142926

Tables

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Table 2-1

Generalized Vertical Distribution of Chemicals

Depth of Soil (feet)	Average Concentration[1] and Range of Concentrations[2]									
	PAHs		Phenol		Benzene		Arsenic		Cyanide	
	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)	Soil (mg/kg)	Groundwater (mg/L)
0–4.5 (vadose zone)	**1900** (ND–76,000)	—	**1.2**[3] (ND–41[3])	—	**1.2** (ND– 62)	—	**102** (ND—1800)	—	**54** (ND–1400)	—
4.5–21.5 (shallow portion of the sand aquifer)	**300** (ND–20,000)	**0.58** (1.1×10^{-5}—2.4)	**1.6** (ND–110)	**0.045** (ND– 0.45)	**0.016**[4] (ND–0.68[4])	**0.0093** (ND– 0.07)	**27** (1.4–760)	**0.32** (ND–4.1)	**1.6** (ND–52)	**0.056** (ND–0.65)
21.5–base of sand aquifer (deep portion of the sand aquifer)	**4.0** (ND–180)	**0.32** (7.4×10^{-6}–1.4)	**68** (ND–310)	**240** (ND–1500)	**0.049** (ND–0.8)	**1.1** (ND–7.8)	**26** (1.2–250)	**11** (0.0041–70)	**0.69** (ND–4.1)	**0.32** (0.0028–0.71)

[1]The arithmetic mean (average) is shown in bold on the table. Averages are computed on the 1992–1993 data. Groundwater data to the north of the site are not included in the arithmetic mean calculation.

[2]The range is represented by the data within the fenceline of the site to the north and south, the harbor on the west and the shoreline of Lake Michigan to the east.

[3]SB50 at 950 mg/kg phenol was eliminated from arithmetic mean calculation and range. Including this data point gives a mean of 12.0 mg/kg and a range of ND-950 mg/kg. This single data point is identified as a ı outlier.

[4]TT1001 at 31 mg/kg benzene was eliminated from arithmetic mean calculation and range. Including this data point gives a mean of 0.32 mg/kg and a range of ND-31 mg/kg. This single data point is identified as an outlier.

-- Not applicable

TABLE 2-2

1996 AND 1997 MONITORING WELL SAMPLES WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW1S	MW3S	MW4S	MW5S	MW6S		
	07/17/96	07/16/96	07/17/96	07/16/96	07/16/96	09/10/97 Sample	09/10/97 Replicate A
Phenol	0.010	0.010 U	0.010 U	0.010 U	0.072	1	--
2-Chlorophenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.15 U	--
o-Cresol	0.010 U	0.010 U	0.010 U	0.010 U	0.037	0.33	--
m-Cresol	--	--	--	--	--	--	--
p-Cresol	0.007 J	0.010 U	0.010 U	0.010 U	0.053	0.56	--
2,4-Dimethylphenol	0.001 J	0.010 U	0.010 U	0.010 U	0.050	0.16	--
2-Nitrophenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.15 U	--
Benzoic Acid	0.050 U	0.050 U	0.050 U	0.050 U	0.100 U	0.75 U	--
2,4-Dichlorophenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.15 U	--
4-Chloro-3-methylphenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.15 U	--
2,4,6-Trichlorophenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.15 U	--
2,4,5-Trichlorophenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.75 U	--
2,4-Dinitrophenol	0.050 U	0.050 U	0.050 U	0.050 U	0.100 U	0.75 U	--
4-Nitrophenol	0.050 U	0.050 U	0.050 U	0.050 U	0.100 U	0.75 U	--
2-Methyl-4,6-dinitrophenol	0.050 U	0.050 U	0.050 U	0.050 U	0.100 U	0.75 U	--
Pentachlorophenol	0.010 U	0.010 U	0.010 U	0.010 U	0.020 U	0.75 U	--
Benzene	0.031	0.0010 U	0.0010 U	0.015	0.055	0.081	--
Ethyl Benzene	0.0097	0.0010 U	0.0010 U	0.0010 U	0.044	0.074	--
Toluene	0.0041	0.0010 U	0.0010 U	0.0010 U	0.056	0.061	--
m & p Xylene	0.020	0.0020 U	0.0020 U	0.0020 U	0.026	--	--
o-Xylene	0.012	0.0019	0.0010 U	0.0010 U	0.038	--	--
Xylenes	--	--	--	--	--	0.12	--
Arsenic, total	0.153	0.400	0.0309	0.352	0.135	0.300	--
Arsenic, filtered	0.157	0.304	0.0145	0.225	0.0972	0.287	--
Iron, total	0.280	1.33	1.70	4.830	0.590	--	--
Iron, filtered	--	--	--	--	--	0.467	--
Manganese, filtered	--	--	--	--	--	0.191	--
Total Alkalinity as CaCO3	615	367	417	2877	522	536	536
Total Dissolved Solids	--	--	--	--	--	617	619
Specific Gravity @4oC, g/cc	1.0009	1.0012	1.0020	1.0016	1.0012	--	--
Chloride	16.6	9.6	39.1	3.8	32.5	82.4	98.3
Cyanide, total	0.0376	0.0553	0.0066	0.0056	0.0050 U	--	--
Cyanide, WAD	--	--	--	--	--	0.0050 U	<0.0050
Sulfate	34.0	42.4	119	144	60.9	40.6	42.5
Sulfide, total	1.0	0.1 U	0.1 U	0.1 U	1.1	0.4	0.4
Thiocyanate	0.553	0.264	0.100 U	0.264	3.370	7.3	7.03
Ammonia Nitrogen	57.5	0.1	0.4	1.4	32.9	51.7	42.8
Nitrate	0.05 U	0.05	0.23	0.07	0.05	0.05 U	<0.05
Nitrite	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	0.05 U	<0.05
Phosphorus, total	0.11	0.22	0.11	3.47	0.18	0.37	0.37
Total Kjeldahl Nitrogen	61.0	0.1 U	0.3	2.4	40.6	68.3	68.3
Biochemical Oxygen Demand (5-day)	10 U	10 U	4 U	10 U	10 U	21	21
Chemical Oxygen Demand	53	29	32	29	53	41	41
Carbon, dissolved	171	110	109	76.0	132	52.5	52.5
Phenol, 4AAP	0.04	0.01 U	0.01 U	0.03	0.61	5.89	4.87
Carbon, total organic	11.8	4.2	3.0	3.4	5.6	12.5	12.5
Carbon, dissolved organic	12.4	5.6	1.0 U	1.0 U	7.9	10.0	10.0

-- Not analyzed.
J Associated value is an estimate.
U Not detected.
3,.010
05/18/98

TABLE 2-2 (cont.)

1996 AND 1997 MONITORING WELL SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW6S	MW7S	MW8S	MW9S	MW10S	MW12S	MW13S
	09/10/97 Replicate B	07/17/96	07/18/96	07/17/96	07/16/96	07/19/96	07/18/96
Phenol	--	0.009 J	0.015 B	0.110	0.002 J	0.010 U	0.049
2-Chlorophenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
o-Cresol	--	0.010 U	0.002 J	0.063	0.010 U	0.010 U	0.011
m-Cresol	--	--	--	--	--	--	--
p-Cresol	--	0.007 J	0.004 BJ	0.120	0.010 U	0.010 U	0.031
2,4-Dimethylphenol	--	0.001 J	0.010 U	0.030	0.001 J	0.010 U	0.002 J
2-Nitrophenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzoic Acid	--	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.005 J
2,4-Dichlorophenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
4-Chloro-3-methylphenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
2,4,6-Trichlorophenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
2,4,5-Trichlorophenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
2,4-Dinitrophenol	--	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
4-Nitrophenol	--	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
2-Methyl-4,6-dinitrophenol	--	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U	0.050 U
Pentachlorophenol	--	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U	0.010 U
Benzene	--	0.0010 U	0.0010 U	0.038	0.027	0.0010 U	0.0010 U
Ethyl Benzene	--	0.0010 U	0.0010 U	0.0017	0.0010 U	0.0010 U	0.0010 U
Toluene	--	0.0010 U	0.0010 U	0.0083	0.0010 U	0.0010 U	0.0010 U
m & p Xylene	--	0.0020 U	0.0020 U	0.022	0.0020 U	0.0020 U	0.0020 U
o-Xylene	--	0.0010 U	0.0010 U	0.011	0.0068	0.0010 U	0.0010 U
Xylenes	--	--	--	--	--	--	--
Arsenic, total	--	0.313	0.0050 U	1.310	0.115	0.0221	0.157
Arsenic, filtered	--	0.162	0.0050 U	1.320	0.070	0.0320	0.136
Iron, total	--	10.3	0.281	17	3.210	0.100 U	0.925
Iron, filtered	--	6.830	--	15.9	--	--	0.911
Manganese, filtered	--	--	--	--	--	--	--
Total Alkalinity as CaCO3	--	347	379	6	268	228	210
Total Dissolved Solids	--	--	--	--	--	--	--
Specific Gravity &4oC, g/cc	--	1.0010	1.0020	1.0027	1.0015	1.0005	1.0008
Chloride	75.6	4.8	129	22.2	5.9	1.5	3.9
Cyanide, total	--	0.0131	0.0055	0.129	0.0384	0.0050 U	0.0050 U
Cyanide, WAD	--	--	--	--	--	--	--
Sulfate	--	54.7	44.0	1380	46.3	13.3	16.3
Sulfide, total	--	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Thiocyanate	--	0.228	0.100 U	0.535	0.246	0.100 U	0.100 U
Ammonia Nitrogen	48.9	1.1	0.2 U	23.5	0.3	0.2 U	0.6
Nitrate	--	0.07	1.37	0.23	0.48	0.10	0.06
Nitrite	--	0.05 U	0.05 U	0.11	0.05 U	0.05 U	0.05 U
Phosphorus, total	--	0.08	0.07	0.39	0.05 U	0.27	0.52
Total Kjeldahl Nitrogen	--	0.8	1.8	26.6	1.9	0.1 U	2.3
Biochemical Oxygen Demand (5-day)	--	10 U	10 U	4 U	10 U	10 U	10 U
Chemical Oxygen Demand	--	20.0 U	20 U	41	25	19	20 U
Carbon, dissolved	--	101	88.7	76.4	73.9	51.4	50.1
Phenol, 4AAP	--	0.01 U	0.23	6.97	0.02	0.12	0.01 U
Carbon, total organic	--	1.7	2.8	7.1	4.3	1.4	2.8
Carbon, dissolved organic	--	2.1	3.7	7.6	2.1	1.4	2.6

-- Not analyzed.
B The analyte was found in the associated blank as well as the sample.
J Associated value is an estimate.
U Not detected.

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05/18/98

TABLE 2-2 (cont.)

1996 AND 1997 MONITORING WELL SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW13S			MW14S	MW1D	MW3D	MW4D	MW5D
	09/10/97 Sample	09/10/97 Replicate A	09/10/97 Replicate B	07/18/96	07/17/96	07/16/96	07/17/96	07/16/96
Phenol	0.051	--	--	0.010 U	180	240	460	0.100 U
2-Chlorophenol	0.010 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
o-Cresol	0.005 j	--	--	0.010 U	26	40	79	1.50
m-Cresol	--	--	--	--	--	--	--	--
p-Cresol	0.018	--	--	0.010 U	74	120	210	0.100 U
2,4-Dimethylphenol	0.001 j	--	--	0.010 U	6.4 J	7.4	15 J	0.530
2-Nitrophenol	0.010 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
Benzoic Acid	0.050 U	--	--	0.050 U	70 U	3.1 J	150 U	0.500 U
2,4-Dichlorophenol	0.010 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
4-Chloro-3-methylphenol	0.010 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
2,4,6-Trichlorophenol	0.010 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
2,4,5-Trichlorophenol	0.050 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
2,4-Dinitrophenol	0.050 U	--	--	0.050 U	70 U	5.0 U	150 U	0.500 U
4-Nitrophenol	0.050 U	--	--	0.050 U	70 U	5.0 U	150 U	0.500 U
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	0.050 U	70 U	5.0 U	150 U	0.500 U
Pentachlorophenol	0.050 U	--	--	0.010 U	14 U	1.0 U	30 U	0.100 U
Benzene	0.0010 U	--	--	0.0010 U	0.730	0.810	0.690	0.690
Ethyl Benzene	0.0010 U	--	--	0.0010 U	0.050 U	0.050 U	0.050 U	0.050 U
Toluene	0.0010 U	--	--	0.0010 U	0.260	0.050	0.050 U	0.050 U
m & p Xylene	--	--	--	0.0020 U	0.100 U	0.100 U	0.100 U	0.100 U
o-Xylene	--	--	--	0.0010 U	0.180	0.050 U	0.050 U	0.050 U
Xylenes	0.0010 U	--	--	--	--	--	--	--
Arsenic, total	0.143	--	--	0.079	4.90	16.2	59.8	5.438
Arsenic, filtered	0.156	--	--	0.087	4.87	15.6	53.5	4.890
Iron, total	--	--	--	2.450	1.16	0.775	1.22	0.421
Iron, filtered	2.04	--	--	--	--	0.745	--	--
Manganese, filtered	1.10	--	--	--	--	--	--	--
Total Alkalinity as CaCO3	261	--	--	236	2280	3140	3090	1319
Total Dissolved Solids	285	300	--	--	--	--	--	--
Specific Gravity @4oC, g/cc	--	--	--	1.0017	1.0030	1.0044	1.0055	1.0022
Chloride	2.3	2.2	2.2	27.7	1330	1570	3320	616
Cyanide, total	--	--	--	0.0050 U	0.354	0.178	0.908	0.117
Cyanide, WAD	0.0050 U	--	--	--	--	--	--	--
Sulfate	2.0 U	2.0 U	--	9.6	416	663	333	136
Sulfide, total	0.1 U	--	--	0.1 U	7.8	3.8	27.5	2.7
Thiocyanate	0.738	--	--	0.125	346	218	426	240
Ammonia Nitrogen	0.2 U	0.2 U	0.2 U	0.2 U	731	730	1030	419
Nitrate	0.05 U	0.05 U	--	0.06	0.07	0.05 U	0.05 U	0.05 U
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	0.05	0.11	0.05 U
Phosphorus, total	0.55	--	--	0.16	1.15	2.81	14.1	0.86
Total Kjeldahl Nitrogen	0.7	--	--	0.3	1140	1540	1860	393
Biochemical Oxygen Demand (5-day)	20 U	--	--	10 U	1100	1420	2300	52
Chemical Oxygen Demand	20 U	--	--	32	2120	2130	4130	416
Carbon, dissolved	28.1	--	--	65.1	974	787	1300	395
Phenol, 4AAP	0.01 U	0.01 U	--	0.06	416	355	963	3.00
Carbon, total organic	6.3	--	--	5.7	495	575	1190	65.4
Carbon, dissolved organic	1.4	--	--	8.7	533	607	265	27.5

-- Not analyzed.

j Reported value is less than the stated laboratory quantitation limit and is considered an estiamted value.

J Associated value is an estimate.

U Not detected.

3,.010

05/18/98

TABLE 2-2 (cont.)

1996 AND 1997 MONITORING WELL SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW6D				MW7D	MW8D
	07/16/96	09/10/97 Sample	09/10/97 Replicate A	09/10/97 Replicate B	07/17/96	07/18/96 Sample
Phenol	160	99	--	--	1000	110
2-Chlorophenol	0.400 U	20 U	--	--	40 U	15 U
o-Cresol	28 J	13 J	--	--	97	28
m-Cresol	--	--	--	--	--	--
p-Cresol	140	20 U	--	--	260	85
2,4-Dimethylphenol	15 J	10 J	--	--	21 J	6.6 J
2-Nitrophenol	0.400 U	20 U	--	--	40 U	15 U
Benzoic Acid	2.00 U	100 U	--	--	200 U	44 J
2,4-Dichlorophenol	0.400 U	20 U	--	--	40 U	15 U
4-Chloro-3-methylphenol	0.400 U	20 U	--	--	40 U	15 U
2,4,6-Trichlorophenol	0.400 U	20 U	--	--	40 U	15 U
2,4,5-Trichlorophenol	0.400 U	100 U	--	--	40 U	15 U
2,4-Dinitrophenol	2.00 U	100 U	--	--	200 U	75 U
4-Nitrophenol	2.00 U	100 U	--	--	200 U	75 U
2-Methyl-4,6-dinitrophenol	2.00 U	100 U	--	--	200 U	75 U
Pentachlorophenol	0.400 U	100 U	--	--	40 U	15 U
Benzene	1.10	2.2	--	--	1.300	11
Ethyl Benzene	0.100	0.13	--	--	0.050 U	0.5 U
Toluene	0.530	0.58	--	--	0.350	0.84
m & p Xylene	0.059	--	--	--	0.130	1.0 U
o-Xylene	0.064	--	--	--	0.050	0.5 U
Xylenes	--	0.10 U	--	--	--	--
Arsenic, total	20.7	28.4	--	--	19	9.6
Arsenic, filtered	21	27.1	--	--	13.9	8.62
Iron, total	7.570	--	--	--	1.390	1.27
Iron, filtered	3.500	4.36	--	--	--	--
Manganese, filtered	--	0.0472	--	--	--	--
Total Alkalinity as CaCO3	4710	5230	--	--	2960	5520
Total Dissolved Solids	--	1890	1790	--	--	--
Specific Gravity @4oC, g/cc	1.0066	--	--	--	1.0054	1.0059
Chloride	3930	4090	2220	2220	4610	940
Cyanide, total	0.612	--	--	--	0.432	1.35
Cyanide, WAD	--	0.106	--	--	--	--
Sulfate	77.2	95.3	96.3	--	476	399
Sulfide, total	7.4	4.0	--	--	7.0	1.1
Thiocyanate	185	214	224	--	734	140
Ammonia Nitrogen	220	2140	2570	2570	1120	1260
Nitrate	0.05 U	0.09	0.07	--	0.08	0.05 U
Nitrite	0.20	0.14	0.13	--	0.07	0.07
Phosphorus, total	8.95	12.4	--	--	2.52	6.15
Total Kjeldahl Nitrogen	1640	2570	--	--	2090	1570
Biochemical Oxygen Demand (5-day	1800	1600	--	--	4000	900
Chemical Oxygen Demand	2630	2890	--	--	6790	1780
Carbon, dissolved	1790	1820	--	--	2130	694
Phenol, 4AAP	366	330	335	--	1160	284
Carbon, total organic	754	1270	--	--	1640	631
Carbon, dissolved organic	760	1620	--	--	1740	573

-- Not analyzed.
J Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
J Associated value is an estimate
U Not detected

3,.010
05/18/98

TABLE 2-2 (cont.)

1996 AND 1997 MONITORING WELL SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW8D	MW9D	MW10D	MW12D	MW13D		
	07/18/96 Duplicate	07/17/96	07/16/96	07/19/96	07/18/96 Sample	07/18/96 Duplicate	09/10/97 Sample
Phenol	--	12	50	0.010 U	480	430	300
2-Chlorophenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	50 U
o-Cresol	--	7.50	20	0.010 U	81	87	35 J
m-Cresol	--	--	--	--	--	--	--
p-Cresol	--	22	45	0.010 U	230	220	150
2,4-Dimethylphenol	--	2.100	6.3 J	0.010 U	18 J	17 J	9.5 J
2-Nitrophenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	50 U
Benzoic Acid	--	5.00 U	1.00 U	0.050 U	150 U	150 U	250 U
2,4-Dichlorophenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	50 U
4-Chloro-3-methylphenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	50 U
2,4,6-Trichlorophenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	50 U
2,4,5-Trichlorophenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	250 U
2,4-Dinitrophenol	--	5.00 U	1.00 U	0.050 U	150 U	150 U	250 U
4-Nitrophenol	--	5.00 U	1.00 U	0.050 U	150 U	150 U	250 U
2-Methyl-4,6-dinitrophenol	--	5.00 U	1.00 U	0.050 U	150 U	150 U	250 U
Pentachlorophenol	--	1.00 U	0.200 U	0.010 U	30 U	30 U	250 U
Benzene	9.9	0.470	4.600	0.0010 U	1.3	--	1.1
Ethyl Benzene	0.5 U	0.020 U	0.050 U	0.0010 U	0.05 U	--	0.10 U
Toluene	0.77	0.170	0.570	0.0010 U	0.058	--	0.10 U
m & p Xylene	1.0 U	0.055	0.100 U	0.0020 U	0.1 U	--	--
o-Xylene	0.5 U	0.035	0.050 U	0.0010 U	0.05 U	--	--
Xylenes	--	--	--	--	--	--	0.10 U
Arsenic, total	--	10	4.150	3.010	29	29	23.8
Arsenic, filtered	--	10.2	4.460	2.860	29.5	29.2	18.4
Iron, total	--	17.5	0.966	7.070	0.922	--	--
Iron, filtered	--	17.3	--	7.060	0.764	--	0.765
Manganese, filtered	--	--	--	--	--	--	0.151
Total Alkalinity as CaCO3	--	1620	3170	359	2730	--	2640
Total Dissolved Solids	--	--	--	--	--	--	1510
Specific Gravity @4oC, g/cc	--	1.0062	1.0055	1.0017	1.005	--	--
Chloride	--	358	1510	319	3760	--	3580
Cyanide, total	--	0.0993	0.711	0.383	0.577	--	--
Cyanide, WAD	--	--	--	--	--	--	0.024
Sulfate	--	2770	1020	300	594	--	425
Sulfide, total	--	2.5	4.1	0.5	12.8	--	2.6
Thiocyanate	--	89.7	408	62.4	665	--	545
Ammonia Nitrogen	--	525	494	80.5	854	--	1220
Nitrate	--	0.05 U	0.05 U	0.08	0.05 U	--	0.25 U
Nitrite	--	0.40	0.05 U	0.05 U	0.05	--	0.5 U
Phosphorus, total	--	1.65	1.66	0.89	6.6	--	3.24
Total Kjeldahl Nitrogen	--	580	1370	96.6	1950	--	1760
Biochemical Oxygen Demand (5-day)	--	150	320	20 U	3100	--	3050
Chemical Oxygen Demand	--	437	1420	100	5190	--	4880
Carbon, dissolved	--	183	845	97.3	1250	--	1420
Phenol, 4AAP	--	53.4	140	0.07	859	857	974
Carbon, total organic	--	116	352	16.7	1290	--	1380
Carbon, dissolved organic	--	107	362	16.3	1290	--	1350

-- Not analyzed.

J Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.

J Associated value is an estimate.

U Not detected.

3,.010

05 18 98

TABLE 2-2 (cont.)

1996 AND 1997 MONITORING WELL SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW13D		MW14D
	09/10/97 Replicate A	09/10/97 Replicate B	07/18/96
Phenol	--	--	0.001 BJ
2-Chlorophenol	--	--	0.010 U
o-Cresol	--	--	0.010 U
m-Cresol	--	--	--
p-Cresol	--	--	0.010 U
2,4-Dimethylphenol	--	--	0.010 U
2-Nitrophenol	--	--	0.010 U
Benzoic Acid	--	--	0.050 U
2,4-Dichlorophenol	--	--	0.010 U
4-Chloro-3-methylphenol	--	--	0.010 U
2,4,6-Trichlorophenol	--	--	0.010 U
2,4,5-Trichlorophenol	--	--	0.010 U
2,4-Dinitrophenol	--	--	0.050 U
4-Nitrophenol	--	--	0.050 U
2-Methyl-4,6-dinitrophenol	--	--	0.050 U
Pentachlorophenol	--	--	0.010 U
Benzene	--	--	0.120
Ethyl Benzene	--	--	0.005 U
Toluene	--	--	0.005 U
m & p Xylene	--	--	0.010 U
o-Xylene	--	--	0.005 U
Xylenes	--	--	--
Arsenic, total	--	--	1.100
Arsenic, filtered	--	--	1.060
Iron, total	--	--	0.592
Iron, filtered	--	--	--
Manganese, filtered	--	--	--
Total Alkalinity as CaCO3	--	--	250
Total Dissolved Solids	1670	--	--
Specific Gravity @4oC, g/cc	--	--	1.0021
Chloride	3310	3650	298
Cyanide, total	--	--	0.0212
Cyanide, WAD	--	--	--
Sulfate	398	--	32.3
Sulfide, total	--	--	0.1 U
Thiocyanate	515	545	0.194
Ammonia Nitrogen	1680	1570	43.7
Nitrate	<0.25	--	0.05 U
Nitrite	<0.05	--	0.05 U
Phosphorus, total	--	--	0.43
Total Kjeldahl Nitrogen	--	--	50.1
Biochemical Oxygen Demand (5-day)	--	--	40 U
Chemical Oxygen Demand	--	--	32
Carbon, dissolved	--	--	71.4
Phenol, 4AAP	907	--	0.05 U
Carbon, total organic	--	--	3.7
Carbon, dissolved organic	--	--	4.0

-- Not analyzed.
B The analyte was found in the associated blank as well as the sample.
J Associated value is an estimate.
U Not detected.

3, .010
05/18/98

TABLE 2-2 (cont.)

1996 AND 1997 MONITORING WELL SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	MW1S	MW3S	MW4S	MW5S	MW6S		MW7S	MW8S
	07/17/96	07/16/96	07/17/96	07/16/96	07/16/96	09/10/97	07/17/96	07/18/96
Temperature, oC	11.0	14.0	12.5	13.1	12.3	14.4	15.1	14.2
Specific Conductance @25oC,umhos/cm	1289	803	1098	839	1150	1310	658	1173
Redox, mV	-144	-4	-49	-116	-130	-173	-60	-44
pH, standard units	6.95	6.61	6.98	7.19	7.42	7.68	6.08	7.09
Dissolved Oxygen	0.17	0.13	0.12	0.24	0.16	0.40	0.26	0.17
Nitrite	--	--	--	--	--	0-1.25	--	--
Nitrate	--	--	--	--	--	0-2.5	--	--
Iron, Ferrous	0.22	0.93	0.69	1.93	0.24	--	5.10	0.09

	MW10S	MW12S	MW13S		MW14S	MW1D	MW3D	MW4D
	07/16/96	07/19/96	07/18/96	09/10/97	07/18/96	07/17/96	07/16/96	07/17/96
Temperature, oC	13.8	15.8	14.1	16.6	18.1	11.1	11.3	11.6
Specific Conductance @25oC,umhos/cm	672	446	427	487	488	9430	11690	1740
Redox, mV	-44	154	-82	-123	-58	-277	-295	-280
pH, standard units	6.95	7.07	7.21	7.03	6.90	8.82	8.42	8.49
Dissolved Oxygen	2.27	1.20	0.76	0.11	0.69	0.08	0.02	0.02
Nitrite	--	--	--	0-1.25	--	--	--	--
Nitrate	--	--	--	0-2.5	--	--	--	--
Iron, Ferrous	1.97	0.11	5.10	--	2.29	0.04	5.10	0.50

	MW5D	MW6D		MW7D	MW8D	MW9D	MW10D	MW12D
	07/16/96	07/16/96	09/10/97	07/17/96	07/18/96	07/17/96	07/16/96	07/19/96
Temperature, oC	10.6	11.1	11.3	11.2	13.4	12.1	11.4	10.9
Specific Conductance @25oC,umhos/cm	4840	20300	2180	20100	1273	7900	11860	2420
Redox, mV	-186	-272	-279	-354	-328	-170	-245	-127
pH, standard units	8.30	7.79	7.78	8.82	8.87	7.05	8.59	7.29
Dissolved Oxygen	0.12	0.05	0.21	0.05	0.02	0.13	0.05	0.14
Nitrite	--	--	0-1.25	--	--	--	--	--
Nitrate	--	--	0-2.5	--	--	--	--	--
Iron, Ferrous	0.39	5.10	--	0.10	0.16	5.10	0.31	5.10

	MW13D		MW14D
	07/18/96	09/10/97	07/18/96
Temperature, oC	10.9	10.8	11.4
Specific Conductance @25oC,umhos/cm	1664	1615	1588
Redox, mV	-268	-280	-112
pH, standard units	8.61	8.52	7.56
Dissolved Oxygen	0.02	0.43	0.13
Nitrite	--	0-1.25	--
Nitrate	--	0-2.5	--
Iron, Ferrous	--	--	1.96

-- Not analyzed.
3,.010
05/18/98

TABLE 2-3

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6104			SB6110		
	09/09/97 Sample	09/09/97 Replicate A	09/09/97 Replicate B	09/09/97 Sample	09/09/97 Replicate A	09/09/97 Replicate B
Sample I.D.	SB-61W04	SB-61W04	SB-61W04	SB-61W10	SB-61W10	SB-61W10
Soil Boring	61	61	61	61	61	61
Depth	4	4	4	10	10	10
Phenol	0.010 U	--	--	0.010 U	--	--
2-Chlorophenol	0.010 U	--	--	0.010 U	--	--
o-Cresol	0.010 U	--	--	0.010 U	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	0.010 U	--	--	0.010 U	--	--
2,4-Dimethylphenol	0.010 U	--	--	0.010 U	--	--
2-Nitrophenol	0.010 U	--	--	0.010 U	--	--
Benzoic Acid	0.050 U	--	--	0.050 U	--	--
2,4-Dichlorophenol	0.010 U	--	--	0.010 U	--	--
4-Chloro-3-methylphenol	0.010 U	--	--	0.010 U	--	--
2,4,6-Trichlorophenol	0.010 U	--	--	0.010 U	--	--
2,4,5-Trichlorophenol	0.050 U	--	--	0.050 U	--	--
2,4-Dinitrophenol	0.050 U	--	--	0.050 U	--	--
4-Nitrophenol	0.050 U	--	--	0.050 U	--	--
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	0.050 U	--	--
Pentachlorophenol	0.050 U	--	--	0.050 U	--	--
Benzene	0.0010 U	--	--	0.0010 U	--	--
Ethyl Benzene	0.0010 U	--	--	0.0010 U	--	--
Toluene	0.0010 U	--	--	0.0010 U	--	--
Xylenes	0.0010 U	--	--	0.0010 U	--	--
Arsenic	0.0050 U	--	--	0.320	--	--
Arsenic, filtered	0.0050 U	--	--	0.257	--	--
Iron, filtered	0.100 U	--	--	3.19	--	--
Manganese, filtered	0.0151	--	--	0.382	--	--
Total Alkalinity as CaCO3	162	--	--	227	--	--
Total Dissolved Solids	217	208	--	269	269	--
Chloride	12.4	12.5	12.4	2.8	2.7	2.8
Cyanide, WAD	5.0 U	--	--	5.0 U	--	--
Sulfate	25.5	26.3	--	11.8	9.9	--
Sulfide, total	0.1 U	--	--	0.1 U	--	--
Thiocyanate	0.131	0.738	--	0.500 U	0.500 U	--
Ammonia Nitrogen	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nitrate	0.10	0.08	--	1.13	0.06	--
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Phosphorus, total	0.04	--	--	1.09	--	--
Total Kjeldahl Nitrogen	0.1 U	--	--	1.4	--	--
Biochemical Oxygen Demand (5-day	20 U	--	--	20 U	--	--
Chemical Oxygen Demand	20 U	--	--	20 U	--	--
Carbon, dissolved	26.0	--	--	44.8	--	--
Phenol, 4AAP	0.01 U	0.01 U	--	0.01 U	0.01 U	--
Carbon, total organic	1.6	--	--	6.2	--	--
Carbon, dissolved organic	2.7	--	--	2.6	--	--
Temperature, oC	19.9	--	--	16.7	--	--
Specific Conductance (25oC,umhos cm	371	--	--	462	--	--
pH, standard units	7.47	--	--	7.47	--	--
Redox, mV	-71	--	--	-187	--	--
Dissolved Oxygen, mg L	1.08	--	--	0.39	--	--
Nitrite	0-1.25	--	--	0-1.25	--	--
Nitrate	0-2.5	--	--	0-2.5	--	--

-- Not analyzed

U Not detected.

9..010

05-18-98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6130			SB6206		
	09/10/97 Sample	09/10/97 Replicate A	09/10/97 Replicate B	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B
Sample I.D.	SB-61W30	SB-61W30	SB-61W30	SB-62W06	SB-62W06	SB-62W06
Soil Boring	61	61	61	62	62	62
Depth	30	30	30	6	6	6
Phenol	160	--	--	0.24	--	--
2-Chlorophenol	25 U	--	--	0.040 U	--	--
o-Cresol	18 j	--	--	0.020 j	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	25 U	--	--	0.063	--	--
2,4-Dimethylphenol	4.8 j	--	--	0.040 U	--	--
2-Nitrophenol	25 U	--	--	0.040 U	--	--
Benzoic Acid	120 U	--	--	0.20 U	--	--
2,4-Dichlorophenol	25 U	--	--	0.040 U	--	--
4-Chloro-3-methylphenol	25 U	--	--	0.040 U	--	--
2,4,6-Trichlorophenol	25 U	--	--	0.040 U	--	--
2,4,5-Trichlorophenol	120 U	--	--	0.020 U	--	--
2,4-Dinitrophenol	120 U	--	--	0.020 U	--	--
4-Nitrophenol	120 U	--	--	0.020 U	--	--
2-Methyl-4,6-dinitrophenol	120 U	--	--	0.020 U	--	--
Pentachlorophenol	120 U	--	--	0.020 U	--	--
Benzene	0.38	--	--	0.0010 U	--	--
Ethyl Benzene	0.010 U	--	--	0.0010 U	--	--
Toluene	0.010 U	--	--	0.0010 U	--	--
Xylenes	0.010 U	--	--	0.0010 U	--	--
Arsenic	21.0	--	--	0.121	--	--
Arsenic, filtered	16.5	--	--	0.128	--	--
Iron, filtered	1.42	--	--	1.64	--	--
Manganese, filtered	0.0725	--	--	0.376	--	--
Total Alkalinity as CaCO3	5380	--	--	233	--	--
Total Dissolved Solids	928	1110	--	272	272	--
Chloride	2300	1810	2060	2.1	2.3	2.2
Cyanide, WAD	0.178	--	--	0.0050 U	--	--
Sulfate	434	419	--	14.9	14.3	--
Sulfide, total	2.4	--	--	0.1 U	--	--
Thiocyanate	315	530	--	1 U	1 U	--
Ammonia Nitrogen	1050	1150	1070	0.4	0.2 U	0.2 U
Nitrate	0.10	0.09	--	0.05 U	0.05 U	--
Nitrite	0.06	0.07	--	0.05 U	0.05 U	--
Phosphorus, total	3.20	--	--	0.37	--	--
Total Kjeldahl Nitrogen	1750	--	--	0.9	--	--
Biochemical Oxygen Demand (5-day)	2850	--	--	10 U	--	--
Chemical Oxygen Demand	4670	--	--	20 U	--	--
Carbon, dissolved	1220	--	--	33.7	--	--
Phenol, 4AAP	588	783	--	0.03	0.01 U	--
Carbon, total organic	1240	--	--	14.7	--	--
Carbon, dissolved organic	1160	--	--	1.7	--	--
Temperature, oC	14.7	--	--	17.6	--	--
Specific Conductance @25oC,umhos/cm	39	--	--	430	--	--
pH, standard units	8.38	--	--	7.46	--	--
Redox, mV	-77	--	--	-198	--	--
Dissolved Oxygen	3.10	--	--	0.53	--	--
Nitrite	2-5	--	--	0-2.5	--	--
Nitrate	5-10	--	--	0-5	--	--

-- Not analyzed.
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected

3,.010
05.18.98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6116			SB6122		
	09/09/97 Sample	09/09/97 Replicate A	09/09/97 Replicate B	09/10/97 Sample	09/10/97 Replicate A	09/10/97 Replicate B
Sample I.D.	SB-61W16	SB-61W16	SB-61W16	SB-61W22	SB-61W22	SB-61W22
Soil Boring	61	61	61	61	61	61
Depth	16	16	16	22	22	22
Phenol	0.010 U	--	--	0.010 U	--	--
2-Chlorophenol	0.010 U	--	--	0.010 U	--	--
o-Cresol	0.010 U	--	--	0.010 U	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	0.010 U	--	--	0.010 U	--	--
2,4-Dimethylphenol	0.010 U	--	--	0.024	--	--
2-Nitrophenol	0.010 U	--	--	0.010 U	--	--
Benzoic Acid	0.050 U	--	--	0.050 U	--	--
2,4-Dichlorophenol	0.010 U	--	--	0.010 U	--	--
4-Chloro-3-methylphenol	0.010 U	--	--	0.010 U	--	--
2,4,6-Trichlorophenol	0.010 U	--	--	0.010 U	--	--
2,4,5-Trichlorophenol	0.050 U	--	--	0.050 U	--	--
2,4-Dinitrophenol	0.050 U	--	--	0.050 U	--	--
4-Nitrophenol	0.050 U	--	--	0.050 U	--	--
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	0.050 U	--	--
Pentachlorophenol	0.050 U	--	--	0.050 U	--	--
Benzene	0.0010 U	--	--	0.0077	--	--
Ethyl Benzene	0.0010 U	--	--	0.0010 U	--	--
Toluene	0.0010 U	--	--	0.0010 U	--	--
Xylenes	0.0010 U	--	--	0.0010 U	--	--
Arsenic	0.420	--	--	0.143	--	--
Arsenic, filtered	0.338	--	--	0.116	--	--
Iron, filtered	1.74	--	--	0.100 U	--	--
Manganese, filtered	0.239	--	--	0.106	--	--
Total Alkalinity as CaCO3	179	--	--	518	--	--
Total Dissolved Solids	219	211	--	400	383	--
Chloride	6.0	6.1	5.9	121	123	92
Cyanide, WAD	0.0050 U	--	--	0.0050 U	--	--
Sulfate	16.7	18.1	--	14.0	10.7	--
Sulfide, total	0.1 U	--	--	0.3	--	--
Thiocyanate	0.653	0.823	--	2.10	2.01	--
Ammonia Nitrogen	0.2 U	<0.2	0.7	49.9	47.5	48.0
Nitrate	0.08	0.21	--	0.06	0.08	--
Nitrite	0.05 U	<0.05	--	0.05 U	0.05	--
Phosphorus, total	0.18	--	--	1.20	--	--
Total Kjeldahl Nitrogen	1.6	--	--	55.8	--	--
Biochemical Oxygen Demand (5-day)	20 U	--	--	20 U	--	--
Chemical Oxygen Demand	20 U	--	--	291	--	--
Carbon, dissolved	27.6	--	--	23.7	--	--
Phenol, 4AAP	0.08	0.71	--	0.02	0.01 U	--
Carbon, total organic	6.5	--	--	22.3	--	--
Carbon, dissolved organic	3.7	--	--	5.3	--	--
Temperature, oC	16.0	--	--	18.0	--	--
Specific Conductance (25oC, umhos/cm)	70	--	--	50	--	--
pH, standard units	7.76	--	--	8.06	--	--
Redox, mV	-130	--	--	-30	--	--
Dissolved Oxygen	9.00	--	--	8.45	--	--
Nitrite	0-1.25	--	--	0-1.25	--	--
Nitrate	0-2.5	--		0-2.5	--	--

-- Not analyzed

U Not detected.

