State of Michigan
Department of Environment, Great Lakes, and Energy
HAZARDOUS WASTE MANAGEMENT FACILITY POSTCLOSURE OPERATING LICENSE

NAME OF LICENSEE: Ford Motor Company

NAME OF FACILITY OWNER: Ford Motor Company

NAME OF FACILITY OPERATOR: Ford Motor Company

NAME OF TITLEHOLDER OF LAND: Ford Motor Company

FACILITY NAME: Ford River Raisin Warehouse

FACILITY LOCATION: 3200 East Elm Avenue, Monroe, Michigan

EPA IDENTIFICATION (ID) NUMBER: MID 005 057 005

REAPPLICATION DATE: April 1, 2032

EFFECTIVE DATE: September 30, 2022
FIVE-YEAR REVIEW DATE: September 30, 2027
EXPIRATION DATE: September 30, 2032

AUTHORIZED ACTIVITIES

Pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), being §§324.11101 to 324.11153 of the Michigan Compiled Laws, and the hazardous waste management administrative rules (hereafter called the "rules") promulgated thereunder, being Rule (R) 299.9101 *et. seq.* of the Michigan Administrative Code, by the Michigan Department of Environment, Great Lakes, and Energy (EGLE), a postclosure operating license (hereafter called the "license") is issued to Ford Motor Company (hereafter called the "licensee") to operate a hazardous waste management facility (hereafter called the "facility") located at latitude 41.90401, and longitude -83.35089. The licensee is authorized to conduct the following hazardous waste management activities:

☐ STORAGE	☐ TREATMENT	☐ DISPOSAL	☒ POSTCLOSURE
☐ Container	☐ Container	☐ Landfill	☐ Tank
☐ Tank	☐ Tank	☐ Land Application	☐ Surface Impoundment
☐ Waste Pile	☐ Surface Impoundment	☐ Surface Impoundment	☒ Landfill
☐ Surface Impoundment	☐ Incinerator		☐ Waste Pile
☐ Drip Pad	☐ Other		

APPLICABLE REGULATIONS AND LICENSE APPROVAL

The conditions of this license were developed in accordance with the applicable provisions of the rules, effective August 3, 2020. The licensee shall comply with all terms and conditions of this license, Part 111, and its rules. This license consists of 21 pages of conditions attached hereto as well as those in Attachments 1 through 7, and the applicable rules contained in R 299.9101 through R 299.11008, as specified in the license. For purposes of compliance with this license, applicable rules are those that are in effect on the date of issuance of this license, in accordance with R 299.9521(3)(a).

This license is based on the information in the license application submitted on May 1, 2017 and any subsequent amendments (hereafter referred to as the "application"). Pursuant to R 299.9519(11)(c), the license may be revoked if the licensee fails, in the application or during the license issuance process, to disclose fully all relevant facts or, at any time, misrepresents any relevant facts. As specified in R 299.9519(1), the facility shall be constructed, operated, and maintained in accordance with Part 111 of Act 451, the rules, and this license.

This license is effective on the date of issuance and shall remain in effect for ten years from the date of issuance, unless revoked pursuant to R 299.9519 or continued in effect as provided by the Michigan Administrative Procedures Act, 1969 PA 306, as amended (Act 306). Pursuant to R 299.9516, this license shall be reviewed by the Director five years after the date of issuance and shall be modified as necessary in accordance with the provisions of R 299.9519, and R 299.9520.

Issued this 30th day of September 2022

By: Kimberly M. Tyson

Kimberly M. Tyson, Manager
Hazardous Waste Section
Materials Management Division

HAZARDOUS WASTE MANAGEMENT FACILITY POSTCLOSURE OPERATING LICENSE
FOR
FORD RIVER RAISIN WAREHOUSE
MID 005 057 005

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PART I
STANDARD CONDITIONS

A. TERMINOLOGY AND REFERENCES

Throughout this license, the term "Division" means the Materials Management Division, and any successor organization, within EGLE responsible for administering Part 111 of Act 451 and the rules. Throughout this license, "Director" means the Director of EGLE or the Director's duly authorized designee such as the Division Director. All of the provisions of Title 40 of the Code of Federal Regulations (CFR) referenced in this license are adopted by reference in Rule (R) 299.11003.

B. EFFECT OF LICENSE

Except as otherwise provided by law, any treatment, storage, or disposal of hazardous waste not specifically authorized in this license is prohibited. Issuance of this license does not authorize any injury to persons or property, any invasion of other private rights, or any infringement of federal, state, or local law or regulations {R 299.9516(8)}; nor does it obviate the necessity of obtaining such permits or approvals from other units of government as may be required by law. Compliance with the terms of this license does not constitute a warranty or representation of any kind by EGLE, nor does EGLE intend that compliance with this license constitutes a defense to any order issued or any action brought under Act 451 or any other applicable state statute or §106(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) {42 U.S.C. 9606(a)}, the Resource Conservation and Recovery Act of 1976, as amended (RCRA), and its rules, or any other applicable federal statute. The licensee, however, does not represent that it will not argue that compliance with the terms of this license may be a defense to such future regulatory actions. Each attachment to this license is a part of, and is incorporated into, this license and is deemed an enforceable part of the license.

C. SEVERABILITY

The provisions of this license are severable, and if any provision of this license, or the application of any provision of this license to any circumstance, is held invalid, the application of such provision to other circumstances and the remainder of this license shall not be affected thereby.

D. RESPONSIBILITIES

1. The licensee shall comply with Part 111 of Act 451, the rules, and all conditions of this license, except to the extent authorized by EGLE pursuant to the terms of an emergency operating license. Any license noncompliance, except to the extent authorized by EGLE pursuant to the terms of an emergency operating license, constitutes a violation of Part 111 of Act 451, and is grounds for enforcement action, license revocation, license modification, or denial of a license renewal application. {§§11148, 11150, and 11151 of Act 451; R 299.9521(1)(a) and (c) and (3)(a) and (b); and 40 CFR §270.30(a)}

2. If the licensee wishes to continue an activity regulated by this license after the expiration date of this license, the licensee shall submit a complete application for a new license to the Division Director at least 180 days before this license expires, September 30, 2032, unless an extension is granted pursuant to R 299.9510(5). To the extent the licensee makes a timely and sufficient application for renewal of this license, this license and all conditions herein will remain in effect beyond the license expiration date and shall not expire until a decision on the application is finally made by EGLE, and if the application is denied or the terms of the new license are limited, until the last day for applying for judicial

review of the new license or a later date fixed by order of the reviewing court consistent with §91(2) of Act 306. {R 299.9521(1)(a) and (c) and (3)(a) and 40 CFR §270.30(b)}

3. The licensee shall comply with the conditions specified in R 299.9521(1)(b)(i) to (iii) and 40 CFR §270.30(c) through (k), (l)(2), (3), (5), (7), and (11), and (m). {§§11123(3), 11146(1) and (2), and 11148(1) of Act 451 and R 299.9501(1), R 299.9516, R 299.9519, R 299.9521(1)(a) and (b) and (3)(a) and (b), R 299.9522, and R 299.9525}

4. The licensee shall give notice to the Division as soon as possible prior to any planned physical alterations or additions to the licensed facility. {R 299.9501, R 299.9519(1), and Part 6 of the Part 111 Rules}

E. **SUBMITTAL DEADLINES**

When the deadline for submittals required under this license falls on a weekend or legal state holiday, the deadline shall be extended to the next regular business day. This extension does not apply to the deadline for financial mechanisms and associated renewals, replacements, and extensions of financial mechanisms required under this license. The licensee may request extension of the deadlines for submittals required under this license. The licensee shall submit such requests at least five business days prior to the existing deadline for review and approval by the Division Director. Written extension requests shall include justification for each extension. {R 299.9519 and R 299.9521(3)(a)}

PART II
GENERAL OPERATING CONDITIONS

A. DESIGN AND OPERATION OF FACILITY

The licensee shall maintain and operate the facility to minimize the possibility of fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste or hazardous waste constituents to the environment, including air, soil, to waters of the state that could threaten human health or welfare or the environment. {R 299.9602, R 299.9606, and R299.9607, and 40 CFR §§264.31 and 264.51}

B. QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

The licensee shall ensure that all samples collected for the purposes of waste characterization and environmental monitoring are collected, transported, analyzed, stored, and disposed of by trained and qualified individuals in accordance with their Quality Assurance/Quality Control (QA/QC) Plans. The QA/QC Plans shall be established using Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, United States Environmental Protection Agency (U.S. EPA) Publication SW-846, Chapter 1, Update V (July 2014) as guidance, and any facility or contractor's written standard operating procedures (SOP) that are equivalent or more stringent than SW-846, Chapter 1. The licensee shall make the written QA/QC Plans available to the Division Director or an authorized representative upon request. {R 299.9521(3)(a), and (b) and R299.9611(2)}

C. SECURITY

The licensee shall comply with the barrier, surveillance, and signage requirements of R 299.9605(1) and 40 CFR §264.14.

D. GENERAL INSPECTION REQUIREMENTS

The licensee shall inspect the facility, remedy any deterioration or malfunction of equipment or structures, and document inspections and remedies in accordance with the Inspection Schedule, Attachment 1, of this license, and comply with the inspection requirements of R 299.9605(1) and 40 CFR §264.15.

E. PERSONNEL TRAINING

The licensee shall comply with the personnel training requirements of R 299.9605 and 40 CFR §264.16. The Personnel Training Program, Attachment 2, of this license, shall, at a minimum, cover all items in R 299.9605 and 40 CFR §264.16.

F. PREPAREDNESS AND PREVENTION

The licensee shall comply with the preparedness and prevention requirements of R 299.9606 and 40 CFR Part 264, Subpart C.

G. CONTINGENCY PLAN

The licensee shall comply with the contingency plan requirements of R 299.9607 and 40 CFR Part 264, Subpart D. The Contingency Plan, Attachment 3 of this license, and the prescribed emergency procedures shall be immediately implemented by the licensee whenever there is a fire, explosion, or other release of hazardous waste or hazardous waste constituents that threatens or could threaten human health or the environment, or if the licensee has knowledge that a spill has reached surface water or groundwater.

H. **DUTY TO MITIGATE**

Upon notification from the Division Director or his or her designee that an activity at the facility may present an imminent and substantial endangerment to human health or the environment, the licensee shall immediately comply with an order issued by the Division Director pursuant to §11148(1) of Act 451 to halt such activity and conduct other activities as required by the Division Director to eliminate the said endangerment. The licensee shall not resume the halted activity without the prior written approval from the Division Director. {§11148 of Act 451 and R 299.9521(3)(b)}

I. **MANIFEST SYSTEM**

The licensee shall comply with the manifest requirements of R 299.9304, R 299.9305, and R 299.9608.

J. **RECORD KEEPING AND REPORTING**

1. The licensee shall comply with the written operating record requirements of R 299.9609 and 40 CFR §264.73 and Part 264, Appendix I.

2. The licensee shall comply with the biennial report requirements of R 299.9610. {R 299.9521(1)(a) and 40 CFR §270.30(l)(9)}

3. The licensee shall submit the results of all environmental monitoring required by this license and any additional environmental sampling or analysis conducted beyond that required by this license to the Division Director within 60 days after any sample collection. The information shall be provided in the form of an Environmental Monitoring Report, using a format approved by the Division Director. The Report shall include, at a minimum, the laboratory report in pdf format and the data in an electronic spreadsheet format. {R 299.9521(1)(a) and R 299.9521(3)(b) and 40 CFR §270.30(l)(4)}

4. The licensee shall provide environmental monitoring information or data that is required pursuant to this license, to an authorized representative of an environmental or emergency response department of the city of Monroe or Monroe County, who requests such information or data and that has jurisdiction over the facility. Such information or data shall be made available on the same day the licensee forwards this information to the Division Director. {R 299.9521(3)(b)}

5. The licensee shall immediately report to the Division Director any noncompliance with the license that may endanger human health or the environment by doing both of the following:

    (a) The licensee shall immediately notify the Hazardous Waste Section at 517-284-6546, if the noncompliance occurs Monday through Friday during the period of 8:00 a.m. to 5:00 p.m., except state holidays, or by calling EGLE’s Pollution Emergency Alerting System (PEAS) at 1-800-292-4706 during all other times. This notice shall include the following:

        (i) Information concerning the fire, explosion, release, or discharge of any hazardous waste or hazardous waste constituent that could threaten human health or the environment, that has reached surface water or groundwater, or that may endanger public drinking water supplies or the environment; and

(ii) A description of the occurrence and its cause, including all of the information outlined in R 299.9607(2)(a)-(i).

(b) The licensee shall also follow up the verbal notice by providing a written report to the Division Director within five days of the time the licensee becomes aware of the circumstances. The written report shall contain all of the information in Condition II.J.5.(a)(i)-(ii) of this license along with a description of the noncompliance and its cause; the periods of noncompliance (including exact dates and times); whether the noncompliance has been corrected and, if not, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance and when those activities occurred or will occur. The Division Director may waive the 5-day written notice requirement in favor of submittal of a written report within 15 days of the time the licensee becomes aware of the circumstances.

{R 299.9521(1)(a) and R 299.9607 and 40 CFR §270.30(l)(6)}

6. The licensee shall report all other instances of noncompliance with this license, Part 111 of Act 451, the rules, and any other applicable environmental laws or rules that apply to the licensed facility, at the time monitoring reports required by this license are submitted or within 30 days, whichever is sooner. The reports shall contain the information listed in Condition II.J.5. of this license. {R 299.9521(1)(a) and 40 CFR §270.30(l)(10)}

7. The licensee may make minor modifications to the forms contained in the attachments to this license. The modifications may include changing the format, updating existing references and information, adding necessary information, and changing certification and notification information in accordance with Part 111 of Act 451 and its rules and RCRA and its regulations. The licensee shall submit the modifications to the Division Director prior to implementing the use of the modified form(s). If the Division Director does not reject or require revision of the modified form(s) within 14 days of receipt, the licensee shall implement use of the modified form(s) and the form(s) shall be incorporated into this license as a replacement for the existing form(s).

K. **POSTCLOSURE**

The licensee shall comply with the postclosure monitoring requirements of R 299.9613 and monitor and maintain the facility in accordance with the Postclosure Plan, Attachment 4, of this license. The licensee shall submit a certification of postclosure in accordance with R 299.9613(5). {R 299.9613 and 40 CFR §§264.116 through 264.119}]

L. **FINANCIAL ASSURANCE FOR POSTCLOSURE**

1. On the effective date of this license, the facility postclosure cost estimate is $ 5,169,500.00. This estimate includes a corrective action component for the ongoing groundwater remediation.

