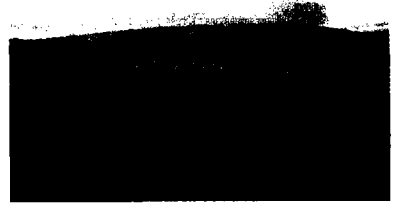


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# **Addendum to the Quality Assurance Project Plan for the Monitored Natural Attenuation Engineering Demonstration Project**

*Lemberger Landfill and  
Lemberger Transport and Recycling Site  
Town of Franklin, Wisconsin*

**Revision 0  
April 2006**

*Prepared for  
Lemberger Site Remediation Group*



RMT, Inc. | Lemberger Site Remediation Group  
Final - Revision 0  
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## Approvals

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### Lemberger Landfill and Lemberger Transport and Recycling Site Town of Franklin, Wisconsin

Revision 0  
April 2006

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Remedial Project Manager - U.S. Environmental Protection Agency

 5/25/2006  
Quality Assurance Reviewer - U.S. Environmental Protection Agency

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Project Manager - RMT, Inc.

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Quality Assurance Manager - RMT, Inc.

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Quality Assurance Manager - Pace Analytical Services, Inc.

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Quality Assurance Manager - RMT, Inc.

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Quality Assurance Manager - Pace Analytical Services, Inc.

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	– Oxidation-Reduction Potential (ORP) Measurement
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	– Sample Containers, Preservation, and Holding Times
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	– Decontamination Procedures: Personnel and Equipment
	– Disposal of Monitoring- or Investigation-derived Waste Materials

**Provided As Separately Bound But Related Submittal**

Analytical Laboratory Standard Operating Procedures - Pace Analytical Services, Inc.

SOP NUMBER	DESCRIPTION
GB-I-014 - Rev. 0	Alkalinity (Standard Methods)
KM-I-001 - Rev. 1	Total Organic Carbon
GB-I-018 - Rev. 0	Total Alkalinity (by Lachat 8000)
GB-I-009 - Rev. 0	Ion Chromatography
GB-O-017 - Rev. 0	Dissolved Methane, Ethane, and Ethylene
ALL-I-015 - Rev. 1	pH
GB-I-026 - Rev. 0	Trace Metals by ICPMS

# Introduction

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The original Quality Assurance Project Plan (QAPP) for the field sampling and analytical testing requirements of the groundwater remedial action and the post-closure care of the Lemberger Landfill (LL) Site and the Lemberger Transport and Recycling (LTR) Site is included (as Appendix E) in the document titled "Final Operation and Maintenance Plan, Lemberger Landfill RD/RA, Operable Unit 1" (the O&M Plan), issued in February 1997, and approved by the United States Environmental Protection Agency (USEPA). The required sampling and testing for the Lemberger site have been performed in accordance with the approved O&M Plan, including the QAPP, since startup of the groundwater remediation system in March 1997.

Only one addendum to the original 1997 QAPP has been previously requested and approved. That addendum, approved by USEPA on 10 August 2004, authorized changes to certain laboratory reporting formats (data deliverables) and to the analytical methods for metals in aqueous samples. The additions and modifications to the groundwater monitoring program summarized in this QAPP Addendum comprise the second addendum to the original 1997 QAPP.

This second QAPP Addendum addresses modifications to the groundwater monitoring program that are needed to support the upcoming engineering demonstration project for the use of monitored natural attenuation (MNA) at the Lemberger site. At the conclusion of the MNA demonstration project, it is expected that the low-flow monitoring well purging and sampling methods described in this QAPP Addendum will continue to be included as a component of a long-term groundwater monitoring program for the site, which will be designed to meet the data quality objectives that are appropriate at that future time.

This QAPP Addendum includes a significant number of references to a separate document titled "Workplan for Monitored Natural Attenuation Engineering Demonstration Project - Revision 1, April 2006" (the Revision 1 workplan), which provides additional information and details regarding the MNA demonstration project. This QAPP Addendum and the Revision 1 workplan should be reviewed and used together.

# Section 1

## Group A - Project Management

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### 1.1 A1 - Title and Approval Sheet

Refer to the initial two sheets of this document.

### 1.2 A2 - Table of Contents

Refer to pages i to iii.

### 1.3 A3 - Distribution List

This addendum to the currently approved Quality Assurance Project Plan (QAPP) (February 1997), and any subsequent revisions or addenda, will be distributed per the project distribution list as approved by the United States Environmental Protection Agency (USEPA) Remedial Project Manager (RPM) at the time the document is approved by USEPA.

### 1.4 A4 - Project/Task Organization

The management, quality assurance (QA), field, and laboratory responsibilities for the work that is the subject of this QAPP Addendum will be assigned to, and the work will be performed by, the same persons who currently function in these roles on the project.

Training of field personnel who may be needed to perform specific tasks associated with the work addressed under this QAPP Addendum, such as low-flow monitoring well purging and sampling methods and use of field test (Hach) kits, will be provided by experienced field staff from RMT, Inc.'s Madison, Wisconsin, office.

No changes in the current project organizational structure or communication procedures are necessary to implement the work that is the subject of this QAPP Addendum.

### 1.5 A5 - Problem Definition/Background

The groundwater extraction and treatment (pump-and-treat) system selected by USEPA in the 1991 Record of Decision for remediation of groundwater at the Lemberger site began operation on 17 March 1997, and has remained in operation since that time. Initial evaluations of the



groundwater remediation effectiveness of the pump-and-treat system performed in 1998 through 2000 determined that the original extraction well system was not capturing the full extent of the volatile organic compound (VOC) plume. In response to these findings, the groundwater flow model developed for the site, which has been calibrated to observed site conditions, was used to evaluate optional approaches and to develop recommendations for upgrading the original extraction well system, to attempt to achieve the VOC plume capture effectiveness envisioned in the 1991 Record of Decision.

The recommended improvements to the extraction well system were approved by USEPA, and the design and construction of the upgraded system was completed in 2001. Four new extraction wells began operation in December 2001. Unlike the intended purpose of the six original extraction wells, these four additional extraction wells were installed at locations that were intended to intercept and extract VOC-contaminated groundwater primarily near the Lemberger Transport and Recycling (LTR) landfill site, where VOC sources present in the fractured bedrock beneath the landfill continue to generate a VOC plume in the bedrock aquifer.

After operation of the upgraded extraction well system for 2 years, the monitoring data indicated limited to no improvement in groundwater quality attributable to operation of the four additional extraction wells installed in 2001. At the request of the Lemberger Site Remediation Group (LSRG), RMT, Inc. (RMT), performed a technical assessment of the effectiveness of the extraction well system in meeting the groundwater remediation objectives and performance expectations. The data, findings, and conclusions of that technical assessment were provided in the report titled "Assessment of Remedial Action Effectiveness, Lemberger Landfill and Lemberger Transport and Recycling Sites, Town of Franklin, Wisconsin, RMT, Inc., June 2004" (the 2004 Report) submitted to USEPA and the Wisconsin Department of Natural Resources (WDNR) in June 2004. Key conclusions of the 2004 Report were that approximately 5 percent of the total dissolved VOC mass that originates from VOC sources remaining in the bedrock aquifer beneath the LTR landfill is being captured by the extraction well system; that approximately 90 percent of the VOC mass is being degraded by naturally occurring, primarily biological, processes; and that the remaining 5 percent of the VOC mass originating at the LTR landfill remains in the groundwater at very low VOC concentrations at the downgradient termination of the far-field plume, where the groundwater discharges to surface water.

On the basis of the 2004 Report, RMT, on behalf of the LSRG, submitted a letter to USEPA and WDNR on 9 February 2005, requesting USEPA's approval to perform a full-scale engineering demonstration project of natural attenuation processes for remediation of the VOC plume at the

site. The purpose of the proposed demonstration project is to define, and if practical, to quantify, the nature and effectiveness of the natural attenuation processes occurring at the site. The 9 February request letter also indicated that if the findings and conclusions of the project demonstrate the sufficiency and protectiveness of natural attenuation processes, the LSRG would then request a formal change of the groundwater remedial action from the current use of pump-and-treat technology, to the use of monitored natural attenuation (MNA) as the appropriate long-term remedial alternative for the site.

In a 26 April 2005 letter to the LSRG's common counsel, Doug Clark of Foley & Lardner, USEPA concluded that there is sufficient justification to perform the requested natural attenuation demonstration project. USEPA also indicated that a workplan for the demonstration project, and other pertinent documents, such as this QAPP Addendum, should be prepared and submitted to USEPA and WDNR for review.

A document titled "Workplan for Monitored Natural Attenuation Engineering Demonstration Project" was submitted to USEPA and WDNR in August 2005. Written comments on the August 2005 workplan were sent to the LSRG by USEPA on 1 December 2005. Written responses to the agencies' comments were submitted to USEPA and WDNR on 10 February 2006 by RMT, on behalf of the LSRG. A revision (Revision 1) of the August 2005 workplan has been prepared to address the agencies' comments on the original workplan. The Revision 1 workplan is being submitted to the agencies for review concurrently with this QAPP Addendum.

Additional information on the background and purpose of the MNA engineering demonstration project is provided in Sections 2 and 3 of the Revision 1 workplan.

## **1.6 A6 - Project/Task Description**

A general overview of the groundwater monitoring program for the MNA engineering demonstration project is included in Section 4 of the Revision 1 workplan. A list and description of the "MNA parameters" that will be analyzed for groundwater samples collected during the project is provided in Subsection 4.3 of the Revision 1 workplan, including the rationale for the selected MNA parameters. A list of the analytical methods, method detection limits, and other information for each of the MNA parameters to be evaluated is included in Table 1 in this QAPP Addendum.

The sample collection methods and equipment are described in Subsection 4.3.3 in the Revision 1 workplan. Validation of data for the MNA parameters will be performed in accordance with the currently approved QAPP.

An assessment of the data quality for the MNA parameters will be included in each of the semiannual status reports and in the overall project evaluation report that will be provided for the MNA demonstration project, as noted in Subsections 5.1.2 and 5.2 of the Revision 1 workplan.

## 1.7 A7 - Quality Objectives and Criteria for Measurement Data

The Data Quality Objectives (DQOs) Process is a series of planning steps based on the Scientific Method that are designed to ensure that the type, quality, and quantity of environmental data used in decision making are appropriate for the intended application.

DQOs are qualitative and quantitative statements derived from outputs of each step of the DQOs Process that:

- clarify the study objective;
- define the most appropriate type of data to collect; and
- determine the most appropriate conditions from which to collect the data.

Development of DQOs is based on the seven-step process described in USEPA documents EPA QA/G-4 (September 1994) and EPA QA/G-9 (January 1998).

- **Step 1: State the Problem** – a description of the problem(s) and specifications of available resources and relevant deadlines for the study.
  - Identify the members of the planning team.
    - The members of the planning team will include the Lemberger Site Remediation Group (LSRG), the Analytical Laboratory Quality Assurance Manager, and the RMT Project Manager.
  - Identify the primary decision makers.
    - The primary decision maker is the LSRG's Technical Committee. Decisions require the concurrence of the USEPA Remedial Project Manager.
  - Develop a concise description of the problem.
    - The problem is to monitor the concentrations of selected inorganic and organic constituents in groundwater, and to assess the effectiveness of

natural attenuation in reducing the impacts of groundwater contaminants, restoring the groundwater resource to its full potential for beneficial use, and maintaining the current “protective” status of the site, as has been determined by USEPA.

- Specify available resources and relevant deadlines for the study.
  - The LSRG will provide the resources needed to meet the stated objectives. The project schedule is described in Subsection 2.3 in the Revision 1 workplan.
- **Step 2: Identify the Decision** – a statement of the decision that will use environmental data and the actions that could result from this decision.
  - Identify the principal study decision.
    - The principal decision to be made is whether MNA is an appropriate component of a revised remedial action approach for groundwater at the Lemberger site.
    - Specific decisions and objectives for the demonstration project are listed in Subsection 2.1 of the Revision 1 workplan.
  - Define alternative actions that could result from resolution of the principal study question.
    - The results may indicate that MNA is not appropriate as a component of the long-term groundwater remedial action, in which case continued operation of the pump-and-treat system, or other remedial actions, may be required.
    - The results may indicate that MNA is an appropriate component of the long-term groundwater remedial action, in which case a Record of Decision Amendment will be required.
  - Combine the principal study question and the alternative actions into a decision statement.
    - Determine whether or not MNA is an appropriate component of a long-term remedial action for groundwater at the Lemberger site.

- **Step 3: Identify Inputs to the Decision** – a list of environmental variables or characteristics that will be measured and other information needed to resolve the decision statement.
  - Identify the information that will be required to resolve the decision statement.
    - To resolve the decision statement, the planning team needs to obtain measurements of the concentrations of the constituents specified in Table 1, following the sampling schedule shown in Table 3.
  - Determine the sources for each item of the information identified.
    - The groundwater will be sampled at the monitoring wells listed in Tables 2 and 3 and will be tested using the methods listed in Table 1.
  - Identify the information that is needed to establish the action level.
    - Establishing action levels or threshold values is not relevant to the objectives of this MNA demonstration project. The Method Detection Limits for the MNA parameters listed in Table 1 in this document will be sufficient to resolve the decision statement.
  - Confirm that appropriate measurement methods exist to provide the necessary data.
    - The groundwater will be tested using the methods listed in Table 1, which includes the Method Detection Limits and the Estimated Quantitation Limits. These limits are within the required ranges outlined in the USEPA guidance documents cited in Section 6 of the Revision 1 workplan.
- **Step 4: Define the Boundaries of the Study** – a detailed description of the spatial and temporal boundaries of the problem, characteristics that define the populations of interest, and any practical considerations of interest.
  - Specify the characteristics that define the population of interest.
    - Groundwater samples will be collected from the wells listed in Tables 2 and 3. Figure 1 of the Revision 1 workplan provides monitoring well locations. Further discussion of the suitability of the existing monitoring well network for meeting the objectives of the MNA demonstration project is included in Subsection 4.1 in the Revision 1 workplan.
  - Define the spatial boundary of the decision statement.
    - *Define the geographic area to which the decision statement applies* – Decisions will apply to the groundwater contaminant plume associated with the Lemberger site in the Town of Franklin, Wisconsin.

