



Post-Closure Plan

D.E. KARN GENERATING FACILITY

BOTTOM ASH POND POST-CLOSURE PLAN

Essexville, Michigan

Pursuant to 40 CFR 257.104

Submitted To: Consumers Energy Company
1945 W. Parnall Road
Jackson, Michigan 49201

Prepared By: Golder Associates Inc.
15851 South US 27, Suite 50
Lansing, Michigan 48906

October 2016

1655284

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CERTIFICATION

Professional Engineer Certification Statement [40 CFR 257.104(d)(4)]

I hereby certify that, having reviewed the attached documentation and being familiar with the provisions of Title 40 of the Code of Federal Regulations Section 257.104 (40 CFR Part 257.104), I attest that this Post-Closure Plan is accurate and has been prepared in accordance with good engineering practices, including the consideration of applicable industry standards, and with the requirements of 40 CFR Part 257.104.

Golder Associates Inc.


Signature

October 14, 2016

Date of Report Certification

Jeffrey R. Piaskowski, PE
Name

6201061033

Professional Engineer Certification Number





Table of Contents

CERTIFICATION.....	C-1
Professional Engineer Certification Statement [40 CFR 257.104(d)(4)].....	C-1
1.0 INTRODUCTION.....	1
2.0 FACILITY CONTACT [40 CFR 257.104(d)(1)(ii)]	2
3.0 MONITORING AND MAINTENANCE ACTIVITIES [40 CFR 257.104(d)(1)(i,iii)]	3
3.1 Site Maintenance [40 CFR 257.104(d)(1)(i)].....	3
3.2 Periodic Inspection Requirements [40 CFR 257.104(d)(1)(i)].....	3
3.3 Site Use Restrictions [40 CFR 257.104(d)(1)(iii)].....	4
3.4 Groundwater Monitoring.....	4
4.0 REFERENCES.....	6

List of Tables

Table 3.4.1	Groundwater Detection Monitoring Constituents
Table 3.4.2	Groundwater Assessment Monitoring Constituents

List of Figures

Figure 1	Site Location Map
Figure 2	General Site Plan

List of Appendices

Appendix A	General Site Inspection Sheet
Appendix B	Groundwater Sampling Analysis and Procedure Plan



1.0 INTRODUCTION

On April 17, 2015, the United States Environmental Protection Agency (EPA) issued the Coal Combustion Residual (CCR) Resource Conservation and Recovery Act (RCRA) Rule (40 CFR 257 Subpart D) (“CCR RCRA Rule”) to regulate the beneficial use and disposal of CCR materials generated at coal-fired electrical power generating complexes. In accordance with the CCR RCRA Rule, any CCR surface impoundment or CCR landfill that was actively receiving CCRs on the effective date of the CCR RCRA Rule (October 19, 2015) was deemed to be an “Existing CCR Unit” on that date and subject to self-implementing compliance standards and schedules. Consumers Energy Company (CEC) identified the Bottom Ash Pond at the D.E. Karn Generating Facility (DE Karn) as an existing CCR surface impoundment. DE Karn is located in Essexville, Michigan as presented on Figure 1 – Site Location Map. The location of the Bottom Ash Pond is presented on Figure 2 – General Site Plan.

This post-closure plan is limited to the Bottom Ash Pond at DE Karn. The intent of the post-closure plan is to assure that integrity and effectiveness of the final cover is maintained over the 30-year post-closure care period. The Bottom Ash Pond is anticipated to be certified closed by January 1, 2024, which would result in the 30-year post-closure care period lasting through 2053 if the site is operating under detection monitoring.



2.0 FACILITY CONTACT [40 CFR 257.104(d)(1)(ii)]

The post-closure point of contact for the Bottom Ash Pond at DE Karn is:

Caleb Batts
Karn / Weadock CCR Lead
2742 North Weadock Highway
Essexville, Michigan 48732
(989) 891-3363
Caleb.batts@cmsenergy.com



3.0 MONITORING AND MAINTENANCE ACTIVITIES [40 CFR 257.104(d)(1)(i,iii)]

3.1 Site Maintenance [40 CFR 257.104(d)(1)(i)]

The following general site maintenance and monitoring will be conducted to ensure the integrity and effectiveness of the final cover system:

- Fertilizer will be applied in areas of stressed or poor quality cover vegetation as needed.
- Vegetative cover will be mowed as needed to restrict uncontrolled woody plant establishment on the cover for the remainder of the 30-year post-closure period (estimated through 2053). This includes mowing the side slopes around the perimeter of the Bottom Ash Pond.
- Areas of erosion, including erosion from run-off or vehicle use, will be repaired by restoring the thickness of the protective cover and topsoil and seeding as necessary upon discovery.
- Erosion repairs will utilize clean soils. Typically, repair is expected to involve minor regrading, spreading of small amounts of additional soil, and reseeding. Areas of repeated erosion will be evaluated to determine if additional protection, such as erosion blankets or riprap, should be added.
- Groundwater monitoring system will be maintained in accordance with applicable requirements from 40 CFR 257.90 to 40 CFR 257.98.
- Differential settlement will be repaired as follows:
 - Minor differential settlement in which no ponding can occur or, in which the subsurface drainage will not be compromised, shall be repaired by stripping topsoil, adding sandy soil, and replacing topsoil to attain a smooth surface before seeding.
 - If differential settlement has occurred to the extent that drainage is compromised, surface soils shall be removed in the area to expose the geomembrane. The geomembrane shall be cut back and sand added to attain the liner grade. Geomembrane, protective soil, and topsoil (erosion layer) shall be replaced and seeded with repair certification maintained in the site files.

Areas requiring repair due to erosion or settlement will be identified during annual site inspections which are detailed below in Section 3.2.

3.2 Periodic Inspection Requirements [40 CFR 257.104(d)(1)(i)]

Periodic site inspections verifying the integrity and effectiveness of the final cover system will be conducted throughout the 30-year post-closure period (estimated through 2053) on no less than an annual basis. When and if items requiring construction and/or maintenance are identified during an inspection, CEC will schedule and conduct repairs promptly while noting the risk associated with the deficiency. During site inspections, the inspector will walk the entire closed Bottom Ash Pond area and document the problematic items on the "General Site Inspection Sheet" provided in Appendix A.

If maintenance is required, only low ground-pressure tire or track equipment should be utilized to correct the deficiencies on closed portions of the Bottom Ash Pond. Larger equipment can be used, but the equipment loading cannot exert more than five pounds per square inch (psi) on the liner material.



If repairs to the geosynthetics (e.g., geomembrane, geotextile, etc.) are necessary, a certified geosynthetic installer must conduct the repairs under the direction of a quality assurance representative. Repairs will be documented in a report, and a copy will be placed in the site's operating record.

3.3 Site Use Restrictions [40 CFR 257.104(d)(1)(iii)]

Currently, the identified end use for the Bottom Ash Pond at DE Karn has been limited to securing the area and maintaining the site as described in Sections 3.1 and 3.2. If the area is to be developed in the future, the integrity of the geomembrane cover liner shall be confirmed with the proposed use, and institutional controls for maintaining the integrity of the geomembrane cover will be provided through an update to the post-closure plan. Once closed, the owner or operator must record a notation on the deed to the property. The notation on the deed must in perpetuity notify any potential purchaser of the property that:

- The land has been used as a CCR unit; and
- Its use is restricted under the post-closure care requirements as provided by Section 257.104(d)(1)(iii).

Use of the site will be restricted by either fencing and gating or procedure to prohibit access other than for performing inspections, maintenance, and monitoring; established easements; and to restrict the use of intrusive vehicles and activities at the site.

3.4 Groundwater Monitoring

Fourteen groundwater monitoring wells were installed to establish a groundwater monitoring system for the Bottom Ash Pond under 40 CFR 257.91(e)(1) during the fourth quarter of 2015. The groundwater monitoring well locations are provided on Figure 2 – General Site Plan. Groundwater monitoring wells will be used to collect data to develop an initial annual groundwater monitoring and corrective action report that is required to be certified by a qualified professional engineer (QPE) and posted in the operating record by January 31, 2018 per 40 CFR 257.90(e). In conformance with 40 CFR 257.93, a groundwater sampling and analysis procedure plan was developed for the groundwater monitoring program. The plan is included in Appendix B – Groundwater Sampling Analysis and Procedure Plan and includes direction on how to perform or acquire the following:

- | | |
|---------------------------------------------|---------------------------------------------|
| ■ Groundwater elevations | ■ Quality assurance/Quality control (QA/QC) |
| ■ Sample collection and handling procedures | ■ Investigation derived waste (IDW) |
| ■ Equipment decontamination procedures | ■ Field documentation |
| ■ Chain of custody control | ■ Analytical suite and procedures |
| ■ Sample preservation and shipment | ■ Optional additional analyses |
| | ■ Data evaluation |



Once the CCR unit is certified closed, post-closure periodic groundwater samples will be collected at least semi-annually and analyzed for 30 years for the following constituents in Table 3.4.1 – Groundwater Detection Monitoring Constituents.

Table 3.4.1 – Groundwater Detection Monitoring Constituents

Common Name		
Boron	Fluoride	pH
Calcium	Sulfate	
Chloride	Total Dissolved Solids (TDS)	

If a statistically significant increase over background levels for one or more of the constituents listed in Table 3.4.1 is detected during groundwater detection monitoring, then CEC will follow the procedures outlined in 40 CFR 257.93(h) and 257.94(e). If required by 40 CFR 257.94(e), an assessment groundwater monitoring program will be established meeting the requirements of 40 CFR 257.95 for the constituents presented in Table 3.4.2 – Groundwater Assessment Monitoring Constituents. The data will be presented in an annual groundwater monitoring and corrective action report per 40 CFR 257.90(e).

