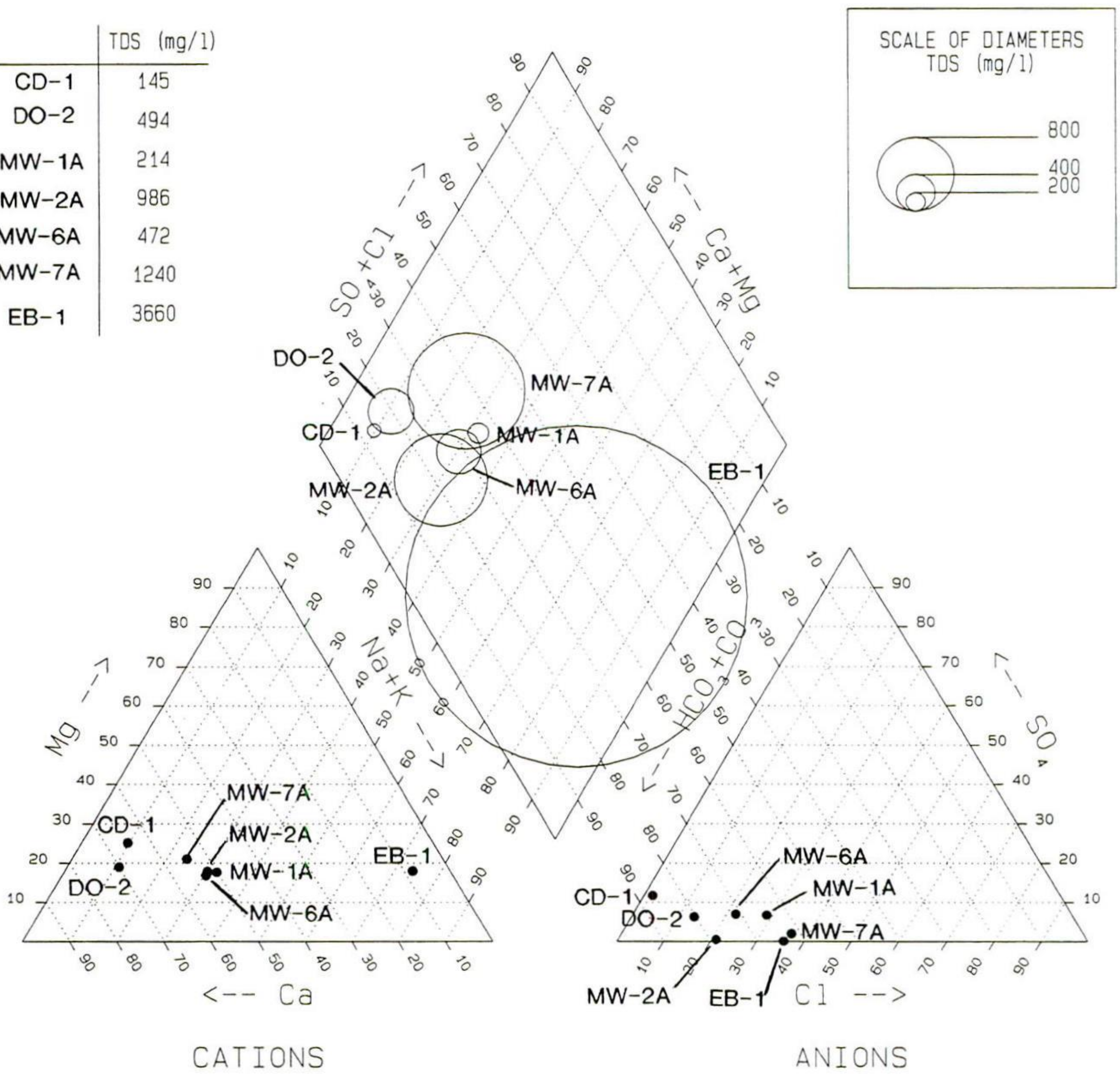
Sheet 1 of 8

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Overburden Monitoring Wells

	TDS (mg/l)
CD-1	145
DO-2	494
MW-1A	214
MW-2A	986
MW-6A	472
MW-7A	1240
EB-1	3660



BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

CD-1

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	38.1	0.04990	1.90	65.0%
Diss. Mg	8.94	0.08224	0.73	25.1%
Diss. Na	5.6	0.04350	0.24	8.3%
Diss. K	1.71	0.02558	0.04	1.5%
		Totals:	2.92	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2	0.02820	0.05	1.9%
SO_4	17	0.02082	0.35	11.8%
CO_3	2.4	0.03333	0.08	2.7%
HCO_3	154	0.01639	2.52	83.7%
		Totals:	3.01	100.0%

Cation/Anion Balance Error: 1.45%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 130 mg/l $CaCO_3$
pH: 8.5 SU
$[H^+]$: $10^{-8.5}$

B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	DO-2 Sheet 3 of 8

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data – Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	72.2	0.04990	3.60	69.9%
Diss. Mg	11.9	0.08224	0.97	19.0%
Diss. Na	12.5	0.04350	0.54	10.6%
Diss. K	1.06	0.02558	0.02	0.5%
		Totals:	5.15	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	26.3	0.02820	0.74	13.4%
SO_4	16.9	0.02082	0.35	6.4%
CO_3	4.1	0.03333	0.13	2.5%
HCO_3	263	0.01639	4.30	77.8%
		Totals:	5.53	100.0%

Cation/Anion Balance Error: 3.56%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2 \times 10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 222 mg/l $CaCO_3$

pH: 8.5 SU

$[H^+]$: $10^{-8.5}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-1A

Sheet 4 of 8

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	40.3	0.04990	2.01	49.9%
Diss. Mg	8.69	0.08224	0.71	17.7%
Diss. Na	27.1	0.04350	1.18	29.2%
Diss. K	4.92	0.02558	0.12	3.1%
		Totals:	4.03	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	46	0.02820	1.30	28.8%
SO_4	14.6	0.02082	0.30	6.8%
CO_3	2.7	0.03333	0.08	2.0%
HCO_3	171	0.01639	2.81	62.4%
		Totals:	4.50	100.0%

Cation/Anion Balance Error: 5.51%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 145 mg/l $CaCO_3$

pH: 8.5 SU

$[H^+]$: $10^{-8.5}$

B&L

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW−2A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data − Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	183	0.04990	9.13	51.7%
Diss. Mg	38.5	0.08224	3.17	17.9%
Diss. Na	115	0.04350	5.00	28.3%
Diss. K	14.2	0.02558	0.36	2.1%
		Totals:	17.66	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	149	0.02820	4.20	21.0%
SO_4	5	0.02082	0.10	0.5%
CO_3	1.5	0.03333	0.05	0.2%
HCO_3	953	0.01639	15.63	78.2%
		Totals:	19.98	100.0%

Cation/Anion Balance Error: 6.16%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 784 mg/l $CaCO_3$
pH: 7.5 SU
$[H^+]$: $10^{-7.5}$

BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION	MW-6A Sheet 6 of 8

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	88.7	0.04990	4.43	52.5%
Diss. Mg	17.3	0.08224	1.42	16.9%
Diss. Na	55	0.04350	2.39	28.4%
Diss. K	7.4	0.02558	0.18	2.2%
		Totals:	8.42	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	71.8	0.02820	2.02	22.1%
SO_4	30.6	0.02082	0.63	7.0%
CO_3	0.78	0.03333	0.02	0.3%
HCO_3	395	0.01639	6.47	70.7%
		Totals:	9.16	100.0%

Cation/Anion Balance Error: 4.15%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 325 mg/l $CaCO_3$
pH: 7.6 SU
$[H^+]$: $10^{-7.6}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

MW-7A

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data – Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	255	0.04990	12.72	54.5%
Diss. Mg	59.9	0.08224	4.93	21.1%
Diss. Na	129	0.04350	5.61	24.0%
Diss. K	3.98	0.02558	0.10	0.4%
		Totals:	23.36	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	276	0.02820	7.78	36.4%
SO_4	20.2	0.02082	0.42	2.0%
CO_3	0.79	0.03333	0.02	0.1%
HCO_3	804	0.01639	13.17	61.5%
		Totals:	21.40	100.0%

Cation/Anion Balance Error: 4.39%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 660 mg/l $CaCO_3$

pH: 7.3 SU

$[H^+]$: $10^{-7.3}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

EB-1

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data – Overburden Monitoring Wells

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	90.3	0.04990	4.51	7.9%
Diss. Mg	125	0.08224	10.28	18.0%
Diss. Na	780	0.04350	33.93	59.4%
Diss. K	328	0.02558	8.38	14.7%
		Totals:	57.11	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	1226	0.02820	34.57	35.7%
SO_4	5	0.02082	0.10	0.1%
CO_3	4.7	0.03333	0.15	0.2%
HCO_3	3785	0.01639	62.03	64.0%
		Totals:	96.86	100.0%

Cation/Anion Balance Error: 25.82%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 3110 mg/l $CaCO_3$

pH: 7.4 SU

$[H^+]$: $10^{-7.4}$

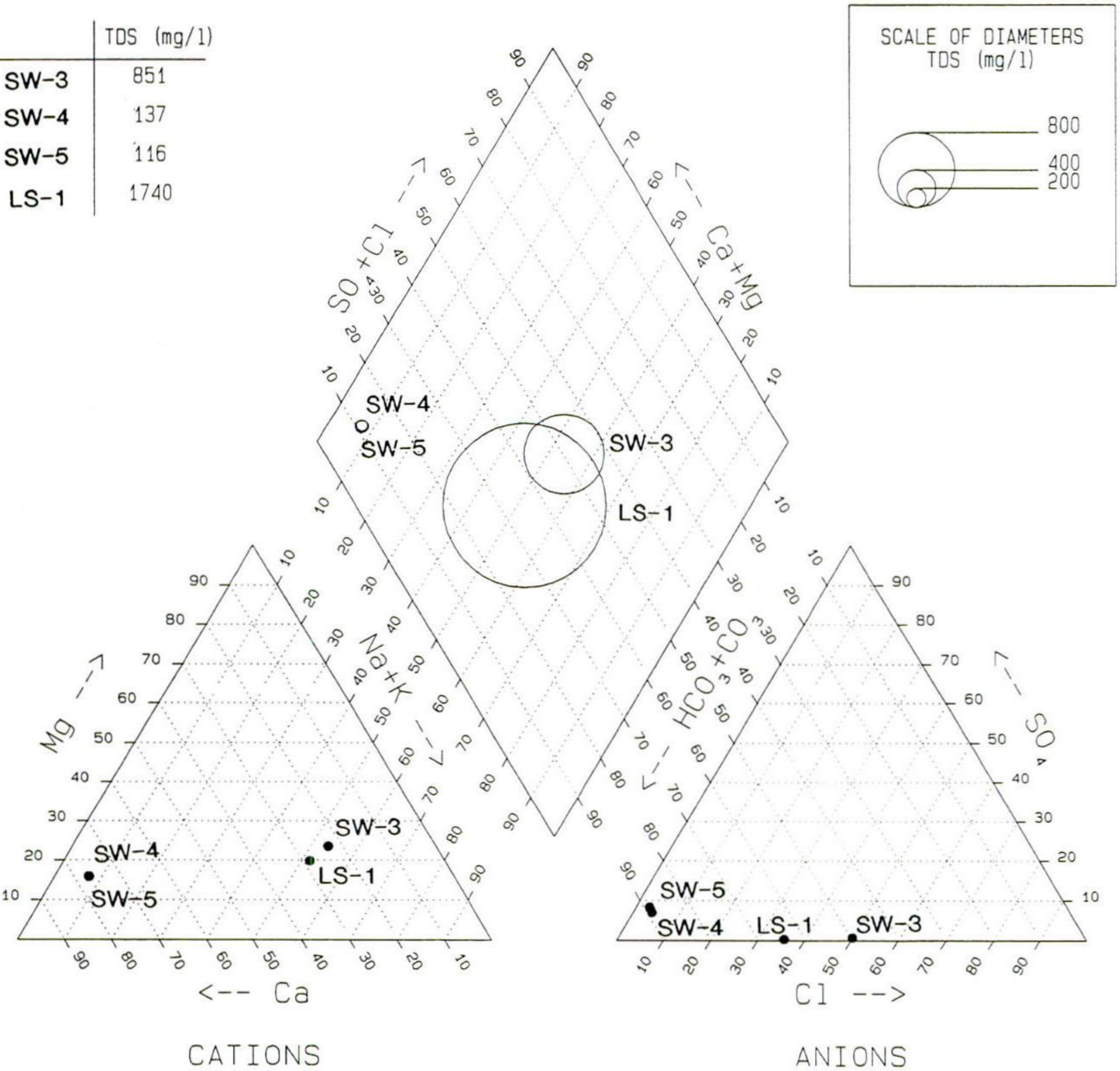
B&L BARTON & LOGUIDICE, P.C.	CATION/ANION DISTRIBUTION PIPER TRILINEAR DIAGRAM	Sheet 1 of 5

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Surface Water Locations

	TDS (mg/l)
SW-3	851
SW-4	137
SW-5	116
LS-1	1740



BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

SW-3

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	65.2	0.04990	3.25	22.7%
Diss. Mg	41.1	0.08224	3.38	23.6%
Diss. Na	157	0.04350	6.83	47.6%
Diss. K	34.6	0.02558	0.88	6.2%
		Totals:	14.35	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	239	0.02820	6.74	50.0%
SO_4	5	0.02082	0.10	0.8%
CO_3	2.5	0.03333	0.08	0.6%
HCO_3	400	0.01639	6.56	48.6%
		Totals:	13.48	100.0%

Cation/Anion Balance Error: 3.11%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 332 mg/l $CaCO_3$
pH: 8.1 SU
$[H^+]$: $10^{-8.1}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

SW-4

Sheet 3 of 5

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data – Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	32.1	0.04990	1.60	76.8%
Diss. Mg	4.03	0.08224	0.33	15.9%
Diss. Na	2.92	0.04350	0.12	6.1%
Diss. K	1.03	0.02558	0.02	1.3%
		Totals:	2.09	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	3.1	0.02820	0.08	4.1%
SO_4	7.3	0.02082	0.15	7.1%
CO_3	0.56	0.03333	0.01	0.9%
HCO_3	115	0.01639	1.88	87.9%
		Totals:	2.14	100.0%

Cation/Anion Balance Error: 1.15%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 94.8 mg/l $CaCO_3$

pH: 8.0 SU

$[H^+]$: $10^{-8.0}$

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BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

SW-5

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	29.4	0.04990	1.47	76.7%
Diss. Mg	3.69	0.08224	0.30	15.9%
Diss. Na	2.71	0.04350	0.11	6.2%
Diss. K	.903	0.02558	0.02	1.2%
		Totals:	1.91	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2	0.02820	0.05	3.0%
SO_4	7.5	0.02082	0.15	8.3%
CO_3	0.31	0.03333	0.01	0.6%
HCO_3	101	0.01639	1.65	88.1%
		Totals:	1.87	100.0%

Cation/Anion Balance Error: .98%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 83.1 mg/l $CaCO_3$

pH: 7.8 SU

$[H^+]$: $10^{-7.8}$

B&L

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

LS-1

Sheet 5 of 5

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

August 1997 Data – Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	173	0.04990	8.63	28.4%
Diss. Mg	73.2	0.08224	6.02	19.8%
Diss. Na	297	0.04350	12.92	42.5%
Diss. K	111	0.02558	2.84	9.3%
		Totals:	30.41	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	432	0.02820	12.18	35.5%
SO_4	5	0.02082	0.10	0.3%
CO_3	0.66	0.03333	0.02	0.06%
HCO_3	1341	0.01639	21.97	64.1%
		Totals:	34.28	100.0%

Cation/Anion Balance Error: 5.98%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2 \times 10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 1100 mg/l $CaCO_3$
pH: 7.0 SU
$[H^+]$: $10^{-7.0}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION PIPER TRILINEAR DIAGRAM

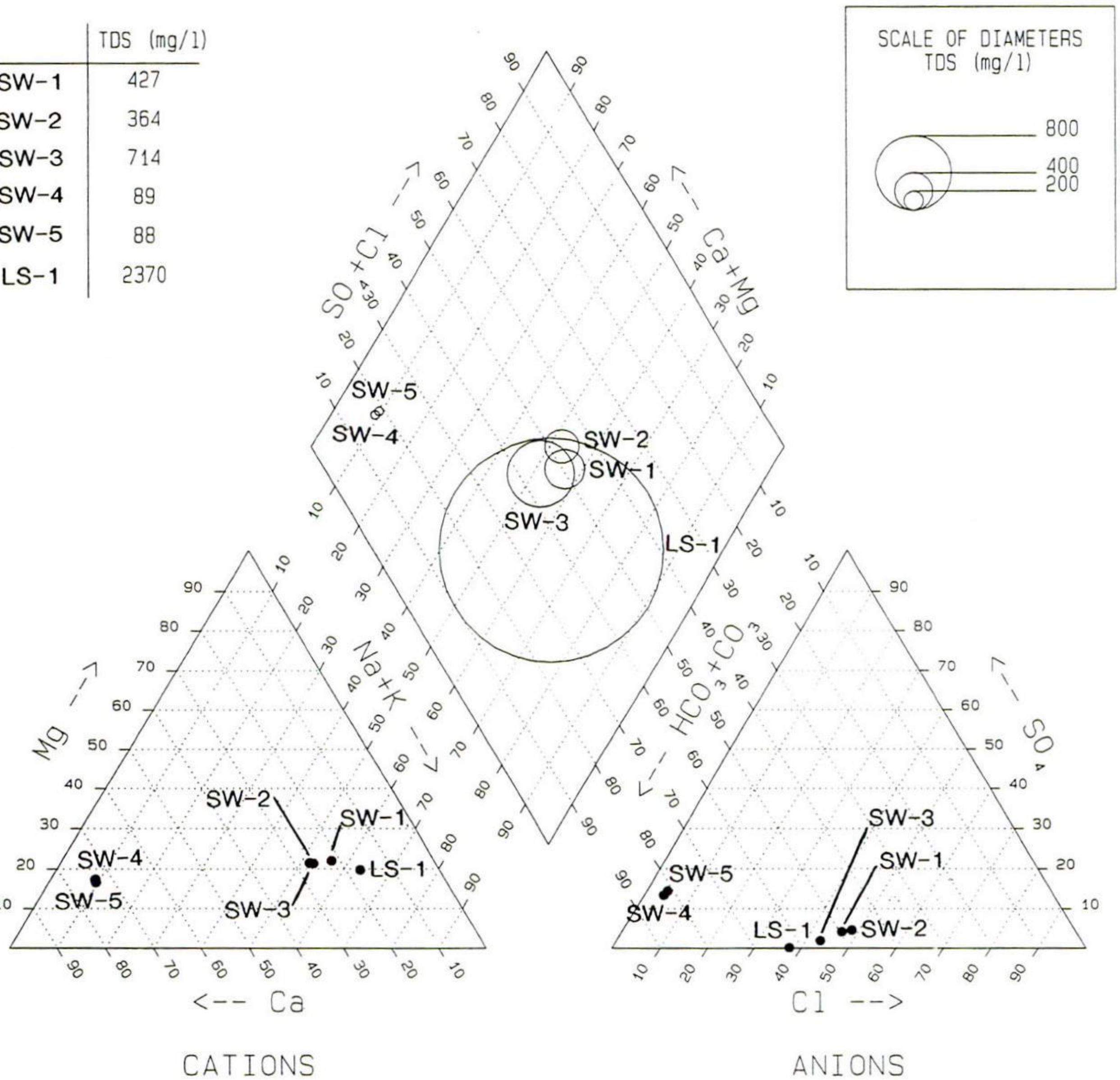
Sheet 1 of 7

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Surface Water Locations

	TDS (mg/l)
SW-1	427
SW-2	364
SW-3	714
SW-4	89
SW-5	88
LS-1	2370



PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	33.5	0.04990	1.67	21.5%
Diss. Mg	20.9	0.08224	1.72	22.1%
Diss. Na	92.7	0.04350	4.03	51.8%
Diss. K	14.3	0.02558	0.36	4.7%
		Totals:	7.79	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	119	0.02820	3.36	46.7%
SO_4	14.3	0.02082	0.29	4.1%
CO_3	2.6	0.03333	0.08	1.2%
HCO_3	211	0.01639	3.45	48.0%
		Totals:	7.19	100.0%

Cation/Anion Balance Error: 3.98%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 177 mg/l $CaCO_3$

pH: 8.4 SU

$[H^+]$: $10^{-8.4}$

B&L

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

SW-2

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	29.9	0.04990	1.49	25.7%
Diss. Mg	15.1	0.08224	1.24	21.4%
Diss. Na	65.3	0.04350	2.84	48.9%
Diss. K	9.35	0.02558	0.23	4.1%
		Totals:	5.81	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	110	0.02820	3.10	48.5%
SO_4	13.9	0.02082	0.28	4.5%
CO_3	2.8	0.03333	0.09	1.4%
HCO_3	177	0.01639	2.91	45.5%
		Totals:	6.39	100.0%

Cation/Anion Balance Error: 4.73%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 150 mg/l $CaCO_3$
pH: 8.5 SU
$[H^+]$: $10^{-8.5}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	66.7	0.04990	3.33	26.6%
Diss. Mg	32.7	0.08224	2.69	21.5%
Diss. Na	133	0.04350	5.79	46.2%
Diss. K	28.1	0.02558	0.71	5.7%
		Totals:	12.52	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	193	0.02820	5.44	43.2%
SO_4	11.5	0.02082	0.23	1.9%
CO_3	5.1	0.03333	0.17	1.3%
HCO_3	412	0.01639	6.75	53.6%
		Totals:	12.60	100.0%

Cation/Anion Balance Error: .31%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2 \times 10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 346 mg/l $CaCO_3$

pH: 8.4 SU

$[H^+]$: $10^{-8.4}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

SW-4

Sheet 5 of 7

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data – Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	25.2	0.04990	1.26	73.4%
Diss. Mg	3.62	0.08224	0.29	17.4%
Diss. Na	3.05	0.04350	0.13	7.7%
Diss. K	.969	0.02558	0.02	1.4%
		Totals:	1.71	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2.6	0.02820	0.07	4.1%
SO_4	11.5	0.02082	0.23	13.4%
CO_3	1.1	0.03333	0.03	2.0%
HCO_3	87	0.01639	1.43	80.4%
		Totals:	1.78	100.0%

Cation/Anion Balance Error: 1.94%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 73.4 mg/l $CaCO_3$
pH: 8.4 SU
$[H^+]$: $10^{-8.4}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	26.3	0.04990	1.31	73.7%
Diss. Mg	3.6	0.08224	0.29	16.6%
Diss. Na	3.31	0.04350	0.14	8.1%
Diss. K	1.09	0.02558	0.02	1.6%
		Totals:	1.78	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	2.9	0.02820	0.08	4.4%
SO_4	12.9	0.02082	0.26	14.5%
CO_3	1.1	0.03333	0.03	2.0%
HCO_3	89	0.01639	1.47	79.1%
		Totals:	1.85	100.0%

Cation/Anion Balance Error: 2.03%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 75.2 mg/l $CaCO_3$

pH: 8.4 SU

$[H^+]$: $10^{-8.4}$

BARTON & LOGUIDICE, P.C.

CATION/ANION DISTRIBUTION

LS-1

Sheet 7 of 7

PROJECT: Remedial Investigation
CLIENT: Cortland County Department of Solid Waste
LOCATION: Old Cortland County Landfill

PROJECT No. 331.22

October 1997 Data - Surface Water Locations

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Cations
Diss. Ca	133	0.04990	6.64	16.6%
Diss. Mg	95.9	0.08224	7.89	19.8%
Diss. Na	475	0.04350	20.66	51.8%
Diss. K	183	0.02558	4.68	11.7%
		Totals:	39.87	100.0%

Solute	Conc. (mg/l)	Conversion Factor	EPM	% of Major Anions
Cl	785	0.02820	22.14	37.5%
SO_4	5	0.02082	0.10	0.2%
CO_3	4.4	0.03333	0.14	0.2%
HCO_3	2236	0.01639	36.65	62.1%
		Totals:	59.03	100.0%

Cation/Anion Balance Error: 19.38%

Alkalinity conversion (from mg/l $CaCO_3$):

$$\text{mg/l } HCO_3 = \frac{\text{Alkalinity}}{(1 + 2\times10^{-10.3} / [H^+]) \times 50} \times 61$$

$$\text{mg/l } CO_3 = \frac{\text{Alkalinity}}{(2 + [H^+] / 10^{-10.3}) \times 50} \times 60$$

Alkalinity: 1840 mg/l $CaCO_3$

pH: 7.6 SU

$[H^+]$: $10^{-7.6}$

APPENDIX F

AIR MONITORING RESULTS

O'ROURKE
INCORPORATED

ENVIRONMENTAL
HEALTH & SAFETY
SERVICES

JUL 22 1997

July 21, 1997

Mr. Mark Chauvin
Barton & Loguidice
290 Elwood Davis Road
Liverpool, New York 13088

Re: Air Monitoring Results - Cortland County Landfill

Dear Mr. Chauvin:

Please find enclosed the results of your samples which were collected at the Cortland County Landfill during the Week of July 7, 1997. All analysis was performed by Friend Laboratory, Inc., Waverly, New York.

A total of 13 samples and 2 Field blanks were submitted for analysis of Asbestos fibers by NIOSH Method 7400. All samples were collected per NIOSH method 7400 using an SKC Sample pump calibrated to 2.0 liters per minute. Sample pumps were calibrated on a daily basis prior to use in the field.

All results are below analytical detection limits and OSHA Permissible Exposure Limits (PELs). A summary of ir monitoring data and laboratory results are attached.

Thank you for allowing O'Rourke Incorporated the opportunity to provide these services.

Should you have any questions, please feel free to call.

Thank you for you business.

Sincerely,

O'ROURKE INCORPORATED

T O'Rourke

Timothy M. O'Rourke, CIH

enc: lab report, invoice

P.O. Box 236 • 1 Clinton St. • Tully, NY 13159 • Phone: (315) 696-4619 • Fax: (315) 696-6442 • E*Mail: OrourkeInc@aol.com

O'ROURKE INCORPORATED
ENVIRONMENTAL HEALTH & SAFETY SERVICES

Summary of Air Monitoring Data

Cortland County Landfill

Date	*Sample I.D.*	*Sample location*	*Sample Volume (l)*	*Concentration (F/cc)*	*OSHA PEL (F/cc)*
7/07/97	83976	Mark	178	<0.01	0.1
7/07/97	83977	Rich	180	<0.01	0.1
7/07/97	83978	Paul	164	<0.01	0.1
7/08/97	83979	Mark	338	<0.01	0.1
7/08/97	83980	Rich	728	<0.01	0.1
7/08/97	83981	Damian	646	<0.01	0.1
7/09/97	83982	Mark	332	<0.01	0.1
7/09/97	83983	Rich	938	<0.01	0.1
7/09/97	98984	Damian	648	<0.01	0.1
7/10/97	83986	Rich	812	<0.01	0.1
7/10/97	83987	Damion	802	<0.01	0.1
7/09/97		Blank	--	0.00 F/fd	NA
7/10/97		Blank	--	0.00 F/fd	NA

l - liters

F/cc - Fibers per cubic centimeter

F/fd - Fibers per field

FLI
FRIEND LABORATORY INC

ONE RESEARCH CIRCLE WAVERLY, NY 14892-1532
TELEPHONE (607) 565-3500 FAX (607) 565-4083

LABORATORY ANALYSIS REPORT

CLIENT : O'Rourke, Inc.
PROJECT : CORTLAND LANDFILL
SITE : PERSONAL SAMPLES
LOCATION : CORTLAND, NY

07/10/97
Project #
P.O. #

Analysis - Fibers

Type of : Personal
Activity/Samples : Not sampled by FLI

Sample ID Field	Sample ID Lab	Sample Location	Air Volume (L)	Qty. (f/fd)	Conc. (F/CC)
1	83976	MARK	178	0.02	<0.01
2	83977	RICH	180	0.01	<0.01
3	83978	PAUL	164	0.01	<0.01

Field Blanks: Sample # Lab # Conc. (f/fd)
Sample # Lab # Conc. (f/fd)

Inter- and intra-laboratory standard deviations available upon request.

Sampling Technician : CLIENT
Certificate # : NA
Date Sampled : 07/07/97
Date Received : 07/07/97

Analyst : PP
Date Analyzed : 07/07/97

Microscope Make : OLYMPUS
Microscope Model : CH-2
Microscope Serial # : OJ0103
Field Area : 0.00785

Methodology : NIOSH 7400, A rules, not specific for asbestos fibers.

L = Liters
f/cc = Fibers per cubic centimeter
f/mm2 = Fibers per square millimeter
f/filt = Fibers per filter
< = Less Than
NA = Not Applicable
f/fd = Fibers per field
u = Uncountable

Comments :

Approved by : Randy Hoff [signature]

FLI
FRIEND LABORATORY INC

ONE RESEARCH CIRCLE WAVERLY, NY 14892-1532
TELEPHONE (607) 565-3500 FAX (607) 565-4083

LABORATORY ANALYSIS REPORT

CLIENT : O'Rourke, Inc.
PROJECT : CORTLAND CO LANDFILL
SITE : TRENCH DAY 2
LOCATION : CORTLAND, NY

07/17/97
Project #
P.O. #

Analysis - Fibers

Type of : Personal
Activity/Samples : Not sampled by FLI

Sample ID Field	Sample ID Lab	Sample Location	Air Volume (L)	Qty. (f/fd)	Conc. (F/CC)
1	83979	MARK	338	0.02	<0.01
2	83980	RICH	728	0.04	<0.01
3	83981	DAMIAN	646	0.01	<0.01

Field Blanks: Sample # Lab # Conc. (f/fd)
Sample # Lab # Conc. (f/fd)
Inter- and intra-laboratory standard deviations available upon request.

Sampling Technician : PP
Certificate # : AH88-10546
Date Sampled : 07/08/97
Date Received : 07/08/97
Analyst : PP
Date Analyzed : 07/08/97
Microscope Make : OLYMPUS
Microscope Model : CH-2
Microscope Serial # : OJ0103
Field Area : 0.00785
Methodology : NIOSH 7400, A rules, not specific for asbestos fibers.

L = Liters
f/cc = Fibers per cubic centimeter
f/mm2 = Fibers per square millimeter
f/filt = Fibers per filter
< = Less Than
NA = Not Applicable
f/fd = Fibers per field
u = Uncountable

Comments :

Approved by : Randy J. Sheffler

FLI
FRIEND LABORATORY I·N·C

ONE RESEARCH CIRCLE WAVERLY, NY 14892-1532
TELEPHONE (607) 565-3500 FAX (607) 565-4083

LABORATORY ANALYSIS REPORT

CLIENT : O'Rourke, Inc.
PROJECT : CORTLAND CO. LANDFILL
SITE : TRENCH DAY 3
LOCATION : CORTLAND, NY

07/17/97
Project # CORTLANK
P.O. #

Analysis - Fibers
Type of Activity/Samples : Personal

Sample ID Field	Sample ID Lab	Sample Location	Air Volume (L)	Qty. (f/fd)	Conc. (F/CC)
1	83982	MARK	322	0.01	<0.01
2	83983	RICH	938	0.01	<0.01
3	83984	DAMIAN	648	0.01	<0.01

Field Blanks: Sample # BLANK Lab # 83985 Conc. (f/fd) 0.00
Sample # Lab # Conc. (f/fd)
Inter- and intra-laboratory standard deviations available upon request.

Sampling Technician : PP
Certificate # : AH88-10546
Date Sampled : 07/09/97
Date Received : 07/09/97
Analyst : PP
Date Analyzed : 07/09/97
Microscope Make : OLYMPUS
Microscope Model : CH-2
Microscope Serial # : OJ0103
Field Area : 0.00785
Methodology : NIOSH 7400, A rules, not specific for asbestos fibers.

L = Liters
f/mm2 = Fibers per square millimeter
< = Less Than
f/fd = Fibers per field
f/cc = Fibers per cubic centimeter
f/filt = Fibers per filter
NA = Not Applicable
u = Uncountable

Comments :

Approved by : Randy J. Steffe

FLI
FRIEND LABORATORY INC

ONE RESEARCH CIRCLE WAVERLY, NY 14892-1532
TELEPHONE (607) 565-3500 FAX (607) 565-4083

LABORATORY ANALYSIS REPORT

CLIENT : O'Rourke, Inc.
PROJECT : CORTLAND CO. LANDFILL
SITE : TRENCH DAY 4
LOCATION : CORTLAND, NY

07/17/97
Project #
P.O. #

Analysis - Fibers

Type of : Personal
Activity/Samples : Not sampled by FLI

Sample ID Field	Sample ID Lab	Sample Location	Air Volume (L)	Qty. (f/fd)	Conc. (F/CC)
1	83986	RICH	812	0.01	<0.01
2	83987	DANIAN	802	0.03	<0.01

Field Blanks: Sample # BLANK Lab # 83988 Conc. (f/fd) 0.00
Sample # Lab # Conc. (f/fd)
Inter- and intra-laboratory standard deviations available upon request.

Sampling Technician : PP
Certificate # : AH88-10546
Date Sampled : 07/10/97
Date Received : 07/10/97
Analyst : PP
Date Analyzed : 07/10/97
Microscope Make : OLYMPUS
Microscope Model : CH-2
Microscope Serial # : OJ0103
Field Area : 0.00785
Methodology : NIOSH 7400, A rules, not specific for asbestos fibers.

L = Liters
f/mm2 = Fibers per square millimeter
< = Less Than
f/fd = Fibers per field
f/cc = Fibers per cubic centimeter
f/filt = Fibers per filter
NA = Not Applicable
u = Uncountable

Comments :

Approved by : Randy J. Sheffer

APPENDIX G

GEOPHYSICAL INVESTIGATION
(Subcontractor Report)

Berkshire

Project Number 97-611

Geophysical Investigation

at the

Cortland County Landfill
Cortland County, New York

Submitted to:

Barton & Loguidice, P.C.
290 Elwood Davis Road, Box 3107
Syracuse, NY 13220

Submitted by:

Berkshire Environmental, Inc.
409 Penn Avenue
Sinking Spring, PA 19608

June 1997

Respectfully submitted,

Christopher E. Papadakis, P.G.
Geophysical Engineer

Bridget L. Calhoun
Project Geophysicist

GEOPHYSICS • ENVIRONMENTAL • WATER SUPPLY

TABLE OF CONTENTS

LIST OF FIGURES

1.0 OVERVIEW

Between June 2nd and 4th, 1997, **Berkshire Environmental, Inc.** (**Berkshire**) performed an integrated electromagnetic (Geonics EM-34) and magnetic (GEM gradiometer) investigation at the Cortland County Landfill, Cortland County, New York. The primary objectives of the geophysical investigation were to: 1) detect and determine preliminary limits of possible contamination emanating from the landfill; and 2) detect and delineate a cache of drums reportedly buried in a portion of the landfill. **Berkshire** implemented an EM-34 survey to meet the first objective and a magnetic gradient survey to satisfy the latter objective.

2.0 GEOPHYSICAL THEORY

2.1 Electromagnetic Induction

Electromagnetic (EM) induction is used to map electrical conductivity variations and is sensitive to changes in subsurface saturation, ion concentration, and metallic targets. The method involves the generation of an alternating magnetic field which induces eddy currents to flow in conductive materials. These eddy currents produce a secondary magnetic field which is sensed and measured. The subsurface's apparent conductivity is derived by comparing the primary magnetic field with the measured secondary field and recorded in milliSiemens/meter, the inverse of resistivity.

The apparent conductivity represents a composite value for all geo-electric layers within the investigated zone. The depth of investigation is dependent on the spacing between the transmitter and receiver coils and their orientation. **Berkshire** collected ground conductivity data using its in-house Geonics EM-34 system (**Figure 1**) in the vertical and horizontal dipole modes. The maximum exploration depth of each mode is summarized in **Table 1**.

Table 1

Instrument	Intercoil Spacing	Dipole Orientation	Exploration Depth
EM-34	10 meter	Vertical	50 ft
	10 meter	Horizontal	25 ft

2.2 Magnetics

Magnetic exploration is a nondestructive, nonintrusive geophysical technique used to detect localized changes in the Earth's magnetic field caused by buried ferromagnetic objects or materials. A magnetometer is a device employed to record the natural magnetic field of the Earth, and readings are measured in nanoTeslas (nT). This instrument is used to locate and laterally map buried, magnetically susceptible objects or materials.

The presence of ferromagnetic materials alters the Earth's natural magnetic field in both magnitude and direction, thus creating magnetic anomalies. The magnitude and extent of these anomalous responses are dependent on several variables, including target to magnetic sensor distance, target material, mass, and orientation. A direct correlation between target size, material, and depth of burial to magnetic anomaly intensity is not definite, therefore, the application of other geophysical imaging or direct excavation is often required.

For near-surface environmental investigations, **Berkshire** employs a gradient magnetometer (gradiometer) system. This design consists of two vertically separated proton precession magnetometers that permits an instantaneous determination of the total magnetic field over a known vertical distance. Vertical magnetic gradient data are digitally recorded in nT/m during the course of a survey. The advantage of a gradiometer system is the ability to determine the vertical magnetic field gradient, thus eliminating the need to reoccupy a base station. Base station reoccupation is required for single sensor magnetometers to correct for natural, time-varying magnetic field changes (diurnal variations). With the gradiometer, the effects of diurnal variation are negated since the gradiometer system measures the instantaneous difference between the two sensors. **Berkshire** employed its in-house GEM Overhauser GSM-19 gradiometer (**Figure 2**) using a magnetic sensor separation of 1.84 ft (0.56 m). This instrument is capable of detecting shallow buried (<25 ft subsurface), ferrous objects and materials.

3.0 FIELD DESIGN

3.1 Electromagnetic Induction

Based on site plans provided by **Barton & Loguidice**, **Berkshire** established eight (8) EM-34 profile lines (S1 - S8) with a total length of 10,740 linear ft around the landfill property with a concentration of profiles south of the landfill (**Figure 3 and Attachment 1**). The profiles were flagged on 20 ft intervals and surrounded the landfill, except in the far north end where concentrated metal debris would have made EM data ineffective. **Berkshire** positioned each profile line relative to surface features, and final (X,Y,Z) surveying was conducted by **Mr. Bruce Davison, L.S.**.

Initially, the EM-34 was calibrated and background values recorded in an area of exposed bedrock and devoid of cultural features, southwest of station 11+60 on Profile S3. Vertical and horizontal dipole mode EM-34 data points were collected every 20 ft along each profile, resulting in a total of 545 locations (1090 values). All EM data were monitored for QA/QC by the **Berkshire** Sr. geophysicist and the location of surficial interferences noted for later correlation.

3.2 Magnetics

The magnetic survey was designed to explore for steel drums reportedly buried beneath the south end of the landfill. Initially, **Berkshire** established a 10 x 10 ft control grid over a ~1 acre portion of the landfill to conduct the proposed pilot study. However, after a discussion between **Barton & Loguidice** and a Cortland County Landfill employee, the suspected drum area was constrained to a ~1 acre area generally south of the dirt access road (**Attachment 1**).

Due to the reduced site size and need for high-resolution delineation, **Berkshire** established a 10 x 10 ft control grid in this area and staked the corner points. Magnetic data were collected on a 5 x 5 ft pattern by bisecting the control grid (**Figure 4**). A total of 1,449 magnetic data points were digitally stored, downloaded to an in-field computer, and reviewed for data QA/QC. **Berkshire** generated and interpreted preliminary, **color-enhanced** contour maps of the magnetic gradient and total magnetic data and field flagged strong anomalies.

4.0 INTERPRETATION and RESULTS

4.1 Electromagnetic Induction

As indicated in **Figure 3**, the EM-34 data south of the landfill were combined and contoured (**Figures 5 & 6**). To maintain data integrity and to minimize linear distortion, these contour maps were generated using a 100 ft search radius. The contour maps display anomalous responses on Profiles S3 and S6. Generalizations concerning these and other responses are presented below:

- Based on EM-34 calibration readings, background values of ~3.3 (vertical) and ~2.5 (horizontal) can be expected in areas of exposed rock and higher readings would be expected with soil cover or near-surface water.
- In general, horizontal dipole values are of equal or greater amplitude than the vertical dipole readings. This suggests that less water is present at depth.
- EM-34 values were generally highest at the southern end of the landfill and near the ponds. Values typically decreased away from this area.
- Some EM-34 profiles encountered landfill material. In these areas, metallic objects often caused negative vertical dipole readings and high positive horizontal dipole values.

All EM-34 data were reviewed and the recorded values plotted on scaled graphs (**Appendix A: Figures A-S1 - A-S8**). The following sections describe specific interpretations for each profile.

Profile S1

Profile S1 started at the north end of the landfill near a metal and tire staging area and extended 3,100 ft south along the western edge of the landfill (**Figure 3 & Attachment 1**). In general, background values are interpreted between stations 0+00 and ~11+50. The profile intersects an area of the landfill between stations ~11+50 and 20+00 producing a large amplitude anomaly. South of station ~20+00, the EM-34 values display a moderately high background, but are not considered anomalous. The variation in horizontal dipole values between stations 26+00 and 30+00 may be due to a (reinforced?) concrete barrier along the new landfill access road.

Profile S2

Profile S2 started in the area of expose rock located southeast of the landfill. Positioned off the eastern edge of the landfill, Profile S2 extended north 1,700 ft, and then proceeded 700 ft northwest and terminated in an area of scrap metal and fill (**Figure 3 & Attachment 1**). Interpretation of Profile S2 revealed generally background conditions between stations 0+00 and 20+00. A visible increase in these background values occurs near station 12+20 where the exposed rock surface ended and a soil layer was present. The lower values between stations 20+00 and 23+00 are attributed to the access road which may be drier and less conductive. The last 80 ft of Profile S2 display responses characteristic of surface scrap or buried metallic fill.

Profile S3

Profile S3 started west-southwest of the suspected drum disposal area and followed the southern edge of the landfill. Near the treeline at station 6+00, Profile S3 turned slightly northward and extended a total distance of 1,160 ft (**Figure 3 & Attachment 1**). Between stations 7+00 to 9+20, the profile traversed a section of landfill. A comparison of EM-34 responses on either side of this fill material confirms that significantly higher conductivity is present between stations 0+00 to 7+00, while generally lower background values are present between stations 9+20 and 11+60. The magnitude of the recorded EM-34 data between stations 0+00 and 7+00 may be a response to near-surface saturation, but may also indicate inorganic groundwater contamination.

Profile S4

Profile S4 started in the area of exposed bedrock southeast of the landfill and extended 940 ft southwest through the woods toward (**Figure 3 & Attachment 1**). In general, EM-34 values recorded on Profile S4 are low. Furthermore, vertical dipole data are generally higher than the horizontal dipole data which suggests that the near-surface is fairly well drained. EM values increase at the western end of the profile near the ponds in response to higher near-surface saturation.

Profile S5

Profile S5 started near the southeast corner of the magnetic survey and extended south 860 ft between the ponds and the treeline (**Figure 3 & Attachment 1**). Recorded EM-34 values display a decreasing trend away from the landfill. This trend suggests that near-surface saturation decreases dramatically within the first ~450 ft south of the landfill, after which the recorded EM-34 values stabilize. In addition, station 6+00 on Profile S5 intersects Profile S4 at station ~9+00 and there is good correlation between in the two plots.

Profile S6

Profile S6 started near the south end of the landfill and extended 620 ft south along the western edge of the ponds (**Figure 3 & Attachment 1**). Similar to Profile S5, recorded EM-34 values display a decreasing trend away from the landfill. A number of leachate seeps were observed in the field and correlate to elevated EM-34 values between stations 3+20 and 3+80. The large spike on Profile S6 between stations 2+00 and 2+80 is interpreted as metallic fill material and may suggest that former landfill activity extended further east than previously documented and could also be the source for the observed leachate seeps.

Profile S7

Profile S7 started just southwest of the Buckbee Mears Disposal Area and extended 680 ft east-northeast (**Figure 3 & Attachment 1**). Recorded values display a moderate amount of variability. Horizontal dipole values range between ~5.5 and 7.0, while the vertical dipole readings show more variability. It is possible that the vertical dipole responses between stations 1+00 and 2+60 are due to bedrock fracturing.

Profile S8

Profile S8 starts ~220 ft south of Profile S7 (0+00) and extends 980 ft nearly due east (**Figure 3 & Attachment 1**). The most prominent feature on Profile S8 is interpreted landfill material between stations 3+60 and 6+00. The fill is interpreted to be non-metallic since none of the vertical dipole readings show the characteristic negative response associated with metal objects. The vertical dipole responses between stations 2+40 and 3+40 may also be due to bedrock fracturing. Correlation of these features between Profiles S7 and S8 would result in a generally northwest-southeast trend. Additional surface features on Profile S8 include a creek from station 1+60 to 1+80 and a steel culvert at ~6+85.

4.2 Magnetics

As anticipated, contour maps of the recorded magnetic gradient (**Figure 7**) and total magnetic field (**Figure 8**) data reveal consistently high background values which is common at municipal landfills. A total of four magnetic anomalies are interpreted at coordinates (525,170), (580,95), (630,105), and (690,45) (**Figure 7 - red**). The first three anomalies were staked in the field and their surveyed locations are plotted on **Attachment 1**.

The areas highlighted in red on **Figure 7** are considered anomalous, however the continuous area between coordinates (580,95) and (630,105) may be evidence for a large trench or cache of buried metal. Further examination of **Figure 7** reveals that the interpreted magnetic gradient anomalies are surrounded by negative values, highlighted in yellow. This dipolar response is also consistent with buried ferromagnetic objects.

5.0 SUMMARY and CONCLUSIONS

Berkshire Environmental, Inc. performed an integrated electromagnetic (Geonics EM-34) and magnetic investigation at the Cortland County Landfill, Cortland County, New York between June 2^{nd} and 4^{th}, 1997. The primary objectives of the geophysical investigation were to: 1) detect and determine preliminary limits of possible contamination emanating from the landfill; and 2) detect and delineate a cache of drums reportedly buried in a portion of the landfill. To meet the first objective, **Berkshire** implemented an EM-34 survey, while a magnetic survey was used to fulfill the second objective.

Berkshire collected and interpreted a total of 10,740 linear ft of EM-34 profiles and ~1,449 magnetic data points during the study. The results of the EM-34 investigation revealed the following:

- Vertical dipole EM-34 response, which may be due to bedrock fracturing, are interpreted between stations 1+00 and 2+60 on Profile S7 and 2+40 and 3+40 on Profile S8.

- Near-surface, inorganic groundwater contamination may be present between stations 3+20 and 3+80 on Profile S6 and between stations 0+00 and 7+00 on Profile S3.

- In general, horizontal dipole values are of equal or greater amplitude than the vertical dipole readings which suggests that saturation decreases with depth.

- EM-34 values were generally highest at the southern end of the landfill and near the ponds and typically decreased away from this area.

- Some EM-34 profiles encountered landfill material. On profile S6 the interpreted fill appears to be outside the previously documented landfill boundary.

The results of the magnetic survey revealed four anomalies, three of which were field-flagged. The anomalies are interpreted at coordinates (525,170), (580,95), (630,105), and (690,45). The continuous, high magnetic gradient responses extending away from these coordinates may be a evidence for a more continuous trench or occurrence of buried metal. **Berkshire** recommends that any excavation in the suspected drum burial area begin at the coordinates of these interpreted anomalies.

6.0 CLOSING

The field procedures and interpretative methodologies used in this project are consistent with standard, recognized practices in similar geophysical investigations. The correlation of geophysical responses with probable subsurface features is based on the past result of similar surveys although it is possible some variation could exist at this site. This warranty is in lieu of all other warranties either implied or expressed. **Berkshire** assumes no responsibility for interpretations made by others based on work performed by or recommendations made by **Berkshire.**

Geonics EM34-3XL Instrumentation

Berkshire

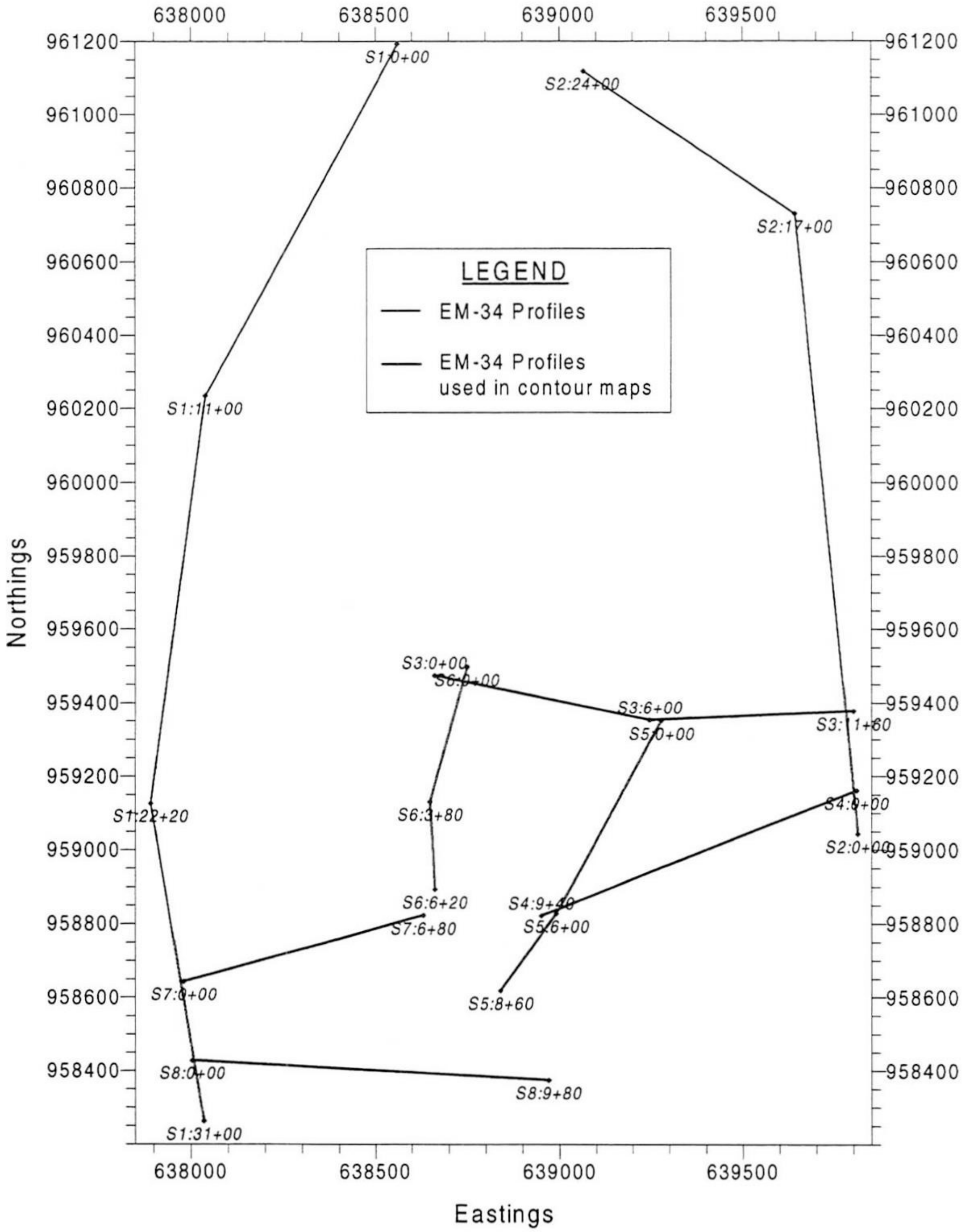
Geophysical Instrumentation **Figure 1**