3, .010

05 18 98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6212			SB6218			
	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B	09/13/97 Sample	09/13/97 Duplicate	09/13/97 Replicate A	09/13/97 Replicate B
Sample I.D.	SB-62W12	SB-62W12	SB-62W12	SB-62W18	SB-62W18	SB-62W16	SB-62W18
Soil Boring	62	62	62	62	62	62	62
Depth	12	12	12	18	18	18	18
Phenol	0.042	--	--	0.017	0.035	--	--
2-Chlorophenol	0.010 U	--	--	0.010 U	0.010 U	--	--
o-Cresol	0.004 j	--	--	0.002 j	0.003 j	--	--
m-Cresol	--	--	--	--	--	--	--
p-Cresol	0.011	--	--	0.007 j	0.010	--	--
2,4-Dimethylphenol	0.010 U	--	--	0.010 U	0.010 U	--	--
2-Nitrophenol	0.010 U	--	--	0.010 U	0.010 U	--	--
Benzoic Acid	0.050 U	--	--	0.013 j	0.012 j	--	--
2,4-Dichlorophenol	0.010 U	--	--	0.010 U	0.010 U	--	--
4-Chloro-3-methylphenol	0.010 U	--	--	0.010 U	0.010 U	--	--
2,4,6-Trichlorophenol	0.010 U	--	--	0.010 U	0.010 U	--	--
2,4,5-Trichlorophenol	0.050 U	--	--	0.050 U	0.050 U	--	--
2,4-Dinitrophenol	0.050 U	--	--	0.050 U	0.050 U	--	--
4-Nitrophenol	0.050 U	--	--	0.050 U	0.050 U	--	--
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	0.050 U	0.050 U	--	--
Pentachlorophenol	0.050 U	--	--	0.050 U	0.050 U	--	--
Benzene	0.0010 U	--	--	0.013	--	--	--
Ethyl Benzene	0.0010 U	--	--	0.0010 U	--	--	--
Toluene	0.0010 U	--	--	0.0010 U	--	--	--
Xylenes	0.0010 U	--	--	0.0011	--	--	--
Arsenic	0.515	--	--	1.12	1.14	--	--
Arsenic, filtered	0.512	--	--	1.07	0.991	--	--
Iron, filtered	1.31	--	--	0.898	0.888	--	--
Manganese, filtered	0.114	--	--	0.0595	0.0588	--	--
Total Alkalinity as CaCO3	227	--	--	287	--	--	--
Total Dissolved Solids	274	263	--	413	--	399	--
Chloride	3.0	2.9	2.9	74.1	--	74.1	74.7
Cyanide, WAD	0.0050 U	--	--	0.0050 U	--	--	--
Sulfate	6.5	7.0	--	2.0 U	--	2.0 U	--
Sulfide, total	0.1 U	--	--	0.1 U	--	--	--
Thiocyanate	1 U	1 U	--	1 U	--	1 U	--
Ammonia Nitrogen	0.2 U	0.2 U	0.2 U	6.9	7.3	6.1	6.3
Nitrate	0.05 U	0.05 U	--	0.05 U	0.39	0.06	--
Nitrite	0.05 U	0.05 U	--	0.05 U	--	0.05 U	--
Phosphorus, total	0.94	--	--	0.35	0.39	--	--
Total Kjeldahl Nitrogen	1.4	--	--	8.3	6.5	--	--
Biochemical Oxygen Demand (5-day)	10 U	--	--	20 U	--	--	--
Chemical Oxygen Demand	20 U	--	--	40	20 U	--	--
Carbon, dissolved	38.8	--	--	44.0	--	--	--
Phenol, 4AAP	0.01 U	0.01 U	--	0.01 U	0.02	0.01 U	--
Carbon, total organic	7.4	--	--	4.1	3.0	--	--
Carbon, dissolved organic	4.0	--	--	3.5	--	--	--
Temperature, oC	15.1	--	--	12.7	--	--	--
Specific Conductance @25oC, umhos/cm	430	--	--	710	--	--	--
pH, standard units	7.81	--	--	7.85	--	--	--
Redox, mV	-211	--	--	-152	--	--	--
Dissolved Oxygen	0.47	--	--	1.02	--	--	--
Nitrite	0-1.25	--	--	3-15	--	--	--
Nitrate	0-2.5	--	--	10-15	--	--	--

-- Not analyzed.
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.
3, 012
05 18 98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6224			SB6230			
	09/13/97 Sample	09/13/97 Replicate A	09/13/97 Replicate B	09/13/97 Sample	09/13/97 Duplicate	09/13/97 Replicate A	09/13/97 Replicate B
Sample I.D.	SB-62W24	SB-62W24	SB-62W24	SB-62W30	SB-62W30	SB-62W30	SB-62W30
Soil Boring	62	62	62	62	62	62	62
Depth	24	24	24	30	30	30	30
Phenol	1.4	--	--	430	--	--	--
2-Chlorophenol	0.30 U	--	--	70 U	--	--	--
o-Cresol	1.1	--	--	43 j	--	--	--
m-Cresol	--	--	--	--	--	--	--
p-Cresol	2.2	--	--	170	--	--	--
2,4-Dimethylphenol	0.47	--	--	10 j	--	--	--
2-Nitrophenol	0.30 U	--	--	70 U	--	--	--
Benzoic Acid	1.5 U	--	--	350 U	--	--	--
2,4-Dichlorophenol	0.30 U	--	--	70 U	--	--	--
4-Chloro-3-methylphenol	0.30 U	--	--	70 U	--	--	--
2,4,6-Trichlorophenol	0.30 U	--	--	70 U	--	--	--
2,4,5-Trichlorophenol	1.5 U	--	--	350 U	--	--	--
2,4-Dinitrophenol	1.5 U	--	--	350 U	--	--	--
4-Nitrophenol	1.5 U	--	--	350 U	--	--	--
2-Methyl-4,6-dinitrophenol	1.5 U	--	--	350 U	--	--	--
Pentachlorophenol	1.5 U	--	--	350 U	--	--	--
Benzene	0.047	--	--	0.75	0.72	--	--
Ethyl Benzene	0.0010 U	--	--	0.025 U	0.050 U	--	--
Toluene	0.0010 U	--	--	0.025 U	0.050 U	--	--
Xylenes	0.0010 U	--	--	0.025 U	0.050 U	--	--
Arsenic	0.991	--	--	62.7	--	--	--
Arsenic, filtered	1.09	--	--	53.6	--	--	--
Iron, filtered	0.412	--	--	1.23	--	--	--
Manganese, filtered	0.0189	--	--	0.0161	--	--	--
Total Alkalinity as CaCO3	622	--	--	2840	--	--	--
Total Dissolved Solids	492	500	--	1980	--	2040	--
Chloride	446	459	459	3950	--	4000	4100
Cyanide, WAD	0.0094	--	--	0.428	--	--	--
Sulfate	2.0 U	2.0 U	--	630	--	627	--
Sulfide, total	0.2	--	--	11.1	--	--	--
Thiocyanate	1.14	2.81	--	679	--	804	--
Ammonia Nitrogen	253	236	177	903	996	1200	1270
Nitrate	0.05 U	0.06	--	0.05 U	--	0.05 U	--
Nitrite	0.05 U	0.05 U	--	0.05 U	--	0.05 U	--
Phosphorus, total	0.70	--	--	4.85	--	--	--
Total Kjeldahl Nitrogen	257	--	--	1480	--	--	--
Biochemical Oxygen Demand (5-day)	23	--	--	3600	--	--	--
Chemical Oxygen Demand	185	--	--	5980	--	--	--
Carbon, dissolved	116	--	--	1600	--	--	--
Phenol, 4AAP	5.04	5.42	--	1150	--	1130	--
Carbon, total organic	29.8	--	--	1710	--	--	--
Carbon, dissolved organic	19.2	--	--	1630	--	--	--
Temperature, oC	11.5	--	--	12.3	--	--	--
Specific Conductance (25c,umhos/cm	283	--	--	1531	--	--	--
pH, standard units	8.28	--	--	8.63	--	--	--
Redox, mV	-202	--	--	-278	--	--	--
Dissolved Oxygen	0	--	--	0.04	--	--	--
Nitrite	2-3	--	--	2-3	--	--	--
Nitrate	3-5	--	--	3-5	--	--	--

-- Not analyzed.
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.

3,.010
05/18/98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6306			SB6312		
	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B
Sample I.D.	SB-63W06	SB-63W06	SB-63W06	SB-63W12	SB-63W12	SB-63W12
Soil Boring	63	63	63	63	63	63
Depth	6	6	6	12	12	12
Phenol	0.056	--	--	0.17	--	--
2-Chlorophenol	0.010 U	--	--	0.030 U	--	--
o-Cresol	0.006 j	--	--	0.014 j	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	0.022	--	--	0.047	--	--
2,4-Dimethylphenol	0.001 j	--	--	0.030 U	--	--
2-Nitrophenol	0.010 U	--	--	0.030 U	--	--
Benzoic Acid	0.050 U	--	--	0.15 U	--	--
2,4-Dichlorophenol	0.010 U	--	--	0.030 U	--	--
4-Chloro-3-methylphenol	0.010 U	--	--	0.030 U	--	--
2,4,6-Trichlorophenol	0.010 U	--	--	0.030 U	--	--
2,4,5-Trichlorophenol	0.050 U	--	--	0.15 U	--	--
2,4-Dinitrophenol	0.050 U	--	--	0.15 U	--	--
4-Nitrophenol	0.050 U	--	--	0.15 U	--	--
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	0.15 U	--	--
Pentachlorophenol	0.050 U	--	--	0.15 U	--	--
Benzene	0.0010 U	--	--	0.0014	--	--
Ethyl Benzene	0.0010 U	--	--	0.0010 U	--	--
Toluene	0.0010 U	--	--	0.0010 U	--	--
Xylenes	0.0010 U	--	--	0.0010 U	--	--
Arsenic	0.0120	--	--	0.477	--	--
Arsenic, filtered	0.0078	--	--	0.498	--	--
Iron, filtered	0.343	--	--	1.33	--	--
Manganese, filtered	0.331	--	--	0.106	--	--
Total Alkalinity as CaCO3	203	--	--	221	--	--
Total Dissolved Solids	251	236	--	260	264	--
Chloride	11.8	12.6	12.0	2.5	2.5	2.4
Cyanide, WAD	0.0050	--	--	0.0050 U	--	--
Sulfate	6.3	5.2	--	4.8	6.5	--
Sulfide, total	0.1 U	--	--	0.1 U	--	--
Thiocyanate	1.48	1.64	--	1.31	1.48	--
Ammonia Nitrogen	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.4
Nitrate	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Phosphorus, total	0.15	--	--	0.92	--	--
Total Kjeldahl Nitrogen	0.6	--	--	1.8	--	--
Biochemical Oxygen Demand (5-day)	10 U	--	--	10 U	--	--
Chemical Oxygen Demand	20 U	--	--	20 U	--	--
Carbon, dissolved	37.2	--	--	33.4	--	--
Phenol, 4AAP	0.04	0.15	--	0.08	0.09	--
Carbon, total organic	3.1	--	--	4.0	--	--
Carbon, dissolved organic	2.9	--	--	2.0	--	--
Temperature, oC	19.3	--	--	16.2	--	--
Specific Conductance @25oC,umhos/cm	430	--	--	423	--	--
pH, standard units	7.47	--	--	7.70	--	--
Redox, mV	-173	--	--	-205	--	--
Dissolved Oxygen	0.12	--	--	0.05	--	--
Nitrite	7-10	--	--	2-4	--	--
Nitrate	20-25	--	--	5-10	--	--

-- Not analyzed.
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.

B,.010
05-18-98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6318			SB6324		
	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B
Sample I.D.	SB-63W18	SB-63W18	SB-63W18	SB-63W24	SB-63W24	SB-63W24
Soil Boring	63	63	63	63	63	63
Depth	18	18	18	24	24	24
Phenol	0.082	--	--	0.051	--	--
2-Chlorophenol	0.020 U	--	--	0.0010 U	--	--
o-Cresol	0.008 j	--	--	0.004 j	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	0.023	--	--	0.014	--	--
2,4-Dimethylphenol	0.020 U	--	--	0.010 U	--	--
2-Nitrophenol	0.020 U	--	--	0.010 U	--	--
Benzoic Acid	0.10 U	--	--	0.050 U	--	--
2,4-Dichlorophenol	0.020 U	--	--	0.010 U	--	--
4-Chloro-3-methylphenol	0.020 U	--	--	0.010 U	--	--
2,4,6-Trichlorophenol	0.020 U	--	--	0.010 U	--	--
2,4,5-Trichlorophenol	0.10 U	--	--	0.050 U	--	--
2,4-Dinitrophenol	0.10 U	--	--	0.050 U	--	--
4-Nitrophenol	0.10 U	--	--	0.050 U	--	--
2-Methyl-4,6-dinitrophenol	0.10 U	--	--	0.050 U	--	--
Pentachlorophenol	0.10 U	--	--	0.050 U	--	--
Benzene	0.0010 U	--	--	0.022	--	--
Ethyl Benzene	0.0010 U	--	--	0.0010 U	--	--
Toluene	0.0010 U	--	--	0.0010 U	--	--
Xylenes	0.0016	--	--	0.0010 U	--	--
Arsenic	0.393	--	--	0.782	--	--
Arsenic, filtered	0.377	--	--	0.762	--	--
Iron, filtered	1.53	--	--	1.70	--	--
Manganese, filtered	0.0979	--	--	0.0658	--	--
Total Alkalinity as CaCO3	231	--	--	293	--	--
Total Dissolved Solids	297	263	--	399	428	--
Chloride	2.8	2.7	2.9	85.0	83.9	84.5
Cyanide, WAD	0.0058	--	--	0.0064	--	--
Sulfate	2.0 U	2.0 U	--	2.0 U	2.0 U	--
Sulfide, total	0.1 U	--	--	0.2	--	--
Thiocyanate	1.64	1 U	--	1.64	1.31	--
Ammonia Nitrogen	0.9	0.4	0.2 U	9.9	9.5	10.8
Nitrate	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Phosphorus, total	0.37	--	--	1.19	--	--
Total Kjeldahl Nitrogen	2.2	--	--	13.5	--	--
Biochemical Oxygen Demand (5-day)	10 U	--	--	10 U	--	--
Chemical Oxygen Demand	20 U	--	--	44	--	--
Carbon, dissolved	40.0	--	--	47.2	--	--
Phenol, 4AAP	0.20	0.28	--	0.01 U	0.06	--
Carbon, total organic	9.4	--	--	9.5	--	--
Carbon, dissolved organic	3.9	--	--	2.4	--	--
Temperature, oC	16.4	--	--	12.7	--	--
Specific Conductance (25oC,umhos/cm)	130	--	--	721	--	--
pH, standard units	7.88	--	--	7.66	--	--
Redox, mV	-144	--	--	-185	--	--
Dissolved Oxygen	[illegible]	--	--	0.01	--	--
Nitrite	0-1.25	--	--	0-1.25	--	--
Nitrate	0-2.5	--	--	0-2.5	--	--

-- Not analyzed.
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.

[illegible]
05/28/98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6330			SB6406		
	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B	09/11/97 Sample	09/11/97 Replicate A	09/11/97 Replicate B
Sample I.D.	SB-63W30	SB-63W30	SB-63W30	SB-64W06	SB-64W06	--
Soil Boring	63	63	63	64	64	--
Depth	30	30	30	6	6	--
Phenol	490	--	--	0.010 U	--	--
2-Chlorophenol	90 U	--	--	0.010 U	--	--
o-Cresol	50 j	--	--	0.010 U	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	200	--	--	0.010 U	--	--
2,4-Dimethylphenol	11 j	--	--	0.010 U	--	--
2-Nitrophenol	90 U	--	--	0.010 U	--	--
Benzoic Acid	450 U	--	--	0.005 j	--	--
2,4-Dichlorophenol	90 U	--	--	0.010 U	--	--
4-Chloro-3-methylphenol	90 U	--	--	0.010 U	--	--
2,4,6-Trichlorophenol	90 U	--	--	0.010 U	--	--
2,4,5-Trichlorophenol	450 U	--	--	0.050 U	--	--
2,4-Dinitrophenol	450 U	--	--	0.050 U	--	--
4-Nitrophenol	450 U	--	--	0.050 U	--	--
2-Methyl-4,6-dinitrophenol	450 U	--	--	0.050 U	--	--
Pentachlorophenol	450 U	--	--	0.050 U	--	--
Benzene	0.68	--	--	0.0010 U	--	--
Ethyl Benzene	0.050 U	--	--	0.0010 U	--	--
Toluene	0.050 U	--	--	0.0010 U	--	--
Xylenes	0.050 U	--	--	0.0010 U	--	--
Arsenic	50.8	--	--	0.0050 U	--	--
Arsenic, filtered	49.4	--	--	0.0050 U	--	--
Iron, filtered	1.04	--	--	0.100 U	--	--
Manganese, filtered	0.0242	--	--	0.0474	--	--
Total Alkalinity as CaCO3	2670	--	--	185	185	--
Total Dissolved Solids	1590	1610	--	230	243	--
Chloride	3340	2890	3190	7.0	6.7	6.5
Cyanide, WAD	0.243	--	--	0.0050 U	0.0050 U	--
Sulfate	588	562	--	37.0	34.5	--
Sulfide, total	6.7	--	--	0.1 U	0.1 U	--
Thiocyanate	581	621	--	1 U	1 U	--
Ammonia Nitrogen	979	1190	1010	0.2 U	0.2 U	0.2 U
Nitrate	0.05 U	0.05 U	--	0.84	0.82	--
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Phosphorus, total	5.17	--	--	0.08	0.08	--
Total Kjeldahl Nitrogen	1850	--	--	0.6	0.6	--
Biochemical Oxygen Demand (5-day)	2500	--	--	20 U	20 U	--
Chemical Oxygen Demand	5380	--	--	20 U	20 U	--
Carbon, dissolved	1500	--	--	17.9	17.9	--
Phenol, 4AAP	900	918	--	0.29	0.01	--
Carbon, total organic	1300	--	--	2.8	2.6	--
Carbon, dissolved organic	1250	--	--	2.0	2.0	--
Temperature, oC	11.4	--	--	18.9	--	--
Specific Conductance @25oC,umhos/cm	1400	--	--	30	--	--
pH, standard units	8.58	--	--	7.43	--	--
Redox, mV	-298	--	--	10	--	--
Dissolved Oxygen	0.04	--	--	5.77	--	--
Nitrite	0-1.25	--	--	10-15	--	--
Nitrate	0-2.5	--	--	20-30	--	--

-- Not analyzed.
j Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.

3,.110
05 18 98

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6412			SB6418		
	09/11/97 Sample	09/11/97 Replicate A	09/11/97 Replicate B	09/11/97 Sample	09/11/97 Replicate A	09/11/97 Replicate B
Sample I.D.	SB-64W12	SB-64W12	SB-64W12	SB-64W18	SB-64W18	SB-64W18
Soil Boring	64	64	64	64	64	64
Depth	12	12	12	18	18	18
Phenol	0.010 U	--	--	0.010 U	--	--
2-Chlorophenol	0.010 U	--	--	0.010 U	--	--
o-Cresol	0.010 U	--	--	0.010 U	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	0.010 U	--	--	0.010 U	--	--
2,4-Dimethylphenol	0.010 U	--	--	0.010 U	--	--
2-Nitrophenol	0.010 U	--	--	0.010 U	--	--
Benzoic Acid	0.006 J	--	--	0.15 e	--	--
2,4-Dichlorophenol	0.010 U	--	--	0.010 U	--	--
4-Chloro-3-methylphenol	0.010 U	--	--	0.010 U	--	--
2,4,6-Trichlorophenol	0.010 U	--	--	0.010 U	--	--
2,4,5-Trichlorophenol	0.050 U	--	--	0.050 U	--	--
2,4-Dinitrophenol	0.050 U	--	--	0.050 U	--	--
4-Nitrophenol	0.050 U	--	--	0.050 U	--	--
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	0.050 U	--	--
Pentachlorophenol	0.050 U	--	--	0.050 U	--	--
Benzene	0.0010 U	--	--	0.0010 U	--	--
Ethyl Benzene	0.0010 U	--	--	0.0010 U	--	--
Toluene	0.0010 U	--	--	0.0010 U	--	--
Xylenes	0.0010 U	--	--	0.0010 U	--	--
Arsenic	0.0378	--	--	0.0403	--	--
Arsenic, filtered	0.0348	--	--	0.0478	--	--
Iron, filtered	0.461	--	--	1.29	--	--
Manganese, filtered	0.0533	--	--	0.0807	--	--
Total Alkalinity as CaCO3	128	--	--	201	--	--
Total Dissolved Solids	180	173	--	245	239	--
Chloride	7.3	7.2	--	4.0	3.3	3.9
Cyanide, WAD	0.0050 U	--	--	0.0050 U	0.0050 U	--
Sulfate	31.6	31.8	--	12.8	2.8	--
Sulfide, total	0.1 U	--	--	0.1 U	0.1 U	--
Thiocyanate	1 U	1 U	--	1 U	1 U	--
Ammonia Nitrogen	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U
Nitrate	0.05 U	0.05 U	--	0.05	0.05 U	--
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Phosphorus, total	0.52	--	--	0.37	0.37	--
Total Kjeldahl Nitrogen	0.1 U	--	--	0.9	0.9	--
Biochemical Oxygen Demand (5-day)	20 U	--	--	20 U	20 U	--
Chemical Oxygen Demand	20 U	--	--	20 U	20 U	--
Carbon, dissolved	4.9	--	--	15.4	15.4	--
Phenol, 4AAP	0.36	0.91	--	0.01 U	0.02	--
Carbon, total organic	1.9	--	--	3.2	3.2	--
Carbon, dissolved organic	1.2	--	--	3.0	3.0	--
Temperature, oC	17.4	--	--	15.9	--	--
Specific Conductance @ 25c, umhos/cm	--	--	--	40	--	--
pH, standard units	7.85	--	--	7.84	--	--
Redox, mV	-102	--	--	-166	--	--
Dissolved Oxygen	2.1[illegible]	--	--	2.36	--	--
Nitrite	10-15	--	--	2-4	--	--
Nitrate	15-2[illegible]	--	--	2.5-5	--	--

-- Not analyzed.
e Estimated value, exceeded the instrument calibration range.
J Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.
[illegible]

TABLE 2-3 (cont.)

1997 BEACH TRANSECT SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	SB6424			SB6430		
	09/11/97 Sample	09/11/97 Replicate A	09/11/97 Replicate B	09/12/97 Sample	09/12/97 Replicate A	09/12/97 Replicate B
Sample I.D.	SB-64W24	SB-64W24	SB-64W24	SB-64W30	SB-64W30	SB-64W30
Soil Boring	64	64	64	64	64	64
Depth	24	24	24	30	30	30
Phenol	0.010 U	--	--	140	--	--
2-Chlorophenol	0.010 U	--	--	30 U	--	--
o-Cresol	0.010 U	--	--	15 J	--	--
m-Cresol	--	--	--	--	--	--
p-Cresol	0.010 U	--	--	55	--	--
2,4-Dimethylphenol	0.010 U	--	--	30 U	--	--
2-Nitrophenol	0.010 U	--	--	30 U	--	--
Benzoic Acid	0.076	--	--	150 U	--	--
2,4-Dichlorophenol	0.010 U	--	--	30 U	--	--
4-Chloro-3-methylphenol	0.010 U	--	--	30 U	--	--
2,4,6-Trichlorophenol	0.010 U	--	--	30 U	--	--
2,4,5-Trichlorophenol	0.050 U	--	--	150 U	--	--
2,4-Dinitrophenol	0.050 U	--	--	150 U	--	--
4-Nitrophenol	0.050 U	--	--	150 U	--	--
2-Methyl-4,6-dinitrophenol	0.050 U	--	--	150 U	--	--
Pentachlorophenol	0.050 U	--	--	150 U	--	--
Benzene	0.0010 U	--	--	0.23	--	--
Ethyl Benzene	0.0010 U	--	--	0.010 U	--	--
Toluene	0.0010 U	--	--	0.010 U	--	--
Xylenes	0.0010 U	--	--	0.013	--	--
Arsenic	0.0971	--	--	12.0	--	--
Arsenic, filtered	0.0818	--	--	12.9	--	--
Iron, filtered	1.15	--	--	0.860	--	--
Manganese, filtered	0.0402	--	--	0.128	--	--
Total Alkalinity as CaCO3	323	--	--	1970	--	--
Total Dissolved Solids	380	370	--	629	595	--
Chloride	118	112	110	936	840	1050
Cyanide, WAD	0.0090	--	--	0.145	--	--
Sulfate	2.0 U	2.0 U	--	194	152	--
Sulfide, total	0.2	--	--	4.2	--	--
Thiocyanate	1 U	1 U	--	161	171	--
Ammonia Nitrogen	27.7	28.7	27.5	491	532	569
Nitrate	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Nitrite	0.05 U	0.05 U	--	0.05 U	0.05 U	--
Phosphorus, total	0.71	--	--	5.39	--	--
Total Kjeldahl Nitrogen	36.3	--	--	654	--	--
Biochemical Oxygen Demand (5-day)	20 U	--	--	800	--	--
Chemical Oxygen Demand	48	--	--	1390	--	--
Carbon, dissolved	34.2	--	--	445	--	--
Phenol, 4AAP	0.14	0.10	--	246	265	--
Carbon, total organic	4.2	--	--	362	--	--
Carbon, dissolved organic	3.4	--	--	356	--	--
Temperature, oC	14	--	--	12.9	--	--
Specific Conductance @ 25o,umhos/cm	70	--	--	619	--	--
pH, standard units	7.80	--	--	8.14	--	--
Redox, mV	-148	--	--	-296	--	--
Dissolved Oxygen	0.06	--	--	0.05	--	--
Nitrite	0-1.25	--	--	2-5	--	--
Nitrate	0-2.5	--	--	5-10	--	--

-- Not analyzed.
J Reported value is less than the stated laboratory quantitation limit and is considered an estimated value.
U Not detected.

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TABLE 2-4

1997 BEACH TRANSECT SAMPLES
SOIL DATA

(concentrations in mg/kg)

	SB6402	SB6404	SB6410	SB6416	SB6422	SB6428
	09/12/97	09/12/97	09/11/97	09/11/97	09/11/97	09/11/97
Sample I.D.	SB64(0-2')	SB64(2-4')	SB64(8-10'	SB6414-16'	SB6420-22'	SB6426-28'
Soil Boring	64	64	64	64	64	64
Depth	0-2'	2-4'	8-10'	14-16'	20-22'	26-28'
Carbon, total organic	138	136	164	576	855	532

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Table 2-5

Comparison of Coal Coking and Coal Conversion Effluents

Parameter	Coke Plant Ammonia Still Effluent	Coke Plant Waste Ammonia Liquor[a]	Synthane Process By-Product Water[b]	Hygas Process Wastewater[c]	H-coal Liquefaction Foul Water[d]
COD (mg/L)	3,400–5,700	2,500–10,000	15,000–43,000	3,000–5,100	88,000 (26,500)
Phenol (mg/L)	620–1,150	400–3,000	1,700–6,600	560–900	-6,800
NH_3-N (mg/L)	22–100	1,800–6,500	7,200–11,000	2,600–4,600	17,000
NO_3^--N (mg/L)	<0.2	—	—	1–5	<1
Kjeldahl-N (mg/L)	21–27	—	—	4–10	50
P (mg/L)	0.9	<1	—	0.5–1.8	—
CN^- (mg/L)	1.6–6	10–100	0.1–0.6	0.1–0.7	—
SCN^- (mg/L)	230–590	100–1,500	22–200	17–45	—
S^{2-} (mg/L)	8	200–500	—	60–220	29,000
SO^{2-}_4 (mg/L)	325–350	—	—	60–180	—
Alkalinity (mg/L as $CaCO_3$)	525–920	2,800–4,300[e]	10,000–20,000	9,800–15,000	—
Conductivity (μmho/cm)	3,500–6,000	—	—	30,000	—
pH (units)	9.3–9.8	7.5–9.1	8.5–9.3	7.8–8.0	9.5

[a] Data sources: Rubin and McMichael (1975); Wong-Chong et al. (1978); Kostenbader and Flecksteiner (1969); Effluent Guidelines (1974a).

[b] Johnson et al. (1977).

[c] Luthy and Tallon (1978). Hygas wastewater was comprised of equal volumes of cyclone and quench effluents.

[d] Reap et al. (1977). Stripped foul water with sulfide removed had an average COD of 26,500 mg/liter.

[e] Calculated from data of Jablin and Chanko(1972).

Source: Luthy and Walters, 1979

Table 2-6

Average Concentration of Constituents in Liquid Streams at a By-Product Coke Plant

Source	Flow (mgd)	Phenols (mg/L)	Cyanides as CN (mg/L)	Thiocyanates as NH_4SCN (mg/L)	Ammonia as N		Thiosulfates as S (mg/L)	Sulfides as H_2S (mg/L)
					Free (mg/L)	Fixed (mg/L)		
Intake Water		<0.015	<0.1	NA	5.3	0.2	<0.36	0.23
Phenol Removal Plant—Influent (weak ammonia liquor)	0.117	545	37.5	680	3,059	68.1	357	45.0
Phenol Removal Plant—Effluent or Ammonia Still—Influent (dephenolized weak ammonia liquor)	0.097	67.1	30.0	666	2,976	44.8	343	17.7
Ammonia Still—Effluent	0.146	39.3	15.3	462	60.3	14.2	198	29.3
Intercepting Sumps								
Main Sump	0.50	9.2	3.0	1.05	7.5	0.35	3.7	1.5
Wash Oil Cooler Sump	2.5	<0.05	<0.1	NA	5.2	0.17	<0.18	<0.04
Quench Water								
Old Station	1.36	0.38	<0.1	NA	4.35	0.05	<0.16	<0.04
New Station	1.07	0.10	<0.1	NA	3.20	0.04	<0.16	0.23

NA = Not Determined

Source: Monroe, 1974

TABLE 2-7

1996 SURFACE WATER SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	H1		L1		L2	
	07/19/96	08/21/96	07/19/96	08/21/96	07/19/96	08/21/96
Specific Gravity @4oC	1.0004	--	1.0010	--	1.0009	--
Cyanide, WAD	0.005 U	--	0.005 U	--	0.005 U	--
Ammonia Nitrogen	0.2 U	--	0.2 U	--	0.2 U	--
Ammonia Nitrogen, low level	0.097	0.086	0.076	--	0.093	--
Phenol, 4AAP	0.23	0.01 U	0.37	0.01 U	0.09	0.01 U
Phenol, 4AAP, low level	--	0.001 U	--	0.001 U	--	0.001 U
Arsenic, total	0.002 U	--	0.002 U	--	0.002 U	--
Benzene	0.001 U	--	0.001 U	--	0.001 U	--
Phenol	--	0.006 U	--	0.006 U	--	0.006 U
2-Chlorophenol	--	0.006 U	--	0.006 U	--	0.006 U
o-Cresol	--	0.006 U	--	0.006 U	--	0.006 U
p-Cresol	--	0.006 U	--	0.006 U	--	0.006 U
2,4-Dimethylphenol	--	0.006 U	--	0.006 U	--	0.006 U
2-Nitrophenol	--	0.006 U	--	0.006 U	--	0.006 U
Benzoic Acid	--	0.029 U	--	0.029 U	--	0.029 U
2,4-Dichlorophenol	--	0.006 U	--	0.006 U	--	0.006 U
4-Chloro-3-methylphenol	--	0.006 U	--	0.006 U	--	0.006 U
2,4,6-Trichlorophenol	--	0.006 U	--	0.006 U	--	0.006 U
2,4,5-Trichlorophenol	--	0.006 U	--	0.006 U	--	0.006 U
2,4-Dinitrophenol	--	0.029 U	--	0.029 U	--	0.029 U
4-Nitrophenol	--	0.029 U	--	0.029 U	--	0.029 U
2-Methyl-4,6-dinitrophenol	--	0.029 U	--	0.029 U	--	0.029 U
Pentachlorophenol	--	0.006 U	--	0.006 U	--	0.006 U

	L3		COMPOSITE (1)
	07/19/96	08/21/96	08/21/96
Specific Gravity @4oC	1.0007	--	--
Cyanide, WAD	0.005 U	--	--
Ammonia Nitrogen	0.2 U	--	--
Ammonia Nitrogen, low level	0.080	--	0.094
Phenol, 4AAP	0.02	0.01 U	--
Phenol, 4AAP, low level	--	0.001 U	--
Arsenic, total	0.002 U	--	--
Benzene	0.001 U	--	--
Phenol	--	0.006 U	--
2-Chlorophenol	--	0.006 U	--
o-Cresol	--	0.006 U	--
p-Cresol	--	0.006 U	--
2,4-Dimethylphenol	--	0.006 U	--
2-Nitrophenol	--	0.006 U	--
Benzoic Acid	--	0.029 U	--
2,4-Dichlorophenol	--	0.006 U	--
4-Chloro-3-methylphenol	--	0.006 U	--
2,4,6-Trichlorophenol	--	0.006 U	--
2,4,5-Trichlorophenol	--	0.006 U	--
2,4-Dinitrophenol	--	0.029 U	--
4-Nitrophenol	--	0.029 U	--
2-Methyl-4,6-dinitrophenol	--	0.029 U	--
Pentachlorophenol	--	0.006 U	--

-- Not analyzed.

U Not detected

(1) Composite sample consists of remaining volume from H1, L1, L2, and L3

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TABLE 2-7 (cont.)

1996 SURFACE WATER SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	H1	L1	L2	L3
	07/19/96	07/19/96	07/19/96	07/19/96
Temperature, oC	8.2	11.5	11.7	11.5
Specific Conductance @25oC,umhos/cm	286	228	290	300
Redox, mV	143	111	131	128
pH, standard units	7.97	7.80	8.04	8.01
Dissolved Oxygen, mg/L	11.30	11.50	11.80	11.11
Nitrite	--	--	--	--
Nitrate	--	--	--	--
Iron, Ferrous	--	--	--	--

-- Not analyzed.

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TABLE 2-8

1997 SURFACE WATER SAMPLES
WATER QUALITY DATA

(concentrations in mg/L, unless noted otherwise)

	H-1	LM-1N	LM-2N	LM-3N	LM-4N	LM-5N	LM-6N	LM-1S
	09/14/97	09/14/97	09/14/97	09/14/97	09/14/97	09/14/97	09/14/97	09/14/9
Phenol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020
o-Cresol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020
m-Cresol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020
p-Cresol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020
2,4-Dimethylphenol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020
Phenol, 4AAP	0.01 U	0.01 U	0.01 U	0.06	0.45	0.01 U	0.50	0.20
Benzene	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010
Total Dissolved Solids	173	170	180	175	167	161	177	173
Chloride	11.1	11.2	11.0	11.0	11.1	10.9	10.8	11.0
Sulfate	21.8	32.6	24.0	22.8	21.9	22.0	20.1	22.7
Ammonia Nitrogen	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Temperature, oC	21.4	20.4	19.7	19.7	20.0	20.6	19.8	20.5
Specific Conductance @25oC,umhos/cm	287	286	285	285	285	284	283	286
pH, standard units	8.08	8.04	8.07	8.13	8.16	8.12	8.17	8.22
Redox, mV	62	32	34	46	58	66	67	68
Dissolved Oxygen	8.7	8.64	8.07	8.74	8.72	8.75	8.66	9.84

	LM-2S	LCZ-H1	LCZ-2N	LCZ-3N	LCZ-5N	LCZ-6N	LCZ-2S
	09/14/97	09/14/97	09/14/97	09/14/97	09/14/97	09/14/97	09/14/97
Phenol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
o-Cresol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
m-Cresol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
p-Cresol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
2,4-Dimethylphenol	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U	0.0020 U
Phenol, 4AAP	0.31	0.23	0.01 U	0.01 U	0.13	0.10	0.04
Benzene	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U	0.0010 U
Total Dissolved Solids	165	176	192	169	164	168	194
Chloride	11.3	10.8	10.9	10.8	10.7	18.8	10.8
Sulfate	23.7	47.0	23.6	21.0	22.5	25.7	22.9
Ammonia Nitrogen	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U
Temperature, oC	21.5	20.6	20.5	20.5	22.4	21.3	20.6
Specific Conductance @25oC,umhos/cm	286	284	285	285	286	285	282
pH, standard units	8.19	8.22	8.09	8.17	8.11	8.16	8.14
Redox, mV	83	88	68	77	112	99	77
Dissolved Oxygen	8.63	8.79	7.86	7.87	7.51	7.92	9.21

U Not detected.

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Table 2-9

Computed Surface Water Quality (Assuming Maximum Projected Groundwater Loading)

	Mixing Ratio	Surface Water Concentration[1] Arsenic (μg/L)	Phenols (μg/L)	Ammonia (μg/L)
Lake Michigan Basin Water Quality Standards		**148 chronic 340 acute**	**100**	**15,000[2]**
Waukegan Harbor, Calculated Water Quality	High (6,200:1)	0.20	4.5	30
	Average (1,600:1)	0.79	18	110
	Low (800:1)	1.6	36	220
Breakwater Area, Calculated Water Quality	High (32,000:1)	0.14	0.61	4.2
	Average (7,600:1)	0.58	2.6	18
	Low (1,600:1)	2.8	13	88
Lake Michigan Open Waters Water Quality Standards		**50**	**1**	**20**
Lake Michigan East of Site, Calculated Water Quality	High (22,000:1)	0.23	3.1	8.4
	Average (12,000:1)	0.44	5.9	16
	Low (2,900:1)	1.7	23	64
Longshore Current Zone, Calculated Water Quality	High (90,000:1)	0.032	0.40	1.5
	Average (50,000:1)	0.062	0.77	2.9
	Low (9,000:1)	0.34	4.2	16
National Ambient Water Quality Criteria for the Protection of Aquatic Life	—	**190 chronic**	**117 chronic**	**1,490 chronic**
		360 acute	**2,010 acute**	**2,600 acute**

[1] The computed surface water concentrations are highly conservative because, in addition to using the peak groundwater mass flux, they do not account for natural attenuation mechanisms that remove mass, such as anaerobic biodegradation, aerobic biodegradation, adsorption, and chemical changes.

[2] In addition, un-ionized ammonia nitrogen must meet the following acute and chronic standards: April through October, acute 330 μg/L, chronic 57 μg/L; November through March, acute 140 μg/L, chronic 25 μg/L.

