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

Field Sampling Plan
Long-term Response Action

FID 632 013 360 RR CORR

Onalaska Municipal Landfill Site
Onalaska, Wisconsin

WA No. 003-RARA-05L5 /
Contract No. 68-W6-0025

PREPARED FOR

U.S. Environmental Protection Agency

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July 1997

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Onalaska Field Sampling Plan

Introduction

This plan describes the long-term field sampling program for the Onalaska Municipal Landfill site located in Onalaska Township, Wisconsin (Figures 1 and 2). The sampling program is outlined in the U.S. Environmental Protection Agency's (EPA) Record of Decision (ROD). The field sampling program was designed to monitor the effectiveness of the groundwater collection and monitoring systems in meeting the requirements of the ROD and potential adverse impacts on nearby wetlands. Although not specifically addressed as a ROD requirement, monitoring of adjacent surface water and sediments is included as part of the field sampling plan. Monitoring of treated groundwater discharge will be addressed in a separate plan [1].

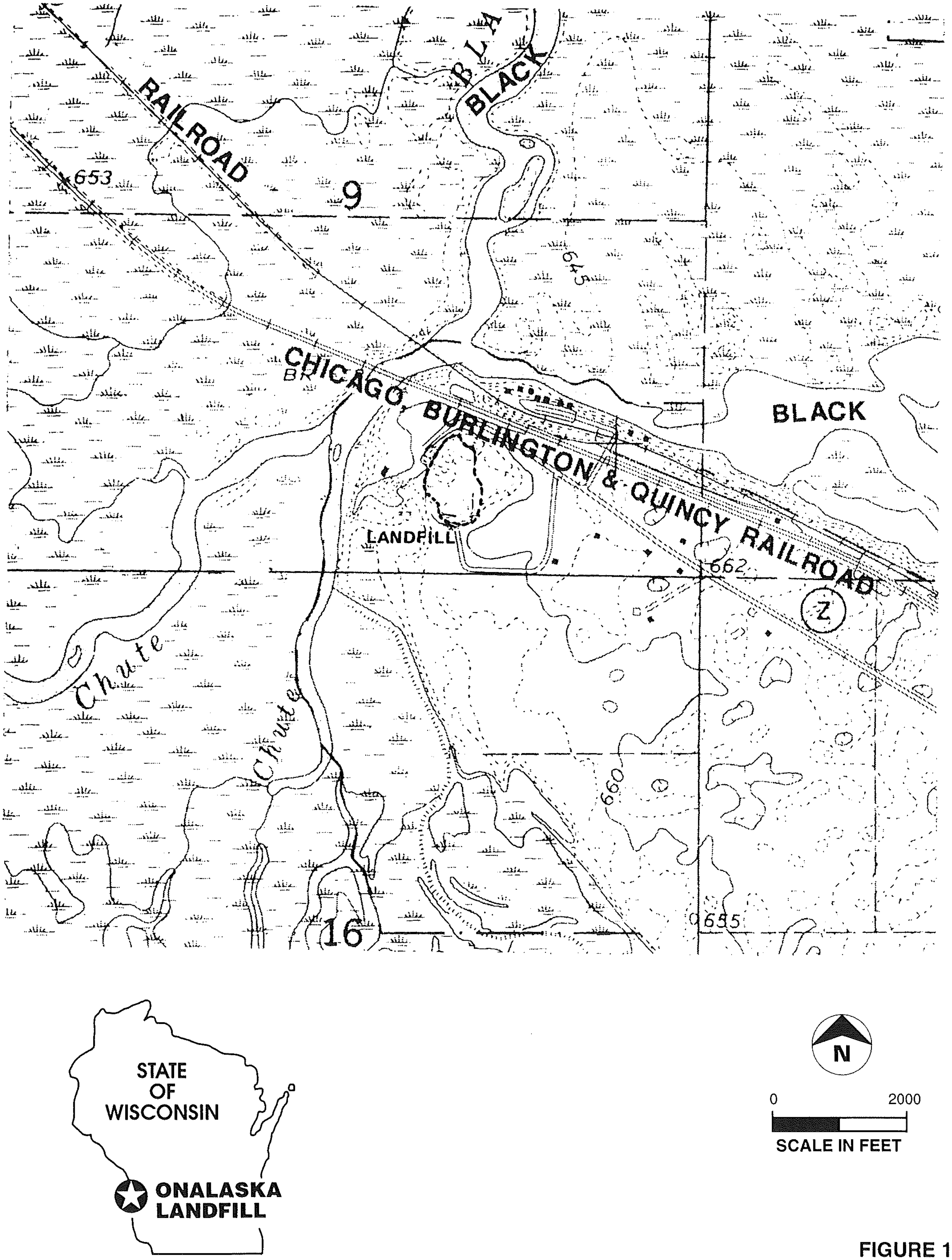
Contaminants Found in Groundwater During the Remedial Investigation

Groundwater samples were collected from monitoring wells during the Remedial Investigation (RI) in the spring and summer of 1989. Contaminant concentrations in the groundwater at individual monitoring well locations within the landfill or at the landfill boundary exceeded one or more standards or criteria. The Safe Drinking Water Act maximum contaminant levels (MCLs) for arsenic; barium; benzene; 1,1-dichloroethene; toluene; 1,1,1-trichloroethane (1,1,1-TCA); trichloroethene (TCE); and xylene were exceeded at one or more monitoring well locations. The Wisconsin Groundwater preventative action limits (PALs) for benzene; arsenic; barium; chromium; 1,1-dichloroethene; 1,1,1-TCA; TCE; toluene; and xylene were exceeded at one or more monitoring well locations.

A series of shallow groundwater samples were collected during the RI and were analyzed using a close support laboratory. The primary objectives of the shallow groundwater analysis were to determine the extent of the floating nonaqueous phase and to help select groundwater monitoring well locations. The close support laboratory analyzed a total of 81 samples for the following organic compounds:

- Toluene
- Total xylenes
- 1,1,1-TCA
- TCE
- Perchloroethylene (PCE)

These compounds were selected on the bases of historical groundwater analyses, site history, and their chemical properties (e.g., mobility). Measured concentrations of toluene were as high as 43,000 µg/L. Of the three chlorinated compounds analyzed for, 1,1,1-TCA was the most prevalent, and was found at concentrations as high as 730 µg/L.

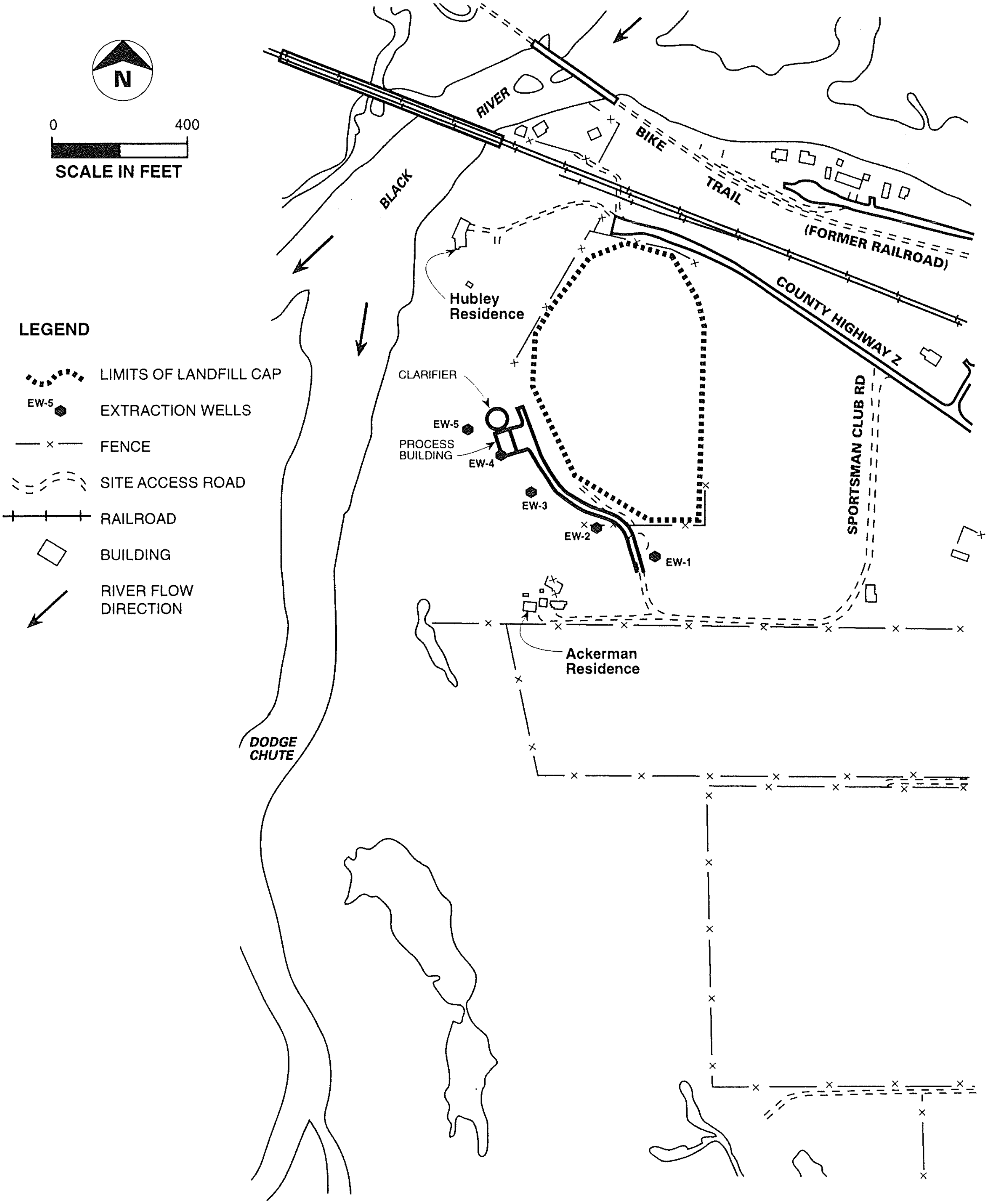


SOURCE: U.S. Geological Survey, Trempealeau, 15' Quadrangle.

FIGURE 1
SITE LOCATION MAP

ONALASKA LANDFILL
FIELD SAMPLING PLAN

E140811.DV05 Site Loc Map 7-22-97ll



E140811.DV.05 Site Map 7-22-97ill

FIGURE 2
SITE MAP
ONALASKA LANDFILL
FIELD SAMPLING PLAN

Two rounds of groundwater sampling for contract laboratory analysis were conducted. These samples were analyzed for the complete target compound list (TCL) and 13 special analytical services (SAS) parameters.

Volatile organic compounds (VOCs) were generally observed to be present at concentrations much greater than semivolatile organic compounds (SVOCs), sometimes more than an order of magnitude greater. The majority of the VOCs detected during the RI were found in shallow monitoring wells (MW-5S, MW-3S, and B-4S) and were BTEX compounds. The vertical extent of BTEX and chlorinated compound contamination is mostly confined to the upper 10 to 20 feet of the aquifer. Ethylbenzene, 1,1-DCA and chloroethane were detected, however, at depths up to 50 to 60 feet below the water table. The vertical extent of SVOC contamination is also mostly confined to the upper 10 to 20 feet of the aquifer. There were no SVOCs detected in any of the deep monitoring wells.

Monitoring wells along the southwestern edge of the landfill and southwest of the landfill exhibited the most occurrences of inorganic chemicals in concentrations above background levels. These are primarily shallow and medium wells that included MW-2S, MW-2M, MW-3S, MW-4S, MW-B4S, MW-5S, and MW-8S. Four chemicals, barium, iron, manganese, and sodium, were detected above background with greater frequency than the other inorganic chemicals. The higher concentrations of these four chemicals tend to occur in wells along the southwestern edge of the landfill or southwest of the landfill.

Record of Decision Goals

The ROD, signed August 14, 1990, defines the selected remedy and addresses the goals of the remedial action. The ROD goals and selected remedy are consistent with the RI/FS and Proposed Plan. The selected action for the remedy includes the following remedial actions for groundwater:

- Extraction and treatment of the groundwater contaminant plume to meet Federal Safe Drinking Water Act (SDWA) drinking water standards and State of Wisconsin groundwater quality standards
- Periodic monitoring of the groundwater contaminant plume
- Deed restrictions limiting surface and groundwater use at the Onalaska Municipal Landfill site
- Continued reliance on state institutional controls governing groundwater use within the proximity of landfills

The groundwater remedial action goals stated in the ROD are to achieve Federal drinking water standards under the SDWA (Maximum Contaminant Levels [MCLs] or nonzero Maximum Contaminant Level Goals [MCLGs]) and the more stringent State of Wisconsin groundwater quality standards under Ch. NR 140, Wisconsin Administrative Code (Preventive Action Limits [PALs]).

The MCLs and nonzero MCLGs must be met at the landfill waste boundary and the more stringent Wisconsin standards (PALs) must be met at any point beyond the property boundary or the design management zone (DMZ). The DMZ as defined in NR 140 is a 3-dimensional boundary surrounding a regulated facility. The boundary extends from the ground surface through all saturated geological strata. The DMZ defined for the Onalaska site extends 250 feet horizontally from the waste boundary as shown in Figure 3. Because the property boundary is generally closer than the DMZ to the waste boundary, the PALs apply at the property boundary with the exception of the southwest corner of the property where the PALs apply to the DMZ.

If it becomes apparent that it is technically or economically infeasible to achieve a Wisconsin PAL, then a Wisconsin alternative concentration limit (ACL) may be considered.

If it becomes apparent that it is technically impractical to achieve the groundwater cleanup standards, including any ACL established, then alternate methods of controlling the groundwater plume or source would be considered. If those alternate methods are not able to attain the groundwater cleanup standards or ACL, then a Comprehensive Environmental Response and Compensation Liability Act (CERCLA) waiver may be considered.

Purpose

The purpose of this plan is to recommend procedures for periodic monitoring of the groundwater, surface water, and sediments over time. Periodic monitoring is necessary to verify that the groundwater collection system is containing the contaminated groundwater and preventing its migration, to evaluate whether adjacent wetlands and river are being impacted from the extraction of groundwater, and to determine whether the system is reducing the level of contaminants in the plume.

This plan discusses the following:

- Well monitoring network
- Groundwater sampling frequency at each well
- Groundwater Cleanup Standards
- Compounds to be analyzed for
- Supplementary sampling of adjacent surface water and sediments
- Sampling procedures, analytical programs, methods of analyses, Quality Assurance/ Quality Control (QA/QC) protocols for contract lab program (CLP) analyses
- Procedures for field measurements
- Reporting procedures
- Quality Assurance Project Plan (QAPP)
- Operation and Maintenance (O&M) of the wells

The guidelines presented in this groundwater monitoring plan are based on the best available information at the time of design and may not account for unanticipated field conditions. Therefore, the results of each data set collected shall be evaluated in the context of satisfying the intent of the ROD.

Sampling Rationale and Intended Data Use

The objectives of the groundwater monitoring program are to:

- Provide data to evaluate the effects of hydraulic gradient control and collection of contaminated groundwater within the aquifer
- Provide data to evaluate reduction of groundwater contaminant concentrations in the aquifer onsite in relation to associated cleanup criteria
- Provide data to evaluate reduction of groundwater contaminant concentrations in the aquifer offsite between the landfill and the Black River
- Monitor water levels in the wetlands adjacent to the site to ensure water levels are not lowered so as to adversely affect the wetlands.

These data shall be used to evaluate the effectiveness of the remedial action design and determine when groundwater extraction may cease.

Groundwater Monitoring Network

The groundwater monitoring network was designed to provide groundwater quality data for the site and adjacent area and is comprised of wells constructed during the RA and during the RI. The groundwater monitoring network consists of six piezometers, twelve monitoring wells, five extraction wells, and three air wells. The selected monitoring wells are primarily located hydraulically downgradient to the south, southeast, and west of the landfill site. One monitoring well is located upgradient of the landfill to provide background groundwater quality. The rationale for selection of each well and piezometer is summarized in Table 1. These wells will permit evaluation of the hydraulic gradient control and groundwater quality in the aquifer. Well and piezometer locations are shown in Figure 3.

Piezometers

Six piezometers (PZ-1, PZ-2, PZ-3, PZ-4, PZ-5, PZ-6)were installed for the purposes of determining the impact of groundwater pumping on the wetlands area to the south of the site and to ensure that the plume of contaminated groundwater is being captured by the system of extraction wells. Potential adverse impacts on the wetlands will be evaluated using pre and post-pumping groundwater elevation data collected at the two piezometers (PZ-3 and PZ-4) located in the wetlands area. Plume capture will be determined by the horizontal hydraulic gradients, as defined by the water table elevations in the piezometers and in the monitoring wells, such as MW-14S, which is located near the edge of the plume. Piezometer PZ-1 was installed to measure the inward gradient along the western boundary of the plume. Piezometers PZ-5 and PZ-6 are used to measure the inward gradient along the eastern boundary of the plume.

TABLE 1
Monitoring Well Network Rationale
(Page 1 of 2)

Well Designation	Rationale
PZ-1	Monitor groundwater level west of westernmost extraction well to determine if necessary capture zone is being attained
PZ-2	Monitor groundwater level between wetlands and extraction system to determine if wetlands water levels are being lowered
PZ-3	Monitor groundwater level between wetlands and extraction system to determine if wetlands water levels are being lowered
PZ-4	Monitor groundwater level between wetlands and extraction system to determine if wetlands water levels are being lowered
PZ-5	Monitor groundwater level east of easternmost extraction well to determine if necessary capture zone is being attained
PZ-6	Monitor groundwater level east of easternmost extraction well to determine if necessary capture zone is being attained
MW-1S	Monitor shallow background groundwater quality upgradient of the landfill and the extraction system to allow statistical evaluation of background groundwater characteristics
MW-2S	Monitor shallow groundwater quality and vertical distribution beneath the landfill
MW-2M	Monitor intermediate groundwater quality and vertical distribution beneath the landfill
MW-2D	Monitor deep groundwater quality and vertical distribution beneath the landfill
MW-4S	Monitor shallow groundwater quality along landfill waste boundary (compliance point for MCLs and nonzero MCLGs as defined in the ROD)
MW-5S	Monitor shallow groundwater quality along landfill waste boundary (compliance point for MCLs and nonzero MCLGs as defined in the ROD)
MW-6S	Monitor shallow groundwater quality and water levels downgradient of landfill and extraction system to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs)
MW-6M	Monitor intermediate groundwater quality and water levels downgradient of landfill and extraction system to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs)
MW-8S	Monitor shallow groundwater quality and water levels downgradient of landfill and extraction system to determine if contaminated groundwater has been captured (compliance point for Wisconsin PALs)

TABLE 1
Monitoring Well Network Rationale
(Page 2 of 2)

Well Designation	Rationale
MW-8M	Monitor intermediate groundwater quality and water levels downgradient of landfill and extraction system to determine if contaminated groundwater has been captured (compliance point for Wisconsin PALs)
MW-12S	Monitor shallow groundwater quality and water levels east of easternmost extraction well to determine if necessary capture zone is being attained and whether contaminated groundwater has been captured (compliance point for Wisconsin PALs)
MW-14S	Monitor shallow groundwater quality and water levels west of westernmost extraction well to determine if necessary capture zone is being attained and whether contaminated groundwater has been captured (compliance point for Wisconsin PALs)
EW-1	Groundwater extraction well—water quality monitored to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs)
EW-2	Groundwater extraction well—water quality monitored to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs).
EW-3	Groundwater extraction well—water quality monitored to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs).
EW-4	Groundwater extraction well—water quality monitored to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs)
EW-5	Groundwater extraction well—water quality monitored to determine if reduction in groundwater concentration occurs over time (compliance point for Wisconsin PALs)
AW-14	Monitor groundwater level near extraction well EW-4
AW-25	Monitor groundwater level between extraction well EW-2 and EW-3
AW-29	Monitor groundwater level near extraction well EW-2

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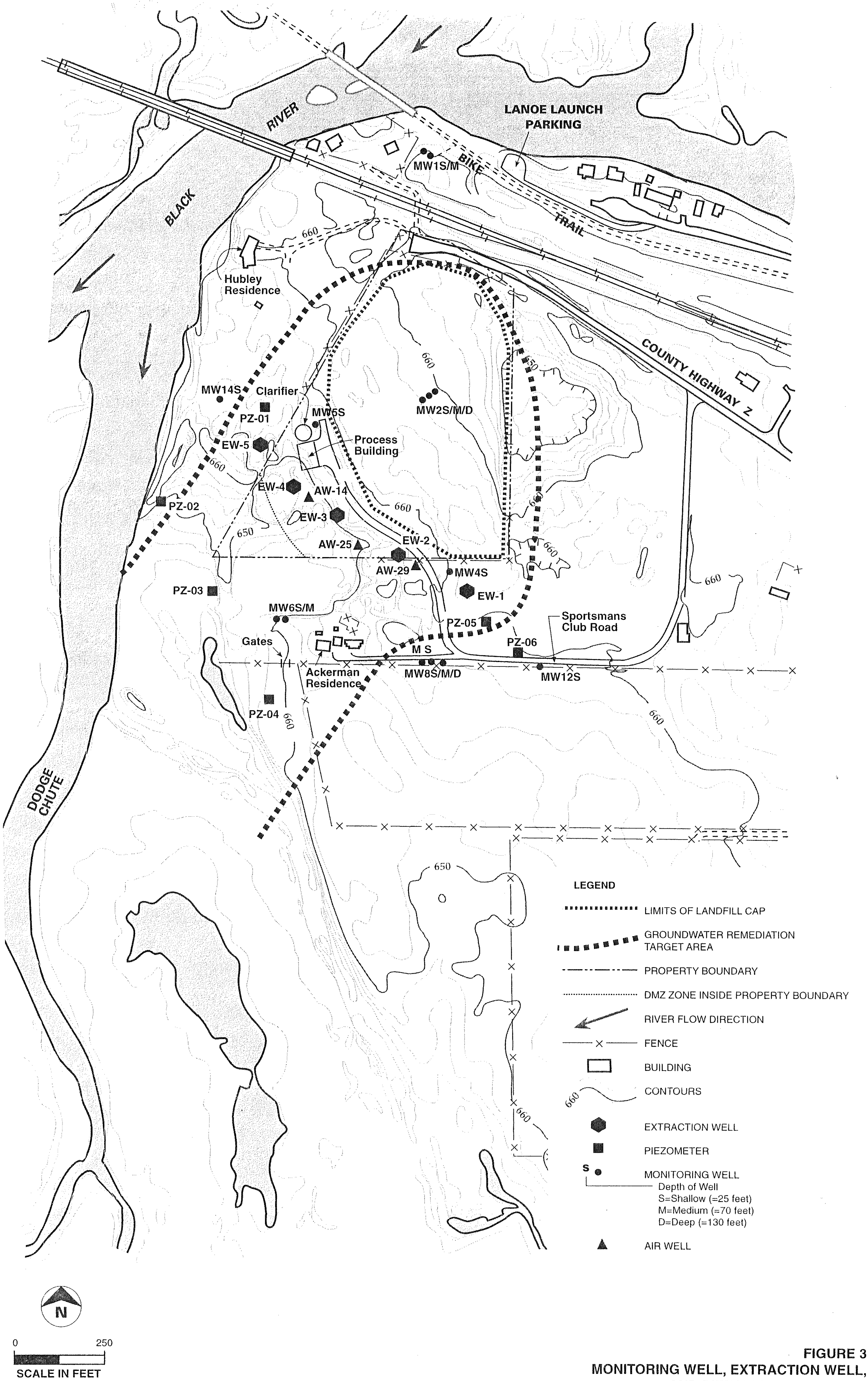

FIGURE 3
MONITORING WELL, EXTRACTION WELL, AND PIEZOMETER NETWORK
ONALASKA LANDFILL
FIELD SAMPLING PLAN

Monitoring Wells

The monitoring wells (MW-1S, MW-4S, MW-5S, MW-6S, MW-6M, MW-8S, MW-8M, MW-12S and MW-14S) shall be used to monitor:

- If contaminated groundwater has been captured successfully (contaminants of concern are below action levels at point of compliance)
- Groundwater quality changes downgradient of the collection system capture zone (i.e., how quickly concentrations of contaminants of concern decrease after the extraction system is functioning)
- Hydraulic gradient control (contaminated groundwater plume is moving toward the extraction wells)

Groundwater quality downgradient of the landfill and extraction well network will be monitored in shallow wells MW-6S and MW-8S and in intermediate wells MW-6M and MW-8M. These well locations were selected to place wells outside of the capture zone. MW-12S and MW-14S are located on or near the periphery of the capture zone and will be used to monitor groundwater quality and hydraulic gradient control east and west of the extraction well network. Wells along the landfill waste (MW-4S and MW-5S) are sampled because these wells represent the compliance point defined in the ROD (the landfill waste boundary) for MCLs and nonzero MCLGs. MW-2S, MW-2M, and MW-2D will be used to monitor groundwater quality beneath the landfill to determine if groundwater contaminants are migrating vertically. MW-1S will be used to monitor background groundwater quality upgradient of the landfill.