GEM GSM-19 Instrumentation

Berkshire

Geophysical Instrumentation

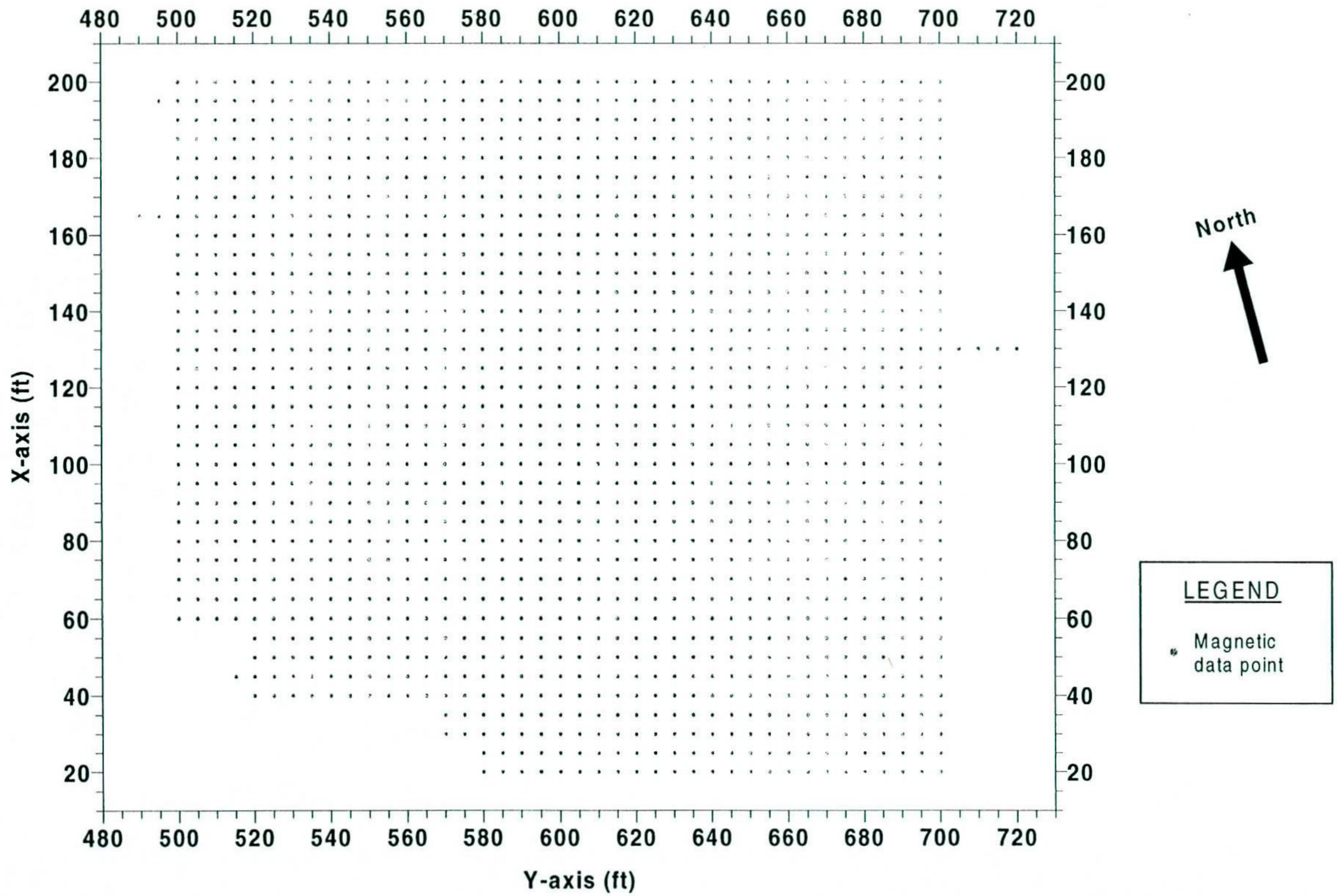
Figure 2



Berkshire

EM-34 Data Reference Map

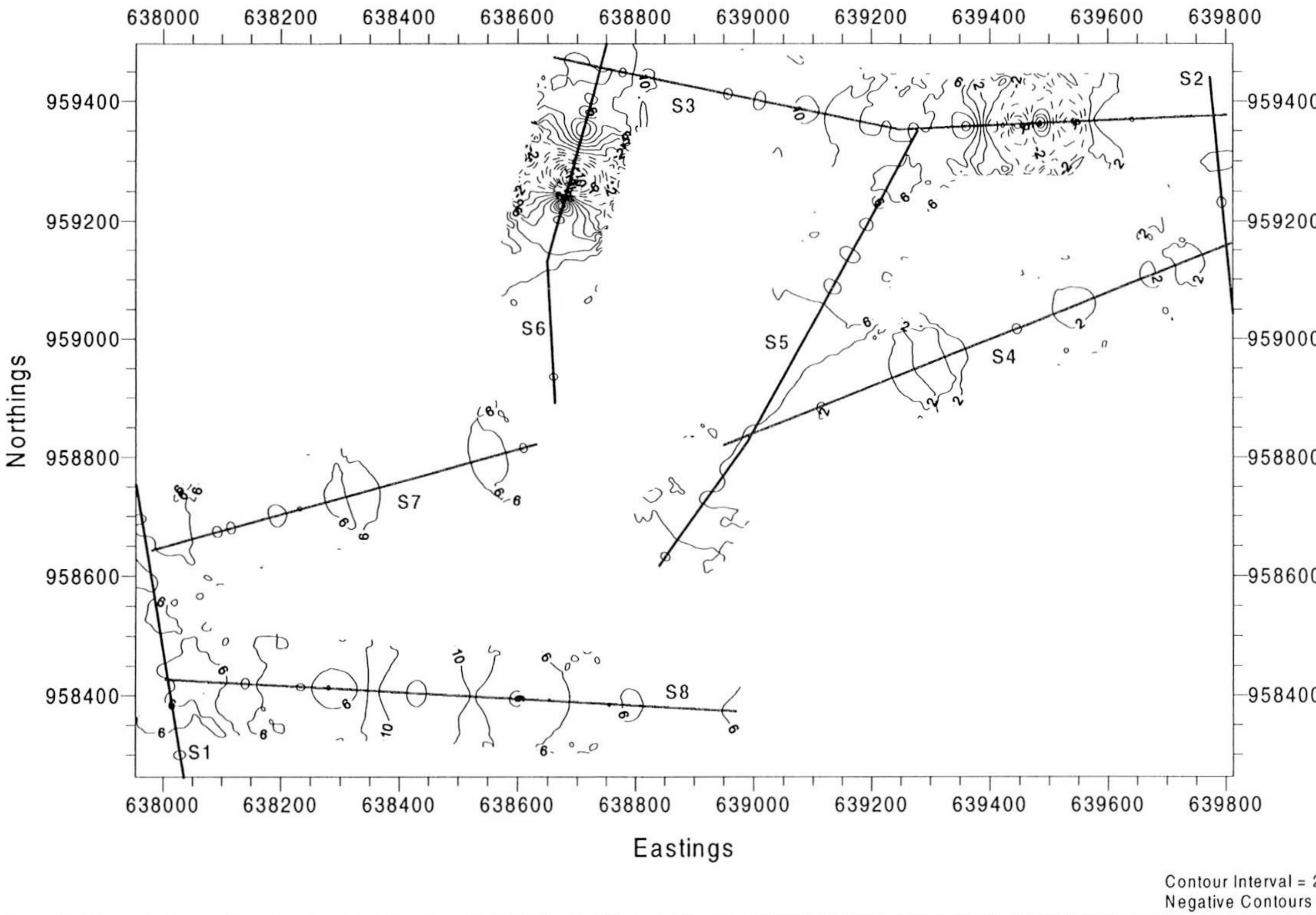
Figure 3



Berkshire

Magnetic Data Reference Map

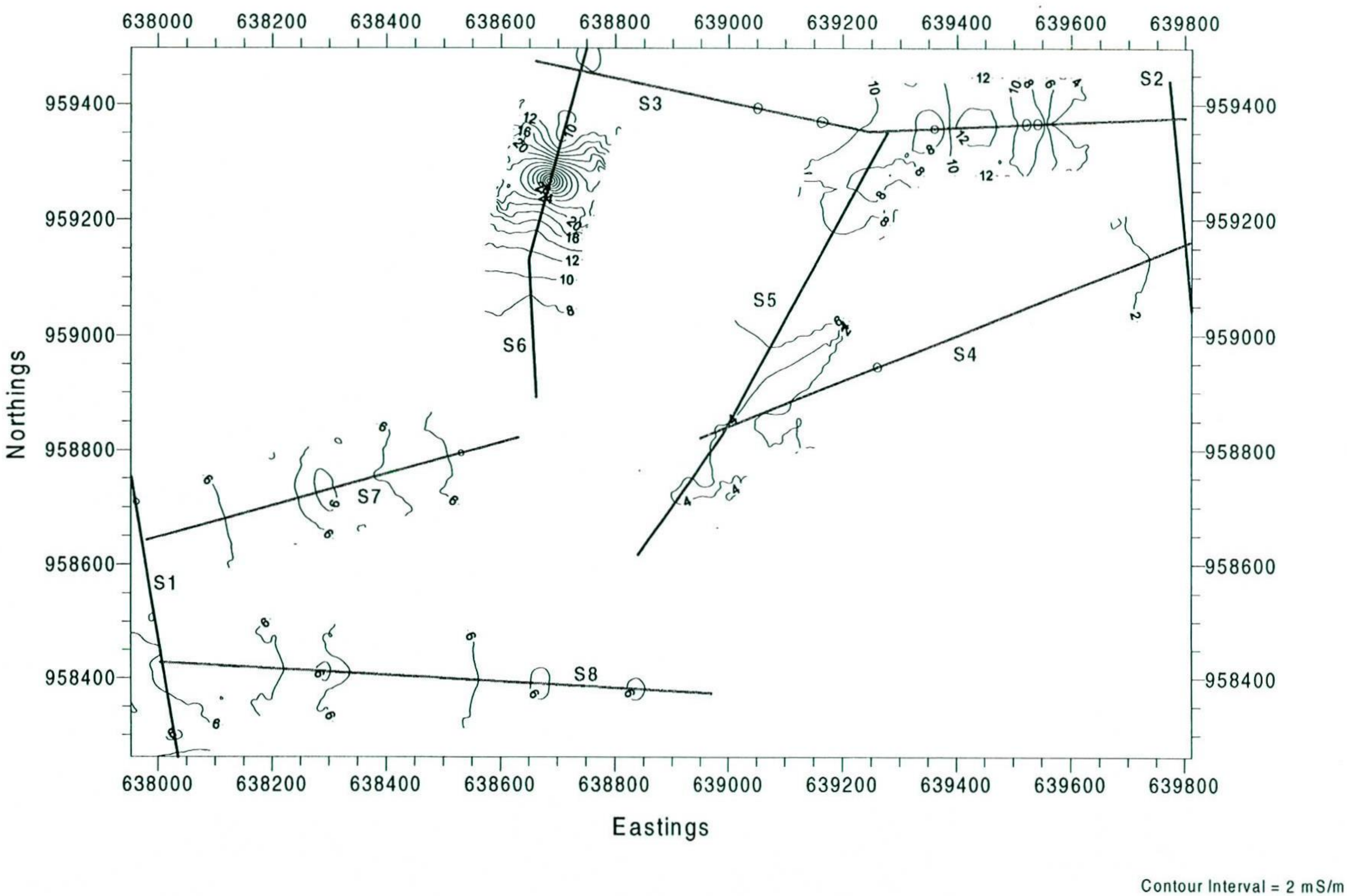
Figure 4



Berkshire

EM-34 Vertical Dipole Contour Map

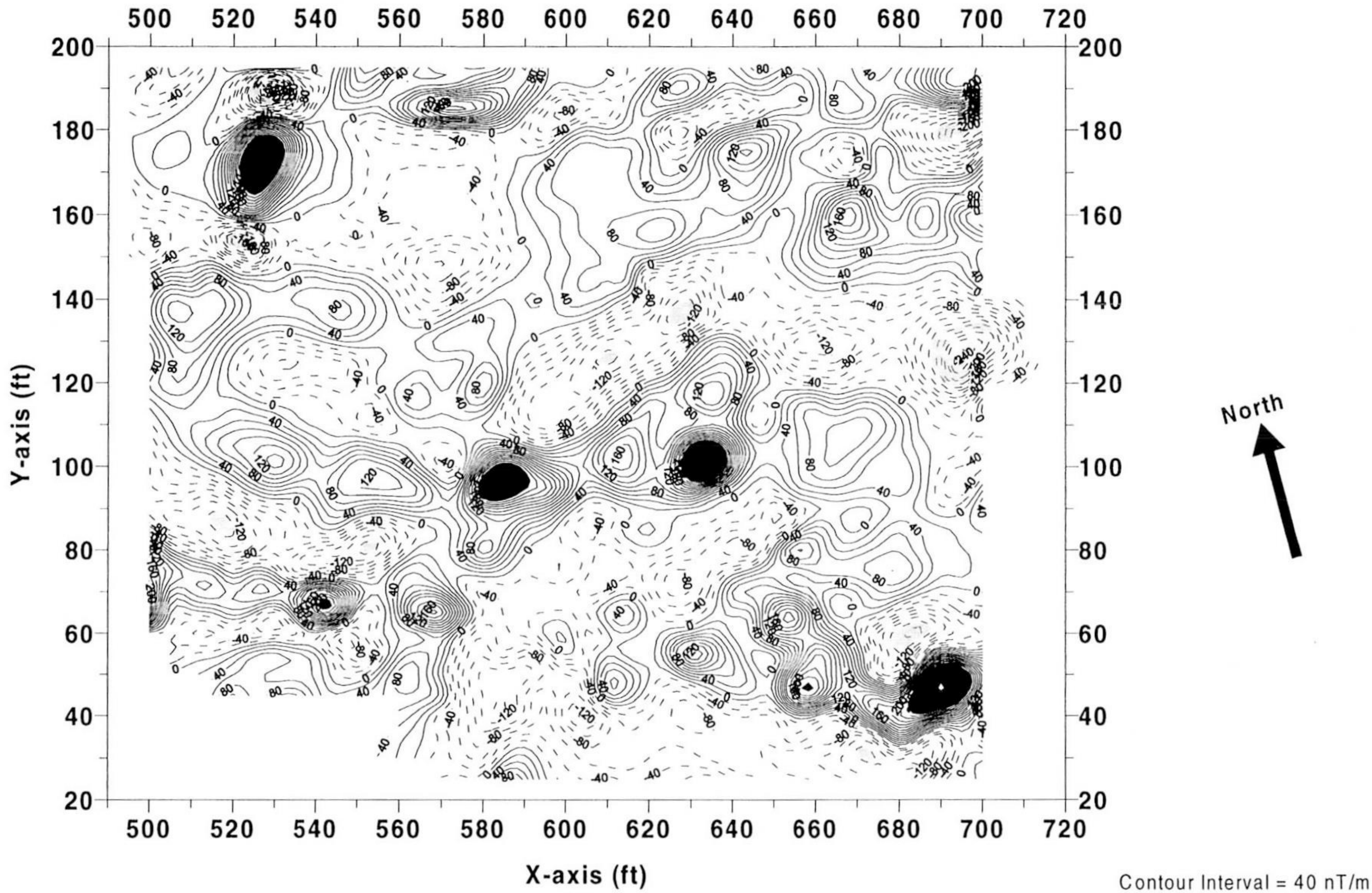
Figure 5



Berkshire

EM-34 Horizontal Dipole Contour Map

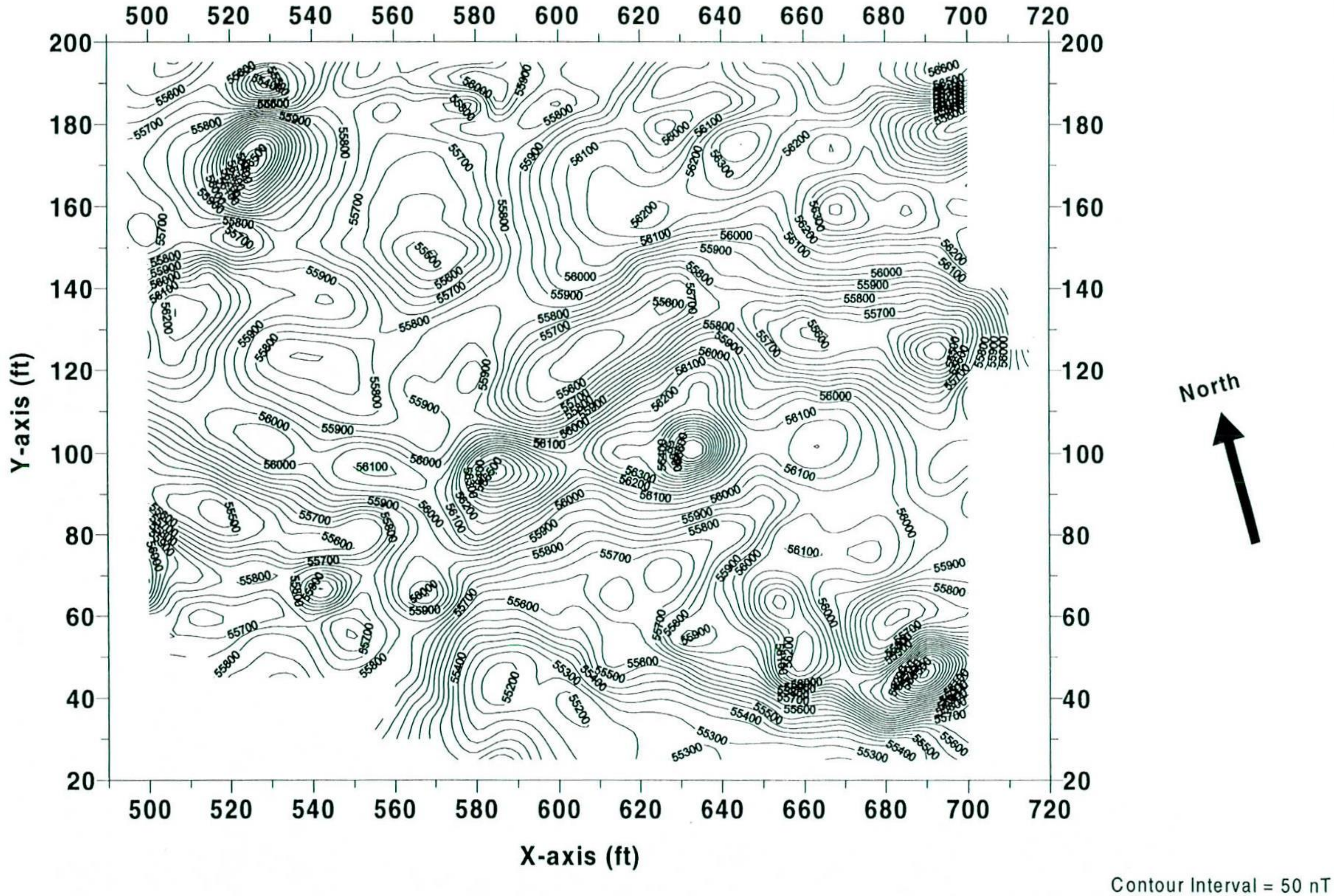
Figure 6



Berkshire

Magnetic Gradient Interpretation Map

Figure 7



Berkshire

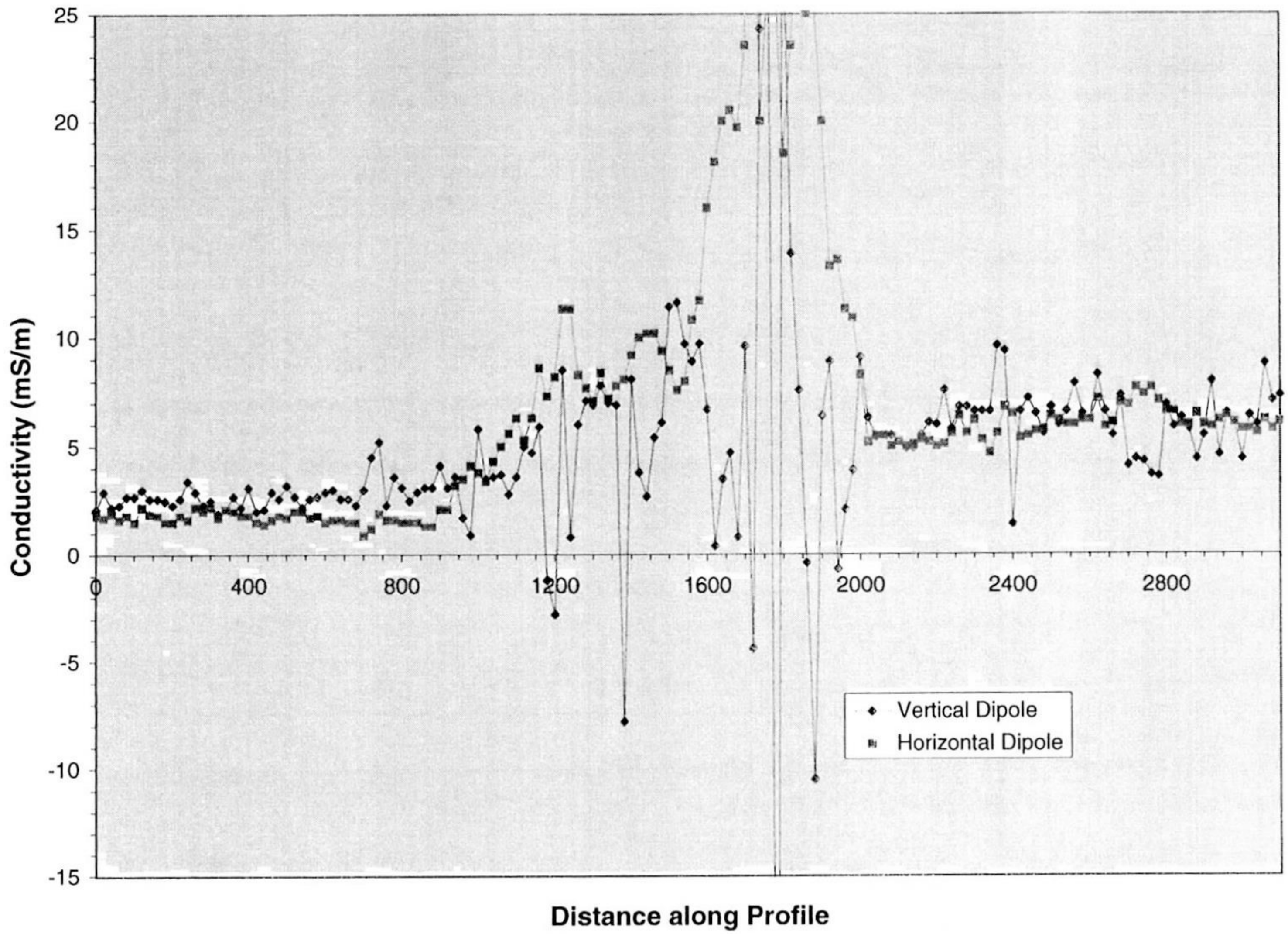
Total Magnetic Field Map

Figure 8

Berkshire

Appendix A

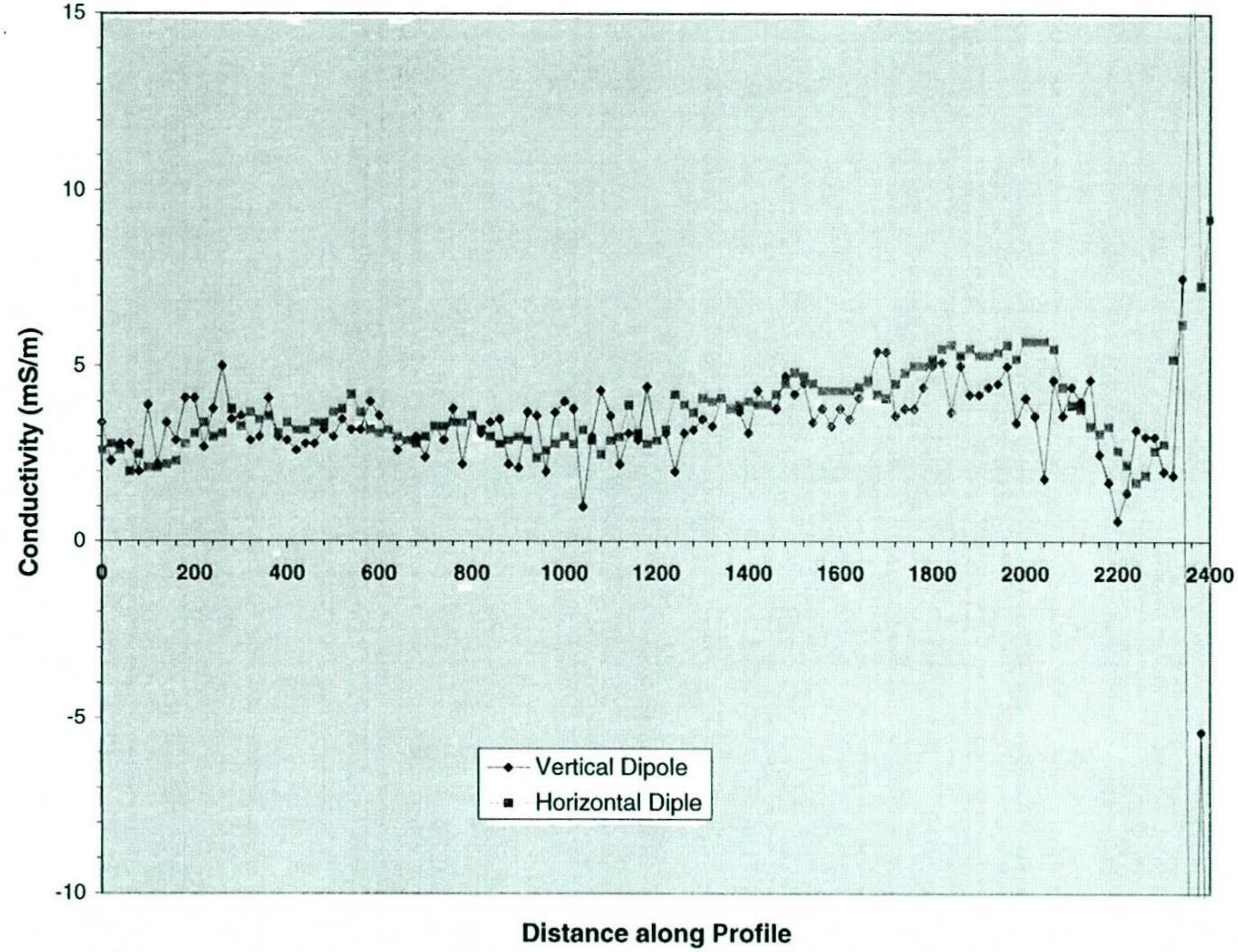
EM-34 Profiles



Berkshire

EM-34 Profile

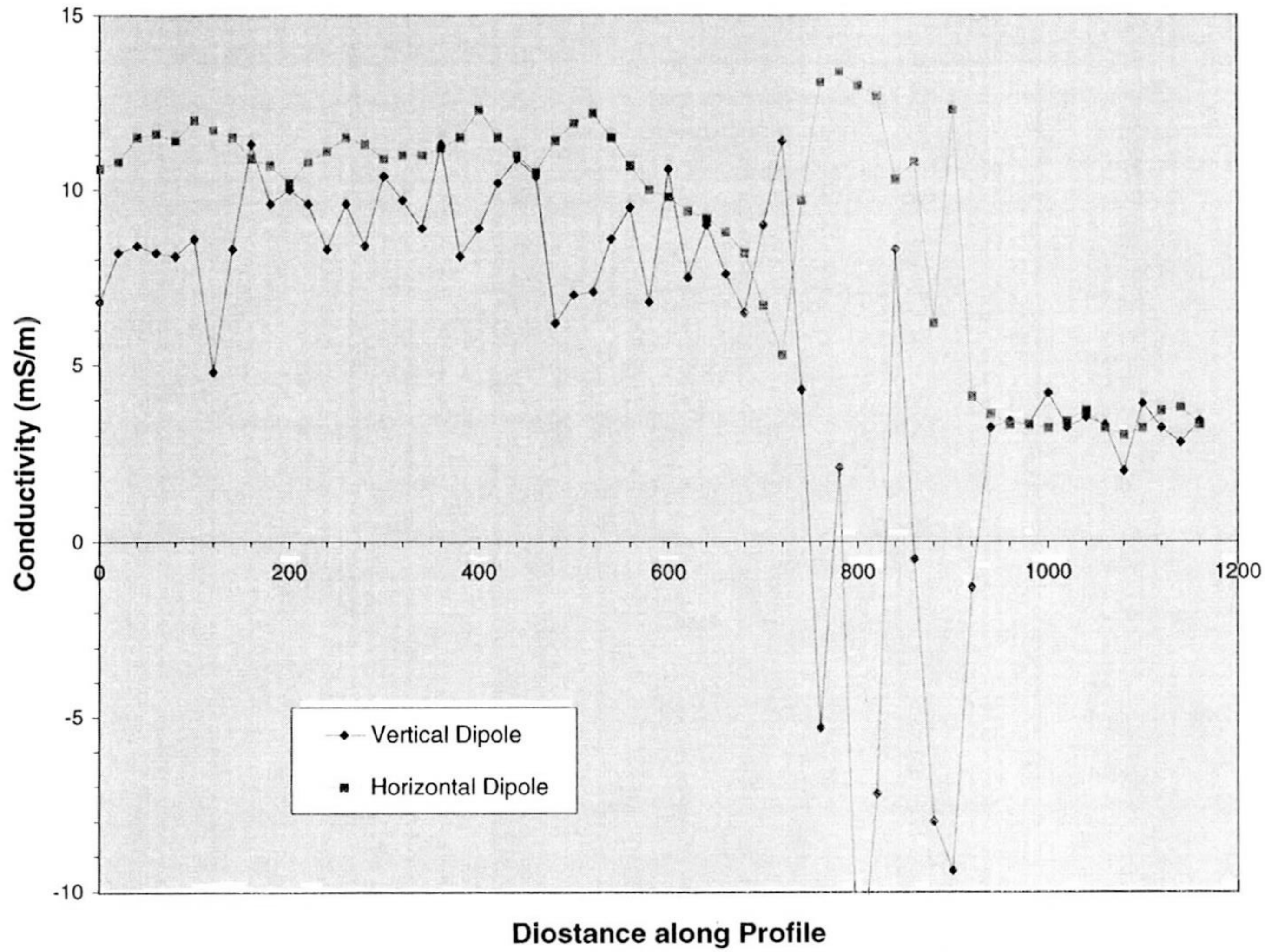
Figure A-S1



Berkshire

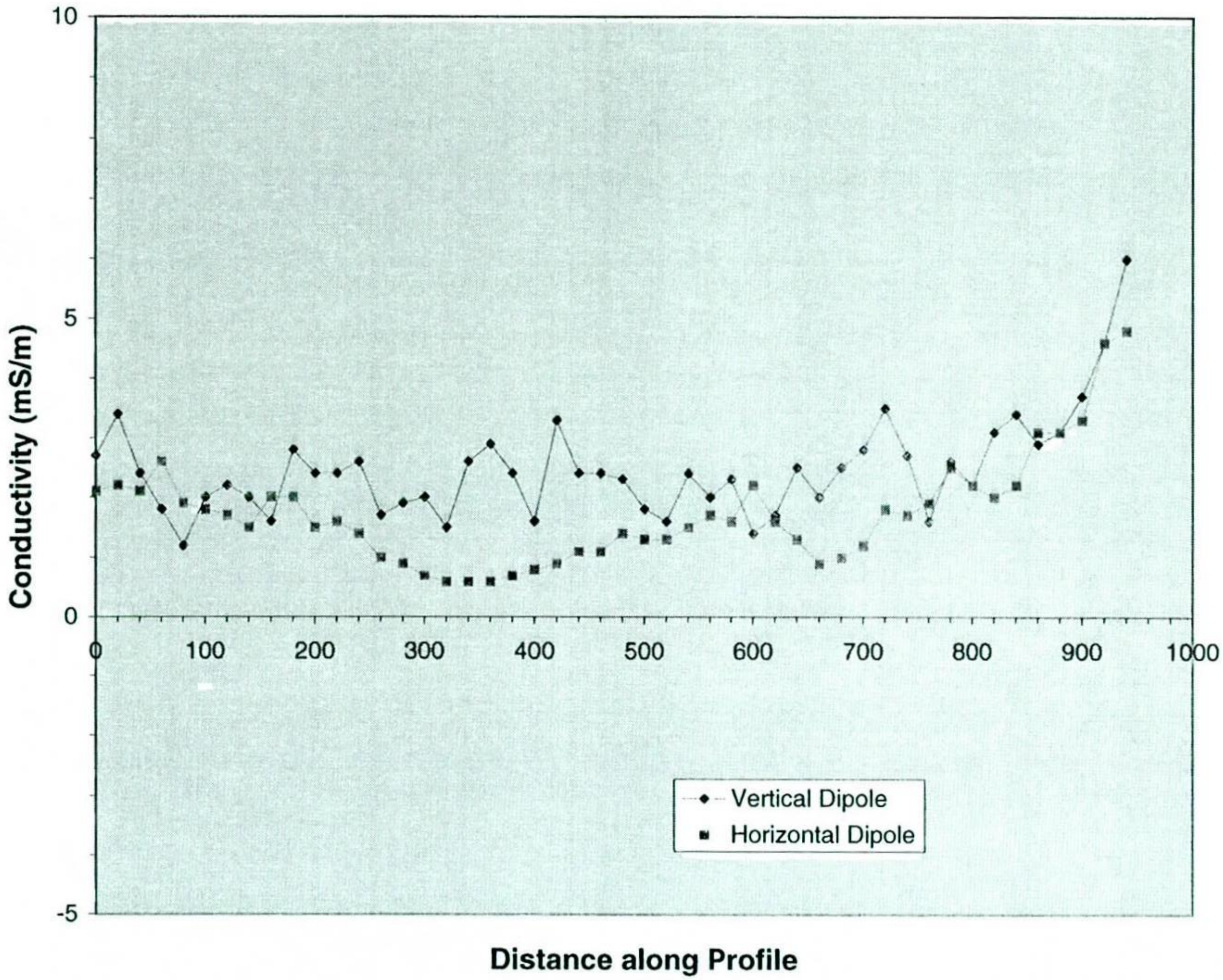
EM-34 Profile

Figure A-S2



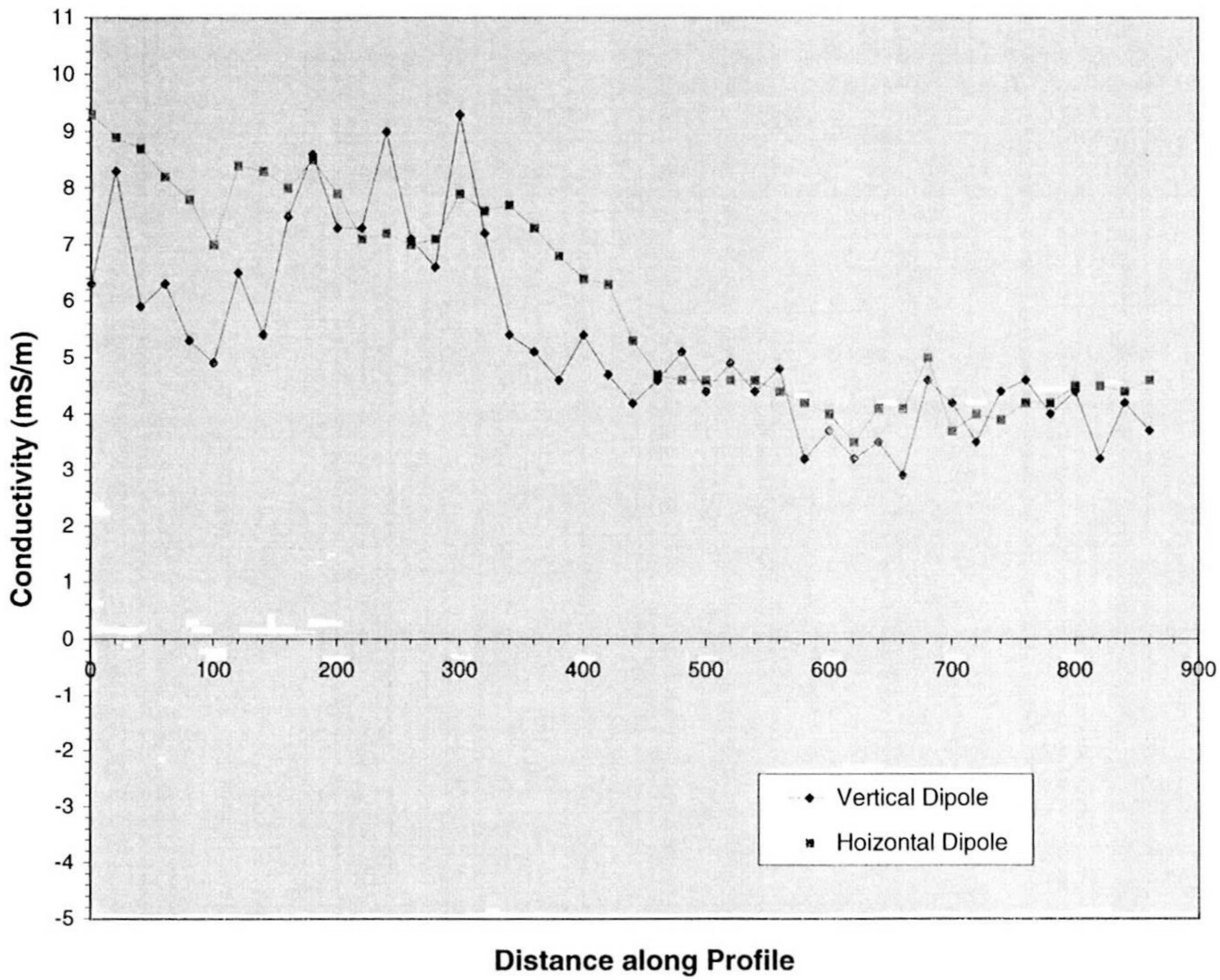
EM-34 Profile

Figure A-S3



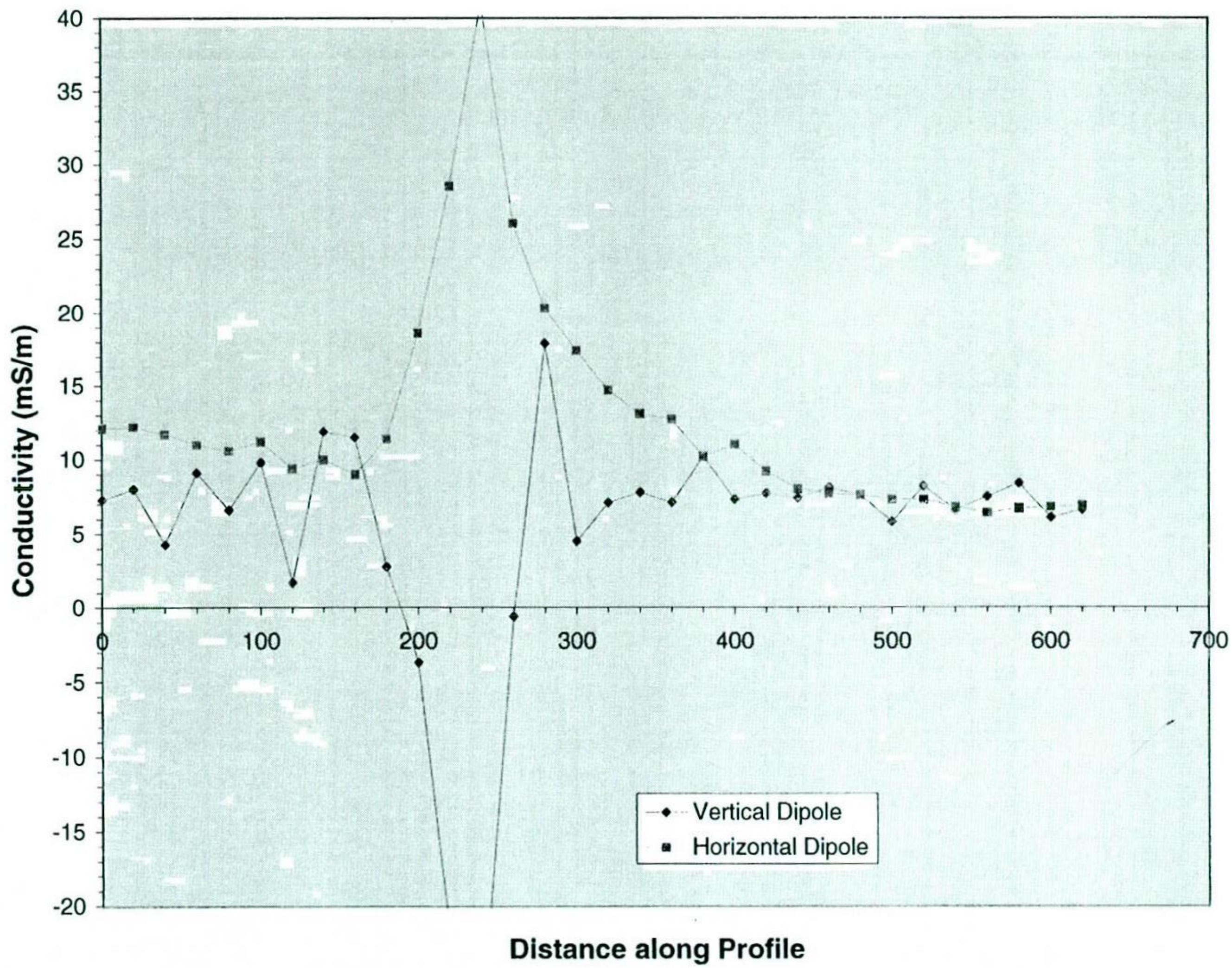
EM-34 Profile

Figure A-S4



EM-34 Profile

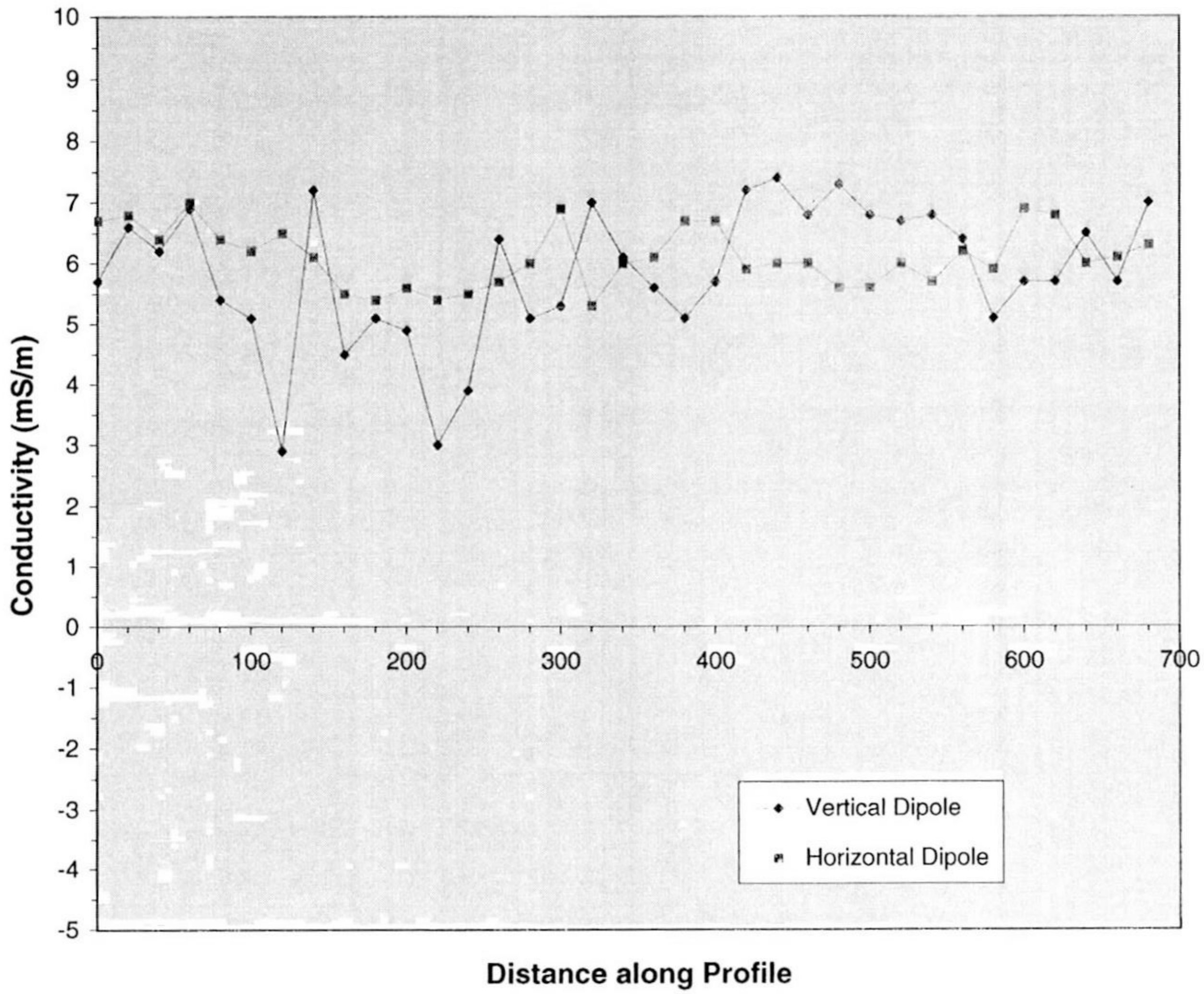
Figure A-S5



Berkshire

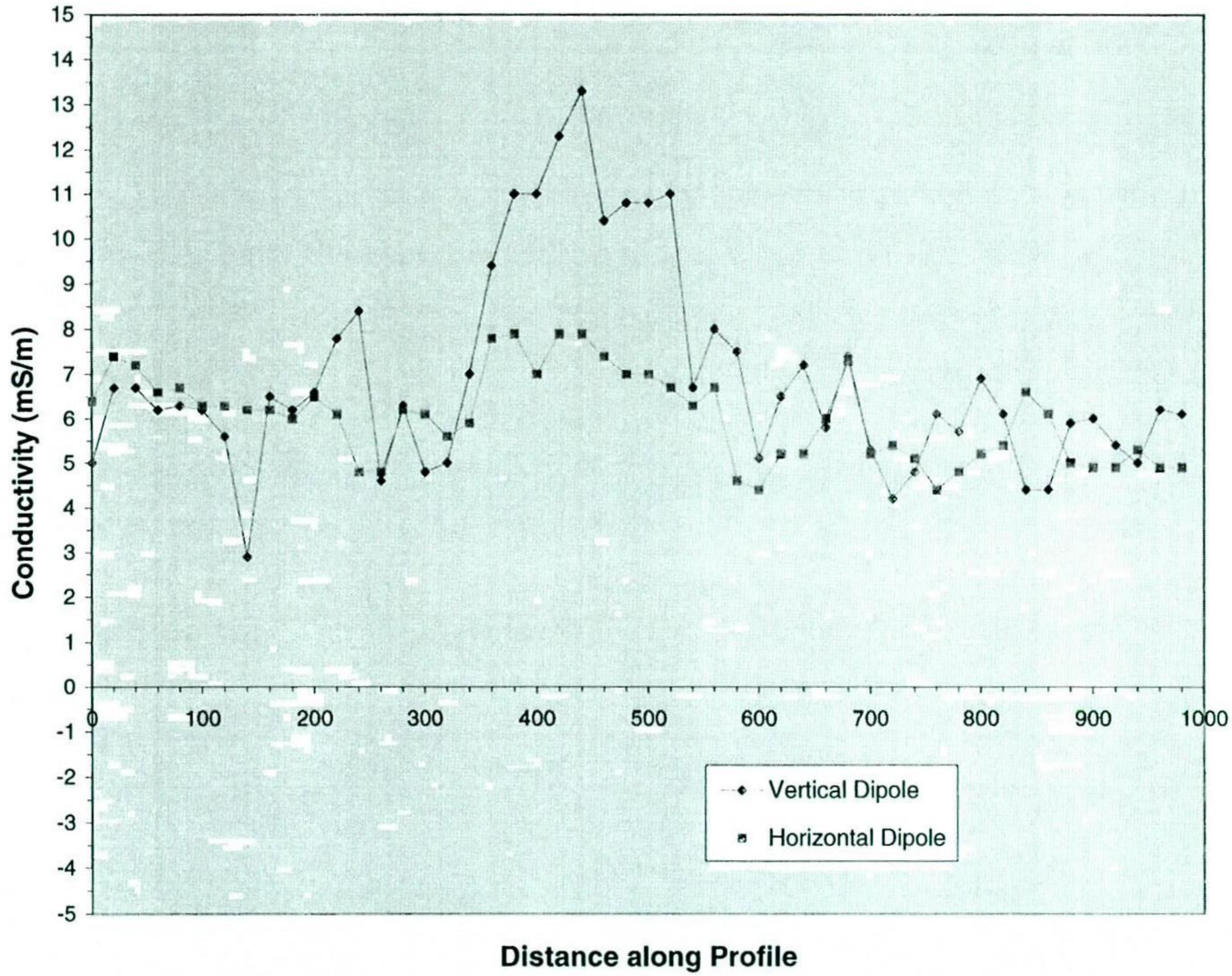
EM-34 Profile

Figure A-S6



EM-34 Profile

Figure A-S7



EM-34 Profile

Figure A-S8

Berkshire

Appendix B

Survey Coordinates

STATE OF NEW YORK · GARY BRUCE DAVISON · No. 49603 · LICENSED LAND SURVEYOR

Office:
27 N. Church St.
Cortland, NY 13045
(607) 753-8015

"Personal, Professional Service"

June 10,1997

To: Chris Papadakis,P.G.
Berkshire Environmental,Inc.
409 Penn Avenue
Sinking Spring, PA. 19608

Re: Cortland Co.Landfill Geophysical Profiles

Listed below are the profile point locations and elevations. I have also enclosed a drawing of same for your use.

Point No.	Northing	Easting	Elev.	Point Description
1020	958262.5	638034.5	1711.9	S-1 31+00
1021	958427.7	638003.3	1730.1	S-8 0+00
1022	958642.8	637980.2	1742.5	S-7 0+00
1023	958617.8	638840.2	1726.2	S-5 8+60
1024	958373.8	638969.5	1719.8	S-8 9+80
1025	958892.5	638662.2	1738.6	S-6 6+20
1026	958821.9	638630.1	1735.2	S-7 6+80
1027	958820.7	638950.0	1734.9	S-4 9+40
1028	958827.2	638989.9	1737.0	S-5 6+00
1029	959131.0	638648.8	1750.9	S-6 3+80
1030	959352.4	639246.2	1765.7	S-3 6+00
1031	959350.3	639277.7	1768.8	S-5 0+00
1032	959370.9	639322.5	1776.1	700.020
1033	959397.8	639319.1	1780.8	690.045
1034	959480.1	639227.5	1787.5	580.095
1035	959476.9	639277.6	1791.5	630.105
1036	959613.4	639171.5	1802.5	500.200
1037	959556.5	639362.6	1808.4	700.200
1038	959043.1	639811.8	1775.4	S-2 0+00
1039	959161.3	639808.6	1774.8	S-4 0+00
1040	959376.9	639800.2	1779.4	S-3 11+60
1041	960729.9	639642.6	1820.5	S-2 ~~14+00~~ 17+00
1042	961193.0	638560.1	1860.7	S-1 0+00
1043	960234.5	638028.0	1810.5	S-1 11+00
1044	959496.7	638749.4	1768.7	S-6 0+00
1045	959473.8	638660.5	1765.7	S-3 0+00
1046	961118.1	639063.9	1868.7	S-2 24+00
1047	959126.3	637890.9	1764.9	S-1 22+20

FAXED 6/10/97 with original to follow in mail with drawing. The drawing is on reproducible material so that you can run mylars or prints for worksheets as desired.

Berkshire

409 Penn Avenue
Sinking Spring, Pennsylvania 19608
(610)670-5900
(610)670-5903 FAX
beainc@postoffice.ptd.net

APPENDIX H

DOCUMENTATION REPORT FOR THE EXPLORATORY TRENCHING ACTIVITIES AT THE OLD CORTLAND COUNTY LANDFILL (Subcontractor Report)

DOCUMENTATION REPORT FOR THE EXPLORATORY TRENCHING ACTIVITIES AT THE OLD CORTLAND COUNTY LANDFILL SOLON, NEW YORK

ECKENFELDER INC.

DOCUMENTATION REPORT FOR THE EXPLORATORY TRENCHING ACTIVITIES AT THE OLD CORTLAND COUNTY LANDFILL SOLON, NEW YORK

Prepared for:
Barton & Loguidice, P.C.
Consulting Engineers
290 Elwood Davis Road
Box 3107
Syracuse, New York 13220

Prepared by:

ECKENFELDER INC.®
1200 MacArthur Boulevard
Mahwah, New Jersey 07430
(201) 529-0800

September 1997

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10/16/97

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1.0 INTRODUCTION

This Report has been prepared to document activities associated with the exploratory trenching at the Old Cortland County Landfill in Cortland County, New York. The purpose of the exploratory trenching was to investigate the suspected locations of disposed drums in the landfill and to evaluate the condition of drums found, if any. The exploratory trenching was performed as part of a Remedial Investigation (RI) at the site, being conducted by Barton & Loguidice, P.C. (B&L) (i.e., the prime contractor).

Daily observation of the exploratory trenching was performed by ECKENFELDER INC., as a subcontractor to B&L. Grant Street Construction Co., Inc. was retained by B&L to perform the excavation/backfilling activities associated with the project. Daily reports were prepared by ECKENFELDER INC. to document the field activities. Daily reports are attached in Appendix A of this report. On-site observation included the following:

- Site Preparation Activities
- Excavation Activities
- Waste/Soil Classification
- Backfilling and Cap Repair
- Work Area Monitoring
- Decontamination Procedures
- Health and Safety Procedures
- Photographic Documentation

This report describes the activities associated with the exploratory trenching including test pit logs, survey information (i.e., trench locations plan) and conclusions.

2.0 SITE PREPARATION ACTIVITIES

Prior to the excavation activities associated with the exploratory trenching, site preparation activities were conducted. Site preparation activities included the following:

- Decontamination Pad Construction
- Survey
- Vegetation Removal

Site preparation activities are described in the following sections of this report.

2.1 DECONTAMINATION PAD

The decontamination pad was constructed on a sloped parcel of land approximately 25 feet wide by 75 feet long. Initially, the decontamination pad area was graded and vegetation removed. Following grading activities, haybales were installed around the perimeter of the area with the exception of the upgradient end of the decontamination pad. The upgradient end remained open to allow equipment (i.e., backhoe, front-end loader, etc.) access to the pad. The floor of the decontamination pad was covered with heavy plastic. The edges of the plastic were draped over the perimeter haybales, then covered with approximately 18 inches of gravel. A perforated, plastic, 55 gallon drum was installed on top of the plastic sheeting and surrounded by the gravel. The plastic drum was installed in the southeast corner (i.e., the lowest point in the decontamination pad) to facilitate removal of collected decontamination rinsate.

The decontamination pad will remain in-place for future site work (i.e., drill rig decontamination, etc.). A photograph of the decontamination pad is contained in Appendix B of this report.

2.2 SURVEY

A geophysical survey (i.e., magnetometer survey) was conducted by B&L to locate potential areas where drums may have been buried at the site. Based on the results of the magnetometer survey, several locations were identified as potential areas for further exploration (i.e., trenching). A surveyor licensed in the State of New York was retained by B&L to locate/stake each suspected area.

2.3 VEGETATION REMOVAL

Prior to the excavation activities at each trench/test pit location, the existing vegetation was cleared from the area. The excavation equipment was utilized to clear the vegetation. Once the area was cleared of vegetation, excavation/exploratory trenching activities commenced, as described in the following section of this report.

3.0 EXPLORATORY TRENCHING

Exploratory trenching activities were conducted using a large backhoe (Kobelco X914). A total of eight (8) trenches/test pits were excavated at various locations at the site. Initially, trench locations were based on the results of the magnetometer survey. Supplemental trenches were added to provide operator coverage over the suspected drum disposal area. The locations of the test pits are shown on the Trench/Test Pit Location Map, contained in Appendix C of this report. The depth of the test pits ranged from 12 to 24 feet (from ground surface). The test pit excavations were discontinued when it was determined that the excavation had proceeded through the waste into the underlying, undisturbed, natural soils associated with the base of the landfill. Table 3-1 – "Trench/Test Pit Summary" provides a description of each test pit. Test pit field logs are contained in Appendix A of this report.

Drums or evidence of drums were not observed in any of the trenches/test pits. In some of the test pits, a larger quantity of metal/steel (i.e., crushed appliances, metal strapping, etc.) was encountered which may have resulted in the anomalies detected in the geophysical survey.

Each test pit was excavated in a similar manner. Initially, the existing soil cover (cap) was removed and stockpiled, on the "downhill" side of the trench, for future use. The underlying waste materials were excavated and stockpiled on plastic sheeting, adjacent to the trench. Excavated waste materials were placed on the "uphill" side of the trench. Water seeping out of the excavated waste materials was allowed to run across the plastic sheeting, back into the excavation. To control the air quality within the excavation (i.e., reduce the risk of landfill gas build up) large industrial fans were installed to pull fresh air through the trenches. Ambient air quality was continually monitored during excavation activities in accordance with the "Operations Plan for the Observation of Exploratory Trenching at the Old Cortland County Landfill", dated June 1997, prepared by ECKENFELDER INC. The ambient air in the work area was monitored with a photoionization detector (HNU) and a combustible gas meter. Ambient air quality in the work area remained at background levels. Also, the excavated waste materials were screened with the HNU for organic vapors. Ambient air quality in the work area remained at background levels. Air monitoring results (waste material screening) are contained

TABLE 3-1
EXPLORATORY TRENCHING
AT THE OLD CORTLAND COUNTY LANDFILL
TRENCH/TEST PIT SUMMARY

TEST PIT #	TOTAL DEPTH (ft.)	DESCRIPTION OF EXCAVATED MATERIAL	DEPTH TO WATER (ft.)	REMARKS
1	16.0	Municipal Solid Waste Mixed with soil	13.5	Base of Waste/Underlying soils encountered at 14.0'.
2	20.0	Municipal Solid Waste Mixed with soil	13.5	Base of Waste/Underlying soils encountered at 16.0'.
3	16.0	Municipal Solid Waste Mixed with soil	6.0	Base of Waste/Underlying soils encountered at 9.0'.
4	16.0	Municipal Solid Waste Mixed with soil	Dry	Base of Waste/Underlying soils encountered at 11.0'.
5	16.0	Municipal Solid Waste Mixed with soil	Dry	Base of Waste/Underlying soils encountered at 11.0'.
6	20.0	Municipal Solid Waste Mixed with soil	Dry	Base of Waste/Underlying soils encountered at 16.0'.
7	24.0	Municipal Solid Waste Mixed with soil	Dry	Base of Waste/Underlying soils encountered at 19.0'.
8	12.0	Municipal Solid Waste Mixed with soil	Dry	Base of Waste/Underlying soils encountered at 9.0'.

NOTE:
1. Measurements are from Ground Surface

in Appendix A of this report. Air monitoring results of the excavated waste material remained at or near background levels, with the exception of a few elevated levels, observed at instances when the monitoring equipment was held directly to some of the waste materials (i.e., asphalt type materials, etc.).

Following excavation and documentation activities, the test pits were backfilled with the removed waste materials. The backhoe bucket was used to compact the waste as it was returned to the trenches/test pits. The plastic sheeting was backfilled along with the waste materials in the trench and the soil cover materials replaced. The subsoil (i.e., the material directly over the waste, underlying the topsoil) cover materials were placed and compacted with the backhoe bucket. Following subsoil installation, the topsoil layer was replaced and seeded.

Following backfilling and replacement of cover soils (i.e., cap), the surveyor located and staked each test pit. As described above, the locations of the trenches/test pits are shown on Figure 1, contained in Appendix C of this report.

Upon completing the exploratory trenching activities, the excavation equipment was decontaminated. Decontamination procedures were conducted as described in the Operations Plan, referenced above. Rinsate from the decontamination activities was collected in containers. The containers will be sampled by B&L. Based on the analytical results, appropriate disposal methods will be decided upon by B&L.

4.0 SUMMARY AND CONCLUSIONS

ECKENFELDER INC's observations during the exploratory trenching activities lead to the following conclusions:

- Exploratory trenching activities were conducted in accordance with the "Operations Plan".
- Exploratory trenching activities were conducted in accordance with the requirements of the Project Health and Safety Plan.
- Drums or evidence of drums were not encountered in any of the trenches/test pits.

APPENDIX A

FIELD REPORTS AND LOGS

ECKENFELDER INC.

DAILY FIELD REPORT

Project : Old Cortland County Landfill	**DATE:** 7/7/97
Location: Cortland, New York	**DAY** 1 **OF CONSTRUCTION**
Observers: P.D. MUTCH	**WEATHER:** PARTLY CLOUDY
	TEMPERATURE: NA am 80° noon ____ pm

VISITORS:

MARK CHAUVIN B&L
GRANT STREET CONSTRUCTION

DESCRIPTION OF WORK:

GRANT STREET CONSTRUCTION ON-SITE CONTRACTING BEGAN 7/7/97 [illegible]

BEGAN EXCAVATION OF TRENCH / TEST PIT #1 @ 3:30 PM ±
APPROXIMATELY 3' OF COVER SOIL, TRENCH ADVANCED TO
13.0' ±. LIGHTENING STORM @ 4:30, ENDED WORK FOR
THE DAY, SEE TEST PIT LOG AND EQUIPMENT AND
PERSONNEL CHECKLIST ATTACHED

ATTACHMENTS:

- ☐ Description of Work (Continued)
- ☐ Equipment/Personnel Checklist
- ☐ Other ____________

P.D. Mutch 7/7/97
Signature of Preparer Date

Form: CF_0134.01A.XLS

ECKENFELDER INC.	DAILY FIELD REPORT - EQUIPMENT AND PERSONNEL CHECKLIST Page 2 of 2
Project : Old Cortland County Landfill Location: Cortland, New York	DATE: JULY 7, 1997

Contractors and Subcontractors	Number and Title of Personnel
GRANT STREET CONSTRUCTION	1 OPERATOR & 1 LABOR
B & L	MARK CHAUVIN - PROJECT MANAGER
ECKENFELDER INC	PAUL MUTCH - " "

Equipment	No.	Operating Hours	Downtime
TEREX 6OC - FRONTEND LOADER	1		
KOBELCO X914 BACKHOE	1		

P.D. Mutch — Signature of Preparer

JULY 7, 1997 — Date

Form: CF_0134.01C.XLS

ECKENFELDER INC.

DAILY FIELD REPORT

Page 1 of 1

Project: Old Cortland County Landfill	**DATE:** 7/8/97
Location: Cortland, New York	**DAY** 2 **OF CONSTRUCTION**
Observers: Lamia Carll	**WEATHER:** Sun
	TEMPERATURE: 50° am 80° noon 80 pm

VISITORS:

Brian Davidson — Ralph Pitoni

Mark Olsewicz — Barton & Loguidice

Rich Comerzzi — Grand Street Const.

DESCRIPTION OF WORK:

0800 – 0000 – Continued work on test pit #1 hit ground water at 13.5 feet below ground surface discontinued trenching due to this condition. Proceed to move 30' to the east of test pit #1 and begin test pit #2. This pit was advanced to 20 feet. Trash was visible to @ 16.0' below ground surface. Below the trash level was Gray/Brown Silt & Clay / Clay & Silt, with decreasing amounts of large gravel and boulders w/ depth. At 13.5 feet water was seen entering the trench from all sides at a high rate of speed. Below 20 feet a hard packed layer was obvious and Advancement was stopped. Brian Davidson was on site from 12:00 to 5:00. Both trenches were backfilled according to the scope of work

ATTACHMENTS:

- ☐ Description of Work (Continued)
- ☐ Equipment/Personnel Checklist
- ☐ Other ______

Lamia Carll 7/9/97

Signature of Preparer — Date

Form: CF_0134.01A.XLS

q:\proj\0134.01\daily report

6/27/97

ECKENFELDER INC.

DAILY FIELD REPORT

Project: Old Cortland County Landfill

Location: Cortland, New York

Observers: Damian Cavalli

DATE: 7/9/97

DAY 3 **OF CONSTRUCTION**

WEATHER: Rain / Clouds

TEMPERATURE: 50 am 52 noon 54 pm

VISITORS:

Brian Davidson   Ralph Pitman

Rick Caraccioli

Mark Chaurin

DESCRIPTION OF WORK:

Today Pits #3, #4 #5 were excavated. Each pit was excavated to relatively the same depth of [illegible] below ground surface. Water was encountered in test pit #3. Excavation continued through the water with the excavator assuming the responsibility of handling any drums that were at [illegible] of being damaged. No drums were encountered in any test pit. All Test pits were backfilled according to the scope of work at the end of the day. Photos have been taken during all aspects of excavation. All visitors were off site by 1800 hours. Rain was a factor most of the day and work was stopped for approximately 45 minutes due to storm rain and lightning.

ATTACHMENTS:

- ☐ Description of Work (Continued)
- ☐ Equipment/Personnel Checklist
- ☐ Other

Damian Cavalli   7/9/97

Signature of Preparer   Date

Form: CF_0134.01A.XLS

ECKENFELDER INC.

DAILY FIELD REPORT

Project : Old Cortland County Landfill	**DATE:** 7/-/97
Location: Cortland, New York	**DAY** 4 **OF CONSTRUCTION**
Observers: Damian Carroll	**WEATHER:** 75° Sun
	TEMPERATURE: 65 am 70 noon 75 pm

VISITORS:

Brian Davidson [illegible] Rick Campagni
Robert [illegible] Warren [illegible]
Mark Chauvin

DESCRIPTION OF WORK:

Today is the last day of excavating test pits. Test pits [illegible] were excavated and backfilled around [illegible] of the [illegible] [illegible]. The drums were identified and excavation continued at least 2 feet into natural undisturbed soil in all pits. Throughout the project the PID and combustible gas meter never recorded anything that required us to upgrade our PPE. Warren [illegible] has notified me that none of the workers including Rick Campagni, Mark Chauvin and I were ever exposed to any detectable levels of [illegible].
Work started today at 07:30 and ended at 12:00 [illegible] [illegible] w/ a [illegible] [illegible]. Rick Campagni and Mark Chauvin were on site when I left.

ATTACHMENTS:

- ☐ Description of Work (Continued)
- ☐ Equipment/Personnel Checklist
- ☐ Other ______

Damian 7/-/97

Signature of Preparer Date

Form: CF_0134.01A.XLS

ECKENFELDER INC.

PROJECT No.

TEST PIT LOGS

PROJECT: Old Oakland County Landfill — SHEET 1 OF 1

CLIENT: Barton & Loguidice

CONTRACTOR: [illegible] Construction — EQUIPMENT: [illegible] X 914

OPERATOR: [illegible] — INSPECTOR: Damian [illegible]

LOG OF TEST PIT No. 1 — Date: 7-8-97 — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-3' Brown c-f SAND, some Silt, trace c-f Gravel	Refuse from 3.0' to 14.0'.
	5			
			3'-14' Refuse some gray little SILT, trace c-f SAND, trace c-f Gravel.	Hnu recorded 5.0 ppm during excavation from side of Test Pit.
	10			
			@ 13.5' Water	
	15		14'-16' Gray/Brown Silty CLAY, little c-f Gravel, dry	
			16' = End of Test Pit.	
	20			

LOG OF TEST PIT No. — Date: — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible gas meter remained constant at [illegible] during excavation and 20% LEL during excavation

ECKENFELDER INC. PROJECT No. 0134.02

TEST PIT LOGS

PROJECT: Cortland County Landfill SHEET 1 OF 1

CLIENT: Barton & Loguidice

CONTRACTOR: Grand Street Construction EQUIPMENT: Kobelco 7014

OPERATOR: Vick Campanari INSPECTOR: Damian Carvelli

LOG OF TEST PIT No. 2 Date: 7-8-97 Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-3' Brown c-m-f SAND some Silt, some c-m-f Gravel.	Refuse from 3.0' to 16.0'
	5			
			3'-16' Refuse, little brown/gray Silty CLAY, trace c-m-f Gravel.	Between 3.0' and 15.0' were recorded varied readings between 0.0ppm to 5.0ppm over refuse.
	10		@ 13.5 Water.	
	15		16'-20' = Gray/Brown Silty CLAY, little c-m-f Gravel, dry	
	20		20.0' = End of TEST PIT	

LOG OF TEST PIT No. Date: Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible gas meter remained constant at 20.8% oxygen concentration and 0.0% LEL during excavation.

ECKENFELDER INC. | PROJECT No. | **TEST PIT LOGS**

PROJECT: Cortland County Landfill — SHEET 1 OF 1

CLIENT: Barton & Loguidice

CONTRACTOR: Grant Street Construction — EQUIPMENT: Hobelco 1914

OPERATOR: Rick Compagni — INSPECTOR: Damian Carroll

LOG OF TEST PIT No. 3 — Date: — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-3' Brown cmf SAND, trace (?) Silt, trace cmf SAND	Refuse from 4.0' to 9.0'
	5		@ 3.0'-9.0' = Refuse and Gray Silty CLAY	
			@ 8.0' = WATER	Hnu didn't register any readings during excavation in breathing zone
	10		@ 9.0-16.0' = Gray/brown Silty CLAY, some cf Gravel, ...	
	15		@ 16' = End of TEST Pit	
	20			

LOG OF TEST PIT No. — Date: — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible gas meter remained constant at 20.9% oxygen concentration and had a reading of .05% LEL of 2.5 ...

ECKENFELDER INC.	PROJECT No.	TEST PIT LOGS

PROJECT: Cortland County Landfill — SHEET 1 OF 1

CLIENT: Barton & Loguidice

CONTRACTOR: Grant Street Construction — EQUIPMENT: Kobelco X 914

OPERATOR: Rick Compagni — INSPECTOR: Damian Carelli

LOG OF TEST PIT No. 4 — **Date:** 7/8/97 — **Elevation:**

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-3 = Brown c-f SAND, trace (-) silt, trace c-f Gravel.	Refuse from 3.0'-11.0'
	5		3.0'-11.0' = Refuse, some gray brown silty CLAY	-Hnu not used during excavation due to weather.
	10		@ 11.0'-16.0' Gray brown silty CLAY, some (-) c(-) Gravel, dry.	
	15		@ 16.0 = End of TEST PIT	
	20			

LOG OF TEST PIT No. — **Date:** — **Elevation:**

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible gas readings remained constant at 20.8% Oxygen and 0.0% LEL during excavation

ECKENFELDER INC.	PROJECT No.	TEST PIT LOGS

PROJECT: Cortland County Landfill — SHEET 1 OF 1

CLIENT: Barton & Loguidice

CONTRACTOR: Grant Street Construction — EQUIPMENT: Hitachi 914

OPERATOR: Rich Compaani — INSPECTOR: Damian Vanetti

LOG OF TEST PIT No. 5 — Date: 7-9-97 — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			Brown cmf SAND, trace (+) Silt, trace cmf Gravel	Refuse from 3.0'-11.0'
	5		@ 3.0-11.0' = Refuse, some brown/gray silty CLAY	HNU was not used during excavation due to weather.
	10		@ 11.0-16.0' = Brown/gray silty CLAY, some cf Gravel, dry.	
	15		@ 16.0 END OF TEST PIT	
	20			

LOG OF TEST PIT No. — Date: — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible gas meter remained constant at 20.8% oxygen concentration and 00% LEL during excavation.

ECKENFELDER INC.

PROJECT No.

TEST PIT LOGS

PROJECT: Cortland County Landfill

SHEET 1 OF 1

CLIENT: Barton & Loguidice

CONTRACTOR: Grant Street Construction

EQUIPMENT: Kobelco X 914

OPERATOR: Rich Campanni

INSPECTOR: Damian Comolli

LOG OF TEST PIT No. 6 Date: 7-10-97 Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-1.5 Brown cmf SAND, trace (+) silt, some cmf Gravel.	Refuse from 4.0' to 16.0'
			1.5-4.0' = Gray Silty CLAY, some cmf Gravel.	
	5		@ 4.0-16.0' - Refuse and gray silty CLAY.	HNU did not register any readings during excavation.
	10		@ 16.0-20.0' Gray brown Silty CLAY little (+) Gravel, dry	
	15		@ 20.0' = End of Test Pit	
	20			

LOG OF TEST PIT No. Date: Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible gas meter remained steady at 21 % oxygen concentration and 0 % LEL during excavation

ECKENFELDER INC.

PROJECT No.

TEST PIT LOGS

PROJECT: Cortland County Landfill — SHEET 1 OF 1

CLIENT: Rust [illegible]

CONTRACTOR: [illegible] Construction — EQUIPMENT: Kobelco [illegible]

OPERATOR: [illegible] Compagni — INSPECTOR: Damian Correll

LOG OF TEST PIT No. 7 — Date: 7-10-97 — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-3.5' = Brown c m f SAND, some c m f Gravel, trace silt.	[illegible]
	5		3.5-5.0' = Gray Silty CLAY, little c m f Sand	
			@5.0'-19.0' [illegible]	Hnu readings varied from 0.0 to [illegible] during excavation.
	10			
	15			
			@19.0'-24.0' Gray [illegible], little [illegible] Gravel	
	20			
			24.0' = End of Test Pit	

LOG OF TEST PIT No. — Date: — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible Gas meter read 20.8% oxygen [illegible] and 0% LEL throughout excavation of Test Pit.

ECKENFELDER INC. PROJECT No.

TEST PIT LOGS

PROJECT: Portland County Landfill — SHEET 1 OF 1

CLIENT: Foster & Heinrich

CONTRACTOR: [illegible] Street Construction — EQUIPMENT: Hobbler 4914

OPERATOR: Rich Compagni — INSPECTOR: Damian Carroll

LOG OF TEST PIT No. 8 — Date: 7/10/87 — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
			0-2.0' Brown C m F SAND, trace (+) silt, some c m F Gravel.	Refuse from 2.0-9.0'
	5		@2.0-9.0 - Refuse, some Gray silty CLAY.	HNU reading of 1.0 ppm between 4-6'.
	10		@9.0-12.0 = Gray silty CLAY, little c m F Gravel	
	15		@12.0 = End of Boring	
	20			

LOG OF TEST PIT No. — Date: — Elevation:

WELL CONSTRUCTION	DEPTH FT.	SAMPLE No. DEPTH	CLASSIFICATION	
	5			
	10			
	15			
	20			

COMMENTS: Combustible Gas meter read 20.8% oxygen concentration and 00% LEL throughout excavation of Test Pit.

EXPLORATORY TRENCHING AT THE OLD CORTLAND COUNTY LANDFILL
WASTE PILE SCREENING
AIR MONITORING RESULTS SUMMARY

DATE	TIME	P.I.D.[1] READING	COMBUSTIBLE GAS (% LEL)	TEST PIT NO.	REMARKS
7/7/97	3:45	0	0	1	Background
	4:05	0	0	1	Downwind of Test Pit
	4:07	0	0	1	Waste Pile Screening
	4:10	0	0	1	Waste Pile Screening
	4:20	2	0	1	Waste Pile Screening
	4:25	0	0	1	Waste Pile Screening
	4:35	5	0	1	Waste Pile Screening
	4:40	0	0	1	Waste Pile Screening
	4:45	0	0	1	Background
7/8/97	10:30	0	0	2	Waste Pile Screening
	12:00	4.0	0	2	Waste Pile Screening
	12:15	5/0	0	2	Waste Pile Screening
	1:30	5/2	0	2	Waste Pile Screening
	1:45	0	0	2	Waste Pile Screening
	1:55	0	0	2	Waste Pile Screening
	2:30	0	0	2	Waste Pile Screening
7/9/97	8:45	0	0	3	Waste Pile Screening
	10:00	0	0	3	Waste Pile Screening
	10:10	0	0	3	Waste Pile Screening
	10:15	0	0	3	Waste Pile Screening
	10:20	0	0	3	Waste Pile Screening
	10:25	0	0	3	Waste Pile Screening
	10:37	0	0	3	Waste Pile Screening
7/9/97	11:09	*	0	4	Waste Pile Screening
	11:15	*	0	4	Waste Pile Screening
	11:20	*	0	4	Waste Pile Screening
	11:35	*	0	4	Waste Pile Screening
	11:45	*	0	4	Waste Pile Screening
	11:50	*	0	4	Waste Pile Screening
	11:52	*	0	4	Waste Pile Screening

EXPLORATORY TRENCHING AT THE OLD CORTLAND COUNTY LANDFILL
WASTE PILE SCREENING
AIR MONITORING RESULTS SUMMARY

DATE	TIME	P.I.D.[1] READING	COMBUSTIBLE GAS (% LEL)	TEST PIT NO.	REMARKS
7/9/97	12:55	*	0	5	Waste Pile Screening
	1:10	*	0	5	Waste Pile Screening
	1:15	*	0	5	Waste Pile Screening
	1:20	*	0	5	Waste Pile Screening
	1:30	*	0	5	Waste Pile Screening
	2:00	*	0	5	Waste Pile Screening
	2:10	*	0	5	Waste Pile Screening
	2:20	*	0	5	Waste Pile Screening
	2:25	*	0	5	Waste Pile Screening
	2:30	*	0	5	Waste Pile Screening
7/10/97	8:30	0	0	6	Waste Pile Screening
	8:50	0	0	6	Waste Pile Screening
	9:00	0	0	6	Waste Pile Screening
	9:15	0	0	6	Waste Pile Screening
	9:30	0	0	6	Waste Pile Screening
	10:00	0	0	6	Waste Pile Screening
7/10/97	11:40	1.5	0	7	Waste Pile Screening
	11:45	1.0	0	7	Waste Pile Screening
	11:53	0.5	0	7	Waste Pile Screening
	12:00	3.0	0	7	Waste Pile Screening
	12:09	1.5	0	7	Waste Pile Screening
	12:15	2.0	0	7	Waste Pile Screening
	12:25	1.0	0	7	Waste Pile Screening
	12:35	0.0	0	7	Waste Pile Screening
7/10/97	2:35	0.0	0	8	Waste Pile Screening
		1.0	0	8	Waste Pile Screening
		1.0	0	8	Waste Pile Screening
		0.0	0	8	Waste Pile Screening
		0.0	0	8	Waste Pile Screening
	3:35	0.0	0	8	Waste Pile Screening

NOTES:
1. Photoionization Detector (P.I.D.) utilized was a H_NU
2. Health and Safety monitoring of ambient air quality in the work zone was continuously monitored with the P.I.D. and combustible gas meter. Ambient air monitoring level in the work zone remained at background levels during test pit excavations.

* P.I.D. out of service - rain. The waste materials excavated did not exhibit any visible difference from previously excavated materials.

APPENDIX B

PHOTOGRAPHS

PHOTO 1: Decontamination Pad Construction

PHOTO 2: Trench #1 Excavation

PHOTO 3: Trench #1 Excavated Material

PHOTO 4: Trench #2 Excavation

PHOTO 5: Trench #2 Excavation

PHOTO 6: Trench #3 Area

PHOTO 7: Trench #4 Preparation

PHOTO 8: Trench #4 Excavation

PHOTO 9: Trench #4 Excavation

PHOTO 10: Trench #5 Area

PHOTO 11: Trench #5 Excavation

PHOTO 12: Trench #5 Sidewall

PHOTO 13: Trench #5 Excavated Material

PHOTO 14: Trench #6 Area

PHOTO 15: Trench #6 Excavation

PHOTO 16: Trench #6 Excavation and Excavated Material

PHOTO 17: Trench #7 Excavation and Excavated Material

PHOTO 18: Trench #7 Excavation and Excavated Material

PHOTO 19: Trench #8 Excavation

PHOTO 20: Trench #8 Excavation and Excavated Material

APPENDIX C

TRENCH/TEST PIT LOCATION MAP

APPENDIX I

OLD CORTLAND COUNTY LANDFILL CLOSURE PROJECT VEGETATION AND WILDLIFE INVENTORY STUDY (Subcontractor Report)

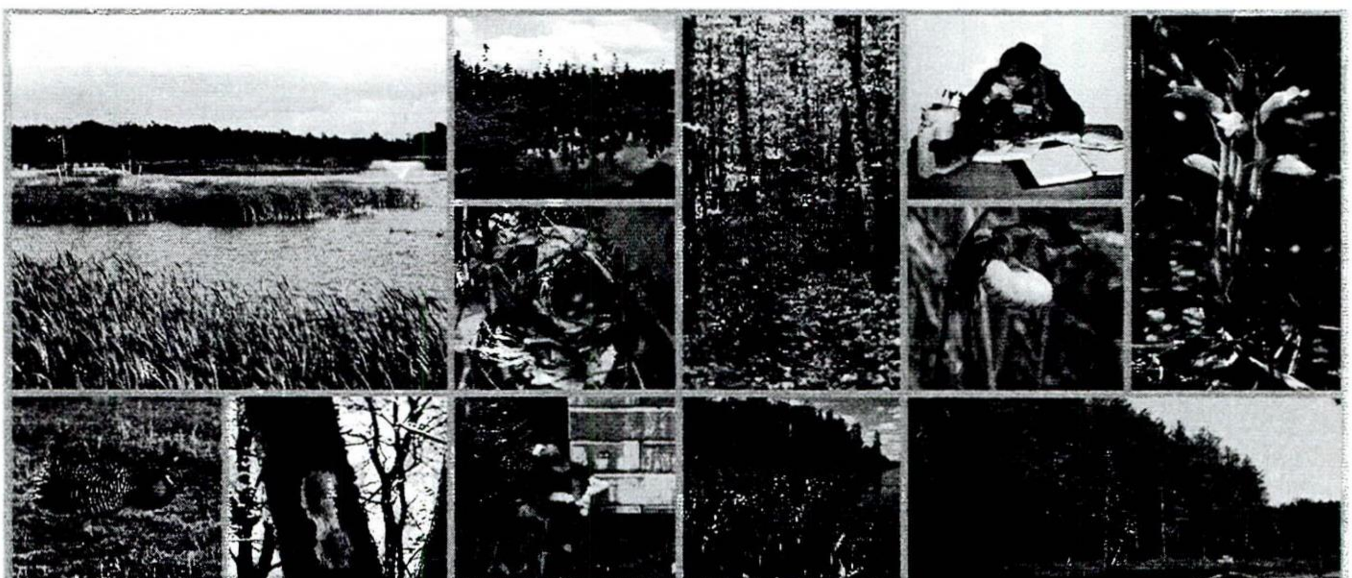
Old Cortland County Landfill Closure Project

Vegetation and Wildlife Inventory Study

Towns of Cortlandville and Solon, New York

Barbara C. Reuter
The Environmental Collaborative
309 Palmer Drive
Fayetteville, New York 13066

Roy S. Slack
Environmental Consulting
234 Besaw Road
Phoenix, New York 13135



The Environmental Collaborative

Old Cortland County Landfill Closure Project

October 1997

Prepared For:

Barton & Loguidice, P.C. and Cortland County

Prepared By:

Barbara C. Reuter
The Environmental Collaborative
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234 Besaw Road
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Contents

Introduction

The Environmental Collaborative was contracted by Barton & Loguidice, P.C., on behalf of Cortland County, to undertake a study to evaluate the existing ecological conditions of the Old Cortland County Landfill. This study, which is required as part of a Remedial Investigation/Feasibility Study (RI/FS), provides information specified in the following sections of Step 1 (Site Description) of the New York State Department of Environmental Conservation (NYSDEC) *Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites* (FWIA).

The sections of Step 1 are as follows:

- Section A - Site Maps
- Section B - Description of Fish and Wildlife Resources
- Section C - Description of Fish and Wildlife Resource Value
- Section D - Identification of Applicable Fish and Wildlife Regulatory Criteria

Contamination can affect on-site and off-site resources. This happens mostly through surficial and groundwater flow. This study concentrates on surface impact due to potential leakage of contaminants from the source. This would be evidenced by stressed vegetation over and around the area of contamination, visual evidence of contaminants (i.e., discoloration of soil and water), disfigured wildlife species, and/or lack of certain species that should be present, particularly in water bodies.

Background

While in operation, the Old Cortland County Landfill facility accepted domestic, commercial, and industrial wastes originating in the City of Cortland and surrounding townships. Although the majority of this waste was domestic in nature, a number of drums containing liquid hazardous wastes from nearby industries and manufacturers were disposed of at the landfill. Article 27 of the Environmental Conservation Law gives the NYSDEC responsibility for remedial programs at the more than 900 inactive hazardous waste sites that exist in New York State. Given that liquid hazardous wastes were disposed of at the Old Cortland County Landfill, the County is required to gather information to aid the NYSDEC Division of Fish and Wildlife in determining the nature of the danger, if any, to the environment posed by this hazardous waste.

As part of the RI/FS, a number of studies were conducted, one of which was to evaluate the existing ecological conditons of the site. As put forth in the FWIA, this particular investigation was intended to: (1) identify the fish and wildlife resources that presently exist and that existed before contaminant introduction, and (2) provide information necessary for the design of a remedial investigation. As part of the above effort, vegetation cover types and plant species were also identified. The results of this investigation will be incorporated into the RI/FS being prepared by Barton & Loguidice.

Site Description

The Old Cortland County Landfill and adjacent land is part of an approximate 540-acre property owned by Cortland County. The Old Cortland County Landfill encompasses approximately 30 acres of this land, while the remainder of the site includes the abandoned City of Cortland Landfill, the closed Pine Tree Landfill, the existing County Landfill, borrow areas, and infrastructure.

Cortland County is located in the northern part of the Appalachian Plateau Province, otherwise known in New York State as the Allegheny Plateau. This plateau region consists of a series of hills with an almost uniform elevation, interspersed with rather steep-sided and often deep valleys. The Old Cortland County Landfill and adjacent land is characteristic of this landscape type, i.e., hills and valleys, many with streams and drainage ways. The highest point on the site is the old landfill. The majority of drainage off the site is to the west, east, and south.

The vegetation on the site consists of a patchwork of forest, shrub, and old field community types, dominated by common plant species and harboring a wide array of common wildlife species. Several water features occur within the site, including a number of settling ponds, portions of three streams, and various shallow wetlands created by excavation activities when the landfill was in operation.

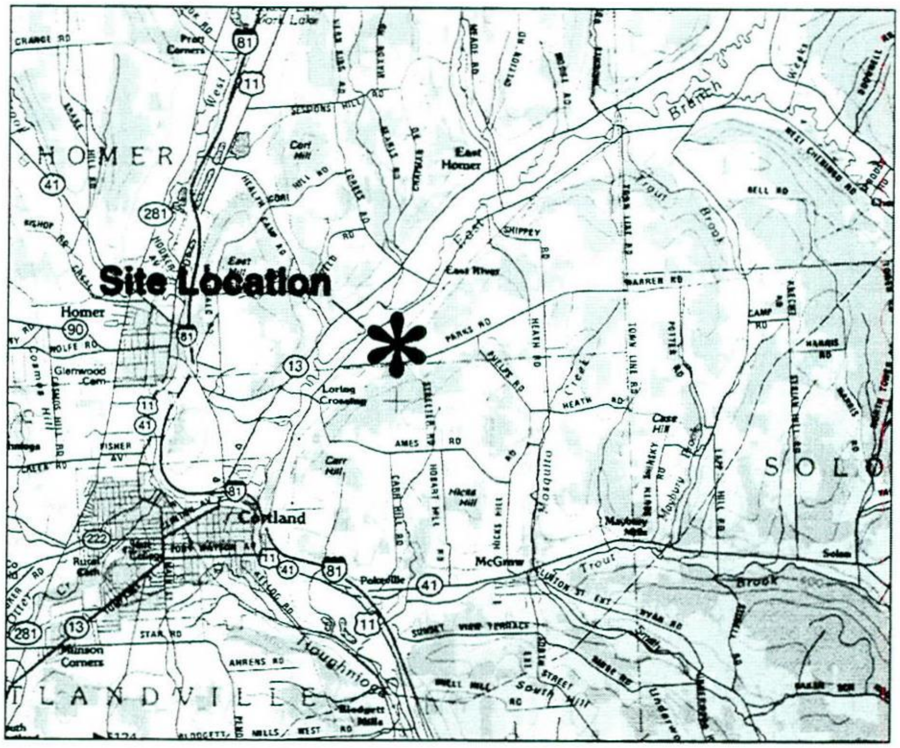


Figure 1. Location of the Old Cortland County Landfill site.

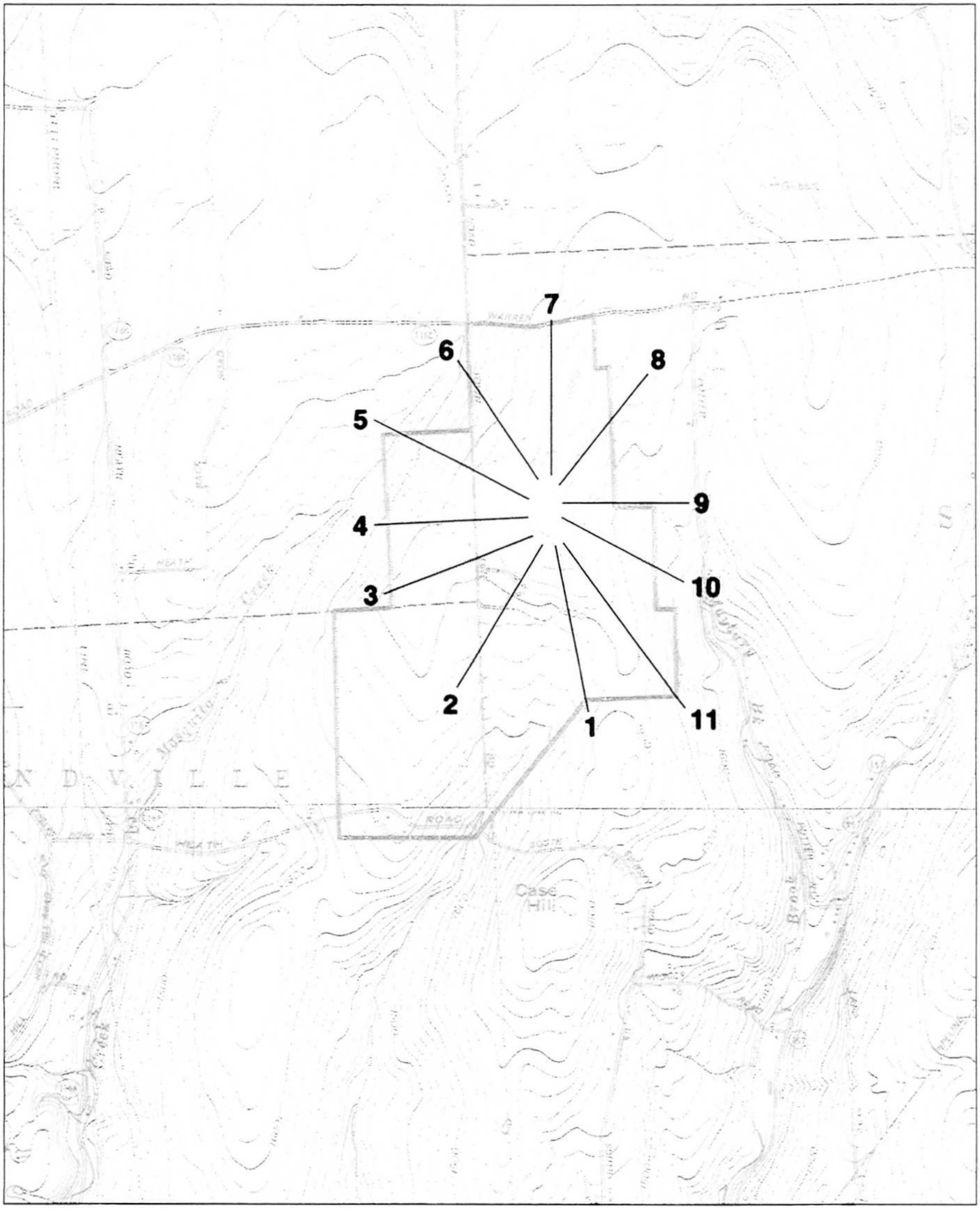
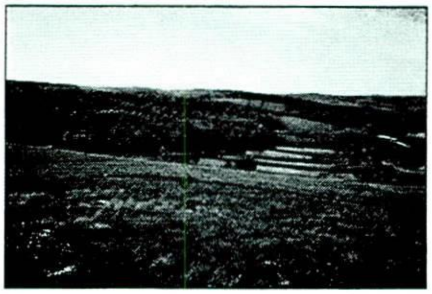
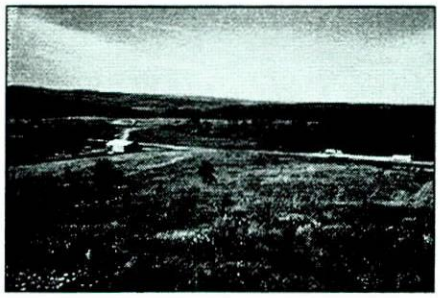


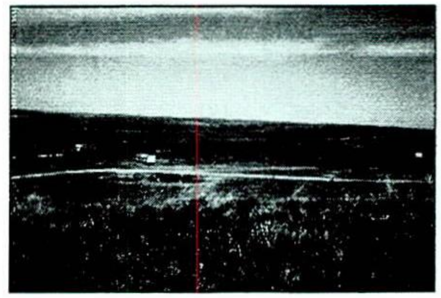
Figure 2. Key to panoramic views of the site shown on the following page.



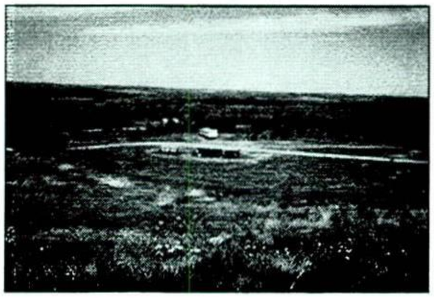
Panoramic view 1



Panoramic view 2

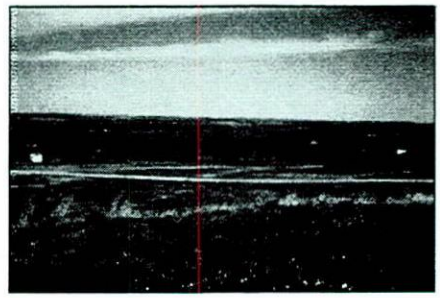


Panoramic view 3



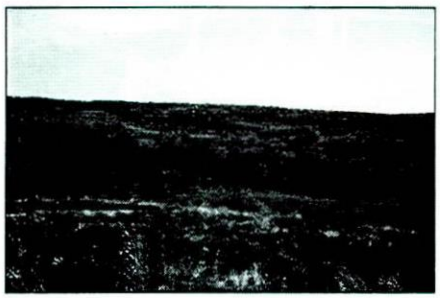
Panoramic view 4

Panoramic view 5

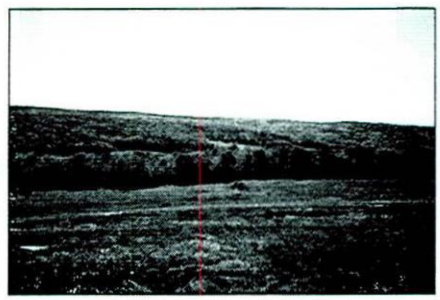


Panoramic view 6

Panoramic view 7



Panoramic view 8



Panoramic view 9

Panoramic view 10

Panoramic view 11

Section A

To assess the impact of contamination on vegetation and wildlife resources, it was important to develop maps showing the locations of any known rare species and/or unique natural features or community types, as well as water features, on or adjacent to the site, and to compile a comprehensive plant and wildlife species inventory for the site.

Site Maps

The preparation of the site maps was conducted by Barbara C. Reuter, Botanist and Wetland Specialist. Published data sources included NYSDEC Significant Habitat Files, New York Natural Heritage Program Element Occurrence Records, New York State Breeding Bird Atlas data, Cortland County Soil Survey, National Wetland Inventory maps, 6NYCRR maps, and U.S. Fish and Wildlife data. Information obtained from these sources was identified on a topographic map covering the site and the area within two miles of the site perimeter (Figure 3 - Appendix A). In addition, drainage information depicting watersheds and surficial runoff patterns are depicted in Figure 4 in Appendix A.

A draft vegetation cover map for the site and the area within 0.5-mile radius of the perimeter of the site was prepared with the use of the most recent aerial photographs, Cortland County Soil Survey, NYSDOT maps, Cornell University Land Use and Natural Resource maps, and Cortland County Soil and Water Conservation District maps. This cover map was further refined by conducting a detailed survey of the on-site and adjacent area vegetation (Figure 5 - Appendix A). The various vegetation community types were evaluated based on species composition and structural diversity (i.e., foliage height, spatial distribution, percent cover, age class, species distribution, vegetation layering), and are described according to *Ecological Communities of New York State* by Carol Reschke of the New York Natural Heritage Program (1991). The majority of the vegetation inventory occurred in May and June, with a follow-up site visit in late August.

Plant Communities

There are a number of vegetation community types on and adjacent to the site, including agricultural field, old field, hedgerow, shrub upland, pine plantation, forest, and wetland. The following is a general description of each of the vegetation community types, including a discussion on dominant species and general characteristics of the community. A list of all plant species, including scientific and common names, identified on the site is presented in Table 1 in Appendix B.

Agricultural Field

There are a number of agricultural fields throughout the study area. At the time of this study, the majority of these fields were planted in hay and are similar to the cropland/field crop community described by Reschke. Several fields were planted in corn (*Zea mays*) and are classified by Reschke as cropland/row crop. It is assumed that the crops in these areas are rotated from year to year. In addition, a number of areas were used as pasture for cattle and horses, and are classified by Reschke as pastureland. The vegetation in these areas tends to be very short and often times unidentifiable due to continual grazing by animals.

The fields planted in hay are dominated by the following species: timothy (*Phleum pratense*), bluegrass (*Poa pratensis*), red clover (*Trifolium pratense*), and alsike clover (*Trifolium hybridum*). Tall buttercup (*Ranunculus acris*) was also present in small amounts.

Old Field

There are a number of old field areas throughout the study area, although the largest of these occurs within the boundaries of the County-owned land. This particular vegetation community type is classified by Reschke as successional old field. The overall character of the old field areas tends to be the same; that is, areas dominated by forbs (broad-leaved flowering plants) and grasses. These areas have been cleared in the past for farming or development, and then abandoned. In places where the land was originally farmed, the plant cover tends to be rather dense, with over 100 percent cover (due to overlapping layers) in many places. In areas that were cleared for development purposes, as in the case of the landfill and associated facilities, the plant cover is often less than 100 percent. This is particularly true where the topsoil was stripped off and the shale bedrock was removed for use as cover material for the landfill (Figures 6 and 7). The height of the vegetation in these old field areas tends to range from 1 to 3 feet, although some species may attain greater height.

Figure 6. An area to the east of the Old Cortland County Landfill that was scraped of topsoil and subsoil. Old field vegetation is dominant is this area.

Figure 7. A view of the old field area to the east of the Old Cortland County Landfill.

Although the species composition and distribution varies from area to area, often times based on past use, there are many species that are common in most of the old fields within the study area. These include orchard grass (*Dactylis glomerata*), rough-stemmed goldenrod (*Solidago rugosa*), bluegrass, dandelion (*Taraxacum officinalis*), wild strawberry (*Fragaria virginiana*), English plantain (*Plantago lanceolata*), common yarrow (*Achillea millefolium*), red clover, sweet vernalgrass, tall buttercup, old-field cinquefoil (*Potentilla simplex*), field peppergrass (*Lepidium campestre*), ox-eye daisy (*Leucanthemum vulgare*), bird's-foot trefoil (*Lotus corniculata*), yellow sweetclover (*Melilotus officinalis*), Canada goldenrod (*Solidago canadensis*), and mullein (*Verbascum thapsus*).

A number of shrub and understory tree species are present within the old field areas, although they collectively have less than 50 percent cover within this community type. Common species include hawthorn (*Crataegus* spp.), apple (*Malus* spp.), honeysuckle (*Lonicera tatarica*), red raspberry (*Rubus idaeus*), and black raspberry (*Rubus occidentalis*).

Shrub Upland

Small areas of shrub upland occur within the study area and tend to either contain patches of old field or simply grade into old field, with the boundary between the two community types rather indistinguishable. This community type is classified by Reschke as successional shrubland. As with the old field community type, shrub uplands occur on sites that were once cleared for farming, logging, development, etc. and then abandoned. This particular vegetation community type has at least 50 percent shrub cover, although the density of shrubs varies between the different areas. The most common species noted within the project study area include hawthorn, apple, honeysuckle, red raspberry, gray dogwood (*Cornus foemina*), and black raspberry. In some shrub upland areas, hawthorn and apple tend to dominate, while in other areas, various raspberries are the dominant species.

Plantation

There are several areas of evergreen plantation within the site boundaries, although because of size, only one area is indicated on the Vegetation Cover Type map (Figure 5). This is because there are a number of small areas with confers that have been planted, but occur within other communities and are too small to map as separate units. Reschke has several classifications for plantations, including pine plantation, spruce/fir plantation, and conifer plantation. All of these community types contain softwoods that were planted for cultivation and harvest of timber products and/or used as landscape plants. Usually these community types are made up of monocultures or they may be mixed stands with two or more codominant species.

The plantations within the site boundaries tend to be mixed, with the following species present: white pine

(*Pinus strobus*), Norway spruce (*Picea abies*), Austrian pine (*Pinus nigra*), scotch pine (*Pinus sylvestris*), balsam fir (*Abies balsamea*), European larch (*Larix decidua*), white spruce (*Picea glauca*), and Colorado blue spruce (*Picea pungens*). The trees in some of the smaller plantation areas tend to consist of one species that were planted quite close together resulting in a fairly dense canopy. These trees also tend to be quite mature and average 50 feet in height. The understory in these more dense plantations tends to be almost nonexistent, although live-forever (*Sedum telephium*) and thyme-leaved speedwell (*Veronica serpyllifolia*) were noted in some areas. The largest plantation area that is shown in Figure 5 has much smaller trees (ranging from 8 to 12 feet in height) and were planted quite far apart. Apparently these trees were to be used as landscaping plants by the County. Old field vegetation is abundant in this plantation area.

Hedgerow

There are many well-developed hedgerows throughout the study area. This particular community type is not described in Reschke. Prior to the settlement of the area by Europeans, this part of the region was covered in extensive forests. When portions of these forests were cut for purposes of agriculture, trees were left between the fields. The tree species in these hedgerows give a good indication of the species composition of the original forests. Other species, particularly shrubs and herbaceous plants, tend to invade these areas along the exposed edges.

The most common species noted in this community type within the study area include black cherry (*Prunus serotina*), sugar maple (*Acer saccharum*), hawthorn, apple, green ash (*Fraxinus pennsylvanica*), white ash (*Fraxinus americana*), shadblow serviceberry (*Amelanchier* spp.), trembling aspen (*Populus tremuloides*), various blackberries and raspberries, grape (*Vitis* spp.), pagoda dogwood (*Cornus alternifolia*), and sweet vernalgrass (*Anthoxanthum odoratum*).

Deciduous Forest

The deciduous forests within the study area are similar to the successional northern hardwoods described in Reschke, although there are areas with species common in the successional southern hardwoods. These forests are dominated by light-requiring, wind-dispersed species that are well-adapted to establishment following disturbance, and they tend to range in age and structure from early successional to late successional (10 to 40 years old). A characteristic feature of successional forests is the lack of reproduction of the canopy species. Most of the tree seedlings and saplings in successional forests are species that are more shade-tolerant than the canopy species. Shrub layer and ground layer plants may include species characteristic of successional old fields and/or species that occurred on or near the site prior to disturbance. These forest areas tend to be rather dense in the understory and difficult to walk through.

The early successional deciduous forests within the study area are dominated by a mix of trembling aspen, gray birch (*Betula populifolia*), black cherry, fire cherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), and black locust (*Robinia pseudo-acacia*). Common elderberry (*Sambucus canadensis*), northern blackberry (*Rubus allegheniensis*), honeysuckle, and red raspberry are common shrubs, while sugar maple, green ash, and white ash saplings are common saplings. At times it is difficult to identify the boundary between the shrub upland and early successional deciduous forest community types, since many of the species are the same and they tend to grade from one to the other.

The later successional deciduous forests within the study area tend to be dominated by white and green ash, with some sugar maple also present. The trees in these forests are more mature (40 to 80 years old) and range in height from 50 to 80 feet tall. The overall character of the forests is that they are more open, with fewer shrubs and saplings in the understory. Pagoda dogwood and beech (*Fagus grandifolia*), black cherry, and sugar maple saplings are common in the understory. The herbaceous layer is lacking in some areas, although it is fairly dense in others. Common species include blue cohosh (*Caulophyllum thalictroides*), red trillium (*Trillium erectum*), wild leek (*Allium canadense*), two-leaved toothwort (*Cardamine diphylla*), white baneberry (*Actaea pachypoda*), jack-in-the-pulpit (*Arisaema triphyllum*), marginal fern (*Dryopteris marginalis*), Christmas fern (*Polystichum acrosticoides*), hepatica (*Hepatica nobilis*), and partridgeberry (*Mitchella repens*).

Some of the larger, more mature forest areas within the study area are similar to the beech-maple mesic forest described in Reschke. This community type tends to be broadly defined, but generally consists of sugar maple and beech in the overstory with relatively few shrubs and herbs in the understory. Common associates in this forest type are basswood (*Tilia americana*), American elm (*Ulmus americana*), white ash, yellow birch (*Betula alleghaniensis*), and pagoda dogwood. The most common understory species include beech and sugar maple seedlings. The groundlayer species consist of those species already listed as occurring in the late successional deciduous forests.

Wetland

There are a number of wetlands and other waterbodies that occur within the study area. These include the following (note: vegetation community type classifications in Reschke are in parentheses after the appropriate wetland/waterbody): wet meadow (there is no equivelent in Reschke), emergent wetland (shallow emergent marsh), shrub wetland (shrub swamp), stream (midreach stream), and pond (reservoir/artificial impoundment).