Table 3.4.2 – Groundwater Assessment Monitoring Constituents

Common Name		
Antimony	Chromium	Mercury
Arsenic	Cobalt	Molybdenum
Barium	Fluoride	Selenium
Beryllium	Lead	Thallium
Cadmium	Lithium	Radium 226 and 228 combined

The annual groundwater monitoring and corrective action report will be:

- Maintained in the DE Karn operating record per 40 CFR 257.105(h)(1)
- Submitted to the Michigan Department of Environmental Quality (MDEQ) per the notification requirement in 40 CFR 257.106(h)(1)
- Posted on a publicly accessible internet website per 40 CFR 257.107(h)(1)

If additional notification is warranted, CEC will notify appropriate parties per 40 CFR 257.106(h).



4.0 REFERENCES

"Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments," Title 40 – Protection of the Environment Part 257 – Criteria for Classification of Solid Waste Disposal Facilities and Practices Subpart D – Standards for the Disposal of Coal Combustion Residuals in Landfills and Surface Impoundments.

FIGURES

Path: \\sacramento\ad\Site\ Work for Other Offices\Karn & Weadock\PRODUCTION - File Name: 1655284_Karn Location Map.dwg



MICHIGAN COUNTIES
NOT TO SCALE

SITE LOCATION

REFERENCE(S)

BASE MAP TAKEN FROM USGS 7.5 MINUTE QUADRANGLE
BAY CITY NE, MICHIGAN
DATED 2014



CLIENT
CONSUMERS ENERGY COMPANY
2742 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MI. 48732

CONSULTANT



YYYY-MM-DD 2016-08-22

DESIGNED MAL

PREPARED MAL

REVIEWED JRP

APPROVED MAB

PROJECT
D.E. KARN UNITS #1 AND #2
BOTTOM ASH POND

TITLE
SITE LOCATION MAP

PROJECT NO.
1655284

REV.
0

FIGURE
1

IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI A

Path: \\azaramentolacash\Sites\Work for Other Offices\1655284_DE Karn Bottom Ash Pond\CIVIL 3D\1 File Name: 1655284_2016-08 Survey.MXD.dwg



- LEGEND**
- MW-15006 BACKGROUND MONITORING WELL
 - JCW-MW-15002 MONITORING WELL

CLIENT
CONSUMERS ENERGY COMPANY
2742 NORTH WEADOCK HIGHWAY
ESSEXVILLE, MI 48732

CONSULTANT



YYYY-MM-DD	2016-09-09
DESIGNED	MMJ
PREPARED	CMN
REVIEWED	JRP
APPROVED	MAB

PROJECT
D.E. KARN ASH BOTTOM POND

TITLE/TITLE
GENERAL SITE PLAN

PROJECT NO.
1655284

REV.
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FIGURE
2

1" IF THIS MEASUREMENT DOES NOT MATCH WHAT IS SHOWN, THE SHEET SIZE HAS BEEN MODIFIED FROM ANSI B

APPENDIX A
GENERAL SITE INSPECTION SHEET



GENERAL SITE INSPECTION D.E. KARN BOTTOM ASH POND CLOSURE AREA

Inspector:	Inspection Date:
Post Closure Manager:	Review Date:

SITE CONDITIONS	
Weather:	Temperature:
Precipitation:	Wind:

INSPECTION TASKS
1) Note areas of erosion (gullies exceeding 6 inches deep).
2) Note areas of sedimentation.
3) Note areas of settlement that have compromised surface drainage controls.
4) Note areas of ponding.
5) Note areas of vegetative stress.

6) Note areas of woody plant growth.
7) Note location of animal burrows.
8) Condition of ditches, culverts, and channels.



GENERAL SITE INSPECTION D.E. KARN BOTTOM ASH POND CLOSURE AREA

9) Condition of site access road(s), silt fences surrounding the site.
10) Condition of fencing and gates.

11) Proper site restriction signage.
12) Miscellaneous findings.

ADDITIONAL COMMENTS

CORRECTIVE ACTION PLAN (To Be Completed by Post Closure Manager)

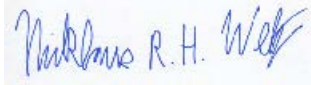
APPENDIX B
GROUNDWATER SAMPLING ANALYSIS AND PROCEDURE PLAN

Consumers Energy Company

ELECTRIC GENERATION FACILITIES RCRA CCR DETECTION MONITORING PROGRAM

DE Karn Monitoring Program
Sample and Analysis Plan
Essexville, Michigan

May 18, 2016



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ELECTRIC GENERATION FACILITIES RCRA CCR DETECTION MONITORING PROGRAM

DE Karn Monitoring Program Sample and Analysis Plan

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DE000722.0002.00004

Date:

May 18, 2016

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CONTENTS

1	Introduction	1
2	PURPOSE AND OBJECTIVES	1
3	Implementation and Sampling Schedule	1
4	Sample Collection and Handling Procedures	2
4.1	Groundwater Elevations	2
4.2	Groundwater Sample Collection	3
4.3	Sample Preservation and Shipment.....	4
4.4	Quality Assurance/Quality Control (QA/QC)	4
4.5	Equipment Decontamination Procedures.....	5
4.6	Investigation Derived Waste (IDW)	5
4.7	Field Documentation	5
5	Analytical Suite and Procedures	6
6	Data Evaluation.....	8

TABLES

Table 1	Monitoring Well Construction Details
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FIGURES

Drawing SG-22355 – DE Karn Monitoring Wells, CCR Monitoring

APPENDICES

A	Low Stress (Low Flow) Purging and Sampling of Groundwater Monitoring Wells SOP (Procedure CHEM-2.7.06)
B	Chain-of-Custody, Handling, Packing and Shipping SOP (Procedure CHEM-1.2.04)

1 INTRODUCTION

ARCADIS has prepared this Groundwater Sampling and Analysis Plan (SAP) to evaluate background and downgradient groundwater quality at the DE Karn electric generation facility (DEK), located in Essexville, Michigan (Site). The collection of groundwater data will be completed to achieve compliance under the recently published 40 CFR Part 257, Subpart D – Standards for the Disposal of Coal Combustion Residuals (CCR) in Landfills and Surface Impoundments. The methodologies outlined in this SAP are consistent with the regulations, general federal and state guidance, ARCADIS and Consumers Energy (CE) Standard Operating Procedures (SOPs), and industry standards.

2 PURPOSE AND OBJECTIVES

The groundwater monitoring and corrective action compliance requirements for existing CCR units are set forth in 40 CFR 257.90 through 257.98. The groundwater sampling and analysis requirements are detailed in 40 CFR 257.93, and require the development of a SAP which details the sampling and analysis procedures that will be utilized to provide an accurate representation of groundwater quality at the background and downgradient wells. As per, 40 CFR 257.93(a) this SAP includes a description of the procedures and techniques that will be implemented for:

- Sample collection
- Sample preservation and shipment
- Analytical procedures
- Chain of custody control
- Quality assurance and quality control

3 IMPLEMENTATION AND SAMPLING SCHEDULE

As set forth in 40 CFR 257.93, a minimum of eight (8) background samples must be collected prior to October 17, 2017. Establishment of a groundwater monitoring system is necessary for the DE Karn Bottom Ash Pond (CCR Surface Impoundment). Background and detection monitoring events will be completed concurrently by comparison of data from monitoring wells located both away from (background) and downgradient of any impoundments still receiving ash as of the implementation date of the rule (October 19, 2015).

The sampling events will be distributed to account for seasonal variability and will be spaced at least 30 days apart to be considered statistically independent. The following is a conceptual schedule to be followed assuming sampling is completed at the end of each calendar quarterly sampling interval beginning December 2015 and ending in September 2017 for a total of eight (8) independent samples. Adjustments to the timing of sampling events can be made as long as the requirements listed above are still met.

- Event 1 – 4th Quarter 2015 (December)

- Event 2 – 1st Quarter 2016 (March)
- Event 3 – 2nd Quarter 2016 (June)
- Event 4 – 3rd Quarter 2016 (September)
- Event 5 – 4th Quarter 2016 (December)
- Event 6 – 1st Quarter 2017 (March)
- Event 7 – 2nd Quarter 2017 (June)
- Event 8 – 3rd Quarter 2017 (September)

Resampling of a well due to an anomalous result, either relative to data collected from other monitoring wells of similar type, or relative to other time-series data at an individual monitoring well may be completed at any time. The timing of the resampling event, and the reason for additional data collection will determine if events are statistically dependent and inform the appropriate method for addressing interpretation or inclusion of data. Additional analytes may also be required pending the results of the quarterly monitoring events (in accordance with Section 257.94(e)). This document does not cover collection and analysis of such additional data.

4 SAMPLE COLLECTION AND HANDLING PROCEDURES

The following sections address the methods and procedures associated with the collection and handling of groundwater samples at the Site. The monitoring well locations are shown in Drawing SG-22355, and relevant construction details and monitoring purpose (e.g. background or downgradient) provided in Table 1. A total of fourteen (14) monitoring wells are present at the DEK facility. Six (6) monitoring wells (Table 1) are designated as downgradient monitoring wells to assess the uppermost aquifer at the site. Additionally, eight (8) monitoring wells will be utilized to monitor background groundwater (Drawing SG-22355). Of the fourteen (14) monitoring wells one (1) is an existing monitoring well, designated as follows:

Historical Well Name	RCRA Well Name
MW-116A	JCW-MW-15027

4.1 Groundwater Elevations

Groundwater level data will be collected from all monitoring wells during each sampling event, prior to sampling. The monitoring well locations are depicted on Drawing SG-22355. Groundwater level monitoring will be conducted in accordance with Section 9.2 of Low Stress (Low Flow) Purging and Sampling of Groundwater Monitoring Wells SOP presented in Appendix A.

