ANNUAL GROUNDWATER QUALITY AND BASELINE NATURAL ATTENUATION REPORT FOR 2001

ONALASKA MUNICIPAL LANDFILL
Onalaska, Wisconsin

Remedial Action

WA No. 103-RALR-05L5 / Contract No. 68-W6-0025

April 2002

Contents

Appendixes

1. Introduction

1.1 Purpose

The groundwater monitoring program at the Onalaska Municipal Landfill was implemented in 1995. The program had the following objectives:

- Provide data to determine whether the extraction system was reducing concentrations of groundwater contaminants in the aquifer between the landfill and the Black River.
- Provide data to determine whether groundwater contaminant concentrations in the aquifer had been reduced to below the cleanup criteria.
- Provide data to verify that a hydraulic gradient was being maintained by the extraction system in order to contain and collect contaminated groundwater.
- Monitor the impact on water levels in the wetlands adjacent to the site to make sure that the extraction system was not lowering water levels to such a point as to adversely affect the wetlands.
- Provide information on background water quality.
- Identify any seasonal fluctuations in groundwater quality.

During 2001, the USEPA, at the recommendation of the Wisconsin Department of Natural Resources (WDNR), decided to temporarily discontinue active groundwater extraction and treatment in order to evaluate whether natural attenuation of site groundwater contaminants is an effective alternative to groundwater extraction and treatment. A Monitored Natural Attenuation (MNA) program was implemented in the fall of 2001 to replace the original groundwater monitoring program. The primary objectives of the MNA program are to assess:

- Whether there are meaningful trends of contaminant mass decreasing over time at appropriate monitoring points
- Whether there are indicators of active natural attenuation at the site based on hydrogeological and geochemical data and calculated contaminant degradation rates
- Whether natural attenuation is an acceptable remedy for the site

The extraction wells were turned off the Friday before the MNA baseline sampling event, which began on a Monday. The extraction wells and treatment system were restarted after the MNA baseline sampling event to use up the remaining inventory of treatment chemicals (sodium hydroxide and polymer). The last of the treatment chemicals were consumed on November 26. The extraction wells and treatment system were shut down and will remain off for the duration of the MNA study. The study is expected to last several years, and MNA could be implemented as a permanent remedy.

1.2 Report Organization

The spring sampling event in 2001 was performed following the original groundwater monitoring program. The fall sampling event in 2001 constituted the baseline sampling

TABLE 1-1
Contaminants Included in the Natural Attenuation Plan
Annual Groundwater Quality and Baseline Natural Attenuation Report for 2001

Contaminants	Wisconsin NR140 PAL [µg/L]	Wisconsin NR140 ES [µg/L]	Federal MCL [µg/L]
Organic Contaminants			
BETX			
Benzene	0.5	5	5
Ethylbenzene	140	700	700
Toluene	200	1,000	1,000
Total Xylenes	1,000	10,000	10,000
Chlorinated VOCs			
1,1-Dichloroethane	85	850	N.A.
1,1-Dichloroethene	0.7	7	7
1,1,1-Trichloroethane	40	200	200
cis-1,2-Dichloroethene	7	70	70
Trans-1,2-Dichloroethene	20	100	100
Trichloroethene	0.5	5	5
Tetrachloroethene	0.5	5	5
Methylene Chloride (MW-4S Only)	0.5	5	N.A.
Vinyl Chloride (Chloroethene)	0.02	0.2	2
Other VOCs			
1,2,4- and 1,3,5- Trimethylbenzene	96	480	N.A.
Naphthalene	8	40	N.A.
Metal Contaminants			
Arsenic	5	50	10
Barium	400	2,000	2,000
Iron	150	300	N.A.
Lead	1.5	15	15
Manganese	25	50	N.A.
Cadmium	0.5	5	5
Cobalt	8	40	N.A.
Mercury	0.2	2	2
Vanadium	6	30	N.A.

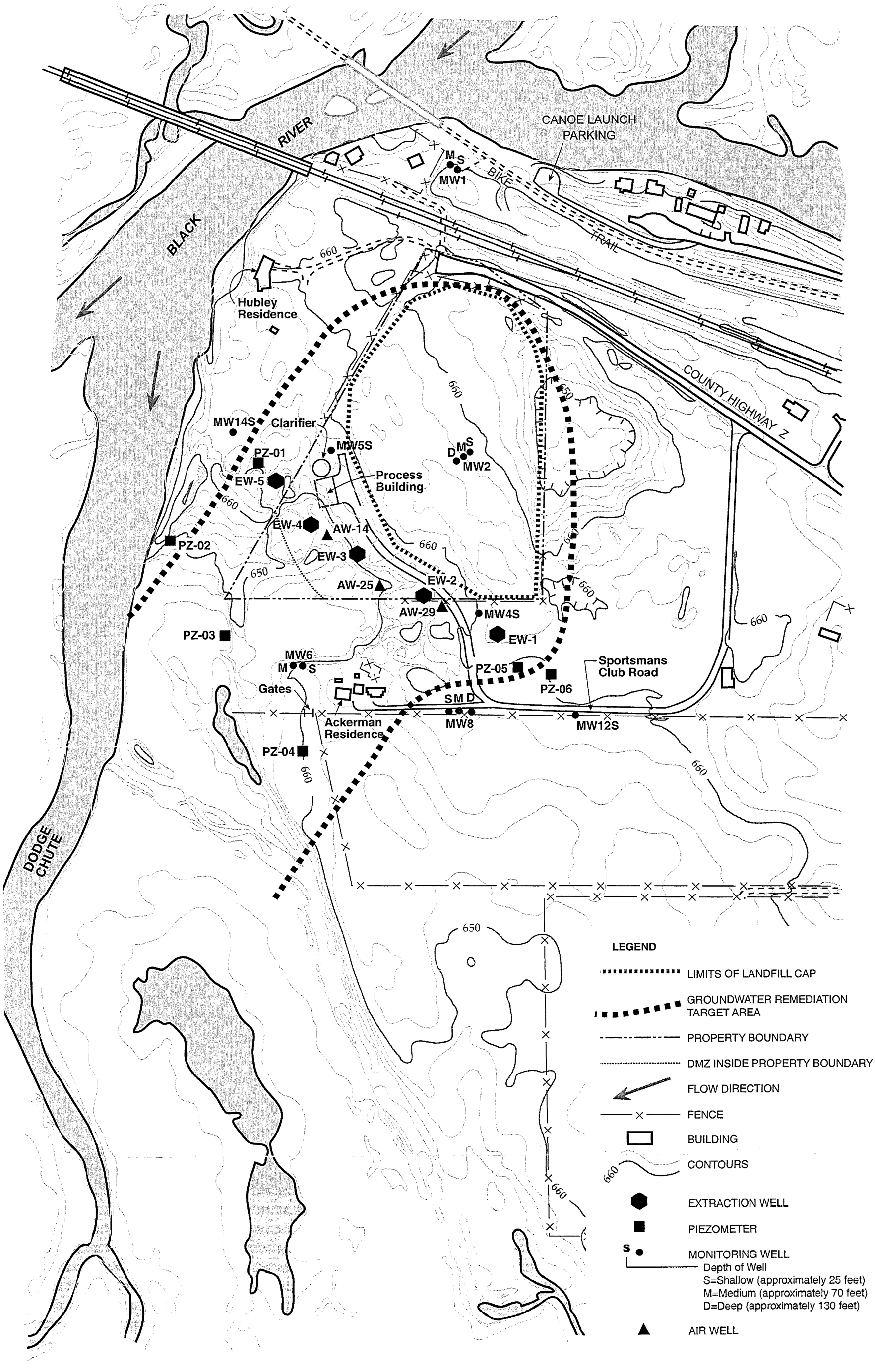


FIGURE 1-1
MONITORING WELL, EXTRACTION WELL, AND PIEZOMETER NETWORK
ONALASKA LANDFILL

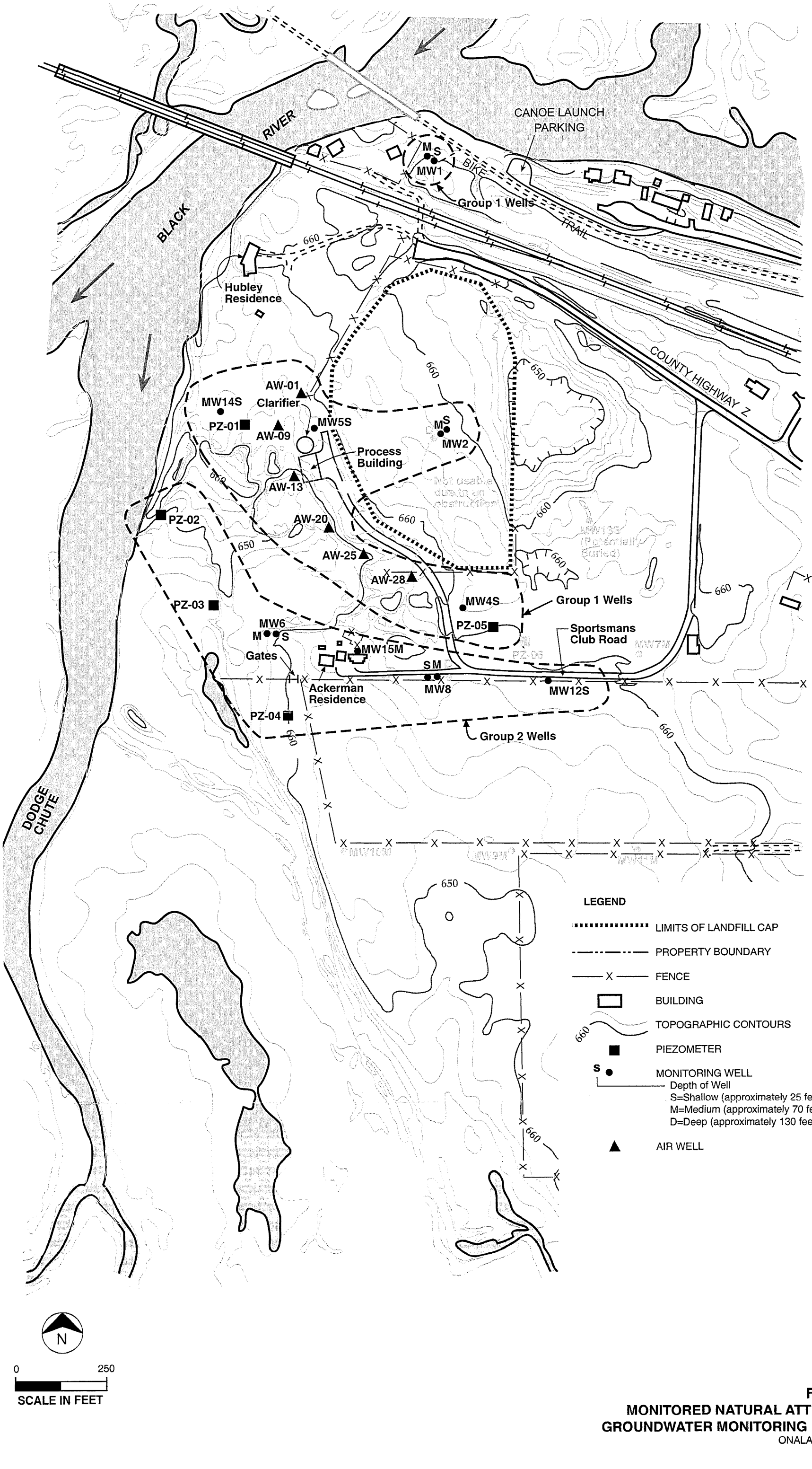


FIGURE 1-2
MONITORED NATURAL ATTENUATION
GROUNDWATER MONITORING NETWORK
ONALASKA LANDFILL

Both the Group 1 and Group 2 wells were sampled during the baseline MNA event in October 2001.

Groundwater level measurements will be taken from both the Group 1 and Group 2 wells during each monitoring event. Quarterly groundwater elevation monitoring will be conducted in 2002 to determine if the groundwater flow direction varies significantly in the first and last quarter versus the second and third quarter. Semiannual groundwater elevation monitoring in the spring and fall will be conducted thereafter.

2. Sampling Event Information

2.1 Spring Sampling Event

The spring sampling event occurred May 16 through 18, 2001. All samples were sent by overnight courier to Severn Trent Laboratory in North Canton, Ohio, for testing of select VOCs, metals, and wet chemistry parameters. Severn Trent Laboratory sent the VOC samples from the two residential wells and all color samples to their subcontract laboratory, Northern Lake Services, in Crandon, Wisconsin. The monitoring wells were sampled in accordance with the procedures described in the *Field Sampling Plan*. The following observations were made during the spring 2001 sampling event:

- An organic odor was noted in MW-4S and MW-14S.
- A Mini-Rae photoionization detector (PID) reading >1,999 ppm (e.g., off scale) was measured in AW-14.
- The Mini-Rae reading was 1,246 ppm in MW-4S when the cap was first removed but dropped to 70 to 100 ppm after a minute or two.
- The Mini-Rae reading was 92 ppm in MW-14S when the cap was first removed, but dropped to 0.1 to 20 ppm after a minute or two.

2.2 Fall Sampling Event

The fall 2001 sampling event, constituting the MNA program baseline sampling event, occurred October 30 through November 2, 2001. All samples were sent by overnight courier to the Severn Trent Laboratory for testing of select VOCs, metals, and natural attenuation parameters. Severn Trent Laboratory sent the VOC samples from the two residential wells to their subcontract laboratory, Northern Lake Services. The monitoring wells were sampled in accordance with the procedures described in the *Field Sampling Plan*. The following observations were made during the fall 2001 sampling event:

- An organic odor was noted in MW-4S and MW-14S.
- A Mini-Rae reading of 40 to 174 ppm was measured in MW-4S.
- A Mini-Rae PID reading >1,999 ppm (e.g., off scale) was measured in MW-5S.

TABLE 3-1
Summary of 2001 Groundwater Monitoring Analyses Validation
Annual Groundwater Quality and Baseline Natural Attenuation Report for 2001

Parameter	Well	Spring or Fall	SAS No.	Project Qualifier	CH2M HILL Validation Comments
Cobalt	MW-1S, MW-1S FR, MW-1M	S	01CF12-09, 10, 11	UB	Undetected due to blank contamination
Arsenic	Ackerman, Hubley, MW-1S, MW-1S FR, MW-2D, MW-4S, MW-4S FR, MW-5S, MW-6M, MW-6S, MW-8M, MW-8S, MW-14S	S	01CF12-01, 03, 09, 10, 12, 14, 15, 16, 17, 18, 19, 20, 21	UB	Undetected due to blank contamination
Barium	Ackerman, Hubley, MW-1S, MW-1S FR, MW-6S, MW-14S	S	01CF12-01, 03, 09, 10, 17, 21	J	Estimated due to blank contamination
Vanadium	MW-1S FR	S	01CF12-10	J	Estimated due to blank contamination
Arsenic	AW-20, AW-25, MW-4S	F	02CF05-06, 07, 17	J	Estimated due to blank contamination
Barium	Ackerman, Hubley, AW-9, MW-1S, MW-1S FR, MW-8S, MW-12S, PZ-1, PZ-2, PZ-3, PZ-4, PZ-5	F	02CF05-01, 04, 11, 13, 14, 23, 24, 26, 27, 28, 29, 30	J	Estimated due to blank contamination
Cadmium	AW-13	F	01CF05-05	UB	Undetected due to blank contamination
Cobalt	AW-1, MW-14S, MW-14S FR, PZ-2	F	02CF05-03, 25, 19, 21	UB	Undetected due to blank contamination
Cobalt	AW-20, AW-25, MW-5S, MW-6S	F	02CF05-06, 07, 27, 34	J	Estimated due to blank contamination
Lead	Ackerman, MW-1S, MW-1M, MW-1S FR, MW-6S, MW-6M, MW-8S, MW-8M, MW-12S, PZ-3, PZ-4	F	02CF05-01, 12, 13, 14, 20, 21, 22, 23, 24, 28, 29	UJ	Undetected and estimated in quantity due to a low spike recovery
Lead	Hubley	F	02CF05-11	J	Estimated in quantity due to a low spike recovery
Manganese	AW-9	F	02CF05-04	UB	Undetected due to blank contamination
Manganese	PZ-5	F	02CF05-30	J	Estimated due to blank contamination
Mercury	Ackerman	F	02CF05-01	J	Estimated due to blank contamination
Nitrate	MW-8S, MW-12S	F	02CF05-23, 24	J	Estimated due to exceedance in calibration
Vanadium	AW-13, AW-20	F	01CF05-05, 06	UB	Undetected due to blank contamination
Vanadium	AW-13, PZ-1, PZ-2, PZ-3	F	01CF05-05, 26, 27, 28	J	Estimated due to blank contamination

TABLE 3-2
Statistical Evaluation of Select Parameters from Background Monitoring Wells MW-1S and MW-1M
Annual Groundwater Quality and Baseline Natural Attenuation Report for 2001

Parameter (µg/L)	Average	Standard Deviation	No. of Results	Avg. + 2 Std. Deviations	Original PAL	Preliminary WACL
Preliminary Shallow Well (MW-1S) Background based WACLs for Select Parameters						
Arsenic	5.4	1.8	18	9	5	9
Barium[a]	114	89	18	292	400	300
Cobalt[b]	4.9	2.4	5	10	8	—
Iron	574	1,197	18	2,967	150	3,000
Manganese	949	913	18	2,774	25	2,800
Vanadium[b]	4.7	2.4	5	9	6	—
Color (color units)	36	48	16	132.3	7.5	140
Preliminary Medium Depth Well (MW-1M) Background based WACLs for Select Parameters						
Arsenic[b]	10.4	3.3	5	17	5	—
Barium[a, b]	242	32	5	307	400	—
Cobalt[b]	Non Detect		5	—	8	—
Iron[b]	1,562	3,482	5	8,525	150	—
Manganese[b]	1,560	215	4	1,989	25	—
Vanadium[b]	Non Detect		5	—	6	—

Parameter (µg/L)	Average	Standard Deviation	No. of Results	Avg. + 3 Std. Deviations	Avg. + NR140.20 Table 3 Incr.	Greater of 2 Prev. Col.
Preliminary Background Levels For Parameters Without PALs (Based on MW-1S Data)						
Alkalinity, Total as $CaCO_3$ (mg/L)	119	23	9	189	219	219
pH[c] (pH units)	6.9	NA	18	NA	NA	NA
Total dissolved solids (mg/L)	249	377	17	1,381	449	1,381
Total Organic Carbon (mg/L)	5	1	10	8	6	8
Other Parameters Requiring Monitoring:						
Turbidity (NTU)	68	73	16	287	NA	287

[a]ACL not appropriate because WACL would be less than PAL.
[b]8 results are needed before calculating a preliminary WACL.
[c]A PAL for pH is established as plus or minus one pH unit from the average. Therefore a pH of 5.9 to 7.9 is allowable.

NA = Not Applicable

3.4.5 Trimethylbenzenes (1,2,4- and 1,3,5- combined)

Wells exceeding PAL in 2001: AW-20, AW-25, MW-4S, MW-5S

Wells exceeding ES in 2001: MW-4S, MW-5S

The NR 140 PAL is 96 $\mu g/L$ and the NR 140 ES is480 $\mu g/L$ for the combined concentration of 1,2,4- and 1,3,5-trimethylbezenes. 1,2,4- and 1,3,5-trimethylbenzenes were not on the list of contaminants of concern presented in the ROD. However, 1,2,4- and 1,3,5-trimethylbenzenes were identified in the 1999 priority pollutant scan as "tentatively identified compounds" (TICs) and were added to the monitoring program because there are PALs and ESs established for them. The highest combined concentrations detected in 2001 were 600 $\mu g/L$ in MW-4S during the spring and 880 $\mu g/L$ in MW-5S during the fall.

3.4.6 Naphthalene

Wells exceeding PAL in 2001: MW-4S, MW-5S

Wells exceeding ES in 2001: None

The NR 140 PAL is 8 $\mu g/L$ and the NR 140 ES is40 $\mu g/L$. Naphthalene was not on the list of contaminants of concern presented in the ROD. However, naphthalene was detected above the PAL at MW-5S during the 1999 priority pollutant scan and was added to the monitoring program because there are PALs and ESs established for this contaminant. The highest concentration detected in 2001 was 27 $\mu g/L$ in MW-5S.

3.4.7 Methylene Chloride

Wells exceeding PAL in 2001: None

Wells exceeding ES in 2001: None

The NR 140 PAL is 0.5 $\mu g/L$ and the ES is5 $\mu g/L$. The detection limit in the spring monitoring event was above the ES due to laboratory dilution. Methylene chloride was not on the list of contaminants of concern presented in the ROD. However, methylene chloride was detected at concentrations above the PAL and ES in MW-4S during the fall 2000 sampling event and was added to the monitoring program for MW-4S. Methylene chloride monitoring is limited to MW-4S because it is sometimes the result of laboratory contamination, and this was suspected as a possible explanation for the result reported in 1999. Per the approved recommendation from the Annual Groundwater Quality And Capture Report for 2000, methylene chloride was added to the monitoring program for 2001 and is to be eliminated from subsequent monitoring events if not detected above the PAL in the two 2001 monitoring events. Methylene chloride was not detected at 0.34 $\mu g/L$ during the fall monitoring event but because of the elevated detection limit of 20 $\mu g/L$ (note that it was nondetect at this detection limit) in the spring monitoring event, an additional round of sampling with a sufficiently low detection limit is required before methylene chloride parameter can be eliminated from future monitoring.

Based on MW-1S background data to date, the average background arsenic concentration in shallow well MW-1S is 5.4 μg/L (see Table 3-2). Evaluation of MW-1S background data to date using the procedures to establish an ACL yields a value of 9 μg/L (see Table 3-2). Insufficient data exist for background arsenic concentrations in medium depth groundwater, but the first five rounds of data in MW-1M would yield a higher ACL (see Table 3-2). An ACL based on both MW-1S and MW-1M may be appropriate for the extraction wells that draw groundwater from both the shallow and medium aquifers. Arsenic was detected in the medium depth background well during the spring and fall (12.8 and 11.7 μg/L). Arsenic was not detected in the shallow depth background well during the spring and fall, but the detection limit was elevated to 10 μg/L in the spring due to the contamination in the blank. Although the background concentration of arsenic may prevent compliance with the PAL at times, the data indicate that the landfill has contributed to arsenic concentrations greater than background.

Arsenic concentrations appear to vary between sampling events, but there is no noticeable trend to indicate that arsenic concentrations are decreasing with time.

3.5.2 Barium

Wells exceeding PAL in 2001:	EW-1, EW-2, EW-3, EW-4, MW-6M, MW-8M, MW-15M
Wells exceeding PAL in 2001 located outside of the property boundary:	EW-1, MW-6M, MW-8M, MW-15M
Wells exceeding ES and MCL in 2001:	None

The NR 140 PAL is 400 μg/L, and the NR 140 ES and federal MCL are 2,000 μg/L. The detection limit was below the PAL. The highest concentration detected in 2001 was 997 μg/L in MW-6M in the fall sampling event.

Based on MW-1S background data to date, the average background barium is 114 μg/L (see Table 3-2). Evaluation of background MW-1S data to date using the procedures to establish an ACL yields a value of 300 μg/L (see Table 3-2). Given that this value is less than the current NR 140 PAL, an ACL based on background barium in shallow groundwater will not be appropriate unless future background results deviate significantly the from results to date. The minimum of eight background values required to calculate an ACL for background barium in medium depth groundwater will not be available until the spring of 2003. However, the MW-1M results to date indicate that an ACL based on background barium in medium groundwater would also be less than the PAL and therefore inappropriate. Although the background concentration of barium at times may prevent compliance with the PAL, the data indicate that the landfill has contributed to barium concentrations greater than background.

As the graphs show, the concentration of barium appears to have decreased slightly since early sampling events in the wells with some of the highest concentrations (e.g., MW-6M, EW-3, EW-2, and EW-1). However, the concentration of barium does not appear to have decreased significantly in any wells over the last 3 years.

Iron in background well MW-1S has varied significantly between sampling events. Based on background data to date, the average background iron is 574 μg/L (see Table 3-2). Evaluation of background data to date using the procedures to establish an ACL yields a value of 3,000 μg/L (see Table 3-2). Insufficient data exist for background iron concentrations in medium depth groundwater, but the first five rounds of data in MW-1M would yield a higher ACL (see Table 3-2). An ACL based on both MW-1S and MW-1M may be appropriate for the extraction wells, which draw groundwater from both the shallow and medium aquifers. Iron concentrations in the Hubley and Ackerman residential wells appear to be completely attributable to the background concentration. Iron concentration in some of the other wells may also be completely attributable to the background concentration. Although the background concentration of iron may prevent compliance with the PAL and ES in many wells, the data indicate that the landfill has contributed to concentrations greater than background.

Iron concentration decreased significantly in MW-8S in the first few years of groundwater extraction. However, the concentration of iron does not appear to have significantly decreased in any wells over the last several years.

3.5.6 Lead

Wells exceeding PAL in 2001:	Ackerman, MW-1S
Wells exceeding ES and MCL in 2001:	None

The NR 140 PAL is 1.5 μg/L, the NR 140 ES and the Federal action level MCL for lead is 15 μg/L. The detection limit was below the PAL. Lead was detected in the Ackerman well and MW-1S at 2.1 μg/L in the spring event. Although above the PAL, this is well below the drinking water action level and based on the fact that lead is not typically detected at the site and the fact that it was also detected in background well MW-1S, the result can be attributed to background concentrations or a laboratory anomaly.

3.5.7 Manganese

Wells exceeding PAL in 2001:	Ackerman, Hubley, AW-1, AW-13, AW-20, AW-25, AW-28, EW-1, EW-2, EW-3, EW-4, EW-5, MW-1S, MW-1M, MW-2S, MW-4S, MW-5S, MW-6S, MW-6M, MW-8S, MW-8M, MW-14S, MW-15M, PZ-1, PZ-2, PZ-3, PZ-4, PZ-5
Wells exceeding PAL in 2001 located outside of the property boundary:	Ackerman, Hubley, AW-1, AW-28, EW-1, EW-5, MW-1S, MW-1M, MW-4S, MW-6S, MW-6M, MW-8S, MW-8M, MW-14S, MW-15M, PZ-1, PZ-2, PZ-3, PZ-4, PZ-5
Wells exceeding preliminary ACL in 2001:	AW-20, AW-25, MW-2S, MW-14S, PZ-2
Wells exceeding preliminary ACL in 2001 located outside of the property boundary:	MW-14S, PZ-2

metals in the groundwater downstream of the landfill. This is most apparent for arsenic, barium, iron, and manganese. However, the metals concentrations in some wells downstream of the landfill appear to be due to background concentrations. These metals include iron and manganese in the Hubley and Ackerman residential wells.

There is not enough data yet to perform background statistical evaluations for some metals, including cadmium, cobalt, mercury and vanadium. These metals were added after the 1999 priority pollutant scan. Based on the data since the addition of these metals to the sampling program, the concentration of these metals generally have been near or below PALs and detection limits at all wells sampled. The barium concentration decreased significantly in MW-6M during the first few years of groundwater extraction. Similarly, the iron concentration decreased significantly in MW-8S during the first few years of groundwater extraction. However, the concentration of these and other metals does not appear to have decreased significantly over the last few years.

Concentrations of metals will continue to be compared to preliminary calculated WACLs if greater than PALs because the background concentrations for some metals exceed PALs. However, the metals concentrations in some wells with elevated concentrations from the landfill likely will remain above WACLs. It is recommended that WACLs be requested of the WDNR at some future date, when it appears that the only parameters exceeding PALs at the site are due to background concentrations. The statistical evaluation would be similar to that provided in Table 3-2, but it would include the additional results that would have accumulated up to the time of the request.

3.6 Wet Chemistry

3.6.1 Color

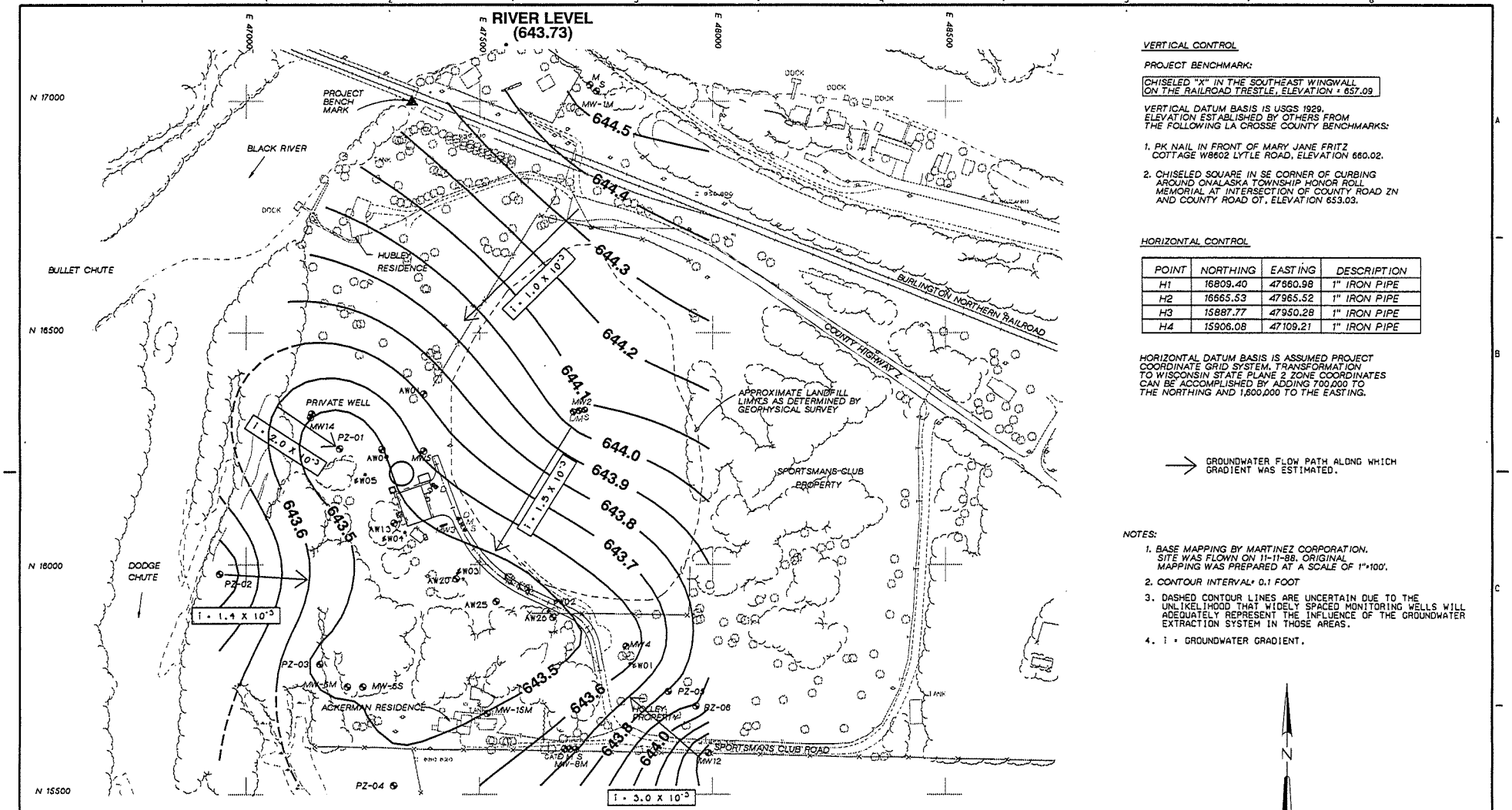
Wells exceeding PAL in 2001:	Ackerman, Hubley, EW-1, EW-2, EW-3, EW-4, EW-5, MW-1S, MW-1M, MW-8S, MW-8M
Wells exceeding PAL in 2001 located outside the property boundary:	Ackerman, Hubley, EW-1, EW-5, MW-1S, MW-1M, MW-8S, MW-8M
Wells exceeding preliminary ACL:	None

The NR 140 PAL for color is 7.5 CU, and the NR 140 ES is 15 CU. Based on background data to date, the average background color is 36 CU (see Table 3-2). Evaluation of background data to date using the procedures to establish an ACL yields a value of 140 CU (see Table 3-2). None of the wells monitored exceeded this criterion. Therefore, background color is more significant than color resulting from landfill contaminants. The highest color detected in 2001 was 140 CU in background medium depth well MW-1M in the spring sampling event. The tests for color are highly dependent on the analyst's judgment; therefore, the results of these tests are not precise and will vary. The imprecision is apparent even between duplicate samples from the spring 2001 monitoring event, which were as follows: 10 CU for MW-1S versus 5 CU for MW-1S (dup). Color has been lower at all wells since December 1996. However, the imprecision of the analysis may be the cause of some of the variation in results between sampling rounds.

TABLE 4-1
Groundwater Elevation Data
Annual Groundwater Quality and Baseline Natural Attenuation Report for 2001

		Spring 2001		Fall 2001	
Well	Well Rim Elevation [ft]	Depth to Water [ft]	Water Elevation [ft]	Depth to Water [ft]	Water Elevation [ft]
Black River*	655.77	11.97	643.73	13.60	642.17
AW-01	661.94			20.44	641.50
AW-09	658.40			17.02	641.38
AW-13	657.16	13.68	643.48		
AW-14	655.90			14.11	641.79
AW-20	651.09			9.71	641.38
AW-25	655.57	12.15	643.42	14.25	641.32
AW-28	659.23			17.93	641.30
AW-29	661.20	17.71	643.49		
MW-01S	663.22	18.67	644.55	20.90	642.32
MW-01M	663.47	18.90	644.57	21.13	642.34
MW-02S	671.34	27.25	644.09	29.57	641.77
MW-04S	664.11	20.58	643.53	22.95	641.16
MW-05S	655.56	11.94	643.62	13.94	641.62
MW-06S	646.25	2.75	643.50	4.93	641.32
MW-06M	648.20	4.62	643.58	6.78	641.42
MW-08S	659.11	15.42	643.69	17.76	641.35
MW-08M	659.07	15.15	643.92	17.48	641.59
MW-12S	662.95	18.57	644.38	21.12	641.83
MW-14S	654.32	10.82	643.50	12.88	641.44
PZ-01	654.73	11.36	643.37	13.30	641.43
PZ-02	649.76	5.76	644.00	8.40	641.36
PZ-03	647.10	3.64	643.46	5.77	641.33
PZ-04	647.43	3.91	643.52	6.10	641.33
PZ-05	660.23	16.42	643.81	18.89	641.34
PZ-06	659.08	15.19	643.89		

*The depth to water for the Black River is measured from a surveyed point on the bicycle trail bridge near MW-01S (top of 3rd I-beam from SE end of bridge on the downstream side).



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47860.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

→ GROUNDWATER FLOW PATH ALONG WHICH GRADIENT WAS ESTIMATED.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.1 FOOT
3. DASHED CONTOUR LINES ARE UNCERTAIN DUE TO THE UNLIKELIHOOD THAT WIDELY SPACED MONITORING WELLS WILL ADEQUATELY REPRESENT THE INFLUENCE OF THE GROUNDWATER EXTRACTION SYSTEM IN THOSE AREAS.
4. I = GROUNDWATER GRADIENT.

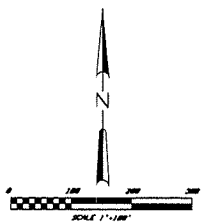


FIGURE 4-1

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

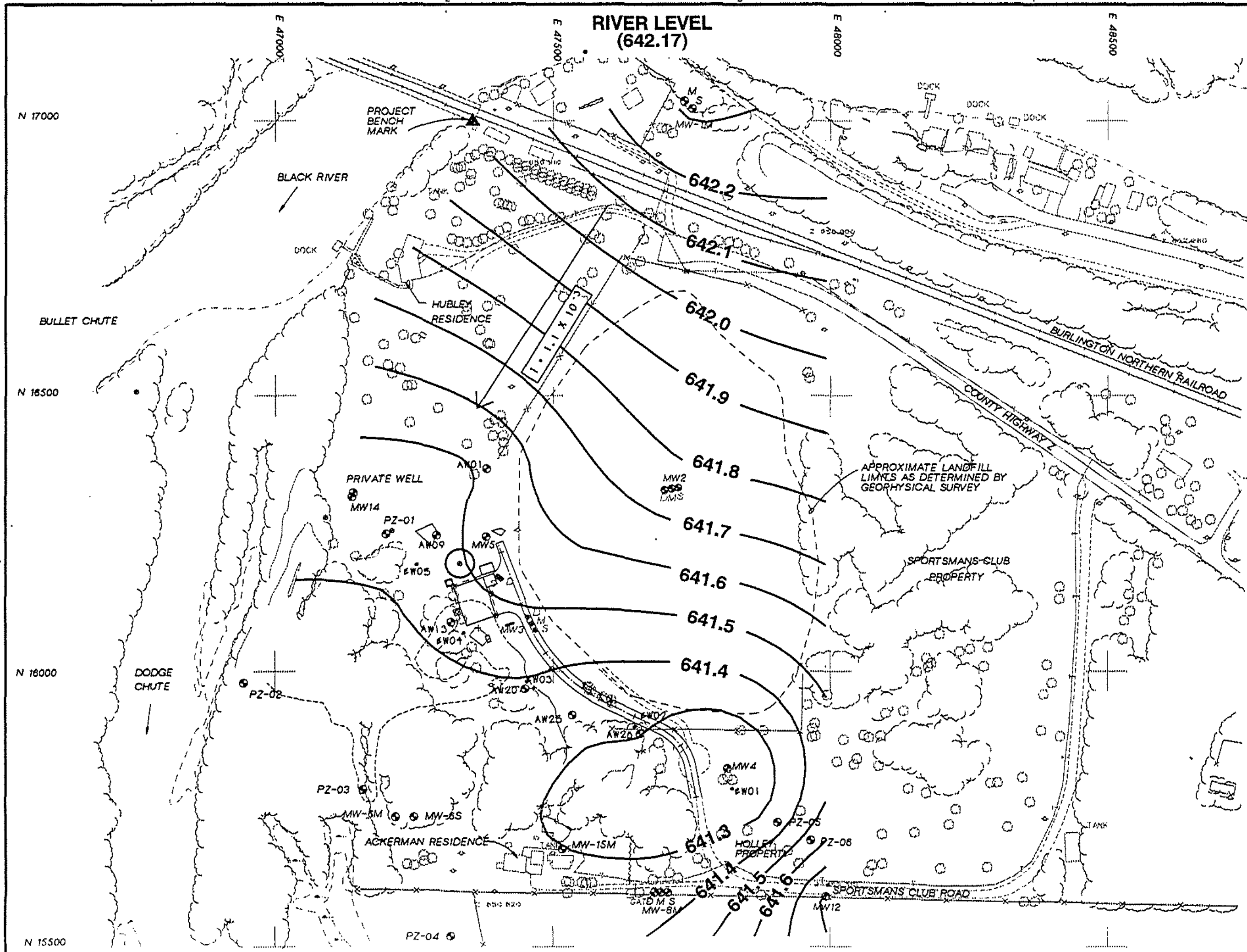
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

GROUNDWATER CONTOUR MAP
SHALLOW MONITORING WELLS
MAY, 2001

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159905\ONALASKA\CAD\DRAWINGS\WATERLEVEL\MAY-5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

→ GROUNDWATER FLOW PATH ALONG WHICH GRADIENT WAS ESTIMATED.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.1 FOOT
3. i = GROUNDWATER GRADIENT.

FIGURE 4-3

CH2M HILL	DSGN / DR / CHK / APVD	NO.	DATE	REVISION	BY	APVD

BAR IS ONE INCH ON ORIGINAL DRAWING. 0 — 1". IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

GROUNDWATER CONTOUR MAP
SHALLOW MONITORING WELLS
OCTOBER, 2001

SHEET / DWG NO. / DATE / PROJ NO.

04/04/2002 U:\159908\ONALASKA\CAD\DRAWINGS\WATERLEVEL-OCT-5.DGN

4.4 Groundwater Extraction

The groundwater extraction system at the Onalaska site consists of five extraction wells located south of the landfill in a line extending roughly from the northwest to the southeast (see Figure 1-1). The object of the groundwater extraction system is to capture groundwater flowing south and southwest of the landfill in the area defined by the groundwater remediation target area, shown as a dashed line in Figure 1-1.

The groundwater pumping rates are summarized by year in Table 4-1. During the feasibility study, the amount of groundwater flowing through the sand and gravel aquifer beneath the site was estimated at 350,000 gallons per day. The groundwater extraction and treatment system removed and treated a total of 234,774,790 gallons in 2001. This is an average removal of 815,190 gallons per day during the period that the extraction wells were running. The high extraction rates were designed to ensure a hydraulic gradient toward the extraction wells in order to capture and contain the plume of contaminated groundwater. This results in a high rate of flushing and dilution.

TABLE 4-2
Groundwater Pumping Rates
Annual Groundwater Quality and Baseline Natural Attenuation Report for 2001

Year	Total Volume Extracted and Treated (gal)	Average Daily Extraction Rate (gal/day)	Average Pumping Rate (gpm)
1994	176,247,120	855,568[a]	594[a]
1995	261,374,480	716,094	497
1996	247,556,080	678,236	471
1997	279,514,300	765,793	532
1998	257,877,450	706,514	491
1999	344,720,570	944,440	656
2000	365,955,490	1,002,618	696
2001	234,774,790	815,190[b]	566[b]
Totals & Averages	2,168,020,280	810,557	563

[a] The 1994 average daily extraction rate and average pumping rate were calculated based on a partial year rather than 365 days because pumping began in the spring of 1994.

[b] The 2001 average daily extraction rate and average pumping rate were calculated based on a partial year rather than 365 days because the plant was shut down for the natural attenuation study on November 26 and because the plant was shut down for over a month in May and June for stripping tower packing replacement.

5. Natural Attenuation Evaluation

Baseline data for MNA was obtained during the October 2001 sampling event. Data consisted of MNA indicators, VOCs, and metals. This section will discuss the indications of MNA, and the correlation between MNA parameters and observed contaminant distributions. Future MNA data will be compared to this baseline evaluation to determine natural attenuation trends and contaminant reduction at the site.

Concentration isopleth drawings using data from the October 2001 baseline MNA monitoring event are included in Appendix C. Constituents that were not detected at the

not known. However, based on past priority pollutant scans in EW-3 and other wells at the site, it is unlikely that there are unidentified organic priority pollutants or WDNR regulated organic pollutants at significant concentrations in this area. Therefore, the balance may be solubilized unregulated organic material from the landfill.

PZ-2, which had the highest TOC concentration of any well sampled, is located well west of the landfill and just east of the stagnant Dodge Chute of the Black River. It is likely that natural organic deposits from the adjacent river sediments and low-lying forest are the primary source of the high TOC concentration at PZ-2. This is supported by the fact that the TOC concentrations at AW-1, AW-9, AW-13, PZ-1, and MW-14S, which are upstream of PZ-2, are not significantly elevated above background. Only one well between the landfill and PZ-2, MW-5S, also had elevated TOC (10 mg/L), and that was less than the TOC at PZ-2. Also, as indicated by the hydraulic contour map from the spring sampling event, before the extraction wells were turned off, the influence of the extraction wells may have caused groundwater from below the river to flow toward the east past PZ-2. The only organic compound detected at PZ-2 was methane at 2.4 mg/L. The methane concentration at PZ-2 was the second highest of any well measured. Methane is generated from the decomposition of organic material, which can occur from the decomposition of natural organic compounds or landfill material. As noted in the discussion of methane below, based on the other wells between the landfill and PZ-2, there is evidence similar to that noted for the TOC concentration that the high methane concentration at PZ-2 is not caused by the landfill.

5.1.2 Oxidation/Reduction Potential

The ORP conditions of the shallow groundwater at the site appear typical of contaminated sites at which natural attenuation mechanisms are active. Natural groundwater ORP is relatively high (approximately 180 mV) near the background monitoring well (MW-1S), which is indicative of oxidizing conditions. ORP decreases in the direction of groundwater flow toward and through the landfill. ORP was lowest in three areas:

- In the vicinity of PZ-1 and MW-14S (ORP of –53 mV and –14 mV respectively)
- In the vicinity of AW-20 (ORP of –6)
- In the Hubley residential well (ORP of –7)

It is unclear why the ORP reading was lowest at PZ-1 versus wells with higher TOCs and organic contaminants of concern. One possibility is that the contaminants from MW-14S (the flow direction has been from MW-14S toward PZ-1 between 1994 and the fall of 2001 with the extraction wells running) and the landfill have been oxidized by the time they reach the vicinity of PZ-1, thereby reducing the ORP and the contaminant concentrations. The low ORP at MW-14S is consistent with the fact that there is organic contamination in MW-14S, as evinced by the organic odor present at MW-14S. The low ORP at AW-20 is consistent with the elevated TOC at AW-20 and the fact that AW-20 is roughly centered in the groundwater remediation target area southwest of the landfill. The cause of the low ORP in the Hubley residential well is not known, although it may be the result of the well being deeper than the others. Shallow groundwater ORP is relatively high near MW-8S and MW-12S, indicating oxidizing conditions similar to background. The ORP also is high in the deeper Ackerman residential well for unknown reasons. ORP is indicative of slightly oxidizing conditions at the remaining wells. Dissolved oxygen (DO) concentrations mirror the ORP pattern in shallow groundwater, except that DO appears to be considerably lower than expected in the background area.

contaminants discussed herein, indicating a relatively high level of organic contamination at MW-5S. As discussed above for TOC, it is likely that natural organic deposits from the adjacent river sediments and low-lying forest are the primary source of the high methane concentration at PZ-2. This is supported by the fact that the methane concentrations at AW-1, AW-9, AW-13, PZ-1, and MW-14S, which are upstream of PZ-2, are less than at PZ-2. Only MW-5S, which is between the landfill and PZ-2, had a higher methane concentration. Also, as indicated by the hydraulic contour map from the spring sampling event before the extraction wells were turned off, the influence of the extraction wells may have caused groundwater from below the river to flow toward the east past PZ-2.

5.1.8 Temperature

Temperatures are elevated one to two degrees toward the southwest of the landfill, which may be due in part to biological activity in the landfill.

5.1.9 pH

pH was depressed from 7.2 in the shallow background well to a low of 5.2 in AW-01. There are not any notable pH patterns.

5.1.10 Specific Conductance

Specific conductance was greatest to the southwest of the landfill. Specific conductance often correlates with dissolved solids concentration, and the location of the high values correlates well with high dissolved metal concentrations.

5.1.11 Chloride

The chloride concentration pattern is not consistent with that of other parameters monitored. There is no apparent increase in chloride concentration downstream of the landfill. Instead, the chloride concentration is elevated near MW-12S and MW-8S. Although the pattern is not identical, levels of nitrate, sulfate, and DO also were elevated at these wells, and the explanation may be related. Elevated nitrate and chloride concentrations sometimes are indicative of landfill leachate, but the specific conductance patterns do not indicate a direct pattern of leachate migration from the main landfill mass to this location. Also, this location is slightly cross-gradient of the predominant groundwater flow direction. The elevated water levels at MW-12S could be indicative of a recharge source from the medium zone aquifer.

5.2 Hydrocarbons

5.2.1 Ethylbenzene, Total Xylenes, and Naphthalene

Ethylbenzene, total xylenes, and naphthalene contamination is centered around MW-5S. The lower concentrations in the other wells indicates that these contaminants were captured by the extraction wells. The progressively lower concentrations at greater distances from the landfill also indicate the contaminants are being removed within the aquifer. The removal mechanism most likely is biological degradation. There is other strong evidence that microbial respiration is degrading hydrocarbons as follows:

- Hydrocarbon contamination correlates with increased alkalinity and decreased pH, indicating increased microbial respiration in areas with hydrocarbon contamination.

concentration coincides with several other contaminants discussed herein which indicates that MW-5S is near the middle of multiple contaminant plumes.

5.5 Conclusions

Continued monitoring according to the *Natural Attenuation Plan* (CH2M HILL 2001) is warranted to determine the extent to which natural attenuation of organics is occurring and to estimate degradation rates.

6. Recommended Adjustments to the Monitoring Program

6.1 Adjustments Incorporated in 2001 Based on 2000 Recommendations

The recommended adjustments from the *Annual Groundwater Quality and Capture Report for 2000* Subsection 6.2 were discussed with Tim Prendiville/USEPA WAM and approved. These changes were implemented as part of the 2001 monitoring program.

6.2 Recommendations for 2002

No changes are recommended for 2002.

7. References

CH2M HILL. *Remedial Investigation Report, Onalaska Municipal Landfill Site.* 1989.

CH2M HILL. *Field Sampling Plan, Onalaska Municipal Landfill Site.* 1997.

CH2M HILL. *Annual Groundwater Quality and Capture Report for 1999, Onalaska Municipal Landfill.* 2000.

CH2M HILL. *Annual Groundwater Quality and Capture Report for 2000, Onalaska Municipal Landfill.* 2001.

CH2M HILL. *Monitored Natural Attenuation Plan, Onalaska Landfill Site.* 2001.

CH2M HILL. *Quality Assurance Project Plan, Onalaska Municipal Landfill Site.* 2002.

U.S. Environmental Protection Agency. *National Functional Guidelines for Data Review.* 1994.