Wet meadows are dominated by herbaceous wetland plant species and have mineral soils that are permanently or seasonally saturated. These areas tend to occur in low depressions within the landscape where there is a high water table and/or surface runoff accumulates. This results in seasonal ponding of water, particularly during the spring and fall when precipitation events are rather frequent. The majority of wet meadow areas within the study site boundaries occur in low depressions that were created when topsoil was stripped off and shale bedrock was removed for use as cover material for the landfill. The vegetation in these areas tends to be scattered, while other wet meadow areas have a dense cover of plants. The most common species include various sedges (*Carex* spp.), spikerushes (*Eleocharis* spp.), and rushes (*Juncus* spp.), although slender mannagrass (*Glyceria melicaria*), spotted joe-pye-weed (*Eupatorium maculatum*), boneset (*Eupatorium perforatum*), flat-top goldenrod (*Eupatorium graminifolia*), marsh bedstraw (*Galium palustre*), and purple loosestrife (*Lythrum salicaria*) are also present. Several species of shrubs are present in small numbers within the wet meadows. These are various shrub willows (*Salix* spp.) and broadleaf spiraea (*Spiraea latifolia*).

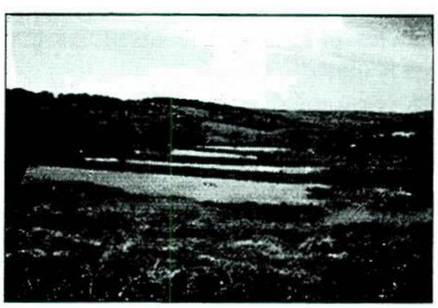


Figure 8. The four settling ponds below the Old Cortland County Landfill.

Emergent wetland occurs in places where the water tends to be deeper than the wet meadows (up to 3 feet deep). Several of these areas occur in the northern part of the study area, as well as around the perimeters of two small ponds to the west of the closed Old Cortland County Landfill and the settling ponds south of the closed Old Cortland County Landfill. The dominant species in these areas is narrow-leaved cattail (*Typha angustifolia*).

Shrub wetland is a community type dominated by shrubs. Like the wet meadow community type, the soils in this particular type of shrub wetland are mineral in nature (as opposed to muck) and tend to be seasonally to permanently saturated, with some ponding during the wetter parts of the year. Shrub wetlands tend to be quite variable in nature and may be dominated by different species, depending on the location and specific conditions of the area. However, the shrub wetlands within the project site are dominated by various shrub willows, with some broad-leaved spiraea in places. These wetlands are integrated quite extensively with the wet meadow and emergent wetland community types.

Several ponds occur within the confines of the project study area. Six of these ponds occur within the watershed containing the Old Cortland County Landfill. Because these are the only ponds that lie within the area of concern for this particular study, the following discussion concentrates on these water resources. The ponds were all created as part of the infrastructure for the various landfill operations on the site and are all relatively deep (i.e., over 3 feet). The dominant submerged aquatic plant in the four northernmost settling ponds are various pondweeds (*Potamogeton* spp.). These ponds are also surrounded by a fringe of narrow-leaved cattail, as described previously. The two southernmost ponds do not contain any submerged aquatic vegetation nor are they surrounded by a fringe of cattails.

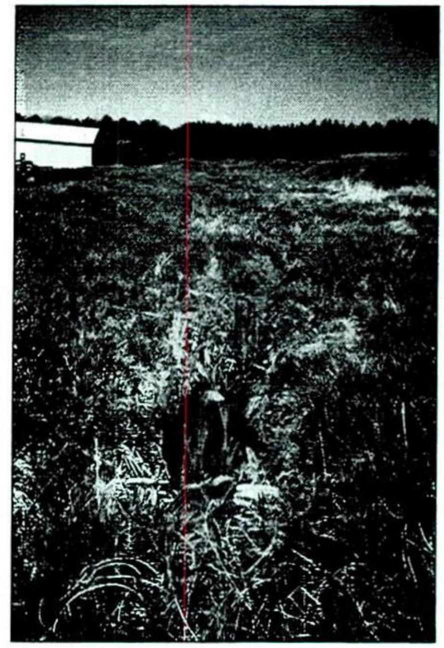


Figure 9. Iron staining was noted in a drainage ditch leading into the upper most settling pond.

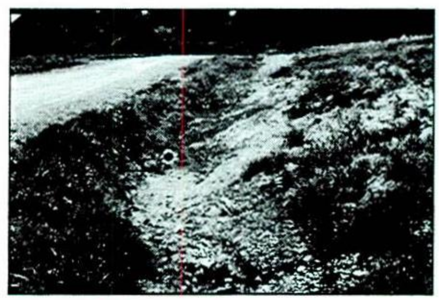


Figure 10. Iron staining was also noted in a ditch immediately adjacent to the south end of the Old Corltnad County Landfill.

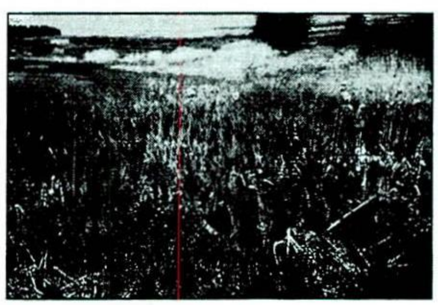


Figure 11. Iron staining in a drainage swale leading into the northeast corner of the pond was not evident in the pond itself.

There are portions of three streams within the boundaries of the County owned land. These are Mosquito Creek, Maybury Brook, and an unnamed tributary to Trout Brook. There are several other streams and rivers within the project study area, including but not limited to Mosquito Creek, Trout Brook, and the East Branch of the Tioughnioga River. Figure 3 shows the water resources within the project study area, and Figure 4 shows the watershed boundaries. As indicated on these maps, only one stream (the unnamed tributary to Trout Brook) is within the watershed containing the Old Cortland County Landfill. However, because of the close proximity of Maybury Brook to this area, this stream was also investigated. Since these are the areas of concern for this particular study, the following discussion concentrates on these water resources.

The unnamed tributary to Trout Brook is a fast running, shallow stream that ranges in width from 3 to 5 feet, although it widens to about 8 feet in places. At the time of the field work in May and June, the depth of water averaged 3 inches, although it ranged from 2 to 6 inches. However, by late August, there was virtually no water in the stream. The substrate consists of exposed shale bedrock and cobbles, with some larger rocks scattered within the confines of the stream. There are a number of riffles and a couple of small, deep pools. The source of the water in this stream comes from the four settling ponds south of the Old Cortland County Landfill and from seeps and overland flow to the northeast of the settling ponds. The stream occurs in a well defined channel with relatively steep banks. There is no vegetation within the stream, although some wetland vegetation occurs adjacent to the stream in small areas that periodically flood. Maybury Brook is similar to the unnamed tributary to Trout Brook, although the stream channel is wider in places. At the time of the field work, the depth of the stream ranged from 2 to 6 inches, with only a few deep pools in places. The source of water is a wet meadow/emergent wetland in a pasture on a farm at the intersection of Warren Road and Potter Road. As with the unnamed tributary, there is no vegetation within the confines of the stream.

Rare Species

According to the New York Natural Heritage Program Element Occurrence Records and the U.S. Fish and Wildlife data, there are no rare plant species on or within the 2-mile perimeter of the site (refer to correspondence in Appendix C).

Vegetation Summary

The vegetation community types identified on and adjacent to the site, as well as the particular species observed within them are considered common throughout New York State. In addition, there were no visual signs of stressed vegetation noted anywhere on the site, including the area immediately over and around the area of the buried drums or observed surficial leachate outbreaks.

Section B

Section B of the FWIA is a description of the fish and wildlife resources on and within 0.5 miles of the perimeter of the site. The purpose is to survey these resources to determine if there are any impacts due to contamination.

Description of Fish and Wildlife Resources

The wildlife survey was conducted by Roy S. Slack, Wildlife Biologist. The wildlife species within and around the aquatic resources located on and adjacent to the site were identified. These resources included wetlands, ponds (including settling ponds), and streams (Maybury Brook and the unnamed tributary to Trout Brook). The physical features of these aquatic habitats were noted in terms of general qualitative characteristics (i.e., gradient, flow, substrate, etc.), along with vegetation and wildlife species present. More detailed habitat characteristics (i.e., water chemistry, temperature, dissolved oxygen, etc.) was provided by B&L. Vegetation, fish, and benthos were sampled at six locations, three in Maybury Brook and three in the unnamed tributary to Trout Brook. The locations of the sampling sites are depicted in Figure 12 on the following page. The vegetation and fish samples were qualitative in nature, and the relative abundance and distribution of aquatic vegetation and fish species are described below. The benthic samples were quantitative and collected according to the Kick Method described in the NYSDEC Division of Water *Quality Assurance Work Plan for Biological Stream Monitoring in New York State* (Bode 1988). Another NYSDEC Division of Water publication referenced for collecting and handling the benthic samples was *Methods for Rapid Biological Assessment of Streams* (Bode *et al.*, 1991).

Information concerning on-site wildlife species was collected by consulting published reports. Existing data concerning wildlife resources on and in the vicinity of the site were verified and supplemented by field evaluation of the wildlife community and habitat on site. As with the vegetation inventory, the wildlife survey was scheduled for times of the year when observation of various species (both rare and common) was most likely, (i.e., May and June), with a follow-up site visit in late August. This maximized the likelihood of observing breeding amphibians, basking reptiles, and migratory and breeding birds. Field inventory techniques relied primarily on visual and auditory recording of species. Birds were documented by sight and song, and evidence of breeding was noted (territorial singing, carrying nest material, nests, carrying food for young, etc.).

Mammals were identified through direct observation of species and/or their sign (dens, tracks, droppings, bones, etc.). Reptiles and amphibians were surveyed through systematic searches of wooded areas, wetlands, streams, and pond shorelines. In searching for snakes and salamanders, rocks, logs, and other debris were turned over and examined. Visual surveys were used to determine turtle species present within the project limits. Fish and other aquatic organisms (benthos) were sampled using minnow traps and/or a kick net. The species captured were identified and re-

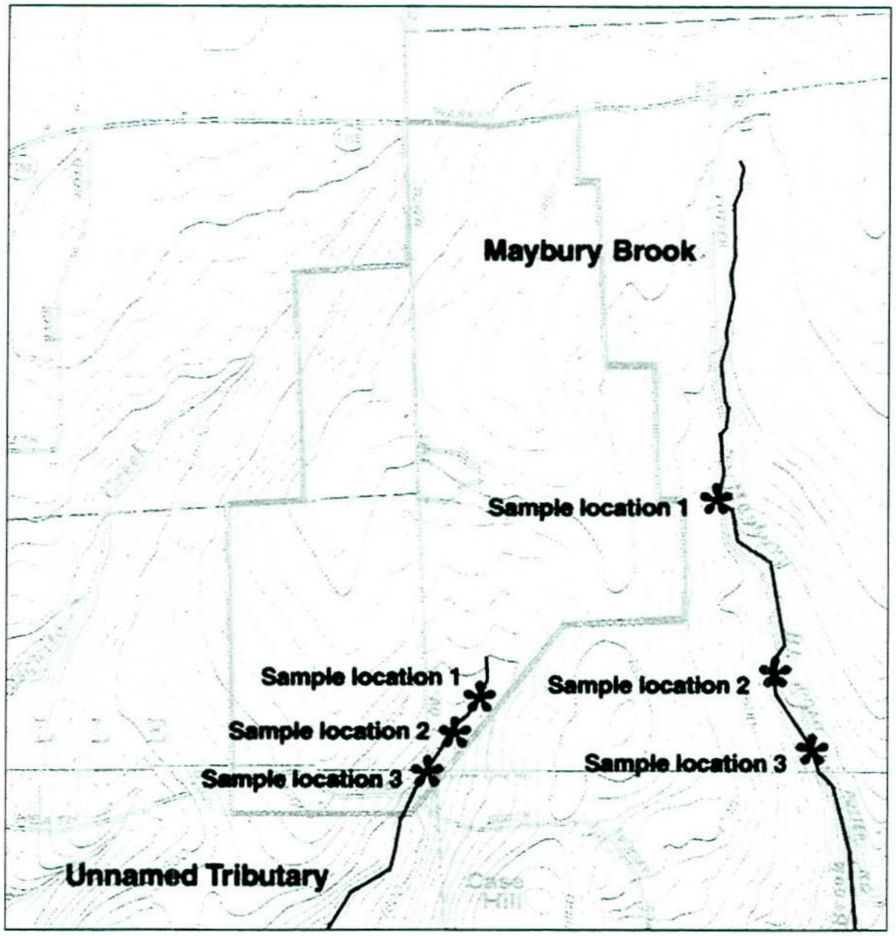


Figure 12. Location of the benthos sampling locations along the unnamed tributary and Maybury Brook.

corded, with particular attention paid to the abundance and diversity of benthos.

One field visit took place in the evening to allow observation of nocturnal species such as owls, bats, furbearers, and mating toads and frogs. Snap traps were selectively used to sample small mammal populations in representative habitats on the site.

Observations of stress on vegetation and wildlife species was noted by looking for atypical biotic conditions such as reduced density, reproduction, vigor of vegetation, wildlife mortality, changes in species assemblages and distribution, and/or the absence of expected biota. Evidence of contamination, such as stained soils, leachate seeps, or exposed waste, were also be noted and are described below.

Wildlife Habitat

As a result of the intermixing of a variety of habitats on the Old Cortland County Landfill Site and the immediate adjacent properties, the area supports a rich wildlife species community. However, much of the area is dominated by more common species that are typically associated with edge habitat, small woodlots, and shrubby environments. Aquatic habitats on the Old Cortland County Landfill property include: (1) several ponds north of the old landfill and the settling ponds on the south side of the old landfill; (2) the unnamed tributary that drains the central portion of the property, and Maybury Brook which drains the eastern portion of the property; and (3) a number of shallow emergent wetlands within open fields. There are also several ponds associated with the active landfill area that lies to the southwest of the Old Cortland County Landfill Site.

Fish

Two species of fish were identified on the Old Cortland County Landfill site. These were Brown Bullhead (*Ictalurus nebulosus*) and Blacknose Dace (*Rhinichthys atratulus*). Brown Bullhead were introduced in the settling ponds prior to 1997. It is apparent that reproduction of this species within the settling ponds has occurred, since several small Brown Bullheads were captured in minnow (funnel) traps that were set in the unnamed tributary downstream of the ponds. It is assumed these particular fish were washed down from the ponds since the rocky, steep-gradient stream is not bullhead habitat. However, the unnamed tributary is typical habitat for Blacknose Dace. Lee *et al.* (1980 *et seq.*) describes typical habitat as small, usually cool, gravelly or rocky streams of high to moderate gradient, where the species is found in pools and slower runs. This species is common throughout the northeastern United States and occurs as far south as North Carolina and as far west as Nebraska (Eddy 1969).

The unnamed tributary is a Class C stream with C(t) standards. However, the reach of the stream that lies on the County property can virtually dry up

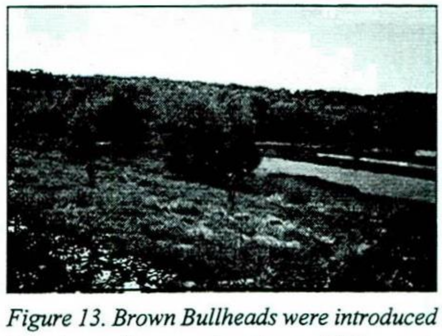


Figure 13. Brown Bullheads were introduced into the settling ponds prior to 1997.

Figure 14. The settling ponds provided habitat for a number of aquatic insects, as well as fish, reptiles,and amphibians.

in late summer, leaving only a few small pools as refugia for fish. Although there are no trout in the reach of the stream that lies on County property, the stream may support Brook Trout (*Salvelinus fontinalis*) near its confluence with Trout Brook. Trout

Figure 15. Unnamed tributary - Sample Location 1. Photograph taken in June.

Figure 16. Unnamed tributary - Sample Location 2. Photograph taken in August.

Brook supports reproducing populations of both Brook Trout and Brown Trout (*Salmo trutta*) (J. Robins, NYSDEC, pers. comm.).

Benthos

A number of benthic organisms (i.e., insect larvae) were noted in the settling ponds. Larval dragonflies were common, and several unidentified mayfly (Ephemeroptera) larvae were also observed. Adults of several species of dragonflies and damselflies were observed flying around the ponds, including adult Civil Bluet Damselflies (*Enallagma civile*), Green Darner Dragonflies (*Anax junius*), and Common Skimmers (*Celithemis* spp.). Several aquatic beetles and other aquatic insect species observed or captured in funnel traps include Diving Beetles (Dytiscidae), Whirligig Beetles (Gyrinidae), Water Striders (Gerridae), Backswimmers (Notonectidae), Water Boatmen (Corixidae), and Diving Beetles (*Cybister fimbriatus*).

The unnamed tributary to Trout Brook and Maybury Brook were sampled for benthic organisms using the kick-net method. The sampling sites were located in areas of the streams where the stream contains stretches of riffle and run habitat. Areas with more riffle were considered best because of the higher oxygen levels needed by aquatic organisms. In addition, both streams provided many flat rocks lying on the stream bed, not embedded within the stream bed. This provides good protection for aquatic organisms

Figure 17. Unnamed tributary - Sample Location 3. Photograph taken in August.

Figure 18. Maybury Brook - Sample Location 1. Photograph taken in June.

Figure 19. Maybury Brook - Sample Location 2. Photograph taken in June.

Figure 20. Maybury Brook - Sample Location 3. Photograph taken in June.

as they lie in wait for sources of food to float past. Finally, areas that were shaded were also considered better than areas exposed to prolonged periods of sunlight because warmer water temperatures result in lower dissolved oxygen. However, locating all three sample sites in shaded areas was not possible for the unnamed tributary, which is exposed for most of the length of the stream within the study area.

Both streams supported a large number of aquatic organisms (see Table 2). Maybury Brook contained a high percentage of stonefly (Plecoptera) larvae, while the unnamed tributary contained higher percentages of mayfly (Ephemeroptera) and caddisfly (Trichoptera). Many of the stonefly larvae collected in Maybury Brook were very small (less than 3mm), while the larger larvae were near emergence. It may be possible that the larger percentage of stoneflies in the sample is the result of a recent hatch in this stream.

The differences in the composition of the benthic populations in these streams is to some extent due to both man-made and natural differences in the streams themselves. Both streams would be expected to have been impacted to some extent by human activity. The unnamed tributary originates near the Old Cortland Landfill site, while Maybury Brook originates in an agricultural area. Runoff from these areas would certainly have some influence upon water quality in these streams. In addition, the upper reaches of the unnamed tributary to Trout Brook dries up during the late summer and early fall months. This would also influence the composition of the benthic community in this stream.

The presence of fish in the unnamed tributary could influence the relative abundance of larval insects by reducing the abundance of larvae that are more susceptible to predation. Differences in the type of environment within the streams would also account for differences in fauna associations. The unnamed tributary is primarily fed by surface water flow from the man-made settling ponds on the landfill. This input of epilimnotic water would result of warmer water temperatures and lower dissolved oxygen levels within the stream during much of the year, as compared to Maybury Brook which originates from seepages, springs, and surface water runoff from an emergent wetland. Many of the mayfly larvae collected in the unnamed tributary may have also originated in the settling ponds and were washed downstream during spring runoff. Such washdown is also suspected as the source of the leeches and predaceous diving beetle larvae that were found in the stream. Leeches and predaceous diving beetles were common in the ponds on the landfill.

Several common methods used to measure the levels to which streams have been impacted is to compare Biotic Index Values, EPT Values and Species Richness (Bode 1988). While the insect larvae collected in the unnamed tributary and Maybury Brook were identified only to the familial or generic level, the number of species in each stream probably ranged from 12 to 18, thus indicating that both streams have been moderately impacted.

The EPT Value for each stream was calculated by taking the average number of mayflies (Ephemeroptera), stoneflies (Plecoptera) and caddisflies (Trichoptera) within each sample (Table 3). The value for Maybury Brook was 5.0, while the value for the unnamed tributary was 2.7. Thus, while these values indicate that both streams are in the "moderately impacted" range of Bode (1988), the unnamed tributary appears to have been subjected to greater water quality degradation. This is not unexpected since this tributary receives runoff from the existing landfill, as well as the closed landfill areas.

Biotic Index Values do not indicate that either stream has been impacted (Table 4). The biotic index of 3.22 for Maybury Brook and 3.36 for the unnamed tributary are well within the acceptable range (0-4.50) for "non-impacted" streams (Bode *et al* 1991). However, this index can underestimate stream degradation due to non-organic problems (Bode 1988). Therefore, given that the Species Richness and EPT Values indicate moderate impacts to the streams, and assuming that the Biotic Index Values for stream degradation was underestimated, as just explained, the results of these three methods are not contradictory.

Amphibians & Reptiles

Ten species of amphibians and four species of reptiles were observed on or near the Old Cortland County Landfill Site (Table 5). Species such as the Red-spotted Newt (*Notophthalmus v. viridescens*), American Toad (*Bufo americanus*), Northern Spring Peeper (*Pseudacris crucifer*), Green Frog (*Rana clamitans melanota*), Common Snapping Turtle (*Chelydra s. serpentina*), and Eastern Painted Turtle (*Chrysemys p. picta*) were found in the various ponds, including the settling ponds, on the landfill property. Several distinct sizes of Green Frog tadpoles indicate that the species overwinters in the larval stage in these ponds. The adult Newts would also be permanent residents in the ponds. Redback Salamanders (*Plethodon cinereus*) were confined to the forested areas on the site. This terrestrial species of salamander is common in wooded areas throughout the northeastern United States. Northern Two-lined Salamanders (*Eurycea bislineata*) were common in the unnamed tributary which drains

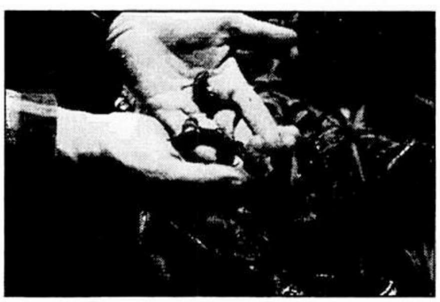


Figure 21. Numerous red spotted newts were found in the settling ponds.

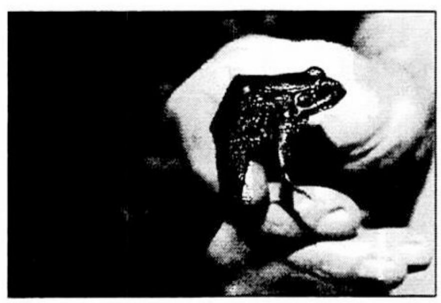


Figure 22. A number of adult green frogs were also found in the settling ponds.

the settling ponds and adjacent areas. Several Northern Dusky Salamanders (*Desmognathus f. fuscus*) were also found in this stream. The rocky substrate that is common throughout this stream is typical habitat for both of these species, which are found in small streams throughout much of the northeastern United States (Conant and Collins 1991).

The only snakes observed during the study were Eastern Garter Snake (*Thamnophis s. sirtilis*) and Eastern Milk Snake (*Lampropeltis t. triangulum*). These two species are common in the area, but may be relatively uncommon on the landfill property because of past disturbance.

Birds

Sixty-six species of birds were observed on or near the Old Cortland County Landfill Site (Table 6). The vast majority of species are those that are often found along woodland edges and shrubby fields in upland areas, habitats that are common on the landfill and adjacent property, as well as throughout much of central New York. Among the species that were particularly common on the landfill property were Mourning Dove (*Zenaida macroura*), Gray Catbird (*Dumetella carolinensis*), American Robin (*Turdus migratorius*), Cedar Waxwing (*Bombycilla cedrorum*), Northern Cardinal (*Cardinalis cardinalis*), Indigo Bunting (*Passerina cyanea*), American goldfinch (*Carduelis tristis*), and Song Sparrow (*Melospiza melodia*).

The open field portion of the Old Cortland County Landfill provided nesting habitat for Savannah Sparrows (*Passerculus sandwichensis*) and Red-winged Blackbirds (*Agelaius phoeniceus*). In wet shrubby areas, Common Yellowthroats (*Geothlypis trichas*), and Yellow Warblers (*Dendroica petechia*) were also common. Several pairs of Killdeer (*Charadrius vociferus*) also occurred along the landfill roads.

Figure 23. Canada Geese and Mallards were observed on the settling ponds.

The avifauna associated with the forests are typical of those found in relatively small woodlots throughout New York State. Species such as Black-capped Chickadee (*Poecile atricapillus*), Red-eyed Vireo (*Vireo olivaceus*), Black-and-white Warbler (*Mniotilta varia*), Veery (*Catharus fuscescens*), Wood Thrush (*Hylocichla mustelina*), Scarlet Tanager (*Piranga olivacea*), and Rose-breasted Grosbeak (*Pheucticus ludovicianus*) were distributed throughout the forested areas. House Wrens (*Troglodytes aedon*), Warbling Vireos (*Vireo gilvus*), Yellow Warblers, Baltimore Orioles (*Icterus galbula*), and Song Sparrows are common along the forest edges, in wooded hedgerows, and in the wooded corridor along the unnamed tributary.

Several species observed around the buildings on the property include Barn Swallow (*Hirundo rustica*), Eastern Phoebe (*Sayornis phoebe*), European Starling (*Sturnus vulgaris*), House Finch (*Carpodacus mexicanus*), and House Sparrow (*Passer domesticus*).

Two upland game species were observed on the property. Ruffed Grouse (*Bonasa umbellus*) are common in the hardwoods and early successional forests, while Wild Turkey (*Meleagris gallopavo*) were noted in the forest, open field, and agricultural areas. Waterfowl observed on the settling ponds on the landfill property included Canada Geese (*Branta canadensis*) and Mallards (*Anas platyrhynchos*). According to landfill personnel, mallards have nested near the ponds in previous years, but no young were observed during 1997. American Woodcock (*Philohela minor*) should also be present in open field and scattered shrub areas, although none were observed during the site visits.

Birds of prey observed on the landfill property were Red-tailed Hawk (*Buteo jamaicensis*) and Northern Harrier (*Circus cyaneus*). A pair of Harriers hunted regularly on the Old Cortland County Landfill Site in the open field habitat, including the areas around the settling ponds. American Kestrels (*Falco sparverius*) were observed hunting in nearby farm fields and can also be expected to occur on the property, particularly during migration and the winter months. No owls were seen or heard, although appropriate habitat is available for the Great Horned Owl (*Bubo virginianus*), Barred Owl (*Strix varia*), and Eastern Screech Owl (*Otus asio*).

Several bird species were observed around the settling ponds and the emergent wetlands that border the ponds. Red-winged Blackbirds were seen nesting in the cattails and shrubs around the edges of the ponds, while Spotted Sandpipers (*Actitis macularia*) were regularly seen around the ponds and probably nested in the grassy areas nearby. As previously noted, Canada Geese and Mallards were regularly observed on the ponds. On several occasions, Great Blue Herons (*Ardea herodias*) and Green Herons (*Butorides virescens*) were also observed feeding along the edges of the ponds where Green Frog tadpoles were abundant. Tree Swallows (*Tachycineta bicolor*) and Barn Swallows (*Hirundo rustica*) were also observed feeding on insects over these ponds.

Mammals

Nineteen species of mammals were observed on or near the Old Cortland County Landfill Site (Table 7). White-tail Deer (*Odocoileus virginianus*) were particularly common and were observed in, or can be expected to occur in, virtually all portions of the property. Species such as Opossum (*Didelphis marsupialis*), Coyote (*Canis latrans*), Striped Skunk (*Mephitis mephitis*), and Raccoon (*Procyon lotor*) can also be expected to occur in any habitat on or adjacent to the property. The Raccoon, in particular, would be expected to feed along the streams and the edges of the ponds on the property. A number of dogs, some possibly feral, also occur regularly within the study area.

Gray Squirrels (*Sciurus carolinensis*) and Eastern Chipmunks (*Tamias striatus*) were common in the forested areas. Woodchucks (*Marmota monax*) occurred in open fields, hayfields, and along forested edges. One Red Squirrel (*Tamiasciurus hudsonicus*) was observed in a stand of pines near the existing landfill weigh station. This species is probably more common in larger coniferous stands. These species are associated with upland areas and may only occasionally utilize the streams in the area as a water source.

Small mammals such as Short-tailed Shrew (*Blarina brevicauda*), Masked Shrew (*Sorex cinereus*), Hairy-tailed mole (*Parascalops breweri*), Star-nosed Mole (*Condylura cristata*), White-footed Mouse (*Peromyscus leucopus*), and Meadow Vole (*Microtus pennsylvanicus*) are common, even abundant, in appropriate habitat. One Woodland Jumping Mouse (*Napaeozapus insignis*) was also found at the edge of a small woodlot.

Figure 24. Many tunnels made by mice and voles were observed on the berms separating the upper four settling ponds.

Of these species, Star-nosed Mole was found to be common in the wetland areas adjacent to the settling ponds and the unnamed tributary which drains from them. This species typically inhabits wet areas where it feeds primarily on earthworms. The species is an adept swimmer, enabling it to use flooded burrows under the frozen surface during the winter. It may even forage in the stream where it would feed on worms and aquatic insects (Whitaker 1995).

Masked Shrew and Meadow Vole were found in the grassy areas surrounding the settling ponds, as well as in upland open field habitat. Hairytail Mole, White-footed Mouse, and Woodland Jumping Mouse were found in upland forests and shrub areas.

Other small mammals that undoubtedly occur on the property are Red-backed Vole (*Cleithrionomys gapperi*), other small shrews (*Sorex* spp.), House Mouse (*Mus musculus*), and various bats (*Myotis* spp.).

Muskrat (*Ondatra zibethica*) reside in the settling ponds, as observed by bank burrows, where they feed on cattails and various pondweeds.

Rare Species

According to the New York Natural Heritage Program Element Occurrence Records, the New York State Breeding Bird Atlas, and the U.S. Fish and Wildlife data, there are no rare wildlife species on or within the 2-mile perimeter of the site (refer to correspondence in Appendix C). However, Northern Harriers are listed as a Threatened species by the New York State (Environmental Conservation Law Section 11-0535) and a pair were observed on several occasions hunting within the study area.

Wildlife Summary

The relatively large number of vegetation community types on and adjacent to the site provides habitat for a rather rich wildlife species community. However, much of the area is dominated by more common species that are typically associated with edge habitat, small woodlots, and shrubby environments. None of the wildlife species observed on and around the reported drum disposal area were disfigured or showed any visible signs of stress. In addition, there were no species absent from the site that would normally be expected to occur there. Finally, wildlife species dependent on aquatic resources are often highly susceptible to contamination. However, even though the benthos analysis indicated a moderate amount of impact to the unnamed tributary to Trout Brook and Maybury Brook, this is not necessarily attributable to contamination linked to the Old Cortland County Landfill. In fact, the settling ponds and the unnamed tributary to Trout Brook, all of which are downstream of the reported drum disposal area, contained abundant populations of reproducing reptiles, amphibians, and benthos organisms.

Section C

An evaluation was made of the existing habitat to associated fauna. This was accomplished by determining the degree to which the habitats within 0.5 miles of the site meet the requirements for food, cover, bedding areas, breeding and roosting sites for various species of wildlife. Qualitative assessments of fish and wildlife population densities and diversities were determined. This information was then used to assess, in a qualitative manner, the general ability of the area to support fish and wildlife.

The current and potential use of fish and wildlife resources by humans was assessed in terms of hunting, fishing, wildlife observation, scientific research, and other recreational or economic activities. Included within this assessment were resources on the site as well as within 0.5 miles of the site perimeter, documented resources within 2 miles of the site perimeter, and resources downstream of the site that may be affected by contaminants.

Description of Fish and Wildlife Resource Value

The following is a discussion of the value of the Old Cortland County Landfill site as it relates to providing habitat for associated fauna and a resource for human use.

Value of Habitat to Associated Fauna

The aquatic habitats on the Old Cortland County Landfill property consist of ponds, streams, and emergent wetlands. The fishery resources of the site are limited to the Brown Bullheads that were introduced into the settling ponds and the Black-nosed Dace that are resident in the unnamed tributary. The dace population appears healthy and the species is common in the larger pools of the stream. Over 70 individuals, including gravid females, were found in the largest pool which is located where an old farm road crosses the stream in the southern part of the site. In addition, both the unnamed tributary and Maybury Brook are classified as trout streams by the New York State Department of Environmental Conservation (NYSDEC) and probably support populations of Brook Trout farther downstream from the landfill property.

The streams such as the unnamed tributary and Maybury Brook provide habitat for benthic organisms that are associated with small, rocky substrate streams. Stoneflies, which were very common in Maybury Brook, are normally associated with swiftly moving, well oxygenated water. Mayflies, which were more abundant in the unnamed tributary, are often the most abundant insect larvae in small streams and can be important as a source of food for fish (Little 1963).

While both the unnamed tributary and Maybury Brook provide stream habitat for various wildlife species, both streams are impacted to some extent by human activity, as indicated by the results of the benthos sampling. The unnamed tributary receives runoff from the Old Cortland County Landfill site and from the existing landfill. The stream also has a base flow at or near zero during dry periods of the year. Maybury Brook originates in an agricultural area and, thus, receives some organic runoff. Other sources of runoff are Potter Road, which parallels the upper reaches of the stream, and several residences which border the stream. These factors, to some extent, reduce the value of the habitat provided by these streams. While water quality samples collected by B&L show that the unnamed tributary to Trout Brook has elevated levels of some inorganics, the presence of a wide variety of aquatic organisms in the stream indicates that there is no apparent impact from the Old Cortland County Landfill.

Within a 0.5-mile radius of the property, several streams provide habitat for various fish species. Maybury Brook and the unnamed tributary to Trout Brook, as well as Mosquito Creek, which flows southward along the east side of the landfill property, all discharge into Trout Brook. Trout Brook offers more aquatic habitat to fish and supports populations of Brook Trout and Brown Trout.

The Old Cortland Landfill site and the surrounding area within 0.5 miles provides a mosaic pattern of wildlife habitat types. These include streams, ponds, wetlands, agricultural fields, old fields, shrub uplands, hedgerows, deciduous forests, and plantations. As a result of this wide variety of habitat types, the majority of wildlife species that occur in the area are those that are associated with an entire ecotone or can find suitable habitat in relatively small, patchy blocks of one vegetation cover type. However, as seen in Tables 2, 5, 6, and 7, a rather large and diverse number of wildlife species are present on and adjacent to the site.

There are several factors that limit the value of particular cover types as wildlife habitat. Areas that are currently planted as hayfield are utilized by species that are associated with open field habitat. The mowing of these fields and the harvesting of the hay can, however, limit or even eliminate the successful reproduction of open field species, particularly for birds (e.g., Eastern Meadowlarks, Savannah Sparrows, and Bobolinks) and small mammals (e.g., Meadow Voles). Thus, the reclaimed habitat on the Old Cortland County Landfill site, if maintained as open field, can provide a valuable habitat area for open field species.

Borrow areas on the landfill property also offer open field habitat. However, stripping of topsoil has resulted in severe limitations for these areas to provide adequate food and cover for wildlife. For example, while Savannah Sparrows and Eastern Meadowlarks were fairly common as a nesting species in the grasses on the reclaimed portion of the landfill site, only a few pairs of Savannah Sparrows were observed in the areas that had been stripped of topsoil. The Bobolink, a grassland species that was common in hayfields within a half mile of the property, were totally absent from the Old Cortland County Landfill site. These open field areas will never reach their full potential as open field habitat as long as so much exposed rock remains on the surface.

Value of Resources to Humans

The fishery resources of the site are very limited and have little value to humans. The only fish species known to exist on the Old Cortland Landfill site proper is the Brown Bullhead which was introduced into the landfill settling ponds. These ponds are not accessible to the public, nor should resident fish in these ponds be consumed by humans.

The only other known fishery resource on the landfill property are the Black-nosed Dace that inhabit the unnamed tributary on the property. These fish have little value to humans, except as potential baitfish. Mosquito Creek, which is located along the western side of the property, and Maybury Brook, which drains the eastern portion of the property, are both small, rocky bottomed streams that may also support dace and possibly other fish species which could be used for bait.

Trout Brook is located south of the landfill property and receives drainage from the unnamed tributary, Maybury Brook, and Mosquito Creek, as well as a number of other streams. Trout Brook supports reproducing populations of Brook Trout and Brown Trout. In prior years, Trout Brook was also stocked by the NYSDEC (Robins, NYSDEC, pers. comm). However, since public access to much of the stream is limited due to the posting of private property, even this stream currently has somewhat limited value to humans.

The primary value of wildlife that are associated with the site would be as a resource for hunters. While hunting is not allowed on the property, the game species observed are also found in adjacent areas, and some species that would be hunted in the area (e.g., White-tailed Deer, Canada Goose, and Wild Turkey) readily move on and off the property. Other game species noted on the site include Mallard, Ruffed Grouse, Ring-necked Pheasant, Mourning Dove, Eastern Cottontail, and Gray Squirrel. Since there are no public lands for hunting on or immediately adjacent to the landfill property, utilization of this resource is restricted to private property where hunting is allowed.

In terms of the site and surrounding land providing educational, scientific research, and recreational opportunities, these activities are restricted only by the fact that the majority of land in the area is under private ownership. The hazardous and municipal solid waste buried on the site would not interfere with any of these activities.

Section D

Identification was made of the contaminant-specific and site-specific criteria applicable to the remediation of fish and wildlife resources for the Old Cortland County Landfill site. Various government publications were used in determining these criteria, including the New York State Code of Rules and Regulations (6NYCRR) Parts 182, 608 701, 702, 703, and 800, and New York State Environmental Conservation Law (NYS ECL) Articles 11 and 15.

Identification of Applicable Fish and Wildlife Regulatory Criteria

A number of New York State Codes, Rules, and Regulations that have been promulgated under the NYS ECL (Chapter 43-B of the Consolidated Laws), as well as several Federal laws, are applicable to the Old Cortland County Landfill site. These laws are found in Article 11 (Fish and Wildlife), Sections 11-0503, 11-0515, and 11-0535, Article 15 (Water Resources), Title 5 (Protection of Waters), and Section 404 of the Clean Water Act. The following is a list of the contaminant-specific and site-specific regulatory criteria applicable to the site.

Contaminant-Specific Criteria

The following 6NYCRR protecting water quality are applicable to the Old Cortland County Landfill Site:

Part 701 - Classification - Surface Waters and Groundwater

Section 701.1 *General conditions applying to all water classifications.*

The discharge of sewerage, industrial waste or other wastes shall not cause impairment of the best usages of the receiving water as specified by the water classifications at the location of discharge and at other locations that may be affected by such discharge.

Part 702 - Derivation and use of Standards and Guidance Values

Section 702.1 *Basis for derivation of water quality standards and guidance values.*

(a) The control of taste-, color-, and odor-producing, toxic and other deleterious substances is implemented through the use of standards and guidance values.

(b) The derivation of standards and guidance values will consider, to the extent possible, variations in natural or background conditions of waters, including but not limited to alkalinity, temperature, hardness and pH.

Section 702.9 *Standards and guidance values for protection of aquatic life.*

(a) Standards and guidance values for the protection of the best usage of fishing shall also prevent tainting of aquatic food and shall be protective of the health of wildlife consumers of aquatic life from the substances that may bioaccumulate and are referred to as aquatic values.

(b) Where the waters are to be suitable for both fish propagation and survival, standards and guidance values shall be the most stringent of the values derived using the procedures found in sections 702.10 through 702.14 of the Part.

(c) Where the waters are to be suitable for only fish survival, the standards and guidance values shall be the most stringent of the values derived using the procedures found in sections 702.10 through 702.14 of the Part.

Part 703 - Surface Water and Groundwater Quality Standards and Groundwater Effluent Standards

Section 703.1 *Substance form.*

A water quality standard, guidance value or groundwater effluent standard includes all (total) forms of the substance, unless indicated otherwise. There a standard or guidance value is for a specific form of the substance, water quality-based effluent limitations for SPDES permits may include other forms of the substance to account for changes in the substance that occur in the receiving water.

Site-Specific Criteria

The following 6NYCRR and Federal regulations regarding the protection of endangered and threatened species and the use and protection of water bodies are applicable to the Old Cortland County Landfill site:

Part 182 - Endangered and Threatened Species of Wildlife; Species of Concern

Section 182.4 prohibits the "taking" of any endangered or threatened species and thereby provides protection for any such species that may exist on the Old Cortland County Landfill site or adjacent areas.

Section 182.4 *License or permit.*

The department may, at its discretion, issue a license or permit to a person to take, transport, sell, import and/or possess endangered or threatened species of fish and wildlife for purposes it deems legitimate. Such license or permit shall state the species to which it applies and any other conditions the department may deem appropriate.

Part 608 - Use and Protection of Waters

Section 608.2 requires a stream disturbance permit be obtained prior to any work that may affect a protected stream.

Section 608.2 *Disturbance of protected streams.*

(a) *Permit required.* Except as provided in subdivision (b) of this section, no person or local public corporation shall change, modify or disturb any protected stream, its bed or banks, nor remove from its bed or banks sand, gravel or other material, without a permit issued pursuant to this section.

Part 800 ff - Classes and Standards of Quality and Purity Assigned to Fresh Surface and Tidal Salt Waters

Part 931 of 6NYCRR (Section 931.4, pages 4179 - 4180) specifically lists the surface water class and water quality standards for each specific stream, or stream reach, on or adjacent to the Old Cortland County Landfill site. The classified streams on the USGS Truxton (map reference K-15-b) and McGraw (map reference K-15-d) quadrangle maps are illustrated in Section 931.6.

Applicable Technical Guidance Documents

The Division of Fish and Wildlife's "Technical Guidance for Screening Contaminated Sediminents (NYSDEC July 1994) and the Division of Water's Technical and Operational Guidance Series (NYSDEC DOW 1991) are applicable to the Old Cortland County Landfill Site for determining screening levels of contaminants.

Federal Regulations

All Waters of the United States, including wetlands, ponds, and streams, on the Old Cortland County Landfill site and in the adjacent area are regulated by the U.S. Army Corps of Engineers under Section 404 of the Clean Water Act. For activities that would result in the placement of fill within the boundaries of any Waters of the United States under the Corps' jurisdiction, a Federal permit is required.

Conclusions

The purpose of this study was to determine if the vegetation and wildlife resources of the Old Cortland County Landfill have been impacted from industrial and municipal wastes disposed of at the landfill including a number of buried drums containing hazardous substances. Impacts to vegetation and wildlife would be evidenced by stressed vegetation over and around the area of contamination, visual evidence of contaminants (i.e., discoloration of soil and water), disfigured wildlife species, and/or lack of certain species that should be present, particularly in water bodies. Therefore, a study was conducted to identify the fish and wildlife resources that presently exist and that existed prior to waste disposal in order to identify possible remedial actions required to address risks to these communities. In addition, vegetation cover types and plant species were also identified on and adjacent to the site.

Figure 25. The area of the Old Cortland County Landfill reportedly containing the buried drums. Note that there is no noticable affect of the substances in these drums on the vegetation.

A number of vegetation community types occur on and adjacent to the site, including agricultural field, old field, hedgerow, shrub upland, pine plantation, forest, and wetland. These particular community types, as well as the species identified within them, are considered common throughout New York State. In addition, there were no visual signs of stressed vegetation noted anywhere on the site, including the area immediately over and around the area of the buried drums or observed surficial leachate outbreaks.

The vegetation community types on and adjacent to the Old Cortland County Landfill provides a wide variety of habitat types for wildlife. Included in these habitat types are wetlands, ponds (including settling ponds), and streams (Maybury Brook and the unnamed tributary to Trout Brook). As a result of the intermixing of these habitats, the area supports a rich wildlife species community. However, as is true with the plant species noted on the site, much of the area is dominated by more common species that are typically associated with edge habitat, small woodlots, and shrubby environments.

In addition, according to the New York Natural Heritage Program Element Occurrence Records, the New York State Breeding Bird Atlas, and the U.S. Fish and Wildlife data, there are no rare plant or wildlife species on or within the 2-mile perimeter of the site. However, a pair of Northern Harriers, a Threatened species in New York State, were observed on several occasions hunting within the study area.

Since wildlife species dependent on aquatic resources are often highly susceptible to contamination, this study concentrated on identifying the aquatic resources within and downstream of the landfill. In addition, the aquatic organisms within these resources were identified. An unnamed tributary to Trout Brook originates near the Old Cortland County Landfill and flows south to Trout Brook. Another stream adjacent to the east side of the property is Maybury Brook, which originates in an agricultural pasture. Both streams were sampled to determine the affect, if any, that the landfilled wastes and the substances within the buried drums might be having on the aquatic resources.

The settling ponds, as well as both streams, contained abundant populations of various reptiles and amphibians. In addition, both streams were found to support a large number of benthos organisms (aquatic insect larvae). Maybury Brook contained a high percentage of stonefly larvae, while the unnamed tributary contained higher percentages of mayfly and caddisfly. All three of these groups of organisms are good indicators of the relative quality of streams since they do not tolerate poor water quality.

It has been determined that the differences in composition of the benthic organisms in these streams is most likely due to man-made and natural differences in the streams themselves. Based on the origins of these streams, the water quality is not expected to be high. However, given that three different indicator species of good water quality are present in the two subject streams, there does not appear to be any impact to these communities associated with wastes or the buried drums in the Old Cortland County Landfill.

Differences in the type of environment within the streams would also account for differences in fauna associations. The unnamed tributary is primarily fed by surface water flow from the man-made settling ponds on the landfill. This input of epilimnotic water would result of warmer water temperatures and lower dissolved oxygen levels within the stream during much of the year, as compared to Maybury Brook which originates from seepages, springs, and surface water runoff from an emergent wetland.

Several common methods used to measure the levels to which streams have been impacted is to compare Species Richness, Biotic Index Values, and EPT Values (Bode 1988). An evaluation of Species Richness indicates that both streams have been moderately impacted, most likely by factors other than contamination from hazardous and municipal solid wastes. However, as noted by Bode (1988), the Biotic Index Values often underestimate stream degradation due to non-organic problems. Finally, the EPT Value for each stream indicates that both streams are in the "moderately impacted" range, as set forth by Bode (1988), with the unnamed tributary having been subjected to greater water quality degradation than Maybury Brook. The above-noted indices indicate that the unnamed tributary to Trout Brook is degraded more than Maybury Brook. This is not unexpected since this tributary receives both surface water and groundwater flow from the existing landfill complex. Water quality data collected by B&L indicate possible degradation due to the presence of inorganics that are apparently leaching from the landfills. There is no indication, however, that the observed degradation of the streams is associated with an impact to the biotic stream community.

There was no evidence of stained soils, leachate seeps, or exposed hazardous wastes over or around the reported drum disposal area, nor was there any evidence of stressed vegetation or wildlife species. Vegetation and wildlife species that were observed on the site, particularly around the drum disposal area, did not show any signs of disfiguration, and there were no species absent from the site that would normally be expected to occur there. Iron staining was noted in several drainage ditches leading into the upper most settling pond near the closed landfill. However, this type of staining is fairly common and does not appear to be associated with an impact on the site's vegetation and/or wildlife.

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Appendix A - Figures

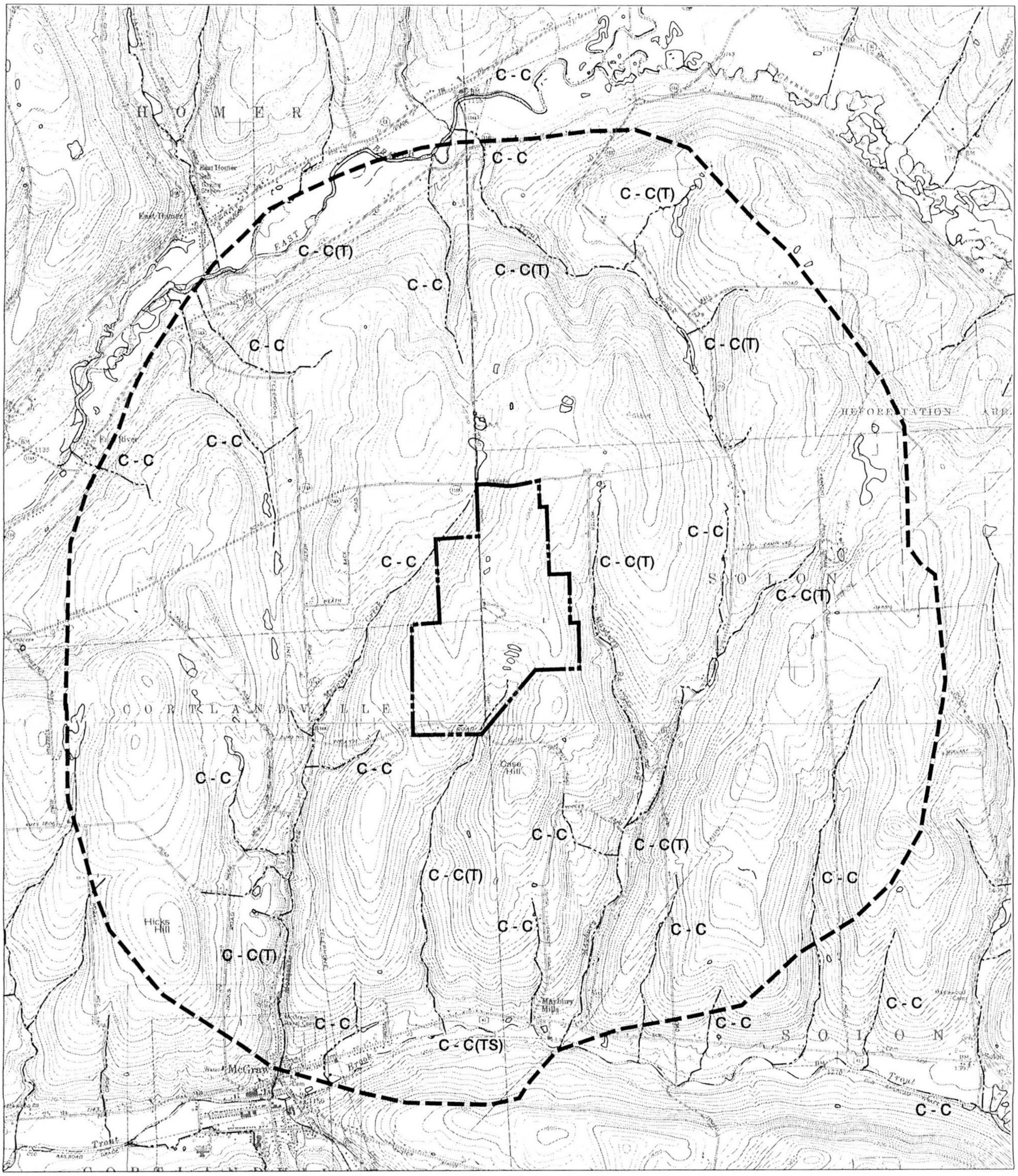

Figure 3: Natural Resources Map

Vegetation and Wildlife Inventory

Old Cortland County Landfill
Remedial Investigation/Feasibility Study

The Environmental Collaborative ■ 309 Palmer Drive ■ Fayetteville, NY 13066 ■ 315.637.3701

Figure 4: Watershed Map

0 500 1000 2000 Scale in Feet North

Legend:
- Watershed Boundary
- Site Boundary
- Study Limits
- Direction of Surface Flow of Water

Vegetation and Wildlife Inventory

Old Cortland County Landfill
Remedial Investigation/Feasibility Study

The Environmental Collaborative ■ 309 Palmer Drive ■ Fayetteville, NY 13066 ■ 315.637.3701

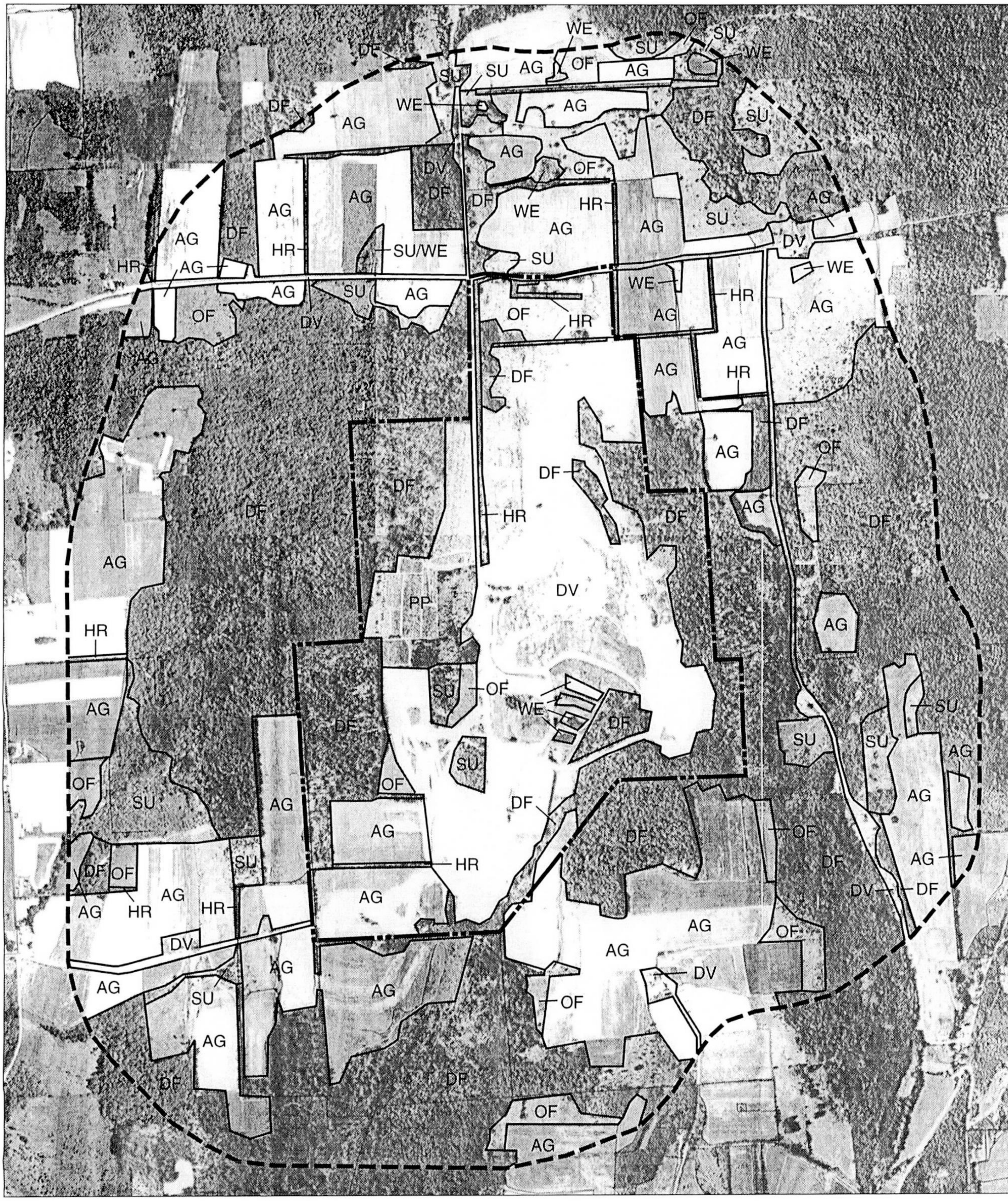

Figure 5: Vegetation Cover Type Map

0 500 1000 2000 Scale in Feet North

Vegetation and Wildlife Inventory

Old Cortland County Landfill
Remedial Investigation/Feasibility Study

Legend:

AG - Agricultural Land
DV - Developed Land
DF - Deciduous Forest
HR - Hedgerow
OF - Old Field
PP - Plantation
SU - Shrub Upland
WE - Wetland
—— Cover Type
- - - - Site Boundary
— — Study Limits

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Appendix B - Tables

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	**OF**	**HR**	**SU**	**PP**	**DF**	**WE**
TREES								
Abies balsamea	Balsam fir					X		
Acer rubrum	Red maple		X	X	X	X	X	
Acer nigrum	Box-elder							X
Acer saccharum	Sugar maple			X	X		X	
Amelanchier spp.	Shadbush serviceberry						X	
Betula alleghaniensis	Yellow birch						X	
Betula populifolia	Gray birch		X		X	X	X	
Cornus alternifolia	Pagoda dogwood			X			X	
Crataegus spp.	Hawthorn		X	X	X		X	
Fagus grandidentata	Beech						X	
Fraxinus americana	White ash						X	
Fraxinus pennsylvanica	Green ash		X				X	
Larix decidua	European larch					X		
Malus spp.	Apple		X	X	X		X	
Picea abies	Norway spruce					X		
Picea glauca	White spruce					X		
Picea pungens	Colorado blue spruce					X		

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	OF	HR	SU	PP	DF	WE
TREES (continued)								
Pinus nigra	Austrian pine					X		
Pinus strobus	White pine					X		
Pinus sylvestris	Scotch pine					X		
Populus tremuloides	Trembling aspen		X	X	X		X	
Prunus pensylvanica	Fire cherry			X			X	
Prunus serotina	Black cherry			X			X	
Prunus virginiana	Choke-cherry			X			X	
Robinia pseudoacacia	Black locust						X	
Tilia americana	Basswood						X	
Ulmus americana	American elm						X	
SHRUBS								
Berberis thunbergii	Japanese barberry						X	
Lonicera tatarica	Honeysuckle		X	X	X		X	
Rhus typhina	Staghorn sumac			X	X			
Ribes cynosbati	Prickly gooseberry						X	
Rosa multiflora	Multiflora rose		X	X	X			
Rubus allegheniensis	Northern blackberry		X	X	X	X	X	
Rubus idaeus	Red raspberry		X	X	X	X	X	

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	**OF**	**HR**	**SU**	**PP**	**DF**	**WE**
SHRUBS (continued)								
Rubus occidentalis	Black raspberry		X	X	X	X	X	
Salix spp.	Willow							X
Sambucus canadensis	Common elderberry						X	
Spiraea latifolia	Broadleaf spiraea							X
Viburnum lantanoides	Hobblebush						X	
Viburnum lentago	Nannyberry						X	
VINES								
Vitis aestivalis	Summer grape			X	X		X	
HERBS								
Achillea millefolium	Common yarrow		X		X			
Actaea pachypoda	White baneberry						X	
Alisma subcordatum	Water-plantain							X
Allium canadense	Wild leek						X	
Antennaria spp.	Pussytoes		X					
Anthoxanthum odoratum	Sweet vernalgrass		X	X	X	X		
Arctium minus	Burdock		X					
Arisaema triphyllum	Jack-in-the-pulpit						X	
Aster novae-angliae	New England aster							X

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	OF	HR	SU	PP	DF	WE
HERBS (continued)								
Brassica rapa	Field mustard		X		X			
Caltha palustris	Marsh marigold							X
Cardamine diphylla	Two-leaved toothwort						X	
Carex stipata	Sedge							X
Carex vulpinoidea	Sedge							X
Caulophyllum thalictroides	Blue cohosh						X	
Centaurea maculosa	Knapweed		X		X			
Cerastium fontanum	Common mouse-ear		X		X			
Cirsium discolor	Field thistle		X		X			
Convolvulus arvensis	Field bindweed				X			
Coronilla varia	Crown vetch		X		X	X		
Dactylis glomerata	Orchard grass		X		X	X		
Daucus carota	Queen Anne's lace		X		X	X		
Dipsacus sylvestris	Teasel		X					
Eleocharis spp.	Spikerush							X
Epilobium hirsutum	Hairy herb-willow							X
Equisetum arvense	Scouring horsetail							X
Erigeron annuus	Daisy fleabane		X		X	X		

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	OF	HR	SU	PP	DF	WE
HERBS (continued)								
Erythronium americanum	Yellow troutlily						X	
Eupatorium perforatum	Boneset							X
Eupatorium maculatum	Spotted joe-pye-weed							X
Euthamia graminifolia	Flat-top goldenrod		X					X
Fragaria virginiana	Wild strawberry		X	X	X	X	X	
Galium mollugo	White bedstraw		X		X			
Galium palustre	Ditch bedstraw							X
Geranium robertianum	Herb robert							X
Geum alleppicum	White avens						X	
Geum canadense	Yellow avens						X	
Geum laciniatum	Rough avens		X					
Glechoma hederacea	Ground ivy		X		X	X		
Glyceria melicaria	Slender mannagrass							X
Hepatica nobilis	Hepatica						X	
Hesperis matronalis	Dame's-rocket						X	
Hieracium aurantiacum	Orange hawkweed		X					
Hieracium pratense	Field hawkweed		X		X			
Hypericum punctatum	Spotted St. John's-wort		X		X			

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	OF	HR	SU	PP	DF	WE
HERBS (continued)								
Impatiens capensis	Spotted touch-me-not							X
Juncus effusus	Soft rush							X
Juncus tenuis	Slender yard-rush							X
Lathyrus palustris	Vetchling		X		X			
Leonurus cardiaca	Motherwort		X		X			
Lepidium campestre	Field peppergrass		X		X			
Lepidium virginicum	Wild peppergrass		X		X			
Leucanthemum vulgare	Ox-eye daisy		X		X			
Lotus corniculata	Bird's-foot trefoil		X		X			
Lythrum salicaria	Purple loosestrife							X
Medicago lupulina	Black medic		X		X			
Melilotus alba	White sweetclover		X		X			
Mitchella repens	Partridgeberry						X	
Myosotis scorpioides	Forget-me-not							X
Oenothera biennis	Evening primrose		X		X			
Phalaris arundinacea	Reed canary grass							X
Phleum pratense	Timothy	X	X		X	X		
Phragmites australis	Common reed							X

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	OF	HR	SU	PP	DF	WE
HERBS (continued)								
Plantago lanceolata	English plantain		X		X	X		
Poa compressa	Canada bluegrass	X	X		X	X		
Poa pratensis	Kentucky bluegrass		X		X	X		
Podophyllum peltatum	Mayapple						X	
Polygonum cuspidatum	Japanese bamboo		X					
Potamogeton spp.	Pondweed							X
Potentilla simplex	Old-field cinquefoil		X	X	X	X		
Ranunculus acris	Tall buttercup	X	X		X	X		
Rumex acetosella	Sheep sorrel		X					
Rumex crispus	Curly dock		X					
Saponaria officinalis	Bouncing-bet		X					
Scirpus atrovirens	Bulrush							X
Sedum telephium	Live-forever					X		
Sisyrinchium spp.	Blue-eyed grass		X			X		
Solanum dulcamara	Enchanter's nightshade							X
Solidago canadensis	Canada goldenrod		X		X			
Solidago rugosa	Rough-stemmed goldenrod		X		X			
Stellaria graminea	Common stitchwort		X					

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	OF	HR	SU	PP	DF	WE
HERBS (continued)								
Taraxacum officinalis	Dandelion		X		X			
Trifolium campestre	Hop-clover		X					
Trifolium hybridum	Alsike clover	X						
Trifolium pratense	Red clover	X	X		X			
Trifolium repens	White clover		X					
Trillium erectum	Red trillium						X	
Trillium grandiflorum	White trillium						X	
Tussilago farfara	Colt's-foot		X					
Typha angustifolia	Narrow-leaved cattail							X
Veratrum viride	False hellebore							X
Verbascum blatteria	Moth-mullein		X					
Verbascum thapsus	Mullein		X					
Veronica chamaedrys	Bird's-eye speedwell		X					
Veronica peregrina	Purslane speedwell		X					
Veronica serpyllifolia	Thyme-leaved speedwell		X					
Viola sororia	Common violet					X		
Zea mays	Corn	X						

Table 1. Plant Species* Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

		HABITAT TYPE**						
		AG	**OF**	**HR**	**SU**	**PP**	**DF**	**WE**
FERNS AND FERN ALLIES								
Botrychium virginianum	Rattlesnake fern						X	
Dennstaedtia punctilobula	Hay-scented fern						X	
Dryopteris marginalis	Marginal wood fern						X	
Dryopteris carthusiana	Spinulose wood fern						X	
Onoclea sensibilis	Sensitive fern							X
Osmunda cinnamomea	Cinnamon fern						X	
Polystichum acrosticoides	Christmas fern						X	

***Plant Species**

Scientific and common names of plant species according to *Revised Checklist of New York State Plants* (Mitchell and Tucker 1997)

Habitat Types

AG - Agricultural Land

OF - Old Field

HR - Hedgerow

SU - Shrub Upland

PP - Plantation

DF - Forest

WE - Wetland

Table 2. Aquatic Organisms (Benthos) Collected in Maybury Brook and the Unnamed Tributary

Maybury Brook				Sample 1	Sample 2	Sample 3
Order	***Family***	***Genus***	***Common Name***	***Quantity***	***Quantity***	***Quantity***
Ephemeroptera - Mayflies	Potamanthidae	Anthopotamus	Mayfly	1%		1%
	Heptageniidae		Stream mayflies	3%	5%	7%
	Ephemeridae	Litobrancha	Burrowing mayflies	6%	10%	4%
Odonata - Dragonflies and Damselflies	Coenagrionidae		Bluet damselfy			
Plecoptera - Stoneflies	Perlidae	Eccoptera	Stonefly	78%	76%	78%
Trichoptera - Caddisflies	Hydropsychidae	Parapsyche	Caddisfly	3%	2%	2%
	Polycentropodidae		Caddisfly			1%
Coleoptera - Beetles	Dytiscidae		Predaceous diving beetles			
	Elmidae		Riffle beetles			1%
Diptera - True flies	Empididae	Clinocera	Dance flyes	1%		
	Ceratopogonidae	Bezzia	Punkies			
	Chironomidae		Midges	7%	6%	4%
	Simuliidae		Blackflies		1%	1%
	Tipullidae		Cranefly			
	Tipuliidae	Antocha	Cranefly			
		Limonia	Cranefly			
Decapoda - Crayfish		Cambarus	Crayfish	1%		1%
Hirundinea - Leeches	Hirudinidae		Leeches			

Unnamed Tributary				Sample 1	Sample 2	Sample 3
Order	***Family***	***Genus***	***Common Name***	***Quantity***	***Quantity***	***Quantity***
Ephemeroptera - Mayflies	Potamanthidae	Anthopotamus	Mayfly			
	Heptageniidae		Stream mayflies			
	Ephemeridae	Litobrancha	Burrowing mayflies	25%	34%	34%
Odonata - Dragonflies and Damselflies	Coenagrionidae		Bluet damselfy	2%		
Plecoptera - Stoneflies	Perlidae	Eccoptera	Stonefly			3%
Trichoptera - Caddisflies	Hydropsychidae	Parapsyche	Caddisfly	32%	14%	21%
	Polycentropodidae		Caddisfly	2%		
Coleoptera - Beetles	Dytiscidae		Predaceous diving beetles	5%	2%	
	Elmidae		Riffle beetles			
Diptera - True flies	Empididae	Clinocera	Dance flyes			
	Ceratopogonidae	Bezzia	Punkies	9%	9%	1%
	Chironomidae		Midges	5%	13%	4%
	Simuliidae		Blackflies		18%	24%
	Tipulidae	Unidentified	Cranefly	5%	4%	6%
	Tipulidae	Antocha	Cranefly	7%	2%	
		Limonia	Cranefly		2%	
Decapoda - Crayfish		Cambarus	Crayfish	5%	2%	4%
Hirundinea - Leeches	Hirudinidae		Leeches	2%		3%

Table 3. EPT Index Calculations

Maybury Brook				
Taxa	**Common Name**	**Sample 1**	**Sample 2**	**Sample 3**
Anthopotamus	Mayfly	1	0	1
Heptagenidae	Stream mayfly	3	5	7
Ephemeridae	Burrowing mayfly	6	10	4
Perlidae	Stonefly	78	76	78
Hydropsychidae	Caddisfly	3	2	2
Polycentropodidae	Caddisfly	0	0	1
	Total Species	5	4	6

Unnamed Tributary				
Order	**Family**	**Sample 1**	**Sample 2**	**Sample 3**
Ephemeridae	Burrowing mayfly	25	34	34
Perlidae	Stonefly	0	0	3
Hydropsychidae	Caddisfly	32	14	21
Polycentropodidae	Caddisfly	2	0	0
	Total Species	3	2	3

Table 4. Biotic Index Values

Maybury Brook								
Taxa	**Common Name**	**Tolerance Value**	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 1**	**Sample 2**	**Sample 3**
Anthopotamus	Mayfly	4	1	0	1	4	0	4
Heptagenidae	Stream mayfly	3	3	5	7	9	15	21
Ephemeridae	Burrowing mayfly	2	6	10	4	12	20	8
Perlidae	Stonefly	3	78	76	78	234	228	234
Hydropsychidae	Caddisfly	5	3	2	2	15	10	10
Polycentropodidae	Caddisfly	8	0	0	1	0	0	8
Elmidae	Riffle beetle	5	0	0	1	0	0	5
Clinocera	Dance flies	6	1	0	0	6	0	0
Chironomidae	Midges	6	7	6	4	42	36	24
Simulidae	Blackflies	5	0	1	1	0	5	5
Cambarus	Crayfish	6	1	0	1	6	0	6
		Sum	100	100	100	328	314	325

Mean Hilsenhoff Biotic Index 3.22

Unnamed Tributary								
Taxa	**Common Name**	**Tolerance Value**	**Sample 1**	**Sample 2**	**Sample 3**	**Sample 1**	**Sample 2**	**Sample 3**
Ephemeridae	Burrowing mayfly	2	25	34	34	50	68	68
Coenagrionidae	Bluet damselfly	8	2	0	0	16	0	0
Perlidae	Stonefly	3	0	0	3	0	0	9
Hydropsychidae	Caddisfly	5	32	14	21	160	70	105
Polycentropodidae	Caddisfly	8	2	0	0	16	0	0
Dytiscidae	Pred. diving beetle	5	5	2	0	25	10	0
Ceratopogonidae	Punkies	6	9	9	1	54	54	6
Chironomidae	Midges	6	5	13	4	30	78	24
Simulidae	Blackflies	5	0	18	24	0	90	120
Tipulidae		4	5	4	6	20	16	24
Antocha		3	7	2	0	21	6	0
Limonia		6	0	2	0	0	12	0
Cambarus	Crayfish	6	5	2	4	30	12	24
Hirudinea	Leeches	7	2	0	3	14	0	21
		Sum	99	100	100	345	338	324

Mean Hilsenhoff Biotic Index 3.47

Table 5. Amphibians and Reptiles Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		HABITAT TYPE**						
		AG	OF	HR	SU	PP	FO	WE
AMPHIBIANS - SALAMANDERS								
Desmognathus f. fuscus	Northern Dusky Salamander							X
Eurycea bislineata	Northern Two-lined Salamander							X
Notophthalmus v. viridescens	Red-spotted Newt							X
Plethodon cinereus	Redback Salamander						X	
AMPHIBIANS - FROGS								
Bufo a. americanus	American Toad	X	X		X			X
Hyla versicolor	Gray Treefrog			X	X			X
Pseudacris c. crucifer	Northern Spring Peeper							X
Rana catesbeiana.	Bullfrog	X						X
Rana clamitans melanota.	Green Frog	X						X
Rana sylvatica	Wood Frog					X		X
REPTILES - TURTLES								
Chelydra s. serpentina	Common Snapping Turtle							X
Chrysemys p. picta	Eastern Painted Turtle							X

Table 5. Amphibians and Reptiles Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		HABITAT TYPE**						
		AG	OF	HR	SU	PP	FO	WE
REPTILES - SNAKES								
Lampropeltis t. triangulum	Eastern Milk Snake	X						
Thamnophis s. sirtalis	Eastern Garter Snake		X				X	X

*** Species Names**

Scientific and common names of wildlife species according to S*tandard Common and Current Scientific Names for North American Amphibians and Reptiles* (Soc. Study Amphibians and Reptiles 1990)

**** Habitat Types**

AG - Agricultural Land

OF - Old Field

HR - Hedgerow

SU - Shrub Upland

PP - Pine Plantation

FO - Forest

WE - Wetland

Table 6. Birds Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		**HABITAT TYPE****						
		AG	**OF**	**HR**	**SU**	**PP**	**FO**	**WE**
Ardea herodias	Great Blue Heron							X
Butorides striatus	Green-backed Heron				X			X
Branta canadensis	Canada Goose							X
Anas platyrhynchos	Mallard							X
Cathartes aura	Turkey Vulture	X					X	
Circus cyaneus	Northern Harrier	X	X					X
Buteo jamaicensis	Red-tailed Hawk		X				X	
Falco sparvervius	American Kestrel		X					
Phasianus colchicus	Ring-necked Pheasant		X					
Bonasa umbellus	Ruffed Grouse						X	
Meleagris gallopavo	Wild Turkey	X	X				X	
Charadrius vociferus	Killdeer		X					
Actitis macularia	Spotted Sandpiper							X
Larus delawarensis	Ring-billed Gull							X
Larus argentatus	Herring Gull							X
Columba livia	Rock Dove	X						

Table 6. Birds Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		**HABITAT TYPE****						
		AG	**OF**	**HR**	**SU**	**PP**	**FO**	**WE**
Zenaida macroura	Mourning Dove	X	X	X	X	X	X	
Sphyrapicus varius	Yellow-bellied Sapsucker					X		
Picoides pubescens	Downy Woodpecker						X	
Colaptes auratus	Northern Flicker		X	X			X	
Dryocopus pileatus	Pileated Woodpecker						X	
Contopus virens	Eastern Wood-Pewee						X	
Empidonax alnorum	Alder Flycatcher			X	X			
Empidonax minimus	Least Flycatcher			X			X	
Sayornis phoebe	Eastern Phoebe	X	X					
Tyrannus tyrannus	Eastern Kingbird	X	X					
Tachycineta bicolor	Tree Swallow	X	X					X
Hirundo rustica	Barn Swallow	X	X					X
Cyanocitta cristata	Blue Jay			X	X		X	
Corvus brachyrhynchos	American Crow	X	X	X	X		X	
Poecile atricapillus	Black-capped Chickadee			X	X		X	
Sitta carolinensis	White-breasted Nuthatch						X	

Table 6. Birds Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		**HABITAT TYPE****						
		AG	**OF**	**HR**	**SU**	**PP**	**FO**	**WE**
Troglodytes aedon	House Wren			X			X	
Catharus fuscescens	Veery						X	
Hylocichla mustelina	Wood Thrush						X	
Turdus migratorius	American Robin			X			X	
Dumetella carolinensis	Gray Catbird			X	X		X	
Bombycilla cedrorum	Cedar Waxwing			X	X		X	
Sturnus vulgaris	European Starling	X	X	X	X		X	X
Vireo flavifrons	Yellow-throated Vireo						X	
Vireo gilvus	Warbling Vireo			X			X	
Vireo olivaceous	Red-eyed Vireo			X	X		X	
Dendroica petechia	Yellow Warbler		X	X	X	X	X	X
Dendroica pensylvanica	Chestnut-sided Warbler				X	X		
Dendroica coronata	Yellow-rumped Warbler			X			X	
Setophaga ruticilla	American Redstart						X	
Seiurus aurocapillus	Ovenbird						X	
Oporornis philadelphia	Mourning Warbler						X	

Table 6. Birds Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		HABITAT TYPE**						
		AG	OF	HR	SU	PP	FO	WE
Geothlypis trichas	Common Yellowthroat		X	X	X			X
Piranga olivacea	Scarlet Tanager						X	
Pheucticus ludovicianus	Rose-breated Grosbeak						X	
Passerina cyanea	Indigo Bunting		X					
Pipilo erythrophthalmus	Eastern Towhee				X		X	
Spizella passerina	Chipping Sparrow		X					
Spizella pusilla	Field Sparrow		X		X	X		
Passerculus sandwichensis	Savannah Sparrow	X	X					
Melospiza melodia	Song Sparrow	X	X	X	X	X	X	
Dolichonyx oryzivorus	Bobolink	X	X					
Agelaius phoeniceus	Red-winged Blackbird	X	X	X	X			X
Sturnella magna	Eastern Meadowlark	X	X					
Quisculus quiscula	Common Grackle	X	X	X	X	X	X	
Molothrus ater	Brown-headed Cowbird			X	X			
Icterus galbula	Baltimore Oriole			X			X	
Carpodacus mexicanus	House Finch			X	X	X		

Table 6. Birds Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		HABITAT TYPE**						
		AG	OF	HR	SU	PP	FO	WE
Carduelis tristis	American Goldfinch	X	X	X	X			
Passer domesticus	House Sparrow	X						

*** Species Names**

Scientific and common names of species according to *AOU Check-list of North American Birds (6th Edition)* (A.O.U.1983) and its supplements (A.O.U. 1991, 1993, 1995, 1997)

**** Habitat Types**

AG - Agricultural Land

OF - Old Field

HR - Hedgerow

SU - Shrub Upland

PP - Pine Plantation

FO - Forest

WE - Wetland

Table 7. Mammals Observed on the Old Cortland County Landfill Site Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		HABITAT TYPE**						
		AG	OF	HR	SU	PP	FO	WE
MARSUPIALS								
Didelphis marsupialis	Opossum	X						
INSECTIVORES								
Sorex cinereus	Masked Shrew		X				X	
Blarina brevicauda	Shorttail Shrew		X					
Condylura cristata	Starnose Mole							X
Parascalops breweri	Hairytail Mole						X	
CARNIVORES								
Procyon lotor	Raccoon	X						X
Mephitis mephitis	Striped Shunk	X						
Canis latrans	Coyote	X			X	X		
Canis familiaris	Domestic Dog	X				X		
RODENTS								
Marmota monax	Woodchuck	X						
Tamias striatus	Eastern Chipmunk						X	
Sciurus carolensis	Eastern Gray Squirrel						X	
Tamiasciurus hudsonicus	Red Squirrel					X		

Table 7. Mammals Observed on the Old Cortland County Landfill Site
Towns of Solon and Cortlandville, Cortland County, New York

SPECIES*		HABITAT TYPE**						
		AG	OF	HR	SU	PP	FO	WE
RODENTS (continued)								
Peromyscus leucopus	White-footed Mouse						X	
Microtus pennsylvanicus	Meadow Vole	X	X					
Ondatra zibethica	Muskrat							X
Napaeozapus insignis	Woodland Jumping Mouse						X	
RABBITS								
Sylvilagus floridanus	Eastern Cottontail	X	X	X	X		X	
HOOVED MAMMALS								
Odocoileus virginianus	Whitetail Deer	X	X		X	X	X	

*** Species Names**

Scientific and common names of species according to *A Field Guide to the Mammals* (Burt and Grossenheider 1964)

**** Habitat Types**

AG - Agricultural Land

OF - Old Field

HR - Hedgerow

SU - Shrub Upland

PP - Pine Plantation

FO - Forest

WE - Wetland

Appendix C - Agency Correspondence

NEW YORK STATE
DEPARTMENT OF ENVIRONMENTAL CONSERVATION
Wildlife Resources Center
700 Troy-Schenectady Road
(518) 783-3932 Latham, NY 12110-2400

June 2, 1997

John P. Cahill
Acting Commissioner

Barbara C. Reuter
The Environmental Collaborative
309 Palmer Drive
Fayetteville, NY 13066

Dear Ms. Reuter:

We reviewed the New York Natural Heritage Program files with respect to your recent request for biological information concerning the Old Cortland County Landfill Remedial Investigation Study, site as indicated on your enclosed map, located in the Towns of Cortlandville and Solon, Cortland County, New York State.

We did not identify any potential impacts to endangered, threatened, or special concern wildlife species, rare plant, animal or natural community occurrences, or other significant habitat.
The Breeding Bird Atlas data you requested is enclosed.

