GRAFTECH INTERNATIONAL HOLDINGS INC.

(Formerly UCAR Carbon Company, Republic Site)

Niagara County, New York

POST-CLOSURE LANDFILL SITE MANAGEMENT PLAN FOR SWMF #32N03 (Registry No. 932035)

Prepared by:

J. M. Bursley

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GrafTech International Holdings Inc.
12900 Snow Road, Parma, OH 44130
216-676-2175

December 2013

SITE MANAGEMENT PLAN REVISION LOG

Table 1 - Revisions to Final Approved Site Management Plan

Revision Number	Submittal Date	Summary of Revision	NYSDEC Approval Date

TABLE OF CONTENTS

LIST OF APPENDICES

1.0 SITE MANAGEMENT PLAN INTRODUCTION

This document is the Site Management Plan (SMP) for the GrafTech International Holdings Inc. ("GTIH") (formerly UCAR Carbon Company Inc.) closed landfill facility, SWMF #32N03, (formerly Republic Site, Registry No. 932035) ("Landfill Site"), on Parcel # 130.20-1.1 in the Town of Niagara, Niagara County, State of New York. The Landfill Site is located off of Hyde Blvd. behind the former UCAR Carbon Republic Plant. This SMP meets the minimum requirements of the provisions of the Inactive Hazardous Waste Site Program, administered by the New York State Department of Environmental Conservation ("NYSDEC"), Division of Environmental Remediation (DER). This SMP was prepared in accordance with applicable sections of the DEC Program Policy DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010. This SMP is intended to update and replace the Operation, Monitoring and Maintenance (OM&M) Manual, which was previously submitted to the NYSDEC on September 30, 2009, and subsequently approved by the state on November 4, 2009.

The total size of the Landfill Site is 61.80 acres. In 1987, the site was closed and an engineered cap installed over solid waste management area, comprising 16.48 acres of the Landfill Site. The Landfill Site was reclassified by the NYSDEC from a Class 2a to a Class 4 Inactive Hazardous Waste Site in September 1997. **There is no required Remedial Program or remedial objectives for this Landfill Site.** Therefore, the scope of this SMP is limited to post-closure site management, consisting of Engineering Controls, Institutional Controls in the form of an Operation and Maintenance Plan, contingency plans for soil excavation and property transfers, and reporting to the NYSDEC per the state Periodic Review and Reporting (PRR) requirements.

GTIH will designate a current employee, contract employee, or third party contractor to be the responsible manager for the Landfill Site ("Designated Manager"). All official correspondence from the state concerning the Landfill Site should be provided to this Designated Manager. As of June 2013, the GTIH Corporate Senior Manager, Environmental Risk Management is the Designated Manager responsible for managing the Landfill Site. This position is currently filled by Ms. Juanita M. Bursley, who meets the NYSDEC criteria as a Certified Environmental Professional Her contact information is provided below.

Juanita M. Bursley
Corporate Sr. Manager, Environmental Risk Management
GrafTech International Holdings Inc.
12900 Snow Rd.
Parma, OH 44130
216-676-2175 Office
216-676-2697 Fax
Email: Juanita.Bursley@graftech.com

The GTIH-Designated Representative will also be responsible for communicating any significant issue that could prevent full conformance with this SMP, or other important matters concerning the Landfill Site outside the scope of this Plan, to the Designated Manager. The Designated Manager is responsible for conformance with the SMP, including following applicable company procedures to allocate the necessary resources and to contract with third parties for services, as needed, to perform the routine inspections, environmental monitoring and maintenance at the Landfill Site as described in this Plan; and, whenever necessary, to implement the appropriate repairs and/or corrective actions that adequately and timely address any identified deficiency.

GTIH will also have a qualified person on contract ("GTIH-Designated Representative"), who will function as the local point-of-contact and be responsible for the day-to-day operations at the Landfill Site, including carrying out the routine site management activities described in this SMP; these include the specified site inspections, scheduling the annual monitoring event, making or scheduling needed maintenance and repairs, as needed, to the Engineered Controls, responding to neighborhood requests, and informing the Designated Manager when additional resources are needed. As of December 2013, GTIH has contracted with the National Maintenance Contracting Corporation to provide these services and serve as the GTIH-Designated Representative. Contact information is provided below:

MR. SAMUEL LEHR
NATIONAL MAINTENANCE CONTRACTING CORP.
5600 NIAGARA FALLS BLVD
PO BOX 258
NIAGARA FALLS, NY 14304
24/7 MOBILE: (716) 695-5042
` Fax: (716) 285-3580

The NYSDEC, the Niagara County Director Environmental Health (held by Mr. Jim Devald as of the date of this SMP), and the Town of Niagara Clerk (held by Mrs. Sylvia Virtuoso as of the date of this SMP) will all be notified should there be a significant change to the above contact information.

The SMP will be reviewed every five years to ensure that the Plan is current with NYSDEC policies, regulations and recognized best management practices. The first review will be completed no later than December 31, 2018, unless GTIH has requested and received NYSDEC's approval to discontinue the annual sampling program following the spring 2017 sampling campaign, after the state's review and assessment of thirty (30) years of post-closure groundwater monitoring data. However, should an annual sampling plan be continued after 2018, any changes to the SMP deemed appropriate by GTIH after conducting the five year review, or at any time in the interim, will be timely communicated to the NYSDEC and a revised SMP submitted for approval. All submissions of proposed revisions to the SMP and subsequent approvals received from NYSDEC will be recorded on the SMP revision log.

2.0 INSTITUTIONAL CONTROLS AND ENGINEERING CONTROLS (IC/EC)

2.1 Engineering Controls

There is no required Remedial Program or remedial objectives for this Landfill Site. The engineering controls (EC) in place at the Landfill Site include a physical barrier, an engineered cap installed in 1987, which was employed to contain and eliminate potential exposure pathways to contaminants in the waste disposal area. Another EC employed at the Landfill Site is a security system consisting of an eight (8) foot high metal hurricane-style perimeter fence and two (2) gates, which are kept locked to restrict unauthorized access. In addition, the casing on each groundwater monitoring well is equipped with a locking device and padlock, which is kept locked except when drawing samples, to help prevent unauthorized access and potential contamination to groundwater.

2.2 Institutional Control

The institutional control in place is the implementation of this SMP that includes an Operation and Monitoring Plan, which specifies the groundwater monitoring program, the routine facility inspections for the engineered cap and the security features of the Landfill Site; site maintenance; and recordkeeping and reporting requirements. The inspection and groundwater monitoring programs are designed and conducted to ensure the EC remain in place, are properly maintained and continue to be effective. Groundwater monitoring for Contaminants of Concern is conducted annually per an established rotating schedule. Further details of the groundwater monitoring program are provided below in subsection 3.1 of Section 3.0 Operation and Monitoring Plan. No soil vapor monitoring program is required for the Landfill Site, based on the results of a prior soil vapor monitoring investigation; details are provided below in subsection 3.2 of Section 3.0 Operation and Monitoring Plan. Facility inspections are performed at determined frequencies, both weekly and quarterly, and are documented. Further details of the site inspection programs are provided below in subsection 3.3 of Section 3.0 Operation and Monitoring Plan.

3.0 OPERATION AND MONITORING PLAN

3.1 Monitoring Plan for Groundwater

The Solid Waste Management Facility at the Landfill Site was closed and capped in 1987. A groundwater monitoring well network was installed to monitor groundwater quality to evaluate the long-term effectiveness of the Engineered Controls. The GTIH groundwater monitoring network at the Landfill Site consists of twelve (12) wells. Details of the past monitoring programs for groundwater are provided below.

Between 1987 and 2000, groundwater monitoring was conducted quarterly at all site wells. In 2000, the post-closure groundwater monitoring program and the collected groundwater quality data from 1987 to 2000 were reviewed cooperatively by GTIH and the NYSDEC Division of Environmental Remediation (DER), represented by Mr. Michael Hinton, and the Division of Solid and Hazardous Materials, represented by Ms. Mary McIntosh. Based on that review, a modified groundwater monitoring program was designed to meet the requirements of 6 NYCRR Section 360 for solid waste landfill closures, and to continue to monitor the effectiveness of the established Landfill Site IC/EC in protecting groundwater quality. The modified post-closure groundwater monitoring program, which was implemented from April 2000 to November 2005, consisted of semi-annual sampling of the twelve (12) on-site monitoring wells (listed in **Appendix B)** for the selected parameters (listed in **Table 2) .** See the description in the letter from Mary E. McIntosh (NYSDEC) to Robert Bucci (former GTIH Designated Representative), dated January 18, 2000 (see **Appendix C**).

In 2005, the post-closure groundwater monitoring program and historical data for the Landfill Site were once again reviewed by GTIH and the NYSDEC DER, again represented by Mr. Michael Hinton, and the Division of Solid and Hazardous Materials, again represented by Ms. Mary McIntosh. Based on that subsequent review, a modified groundwater monitoring program was designed to meet the requirements of 6 NYCRR Section 360 for solid waste landfill closure and to continue to monitor the effectiveness of the landfill closure and IC/EC in protecting groundwater quality. The new annual sampling program that was adopted in November 2005 is based on responses by NYSDEC, comments from Ms. Mary McIntosh dated September 20, 2005 (see **Appendix D**), and the response from Carol Barron (for James K. Jay) of Conestoga-Rovers & Associates (CRA), dated November 4, 2005, regarding the post-closure monitoring requirements (see **Appendix E)**.

As agreed by the above parties, the new groundwater monitoring program for the Landfill Site began in autumn of 2006 and consists of an annual sampling of a network of seven (7) selected on-site wells, including five (5) of the twelve (12) wells installed by the owner (BW-1, BW-2, BW-3, BW-4, and MW-3) and two (2) of the six (6) additional monitoring wells that were installed by the state at the Landfill Site in 1993 (GW-8B and GW-9B), The annual sampling event is conducted on a staggered schedule, rotating every year between spring and autumn. The annual sampling is completed in the spring every odd year, and in autumn every even year. A minimum of one sampling event must occur in every calendar year. The above-described groundwater monitoring program continues to be implemented as of the date of this SMP, and will continue to be administered in accordance with this schedule until such time as GTIH receives direction from the

NYSDEC to modify the sampling frequency, parameters, methodologies, etc., or receives the NYSDEC's approval to discontinue the annual sampling program following their review and assessment of the collected data after thirty (30) years of post-closure groundwater monitoring. GTIH may request the state to conduct such an evaluation after the spring 2017 sampling campaign, or any time thereafter.

The groundwater samples are analyzed for the following parameters every year using the referenced EPA standard test methods (see **Table 2**).

TABLE 2

PARAMETERS	METHODOLOGY
Volatile Organic Compounds (VOCs)	SW-846 8260B (September 1986 with all subsequent revisions)
Total and Dissolved Iron, Potassium and Zinc	SW-846 6010 (September 1986 with all subsequent revisions)
Ammonia	USEPA 350.1 (March 1983 with all subsequent revisions)
Nitrite	USEPA 353.2 (March 1983 with all subsequent revisions)
Total Kjeldahl Nitrogen (TKN)	USEPA 351.2 (March 1983 with all subsequent revisions)
Turbidity	Field Measurement
Specific Conductance	Field Measurement
pH	Field Measurement
Temperature	Field Measurement

Groundwater elevations are measured and recorded during each monitoring campaign. Analytical results are compared to the New York State Class GA water criteria and to the historical monitoring data available for the Landfill Site.