- *When appropriate, divide the population into strata that have relatively homogeneous characteristics* – Groundwater samples will be collected from various monitoring wells across the site, as noted in Tables 2 and 3. The wells are screened in the relevant water-bearing geologic strata at the site.
- Define the temporal boundary of the decision statement.
  - *Determine the time frame to which the decision statement applies* – The decision to be made regarding the suitability of MNA as a remedial action component will apply to the long-term site status, following completion of the MNA demonstration project.
  - *Determine when to collect the data* – Groundwater sampling will be performed throughout the planned 2-year duration of the MNA demonstration project.
- Define the scale of decision making.
  - The decision to be made regarding the suitability of MNA will apply to groundwater at all monitoring well locations except beneath the LTR landfill and within the slurry wall boundary at the LL site.
- Identify practical constraints on data collection.
  - Potential interferences with the ability to collect groundwater samples include inclement weather, accidental damage to or intentional abandonment of monitoring wells, or denial for access by property owners.
- **Step 5: Develop a Decision Rule** – to define the parameter of interest, specify the action level and integrate previous DQO outputs into a single statement that describes a logical basis for choosing among alternative actions.
  - Develop a decision rule.
    - If the technical evaluation performed at the conclusion of the MNA demonstration project indicates that MNA is an appropriate component of a revised remedial action approach for groundwater at the Lemberger site, then an amendment of the Record of Decision will be prepared by USEPA to authorize indefinite shut down of the pump-and-treat system and use of MNA for groundwater remediation at the site.
    - The MNA evaluation methods described in the various USEPA guidance documents listed in Section 6 of the Revision 1 workplan will be used with the data produced from the MNA demonstration project to resolve the decision statement.

- **Step 6: Specify Tolerable Limits on Decision Errors** – the decision maker’s tolerable decision error rates based on a consideration of the consequences of making a decision error.
  - Define acceptable limits on the probability of making a decision error.
    - The tolerable “gray region” or “area of uncertainty” around the true value of any of the MNA parameters that will be monitored for this demonstration project or study is wide. The probability of making a decision error is minimal, due to factors such as: the quantity of monitoring wells (51) to be sampled; the quantity of separate sampling rounds; the manner in which the data will be evaluated (trend analysis, loss-of-mass calculations, molar ratios of breakdown products, etc.); and the duration of the demonstration project (2 years). Therefore, establishing specific numerical limits on the probability of or tolerance for making a decision error is unnecessary.
- **Step 7: Optimize the Plan.**
  - Develop the general data collection design.
    - Data will be collected from all available groundwater monitoring wells, as described in the Revision 1 workplan and in the currently approved QAPP. These wells will provide data that are representative of all aquifer units of interest needed to determine the existence of biologically mediated remediation.

## 1.8 A8 - Special Training/Certification

The data collection tasks for the MNA demonstration project require field personnel with the training and knowledge needed to perform low-flow purging and sampling of monitoring wells, and field analysis of certain water quality parameters using manufactured field test kits and equipment. Training and experience in standard sample handling and documentation procedures are also necessary. The personnel assigned to collect the groundwater samples during the MNA demonstration project will receive thorough, hands-on field training in all required procedures using all appropriate equipment, test kits, etc., prior to the start of sampling associated with the project. In addition, experienced staff will accompany the assigned sampling technician during the initial sampling round at the site, until the experienced staff determines that the sampling technician is able to properly perform all necessary sampling, testing, and documentation tasks. Notes documenting the training provided for the sampling technician will be recorded in the field logbook.

## **1.9 A9 - Documents and Records**

The documents and records to be produced during the MNA demonstration project, including field as well as fixed laboratory documentation and records, will be consistent with the currently approved QAPP.



## Section 2

# Group B - Data Generation and Acquisition

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### 2.1 B1 - Sampling Process Design

The schedule for the groundwater sampling program during the 2-year MNA demonstration project is described in Subsections 4.3.5 and 4.8 of the Revision 1 workplan, and in Table 3 of this QAPP Addendum. The sampling design rationale is discussed in Section 4 of the Revision 1 workplan.

### 2.2 B2 - Sampling Methods

The procedures that will be followed for low-flow purging and sampling of monitoring wells are described in Appendix A of the Revision 1 workplan, and are included in Appendix A of this QAPP Addendum. Procedures for cleaning and decontaminating field equipment and sample containers, and other requirements for field supplies and sample containers, are described in the Field Analysis Standard Operating Procedures in the currently approved QAPP.

### 2.3 B3 - Sample Handling and Custody

Sample handling, sample identification, and sample custody procedures will be in accordance with the currently approved QAPP.

### 2.4 B4 - Analytical Methods

Laboratory analysis of all groundwater samples collected during the MNA demonstration project will be performed by the currently approved analytical laboratory for the Lemberger site, Pace Analytical Services, Inc. The Standard Operating Procedures (SOPs) of Pace Analytical Services for the MNA parameters as listed in Table 1 are provided in a separately bound document submitted with this QAPP Addendum. (A list of the laboratory SOPs for the MNA parameters is included in the Table of Contents of this QAPP Addendum.) Analysis of groundwater samples collected during the MNA demonstration project for constituents other

than the MNA parameters listed in Table 1 of this document will be performed following currently approved laboratory SOPs.

## **2.5 B5 - Quality Control**

Field and laboratory quality control (QC) samples will be collected as summarized in Table 4 and as described in the currently approved QAPP. Reference standards for field instruments and testing equipment will be used in accordance with the Field Analysis SOPs included in Appendix A.

## **2.6 B6 - Instrument/Equipment Testing, Inspection, and Maintenance**

Maintenance of field instruments and equipment that will be used for the MNA demonstration project is regularly performed and documented by RMT's Field Services staff in the Madison, Wisconsin, office. Spare parts and supplies for all equipment are also stocked by Field Services staff and are readily available for shipment to field personnel if needed. Maintenance of laboratory instruments is performed in accordance with the currently approved QAPP.

## **2.7 B7 - Instrument/Equipment Calibration and Frequency**

Calibration of field instruments and equipment will be performed in accordance with the Field Analysis SOPs included in Appendix A. Calibration of laboratory instruments will be performed in accordance with all approved laboratory SOPs.

## **2.8 B8 - Inspection/Acceptance of Supplies and Consumables**

Supplies or reagents used at the site for sample collection or field analysis will be stored in a clean location inside the groundwater Treatment Building. Supplies, reagents, etc., used at Pace Analytical Laboratories, Inc., will be managed following the laboratory's SOPs.

## **2.9 B9 - Non-direct Measurements**

Existing data produced from the remedial action monitoring and other environmental investigations at the site over the previous 9 years may be used to supplement the data to be collected during the MNA demonstration project to support project decisions. The existing data were produced, validated, and documented in accordance with the USEPA-approved QAPP.

## **2.10 B10 - Data Management**

Data to be produced during the MNA demonstration project will be managed following the same USEPA-approved procedures used for the remedial action monitoring program over the last 9 years, in accordance with the currently approved QAPP.

## Section 3

# Group C - Assessment and Oversight

---

### 3.1 C1 - Assessments and Response Actions

As noted in Subsection 1.8, experienced staff who are familiar with all equipment and procedures associated with the groundwater sampling and testing requirements for the MNA demonstration project will accompany and assist the assigned sampling technician during the initial sampling round for the MNA parameters. A subsequent on-site technical system audit of the sample collection, handling, and documentation procedures used by the sampling technician will be performed by experienced office-based personnel during a sampling round scheduled sometime between 6 months and 12 months after the start of the MNA demonstration project. Any corrective actions that may be identified as needed will be implemented immediately during the on-site audit, and the RMT project manager will be informed of the actions taken for periodic follow-up with the sampling technician during the remainder of the demonstration project.

### 3.2 C2 - Reports to Management

Reports to be produced for the MNA demonstration project are described in Section 5 of the Revision 1 workplan.

## **Section 4**

# **Group D - Data Validation and Usability**

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### **4.1 D1 - Data Review, Verification, and Validation**

Data verification and validation procedures and criteria will be in accordance with the currently approved QAPP.

### **4.2 D2 - Verification and Validation Methods**

All data produced during the MNA demonstration project will be verified and validated by the Data Management personnel who have performed detailed technical validation of all monitoring data collected at the Lemberger site for the last several years. The same data validation procedures that are used for the current groundwater monitoring program will be used for the data produced during the MNA demonstration project.

### **4.3 D3 - Reconciliation With User Requirements**

The MNA demonstration project data will be evaluated and reported with all other required monitoring data in the Quarterly Data Transmittals. These transmittals include an assessment of all data with respect to the measurement performance criteria, and a summary assessment regarding the usability of all collected data.



**Table 1**  
**Monitored Natural Attenuation Parameters, Analytical Methods, and Reporting Limits**

GROUNDWATER PARAMETER	FIELD OR LABORATORY	METHOD	EQUIPMENT	LIMIT OF DETECTION (LOD)	LIMIT OF QUANTITATION (LOQ)	FIELD PRESERVATION	SAMPLE VOLUME (mL)	HOLDING TIME
Alkalinity (total)	Field	Hach kit	Hach kit	10 mg/L as CaCO <sub>3</sub> (4)	N/A	N/A	≥15 mL	Analyze immediately
Carbon dioxide	Field	Hach kit	Hach kit	1.25 mg/L	25 mg/L	N/A	≥23 mL	Analyze immediately
Dissolved oxygen	Field	360.1(1)	Probe	0.1 mg/L(5)	N/A	N/A	N/A	Analyze immediately
Iron (II)	Field	8146 WAH	Hach kit	0.1 mg/L	N/A	N/A	35 mL	Analyze immediately
Oxidation-reduction potential	Field	Standard methods(2)	Electrode	N/A	N/A	N/A	N/A	Analyze immediately
pH	Field	150.1(1)	Electrode	N/A	0.1 standard units	N/A	N/A	Analyze immediately
Specific conductivity	Field	120.1(1)	Electrical conductivity meter	N/A	10 mS/cm	N/A	N/A	Analyze immediately
Temperature	Field	--	Meter	N/A	0.1°C	N/A	N/A	Analyze immediately
Turbidity	Field	SM 2130B	Meter	N/A	1 NTU	N/A	N/A	Analyze immediately

Table 1 (continued)  
 Monitored Natural Attenuation Parameters, Analytical Methods, and Reporting Limits

GROUNDWATER PARAMETER	FIELD OR LABORATORY	METHOD	EQUIPMENT	LIMIT OF DETECTION (LOD)	LIMIT OF QUANTITATION (LOQ)	FIELD PRESERVATION	SAMPLE VOLUME (mL)	HOLDING TIME
Alkalinity (total)	Laboratory	2320B <sup>(2)</sup>	Per method	3.7 mg/L	10 mg/L	Cool to 4°C	250 mL HDPE <sup>(6)</sup>	14 days
Chloride	Laboratory	300.0 <sup>(1)</sup>	Per method	0.88 mg/L	5.0 mg/L	Cool to 4°C	250 mL HDPE <sup>(6)</sup>	28 days
Ethane	Laboratory	M8015B <sup>(3)</sup>	Per method	1.6 µg/L	10 µg/L	Cool to 4°C HCl to pH<2	3 x 40 mL VOA vial	14 days <sup>(7)</sup>
Ethene	Laboratory	M8015B <sup>(3)</sup>	Per method	1.4 mg/L	10 mg/L	Cool to 4°C HCl to pH<2	3 x 40 mL VOA vial	14 days <sup>(7)</sup>
Manganese	Laboratory	6020 <sup>(3)</sup>	Per method	0.4 µg/L	2.0 µg/L	Cool to 4°C HNO <sub>3</sub> to pH<2	250 mL HDPE	6 months
Methane	Laboratory	M8015B <sup>(3)</sup>	Per method	2 µg/L	10 µg/L	Cool to 4°C HCl to pH<2	3 x 40 mL VOA vial	14 days <sup>(7)</sup>
Nitrate	Laboratory	300.0 <sup>(1)</sup>	Per method	0.078 mg/L	0.40 mg/L	Cool to 4°C H <sub>2</sub> SO <sub>4</sub> to pH<2	250 mL HDPE	28 days
Nitrite	Laboratory	300.0	Per method	0.46 mg/L	0.10 mg/L	Cool to 4°C H <sub>2</sub> SO <sub>4</sub> to pH<2	250 mL HDPE	28 days



Table 1 (continued)  
 Monitored Natural Attenuation Parameters, Analytical Methods, and Reporting Limits