The absence of data does not necessarily mean that rare or endangered elements, natural communities or other significant habitats do not exist on or adjacent to the proposed site, but rather that our files currently do not contain any information which indicates the presence of these. Our files are continually growing as new habitats and occurrences of rare species and communities are discovered. In most cases, site-specific or comprehensive surveys for plant and animal occurrences have not been conducted. For these reasons, we cannot provide a definitive statement on the presence or absence of species, habitats or communities. This information should not be substituted for on-site surveys that may be required for environmental assessment.

This response applies only to known occurrences of rare plants and natural communities. . You should contact our regional office, Division of Regulatory Affairs, at the address enclosed for information regarding any regulated areas or permits that may be required (e.g., regulated wetlands) under State Law.

If this proposed project is still active one year from now we recommend that you contact us again so that we may update this response.

Sincerely,

Nicholas Conrad

Nicholas B. Conrad
Information Services
New York Natural Heritage Program

Encs.
cc: Reg. 7, Wildlife Mgr.
Reg. 7, Fisheries Mgr.

NEW YORK STATE BREEDING BIRD ATLAS

BREEDING SPECIES OF : OLD CORTLAND COUNTY LANDFILL AREA

1980-1985 DATA AOU CHECKLIST ORDER

COMMON NAME	SCIENTIFIC NAME	BREED-ING CODE	YEAR	NEW YORK LEGAL STATUS	NATURAL HERITAGE PROGRAM STATE RANK
Great Blue Heron	Ardea herodias	S2	84	Protected	S5
Green-backed Heron	Butorides striatus	X1	85	Protected	S5
Wood Duck	Aix sponsa	X1	85	Game Species	S5
Mallard	Anas platyrhynchos	FL	85	Game Species	S5
Sharp-shinned Hawk	Accipiter striatus	X1	85	Protected	S4
Red-tailed Hawk	Buteo jamaicensis	S2	84	Protected	S5
American Kestrel	Falco sparverius	FL	84	Protected	S5
Ruffed Grouse	Bonasa umbellus	FL	85	Game Species	S5
Wild Turkey	Meleagris gallopavo	FL	85	Game Species	S5
American Crow	Corvus brachyrhynchos	FL	85	Game Species	S5
Killdeer	Charadrius vociferus	FL	85	Protected	S5
Spotted Sandpiper	Actitis macularia	P2	85	Protected	S5
Common Snipe	Gallinago gallinago	FL	85	Game Species	S5
American Woodcock	Scolopax minor	X1	85	Game Species	S5
Rock Dove	Columba livia	ON	84	Unprotected	SE
Mourning Dove	Zenaida macroura	NY	85	Protected	S5
Eastern Screech-Owl	Otus asio	X1	83	Protected	S5
Great Horned Owl	Bubo virginianus	FL	84	Protected	S5
Barred Owl	Strix varia	S2	84	Protected	S5
Ruby-throated Hummingbird	Archilochus colubris	X1	84	Protected	S5
Belted Kingfisher	Ceryle alcyon	ON	84	Protected	S5
Yellow-bellied Sapsucker	Sphyrapicus varius	S2	84	Protected	S5
Downy Woodpecker	Picoides pubescens	FL	85	Protected	S5
Hairy Woodpecker	Picoides villosus	S2	81	Protected	S5
Northern Flicker	Colaptes auratus	FL	85	Protected	S5
Pileated Woodpecker	Dryocopus pileatus	S2	84	Protected	S5
Eastern Wood-Pewee	Contopus virens	S2	84	Protected	S5
Willow Flycatcher	Empidonax traillii	T2	85	Protected	S5
Least Flycatcher	Empidonax minimus	T2	85	Protected	S5
Eastern Phoebe	Sayornis phoebe	FL	85	Protected	S5
Great Crested Flycatcher	Myiarchus crinitus	S2	81	Protected	S5
Eastern Kingbird	Tyrannus tyrannus	NY	84	Protected	S5
Tree Swallow	Tachycineta bicolor	ON	85	Protected	S5

NEW YORK STATE BREEDING BIRD ATLAS
BREEDING SPECIES OF : OLD CORTLAND COUNTY LANDFILL AREA
1980-1985 DATA AOU CHECKLIST ORDER

COMMON NAME	SCIENTIFIC NAME	BREED-ING CODE	YEAR	NEW YORK LEGAL STATUS	NATURAL HERITAGE PROGRAM STATE RANK
Bank Swallow	Riparia riparia	ON	84	Protected	S5
Barn Swallow	Hirundo rustica	FY	85	Protected	S5
Blue Jay	Cyanocitta cristata	FY	85	Protected	S5
Black-capped Chickadee	Parus atricapillus	FY	84	Protected	S5
White-breasted Nuthatch	Sitta carolinensis	FL	84	Protected	S5
Brown Creeper	Certhia americana	X1	81	Protected	S5
House Wren	Troglodytes aedon	NY	85	Protected	S5
Winter Wren	Troglodytes troglodytes	FY	84	Protected	S5
Golden-crowned Kinglet	Regulus satrapa	T2	85	Protected	S5
Veery	Catharus fuscescens	S2	84	Protected	S5
Wood Thrush	Hylocichla mustelina	S2	84	Protected	S5
American Robin	Turdus migratorius	FY	85	Protected	S5
Gray Catbird	Dumetella carolinensis	FY	85	Protected	S5
Brown Thrasher	Toxostoma rufum	FY	85	Protected	S5
Cedar Waxwing	Bombycilla cedrorum	P2	85	Protected	S5
European Starling	Sturnus vulgaris	FY	84	Unprotected	SE
Solitary Vireo	Vireo solitarius	X1	84	Protected	S5
Warbling Vireo	Vireo gilvus	FY	85	Protected	S5
Red-eyed Vireo	Vireo olivaceus	FY	84	Protected	S5
Blue-winged Warbler	Vermivora pinus	T2	85	Protected	S5
Nashville Warbler	Vermivora ruficapilla	FY	85	Protected	S5
Yellow Warbler	Dendroica petechia	FY	85	Protected	S5
Chestnut-sided Warbler	Dendroica pensylvanica	T2	85	Protected	S5
Magnolia Warbler	Dendroica magnolia	T2	85	Protected	S5
Black-throated Blue Warbler	Dendroica caerulescens	T2	85	Protected	S5
Yellow-rumped Warbler	Dendroica coronata	S2	85	Protected	S5
Black-throated Green Warbler	Dendroica virens	S2	85	Protected	S5
Black-and-white Warbler	Mniotilta varia	FY	84	Protected	S5
American Redstart	Setophaga ruticilla	FY	85	Protected	S5
Ovenbird	Seiurus aurocapillus	FY	85	Protected	S5
Louisiana Waterthrush	Seiurus motacilla	S2	85	Protected	S5
Mourning Warbler	Oporornis philadelphia	FY	85	Protected	S5
Common Yellowthroat	Geothlypis trichas	FY	85	Protected	S5

NEW YORK STATE BREEDING BIRD ATLAS
BREEDING SPECIES OF : OLD CORTLAND COUNTY LANDFILL AREA
1980-1985 DATA AOU CHECKLIST ORDER

COMMON NAME	SCIENTIFIC NAME	BREED-ING CODE	YEAR	NEW YORK LEGAL STATUS	NATURAL HERITAGE PROGRAM STATE RANK
Canada Warbler	Wilsonia canadensis	FY	84	Protected	S5
Scarlet Tanager	Piranga olivacea	S2	81	Protected	S5
Northern Cardinal	Cardinalis cardinalis	FY	85	Protected	S5
Rose-breasted Grosbeak	Pheucticus ludovicianus	FL	85	Protected	S5
Indigo Bunting	Passerina cyanea	T2	85	Protected	S5
Rufous-sided Towhee	Pipilo erythrophthalmus	FL	85	Protected	S5
Chipping Sparrow	Spizella passerina	FY	85	Protected	S5
Field Sparrow	Spizella pusilla	FY	85	Protected	S5
Savannah Sparrow	Passerculus sandwichensis	T2	85	Protected	S5
Grasshopper Sparrow	Ammodramus savannarum	T2	85	Protected-Special Concern	S4
Song Sparrow	Melospiza melodia	FY	85	Protected	S5
Dark-eyed Junco	Junco hyemalis	FL	85	Protected	S5
Bobolink	Dolichonyx oryzivorus	FL	85	Protected	S5
Red-winged Blackbird	Agelaius phoeniceus	FY	85	Protected	S5
Eastern Meadowlark	Sturnella magna	FL	85	Protected	S5
Common Grackle	Quiscalus quiscula	FL	85	Protected	S5
Brown-headed Cowbird	Molothrus ater	FL	85	Protected	S5
Northern Oriole	Icterus galbula	T2	85	Protected	S5
House Finch	Carpodacus mexicanus	FY	85	Protected	SE
Red Crossbill	Loxia curvirostra	X1	85	Protected	S3
American Goldfinch	Carduelis tristis	P2	85	Protected	S5
House Sparrow	Passer domesticus	FY	84	Unprotected	SE

New York State
Breeding Bird Atlas

The enclosed data from the New York State Breeding Bird Atlas represents a cumulative effort from 1980-1985. These data are the result of on-site block by block surveys conducted by numerous individuals. The appropriate blocks were then selected to form a unit for which we can provide a listing of Confirmed, Probable and Possible breeding birds. The intensity level and effort in data collecting varies throughout the State. Some blocks have been more thoroughly searched than others. For these reasons, we cannot provide a definitive statement concerning the absence of a breeding record for a species not listed in the unit. We can only provide a listing of species known to be breeding or suspected of breeding within this unit.

The highest level of confirmation of breeding recorded during the Atlas period was retained in this list. The list is grouped by breeding level with Confirmed breeders listed first followed by Probable and Possible breeders.

Definitions of the New York State legal status and the Natural Heritage Program (NHP) State ranking are provided on the enclosed sheet entitled "New York State Breeding Bird Atlas Species Status." The NHP rank reflects "believed" rarity within the State. It does not confer any legal protection to the species and is meant only as a "working" list, subject to changes based upon the most recent data available.

Questions concerning these data may be addressed to:

Information Services
New York Natural Heritage Program
N.Y.S.D.E.C.
Wildlife Resources Center
700 Troy-Schenectady Road
Latham, New York 12110-2400

Copies of the published book "The Atlas of Breeding Birds in New York State", Andrle, Robert F. and Janet R. Carroll, Editors, may be purchased directly from Cornell University Press. Call toll free 1-800-666-2211 to order and have billed to your charge card.

New York State Breeding Bird Atlas
Species Status

New York State Legal Status

Endangered - any species which meet one of the following criteria:

1) Any native species in imminent danger of extirpation or extinction in New York.

2) Any species listed as endangered by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

Threatened - any species which meet one of the following criteria:

1) Any native species likely to become an endangered species within the foreseeable future in New York.

2) Any species listed as threatened by the United States Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11, and not listed as endangered in New York.

Protected-Special Concern - those species which are not yet recognized as endangered or threatened, but for which documented concern exists for their continued welfare in New York and are Federally protected wild birds.

Protected-Game Species - species classified as small game in New York by Environmental Conservation Law, may have an open season for part of the year and are protected at other times.

Protected - those species listed as wild game, protected wild birds, and endangered species as defined in the Environmental Conservation Law.

Unprotected - species which may be taken at any time without limit; however, a license to take may be required.

Natural Heritage Program State Ranks

S1 - Typically 5 or fewer occurrences, very few remaining individuals, acres, or miles of stream, or some other factor of its biology making it especially vulnerable in New York State.

S2 - Typically 6 to 20 occurrences, few remaining individuals, acres, or miles of stream, or factors demonstrably making it very vulnerable in New York State.

S3 - Typically 21 to 100 occurrences, limited acreage, or miles of stream in New York State.

S4 - Apparently secure in New York State.

S5 - Demonstrably secure in New York State.

SH - Historically known from New York State, but not seen in the past 15 years.

SX - Apparently extirpated from New York State.

SE - Exotic, not native to New York State.

SR - State report only, no verified specimens known from New York State.

SU - Status in New York State is unknown.

NR - Not ranked, usually a hybrid species.

NEW YORK STATE BREEDING BIRD ATLAS
KEY TO BREEDING EVIDENCE

CODE DEFINITION OF CRITERIA

Possible Breeding

X1 Species observed in possible nesting habitat but no other indication of breeding noted, or singing male(s) present (or breeding calls heard), in breeding season (based upon one visit).

Probable Breeding

P2 Pair observed in suitable habitat in breeding season.

S2 Singing male present (or breeding calls heard) on more than one date in the same place.

T2 Bird (or pair) apparently holding territory.

D2 Courtship and display, agitated behavior or anxiety calls from adults suggesting probable presence nearby of a nest or young; well-developed brood-patch or cloacal protuberance on trapped adult. Includes copulation.

N2 Visiting probable nest site. Nest building by wrens and woodpeckers.

B2 Nest building or excavation of a nest hole.

Confirmed Breeding

DD Distraction display or injury-feigning.

UN Used nest found.

FE Female with egg in the oviduct.

FL Recently fledged young (including downy young of precocial species - waterfowl, shorebirds).

ON Adult(s) entering or leaving nest site in circumstances indicating occupied nest.

FS Adult carrying fecal sac.

FY Adult(s) with food for young.

NE Identifiable nest and eggs, bird setting on nest or eggs, identifiable eggshells found beneath nest, or identifiable dead nestling(s).

NY Nest with young.

United States Department of the Interior

FISH AND WILDLIFE SERVICE

3817 Luker Road
Cortland, New York 13045

June 4, 1997

Ms. Barbara C. Reuter
The Environmental Collaborative
309 Palmer Drive
Fayetteville, NY 13066

Dear Ms. Reuter:

This responds to your letter of May 23, 1997, requesting information on the presence of endangered or threatened species in the vicinity of the Old Cortland County Landfill in the Towns of Cortlandville and Solon, Cortland County, New York. The information will be used in an evaluation of ecological conditions at the landfill as part of the Remedial Investigation/Feasibility Study.

Except for occasional transient individuals, no Federally listed or proposed endangered or threatened species under our jurisdiction are known to exist in the project impact area. Therefore, no Biological Assessment or further Section 7 consultation under the Endangered Species Act (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.) is required with the U.S. Fish and Wildlife Service (Service). Should project plans change, or if additional information on listed or proposed species becomes available, this determination may be reconsidered. A compilation of Federally listed and proposed endangered and threatened species in New York is enclosed for your information.

The above comments pertaining to endangered species under our jurisdiction are provided pursuant to the Endangered Species Act. This response does not preclude additional Service comments under the Fish and Wildlife Coordination Act or other legislation.

For additional information on fish and wildlife resources or State-listed species, we suggest you contact:

New York State Department of
Environmental Conservation
Region 7
1285 Fisher Avenue
Cortland, NY 13045-1090
(607) 753-3095

New York State Department of
Environmental Conservation
Wildlife Resources Center - Information Serv.
New York Natural Heritage Program
700 Troy-Schenectady Road
Latham, NY 12110-2400
(518) 783-3932

The National Wetlands Inventory (NWI) map of the Truxton Quadrangle is available and may show wetlands in the project vicinity. However, while the NWI maps are reasonably accurate, they should not be used in lieu of field surveys for determining the presence of wetlands or delineating wetland boundaries for Federal regulatory purposes.

Work in certain waters and wetlands of the United States may require a permit from the U.S. Army Corps of Engineers (Corps). If a permit is required, in reviewing the application pursuant to the Fish and Wildlife Coordination Act, the Service may concur, with or without stipulations, or recommend denial of the permit depending upon the potential adverse impacts on fish and wildlife resources associated with project implementation. The need for a Corps permit may be determined by contacting Mr. Paul Leuchner, Chief, Regulatory Branch, U.S. Army Corps of Engineers, 1776 Niagara Street, Buffalo, NY 14207 (telephone: [716] 879-4321).

If you require additional information please contact Michael Stoll at (607) 753-9334.

Sincerely,

Mark W. Clough
ACTING FOR

Sherry W. Morgan
Field Supervisor

Enclosure

cc: NYSDEC, Cortland, NY (Compliance Services)
NYSDEC, Latham, NY
COE, Buffalo, NY

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN NEW YORK

Common Name	Scientific Name	Status	Distribution
FISHES			
Sturgeon, shortnose*	*Acipenser brevirostrum*	E	Hudson River & other Atlantic coastal rivers
REPTILES			
Turtle, bog	*Clemmys muhlenbergii*	PT	Albany, Columbia, Dutchess, Genesee, Orange, Oswego, Putnam, Seneca, Ulster, Wayne, and Westchester Counties
Turtle, green*	*Chelonia mydas*	T	Oceanic summer visitor coastal waters
Turtle, hawksbill*	*Eretmochelys imbricata*	E	Oceanic summer visitor coastal waters
Turtle, leatherback*	*Dermochelys coriacea*	E	Oceanic summer resident coastal waters
Turtle, loggerhead*	*Caretta caretta*	T	Oceanic summer resident coastal waters
Turtle, Atlantic ridley*	*Lepidochelys kempii*	E	Oceanic summer resident coastal waters
BIRDS			
Eagle, bald	*Haliaeetus leucocephalus*	T	Entire state
Falcon, peregrine	*Falco peregrinus*	E	Entire state - re-establishment to former breeding range in progress
Plover, piping	*Charadrius melodus*	E T	Great Lakes Watershed Remainder of coastal New York
Tern, roseate	*Sterna dougallii dougallii*	E	Southeastern coastal portions of state
MAMMALS			
Bat, Indiana	*Myotis sodalis*	E	Entire state
Cougar, eastern	*Felis concolor couguar*	E	Entire state - probably extinct
Whale, blue*	*Balaenoptera musculus*	E	Oceanic
Whale, finback*	*Balaenoptera physalus*	E	Oceanic
Whale, humpback*	*Megaptera novaeangliae*	E	Oceanic
Whale, right*	*Eubalaena glacialis*	E	Oceanic
Whale, sei*	*Balaenoptera borealis*	E	Oceanic
Whale, sperm*	*Physeter catodon*	E	Oceanic
MOLLUSKS			
Snail, Chittenango ovate amber	*Succinea chittenangoensis*	T	Madison County
Mussel, dwarf wedge	*Alasmidonta heterodon*	E	Orange County - lower Neversink River

* Except for sea turtle nesting habitat, principal responsibility for these species is vested with the National Marine Fisheries Service.

FEDERALLY LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES IN NEW YORK (Cont'd)

Common Name	Scientific Name	Status	Distribution
BUTTERFLIES			
Butterfly, Karner blue	*Lycaeides melissa samuelis*	E	Albany, Saratoga, Warren, and Schenectady Counties
PLANTS			
Monkshood, northern wild	*Aconitum noveboracense*	T	Ulster, Sullivan, and Delaware Counties
Pogonia, small whorled	*Isotria medeoloides*	T	Entire state
Swamp pink	*Helonias bullata*	T	Staten Island - presumed extirpated
Gerardia, sandplain	*Agalinis acuta*	E	Nassau and Suffolk Counties
Fern, American hart's-tongue	*Asplenium scolopendrium* var. *americana*	T	Onondaga and Madison Counties
Orchid, eastern prairie fringed	*Platanthera leucophea*	T	Not relocated in New York
Bulrush, northeastern	*Scirpus ancistrochaetus*	E	Not relocated in New York
Roseroot, Leedy's	*Sedum integrifolium* ssp. *Leedyi*	T	West shore of Seneca Lake
Amaranth, seabeach	*Amaranthus pumilus*	T	Atlantic coastal plain beaches
Goldenrod, Houghton's	*Solidago houghtonii*	T	Genesee County

E=endangered T=threatened P=proposed

APPENDIX J

BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT OF THE OLD CORTLAND COUNTY LANDFILL (Subcontractor Report)

McLaren Hart, Inc.

January 30, 1998

Mark J. Chauvin
Barton & Loguidice, P.C.
290 Elwood Davis Road
Syracuse, NY 13220

RE: CORTLAND LANDFILL RISK ASSESSMENT

Dear Mark:

Attached is the revised risk assessment for your use. It has been our pleasure producing this document for you. If you have any questions or issues, please give me a call at (908) 647-8111.

Sincerely,

Charles R. Harman, P.W.S.
Supervising Environmental Scientist

BASELINE HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT OF THE OLD CORTLAND COUNTY LANDFILL

Submitted to:

Barton & Loguidice, P.C.
290 Elwood David Rd.
Box 3107
Syracuse, NY 13220

Proposal No. AB97-0031

January 1998

Prepared by:

McLaren/Hart, Inc.
25 Independence Boulevard
Warren, New Jersey 07059
(908) 647-8111

(G:\CLIENTS\CHEMRISK\CORTLAND\Eco\NEWERA.WPD)

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LIST OF TABLES

LIST OF ACRONYMS

AF	Adherence Factor
AT	Averaging Time
AVS	Acid Volatile Sulfide
BOD	Biochemical Oxygen Demand
BW	Body Weight
C & D	construction and demolition debris
CEC	Cation Exchange Capacity
COD	Chemical Oxygen Demand
COPCs	Chemicals of Potential Concern
COPECs	Chemicals of Potential Ecological Concern
CSFs	Cancer Slope Factors
CSM	Conceptual Site Model
DO	Dissolved Oxygen
EC_{50}	Effective Concentration for 50%
ED	Exposure Duration
EF	Exposure Frequency
Eh	Eh-Redox Potential
EqP	Equilibrium Partitioning
EPC	Exposure Point Concentration
EPT	Ephemeroptera\Plecoptera\Trichoptera
ER-L	Effects Range-Low
ER-M	Effects Range-Medium
GLWWQI	Great Lakes Water Quality Initiative
HEAST	Health Effects Assessment Summary Table
HI	Hazard Index
HQ	Hazard Quotient
IEUBk	Integrated Exposure Uptake and Biokinetic Model
IRIS	Integrated Risk Information System
K_{ow}	Octanol Water Partitioning Coefficient
LCV	Lowest Chronic Value
LD_{50}	Lethal Dose for 50 % of the population
LEL	Lowest Effect Level
LMS	Linear Multistage Model
LOAEL	Lowest Observed Adverse Effects Levels
LOEC	Lowest Observed Effect Concentration
MOE	Ministry of Environment
NAWQC	National Ambient Water Quality Criteria
NEL	No Effect Level

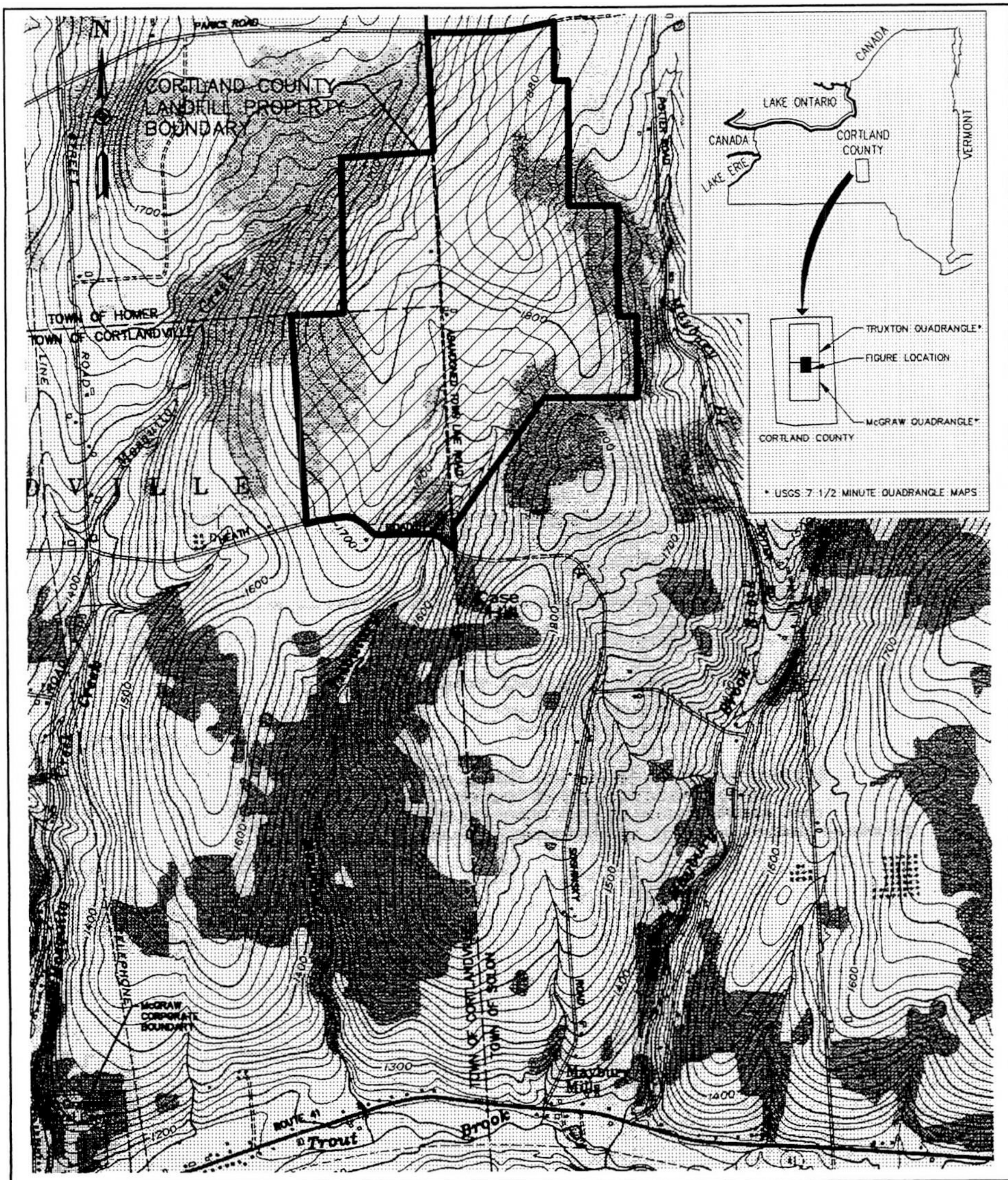
LIST OF ACRONYMS (Continued)

NOAA	National Oceanic and Atmospheric Association
NOAEL	No Observed Adverse Effects Levels
NOEC	No Observed Effect Concentration
NYSDEC	New York State Department of Environmental Conservation
ORNL	Oak Ridge National Laboratory
PC	Permeability Constant
PCBs	Polychlorinated Biphenyls
RAF	Relative Absorption Factor
RBCs	Risk-Based Concentrations
RFDs	Reference Doses
RfC	Reference Concentration
RI/FS	Remedial Investigation/Feasibility Study
RME	Reasonable Maximum Exposure
SA	Surface Area
SEL	Severe Effects Level
SEM	Simultaneously Extracted Metals
SCV	Secondary Chronic Value
SLC	Screening Level Concentrations
SQG	Sediment Quality Guidelines
SQL	Sample Quantitation Limit
SVOCs	Semivolatile Organic Compounds
SWQSs	Surface Water Quality Standards
TAL	Target Analyte List
TCL	Target Compound List
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TOC	Total Organic Carbon
UCL	Upper Confidence Limit
USEPA	United States Environmental Protection Agency
VOCs	Volatile Organic Compounds
WI DNR SQC	Wisconsin Department of Natural Resources Sediment Quality Criteria

1.0 INTRODUCTION

ChemRisk, a service of McLaren/Hart, Inc. (McLaren/Hart) has been retained by Barton & Loguidice, P.C. to conduct a Baseline Human Health and Ecological Risk Assessment (HHRA and BERA) for the Old Cortland County Landfill (the Site) located on Town Line Road in the Town of Solon, Cortland County, New York (Figure 1). The risk assessments are conducted to achieve regulatory compliance with NYSDEC requirements for Remedial Investigation/Feasibility Study (RI/FS) activities at a State superfund site. The risk assessments fulfill Task 18 outlined in the *Old Cortland County Landfill Remedial Investigation/Feasibility Study Final Work Plan* (Barton & Loguidice, P.C., 1996).

The purpose of the HHRA and the BERA was to evaluate the potential human health and ecological risks associated with chemical constituents identified at the Site under existing baseline conditions. The Site and adjacent land encompass approximately 539.9 acres owned by Cortland County (Barton & Loguidice, P.C., 1996). The Old Cortland Landfill covers approximately 38 of these acres, while the remainder of the Site includes the abandoned City of Cortland Landfill, the Buckbee-Mears sludge disposal areas, the existing County Landfill, borrow areas, and associated infrastructure. The area includes a variety of habitats including agricultural land, developed land, deciduous forests, shrubs, old fields, plantations, wetlands, ponds, and streams. During RI/FS investigations conducted in August 1997, soil, sediment, surface water, and groundwater samples were collected from several of these areas on the Site (Figure 2 enclosed at the end of this report). A follow-up round of groundwater and surface water samples were collected during October 1997. In addition, surface water had been collected on a quarterly basis from March 1991 to December 1996 at two locations from the unnamed tributary. Biological surveys (i.e., vegetation, benthic macroinvertebrates, fish, mammals, and birds) were also conducted during May, June, and August 1997 by the Environmental Collaborative and Environmental Consulting (Reuter and Slack, 1997). The HHRA and BERA were developed utilizing these data which are presented in detail in Table 1-1.



SOURCE: BARTON & LOGUIDICE, P.C., CONSULTING ENGINEERS

FIGURE 1

SITE LOCATION MAP

OLD CORTLAND COUNTY LANDFILL
REMEDIAL INVESTIGATION
TOWN OF SOLON, CORTLAND COUNTY, NY

McLaren Hart INC.

SCALE: 1" = 2,000' | DATE: 01/29/98

DWG: 92400100 01/29/98

Table 1-1: Data Utilized for the HHRA and BERA

Media	Location [a]	Analysis
Surface Water	Unnamed Tributary: SW-1 and SW-2 [March 1991-December 1996; October 1997] Pond 1: SW-3 [August 1997] Maybury Brook: SW-4 and SW-5 [August 1997]	Volatile Organic Compounds (VOCs)
		Semivolatile Organic Compounds (SVOCs)
		Pesticides/PCBs
		Total and Dissolved Inorganics
		Wet Chemistry: Biochemical Oxygen Demand (BOD), Chloride, Chemical Oxygen Demand (COD), Color, Cr VI, Ammonia, Nitrate, Total Phenol, Sulfate, Alkalinity, Total Dissolved Solids (TDS), Total Kjeldahl Nitrogen (TKN), Total Organic Carbon (TOC), and Hardness
		Physical Parameters: Temperature, pH, Eh-Redox Potential (Eh), Conductivity, Turbidity, and Dissolved Oxygen (DO)
Sediment	Unnamed Tributary: SED-1 and SED-2 Pond 1: SED-3 Maybury Brook: SED-4 and SED-5 Pond 4: SED-6 [August 1997]	Volatile Organic Compounds (VOCs)
		Semivolatile Organic Compounds (SVOCs)
		Pesticides/PCBs
		Total Inorganics
		Wet Chemistry: BOD, Bromide, Chloride, COD, Cr VI, Ammonia, Nitrate, Total Phenol, Sulfate, Alkalinity, TKN, TOC, and Hardness
Soil	Landfill Perimeter: SB-1 and SB-2 [August 1997]	Volatile Organic Compounds (VOCs)
		Semivolatile Organic Compounds (SVOCs)
		Pesticides/PCBs
		Total Inorganics

Media	Location [a]	Analysis
Soil (Cont.)	Landfill Perimeter: SB-1 and SB-2 [August 1997]	Wet Chemistry: BOD, Bromide, Chloride, COD, Cr VI, Ammonia, Nitrate, Total Phenol, Sulfate, Alkalinity, TKN, TOC, and Hardness
Ground-water	Shallow Monitoring Wells: MW-1A DO-2 MW-2A CD-1 MW-4A MW-5A MW-6A MW-7A Deep Monitoring Wells: MW-1B MW-2B MW-3A MW-3B MW-6B D-1 CD-1 [August and October 1997]	Volatile Organic Compounds (VOCs) Semivolatile Organic Compounds (SVOCs) Pesticides/PCBs Total and Dissolved Inorganics Physical Parameters: Temperature, pH, Eh, Conductivity, Turbidity Wet Chemistry: BOD, Bromide, Chloride, COD, Color, Cr VI, Ammonia, Nitrate, Total Phenol, Sulfate, Alkalinity, TDS, TKN, TOC, and Hardness
Biological Surveys	Entire Site Maybury Brook, Unnamed Tributary Settling Ponds, Maybury Brook, Unnamed Tributary Entire Site [May, June, and August 1997]	Vegetation Survey Benthic Macroinvertebrate Survey Fish Survey Mammalian Survey Avian Survey

[a] Sampling locations are presented in Figure 2 enclosed at the end of this report.

The HHRA provides a semi-quantitative risk assessment of the potential human health risk associated with potential exposure to surface water, soil, ground water, and sediment at the Site, under a no-action scenario. The methodology employed is consistent with the *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A* (USEPA, 1989a) and the *Proposal for Baseline Human Health and Ecological Risk Assessment of the Old Cortland County Landfill* (McLaren/Hart, 1997). In accordance with USEPA guidance, requirements for this assessment included the following elements:

- Data evaluation;
- Toxicity Assessment;
- Exposure Assessment; and
- Risk characterization.

The BERA was structured utilizing the standard paradigm for risk assessment as outlined in the *Framework for Ecological Risk Assessments* (USEPA 1992b), *Proposed Guidelines for Ecological Risk Assessment* (1996a), and the *Proposal for Baseline Human Health and Ecological Risk Assessment of the Old Cortland County Landfill* (McLaren/Hart, 1997). The BERA consists of the following elements:

- Ecological Problem Formulation;
- Ecological Exposure Assessment;
- Ecological Effects Assessment; and
- Ecological Risk Characterization.

The BERA begins with a problem formulation phase that defines the contaminant sources, the receiving environment, and the assessment endpoints. Then, for each endpoint, there is an analytical phase consisting of the exposure and effects assessments. The risk characterization then combines the components of the analysis phase.

1.1 OBJECTIVES AND SCOPE

The objectives and scope of the HHRA and BERA are presented in Section 1.1.1 and 1.1.2, respectively.

1.1.1 Human Health Risk Assessment

The objective of the HHRA is to evaluate the potential carcinogenic risk and noncarcinogenic hazards associated with human exposure to the chemicals of potential concern (COPCs) detected in surface water, sediment, soil, and groundwater at the Site.

This assessment was performed in two stages. First, chemicals detected at the Site were compared to the New York Cleanup Criteria to determine the COPCs for this evaluation. Second, based on the future recreational use of the area by both children and adults and the possibility of trespassers at the site, several exposure pathways were identified and the potential carcinogenic risk and noncarcinogenic hazard was estimated for COPCs in each medium.

1.1.2 Baseline Ecological Risk Assessment

The objective of the BERA was to evaluate the likelihood of impacts to aquatic and terrestrial ecological receptors from the chemicals of potential ecological concern (COPECs) associated within the various habitats on the Site. The BERA evaluated those site-related COPECs and assessed the magnitude of potential risks to the ecological resources from contaminated media.

Chemicals which were detected in surface water, sediment, and soils on the Site were screened against ecotoxicological benchmarks to determine COPECs. The nature and magnitude of ecological risk associated with the presence of COPECs measured in various media were then assessed. The biological surveys were utilized to evaluate the actual status of the vegetation, fish, benthic macroinvertebrate, mammalian, and avian communities at the Site. In summary, this BERA will evaluate the potential for adverse impacts to the aquatic receptors including fish and benthic macroinvertebrate communities within Maybury Brook, the Unnamed Tributary, and Ponds 1 and 4; and terrestrial receptors including vegetation and herbivorous wildlife foraging on the Site.

1.2 ENVIRONMENTAL DESCRIPTION

The purpose of the environmental description is to characterize the receiving ecosystem and identify ecological and human receptors which may be adversely impacted by COPCs or COPECs on the Site. This section will briefly describe the aquatic and terrestrial environment and associated ecological resources on the Site. This information is provided in detail in the *Old Cortland County Landfill Closure Project Vegetation and Wildlife Inventory Study* (Reuter and Slack, 1997).

1.2.1 Available Habitat

The Old Cortland Landfill and its surroundings are composed of a variety of habitats which support many wildlife species. The terrestrial habitat is composed of vegetative community types including agricultural fields, old fields, hedgerows, shrub uplands, pine plantations, forests, and wetlands. The specific evaluation of the species composition, structural diversity (i.e., foliage height, spatial distribution, percent cover, age class, species distribution, vegetation layering), and vegetative inventory (i.e., common and scientific name of dominant species) observed on the Site is presented in Reuter and Slack (1997).

The aquatic environment within the County owned property includes the four settlement ponds (Ponds 1 through 4- north to south) and portions of three streams. These streams include Mosquito Creek, Maybury Brook, and the Unnamed Tributary to Trout Brook. Trout Brook and the East Branch of the Tioughnioga River are located within the RI/FS project study area. Of the three streams, the Unnamed Tributary and Maybury Brook (due to its close proximity to the landfill), were investigated during RI/FS activities.

The four settlement ponds, located south of the Old Cortland Landfill, flow to the Unnamed Tributary. At the time of the survey, the Unnamed Tributary was characterized as a fast moving, channelized, shallow, intermittent stream approximately 3 to 8 feet wide, 2 to 6 inches deep (average= 3 inches), with relatively steep banks. By late August surface water flow within the stream was nonexistent, thereby exposing the substrate of slate bedrock and cobbles with some larger rocks. The only water remaining in the tributary during late summer occurs in several small pools.

Maybury Brook is similar to the Unnamed Tributary, although the stream channel is wider in places. During the survey, the stream was 2 to 6 inches deep with only a few deep pools. The source of water to this stream is a wet meadow/emergent wetland in a pasture on a farm at the intersection of Warren Road and Potter Road.

1.2.2 Terrestrial and Aquatic Receptors

Due to the intermixing of a variety of habitats, the Site and surrounding areas support a rich wildlife species community. Much of the area is dominated by common species that are typically associated with edge habitat, small woodlots, and shrubby environments. A total of nineteen species of mammals were observed in the area. Whitetail deer (*Odocoileus virginianus*) and eastern cottontail (*Sylvilagus floridanus*) were particularly common in all portions of the property. Many carnivores (e.g., coyote [*Canis latrans*], dogs [*Canis familiarus*], eastern striped skunk [*Mephitis mephitis*], and raccoons [*Procyon lotor*]), small mammals (e.g., shrews, moles, white-footed mice [*Peromyscus leucopus*], meadow voles [*Microtus pennsylvanicus*], various bats [*Myotis* spp.], etc.), and other rodents (e.g., woodchucks [*Marmota monax*], eastern chipmunks [*Tamias striatus*], eastern gray squirrel [*Sciurus carolinensis*], red squirrel [*Tamiasciurus hudsonicus*], muskrat [*Ondatra zibethica*], and woodland jumping mouse [*Napaeozapus insignis*]) were observed within various habitats.

A total of sixty-six birds were observed on or near the Old Cortland Landfill. The vast majority of species are those that are often found within these habitat types (woodland edges, shrubby fields in upland areas, woodlots, hardwoods, wetlands, ponds) within New York State. Due to the large number of birds observed in this area, the comprehensive list (including common and scientific name) of avifauna are retained in Reuter and Slack (1997).

The aquatic receptors residing in the settling ponds, Unnamed Tributary, or Maybury Brook include fish (e.g., brown bullhead [*Ictalurus nebulsus*], blacknose dace [*Rhinichthys atratulus*], and brook trout [*Salvelinus fontinalis:* found near the confluence with Trout Brook]), benthic macroinvetebrates (See Section 3.2.3.3), amphibians and reptiles. A total of ten species of amphibians and four species of reptiles were observed on or near the Site. Species including red-spotted newt (*Notophthalmus v. viridenscens*), American toad (*Bufo americanus*), northern spring peeper (*Pseudoacris crucifer*), green frog (*Rana clamitans melanota*), common snapping turtle (*Chelydra s. serpentina*), and eastern painted turtle (*Chrysemys picta picta*) were found in the settling ponds. Redback salamanders (*Plethodon cinereus*) was common in the forested habitat, while the northern two-lined salamanders (*Eurycea bislineata*) and northern dusky salamander (*Desmognathus fuscus fuscus*) were observed in the Unnamed Tributary. The eastern garter snake (*Thamnophis s. sirtalis*) and eastern milk snake (*Lampropeltis triangulum triangulum*) were also observed in various undisturbed habitats.

1.3 SOURCES OF POTENTIAL EXPOSURE

The major sources of potential exposure to ecological or human receptors are the sediments, surface water, groundwater, and soils on or surrounding the Old Cortland Landfill. The chemical constituents which may be present in these media could have originated from private (1950s), combined municipal solid waste (mid 1960s to 1987), and/or construction and demolition debris (C & D) (1987-1988) disposal over the last 48 years. During the first couple of years of the County operation, a number of 55-gallon drums were disposed of within a portion of the landfill. These drums reportedly contained liquid and hazardous wastes which had been generated from local industries. An approximate 3-5 acre area south of the landfill was used to dispose of ferrous oxide sludge which had been generated by the Buckbee-Mears Corporation (Barton & Loguidice, P.C., 1996).

Chemical constituents potentially derived from wastes disposed of in the landfill may also be present in the leachate seep identified on the southern side of the landfill. During site walkovers conducted by Barton & Loguidice, P.C. in August 1996 , this seep was identified within the drainage swale at the toe of the slope. The observed seep apparently discharged to the first (northernmost) settlement pond (Pond 1) which eventually discharges to the Unnamed Tributary to Trout Brook. During these walkovers, the leachate directly in the ditch was an orange-brown color, whereas the ponds appear visibly unaffected by this discharge. Additionally, some of the surface water drainage from the site appeared to enter Maybury Brook to the east of the landfill (Barton & Loguidice, P.C., 1996).

Aquatic biota and terrestrial wildlife inhabiting the area may be exposed to chemical constituents found in these surface water bodies. Vegetation and wildlife receptors may also be exposed to chemicals present in surface soils on or near the landfill.

2.0 HUMAN HEALTH RISK ASSESSMENT

2.1 INTRODUCTION

This section evaluates the potential future carcinogenic and noncarcinogenic health risks associated with human exposure to the residual concentrations of chemicals detected in groundwater, surface water, soil, and sediment at the Cortland County Landfill Site (the Site). Potential risks were assessed in accordance with USEPA's *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A* [EPA/540/1-89/002] (USEPA, 1989a). This characterization employed the following four steps in assessing the potential risk associated with the chemicals of potential concern (COPCs) detected in the various media.

- Data Evaluation
- Toxicity Assessment
- Exposure Assessment
- Risk Characterization

This baseline risk assessment focuses on exposure to recreators and trespassers potentially exposed to soil, surface water and sediment at the Site. The assessment also evaluates a hypothetical scenario of off-site residents who would be exposed to groundwater in addition to other media of concern. It should be noted that this hypothetical scenario would require nearby residents to have the opportunity to routinely ingest groundwater on site from within the areas of contamination. This would be the only possible scenario for residents to ingest contaminated groundwater. The RI Report indicates that the existing nearby residents are not within the discharge zone for groundwater flowing beneath (and receiving contaminants from) the landfill due to the apparent pattern of groundwater flow. The estimated elevation of the water table at these residences would suggest that they are actually upgradient from the discharge area where groundwater would flow off site. The RI Report also indicates that groundwater within both the overburden and the bedrock discharges to surface water within close proximity to the landfill, and therefore, does not exhibit the potential to recharge the nearest residential water supplies. Analytical data generated from samples collected at the three nearest residents to the landfill since 1989 have never indicated an impact from the landfill.

2.2 DATA EVALUATION

As presented in Table 1-1, groundwater, surface water, sediment, and soil samples collected during the RI were analyzed for an extensive list of chemicals. The data evaluated in the human health risk assessment include the target compound list (TCL) volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides/poylchlorinated biphenyls (PCBs), and target analyte list (TAL) metals. The analytical data showing detected concentrations of chemicals are presented in Tables 2-1 through 2-7 for each of the media and data groups evaluated. The analytical data were collected and tabulated by Barton & Loguidice, P.C as presented in the RI Report (B&L 1998). Data validation was performed by Enviro Analytics. All the data used in this risk assessment were collected between August and October 1997, except for surface water data at locations SW-1 and SW-2 where historical results from March 1991 through October 1997 were included in the evaluation.

The data were evaluated for use in the risk assessment according to the following criteria:

- Chemicals that were not detected in a data group (example: soil, overburden or bedrock groundwater) were eliminated from further analysis for that group.

- All analytical results reported as detects were used at the reported value. This included estimated ("J" qualified) data.

- For non-detects, one half the sample quantitation limit (SQL) was used as a proxy concentration (rather than using zero or eliminating the data point). In instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group (i.e., unusually high SQL), the maximum detect was used as the proxy value for that non-detect. SQLs were adjusted in the data sets due to the limited number of samples in each group and the presence of low estimated concentrations of chemicals.

Tables 2-1 through 2-7 present, for each data group, the detected constituents; the frequency of detection (ratio of the number of detects to the total number of samples in that group); the maximum and minimum detected values; the arithmetic mean; and the exposure point concentrations (EPC). The EPC is represented by the lesser of the 95 percent upper confidence level (UCL) on the arithmetic mean (assuming a one-tailed distribution) and the maximum detected concentration. A high level of confidence (95 percent) is used to compensate for the uncertainty involved in representing Site conditions with a finite number of samples. To assure that average exposures at the Site are not underestimated, EPCs for each COPC are represented by the 95% UCL of the mean which exceeds the actual average concentration 95 times out of a 100.

2.2.1 Determination of COPCs

The maximum detected concentration of VOC, SVOC, pesticides/PCBs, and metals in soil, groundwater, surface water, soil, and sediment at the Site were compared to the New York State Department of Environmental Conservation (NYSDEC) cleanup criteria for soil, groundwater, surface water, and sediment. The screening criteria are included as the last column on Tables 2-1 through 2-7.

Based upon the comparison to NYSDEC criteria, the following chemicals exceed their respective screening criteria and are summarized as the COPCs identified in each medium. Constituents that were detected in a data group but do not have specific screening criteria, were retained as COPCs. Essential nutrients: calcium and potassium do not have cleanup criteria and were not evaluated further in this assessment. Magnesium and sodium were retained as COPCs only in groundwater when the maximum concentration detected of these metals exceeded the NYSDEC criteria.

COPCs in Surface Water

Surface water data were screened using the NYSDEC Surface Water Criteria from January 1994. Surface water samples were collected at five locations: SW-1 through SW-5. Samples SW-1 and SW-2 were collected at the head of the unnamed tributary, a shallow stream, 2 to 6 inches deep and 3 to 8 feet wide. Sample SW-3 was collected from Pond 1 and represents influx from the landfill. The data from these three locations, SW-1 through SW-3 were grouped together to evaluate potential risk to a trespasser wading through these surface water bodies and are shown in Table 2-1. *The COPCs identified in this data group were: aluminum, arsenic, iron, lead, and manganese.*

Samples SW-4 and SW-5 were collected at Maybury Brook, which is deeper and wider than the unnamed tributary and is surrounded by agricultural land. Maybury Brook was evaluated as a potential location for recreational fishing since it is classified as a Class C (T) stream. The data from these locations were used to assess the potential risk to a recreator and are presented in Table 2-2. *The COPC identified in this data group was aluminum.*

COPCs in Groundwater

The following compounds were identified as preliminary COPCs in groundwater in the RI work plan based upon previous detection during post-closure monitoring at the nearby Pine Tree Landfill between 1992 and 1993: chloroethane, chloroform, chloromethane, cis-1,2-dichloroethene, dichlorofluoromethane, 1,1-dichloroethane, toluene, trans-1,2-dichloroethane, 1,1,1-trichloroethane, trichloroethene, and vinyl chloride.

Current groundwater data at the Site includes data from overburden and bedrock aquifers. A comparison of overburden and bedrock data revealed that wells screened in the overburden zone had higher concentrations and a larger number of chemicals detected. Although it is unlikely that residential wells would be installed in the overburden, both sets of data were used to evaluate hypothetical risk to residents via ingestion and inhalation of volatilized compounds during residential use.

All data were screened using the NYSDEC Groundwater Criteria from January 1994. Upon evaluation of recent data, and screening against applicable criteria, the following compounds were identified as COPCs in the groundwater. Eighteen overburden samples were evaluated and the following COPCs were identified in this group, as shown on Table 2-3: *vinyl chloride, chloroethane, 1,2-dichloroethene (total), 1,1-dichloroethane, benzene, chlorobenzene, ethylbenzene, xylenes, aluminum, antimony, arsenic, barium, beryllium, chromium cobalt, copper, iron, lead, magnesium, manganese, nickel, sodium, vanadium, and zinc*. Sample EB-1, collected from a temporary well installed within the waste mass, was not included in the data set since it was not representative of groundwater areas that would hypothetically be tapped into.

Eleven bedrock samples were evaluated and the following COPCs were identified in this data group, as shown on Table 2-4: *1,2-dichloroethene, 1,1-dichloroethane, benzene, aluminum, antimony, arsenic, barium, cobalt, iron, magnesium, manganese, nickel, sodium, and vanadium*.

In addition, Tables 2-3a and 2-4a represent the overburden and bedrock data using dissolved metal concentrations. The groundwater at the site is most likely not going to be ingested by residents. However in the event that residents consume the on-site groundwater, the water would be filtered at a minimum. Therefore, an evaluation of the dissolved metal concentrations is more appropriate to calculate potential risk from ingestion of groundwater. The COPCs identified in overburden groundwater for dissolved metal data were: *benzene, chloroethane, chlorobenzene, 1,1-dichloroethene, 1,2-dichloroethane, ethylbenzene, vinyl chloride, xylenes, aluminum, antimony, barium, boron, iron, magnesium, manganese, and sodium*. The COPCs identifed in the bedrock groundwater for dissolved metal data were: *benzene, 1,1-dichloroethene, 1,2-dichloroethane, barium, iron, magnesium, manganese, and sodium.*

COPCs in Soil

Composite samples from two soil borings (SB-1 and SB-2) advanced south of the perimeter of the Old County Landfill were evaluated to assess potential exposure to a trespasser at the Site. This is an extremely conservative approach since the soil data used are subsurface (below 2 feet) and not representative of the soil that will be encountered by a trespasser. Generally, subsurface soil data is used to assess the potential for impact to groundwater. However in the absence of surface soil data, a trespasser scenario was evaluated. The data are presented in Table 2-5 and the COPCs identified were: *aluminum, antimony, arsenic, beryllium, boron, iron, lead, nickel, and zinc*. The soil data were screened using the NYSDEC Recommended Cleanup Objectives from June 1995.

COPCs in Sediment

A total of five sediment locations, SED-1 through SED-5, were collected alongside surface water locations SW-1 through SW-5. Additionally SED-6 was collected from a settlement pond adjacent to the Buckbee Mears Disposal Area. The sediment samples were grouped similar to the surface water samples. Samples SED-1, SED-2, SED-3, and SED-6 were used to evaluate exposure to a potential trespasser. The data are presented in Table 2-6 and the COPCs identified were: *acetone, aluminum, arsenic, and barium*.

Samples SED-4 and SED-5 collected along Maybury Brook were used to evaluate potential exposure to a recreator. The data are presented in Table 2-7 and the COPC identified in this data group is *aluminum*, similar to the surface water data group for this receptor. In the absence of sediment criteria appropriate for human health risk evaluation, the sediment data were screened using NYSDEC Recommended Cleanup Objectives for soil from June 1995.

2.3 TOXICITY ASSESSMENT

The quantification of potential risk is ultimately based upon the chemical-specific toxicity criteria for the individual COPCs. These toxicity criteria are represented by carcinogenic slope factors (CSFs) for health effects involving the development of cancer and reference doses (RfDs) for the evaluation of the noncarcinogenic hazards or the likelihood of developing noncancerous health effects as a result of exposure to the COPCs. The toxicity criteria have been developed by USEPA and are presented in USEPA's Integrated Risk Information System (IRIS) database (USEPA, 1998).

For noncarcinogenic COPCs, no observed adverse effects levels (NOAELs) and lowest observed adverse effect levels (LOAELs) derived from both animal and human studies are used by the USEPA to establish chronic RfDs for humans. The USEPA (1989a) defines the chronic RfD...as an estimate (with uncertainty spanning perhaps an order of magnitude or greater) of a daily exposure level for the human population, including sensitive subpopulations, that is likely to be without an appreciable risk of deleterious effects during a lifetime. Uncertainty factors are incorporated into RfDs in an attempt to account for limitations in the quality or quantity of available data. For the purpose of this risk characterization, RfDs established by the USEPA provide the basis for assessing potential noncarcinogenic chronic health risks for receptor populations.

Carcinogenesis is currently considered to be a non-threshold phenomenon by USEPA, *i.e.*, it is assumed that any dose of a carcinogen, no matter how small, presents some degree of risk. Table 2-8 presents the toxicity criteria used to estimate the potential noncarcinogenic and carcinogenic risks associated with the exposure pathways evaluated for this assessment.

Toxicity profiles for each of the COPCs identified in the various media are presented in Appendix C.

2.4 Exposure Assessment for Humans

Exposure pathways describe unique mechanisms by which a population or an individual may be exposed to a chemical. Exposure pathways are determined by environmental conditions, by the potential for the chemical to move from one medium (e.g., soil, water, or, air) to another, and by the general lifestyles and work activities of the potentially exposed population. For an exposure pathway to be complete, each of the following must exist:

- a source and mechanism for chemical release;
- a transport medium (e.g., air, water, consumable fish tissue);
- a point of potential human contact with the medium; and,
- a route of uptake for the chemical at the contact point (e.g., inhalation, ingestion).

2.4.1 Receptor Populations and Exposure Pathways Identified

The receptors evaluated for potential health risks associated with exposure to residual concentrations of chemicals in soil, sediment, groundwater, and surface water at the landfill are the following:

- Adult resident (ingestion of groundwater)
- Child resident (ingestion of groundwater)
- Adult trespasser (incidental ingestion of soil and sediment, dermal contact with soil and sediment, and dermal contact with surface water)
- Adult and child recreator (Dermal contact with surface water and sediment)

A discussion of intake and the exposure parameters used to represent each receptor in estimating this intake is presented below.

2.4.2 Estimation of Intake

The health hazards associated with exposure to a chemical are directly related to the degree of intake. For any route of exposure, intake (I) is the product of exposure (E) and the absorption efficiency or bioavailability (B) of the COPCs associated with this exposure:

$$I = E \times B$$

Although the various exposure parameters may make this equation appear more complex, the mathematical relationship holds true for all exposure routes and is generally expressed as mass of chemical per mass of body weight per day (mg/kg-day). The equations used to calculate intake for each exposure pathway are presented in Table 2-9 along with the pathway-specific exposure parameters.

2.4.2.1 Exposure Parameters

The exposure parameters for the various environmental media, as well as recommendations for exposure frequencies and duration for the various exposure pathways, have been identified or developed in accordance with USEPA risk assessment methodology. Permeability constants (PC) used in estimating dermal intake are chemical-specific default values (USEPA, 1992). USEPA's standard default exposure factors (USEPA, 1991) are used in calculating the pathway-specific intakes where appropriate.

Chemical Concentration in Media (CW or CS)

The potential risks associated with exposure to chemicals in each of the media were calculated using the 95% UCL concentration for each of the COPCs. This concentration is considered to be representative of a reasonable maximum exposure (RME) (USEPA, 1989a). EPCs calculated for COPCs in the various media and data groups are presented in Tables 2-1 through 2-7.

Ingestion Rate (IR)

The default groundwater ingestion rates of 1 liter per day (L/day) for children and 2 L/day for adults were employed. The default soil/sediment ingestion rates of 50 milligrams per day (mg/day) for adults and 100 mg/day for children were used for trespasser and recreator scenarios at the Site.

Relative Absorption Factor (RAF)

The degree to which a chemical is absorbed following exposure accounts for that chemical's bioavailability in the receptor (Paustenbach, 1987). Bioavailability is an important exposure parameter because it represents the amount of chemical that may actually enter the receptor's bloodstream and determines the actual dose (intake) via each route of exposure. Bioavailabilities are reported as the percentage of the applied or administered chemical that is ultimately absorbed into the body. For example, complete dermal absorption of 1 mg of a chemical contained within 100 mg of soil represents a dermal bioavailability of 1%. For exposure via ingestion, the bioavailability of a chemical is often conservatively assumed to be 100% (*i.e.*, RAF is set equal to 1) to account for variabilities in the digestive process. For exposure via dermal contact, RAFs have been developed to estimate dermal uptake of chemicals in sediment based upon the chemical properties of the various classes of chemicals. The dermal absorption factors employed by USEPA Region III have been incorporated into the estimation of uptake via this route of exposure (USEPA, 1995). The absorption factors applied are as follows:

VOCs:	25%
Arsenic:	3.2%
Other Metals:	1%

Adherence Factor (AF)

Adherence of soil to exposed skin is an integral consideration in assessing dermal exposure to contaminated soil and /or sediment. The literature provides a range of soil adherence factors from four studies (Lepow et al., 1975; Roels et al., 1980; QueHee et al., 1985; Driver et al., 1989). In evaluating these studies, the USEPA indicated that each study has some degree of associated uncertainty (USEPA. 1992a). USEPA (1992a) states that the lower end of this range (0.2 mg/cm^2) may be the best value to represent an average over all exposed skin and 1 mg/cm^2 may be a reasonable upper value. This reasonable upper value of 1 mg/cm^2 or 0.01kg/m^2 was used in this analysis. Depending on sediment type, this value may overestimate the amount of sediment that adheres to the skin, since concurrent exposure with surface water may wash the sediment off the skin (USEPA, 1989b)

Skin Surface Area (SA)

The skin surface area assumed to be exposed and in contact with sediment, soil and surface water varies depending on the site, exposure scenario, type of activity, and potentially exposed populations. For this analysis, the surface areas exposed to soils for the adult trespasser, were estimated based upon the average 50th percentile of total body surface area (for adult males and females). A surface area of 4508 cm^2 or 0.4508 m^2 was estimated based upon exposure of the hands (793 cm^2), forearms (1140 cm^2), 50% of the head (570 cm^2), and the lower legs (2005 cm^2). The surface areas exposed to sediment for the adult trespasser and adult recreator were estimated based upon the average 50th percentile of total body surface area (for adult males and females). A surface area of 4985 cm^2 or 0.4985 m^2 was estimated based upon exposure of the hands (793 cm^2), forearms (1140 cm^2), the lower legs (2005 cm^2), and the feet (1047cm^2). Exposed skin surface area in contact with surface water was estimated to be similar to sediment given the shallow nature of the streams which precludes swimming, restricting recreators and trespassers to a wading exposure only.

Exposure Frequency (EF)

As presented in Table 2-9, it is assumed reasonable that adults trespassing will spend no more than 2 days per week for 6 months out of the year (52 days) on the Site premises. This is conservative, in that it assumes that much of the leisure time available to the adult throughout the six months would be spent in this activity. However exposure to surface water and related sediment was estimated to be 32 days (2 days per week for 16 weeks) based on the location of the Site and related seasonal weather.

Recreation activities associated with the Site include fishing at Maybury Brook and the associated surface water body. The fishing season ranges primarily from April to July, therefore, it is estimated that a recreator will spend no more than 2 days per week for a total of 4 months fishing and wading in the stream.

Exposure Duration (ED)

Exposure duration of 30 years, representing a combined duration for the child and adult, was incorporated into the risk estimates for the recreator. This conservatively assumes that children will wade in the stream and continue to fish at the stream when they are adults for a total period of 30 years. Trespassers evaluated were adult with a exposure duration of 30 years.

Body Weight (BW)

USEPA's standard default body weight of 70 kg and 15 kg were employed for the average adult and child body weights, respectively.

Averaging Time (AT)

Averaging time is dependent on the type of toxic effect being assessed. For chronic exposures involving noncarcinogenic effects, intakes are averaged over the period of exposure. Therefore, the averaging time is equal to the exposure duration expressed as days (i.e., ED x 365 days/year). In evaluating carcinogens, intakes are calculated by prorating the total cumulative dose over the entire lifetime, which is considered to be 70 years (i.e., 70 years x 365 days/year for a total of 25550 days). This approach is based on USEPA's adoption of the non threshold mechanism of action for carcinogens which assumes that a high dose of a carcinogen received over a short period of time is equivalent to a corresponding low dose spread over a lifetime (USEPA, 1989a).

2.4.2.2 Fate and Transport of COPCs

The majority of the COPCs identified at the Site are inorganics. Low levels of VOCs were also detected in the groundwater at the Site. VOCs are fairly soluble and characterized by low partition coefficients. Therefore, they are mobile. Both the overburden groundwater and bedrock groundwater data were evaluated separately due to the higher detections of VOCs in the overburden zone and the potential for migration of VOCs from the overburden to the bedrock zone.

Most of the inorganic COPCs identified at the Site are naturally occurring (*eg:* aluminum, magnesium, manganese, iron, and sodium). The inorganic COPCs tend to adsorb to clay and rock particles or from insoluble precipitates especially under the neutral or basic conditions observed at the Site. All of the metals of concern at the Site have predominant valence states of 2 or greater and have a high affinity for adsorption. Given the neutral-basic condition of groundwater (pH ranged from 6.3 to 8.8) and surface water (pH ranged from 7 to 8.1) at the Site, the metals will predominantly remain as complexes with a low probability for leaching and related migration.

2.5 RISK CHARACTERIZATION

As the final step of the risk assessment process, risk characterization is the point at which a scientific interpretation of the assessment is provided. The purpose of risk characterization is to integrate and summarize the information, results, and conclusions presented in the data evaluation, toxicity assessment and exposure assessment. The risk characterization is designed to provide both a quantitative and qualitative evaluation of the potential risks associated with the chemicals and exposure pathways for the Site.

To characterize the potential noncarcinogenic effects, comparisons are made between projected intakes of the COPCs and their associated noncarcinogenic toxicity criteria (*i.e.*, RfDs). The potential carcinogenic risks are characterized as the probability that an individual will develop cancer over a lifetime as a result of exposure to the COPCs detected at the Site. This probability is estimated from the projected chemical intake and the chemical-specific dose-response criteria used to evaluate the carcinogenic potential of the individual chemicals evaluated (*i.e.*, CSFs). Major assumptions, scientific judgement, and to the extent possible, estimates of the uncertainties embodied in the assessment are presented in this section. (USEPA, 1989a)

2.5.1 Risk Characterization Summary for Lead

Lead has been identified as a COPC in surface water (trespasser only), groundwater (overburden data group only), and soil at the Site. Due to the lack of available toxicity criteria (RfDs and CSFs), a quantitative evaluation of the health risks associated with exposure to lead was not performed. The maximum concentrations of lead in each of the media were well below the USEPA's target residential concentration of 400 ppm in soil (USEPA, 1994) which has been developed for a child exposure based on USEPA's Integrated Exposure Uptake and Biokinetic Model (IEUBK) model. This qualitative approach indicated that under the conditions described in these analyses lead is not anticipated to produce unacceptable health risks for the exposure scenarios evaluated.

2.5.2 Noncarcinogenic Risk Characterization

Noncarcinogenic hazards are estimated by dividing calculated chemical intakes for each of the COPCs by their corresponding RfD. The resulting ratio is termed the hazard quotient (HQ). HQs exceeding one are indicative of intake values greater than the reference dose, potentially resulting in noncancerous health effects as a result of that environmental exposure. If more than one exposure pathway is evaluated, HQs are summed across pathways to yield a total hazard. In the event that more than one environmental medium is impacted, the HQs are summed for each of the media evaluated, yielding cumulative hazard indices (HIs) for individual receptor populations.

For the purposes of this assessment, hazards from detected concentrations of COPCs in soil, sediment, surface water, and groundwater were calculated. The intake calculations and summation of these hazards and risk probabilities are presented in Appendix A. The noncarcinogenic risk estimates for the various receptors are as follows:

Resident

As previously indicated, the ingestion of groundwater by residents is a hypothetical scenario. The results of previous investigations indicate that residential wells around the Site are currently not impacted. In addition, the RI Report suggests that off-site residential wells do not have the potential to be impacted due to site groundwater flow patterns and the probability that both overburden and bedrock groundwater discharges to surface water before leaving the site. However, assuming that groundwater at the Site is ingested by residents, the bedrock aquifer would appear to be the most likely source for well construction that would support potable water. It can also be assumed that the groundwater would be filtered prior to consumption. Therefore, filtered (dissolved) metal data from the bedrock is the most representative data set for the evaluation of this hypothetical scenario.

Adult and child residents were evaluated to estimate risk from ingestion of groundwater. The non-carcinogenic HIs calculated ranged from 6.3 to 82.8. The HI of 6.3 represents the most plausible exposure scenario based on the bedrock data group with dissolved metals. The HI of 82.8 represents the worst case exposure based on the overburden data group using unfiltered (total) metals. The elevated HIs were based on the concentration of manganese detected in the groundwater. Tables 2-10 through 2-13 present the calculated HIs for groundwater exposure.

Recreator

Adult and child recreators were assumed to wade in Maybury Brook while fishing. The total noncarcinogenic risk from dermal contact with surface water and sediment and incidental ingestion of sediment was estimated to be 0.002. Table 2-14 presents the calculated risk estimates for this scenario.

Trespasser

Adult trespassers at the Site were assumed to come in contact with soil, sediment, and surface water at the Site. The total noncarcinogenic risk from dermal contact with soil, surface water, and sediment; and incidental ingestion of soil and sediment was estimated to be 0.0017. Table 2-15 presents the calculated risk estimates for this scenario.

2.5.3 Carcinogenic Risk Characterization

Carcinogenic risks are estimated by multiplying the calculated chemical intake for each carcinogen by its corresponding CSF. The result is a chemical-specific lifetime incremental cancer risk. This value represents a conservative upper-bound probability of developing cancer during a 70-year lifetime as a result of exposure to the COPC concentrations in the media evaluated. Within each media, cancer risks associated with multiple pathways of exposure are summed to yield a chemical-specific lifetime incremental cancer risk for the receptor populations identified. In addition, in cases where an individual from a given scenario could be exposed to multiple chemicals in one media, chemical-specific total risks are also summed to yield a total media-specific risk estimate.

Cancer risks are summed regardless of differences in target organ, weight-of-evidence for human carcinogenicity, or potential chemical interactions (e.g., antagonistic or synergistic effects). This approach is consistent with USEPA's current approach to carcinogenic effects, which is to assume effects are additive unless adequate information to the contrary is available (USEPA, 1989a).

Carcinogenic risk estimates for the various receptors are as follows:

Resident

The total risk estimates calculated for adult and child residents ingesting groundwater ranged from 9×10^{-7} to 2.48×10^{-3}. The carcinogenic risk estimate for the ingestion of bedrock groundwater represented by dissolved metals, the most representative data group, is 9×10^{-7}. Tables 2-10 through 2-13 present the calculated risk estimates for this scenario.

Recreator

Adult and child recreators were assumed to wade in Maybury Brook while fishing. Aluminum was the only COPC identified in both surface water and sediment that would be encountered by a recreator. Aluminum is not a carcinogen; therefore there is no carcinogenic risk to recreators exposed to surface water and sediment along Maybury Brook. Table 2-14 indicates that cancer risk estimates are not applicable.

Trespasser

Adult trespassers at the Site were assumed to come in contact with soil, sediment, and surface water at the Site. The total carcinogenic risk to an adult recreator from dermal contact with soil, surface water, and sediment; and incidental ingestion of soil and sediment was estimated to be 1.93×10^{-6}. Table 2-15 presents the calculated risk estimates for this scenario.

2.5.4 Risk Perspective at the Cortland Landfill Site

The significance of the potential risks estimated for this Site were evaluated by comparing the calculated risks to established target levels or acceptable risk benchmarks. Federal agencies have adopted human health risk benchmarks that have been deemed acceptable based on several factors, notably the benefits of the chemical being regulated, the ability to avoid risk from other sources and the cost factors involved in reducing that risk. The target hazard level for noncarcinogenic effects is an overall HI of 1. For risks associated with developing cancer, USEPA guidelines suggest that the total incremental carcinogenic risk for an individual resulting from multiple-pathway exposures should not exceed a range of 10^{-6} to 10^{-4} (USEPA, 1989a).

The hazard estimates and risk probabilities identified for the trespasser and recreator exposure to soil, sediment, and surface water are less than USEPA's target HQ benchmark of 1 for noncarcinogenic effects, nor do they exceed USEPA's acceptable risk range of a 1×10^{-6} to 1×10^{-4} chance of developing cancer.

Ingestion of groundwater at the Site by off-site residents is currently incomplete and unlikely in the future but was evaluated as a hypothetical scenario. Groundwater exposure was evaluated using four data groups: bedrock data for dissolved metals; bedrock data for total metals; overburden data for dissolved metals; and overburden data for dissolved metals. Filtered metal data from the bedrock aquifer is the most representative data set for the evaluation of this hypothetical scenario. Carcinogenic risk estimates based on this data group indicated an acceptable level of risk. The calculated non-carcinogenic HI, however, based on this data group, 6.3, exceeded the USEPA target level of 1. The noncarcinogenic risks in groundwater were based on the concentrations of manganese reported in the wells. Manganese is a naturally occurring metal. Background concentrations of manganese in soil range from 50 to 5000 ppm in Eastern United States (NYSDEC, 1994a). The highest concentration of manganese detected in soil at the Site was nearer to the low end of this range at 611 ppm and the corresponding highest concentration detected in groundwater was 35.7 ppm (total manganese in the overburden data group). The highest concentration of dissolved manganese detected in bedrock groundwater (the most plausible scenario for hypothetical groundwater ingestion) was 8.07 ppm. These concentrations are orders of magnitude greater than the NYSDEC Groundwater Criteria of 0.3 ppm, Federal Secondary Maximum Contaminant Level (MCL) of 0.05 ppm and the Region III Risk-Based Concentration (RBC) of 0.840 ppm (USEPA, 1997) for manganese.

Elevated dissolved manganese concentrations do not persist for great distance beyond the immediate perimeter of the landfill. Therefore, manganese does not exhibit high solubility at the site despite its presence in a soluble form. In other words, dissolved manganese concentrations rapidly decrease as groundwater migrates away from the landfill due to a greater affinity to become bound to soil particles or bedrock surfaces or otherwise attenuated. The significance of this condition confirms that the manganese concentrations at the landfill perimeter are elevated due to the continuous generation of leachate in the landfill. The landfill will be capped prior to closure. This will ensure that future surface water infiltration and direct exposure to soil and related vapors are eliminated at the Site. The elimination of surface water infiltration will further ensure the eventual elimination of continued leachate generation. The absence of a continuous attenuation to reduce manganese levels to within State standards. Moreover, residential exposure to groundwater is a hypothetical scenario and is unlikely to be a true exposure pathway in the future.

2.5.5 Qualitative Uncertainty Analyses

While risk estimates calculated using quantitative risk assessment methodologies offer plausible estimates of the upper bound of risk, such estimates are not actual predictions of risk, because of the numerous conservative assumptions upon which they are based. Conservative assumptions regarding chemical toxicity, Site characteristics, and human exposure potential are applied such that any uncertainty in the risk assessment process will be likely to over estimate rather than underestimate potential risks. Thus, the estimated risk must be evaluated in conjunction with the uncertainties and assumptions in the risk assessment, in order to understand the true meaning of the estimated risk.

Some assumptions are based on defensible scientific research, while others are less justifiable. Clearly, assumptions based on strong scientific evidence contribute relatively little uncertainty to the process, while assumptions with weaker scientific bases contribute much greater uncertainty to the overall assessment. Assumptions with relatively weak scientific basis are addressed through the adoption of conservative estimates for various exposure and toxicity criteria. Some of the assumptions which introduce uncertainty to this risk assessment are described below.

2.5.5.1 Representative Chemical and Exposure Point Concentrations

A major assumption incorporated into this assessment involves the determination of representative exposure point concentrations for each of the COPCs. The use of the 95% UCL concentrations for the COPCs evaluated provides for a conservative estimate of risk associated with exposure to that chemical within a given media. It is very unlikely that an individual would be continually exposed to such a high concentration of a given chemical. Therefore, this approach is likely to overestimate the potential risk associated with exposure to the individual COPCs identified for the Site.

2.5.5.2 Environmental Fate and Transport

Migration and dilution of chemicals in surface water and sediment present additional sources of uncertainty in the risk assessment. While it is improbable that any of the COPCs are completely resistant to degradation, the chemical reactions which cause degradation are sufficiently complex as to disallow calculation of chemical- and site-specific degradation rates. Consequently, exposure point concentrations do not account for natural attenuation over time.

2.5 5.3 Exposure Assumptions

Several conservative assumptions relating to the exposure assessment may not, in fact, reflect actual conditions at this Site; as a result, levels of chemical intake are likely overestimated. For example, some of the exposure pathways evaluated may not be complete (e.g.; the groundwater exposure pathway). That is, exposure is not possible in the absence of any one of the following four elements: (a) source and mechanism of chemical release to the environment; (b) an environmental transport medium; (c) a point of potential human contact with that medium; and (d) a human contact route at the contact point.

In addition, several conservative assumptions regarding human behavior have been incorporated into the exposure assessment (fishing at a given stream 32 days in a year for 30 years). Finally, the exposure scenarios developed for this risk assessment do not account for exposure to chemicals not related to the Site. Rather, it was assumed that exposure to non-site-related chemicals is insignificant relative to exposure to site-related chemicals. Acceptable risk benchmark values were not adjusted to allow for exposures to chemicals originating off-site.

2.5.5.4 Noncarcinogenic Health Effects

In addition to the uncertainty inherent in the derivation of NOAELs and LOAELs, development of noncarcinogenic health criteria involves route-to-route extrapolation, use of subchronic studies to derive chronic health criteria, and differences in sensitivity between individuals within the exposed population. In an effort to compensate for these uncertainties in a health protective manner, safety or modifying factors are applied by USEPA to the NOAELs selected for derivation of the RfD. Application of these uncertainty factors may be overly protective by several orders of magnitude.

For many compounds, animal studies provide the only reliable information on which to base an estimate of adverse human health effects. The practice of extrapolating effects observed in experimental animals to predict human toxic response to chemicals incorporates a number of conservative assumptions and safety factors. As a result, health effects in humans are likely overestimated, rather than underestimated, introducing additional uncertainty into the development of the RfD. For example, among the safety factors often incorporated into the development of RfDs, a factor of 10 is generally used to account for the presumed greater sensitivity of humans to chemicals; relative to laboratory animals. In fact, the opposite may be true for some chemicals; laboratory animals may be more sensitive than humans to some chemicals.

Extrapolation from high to low doses also adds considerable uncertainty to the development of RfDs, and hence, risk assessments. The concentrations of chemicals to which people are exposed in the environment are usually much lower (sometimes by several of orders of magnitude) than concentrations used in studies from which dose-response relationships have been developed. Predicting effects, therefore, often requires the use of models containing assumptions that allow for extrapolation of effects from high to low doses. A great uncertainty in any risk assessment process involves the characterization of human health effects based on studies performed in rodents.

2.5.5.5 Carcinogenic Health Risks

Usually, the level of uncertainty is larger for carcinogens than non-carcinogens; because of inherent uncertainties in development of the CSFs. CSFs calculated by USEPA are based on the Linear Multistage (LMS) model, which assumes that risk can be extrapolated in a linear manner from the high doses used in animal bioassays to the low doses characteristic of human environmental exposures. However, use of the LMS model for the determination of CSFs completely ignores the concepts of threshold dose, initiation/promotion, and epigenetic mechanisms of carcinogenesis. As such, CSFs are considered to represent potential risks at the 95 % UCL. The accuracy of risk estimates at low doses predicted by the LMS model is unknown, but the risks associated with low levels of environmental exposure may actually be zero (USEPA, 1986).

In the absence of evidence of synergistic or antagonistic effects of chemical mixtures, the assumption was made, in accordance with USEPA guidance that the effects of chemical mixtures are additive. This assumption, however, does not account for dissimilarities in mechanisms of action. Furthermore, compounds may actually induce different toxic effects in different species or in different systems within a given species.

2.5.6 Summary of Risk Characterization

Exposure to COPCs in surface water, soil, sediment, and groundwater at the Cortland County Landfill Site have been evaluated to determine if the detected concentrations of COPCs in these media pose a potential risk to the human health of residents and local trespassers and recreators. Based on USEPA's benchmark levels of acceptable carcinogenic risk (10^{-6} to 10^{-4}) and a noncarcinogenic hazard index of 1, the COPCs identified in surface water, sediment and soil are not associated with an excess health risk or hazard for potential recreators and trespassers.

However the hypothetical (although unlikely) exposure used to evaluate groundwater at the Site, results in elevated hazard quotients for residential ingestion of groundwater. In evaluating these risks, it is important to note that the quantitative assessment of risk incorporates numerous conservative assumptions to compensate for various uncertainties in the actual conditions at the Site. Although some uncertainty is inherent in the calculations of noncarcinogenic hazards and carcinogenic risks, the overwhelming tendency of risk assessment is to err on the side of safety. Therefore, although the estimated hazards and risks calculated for potential exposures at the Site may be viewed as upper-bound estimates, it is likely that actual exposures will result in significantly less risk than those presented in this assessment.

Table 2-1. Data Summary for Surfacewater Samples Used to Evaluate Exposure to a Potential Trespasser, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria Part 703 (mg/L)
Metals					
Aluminum	11 / 14	0.0499 - 0.72	0.27	**0.36**	0.1
Arsenic	6 / 14	0.001 - 0.003	0.0013	**0.0016**	NA
Barium	8 / 14	0.07 - 0.766	0.22	0.31	1
Beryllium	5 / 14	0.00010 - 0.009	0.0061	0.0080	1.1
Boron	4 / 4	0.406 - 1.01	0.71	1	10
Calcium	40 / 40	23 - 96	47	53	NA
Chromium	1 / 14	0.00360	0.0027	0.0034	0.05
Cobalt	1 / 6	0.0019	0.0012	0.0018	0.005
Copper	3 / 14	0.0018 - 0.07	0.014	0.023	0.2
Iron	38 / 40	0.08 - 26	1.4	**2.5**	0.3
Lead	24 / 40	0.001 - 0.055	0.0050	**0.0080**	0.05
Magnesium	40 / 40	5.9 - 36.3	16	18	NA
Manganese	37 / 40	0.02 - 25	1.1	**2.1**	0.3
Nickel	4 / 14	0.0072 - 0.0213	0.015	0.017	0.225
Potassium	39 / 40	2.8 - 31.4	10	12	NA
Sodium	40 / 40	4.1 - 140	50	58	NA
Zinc	11 / 14	0.005 - 0.131	0.031	0.13	0.3

Concentrations are reported in milligrams per liter (mg/L).
Samples collected from Surface Water locations SW-1, SW-2, and SW-3.

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration fo that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.
[box] Evaluated as a Constituent of Potential Concern based on maximum detect exceeding New York State Criteria.
Calcium, magnesium, potassium, and sodium were not evaluated as COPCs as they are essential nutrients.