2. The licensee shall continuously maintain financial assurance for the current postclosure cost estimate as required under R 299.9703.

M. **FINANCIAL ASSURANCE FOR CORRECTIVE ACTION**

In accordance with R 299.9712, the licensee shall include a cost estimate as a part of any corrective action work plan required by Part V of this license. Within 60 days after approval of each work plan the licensee shall provide financial assurance to cover the costs associated with implementing such work plan in accordance with R 299.9713.

N. **LAND DISPOSAL RESTRICTIONS**

The licensee shall comply with all of the requirements of 40 CFR Part 268. {R 299.9627 and 40 CFR Part 268}

O. **DOCUMENTS TO BE MAINTAINED AT THE FACILITY**

The licensee shall maintain at the facility the following documents and amendments required by this license, until closure/postclosure is completed, certified by an independent registered professional engineer, and the facility is released from financial assurance requirements for closure/postclosure by the Director:

1. Inspection Schedules and records.

2. Personnel Training Program documents and records.

3. Contingency Plan.

4. Postclosure Plan

5. Cost estimates for facility postclosure and corrective action and copies of related financial assurance documents.

6. Operating record.

7. Site Security Plan.

8. Facility engineering plans and specifications.

9. Record keeping procedures.

10. Environmental monitoring plans, including sampling and analysis plans and QA/QC Plans.

11. Environmental monitoring data and statistical records.

12. Preventative procedures (Personnel Protection Plan).

13. Postclosure Notices.

{R 299.9521(3)(a)}

P. **ENGINEERING PLANS**

The licensee shall construct, operate, and maintain the facility in accordance with the Engineering Plans, Attachment 5 of this license, and any modifications to those plans shall be made in accordance with this license.

PART III
LANDFILL POSTCLOSURE CONDITIONS

A. COVERAGE OF LICENSE

The hazardous waste landfill and the leachate collection and removal systems, along with associated piping, pumps, structures, and equipment at the facility shown in the General Layout of the Engineering Plans, Attachment 5, of this license, are covered by the license. {R 299.9521(1)(b)}

B. DESIGN AND RUN-ON, RUNOFF, AND CONTAMINANT CONTROL

1. The licensee shall operate and maintain the existing run-on and runoff management system for collection and control of storm water. {R 299.9604(1)(c)}

2. The licensee shall expeditiously empty or otherwise manage collection and holding facilities (e.g., tanks or catch basins) associated with run-on and runoff control systems after storms to maintain the design capacity of the system. {R 299.9619 and 40 CFR §264.301(h)}

3. The licensee shall operate and maintain a leachate collection and removal system in accordance with this license and the Engineering Plans, Attachment 5, of this license. The leachate captured by this system shall be discharged to the sewer system, operated by the city of Monroe.

4. The licensee shall survey the benchmarks once every two years. A visual survey of the final cover will be performed in accordance with the criteria identified in the Postclosure Plan, Attachment 4, of this license. A survey of the final cover will be performed once every five years. Following this survey, a contour map of the final cover shall be submitted to the Division with the annual report. {R 299.9619 and 40 CFR §264.310(b)(1), (5), and (6)}

C. ADDITIONAL REPORTING

The licensee shall submit an annual inspection and maintenance summary report to the Division by March 1st of each year during the active life of the landfill and the postclosure care period. The annual inspection and maintenance report shall include a summary of all maintenance activities performed by the licensee to maintain the integrity of the landfill and the final cover such as mowing, fertilization, and liming, and a copy of the associated inspection logs.

{R 299.9521(2)(a) and (b) and 40 CFR §270.31}

PART IV
ENVIRONMENTAL MONITORING CONDITIONS

A. GROUNDWATER MONITORING PROGRAM

1. The licensee shall conduct a detection monitoring program. Under this program, the licensee shall operate and maintain a groundwater monitoring system consisting of monitoring wells PCW-1 through PCW-14 and piezometers PCP-1 through PCP-14, PCP-3 (Deep), and PCL-1 through PCL-5 as shown in the General Layout of the Postclosure Groundwater Sampling and Analysis Plan (SAP), Attachment 6, of this license. {R 299.9611(2)(b) and R 299.9612}

   The licensee shall sample the monitoring wells in accordance with the Postclosure Groundwater SAP, Attachment 6, of this license and the procedures specified below:

   (a) Static water level measuring devices, pumps and/or sampling equipment shall be compatible with the parameters sampled and must be thoroughly cleaned and rinsed before use in each monitoring well. Sampling procedures shall assure that cross-contamination and changes in water chemistry do not occur. {R 299.9612 and 40 CFR §264.97(d) and (e)}

   (b) The static water elevation shall be determined by methods giving precision to 1/8 inch or 0.01 foot prior to purging water from the wells for sampling. Measurements shall be made from the top of the casing with the elevation of all casings in the monitoring well system related to a permanent reference point, using United States Geological Survey datum. {R 299.9612, and 40 CFR §264.97(f)}

   (c) To ensure representative groundwater samples are collected, the licensee shall purge and sample monitoring wells as specified in Section 4.2 and 4.3, on pages 4, and 5 of the Postclosure Groundwater SAP, Attachment 6, of this license. Wells shall be sampled immediately after purging where recovery rates allow. Where wells are pumped dry during purging, recovery rates shall be determined, and samples taken as soon as sufficient recovery occurs. {R 299.9612, and 40 CFR §264.97(d) and (e)}

   (d) All monitoring wells shall be adequately protected from vehicular traffic, be clearly labeled, securely capped, and locked when not in use. {R 299.9612, and 40 CFR §264.97(c)-(e)}

   (e) Prior to undertaking monitoring well replacement or repair, the licensee shall obtain the written approval of the Division Director, unless the well has been damaged or rendered inoperable, and the location, design, and depth of the monitoring well remains unchanged. {R 299.9612(1)(b), and R 299.9519(5)(c)(i)}

   (f) Data and evaluations must be submitted to the Division Director in accordance with the time frame specified in Condition II.J.3. of this license. {R 299.9521 (1)(a), and R 299.9521 (3)(b), and 40 CFR §270.30(l)(4)}

2. Water removed from each monitoring well shall be managed as specified in Section 4.2, on page 4 of the Postclosure Groundwater SAP, Attachment 6, of this license. {R 299.9521(3)(b)}

3. The licensee shall collect and analyze samples according to the schedule, parameters, and procedures specified in the Postclosure Groundwater SAP, Attachment 6, of this license. The licensee shall submit proposed revisions to the Postclosure Groundwater SAP to the Division Director for approval prior to implementation and shall revise any other affected document accordingly. If approved, the revisions shall become part of this license. {R 299.9519(5)(c)(ii), R 299.9611(2)(a), and R 299.9612 and 40 CFR §264.97(d) and (e)}

4. The licensee shall submit an annual groundwater report to the Division Director no later than March 1st of each year for the previous calendar year's activities. At a minimum, the report shall include the following information:

   (a) A narrative summary of the previous calendar year's sampling events, including sampling event dates, the identification of any significant problems with respect to Postclosure Groundwater SAP procedures, and copies of field log sheets.

   (b) A determination of the groundwater flow rate and direction in the monitored zone, including the preparation of a groundwater level contour map from this data.

   (c) A summary of groundwater quality data results, including a narrative summary of results and trends, data graphs, and data tables.

   (d) A presentation of the statistical analysis of the data and the identification of any statistically significant increases (or changes in pH) pursuant to Condition IV.A.6. of this license.

   (e) An analysis and discussion of laboratory and field related QA/QC information. This shall include results of equipment, field, and trip blanks, and discussion and evaluation of the adequacy of the data with respect to Postclosure Groundwater SAP specifications and requirements.

   (f) A summary and evaluation of the quarterly hydraulic monitoring data collected pursuant to Condition IV.A.11. of this license.

   This annual report is in addition to the reporting requirement of Condition II.J.3. of this license. {R 299.9521(3)(b) and R 299.9612(1) and 40 CFR §264.97(j)}

5. The licensee shall establish baseline groundwater quality values at monitoring wells for the parameters specified in Table 1 of the Postclosure Groundwater SAP, Attachment 6 of this license.

   (a) Baseline values for the Group I groundwater monitoring parameters determined as specified in Sections 9.1.1 and 9.1.2 of the Postclosure Groundwater SAP, Attachment 6, of this license shall be the laboratory detection limits(s) for the parameters(s).

   (b) Baseline values for the Group I groundwater monitoring parameters determined as specified in Sections 9.1.1 and 9.1.2 of the Postclosure Groundwater SAP, Attachment 6, of this license. {R 299.9612(1)(c), (d), and (e) and 40 CFR §264.97(a) and (g)}

6. Within 60 days of each sampling of each monitoring well, the licensee shall determine if a statistically significant increase (or change in pH) has occurred compared to background levels for each parameter listed in Table 1 of the Postclosure Groundwater SAP, Attachment 6, of this license. For Group 1 groundwater monitoring parameters determined as specified in Sections 9.1.1 and 9.1.2 of the Postclosure Groundwater SAP, Attachment 6, of this license, any occurrence above the laboratory detection limit(s) for the parameter(s) shall be considered statistically significant. {R 299.9612(1) (e), and 40 CFR §264.97(h), and (i)}

7. If a statistically significant increase (or change in pH) is detected, the licensee shall notify the Division, Hazardous Waste Section, Technical Support Unit, by telephone within one working day and arrange a resampling as soon as possible to confirm if a statistically significant increase (or change in pH) exists. Resampling must include not less than four replicate samples at the affected well(s) for the parameter(s) in question. A statistically significant exceedance shall be confirmed using the statistical evaluation procedures defined in Section 9 of the Postclosure Groundwater SAP, Attachment 6, of this license. For the Group I groundwater monitoring parameters determined as specified in Sections 9.1.1 and 9.1.2 of the Postclosure Groundwater SAP, Attachment 6, of this license, a statistically significant increase shall be confirmed if at least two of the four resample results are detected above the laboratory detection limit(s) for the parameter(s), or if at least one of the resample results is detected at five times the laboratory detection limit. {R 299.9612 and 40 CFR §264.97(g)}

8. If the licensee determines pursuant to Conditions IV.A.6. and IV.A.7. of this license that a statistically significant increase has been confirmed for primary parameters, the licensee shall: {R 299.9612 and 40 CFR §264.98(f) and (g)}

   (a) Notify the Division Director within one working day by calling the Materials Management Division project geologist or permit engineer for the site, the appropriate Materials Management Division District Supervisor, or in the event of their unavailability, the Department of Environment, Great Lakes, and Energy PEAS at 1-800-292-4706.

   (b) Provide follow-up notification to the Division Director in writing within seven calendar days after the telephone call. The notification shall indicate what parameters or constituents have shown statistically significant changes and the wells in which the changes have occurred.

   (c) As soon as possible, sample the groundwater in the monitoring wells within 500 feet of the affected well for primary and secondary parameters and determine the concentration of all constituents identified in 40 CFR, Part 261, Appendix IX, that are present in groundwater, and for which approved analysis methods exist. The licensee shall also establish background values for Appendix IX constituents detected pursuant to R 299.9612 and 40 CFR §264.98(g)(3).

   (d) Immediately take steps to determine the cause of the contamination and eliminate the source of discharge.

   (e) Within 90 days after the determination, submit to the Division Director an application for a license modification to establish a compliance monitoring and corrective action program meeting the requirements of R 299.9612. The application shall include the following information:

(i) An identification of the concentration of all Appendix IX constituents found in the groundwater.

(ii) Any proposed changes to the groundwater monitoring system at the facility necessary to meet the requirements of R 299.9612.

(iii) Any proposed changes to the monitoring frequency, sampling and analysis procedures or methods, or statistical procedures used at the facility necessary to meet the requirements of R 299.9612.

(f) Within 180 days after the determination, submit to the Division Director a detailed description of corrective actions that shall achieve compliance with applicable laws and rules, including a schedule of implementation. Corrective action shall also meet the requirements of R 299.9629 and include a plan for a groundwater monitoring program that shall demonstrate the effectiveness of the corrective action. Such a groundwater monitoring program may be based on a compliance monitoring program developed to meet the requirements of 40 CFR §264.99.

(g) During the period prior to a license modification requiring a compliance monitoring and corrective action program, the licensee shall provide the Division Director, or designee, with weekly telephone updates and written reports every two weeks regarding the progress to date in determining the cause of contamination and eliminating the discharge. The licensee shall include in the written report the results of all samples from environmental monitoring conducted by the licensee.

9. If the licensee determines pursuant to Conditions IV.A.6. and IV.A.7. of this license that a statistically significant increase (or change in pH) in hazardous constituents has occurred in groundwater, it may demonstrate that a source other than the licensed facility caused the increase (or change in pH) or that the increase (or change in pH) resulted from error in sampling, analysis, or evaluation. While the licensee may make a demonstration under this condition in addition to, or in lieu of, submitting a license modification application within the time specified in Condition IV.A.8.(e) of this license, the licensee is not relieved of the requirement to submit a license modification application within the time specified unless the demonstration made under this condition successfully shows that a source other than the licensed facility caused the increase (or change in pH) or that the increase (or change in pH) resulted from an error in sampling, analysis, or evaluation. In making a demonstration under this condition, the licensee shall:

(a) Notify the Division Director within 7 days after the determination that it intends to make a demonstration under this condition.

(b) Within 90 days after the determination, submit a report to the Division Director that demonstrates that a source other than the licensed facility solely caused the increase (or change in pH) or that the increase (or change in pH) was caused by error in sampling, analysis, or evaluation.

(c) Within 90 days after the determination, submit to the Division Director an application for a license modification to make any appropriate changes to the groundwater monitoring program at the facility.

(d) Continue to monitor groundwater in compliance with this license.