Upon arrival at the site, all monitoring wells will be opened and allowed to equilibrate with ambient air pressures prior to measuring the depths to water. Groundwater level measurements will then be made to the nearest 0.01 foot with an electronic water level indicator from the entire monitoring well network prior to sampling – monitoring wells that constitute a groundwater monitoring system for a CCR Unit shall be preferentially sampled in order to further minimize water level elevational changes relative to the CCR

Unit. The entire monitoring well network shall be gauged on the same day in order to provide an interpretative groundwater flow map and to minimize temporal bias of measured groundwater elevation changes for the monitoring well network.

Depth to water will be measured from established top of casing reference points as referenced in the record survey drawing. Groundwater levels, well conditions, and any pertinent observations will be recorded on the depth to water level measurements field log provided in Appendix A.

The calculated hydraulic gradient will be used along with previously completed hydraulic conductivity testing to determine the apparent groundwater rate and direction during each sampling event.

4.2 Groundwater Sample Collection

Groundwater samples will be collected from the monitoring wells following Low-Flow (Minimal Drawdown) Groundwater Sampling Procedures (US EPA, 1996), as detailed in the Low Stress (Low Flow) Purging and Sampling of Groundwater Monitoring Wells SOP (Appendix A). Low flow sampling will commence with the installation of either a peristaltic, stainless-steel 12-volt submersible impeller pump or bladder pump to a depth representing the middle of the saturated screen interval. An appropriate length of polyethylene tubing will be connected to the pump discharge prior to pump placement. The discharge line will be connected to a flow-cell and multi-meter to collect water quality indicator parameters (described below) during well purging to determine water quality stabilization.

The pump will be operated at a flow rate that ensures low volatilization and low well disturbance. Water quality indicator parameters and depth to water will be recorded at 3 to 5 minute intervals during the purging process and recorded on the sampling worksheet provided in Appendix A. Purging and sampling will proceed at a low pumping rate, expected to be between approximately 0.1 and 0.5 liters per minute or less, such that the water column in the well is not lowered more than 0.3 feet below the initial static depth to water measurement. The subject well will be considered ready to sample when three consecutive water quality measurements meet the stabilization criteria presented below.

Parameter	Stabilization Criteria
pH	3 readings within +/- 0.1 standard units (SU)
Specific Conductance	3 readings within +/- 3% millisiemens per centimeter (mS/cm)
Temperature	For Information Only
Turbidity	+/- 10% Nephelometric Turbidity Unit (NTU) variance between three consecutive readings and a turbidity less than 10 NTU
Oxygen Reduction Potential (ORP)	3 readings within +/- 10 millivolts (mV)
Dissolved Oxygen (DO)	3 readings within +/- 0.3 milligrams per liter (mg/L)

If the well is dry, no attempt at sampling will be conducted, as the aquifer is not considered to have sufficient quantity at that location. Additionally, if the well is pumped dry during low-flow monitoring activity, the well will be left overnight to accumulate water, then a sample collected assuming the NTU criteria can be met. Equipment will be calibrated in accordance with the manufactures recommendations. Calibration information will be recorded in the field notes.

4.3 Sample Preservation and Shipment

Samples will be collected immediately following stabilization of field parameters as set forth in in the preceding section. Groundwater samples will be collected into the laboratory provided sample containers required for the analyses specified in the following section. The groundwater samples will be collected from the discharge tubing upstream of the water quality meter flow cell. Care will be taken to allow for a non-turbulent filling of laboratory containers. Routine samples will not be filtered in the field to provide a measure of total recoverable metals that will include both the dissolved and particulate fractions of metals as per the CCR RCRA Rule.

If a more detailed understanding of the source of metals concentrations in groundwater is required for select monitoring wells, field filtered samples may be analyzed in addition to routine analysis. Field filtering may also be completed on highly turbid samples (greater than 10 NTU at stabilization). Field filtering will be completed using a 0.45 micron filter. If required, prior to the subsequent sampling event, an attempt will be made to redevelop any monitoring wells that produce highly turbid samples prior to subsequent sampling event. Where samples are filtered, a corresponding, unfiltered sample will also be collected.

The samples will be labelled, stored and transported to the laboratory according to the Chain-of-Custody, Handling, Packing and Shipping SOP presented in Appendix B. Following collection, samples will be immediately labelled, logged on the chain-of-custody, and placed in a cooler with ice. Sample coolers transported to the laboratory via overnight or next day air freight will be sealed with packing tape and a signed Chain-of-Custody seal. Sample coolers transported to the laboratory directly must be secured to ensure sample integrity is maintained. The samples will be packaged and shipped according to U. S. Department of Transportation and EPA regulations. The documentation of actual sample storage and transport will be by the use of chain-of-custody procedures. A laboratory provided chain-of-custody record will contain the dates and times of collection, receipt, and completion of all the analyses on a particular set of samples. The laboratory will return a copy of the chain-of-custody with the analytical report.

4.4 Quality Assurance/Quality Control (QA/QC)

Quality assurance/quality control (QA/QC) samples will be collected to ensure sample containers are free of analytes of interest, assess the variability of the sampling and laboratory methods, and monitor the effectiveness of decontamination protocols. The following QA/QC samples will be collected during each groundwater sampling event:

- Field duplicates will be collected at a frequency of one duplicate sample per 10 groundwater samples with at least one duplicate collected from each Unit. The field duplicates will be collected at the same time and in the same manner as the original sample.

- Matrix spike/matrix spike duplicate (MS/MSD) samples will be collected at a frequency of one MS/MSD sample per 20 groundwater samples with at least one MS/MSD collected from each Unit. Duplicate and MS/MSD samples will be collected from different monitoring wells.
- Field blanks will be collected at a frequency of one field blank per 20 groundwater samples with at least one field blank collected from each Unit.
- Equipment blanks will be collected at a frequency of one equipment blank per 10 groundwater samples with at least one duplicate collected from each Unit. The equipment blank will be collected by pouring distilled (or de-ionized) water over the decontaminated static water level meter or low flow pump and into the laboratory supplied containers.

The groundwater monitoring system at DEK consists of 14 monitoring wells. Therefore, a total of 2 field duplicates, 1 MS/MSD, 1 field blank, and 2 equipment blanks will be collected during each sample event. The QA/QC samples will be submitted to the laboratory for the routine analyses specified in Section 5 and in Appendix III and IV to Part 257. The laboratory should provide adequate documentation of laboratory reporting and QA/QC procedures.

4.5 Equipment Decontamination Procedures

All non-dedicated equipment will be decontaminated prior to use and between samples, following procedures presented in paragraph 9.6 of the SOP in Appendix A (CHEM-2.7.06). Non-dedicated equipment will include a water level meter and low flow sampling pump. Each item will be cleaned using distilled (or de-ionized) water, and when necessary, non-phosphate detergent wash followed by a distilled (or de-ionized) water rinse. When a peristaltic pump is used for low flow sampling, decontamination is not required, only replacement of the pump head tubing.

All dedicated equipment will be disposed of after each sampling point. Dedicated equipment will include polyethylene tubing and bladders if a bladder pump is used for low-flow sampling.

The flow-cell and water quality multi-meter (sonde) will be decontaminated at the completion of low-flow sampling. All sample collection will occur upstream of this device and therefore will not affect groundwater sample analytical results.

4.6 Investigation Derived Waste (IDW)

All waste created during monitoring well sampling will remain on site. All purge water from wells installed within the CCR Units will be discharged back onto the ground near the well it was purged from. All purge water from wells installed outside of a CCR Unit will be discharged to the ground in a manner that it doesn't directly enter a surface water or drain. All IDW will be handled according to details provided in paragraphs 9.3.8 and 9.4.10 of the SOP provided in Appendix A (CHEM-2.7.06).

4.7 Field Documentation

All information pertinent to the field activities and sampling efforts will be recorded in a log or notebook, following the documentation procedures presented in section 5.4 of the SOP in Appendix A (CHEM-

2.7.06). Field logs are provided in the Attachments to Appendix A. At a minimum, entries in the sample logs will include the following:

- Property details and location
- Type of sample (for example, groundwater, surface water, waste)
- Number and volume of samples taken
- Sampling methodology
- Date and time of collection
- Sample identification number(s)
- Field observations including weather
- Any field measurements made (for example, pH, temperature and water depth)
- Personnel present

Records shall contain sufficient information so that the sampling activity can be reconstructed without relying on the collector's memory. The sample logs will be preserved in electronic format.

5 ANALYTICAL SUITE AND PROCEDURES

As required for existing CCR units, all groundwater samples collected at the DEK facility will be submitted to a laboratory for the analyses specified in Appendix III and IV to Part 257. The analytical methods and reporting limits for each constituent are summarized below. If required, and in consultation with the laboratory, a comparable analytical method may be substituted for the analytical method recommended below. Analytical methods may also be modified to incorporate newer versions of the stated methods. All groundwater samples will be submitted to Consumers Energy Trail Street Laboratory. If any analyses are subsequently subcontracted to another accredited laboratory, the samples will be shipped using appropriate methods and documentation. All analyses will be performed within required hold times and consistent with the data quality objectives of this SAP.