U.S. Environmental Protection Agency. Record of Decision: Selected Remedial Alternative for the Onalaska Municipal Landfill Site. October 10, 2000.

WDNR Bureau of Solid and Hazardous Waste Management. *PAL/ACL Calculations Guidance for Solid Waste Facilities.* 1994

Appendix A
Tabulated 2001 Groundwater Monitoring Results

Onalaska Municipal Landfill
Groundwater Monitoring Results
Spring, 2001

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		Ackerman	Ackerman	EW-01	EW-02	EW-03	EW-04	EW-05
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water, Dup	Water	Water	Water	Water	Water
Sample Collection Date:		05/17/2001	05/17/2001	05/18/2001	05/18/2001	05/18/2001	05/18/2001	05/18/2001
Field Sample Identification:		01CF12-01	01CF12-02	01CF12-04	01CF12-05	01CF12-06	01CF12-07	01CF12-08
Laboratory Sample Identification:		A1E180222011	A1E180222012	A1E210106001	A1E210106002	A1E210106003	A1E210106004	A1E210106005
General Chemistry and Field Tests	**Units**							
pH	pH Units	7.1 =	NR	6.6 =	6.6 =	6.6 =	6.6 =	6.7 =
Color	color unit	25 =	25 =	30 =	80 =	100 =	100 =	50 =
Total Dissolved Solids (Residue, Filterable)	mg/L	260 =	260 =	240 =	520 =	200 =	170 =	150 =
Turbidity	NTU	78 =	73 =	17 =	30 =	33 =	27 =	6.9 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Spring, 2001

Field Site Identifier:		OML	OML	OML	OML	OML
Field Sample Location:		MW-06M	MW-06S	MW-08M	MW-08S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water
Sample Collection Date:		05/17/2001	05/17/2001	05/17/2001	05/17/2001	05/18/2001
Field Sample Identification:		01CF12-18	01CF12-17	01CF12-20	01CF12-19	01CF12-21
Laboratory Sample Identification:		A1E180222007	A1E180222006	A1E180222009	A1E180222008	A1E210106009
General Chemistry and Field Tests	**Units**					
pH	pH Units	7.4 =	7.3 =	7.4 =	7.6 =	6.7 =
Color	color unit	5 U	5 U	10 =	17 =	5 =
Total Dissolved Solids (Residue, Filterable)	mg/L	210 =	320 =	160 =	170 =	120 =
Turbidity	NTU	1 U	1 U	1 U	1 U	1 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Spring, 2001

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		Ackerman	Ackerman	EW-01	EW-02	EW-03	EW-04	EW-05
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water, Dup	Water	Water	Water	Water	Water
Sample Collection Date:		05/17/2001	05/17/2001	05/18/2001	05/18/2001	05/18/2001	05/18/2001	05/18/2001
Field Sample Identification:		01CF12-01	01CF12-02	01CF12-04	01CF12-05	01CF12-06	01CF12-07	01CF12-08
Laboratory Sample Identification:		A1E180222011	A1E180222012	A1E210106001	A1E210106002	A1E210106003	A1E210106004	A1E210106005
Volatiles	**Units**							
1,2,4-Trimethylbenzene	ug/L	NR	NR	NR	NR	NR	NR	NR
1,3,5-Trimethylbenzene (Mesitylene)	ug/L	NR	NR	NR	NR	NR	NR	NR
Benzene	ug/L	0.13 U	0.13 U	5 U	5 U	1 U	1.4 U	1.2 U
Ethylbenzene	ug/L	0.17 U	0.17 U	2.1 J	3.2 J	0.47 J	0.44 J	0.51 J
Methylene Chloride	ug/L	NR	NR	NR	NR	NR	NR	NR
Naphthalene	ug/L	NR	NR	NR	NR	NR	NR	NR
Toluene	ug/L	0.12 U	0.12 U	5 U	5 U	1 U	1.4 U	1.2 U
Xylenes, Total	ug/L	0.64 U	0.64 U	24 =	24 =	10 =	1.1 J	5.2 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Spring, 2001

Field Site Identifier:		OML	OML
Field Sample Location:		MW-05S	MW-14S
Sample Interval:		N/A	N/A
Matrix:		Water	Water
Sample Collection Date:		05/17/2001	05/18/2001
Field Sample Identification:		01CF12-16	01CF12-21
Laboratory Sample Identification:		A1E180222005	A1E210106009
Volatiles	**Units**		
1,2,4-Trimethylbenzene	ug/L	360 =	NR
1,3,5-Trimethylbenzene (Mesitylene)	ug/L	91 =	NR
Benzene	ug/L	18 U	NR
Ethylbenzene	ug/L	13 J	NR
Methylene Chloride	ug/L	NR	NR
Naphthalene	ug/L	5.8 J	1 U
Toluene	ug/L	18 U	NR
Xylenes, Total	ug/L	130 =	NR

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Spring, 2001

	Field Site Identifier:	OML	OML	OML	OML	OML	OML	OML
	Field Sample Location:	Ackerman	EW-01	EW-02	EW-03	EW-04	EW-05	Hubley
	Sample Interval:	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Matrix:	Water	Water	Water	Water	Water	Water	Water
	Sample Collection Date:	05/17/2001	05/18/2001	05/18/2001	05/18/2001	05/18/2001	05/18/2001	05/17/2001
	Field Sample Identification:	01CF12-01	01CF12-04	01CF12-05	01CF12-06	01CF12-07	01CF12-08	01CF12-03
	Laboratory Sample Identification:	A1E180222011	A1E210106001	A1E210106002	A1E210106003	A1E210106004	A1E210106005	A1E180222013
Metals	**Units**							
Arsenic	ug/L	10 UB	10.7 =	14.3 =	17.4 =	14.6 =	10.3 =	10 UB
Barium	ug/L	21.9 J	439 =	676 =	662 =	492 =	254 =	80.9 J
Cadmium	ug/L	NR	2 U	2 U	2 U	2 U	2 U	NR
Cobalt	ug/L	NR	NR	NR	NR	NR	NR	NR
Iron	mg/L	1.41 =	1.93 =	6.88 =	6.18 =	4.12 =	1.82 =	0.1 U
Lead	ug/L	2.1 =	1 U	1 U	1 U	1 U	1 U	1 U
Manganese	ug/L	91.7 =	1,630 =	2,230 =	2,330 =	1,880 =	1,910 =	309 =
Mercury	ug/L	NR	0.2 U	0.2 U	0.2 U	0.2 U	0.2 U	NR
Vanadium	ug/L	NR	NR	NR	NR	NR	NR	NR

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Spring, 2001

	Field Site Identifier:	OML	OML	OML	OML	OML
	Field Sample Location:	MW-06M	MW-06S	MW-08M	MW-08S	MW-14S
	Sample Interval:	N/A	N/A	N/A	N/A	N/A
	Matrix:	Water	Water	Water	Water	Water
	Sample Collection Date:	05/17/2001	05/17/2001	05/17/2001	05/17/2001	05/18/2001
	Field Sample Identification:	01CF12-18	01CF12-17	01CF12-20	01CF12-19	01CF12-21
	Laboratory Sample Identification:	A1E180222007	A1E180222006	A1E180222009	A1E180222008	A1E210106009
Metals	**Units**					
Arsenic	ug/L	10 UB	10 UB	4 UB	10 UB	10 UB
Barium	ug/L	580 =	98 J	867 =	113 =	45.6 J
Cadmium	ug/L	NR	NR	NR	NR	NR
Cobalt	ug/L	NR	NR	NR	NR	NR
Iron	mg/L	0.1 U	0.1 U	0.1 U	0.1 U	0.189 =
Lead	ug/L	1 U	1 U	1 U	1 U	1 U
Manganese	ug/L	2,500 =	432 =	1,960 =	1,790 =	182 =
Mercury	ug/L	NR	NR	NR	NR	NR
Vanadium	ug/L	NR	NR	NR	NR	NR

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		Ackerman	AW-01	AW-09	AW-13	AW-20	AW-25	AW-28
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		WP	Water	Water	Water	Water	Water	Water
Sample Collection Date:		10/30/2001	11/01/2001	11/01/2001	11/02/2001	11/02/2001	11/02/2001	11/02/2001
Field Sample Identification:		02CF05-01	02CF05-03	02CF05-04	02CF05-05	02CF05-06	02CF05-07	02CF05-08
Laboratory Sample Identification:		A1K010206004	A1K020162006	A1K020162005	A1K030112004	A1K030112003	A1K030112002	A1K030112001
General Chemistry and Field Tests	**Units**							
Alkalinity, Total (As CaCO3)	mg/L	240 J	300 J	190 J	450 J	350 J	370 J	260 J
pH	pH Units	7 =	5.2 =	5.8 =	6 =	5.8 =	5.8 =	5.6 =
Chloride (As Cl)	mg/L	6.3 =	5.5 =	2.9 =	2.8 =	5.6 =	3.2 =	3 =
Dissolved Oxygen	mg/L	1.3 =	2.3 =	3.8 =	4.2 =	1.1 =	0.9 =	1.7 =
Nitrogen, Nitrate (As N)	mg/L	0.02 U	4 =	0.79 =	0.02 U	2 =	0.55 =	1 =
Oxidation-Reduction Potential	millivolts	210.3 =	70.3 =	6 =	32 =	-6 =	23 =	43 =
Specific Conductance	ms/cm	0.453 =	0.603 =	0.379 =	0.804 =	0.748 =	0.679 =	0.52 =
Sulfate (As SO4)	mg/L	11.9 =	9.8 =	4.8 =	3.1 =	9.8 =	3.5 =	5.5 =
Total Organic Carbon	mg/L	0.4 U	5 =	1 =	5 =	16 =	10 =	3 =
Temperature	deg c	11.7 =	14.7 =	15.4 =	15.4 =	14.4 =	14.2 =	12.3 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-05S	MW-06M	MW-06S	MW-08M	MW-08S	MW-12S	MW-14S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water	Water	Water	Water	Water	Water
Sample Collection Date:		11/02/2001	10/31/2001	10/31/2001	10/30/2001	10/30/2001	10/30/2001	11/01/2001
Field Sample Identification:		02CF05-19	02CF05-20	02CF05-21	02CF05-22	02CF05-23	02CF05-24	02CF05-25
Laboratory Sample Identification:		A1K030112005	A1K010206010	A1K010206009	A1K010206001	A1K010206002	A1K010206003	A1K020162002
General Chemistry and Field Tests	**Units**							
Alkalinity, Total (As CaCO3)	mg/L	270 J	140 J	130 J	200 =	140 J	190 J	95 J
pH	pH Units	5.9 =	7 =	6.2 =	7.1 =	7 =	6.9 =	5.6 =
Chloride (As Cl)	mg/L	2.2 =	5.2 =	6.6 =	3.9 =	18.3 =	39.8 =	5.1 =
Dissolved Oxygen	mg/L	0.5 =	0.4 =	0.6 =	0.4 =	5.3 =	9.7 =	1.96 =
Nitrogen, Nitrate (As N)	mg/L	0.02 U	0.02 U	0.02 U	0.02 U	26.4 J	18.1 J	0.45 =
Oxidation-Reduction Potential	millivolts	22 =	33 =	56 =	185.4 =	208 =	215.7 =	-14.3 =
Specific Conductance	ms/cm	0.568 =	0.267 =	0.283 =	0.344 =	0.647 =	0.629 =	0.268 =
Sulfate (As SO4)	mg/L	0.38 U	0.38 U	6.4 =	0.38 U	15.6 =	12.7 =	17 =
Total Organic Carbon	mg/L	10 =	4 =	7 =	2 =	0.4 U	1 =	6 =
Temperature	deg c	13.2 =	11.7 =	11.8 =	1.66 =	12.5 =	12.7 =	12.9 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		Ackerman	Ackerman	Ackerman	AW-01	AW-09	AW-13	AW-20
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		WP	WP	WP, Dup	Water	Water	Water	Water
Sample Collection Date:		10/30/2001	10/30/2001	10/30/2001	11/01/2001	11/01/2001	11/02/2001	11/02/2001
Field Sample Identification:		02CF05-01	02CF05-01	02CF05-02	02CF05-03	02CF05-04	02CF05-05	02CF05-06
Laboratory Sample Identification:		269237	A1K010206004	269238	A1K020162006	A1K020162005	A1K030112004	A1K030112003
Volatiles and Gases	**Units**							
1,1,1-Trichloroethane	ug/L	0.16 U	0.16 U	0.16 U	0.15 U	0.15 U	0.15 U	0.15 U
1,1-Dichloroethane	ug/L	0.15 U	0.15 U	0.15 U	0.16 U	0.16 U	0.16 U	0.16 U
1,1-Dichloroethene	ug/L	0.17 U	0.17 U	0.17 U	0.24 U	0.24 U	0.24 U	0.24 U
1,2,4-Trimethylbenzene	ug/L	0.29 U	0.29 U	0.29 U	45 =	0.12 U	17 =	260 =
1,3,5-Trimethylbenzene (Mesitylene)	ug/L	0.26 U	0.26 U	0.26 U	43 =	0.17 U	7.1 =	120 =
Benzene	ug/L	0.13 U	0.13 U	0.13 U	0.16 U	0.16 U	0.16 U	0.16 U
cis-1,2-Dichloroethene	ug/L	0.18 U	0.18 U	0.18 U	0.22 U	0.22 U	0.22 U	0.22 U
Ethylbenzene	ug/L	0.17 U	0.17 U	0.17 U	0.32 J	0.12 U	0.12 U	0.78 J
Methylene Chloride	ug/L	NR	NR	NR	NR	NR	NR	NR
Naphthalene	ug/L	0.41 U	0.41 U	0.41 U	0.46 J	0.22 U	0.22 U	1.1 =
Tetrachloroethene	ug/L	0.17 U	0.17 U	0.17 U	0.3 J	0.23 U	0.23 U	0.23 U
Toluene	ug/L	0.12 U	0.12 U	0.12 U	0.18 U	0.18 U	0.18 U	0.78 J
trans-1,2-Dichloroethene	ug/L	0.12 U	0.12 U	0.12 U	0.15 U	0.15 U	0.15 U	0.15 U
Trichloroethene	ug/L	0.16 U	0.16 U	0.16 U	0.14 U	0.14 U	0.14 U	0.14 U
Vinyl Chloride	ug/L	0.14 U	0.14 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U
Xylenes, Total	ug/L	NR	NR	NR	10 =	0.33 U	0.48 J	15 =
M,P-Xylene (Sum Of Isomers)	ug/L	0.42 U	0.42 U	0.42 U	NR	NR	NR	NR
O-Xylene (1,2-Dimethylbenzene)	ug/L	0.22 U	0.22 U	0.22 U	NR	NR	NR	NR
Ethane	ug/L	0.089 U	0.089 U	NR	0.089 U	0.089 U	0.089 U	0.089 U
Ethene	ug/L	0.083 U	0.083 U	NR	0.083 U	0.083 U	0.083 U	0.083 U
Methane	ug/L	13 =	13 =	NR	1,100 =	0.78 =	120 =	1,300 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

Field Site Identifier:		OML	OML	OML	OML	OML	OML	OML
Field Sample Location:		MW-04S	MW-04S	MW-05S	MW-06M	MW-06S	MW-08M	MW-08S
Sample Interval:		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Matrix:		Water	Water, Dup	Water	Water	Water	Water	Water
Sample Collection Date:		11/01/2001	11/01/2001	11/02/2001	10/31/2001	10/31/2001	10/30/2001	10/30/2001
Field Sample Identification:		02CF05-17	02CF05-18	02CF05-19	02CF05-20	02CF05-21	02CF05-22	02CF05-23
Laboratory Sample Identification:		A1K020162008	A1K020162009	A1K030112005	A1K010206010	A1K010206009	A1K010206001	A1K010206002
Volatiles and Gases	**Units**							
1,1,1-Trichloroethane	ug/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
1,1-Dichloroethane	ug/L	0.16 U	0.16 U	0.16 U	0.54 J	0.33 J	0.16 U	0.16 U
1,1-Dichloroethene	ug/L	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U	0.24 U
1,2,4-Trimethylbenzene	ug/L	380 =	330 =	670 =	0.12 U	0.12 U	0.12 U	0.12 U
1,3,5-Trimethylbenzene (Mesitylene)	ug/L	91 =	76 =	210 =	0.17 U	0.17 U	0.17 U	0.17 U
Benzene	ug/L	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U	0.16 U
cis-1,2-Dichloroethene	ug/L	0.22 U	0.22 U	0.22 U	0.39 J	0.22 U	0.22 U	0.22 U
Ethylbenzene	ug/L	5.9 =	4.9 =	25 =	0.12 U	0.12 U	0.12 U	0.12 U
Methylene Chloride	ug/L	0.34 U	0.34 U	NR	NR	NR	NR	NR
Naphthalene	ug/L	7.3 =	5.5 =	27 =	0.22 U	0.22 U	0.22 U	0.22 U
Tetrachloroethene	ug/L	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U	0.23 U
Toluene	ug/L	0.18 U	0.18 U	0.48 J	0.18 U	0.18 U	0.18 U	0.18 U
trans-1,2-Dichloroethene	ug/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Trichloroethene	ug/L	0.14 U	0.14 U	0.14 J	0.19 J	0.16 J	0.4 J	0.14 U
Vinyl Chloride	ug/L	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U
Xylenes, Total	ug/L	30 =	22 =	180 =	0.33 U	0.33 U	0.33 U	0.33 U
M,P-Xylene (Sum Of Isomers)	ug/L	NR	NR	NR	NR	NR	NR	NR
O-Xylene (1,2-Dimethylbenzene)	ug/L	NR	NR	NR	NR	NR	NR	NR
Ethane	ug/L	0.089 U	0.089 U	8.9 U	0.089 U	0.089 U	0.089 U	0.089 U
Ethene	ug/L	0.083 U	0.083 U	8.3 U	0.083 U	0.083 U	0.083 U	0.083 U
Methane	ug/L	1,000 =	650 =	3,600 =	140 =	7.3 =	33 =	0.074 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

Field Site Identifier:		OML	OML
Field Sample Location:		PZ-04	PZ-05
Sample Interval:		N/A	N/A
Matrix:		Water	Water
Sample Collection Date:		10/31/2001	11/01/2001
Field Sample Identification:		02CF05-29	02CF05-30
Laboratory Sample Identification:		A1K010206012	A1K020162007
Volatiles and Gases	**Units**		
1,1,1-Trichloroethane	ug/L	0.15 U	0.15 U
1,1-Dichloroethane	ug/L	0.16 U	0.16 U
1,1-Dichloroethene	ug/L	0.24 U	0.24 U
1,2,4-Trimethylbenzene	ug/L	0.12 U	0.26 J
1,3,5-Trimethylbenzene (Mesitylene)	ug/L	0.17 U	0.28 J
Benzene	ug/L	0.16 U	0.16 U
cis-1,2-Dichloroethene	ug/L	0.22 U	0.22 U
Ethylbenzene	ug/L	0.12 U	0.12 U
Methylene Chloride	ug/L	NR	NR
Naphthalene	ug/L	0.22 U	0.22 U
Tetrachloroethene	ug/L	0.23 U	0.23 U
Toluene	ug/L	0.18 U	0.18 U
trans-1,2-Dichloroethene	ug/L	0.15 U	0.15 U
Trichloroethene	ug/L	0.23 J	0.14 U
Vinyl Chloride	ug/L	0.15 U	0.15 U
Xylenes, Total	ug/L	0.33 U	0.33 U
M,P-Xylene (Sum Of Isomers)	ug/L	NR	NR
O-Xylene (1,2-Dimethylbenzene)	ug/L	NR	NR
Ethane	ug/L	0.089 U	0.089 U
Ethene	ug/L	0.083 U	0.083 U
Methane	ug/L	37 =	2 =

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

	Field Site Identifier:	OML	OML	OML	OML	OML	OML	OML
	Field Sample Location:	Ackerman	AW-01	AW-09	AW-13	AW-20	AW-25	AW-28
	Sample Interval:	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Matrix:	WP	Water	Water	Water	Water	Water	Water
	Sample Collection Date:	10/30/2001	11/01/2001	11/01/2001	11/02/2001	11/02/2001	11/02/2001	11/02/2001
	Field Sample Identification:	02CF05-01	02CF05-03	02CF05-04	02CF05-05	02CF05-06	02CF05-07	02CF05-08
	Laboratory Sample Identification:	A1K010206004	A1K020162006	A1K020162005	A1K030112004	A1K030112003	A1K030112002	A1K030112001
Metals	**Units**							
Arsenic	ug/L	NR	3.9 U	3.9 U	3.9 U	8.6 J	7.2 J	3.9 U
Barium	ug/L	23.2 J	261 =	71.5 J	192 =	186 =	246 =	129 =
Cadmium	ug/L	0.28 U	0.28 U	0.28 U	0.42 UB	0.28 U	0.28 U	0.28 U
Cobalt	ug/L	1.3 U	1.7 UB	1.3 U	1.3 U	3.8 J	4.4 J	1.3 U
Iron	mg/L	3.38 =	2.07 =	0.088 U	0.273 =	6.51 =	6.43 =	1.04 =
Iron	ug/L	NR	NR	NR	NR	NR	NR	NR
Lead	ug/L	1 UJ	1 U	0.74 U	1 U	1 U	1 U	0.74 U
Manganese	ug/L	114 J	1,620 J	1.9 UB	2,320 J	3,780 J	3,150 J	774 J
Mercury	ug/L	0.072 J	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Vanadium	ug/L	0.82 U	0.82 U	0.82 U	2 J	0.87 UB	0.82 U	0.82 U

QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Onalaska Municipal Landfill
Groundwater Monitoring Results
Fall, 2001

	Field Site Identifier:	OML	OML	OML	OML	OML	OML	OML
	Field Sample Location:	MW-06M	MW-06S	MW-08M	MW-08S	MW-12S	MW-14S	MW-14S
	Sample Interval:	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Matrix:	Water	Water	Water	Water	Water	Water	Water, Dup
	Sample Collection Date:	10/31/2001	10/31/2001	10/30/2001	10/30/2001	10/30/2001	11/01/2001	11/01/2001
	Field Sample Identification:	02CF05-20	02CF05-21	02CF05-22	02CF05-23	02CF05-24	02CF05-25	02CF05-34
	Laboratory Sample Identification:	A1K010206010	A1K010206009	A1K010206001	A1K010206002	A1K010206003	A1K020162002	A1K020162003
Metals	**Units**							
Arsenic	ug/L	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U	3.9 U
Barium	ug/L	997 J	119 J	536 J	92.5 J	34.5 J	105 =	109 =
Cadmium	ug/L	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U	0.28 U
Cobalt	ug/L	1.3 U	1.5 J	1.3 U	1.3 U	1.3 U	2.7 UB	2.7 UB
Iron	mg/L	0.088 U	0.088 U	0.088 U	0.088 U	0.088 U	8.46 =	9,370 =
Iron	ug/L	NR	NR	NR	NR	NR	NR	NR
Lead	ug/L	1 UJ	0.74 UJ	0.74 UJ	1 UJ	1 UJ	0.74 U	0.74 U
Manganese	ug/L	2,400 J	1,830 J	2,090 J	65 J	0.9 U	2,560 J	2,810 J
Mercury	ug/L	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U	0.069 U
Vanadium	ug/L	0.82 U	0.82 U	0.82 U	0.82 U	0.82 U	0.82 U	0.82 U

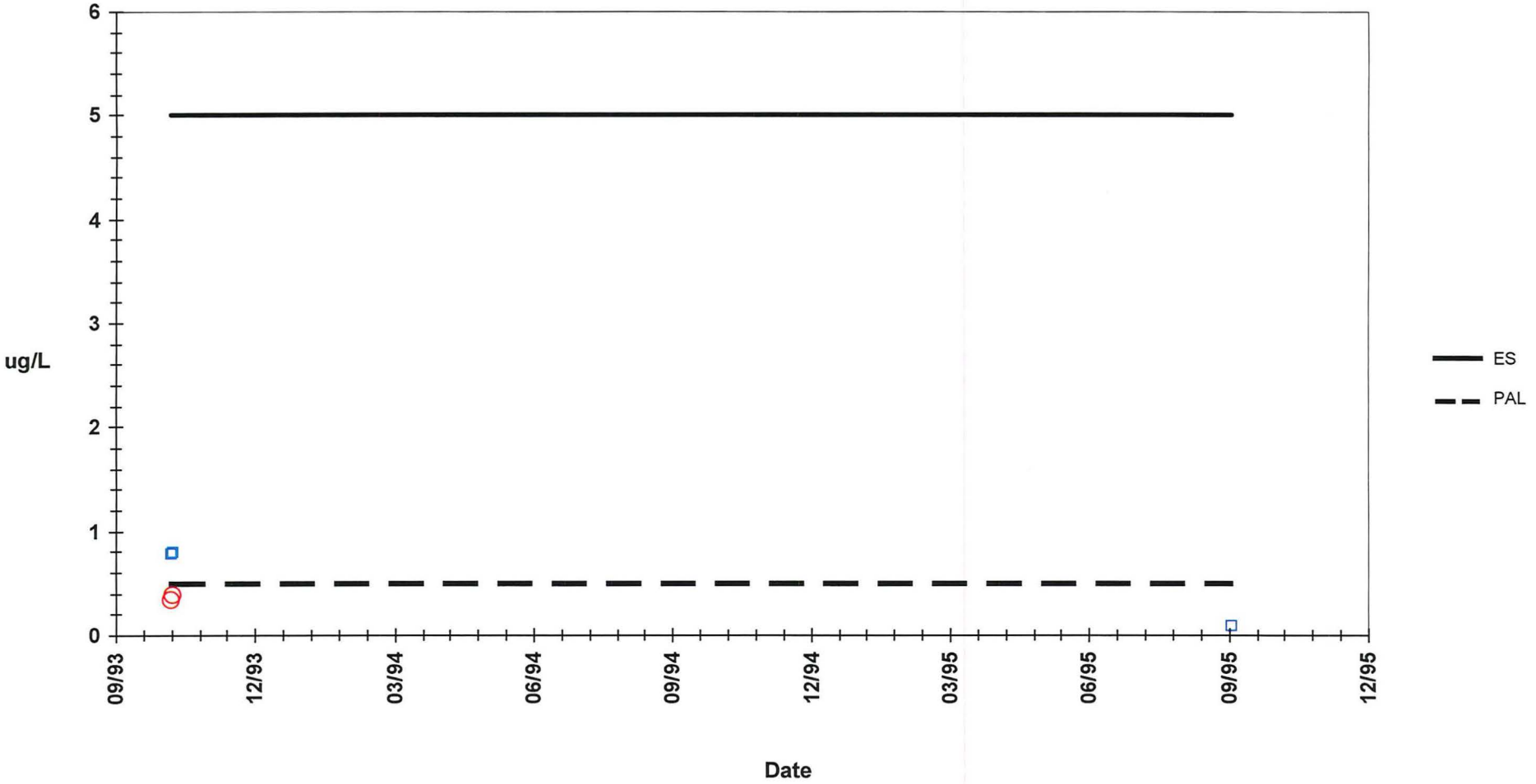
QUALIFIER KEY: "U" - Analyte not found at the listed detection limit; "J" - Estimated Result; "B" - Analyte detected in Blank; "=" - Analyte found; "R" - Rejected; "NR" - Not Reported