{R 299.9612 and 40 CFR §264.98(g)(6)}

10. In the event that the Division Director determines from the findings of Conditions IV.A.6., and IV.A.7. of this license that a statistically significant increase (or change in pH) in hazardous constituents has occurred in the groundwater, and the Director finds, in accordance with §11148 of Act 451, that the increase (or change in pH) may present an imminent and substantial hazard to the health of persons or to the natural resources, or is endangering or causing damage to public health or the environment, the licensee shall immediately comply with an order issued by the Director pursuant to §11148(1) of Act 451 to conduct activities as required by the Director to eliminate the said endangerment. {R 299.9612(1)(g)}

11. The licensee shall measure static water levels and conduct hydraulic monitoring on a quarterly basis as specified in Section 3.1 of the Postclosure Groundwater SAP, Attachment 6, of this license. In addition to demonstrating upward and inward gradients the licensee shall annually demonstrate that the 6-inch perforated corrugated polyethylene (CPE) pipe installed within the leachate collection system trenches is open and in free-flow condition as specified in Section 3.1 of the Postclosure Groundwater SAP, Attachment 6, of this license. If hydraulic monitoring indicates that an inward gradient is not being contained at the containment unit(s), and/or that the artesian condition no longer exists in the bedrock aquifer beneath the containment unit(s), and/or the CPE pipe within the leachate collection system is not open and free-flowing, then the license shall do all of the following:

(a) Immediately notify the Division Director by calling the Materials Management Division project geologist or permit engineer for the site, the appropriate Materials Management Division District Supervisor, or in the event of their unavailability, the Department of Environment, Great Lakes, and Energy PEAS at 1-800-292-4706.

(b) Provide follow-up notification to the Division Director in writing within 5 calendar days of the verbal notification. The written notification shall include a description of the specific monitor well(s), piezometer(s), and area(s) of the containment unit(s) at which the inward and/or upward gradient is not detected.

(c) Adjust the detection monitoring frequency of the monitoring wells at the affected containment unit(s) to quarterly.

(d) Measure static water levels to confirm that the artesian condition in the bedrock aquifer no longer exists within 30 days. If the loss of the artesian condition is confirmed, submit a bedrock aquifer groundwater monitoring plan (chemical and hydraulic) to the Division Director within 90 days of the confirmation, and upon approval, implement the bedrock aquifer groundwater monitoring plan.

12. The licensee shall submit a statistical summary report to the Division Director within 60 days after the effective date of this license. At a minimum, the statistical summary report shall include a narrative and tabular summary of the results of the statistical evaluation of all data (from initiation to current) of the Detection Monitoring Phase of the Postclosure Groundwater SAP, Attachment 6, of this license.

B. **LEACHATE MONITORING PROGRAM**

1. The licensee shall conduct an annual leachate monitoring program as described in Section 3.3 of the Postclosure Plan, Attachment 4, of this license.

2. The licensee shall monitor the monthly volume of leachate pumped from the facility and record the volume in the operating record. {R 299.9609(1)(b) and R 299.9619(4)(c)(iii)}

3. Any organic parameter that is added to the monitored parameters due to its elevated presence in the leachate monitoring conducted as specified in Section 3.3.1.2 of the Postclosure Plan, Attachment 4, of this license shall be added to the groundwater and surface water monitoring parameters by the licensee.

4. The licensee shall report leachate monitoring results as required by Condition II.J.3. of this license.

5. The licensee shall submit an annual leachate monitoring report to the Materials Management Division by March 1st of each year during the active life of the landfill and the postclosure care period. The annual leachate monitoring report shall include:

   (a) Leachate volume calculations.

   (b) A graphical presentation of the monthly and yearly quantities of leachate being generated and pumped from the containment units.

   (c) A graphical comparison between leachate quantities pumped/generated during the reported year and the leachate quantities pumped/generated from previous years.

   (d) Calculated leachate generation from each separate unit (i.e., East Containment Unit [ECU] and West Containment Unit [WCU]) and notation of any significant changes in leachate generation observed at individual utility access holes in the two containment units.

   (e) Reasons for increases/decreases in leachate quantities. If there is an increase in leachate quantities, the source shall be indicated in the leachate monitoring report.

   (f) A narrative and tabular summary of the analytical results of the quarterly and annual leachate monitoring events, including recommendations for modifications to the groundwater detection monitoring program based on the analytical results.

   (g) The results of the annual integrity testing (including video documentation) for the 6-inch perforated CPE pipe installed within the leachate collection system trenches to confirm the CPE is open and in free-flow condition as specified in Section 3.1.3 of the Postclosure Plan, Attachment 4, of this license.

{R 299.9521(3)(a) and (b) and R 299.9611(5)}

C. EFFLUENT MONITORING PROGRAM

1. The licensee shall conduct monitoring of the treated effluent discharged to the sewer system in accordance with the permit issued to the facility by city of Monroe. The licensee shall comply with the city of Monroe discharge limitations.

2. The licensee shall provide written notification to the Division Director of any changes in the approved effluent monitoring program or discharge limitations and provide a copy of the revised approval from the city of Monroe.

{R 299.9521(3)(a) and (b) and R 299.9611(5)}

PART V
CORRECTIVE ACTION CONDITIONS

A. CORRECTIVE ACTION AT THE FACILITY

1. The licensee shall implement corrective action for all releases of a contaminant from any waste management unit (WMU) at the facility, regardless of when the contaminant may have been placed in or released from the WMU. For the purposes of this license, the term "corrective action" means an action determined by the Division Director to be necessary to protect the public health, safety, welfare, or the environment, and includes, but is not limited to, investigation, evaluation, cleanup, removal, remediation, monitoring, containment, isolation, treatment, storage, management, the temporary relocation of people, and the provision of alternative water supplies, or any corrective action allowed under Title II of the federal Solid Waste Disposal Act, PL 89-272, as amended, or regulations promulgated pursuant to that act. For the purposes of this license, the process outlined in Part 111 of Act 451 and the environmental protection standards adopted in R 299.9629 shall be used to satisfy the corrective action obligations under this license. {§§11102 and 11115a of Act 451 and R 299.9629}

2. To the extent that a release of a hazardous substance, as defined in §20101(x) of Act 451, that is not also a contaminant, as defined in §11102(2) of Act 451, is discovered while performing corrective action under this license, the licensee shall take concurrent actions as necessary to address the Part 201, Environmental Remediation, of Act 451 remedial obligations for that release. {R 299.9521(3)(b)}

B. CORRECTIVE ACTION BEYOND THE FACILITY BOUNDARY

The licensee shall implement corrective action beyond the facility in accordance with §11115a of Act 451 and R 299.9629(2).

C. IDENTIFICATION OF WASTE MANAGEMENT UNITS

The WMUs at the facility are identified below and shown on the General Layout in Corrective Action Information, Attachment 7, of this license.

1. The following WMUs, identified in Corrective Action Information, Attachment 7, of this license, require further corrective action at this time that includes, at a minimum, further investigation to determine if a release of a contaminant has occurred and, if a release has occurred, the nature and extent of the release.

   (a) WMU Number 1: Salaried Parking Lot
   WMU Number 2: Coal Pile
   WMU Number 3: Former Coal Pile
   WMU Number 4: Rifle Range
   WMU Number 5: Demolition Disposal Area
   WMU Number 6: Empty Drum Storage Area
   WMU Number 7: Former Drum Storage Area
   WMU Number 8: Current Drum Storage Area
   WMU Number 9: Filter Press Area
   WMU Number 10: Dead Tree Area
   WMU Number 14: Tower Area
   WMU Number 15: West Lagoon
   WMU Number 17: Fire Line Area

Descriptions for these WMUs are provided in the Corrective Action Information, Attachment 7, of this license.

2. The following WMUs, identified in the Corrective Action Information, Attachment 7, of this license, require no further corrective action at this time. No further corrective action is required at this time for the units because previous remedial efforts have met applicable closure criteria. However, it should be noted that formal approval of Closure Certification for these WMUs has not yet been granted by the Materials Management Division.

WMU Number 11:	West/West Marsh Area
WMU Number 12:	North/North Intake Canal – Grid 1
WMU Number 13:	North/North Intake Canal – Grid 2
WMU Number 16:	Process Canal

Descriptions for these WMUs are provided in the Corrective Action Information, Attachment 7, of this license.

{§§11102 and 11115a of Act 451 and R 299.9521(3)(b) and R 299.9629}

3. Within 30 days of discovery of a new WMU, a release of a contaminant from a new WMU, or a release of a contaminant from an existing WMU, the licensee shall provide written notification to the Division Director. The written notification shall include all of the following information:

   (a) The location of the unit on the facility topographic map.

   (b) The designation of the type of unit.

   (c) The general dimensions and structural description, including any available drawings of the unit.

   (d) The date the unit was operated.

   (e) Specification of all waste(s) that have been managed in the unit.

   (f) All available information pertaining to any release of a contaminant from the unit.

4. Based on a review of all of the information provided in Condition V.C.3. of this license, the Division Director may require corrective action for the newly identified WMU. The licensee shall submit a written Corrective Action Investigation Work Plan to the Division Director within 60 days of written notification by the Division Director that corrective action for the unit is required.

{§§11102 and 11115a of Act 451 and R 299.9504(1), R 299.9508(1)(b), and R 299.9629 and 40 CFR §270.14(d)}

D. CORRECTIVE ACTION INVESTIGATION

The licensee shall conduct a Corrective Action Investigation to determine if a release of a contaminant(s) from any of the WMU identified in Condition V.C. of this license has occurred and, if a release(s) has occurred, evaluate the nature and extent of the release(s). The licensee shall submit a written Corrective Action Investigation Work Plan, Corrective Action Investigation Final Report documenting compliance with the approved Work Plan and supporting further corrective action at the facility, and Corrective Action Investigation progress reports to the Division Director for review and approval in accordance with Condition V.K of this license. The Division Director will approve, modify and approve, or provide a Notice of Deficiency (NOD) for the Work Plan and Final Report. Upon approval, the Work Plan and Final Report become enforceable conditions of this license. {§§11102 and 11115a of Act 451, and R 299.9629}

E. INTERIM MEASURES

The licensee shall conduct interim measures (IM) at the facility, if determined necessary by the licensee or the Division Director, to cleanup or remove a released contaminant or to take other actions, prior to the implementation of corrective measures, as may be necessary to prevent, minimize, or mitigate injury to the public health, safety, or welfare, or to the environment. The licensee shall submit a written IM Work Plan, an IM Final Report documenting compliance with the approved Work Plan and supporting further corrective action at the facility, and IM progress reports to the Division Director for review and approval in accordance with Condition V.K of this license. The Division Director will approve, modify and approve, or provide an NOD for the Work Plan and Final Report. Upon approval, the Work Plan and Final Report become enforceable conditions of this license. {§§11102 and 11115a of Act 451 and R 299.9629}

F. DETERMINATION OF NO FURTHER ACTION

1. The licensee shall continue corrective action measures to the extent necessary to ensure that the applicable environmental protection standards adopted in Part 111 of Act 451, are met, if the limits are not less stringent than allowed pursuant to the provisions of RCRA.

2. Based on the results of the Corrective Action Investigation and other relevant information, the licensee shall submit a written request for a license minor modification to the Division Director if the licensee wishes to terminate corrective action for a specific WMU identified in Condition V.C. of this license. The licensee must demonstrate that there have been no releases of a contaminant(s) from the WMU and that the WMU does not pose a threat to public health, safety, welfare, or the environment.

3. Based on the results of the Corrective Action Investigation and other relevant information, the licensee shall submit a written request for a license major modification to the Division Director if the licensee wishes to terminate facility-wide corrective action. The licensee must conclusively demonstrate that there have been no releases of a contaminant(s) from any of the WMU at the facility and that none of the WMUs pose a threat to public health, safety, welfare, or the environment.

4. If, based upon a review of the licensee's request for a license modification pursuant to Condition V.F.2., or V.F.3. of this license, the results of the completed Corrective Action Investigation, and other relevant information, the Division Director determines that the releases or suspected releases of a contaminant(s) do not exist and that the WMU(s) do not pose a threat to public health, safety, welfare, or the environment, the Division Director will approve the requested modification, subject to Conditions V.F.5., and V.F.6., below.

5. A determination of no further action shall not preclude the Division Director from requiring continued or periodic monitoring of air, soil, groundwater, or surface water, if necessary to protect public health, safety, welfare, or the environment, when facility-specific circumstances indicate that potential or actual releases of a contaminant(s) may occur.

6. A determination of no further action shall not preclude the Division Director from requiring further corrective action at a later date, if new information or subsequent analysis indicates that a release or potential release of a contaminant(s) from a WMU at the facility may pose a threat to public health, safety, welfare, or the environment. The Division Director will initiate the necessary license modifications if further corrective action is required at a later date.

{§§11102 and 11115a of Act 451 and R 299.9629(2)}

G. CORRECTIVE MEASURES STUDY

If the Division Director determines, based on the results of the Corrective Action Investigation and other relevant information, that remedial activities are necessary, the Division Director may notify the licensee in writing that a Corrective Measures Study (CMS) is required. If notified by the Division Director, the licensee shall conduct a CMS to develop and evaluate the corrective measures alternative(s) necessary to address the release(s) of a contaminant(s) or hazardous substances and the WMU(s) that are identified in the approved Corrective Action Investigation Final Report as requiring final remedial activities. The licensee shall submit a written CMS Work Plan, a CMS Final Report documenting compliance with the approved Work Plan and supporting further corrective action at the facility, and CMS progress reports to the Division Director for review and approval in accordance with Condition V.K. of this license. The Division Director will approve, modify and approve, or provide an NOD for the Work Plan and Final Report. Upon approval, the Work Plan and Final Report become enforceable conditions of this license. {§§11102 and 11115a of Act 451 and R 299.9629}

H. CORRECTIVE MEASURES IMPLEMENTATION PLAN

1. The licensee shall conduct final corrective measures based on the CMS Final Report approved by the Division Director. The licensee shall submit a written Corrective Measures Implementation (CMI) Work Plan to the Division Director for review and approval. The licensee shall also submit a written CMI Final Report documenting the compliance with the approved CMI Work Plan and providing justification that the corrective actions may cease, and CMI progress reports to the Division Director for review and approval in accordance with Condition V.K. of this license. The Division Director will approve, modify and approve, or provide an NOD for the Work Plan and Final Report. Upon approval, the Work Plan and Final Report become enforceable conditions of this license.

2. The Division will provide notice of its draft decision on the CMI Work Plan to persons on the facility mailing list and provide an opportunity for a public hearing.

3. The licensee shall implement the approved CMI Work Plan within 60 days of receipt of the Division Director's written approval of the Work Plan.