Appendix III to Part 257—Constituents

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
Boron	EPA 6020B	HNO ₃ , pH <2	180	20
Calcium	EPA 6020B	HNO ₃ , pH <2	180	1,000
Chloride	EPA 300.0	None, <6°C	28	1,000
Fluoride [#]	EPA 300.0	None	28	1,000
pH	Stabilized field measurement	NA	NA	0.1 standard units
Sulfate	EPA 300.0	None, <6°C	28	2,000
Total Dissolved Solids	SM 2540C	None, <6°C	7	1,000

DE Karn Monitoring Program Sample and Analysis Plan

HNO₃ – Nitric acid
NA – Not applicable

Appendix IV to Part 257—Constituents

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
Antimony	EPA 6020B	HNO ₃ , pH <2	180	1
Arsenic	EPA 6020B	HNO ₃ , pH <2	180	1
Barium	EPA 6020B	HNO ₃ , pH <2	180	5
Beryllium	EPA 6020B	HNO ₃ , pH <2	180	1
Cadmium	EPA 6020B	HNO ₃ , pH <2	180	0.2
Chromium, total	EPA 6020B	HNO ₃ , pH <2	180	1
Cobalt	EPA 6020B	HNO ₃ , pH <2	180	15
Fluoride [#]	EPA 300	None, <6°C	28	1,000
Lead	EPA 6020B	HNO ₃ , pH <2	180	1
Lithium	EPA 6020B	HNO ₃ , pH <2	180	10
Mercury	EPA 7470A	HNO ₃ , pH <2	28	0.2
Molybdenum	EPA 6020B	HNO ₃ , pH <2	180	5
Selenium	EPA 6020B	HNO ₃ , pH <2	180	1
Thallium	EPA 6020B	HNO ₃ , pH <2	180	2
Radium 226 and 228 combined [^]	EPA 903.1/904.0	HNO ₃ , pH <2	None	1 picocurie per liter (pCi/L)

[#] Listed in both Appendix III and Appendix IV

[^]Requires a larger sample volume (minimum 2 liter)

5.1 Optional Additional Analyses

To interpret groundwater monitoring data and determine the appropriate statistical methods for use in comparison of background and downgradient data sets, an understanding of aquifer connectivity and water types may be required. To determine if samples are collected from comparable aquifer units the predominant water type will be determined using Piper and Stiff diagrams.

Piper and Stiff diagrams are a graphical representation of the major anion and cation composition of a water sample and are useful in establishing if groundwater samples are from the same or a similar aquifer unit. To generate Piper and Stiff diagrams additional analytical data beyond that collected during routine sampling will be required. The additional analytical requirements are shown in the table below.

Constituent	Analytical method	Preservation	Hold Time (Days)	Reporting Limit (µg/L)
Bicarbonate, carbonate and total alkalinity	ASM 2320B	None, 6°C	14	10,000
Magnesium	EPA 6020B	HNO ₃ , pH <2	180	1,000
Sodium	EPA 6020B	HNO ₃ , pH <2	180	1,000
Potassium	EPA 6020B	HNO ₃ , pH <2	180	500

6 DATA EVALUATION

In accordance with 40 CFR 257.93 data collected from eight samples from each background well will be used to calculate background concentrations for each constituent at each site. Background concentrations for each constituent will be calculated using an appropriate statistical method for each background well and constituent pair at the site, selected based on the distribution of the data in accordance with 40 CFR 257.93.

The data collected from background and downgradient monitoring wells will be compared using an appropriate statistical method, to be determined based on the distribution of data for each constituent, to assess if downgradient concentrations are consistent with background concentrations for each constituent. The statistical method used for this analysis will be one, or a combination, of the four statistical methods described below and in 40 CFR 257.93(f) and will meet the performance standards outlined in 40 CFR 257.93(g).

A combination of statistical methods may be applied depending on the statistical distribution observed for each specified constituent in each monitoring well. The four specific statistical procedures provided in 40 CFR 257.93(f) are: (1) a parametric analysis of variance followed by multiple comparison procedures to identify statistically significant evidence of contamination; (2) an analysis of variance based on ranks followed by multiple comparison procedures to identify statistically significant evidence of contamination; (3) a tolerance or prediction interval procedure; and (4) a control chart approach.

The potential for seasonal and spatial variability as well as temporal trends will be considered when selecting the statistical method for comparison. Data will also be displayed graphically using box-and-whisker plots, which provide a visual representation of the statistical properties and distribution of each dataset, to aid in interpretation of the statistical analysis.

In order to select the appropriate method for statistical analysis for each constituent at each monitoring well, the distribution type for each constituent/well pair will be calculated. Normally distributed data will use parametric methods for comparisons and non-normally distributed data will use non-parametric methods, consistent with the requirements outlined in 40 CFR 257.93(g).

Statistical comparisons will be performed using a confidence level of 99 percent (alpha of 0.01) for comparisons of individual data point to background concentrations, and a confidence level of 95 percent (alpha of 0.05) where multiple data points will be compared to background, consistent with 40 CFR 257.93(g).

TABLES



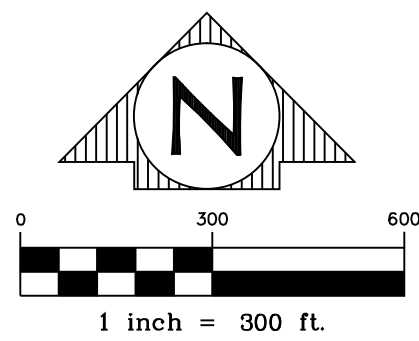
Table 1
Monitoring Well Construction and Development Summary
Consumers Energy Co.
D.E. Karn Generating Facility
Essexville, Michigan

MW ID	Former MW ID	Site Coordinates				Date Installed	Geologic Unit of Screen Interval	Well Construction	Well Screen Length (ft)	Screen Interval (ft bgs)	Development Details				
		Northing	Easting	Ground Surface Elevation (ft above msl)	TOC Elevation (ft above msl)						Static DTW (ft below TOC)	Total Depth	Pumping DTW (ft below TOC)	Gallons Removed	Final Turbidity (NTU)
Background Monitoring Well															
MW-15002	--	777616.50	13263683.70	584.90	587.71	9/17/2015	Sand	2" PVC, 10 slot	10	4 - 14	7.8	16.9	NR	150	15.7
MW-15008	--	778850.30	13262994.10	582.70	585.36	9/24/2015	Sand	2" PVC, 10 slot	10	4 - 14	4.78	17.46	5.76	110	2.94
MW-15016	--	777566.20	13263941.70	583.70	586.49	9/30/2015	Sand	2" PVC, 10 slot	3	2.5-5.5	4.33	8.03	8.00	51	5.1
MW-15018	--	777822.40	13263663.80	583.60	586.42	10/1/2015	Sand	2" PVC, 10 slot	4	3 - 7	6.26	10.03	10.00	68	2.07
MW-15019	--	778024.10	13263504.90	583.50	586.17	10/1/2015	Sand/Clay Sand	2" PVC, 10 slot	10	4 - 14	6.02	16.00	10.17	280	0.84
MW-15020	--	778708.40	13263077.40	582.50	585.95	10/1/2015		Sand	2" PVC, 10 slot	10	4 - 14	5.41	17.03	5.95	135
MW-15024	--	778249.10	13263347.90	583.70	586.56	10/8/2015	Sand	2" PVC, 10 slot	10	4 - 14	6.40	17.11	11.37	200	2.6
MW-15027	MW-116A	778601.30	13263139.30	583.20	586.25	4/26/2005	Sand	NR	10	5 - 15	5.73	18.29	6.45	110	1.51
Downgradient MW															
DEK MW-15001	--	782854.00	13263363.70	592.10	594.64	10/9/2015	Sand	2" PVC, 10 slot	1	16 - 17	8.78	20.22	12.18	112.5	6.00
DEK MW-15002	--	782690.60	13262816.80	588.30	590.87	10/9/2015	Sand	2" PVC, 10 slot	3	10 - 13	4.79	15.68	12.96	175	9.81
DEK MW-15003	--	783112.80	13263202.10	599.90	602.79	10/12/2015	Sand	2" PVC, 10 slot	4	21 - 25	NR	23.52	22.46	200	8.57
DEK MW-15004	--	783407.40	13262642.00	604.90	607.40	10/12/2015	Sand	2" PVC, 10 slot	5	30 - 35	17.99	38.10	22.85	275	0.98
DEK MW-15005	--	783163.00	13262105.30	586.80	589.72	10/13/2015	Sand	2" PVC, 10 slot	5	14.5 - 19.5	7.79	22.01	11.40	225	0.52
DEK MW-15006	--	782812.90	13262180.20	586.50	589.24	10/13/2015	Sand	2" PVC, 10 slot	5	13.5 - 18.5	NR	NR	11.97	190	0.87