Appendix B
Graphed Groundwater Monitoring Results to Date

Onalaska Municipal Landfill

Benzene

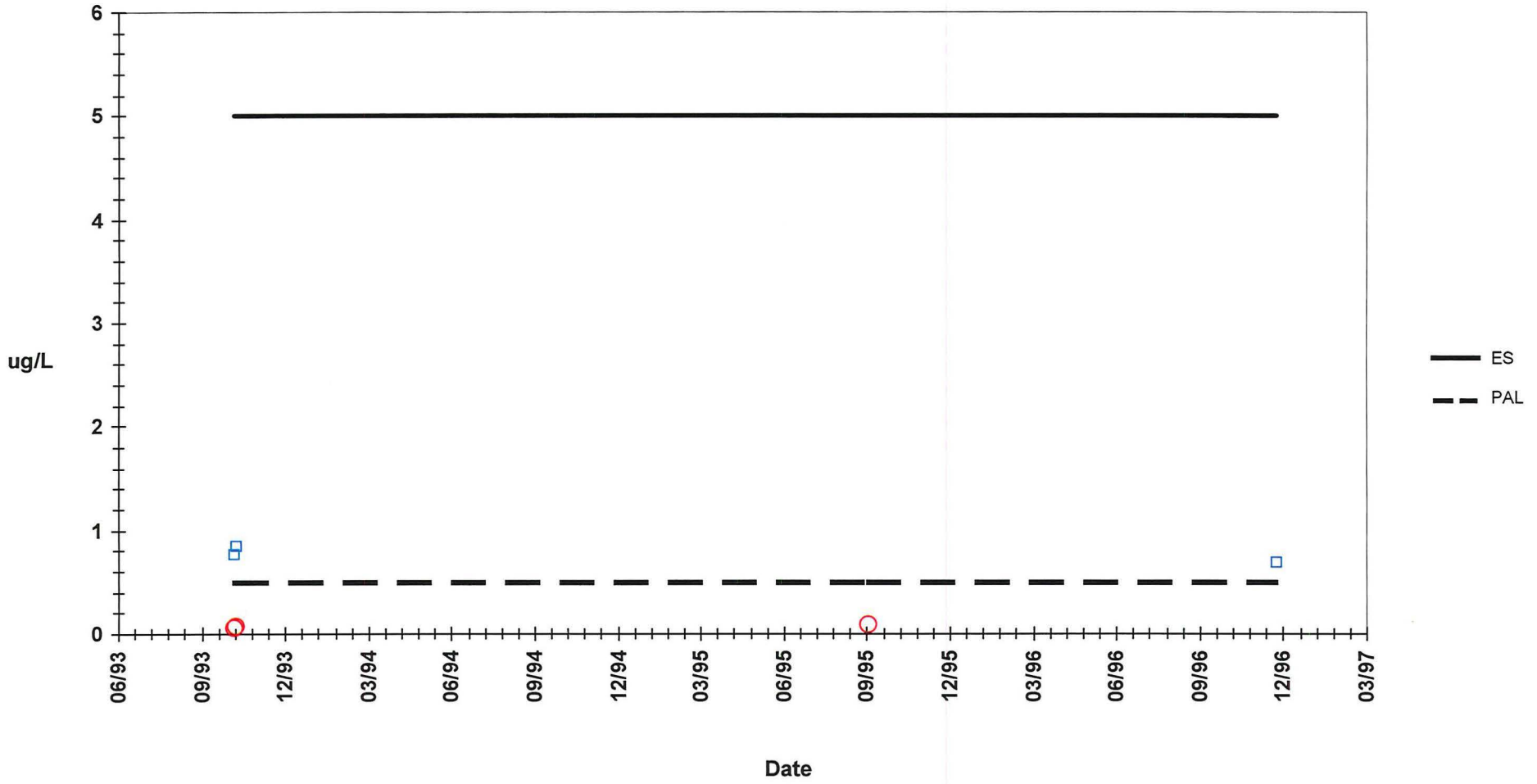
Detected Values Only



Onalaska Municipal Landfill

Benzene

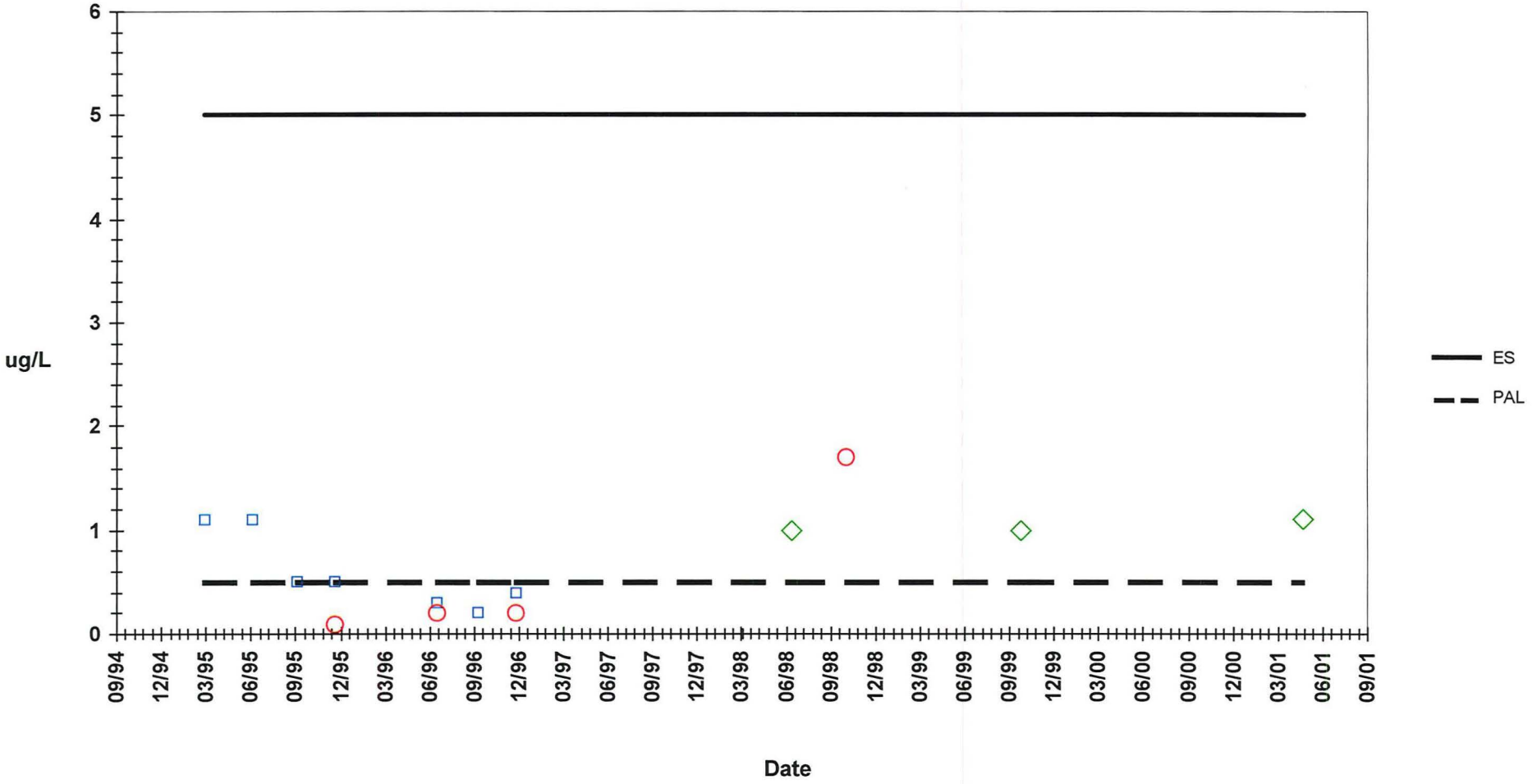
Detected Values Only



Onalaska Municipal Landfill

Benzene

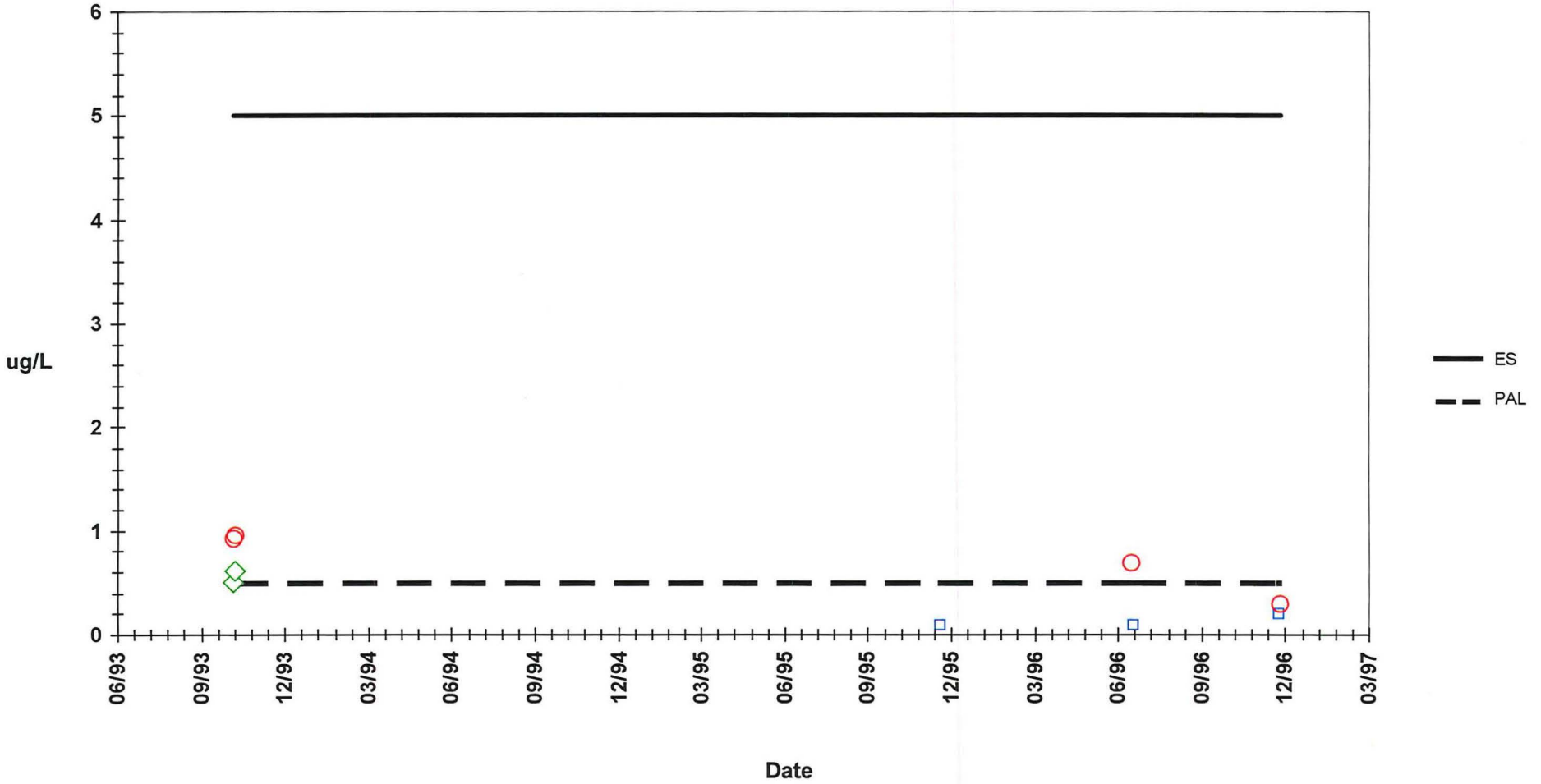
Detected Values Only



Onalaska Municipal Landfill

Benzene

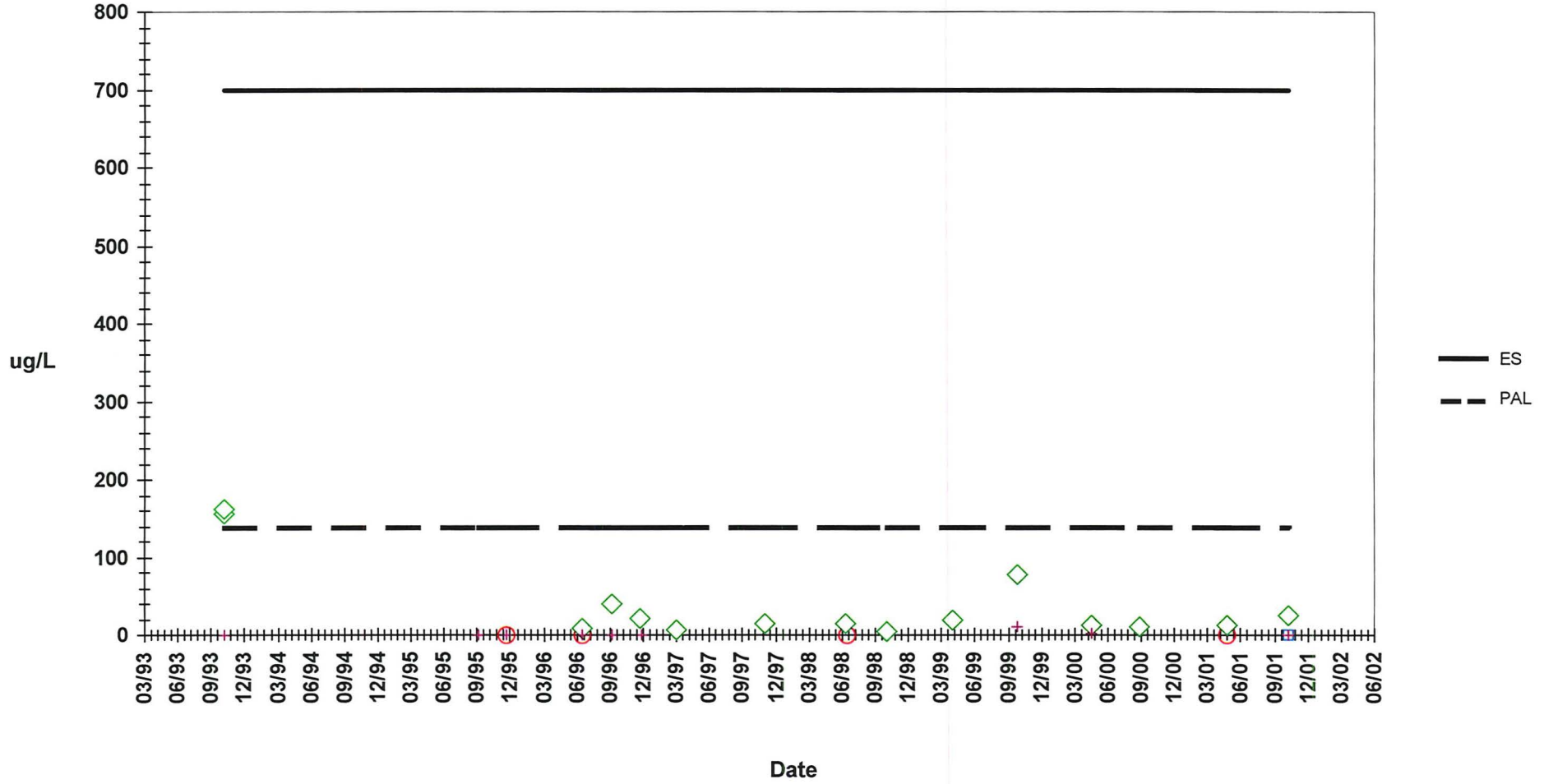
Detected Values Only



Onalaska Municipal Landfill

Ethylbenzene

Detected Values Only

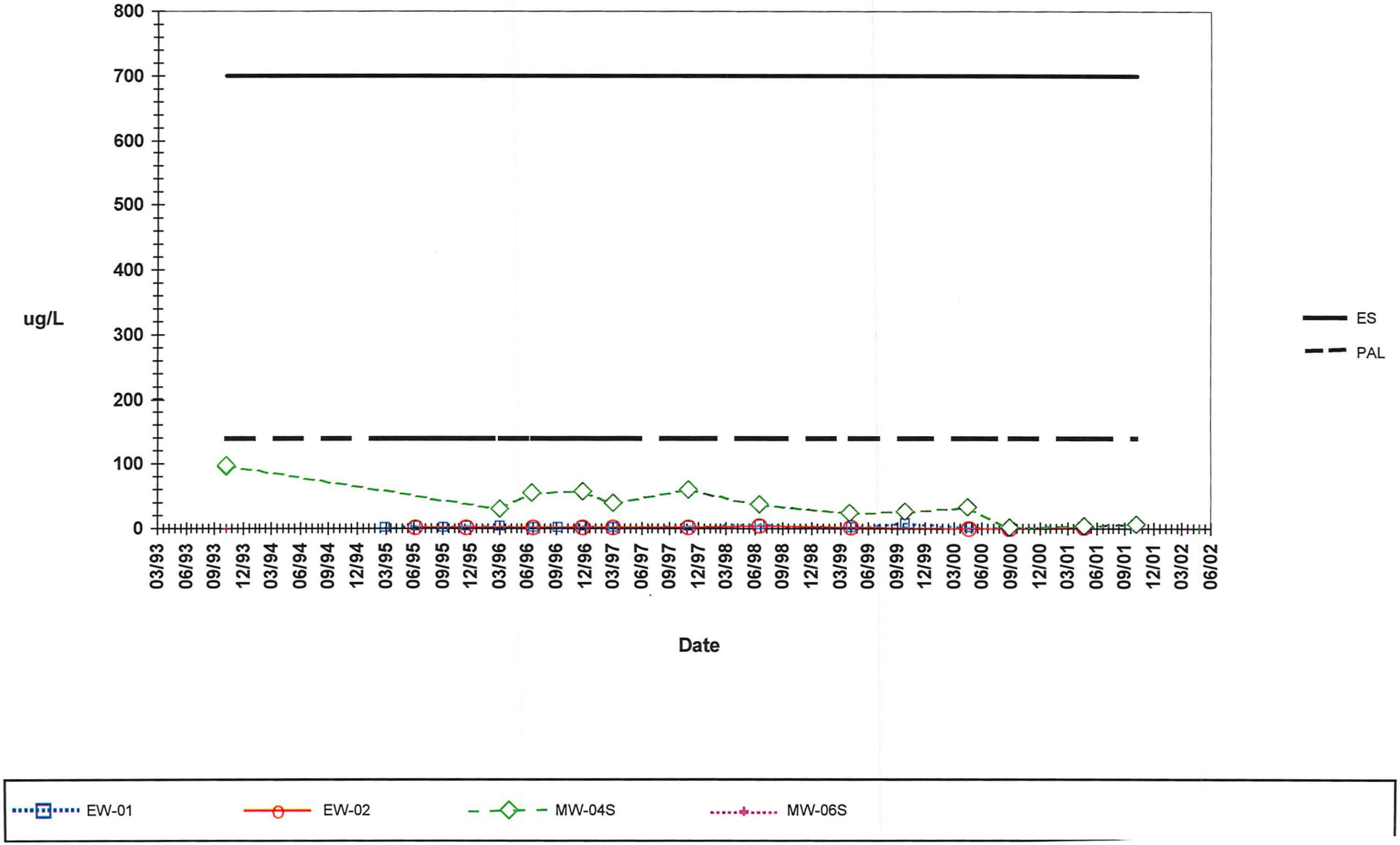


AW-01 EW-05 MW-05S MW-14S

Onalaska Municipal Landfill

Ethylbenzene

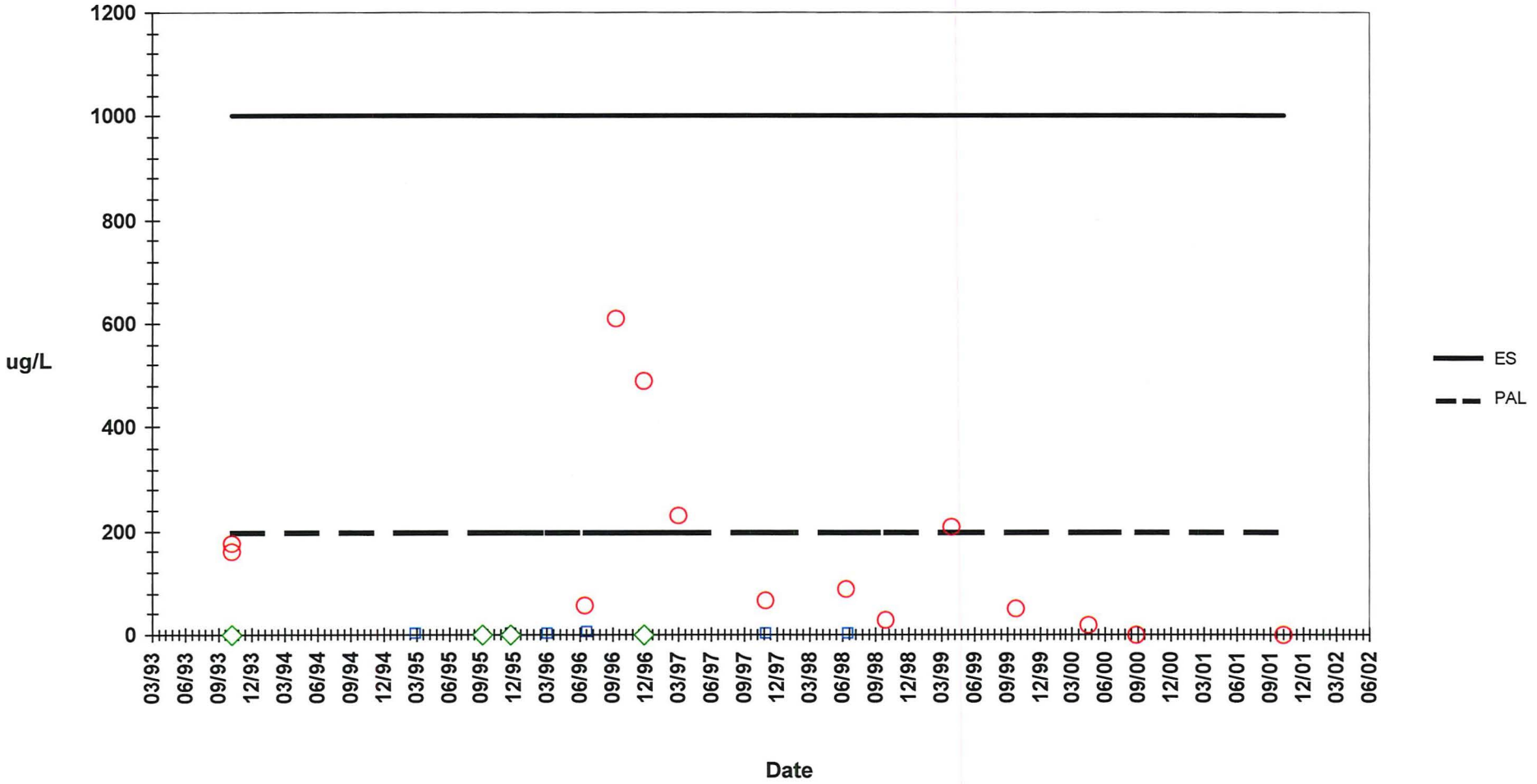
Detected Values Only



Onalaska Municipal Landfill

Toluene

Detected Values Only

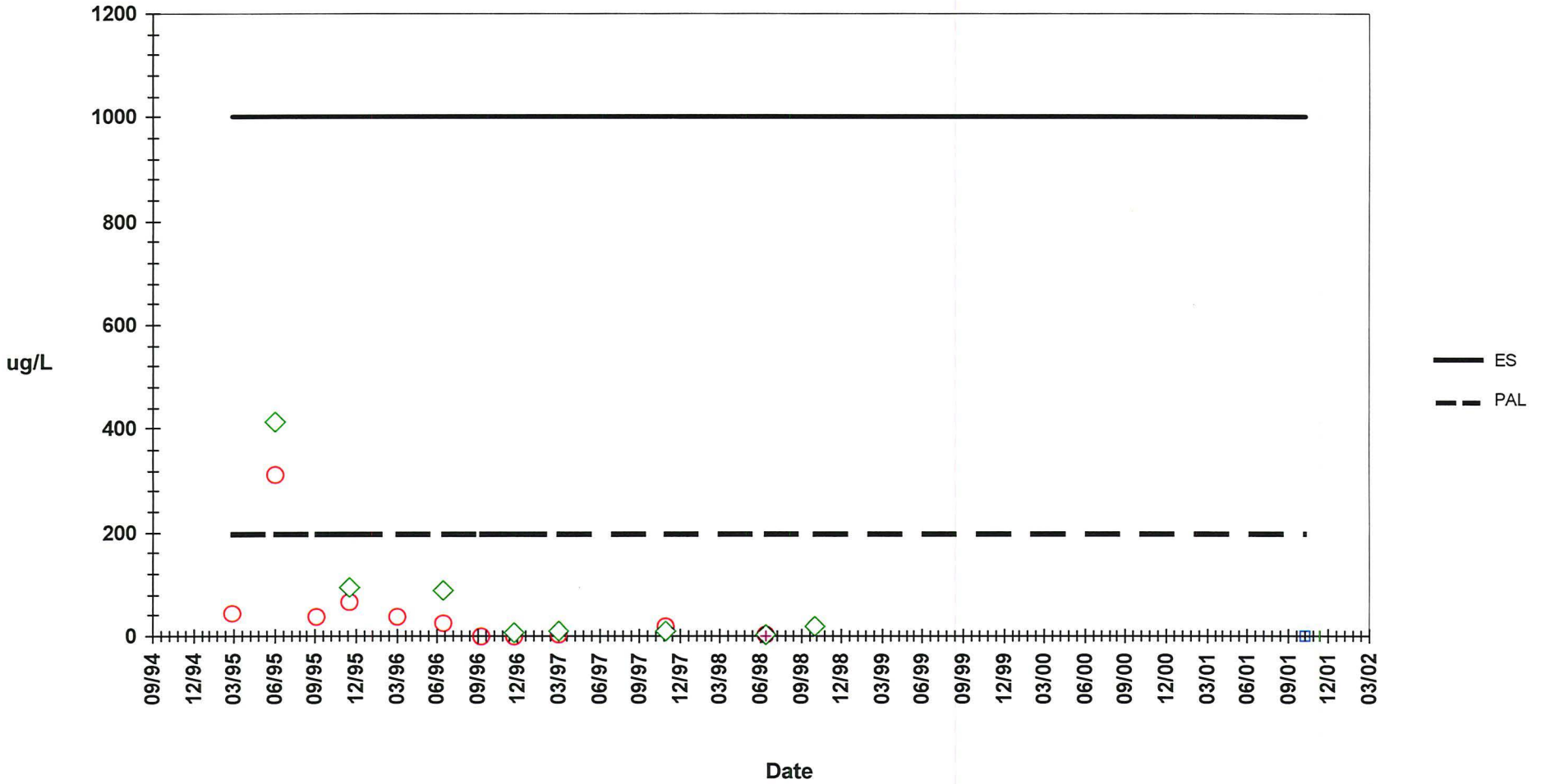


EW-05 MW-05S MW-14S

Onalaska Municipal Landfill

Toluene

Detected Values Only

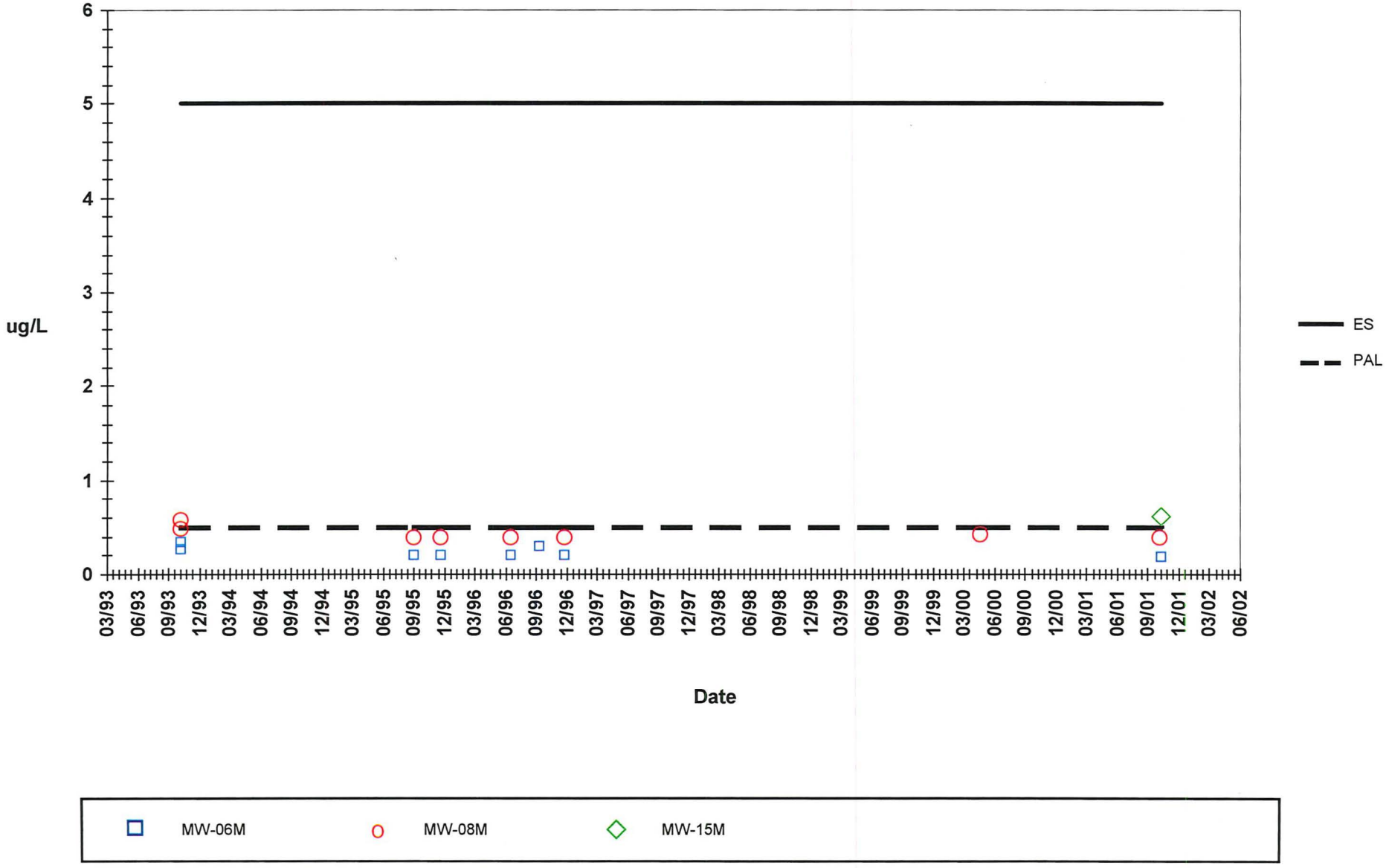


AW-20 EW-03 EW-04 MW-02S

Onalaska Municipal Landfill

Trichloroethene

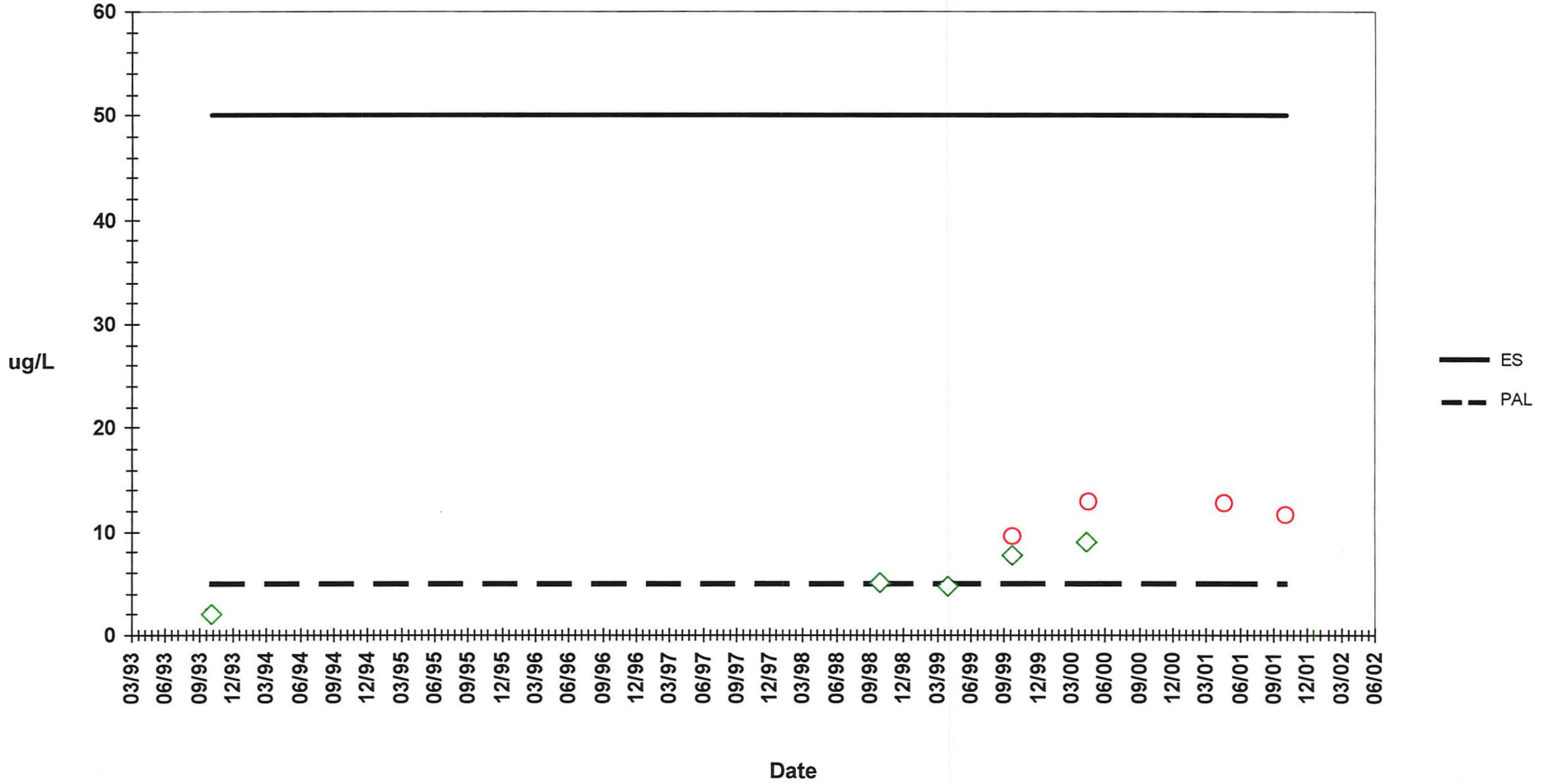
Detected Values Only



Onalaska Municipal Landfill

Arsenic

Detected Values Only

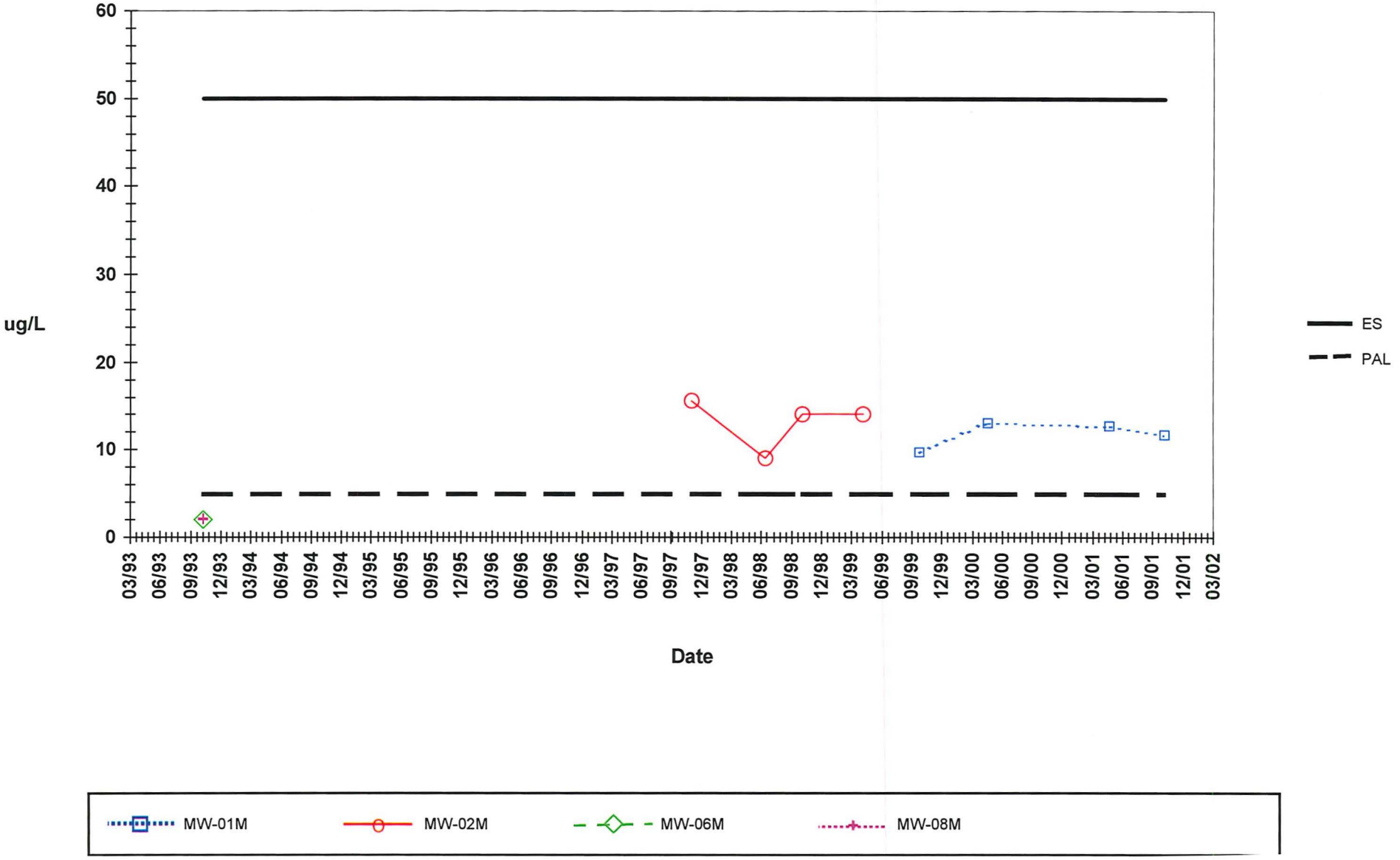


HUBLEY MW-01M MW-01S

Onalaska Municipal Landfill

Arsenic

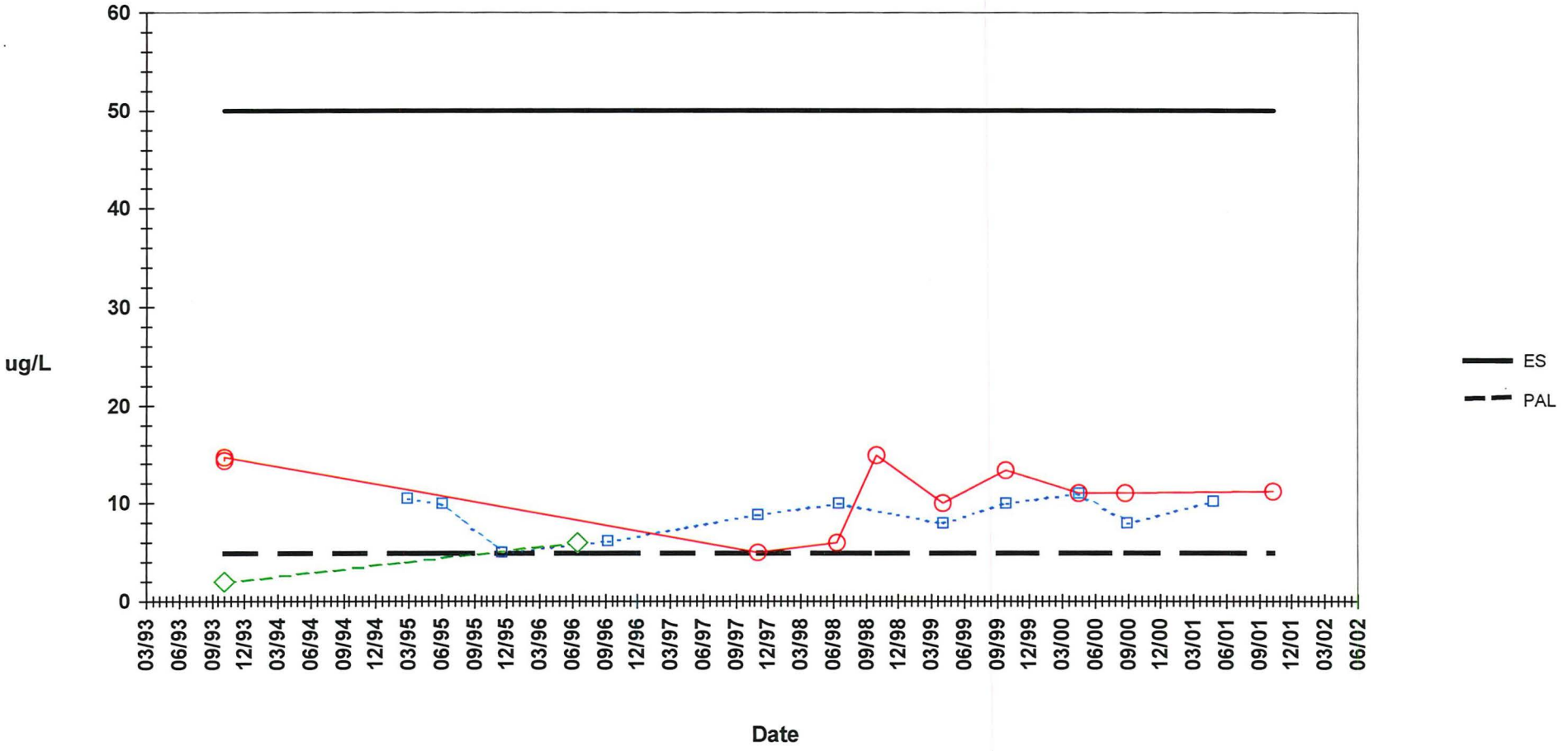
Detected Values Only



Onalaska Municipal Landfill

Arsenic

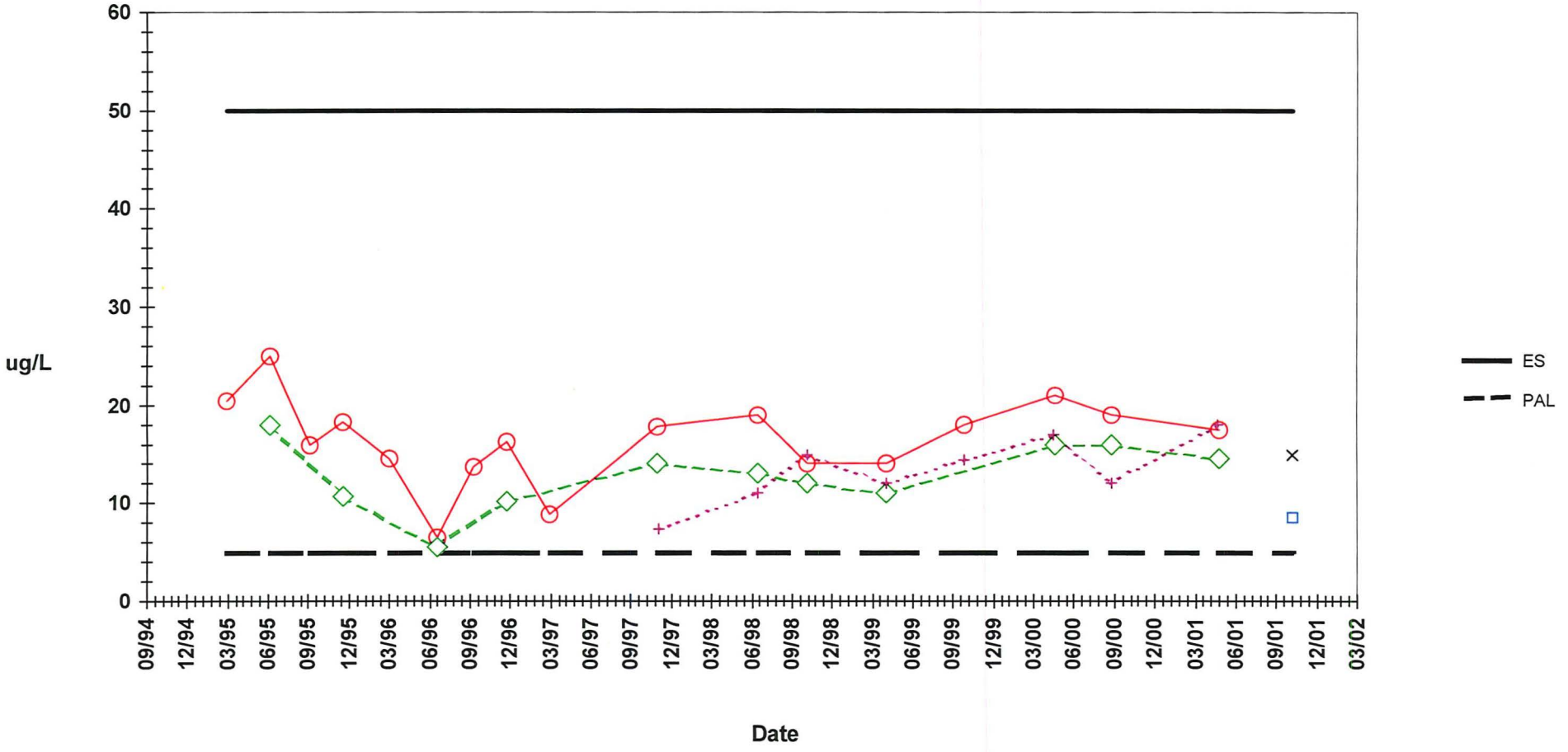
Detected Values Only



Onalaska Municipal Landfill

Arsenic

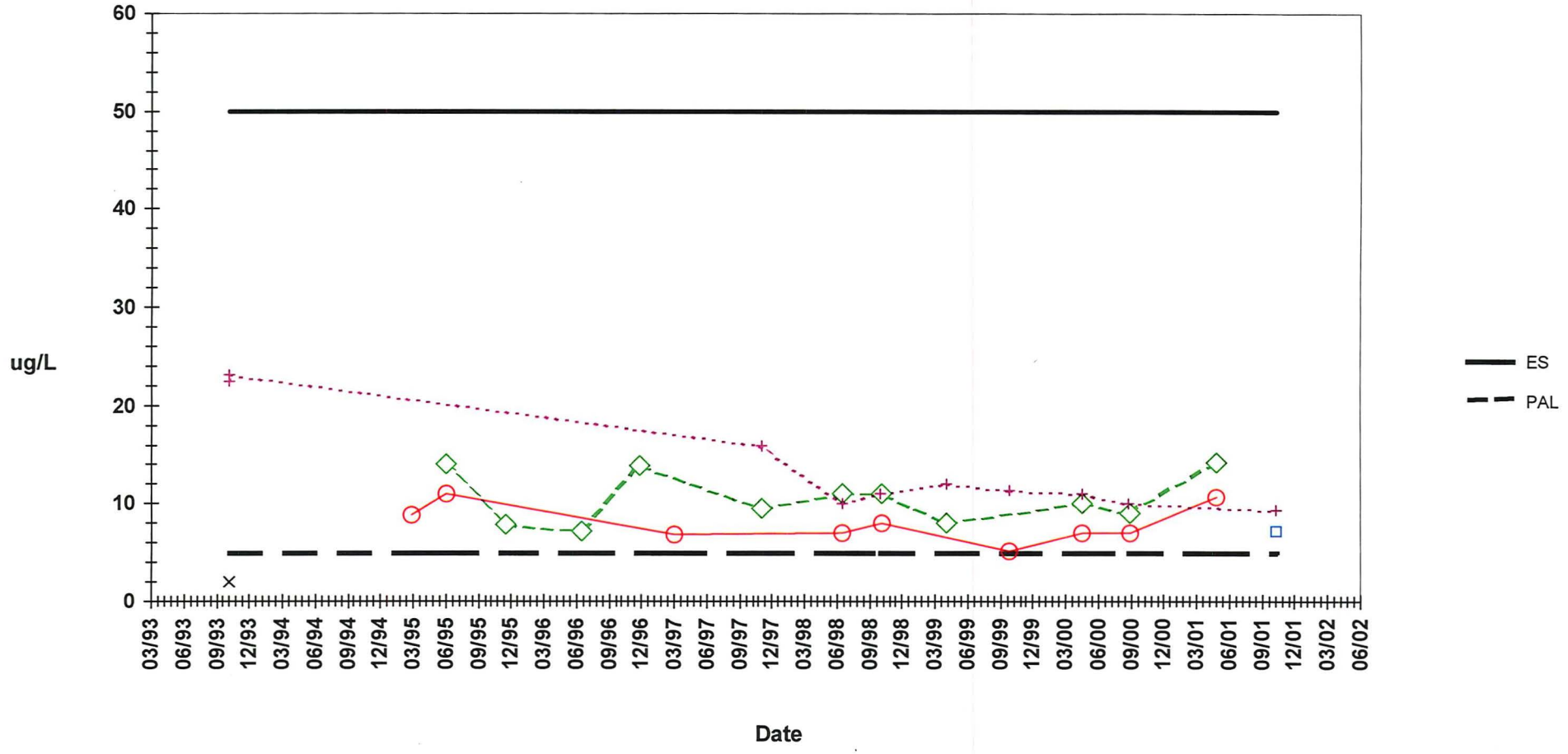
Detected Values Only



Onalaska Municipal Landfill

Arsenic

Detected Values Only