{§§11102 and 11115a of Act 451 and R 299.9629}

I. CORRECTIVE ACTION MANAGEMENT UNITS

If applicable, the licensee shall comply with the requirements of R 299.9635 in order to designate an area at the facility as a corrective action management unit for implementation of corrective measures. {R 299.9521(3)(a)}

J. TEMPORARY UNITS

If applicable, the licensee shall comply with the requirements of R 299.9636 in order to designate tank or container storage units used for the treatment or storage of remediation wastes as temporary units for implementation of corrective measures. {R 299.9521(3)(a)}

K. SUMMARY OF CORRECTIVE ACTION SUBMITTALS

The licensee shall submit the required documents in accordance Conditions V.C., V.D., V.E., V.G., and V.H. of this license and the schedule below.

Document	Submittal Deadline
Written notification of a new release of a contaminant from an existing WMU, a new WMU, or a release of a contaminant from a new WMU	Within 30 days of discovery
Corrective Action Investigation Work Plan for a newly identified release of a contaminant from an existing WMU, a new WMU, or a release of a contaminant from a new WMU	Within 60 days of receipt of notification that a Corrective Action Investigation is required
Revised Corrective Action Investigation Work Plan for WMUs and contaminant releases	Within 45 days of receipt of Corrective Action Work Plan NOD
Corrective Action Investigation progress reports	Within 60 days of initiation of the investigation and every 60 days thereafter, unless otherwise approved.
Corrective Action Investigation Final Report for WMUs and contaminant releases	Within 60 days of completion of Corrective Action investigation
Revised Corrective Action Investigation Final Report for WMUs and contaminant releases	Within 30 days of receipt of Corrective Action Investigation Final Report NOD
IM Work Plan for WMUs and contaminant releases	Within 60 days of receipt of notification that IM Work Plan is required
Revised IM Work Plan for WMUs and contaminant releases	Within 45 days of receipt of IM Work Plan NOD
IM progress reports	Within 60 days of initiation of the IM and every 60 days thereafter, unless otherwise approved.
IM Final Report for WMUs and contaminant releases	Within 60 days of completion of the IM

Document	Submittal Deadline
Revised IM Final Report for WMUs and contaminant releases	Within 30 days of receipt of IM Final Report NOD
CMS Work Plan for WMUs and contaminant releases	Within 60 days of receipt of notification that CMS is required
Revised CMS Work Plan for WMUs and contaminant releases	Within 45 days of receipt of CMS Work Plan NOD
CMS progress reports	Within 60 days of initiation of the CMS and every 60 days thereafter, unless otherwise approved.
CMS Final Report for WMUs and contaminant releases	Within 60 days of completion of the CMS
Revised CMS Final Report for WMUs and contaminant releases	Within 30 days of receipt of CMS Final Report NOD
CMI Work Plan for WMUs and contaminant releases	Within 90 days of approval of the CMS Final Report
Revised CMI Work Plan for WMUs and contaminant releases	Within 45 days of receipt of CMI Work Plan NOD
CMI progress reports	Within 60 days of initiation of the CMI and every 60 days thereafter, unless otherwise approved.
CMI Final Report for remediated WMUs and contaminant releases	Within 60 days of the remedial actions have been completed and cleanup criteria have been met
Revised CMI Final Report for WMUs and contaminant releases	Within 30 days of receipt of CMI Final Report NOD

L. **CORRECTIVE ACTION DOCUMENTS RETENTION**

The licensee shall maintain all corrective action documents required by this license at the facility. The documents shall be maintained for the operating life of the facility or until the facility is released from financial assurance requirements for corrective action by the Division Director, whichever is longer. The licensee shall offer such documents to the Division Director prior to discarding those documents. {§§11102 and 11115a of Act 451 and R 299.9521(3)(b) and R 299.9629}

Attachment 1

Inspection Schedule

FORM EQP 5111 ATTACHMENT TEMPLATE A5
INSPECTION REQUIREMENTS

This document is an attachment to the Michigan Department of Environmental Quality's *Instructions for Completing Form EQP 5111, Operating License Application Form for Hazardous Waste Treatment, Storage, and Disposal Facilities.* See Form EQP 5111 for details on how to use this attachment.

The administrative rules promulgated pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), being R 299.9504, R 299.9508, R 299.9605 and Title 40 of the Code of Federal Regulations (CFR) §§264.15 and 270.14(b)(5), establish requirements for inspections at hazardous waste management facilities. All references to 40 CFR citations specified herein are adopted by reference in R 299.11003

This license application template addresses requirements for inspections at the following hazardous waste management facility: *River Raisin Warehouse* in *Monroe*, Michigan. (Check as appropriate)

☒ Applicant for Operating License for Existing Facility

☐ Applicant for Operating License for New, Altered, Enlarged, or Expanded Facility

This template is organized as follows:

INTRODUCTION
[R 299.9605 and 40 CFR §264.15(a)].

This section presents information pertaining to inspection and maintenance performed for the Western Containment Unit (WCU) and the Eastern Containment Unit (ECU) at the Ford River Raisin Warehouse (RRW). Post-closure monitoring activities were initiated on March 15, 2000 and were conducted in accordance with procedures specified in the Post-Closure Operating License Application, Volume III - Post Closure Plan, dated June 26, 2000.

Information regarding detailed inspection activities is contained in the Post Closure Plan, which is included as Attachment A11 of this application.

A5.A WRITTEN SCHEDULE
[R 299.9605 and 40 CFR §264.15(b)(1)]

The Post-Closure Plan identifies four types of inspections to be performed: weekly, monthly, semi-annual and annual. During weekly inspections, a general visual inspection of the containment units and selected leachate collection system components will be performed. The containment units will be checked for general operation and function. If any items are found to be deficient, they are noted on the inspection log and described further at the end of the log.

The monthly and semi-annual inspections will include all items checked during the weekly inspections in addition to a detailed inspection of the post-closure groundwater monitoring system, further items of the leachate collection system, and a measurement of the sediment containment unit (SCU) leachate level. The annual inspections will include all items checked during the monthly or semi-annual inspections in addition to the confirmation that integrity verification of leachate collection piping has been within the last 12 months for the ECU and WCU. Just as with the weekly inspections, any deficient items will be described at the end of the log. The weekly, monthly, semi-annual, and annual inspection logs are attached.

Additional specific detailed information regarding inspection schedules is contained in the Post Closure Plan, which is included as an Attachment A11 of this application.

A5.A.1 Types of Problems
[R 299.9605 and 40 CFR §264.15(b)(3)]

Inspections of the cover system in place on the ECU and WCU will be completed on a weekly, monthly, semi-annual and annual basis. Qualified personnel will visually inspect both the ECU and WCU by traversing the units on foot and by driving along the access road along the perimeter of the units. Inspection personnel will observe the current conditions and address any changes in the appearance of the cover system. Issues and concerns will be addressed either by RRW staff or inspection personnel. Provided below is a brief summary of inspection activities that will be conducted for the WCU and ECU, including detailed cover system integrity inspection procedures. The cover system visual inspections include the following twelve items:

1. Vegetative cover maintained (mowed) and free of bare spots

Inspection personnel will observe that the vegetative cover located on the WCU and ECU is maintained and free of bare spots. Inspection personnel will make these observations by traversing the cover system on foot and by driving along the access road. If the vegetative cover is not mowed to an acceptable length (less than 6”) at the time of the inspection, it is noted on the Inspection Log and given to the RRW Representative. If an area of the cover system needs to be mowed, the task will be completed by a RRW Employee. If bare spots are noted during the inspection, top soil is placed in the area and vegetation established. Bare spots maybe addressed at the time of the inspection or prior to the next inspection by inspection personnel. The vegetative cover is routinely mowed and maintained by a RRW employee. All activities regarding the vegetative cover will be documented on the Inspection Log.

2. *Cover free of undesirable plant species.*

Inspection personnel will observe that the cover system is free of undesirable plant species by traversing the cover system on foot and by driving along designated access roads. Undesirable plants include noxious weeds and tree species. If undesirable plant species are observed during the site inspection, inspection personnel will spray the undesirable plant with an appropriate herbicide. All undesirable plants and removal of these plants will be documented on the Inspection Log. Weed growth is also maintained during routine mowing of the cover system by RRW personnel.

3. *No evidence of burrowing animals.*

The cover system will be observed each week for the presence of burrowing animals. Inspection personnel will make these observations by traversing the ECU and WCU on foot and by observations made from the access road. The presence of any burrowing animals within the cover system is unacceptable. Burrow holes will be addressed by utilizing the mud-packing method, which is an MDEQ approved method for rodent control. This method can be accomplished by placing one or two lengths of metal stove or vent pipe in a vertical position over the entrance of the den. The mud-packing mixture is then poured into the pipe until the burrow and pipe are filled with the earth-water mixture. The pipe is removed and dry earth is tamped into the entrance. The mud-pack is made by adding water to a 90 percent earth and 10 percent cement mixture until a slurry or thin cement consistency is attained. All entrances will be plugged with the well-compacted earth and vegetation re-established. Burrow holes will be addresses by inspection personnel during the inspection or prior to the next inspection.

4. *No visible surface erosion, soft, wet or unstable areas noted on cover*

Inspection personnel will observe the cover system for areas of erosion, soft, wet or unstable areas during each inspection. Inspection personnel will make these observations by traversing the ECU and WCU on foot and by observations made from the access road. Any areas of erosion, soft, wet or unstable areas within the cover system are unacceptable. Inspection personnel will document any areas of standing water on the Inspection Log and address the issues prior to the next inspection. Inspection personnel will address the area of concern by filling in any erosional features and establishing acceptable vegetation. When filling in the areas inspection personnel will maintain an acceptable drainage pattern to address and prevent the formation of further erosion or soft, wet or unstable areas within the cover system. All activities regarding repairs will be documented on the Maintenance Log.

5. *No evidence of standing surface water.*

Inspection personnel will observe the cover system for areas of standing surface water during each inspection. Inspection personnel will make these observations by traversing the ECU and WCU on foot and by observations made from the access road. Standing surface water is unacceptable on the landfill cover system. If standing surface water is observed, the area will be filled and vegetation established in order to create an acceptable drainage pattern on the cover system. Inspection personnel will document any areas of standing water on the Inspection Log and address the issues prior to the next inspection.

6. *No areas of settlement/subsidence noted.*

Inspection personnel will observe the cover system for areas of settlement and subsidence. Inspection personnel will make these observations by traversing the ECU and WCU on foot and by observations made from the access road. Any area of subsidence or settlement located within the cover system is unacceptable. If these areas are observed, inspection personnel will address the areas by be filling the area with topsoil and will establish acceptable vegetation in order to prevent low-lying areas and maintain the drainage pattern of the cover system. Inspection personnel will document any areas of standing water on the Inspection Log and address the issues prior to the next inspection.

7. *No cracks in cover soils.*

Inspection personnel will observe the cover system for cracks in the cover soils. Inspection personnel will make these observations by traversing the ECU and WCU on foot and by observations made from the access road. Any area of cracks located within the cover system is unacceptable. If cracks are observed in the cover soils, inspection personnel will address the areas by be filling the cracks with topsoil and establishing vegetation. Inspection personnel will document any areas of cracking on the Inspection Log and address the issues prior to the next inspection.

8. *Cover free of any other apparent problems which may lead to malfunction*

Inspection personnel will observe the cover system for any other apparent problems which may lead to malfunction. Inspection personnel will make these observations by traversing the ECU and WCU on foot and by observations made from the access road. Any observation made by inspection personnel during the site inspections that may lead to malfunction will be documented on the Inspection Log and addressed by either inspection personnel or RRW employees in a time frame appropriate to the situation.

9. *Gravel toe drain stable and free of clogging vegetation.*

Observations will be made of the gravel toe drain during each of the site inspections. Observations will be made by inspecting the gravel toe drains on foot and by car along the access road. Vegetation observed in the growing in the gravel toes drains will be removed by either spraying with an herbicide or by physically removing the plant. Inspection personnel will spray small areas of vegetation within the gravel to drain during the site inspection or prior to the next inspection. However, when larger growth areas are observed inspection personnel will inform a RRW representative who will obtain a commercial lawn service to spray the gravel toe trains with an herbicide. In addition, if trees or other large plants are observed, the RRW representative may appoint RRW employees to remove large trees or plants from the gravel toe drains. Inspection personnel will document all spraying and plant removal on the Maintenance Log.

10. Stormwater inlets/outlets are free of sediment and debris and are functional.

During the site inspection stormwater outlets are observed for the presence of sediment and debris which may block flow. Any sediment or debris that may potentially block flow is considered unacceptable and will be removed by inspection personnel during the inspection. Any sediment or debris removal will be documented on the Maintenance Log.

11. Access road intact and functional.

Observations will be made of the access road during each of the site inspections. Observations will be made by driving along the access road. The road will be observed for any holes, washout areas or any physical obstructions that would limit travel on the access road. Any factor that would limit the ability to travel the access road is unacceptable. Inspection personnel will document unacceptable areas of the access road areas on the Inspection Log and inform a RRW Representative. The access road will be repaired or in the process of repair prior to the next inspection. The access road is maintained and repaired by RRW personnel. All areas in need of repair will be documented on the Inspection Log and repaired areas will be documented on the Maintenance Log.

12. Asphalt pavement above cover intact and functional.

Observations will be made of the asphalt pavement cover during each of the site inspections to insure that it is intact and functional. Observations will be made on foot and by driving along the access road. Inspection personnel will document any areas in need of repair on the Inspection Log. Any repairs made to the asphalt pavement cover will be made by RRW personnel prior to the next inspection. All areas repaired will be documented on the Maintenance Log.

The leachate collection system was designed with pump system warning lights. On a weekly basis during the post-closure period, the warning lights on the leachate collection system manholes will be checked for indications of pump system failure. This will be recorded on the Inspection Log

On a monthly basis, leachate sediment within the manholes will be measured for indications of leachate volume and monitoring for storage capacity. In addition, the Sediment Containment Unit (SCU) leachate level will be measured and compared to the as-built elevations for indications of leachate accumulation within the SCU. Measurements will be recorded on the Inspection Log.

On an annual basis, the leachate collection and removal system (LCRS), specifically, the 6” perforated corrugated polyethylene (CPE) pipe will be completely inspected to ensure that the integrity and capacity of the systems are being maintained. The LCRS inspection is limited to those components of the system that can be observed without damage to the structure.

Benchmarks and final cover configuration surveys will be performed every five years.

Additional specific detailed information regarding inspection schedules is contained in the Post Closure Plan, which is included as an Attachment A11 of this application.

13. Inspections of emergency equipment

Inspection of containment unit emergency equipment is detailed in the Contingecy Plan (Attachment A7 of this application).