Table 3-1

Potential Chemical-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Regulation	Requirement	ARAR Status	Analysis
Soil and Groundwater			
35 Illinois Administrative Code, Part 742, Tiered Approach to Corrective Action Objectives (TACO)	TACO establishes a framework for determining soil cleanup standards, for developing groundwater quality objectives, and for establishing institutional controls.	To be considered	Provides guidance for development of site-specific soil and groundwater remediation objectives.
TSCA	Establishes requirements and thresholds for management of PCBs.	Relevant and appropriate	TSCA is relevant and appropriate to defining the management of PCBs in soils
CERCLA Guidance Land Use in the CERCLA Remedy Selection Process	Establishes appropriate considerations in defining future land use.	To be considered.	Provides guidance to EPA in selecting land use for remedy selection purposes
Groundwater			
Safe Drinking Water Act (SDWA)— Maximum Contaminant Levels (MCLs) 40 CFR 141 61 (organic chemicals) 40 CFR 141 62 (inorganic chemicals)	CERCLA 121(d) states that a remedial action will attain a level under the SDWA. MCLs are enforceable maximum permissible level of a contaminant which is delivered to any user of a public water system.	Relevant and appropriate.	MCLs are relevant and appropriate for potential drinking water sources by EPA policy (see NCP). Remedies may not have to demonstrate compliance with an ARAR that is technically impracticable (see NCP)
SDWA—Maximum Contaminant Level Goals (MCLGs) 40 CFR 141 50 (organic chemicals) 40 CFR 141 51 (inorganic chemicals)	CERCLA 121(d)(2)(A) states that a remedial action attain MCLGs where relevant and appropriate. MCLGs are non-enforceable health goals under the SDWA.	Relevant and appropriate.	Non zero MCLGs may be relevant and appropriate. MCLGs equal to zero are not appropriate for cleanup of groundwater or surface water at CERCLA sites by EPA policy (see NCP).
SDWA—Secondary MCLs (SMCLs) 40 CFR 143	Non-enforceable limits intended as guidelines for use by states in regulating water supplies	To be considered	SMCLs may be considered if drinking water use of aquifer is considered feasible
Office of Drinking Water. Drinking water health advisories	Guidance levels for drinking water issued by Office of Drinking Water	To be considered	May be used for chemicals without MCLs if groundwater is to meet drinking water quality.

Table 3-1 (continued)

Potential Chemical-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Regulation	Requirement	ARAR Status	Analysis
Illinois Water Quality Standards (IWQS) 35 Illinois Administrative Code 620	Groundwater must meet the standards appropriate to the groundwater's class as specified in Subpart D/Section 620.401-440.	See specific category	See specific category
IWQS Class I Potable Resource Groundwater (Section 620 210, 620 410)	Standards for potential potable water supply.	Relevant and appropriate.	Relevant and appropriate if groundwater were designated for potable water use Not applicable to groundwater 10 feet or less from ground surface.
IWQS Class II: General Resource Groundwater (Section 620 220, 620 420)	Applicable to groundwater compatible with agricultural, industrial, recreational, or beneficial uses and not in Classes I, III, or IV.	Relevant and appropriate.	Relevant and appropriate to groundwater 10 feet or less from ground surface, or if groundwater is not designated for potable use
Class III. Special Resource Groundwater (Section 620 230; 620 430)	Applicable to groundwater determined by Pollution Control Board as demonstrably unique and suitable for more stringent standard than otherwise applicable, vital for sensitive ecosystem; discharge to dedicated nature preserve.	Not an ARAR	Groundwater is not demonstrably unique nor does it discharge to dedicated nature preserve.
Class IV: Other Groundwater (Section 620 240, 620 440)	Other groundwater includes: groundwater which underlies potential primary or secondary source, groundwater underlying various coal mining and processing areas, and groundwater within previously mined areas.	Not an ARAR	Site was not a coal mining and processing area contemplated under this class
Alternative Groundwater Quality Standards Groundwater Quality Restoration Standards (Section 620 450(a))	Applies to groundwater within a groundwater management zone. May allow concentrations higher than designated use after remediation.	Relevant and appropriate.	May be relevant and appropriate where institutional controls prohibit use of groundwater.
Guidance for Evaluating the Technical Impracticability of Ground Water Restoration, OSWER Directive No 9234 2 25, dated September 1993	Applies to groundwater at contaminated sites. Establishes criteria for assessing the technical impracticability of groundwater remediation.	To be considered.	Conditions at the site make groundwater restoration technically impracticable

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Table 3-1 (continued)

Potential Chemical-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Regulation	Requirement	ARAR Status	Analysis
Surface Water			
Illinois Water Quality Standards Illinois Administrative Code, Title 35, Subtitle C, Chapter 1, Parts 302 and 303	Section 11 of Environmental Protection Act - regulation to restore, maintain, and enhance purity of the water of the state.	See specific category	See specific category.
Part 302, General Use - Subpart B Sections 302 201-212	Waters of state for which there is no specific designation • acute standards apply within mixing zone • chronic apply after mixing zone	Relevant and appropriate	For Illinois surface waters
Part 302, Public and food processing water supply—Subpart C, Sections 302 301-305	Applies to waters of state designated for waters drawn for treatment and distribution as a potable supply or food processing at the point of withdrawal.	Relevant and appropriate	For Lake Michigan at point of water withdrawal
Part 302, Secondary Contact and Indigenous Aquatic Life Standards. Subpart D, Sections 302 401-410	Applicable to waters designated in 35 Ill. Adm. Code 303 204 and 303 441.	Not an ARAR	Does not apply to Lake Michigan
Part 302, Subpart E - Lake Michigan Water Quality Standards. Section 302 501-509	Applicable to waters of Lake Michigan and the Lake Michigan Basin.	Relevant and appropriate	Subpart E is for Lake Michigan
Part 303, Subpart C: Specific Use Designations and Site Specific Water Quality Standards, Section 303 443	Defines standards for "open waters" and "other waters" of the Lake Michigan Basin.	Relevant and appropriate	Lake Michigan Basin standards are relevant and appropriate to the harbor and lake adjacent to the site.
Federal Ambient Water Quality Criteria (FWQC) established under Section 303 and 304 of Clean Water Act	Protection of human health from consumption of fish and water, consumption of fish.	Not appropriate	Relevant but not appropriate. Not applicable because State water standards available.
	Protection of aquatic life	Not an ARAR	Relevant but not appropriate. Not applicable because State water quality standards available
Great Lakes Water Quality Agreement of 1978 (amended by protocol)	Establishes levels of protectiveness for Great Lakes water quality in executive agreement with Canada	Not an ARAR	GLWQA not enforceable under U S law

Table 3-1 (continued)

Potential Chemical-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Regulation	Requirement	ARAR Status	Analysis
Great Lakes Initiative, Clean Water Act 33 U S C §§1251-1387 at 33 U S C 1268, as amended by the Great Lakes Critical Programs Act (Public Law 101 546)	GLI establishes water quality standards, antidegradation policies, and implementation procedures with which state standards must comply for waters in the Great Lakes System	Relevant and appropriate	GLI establishes the basis for Illinois State Standards for Lake Michigan water quality

Table 3-2

Potential Location-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Location-Specific Concern	Requirement	Prerequisite	Citation	ARAR Status	Analysis
Wetland	Action to prohibit discharge of dredged or fill material into wetlands without permit.	Wetlands as defined in U.S. Army Corps of Engineers regulations.	Clean Water Act section 404; 40 CFR Parts 230, 33 CFR Parts 320-330.	Potential ARAR	May apply to actions within public beach.
	Action to avoid adverse effects, minimize potential harm, and preserve and enhance wetlands, to the extent possible.	Action involving construction of facilities or management of property in wetlands, as defined by 40 CFR Part 6, Appendix A, section 4(j)	Executive Order 11990, Protection of Wetlands, 40 CFR Part 6, Appendix A	Potential ARAR	May apply to actions within public beach
Wilderness area	Area must be administered in such manner as will leave it unimpaired as wilderness and to preserve its wilderness.	Federally owned area designed as wilderness area.	Wilderness Act (16 USC 1131 *et seq.*); 50 CFR 35.1 *et seq.*	Not an ARAR	Site not designated as a National Wildlife Refuge.
Wildlife refuge	Only actions allowed under the provisions of 16 USC Section 668 dd may be undertaken in areas that are part of the National Wildlife Refuge System.	Area designated as part of National Wildlife Refuge System.	16 USC 668dd *et seq.*; 50 CFR Part 27	Not an ARAR	Site not designated as a federal wilderness area.
Area affecting stream or river	Action to protect fish or wildlife.	Diversion, channeling or other activity that modifies a stream or river and affects fish or wildlife.	Fish and Wildlife Coordination Act (16 USC 661 *et seq.*); 40 CFR 6.302	Not an ARAR	No stream modification anticipated.
Within area affecting national wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river	Activities that affect or may affect any of the rivers specified in section 1276(a).	Wild and Scenic Rivers Act (16 USC 1271 *et seq.*); 40 CFR 6.302(e)	Not an ARAR	No national wild or scenic rivers are located on site or will be impacted by site remediation.

Table 3-2 (continued)

Potential Location-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Location-Specific Concern	Requirement	Prerequisite	Citation	ARAR Status	Analysis
Waters of the United States	A permit is required for work in or affecting navigable waters of the U.S. This includes dredging, disposal of fill material, filling or modification of said waters below the ordinary high water level (OHWL).	Waters which are presently used or have been used in the past or may be susceptible for use to transport interstate or foreign commerce.	Section 10 of the Rivers and Harbors Act. 33 CFR Part 332.	ARAR	Site is adjacent to a harbor.
Within coastal zone	Conduct activities in manner consistent with approved state management programs.	Activities affecting the coastal zone including lands therein and thereunder and adjacent shorelands.	Coastal Zone Management Act (16 USC Section 1451 *et seq.*)	Not an ARAR	Site is not in a coastal area.
Within designated coastal barrier	Prohibits any new federal expenditure within the Coastal Barrier Resource System.	Activity within the Coastal Barrier Resource System.	Coastal Barrier Resources Act (16 USC 3501 *et seq.*)	Not an ARAR	No dredge and fill activities planned.
Within 61 meters (200 feet) of a fault displaced in Holocene time	New treatment, storage or disposal of hazardous waste prohibited.	RCRA hazardous waste, treatment, storage or disposal.	40 CFR 264.18(a)	Not an ARAR	There is no evidence of a potentially active fault within 61 meters of site.
Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout.	RCRA hazardous waste, treatment, storage, or disposal.	40 CFR 264.18(b)	Not an ARAR	Site not within 100-year floodplain.
Within floodplain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values.	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood-prone areas.	Executive Order 11988, Protection of floodplains (40 CFR 6, Appendix A); Fish and Wildlife Coordination Act (16 USC 661 *et seq.*); 40 CFR 6.302	Not an ARAR	Site actions not within floodplain.
Within salt dome formation, underground mine, or cave	Placement of non-containerized or bulk liquid hazardous waste prohibited.	RCRA hazardous waste placement	40 CFR 264.18	Not an ARAR	Site does not contain salt dome, mines, or caves.

Table 3-2 (continued)

Potential Location-Specific ARARs
Waukegan Manufactured Gas and Coke Plant Site

Location-Specific Concern	Requirement	Prerequisite	Citation	ARAR Status	Analysis
Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts.	Alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data.	National Historical Preservation Act (16 USC Section 469); 36 CFR Part 65	Not an ARAR	There are no known archaeological or historical artifacts on the site.
Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to national historic landmarks.	Property included in or eligible for the National Register of Historic Places	National Historic Preservation Act, Section 106 (16 USC 470 *et seq.*); 36 CFR Part 800	Not an ARAR	Site not on the National Register of Historic Places.
Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of Interior.	Determination of presence of endangered or threatened species.	Endangered Species Act of 1973 (16 USC 1531 *et seq.*); 50 CFR Part 200, 50 CFR Part 402 Fish and Wildlife Coordination Act (16 USC 661 *et seq.*); 33 CFR Parts 320-330	Not an ARAR	While no endangered species exist at the site, threatened or endangered species are present in nearby areas.
Consent decree for the Outboard Marine Corporation/Waukegan Harbor site	Actions must be consistent with the Consent Decree and Record of Decision (as amended) for the Waukegan Harbor site	The Consent Decree became effective April 27, 1989.	Outboard Marine Corporation/ Waukegan Harbor site court administered consent decree in the case of the United States of America and the People of the State of Illinois v. OMC	Potentially applicable	Establishes site use restrictions for operation of hazardous waste storage units, land transfer restrictions, and sets PCB remediation standards.

Table 3-3

Summary of Soil Risk Values
Waukegan Manufactured Gas and Coke Plant Site
(concentrations in mg/kg)

Chemical	Residential		Commercial/Industrial			Utility/Construction		
	RME	CTE	RME	CTE	RHE	RME	CTE	RHE
Cancer Risk: 1×10^{-6}								
PCBs	0.12	8.08	0.25	3	31	17	118	16.5
Arsenic	1.09	55.2	2.68	23	205	106	659	94
Benzene	1.91	41.3	3.23	10	6	580	1,786	238
Benzo(a)anthracene	1.78	68.1	5.94	33	150	122	709	116
Benzo(a)pyrene	0.18	6.81	0.59	3	15	12	70.9	11.6
Benzo(b)fluoranthene	1.78	68.1	5.94	33	150	122	709	116
Dibenzo(a,h)anthracene	0.18	6.81	0.59	3	15	12	70.9	11.6
Indeno(g,h,i)pyrene	1.78	68.1	5.94	33	150	122	709	116
Non-Cancer Risk: HI=1								
Dibenzofuran	653	17,033	983	4,955	186,779	4,591	40,427	5,390
4-Methylphenol	817	21,292	1,229	6,194	233,474	5,739	50,534	6,738
Naphthalene	5,203	141,944	7,704	39,961	1,565,513	39,438	369,220	48,556

Table 3-4

Summary of Chemical-Specific Criteria for Groundwater Waukegan Manufactured Gas and Coke Plant Site (concentrations in μg/L)

	MCLs[a]	MCLGs[a]	IGQS[b]	
			Class I	Class II
Benzene	5	0	5	25
Ethylbenzene	700	700	700	1000
Toluene	1000	1000	1000	2500
Xylenes (total)	10000	10000	10000	10000
BETX			11705	13525
Phenol				
Phenols			100	100
o-Cresol				
p-Cresol				
2,4-Dimethylphenol				
Acenaphthene				
Acenaphthylene				
Anthracene				
Benzo(a)anthracene				
Benzo(a)pyrene	0.2	0	0.2	2
Benzo(b)fluoranthene				
Benzo(g,h,i)perylene				
Benzo(k)fluoranthene				
Carbazole				
Chrysene				
Dibenzo(a,h)anthracene				
Dibenzofuran				
Fluoranthene				
Fluorene				
Indeno(1,2,3-cd)pyrene				
2-Methylnaphthalene				
Naphthalene				
Phenanthrene				
Pyrene				
PCBs[c]			0.5	2.5

Table 3-4 (continued)

Summary of Chemical-Specific Criteria for Groundwater
Waukegan Manufactured Gas and Coke Plant Site
(concentrations in μg/L)

			IGQS[b]	
	MCLs[a]	**MCLGs[a]**	**Class I**	**Class II**
Ammonia				
Arsenic	50		50	200
Cadmium	5	5	5	50
Cyanide	200	200	200	600
Lead			7.5	100
Mercury			2	10
Selenium	50	50	50	50
Thiocyanate				

[a] MCLs—Maximum Contaminant Level
MCLG—Maximum Contaminant Level Goal

[b] IGQS—Illinois Groundwater Quality Standards
Class I Section 620.410—Potable Resource Groundwater
Class II Section 620.420—General Resource Groundwater

[c] PCB-1248 is the isomer that has been detected at the WCP site.

Table 3-5

Summary of Chemical-Specific Criteria for Surface Water Waukegan Manufactured Gas and Coke Plant Site (concentrations in μg/L)

Chemical	ARARs								
	FAWQC[a]		Illinois Water Quality Standard[b]						
			Subpart E: Lake Michigan Basin (Harbor and Breakwater Areas)					Subpart C Public & Food Processing[d]	Subpart E: Open Waters of the Lake Michigan Basin
	Acute	Chronic	Acute	Chronic	Human Health Standard	Wildlife Standard	Standard		
Ammonia as N	14,900	2,600				-	15,000		20
Ammonia as N, un-ionized[f]			330/140	57/25					
Arsenic	360	190							50
Arsenic (III)	360	190	340	148				50	
Arsenic (V)	850								
Cadmium	5.6	1.4	6.4 c	3.1 c				10	
Cyanide, weak and dissociable	22	5.2	22	5.2					
Cyanide, total									
Lead	121	4.7	180 c	9.5 c				50	50
Mercury	2.4		1.7	0.91	0.0018	0.0013			
Thiocyanate									
Selenium	20	5	d	5.0			1,000	10	10
Benzene					310				12
Ethylbenzene			216	17.2					
Toluene					51,000				5,600
Xylene			1,500	117					
PCBs[e]					0.0000067	0.00012			
Phenols							100	1	1
Phenol									
o-Cresol (2-methyphenol)									
p-Cresol (4-methylphenol)									
2,4-Dimethylphenol					8,700				450
Acenaphthene	80	23							
Acenaphthylene									

Table 3-5 (continued)

Summary of Chemical-Specific Criteria for Surface Water
Waukegan Manufactured Gas and Coke Plant Site
(concentrations in µg/L)

Chemical	ARARs								
	FAWQC[a]		Illinois Water Quality Standard[b]						
			Subpart E: Lake Michigan Basin (Harbor and Breakwater Areas)					Subpart C Public & Food Processing[d]	Subpart E: Open Waters of the Lake Michigan Basin
	Acute	Chronic	Acute	Chronic	Human Health Standard	Wildlife Standard	Standard		
Anthracene									
Benzo(a)anthracene									
Benzo(b)fluoranthene									
Benzo(g,h,i)perylene									
Benzo(k)fluoranthene									
Carbazole									
Chrysene									
Dibenzo(a,h)anthracene									
Dibenzofuran									
Fluoranthene	33.6	6.16							
Fluorene									
Indeno(1,2,3 cd)									
2-Methylnaphthalene									
Naphthalene									
Phenanthrene									
Pyrene									

a Federal Ambient Water Quality Criteria (FAWQC) for the protection of aquatic life.
b Illinois Water Quality Standards—35 Ill. Adm. Code Subtitle C, Chapter 1, Parts 302 and 303.
c Based on hardness. Hardness assumed to be 136 mg/L based on RI surface water sample data.
d IEPA is awaiting new value.
e Bioaccumulative.
f Seasonal dependence: first value is for April–October, second is for November–March.

Table 4-1

Soil Volume Estimates (RHE Utility Worker)

Soil Category	Estimated Volume (cubic yards)		Volume Used for Technology Screening (cubic yards)
	Representative Volume	High Volume	
PAH Remediation Zone Soil	7,100	14,900	7,100
Arsenic Remediation Zone Soil	3,300	7,200	3,300
Marginal Zone Soil	26,000	90,000	26,000
Total	**36,400**	**112,100**	**36,400**

Marginal zone soil is based on 25 mg/kg (high volume) or 100 mg/kg (representative volume) of arsenic for the soil to groundwater pathway. See Appendix 4-A for further discussion on post-excavation risk satisfying 10^{-5} RHE and 10^{-5} RME.

Table 4-2

Identification and Screening of Remedial Technologies and Process Options
Vadose Zone Soil

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Unit Cost[1]	Retained for Alternative Development
No Action			Not effective for soil remediation at this site.	Readily implementable.	None.	Yes.
Routine Monitoring		Soil Monitoring	Used to verify results of other remedial actions.	Readily implementable.	Cost depends on the number of samples and parameters required for monitoring.	Yes.
Institutional Controls (Access/Use Restrictions)		Limit Access to Site	Effective for restricting exposure to soil.	Readily implementable.	None.	Yes.
		Development Restrictions	Effective for restricting exposure to soil.	Property owner can readily implement.	None.	Yes.
Containment	Vertical Barrier	Slurry Wall Sheetpile Wall Soilsaw Waterloo Barrier	Not effective for soil remediation at this time. However, may be used as part of the remedy for groundwater.	Readily implementable. Portions of site cannot be contained due to access limitations or technical impracticability.	$5 to 20/SF (Soilsaw $5/SF)	No. Does not meet effectiveness evaluation criteria.
	Cap	Soil Cover	Restricts exposure to covered materials. Does not reduce infiltration.	Readily implementable. Soil stockpile may be used as part of the soil cover. Some clearing, grubbing, and grading is necessary.	$60,000/acre	No. Does not reduce infiltration.
		Asphalt Cap	Effectively eliminates exposure to capped materials. Reduces infiltration.	Readily implementable. Soil stockpile may be used as part of the subgrade preparation. Some clearing, grubbing, and grading is necessary. Compatible with future site use as a boat storage area.	$150,000/acre plus stormwater management	Yes.
		Low Permeability Cap	Effectively eliminates exposure to capped materials. Minimizes infiltration.	Readily implementable. Soil stockpile may be used as part of the subgrade for the cover. Some clearing, grubbing and grading is necessary.	$200,000/acre to $350,000/acre	No. Does not add significant additional effectiveness compared to other caps based on the additional cost.
Containment (continued)	Cap (continued)	Phytoremediation Cap	Eliminates exposure to capped materials, minimizes infiltration, and is used for groundwater migration control.	Readily implementable. Soil stockpile may be used as part of the subgrade for the cover. Some clearing, grubbing, and grading is necessary.	$15,000/acre	Yes.

Table 4-2 (continued)

Identification and Screening of Remedial Technologies and Process Options
Vadose Zone Soil

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Unit Cost[1]	Retained for Alternative Development
Excavation and Disposal	Onsite Disposal	Containment Cell	Effectively eliminates exposure to contained materials.	Readily implementable.	$20/ton	Yes.
	Offsite Disposal	Solid Waste Landfill	Effectively eliminates exposure to removed materials.	Readily implementable. Landfill disposal requirements will need to be established.	$25/ton to $50/ton	Yes.
		Hazardous Waste Landfill	Effectively eliminates exposure to removed materials.	Readily implementable.	$120 to $400/ton Depends on treatment necessary for land disposal requirements.	Yes.
Excavation and Treatment	Biological Treatment	Composting (Spread contaminated soil, add nutrients, and till soil.)	Demonstrated effectiveness for BETX, PAHs, and phenolic compounds.[2] Potential effectiveness for cyanide.[3] No expected effectiveness for metals.[2] Degradation rates slow or not demonstrated for high molecular weight PAHs. Metals may inhibit biological activity. May be effective if combined with chemical oxidation.	Readily implementable. Requires large onsite land area for implementation.	$30/cy to $120/cy	Yes, if used in combination with chemical oxidation.
		Biopile (Place soil pile on a pad or aeration system and add nutrients.)	Demonstrated effectiveness for BETX and phenolic compounds.[2] Potential effectiveness for cyanide.[3] No expected effectiveness for metals.[2] Degradation rates slow or not demonstrated for high molecular weight PAHs. Metals may inhibit biological activity.	Readily implementable. Requires onsite land area for implementation.	$50/cy to $120/cy	No. Not effective on PAH soil.

Table 4-2 (continued)

Identification and Screening of Remedial Technologies and Process Options
Vadose Zone Soil

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Unit Cost[1]	Retained for Alternative Development
Excavation and Treatment (continued)	Biological Treatment (continued)	Bioslurry Reactor (Mix soils in an aqueous phase and add nutrients and oxygen to promote aerobic biodegradation.)	Demonstrated effectiveness for BETX, PAHs, and phenolic compounds.[2] Potential effectiveness for cyanide.[3] No expected effectiveness for metals.[2] Degradation rates slow or not demonstrated for high molecular weight PAHs. Metals may inhibit biological activity.	Readily implementable. May require soil processing or soil washing equipment for separation of larger soil particles.	$450 to $750/ton[4]	No. Not cost-effective compared to other treatment technologies.
	Physical/Chemical Treatment	Soil Washing (Removal of metals and organic contaminants using a wash of detergents or solvents.)	Demonstrated effectiveness for BETX and metals.[2] Potentially effective for PAHs and phenolic compounds.[2] Soils with organics and metals require a combination of washing reagents. Based on technology evaluation testing, this process option is not effective in treating the soil.	Expected to be implementable. The variation in the soil and contaminant characteristics may make formulation of a washing fluid difficult.	$150 to $350/ton Depends on the separation coefficients of the contaminants and the cost of the washing fluid.	No. Based on technology evaluation testing, this technology is not anticipated to be effective.
		Stabilization/Solidification (Mixing of media with cementing material such as asphalt lime, flyash, or portland cement or stabilization reagents.)	Demonstrated effectiveness for metals and cyanide.[3] Potentially effective for organic compounds. High organic content may interfere with bonding of waste material. May be useful for metals-bearing soil or residuals of other treatment technologies.	Readily implementable. The variation of the soil and contaminants may make selection/ formulation of an effective reagent difficult.	$40/ton to $120/ton Depends on the type and quantity of reagent required.	Yes.
		Thermal Desorption (Volatilization of organics at high temperature.)	Demonstrated effectiveness for organic compounds.[2] Expected effectiveness for inorganic cyanides.[3] No expected effectiveness for metals.[2] Mercury may volatilize.[2] Technology evaluation testing did not prove this process option to be effective for all site soils. However, various coal tar sites have been effectively remediated by thermal desorption.	Readily implementable. Treatment unit could be set up onsite. May be difficult to obtain public acceptance.	$200/ton Cost depends on the moisture content of the soil and required treatment levels. Costs assumes IEPA classification of thermal desorption unit is same as incineration.	Yes.

Table 4-2 (continued)

Identification and Screening of Remedial Technologies and Process Options
Vadose Zone Soil

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Unit Cost[1]	Retained for Alternative Development
Excavation and Treatment (Continued)	Physical/Chemical Treatment (Continued)	Solvent Extraction (Physical separation process that removes contaminants to the extract phase with organic solvents.)	Demonstrated effectiveness for non-halogenated organic compounds.[2] No expected effectiveness for metals.[2]	Difficult to implement. Treatment unit could be set up onsite. Materials handling may be difficult.	\$150 to \$450/ton[4] Depends on the solvent and ability to recycle the solvent.	No. Metals resist removal. Not cost-effective compared to other treatment technologies.
		Incineration Onsite or at RCRA Facility (Destruction by burning at very high temperatures.)	Demonstrated effectiveness for organic compounds.[2] Expected effectiveness for inorganic cyanide.[3] No expected effectiveness for metals.[2]	Implementable. Wastes containing metals that volatilize below 2000 °F and soil containing fine particulate matter may cause air emissions concerns. May be difficult to obtain public acceptance for onsite incineration.	\$660 to \$1100/ton (offsite) Depends on soil type, contaminant concentration, and emission control requirements.	No. Soils contain metals that could volatilize (As, Cd, Hg, Se). Not cost-effective compared to other treatment technologies. Public opposition to incinerators is commonly encountered.
		Co-burning at Power Plant (Burn in a coal-fired power plant.)	Demonstrated effectiveness for organic compounds.[2] Expected effectiveness for inorganic cyanide.[3] No expected effectiveness for metals.[2]	Readily implementable. Power plant is located offsite. May require onsite processing with noncohesive material to improve handling and pass TCLP requirements.	\$50/ton	Yes.
		Vitrification (Conversion of soil to glass at very high temperatures.)	Potentially effective for organic wastes.[2] Post-treatment of metals may be required.[2]	Not implementable. This technology has not been implemented on a Superfund site, only a nuclear waste site.[2]	\$40 to \$1200/ton	No. Not implementable and not cost-effective compared to other treatment technologies.
		Cement Kiln Incineration/ Fuel Blending (Materials with high Btu content used as an alternate fuel or blended with fuel.)	Demonstrated effectiveness for organic compounds. Expected effectiveness for inorganic cyanides.[3] Cement kilns can accept some metals. Surcharges are applied to high levels of inorganics.	Implementable. Must meet cement kiln requirements for burning and disposal. Btu content of most contaminated soils may be too low.	\$390 to \$850/ton (vendor costs) Depends on the volume to be treated.	No. Not cost-effective compared to other treatment technologies.

Table 4-2 (continued)

Identification and Screening of Remedial Technologies and Process Options
Vadose Zone Soil

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Unit Cost[1]	Retained for Alternative Development
Excavation and Treatment (Continued)	Physical/Chemical Treatment (Continued)	Chemical Oxidation	Demonstrated effectiveness for organic compounds—has been used on petroleum-based compounds, has been laboratory tested on coal-based compounds. For high-molecular-weight PAHs, this is considered a preparatory step to biological treatment.	Implementable. The selection of the soil mixing system is critical.	$110 to $220/ton	Yes. Used in combination with biological treatment.
In-Situ Treatment	Biological Treatment	Aerobic Bioremediation (System of injection galleries or wells to add oxygen, nutrients, and bacteria to medium.)	Demonstrated effectiveness for BETX and phenolic compounds.[2] Potential effectiveness for cyanide.[3] No expected effectiveness for metals.[2] Degradation rates slow or not demonstrated for high molecular weight PAHs. Metals may inhibit biological activity.	Poor implementability. The variability of the soil and contaminants may make delivery of required additives to target zones problematic. Fill and construction debris may make implementation difficult in areas of the site.	Moderate to high. Depends on size of system.	No. Implementability challenges are expected to compromise effectiveness.
		Phytoremediation	Innovative technology. Has been applied to sites for organic COC remediation. Has been used for metals.	Implementable.	Low. Depends on the level of management required after initial planting.	Yes.
		Bioventing	Innovative technology. Effective for petroleum compounds and volatile organic compounds. Degradation rates slow or not demonstrated for high-molecular-weight PAHs. No expected effectiveness for metals. Metals may inhibit biological activity.	Poor implementability. The variability of the soil and contaminants may make delivery of air difficult. Fill and construction debris may make implementation difficult in areas of the site.	Moderate to high. Depends on size of system.	No. May not be effective for PAH compounds and poor implementability.
	Physical/Chemical Treatment	Stabilization/Solidification (Mixing of media with cementing material such as lime, flyash, or portland cement or stabilization reagents.)	Demonstrated effectiveness for metals and cyanide. Potentially effective for organic compounds. High organic content may interfere with bonding of waste material.	Poor implementability. The variation of the soil and contaminants in each of the contamination areas may require selection/formulation of more than one reagent/mix design. Fill and construction debris may make implementation difficult in areas of the site.	$40/ton to $150/ton Depends on type and quantity of reagent required.	No. Not as implementable compared to other treatment technologies.

Table 4-2 (continued)

Identification and Screening of Remedial Technologies and Process Options Vadose Zone Soil

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Unit Cost[1]	Retained for Alternative Development
In-Situ Treatment (Continued)	Physical/Chemical Treatment (continued)	Soil/Solvent Flushing (Injection of solvents or water with detergents, then capture and treatment of effluent.)	Potential effectiveness for BETX, PAHs, As, Se, Cd, Hg, and Pb.[2] Demonstrated effectiveness for non-volatile metals.[2] Fill and debris areas may result in inconsistent removal.	Poor implementability. The variation of contamination areas and relatively shallow soils may limit implementation of this process in some contamination areas. Heavy metals may require pH adjustment (leaching) for removal.	Moderate. Depends on the contaminant separation coefficient and size of system.	No. Not cost-effective for shallow soils. Poor implementability for removal of a variety of contaminants.
		Vapor Extraction (Series of wells and vacuum pumps to remove volatile compounds.)	No expected effectiveness for metals.[2] Demonstrated effectiveness for BETX and phenolic compounds.[2] Only applicable for volatile contaminants with vapor pressures above a minimum of 0.1 mm Hg. Ineffective for higher molecular weight PAHs.	Implementable. Fill and construction debris may cause implementation problems.	Moderate. Depends size of system.	No. Not cost-effective for shallow soils. Does not remove metals or high molecular weight PAHs.
		Thermal Oxidation (Thermal heating of soil to oxidize organic compounds. Off-gas emissions controlled by a vapor extraction system.)	No expected effectiveness for metals. Innovative, yet promising new technology. Anticipated effectiveness for BETX and PAH compounds.	Implementable. Field demonstration of a full-scale system was conducted at a Superfund site.	\$150 - \$400/ton Depends on depth of contamination, moisture content and other parameters.	Yes.
		Vitrification (Conversion of soil to glass at very high temperatures.)	Potentially effective for organic wastes. Post-treatment of metals may be required.	Not implementable. This technology has not been implemented on a Superfund site, only a nuclear waste site.[2] Due to the shallow groundwater table at the site, in-situ vitrification is likely infeasible.	\$300 to \$500/ton	No. Not implementable.

Table 4-3

Identification and Screening of Remedial Technologies and Process Options Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
No Action			Not effective for groundwater remediation onsite.	Readily implementable.	None.	Yes.
Routine Monitoring		Groundwater and Surface Water Monitoring	Used to verify the results of other remedial actions.	Readily implementable.	Cost depends on the frequency and number of samples and the parameters required for monitoring.	Yes.
Institutional Controls (Access/Use Restrictions)		Restrict Groundwater Use	Effective at preventing exposure to groundwater.	Readily implementable. City restrictions on groundwater use as drinking water from the 1987 Waukegan Zoning Ordinance already in effect. County restrictions readily implementable.	None.	Yes. City controls already in effect.
Monitored Natural Attenuation		Allow bioremediation and other natural processes to remediate groundwater	Bioremediation has been demonstrated effective for BETX, ammonia, thiocyanate, and phenolic compounds. Natural processes attenuate metals concentrations. Technology testing with onsite water showed effective for aerobic removal of phenols and organic compounds.	Readily implementable.	Low.	Yes.
Groundwater Extraction		Extraction Wells, French Drain, or Horizontal Wells	Use in conjunction with treatment and discharge technologies.	Readily implementable. Flexible regarding location and configuration.	Low–Moderate Depends on number of wells.	Yes.
Groundwater Migration Control/ Containment	Hydrodynamic Containment	Extraction Wells	Effective at controlling migration of dissolved chemicals. Use in conjunction with treatment and discharge technologies. Enhances physical containment technology effectiveness.	Readily implementable. Flexible regarding location and configuration of system. Potentially large volume of water collected to contain the groundwater at the site. Treatment/ disposal of extracted groundwater required.	High cost depending on the number of wells installed. Moderate O&M costs for well re-development, pump maintenance, etc.	No. Not as effective as vertical barriers. Location of site is adjacent to Lake and Harbor and may make pumping rates high.

Table 4-3 (continued)

Identification and Screening of Remedial Technologies and Process Options
Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
Groundwater Migration Control/ Containment (cont.)	Hydrodynamic Containment (cont.)	Interception Drains/ Horizontal Wells	Effective at controlling migration of dissolved chemicals. Use in conjunction with treatment and discharge technologies. Enhances physical containment technology effectiveness.	Readily implementable. Potentially large volume of water collected to contain the groundwater at the site. Treatment/ disposal of extracted groundwater required.	High cost depending on the number of drains/ wells installed. Moderate to high O&M costs for drain/well re-development, pump maintenance, etc.	No. Not as effective as vertical barriers. Location of site is adjacent to Lake and Harbor and may make pumping rates high.
	Vertical Barrier	Slurry Wall	Effective at limiting migration of chemical compounds.	Readily implementable. Limited access to portions of site due to buildings. Mix design completed to determine compatibility of slurry wall with contaminants.	$5 to $20/SF	Yes.
		Sheet Pile Wall	Effective at limiting migration of chemical compounds.	Readily implementable. Portions of site cannot be contained due to access limitations or technical impracticability.	$15 to $30/SF	Yes.
	Cap	Soil Cover and Revegetation	Reduces infiltration volume if properly graded and vegetated.	Readily implementable. Soil stockpile may be used as part of the cover. Clearing, grubbing and grading is necessary.	$60,000/acre	No, not as effective as phytoremediation.
		Asphalt Cap	Significantly reduces infiltration volume.	Readily implementable. Soil stockpile may be used as part of the cover. Clearing, grubbing and grading is necessary. Compatible with future use of portions of the site as a boat storage area or parking area.	$120,000/acre	Yes.
		Low Permeability Cap	Significantly reduces infiltration volume.	Readily implementable. Soil stockpile may used as part of the cover. Clearing, grubbing and grading is necessary.	$200,000 - $350,000/acre	No. Not as cost-effective as asphalt cap.
		Phytoremediation	Eliminates exposure to capped materials, used for groundwater migration control.	Readily implementable. Soil stockpile may be used as part of the subgrade for the cover. Some clearing, grubbing and grading is necessary.	$25,000/acre	Yes.

Table 4-3 (continued)

Identification and Screening of Remedial Technologies and Process Options
Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
Ex-Situ Treatment	Biological Treatment	Aerobic (Use micro-organisms in an oxygen-rich environment to degrade organics.)	Effective at reducing volume and toxicity of contaminant mass. Demonstrated effectiveness for non-halogenated organic compounds.[2] Effective for ammonia, thiocyanate, and phenolic compounds. No expected effectiveness for metals.[2] Potential effectiveness for cyanide.	Readily implementable. Conventional technology. Sludge treatment/disposal required. Polishing treatment may be necessary. Higher energy input required.	Moderate to high costs. O&M costs high.	Yes.
		Anaerobic (Use micro-organisms in an oxygen-starved environment to degrade organics.)	Effective at reducing volume and toxicity of contaminant mass. Demonstrated effectiveness at treating high-strength organic matter. No expected effectiveness for metals. Longer treatment time may be required than aerobic processes.	Readily implementable. Sludge treatment/disposal required. Polishing treatment may be necessary.	Moderate to high costs. O&M costs high.	No. Not as effective as aerobic treatment.
	Physical/Chemical Treatment	Precipitation (Physical/chemical process transforms dissolved contaminants into an insoluble solid that can be removed by sedimentation or filtration.)	Effective at reducing volume and toxicity of contaminant mass. Demonstrated effectiveness for metals.[2] No expected effectiveness for organic compounds.[2] pH sensitive.[2] Uncertain effectiveness for removing low concentrations of cyanide, based on results of water treatment technology testing.	Readily implementable. Conventional technology. Sludge treatment/disposal required.[2] Polishing treatment (i.e., filtration) is necessary.[2] Electro-chemical precipitation pilot study removed arsenic in groundwater at the site.	$0.07 - $0.28/1000 gal.[2] O&M costs high.	Yes.
		Ion Exchange (Chemical reaction with resins to remove metals/ cyanide.)	Effective at reducing volume and toxicity of metals.[2] No expected effectiveness for organic compounds.[2] Suspended solids may cause resin binding.[2] Uncertain effectiveness for removing low concentrations of cyanide.	Readily implementable. Regeneration of ion exchange resin required.[2] Disposal of regeneration solution required.[2] Sludge treatment/disposal required.	$0.30 - 0.80/1000 gal.[2] O&M costs high.	No. Not as cost effective as precipitation.