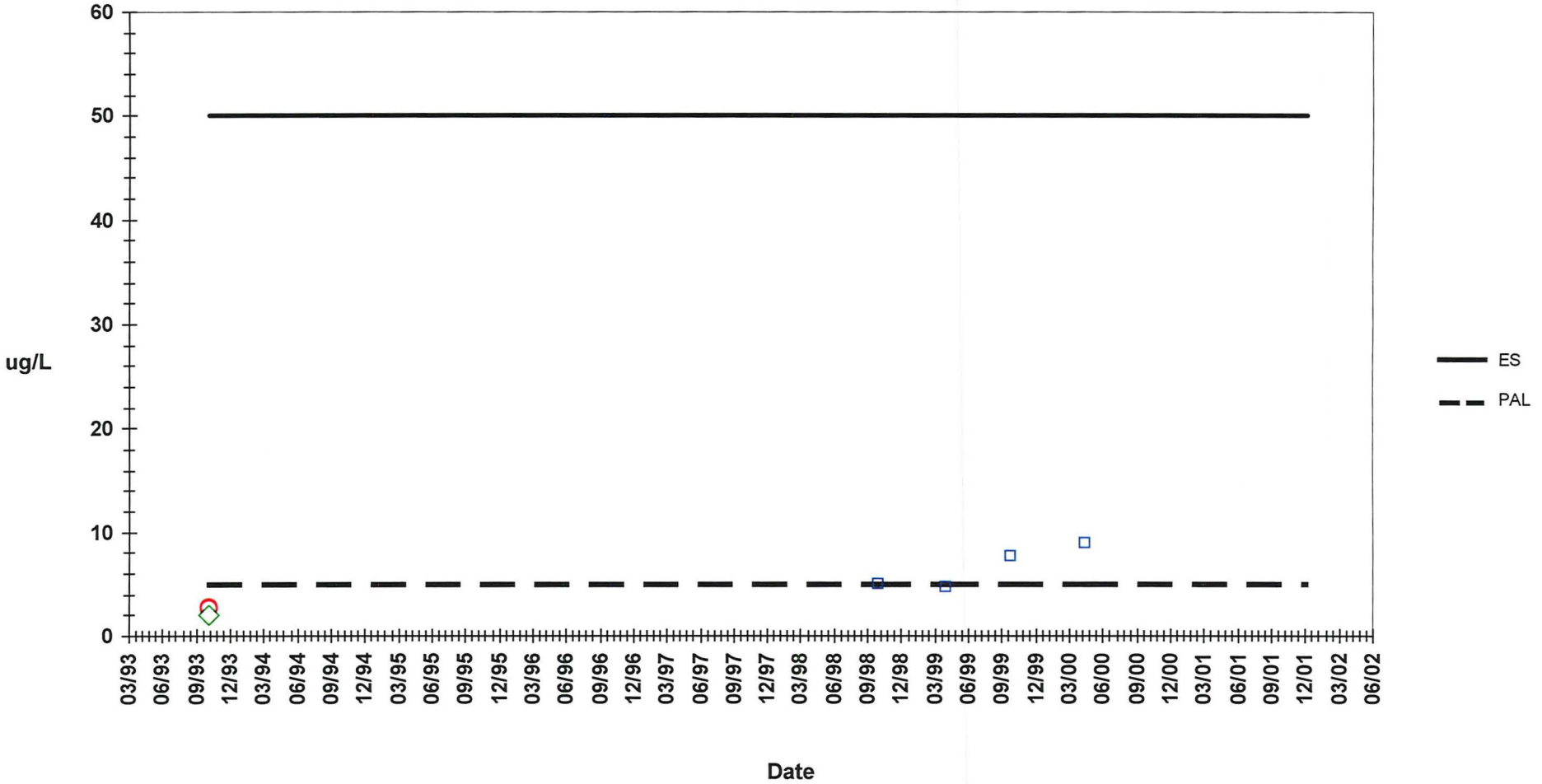


AW-25 EW-01 EW-02 MW-04S MW-06S

Onalaska Municipal Landfill

Arsenic

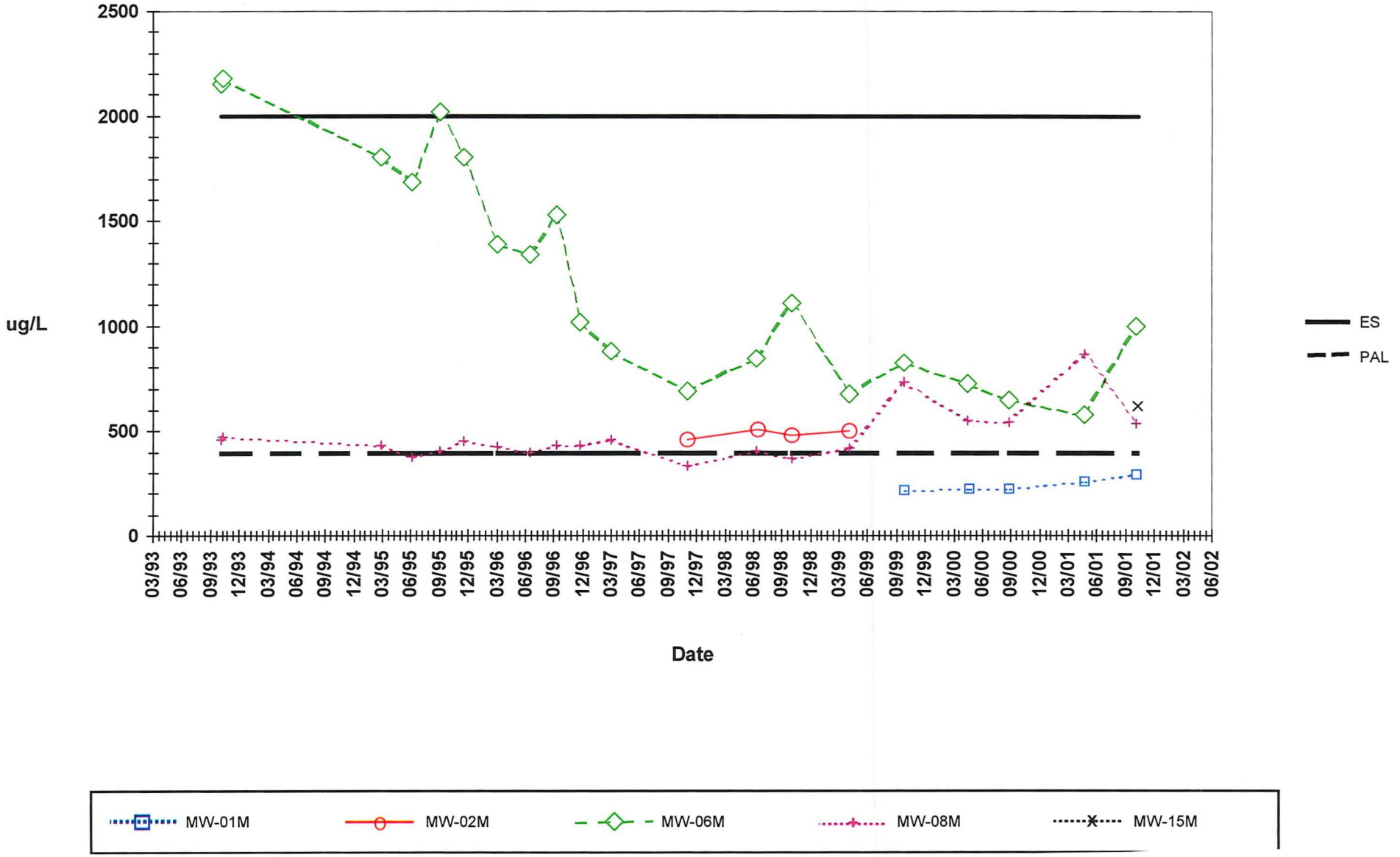
Detected Values Only



Onalaska Municipal Landfill

Barium

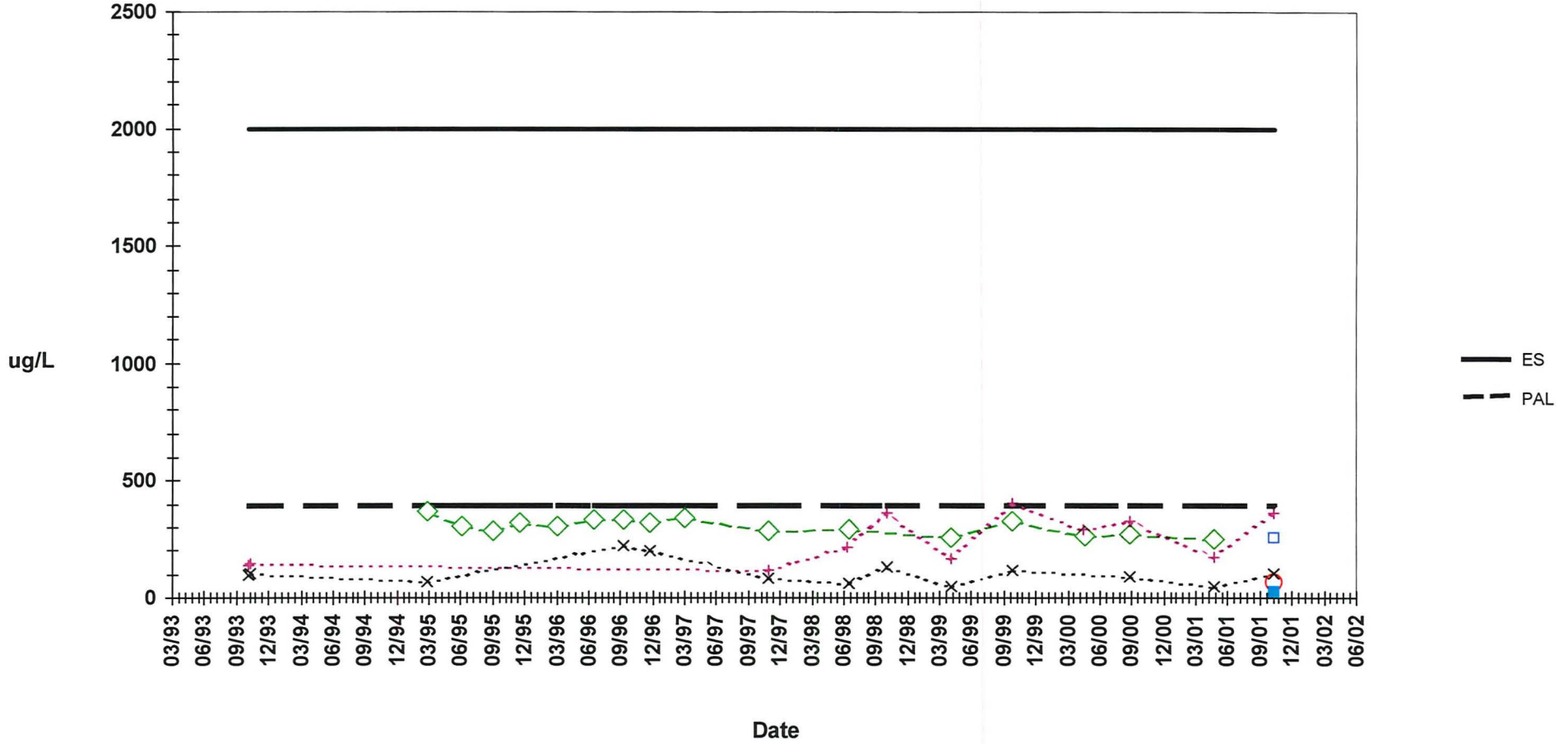
Detected Values Only



Onalaska Municipal Landfill

Barium

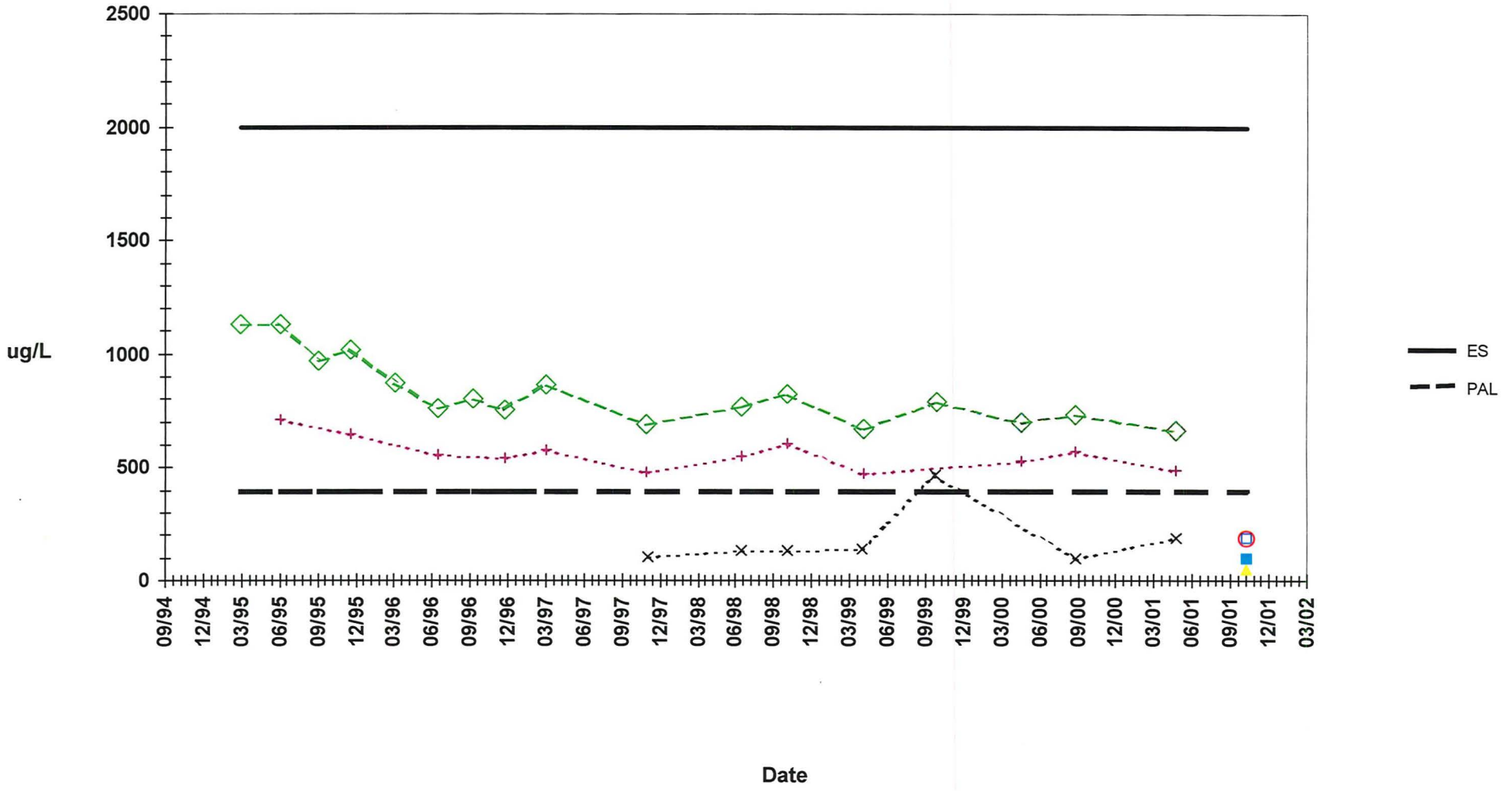
Detected Values Only



Onalaska Municipal Landfill

Barium

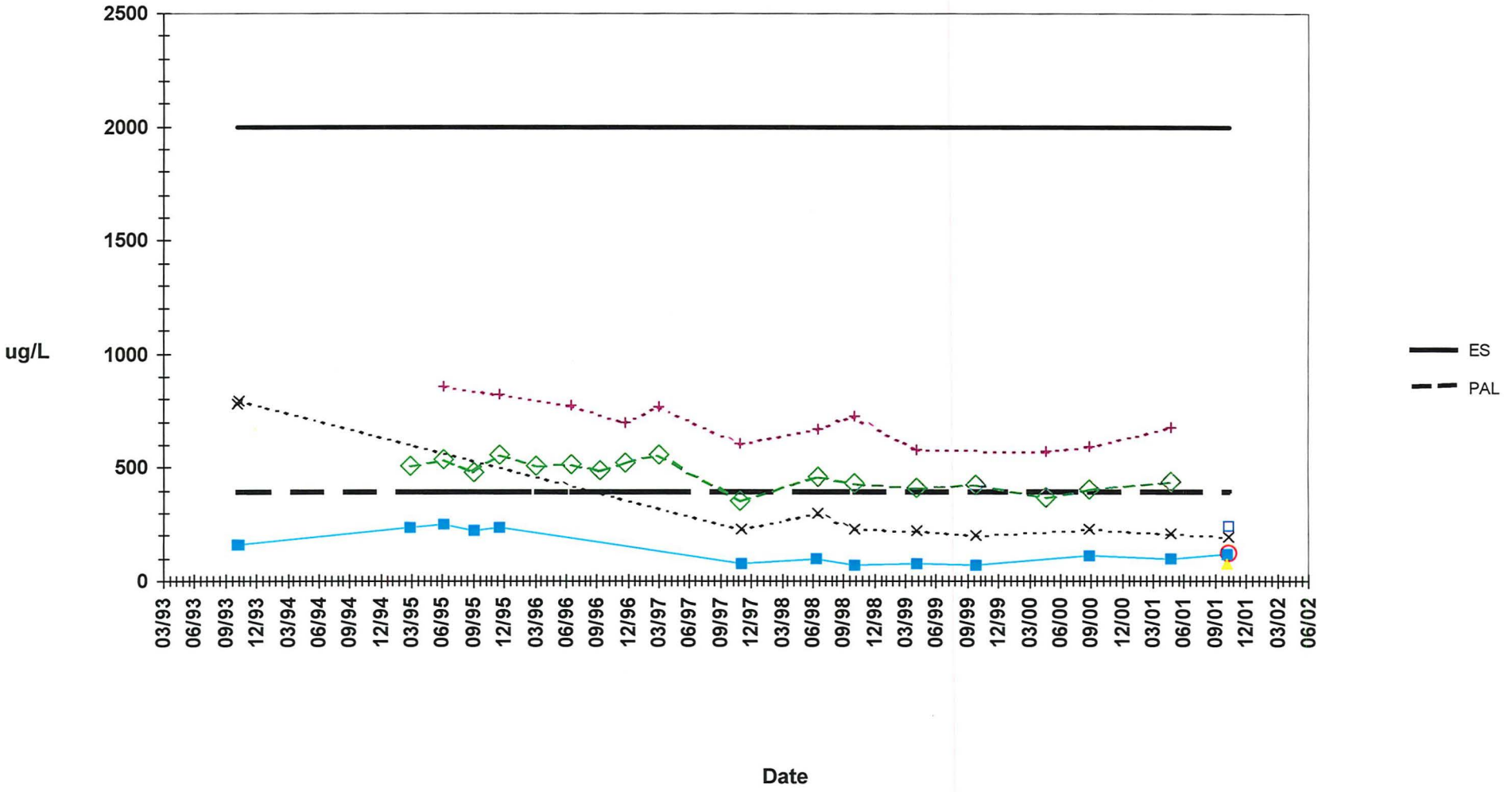
Detected Values Only



Onalaska Municipal Landfill

Barium

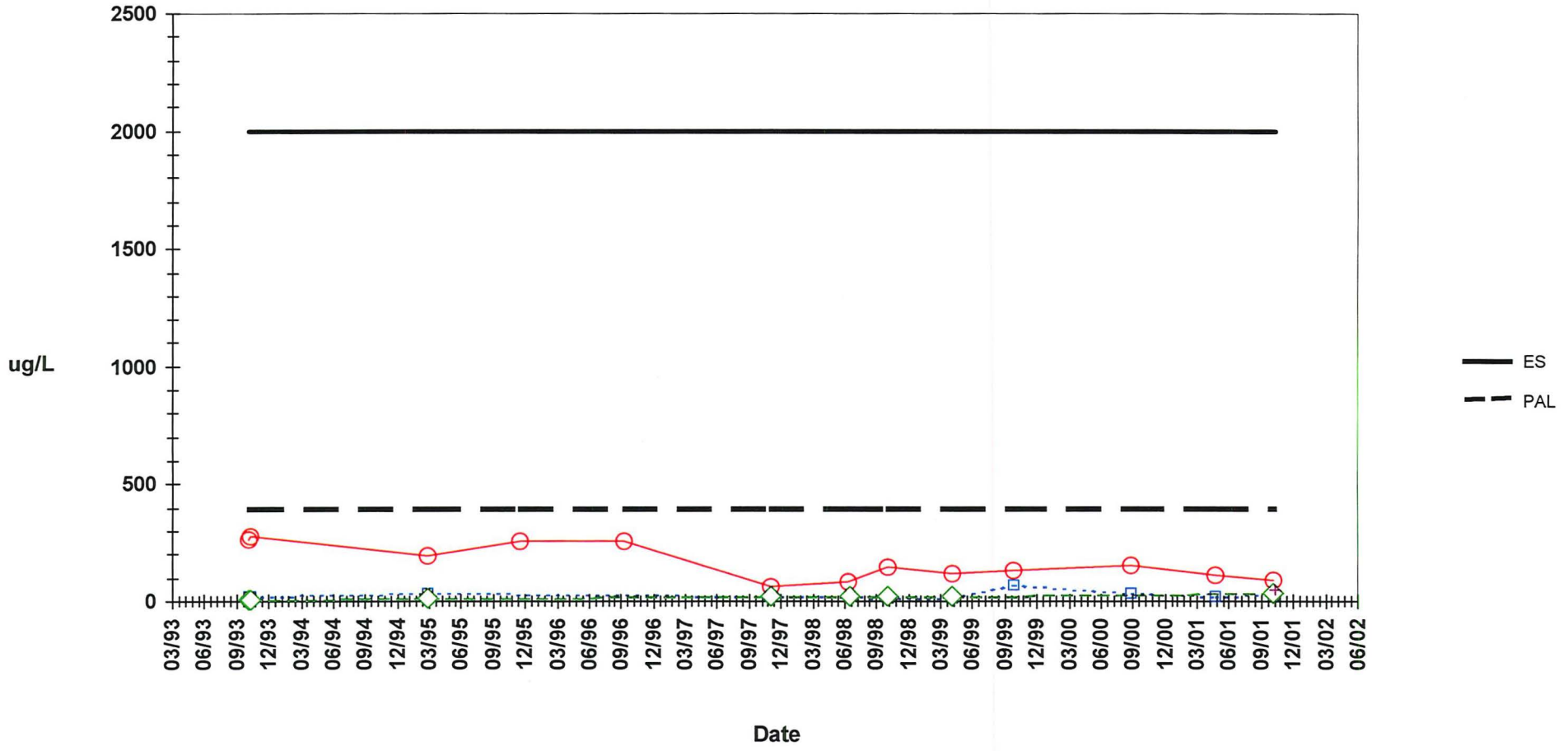
Detected Values Only



Onalaska Municipal Landfill

Barium

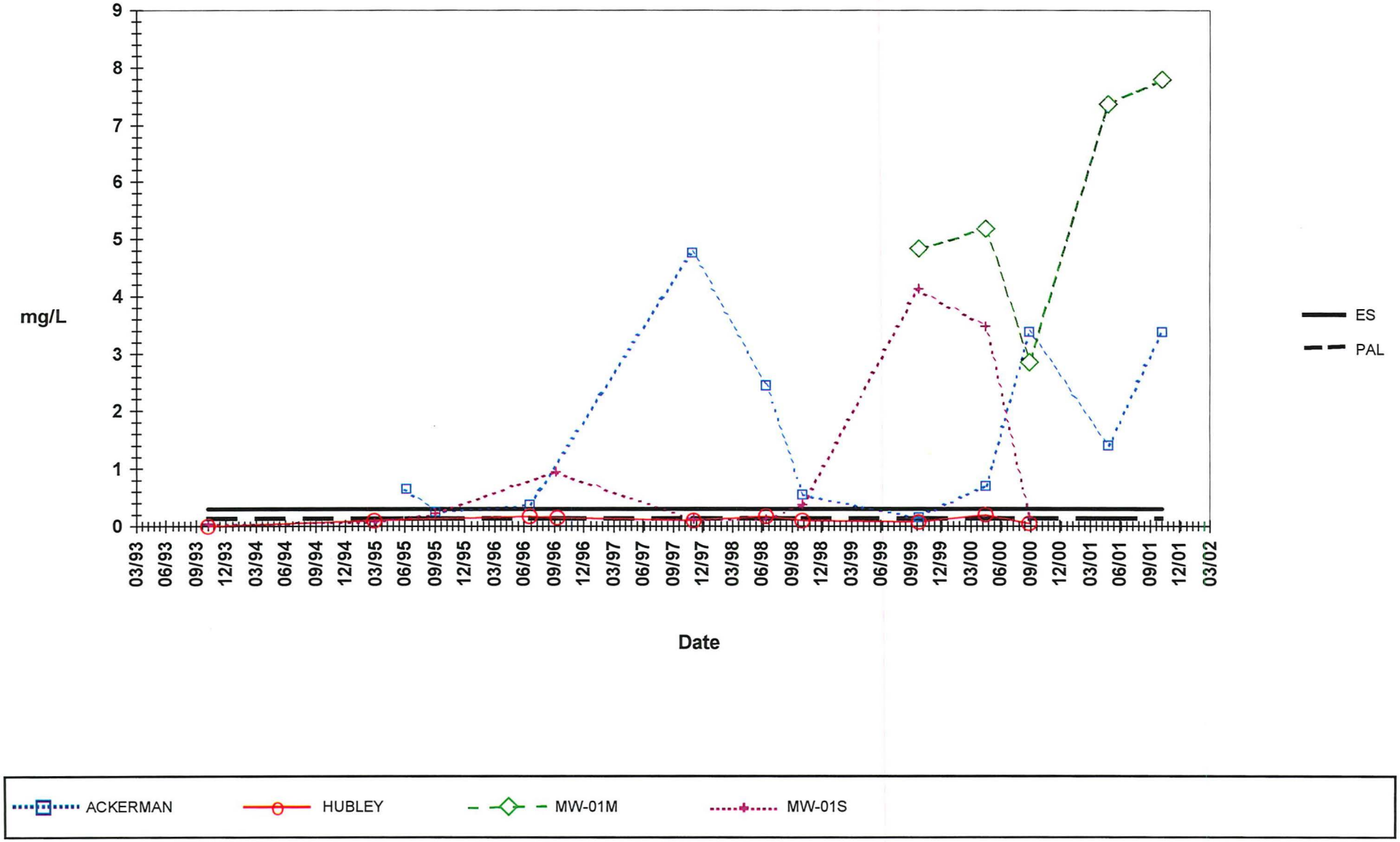
Detected Values Only



Onalaska Municipal Landfill

Iron

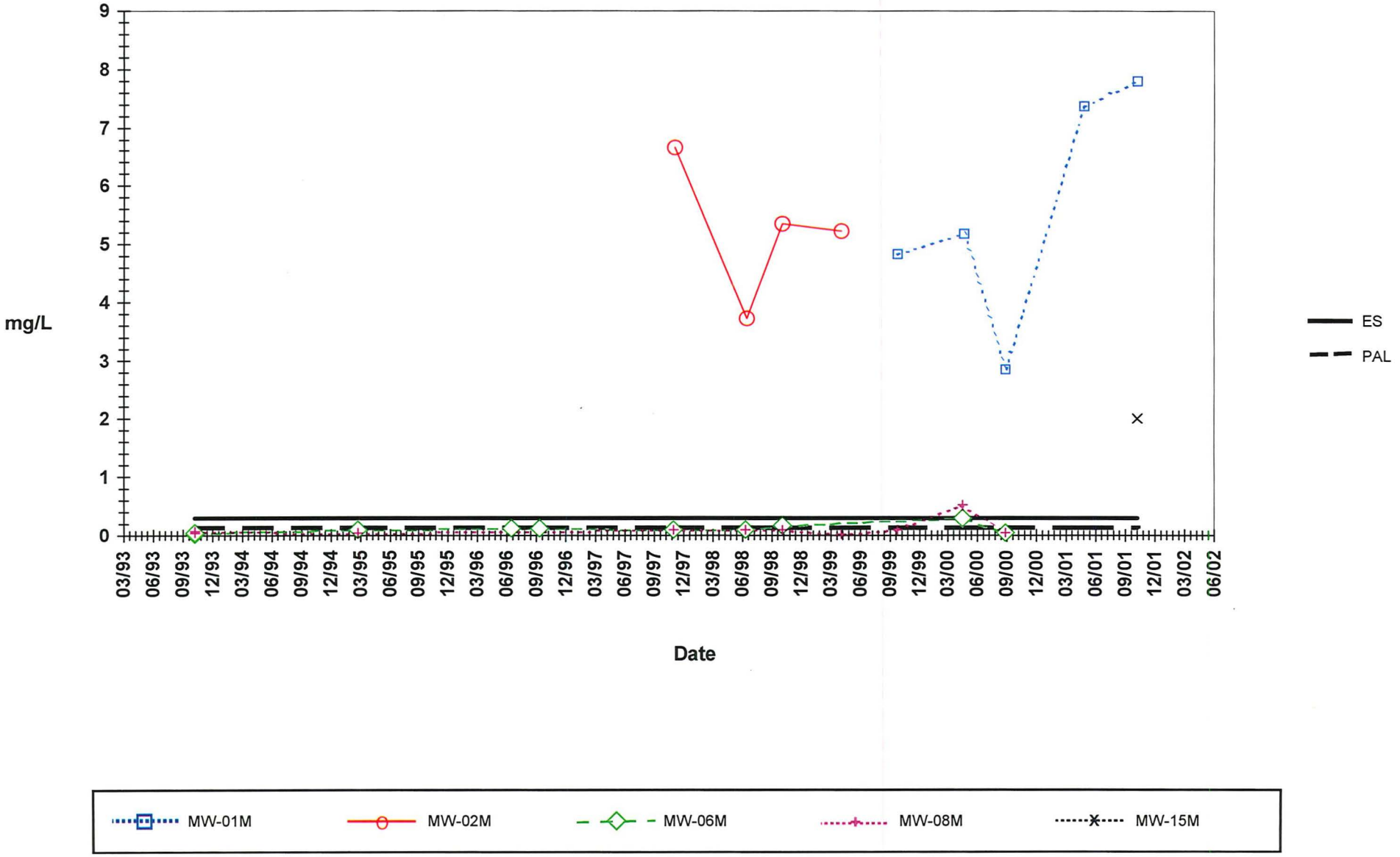
Detected Values Only



Onalaska Municipal Landfill

Iron

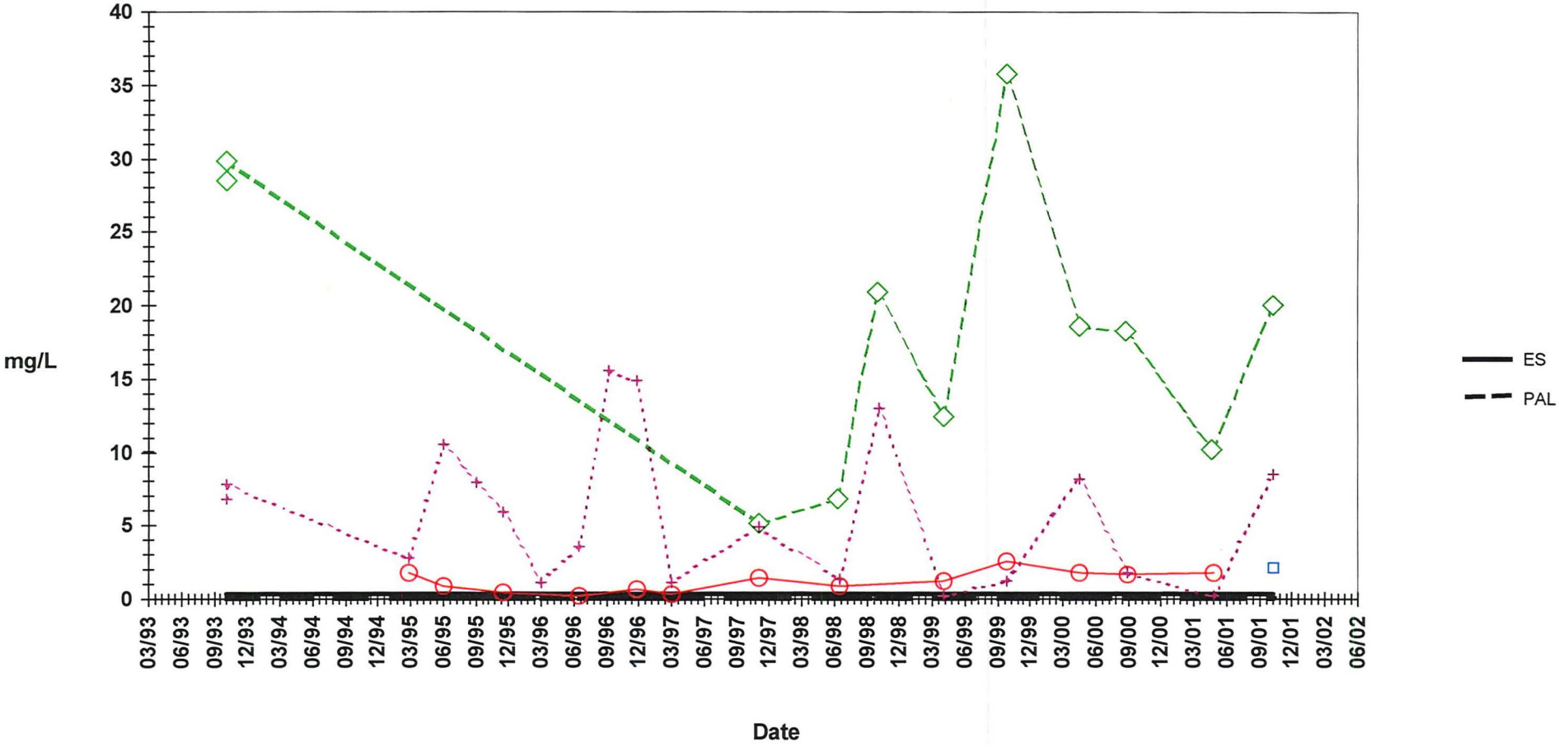
Detected Values Only



Onalaska Municipal Landfill

Iron

Detected Values Only

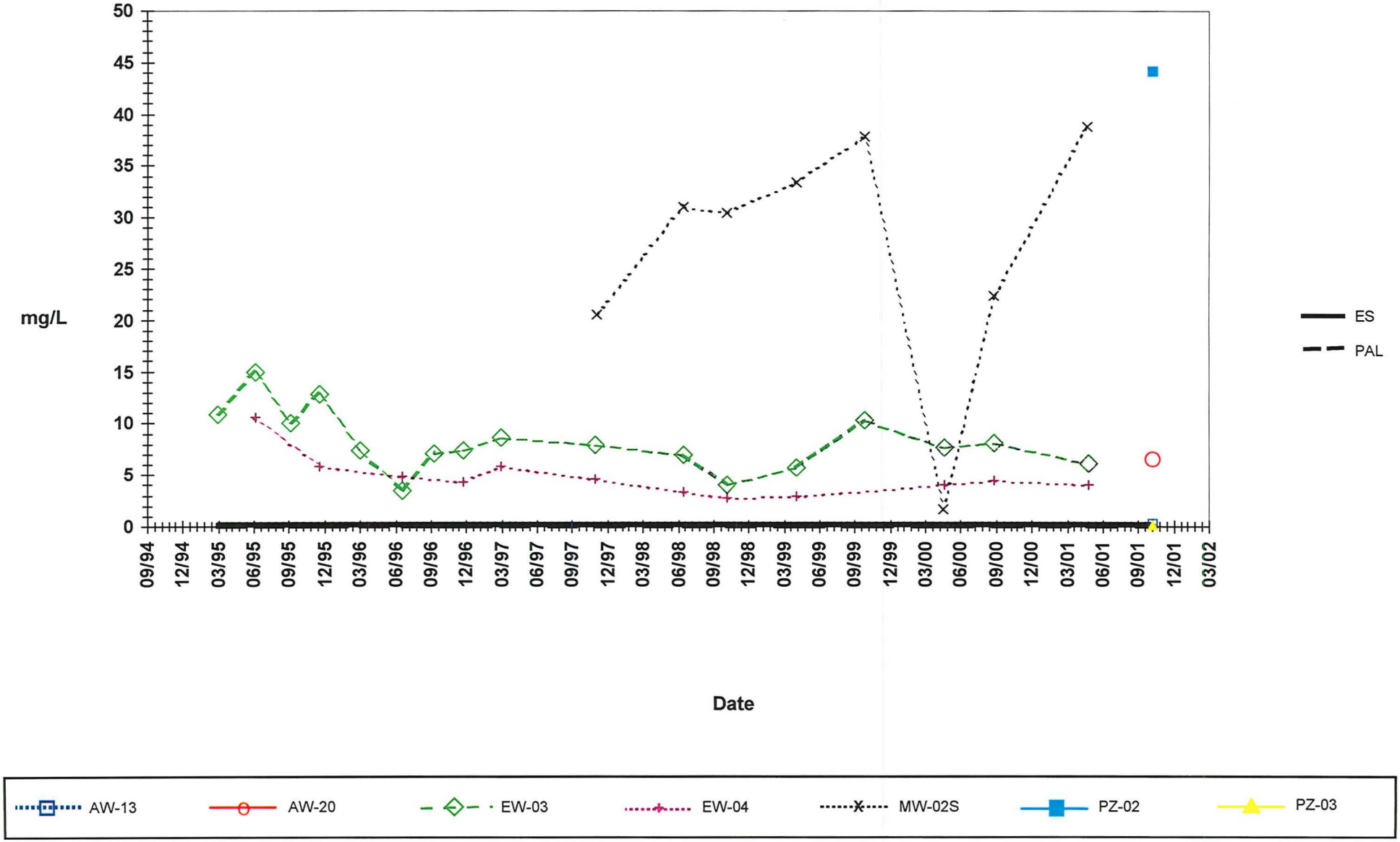


AW-01 EW-05 MW-05S MW-14S

Onalaska Municipal Landfill

Iron

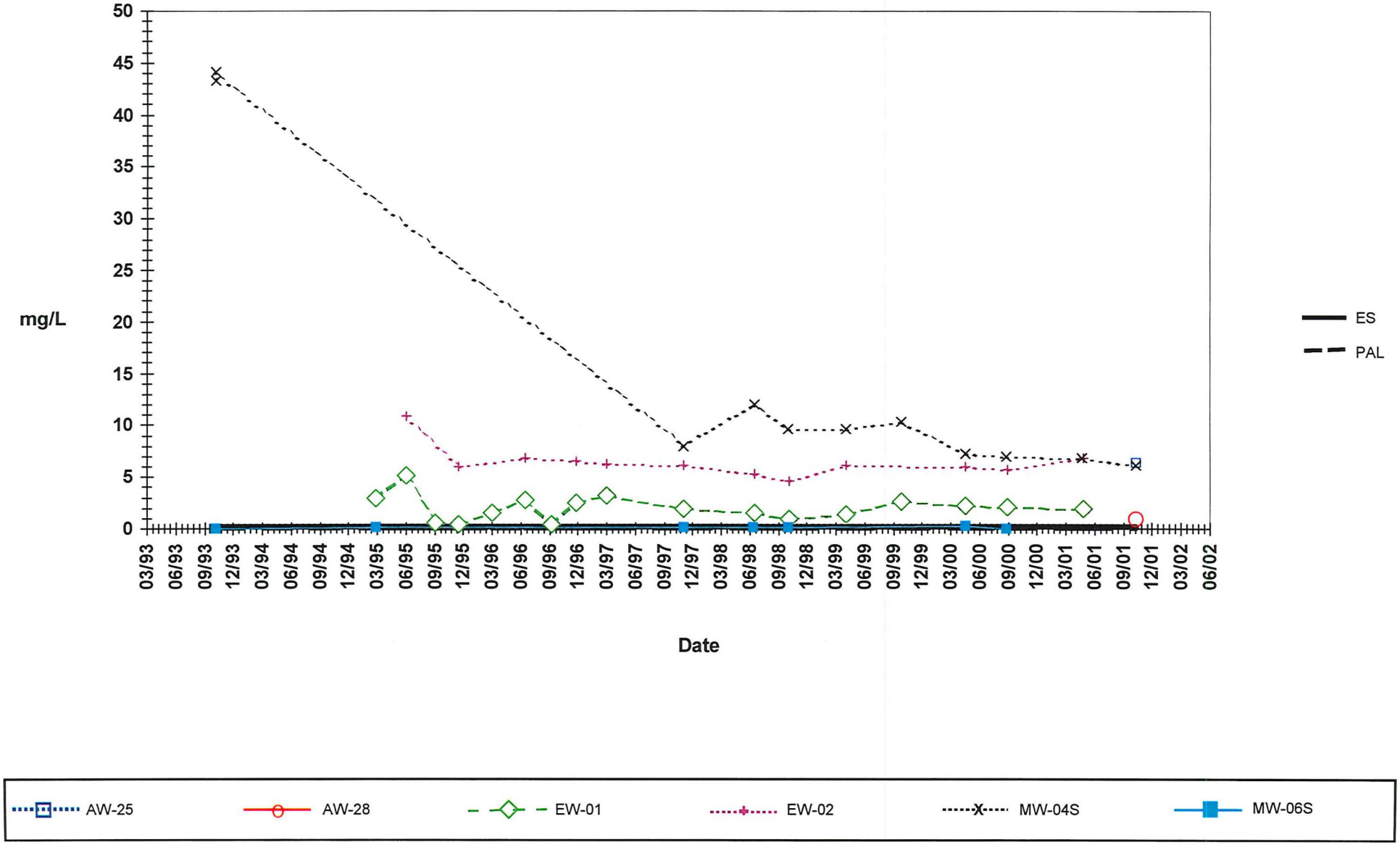
Detected Values Only



Onalaska Municipal Landfill

Iron

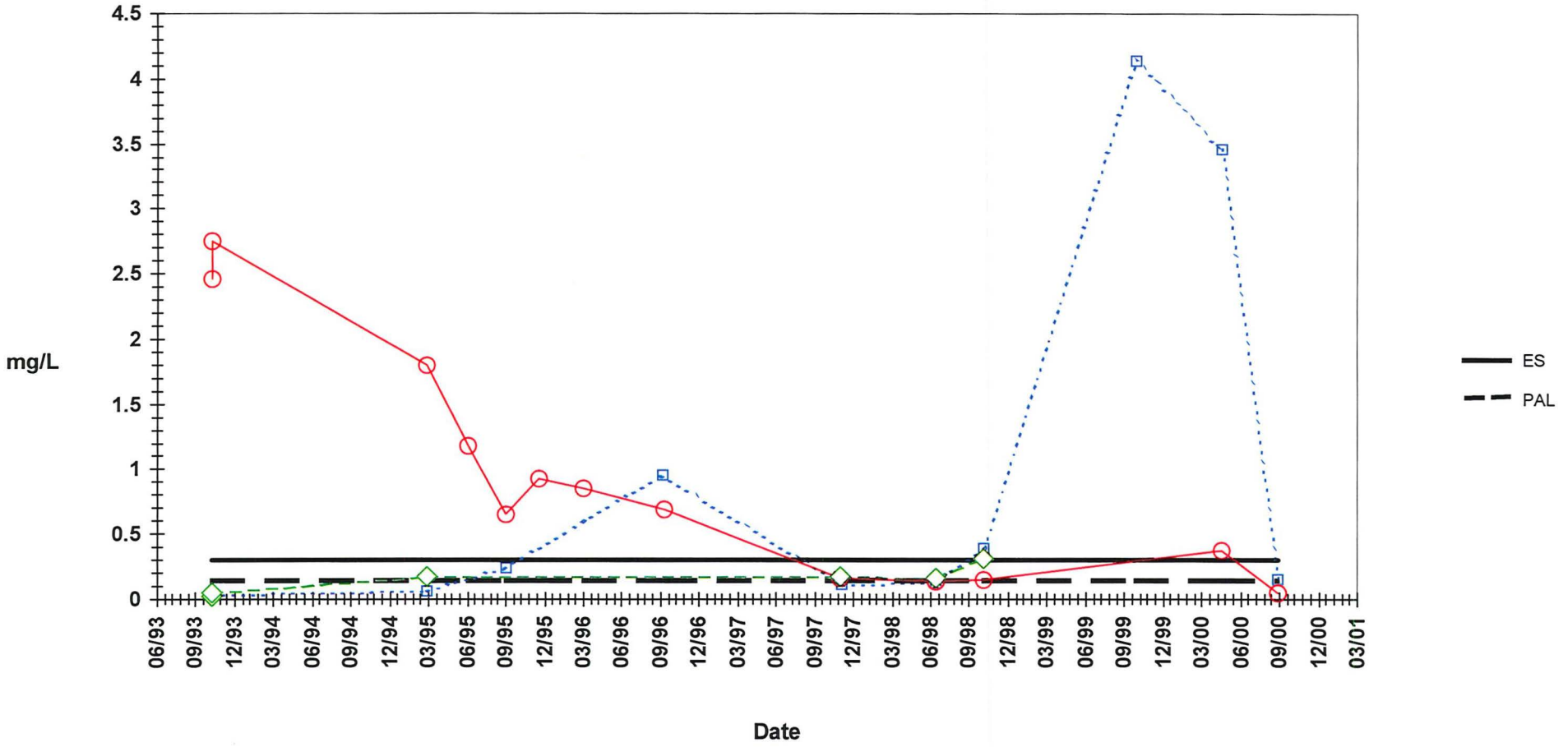
Detected Values Only



Onalaska Municipal Landfill

Iron

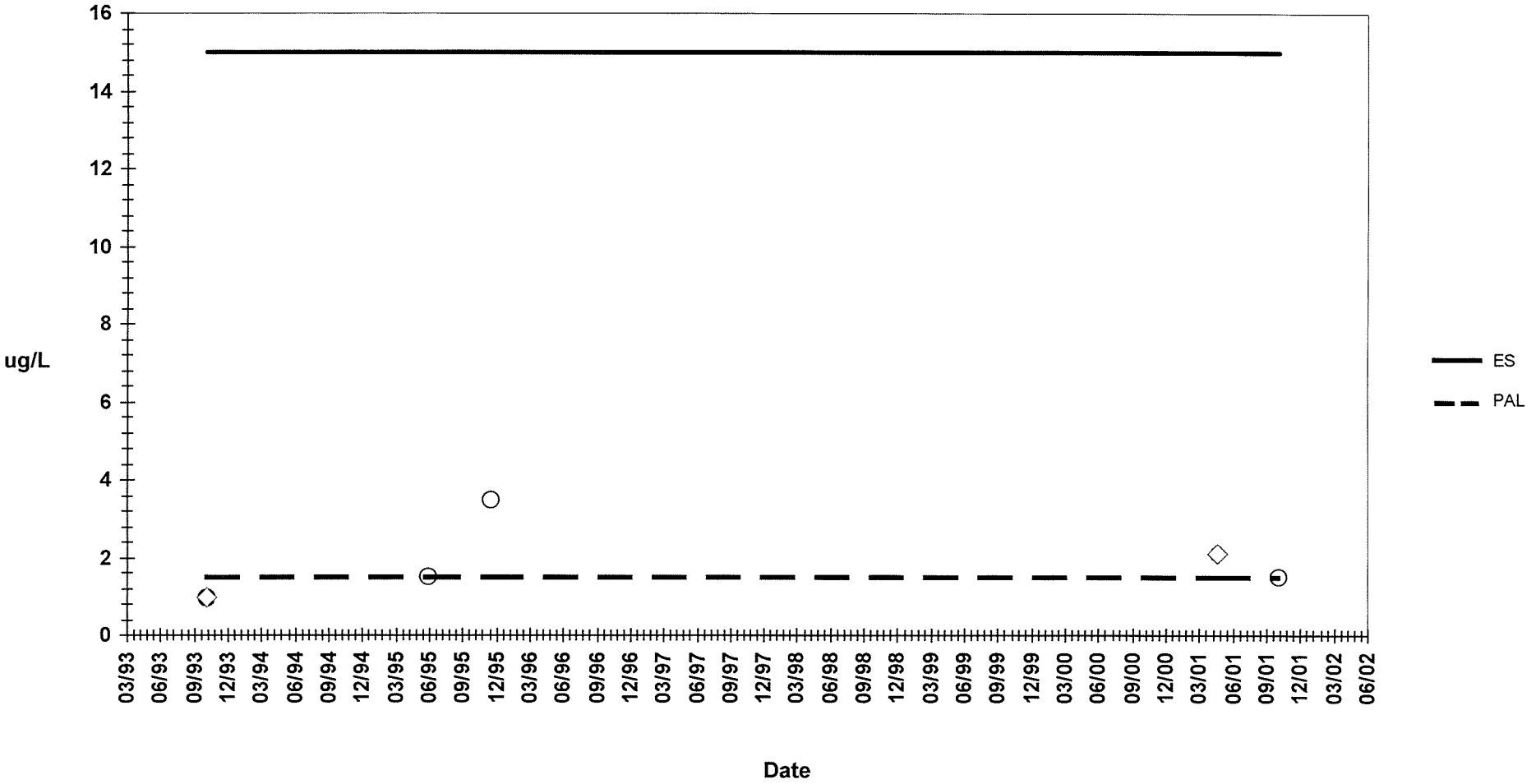
Detected Values Only



Onalaska Municipal Landfill

Lead

Detected Values Only

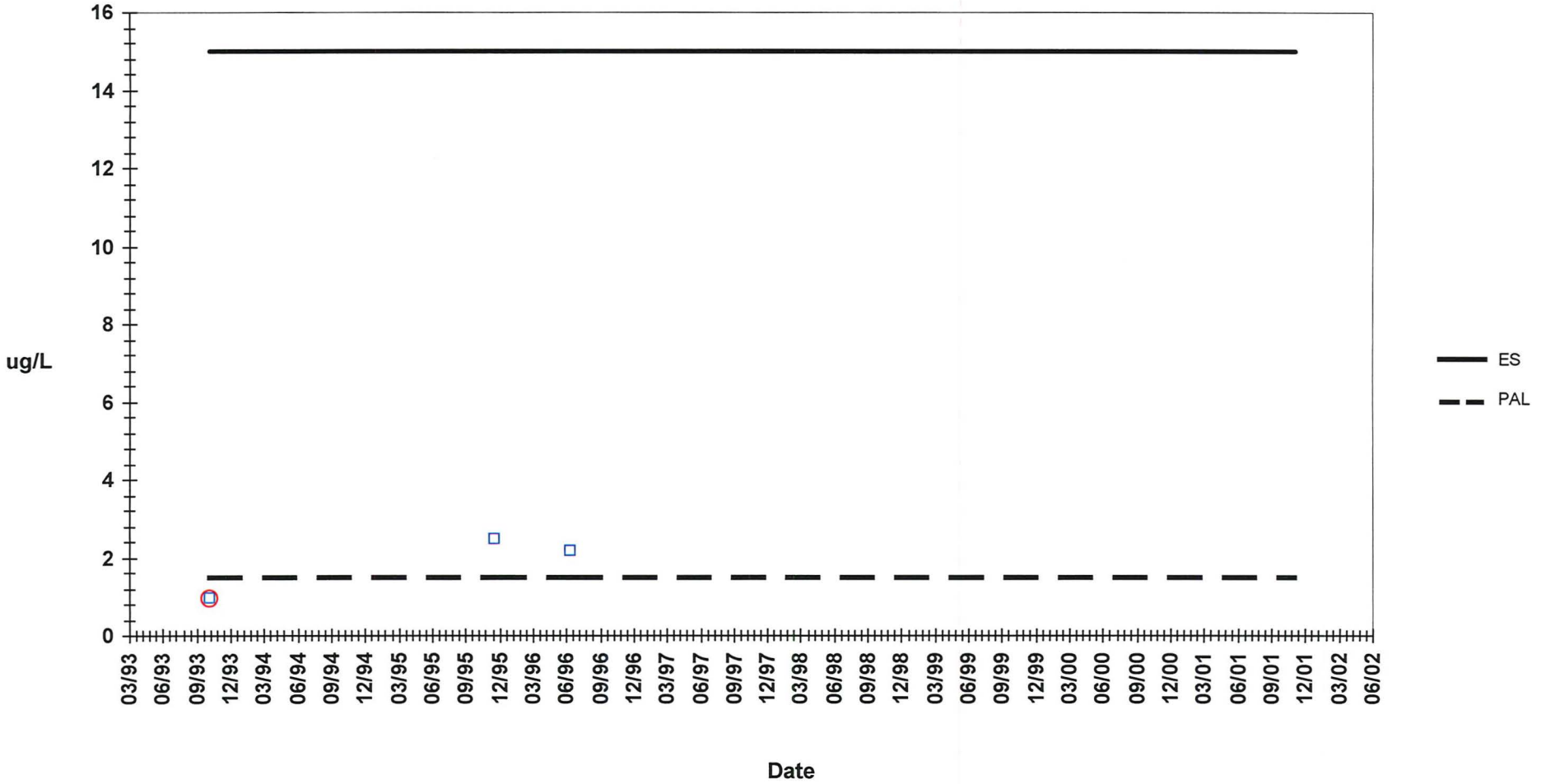


Ackerman HUBLEY MW-01S

Onalaska Municipal Landfill

Lead

Detected Values Only



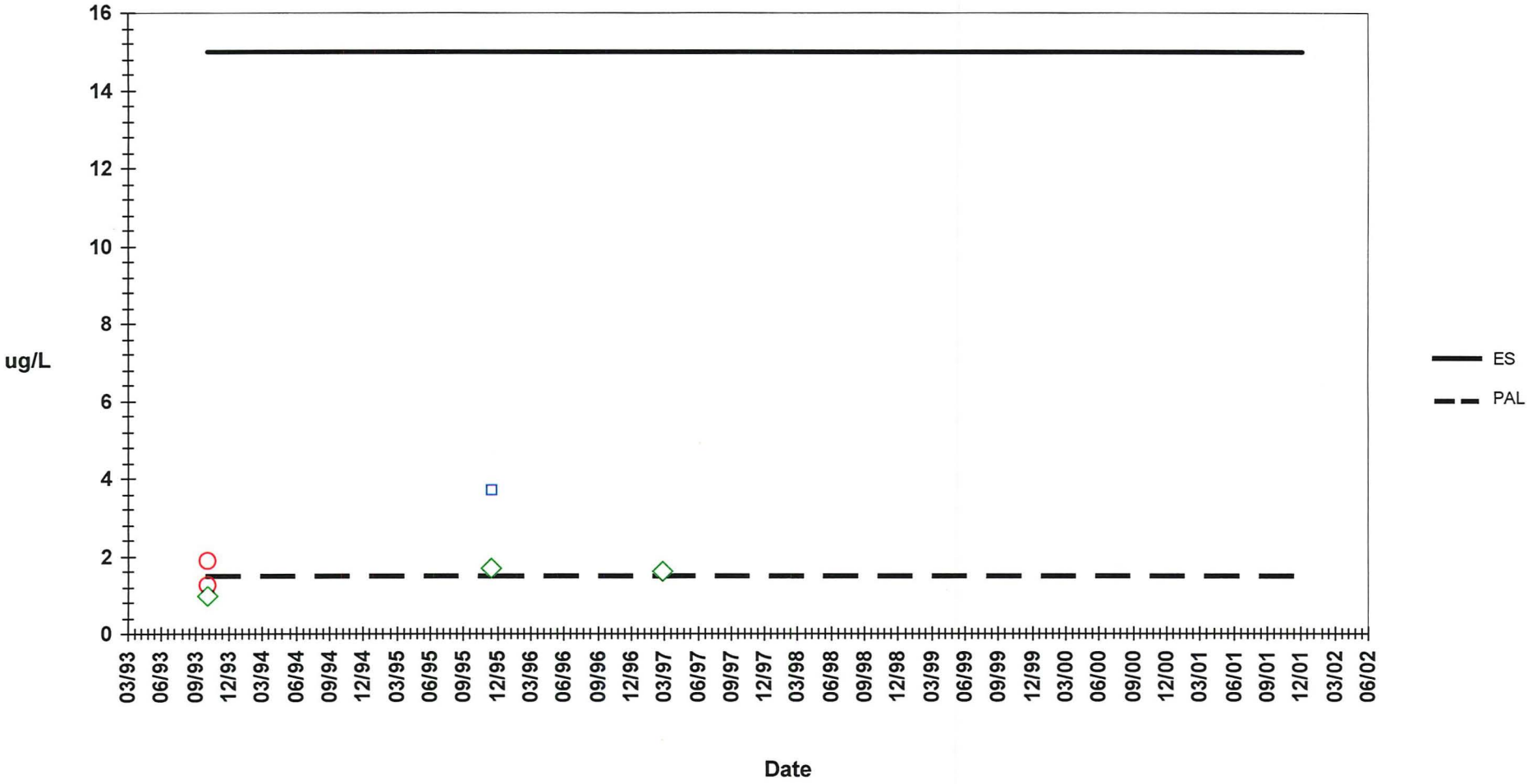
MW-06M

MW-08M

Onalaska Municipal Landfill