GROUNDWATER PARAMETER	FIELD OR LABORATORY	METHOD	EQUIPMENT	LIMIT OF DETECTION (LOD)	LIMIT OF QUANTITATION (LOQ)	FIELD PRESERVATION	SAMPLE VOLUME (mL)	HOLDING TIME
pH	Laboratory	150.1 <sup>(1)</sup>	Electrode	N/A	0.1 standard units	Cool to 4°C	250 mL HDPE <sup>(6)</sup>	14 days
Sulfate	Laboratory	300.0 <sup>(1)</sup>	Per method	0.83 mg/L	4.0 mg/L	Cool to 4°C	250 mL HDPE <sup>(6)</sup>	28 days
Temperature	Laboratory	--	Thermometer	N/A	0.1°C	N/A	250 mL HDPE <sup>(6)</sup>	N/A
Total inorganic carbon	Laboratory	415.2 <sup>(1)</sup>	Per method	0.80 mg/L	2.0 mg/L	Cool to 4°C, no headspace, H <sub>2</sub> SO <sub>4</sub> to pH<2	2 x 60 mL glass bottles	28 days
Total organic carbon	Laboratory	415.2 <sup>(1)</sup>	Per method	0.80 mg/L	2.0 mg/L	Cool to 4°C, no headspace, H <sub>2</sub> SO <sub>4</sub> to pH<2	2 x 60 mL glass bottles	28 days

Notes:

- <sup>(1)</sup> USEPA 600/4-79-020: Methods for Chemical Analysis of Water and Waste.
- <sup>(2)</sup> Standard Methods for the Examination of Water and Wastewater, 19<sup>th</sup> Edition, 1995.
- <sup>(3)</sup> SW-846, Test Methods for Evaluating Solid Waste, Physical and Chemical Methods, USEPA, 3<sup>rd</sup> Edition, 1986.
- <sup>(4)</sup> Based on Hach Method 8203 digital titration.
- <sup>(5)</sup> Based on typical field meter and dissolved oxygen probe with a resolution of 0.01 mg/L and used under normal field operating conditions.
- <sup>(6)</sup> Same HDPE bottle can be used for alkalinity, chloride, pH, sulfate, and temperature.
- <sup>(7)</sup> 7 days if unpreserved. Should be shipped daily.

N/A = not applicable.

Table 2  
 Currently Approved Groundwater Monitoring Program - Well Group Designations  
 Lemberger Site

WELL GROUP						METALS BACKGROUND WELL	RESIDENTIAL GROUP I	RESIDENTIAL GROUP II
IA	IB	IIA	IIB	IIIA	IIIB	IV		
RM-7D	EW-1D	RM-2I	EW-6S	RM-3I <sup>(3)</sup>	GW-1	RM-4S	GR-13	GR-8
RM-7XD	EW-3D	RM-3D <sup>(3)</sup>	RM-2D <sup>(1)</sup>	RM-4D	GW-2	RM-205I <sup>(3)</sup>	GR-26	GR-9
RM-8D	EW-4I	RM-55 <sup>(3)</sup>	RM-203I <sup>(1)(3)</sup>	RM-7S <sup>(3)</sup>	GW-3	RM-205D <sup>(3)</sup>	GR-27	GR-10
RM-209D	EW-4D	RM-5I <sup>(3)</sup>	RM-210I <sup>(1)</sup>	RM-11D	RM-211D <sup>(1)(3)</sup>		GR-31	GR-11
RM-303D	EW-6D	RM-5D <sup>(3)</sup>		RM-102D			GR-41	GR-12
RM-306D	EW-7D	RM-10D		RM-201I			GR-60R	GR-14
RM-307D	EW-8D	RM-101I		RM-201D				GR-15
RM-213D <sup>(4)</sup>	EW-9D	RM-101D		RM-202I				GR-16
RM-214D <sup>(4)</sup>	RM-203D <sup>(1)</sup>	RM-103S <sup>(3)</sup>		RM-202D				GR-17
	RM-210D <sup>(1)</sup>	RM-103D <sup>(3)</sup>		RM-206S <sup>(3)</sup>				GR-24
	RM-212I <sup>(1)</sup>	RM-204I		RM-207S <sup>(3)</sup>				GR-25
	RM-212D <sup>(1)</sup>	RM-204D		RM-208S <sup>(3)</sup>				GR-30
		RM-208D <sup>(3)</sup>		RM-208I <sup>(3)</sup>				GR-33
		RM-304D		RM-301S <sup>(3)</sup>				GR-62
		RM-305D		RM-302S <sup>(3)</sup>				GR-63
		RM-308D						GR-64
								GR-65

Notes:

- (1) Sentinel well.  
 (2) The previous metals background well (RM-9D) and RM-103I were abandoned during the LTR site bedrock investigation drilling program in summer 2005.  
 (3) Well will be sampled and analyzed quarterly for VOCs and metals with the Group IA wells, during the 24-month MNA demonstration period.  
 (4) Well constructed in September 2005 during the LTR site bedrock investigation.

Table 3  
 Groundwater Monitoring Program for MNA Demonstration Project - Sampling Schedule (Project Years 1 and 2)  
 Lemberger Site

WELL GROUP	PROJECT YEAR 1												PROJECT YEAR 2											
	MONTH NUMBER												MONTH NUMBER											
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
IA		V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)	
IB (Note 1)		V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)			V&M (MNA)	
IIA					V&M (MNA)						V&M (MNA)						V&M (MNA)						V&M (MNA)	
IIB (Note 2)		(V)			V&M (MNA)			(V)			V&M (MNA)			(V)			V&M (MNA)			(V)			V&M (MNA)	
IIIA								V&M (MNA)												V&M (MNA)				
IIIB (Note 2)		(V)			(V)			V&M (MNA)			(V)			(V)			(V)			V&M (MNA)			(V)	
IV								(V)												(V)				
Metals																								
Background Well (Note 3)																								
Residential Group I		V			V			V			V			V			V			V			V	
Residential Group II		(V)			V			(V)			(V)												(V)	

Abbreviations:

V&M = volatile organic compounds and metals.

S/P/C = semivolatile organic compounds, pesticides/PCBs, and cyanide.

MNA = monitored natural attenuation parameters.

V = volatile organic compounds only.

Notes:

1. Sampling of extraction wells is not included; however, groundwater elevation will be measured at each extraction well during each monitoring round.
2. Groundwater collection (GWC) sumps, including EW-6S, will not be sampled.
3. This well (RM-9D) was abandoned during the bedrock investigation drilling program in summer 2005.
4. Abbreviations shown in **bold** font in parentheses are analyses added to the currently approved monitoring program, for the MNA demonstration project. Abbreviations in nonbold font without parentheses are analyses required by the currently approved monitoring program.
5. The two monitoring wells that were constructed as part of the LTR bedrock investigation in 2005 (RM-213D and RM-214D) will be sampled with Well Group 1A.

**Table 4**  
**MNA Demonstration Project**  
**Investigative and Field Quality Control Sample Count by Quarter**  
**Lemberger Site**

SAMPLE TYPE AND QUALITY CONTROL SAMPLES	PROJECT YEAR 1				PROJECT YEAR 2			
	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER	FIRST QUARTER	SECOND QUARTER	THIRD QUARTER	FOURTH QUARTER
<b>Groundwater Samples</b>								
Primary Field Samples	19	35	37	35	25	31	37	35
Field Blanks	1	1	1	1	1	1	1	1
Trip Blanks <sup>(1)</sup>	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler
Field Duplicates	1	2	1	2	1	2	1	2
Matrix Spike/Matrix Spike Duplicates	1	2	1	2	1	2	1	2
<b>Residential Well Samples</b>								
Primary Field Samples	23	23	23	23	6	23	6	23
Field Blanks	0	0	0	0	0	0	0	0
Trip Blanks <sup>(1)</sup>	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler	1 per cooler
Field Duplicates	1	1	1	1	1	1	0	1
Matrix Spike/Matrix Spike Duplicates	1	1	1	1	1	1	0	1

**Notes:**

<sup>(1)</sup> One trip blank will be packed in each cooler containing samples for volatile organic analysis.



# **Appendix A**

## **Field Analysis**

### **Standard Operating Procedures**

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**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Well Purging and Sampling: Equipment and Procedures

**SCOPE:** Low flowrate well purging and associated sampling equipment and procedures

## WELL PURGING AND SAMPLING: EQUIPMENT AND PROCEDURES

### Well Purging Procedures

Wells are purged before sampling in order to remove stagnant water from the well casing that is not representative of local groundwater characteristics. Well purging will be accomplished by a low-flow submersible pump (Grundfos Redi-Flo2, QED Sample Pro bladder pump, or equivalent). At each well, follow these procedures:

- Wear nitrile or latex powderless gloves, and discard the gloves after sampling each well.
- Place a new plastic dropcloth (approximately 6 feet by 4 feet in size) around the well to minimize possible contamination of sampling equipment with soil.
- Measure the volume of water in the well casing. Pump from the well at low flowrates until chemical stabilization is attained (as specified below), until four well volumes have been removed, or until the well is purged dry.

Install dedicated tubing in each well to be sampled with a low-flow pump. The steps for purging a well with a low-flow pump (Grundfos, or similar) are as follows:

### Laboratory

1. Prior to entering the field, inspect the sampling pump and discharge tubing for damage and wear.
2. Decontaminate the sampling pump by submerging it in a stainless-steel tank, and pumping soapy tap water through the pump. Transfer the pump to a stainless-steel container filled with Type 2 ASTM-grade deionized water. Pump the deionized water through the pump to remove soapy residue. After rinsing, collect a sample of the deionized water that has been flushed through the pump for VOC analysis. If no VOCs are detected, put the pump into service. If VOCs are detected, repeat the decontamination process.

### Field

1. Calculate the groundwater volume in the well by subtracting the depth to water from the total depth of the well, and multiplying the difference by the cross-sectional area of the well casing using the inside diameter of the pipe. A conversion factor may be used to determine the number of gallons per linear foot. The calculation for well volume would then be: depth to bottom minus depth to water times the conversion factor for gallons per linear foot. The conversion factor for a 2-inch-diameter well is 0.163 gallon per linear foot.



2. Slowly lower the pump and hose into the well.
3. Place the pump below the static water level within the well screen zone.
4. Attach the discharge tubing to the flow-through cell inlet.
5. Turn the pump on. Minimize turbulence. Pump at a flowrate of approximately 1 L/min or less.
6. After the flow-through cell has filled and any trapped air bubbles have been removed, monitor and record indicator parameters such as dissolved oxygen, specific conductance, pH, ORP, and temperature on the sample log.

Continue purging until chemical stabilization is attained, as indicated when three consecutive readings, spaced 2 minutes or 0.5 well volumes apart, are within the following ranges:

Dissolved oxygen       $\pm$  0.2 mg/L or 10%

Specific conductance:    $\pm$  10%  $\mu$ mhos/cm

pH:                                $\pm$  0.1 pH units

Temperature:                $\pm$  0.1°C or 10%

7. An alternative method of purging is to purge at a flowrate of 1 L/min or less until four well volumes have been removed.

The steps for purging wells with a QED Sample Pro bladder pump are as follows:

1. Calculate the well volume as described above.
2. Connect a dedicated Teflon<sup>®</sup> bladder, the gas supply, and the sample discharge lines to the pump. Lower the pump slowly into the screened interval of the well.
3. Attach a compressed gas source and the pump's gas supply line to the controller, and begin purging. Adjust the pumping rate to 1 L/min or less.
4. Continue purging as described in steps 4 through 6 above.

The steps for purging a well that goes dry are as follows:

1. Purge the well dry by pumping, using one of the methods described above.
2. Allow the well to recover at least once before sampling. If time permits, purge the well a second time.

### **Groundwater Sampling Procedures**

The same low-flow pump or bladder pump used to purge the well will be used to collect the groundwater samples. Sampling will be conducted in a manner that avoids agitation of the water column, i.e., by using pumping rates that allow sample collection with minimal disturbance of the sample.

Prior to sampling at each well, ensure that the following tasks have been performed:

- Water level and depth to well bottom measurements are completed.
- Well purging is completed.
- Sample bottles are inventoried.
- Appropriate forms and logbooks are available.
- Field Chain-of-Custody Record is current.
- Field meters are calibrated.
- Field filtration equipment is cleaned and prepared.

Samples are to be collected immediately after well purging. In cases where a well has gone dry, collect samples after the well has recovered enough volume to collect samples.

Procedures for sampling of monitoring wells are as follows:

- Verify that sufficient vials and bottles are available for each sampling location and that each is properly labeled.
- Collect and containerize samples in the order of the volatilization sensitivity of the parameters, using the same discharge tubing on the pump that was used for purging. The preferred collection order for the groundwater parameters is as follows:
  1. Volatile organics
  2. Dioxins and furans
  3. Semivolatile organics
  4. Pesticides and PCBs

5. Cyanide
6. Filterable metals and mercury
7. Samples for in-field water quality measurements (CO<sub>2</sub>, ferrous iron, total alkalinity)
  - Fill sample vials for volatile organics by allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. Do not rinse the sample vial. Fill the sample vial or bottle with a minimum of splashing. Fill each vial until the water forms a positive meniscus at the brim. Allow the vial to overflow slightly, then replace the cap by gently setting it on the water meniscus. Tighten firmly, but do not overtighten. If air bubbles larger than 4 mm are present, reopen the bottle and add sample to form a positive meniscus, and then reseal the bottle.
  - Test samples collected for cyanide analysis for the presence of chlorine, since oxidizing agents can decompose most cyanide species. Collect cyanide samples in the following manner:
    8. Fill the sample bottle to within 1/2 inch from the top.
    9. Test the sample with potassium iodide-starch test paper to determine the presence of chlorine.
    10. If the starch paper turns blue, add ascorbic acid crystals until the sample produces no color change to the starch paper.
    11. Preserve the sample by adding, dropwise, 10N sodium hydroxide (NaOH) until the pH of the sample is greater than or equal to 12.
- Record each sample on a Water Sample Log.
- Store sample containers in a cooler with ice for shipment to the laboratory.
- Collect duplicate samples and field blanks at the rate specified in the approved quality control document for the sampling effort.
- Trip blanks (VOCs only) will accompany each iced cooler containing VOC samples shipped to the laboratory.
- Update the Chain-of-Custody Record.