Table 4-3 (continued)

Identification and Screening of Remedial Technologies and Process Options Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
Ex-Situ Treatment (Continued)	Physical/Chemical Treatment (Continued)	Air Stripping (Mixing large volumes of air with water in a packed column to promote controlled volatilization of contaminants.)	Demonstrated effectiveness for removing volatile organic compounds. No expected effectiveness for metals. No expected effectiveness for low concentrations of cyanide. Stripping of ammonia is effective with pH adjustment.	Readily implementable. Control of emissions may be required.[3]	\$0.30 to \$0.50/1000 gal. O&M costs high.	No. Effective on too narrow a range of organic compounds.
		Steam Stripping (Like air stripping but uses steam.)	Demonstrated effectiveness for removing volatile organic compounds and phenol. No expected effectiveness for metals. Uncertain effectiveness for removing low concentrations of cyanide. Stripping of ammonia is effective with pH adjustment.	Readily implemented. Control of air emissions may be required.[3]	Moderate to high costs.	No. Not as effective as other physical/chemical treatment processes for organic removal.
		Chemical Oxidation (Mixing with oxidizers such as hydrogen peroxide.)	Effective at reducing toxicity of contaminant mass. Demonstrated effectiveness for organic compounds and metals.[2] Potential for formation of HCN.[4] Uncertain effectiveness for removing low concentrations of cyanide.	Readily implementable. Sludge treatment/disposal required.[2] Oxidized products treatment/disposal is necessary.[2]	\$70 - \$150/1000 gal.[2] Moderate to high cost, depending on concentration of contaminants.	No. Not as cost effective as biological treatment
		Membrane Filtration (Use of high pressure to force water through a filtering membrane.)	Effective at removing volume of contaminant mass. Demonstrated effectiveness for phenolic compounds and metals.[2] Potential effectiveness for BETX compounds.[2] Size of particles may interfere with operation.[2] Reliability is determined by contaminant-specific membranes.[2] Uncertain effectiveness for removing low concentrations of cyanide.	Readily implementable. Particulate removal required.[4] Reduction of concentrate required.[4] Sludge treatment/disposal required.[2]	\$1.40 - \$4.60/1000 gal.[2] Large volume of residuals generated that may require additional treatment. O&M costs high.	No. Other treatment technologies provide adequate organic and metal removal for considerably less cost.

Table 4-3 (continued)

Identification and Screening of Remedial Technologies and Process Options
Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
Ex-Situ Treatment (Continued)	Physical/Chemical Treatment (Continued)	Carbon Adsorption (Passage of water over activated carbon. Contaminants bind to the surface by physical and/or chemical means.)	Effective at removing contaminant mass. Demonstrated effectiveness for organic compounds.[2] Potential effectiveness for metals.[2] High suspended solids (>50 mg/L) can foul carbon.[2] High levels of organic material (>1,000 mg/L) rapidly exhaust carbon.[2] Sensitive to water quality changes.[4] No expected effectiveness for low concentrations of cyanide, based on results of water treatment technology testing.	Readily implementable. Spent carbon disposal/regeneration required.[2] Activated carbon may be used in conjunction with other treatment processes.	$0.50 - $2.50/1000 gal.[2] O&M costs high.	Yes.
		Sedimentation/Filtration (Variable level of treatment that may include sedimentation, skimming, filtering, or phase separation.)	Effective at reducing volume and toxicity of contaminant mass. No expected effectiveness for low concentrations of cyanide, based on results of water treatment technology testing.	Readily implementable.	Low cost.	Yes.
	Offsite Treatment	Private Treatment	Effective at reducing volume and toxicity of contaminant mass.	Readily implementable for very small volumes of water. Requires transportation and treatment of water at a licensed facility.	$1.20/gal (treatment of Waukegan water) High unit cost.	No. Volume of water managed for full-scale remediation is too large.
In-Situ Treatment	Biological Treatment	Phytoremediation	Innovative technology. Being used for hydrocarbons, chlorinated solvents, and some metals. Expected effectiveness for phenol and ammonia as well.	Implementation requires careful selection of plants to accomplish objectives. Some preliminary testing may be required. Root zone does not extend to deep groundwater.	Low.	No.

Table 4-3 (continued)

Identification and Screening of Remedial Technologies and Process Options Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
In-Situ Treatment (cont.)	Biological Treatment (cont.)	Biosparging (Vertical mixing and air sparge [a variation on air sparging] systems possibly including nutrient addition to accelerate natural processes that biodegrade COCs.)	Effective at reducing volume and toxicity of dissolved contaminants. Demonstrated effectiveness for BETX, ammonia, thiocyanate, and phenolic compounds. Testing completed for onsite water. Testing indicated that biosparging would be difficult to implement onsite.	Treatability testing indicated that biosparging would be very difficult to implement on the site.	$200/lf of horizontal sparge well. Moderate to high costs depending on number and length of injection galleries or wells.	No.
		Stripping (System of injection galleries or wells used to inject air or steam into groundwater where volatiles are removed by air stripping.)	Demonstrated effectiveness for removing volatile organic compounds and ammonia. No expected effectiveness for metals. No expected effectiveness for low concentrations of cyanide.	Implementable.	Moderate to high costs depending on number and length of injection galleries or wells.	No. Does not meet effectiveness evaluation criteria.
		Chemical Fixation (System of injection galleries or wells used for chemical complexation and precipitation of metals and inorganics.)	Effectiveness uncertain. Used for inorganics only.	Fair technical implementability. Removal of inorganics by chemical/ physical processes is experimental.	Moderate to high costs depending on number and length of injection galleries or wells.	No. Does not meet effectiveness and implementability evaluation criteria.
		Chemical Reaction (System of injection galleries or wells to inject oxidizers such as ozone or hydrogen peroxide.)	Effectiveness uncertain. Used for organics and inorganics.	Fair technical implementability. Removal of inorganics by chemical/ physical processes is experimental.	Moderate to high costs depending on number and length of injection galleries or wells.	No. Does not meet effectiveness and implementability evaluation criteria.
		Electrokinetic Remediation	Effectiveness uncertain. Successfully used for removal of metals in groundwater for projects in Europe.	Requires sophisticated equipment and technical capabilities.	High cost.	No. Not cost-effective compared to other technologies.

Table 4-3 (continued)

Identification and Screening of Remedial Technologies and Process Options Groundwater

General Response	Remedial Technology	Process Option	Effectiveness	Implementability	Cost[1]	Retained for Alternative Development
Discharge	Discharge to Surface Water	Lake Michigan	Effectiveness dependent on meeting permit discharge requirements.	Technically implementable. Requires conveyance to Lake Michigan. Advanced wastewater treatment may be necessary. NPDES permit may be required.	Very high cost. Treatment residual disposal may be costly. High costs for O&M and discharge monitoring.	No. Other technologies provide discharge for less cost.
		Waukegan Harbor	Effectiveness dependent on meeting permit discharge requirements.	Technically implementable. Requires conveyance to Waukegan Harbor. Advanced wastewater treatment may be necessary.	High cost. Treatment residual disposal may be costly. High costs for O&M and discharge monitoring.	Yes.
		POTW	Effective at reducing volume and toxicity of contaminant mass. Pretreatment prior to discharge to the POTW is necessary.	Technically implementable. Requires conveyance of contaminated groundwater to treatment facility. Fair administrative implementability. Requires sewer connection and permit to discharge to POTW.	$0.10/gal High cost depending on POTW fees and pretreatment discharge requirements.	Yes, but practical for only low flow rates.
	Reinjection	Reinjection Wells	Effective and reliable discharge technology. Reliability dependent on meeting permit discharge requirements.	Technically implementable.	Moderate cost depending on discharge sampling requirements.	Yes.
	Reinfiltration	Drain Fields	Effective and reliable discharge technology. Reliability dependent on meeting permit discharge requirements.	Technically implementable. May impact future site development because of potential large area required.	Low cost depending on discharge sampling requirements.	No. Requires significant area to implement and may impact future site development.

Table 4-4

Summary of Retained Remedial Technologies and Process Options
Vadose Zone Soil

General Response	Remedial Technology	Process Option
No Action		
Routine Monitoring		Soil Monitoring
Institutional Controls (Access/Use Restrictions)		Limit Access to Site
		Development Restrictions
Containment	Cap	Asphalt Cap
		Phytoremediation Cap
Excavation and Disposal	Onsite Disposal	Containment Cell
	Offsite Disposal	Solid Waste Landfill
		RCRA Hazardous Waste Landfill
Excavation and Treatment	Chemical/Biological Treatment	Composting[1]
	Physical/Chemical Treatment	Stabilization/Solidification
		Thermal Desorption
		Power Plant Co-Burning
		Chemical Oxidation[1]
In-Situ Treatment	Biological Treatment	Phytoremediation
	Physical Treatment	Thermal Oxidation

[1] Chemical oxidation and biological treatment are used in sequence to treat PAHs. Not retained as cost-effective if not used together.

Table 4-5

**Summary of Retained Remedial Technologies and Process Options
Groundwater**

General Response	Remedial Technology	Process Option
No Action		
Routine Monitoring		Groundwater and Surface Water Monitoring
Institutional Controls (Access/Use Restrictions)		Restrict Groundwater Use
Monitored Natural Attenuation		Monitored Natural Attenuation
Groundwater Excavation		Extraction Wells, French Drain or Horizontal Wells
Groundwater Migration Control/Containment	Vertical Barrier	Slurry Wall
		Sheet Pile Wall
	Cap	Asphalt Cap
		Phytoremediation Cap
Ex-Situ Treatment	Biological Treatment	Aerobic
	Physical/Chemical Treatment	Precipitation
		Carbon Adsorption
		Sedimentation/Filtration
Discharge	Discharge to Surface Water	Waukegan Harbor
		POTW
	Reinjection	Reinjection Wells

Table 4-6

Development of Alternatives
Vadose Zone Soil
Waukegan Manufactured Gas and Coke Plant Site

Site-Specific Response	Alternative	Arsenic Remediation Zone	PAH Remediation Zone	Marginal Zone Soil
No Action	Alternative 1	No Action	No Action	No Action
Institutional Controls	Alternative 2	Maintain commercial/ industrial use. Excavation work consistent with OSHA. Fence harbor side.	Same as arsenic remediation zone.	Same as arsenic remediation zone.
Cap	Alternative 3 A-Asphalt Cap B-Phytoremediation Cap	Cap	Cap	Cap
Excavation and Disposal (Onsite or Offsite)	Alternative 4a Onsite	Onsite Containment	Onsite Containment	Cap
	Alternative 4b Offsite	RCRA Subtitle C Landfill	RCRA Subtitle C Landfill	RCRA Subtitle C/D Landfill or Cap
Treatment (In-situ and Ex-situ)	Alternative 5a	Stabilization/Solidification	Thermal Treatment (Power Plant Co-Burning, In-situ Thermal Oxidation, or Other Treatment)	Phytoremediation Cap
	Alternative 5b			Asphalt Cap
	Alternative 5c			RCRA Subtitle C/D Landfill
	Alternative 6	Stabilization/Solidification	Thermal Treatment (Power Plant Co-Burning, In-situ Thermal Oxidation, or Other Treatment)	Ex-Situ Chemical Oxidation/ Biological Treatment or Stabilization/Solidification
	Alternative 7	Stabilization/Solidification	Thermal Treatment (Power Plant Co-Burning, In-situ Thermal Oxidation, or Other Treatment)	Thermal Desorption or Stabilization/Solidification

Table 4-7

Development of Alternatives
Groundwater
Waukegan Manufactured Gas and Coke Plant Site

Alternative	Lake Michigan	Waukegan Harbor
Alternative 1	No Action	No Action
Alternative 2	Monitored Natural Attenuation	Monitored Natural Attenuation
Alternative 3	Monitored Natural Attenuation	Infiltration-Reducing Cap
Alternative 4	Treatment Cells and Monitored Natural Attenuation	Asphalt Cap, Vertical Barrier, Treatment Cells
Alternative 5	Treatment Cells and Monitored Natural Attenuation	Infiltration-Reducing Cap, Treatment Cells
Alternative 6	Aquifer Restoration	Aquifer Restoration

Treatment Cell includes groundwater extraction, ex-situ treatment of the groundwater, reinjection of the treated water, which enhances natural attenuation of organic constituents.

Table 4-8

Screening of Alternatives
Vadose Zone Soil
Waukegan Manufactured Gas and Coke Plant Site

Alternative Description	Effectiveness	Implementability	Cost	Retained for Detailed Analysis
Alternative 1 No Action	Long-term conditions are the same as identified in the baseline risk assessment.	Readily implementable	$0	Yes.
Alternative 2 Institutional Controls Maintain commercial industrial use. Excavation work consistent with OSHA. Fence harbor side.	Does not reduce volume, mobility, or toxicity.	Readily implementable.	$100,000	No, not retained by itself; used in combination with other technologies.
Alternative 3 Cap Asphalt, phytoremediation.	Can prevent the migration of contaminants and reduce risk but does not reduce volume or toxicity, except phytoremediation, which gradually reduces mobility, volume, and toxicity.	Readily implementable. O&M required. Development restriction required.	$4,100,000 (asphalt cap)	No, not retained by itself; used in combination with other technologies.
Alternative 4a Excavation and Disposal—Onsite containment for Arsenic and PAH Remediation Zone soil and cap for marginal soil.	Reduces risk and mobility, but does not reduce volume or toxicity.	Readily implementable. O&M required.	$8,100,000	Yes.
Alternative 4b Excavation and Disposal—Offsite RCRA Subtitle C landfill for Arsenic and PAH Remediation Zone soil and RCRA Subtitle C/D landfill or capping for marginal soil.	Reduces risk and mobility, but does not reduce volume or toxicity.	Readily implementable.	$8,500,000 (uses cost for Subtitle C landfill for arsenic and PAH soils and capping for marginal soils)	Yes.
Alternative 5a Treatment of PAH Remediation Zone soil and stabilization/solidification for Arsenic Remediation Zone soil. Phytoremediation cap for marginal PAH soil	Demonstrated effectiveness for the treatment of PAHs and arsenic. Treatability testing required for stabilization/solidification and possibly for treatment of PAH material.	Readily implementable. Phytoremediation is an innovative technology for remediation of PAH soil.	$7,200,000 (uses cost for power plant treatment)	Yes.
Alternative 5b Treatment of PAH Remediation Zone soil and stabilization/solidification for Arsenic Remediation Zone soil. Asphalt cap for marginal soil.	Demonstrated effectiveness for the treatment of PAHs and arsenic. Treatability testing required for stabilization/solidification and possibly for treatment of PAH material.	Readily implementable. Future land use may be constrained. Requires stormwater detention pond.	$8,800,000 (uses cost for power plant treatment)	Yes.

Table 4-8 (continued)

Screening of Alternatives
Vadose Zone Soil
Waukegan Manufactured Gas and Coke Plant Site

Alternative Description	Effectiveness	Implementability	Cost	Retained for Detailed Analysis
Alternative 5c Treatment of PAH Remediation Zone soil and stabilization/solidification for Arsenic Remediation Zone soil. Disposal at a RCRA Subtitle C/D landfill for marginal soil.	Demonstrated effectiveness for the treatment of PAHs and arsenic. Treatability testing required for stabilization/solidification and possibly for treatment of PAH material. Reduces risk and mobility, but does not reduce volume or toxicity for remaining soil.	Readily implementable.	$8,000,000 (uses cost for power plant treatment and RCRA Subtitle D landfill)	Yes.
Alternative 6 Treatment of PAH Remediation Zone soil, and stabilization/solidification of Arsenic Remediation Zone soil. Chemical oxidation/biological treatment of remaining PAH soil, and stabilization/solidification of remaining marginal soil.	Variable effectiveness of chemical/biological treatment of PAHs and arsenic soil. Treatability testing required for stabilization/ solidification of arsenic and chemical/ biological treatment of PAHs and arsenic and possibly for power plant co-burning. Reduces risk, mobility, volume and toxicity.	Implementable. These technologies have been implemented full scale on other sites. These technologies require space for equipment and operations onsite. Specific implementability issues pertain to each process option.	$10,900,000	No. Not cost-effective compared to other treatment alternatives. The benefit of additional remediation of PAH and arsenic soil does not significantly reduce the risk or mobility compared to the extra cost for implementing other treatment or containment alternatives.
Alternative 7 Treatment of PAH Remediation Zone soil and stabilization/solidification of Arsenic Remediation Zone soil. Thermal desorption of remaining PAH soil and stabilization/solidification of remaining marginal soil.	Treatability testing required for stabilization/ solidification of arsenic and possibly for power plant co-burning. Reduces risk, mobility, volume and toxicity.	Implementable. These technologies have been implemented full scale on other sites. These technologies require space for equipment and operations onsite. Specific implementability issues pertain to each process option.	$24,800,000	No. Not cost-effective compared to other treatment alternatives. The benefit of additional remediation of PAH and arsenic soil does not significantly reduce the risk or mobility compared to the extra cost for implementing other treatment or containment alternatives.

Table 4-9

Screening of Alternatives
Groundwater
Waukegan Manufactured Gas and Coke Plant Site

Alternative	Effectiveness	Implementability	Cost	Retained for Detailed Analysis
Alternative 1 No Action	Long-term conditions are the same as identified in the baseline risk assessment.	Readily implementable	$0	Yes.
Alternative 2 Monitored Natural Attenuation for Harbor and Lake	Does not reduce volume, mobility, or toxicity.	Readily implementable.	$3,300,000	No. Not effective with no other treatment or containment remedies. Used in combination with other alternatives.
Alternative 3 Asphalt Cap for Harbor, Monitored Natural Attenuation for Lake	Reduces infiltration and mass flux on the harbor side and some reduction of volume and toxicity on the lake side for some chemicals (i.e., phenols).	Implementable.	$5,700,000 (phytoremediation cover) - $7,400,000 (asphalt cap)	No. Not sufficiently effective for reducing volume, toxicity or mobility on lake side. Used in combination with other alternatives.
Alternative 4 Asphalt Cap, Vertical Barrier and Treatment Cells[1] for Harbor and Lake, Monitored Natural Attenuation for Lake	Reduces risk, volume, and toxicity. May reduce mobility over time.	Implementable. Treatment cell pilot test can be performed during the design phase. Slurry wall technology testing indicated that the technology is implementable.	$32,000,000 (costs for the asphalt cap are not included in this cost—included with the vadose zone soil costs)	Yes.
Alternative 5 Infiltration-Reducing Cap, Treatment Cells[1] for Harbor and Lake, Monitored Natural Attenuation for Lake	Reduces risk, volume, toxicity, and mobility over time.	Implementable. Wastewater treatability studies and reinjection pilot tests can be performed during the design phase.	$16,000,000 (costs for the infiltration-reducing cap are not included in this cost - included with the vadose zone soil costs)	Yes.
Alternative 6 Aquifer Restoration	Reduces risk, volume, toxicity and mobility. Restores aquifer to drinking water quality.	Implementable, but requires 50 years or more to complete. Wastewater treatability studies can be performed during the design phase.	$93,000,000	Yes. Representative of the level of effort required for "early" aquifer restoration. Treatment to discharge standards may be difficult.

[1] Treatment cells include groundwater extraction, ex-situ treatment of the groundwater, reinjection of the treated water, which enhances natural attenuation of organic constituents.

Table 4-10

Remedial Alternatives Retained for Detailed Analysis
Waukegan Manufactured Gas and Coke Plant Site

Alternative		Description: Vadose Zone Soil	Description: Groundwater
Alternative 1	No action	No action	No action
Alternative 2	Containment	A - Treatment Power plant co-burning or other treatment for PAH Remediation Zone soil, and stabilization/solidification of Arsenic Remediation Zone soil. Asphalt/building cap. B - Disposal Offsite disposal of PAH Remediation Zone soil and Arsenic Remediation Zone soil. Asphalt/building cap. C - Containment Excavation and disposal of PAH Remediation Zone soil and Arsenic Remediation Zone soil in an onsite containment unit. Asphalt/building cap.	Slurry wall with asphalt cap. Treatment cells on beach and harbor with reinjection in cells. Treatment includes removal of arsenic, phenol, organics and ammonia. Monitored natural attenuation over entire site.
Alternative 3	Removal	A - Treatment Power plant co-burning or other treatment of PAH Remediation Zone soil, and stabilization/solidification of Arsenic Remediation Zone soil. Phytoremediation/asphalt/building cap. B - Disposal Offsite disposal of PAH Remediation Zone soil and Arsenic Remediation Zone soil. Phytoremediation/asphalt/building cap.	Treatment cells on beach and harbor with reinjection in cells. Treatment includes removal of arsenic, phenol, organics and ammonia. Monitored natural attenuation over entire site.
Alternative 4	Aquifer Restoration	Power plant co-burning or other treatment of PAH Remediation Zone soil, and stabilization/solidification of Arsenic Remediation Zone soil. Disposal of marginal soil.	Treat groundwater to discharge standards. Pre-treatment includes removal of arsenic, phenol, organics, ammonia, and cyanide. Discharge treated water to NSSD.

Overall Protection of Human Health and Environment

- How Alternative Provides Human Health and Environmental Protection

Compliance with ARARs

- Compliance with Chemical-Specific ARARs
- Compliance with Action-Specific ARARs
- Compliance with Location-Specific ARARs
- Compliance with Other Criteria, Advisories, and Guidances

Long-term Effectiveness and Permanence

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls

Reductions of Toxicity, Mobility, and Volume Through Treatment

- Treatment Process Used and Material Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree of Expected Reductions in Toxicity, Mobility, and Volume
- Degree to Which Treatment is Irreversible
- Type and Quantity of Residuals Remaining After Treatment

Short-term Effectiveness

- Protection of Community During Remedial Actions
- Protection of Workers During Remedial Actions
- Environmental Impacts
- Time Until Remedial Action Objectives are Achieved

Implementability

- Ability to Construct and Operate the Technology
- Reliability of Technology
- Ease of Undertaking Additional Remedial Actions, if Necessary
- Ability to Monitor Effectiveness of Remedy
- Ability to Obtain Approvals from Other Agencies
- Availability of Off Site Treatment, Storage, and Capacity
- Availability of Necessary Equipment and Specialists
- Availability of Prospective Technologies

Cost

- Capital Costs
- Operating and Maintenance Costs
Present Worth Costs

State Acceptance

Community Acceptance

(Source: USEPA, October 1988)

Table 5-1

EVALUATION FACTORS FOR DETAILED ANALYSIS OF ALTERNATIVES
Waukegan Manufactured Gas & Coke Plant Site

Table 5-2

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Federal Requirements						
Clean Air Act						
National Ambient Air Quality Standards (NAAQS) Section 109 (40 CFR 50) NAAQS specify the maximum concentration of the pollutant which is to be permitted in the ambient air, as averaged over a specified time period. NAAQS created for carbon monoxide, lead, nitrogen dioxide, particulate matter, ozone, and sulfur dioxide. Preconstruction review for new sources.	Relevant and appropriate to remedial actions that include emissions to the atmosphere. On-site CERCLA actions are exempt from permitting; however, the remedial action is obligated to comply with the substantive requirements of air regulations and emissions standards.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
State Implementation Plan (SIP) Section 110 (40 CFR 51) Development of SIP for implementation, maintenance, and enforcement of NAAQS in air quality control regions. State sets requirements for emission sources in order to achieve NAAQS.	Not an ARAR. State air regulations developed under SIP.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Resource Conservation and Recovery Act (RCRA)						
RCRA - In General 42 U.S.C. 6901 Requirements for management of solid and hazardous waste.	Relevant and appropriate for on-site actions. May be applicable to off-site actions if hazardous waste is shipped off-site.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
RCRA Subtitle C						
Hazardous Waste Management System 40 CFR 260 Management of generation, treatment storage, disposal, and transport of hazardous waste. State of Illinois administers RCRA in Illinois. Refer to State ARARs. Refer to specific sections on transport, storage, treatment, or disposal	Applicable to off-site transportation. RCRA applicability requires a RCRA hazardous waste (see 40 CFR 261) and action which constitutes generation, transport, treatment, storage, or disposal. If waste was disposed after effective date of RCRA, disposal triggered RCRA, otherwise RCRA will be triggered by treatment of the waste. Management of treatment residuals subject to RCRA if residuals retain characteristic.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A

Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Definition and identification of hazardous waste 40 CFR 261 Identifies RCRA hazardous wastes as: (1) characteristic; (2) listed; or (3) mixture of solid waste and listed hazardous waste.	No listed waste present on-site. Excavated material will be properly characterized to ensure proper management.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Standards for Generators 40 CFR 262 Establishes regulation covering activities of generators of hazardous wastes. Requirements include ID number, record keeping, and use of uniform national manifest	Applicable if wastes are RCRA hazardous and go off-site.	See Alt. 2A	May be relevant and appropriate for on-site containment.	See Alt. 2A	See Alt. 2A	See Alt. 2A
Standards for Transport 40 CFR 263 The transport of hazardous waste is subject to requirements including DOT regulations, manifesting, record keeping, and discharge cleanup.	Applicable if wastes are RCRA hazardous and go off-site.	See Alt. 2A	Not applicable for on-site containment unit.	See Alt. 2A	See Alt. 2A	See Alt. 2A
Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities (40 CFR 264)						
Subpart A – General 40 CFR 264.1–264.4 General requirements and application of section 264 standards.	Relevant and appropriate to treatment, containment and capping of RCRA hazardous waste.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subpart D—Contingency Plan and Emergency Procedures 40 CFR 264.50–264.56	Relevant and appropriate to remedy construction for RCRA hazardous waste.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subpart F—Releases from Solid Waste Management Units (SWMU) 40 CFR 264.90—264.101 Requirements for releases from SWMUs includes monitoring, protection of groundwater, corrective action, and detection monitoring.	Not applicable for excavation and treatment off site.	Not applicable for excavation and disposal off site.	May be relevant and appropriate for on-site containment unit.	See Alt. 2A	See Alt. 2B	See Alt. 2B

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Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Subpart G—Closure and Postclosure 40 CFR 264 110–264 120 General closure and postclosure care requirements Closure and postclosure plans (including operation and maintenance), site monitoring, record keeping, and site use restriction	Relevant and appropriate if RCRA hazardous wastes are left on site	See Alt. 2A	See Alt. 2A	See Alt 2A	See Alt 2A	See Alt 2A
Subpart L—Waste Piles 40 CFR 264 251–264 259 Requirements for hazardous waste kept in piles Requirements include liner, leachate collection unless under an appropriate structure	Not an ARAR Waste piles are not part of remedy	See Alt. 2A	See Alt. 2A	See Alt 2A	See Alt 2A	See Alt 2A
Subpart N—Landfills 40 CFR 264 301–264 317 Requirement for design, operation, and maintenance of a new hazardous waste landfill Includes minimum technology requirements under HSWA (double liner, leachate collection)	Not an ARAR	See Alt. 2A	Applicable to soil if it is hazardous.	See Alt 2A	See Alt 2A	See Alt 2A
Subpart S—Corrective Action for Solid Waste Management Units 40 CFR 264 552–264.553 Requirements of corrective action management and units (CAMU) and temporary units (TUs). Designation of CAMU is made on site-specific basis by regional administrator consistent with criteria listed in regulation, requirements for CAMU are site-specific	Relevant and appropriate if residuals to dispose of are hazardous	See Alt. 2A	See Alt 2A	See Alt 2A	See Alt 2A	See Alt 2A
Subpart X—Miscellaneous Treatment 40 CFR 264 600–264 603 Standards for performance of miscellaneous treatment units General environmental performance standards which are protection of human health and the environment Prevent releases to environment	Relevant and appropriate if materials to be treated are RCRA hazardous	See Alt. 2A	No treatment will occur	See Alt 2A	See Alt 2A	See Alt 2A

Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Standards for Management of Specific Hazardous Wastes and Facilities (40 CFR 266)						
Land Disposal Restrictions 40 CFR 268, Subpart C and Subpart D The land disposal restrictions and treatment requirements for materials subject to restrictions on land disposal. Must meet waste-specific treatment standards prior to disposal in a land disposal unit.	Relevant and appropriate if residuals are hazardous, but CAMU would not trigger LDRs.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Clean Water Act						
NPDES 40 CFR122, 125 Regulates the discharge of water into surface water bodies. The State of Illinois has authority to administer NPDES in Illinois.	Not ARAR. Treated water will be reinjected into groundwater treatment cells.	See Alt. 2A	See Alt. 2A	See Alt. 2A		Not ARAR. No direct discharge to surface water. Pretreated water will go to POTW.
Pretreatment Standards 40 CFR403 Pretreatment standards for the control of pollutants discharged to POTWs. The POTW should have either an EPA approved program or sufficient mechanism to meet the requirements of the national program in accepting CERCLA waste.	Not ARAR. Treated water will be reinjected into groundwater treatment cells.	See Alt. 2A	See Alt. 2A	See Alt. 2A		Applicable. Treated water must meet NSSD pretreatment standards.
Safe Drinking Water Act Illinois governs reinjection to groundwater. See State ARARs.						
Toxic Substances Control Act (TSCA) PCBs Not applicable. PCBs less than 50 ppm on site.						
Occupational Safety and Health Act						
29 U.S.C. 651 29 CFR 1910 29 CFR 1910.126 General Industry Standards—Protection of worker health at hazardous waste operations. Requires training, protective equipment, proper handling of wastes, monitoring of employee health, and emergency procedures for workers at hazardous waste operations.	Applicable. OSHA applies to all workers on the site during construction and operation of remedial actions.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
29 CFR 1926 Safety and health standard.	Potential ARAR. Applies to all workers.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A

Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Hazardous Materials Transportation Act						
49 CFR 100-109 Transportation of hazardous materials. Specific DOT requirements for labeling, packaging, shipping papers, and transport by rail, aircraft, vessel, and highway.	Applicable. Off-site shipment of waste may occur.	See Alt. 2A	Not ARAR, no shipment of waste off-site.	See Alt. 2A	See Alt. 2A	See Alt. 2A
State Requirements						
Wastewater Treatment and Disposal Illinois Adm. Code Title 35 Subtitle C						
Chapter 1 Water Quality Standards Designates stream classifications, monitoring requirements, POTW Regulations, effluent and pretreatment standards, NPDES permits.	Not ARAR. Treated water will be reinjected into groundwater treatment cells.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	Applicable. Treated water must meet NSSD pretreatment standards.
Waste Disposal Illinois Adm. Code Title 35 Subtitle G Chapter 1						
Subchapter c, Parts 720-729 Hazardous waste operating requirements. Standards for waste management, generators, transporters, owners, and operators of treatment, storage and disposal facilities.	Relevant and appropriate to management of hazardous waste.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c, Part 721 Identification and listing of hazardous waste.	Not an ARAR. Material is not a listed waste. Excavated material will be characterized to ensure proper management.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c, Part 722 Standards applicable for generators of hazardous waste.	Relevant and appropriate to management of hazardous waste on-site.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c, Part 724 Subpart G—Closure and Postclosure General closure and postclosure care requirements. Closure and postclosure plans (including operation and maintenance), site monitoring, record keeping, and site use restriction.	Relevant and appropriate if hazardous waste is left on site.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	Closure requirements not necessary if remedy meets ARARs.

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Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Subchapter c. Part 724 Subpart I–Use and Management of Containers Standards applicable for owners and operators of hazardous waste facilities that store containers of hazardous waste	Not an ARAR. Remedy will not employ containers.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart J–Tank Systems Standards applicable for owners and operators that use tank systems for storing or treating hazardous waste	Not an ARAR. Tank systems will not be used to store hazardous waste	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart K–Surface Impoundments Standards applicable for owners and operators that use surface impoundments to treat, store or dispose of hazardous waste	Not an ARAR. Surface impoundment not used in remedy	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart L—Waste Piles Requirements for hazardous waste kept in piles. Requirements include liner, leachate collection unless in a container or structure.	Not an ARAR. Waste piles not used in remedy.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart M–Land Treatment Standards applicable for owners and operators of facilities that treat or dispose of hazardous waste in land treatment units	Not an ARAR. Land treatment not used in remedy	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart N–Landfills Regulations for owners and operators of facilities that dispose of hazardous waste in landfills. Requirements for design, operation, and maintenance of hazardous waste landfills	Not an ARAR. Landfill not a part of remedy.	See Alt. 2A	Relevant and appropriate for disposal of hazardous waste material in on-site containment unit.	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart O–Incinerators Standards applicable for owners and operators of hazardous waste incinerators.	Not an ARAR. No on-site incineration to take place	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter c. Part 724 Subpart X–Miscellaneous Units Standards applicable for owners and operators that treat, store or dispose of hazardous waste in miscellaneous units	Relevant and appropriate if materials to be treated are RCRA hazardous	See Alt. 2A	No treatment will occur	See Alt. 2A	See Alt. 2A	See Alt. 2A

Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Subchapter c, Part 728 Identifies land disposal restrictions and treatment requirements for materials subject to restrictions on land disposal. Must meet waste-specific treatment standards prior to disposal in a land disposal unit	Relevant and appropriate to disposal of hazardous waste.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter d, Part 730 Underground injection control and underground storage tank programs	Potential ARAR for reinjection of treated water in treatment cells.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	Not applicable
Subchapter f Site remediation program. Development of risk-based remediation objectives.	May be relevant and appropriate for waste excavated. Risk based cleanup goals are developed in Chapter 3.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	Not applicable
Subchapter g Requires chief operator of certain waste disposal sites (solid and hazardous waste) to obtain prior conduct certification	CERCLA site is exempt from permitting. Chief operator of waste disposal site would be required to comply with substantive requirements. Requirement may be relevant and appropriate to capping	See Alt. 2A	May be relevant and appropriate for on-site containment unit	See Alt. 2A	See Alt. 2A	Not applicable. Wastewater treatment is considered treatment not disposal
Subchapter h Illinois "Superfund" program	Not applicable. The Illinois Hazardous Substances Pollution Contingency Plan is applicable to State response taken at sites which are not the subject of a federal response taken pursuant to CERCLA	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Subchapter i, Parts 807-810 Solid Waste and Special Waste Hauling	May be applicable to solid waste/special waste, possibly including wastewater sludge, stored on-site prior to off-site disposal	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Part 811 Applies to all new landfills	Not an ARAR	See Alt. 2A	Applicable for on-site containment unit.	See Alt. 2A	See Alt. 2A	See Alt. 2A
• Subpart A-General Standards for All Landfills Location standards, operating standards, closure and post-closure maintenance	Not an ARAR.	See Alt. 2A	The site is not located within the 100-year floodplain. Potential ARAR for on site containment unit	See Alt. 2A	See Alt. 2A	See Alt. 2A

Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
• Subpart C–Putrescible and Chemical Waste Landfills General Location standards, liner and leachate collection system requirements, final cover requirements.	Not an ARAR.	See Alt. 2A	Applicable for on-site containment unit.	See Alt. 2A	See Alt. 2A	See Alt. 2A
• Subpart C–Putrescible and Chemical Waste Landfills Facility Location (811.302) Location of landfill including setback zone, proximity to sole source aquifer, residences, schools, hospitals or runways.	Not an ARAR.	See Alt. 2A	Barriers may need to be placed to block view of containment unit.	See Alt. 2A	See Alt. 2A	See Alt. 2A
Air Pollution Illinois Adm. Code Title 35 Subtitle B						
Part 201, Permits and General Provisions. 201.142 Construction Permit Required	Not an ARAR. A CERCLA site is exempt from permitting.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Part 212, Subpart K (Fugitive Particulate Matter). Site construction and processing activities would be subject to Sections 212.304 to .310 and 312 which relate to dust control.	Potential ARAR. Remedial action may generate fugitive dust. Rules require dust control for storage piles, conveyors, on-site traffic, and processing equipment. An operating program (plan) is required and is to be designed for significant reduction of fugitive emissions.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Part 218, Organic Material Emission Standards and Limitations for the Chicago Area (includes Lake County); Subpart C: Miscellaneous Equipment; 218.141 Separation Operations	Not an ARAR. On-site wastewater treatment does not process water containing free phase organic material.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Part 218, Organic Material Emission Standards and Limitations for the Chicago Area (includes Lake County); Subpart K: Use of Organic Material; 218.301-.303	Not an ARAR. The discharge of greater than 8 lbs/hr of VOC from any aspect of the remedial action is not likely.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Part 228 Asbestos May apply if asbestos containing material is encountered.	Not an ARAR. Excavation of soil is not expected to uncover asbestos containing material.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A
Part 245 Odors May apply if pollutants have strong odors that are determined to be a nuisance.	Potential ARAR. Excavation of soil and wastewater treatment processes may create odors.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A

Table 5-2 (cont.)

Development of Action-Specific ARARs
Waukegan Manufactured Gas and Coke Plant

Regulations	Alternative 2 Disposal			Alternative 3 Removal		Alternative 4 Aquifer Restoration
	Alt. 2A	Alt. 2B	Alt. 2C	Alt. 3A	Alt. 3B	
Part 900 Noise: General Provisions; may apply if sustained noise intensity exceeds nuisance levels.	Potential ARAR. Excavation and processing will generate noise. Treatment equipment (blowers, etc) may generate noise.	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A	See Alt. 2A

Table 5-3

Summary of Total Estimated Cost
Alternative 2 Containment
Option 2A Treatment

Category	Item	Representative Cost	Reference Table for Cost Estimate Details
Capital Cost	General Requirements (Soil and Groundwater) Mobilization/demobilization Site preparation Site restoration	$2,400,000	Table 5-C-5 & Table 5-C-14
	Soil Remediation Treatment of Arsenic and PAH Remediation Zone soil Asphalt cap and detention pond for remaining soil	$5,900,000	Table 5-C-5
	Groundwater Remediation Slurry wall Treatment cells (total 60 gpm) Phenol and organics treatment Arsenic treatment Ammonia treatment Monitored natural attenuation	$7,000,000	Table 5-C-14
	Contingencies, Insurance, Bonds	$3,000,000	Table 5-C-5 & Table 5-C-14
	Noncontractor [1]	$2,800,000	Table 5-C-6 & Table 5-C-15
	Subtotal Capital Cost	$21,100,000	
Operation, Maintenance, and Repair (O, M & R)	Annual Cost (Years 1 - 5)	$1,900,000	Table 5-C-7 & Table 5-C-16
	Annual Cost (Years 6 - 30)	$710,000	Table 5-C-7 & Table 5-C-16
	Present Worth of O, M & R [2]	$17,800,000	Table 5-C-7 & Table 5-C-16
ESTIMATED TOTAL PRESENT WORTH		**$38,900,000**	

[1] Noncontractor includes engineering and regulatory.

[2] Present worth net discount rate of 5 percent over 30 years.