Monitoring using only shallow and intermediate wells is performed because the majority of the VOCs detected during the Remedial Investigation were found in shallow monitoring wells (MW-5S and former wells MW-3S and B4S). The vertical extent of BTEX and chlorinated compounds contamination is mostly confined to the upper 10 to 20 feet of the aquifer. Ethylbenzene, 1,1-DCA and chloroethane were detected, however, at depths up to 50 to 60 feet below the water table. The vertical extent of semivolatile organic compounds (SVOCs) contamination is also mostly confined to the upper 10 to 20 feet of the aquifer. There were no SVOCs detected in any of the deep monitoring wells.

Extraction Wells

A series of five extraction wells have been installed in locations that capture the contaminant plume prior to offsite groundwater discharge. The extraction well network can extract approximately 775 gallons per minute (gpm) of contaminated groundwater for treatment. The rate of pumpage for each well can be varied during operation, based on results of monitoring wells and piezometers. Groundwater from the extraction wells will be monitored to assess the degree that contaminant cleanup is occurring.

Compliance with Groundwater Standards

MW-4S and MW-5S represent the compliance point defined in the ROD (the landfill waste boundary) for MCLs and nonzero MCLGs. The compliance point for the PALs (any point beyond the property boundary or DMZ) are represented by monitoring wells MW-4S, MW-6S, MW-6M, MW-8S, MW-8M, MW-12S, and MW-14S and the extraction wells. The groundwater standards and compliance points are discussed in more detail later in this document.

Surface Water and Sediments

The groundwater beneath the site generally flows in a south-southwesterly direction toward the wetlands bordering the Black River. Although no site-derived contamination was detected in the surface water and sediment samples collected during the Remedial Investigation (RI), surface water and sediments will be sampled annually to monitor for potential offsite contaminant migration during performance of the remedial action. Surface water and sediment grab samples will be collected from the wetland area and Dodge Chute by the Wisconsin DNR.

Sampling Schedule and Frequency

The groundwater monitoring plan includes semi-annual sampling events from monitoring wells, extraction wells and residential wells; and collection of semi-annual groundwater elevation data from piezometers, monitoring wells, and air wells. In addition, surface water and sediment samples will be collected by the WDNR from two or more locations.

The sampling schedule will be evaluated annually and adjusted as needed depending on the analytical results and the operation of the extraction and treatment system. The frequency of sampling will be reevaluated annually. The sampling plan is described below.

Semi-Annual Sampling and Elevation Measurements

The primary purpose of the semi-annual sampling and elevation measurements is to continue to evaluate the groundwater extraction and treatment system for reliable operation and monitor the reduction of contaminant concentrations in the aquifer. Semi-annual groundwater samples from the twelve monitoring wells, five extraction wells, and two residential wells will be collected during April/May and September/October. The residential wells are at the Hubley and Ackerman homes (Figure 3).

Semi-annual groundwater elevation measurements will be taken from the piezometers, monitoring wells, and air wells.

Depending on the analytical results from the semi-annual sampling and the absence of operational problems, the sampling schedule may be modified further. After 5 years of operation (1999) of the groundwater extraction and treatment system, the groundwater quality will be evaluated to determine if the groundwater standards are being met. In addition to the evaluation of results of semi-annual samples collected over the 5-year period, a full priority pollutant scan will be performed to determine if additional parameters should be added to the compounds listed in Table 2. If the groundwater goals (or ACLs, if established) have not been met, sampling will continue until the cleanup goals are achieved. The frequency of sampling will be evaluated based on the trends observed in the first 5 years. If an applicable and appropriate requirements (ARAR) waiver is established, the groundwater goals and the need or frequency of further sampling will be addressed as part of the waiver process.

TABLE 2
Groundwater Monitoring Analyte List and Action Levels

Target Analytes	Units	PAL[a,b]	MCL[b]	MCLG[b]	Detection Limit
ROD Compounds					
Benzene	µg/L	0.5	5	0	1.0
Toluene	µg/L	68.6	1,000	1,000	1.0
Xylenes	µg/L	124	10,000	10,000	1.0
Ethylbenzene	µg/L	140	700	700	1.0
Trichloroethene	µg/L	0.5	5	0	1.0
1,1-Dichloroethane	µg/L	85			1.0
1,1,1-Trichloroethane	µg/L	40	200	200	1.0
1,1-Dichloroethene	µg/L	0.7	7	7	1.0
Arsenic	µg/L	5	50		5
Barium	µg/L	400	2,000	2,000	200
Lead	µg/L	1.5	15	0	1.5
	µg/L				
Others					
Tetrachloroethylene	µg/L	0.5	5	0	0.5
Total Dissolved Solids (TDS)	mg/L	[c]			20
Oil and Grease	mg/L				0.4
Iron	mg/L	0.15			0.1
Manganese	mg/L	0.025			0.01
pH	pH units				
Color	color units	7.5			1
Turbidity	NTU[d]				1
Odor	TON[e]	1.5			1

[a] NR 140.

[b] October 1996

[c] To be established from 8 rounds of background data.

[d] Nephelometric turbidity units.

[e] Threshold odor number.

Note: Groundwater samples from the monitoring, extraction, and private wells will be analyzed for the compounds listed above except MW-2S, MW-2M, MW-2D, MW-4S, and MW-5S which will be analyzed for VOCs and metals only.

Annual Surface Water and Sediment Sampling

Annual surface water samples will be collected from the Black River, Dodge Chute, or wetland areas downgradient from the site. Specific locations will be determined by the WDNR. The primary purpose of these samples is to monitor for any unusual increase in contaminant concentrations that may be attributed to remedy implementation activities.

Analytical Procedures

Groundwater samples from the monitoring, extraction, and private wells will be analyzed for the compounds listed in Table 2. Monitoring wells MW-2S, MW-2M, MW-2D, MW-4S, and MW-5S will be analyzed for VOCs and metals only.

Table 2 consists of compounds identified in Table 3B of the ROD as the "Chemicals of Concern" and additional parameters that were added to the ROD list in order to better monitor the landfill or as a means to meet WDNR sampling and reporting requirements. The additional parameters are:

- Total dissolved solids (TDS) analyses—to be used to indicate the relative strength of the leachate contributed by the landfill.
- Oil and grease analyses—to be used to monitor for the presence of the nonaqueous phase contaminants detected in the RI.
- Tetrachloroethylene (PCE), manganese, iron, color odor, and turbidity were added to Table 2 to fulfill DNR requirements for semi-annual monitoring.

Groundwater samples will be analyzed for the listed compounds, VOCs and inorganic chemicals in accordance with the analytical procedures specified in the quality assurance project plan (QAPP). Field temperature and pH will also be recorded for each well during sampling events. Field sampling procedures, methods of analyses, and QA/QC protocols for analyses will be conducted in accordance with the QAPP.

Groundwater Cleanup Standards

Under the remedy selected in the ROD, the following cleanup standards were adopted:

- Groundwater contaminant plume located at any point beyond the property boundary or DMZ:
  - Preventive Action Limits (PALs) from Wisconsin Administrative Code Chapter NR 140
- Groundwater contaminant plume located at landfill waste boundary:
  - Maximum Contaminant Levels (MCLs) from the Safe Drinking Water Act, 40 CFR 141.61 and 40 CFR 143
  - Maximum Contaminant Level Goals (MCLGs) above zero from the Safe Drinking Water Act, 40 CFR 141.50

The ROD requires that the more stringent Wisconsin standards promulgated in NR 140, Wisconsin Administrative Code (WAC), be achieved "at any point beyond the property boundary or beyond the 3-dimensional design management zone, whichever is closer to the waste boundary." The DMZ as defined in NR 140 is a 3-dimensional boundary surrounding a regulated facility. The boundary extends from the ground surface through all saturated geological strata. The DMZ defined for the Onalaska site extends 250 feet horizontally from the waste boundary as shown in Figure 3. Because the property boundary is generally closer than the DMZ to the waste boundary, the PALs apply at the property boundary with the exception of the southwest corner of the property where the PALs apply to the DMZ.

The monitoring wells included in the groundwater monitoring network are located beyond the waste boundary shown in Figure 3. The analytical results from the groundwater samples will be compared to the groundwater contaminants of concern listed in Table 2.

A Wisconsin alternative concentration limit (ACL) may be proposed, if it is determined that PALs cannot be met feasibly.

Data Analysis and Evaluation

Background Monitoring

Background groundwater quality will be measured in monitoring well MW-1S located upgradient of the landfill. Background concentrations from groundwater will be established by statistical evaluation of eight sample results from the background well. For parameters that do not have a PAL established per NR 140.11 (Table 1), the PAL shall be the background value plus 3 standard deviations or the background value plus the increase in that parameter listed in Table 3 of NR 140.20, whichever is greater. Exceptions include field pH (PAL=1 unit above background) and field temperature (add/subtract 3 standard deviations or 10°F, depending on which is greater). The background concentrations will be evaluated to determine if regional groundwater quality exceeds PALs. If background concentrations exceed PALs, alternative concentration limits (ACLs) may be developed and used in lieu of PALs to evaluate if remedial action goals have been achieved.

Baseline Monitoring

Baseline monitoring was conducted in November of 1993 prior to commencement of the remedial action. Three discrete samples were collected and analyzed from monitoring wells MW-1S, MW-4S, MW-6S, MW-6M, MW-8S, MW-8M, MW-5S, MW-12S, and MW-14S in the monitoring program to develop baseline concentrations. Results from the baseline analyses are used to evaluate spatial variability of quality in the sampled groundwater. The mean and maximum concentrations for each compound at each well is used to assess trends.

Semi-Annual Monitoring and Evaluation

Semi-annual samples will be analyzed for the VOCs, inorganic constituents and conventional parameters. Results from these analyses will be compiled and used to assess the operation and maintenance of the groundwater extraction and treatment system, and to troubleshoot and improve system operation.

After each semi-annual sampling round, the analytical results from each well will be compiled and used to monitor aquifer concentrations and evaluate the performance of the groundwater extraction and treatment system. These data will be used to identify and implement any corrective action required to maintain reliable operation. At the end of each year of semi-annual sampling, the analytical results will be compiled and compared to the groundwater standards shown in Table 2 and evaluated for changes in the aquifer contaminant concentrations in the aquifer. Wisconsin DNR guidance [2] on methods for calculating compliance with groundwater quality regulations will be used to prepare these comparisons and evaluation of changes in concentrations.

Annual Evaluation of Semi-Annual Results

The semi-annual results of the sampling and analysis program will be compiled annually. The analytical results will be averaged and the data evaluated to examine spatial and temporal trends. This analysis will also include groundwater elevation readings. The types of spatial and temporal trends conducted will be evaluated after each year of sampling. Initially, the analysis will include:

- Plots of mean concentration versus time for each parameter analyzed for the individual wells
- Plots of concentration versus time of moving averages for each parameter analyzed for individual wells
- Regression analyses on plots of moving average concentration versus time to determine direction of trends

The entire monitoring program also will be reevaluated annually. Specific adjustments to the program that may be necessary include:

- Analyte list—Do analytes need to be added or deleted?
- Sampling frequencies—Are semi-annual sampling and groundwater elevation readings adequate or excessive?
- Monitoring well network—Is the monitoring well network adequate? Does any well need to be replaced? Should additional wells be installed? Can some of the monitoring wells be deleted from the sampling program?
- Sampling program—Do the analytical data indicate that the overall concentrations are decreasing? Should the monitoring program continue?

Sampling Equipment and Procedures

General procedures for measuring water levels, performing field tests, and collecting water quality samples are described below. Additional details related to specific sampling and decontamination procedures, sampling frequencies, and analytical requirements are discussed in the QAPP.

All wells will be sampled using the same equipment and procedures. Wells installed during the remedial investigation were constructed using both PVC and stainless steel riser and screens. The single well and the piezometers installed during remedial action were constructed using 2-inch Schedule 40 PVC. Typical well and piezometer construction details are shown in Figure 4.

All groundwater samples will be collected using the equipment identified below.

Field Equipment

The following equipment is required to sample the wells:

- Equipment needed to open the wells
  - Key to unlock wells and gates
  - Organic vapor detector (HNu, OVM, or OVA)
  - T-bar, socket set, or screw driver to remove flush mount covers
  - Bolt cutters (if lock is rusted and cannot be opened)
- Equipment for measuring water levels
  - Electronic water level indicator
- Equipment for purging wells
  - Bailer (disposable ones can be used)
  - Nylon cord (approximately 1000 feet needed)
  - Buckets or containers of known volume to measure purge water quantity
- Sample collection and field testing equipment
  - Bailer
  - Sample containers with preservatives and labels provided by the analytical laboratory
  - Coolers (approximately 8 needed)
  - Ice
  - pH with temperature meter
  - Decontamination solutions (TSP, 10 percent methanol, and distilled water), containers, brushes, etc.
  - HPLC-quality water for field blanks (approximately 2 gallons needed)
  - Peristaltic pump (for filtering metal samples)
  - Tubing for peristaltic pump (approximately 40 feet needed)
  - Inline 0.45 micron filters (approximately 22 needed)
- General Supplies
  - Packing supplies (bubble wrap, utility knife, strapping tape)
  - Ziplock baggies (quart and gallon size)
  - Duct tape and clear tape

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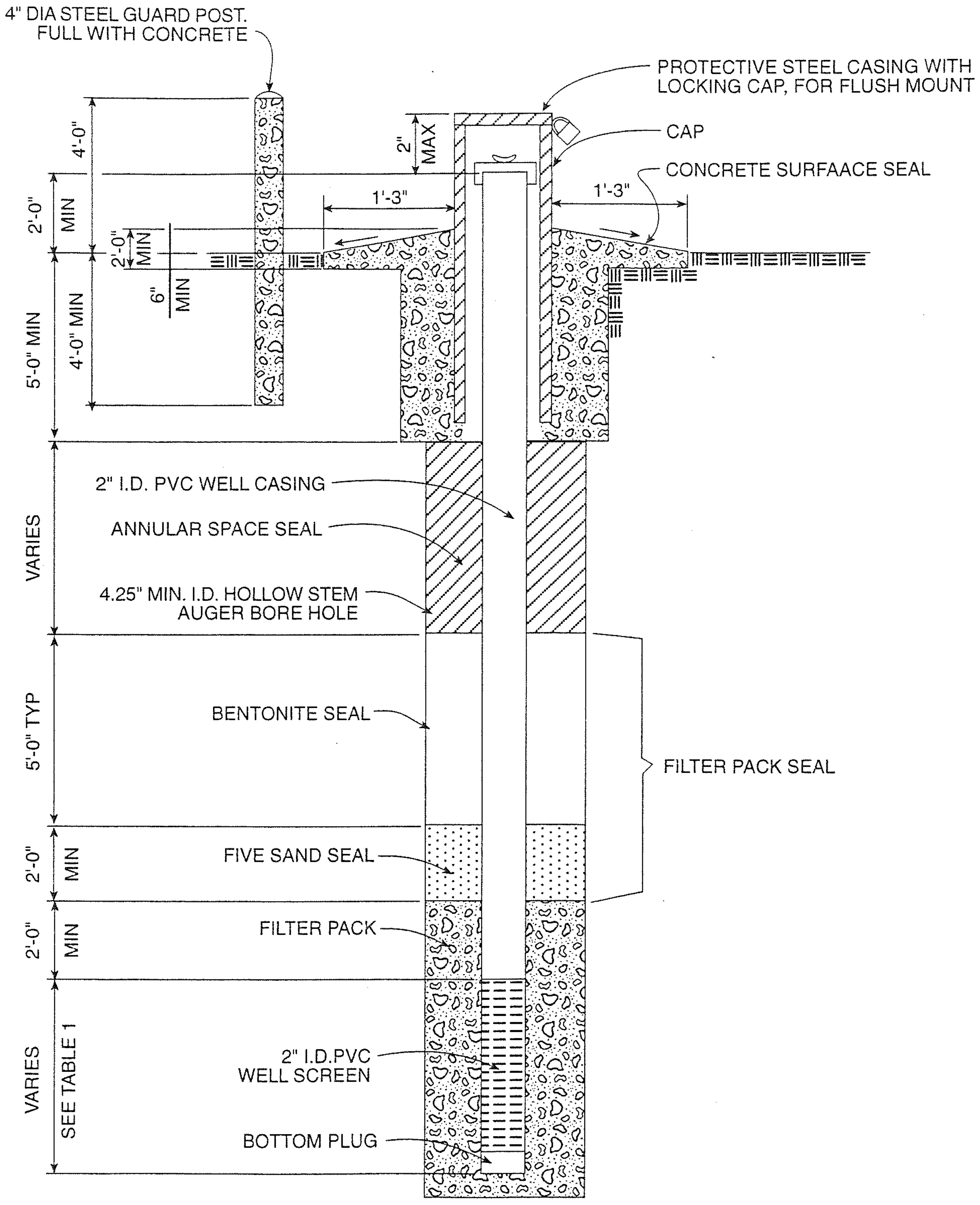


TYPICAL WELL SECTION DETAIL

NTS

TABLE 1
PIEZOMETER AND MONITORING WELL DEPTHS AND INSTALLATION DETAILS

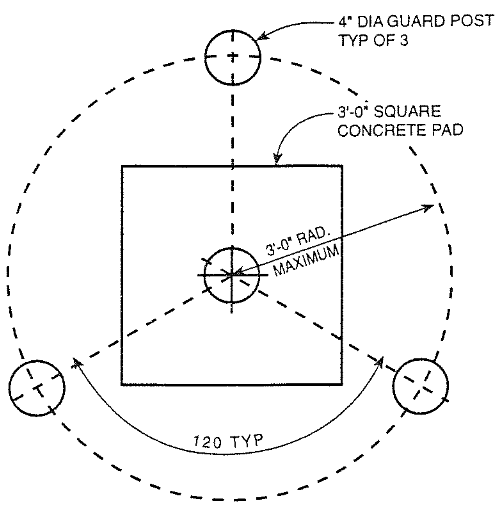
MONITORING WELL NUMBER	APPROXIMATE TOTAL DEPTH (FT)	APPROXIMATE WELL CASING LENGTH (FT)	WELL SCREEN LENGTH (FT)	TYPE OF PROTECTIVE COVER
MW-1S	26	16	10	PSC
MW-2S	25	15	10	PSC
MW-2M	70	60	10	PSC
MW-2D	130	120	10	PSC
MW-4S	30	20	10	PSC
MW-5S	23	13	10	FMC
MW-6S	31	21	10	PSC
MW-6M	80	70	10	PSC
MW-8S	23	13	10	FMC
MW-8M	61	51	10	FMC
MW-12S	26	16	10	PSC
MW-14S	16	6	10	FMC
PZ-1	30	20	10	FMC
PZ-2	18	8	10	FMC
PZ-3	30	20	10	FMC
PZ-4	30	20	10	FMC
PZ-5	25	15	10	FMC
PZ-6	26	16	10	FMC

ABBREVIATIONS

FMC = FLUSH MOUNT COVER
PSC = PROTECTIVE STEEL CASING
NTS = NOT TO SCALE

NOTE:

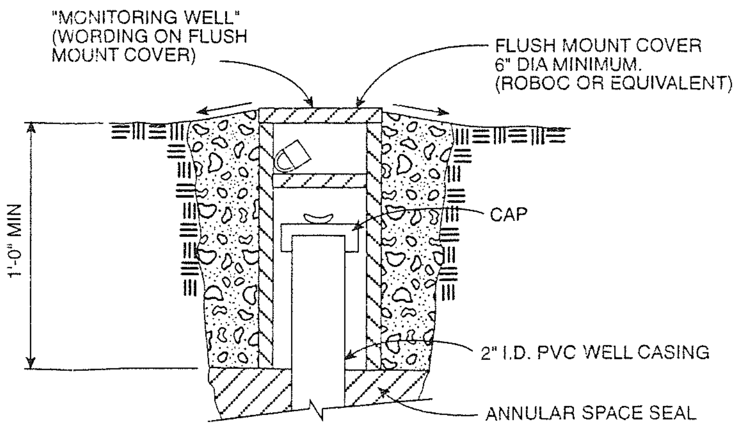
1. MONITORING WELL DEPTHS AND INSTALLATION DETAILS SHOWN ARE APPROXIMATE.



PLAN

CONCRETE PAD AND GUARD DETAIL

NTS



FLUSH MOUNT DETAIL

NTS

FIGURE 4
PIEZOMETER AND MONITORING WELL
CONSTRUCTION DETAILS
ONALASKA LANDFILL
FIELD SAMPLING PLAN

E140811.DV05 Piez& Mon. Well Const. 7-22-97 TLL

  - Garbage bags
  - Paper towels
  - First aid kit

- Sample Records
  - Field notebooks
  - Chain-of-custody forms

Preventive Maintenance

Well Covers and Protection

The well covers and surface protection (bumper posts) require minimum maintenance. The protective steel casings require periodic painting to prevent rusting. Damaged locks on well covers will be replaced as needed. Damaged concrete surface pads around wells will be repaired or replaced as needed.