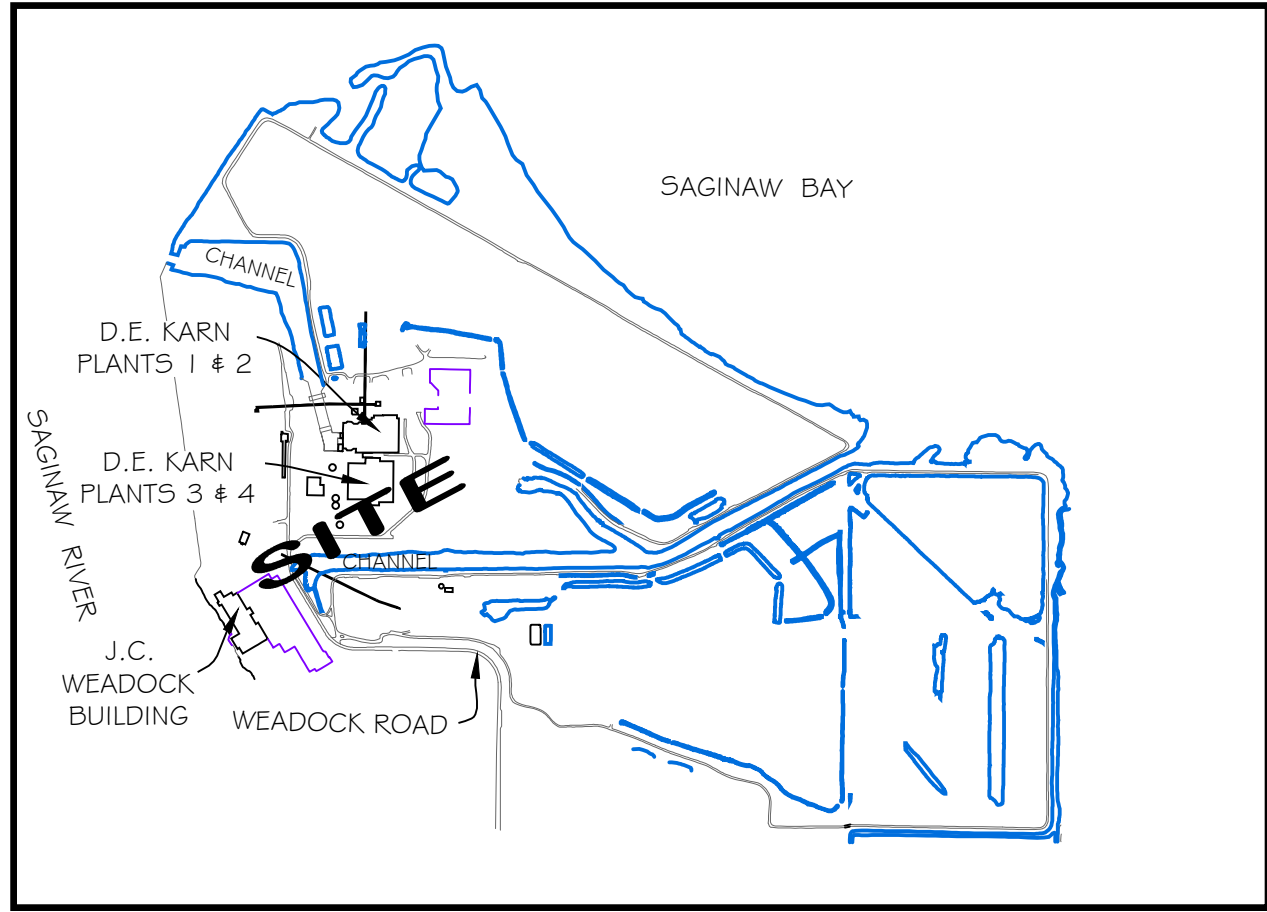
Notes:
ft = feet
bgs = below ground surface
TOC = top of casing
NR = Not recorded
NA = Not applicable
msl = mean sea level

FIGURES





KARN / WEADOCK CCR MONITORING BENCHMARKS AFTER ADJUSTMENTS		
BM #	ELEV	DESCRIPTION
150	584.18	NAIL, WEST FACE POWER POLE, 80'± NORTH OF RAILROAD TRACKS, 140' EAST WEADOCK ROAD
151	584.84	NAIL, SOUTHEAST FACE LIGHT POLE, 170'± NORTHWEST CENTERLINE WEADOCK ROAD, 8' SOUTHWEST RAILROAD TRACKS
152	586.80	SOUTH SOUTHEASTERLY FLANGE BOLT HYDRANT NEAR SOUTHEAST PC OF RAILROAD TRACKS
5035H	585.12	NGS BENCHMARK DISK OVER STEEL ROD IN NOAA CASING & COVER
153	586.50	NAIL, NORTH SIDE LIGHT POLE, SOUTH SIDE WEADOCK ROAD, 100'± EAST "DEER XING/DO NOT PASS" SIGN
154	587.31	NAIL, WEST SIDE LIGHT POLE, SOUTHWEST CORNER WEADOCK ASH POND
155	596.21	MARKER "SQUARE", TOP OF EAST END CONCRETE CURB NORTH OF DIESEL PUMP @ FLY ASH SILO
156	592.51	FOUND RAILROAD SPIKE, SOUTH FACE LIGHT POLE, SOUTH SIDE BARRIER ACROSS DISCHARGE CHANNEL
157	592.59	FOUND NAIL, SOUTH FACE WESTERLY MOST POWER POLE @ NORTH SIDE DIKE
158	591.71	FOUND NAIL, SOUTH FACE 4TH POWER POLE FROM THE WEST 5 POWER POLES @ NORTH SIDE DIKE
159	592.51	FOUND NAIL, SOUTH FACE POWER POLE @ NORTHEAST CORNER DIKE
160	591.38	SET CHISELED "SQUARE" IN CONCRETE BASE MONITORING WELL 53R @ EAST SIDE DIKE/ EAST-WEST HAUL ROAD INTERSECTION
161	588.77	FOUND NAIL, NORTH FACE 26" COTTONWOOD @ INTERSECTION OF SLURRY WALL & NORTH-SOUTH ROAD
162	584.50	NAIL, WEST FACE POWER POLE, 45'± EAST OF CENTERLINE BOUTELL ROAD, 45'± SOUTH MW15025



LOCATION MAP

NOT TO SCALE

SECTION 1, 2, 11 & 12
HAMPTON TOWNSHIP

T14N-R5E
BAY COUNTY

BASIS OF BEARING

MICHIGAN STATE PLANE COORDINATE SYSTEM,
SOUTH ZONE NAD83 (1994). COMBINED SCALE FACTOR = 0.99996843

BASIS OF ELEVATION

NORTH AMERICAN VERTICAL DATUM 1988
(NAVD88)

*NAVD88 = NORTH AMERICAN VERTICAL DATUM OF 1988
*NGVD29 = NATIONAL GEODETIC VERTICAL DATUM OF 1929
*USLS = UNITED STATE LAKE SURVEY 1935
*IGLD55 = INTERNATIONAL GREAT LAKES DATUM 1955 ADJUSTMENT
*IGLD85 = INTERNATIONAL GREAT LAKES DATUM 1985 ADJUSTMENT
* REPORTED IN UNITS OF FEET.

CONVERSIONS

NAVD88 TO USLS = +0.92'
NAVD88 TO IGLD85 = -0.11'
USLS TO IGLD55 = -1.754'
USLS TO NGVD29 = -0.297'
IGLD55 TO IGLD85 = +0.72'

NOTE: THE CONVERSIONS TO USLS AND TO IGLD DATUMS ONLY APPLY TO THE IMMEDIATE AREA AT THE KARN PLANT AND SHOULD NOT BE USED ELSEWHERE.



SURVEYOR'S NOTES:

1) THE HORIZONTAL COORDINATE VALUES AND GROUND ELEVATIONS WERE OBTAINED WITH GPS RTK EQUIPMENT UTILIZING THE EXISTING SITE SURVEY MONUMENT PERMANENT CONTROL AS FOR THE LOCATION AND ELEVATION CONTROL OF THE BASE STATION. CHECKS WERE MADE BY LOCATING OTHER BASELINE OR PERMANENT CONTROL POINTS OF KNOWN/REPORTED VALUES FOR ACCURACY VERIFICATION. THE TOP OF CASING ELEVATION VALUES WERE ESTABLISHED BY UTILIZING A DIGITAL LEVEL AND RUNNING A CLOSED LEVEL LOOP FROM POINTS OF KNOWN ELEVATION (BASELINE/PERMANENT CONTROL MONUMENTATION AND PREVIOUSLY UTILIZED SITE BENCHMARKS). EACH TOP OF CASING WAS INCLUDED AS A TURN POINT FOR THE LEVEL LOOP. NO SIDE SHOTS WERE USED AS PART OF THE LEVEL LOOP.

2) AERIAL IMAGERY IS SHOWN FROM JUNE 2007 FLIGHT FOR THE PORTION SOUTH OF THE STORAGE TANKS AT THE SOUTH END OF THE SITE AND APRIL 2013 FLIGHT FOR THE IMAGERY NORTH OF THE STORAGE TANKS. IMAGERY PROVIDED BY AIR-LAND SURVEYS.

LEGEND

- DEK MW-406 ● DE KARN BOTTOM ASH POND WELL
- MW-408 ● BACKGROUND MONITORING WELL
- MW-409 ● EXISTING MONITORING WELL

FIG 1, REV2	ARCADIS RCRA CCR GROUNDWATER MONITORING PROGRAM	A	11/30/15	EDIT TABLE AND LEGEND	EMB							DATE 11/05/15
												DR. J. PLUMMER
												FIELD BOOK # 1989
												FLD. BC/DM
												CHKD. H. HORTON
												11/06/15
												APP.
DRAWING NO.	REFERENCE DRAWINGS	REV.	DATE	DESCRIPTION	BY	APP.	REV.	DATE	DESCRIPTION	BY	APP.	

Consumers Energy

DE KARN MONITORING WELLS CCR MONITORING		T14N-R5E BAY COUNTY	
SECTION 1, 2, 11 & 12 HAMPTON TOWNSHIP	SAP 25477881		
SCALE: 1"=300'	DRAWING NO. 5G-22355	SHEET I	REV. A
FILE NAME: 22355BASE.DWG			
ROWE # 1501110			

APPENDIX A

Low Stress (Low Flow) Purging and Sampling of Groundwater
Monitoring Wells SOP (Procedure CHEM-2.7.06)



**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

Written or Revised by Katharyn L Schlueter Date 08/07/09
Level I or Above

Technical Review by Gordon L Cattell Date 08/07/09
Level II or Above (not author)

Technical Approval by Emil Blaj Date 08/07/09
Level III

This electronically produced document has been reviewed and approved by the above-named individuals. The original document bearing the approval signatures is maintained on file by Consumers Energy, Laboratory Services.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

1.0 SCOPE

- 1.1 This procedure is a general method for collecting low stress/low flow ground water samples from monitoring wells. Upon approval by the responsible party, this procedure may be used as a substitute for macro-purging techniques where 3 to 5 well volumes have traditionally been purged prior to sampling. The low stress/low flow method is the preferred technique for ground water monitoring wells located at the former Manufactured Gas Plant (MGP) sites of Consumers Energy.
- 1.2 The presented technique applies to monitoring wells that have an inner casing with a nominal diameter of at least 1.0 inch, and maximum-screened lengths of ten feet per interval.
- 1.3 The technique is appropriate for collection of ground water samples that will be analyzed for: volatile and semi-volatile organics including pesticides and polychlorinated biphenyls (PCBs), total and dissolved metals, and various other analytes such as sulfates, cyanides, and nitrates/nitrites.
- 1.4 The technique is also appropriate when the following conditions are desired: lower turbidity in the sample containers, significantly less purge water for disposal, and higher analyte repeatability.