Table 5-4

Summary of Total Estimated Cost
Alternative 2 Containment
Option 2B Disposal

Category	Item	Representative Cost	Reference Table for Cost Estimate Details
Capital Cost	General Requirements (Soil and Groundwater) Mobilization/demobilization Site preparation Site restoration	$2,300,000	Table 5-C-8 & Table 5-C-14
	Soil Remediation Disposal of Arsenic and PAH Remediation Zone soil Asphalt cap and detention pond for remaining soil	$5,200,000	Table 5-C-8
	Groundwater Remediation Slurry wall Treatment cells (total 60 gpm) Phenol and organics treatment Arsenic treatment Ammonia treatment Monitored natural attenuation	$7,000,000	Table 5-C-14
	Contingencies, Insurance, Bonds	$2,800,000	Table 5-C-8 & Table 5-C-14
	Noncontractor [1]	$2,700,000	Table 5-C-9 & Table 5-C-15
	Subtotal Capital Cost	$20,000,000	
Operation, Maintenance, and Repair (O, M & R)	Annual Cost (Years 1 - 5)	$1,900,000	Table 5-C-10 & Table 5-C-16
	Annual Cost (Years 6 - 30)	$710,000	Table 5-C-10 & Table 5-C-16
	Present Worth of O, M & R [2]	$17,800,000	Table 5-C-10 & Table 5-C-16
ESTIMATED TOTAL PRESENT WORTH		**$37,800,000**	

[1] Noncontractor includes engineering and regulatory.

[2] Present worth net discount rate of 5 percent over 30 years.

Table 5-5

Summary of Total Estimated Cost
Alternative 2 Containment
Option 2C On-Site Containment Unit

Category	Item	Representative Cost	Reference Table for Cost Estimate Details
Capital Cost	General Requirements (Soil and Groundwater) Mobilization/demobilization Site preparation Site restoration	$2,300,000	Table 5-C-11 & Table 5-C-14
	Soil Remediation Onsite containment unit for Arsenic and PAH Remediation Zone soil Asphalt cap and detention pond for remaining soil	$4,000,000	Table 5-C-11
	Groundwater Remediation Slurry wall Treatment cells (total 60 gpm) Phenol and organics treatment Arsenic treatment Ammonia treatment Monitored natural attenuation	$7,000,000	Table 5-C-14
	Contingencies, Insurance, Bonds	$2,600,000	Table 5-C-11 & Table 5-C-14
	Noncontractor [1]	$3,200,000	Table 5-C-12 & Table 5-C-15
	Subtotal Capital Cost	$19,100,000	
Operation, Maintenance, and Repair (O, M & R)	Annual Cost (Years 1 - 5)	$2,000,000	Table 5-C-13 & Table 5-C-16
	Annual Cost (Years 6 - 30)	$730,000	Table 5-C-13 & Table 5-C-16
	Present Worth of O, M & R [2]	$18,100,000	Table 5-C-13 & Table 5-C-16
ESTIMATED TOTAL PRESENT WORTH		**$37,200,000**	

[1] Noncontractor includes engineering and regulatory.

[2] Present worth net discount rate of 5 percent over 30 years.

Table 5-6

Summary of Total Estimated Cost
Alternative 3 Removal
Option 3A Treatment

Category	Item	Representative Cost	Reference Table for Cost Estimate Details
Capital Cost	General Requirements (Soil and Groundwater) Mobilization/demobilization Site preparation Site restoration	$1,700,000	Table 5-C-17 & Table 5-C-23
	Soil Remediation Treatment of Arsenic and PAH Remediation Zone soil Phytoremediation cap for remaining soil	$4,700,000	Table 5-C-17
	Groundwater Remediation Treatment cells (total 60 gpm) Phenol and organics treatment Arsenic treatment Ammonia treatment Monitored natural attenuation	$3,500,000	Table 5-C-23
	Contingencies, Insurance, Bonds	$1,900,000	Table 5-C-17 & Table 5-C-23
	Noncontractor [1]	$2,300,000	Table 5-C-18 & Table 5-C-24
	Subtotal Capital Cost	$14,100,000	
Operation, Maintenance, and Repair (O, M & R)	Annual Cost (Years 1 - 5)	$1,700,000	Table 5-C-19 & Table 5-C-25
	Annual Cost (Years 6 - 30)	$320,000	Table 5-C-19 & Table 5-C-25
	Present Worth of O, M & R [2]	$10,900,000	Table 5-C-19 & Table 5-C-25
ESTIMATED TOTAL PRESENT WORTH		**$25,000,000**	

[1] Noncontractor includes engineering and regulatory.

[2] Present worth net discount rate of 5 percent over 30 years.

Table 5-7

Summary of Total Estimated Cost
Alternative 3 Removal
Option 3B Disposal

Category	Item	Representative Cost	Reference Table for Cost Estimate Details
Capital Cost	General Requirements (Soil and Groundwater) Mobilization/demobilization Site preparation Site restoration	$1,400,000	Table 5-C-20 & Table 5-C-23
	Soil Remediation Disposal of Arsenic and PAH Remediation Zone soil Phytoremediation cap for remaining soil	$4,100,000	Table 5-C-20
	Groundwater Remediation Treatment cells (total 60 gpm) Phenol and organics treatment Arsenic treatment Ammonia treatment (40%) Monitored natural attenuation	$3,500,000	Table 5-C-23
	Contingencies, Insurance, Bonds	$1,700,000	Table 5-C-20 & Table 5-C-23
	Noncontractor [1]	$2,250,000	Table 5-C-21 & Table 5-C-24
	Subtotal Capital Cost	$13,000,000	
Operation, Maintenance, and Repair (O, M & R)	Annual Cost (Years 1 - 5)	$1,700,000	Table 5-C-22 & Table 5-C-25
	Annual Cost (Years 6 - 30)	$320,000	Table 5-C-22 & Table 5-C-25
	Present Worth of O, M & R [2]	$10,900,000	Table 5-C-22 & Table 5-C-25
ESTIMATED TOTAL PRESENT WORTH		**$23,900,000**	

[1] Noncontractor includes engineering and regulatory.

[2] Present worth net discount rate of 5 percent over 30 years.

Table 5-8

Summary of Total Estimated Cost
Alternative 4 Aquifer Restoration

Category	Item	Representative Cost	Reference Table for Cost Estimate Details
Capital Cost	General Requirements (Soil and Groundwater) Mobilization/demobilization Site preparation Site restoration	$4,500,000	Table 5-C-26 & Table 5-C-29
	Soil Remediation Treatment of Arsenic and PAH Remediation Zone soil Off-site disposal of remaining soil	$16,700,000	Table 5-C-26
	Groundwater Remediation Aquifer restoration (200 gpm pumping rate) Treatment of phenol, organics, arsenic, ammonia, cyanide Discharge to NSSD	$13,400,000	Table 5-C-29
	Contingencies, Insurance, Bonds	$6,600,000	Table 5-C-26 & Table 5-C-29
	Noncontractor [1]	$3,000,000	Table 5-C-27 & Table 5-C-30
	Subtotal Capital Cost	$44,200,000	
Operation, Maintenance, and Repair (O, M & R)	Annual Cost	$3,100,000	Table 5-C-28 & Table 5-C-31
	Present Worth of O, M & R [2]	$56,500,000	Table 5-C-28 & Table 5-C-31
ESTIMATED TOTAL PRESENT WORTH		**$101,000,000**	

[1] Noncontractor includes engineering and regulatory.

[2] Present worth net discount rate of 5 percent over 30 years.

Table 6-1

Summary of Detailed and Comparative Analyses of Alternatives
Waukegan Manufactured Gas and Coke Plant Site

Alternatives	Protection of Human Health and Environment		Compliance with ARARs		Long-Term Effectiveness	Reduction of Toxicity, Mobility and Volume (through treatment)		Short-Term Effectiveness	Implement-ability	Cost ($1,000,000)	Comments
	Cleanup Standards	Extra Protection	GW MCLs	Soil		GW	Soil				
Alternative 1 No Action	No	No	No	No	No	No	No	No	Easy	$0	Used as a baseline comparison to other alternatives.
Alternative 2 Containment	Yes	Yes	Yes[1] (GMZ based)	Yes	Yes	Some	Some	Yes	Implementable	$39 (2A)	Long-term maintenance, impacts future site development.
Alternative 3 Removal	Yes	Yes	Yes[1] (GMZ based)	Yes	Yes	Yes	Yes	Yes	Implementable	$25 (3A)	Maximizes future site development.
Alternative 4 Aquifer Restoration	Yes	Yes, if achievable	No[2] (Class I)	Yes	No, not achievable	Yes	Yes	Exposure to excess soil	Technically impracticable.	$100	May be technically impracticable.

[1] Complies with GMZ based requirements.
[2] Technically impracticable for Class I requirements.

Figures

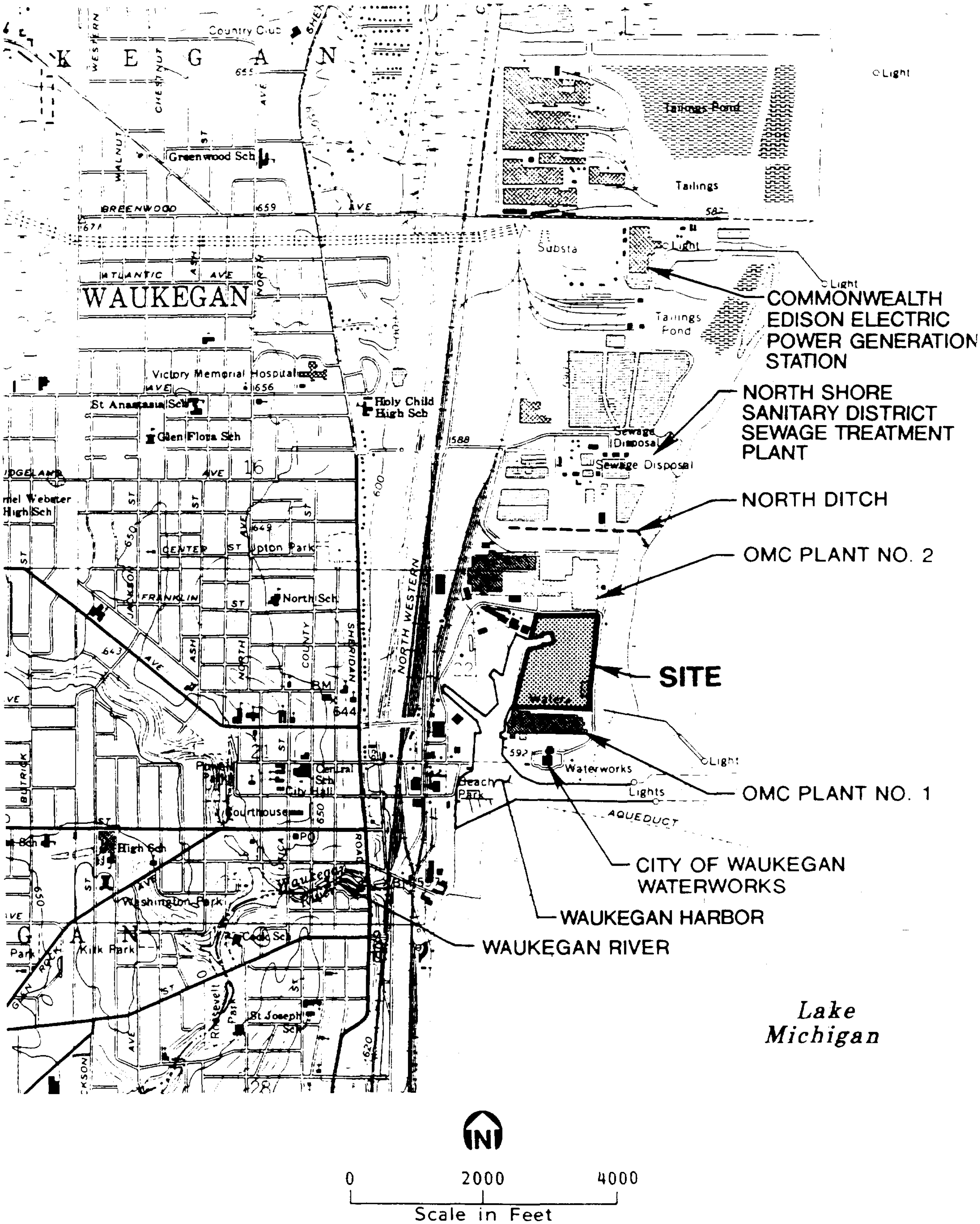
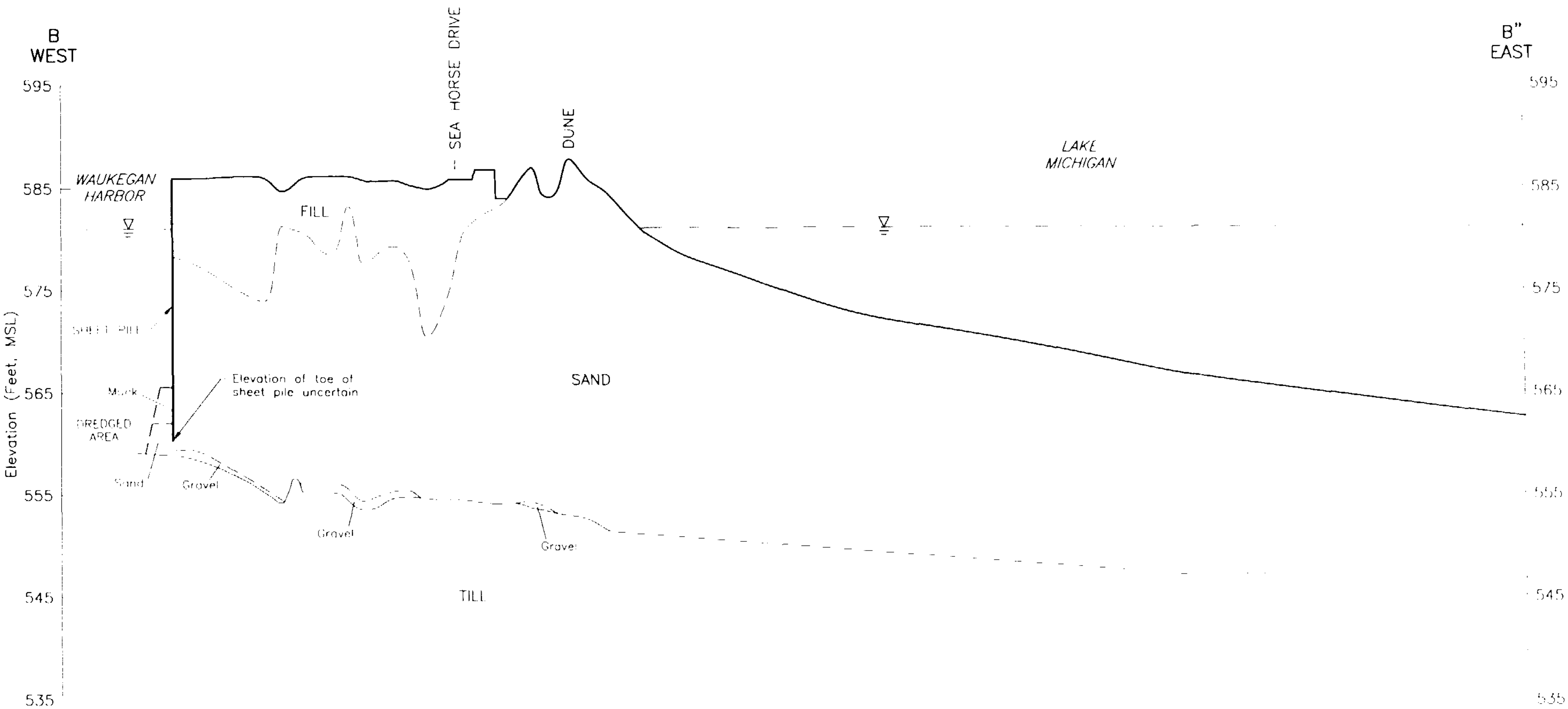
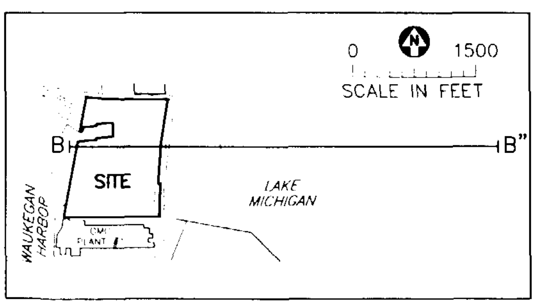


Figure 2-1

SITE LOCATION MAP
Waukegan Manufactured Gas and Coke Pla





SITE AND CROSS SECTION LOCATION

Figure 2 2

GEOLOGIC CROSS SECTION B B"
(GENERALIZED SCHEMATIC BASED ON RI REPORT
CROSS SECTION B-B')
Waukegan Manufactured Gas and Coke Plant

Figure 2-3

LAKE MICHIGAN BEACH LINE POSITION WITH TIME

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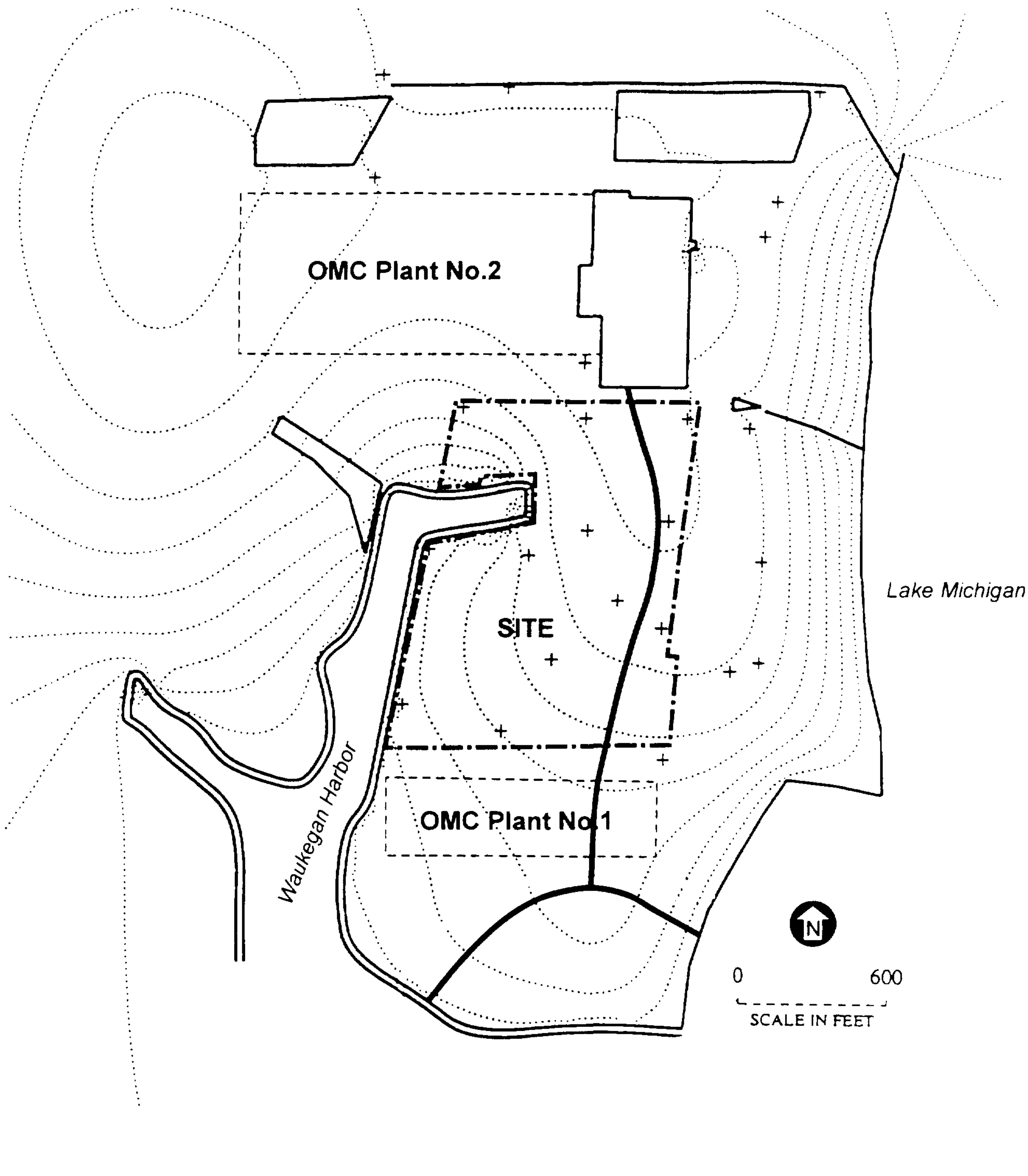


Groundwater Surface Contours (Contour Interval 0.25 feet)

Piezometer or Monitoring Well Location

Site Boundary

Groundwater Flow Divide

Figure 2-4

GROUNDWATER CONTOURS AND FLOW DIVIDES
(SLAEM GROUNDWATER MODEL)
Waukegan Manufactured Gas And Coke Plant

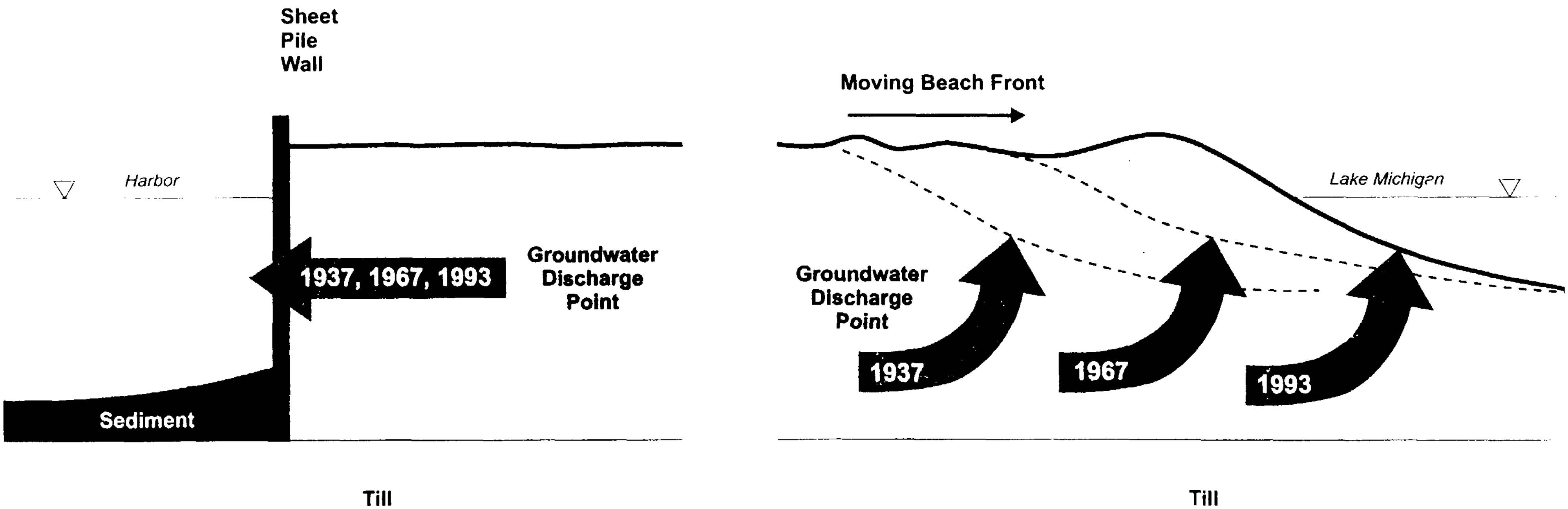
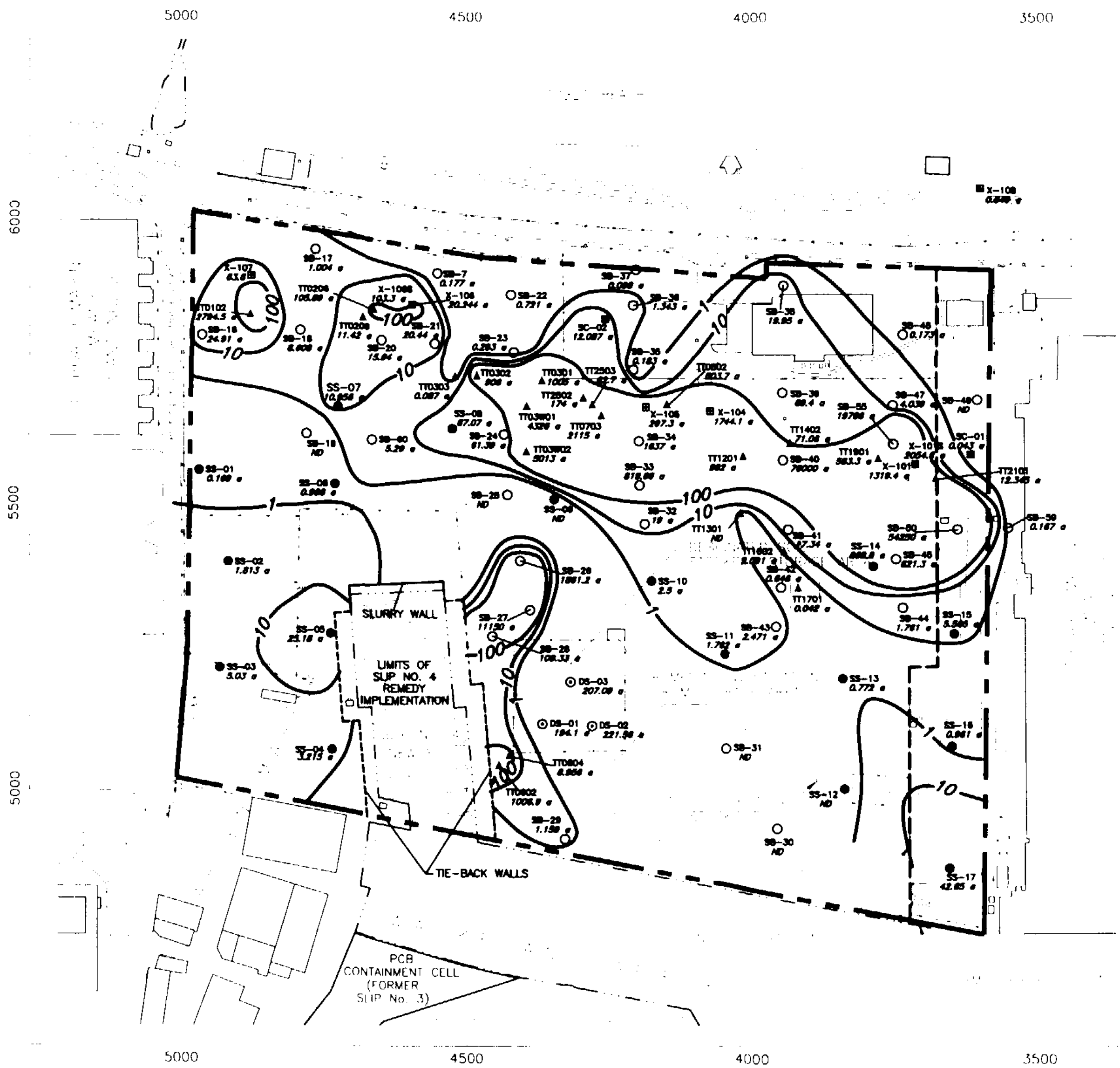


Figure 2-5

CONCEPTUAL ILLUSTRATION
GROUNDWATER DISCHARGE



0 200
SCALE IN FEET

DS-01	Designated Soil Stockpile Sample Location
X-106	Illinois Environmental Protection Agency Soil Sample Location
SS-07	Surficial Soil Sample Location
SC-01	Surficial Soil Sample Location
TT0804	Test Trench Sample Location
SB-33	Soil Boring Location
2.5	Total PAH Concentration (mg/kg)
ND	Not Detected
—*10*—	Total PAH Concentrations (mg/kg) In (Contours Are Approximate)

NOTE:

See Analytical Data Tables In RI Report For Explanation Of Data Qualifiers

Soil Stockpile Concentrations Are Located At Depths Below The Base Of The Soil Stockp

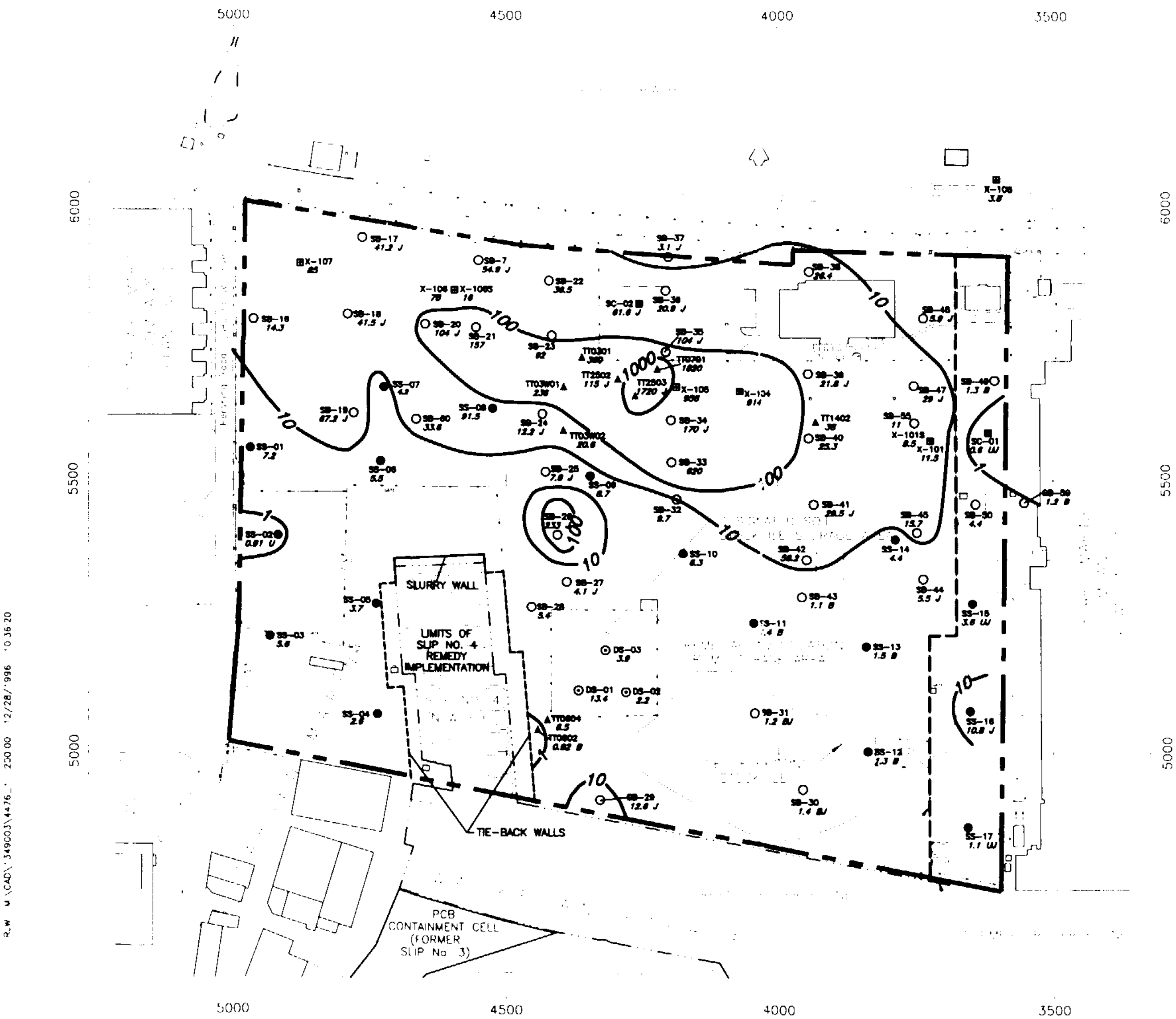
Designated Soil Stockpile Concentrations Are From Within The Containment Cell And Are Excluded From Contouring

Sample Matrices And Concentrations Of Samples >1000 mg/kg TPAH

SAMPLE	TOTAL PAH CONCENTRATION	MATRIX
TT0102	2794.5 a	Visibly Contaminated Sand
TT03W01	4326 a	Visibly Contaminated Industrial Pond Deposit
TT03W02	5013 a	Visibly Contaminated Sand
TT0602	1006.9 a	Visibly Contaminated Soil
TT0703	2115 a	Visibly Contaminated Soil
X-101	1319.4 a	Not Known
X-1015	2054.6 a	Not Known
X-104	1744.1 a	Not Known
SB-26	1861.2 a	Coal And Coke Fines
SB-27	11,150 a	Sand
SB-34	1637 a	Visibly Contaminated Sand With Coal Fines
SB-40	76,000 a	Visibly Contaminated Soil
SB-50	54,250 a	Visibly Contaminated Soil
SB-55	19,766 a	Visibly Contaminated Soil

Figure 2-6

DISTRIBUTION OF TOTAL PAH CONCENTRATIONS IN VADOSE ZONE SOILS
DEPTH 0.5'-4.5'
Waukegan Manufactured Gas And Coke Plan



0 200
SCALE IN FEET

⊙DS-01	Designated Soil Stockpile Sample Location
⊞X-106	Illinois Environmental Protection Agency Soil Sample Location
●SS-07	Surficial Soil Sample Location
■SC-01	Surficial Soil Sample Location
▲TT0604	Test Trench Sample Location
○SB-33	Soil Boring Location
29.5	Arsenic Concentration (mg/kg)
ND	Not Detected
—10—	Arsenic Concentrations (mg/kg) In (Contours Are Approximate)

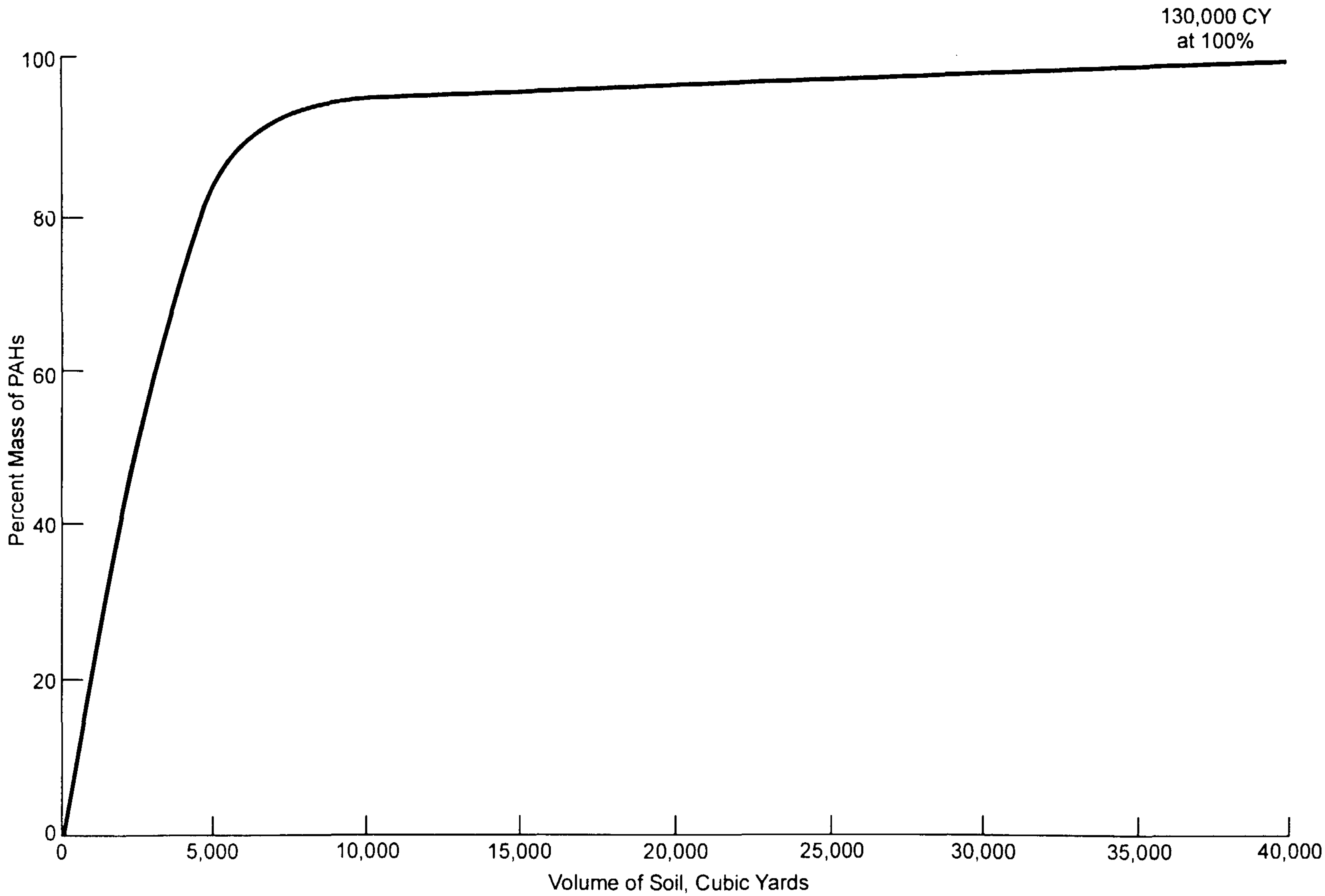
NOTE

See Analytical Data Tables In RI Report For Explanation Of Data Qualifiers.

Soil Stockpile Concentrations Are Located At Depths Below The Base Of The Soil Stockpile.

Designated Soil Stockpile Concentrations Are From Within The Containment Cell And Are Excluded From Contouring.