### **Documentation**

The sampler will maintain a field logbook. The field notebook will be used to document the time and date of purging and sampling, purging rates and stabilization data, samples collected, sample identification and location, general observations, problems encountered, and any other information that may be relevant to the sampling event. Field testing results for pH, specific conductance, temperature, and other measurements will be documented on field log forms. Chain-of-Custody Records will be completed.

### **Groundwater Field-Filtration Procedures**

Filtering in the field will be required for the metals samples to prevent changes due to precipitation or biological activity and to collect a more representative sample of the water moving through the aquifer. In many cases, there may be a small amount of silt or clay in the water after purging the well. This sediment is not representative of constituents transported in groundwater flow systems. The filtering is performed in the field immediately following sample collection because even short delays may drastically change the water chemistry.

Equipment necessary for field-filtering consists of dedicated high-density polyethylene (HDPE) tubing and disposable high-capacity 0.45- $\mu$ m filter cartridges.

The procedures for filtering samples directly from the low-flow pump or bladder pump discharge line are as follows:

- Attach a disposable high-capacity 0.45- $\mu$ m filter cartridge to the discharge line of the pump.
- Allow at least 100 mL of sample water to discharge through the filter prior to filling the appropriate sample bottle.
- Collect the filtered water directly into the appropriate sample containers.



**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Dissolved Concentration Measurements for Carbon Dioxide, Alkalinity, and Ferrous Iron

**SCOPE:** Direct measurement of aqueous concentrations using field titration kits

### **Sample Collection**

The groundwater concentration of three unstable parameters will be measured in the field using Hach colorimetric test kits as described in the sample collection SOP. The field analyses require approximately 30 mL per analyte. The individual samples do not require preservation. The analyses will be completed as soon after collection as is practicable.

### **Equipment and Material Specifications**

Separate Hach® Test Kits will be used to measure carbon dioxide, alkalinity, and ferrous iron:

Carbon dioxide	Hach kit Model CA-23 Range: 0-100 mg/L
Alkalinity	Hach kit Model AL-AP Range: 0-400 mg/L as CaCO <sub>3</sub>
Ferrous iron	Hach kit Model IR-18C Range: 1-10 mg/L

### **Analysis Procedure**

The manufacturer's supplied instructions will be used for each field analysis. Copies of the Hach instructions for the three tests are attached to this SOP.

### **Preventive Maintenance and Frequency**

Test kits should be kept clean and stored out of direct sunlight. All test kit reagents and test solutions must be used before the expiration date provided on the packaging.

### **Equipment Decontamination**

The equipment will be cleaned between analyses as follows:

- Clean labware with a soap (phosphate-free) and potable water mixture.
- Rinse with distilled or deionized water (ASTM Type II).
- Use soft non-abrasive tissues or allow to air dry.

**Data Reduction, Validation, and Reporting**

The raw data collected in the field will be recorded in a field logbook. A narrative of problems encountered and corrective actions taken, calibration checks, and repeated measurements, as well as general comments deemed of interest, will be included in a logbook.

**Quality Control**

Duplicate measurements will be performed at a frequency of 1 per 10 or fewer measurements.



# CARBON DIOXIDE TEST KIT

Model CA-23

Cat. No. 1436-01




**HACH**

## Low Range

1. Fill the mixing bottle to the 23-mL mark with the water sample.
2. Add one drop of Phenolphthalein Indicator Solution to the sample.
3. Add the Sodium Hydroxide Solution drop by drop to the sample. Count each drop as it is added. Swirl the bottle to mix after each drop is added as shown in Figure 1. Continue adding drops until a light pink color forms and persists for 30 seconds.
4. Each drop of Sodium Hydroxide Solution used equals 1.25 mg/L carbon dioxide ( $\text{CO}_2$ ).

***WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use appropriate safety equipment.***

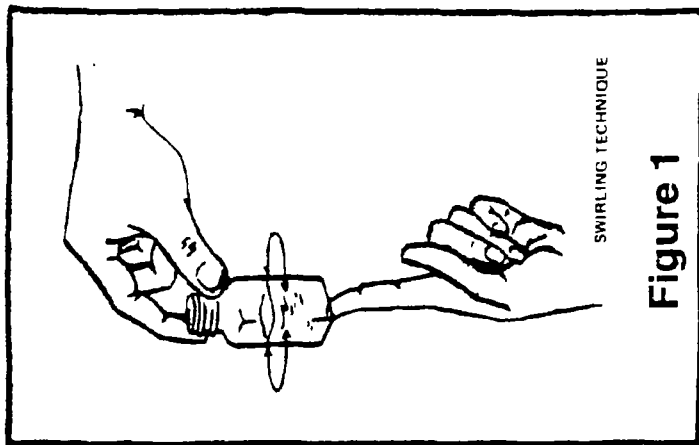
 HACH COMPANY, P.O. BOX 389, LOVELAND, COLORADO 80359  
TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 970-669-3050, TELEX: 160840

## Medium Range

1. Fill the mixing bottle to the 15 mL mark with the water sample.
2. Add one drop of Phenolphthalein Indicator Solution to the sample.
3. Add the Sodium Hydroxide Solution drop by drop. Count each drop as it is added. Swirl the bottle to mix after each drop is added. Continue adding drops until a light pink color forms and persists for 30 seconds.
4. Each drop of Sodium Hydroxide Solution used equals 2 mg/L carbon dioxide ( $\text{CO}_2$ ).

## High Range

1. Fill the plastic measuring tube level full with the water to be tested. Transfer to the mixing bottle by placing the mixing bottle over the tube and then turning the bottle right-side up.
2. Add one drop of Phenolphthalein Indicator Solution to the contents of the mixing bottle.
3. Add the Sodium Hydroxide Solution drop by drop. Count each drop as it is added. Swirl the bottle to mix after each drop is added. Continue adding drops until a light pink color forms and persists for 30 seconds.
4. Each drop of Sodium Hydroxide Solution used equals 5 mg/L carbon dioxide ( $\text{CO}_2$ ).



## REPLACEMENTS

Cat. No.	Description	Unit
1897-36	Phenolphthalein Indicator Solution, 1 g/L	15 mL (1/2 oz) SCDB*
671-37	Sodium Hydroxide Solution, 0.01N	118 mL (4 oz) MDB†
438-00	Measuring Tube	each
2327-06	Mixing Bottle	pkg/6

\*Self-contained Dropping Bottle

†Marked Dropping Bottle

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# ALKALINITY TEST KIT

Model AL-AP

Cat.No. 24443-00



## High Range

1. Fill the plastic measuring tube level full with the water to be tested. Pour the contents of the tube into the mixing bottle.
2. Open one Phenolphthalein Indicator Powder Pillow as shown in Figure 1. Add the contents of the pillow to the mixing bottle. Swirl to mix as shown in Figure 2.
3. If the water remains colorless after the addition of the phenolphthalein, the phenolphthalein alkalinity is zero. If this is the case, proceed to Step 6.
4. If the water becomes pink with the addition of phenolphthalein, add Sulfuric Acid Standard Solution drop-wise while swirling to mix after each drop. Continue adding and counting the drops until the water becomes colorless.

***WARNING: The chemicals in this kit may be hazardous to the health and safety of the user if inappropriately handled. Please read all warnings before performing the test and use appropriate safety equipment.***



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TELEPHONE: WITHIN U.S. 800-227-4224, OUTSIDE U.S. 970-669-3050, TELEX: 160840

5. The phenolphthalein alkalinity in grains per gallon as calcium carbonate ( $\text{CaCO}_3$ ) is equal to the number of drops of sulfuric acid used. To convert to milligrams per liter, multiply the g/g value by 17.
6. Add the contents of one Bromocresol Green-Methyl Red Indicator Powder Pillow to the mixing bottle and swirl to mix. The color will change to blue-green.
7. Continue the drop-count procedure, adding sulfuric acid while counting the drops and swirling to mix until the color changes to pink.
8. The total (methyl orange) alkalinity in g/g as  $\text{CaCO}_3$  is equal to the total number of drops of sulfuric acid used in both Steps 4 and 7. To convert to mg/L total alkalinity, multiply the g/g value by 17.

### Low Range

1. Fill the mixing bottle to the 15-mL mark with the water to be tested.
2. Add the contents of one Phenolphthalein Indicator Powder Pillow and swirl to mix as shown in Figure 2.
3. If the water remains colorless, the phenolphthalein alkalinity is zero. Proceed to Step 6. If the water becomes pink, proceed to Step 4.
4. Add Sulfuric Acid Standard Solution drop-wise while swirling to mix after each drop. Continue adding and counting the drops until the water becomes colorless.
5. The phenolphthalein alkalinity in grains per gallon as calcium carbonate ( $\text{CaCO}_3$ ) is found by dividing the number of drops of sulfuric acid used in Step 4 by 2.5. To convert to milligrams per liter alkalinity, multiply the g/g value by 17.

6. Add the contents of one Bromcresol Green-Methyl Red Indicator Powder Pillow to the mixing bottle and swirl to mix. The color will change to blue-green.
7. Continue the drop-count procedure, adding sulfuric acid while counting the drops and swirling to mix until the color changes to pink.
8. The total (methyl-orange)alkalinity in g/g as  $\text{CaCO}_3$  is found by dividing the total number of drops of sulfuric acid used in both Step 4 and Step 7 by 2.5. To convert to mg/L total alkalinity, multiply the g/g value by 17.

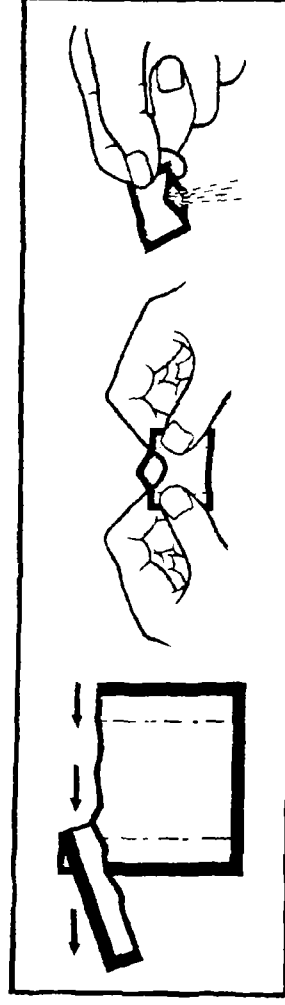
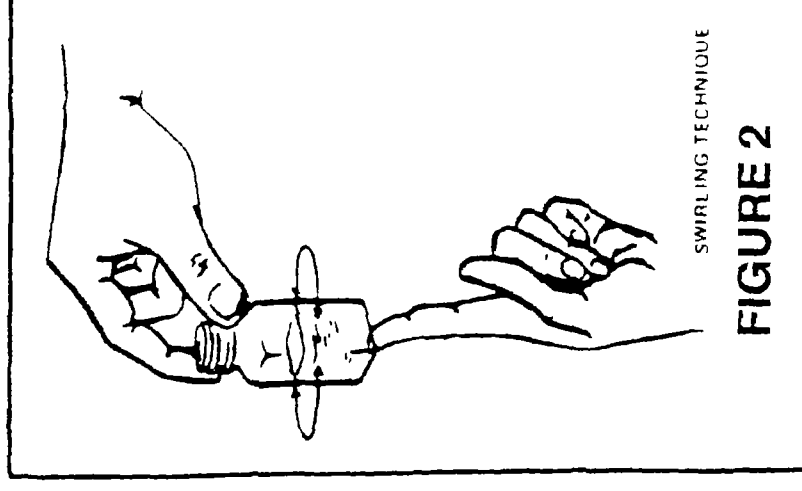


FIGURE 1



## Replacements

<b>Cat. No.</b>	<b>Description</b>	<b>Unit</b>
24374-00	Reagent Set - contains one each:	each
943-99	Bromocresol Green-Methyl Red Indicator	pk/100
	Powder Pillows	
942-99	Phenolphthalein Indicator Powder Pillows	pk/100
26205-32	Sulfuric Acid Standard Solution 0.030N	100 mL MDB*
2327-06	Bottle, mixing	pk/6
438-00	Measuring Tube, plastic, 5.83 mL	each

\*Marked dropping bottle

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9/97

Made in U.S.A.