2.0 APPLICABLE DOCUMENTS AND REFERENCES

- 2.1 CHEM-1.1.02, Chemistry Department Procedure Requirements.
- 2.2 Ground Water Issue, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures, Puls and Barcelona, USEPA, Office of Research and Development, Office of Solid Waste and Emergency Response, EPA/540/S-95/504, April 1996.
- 2.3 Low Stress (Low Flow) Purging and Sampling Procedure for the Collection of Ground Water Samples From Monitoring Wells, USEPA Region 1, SOP No GW 0001, Revision 2, July 30, 1996.
- 2.4 Technical Guidance on Low-Flow Purging and Sampling and Passive Sampling, D M and G L Nielson, The Nielson Environmental Field School, NEFS-TG001-99, December 1999.
- 2.5 Manufacturer Operation Manual, as appropriate.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 2.6 Standard Guide for Purging Methods for Wells Used for Ground-Water Quality Investigations, D6452-99, American Society for Testing and Materials.
- 2.7 MDEQ RRD Operational Memorandum 2, Attachment 5, Sampling and Analysis, October 2004, Revision.
- 2.8 Field worksheets (Attachments A-D).

3.0 DEFINITIONS

- 3.1 COC – Chain of Custody
- 3.2 NAPL – Non-aqueous Phase Liquids
- 3.3 LNAPL – Light Non-aqueous Phase Liquids
- 3.4 DNAPL – Dense Non-aqueous Phase Liquids
- 3.5 DTW – Depth-to-Groundwater

4.0 SUMMARY OF METHOD

- 4.1 Once depth-to-water is measured; a suitable pumping device is lowered to the target depth, generally mid-screen. Ground water is purged from the well casing at a slow rate, typically 100-500 mL/minute. While drawdown is measured and minimized, the purged water is diverted to a flow cell that contains several probes for indicating stabilization parameters, such as pH, conductivity, etc. Once the parameters have stabilized within pre-determined limits, the purged water stream is diverted from the flow cell to sample containers for collection of proper test parameters.

5.0 PREREQUISITES

5.1 MEASURING AND TEST EQUIPMENT

- 5.1.1 Flow-cell, hand-held monitor, and sonde, containing in-line probes calibrated for at least dissolved oxygen and oxidation-reduction potential (ORP). If necessary, pH and conductivity may be monitored with external monitors, although in-line probes are recommended. Turbidity or other probes/monitors may be added as site-specific requirements dictate.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 5.1.2 Adjustable rate groundwater pumping devices including: Peristaltic pump with pump head and electrical power source; bladder pump(s) with controller and a source of compressed air; gear pump (Keck or “bullet”), with controller and electrical power source. Gear and bladder pumps should be constructed of stainless steel or PTFE.
- 5.1.3 Tubing of the appropriate size, length, and material.
- 5.1.4 Interface probe for determining the presence or absence of NAPLs.
- 5.1.5 Water level measuring device with a minimum 0.01-foot accuracy.
- 5.1.6 Flow measurement supplies such as a rotometer or graduated cylinder with a stopwatch.
- 5.1.7 Portable PID meter, calibrated the same day as use.
- 5.1.8 Decontamination supplies, including deionized water, brushes, buckets, and commercially available 2-propanol soaked wipes.
- 5.1.9 Sample bottles with appropriate preservatives.
- 5.1.10 Field hazardous materials kit, including eyewash, sampling gloves, goggles, earplugs, etc.
- 5.1.11 Purge water collection device, such as a sturdy plastic bucket.
- 5.2 REAGENTS
 - 5.2.1 Assorted standards as needed to fully calibrate the above system.
- 5.3 CALIBRATION REQUIREMENTS
 - 5.3.1 All meters, probes, etc must be calibrated according to manufacturer’s instructions. Periodic checks are recommended during or at the end of the day to ensure the calibration curves. Written documentation is required for all calibrations and periodic checks.
 - 5.3.1.1 In general, daily recalibration will be required. In some cases where a periodic check indicates the calibration curves are still valid, no daily calibration may be necessary.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

5.4 QUALITY CONTROL DOCUMENTS AND RECORDS

- 5.4.1 Historical documentation, including well construction data (eg, screen depth), well location map, and field data from a previous sampling event.
- 5.4.2 Material Safety Data Sheets (MSDSs) for all reagents taken to the job site.
- 5.4.3 A field log book or field worksheet must be kept at each sampling event (see Attachments A-D). The following should be documented:
 - 5.4.3.1 Field instrumentation calibration data.
 - 5.4.3.2 Monitoring well identification number and physical condition.
 - 5.4.3.3 Monitoring well data such as casing material, casing diameter, and screen length.
 - 5.4.3.4 Monitoring well depth and DTW, measurement technique, date and time of measurement.
 - 5.4.3.5 Presence and thickness of NAPLs and detection method.
 - 5.4.3.6 Sample tubing material, diameter, length, placement, and pump type.
 - 5.4.3.7 Pumping rate, water level, water quality indicator values, date and time of measurements.
 - 5.4.3.8 Identification of any unacceptable water quality indicator values.
 - 5.4.3.9 Time and date of sample collection.
 - 5.4.3.10 Sample ID and control number.
 - 5.4.3.11 Field observations.
 - 5.4.3.12 Sampler's name or initials.
- 5.4.4 The COC must contain the analytical parameters requested, sample time and date, sampler's name or initials, site location, sample ID, control number, preservatives added, and filtration status.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 5.4.5 The sample labels must contain the sample ID, control number, sample time and date, sampler's initials, preservative, filtration status, and analytical parameter requested.
- 5.4.6 Field worksheets (Attachments A-D).
 - 5.4.6.1 Monitoring Well Sampling Worksheet (Attachment A)
 - 5.4.6.2 Monitoring Well Depth-To-Water Measurements Worksheet (Attachment B)
 - 5.4.6.3 Flowcell/Sonde Calibration and Periodic Checks Worksheets (Attachment C)
 - 5.4.6.4 Field Screening of Monitoring Wells Via PID (Attachment D)
- 5.5 PERSONNEL REQUIREMENTS
 - 5.5.1 All tests and data reporting shall be performed by certified persons of Level I or above, in the appropriate discipline. (The project report shall be issued and reviewed by a certified person of Level II or above, in the appropriate discipline. The project report, if so indicated on the work request [or form similar in intent], may require approval from a certified person of Level III, in the appropriate discipline.)
- 5.6 ENVIRONMENTAL CONDITIONS

See Section 6.0.

6.0 PRECAUTIONS

- 6.1 The site-specific Health and Safety Plan is used to identify any physical or chemical precautions and actions to be taken to prevent injury. A pre-job briefing shall be conducted prior to initiating sampling.
- 6.2 Observe normal safety practices as specified in the latest online revision of the Environmental and Laboratory Services Accident Prevention Manual and the Consumers Energy Chemical Hygiene Plan in Lotus Notes.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

7.0 LIMITATIONS AND ACTIONS

- 7.1 This technique is generally not suitable for very low-yield wells (<50 mL/minute with continued drawdown).
- 7.2 Even with pre-planning, a number of problems may be encountered which will challenge the sampler. These include: insufficient yield, failure of one or more key indicator parameters to stabilize, cascading, and equipment failure. Each of these problems will be addressed on a case-by-case basis and their impact can be minimized by consulting the references in Section 2.
- 7.3 This method does not address the collection of light or dense non-aqueous phase liquids (LNAPLs and DNAPLs). Collection of these sample types is both atypical and non-standardized and must therefore be addressed on an as-needed basis.

8.0 ACCEPTANCE CRITERIA

Refer to Section 9.3.9.3 in this procedure.

9.0 PROCEDURE

- 9.1 Orient the equipment and yourself upwind of the monitoring wells if possible.
- 9.2 DETERMINATION OF DEPTH-TO-GROUNDWATER (DTW)
 - 9.2.1 Start at either the well known, or believed to have, the least contaminated groundwater and proceed systematically to the well known, or believed to have, the highest level of contamination.
 - 9.2.2 Check the well casing protector, lock, locking cap, and well casing for obvious damage or evidence of tampering. Record any abnormal observations.
 - 9.2.3 The sampler may desire to minimize contamination from the ground and provide a clean area for laying down equipment. This can be accomplished by cutting a section from a sheet of plastic and fitting it around the well casing protector.
 - 9.2.4 Remove the well cap. At some sites, it may be necessary to remove all well caps first, then proceed to 9.2.5. This will be determined prior to any field events.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 9.2.5 If the site has not been characterized yet, or there is insufficient history, it will be useful to determine the concentration of organic vapors in the heads case. Using a portable, calibrated, PID meter measure and record the organic vapor concentration as follows: (1) At the highest risk breathing zone elevation, defined here as the point located at roughly 6" above the center of the top of the well casing. (2) At 0-6" within the well casing.
- 9.2.6 If the well casing does not have a reference point, make one. The reference point is typically a V-cut or an indelible mark in the well casing.
- 9.2.7 Measure and record the DTW to 0.01 feet. Duplicate the reading. Hold the tape against the reference point when making the reading. Care should be taken to minimize disturbance of the water column.
- 9.2.8 Measure and record the thickness and depth of any NAPLs.
- 9.2.9 If desired or required by the site plan, measure the depth of the well. Care should be taken to minimize disturbance of the water column and any sediment that has accumulated.
- 9.2.10 Decontaminate the electronic tape and interface meter. Wipe dry using a clean Kaydry-type material. Rinse with DI water and wipe dry again. If organic contamination is suspected, the sampler must decontaminate accordingly before proceeding. One option is to use commercially prepared decontamination wipes that are saturated with 2-propanol.
- 9.2.11 If the monitoring well will be sampled the same day and will remain in visual range and/or without a reasonable risk of tampering, loosely recap the well and leave the well casing protector unlocked. Otherwise, secure the well as if not returning.
- 9.2.12 If a sheet of plastic has been fitted around the well casing protector, leave it in place if the well will be sampled the same day.
- 9.2.13 Continue with the determination of DTW on the rest of the monitoring wells. Continue with purging and sampling when appropriate (ie, large distance between wells).