Field Equipment

Each piece of field equipment will be tested prior to each use to verify it is in proper working order before it is sent to the site. Only properly-working equipment will be sent to the site. The instrument operator's manual will dictate the frequency of calibration and maintenance.

Groundwater Sampling and Measurements

Each well consists of a 2-inch-diameter Schedule 40 PVC well riser and well screen. The general sampling procedures and sequence described below are recommended as a guide to sampling each well. Groundwater measurements and sampling will proceed in the following sequence:

1. Organize and decontaminate sampling equipment and calibrate instruments
2. Remove padlock
3. Open well cover and remove well riser cap
4. Monitor inside well casing with an organic vapor detector
5. Measure and record static water level relative to top of casing per procedures summarized below (see Groundwater Elevation Measurements)
6. Calculate and record the volume of water in the well in accordance with the following formula:

   Wellbore water volume = $\pi \times r^2 \times h$,

   where h = height of water column
   r = radius of well bore

   (Note: Units must be consistent in all calculations)

7. Purge well per procedures summarized below (see Procedures to Purge Wells)

8. Perform field analyses; record pH and temperature readings
9. Collect water samples per procedures outlined below (see Water Sample Collection Procedures)
10. Preserve samples for storage and laboratory analyses
11. Complete sample records and chain-of-custody forms and seals
12. Ship samples via overnight courier to analytical laboratory

Wisconsin DNR guidelines for groundwater sampling are presented in "Groundwater Sampling Desk Reference" [3] and "Groundwater Sampling Field Manual" (Appendix A).

Groundwater Elevation Measurements

Determine the depth to water in the well to the nearest 0.01 foot using an electronic water level indicator. When the electrode or probe comes into contact with the water, an electrical circuit is completed, activating the meter light and beeper. Determine the depth of water using the following steps:

1. Lower the electrode or probe into the well by pulling the cable from the hand-held reel.
2. Continue lowering until completion of the circuit is indicated by illumination of the small light, a beep, or deflection of the ammeter needle.
3. Measure the length of cable in the well from the marked edge on the top of well casing to the probe (depth to the water table) to the nearest 0.01 foot. This length is subtracted from the top of the casing elevation to determine the water table elevation.
4. Record depth in the field notebook.

Procedures to Purge Wells

Prior to sampling, wells will be purged by removing three to five standing water column volumes as calculated previously. The amount of purge water will be measured by filling and counting 5-gallon buckets. Disposal of purge water will follow procedures in the waste disposal plan discussed below.

Water Sample Collection Methods

Samples will be collected after the requisite volume has been purged from the well. Volatile organic analysis (VOA) vials will be filled first; containers for filtered metals will be filled last. Place the mouth of the VOA vial at the end of the bailer and allow bottle to fill slowly. Fill vial in a steady, gentle stream with a minimum of agitation. Fill until a meniscus forms on the mouth of the VOA vial. Cap vial and check for air bubbles by inverting vial and tapping on the palm of the hand. If bubbles are present, repeat procedure until a bubble-free sample is obtained.

Fill remaining sample containers to the shoulder. Filtered metals samples should be field filtered. Field filtering procedures are described in Appendix A of this document or in the QAPP.

Sample Shipping

Coolers will be used to transport samples from the field to the analytical laboratory. Samples requiring preservation by cooling will be kept cold and uniform at all times.

All shipments will be accompanied by a chain-of-custody record identifying the contents. The original record will accompany the shipment, and a copy will be retained by the sampler.

The copy of the airbill accompanying each shipping container will be retained as part of the permanent documentation. Commercial carriers are not required to sign the custody form as long as the custody forms are sealed inside the sample cooler and the custody seals remain intact.

Waste Disposal

Wastes generated during sampling will consist of well purge water, wastes from decontamination, and protective clothing.

If HNu reading (or equivalent photoionization device) exceeds 1 part per million (ppm), the water will be treated in the onsite groundwater treatment system. If HNu headspace readings are less than 1 ppm, purge water will be discharged to the ground.

Decontamination

Field equipment used in well sampling will be decontaminated between wells with a TSP and distilled water solution, followed by a 10 percent methanol and distilled water solution, followed by a distilled water rinse. At the conclusion of the sampling event, sampling equipment will be decontaminated again with this procedure.

Documentation

Field activities should be documented in the field notebook and on chain-of custody forms. The following items should be included in the field book documentation:

- Site
- Sample team
- Daily weather conditions
- Daily activities and time of activities
- Visitors to the site
- Instruments used including make/model, serial no., and calibration results
- Well observations
  - Well number
  - Well condition including condition of lock
  - Depth of well
  - Depth to water

- Purge volume
- Water appearance (clarity, color, odor)
- Field parameter readings
- Sample information (date, time, sample no., type of sample)

Information on completing chain-of-custody forms is in Appendix B.

Corrective Action

Field Corrections

Deviations from routine procedures and subsequent corrective measures will be documented in a field log book and reported to the appropriate agency. Because possible deviations are dependent upon unknown field conditions, corrective measures cannot be specified. For field measurements, the corrective action must be suited to the situation and may include:

- Repetition of measurement to check the error
- Checking batteries
- Recalibration of the instrument
- Replacement of the instrument

Reporting

Semi-Annual

The semi-annual report will consist of a Technical Memorandum (TM) to the USEPA and Wisconsin Department of Natural Resources. The major components of the report will be:

- Date of sampling events
- Personnel involved in the sampling event(s) and their respective responsibilities
- List of the wells sampled during the event
- Summary of the procedures used during the sampling event, including any noted deviations
- List of pertinent observations taken during the sampling events
- Summary of the analytical data with QA/QC qualifiers
- List of contaminants of concern detected and their concentrations
- Comparison of results to groundwater standards
- Data table of groundwater elevation data

The TM will be delivered within 30 days following receipt of all analytical data and QA reviews.

Annual

The annual report to the USEPA and Wisconsin Department of Natural Resources will consist of:

- Date and time of the sampling events
- Personnel involved in the sampling events and their respective responsibilities
- List of the wells sampled during the event
- Summary of the procedures used during the sampling event, including any deviations from standard procedures
- List of pertinent observations taken during the sampling event
- Summary of the analytical results received from the laboratory and the validated results
- Comparison of baseline results with analytical results
- Temporal and spatial trends of the contaminant plume concentrations
- A summary of average concentrations (for each well) for the contaminants of concern
- Recommendations of changes to monitoring program including additions to the contaminants of concern
- Appendix containing semi-annual TMs
- Appendix addressing the analytical data and the QA/QA evaluations of the laboratory data

Data attachments to the annual report will include:

- Data validation report
- Chain-of-custody forms
- Data table of compiled groundwater elevation values for all monitoring wells
- Potentiometric surface map (groundwater contour map) drawn using the groundwater elevation values collected during the sampling event
- Summary table of field parameters

The annual report will be delivered within 60 days after receipt of all analytical data and quality assurance (QA) reviews for the annual sampling round. The reports for the semi-annual sampling rounds will be delivered separately within the reporting period, and also will be incorporated into the annual report.

References

[1] *Operation and Maintenance Summary Manual, Groundwater Treatment Remedial Action.* CH2M HILL. August 1994.

[2] *Methods for Determining Compliance with Groundwater Quality Regulations at Waste Disposal Facilities.* Wisconsin Department of Natural Resources. January 1989.

[3] *Groundwater Sampling Desk Reference,* Wisconsin DNR, PUBL-DG-037 96, September 1996

Appendix A
Groundwater Sampling Field Manual

Groundwater Sampling Field Manual

PUBL-DG-038 96
Produced by the Wisconsin Department of Natural Resources
Bureau of Drinking Water and Groundwater
September 1996

Groundwater Sampling Field Manual

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DISCLAIMER

The mention of trade names or commercial products in this document does not constitute an endorsement or recommendation by the Wisconsin Department of Natural Resources. Also, while this document and the accompanying Desk Reference include brief mention of health and safety issues, neither document adequately addresses all health and safety issues and requirements. Both documents should be supplemented with other appropriate references, requirements and training on health and safety.

ADDITIONAL COPIES

Additional copies of this document titled **Groundwater Sampling Field Manual, Stock # 1729,** and the accompanying document titled **Groundwater Sampling Desk Reference, Stock # 1728,** may be purchased from Wisconsin Department of Administration, Document Sales Unit. Call Document Sales at (608) 266-3358 or TTY (608) 264-8499 for pricing information (business hours 7:45 am to 4:30 pm).

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GROUNDWATER SAMPLING FIELD MANUAL

1.0 INTRODUCTION

1.1 PURPOSE AND USE OF THIS FIELD MANUAL

This field manual provides you with easy-to-use, WDNR-recommended procedures for consistently collecting quality, representative groundwater samples and measurements.

Before going out in the field, you should develop a sampling plan and a QA/QC plan. All sampling personnel should read these plans. The *Groundwater Sampling Desk Reference, PUBL-DG-037-96 REV,* contains detailed information on creating such plans. Consistently follow the procedures and protocols specified in these plans ***throughout a project's life***. ***Always*** clearly document any deviations from them, including reasons for the deviations.

Most sections of this manual contain an "Alternative Methods" subsection to help you consider alternative procedures and equipment not covered in this manual. This manual contains commonly used equipment and procedures and is not intended to limit your choice of procedures and equipment to use for a specific site or project. Therefore, WDNR will allow alternative procedures as long as they provide scientifically valid and legally defensible groundwater data.

This manual uses the ☞ iconic symbol to highlight key points to follow for all procedural options. This manual also uses "***Note***", "***Important note***", "***Caution***", and "***Tip***" to highlight important points that apply to a specific subsection or procedural option (e.g., coated tapes).

1.2 PRELIMINARY SITE DATA

Instructions on collecting subsurface stratigraphy data and preliminary screening discrete-depth groundwater samples are beyond this field manual's scope. Refer to Section 2.0 of the *Groundwater Sampling Desk Reference* for a more detailed discussion on the collection, use and limitations of such data. In addition, refer to the instructions and specifications provided by the manufacturer of your sampling and monitoring equipment.

1.3 VADOSE ZONE SOIL-WATER MONITORING

Instructions on vadose zone soil-water sampling and monitoring are beyond this field manual's scope. Refer to Section 5.0 of the *Groundwater Sampling Desk Reference* for a more detailed discussion on the collection, use and limitations of such data. In addition, refer to the instructions and specifications provided by the manufacturer of your sampling and monitoring equipment.

2.0 SAMPLING PROCEDURES FOR MONITORING WELLS

2.1 PRE-FIELD CHECKLISTS AND DOCUMENTATION

Pre-field Checklists (Included in Appendix A)

Go through the following two checklists before heading out to the field. You may modify these checklists to meet specific project needs.

1. Pre-field Work Procedures Checklist - Monitoring Wells.
2. Equipment Checklist - Monitoring Well Sampling.

Documentation of the Sampling Event

1. **Sampling Plan.** The sampling plan documents the equipment and procedures you use during a sampling event. ***Document any deviations*** from the sampling plan; use the "Field Procedures Documentation" sheet included in Appendix A. Or, create your own form to record deviations.

2. **Well-Specific Field Sheet - Monitoring Wells (Appendix A).** Document well, purging and sampling information, measurements, etc., on this sheet. Or, customize your own data sheet.

3. **Field Procedures Documentation (Appendix A).** If a sampling plan is not available, you may use the "Field Procedures Documentation" sheet included in Appendix A. Customize this sheet as necessary.

4. **Chain of Custody Form (Appendix A).** Document the possession of groundwater samples collected by filling out a chain of custody form. Use this form to document each time the samples change possession. Refer to the "Chain of Custody for Samples Requiring Strict Custody" instruction included in Appendix C when collecting enforcement samples.

2.2 MEASURING STATIC WATER LEVEL

☞ Measure the static water level for a well ***before*** purging, sampling or inserting any other instrument or device into a well's water column.

☞ Collect water level measurements from all site wells within a reasonably short time, preferably the same day.

☞ Collect measurements in the order of least contaminated to most contaminated wells (if known). Decontaminate the measuring device between each well.

☞ Read water level measurements to the nearest 0.01 foot from a permanently-marked spot on the well (e.g., top of casing or reference elevation).

☞ When possible, use one measuring device for all site wells. If using more than one measuring instrument, check the calibration of both instruments against the same well to ensure that they provide the same water level measurements.

☞ After removing a ***water/air tight well cap*** (e.g., flush mounted well), allow the water level in the well to stabilize. This may be especially important for wells screened in silt and clay (low permeability) formations. Take several measurements to ensure that the water level has stabilized.

☞ Bring along records of previous water level measurements taken on the well.

Electronic Water Level Indicator

1. Lower the decontaminated probe or electrode into the well until the instrument indicates that you've reached the water column.
2. Slowly raise and lower the probe or electrode in and out of the water column until you are satisfied that the instrument is providing a reliable water level reading. If necessary, adjust the instrument's sensitivity according to the manufacturer's instructions.
3. Read the measurement on the cable or tape to the nearest 0.01 foot against the top of casing or reference elevation on the well. Record this measurement as "depth to water."

Popper

1. Lower the decontaminated popper and tape into the well until you hear a "pop," indicating that you've reached the water column.
2. Raise and lower the popper, listening for a repeating "pop" sound. Continue doing this until you are satisfied that you have a reliable reading.
3. Read the measurement on the tape to the nearest 0.01 foot against the top of casing or reference elevation on the well. Record this measurement as "depth to water."
4. You can also use the popper to measure the ***well depth*** by lowering the popper and tape through the water column until the tape becomes slack. Slowly pull the tape up until it just becomes taut again. Read the tape against the top of casing or reference elevation on the well and record this measurement as "depth to well bottom."

Caution! Deep wells, water table wells, high noise areas and floating products in wells may make it difficult to hear the "pop" and collect a reliable "depth to water" reading. Some individuals can "feel" the water surface without hearing a pop; however, if you are not confident you are collecting a reliable reading, use another measuring method.

Indicator Substance

Important Note: If you use a tape coated with an indicator substance, you ***must ensure*** that the indicator substance will not contaminate the well or subsequent samples collected from that well. If you have any doubt, choose another water level measurement method.

1. Coat at least 2 feet of the end of the tape.
2. Lower the coated tape into the well until you hear or feel the tape reach the water column. Lower the tape a few inches into the water and wait at least five seconds.
3. Without moving the tape, read and record the tape measurement to the nearest 0.01 foot against the top of casing or reference elevation on the well.
4. Withdraw the tape from the well and record the measurement where the wetted and dry portions of the tape intersect.
5. Subtract the measurements (Step 3 minus Step 4). Record this measurement as "depth to water."

Alternative Methods

Alternative water level measuring devices or methods are acceptable if they (1) are consistently accurate to ±0.01 foot; (2) do not affect the integrity and chemistry of groundwater samples; (3) do not affect the groundwater geochemistry or well materials; and (4) can be thoroughly decontaminated between wells. Document the type of alternative device or alternative method used. Include this information in the sampling plan and groundwater data reports generated for the site or project. Follow the manufacturer's instructions for the instrument's use and its limitations.

Refer to the *Groundwater Sampling Desk Reference* regarding procedures for using transducers, air-line or bubble tubes, float methods or ultrasonic methods for measuring depth to water in a well.

Calculating Groundwater Elevation

After obtaining depth to water measurements, subtract the "depth to water" from the "top of casing or reference elevation" and record this data as "groundwater elevation."

2.3 MEASURING AND SAMPLING IMMISCIBLE LAYERS

☞ Measure and sample light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liguid (DNAPL) layers ***before*** purging a well.

☞ Disposable equipment (e.g., disposable bailers or disposable peristaltic pump tubing) is recommended because equipment decontamination may be quite difficult.

☞ A single or double check valve bailer works well for LNAPL collection and double check valve bailer works well for DNAPL collection. Peristaltic pumps may also be effective.

Measuring the Thickness of Immiscible Layers

1a. Measure **LNAPL** thickness with either an LNAPL/water interface probe or a weighted tape coated with a water and LNAPL-sensitive substance to distinguish between the air/LNAPL and LNAPL/water interfaces.

1b. You may also measure **DNAPL** thickness with an interface probe.

Sampling Immiscible Layer > 1 foot Thick in Well

<u>Sampling LNAPLs</u>

1. Slowly lower the bailer into the LNAPL, but not into the water, and then bring the LNAPL sample to the surface.
2. If both water and LNAPL are present in the bailer, allow the liquids to separate, then drain the water into a waste container.
3. Fill the sample containers with the remaining LNAPL.

<u>Sampling DNAPLs</u>

1. Slowly lower a double check valve bailer to the bottom of the well and allow it to fill with the DNAPL. ***Slowly*** raise the bailer out of the water column.
2. Drain any sediment-laden DNAPL or water into a waste container.
3. Fill the sample containers with the remaining DNAPL.

Sampling Immiscible Layer < 1 foot Thick in Well

Note: A ***top-filling*** stainless steel bailer or weighted top-filling bailer usually works best. Most bottom emptying bailers can be temporarily sealed at the bottom.

Sampling LNAPLs

1. Use the apparent LNAPL thickness and depth to water sample measurements to determine how far to lower the top of the bailer into the well. Slowly lower the bailer until its ***top*** is in the upper half of the LNAPL's thickness. Allow the bailer to fill with the LNAPL.
2. After a few seconds, raise the bailer out of the well. If both water and LNAPL are present, allow the liquids to separate, then drain the water into a waste container.
3. Fill the sample containers with the LNAPL remaining in the bailer.

Sampling DNAPLs

1. Use the same procedures just described for DNAPLs in layers thicker than 1 foot.

2.4 PURGING AND SAMPLING PROCEDURES

The ***goal of purging*** is either to remove stagnant water from the well or prevent stagnant water from entering samples as you are collecting them. Stagnant water does not represent groundwater.

The ***goal of sampling*** is to collect unaltered samples that represent the physical and chemical composition of groundwater.

☞ Purge and sample wells in order of least-to-most contaminated. (This is not necessary if you use dedicated or disposable equipment.) If you do not know this order, sample the upgradient wells first, then the furthest down-gradient or side-gradient wells, and finally the wells closest to, but down-gradient of the most contaminated area.

☞ Wait at least one week before sampling a newly-constructed and developed well; waiting a month or more may be appropriate for wells constructed in silt or clay.

☞ When using a bailer, purge and sample ***SLOWLY AND CAREFULLY***. Use a bottom-emptying device to decant samples from the bailer.

☞ Do ***not*** use cotton or cloth rope or line; use stainless steel cord, Teflon®-coated cord, nylon, or equivalent cord that can be decontaminated between each well. Or, use disposable rope or line.

☞ Decontaminate all equipment and accessories between use in each well. Store and transport all equipment in clean containers.

☞ Place a clean plastic sheet or other protective covering around the base of the well to prevent the equipment from contacting the ground. If you do not use a protective covering, ensure that your equipment does not touch the ground or a contaminated surface.

Wells that do NOT Purge Dry

This section applies to wells that take less than ~ 1 hour for their water levels to recover, or nearly so, after they have been purged.

The following purging and sampling procedures are recommended for wells that do not purge dry. The first procedure (A) consistently yields the ***highest level of data quality.*** The last procedure (C) may yield a ***lower level of data quality***:

A. Low-flow Purging < 1 L/min (0.26 gpm), Low-flow Sampling < 300 ml/min (0.3 L/min or 0.1 gpm) and Monitoring Indicator Parameters for Stability in a Closed Flow-through Cell

1. SLOWLY lower the pump to the ***middle*** of the well's screened area. (A dedicated system is recommended.) Securely fasten the power cable and sample tubing at the top of the well. Connect the power source, controller box, gas source, etc., to the pumping equipment.

2. Connect the sample tubing to the water entry point of the closed flow-through cell.

   Closed Flow-Through Cell

   Air pockets may exist in the upper neck of each port hole that has a probe inserted into it – this is not a problem. Just make sure the probe's sensors are completely submerged in water during use.

   Avoid exposing the flow-through cell to extreme heat and sun in the summer and freezing temperatures in the winter.

3. Set up and calibrate all indicator parameter instruments and place each probe into its respective port of the closed flow-through cell.

4. Set the pump controller to the desired purging rate (i.e., < 1 L/min). Do ***not*** use a valve to reduce the flow from a pump; valves can cause an "orifice" effect that can cause sample agitation and alteration.

5. Record the "purging time start," and start purging the well at a rate of 1 L/min or less. During purging, the water level in the well should not decrease significantly and should stabilize after purging for a few minutes. If the water level continues to decline while purging, decrease the purging rate if possible. Record the "purging

flow rate" as an average. Use a graduated beaker, cylinder, calibrated bucket or other device to measure the flow rate while purging and sampling.

6a. Purge the well until you have taken at least three consecutive readings, spaced ~ 2 minutes or ~ 0.5 well volumes or more apart, are within the following ranges for the following indicator parameters:

Dissolved Oxygen	± 0.2 mg/L
Specific Conductance	± 5.0 µmhos/cm for values < 1000 µmhos/cm ± 10.0 µmhos/cm for values > 1000 µmhos/cm
pH	± 0.1 pH units
Temperature	± 0.1 °C
Turbidity	< 5 NTUs (***Required*** if metals samples will not be filtered. ***Recommended*** if sorptive compounds or elements are collected. ***Optional***, but recommended, if other compounds or elements are collected).
Eh (***optional***)	± 30 mv

Stable dissolved oxygen, specific conductance and turbidity readings are considered the most reliable parameters for indicating that stagnant water has been replaced by formation water. You may adjust the ± ranges and which indicator parameters you use to indicate that stagnant water has been replaced by formation water to reflect site-specific data, geochemistry, and hydrogeologic conditions.

Turbidity stabilization and NTU readings below 5 are required if you will not be filtering metals samples. In addition, monitor turbidity stabilization when collecting sorptive, hydrophobic, or high octanol-water partition coefficient (Kow) compounds or elements.

OR

6b. Purge the well until the readings for indicator parameters listed above (or well-specific indicator parameters) vary within ±10% over three or more consecutive readings, spaced ~2 minutes or ~ 0.5 well volumes or more apart.

7. Record the final three stable readings for each indicator parameter on the "Well Specific Field Sheet - Monitoring Wells" (Appendix A). Or, use your own customized data sheet. Record indicator parameter data measured before stabilization on graph paper. Or, customize your own data sheet.

8. Record the "volume purged," "purging time stop," "purged dry (Y/N)," and any problems purging.

9. Collect samples as described under Section 2.5. Record "sample flow rate" as an average, "time sample collected," and any other pertinent information related to the sampling event.

B. Purging FOUR Well Volumes with a Standard pump and Sampling with a Pump or Grab Sampler

1. SLOWLY lower the pump to the ***middle*** of the screened area of the well. Securely fasten the power cable and sample tubing. Connect the power source, controller box, gas source, etc., to the pumping equipment.