If a discernible negative trend in groundwater quality is observed, the monitoring program will be reviewed again to ensure that it is still adequate. In particular, the level of redundancy will be reassessed. Any amendments to the sampling program proposed by GTIH will be discussed and approved by NYSDEC, the Division of Environmental Remediation and the Division of Solid and Hazardous Materials, before implementation. If the negative trend continues, the potential source(s) of the contaminant(s) will be evaluated to determine the cause(s) and, if appropriate, a corrective action plan developed and implemented. See **Appendix F** for the Landfill Site Plan and Groundwater Well Locations for the Post-Closure Monitoring Program.

As of December 2013, GTIH continues to contract with CRA for groundwater sampling services at the Landfill Site. During each annual groundwater monitoring campaign, CRA follows standard recognized field procedures to collect representative groundwater samples, and follows QA/QC procedures in accordance with state requirements and current recognized industry standards (see **Appendices G and H**). The collected samples are then sent to TestAmerica Lab to be analyzed for the selected parameters using the specified standard analytical procedures. However, GTIH reserves the right to enter into contracts with other qualified environmental consulting companies and/or laboratories for the above services. GTIH will only contract with an accredited laboratory, holding a current certification in the state's Environmental Laboratory Accreditation Program (ELAP), to provide analytical services for compliance with this groundwater monitoring program.

3.2 Soil Vapor Monitoring

On August 21, 2006, GTIH received a written request from the NYSDEC to conduct a soil vapor intrusion evaluation at the Landfill site, based on the facts that some chlorinated aliphatic compounds had been detected during the 2005 groundwater sampling event in bedrock wells located along the northern property boundary, and that there are residential properties adjacent to the southern boundary of the site. Despite numerous low risk factors at the Landfill Site, GTIH agreed to voluntarily perform the requested study along the southern property boundary along Rhode Island Avenue to assess the potential for soil gas presence and migration in the direction of the bordering residential properties.

In October 2006, GTIH submitted a written Soil Gas Investigation Work Plan for agency approval. The Work Plan conformed to the applicable requirements of the “Guidance for Evaluating Soil Vapor Intrusion in the State of New York” prepared by the New York State Department of Health (February 2005 Public Comment Draft). NYSDEC reviewed that plan in December 2006 and recommended GTIH add a fourth soil gas probe at the west side near the access road to the Landfill Site. In January 2007, GTIH resubmitted a revised written Soil Gas Investigation Work Plan based on agency comments, for their approval. On February 8, 2007, NYSDEC approved the revised Work Plan inclusive of the following three (3) conditions: that the study be completed before March 31, 2007; that a Data Usability Summary Report following the agency guidelines be included; and that a community Fact Sheet was not required unless additional investigation, based on the results of the initial vapor intrusion study, required the performance of off-site work.

NYSDEC was advised of the schedule in advance, and on March 8, 2007, four (4) soil vapor implants were installed along the south fence line of the property in order to collect soil gas samples near the residences along Rhode Island Avenue. On March 26, 2007 these implants were purged for approximately twenty-five (25) minutes. On March 27, 2007, the four (4) soil vapor implants were sampled using one-(1) liter vacuum canisters. The vacuum canisters were allowed to collect soil gas from each implant for a minimum of two (2) hours, and a maximum of three (3) hours; none of the canisters drew in any (or enough) air for analysis. The purge pump was again connected to the implant tubing and the discharge from the pump checked for helium. Again the pump rates dropped to zero

(0) cc/min, indicating no soil gas drawn from the implant, and no helium was noted in the discharge from the pump. After a minimum of two (2) hours, the volume of soil vapor drawn into each cylinder at the four (4) sampling locations was insufficient to analyze the contents in the laboratory. The inability to draw soil vapor from any of the implants suggests that the clay soils are too tight to allow migration of vapors. On May 5, 2007, GTIH submitted the results of the attempted soil vapor sampling event in March 2007 with the conclusion that no threat was posed to neighboring residential properties and recommended that no further action concerning vapor studies was warranted.

On December 29, 2008, the NYSDEC and the New York State Department of Health (NYS DOH) informed GTIH, in writing, that they had reviewed the submitted Soil Intrusion Evaluation report for the GTIH Republic Landfill Site report, dated May 2, 2007. Furthermore, both agencies determined that the potential for soil vapor intrusion into neighboring homes and businesses had been satisfactorily evaluated and concurred with GTIH's recommendation that no further action is needed at this Landfill Site regarding soil vapor intrusion (see **Appendix I**). Therefore, no vapor intrusion monitoring program is included with this SMP.

3.3 Site Inspections and Records

Routine inspections of the facilities and controls at the Landfill Site are conducted and the results are documented by the GTIH-Designated Representative (refer to **Appendices A and B** for the standard weekly and quarterly inspection forms, respectively). The GTIH-Designated Representative is responsible for scheduling and managing the routine maintenance, repairs or any other actions needed to correct any deficiencies identified during these periodic inspections.

Details are provided below of the weekly and the quarterly inspection programs.

General Landfill and Site Security Inspections and Records - Weekly

The following areas are to be inspected once per week and the inspection results documented on the standard inspection form (See **Appendix A**).

1) Fence (general condition, evidence of security breaches).

2) Gate (general condition, lock, evidence of security breaches).

3) Cap (general condition, signs of erosion, adequate vegetation).

4) Surrounding area (general condition).

5) Note: should any evidence of a site security breach be found during the above inspections, the groundwater well installations will also be inspected for potential tampering or damage, and those inspections documented on the standard quarterly monitoring well inspection form (See **Appendix B**) .

Any noted deficiency will be identified on the inspection record and the corrective action documented on a subsequent inspection record when completed. Any fence areas that are found to be damaged will also be duly noted on the inspection map.

Groundwater Monitoring Well Inspections and Records - Quarterly

The GTIH-Designated Representative, or another contracted inspector, will inspect all the active on-site GTIH-owned groundwater monitoring well installations once a month to ensure they are kept in good condition and are properly secured with a lock. The inspector will record his/her name, the date and time of the inspection, the inspection results and any recommended corrective actions. (See **Appendix B**).

1) Closed locks on the well casing caps.

2) Outer casing.

3) Concrete seals.

Documentation of any needed corrective actions will be recorded on the subsequent inspection record when completed.

Copies of completed inspection forms will be made available for review during scheduled NYSDEC site inspections, or copies can be provided upon written request.

3.4 Routine Maintenance and Repairs

Repairs will be scheduled with outside contractor(s) as needed to ensure that any deficiencies discovered during the routine inspections are timely corrected.

Lawn mowing and other general care will be scheduled, as needed. The perimeter of the Landfill Site will typically be mowed a minimum of three (3) times per year or more frequently, if needed, depending on the amount of rainfall and other factors affecting the growing season. The capped area will be cut a minimum of once per year after September 1^{st}.

General clean-up of any debris along the fence line, etc. will be performed, as needed, to keep the Landfill Site clear of any objectionable or unsightly materials.

3.5 Record Retention

Inspection and maintenance records are stored off-site, as there is no adequate document storage facility at the Landfill Site. Completed weekly inspection forms for the requested period of interest will be made available to the NYSDEC for review during prescheduled site inspections. Copies of the inspection forms in electronic format will be made available to the state within ten (10) business days of receiving a written request from the NYSDEC. All inspection records will be retained for a minimum of three (3) years by GTIH, by the GTIH-Designated Representative, or by a document storage service facility under contract with GTIH.

4.0 SOIL EXCAVATION PLAN PROVISIONS

No soil excavation plan is included in this SMP because GTIH has no immediate plans or anticipates any future plans to excavate and/or remove soils from the Landfill Site. GTIH will prepare and submit a written Soil Excavation Plan to the NYSDEC for approval, no later than thirty (30) days prior to commencing such activities, should this situation change at any time in the future. This plan would address the particulars of the planned project, including the scope of work, safety measures to be implemented, etc. In the event of an unlikely and unforeseen emergency event that disturbs the soils on-site, such as a weather-related or another natural disaster, or that requires GTIH to disturb the soils on-site, GTIH would follow all applicable

OSHA regulations to protect the workers, would stage the removed soils as close to the excavation site as safely possible, and would contact the NYSDEC within forty-eight (48) hours of this event. The described procedure is consistent with GTIH's OM&M Manual that was approved by the state on November 4, 2009.

5.0 PROPERTY TRANSFER PROVISIONS

GTIH has no immediate plans or anticipates any future plans to either change the use of the Landfill Site or divest the Landfill Site, which might constitute a change in use of the site pursuant to state rules. However, should these circumstances change in the future, provisions will be made to timely transfer management responsibilities for the Landfill Site to the new owner, including the routine site inspections, and the required notifications and reports to the NYSDEC. GTIH will provide site related documentation to the new owner, including a copy of the approved SMP, with any proposed updates; the completed inspection reports; the last Periodic Reviews Report (PRR) submitted to the NYSDEC; and the signed IC/EC certification for the period of time between January 1st of the year of the transfer of ownership, and the property sale closing date. The new owner will be responsible for complying with all provisions of the SMP from the date of closing the sale transaction forward, including submittal of the PRR to the NYSDEC by the established due date for the calendar year in which the property is divested, and meeting the IC/EC certification requirements. NYSDEC will be notified within ten (10) business days* of a transfer of ownership.

Should the property transfer constitute a change in use of the Landfill Site pursuant to 6 NYCRR 375-1.11(d), NYSDEC will be notified at least sixty (60) days in advance of the change in ownership, including notification of GTIH's fulfillment of the applicable requirements outlined in this section of the SMP. The date of the change of ownership, the date of document transfer from GTIH to the new owner, and the change of use designation, if applicable, will be reported by the new owner in the first PRR submitted to the NYSDEC, following the closure of the sale transaction for the Landfill Site. Except for the specified time limit to notify NYSDEC of the property sale transaction, which was extended from five (5) to ten (10) business days*, the described procedure is consistent with GTIH's OM&M Manual that was approved by the state on November 4, 2009.

6.0 PERIODIC REVIEW AND REPORTING (PRR)

The Landfill Site management activities and documentation will be periodically reviewed and evaluated to confirm that they conform to the criteria outlined in this SMP. These evaluations will be documented in a Periodic Review Report (PRR) to be prepared and submitted annually to NYSDEC by the established deadline. The PRR will summarize the results of the site inspections and include a tabular summary of the groundwater monitoring data for the report period, including the parameters tested and the applicable standard test methods. Analytical data laboratory reports by sampling point, a chain-of-custody log and other documentation will be provided in a separate annual groundwater monitoring report, as further described below in this section.

The PRR will include a written IC/EC certification, in a reporting format approved by the NYSDEC, which is signed by a Qualified Environmental Professional (QEP), attesting that the established IC/EC are in place, are performing properly and have remained effective during the certification period. In the event such certification cannot be provided due to a failure of the established IC/EC, GTIH will timely notify the NYSDEC and submit a work plan and a schedule to implement appropriate corrective measures.

The PRR will also provide related conclusions and any recommendations for modification(s) to the IC/EC, and report on any corrective measures taken during the reporting period. If applicable, the PRR will document a change of use and/or a property transfer to a new owner, as set forth in chapter 6 of the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, dated May 2010 (or another applicable subsequent publication(s)).

If a property transfer and/or a change in use took place for the Landfill Site within the subject reporting year, the date of the change of ownership, the date(s) of document transfer from GTIH to the new owner, and the change of use designation, if applicable, will be reported by the new owner in the first PRR submitted to the NYSDEC following the closure of the sale transaction.