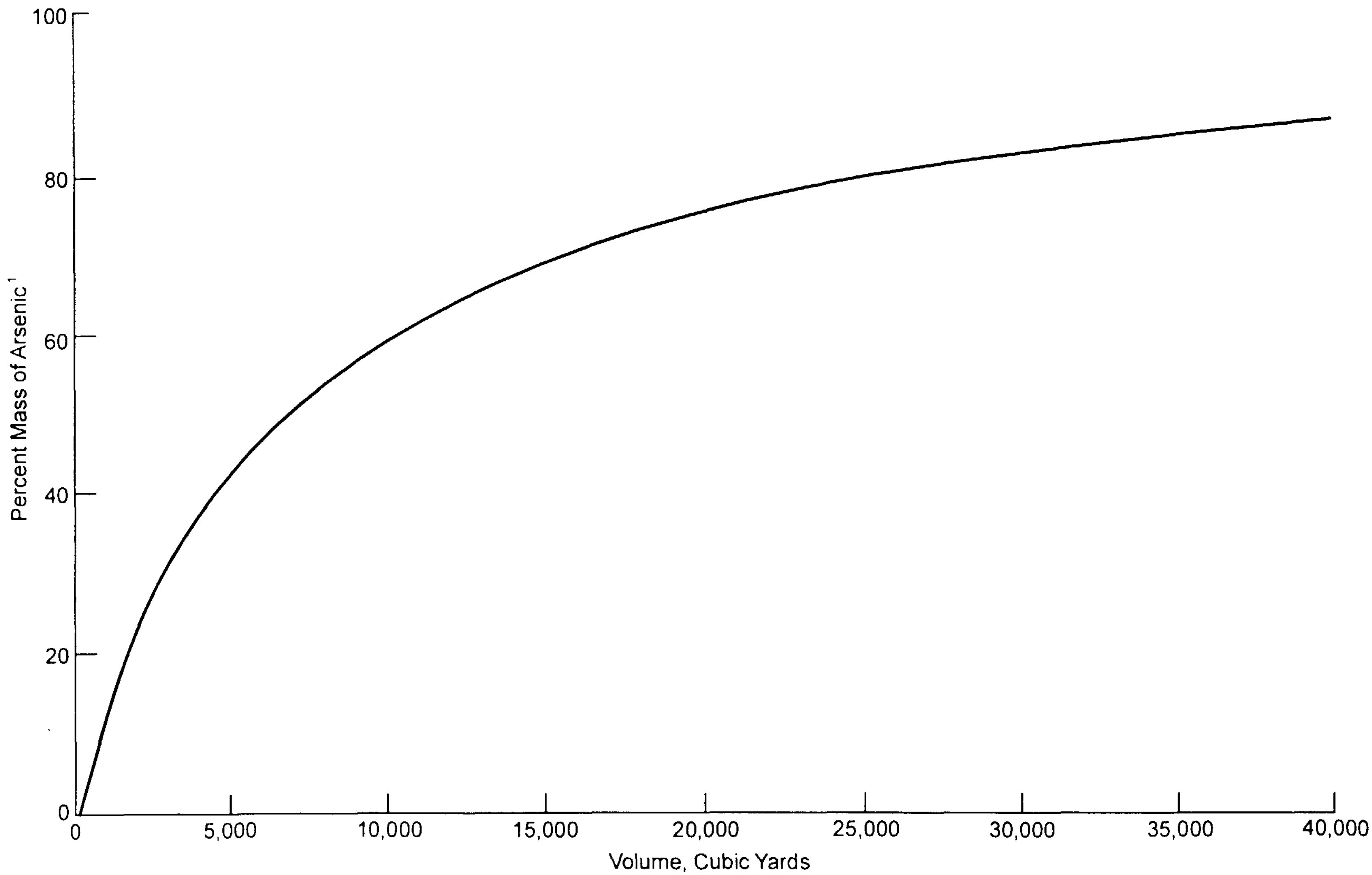
Figure 2-7
DISTRIBUTION OF ARSENIC CONCENTRATIONS IN VADOSE ZONE SOILS
DEPTH 0.5'-4.5'
Waukegan Manufactured Gas And Coke Plant



Note: Includes 4600 cubic yards tarry soil at an average concentration of 27,000 mg/kg total PAHs

Figure 2-8

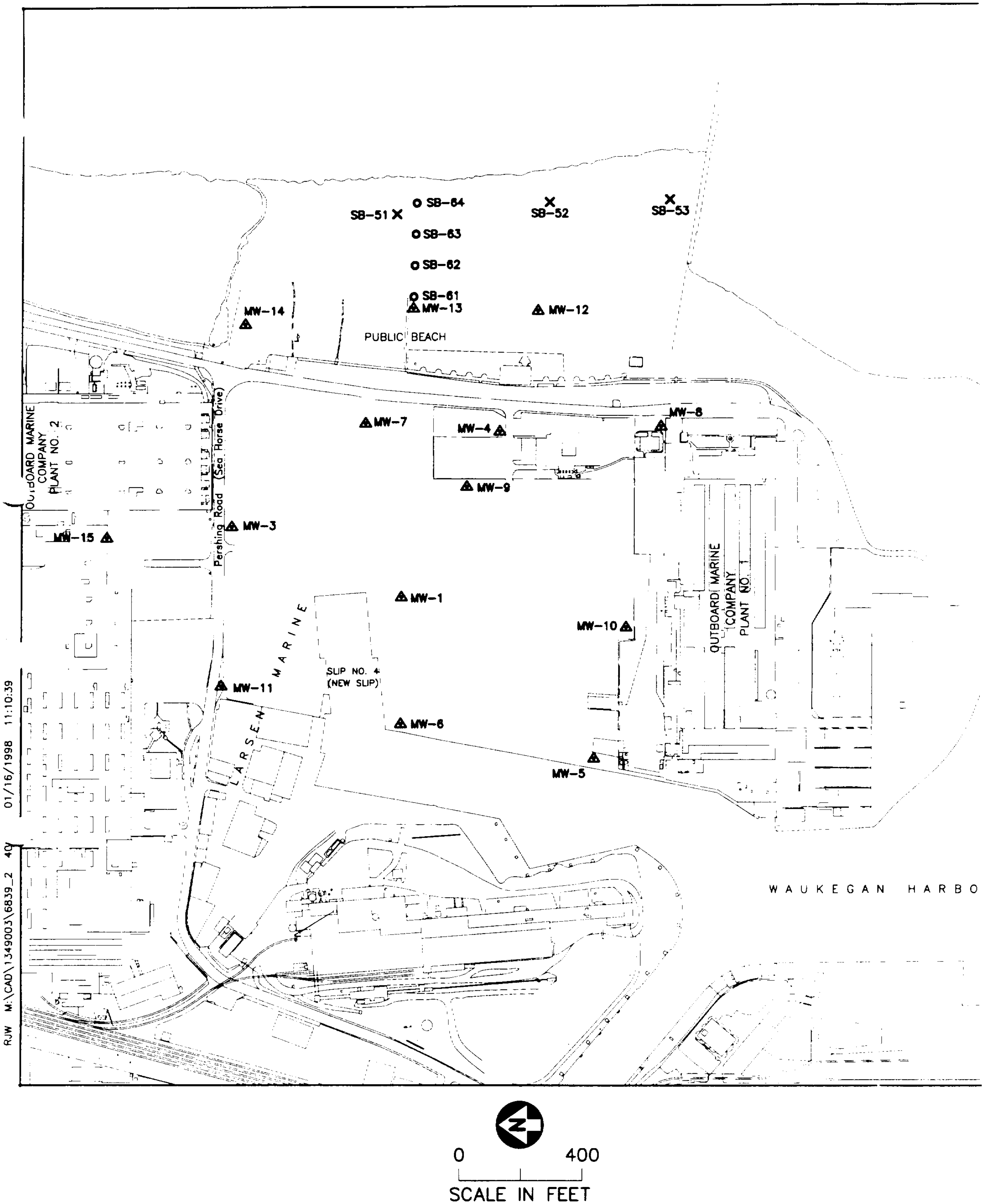
CUMULATIVE PERCENT TOTAL MASS OF
PAH CONTAMINATED SOIL
Waukegan Manufactured Gas & Coke Plant Site



[1] Above 16 ppm Background

Figure 2-9

CUMULATIVE PERCENT TOTAL MASS OF ARSENIC CONTAMINATED SOIL (0 to 5ft)
Waukegan Manufactured Gas & Coke Plant Site



MW-7 Sand Aquifer Monitoring Well

× Previous Beach Boring Location

o Beach Transect Groundwater Sample Location

Figure 2–10

1997 BEACH TRANSECT
GROUNDWATER SAMPLING LOCATIONS
Waukegan Manufactured Gas & Coke Plant

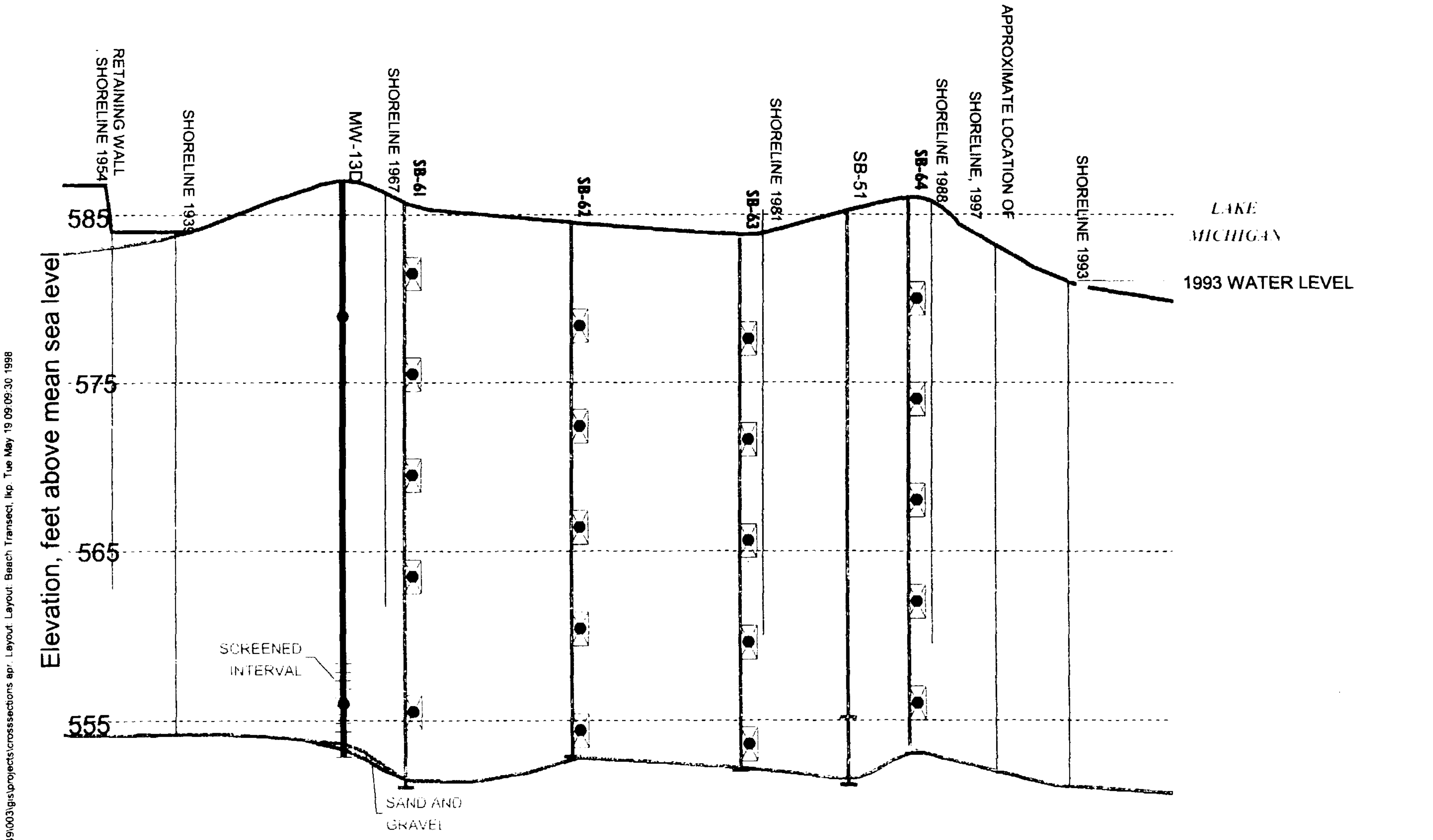


Figure 2-11

BEACH TRANSECT
GROUNDWATER SAMPLING LOCATIONS
CROSS-SECTION VIEW

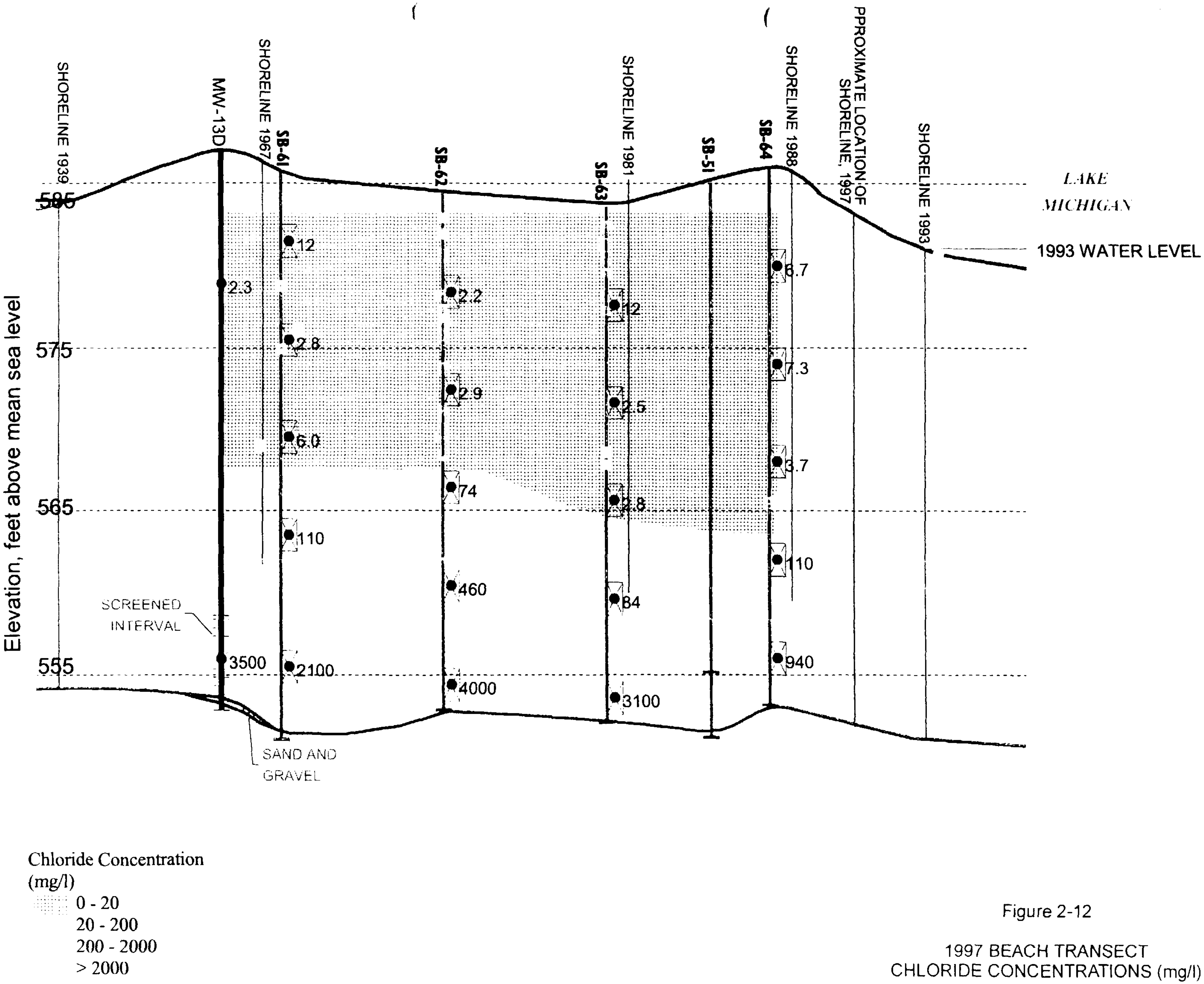
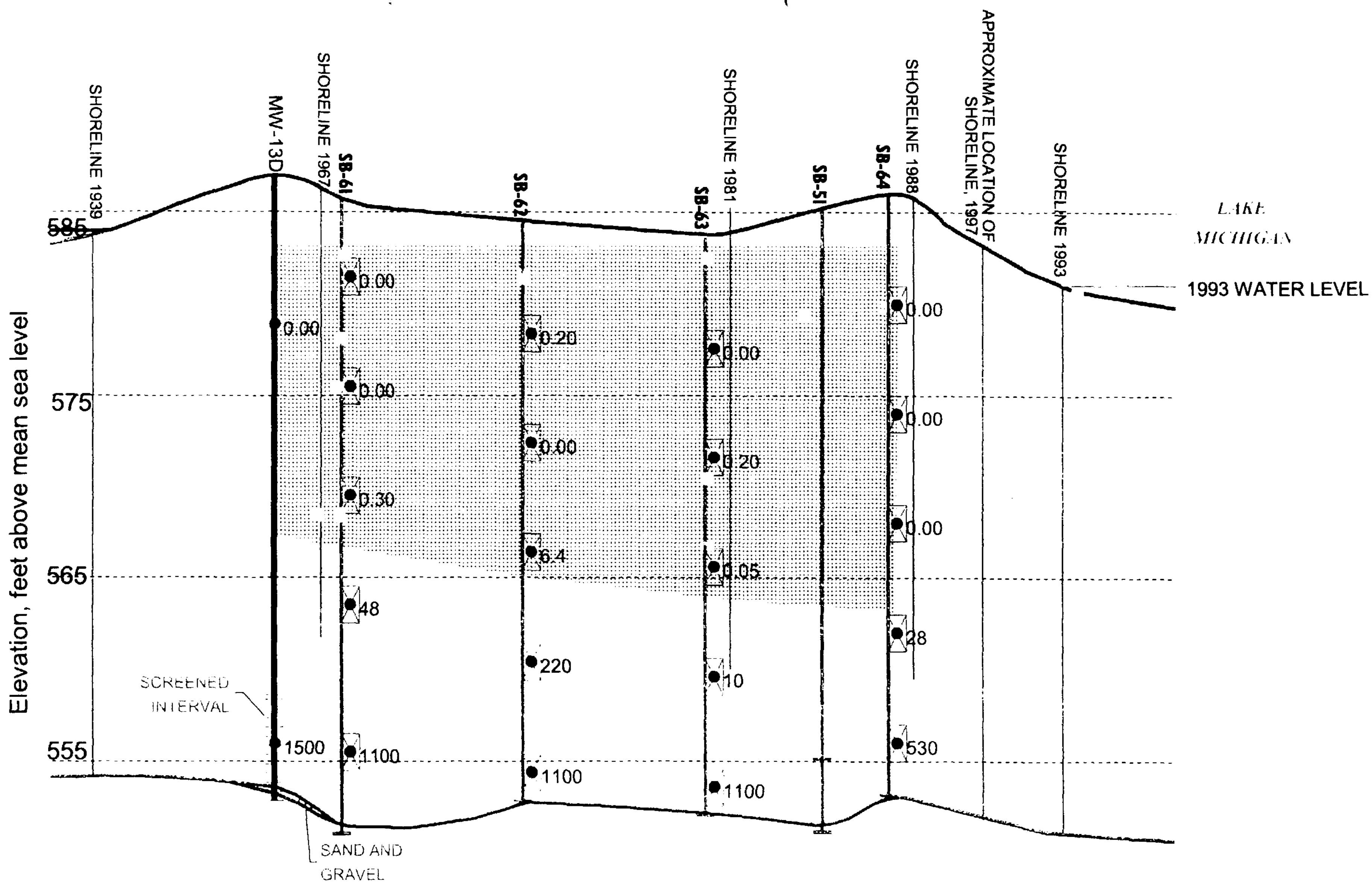


Figure 2-12

1997 BEACH TRANSECT
CHLORIDE CONCENTRATIONS (mg/l)



Ammonia Concentration (mg/l)
0 - 10
10 -100
100 - 1000
> 1000

Figure 2-13

1997 BEACH TRANSECT
AMMONIA CONCENTRATIONS (mg/l)

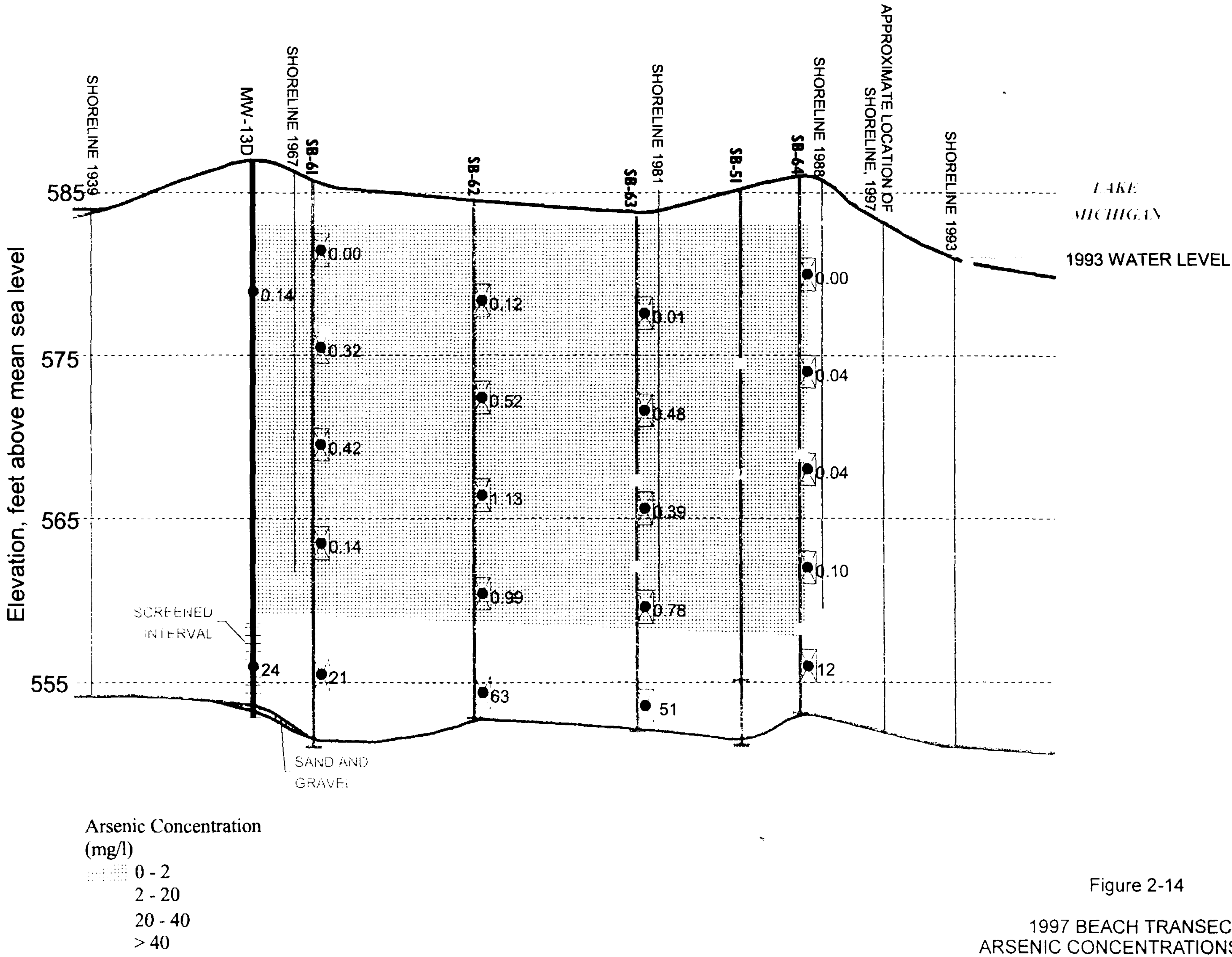


Figure 2-14

1997 BEACH TRANSECT
ARSENIC CONCENTRATIONS (mg/l)

Arcview 3.0a, r:\projects\13\491003\gis\projects\crosssections.apr, Layout: Layout Arsenic, lkp, Tue May 19 09:32:46 1998

