DNR

# RAC V

RESPONSE ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region V

**NATURAL ATTENUATION PLAN**

**ONALASKA LANDFILL SITE**
**ONALASKA, WISCONSIN**

**Long-Term Remedial Action**

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

**December 4, 2001**

PREPARED FOR

U.S. Environmental Protection Agency

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

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# Contents



## Tables



## Figures

# Introduction

This Monitored Natural Attenuation Study Plan was prepared for Region 5 of the U.S. Environmental Protection Agency (USEPA) per Revision 1 of the Statement of Work dated July 30, 2001. The USEPA decided, at the recommendation of the Wisconsin Department of Natural Resources (WDNR), to temporarily discontinue active groundwater extraction and to evaluate natural attenuation of site contaminants in the groundwater. This document includes a summary of current and historical contaminant concentrations and distribution and discusses the potential for contaminants to migrate without the containment provided by the groundwater extraction wells. Based on this, a monitored natural attenuation study is proposed, including monitoring locations and frequency, parameters to be analyzed, the evaluation and reporting process, and criteria for determining if natural attenuation is an acceptable remedy for the site.

# Site Background

## Physical Setting

The Onalaska Landfill is roughly 10 miles north of the City of La Crosse, Wisconsin, near the confluence of the Mississippi and Black rivers. The site was mined as a sand and gravel quarry, then used as a municipal and industrial waste landfill between 1969 and 1980.

Unconsolidated deposits at the site are 135 to 142 feet thick and consist primarily of sand and gravel of glaciofluvial and alluvial origin. Beneath the unconsolidated deposits lies sandstone bedrock. Natural groundwater flow direction in the unconsolidated material (documented prior to groundwater extraction) is predominantly south-southwesterly toward the wetlands that border the Black River and Dodge Chute (Figure 1). During high river stages in the spring, the groundwater flow direction can be diverted toward the south-southeast. Average groundwater flow velocity beneath the site was estimated during the remedial investigation (RI) to range between 55 and 110 feet per year, with an estimated average of 70 feet per year.

## Groundwater Quality

### Historically

The RI determined that landfill-related contaminants are present in groundwater downgradient from the landfill (CH2M HILL, 1989a). Landfill-related contaminants were detected during RI groundwater sampling to a maximum depth of roughly 60 feet below the groundwater table surface and to a horizontal distance of roughly 500 feet south-southwesterly from the landfill boundary (Figure 1). The baseline risk assessment, completed concurrently with the RI, evaluated potential public health and environmental risks posed by the site under the no-action alternative (i.e., no remedial action [RA]). The baseline risk assessment concluded that the site would pose unacceptable risks for people exposed to contaminants through use of contaminated groundwater as a water supply source. A deeper well was installed for the affected residence. Quarterly sampling results from 1995 through 1996 and semiannual sampling results from 1997 to date indicate that the deep groundwater source for the residence is not affected by the landfill.

The highest contaminant concentrations detected in the groundwater during the RI were also compared to federal ambient surface water quality criteria for aquatic life and to Wisconsin ambient surface water quality standards. Except for three inorganic chemicals (cadmium, chromium if present as hexavalent chromium, and zinc), no standards or criteria were exceeded in the groundwater. When dilution of the groundwater into the surface water was considered, no standards or criteria were exceeded (CH2M HILL, 1989b).

The USEPA considered the findings of the feasibility study (FS) in evaluating remediation alternatives in its Record of Decision (ROD) for the site. The ROD, issued in 1990, required that the landfill cap be upgraded to inhibit infiltration to groundwater through the filled zone; that in situ treatment be conducted for a smear zone of light non-aqueous phase liquid (LNAPL) residual; and that groundwater be extracted downgradient of the landfill to contain site-related contaminants (volatile organic compounds [VOCs] and metals). The landfill cap, in situ treatment, and groundwater extraction system were installed at the site between 1993 and 1994.

### Current

As a result of the installation of the new landfill cap, operation of the bioventing system to treat organic contaminants in the smear zone, and operation of a groundwater extraction system since May 1994, the mass and concentration of many of the organic contaminants have decreased. Figure 2 compares the concentration of VOCs detected during the RI to 2000 and 2001 results. The concentrations of organic contaminants in the original monitoring program have been below Wisconsin preventive action limits (PALs) for the last few years. However, as a result of the 5-year priority pollutant scan in 1999 and a comprehensive VOC analysis in 2000, two organic contaminants were positively identified at concentrations exceeding PALs and enforcement standards (ESs). A third organic contaminant, methylene chloride, was also detected in one well (MW-4S) at concentrations exceeding the PAL and ES, but additional sampling is required to determine if it was a lab anomaly. These parameters were just added to the semiannual monitoring plan, so no conclusions can be made as to whether the concentrations of these contaminants were decreasing with time while the extraction wells were operating.

The concentration of some of the metal contaminants, such as barium, have decreased significantly in some wells since 1994. However, the concentrations of many of the metal contaminants appear to have randomly fluctuated between sampling events without a discernable decreasing trend since 1994. Several metal contaminants remain above PALs (arsenic, barium, and cadmium) and ESs (iron and manganese). Although the elevated metal contaminant concentrations are partially or fully attributable to background concentrations in some wells, the concentrations of several metal contaminants are elevated above background in many of the wells downstream of the landfill.