Lead

Detected Values Only

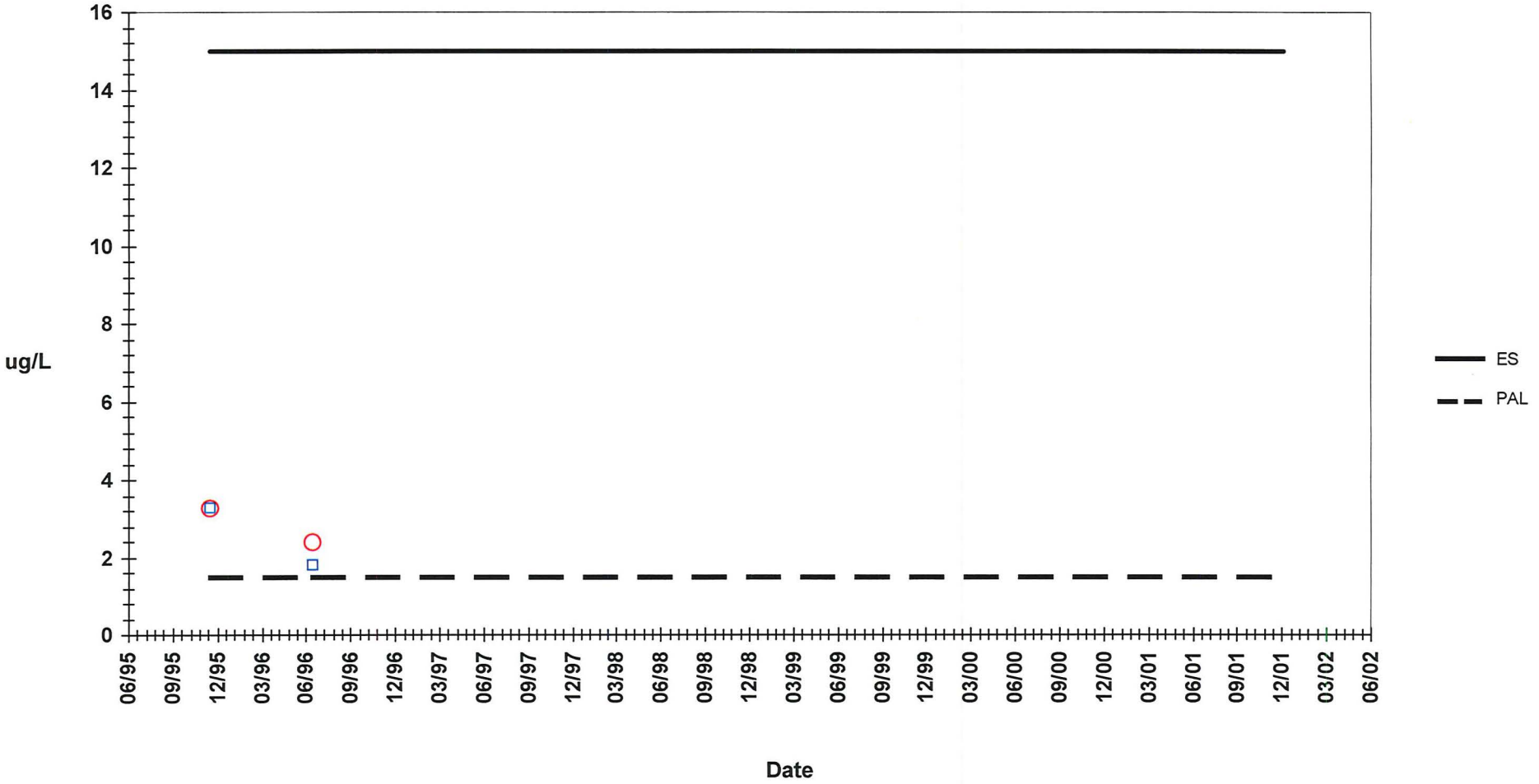


EW-05 MW-05S MW-14S

Onalaska Municipal Landfill

Lead

Detected Values Only

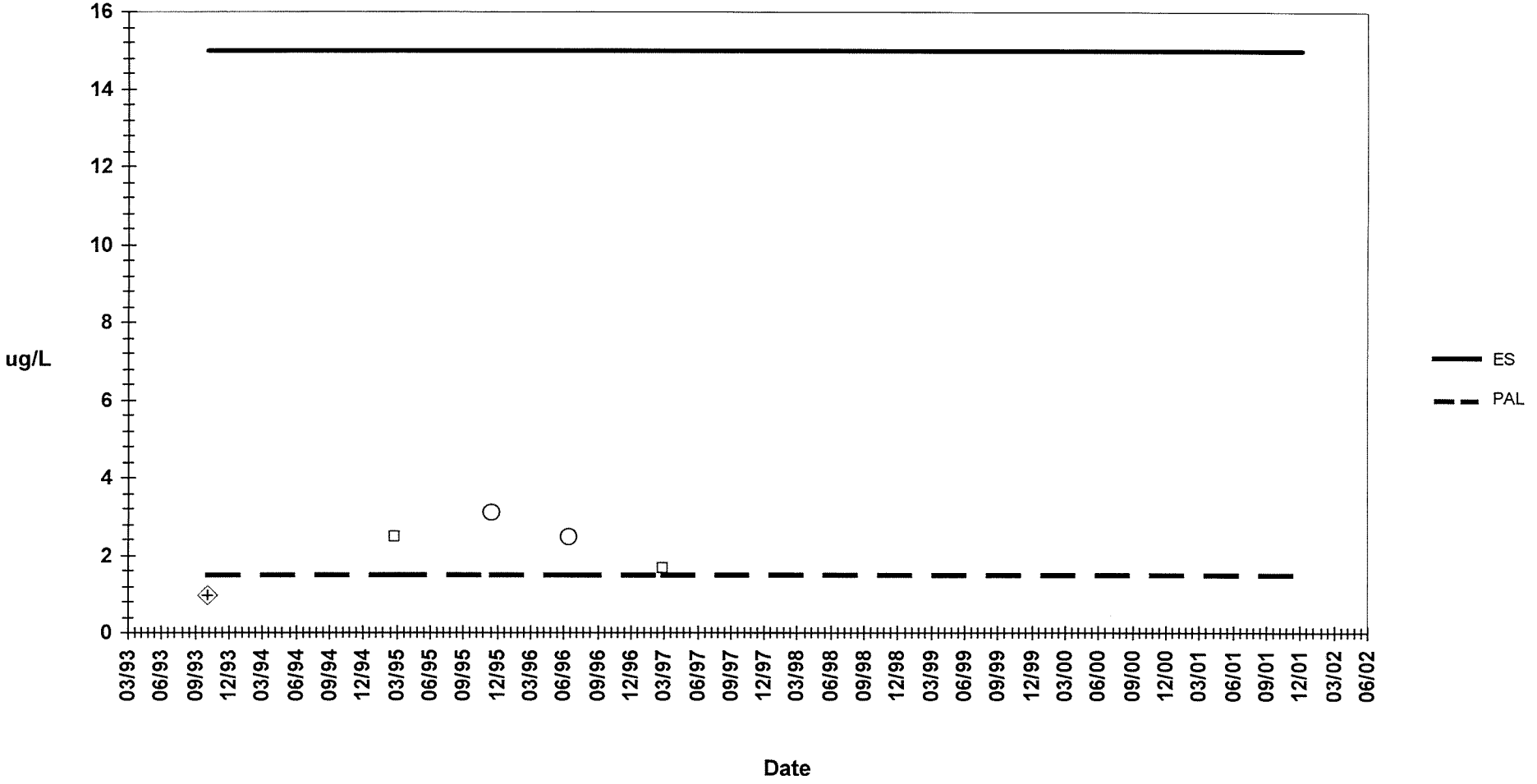


EW-03 EW-04

Onalaska Municipal Landfill

Lead

Detected Values Only

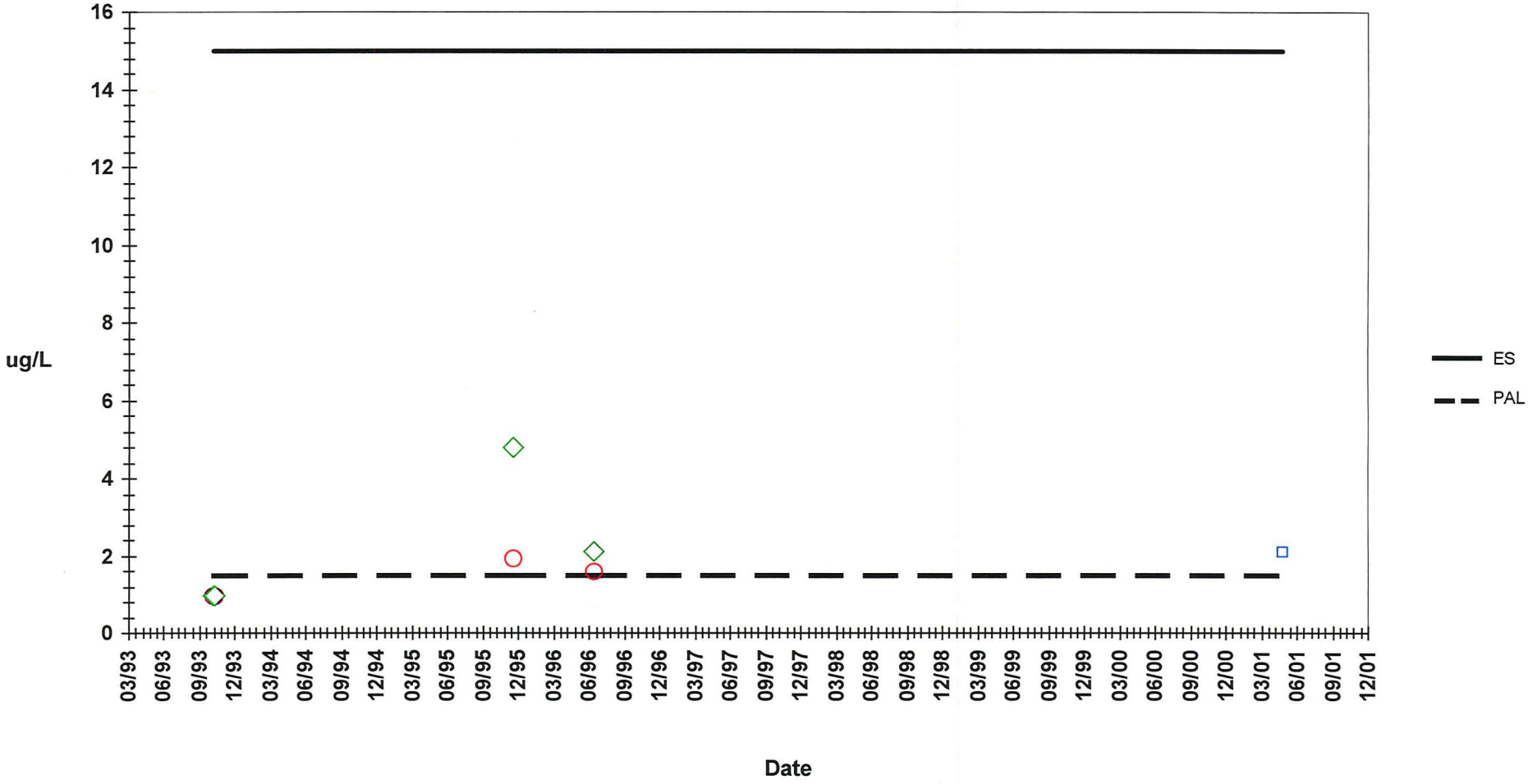


EW-01 EW-02 MW-04S MW-06S

Onalaska Municipal Landfill

Lead

Detected Values Only

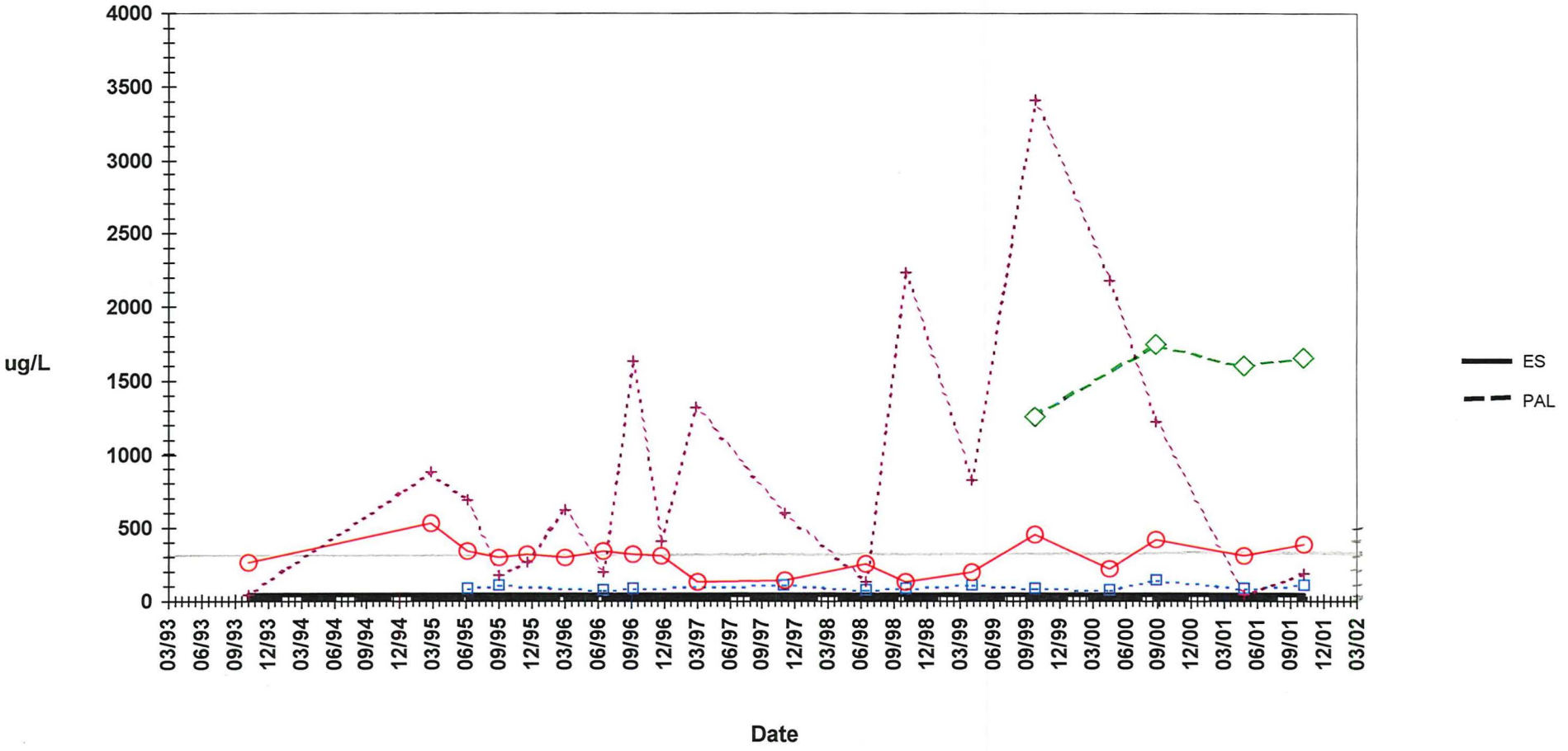


MW-01S MW-08S MW-12S

Onalaska Municipal Landfill

Manganese

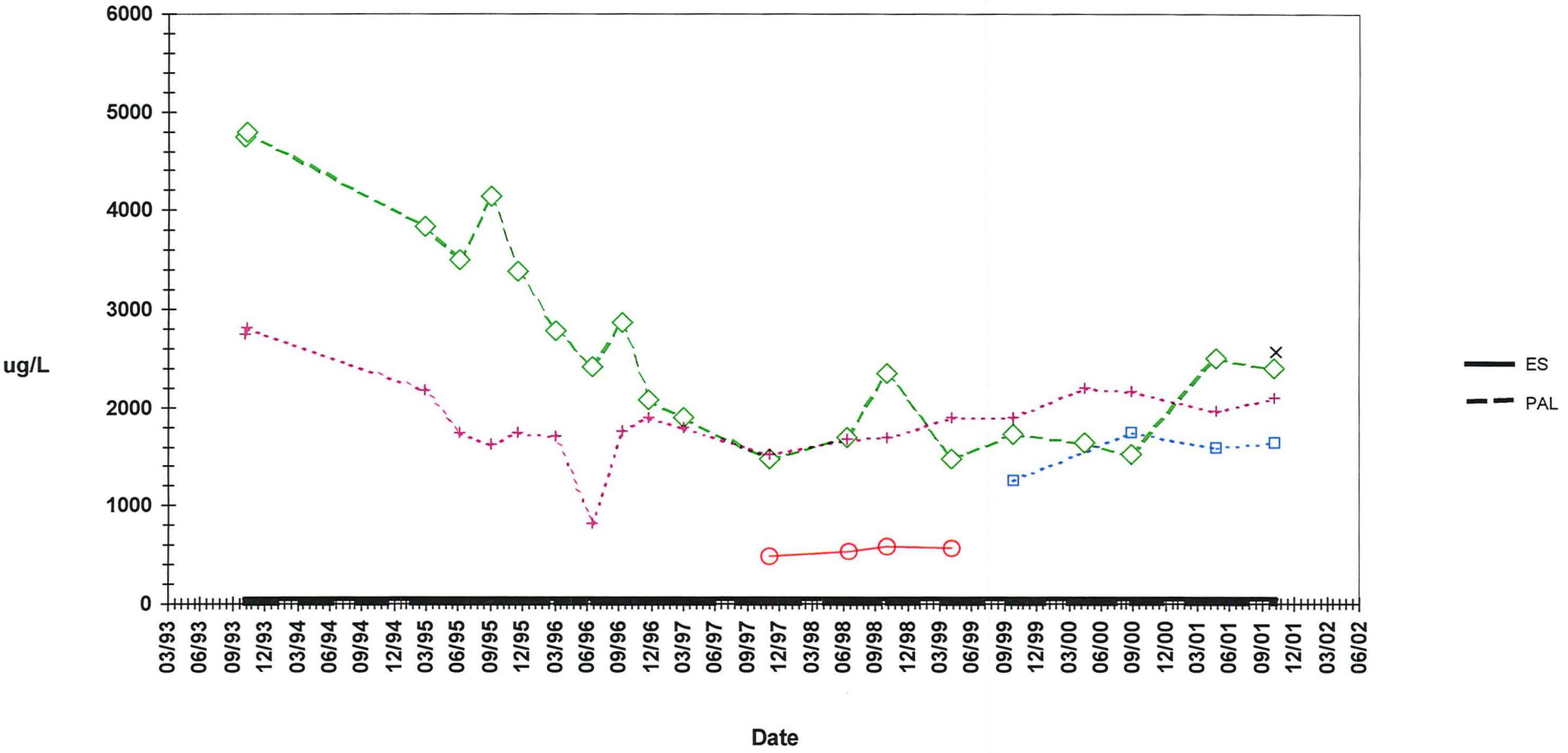
Detected Values Only



Onalaska Municipal Landfill

Manganese

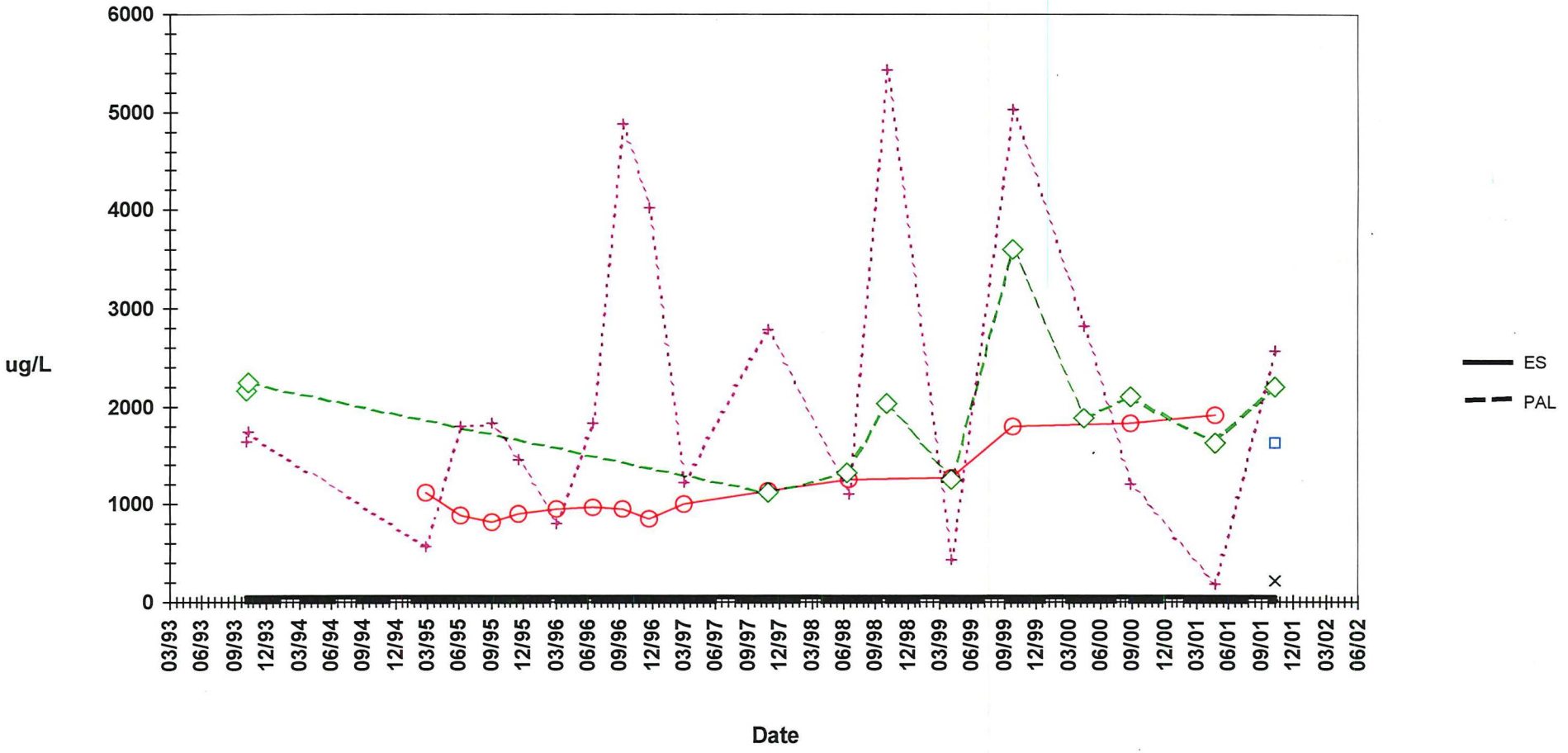
Detected Values Only



Onalaska Municipal Landfill

Manganese

Detected Values Only

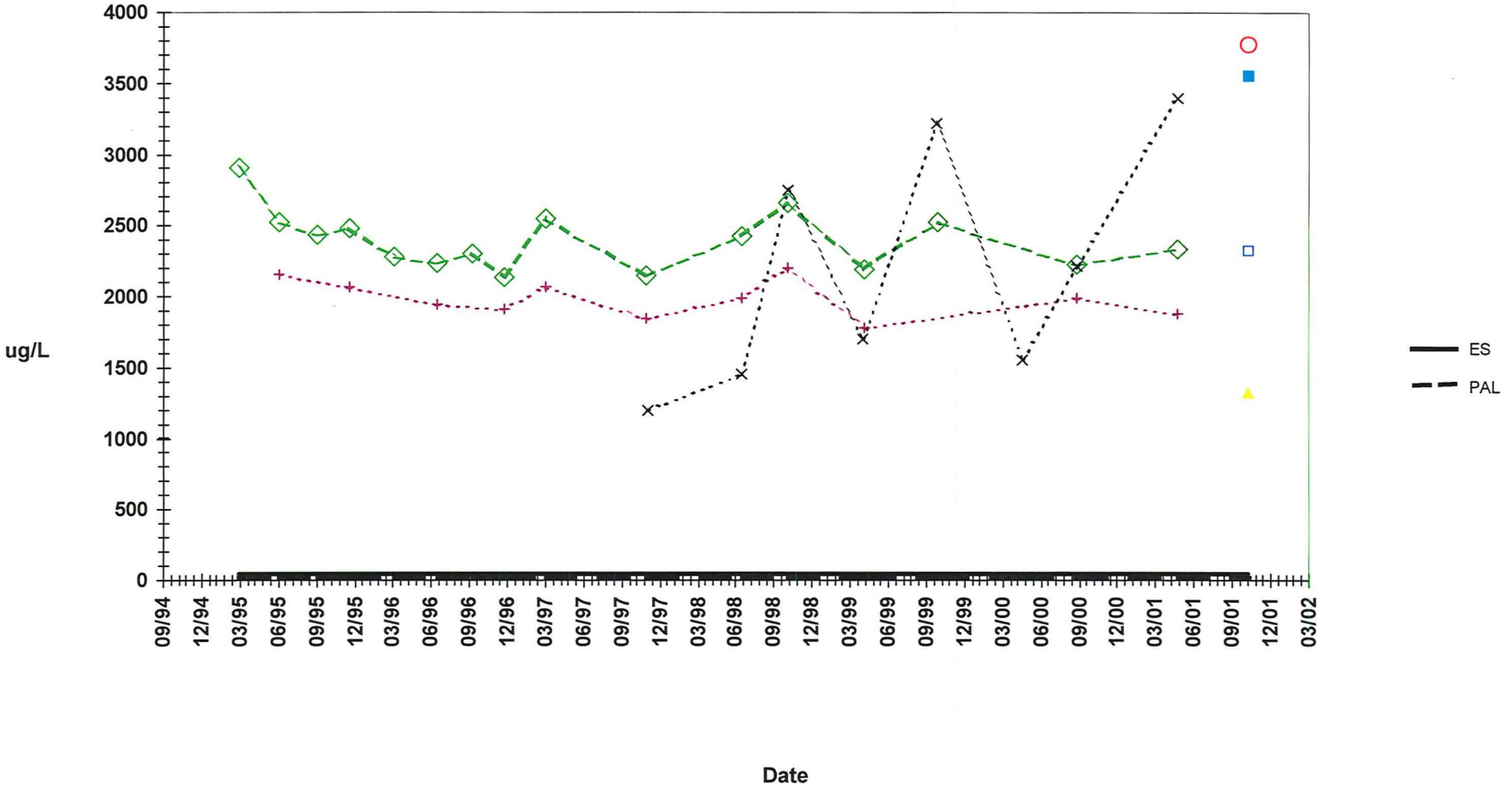


AW-01 EW-05 MW-05S MW-14S PZ-01

Onalaska Municipal Landfill

Manganese

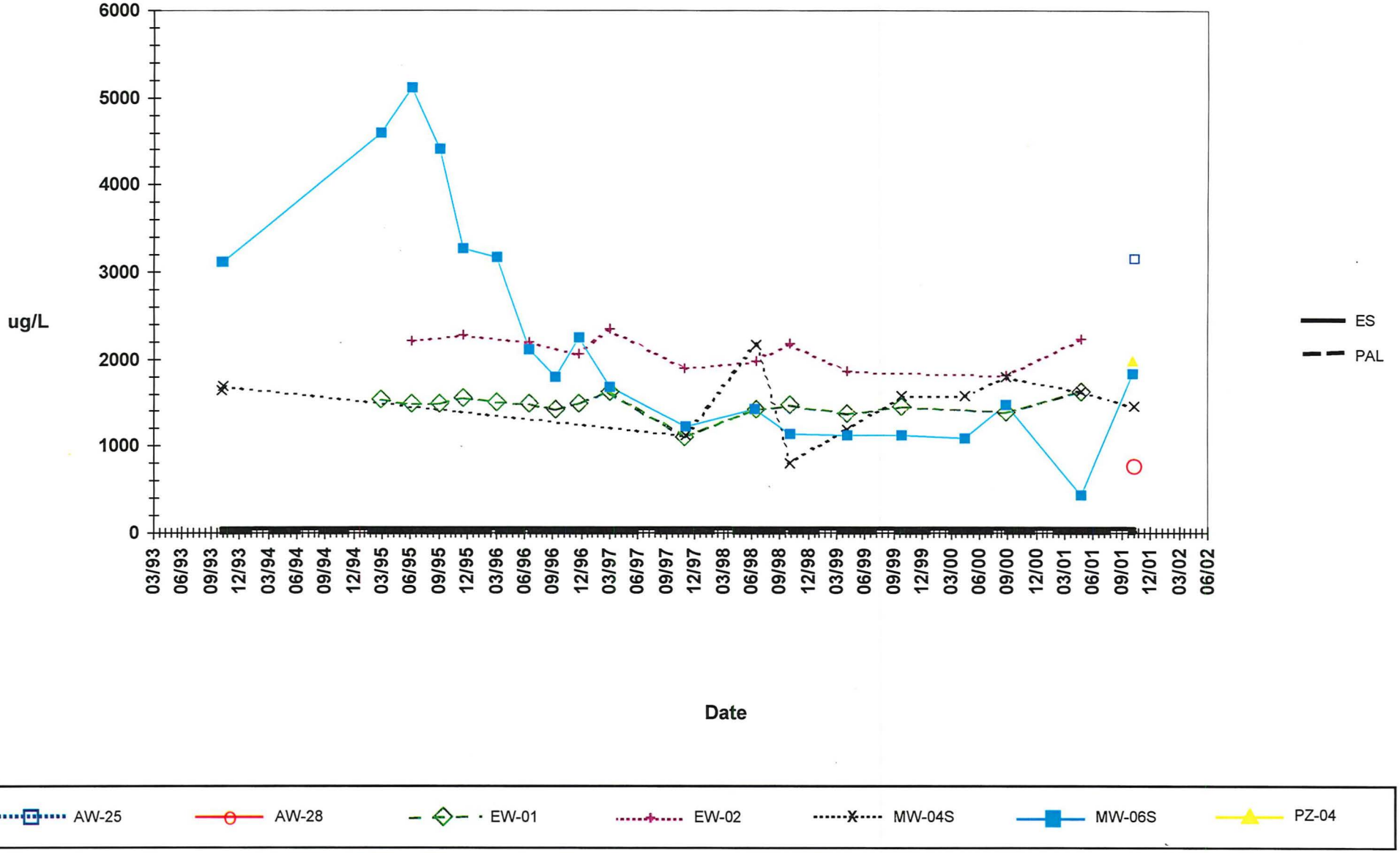
Detected Values Only



Onalaska Municipal Landfill

Manganese

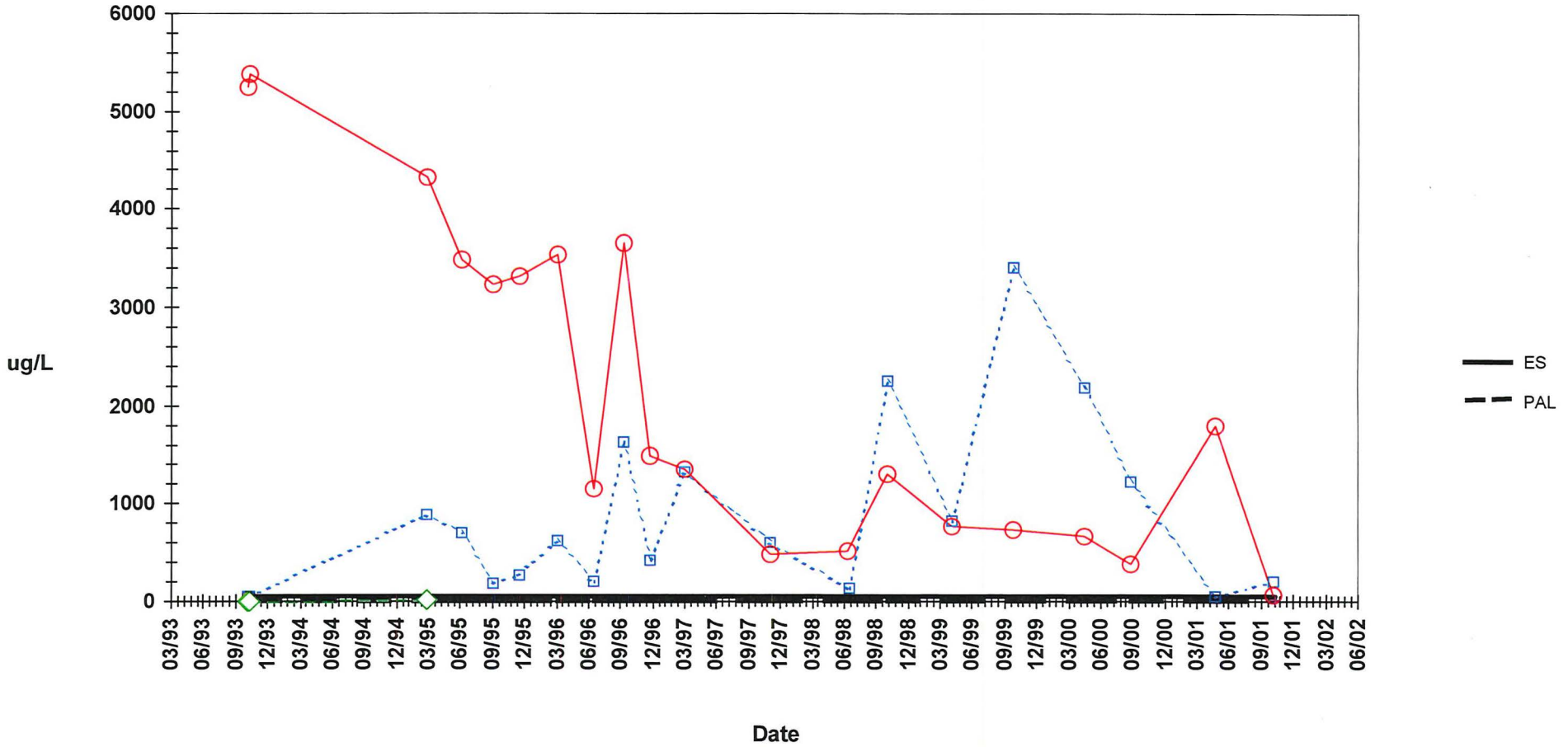
Detected Values Only



Onalaska Municipal Landfill

Manganese

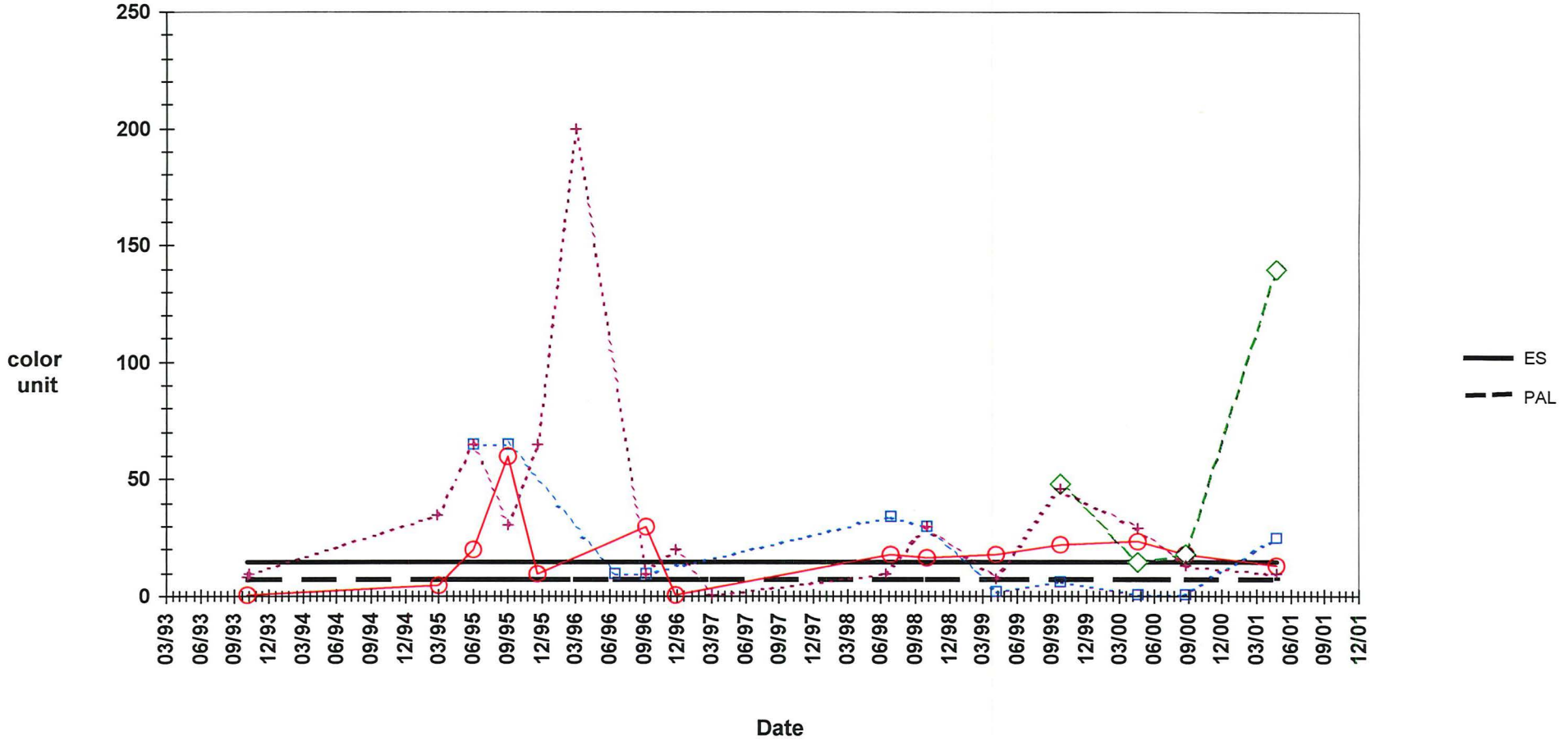
Detected Values Only



Onalaska Municipal Landfill

Color

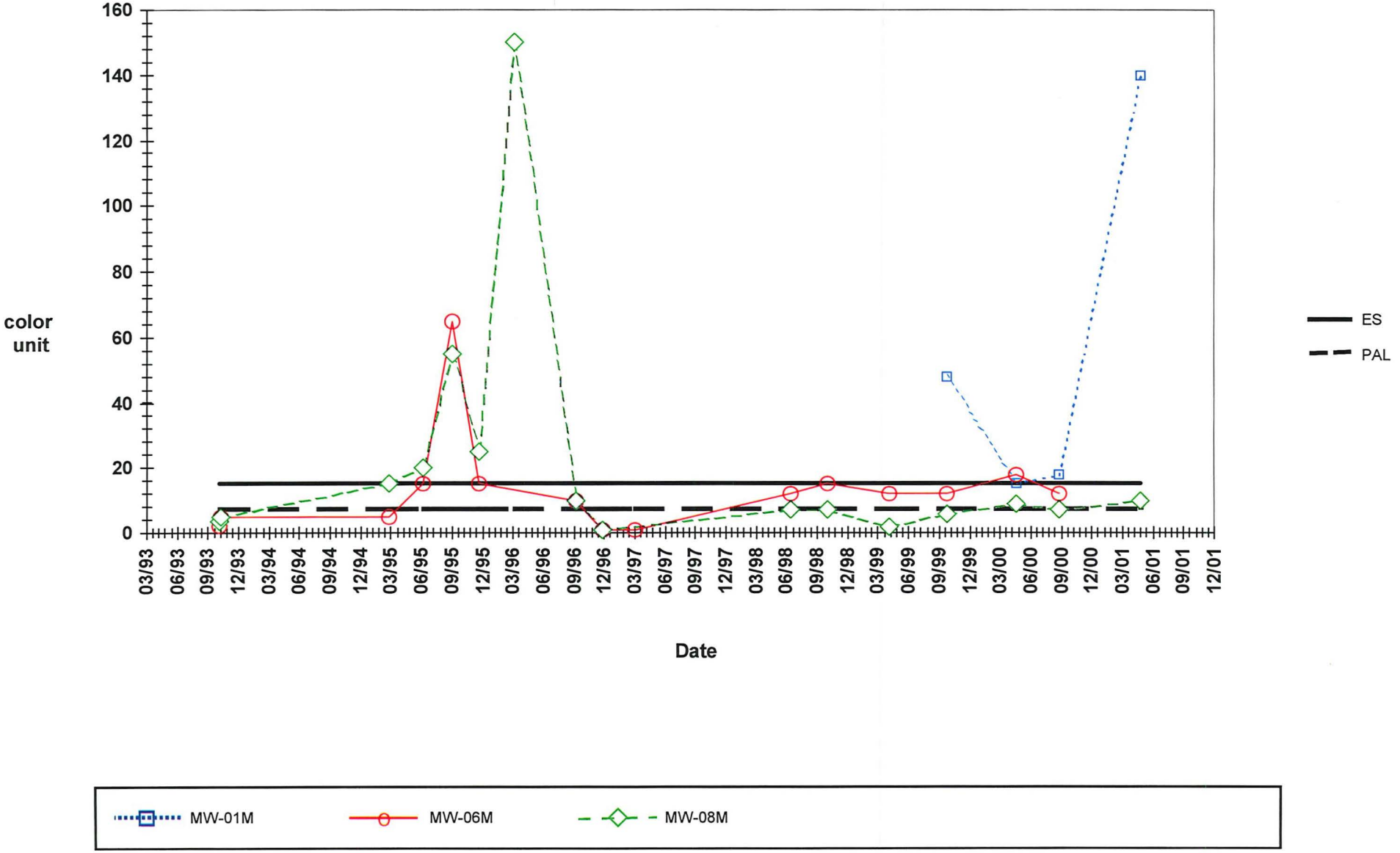
Detected Values Only



Onalaska Municipal Landfill

Color

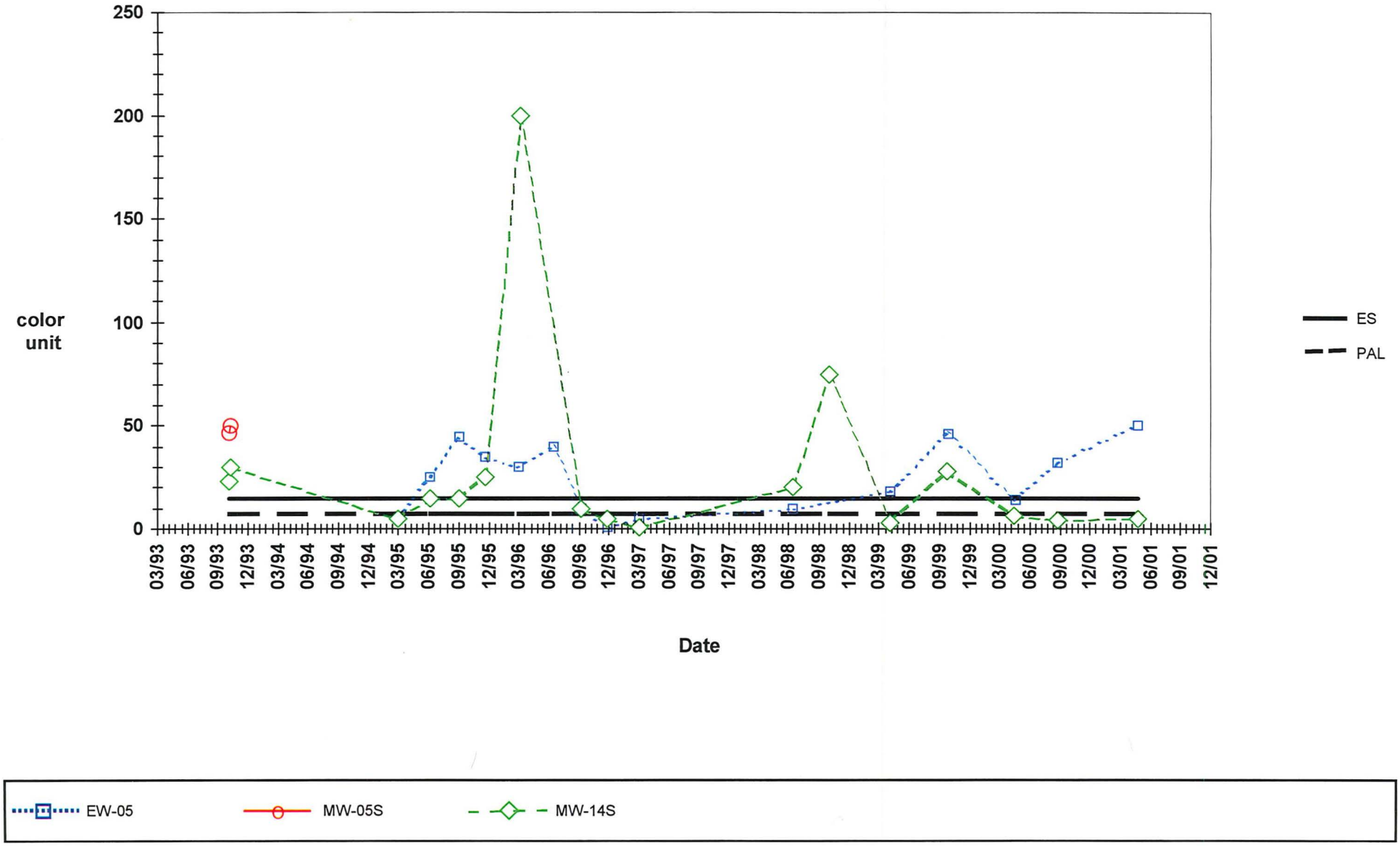
Detected Values Only



Onalaska Municipal Landfill

Color

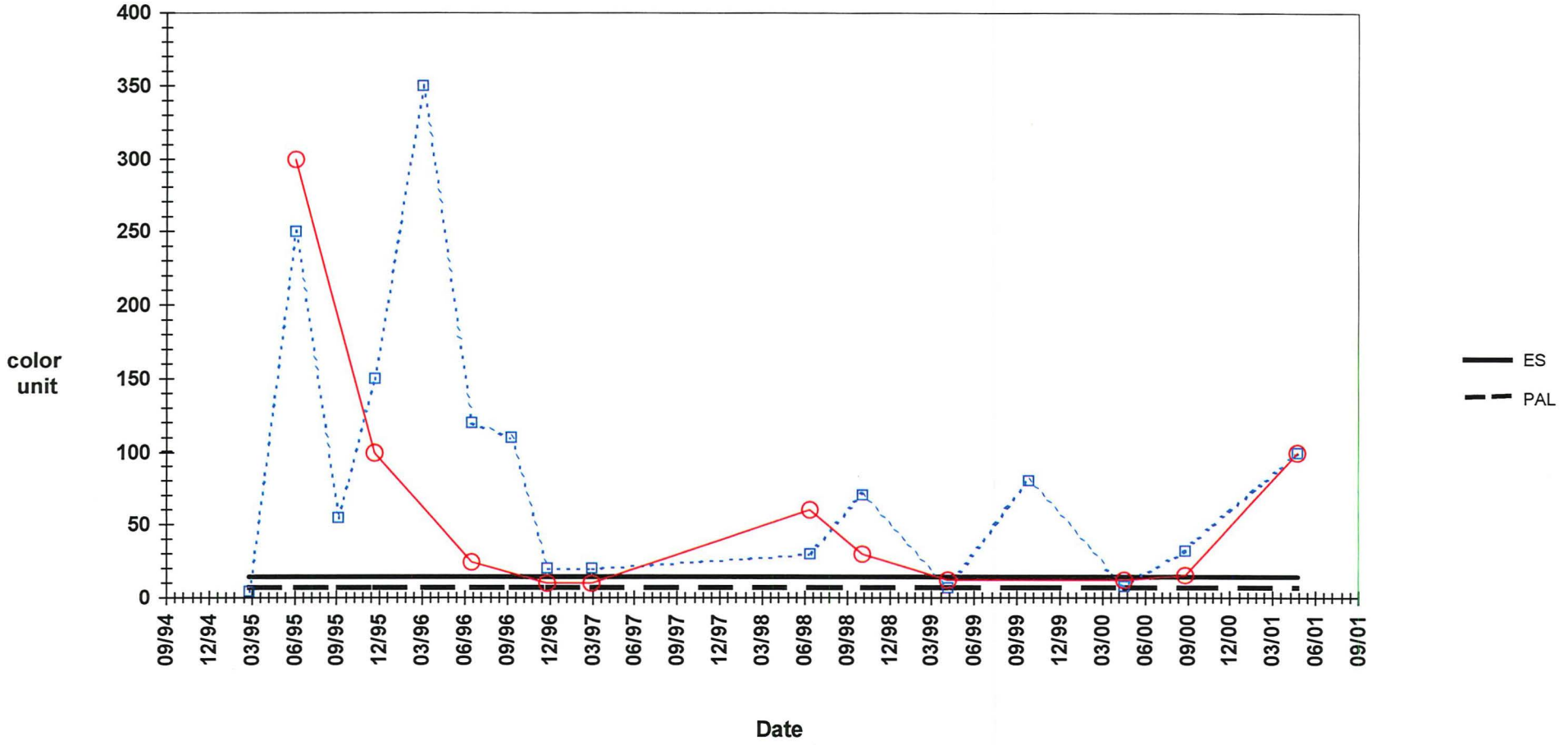
Detected Values Only



Onalaska Municipal Landfill

Color

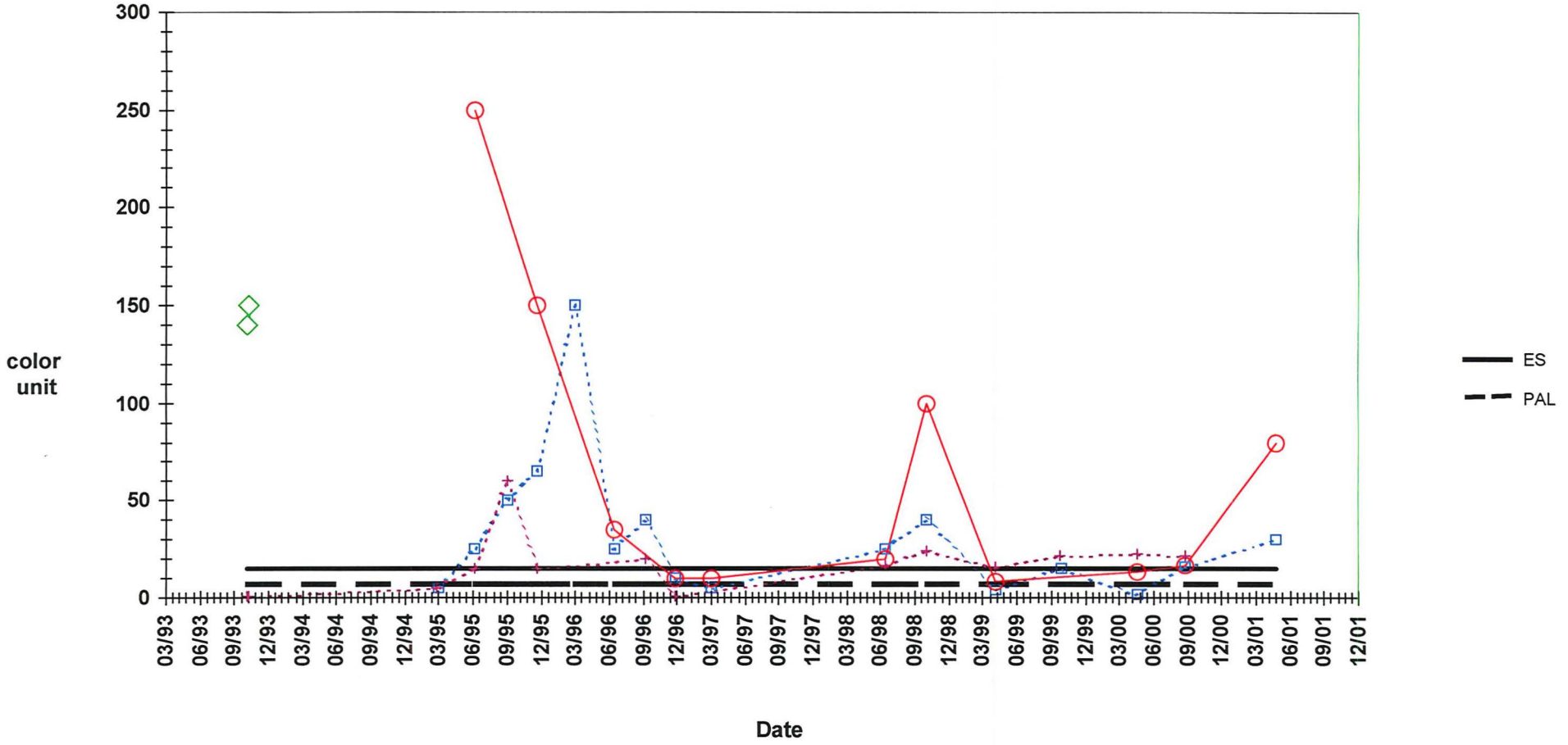
Detected Values Only



Onalaska Municipal Landfill

Color