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

9.3 PURGING

- 9.3.1 If not already determined at the laboratory or by prior sampling events, determine the type of pump to be used (operation of each pump type will not be covered here).
- 9.3.2 For ease of use and portability, a peristaltic pump may generally be used for any well where DTW plus casing height above grade does not exceed 15 feet.
- 9.3.3 Keck (gear or “bullet”) and bladder pumps can be used in any instance where there is sufficient water in the casing to completely submerge the pump and intake screen at all times.
- 9.3.4 Use well installation and historical data to determine the length of tubing needed to place the pump intake or tubing at the desired sample depth, generally mid-screen. Attach the tubing to the pump and prepare to lower the tubing or tubing/pump down the well. To keep from introducing contamination into the monitoring well, never allow the tubing or tubing/pump to touch bare ground.
- 9.3.5 Install the tubing or pump/tubing. Slowly lower the pump, tubing, and any safety cable and electrical lines into the monitoring well. Final placement is generally at mid-screen. Typically, the intake must be kept at least 2 feet above the bottom of the well to prevent disturbance and resuspension of any sediment or NAPL present in the bottom of the well. Once the desired depth is reached, clamp or otherwise secure the tubing to prevent the pump/tubing from dropping any lower. Record the depth to which the pump was lowered.
- 9.3.6 Before starting the pump, wait a few minutes and measure the water level again. Record this level. This short waiting period allows for reduced turbidity and reequilibrium of the water level. Leave the electronic tape in the well for later use.
- 9.3.7 Attach the in-line flow cell. Start the pump and collect roughly 100 mL/minute. Start with a faster or slower pumping rate if historical data suggests to do so.
- 9.3.8 Collect all water for proper disposal.
- 9.3.9 Monitor and record the water quality parameters and water level every 3-5 minutes.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 9.3.9.1 Ideally, a steady flow rate should be maintained that results in a stabilized water level. Pumping rates should be reduced or increased to ensure stabilization of the water level in the well. Avoid entrainment of air in the tubing.
- 9.3.9.2 Record the time of the readings and the pump rate.
- 9.3.9.3 The well is considered stabilized and ready for sample collection when the indicator parameters have stabilized for three consecutive readings as follows:
- ± 0.1 pH units
 - $\pm 3\%$ conductivity units (specific conductance)
 - ± 10 mV for redox potential (Eh/ORP)
 - $\pm 10\%$ for DO and turbidity
 - Temperature – For information only. Record only.

Dissolved oxygen and turbidity usually require the longest time to achieve stabilization. (Above criteria may not apply to very clean wells.)

9.4 SAMPLE COLLECTION

- 9.4.1 The pump must not be removed from the well between purging and sample collection. It is recommended that the pump not be turned off between purging and sample collection. Continue to collect excess groundwater for proper disposal.
- 9.4.2 Disconnect or bypass the flow cell.
- 9.4.3 Collect samples at the same flow rate as the purging rate. Minimize potential contamination from dust, rain, etc by shielding the open bottles as needed.
- 9.4.4 Samples will be collected directly into the sample containers. Minimize aeration by allowing the water to flow down the side of the container rather than splashing against the bottom of the bottle. Avoid placing the sample tubing below the liquid level of the sample being collected. Label the containers and chill immediately.
- 9.4.5 VOC samples must be collected first except as noted below for Low Level Mercury. Check for air bubbles in the container before proceeding to collecting the next parameter. Carbonaceous waters will naturally produce bubbles in the containers, which cannot, and should not, be removed.

TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND WATER MONITORING WELLS

NOTE: A sample for low level mercury should be the first sample collected when multiple analyte containers will be filled. Low level mercury sample bottles should be pre-cleaned and individually stored in Ziploc®-style plastic bags. Use clean nitrile gloves for each sample collection point, immediately prior to handling any bagged sample bottles.

When collecting a sample from a monitoring well:

- Remove the sample bottle from the plastic bag and remove the cap.
- The bottle should be thoroughly rinsed with the sample stream, holding the sample tubing very close to, not within, the open bottle (approximately 1/8"). Never place the sample tubing within the bottle.
- Fill to approximately 1/4" below the bottle threads, affix a label, cap the bottle, and return it to the plastic bag.
- Place the bagged bottle in a cooler designated only for low level mercury.

9.4.6 Semi-volatile samples must be collected next, followed by any other parameters that do not require filtration.

9.4.7 Samples that require only filtration with no additional preparation steps should be collected using in-line filters. Filtered samples are typically collected last. One exception is collection for available cyanide, which must be collected last due to the potential for cross-contamination from the lead carbonate reagent.

9.4.8 Once all samples from the monitoring well are collected, remove the tubing or pump/tubing. Record the stop time, if required. In addition, the total volume purged can be calculated and recorded.

9.4.9 Cap and secure the monitoring well.

9.4.10 In general, the purged water is poured on to the ground next to the monitoring well. Whether to collect in a drum or to use another strategy will be determined prior to starting any field activities.

9.4.11 Continue with sampling all of the other monitoring wells.

9.5 **FIELD QUALITY CONTROL (QC) SAMPLES**

9.5.1 Field QC samples must be collected to determine if sample collection and handling procedures have adversely affected the quality of the ground water samples. All QC samples are treated the same as samples with regard to volume, bottle type, preservatives, and any pretreatment.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

9.5.2 TYPES OF QC SAMPLES

- 9.5.2.1 Trip Blank – For VOCs only. Consists of DI water in a VOC vial (contains preservative) and is prepared at the lab prior to the field event. The vial is left capped and chilled while sampling. Used to determine if sample holding and transport has introduced contamination into the samples.
- 9.5.2.2 Field Blank – Consists of DI water in an appropriate bottle with the appropriate preservative. Obtained from the lab prior to the sampling event and can prepare for a variety of analytes. The bottle is uncapped while sampling to indicate contamination that may have occurred during the operation.
- 9.5.2.3 Equipment Blank – DI water is exposed to the sample path at any time decontamination needs to be verified. Collect for any suspect parameter and treat it exactly the same as if collecting a sample.
- 9.5.2.4 Sample Duplicate – One monitoring well per 20 will be selected for collection of a duplicate sample. This is simply an additional set of the sample collected in exactly the same manner as the original sample. The sample type is used to determine precision.
- 9.5.2.5 Matrix Spike and Matrix Spike Duplicate – One monitoring well per 20 will be selected. These are additional sets of samples collected in exactly the same manner as the sample is collected. This sample type is used to determine accuracy but can also indicate matrix bias.

9.6 DECONTAMINATION

9.6.1 **General Considerations**

- 9.6.1.1 All nondedicated sampling equipment that is to be reused must be decontaminated prior to its reuse.
- 9.6.1.2 All disposable tubing will be properly discarded and new tubing used in its place. No tubing will be reused.
- 9.6.1.3 All equipment washings/rinsates must be collected for proper disposal.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 9.6.1.4 The flow cell may be cleaned using the procedure in Section 9.6.2.1 or a manufacturer recommended procedure. Special attention must be paid to care of the probes on the sonde portion of the unit.
- 9.6.1.5 To avoid cross-contamination, pumps that are contaminated with NAPLs will be isolated and decontaminated at the laboratory.
- 9.6.2 **Between Well and End-of-Day Decontamination Process**
- 9.6.2.1 Flow Cell
- A. In the case of the flow cell when new tubing will be used, a double rinse at half volume using deionized water is typically adequate. Continue with sampling. If the sample location is historically not contaminated, this step may be omitted.
 - B. If NAPLs, odors, or colors are present and cannot be flushed out, assess if the probes are fouled by spot-checking the calibration curves. If the probes are not fouled, no further action is necessary since the flow cell does not contact the sample. Continue with sampling.
 - C. If the probes are fouled, contact the MGP sample coordinator at the laboratory for guidance.
 - D. At the end of the day, the in-line flow cell should be free of sediment and NAPLs. Fill the cell with tap water, insert the sonde, and store.
- 9.6.3 **Pumps**
- 9.6.3.1 Peristaltic pumps need to only have the pump head tubing and sample tubing replaced.
- 9.6.3.2 If the equipment, such as the peristaltic pump case, is contaminated with organic material, wipe down with commercially available wipes presaturated with 2-propanol. If the organic material does not dislodge, stop now, isolate for decontamination at the lab, and use different equipment for the next monitoring well.
- 9.6.4 **Specific Bladder and Keck (gear or bullet) Pump Decontamination Measures**

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

- 9.6.4.1 Pump pre-rinse – Operate the pump in a deep basin containing 1-5 gallons of deionized water and continue through several cycles.
- 9.6.4.2 Pump wash – Operate the pump in a deep basin containing 1-5 gallons of nonphosphate detergent solution, such as Alconox. Operate through several cycles.
- 9.6.4.3 Pump rinse – Operate the pump in a deep basin containing 1-5 gallons of DI water. Continue for several cycles.
- 9.6.4.4 Disassemble pump, if required, and continue with 9.6.4.5. If not required, go to 9.6.4.7.
- 9.6.4.5 Pre-rinse, wash, and rinse as above, scrubbing as needed at the wash stage.
- 9.6.4.6 Reassemble the pump.
- 9.6.4.7 Store the pump so as to keep it clean until needed.