The annual PRR will be submitted to the NYSDEC, care of the Project Manager, for the certification period, i.e., the subject calendar year, by the due date stipulated by the state (typically within forty-five (45) days after issuance of the 45-Day Reminder Notice by the Albany office), or before any other reporting deadline stipulated by the NYSDEC by formal notification or via other written communication to GTIH’s Designated Manager for the Landfill

Site (including electronic forms). The PRR and required documentation, including a summary of the annual groundwater monitoring results and the IC/EC certification, will be provided both in print and in an electronic format acceptable to NYSDEC (currently a searchable PDF format). In addition, printed full copies of the annual PRR will be mailed to the following agencies and offices.

- Nr. Brian Sadowski (or his replacement)
  NYSDEC, Div. of Environmental Remediation, Region 9
- Mr. Michael Hinton (or his replacement)
  NYSDEC, Div. of Environmental Remediation, Region 9
- Mr. Matthew Forcucci (or his replacement)
  New York State Department of Health

In addition to the annual PRR, a separate annual groundwater monitoring report, including copies of the analytical data laboratory reports and chain-of-custody documentation, will be prepared and submitted in both print and electronically in a searchable PDF format to NYSDEC within ninety (90) days of the annual sampling event. The analytical data from the annual groundwater monitoring event will also be submitted electronically in a standardized electronic data deliverable (EDD) format that meets NYSDEC's published guidelines. In addition, printed full copies of the annual groundwater monitoring report will be mailed to the following agencies and offices.

A. <u>New York State DEC</u>

   a. Geologist II, Div. of Solid and Hazardous Materials (held by Ms. Mary E. McIntosh, Eng. as of the date of this SMP)

B. <u>Niagara County</u>

   a. Director Environmental Health (held by Mr. Jim Devald as of the date of this SMP)

C. <u>Town of Niagara</u>

   a. Town Clerk (held by Mrs. Sylvia Virtuoso as of the date of this SMP)

APPENDIX A - WEEKLY GENERAL LANDFILL AND SITE SECURITY INSPECTION REPORT

Date	Time	Inspector Name

ENCE ARE/	OK	DAMAGED	REPAIR DATE	REMARKS
A				
B				
C				
D				
E				
F				
G				
H				
I				
J				

GATE	OK	DAMAGED	REPAIR DATE	REMARKS
1				
2				
3				

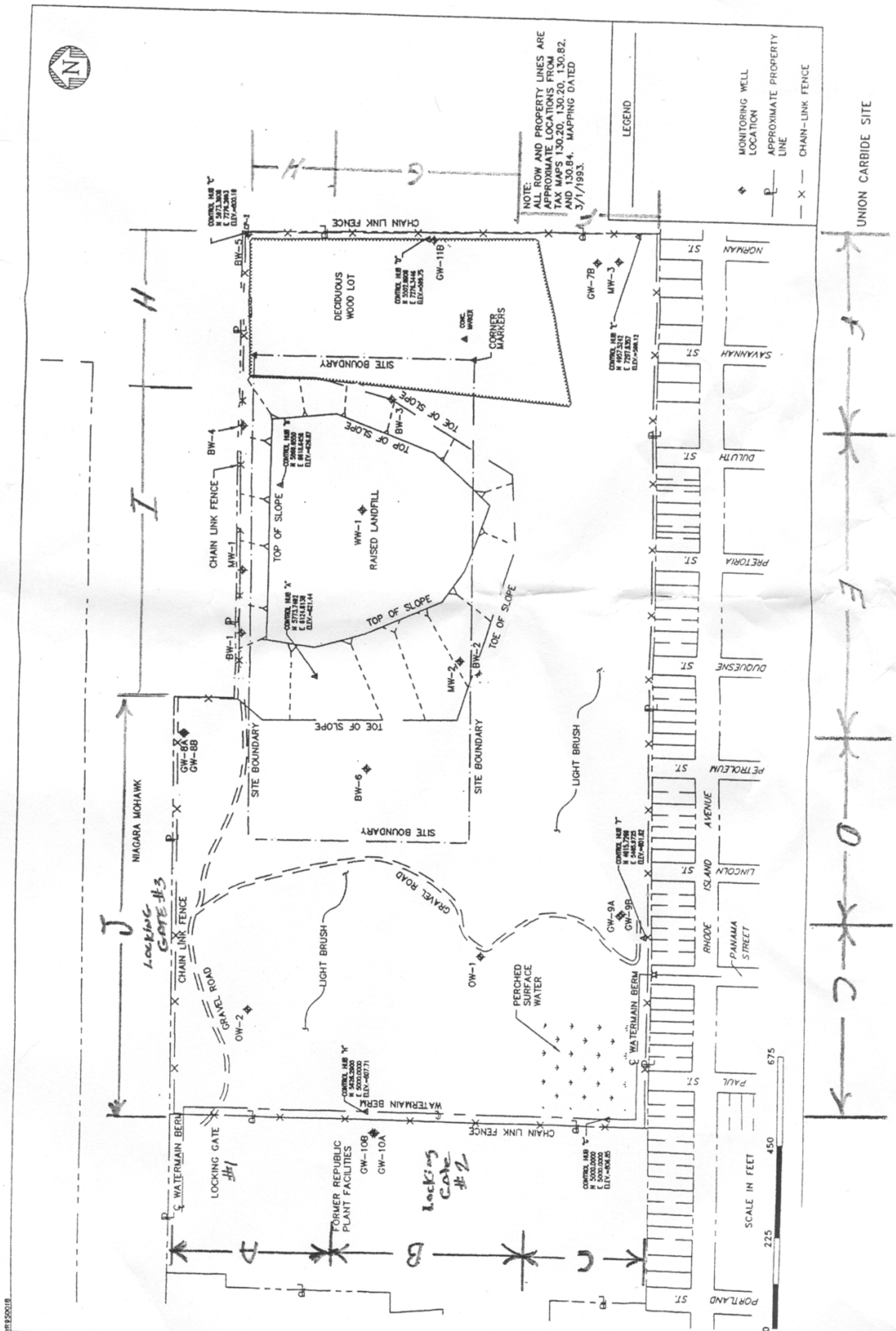
SECURITY-RELATED ENGINEERED CONTROLS COMMENTS: (Check for condition, damage, signs of security breach)

CAP COMMENTS: (Check for erosion and adequate vegetation)

SURROUNDING AREA COMMENTS: (Check for condition, damage, signs of security breach)

RECORD THE DATE(S) THAT THE ENTIRE CAP WAS MOWED:______________________

IN THE EVENT THAT ANY SIGN OF A SITE SECURITY BREACH IS IDENTIFIED DURING THE ABOVE SITE INSPECTIONS, COMPLETE A FULL GROUNDWATER MONITORING WELL INSPECTION AND DOCUMENT RESULTS USING THE QUARTERLY GROUNDWATER WELL INSPECTION REPORT FORM (APPENDIX B) AND ATTACH TO THIS FORM.



NOTE: ALL ROW AND PROPERTY LINES ARE APPROXIMATE LOCATIONS FROM TAX MAPS 130.20, 130.20, 130.82, AND 130.84. MAPPING DATED 3/1/1993.
LEGEND
MONITORING WELL LOCATION
APPROXIMATE PROPERTY LINE
CHAIN-LINK FENCE
UNION CARBIDE SITE
CHAIN LINK FENCE
DECIDUOUS WOOD LOT
CORNER MARKERS
SITE BOUNDARY
TOE OF SLOPE
TOP OF SLOPE
RAISED LANDFILL
WW-1
BW-1
BW-2
BW-3
BW-4
BW-5
BW-6
MW-1
MW-2
MW-3
GW-7B
GW-8A
GW-8B
GW-9A
GW-9B
GW-10A
GW-10B
GW-11B
OW-1
OW-2
LIGHT BRUSH
GRAVEL ROAD
NIAGARA MOHAWK
PERCHED SURFACE WATER
WATERMAIN BERM
LOCKING GATE #1
Locking Gate #2
Locking Gate #3
FORMER REPUBLIC PLANT FACILITIES
NORMAN ST.
SAVANNAH ST.
DULUTH ST.
PRETORIA ST.
DUQUESNE ST.
PETROLEUM ST.
LINCOLN ST.
RHODE ISLAND AVENUE
PANAMA STREET
PAUL ST.
PORTLAND ST.
SCALE IN FEET
0
225
450
675

APPENDIX B - QUARTERLY GROUNDWATER WELL INSPECTION REPORT

GRAFTECH WELLS

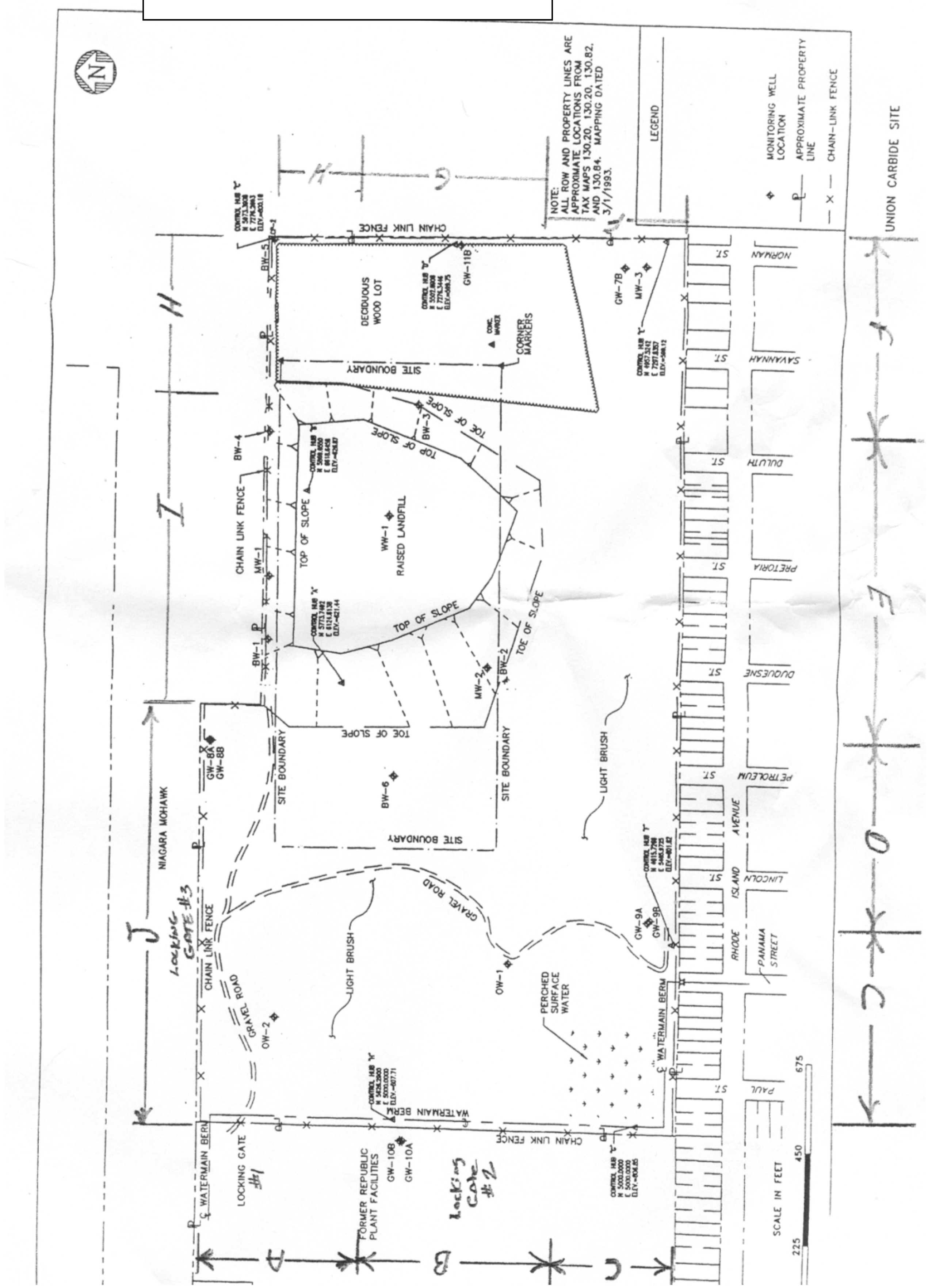
WELL I.D. NUMBER	WELL I.D. TAG INTACT (YES/NO)	LOCK CONDITION	OUTER CASING CONDITION	CONCRETE SEAL CONDITION	COMMENTS
MW1-78					
MW2-78					
MW3-79					
BW1-86					
BW2-86					
BW3-86					
BW4-86					
BW5-86					
BW6-86					
WW1-86					
OW1-88					
OW2-88					