2. Use **Equation 1** or **Table 1** (see the following this section) to calculate the number of gallons to remove ***four*** well volumes from the well. Record this data as "four well volumes."

3a. Using a **pump** to *purge **and** sample* the well: Record the "purging time start" and start purging the well. Minimize well drawdown; it should stabilize before sampling. If the water level continues to decline during purging, try using a lower purging rate. Use a graduated beaker, cylinder, calibrated bucket or other device to calculate the flow rate while purging and sampling.

3b. Using a **pump** to *purge* the well and then using a **grab sampler** to *sample* the well: Record the "purging time start" and start purging the well with the pump's inlet at the ***top*** of the water column. As you are purging, ***slowly lower the pump*** so that, after four well volumes are purged, the pump's inlet is near the bottom of the well (within ~ 1 foot). ***Important note*:** Before collecting samples with a grab sampler, you must lower the pump while purging the well, thus removing any stagnant water before collecting samples.

4. Record "purging flow rate" as an average, "volume purged," "purging time stop," "purged dry (Y/N)," and any problems purging.

5a. If you use a **pump** to collect samples, the sampling flow rate should be as low as possible, and preferably less than the purging flow rate.

5b. If you use a **grab sampler**, try not to disturb the samples. If you use a bailer, use a bottom-emptying device to decant your samples.

6. Collect samples as described under Section 2.5. Record "sample flow rate" as an average, "time sample collected," and any other pertinent information related to the sampling event.

C. Purging FOUR Well Volumes with a Bailer and then Sampling with a Bailer or Other Grab Sampler

1. Use **Equation 1** or **Table 1** (see the following section) to calculate the number of gallons needed for removing ***four*** well volumes. Record this data as "four well volumes."

2. Record the "purging time start." Lower and raise a decontaminated bailer in and out of the water column ***very slowly*** and purge four well volumes.

   Tip! To hasten purging and sampling with a bailer, tie an overhand knot, string or other easily-removable marker to the rope or cable just short of the well's depth to water. You can then rapidly lower the bailer into the well to just above the water column, then ***gently and slowly*** lower it into, then out of the water column.

3. Use a calibrated bucket or other device to keep track of the volume of water you remove. Purge four well volumes.

4. Record "volume purged," "purging time stop," "purged dry (Y/N)," and any problems purging.

5. Sample the well by ***slowly and gently*** lowering the bailer until it is submerged and in the middle of the well screen. Do not allow the bailer to contact the bottom of the well. ***Very slowly and carefully*** raise the bailer out of the water column and to the surface. Do not bang it against the side of the well (typical of the "helicoptering" technique).

6. Collect samples as described under Section 2.5. Use of a bottom-emptying device to decant samples from a bailer. Record "time sample collected" and any other pertinent information related to the sampling event.

EQUATION 1
Volume to be Purged from a Monitoring Well

$$V = \pi \times (D/2)^2 \times H \times 4 \times 7.48 \text{ gallons/ft}^3$$

Where:

V = Total purge volumes (i.e., four well volumes in gallons)
π = Pi (3.1416)
D = Inside diameter of well casing (feet)
H = Feet of water in well (depth to well bottom minus depth to water)

TABLE 1
Four Well Volumes of Water (in gallons) per One-Foot Section of Well Casing

Nominal casing or pipe size (inch)	Well casing or pipe schedule	Actual inside diameter of well casing (inch)	Four well volumes per one foot of water in well
1	40	1.05	0.18
1	80	0.96	0.15
1.25	40	1.38	0.31
1.25	80	1.28	0.27
1.5	40	1.61	0.42
1.5	80	1.50	0.37
2	5	2.25	0.82
2	40	2.07	0.70
2	80	1.94	0.61
3	40	3.07	1.54
3	80	2.90	1.37
4	5	4.33	3.07
4	40	4.03	2.65
4	80	3.83	2.39

How to calculate four well volumes using Table 1

Step 1: Measure the actual inside diameter of the well casing - find on column three of chart. You may also use the nominal pipe size and schedule in lieu of a measurement.

Step 2: Calculate feet of water in the well casing (depth to well bottom minus depth to water).

Step 3: Multiply step 2 by the applicable value in column four. For example, you have a 2-inch, schedule 40 casing that measures 2.07 inside diameter and you have 20 feet of water (step 2) in the well. Multiply 20 feet by 0.70 (column 4) = 14 gallons; therefore, you must purge 14 gallons from the well before collecting samples.

To Convert:

Gallons to liters, multiply gallons by 3.785
Liters to gallons, multiply liters by 0.2642
Milliliters to gallons, multiply milliliters by 0.0002642
Feet to meters, multiply feet by 0.3048
Centimeters to feet, multiply centimeters by 0.03281

Wells that Purge Dry

This section applies to wells that take ~ 1 or more hours to recover, or nearly so, after they have been purged dry, or nearly so.

A. Low-flow Purging and Sampling in a WATER TABLE WELL (water level intersects the well screen)

1. Slowly lower the pump to the ***lower portion*** of the screened area of the well but without setting it at the very bottom of the well. Secure the power cable and sample tubing. A dedicated system is recommended over a portable system.

2. Record the "purging time start" and start purging the well at < 300 ml/min or <0.1 gpm. Purge until drawdown reaches the top of the pump or until the pump runs dry, then shut the pump off immediately! (***Caution!*** Some pumps can be damaged by running them dry - follow the manufacturer's instructions.) Record the "purging flow rate" as an average.

   Note: A pressure transducer or electric water level indicator can assist in determining when drawdown reaches the top of the pump. If you use an electric water level indicator, lower the probe tip to the well pump and turn the instrument on before pumping. Start pumping, then shut off the pump when the water level indicator shuts off.

3. Allow the well to recover, or nearly so. If time permits, purge the well a second time and allow the water to recover again before sampling. To save time, purge a well the first time, move on to the next well and purge it, then come back to the first well to purge it again before sampling. (With portable equipment - decontaminate first.) Record "volume purged," "purging time stop," "purged dry (Y)," and any problems purging.

4. Collect samples as described under Section 2.5. (Collect samples within 24 hours of purging, if possible.) Record "sampling flow rate" as an average, "time sample collected," and any other pertinent information related to the sampling event.

B. Low-flow Purging and Sampling in a PIEZOMETER (water level is above the top of well screen)

1. SLOWLY lower the pump to the ***lower portion*** of the screened area of the well but do not set the pump on the very bottom of the well. Secure the power cable and sample tubing at the top of the well. A dedicated system is recommended over a portable system.

2. Record the "purging time start" and start purging the well at <300 ml/min or <0.1 gpm. Purge the well until the water level is just below the top of the well screen. (Use a pressure transducer, water level indicator or similar method.) Shut off the

pump and record the "purging flow rate" as an average, "volume purged," "purging time (stop)," "purged dry (Y)," and any problems purging.

3. Allow the well to recover, or nearly so, then begin collecting samples as described under Section 2.5. (Collect samples within 24 hours of purging, if possible.) If the water level in the well reaches the top of the screen before all samples are collected, shut off the pump, allow the well to recover again, then resume collecting the rest of the samples. Record "sample flow rate" as an average, "time samples collected," and any other pertinent information related to the sampling event.

C. Purging and Sampling with a BAILER, or other grab sampler, in a Water Table Well or Piezometer

1. Record "purging time start" and bail the well dry, or nearly so. Take extra care to purge the well very slowly and very gently. Do not allow the bailer to contact the bottom of the well.

2. Allow the well to recover, or nearly so. If time permits, purge the well dry, or nearly so, a second time. Record "volume purged," "purging time stop," "well purged dry (Y)," and any problems purging.

3. Collect samples as described under Section 2.5, within 24 hours of well recovery, if possible. Use a bottom-emptying device to decant samples from the bailer. Record "time sample collected" and any other pertinent information related to the sampling event.

Alternative Methods

Alternative purging and sampling methods and equipment are acceptable if they provide representative groundwater samples. Your purging and sampling method and your equipment must not adversely affect sample integrity, chemistry, temperature and turbidity. In addition, alternative equipment must have minimal or no effect on groundwater geochemistry, aquifer permeability and well materials. Equipment materials must minimize sorption and leaching. Use the equipment in a manner that minimally alters the groundwater samples. If you meet these conditions, WDNR pre-approval is not required; however, verbal or written approval from WDNR is recommended before you use alternative purging and sampling equipment or procedures.

Document and describe any alternative equipment and procedures you use to purge a well and collect samples. Include this information in the sampling plan and groundwater data reports you generate for a site or project.

2.5 SAMPLE COLLECTION

Sample Collection and Filling Procedures

☞ Take in-field water quality measurements before or ***immediately*** after sample collection. (See Section 2.6.)

☞ Open only one sample container or one set of sample containers immediately before filling. Preserve samples within 15 minutes of collection and immediately place on ice.

☞ Minimize the contact of extraneous contamination with sample containers and equipment. Common extraneous contaminants include perfumes, cosmetics, bug spray, sun tan lotion, Sharpie®, spray lubricants (e.g., WD-40®) and engine fumes. Sample up wind or remove extraneous contaminants before opening containers and collecting samples.

☞ Use waterproof labels. Write on them with a permanent, waterproof marking device (e.g., grease pencil). Labels should include:

- ✓ A unique sample number and WUWN (if applicable).
- ✓ Site/project name or other identifier.
- ✓ Date and time sample collected.
- ✓ Sample collectors initials.
- ✓ Type of preservation added and analysis required.

☞ Appendix C includes a table that indicates a substance's potential to volatilize from a water sample during sample collection. Use extra caution when collecting samples that have a "medium" or "high" potential to volatalize from water.

☞ Remember to keep complete and accurate records. Record all field information before proceeding to the next well.

Order of Filling Sample Containers

Collect sample parameters in the following order:

1. Unfiltered samples for in-field water quality measurements. (This is not necessary if you take down-well or closed flow-through cell measurements.)
2. Volatile organic compounds (VOCs).
3. Non-filtered, non-preserved (e.g., sulfate, total chromium VI, mercury, semi- and non-volatiles, pesticides, PCBs).
4. Non-filtered, preserved (e.g., nitrogen series [ammonia, nitrates, nitrites, etc.], phenolics, total phosphorous, total metals, cyanide, total organic carbon).
5. Filtered, non-preserved (e.g., dissolved chromium VI).
6. Filtered, preserved immediately (e.g., dissolved metals)
7. Miscellaneous parameters.

Note: Collect sulfate samples before sulfuric acid preserved samples (e.g., nitrogen series). Collect nitrogen series samples before nitric acid preserved samples (e.g., boron, dissolved metals).

Procedures for Filling Sample Containers

Note: If a sample container already has preservative in it before you fill it (common for VOC vials), do not rinse the container before filling and take care to minimize sample overflow that may dilute the preservative.

1. Tip the sample container at a slight angle and allow a slow steady stream of water to run down its inner wall. Hold the sampling discharge tube close to the sample container but do not touch it.

2. Immediately after filling a sample container, if not already done, add any required preservative (filter first, if required), replace the cap, add the label, and place the sample in a plastic bag (optional) on ice in a cooler.

3. Record the "time sample collected." To avoid confusion, you may wish to record sample collection time in military time (e.g., 1300 instead of 1:00 pm, 1845 instead of 6:45 pm, etc.,)

Volatile Organic Compounds (VOCs)

Note: Do ***not*** filter VOC or other organic samples. Turn off any nearby gasoline engines or sample up wind of any engine exhaust. Remember to store one trip blank per cooler when collecting volatile (VOCs, GRO, and PVOCs) samples. Store empty VOC containers on ice to help you reduce VOC volatilization when you fill them.

1. If a laboratory hasn't already done so, add sufficient preservation to the container.

2. Tip the container at a slight angle and allow a slow, steady stream of water to run down its inner wall.

3. Fill the sample container until the water forms a positive meniscus at the brim, then immediately replace the cap.

4. Invert the sample container and tap it lightly to check for bubbles. If bubbles are present, fill a new sample container (containing preservative) and check for bubbles the same way. If bubbles are unavoidable, collect numerous samples and save those with the least amount of bubbles. Do not try to reopen and add more water to samples that have bubbles.

   Refill a ***used*** container only if you again add sufficient preservative ***and*** refill it with water from the same well, to avoid cross-contamination between samples.

5. Label the sample, place it in a plastic bag (optional), then immediately place it on ice in a cooler. Record the "time sample collected."

Semi-volatiles and Pesticides

When collecting semi-volatiles and pesticides, unless project objectives or regulations require otherwise, use similar, but less rigourous, procedures as those described for collecting VOC samples. Use the same equipment decontamination and storage procedures you use for collecting VOC samples.

When collecting semi-volatiles and pesticides, the type of sample container, volume and preservative may be quite different than that required for VOC samples. In addition, leave approximately ½ inch of air space when filling sample bottles to allow for expansion. Otherwise, the bottles may break.

> *Note:* The number of sample bottles required depends on the number of different extraction, clean-up, analytical methods and quality control (QC) needed for the project. Remember that laboratories are required to duplicate and spike samples at a set frequency. Collecting insufficient sample volumes may result in higher detection limits, because sample volume must be reduced to accommodate QC requirements.

Inorganics

Inorganic samples (e.g., dissolved metals) are quite susceptible to aeration, oxidation, precipitation, coprecipitation, extraneous contamination and cross-contamination during sampling, filtering and handling. Therefore, take extra care to avoid sample aeration before filtering (if required) and preserving. Unless WDNR requires or approves otherwise, ***field filter*** inorganic samples and ***preserve immediately*** after collection. Refer to Section 2.7 regarding filtering procedures.

Other Sample Parameters

Other sample parameters subject to rapid change (by aeration and subsequent changes in redox state, or addition or loss of dissolved gasses) once groundwater is removed from a well include: chromium VI, pH, Eh, oxygen, inorganic carbon, alkalinity, TOC, ammonium, nitrate/nitrite, sulfide, cyanide, molybdenum, mercury, selenium, dissolved iron (ferrous iron - FE^{+2}), manganese, zinc, cadmium, lead, vanadium, arsenic and phosphate. Take precautions to avoid altering these parameters during sampling. Add preservative, if required, ***immediately*** and place on ice in a cooler.

For those interested in monitoring indicators of biodegredation that may be occurring in groundwater at a site, use a field test kit (e.g., colorimetric), sensor probe or other field test (e.g., portable gas chromatogram) to quantify pH, dissolved oxygen, nitrate, sulfate, ferrous iron, redox potential and manganese ***in the field*** immediately after sample collection. In addition, alkalinity, methane and carbon dioxide should be measured in the field immediately after collection, or less preferably, in the laboratory.

Contact a qualified laboratory for specific directions on collecting, preserving and handling samples not discussed in this manual.

2.6 FIELD WATER QUALITY MEASUREMENTS

☞ Use a closed flow-through cell. Or, you can use a down well measuring probe; however, well water must be flowing past the probe during measurements (i.e., the probe is near the pump's inlet during purging or is lowered and raised in the screened portion of the well).

☞ If you do not use a closed flow-through cell or a down-well probe, take in-field measurements immediately, or less preferably, within 30 minutes of collection.

☞ Avoid exposing instruments and samples to extreme heat or cold.

☞ Specific conductance, pH, dissolved oxygen and Eh can change rapidly due to aeration, oxidation and the loss or gain of dissolved gasses as you remove groundwater from a well. Minimize atmospheric contact with the sample.

Following are procedures for "***out of the well***" (i.e., closed flow-through cell or sample bottle) water quality measurements. Your equipment's operation manual may deviate from guidelines provided here. Follow the manufacturer's instructions for your instrument and familiarize yourself with the methodology in the most recent version of *Standard Methods for the Examination of Water and Wastewater*.

Temperature

1. Place the thermometer or probe into a closed flow-through cell or sample bottle and allow the purge water to continuously flow past the thermometer or probe. If you use a sample bottle, allow the water to overflow while measuring temperature.

2. Allow the thermometer or probe to equilibrate with the water for a minute or more, then record the temperature. Do not remove the thermometer or probe from the water when taking the reading.

3. Decontaminate the thermometer or probe and store properly.

Specific Conductance (conductivity and electric conductance)

Note: Measure specific conductance ***before*** pH (unless using a flow-through cell). In addition, as specific conductance is a temperature sensitive measurement, adjust readings to 25°C.

1. Calibrate the conductivity instrument and probe against a standard potassium chloride (KCl) solution. Do this in the field, or less preferably, in the laboratory. Calibrate the instrument according to the manufacturer's instructions. Recalibrate at least daily; more often is recommended and prudent. Record calibration data.

2. If required, set the instrument to the anticipated range for measurement (e.g., *x*100 µmhos/cm).

3a. If your instrument ***automatically compensates for temperature***, record the measurement as "field specific conductance at 25°C." Don't forget to multiply the measurement by the range at which the instrument is set.

3b. If your instrument ***does not automatically compensate for temperature***, measure the temperature of the sample and set the instrument's temperature dial to the sample temperature. Record the measurement as the "field specific conductance at 25°C." Don't forget to multiply the measurement by the range at which the instrument is set.

3c. If your instrument cannot compensate for temperature, apply a correction factor as specified in the manufacturer's instructions or by using the following formula:

$$\textbf{specific conductance @ 25°C} = \frac{\textbf{sample conductivity (µmhos/cm)}}{\textbf{1 + 0.0191 } x \textbf{ (sample temp. in °C - 25)}}$$

Note: Conductivity meters that do not automatically correct readings to 25°C usually include a conversion table or chart for correcting data to 25°C.

4. Decontaminate the electrode and store properly.

Note: Most problems related to collecting poor conductivity data include: weak batteries; fouling of the electrode (chemical cleaning may be necessary); insufficient submersion of the probe into the sample; allowing the probe to touch the container walls; improper or no instrument calibration; not allowing the probe to equalize with the sample temperature; and improperly or not converting readings to 25°C.

pH

1. Calibrate the pH instrument with pH buffer solutions that span the range of expected groundwater pH values. Two fresh pH buffer solutions (7.00 and 4.00 ***or*** 7.00 and 10.00) having temperatures within 5°C of the groundwater samples are required for instrument calibration. Properly fill the probe with a salt solution, if required. Follow the manufacturer's instructions for the procedures and frequency of instrument calibration. Calibrate the instrument at least daily; more often is recommended and prudent. Record calibration data.

2a. Place the calibrated pH probe into a closed flow-through cell and allow the purge water to continuously flow past the probe.

2b. If you measure pH from a sample container, fill a container for this measurement ***only***. Do not insert a pH probe into a sample that will later be analyzed for other parameters.

3. Allow the pH probe to equilibrate with the water for a minute or more, then record pH. Do not remove the pH probe from the water while taking the reading. Read pH measurements to the nearest 0.1 pH units.

4. Rinse the pH probe with reagent grade water and store in the buffer solution or as recommended by the equipment's manufacturer.

Turbidity

Measure the turbidity of a sample the same day you collect it, preferably in the field immediately after collection.

If you cannot measure sample turbidity soon after collection, you may store samples in the dark for up to 24 hours before measuring turbidity. Shake the sample vigorously before measuring. *Standard Methods for the Examination of Water and Wastewater* discusses interferences and procedures for measuring turbidity.

1a. Use a turbidity meter according to the manufacturer's instructions. Read turbidity to the nearest 0.1 Nephelometric Turbidity Unit (NTU) and record your measurement. In addition, provide this measurement to the laboratory if any well samples will be analyzed for metals.

1b. When you do not use a turbidity meter, describe the turbidity (e.g., slight, moderate) and record your observations or have a laboratory determine sample turbidity within 24 hours of sample collection.

Dissolved Oxygen

You can measure dissolved oxygen (DO) with an electrometric method (dissolved oxygen meter), colorimetric method, the Winkler method, or with the iodometric method. (See most recent version of *Standard Methods for the Examination of Water and Wastewater.*) Dissolved oxygen meters usually require calibration before use and a visual check of the probe to verify that the membrane is not damaged.

To function properly, most DO probes require that water continuously flow past the membrane while measurements are being taken. Therefore, for down-well measurements of DO after purging a well, use either a DO probe equipped with a stirring rod or, less preferably, slowly raise and lower the probe in the water column while taking readings. If you use a DO probe on a water sample removed from the well, either use a probe equipped with a stirring rod or, while purging the well, allow the purge water to overflow from the sample container while taking DO readings.

If your DO meter is not responding as expected or is very sluggish, you may need to change the probe's membrane; follow the manufacturer's instructions for doing this. Lowering a probe into a deep well may also result in sluggish performance because signal strength weakens with cable distance.

Color

1. Note the color against a white background. If filtering is required, note the color ***after*** filtering. Document whether you noted sample color for a filtered or nonfiltered sample.
2. Describe the color by common descriptors (e.g., light gray), or use an industry-recognized and standardized color description method (e.g., a color comparison disk for water). Record your observations.

Odor

Important Note: WDNR neither requires nor advocates smelling groundwater samples.

1a. If you do not know the type and approximate concentration of substances in a sample, do ***not*** attempt to smell it. Record sample odor only if you notice it unintentionally.

1b. If the type and concentration of substances are known and below safe values as established by Occupational Safety and Health Association (OSHA) or the National Institute for Occupational Safety and Health (NIOSH) *Pocket Guide to Chemical Hazards*, carefully wave your hand over the sample and note any distinct odor. Do not "stick your nose" in the sample to check for odor. Record any noticeable odor (e.g., pungent, solvent).

Eh (Oxidation-reduction potential)

Eh is usually measured with a noble metal (e.g., platinum) and a reference electrode system using a pH meter that reads millivolts. Take field measurements of Eh in an air-tight flow-through cell or similar air-tight device. Read Eh measurements to the nearest 10 millivolts (mV).

Follow the equipment manufacturer's instructions and refer to the most recent version of *Standard Methods for the Examination of Water and Wastewater.*

Other Water Quality Measurements

Other water quality measurements that may change physically and chemically soon after collection include dissolved carbon dioxide and alkalinity. These parameters are best measured in-field and immediately after collection. Follow the equipment manufacturer's instructions and the most recent version of *Standard Methods for the Examination of Water and Wastewater* for measuring these parameters.

2.7 SAMPLE FILTRATION

☞ WDNR ***strongly recommends*** direct, in-line filtering of samples. It is fast, simple and greatly reduces sample alteration. Direct, in-line filtering means that you attach the filter ***directly*** to a pump's discharge line or to the discharge tube of a grab sampler (e.g., bailer). If you place a sample into any type of container or transfer vessel before filtering, any filtering that follows is not direct, in-line filtering.

☞ If you do not use direct, in-line filtration, filter samples ***immediately*** after collection, document when you filtered the samples.

☞ Use a 0.45 micron pore size filter membrane for filtering. If possible, rinse or flush the filter membrane and filtering device with a minimum of 0.5 liters (500 mls) of reagent grade water before use.

☞ Avoid applying high pressure (>50 psi) when filtering samples. For silt-laden or turbid samples, try using a pre-filter (e.g., glass microfiber), a filter membrane of larger diameter or larger surface area, or a slower pumping rate or bailing technique. If high turbidity is a recurring problem, the well may need to be redeveloped or rehabilitated.