Table 2-2. Data Summary for Surfacewater Samples Used to Evaluate Exposure to a Potential Recreator at Maybury Brook, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria (Part 703) mg/L
Metals					
Aluminum	4 / 4	0.0416 - 0.188	0.085	**0.17**	0.1
Barium	4 / 4	0.0562 - 0.0743	0.065	0.074	1
Beryllium	3 / 4	0.00010 - 0.00097	0.00041	0.00092	1.1
Boron	4 / 4	0.0161 - 0.026	0.022	0.026	10
Cadmium	2 / 4	0.00047 - 0.0010	0.00044	0.00091	0.010
Calcium	4 / 4	26.1 - 34.4	30	34	NA
Chromium	2 / 4	0.00063 - 0.00080	0.00046	0.00080	0.050
Iron	4 / 4	0.0309 - 0.249	0.1	0.22	0.3
Magnesium	4 / 4	3.65 - 4.41	4	4.4	NA
Manganese	4 / 4	0.0019 - 0.0229	0.012	0.022	0.3
Potassium	3 / 4	0.981 - 1.15	0.82	1.2	NA
Sodium	4 / 4	1.02 - 3.3	2.6	3.3	NA
Zinc	4 / 4	0.0155 - 0.0252	0.018	0.024	0.3

Concentrations are reported in milligrams per liter (mg/L).
Samples collected from Surface Water locations SW-4 and SW-5.

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
[Boxed] Evaluated as a Constituent of Potential Concern based on maximum detect exceeding New York State Criteria.
Calcium, magnesium, potassium, and sodium were not evaluated as COPCs as they are essential nutrients.

Table 2-3. Data Summary for Overburden Groundwater Samples, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria June 1995 (mg/L)
VOCs					
Vinyl Chloride	2 / 16	0.002 - 0.005	0.0048	**0.0050**	0.0020
Chloroethane	4 / 16	0.001 - 0.005	0.0044	**0.0050**	0.0050
Acetone	1 / 16	0.01 - 0.01	0.0053	0.0059	0.05
1,2-Dichloroethene (Total)	2 / 16	0.001 - 0.002	0.0019	**0.0020**	NA
1,1-Dichloroethane	3 / 16	0.001 - 0.004	0.0036	**0.0040**	NA
Benzene	2 / 16	0.005 - 0.006	0.0051	**0.0052**	0.0007
Chlorobenzene	1 / 16	0.005	0.005	**0.0050**	0.0050
Ethylbenzene	2 / 16	0.002 - 0.005	0.0048	**0.0050**	0.0050
Xylenes (total)	2 / 16	0.001 - 0.005	0.0048	**0.0050**	NA
SVOCs					
Diethylphthalate	2 / 16	0.001 - 0.001	0.001	0.0010	0.050
di-n-Butylphthalate	1 / 16	0.00100	0.001	0.0010	0.050
Bis(2-ethylhexyl)phthalate	4 / 16	0.001 - 0.003	0.0028	0.0030	0.050
Metals					
Aluminum	16 / 16	0.228 - 724	79	**160**	0.05
Antimony	5 / 16	0.003 - 0.0049	0.0023	**0.0029**	0.003
Arsenic	13 / 16	0.0034 - 0.353	0.045	**0.082**	0.025
Barium	16 / 16	0.258 - 8.11	1.5	**2.3**	1
Beryllium	15 / 16	0.0001 - 0.0287	0.0032	**0.0063**	0.003
Boron	16 / 16	0.021 - 1.21	0.26	0.41	1
Cadmium	8 / 16	0.0004 - 0.0042	0.00084	0.0013	0.01
Calcium	16 / 16	32.1 - 430	140	180	NA
Chromium	15 / 16	0.00093 - 1.07	0.12	**0.23**	0.05
Cobalt	15 / 16	0.0035 - 0.59	0.068	**0.13**	NA
Copper	16 / 16	0.0037 - 0.996	0.12	**0.22**	0.20
Iron	16 / 16	0.46 - 1550	160	**330**	0.3
Lead	15 / 16	0.0024 - 0.454	0.05	**0.098**	0.025
Magnesium	16 / 16	9.45 - 309	52	**84**	35
Manganese	16 / 16	0.0661 - 35.7	9.7	**15**	0.3

Table 2-3. Data Summary for Overburden Groundwater Samples, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria June 1995 (mg/L)
Metals (continued)					
Mercury	1 / 16	0.0014	0.00013	0.00028	0.002
Nickel	15 / 16	0.0044 - 1.33	0.15	**0.29**	NA
Potassium	16 / 16	0.897 - 77.5	13	21	NA
Selenium	4 / 16	0.0033 - 0.0065	0.003	0.0045	0.01
Silver	3 / 16	0.0013 - 0.0024	0.00068	0.00093	0.05
Sodium	16 / 16	5.62 - 119	45	**64**	20
Thallium	1 / 16	0.004	0.0022	0.0035	0.004
Vanadium	16 / 16	0.0012 - 0.856	0.098	**0.19**	NA
Zinc	16 / 16	0.0212 - 3.36	0.38	**0.74**	0.3

Concentrations are reported in milligrams per liter (mg/L).

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.

Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.

NA Not available.

SQLs Practical sample quantitation limits for the non-detects.

One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.

[box] Evaluated as a Constituent of Potential Concern based on maximum detect excedding New York State Criteria.

Calcium and potassium were not evaluated as a COPCs as they are essential nutrients.

Table 2-3a. Data Summary for Overburden Groundwater Samples Including Dissolved Metals, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria June 1995 (mg/L)
VOCs					
Vinyl Chloride	2 / 16	0.002 - 0.005	0.0048	**0.0050**	0.0020
Chloroethane	4 / 16	0.001 - 0.005	0.0044	**0.0050**	0.0050
Acetone	1 / 16	0.01 - 0.01	0.0053	0.0059	0.05
1,2-Dichloroethene (Total)	2 / 16	0.001 - 0.002	0.0019	**0.0020**	NA
1,1-Dichloroethane	3 / 16	0.001 - 0.004	0.0036	**0.0040**	NA
Benzene	2 / 16	0.005 - 0.006	0.0051	**0.0052**	0.0007
Chlorobenzene	1 / 16	0.005	0.005	**0.0050**	0.0050
Ethylbenzene	2 / 16	0.002 - 0.005	0.0048	**0.0050**	0.0050
Xylenes (total)	2 / 16	0.001 - 0.005	0.0048	**0.0050**	NA
SVOCs					
Diethylphthalate	2 / 16	0.001 - 0.001	0.001	0.0010	0.050
di-n-Butylphthalate	1 / 16	0.00100	0.001	0.0010	0.050
Bis(2-ethylhexyl)phthalate	4 / 16	0.001 - 0.003	0.0028	0.0030	0.050
Metals (dissolved)					
Aluminum	12 / 16	0.0142 - 0.0755	0.026	**0.035**	0.05
Antimony	1 / 16	0.0059 - 0.0059	0.0018	**0.0023**	0.003
Barium	16 / 16	0.0649 - 1.06	0.51	**0.67**	1
Boron	16 / 16	0.016 - 1.21	0.25	**0.41**	1
Iron	16 / 16	0.005 - 11.5	2.1	**3.8**	0.3
Magnesium	16 / 16	8.69 - 59.9	23	**31**	35
Manganese	16 / 16	0.0059 - 30.9	6.5	**11**	0.3
Sodium	16 / 16	5.44 - 129	49	**70**	20

Concentrations are reported in milligrams per liter (mg/L).

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.
[box] Evaluated as a Constituent of Potential Concern based on maximum detect excedding New York State Criteria..
Calcium and potassium were not evaluated as a COPCs as they are essential nutrients.

Table 2-4. Data Summary for Bedrock Groundwater Samples, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria June 1995 (mg/L)
VOCs					
Chloroethane	2 / 14	0.003 - 0.004	0.0039	0.0040	0.0050
1,2-Dichloroethene (Total)	1 / 14	0.001	0.001	**0.0010**	NA
1,1-Dichloroethane	2 / 14	0.001 - 0.001	0.001	**0.0010**	NA
Benzene	2 / 14	0.002 - 0.002	0.002	**0.0020**	0.0007
Chlorobenzene	1 / 14	0.001	0.001	0.0010	0.0050
Ethylbenzene	1 / 14	0.001	0.001	0.0010	0.0050
SVOCs					
di-n-Butylphthalate	1 / 14	0.001	0.001	0.0010	0.050
Bis(2-ethylhexyl)phthalate	3 / 14	0.001 - 0.01	0.0051	0.006	0.050
Metals					
Aluminum	13 / 14	0.0521 - 21.7	3.5	**6.3**	0.05
Antimony	3 / 14	0.00350	0.0019	**0.0023**	0.003
Arsenic	7 / 14	0.0032 - 0.0127	0.0044	**0.0062**	0.025
Barium	14 / 14	0.154 - 1.59	0.48	**0.69**	1
Beryllium	10 / 14	0.0001 - 0.0011	0.00028	0.00044	0.003
Boron	14 / 14	0.0197 - 0.355	0.13	0.19	1
Chromium	10 / 14	0.0017 - 0.0249	0.005	0.0081	0.05
Cobalt	9 / 14	0.0014 - 0.0141	0.0047	**0.007**	NA
Copper	14 / 14	0.0018 - 0.0315	0.0079	0.0110	0.2
Iron	14 / 14	0.0977 - 26.6	5.4	**8.8**	0.3
Lead	8 / 14	0.0013 - 0.0077	0.0025	0.0036	0.025
Magnesium	14 / 14	4.97 - 61.7	18	**27**	35
Manganese	14 / 14	0.0245 - 8.24	1.8	**3.2**	0.3

Table 2-4. Data Summary for Bedrock Groundwater Samples, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria June 1995 (mg/L)
Metals (continued)					
Nickel	9 / 14	0.0018 - 0.0248	0.0071	**0.011**	NA
Potassium	14 / 14	0.529 - 7.43	2.4	3.2	NA
Sodium	14 / 14	4.76 - 64.1	23	**33**	20
Thallium	1 / 14	0.0037	0.0015	0.0018	0.004
Vanadium	8 / 14	0.0012 - 0.0296	0.0049	**0.0086**	NA
Zinc	14 / 14	0.0155 - 0.112	0.047	0.062	0.3

Concentrations are reported in milligrams per liter (mg/L).

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.
[Boxed] Evaluated as a Constituent of Potential Concern based on maximum detect exceeding New York State Criteria.
Calcium and potassium were not evaluated as COPCs as they are essential nutrients.

Table 2-4a. Data Summary for Bedrock Groundwater Samples Including Dissolved Metals, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Criteria June 1995 (mg/L)
VOCs					
Chloroethane	2 / 14	0.003 - 0.004	0.0039	0.0040	0.0050
1,2-Dichloroethene (Total)	1 / 14	0.001	0.001	**0.0010**	NA
1,1-Dichloroethane	2 / 14	0.001 - 0.001	0.001	**0.0010**	NA
Benzene	2 / 14	0.002 - 0.002	0.002	**0.0020**	0.0007
Chlorobenzene	1 / 14	0.001	0.001	0.0010	0.0050
Ethylbenzene	1 / 14	0.001	0.001	0.0010	0.0050
SVOCs					
di-n-Butylphthalate	1 / 14	0.001	0.001	0.0010	0.050
Bis(2-ethylhexyl)phthalate	2 / 14	0.001 - 0.006	0.0048	0.0053	0.050
Metals					
Antimony	1 / 14	0.0038	0.0017	**0.002**	0.003
Barium	14 / 14	0.151 - 1.55	0.43	**0.65**	1
Iron	14 / 14	0.0061 - 1.42	0.24	**0.43**	0.3
Magnesium	14 / 14	4.63 - 61.7	18	**27**	35
Manganese	14 / 14	0.0254 - 8.07	1.7	**3.1**	0.3
Sodium	14 / 14	5.29 - 62.8	24	**34**	20

Concentrations are reported in milligrams per liter (mg/L).

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.
[Box] Evaluated as a Constituent of Potential Concern based on maximum detect exceeding New York State Criteria.
Calcium and potassium were not evaluated as COPCs as they are essential nutrients.
Metals data represent only those compounds that exceeded the NYSDEC Criteria.

Table 2-5. Data Summary for Soil Boring and Test Pit Samples, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Recommended Cleanup Objective (ppm)
VOCs					
2-Butanone	1 / 2	0.003 - 0.003	0.003	0.003	0.30
SVOCs					
Diethylphthalate	2 / 2	0.16 - 0.19	0.18	0.19	7.1
Metals					
Aluminum	2 / 2	16200 - 18000	17000	**18000**	NA
Antimony	2 / 2	0.76 - 0.85	0.81	**0.85**	NA
Arsenic	2 / 2	8.6 - 11.2	9.9	**11**	7.5
Barium	2 / 2	174 - 245	210	250	300
Beryllium	2 / 2	0.65 - 0.69	0.67	**0.69**	0.16
Boron	2 / 2	3.3 - 4	3.7	**4**	NA
Calcium	2 / 2	1490 - 1710	1600	1700	NA
Cobalt	2 / 2	11.8 - 15.1	13	15	30
Copper	2 / 2	16 - 22.3	19	22	25
Iron	2 / 2	34000 - 40100	37000	**40000**	2000
Lead	2 / 2	9 - 10.8	9.9	**11**	NA
Magnesium	2 / 2	4870 - 5250	5100	5300	NA
Manganese	2 / 2	593 - 611	600	610	NA
Nickel	2 / 2	29.5 - 33.6	32	**34**	13
Potassium	2 / 2	1410 - 1940	1700	1900	NA
Sodium	2 / 2	136 - 149	140	150	NA
Vanadium	2 / 2	19.3 - 20.7	20	21	150
Zinc	2 / 2	70.2 - 74.8	73	**75**	20

Concentrations are reported in milligrams per kilogram (mg/kg).

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.

Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.

NA Not available.

SQLs Practical sample quantitation limits for the non-detects.

One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.

[box] Evaluated as a Constituent of Potential Concern based on maximum detect exceeding New York State Recommended Criteria.

Calcium, magnesium, potassium, and sodium were not evaluated a COPCs as they are essential nutrients.

Table 2-6. Data Summary for Sediment Samples Used to Evaluate Exposure to a Potential Trespasser, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Recommended Cleanup Objective (ppm)
VOCs					
Acetone	1 / 4	0.29	0.078	**0.240**	0.10
2-Butanone	1 / 4	0.11	0.033	0.094	0.30
Toluene	1 / 4	0.006	0.0059	0.0060	1.50
SVOCs					
4-Methylphenol	1 / 4	0.57	0.33	0.55	0.90
Isophorone	1 / 4	0.039	0.039	0.039	4.4
bis(2-Ethylhexyl)phthalate	2 / 4	0.22 - 0.44	0.26	0.4	50
Metals					
Aluminum	4 / 4	13200 - 22900	19000	**23000**	NA
Arsenic	4 / 4	5.8 - 28.3	16	**27**	7.5
Barium	4 / 4	103 - 815	320	**710**	300

Concentrations are reported in milligrams per kilogram (mg/kg).
Samples collected from Sediment locations SED-1, SED-2, SED-3, and SED-6.

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.

Table 2-7. Data Summary for Sediment Samples Used to Evaluate Exposure to a Potential Recreator at Maybury Brook, Old Cortland County Landfill, Cortland, New York.

Constituent	Frequency Detects / Total	Range of Detects Min - Max	Arithmetic Average	EPC	NY State Recommended Cleanup Objective (ppm)
Metals					
Aluminum	2 / 2	11700 - 13300	13000	**13000**	NA
Arsenic	2 / 2	5.1 - 7.3	6.2	7.3	7.5
Barium	2 / 2	84.3 - 97.7	91	98	300

Concentrations are reported in milligrams per kilogram (mg/kg).
Samples collected from Sediment locations SED-4 and SED-5.

EPC Exposure point concentration; lesser of the UCL and the maximum detected concentration.
Average Arithmetic average of the total number of samples, using proxy concentrations for non-detects.
NA Not available.
SQLs Practical sample quantitation limits for the non-detects.
One-half the SQL is used as a proxy concentration; in instances where one-half the SQL exceeded the maximum detected concentration for that constituent in the data group, the maximum detect was used as the proxy value for the non-detect.

Table 2-8. Toxicity Criteria for COPCs, Old Cortland County Landfill, Cortland, New York.

COPCs	Reference Dose RfDo mg/kg-day	Reference Dose RfDi mg/kg-day	Cancer Slope Factor CSFo $(mg/kg\text{-}day)^{-1}$
VOCs			
Acetone	1.00E-01	NE	NA
Benzene	NA	1.71E-03	2.9E-02
Chlorobenzene	2.00E-02	--	NA
Chloroethane	4.00E-01	--	NA
1,1-Dichlorethane	1.00E-01	--	NA
1,2-Dichloroethene (total)	9.00E-03	NE	NA
Ethylbenzene	1.00E-01	--	NA
Vinyl Chloride	NE	NE	1.90+00
Xylenes (total)	2.00E+00	NE	NA
Inorganics			
Aluminum	1.00E+00	NE	NA
Antimony	4.00E-04	NE	NA
Arsenic	3.00E-04	NE	1.5E+00
Barium	7.00E-02	NE	NA
Beryllium	5.00E-03	NE	4.3E+00
Boron	9.00E-02	NE	NA
Chromium	1.00E+00	--	NA
Cobalt	6.00E-02	NE	NA
Copper	4.00E-02	NE	NA
Iron	3.00E-01	NE	NA
Magnesium	NE	NE	NA
Manganese	2.30E-02	--	NA
Nickel	2.00E-02	NE	NA
Sodium	NE	NE	NA
Vanadium	7.00E-03	NE	NA
Zinc	3.00E-01	NE	NA

RfD_o Reference dose for the oral pathway
RfD_i Reference dose for the inhalation pathway
CSF_o Cancer slope factor for the oral pathway
-- Not presented in this table
NE Not established
NA Not applicable
References: IRIS (1998), EPA Region III RBC Table (8/25/97)

Table 2-9. Exposure Parameters Used in the Exposure Assessment for the Cortland Landfill Site

(A) Resident (adult and child): Ingestion of Groundwater.

Intake (mg/kg-day) = (CW x IR x EF x ED x 1/BW x 1/AT)

Exposure Parameter	Value	Explanation/source
CW= Concentration in groundwater	Chemical-specific (mg/L)	95 % Upper Confidence Limit on the mean or maximum detected concentration
IR = Ingestion rate	1.0 L/day 2.0 L/day	Child (0-6) (USEPA, 1989) Adult (USEPA, 1989)
EF = Exposure Frequency	365 days/year	
ED = Exposure Duration	6 years 24 years	Child exposure (USEPA, 1996) Adult exposure (USEPA, 1996)
BW = Body Weight	15 kg 70 kg	Child (USEPA, 1996) Adult (USEPA, 1996)
AT = Averaging Time	365 days/year x ED 365 days/year x 70 years	Averaging time for non-carcinogens Averaging time for carcinogens (USEPA, 1996)

(B) Trespasser (adult)/Recreator (adult+child): Ingestion of Soil/Sediment

Intake (mg/kg-day) = (CS x IR x RAF x CF x EF x ED x 1/BW x 1/AT)

Exposure Parameter	Value	Explanation/source
CS = Concentration in soil/sediment	Chemical-specific (mg/kg)	95 % Upper Confidence Limit on the mean or maximum detected concentration
IR = Ingestion rate	100 mg/day 50 mg/day	Child (USEPA, 1989) Adult (USEPA, 1989)
RAF = Relative Absorption Factor	1 (100%)	Unitless
CF = Conversion Factor	10^{-6} kg/mg	
EF = Exposure Frequency	52 days/year (soil) 32 days/year (sediment)	2 days/week - 26 weeks 2 days/week- 13 weeks
ED = Exposure Duration	30 years 6 years 24 years	Trespasser-Adult exposure (USEPA, 1996) Recreator-Child exposure (USEPA, 1996) Recreator-Adult exposure (USEPA, 1996)
BW = Body Weight	15 kg 70 kg	Child (USEPA, 1996) Adult (USEPA, 1996)
AT = Averaging Time	365 days/year x ED 365 days/year x 70 years	Averaging time for non-carcinogens Averaging time for carcinogens (USEPA, 1996)

(C)Trespasser (adult): Dermal Contact with Soil/Sediment

Intake (mg/kg-day) = (CS x SA x AF x RAF x CF x EF x ED x 1/BW x 1/AT)

Exposure Parameter	Value	Explanation/source
CS = Concentration in soil/sediment	Chemical-specific (mg/kg)	95 % Upper Confidence Limit on the mean or maximum detected concentration
SA = Skin Surface Area	0.4508 m^2 (soil) 0.4985 m^2 (sediment)	Adult Adult
AF = Adherence Factor	0.01 kg/m^2	(USEPA, 1995)
RAF = Relative Absorption Factor	Chemical-class dependent	Unitless (USEPA, 1995)
CF = Conversion Factor	10^{-6} kg/mg	
EF = Exposure Frequency	52 days/year (soil) 32 days/year (sediment)	2 days/week - 26 weeks 2 days/week - 13 weeks
ED = Exposure Duration	30 years	Adult
BW = Body Weight	70 kg	Adult (USEPA, 1996)
AT = Averaging Time	365 days/year x ED 365 days/year x 70 years	Averaging time for non-carcinogens Averaging time for carcinogens (USEPA, 1996)

(D) Trespassor (adult): Dermal Contact with Surface water.

Intake (mg/kg-day) = (CW x SA x PC x CF x ET x EF x ED x 1/BW x 1/AT)

Exposure Parameter	Value	Explanation/source
CW = Concentration in surface water	Chemical-specific (mg/L)	95 % Upper Confidence Limit on the mean or maximum detected concentration
SA = Skin Surface Area	4985 cm^2	Adult
PC = Permeability Constant	Chemical-specific (cm/hr)	(USEPA, 1995)
CF = Conversion Factor	10^{-3} L/cm^3	
ET = Exposure Time	2 hrs/day	
EF = Exposure Frequency	32 days/year	2 days/week - 16weeks
ED = Exposure Duration	30 years	Adult
BW = Body Weight	70 kg	Adult (USEPA, 1996)
AT = Averaging Time	365 days/year x ED 365 days/year x 70 years	Averaging time for non-carcinogens Averaging time for carcinogens (USEPA, 1996)

(E) Recreator (adult and child): Dermal Contact with Sediment.

Intake (mg/kg-day) = (CS x SA x AF x RAF x CF x EF x ED x 1/BW x 1/AT)

Exposure Parameter	Value	Explanation/source
CW = Concentration in sediment	Chemical-specific (mg/kg)	95 % Upper Confidence Limit on the mean or maximum detected concentration
SA = Skin Surface Area	0.2299 m^2 0.4985 m^2	Child Adult
AF=Adherence Factor	0.01 kg/m^2	(USEPA,1995)
RAF=Relative Absorption Factor	Chemical-class dependent	Unitless (USEPA, 1995)
CF = Conversion Factor	10^{-3} L/cm^3	
EF = Exposure Frequency	32 days/year	2 days/week - 16weeks
ED = Exposure Duration	6 years 24 years	Child Adult
BW = Body Weight	15 kg 70 kg	Child (USEPA, 1996) Adult (USEPA, 1996)
AT = Averaging Time	365 days/year x ED 365 days/year x 70 years	Averaging time for non-carcinogens Averaging time for carcinogens (USEPA, 1996)

(F) Recreator (adult and child): Dermal Contact with Surface water.

Intake (mg/kg-day) = (CW x SA x PC x CF x ET x EF x ED x 1/BW x 1/AT)

Exposure Parameter	Value	Explanation/source
CW = Concentration in surface water	Chemical-specific (mg/L)	95 % Upper Confidence Limit on the mean or maximum detected concentration
SA = Skin Surface Area	2299 cm^2 4985 cm^2	Child Adult
PC = Permeability Constant	Chemical-specific (cm/hr)	(USEPA, 1995)
CF = Conversion Factor	10^{-3} L/cm^3	
ET = Exposure Time	4 hrs/day	
EF = Exposure Frequency	32 days/year	2 days/week - 16weeks
ED = Exposure Duration	6 years 24 years	Child Adult
BW = Body Weight	15 kg 70 kg	Child (USEPA, 1996) Adult (USEPA, 1996)
AT = Averaging Time	365 days/year x ED 365 days/year x 70 years	Averaging time for non-carcinogens Averaging time for carcinogens (USEPA, 1996)

Table 2-10
Pathway and Total Risk Estimates for Residential
Exposure to Bedrock Ground Water[1]
Cortland Landfill

	ADJACENT RESIDENT Child (1 - 6 years)	Adult (>18 years)	Total (child + adult)
CARCINOGENIC RISK :			
Ground Water Ingestion	**3.31E-07**	**5.68E-07**	**9.00E-07**
NONCARCINOGENIC HAZARD:			
Ground Water Ingestion	**1.16E+01**	**4.99E+00**	**6.32E+00**

[1] EPCs for inorganics represent dissolved fraction

Table 2-11
Pathway and Total Risk Estimates for Residential
Exposure to Bedrock Ground Water[1]
Cortland Landfill

	ADJACENT RESIDENT Child (1 - 6 years)	Adult (>18 years)	Total (child + adult)
CARCINOGENIC RISK :			
Ground Water Ingestion	**5.35E-05**	**9.17E-05**	**1.45E-04**
NONCARCINOGENIC HAZARD:			
Ground Water Ingestion	**1.43E+01**	**6.12E+00**	**7.75E+00**

[1] EPCs for inorganics represent total fraction

Table 2-12
Pathway and Total Risk Estimates for Residential
Exposure to Overburden Ground Water[1]
Cortland Landfill

	ADJACENT RESIDENT Child (1 - 6 years)	Adult (>18 years)	Total (child + adult)
CARCINOGENIC RISK :			
Ground Water Ingestion	**5.51E-05**	**9.45E-05**	**1.50E-04**
NONCARCINOGENIC HAZARD:			
Ground Water Ingestion	**3.43E+01**	**1.47E+01**	**1.86E+01**

[1] EPCs for inorganics represent dissolved fraction

Table 2-13
Pathway and Total Risk Estimates for Residential
Exposure to Overburden Ground Water[1]
Cortland Landfill

	ADJACENT RESIDENT Child (1 - 6 years)	Adult (>18 years)	Total (child + adult)
CARCINOGENIC RISK :			
Ground Water Ingestion	**9.13E-04**	**1.56E-03**	**2.48E-03**
NONCARCINOGENIC HAZARD:			
Ground Water Ingestion	**1.52E+02**	**6.53E+01**	**8.28E+01**

[1] EPCs for inorganics represent total fraction

Table 2-14
Pathway and Total Risk Estimates for Recreator
Exposure to Surface Water and Sediment[1]
Old Cortland County Landfill

	RECREATOR Child (1 - 6 years)	Adult (>18 years)	Total (child + adult)
CARCINOGENIC RISK :			
Surface Water Dermal Contact	NA	NA	NA
Sediment Dermal Contact	NA	NA	NA
Sediment Incidental Ingestion	NA	NA	NA
TOTAL CARCINOGENIC RISK:	**NA**	**NA**	**NA**
NONCARCINOGENIC HAZARD:			
Surface Water Dermal Contact	1.46E-06	6.79E-07	8.36E-07
Sediment Dermal Contact	1.75E-07	8.12E-08	9.99E-08
Sediment Incidental Ingestion	7.60E-03	8.14E-04	2.17E-03
TOTAL NONCARCINOGENIC HAZARD:	**7.60E-03**	**8.15E-04**	**2.17E-03**

[1] The only COPC identified for these media and receptor populations is Aluminum.
NA: Not Applicable. Aluminum, the only COPC identified, is not carcinogenic.

Table 2-15
Pathway and Total Risk Estimates for Trespasser
Exposure to Surface Water, Sediment and Soil
Old Cortland County Landfill

	TRESPASSER Adult (30-year exposure)
CARCINOGENIC RISK :	
Surface Water Dermal Contact	2.05E-09
Sediment Dermal Contact	3.47E-12
Sediment Incidental Ingestion	1.09E-06
Soil Dermal Contact	7.65E-11
Soil Incidental Ingestion	8.41E-07
TOTAL CARCINOGENIC RISK:	**1.93E-06**
NONCARCINOGENIC HAZARD:	
Surface Water Dermal Contact	2.11E-04
Sediment Dermal Contact	2.01E-08
Sediment Incidental Ingestion	1.44E-03
Soil Dermal Contact	1.76E-06
Soil Incidental Ingestion	1.58E-02
TOTAL NONCARCINOGENIC HAZARD:	**1.75E-02**

3.0 BASELINE ECOLOGICAL RISK ASSESSMENT

The following chapter presents the BERA using the standard format (i.e., Problem Formulation, Exposure Assessment, Effects Assessment, and Risk Characterization) for each endpoint receptor. The receptor communities evaluated in this assessment include: fish, benthic macroinvertebrates, vegetation, and herbivorous wildlife.

3.1 ECOLOGICAL PROBLEM FORMULATION

The problem formulation utilizes the description of the relevant environmental features (Section 1.2) and the description of the sources of potential exposure (Section 1.3) to identify ecological receptors and endpoints at the Site. This information is then summarized in the form of a site conceptual model. The conceptual model presents hypothetical hazards posed by the contaminants to the endpoint biota.

3.1.1 Assessment and Measurement Endpoints

Ecological assessment endpoints represent the environmental attributes or characteristics to be protected. The assessment endpoints selected for this BERA included the evaluation of the reduction of species richness and diversity of the fish, benthic macroinvertebrates, vegetation and herbivorous wildlife communities resulting from toxicity to chemicals.

Since the above assessment endpoints generally can not be measured directly, measurement endpoints were identified. There are two types of measurement endpoints or lines of evidence which will be used to assess the status and potential changes in the attributes of the environment: 1) *ecotoxicological benchmarks* derived from chemical toxicity data from the literature to determine the potential for ecological effects, and 2) biological survey data which are direct estimates of the assessment endpoint. The specific measurement endpoints used for each assessment endpoint in this BERA are described below.

3.1.1.1 Fish Community

Chemical Toxicity Data: The New York State Department of Environmental Conservation (NYSDEC) Surface Water Quality Standards (SWQSs) (Title 6, Chapter X Parts 700-705; NYSDEC, 1994b) were utilized for the chemical screening. If these benchmarks were unavailable, Tier II Secondary Chronic Values (SCVs) (EPA, 1993; Suter, 1996), or Lowest Chronic Values (LCVs) for daphnids (Suter, 1996) were used as measurement endpoints for the fish community. These benchmarks will be used to identify COPECs and determine if surface water concentrations measured in Maybury Brook, Pond 1, and the Unnamed Tributary have the potential to adversely impact the fish community.

Biological Surveys: Qualitative fish community surveys were conducted in Maybury Brook and the Unnamed Tributary to Trout Brook in May, June, and August, 1997 by the Environmental Collaborative (Reuter and Slack, 1997). Fish were collected using minnow traps and kick nets. The relative abundance and distribution of fish (measurement endpoints) in these streams were evaluated and are assumed to be representative of the status of the fish population (the assessment endpoint) in these areas.

3.1.1.2 Benthic Macroinvertebrate Community

Chemical Toxicity Data: NYSDEC Sediment Criteria (NYSDEC, 1994c) were primarily utilized for the chemical screening process. If these criteria were unavailable, Ontario Ministry of the Environment (MOE) Lowest Effects Levels (LELs) and Severe Effects Levels (SELs) (Persaud et al., 1993), National Oceanic and Atmospheric Association (NOAA) Effects Range-Low (ER-L) and Effects Range-Median (ER-M) (Long et al., 1995), or Wisconsin Department of Natural Resources

Sediment Quality Criteria (WI DNR SQC) (Geisy and Hoke, 1990) were used to identify COPECs and determine if sediment concentrations measured in the Maybury Brook, the Unnamed Tributary, and the southernmost settling pond (Pond 4) have the potential to adversely impact benthic macroinvertebrates.

Biological Survey: Qualitative benthic macroinvertebrate surveys were conducted within Maybury Brook and the Unnamed Tributary by the Environmental Collaborative during May, June, and August, 1997. The benthic macroinvertebrate samples were quantitative in nature and were collected according to the Kick Method and handling procedures described in the NYSDEC Division of Water *Quality Assurance Work Plan for Biological Stream Monitoring in New York State* (Bode, 1988) and *Methods for Rapid Biological Assessment of Streams* (Bode et al., 1991). Species richness and abundance (the measurement endpoints) are assumed to be representative of the status of the entire benthic macroinvertebrate population (the assessment endpoint) within these streams.

3.1.1.3 Vegetation

Chemical Toxicity Data: To evaluate potential risks to the terrestrial plant community, the chemical concentrations detected in soil were compared to phytotoxicity benchmarks. Phytotoxicity benchmarks which represent chronic toxicity thresholds for growth or production of vascular plants for chemicals in soil were derived at Oak Ridge National Laboratory (ORNL) (Will and Suter, 1995). These test endpoints are assumed to correspond to the assessment endpoint for this community. That is, the sensitivity distribution of the test species is assumed to approximate the distribution of species that would colonize the Site and surrounding areas. Exceedence of the test endpoints is assumed to correspond to 20% reductions in abundance or productivity, with some uncertainty.

Biological Surveys: Vegetation surveys were conducted on the Site and surrounding areas during May, June, and August 1997 by the Environmental Collaborative (Reuter and Slack, 1997). The vegetative community was qualitatively evaluated based on species composition and structural diversity (i.e., foliage height, spatial distribution, percent cover, age class, species distribution, vegetation layering).

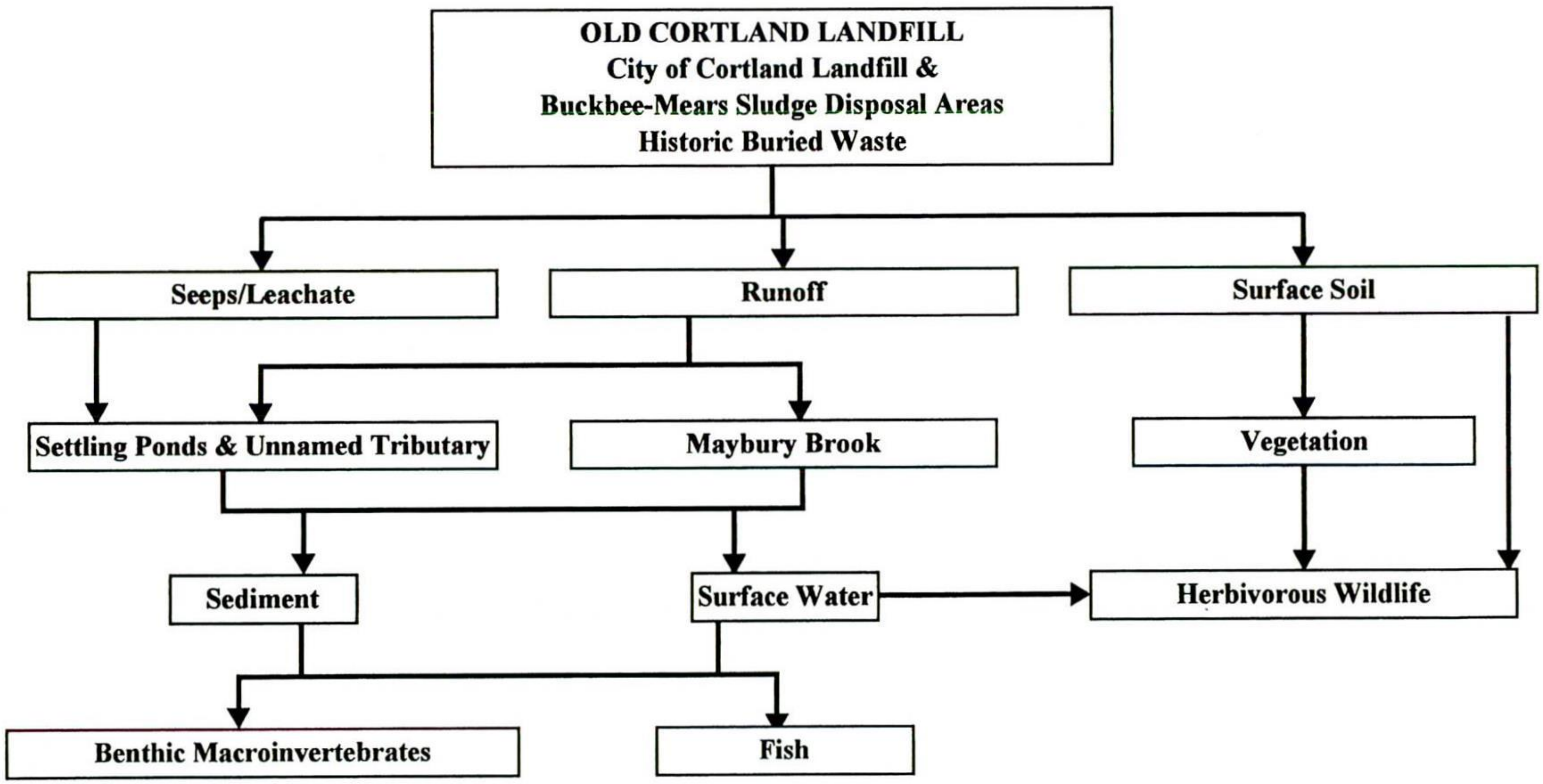
3.1.1.4 Herbivorous Wildlife

Chemical Toxicity Data: To evaluate the potential risks to herbivorous wildlife foraging on the Site, the eastern cottontail and the white-tail deer were selected as representative species for this trophic level. Point estimates of chemical exposure were calculated and compared with ecotoxicological benchmarks derived at ORNL (Sample et al., 1996). These benchmarks were derived using chronic toxicity thresholds for contaminants of concern in mammals. Greater weight was given to data from long-term feeding studies with wildlife species. Preference was also given to tests that included reproductive endpoints. Generally, the benchmarks used for the eastern cottontail and the white-tail deer were derived from rodent or mink toxicity tests using a body scaling factor. Total chemical exposures, from ingestion of vegetation and surface water, which exceed wildlife No Observable Adverse Effects Levels (NOAELs) may indicate the potential for adverse impacts to herbivorous wildlife.

3.1.2 Conceptual Site Model

The conceptual site model (CSM) describes the hypothesized source of COPECs, routes of exposure and transport, and ecological receptors (Figure 3). The CSM illustrates that the primary source of COPECs into the surrounding environment may be from historic buried waste in the Old Cortland County Landfill, City of Cortland Landfill or the Buckbee-Mears sludge disposal areas. Potential leachate at the southern portion of the landfill appears to discharge into Pond 1 and be transported through the other settlement ponds to the Unnamed Tributary, eventually flowing into Trout Brook. Runoff from the Site may also be transported to Maybury Brook located east of the landfill.

FIGURE 3: CONCEPTUAL SITE MODEL - OLD CORTLAND LANDFILL



D4709.OPX

COPECs in both the surface water and sediments, if bioavailable, could potentially effect fish, invertebrates, plants, and wildlife through several exposure mechanisms. Those mechanisms include direct contact and ingestion. Aquatic biota are directly exposed to COPECs in water. Detritus and sediments are consumed by benthic invertebrates and detritivorous fish. The benthic invertebrates are also directly exposed to the sediments. The food web may transfer COPECs taken up by these routes to higher order predators.

3.1.3 Organization of the BERA

The risks from chemicals to each of the ecological assessment endpoints in the current baseline condition are assessed separately (Sections 3.2 to 3.4). Each includes an exposure assessment, effects assessment, and risk characterization. The components of the assessment are explained below.

Exposure assessment characterizes the distribution in space and time of the concentrations of chemicals to which organisms are exposed. This section describes the modes of potential exposure that can occur for the selected assessment endpoints, describes how exposure is estimated, and presents the exposure data available for the BERA.

Effects assessment characterizes the relationship between chemicals identified during the investigative sampling and ecological receptors (assessment and measurement endpoints). The principle lines of evidence concerning effects are biological survey data that indicate the actual state of the receiving environment and chemical toxicity data which indicate the potential toxic effects of concentrations measured in site media.

Risk characterization is the phase of risk assessment in which the information concerning exposure and the information concerning potential effects of exposure are integrated to estimate risks (the likelihood of effects given the exposure). Risk characterization in ecological risk assessment is performed by a weight-of-evidence analysis. Procedurally, the risk characterization in this assessment is performed for each assessment endpoint by (1) screening measured chemical concentrations to ecotoxicological benchmarks, (2) estimating the effects of the contaminants retained by the screening analysis, (3) estimating the effects of exposure on the endpoint biota based on the results of the biological survey data, (4) logically integrating the evidence to characterize risks to the endpoint, and (5) listing and discussing the uncertainties in the assessment.

3.2 RISKS TO THE FISH COMMUNITY

This section presents the exposure assessment, effects assessment, and evaluation of risks to the fish community from chemicals measured in surface water within Maybury Brook, Pond 1, and the Unnamed Tributary.

3.2.1 Exposure Assessment for Fish

Fish may be exposed to chemicals through transpiration of waterborne chemicals across the gill membrane, through dermal contact, or through ingestion of water and food. Since there are no appropriate quantitative models available to calculate dermal contact or dietary exposure for fish, the primary route of exposure was assumed to be respiratory uptake of surface water.

Since fish are mobile within the water column and water in the system is replaced over space and time, the mean water concentration within an area is an appropriate estimate of chronic exposure experienced by fish. If sufficient samples were collected, the 95% UCL of the arithmetic mean is an appropriately conservative estimate for use in the chemical screening process. The 95% UCL was calculated for quarterly monitoring data collected from March 1991 through December 1996 in the Unnamed Tributary. Only two samples were collected in Pond 1 and Maybury Brook during August and October 1997. Therefore, the maximum concentration was used for these locations in the screening process.

Surface water samples were collected quarterly at two locations in the Unnamed Tributary (SW-1 [headwaters] and SW-2 [downstream]) from March 1991 to December 1996 and in October 1997. Surface water was also collected at one location in Pond 1 (SW-3), and two locations in Maybury Brook (SW-4 [background] and SW-5 [adjacent Site]) in August and October 1997. Each surface water sample was analyzed for VOCs, SVOCs, Pesticides/PCBs, total and dissolved metals, wet chemistry (i.e., hardness, alkalinity, TDS, etc.), and physical parameters (i.e., pH, DO, conductivity, etc.) (Table 1-1).

The bioavailability of the COPEC measured in surface water is dependent on the fraction (dissolved or total) of the surface water in which the COPEC was found. The consensus of the scientific community and of the USEPA Office of Water (USEPA, 1996b) is that aquatic biota are exposed to the dissolved fraction of the metal in water, rather than the total metal. The COPECs in the dissolved fraction of surface water is considered to be the bioavailable form (Prothro, 1993). However, USEPA (personal communication with L. Wellman, November 13, 1997) has mandated the use of both total and dissolved phase surface water concentrations of metals for the calculation of exposure to aquatic biota.

3.2.2 Ecological Effects Assessment for Fish

Potential effects of chemicals on fish were evaluated using surface water benchmarks and biological survey data. The benchmarks used for comparison to surface water concentrations and sampling methodologies for the fish community surveys are described below.

3.2.2.1 Benchmarks for Aqueous Toxicity

Metals detected in surface water collected from the Unnamed Tributary, Maybury Brook, and Pond 1, were compared with ecotoxicological benchmarks to determine the potential for impacts to aquatic biota. NYSDEC Surface Water Quality Criteria (SWQCs) (NYSDEC, 1994b), Tier II secondary chronic values (SCVs), and lowest chronic values (LCVs) for daphnids (Suter, 1996) were used to identify COPECs measured in total and dissolved surface water. These ecotoxicological benchmarks are discussed below.

NYSDEC Surface Water Quality Standards

The NYSDEC SWQSs for the protection of aquatic life shall prevent tainting of aquatic food and shall be protective of the health of wildlife consumers of aquatic life from substances that may bioaccumulate. The standards were derived for both fish propagation and survival as determined as the threshold for chronic toxic effects. These toxic effects are important to the propagation of the test species, including but not limited to embryo-larval productivity, teratogenesis or other reproductive effects, growth, long-term mortality or oncogenesis. Aquatic life standards (including SCVs or LCVs) were unavailable for the comparison of nitrate and chloride concentrations. Therefore, NYSDEC human health standards for consumption as a drinking water source were used for comparison.

Tier II Secondary Chronic Values (SCVs)

Tier II SCVs were calculated using the methodology presented in the Great Lakes Water Quality Initiative (GLWQI) (40 CFR 122 et al.) which is similar to the calculation of the National Ambient Water Quality Criteria (NAWQC), the most commonly used freshwater chemical screening value. Tier II SCVs and NAWQCs are developed based upon the use of the LD_{50} (a statistically or graphically estimated dose that is expected to be lethal to 50% of a group of organisms under specified conditions) results associated with standard acute and chronic toxicity tests (USEPA, 1986b; 1996b).

Tier II values are concentrations that would be expected to be higher than the NAWQC for a chemical in no more than 20% of cases if sufficient test data were obtained to calculate the NAWQC (Suter, 1996). NAWQCs for the protection of aquatic life are based on thresholds for statistically significant effects on individual responses of fish and aquatic invertebrates. Those thresholds correspond to approximately 25% reductions in the parameters of chronic fish tests (Suter et al., 1987). Because of the compounding individual responses across life stages, the chronic NAWQCs frequently correspond to much more than a 20% effect on a continuously exposed fish population (Barnthouse et al., 1990). Therefore, the exceedence of the Tier II SCVs are assumed to correspond to 20% or greater effect on the survivorship, growth, or fecundity of the fish community. Tier II SCVs were used for total and dissolved barium and manganese concentrations measured in surface water.

Lowest Chronic Values (LCVs) for Daphnids

Daphnid LCVs are the lowest value, from acceptable daphnid chronic toxicity tests, of the geometric mean of the Lowest Observed Effects Concentration (LOEC) and No Observed Effects Concentration (NOEC). The lowest chronic values are considered conservative benchmarks when assessing potential impacts. These values were estimated based on 48-hour EC_{50} for daphnids. The EC_{50} is the median effective concentration for death or some equivalent effect (e.g. immobilization) for daphnids. Specific equations for LCV derivation are found in Suter and Mabrey (1994) or Suter (1996). LCVs were used for total and dissolved concentrations of the nutrients calcium, potassium, sodium, and magnesium measured in surface water.

3.2.2.2 Biological Survey Data

Fish were collected at three locations within the Unnamed Tributary and Maybury Brook during May, June, and August, 1997 (Reuter and Slack, 1997). Fish were collected using minnow traps and kick nets at each location. Species richness and abundance at each location were evaluated to assess the status of the community within the two streams.

3.2.3 Risk Characterization for Fish

This section presents the evaluation of risks to the fish community inhabiting the Unnamed Tributary and the Maybury Brook. This assessment utilizes two lines of evidence including chemical concentrations measured in surface water and biological surveys conducted within these two streams.

3.2.3.1 Screening of Chemicals in Surface Water Against Benchmarks

All chemicals detected in surface water on the Site collected during August and October 1997 were screened against ecotoxicological benchmarks to determine the potential for adverse impacts to aquatic biota. The 95% UCL of the concentrations reported from quarterly sampling from March 1991 to December 1996 at locations SW-1 and SW-2 in the Unnamed Tributary were compared to ectoxicological benchmarks to determine the potential for historical impacts. This was conducted by dividing the metal concentration (95% UCL or measured concentration) by the ecotoxicological benchmark. Hazard Quotients (HQs) were calculated using the following equation:

$$\text{Hazard Quotient} = \frac{\text{Chemical Exposure Concentration } (\mu g/L)}{\text{Ecotoxicological Benchmark}}$$

If the HQ is less than or equal to 1, then there is little probability of an adverse ecological impact to aquatic receptors from the chemical exposure. HQs greater than one indicate that a chemical is a COPEC and may potentially produce adverse ecological impacts to aquatic biota. Concentrations of most metals analyzed in surface water samples did not exceed the appropriate ecotoxicological benchmarks. The metal concentrations detected in the Unnamed Tributary (SW-1 and SW-2), Pond 1 (SW-3) and Maybury Brook (SW-4 and SW-5), ecotoxicological benchmarks, and HQs are presented in Table B1 (Appendix B).

The results of the screening process indicated that exposure to concentrations of barium may result in the potential for adverse impacts to fish at the five locations. Barium was identified in both total and filtered surface water collected at the locations in the Unnamed Tributary, Pond 1, and Maybury Brook. The presence of barium in the Maybury Brook is not associated with the Site since the surface water collected from the upstream location (SW-4) contained higher levels of barium than at the downstream location (SW-5: adjacent the Site). Therefore, barium is not considered a Site-related COPEC in Maybury Brook. Manganese was also detected in both total and dissolved samples collected from upstream location of the Unnamed Tributary (SW-1) and Pond 1 (SW-3) at concentrations above NYSDEC standards. Manganese was also detected above standards at the downstream location of the Unnamed Tributary (SW-2) during several months between March 1991 and December 1996. This suggests that manganese has the potential to impact aquatic biota at these locations.

Chemicals including aluminum (SW-3 and SW-5) and iron (SW-3) were only detected at concentrations in excess of water quality standards in unfiltered samples. These constituents are particle bound and are unlikely bioavailable to the aquatic biota inhabiting these locations. Furthermore, these constituents decrease downstream in the southern ponds and in the Unnamed Tributary. Consequently, these constituents would unlikely impact the aquatic biota in the ponds, Unnamed Tributary, and Maybury Brook.

Wet chemistry parameters such as pH, chloride, ammonia, nitrate, and sulfate were within the specified range or were below the NYSDEC SWQSs during August and October 1997. However, in December 1991, pH measurements (8.9) were recorded in excess of the NYSDEC SWQS range (6.5 to 8.5) in the Unnamed Tributary. The color of the water (SW-1, SW-2, and SW-3), total phenol concentration (all locations), and TDS (SW-1 and SW-3) measured in the surface water slightly exceeded NYSDEC SWQSs. The total phenol concentration is not considered a Site-related COPEC within Maybury Brook since it was present at higher concentrations at the upstream location

(SW-4). Additional wet chemistry parameters, including BOD, Eh, conductivity, bromide, alkalinity, TKN, TOC, and hardness presented in Table B1 were not evaluated due to the lack of toxicological data and screening benchmarks. In summary, the chemicals which were identified as COPECs are presented in Table 3-1.

3.2.3.2 Fish Community Survey

Qualitative fish community surveys are useful in assessing the ecological changes in an aquatic ecosystem. Specifically, species diversity (number of species) and abundance (numbers of individuals of each species) may be used to assess the status of an aquatic ecosystem. These surveys conducted by the Environmental Collaborative identify the species diversity and abundance of the fish community in the Unnamed Tributary and Maybury Brook (Rieter and Slack, 1997). The fish survey did not include an evaluation of the population within the settlement ponds themselves. Therefore, conclusions can not be made regarding the current status of the fish population within these ponds. The results of the surveys conducted by Rieter and Slack (1997) are summarized below.

The fish surveys conducted on the Site only indicated the presence of two species of fish within the Site boundaries, brown bullhead and blacknose dace. Brown bullhead were introduced into the settling ponds prior to 1997 and were collected downstream of the ponds in the Unnamed Tributary. Reproduction had occurred within the water bodies as evidenced by the capture of juvenile bullheads in the Unnamed Tributary. The surveyers assumed that these bullheads collected within the tributary were washed down from the upstream ponds. The rocky, steep-gradient stream habitat of the tributary is unlike the preferential habitat of the bullhead.

The surface water flow within the Unnamed Tributary is intermittent and during late summer and early fall only small pools are present within the stream that can support fish. Therefore, the

Table 3-1: COPECs Identified in Surface Water in Pond 1, the Unnamed Tributary, and Maybury Brook

Location	COPECs	Hazard Quotients (Range)
SW-3: Pond 1	Aluminum (Total Only)	0.58-1.58
	Barium (Total) (Dissolved)	149-201 145-197
	Manganese (Total) (Dissolved)	2.8-9.4 0.02-2.4
	Iron (Total Only)	0.88-4.3
	Total Dissolved Solids	1.4-1.7
	Total Phenols	5.1-8.3
SW-1: Upstream Unnamed Tributary	Barium (Total) (Dissolved)	45.8-49.8 47.1-48.3
	Manganese (Total) (Dissolved)	1.2-55.9 1.1-29.3
SW-2: Downstream Unnamed Tributary	Aluminum (Total only)	.93-6.1
	Barium (Total) (Dissolved)	28.9-33.2 29.5-31.6
	Manganese (Total) (Dissolved)	.44-4.4 .34-2.8
SW-4: Upstream Maybury Brook	Barium (Total) (Dissolved)	15.7-19.6 15.2-17.8
	Total Phenol	1.5-1.8
SW-5: Downstream Maybury Brook	Aluminum (Total only)	.43-1.8
	Barium (Total) (Dissolved)	14.8-17.9 14.5-16.4
	Total Phenol	1.3-1.8

Notes:
1) SW-3, SW-1, and SW-2 provided in order of upstream to downstream locations.

population dynamics of the fish population within the tributary is highly dependent on the habitat availability and the intermittent nature of the stream.

3.2.3.3 Weight of Evidence Summary

Two lines of evidence were used to evaluate the fish community in the Unnamed Tributary and Maybury Brook: metal concentrations in surface water and the fish community survey. A summary of these lines of evidence are presented in Table 3-2.

3.2.3.4 Uncertainties Concerning Risks to the Fish Community

The uncertainties associated with the evaluation of risks to the aquatic biota are identified below.

- **Surface Water Concentrations**. Two surface water samples were collected at three locations (SW-3, SW-4, and SW-5) in August and October 1997. Twenty surface water samples have been collected from March 1991 to October 1997 at two locations (SW-1 and SW-2) in the Unnamed Tributary. The total and dissolved concentrations were assumed to be representative of current and future exposures experienced by the fish or pelagic invertebrate community inhabiting the ponds and streams.

- **Chemical Screening**. The comparison of laboratory toxicity data for individual chemicals to measured concentrations of individual chemicals in the environment does not address the potential for combined effects of multiple chemicals, the effects of site-specific conditions on contaminant availability and toxicity, or the range of responses of individual species of different life stages.

Table 3-2: Risk Characterization Summary for the Fish Community

Evidence	Result[a]	Explanation
Media Analyses	+	Concentrations of barium or manganese in both filtered and unfiltered surface water exceeded chronic surface water benchmarks at Pond 1, Unnamed Tributary, and Maybury Brook (barium only). Barium is not considered a Site-related COPEC in Maybury Brook due to elevated concentrations measured upstream.
	-	Aluminum, iron, and total phenol slightly exceeded chronic benchmarks in unfiltered surface water samples. These constituents are unlikely available to fish.
Biological Surveys	-	Fish surveys indicated the presence of 2 fish species (Brown Bullheads and Blacknose Dace) in the settlement ponds and Unnamed Tributary. Blacknose Dace were also collected in Maybury Brook. Reproduction has occurred in the ponds as evidenced by the capture of juveniles in the Unnamed Tributary. The population is likely affected by the habitat availability and the intermittent nature of the Unnamed Tributary. The biological survey does not provide evidence of an impact on the fish community within the streams.
Weight-of-Evidence	-	Due to the exceedence of the conservative benchmarks, the concentrations of barium at five locations and manganese at three locations may have the potential to chronically impact the fish inhabiting the immediate area. However, these concentrations have not impacted the reproductive success of the fish, nor resulted in acute toxic responses (unobserved during fish surveys). Additionally, potential impacts which may be experienced by the aquatic biota in the Unnamed Tributary are likely more dependent on the intermittent nature and the habitat of the stream. Although the concentrations of barium in the Maybury Brook (both upstream and downstream) exceed the Tier II SCV, this constituent is not site- related.

[a]+ Indicates that the evidence may result in a potential impact to species richness and abundance of the fish community.
\- Indicates that the evidence is not consistent with an impact on the species richness and abundance of the fish community.

- **Aquatic Toxicity Tests.** No aquatic toxicity tests were conducted on surface water within the ponds and streams. Therefore, it is not known if barium is bioavailable and potentially exerting a toxic response on the aquatic organisms.

- **Fish Surveys.** Quantitative fish surveys were not conducted in the Unnamed Tributary or Maybury Brook and qualitative fish surveys were not conducted in the 4 Ponds. Therefore, the assessment endpoint (i.e., reduction in species diversity and abundance) could not be evaluated at these locations.

- **Multiple Benchmarks**. Water toxicity data is much more standardized than soil or sediment toxicity data. However, alternative methods for calculating thresholds for aquatic toxic effects from laboratory tests produce benchmarks that vary over a range greater than two orders of magnitude (Suter, 1996).

3.3 RISKS TO THE BENTHIC MACROINVERTEBRATE COMMUNITY

This section presents the evaluation of the potential for adverse impacts to the benthic macroinvertebrate community from chemicals measured in sediments collected from the Unnamed Tributary (SED-1 and SED-2), Pond 1 (SED-3), Pond 4 (SED-6), and Maybury Brook (upstream: SED-4 and downstream: SED-5). The results of chemical analyses of sediment and biological surveys were used to evaluate the potential for such impacts.

3.3.1 Exposure Assessment for Benthic Macroinvertebrates

Benthic macroinvertebrates can be exposed to chemicals found adhered or adsorbed to sediment particles or dissolved in pore water between sediment particles. Primary routes of exposure for benthic invertebrates are generally absorption and respiration of sediment pore water and ingestion of sediment and sediment-associated food. Compared to surface water, sediment chemical concentrations have low temporal variability. Benthic invertebrates are also less mobile than water-column species, thereby localizing chemical exposure. Therefore, it was assumed that sediment-associated biota received 100% of their exposure from the sediment at each location. Furthermore, no appropriate quantitative models for exposure through dermal contact, ingestion of sediment, and consumption of food are available. Therefore, the measured concentrations of chemicals in the sediment are considered a conservative estimate of exposure to the benthic macroinvertebrate community.

3.3.2 Effects Assessment for Benthic Macroinvertebrates

This section presents information on the sediment screening benchmarks used for the BERA and methodologies used for the benthic macroinvertebrate surveys conducted by the Environmental Collaborative.

3.3.2.1 Benchmarks for Sediment Toxicity

Chemicals detected in sediments collected from the Unnamed Tributary, Pond 1, Pond 4, and Maybury Brook were screened against ecotoxicological benchmarks to determine if there is a potential for impacts to the benthic macroinvertebrates in the area. NYSDEC Lowest Effects Levels (LELs) (NYSDEC, 1994c), Ontario Ministry of the Environment (MOE) LELs and Severe Effects Levels (SELs) (Persaud, 1993), National Oceanic and Atmospheric Administration (NOAA) Effects Range-Low (ER-L) and Effects Range-Median (ER-M) (Long et.al., 1995), Sediment Quality Benchmarks (EPA, 1996b), Tier II chronic SQBs (Jones et al., 1996), SQBs for Daphnids (Jones et al., 1996), and Wisconsin Department of Natural Resources (WIDNR) Sediment Quality Criteria (SQC) (Geisy and Hoke, 1990) were used to screen chemical concentrations measured in sediment. The above mentioned screening benchmarks are discussed below.

NYSDEC Lowest Effects Levels (LELs)

The New York Sediment Screening Criteria (NYSDEC, 1994c) represents the lowest concentration of the NOAA ER-L (Long et al., 1995) or the MOE LEL (Persaud et al., 1993). These screening benchmarks are discussed in detail in the sections below.

MOE Lowest Effects Level/Severe Effects Level (LEL/SEL)

The MOE has prepared provincial sediment quality guidelines (SQGs) using the Screening Level Concentration (SLC) Approach. The SLC approach estimates the highest concentration of a particular chemical in sediment that can be tolerated by approximately 95% of benthic infauna (Neff et al., 1988). The SLC is derived from synoptic data on sediment chemical concentrations and benthic invertebrate distributions. These values are based on Ontario sediments and benthic species from a wide range of geographical areas within the province (Persuad et al., 1990). The guidelines define three levels of ecotoxic effects and are based on the chronic, long term effects of constituents on benthic organisms. These levels are a No Effect Level (NEL), an LEL, and an SEL. The LEL is the level at which actual ecotoxic effects may become apparent, although the LEL is a level of chemical measured in sediment that can be tolerated by the majority of benthic organisms. The SEL indicates the level at which pronounced disturbance of the sediment-dwelling community may be expected. This is the sediment concentration of a compound that may be detrimental to the majority of benthic species (Persaud et al., 1993). If a total metal concentration in a sediment sample is less than the LEL, the effects of the metal in the sediment are considered to be acceptable. If the concentration is greater than the LEL but less than the SEL, the sediment is considered to be contaminated, with moderate impacts to benthic life. If the concentration is greater than the SEL, the sediment is contaminated and significant harm to benthic aquatic life is anticipated (NYSDEC, 1994b).

NOAA Effects Range-Low/Effects Range-Median (ER-L/ER-M)

The NOAA ER-L and ER-M values correspond to the tenth and fiftieth percentile of estuarine sediment concentrations reported to be associated with some level of toxic effects (Long et al., 1995).

They are used by NOAA as concentrations above which adverse effects may begin or are predicted among sensitive life stages and/or species as determined in sublethal tests.

USEPA Sediment Quality Benchmarks (SQBs), Tier II SQBs, and Daphnid SQBs

Sediment Quality Benchmarks (SQBs) (USEPA, 1996b, Jones et al., 1996) are derived by the equilibrium partitioning (EqP) method. The EqP method quantifies the hydrophobicity of the chemical by using the octanol/water partition coefficient (K_{ow}) and determines the sorption capacity of the sediment by the mass fraction of organic carbon in the sediment (USEPA, 1996b). The USEPA and Tier II SQBs are based on the toxicity in water expressed as the Tier II Secondary Chronic Value (Section 3.2.2.1), and partitioning of the contaminant between organic matter and pore water. The Daphnid SQB is also based on the partitioning of the contaminant between matter and pore water and the Lowest Chronic Value for daphnids (Section 3.2.2.1).

Compounds with no NYSDEC LELs, MOE LEL/SEL, NOAA ER-L/ER-Ms, or SQBs were screened against Open Water Disposal values (Persaud et al., 1993) or WI DNR SQCs (Geisy and Hoke, 1990).

3.3.2.2 Benthic Macroinvertebrate Survey

Since benthic macroinvertebrates are in direct contact with sediments and surface water, have short life cycles, and do not migrate, community surveys are useful in assessing the current quality of an aquatic ecosystem. Identification of certain species may be indicative of water quality as species exhibit differential sensitivities to various types of chemicals. The presence of sensitive species such as EPT taxa (Ephemeroptera/Plecoptera/Trichoptera) may indicate good water quality, while collection of only tolerant species may suggest poor water quality. Benthic macroinvertebrate diversity, abundance, and distribution were used to evaluate the current status of the Unnamed Tributary and Maybury Brook.

Quantitative benthic macroinvertebrate surveys were conducted by the Environmental Collaborative during May, June, and August, 1997 using the kick net method (Reuter and Slack, 1997). The sampling sites were located in areas of the streams containing stretches of riffle and run habitats. The benthic organisms were identified and measurements of species richness, Biotic Index Values and Ephemeroptera Plecoptera Trichoptera (EPT) Values were evaluated. Reuter and Slack (1997) provide details on the specific procedures utilized during these surveys.

3.3.3 Risk Characterization for Benthic Macroinvertebrates

Risks presented to benthic macroinvertebrate communities inhabiting the Unnamed Tributary, Ponds 1 and 4, and Maybury Brook, as determined by two lines of evidence (sediment analysis and biological surveys), are discussed in the following sections.

3.3.3.1 Screening of Chemicals in Sediments Against Benchmarks

Potential impacts to benthic macroinvertebrates from exposure to chemicals measured in sediments were evaluated by the calculation of HQs. As discussed in Section 3.2.3.1, HQs are quotients of ratios of exposure concentrations divided by the ecotoxicological benchmark concentrations.

$$\text{Hazard Quotient} = \frac{\text{Chemical Concentration in Sediment (mg/kg)}}{\text{Ecotoxicological Benchmark}}$$

If the HQ is less than or equal to 1, then the probability of adverse ecological impacts to aquatic receptors from the chemical exposure is negligible. HQs greater than one indicate that a chemical is a COPEC for the receptor and may potentially produce adverse ecological impacts. One intent of this BERA is to screen out chemicals that are clearly not of concern. Therefore, conservative estimates of exposure (total bulk dry weight concentrations measured in sediment) and conservative benchmarks (e.g., NYSDEC LELs, MOE LELs, NOAA ER-L sediment guidelines) were used for the screening process. It must be emphasized that these values are highly conservative and are not necessarily indicative of site conditions, but are used for screening purposes. The chemical concentration, sediment screening benchmark and associated HQ are presented in Table B2.

The magnitude of the potential impact from the COPECs identified in sediment (Table B2) were evaluated by comparing the chemical concentration to an Effects Range-Median (ER-M) value or Severe Effects Level (SEL) (Persaud et al., 1993). If the concentration is greater than the LEL but less than the SEL concentration, the sediment is considered to be contaminated, with moderate impacts to benthic life. If the concentration is greater than the SEL, the sediment is contaminated and significant harm to benthic aquatic life is anticipated (NYSDEC, 1994c). If the chemical concentration is in excess of the single low benchmark which is available (i.e., WI DNR SQC, SQB), possible impacts may result to the benthic community. The COPECs identified in sediment at each location and the magnitude of the potential impact (i.e., possible, moderate, or significant impacts) are presented in Table 3-3.

3.3.3.2 Bioavailability of COPECs

Although screening total metal concentrations measured in sediment against benchmarks at each location is an important first step in the process of identifying and evaluating sediment COPECs, this technique is considered highly conservative. Total sediment concentrations do not represent the exposure concentration bioavailable to the organism and may not provide an accurate assessment of the actual toxicity experienced by benthic invertebrates. Therefore, this screening technique likely overestimates the potential toxicity associated with COPECs. Factors affecting bioavailability must be taken into consideration to provide a more realistic assessment of risks to the benthic macroinvertebrate community.

Aquatic organisms in the settling ponds, Unnamed Tributary, and Maybury Brook may take up metals from the environment through exposure pathways identified in Section 3.3.1. However, the

Table 3-3: COPECs Detected in Sediment and Magnitude of Impact
Old Cortland County Landfill RI/FS, Cortland, New York

Location	COPEC	Concentration (mg/kg)	LEL Benchmark	Low HQ	SEL Benchmark	High HQ	Potential Impact?
Unnamed Tributary SED-1	Acetone	0.29	0.00877	**33.067**	NA	NA	Possible
	Arsenic	28.3	6	**4.717**	33	0.858	Moderate
	Barium	815	500	**1.630**	NA	NA	Possible
	Chromium	30.3	26	**1.165**	110	0.275	Moderate
	Copper	27.5	16	**1.719**	110	0.250	Moderate
	Iron	55900	20000	**2.795**	40000	**1.398**	Signficant
	Manganese	26100	460	**56.739**	1100	**23.727**	Signficant
	Nickel	39.6	16	**2.475**	50	0.792	Moderate
	Zinc	229	120	**1.908**	270	0.848	Moderate
	Ammonia	246	100	**2.460**	NA	NA	Possible
	Total Kjeldahl Nitrogen	3250	600	**5.417**	4800	0.677	Moderate
	Total Organic Carbon	39700	10000	**3.970**	100000	0.397	Moderate
Unnamed Tributary SED-2	Arsenic	14.4	6	**2.400**	33	0.436	Moderate
	Iron	37100	20000	**1.855**	40000	0.928	Moderate
	Manganese	1230	460	**2.674**	1100	**1.118**	Signficant
	Nickel	25.9	16	**1.619**	50	0.518	Moderate
Pond 1 SED-3	Arsenic	14.3	6	**2.383**	33	0.433	Moderate
	Chromium	31.3	26	**1.204**	110	0.285	Moderate
	Copper	27.5	16	**1.719**	110	0.250	Moderate
	Iron	62700	20000	**3.135**	40000	**1.568**	Signficant
	Manganese	1220	460	**2.652**	1100	**1.109**	Signficant
	Nickel	53	16	**3.313**	50	**1.060**	Signficant
	Zinc	145	120	**1.208**	270	0.537	Moderate
	Total Kjeldahl Nitrogen	2900	600	**4.833**	4800	0.604	Moderate
	Total Organic Carbon	66900	10000	**6.690**	100000	0.669	Moderate

Table 3-3: COPECs Detected in Sediment and Magnitude of Impact
Old Cortland County Landfill RI/FS, Cortland, New York

Location	COPEC	Concentration (mg/kg)	LEL Benchmark	Low HQ	SEL Benchmark	High HQ	Potential Impact?
Mayberry Brook SED-4 (Upstream)	Copper	18	16	**1.125**	110	0.164	Moderate
	Iron	29100	20000	**1.455**	40000	0.728	Moderate
	Manganese	501	460	**1.089**	1100	0.455	Moderate
	Nickel	25.7	16	**1.606**	50	0.514	Moderate
Mayberry Brook SED-5 (Downstream)	Arsenic	7.3	6	**1.217**	33	0.221	Moderate
	Copper	18.1	16	**1.131**	110	0.165	Moderate
	Iron	33000	20000	**1.650**	40000	0.825	Moderate
	Manganese	523	460	**1.137**	1100	0.475	Moderate
	Nickel	27	16	**1.688**	50	0.540	Moderate
Pond 4 SED-6	Copper	17.5	16	**1.094**	110	0.159	Moderate
	Iron	34000	20000	**1.700**	40000	0.850	Moderate
	Nickel	29.3	16	**1.831**	50	0.586	Moderate

Notes:

1. NA= Not available
2. There are no SEL benchmarks for acetone (SQB-Daphnid), barium (WIDNR SQC), and ammonia (open water disposal).
3. If no SEL available, possible impacts are predicted.
4. If chemical concentration is above the LEL but lower than the SEL, moderate impacts to the benthic community are predicted (NYSDEC, 1994).
5. If chemical concentration is above the LEL and the SEL, signficant impacts to the benthic community are predicted (NYSDEC, 1994).
   Although NYSDEC predicts impacts to be potentially "signficant" if the chemical concentration exceedes the SEL, a "signficant" impact has not been indicated or demonstrated.

degree of exposure and the concentration of inorganic chemicals in invertebrates is highly dependent on the bioavailability of particulate-bound chemicals, the metal speciation, and the chemical characteristics of the surrounding matrix (USEPA, 1992b; Ankley et al., 1994; and Anderson et al., 1984).

The simple presence of a COPEC identified after screening against benchmarks is not necessarily indicative of an ecological impact to surrounding receptors. Exceedences of sediment screening criteria does not infer effects at a particular location. If COPECs in sediments are not biologically available to ecological receptors for uptake, then the risks afforded by their presence are limited. In many situations, inorganic constituents can tend to bind to non-hazardous materials in sediments such as silts and clay particles or organic material, thereby limiting their availability for uptake. This concept is documented in Power and Chapman (1992) which states:

> "there are many circumstances when field collected sediments that are highly contaminated, based on bulk chemistry data, are not toxic. Sediment chemical measures only provide information on contamination because the toxicity of a chemical substance in sediment varies with its concentration and with conditions encountered within a specific sediment."

Numerous other studies have shown that dry weight concentrations of metals in sediments cannot be used to predict toxicity to benthic organisms.

One of the factors which affects the bioavailability of metals is the grain size of particles. The distribution of grain size in the sediment (particularly, the percentage of small particle size) will affect the percentage of metals that will adhere to the sediments, and therefore will not be bioavailable. Förstner (1990) noted that pollutants mainly bind to small particles, such as those characteristic of silts and clays.

A major factor affecting metal bioavailability in sediments is acid volatile sulfides (AVS). Studies by Di Toro et al. (1990) demonstrated that the toxicity of cadmium to marine amphipods was linked to metals and AVS ratios. In this experiment, significant mortality was not observed when the acid-extractable cadmium concentration was less than or equal to the AVS concentration. Since then, many studies using freshwater and saltwater sediments spiked with cadmium, copper, lead, nickel and zinc (Carlson et al., 1991; Di Toro et al., 1992; and Casas and Crecelius, 1994) have demonstrated the utility of these parameters in causally linking toxicity to metals in sediments.

AVS is a reactive pool of solid phase iron and manganese sulfide that binds to metals rendering them biologically unavailable, and therefore nontoxic to biota. Simultaneously extracted metal (SEM), the metal extracted by the AVS analytical method (not total metals), is the best estimate of potentially bioavailable metal concentrations for comparison to AVS. Cadmium, copper, lead, nickel, zinc or divalent mixtures have been shown to contain little interstitial metal and were found to be nontoxic to saltwater or freshwater snails, oligochaetes, polychaetes or amphipods when the molar concentration of AVS exceeded the molar concentration of SEM (SEM/AVS ratio <1.0). Toxicity was often, but not always, observed at SEM/AVS >1.0 (Hansen et al., 1996).

AVS concentrations in the sediments of the streams and ponds on the Site may be sufficiently elevated to bind the copper, nickel, and zinc, rendering them unavailable. The manganese and iron may also be bound to these metals limiting the availability of both chemical constituents (manganese, iron, and divalent metals).

3.3.3.3 Benthic Macroinvertebrate Surveys

The benthic macroinvertebrate surveys were conducted by the Environmental Collaborative during May, June, and August 1997 in the settlement ponds, Unnamed Tributary, and Maybury Brook (Reuter and Slack, (1997). The results of the survey within each of these areas are presented below.

Settlement Ponds

A qualitative survey was conducted in the settlement ponds using funnel traps. The ponds contained several species of insect larvae including dragonflies and mayflies (Ephemeroptera). Adults of several species of dragonflies and damselflies were observed flying around the ponds, including civil bluet damselflies (*Enallagma civile*), green darner dragonflies (*Anax junius*), and common skimmers (*Celithemis* spp.). Diving beetles (Dytiscidae), whirligig beetles (Gyrinidae), water striders (Gerridae), backswimmers (Notonectidae), water boatmen (Corixidae), and diving beetles (*Cybister fimbriatus*) were also observed in the ponds.

Unnamed Tributary

The quantitative survey conducted at three locations revealed that the stream supported a large number of aquatic organisms. The Unnamed Tributary contained a high percentage of mayflies (average= 31%) and caddisflies (Trichoptera: average= 24%). Many of these mayfly larvae collected in the tributary may have originated in the settling ponds and were washed downstream during spring runoff. Such washdown is also suspected as the source of the leeches and predaceous diving beetle larvae that were found in the stream. These leeches and beetles were common in the ponds. A total of 18 different species were collected within the tributary.

The Biotic Index Value of 3.22 does not indicate that the tributary is impacted. The value is well within the acceptable range (0-4.5) for "non-impacted" streams (Bode et al., 1991). However, this index can underestimate stream degradation due to nonorganic problems (Bode, 1988). The EPT value for the tributary (calculated using the average number of mayflies, stoneflies, and caddisflies within each sample) was 2.7. This value indicates that the tributary is "moderately impacted" (Bode, 1988) and is likely subjected to water quality degradation. These results were not unexpected since this tributary receives runoff from the existing landfill and the closed landfill areas. Other factors which may be limiting the benthic macroinvertebrate community population within this tributary include: 1) absence of surface water during late summer and early fall months; 2) predation by blacknose dace and brown bullhead; 3) inflow of epilimnotic water with warm water temperature and low dissolved oxygen (DO) levels (i.e., 4.7 during June 1995); and 4) constant sunlight which may increase water temperature and lower DO levels.

Maybury Brook

The quantitative survey conducted at three locations within Maybury Brook resulted in the collection of many aquatic organisms. The community was dominated by stoneflies (Trichoptera: average= 77.3%), some mayflies (average = 12.3%) and few caddisflies (average =2.7%). The many stonefly larvae were very small and may have been a result of a recent hatch within the stream. A total of 18 different species were collected within Maybury Brook during the survey.

The Biotic Index Value for Maybury Brook was 3.22 which is within the acceptable range (0-4.5) for "nonimpacted" streams (Bode et al., 1991). As mentioned above, this index can underestimate stream degradation. An EPT Value of 5.0, which was higher than that observed in the Unnamed Tributary, indicates that the stream is "moderately impacted" (Bode, 1988).

3.3.3.4 Weight of Evidence Summary

Two lines of evidence, media analysis and biological surveys were evaluated to assess the ecological status of the benthic community within Pond 1 and 4, the Unnamed Tributary, and Maybury Brook. Table 3-4 summarizes the lines of evidence evaluated to assess the potential ecological status of the benthic macroinvertebrate community at each location.

3.3.3.5 Uncertainties Concerning Risks to the Benthic Macroinvertebrate Community

Uncertainties associated with the evaluation of risks to the benthic macroinvertebrate community are presented below.

Table 3-4: Risk Characterization Summary for the Benthic Macroinvertebrate Community

Evidence	Result[a]	Explanation
Media Analyses	+	Unnamed Tributary: COPECs identified at upstream location included acetone, arsenic, barium, chromium, copper, iron, nickel, manganese, zinc, ammonia, TKN, and TOC. COPECs identified at the downstream location included arsenic, iron, manganese and nickel. Pond 1: COPECs included arsenic, chromium, copper, iron, manganese, nickel, zinc, TKN, and TOC. Maybury Brook: COPECs identified at both upstream and downstream locations included arsenic, copper, iron, manganese, and nickel. Since COPECs were identified at both upstream and downstream locations, COPECs are not site-related. Pond 4: COPECs included copper, iron, and nickel.
Biological Surveys	-	Ponds: The qualitative survey, which identified 9 different taxa, could not be used to evaluate the potential for impacts. Unnamed Tributary: Invertebrate community was diverse (18 taxa) and was dominated by mayfies and caddisflies (55%). Biotic index (3.22) indicated tributary "not impacted", while the EPT value (2.7) indicated "moderately impacted". Maybury Brook: Invertebrate community was diverse (18 taxa) and was dominated by stoneflies, mayfies and caddisflies (92%). Biotic index (3.22) indicated stream "not impacted", while the EPT value (5) indicated "moderately impacted". Available habitat and intermittent nature of the Unnamed Tributary likely influences the community structure within the streams. Since a reference location was not assessed, a reduction in species diversity and abundance was unable to be evaluated. The biological survey does not provide evidence of an impact on the benthic macroinvertebrate communities within the streams and ponds.
Weight-of-Evidence	±	Chemical mediated impacts to the benthic macroinvertebrate community are possible at the five sampling locations. However, impacts appear to be minimal since the benthic macroinvertebrate community was diverse, abundant, and dominated by sensitive species. Impacts may be minimized due to the decreased bioavailability of the COPECs from the presence of AVS, TOC, and small grain size.

[a]+ Indicates that the evidence may result in a potential impact to species richness and abundance of the benthic macroinvetebrate community.

\- Indicates that the evidence is not consistent with an impact on the species richness and abundance of the benthic macroinvertebrate community.

± Indicates the evidence is too ambigous to interpret.

- **Chemical Concentrations Measured in Sediment Samples.** Risks to the benthic community were evaluated based on the concentrations measured in one sediment sample at each location. These concentrations were assumed to be representative of current and future conditions.

- **Chemical Screening**. Sediment benchmarks are derived for freshwater (MOE LEL) and estuarine (ER-Ls) sediments. Behavior of the chemicals (and therefore bioavailability) may vary according to the parameters (pH, TOC, grain size) in sediment. Additionally, since sediments may be heterogeneous over a large area, exposures of test organisms to the chemicals may be different than the estimated exposure to the fish and invertebrates.