## Future Migration Potential of Contaminant Groups

It is anticipated that site contaminants will migrate beyond their current location in the direction observed during the RI (Figure 1) once the extraction system is turned off. Given the relatively slow travel times, several years may be required for the contaminants to reach some of the site monitoring wells. Because roughly three times the natural groundwater flow was drawn through the site, thereby creating a dilution effect when the extraction wells were running, concentrations within the former groundwater extraction capture zone may increase. Concentrations may increase downstream of the extraction wells because of contaminant plume expansion without the hydraulic barrier created by the extraction wells. The contaminant concentrations are expected to be lower than RI conditions because of the landfill cap inhibiting infiltration and the successful removal or in situ destruction of a significant percentage of the mass of these contaminants during the RA.

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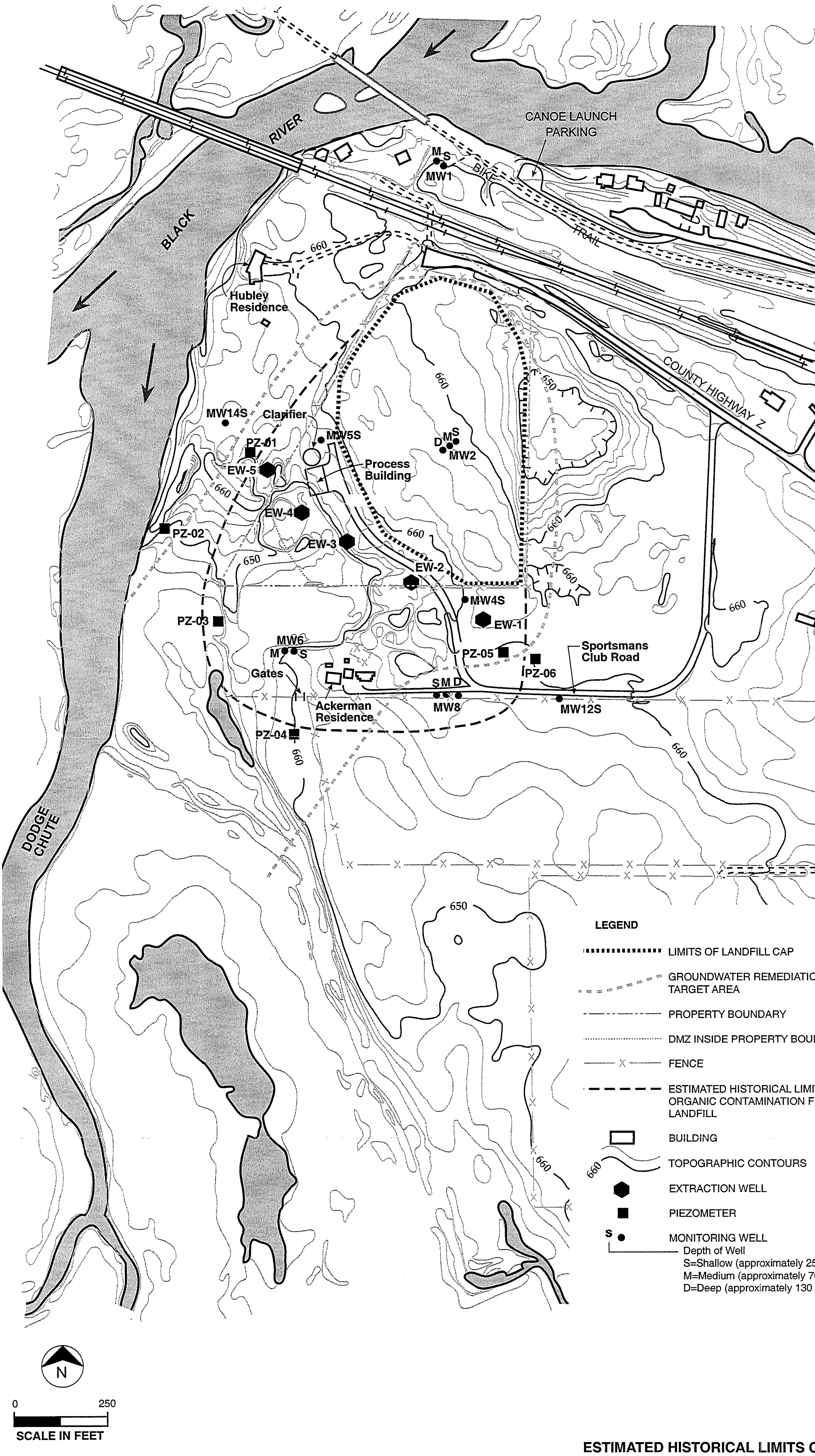