☞ If possible, allow 150 mls or so of sample to pass through the filtering device before filling sample containers. If possible, rinse sample containers once with filtrate.

Filtration Procedures

IMPORTANT: ***Immediately*** after or during collection, ***field filter*** samples collected for metals analyses. There are three exceptions:

1) Total metals results are required. This requirement may be in a Wastewater permit, administrative rule, sampling contract or other requirement or agreement.

2) WDNR grants a verbal or written approval to the responsible party, or its representative, allowing unfiltered metal sample results.

3) Low-flow sampling procedures are used, three consecutive in-field turbidity readings (spaced ~2 minutes or ~ 0.5 well volumes or more apart) are all 5 NTUs or less ***and*** WDNR grants verbal or written approval to the responsible party, or its representative, allowing unfiltered metal sample results.

A. Low-flow Purging and Sampling, NO FILTRATION and Three Consecutive Turbidity Readings of 5 NTUs or less

This procedure involves purging a well at 1 L/min (0.26 gpm) or less and sampling the well at 300 ml/min (0.3 L/min or 0.1 gpm) or less. The sample does not require filtering if low-flow sampling procedures are used, three consecutive in-field turbidity readings (spaced ~2 minutes or ~ 0.5 well volumes or more apart) are all 5 NTUs or less ***and***

WDNR grants verbal or written approval to the responsible party, or its representative, allowing unfiltered metal sample results. Record that the samples were not filtered and that they have turbidity readings of 5 NTUs or less.

Under this scenario, purging and sampling rates should be at or less than natural flow conditions existing in the aquifer. Low turbidity values (<5 NTUs) for the sample should reflect the naturally mobile colloids and particulates moving through the groundwater.

B. Low-flow Purging and Sampling, and Direct, In-line Filtration

1. After completing well purging as described under Section 2.4, reduce the pumping rate as low as possible to deliver a slow discharge. Do not use a valve to reduce the flow rate.
2. Attach the direct, in-line filter ***directly*** to the pump's discharge line. (If applicable, remove the sample tubing from the flow-through cell first.)
3. Discard the first 150 mls or so of filtered sample. Collect the subsequent filtered samples into appropriate sample containers.
4. Immediately preserve the samples, replace the cap, label the samples, and place them on ice in a cooler.
5. Record "sample field filtered (Y)" and the "time samples filtered." Dispose of the used in-line filter - ***do not*** reuse it.

C. Purging and Sampling with a Bailer and Direct, In-line Filtration

1. Purge and sample the well as described under Section 2.4.
2. Connect the direct, in-line filter to the bailer as described by the manufacturer's instructions. Pressure-fed systems are recommended over gravity-fed systems.
3. If the bailer's volume allows, discard the first 150 mls or so of filtered sample. Collect the subsequent filtered samples into appropriate sample containers.
4. Immediately preserve the samples, replace the cap, label the samples and place them on ice in a cooler.
5. Record "sample field filtered (Y)" and the "time samples filtered." Dispose of the used in-line filter - ***do not*** reuse it.

D. Sample Transfer and Pressure Filtration: Field Filtering Immediately After Sample Collection

Note: Use positive pressure filtration rather than vacuum filtration, which causes excessive sample aeration and agitation.

1a. If you use a **self-contained filtering device**, gently pour the sample (preferably directly from the pump's or grab sampler's discharge line) directly into the self-contained device fitted with a disposable filter membrane. Attach the pressure line to the device.

1b. If you use a **transfer vessel**, gently pour the sample (preferably directly from the pump's or grab sampler's discharge line) into the transfer vessel. Set up the reusable filtering device with a disposable filter membrane or use a disposable, in-line filter in conjunction with the transfer vessel.

Note: Some laboratories may recommend a dilute nitric acid/reagent grade water rinse of the filtering equipment (i.e., described in "1a" and "1b") to prevent extraneous contamination of filtered samples.

2. If you have sufficient sample volume, discard the first 150 mls or so of filtered sample. Collect the rest of the filtered sample into appropriate sample containers.

3. Immediately preserve the samples, replace the cap, label the samples and place them on ice in a cooler. Record "time samples filtered" and "samples field filtered (Y)."

4. Dispose of the used filter membrane - ***do not*** reuse it. Decontaminate the transfer vessel and filtering device and store for later use.

E. Sample Transfer and Filtration: Field Filtering NOT Done Immediately or Sample is Filtered Later in a Laboratory

Unless the parameters being collected are not subject to change during sample storage (e.g., changes in dissolved gas content, pH, Eh, redox potential, and dissolved/solid phases), filter samples in the field ***immediately*** after collection. If a sample is not subject to change and is held for extended periods of time, filtering may be done later. Record the filtering place, time and method.

Alternative Methods

Alternative filtration techniques are acceptable if you use a 0.45 micron pore size filter membrane that is nonsorptive and does not leach contaminants into the sample. The materials and operation of the filtering device must have little or no physical or chemical effect on the sample being filtered. Follow the manufacturer's instructions for proper use.

Document and describe the device, membrane and procedure used for filtering. This information must appear in your sampling plan and groundwater data reports for a site or project.

2.8 SAMPLE PRESERVATION AND HANDLING

Sample Preservation

Appendix C includes sample preservation for a variety of compounds and parameters. You may add preservative to sample bottles before or immediately after sample collection. (Filter the sample, if required, before adding preservative.) If you add preservative to a container before adding the sample, take care to minimize sample overflow that may dilute the preservative.

Checking and Adjusting the pH of a Preserved Sample

Note: Do ***not*** check the pH of VOC samples.

When using a pH meter to check the pH of a preserved sample, follow these procedures:

1. If applicable, check and fill the reference electrode with solution as recommended by the instrument's manufacturer.

2. Calibrate the instrument according to the manufacturer's instruction. Two fresh pH buffer solutions (7.00 and 4.00 ***or*** 7.00 and 10.00) having temperatures within 5°C of the groundwater samples are typically required for instrument calibration.

3. Pour a small portion of the preserved sample into a separate container. Immerse the electrode into the separate container and wait for the reading to stabilize. Do not swirl or stir the electrode while taking the reading unless recommended by the manufacturer.

4a. If sample pH needs adjustment, add additional preservative to the original sample and repeat Step 3.

4b. If sample pH is acceptable, dispose of the separate sample (do ***not*** pour it back into the original sample container), replace the lid on the original sample and place it on ice in a cooler.

5. Rinse the electrode with reagent grade water and store the electrode in the buffer solution or as recommended by the manufacturer.

When using pH paper to check the pH of a preserved sample, follow these procedures:

1. Gently tip the sample container on its side to wet the inside of the lid and remove the lid.

2. Touch the pH paper to the droplets inside the lid and read the pH. Do ***not*** put the pH paper directly into the sample container. Compare the color of the pH paper to color-pH provided by the manufacturer.

3a. If sample pH needs adjustment, add additional preservative to the sample, rinse the container lid with reagent grade water, replace the container lid and repeat Steps 1 and 2.

3b. If sample pH is acceptable, rinse the container lid with reagent grade water, shake the lid to remove any excess water and replace the lid.

Sample Handling and Storage

After samples are collected, filtered (if required), labeled and preserved (if required), they must be placed ***immediately*** on ice. Keep samples at or below 4°C, but above freezing throughout storage, handling and shipping. Make sure there is enough ice for the duration of sample storage and transport. WDNR ***discourages*** using frozen cold packs (e.g., "blue ice"). If you do use them, place a temperature blank in the cooler so the laboratory can document the temperature of the samples when they arrive.

Breakable sample containers (e.g., glass VOC vials) should be separated by bubble wrap, foam, ice, etc. At least a portion of each container must contact the ice, otherwise the protective layer (e.g., bubble wrap) may insulate the sample from the cooling effects of the ice. Placing samples in a plastic bag can help minimize the chance of cross-contamination among samples should a container break.

2.9 QUALITY ASSURANCE/QUALITY CONTROL

☞ Field QA/QC efforts must match the data quality objectives established or required for the project and sampling event.

☞ Remember that QA/QC procedures and samples are not optional. Each WDNR program may have different QA/QC requirements. Check WDNR program guidance or contact a WDNR project manager for details.

☞ All QA/QC samples must be collected, handled and processed in the ***same exact manner*** as the other analytical samples being collected. Make sure the laboratory receives sufficient sample volumes or additional containers to perform required QC procedures.

☞ All purging, sampling and decontamination wastewaters and materials must be stored, handled and disposed of properly. Contact your WDNR project manager or WDNR program for details.

Quality Control Samples

Trip Blank

Include one trip blank per cooler if collecting volatiles (i.e., VOCs, GRO, or PVOCs). Prepare trip blanks with laboratory ***reagent grade water***. ***Do not*** prepare them with water (even if distilled or deionized) purchased at a store; there is no guarantee that store-bought water is free of contamination. Trip blanks must be analyzed by the same laboratory that is analyzing the volatile samples. The trip blanks should not be opened until they are analyzed.

WDNR typically requires one trip blank per vehicle and one trip blank per cooler. Store, transport and ship all volatile samples in one cooler to minimize the number of trip blanks.

Note: If holding times permit, trip blanks do not need to be analyzed if VOC, GRO and PVOC compounds are not detected in ***any*** of the groundwater samples. The holding time for a trip blank begins when groundwater samples are being collected.

Field Blank (field rinsate blank, decontamination blank, equipment blank)

Collect one field blank for every 10 samples or less collected. Decontaminate the sampling equipment for the field blank the same way you do when collecting other samples. After decontaminating the sampling device (e.g., bailer or pump), fill it with laboratory ***reagent grade water***, then collect a sample of the reagent grade water - this is your field blank. Collect the field blank from equipment used in a site's most contaminated well, if possible. The field blank should be analyzed for the same parameters as the samples. Field blanks are ***not*** required if you use dedicated sampling equipment ("permanently" left in the well) or disposable sampling equipment.

Field Duplicate

Collect one field duplicate for every 10 samples or less collected. Collect the field duplicate from the most contaminated well, if possible. The field duplicate should be analyzed for the same parameters as the samples. When using a grab sampler (e.g., bailer), collect the duplicate from the same bailer of water as the original sample is collected, bailer volume permitting.

Field Split Samples

Typically not required. Collect the sample from the well, filter if required, and dispense into two or more containers. Preserve the samples if required and send them to separate laboratories for analysis. The samples must be analyzed by identical laboratory analytical methods to be comparable.

Sequential Samples

Typically not required. Sequential samples are taken from the same well during the same sampling event but are collected with different equipment or procedures. These samples can be used to detect variability in analytical results caused by different sampling equipment or procedures.

Equipment Decontamination

Check with your laboratory for recommended equipment cleaning solutions and procedures for each analyte you are sampling. Collection of inorganic compounds may necessitate a dilute acid equipment rinse first. Collection of organic compounds may require a pesticide grade isopropanol, acetone, methanol or hexane equipment rinse. If you use pesticide grade hexane, take extra safety precautions because hexane is quite flammable. Use your professional judgment to decide which of the following procedures to use:

Minimum Decontamination Procedures

1. Disassemble the equipment if possible. Use a weak non-phosphate detergent (e.g., Alquinox®, Liquinox®) and water solution, and scrub the equipment inside and out. Visually inspect the equipment to ensure no visible contamination is present.

   Note: If welfare or indicator parameters (Table 2 and 3, respectively, of ch. NR 140), or non-sorptive elements or compounds are the only contaminants to come in contact with the equipment, Step 1 may not be necessary. Consult with WDNR staff if you are uncertain.

2. Thoroughly rinse the equipment with organic-free tap water. Reassemble the equipment, if applicable.

3. Store and transport the equipment in clean plastic, aluminum foil, or a container that will protect the equipment from extraneous contamination.

More Rigorous Decontamination Procedures

1. Wash equipment with a non-phosphate detergent solution and scrub with an inert brush. For internal mechanisms and tubing, circulate the detergent solution through the equipment.

2. Thoroughly rinse the equipment with organic-free tap water.

3a. For ***organic*** (e.g., VOCs) sample collection, rinse equipment with an organic desorbing agent (e.g., pesticide grade isopropanol, acetone, methanol or hexane).

3b. For ***inorganic*** sample collection, rinse equipment with inorganic desorbing agent (e.g., dilute [0.1 Normal] reagent grade hydrochloric acid or nitric acid solution). For stainless steel and low-carbon steel, a more dilute hydrochloric acid solution (1 percent) is recommended.

Note: If you use organic or inorganic desorbing agents, check with your laboratory regarding potential analytical interferences caused by desorbing agents and their proper use and disposal.

4. Rinse the equipment with organic-free tap water only if you are using an ***inorganic*** desorbing agent.

5. Rinse with laboratory reagent grade water. If practical, allow the equipment to air dry before its next use or storage.

6. Store and transport the equipment in clean plastic, aluminum foil or a container that will protect it from extraneous contamination.

Other decontamination methods such as high pressure steam cleaning, hot-water power wash, ultrasonic cleaning and other methods decontaminate most equipment satisfactorily. Refer to the manufacturer's instructions for use.

Note: Dedicated sampling equipment ("permanently" left in the well) significantly reduces the need for equipment decontamination. Sampling equipment used in wells containing free product should be dedicated (suspended above the water column) or disposable.

Sample Tracking, Security and Chain of Custody Procedures

Sample tracking, security and chain of custody procedures provide a legal record of sample transport, possession and handling.

Sample Identification

Use waterproof labels or a similar method to identify each sample container. Use a permanent waterproof marker. Avoid placing labels on container lids; however, if you do place a label on a lid, make sure it's attached to the container as well. Labels should include the following information:

✓ a unique sample number and WUWN (if applicable)
✓ site/project name
✓ date and time sample collected
✓ sample collectors initials
✓ preservation and analysis required

Sample Seals

Some sampling protocols require sample seals. Affix the seal to the sample container so that it has to be broken to open the container. Write your initials, the date and time on the seal.

Shipping Custody Seal

Use tape or a lock to seal the container for shipping. If you use tape, write your signature, the date and time on the tape.

Chain of Custody Record

Complete a chain of custody (COC) record for each sampling event. Each time the samples change possession, whoever relinquishes and whoever receives the samples must sign, date and time the chain of custody form.

> *Note:* If you place the chain of custody record in a sealed shipper, you do not need to have the commercial courier (e.g., UPS) sign, date and time the record; however, the courier should have a record of when he or she picked up the samples and where they were sent.

Appendix A includes an example chain of custody form. Check with the WDNR program, WDNR project manager, and the laboratory for more specific chain of custody procedures or forms required. Appendix C contains "Chain of Custody for Samples Requiring Strict Custody" when collecting enforcement samples.

3.0 SAMPLING PROCEDURES FOR WATER SUPPLY WELLS

Important note: This section addresses the collection and measurement of ***raw, untreated groundwater samples*** from water supply wells. Ch. NR 809 and SDWA compliance monitoring and sampling are beyond this manual's scope and intent; contact a WDNR water supply specialist or investigator when collecting these samples.

3.1 PRE-FIELD CHECKLISTS AND DOCUMENTATION

Pre-field Checklists (Included in Appendix B)

Go through the following two checklists before heading out to the field. You can modify these checklists to meet specific project needs.

1. Pre-field Work Procedures Checklist - Water Supply Wells.
2. Equipment Checklist - Water Supply Well Sampling.

Documentation of the Sampling Event

1. **Sampling Plan.** The sampling plan documents equipment and procedures used during a sampling event. All sampling personnel must read it before heading out to the field and must bring it to each sampling event. Any deviations from the sampling plan must be documented on the "Field Procedures Documentation" sheet included in Appendix B, or on a customized documentation sheet.

2. **Well-Specific Field Sheet - Water Supply Wells (Appendix B).** Document well information, purging and sampling information, measurements, etc., on this sheet or customize your own data sheet.

3. **Field Procedures Documentation (Appendix B).** If a sampling plan is not available, you can use the "Field Procedures Documentation" sheet included in Appendix B. Customize this sheet to meet specific needs.

4. **Groundwater Monitoring Inventory Form (Appendix B).** Complete this form if a well has not previously been monitored. This form documents information about the well so it can be entered into WDNR's computerized data base.

5. **Assigning a Wisconsin Unique Well Number (WUWN).** All public and private water supply wells must be documented with a WUWN. Each well must have only ***one*** WUWN. Refer to Section 3.2 for WUWN private well labeling procedures.

6. **Chain of Custody Form (Appendix B).** Document the procession of samples collected from water supply wells by completing a chain of custody form and documenting each time the samples change procession.

3.2 INITIAL PROCEDURES

Coordination with the Well Owner/Operator

1. Call the well owner/operator at least 24 hours before you plan to collect measurements and samples from the well. If you are sampling a private or domestic well, call the well owner at least one week in advance. Briefly explain to the well owner what you plan to do and why. Explain your procedures for measuring the water level, well casing depth and total well depth, and for collecting any samples.

2. If the well owner/operator allows you to perform these measurements, ask if it is all right to add chlorine or an alternative disinfectant to the well after taking the measurements. Explain to the owner why disinfection is essential and what disinfection technique you plan to use. If the owner rejects having the well disinfected, do not take measurements on the well. If obtaining measurements is crucial, ask an appropriate WDNR representative in the Bureau of Drinking Water and Groundwater to talk to the well owner to further explain the necessity of the measurements and that the well will be properly disinfected afterwards.

3. If the well owner/operator allows measurements and disinfection of the well, ask the well owner/operator to use a minimal amount of water in the morning/afternoon before your arrival, so the water level in the well recovers before being measured.

4. Before collecting any water level, well casing depth or well depth measurements, ask the well owner to turn off the pump to avoid an electrical hazard and to prevent the pump from starting when you are collecting measurements.

Initial Coliform Bacteria Testing

Before performing ***any*** tasks on the well, collect a water sample for coliform bacteria analysis using sampling procedures described under Section 3.7.

Wisconsin Unique Well Number (WUWN) Labeling Procedures

1. Determine if the well already has a WUWN - this is ***absolutely*** necessary to ensure that each well has ***only one*** WUWN assigned to it! WDNR water supply specialists/investigators at WDNR regional offices can tell you which water supply wells already have a WUWN - ask them for the most up-to-date list.

2. Determine which type of WUWN label is needed for the private well (i.e., printronix, blank, and preprinted labels). If you are uncertain which label is required, refer to the *Groundwater Sampling Desk Reference* or contact a WDNR regional office water supply specialist/investigator. If you assign a WUWN to a private well, you must fill out a "Groundwater Monitoring Inventory Form" (Form 330-67 Rev. 12-92), and send it to the Bureau of Drinking Water and Groundwater, P.O. Box 7921, Madison, WI 53707-7921.

3. If the well owner consents to it, you should place WUWN labels on the well's fuse box and sampling tap. Attach one of the WUWN labels to the home's main electric fuse box. Attach a second label to the pipe next to the sampling tap located ***before*** the pressure tank. Wipe the pipe as clean and dry as possible and wrap duct tape around the pipe to provide a dry surface to affix the label. Attach the label horizontally to the duct tape.

   Note: While public water supply wells have WUWNs assigned to them, they normally do ***not*** have WUWN labels placed on them unless requested by the public water utility, in which case a specialized label is provided. Contact the Bureau of Drinking Water and Groundwater in Madison for further details.

3.3 MEASURING WATER LEVEL, CASING DEPTH AND TOTAL WELL DEPTH

☞ Measure the water level, well casing depth, and total well depth only after receiving training from someone experienced in the proper procedures. If the well has a pitless adaptor, it may be impossible to collect these measurements.

☞ If available, use a well construction log to obtain well casing depth and total well depth information. If this information is not available, you may need to remove the well's pump, if the well owner permits, before measuring well casing depth or total well depth. Use ***extreme care*** so as not to damage or contaminate the well or pump. A licensed well driller, arranged for far in advance, should remove and replace the pump.

☞ Before taking any well measurements, ask the well owner/operator to turn off the pump. This is for your own personal safety and to protect the pump from damage as equipment is lowered into the well. Make sure the well and wiring are not damaged during measuring and sampling.

Disinfection Procedures for Equipment

Important Note: Before placing ***any*** equipment into a water supply well, potable or non-potable, properly disinfect the equipment.

1. Disinfect all equipment before and after placing it into the well to prevent the introduction of coliform bacteria, iron bacteria, or any other source of contamination.

2. Rinse all equipment parts inside and out that will enter the well (e.g., steel tape, water level indicator, weighted magnet, etc.,). Rinse with a dilute chlorine solution, about 50 ppm, i.e., about 2 capfuls of liquid chlorine bleach to 1 gallon of water. The liquid chlorine bleach must not contain any additives such as "fresh scent." You may also use dry calcium hypochlorite granules to make the chlorine solution.

3. If there are no inside parts that may become contaminated, you may use a clean cloth or paper towels soaked in a dilute chlorine solution to sterilize your equipment. Do not reuse the towels.

4. Place disinfected equipment on a clean cloth or on plastic, not on bare ground.

Measuring Water Level

Note: Refer to Section 2.2 when using an electric water level indicator, popper or coated tape to measure the static water level in a well.

1. Take a series of water level measurements to determine if the well is still recovering. If at least three consecutive readings separated by a minute or more are within ± 0.01 foot, then use this as your reading. Record the reading and method used to collect this measurement. Disinfect the equipment.

2. If you are taking water level measurements to determine groundwater elevations, mark the side of the casing where the water level is measured to provide a marking point for surveying.

Measuring Well Casing Depth

1. Use a weighted magnet that is strong enough to cling to the steel casing but will also slide down it. The tape or cable should be calibrated and marked to tenths of a foot.

2. Lower the disinfected magnet, which is attached to a marked disinfected cable, along the steel casing until the magnet slips off the end of the casing.

3. Measure the length of the steel casing to it top. Repeat this process until you are satisfied you have a reliable reading.

4. Record this measurement and the method used for collecting it. Disinfect the equipment and store properly.

Measuring Total Well Depth

1. Measure the total well depth with a weighted synthetic tape or cord (***not*** cotton or cloth) calibrated and marked to tenths of a foot. Any tape or cord used must have very little or no stretch under tension.

2. Lower the disinfected weighted tape or cord through the water column until it becomes slack. Slowly pull the tape or cord until it just becomes taut.

3. Read the tape against the top of the well casing to the nearest 0.1 foot and record the measurement. Disinfect the equipment and store properly.

Disinfection of Well after Measurements

Properly disinfect the well after taking any measurements. While there are no formal standards for proper concentrations of the chlorine disinfection solution, a 50 ppm chlorine solution should be adequate for chlorinating wells as a preventive assurance method.

After Water Level Measurements

1. Pour one cup of full-strength liquid chlorine bleach or drop three to five HTH tablets down the well to disinfect 20 feet of standing water in a 6-inch diameter well. Reseal the well.