ON-SITE WELLS INSTALLED BY NYSDEC

(Installed Sept./Oct. 93)

WELL I.D. NUMBER	WELL I.D. TAG INTACT (YES/NO)	LOCK CONDITION	OUTER CASING CONDITION	CONCRETE SEAL CONDITION	COMMENTS
GW7B-93					
GW8A-93					
GW8B-93					
GW9A-93					
GW9B-93					
GW11B-93					

APPENDIX B MAP



APPENDIX C

New York State Department of Environmental Conservation
Division of Solid and Hazardous Materials, Region 9
270 Michigan Avenue, Buffalo, New York, 14203-2999
Phone: (716) 851-7220 • **FAX:** (716) 851-7226
Website: www.state.ny.us

John P. Cahill
Commissioner

January 18, 2000

Mr. Robert Bucci
Site Manager
UCAR Carbon Company Inc.
P.O. Box 887
Niagara Falls, New York 14302-0887

Dear Mr. Bucci:

UCAR Republic Solid Waste
Management Facility #32N03

Thank you for your letter of October 25, 1999 regarding the monitoring program at the UCAR closed Republic Landfill. As you are aware, both the Division of Solid Materials and the Division of Environmental Remediation have wells on the site and an interest in the post-closure monitoring program. Mr. Michael Hinton of the Division of Environmental Remediation and I met to discuss how the concerns of both programs can be met in a monitoring program that will be both efficient and comprehensive. We are requesting that the following program be implemented:

1. Sample all of the on-site wells once initially (wells GW-7B, GW-8A, GW-8B, GW-9A, GW-9B, GW-10A, GW-10B, GW-11B under the Environmental Remediation program, and wells BW-1, BW-2, BW-3, BW-4, BW-5, BW-6, MW-1, MW-2, MW-3 under the Solid Materials Program for Part 360 baseline volatile organics using method 8260.

2. If volatile organics are not detected in the Environmental Remediation Program wells, eliminate all of them except well GW-9B from the monitoring program.

3. Perform semi-annual (twice yearly) sampling at wells BW-1, BW-2, BW-3, BW-4, BW-5, BW-6, MW-1, MW-2, MW-3 and GW-9B, as indicated on the attached table.

This program will satisfy the monitoring concerns of both programs and represents a reduction from the quarterly program now being conducted at the site. If you have any questions, or wish to meet to discuss this proposal further, please contact me at 851 7220. Thank you.

Yours truly,

Mary E. McIntosh
Engineering Geologist II

MEM:lj

Attachment

cc: Mr. Mark Hans, Regional Solid Materials Engineer
Mr. Michael Hinton, Environmental Engineer II

a:bucci.mem

NEW YORK STATE CENSUS 2000
BE PART OF THE COUNT
SEA PARTE DE LA CUENTA

LANDFILL SITE MANAGEMENT PLAN FOR SWMF #32N03 (REGISTRY NO. 932035)

APPENDIX D

New York State Department of Environmental Conservation
Division of Solid and Hazardous Materials, Region 9
270 Michigan Avenue, Buffalo, New York, 14203-2999
Phone: (716) 851-7220 • **FAX:** (716) 851-7226
Website: www.dec.state.ny.us

Denise M Sheehan
Commissioner

September 20, 2005

Mr. James K. Kay, P. Eng.
Conestoga-Rovers and Associates
23271 George Urban Blvd.
Depew, New York 14043

Dear Mr. Kay:

UCAR Carbon Landfill
#32NO3

This office has reviewed your submission of July 27, 2005 in support of a reduction in the monitoring program for the closed UCAR Carbon Landfill. You have requested, on behalf of the company, a reduction to annual sampling in four wells for volatile organics only. The following comments have been generated by myself as a representative of the Division of Solid and Hazardous Materials, and Mr. Michael Hinton of the Division of Environmental Remediation (please note that our respective divisions were reversed in the report):

1. The report does not contain the correct class GA standards for several parameters. In Table 3 the standard for iron is listed as 300 mg/l, but it is really 300 ug/l or .3 mg/l. The standard for zinc is listed as 300 mg/l but it is really 2000 ug/l or 2 mg/l. The standard for ammonia is listed as no standard, but the standard is 2000 ug/l or 2 mg/l. Because of the incorrect standards applied, several of the conclusions from the review of the monitoring data are erroneous. For example, the report states that in 6 of the 11 wells currently monitored, the concentrations of constituents of concern are currently lower than the water quality criteria cited. In reality, most of the wells exhibit elevated levels of one or more of the parameters. Many of the wells exhibit elevated levels of iron (MW-1, MW-3, GW-8B, GW-9B, BW-1, BW-2, BW-3, BW-4, BW-5, and BW-6). Ammonia is elevated in wells MW-1 and BW-4. Zinc is elevated in wells BW-1 and BW-4.

2. The Division of Environmental Remediation investigated the area north of UCAR for other sources of the contaminants detected in wells along the north property boundary, and no alternate source was found. The Division of Environmental Remediation sent a copy of this report to UCAR.

3. The report notes that vinyl chloride was detected in well BW-3 up to 26 ug/l, but this value is not shown in Table 3. What was the sampling date on which this level was recorded?

4. The report states that the concentration of cis-1,2-DCE has ranged between 20 and 27 ug/l. Table 3 shows that a concentration of 14 ug/l was recorded.

5. Due to the incorrect groundwater standards used in the evaluation of the data, we do not agree with Conestoga-Rovers conclusions that only 4 wells exhibit consistent presence of compounds of concern at concentrations exceeding water quality criteria, with these compounds limited to volatile organics. Therefore we cannot agree to Conestoga-Rovers proposed changes in the monitoring program. The Department will allow a reduction in the frequency of monitoring to annual for the following wells: BW-1, BW-2, BW-3, BW-4, MW-3, GW-8B, and GW-9B. These wells must be sampled for the same list of parameters currently sampled for at the site (Part 360 volatiles, ammonia, iron (total and soluble), potassium (total and soluble), zinc (total and soluble), nitrite, TKN, turbidity, groundwater elevation, pH, specific conductance, and temperature. The timing of the annual sampling shall be rotated yearly between spring and fall, so that one year sampling will be done in the spring, and the next year it will be done in the fall. A sampling event must occur in every calendar year.

If you have any questions on the program hereby approved by the Department, please contact me at (716) 851-7220.

Yours truly,

Mary E. McIntosh

Mary E. McIntosh, C.P.G.
Engineering Geologist II

MEM:dcg
mcm\kay.ltr

cc: Mr. Mark Hans, Regional Solid Materials Engineer
Mr. Michael Hinton, Environmental Engineer II
Mr. Robert Bucci, UCAR
Ms. Carol Barron, Conestoga-Rovers

APPENDIX E

CONESTOGA-ROVERS
& ASSOCIATES

2371 George Urban Blvd., Depew, New York 14043
Telephone: 716-206-0202 Facsimile: 716-206-0201

November 4, 2005

Reference No. 5513

Ms. Mary E. McIntosh, C.P.G.
Engineering Geologist II
NYSDEC
270 Michigan Avenue
Buffalo, New York 14203-7226

Dear Ms. McIntosh:

Re: Responses to NYSDEC Comments Dated September 20, 2005
UCAR Republic SWMP No. 32N03

The enclosed responses to NYSDEC comments dated September 20, 2005, regarding the post-closure monitoring program review for the above-referenced site are being submitted by Conestoga Rovers & Associates on behalf of UCAR Carbon Corporation. Included with the responses is a groundwater analytical data table showing the corrected groundwater quality criteria as cited in the comment letter.

It is our understanding from the comment letter that the approved modified monitoring program consists of the following:

> Annual sampling of seven wells (BW-1, BW-2, BW-3, BW-4, MW-3, GW-8B, and GW-9B) with analysis of the samples for Part 360 volatiles, ammonia, iron (total and soluble), potassium (total and soluble), zinc (total and soluble), nitrite, TKN, turbidity, groundwater elevation, pH, specific conductance, and temperature. Monitoring will be rotated between the spring and fall seasons such that one year sampling will be conducted in the spring and the next year it will be conducted in the fall. Sampling will be conducted once in each calendar year and reporting will be submitted annually following receipt and review of the groundwater analytical data.

The next monitoring event will be conducted in the fall of 2006.

Yours truly,

CONESTOGA-ROVERS & ASSOCIATES

Carol Barron for

James K. Kay, P. Eng.

JKK/dl/13
Encl.