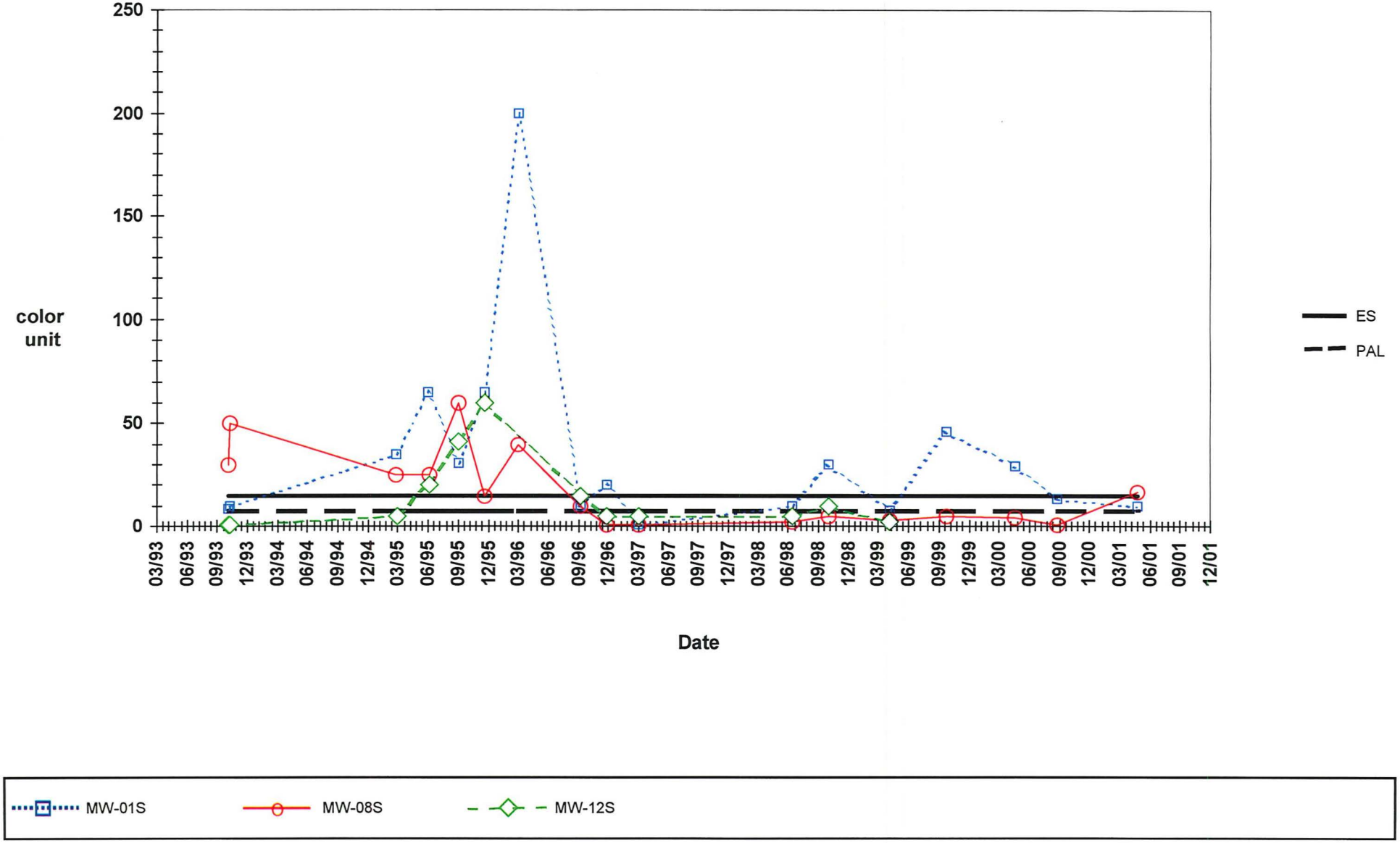
Detected Values Only



Onalaska Municipal Landfill

Color

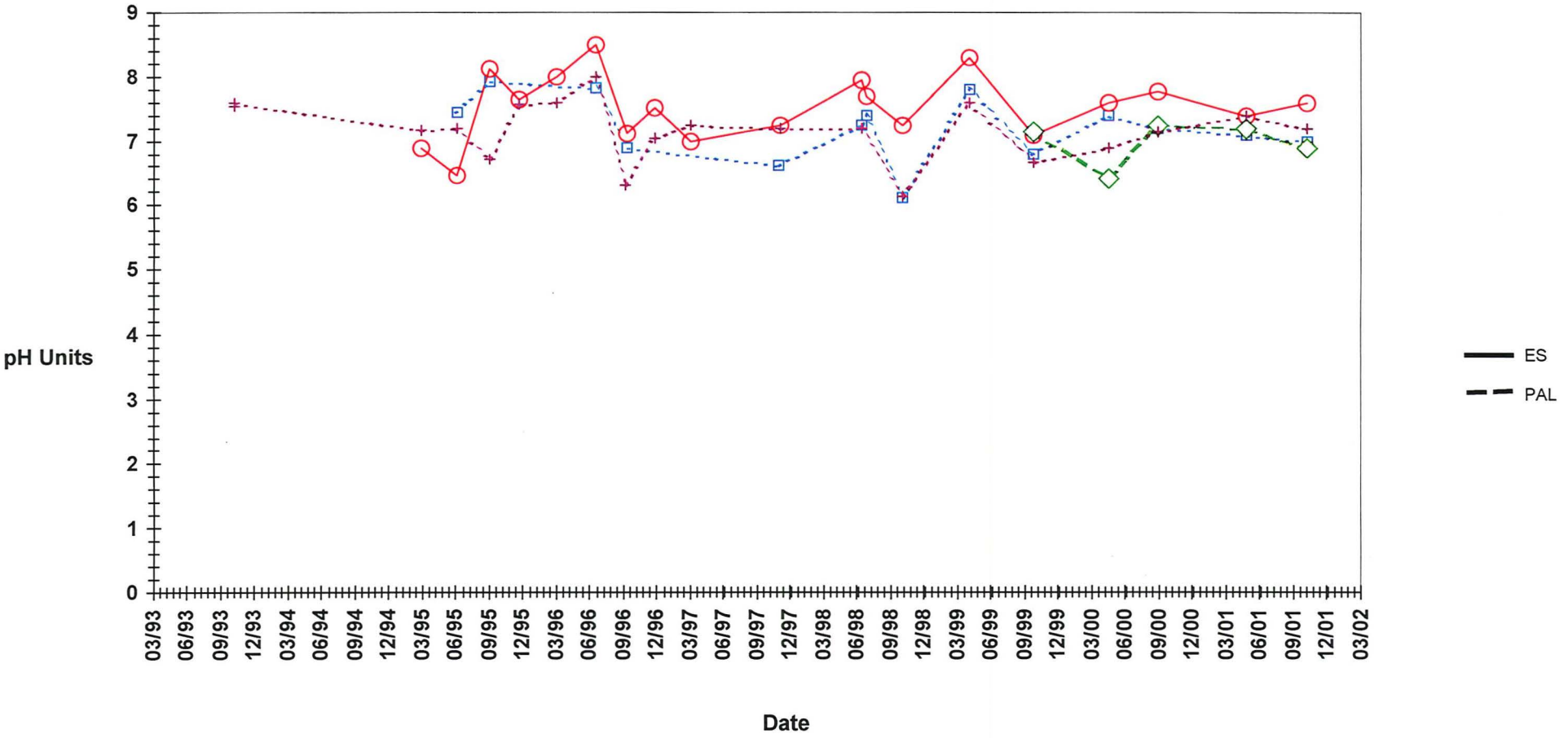
Detected Values Only



Onalaska Municipal Landfill

pH

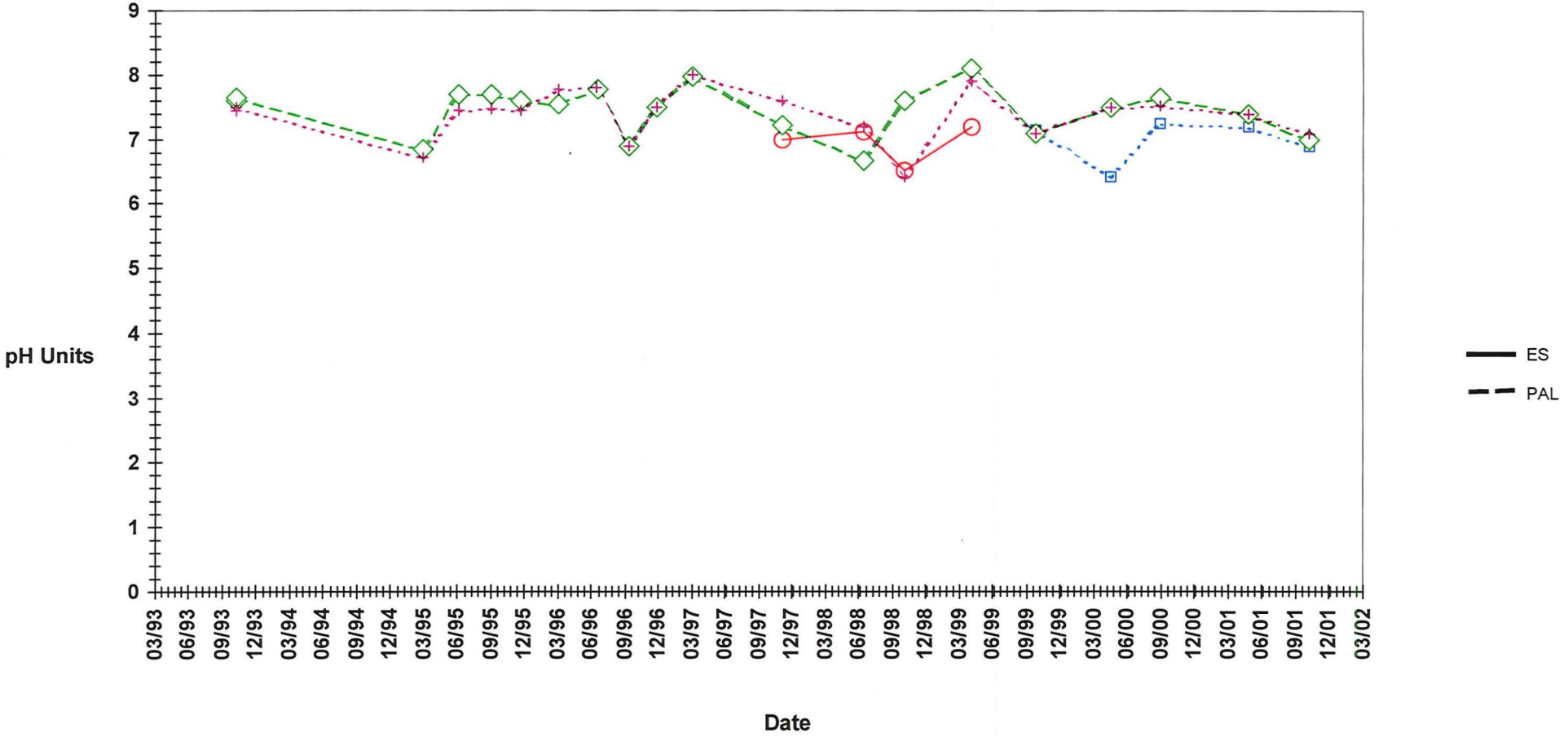
Detected Values Only



Onalaska Municipal Landfill

pH

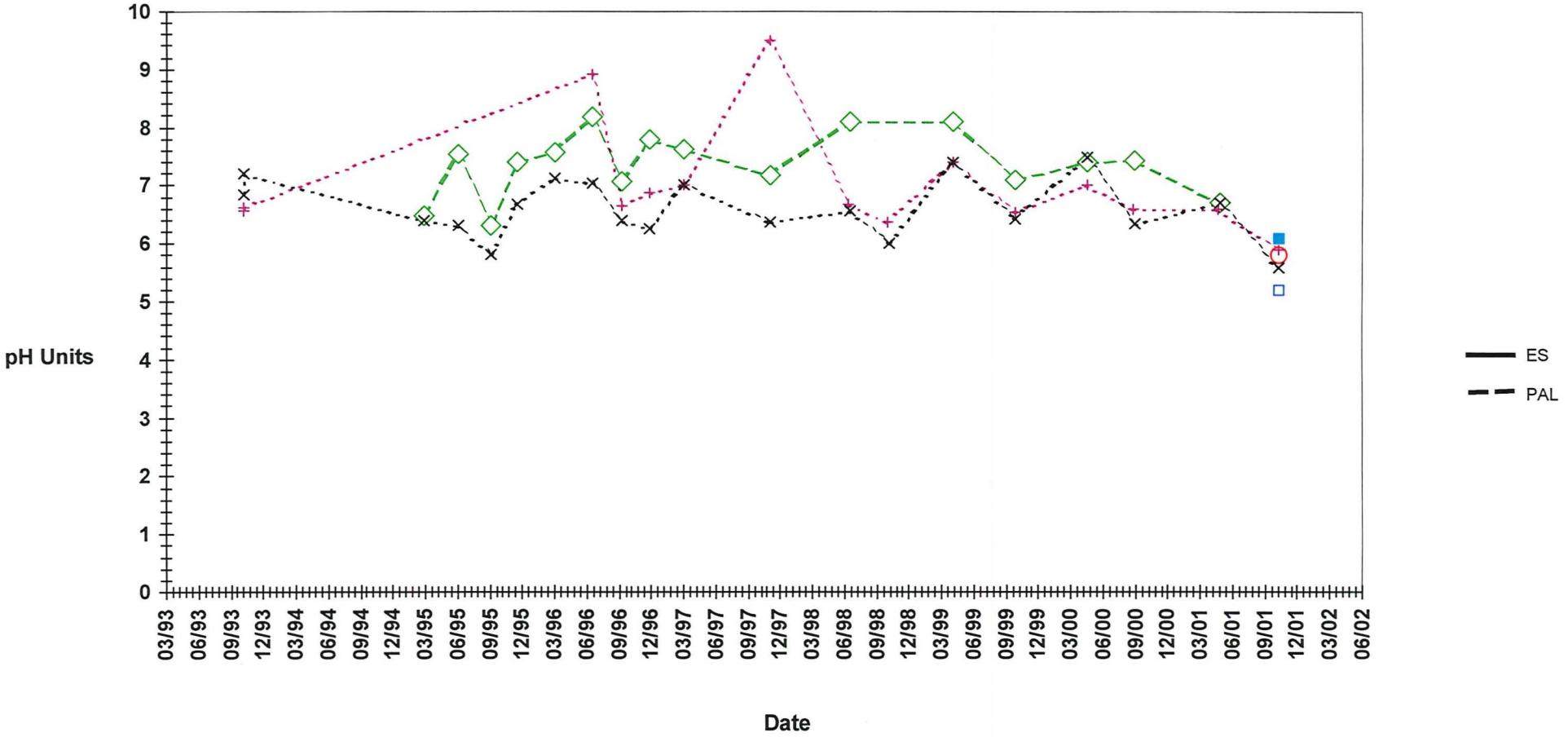
Detected Values Only



Onalaska Municipal Landfill

pH

Detected Values Only

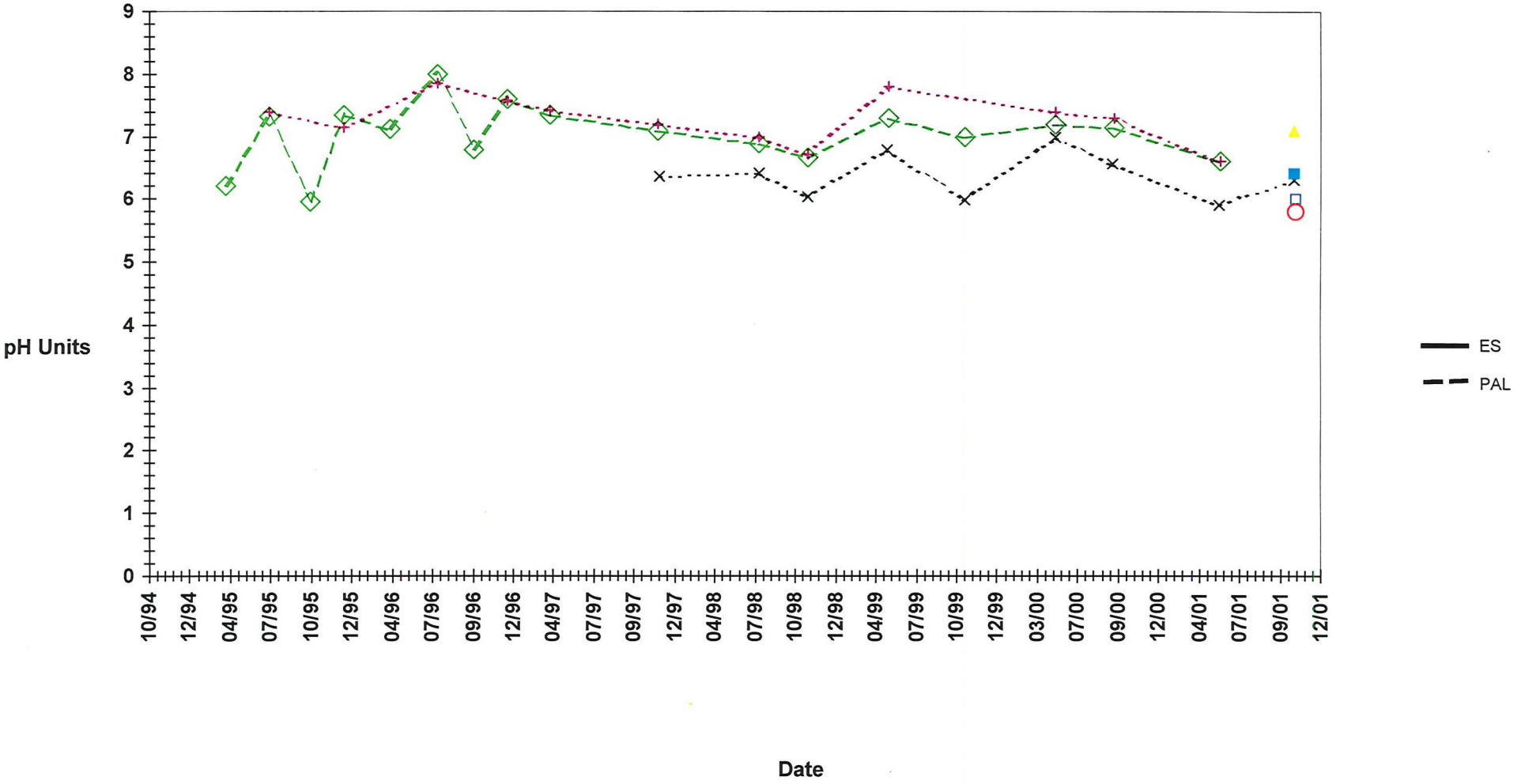


AW-01 AW-09 EW-05 MW-05S MW-14S PZ-01

Onalaska Municipal Landfill

pH

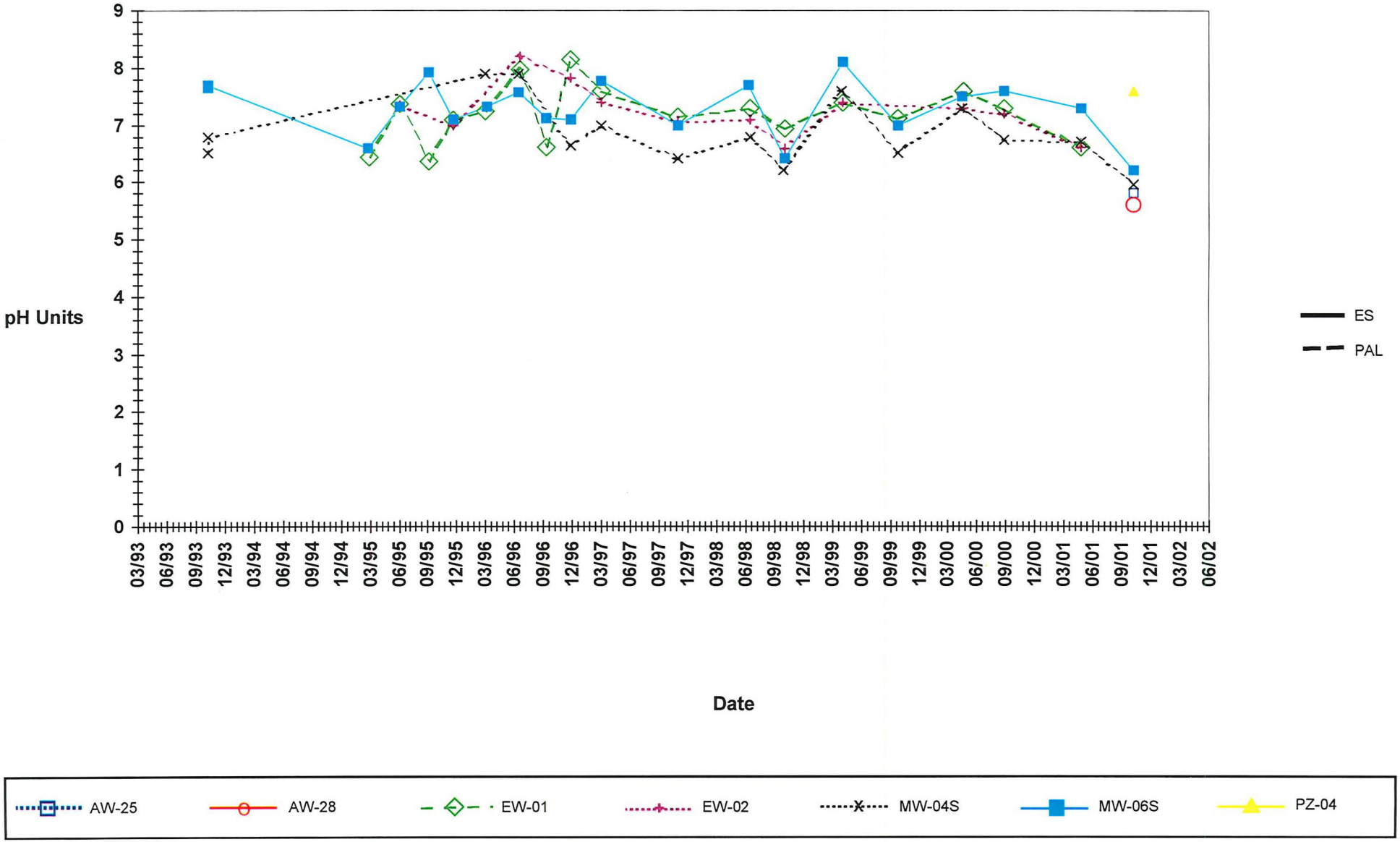
Detected Values Only



Onalaska Municipal Landfill

pH

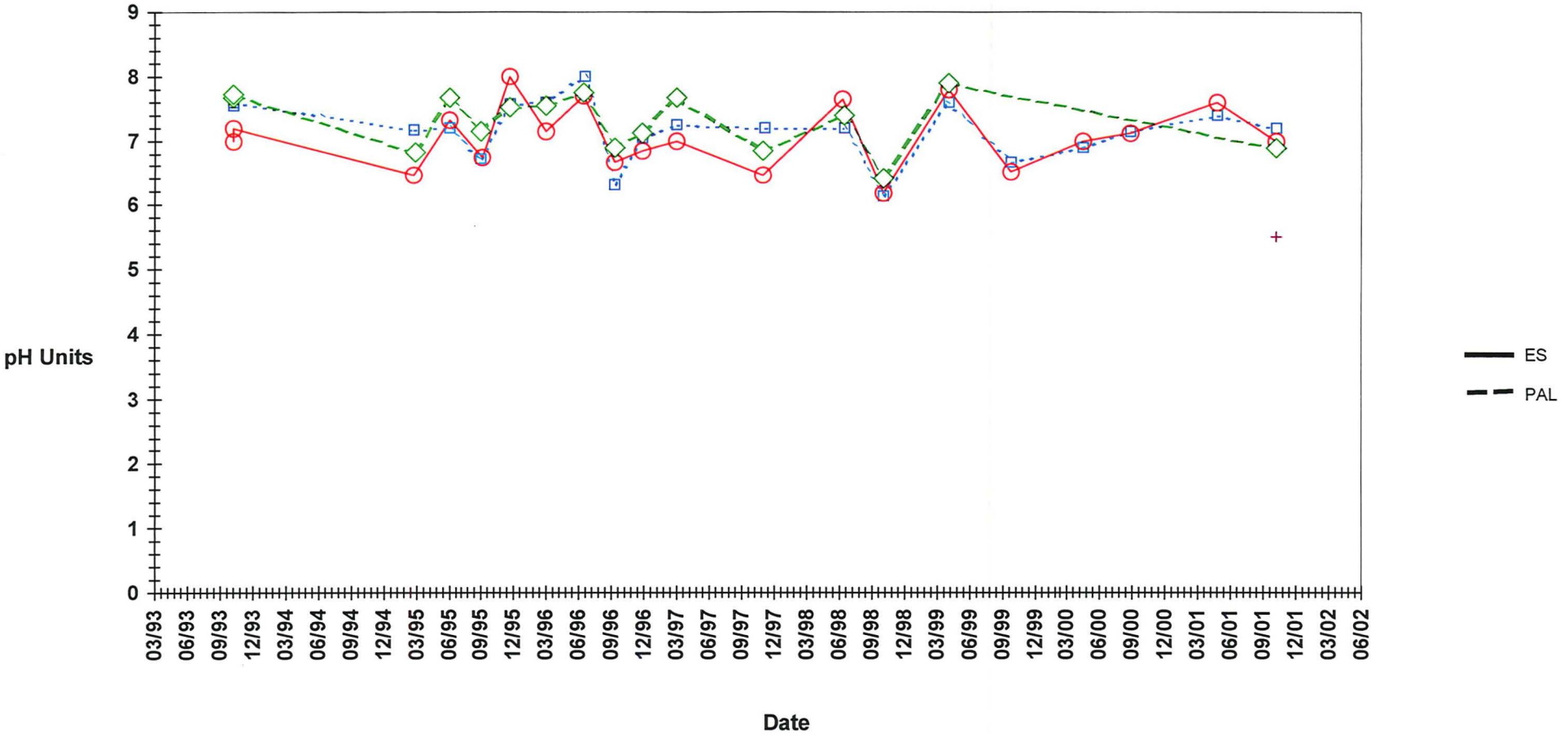
Detected Values Only



Onalaska Municipal Landfill

pH

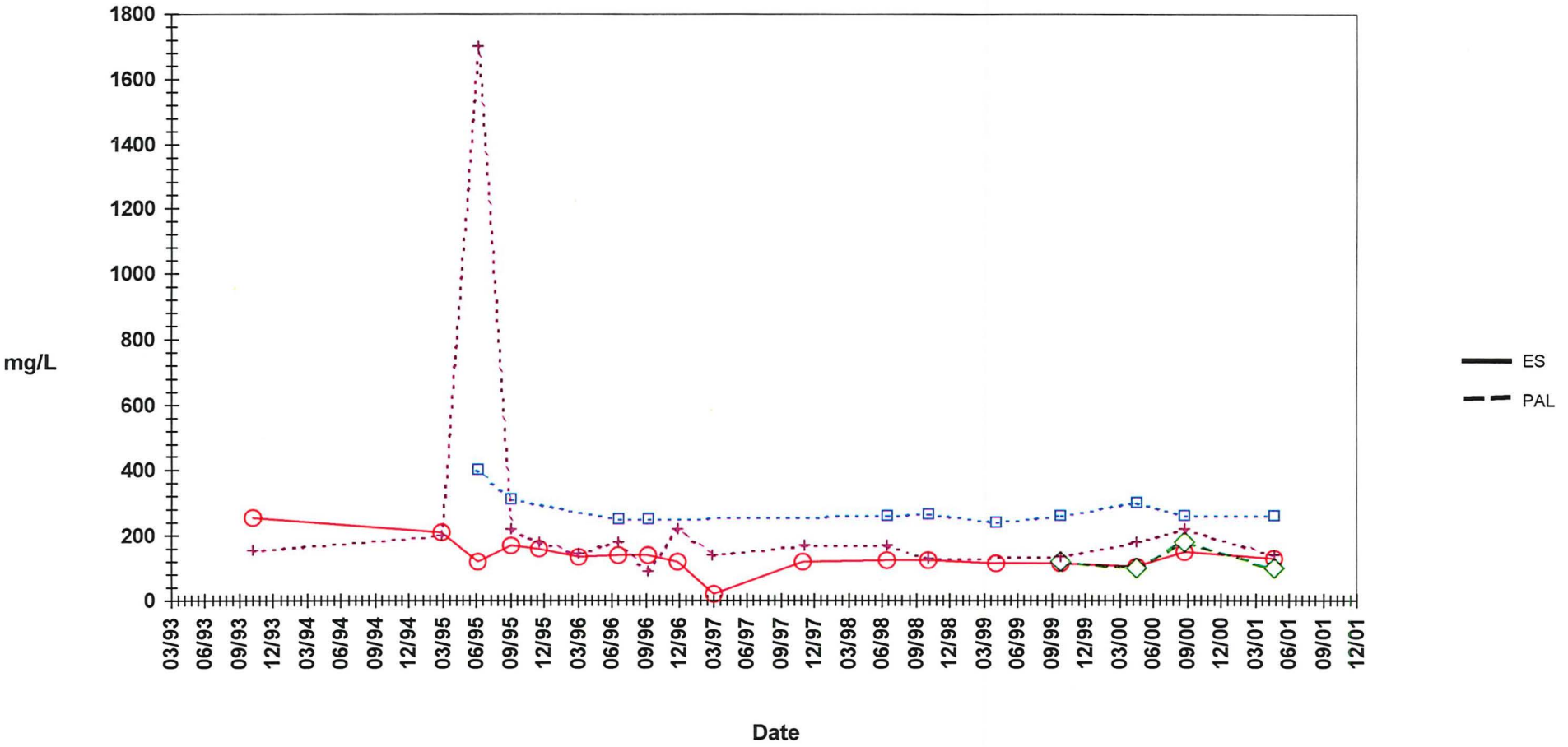
Detected Values Only



Onalaska Municipal Landfill

Total Dissolved Solids (Residue, Filterable)

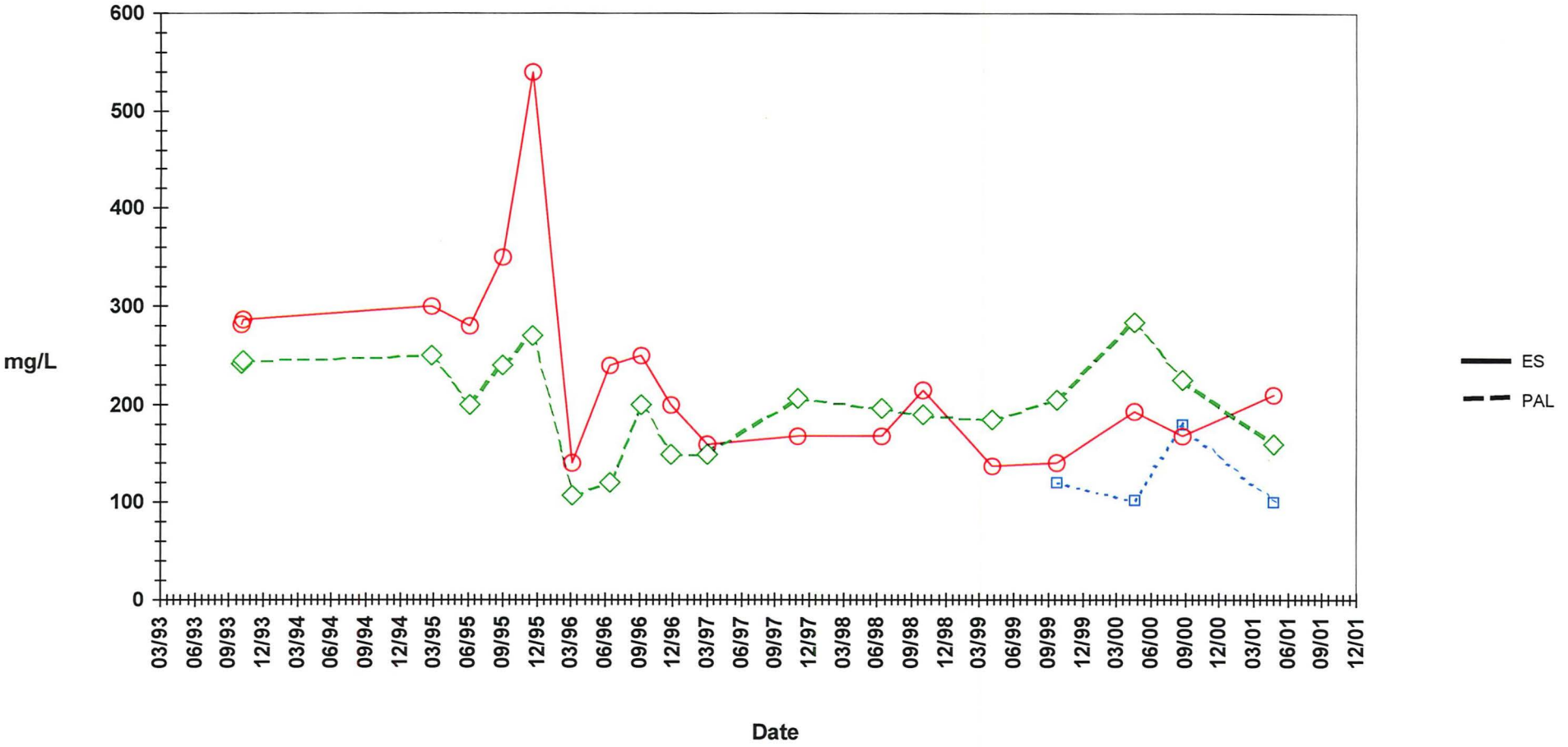
Detected Values Only



Onalaska Municipal Landfill

Total Dissolved Solids (Residue, Filterable)

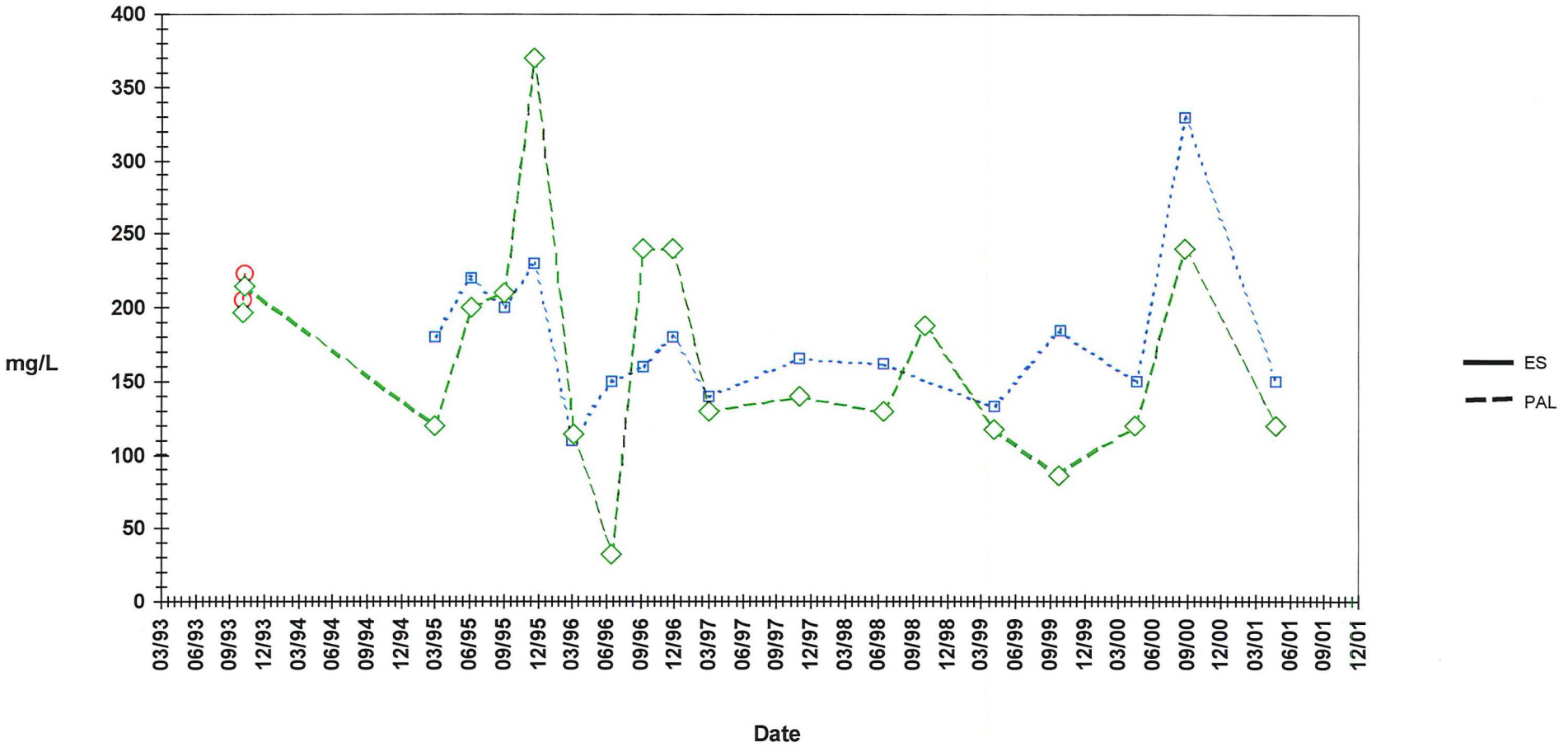
Detected Values Only



Onalaska Municipal Landfill

Total Dissolved Solids (Residue, Filterable)

Detected Values Only

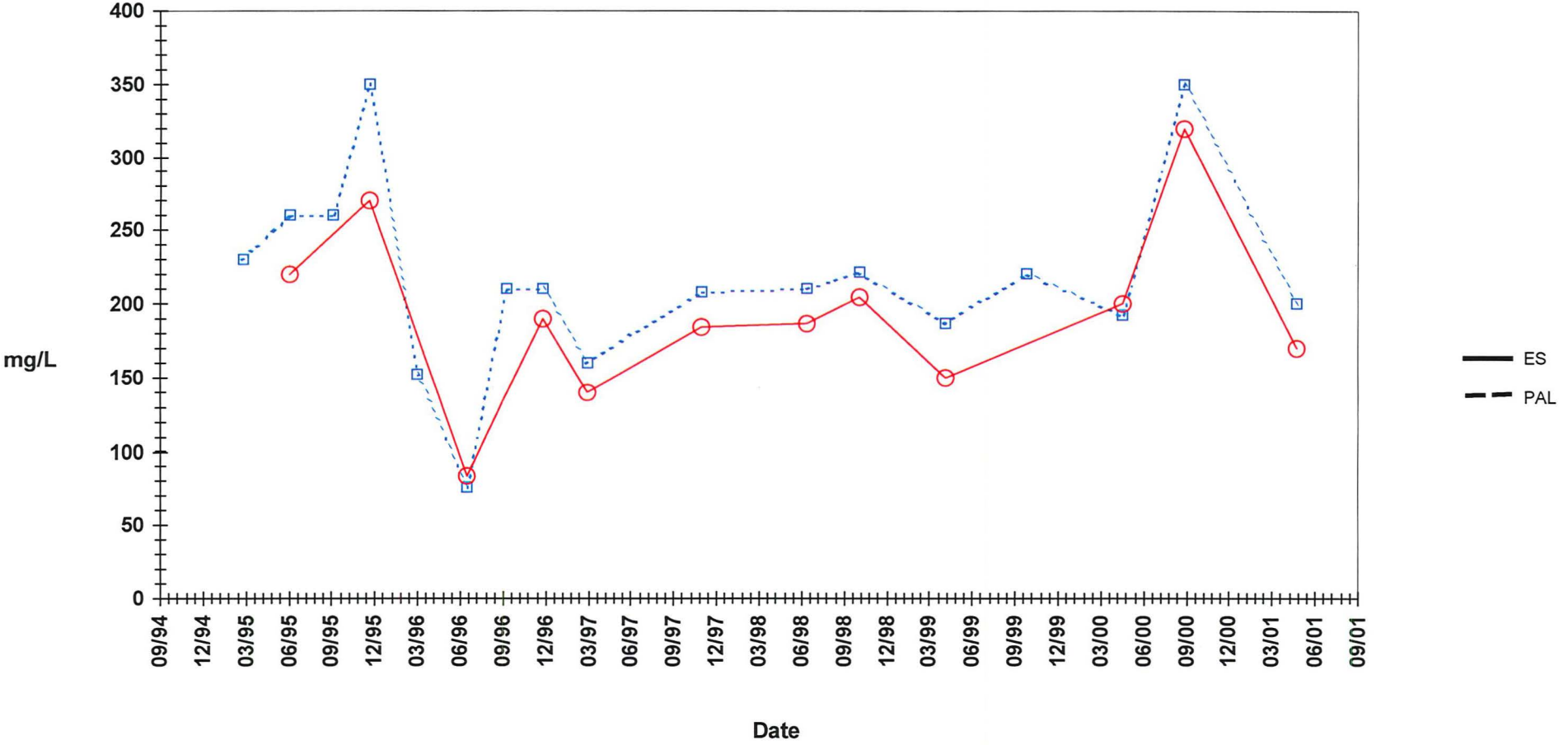


EW-05 MW-05S MW-14S

Onalaska Municipal Landfill

Total Dissolved Solids (Residue, Filterable)

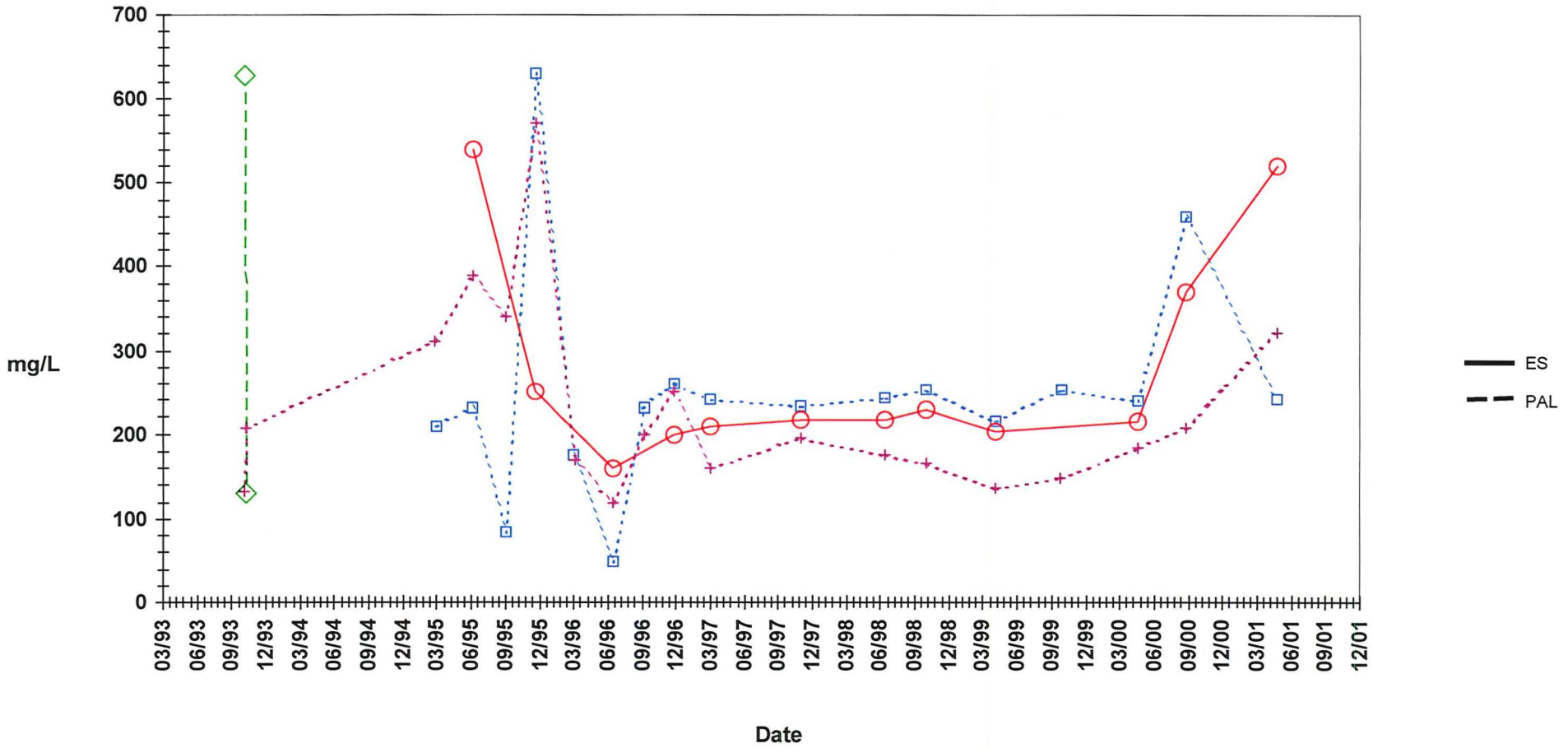
Detected Values Only



Onalaska Municipal Landfill

Total Dissolved Solids (Residue, Filterable)

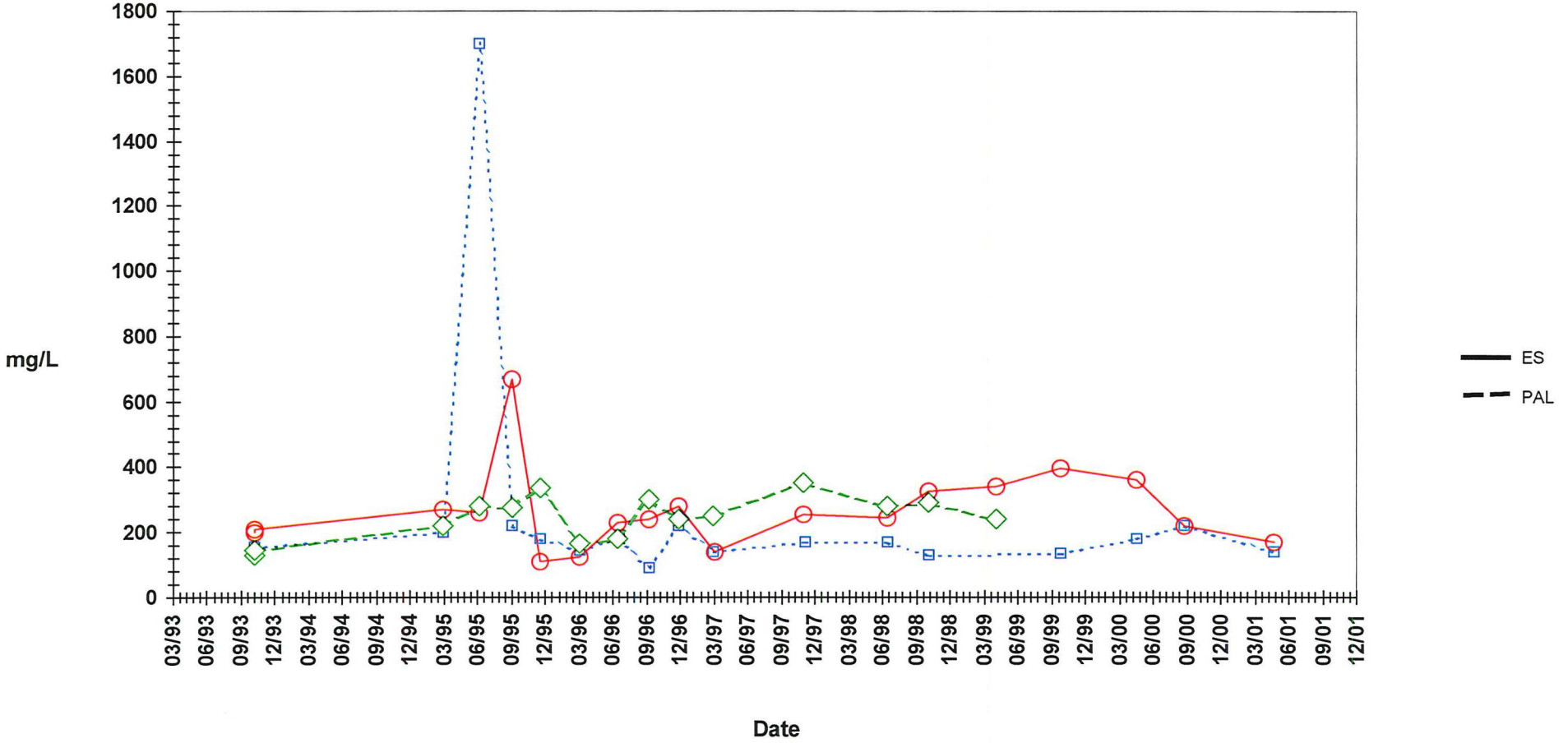
Detected Values Only



Onalaska Municipal Landfill

Total Dissolved Solids (Residue, Filterable)