2. Allow the solution to remain in the well at least 30 minutes, although at least 8 hours is recommended.

3. Tell the well owner/user to run all taps until the chlorine odor and taste disappear (usually less than one hour).

After Well Casing and Total Well Depth Measurements

If you are measuring only the well casing depth, the amount of 50 ppm chlorine solution you need to displace the affected portion of the well will depend upon how far you lower the magnet into the water. If measuring total well depth, disinfect the entire well by displacing all water out of the well. The total amount of 50 ppm chorine solution to add will depend upon the diameter, depth, and amount of water in the well. For a 50 ppm chlorine solution made from common household bleach (approx. 5 percent available chlorine as sodium hypochlorite):

> Add about 1 gallon of bleach (no additives) to 1,000 gallons of water or about 1 pint of bleach to 125 gallons of water.

For a 50 ppm chlorine solution made from dry calcium hypochlorite (approx. 70 percent available chlorine):

> Add about 1 pound (approx. 16 oz.) of dry hypochlorite to 1,000 gallons of water or about 0.1 pounds (approx. 2 oz.) to 100 gallons of water.

Approximate amount of chlorine solution (CS) to displace the water in a well:

2" diameter well	Add 2 gallons of CS per 10 feet of well water
4" diameter well	Add 7 gallons of CS per 10 feet of well water
6" diameter well	Add 15 gallons of CS per 10 feet of well water
8" diameter well	Add 25 gallons of CS per 10 feet of well water

1. Mix the appropriate amount of chlorine solution for the volume of water to be displaced.

2. Pour the entire chlorine solution, in a circular motion, down the well's inside casing, pump equipment and wiring. Reseal the well.

3. Activate the well pump and turn on all taps, both hot and cold, until you detect a bleach smell at each tap, then shutoff all taps. To save energy, turn off the hot water heater.

4. Allow the chlorine solution to remain in the well and piping at least 8 to 12 hours, preferably 24 hours, to ensure that the well and piping are thoroughly disinfected.

5. After at least 8 hours, tell the well owner to flush the well and piping system free of the chlorine solution.

Discharge of Chlorinated Water

Unfortunately, there really is no good place to discharge the chlorine solution that comes out of the well and faucets. Do not discharge the solution directly to a lake, stream, wetland, lawn, garden, sanitary or storm sewer. Large quantities of chlorine may disrupt a septic system. Discharge the pumped water to an area that will not harm fish or sensitive plants.

Probably the best place to discharge the chlorine solution is onto a driveway or other paved area, preferably on a hot, sunny day so the solution can evaporate. Discharging the chlorinated solution to a ditch may also be appropriate.

Post Disinfection Coliform Bacteria Testing Procedures

After the system is ***completely*** free of any chlorine smell and taste, and after waiting several days to a week, collect a second coliform bacteria sample (refer to Section 3.7) from the same tap as the first sample. Properly-trained well owners, WDNR staff, local health staff or special consultants may collect the sample. When collecting post-disinfection coliform samples, you may need to use a thiosulfate sample bottle since a chlorine residual may remain in the well.

If either the initial coliform test or the post disinfection coliform test is ***positive*** for bacteria, ***immediately*** contact a WDNR drinking water specialist/investigator for further instructions.

3.4 WELL PURGING

☞ Draw a diagram of where you purge the well and collect samples.

Large Water Supply Systems (i.e., public water supplies with distribution systems)

1. Purge and collect samples from a sample tap or faucet near the pump and ahead of treatment, storage or pressure systems.
2. Make sure the pump is activated, that water is flowing from the tap for at least five minutes and that the water is cold before you collect any samples.

Small Water Supply Systems (i.e., private water supply and distribution systems)

1. Purge and collect samples from a sample tap as close to the well's pump as possible, before the water passes through any softener, heater, storage or pressure system, or tank. Document if you cannot collect a sample located before a water heater or treatment system.
2. If possible, remove any aerators, filters or other devices from the tap before collecting any samples. If you must collect the sample from an outside tap, remove any hoses first.

3a. If you collect samples from a tap located ***before*** the pressure tank, first make sure the pump is activated and allow the water to run from the tap for at least two minutes – until the water is cold or for one full pump cycle.

3b. If you collect samples from a tap located ***after*** the pressure tank, first allow the water to run from the tap for at least five minutes – until the water is cold or for one full pump cycle. Run the water until the pressure tank and pump cycle the water two or three times. Document that you've collected samples from a tap located after the pressure tank.

3.5 FIELD WATER QUALITY MEASUREMENTS

Take in-field water quality measurements on unfiltered water supply well samples according to the procedures in Section 2.6.

3.6 SAMPLE FILTRATION

Do ***not*** filter groundwater samples from water supply wells.

3.7 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

Collect, preserve and handle water supply samples according to the procedures, where applicable, described in Sections 2.5 and 2.8. Collection of bacteriological samples are an exception; those procedures are described in this section.

Procedural exception when collecting VOCs from water supply wells:

If the sampling tap has an aerator, filter or other device, remove it. Run the water for at least two minutes, until cold. Reduce the water flow to a thin stream, then collect the VOC samples as described in Section 2.5.

Bacteriological Sampling

Select a sampling faucet least likely to provide an erroneous "unsafe" test result due to bacteriological contamination originating from the faucet. Use the following criteria to select a faucet:

- Choose cold-water faucets only.
- Choose a faucet ***not*** connected to the building's water softener.
- Avoid swing faucets.
- Choose a smooth-end faucet over a threaded-end faucet, if possible.
- Never sample from a flexible hose.
- Never sample a drinking fountain.
- Never sample a faucet that cannot be thoroughly flamed, such as a dripping faucet, outside hose bibb with an unremovable vacuum breaker, a faucet with an unremovable aerator, a plastic bathroom fixture, or a metal fixture with external plastic or rubber inserts (sometimes on the bottom of the fixture).
- Avoid faucets that cannot deliver a smooth stream of water.
- Avoid faucets that are seldom used.
- Never sample a fire hydrant.

1. Remove the aerator and any washers.

2. Run water from the faucet to determine if it can deliver a smooth stream of water.

3. Flame the faucet for at least 15 seconds. Use a propane or butane torch. Do ***not*** use a candle, cigarette lighter, rolled newspaper, etc. Flame the outside and inside of the faucet. The flame must come into direct contact with the inside of the faucet. If possible, look at the inside surface of the faucet – if it is still wet, keep flaming.

4. Do ***not*** touch the faucet after it has been flamed.

5. Before collecting a sample, run the water for at least three minutes. Turn the faucet on so it delivers a smooth steady stream of water with minimal splashing. The flow rate should be high enough to deliver a smooth stream of water but low enough to permit the filling of sample bottles without turning the valve down before sampling.

Rule of thumb: The longer the water runs from the faucet, the greater your chance for collecting a representative sample.

6. Do ***not*** readjust the flow rate before collecting samples. Fill the sample bottles ¾ full. This provides space for the laboratory to shake the sample to ensure uniform sample quality.

7. Replace the sample cap tightly! Place the sample container in a clean, unused sealable plastic bag to minimize exposure to any extraneous contamination during storage and transport. Bacteriological samples usually have to be analyzed soon after collection (within 30 hours of their collection for samples sent to the SLOH).

    Important note: If you even ***think or suspect*** that a sample may have become accidentally contaminated, throw it out and collect a new sample following Steps 1 to 7.

Other Sample Parameters

Make sure you have the appropriate sample bottles as required by your laboratory and that they are pre-cleaned as appropriate for the parameters you are analyzing. Follow your laboratory's instructions for sample collection.

If you are unfamiliar with proper sampling procedures or need to know from which sample taps to collect other parameters (e.g., inorganic, radiological, total trihalomethanes [TTHM], etc.), ask a WDNR representative in the Water Supply program for instructions.

3.8 QUALITY ASSURANCE/QUALITY CONTROL

Refer to and follow the procedures described in Section 2.9. Appendix B includes an example chain of custody form you may use when collecting water supply well samples.

APPENDIX A

MONITORING WELLS

Checklists

- Pre-field Work Procedures Checklist - Monitoring Wells
- Equipment Checklist - Monitoring Well Sampling

Documentation Sheets and Forms

- Well Specific Field Sheet (WSFS) - Monitoring Wells
- Groundwater Sampling Field Procedures Documentation
- Chain of Custody Form for the LUST Program
  (Form 4400-151)

* Master copies of the above forms are also located in the plastic sheet protector at the back of this manual. Please keep these masters and copy as needed.

PRE-FIELD WORK PROCEDURES CHECKLIST - MONITORING WELLS

All the following procedures may not be necessary for each sampling event. Use those procedures applicable to your sampling plan or customize this list.

LOGISTICS

___ Arrange for site access with the land/home/facility owner and tenants.
___ Locate the nearest post office, UPS office, Fedex drop off spot, etc., if you will need to ship the samples from the field. (UPS has a 70 lb. restriction per container.)

LABORATORY ARRANGEMENTS

___ Select a qualified laboratory to perform the sample analysis. Check that the laboratory (and subcontracted lab) is certified to perform the required analysis.
___ Make sure you have sufficient numbers, types, and volumes of sample containers – **get extras!** Remember QA/QC sample containers and trip blanks.
___ Discuss sample preservation, holding time, shipping requirements, and QA/QC expectations with the laboratory.
___ Inform the laboratory of the date and number of samples you will send.
___ Familiarize yourself with chain of custody and other sample tracking procedures.

SITE HISTORY

___ Review past water quality data or SAP to determine the well sampling order.

EQUIPMENT AND FIELD PREPARATION

___ Review the sampling and analysis plan (SAP) and QA/QC plan.
___ Organize equipment (Equipment Checklist - Monitoring Well Sampling).
___ Check that equipment is in good working condition:

    ✓ Test and recharge/replace batteries as necessary.
    ✓ Test the equipment with tap water or calibration standards.
    ✓ Inspect the equipment for defects, loose bolts, frayed wiring, etc.
    ✓ Check the instruments' ability to calibrate and function properly.

___ Check that all equipment is properly decontaminated and stored for transport.
___ Fill out the Well Specific Field Sheet (WSFS) as much as possible before heading out to the field.

HEALTH AND SAFETY EQUIPMENT AND PREPARATION

___ If required, prepare and follow a health and safety plan (HSP).
___ Inform sub-contractors and other site personnel of contaminants and site hazards.

EQUIPMENT CHECKLIST - MONITORING WELL SAMPLING

All the following items may not be necessary for each sampling event. Check those items applicable to your sampling plan or customize this list.

GENERAL AND LOGISTICS

___ Permission/notification to land/home owner/tenant
___ Directions to the site and site access roads/site access keys
___ Contact names, addresses and phone numbers
___ Site map showing well locations, keys for well locks
___ Calculator and/or purge volume conversion tables
___ ______________________________

DOCUMENTATION AND REFERENCE MATERIALS

___ *Groundwater Sampling Field Manual*
___ Sampling and analysis plan (SAP), QA/QC plan, and health and safety plan (HSP)
___ Well Specific Field Sheet (WSFS) and Field Procedures Documentation sheet
___ Well and boring logs
___ Field note book and waterproof pens
___ Clipboard with waterproof cover
___ Chain of custody forms and other sample tracking forms
___ Camera and film
___ ______________________________

PURGING AND SAMPLING EQUIPMENT

___ Plastic sheet or equivalent ground cover
___ Purging pump or bailer and accessories (inert material)
___ Sampling pump or bailer and accessories (inert material)
___ Pump or bailer rope/cable (no cotton or cloth) and tripod
___ Pump sample tubing (inert material)
___ Pump power supply, air compressor, inert gas, etc.
___ Calibrated buckets or similar device for purge water
___ Waterproof grease markers or pens (Sharpies™ are a potential source of VOCs)
___ Sample containers (provided by lab) - **bring extra,** and water proof labels/tags
___ QA/QC sample bottles (VOC trip blanks filled by lab)
___ Sample transfer containers and wide mouth funnel
___ Filtering apparatus and all accessories
___ Filter membranes (0.45 micron) and pre-filters, or
___ Disposable in-line filters
___ 55 gallon drums for wastewater and drum labels
___ ______________________________

FIELD MEASUREMENTS AND EQUIPMENT

___ Water level measuring instrument (0.01 foot increments) and backup device
___ Thermometer or temperature instrument
___ Conductivity meter and calibration standards (KCl)
___ pH meter, buffer solutions (pH 4, 7 and 10) and beakers
___ Dissolved oxygen meter and membrane replacement kit and/or Eh meter
___ Turbidity meter
___ All meters fully charged and operational; spare batteries
___ Closed flow through cell
___ Squirt bottles filled with reagent grade water
___ ______________________________

DECONTAMINATION EQUIPMENT

___ Non-phosphate cleaner and scrub brushes
___ Wash and rinse tubs or buckets and wastewater containers
___ Laboratory reagent grade water (two gallons/well usually sufficient)
___ Clean containers to transport equipment
___ ______________________________

SAMPLE PRESERVATION AND SHIPPING

___ Sample preservatives, transfer pipettes and pH paper
___ Coolers sufficiently large to hold all samples, including QA/QC samples
___ Crushed or cubed ice (frozen cold packs discouraged, need temp. blank)
___ Bubble wrap, Ziplock™ bags or equivalent to protect sample containers
___ Strapping tape, postage, Fedex or UPS shipping labels, COC forms, etc.,
___ ______________________________

TOOLS AND MISCELLANEOUS

___ Extra locks, keys for wells, flashlight, rain gear, etc.
___ Propane torch for frozen locks and bolt cutters for corroded locks
___ Adjustable wrench, screw drivers, hammer, scissors, knife, duct tape, etc.
___ Plastic garbage bags for contaminated waste
___ Bailer retrieval device (e.g., weighted hook)
___ Drum bung wrench and racket socket set (typ. 15/16" socket for 55 gallon drums)
___ ______________________________

PERSONAL PROTECTIVE EQUIPMENT

___ Respirators and cartridges (compatible for contaminants)
___ Safety glasses and/or splash shield
___ Inner and outer gloves (compatible for contaminants)
___ Hard hat and steel toed boots
___ Air monitoring equipment
___ First aid kit and eye wash kit
___ ___________________________

WELL SPECIFIC FIELD SHEET - MONITORING WELLS (Sheet ___ of ___)

Facility/Project Name: ____________________ Date: ____________________
Section/Grid or Address: ____________________
License or Permit #: ____________________
Weather today and past weeks (precipitation): ____________________
Persons Sampling: ____________________

Well Name					
DNR Well ID No.					
Wis. Unique Well No. (WUWN)					
Damage to Well? (Y/N)					
Top of Casing or Reference Elevation (MSL)					
Depth to Water (to 0.01 ft)					
Groundwater Elevation (MSL)					
Depth to Well Bottom (ft)					
4 Well Volumes (gal. or liters)					
Purging Device; dedicated (D) or portable (PT)					
Purge Device Intake Depth (ft)					
Purging Time (start - stop)					
Average Purging Flow Rate (gpm or L/min)					
Volume Purged (gal. or liters)					
Purged Dry? (Y/N)					
Problems Purging? (Y/N)					
Sampling Device (D or PT)					
Sampler Intake Depth (ft)					
Average Sampling Flow Rate (gpm or L/min)					
Time Sample Collected					
Preservative (e.g., HCL)					
Field Temperature (°C)					
Field Specific Conductance @25°C (µMhos/cm)					
Time Measured					

Well Name					
Field pH (standard units)					
Time Measured					
Turbidity (NTUs or describe) (e.g. slight, moderate)					
Time Measured					
Dissolved Oxygen (mg/l)					
Time Measured					
Eh - redox potential (mv)					
Time Measured					
Color (describe - grey, etc)					
Odor (describe - pungent, etc)					
Sample Field Filtered? (Y/N)					
Time Samples Filtered					
Well Capped & Locked? (Y/N)					

Comments (Discuss well damage, purging or sampling problems, deviations from sampling plan, etc.):

Sheet Completed by ____________________ Date ____________________

GROUNDWATER SAMPLING FIELD PROCEDURES DOCUMENTATION

Facility/Project Name: ______________________________ Date: ______________
Section/Grid Location or Address: ______________________________
Facility Type: ______________________________ License/Permit #: __________
DNR Regulatory Program: ______________________________
Weather (temp., cloudiness, bar. pres., wind): ______________________________
____
Persons Sampling and Title: ______________________________
____
____
Water Level Equipment (type, model): ______________________________
Purging Equipment (type, model, material): ______________________________
____
Purging Method (4 well vol. or stabilization): ______________________________
How Purge Volume Measured? (eg., calibrated bucket): ______________________________
Sample Collection Equipment (type, model, material): ______________________________
____
Method of Sample Withdrawal (bottom emptying device, low flow): ______________
Type of Transfer Containers: ______________________________
Filtering Equipment (type, material): ______________________________
Filter Membrane (type, pore size): ______________________________
When Were Samples Sent to Lab? ______________________________
What Lab Were the Samples Sent to? ______________________________
Were Enforcement Samples Sent? ______________________________
How Were Samples Kept Cool (ice, other)? ______________________________
Equipment Decontamination Procedures? ______________________________
____
Decontamination Water Disposal? ______________________________
____
pH Meter (type, model): ______________________________
    Person calibrating: ______________________________
    Frequency calibrated: ______________________________
    Calibration procedures (buffers used): ______________________________
    Problems with meter: ______________________________
Conductivity Meter (type, model): ______________________________
    Person calibrating: ______________________________
    Frequency calibrated: ______________________________
    Calibration procedures: ______________________________
    Problems with meter: ______________________________

Turbidity Equipment (type, model): ______________________________

Person calibrating/set-up: ______________________________

Frequency calibrated: ______________________________

Calibration procedures: ______________________________

Problems with meter: ______________________________

Dissolved Oxygen Meter (type, model): ______________________________

Person calibrating/set-up: ______________________________

Frequency calibrated: ______________________________

Calibration procedures: ______________________________

Problems with meter: ______________________________

When Were In-field Measurements Taken (immediately after collection or XX minutes after collection)?: ______________________________

Comments (difficulties, questionable data, deviations from sampling plan, etc): ______________________________

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State of Wisconsin
Department of Natural Resources

CHAIN OF CUSTODY RECORD
LUST PROGRAM
Form 4400-151 Rev. 4-93

Note: Use of this form is voluntary but is requested by the Department pursuant to ch. NR 149, NR 500-540, NR 158 and NR 419, Wis. Adm. Code. Personally identifiable information will be used for no other purpose.

Sample Collector(s)
Title/Work Station/Company
Telephone Number (include area code)
Property Owner
Property Address
Telephone Number (include area code)

I hereby certify that I received, properly handled, and disposed of these samples as noted below:

Relinquished By (Signature)
Date/Time
Received By (Signature)
Relinquished By (Signature)
Date/Time
Received By (Signature)
Relinquished By (Signature)
Date/Time
Received for Laboratory By (Signature)

Sample Condition on Receipt by Laboratory
LABORATORY USE ONLY

Temperature of temperature blank: ______

If samples were received on ice and there was ice remaining, you may report the temperature as "received on ice". If all of the ice was melted, the temperature of the melt may be substituted for a temperature blank.

Field ID Number[1]	Date Collected	Time Collected	Sample		Preserv. Type	Field Screening	Description	Analysis Type	Lab ID Number	No./Type of Containers	Cracked /Broken	Improperly Sealed	Good Condition	Other Comments
			Type[2]	Device[3]										

[1] Sample description must clearly correlate the sample ID to the sampling location shown on a map.

[2] Specify groundwater, surface water, soil, leachate, sludge, etc.

[3] Type of sampling device; split spoon, hand auger, metal spatula, soil syringe, etc.

DEPARTMENT USE/OPTIONAL FOR SOIL SAMPLERS

Disposition of unused portion of sample

Laboratory should: ☐ Dispose ☐ Retain for ____ days
☐ Return ☐ Other

DEPARTMENT USE ONLY

Split samples: Offered? ☐ Yes ☐ No (Check one)
Accepted? ☐ Yes ☐ No (Check one)

Accepted By: ______________________________
Signature

APPENDIX B

WATER SUPPLY WELLS

Checklists

- Pre-field Work Procedures Checklist - Water Supply Wells
- Equipment Checklist - Water Supply Well Sampling

Documentation Sheets and Forms

- Well Specific Field Sheet (WSFS) - Water Supply Wells
- Groundwater Sampling Field Procedures Documentation
- Groundwater Monitoring Inventory Form
  (Form 330-67 Rev. 12-92)
- Chain of Custody Form

* Master copies of the above forms are also located in the plastic sheet protector at the back of this manual. Please keep these masters and copy as needed.

PRE-FIELD WORK PROCEDURES CHECKLIST - WATER SUPPLY WELLS

All the following procedures may not be necessary for each sampling event. Use those procedures applicable to your sampling protocol or customize this list.

LOGISTICS

___ Contact the well owner to confirm the location, sampling date and time, and to discuss any site access issues.
___ Determine if the well has been inventoried. If not, obtain a WDNR well inventory number (Wisconsin Unique Well Number - WUWN).
___ Locate the nearest post office, UPS office, Fedex drop off spot, etc., if you will need to ship samples from the field. (UPS has a 70 lb. restriction per container.)

LABORATORY ARRANGEMENTS

___ Select a qualified laboratory to perform the sample analysis. Check that the laboratory (and subcontracted lab) is certified to perform the required sample analysis.
___ Make sure you have sufficient numbers, types, and volumes of sample containers needed - **get extras!** Remember QA/QC sample containers and trip blanks.
___ Discuss sample preservation, holding time, shipping requirements, and QA/QC expectations with the laboratory.
___ Inform the lab of the date and number of samples you will send.
___ Familiarize yourself with chain of custody and other sample tracking procedures.

SITE HISTORY

___ Review past water quality data to determine the well sampling order.
___ Review the site hydrogeology and information available on the well.

EQUIPMENT AND FIELD PREPARATION

___ Organize equipment (Equipment Checklist - Water Supply Well Sampling).
___ Check that equipment is in good working condition:

- ✓ Test and recharge/replace batteries as necessary.
- ✓ Test equipment with tap water or calibration standards.
- ✓ Inspect the equipment for defects, loose bolts, frayed wiring, etc.
- ✓ Check the instruments' ability to calibrate and function properly.

___ Check that all the equipment is properly decontaminated and stored for transport.

HEALTH AND SAFETY EQUIPMENT AND PREPARATION

___ If required, prepare and follow a safety and health plan (SHP).
___ Inform sub-contractors and other site personnel of contaminants and site hazards.

EQUIPMENT CHECKLIST - WATER SUPPLY WELL SAMPLING

All the following items may not be necessary for each sampling event.