A5.A.2 Frequency of Inspection
[R 299.9605 and 40 CFR §§264.15(b)(4), 264.174, 264.193, 264.195, 264.226, 264.254, 264.278, 264.303, 264.347, 264.602, 264.1033, 264.1052, 264.1053, 264.1058, and 264.1083 through 264.1089, where applicable]

The Post-Closure Plan identifies four types of inspections to be performed: weekly, monthly, semi-annual and annual. During weekly inspections, a general visual inspection of the units and selected leachate collection system components will be performed. The monthly and semi-annual inspections will include all items checked during the weekly inspections in addition to a detailed inspection of the post-closure groundwater monitoring system.

A5.B REMEDY SCHEDULE
[R 299.9605 and 40 CFR §264.15(c)]

The Post-Closure Plan (Attachment A11) includes procedures for rectifying system failures and correcting items that are damaged or nonfunctional that the inspections reveal. Maintenance Logs are attached.

A5.C INSPECTION LOG OR SUMMARY
[R 299.9605 and 40 CFR §264.15(d)]

The owner or operator must record inspections in an inspection log or summary. Copies of these records must be kept for at least three years from the date of inspection. At a minimum, these records must include the date and time of the inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions taken. Inspection personnel will record all of findings on the attached Inspection Log. Each Inspection Log is given to a RRW representative for a signature. Maintenance logs will be created when maintenance is performed to mend failures, damaged and or nonfunctional items. The weekly, monthly, semi-annual, and annual inspection logs and maintenance logs will be maintained electronically after signature is received and can be available for EGLE review upon request.
Copies of the inspection and maintenance logs are included in Attachment C of the Post Closure Operating License Post Closure Plan.

FORD MOTOR COMPANY

INSPECTION LOG

Weekly Monthly Semi-Annual Annual

Inspection Performed On: Date: ____________ Time: ____________

Inspection Performed By: Name: ______________________________

Company: ______________________________

Directions:

Along the right side of the form is an indication of when each item is to be inspected (see type of inspection above). After inspecting the following items as described, check the appropriate box. For those items where a problem is noted, provide a detailed written description of the problem in the space provided at the end of the form. If more space is needed, attach additional sheets along with sketches, photographs, etc. Be sure to number each page, including any attached pages.

	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
Part A - Security System (Existing Site Security)				
1. Guard on duty at plant entrance.				**W**,M,S,A
2. Perimeter landfill fencing in place and gates locked, locks in good shape.				**W**,M,S,A
Part B - Groundwater Monitoring System (see attached sketch)				
1. All wells/piezometers accessible.				M,S,A
2. Protective covers secure and locked, locks in good shape (operable).				M,S,A
3. Protective covers functioning.				M,S,A
4. No evidence of standing water at surface of well/piezometer.				M,S,A
5. Each well/piezometer labeled clearly and correctly.				M,S,A
6. No evidence of standing water at surface of well/piezometer.				M,S,A
7. Surface seal at each well/piezometer intact and functional.				M,S,A
8. Cap secure on each well/piezometer.				M,S,A
9. No unusual obstruction apparent in well/piezometer.				M,S,A
10. No evidence of sediment build-up in well/piezometer, based on comparison of expected and measured total depths.				M,S,A
11. No evidence of screen clogging, based on comparison of expected and actual recovery rates at individual wells/piezometers.				M,S,A
12. No other problems which may cause the monitoring system to perform ineffectively.				M,S,A

FORD MOTOR COMPANY

INSPECTION LOG

Inspection Performed On: Date: ___________

Part C - Miscellaneous Inspection Items

	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. On-site monuments located and intact (see attached sketches).				M,S,A
2. Any repairs made to correct problems since the last site inspection appear to have been acceptable and problem(s) alleviated.				**W**,M,S,A
3. All problems noted on previous inspection report have been corrected.				**W**,M,S,A
4. No other evidence of hazardous waste discharge or leakage from the containment units or other possible sources were noted in the containment unit areas, other than those noted in this report.				**W**,M,S,A

Part D - Eastern Containment Unit Cover

	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. Vegetative cover maintained (mowed) and free of bare spots.				**W**,M,S,A
2. Cover free of undesirable plant species.				**W**,M,S,A
3. No evidence of burrowing animals.				**W**,M,S,A
4. No visible surface erosion, soft, wet or unstable areas noted on cover.				**W**,M,S,A
5. No evidence of standing surface water.				**W**,M,S,A
6. No areas of settlement/subsidence noted.				**W**,M,S,A
7. No cracks in cover soils.				**W**,M,S,A
8. Cover free of any other apparent problems which may lead to malfunction.				**W**,M,S,A
9. Gravel toe drain stable and free of clogging vegetation.				**W**,M,S,A
10. Stormwater inlets/outlets are free of sediment and debris and are functional.				**W**,M,S,A
11. Access road intact and functional.				**W**,M,S,A
12. Asphalt pavement above cover intact and functional.				**W**,M,S,A

Part E - Western Containment Unit Cover

	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. Vegetative cover maintained (mowed) and free of bare spots.				**W**,M,S,A
2. Cover free of undesirable plant species.				**W**,M,S,A
3. No evidence of burrowing animals.				**W**,M,S,A
4. No visible surface erosion, soft, wet or unstable areas noted on cover.				**W**,M,S,A
5. No evidence of standing surface water.				**W**,M,S,A
6. No areas of settlement/subsidence noted.				**W**,M,S,A
7. No cracks in cover soils.				**W**,M,S,A
8. Cover free of any other apparent problems which may lead to malfunction.				**W**,M,S,A
9. Gravel toe drain stable and free of clogging vegetation.				**W**,M,S,A
10. Stormwater inlets/outlets are free of sediment and debris and are functional.				**W**,M,S,A
11. Access road intact and functional.				**W**,M,S,A
12. Asphalt pavement above cover intact and functional.				**W**,M,S,A

FORD MOTOR COMPANY

INSPECTION LOG

Inspection Performed On: Date: ___________

Part F - Eastern Containment Unit Leachate Collection System

Item	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. Manhole covers securely in place, locked, locks in good shape (see sketch).	☐	☐	☐	**W**,M,S,A
2. Leachate pumps are properly positioned and functional.	☐	☐	☐	**W**,M,S,A
3. Manhole sumps have less than three inches of sediment.	☐	☐	☐	M,S,A
4. Pump warning lights indicate system is functional.	☐	☐	☐	**W**,M,S,A
5. Secondary containment pipe free of liquids.	☐	☐	☐	M,S,A
6. Perimeter and interior pipe cleanouts are accessible, intact, and locked, locks in good shape.	☐	☐	☐	**W**,M,S,A
7. Collection piping cleaned within the last 12 months (as-built summary of pipe lengths attached).	☐	☐	☐	A

Part G - Western Containment Unit Leachate Collection System

Item	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. Manhole covers securely in place, locked, locks in good shape (see sketch).	☐	☐	☐	**W**,M,S,A
2. Leachate pumps are properly positioned and functional.	☐	☐	☐	**W**,M,S,A
3. Manhole sumps have less than three inches of sediment.	☐	☐	☐	M,S,A
4. Pump warning lights indicate system is functional.	☐	☐	☐	**W**,M,S,A
5. Secondary containment pipe free of liquids.	☐	☐	☐	M,S,A
6. Perimeter and interior pipe cleanouts are accessible, intact, and locked, locks in good shape.	☐	☐	☐	**W**,M,S,A
7. Collection piping cleaned within the last 12 months (as-built summary of pipe lengths attached).	☐	☐	☐	A

Part H - Sediment Containment Unit Leachate Collection System

Item	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. Riser pipe cover securely in place and locked, lock in good shape.	☐	☐	☐	**W**,M,S,A
2. Leachate level checked within the last month and is at an acceptable level ($\leq$ 581.4).	☐	☐	☐	M,S,A

_______________________________ Inspector's Signature

_______________________________ Client Representative's Signature

FORD MOTOR COMPANY

INSPECTION LOG

Inspection Performed On: Date: ___________

Notes:

FORD MOTOR COMPANY

MAINTENANCE LOG

Maintenance Performed On: Date: ____________ Time: ____________

Maintenance Performed By: Name(s): ______________________________

Company: ______________________________

Describe the items(s) repaired or replaced: ______________________________

Date(s) item(s) was/were last inspected: ______________________________

Is this a recurring problem? When did it first occur? ______________________________

Describe in detail the repairs/corrections that have been made. Attach reports, plans sketches, photographs, or any other documentation as appropriate.

______________________________ Inspector's Signature

______________________________ Client Representative's Signature

Attachment 2

Personnel Training Program

FORM EQP 5111 ATTACHMENT TEMPLATE A10
PERSONNEL TRAINING

This document is an attachment to the Michigan Department of Environmental Quality's *Instructions for Completing Form EQP 5111, Operating License Application Form for Hazardous Waste Treatment, Storage, and Disposal Facilities.* See Form EQP 5111 for details on how to use this attachment.

The administrative rules promulgated pursuant to Part 111, Hazardous Waste Management, of the Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451), R 299.9501, R 299.9605 and Title 40 Code of Federal Regulations (CFR) §§264.16 and 270.14(b)(12), establish requirements for personnel training programs at hazardous waste management facilities. All references to 40 CFR citations specified herein are adopted by reference in R 299.11003.

This license application template addresses requirements for a personnel training program at the hazardous waste management facility for the River Raisin Warehouse in Monroe, Michigan. The information included in the template demonstrates how the facility meets the personnel training requirements for hazardous waste management facilities.

This template is organized as follows:

A10.A CONTENT OF INTRODUCTORY AND CONTINUING EDUCATION TRAINING PROGRAMS

[R 299.9605 and 40 CFR §264.16(a)]

Personnel associated with Post-Closure tasks will successfully complete a training program consisting of site-specific document review and on-the-job training for all personnel involved with containment unit inspections and environmental monitoring activities at the Ford River Raisin Warehouse (RRW). All personnel are trained on site under the direct supervision of senior staff members familiar with current status of on-site hazards, and the post-closure care activities are directed by a State of Michigan Registered Professional Engineer and a Certified Hazardous Materials Manager.

A10.A.1 Outline for Introductory Training Program
[R 299.9605 and 40 CFR §§264.16(a)(1) and 264.16(d)(3)]

Prior to conducting any on-site activities, personnel associated with Post-Closure tasks will receive site specific introductory training and specialized certified training. The training consists of the following topics:

- HAZWOPER
- Review of background information of site environmental conditions and general construction and configuration of containment units
- Review of Contingency Plan
- Job Specific Training

A10.A.2 Outline for Continuing Education
[R 299.9605 and 40 CFR §§264.16(a)(1) and 264.16(d)(3)]

Continuing education is implemented as needed. The training director administers the continuing education requirements. Annual HAZWOPER refresher trainings along with job specific trainings will be conducted pursuant to each job description.

A10.B PERSONNEL SUBJECT TO TRAINING REQUIREMENTS
[R 299.9605 and 40 CFR §§264.16(a),(d)]

A10.B.1 Job Titles and Job Descriptions
[R 299.9605 and 40 CFR §§264.16(d)(1),(2)]

Environmental Scientist and or Technicians will be conducting tasks associate with Post-Closure activities. Below are the general job descriptions for each.

Environmental Scientist Job Description

General Characteristics:
• Applies standard techniques, procedures and criteria to perform assigned tasks as part of a broader assignment.
• Exercises judgment on details of work and in application of standard methods for conventional work.

Technical Responsibilities:
• Collects data, gathers information or documents and prepares simple reports required for project permits.
• Performs standard computations or analysis.
• Prepares drawings and visual aids.
• Performs a variety of routine tasks, which provide experience and familiarity with methods, practices

Direction Received:
• Receives close supervision on unusual or difficult problems, and general review of all aspects of work.

Communication Skills:
• Possesses basic oral and written communication skills.
• Interacts with other staff.

Technician Job Description

General Characteristics:
• Applies standard techniques, procedures and criteria to perform assigned tasks as part of a broader assignment.
• Exercises judgment on details of work and in application of standard methods for conventional work.

Technical Responsibilities:
• Coordinates, produces, completes and analyzes sketches, layouts, graphs, charts and drawings required for specific projects and reports.
• Understands the CADD system, procedures and coordinates layout details and dimensions (as applicable).
• Performs non-routine and complex assignments involving responsibility for planning and conducting a complete project of relatively limited scope or a portion of a large and more diverse project; may include budget management.
• Performs quality assurance checks.
• Manages material and field equipment.
• Performs routine tasks, which provide experience and familiarity with the technical staff, methods and practices.

Direction Received:
• Independently maintains accuracy, quality, and completeness and schedule adherence.

Communication Skills:
• Possesses basic oral and written communication skills.

A10.B.2 Description of How Training is Designed to Meet Actual Job Tasks
[R 299.9605 and 40 CFR §§264.16(a)(1) and (d)(3)]

The senior staff members assigned to instruct proposed inspection personnel familiarize the personnel with the site, introduce them to the RRW staff and safety procedures, and provide the personnel with a line-by-line presentation of the inspection components contained within the inspection logs. These items include inspection components of the containment unit cover, the leachate collection systems components, and monitoring wells and piezometers. Personnel are instructed to follow up on maintenance issues that are the responsibility of the RRW, and to conduct other maintenance activities such as erosion control, well maintenance, access road maintenance, the clearing of unwanted vegetation, and to mitigate damage created by burrowing animals. Personnel are instructed on the completion of the weekly, monthly, semi-annual, and annual inspection logs, and the completion of maintenance logs for any maintenance activity conducted at the RRW.

A10.C FREQUENCY OF REQUIRED TRAINING
[R 299.9605 and 40 CFR §§264.16(b), (c)]

A10.C.1 Initial Training
[R 299.9605 and 40 CFR §264.16(b)]

Each employee completes the site specific training within six months of their assignment to the facility. Employees undergoing initial training are not allowed to work in unsupervised positions until the required training is completed.

A10.C.2 Continuing Education
[R 299.9605 and 40 CFR §264.16(c)]

Annual HAZWOPER refresher trainings will be conducted. Other job specific trainings will be conducted pursuant to each job description on an as need basis.

A10.D TRAINING DIRECTOR
[R 299.9605 and 40 CFR §264.16(a)(2)]

All personnel are trained on site and off site under the direct supervision of senior staff members familiar with current status of on-site hazards. The post-closure care activities are directed by a State of Michigan Registered Professional Engineer and a Certified Hazardous Materials Manager.