- **Iron, Ferrous, Test Kit**

1,10 Phenanthroline Iron Reagent Method

- **Trousse d'analyse fer ferreux**

Méthode réactif fer 1, 10 Phéanthroline

- **Eisen, 2wertig Test Kit**

1,10 Phenanthrolin-Eisenreagenz Methode

- **Kit de análisis para hierro ferroso**

Método reactivo de fenatrolina de hierro 1,10

0.0 – 10.0 mg/L

- Mod. IR-18C

- # 26672-00

- To ensure accurate results, read carefully before proceeding.
- Pour obtenir des résultats exacts, lire attentivement le mode d'emploi avant d'utiliser la trousse.
- Um genaue Ergebnisse zu gewährleisten, lesen Sie das Folgende bitte aufmerksam durch, bevor Sie fortfahren.
- Para obtener resultados precisos, lea detenidamente las instrucciones antes de proceder al análisis.

**WARNING**

*Handling chemical samples, standards, and reagents can be dangerous. Review the Material Safety Data Sheets before handling any chemicals.*

**ATTENTION**

*La manipulation des échantillons chimiques, étalons et réactifs peut être dangereuse. Lire les fiches de données de sécurité des produits avant de manipuler tout produit chimique.*

**WARNUNG**

*Die Handhabung chemischer Proben, Standards und Reagenzien kann gefährlich sein. Bitte gehen Sie die Materialsicherheitsdatenblätter durch, bevor Sie Chemikalien handhaben.*

**ADVERTENCIA**

*El manejo de sustancias químicas, patrones y reactivos, puede resultar peligroso. Lea las fichas de informaciones de seguridad de materiales antes de manipular cualquier producto químico.*



## **Introduction**

The 1,10 phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the ferrous iron concentration. Ferric iron does not react. The ferric iron ( $\text{Fe}^{3+}$ ) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

## **Introduction**

L'indicateur 1,10 phénanthroline dans le réactif fer ferreux réagit avec le fer ferreux présent dans l'échantillon pour former une coloration orange proportionnelle à la concentration de fer ferreux. Le fer ferrique ne réagit pas. La concentration de fer ferrique ( $\text{Fe}^{3+}$ ) peut être déterminée en soustrayant la concentration de fer ferreux des résultats d'une analyse de fer total.

## **Einleitung**

Der 1,10 Phenantrolin Indikator im Eisen(II)-Reagenz reagiert mit Eisen(II) in der Probe durch Bildungen einer orangen Farbe, proportional zur Konzentration des zweiwertigen Eisens. Eisen(III) reagiert nicht. Die Konzentration des dreiwertigen Eisen ( $\text{Fe}^{3+}$ ) kann bestimmt werden, indem man die Konzentration des zweiwertigen Eisens von den Ergebnissen eines Eisen Gesamt Tests subtrahiert.

## **Introducción**

El indicador de 1,10-fenantrolina en el Reactivo para Hierro Ferroso reacciona con el hierro ferroso de la muestra para formar un color anaranjado en proporción con la concentración de hierro ferroso. El hierro férrico no reacciona. La concentración de hierro férrico ( $\text{Fe}^{3+}$ ) puede ser determinada restando la concentración de hierro ferroso de el resultado de una prueba de hierro total.

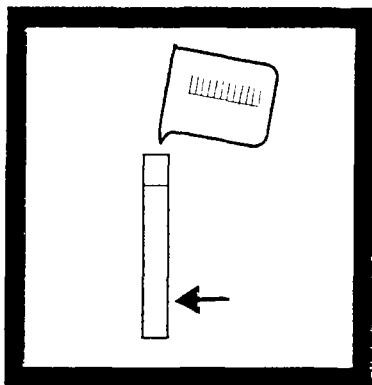
## Measuring Hints and General Test Information

- Wash all labware between tests. Contamination may alter test results. Clean with a non-abrasive detergent or a solvent such as isopropyl alcohol. Use a soft cloth for wiping or drying. Do not use paper towels or tissue on plastic tubes as this may scratch them. Rinse with clean water (preferably deionized water).
- Rinse all viewing tubes thoroughly with the sample water before testing.
- Use clippers to open plastic powder pillows.
- For critical testing, reagent accuracy should be checked with each new lot of reagents. Prepare a ferrous iron stock solution (100 mg/L Fe) by dissolving 0.702 grams of ferrous ammonium sulfate, hexahydrate, in one liter deionized water. Dilute 5.00 mL of this solution to 100 mL with deionized water to make a 5.0 mg/L standard solution. Prepare this immediately before use. Follow the ferrous iron test instructions using this solution instead of a water sample.

## Conseils pour les mesures et informations générales sur l'analyse

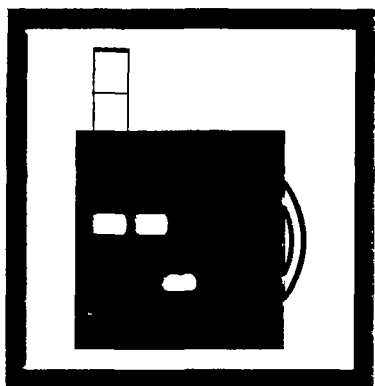
- Laver toute la verrerie entre les analyses. La contamination peut fausser les résultats d'analyses. Laver avec un détergent non abrasif ou un solvant tel que l'isopropanol. Utiliser un tissu doux pour essuyer ou sécher. Ne pas utiliser de tissu ou papier d'essuyage sur les tubes en plastique pour ne pas les rayer. Rincer à l'eau propre (de préférence de l'eau désionisée).
- Rincer soigneusement tous les tubes colorimétriques avec l'échantillon d'eau avant l'analyse.
- Utiliser la pince coupante pour ouvrir les gélules en plastique.
- Pour des analyses critiques, l'exactitude du réactif doit être vérifiée pour chaque nouveau lot de réactifs. Préparer une solution-mère de fer ferreux (100 mg/L Fe) en dissolvant 0,702 grammes d'ammonium-fer (II) sulfate, hexahydrate, dans un litre d'eau désionisée. Diluer 3,00 mL de cette solution à 100 mL avec de l'eau désionisée pour obtenir une solution étalon à 3,0 mg/L. Préparer cette solution immédiatement avant emploi. Suivre les instructions d'analyse du fer ferreux en remplaçant l'échantillon par cette solution étalon.

## • Procedure • Technique • Verfahren • Procedimiento



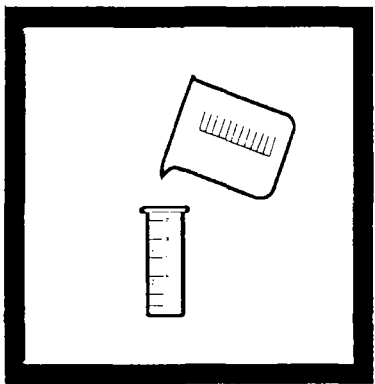
1. Fill a viewing tube to the first (5-mL) line with sample water. This is the blank.

- ♦ Remplir un tube colorimétrique jusqu'au premier trait (5 mL) avec l'échantillon d'eau. Ceci est le blanc.
- ♦ Füllen Sie ein Prüfröhrchen bis zur ersten (5 mL) Linie mit Probenwasser. Dieses ist die Blindprobe.
- ♦ Llene un tubo para colorimetria hasta la primera marca (5 mL) con la muestra de agua. Esto constituye el blanco.



2. Place this tube in the top left opening of the color comparator.

- ♦ Placer ce tube dans l'ouverture supérieure gauche du comparateur.
- ♦ Stellen Sie dieses Röhrchen in die obere linke Öffnung des Farbkomparators.
- ♦ Coloque este tubo en la abertura superior izquierda del comparador.



3. Fill the measuring vial to the 25-mL mark with sample water.

- ♦ Remplir le tube de mesure jusqu'au trait 25 mL avec l'échantillon d'eau.
- ♦ Füllen Sie das Messröhrchen bis zur 25 mL Markierung mit dem Probenwasser.
- ♦ Llene el frasco medidor hasta la marca de 25 mL con el agua de la muestra.



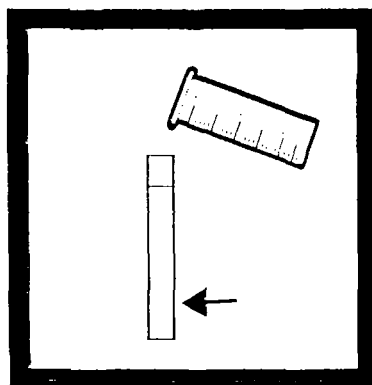
4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the measuring vial.

- ♦ Ajouter le contenu d'une gélule de réactif du fer ferreux au tube de mesure.
- ♦ Geben Sie den Inhalt eines Eisen(II)-Reagenz-Pulverkissens in das Messröhrchen.
- ♦ Agregue el contenido de una cápsula del Reactivo para Hierro Ferroso al frasco medidor.



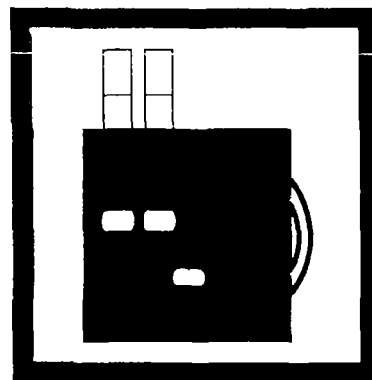
5. Swirl to mix. An orange color will develop if ferrous iron is present. Allow three minutes for full color development.

- ♦ Agiter pour mélanger. En présence de fer ferreux, une coloration orange se développe. Attendre le développement complet de la coloration.
- ♦ Schwenken Sie zum Vermischen. Ist Eisen(II) vorhanden, entwickelt sich eine orange Färbung. Warten Sie drei Minuten, bis sich die Farbe vollständig ausgebildet hat.
- ♦ Agite para mezclar. Se formará un color anaranjado en presencia de hierro ferroso. Deje pasar tres minutos para que el color se desarrolle completamente.



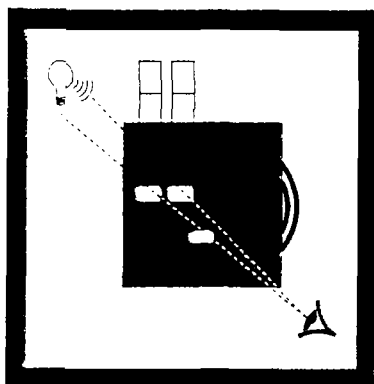
6. Fill another viewing tube to the first (5-mL) mark with the prepared sample.

- ♦ Remplir un autre tube jusqu'au premier trait (5 mL) avec l'échantillon préparé.
- ♦ Füllen Sie ein weiteres Prüfröhrchen bis zur ersten (5 mL-) Linie mit der vorbereiteten Probe.
- ♦ Llène otro tubo para colorimetría hasta la marca de 5mL con la muestra preparada en los puntos 4 y 5.



7. Place the second tube in the top right opening of the color comparator.

- ♦ Placer le second tube dans l'ouverture supérieure droite du comparateur.
- ♦ Setzen Sie das zweite Röhrchen in die obere rechte Öffnung des Farbkomparators.
- ♦ Coloque el segundo tubo en la abertura superior derecha del comparador.

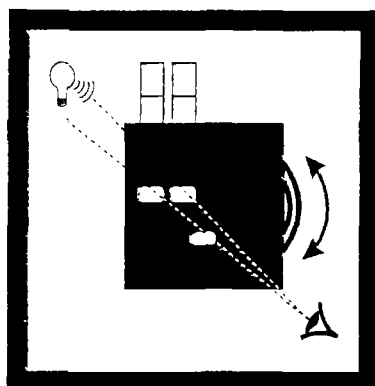


8. Hold comparator up to a light source such as the sky, a window or a lamp. Look through the openings in front.

♦ Tenir le comparateur face à une surface uniformément éclairée (ciel, lampe, fenêtre) et regarder par les ouvertures de la face antérieure du comparateur.

♦ Halten Sie den Komparator gegen eine Lichtquelle wie zum Beispiel den Himmel, ein Fenster oder eine Lampe. Sehen Sie durch die Öffnungen vorn.

♦ Lleve el comparador hasta una fuente de luz, tal como el cielo, una ventana o una lámpara. Mire a través de las aberturas frontales del comparador.

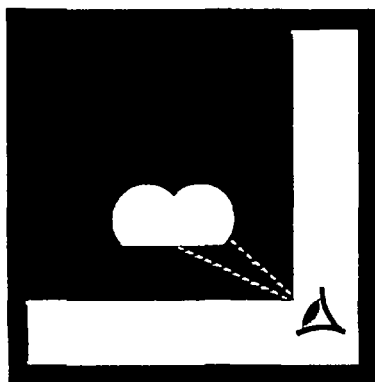


9. Rotate the color disc until the color matches in the two openings.

♦ Tourner le disque jusqu'à égalité des teintes dans les deux ouvertures.

♦ Drehen Sie die Farbscheibe, bis die Farbe in den beiden Öffnungen übereinstimmt.

♦ Haga girar el disco de color hasta que el color coincida en ambas aberturas.



10. Read the mg/L ferrous iron in the scale window.

♦ Lire la concentration du fer ferreux en mg/L dans la fenêtre de l'échelle.

♦ Lesen Sie die mg/L Eisen(II) im Skalenfenster ab.

♦ Lea la concentración de hierro ferroso en mg/L en la ventanilla graduada.