GENERAL AND LOGISTICS

___ Permission/notification to well owner and site access keys
___ Directions to the site, access roads and location of wells
___ Contact names, addresses and phone numbers
___ ____

DOCUMENTATION AND REFERENCE MATERIALS

___ *Groundwater Sampling Procedures Field Manual*, sampling plan & QA/QC plan
___ Field note book, waterproof pens and clipboard
___ Inventory sheets or field data sheets
___ Chain of custody forms and other sample tracking forms
___ ____

EQUIPMENT AND SUPPLIES

___ Thermometer or temperature instrument
___ Conductivity meter and calibration standards (KCl)
___ pH meter, buffer solutions (pH 4, 7 and 10) and beakers
___ All meters and equipment fully charged/operational; spare batteries
___ Reagent grade water, gloves, ground cloth
___ Paper towels or disposable clean rags
___ Inert plastic bags to transport pump sample tubing, etc.
___ ____

PURGING AND SAMPLING

___ Special tap connection(s) and sampling tube for inaccesable sample taps
___ Calibrated buckets or similar device for purge water
___ Waterproof grease markers (Sharpies™ are a potential source of VOCs)
___ Sample containers (provided by lab) - **bring extra**, and waterproof labels/tags
___ QA/QC sample bottles (VOC trip blanks filled by lab)
___ ____

PRESERVATION AND SHIPPING

___ Sample preservatives, transfer pipettes and coolers with ice
___ Bubble wrap, Ziplock™ bags or equivalent to protect sample containers
___ Strapping tape, postage, Fedex or UPS shipping labels, etc

TOOLS AND MISCELLANEOUS

___ Flashlight and first aid kit
___ Adjustable wrench, screw drivers, hammer, scissors, knife, duct tape, etc.
___ ____

WELL SPECIFIC FIELD SHEET - WATER SUPPLY WELLS

Name of Well Owner: ____________ Date: ____________
Section/Grid or Address: ____________
License or Permit #: ____________
Weather Conditions (temp, rain): ____________
Person(s) Sampling: ____________

Well verified on well construction report? ____________

Does well have a WUWN and what is it? ____________

Depth to water in well to nearest 0.1 feet [1] ____________

Depth to bottom of well casing [1] ____________

Depth to bottom of well [1] ____________

Location of tap used for purging (before or after pressure tank) ____________

____

Length of time well purged (minutes) ____________

Location of tap used for collecting the samples (before or after pressure tank) ____________

____

Time sample collected ____________

Field temperature (°C) ____________

Field Specific Conductance @ 25°C ____________ Time ____________

Field pH (standard units) ____________ Time ____________

Color (describe) ____________

Odor (describe) ____________

Turbidity (NTUs or describe) ____________

Comments (problems, procedures): ____________

____

____

____

____

____

[1] Describe how measured in comments

wsfs.fmw

GROUNDWATER SAMPLING FIELD PROCEDURES DOCUMENTATION

Facility/Project Name: ______________________ Date: ____________

Section/Grid Location or Address: ______________________

Facility Type: ______________ License/Permit #: ____________

DNR Regulatory Program: ______________________

Weather (temp., cloudiness, bar. pres., wind): ______________________

____

Persons Sampling and Title: ______________________

____

____

Water Level Equipment (type, model): ______________________

Purging Equipment (type, model, material): ______________________

____

Purging Method (4 well vol. or stabilization): ______________________

How Purge Volume Measured? (eg., calibrated bucket): ______________________

Sample Collection Equipment (type, model, material): ______________________

____

Method of Sample Withdrawal (bottom emptying device, low flow): ____________

Type of Transfer Containers: ______________________

Filtering Equipment (type, material): ______________________

Filter Membrane (type, pore size): ______________________

When Were Samples Sent to Lab? ______________________

What Lab Were the Samples Sent to? ______________________

Were Enforcement Samples Sent? ______________________

How Were Samples Kept Cool (ice, other)? ______________________

Equipment Decontamination Procedures? ______________________

____

Decontamination Water Disposal? ______________________

____

pH Meter (type, model): ______________________

  Person calibrating: ______________________

  Frequency calibrated: ______________________

  Calibration procedures (buffers used): ______________________

  Problems with meter: ______________________

Conductivity Meter (type, model): ______________________

  Person calibrating: ______________________

  Frequency calibrated: ______________________

  Calibration procedures: ______________________

  Problems with meter: ______________________

Turbidity Equipment (type, model): ______

Person calibrating/set-up: ______
Frequency calibrated: ______
Calibration procedures: ______
Problems with meter: ______

Dissolved Oxygen Meter (type, model): ______

Person calibrating/set-up: ______
Frequency calibrated: ______
Calibration procedures: ______
Problems with meter: ______

When Were In-field Measurements Taken (immediately after collection or XX minutes after collection)?: ______

Comments (difficulties, questionable data, deviations from sampling plan, etc): ______

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Department of Natural Resources

GROUNDWATER MONITORING INVENTORY FORM

Form 3300-67 Rev. 8-95

Wisconsin Unique Well Number |__|__|__|__|__| ☐ Add ☐ Change

Inventory Completed By (Last Name, First, MI) ______________________

Date __ __/__ __/__ __ __ __
m m d d y y y y

With ☐ DNR ☐ __ __ __ __ __

Facility Name ______________________

Facility ID # ________

Local Well ID ________

High Cap Well # ________

Primary Contact Name (Last, First, MI)

Telephone Number ( )

Mailing Address

City State Zip Code

☐ Owner ☐ Operator ☐ Occupant ☐ Consultant ☐ Manager ☐ Contractor ☐ Driller ☐ Business ☐ Facility ☐ Sampler ☐ Other

Other Contact Name (Last, First, MI)

Telephone Number ( )

Mailing Address

City State Zip Code

☐ Owner ☐ Operator ☐ Occupant ☐ Consultant ☐ Manager ☐ Contractor ☐ Driller ☐ Business ☐ Facility ☐ Sampler ☐ Other

Well Location

☐ Town ☐ City ☐ Village

Fire # (If avail.)

County

Grid or Street Address or Road (If avail.)

Govt. Lot # ______________

OR

____1/4 of ____1/4 of Section ______

T________; R ________ ☐ E ☐ W

OR Deg. Min. Sec.

Latitude ______ ______ ______

Longitude ______ ______ ______

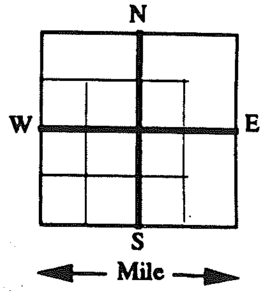
Subdivision Name

Lot

Block

(X) 1/4 1/4 Sec.

Location



Construction Type

☐ Drilled ☐ Driven Point ☐ Jetted ☐ Dug ☐ Spring ☐ Other

Land Surface Elevation __________ ft. MSL

Number of Wells on Property ________

Construction Date __ __/__ __/__ __ __ __
m m d d y y y y

Constructor

Well Use

☐ Private Potable ☐ Priv. Non-Potable ☐ Monitoring Well ☐ Community-Municipal ☐ Community OTM ☐ Non Transient Non-Com. ☐ Transient Non-Com.

Source of Well Data

☐ Well Report ☐ Owner/Occupant ☐ Other*

Well Status

☐ Active Use ☐ Inactive ☐ Perm Filled

Depth From Land Surface To:

Bedrock ________ ft.

Well Bottom ________ ft.

Static Water ________ ft.

Casing Bottom ________ ft.

Casing Diameter ________ in.

Water Bearing Formation

☐ Unconsolidated ☐ Limestone ☐ Sandstone ☐ Shale ☐ Crystalline

Comments: eg. reason for inventory, samples taken, directions to property, details of well location on property, collected before or after water softener. ______________________

***For "Other", enter a description in the comment area if needed.**

Instructions

1. All wells sampled by DNR employees must be inventoried and assigned a Wisconsin Unique Well ID in the Department's data system. Use this form to create a new inventory record or to change an existing record for a well . Use a separate form for each well.

2. Mandatory fields are indicated by shadowing and MUST be completed or your form will not be entered into the computer system. Fill in all applicable portions of the form as completely as possible.

3. If the well is being inventoried for the first time, check the "add" box in the upper right corner of the form. If there is a change to existing information, check the "change" box in the upper right corner and then fill in the Wisconsin Unique Well Number and ONLY THE INFORMATION THAT NEEDS TO BE CHANGED.

   If the form is filled out by DNR staff, check the DNR box. If the person completing this inventory form is associated with another agency; fill in the agency acronym letters.

4. For a private well, the primary contact should be the well owner or the resident occupant of the property served by the well, if the owner or occupant is known.

5. Check only ONE contact type code box for each contact name. Check the one that is the most relevant if more than one applies. If the well owner is the occupant, check "Owner" as the contact type. Check the facility or business box ONLY if there is not a person to contact.

6. Wells should be located as precisely as possible. If the well is located by Public Land Survey, record the T, R, S, 1/4 1/4 section. If the well is located by latitude and longitude, record the location to the nearest second. If the well is located in a government lot, record the latitude and longitude as well as the government lot number.

7. Check only ONE box in the Well Use section. If a spring is being inventoried, check Spring under Construction Type in addition to the well use box.

8. County Codes and Names:

   1. Adams
   2. Ashland
   3. Barron
   4. Bayfield
   5. Brown
   6. Buffalo
   7. Burnett
   8. Calumet
   9. Chippewa
   10. Clark
   11. Columbia
   12. Crawford
   13. Dane
   14. Dodge
   15. Door
   16. Douglas
   17. Dunn
   18. Eau Claire
   19. Florence
   20. Fond Du Lac
   21. Forest
   22. Grant
   23. Green
   24. Green Lake
   25. Iowa
   26. Iron
   27. Jackson
   28. Jefferson
   29. Juneau
   30. Kenosha
   31. Kewaunee
   32. La Crosse
   33. Lafayette
   34. Langlade
   35. Lincoln
   36. Manitowoc
   37. Marathon
   38. Marinette
   39. Marquette
   40. Menominee
   41. Milwaukee
   42. Monroe
   43. Oconto
   44. Oneida
   45. Outagamie
   46. Ozaukee
   47. Pepin
   48. Pierce
   49. Polk
   50. Portage
   51. Price
   52. Racine
   53. Richland
   54. Rock
   55. Rusk
   56. St. Croix
   57. Sauk
   58. Sawyer
   59. Shawano
   60. Sheboygan
   61. Taylor
   62. Trempealeau
   63. Vernon
   64. Vilas
   65. Walworth
   66. Washburn
   67. Washington
   68. Waukesha
   69. Waupaca
   70. Waushara
   71. Winnebago
   72. Wood

9. Return this form to the DNR Bureau of Water Supply, P.O. Box 7921, Madison, WI 53707-7921, unless you are part of a special sampling program and have been instructed to return the form elsewhere.

State of Wisconsin
Department of Natural Resources

CHAIN OF CUSTODY RECORD

Form 4100-145 7-87

Sample Collector(s)	Title/Work Station	Telephone No. (include area code)
Property Owner	Property Address	Telephone No. (include area code)

Split Samples: Offered? ☐ Yes ☐ No (Check One)
Accepted? ☐ Yes ☐ No (Check One) Accepted By: ____________________
Signature

Field ID No.	Date	Time	Sample Type		Station Location Sample Description	Lab ID Number	No. of Containers	Comments
			Comp	Grab				

I hereby certify that I received, properly handled, and disposed of these samples as noted below:

Relinquished By (Signature)	Date/Time	Received by: (Signature)
Relinquished By (Signature)	Date/Time	Received by: (Signature)
Relinquished By (Signature)	Date/Time	Received for Laboratory By: (Signature)

Disposition of Unused Portion of Sample:

Dispose ________ Retain for ________ days

Return ________ Other ________

APPENDIX C

REFERENCE MATERIALS

- Sample Containers, Preservation and Holding Time Requirements
- Chain of Custody Procedures for Enforcement Samples
- Potential of a Substance for Volatilizing from a Water Sample
- Equivalency and Conversion Tables

Sample Containers, Preservation and Holding Time Requirements

Parameter	Volume[3] (ml)	Container[1]	Preservation[2]	Holding Time
Alkalinity ($CaCO_3$)	200	G,P	Cool 4°C	14 days
BOD - 5 Day	500 - 1000	G,P	Cool 4°C	48 hrs
BOD - Long Term	500	G,P	Cool 4°C	24 hrs
Boron	50 - 100	P	HNO_3 pH<2 Cool 4°C	28 days
Chemical Oxygen Demand (COD)	50 - 250	G,P	H_2SO_4 pH<2 Cool 4°C	28 days
Chloride	100 - 200	G,P	Cool 4°C	28 days
Chloride - I.C.[4]	25	G,P	Cool 4°C	28 days
Color	50 - 500	G,P	Cool 4°C	48 hrs
Corrosivity	1000		Cool 4°C	
Cyanide - Total[6]	1000	G,P	NaOH pH>12 Cool 4°C	14 days
Cyanide - Amendable to chlorination[6]	1000	G,P	NaOH pH>12[6] Cool 4°C	14 days
Fluoride	250 - 300	G,P	Cool 4°C	28 days
Metals - dissolved (except mercury & Cr^{+6})	250 - 1000[5]	P	Filter immed. HNO_3 pH<2 Cool 4°C	180 days
Hexavalent Chromium (Cr^{+6})	50 - 100	P	Cool 4°C	24 hrs
Mercury - dissolved	500[5]	P or Teflon®	Filter immed. HNO_3 pH<2 Cool 4°C	28 days

Parameter	Volume[3] (ml)	Container[1]	Preservation[2]	Holding Time
NITROGEN				
Ammonia	500	G,P	H_2SO_4 pH<2 Cool 4°C	28 days
Nitrate + Nitrite	100 - 200	G,P	H_2SO_4 pH<2 Cool 4°C	28 days
Nitrate/Nitrite (Drinking water only)	100	G,P	Cool 4°C	48 hrs
Nitrate - I.C.[4]	60	G,P	Cool 4°C	48 hrs
Nitrite - I.C.[4]	60	G,P	Cool 4°C	48 hrs
Total Kjeldahl	500	G,P	H_2SO_4 pH<2 Cool 4°C	28 days
Oil & Grease	2000	G only widemouth	H_2SO_4 pH<2 Cool 4°C	28 days
Pesticides & PCBs	Consult Laboratory	G amber/TLS	Cool 4°C	7 days to extraction
pH	25	G,P	None	immed. & on-site
Phenolics	1000[5]	G only/TLS	H_2SO_4 pH<2 Cool 4°C	28 days
PHOSPHOROUS				
Dissolved (soluble)	50 - 250	G,P	Filter, H_2SO_4 Cool 4°C	28 days
Total	50 - 250	G,P	H_2SO_4 pH<2 Cool 4°C	28 days
RESIDUE				
Dissolved Filterable	100	G,P	Cool 4°C	48 hrs
Total & Total Volatile	100	G,P	Cool 4°C	7 days
Semi-volatiles to extract	2 liters	G amber/TLS	Cool 4°C	7 days
Silica - dissolved	50 - 100	P only	Cool 4°C	28 days
Specific Conductance	100	G,P	Cool 4°C	28 days

Parameter	Volume[3] (ml)	Container[1]	Preservation[2]	Holding Time
Sulfate	50 - 100	G,P	Cool 4°C	28 days
Sulfide	100 - 625[5]	G,P	2 ml 2 N zinc acetate and NaOH ph>9 Cool 4°C	7 days
Sulfite	100 - 625[5]	G,P	Add EDTA Cool 4°C	immed.
Surfactants (MBAS)	250	G,P	Cool 4°C	48 hrs
Turbidity	100 - 250	G,P	Cool 4°C store in dark	48 hrs
Volatile Organics (VOCs)	2 to 4 40 ml vials	G vials/TLS	HCL pH<2 No headspace Cool 4°C	14 days

ABBREVIATIONS and ENDNOTES:

G	Glass bottle (typically borosilicate)
P	Plastic bottle (typically polypropylene, polyethylene or PVC)
TLS	Teflon® lined septa

[1] In many cases, Teflon® and stainless steel containers (except for metals) are acceptable. For metals, polyethylene with a polypropylene cap (no liner) is preferred - a dilute nitric acid rinse may be recommended by some laboratories.

[2] Preserve samples immediately after collection. Consult the laboratory for volumes of preservative required per sample. Verify the pH of the sample (except VOCs).

[3] Volume listed may not include quality control (QC) volume required by laboratory (except those volumes that include a number 5 superscript). Check with the laboratory if unsure of the laboratories QC volume requirements.

[4] Ion chromatography (IC) analysis only. Ion chromatography is not universally available at certified laboratories and may require special arrangements.

[5] Volume includes quality control (QC) effort required by laboratories.

[6] Cyanide samples containing residual chlorine should be treated with 0.6 grams ascorbic acid/L of sample at the time of collection. Sulfide will interfere with the cyanide test and must be removed before the pH is adjusted. Contact the laboratory for special instructions for collecting samples containing sulfide.

Chain of Custody for Samples Requiring Strict Custody

To be admissible as evidence, sample results must be traceable back through their collection, storage, handling, shipment and analysis so that the court is satisfied how the sample results submitted as evidence were collected, transferred and claimed. This is accomplished by a written record documenting the sample identity from collection to introduction as evidence.

Field records identifying sampling personnel, equipment, collection, storage and transfer techniques, and field conditions are required. The sample collector is responsible for maintaining sample custody and integrity until the samples are transferred via a dated and signed chain of custody form to a carrier or are personally delivered and transferred directly to the laboratory.

A sample is in custody if it is:

1. In physical possession, or
2. In view, after being in physical possession, or
3. Secured so that no one can tamper with it.

The courts have accepted two degrees of chain of custody. The first, described below, involves physical possession of the sample from collection to laboratory possession. With this chain of custody method, the sample collector or other person to which sample possession was transferred to delivers the samples to the laboratory. The second chain of custody method is by shipping the samples through a mail carrier. Mail carriers may not assume any liability or responsibility for compromised sample integrity during shipping (e.g., broken samples and/or containers, ice melting in cooler, etc.).

In both cases, a written record must be transferred with the samples. However, when using the second method described above, the sample collector fills out a chain of custody record, seals it in a shipping container, and mails it by a carrier to the laboratory. Upon arrival, a pre-determined laboratory custodian receives the samples, notes the shippers condition (whether sealed or unsealed), each sample container's condition (broken samples, ice present in cooler, etc.), and assumes custody of the samples by signing and dating the chain of custody record. The laboratory maintains possession of the chain of custody record until the sample analysis is complete and then sends the analytical results, along with the chain of custody record, to the sample collector or other pre-designated receiver of the analytical results and chain of custody records.

For routing surveillance samples, the second chain of custody method should suffice. If enforcement action may occur based on the type of samples and/or regulatory programs or agencies involved, the first chain of custody method involving the sample collector physically delivering and transferring possession of the samples to the laboratory is recommended.

Field Chain of Custody Procedures

1. Limit sample collection and handling to as few people as possible. If sample transfers are necessary, use signed receipts of possession. The chain of custody record must accompany the samples. Keep a copy of the chain of custody record for your own records.

2. If the samples are known or suspected of being hazardous, give a receipt for each sample collected to the property or facility owner (s. 144.69, Wis. stats.). The property or facility owner may request split samples.

3. If the samples are known or suspected of being hazardous (e.g., explosion or corrosion hazard), special shipping procedures may be required by the mail carrier. Check with the mail carrier for restrictions and procedures.

4. Follow the Quality Assurance/Quality Control procedures discussed in Section 2.9 of this manual and in the *Groundwater Sampling Desk Reference Manual.*

5. Record field measurements and other important data in a bound field note book, on field measurement data sheets provided by WDNR, or on modified data sheets that meet site-specific needs. For legal purposes, indelible ink should be used for recording all data and errors in field records should be crossed out with one line and initialed.

6. Complete appropriate laboratory tracking forms and attach them to the chain of custody record. Complete these forms in indelible ink.

7. When required or applicable, document with photographs sample locations, pollution sources, violations, etc. If possible, use cameras that print the date the photos were taken.

8. Maintain physical possession and sample integrity of the collected samples until they are properly transferred to the laboratory custodian or the mail carrier.

9. Obtain a sample possession transfer receipt (a copy of the dated and signed chain of custody record) after transferring possession of the samples to the laboratory custodian or the mail carrier.

Sample Security When Strict Custody Procedures are Necessary

Use the following procedures when securing and transferring possession of strict custody samples:

1. Use sample seals. Tape the sample container so that the tape must be cut or ripped to open the container. Use nylon-reinforced tape or other tape that cannot be tampered with without being noticed upon receipt. Sign and date the tape across the top.

2. Using an indelible permanent marker or ink, write the following information on the security tape, writing across the overlapping ends:

    a. Name of the sample collector(s), date, time, well number, facility name, etc., where the samples were collected.

    b. Write the words "**Strict Custody Requirements**," or similar language indicating that sample security is critical.

    c. Write "To be opened by ______ personnel only." In the blank, specify water chemistry unit, pesticide and organic chemistry unit, water microbiological unit, or other appropriate personnel.

    d. If all the samples are organic, specify "organic." If they are all inorganic, specify "inorganic." If the samples are a combination of both or others, specify accordingly.

By overlapping and writing over the edges of the security tape, it will be possible to detect if someone has tampered with the sample container. If someone were to remove the tape and then reseal it, it would be difficult to seamlessly realign the writing.

Do not use sealing wax to seal the tape. Sealing wax is brittle and will chip and break during normal use. This gives the appearance of tampering even when none has occurred.

Sample containers labeled "Strict Custody Requirements," or with similar language, must be locked up by the laboratory upon receipt and not removed from the locked refrigerator until ready to be analyzed. The laboratory will hold all strict custody samples until notified otherwise. When the case is resolved, either by trial or stipulation, the enforcement specialist should notify the laboratory that the samples associated with the case may be discarded or destroyed.