**FIGURE 1**
**ESTIMATED HISTORICAL LIMITS OF ORGANIC CONTAMINATION FROM THE LANDFILL**
ONALASKA LANDFILL

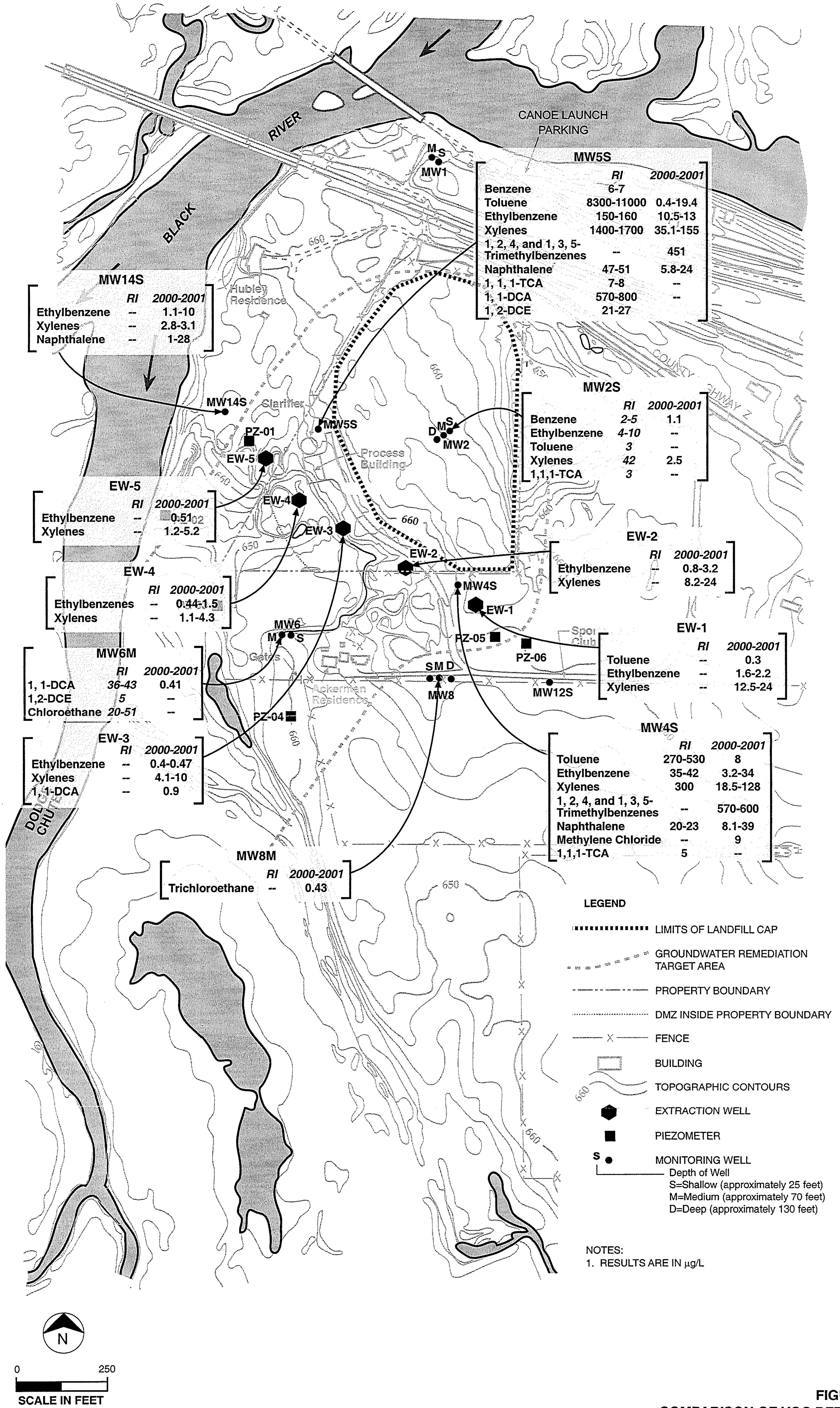


**FIGURE 2**
**COMPARISON OF VOC DETECTS DURING THE RI TO 2000 AND 2001**
ONALASKA LANDFILL

The future migration of the contaminants of concern at the site, as established during the RI/FS and RA, are discussed below:

- BETX compounds (benzene, ethylbenzene, toluene, and xylene) and naphthalene are a subset of the VOC group. BETX and naphthalene concentrations may increase slightly above recently observed levels and move outward but are not expected to migrate beyond the limits observed in the RI because they typically biodegrade at relatively quick rates.
- 1,2,4- and 1,3,5-Trimethylbenzene are a subset of the VOC group. They are less biodegradable than the BETX and naphthalene contaminants and may travel downgradient with natural groundwater flow. Other natural attenuation processes, such as sorption and dispersion, will influence the concentrations. These compounds may migrate to the VOC plume boundary observed during the RI (although trimethylbenzenes were not analyzed for during the RI) and possibly beyond it with time. However, the baseline risk analysis concluded that major risks from the site would occur only if people were exposed to contaminants through use of contaminated groundwater as a water supply source. A deeper well was installed at the Ackerman residence to minimize the risk. Groundwater may eventually discharge to the Dodge Chute or adjacent wetlands; however, no surface water standards have been established for trimethylbenezenes in Wisconsin. If these compounds eventually migrate and discharge to Dodge Chute, it is expected that surface water concentrations will be below detection limits.
- Chlorinated VOCs are a subset of the VOC group. Although monitoring of chlorinated VOCs had been discontinued (except methylene chloride monitored at MW-4S) because they have not been detected in successive, recent sampling events, chlorinated VOC concentrations may increase over time at some locations after the extraction system is shut down. Because of the presence of other residual organic substrate (e.g., organics leached from the landfill) in the groundwater, conditions may be conducive to biodegradation of the chlorinated solvents.
- Inorganic concentrations including metal contaminant concentrations are expected to increase above the levels currently observed. The areal distribution of inorganics may expand over time, depending on the geochemical conditions (e.g., oxidation reduction potential) that develop after the groundwater extraction system is shut down. Increased concentrations and expansion of the contamination are most probable for iron, manganese, and arsenic. Similar to trimethylbenzenes, the risk to human exposure was minimized by the installation of a deeper well at the Ackerman residence.