A10.E DOCUMENTATION AND RECORD KEEPING REQUIREMENTS
[R 299.9605 and 40 CFR §§264.16(d) and (e)]

A10.E.1 Documentation
[R 299.9605 and 40 CFR §264.16(d)]

A10.E.1(a) Job Titles and Names of Employees Filling Each Job
[R 299.9605 and 40 CFR §264.16(d)(1)]

Job titles and employee names conducting post-closure activities are maintained at the facility in paper form. This form may be updated regularly as needed.

A10.E.1(b) Written Job Descriptions
[R 299.9605 and 40 CFR §264.16(d)(2)]

Written job descriptions for the jobs titles listed above are maintained at the facility in paper form. Job descriptions may be updated regularly as needed.

A10.E.1(c) Written Description of Type and Amount of Training Given to Each Position
[R 299.9605 and 40 CFR §264.16(d)(3)]

Written description of the type and amount of the training given to each employee is maintained at the facility. Written description of the type and amount of the trainings may be updated as needed.

A10.E.1(d) Documentation That Training Has Been Given to and Completed by Facility Personnel
[R 299.9605 and 40 CFR §264.16(d)(4)]

Documentation that training has been given to and completed by each employee is maintained at the facility.

A10.E.2 Record Keeping
[R 299.9605 and 40 CFR §264.16(e)]

Training records for current employees will be kept at the facility and will be updated as needed.

Attachment 3

Contingency Plan

Post-Closure Operating License Application – Contingency Plan

Ford River Raisin Warehouse, 3200 E. Elm Avenue, Monroe Michigan

Ford Motor Company

October 18, 2021

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The Power of Commitment

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S0	0	K. Aspinall	D. Canfield				
[Status code]							
[Status code]							
[Status code]							
[Status code]							

Table of Contents

1. Introduction

This Contingency Plan was developed to be part of the Post-Closure Renewal Operating License Application for the Ford Motor Company (Ford), River Raisin Warehouse. This Contingency Plan was prepared by GHD Services Inc. (GHD). The Ford River Raisin Warehouse is located at 3200 East Elm Avenue in Monroe, Michigan. The purpose of this Contingency Plan is to prevent and minimize the hazards to human health and the environment from fire, explosions, system failures, or chemical releases to the air, soil, surface water and ground water. Reasonably predictable emergency events that could occur are identified and response actions that will ensure protection of human health and the environment are specified. Organizations and personnel responsible for emergency response are identified, as well as the chain of command and lines of communications.

This Contingency Plan will address post-closure activities associated with the two onsite corrective action management units (CAMUs) and the on-going corrective action activities associated with several solid waste management units (SWMUs) at the River Raisin Warehouse. Generally, the activities include but are not limited to soil and ground water sampling, leachate management, soil and/or water removal, site inspections, grounds maintenance, and surveying.

2. Emergency Response Plan (ERP)

This section of the River Raisin Warehouse Contingency Plan identifies the various organizations and their key personnel and responsibilities with regard to this Contingency Plan, the potential incidents which may require implementation of this Contingency Plan, and the response actions which may be implemented in the event of an incident such as fire, explosion, system failures, or chemical release that could threaten human health or the environment.

2.1 Organization and Responsibilities

The general organization by job title and responsibilities for the River Raisin Warehouse activities are described below. Each entity having involvement with the River Raisin Warehouse may assign personnel to each job title to represent their organization. The entities involved are discussed in the following subsections.

2.1.1 Michigan Department of Environment, Great Lakes, and Energy

The Michigan Department of Environment, Great Lakes, and Energy (EGLE), Materials Management Division (MMD) reviews all documentation and oversees post-closure and corrective action activities at the River Raisin Warehouse.

2.1.2 Ford Environmental Engineer

The Ford Environmental Engineer is responsible for management and monitoring of the post-closure and corrective action activities at the River Raisin Warehouse.

2.1.3 Resident Engineer

The Resident Engineer (RE) is responsible for coordinating and overseeing post-closure and corrective action activities, staff and subcontractors. In this case, GHD is the resident engineer.

2.2 Emergency Response Actions

EGLE-MMD will be notified immediately upon discovery of an incident which requires implementation of the Contingency Plan. The Ford Environmental Engineer or the RE will be responsible for notifying the EGLE-MMD. Contingencies include the emergency response actions to be implemented if systems fail, chemical spills occur, or if there is a fire or explosion. In the event of an imminent or actual emergency situation, the Ford Environmental Engineer, or the RE or his designee will coordinate the following activities:

- Immediately assess possible hazards to human health or the environment that may result from the emergency situation.
- Immediately notify the appropriate public agency.
- Identify the character, exact source, amount and distribution of any released materials.
- Recommend appropriate action to protect human health and safety in emergency situations.

The following sections address contingency planning and response for various events that may occur at the River Raisin Warehouse.

2.2.1 Fire or Explosion

The threat of fire is an ever-present risk at the plant site. Because fires can quickly become uncontrollable, and site personnel are not trained professional fire fighters, if there is any doubt that a fire can be quickly and safely contained and extinguished, personnel will sound the evacuation alarm and orderly vacate the area and/or the site. The following response procedures will be adhered to during all possible fire emergencies unless the policy conflicts with that of a life-threatening situation.

- **Evacuation Alarm**: Anyone who sees a fire or explosion will sound the evacuation alarm. The alarm will be recognized by a series of three (3) short blasts on a car horn or air horn.
- **Egress Procedures**: When the alarm sounds, workers will suspend operations, disconnect or shut off equipment and proceed to the nearest exit and assembly point.
- **All Clear**: After the Environmental Engineer has determined that the fire has been extinguished and that it is safe to resume site operations, the all clear signal will be given by word of mouth or by a series of three (3) long blasts on a car horn or air horn.

The excerpt of the Fire or Explosion plan from Ford’s Emergency Response Plan is included as an attachment to this Contingency Plan.

2.2.2 System Failures

The CAMUs located at the River Raisin Warehouse incorporate a leachate collection and control system. As part of the post-closure activities, the components of the system are inspected on a weekly basis by the RE, and periodically by Ford personnel. Any upset conditions, spills, or leaks will be reported immediately to the Ford Environmental Engineer. Although a given system failure may not be deemed an emergency situation, the RE or Ford Environmental Engineer should immediately assess any possible hazards to human health or the environment that may result from the system failure. If deemed an emergency situation, the RE or Ford Environmental Engineer should immediately notify the appropriate public agency, identify the character, exact source, amount and distribution of any released materials, and recommend appropriate action to protect human health and safety and the environment.

2.2.3 Chemical Releases

In the event of a chemical release not associated with the CAMUs, Ford personnel should immediately contact the Ford Environmental Engineer. Ford personnel should initiate control and containment measures, locate the source of the leak, and if practical, stop the leak. The Ford Environmental Engineer should estimate the volume of the release, assess the need for a spill cleanup contractor, and begin cleanup operations as soon as possible.

All measures will be undertaken to prevent the contact of any released materials with incompatible materials (e.g. corrosive material with water, skin, eyes, and metals and flammable materials with any spark emitting sources or open flames). Released materials that are not contained will be prevented from entering any floor drains, such as through the use of oil booms or dams and inert absorbent materials. The release of corrosive materials will be cautiously and slowly neutralized (acids with an alkaline compound and alkaline solutions with a dilute acidic material). Spark-proof equipment will be used to remove flammable materials.

2.3 Emergency Contact List

The following list provides names and telephones numbers for emergency contact personnel. In the event of a medical emergency, personnel will take direction from the RE or Ford Environmental Engineer and notify the appropriate emergency organization.

Emergency	Names	Address	Telephone Number
Police	Monroe City Police Dept.	100 E 2nd Street, Suite 1, Monroe, MI	911 (734) 243-7500
Fire	Monroe Charter Township Fire Department	15331 S Dixie Hwy, Monroe, MI	911 (734) 241-1626
Hospital	ProMedica Monroe Regional Hospital	718 N Macomb Street, Monroe, MI	(734) 240-8400
Poison Control Center			(800) 252-2022
Center for Disease Control			(404) 488-4100
Chemtrec			(800) 424-9555
National Response Center			(800) 424-8802
MI Pollution Emergency Alert System (PEAS)			(800) 292-4706
EGLE – MMD (Hazardous Waste)			(517) 284-6546
Emergency Coordinators			
River Raisin Warehouse Environmental Engineer	Chuck Pinter	290 Town Center Dr, Suite 800, Dearborn, MI	(734) 260-0928
Resident Engineer	David Canfield	26850 Haggerty, Farmington Hills, MI	(315) 447-9024
River Raisin Warehouse Security	Kevin Kilmer	3200 East Elm Avenue, Monroe, MI	(734) 790-5757
River Raisin Warehouse Emergency Planning Coordinator	Sean Townsend	3200 East Elm Avenue, Monroe, MI	(419) 490-3436

The Plant has made arrangements with the City of Monroe Police Department and the City of Monroe Fire Chief to act as the Hazardous Waste Coordinator or Incident Commander in the case of a hazardous waste incident. The following services provided by the City of Monroe Police and Fire are as follows:
- Immediate response
- Crowd control assistance
- Temporary security to affected areas
- Public safety escorts
- First responder limited rescue operations
- Evacuation of surrounding areas if required

The Plant has also made arrangements with ProMedica Monroe Regional Hospital to make the hospital aware of the type of hazardous wastes stored at the Plant and the possible illnesses and injuries with such materials.

The plant has made EGLE-WHMD aware of the type of hazardous waste and requested assistance for potential hazardous waste emergencies.

2.4 Notification of Releases

If any incident at the River Raisin Warehouse threatens to cause endangerment to the public health, welfare, or the environment, the RE or Ford Environmental Engineer shall immediately take all appropriate action to prevent, abate, or minimize the emergency situation. The RE or Ford Environmental Engineer will also notify appropriate local emergency response personnel, and if required, the MDEQ-WHMD.

Notifications may also be required to other regulatory agencies, depending upon the emergency situation.

2.5 Emergency Equipment

Emergency equipment associated with the ECU and WCU include 8 float switches associated with leachate manholes that monitor fluid level. These switches are maintained as necessary.

2.6 Emergency Decontamination Equipment

GHD maintains relationships with contractors who provide emergency equipment and decontamination of emergency equipment. Clean Harbors and US Ecology have contracts with GHD to provide emergency services if necessary.

Specifically for the ECU and WCU, the wastewater treatment plant contains an emergency eyewash station and emergency shower. There are multiple fire extinguishers located throughout the wastewater treatment plant and the Site itself, all of which are maintained by Ford.

3. Evacuation Plan

Evacuations may be necessary if there is a hazardous materials release or other emergency situation. All personnel and visitors may need to evacuate the entire Site or part of the Site depending on the emergency. The River Raisin Warehouse has an Emergency Response Plan, of which an Evacuation/Shelter-in-place Plan is included (Section 3.5). The Evacuation Plan describes annual drills, signals, roles and responsibilities, and marshaling areas. The excerpt of the Evacuation/Shelter-in-place plan from Ford's Emergency Response Plan is included as an attachment to this Contingency Plan.