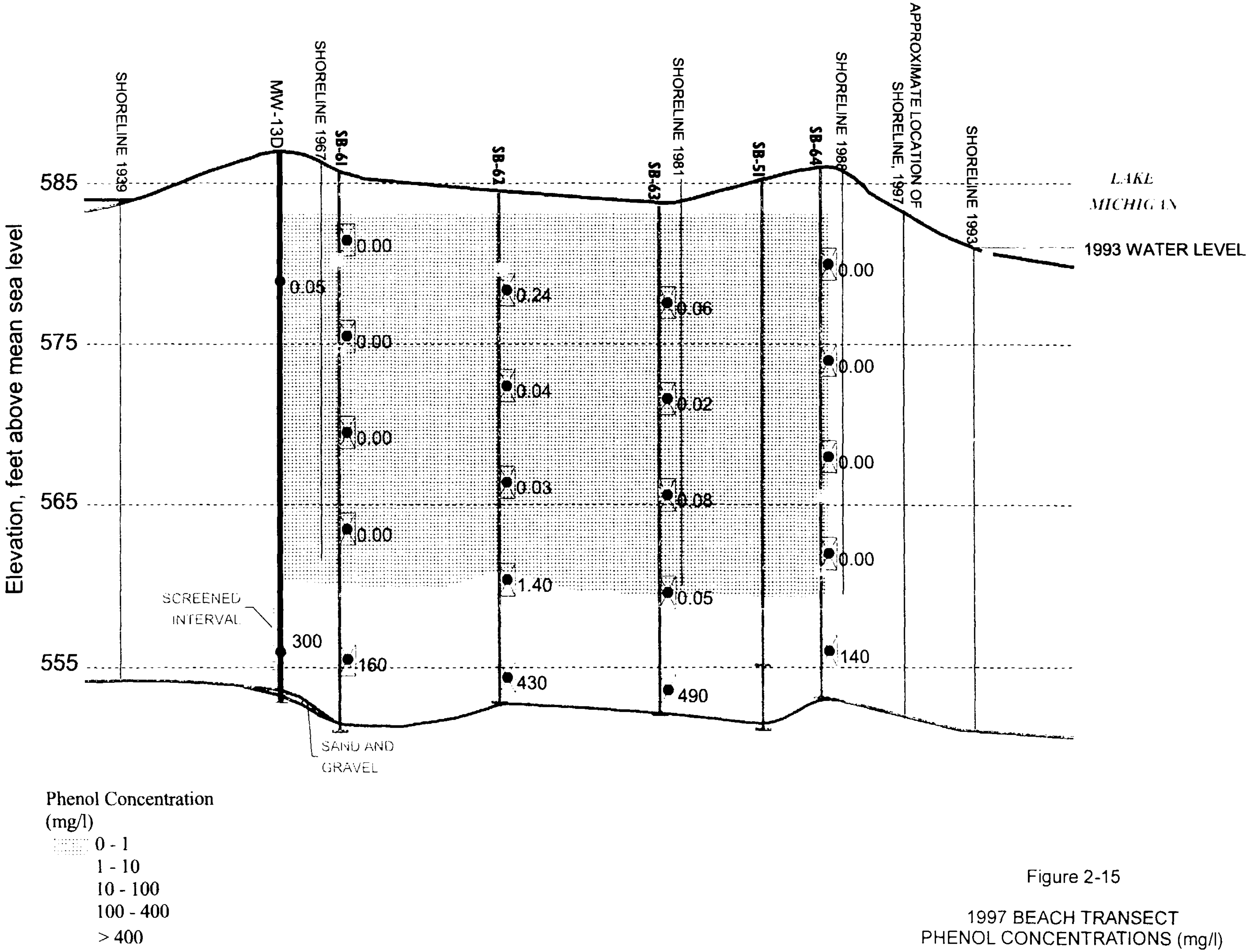


Figure 2-15

1997 BEACH TRANSECT
PHENOL CONCENTRATIONS (mg/l)

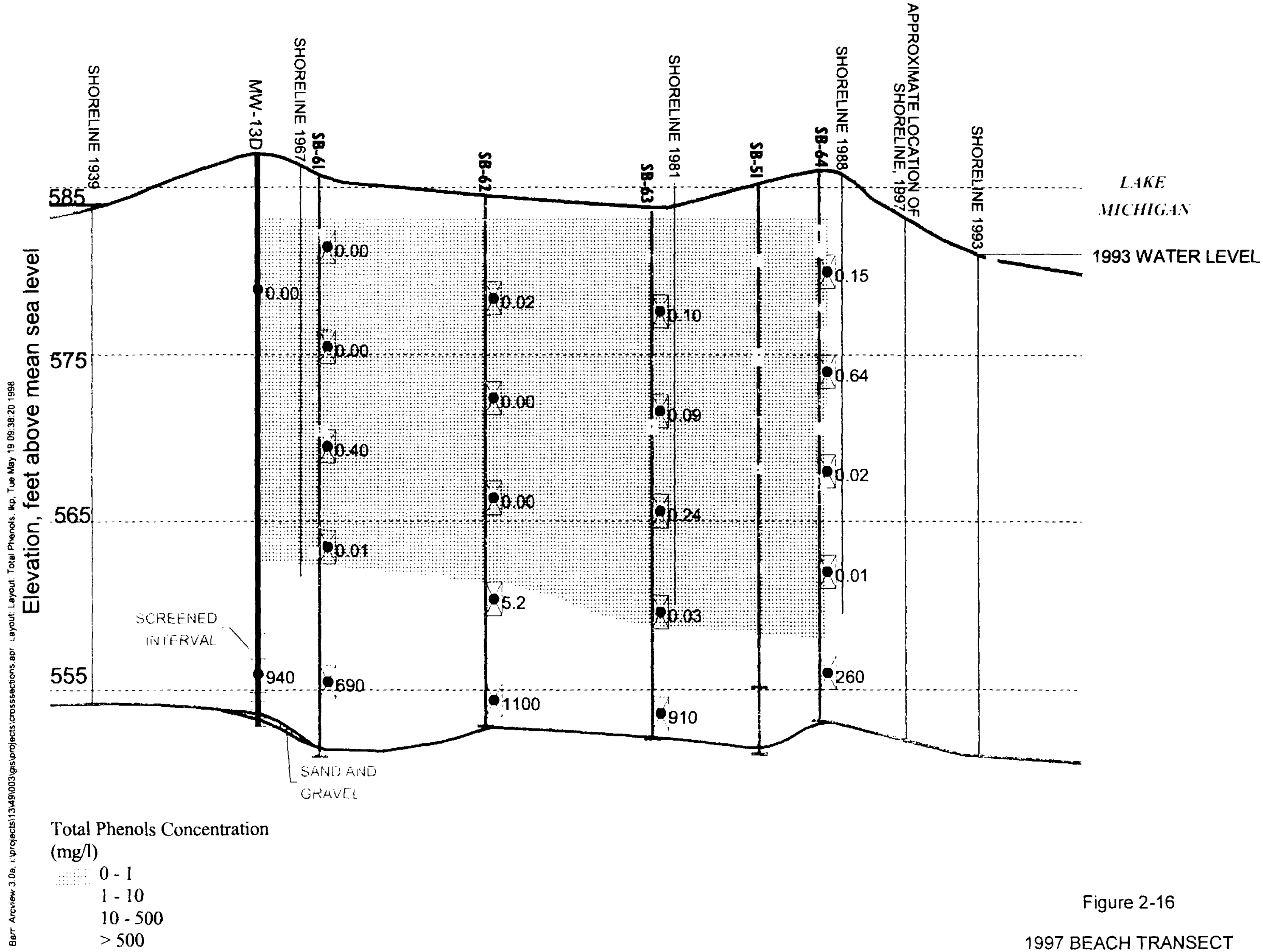


Figure 2-16

1997 BEACH TRANSECT
TOTAL PHENOLS CONCENTRATIONS (mg/l)

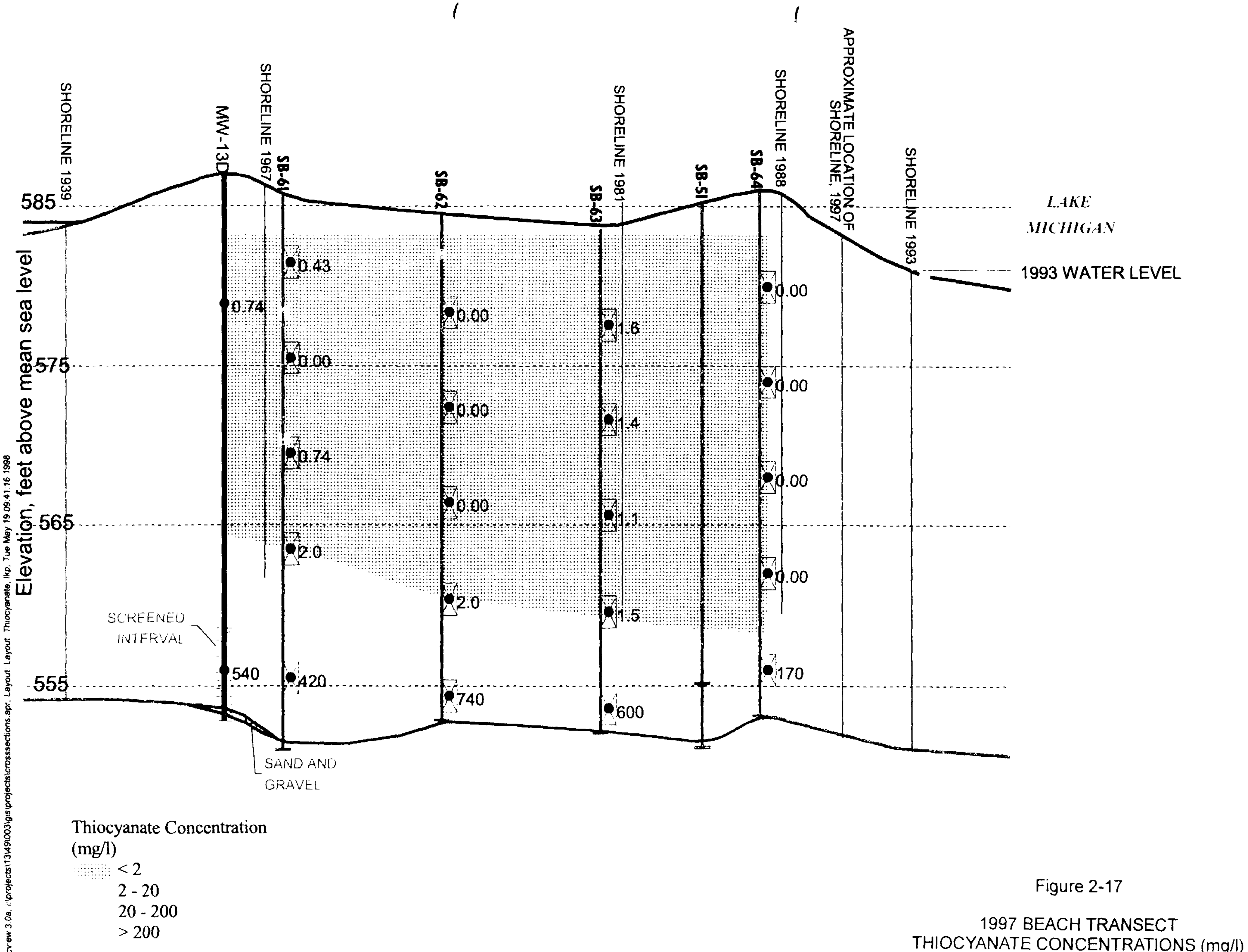


Figure 2-17

1997 BEACH TRANSECT
THIOCYANATE CONCENTRATIONS (mg/l)

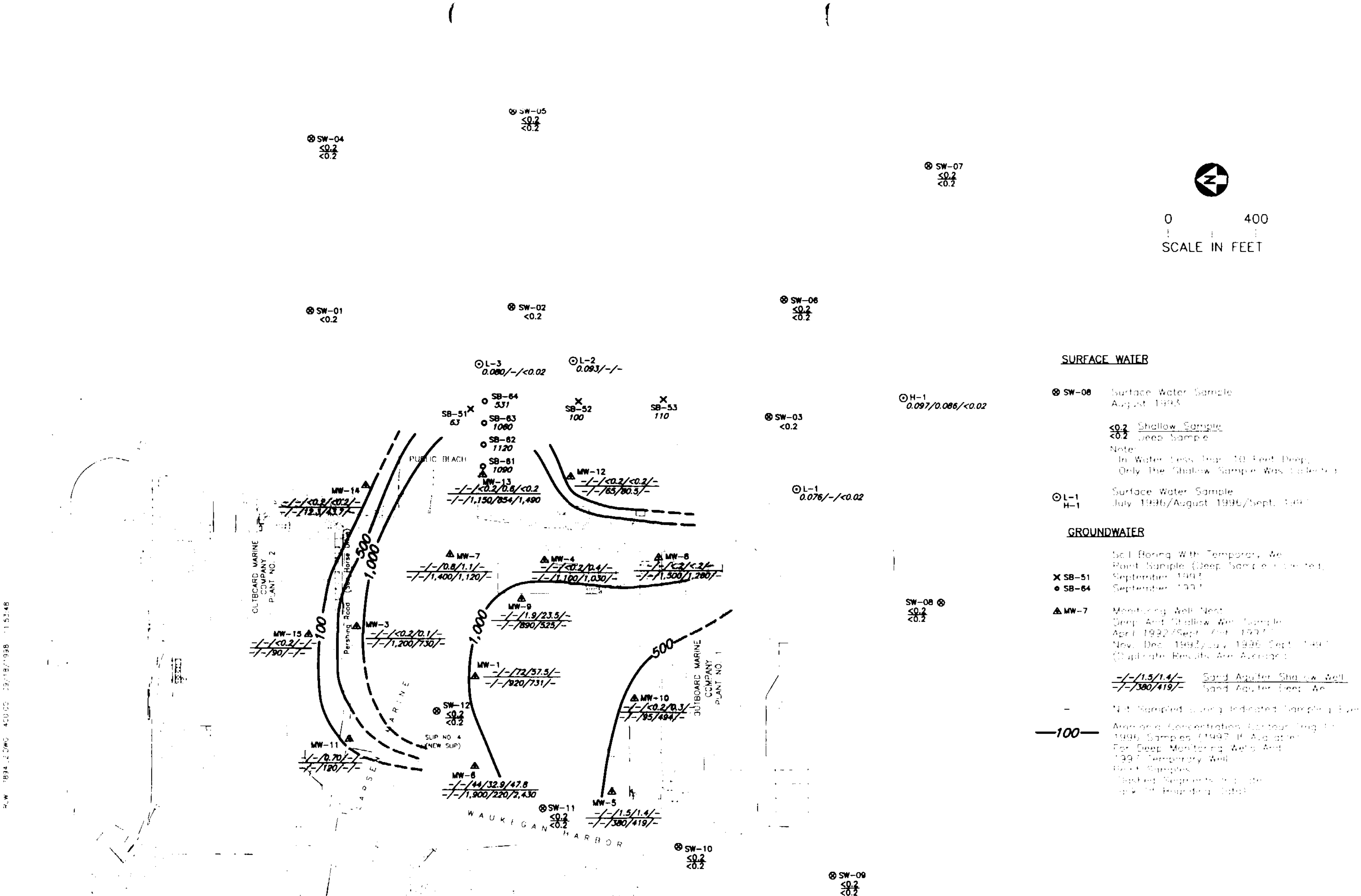


Figure 2–18
AMMONIA CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant

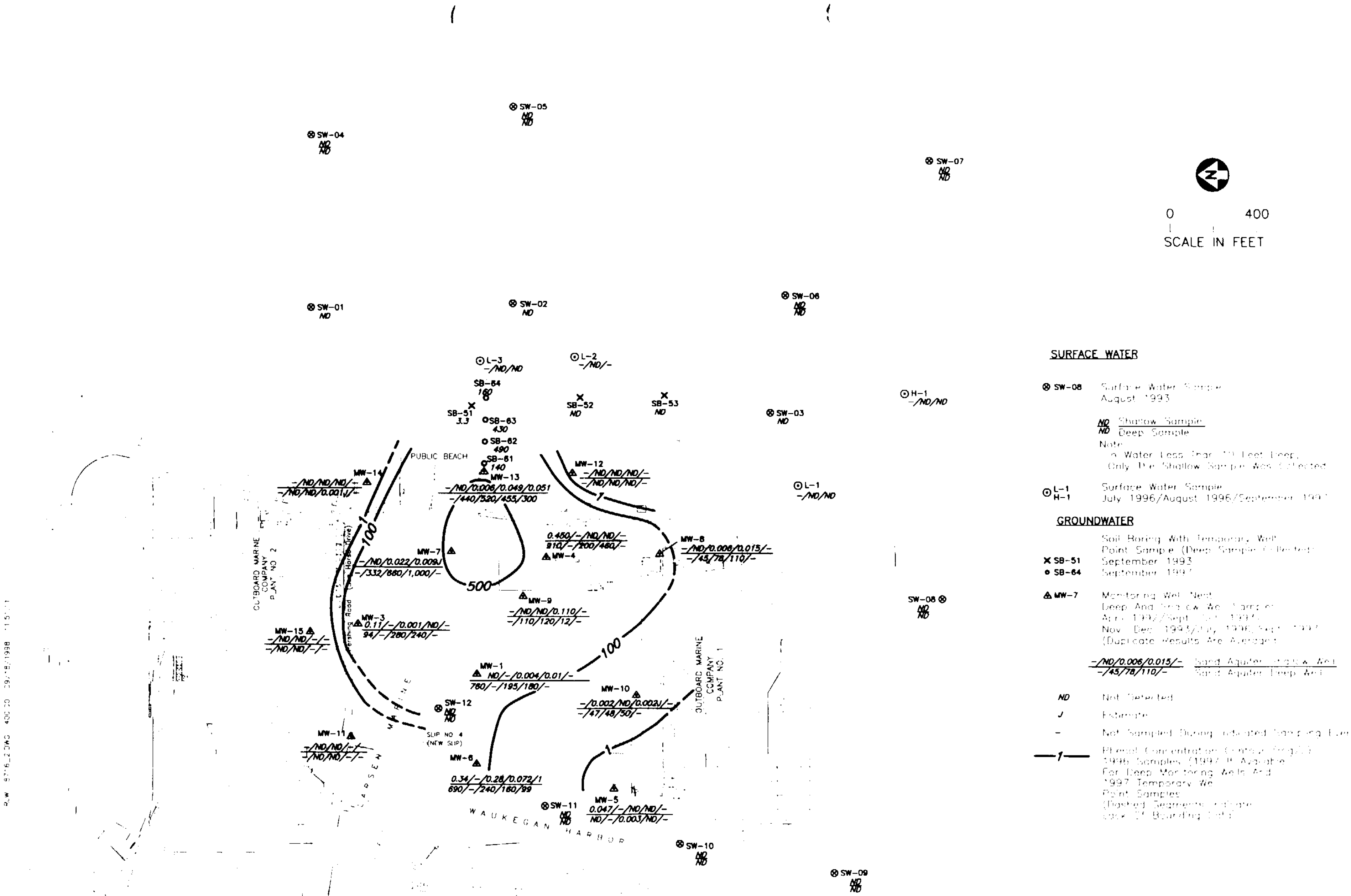
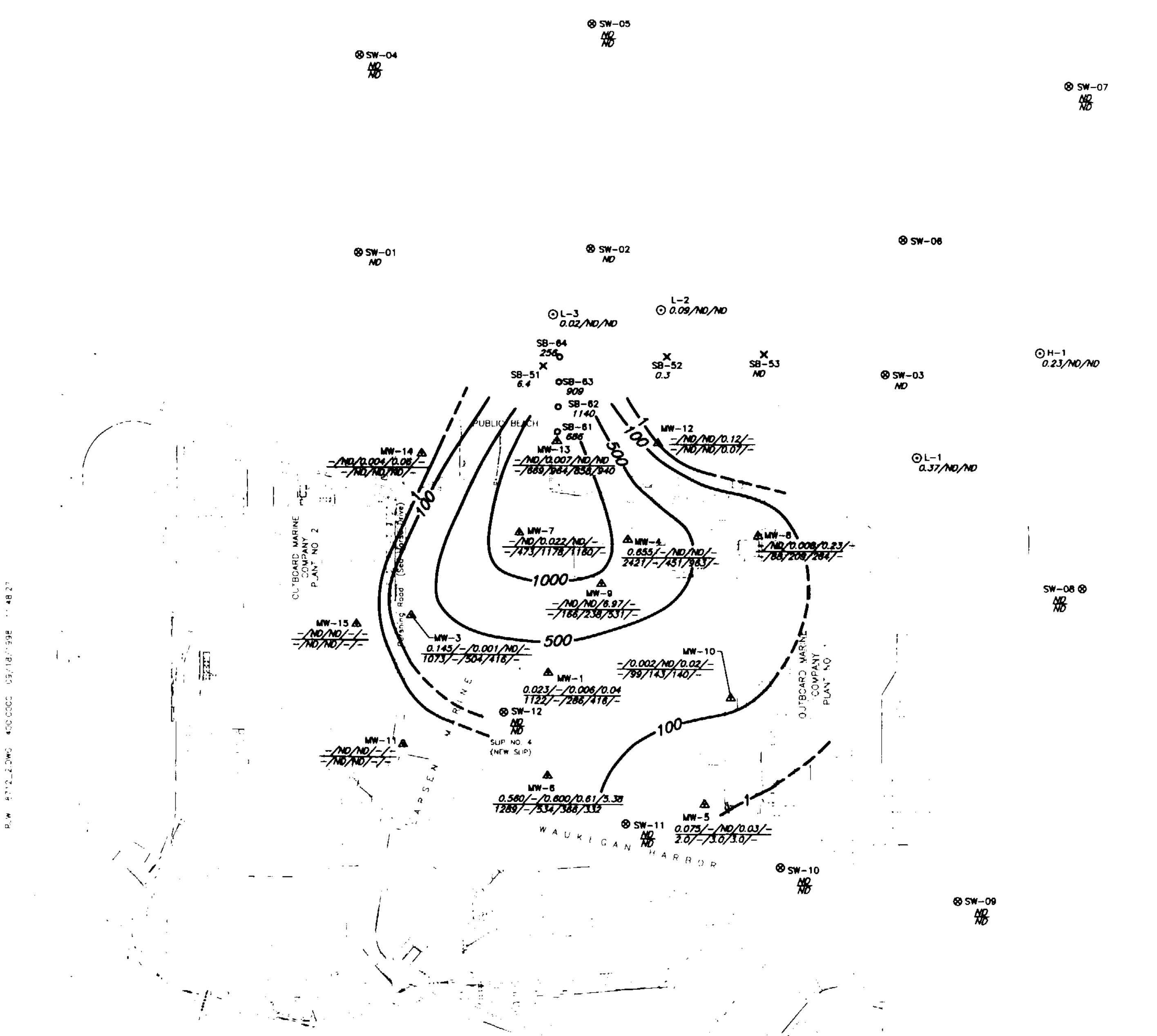


Figure 2-19
PHENOL CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant



0 400
SCALE IN FEET

SURFACE WATER

SW-08 (1) Surface Water Sample Location August 1993

ND Shallow Sample
ND Deep Sample

Note
In Water Less Than 10 Feet Deep, Only The Shallow Sample Was Collected

L-1 H-1 (2) Surface Water Sample Location July 1996/August 1996/September 1997

GROUNDWATER

Soil Boring With Temporary Well Point Sample (Deep Sample Collected)
SB-51 (1) September 1993
SB-64 (2) September 1997

MW-7 Monitoring Well Nest
Deep And Shallow Well Samples
April 1992/Sept. Oct. 1993/
Nov.-Dec. 1993/July 1996/Sept. 1997
(Duplicate Results Are Averaged)
(1) April 1992/Sept. ...
(2) July 1996 And Sept. 1997

0.023/-/0.006/0.04/- Sand Aquifer Shallow Well
1122/-/286/416 Sand Aquifer Deep Well

ND Not Detected

- Not Sampled During Indicated Sampling Event

—1— Total Phenols Concentration ... 1996 Samples (1997 If Available For Deep Monitoring Wells And 1997 Temporary Well Point Samples) (Dashed Segments Indicate Lack Of Bounding Data)

Note
(1) Totals Determined By Summation Of Phenolic Compounds By Method ...
(2) Totals Determined By 4AAP Analytical Method

Figure 2-20

TOTAL PHENOLS CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant

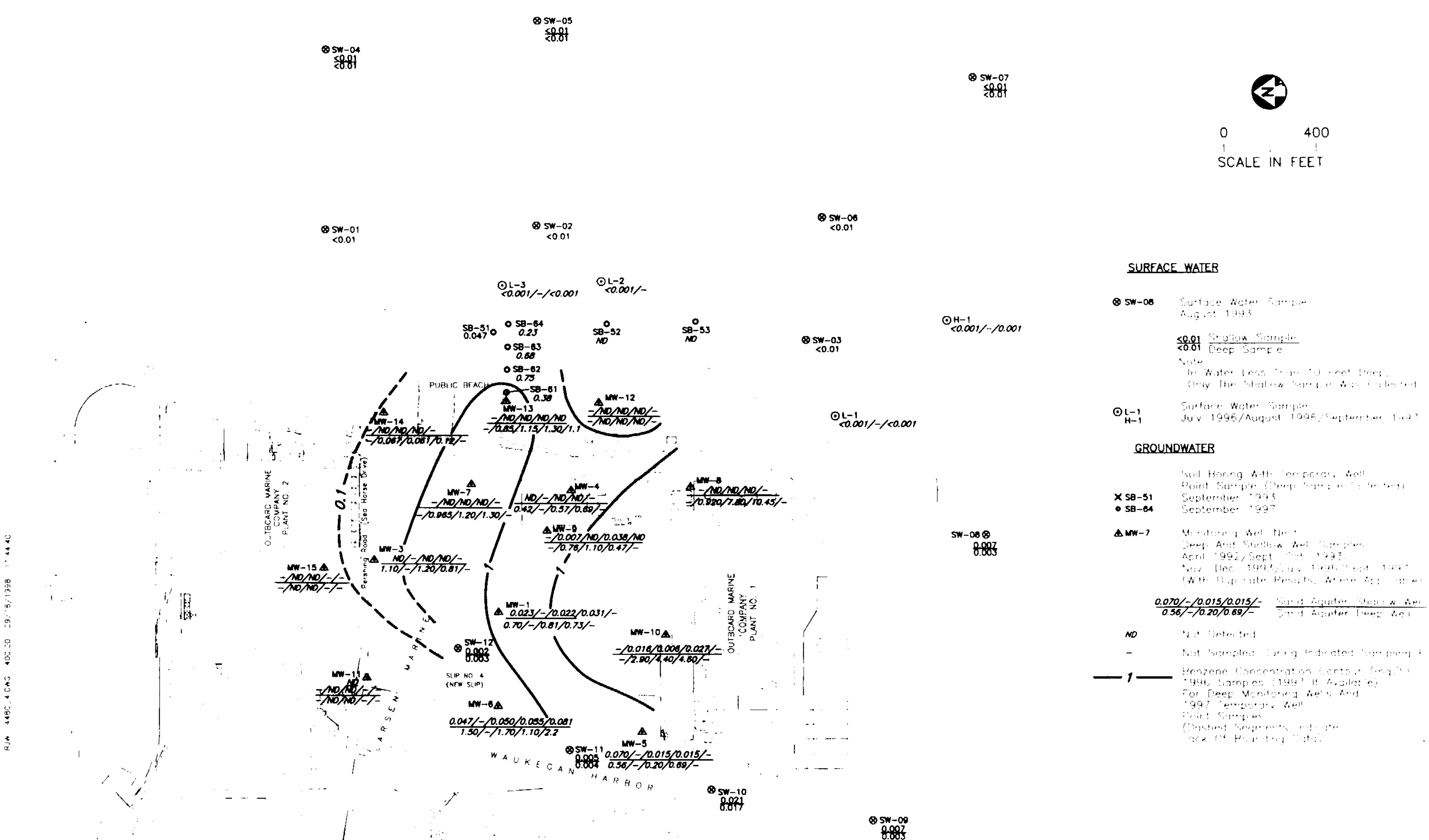


Figure 2-21
BENZENE CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant

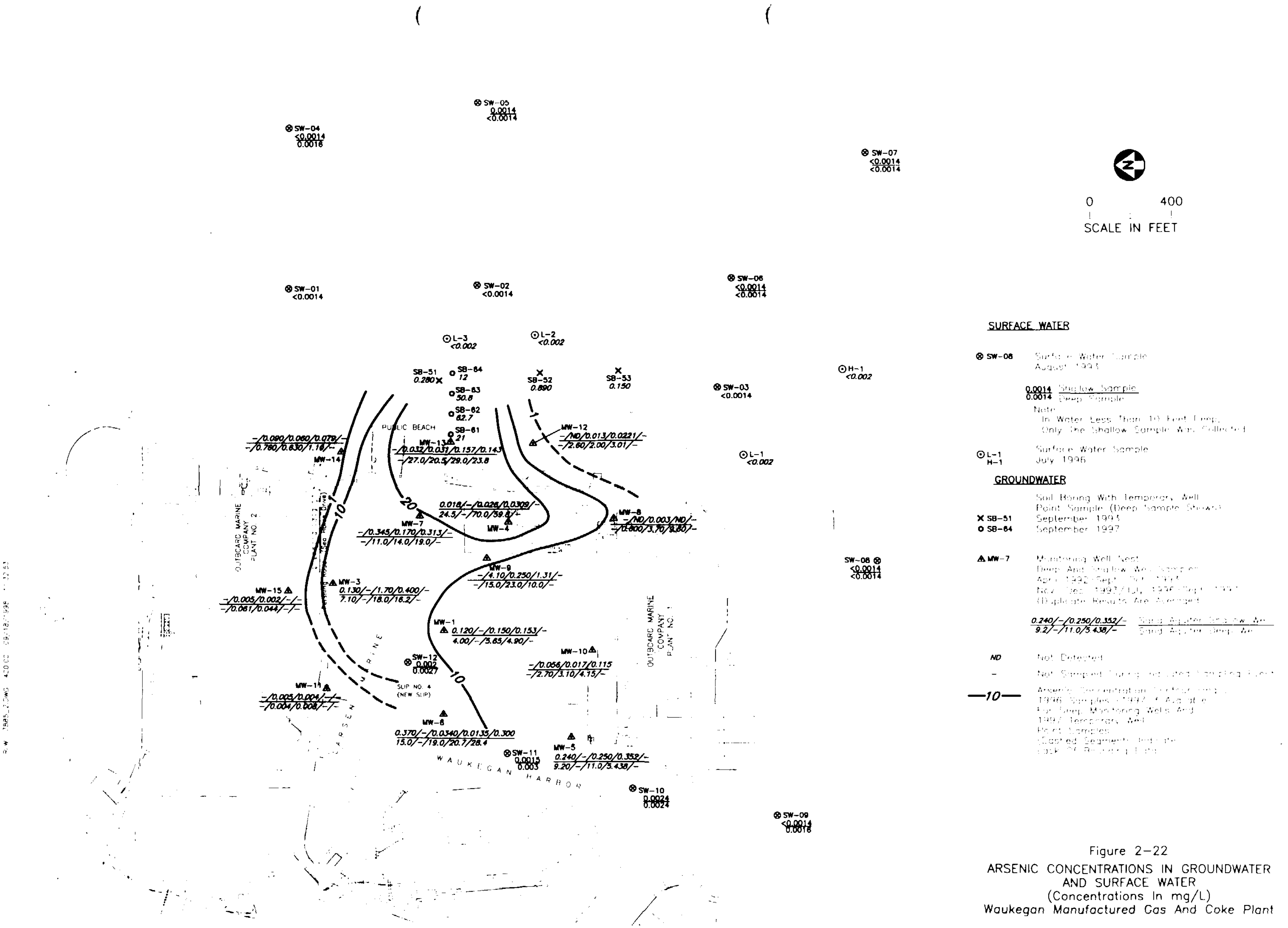
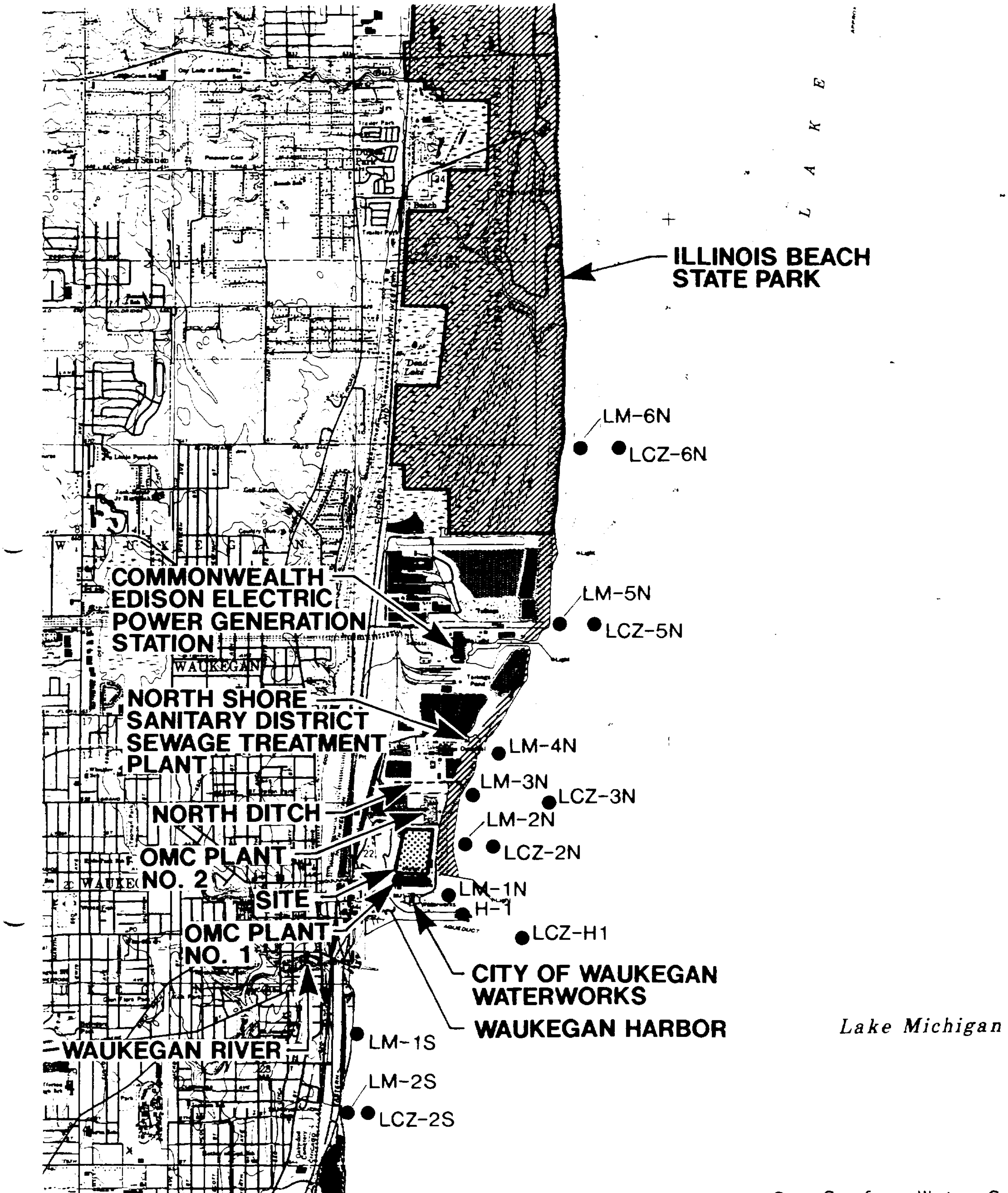


Figure 2–22
ARSENIC CONCENTRATIONS IN GROUNDWATER AND SURFACE WATER
(Concentrations In mg/L)
Waukegan Manufactured Gas And Coke Plant



Source: Waukegan and Zion, Illinois Quadrangles, 7.5 Minute Series 1980.

LM-1N ● Surface Water Sampling Location

N

0 4000 8000
Scale in Feet

ILLINOIS
QUADRANGLE LOCATION

Figure 2-23

SEPTEMBER 1997 SURFACE WATER SAMPLING LOCATIONS
Waukegan Manufactured Gas & Coke Plant

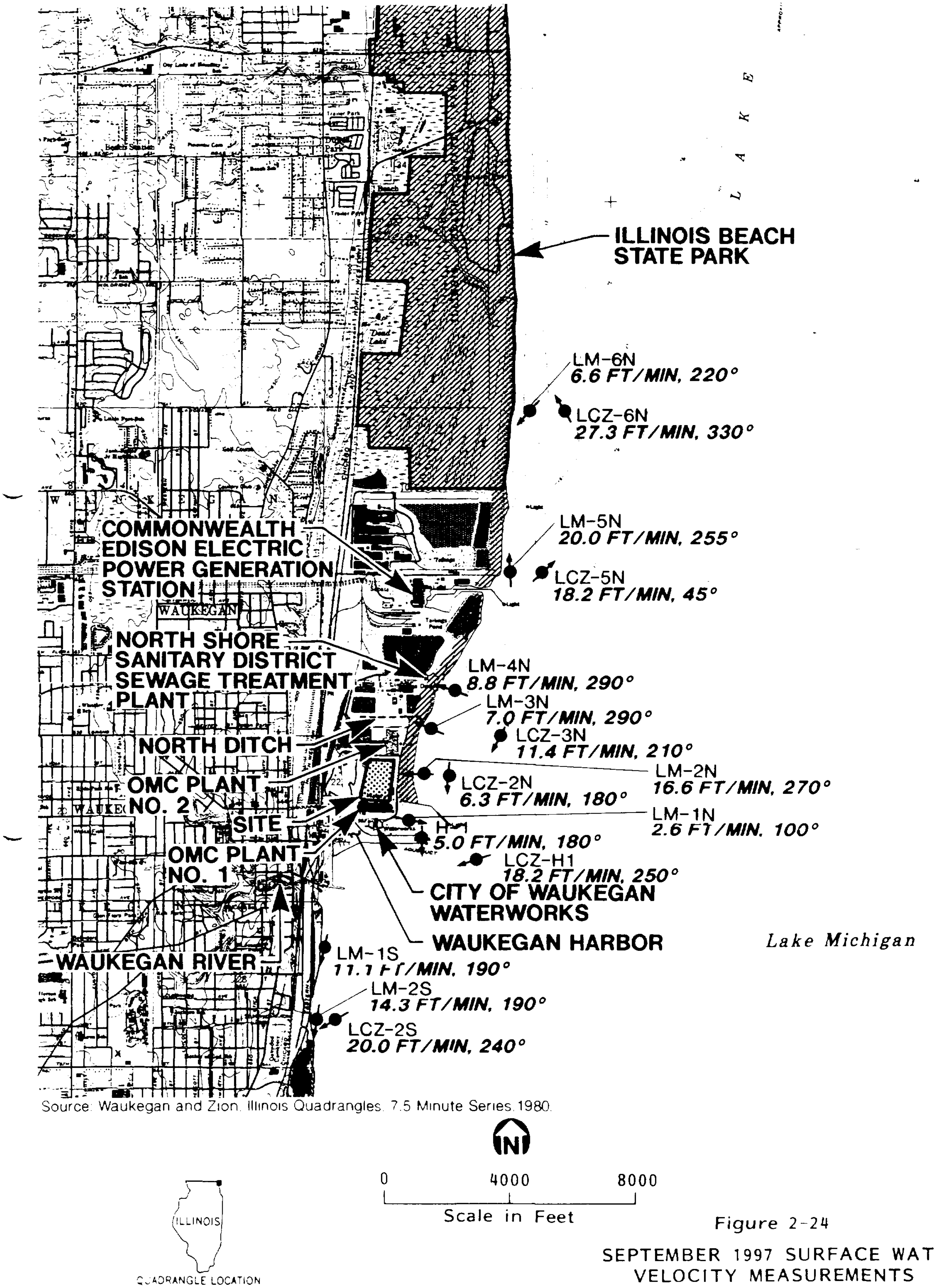
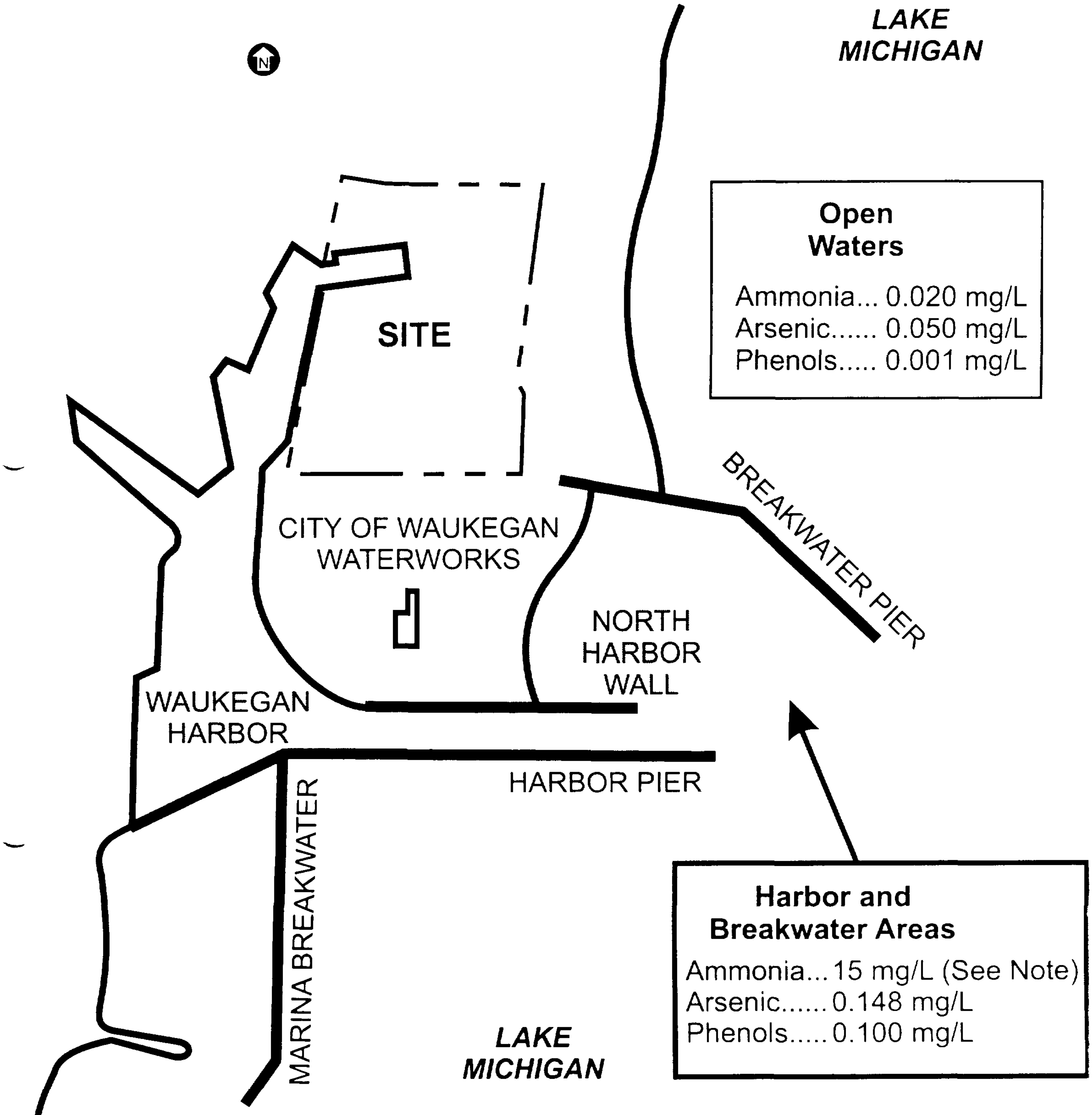


Figure 2-24

SEPTEMBER 1997 SURFACE WATER VELOCITY MEASUREMENTS
Waukegan Manufactured Gas & Coke Plan



NOTE: Ammonia standards: maximum total ammonia as N is 15 mg/L. In addition, the following maximums apply to un-ionized ammonia.

	Un-ionized Ammonia (mg/L)	
	Acute	Chronic
April - October	0.330	0.057
November - March	140	0.025

Figure 3-1

LAKE MICHIGAN SURFACE WATER QUALITY CRITERIA
Waukegan Manufactured Gas & Coke Plant Site

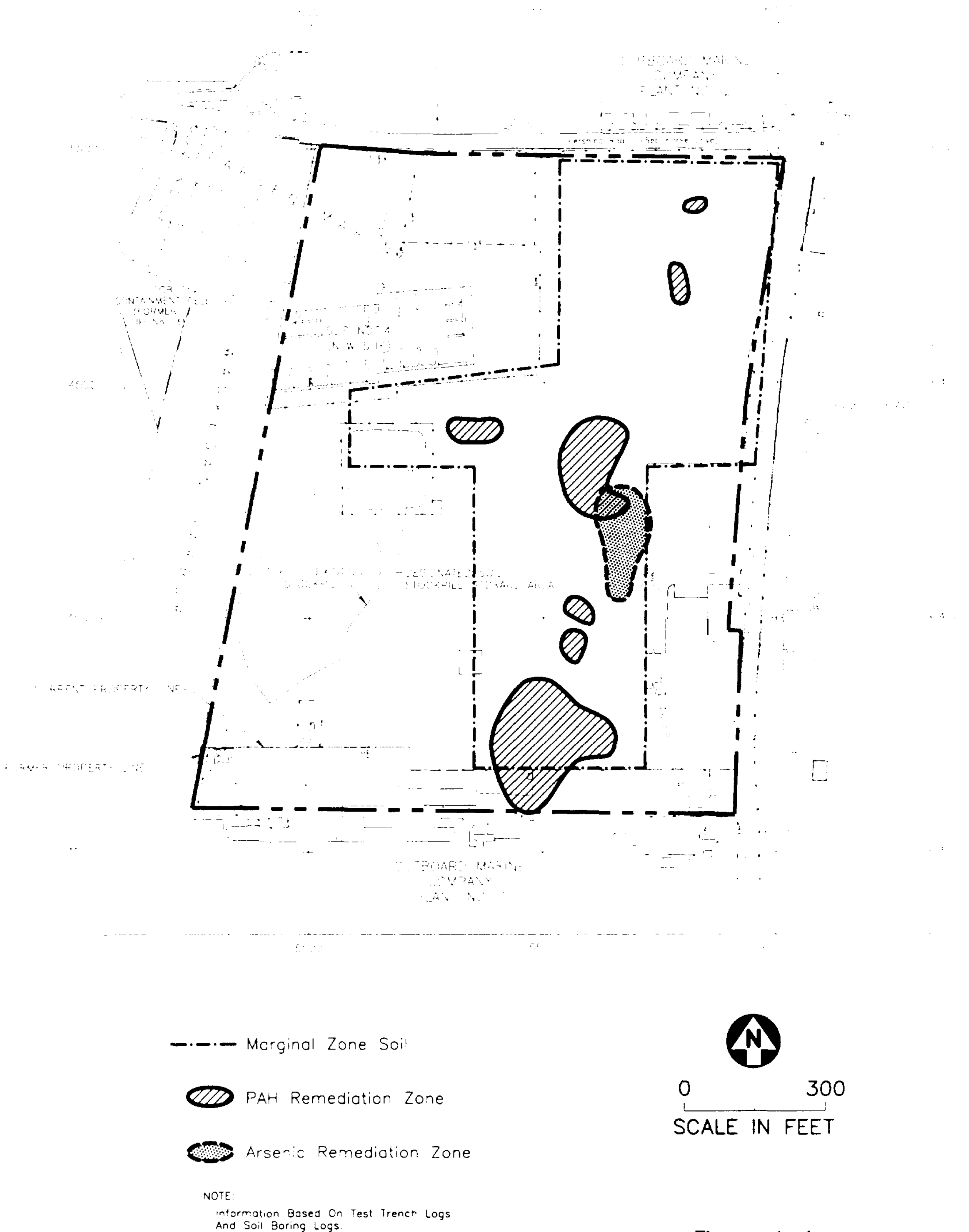
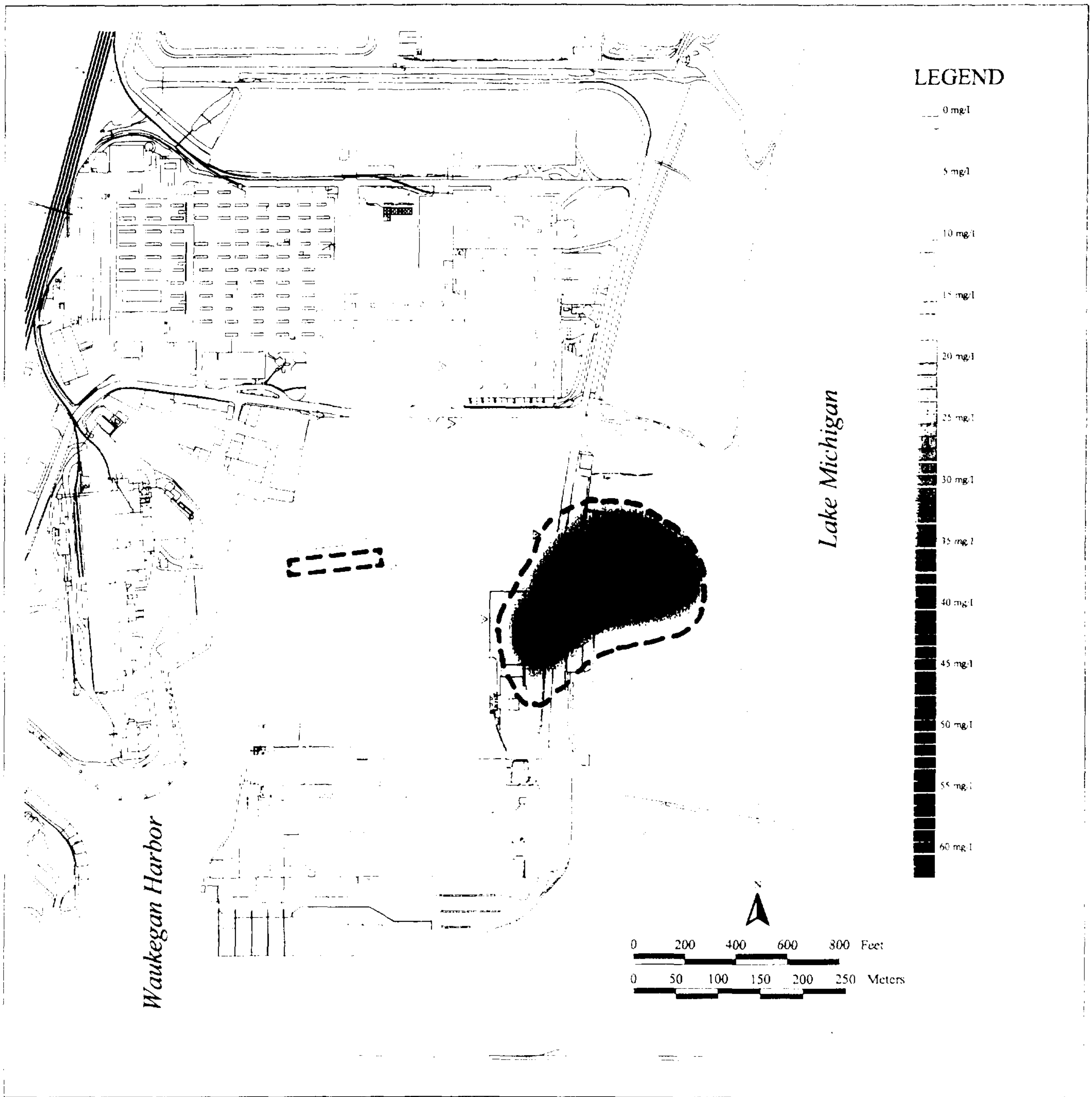


Figure 4-1
ANTICIPATED AREA OF
SOIL REMEDIATION
Waukegan Manufactured Gas & Coke Plant Site



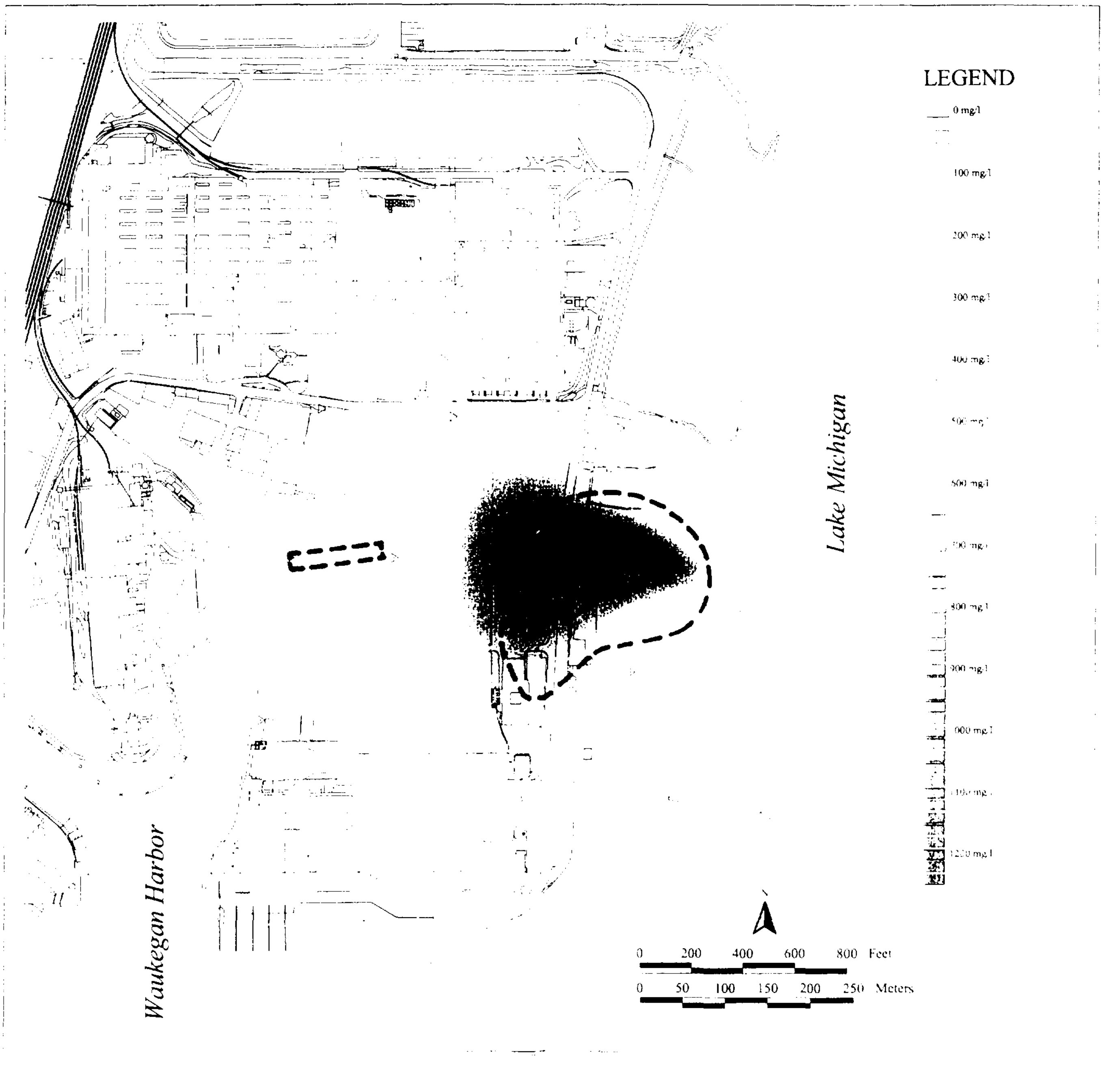
Note: Area Shown in Blue Exceeds MCL for Arsenic at a Concentration of 0.05 mg/L
Natural Attenuation will occur throughout the Groundwater Remediation Zone