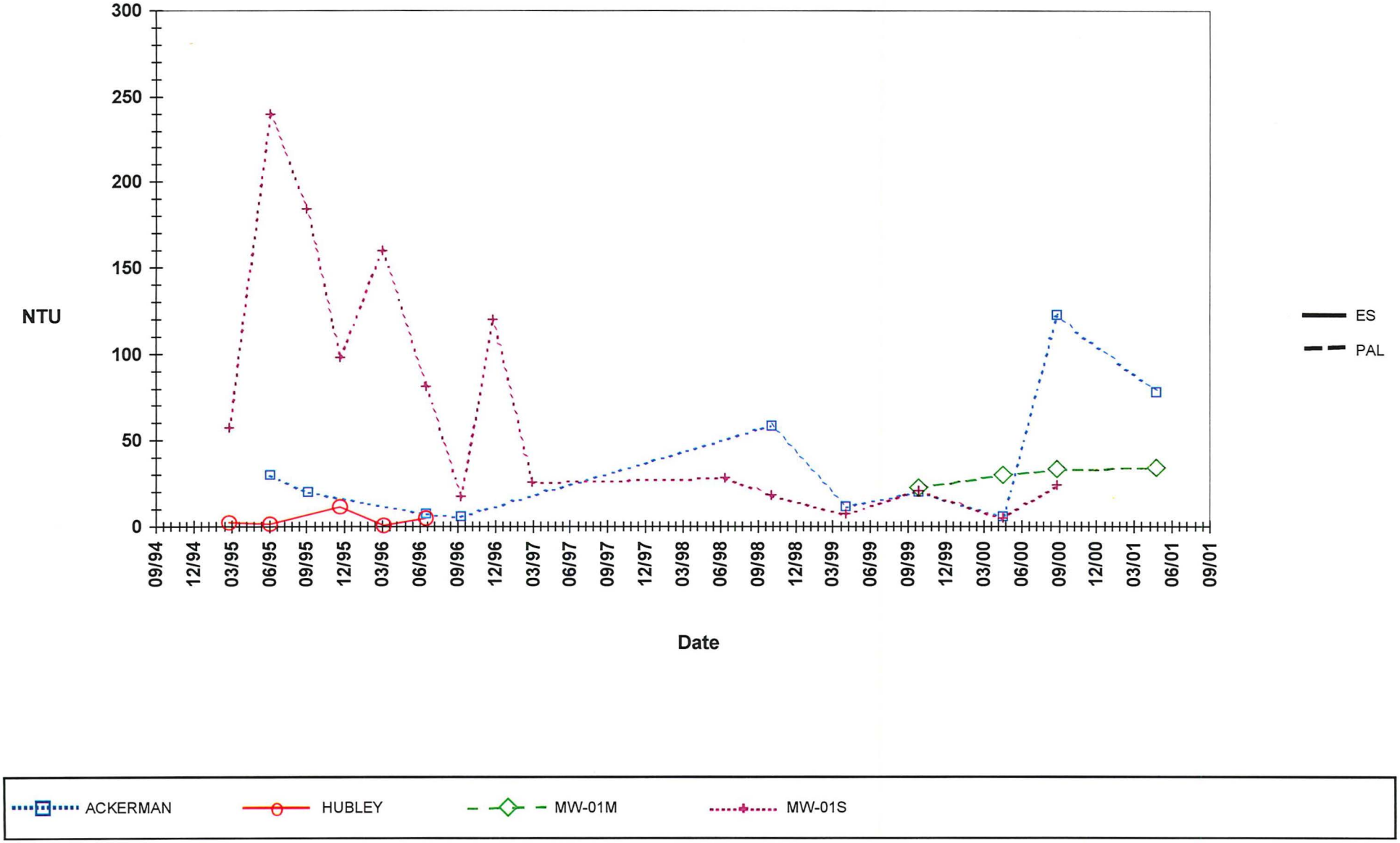
Detected Values Only



Onalaska Municipal Landfill

Turbidity

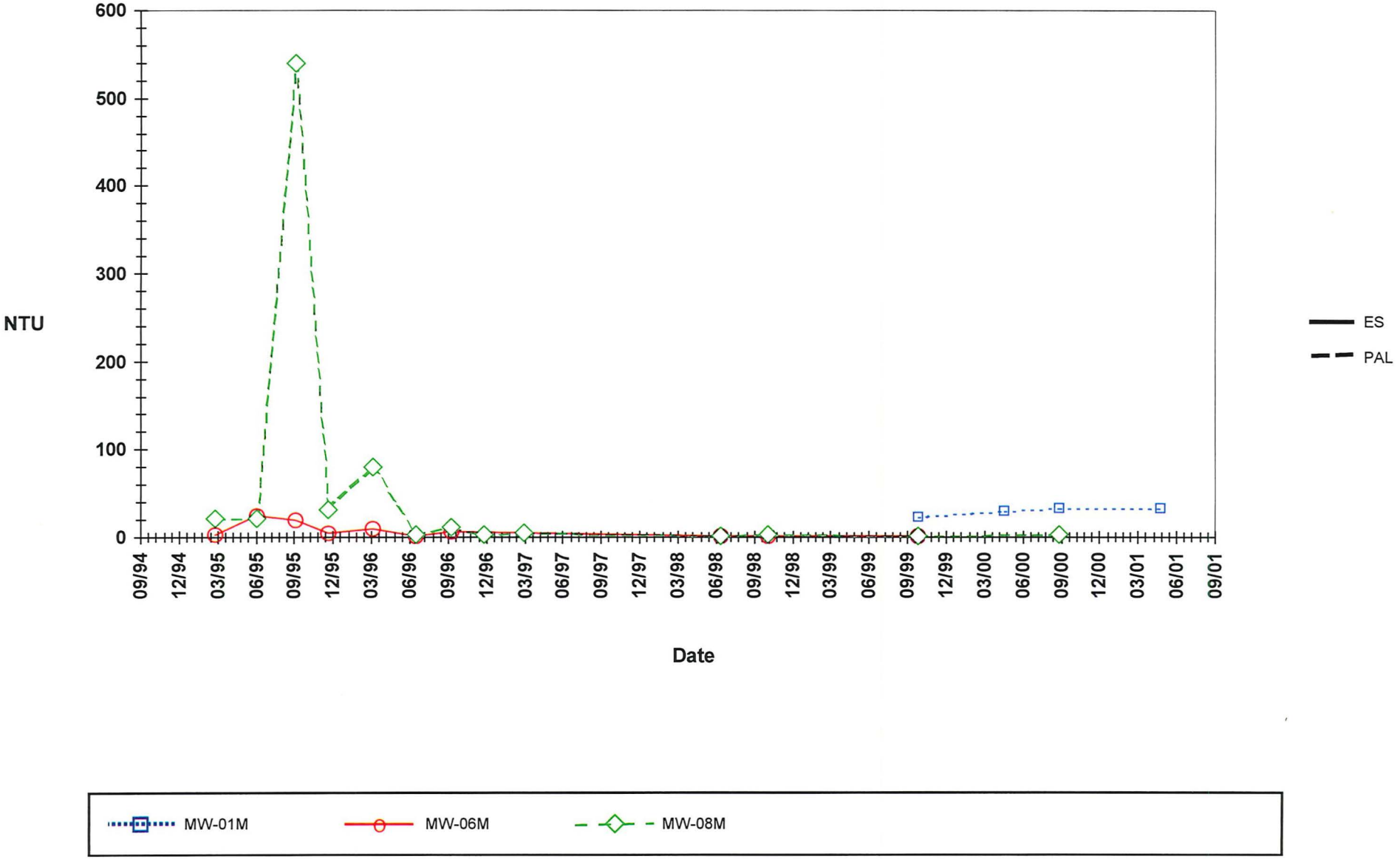
Detected Values Only



Onalaska Municipal Landfill

Turbidity

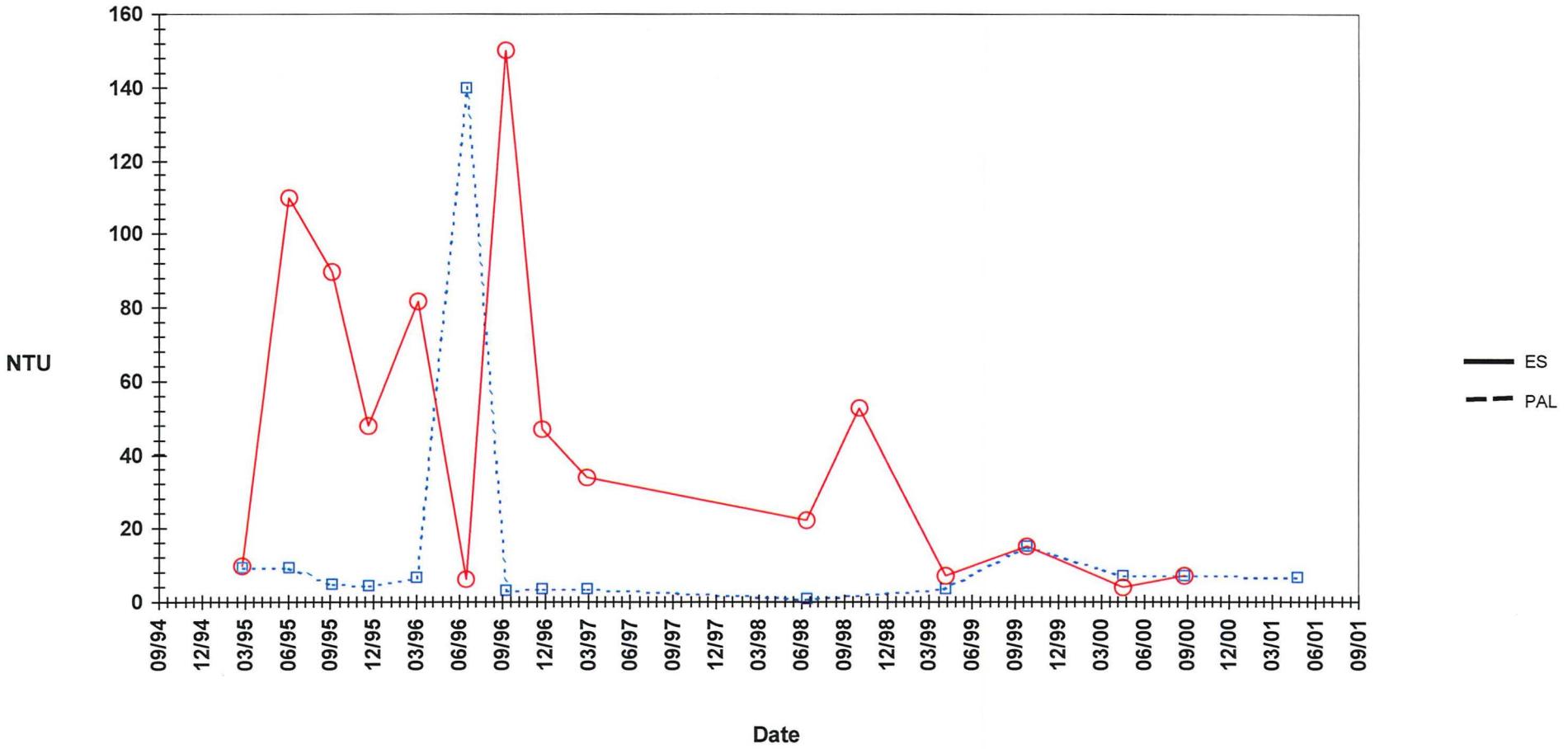
Detected Values Only



Onalaska Municipal Landfill

Turbidity

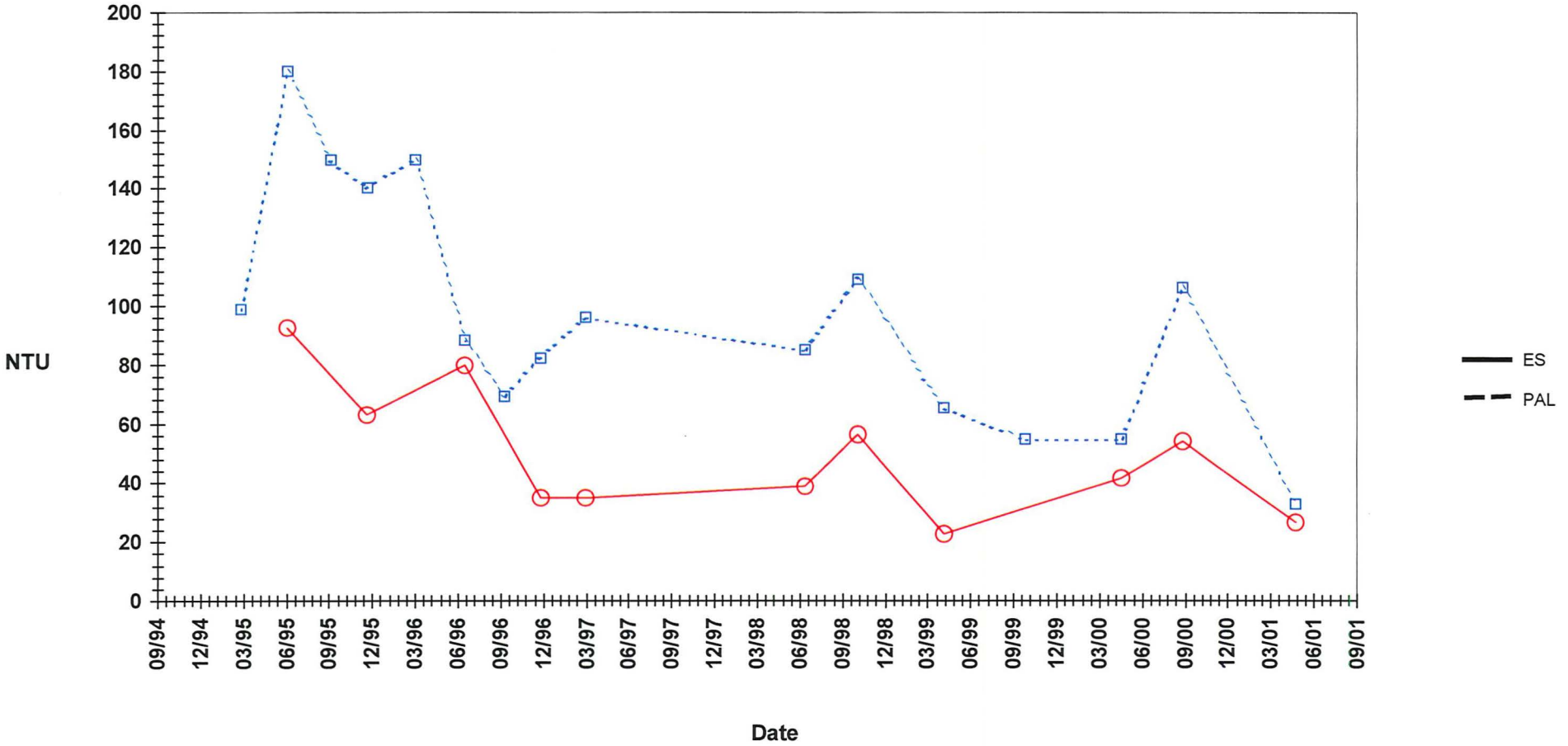
Detected Values Only



Onalaska Municipal Landfill

Turbidity

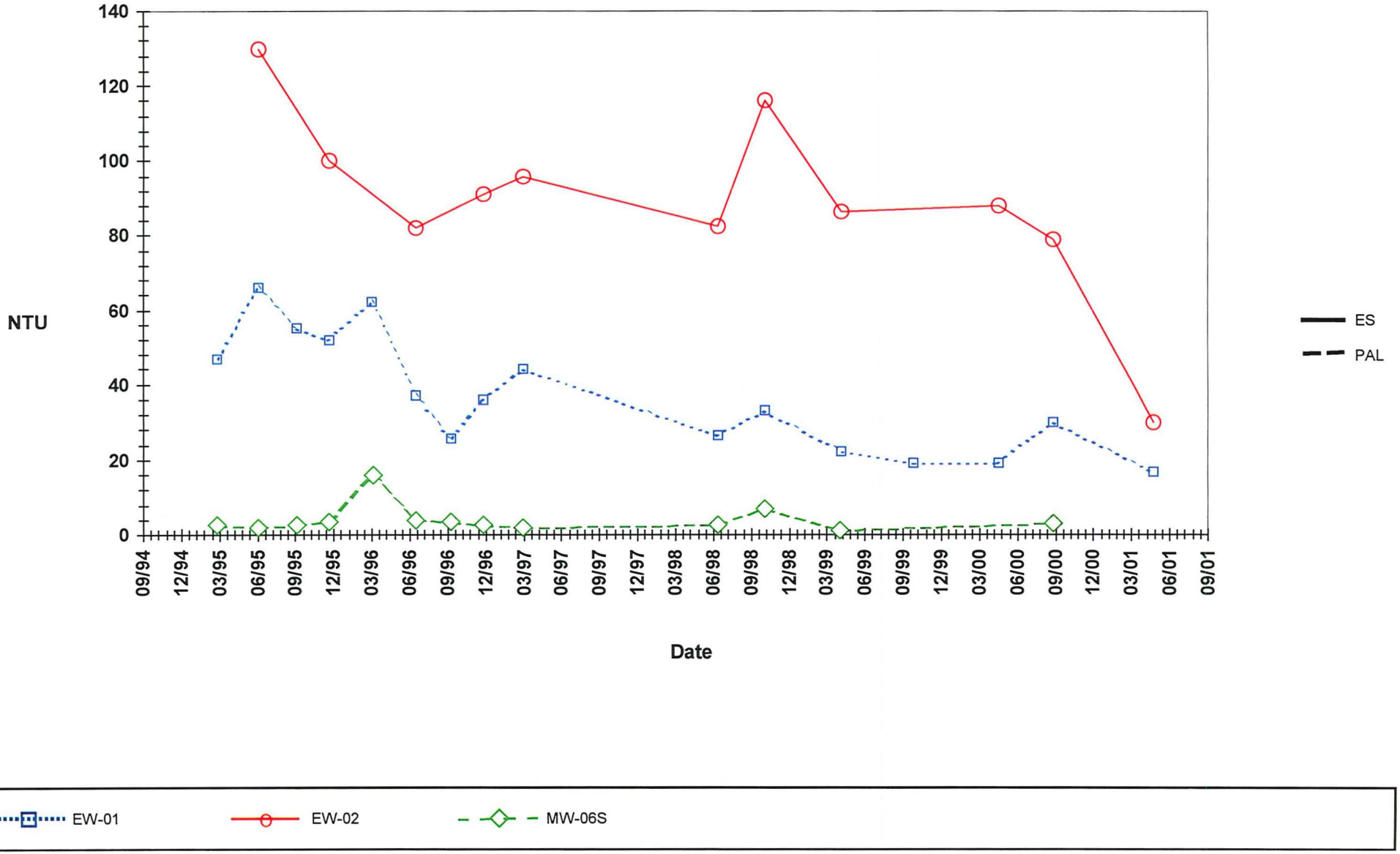
Detected Values Only



Onalaska Municipal Landfill

Turbidity

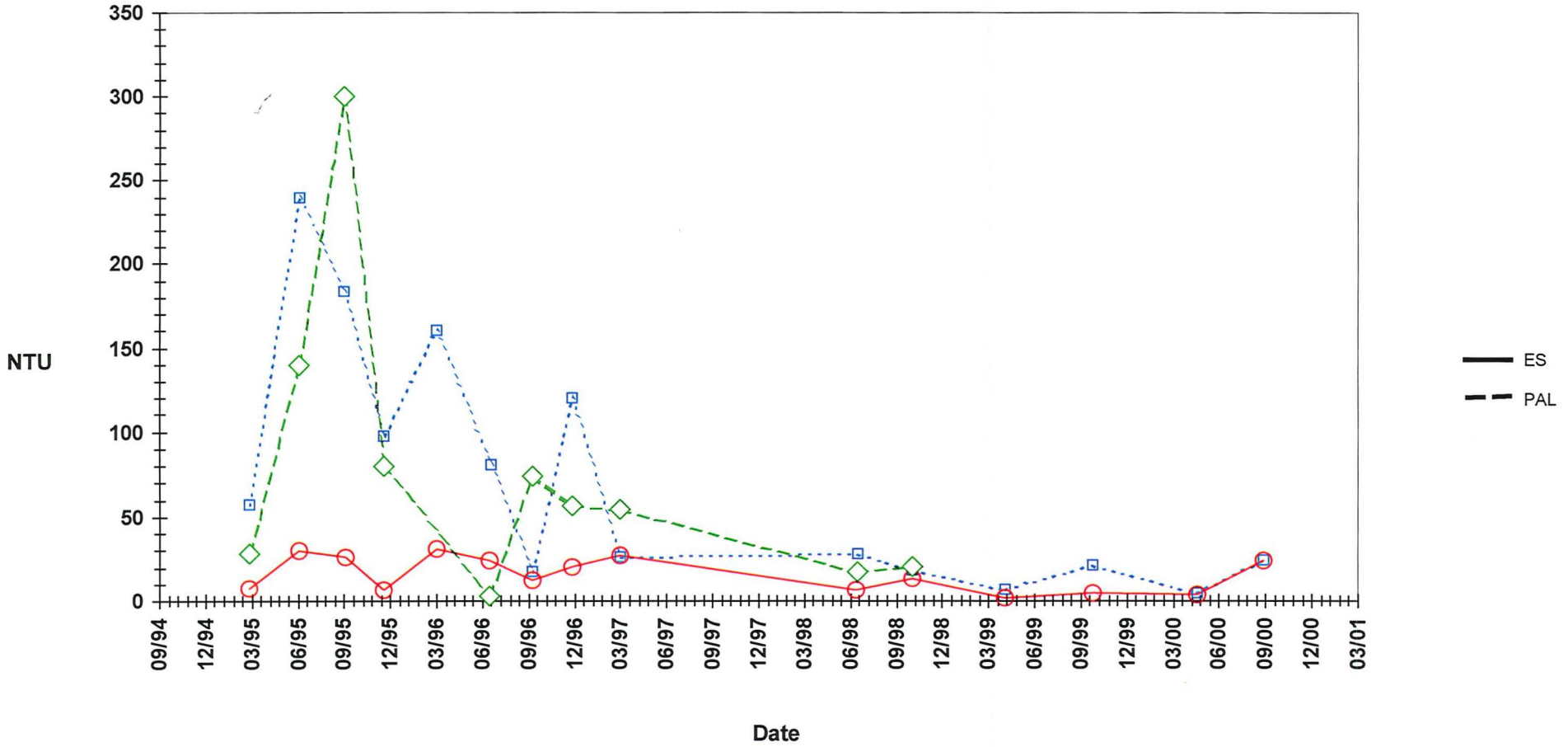
Detected Values Only



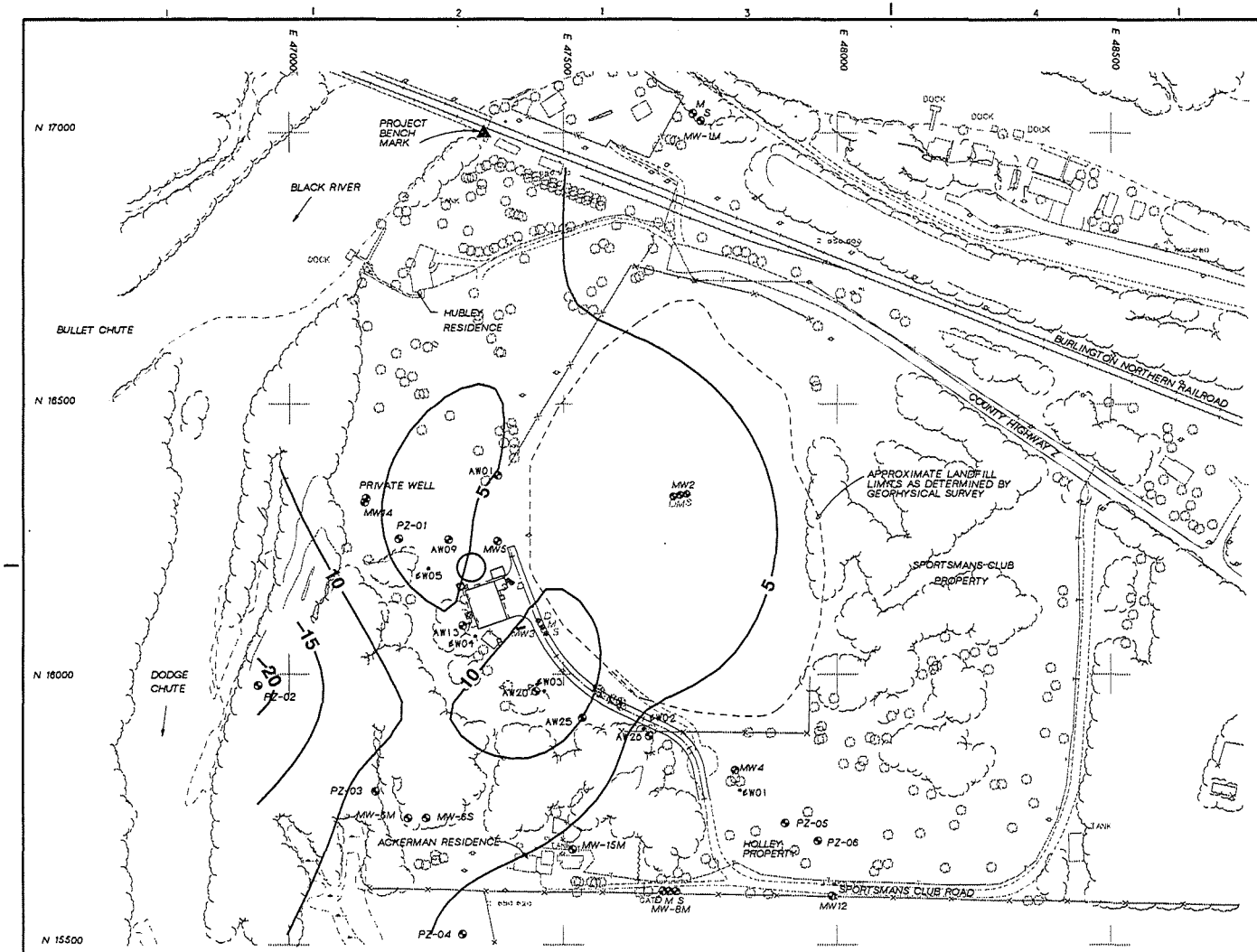
Onalaska Municipal Landfill

Turbidity

Detected Values Only



Appendix C
Natural Attenuation Figures



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 5 mg/L

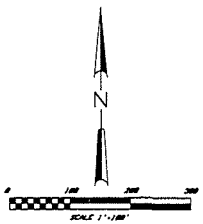


FIGURE C-1

SHALLOW MONITORING WELLS
TOTAL ORGANIC CARBON (mg/L)
OCTOBER, 2001

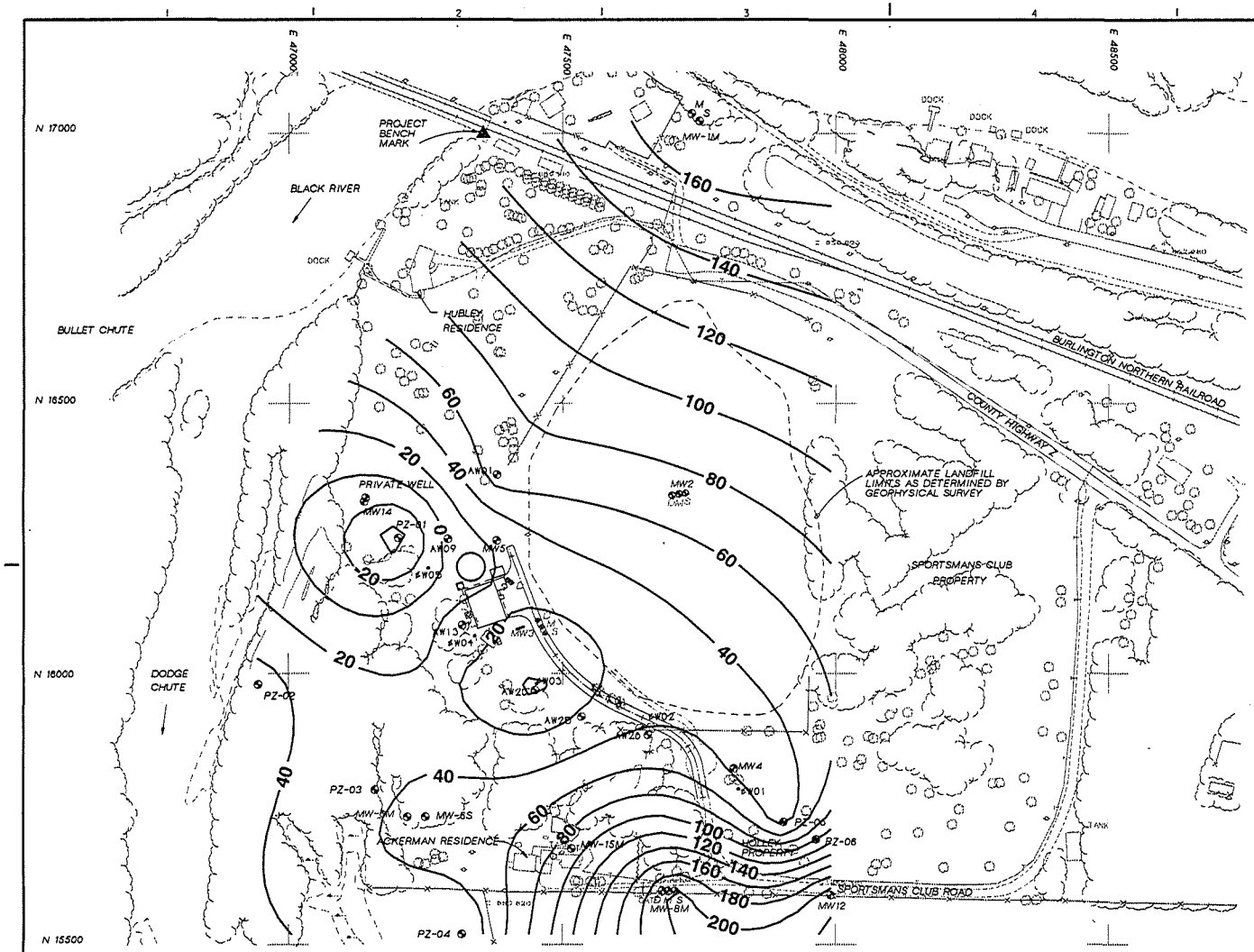
GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

DSGN
DR
CHK
APVD
NO. DATE REVISION BY APVD
CH2M HILL

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159005\ONALASKA\CAD\DRAWINGS\TOC-5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 20 mV

N

SCALE 1"=100'

FIGURE C-2

CH2M HILL

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

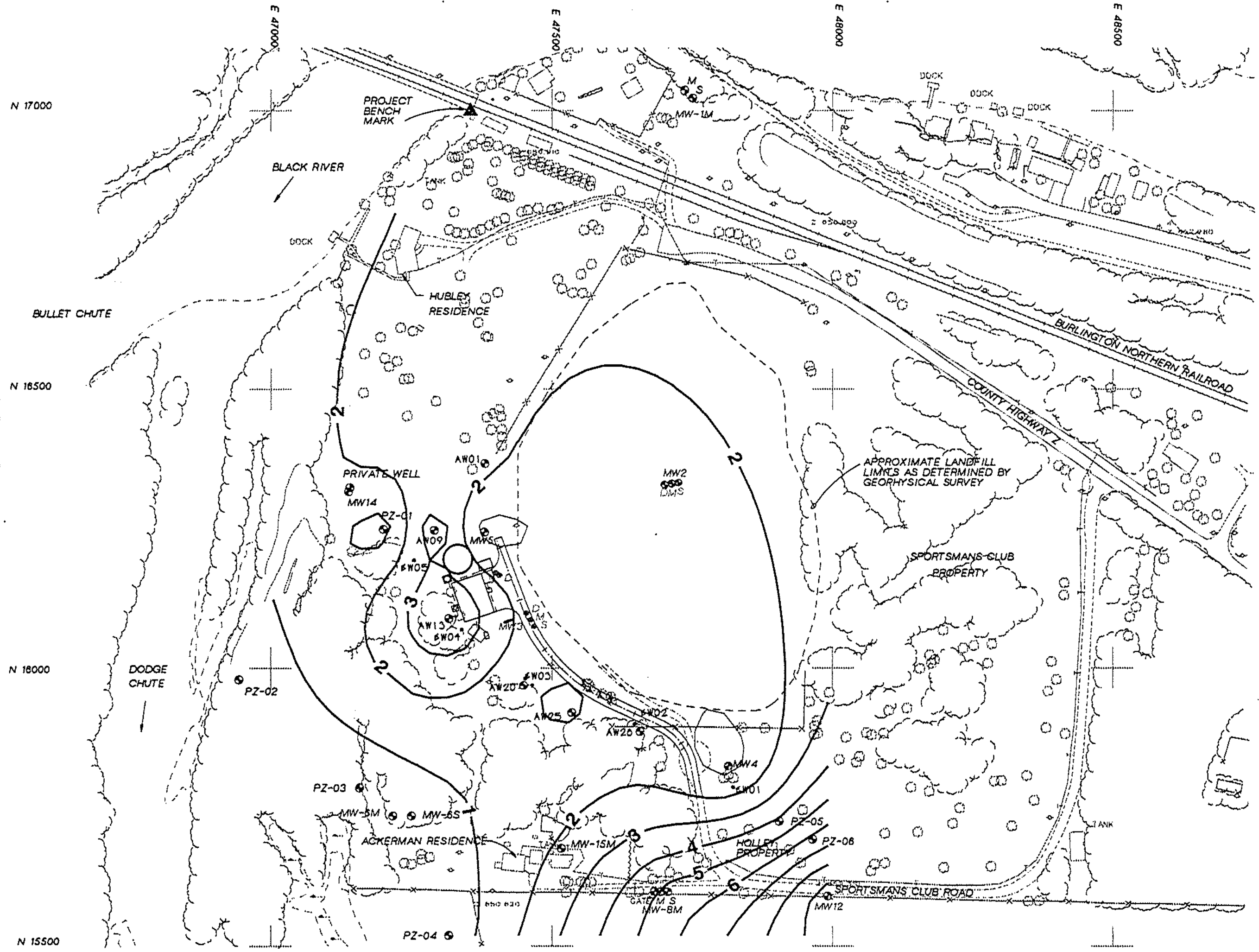
BAR IS 0.5 INCH ON ORIGINAL DRAWING. IF NOT 0.5 INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
OXIDATION-REDUCTION POTENTIAL(mV)
OCTOBER, 2001

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159900\ONALASKA\CAD\DRAWINGS\ORP45.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE. ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 1 mg/L

SCALE 1"=100'

FIGURE C-3

CH2M HILL

DSGN | DR | CHK | APVD

NO. | DATE | REVISION | BY | APVD

BAR IS ONE INCH ON ORIGINAL DRAWING. 0 — 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

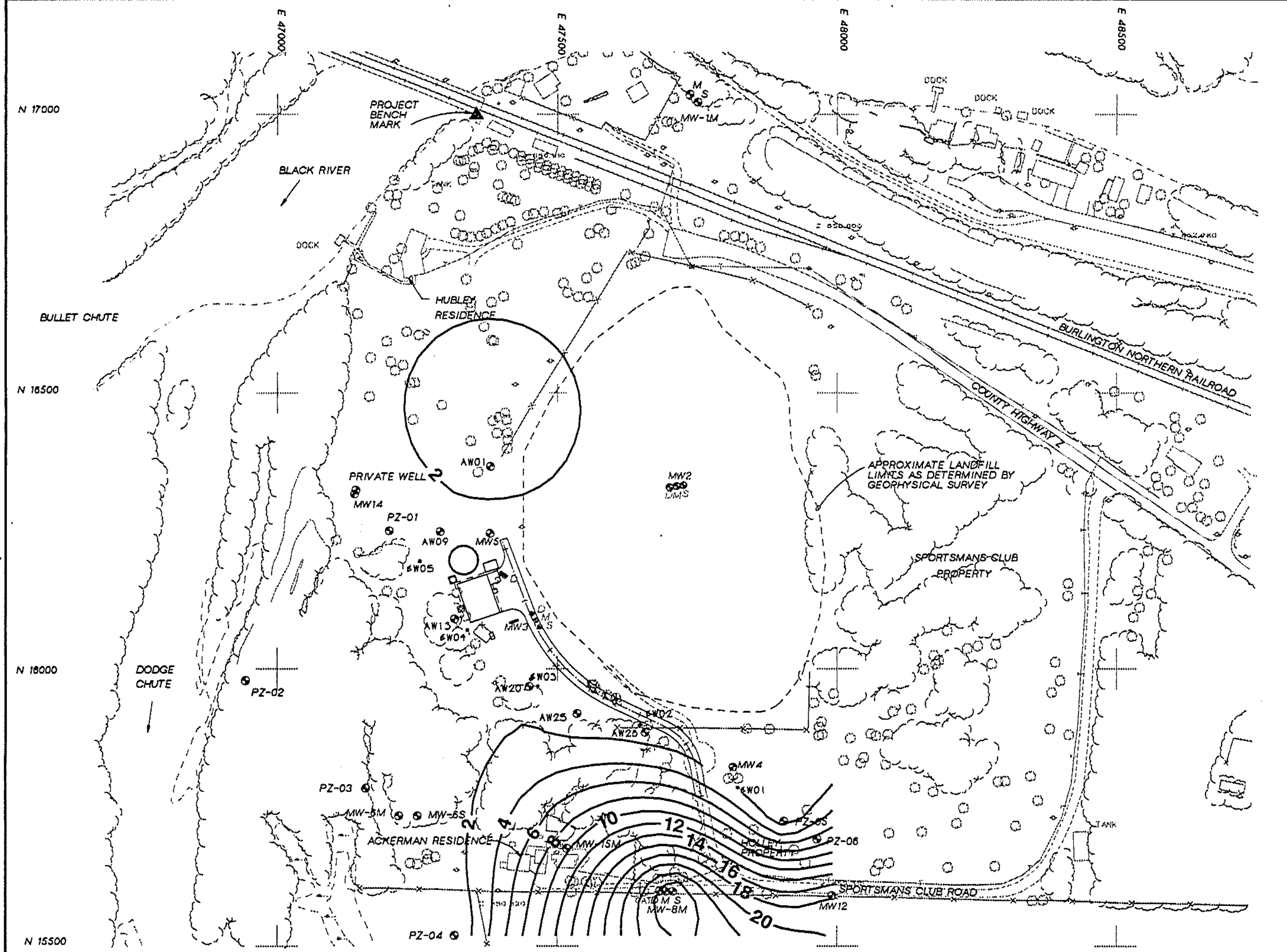
GROUNDWATER REMEDIAL ACTION

ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
DISSOLVED OXYGEN (mg/L)
OCTOBER, 2001

SHEET | DWG NO. | DATE | PROJ NO.

04/04/2002 U:\159908\ONALASKA\CAD\DRAWINGS\D1550X.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 2 mg/L

FIGURE C-4

CH2M HILL

DSGN / DR / CHK / APVD

NO. | DATE | REVISION | BY | APVD

REUSE OF DOCUMENTS
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.
©CH2M HILL

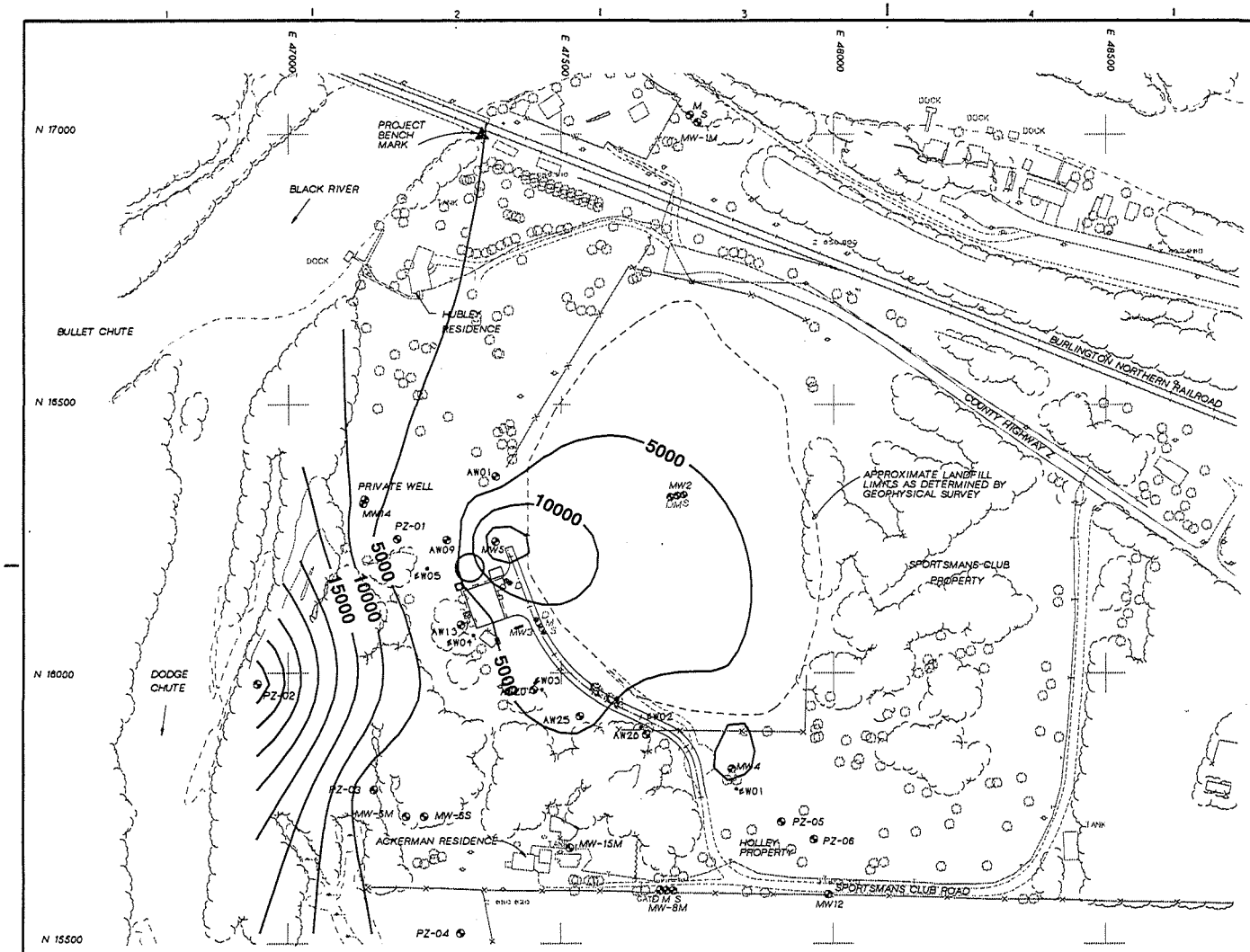
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
NITRATE (mg/L as N)
OCTOBER, 2001

SHEET / DWG NO. / DATE / PROJ NO.

04/04/2002 U:=159900=ONALASKA=CAD=DRAWINGS=NITRATE=S.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL = 5000 µg/L

N

SCALE 1"=100'

FIGURE C-5

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

CH2M HILL

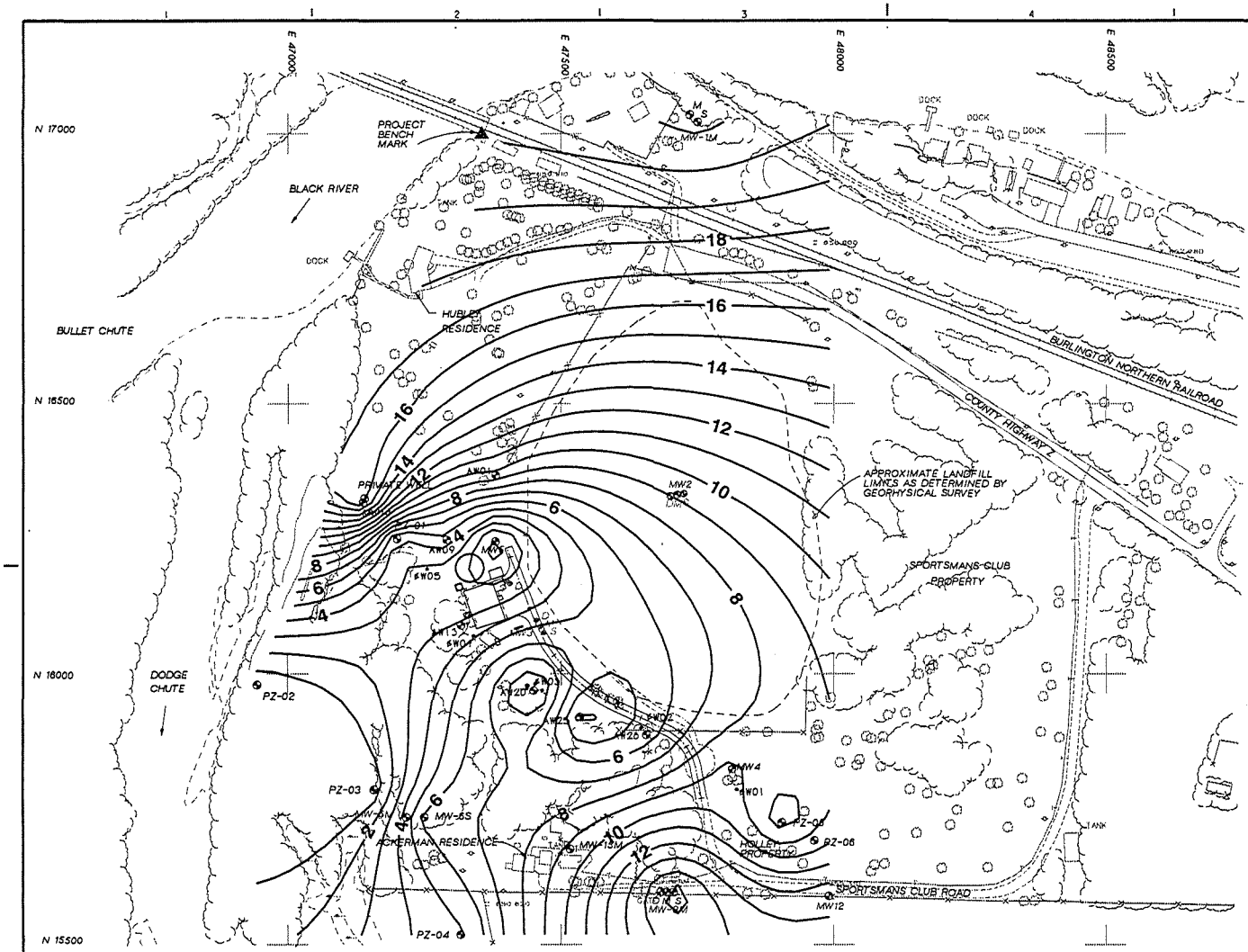
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
DISSOLVED IRON (µg/L)
OCTOBER, 2001

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159900\ONALASKA\CAD\DRAWINGS\IRON05.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 1 mg/L

N

SCALE 1"=100'

FIGURE C-6

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

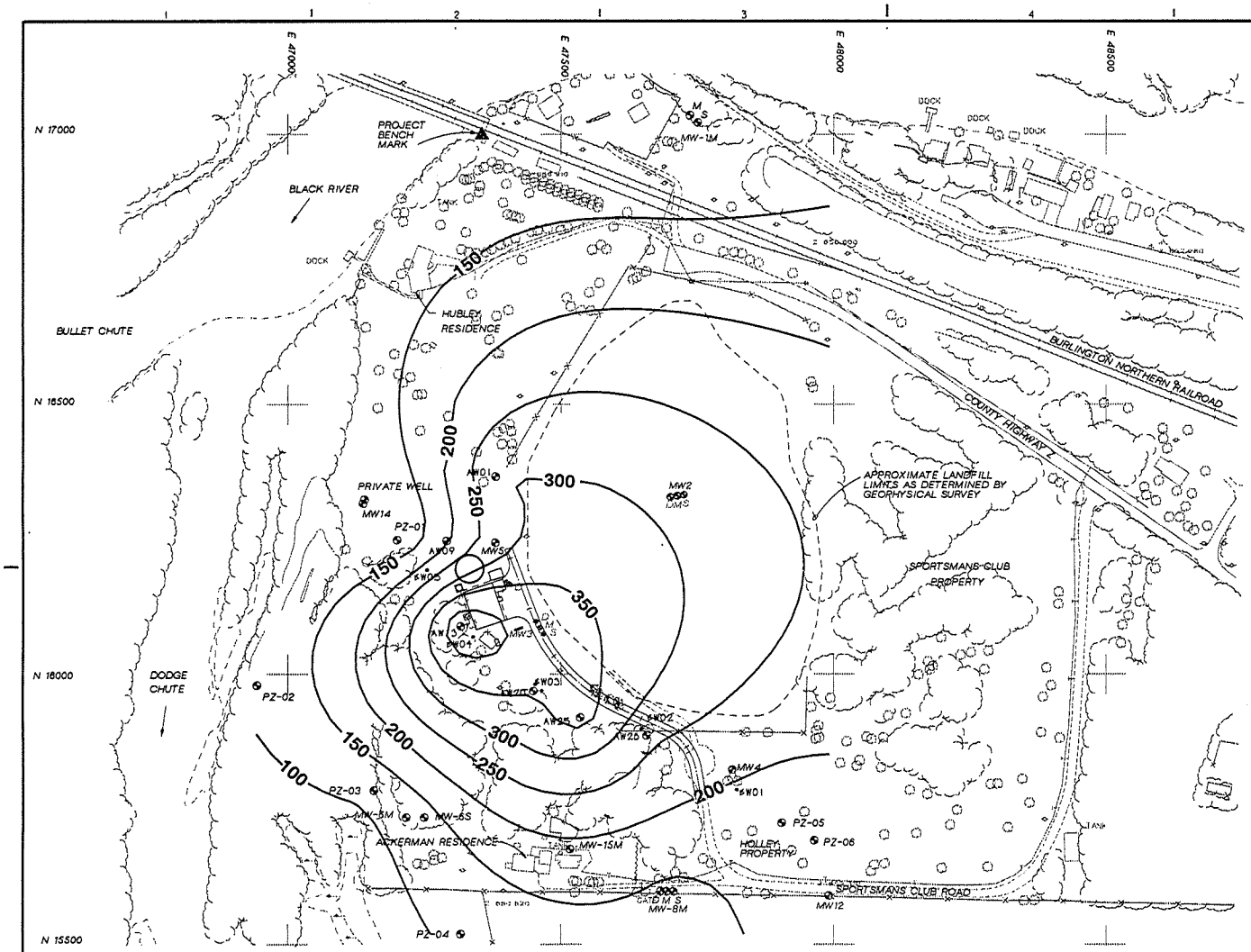
BAR IS ONE INCH ON ORIGINAL DRAWING.
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
SULFATE (mg/L AS SO_4)
OCTOBER, 2001

SHEET
DWG NO.
DATE
PROJ NO.

09/04/2002 U:\159906\ONALASKA\CAD\DRAWINGS\SULFATE\5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 50 mg/L as $CaCO_3$

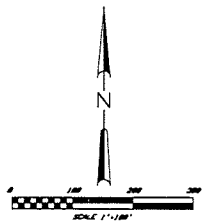


FIGURE C-7

DSGN	
DR	
CHK	
APVD	

NO.	DATE	REVISION	BY	APVD

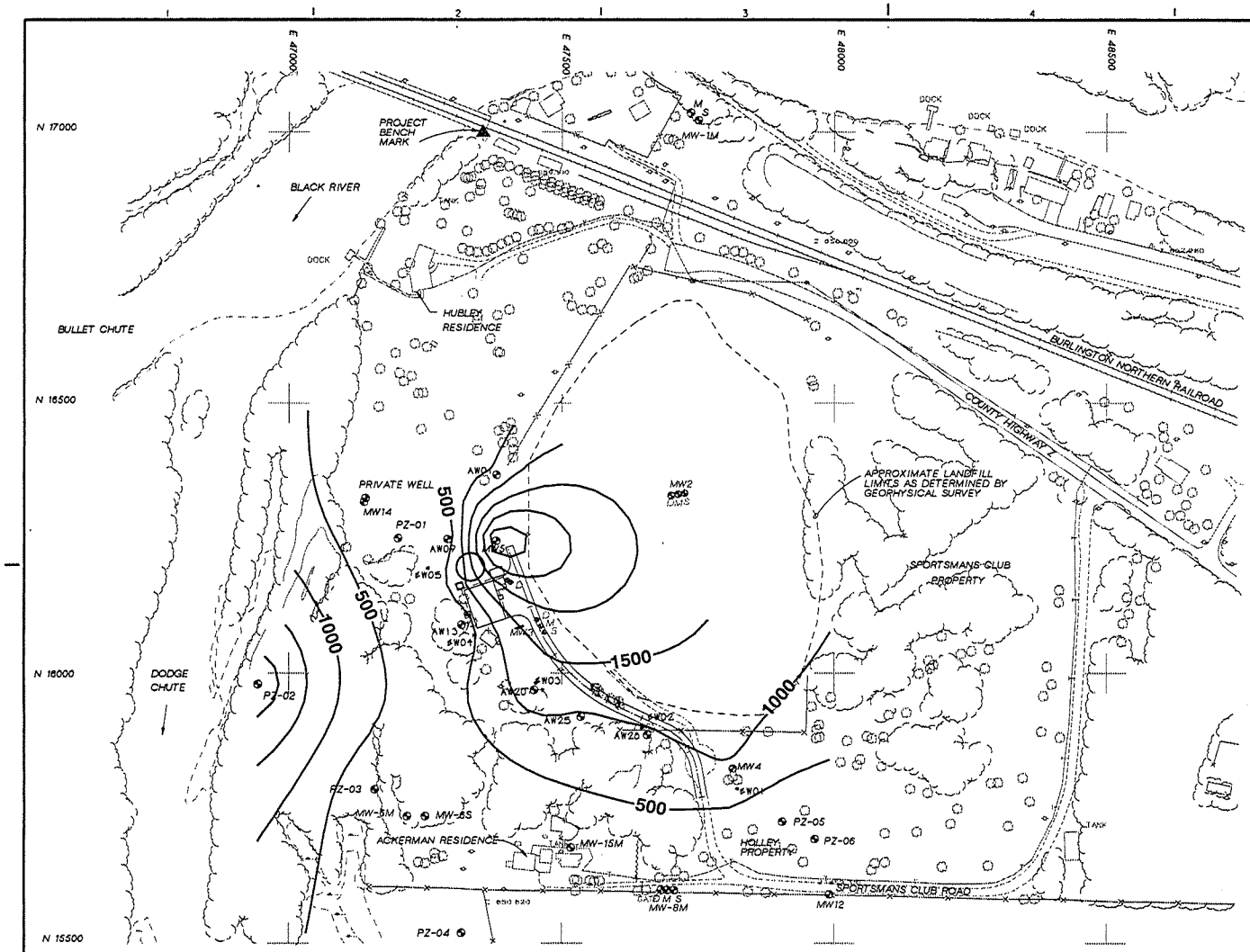
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
ALKALINITY (mg/L as $CaCO_3$)
OCTOBER, 2001

SHEET	
DWG NO.	
DATE	
PROJ NO.	

04/04/2002 U:\159908\ONALASKA\GAP\DRAWINGS\ALK-9.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD. ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 500 µg/L

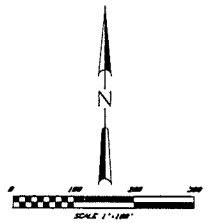


FIGURE C-8

SHALLOW MONITORING WELLS
METHANE (µg/L)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

DSGN
DR
CHK
APVD

NO. | DATE | REVISION | BY | APVD

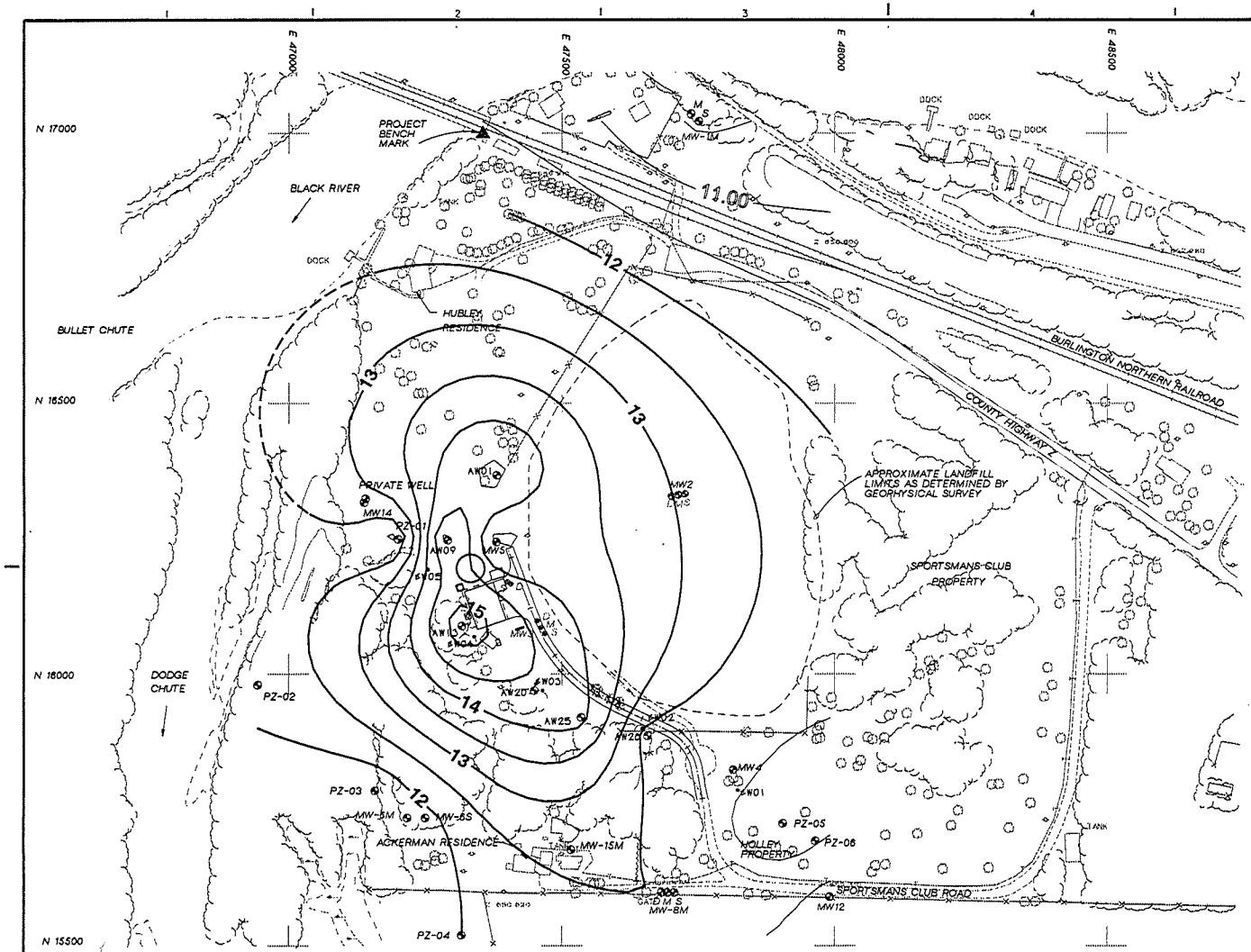
REUSE OF DOCUMENTS
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.