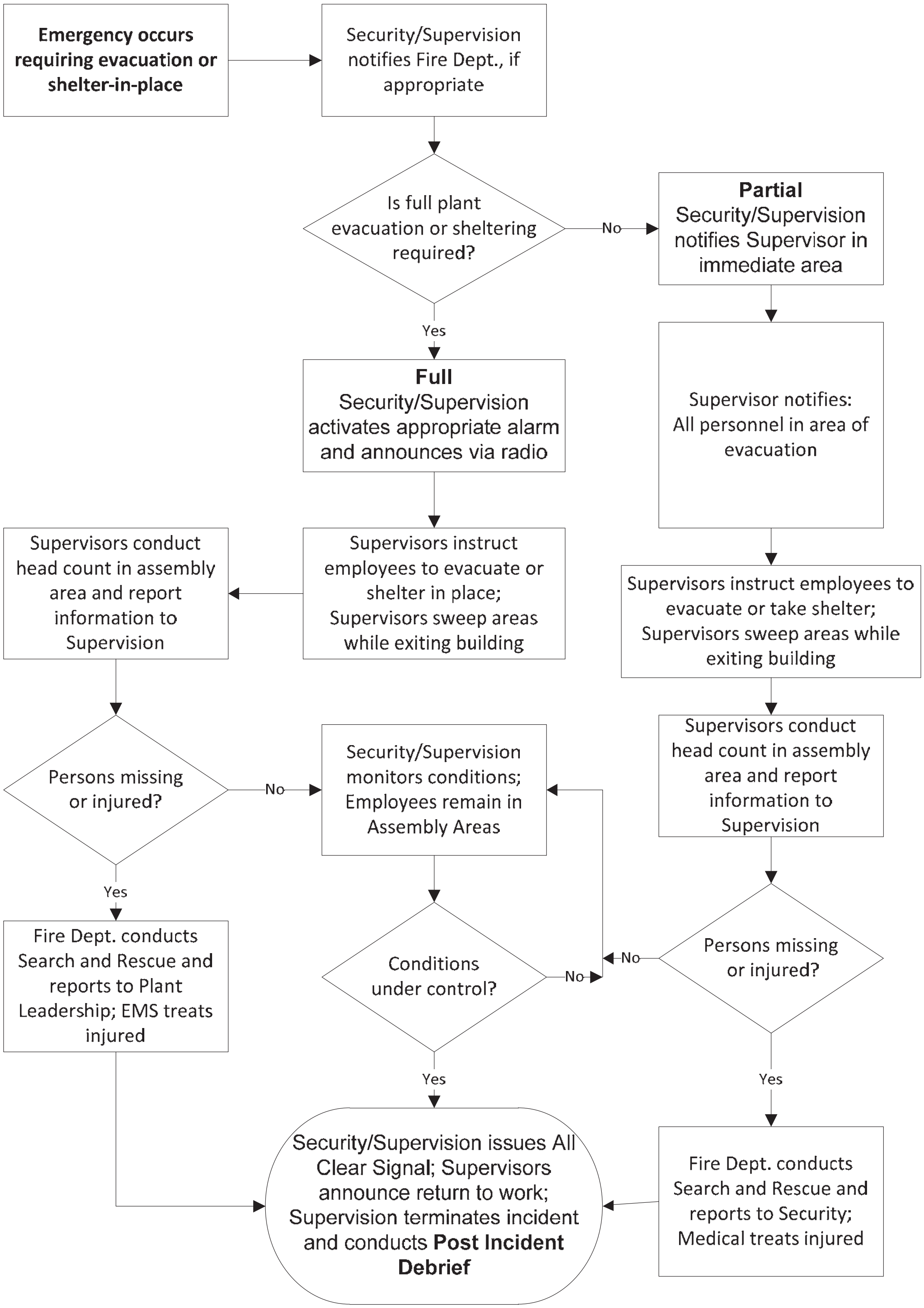
Attachments

Ford Emergency Response Plan

3.5 – Evacuation/Shelter-in-place Plan

3.6 – Fire or Explosion Plan

3.5 Evacuation/Shelter-in-Place



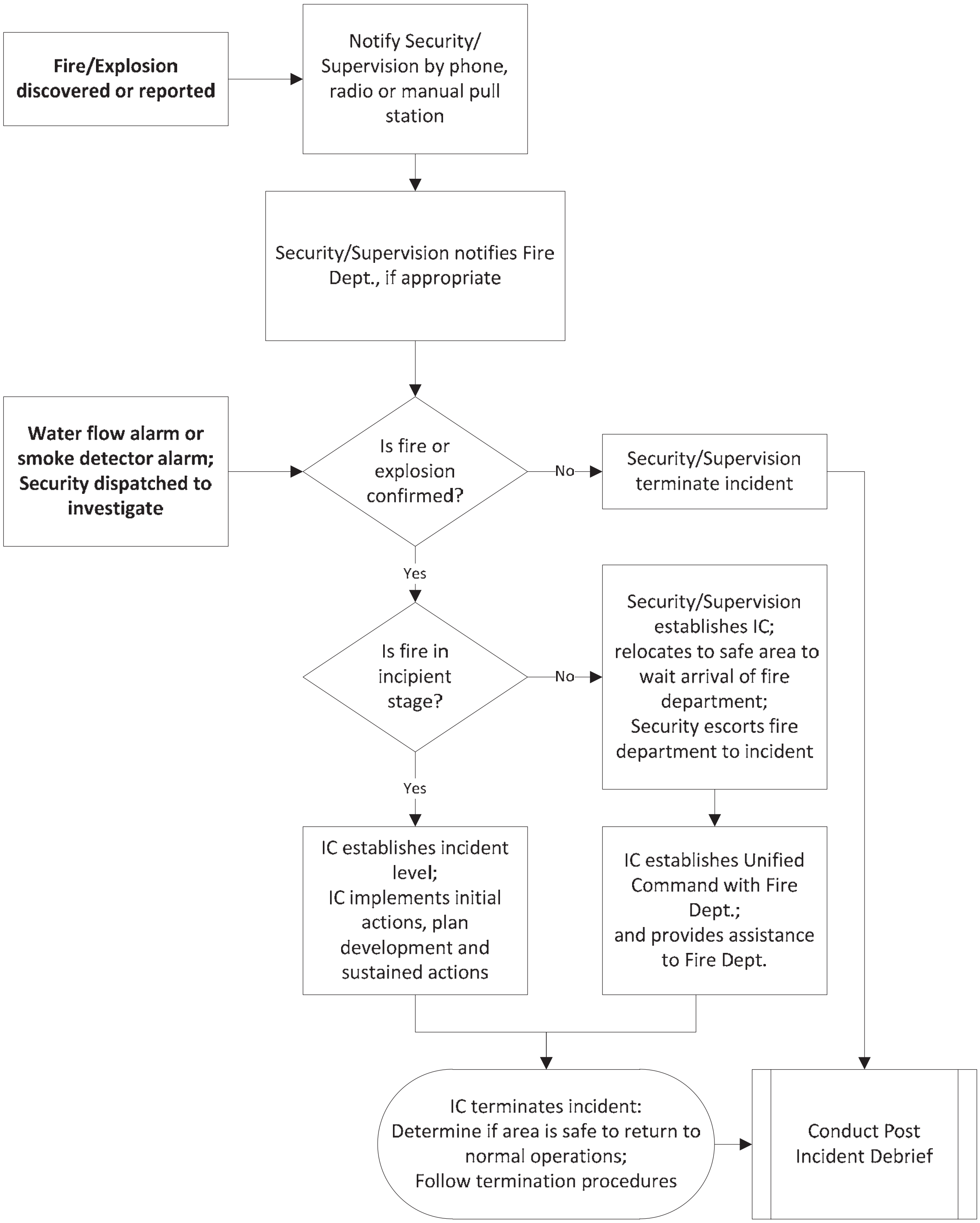
Standard Operating Guide for Evacuations

Phase I: Initial Actions	• Security/Supervision orders evacuation *Plant Evacuation:* • Security/Supervision activates evacuation alarm and notifies affected personnel • Supervisors ensure employees evacuate to outside assembly zones • Supervisors sweep evacuated areas
Phase II: Plan Development	• Establish Unified Command with outside agencies, if applicable • Determine resource requirements
Phase III: Sustained Actions	• Employees evacuate to outside assembly zones • Supervisors conduct roll call and report status to Security/Supervision • Security/Supervision notifies ERT/Fire Department • If necessary, Fire Department perform search and rescue • Security/Supervision conditions and consults with Plant Manager • Employees remain in outside assembly zones until “All Clear” signal is given • Security/Supervision approves reoccupying building or area • Security/Supervision issue “All Clear” radio announcement • Supervisors announce return to work
Phase IV: Termination	• Security/Supervision conducts Post Incident Analysis within 24 hours • Security/Supervision arranges critique of incident with relevant parties within 72 hours of incident • Designated personnel complete incident documentation

Standard Operating Guide for Shelter-in-Place

Phase I: Initial Actions	• Security/Supervision orders shelter-in-place *Shelter-in-Place:* • Security/Supervision notify personnel of need to take shelter via PA system • Supervisors ensure employees move to shelter areas • Supervisors sweep evacuated areas
Phase II: Plan Development	• Establish Unified Command with outside agencies, if applicable • Determine resource requirements
Phase III: Sustained Actions	• Employees move to shelter areas • Security/Supervision notifies Fire Department • Security/Supervision monitors conditions and consults with Plant Manager or Superintendent • Employees remain in shelter areas until “All Clear” signal is given • Security/Supervision approves reoccupying building or area and announces “All Clear” • Supervisors announce return to work • Supervisors perform head count
Phase IV: Termination	• Security/Supervision conducts Post Incident Analysis within 24 hours • Security/Supervision arranges critique of incident with relevant parties within 72 hours of incident • Designated personnel complete incident documentation

3.6 Fire or Explosion



Standard Operating Guide: Fire or Explosion

Phase I: Initial Actions	**Notification** • Call 911 or activate manual pull station • Notify Security/Supervision • Security/Supervision confirms notification to Fire Department
	Identification • Security/Supervision determines if fire/explosion has occurred • If no fire has occurred, incident is terminated and Security Officer completes incident report • Security/Supervision establishes command and makes assignments
	Isolation • Zone the incident area • Limit access to hot zone • Take control of care and treatment of injured surface victims • Stop all work in affected area and begin equipment shutdown
	Protection • Evacuate all personnel not involved in firefighting • Monitor equipment in area for leaks, pressure build-up, gas generation and/or rupture • Monitor control valves for sprinkler systems
Phase II: Plan Development	• Escort Fire Dept. to incident scene • Establish Unified Command with Fire Dept. • Assist Fire Dept. in developing Strategic Goals and Tactical Operations • Determine resource requirements (on-scene, on-duty, mutual aid, state/federal/provincial)
Phase III: Sustained Actions	• Assist Fire Dept. in implementing the Incident Action Plan without engaging in firefighting beyond the incipient level • Assist Fire Dept. with operation of fire protection systems • Assist Fire Dept. in evaluating Incident Action Plan

Phase IV: Termination	Procedures for Response Personnel
	• Security/Supervision continue to enforce scene control • All personnel will be accounted for • Security/Supervision will conduct a debriefing
	Follow-Up Procedures
	• Post Incident Analysis will take place within 24 hours of the incident • Incident Critique involving all participating agencies will occur within 72 hours of the incident • CISD will be available to all personnel who require assistance • All equipment will be accounted for, recovered, re-conditioned, and restocked • Control of the site will be transferred to the authority having jurisdiction • Designated personnel will complete documentation of the incident (**See Annex 4**)

Attachment 4

Postclosure Plan

FORM EQP 5111 ATTACHMENT TEMPLATE A11
CLOSURE AND POSTCLOSURE CARE PLANS

This document is an attachment to the Michigan Department of Environmental Quality's (DEQ) *Instructions for Completing Form EQP 5111, Operating License Application Form for Hazardous Waste Treatment, Storage, and Disposal Facilities.* See Form EQP 5111 for details on how to use this attachment.

The administrative rules promulgated pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended, (Act 451), R 299.9613 and Title 40 of the Code of Federal Regulations (CFR), Part 264, Subpart G, establishes requirements for the closure and, if necessary, postclosure care of hazardous waste management facilities. All references to 40 CFR citations specified herein are adopted by reference in R 299.11003. This license application template addresses requirements for the proper closure and, if necessary, postclosure care of the hazardous waste management units and the hazardous waste management facility for the *River Raisin Warehouse* in Monroe, Michigan. The information provided in this template was used to prepare the closure and postclosure care cost estimate provided in Template A12, "Closure and Postclosure Care Cost Estimates."

Ensure that all samples collected for waste characterization and environmental monitoring during closure and postclosure care activities are collected, transported, analyzed, stored, and disposed by trained and qualified individuals in accordance with the QA/QC Plan. The QA/QC Plan should, at a minimum, include the written procedures outlined in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA Publication SW-846, Third Edition, Chapter 1 (November 1986), and its Updates.

A11 POSTCLOSURE PLAN
[R 299.9613 and 40 CFR §264.118]

A11.1 Applicability
(Check as appropriate)

☐ **Not applicable**: Hazardous waste will not be left behind at closure. A survey plat, postclosure care, postclosure certifications, and other notices are not required.

☒ **Applicable**:

- ☐ Contingent plan
- ☒ Landfill unit

A11.2 Postclosure Care Objectives

The River Raisin Warehouse facility will complete the activities listed in Table A11.1 in order to achieve the following:

1. Maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events;
2. Operate the leachate collection and removal system until leachate is no longer detected;
3. Maintain and monitor the leak detection system in accordance with R 299.9613 and 40 CFR §§264.301(c)(3)(iv) and (4) and 264.303(c), and comply with all other applicable leak detection system requirements of this part;
4. Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of R 299.9612 and 40 CFR, Part 264, Subpart F;
5. Prevent run-on and run-off from eroding or otherwise damaging the final cover; and
6. Protect and maintain surveyed benchmarks used in complying with R 299.9613 and 40 CFR §264.309.

Note: For detailed information for how the above activities are to be completed, please see the attached Post-Closure Operating License Post-Closure Plan revised may 2017.

A11.3 Postclosure Care Period Point of Contact

The planned monitoring and maintenance activities and the associated frequencies are designed to ensure the integrity of the cap and final cover system and the proper functioning of the monitoring system for each unit listed in Table A11.1. The point of contact for ensuring the performance of these activities is listed below.

Name and/or Title	David Canfield, PE
Address	26850 Haggerty Road, Farmington Hills, MI 48331
Telephone	248-893-3414

A11.4 Postclosure Care Activities

Table A11.1 Postclosure Monitoring and maintenance

The following table identifies, for each unit requiring postclosure care, planned monitoring and maintenance activities and the frequency at which these activities will be performed.

Unit	Planned Monitoring Activities	Frequency	Planned Maintenance Activities	Frequency
Western Containment Unit	See attached Post-Closure Plan	See attached Post-Closure Plan	See attached Post-Closure Plan	See attached Post-Closure Plan
Eastern Containment Unit	See attached Post-Closure Plan	See attached Post-Closure Plan	See attached Post-Closure Plan	See attached Post-Closure Plan

Sediment Containment Unit	See attached Post-Closure Plan	See attached Post-Closure Plan	See attached Post-Closure Plan	See attached Post-Closure Plan

A11.5 Postclosure Care Plan Amendment
[R 299.9613 and 40 CFR §264.118(d)]

The Postclosure Care Plan will be amended whenever:

1. Changes in the operations or facility design will affect closure and postclosure care; or
2. There is a change in the expected year of closure, if applicable; or
3. Unexpected events during closure require a modification to the plan.

A11.6 Certification of Postclosure
[R 299.9613]

Within 60 days of completion of postclosure care Ford will submit to the Director, by registered mail, a certification that postclosure care for the hazardous waste management unit or facility, as applicable, has been completed in accordance with the specifications in the approved postclosure plan. The certification will be signed by the owner/operator of River Raising Warehouse and by an independent registered professional engineer. Documentation supporting the independent registered engineer's certification will be furnished to the Director in accordance with R 299.9613(5). The River Raisin Warehouse facility will maintain financial assurance for postclosure until the Director releases the River Raisin Warehouse facility from the financial assurance requirements for postclosure under R 299.9703 and 40 CFR §264.143(i).

The certification must be worded as follows:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to be the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

RESOURCE CONSERVATION AND RECOVERY ACT
MICHIGAN PUBLIC ACT 451,
ARTICLE II, CHAPTER 3
PART 111 – HAZARDOUS WASTE MANAGEMENT

POST CLOSURE OPERATING LICENSE POST CLOSURE PLAN

WASTE DISPOSAL SURFACE IMPOUNDMENTS FOR
FORD RIVER RAISIN WAREHOUSE
MONROE, MICHIGAN
MID 005 057 005

MAY 2017
(REVISION TO OCTOBER 9, 2012 POST-CLOSURE PLAN PREPARED FOR FORD MOTOR COMPANY)

PREPARED FOR:
FORD MOTOR COMPANY
290 TOWN CENTER DRIVE, SUITE 800
DEARBORN, MICHIGAN 48126

Mannik Smith GROUP

TABLE OF CONTENTS

1.0 INTRODUCTION AND SITE DESCRIPTION

This document describes the monitoring and maintenance activities following closure of the surface impoundments and associated areas at the Ford Motor Company (Ford) Ford River Raisin Warehouse (RRW). This plan is prepared in accordance with the requirements of 40 §265.188. The activities described in this plan are performed in accordance with the requirements of 40 CFR §117 through §120.

The RRW is located at 3200 East Elm Avenue in Monroe, Michigan. The site lies adjacent to marshy areas near the shore of Lake Erie, north of the mouth of the River Raisin, as shown on Figure 1, Site Location Map.