# Proposed Natural Attenuation Monitoring Plan

The proposed monitoring plan was developed to address the first two lines of evidence as provided in "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites" (USEPA, 1999). The first two lines of evidence are:

- The demonstration of meaningful trends of decrease of contaminant mass over time at appropriate monitoring points
- The demonstration of active natural attenuation at the site with hydrogeological and geochemical data and the calculation of degradation rate processes

As recommended in the USEPA document, the third line of evidence, field or microcosm studies, could be done in the future, but is only recommended for consideration if the first two lines of evidence are inconclusive.

## Monitoring Wells

### Description and Explanation of Proposed Monitoring Network

Selected groundwater monitoring wells, piezometers, and air injection wells will be used to monitor groundwater during the natural attenuation study. The wells have been separated into two groups based on proximity to the landfill. The two groups of wells are shown in Figure 3 and are listed in Table 1.

**TABLE 1**
Wells Listed by Group
*Onalaska Municipal Landfill—Remedial Action Site*

| Group 1 Wells | | | Group 2 Wells | |
|---|---|---|---|---|
| MW-1S | MW-5S | AW-9 | MW-6S | MW-15M |
| MW-1M | MW-14S | AW-13 | MW-6M | PZ-2 |
| MW-2S[a] | PZ-1 | AW-20 | MW-8S | PZ-3 |
| MW-2M[a] | PZ-5 | AW-25 | MW-8M | PZ-4 |
| MW-4S | AW-1 | AW-28 | MW-12S | [b] |

a. From west to east the MW-2 wells are deep, medium, and shallow. The deep well has an obstruction at 29.5 feet, rendering this well unusable (the type or cause of the obstruction is unknown). The obstruction led to confusion and the incorrect labeling of MW-2D, MW-2M, and MW-2S as MW-2S, MW-2D, and MW-2M respectively for sampling and reporting from 1997 to date. The wells were installed during the RI (i.e., 1989 or earlier) and these wells were added to the RA monitoring network in 1997 to evaluate the effectiveness of the RA. CH2M HILL's electronic data base will be corrected but the above correction must be made when comparing reports from this date forward to sampling correspondence and reports from 1997 to date.

b. The Ackerman and Hubley residential wells will be sampled once per year to verify they are not impacted. However, these wells will not be used in the monitored natural attenuation study.

Both Group 1 and 2 wells were monitored for the first sampling event the week of October 29, 2001, to establish baseline conditions at the time the groundwater extraction system was shut down. The baseline data will be useful in evaluating natural attenuation rates and trends in future data.

Group 1 wells will be sampled and analyzed semiannually. The Group 2 wells will be sampled annually or less frequently, depending on the results of future monitoring events. A lower monitoring frequency is proposed for the Group 2 wells because of the time required for contaminants to migrate from the vicinity of the Group 1 wells to the Group 2 wells (an estimated 3 or more years on average, assuming no retardation). If concentrations in the Group 2 wells increase and begin to approach PALs, or statistically determined preliminary alternative concentration limits (ACLs) in cases where background concentrations exceed PALs, the monitoring frequency will be reviewed and Group 2 wells may be sampled more frequently. The frequency also may be increased if appropriate to better evaluate whether natural attenuation is occurring for contaminants detected at elevated concentrations in the Group 1 wells.