Groundwater Monitoring Well

Groundwater Treatment Zone

Figure 4-2

GROUNDWATER REMEDIATION ZONE
CONCENTRATIONS OF ARSENIC IN THE
DEEP PORTION OF THE SAND AQUIFER
Waukegan Manufactured Gas & Coke Plant Site



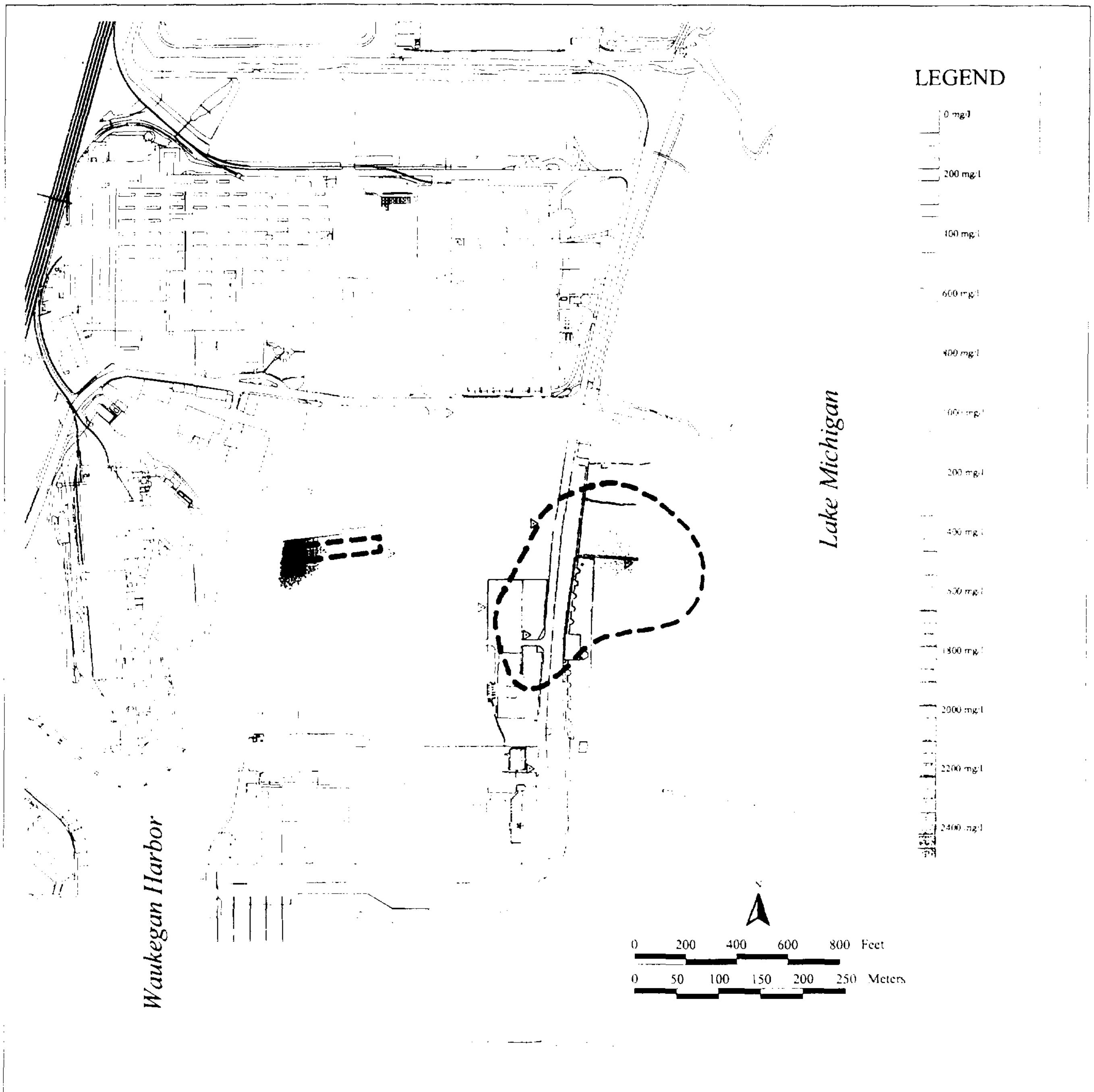
Note: Area Shown in Blue Exceeds MCL for Total Phenols at a Concentration of 0.1 mg/L
Natural Attenuation will occur throughout the Groundwater Remediation Zone.

△ Groundwater Monitoring Well

▬ ▬ ▬ Groundwater Treatment Zone

Figure 4-3

GROUNDWATER REMEDIATION ZONE
CONCENTRATIONS OF PHENOLS IN THE
DEEP PORTION OF THE SAND AQUIFER
Waukegan Manufactured Gas & Coke Plant Site



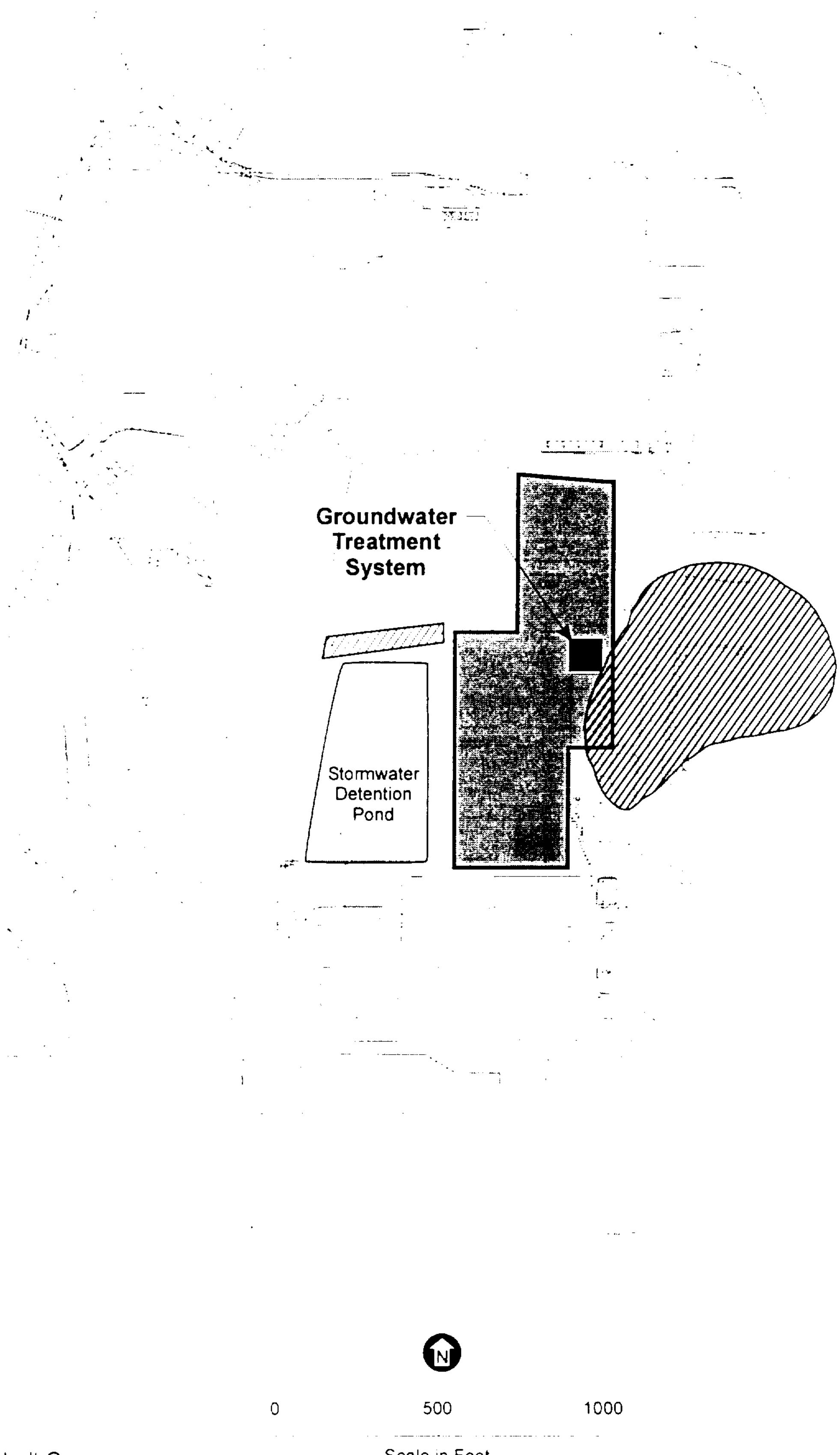
Note: Area in Green Shows Concentrations of Ammonia. (No Groundwater Standard for Ammonia)
Natural Attenuation will occur throughout the Groundwater Remediation Zone.

Groundwater Monitoring Well

Groundwater Treatment Zone

Figure 4-4

GROUNDWATER REMEDIATION ZONE
CONCENTRATIONS OF AMMONIA IN THE
DEEP PORTION OF THE SAND AQUIFER
Waukegan Manufactured Gas & Coke Plant Site



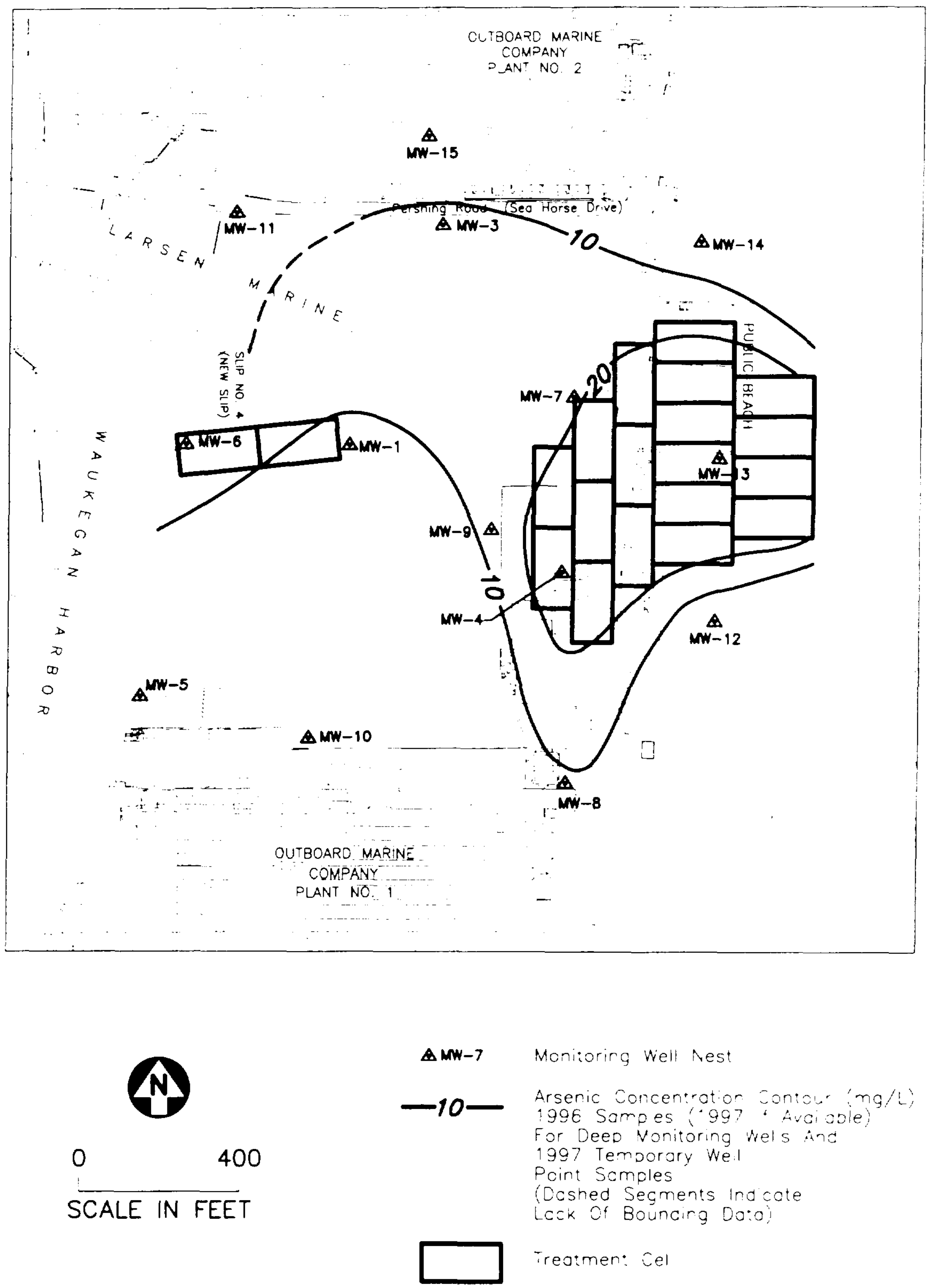
Asphalt Cap

Slurry Wall

Groundwater Treatment Zone

Figure 5-1

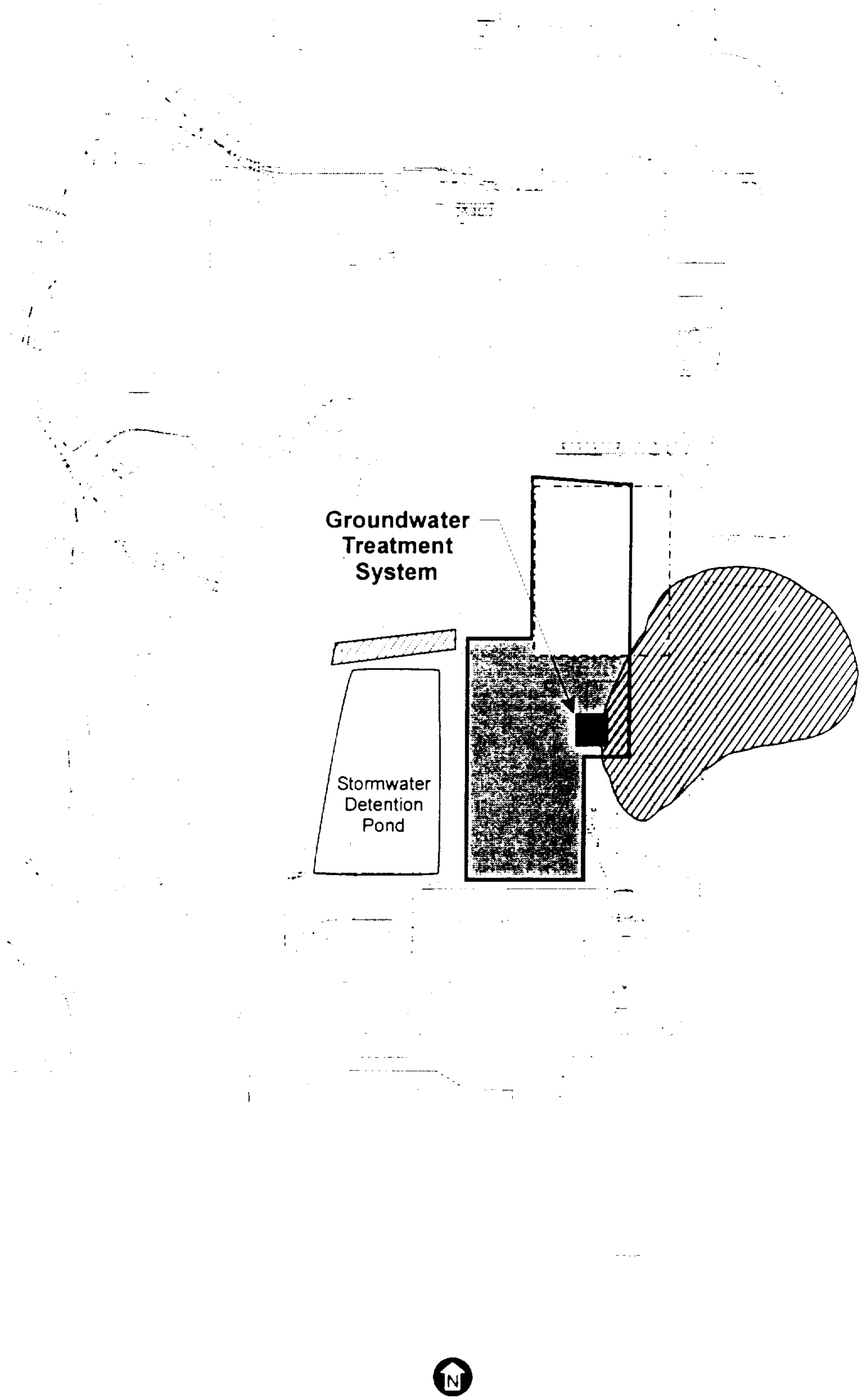
ALTERNATIVE 2A and 2B CONCEPTUAL LAYOUT CONTAINMENT
Waukegan Manufactured Gas & Coke Plant Site



RJW 8865_2.DWG 400.00 09/18/1996 11:30:43

Figure 5-2

TREATMENT CELL IMPLEMENTATION ZONE
ALTERNATIVES 2 AND 3
Waukegan Manufactured Gas & Coke Plant Site



Asphalt Cap

Slurry Wall

Vault

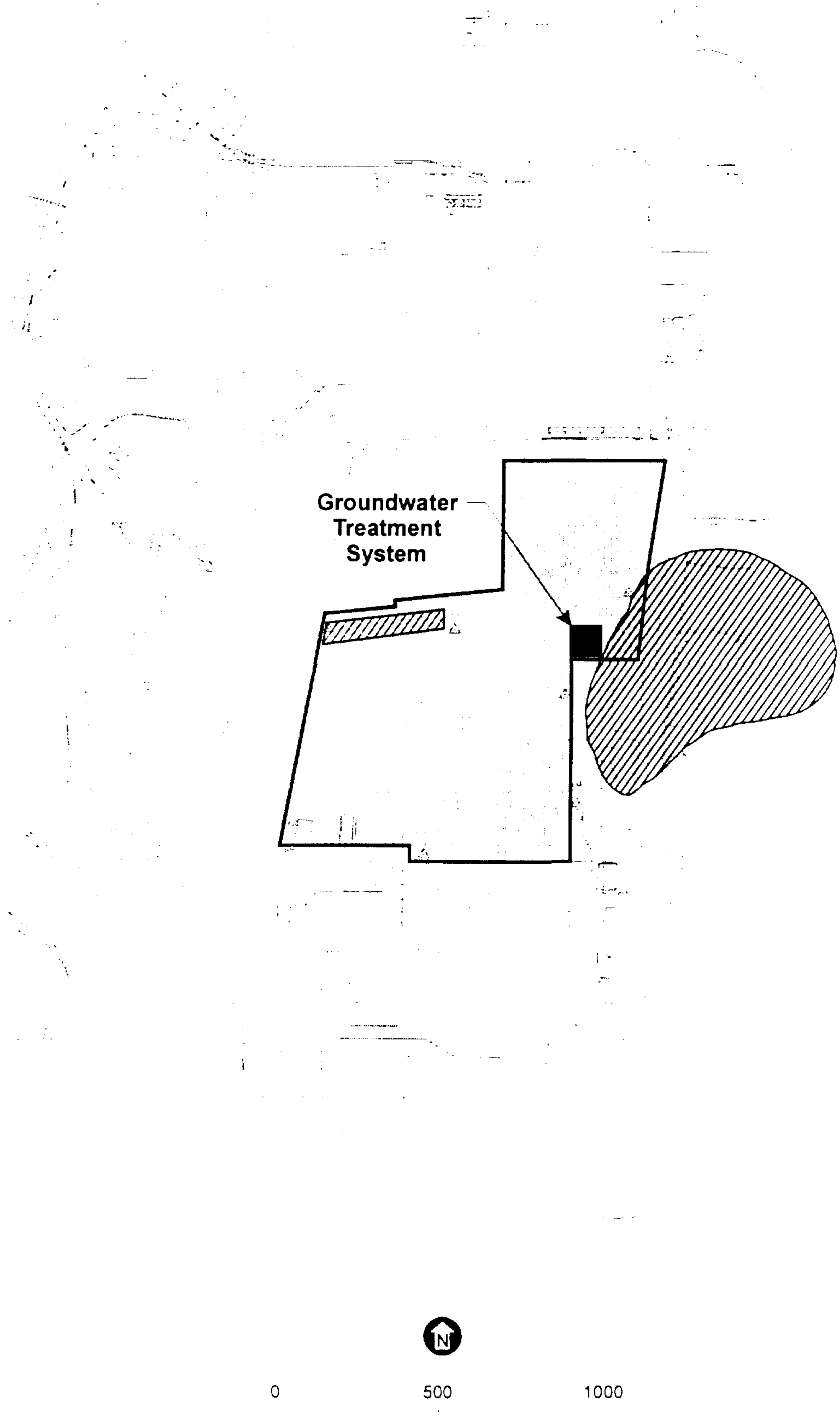
Groundwater Treatment Zone

0 500 1000

Scale in Feet

Figure 5-3

ALTERNATIVE 2C CONCEPTUAL LAYOUT
CONTAINMENT
Waukegan Manufactured Gas & Coke Plant Site



Phytoremediation Cap

Groundwater Treatment Zone

Figure 5-4

ALTERNATIVE 3A and 3B CONCEPTUAL LAYOUT
REMOVAL
Waukegan Manufactured Gas & Coke Plant Site

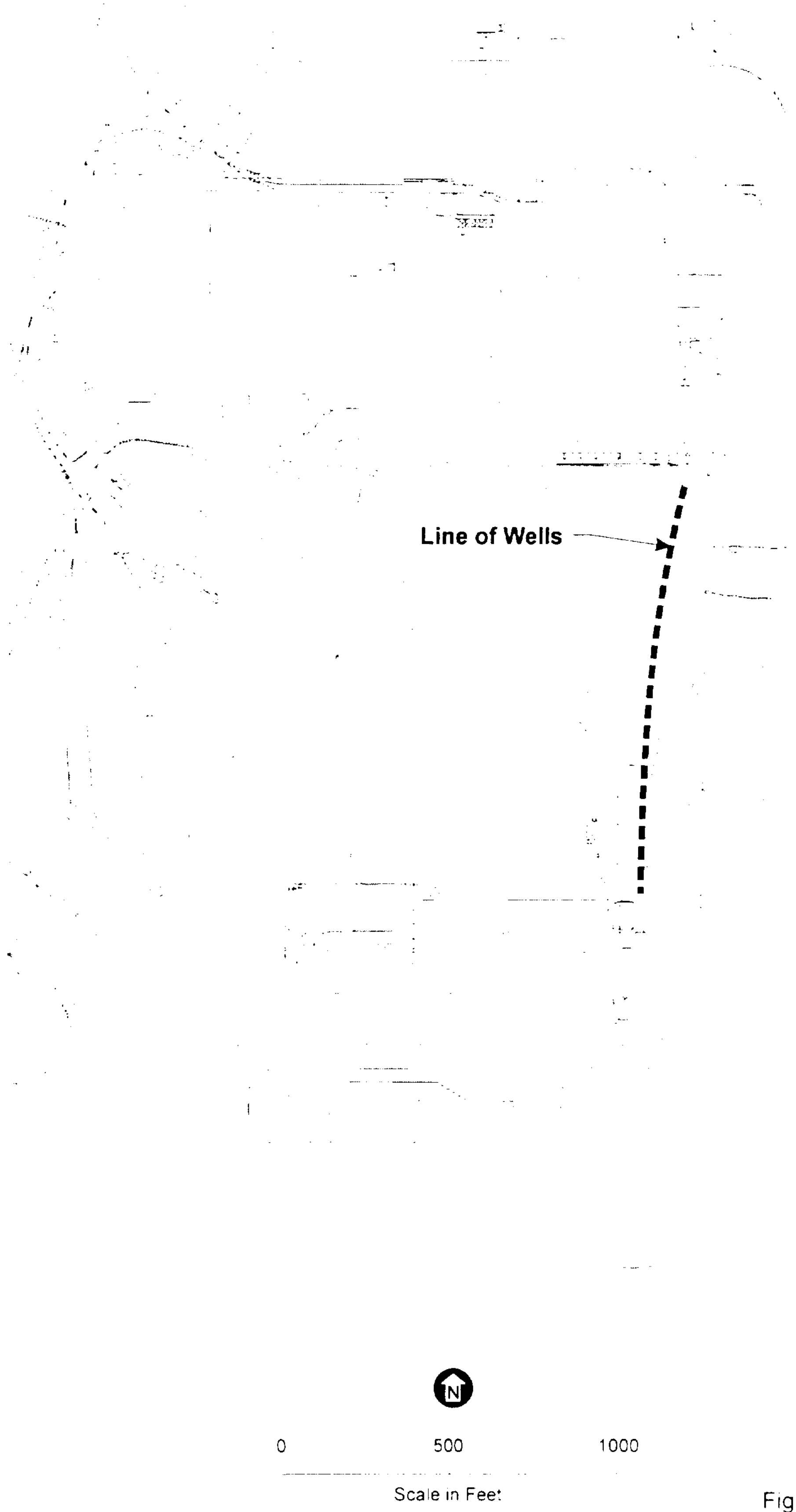


Figure 5-5

ALTERNATIVE 4 CONCEPTUAL LAYOUT
AQUIFER RESTORATION
Waukegan Manufactured Gas & Coke Plant Site

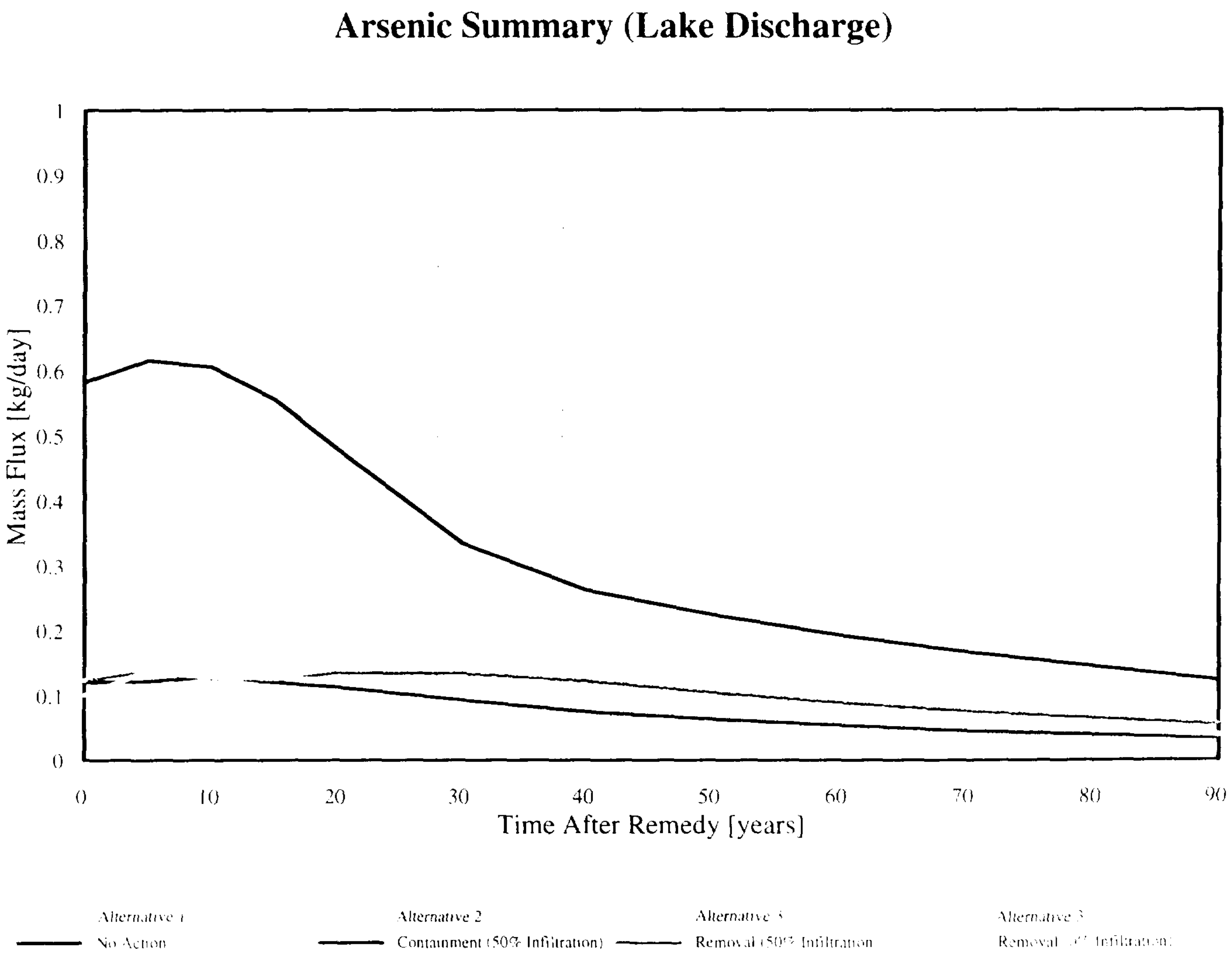


Figure 5-6

MASS FLUX COMPARISON FOR
REMEDIAL ALTERNATIVES - LAKE DISCHARGE
ARSENIC SUMMARY
Waukegan Manufactured Gas & Coke Plant Site

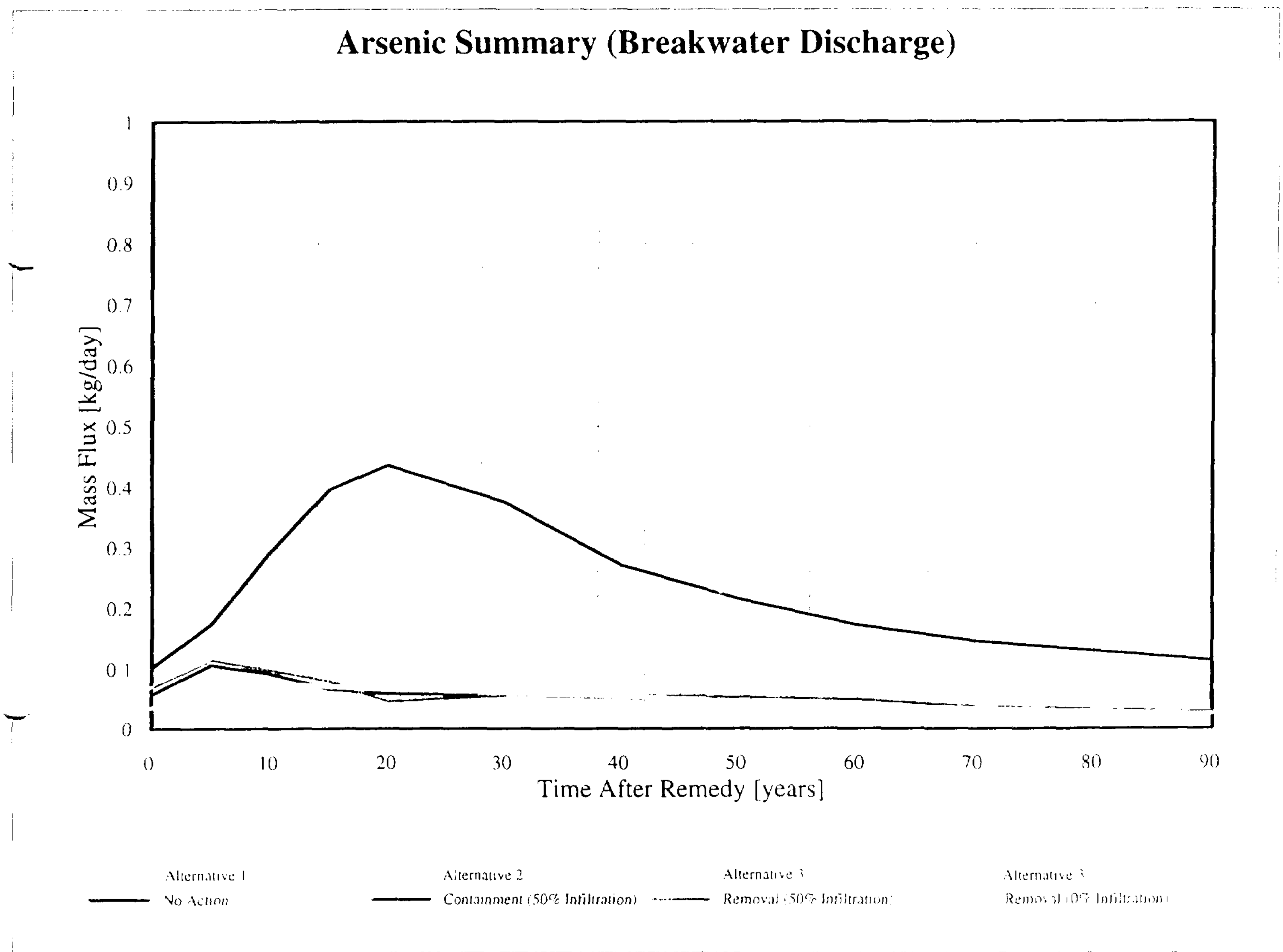


Figure 5-7

MASS FLUX COMPARISON FOR
REMEDIAL ALTERNATIVES - BREAKWATER DISCHARGE
ARSENIC SUMMARY
Waukegan Manufactured Gas & Coke Plant Site

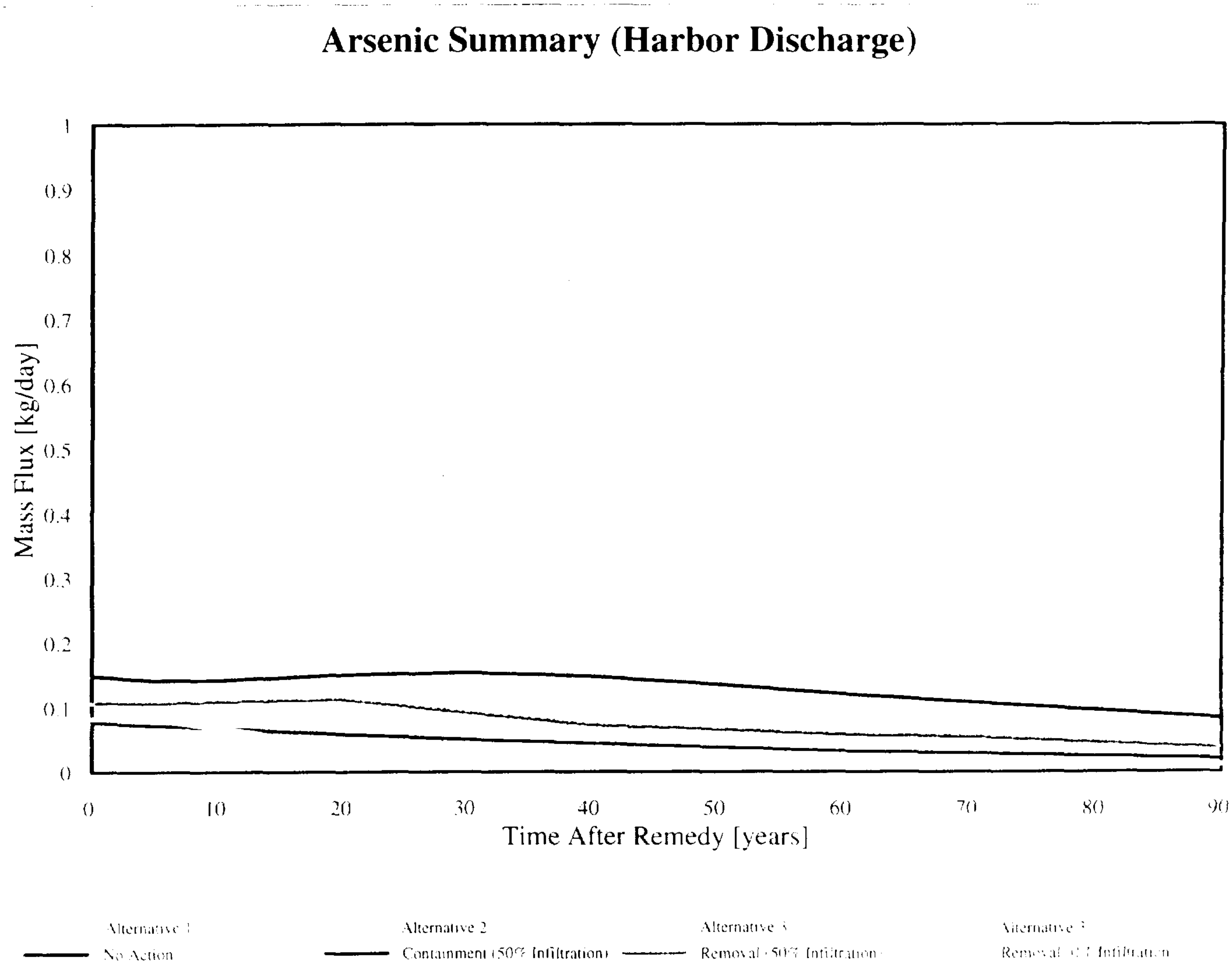


Figure 5-8

MASS FLUX COMPARISON FOR
REMEDIAL ALTERNATIVES - HARBOR DISCHARGE
ARSENIC SUMMARY
Waukegan Manufactured Gas & Coke Plant Site

Appendix 2-A

Beach Accretion in the Waukegan Area

Appendix 2-A

Beach Accretion in The Waukegan Area

List of Figures

Attachment