c.c.: M. Hans, NYSDEC
M. Hinton, NYSDEC
R. Bucci, UCAR
C. Barron, CRA

APPENDIX F

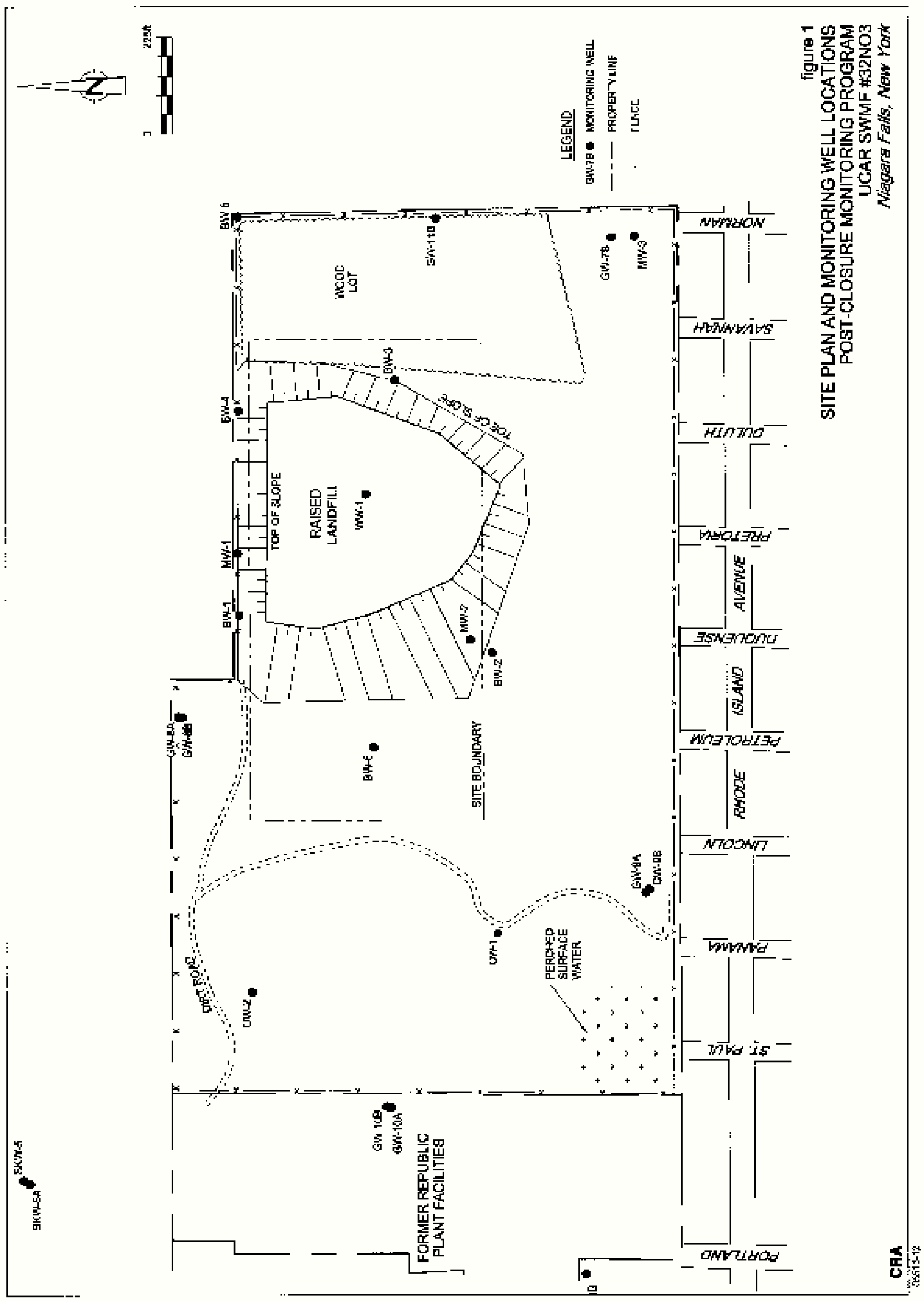


figure 1
SITE PLAN AND MONITORING WELL LOCATIONS
POST-CLOSURE MONITORING PROGRAM
UCAR SWMF #32N03
Niagara Falls, New York
LEGEND
MONITORING WELL
PROPERTY LINE
FENCE
WOOD LOT
RAISED LANDFILL
TOP OF SLOPE
TOE OF SLOPE
SITE BOUNDARY
PERCHED SURFACE WATER
DIRT ROAD
FORMER REPUBLIC PLANT FACILITIES
NORMAN
SAVANNAH
DULUTH
PRETORIA
AVENUE
DUQUENSE
ISLAND
PETROLEUM
RHODE
LINCOLN
PANAMA
ST. PAUL
PORTLAND
CRA

6. Wrap samplers in aluminum foil to prevent contamination.

Caution: *Check the QAPP to confirm the cleaning protocol. Use of incorrect cleaning protocol could invalidate chemical data.*

7.6.1 PURGE WATER AND DECONTAMINATION FLUID DISPOSAL

Project-specific disposal methods for purged groundwater and decontamination fluids are determined by the Project Manager during the sampling program's planning and preparation stage (see Section 7.3), but may include:

1. Off-site treatment at private treatment/disposal facility or publicly owned treatment facilities (sanitary sewer)
2. On-site treatment at a client-operated facility
3. Direct discharge to the surrounding ground surface, allowing infiltration to the underlying subsurface
4. Direct discharge to an impervious pavement surface allowing for evaporation

Options 3 and 4 are permitted only after careful review of these practices and the anticipated site conditions. Under no circumstances shall CRA personnel aggravate an existing condition or spread contamination into clean areas.

Decontamination fluids (specifically cleaning solvents/acids) are segregated and collected separately from wash water and purge water. Often small volumes of solvents used during the course of a groundwater, residential, or surface water sampling program will evaporate if left in an open pail. If evaporation is not possible, off-site disposal need to be arranged.

7.7 FIELD PROCEDURES FOR GROUNDWATER SAMPLING

The typical series of events that takes place for a groundwater sampling program is:

1. Well identification and inspection
2. Air monitoring
3. Water level monitoring
4. Well depth sounding
5. Well volume calculation
6. Purging and sampling equipment installation
7. Well purging and stabilization monitoring
8. Sample collection, sample preparation, completion of chain-of-custody, (COC) sample packaging

9. Final water level monitoring (if required), purging, sampling equipment removal, secure the well
10. Equipment decontamination
11. Field note completion and review
12. Sample shipment and COC distribution
13. Purged groundwater and decontamination fluid disposal
14. Sample record documentation, equipment return
15. Completion and distribution of appropriate forms

It is recommended that new plastic sheeting be placed on the ground around the well to prevent contamination of purging and sampling equipment and accessories (e.g., pumps, hoses, rope.).

7.7.1 WELL IDENTIFICATION AND INSPECTION

At sites with numerous wells or wells nests, misidentification of wells has occurred. The CRA representative must be alert to the possibility of potential cap switching, mislabeled wells, or unlabeled well locations.

Determine proper well location and identification by comparing the well log details to the measured well depths (i.e., total well depth, casing diameter, casing stick-up, or stick-down distances), field tie-ins, and site plan.

Once well identification has been established, complete a thorough well inspection:

1. Determine if the well cap and lock are secure, and check for vandalism
2. If no lock is present, dedicate a new lock to the well location
3. Examine the integrity of the surface seal
4. Check for cracks, evidence of frost heave, or subsidence in the vicinity of the well
5. Examine the integrity of the protective casing. Ensure that the casing can be closed and locked
6. If required, re-label the well to assist in future identification
7. If the well is installed with dedicated sampling equipment, check for cracks or leaks in tubing, and worn or frayed rope
8. Record all the well inspection details in the field book to document well conditions and suitability for groundwater sampling activities
9. Forward the well inspection results to the Project Coordinator, especially if repairs are required

7.7.2 AIR MONITORING

Prior to removing a well cap, measure the breathing space above the well with a photoionization detector (PID) to establish background of undifferentiated organic vapor levels. Repeat this process once the well cap has been removed. If either of the PID levels exceed the air quality criteria established in the HASP, air-purifying respiratory (APR) protection or a supplied air system is required. Also take a PID reading inside the riser pipe. This PID reading is a good indication of elevated chemical or non-aqueous phase liquids (NAPL) presence. Report all elevated PID levels to the Project Coordinator immediately to determine if additional health and safety and personnel protective equipment is required. The HASP will provide the required action levels and PPE.

7.7.3 WATER LEVEL MONITORING/WELL DEPTH SOUNDING

Prior to commencing well purging and groundwater sampling, the water level is measured for hydraulic monitoring and to determine the well volume. Typically, a complete round of water level measurements is taken at a site to establish groundwater conditions prior to initiating well purging or groundwater sampling activities.

A watertight cap provides an airtight seal on the casing and the water level positioned in the casing area. The cap creates a vacuum or pressurized condition in the casing section which can support or depress the water column in the well casing. This can produce an artificially high or low water level in the well casing. This effect can cause a few inches or feet of error in the static water level. Once the cap is removed, allow the pressure to stabilize for about a half hour. Measure the water level frequently to ensure that stabilization of the water level has occurred. Once the water level has stabilized (i.e., is static) the correct water level may be measured.

A number of instruments are available to measure groundwater levels. CRA typically uses:

- Battery-operated water level indicators (i.e., audible and/or visual identification of water level)
- Battery-operated oil/water interface probes (i.e., audible and/or visual identification of water levels and presence of NAPL)
- Electronic transducers (numerous manufacturers) and recording devices for long-term hydraulic monitoring
- Stevens™ recorders (both float and electronic instrumentation) for long-term hydraulic monitoring

Section 8.0 describes in detail the equipment and monitoring techniques for water level measurements.

Well depth sounding is often required to confirm well identification, evaluate the accumulation of sediment in the well bottom, or assist in determining the standing well volume. Sounding is performed using a water level indicator or a measuring tape with a weighted end. The water level indicator or weighted tape is lowered to the bottom of the well and a comparison is made of the installed well depth versus the measured well depth. The presence of excessive sediment or drill cuttings may warrant redevelopment of the well prior to well purging and groundwater sampling activities.

The total well depth is compared to the original installed total well depth. If the well screen is more than 50 percent blocked by accumulated sediment, the well is redeveloped prior to the next groundwater sampling event. Report all wells requiring redevelopment to the Project Coordinator. Well depth sounding is performed on an annual or biannual basis if the well is equipped with a dedicated pump.

For LFP, well depth measurement is performed to ensure proper pump intake placement. The used of a wide-based probe, such as a weighted tape, is necessary to minimize penetration and disturbance of accumulated sediment. The measuring device is lowered slowly through the water column to the well bottom to minimize mixing of the stagnant well casing water and disturbance of sediment.

Note:	*Don't forget that decontamination procedures apply to the water level monitoring equipment as well as the groundwater sampling equipment. If well sounding is performed, the entire measuring device must be thoroughly decontaminated prior to re-use. Measuring the well depth with certain water level indicators may damage the probe seal. Therefore, a tape with a weighted end should be used to measure well depth.*

7.7.4 WELL VOLUME CALCULATION

Prior to commencing well purging, the volume of water in the well must be known to determine the volume of groundwater to be removed. A well volume is defined as the volume of water contained in the well screen and casing (and in the case of an open bedrock hole, the volume of water in the open corehole and possibly in the well casing). To determine the standing water volume in a well:

1. Calculate the distance from the bottom of the well to the static water level.
2. Measure the inside diameter of the well or casing. Obtain the volume of standing water in the well using the following formula:

   $$V = \pi r^2 h \text{ (7.48 U.S gallons/cubic feet) (1 liter/1,000 cubic centimeters)}$$

   where:

   V = volume of water in gallons or liters
   π = 3.142
   r = radius of well casing (feet or meters)
   h = depth of water column in the well (feet or meters)

Typical 1-Foot Casing Volumes	
Diameter (inches)	*Gallons (U.S.) of Water Per Foot of Casing*
1.5	0.09
2	0.16
3	0.37
4	0.65
6	1.47

Typical 1 Meter Casing Volumes		
Diameter		*Litres per Meter of Casing*
(inches)	*(cm)*	
1.5	3	1.14
2	5	2.02
3	8	4.56
4	10	8.11
6	15	18.24

7.7.5 WELL PURGING AND STABILIZATION MONITORING

7.7.5.1 TYPICAL METHOD

Prior to initiating groundwater sample collection, the wells is purged of the standing stagnant groundwater volume. This volume is not representative of the groundwater in the hydrostratigraphic unit. Purging is performed until the water in the well is representative of the actual conditions in the hydrostratigraphic unit. Stabilization is usually achieved by the removal of three to five times the volume of standing water in the well (USEPA convention). Purging is considered complete once purged groundwater is free of sediment and field parameters including specific conductance, temperature, and turbidity are stable. Stabilization is achieved when field measurements for specific conductance and temperature are within a range of plus or minus 10 percent of the average for the last three readings. Field measurement for pH should be within a range of plus or minus 0.1 pH unit of the average for the last three readings, and groundwater turbidity values should be less than 5 nephelometric turbidity units (NTU) (guidance value only). Once the number of well volumes required to achieve stabilization is established, the volume required to reach stabilization for future sampling events is reduced or eliminated. Extended purging of a well will generally result in achieving sediment-free groundwater conditions.

During purging, if stabilization has not occurred after removal of five well volumes, purging is continued until ten well volumes have been removed. If stabilization still has not been achieved, stabilization may be dropped as a pre-condition to groundwater sampling. The Project Coordinator should be notified that stabilization has not occurred after the removal of ten well volumes.

At high yielding wells, removing three to five well volumes is usually sufficient prior to initiating groundwater sampling. For low yield wells (i.e., wells that pump dry after one well volume) it is necessary to purge the well dry on three successive days, unless the well recovers to full static conditions in a shorter time. If the recharge is relatively high, groundwater sampling will be initiated once the well has fully recovered to static groundwater conditions, or to a level that is sufficient to collect the necessary groundwater sample volume.