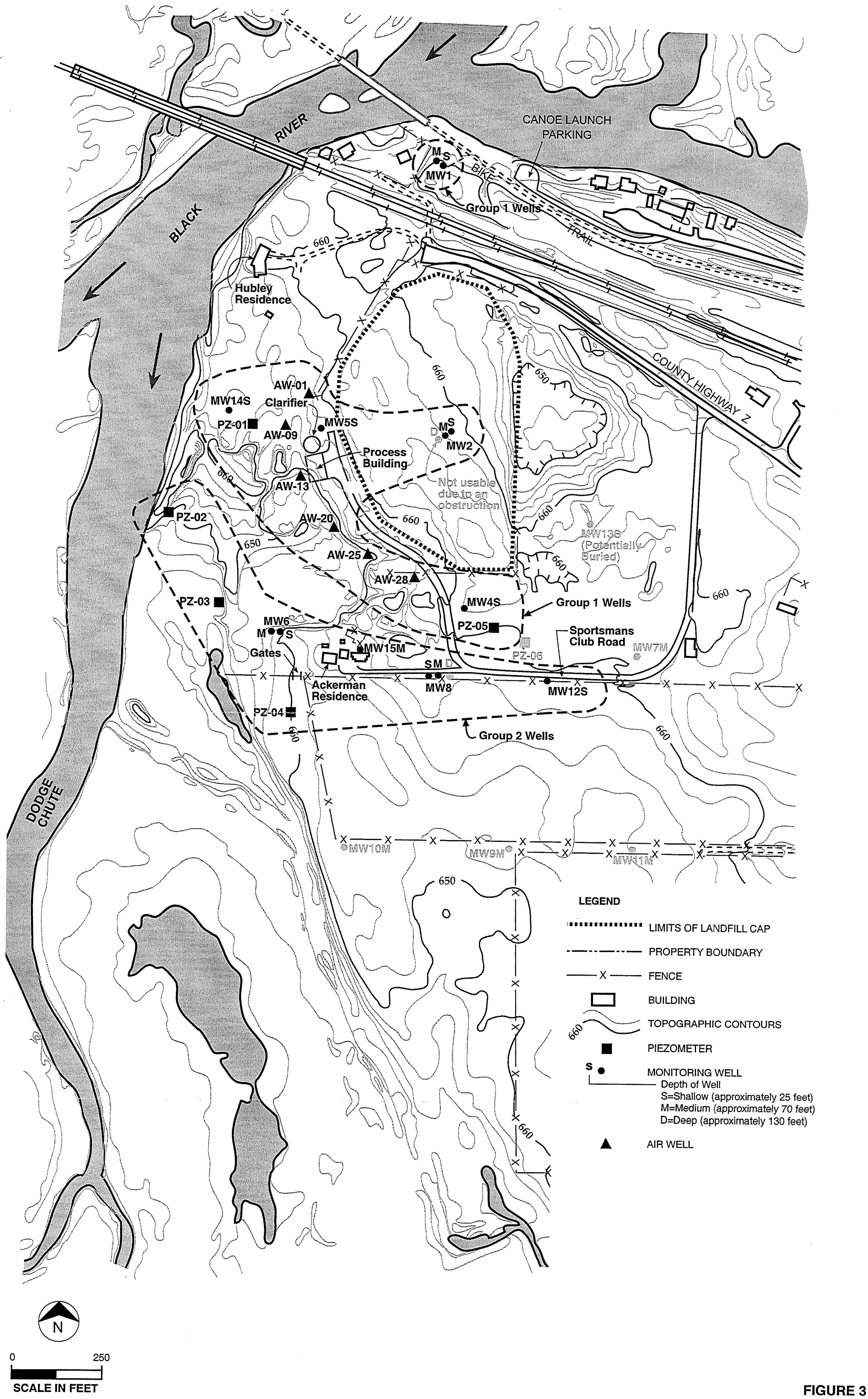


**FIGURE 3**
**MONITORED NATURAL ATTENUATION GROUNDWATER MONITORING NETWORK**
ONALASKA LANDFILL

Groundwater level measurements will be taken quarterly (i.e., during the two semiannual sampling events and during two other quarters) in 2002 in piezometer PZ-06 and all the Group 1 and Group 2 wells to better define the hydraulic gradient without the extraction wells operating. The hydraulic gradient data can then be used to locate additional wells if determined necessary as described in a later section of this plan. Starting in 2003, the groundwater level measurements will be taken semiannually during the sampling events in piezometer PZ-06 and all the Group 1 and 2 wells.

Most of the Group 1 wells were selected to provide approximately equally spaced sampling locations downgradient of the landfill. The wells were selected so that they traverse the entire historical limits of the contaminated groundwater plume from the landfill. As a secondary consideration, wells were selected so that there is a sampling location near each idle extraction well in case any comparisons may be appropriate in the future. MW-1S and MW-1M are included in the Group 1 wells in order to gather sufficient data for statistical evaluation of background groundwater characteristics. Sampling from these wells will be reduced to once per year (i.e., these wells will be re-categorized from Group 1 to Group 2 wells) after eight useable results are accumulated for each relevant parameter unless the characteristics in these wells are observed to fluctuate substantially on a semiannual basis. MW-2S and MW-2M were included in the Group 1 wells to provide information about groundwater quality below the landfill. AW-09 was included in the Group 1 wells with two considerations in mind: it will provide information regarding groundwater quality at a distance from the landfill comparable to most of the other selected air wells; and it will also provide information that can be compared to wells MW-5S and AW-01, which are closer to the landfill perimeter. Similarly, PZ-01 was selected to provide an additional monitoring point progressively further from AW-09 and inner wells MW-5S and AW-01. MW-14S was included because of the historical contamination found in it and for comparison to well AW-01 and nearby well PZ-01. Comparison of contaminants between these wells may provide information that can be used to determine whether natural attenuation processes are occurring in the first 300 feet from the landfill. The contaminant concentration trends between these wells are expected to be indicative of trends elsewhere downgradient from the landfill.

The Group 2 wells were selected to use existing wells toward the outer periphery of the estimated historical limits of contamination from the landfill (Figure 1). As discussed above, contaminants are expected to migrate in the same direction and potentially to the same extent as occurred before the USEPA's ROD was implemented. The Group 2 wells will allow determination of whether natural attenuation processes are resulting in the decrease of contaminant mass when compared to the Group 1 wells. Allowing the contaminants to potentially migrate out to the Group 2 wells should not pose a health risk because there are no longer any shallow or medium depth residential wells within the estimated historical limits of landfill contamination. The distance from the Group 1 wells to the Group 2 wells allows more time and an increased opportunity for natural attenuation processes to occur versus the well pairings discussed above within the Group 1 wells. Therefore, the primary emphasis will be the comparison of contaminant concentrations between Group 1 and Group 2 wells for evaluating the suitability of natural attenuation processes for the site.

### Additional Monitoring Wells

Additional monitoring wells at new locations are not recommended initially. Additional wells may be recommended in the future based on monitoring results. Ideally an additional shallow monitoring well would be located downgradient of MW-4S because MW-6S and MW-8S may not be directly downgradient of MW-4S. However, it is recommended that the need for this be determined from evaluation of data collected in the existing monitoring network. Hydraulic gradient data taken from the quarterly and semiannual groundwater level measurements described above can be used to locate additional wells if additional wells are determined necessary.