3.4 RISKS TO TERRESTRIAL VEGETATION

This section presents the evaluation of risks to vegetation from chemicals measured in surface soil from the Site. The current status of the vegetative community, as determined by Reuter and Slack (1997), was also summarized in this assessment as a line of evidence.

3.4.1 Exposure to Terrestrial Vegetation

The main exposure route for plants is uptake of chemicals from the soil through the roots. This may occur in a passive mode as the plant takes up water for respiration or by active uptake mechanisms. Another potential route of exposure is through association of chemicals with airborne soil particles (dust).

The concentrations of chemicals in soils are derived from double acid-extractions (nitric and hydrochloric). This metal concentration generally represents the total potential reservoir of metals in the soil, but plants are never exposed to the total amount of metals in the soil. Instead, plants are exposed only to the soluble fraction of metals in the soil. The fraction of soluble metals is determined by the chemical characteristic of the metal and the characteristics of the soil (i.e.., pH, cation exchange capacity [CEC], electron reduction potential [Eh], TOC, grain size, etc.).

3.4.2 Effects Assessment for Terrestrial Vegetation

This section presents information on the phytotoxicity screening benchmarks used for the BERA and methodologies used for the vegetation surveys conducted by the Environmental Collaborative (Reuter and Slack, 1997).

3.4.2.1 Phytotoxicity Benchmarks

To determine if chemical concentrations measured in soils and uncapped sludge disposal areas within the vegetated area may be toxic to the plant community at the Site, the concentrations were compared to Lowest Observed Effects Concentrations (LOECs) as determined in laboratory studies. The soil screening benchmarks are based on data provided by toxicity studies in the field or more commonly in greenhouse and growth chamber settings. The LOECs, resulting from these toxicity tests, were ranked and a number that approximated the 10th percentile was selected. If 10 LOECs were available for the phytotoxicity benchmark derivation, the lowest LOEC was selected as the screening benchmark. Consequently, the screening phytotoxicity benchmarks which were used in this BERA are considered conservative. These phytotoxicity studies evaluated the effects of each chemical on various trees, wildflowers, grasses, and vegetable species. The plants were exposed to a variety of concentrations, soil types (with differing physicochemical properties), and exposure periods. Measurement endpoints common to the phytotoxicity tests included growth and yield parameters. Growth and yield measurements are direct estimates of the potential impacts to the plant community.

3.4.2.2 Vegetation Survey

Vegetation surveys were conducted by the Environmental Collaborative during May, June, and August, 1997. The various vegetation community types (i.e., agricultural field, shrub upland, pine plantation, forest, etc.) were evaluated based on species composition and structural diversity, including foliage height, spatial distribution, percent cover, age class, species distribution, and vegetation layering. These communities were described according to *Ecological Communities of New York State* (Reschke, 1991).

3.4.3 Risk Characterization for Terrestrial Vegetation

Risks presented to terrestrial vegetative communities inhabiting the Site, as determined by two lines of evidence (subsurface soil analysis and biological surveys), are discussed in the following sections.

3.4.3.1 Screening of Chemicals in Soils Against Benchmarks

COPECs in the soil were identified by comparing the minimum and maximum chemical concentrations measured in soils to the phytotoxicological screening benchmarks (Section 3.3.2) (Table B3). Hazard quotients (HQs) were calculated using the following equation:

$$\text{Hazard Quotient} = \frac{\text{Chemical Concentration in Soil}}{\text{Phytotoxicological Benchmark}}$$

If the HQ is less than or equal to 1, then the probability of adverse ecological impacts to terrestrial vegetation from chemical exposure is negligible. HQs greater than one indicate that a chemical is a COPEC and may potentially produce adverse ecological impacts to vegetation.

The following COPECs were identified during the screening process:

COPEC	Hazard Quotients (Range)
Aluminum	324-360
Arsenic	0.86-1.1
Boron	6.6-8.0
Chromium	21.4-23.6
Manganese	1.2
Nickel	0.98-1.1
Vanadium	9.7-10.4
Zinc	1.4-1.5

The potential for adverse impacts from these constituents are likely much lower since this screening process utilized the chemical concentration detected in buried sludges and subsurface soils below the water table within a small area of the Site known to exhibit groundwater contaminants. The soil samples were collected at the southern portion of the Old Cortland Landfill and, although unlikely, were assumed to be representative of concentrations measured in surface soils within the surrounding areas. The surface soil, which is the biological active zone, would likely contain lower concentrations of these COPECs. The toxicological profiles for each of these COPECs are provided in Appendix C.

3.4.3.2 Vegetation Surveys

The habitat found within the vicinity of the soil sample collection (SB-1, and SB-2) was classified as developed land (Reuter and Slack, 1997). Since the subsurface soil concentrations were assumed to be present in surface soil on a larger spatial scale (i.e., outside the developed land area), the status of the vegetative communities located in surrounding areas may be representative of potential existence of phytotoxicological impacts. The results of the vegetative survey within these surrounding areas is summarized below.

Vegetative communities surrounding the landfill (specifically at the soil sampling locations), include wetlands (e.g., wet meadow, emergent wetland, and shrub upland), deciduous forests, and open fields. These areas are composed of a diverse, abundant, and typical vegetative community characteristic of each habitat classification. The early successional deciduous forests were dominated by a mix of trembling aspen (*Betula populafolia*), black cherry (*Prunus serotina*), fire cherry (*Prunus pensylvanica*), chokecherry (*Prunus virginiana*), and black locust (*Robinia pseudo-acacia*). Common elderberry (*Sambucus canadensis*), northern blackberry (*Rubus allegheniensis*), honeysuckle (*Lonicera tatarica*), and red raspberry (*Rubus idaeus*) were common shrubs, while sugar maple (*Acer saccharum*), green ash (*Fraxinus pennsylvanica*), and white ash (*Fraxinus americana*) saplings were common. Overall, the deciduous forest community contained a total of 18 tree species, 9 shrub species, 15 herbaceous species, and 6 fern species (Reuter and Slack, 1997).

The wet meadows found within the surrounding areas of the settling ponds were dominated by a variety of herbaceous wetland species including various sedges (*Carex* spp.), spikerushes (*Eleocharis* spp.), and rushes (*Juncus* spp.). Slender mannagrass (*Glyceria melicaria*), spotted joe-pye-weed (*Eupatorium maculatum*), boneset (*Eupatorium perforatum*), marsh bedstraw (*Galium palustre*), purple loosestrife (*Lythrum salicaria*), shrub willows (*Salix* spp.), and broad-leaf spiraea (*Spiraea latifolia*) were also present within the wet meadows. The emergent wetland habitat, north of Pond 1 and surrounding the other settling ponds, was dominated by narrow leaved cattails (*Typha angustifolia*). Overall, the wetland habitat was composed of a total of 3 tree species, 26 herbaceous species, and 1 fern species (Reuter and Slack, 1997).

Old field areas, west of the Old Cortland Landfill, were dominated by forbs (broad-leaved flowering plants) and grasses. These areas were abandoned after they were cleared in the past for farming or development. At the time of the survey, the plant cover was dense (100% cover) in places where the land was originally farmed, while the landfill proper and associated facilities consisted of less than 100% vegetative cover. Although some plant species were tall, plants within these old field areas ranged in height from 1 to 3 feet. Overall, these areas contained diverse communities composed of approximately 6 tree species, 5 shrub species, and 54 herbaceous species (Reuter and Slack, 1997).

3.4.3.3 *Weight of Evidence Summary*

Two lines of evidence, media analysis and biological surveys, were evaluated to assess the ecological status of the vegetative community inhabiting the Site. Table 3-5 summarizes the lines of evidence evaluated to assess the potential ecological status of the community.

3.4.3.4 *Uncertainties Concerning Risks to the Vegetative Community*

Uncertainties associated with the evaluation of risks to the vegetative community are presented below.

- **Chemical Concentrations Measured in Subsurface Soil Samples.** Risks to the vegetative community were evaluated based on the concentrations measured in two subsurface soil samples. This evaluation assumes that these concentrations measured at the base of the landfill are equivalent to the concentrations potentially present in the surface soil in surrounding areas. This is an extremely conservative assessment which may overestimate the level of exposure and risk to the flora inhabiting the Site.

- **Bioavailability of Chemicals.** It was assumed that 100% of the chemical concentration reported in subsurface soils was bioavailable. The double acid extraction method used to determine the soil concentrations reflect the total potential pool of chemicals. The bioavailability of these chemicals is dependent upon the chemical (e.g., pH, organic carbon) and physical (e.g., clay, moisture content) nature of the soil and can not be addressed for this assessment. Therefore, exposure estimates based upon the chemical concentrations in soil are highly conservative and are likely to overestimate the actual chemical exposure experienced.

Table 3-5: Risk Characterization Summary for the Vegetative Community

Evidence	Result[a]	Explanation
Media Analyses	+	Aluminum, arsenic, boron, chromium, manganese, nickel, vanadium, and zinc concentrations in subsurface soil collected in developed areas exceeded phytotoxicity benchmarks and were identified as COPECs.
Biological Surveys	-	Surrounding vegetative communities in the wetland, deciduous forest, and open field habitats were very diverse and were composed of common typical plants found within the habitat classification. The results of this vegetative survey did not provide evidence of an impact on the vegetation inhabiting the Site.
Weight-of-Evidence	-	The conservative screening process resulted in the identification of several COPECs in a localized developed area. Based on the assumption that these subsurface concentrations are similar to that found in surface soils of the surrounding areas, the vegetative surveys indicates that these COPEC concentrations are unlikely impacting the plants. The potential risks from these metals are likely substantially reduced due to decreased bioavailability and exposure to the plants.

[a]+ Indicates that the evidence may result in a potential impact to species richness and abundance of the plant community.

\- Indicates that the evidence is not consistent with an impact on the species richness and abundance of the plant community.

- **Single Chemical Tests vs Exposure to Multiple Chemicals in the Field**. While plants are potentially exposed to multiple chemicals concurrently, published toxicological values only consider effects experienced by exposures to single chemicals. Because some chemicals can interact antagonistically, single chemical studies may overestimate their toxic potential. Similarly, for those chemicals that interact synergistically, single chemical studies may underestimate their toxic potential.

- **Inorganic Constituents or Species in the Environment**. Toxicity of metal species varies dramatically depending upon the valence state or form (organic or inorganic) of the metal. For example, arsenic III is more toxic than arsenic V. The available data on the chemical concentrations in media do not report which species or form of chemical was observed. Because benchmarks used for comparison represented the more toxic species, if the less toxic species/form of the metal was actually present in soil, potential toxicity at the site may be overestimated.

3.5 RISKS TO HERBIVOROUS WILDLIFE

This section presents the evaluation of risks to herbivorous wildlife from chemicals measured in surface soil and surface water collected from the Site.

3.5.1 Exposure Assessment for Herbivorous Wildlife

Wildlife may be exposed to contamination through dermal contact with water or soil, or through ingestion of contaminated water or food. However, since there are no conceptual models to estimate dermal contact, only dietary exposure was assessed. The total oral exposure experienced by an individual is the sum of exposures attributable to each source and may be described as:

$$E_{total} \approx E_{food} + E_{water} + E_{soil}$$

Where:

E_{total} = total exposure from all pathways

E_{food} = exposure from food consumption

E_{water} = exposure from water

E_{soil} = exposure from soil

For exposure estimates to be useful in the assessment of risks to wildlife, exposures must be expressed in terms of body weight-normalized daily dose or mg contaminant per kg body weight per day (mg/kg/d). Exposure estimates expressed in this manner may then be compared with toxicological benchmarks for wildlife, such as those derived by Sample et al. (1996), or to doses reported in the toxicological literature.

Estimation of the daily contaminant dose an individual may receive from a particular medium for a particular contaminant may be calculated using the following equation:

$$E_j = \sum_{I=1}^{m} \frac{(IR_i \times C_{ij})}{BW}$$

Where:

E_j	=	total exposure to contaminant (j) (mg/kg/d)
m	=	total number of ingested media (e.g., food, water, sediment/soil)
IR_j	=	consumption rate for medium (I) (kg/d or L/d)
C_{ij}	=	concentration of contaminant (j) in medium (I) (mg/kg or mg/L)
BW	=	body weight of endpoint species (kg).

Exposure estimates were calculated for all contaminants detected within soil at the Site. Because wildlife are mobile, their exposure is best represented by the mean contaminant concentration in media. To be conservative, the 95% upper confidence limit (UCL) is used in exposure estimates. However, since there are a limited number of soil samples, the maximum concentration was used to calculate exposure.

Herbivorous wildlife may be exposed to contaminants through their diet via ingestion of vegetation, surface water, or incidental ingestion of soil. The eastern cottontail and the whitetail deer were used as representative species for this trophic level in this BERA.

Exposure Parameters

The species-specific life history parameters used to calculate exposure for the Eastern cottontail and the whitetail deer are listed below. All exposure parameters are extracted from Sample and Suter (1994); however, the primary citation is indicated adjacent to the parameter.

To estimate contaminant exposure potentially experienced by the Eastern cottontail foraging on the Site, the following assumptions were made:

- Body weight = 1.2 kg (Chapman et al., 1980).
- Food consumption = 0.237 kg/d (Dalke and Sime, 1941).
- Soil consumption = 0.015 kg/d (Arthur and Gates, 1988).
- Surface water consumption = 0.116 L/d (Sample and Suter, 1994)
- Diet consists of 100% vegetation (Sample and Suter, 1994).

To estimate contaminant exposure potentially experienced by the whitetail deer foraging on the Site, the following assumptions were made:

- Body weight = 56.5 kg (Smith, 1991).
- Food consumption = 1.74 kg/d (Mautz et al. 1976).
- Soil consumption = 0.0348 kg/d (Beyer et al., 1994).
- Surface water consumption = 3.7 L/d (Sample and Suter, 1994)
- Diet consists of 100% vegetation (Sample and Suter, 1994).

Using the above equation, and the assumptions and data described above, exposure to contaminants were estimated for both endpoint receptors (Tables B4 and B5).

Contaminant Concentrations in Biotic and Abiotic Media

Contaminant concentrations in soil and vegetation are needed to estimate exposure. The maximum soil concentration was used to calculate incidental ingestion of soil for each endpoint species. The soil samples which were used in the calculations were collected at a depth ranging from - to 8 feet. Since subsurface soils were only collected at the Site, these concentrations were assumed to be similar to concentrations which may be present in surface soils. The use of the subsurface soil samples collected at the southern portion of the landfill is considered highly conservative since these concentrations are likely the highest measured on the Site.

Chemicals which were not detected or do not have associated wildlife ecotoxicological benchmarks were not evaluated. Chemical concentrations in vegetation on the Site were estimated using the maximum soil concentration and the soil-plant uptake factors. Literature-derived soil-plant uptake factors for inorganic constituents including arsenic, cadmium, lead, nickel, and selenium were derived at Oak Ridge National Laboratory (Sample et al., 1997). Other inorganic uptake factors were derived by Baes et al. (1984). Soil-plant uptake factors for organic constituents were derived from the log octanol-water partition coefficient (log K_{ow}) using the following equation (Travis and Arms, 1988):

$$\text{Log soil-plant uptake factor} = 1.588 - 0.578 (\log K_{ow})$$

Using the generalized wildlife model, exposure assumptions and data described above, exposure to chemicals were estimated for both endpoint receptors (Tables B4 and B5).

3.5.2 Effects Assessment for Herbivorous Wildlife

To determine if the contaminant exposure experienced by herbivorous wildlife foraging on the Site could produce adverse effects, exposure estimates from Section 3.3.1 were compared to No Observed Adverse Effects Levels (NOAELs) and Lowest Observed Adverse Effects Levels (LOAELs) derived according to the methods outlined by Sample et al., (1996) and USEPA (1993). NOAELs represent the highest exposure at which no adverse effects were observed among the animals tested. LOAELs represent the lowest exposure at which significant adverse effects are observed.

Toxicological studies of the effects of contaminants observed within the soil were obtained from the open literature. Studies of the effects of long-term, chronic oral exposures, whether in food, water, or by oral intubation, were used. To make the NOAELs and LOAELs relevant to possible population effects, preference was given to studies that evaluated effects on reproductive parameters. In the absence of a reproduction endpoint, studies that considered effects on growth, survival, and longevity were used.

Smaller animals have higher metabolic rates and are usually more resistant to toxic chemicals because of more rapid rates of detoxification. It has been shown that metabolism is proportional to body surface area which, for lack of direct measurements, can be expressed in terms of body weight (bw) raised to the 3/4 power ($bw^{3/4}$) (Travis and White, 1988; Travis et al., 1990; and USEPA, 1992b). If the dose (d) itself has been calculated in terms of unit body weight (i.e., mg/kg), then the dose per unit body surface area (D) equates to:

$$D = \frac{d \ x \ bw}{bw^{3/4}} = d \ x \ bw^{1/4} \qquad (1)$$

The assumption is that the effective dose per body surface area for species "a" and "b" would be equivalent. Therefore, knowing the body weights of two species and the dose (d_b) producing a given effect in species "b," the dose (d_a) producing the same effect in species "a" can be determined. Using this approach, if a NOAEL was available for the test species ($NOAEL_t$), the equivalent NOAEL for a wildlife species ($NOAEL_w$) was calculated by using the adjustment factor for differences in body size:

$$NOAEL_w = NOAEL_t \left(\frac{bw_t}{bw_w} \right)^{1/4} \qquad (2)$$

This methodology is equivalent to that the USEPA uses in their carcinogenicity assessments and Reportable Quantity documents for adjusting from animal data to an equivalent human dose.

In cases where a NOAEL for a specific chemical was not available, but a LOAEL had been determined experimentally or where the NOAEL was from a subchronic study, the chronic NOAEL was estimated. USEPA (1993) suggests the use of uncertainty factors of 1 to 10 for subchronic to chronic NOAEL and LOAEL to NOAEL estimation. Because no data were available to suggest the use of lower values, uncertainty factors of 10 were used in all instances in which they were required.

3.5.3 Risk Characterization for Herbivorous Wildlife

Only one line of evidence, chemical toxicity data, was available for the assessment of risks to herbivorous wildlife. The evaluation of risks to herbivorous wildlife from the consumption of vegetation, soil and surface water from the Site are discussed in the following sections.

3.5.3.1 Screening of Chemical Exposure Estimates Against Benchmarks

Chemicals of potential concern for Eastern cottontail and whitetail deer were identified by comparing the total chemical exposure experienced by each receptor to the NOAEL. HQs were calculated using the following formula:

$$HQ = \frac{\text{Estimated Exposure (mg/kg/d)}}{\text{NOAEL}}$$

HQs greater than one indicate that individuals may experience adverse effects from the consumption of soil and surface water at the Site. Chemical concentrations predicted in vegetation and measured in soil and water, ecotoxicological benchmarks, and associated HQs are presented in Tables B4 and B5. The results of this risk screening process identified the following COPECs from ingestion of plants, soil, and surface water on the Site for each endpoint.

Whitetail Deer

Aluminum and arsenic were the only COPECS which may pose a risk to whitetail deer foraging in the Site. Total exposure to aluminum and arsenic were in excess of NOAELs by 45.4 to 11.1 times, respectively. The total exposures also exceeded the LOAEL by 4.5 and 1.1 times. Therefore, there is a potential for individual whitetail deer foraging at the Site to experience adverse impacts from aluminum and arsenic exposure. This statement is only valid if: 1) the maximum concentration measured in the subsurface soil is similar to the surface soils of the entire Site, 2) the contaminated area of the Site is similar in size to the foraging territory (average= 27 acres [Sample and Suter, 1994]) of the deer, 3) 100% of the deer's exposure is obtained from this area, and 4) the soil-plant uptake factors are accurate, providing a realistic predicted concentration in the vegetation at the Site.

It is highly unlikely that these conditions are realistically occurring on the Site. The maximum aluminum and arsenic concentrations measured in subsurface soils are likely much higher than surface soil. More importantly, the home range of the deer is much greater than the localized soil contamination. The total chemical exposure which the deer would be experiencing is much less than the conservative estimate (i.e., assuming 100% of diet from location with maximum chemical concentration) calculated for this BERA. The potential impacts from aluminum and arsenic exposure are discussed in the toxicological profiles for wildlife provided in Appendix C.

Eastern Cottontail

Aluminum, arsenic, and vanadium were the only COPECS which may pose a risk to eastern cottontails foraging in the Site. Total exposure to aluminum, arsenic, and vanadium were in excess of NOAELs by 311.9, 27.3, and 1.98 times, respectively. The total exposures also exceeded the LOAEL for aluminum and arsenic by 31 and 2.7 times. Therefore, there is a potential for individual eastern cottontails foraging at the Site to experience adverse impacts from aluminum and arsenic exposure. Adverse impacts from vanadium exposure are highly unlikely, since exposure is only 19% of the LOAEL. These statements are only valid if: 1) the maximum concentration measured in the subsurface soil is similar to the surface soils of the entire Site, 2) the foraging territory is maintained within the most contaminated areas of the Site, 3) 100% of the cottontail's exposure is obtained from this area, and 4) the soil-plant uptake factors are accurate providing a realistic predicted concentration in the vegetation at the Site.

The potential impacts from aluminum and arsenic exposure are discussed in detail in the toxicological profile provided in Appendix C.

3.5.3.2 Weight of Evidence Summary

The screening process for this assessment identified aluminum and arsenic exposures slightly in excess of LOAELs for both whitetail deer and eastern cottontails. These exposure estimates are highly conservative for both receptors as a result of: 1) the conservative modeling techniques used to predict the chemical concentration in vegetation; 2) the assumption of 100% dietary intake within the area; and 3) the assumption of 100% chemical bioavailability. In reality, the exposure from aluminum and arsenic is greatly minimized and unlikely impacts the population of deer and cottontails inhabiting the Site.

3.5.3.3 Uncertainties Concerning Risks to Herbivorous Wildlife

The following issues constitute the major sources of uncertainty in the risk assessment for herbivorous wildlife.

- **Soil to Vegetation Uptake Factors**. There is a large degree of uncertainty when using soil to vegetation uptake factors to model chemicals found in vegetation. Uptake factors of inorganics will vary by soil condition (i.e., pH, water availability, organic matter content, texture, aeration, elemental concentrations, etc.) (Sommers et al., 1987; Chaney et al., 1984).

Using plant uptake factors assumes that all species and all soil conditions will result in the same uptake rate. Also, using uptake factors assumes that the uptake rate is best estimated by taking the average of all observed values. The Site specific factors were not taken into consideration for the uptake factors which were used. Therefore, the predicted contaminant concentrations in vegetation may be overestimated or underestimated; thus overestimating or underestimating contaminant exposure for herbivorous wildlife.

- **Bioavailability of Chemicals**. It was assumed that 100% of the chemical concentrations reported in soil and modeled vegetation were bioavailable. The double acid extraction method used to determine soil concentrations reflects the total potential pool of chemicals. The future bioavailability of these contaminants, which is dependent upon the chemical (e.g., pH, organic carbon) and physical (e.g., clay, moisture content) nature of the soil, can not be addressed for this assessment. Therefore, exposure estimates based upon the contaminant concentrations in media are highly conservative and are likely to overestimate the actual chemical exposure experienced.
- **Extrapolation from Published Toxicity Data**. To estimate toxicity of contaminants at the Site, it was necessary to extrapolate from NOAELs observed for test species (i.e., rats and mice). While it was assumed that toxicity could be estimated as a function of body size, the accuracy of the estimate is not known. For example, eastern cottontails may be more or less sensitive than rats or mice to a particular chemical.

  Additional extrapolation uncertainty exists for those chemicals for which data consisted of either LOAELs or was subchronic in duration. For either case, an uncertainty factor of 0.1 was employed to estimate NOAELs or chronic data. The uncertainty factor of 0.1 may either over- or underestimate the actual LOAEL-NOAEL or subchronic-chronic relationship.

- **Variable Food and Water Consumption.** While food consumption by wildlife was assumed to be similar to that reported for the same species in other locations, the validity of this assumption cannot be determined. Food consumption on the Site may be greater or less than that reported in the literature, resulting in either an increase or decrease in chemical exposure. Similarly, water consumption was estimated according to the allometric equations of Calder and Braun (1983). The accuracy with which the estimated water consumption represents actual water consumption is unknown.

- **Representativeness of Subsurface Soil Samples**. The maximum chemical concentration measured in two subsurface soil samples located at the southern portion of the landfill were used for this assessment. The use of the maximum subsurface soil sample likely overestimates the potential exposure to surface soils in the surrounding areas, thus overestimating the potential for impacts to herbivorous wildlife inhabiting the Site.

4.0 CONCLUSIONS

The conclusions of the HHRA and BERA are presented in the following sections.

4.1 HHRA

The following conclusions have been drawn regarding the results of the HHRA for exposure of residents, recreators, and trespassers to detected concentrations of COPCs in soil, surface water, sediment, and groundwater at the Site. Concentrations of commonly found, naturally occurring metals in the various media were the primary COPCs contributing to the risk to receptors. In the absence of site-specific background concentrations for metals, all compounds that exceeded the NYSDEC criteria in the various media were evaluated as COPCs.

Residents

Residents were assumed to be exposed to COPCs in groundwater via ingestion. It should be cautioned that this was a conservative evaluation for screening purposes, as groundwater is not utilized at the Site for drinking purposes. Groundwater data at the Site was differentiated between the overburden and bedrock aquifers. Residential exposure to groundwater is generally evaluated based on bedrock data. However, upon evaluation of the groundwater data for the Site, it was observed that the shallow monitoring wells representing the overburden aquifer had higher concentrations of chemicals detected, as compared to the deep wells representing the bedrock aquifer. Due to the possibility of COPCs migrating from the overburden to the bedrock zone, both sets of data, including both dissolved and total concentrations, were evaluated to provide a range of risk estimates. In summary, four data groups were used to calculate exposure point concentrations (EPCs) for residential exposure to groundwater.

Noncarcinogenic hazard to adult and child residents from ingestion of groundwater ranged from 6.3 to 82.8 exceeding the USEPA target level of 1. The carcinogenic risk to adult and child residents from ingestion of groundwater ranged from 9×10^{-7} to 2.48×10^{-3}. An HI of 6.3 and a carcinogenic risk of 9×10^{-7} represent the potential risk from ingestion of filtered bedrock groundwater, which is the most plausible, yet unlikely exposure, in this hypothetical scenario. The carcinogenic risk calculated under the most likely scenario is acceptable and lower then the USEPA range of 1×10^{-6} to 1×10^{-4}. The noncarcinogenic risks were based on concentrations of manganese detected in the groundwater.

Recreators

Recreators were assumed to be exposed to COPCs at the Site via dermal exposure to surface water and sediment; and incidental ingestion of sediment while wading and fishing at the Maybury Brook. The noncarcinogenic HI of 0.002 for exposure to adult and child recreators wading and fishing at the Maybury Brook was within USEPA's target of 1. There was no carcinogenic risk to recreators based on aluminum, the only COPC identified in both surface water and sediment that recreators were likely to be exposed to.

Trespassers

Trespassers were assumed to be exposed to COPCs at the Site via dermal exposure to soil, surface water, and sediment; and incidental ingestion of soil and sediment. The total noncarcinogenic HI of 0.017 and carcinogenic risk of 1.9×10^{-6} for exposure to adult trespassers at the Site were within USEPA acceptable levels.

In conclusion, the primary COPCs responsible for risks to human health at the Site were inorganic constituents (primarily manganese). While it is possible that some level of metals may be derived from landfill contents, the metals identified during the groundwater sampling are naturally occurring constituents. Therefore, background concentrations may be contributed by upgradient sources. Capping the landfill (or the excavation of waste disposal areas) will serve to reduce infiltration via rainfall percolation, thus restricting migration of COPCs within groundwater under the cap. This action will act as source control measure, and will allow for natural attenuation to reduce manganese levels to within State standards. Based on the findings of minimal risk by the HHRA, and knowing that there are no human receptors exposed to groundwater, it can be concluded that capping the landfill will be appropriate in terms of addressing concerns of human health impacts derived under the hypothetical groundwater ingestion scenario.

4.2 BERA

This BERA characterizes the current or potential toxicological impacts associated with exposure of terrestrial and aquatic flora and fauna to site-related COPECs. The conclusions for this BERA are presented for the fish, benthic macroinvertebrate, vegetation, and herbivorous wildlife communities inhabiting the Site. Table 4-1 presents a summary of all COPECs identified during the screening process for each media and ecological endpoint. The following conclusions can be made concerning the potential for impacts to ecological receptors from exposure to chemical constuents at the Site.

- **Fish Community**: The screening process of chemicals detected in surface water indicated that barium and/or manganese (measured in both filtered and unfiltered samples) may chronically impact the fish community inhabiting localized areas within the Unnamed Tributary, Pond 1, and Maybury Brook. Aluminum, iron, and total phenol also slightly exceeded chronic benchmarks in unfiltered surface water samples (Table 4-1). These constituents are particle bound and are unlikely available to fish.

  The concentrations of COPECs have not impacted the reproductive success of the fish, nor resulted in acute toxic responses (unobserved during fish surveys). Potential impacts which may be experienced by aquatic biota in the Unnamed Tributary are likely more dependent on the intermittent nature and the habitat of the stream. Therefore, it is believed that the risks to this community are over estimated on the basis of the chemical data and do not represent true impacts.

Barium which was identified as a COPEC in Maybury Brook is not site-related, since barium was measured at higher levels at the upstream location.

Table 4-1. COPECs Identified in Surface Water, Sediment, and Soil Which May Pose a Risk to Fish, Benthic Macroinvertebrate, Vegetation, or Wildlife Communities.

Location	COPEC	Surface Water	Sediment	Soil	
		Fish	Benthic Macroinvertebrates	Vegetation	Wildlife
Upstream Unnamed Tributary (SW-1 or SED-1)	Acetone		✓[c]		
	Arsenic		✓[d]		
	Barium	✓[a]	✓[c]		
	Chromium		✓[d]		
	Copper		✓[d]		
	Iron		✓[c]		
	Manganese	✓[a]	✓[c]		
	Nickel		✓[d]		
	Zinc		✓[d]		
	Ammonia		✓[c]		
	TKN		✓[d]		
	TOC		✓[d]		
Downstream Unnamed Tributary (SW-2 or SED-2)	Aluminum	✓[b]			
	Arsenic		✓[d]		

Table 4-1. COPECs Identified in Surface Water, Sediment, and Soil Which May Pose a Risk to Fish, Benthic Macroinvertebrate, Vegetation, or Wildlife Communities.

Location	COPEC	Surface Water	Sediment	Soil	
		Fish	Benthic Macroinvertebrates	Vegetation	Wildlife
Downstream Unnamed Tributary (SW-2 or SED-2)	Barium	✓ [a]			
	Iron		✓ [d]		
	Manganese	✓ [a]	✓ [c]		
	Nickel		✓ [d]		
Pond 1 (SW-3 or SED-3)	Aluminum	✓ [b]			
	Arsenic		✓ [d]		
	Barium	✓ [a]			
	Chromium		✓ [d]		
	Copper		✓ [d]		
	Iron	✓ [b]	✓ [c]		
	Manganese	✓ [a]	✓ [c]		
	Nickel		✓ [c]		
	TDS	✓ [b]			
	TKN		✓ [d]		
	TOC		✓ [d]		

Table 4-1. COPECs Identified in Surface Water, Sediment, and Soil Which May Pose a Risk to Fish, Benthic Macroinvertebrate, Vegetation, or Wildlife Communities.

Location	COPEC	Surface Water	Sediment	Soil	
		Fish	Benthic Macroinvertebrates	Vegetation	Wildlife
Pond 1 (SW-3 or SED-3)	Total Phenol	✓ [b]			
	Zinc		✓ [d]		
Upstream Maybury Brook (SW-4 or SED-4)	Barium	✓ [a]			
	Copper		✓ [d]		
	Iron		✓ [d]		
	Manganese		✓ [d]		
	Nickel		✓ [d]		
	Total Phenol	✓ [b]			
Downstream Maybury Brook (SW-5 or SED-5)	Aluminum	✓ [b]			
	Arsenic		✓ [d]		
	Barium	✓ [a]			
	Copper		✓ [d]		
	Iron		✓ [d]		
	Manganese		✓ [d]		
	Nickel		✓ [d]		
	Total Phenol	✓ [b]			

Table 4-1. COPECs Identified in Surface Water, Sediment, and Soil Which May Pose a Risk to Fish, Benthic Macroinvertebrate, Vegetation, or Wildlife Communities.

Location	COPEC	Surface Water	Sediment	Soil	
		Fish	Benthic Macroinvertebrates	Vegetation	Wildlife
Pond 4 (SED-6)	Copper		✓ [d]		
	Iron		✓ [d]		
	Nickel		✓ [d]		
Landfill Area	Aluminum			✓	✓ [f]
	Arsenic			✓	✓ [f]
	Boron			✓	
	Chromium			✓	
	Manganese			✓	
	Nickel			✓	
	Vanadium			✓	✓ [g]
	Zinc			✓	

Notes:

[a] Concentration in both total and dissolved surface water exceeded ecotoxicological benchmarks.
[b] Concentration in total surface water exceeded ecotoxicological benchmarks.
[c] Concentration in sediment exceeded a Sediment Quality Benchmark (SQB), Open Water Disposal benchmark, or WI DNR Sediment Quality Criteria (SQC).
[d] Concentration in sediment exceeded an LEL, but was less than an SEL.
[e] Concentration in sediment exceeded both the LEL and the SEL.
[f] Exposure estimate exceeded both the NOAEL and the LOAEL for whitetail deer and eastern cottontails.
[g] Exposure estimate exceeded only the NOAEL for eastern cottontails.

- **Benthic Macroinvertebrate Community**: The results of the conservative screening process indicated the presence of COPECs in sediments in the Unnamed Tributary, Maybury Brook, Pond 1 and Pond 4 (Table 4-1). These COPECs indicate a minimal potential impact to benthic macroinvertebrate communities inhabiting these locations. However, impacts appear to be overestimated and not representative of actual conditions since the benthic macroinvertebrate community was diverse, abundant, and dominated by sensitive species. The apparent absence of actual impacts may be attributed to the decreased bioavailability of the COPECs from the presence of AVS, TOC, and small grain size.

- **Vegetative Community**: The conservative screening process identified COPECs (Table 4-1) in subsurface soil collected in the developed area of the Old Cortland Landfill. The surrounding vegetative communities in the wetlands, deciduous forests, and open field habitats were very diverse and were composed of common typical plants found within the habitat classification. Despite the conservative assumption that the subsurface concentrations are similar to that found in surface soils of the surrounding areas, the vegetative surveys indicated that the COPECs are unlikely impacting the plants. The potential risks from these metals appear to be reduced due to the decreased bioavailability and exposure to plants. Any potential risks associated with the COPECs will be eliminated following the installation of a cap directly over the landfill.

- **Herbivorous Wildlife**: The screening process identified aluminum and arsenic exposures slightly in excess of LOAELs for both whitetail deer and eastern cottontails. The exposure estimates, as a result of the consumption of vegetation and soil, are considered highly conservative due to 1) the use of the maximum chemical concentration measured in subsurface soils; 2) the conservative modeling techniques used to predict chemical concentrations in vegetation; 3) the actual large home range of the receptors which minimizes the exposure from foraging on the small localized areas of identified subsurface contamination; and 4) the reduced bioavailability of the chemical after ingestion. In consideration of these conservative assumptions, it is unlikely that the actual exposure from aluminum and arsenic would result in any impacts to the population of herbivorous wildlife (specifically deer and cottontails) inhabiting the Site. Any potential impacts to wildlife which may exist on Site will be eliminated due to the installation of a cap on the landfill proper.

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Table A-1: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Surface water in Adult Trespasser

Carcinogenic Risk Estimate
Absorbed Intake = CW*SA*PC*CF*EF*ED/(BW*ATc)
Estimated Risk =Absorbed Intake*CSF

COPC: Constituent of Potential Concern	**CW** Conc. in Surface water (mg/L)	**SA** Exposed Surface Area (skin) (cm2)	**PC** Permeability Constant (cm/hr)	**CF** Conversion Factor (L/cm^3)	**ET** Exposure Time (hr/day)	**EF** Exposure Frequency (days/yr)	**ED** Exporure Duration (years)	**BW** Body Weight (kg)	**ATc** Averaging Time (days)	**Intake** (mg/kg-day)	**CSF** Cancer Slope Factor (mg/kg-day)-1	**Carcinogenic Risk Estimate**
Aluminum	0.36	4985	1.60E-04	1.00E-03	2	32	30	70	25550	3.08E-07	NE	NA
Arsenic	0.0016	4985	1.60E-04	1.00E-03	2	32	30	70	25550	1.37E-09	1.50E+00	2.05E-09
Iron	2.5	4985	1.60E-04	1.00E-03	2	32	30	70	25550	2.14E-06	NE	NA
Manganese	2.1	4985	1.60E-04	1.00E-03	2	32	30	70	25550	1.80E-06	NE	NA
											Total Risk:	**2.05E-09**

Noncarcinogenic Hazard Quotient
Absorbed Intake = CW*SA*PC*CF*EF*ED/(BW*ATnc)
Hazard Quotient = Absorbed Intake/RFD

COPC: Constituent of Potential Concern	**CW** Conc. In Surface Water (ppm)	**SA** Exposed Surface Area (skin) (cm2)	**PC** Sed. to skin Adherence Factor (cm/hr)	**CF** Conversion Factor (L/cm^3)	**ET** Exposure Time (hr/day)	**EF** Exposure Frequency (days/yr)	**ED** Exporure Duration (years)	**BW** Body Weight (kg)	**ATnc** Averaging Time (days)	**Intake** (mg/kg-day)	**RFD** Oral Chronic (mg/kg-day)	**Non-Carcinogenic Hazard Quotient**
Aluminum	0.36	4985	1.60E-04	1.00E-03	2	32	30	70	8760	8.99E-07	1.00E+00	8.99E-07
Arsenic	0.0016	4985	1.60E-04	1.00E-03	2	32	30	70	10950	3.20E-09	3.00E-04	1.07E-05
Iron	2.5	4985	1.60E-04	1.00E-03	2	32	30	70	10950	4.99E-06	3.00E-01	1.66E-05
Manganese	2.1	4985	1.60E-04	1.00E-03	2	32	30	70	10950	4.20E-06	2.30E-02	1.82E-04
											Total HI:	**2.11E-04**

NE: none established

Table A-2: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Surface water in Child Recreator

Carcinogenic Risk Estimate
Absorbed Dose = (CW*SA*PC*ET*EF*ED*CF)/(BW*ATc)
Estimated Risk = Absorbed Dose*CSF

COPC: Chemical of Potential Concern	CW Chemical Conc. in Water (ppm or mg/L)	SA Exposed Surface Area (skin) (cm2)	PC* Permeability Constant (Chemical specific) (cm/hr)	ET Exposure Time (hrs/day)	EF Exosure Frequency (days/yr)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	CF Conversion Factor (L/cm3)	Absorbed Dose (mg/kg-day)	CSF Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate Mean
Aluminum	0.17	2,299	1.60E-04	4	32	6	15	25550	1.00E-03	1.25E-07	NA	NA

Noncarcinogenic Risk Estimate
Absorbed Dose = (CW*SA*PC*ET*EF*ED*CF)/(BW*ATnc)
Hazard Quotient = Absorbed Dose/RFD

COPC: Chemical of Potential Concern	CW Chemical Conc. in Water (ppm or mg/L)	SA Exposed Surface Area (skin) (cm2)	PC* Permeability Constant (Chemical specific) (cm/hr)	ET Exposure Time (hrs/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	CF Conversion Factor (L/cm3)	Absorbed Dose Mean (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	0.17	2,299	1.60E-04	4	32	6	15	2190	1.00E-03	1.46E-06	1.00E+00	1.46E-06

Table A-3: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Surface water in Adult Recreator

Carcinogenic Risk Estimate
Absorbed Dose = (CW*SA*PC*ET*EF*ED*CF)/(BW*ATc)
Estimated Risk = Absorbed Dose*CSF

COPC: Chemical of Potential Concern	CW Chemical Conc. in Water (ppm or mg/L)	SA Exposed Surface Area (skin) (cm2)	PC* Permeability Constant (Chemical specific) (cm/hr)	ET Exposure Time (hrs/day)	EF Exosure Frequency (days/yr)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	CF Conversion Factor (L/cm3)	Absorbed Dose (mg/kg-day)	CSF Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate Mean
Aluminum	0.17	4,985	1.60E-04	4	32	24	70	25550	1.00E-03	2.33E-07	NA	NA

Noncarcinogenic Risk Estimate
Absorbed Dose = (CW*SA*PC*ET*EF*ED*CF)/(BW*ATnc)
Hazard Quotient = Absorbed Dose/RFD

COPC: Chemical of Potential Concern	CW Chemical Conc. in Water (ppm or mg/L)	SA Exposed Surface Area (skin) (cm2)	PC* Permeability Constant (Chemical specific) (cm/hr)	ET Exposure Time (hrs/day)	EF Exposure Frequency (days/yr)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	CF Conversion Factor (L/cm3)	Absorbed Dose Mean (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	0.17	4,985	1.60E-04	4	32	24	70	8760	1.00E-03	6.79E-07	1.00E+00	6.79E-07

Table A-4: Carcinogenic and Noncarcinogenic Risk Estimates for Sediment Ingestion in Adult Recreator

Carcinogenic Risk Estimate
Intake = CS*IR*CF*FI*ABS*EF*ED*1/BW*1/ATc
Estimated Risk = Intake*CSFo

COC: Chemical of Concern	CS Chemical concentration in sediment (mg/kg)	IR Ingestion Rate (mg sed/day)	CF Conversion Factor (kg/mg)	FI Fraction Ingested from Contaminated Source (unitless)	RAF Fraction of Contaminant Absorbed (unitless)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Aluminum	13000	50	1.00E-06	1	1	32	24	70	25550	2.79E-04	NE	NA

Noncarcinogenic Hazard Quotient
Intake = CS*IR*CF*FI*ABS*EF*ED*1/BW*1/ATnc
Hazard Quotient = Intake/RFD

COC: Chemical of Concern	CS Chemical concentration in sediment (mg/kg)	IR Ingestion Rate (mg sed/day)	CF Conversion Factor (kg/mg)	FI Fraction Ingested from Contaminated Source (unitless)	RAF Fraction of Contaminant Absorbed (unitless)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	13000	50	1.00E-06	1	1	32	24	70	8760	8.14E-04	1.00E+00	8.14E-04

NE: none established

Table A-5: Carcinogenic and Noncarcinogenic Risk Estimates for Sediment Ingestion in Child Recreator

Carcinogenic Risk Estimate
Intake = CS*IR*CF*FI*RAF*EF*ED*1/BW*1/ATc
Estimated Risk = Intake*CSFo

COC: Chemical of Concern	**CS** Chemical concentration in sediment (mg/kg)	**IR** Ingestion Rate (mg sed/day)	**CF** Conversion Factor (kg/mg)	**FI** Fraction Ingested from Contaminated Source (unitless)	**RAF** Fraction of Contaminant Absorbed (unitless)	**EF** Exposure Frequency (days/year)	**ED** Exposure Duration (years)	**BW** Body Weight (kg)	**ATc** Averaging Time: carcinogen (days)	**Intake** (mg/kg-day)	**CSF** Cancer Slope Factor (mg/kg-day)-1	**Carcinogenic Risk** Estimate
Aluminum	13000	100	1.00E-06	1	1	32	6	15	25550	6.51E-04	NE	NA

Noncarcinogenic Hazard Quotient
Intake = CS*IR*CF*FI*ABS*EF*ED*1/BW*1/ATnc
Hazard Quotient = Intake/RFD

COC: Chemical of Concern	**CS** Chemical concentration in sediment (mg/kg)	**IR** Ingestion Rate (mg sed/day)	**CF** Conversion Factor (kg/mg)	**FI** Fraction Ingested from Contaminated Source (unitless)	**RAF** Fraction of Contaminant Absorbed (unitless)	**EF** Exposure Frequency (days/year)	**ED** Exposure Duration (years)	**BW** Body Weight (kg)	**ATnc** Averaging Time: noncarcinogen (days)	**Intake** (mg/kg-day)	**RFD** Oral Chronic (mg/kg-day)	**Non-Carcinogenic Hazard Quotient**
Aluminum	13000	100	1.00E-06	1	1	32	6	15	2190	7.60E-03	1.00E+00	7.60E-03

NE: none established
NA: not applicable

Table A-6: Carcinogenic and Noncarcinogenic Risk Estimates for Sediment Ingestion in Adult Trespasser

Carcinogenic Risk Estimate
Intake = CS*IR*CF*FI*RAF*EF*ED*1/BW*1/ATc
Estimated Risk = Intake*CSFo

COC: Chemical of Concern	CS Chemical concentration in sediment (mg/kg)	IR Ingestion Rate (mg sed/day)	CF Conversion Factor (kg/mg)	FI Fraction Ingested from Contaminated Source (unitless)	RAF Fraction of Contaminant Absorbed (unitless)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Acetone	0.24	50	1.00E-06	1	1	32	30	70	25550	6.44E-09	NE	NA
Aluminum	23000	50	1.00E-06	1	1	32	30	70	25550	6.17E-04	NE	NA
Arsenic	27	50	1.00E-06	1	1	32	30	70	25550	7.25E-07	1.50E+00	1.09E-06
Barium	710	50	1.00E-06	1	1	32	30	70	25550	1.91E-05	NE	NA
											Total Risk:	**1.09E-06**

Noncarcinogenic Hazard Quotient
Intake = CS*IR*CF*FI*ABS*EF*ED*1/BW*1/ATnc
Hazard Quotient = Intake/RFD

COC: Chemical of Concern	CS Chemical concentration in sediment (mg/kg)	IR Ingestion Rate (mg sed/day)	CF Conversion Factor (kg/mg)	FI Fraction Ingested from Contaminated Source (unitless)	RAF Fraction of Contaminant Absorbed (unitless)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Acetone	0.24	50	1.00E-06	1	1	32	30	70	10950	1.50E-08	1.00E-01	1.50E-09
Aluminum	23000	50	1.00E-06	1	1	32	30	70	10950	1.44E-03	1.00E+00	1.44E-03
Arsenic	27	50	1.00E-06	1	1	32	30	70	10950	1.69E-06	3.00E-04	5.07E-10
Barium	710	50	1.00E-06	1	1	32	30	70	10950	4.45E-05	7.00E-02	3.11E-06
											Total HI:	**1.44E-03**

NA: not applicable
NE: not established

Table A-7: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Sediment in Adult Recreator

Carcinogenic Risk Estimate
Absorbed Intake = CS*SA*AF*RAF*CF*EF*ED/(BW*ATc)
Estimated Risk =Absorbed Intake*CSF

COPC: Chemical of Potential Concern	CS Conc. in Sediment (mg/kg)	SA Exposed Surface Area (skin) (m2)	AF Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (kg/mg)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATc Averaging Time (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Aluminum	13000	0.4985	0.01	0.01	1.00E-06	32	24	70	25550	2.78E-08	NE	NA

Noncarcinogenic Hazard Quotient
Absorbed Intake = CW*SA*PC*CF*EF*ED/(BW*ATnc)
Hazard Quotient = Absorbed Intake/RFD

COPC: Chemical of Potential Concern	CS Conc. In Sediment (ppm)	SA Exposed Surface Area (skin) (m2)	AF Sed. to skin Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (L/cm^3)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	13000	0.4985	0.01	0.01	1.00E-06	32	24	70	8760	8.12E-08	1.00E+00	8.12E-08

NE: none established
NA: not applicable

Table A-8: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Sediment in Child Recreator

Carcinogenic Risk Estimate
Absorbed Intake = CS*SA*AF*RAF*CF*EF*ED/(BW*ATc)
Estimated Risk =Absorbed Intake*CSF

COPC: Chemical of Potential Concern	CS Conc. in Sediment (mg/kg)	SA Exposed Surface Area (skin) (m2)	AF Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (kg/mg)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATc Averaging Time (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Aluminum	13000	0.2299	0.01	0.01	1.00E-06	32	6	15	25550	1.50E-08	NE	NA

Noncarcinogenic Hazard Quotient
Absorbed Intake = CW*SA*PC*CF*EF*ED/(BW*ATnc)
Hazard Quotient = Absorbed Intake/RFD

COPC: Chemical of Potential Concern	CS Conc. In Sediment (ppm)	SA Exposed Surface Area (skin) (cm2)	AF Sed. to skin Adherence Factor (kg/m2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (kg/mg)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	13000	0.2299	0.01	0.01	1.00E-06	32	6	15	2190	1.75E-07	1.00E+00	1.75E-07

NE: none established
NA: not applicable

Table A-9: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Sediment in Adult Trespasser

Carcinogenic Risk Estimate
Absorbed Intake = CS*SA*AF*RAF*CF*EF*ED/(BW*ATc)
Estimated Risk =Absorbed Intake*CSF

COPC: Chemical of Potential Concern	CW Conc. in Sediment (mg/kg)	SA Exposed Surface Area (skin) (m2)	AF Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (kg/mg)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATc Averaging Time (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Acetone	0.24	0.4985	0.01	0.25	1.00E-06	32	30	70	25550	6.42E-13	NE	NA
Aluminum	23000	0.4985	0.01	0.010	1.00E-06	32	30	70	25550	6.15E-08	NE	NA
Arsenic	27	0.4985	0.01	0.032	1.00E-06	32	30	70	25550	2.31E-12	1.50E+00	3.47E-12
Barium	710	0.4985	0.01	0.010	1.00E-06	32	30	70	25550	1.90E-09	NE	NA
											Total Risk:	**3.47E-12**

Noncarcinogenic Hazard Quotient
Absorbed Intake = CW*SA*PC*CF*EF*ED/(BW*ATnc)
Hazard Quotient = Absorbed Intake/RFD

COPC: Chemical of Potential Concern	CW Conc. in Sediment (mg/kg)	SA Exposed Surface Area (skin) (m2)	AF Sed. to skin Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (kg/mg)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Acetone	0.24	0.4985	0.01	0.25	1.00E-06	32	30	70	10950	3.75E-13	1.00E-01	3.75E-12
Aluminum	23000	0.4985	0.01	0.01	1.00E-06	32	30	70	10950	1.44E-09	1.00E+00	1.44E-09
Arsenic	27	0.4985	0.01	0.032	1.00E-06	32	30	70	10950	5.39E-12	3.00E-04	1.80E-08
Barium	710	0.4985	0.01	0.010	1.00E-06	32	30	70	10950	4.43E-11	7.00E-02	6.33E-10
											Total Risk:	**2.01E-08**

NE: none established
NA: not applicable

Table A-10: Carcinogenic and Noncarcinogenic Risk Estimates for Soil Ingestion in Adult Trespasser

Carcinogenic Risk Estimate
Intake = CS*IR*CF*FI*RAF*EF*ED*1/BW*1/ATc
Estimated Risk = Intake*CSFo

COPC: Chemical of Potential Concern	CS Chemical concentration in soil (mg/kg)	IR Ingestion Rate (mg soil/day)	CF Conversion Factor (kg/mg)	FI Fraction Ingested from Contaminated Source (unitless)	RAF Fraction of Contaminant Absorbed (unitless)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Aluminum	18000	50	1.00E-06	1	1	52	30	70	25550	7.85E-04	NE	NA
Antimony	0.85	50	1.00E-06	1	1	52	30	70	25550	3.71E-08	NE	NA
Arsenic	11	50	1.00E-06	1	1	52	30	70	25550	4.80E-07	1.50E+00	7.20E-07
Beryllium	0.69	50	1.00E-06	1	1	52	30	70	25550	3.01E-08	4.03E+00	1.21E-07
Boron	4	50	1.00E-06	1	1	52	30	70	25550	1.74E-07	NE	NA
Iron	40000	50	1.00E-06	1	1	52	30	70	25550	1.74E-03	NE	NA
Nickel	34	50	1.00E-06	1	1	52	30	70	25550	1.48E-06	NE	NA
Zinc	75	50	1.00E-06	1	1	52	30	70	25550	3.27E-06	NE	NA
											Total Risk:	**8.41E-07**

Noncarcinogenic Hazard Quotient
Intake = CS*IR*CF*FI*ABS*EF*ED*1/BW*1/ATnc
Hazard Quotient = Intake/RFD

COC: Chemical of Concern	CS Chemical concentration in soil (mg/kg)	IR Ingestion Rate (mg soil/day)	CF Conversion Factor (kg/mg)	FI Fraction Ingested from Contaminated Source (unitless)	RAF Fraction of Contaminant Absorbed (unitless)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	18000	50	1.00E-06	1	1	52	30	70	10950	1.83E-03	1.00E+00	1.83E-03
Antimony	0.85	50	1.00E-06	1	1	52	30	70	10950	8.65E-08	4.00E-04	2.16E-04
Arsenic	11	50	1.00E-06	1	1	52	30	70	10950	1.12E-06	1.50E+00	7.46E-07
Beryllium	0.69	50	1.00E-06	1	1	52	30	70	10950	7.02E-08	4.03E+00	1.74E-08
Boron	4	50	1.00E-06	1	1	52	30	70	10950	4.07E-07	9.00E-02	4.52E-06
Iron	40000	50	1.00E-06	1	1	52	30	70	10950	4.07E-03	3.00E-01	1.36E-02
Nickel	34	50	1.00E-06	1	1	52	30	70	10950	3.46E-06	2.00E-02	1.73E-04
Zinc	75	50	1.00E-06	1	1	52	30	70	10950	7.63E-06	3.00E-01	2.54E-05
											Total HI:	**1.58E-02**

NA: not applicable
NE: not established

Table A-11: Carcinogenic and Noncarcinogenic Risk Estimates for Dermal Contact with Soil in Adult Trespasser

Carcinogenic Risk Estimate
Absorbed Intake = CS*SA*AF*RAF*CF*EF*ED/(BW*ATc)
Estimated Risk =Absorbed Intake*CSF

COPC: Chemical of Potential Concern	CW Conc. in Soil (mg/kg)	SA Exposed Surface Area (skin) (m2)	AF Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (kg/mg)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATc Averaging Time (days)	Intake (mg/kg-day)	CSF Cancer Slope Factor (mg/kg-day)-1	Carcinogenic Risk Estimate
Aluminum	18000	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	7.08E-08	NE	NA
Antimony	0.85	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	3.34E-12	NE	NA
Arsenic	11	0.4508	0.01	0.032	1.00E-06	52	30	70	25550	4.33E-11	1.50E+00	6.49E-11
Beryllium	0.69	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	2.71E-12	4.30E+00	1.17E-11
Boron	4	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	1.57E-11	NE	NA
Iron	40000	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	1.57E-07	NE	NA
Nickel	34	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	1.34E-10	NE	NA
Zinc	75	0.4508	0.01	0.01	1.00E-06	52	30	70	25550	2.95E-10	NE	NA
											Total Risk:	**7.65E-11**

Noncarcinogenic Hazard Quotient
Absorbed Intake = CW*SA*PC*CF*EF*ED/(BW*ATnc)
Hazard Quotient = Absorbed Intake/RFD

COC: Chemical of Concern	CW Conc. In Surface Water (ppm)	SA Exposed Surface Area (skin) (m2)	AF Sed. to skin Adherence Factor (kg/m^2)	RAF Relative Absorption Factor (unitless)	CF Conversion Factor (L/cm^3)	EF Exposure Frequency (days/yr)	ED Exporure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Aluminum	18000	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	1.65E-07	1.00E+00	1.65E-07
Antimony	0.85	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	7.80E-12	4.00E-04	1.95E-08
Arsenic	11	0.4508	0.01	0.032	1.00E-06	52	30	70	10950	1.01E-10	3.00E-04	3.36E-07
Beryllium	0.69	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	6.33E-12	5.00E-03	1.27E-09
Boron	4	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	3.67E-11	9.00E-02	4.08E-10
Iron	40000	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	3.67E-07	3.00E-01	1.22E-06
Nickel	34	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	3.12E-10	2.00E-02	1.56E-08
Zinc	75	0.4508	0.01	0.01	1.00E-06	52	30	70	10950	6.88E-10	3.00E-01	2.29E-09
											Total Risk:	**1.76E-06**

NE: none established
NA: not applicable

Table A-12. GROUND WATER INGESTION (Bedrock data group with dissolved metals)
Exposure Scenario: Residential-Adult

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0020	2	365	24	70	25550	1.96E-05	2.90E-02	5.68E-07
1,2-Dichloroethene (total)	0.0010	2	365	24	70	25550	9.80E-06	NA	NA
1,1-Dichloroethane	0.0010	2	365	24	70	25550	9.80E-06	NA	NA
Metals									
Antimony	0.0020	2	365	24	70	25550	1.96E-05	NA	NA
Barium	0.65	2	365	24	70	25550	6.37E-03	NA	NA
Iron	0.43	2	365	24	70	25550	4.21E-03	NA	NA
Magnesium	27	2	365	24	70	25550	2.64E-01	NA	NA
Manganese	3.1	2	365	24	70	25550	3.04E-02	NA	NA
Sodium	34	2	365	24	70	25550	3.33E-01	NA	NA
								Total Risk:	**5.68E-07**

Table A-12. GROUND WATER INGESTION (Bedrock data group with dissolved metals)
Exposure Scenario: Residential-Adult

Noncarcinogenic Hazard Quotient
Intake = CW*IR*EF*ED/(BW*ATnc)
Hazard Quotient = Intake/RFD

COI: Chemical of Interest	**CW** Mean (mg/L)	**IR** Ingestion Rate (L/day)	**EF** Exposure Frequency (days/year)	**ED** Exposure Duration (years)	**BW** Body Weight (kg)	**ATnc** Averaging Time: noncarcinogen (days)	**Intake** (mg/kg-day)	**RFD** Oral Chronic (mg/kg-day)	**Non-Carcinogenic Hazard Quotient**
Benzene	0.0020	2	365	24	70	8760	5.71E-05	0.00171	3.34E-02
1,2-Dichloroethene (total)	0.0010	2	365	24	70	8760	2.86E-05	9.00E-03	3.17E-03
1,1-Dichloroethane	0.0010	2	365	24	70	8760	2.86E-05	1.00E-01	2.86E-04
Metals									
Antimony	0.0020	2	365	24	70	8760	5.71E-05	4.00E-04	1.43E-01
Barium	0.72	2	365	24	70	8760	2.06E-02	7.00E-02	2.94E-01
Iron	0.49	2	365	24	70	8760	1.40E-02	3.00E-01	4.67E-02
Magnesium	29	2	365	24	70	8760	8.29E-01	NA	NA
Manganese	3.6	2	365	24	70	8760	1.03E-01	2.30E-02	4.47E+00
Sodium	38	2	365	24	70	8760	1.09E+00	NA	NA
								Total HI:	**4.99E+00**

Table A-13. GROUND WATER INGESTION (Bedrock data group with dissolved metals)
Exposure Scenario: Residential-Child

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0020	1	365	6	15	25550	1.14E-05	2.90E-02	3.31E-07
1,2-Dichloroethene (total)	0.0010	1	365	6	15	25550	5.71E-06	NA	NA
1,1-Dichloroethane	0.0010	1	365	6	15	25550	5.71E-06	NA	NA
Metals									
Antimony	0.0020	1	365	6	15	25550	1.14E-05	NA	NA
Barium	0.72	1	365	6	15	25550	4.11E-03	NA	NA
Iron	0.49	1	365	6	15	25550	2.80E-03	NA	NA
Magnesium	29	1	365	6	15	25550	1.66E-01	NA	NA
Manganese	3.6	1	365	6	15	25550	2.06E-02	NA	NA
Sodium	38	1	365	6	15	25550	2.17E-01	NA	NA
								Total Risk:	**3.31E-07**

Table A-13. GROUND WATER INGESTION (Bedrock data group with dissolved metals)
Exposure Scenario: Residential-Child

Noncarcinogenic Hazard Quotient

Intake = CW*IR*EF*ED/(BW*ATnc)

Hazard Quotient = Intake/RFD

COI: Chemical of Interest	CW Mean (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Benzene	0.0020	1	365	6	15	2190	1.33E-04	0.00171	7.80E-02
1,2-Dichloroethene (total)	0.0010	1	365	6	15	2190	6.67E-05	9.00E-03	7.41E-03
1,1-Dichloroethane	0.0010	1	365	6	15	2190	6.67E-05	1.00E-01	6.67E-04
Metals									
Antimony	0.0020	1	365	6	15	2190	1.33E-04	4.00E-04	3.33E-01
Barium	0.72	1	365	6	15	2190	4.80E-02	7.00E-02	6.86E-01
Iron	0.49	1	365	6	15	2190	3.27E-02	3.00E-01	1.09E-01
Magnesium	29	1	365	6	15	2190	1.93E+00	NA	NA
Manganese	3.6	1	365	6	15	2190	2.40E-01	2.30E-02	1.04E+01
Sodium	38	1	365	6	15	2190	2.53E+00	NA	NA
								Total HI:	**1.16E+01**

Table A-14. GROUND WATER INGESTION (Bedrock data group)
Exposure Scenario: Residential-Child

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0020	1	365	6	15	25550	1.14E-05	2.90E-02	3.31E-07
1,2-Dichloroethene (total)	0.0010	1	365	6	15	25550	5.71E-06	NA	NA
1,1-Dichloroethane	0.0010	1	365	6	15	25550	5.71E-06	NA	NA
Metals					15				
Aluminum	6.3	1	365	6	15	25550	3.60E-02	NA	NA
Antimony	0.0023	1	365	6	15	25550	1.31E-05	NA	NA
Arsenic	0.0062	1	365	6	15	25550	3.54E-05	1.50E+00	5.31E-05
Barium	0.69	1	365	6	15	25550	3.94E-03	NA	NA
Cobalt	0.007	1	365	6	15	25550	4.00E-05	NA	NA
Iron	8.8	1	365	6	15	25550	5.03E-02	NA	NA
Magnesium	27	1	365	6	15	25550	1.54E-01	NA	NA
Manganese	3.2	1	365	6	15	25550	1.83E-02	NA	NA
Nickel	0.011	1	365	6	15	25550	6.29E-05	NA	NA
Sodium	33	1	365	6	15	25550	1.89E-01	NA	NA
Vanadium	0.086	1	365	6	15	25550	4.91E-04	NA	NA
								Total Risk:	**5.35E-05**

Table A-14. GROUND WATER INGESTION (Bedrock data group)
Exposure Scenario: Residential-Child

Noncarcinogenic Hazard Quotient

Intake = CW*IR*EF*ED/(BW*ATnc)

Hazard Quotient = Intake/RFD

COI: Chemical of Interest	CW Mean (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Benzene	0.0020	1	365	6	15	2190	1.33E-04	0.00171	7.80E-02
1,2-Dichloroethene (total)	0.0010	1	365	6	15	2190	6.67E-05	9.00E-03	7.41E-03
1,1-Dichloroethane	0.0010	1	365	6	15	2190	6.67E-05	1.00E-01	6.67E-04
Metals									
Aluminum	6.3	1	365	6	15	2190	4.20E-01	1.00E+00	4.20E-01
Antimony	0.0023	1	365	6	15	2190	1.53E-04	4.00E-04	3.83E-01
Arsenic	0.0062	1	365	6	15	2190	4.13E-04	3.00E-04	1.38E+00
Barium	0.69	1	365	6	15	2190	4.60E-02	7.00E-02	6.57E-01
Cobalt	0.007	1	365	6	15	2190	4.67E-04	6.00E-02	7.78E-03
Iron	8.8	1	365	6	15	2190	5.87E-01	3.00E-01	1.96E+00
Magnesium	27	1	365	6	15	2190	1.80E+00	NA	NA
Manganese	3.2	1	365	6	15	2190	2.13E-01	2.30E-02	9.28E+00
Nickel	0.011	1	365	6	15	2190	7.33E-04	2.00E-02	3.67E-02
Sodium	33	1	365	6	15	2190	2.20E+00	NA	NA
Vanadium	0.0086	1	365	6	15	2190	5.73E-04	7.00E-03	8.19E-02
								Total HI:	**1.43E+01**

Table A-15. GROUND WATER INGESTION (Bedrock data group)
Exposure Scenario: Residential-Adult

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0020	2	365	24	70	25550	1.96E-05	2.90E-02	5.68E-07
1,2-Dichloroethene (total)	0.0010	2	365	24	70	25550	9.80E-06	NA	NA
1,1-Dichloroethane	0.0010	2	365	24	70	25550	9.80E-06	NA	NA
Metals									
Aluminum	6.3	2	365	24	70	25550	6.17E-02	NA	NA
Antimony	0.0023	2	365	24	70	25550	2.25E-05	NA	NA
Arsenic	0.0062	2	365	24	70	25550	6.07E-05	1.50E+00	9.11E-05
Barium	0.69	2	365	24	70	25550	6.76E-03	NA	NA
Cobalt	0.007	2	365	24	70	25550	6.86E-05	NA	NA
Iron	8.8	2	365	24	70	25550	8.62E-02	NA	NA
Magnesium	27	2	365	24	70	25550	2.64E-01	NA	NA
Manganese	3.2	2	365	24	70	25550	3.13E-02	NA	NA
Nickel	0.011	2	365	24	70	25550	1.08E-04	NA	NA
Sodium	33	2	365	24	70	25550	3.23E-01	NA	NA
Vanadium	0.0086	2	365	24	70	25550	8.42E-05	NA	NA
								Total Risk:	**9.17E-05**

Table A-15. GROUND WATER INGESTION (Bedrock data group)
Exposure Scenario: Residential-Adult

Noncarcinogenic Hazard Quotient
Intake = CW*IR*EF*ED/(BW*ATnc)
Hazard Quotient = Intake/RFD

COI: Chemical of Interest	CW Mean (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Benzene	0.0020	2	365	24	70	8760	5.71E-05	0.00171	3.34E-02
1,2-Dichloroethene (total)	0.0010	2	365	24	70	8760	2.86E-05	9.00E-03	3.17E-03
1,1-Dichloroethane	0.0010	2	365	24	70	8760	2.86E-05	1.00E-01	2.86E-04
Metals									
Aluminum	6.3	2	365	24	70	8760	1.80E-01	1.00E+00	1.80E-01
Antimony	0.0023	2	365	24	70	8760	6.57E-05	4.00E-04	1.64E-01
Arsenic	0.0062	2	365	24	70	8760	1.77E-04	3.00E-04	5.90E-01
Barium	0.69	2	365	24	70	8760	1.97E-02	7.00E-02	2.82E-01
Cobalt	0.007	2	365	24	70	8760	2.00E-04	6.00E-02	3.33E-03
Iron	8.8	2	365	24	70	8760	2.51E-01	3.00E-01	8.38E-01
Magnesium	27	2	365	24	70	8760	7.71E-01	NA	NA
Manganese	3.2	2	365	24	70	8760	9.14E-02	2.30E-02	3.98E+00
Nickel	0.011	2	365	24	70	8760	3.14E-04	2.00E-02	1.57E-02
Sodium	33	2	365	24	70	8760	9.43E-01	NA	NA
Vanadium	0.0086	2	365	24	70	8760	2.46E-04	7.00E-03	3.51E-02
								Total HI:	**6.12E+00**

Table A-16. GROUND WATER INGESTION (Overburden data group with dissolved metals)
Exposure Scenario: Residential-Child

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	**CW** (mg/L)	**IR** Ingestion Rate (L/day)	**EF** Exposure Frequency (days/year)	**ED** Exposure Duration (years)	**BW** Body Weight (kg)	**ATc** Averaging Time: carcinogen (days)	**Intake** (mg/kg-day)	**CSFo** Cancer Slope Factor (oral) (mg/kg-day)-1	**Carcinogenic Risk Estimate**
VOCs									
Benzene	0.0052	1	365	6	15	25550	2.97E-05	2.90E-02	8.62E-07
Chlorobenzene	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
Chloroethane	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
1,2-Dichloroethene (total)	0.0020	1	365	6	15	25550	1.14E-05	NA	NA
1,1-Dichloroethane	0.0040	1	365	6	15	25550	2.29E-05	NA	NA
Ethylbenzene	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
Vinyl Chloride	0.0050	1	365	6	15	25550	2.86E-05	1.90E+00	**5.43E-05**
Xylenes (total)	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
Metals (dissolved)									
Aluminum	0.035	1	365	6	15	25550	2.00E-04	NA	NA
Antimony	0.0023	1	365	6	15	25550	1.31E-05	NA	NA
Barium	0.67	1	365	6	15	25550	3.83E-03	NA	NA
Boron	0.41	1	365	6	15	25550	2.34E-03	NA	NA
Iron	3.8	1	365	6	15	25550	2.17E-02	NA	NA
Magnesium	31	1	365	6	15	25550	1.77E-01	NA	NA
Manganese	11	1	365	6	15	25550	6.29E-02	NA	NA
Sodium	70	1	365	6	15	25550	4.00E-01	NA	NA
								Total Risk:	**5.51E-05**

Table A-16. GROUND WATER INGESTION (Overburden data group with dissolved metals)
Exposure Scenario: Residential-Child

Noncarcinogenic Hazard Quotient
Intake = CW*IR*EF*ED/(BW*ATnc)
Hazard Quotient = Intake/RFD

COI: Chemical of Interest	**CW** Mean (mg/L)	**IR** Ingestion Rate (L/day)	**EF** Exposure Frequency (days/year)	**ED** Exposure Duration (years)	**BW** Body Weight (kg)	**ATnc** Averaging Time: noncarcinogen (days)	**Intake** (mg/kg-day)	**RFD** Oral Chronic (mg/kg-day)	**Non-Carcinogenic Hazard Quotient**
Benzene	0.0052	1	365	6	15	2190	3.47E-04	0.00171	2.03E-01
Chlorobenzene	0.0050	1	365	6	15	2190	3.33E-04	2.00E-02	1.67E-02
Chloroethane	0.0050	1	365	6	15	2190	3.33E-04	4.00E-01	8.33E-04
1,2-Dichloroethene (total)	0.0020	1	365	6	15	2190	1.33E-04	9.00E-03	1.48E-02
1,1-Dichloroethane	0.0040	1	365	6	15	2190	2.67E-04	1.00E-01	2.67E-03
Ethylbenzene	0.0050	1	365	6	15	2190	3.33E-04	1.00E-01	3.33E-03
Vinyl Chloride	0.0050	1	365	6	15	2190	3.33E-04	NA	NA
Xylenes (total)	0.0050	1	365	6	15	2190	3.33E-04	2.00E+00	1.67E-04
Metals									
Aluminum	0.035	1	365	6	15	2190	2.33E-03	1.00E+00	2.33E-03
Antimony	0.0023	1	365	6	15	2190	1.53E-04	4.00E-04	3.83E-01
Barium	0.67	1	365	6	15	2190	4.47E-02	7.00E-02	6.38E-01
Boron	0.41	1	365	6	15	2190	2.73E-02	9.00E-02	3.04E-01
Iron	3.8	1	365	6	15	2190	2.53E-01	3.00E-01	8.44E-01
Magnesium	31	1	365	6	15	2190	2.07E+00	NA	NA
Manganese	11	1	365	6	15	2190	7.33E-01	2.30E-02	**3.19E+01**
Sodium	70	1	365	6	15	2190	4.67E+00	NA	NA
								Total HI:	**3.43E+01**

Table A-17. GROUND WATER INGESTION (Overburden data group with dissolved metals)
Exposure Sceanrio:Residential-Adult

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0052	2	365	24	70	25550	5.09E-05	2.90E-02	**1.48E-06**
Chlorobenzene	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
Chloroethane	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
1,2-Dichloroethene (total)	0.0020	2	365	24	70	25550	1.96E-05	NA	NA
1,1-Dichloroethane	0.0040	2	365	24	70	25550	3.92E-05	NA	NA
Ethylbenzene	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
Vinyl Chloride	0.0050	2	365	24	70	25550	4.90E-05	1.90E+00	**9.31E-05**
Xylenes (total)	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
Metals (dissolved)									
Aluminum	0.035	2	365	24	70	25550	3.43E-04	NA	NA
Antimony	0.0023	2	365	24	70	25550	2.25E-05	NA	NA
Barium	0.67	2	365	24	70	25550	6.56E-03	NA	NA
Boron	0.41	2	365	24	70	25550	4.02E-03	NA	NA
Iron	3.8	2	365	24	70	25550	3.72E-02	NA	NA
Magnesium	31	2	365	24	70	25550	3.04E-01	NA	NA
Manganese	11	2	365	24	70	25550	1.08E-01	NA	NA
Sodium	70	2	365	24	70	25550	6.86E-01	NA	NA
								Total Risk:	**9.45E-05**

Table A-17. GROUND WATER INGESTION (Overburden data group with dissolved metals)
Exposure Sceanrio:Residential-Adult

Noncarcinogenic Hazard Quotient

Intake = CW*IR*EF*ED/(BW*ATnc)

Hazard Quotient = Intake/RFD

COI: Chemical of Interest	**CW** Mean (mg/L)	**IR** Ingestion Rate (L/day)	**EF** Exposure Frequency (days/year)	**ED** Exposure Duration (years)	**BW** Body Weight (kg)	**ATnc** Averaging Time: noncarcinogen (days)	**Intake** (mg/kg-day)	**RFD** Oral Chronic (mg/kg-day)	**Non-Carcinogenic Hazard Quotient**
Benzene	0.0052	2	365	24	70	8760	1.49E-04	0.00171	8.69E-02
Chlorobenzene	0.0050	2	365	24	70	8760	1.43E-04	2.00E-02	7.14E-03
Chloroethane	0.0050	2	365	24	70	8760	1.43E-04	4.00E-01	3.57E-04
1,2-Dichloroethene (total)	0.0020	2	365	24	70	8760	5.71E-05	9.00E-03	6.35E-03
1,1-Dichloroethane	0.0040	2	365	24	70	8760	1.14E-04	1.00E-01	1.14E-03
Ethylbenzene	0.0050	2	365	24	70	8760	1.43E-04	1.00E-01	1.43E-03
Vinyl Chloride	0.0050	2	365	24	70	8760	1.43E-04	NA	NA
Xylenes (total)	0.0050	2	365	24	70	8760	1.43E-04	2.00E+00	7.14E-05
Metals									
Aluminum	0.035	2	365	24	70	8760	1.00E-03	1.00E+00	1.00E-03
Antimony	0.0023	2	365	24	70	8760	6.57E-05	4.00E-04	1.64E-01
Barium	0.67	2	365	24	70	8760	1.91E-02	7.00E-02	2.73E-01
Boron	0.41	2	365	24	70	8760	1.17E-02	9.00E-02	1.30E-01
Iron	3.8	2	365	24	70	8760	1.09E-01	3.00E-01	3.62E-01
Magnesium	31	2	365	24	70	8760	8.86E-01	NA	NA
Manganese	11	2	365	24	70	8760	3.14E-01	2.30E-02	**1.37E+01**
Sodium	70	2	365	24	70	8760	2.00E+00	NA	NA
								Total HI:	**1.47E+01**

Table A-18. GROUND WATER INGESTION (Overburden data group)
Exposure Scenario: Residential-Child

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0052	1	365	6	15	25550	2.97E-05	2.90E-02	8.62E-07
Chlorobenzene	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
Chloroethane	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
1,2-Dichloroethene (total)	0.0020	1	365	6	15	25550	1.14E-05	NA	NA
1,1-Dichloroethane	0.0040	1	365	6	15	25550	2.29E-05	NA	NA
Ethylbenzene	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
Vinyl Chloride	0.0050	1	365	6	15	25550	2.86E-05	1.90E+00	**5.43E-05**
Xylenes (total)	0.0050	1	365	6	15	25550	2.86E-05	NA	NA
Metals									
Aluminum	160	1	365	6	15	25550	9.14E-01	NA	NA
Antimony	0.0029	1	365	6	15	25550	1.66E-05	NA	NA
Arsenic	0.082	1	365	6	15	25550	4.69E-04	1.50E+00	**7.03E-04**
Barium	2.3	1	365	6	15	25550	1.31E-02	NA	NA
Beryllium	0.0063	1	365	6	15	25550	3.60E-05	4.30E+00	**1.55E-04**
Boron	0.41	1	365	6	15	25550	2.34E-03	NA	NA
Chromium	0.23	1	365	6	15	25550	1.31E-03	NA	NA
Cobalt	0.13	1	365	6	15	25550	7.43E-04	NA	NA
Copper	0.22	1	365	6	15	25550	1.26E-03	NA	NA
Iron	330	1	365	6	15	25550	1.89E+00	NA	NA
Magnesium	84	1	365	6	15	25550	4.80E-01	NA	NA
Manganese	15	1	365	6	15	25550	8.57E-02	NA	NA
Nickel	0.29	1	365	6	15	25550	1.66E-03	NA	NA
Sodium	64	1	365	6	15	25550	3.66E-01	NA	NA
Vanadium	0.19	1	365	6	15	25550	1.09E-03	NA	NA
Zinc	0.74	1	365	6	15	25550	4.23E-03	NA	NA
								Total Risk:	**9.13E-04**

Table A-18. GROUND WATER INGESTION (Overburden data group)
Exposure Scenario: Residential-Child

Noncarcinogenic Hazard Quotient

Intake = CW*IR*EF*ED/(BW*ATnc)

Hazard Quotient = Intake/RFD

COI: Chemical of Interest	CW Mean (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Benzene	0.0052	1	365	6	15	2190	3.47E-04	0.00171	2.03E-01
Chlorobenzene	0.0050	1	365	6	15	2190	3.33E-04	2.00E-02	1.67E-02
Chloroethane	0.0050	1	365	6	15	2190	3.33E-04	4.00E-01	8.33E-04
1,2-Dichloroethene (total)	0.0020	1	365	6	15	2190	1.33E-04	9.00E-03	1.48E-02
1,1-Dichloroethane	0.0040	1	365	6	15	2190	2.67E-04	1.00E-01	2.67E-03
Ethylbenzene	0.0050	1	365	6	15	2190	3.33E-04	1.00E-01	3.33E-03
Vinyl Chloride	0.0050	1	365	6	15	2190	3.33E-04	NA	NA
Xylenes (total)	0.0050	1	365	6	15	2190	3.33E-04	2.00E+00	1.67E-04
Metals									
Aluminum	160	1	365	6	15	2190	1.07E+01	1.00E+00	**1.07E+01**
Antimony	0.0029	1	365	6	15	2190	1.93E-04	4.00E-04	4.83E-01
Arsenic	0.082	1	365	6	15	2190	5.47E-03	3.00E-04	**1.82E+01**
Barium	2.3	1	365	6	15	2190	1.53E-01	7.00E-02	**2.19E+00**
Beryllium	0.0063	1	365	6	15	2190	4.20E-04	5.00E-03	8.40E-02
Boron	0.41	1	365	6	15	2190	2.73E-02	9.00E-02	3.04E-01
Chromium	0.23	1	365	6	15	2190	1.53E-02	1.00E+00	1.53E-02
Cobalt	0.13	1	365	6	15	2190	8.67E-03	6.00E-02	1.44E-01
Copper	0.22	1	365	6	15	2190	1.47E-02	4.00E-02	3.67E-01
Iron	330	1	365	6	15	2190	2.20E+01	3.00E-01	**7.33E+01**
Magnesium	84	1	365	6	15	2190	5.60E+00	NA	NA
Manganese	15	1	365	6	15	2190	1.00E+00	2.30E-02	**4.35E+01**
Nickel	0.29	1	365	6	15	2190	1.93E-02	2.00E-02	9.67E-01
Sodium	64	1	365	6	15	2190	4.27E+00	NA	NA
Vanadium	0.19	1	365	6	15	2190	1.27E-02	7.00E-03	**1.81E+00**
Zinc	0.74	1	365	6	15	2190	4.93E-02	3.00E-01	1.64E-01
								Total HI:	**1.52E+02**