10.0 CALCULATIONS

None

11.0 DATA REPORTING

Refer to Section 5.4 in this procedure. At a minimum the COC shall be stored in the project folder.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

**Consumers Energy Company
Chemistry Section – Laboratory Services Department
Monitoring Well Sampling Worksheet**

Sample

MW_ID		Today's Date		Control Number	
Location					
MW Reference Name			GPS Grid Reference		
Top-of-Casing Elevation (ft)		Depth-to-Screen Bottom (ft)		Depth-to-MidScreen (ft)	
Screen Length (ft)		Casing ID (in)		Typical Purge Volume	
				Protective Casing Mount	
Comments					

Field Measurements

Depth-to-Water (ft)				HC Layer Detected				PID Reading (ppm)			
Time	pH	Temp	Sp Cond	DO	DO	ORP	Pump Rate Indicate	Water Level	Turbidity		
Hr : Min	Units	°C	µS/cm	ppm	% Sat	mV	mL/min gal/min	Draftdown (ft)	NTU		
3-5 Min	± 0.1	na	± 3%	± 10%	± 10%	± 10%	See Notes	<0.33	± 10%		
Completed By >>			Total Pump Time >>			Total Purge Volume >>					
Acceptance criteria are low-flow general acceptance. Pump rate should be <500 mL/min for low-flow and <1 gal/min for high-volume.											

Monitoring Well Depth-to-Water Measurements

Tape ID: Solinst, Model 122, S/N 122001406-1

Sample

[illegible]

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

Project Sonde Check; As-Found Readings & Recalibration

Page 1 of 2

I. *Site or Project Tracking*

Site or Project : _____ Chem. Control # : _____

II. *System Identifiers*

Monitor Brand, Model & S/N:	YSI 650MDS S/N 08C100135
Sonde Brand, Model & S/N:	YSI 6820V2 S/N 08C101426
Flow Cell Brand & Model:	YSI 6160
DO Probe Brand, Model & S/N:	YSI 6150 S/N 08C101539
Turbidity Probe Brand, Model & S/N:	YSI 6136 S/N 08C101363
pH With ORP Brand, Probe Model & Lot:	YSI 6565 Lot Number 08B*26
Conductivity & Temperature Probe Model & S/N:	YSI No additional information

SampleIII. *pH Check*

Standard vs As-found, pH Units	Standard Source	Catalog # & Lot #	Exp. Date
4.00			
7.00			
10.00			

Analyst Initials: _____ Date & Time: _____

As-Found Evaluation

Are the readings within +/- 0.10 of their calibration points? Yes No

If 'No' and you are at the start of a project, then recalibration is **required**.If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solutions listed above were used.

IV. *ORP Check With Zobell Solution*

Standard vs As-found, mV	Source	Catalog # & Lot #	Exp. Date
231			

Analyst Initials: _____ Date & Time: _____

As-Found Evaluation

Is the reading in the 221-241mV range? Yes No

If 'No' and you are at the start of a project, then recalibration is **required**.If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solution listed above was used.

V. *DO Check With DI Water; 100% Saturation*

As-Found: _____ Analyst Initials, Date & Time: _____

As-Found Evaluation

Is the reading in the 90-110 % saturation range? Yes No

If 'No' and you are at the start of a project, then recalibration is **required**.If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, lab DI water was used.

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

Project Sonde Check; As-Found Readings & Recalibration

Page 2 of 2

Site or Project : _____

Chem. Control # : _____

VI. Conductivity Check

Standard vs As-Found, us	Source	Catalog # & Lot #	Exp. Date
0 (DI Water)	Lab DI System	----	----

Analyst Initials: _____

Date & Time: _____

As-Found Evaluation

Is the reading +/- 3% of the reference point? Yes No

If 'No' and you are at the start of a project, then recalibration is **required**.If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solutions listed above were used.

Sample**Linearity Check**

Standard vs As-Found, us	Source	Catalog # & Lot #	Exp. Date

Analyst Initials: _____

Date & Time: _____

VII. Turbidity Check

Standard vs As-Found, NTU	Source	Catalog # & Lot #	Exp. Date
0 (DI Water)	Lab DI System	----	----

Analyst Initials: _____

Date & Time: _____

As-Found Evaluation

Is the reading +/- 10% of the reference point? Yes No

If 'No' and you are at the start of a project, then recalibration is **required**.If 'No' and you are **within, or at the end** of project, indicate whether recalibration has been performed. Yes No

Note: If recalibration was performed, the solutions listed above were used.

Linearity Check

Standard vs As-Found, NTU	Source	Catalog # & Lot #	Exp. Date

Analyst Initials: _____

Date & Time: _____

Reviewed By _____ Date _____

**TITLE: LOW STRESS (LOW FLOW) PURGING AND SAMPLING OF GROUND
WATER MONITORING WELLS**

Field Screening of Monitoring Wells Via PID

Project Information

Site: _____

Project No: _____

Date: _____

Sample

Instrument Information

Instrument ID and Serial Number: _____

Calibration (Span) Gas ID, Lot Number Concentration, etc: _____

Zero Gas ID, Lot Number, Concentration, etc: _____

Periodic Calibration Checks

Time	Analyst	Cal Gas Conc, ppm v/v	Display Conc, ppm v/v

Monitoring Well Screening

MW ID	Time	Analyst	Breathing Zone Display Conc	0-6" Within Casing Display Conc
Background Air				NA

APPENDIX B

Chain-of-Custody, Handling, Packing and Shipping SOP (Procedure
CHEM-1.2.04)



TITLE: CHAIN OF CUSTODY REQUIREMENTS (CoC)

1.0 PURPOSE

To provide guidance for uniform preparation of a Chain-of-Custody document.

2.0 SCOPE

The Chain-of-Custody (CoC) document is required for all samples where the analysis results are used for environmental reporting. It may also be used as requested by the customer for other forms of reporting. This method provides guidance for the use of the CoC document.

3.0 DEFINITIONS

Chain-of-Custody (CoC) – A document that is a management tool used to verify sample identification information, sample inventory and sample possession from the time the sample is collected to the time the sample is received by a laboratory.

4.0 REFERENCE DOCUMENTS

- 4.1 Chapter 1 – SW-846, Test Method for Evaluating Solid Waste, USEPA
- 4.2 ASTM Method D 5283-92, Standard Practice for Generation of Environmental Data Related to Waste Management Activities: Quality Assurance and Quality Control Planning and Implementation
- 4.3 ASTM Method D 4840-95, Standard Guide for Sampling Chain-of-Custody Procedures
- 4.4 Chemistry Department Standard Operating Procedures, as applicable
- 4.5 Laboratory Services Quality Assurance (LSQA) Procedure Manual, as applicable

5.0 PROCEDURE

- 5.1 Prior to sampling, the sample team shall be provided with CoC forms. It shall be the responsibility of the on-site supervisor or designated representative to ensure that CoC requirements, sample collection protocol and proper sample handling protocol are initiated on-site.

TITLE: CHAIN OF CUSTODY REQUIREMENTS (CoC)

- 5.2 A sample is considered under custody if one or more of the following criteria are met:
- The sample is in the sampler's possession.
 - The sample is within the sampler's view after being in possession.
 - The sample was in the sampler's possession and then placed in a secure container to prevent tampering.
 - It is in a designated secure area.
- 5.3 Each CoC shall identify basic site information and include the following:
- The sampling site name, project name or other site/project identification.
 - The initials of the sampling teams.
 - Project Leader or report distribution personnel.
 - If a site sketch or other documents are to be found with the CoC.
 - Necessary remarks as required.
- 5.4 Each sample entry into the CoC shall include the following:
- Date of sample collection.
 - Time of sample collection.
 - Type of sample matrix (soil, water, vapor, product, etc).
 - Sample identification, name or description.
 - Sample depth, if applicable.
 - Number of sample containers.
 - Specific analytical test parameters. In some cases the specific test parameters may not be known at the time of sample collection. However, the samples are collected in accordance with the protocol for a general group of analytes (e.g., dissolved metals, volatile organic compounds) and the specific test analytes are determined after the sampling event. In these cases, the entry for the analytical test parameter is not required.
- 5.5 The original of the CoC record shall accompany the samples and a copy should be maintained by the on-site supervisor.
- 5.6 When transferring the possession of samples, the individuals relinquishing and the individuals receiving the samples should sign, date and note the time on the CoC record.
- 5.7 In cases where the sample leaves the originator's immediate control, such as shipment to the laboratory by a common carrier (e.g., Federal Express or

TITLE: CHAIN OF CUSTODY REQUIREMENTS (CoC)

Consumers Energy's internal mail) a seal should be placed on the shipping container to detect unauthorized entry to the samples. Any shipping containers that arrive at the Laboratory with the seals damaged should be evaluated to ascertain if the contents have been in valid custody.

- 5.8 In the event samples requiring the CoC protocol arrive at the Laboratory without the CoC document, the Laboratory shall complete the CoC document upon sample login and under the supervision of the assigned Laboratory Project Leader or Area Coordinator. The person completing the CoC shall enter the statement "CoC completed by the Laboratory upon receipt of sample(s)" in the remarks section of the CoC and initial the entry.
- 5.9 A sample CoC form is attached (Attachment A).
- 5.10 Other CoC formats and forms may be used as long as the CoC meets the recommendations of this procedure.
- 5.11 The CoC shall be stored in the project folder and retained according to CHEM-1.1.7, Record Retention.

QA Review Katharyn L Schlueter
Chemistry Quality Assurance Coordinator

Date 02/27/08

Administrative Approval Gordon L Cattell
Chemistry Department Supervisor

Date 02/27/08

This electronically produced document has been reviewed and approved by the above-named individuals. The original document bearing the approval signatures is maintained on file by Consumers Energy, Laboratory Services.

TITLE: CHAIN OF CUSTODY FORM (CoC)

[illegible]

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