## REPLACEMENTS

Description	Unit	Cat. No.
Clippers .....	each.....	968-00
Color Comparator.....	each.....	1732-00
Color Disc, Iron Phenanthroline.....	each.....	1874-00
Ferrous Iron Reagent Powder Pillows, 25 mL .....	100/pkg.....	1037-69
Instruction Card, IR-18C Test Kit.....	each.....	26672-88
Vial, measuring, with 2, 5, 10, 15, 20 and 25-mL marks .....	each.....	2193-00
Viewing Tube, plastic.....	4/pkg.....	46600-04
Water, deionized.....	4 L.....	272-56

## REACTIFS ET PIÈCES DE RECHANGE

Désignation	Unité	Réf. N°
Pince coupante pour gélules moyennes.....	1.....	968-00
Comparateur.....	1.....	1732-00
Disque coloré fer, phénanthroline .....	1.....	1874-00
Réactif du fer ferreux en gélules pour 25 mL .....	100/paq.....	1037-69
Mode d'emploi de la trousse IR-18C .....	1.....	26672-88
Tube de mesure marqué 2, 5, 10, 15, 20 et 25 mL .....	1.....	2193-00
Tube colorimétrique en plastique avec bouchon.....	4/paq.....	46600-04
Eau désionisée.....	4 L.....	272-56

## VERBRAUCHSMATERIAL UND ERSATZTEILE

Beschreibung	Einheit	Kat. Nr.
Abschneider.....	1.....	968-00
Farbkomparator .....	1.....	1732-00
Farbscheibe, Eisenphenanthrolin.....	1.....	1874-00
Eisen(II) Reagenz-Pulverkissen, 25 mL.....	100/Stck.....	1037-69
Anleitungskarte, IR-18C Test Kit.....	1.....	26672-88
Messröhrchen m. 2, 5, 10, 15, 20 und 25 mL Markierungen.....	1.....	2193-00
Farbprüfröhrchen, Plastik, mit Kappe .....	4/Stck.....	46600-04
Entsalztes Wasser .....	4 L.....	272-56

## REACTIVOS Y MATERIALES

Descripción	Unidad	Nº Ref.
Pinzas cortantes para cápsulas intermedias.....	1.....	968-00
Comparador de Colores.....	1.....	1732-00
Disco de colores, fenantrolina de hierro.....	1.....	1874-00
Reactivo para Hierro Ferroso, Bolsas de Polvo, 25 mL .....	100/lote.....	1037-69
Tarjeta de Instrucciones, Juego de Prueba IR-18C.....	1.....	26672-88
Frasco medidor, con marcas a 2, 5, 10, 15, 20 y 25 mL.....	1.....	2193-00
Tubo para colorimetría de plástico, con tapa protectora .....	4/lote.....	46600-04
Agua desionizada .....	4 L.....	272-56



## OPTIONAL REAGENTS AND EQUIPMENT

Description	Unit	Cat. No.
Caps. for plastic Color Viewing Tubes 46600-04 .....	4/pkg.....	46600-14
Ferrous Ammonium Sulfate, Hexahydrate.....	113 g.....	11256-14
Flask, volumetric, Class A, 100-mL.....	each.....	26366-42
Flask, volumetric, Class A, 1000-mL.....	each.....	26366-53
Pipet, volumetric, Class A, 5-mL .....	each.....	14515-37
Pipet Filler, safety bulb.....	each.....	14651-00

## REACTIFS ET EQUIPEMENTS OPTIONNELS

Désignation	Unité	Réf. N°
Bouchons pour tubes en plastique 46600-04.....	4/paq.....	46600-14
Ammonium, fer (II) sulfate, 6 H <sub>2</sub> O ACS .....	113 g.....	11256-14
Fiole jaugée, classe A, 100ml.....	1.....	26366-42
Fiole jaugée, classe A, 1000 ml.....	1.....	26366-53
Pipette jaugée, classe A, 5,00ml.....	1.....	14515-37
Poire à pipetter .....	1.....	14651-00

## ZUSÄTZLICHE REAGENZIEN UND ZUBEHÖR

Beschreibung	Einheit	Kat. Nr.
Kappen, für Plastik-Farbprüfröhrchen 46600-04 .....	4/Stck.....	46600-14
Eisen(II)-Ammoniumsulfat, hexahydrat .....	113 g.....	11256-14
Messkolben, Klasse A, 100 mL.....	1.....	26366-42
Messkolben, Klasse A, 1000 mL.....	1.....	26366-53
Messpipette, Klasse A, 5mL .....	1.....	14515-37
Pipettenfüller, Sicherheitsball.....	1.....	14651-00

## REACTIVOS Y EQUIPAMIENTO OPCIONALES

Descripción	Unidad	Nº Ref.
Tapas protectoras para tubos de plástico 46600-04 .....	4/lote.....	46600-14
Sulfato de Amonio Ferroso, Hexahidratado .....	113 g.....	11256-14
Frasco volumétrico, clase A, 100-mL .....	1.....	26366-42
Frasco volumétrico, clase A, 1000-mL .....	1.....	26366-53
Pipeta volumétrica, clase A, 5-0 mL .....	1.....	14515-37
Bulbo de seguridad para llenador de pipeta. ....	1.....	14651-00



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**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** pH Measurement

**SCOPE:** Direct measurement of pH using a field instrument

### **Sample Collection**

The pH of groundwater samples will be measured using a flow-through cell as described in the sample collection SOP. The field analysis does not require any sample preparation or preservation.

### **Equipment and Material Specifications**

WTW Measurement Systems, Inc., MultiLine P3 handheld pH meter

(Additional specifications are provided in the manufacturer's Instruction Manual that is kept in the instrument case.)

### **Calibration Procedure and Frequency**

The pH meter will be calibrated with standard buffer solutions prior to each sampling round. In the field, the meter will be calibrated with two buffer solutions before initial use each day and at least one additional time for every full day of use. Date and time of calibration, standards used, results of calibration, and corrective actions will be recorded on a calibration form. General procedures for the pH meter calibration are described below:

- Turn on instrument.
- Set measuring mode to **pH** on display using the pH/mV, O2 keys, or the up/down arrows.
- Place probe in pH 7 buffer. Press Cal key until **ASY** is displayed.
- Press run/enter key. Wait until reading stabilizes. Set pH display to read 7.00 using the arrow keys.
- Press run/enter key. **mV** reading will be displayed. Range should be +/- 30 mV.
- Press run/enter key. **SLO** display will appear. Remove and rinse probe. Place in pH 4 buffer.
- Press run/enter key. Wait for reading to stabilize. When reading has stabilized, use arrow keys to set display to read 4.00.
- Press run/enter key. This is the slope of the probe. Permissible range is -50.0 mV/pH to -62.0 mV/pH.
- Press the run/enter key. Offset voltage will be displayed. Permissible range is +/-30 mV.
- Press run/enter key. Meter is ready to measure pH.

The calibrations performed, the standards used, and their lot numbers will be recorded on a calibration form. Appropriate new batteries will be purchased and kept with the meters to facilitate immediate replacement in the field, as necessary.

### **Analysis Procedures**

The pH measurements will be made electrometrically using a combination electrode, an automatic temperature compensator probe, and a portable pH meter in a flow-through cell as a monitoring well is purged. The WTW Model P3 and probes may be used in a vertical, horizontal, or tilted position; it may be carried or moved during use without affecting its accuracy or stability of measurement.

- With the probe inserted into a full flow-through cell, check the flow-through cell for air bubbles and remove them if they are found. Wait for the probe to stabilize, and record the stabilized reading to the nearest 0.1 pH Unit.

The instrument's Operation Manual contains additional details for pH measurement procedures and instrument operation instructions.

The meter will be checked before each field trip and daily while in the field for any mechanical or electrical failures, weak batteries, and cracked or fouled electrodes. The meter and electrode will also be checked against standard buffer solutions of known pH values (e.g., 4.0 and 7.0) as described in the instrument's Operation Manual. While in the field, the meter will be checked at least once for every half-day of use, and after every 10 or fewer investigative samples, with fresh buffers. In case of an apparent discrepancy in a pH measurement, the electrode will be recalibrated. The sample will then be reanalyzed. Duplicate analyses will be taken once for every 10 measurements and must agree within 0.1 pH units. If measurements do not agree, the meter will be recalibrated and/or replaced.

To take a pH measurement, follow the last step under "Calibration Procedure and Frequency" above.

### **Preventive Maintenance Procedures and Frequency**

Field preventive maintenance will include a cursory check of instrument operation without disassembly of test equipment. If any of these preliminary checks are negative, the instrument may not be functioning properly, and the back-up meter will be used. Field-check procedures are described below:

#### **pH Meter Checkout Procedure**

- Turn on instrument.
- Set measuring mode to pH on display using the pH/mV, O2 key, or the up/down arrows.
- Place probe in pH buffer 7. Press the Cal key until **CL1** is displayed.
- Press the run/enter key. An **AR** display will start flashing. Wait until display stops flashing and disappears. Wait until the display shows **CL2**. Remove probe and rinse. Place probe in pH buffer 4.
- Press run/enter key again; the **AR** display will appear. Wait until the display disappears. Slope of the electrode in mV will be displayed. Range should be -50.0 mV/pH to -62.0 mV/pH.
- Press run/enter key. Offset voltage will be displayed. Permissible range is +/- 30 mV.
- Press run/enter key. Meter is ready to measure pH.

If error message **E3** occurs at the end of the calibration for each probe, see the troubleshooting section in the instruction manual.

#### **Equipment Decontamination**

The electrode will be cleaned between measurements of water samples as follows:

- Rinse with distilled or deionized water (ASTM Type II).
- Place electrode in pH 7 buffer between uses.

#### **Data Reduction, Validation, and Reporting**

The raw data collected in the field will be recorded on the appropriate form. A narrative of problems encountered and corrective actions taken, calibration checks, and repeated measurements, as well as general comments deemed of interest, will be included in the logbook.

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**Quality Control**

Duplicate pH measurements will be performed at a frequency of 1 per 10 or fewer measurements.





**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Dissolved Oxygen Measurement

**SCOPE:** Direct measurement of dissolved oxygen using a field instrument

Air calibrate the Model P3 probe, as follows:

- Press CAL key, and place probe in air calibration beaker (probes storage bottle).
- Press run/enter key. The **AR** display will appear and start flashing. Wait until display stops flashing. The measurement is the relative slope of the probe. Permissible range is 0.6 to 1.25.

#### **Calibration Frequency**

Calibration will be performed daily before use. Calibration can be disturbed by physical shock, touching the membrane, fouling of the membrane, or drying of the electrolyte. Verification of the calibration will be performed once every 10 or fewer investigative samples by submerging the probe in a beaker of potable water that is equilibrated with the air, and observing that the meter reads the correct value.

#### **Analysis Procedure**

All WTW P3 series probes have similar sensors and should be cared for in the same way. They are precision devices and require careful treatment if measurements of high accuracy are to be made.

Hydrogen sulfide, sulfur dioxide, halogens, neon, and nitrous and nitric oxide are interfering gases. If erroneous readings are suspected, it may be necessary to determine if these substances are the cause.

Before use, the instrument must be prepared as follows:

The WTW Model P3 and probes may be used in a vertical, horizontal, or tilted position; it may be carried or moved during use without affecting its accuracy or stability of measurement.

- A constant flow of water across the probe is required for accurate measurements. If a flow-through cell is being used, the current through the cell is sufficient. With the probe inserted into a full flow-through cell, check the flow-through cell for air bubbles, and remove them if they are found.
- Wait for the probe to stabilize, and record the stabilized reading, in mg/L.

## **Preventive Maintenance Procedures and Frequency**

### ***Batteries***

Instrument batteries are in the upper holder. Four AA-size alkaline batteries are used. The LOBAT warning shows on the display when about 1,500 hours of use remain.

### ***Probe***

#### **Probe Membrane**

Replace the membrane at a minimum every 4 weeks of operation, or whenever a bubble forms in the electrolyte, or whenever the membrane has become fouled or damaged. Inspect the gold cathode when changing the membrane; it should be bright and untarnished. See "Analysis Procedure."

#### **Probe Performance Check**

Every month when the probe is in daily use (less frequently otherwise), or whenever probe response is slow or calibration is unstable, check probe performance as follows:

#### **Calibration Stability**

- Carefully calibrate the probe in moist air inside the calibration bottle with the instrument set in the percent air saturation mode.
- Allow the instrument to operate for 1 hour.
- A properly functioning probe will hold calibration within  $\pm 1$  percent for 1 hour, after the first hour of operation.

#### **Probe Service**

- Damaged or wrinkled membrane: Change the membrane and retest.
- Fouled or silver coated cathode: Clean as instructed in "Analysis Procedure."
- Fouled anode: Soak for 24 hours in 3 percent ammonia (NH<sub>3</sub>); rinse thoroughly with distilled water and retest.
- Damaged cable or connector: Inspect and replace if needed.

If these steps do not restore specifications performance, return the probe to the factory for service.

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**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Specific Conductivity Measurement

**SCOPE:** Direct measurement of specific conductivity using a field instrument

### **Sample Collection**

The specific conductivity of groundwater samples will be measured using a flow-through cell, as described in the sample collection SOPs. The field analysis does not require any specific sample preparation or preservation.