### Comparison of Monitoring Wells, Piezometers, and Air Injection Wells

Existing piezometers and air injection wells were selected in lieu of new monitoring wells because results are expected to be comparable and because installation of new monitoring wells would be costly. All three types of wells are 2 inches in diameter but the screen length and elevation relative to the water table vary between wells. The screen length on the monitoring wells and piezometers is 10 feet and the screen length on the air injection wells is 5 feet. Except for periods of high groundwater level, the screened portion of two of the piezometers, all of the air injection wells, and all but one shallow monitoring well is only partially submerged. Therefore, samples from these wells represent groundwater quality at the top of the water table. Using measurements taken on October 29, 2001 to compare the different types of wells, the shallow monitoring wells, except for MW-6S, represented groundwater quality in the top 3.1 to 9.5 feet, piezometers PZ-02 and PZ-05 represented groundwater quality in the top 9.4 and 5.4 feet respectively, and the air injection wells represented groundwater quality in the top 0.5 to 2.0 feet. Monitoring well MW-6S and three piezometers, PZ-01, PZ-03, and PZ-04, were screened deeper. Based on measurements taken on October 29, 2001, the tops of the 10 foot screened sections in these wells were 6.6 to 15.3 feet below the water table. Therefore, samples from these wells represent groundwater quality at a slightly greater depth than the other shallow wells. However, the groundwater results between the selected wells are expected to be comparable and the costly installation of new wells is not recommended.

## Monitoring Analytes

Analytes for semiannual and annual sampling rounds will include the VOCs, metals, and natural attenuation parameters specified in Table 2. Table 2 includes the parameters proposed to be monitored, rationale for inclusion, Wisconsin groundwater PAL and ES criteria, and Wisconsin water quality criteria. The water quality criteria are included because of the possibility that the contaminants may discharge to the Black River. During the RI, a comparison was made of the federal and Wisconsin water quality criteria and the highest detected organic and metal groundwater contaminant concentrations. Before accounting for dilution in the river, criteria were exceeded for three parameters: cadmium, chromium if present as hexavalent chromium, and zinc. It was stated in the RI that the estimated dilution in the Black River during the 7Q10 river flow (i.e., low flow) is at least a factor of 120. After accounting for the dilution factor of 120, no criteria were exceeded. Therefore, collection of surface water samples is not deemed necessary. Surface water monitoring would be necessary at some future date only if contaminants are detected in wells near the river and wetland area (PZ-02, PZ-03, or PZ-04) at concentrations approaching State of Wisconsin Water Quality criteria.

**TABLE 2**
Proposed Parameter List and Relevant Criteria for Monitored Natural Attenuation
*Onalaska Municipal Landfill—Remedial Action Site*

| | | State of WI Groundwater Criteria[a] | | State of WI Water Quality Criteria[b] | | | |
|---|---|---|---|---|---|---|---|
| Parameter | Rationale | PAL (μg/L) | WI ES (μg/L) | Acute (μg/L) | Chronic (μg/L) | Human Threshold (μg/L) | Human Cancer (μg/L) |
| **Organic Constituents** | | | | | | | |
| **BETX** | | | | | | | |
| Benzene | COC | 0.5 | 5 | | | 610 | 140 |
| Ethylbenzene | COC | 140 | 700 | | | 12,000 | |
| Toluene | COC | 200 | 1,000 | | | 760,100 | |
| Total Xylenes | COC | 1000 | 10,000 | | | | |
| **Chlorinated VOCs** | | | | | | | |
| 1,1-Dichloroethane | COC | 85 | 850 | | | | |
| 1,1-Dichloroethene | COC | 0.7 | 7 | | | | |
| 1,1,1-Trichloroethane | COC | 40 | 200 | | | 270,000 | |
| cis-1,2-Dichloroethene | COC | 7 | 70 | | | 14,000 | |
| trans-1,2-Dichloroethene | COC | 20 | 100 | | | 24,000 | |
| Trichloroethene | COC | 0.5 | 5 | | | | 539 |
| Tetrachloroethene | COC | 0.5 | 5 | | | 46 | 46 |
| Methylene Chloride (MW-4S only) | COC | 0.5 | 5 | | | 95,000 | 2700 |
| Vinyl Chloride (Chloroethene) | COC | 0.02 | 0.2 | | | | 10 |
| **Other VOCs** | | | | | | | |
| 1,2,4- and 1,3,5- Trimethylbenzene | COC | 96 | 480 | | | | |
| **SVOCs** | | | | | | | |
| Naphthalene | COC | 8 | 40 | | | | |
| **Inorganic Constituents** | | | | | | | |
| Arsenic | COC | 5 | ~~50~~ 10 | 339.8 | 152.2 | | ~~50~~ 13.3 |
| Barium | COC | 400 | 2,000 | | | | |
| Iron | COC | 150 | 300 | | | | |
| Lead | COC | 1.5 | 15 | 54.73 | 14.33 | 140 | |
| Manganese | COC | 25 | 300 50 | 525 | (29.2 x 120 = 3504) | | |
| Cadmium | COC | 0.5 | 5 | 4.65 | 1.43 | 1200 | |
| Cobalt | COC | 8 | 40 | | | | |
| Mercury | COC | 0.2 | 2 | 0.83 | 0.44 | 0.0015 | |
| Vanadium | COC | 6 | 30 | | | | |