Note:	*Purging of dry wells should be scheduled to begin on Monday or Tuesday, to reduce weekend requirements.*

Turbidity of purged groundwater is evaluated by a visual examination for sediment/silt presence or by using a nephelometer which physically measures groundwater turbidity in NTUs. Generally, a turbidity value of 50 NTU or less is acceptable, although some regulatory agencies have established lower criteria (i.e., less than 5 NTU). If 50 NTU is not achieved, filtration of samples may be required. LFP can generally result in turbidity values less than 5 NTU.

Note:	*Agitation of the water column within the well will increase turbidity. Therefore, bailers and inertia pumps (Waterra™) are of limited use for collecting sediment-free samples. The tubing of peristaltic pumps must be secured to prevent movement of the tubing within the water column which would disturb sediment. The best method to reduce sediment disturbance is low-volume non-agitation pumping (i.e., bladder pump).*

Well purging is accomplished using dedicated equipment or by using either peristaltic, bladder, or other approved purging methods. Purging and sampling equipment are dependent on the total well depth. Bailing can be used for well purging but this method stirs up sediment and increases the purging effort required before stabilization is achieved. Equipment available for well purging is discussed in Section 7.7.7. Monitoring equipment used during well purging includes a water level indicator, pH meter, thermometer, conductivity meter, and turbidity meter.

7.7.5.2 PURGING ENTIRE WATER COLUMN

The purging equipment is lowered into the top of the standing water column. Well purging is completed from as close to the top of the water column as possible, not from the well bottom, unless poor well recovery occurs. Purging from the top of the water column moves water from the formation through the well screen of the well and into the well casing. This allows for the entire static volume to be removed. Purging at depth in the water column does not remove water above the pump intake and results in the collection of unrepresentative samples.

If required, the pump intake can be adjusted. If the recovery rate is greater than the pumping rate, the pump should remain suspended until the required purged volume has been removed. If the recovery rate is less than the pumping rate, the pump should be lowered to ensure the removal of the required well volume.

7.7.5.3 LOW-FLOW PURGING (LFP) TECHNIQUE

LFP purging results in minimal drawdown during well purging, so less purging is required before formation water is removed. The volume required for purging using LFP is significantly reduced. LFP results in less agitation and mobilization of sediments compared to traditional sampling techniques.

A pre-cleaned stainless steel bladder pump equipped with a Teflon™ bladder is strongly recommended for LFP. The discharge line should be polyethylene or Teflon™ lined tubing with an inside diameter of 1/4 or 3/8 inch (6 or 10 mm). Check the Work Plan or QAPP to ascertain the proper bladder and discharge tubing. Smaller discharge tubing ensures that the tubing remains filled with water and reduces air bubbles at low purging rates. The airline to the pump is generally 1/4-inch (6 mm) inside diameter polyethylene tubing. The pump is secured to nylon rope and positioned in the well so that the pump intake is set at the mid-point of the well screen, or a minimum of 2 feet (0.6 m) above the bottom of the well or accumulated sediment level. It is important that the rope, airline, and discharge tubing are measured prior to installation in the well. The bladder pump and tubing are lowered very slowly through the water column to minimize mixing of the stagnant well casing water and to minimize the agitation of sediment into suspension, which would increase the purging time. It is recommended, and in some instances regulated, that pump installation occurs at least 24 hours prior to initiating LFP. It is recommend that a bladder pump be dedicated to the well for regular monitoring events.

During LFP, the pumping rate should be between 100 and 500 milliliters per minute (mL/min). It is recommended that initial pumping be conducted at a lower rate to limit drawdown in the well. During purging, groundwater levels are measured to maintain a maximum 0.4 foot (0.1 m) of drawdown. The pumping rate can be gradually increased during LFP. Pumping rate increases will be dependent on the drawdown and the stabilization of field parameters discussed below. Pumping rate adjustments should occur in the first 15 minutes of purging. After this time the pumping rate should remain constant and flow rate adjustments should be avoided. During purging, the pumping rate and groundwater level should be measured at least every 10 minutes. It is recommended that water level measurements occur at 5-minute intervals.

During LFP, stabilization of the purged groundwater is required to ensure the collection of representative groundwater samples from the formation and not from the stagnant water in the well casing. Field parameters including pH, temperature, specific conductance, oxidation-reduction potential (ORP), dissolved oxygen (DO), and turbidity should monitored during LFP. The measurement of these field parameters is used to evaluate if stabilization of the purged groundwater has occurred prior to the collection of groundwater samples. The field measurements should be measured and recorded at 5-minute intervals. Groundwater stabilization is considered achieved when three consecutive readings for each of the field parameters, taken at 5-minute intervals, are within the following limits:

- pH ±0.1 pH units of the average value of the three readings
- temperature ±3 percent of the average value of the three readings

- conductivity ±0.005 milliSiemen per centimeter (mS/cm) of the average value of the three readings for conductivity <1 mS/cm and ±0.01 mS/cm of the average value of the three readings for conductivity >1 mS/cm
- ORP ±10 millivolts (mV) of the average value of the three readings
- DO ±10 percent of the average value of the three readings
- turbidity ±10 percent of the average value of the three readings, or a final value of less than 5 NTU

During LFP, field parameters are measured using a flow-through cell apparatus. At the start of LFP the purge water is visually inspected for clarity prior to connecting to the flow-through cell. If the purge water is turbid, LFP continues until the purge water is visually less turbid prior to connecting to the flow-through cell. Field parameters may be obtained using individual meters or a multiple meter unit; however, the use of a flow-through cell is highly recommended. All meters must be calibrated daily in accordance with the manufacturer's and CRA's calibration instructions, and a calibration record maintained in a standard CRA field book.

During LFP the meter readings are monitored for evidence of meter malfunction. The following are common indicators of meter malfunctions:

- DO above solubility (e.g., oxygen solubility is approximately 11 milligrams per liter (mg/L) at 10°C) may indicate a DO meter malfunction
- negative ORP and DO less than 1 to 2 mg/L may indicate either an ORP or a DO meter malfunction (i.e., should have positive ORP and DO less than 1 to 2 mg/L under oxidizing conditions)
- positive ORP and DO less than 1 mg/L may indicate either an ORP or a DO meter malfunction (i.e., should have a negative ORP and DO less than 1 mg/L under reducing conditions)

Meter calibration fluids should be available for meter recalibration in the field. Spare meters should also be available for meter replacement if necessary.

Note: DO levels exceeding the solubility of oxygen in water are erroneous and are indicative of meter malfunction or poor sampling techniques causing turbulence and aeration. DO concentrations cannot exceed:
9 mg/L at 20°C 10 mg/L at 15°C 11 mg/L at 10°C 14 mg/L at 1°C

Stabilization will be considered complete when the field parameters have stabilized as indicated in the above table. Purging will continue if stabilization does not occur, until a maximum of 20 screen volumes has been removed. LFP causes groundwater to be drawn from a significant distance above or below the pump intake. Therefore, the screen volume is based on a 5-foot (1.5 m) screen length. After the removal of 20 screen volumes, purging will continue if the purged water remains visually turbid and appears to be clearing. Also purging will continue if the field parameters vary only slightly outside of the stabilization criteria and appear to be approaching stabilization.

If the recharge to the well is insufficient to conduct LFP, the well should be pumped dry and allowed to recharge sufficiently for the collection of the groundwater sample volume. Wells purged dry are required to meet the stabilization criteria detailed above.

7.7.5.4 SAMPLING TECHNIQUES

Upon completion of purging, with groundwater stabilization and clarity meeting the applicable protocol described above, groundwater sample collection can proceed. Generally the field parameters of pH, temperature, and specific conductance are monitored first, then any other required field measurements.

Samples are collected directly from the purging pump, when possible, or an alternate device (i.e., pump or bailer) may be installed or used. If new sampling equipment is installed, the first few bails or discharge volumes should be discarded to allow acclimation of the sampling equipment with the groundwater.

Samples are typically collected from the pump or bailer with the discharged groundwater collected directly in the appropriate sample containers. The interior of the bottle or cap must not be touched or handled in anyway. New gloves (i.e., disposable nitrile gloves or equivalent) should be worn for the collection of each sample. Caps from sample bottles must not be placed on the ground or in pockets to eliminate the possibility of cross-contamination.

Descriptions of the various equipment and sampling methods for the collection of groundwater samples are contained in Section 7.7.7.

The following describes the main activities involved in the collection of groundwater samples.

7.7.5.5 ORDER OF SAMPLE COLLECTION

Groundwater samples are collected and containerized in the order following volatilization sensitivity:

1. VOCs
2. Semi-volatile organic compounds (SVOCs)
3. Total organic carbon
4. Total organic halides
5. Extractable organics
6. Total metals
7. Dissolved metals
8. Phenols
9. Cyanide

10. Sulfate and chloride
11. Nitrate and ammonia
12. Microbiological parameters
13. Radionuclides

QA/QC requirements for groundwater sampling are described in detail in Section 3.9.

7.7.6 SAMPLE ACQUISITION AND TRANSFER

If groundwater sample collection is performed using a pump, the flow rate must not exceed 100 mL/min during the collection of groundwater samples for VOCs. The low flow rate will reduce the possibility of degassing samples. During the collection of groundwater into the sample container or filtration device, minimize agitation and aeration of the sample. Groundwater samples are transferred directly into the sample container for submittal to the laboratory. Groundwater samples should not be collected in larger containers and subsequently transferred to smaller sample containers; however, on occasion this will be required for filtration or sample composting. During VOC sample collection, samples must not be collected, handled, or containerized near or in the vicinity of a running motor or exhaust which may contaminate the samples.

Groundwater samples for VOCs are collected in laboratory supplied 40 mL glass vials. The vials are filled to the top until a meniscus is formed, then topped with a Teflon™-lined cap. To prevent the loss of volatiles, it is important that no air bubbles or headspace are present in the sample container. Inverting and tapping the vial will check for the presence of air bubbles. If air bubbles are present, the sample should be topped off again and resealed. This process may only be performed a maximum of twice, at which time the sample must be discarded and the sample retaken. If preservatives were present in the bottle from the laboratory, a new sample vial must be used.

Note: Gas bubbles that appear in VOC containers after sample collection may be a result of degassing or reaction with preservative. If this occurs, note this occurrence on the chain-of-custody. Re-sampling is not required in most cases.

During sample collection ensure groundwater samples are preserved according to laboratory requirements. If required and supplied by the laboratory, preserve the samples in accordance with the QAPP. Some laboratories pre-preserve bottles so that once the groundwater sample is added the preservation is completed. In either case, it is advisable to check sample preservation using litmus paper. Using litmus paper ensures that groundwater sample preservation has been completed to the proper pH as required by the QAPP. If preservation of a sample does not meet the requirements of the QAPP, it may be necessary to add additional preservative, or note on the chain-of-custody that incomplete sample preservation has occurred.

Once sample collection is complete, samples are placed in a cooler on ice to maintain a sample temperature no more than 4°C.

7.7.6.1 SAMPLE LABELS/SAMPLE IDENTIFICATION

Label all groundwater samples with the following, written in indelible ink

1. A unique sample number (see Section 3.9 for guidance)
2. Date and time
3. Parameters to be analyzed
4. Job number
5. Sampler's initial

Secure the label to the bottle. It is recommended that bottle labels be covered with wide clear tape to protect the label during sample packing and shipment. Pack glassware in appropriate packing material to deter breakage during sample packing and shipment. Sample labels can be prepared in advance in CRA offices that have label-generating programs.

An example of a groundwater sample log entry is provided on Figure 3.8.