OLD CORTLAND COUNTY LANDFILL SITE

Table A-19. GROUND WATER INGESTION (Overburden data group)
Exposure Scenario: Residential-Adult

Carcinogenic Risk Estimate
Intake = CW*IR*EF*ED/(BW*ATc)
Estimated Risk = Intake*CSFo

COI: Chemical of Interest	CW (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATc Averaging Time: carcinogen (days)	Intake (mg/kg-day)	CSFo Cancer Slope Factor (oral) (mg/kg-day)-1	Carcinogenic Risk Estimate
VOCs									
Benzene	0.0052	2	365	24	70	25550	5.09E-05	2.90E-02	1.48E-06
Chlorobenzene	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
Chloroethane	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
1,2-Dichloroethene (total)	0.0020	2	365	24	70	25550	1.96E-05	NA	NA
1,1-Dichloroethane	0.0040	2	365	24	70	25550	3.92E-05	NA	NA
Ethylbenzene	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
Vinyl Chloride	0.0050	2	365	24	70	25550	4.90E-05	1.90E+00	9.31E-05
Xylenes (total)	0.0050	2	365	24	70	25550	4.90E-05	NA	NA
Metals									
Aluminum	160	2	365	24	70	25550	1.57E+00	NA	NA
Antimony	0.0029	2	365	24	70	25550	2.84E-05	NA	NA
Arsenic	0.082	2	365	24	70	25550	8.03E-04	1.50E+00	1.20E-03
Barium	2.3	2	365	24	70	25550	2.25E-02	NA	NA
Beryllium	0.0063	2	365	24	70	25550	6.17E-05	4.30E+00	2.65E-04
Boron	0.41	2	365	24	70	25550	4.02E-03	NA	NA
Chromium	0.23	2	365	24	70	25550	2.25E-03	NA	NA
Cobalt	0.13	2	365	24	70	25550	1.27E-03	NA	NA
Copper	0.22	2	365	24	70	25550	2.16E-03	NA	NA
Iron	330	2	365	24	70	25550	3.23E+00	NA	NA
Magnesium	84	2	365	24	70	25550	8.23E-01	NA	NA
Manganese	15	2	365	24	70	25550	1.47E-01	NA	NA
Nickel	0.29	2	365	24	70	25550	2.84E-03	NA	NA
Sodium	64	2	365	24	70	25550	6.27E-01	NA	NA
Vanadium	0.19	2	365	24	70	25550	1.86E-03	NA	NA
Zinc	0.74	2	365	24	70	25550	7.25E-03	NA	NA
								Total Risk:	**1.56E-03**

OLD CORTLAND COUNTY LANDFILL SITE

Table A-19. GROUND WATER INGESTION (Overburden data group)
Exposure Scenario: Residential-Adult

Noncarcinogenic Hazard Quotient

Intake = CW*IR*EF*ED/(BW*ATnc)

Hazard Quotient = Intake/RFD

COI: Chemical of Interest	CW Mean (mg/L)	IR Ingestion Rate (L/day)	EF Exposure Frequency (days/year)	ED Exposure Duration (years)	BW Body Weight (kg)	ATnc Averaging Time: noncarcinogen (days)	Intake (mg/kg-day)	RFD Oral Chronic (mg/kg-day)	Non-Carcinogenic Hazard Quotient
Benzene	0.0052	2	365	24	70	8760	1.49E-04	0.00171	8.69E-02
Chlorobenzene	0.0050	2	365	24	70	8760	1.43E-04	2.00E-02	7.14E-03
Chloroethane	0.0050	2	365	24	70	8760	1.43E-04	4.00E-01	3.57E-04
1,2-Dichloroethene (total)	0.0020	2	365	24	70	8760	5.71E-05	9.00E-03	6.35E-03
1,1-Dichloroethane	0.0040	2	365	24	70	8760	1.14E-04	1.00E-01	1.14E-03
Ethylbenzene	0.0050	2	365	24	70	8760	1.43E-04	1.00E-01	1.43E-03
Vinyl Chloride	0.0050	2	365	24	70	8760	1.43E-04	NA	NA
Xylenes (total)	0.0050	2	365	24	70	8760	1.43E-04	2.00E+00	7.14E-05
Metals									
Aluminum	160	2	365	24	70	8760	4.57E+00	1.00E+00	**4.57E+00**
Antimony	0.0029	2	365	24	70	8760	8.29E-05	4.00E-04	2.07E-01
Arsenic	0.082	2	365	24	70	8760	2.34E-03	3.00E-04	**7.81E+00**
Barium	2.3	2	365	24	70	8760	6.57E-02	7.00E-02	9.39E-01
Beryllium	0.0063	2	365	24	70	8760	1.80E-04	5.00E-03	3.60E-02
Boron	0.41	2	365	24	70	8760	1.17E-02	9.00E-02	1.30E-01
Chromium	0.23	2	365	24	70	8760	6.57E-03	1.00E+00	6.57E-03
Cobalt	0.13	2	365	24	70	8760	3.71E-03	6.00E-02	6.19E-02
Copper	0.22	2	365	24	70	8760	6.29E-03	4.00E-02	1.57E-01
Iron	330	2	365	24	70	8760	9.43E+00	3.00E-01	**3.14E+01**
Magnesium	84	2	365	24	70	8760	2.40E+00	NA	NA
Manganese	15	2	365	24	70	8760	4.29E-01	2.30E-02	**1.86E+01**
Nickel	0.29	2	365	24	70	8760	8.29E-03	2.00E-02	4.14E-01
Sodium	64	2	365	24	70	8760	1.83E+00	NA	NA
Vanadium	0.19	2	365	24	70	8760	5.43E-03	7.00E-03	7.76E-01
Zinc	0.74	2	365	24	70	8760	2.11E-02	3.00E-01	7.05E-02
								Total HI:	**6.53E+01**

APPENDIX B

ECOLOGICAL RISK ASSESSMENT SCREENING TABLES

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Total Metals (ppb)							
Aluminum	SW-1	95% UCL	375		100	A	**3.750**
		October	49.9	B	100	A	0.499
	SW-2	95% UCL	609.7		100	A	**6.097**
		October	92.9	B	100	A	0.929
	SW-3	August	158	J	100	A	**1.580**
		October	57.6	B	100	A	0.576
	SW-4	August	66.6	J	100	A	0.666
		October	41.6	B	100	A	0.416
	SW-5	August	43.1	J	100	A	0.431
		October	188	B	100	A	**1.880**
Barium	SW-1	95% UCL	189.2		3.8	Tier II SCV	**49.789**
		October	174	B	3.8	Tier II SCV	**45.789**
	SW-2	95% UCL	110		3.8	Tier II SCV	**28.947**
		October	126		3.8	Tier II SCV	**33.158**
	SW-3	August	766		3.8	Tier II SCV	**201.579**
		October	567		3.8	Tier II SCV	**149.211**
	SW-4	August	74.3	J	3.8	Tier II SCV	**19.553**
		October	59.7	B	3.8	Tier II SCV	**15.711**
	SW-5	August	68	J	3.8	Tier II SCV	**17.895**
		October	56.2	B	3.8	Tier II SCV	**14.789**
Beryllium	SW-1	95% UCL	9		1100	A	0.008
		October	0.1	U	1100	A	0.000
	SW-2	95% UCL	8		1100	A	0.007
		October	0.1	B	1100	A	0.000
	SW-3	August	0.1	J	1100	A	0.000
		October	0.1	U	1100	A	0.000
	SW-4	August	0.53	J	1100	A	0.000
		October	0.97	B	1100	A	0.001
Boron	SW-1	95% UCL	492.8		10000	A	0.049
		October	515		10000	A	0.052
	SW-2	95% UCL	372.7		10000	A	0.037
		October	406		10000	A	0.041
	SW-3	August	1010		10000	A	0.101
		October	915		10000	A	0.092
	SW-4	August	15.5	J	10000	A	0.002
		October	16.1	B	10000	A	0.002
	SW-5	August	25.2	J	10000	A	0.003
		October	26	B	10000	A	0.003
Cadmium	SW-4	August	0.47	J	1.477	A	0.318
		October	1	B	1.03	A	0.971

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Calcium	SW-1	95% UCL	66188.7		116000	Daphnid LCV	0.571
		October	32300		116000	Daphnid LCV	0.278
	SW-2	95% UCL	43460.7		116000	Daphnid LCV	0.375
		October	33600		116000	Daphnid LCV	0.290
	SW-3	August	59100		116000	Daphnid LCV	0.000
		October	67300		116000	Daphnid LCV	0.580
	SW-4	August	34400		116000	Daphnid LCV	0.297
		October	26100		116000	Daphnid LCV	0.225
	SW-5	August	32000		116000	Daphnid LCV	0.000
		October	26200		116000	Daphnid LCV	0.226
Chromium	SW-3	August	3.6	J	522.82	A	0.007
		October	0.4	U	508.97	A	0.001
	SW-4	August	0.8	J	272.65	A	0.003
		October	0.63	B	186.4	A	0.003
Cobalt	SW-3	August	1.9	J	5	A	0.380
		October	1.1	U	5	A	0.220
Copper	SW-3	August	1.8	J	3.44	A	0.523
		October	0.7	U	3.44	A	0.203
Iron	SW-1	95% UCL	4737.8		300	A/A*	**15.793**
		October	267		300	A/A*	0.890
	SW-2	95% UCL	944.9		300	A/A*	**3.150**
		October	165		300	A/A*	0.550
	SW-3	August	1300		300	A/A*	**4.333**
		October	263		300	A/A*	0.877
	SW-4	August	79.2	J	300	A/A*	0.264
		October	30.9	B	300	A/A*	0.103
	SW-5	August	44.9	J	300	A/A*	0.150
		October	249		300	A/A*	0.830
Lead	SW-3	August	2.9	J	13.48	A	0.215
		October	1	U	12.94	A	0.077
Magnesium	SW-1	95% UCL	20357.6		82000	Daphnid LCV	0.248
		October	20200		82000	Daphnid LCV	0.246
	SW-2	95% UCL	12692.8		82000	Daphnid LCV	0.155
		October	17000		82000	Daphnid LCV	0.207
	SW-3	August	36300		82000	Daphnid LCV	0.443
		October	33100		82000	Daphnid LCV	0.404
	SW-4	August	4410	J	82000	Daphnid LCV	0.054
		October	3770	B	82000	Daphnid LCV	0.046
	SW-5	August	4000	J	82000	Daphnid LCV	0.049
		October	3650	B	82000	Daphnid LCV	0.045

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Manganese	SW-1	95% UCL	4487.2		80.3	Teir II SCV	**55.880**
		October	95.6		80.3	Teir II SCV	**1.191**
	SW-2	95% UCL	353.4		80.3	Teir II SCV	**4.401**
		October	35		80.3	Teir II SCV	0.436
	SW-3	August	756		80.3	Teir II SCV	**9.415**
		October	225		80.3	Teir II SCV	**2.802**
	SW-4	August	22.9		80.3	Teir II SCV	0.285
		October	1.9	B	80.3	Teir II SCV	0.024
	SW-5	August	11.6	J	80.3	Teir II SCV	0.144
		October	11.9	B	80.3	Teir II SCV	0.148
Nickel	SW-1	95% UCL	50	U	163.03	A	0.307
		October	9.3	B	144.33	A	0.064
	SW-2	95% UCL	50	U	121.9	A	0.410
		October	7.2	B	131.39	A	0.055
	SW-3	August	21.3	J	225.83	A	0.094
		October	16.9	B	220.27	A	0.077
Potassium	SW-1	95% UCL	12357.9		53000	Daphnid LCV	0.233
		October	13700		53000	Daphnid LCV	0.258
	SW-2	95% UCL	8031		53000	Daphnid LCV	0.152
		October	10600		53000	Daphnid LCV	0.200
	SW-3	August	31400		53000	Daphnid LCV	0.592
		October	28400		53000	Daphnid LCV	0.536
	SW-4	August	1150	J	53000	Daphnid LCV	0.022
		October	1020	B	53000	Daphnid LCV	0.019
	SW-5	August	981	J	53000	Daphnid LCV	0.019
		October	1140	B	53000	Daphnid LCV	0.022
Sodium	SW-1	95% UCL	61977		680000	Daphnid LCV	0.091
		October	88500		680000	Daphnid LCV	0.130
	SW-2	95% UCL	37983		680000	Daphnid LCV	0.056
		October	73300		680000	Daphnid LCV	0.108
	SW-3	August	140000		680000	Daphnid LCV	0.206
		October	134000		680000	Daphnid LCV	0.197
	SW-4	August	3180	J	680000	Daphnid LCV	0.005
		October	3140	B	680000	Daphnid LCV	0.005
	SW-5	August	2850	J	680000	Daphnid LCV	0.004
		October	3300	B	680000	Daphnid LCV	0.005
Zinc	SW-1	95% UCL	58.4		95.74	A	0.610
		October	10.3	B	131.02	A	0.079
	SW-2	95% UCL	33.9		69.17	A	0.490
		October	14.3	B	117.95	A	0.121
	SW-3	August	131	J	216.2	A	0.606
		October	12.3	B	210.23	A	0.059

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Zinc	SW-4	August	15.5	J	109.99	A	0.141
		October	15.7	B	74.12	A	0.212
	SW-5	August	25.2	J	96.48	A	0.261
		October	15.9	B	75.55	A	0.210
Dissolved Metals (ppb)							
Aluminum	SW-1	95% UCL	500	U	100	A	**5.000**
		October	33.1	B	100	A	0.331
	SW-2	95% UCL	500	U	100	A	**5.000**
		October	37.1	B	100	A	0.371
	SW-3	August	35.6	J	100	A	0.356
		October	34.4	B	100	A	0.344
	SW-4	August	21.8	J	100	A	0.218
		October	29.9	B	100	A	0.299
	SW-5	August	29	J	100	A	0.290
		October	37.3	B	100	A	0.373
Barium	SW-1	95% UCL	183.7		3.8	Tier II SCV	**48.342**
		October	179	B	3.8	Tier II SCV	**47.105**
	SW-2	95% UCL	120		3.8	Tier II SCV	**31.579**
		October	112	B	3.8	Tier II SCV	**29.474**
	SW-3	August	749		3.8	Tier II SCV	**197.105**
		October	552		3.8	Tier II SCV	**145.263**
	SW-4	August	67.6	J	3.8	Tier II SCV	**17.789**
		October	57.6	B	3.8	Tier II SCV	**15.158**
	SW-5	August	62.2	J	3.8	Tier II SCV	**16.368**
		October	55	B	3.8	Tier II SCV	**14.474**
Beryllium	SW-1	95% UCL	50	U	1100	A	0.045
		October	0.1	B	1100	A	0.000
	SW-2	95% UCL	50	U	1100	A	0.045
		October	0.1	B	1100	A	0.000
	SW-3	August	0.1		1100	A	0.000
		October	0.1	B	1100	A	0.000
	SW-5	August	0.1	J	1100	A	0.000
		October	0.1	U	1100	A	0.000
Boron	SW-1	95% UCL	NM		10000	A	0.000
		October	535		10000	A	0.054
	SW-2	95% UCL	NM		10000	A	0.000
		October	365		10000	A	0.037
	SW-3	August	1160		10000	A	0.000
		October	898		10000	A	0.090
	SW-4	August	18.1	J	10000	A	0.002
		October	20.9	B	10000	A	0.002

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Boron	SW-5	August	18.1	J	10000	A	0.002
		October	27.3	B	10000	A	0.003
Cadmium	SW-4	August	0.3	J	1.477	A	0.203
		October	0.3	U	1.026	A	0.292
Calcium	SW-1	95% UCL	61891		116000	Daphnid LCV	0.534
		October	33500		116000	Daphnid LCV	0.289
	SW-2	95% UCL	42201.5		116000	Daphnid LCV	0.364
		October	29900		116000	Daphnid LCV	0.258
	SW-3	August	65200		116000	Daphnid LCV	0.562
		October	66700		116000	Daphnid LCV	0.575
	SW-4	August	32100		116000	Daphnid LCV	0.277
		October	25200		116000	Daphnid LCV	0.217
	SW-5	August	29400		116000	Daphnid LCV	0.253
		October	26300		116000	Daphnid LCV	0.227
Chromium	SW-3	August	1	J	522.83	A	0.002
		October	0.4	U	508.97	A	0.001
Cobalt	SW-3	August	1.4	J	5	A	0.280
		October	1.1	U	5	A	0.220
Iron	SW-1	95% UCL	112.3		300	A/A*	0.374
		October	92.4	B	300	A/A*	0.308
	SW-2	95% UCL	81.1		300	A/A*	0.270
		October	22.7	B	300	A/A*	0.076
	SW-3	August	10.4	J	300	A/A*	0.035
		October	22.2	B	300	A/A*	0.074
	SW-4	August	3.2	J	300	A/A*	0.011
		October	4.9	B	300	A/A*	0.016
	SW-5	August	9.6	J	300	A/A*	0.032
		October	5.5	B	300	A/A*	0.018
Magnesium	SW-1	95% UCL	19628.4		82000	Daphnid LCV	0.239
		October	20900		82000	Daphnid LCV	0.255
	SW-2	95% UCL	12777		82000	Daphnid LCV	0.156
		October	15100		82000	Daphnid LCV	0.184
	SW-3	August	41100		82000	Daphnid LCV	0.501
		October	32700		82000	Daphnid LCV	0.399
	SW-4	August	4030	J	82000	Daphnid LCV	0.049
		October	3620	B	82000	Daphnid LCV	0.044
	SW-5	August	3690	J	82000	Daphnid LCV	0.045
		October	3600	B	82000	Daphnid LCV	0.044
Manganese	SW-1	95% UCL	2353.9		80.3	Teir II SCV	**29.314**
		October	92		80.3	Teir II SCV	**1.146**
	SW-2	95% UCL	226.5		80.3	Teir II SCV	**2.821**
		October	27.6		80.3	Teir II SCV	0.344

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Manganese	SW-3	August	1.5	J	80.3	Teir II SCV	0.019
		October	191		80.3	Teir II SCV	**2.379**
	SW-4	August	7.6	J	80.3	Teir II SCV	0.095
		October	1.7	B	80.3	Teir II SCV	0.021
	SW-5	August	9	J	80.3	Teir II SCV	0.112
		October	2.2	B	80.3	Teir II SCV	0.027
Nickel	SW-1	95% UCL	30	U	163.03	A	0.184
		October	9.5	B	144.33	A	0.066
	SW-2	95% UCL	30	U	121.9	A	0.246
		October	6.3	B	131.39	A	0.048
	SW-3	August	21.5	J	225.8	A	0.095
		October	16.6	B	220.27	A	0.075
Potassium	SW-1	95% UCL	12357.9		53000	Daphnid LCV	0.233
		October	14300		53000	Daphnid LCV	0.270
	SW-2	95% UCL	13096.6		53000	Daphnid LCV	0.247
		October	9350		53000	Daphnid LCV	0.176
	SW-3	August	34600		53000	Daphnid LCV	0.000
		October	28100		53000	Daphnid LCV	0.530
	SW-4	August	1030	J	53000	Daphnid LCV	0.019
		October	969	B	53000	Daphnid LCV	0.018
	SW-5	August	903	J	53000	Daphnid LCV	0.017
		October	1090	B	53000	Daphnid LCV	0.021
Sodium	SW-1	95% UCL	65924.9		680000	Daphnid LCV	0.097
		October	92700		680000	Daphnid LCV	0.136
	SW-2	95% UCL	39033.2		680000	Daphnid LCV	0.057
		October	65300		680000	Daphnid LCV	0.096
	SW-3	August	157000		680000	Daphnid LCV	0.231
		October	133000		680000	Daphnid LCV	0.196
	SW-4	August	2920	J	680000	Daphnid LCV	0.004
		October	3050	B	680000	Daphnid LCV	0.004
	SW-5	August	2710	J	680000	Daphnid LCV	0.004
		October	3310	B	680000	Daphnid LCV	0.005
Zinc	SW-1	95% UCL	86.9		95.74	A	0.908
		October	14.3	B	131.02	A	0.109
	SW-2	95% UCL	140		69.17	A	**2.024**
		October	15.6	B	117.95	A	0.132
	SW-3	August	19.9	J	216.2	A	0.092
		October	21.3		210.23	A	0.101
	SW-4	August	43.7	J	109.99	A	0.397
		October	13.6	B	74.12	A	0.183
	SW-5	August	14.9	J	96.48	A	0.154
		October	12.4	B	75.55	A	0.164

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Wet Chemistry (ppm)							
BOD	SW-1	Min (91-96)	4	U	NA	NA	-
		Max (91-96)	20.1		NA	NA	-
		October	2	U	NA	NA	-
	SW-2	Min (91-96)	4	U	NA	NA	-
		Max (91-96)	77		NA	NA	-
		October	2	U	NA	NA	-
	SW-3	August	11		NA	NA	-
		October	2		NA	NA	-
Temperature (Degrees F)	SW-1	Min (91-96)	32		NA	NA	-
		Max (91-96)	71		NA	NA	-
		October	46		NA	NA	-
	SW-2	Min (91-96)	32		NA	NA	-
		Max (91-96)	69		NA	NA	-
		October	45		NA	NA	-
	SW-3	August	79		NA	NA	-
		October	46		NA	NA	-
	SW-4	August	60		NA	NA	-
		October	45		NA	NA	-
	SW-5	August	62		NA	NA	-
		October	45		NA	NA	-
pH	SW-1	Min (91-96)	6.3		6.5-8.5	NYSDEC	-
		Max (91-96)	8.9		6.5-8.5	NYSDEC	-
		October	8.4		6.5-8.5	NYSDEC	-
	SW-2	Min (91-96)	6.2		6.5-8.5	NYSDEC	-
		Max (91-96)	8.9		6.5-8.5	NYSDEC	-
		October	8.5		6.5-8.5	NYSDEC	-
	SW-3	August	8.1		6.5-8.5	NYSDEC	-
		October	8.4		6.5-8.5	NYSDEC	-
	SW-4	August	8		6.5-8.5	NYSDEC	-
		October	8.4		6.5-8.5	NYSDEC	-
	SW-5	August	7.8		6.5-8.5	NYSDEC	-
		October	8.4		6.5-8.5	NYSDEC	-
Eh-Redox Potential (mV)	SW-1	Min (91-96)	24		NA	NA	-
		Max (91-96)	482		NA	NA	-
		October	235		NA	NA	-
	SW-2	Min (91-96)	10		NA	NA	-
		Max (91-96)	478		NA	NA	-
		October	230		NA	NA	-
	SW-3	August	230		NA	NA	-
		October	225		NA	NA	-

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Eh-Redox Potential (mV)	SW-4	August	230		NA	NA	-
		October	230		NA	NA	-
	SW-5	August	230		NA	NA	-
		October	235		NA	NA	-
Conductivity (umhos/cm)	SW-1	Min (91-96)	200		NA	NA	-
		Max (91-96)	1100		NA	NA	-
		October	700		NA	NA	-
	SW-2	Min (91-96)	180		NA	NA	-
		Max (91-96)	701		NA	NA	-
		October	600		NA	NA	-
	SW-3	August	1500		NA	NA	-
		October	1200		NA	NA	-
	SW-4	August	200		NA	NA	-
		October	100		NA	NA	-
	SW-5	August	200		NA	NA	-
		October	100		NA	NA	-
Turbidity (NTUs)	SW-1	Min (91-96)	0.4		5	NYSDEC	0.080
		Max (91-96)	70		5	NYSDEC	**14.000**
		October	40		5	NYSDEC	**8.000**
	SW-2	Min (91-96)	1		5	NYSDEC	0.200
		Max (91-96)	59		5	NYSDEC	**11.800**
		October	35		5	NYSDEC	**7.000**
	SW-3	August	19.3		5	NYSDEC	**3.860**
		October	40		5	NYSDEC	**8.000**
	SW-4	August	6.4		5	NYSDEC	**1.280**
		October	6		5	NYSDEC	**1.200**
	SW-5	August	4.8		5	NYSDEC	0.960
		October	7		5	NYSDEC	**1.400**
Dissolved Oxygen	SW-1	Min (91-96)	1.3		NA	NA	-
		Max (91-96)	13.38		NA	NA	-
		October	7		NA	NA	-
	SW-2	Min (91-96)	2.3		NA	NA	-
		Max (91-96)	12.9		NA	NA	-
		October	6		NA	NA	-
	SW-3	August	4		NA	NA	-
		October	4.8		NA	NA	-
	SW-4	August	7		NA	NA	-
		October	9.8		NA	NA	-
	SW-5	August	6.1		NA	NA	-
		October	10		NA	NA	-

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Bromide	SW-3	August	1.4		NA	NA	-
		October	0.9		NA	NA	-
	SW-5	August	0.6		NA	NA	-
		October	0.7		NA	NA	-
Chloride	SW-1	Min (91-96)	16		250000	H	0.000
		Max (91-96)	140		250000	H	0.001
		October	119		250000	H	0.000
	SW-2	Min (91-96)	11		250000	H	0.000
		Max (91-96)	93		250000	H	0.000
		October	110		250000	H	0.000
	SW-3	August	239		250000	H	0.001
		October	193		250000	H	0.001
	SW-4	August	3.1		250000	H	0.000
		October	2.6		250000	H	0.000
	SW-5	August	2	U	NA	NA	-
		October	2.9		NA	NA	-
COD	SW-1	Min (91-96)	3		NA	NA	-
		Max (91-96)	66		NA	NA	-
		October	40		NA	NA	-
	SW-2	Min (91-96)	2	U	NA	NA	-
		Max (91-96)	90		NA	NA	-
		October	34		NA	NA	-
	SW-3	August	106		NA	NA	-
		October	76		NA	NA	-
Color (Units)	SW-1	Min (91-96)	5	U	15	H	**0.333**
		Max (91-96)	140		15	H	**9.333**
		October	30		15	H	**2.000**
	SW-2	Min (91-96)	5	U	15	H	0.333
		Max (91-96)	100		15	H	**6.667**
		October	30		15	H	**2.000**
	SW-3	August	60		15	H	**4.000**
		October	60		15	H	**4.000**
	SW-4	August	5	U	15	H	0.333
		October	5		15	H	0.333
	SW-5	August	5	U	15	H	0.333
		October	10		15	H	0.667
Ammonia(as N)	SW-1	Min (91-96)	0.05	U	34.4	A	0.001
		Max (91-96)	6.65		34.4	A	0.193
		October	0.15		34.4	A	0.004
	SW-2	Min (91-96)	0.1	U	34.4	A	0.003
		Max (91-96)	5		34.4	A	0.145
		October	0.02	U	34.4	A	0.001

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Ammonia(as N)	SW-3	August	5.8	J	34.4	A	0.169
		October	5.2		34.4	A	0.151
	SW-4	August	0.06		34.4	A	0.002
		October	0.1		34.4	A	0.003
Nitrate (as N)	SW-1	Min (91-96)	0.2	U	10000	H	0.000
		Max (91-96)	5.81		10000	H	0.001
		October	0.16		10000	H	0.000
	SW-2	Min (91-96)	0.2	U	10000	H	0.000
		Max (91-96)	4.06		10000	H	0.000
		October	0.48		10000	H	0.000
	SW-3	August	0.3		10000	H	0.000
		October	2.2		10000	H	0.000
	SW-5	August	0.5		10000	H	0.000
		October	0.1	U	10000	H	0.000
Total Phenols	SW-1	Min (91-96)	0.005	U	0.001	A/A*	**5.000**
		Max (91-96)	0.015		0.001	A/A*	**15.000**
		October	0.0023		0.001	A/A*	**2.300**
	SW-2	Min (91-96)	0.005	U	0.001	A/A*	**5.000**
		Max (91-96)	0.01	U	0.001	A/A*	**10.000**
		October	0.0011		0.001	A/A*	**1.100**
	SW-3	August	0.0083		0.001	A/A*	**8.300**
		October	0.0051		0.001	A/A*	**5.100**
	SW-4	August	0.0018		0.001	A/A*	**1.800**
		October	0.0015		0.001	A/A*	**1.500**
	SW-5	August	0.0013		0.001	A/A*	**1.300**
		October	0.0018		0.001	A/A*	**1.800**
Sulfate	SW-1	Min (91-96)	8		250000	H	0.000
		Max (91-96)	48		250000	H	0.000
		October	14.3		250000	H	0.000
	SW-2	Min (91-96)	9		250000	H	0.000
		Max (91-96)	46		250000	H	0.000
		October	13.9		250000	H	0.000
	SW-3	August	5	U	250000	H	0.000
		October	11.5		250000	H	0.000
	SW-4	August	7.3		250000	H	0.000
		October	1.5		250000	H	0.000
	SW-5	August	7.5		250000	H	0.000
		October	12.9		250000	H	0.000
Total Alkalinity	SW-1	Min (91-96)	47		NA	NA	-
		Max (91-96)	350		NA	NA	-
		October	177		NA	NA	-

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Total Alkalinity	SW-2	Min (91-96)	88		NA	NA	-
		Max (91-96)	223		NA	NA	-
		October	150		NA	NA	-
	SW-3	August	332		NA	NA	-
		October	346		NA	NA	-
	SW-4	August	94.8		NA	NA	-
		October	73.4		NA	NA	-
	SW-5	August	83.1		NA	NA	-
		October	75.2		NA	NA	-
TKN	SW-1	Min (91-96)	1.7		NA	NA	-
		Max (91-96)	8.7		NA	NA	-
		October	1.1		NA	NA	-
	SW-2	Min (91-96)	1.1		NA	NA	-
		Max (91-96)	7.8		NA	NA	-
		October	0.68		NA	NA	-
	SW-3	August	11		NA	NA	-
		October	7.4		NA	NA	-
	SW-4	August	0.2		NA	NA	-
		October	0.27		NA	NA	-
	SW-5	August	0.2	U	NA	NA	-
		October	0.24		NA	NA	-
TOC	SW-1	Min (91-96)	4		NA	NA	-
		Max (91-96)	19		NA	NA	-
		October	15.2		NA	NA	-
	SW-2	Min (91-96)	1		NA	NA	-
		Max (91-96)	25		NA	NA	-
		October	10.7		NA	NA	-
	SW-3	August	33.2		NA	NA	-
		October	24.9		NA	NA	-
	SW-4	August	2.1		NA	NA	-
		October	2.4		NA	NA	-
	SW-5	August	2.1		NA	NA	-
		October	2.3		NA	NA	-
Total Dissolved Solids	SW-1	Min (91-96)	280		500	A	0.560
		Max (91-96)	580		500	A	**1.160**
		October	427		500	A	0.854
	SW-2	Min (91-96)	170		500	A	0.340
		Max (91-96)	370		500	A	0.740
		October	364		500	A	0.728
	SW-3	August	851		500	A	**1.702**
		October	714		500	A	**1.428**

Table B1: Chemical Concentrations Detected in Surface Water, Screening Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Date Collected	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Total Dissolved Solids	SW-4	August	137		500	A	0.274
		October	89		500	A	0.178
	SW-5	August	116		500	A	0.232
		October	88		NA	NA	-
Total Hardness	SW-1	Min (91-96)	120		NA	NA	-
		Max (91-96)	346		NA	NA	-
		October	172		NA	NA	-
	SW-2	Min (91-96)	87		NA	NA	-
		Max (91-96)	251		NA	NA	-
		October	152		NA	NA	-
	SW-3	August	310		NA	NA	-
		October	300		NA	NA	-
	SW-4	August	140		NA	NA	-
		October	88		NA	NA	-
	SW-5	August	120		NA	NA	-
		October	90		NA	NA	-

Notes:

1. J= The associated sample result has been approximated due to a minor QA/QC deviation.
2. U= Not detected.
3. Samples were collected by Barton & Loguidice, P.C. located in Syracuse, New York.
4. Sample analyses were conducted by H2M Labs, Inc. Located in Melville, New York.
5. NA= Not available
6. - = Hazard quotient was not calculated due to unavailable benchmark.
7. Benchmark Type: A= NYSDEC Water Quality Standard; Fish propagation or wildlife consumption of fish.
   A*= NYSDEC Water Quality Standard; Fish survival or wildlife consumption of fish.
   H= NYSDEC Water Quality Standard; Source of drinking water for humans.
   Tier II SCV = Tier II Secondary Chronic Value (Suter, 1996).
   Daphnid LCV= Lowest Chronic Value for a microcrustacean.
8. Benchmarks for cadmium, chromium, copper, lead, nickel, and zinc were derived using the site-specific hardness measured at each location. Average hardness of water collected between March 1991 and December 1996 at locations SW-1 and SW-2 were used to calculate benchmarks for these locations.
9. 95% UCL: Upper Confidence Limit of quarterly monitoring results from March 1991 to December 1996. 1/2 the detection limit was used for concentrations which were not detected.
10. Ammonia benchmark interpolated using average of background temperature and pH values.
11. Min and Max (91-96): Reported minimum and maximum value recorded during quarterly sampling from March 1991 and December 1996 at Locations SW-1 and SW-2.

Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Volatile Organics (ppb)						
Acetone	SED-1	290		8.77	SQB-Daphnid	**33.067**
2-Butanone	SED-1	110	J	271	SQB-Tier II chronic	0.406
Toluene	SED-1	6	J	670	EPA SQB	0.009
Semivolatile Organics (ppb)						
4-Methylphenol	SED-1	570	J	NA	NA	-
Isophorone	SED-2	39	J	NA	NA	-
Bis(2-ethylhexyl)phthalate	SED-1	220	J	199500	NYSDEC LEL	0.001
Inorganics (ppm)						
Aluminum	SED-1	22000	J	NA	NA	-
	SED-2	16600		NA	NA	-
	SED-3	22900	J	NA	NA	-
	SED-4	11700		NA	NA	-
	SED-5	13300		NA	NA	-
	SED-6	13200		NA	NA	-
Arsenic	SED-1	28.3	J	6	NYSDEC LEL (P)	**4.717**
	SED-2	14.4		6	NYSDEC LEL (P)	**2.400**
	SED-3	14.3	J	6	NYSDEC LEL (P)	**2.383**
	SED-4	5.1		6	NYSDEC LEL (P)	0.850
	SED-5	7.3		6	NYSDEC LEL (P)	**1.217**
	SED-6	5.8		6	NYSDEC LEL (P)	0.967
Barium	SED-1	815	J	500	WI DNR SQC	**1.630**
	SED-2	159		500	WI DNR SQC	0.318
	SED-3	219	J	500	WI DNR SQC	0.438
	SED-4	84.3		500	WI DNR SQC	0.169
	SED-5	97.7		500	WI DNR SQC	0.195
	SED-6	103		500	WI DNR SQC	0.206

Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Beryllium	SED-1	0.9	J	NA	NA	-
	SED-2	0.64	J	NA	NA	-
	SED-3	0.8	J	NA	NA	-
	SED-4	0.44	J	NA	NA	-
	SED-5	0.48	J	NA	NA	-
	SED-6	0.51	J	NA	NA	-
Calcium	SED-1	23000	J	NA	NA	-
	SED-2	2010		NA	NA	-
	SED-3	6610	J	NA	NA	-
	SED-4	1330		NA	NA	-
	SED-5	9640		NA	NA	-
	SED-6	1300		NA	NA	-
Chromium	SED-1	30.3	J	26	NYSDEC LEL (P)	**1.165**
	SED-2	20.6	J	26	NYSDEC LEL (P)	0.792
	SED-3	31.3	J	26	NYSDEC LEL (P)	**1.204**
	SED-4	16.6	J	26	NYSDEC LEL (P)	0.638
	SED-5	18	J	26	NYSDEC LEL (P)	0.692
	SED-6	18.6	J	26	NYSDEC LEL (P)	0.715
Cobalt	SED-1	27.1	J	50	Open Water Disposal	0.542
	SED-2	12.3		50	Open Water Disposal	0.246
	SED-3	20	J	50	Open Water Disposal	0.400
	SED-4	10.2	J	50	Open Water Disposal	0.204
	SED-5	10.7	J	50	Open Water Disposal	0.214
	SED-6	13.5		50	Open Water Disposal	0.270
Copper	SED-1	27.5	J	16	NYSDEC LEL (P)	**1.719**
	SED-2	15.3		16	NYSDEC LEL (P)	0.956
	SED-3	27.5	J	16	NYSDEC LEL (P)	**1.719**
	SED-4	18		16	NYSDEC LEL (P)	**1.125**
	SED-5	18.1		16	NYSDEC LEL (P)	**1.131**
	SED-6	17.5		16	NYSDEC LEL (P)	**1.094**

Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Iron	SED-1	55900	J	20000	NYSDEC LEL (P)	**2.795**
	SED-2	37100		20000	NYSDEC LEL (P)	**1.855**
	SED-3	62700	J	20000	NYSDEC LEL (P)	**3.135**
	SED-4	29100		20000	NYSDEC LEL (P)	**1.455**
	SED-5	33000		20000	NYSDEC LEL (P)	**1.650**
	SED-6	34000		20000	NYSDEC LEL (P)	**1.700**
Lead	SED-1	20.3	J	31	NYSDEC LEL (P)	0.655
	SED-2	15.4	J	31	NYSDEC LEL (P)	0.497
	SED-3	14.7	J	31	NYSDEC LEL (P)	0.474
	SED-4	12.6	J	31	NYSDEC LEL (P)	0.406
	SED-5	9.2	J	31	NYSDEC LEL (P)	0.297
	SED-6	11.6	J	31	NYSDEC LEL (P)	0.374
Magnesium	SED-1	6910	J	NA	NA	-
	SED-2	5020		NA	NA	-
	SED-3	9350	J	NA	NA	-
	SED-4	4780		NA	NA	-
	SED-5	6270		NA	NA	-
	SED-6	5130		NA	NA	-
Manganese	SED-1	26100	J	460	NYSDEC LEL (P)	**56.739**
	SED-2	1230		460	NYSDEC LEL (P)	**2.674**
	SED-3	1220	J	460	NYSDEC LEL (P)	**2.652**
	SED-4	501		460	NYSDEC LEL (P)	**1.089**
	SED-5	523		460	NYSDEC LEL (P)	**1.137**
	SED-6	433		460	NYSDEC LEL (P)	0.941
Nickel	SED-1	39.6	J	16	NYSDEC LEL (P)	**2.475**
	SED-2	25.9		16	NYSDEC LEL (P)	**1.619**
	SED-3	53	J	16	NYSDEC LEL (P)	**3.313**
	SED-4	25.7		16	NYSDEC LEL (P)	**1.606**
	SED-5	27		16	NYSDEC LEL (P)	**1.688**
	SED-6	29.3		16	NYSDEC LEL (P)	**1.831**

Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Potassium	SED-1	3330		NA	NA	-
	SED-2	2080		NA	NA	-
	SED-3	1480	J	NA	NA	-
	SED-4	449	J	NA	NA	-
	SED-5	995	J	NA	NA	-
	SED-6	889	J	NA	NA	-
Selenium	SED-2	1.7		NA	NA	-
	SED-3	2.9		NA	NA	-
	SED-4	2	J	NA	NA	-
	SED-5	1.8		NA	NA	-
	SED-6	1.3		NA	NA	-
Sodium	SED-1	347	J	NA	NA	-
	SED-2	138	J	NA	NA	-
	SED-3	246	J	NA	NA	-
	SED-4	46.3	J	NA	NA	-
	SED-5	62	J	NA	NA	-
	SED-6	113	J	NA	NA	-
Thallium	SED-1	5.6		NA	NA	-
Vanadium	SED-1	33.3	J	NA	NA	-
	SED-2	24.8		NA	NA	-
	SED-3	29.1	J	NA	NA	-
	SED-4	14.6		NA	NA	-
	SED-5	17.4		NA	NA	-
	SED-6	17.8		NA	NA	-
Zinc	SED-1	229	J	120	NYSDEC LEL (P/L)	**1.908**
	SED-2	90.9		120	NYSDEC LEL (P/L)	0.758
	SED-3	145	J	120	NYSDEC LEL (P/L)	**1.208**
	SED-4	73.3		120	NYSDEC LEL (P/L)	0.611
	SED-5	86.7		120	NYSDEC LEL (P/L)	0.723
	SED-6	76.7		120	NYSDEC LEL (P/L)	0.639

Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Boron	SED-1	19.1	J	NA	NA	-
	SED-2	6.8	J	NA	NA	-
	SED-3	6.4	J	NA	NA	-
	SED-4	1	J	NA	NA	-
	SED-5	1.8	J	NA	NA	-
	SED-6	2	J	NA	NA	-
Wet Chemistry (ppm)						
Biochemical Oxygen Demand	SED-1	11200		NA	NA	-
	SED-2	611		NA	NA	-
	SED-3	1280		NA	NA	-
	SED-6	1220		NA	NA	-
Bromide	SED-1	69.1		NA	NA	-
	SED-2	76.3		NA	NA	-
	SED-3	104		NA	NA	-
	SED-4	52.4		NA	NA	-
	SED-5	45.4		NA	NA	-
	SED-6	54.2		NA	NA	-
Chloride	SED-6	125		NA	NA	-
Chemical Oxygen Demand	SED-1	202000		NA	NA	-
	SED-2	13900		NA	NA	-
	SED-3	34100		NA	NA	-
	SED-4	3570		NA	NA	-
	SED-5	6240		NA	NA	-
	SED-6	15000		NA	NA	-
Ammonia (as N)	SED-1	246		100	Open Water Disposal	**2.460**
Nitrate (as N)	SED-2	13.4		NA	NA	-
Total Phenols	SED-1	2.2		NA	NA	-
	SED-2	0.22		NA	NA	-
	SED-3	0.3		NA	NA	-

Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient
Total Alkalinity	SED-1	3990		NA	NA	-
	SED-2	186		NA	NA	-
	SED-3	1200		NA	NA	-
	SED-4	184		NA	NA	-
	SED-5	148		NA	NA	-
	SED-6	193		NA	NA	-
Total Kjeldahl Nitrogen	SED-1	3250		600	NYSDEC LEL (P)	**5.417**
	SED-2	309		600	NYSDEC LEL (P)	0.515
	SED-3	2900		600	NYSDEC LEL (P)	**4.833**
	SED-4	129		600	NYSDEC LEL (P)	0.215
	SED-5	224		600	NYSDEC LEL (P)	0.373
	SED-6	502		600	NYSDEC LEL (P)	0.837
Total Organic Carbon	SED-1	39700		10000	NYSDEC LEL (P)	**3.970**
	SED-2	5020		10000	NYSDEC LEL (P)	0.502
	SED-3	66900		10000	NYSDEC LEL (P)	**6.690**
	SED-4	1470		10000	NYSDEC LEL (P)	0.147
	SED-5	2050		10000	NYSDEC LEL (P)	0.205
	SED-6	5550		10000	NYSDEC LEL (P)	0.555
Total Hardness	SED-1	300000		NA	NA	-
	SED-2	109000		NA	NA	-
	SED-3	115000		NA	NA	-
	SED-4	42000		NA	NA	-
	SED-5	90800		NA	NA	-
	SED-6	72400		NA	NA	-

Notes:

1. J= The associated sample result has been approximated due to a minor QA/QC derivation.
2. Samples were collected by Barton & Loguidice, P.C. located in Syracuse, New York.
3. Sample analyses were conducted by H2M Labs, Inc. Located in Melville, New York.

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Table B2: Chemical Concentrations Detected in Sediment, Screening Benchmarks, and Hazard Quotients- Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Location	Concentration	Qualifier	Benchmark	Benchmark Type	Hazard Quotient

4. NA= Not available
5. - = Hazard quotient was not calculated due to unavailable benchmark.
6. Benchmark Type: * SQB Daphnid= Sediment Quality Benchmarks using Equilibrium Partitioning (EqP) methodology using the lowest chronic value (LCV) for daphnids (Jones et al., 1996).
   * SQB Tier II chronic = Sediment Quality Benchmarks using EqP methodology using the Tier II secondary chronic value (Jones et al., 1996).
   * EPA SQB= Sediment Quality Benchmark using EqP methodology (EPA, 1996).
   * LEL (P)= Lowest Effects Level derived by Persuad et al., 1993 used as the NYSDEC sediment criteria (NYSDEC, 1994).
   * NYSDEC LEL (NYSDEC, 1994), NYSDEC LEL (P) is the MOE LEL (Persuad et al., 1993), NYSDEC LEL (P/L) is the MOE LEL and the ER-L (Long et al., 1995).
   * WI DNR SQC= Wisconsin Department of Natural Resources Sediment Quality Criteria (Geisy and Hoke, 1990).
   * Open Water Disposal Guidelines (Persuad et al., 1993).
   * AET= Apparent Effects Threshold (EPA, 1987).

Table B3: Chemical Concentrations (mg/kg) Detected in Soils, Phytotoxicity Benchmarks, and Hazard Quotients - Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Soil Concentrations		Phytotoxicity Benchmark	Hazard Quotient	
	Minimum	Maximum		Low	High
Volatile Organics					
Acetone	0.005	0.041	NA	-	-
2-Butanone	ND	0.003	NA	-	-
Semivolatile Organics					
Diethylphthalate	0.16	0.19	NA	-	-
Metals (ppm)					
Aluminum	16200	18000	50	**324.000**	**360.000**
Antimony	0.76	0.85	5	0.152	0.170
Arsenic	8.6	11.2	10	0.860	**1.120**
Barium	174	245	500	0.348	0.490
Beryllium	0.65	0.69	10	0.065	0.069
Calcium	1490	1710	NA	-	-
Chromium	21.4	23.6	1	**21.400**	**23.600**
Cobalt	11.8	15.1	20	0.590	0.755
Copper	16	22.3	100	0.160	0.223
Iron	34000	40100	NA	-	-
Lead	9	10.8	50	0.180	0.216
Magnesium	4870	5250	NA	-	-
Manganese	593	611	500	**1.186**	**1.222**
Nickel	29.5	33.6	30	0.983	**1.120**
Potassium	1410	1940	NA	-	-
Sodium	136	149	NA	-	-
Vanadium	19.3	20.7	2	**9.650**	**10.350**
Zinc	70.2	74.8	50	**1.404**	**1.496**
Boron	3.3	4	0.5	**6.600**	**8.000**

Notes:

1. Phytotoxicity Benchmarks (Will and Suter, 1995).
2. ND: Not detected, maximum concentration was the only detected value for the chemical.
3. NA: Not Available.
4. - Hazard quotients were not calculated due to unavailable benchmarks.
5. Bolded hazard quotients indicate the identification of a Chemical of Potential Ecological Concern.

Table B4: Maximum and Average Total Chemical Exposure for the Eastern Cottontail
Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Maximum Soil Concentration (mg/kg)	Soil-Plant Uptake Factor	Plant Concentration (mg/kg)	Water Concentration (mg/L)	Exposure (mg/kg/d)				Benchmark (mg/kg/d)	Hazard Quotient
					Plant	Soil	Water	Total		
Volatile Organics										
Acetone	0.041	53.297	2.185	ND	0.431572	0.000513	0	0.43208	7.3	0.059
2-Butanone	0.003	26.3	0.079	ND	0.015583	3.75E-05	0	0.01562	NA	-
Semivolatile Organics										
Diethylphthalate	0.16	1.3899	0.222	ND	0.043921	0.002	0	0.04592	1822	0.000
Metals										
Aluminum	18000	0.004	72.000	0.158	14.22	225	0.015273	239.235	0.767	**311.910**
Antimony	0.85	0.04	0.034	ND	0.006715	0.010625	0	0.01734	0.05	0.347
Arsenic	11.2	0.5529	6.192	ND	1.223015	0.14	0	1.36301	0.05	**27.260**
Barium	245	0.15	36.750	0.766	7.258125	3.0625	0.074047	10.3947	4	2.599
Beryllium	0.69	0.01	0.007	0.00053	0.001363	0.008625	5.12E-05	0.01004	0.49	0.020
Chromium	23.6	0.041	0.968	0.0036	0.191101	0.295	0.000348	0.48645	2011	0.000
Cobalt	15.1	NA	0.000	0.0019	0	0.18875	0.000184	0.18893	NA	-
Copper	22.3	0.4	8.920	0.0018	1.7617	0.27875	0.000174	2.04062	11.2	0.182
Iron	40100	NA	0.000	1.3	0	501.25	0.125667	501.376	NA	-
Lead	10.8	0.3413	3.686	0.0029	0.727993	0.135	0.00028	0.86327	5.88	0.147
Magnesium	5360	NA	0.000	36.6	0	67	3.538	70.538	NA	-
Manganese	611	0.25	152.750	0.756	30.16813	7.6375	0.07308	37.8787	65	0.583
Nickel	33.6	0.7235	24.310	0.0213	4.801146	0.42	0.002059	5.22321	29.4	0.178
Potassium	1940	NA	0.000	31.4	0	24.25	3.035333	27.2853	NA	-
Sodium	149	NA	0.000	140	0	1.8625	13.53333	15.3958	NA	-
Vanadium	20.7	0.006	0.124	ND	0.02453	0.25875	0	0.28328	0.143	**1.981**
Zinc	74.8	0.3701	27.683	0.131	5.467487	0.935	0.012663	6.41515	117.6	0.055
Boron	4	NA	0.000	ND	0	0.05	0	0.05	20.6	0.002

Notes:

1. Soil-Plant Uptake Factors: Arsenic, cadmium, lead, and nickel are average literature dervied soil-to-biota uptake factors (Sample et al., 1997); Organic chemical uptake factors derived using the following equation- log BAF= 1.588 - 0.578(log Kow) (Travis and Arms, 1988); all other inorganic uptake factors from Baes et al. (1987).

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Table B4: Maximum and Average Total Chemical Exposure for the Eastern Cottontail
Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Maximum Soil Concentration (mg/kg)	Soil-Plant Uptake Factor	Plant Concentration (mg/kg)	Water Concentration (mg/L)	Exposure (mg/kg/d)				Benchmark (mg/kg/d)	Hazard Quotient
					Plant	Soil	Water	Total		

2. Plant concentration predicted from the following equation: Soil concentration x Soil-Plant Uptake Factor.
3. Water Concentration is the maximum concentration detected in all surface water samples collected.
4. Soil concentration is the maximum soil concentration detected in the soil boring samples.
5. NA: Not Available
6. - Hazard Quotient was not calculated due to lack of toxicological benchmark.

Table B5: Maximum and Average Total Chemical Exposure for the Whitetail Deer
Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Maximum Soil Concentration (mg/kg)	Soil-Plant Uptake Factor	Plant Concentration (mg/kg)	Water Concentration (mg/L)	Exposure (mg/kg/d)				Benchmark (mg/kg/d)	Hazard Quotient
					Plant	Soil	Water	Total		
Volatile Organics										
Acetone	0.27	53.297	14.390	ND	0.443167	0.0001663	0	0.4433332	2.8	0.158
2-Butanone	0.12	26.3	3.156	ND	0.097194	7.391E-05	0	0.0972675	NA	-
Semivolatile Organics										
Diethylphthalate	0.19	1.3899	0.264	ND	0.008133	0.000117	0	0.0082498	696	0.000
Inorganics										
Aluminum	18000	0.004	72.000	0.158	2.217345	11.086726	0.010347	13.314418	0.293	**45.442**
Antimony	0.85	0.04	0.034	ND	0.001047	0.0005235	0	0.0015706	0.019	0.083
Arsenic	11.9	0.5529	6.580	ND	0.202626	0.0073296	0	0.2099552	0.019	**11.050**
Barium	245	0.15	36.750	0.766	1.13177	0.1509027	0.050163	1.3328354	1.5	0.889
Beryllium	0.69	0.01	0.007	0.00053	0.000212	0.000425	3.47E-05	0.0006722	0.19	0.004
Chromium	23.6	0.041	0.968	0.0036	0.029799	0.0145359	0.000236	0.0445703	768	0.000
Cobalt	15.1	NA	0.000	0.0019	0	0.0093005	0.000124	0.009425	NA	-
Copper	22.3	0.4	8.920	0.0018	0.274704	0.0137352	0.000118	0.2885575	4.3	0.067
Iron	40100	NA	0.000	1.3	0	24.698761	0.085133	24.783894	NA	-
Lead	10.8	0.3413	3.686	0.0029	0.113517	0.006652	0.00019	0.1203589	2.24	0.054
Magnesium	5360	NA	0.000	36.6	0	3.3013805	2.396814	5.6981947	NA	-
Manganese	611	0.25	152.750	0.756	4.704159	0.3763327	0.049508	5.13	25	0.205
Nickel	33.6	0.7235	24.310	0.0213	0.74865	0.0206952	0.001395	0.7707397	11.22	0.069
Potassium	1940	NA	0.000	31.4	0	1.1949027	2.056283	3.2511858	NA	-
Sodium	149	NA	0.000	140	0	0.0917735	9.168142	9.259915	NA	-
Vanadium	20.7	0.006	0.124	ND	0.003825	0.0127497	0	0.0165747	0.055	0.301
Zinc	74.8	0.3701	27.683	0.131	0.852553	0.0460715	0.008579	0.9072035	44.9	0.020
Boron	4	NA	0.000	ND	0	0.0024637	0	0.0024637	7.9	0.000

Notes:

1. Soil-Plant Uptake Factors: Arsenic, cadmium, lead, and nickel are average literature dervied soil-to-biota uptake factors (Sample et al., 1997); Organic chemical uptake factors derived using the following equation- log BAF= 1.588 - 0.578(log Kow) (Travis and Arms, 1988); all other inorganic uptake factors from Baes et al. (1987).

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Table B5: Maximum and Average Total Chemical Exposure for the Whitetail Deer
Old Cortland County Landfill RI/FS, Cortland, New York

Parameter	Maximum Soil Concentration (mg/kg)	Soil-Plant Uptake Factor	Plant Concentration (mg/kg)	Water Concentration (mg/L)	Exposure (mg/kg/d)				Benchmark (mg/kg/d)	Hazard Quotient
					Plant	Soil	Water	Total		

2. Plant concentration predicted from the following equation: Soil concentration x Soil-Plant Uptake Factor.
3. Water Concentration is the maximum concentration detected in all surface water samples collected.
4. Soil concentration is the maximum soil concentration detected in the soil boring samples.
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Aluminum	18000	0.004	72.000	0.158	2.217345	11.086726	0.010347	13.314418	0.293	**45.442**
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Arsenic	11.9	0.5529	6.580	ND	0.202626	0.0073296	0	0.2099552	0.019	**11.050**
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Beryllium	0.69	0.01	0.007	0.00053	0.000212	0.000425	3.47E-05	0.0006722	0.19	0.004
Chromium	23.6	0.041	0.968	0.0036	0.029799	0.0145359	0.000236	0.0445703	768	0.000
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Copper	22.3	0.4	8.920	0.0018	0.274704	0.0137352	0.000118	0.2885575	4.3	0.067
Iron	40100	NA	0.000	1.3	0	24.698761	0.085133	24.783894	NA	-
Lead	10.8	0.3413	3.686	0.0029	0.113517	0.006652	0.00019	0.1203589	2.24	0.054
Magnesium	5360	NA	0.000	36.6	0	3.3013805	2.396814	5.6981947	NA	-
Manganese	611	0.25	152.750	0.756	4.704159	0.3763327	0.049508	5.13	25	0.205
Nickel	33.6	0.7235	24.310	0.0213	0.74865	0.0206952	0.001395	0.7707397	11.22	0.069
Potassium	1940	NA	0.000	31.4	0	1.1949027	2.056283	3.2511858	NA	-
Sodium	149	NA	0.000	140	0	0.0917735	9.168142	9.259915	NA	-
Vanadium	20.7	0.006	0.124	ND	0.003825	0.0127497	0	0.0165747	0.055	0.301
Zinc	74.8	0.3701	27.683	0.131	0.852553	0.0460715	0.008579	0.9072035	44.9	0.020
Boron	4	NA	0.000	ND	0	0.0024637	0	0.0024637	7.9	0.000

Notes:

1. Soil-Plant Uptake Factors: Arsenic, cadmium, lead, and nickel are average literature dervied soil-to-biota uptake factors (Sample et al., 1997); Organic chemical uptake factors derived using the following equation- log BAF= 1.588 - 0.578(log Kow) (Travis and Arms, 1988); all other inorganic uptake factors from Baes et al. (1987).

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					Plant	Soil	Water	Total		

2. Plant concentration predicted from the following equation: Soil concentration x Soil-Plant Uptake Factor.
3. Water Concentration is the maximum concentration detected in all surface water samples collected.
4. Soil concentration is the maximum soil concentration detected in the soil boring samples.
5. NA: Not Available
6. - Hazard Quotient was not calculated due to lack of toxicological benchmark.

APPENDIX C

TOXICITY PROFILES
ECOLOGICAL RISK ASSESSMENT

Aluminum

Experiments Conducted in Soil

Seedling establishment of white clover in a silt loam soil (pH 5.0) was reduced by approximately 30% by the addition of 50 ppm Al as $Al_2(SO_4)_3$ (Mackay et al., 1990), the lowest concentration tested.

Experiments Conducted in Solution

The effects of Al in acidic solutions on tree growth has been evaluated by several authors. Norway spruce was more sensitive than Scots pine to Al in solution (pH 3.8) with a 33% reduction in root weight after 21 d at 8.1 ppm Al (5.4 ppm had no effect) (Gorransson and Eldhuset, 1991). Pine shoot growth rate was reduced 40% with 270 ppm, while 162 ppm Al had no effect. Root growth of 1-yr old Douglas fir seedlings in solution with Al added as $AlCl_3$ (pH 3) was reduced 32% by 32 ppm Al (Keltjens, 1990). Citrus rootstock seedlings grown in nutrient solution with Al added as $Al_2(SO_4)_2$ (pH 4) showed equal or greater sensitivity to Al than coniferous evergreen trees. After 60 d, three of the five rootstocks had reduced weight at 8.3 ppm Al (22-45% reductions). Root length of another was decreased 21% at 2.7 ppm Al, and weight of a mandarin rootstock was reduced 30% at 24.4 ppm.

Sensitivities of horticultural and field crops, and grasses have also been tested. Wheeler and Follet (1991) evaluated the effect of Al as $Al_2(SO_4)_3$ in solution culture (pH 4.7) on onion, asparagus, and squash growth (approximately 30d). Concentrations reducing growth ranged from 0.05 ppm Al (68% reduction in onion root weight) to 0.27 ppm (25% reduction in squash root weight). McLean and Gilbert (1927) evaluated the effect of Al in solution culture on carrot, radish, turnip, and beet growth (77 to 126 d) Concentrations reducing growth ranged from 1.8 ppm Al (25% reduction in beet seedling weight) to 7.2 ppm (39% reduction in turnip top weight). Wallace and Romney (1977a) grew rice and soybean seedlings in solution culture containing Al as $Al_2(SO_4)_3$ for 13 d. Rice plant weight was reduced 28% by 2.7 ppm Al, and leaf weight of soybeans was reduced 33% by the same concentration. Thirty to 50% reductions in barley weights occurred after 30d growth in solution to which 6 to 10 ppm Al had been added as $AlCl_3$ (pH 4.3) (MacLeod and Jackson, 1967). Wong and Bradshaw (1982) evaluated the effect of Al on root and shoot length of Rye grass root growth was reduced 29% after 14 d growth in solution (pH 7) with 0.63 ppm Al added as $KAl(SO_4)_2$.

Mechanism of Phytotoxicity

Al interferes with cell division in roots, decreases root respiration, fixes P in unavailable forms in roots, interferes with uptake, transport, and use of Ca, Mg, P, K, and water, and interferes with enzyme activities (Foy et al., 1978). Symptoms of toxicity include stubby, brittle roots, stunting, late maturity, and collapse of growing points. Seedlings are more susceptible to damage from Al toxicity than are older plants.

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Arsenic

Experiments Conducted in Soil

The tolerance of spruce seedlings to As in soil was tested in field plots by Rosehart and Lee (1973). Three-yr old seedlings grown 335 days in soil to which 1000 ppm As was added as As(III) (lowest concentration tested) experienced a 50% reduction in height.

Soil type affected the toxicity of As(III) added to two soils on the shoot weight of cotton and soybeans grown from seed for 6 weeks (Deuel and Swoboda, 1972). In a sandy loam soil, shoot weights of both crops were reduced (cotton 22%; soybeans 45%) by 11 ppm As (the lowest concentration tested). Soybean growth in a clay soil was reduced 28% by 22.4 ppm As (lowest concentration tested). Cotton growth in this soil was reduced 29% by 89.6 ppm As.

The source of As(V) has been shown to influence the effect on corn grown from seed for 4 weeks in a loamy sand (pH 7.1). Plant weight reductions rose from less than 10% with the addition of 10 ppm As in any form, to almost 100 % for NaH_2AsO_4, over 75% for $Al(H_2AsO_4)_3$, and about 65% for $Ca(H_2AsO_4)_2$ with the addition of 100 ppm As (Woolson et al., 1971).

Experiments Conducted in Solution

Mhatre and Chaphekar (1982) found no effect of As(III) (As_2O_3), up to 1 ppm As, on germination of seeds of sorghum, alfalfa, mung bean, cluster bean, and radish. After 5 d, reductions in root length occurred between 0.001 ppm As (29% reduction in cluster bean) and 1 ppm As (55 and 87% reductions in alfalfa and mung bean). The concentrations of As (V), from Na_2HAsO_4, required for a 50% reduction in seed germination and root length of mustard after 3 d exposure in solution (pH 7.3), was reported by Fargasova (1994) to be 30 ppm. The EC_{50} for root length was 5.5 ppm As.

Mechanism of Phytotoxicity

Arsenic is not essential for plant growth. It is taken up actively by roots, with arsenate being more easily absorbed than arsenite. Arsenic and phosphate ions are likely taken up by the same carrier (Asher and Reay, 1979). The phytotoxicity is strongly affected by the form in which it occurs in soils. Arsenite (III) is more toxic than arsenate (V), and both are considerably more toxic than organic forms (Peterson et al., 1981). In experiments with toxic levels of As, rice and legumes appear to be more sensitive than other plants. Symptoms include wilting of new-cycle leaves, followed by retardation of root and top growth, and leaf necrosis (Aller et al., 1990). As is chemically similar to P, it is translocated in the plant in a similar manner and is able to replace P in many cell reactions. Arsenic (III) probably reacts with sulphydryl enzymes leading to membrane degradation and cell death. Arsenic (V) is known to uncouple phosphorylation and affect enzyme systems (Peterson et al., 1981). The mechanism of toxicity of organo-arsenicals is unclear.

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Boron

Experiments Conducted in Soil

John et al. (1977) investigated the effects of B added as H_3BO_3 on shoot weight of corn seedlings grown 7 weeks in muck and two silt loam soils. Addition of 50 ppm B to the muck soil (pH 4.5; % organic matter 56) resulted in a 56% reduction in plant growth (10 ppm B had no effect). Growth was reduced 37% by the addition of the lowest concentration tested (0.5 ppm) in one silt loam soil (pH 5.7; % organic matter 6), and 83% by the addition of 50 ppm B in the other (pH 5.7; % organic matter 3) (10 ppm had no effect).

Experiments Conducted in Solution

Wallace et al. (1977) evaluated the effect of B (as H_3BO_3) on leaf, stem, and root weights of bush bean seedlings in solution. After 16 d, root and leaf weights were reduced 35 and 45% by 5.4 ppm B, while 1.1 ppm had no effect. Bowen (1979) reported unspecified toxic effects on plants grown in a solution with the addition of 1 ppm B.

Mechanism of Phytotoxicity

Boron is a plant micronutrient involved in transport of sugars across membranes, synthesis of nucleic acids, and protein utilization. It is rapidly taken up, mainly as the neutral $B(OH)_3$ molecule and equally distributed between roots and shoots (Wallace and Romney, 1977). Toxicity symptoms include needle tip necrosis and discoloration in pines (Neary et al., 1975) and burning of leaf edges in other plants. Grasses and legumes appear to have greater than average tolerance to high B concentrations (Gupta, 1984), and pines appear to be particularly sensitive (Stone and Baird, 1956).

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Chromium

Experiments Conducted in Soil

Turner and Rust (1971) investigated the effect of Cr added as Cr(VI) on soybean seedlings grown 3 days in a loam soil. Fresh shoot weight was reduced 30% by 30 ppm Cr, while 10 ppm had no effect. Adema and Henzen (1989) calculated EC_{50} concentrations for effects of Cr added as Cr(VI) on lettuce, tomato and oats grown in a growth chamber from seed for 14 days. The EC_{50} for lettuce in a humic sand soil (pH 5.1, % organic matter 3.7) was greater than 11 ppm, while in a loam soil (pH 7.4, % organic matter 1.4) it was 1.8 ppm Cr. The EC_{50} for tomato in the humic sand soil was 21 ppm, while in the loam soil it was 6.8 ppm Cr. The EC_{50} for oats in the humic sand soil was 31 ppm, while in the loam soil it was 7.4 ppm Cr. Results of these experiments show the ameliorating effects of organic matter on Cr (VI) toxicity.

Experiments Conducted in Solution

Calculated EC_{50} concentrations for effects of Cr(VI) added as $K_2Cr_2O_7$ on lettuce, tomato and oats grown from seed for 14 days ranged from 0.16 (lettuce) to 1.4 ppm Cr (oats) (Adema and Henzen, 1989). The concentration of Cr(VI), from $(NH_4)_2CrO_4$, required for a 50% reduction in seed germination and root length of mustard after 3 d exposure in solution (pH 7.3), was reported by Fargasova (1994) to be 100 ppm. EC_{50} for root length was 46 ppm Cr. Using a 1:1 combination of Cr(III) ($CrCl_3$) and Cr(VI) (K_2CrO_7) in nutrient solution (pH 5), Hara et al. (1976) measured a 68% reduction in weight of cabbage with 10 ppm Cr (2 ppm had no effect).

Top weight of soybean seedlings grown for 5 d in nutrient solution containing Cr(VI) was reduced 21% by 1 ppm Cr, while 0.5 ppm had no effect (Turner and Rust, 1971). Wallace et al. (1977) measured a 30% reduction in leaf weight of bush beans grown 11 d in nutrient solution containing 0.54 ppm Cr as (Cr VI).

Length of the longest root of rye grass was reduced 69% by exposure to 2.5 ppm Cr(VI) (lowest concentration tested) in nutrient solution (pH 7) for 14 d (Wong and Bradshaw, 1982). Length of the longest shoot was not affected at this concentration. Breeze (1973) found little difference in the toxicity of Cr(III) [$Cr_2(SO_4)_3$] and Cr(VI) ($K_2Cr_2O_7$) to rye grass seed germination. Seed exposed to solutions containing 50 ppm Cr (III) or (VI) reduced germination 37 and 38% after 2.5 d.

Nutrient solution containing 0.05 ppm Cr(III) [$Cr_2(SO_4)_3$] reduced leaf and stem weights of chrysanthemum seedlings exposed for 21 d by 31 and 36% (Patel et al., 1976). This was the lowest concentration tested and root weight was not affected.

Based on these experiments, there is an indication that the source of the Cr affects plant response and seed germination is not as sensitive as growth.

Mechanism of Phytotoxicity

Chromium is not an essential element in plants. The (VI) form is more soluble and available to plants than the (III) form and is considered the more toxic form (Smith, et al., 1989). In soils within a normal Eh and pH range, Cr(VI), a strong oxidant, is likely to be reduced to the less available Cr(III) form although the (III) form may be oxidized to the (VI) form in the presence of oxidized Mn

(Bartlett and James, 1979). In nutrient solution, however, both forms are about equally taken up by plants and toxic to plants (McGrath, 1982). Cr(VI), as CrO_4^{2-}, may share a root membrane carrier with SO_4^{2-}. Cr(VI) is more mobile in plants than Cr(III) but translocation varies with plant type. After plant uptake it generally remains in the roots because of the many binding sites in the cell wall capable of binding especially the Cr(III) ions (Smith et al., 1989). Within the plant Cr(VI) may be reduced to the +3 form and complexed as an anion with organic molecules. Symptoms of toxicity include stunted growth, poorly developed roots, and leaf curling. Chromium may interfere with C, N, P, Fe, and Mo metabolism, and enzyme reactions (Kabata-Pendias and Pendias, 1984).

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Wong, M. H. and A. D. Bradshaw. 1982. "A comparison of the toxicity of heavy metals, using root elongation of rye grass, *Lolium perenne*." *New Phytol.* 92:255-61.

Manganese

Experiments Conducted in Soil

Wallace et al. (1977) evaluated the effects of Mn, added as $MnSO_4$ to a loam soil, on leaf and stem weights of bush beans grown from seed for 17 days. Stem weight was reduced 29% by 500 ppm Mn (lowest concentration tested).

Experiments Conducted in Solution

The effects of Mn ($MnSO_4$) on Norway spruce seedling growth was evaluated by Langheinrich et al. (1992). In an experiment run at pH 6 for 32 d, Mn added at 44 ppm (lowest concentration tested) reduced root growth approximately 45% (11 ppm had no effect). In experiments run at pH 4 for 77 d, Mn added at 44 ppm (only concentration tested) reduced growth by approximately 50%.

Rye grass, bush beans, tomatoes, and potatoes have also been tested. After 14 days, a concentration of 0.75 ppm Mn in solution (pH 7) caused a 71% reduction in rye grass growth ($MnSO_4$; lowest concentration tested) (Wong and Bradshaw, 1982). In a 16-d experiment, bush bean weights were reduced approximately 25% by 5.5 ppm Mn ($MnSO_4$; lowest concentration tested) (Wallace et al., 1977). In a 21-d experiment, weights were reduced approximately 40% by 55 ppm, while 5.5 ppm Mn had no effect. LeBot et al. (1990) evaluated the effect of Mn, as $MnSO_4$ on weight of tomato plants growing in nutrient solution (pH 5.5) for 17 d. Manganese at 5.5 ppm reduced plant weight by 27%, while 2.8 ppm had no effect. A concentration of 33.5 ppm Mn (lowest concentration tested) caused a 23% reduction in potato shoot weight after 32 d growth (Marsh and Peterson, 1990).

Mechanism of Phytotoxicity

Manganese is essential for plant growth. It is involved in N assimilation, as a catalyst in plant metabolism, and functions with Fe in the synthesis of chlorophyll (Labanauskas, 1966). Toxicity symptoms include marginal chlorosis and necrosis of leaves, and root browning. Excess Mn interferes with enzymes, decreases respiration, and is involved in the destruction of auxin (Foy et al., 1978). It is fairly uniformly distributed between roots and shoots (Wallace and Romney, 1977).

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Nickel

Experiments Conducted in Soil

A limited number of studies have evaluated the effects of Ni on oak, rye grass, corn, cotton, and beans. Dixon (1988) measured a 30% weight reduction of red oak seedlings grown for 16 weeks in a sandy loam soil (pH 6, % organic matter 1.5) with addition of 50 ppm Ni ($NiCl_2$) (no effect at 20 ppm Ni).

Rye grass shoot weight was reduced 66% with the addition of 180 ppm Ni (as $NiSO_4$) to a loam soil (pH 4.7) in which the plants had been grown for 4 weeks from seed (90 ppm had no effect) (Khalid and Tinsley, 1980). Oats grown from seed for 110 d in the presence of 50 ppm Ni (as $NiCl_2$) in soil (pH 6.1, % organic matter 1.4) had reductions of 38 and 63% in grain and straw weight (Halstead et al., 1969). In a second soil (pH 5.7, % organic matter 4.1) only straw weight was reduced (45%) by addition of 100 ppm Ni (50 ppm had no effect). Traynor and Knezek (1973) measured a 21% reduction in corn plant weight with the addition of 294 ppm Ni (as $NiCl_2$) to a sandy soil (pH 5, % organic matter 2) in which the plants had been grown for 5 weeks from seed. Addition of 220 ppm had no effect.

Wallace et al. (1977) report the results of experiments on the effects of Ni (as $NiSO_4$) on seedlings of a variety of plants grown in a loam soil at several pH's. Corn grown in soil at pH 4.2, 5.6, and 7.5 experienced 74, 80, and 50% reductions in shoot weight after 14 days growth with the addition of 250 ppm Ni. Ni at 100 ppm had no effect. At pH 5.8, bush beans grown for 16 days had a 64% reduction in shoot weight with the addition of 100 ppm (lowest concentration tested). At pH 7.5, a 36% reduction in plant weight occurred with 250 ppm Ni, while 100 ppm had no effect. After 28 days growth in a loam soil at pH 5.8, bush bean leaf weight was reduced 45% by the addition of 100 ppm Ni, while 25 ppm had no effect. For barley under these same growth conditions, 25 ppm Ni (lowest concentration tested) reduced shoot weight 88%.

Two-week old cotton seedlings grown for 35 d in soil (pH 6.8) to which 100 ppm Ni was added (lowest concentration tested) experienced reductions in leaf and stem weights of approximately 45 to 60% (Rehab and Wallace, 1978).

Experiments Conducted in Solution

The effect of Ni on stem diameter increase and plant weight of red pine, maple, dogwood, and honeysuckle was examined by Heale and Ormrod (1982). Seedlings (90-d from cutting) of red pine and honeysuckle grown for 110 d in nutrient solution containing 2 ppm Cu from $NiSO_4$ (lowest concentration tested) had reductions in stem diameter increase and plant weight of 100, and 25%, and 84 and 65%, respectively.. Reductions in stem diameter increase in plant weight were 70% dogwood grown in solution containing 10 ppm Ni, while 2 ppm had no effect. Maple experienced a 48% decease in plant weight only at 10 ppm Cu with the stem diameter increase remaining unaffected up to 20 ppm Cu (highest concentration tested).

The effects of Ni on several horticultural and field crops have been evaluated. Wong and Bradshaw (1982) measured a 29% decrease in length of longest root of rye grass when germinated and grown for 14 d in nutrient solution (pH 7) with 0.13 ppm Ni [$Ni(NH_4)_2(SO_4)_2$], the lowest concentration tested. Wallace (1979) measured 92 and 68% decreases in root and leaf weights of bush bean seedlings when grown for 21 d in nutrient solution (pH 5) with 1.2 ppm Ni, the only concentration tested. The effects of 0.25 to 20 ppm Ni, from $NiSO_4$, on germination and radicle length after 3 d growth in solution of radish, cabbage, turnip, lettuce, wheat, and millet were determined by Carlson et al. (1991b). There was no effect on seed germination up to 20 ppm Ni. Effective concentrations ranged from 1 ppm (25% reduction in radicle length of lettuce and turnip) to 12 ppm (40% reduction in radicle length of millet). The effect of Ni, as $NiCl_2$, on plant weight of cotton grown in nutrient solution (pH 6) was evaluated by Rehab and Wallace (1978). Plant weight was reduced 92% by 5.9 ppm Cd, while 0.59 ppm had no effect.

Patel et al. (1976) found 26 and 27% decreases in leaf and stem weights of chrysanthemum seedlings when grown for 14 d in nutrient solution with 0.59 ppm Ni ($NiSO_4$), while 0.006 ppm had no effect. Root weight was not affected at 0.59 ppm Ni.

Mechanism of Phytotoxicity

Nickel is not generally considered to be an essential element for plants. However, it may be required by nodulated legumes for internal N transport as part of the urease enzyme (Aller et al., 1990). It is generally adsorbed as the Ni(II) ion and translocated in xylem and phloem with an organic chelate (Hutchinson, 1981). Nickel is fairly uniformly distributed between roots and shoots (Wallace and Romney, 1977b). Symptoms of Ni toxicity are generally Fe-deficiency induced chlorosis and foliar necrosis (Khalid and Tinsley, 1980). Excess nickel affects nutrient absorption by roots, root development, and metabolism, and it inhibits photosynthesis and transpiration. Nickel can replace Co and other heavy metals located at active sites in metallo-enzymes and disrupt their functioning.

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Vanadium

Experiments Conducted in Soil

There was no primary reference data describing toxicity of V to plants grown in soil. Kloke (1979) report unspecified toxic effects on plants grown in a surface soil with the addition of 50 ppm V. Vanadium added at a concentration of 2.5 ppm was toxic to plants in a study reported by EPA (1975).

Experiments Conducted in Solution

The effects of V on bean, cabbage, soybean, radish, turnip, lettuce, wheat and millet have been evaluated. Vanadium at 0.51 ppm (NH_4VO_3; lowest concentration tested) caused a 46% reduction in root weight of bush bean seedlings grown in nutrient solution (pH 5) for 14 d (Wallace, 1979). After 55 d, cabbage seedling plant weight was reduced 34% by 4 ppm V added as VCl_3 to nutrient solution (pH 5), while 0.4 ppm had no effect on growth (Hara et al., 1976). Plant weight of soybean seedlings grown for 33 d in nutrient solution containing 6 ppm V (as $VOSO_4$) was reduced 36%, while 3 ppm had no effect on growth (Kaplan et al., 1990). Root and shoot weights of three cultivars of peas germinated and grown for 14 d in solution containing 20 ppm V (V (NH_4VO_3) were reduced 40 and 25% (Nowakowski, 1992).

The effects of 0.5 to 40 ppm V, from $VOSO_4$, on germination and radicle length after 3 d growth in solution of radish, cabbage, turnip, lettuce, wheat, and millet were determined by Carlson et al. (1991b). There was no effect on seed germination up to 40 ppm. Millet was exposed additionally to 50 to 100 ppm V. Effective concentrations for radicle length ranged from 2.5 ppm for lettuce, turnip, and cabbage (30, 50, and 42% reductions) to 60 ppm for millet (50% reduction).

Mechanism of Phytotoxicity

Vanadium is not known to be essential for plant growth although it may be involved in N_2 fixation in nodules of legume roots. Toxicity symptoms include chlorosis, dwarfing, and inhibited root growth (Pratt, 1966). Vanadium inhibits various enzyme systems while stimulating others, the overall effect on plant growth being negative (Peterson and Girling, 1981). After uptake, it remains in the root system in insoluble form with Ca (Wallace and Romney, 1977).

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Zinc

Experiments Conducted in Soil

Muramoto et al. (1990) measured the effects of addition of Zn as ZnO to an alluvial soil (pH 6) on root and stem weights, stem length, and grain yield of wheat and rice grown from seed to maturity. Root weight of rice was reduced about 29% by 1000 ppm (lowest concentration tested). Wheat grain yield and plant weight were reduced 66 and 28% by 1000 ppm (lowest concentration tested).

The effect of Zn on soybean growth has been evaluated. Number of seeds produced per plant was decreased by 28% when plants were grown from seed to maturity in an average garden soil to which 25 ppm Zn was added as $ZnSO_4$ (Aery and Sakar, 1991). Zn at 10 ppm had no effect. The work of White et al. (1979) shows the ameliorating effect on Zn toxicity of increased pH in a sandy loam soil. Soybean leaf weight was reduced 30% by 131 ppm Zn at pH 5.5, while 115 ppm had no effect. At pH 6.5, leaf weight was reduced 33% by 393 ppm Zn, while 327 ppm had no effect.