**TABLE 2**
Proposed Parameter List and Relevant Criteria for Monitored Natural Attenuation
*Onalaska Municipal Landfill—Remedial Action Site*

| | | State of WI Groundwater Criteria[a] | | State of WI Water Quality Criteria[b] | |
|---|---|---|---|---|---|
| Parameter | Rationale | PAL (µg/L) | WI ES (µg/L) | Acute (µg/L) | Chronic (µg/L) |
| **Natural Attenuation Parameters[c]** | | | | | |
| **Field Parameters** | | | | | |
| Oxidation-Reduction Potential | Optimal values of < 50 mV indicate reductive dechlorination may be occurring. | | | | |
| Dissolved Oxygen | Concentrations in groundwater <1mg/L dissolved oxygen indicate anaerobic conditions present. >1mg/L indicate aerobic conditions. | | | | |
| pH | Optimum range of pH is 5 to 9. | | | | |
| Temperature | | | | | |
| Specific Conductance | | | | | |
| **Laboratory Parameters** | | | | | |
| Nitrate | Concentrations in groundwater >1 mg/L nitrate may compete with reductive processes for CVOCs. | 2,000 | 10,000 | | |
| Sulfate | Can be used as electron acceptor once oxygen, nitrate, and iron have been depleted or reduced. Concentrations >20mg/L may compete with reductive pathway. | 125,000 | 250,000 | | |
| Iron (already included above) | Concentrations in groundwater >1mg/L may indicate iron reduction has occurred and reductive dechlorination of CVOCs is possible. | | | | |
| Manganese (already included above | Concentrations in groundwater >1mg/L may indicate manganese reduction has occurred and reductive dechlorination of CVOCs is possible. | | | | |
| Methane, ethane, ethene (dissolved gasses) | Higher concentrations of methane may indicate methanogenesis is occurring, ethene and ethane degradation products of vinyl chloride. | | | | |
| Alkalinity | Reflects higher concentrations of calcium and magnesium, indicating that microbial respiration is releasing CO2 into the groundwater. | | | | |
| Chloride | A measure of CVOC degradation | 125,000 | 250,000 | 757,000 | 395,000 |
| Total Organic Carbon | A general measure of organics' concentration, including those naturally occurring. | | | | |

Proposed organic parameters were chosen from those monitored for (known site constituents) plus those historically and recently shown to exceed state standards.

[a] State of Wisconsin Groundwater Quality Standards as specified in NR 140.

[b] State of Wisconsin Water Quality Standards as described in NR 102 through 105.

[c] Natural Attenuation Parameters recommended in Technical Protocols cited in Final OSWER Directive (USEPA April 1999), and on professional experience

Based on comparison of water quality criteria to the PALs and ESs for the parameters proposed to be monitored in Table 2, the PAL and ES concentration criteria are lower except for cadmium, lead, and mercury. Accounting for the river dilution, the only water quality criterion more restrictive than the PAL and ES is the human threshold criterion for mercury. Multiplying the 0.0015 μg/L human threshold criteria for mercury by 120 yields 0.18 μg/L (the groundwater concentration before river dilution that would trigger the water quality criteria), which is slightly less than the 0.2 μg/L PAL for mercury. Therefore, comparison to PALs and ESs is sufficient for all parameters proposed to be monitored except mercury, which will require comparison to the PAL, ES, and human threshold water quality criterion.

Two other metals, copper and zinc, were also considered for natural attenuation monitoring. The two metals were present on at least one occasion each between 1994 and 2001 at concentrations in the groundwater treatment plant discharge approaching discharge standards for the Black River set by WDNR. Information in Table 3 compares the highest values at any well from the 1999 priority pollutant scan to PAL, ES, and Wisconsin water quality criteria.

**TABLE 3**
Comparison of Copper and Zinc to Applicable Standards
*Onalaska Municipal Landfill—Remedial Action Site*

| Parameter | Maximum Concentration Detected In 1999 Priority Pollutant Scan (µ/L) | State of WI PAL[2] (µ/L) | State of WI ES[2] (µ/L) | Acute Criteria (µ/L) | Chronic Criteria (µ/L) |
|---|---|---|---|---|---|
| Copper | 7.8 | 130 | 1,300 | 9.29 | 6.58 |
| Zinc | 93.5 | 2,500 | 5,000 | 65.66 | 65.66 |
| Mn | | | 300 | 525 | 29.2 |

Assuming concentrations increase by up to three times (the approximate increase in groundwater flow rate and thus potential dilution at the site with the extraction wells running versus without the extraction wells running), the maximum groundwater concentration would remain well below PALs and the maximum increase for copper and zinc concentrations in the river after accounting for a 120 times dilution would be 0.2 and 2.3 μg/L compared to the most restrictive criteria of 6.58 μg/L for copper and 65.66 μg/L for zinc. Given that the maximum estimated concentrations of these metals are well below PALs and that the maximum estimated diluted concentration contributions to the Black River are well below Wisconsin water quality criteria, copper and zinc monitoring is not proposed.

## Sampling and Analysis Methods

Field parameters will be measured using a flow-through cell. Measurements can be taken during the purging process. Readings shall not be taken until all parameters including the more sensitive parameters of dissolved oxygen (DO) and oxidation reduction potential (ORP) stabilize to within 10 percent between two consecutive 5 gallon volumes of purge water. This may require purging more than five well volumes to allow the instruments sufficient time to stabilize and to adequately purge the well to achieve consistent groundwater quality.