Potential of a Substance for Volatilizing from a Water Sample

Substance	CAS Number	Henry's Law Constant (atm-m^3/mole)	Potential for Volatilizing from Water
Acenaphthylene	208-96-8	1.1×10^{-5}	Low
Acetone	67-64-1	3.9×10^{-5}	Low
Aldicarb	116-06-3	1.4×10^{-9}	Low
Ammonia	7664-41-7	3.2×10^{-4}	Moderate
Anthracene	120-12-7	6.5×10^{-5}	Low
Atrazine	1912-24-9	2.6×10^{-13}	Low
Benzene	71-43-2	5.6×10^{-3}	High
Benzo(a)pyrene	50-32-8	1.1×10^{-4}	Moderate
Benzo(b)fluoranthene	205-99-2	1.1×10^{-4}	Moderate
Bromodichloromethane	75-27-4	1.6×10^{-3}	High
Bromoform	75-25-2	5.5×10^{-4}	Moderate
Bromomethane	74-83-9	6.2×10^{-3}	High
Carbaryl	63-25-2	4.4×10^{-9}	Low
Carbofuran	1563-66-2	9.2×10^{-5}	Low
Carbon tetrachloride	56-23-5	3.0×10^{-2}	High
Carbon disulfide	75-15-0	3.0×10^{-2}	High
Chlordane	57-74-9	4.9×10^{-5}	Low
Chloroethane	75-00-3	6.2×10^{-4}	Moderate
Chloroform	67-66-3	2.7×10^{-3}	High
Chloromethane	74-87-3	8.8×10^{-3}	High
Chrysene	218-01-9	9.5×10^{-5}	Low
1,2-Dibromoethane (EDB)	106-93-4	6.7×10^{-4}	Moderate
Dibromochloromethane	124-48-1	8.7×10^{-4}	Moderate
1,2-Dibromo-3-chloropropane	96-12-8	1.5×10^{-4}	Moderate
Dibutyl phthalate	84-74-2	1.8×10^{-6}	Low
Dicamba	1918-00-9	7.9×10^{-9}	Low
1,2-Dichlorobenzene	95-50-1	1.9×10^{-3}	High
1,3-Dichlorobenzene	541-73-1	3.3×10^{-3}	High
1,4-Dichlorobenzene	106-46-7	2.4×10^{-3}	High
Dichlorodifluoromethane	75-71-8	3.4×10^{-1}	High
1,1-Dichloroethane	75-34-3	5.6×10^{-3}	High

Substance	CAS Number	Henry's Law Constant (atm-m^3/mole)	Potential for Volatilizing from Water
1,2-Dichloroethane	107-06-2	9.8 x 10^{-4}	Moderate
1,2-Dichloroethylene (cis)	156-59-2	4.1 x 10^{-3}	High
1,2-Dichloroethylene (trans)	156-60-5	9.4 x 10^{-3}	High
1,1-Dichloroethylene	75-35-4	2.6 x 10^{-2}	High
2,4-Dichlorophenoxyacetic acid	94-75-7	1.0 x 10^{-8}	Low
1,2-Dichloropropane	78-87-5	2.8 x 10^{-3}	High
1,3-Dichloropropene (cis/trans)	542-75-6	1.8 x 10^{-2}	High
Di (2-ethylhexyl) phthalate	117-81-7	3.6 x 10^{-7}	Low
Dimethoate	60-51-5	6.2 x 10^{-11}	Low
2,4-Dinitrotoluene	121-14-2	1.3 x 10^{-7}	Low
2,6-Dinitrotoluene	606-20-2	7.5 x 10^{-7}	Low
Dinoseb	88-85-7	4.6 x 10^{-7}	Low
Dioxins	1746-01-6	5.6 x 10^{-3}	High
Endrin	72-20-8	7.5 x 10^{-6}	Low
Ethylbenzene	100-41-4	8.4 x 10^{-3}	High
Fluoranthene	206-44-0	6.5 x 10^{-6}	Low
Fluorene	86-73-7	1.0 x 10^{-4}	Moderate
Fluoride	16984-48-8	6.0 x 10^{-8}	Low
Fluorotrichloromethane (freon 11)	75-69-4	9.7 x 10^{-2}	High
Formaldehyde	50-00-0	1.7 x 10^{-7}	Low
Heptachlor	76-44-8	1.1 x 10^{-3}	High
Heptachlor epoxide	1024-57-3	3.2 x 10^{-5}	Low
Hexachlorobenzene	118-74-1	1.3 x 10^{-3}	High
Lindane	58-89-9	1.4 x 10^{-5}	Low
Mercury	7439-97-6	1.1 x 10^{-2}	High
Methanol	67-56-1	4.5 x 10^{-6}	Low
Methoxychlor	72-43-5	1.6 x 10^{-5}	Low
Methyl isobutyl ketone	108-10-1	1.4 x 10^{-4}	Moderate
Methyl ethyl ketone (MEK)	78-93-3	2.7 x 10^{-5}	Low
Methylene chloride	75-09-2	2.0 x 10^{-3}	High
Monochlorobenzene	108-90-7	3.8 x 10^{-3}	High
n-Hexane	110-54-3	1.4 x 10^{-2}	High
Naphthalene	91-20-3	4.8 x 10^{-4}	Moderate

Substance	CAS Number	Henry's Law Constant (atm-m^3/mole)	Potential for Volatilizing from Water
Pentachlorophenol	87-86-5	2.4×10^{-6}	Low
Phenol	108-95-2	3.3×10^{-7}	Low
Polychlorinated biphenyls	1336-36-3	1.1×10^{-3}	High
Pyrene	129-00-0	1.1×10^{-5}	Low
Pyridine	110-86-1	8.9×10^{-6}	Low
Simazine	122-34-9	2.7×10^{-9}	Low
Styrene	100-42-5	2.8×10^{-3}	High
1,1,1,2-Tetrachloroethane	630-20-6	2.4×10^{-3}	High
1,1,2,2-Tetrachloroethane	79-34-5	4.6×10^{-4}	Moderate
Tetrachloroethylene	127-18-4	1.8×10^{-2}	High
Toluene	108-88-3	6.6×10^{-3}	High
Toxaphene	8001-35-2	6.6×10^{-6}	Low
1,2,4-Trichlorobenzene	120-82-1	1.4×10^{-3}	High
1,1,1-Trichloroethane	71-55-6	1.7×10^{-2}	High
1,1,2-Trichloroethane	79-00-5	9.1×10^{-4}	Moderate
1,2,3-Trichloropropane	96-18-4	3.4×10^{-4}	Moderate
Trichloroethylene	79-01-6	1.0×10^{-2}	High
2,4,5-Trichlorophenoxy-propionic acid (2,4,5-TP)	93-72-1	8.7×10^{-9}	Low
Trifluralin	1582-09-8	2.6×10^{-5}	Low
1,2,4-Trimethylbenzene	95-63-6	5.6×10^{-3}	High
Vinyl chloride	75-01-4	2.7×10^{-2}	High
Xylene (mixed o-, m-, and p-)	1330-20-7	7.0×10^{-3}	High

CAS Number: Chemical Abstract Service (CAS) registry numbers are unique numbers assigned to a chemical substance and are widely used in scientific publications.

Note: Most metals (exception - mercury) and inorganics are not susceptable to volatilizing from a groundwater sample under normal sampling conditions and temperatures.

(Sources: USEPA Superfund Chemical Data Matrix [SCDM] March 1993 data tables. U.S. Environmental Protection Agency (EPA). 1990. *Basics of Pump-and-Treat Ground-Water Remediation Technology*. U.S. Environmental Protection Agency, Washington, D.C. EPA/600/8-90/003.)

henryalb.tb2

Equivalency and Conversion Tables

Volume Equivalents

unit	cc	in^3	liters	Quarts	Gals	ft^3
cc	1	.06102	.001	.00106	.00026	.00004
in^3	16.387	1	.01639	.01732	.00433	.00058
Pints	473.18	28.875	.47318	.5	.125	.01671
liters	1000	61.023	1	1.0567	.26417	.03531
Quarts	946.36	57.75	.94636	1	.25	.03342
Gallons	3785.4	231	3.7854	4	1	.13368
ft^3	28317.0	1728	28.317	29.922	7.4805	1
meter^3	100000	61023.4	1000	908.08	227.02	35.314

Equivalent Pumping Rate Table

Milliliters per Minute (ml/min)	Liters per Minute (L/min)	Gallons per Minute (gpm)
100	0.1	0.026
200	0.2	0.05
300	0.3	0.08
400	0.4	0.11
500	0.5	0.13
600	0.6	0.16
700	0.7	0.18
800	0.8	0.21
900	0.9	0.24
1000	1	0.26
2000	2	0.53
3000	3	0.79
4000	4	1.06
5000	5	1.32

Conversion formulas for rates not included in this table:
Liters per minute X 0.26417 = gallons per minute
Gallons per minute X 3.7854 = liters per minute

Length

To Convert From	To	Multiply By
inches	centimeters	2.540
inches	feet	0.0833
feet	meters	0.3048
feet	miles	0.0001894
meters	miles	6.214 x 10^{-4}
meters	yards	1.094

1 meter = 10 decimeters = 100 centimeters = 1000 millimeters

Volume

To Convert From	To	Multiply By
cubic centimeters	cubic inches	0.06102
cubic inches	cubic feet	0.00058
cubic inches	liters	0.01639
cubic inches	gallons	0.00433
liters	gallons	0.14546
gallons	cubic feet	0.13368

1 liter = 1 cubic decimeter = 10 deciliters = 100 centiliters = 1000 milliliters = 1000 cubic centimeters

Water attributes

Cubic foot
7.48 gallons
28,317 milliliters
28.317 liters
62.428 lbs

Liter
0.2642 gallons
61 cubic inches
2.205 lbs

Gallon
231 cubic inches
3,785 milliliters
3.785 liters
8.345 lbs

Cubic meter
1,000 liters
264.2 gallons
22.045 lbs

Appendix B
Sample Documentation

EPA Paperwork Preparation

TO:	Onalaska Samplers
COPIES:	Jim Fisher
FROM:	Kathi Kimble
DATE:	July 21, 1997

This memorandum summarizes the EPA paperwork preparation for the Onalaska project site. At Onalaska, Special Analytical Services (SAS) chain of custody (COC) forms are used and tags are filled out for each sample container.

Chain of Custody Forms

Blank SAS/COC forms can be obtained from Lynn Bong/MKE. SAS/COC forms should be filled out as indicated in Figure 1 and the key listed below. Spaces lettered or filled in on the example SAS/COC form in Figure 1 must be filled in as shown.

A. Obtain SAS/COC No. from Dave Shekoski or Lynn Bong prior to sampling. A unique SAS/COC No. is assigned to each sampling event.
B. List the date of shipment.
C. List the carrier, typically this is Federal Express.
D. List the sampler's name.
E. List the airbill no. of the carrier.
F. The sampler's signature.
G. List the laboratory's contact and address.
H. List the sample no. This should consist of "SAS No.-XXX." The "XXX" is the sequential numbering of samples. For example the first sample obtained would be, the SAS number followed by -001 or "SAS No.-001."
I. The matrix is "2" which indicates groundwater.
J. The concentrations are low and this column should be marked with a "L."
K. The samples are grab samples so this column should be marked with a "G."
L. This column should be marked with the appropriate number:

No.	Preservative	Analysis
1	HCl	VOC
2	HNO_3	Metals
4	H_2SO_4	Oil & Grease
6	Ice only	Odor, Miscellaneous Inorganics

M. The analysis should be listed in this space. Several analyses can be listed together as long as they all have the same preservative and were all taken at the same sampling point.
N. The numbers from the sample tags attached to each sample container should be listed.
O. The well name or private well resident should be indicated.
P. Sample date and time should be indicated.

Q. The samplers initials should be recorded.
R. Field QC samples should be indicated. This includes:

B	Field Blank
B	Trip Blank
D	Field Duplicate

This column is for field QC samples only. Laboratory QC samples such as matrix spike (MS) and matrix spike duplicates (MSD) are to be listed in the box marked with a U, not in column J. Field QC samples are given a unique sample number.

S. This box should be indicated with "N" until the sampling is complete and then the last SAS/COC set can be marked with "Y."
T. List which chain of custody the sheet is out of the set for the cooler.
U. Laboratory QC samples should be indicated here. Laboratory QC samples include matrix spikes (MS) and matrix spike duplicates (MSD). Laboratory QC samples are **not** given unique sample numbers, but are assigned and listed with the regular samples. Basically, laboratory QC samples represent extra volume taken for a particular sample number. The extra volume is used for laboratory QC testing. The sample numbers where these extra volumes were taken should be listed in this box.
V. If more than one sampler performed the work, this is where the additional samplers should sign.
W. The chain of custody seal numbers to be used to seal the cooler should be listed here.
X. A sampler should sign here.
Y. The date and time of the sampler's signature should be recorded.

Sample Tags

Sample tags can be obtained from Lynn Bong. Approximately 200 sample tags are needed for each sampling event. An example tag is shown in Figure 2 and described below.

A. SAS No.
B. Sample No. = XXX, the first sample would be 001, the second sample would be 002, etc. Field QC samples (duplicates, blanks) are given their own sample no., but laboratory QC samples (matrix spikes (MS), matrix spike duplicates (MSD)) are given the same sample no. as the original sample taken at that location.
C. Date.
D. Time.
E. Grab sample should be marked.
F. The well number or name of private resident should be indicated, exactly as it appears on the COC.
G. Samplers signature.
H. The preservative type should be marked.
I. The analysis should be marked. COD, hardness, and odor will have to be written into the blank boxes for these analyses.
J. VOC tags—The method should be indicated here. Residential wells are method 524.2 and groundwater monitoring wells are method 8260.
Metal tags—These should be noted as being filtered.
K. Laboratory QC samples should be marked here for matrix spikes and matrix spike duplicates.
L. This is the tag number (including the "5-") which should be recorded in the "Regional Specific Tracking Number or Tag Numbers" column of the SAS/COC.

Sample tags can and should be filled out prior to going into the field to save time. Eight sample containers are collected at each well as listed below:

No. of containers/ No. of tags	Analysis
3	VOCs
1	Metals (dissolved)
2	Oil & Grease
1	Miscellaneous Inorganics
1	Odor

Packing Instructions

Listed below are several packing tips for the quarterly Onalaska groundwater sampling events:

- VOCs should all be packed in one cooler.
- Trip blanks should be placed in each cooler containing VOCs.
- If an error is made on any documentation, DO NOT correct it by writing over it. Draw a single line through the error, make the correction next to it, and initial and date the correction. Make sure all copies are legible.
- The bottom two copies of the SAS/COC forms should accompany each cooler. They should be placed in ziplock bags and taped to the base of the lid of the cooler. The top two copies are returned to CH2M HILL.
- When multiple shipping containers are sent, each one must contain a COC form for the contents of the shipping container.
- Ice should be double bagged in ziplock baggies.
- Coolers should be shipped via Federal Express for priority overnight delivery.
- Federal express is located at the LaCrosse Airport and closes at 6:30 p.m.

QA/QC Samples

QA/QC samples should be obtained as indicated below:

Groundwater

No.	Type	Analyses
2	Trip Blanks	VOCs (method 8260)
2	Field Blank	All parameters
2	Field Duplicate	All parameters
1	MS/MSD	VOCs (method 8260), metals, oil & grease, misc. inorganics

Drinking Water (residential wells)

No.	Type	Analyses
1	Trip Blank	VOCs (method 524.2)
1	MS/MSD	VOCs (method 524.2)

United States Enviromental Protection Agency
Contract Laboratory Program

Special Analytical Services Packing List/Chain of Custody

SAS No. A

Case No.

1. Project Code	Account Code	2. Region No. 5	Sampling Co. CH2M HILL	4. Date Shipped B	Carrier C
Regional Information TGB-102		Sampler *(Name)* D		Airbill Number E	
Non-Superfund Program		Sampler Signature F		5. Ship To G ATTN:	
Site Name ONALASKA MUNICIPAL LDF					
City, State ONALASKA,WI	Site Spill ID L5				

3. Purpose*

Lead: ☒ SF ☐ PRP ☐ ST ☐ FED

Early Action: ☐ CLEM ☐ PA ☐ REM

☐ SI ☐ ESI ☐ RI ☐ OIL ☐ UST

Long-Term Action: ☐ FS ☐ RD ☐ RA ☒ O&M ☐ NPLD

6. Matrix *(Enter in Column A)*

1. Surface Water
2. Ground Water
3. Leachate
4. Field QC
5. Soil/Sediment
6. Oil
7. Waste
8. Other *(Specify in Column A)*

7. Preservative *(Enter in Column D)*

1. HCl
2. HNO3
3. NAHSO4
4. H2SO4
5. NAOH
6. Ice Only
7. Other *(Specify in Column D)*

N. Not Preserved

Sample Numbers (From Labels)	A Matrix (from Box 6) Other:	B Conc.: Low Med High	C Sample Type Comp./Grab	D Preservative (from Box 7) Other:	E Analysis	F Regional Specific Tracking Number or Tag Numbers	G Station Location Identifier	H Mo/Day/Year/Time Sample Collection	I Sampler Initials	J Field QC Qualifier B=Blank S=Spike D=Duplicate R=Rinsate PE=Perform. eval. -=Not a QC Sample
H	I	J	K	L	M	N	O	P	Q	R

Shipment for SAS Complete? (Y / N) S	Page T of ___	Sample(s) to be Used for Laboratory QC U	Additional Sampler Signatures V	Chain of Custody Seal Number(s) W

CHAIN OF CUSTODY RECORD

Relinquished by: *(Signature)* X	Date/Time Y	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date/Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date/Time	Received for Laboratory by: *(Signature)*	Date/Time	Remarks Is custody seal intact? Y / N / none	

DISTRIBUTION: **White – Region Copy** **Gold – Lab Copy for Return to Region** **Yellow – Data User**** **Pink – Lab Copy for Return to Data User****

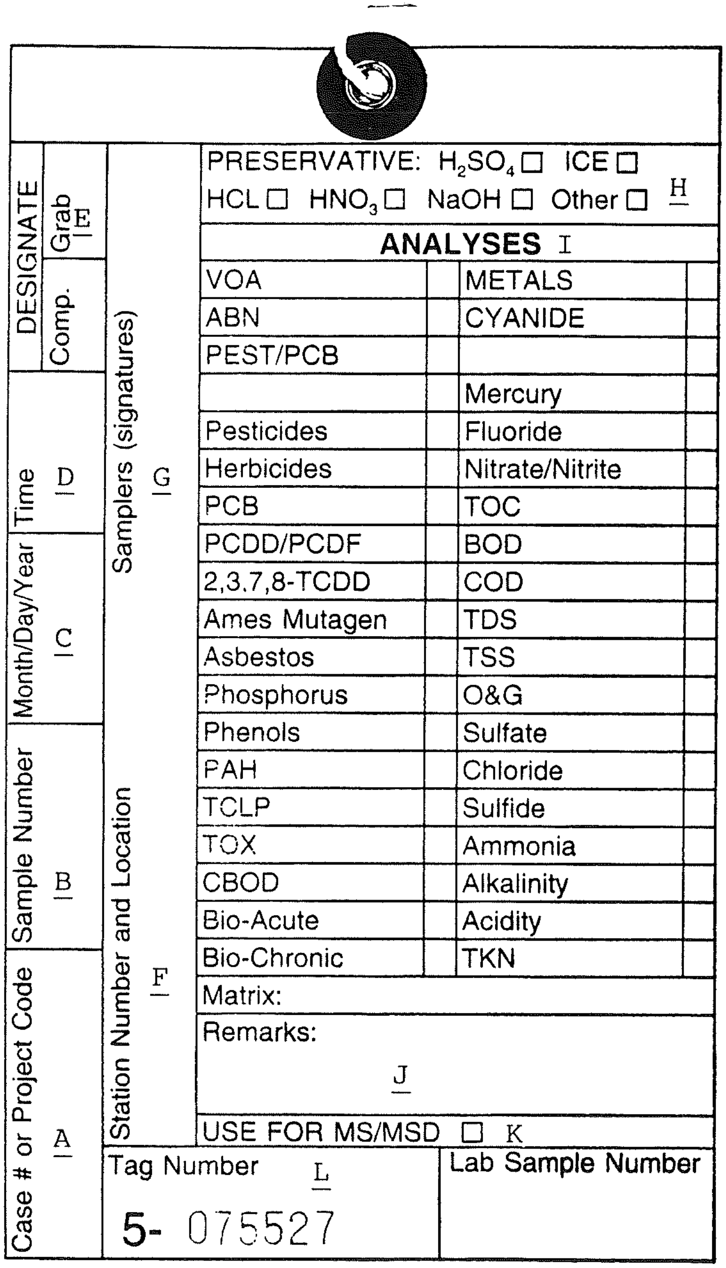
EPA Form 9110-3

SEE REVERSE FOR ADDITIONAL STANDARD INSTRUCTIONS
***SEE REVERSE FOR PURPOSE CODE DEFINITIONS**

****Data User means the organization which contracted the laboratory services**

A21-012-7 REV. 3/94

Figure 1



Case # or Project Code A

Sample Number B

Month/Day/Year C

Time D

DESIGNATE Grab E Comp.

Station Number and Location F

Samplers (signatures) G

PRESERVATIVE: H_2SO_4 ☐ ICE ☐
HCL ☐ HNO_3 ☐ NaOH ☐ Other ☐ H

ANALYSES I

VOA		METALS	
ABN		CYANIDE	
PEST/PCB			
		Mercury	
Pesticides		Fluoride	
Herbicides		Nitrate/Nitrite	
PCB		TOC	
PCDD/PCDF		BOD	
2,3,7,8-TCDD		COD	
Ames Mutagen		TDS	
Asbestos		TSS	
Phosphorus		O&G	
Phenols		Sulfate	
PAH		Chloride	
TCLP		Sulfide	
TOX		Ammonia	
CBOD		Alkalinity	
Bio-Acute		Acidity	
Bio-Chronic		TKN	

Matrix:

Remarks:
J

USE FOR MS/MSD ☐ K

Tag Number L
5- 075527

Lab Sample Number

Figure 2
Sample Container Tag

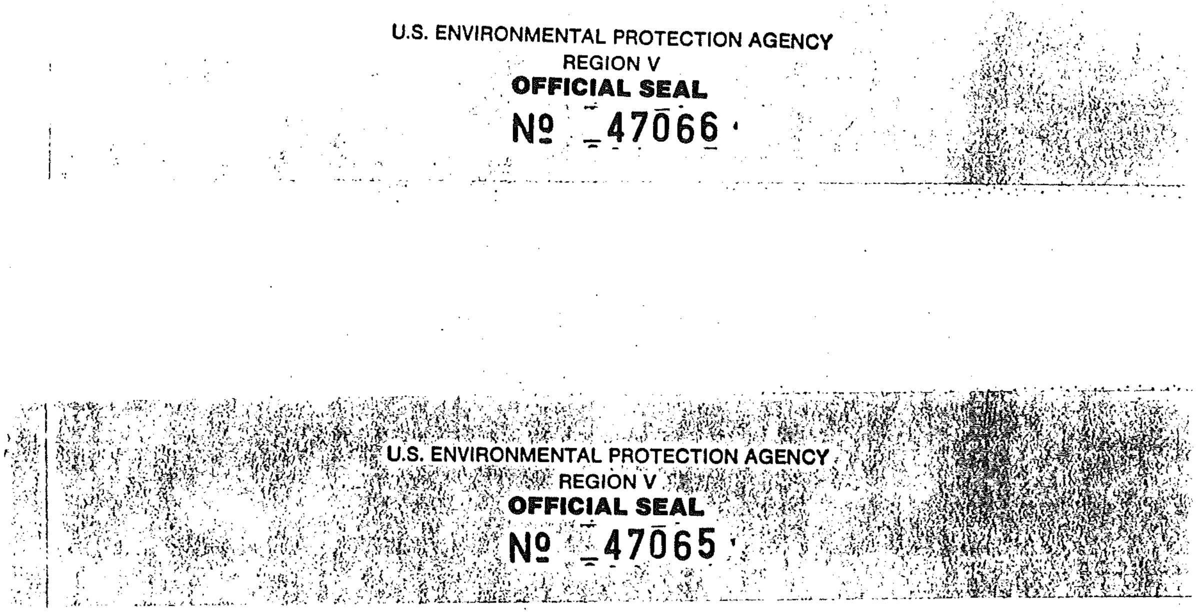


Figure 3
Custody Seals