### **Equipment Specifications**

Instrument:	WTW Measurement Systems, Inc., MultiLine P3 handheld conductivity meter
Conductivity range:	1 uS/cm to 500 mS/cm
Conductivity accuracy:	± 2.5%
Probe accuracy :	± 1.5% of reading
Readability:	1.0 µmhos/cm
Temperature compensation:	Automatic
Temperature range:	-5 to +100°C.
Temperature accuracy:	± 0.2°C
Power supply:	4 AA-size alkaline batteries (provide approximately 2,500 hours of operation)

### **Calibration Procedure and Frequency**

The conductivity cells of the specific conductivity meter will be cleaned and checked against known conductivity standards before each field sampling round. In the field, the instrument will be checked before use each day and at least one additional time for every full day of use, against a standard of known conductivity. Date and time, standards used, results, and corrective actions taken will be recorded in a calibration form. The calibration procedure is described below:

- Press Cal key. Place probe in conductivity calibration solution.
- Press the run/enter key. **AR** display will begin flashing. Wait until flashing stops.
- Press run/enter key. Permissible range is 1,313 to 1,510 µmhos/cm.

### **Analysis Procedure**

The specific conductivity measurements will be made electrometrically using an automatic temperature compensator probe, a portable conductivity meter, and a flow-through cell, as a monitoring well is purged.

The WTW Model P3 and probes may be used in a vertical, horizontal, or tilted position; it may be carried or moved during use without affecting its accuracy or stability of measurement.

- With the probe inserted into a full flow-through cell, check the flow-through cell for air bubbles and remove them if they are found. Wait for the probe to stabilize, and record the stabilized reading.

The calibration solution concentration and composition are as follows: potassium chloride, 0.010 Molar, 1,413 micromhos per centimeter ( $\mu\text{mhos/cm}$ ).

Each meter will be inspected for physical damage before each field trip and daily while in the field. Batteries and conductivity cells will be cleaned and checked daily against known standards as described in the instrument's Operation Manual.

Duplicate field measurements will be taken once for every 10 samples collected. The results should agree within  $\pm 10 \mu\text{mhos/cm}$  and will be recorded on the Water Sample Log.

### **Preventive Maintenance Procedures and Frequency**

#### ***Conductivity Meter***

The maintenance required for the conductivity meter is battery replacement. Four AA-size alkaline batteries will provide approximately 2,500 hours of operation. Accuracy will not be maintained if zinc-carbon cells are used. Replace batteries every 3 months or as needed to reduce the danger of corrosion due to leaky batteries.

#### ***Conductivity Probe***

When the calibration procedure indicates low readings, the probable cause is a dirty probe. Hard water deposits, oil, and organic matter are the most likely contaminants.

For normal cleaning, soak the electrodes for 5 minutes with a generally available bathroom tile cleaning preparation such as Dow Chemical "Bathroom Cleaner"; Horizon Industries Rally "Tile, Porcelain, and Chrome Cleaner"; or Lysol "Basin, Tub, and Tile Cleaner."

For stronger cleaning, a 5-minute soak in a solution made of 10 parts distilled water, 10 parts isopropyl alcohol, and 1 part HCl can be used.

Always rinse the probe after cleaning and before storage.

#### **Equipment Decontamination**

Clean the equipment between uses by rinsing with distilled or deionized water (ASTM Type II).

#### **Data Reduction, Validation, and Reporting**

The raw data collected in the field will be recorded on appropriate forms. A narrative of problems encountered and corrective actions taken, calibration checks, and repeated measurements, as well as general comments deemed of interest, will be included in a logbook.

#### **Quality Control**

Duplicate measurements will be performed at a frequency of 1 per 10 or fewer measurements.





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**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Oxidation-Reduction Potential (ORP) Measurement

**SCOPE:** Direct measurement of ORP using a field instrument

### **Sample Collection**

The groundwater sample will be collected using a flow-through cell as described in the sample collection SOP. The field analysis does not require specific sample preparation or preservation procedures.

### **Equipment Specifications**

Instrument: WTW Measurement Systems, Inc., MultiLine P3 handheld ORP meter

Measuring range: -1,250 mV to +1,250 mV

ORP probe accuracy:  $1 \text{ mV} \pm 1 \text{ digit}$

Readability: 1 mV

Power supply: 4 AA-size alkaline batteries provide approximately 1,500 hours of operation.

### **Calibration Procedure and Frequency**

The ORP probe of the meter will be cleaned and checked against known standards before each field sampling round. In the field, the instrument will be checked before use each day and at least one additional time for every full day of use, against a standard of known ORP. Date and time, standards used, results, and corrective actions taken will be recorded in a calibration form. The calibration procedure is described below:

- Press the arrow keys until the mV reading is displayed.
- Place probe in ORP buffer solution (Yellow Springs Instruments Zobell Solution).
- Compare the instrument reading to the Zobell Standard (225 to 250 mV).
- If the difference is greater than  $\pm 30 \text{ mV}$ , clean or replace the probe.

### **Analysis Procedure**

The ORP measurements will be made electrometrically using an ORP probe, a handheld meter, and a flow-through cell as a well is purged. The WTW Model P3 meter and probes may be used in a vertical, horizontal, or tilted position; it may be carried or moved during use without affecting its accuracy or stability of measurement.

- With the probe inserted into a full flow-through cell, check the flow-through cell for air bubbles and remove them if they are found. Wait for the probe to stabilize, and record the stabilized reading.

Each meter will be inspected for physical damage before each field trip and daily while in the field. Batteries and probes will be cleaned and checked daily against known standards as described in the instrument's Operation Manual.

Duplicate field measurements will be taken once for every 10 samples collected. The results should agree within  $\pm 10$  mV and will be recorded on the Water Sample Log.

### **Preventive Maintenance Procedures and Frequency**

#### ***ORP Meter***

The maintenance required for the meter is battery replacement. Four AA-size alkaline batteries will provide 1,500 hours of operation. Accuracy will not be maintained if zinc-carbon cells are used. Replace batteries every 3 months or as needed to reduce the danger of corrosion due to leaky batteries.

#### ***ORP Probe***

When the calibration procedure indicates errant readings, the probable cause is a dirty probe. Hard water deposits, oil, or organic matter are the most likely contaminants.

For normal cleaning, soak the probe for 5 minutes with a 10 parts water/1 part Alconox (or equivalent) solution. For stronger cleaning, a 5-minute soak in a solution made of 10 parts distilled water/10 parts isopropyl alcohol plus 1 part HCl can be used.

Always rinse the probe after cleaning and before storage.

**Equipment Decontamination**

The equipment will be cleaned between measurements by rinsing with distilled or deionized water (ASTM Type II).

**Data Reduction, Validation, and Reporting**

The raw data collected in the field will be recorded on appropriate forms. A narrative of problems encountered and corrective actions taken, calibration checks, and repeated measurements, as well as general comments deemed of interest, will be included in a logbook.

**Quality Control**

Duplicate ORP measurements will be performed at a frequency of 1 per 10 or fewer measurements.



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**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Temperature Measurement

**SCOPE:** Direct measurement of liquid temperature using a field instrument

### **Sample Collection**

The temperature of groundwater samples will be measured using a flow-through cell as described in the sample collection SOP. The field analysis does not require specific sample preparation or preservation procedures.

### **Equipment and Material Specifications**

Instrument: WTW Measurement Systems, Inc., MultiLine P3 handheld temperature and conductivity probe.

Thermister material: graphite

Temperature range: -5 to +100°C

Probe accuracy:  $\pm 0.2^{\circ}\text{C}$

### **Calibration Procedure and Frequency**

Temperature measurements are made using a thermometer located on the conductivity probe. The thermometers are checked biannually for calibration by immersing them in a bath of known temperature until equilibrium is reached. They will be discarded if found to have more than 10 percent error. The reference thermometer used for the bath calibration is National Bureau of Standards (NBS) traceable.

### **Analysis Procedure**

A temperature measurement will be made electrometrically using the thermometer on the conductivity probe, a portable handheld meter, and a flow-through cell, as a well is purged. The WTW Model P3 and probes can be used in a vertical, horizontal, or tilted position; it may be carried or moved during use without affecting the accuracy or stability of the measurement.

- With the probe inserted into a full flow-through cell, check the flow-through cell for air bubbles and remove them if they are found. Keep the flow-through cell out of direct sunlight if possible. Wait for the probe to stabilize, and record the stabilized reading, to the nearest 0.5°C.

### **Preventive Maintenance and Frequency**

The maintenance required for the thermometer is battery replacement. Four AA-size alkaline batteries will provide 1,500 hours of operation. Accuracy will not be maintained if zinc-carbon

cells are used. Replace batteries every 3 months or as needed to reduce the danger of corrosion due to leaky batteries. Inspect the thermometer and probe for external damage prior to use.

#### **Equipment Decontamination**

The equipment will be cleaned between analyses as follows:

- Rinse with a soap (phosphate-free) and potable water mixture.
- Rinse with distilled or deionized water (ASTM Type II).
- Allow to air dry.

#### **Data Reduction, Validation, and Reporting**

The raw data collected in the field will be recorded in a field logbook. A narrative of problems encountered and corrective actions taken, calibration checks, and repeated measurements, as well as general comments deemed of interest, will be included in a logbook.

#### **Quality Control**

Duplicate measurements will be performed at a frequency of 1 per 10 or fewer measurements.





**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Water and Leachate Level Measurements

**SCOPE:** Measurement of water elevation in a groundwater monitoring well or leachate head level monitoring well using a water level indicator and a reference point of known elevation on the casing to determine the distance between the reference point and the water level in the well

### **Water and Leachate Level Measurements and Equipment**

The water level measurements are independent of water sampling. During groundwater monitoring, groundwater level measurements will be made using a reference point established on the well casing. The reference point typically consists of an indelible mark on the north side of the well casing rim. If the casing is not level, the reference point will be at the highest point of the rim. A battery-operated water level indicator will be the primary device for water level measurements. The indicator is a self-contained, transistorized instrument equipped with a cable and sensor that activates a buzzer and a light when the sensor comes in contact with water. The depth to water is read from permanent 0.01-foot increment markings on the cable.

The leachate level indicator is similar to the water level indicator, but it is dedicated for use in leachate head wells only.

### **Equipment and Material Specifications**

Instrument:	Slope Indicator Co. Water Level Indicator Model 51453 (or equivalent)
Cable marking:	0.01 foot
Power supply:	3 AA-size batteries

### **Calibration Procedure and Frequency**

The cable will be checked every 6 months by laying it on a flat surface and comparing the markings to a steel or fiberglass tape measure. The cable markings must agree within 0.5 percent, or the cable will be replaced.

A sensitivity setting is provided on the instrument to adjust for highly conductive water. The operation manual gives the following instruction to adjust the instrument:

"To determine the proper setting, turn the sensitivity knob to 10. Lower the probe until the indicator's light and buzzer signal that the probe is touching water. Raise the probe out of the water. Turn the sensitivity knob to a lower setting until the light and the buzzer turn off.

Repeat these steps until the light and buzzer turn off promptly when the probe is withdrawn from the water. To maintain accuracy, do not set sensitivity lower than necessary."

### **Measurement Procedures**

All groundwater level measurements will be made using a reference point established on the well casing.

#### **Determining Water Level**

The cable has white depth marks for 0.01 foot, white numerals for 0.1 foot, and yellow numerals for feet. Foot numbers have bars on either side. Use the lower bar (toward the probe) as the foot mark.

Lower the probe down the well until the indicator light first turns on. Read the depth to water to the nearest 0.01 foot at the reference point on the well casing. Turn the sensitivity knob to "off" when the indicator is not in use.

In case of instrument failure, depth to water will be measured by a plover tape, which is a bell- or cup-shaped stainless-steel weight (plover) attached to a nylon-clad, stainless-steel or fiberglass tape. When lowered into the well, a "plopping" or "popping" sound is made when the weight strikes the surface of the water. The depth to water can be determined by lifting and lowering the weight in short strokes, and reading the tape when the weight just strikes the water. Depth to water will be recorded to the nearest 0.01 foot.

#### **Determining Depth to Bottom of Well**

Measurements to determine the total depth of a well will be made using the stainless-steel or fiberglass tape with the attached plover. Depth-to-bottom measurements will be used in the calculation of purging volumes and to assess the integrity of the well (to determine if the well has filled with sediment).

The measuring tape has marks for 0.01 foot and numerals for 0.1 foot intervals. Lower the tape down the well until the plover reaches the bottom of the well. Raise and lower the tape until the point at which the plover reaches the bottom can be felt. Record the depth, using the same reference point as was used to record the depth to water. Also record the additional length added to the tape by the steel plover.

#### **Preventive Maintenance Procedures and Frequency**

Replace batteries every 3 months, or as needed, to reduce the danger of corrosion due to leaking batteries.

#### **Equipment Decontamination**

The equipment will be cleaned between analysis as follows:

- Rinse with a soap (phosphate-free) and potable water mixture.
- Rinse with distilled or deionized water (ASTM Type II).
- Allow to air dry.

#### **Data Reduction, Validation, and Reporting**

The raw data collected in the field will be recorded in a field logbook. A narrative of problems encountered and corrective actions taken, calibration checks and repeated measurements, as well as general comments deemed of interest, will be included in a logbook.

#### **Quality Control**

Duplicate measurements will be performed at a frequency of 1 per 10 or fewer measurements.



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**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Sample Containers, Preservation, and Holding Times

**SCOPE:** Container, preservation, volume, and holding time requirements for groundwater samples

## **SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES**

Tables 1 and 2 summarize container, preservation, volume, and holding time requirements for groundwater samples.