Wells will be purged and sampled using a sampling pump consistent with USEPA recommendations. The internal wetted components of the pump shall not be polyvinyl chloride (PVC) because of concerns regarding sorption of organic contaminants. For consistency with past sampling events and to ensure a representative sample, five well volumes (or more if required to achieve stable field parameter measurements as noted herein) shall be purged from each well sampled rather than a low flow sampling approach. A speed controller must be used to allow high rate purging followed by low flow (e.g., less than or equal to 1 liter or 0.26 gallons per minute) sampling of metals and the various organic parameters.

Sampling shall be done with the sampling pump intake located approximately half way down the submerged screened interval. The pump rate shall be turned down to a low level after purging in order to simulate low flow sampling. This will minimize volatilization of organic compounds and suspension of solids.

Metals were field filtered for the baseline sampling event (except for the residential wells) and previous sampling events. However, based on subsequent discussions with the USEPA, total metals should be used in the future. In order to have a baseline comparison of total versus filtered samples, both total and filtered metals shall be taken during the next sampling event. The following steps are to be taken during all future sampling rounds to redevelop the well and thereby minimize solids in the sample before purging the five well volumes:

- While high rate purging, turn the pump on and off until there is no evidence in the purge water of "dirty" water being released into the well as a result of this procedure.
- While high rate purging, raise and lower the pump from the very bottom of the well to the top of the well screen (i.e., 10 feet from the bottom).

## Evaluation and Reporting

Groundwater monitoring reports shall be submitted to WDNR annually. The report shall provide the following:

- Text including the following sections:
  - Introduction.
  - Sampling Event Information.
- Groundwater Quality Results including:
  - A summary of the data validation.
  - Statistically calculated preliminary alternative concentration limits for parameters present in the background wells above PALs (updated each year using data collected from 1995 to date).
  - Discussion of VOC contaminant, metal contaminant, and natural attenuation parameter results, including discussion of the graphed results, comparison to PALs and ESs, and evaluation of whether there are indications that natural attenuation processes are or are not occurring.

  - Conclusions regarding the effectiveness of natural attenuation with emphasis on contaminants present above PALs and ESs and recommendations based on applicable regulations and discussions with the WDNR whether to continue with monitored natural attenuation, reactivate the groundwater extraction or bioventing equipment, or implement an alternative RA.

- Groundwater elevation results, including a table summarizing groundwater elevations from each monitoring event and groundwater table contour maps from each monitoring event based on interpolation of groundwater elevations at monitored locations.
- Recommended adjustments to the Monitoring Plan.
- Tables summarizing laboratory results by well.
- Figures showing detected parameters versus location on a site plan similar to Figure 2. Interpolated concentration gradients of parameters detected at a sufficiently high number of wells shall be shown if appropriate for evaluating migration and natural attenuation. A separate figure shall be provided for each parameter in such cases.
- Figures for each contaminant present above PALs showing current and past (i.e., starting with the baseline sampling event the week of October 29, 2001) concentrations versus sampling date (i.e., concentration on the y-axis and sampling date on the x-axis). Non-detection results shall not be plotted. Results from spatially close Group 1 wells shall be plotted on the same figure as the corresponding downgradient Group 2 wells to allow easy visual comparison. Similarly, the wells at the north end of the monitoring network which include wells progressively downgradient of the landfill within the Group 1 wells as discussed above shall be plotted on the same figure. Results from a maximum of five wells may be plotted on a single figure. Each well result shall be plotted with different symbols and colors to distinguish between wells. Results from a well may be plotted on more than one figure as appropriate to show results from spatially close Group 1 wells and corresponding downgradient Group 2 wells.

## Evaluation Criteria and Contingency Plan

Once the extraction system is turned off, it is expected that site-related contaminants will migrate downgradient from the landfill. Because contaminants in the groundwater are present downgradient of the site at concentrations exceeding drinking water standards or enforcement standards, groundwater use restrictions need to be recorded with the property deed, recorded using the WDNR GIS registry system, or otherwise ensured.

Natural attenuation will be determined to be ineffective by the WDNR and the groundwater extraction and treatment system restarted or alternative RA implemented if one of the following occurs:

- If the contaminants migrate further than the estimated extent of contamination during the RI (Figure 1) at concentrations exceeding PALs, ACLs based on background concentration, or other applicable standards.

- If contaminants are confirmed at measurably higher concentrations at individual monitoring points compared to those presented in the RI Report and the concentration increase cannot be accounted for as the result of a degradation byproduct.
- If meaningful trends of decrease of contaminant mass over time at appropriate monitoring points are not demonstrated.
- If natural attenuation processes are not sufficiently reducing the concentrations of parameters exceeding PALs, ESs, or other applicable standards as evidenced by concentration comparisons between upgradient and downgradient wells.

# References

CH2M HILL. *Remedial Investigation Report. Onalaska Municipal Landfill, Onalaska, Wisconsin.* December 1989a.

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Wiedemeier, T. H., M. A. Swanson, D. E. Moutoux, E. K. Gordon, J. T. Wilson, B. H. Wilson, D. H. Kampbell, P. E. Haas, R. N. Miller, J. E. Hansen, F. H. Chapelle. *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water.* EPA/600/R-98/128. September 1998.