Section 3.9 details sample labeling requirements for environmental sampling programs. Section 3.9 also details COC requirements and sample shipment requirements.

7.7.7 PURGING/SAMPLING EQUIPMENT

CRA maintains a wide variety of purging and sampling equipment for well purging and groundwater sample collection. The groundwater sampler should be familiar with purging and sampling equipment and understand equipment limitations and proper use. Some equipment is very useful for well purging (i.e., high flow rates) but is not permissible for LFP or for sampling sensitive parameters (e.g., VOCs cannot be collected with a submersible (turbine) or suction pump). If the groundwater sampler understands the various equipment operation and limitations, the proper selection of purging and sampling equipment is made, which will minimize the purging and sampling duration and maximize productivity.

> ***Caution:*** *Gas powered equipment requires special attention to ensure that staff hauling these units do not cause equipment or sample contamination. Frequent changes of disposable glove as well strict separation of sampling crew tasks (i.e., those handling pumps and hoses do not contact generator or are involved in any refueling activities) are required.*

The following subsections describe the equipment available for groundwater sampling, the equipment use, approximate flow rates, and advantages and disadvantages of the equipment.

7.7.7.1 PERISTALTIC PUMPS

A peristaltic pump is acceptable for purging wells and for most groundwater sample analytes. The groundwater sampler must ensure that a peristaltic pump is acceptable to regulatory agencies with local jurisdiction for VOC and SVOC sample collection. The QAPP will provide sampling requirements.

A peristaltic pump is capable of lifting water from a maximum depth of 25 feet (7.6 m) below ground surface or the pump, whichever is greater. A peristaltic pump is a self-priming, low volume, suction pump which consists of a rotor with ball bearing rollers. Flexible silicon tubing is inserted around or in the pump rotor and squeezed in place by the heads as they revolve in a circular pattern. The section of silicon tubing must not exceed 3 feet (0.9 m) in length. Additional rigid polyethylene or Teflon™ tubing is attached to the flexible tubing and placed in the well. Another piece of rigid tubing is attached to the discharge end of the flexible silicon tubing to facilitate sample collection. The entire length of rigid and flexible silicon tubing is dedicated to the well for future use. The tubing is typically tied and suspended in the well. The flexible or rigid tubing is not reused in other wells because cross-contamination will occur.

Note: Often a length of tubing is accidentally dropped into a well and can be difficult to retrieve. Retrieval can be accomplished by sending another piece of tubing down the well overlapping the lost section of tubing. Once in place, rotate the tubing, essentially wrapping or corkscrewing the lost tubing and new tubing together. After a number of turns are completed pull the tubing, hopefully with the lost section wound around the new piece. Repeat the procedure until successful.

Liquid is pulled into the tubing by the peristaltic pump through the creation of a vacuum as the rotor head turns. An advantage of using a peristaltic pump is that no pump parts come in direct contact with the sample. A peristaltic pump is capable of providing low flow sampling rates (i.e., typically less than 500 mL/min) with less agitation than other suction pumps. However, it is important that the tubing is secured during pumping to prevent the tubing from moving and causing agitation. A peristaltic pump also allows for regulation of the flow rate by increasing or decreasing the rotor head speed.

Peristaltic pumps are small and easily mobilized to remote sample locations. They require minimal setup, and do not require decontamination between sample locations. The disadvantages of a peristaltic pump are its limited lift and flow capabilities and the limited ability to collect VOC and SVOC samples. If VOC or SVOC sampling, check the QAPP to see if sampling with a peristaltic pump is allowed. Also check with regulatory agencies with local jurisdiction to see if the use of a peristaltic pump for collection of VOC and SVOC samples is acceptable. If using a peristaltic pump for purging, and the collection of VOCs and SVOC samples with the peristaltic pump is not acceptable, it is common to collect the initial VOC and SVOC analytes with a stainless steel bottom loading bailer. The peristaltic pump can then be used to collect the remaining sample analytes.

Peristaltic pumps are becoming more popular for LFP. However, it should be noted that a peristaltic pump may cause degassing, pH modification, and possible VOC loss.

7.7.7.2 SUCTION PUMPS

A number of suction pumps (e.g., centrifugal) exist that can be used for purging applications only. A suction pump draws water through a suction line by creating a vacuum in the suction line or hose. Once drawn into the pump, the groundwater comes into direct contact with the pump rotor/pumping chamber area and it is therefore undesirable for groundwater sampling due to high groundwater agitation. Decontamination of suction pumps is extremely difficult. As with peristaltic pumps, most suction pumps have a limited lift capability of about 25 feet (7.6 m). Larger suction pumps, like 2-inch (5 cm) trash pumps, can achieve high flow rates under low hydraulic head. Flow rates of 15 to 20 U.S. gallons per minute (USgpm) [57 to 76 liters per minute (L/min)] can be achieved. This high flow rate minimizes purging time. New or dedicated suction line should be used at each well if a suction pump is used for purging.

Large suction pumps are also useful for well development, in conjunction with agitation and surging.

Large suction pumps are not suited for LFP due to degassing, pH modifications, VOC loss, and lack of flow adjustment.

> **Caution:** *The groundwater sampler must prevent the siphoning of purged water from a bulk container back into the well. For example, the following scenario is possible: Joe Sampler has completed purging well 'xyz' and has turned off the 2-inch trash pump. The trash pump discharge line is inserted into a wastewater tank and is submerged below the tank water level. As Joe prepares his glassware and sample pump, the wastewater tank contents are siphoned back into the well. This can result in cross contamination with water from other sites/wells which have been purged either:*
> - *into the tank,*
> - *through the pump, or*
> - *through the discharge line.*
>
> *All discharge lines/groundwater purge pumps must be provided with a check valve to prevent this situation.*

Drilling rig pumps including Moyno, progressive cavity, bean, and mud pumps can be used for well purging and well development.

Suction pumps are a useful tool for high rate purging and well development. They require no additional equipment other than a suction line and discharge line for each well. They are mobile and easily transported around and between sites. Suction pumps are limited to use in wells with less then 25 feet (7.6 m) of lift, are difficult to decontaminate, and are unsuitable for sample collection. Large suction pumps are not suitable for LFP.

7.7.7.3 SUBMERSIBLE PUMPS

A submersible pump generally provides high discharge rates for purging at depths beyond the capabilities of a suction pump. Based on its size, a submersible pump can pump water from substantial depths at very high pumping rates and can provide higher groundwater extraction rates than other methods. At high pumping rates, a submersible pump can cause agitation and aeration. This results in some submersible pumps not being suitable for the collection of groundwater samples for VOC and SVOC analysis.

Adjustable rate submersible pumps, constructed of stainless steel or Teflon™, are suitable and approved for LFP provided low flow rates are maintained.

The submersible pump, including the electrical cable and lowering cable, must be decontaminated between wells in accordance with the Work Plan or QAPP.

A submersible pump installed in bedrock or in a deep well should be attached to rigid piping (i.e., 3/4-inch (1.9 cm) steel) to allow for pulling or pushing of the pump. The pump may need to be pushed or pulled to the appropriate installation depth, past tight spots in the well, and when affixing the electrical cable and lowering the cable/safety line. Even when rigid piping is used, a safety line must be attached to the pump in case the piping becomes unthreaded or the pump connection is lost.

Submersible pumps can provide high flow rates that are useful for deep well or large diameter well purging activities. They tend to be labor intensive because of decontamination problems, power supply, and discharge piping size. Some submersible pumps are not suitable for some sample analytes. Small submersible pumps (i.e., 2-inch (5 cm) Grundfos™) have the proper construction and have adjustable flow rates, making them suitable for LFP.

7.7.7.4 AIR LIFT PUMPS

An air lift pump operates using compressed air or nitrogen. The compressed air or nitrogen comes into direct contact with the groundwater and forces groundwater from the pump chamber through a series of check balls into the discharge line. An air lift pump operates on alternate pump discharge and pump recharge cycles. The pump and recharge cycles are controlled using a control box at ground surface. Air lifting is possible from deep depths with moderate to low flow rates [2 to 3 USgpm (7.6 to 11.5 L/min)] depending on the pump installation depth, static head, discharge tubing diameter, and air supply pressure.

Since the air or nitrogen comes in direct contact with the groundwater, an air lift pump should not be used for the collection of groundwater samples for VOC and SVOC analysis.

An air lift pump is a good tool for deep well purging and development. If an air lift pump is used for purging, an alternate sampling method will be required (e.g., bailers or bladder pump) for the collection of VOC and SVOC groundwater samples.

7.7.7.5 BLADDER PUMPS

Bladder pumps, as with air lift pumps, are driven by compressed air or nitrogen but the air or nitrogen does not come in contact with the groundwater. The contact between the air or nitrogen and the groundwater is eliminated by the presence of a Teflon™, polyethylene, or natural rubber bladder. The pump operation, as with the air lift pump, is cyclic and is controlled using a control box at ground surface. The control box controls the pump filling and discharge time. Because the air or nitrogen does not come in direct contact with the groundwater, and there is limited groundwater agitation and degassing, a bladder pump is the best sampling equipment for the collection of groundwater samples for VOC and SVOC analysis.

Bladder pump operation is very quiescent, causing little formation and well disturbance. By using a bladder pump, collecting a sediment-free groundwater sample is easily achieved. An adjustable rate bladder pump should be used for LFP. Bladder pumps generally are only able to achieve a maximum pumping rate of 1.5 USgpm (5.7 L/min). It is important to note that flow rates should be reduced in deep well applications.

Well purging and sampling can be performed using a bladder pump. Once sampling is completed, the pump should be disassembled and decontaminated in accordance with the Work Plan or QAPP prior to use in other wells. The sample tubing is generally 1/4- or 3/8-inch (6 or 10 mm) diameter polyethylene or Teflon™ lined polyethylene tubing. The air line is generally 1/4-inch (6 mm) polyethylene tubing. The sample and air line tubing are typically suspended in the well for future use (dedicated). At some sites a complete sampling system (bladder pump, discharge tubing, and air line) is dedicated to each well.

Bladder pumps provide excellent sample quality and are useful in deeper sampling applications. There are no analyte restrictions. Bladder pumps are strongly recommended for LFP applications.

Bladder pumps require additional equipment including control box, compressed air or nitrogen, and tubing. The setup of a bladder pump is quite labor intensive unless a dedicated system is in place. Decontamination of a bladder pump requires pump disassembly and re-assembly. Finally, bladder pumps are not capable of high flow rates, thus purging times tend to be increased slightly.

7.7.7.6 INERTIA PUMPS

An Inertia pump or Waterra™ pump is a manually operated or mechanically driven pump which uses only a foot valve on the sample/purge tubing. "Jerking" the sample/purge tubing with the attached foot valve removes groundwater from the well. The rapid lifting and lowering action of the tubing imparts an inertia to the water column within the sample/purge tubing. This causes the water column to rise to ground surface and discharge from the end of the sample/purge tubing. The foot valve holds the water column in the tubing during the lifting process and allows groundwater to enter the sample/purge tubing during the lowering, or down stroke.

CRA owns both manual and mechanical gas-powered inertia systems. Flow rates with inertia pumps are variable and are dependant on cycle speed, tubing size, foot valve size, well depth, and depth to groundwater. The inertia pump is a useful method for purging and for collection of most groundwater sample analytes. Acceptability of VOC and SVOC sampling with inertia pumps is gaining approval in selected areas. Prior to using an inertia pump as a sampling device, check the sampling requirements in the QAPP, or obtain approval from the Project Coordinator.