BAR IS 0.5 INCH ON ORIGINAL DRAWING. IF NOT 0.5 INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

CH2M HILL

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\15090D\ONALASKA\CAD\DRAWINGS\METHANE5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.5 °C

N

SCALE 1"=100'

FIGURE C-9

DSGN | DR | CHK | APVD

CH2M HILL

NO.	DATE	REVISION	BY	APVD

CH2M HILL

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

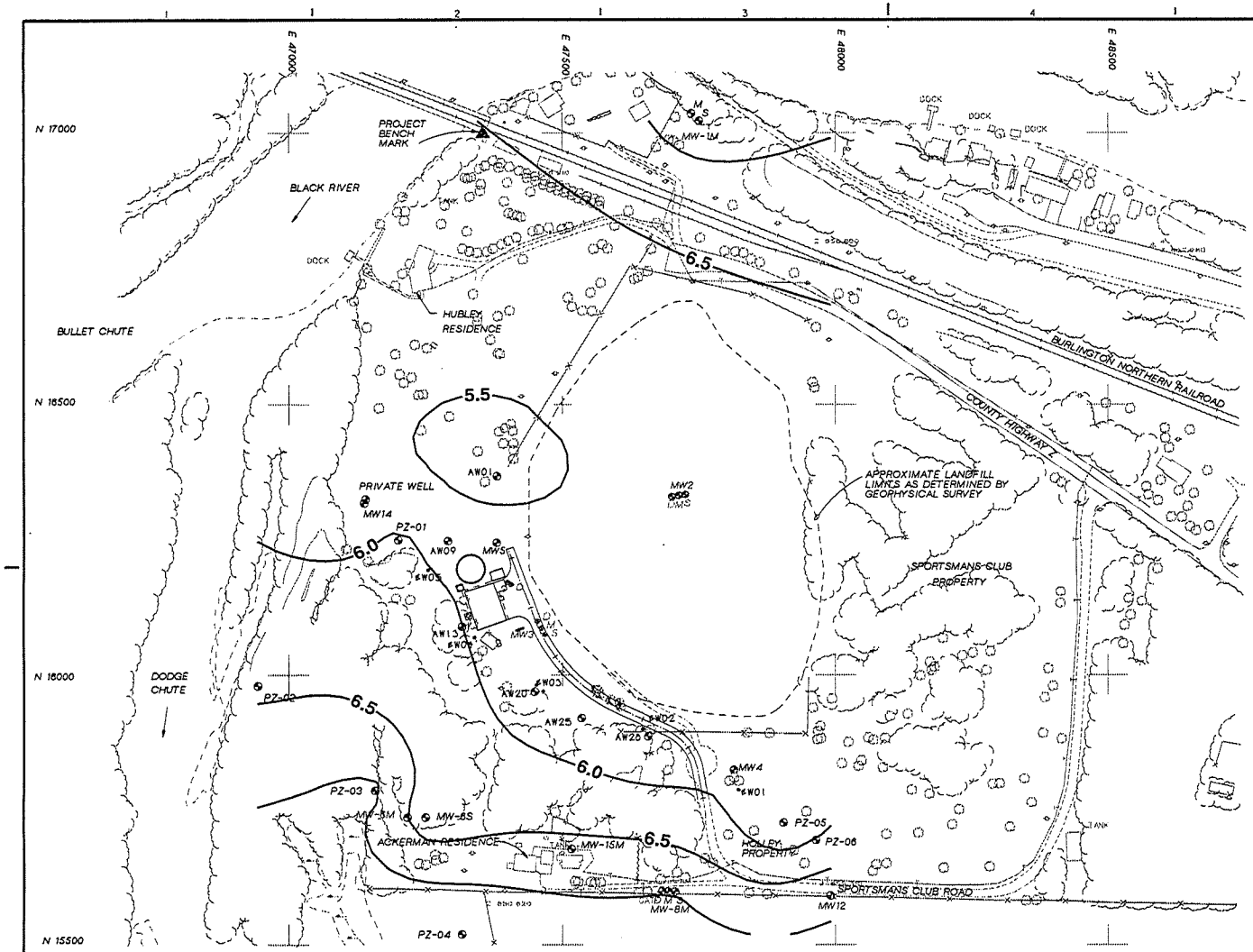
GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
TEMPERATURE (°C)
OCTOBER, 2001

SHEET
DRG NO.
DATE
PROJ NO.

04/04/2002 U:\159900\ONALASKA\CAD\DRAWINGS\TEMP05.DGN

OVERLAY IDENTIFICATION: COMPOSITE, PYRELAY, SCREEN
PROJECT FILE



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.5 pH UNIT

N

SCALE 1"=100'

FIGURE C-10

SHALLOW MONITORING WELLS
pH
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

DESIGN
DR
CHK
APVD

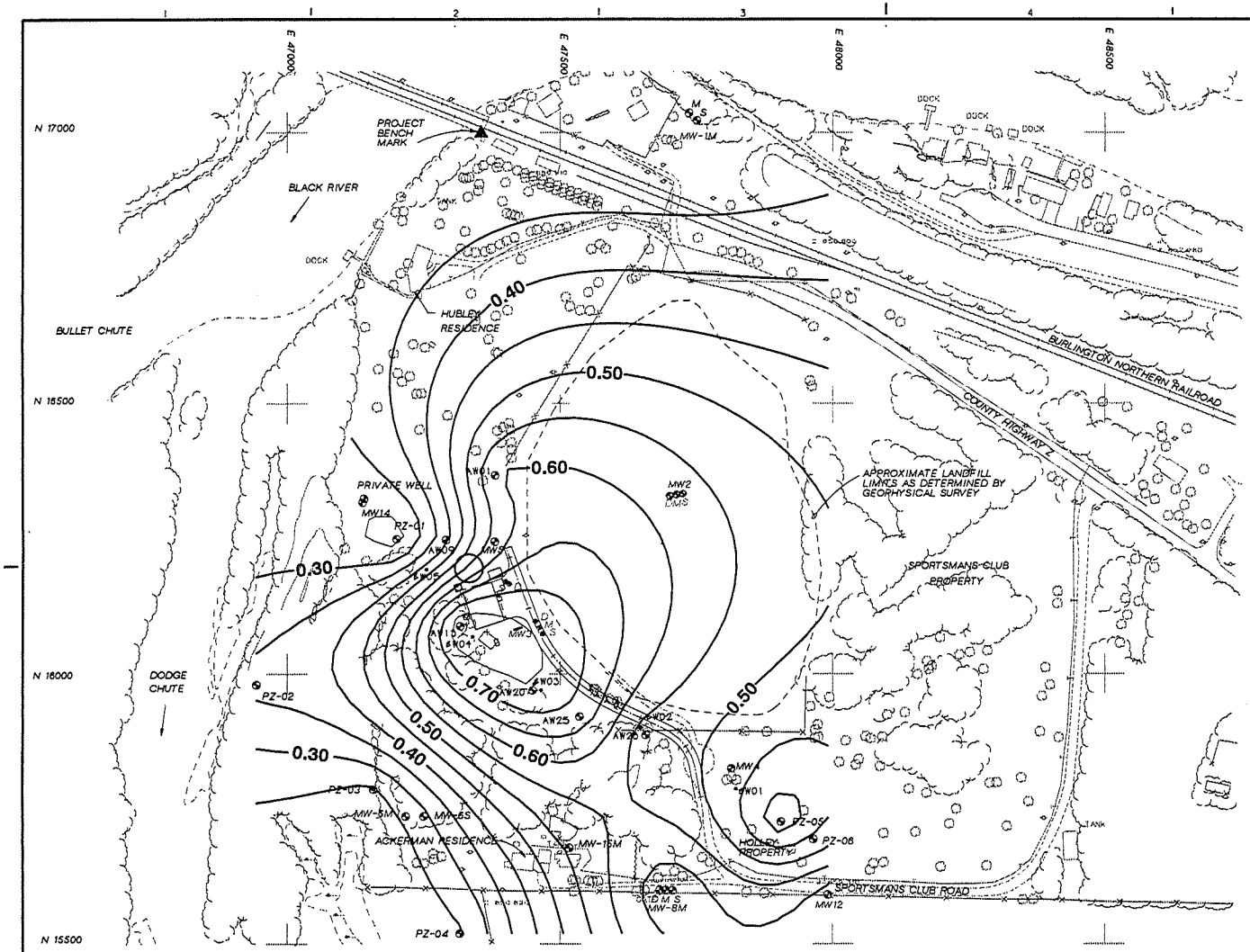
NO. | DATE | REVISION | BY | APVD

CH2M HILL

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159908\ONALASKA\CAD\DRAWINGS\PH\5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.05 mS/cm)

N

SCALE 1"=100'

FIGURE C-11

CH2M HILL

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

© CH2M HILL

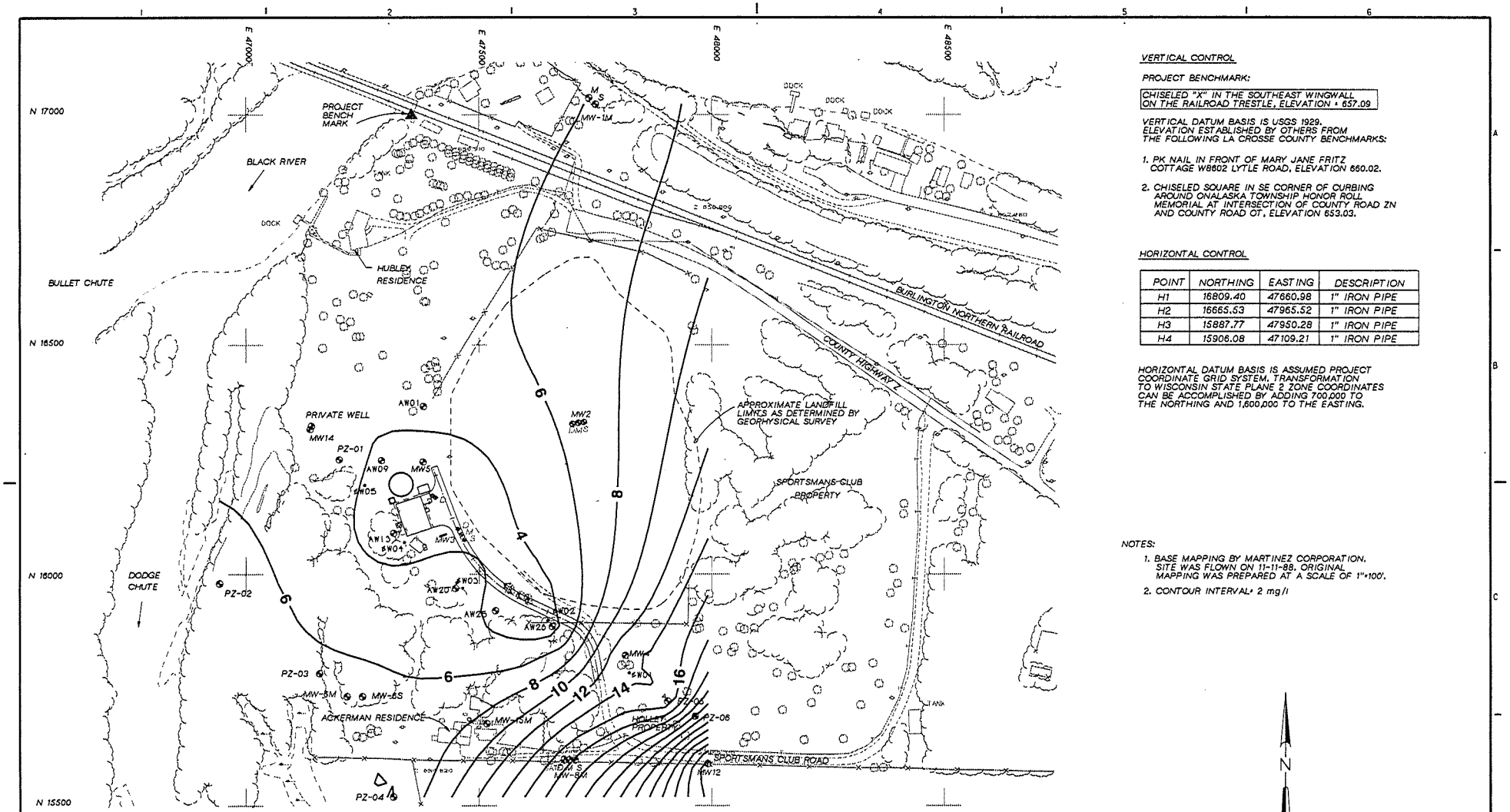
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
SPECIFIC CONDUCTANCE (mS/cm)
OCTOBER, 2001

SHEET
ORIG NO.
DATE
FSOU NO.

04/04/2002 U:\150900\ONALASKA\CAD\DRAWINGS\SPCOND\S_08N



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 2 mg/l

N

SCALE 1"=100'

FIGURE C-12

SHALLOW MONITORING WELLS
CHLORIDE (mg/l)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

CH2M HILL

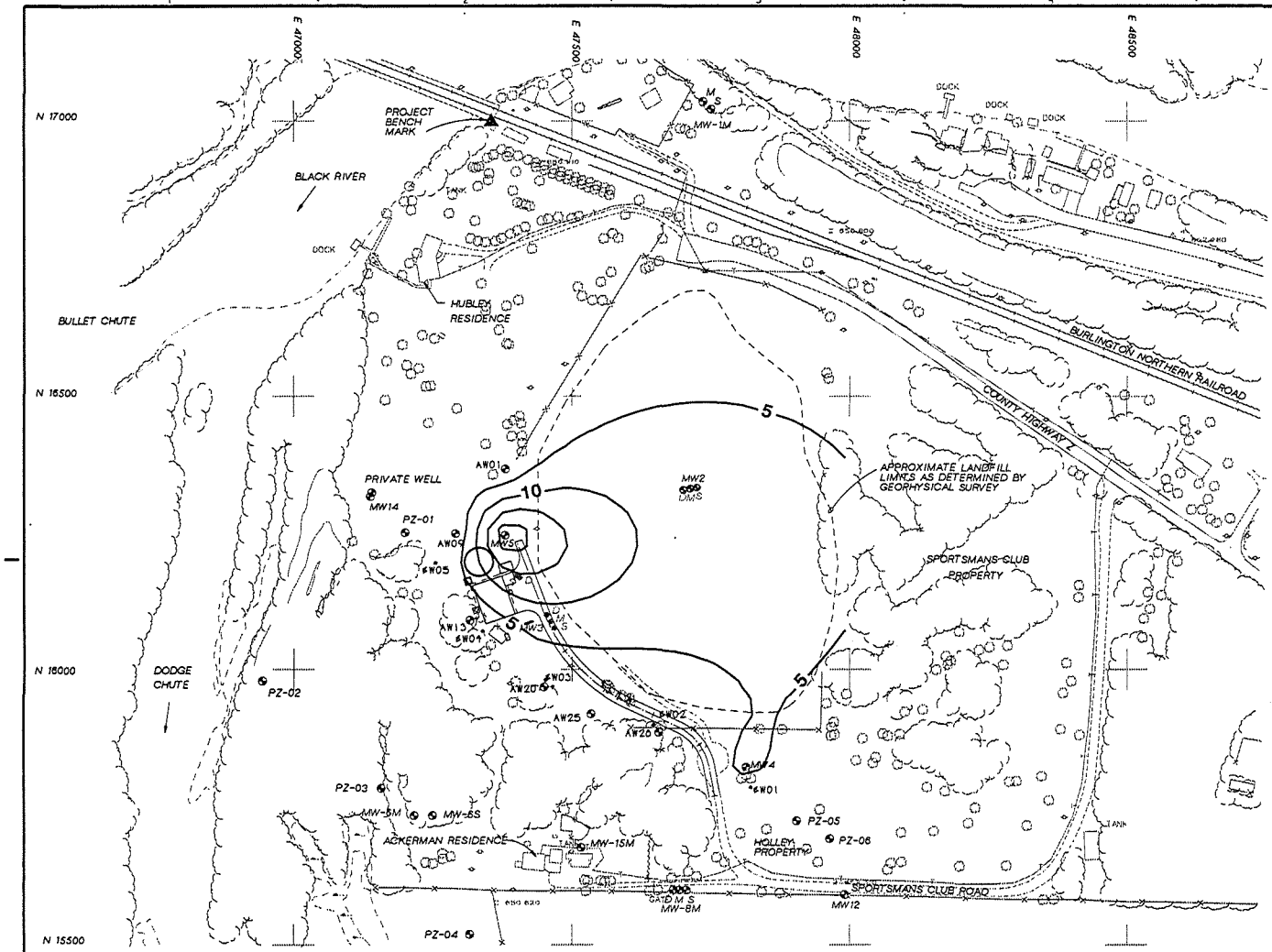
DSGN | DR | CHK | APVD

NO.	DATE	REVISION	BY	APVD

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET | DWG NO. | DATE | PROJ NO.

04/04/2002 U:\159906\ONALASKA\CAD\DRAWINGS\CHLORIDE\9.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 2 µg/L

N

SCALE 1"=100'

FIGURE C-13

SHALLOW MONITORING WELLS
ETHYLBENZENE (µg/L)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

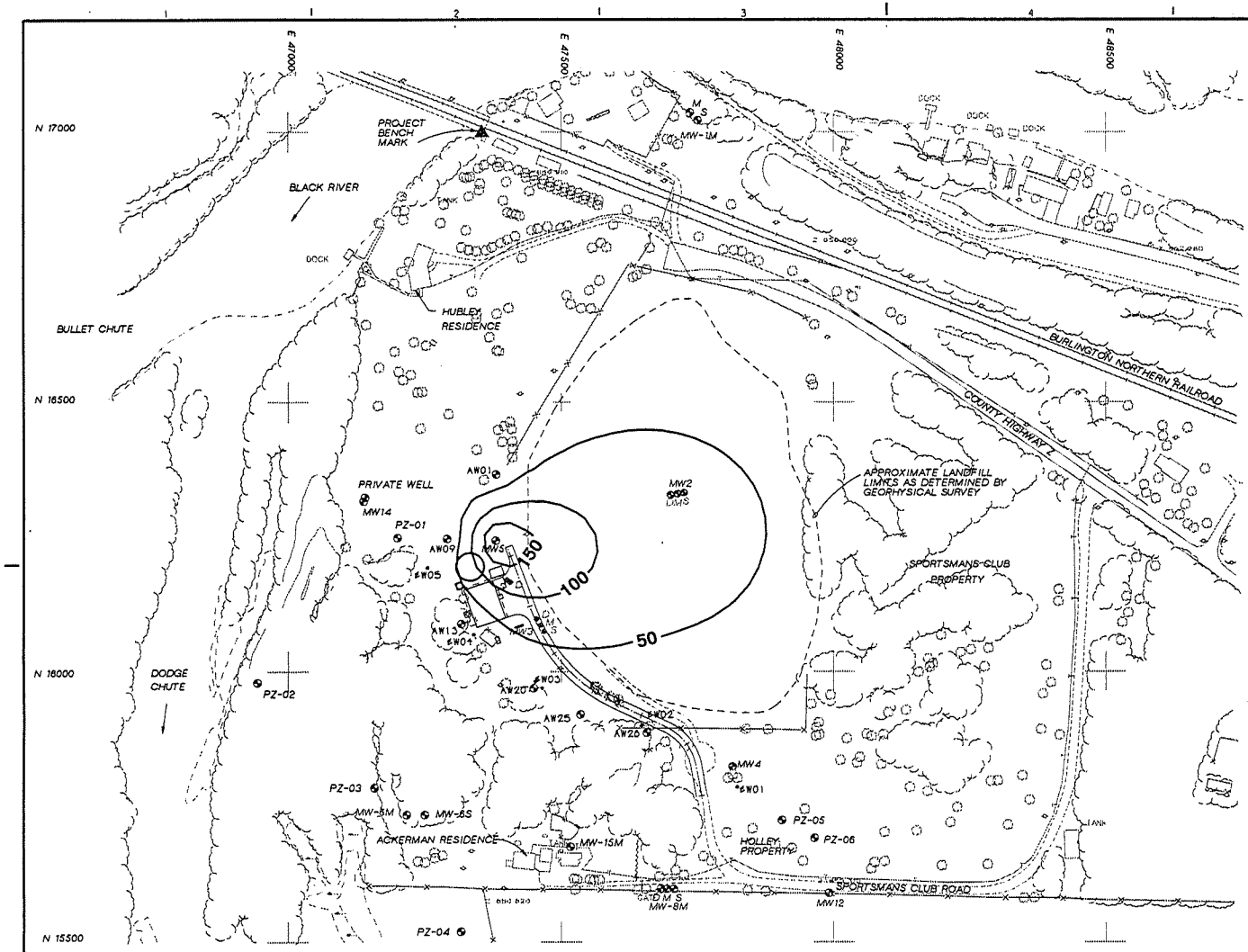
BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DSGN				
DR				
CHK				
APVD				
NO.	DATE	REVISION	BY	APVD

CH2M HILL

SHEET
DWG NO.
DATE
PROJ NO.

01/04/2002 U:\150900\ONALASKA\CAD\DRAWINGS\ETHBENZ\5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE. ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,500,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 50 µg/L

N

SCALE 1"=100'

FIGURE C-14

SHALLOW MONITORING WELLS
TOTAL XYLENES (µg/L)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

CH2M HILL

DSGN
DR
CHK
APVD

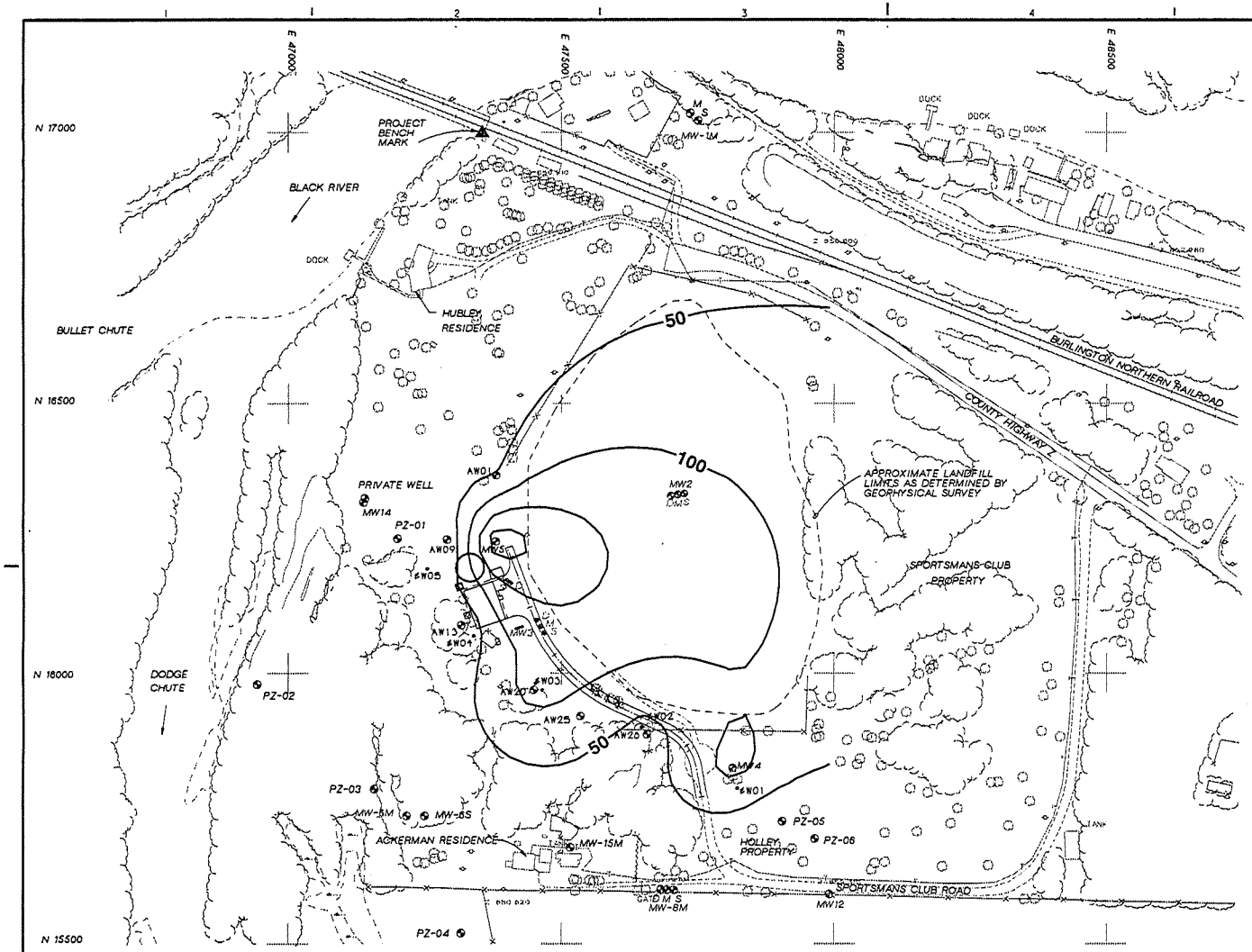
NO. | DATE | REVISION | BY | APVD

OCHIN HILL

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159900\ONALASKA\CAD\DRAWINGS\XYLENES5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT. ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 50 µg/L

N

0 100 200 300
SCALE 1"=100'

FIGURE C-15

SHALLOW MONITORING WELLS
1,3,5 - TRIMETHYLBENZENE (µg/L)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

CH2M HILL

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

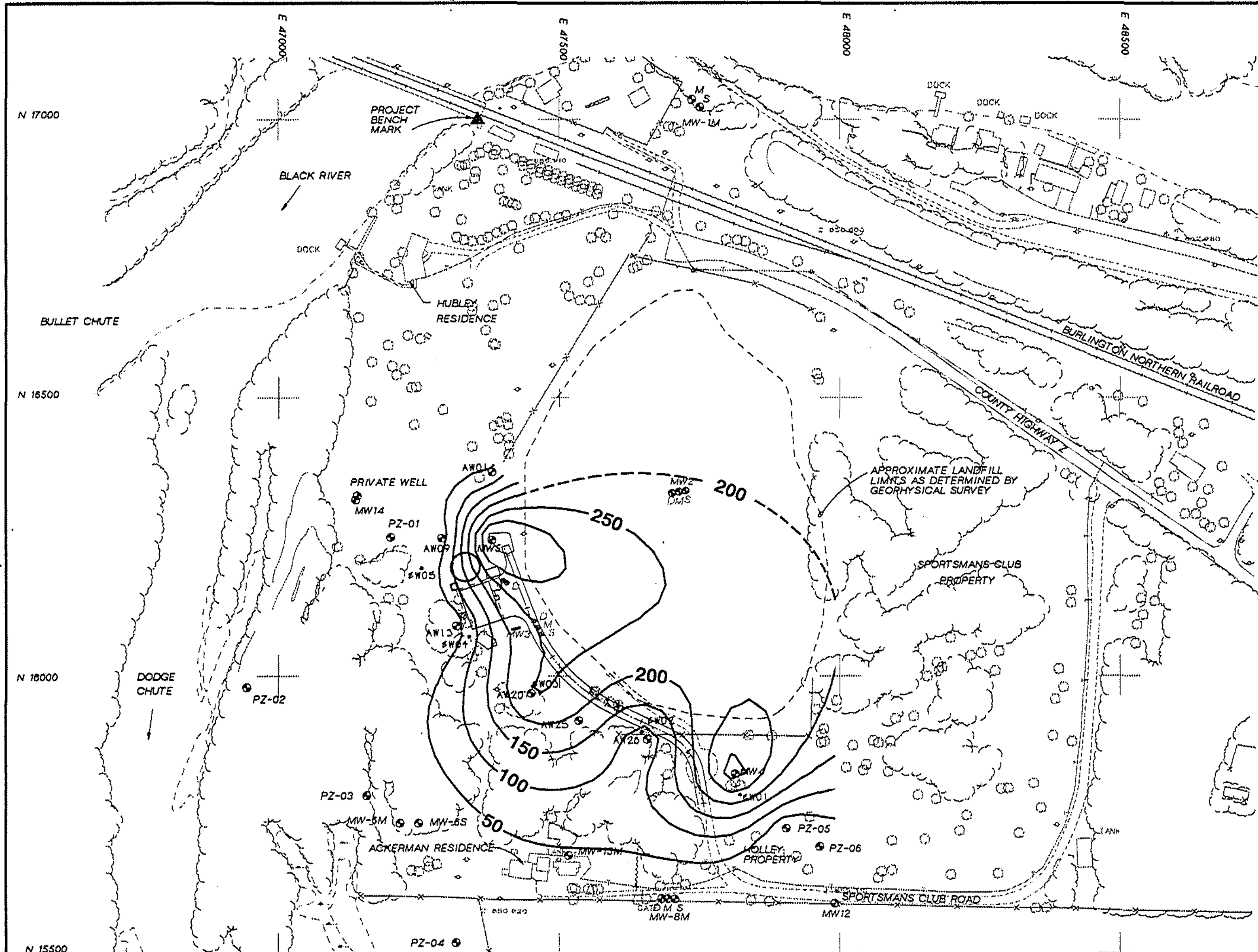
REUSE OF DOCUMENTS
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICES, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.

CH2M HILL

IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159900\ONALASKA\CAD\DRAWINGS\135EMD5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 50 μg/L

FIGURE C-16

CH2M HILL

DSGN					
DR					
CHK					
APVD	NO.	DATE	REVISION	BY	APVD

REUSE OF DOCUMENTS
THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.
©CH2M HILL

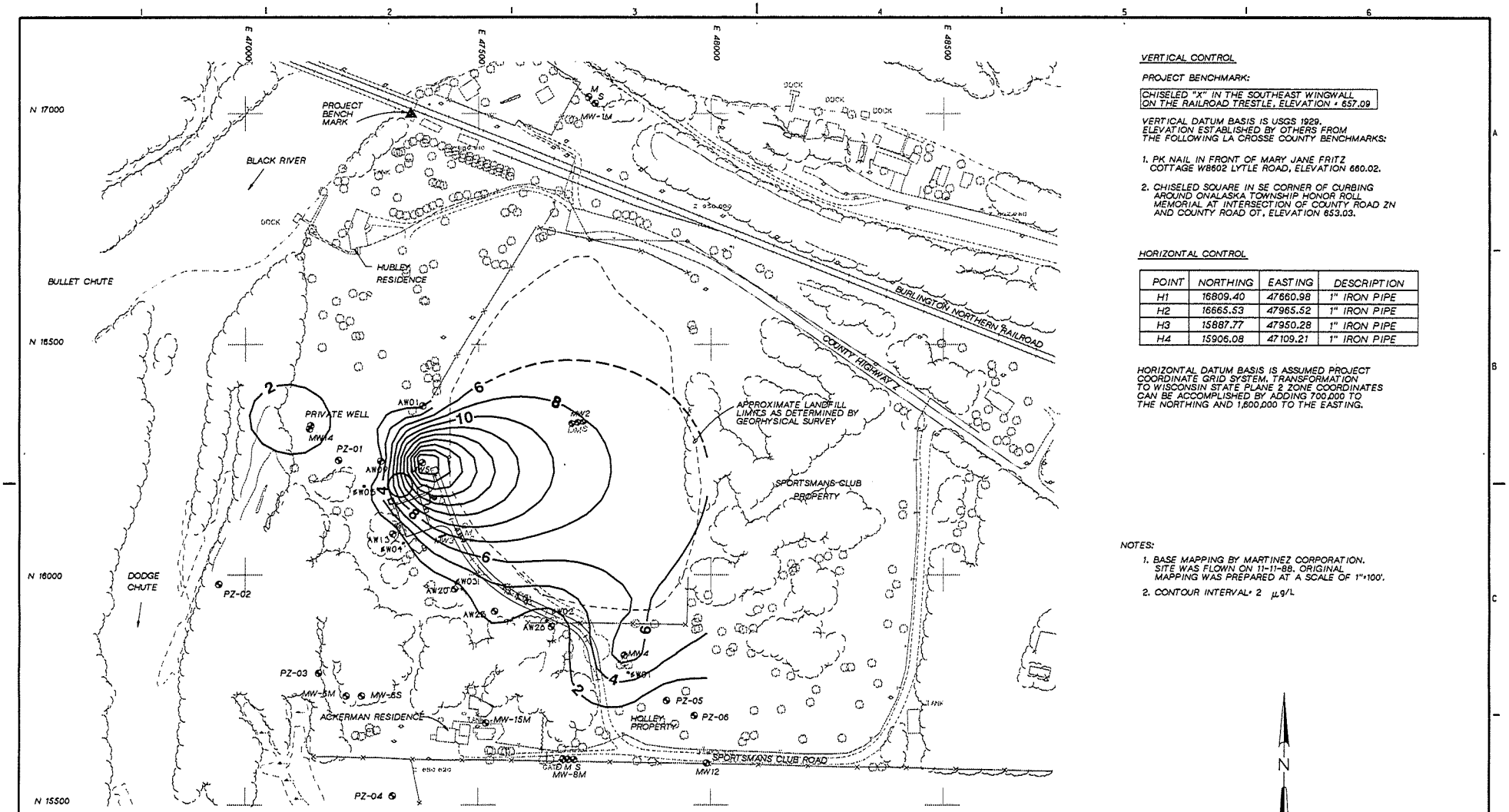
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
1,2,4 - TRIMETHYLBENZENE (μg/L)
OCTOBER, 2001

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159905\ONALASKA\CAD\DRAWINGS\124TMB-S.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 2 µg/L

FIGURE C-17

DSGN
DR
CHK
APVD

NO.	DATE	REVISION	BY	APVD

CH2M HILL

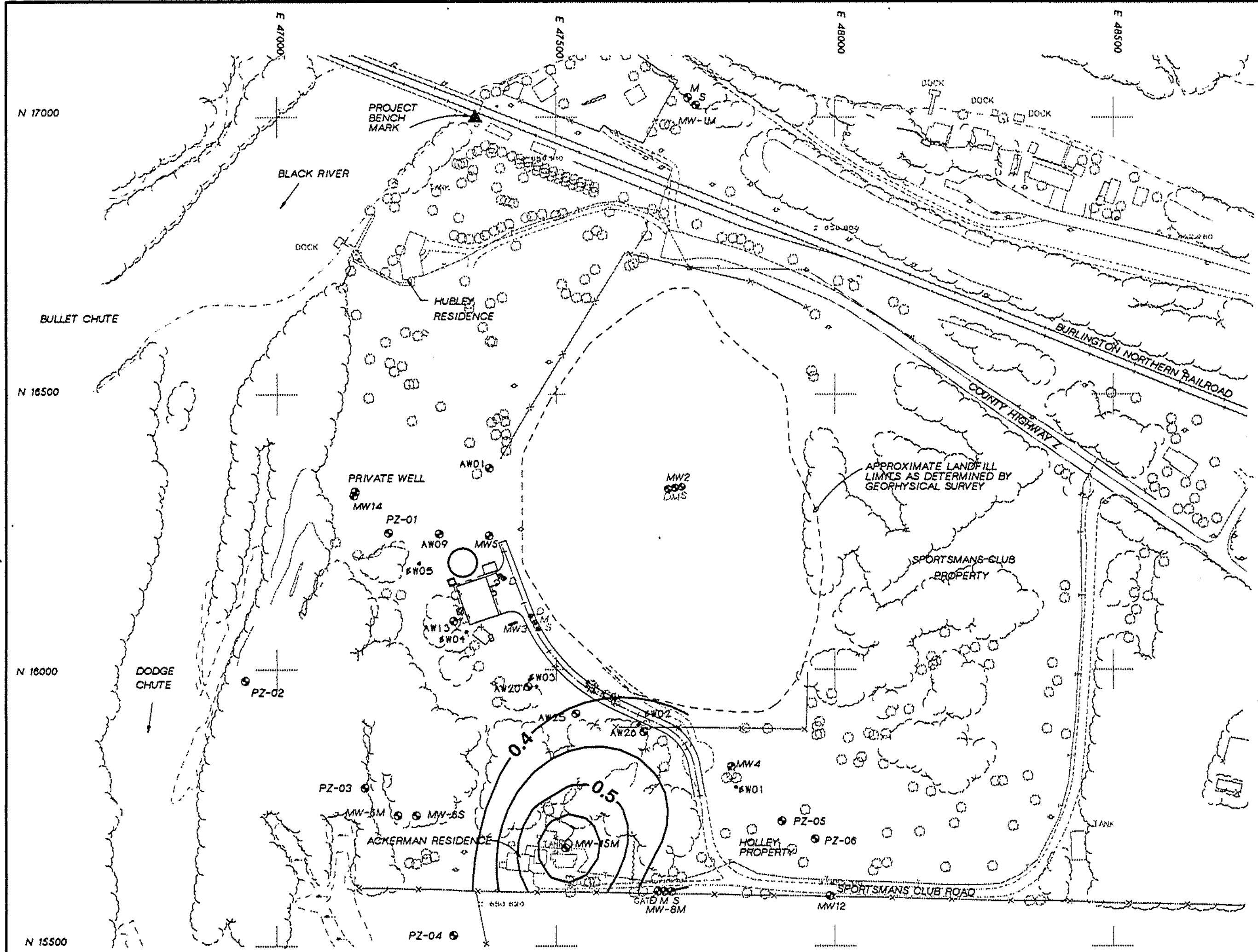
DAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

SHALLOW MONITORING WELLS
NAPHTHALENE (µg/L)
OCTOBER, 2001

SHEET
DRG NO.
DATE
PROJ NO.

04/04/2002 U:\159908\ONALASKA\CAD\DRAWINGS\NAPHTHALENE5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,600,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.05 μg/L

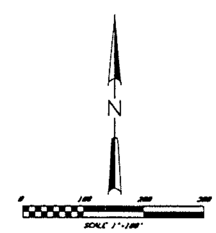


FIGURE C-18

CH2M HILL

DSGN					
DR					
CHK					
APVD	NO.	DATE	REVISION	BY	APVD

BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"
IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

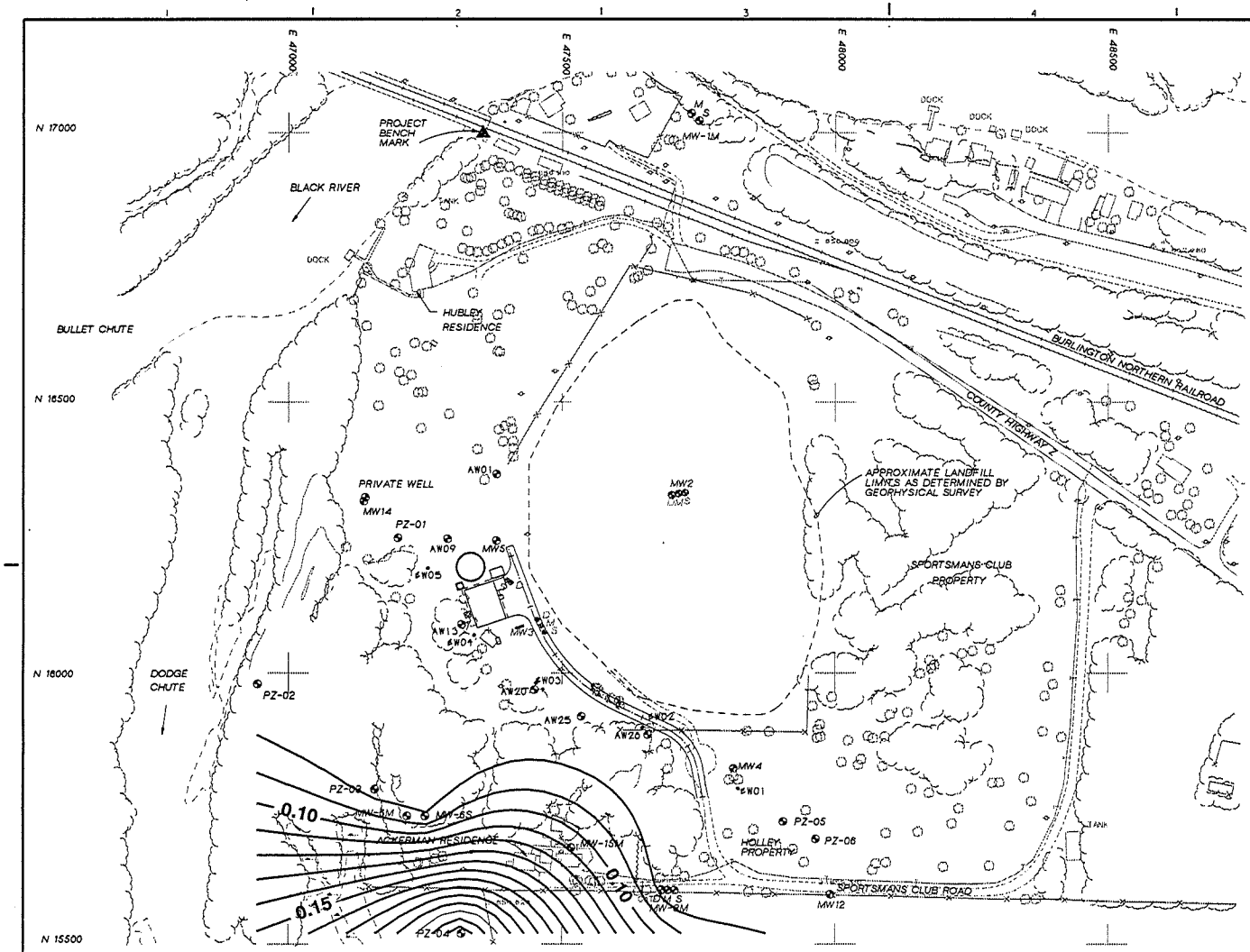
GROUNDWATER REMEDIAL ACTION

ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

MEDIUM MONITORING WELLS
TRICHLOROETHYLENE (μg/L)
OCTOBER, 2001

SHEET
DWG NO.
DATE
PROJ NO.

04/04/2002 U:\159906\ONALASKA\CAD\DRAWINGS\TCE-M.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 657.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,500,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 0.01 µg/L

N

SCALE 1"=100'

FIGURE C-19

SHALLOW MONITORING WELLS
TRICHLOROETHENE (µg/L)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

DSGN | DR | CHK | APVD

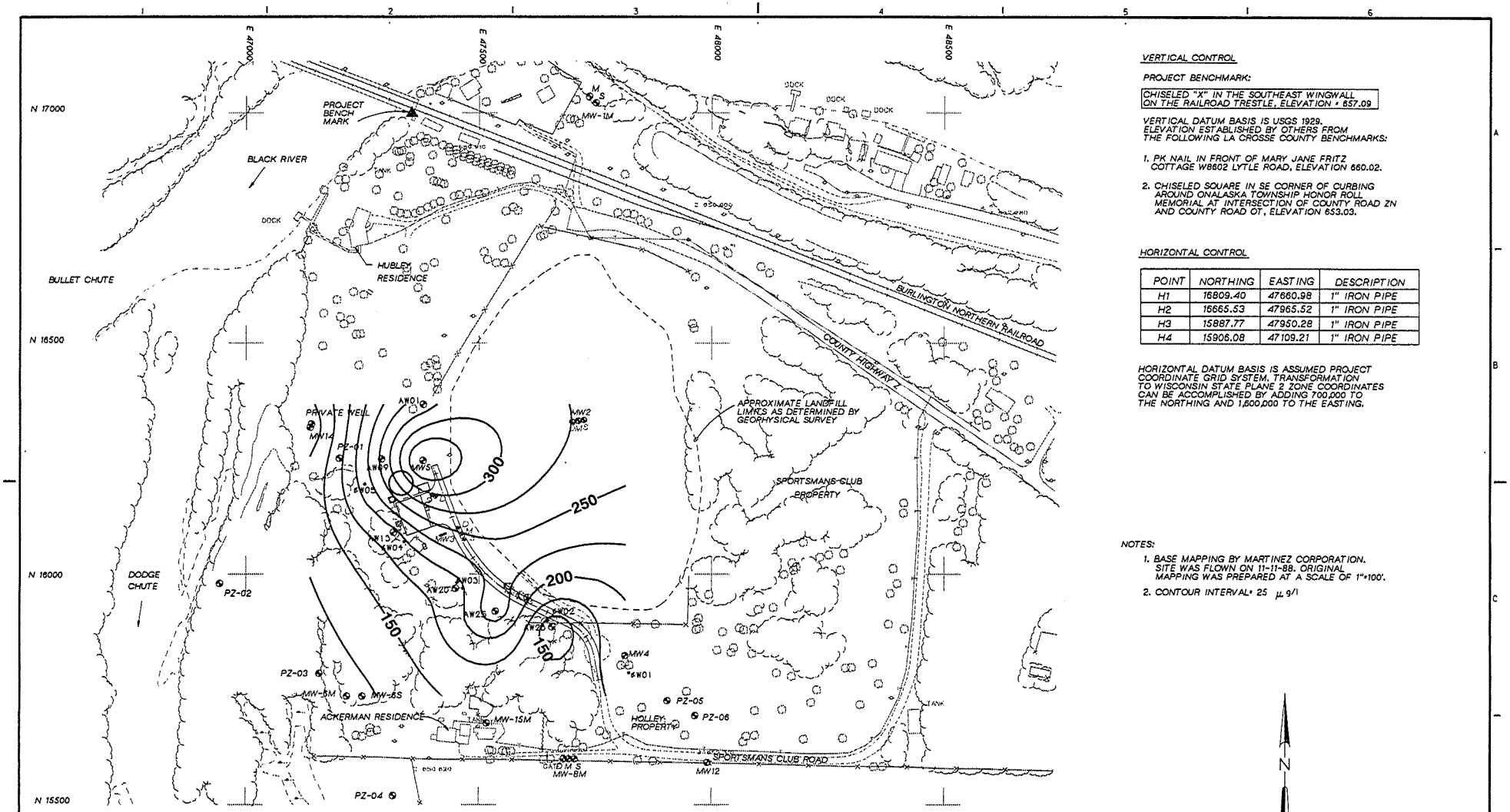
NO. | DATE | REVISION | BY | APVD

CH2M HILL

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET | DWG NO. | DATE | PROJ NO.

04/04/2002 U:\159905\ONALASKA\CAD\DRAWINGS\TC6-5.DGN



VERTICAL CONTROL

PROJECT BENCHMARK:

CHISELED "X" IN THE SOUTHEAST WINGWALL ON THE RAILROAD TRESTLE, ELEVATION = 857.09

VERTICAL DATUM BASIS IS USGS 1929. ELEVATION ESTABLISHED BY OTHERS FROM THE FOLLOWING LA CROSSE COUNTY BENCHMARKS:

1. PK NAIL IN FRONT OF MARY JANE FRITZ COTTAGE W8602 LYTLE ROAD, ELEVATION 660.02.
2. CHISELED SQUARE IN SE CORNER OF CURBING AROUND ONALASKA TOWNSHIP HONOR ROLL MEMORIAL AT INTERSECTION OF COUNTY ROAD ZN AND COUNTY ROAD OT, ELEVATION 653.03.

HORIZONTAL CONTROL

POINT	NORTHING	EASTING	DESCRIPTION
H1	16809.40	47660.98	1" IRON PIPE
H2	16665.53	47965.52	1" IRON PIPE
H3	15887.77	47950.28	1" IRON PIPE
H4	15906.08	47109.21	1" IRON PIPE

HORIZONTAL DATUM BASIS IS ASSUMED PROJECT COORDINATE GRID SYSTEM. TRANSFORMATION TO WISCONSIN STATE PLANE 2 ZONE COORDINATES CAN BE ACCOMPLISHED BY ADDING 700,000 TO THE NORTHING AND 1,800,000 TO THE EASTING.

NOTES:

1. BASE MAPPING BY MARTINEZ CORPORATION. SITE WAS FLOWN ON 11-11-88. ORIGINAL MAPPING WAS PREPARED AT A SCALE OF 1"=100'.
2. CONTOUR INTERVAL= 25 µg/l

N

SCALE 1"=100'

FIGURE C-20

SHALLOW MONITORING WELLS
BARIUM (µg/l)
OCTOBER, 2001

GROUNDWATER REMEDIAL ACTION
ONALASKA MUNICIPAL LANDFILL SITE
ONALASKA TOWNSHIP, WISCONSIN

DSGN | DR | CHK | APVD

NO.	DATE	REVISION	BY	APVD

CH2M HILL

BAR IS ONE INCH ON ORIGINAL DRAWING. IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

SHEET | DWG NO. | DATE | PROJ NO.

04/04/2002 U:\459900\ONALASKA\CAD\DRAWINGS\BARIUM.DGN