### **Sample Containers**

The contaminant-free sample containers used for sample collection and storage in this investigation will meet standards outlined in USEPA's "Specifications and Guidance for Obtaining Contaminant-Free Sample Containers, April 1990." Bottles used for the sampling activity will be certified clean by the manufacturer. For analytes not in Table 1, the bottles should either be cleaned in the same way as for similar types of analytes, or it will be negotiated with the bottle supplier(s) to clean and test the bottles for the analytes of interest to ensure that the contaminant levels of those analytes do not exceed approximately one third of the required quantitation limits. The laboratory will verify the specifications for the bottles by checking the supplier's statement and analytical results for each bottle lot, and these specifications will be documented on a continuing basis. These data will be maintained in the project evidence file and will be available, if requested, for USEPA's review.

### **Quality Control**

The data for field blanks (rinsate blanks), trip blanks, etc., will be monitored for contamination, and corrective actions will be taken as soon as a problem is identified. Corrective action options include the following: (1) discontinuing the use of a specific bottle lot; (2) requesting that the bottle supplier(s) retest a representative bottle from a suspect lot; (3) resampling the sampling point in question; or (4) validating the data. Data validation will take into account that the contaminants could be introduced by the laboratory (i.e., common laboratory solvents, sample handling artifacts, etc.) or that there could be a bottle quality control problem. Performing data validation will allow an informed determination to be made regarding whether the bottles, and hence the data, are still usable, or if other corrective actions are needed.



**TABLE 1**  
**LEMBERGER SITE**  
**MONITORED NATURAL ATTENUATION DEMONSTRATION PROJECT**  
**WATER SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES<sup>1</sup>**

Parameter	Container <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
Volatile organics	Three 40-mL glass VOA vials with Teflon <sup>®</sup> septum, no headspace	pH < 2 with HCl, cool to 4°C, and protect from light.	14 days to analysis (sample should remain on-site less than 24 hours)
Semivolatile organics	Three 1-liter amber glass bottles, Teflon <sup>®</sup> -lined lids; leave small amount of headspace	Cool to 4°C, and protect from light.	Extract within 7 days, analyze within 40 days after extraction
Pesticides and PCBs	Two 1-liter amber glass bottles, Teflon <sup>®</sup> -lined lids; leave small amount of headspace	Cool to 4°C, and protect from light.	Extract within 7 days, analyze within 40 days after extraction
Filterable metals (including mercury) <sup>3</sup>	One 1-liter high-density polyethylene bottle (Teflon <sup>®</sup> -lined lid)	Filter (monitoring wells only) through 0.45-micron filter, cool to 4°C; pH < 2 with HNO <sub>3</sub> .	6 months to analysis 28 days (mercury)
Total metals (including mercury) <sup>3</sup>	One 1-liter high-density polyethylene bottle (Teflon <sup>®</sup> -lined lid)	pH < 2 with HNO <sub>3</sub> ; cool to 4°C.	6 months to analysis 28 days (mercury)
Cyanide	One 1-liter high-density polyethylene bottle (Teflon <sup>®</sup> -lined lid)	pH ≥ 12 with NaOH (added in field). If chlorine is present, add ascorbic acid. Cool to 4°C.	12 days to analysis
Alkalinity, sulfate	1 x 250 mL high-density polyethylene bottle <sup>(3)</sup>	Cool to 4°C	14 days (alkalinity) 28 days (sulfate)

TABLE 1 (CONTINUED)  
 LEMBERGER SITE  
 MONITORED NATURAL ATTENUATION DEMONSTRATION PROJECT  
 WATER SAMPLE CONTAINERS, PRESERVATIVES, AND HOLDING TIMES<sup>1</sup>

Parameter	Container <sup>1</sup>	Preservative	Holding Time <sup>2</sup>
Methane, ethane, and ethene	3 x 40 mL VOA vials with Teflon <sup>®</sup> septum <sup>(2)</sup>	Cool to 4°C, add HCl to pH < 2; protect from light	7 days if unpreserved; 14 days if preserved (sample should remain on-site less than 24 hours)
Nitrate+Nitrite nitrogen	1 x 250 mL high-density polyethylene bottle <sup>(3)</sup>	Cool to 4°C, add H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
Temperature, E <sub>H</sub> , pH, specific conductivity, dissolved oxygen, ferrous iron, ORP, alkalinity (field)	--	--	Immediately after sample collected
Manganese	1 x 250 mL high-density polyethylene bottle <sup>(3)</sup>	Cool to 4°C, add HNO <sub>3</sub> to pH < 2	6 months
Total organic carbon, total inorganic carbon	2 x 60 mL glass bottles	Cool to 4°C, no headspace, add H <sub>2</sub> SO <sub>4</sub> to pH < 2	28 days
<b>Notes:</b> (1) Starting from time of sample collection. (2) Collect three extra containers for MS/MSD samples. (3) Collect one extra container for sample spike and duplicate analyses.			



**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Field Chain-of-Custody

**SCOPE:** Procedures to ensure that appropriate chain-of-custody documentation is maintained throughout the field operations

### **Sample Identification System**

Groundwater samples collected for the monitored natural attenuation demonstration project will be identified by sampling point, according to the labeling system already in use at the site. Duplicate samples will be labeled with a "DUP" prefix, and then numbered sequentially (DUP01, DUP02). A record of the locations of duplicate samples will be kept in field logbooks. Trip blanks will be labeled with a "TB" prefix and then numbered sequentially (TB01, TB02). Matrix spike and matrix spike duplicate samples will be identified as an "MS/MSD" sample and noted as such on the Chain-of-Custody Record. Field blanks will be labeled with the identifier "FB" and numbered sequentially.

A unique laboratory sample I.D. number will be assigned by Pace Analytical Services, Inc., to each sample at the time of receipt. All samples received at one time are grouped together using a common work order number.

Field sample identification numbers will be included on the Chain-of-Custody Records. A copy of the Chain-of-Custody Record will be kept in the field files and in the laboratory to help identify lost or missing samples.

### **Field Documentation**

The field logbook will provide the means of recording data collection activities performed. As such, entries will be described in as much detail as possible so that persons going to the site could reconstruct a particular situation without reliance on memory.

Field logbooks will be field survey books or notebooks. Logbooks will be assigned to field personnel, but will be stored in the office at the site when not in use. Each logbook will be identified by the project name and number.

The title page of each logbook will contain the following:

- Name of the person to whom the logbook is assigned
- Logbook number
- Project name and project number

- Time period (by dates) associated with the specific logbook

At the beginning of each logbook entry, the date, the start time, a description of the weather, the names of all sampling team members present, the level of personal protective equipment being used, and the signature of the person making the entry will be entered. The names of visitors to the site and the purpose of their visit will also be recorded in the field logbook.

Measurements made and samples collected will be recorded. All entries will be made in ink, and no erasures will be made. If an incorrect entry is made, the information will be crossed out with a single strike mark and the correction will be initialed and dated. Whenever a sample is collected or a measurement is made, a detailed description of the location will be recorded. Groundwater monitoring well identification (i.e., RM-7D) will be a sufficient description of location for samples collected at wells that are included in the approved site monitoring program. Photographs taken at the site, if any, will also be noted. All equipment used to make measurements will be identified, along with the date of calibration.

Samples will be collected following the sampling procedures documented in the sample collection SOP. The equipment used to collect samples will be noted, along with the time of sampling, a sample description, the depth at which the sample was collected if a depth-discrete interval is sampled, and the volume and number of sample containers produced.

#### **Sample Handling, Packaging, and Shipment**

The following sample handling procedures will be used:

- The sampling technician will be responsible for the care and custody of the samples until they are transferred to the laboratory or properly dispatched. The number of people handling the samples should be kept to a minimum to facilitate proper field chain of custody.
- All sample bottles will be labeled with the project name and number, the sample identifier, the sample type, the type of preservative if applicable, the sampler's initials, and the date and time of sample collection.
- Sample labels will be completed for each sample bottle using an All-Weather pen with waterproof ink. The All-Weather pens should be capable of writing in wet and freezing weather conditions.

- The sampler will review the overall field activities to determine if proper sample handling and custody procedures were followed during the fieldwork, and will consult with the RMT project manager if factors are identified that may necessitate collection of additional samples.

#### **Sample Shipment Procedures and Transfer of Custody**

The possession of samples must be traceable from the time of collection through the use of chain-of-custody procedures. Specific Chain-of-Custody Records must accompany all sample shipping containers to document the transfer of the shipping containers and samples from the field to the laboratory receiving the samples for analysis. The procedures to be implemented are as follows:

- Prepare sample containers with labels pre-applied by the laboratory.
- Properly identify and label each sample in the field with indelible, waterproof ink.
- Complete Chain-of-Custody Records in the field, indicating sample identification, containers filled, sampling date, sampling time, sample collector, and sample preservation, if applicable. The laboratory's SOPs contain an example of a Chain-of-Custody Record. This information will also be noted in the field notebooks on-site.
- Repack shipping containers with samples, Chain-of-Custody Records, and ice packs. Each set of samples to be shipped together in a single shipping container (i.e., cooler) is assigned a Chain-of-Custody Record, which travels with the shipping container.
- Place completed Chain-of-Custody Records in a plastic bag, and seal and tape them to the inside cover of the shipping container.
- Seal the shipping containers and ship to the laboratory using an overnight delivery service. Common carriers or intermediate individuals will be identified on the Chain-of-Custody Record, and copies of all bills-of-lading will be retained.
- Receive and check shipping containers in the laboratory for broken seals or damaged sample containers. If no problems are noted, samples will be logged into the laboratory, and the Chain-of-Custody Record will be completed. The person relinquishing the samples should request the recipient representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted in the "Received By" space.
- Include copies of the Chain-of-Custody Record with the analytical data.

A separate sample receipt is prepared whenever samples are split with a government agency. The receipt is marked to indicate with whom the samples are being split. The person relinquishing the samples to the agency should request the agency representative's signature acknowledging sample receipt. If the representative is unavailable or refuses, this is noted on the receipt and in the field notebook.

If a Chain-of-Custody Record is lost in shipment, a written statement will be prepared by the person who collected the samples listing the samples that were recorded on the lost form and describing when and how the samples were collected. The statement should include information such as field logbook entries regarding the sample. This statement is submitted to the RMT project manager for further action, as necessary.





**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Decontamination Procedures: Personnel and Equipment

**SCOPE:** Decontamination procedures to be implemented after fieldwork, as necessary

## **DECONTAMINATION PROCEDURES**

### **Field Personnel Decontamination Procedures**

Field personnel decontamination procedures are described in the Health and Safety Plan (HSP) and are summarized as follows:

- Protective disposable outer garments will be removed, placed in plastic bags, and disposed appropriately.
- Disposable outer boots will be removed first, before gloves. If reusable rubber or neoprene boots are worn, they will be washed and rinsed before leaving the contamination reduction zone.
- Field personnel will wash and dry their hands before leaving the contamination reduction zone, and used paper towels will be placed in the disposal bag.

Clean outer garments will be accessible to field personnel in an area free from potential contamination. Water, soap, and paper towels will also be kept in a clean location for both regular cleanup and emergency use.

### **Sample Containers Decontamination Procedures**

Sample containers will be precleaned by the manufacturer.

### **Sampling Equipment Decontamination Procedures**

The water level indicator and cable, steel measuring tape and plopper, and other equipment not dedicated for use at a single well will be cleaned prior to use and between each sampling point using the following procedure:

- Brush with soapy (phosphate-free soap) potable water.
- Triple-rinse with distilled water.
- Air dry.

The dissolved oxygen electrode and cable will be cleaned prior to use and between each sampling point by the following procedure:

- Spray potable or distilled water on the outside surfaces.
- Wipe outside surfaces with paper towel.

The submersible pump will be decontaminated prior to use and between each sampling point using the following procedures:

- Spray the reel and pump with potable or distilled water to rinse off particulates.
- Pump soapy (phosphate-free soap) potable water solution through the pump and tubing for a minimum of 2 minutes.
- Circulate distilled or potable water through the pump and discharge tubing until all traces of soap are gone.
- Pump distilled or deionized water through the pump and tubing for a minimum of 5 minutes.

The flow-through cell and filtering equipment will be precleaned using the following procedures:

- Brush with soapy (phosphate-free soap) potable water and soak for a minimum of 24 hours.
- Rinse with potable water for 3 minutes.
- Rinse with 10 percent nitric acid solution.
- Rinse with deionized water (ASTM Type II water).
- Oven dry.
- Seal in polypropylene plastic to prevent contamination prior to use.
- The pH and conductivity probe will be rinsed with potable water and rinsed again with deionized water. A separate probe will be used for leachate measurements and will not be used for other sample media.



**FIELD ANALYSIS**  
**STANDARD OPERATING PROCEDURE**

**PROCEDURE:** Disposal of Monitoring- or Investigation-Derived Waste Materials

**SCOPE:** Procedures for handling and disposing waste materials produced from site monitoring or investigation

#### **DISPOSAL OF MONITORING- OR INVESTIGATION-DERIVED WASTE MATERIALS**

The waste materials produced during the site activities will be managed as follows:

- **Liquids** - All decontamination and purge water will be discharged through the on-site groundwater treatment system. During periods when the groundwater treatment system is not in operation, the decontamination and purge water will be discharged to the leachate collection system.
- **Used personal protective equipment.** All used Tyvek suits, impervious or PVC overboots, disposable gloves, waste paper, and other wastes will be collected, bagged, and disposed off-site.
- **Samples.** Samples analyzed by Pace Analytical Services, Inc., will be disposed 30 days after the results are reported by the laboratory, in accordance with the laboratory's standard operating procedure for sample disposal.