Inertia pumps are useful for the extraction of dense non-aqueous phase liquids (DNAPL). The only equipment that is exposed to the gross contamination is the foot valve and a small section of the sample/purge tubing. On most projects, the foot valve and sample/purge tubing are dedicated to the well.

Inertia pumps tend to cause extensive disturbance to the water column. The vigorous lifting and lowering of the inertia pump tends to make it difficult to collect sediment-free groundwater samples. Therefore, inertia pumps are not suitable for LFP.

7.7.7.7 BAILERS

A bailer is a manual sampling device consisting generally of a hollow tube (e.g., Teflon™, PVC, or stainless steel) with a lower check ball that permits water entry and prevents water loss. The bailer is lowered slowly into the well. This allows water to enter the bailer through the bottom, and the weight of the water inside the bailer closes the check ball when the bailer is retrieved from the well. A rope or cable is affixed to the bailer to allow the lowering and retrieval of the bailer from the well. Bailing tends to be disruptive to the water column and formation. Obtaining sediment-free groundwater samples using a bailer tends to be difficult, if not impossible. VOCs and SVOCs, as well as other analytes can be collected using a bailer, but it is important that these analytes be as sediment-free as possible. The compatibility of the bailer material and groundwater analytes should be reviewed and approved prior to using a bailer for the collection of groundwater samples. Generally, Teflon™ bailers are acceptable for the collection of most analytes.

Power winches with overhead tripods are available to assist in purging and sampling deep or large volume wells.

Flow rates attained using a bailer is a function of the bailer size and retrieval frequency. Retrieval frequency is dependent on well depth, water depth, and well recharge rate. Bailing is not practical for deep wells or for the removal of large well volumes.

A bailer is a useful tool for well development as the surging action from the bailer insertion and removal from the well promotes sediment suspension and subsequent removal. However, obtaining completely sediment-free samples, or samples below 50 NTU, is difficult if not impossible using a bailer.

A bailer provides representative samples once the well has been adequately developed and purged. A bailer is not suitable for LFP. Rope used for bailing must be kept off the ground and free of other contaminating material that could be introduced to the well. Rope can either be dedicated to the well for future use or discarded.

7.7.7.8 PASSIVE DIFFUSION BAGS

When sampling with diffusion bags the well must be fully developed using an alternate method.

A diffusion bag is a polyethylene bag that contain deionized water. The bag is attached to an appropriate length of rope or cable in order to be submerged to the appropriate depth (indicated in the Work Plan, QAPP, or as instructed by the Project Coordinator). Cable or rope used to suspend diffusion bags can be dedicated to the well for future use or discarded.

Once submerged to the appropriate depth, the diffusion bag is left in the well for an extended period of time, usually 14 days, to allow the bag to equilibrate with the water in the well. The use of diffusion bags eliminates well purging prior to sampling. Placement of multiple diffusion bags in a well allows for vertical groundwater profiling.

Diffusion bags are a low cost method for the collection of groundwater samples. Advantages include:

- No purge water to dispose of
- No equipment decontamination between wells
- Simple logistics and operation
- Reduction in personnel and exposure times
- Samples collected are representative of formation water adjacent to well
- Allow for vertical profiling of water column
- Appropriate for long-term monitoring programs

The disadvantage of diffusion bags is the length of equilibrium time, generally 14 days. Currently, there are membranes available for diffusion bags suitable for the collection of groundwater samples for select SVOC, and metals analyses. However, there are no membranes currently available for polychlorinated biphenyls (PCBs).

Note: *Handle diffusion bags only when wearing clean nitrile or surgical gloves.*

7.7.8 FILTERING OF GROUNDWATER SAMPLES

Filtering is an important process to remove suspended particulate that affect sample results. Filtration of groundwater samples is generally limited to metals analysis.

APPENDIX H

CONESTOGA-ROVERS & ASSOCIATES

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MEMORANDUM

TO:	Jim Kay	REF. NO.:	005513
FROM:	Deb Andrasko/bjw/1	DATE:	May 15, 2009
			E-Mail and Hard Copy If Requested

RE: **Analytical Results and QA/QC Review**
Annual Groundwater Monitoring Program
UCAR Carbon Company, Inc.
Niagara Falls, New York
March 2009

INTRODUCTION

Eight groundwater samples, including one field duplicate sample were collected during March 2009 in support of the annual monitoring program at the UCAR Carbon Site in Niagara Falls, New York (Site). The samples were submitted to Columbia Analytical Services (CAS), located in Rochester, New York, and analyzed for the following:

Parameter	*Methodology*
Volatile Organic Compounds (VOCs)	SW-846 8260B[1]
Total & Dissolved Iron, Potassium, and Zinc	SW-846 6010B[1]
Ammonia	USEPA 350.1[2]
Nitrite	USEPA 353.2[2]
Total Kjeldahl Nitrogen (TKN)	USEPA 351.2[2]

A sampling and analysis summary is presented in Table 1. The analytical results are summarized in Table 2. The quality assurance/quality control (QA/QC) criteria by which the data have been assessed are outlined in the respective methods and the following documents:

i) "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review", October 1999, United States Environmental Protection Agency (USEPA) 540/R-99/008;

ii) "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review", February 1994, USEPA 540/R-94/013.

1 "Test Methods for Solid Waste Physical/Chemical Methods", SW-846, 3rd Edition, September 1986 (with all subsequent revisions).

2 "Methods for Chemical Analysis of Water and Wastes", United States Environmental Protection Agency (USEPA) 600/4-79-220, March 1983 (with all subsequent revisions).

Full Contract Laboratory Program (CLP) equivalent raw data deliverables were provided by the laboratory. The data quality assessment and validation presented in the following subsections were performed based on the sample results, supporting QA/QC and raw data provided.

Holding Time Period And Sample Analysis

The holding time periods are presented in the analytical methods. All samples were properly preserved and cooled to 4°C (±2°C) after collection. All samples were prepared and analyzed within the method-required holding times.

Gas Chromatography/Mass Spectrometer (GC/MS) Mass Calibration

Prior to analysis, GC/MS instrumentation is tuned to ensure optimization over the mass range of interest. To evaluate instrument tuning, the volatile organic compound (VOC) method requires the analysis of the specific tuning compound bromofluorobenzene (BFB). The resulting spectra must meet the criteria cited in the method before analysis is initiated. Analysis of the tuning compound must then be repeated every 12 hours throughout sample analysis to ensure the continued optimization of the instrument.

Instrument tuning data were reviewed. The tuning compound was analyzed at the required frequency throughout the VOC analysis periods. All tuning criteria were met for the analyses, indicating proper optimization of the instrumentation.

Initial Calibration - GC/MS Analyses

To quantify compounds of interest in samples, calibration of the GC/MS over a specific concentration range must be performed. Initially, a minimum of a five-point calibration curve containing all compounds of interest is analyzed to characterize instrument response for each analyte over a specific concentration range.

Calibration data were reviewed for all samples. Linearity of the calibration curve and instrument sensitivity were evaluated against the following criteria:

i) all relative response factors (RRFs) for the GC/MS must be greater than or equal to 0.05; and

ii) percent relative standard deviation (%RSD) values for the GC/MS must not exceed 30 percent, or if linear regression is used, the correlation coefficient (R^2) value must be at least 0.990.

Initial calibration standards were analyzed as required and the data showed acceptable sensitivity and linearity.

Initial Calibration - Metals Analyses

To calibrate the inductively coupled plasma (ICP), a calibration blank and at least one standard must be analyzed at each wavelength to establish the analytical curve. After calibration, an initial calibration verification (ICV) standard must be analyzed to verify the analytical accuracy of the calibration curves within a method-specific percent recovery of the accepted or true value. A Contract Required Detection Limit (CRDL) standard is analyzed before and after sample analyses to verify instrument sensitivity.

A review of the data showed that all metals calibration curves, ICVs and CRDL were analyzed at the proper frequencies and were within the acceptance criteria.

Initial Calibration - General Chemistry Analyses

The general chemistry analyses of ammonia, nitrite, and TKN were calibrated in accordance with the methods and all calibration criteria were met.

Continuing Calibration - GC/MS

To ensure that instrument calibration is acceptable throughout the sample analysis period, continuing calibration standards must be analyzed and compared to the initial calibration curve every 12 hours.

The following criteria were employed to evaluate continuing calibration data:

i) all RRF values for the GC/MS must be greater than or equal to 0.05; and

ii) percent difference (%D) values must not exceed 25 percent.

Continuing calibration standards were analyzed at the required frequency and the results met the above criteria for instrument sensitivity and linearity of response.

Continuing Calibration - Inorganics

Continuing calibration criteria for inorganic analyses were the same criteria as used for assessing the initial calibration data. All continuing calibration verification data were within the acceptance criteria.

Surrogate Compound Recoveries

Surrogates were added to all samples, blanks, and QC samples prior to analysis of VOCs. All recoveries met the method criteria, with the exception of a low surrogate recovery for one sample. All associated results were qualified as estimated based on the indicated low bias (see Table 3).

Method Blank Samples

Method blanks were analyzed for all parameters. All results were non-detect, indicating that contamination during analysis was not a concern.

Laboratory Control Sample (LCS) Analysis

The LCS serves as a measure of overall analytical performance. LCSs are prepared with all analytes of interest and analyzed with each sample batch.

LCSs were prepared and analyzed for all parameters at the proper frequency. The LCS recoveries were within the control limits for all analytes of interest, indicating acceptable analytical accuracy.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analyses

The recoveries of MS analyses are used to assess the analytical accuracy achieved on individual sample matrices. MS/MSD analyses were performed on the sample submitted for analysis, as shown in Table 1. The MS/MSD recoveries were within laboratory control limits for all analytes of interest, indicating good analytical accuracy and precision.

Inductively Coupled Plasma (ICP) Interference Check Sample (ICS) Analysis

To verify that proper inter-element and background correction factors have been established by the laboratory, ICSs are analyzed. These samples contain high concentrations of aluminum, calcium, magnesium, and iron and are analyzed at the beginning and end of each sample analysis period.

ICS analysis results were evaluated for all samples. All ICS recoveries were within the established control limits of 80 to 120 percent.

Serial Dilution - Metals Analyses

The serial dilution determines whether significant physical or chemical interferences exist due to sample matrix. A minimum of one per 20 investigative samples is analyzed at a five-fold dilution. For samples with sufficient analyte concentrations, the serial dilution results must agree within 10 percent of the original results.

Serial dilution analysis was performed on the sample chosen for MS/MSD analyses and all results were within the method criteria.

Internal Standard (IS) Summaries

To correct for changes in GC/MS response and sensitivity, IS compounds are added to investigative samples and QC samples prior to VOC analyses. All results are calculated as a ratio of the IS response. The criteria by which the IS results are assessed are as follows:

i) IS area counts must not vary by more than a factor of two (-50 percent to −100 percent) from the associated calibration standard; and

ii) the retention time of the IS must not vary more than ±30 seconds from the associated calibration standard.

All sample IS results met the above criteria and were correctly used to calculate sample results.

Trip Blanks - VOCs

Trip blanks are transported, stored, and analyzed with the investigative samples to identify potential cross-contamination of VOCs. A trip blank was collected as shown on Table 1. All results were non-detect for the analytes of interest, indicating that contamination during transport and storage was not an issue.

Field Duplicates

Samples were collected in duplicate as summarized in Table 1 and submitted "blind" to the laboratory for analysis. All sample results outside of estimated ranges of detection showed acceptable sampling and analytical precision with the exception of the zinc result for the dissolved metals analysis. The associated result was qualified as estimated based on the indicated variability (see Table 4).

CONCLUSION

Based on the preceding assessment, the data were acceptable for use with the qualifications noted.