Lata and Veer (1990) measured 45 and 22% reductions in plant weights of spinach and coriander after 60 days in soil with 87 ppm Zn.

Experiments Conducted in Solution

Carroll and Loneragan (1968) measured effects of Zn on weight of 1-week old seedlings of barrel medic (*Medicago*), subterranean clover, and lucerne (*Medicago*) grown for 46 d in nutrient solution (pH 6). Zinc at 0.41 ppm reduced weights 80, 40, and 37%, respectively, while 0.08 ppm had no effect. Rye grass root growth was reduced 63% after 14 d growth in solution (pH 7) containing 1.85 ppm Zn ($ZnSO_4$) (Wong and Bradshaw, 1982)..After 16 d, weights bush bean plant weight was reduced approximately 40% by 6.6 ppm Zn (as $ZnSO_4$), while 0.66 ppm had no effect (Wallace et al., 1977).

Patel et al. (1976) found a 30% decrease in root and stem weights of chrysanthemum seedlings when grown for 21 d in nutrient solution with 6.5 ppm Zn (as $ZnSO_4$), while 0.65 ppm had no effect.

Mechanism of Phytotoxicity

Zinc is an essential element for plant growth. It has a part in many enzymes, and is involved in disease protection and metabolism of carbohydrates and proteins. Zinc is actively taken up by roots in ionic form, and less so in organically chelated form (Collins, 1981).It is fairly uniformly distributed between roots and shoots being transported in the xylem in ionic form (Wallace and Romney, 1977b). Transport in the phloem appears to be as an anionic complex (van Goor and Wiersma, 1976). Toxicity symptoms include chlorosis and depressed plant growth (Chapman, 1966). It acts to inhibit CO_2 fixation, phloem transport of carbohydrates, and alter membrane permeability (Collins, 1981).

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Aluminum

Aluminum is an ubiquitous metal, being the third most abundant element in the earth's crust (Krueger et al., 1984). Relative to other metals, the toxicity of aluminum is low (Sorensen et al., 1974). The oral LD_{50} for mice ranges from 770 to 980 mg aluminum/kg body weight (Ondreicka et al., 1966). The principal effect of aluminum is to interfere with phosphorous metabolism; in the alimentary canal, aluminum forms insoluble compounds with phosphorous resulting in an imbalance of calcium and phosphorous (Carrerie et al., 1986). Other effects of aluminum include neurotoxicity. Rats exposed to aluminum display behavioral abnormalities and have reduced acetylcholinesterase activity (Krueger et al., 1984). Mice consuming diets containing 500 to 1000 ppm aluminum displayed ataxia and paralysis of the hind limbs (Golub et al., 1987). In humans, aluminum has been associated with several degenerative diseases of the nervous system, including Alzheimer's disease, Parkinson's disease, and amyotrophic lateral sclerosis (Ganrot, 1986).

Ondreicka et al. (1966) evaluated the effects of aluminum on mammalian reproduction. Mice received 19.3 mg aluminum/kg bodyweight/day (as $AlCl_3$) in drinking water for three generations. While the number of litters and offspring per litter was not reduced, growth was significantly reduced among all offspring in the second and third generations. In a similar study, rats received daily intragastric doses of 0, 180, 360, or 720 mg aluminum/kg body weight/day (Domingo et al., 1987) for one generation. Growth and survival of young was reduced among the groups that received 360 and 720 mg aluminum/kg/day. Other studies also report that while aluminum does not appear to affect the number of litters or number of offspring/litter, growth and survival of offspring of aluminum exposed parents is reduced (Golub et al., 1987; Paternain et al. 1988).

Due to it's interference with phosphorous and calcium metabolism, it has been suggested that aluminum may impair eggshell formation by birds, resulting in eggshell thinning (Nyholm, 1981). To test this hypothesis, Carriere et al. (1986) fed breeding ring doves (*Streptopelia risoria*) a diet containing 1000 ppm aluminum (and adequate but reduced calcium and phosphorous) and observed reproduction. While no reproductive effects or embryonic malformations were observed at this dosage level, significant reproductive effects resulted when birds were fed a diet deficient in calcium and phosphorous that contained 750 ppm aluminum. Therefore, among birds it appears that the manifestation of toxic effects of aluminum are dependent upon the nutritional quality of their diet.

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Arsenic

Arsenic is present in the earth's crust at approximately 2 ppm, but tissues of animals generally contain an average of <0.5 ppm (Venugopal and Luckey, 1978). Arsenic may be a required micronutrient; growth, survival, and reproduction of goats is poor if the diet contains <0.05 ppm As (NAS, 1977).

Arsenic is a carcinogen and teratogen. Other effects include reduced growth, hearing/sight loss, liver/kidney damage, and death (Eisler, 1988). Inorganic arsenic is usually more toxic than organic arsenic compounds. Wildlife mortality and malformations have been observed for chronic doses of 1-10 mg As/kg bw and dietary concentrations of 5-50 ppm (Eisler, 1988). Acute LD_{50}s for mammals of 35–100 mg calcium arsenate/kg body weight and 10-50 mg lead arsenate/kg body weight have been reported (NRCC, 1978).

Schroeder and Mitchner (1971) exposed mice to 5 ppm sodium arsenite in drinking water for three generations. While mice fed arsenic survived well, litter size decreased in subsequent generations. A dose of 0.38 mg arsenic/kg over a lifetime was sufficient to cause a slight decrease in the median lifespan of laboratory mice (Schroeder and Balassa, 1967), but it had no effect on growth. As little as 3 mg arsenic trioxide/kg body weight or 1 mg sodium arsenite/kg body weight can be lethal (NAS, 1977).

Because metabolism of arsenic in rats is unlike that in other animals, results of toxicity studies using rats generally should not be extrapolated to other species (Eisler, 1988).

Among birds, LD_{50}s for arsenic compounds range from 17.4 to 3300 mg/kg bw (Eisler, 1988). While no mortality was observed among mallard ducks fed a diet containing 100 ppm sodium arsenite for 128 days, 12% to 92% mortality was observed for ducks fed diets containing 250 to 1000 ppm arsenite (USFWS, 1964). Camardese et al. (1990) and Whitworth et al. (1991) fed mallards diets containing 30, 100, or 300 ppm sodium arsenate. While no effects were observed on behavior, growth was reduced for male ducks consuming 300 ppm arsenic and for female ducks at all exposure levels.

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Vanadium

Vanadium is a metallic element that occurs in six oxidation states and numerous inorganic compounds. The toxicity of vanadium depends on its physico-chemical state, particularly on its valence state and solubility. Based on acute toxicity, pentavalent NH_4VO_3 has been reported to be more than twice as toxic as trivalent VCl_3 and more than 6 times as toxic as divalent VI_2. Pentavalent V_2O_5 has been reported to be more than 5 times as toxic as trivalent V_2O_3 (Roshchin 1967). In animals, acutely toxic oral doses cause vasoconstriction, diffuse desquamative enteritis, congestion and fatty degeneration of the liver, congestion and focal hemorrhages in the lungs and adrenal cortex (Gosselin et al. 1984). Minimal effects seen after subchronic oral exposures to animals include diarrhea, altered renal function, and decreases in erythrocyte counts, hemoglobin, and hematocrit (Domingo et al. 1985; Zaporowska and Wasilewski 1990).

A vanadyl sulfate concentration of 5 µg/mL in drinking water, plus a vanadium level of 3.2 µg/g in the diet (4.1 mg V/kg total) of mice, was reported to cause no adverse effects over a lifetime exposure period (Schroeder and Balassa, 1967). In similar lifetime studies, rats and mice exhibited no adverse effects when exposed to 5 ppm vanadium (as vanadyl sulfate) in drinking water (Schroeder et al., 1970; Schroeder and Mitchner 1975). The estimated dose levels were 0.7 mg V/kg/day for rats and 0.9 mg V/kg/day for mice. Vanadium pentoxide in the diet of rats at levels of 10 and 100 ppm for their entire lifetime resulted in no significant toxicological effects except for a reduction in hair cystine content (Stokinger, 1981).

White and Dieter (1978) observed no mortality among mallard ducks fed diets containing 1, 10, or 100 ppm vanadyl sulfate for 12 weeks. Altered lipid metabolism was observed among birds fed 100 ppm vanadium; no other effects were observed. Among chickens, 200 to 400 ppm $Ca_2(VO_4)_2$ in the diet produced 100% mortality; weight gain decreased among chicks fed 20 to 40 ppm $Ca_2(VO_4)_2$ (Romoser et al., 1961).

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ACETONE

Acetone is considered to be one of the least toxic solvents used in industry. However, prolonged inhalation of high concentrations may produce irritation of the respiratory tract, coughing, headache, drowsiness, incoordination and in severe cases coma. Workers surveyed exposed for 8 hr/day to an average atmospheric concentration of 1006 ppm. Eye irritation was transient and generally occurred at atmospheric concentrations greater that 1000 ppm.

Acetone has not been tested in a carcinogenicity bioassay. However, negative results were observed in a skin painting test for which acetone was used as the vehicle control. In addition, acetone was found to be non-mutagenic in the Ames assay.

Acetone is a naturally occurring constituent of blood and urine. It is readily absorbed by all routes of administration and is highly soluble in water, thus ensuring widespread distribution in the body tissues. Large doses of acetone are predominantly excreted unchanged in expired air whereas small doses (up to 7 mg/kg) are largely oxidized to carbon dioxide.

The American Conference of Governmental Industrial Hygienists (ACGIH) has set the 8-hour time weighted average (TLV-TWA) for acetone at 750 ppm. An MCL value for water has not been established. Acetone is classified as a hazardous waste by RCRA [52 FR 25942] and thus must be managed according to State and/or Federal hazardous waste regulations. USEPA considers acetone a Group D compound - not classifiable as to human carcinogenicity.

BENZENE

Environmental sources of benzene include: gasoline filling stations, vehicle exhaust fumes, cigarette smoke, underground storage tanks that leak, wastewater from industries that use benzene, poorly maintained toxic waste sites, chemical spills, groundwater adjacent to landfills containing benzene, and possible some food products containing benzene as a natural constituent.

Because benzene evaporates very quickly, the most common exposure to benzene comes from breathing air containing benzene.

Benzene is toxic and is classified as a Group A carcinogen in humans. The main effects of brief exposure to high levels of benzene are drowsiness, dizziness, and headaches. Long-term exposures to benzene may affect normal blood production, possibly resulting in severe anemia and internal bleeding. Some workers exposed to high levels of benzene over a long period of time have developed leukemia.

CHLOROBENZENE

Chlorobenzene is a colorless liquid with an almond-like odor. The compound does not occur widely in nature, but is manufactured for use as a solvent and is used in the production of other chemicals. Chlorobenzene persists in soil (several months), in air (3.5 days), and water (less than 1 day).

Workers exposed to high levels of chlorobenzene complained of headaches, numbness, sleepiness, nausea, and vomiting. However, it is not known if chlorobenzene alone was responsible for these health effects since the workers may have also been exposed to other chemicals at the same time. Mild to severe depression of functions of parts of the nervous system is a common response to exposure to a wide variety of industrial solvents (a substance that dissolves other substances). In animals, exposure to high concentrations of chlorobenzene affects the brain, liver, and kidneys. Unconsciousness, tremors and restlessness have been observed. The chemical can cause severe injury to the liver and kidneys. Data indicate that chlorobenzene does not affect reproduction or cause birth defects. Studies in animals have shown that chlorobenzene can produce liver nodules, providing some but not clear evidence of cancer risk.

The Federal Government has developed regulatory standards and advisories to protect individuals from potential health effects of chlorobenzene in the environment. The Environmental Protection Agency has proposed that the maximum level of chlorobenzene in drinking water be 0.1 parts per million (ppm). For short-term exposures to drinking water, EPA has recommended that drinking water levels not exceed 2 ppm for up to ten days. The Occupational Safety and Health Administration (OSHA) has established a legally enforceable maximum limit of 75 ppm of chlorobenzene in workplace air for an 8 hour/day, 40-hour work week.

CHLOROETHANE

Chloroethane, which is also called ethyl chloride, is a colorless gas (vapor) at room temperature and pressure, with a characteristic, sharp odor. In containers under pressure chloroethane is a liquid, but the liquid evaporates quickly when exposed to room air. It catches fire easily. The largest single use for chloroethane is to make tetraethyl lead, which is a gasoline additive, but as new stricter government regulations reduce the amount of lead additives allowed in gasoline, the production of chloroethane has decreased dramatically in recent years. Other uses include the production of ethyl cellulose, dyes, medicinal drugs, and other commercial chemicals, and use in the foaming of plastics, as a solvent, and as a refrigerant. It is also used to numb skin before medical procedures such as ear piercing and skin biopsy and to treat sports injuries.

Chloroethane is a manmade compound, and human activity is responsible for almost all the chloroethane released to the environment. Most chloroethane released to the environment ends up as a gas in the atmosphere, but small amounts may enter groundwater as a result of filtration through soil. Once in the atmosphere, chloroethane breaks down fairly quickly by reacting with substances in the air. It takes about 40 days for half of any given amount of chloroethane released to the atmosphere to disappear. In groundwater, chloroethane appears to change eventually to a simpler form, possibly by reacting with water, but not enough is known to be sure this occurs or to determine how long this substance persists in groundwater. For further information, see Chloroethane can enter the body when a person breathes air containing chloroethane vapor. Most chloroethane vapor inhaled this way will be removed quickly by the lungs. Chloroethane may also enter the body through the skin, although most of it quickly leaves the skin surface by evaporation. When a person drinks water containing chloroethane, it enters the body through the digestive tract. It is not known how chloroethane leaves the body, or how quickly, when it enters through the skin or digestive tract. Chloroethane will most often enter the body by being inhaled if persons near hazardous waste sites are exposed to it, although it may also enter in contaminated drinking water.

Short-term exposure to very high levels of chloroethane vapor can produce temporary feelings of drunkenness, and still higher levels cause lack of muscle coordination and unconsciousness. Accidental death has resulted from its former medical use as an anesthetic during major surgery. It is not known whether chloroethane produces cancer in humans, but long-term exposure to high levels of chloroethane vapor has been shown to produce cancer in some laboratory animals. It is not yet known whether lower levels produce cancer in animals. Chloroethane spray produces a freezing, numbing sensation on the skin and can result in frostbite if the exposure lasts beyond the recommended time.

Chloroethane levels in the workplace are regulated by the Occupational Safety and Health Administration (OSHA). The occupational exposure limit for an 8 hour workday, 40 hour workweek is 1000 ppm. EPA requires industry to report discharges or spills of 100 pounds or more.

1,1-DICHLOROETHANE

1,1-Dichloroehtane (1,1-DCA) is a colorless, oily, man-made liquid. It was used in the past as a surgical anestitic (at a concentration of 26,000 ppm), but its used was discontinued when it was discovered that at such high doses cardiac arrhythmias were induced. The major source for contamination is through industrial process releases.

Few published reports are available on the chronica toxicity of 1,1-DCE. Subchronic studies show that rats, guinea pigs, cats and rabbits tolerated dichloroethatne at 500 ppm for 13 weeks (6 hours/day, 5 days/week) without adverse effects. Rats, guinea pigs, rabbits and cats tolerated 1000 ppm for 13 weeks, but cats showed histological evidence of kidney injury.

1,1-DCE has been classified as a possible human carcinogen (C) by the USEPA. This classification is based on limited evidence of carcinogenicity in mice and rats as shown by an increased incidence of mamary gland adenocarcinomas and hemangeosarcomas in female rats and and increased incidence of heptocellular carcinomas and benign uterine polyps in mice (IRIS, 1991).

1,2-DICHLOROETHENE

1,2-Dichloroethene (1,2-DCE) exists in both the *cis* and *trans* isomeric forms. However, the *cis* isomer appears to have greater acute toxicity than the *trans* isomer. *Cis*-1,2-DCE has anesthetic properties and has been shown to produce liver and kidney injury in experimental animals. Furthermore, chronic inhalation exposure of the rat to 800 mg/m^3 of *trans*-1,2-DCE produces fatty degeneration of the liver. Acute exposure of humans to high levels of *trans*-1,2-DCE may have adverse effects on the central nervous system and may interact with the hepatic drug-metabolizing monooxygenase system. However, data concerning human exposure to 1,2 DCE is limited. No other human studies of systemic, developmental, or reproductive are available.

The carcinogenicity of *cis* and *trans*-1,2-DCE has not been tested in animals (ATSDR, 1989b; USEPA, 1989b; RTECS, 1987; Sax, 1979).

The absorption, distribution, metabolism and excretion of a chemical can influence its toxicity. The lipophilic properties of this chemical make absorption likely, but only a few studies have examined the absorption and metabolism of 1,2-DCE. These indicate that 1,2-DCE vapors can be absorbed through the lung. Both isomers of 1,2-DCE can be metabolized to dichloroacetic acid and dichloroethanol, (Bonse et al., 1975; Leibman and Ortiz, 1977), but, inhalation studies indicate that *trans*-1,2-DCE is metabolized more slowly than the *cis* isomer (Filser and Bolt, 1979). No studies on the distribution and excretion of 1,2-DCE are available.

The OSHA standard for 1,2 DCE is total 790 mg/m^3 TWA, and ACGIH threshold limit values are 790 mg/m^3 TWA, and 1000 mg/m^3 STEL (ATSDR, 1989b).

ETHYLBENZENE

There are no known reports of lethality in humans following exposure to ethylbenzene vapors. Although occular irritation (230 ppm), throat irritation and chest constriction (430 ppm), dizziness and vertigo (460-1200 ppm) have been reported (Yant et al. 1930).

The primary effect of inhalation of ethylbenzene vapor in animals is CNS toxicity (460 ppm) (Yant et al. 1930). Some studies have indicated hepatoxicity, while others have demonstrated renal effects following inhalation of 50-600 ppm ethylbenzene. There are no known studies of oral or dermal exposure to ethylbenzene in humans. A study by and Wolf et al. 1956 found an LD50 of 3500 mg/kg in rats. Wolf et al. also looked at systemic effects of oral dosing of ethylbenzene. Some renal tubular swelling and respiratory irritation was found. However, this study suffered from several limitations. Signs of dermal and occular irritation in rabbits were reported by Smyth et al. 1962 and Wolf et al 1956. No other studies are known in which systemic effects have been demonstrated.

No association has been found between occupational exposure to ethylbenzene and cancer. Bardodej and Cierk 1988 monitored workers for ten years and found no cases of malignancy. However, no exposure data is available and the study period is too short to draw definitive conclusions. No other studies of genotoxicity or cancer in humans due to exposure to ethylbenzene are available.

VINYL CHLORIDE

Vinyl chloride is used in a wide variety of applications. It is used primarily in the manufacture of polyvinyl chloride products such as pipes, packaging materials, automotive accessories, furniture, wire coatings, wall coverings, and other copolymer products (Cowfer and Magistro, 1985; Eveleth et al., 1990).

Based on its vapor pressure, vinyl chloride in the atmosphere is likely to exist in the vapor phase (Eisenriech et al., 1981; Verscheuren, 1983). In the atmosphere, the primary degradation process is reaction with photochemically produced hydroxyl radicals (Cox et al., 1974; Howard, 1976; Perry et al., 1977). Reactions with ozone or direct photolysis are unlikely to be significant degradation mechanisms for this compound (Zhang et al., 1983).

Vinyl chloride in soils volatilizes rapidly to the atmosphere from dry soil surfaces and has an estimated half-life of approximately 12 hours at 10 cm depth (Verscheuren, 1983; Jury et al., 1984). The K_{oc} of vinyl chloride suggests a very low sorption tendency with high mobility and sufficient potential to leach to ground water (Lyman et al., 1982).

In aquatic systems, vinyl chloride partitions rapidly to the atmosphere (ATSDR, 1995). The half-life for vinyl chloride has been estimated at 43.3, 8.7, and 34.7 hours for volatilization from a pond, river, and lake, respectively (USEPA, 1982). Photolysis of vinyl chloride in water systems is relatively slow process compared to volatilization. In addition, the hydrolytic half-life of vinyl chloride at 25°C has been estimated to be less than 10 years (USEPA, 1976).

Some evidence exists for the carcinogenic potential of vinyl chloride in humans via inhalation (ATSDR, 1995). No studies are available regarding the carcinogenic potential of vinyl chloride in humans due to oral exposure (ATSDR, 1995). In contrast, the results of studies with laboratory animals administered vinyl chloride in the diet and via gavage suggest a statistically significant increase in hepatic angiosarcomas of the liver (Feron et al., 1981; Maltoni et al., 1981; Til et al., 1983, 1991). In addition, no studies are available regarding the carcinogenic potential of vinyl chloride to humans or animals following dermal exposure (ATSDR, 1995).

The USEPA has classified vinyl chloride as a Class A human carcinogen (USEPA, 1995). The USEPA has published an oral slope factor of 1.9 $(mg/kg\text{-}day)^{-1}$ for vinyl chloride based on the occurrence of lung and liver tumors in chronic feeding studies with rats (IRIS, 1997). Likewise, the presence of liver tumors in a 1-year inhalation study with rats has prompted USEPA to publish a unit risk factor of 8.4×10^{-5} mg/m^3, which corresponds to an inhalation slope factor of 0.3 $(mg/kg\text{-}day)^{-1}$ (IRIS, 1997).

Finally, the Agency has not established an oral or inhalation RfD for vinyl chloride.

XYLENES

A major reference used in compiling the information on xylenes was the USEPA Health Advisories for 25 Volatile Organics (USEPA, 1987b).

The primary health effects in humans exposed to xylene via inhalation are disturbances of the central nervous system (USEPA, 1987b). Acute toxicity appears to be affected by physical activity. Inhalation studies in humans revealed no adverse effects in sedentary individuals but, acute toxicity, characterized by central nervous system disturbances such as changes in numerative ability, short-term memory and EEG patterns, occurred during exercise. Inhalation of xylene vapors of 200 ppm has also been associated with eye and respiratory tract inflammation.

Studies in animals indicate that chronic inhalation of xylene at high concentrations may result in minor systemic effects. Studies in animals have failed to produce consistent evidence of the teratogenicity of xylene. No data concerning the reproductive toxicity of xylene is available. No mutagenic effects have been reported for xylene (Litton Bionetics, 1978b; USEPA, 1987b). Oral exposure to xylene has also failed to elicit a significant increase in the incidence of tumors in rats and mice of either sex (IRIS, 1990d). Consequently the USEPA has classified xylenes as Group D, not classifiable as to human carcinogenicity (USEPA, 1987b).

ALUMINUM

Aluminum is a naturally occurring element, though, never found in its elemental state. Exposure results primarily from smelting and refining processes.

Chronic inhalation exposure may cause chronic interstitial pneumonia, cough, or pneumothorax with fatal outcomes. Aluminum fibrosis of lung with encephalopathy is sometimes reported with symptoms referable to the central nervous system. Aluminum salts may cause mucous membrane irritations. No data is available on the carcinogenic effects of Aluminum.

ANTIMONY

Antimony compounds are employed as constituents of metal alloys, flame retardants, batteries, textiles, chemicals, and glass. Some antimony compounds are also used in the treatment of parasitic diseases and infection.

In humans, acute exposures to antimony via inhalation or ingestion may result in vomiting, nausea, and diarrhea. Chronic exposures to antimony may result in myocardial changes, pneumoconiosis, tracheitis, laryngitis, bronchitis, or pustular skin eruptions. A higher incidence of spontaneous abortions among women employed in a metallurgical plant. Effects in experimental animals are similar to humans including respiratory system effects, cardiovascular system effects, and effects on the liver, kidney, and spleen.

The USEPA has not classified antimony as to potential human carcinogenicity. Likewise, the Agency has not determined an oral or inhalation cancer slope factor for antimony.

The USEPA has derived an oral RfD value of 0.0004 mg/kg-d for antimony based on the results of a chronic oral bioassay in which rats administered 0.35 mg/kg-day in drinking water exhibited decreased longevity, blood glucose, and cholesterol (Schroeder et al., 1970). The Agency has not established an inhalation RfD value for antimony.

ARSENIC

Arsenic is an element that exists in various chemical states, including elemental inorganic arsenic, arsenic trioxide, and arsenic pentoxide, with each form having different toxicological potential (ATSDR, 1993). The major sources of environmental arsenic are natural forces such as volcanic activity and weathering of arsenic-containing rocks, and human activity associated with metal smelting, glass manufacturing, pesticide production and use, and fossil fuel burning. Arsenic is also present in small amounts in mainstream cigarette smoke (ATSDR, 1993).

In air, arsenic is adsorbed to particulate matter, with a residence time of about 9 days, depending on particle size. In surface waters, arsenic is predominantly adsorbed to clays, iron oxides, manganese compounds, and organic material. Therefore, sediment serves as a reservoir for arsenic, where it exists mainly in insoluble complexes (ATSDR, 1993). Arsenic also occurs in soil primarily in an insoluble, adsorbed form. Binding of arsenic via organic material, or chemical interaction with iron or calcium, represents an important fixation phenomenon for arsenic in soil (ATSDR, 1993).

Arsenic has been known as a human poison since ancient times because large ingested doses cause death (ATSDR, 1993). Sublethal doses cause stomach and intestinal irritation, decreased production of red and white blood cells, abnormal heart rhythm, blood-vessel damage, and impaired nerve function (ATSDR, 1993). Long-term oral exposure causes darkening of the skin and the appearance of small corns or warts on palms, soles, and torso, which potentially develop into skin cancer. Arsenic has also been reported to increase the risk of liver, bladder, kidney, and lung cancer (ATSDR, 1993).

Arsenic is classified by USEPA as a class A human carcinogen (IRIS, 1997). This classification is based on evidence of lung cancer in human populations exposed via inhalation, and increased incidence of skin cancer in populations exposed to arsenic in drinking water (IRIS, 1997). In addition, USEPA has stated that the carcinogenicity assessment for arsenic may be revised, pending a review of data regarding internal cancers associated with oral exposure to arsenic (IRIS, 1997).

The USEPA has published an oral unit risk value of 5×10^{-5} (mg/m^3) corresponding to an oral slope factor of 1.5 (mg/kg-day)$^{-1}$ for arsenic, based on skin cancer in a Taiwanese population exposed to arsenic in drinking water (Tseng, 1977). However, due to uncertainties associated with the unit risk, USEPA has stated that risk estimates for oral exposure to arsenic may be overstated by as much as an order of magnitude (IRIS, 1997).

The USEPA has also established an inhalation unit risk of 0.0043 mg/kg-day for arsenic based on increased lung cancer mortality observed in multiple populations exposed primarily through inhalation (IRIS, 1997).

In addition, the oral RfD for arsenic of 0.0003 mg/kg-d is based on a study of chronic human exposure to arsenic in drinking water (IRIS, 1997). Hyperpigmentation, keratosis, and possible vascular complications were identified as critical effects. The oral RfD was calculated from a NOAEL of 0.009 mg arsenic/L water (0.008 mg/kg-d) and application of an uncertainty factor of 3 (IRIS, 1997). Confidence in the RfD is medium (IRIS, 1997).

BARIUM

Barium exists as insoluble and soluble barium salts. Soluble barium salts are highly toxic and they have a prolonged stimulant effect on muscles (Clement, 1985). Symptoms of acute barium poisoning in animals are excessive salivation, vomiting, colic, diarrhea, convulsive tremors, slow, hard pulse, and elevated blood pressure. Hemorrhages may occur in the stomach, intestines, and kidneys. Muscular paralysis may follow. Depending on the dose and solubility of the barium salt, death may occur in a few hours or a few days. Similar effects have been reported in humans (Stokinger, 1982).

EPA has not evaluated barium for carcinogenicity (USEPA, 1990_e). Barium in its soluble forms rapidly permeates the gastrointestinal tract to enter the bloodstream. Elimination from the blood is virtually complete within 24 hours (Stokinger, 1982). A study of the metabolism of ^{140}Ba in rats showed 24-hour urinary and fecal excretions to be 7% and 20%, respectively (Stokinger, 1982). Barium is irreversibly deposited in the skeleton in trace amounts (Stokinger, 1982). It is also deposited in the muscles, where it remains for the first 30 hours, before gradual elimination begins. The lungs are also an important storage site for barium, but very little is retained by the liver, kidneys, and spleen, and practically none by the brain, heart and hair (Stokinger, 1982). Barium has a very small but significant solubility (0.22 mg in 100 ml water at 18°C). The small amount of barium in the earth's crust, as well as the insolubility of most barium carbonate and sulfate salts, seems to preclude any ecological danger (Seiler and Sigel, 1988). Although the half-life of barium in air is 4.8 days, it is persistent in surface water (Clement, 1985). The TLV for soluble barium compounds is 500 $\mu g/m^3$ (ACGIH, 1990).

BERYLLIUM

Beryllium can be mobilized in the environment from natural or anthropogenic sources. The largest emission of beryllium is the combustion of coal and fuel oil (ATSDR, 1991). Ore processing, metal fabrication, beryllium oxide production and use, and municipal waste combustion represent much more minor sources of beryllium mobilization. Beryllium can be transported to surface waters through weathering of soils and rocks, effluents from beryllium industries, and runoff from beryllium containing waste sites (ATSDR, 1991). Beryllium may exist naturally in soils or be deposited in soils as a result of disposal of wastes containing beryllium or atmospheric deposition of airborne beryllium (ATSDR, 1991).

In the atmosphere, beryllium particulates will be removed by wet and dry deposition. In water and soil, beryllium will likely be relatively immobile, existing in insoluble form in sediments and soils. Beryllium in water is not expected to bioconcentrate significantly in aquatic organisms; however, bottom-feeding organisms may bioconcentrate beryllium from sediments to some degree (ATSDR, 1991).

The respiratory system is a major target for beryllium toxicity in both humans and animals (ATSDR, 1991). Inhalation of high concentrations of soluble beryllium compounds is associated with chemical pneumonitis; inhalation of less soluble forms may lead to chronic beryllium disease with reductions in lung function. Information on effects after oral exposure to beryllium indicates lower toxicity by this route; studies in animals suggest few systemic effects after oral exposure. Rats exposed to beryllium in their diets developed rickets (ATSDR, 1991).

The USEPA has classified beryllium as a Group B2 carcinogen, probable human carcinogen, based on inadequate data in humans and sufficient data in animals. Beryllium has been shown to induce various types of tumors in primates and rats via inhalation and intratracheal instillation exposures, and in rabbits via intravenous or intramedullary injection (IRIS, 1997).

The USEPA has established an oral cancer slope factor of 4.3 $(mg/kg\text{-}d)^{-1}$ for beryllium based upon the numbers of observed tumors in the exposed group of a study in which male Long-Evans rats were given drinking water containing 5 ppm beryllium sulfate for a lifetime (Schroeder and Mitchener, 1975; IRIS, 1997). The Agency has also published an inhalation cancer slope factor of 8.4 $(mg/kg\text{-}d)^{-1}$ based on the presence of lung tumors in humans due to occupational exposures to beryllium (USEPA, 1995). In addition, the USEPA has determined an inhalation unit risk value of 0.0024 $\mu g/m^3$ (IRIS, 1997).

The chronic oral RfD value for beryllium is based upon the same study as the oral cancer slope factor. Upon natural death, the animals were examined for gross and microscopic changes in the heart, kidney, liver, and spleen as well as some serum chemistry parameters. No adverse effects were observed in the group dosed at 5 ppm beryllium sulfate in drinking water. The water concentration of 5 ppm was assumed to represent a NOAEL and was converted to 0.54 mg/kg-day. An uncertainty factor of 100 to account for interspecies and interindividual variability was applied to the NOAEL to derive the oral RfD value of 0.005 mg/kg-d (IRIS, 1997). Additionally, the USEPA has not proposed an inhalation RfD value for beryllium.

BORON

Boron is a solid substance that widely occurs in nature. It usually does not occur alone, but is often found in the environment combined with other substances to form compounds called borates. Common borate compounds include boric acid, salts of borates, and boron oxide. Boron and salts of borate have been found at hazardous waste sites. Boron alone does not dissolve in water nor does it evaporate easily, but it does stick to soil particles. No information was found on whether common forms of boron evaporate easily or stick to soil particles; however, these forms do dissolve in water. Boron is present in air, water, and soil, but no information is available on how long it remains in these media. There is also no information available on the occurrence of borates in the environment or on how long they persist in the environment. Borates are used mostly in the production of glass. They are also used in fire retardants, leather tanning and finishing industries, cosmetics, photographic materials, with certain metals, and for high-energy fuel. Pesticides for cockroach control and wood preservatives also contain

If humans eat large amounts of boron (4,161 ppm) over short periods of time, it can affect the stomach, intestines, liver, kidney, and brain and can eventually lead to death. Irritation of the nose and throat or eyes can occur if small amounts of boron (4.1 mg/m^3) are breathed in. Boron can irritate the eyes if it comes in contact with them for long periods of time. Animal studies indicate that the male reproductive organs, especially the testes, are affected if large amounts of boron are eaten or drunk for short or long periods of time. Studies in animals also indicate delayed development and structural defects in offspring, primarily in the rib cage, from maternal exposure to boron during pregnancy. These effects have not been seen in humans. Irritation of the nose can occur in animals if large amounts of boron are breathed in for long periods of time. These effects have not been seen in humans. No information is available on whether boron is likely to cause cancer in humans. There is no evidence of cancer in animals exposed to boron for long periods of time.

The federal government has set regulatory standards and guidelines to protect individuals from the effects that may occur if exposed to boron. The EPA has established tolerances for total boron of 30 ppm in or on cottonseed and 8 ppm in or on citrus fruits. The Food and Drug Administration has designated that borax and boric acid are generally recognized as safe (GRAS) as indirect food additives in adhesive components, components of paper, paperboard, sizing and coatings. The Occupational Safety and Health Administration (OSHA) has set a permissible exposure limit of 10 mg/m 3 for boron oxide and sodium tetraborate in the workplace air for 8 hour/day exposures over a 40-hour work week. Limits of 10 mg/m^3 for boron tribromide and 3 mg/m^3 for boron trifluoride have been set.

CHROMIUM

Acute and Chronic Toxicity

Although chromium(III) is considered to be an essential nutrient (ATSDR, 1989a) ingestion of chromium at levels above the recommended daily allowance (RDA) have been associated with toxic effects.

Results from studies of both animals and humans indicate chromium (VI) is irritating and short-term high-level exposure can result in adverse effects. The respiratory tract, including the lungs, appears to be the primary target of inhaled chromium (VI). Data from animals also suggest diminished immune function in the presence of inhaled chromium. Skin ulcers are also known to occur following contact with Cr(VI). Chromium (VI) may also cause adverse effects in the gastrointestinal tract, liver, kidneys and nervous system. Evaluation of the toxicological database for chromium compounds suggests that the effects of Cr(VI) on the nasal mucosa and on lung function in humans may be the most sensitive noncancer end points for inhalation exposure to chromium (VI) compounds.

Pertinent data concerning the reproductive and developmental toxicity of inhaled and injested Cr(VI) is not available, but parenteral exposure has produced adverse reproductive effects in animals. Although acute high doses of chromium (VI) compounds by oral, dermal or parenteral routes can result in renal toxicity in animals, chronic exposure to relatively low levels of Cr(III) and Cr(VI) has not resulted in toxic systemic effects. Dermal exposure to either Cr(III) or Cr(VI) can result in chromium sensitization.

Carcinogenicity

Epidemiological studies of workers chronically exposed to atmospheric concentrations of chromium above 4 mg/m^3 indicate there is an increased risk of lung cancer (ATSDR, 1989a). For this reason, Cr(VI) is currently classified as a known (Group A) human respiratory carcinogen (IRIS, 1988). In contrast, studies of animals exposed to Cr(VI) or Cr(III) via inhalation have not demonstrated an increased cancer risk (Baetjer et al., 1959; Steffee and Baetjer, 1965; Nettesheeim et al, 1972; USEPA, 1984$_c$). The two most likely explanations are that animals are less susceptible to inhaled chromium or that the carcinogenic effects occur only when there is co-exposure with agents such as cigarette smoke. The later hypothesis may well be resolved in an on-going epidemiology study by Petrilli and DeFlora (1988).

Chronic administration of Cr(III) in the diet of rats and mice has not been shown to be carcinogenic (ATSDR, 1989a). The results of oral studies of Cr(VI) are considered by the USEPA to be inadequate to evaluate its carcinogenic potential (ATSDR, 1989a). However, since Cr(VI) at low exposure levels is completely converted to Cr(III) in the acidic conditions of the gastrointestinal tract (prior to absorption), it is unlikely that any Cr(VI) is absorbed following ingestion (Donaldson and Barreras, 1966; Petrilli and DeFlora, 1988).

The mutagenic potential of chromium has been examined both in vitro and in vivo. Cr(VI) has consistently tested positive in both human and nonhuman in vitro studies, including tests for gene mutation (Bonati et al., 1976; USEPA, 1984c), chromosome effects (Bianchi and Levis, 1985) and cell transformation (Bianchi and Levis, 1985). Positive results have been obtained for Cr(III) only in cells with phagocytic activity or when very high concentrations were administered (Bianchi and Levis, 1985). Human in vivo studies of Cr(VI) genotoxicity have produced mixed results, e.g., studies of chromosomal aberrations have been positive (Bigaliev et al., 1977; Sarto et al., 1982), whereas studies of sister chromatid exchange have been negative (Stella et al., 1982; Nagaya, 1986). Nonhuman in vivo assays of Cr(VI) genotoxicity have yielded consistently positive results for mutations (Knudsen, 1980; Paschin et al., 1982; Rasmuson, 1985), chromosome effects (Bigaliev et al., 1977; Wild, 1978; Newton and Lilly, 1986), and cell transformation (DiPaolo and Casto, 1979). The only in vivo assay of Cr(III) genotoxicity in nonhuman systems was negative for chromosome effects (Wild, 1978).

Toxicokinetics

Chromium can enter the body via oral, inhalation, and dermal routes. For the general population, the gastrointestinal (GI) tract is the primary route of entry, although inhalation can be significant near industrial sources and is the primary route of exposure for occupational exposure, along with dermal exposure. Absorption in the GI tract is relatively low and depends on the valence state of chromium [Cr(VI) is more readily absorbed than is Cr(III)], the water solubility of the compound, and gastrointestinal transit time. The intragastric redox state of chromium may also influence absorption.

For example, in vitro gastric juice reduces Cr(VI) to Cr(III). However, whether intragastric reduction of Cr(VI) occurs in vivo is not known.

Uptake of inhaled chromium is influenced by particle size of aerosols and by factors that govern clearance time in the lungs. Studies in animals indicate the kidneys, lungs, and spleen are the primary target organs of inhaled chromium.

Once absorbed, Cr(VI) is reduced to Cr(III). Reduction of Cr(VI) occurs both extra- and intracellularly. Extracellular reduction occurs in the plasma when chromium-protein complexes are formed. These complexes are then excreted by the kidneys. Cell membranes are readily permeable to Cr(VI). Intracellular Cr(VI) is then reduced to form chromium protein complexes which cannot cross the cell membrane. In contrast, Cr(III) crosses cell membranes less readily than Cr(VI) and does not readily bind to intracellular protein. Consequently, intracellular Cr(III) can diffuse out of the cell. In vitro Chromium (VI) can be reduced to chromium (III).

Urinary excretion is the primary mechanism for eliminating chromium from the body. Elimination occurs in at least three (3) phases. The first phase is rapid and represents clearance from the blood, while the other phases are slower and represent clearance from tissues.

Criteria and Standards

Although indications are that Cr(III) is not a carcinogen and that it is effectively non-toxic to humans at doses which would be encountered in environmental situations, the data are equivocal (Baetjer, 1950; Davies, 1984). The IARC Working Group on the Evaluation of the Carcinogenic Risk of Chemicals to Humans came to the conclusion that there is sufficient evidence of respiratory carcinogenicity in men occupationally exposed during chromate production. USEPA classifies hexavalent chromium as a Group A carcinogen via the inhalation route only. The existing chronic inhalation cancer potency factor for hexavalent chromium set by USEPA is 41 $(mg/kg/day)^{-1}$ (USEPA, 1989b).

COBALT

Cobalt is a relatively rare element that can either be stable or radioactive. It is used in nuclear technology and in production of lacquers, varnishes, inks, and enamels (ATSDR, 1990).

Cobalt adsorbs readily to soil and sediment, and is insoluble in water (ATSDR, 1990).

Cobalt is an essential nutrient and deficiency may result in anemia. In larger doses, cobalt is considered a slightly toxic agent which causes changes readily reversible at end of exposure. Acute effects of ingestion of excessive amounts of cobalt are vomiting, diarrhea, and a sensation of warmth.

Chronic oral exposure can cause goiter, decreased thyroid function and increased heart and respiratory rate (ATSDR, 1990).

Absence of carcinogenic response in animal studies and lack of epidemiologic evidence suggest that cobalt and its compounds are unlikely to pose a carcinogenic risk to humans (ATSDR, 1990).

The USEPA has not developed an RfD or RfC for cobalt. In the absence of noncarcinogenic criteria, the EPA Region III (1997) provisional value of 0.06 (mg/kg-day) was applied in this assessment for the evaluation of potential noncarcinogenic effects.

COPPER

Copper is a naturally occurring element and can be found in most plants and animals. It is an essental element for all organisms. Copper compounds are used in gardening products and to control algae in lakes and reservoirs.

Copper may enter an organism via food, water, or inhalation. Once in the body, copper is rapidly absorbed into the bloodstream and then distributed throughout the body.

Copper has been observed to cause respiratory, gastrointestinal, hepatic and dermal irritations in factory workers. Epidemiological studies on laboratory animals have shown minor to severe lung damage, kidney damage in rats, and decreased hemoglobin in pigs. It is classified as a Group D noncarcinogen.

IRON

Iron is the second most abundant metal in the earth's crust, comprising nearly five percent of its total metallic material (Merck, 1983). Iron also exists in blood hemoglobin and is essential to both animals and plants. The metal is usually employed in industry as an alloy with carbon or other metals. Typical alloys of iron include carbon and alloy steels (CRC, 1989).

Toxicological data for iron in both humans and animals is lacking. Toxicity of iron is largely dependent upon the radical with which it is associated (HSDB, 1996). In humans, long-term exposure to iron via inhalation has resulted in siderosis, a mottling of the lungs comparable to benign pnuemoconiosis and does not ordinarily cause significant physiologic impairment (Amdur et al., 1991). Inhalation of iron oxide fumes or dust may also result in siderosis (HSDB, 1996).

The USEPA does not consider iron to be toxicologically significant. Therefore, there is no classification as to its potential carcinogenicity to humans and no toxicity values have been established for this metal. This risk assessment used an USEPA-NCEA regional support provisional RfD value of 0.3 mg/kg-d. This value was used for oral, dermal and inhalation exposures.

MANGANESE

Manganese, which comprises about 0.1% of the earth's crust, is a common component of numerous minerals (ATSDR, 1990). Most manganese in the U.S. is used to produce ferromanganese, which is subsequently used in steel production (ATSDR, 1990). Other manganese compounds are used in the production of batteries, porcelain, and fireworks, as catalysts, in glazes and varnishes, as a fungicide, and as a nutritional supplement (ATSDR, 1990).

Manganese may be released to the atmosphere as industrial emissions (especially from iron and steel foundries) or with the combustion of fossil fuels (ATSDR, 1990). Natural sources of airborne manganese include erosion of soils and volcanic eruptions. Releases of manganese to water may result from industrial facilities or as leachate from soils and landfills. Soils may contain naturally occurring manganese or may contain elevated levels associated with waste disposal (ATSDR, 1990).

Manganese exists primarily adsorbed to particulates in the atmosphere; removal is largely by dry deposition, with lesser removal by rain washout (ATSDR, 1990). In water, manganese transport and partitioning depends upon the solubility of the compound containing manganese, as well as pH and redox potential. In soils and sediments, manganese partitioning is likewise dependent upon cation exchange capacity and organic composition (ATSDR, 1990). Significant bioconcentration of manganese by lower aquatic organisms is possible; however there is some evidence that biomagnification in the food chain is unlikely (ATSDR, 1990).

The primary target for manganese toxicity by all exposure routes in humans appears to be the central nervous system. Humans with very high occupational inhalation exposures have developed a neurological syndrome resembling Parkinson's disease; similar symptoms have been reported in a few cases of high oral exposure (ATSDR, 1990).

The USEPA has classified manganese in Group D, not classifiable as to human carcinogenicity, based on inadequate human and animal carcinogenicity data (IRIS, 1997). The Agency has not derived an oral or inhalation cancer slope factor for manganese.

An oral RFD value of 0.002 mg/kg-d is used in this assessment as per the USEPA Region III Risk Based Concentration Table (8/25/97).

MAGNESIUM AND SODIUM

Magnesium and sodium have been classified as essential nutrients by USEPA, (1989). Each are abundant metallic elemental components of the earths crust. Elevated doses of magnesium may lead to hypotension, ECG changes, and impairment of neuromuscular transmission. Inhalation of magnesium dust can irratate the eyes and mucous membranes of the upper respiratory tract, causing atrophic nasopharyngitis. Certain levels of sodium may be associated with effects on blood pressure in susceptible individuals (USEPA, 1989). However, toxic effects resulting from exposures to these chemicals are expected to occur only at extremely high doses, not considered to be relevant from the perspective of environmental pollution.

Consistent with USEPA guidance (1989), these essential nutrients were not considered further in the quantitative risk assessment unless the concentrations detected exceeded State specific criteria.

NICKEL

Nickel is a naturally occurring metal found in small quantities in the earth's crust. Nickel and it compounds can be detected in all parts of the environment. Nickel used by industries comes from mined ores or from recycling scrap metal. It is used primarily in making various steels and alloys and in electroplating.

The primary source of nickel in the atmosphere is the burning of fuel oil. Nickel is extremely persistent in both water and soil. The average residence time of nickel in soil is estimated to be 3000 years (Nriagu, 1980b). Nickel levels in soil depend on mineral constituents of the soil. These levels may be elevated as the result of land application of sewage sludge, use of phosphate fertilizers and deposition of airborne particulate matter (USEPA, 1986c). There is no evidence that nickel compounds volatilize from soil surfaces. Nickel is reasonably mobile in low PH soils, but less mobile in basic soils and soils with high organic content. No data pertaining to the biodegradation of nickel in soil found in the available literature. Oceans act as the ultimate sink for nickel in the environment.

Very small amounts of nickel have been shown to be essential to some species of animals. Thus, small amounts may also be essential to humans. High levels produce some adverse effects. nickel has been associated with effects on the lung and the immune system. Continued contact with the skin can cause ski allergies, which are the most common adverse effects of nickel exposure to the general population. Surveys indicate that 2.5 to 5.0% of the general population may be nickel-sensitive.

There are no studies regarding developmental effects of nickel in humans. Studies in animals indicate that exposure to high levels of some nickel compounds during pregnancy can cause miscarriages, pregnancy complication, and low birth weight in newborns. A LOAEL of 1.3 mg/m^3 are based on testicular degeneration in rats (Benson et al., 1987a,b).

Nickel has been designated as a priority pollutant by EPA. For exposure via drinking water, EPA advised that 0.35 mg/L of water for lifetime exposure of adults is probable associated with minimal risk. WPA has classified nickel refinery dust and nickel subsulfide as Group A carcinogens, sufficient evidence of carcinogenicity in humans. Potency factors for refinery dust and subsulfide are 0.84 and 1.7 $(mg/kg/day)^{-1}$, respectively. There is inadequate evidence for carcinogenicity of this compound by the oral route (USEPA, 1989).

VANADIUM

Vanadium is used as an industrial catalyst, a chemical reagent, in dyeing and printing. Other vanadium compounds are used as insecticides and in glass and ceramic glazes.

Vanadium itself is not toxic and has not been evaluated for carcinogenicity by the USEPA. Exposure to toxic oxides occurs during refining, smelting, and from oil-fired furnace flues. Short term exposure from inhalation may result in dry cough, sore throat, bronchitis, and chest pains. Pulmonary edema and pneumonia (sometimes fatal) are results of chronic exposure.

ZINC

Zinc is a naturally occurring element and is also an essential nutrient for plants and animals. It is used in a variety of alloys and insulin. It is classified as a Group D noncarcinogen.

Inhalation of zinc dust may cause metal fume fever and decreased serum HDL-cholesterol levels in humans and temporary lung damage in laboratory animals. Ingestion of zinc has caused anemia and liver damage in mice, fetal death in rats, and pancreas damage in cats.

APPENDIX K

FIELD SAMPLING DATA SHEETS

FIELD SAMPLING DATA SHEETS
AUGUST, 1997 SAMPLING EVENT

B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-1A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 80°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify):

WATER LEVEL DATA

Static Water Level (feet)*:	26.92
Measured Well Depth (feet)*:	33.50
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.07

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify)
Measured by: JAB/SMH
Time: 1345 Date: 8/7/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 3.2
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1420 Date: 8/7/97

SAMPLING DATA
Sample Appearance
Color Brown Sediment Heavy silt
Odor none Product: No [X] Yes [ ] Thickness

Field Measured Parameters

pH (Standard Units)	7.80	Sp. Conductivity (umhos/cm)	700
Temperature (° F)	61	Eh-Redox Potential (mV)	-350
Turbidity (NTUs)	>1,000	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: Date:

COMMENTS:

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-1B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 80°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	8.40
Measured Well Depth (feet)*:	55.50
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	7.6

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 1345 Date: 8/7/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 23
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1455 Date: 8/7/97

SAMPLING DATA

Sample Appearance
Color Cloudy Sediment Slight
Odor none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	7.8	Sp. Conductivity (umhos/cm)	100
Temperature (°F)	54	Eh-Redox Potential (mV)	210
Turbidity (NTUs)	68	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

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B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-2A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: sunny Temp: 75°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	6.34
Measured Well Depth (feet)*:	12.82
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.05

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1020 Date: 8/7/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 3.17
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1050 Date: 8/7/97

SAMPLING DATA
Sample Appearance
Color Brown Sediment V. silty
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	6.3	Sp. Conductivity (umhos/cm)	1,600
Temperature (°F)	60	Eh-Redox Potential (mV)	247
Turbidity (NTUs)	1,000	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

B&L Form No. 127 Rev. 7/93

B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-2B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 75°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	7.56
Measured Well Depth (feet)*:	33.52'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.2

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1020 Date: 8/7/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 12.6
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1055 Date: 8/7/97

SAMPLING DATA
Sample Appearance
Color Cloudy Sediment Slight
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	6.7	Sp. Conductivity (umhos/cm)	1,400
Temperature (°F)	52	Eh-Redox Potential (mV)	186
Turbidity (NTUs)	64	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

SAMPLING DATA SHEET

B&L
BARTON & LOGUIDICE, P.C.

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-3A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 70°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	12.58
Measured Well Depth (feet)*:	22.43'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.60

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: TAB/SMH
Time: 850 Date: 8/7/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 4.8(4.0)
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [ ] Recovery Time : 15 min

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: TAB/SMH Time: 915 Date: 8/7/97

SAMPLING DATA
Sample Appearance
Color Cloudy Sediment Slight
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	7.8	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	54°	Eh-Redox Potential (mV)	215
Turbidity (NTUs)	290	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	-

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-3B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: sunny Temp: 70°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	22.26
Measured Well Depth (feet)*:	44.38
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	3.6

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 850 Date: 8/7/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 10.8 (6.0)
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time : 30 min

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: SMH/JAB Time: 945 Date: 8/7/97

SAMPLING DATA
Sample Appearance
Color: Cloudy Sediment: slight
Odor: none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	7.7	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	53	Eh-Redox Potential (mV)	175
Turbidity (NTUs)	421	Dissolved Oxygen (mg/l)	–
Explosive Gases	– %LEL — ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-4A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 85°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	9.90
Measured Well Depth (feet)*:	32.42'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	3.6

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB
Time: 1305 Date: 8/6/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 11 gal (9.0)
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time : 20 min

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB / SMH Time: 1405 Date: 8/6/97

SAMPLING DATA
Sample Appearance
Color Slightly Cloudy Sediment Slight
Odor None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	7.8	Sp. Conductivity (umhos/cm)	600
Temperature (°F)	50	Eh-Redox Potential (mV)	230
Turbidity (NTUs)	114	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

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SAMPLING DATA SHEET

BARTON & LOGUIDICE, P.C.

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-5A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 80

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	12.22
Measured Well Depth (feet)*:	32.28'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	3.27

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 1220 Date: 8/6/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 3.50
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] slow Recovery Time : 30 min

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1255 Date: 8/6/97

SAMPLING DATA

Sample Appearance
Color Cloudy Sediment Silty
Odor none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.1	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	52	Eh-Redox Potential (mV)	210
Turbidity (NTUs)	250	Dissolved Oxygen (mg/l)	-
Explosive Gases	- %LEL - ppm	Total Organic Vapors (ppm)	-

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

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B&L

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-6A

CLIENT: CORTLAND CO. JOB #: 331.22

Weather Conditions: sunny Temp: 80°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ] Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	15.30
Measured Well Depth (feet)*:	19.05'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	0.6

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 1140 Date: 8/7/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 1.8

Did well purge dry? No [X] Yes [ ]

Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1220 Date: 8/7/97

SAMPLING DATA

Sample Appearance

Color L. Brown Sediment Heavy Silt

Odor None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	6.6	Sp. Conductivity (umhos/cm)	800
Temperature (°F)	57	Eh-Redox Potential (mV)	225
Turbidity (NTUs)	750	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-6B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 60°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	15.22
Measured Well Depth (feet)*:	40.75'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.1

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1140 Date: 8/7/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 12.5
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time : 45 min

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1300 Date: 8/7/97

SAMPLING DATA
Sample Appearance
Color Cloudy Sediment silty
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	7.1	Sp. Conductivity (umhos/cm)	500
Temperature (°F)	52	Eh-Redox Potential (mV)	210
Turbidity (NTUs)	350	Dissolved Oxygen (mg/l)	–
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-MW-7A

CLIENT: CORTLAND CO. JOB #: 331.22

Weather Conditions: Sunny Temp: 75°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ] Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	6.46
Measured Well Depth (feet)*:	22.65'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	2.6

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify): ____
Measured by: JAB/SMH
Time: 900 Date: 8/8/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 7.9
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time: None

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 935 Date: 8/8/97

SAMPLING DATA

Sample Appearance
Color: Lt. Brown Sediment: Heavy silt
Odor: None Product: No [X] Yes [ ] Thickness: ____

Field Measured Parameters

pH (Standard Units)	7.1	Sp. Conductivity (umhos/cm)	1,400
Temperature (°F)	65	Eh-Redox Potential (mV)	270
Turbidity (NTUs)	200	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: Re-sampled on 8/12/97 Due to [illegible] samples

B&L

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: R1-EB-1

CLIENT: CORTLAND CO. JOB #: 331.22

Weather Conditions: sunny Temp: 80°

SAMPLE TYPE: Groundwater [ ] Surface Water [ ] Leachate [X]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	59.68
Measured Well Depth (feet)*:	71.20'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.8

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JH B / Sm H
Time: 245 Date: 8/6/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 5.6
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB / Sm H Time: 1500 Date: 8/6/97

SAMPLING DATA

Sample Appearance

Color Grey/Brown Sediment Silty
Odor Leachate Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	6.8	Sp. Conductivity (umhos/cm)	9,500
Temperature (°F)	69°	Eh-Redox Potential (mV)	-74
Turbidity (NTUs)	490	Dissolved Oxygen (mg/l)	–
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) No Filtered metals

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: 60% vol. methane
HNu Reading = 0

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SAMPLING DATA SHEET

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BARTON & LOGUIDICE, P.C.

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: CD-1 (Southern loc)
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 80°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	11.02'
Measured Well Depth (feet)*:	24.70'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	2.23

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: SMH
Time: 930 Date: 8/6/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 6.7
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : Slow None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB Time: 1015 Date: 8/6/97

SAMPLING DATA
Sample Appearance
Color: Lt Brown Sediment: Very Silty
Odor: none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	9.2	Sp. Conductivity (umhos/cm)	200
Temperature (°F)	53°	Eh-Redox Potential (mV)	114
Turbidity (NTUs)	850	Dissolved Oxygen (mg/l)	-
Explosive Gases	- %LEL - ppm	Total Organic Vapors (ppm)	-

Samples Collected (Number/Type) 34 sample bottles collected
MS/MSD location

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: CD-1RA
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: sunny Temp: 60°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	9.30
Measured Well Depth (feet)*:	50.61'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	6.7

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB
Time: 930 Date: 8/6/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 20
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB Time: 1115 Date: 8/6/97

SAMPLING DATA
Sample Appearance
Color S. cloudy Sediment slight
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	8.2	Sp. Conductivity (umhos/cm)	200
Temperature (°F)	51	Eh-Redox Potential (mV)	135
Turbidity (NTUs)	95	Dissolved Oxygen (mg/l)	—
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 17 bottles collected

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: DO-2
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: sunny Temp: 75-80

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ] Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	8.78
Measured Well Depth (feet)*:	27.86'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	3.1

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JFB/SMH
Time: 1015 Date: 8/8/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [X] Non-dedicated [ ]

Volume of Water Purged (gallons): 9.0
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time: 12 min

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JFB/SMH Time: 1105 Date: 8/8/97

SAMPLING DATA
Sample Appearance
Color cloudy Sediment v. silty
Odor none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.1	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	52	Eh-Redox Potential (mV)	145
Turbidity (NTUs)	920	Dissolved Oxygen (mg/l)	—
Explosive Gases	– %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: Re-sampled on 8/12/97 Due to shipping error.

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: D-1
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 75

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	8.92
Measured Well Depth (feet)*:	180.08'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	27.9

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: ______ Date: 8/8/97

PURGING METHOD
Equipment: Bailer [ ] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X] Shallow well sampler

Volume of Water Purged (gallons): 30
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [ ] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X] Shallow well sampler

Sampled by: JAB/SMH Time: 1050 Date: 8/8/97

SAMPLING DATA
Sample Appearance
Color: Clear Sediment: none
Odor: none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	8.8		Sp. Conductivity (umhos/cm)	200
Temperature (°F)	51°		Eh-Redox Potential (mV)	220
Turbidity (NTUs)	5.20		Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL	— ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: Re-sampled on 8/12/97 Due to Shipping error

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: Sw-1

CLIENT: CORTLAND CO. JOB #: 331.22

Weather Conditions: Sunny Temp: 85

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD

Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time: ______

SAMPLING METHOD

Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: ______ Time: ______ Date: ______

Dry

SAMPLING DATA

Sample Appearance
Color ______ Sediment ______
Odor ______ Product: No ☐ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)		Sp. Conductivity (umhos/cm)	
Temperature (°F)		Eh-Redox Potential (mV)	
Turbidity (NTUs)		Dissolved Oxygen (mg/l)	
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) ______

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: SED-1 Location (12:30)

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-2
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 85°

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐ Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: ______ Time: ______ Date: ______

SAMPLING DATA
Sample Appearance — Dry
Color ______ Sediment ______
Odor ______ Product: No ☐ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)		Sp. Conductivity (umhos/cm)	
Temperature (°F)		Eh-Redox Potential (mV)	
Turbidity (NTUs)		Dissolved Oxygen (mg/l)	
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) ______

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: SED-2 location

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-3
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: sunny Temp: 85

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: JAB Time: 1340 Date: 8/11/97

SAMPLING DATA
Sample Appearance
Color: cloudy Sediment: silty
Odor: None Product: No ☐ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)	8.1	Sp. Conductivity (umhos/cm)	1500
Temperature (°F)	79	Eh-Redox Potential (mV)	230
Turbidity (NTUs)	19.30	Dissolved Oxygen (mg/l)	4.0
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-4 (MS/MSD)
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 80°

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: JAB Time: 1000 Date: 8/11/97

SAMPLING DATA
Sample Appearance
Color: Clear Sediment: None
Odor: None Product: No ☒ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)	8.0		Sp. Conductivity (umhos/cm)	200
Temperature (°F)	60		Eh-Redox Potential (mV)	230
Turbidity (NTUs)	6.40		Dissolved Oxygen (mg/l)	7.0
Explosive Gases	– %LEL	– ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 34 bottles (MS/MSD)

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-5
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 80°

SAMPLE TYPE: Groundwater [ ] Surface Water [X] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser [ ]
Other (specify) ____
Measured by: ____
Time: ____ Date: ____

PURGING METHOD
Equipment: Bailer [ ] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [ ]

Volume of Water Purged (gallons): ____
Did well purge dry? No [ ] Yes [ ]
Did well recover? No [ ] Yes [ ] Recovery Time: ____

SAMPLING METHOD
Equipment: Bailer [ ] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [ ]

Sampled by: JAB Time: 1100 Date: 8/11/97

SAMPLING DATA
Sample Appearance
Color Clear Sediment None
Odor None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	7.8		Sp. Conductivity (umhos/cm)	200
Temperature (°F)	62		Eh-Redox Potential (mV)	230
Turbidity (NTUs)	4.80		Dissolved Oxygen (mg/l)	6.1
Explosive Gases	— %LEL	— ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

B&L Form No. 127 Rev. 7/93

B&L

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: LS-1
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: overcast Temp: 80°

SAMPLE TYPE: Groundwater ☐ Surface Water ☐ Leachate ☒
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time: ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: JFB/SMH Time: 300 Date: 8/11/97

SAMPLING DATA
Sample Appearance
Color: Red/Brown Sediment: Silty
Odor: Leachate Product: No ☒ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)	7.0	Sp. Conductivity (umhos/cm)	3,500
Temperature (°F)	69	Eh-Redox Potential (mV)	-75
Turbidity (NTUs)	340	Dissolved Oxygen (mg/l)	–
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 13 bottles collected

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

SAMPLING DATA SHEET

B&L
BARTON & LOGUIDICE, P.C.

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: LS-2
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 80°

SAMPLE TYPE: Groundwater ☐ Surface Water ☐ Leachate ☒
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: ______ Time: ______ Date: ______

SAMPLING DATA
Sample Appearance
Color ______ Sediment ______
Odor ______ Product: No ☐ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)		Sp. Conductivity (umhos/cm)	
Temperature (°F)		Eh-Redox Potential (mV)	
Turbidity (NTUs)		Dissolved Oxygen (mg/l)	
Explosive Gases	%LEL ppm	Total Organic Vapors (ppm)	

Samples Collected (Number/Type) ______

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION:
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Temp:

SAMPLE TYPE: Groundwater ☐ Surface Water ☐ Leachate ☐ Sediment ☐ Other (specify):

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify)
Measured by:
Time: Date:

PURGING METHOD

Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons):
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time :

SAMPLING METHOD

Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: Time: Date:

SAMPLING DATA

Sample Appearance
Color Sediment
Odor Product: No ☐ Yes ☐ Thickness

Field Measured Parameters

pH (Standard Units)		Sp. Conductivity (umhos/cm)	
Temperature (° F)		Eh-Redox Potential (mV)	
Turbidity (NTUs)		Dissolved Oxygen (mg/l)	
Explosive Gases %LEL	ppm	Total Organic Vapors (ppm)	

Samples Collected (Number/Type)

Samples Delivered to: H2M LABORATORIES Time: Date:

COMMENTS:

FIELD SAMPLING DATA SHEETS
OCTOBER, 1997 SAMPLING EVENT

B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: CD-1 (Southern)
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast/snow Temp: 30°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	11.14
Measured Well Depth (feet)*:	24.70
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	2.7

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: TAB/SMH
Time: 950 Date: 10/28/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 8.1
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time: None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: TAB/SMH Time: 1250 Date: 10/28

SAMPLING DATA
Sample Appearance
Color: Heavy Silt Sediment: Silty
Odor: None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.5	Sp. Conductivity (umhos/cm)	200
Temperature (°F)	50°	Eh-Redox Potential (mV)	240
Turbidity (NTUs)	850	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: 022

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

(MS/MSD)

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: CD-1RA
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: overcast Temp: 30°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	9.18
Measured Well Depth (feet)*:	50.61
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	8.2

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 950 Date: 10/28/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): ≈24
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time: None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1045 Date: 10/28/97

SAMPLING DATA
Sample Appearance
Color: Cloudy Sediment: Silty
Odor: none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.7	Sp. Conductivity (umhos/cm)	200
Temperature (°F)	48°	Eh-Redox Potential (mV)	195
Turbidity (NTUs)	70	Dissolved Oxygen (mg/l)	
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	

Samples Collected (Number/Type) MS/MSD location
31 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: 1.25'

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI - MW - 1A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	7.80
Measured Well Depth (feet)*:	33.50
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.19

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 930 Date: 10/30/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 12.5 (9.0)
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time : ____

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1515 Date: 10/30/97

SAMPLING DATA
Sample Appearance
Color Brown Sediment Heavy
Odor None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.5	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	52	Eh-Redox Potential (mV)	235
Turbidity (NTUs)	1,000	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-1B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	7.42
Measured Well Depth (feet)*:	55.50
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	7.8

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 930 Date: 10/30/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 23
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time: None

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1015 Date: 10/30/97

SAMPLING DATA

Sample Appearance
Color: Clear Sediment: none
Odor: none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.8	Sp. Conductivity (umhos/cm)	200
Temperature (°F)	51	Eh-Redox Potential (mV)	230
Turbidity (NTUs)	75	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-2A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: overcast Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	6.20
Measured Well Depth (feet)*:	12.82
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.08

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1455 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 3.24
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : none

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1510 Date: 10/29/97

SAMPLING DATA
Sample Appearance
Color Lt. Brown Sediment H. Silty
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	7.5	Sp. Conductivity (umhos/cm)	1,800
Temperature (°F)	52	Eh-Redox Potential (mV)	
Turbidity (NTUs)	900	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL / — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-2B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	7.58
Measured Well Depth (feet)*:	33.52
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.2

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 1455 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 12.7
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1535 Date: 10/29/97

SAMPLING DATA
Sample Appearance
Color Cloudy Sediment Slight
Odor None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	7.70	Sp. Conductivity (umhos/cm)	1,900
Temperature (°F)	49	Eh-Redox Potential (mV)	65
Turbidity (NTUs)	55	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

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SAMPLING DATA SHEET

BARTON & LOGUIDICE, P.C.

(X)

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RT-MW-3A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	10.98
Measured Well Depth (feet)*:	22.43
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.86

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 930 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 3.7
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 950 Date: 10/29/97

SAMPLING DATA
Sample Appearance
Color: s. cloudy Sediment: s. silty
Odor: none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	8.7	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	53	Eh-Redox Potential (mV)	250
Turbidity (NTUs)	125	Dissolved Oxygen (mg/l)	—
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: MW-X

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-3B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify):

WATER LEVEL DATA

Static Water Level (feet)*:	18.71
Measured Well Depth (feet)*:	44.38
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.18

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify)
Measured by: JAB/SMH
Time: 930 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 12.57 (8.0)
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time :

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1025 Date: 10/29/97

SAMPLING DATA
Sample Appearance
Color Cloudy Sediment Silty
Odor none Product: No [X] Yes [ ] Thickness

Field Measured Parameters

pH (Standard Units)	8.6	Sp. Conductivity (umhos/cm)	600
Temperature (°F)	50°	Eh-Redox Potential (mV)	215
Turbidity (NTUs)	220	Dissolved Oxygen (mg/l)	–
Explosive Gases	– %LEL – ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: Date:

COMMENTS:

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-4A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 30°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify):

WATER LEVEL DATA

Static Water Level (feet)*:	8.86
Measured Well Depth (feet)*:	32.42'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.7

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify)
Measured by: JHB/SMH
Time: 1325 Date: 10/28/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 13 gal (9.0)
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time : 10 min

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JHB/SMH Time: 1355 Date: 10/28/97

SAMPLING DATA
Sample Appearance
Color: S. cloudy Sediment: Slight
Odor: None Product: No [X] Yes [ ] Thickness

Field Measured Parameters

pH (Standard Units)	7.8	Sp. Conductivity (umhos/cm)	800
Temperature (°F)	49	Eh-Redox Potential (mV)	265
Turbidity (NTUs)	75	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: Date:

COMMENTS:

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B&L

BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-5A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: overcast Temp: 36°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	10.22
Measured Well Depth (feet)*:	32.28'
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.4

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 2:30 Date: 10/28/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [X] Non-dedicated [ ]

Volume of Water Purged (gallons): 5.0 gal
Did well purge dry? No [ ] Yes [X]
Did well recover? No [ ] Yes [X] Recovery Time : Overnight

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1215 Date: 10/29/97

SAMPLING DATA

Sample Appearance
Color S. cloudy Sediment slight
Odor none Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.4	Sp. Conductivity (umhos/cm)	300
Temperature (°F)	53	Eh-Redox Potential (mV)	230
Turbidity (NTUs)	75	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL / — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-6A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 40

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ] Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	14.20
Measured Well Depth (feet)*:	19.05
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	0.79

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1230 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 2.3
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1300 Date: 10/29/97

SAMPLING DATA
Sample Appearance
Color Grey/Brown Sediment Heavy Silt
Odor None Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	7.6	Sp. Conductivity (umhos/cm)	900
Temperature (°F)	53	Eh-Redox Potential (mV)	5
Turbidity (NTUs)	800	Dissolved Oxygen (mg/l)	–
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	–

Samples Collected (Number/Type) 12 bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-6B
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: overcast Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	14.44
Measured Well Depth (feet)*:	40.75
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	4.2

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1230 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 12.8
Did well purge dry? No [ ] Yes [ ]
Did well recover? No [ ] Yes [ ] Recovery Time: ______

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1315 Date: 10

SAMPLING DATA
Sample Appearance
Color Cloudy/clear Sediment Slight
Odor none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	7.9	Sp. Conductivity (umhos/cm)	600
Temperature (°F)	50	Eh-Redox Potential (mV)	50
Turbidity (NTUs)	60	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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SAMPLING DATA SHEET

BARTON & LOGUIDICE, P.C.

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-MW-7A
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Overcast Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	3.66
Measured Well Depth (feet)*:	22.65
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	3.07

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1355 Date: 10/29/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 9.29
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [ ] Recovery Time: ______

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1425 Date: 10/29/97

SAMPLING DATA
Sample Appearance
Color: Cloudy Sediment: Heavy Silt
Odor: None Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	7.3	Sp. Conductivity (umhos/cm)	2,300
Temperature (°F)	53	Eh-Redox Potential (mV)	-100
Turbidity (NTUs)	400	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: RI-EB-1
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [X]
Sediment [ ] Other (specify):

WATER LEVEL DATA

Static Water Level (feet)*:	60.18
Measured Well Depth (feet)*:	71.20
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	1.79

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify)
Measured by: JAB/Smith
Time: 1130 Date: 10/30/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 5.3
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Sampled by: JAB/Smith Time: 1155 Date: 10/30/97

SAMPLING DATA
Sample Appearance
Color LT. Brown Sediment Sand/silt
Odor Leachate Product: No [X] Yes [ ] Thickness

Field Measured Parameters

pH (Standard Units)	7.4	Sp. Conductivity (umhos/cm)	9,800
Temperature (°F)	68	Eh-Redox Potential (mV)	< -200
Turbidity (NTUs)	75	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: Date:

COMMENTS:

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: DO-2
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: overcast Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ]
Sediment [ ] Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	7.56
Measured Well Depth (feet)*:	27.86
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	3.3

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ____
Measured by: JAB/SMH
Time: 1600 Date: 10/29/97

PURGING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 9.9
Did well purge dry? No [ ] Yes [ ]
Did well recover? No [ ] Yes [ ] Recovery Time : None

SAMPLING METHOD

Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [X] Non-dedicated [ ]

Sampled by: JAB/SMH Time: 1630 Date: 10/29/97

SAMPLING DATA

Sample Appearance
Color: Cloudy Brown Sediment: Silty
Odor: None Product: No [X] Yes [ ] Thickness ____

Field Measured Parameters

pH (Standard Units)	8.5	Sp. Conductivity (umhos/cm)	500
Temperature (°F)	~~[illegible]~~ 51	Eh-Redox Potential (mV)	155
Turbidity (NTUs)	90	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: ____

B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: D-1
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40°

SAMPLE TYPE: Groundwater [X] Surface Water [ ] Leachate [ ] Sediment [ ] Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	9.89
Measured Well Depth (feet)*:	180.08
Well Casing Diameter (inches):	2"
Volume in Well Casing (gallons):	27

* depth from measuring point

Measuring Point: Top of Riser [X]
Other (specify) ______
Measured by: JAB/SMH
Time: 1040 Date: 10/30/97

PURGING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [ ] Non-dedicated [X]

Volume of Water Purged (gallons): 83 (15)
Did well purge dry? No [X] Yes [ ]
Did well recover? No [ ] Yes [X] Recovery Time : None

SAMPLING METHOD
Equipment: Bailer [X] Submersible Pump [ ] Air Lift System [ ]
Bladder Pump [ ] Foot Valve [ ] Peristaltic Pump [ ]
Dedicated [X] Non-dedicated [X]

Sampled by: JAB/SMH Time: 1100 Date: 10/30/97

SAMPLING DATA
Sample Appearance
Color: Clear Sediment: none
Odor: none Product: No [X] Yes [ ] Thickness ______

Field Measured Parameters

pH (Standard Units)	8.8	Sp. Conductivity (umhos/cm)	300
Temperature (°F)	50	Eh-Redox Potential (mV)	125
Turbidity (NTUs)	4.8	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-1
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: P. Sunny Temp: 40°

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐
Sediment ☐ Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ____
Measured by: ____
Time: ____ Date: ____

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ____
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ____

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: JAB/SMH Time: 1020 Date: 10/31/97

SAMPLING DATA
Sample Appearance
Color Clear Sediment None
Odor none Product: No ☒ Yes ☐ Thickness ____

Field Measured Parameters

pH (Standard Units)	8.4	Sp. Conductivity (umhos/cm)	700
Temperature (°F)	46	Eh-Redox Potential (mV)	235
Turbidity (NTUs)	40	Dissolved Oxygen (mg/l)	7.0
Explosive Gases	— %LEL / — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: SCD-1 (1035)

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SAMPLING DATA SHEET

BARTON & LOGUIDICE, P.C.

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-2
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: P. sunny Temp: 40°

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐ Sediment ☐ Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify): ____
Measured by: ____
Time: ____ Date: ____

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ____
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time: ____

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: JAB/SMH Time: 930 Date: 10/31/97

SAMPLING DATA
Sample Appearance
Color: Clear Sediment: Slight
Odor: None Product: No ☒ Yes ☐ Thickness: ____

Field Measured Parameters

pH (Standard Units)	8.5	Sp. Conductivity (umhos/cm)	400
Temperature (°F)	45	Eh-Redox Potential (mV)	230
Turbidity (NTUs)	35	Dissolved Oxygen (mg/l)	6.0
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: SED-2 (945)

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-3
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: P. Sunny Temp: 40°

SAMPLE TYPE: Groundwater ☐ Surface Water ☐ Leachate ☐ Sediment ☐ Other (specify): ____

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ____
Measured by: ____
Time: ____ Date: ____

PURGING METHOD

Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐ Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐ Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ____
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time: ____

SAMPLING METHOD

Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐ Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐ Dedicated ☐ Non-dedicated ☐

Sampled by: TAB/SMH Time: 1050 Date: 10/31/97

SAMPLING DATA

Sample Appearance
Color: Clear Sediment: none
Odor: none Product: No ☒ Yes ☐ Thickness ____

Field Measured Parameters

pH (Standard Units)	8.4	Sp. Conductivity (umhos/cm)	1200
Temperature (°F)	46	Eh-Redox Potential (mV)	225
Turbidity (NTUs)	40	Dissolved Oxygen (mg/l)	4.8
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ____ Date: ____

COMMENTS: SED-3 (1100)

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW - 4 (ms/msd)
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify): ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: JAB/SMH Time: 1345 Date: 10/30/97

SAMPLING DATA
Sample Appearance
Color: Clear Sediment: none
Odor: none Product: No ☒ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)	8.4	Sp. Conductivity (umhos/cm)	100
Temperature (°F)	45	Eh-Redox Potential (mV)	230
Turbidity (NTUs)	6.0	Dissolved Oxygen (mg/l)	9.8
Explosive Gases	- %LEL - ppm	Total Organic Vapors (ppm)	-

Samples Collected (Number/Type) 3 Bottles MS/MSD

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: SED - 4 (1355)

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: SW-5
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: Sunny Temp: 40°

SAMPLE TYPE: Groundwater ☐ Surface Water ☒ Leachate ☐
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time: ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: TAB/SMH Time: 1445 Date: 10/30/97

SAMPLING DATA
Sample Appearance
Color: Clear Sediment: None
Odor: None Product: No ☒ Yes ☐ Thickness: ______

Field Measured Parameters

pH (Standard Units)	8.4	Sp. Conductivity (umhos/cm)	100
Temperature (°F)	45	Eh-Redox Potential (mV)	235
Turbidity (NTUs)	7.0	Dissolved Oxygen (mg/l)	10.0
Explosive Gases	%LEL - ppm	Total Organic Vapors (ppm)	-

Samples Collected (Number/Type) 12 Bottles

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: (1455) SED-5 (6 Jars)

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BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: LS-1
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: ______ Temp: ______

SAMPLE TYPE: Groundwater ☐ Surface Water ☐ Leachate ☐ Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: ______ Time: 1215 Date: 10/31/97

SAMPLING DATA
Sample Appearance
Color Brown Sediment ______
Odor Leachate Product: No ☒ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)	7.1	Sp. Conductivity (umhos/cm)	4000
Temperature (°F)	50°	Eh-Redox Potential (mV)	<-200
Turbidity (NTUs)	900	Dissolved Oxygen (mg/l)	—
Explosive Gases	— %LEL — ppm	Total Organic Vapors (ppm)	—

Samples Collected (Number/Type) ______

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: ______

B&L
BARTON & LOGUIDICE, P.C.

SAMPLING DATA SHEET

SITE: OLD CORTLAND CO. L.F. SAMPLE LOCATION: LS-2
CLIENT: CORTLAND CO. JOB #: 331.22
Weather Conditions: ______ Temp: ______

SAMPLE TYPE: Groundwater ☐ Surface Water ☐ Leachate ☐
Sediment ☐ Other (specify): ______

WATER LEVEL DATA

Static Water Level (feet)*:	
Measured Well Depth (feet)*:	
Well Casing Diameter (inches):	
Volume in Well Casing (gallons):	

* depth from measuring point

Measuring Point: Top of Riser ☐
Other (specify) ______
Measured by: ______
Time: ______ Date: ______

PURGING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Volume of Water Purged (gallons): ______
Did well purge dry? No ☐ Yes ☐
Did well recover? No ☐ Yes ☐ Recovery Time : ______

SAMPLING METHOD
Equipment: Bailer ☐ Submersible Pump ☐ Air Lift System ☐
Bladder Pump ☐ Foot Valve ☐ Peristaltic Pump ☐
Dedicated ☐ Non-dedicated ☐

Sampled by: ______ Time: ______ Date: ______

SAMPLING DATA
Sample Appearance
Color ______ Sediment ______
Odor ______ Product: No ☐ Yes ☐ Thickness ______

Field Measured Parameters

pH (Standard Units)		Sp. Conductivity (umhos/cm)	
Temperature (°F)		Eh-Redox Potential (mV)	
Turbidity (NTUs)		Dissolved Oxygen (mg/l)	
Explosive Gases	%LEL / ppm	Total Organic Vapors (ppm)	

Samples Collected (Number/Type) ______

Samples Delivered to: H2M LABORATORIES Time: ______ Date: ______

COMMENTS: Dry