Several studies have been performed prior to the final closure of the surface impoundments. The investigations provide information on geology and hydrogeology of the site, as well as the characteristics of the impounded waters. The results of these studies are presented in the following reports and are summarized in the following reports.

- Phase I – Feasibility Study, Closure of Disposal Area,
  prepared by NTH Consultants, Ltd., March 1987;
- Supplemental Waste Characterization Study,
  prepared by NTH Consultants, Ltd., August 1987; and
- Report on Phase II, Preliminary Field Investigation,
  prepared by NTH Consultants, Ltd., August 1988.

The findings of these studies are summarized in the Closure Plan.

The site includes two containment units that contain electroplating wastes (F006) and impacted soils that have been solidified by addition of a fly ash/cement kiln dust/lime kiln dust/cement mixture. The location of the containment units are shown on Figure 2, Site Plan. The containment system of each unit consists of a native clay base, a cutoff wall surrounding each unit keyed into the underlying clay, and a clay/flexible membrane composite cover. Leachate collection systems collect leachate from the interior of the containment units. Leachate is pumped to the on-site wastewater treatment plant and from there to the local publicly owned treatment works (POTW) via the sanitary system. All discharges to the POTW are made in accordance with the RRW's sewer discharge permit and local sewer use ordinance.

A containment unit to store sediments impacted with polychlorinated biphenyl compounds (PCBs) was constructed within the southern half of the Eastern Containment Unit (ECU), see Figure 2. The Sediment Containment Unit (SCU) has a separate leachate collection system, which is accessed by a large diameter pipe on the south side of the SCU. When required, this leachate is characterized in a batch process before hauling it to the appropriate treatment/disposal facility.

The natural artesian ground water conditions at the site along with the leachate collection system maintain an inward and upward hydraulic gradient at the two containment units. Greater detail regarding the containment unit's design and construction can be found in the Closure Plan.

The post-closure care period began in September 1999 and will extend for 30 years following closure. The post-closure ground water monitoring program consists of a hydraulic monitoring component and a ground water quality monitoring component. The hydraulic monitoring system documents the inward hydraulic gradient across the cut off wall, the upward artesian bedrock gradient, and the effectiveness of the leachate collection system and cutoff wall barrier. The ground water quality monitoring determines whether chemical constituents are impacting ground water outside the containment units. Further detail is presented in Section 3.2.

A copy of the current approved Post-Closure Plan will be kept at the RRW for the duration of the post-closure period and the office to be contacted regarding the post-closure monitoring and maintenance activities during the post-closure care period is:

Ford Motor Company – Environmental Quality Office
Fairlane Plaza North - 290 Town Center Drive, Suite 800
Dearborn, Michigan 48126

2.0 MONITORING AND REPORTING

2.1 PREVIOUS GROUND WATER MONITORING

Previous studies of ground water quality at the RRW have considered both water quality beneath the impoundments and water quality outside the impoundments.

A limited evaluation of ground water beneath the impoundments was conducted in 1988 by NTH Consultants (Report on Phase II, Preliminary Field Investigation, August 1988). A number of wells were installed near the future locations of both the Western Containment Unit (WCU) and Eastern Containment Unit (ECU). Wells were installed and sampled in both the shallow marsh sequence deposit and in the confined bedrock aquifer. Concentrations of metals observed in samples collected from the wells in each ground water zone did not indicate vertical migration of waste constituents from the impoundments. Three well water samples collected from marsh sequence soils beneath Area C did contain detectable amounts of cyanide as well as several organic compounds.

Three phenolic compounds (phenol, 2-methyl phenol and 4-methyl phenol) were found in one sample from the bedrock aquifer under the ECU. One phthalate compound (2-ethyl hexylphthalate) was observed in the water sample from the bedrock under the ECU. No organic compounds were observed in the water samples taken from the WCU.

Evaluation of ground water outside the impoundments has been conducted since 1983. The interim ground water monitoring program was designed to detect migration of any chemical constituents from the two RCRA regulated impoundments (now part of the ECU). The interim ground water monitoring system consisted of five monitoring wells (designated MW-1, 2, 3, 5, and 6) located along the northeast side of the ECU and one well (MW-8) located on the west side of the WCU. Based on comparison of historic surface water levels at the impoundments with water levels in the monitoring wells inside the impoundments, all wells were considered downgradient of the impoundments.

The interim monitoring wells were screened in the uppermost saturated soil unit (marsh deposits, shallow sands, or clay). This shallow unit was believed to be the most likely pathway for migration of chemical constituents from the regulated units because of the protection offered to the bedrock aquifer by the overlying clay and a prevailing upward vertical hydraulic gradient. Each monitoring well was installed to a depth of approximately 20 feet below ground surface.

Statistically significant increases in indicator parameter levels have been noted at several times during the course of the monitoring program. In general, the detected concentrations of these parameters have been lower than health-based criteria or the concentrations have not been confirmed during subsequent sampling events. For instance, in December 1993 dissolved cadmium was detected in a ground water sample from MW-8 at a concentration slightly higher than the health-based drinking water criterion developed by the Michigan Department of Environmental Quality, or subsequent authority (MDEQ). However, no dissolved cadmium was detected in a duplicate ground water sample collected from MW-8 during the same sampling event. Similar sporadic occurrences of dissolved nickel, dissolved hexavalent chromium, and total cyanide have been noted. None of these three parameters have been detected at concentrations greater than health-based criteria.

As part of construction of the containment units, all monitoring wells associated with the interim ground water monitoring program were abandoned. These former well locations were situated in the area of the now-existing containment units. Accordingly, this data is no longer applicable. During the licensing process, the issue of low level phenols detected at a single bedrock well location was addressed. An independent technical evaluation was prepared by Professor Don Gray of the University of Michigan documenting the effectiveness of the subsurface underlying clay and the artesian bedrock aquifer in preventing downward chemical migration. This study was accepted by MDEQ and investigation of the bedrock aquifer was confirmed to be unnecessary.

3.0 POST-CLOSURE GROUND WATER MONITORING SYSTEM

The post-closure care period will extend for 30 years following closure. The post-closure ground water monitoring program consists of a hydraulic monitoring component and a ground water quality monitoring component. The hydraulic monitoring system documents the upward artesian bedrock gradient and the effectiveness of the leachate collection system and cutoff wall barrier, while the ground water quality monitoring determines whether chemical constituents within the closed containment units are impacting ground water outside the containment units.

3.1 HYDRAULIC MONITORING

The Final Hazardous Waste Management Facility Postclosure Operating License (License) requires that an inward and upward hydraulic gradient be maintained. Ford will conduct post-closure hydraulic gradient monitoring at the site. The focus of post-closure hydraulic gradient monitoring will be confirmation of the existing inward and upward hydraulic gradient for both the Eastern Containment Unit (ECU) and Western Containment Unit (WCU). Seven separate elements, listed below, will be included within the hydraulic monitoring program.

- Containment Unit As-Built Configuration
- Leachate Collection System Operation
- Leachate Collection System Integrity Verification
- Leachate Collection System Observation Points
- Post-Closure Monitor Well/Piezometer Network
- Ground Water Investigation Monitor Well and Surface Water Points

Independently, each of these elements provides an important component of information concerning subsurface water levels and the ground water flow regime around both the ECU and WCU. Collectively, these elements can conclusively demonstrate that the inward and upward hydraulic gradient is present.

3.1.1 Containment Unit As-Built Configuration

The containment units include four key components to influence subsurface ground water flow: cover system; cutoff wall; solidified sludge and leachate collection and removal system (LCRS). Each of these components was incorporated into construction to create a containment unit configuration that, when coupled with the underlying confined bedrock aquifer, produces an inward and upward gradient.

Cover - A cover system was constructed to seal each containment unit. The composite cover consists of a series of layers including a composite low permeability layer (geomembrane and compacted clay), a drainage layer (sand) and a vegetated soil layer (topsoil). The cover system provides long-term restriction of infiltration of precipitation, mitigating precipitation recharge into the containment units, thereby reducing leachate generation and promoting lower hydraulic head within the containment units.

Cutoff Wall - A subsurface low permeability barrier (i.e., cutoff wall) was constructed around the perimeter of each containment unit, within the existing perimeter containment dikes. The cutoff wall was constructed by replacing a three feet wide section of the containment dike with a low permeability soil-fly ash-bentonite mixture. The three feet wide cutoff wall was keyed a minimum of three feet into the underlying clay till. Field testing during construction indicated that the average permeability of the cutoff wall was 6.6×10^{-8} centimeters/second (cm/sec) for the ECU and 8.7×10^{-8} cm/sec for the WCU. The cutoff wall restricts the flow of ground water into the containment unit, and combined with internal dewatering of the containment units by the leachate collection system, produces higher hydraulic head outside of the containment units.

Solidified Sludge - Sludge within the containment units was solidified as part of the construction. The main focus of solidification was creation of a material capable of meeting the physical performance criteria necessary to ensure stability of the containment units. Multiple additives were utilized for solidification with the primary additives being cement and fly ash and with additional additives such as chip sand, calciment, etc. being incorporated into the mixture in different quantities for various on-site areas of solidification. During the solidification process significant quantities of underlying clay and clay within perimeter dikes was mixed into the solidified matrix. As a result of this solidification, monolithic blocks of solidified sludge were created within the containment units. Field testing during construction indicated that the permeability of the solidified blocks varied significantly with the range being between approximately 1×10^{-4} and 1×10^{-8} cm/sec. This wide range in permeability of the solidified sludge has promoted leachate level variations within the containment units since some of the sludge behaves in a clay-like manner while some behaves in a sand-like manner.

Leachate Collection and Removal System (LCRS) - A LCRS was constructed within the containment units. The LCRS included lateral collection trenches and pipes sloped at approximately one percent towards the perimeter of the containment units and spaced at a maximum of 150 feet intervals. These lateral collection trenches convey leachate by gravity flow from the interior to the perimeter of the containment units. The lateral collection trenches and piping are connected directly (i.e., hard plumbed) to perimeter collection trenches and piping. The perimeter collection trenches and pipes, which are located twenty-five feet inside of the cutoff wall, are sloped at approximately one half percent towards the manholes and convey leachate by gravity flow to the manholes. Leachate is then conveyed from the manholes, via pumping, to the on-site waste water treatment facility. Cleanouts were provided for each piping run to enable maintenance and visual inspection. For the WCU, flow line elevations of the laterals are generally 570 in the interior and 565 at the perimeter and flow line elevations of the perimeter lines are generally 567 at the high end and vary from 565 to 560 at the collection manholes. For the ECU, flow line elevations of the laterals are generally 570 in the interior and 565 at the perimeter and flow line elevations of the perimeter lines are generally 565 at the high end and approximately 558 to 561 at the collection manholes.

Configuration of the LCRS is reflected on Figure 3, Leachate Collection System - WCU and Figure 4, Leachate Collection System – ECU (WCU and ECU Pipe Integrity Verification – October 2011). The LCRS provides internal dewatering of the containment units. The design of the LCRS effectively maintains an inward hydraulic gradient within the containment units by keeping the water level lower than both the surrounding ground water and surface water levels.

Representation of the interaction of the components of the containment units is included as Figure 5, Generalized Containment Unit Subsurface. This graphic representation includes typical leachate, ground water and surface water levels encountered and shows the impact of each separate construction component.

3.1.2 Leachate Collection System Operation

Ford provides continuous operation of the LCRS for the containment units. Leachate within the ECU and WCU is collected by an internal leachate collection system. The system consists of gravel collection trenches, with a 6" corrugated polyethylene pipe at the base. Lateral trenches, roughly perpendicular to the containment unit perimeter, convey leachate from the interior to the perimeter. Perimeter collection trenches direct leachate to collection manholes (LMH-1 through LMH-7). Leachate within the manholes is transferred, via submersible pumps, to leachate pumping station, LPS-1. From LPS-1, leachate is transferred to the existing plant waste water treatment facility (WWTF) for ultimate discharge to the City of Monroe POTW (Permit No. 1030-1).

Final drawdown of the leachate within the containment units was completed in February 1999. Since that date, approximately 27,503,428 gallons of leachate have been treated and sent to the City of Monroe POTW through December of 2016. The monthly leachate generation totals from the containment units are shown on Figure 6. The cumulative leachate generation from the containment units is shown on Figure 7.

The variation in monthly leachate generation is attributed to three separate possible causes. First, initial leachate present within the containment units after closure would tend to increase monthly leachate generation with leachate generation decreasing over time. Second, fluctuations in Lake Erie water levels would tend to impact leachate generation since ground water levels can be expected to mimic Lake Erie water levels. As average Lake Erie water levels increase ground water inflow would increase resulting in higher leachate generation. Likewise, when average Lake Erie water levels decrease ground water inflow would decrease resulting in decreased leachate generation. Finally, fluctuations in precipitation would impact ground water levels by increasing or decreasing ground water recharge.

Ford will continue to monitor operation of the LCRS, in accordance with the License. This monitoring includes monthly volume of leachate pumped from each containment unit, graphical presentation of monthly and annual quantities of leachate generated and comparison of leachate generation over time. This monitoring will be enhanced to include thorough assessment of possible factors that would impact leachate generation, and potentially ground water levels. Leachate generation rates will be evaluated with respect to average Lake Erie water levels, monthly precipitation, and average ground water levels to improve understanding of the interrelationship between these elements. Significant fluctuations in leachate generation will be identified along with possible reasons for the fluctuation. This evaluation and comparison of leachate generation will be utilized to support demonstration of an inward gradient. Ford will calculate leachate generation from each separate unit (ECU and WCU) and note of any significant changes in leachate generation observed at individual manholes within the two containment units.

3.1.3 Leachate Collection System Integrity Verification

In accordance with the License and Post-Closure Plan, Ford has performed annual integrity verification testing for the 6" perforated corrugated polyethylene (CPE) pipe installed within the LCRS trenches. Pipe integrity verification testing has been performed annually from 2000 to 2016. Reports documenting pipe integrity verification testing were prepared and submitted to MDEQ.

Water jet testing of perimeter and lateral collection pipes has been performed using a ¾-inch diameter water jet at 1,000 psi pressure to verify pipe integrity. Additional specialized evaluation of the pipes has been performed on multiple occasions to ensure accurate identification of problem sections. Additional testing has included using higher pressure (up to 2,000 psi) and ¾-inch jet head, using a 4-inch diameter mandrel pulled through the pipe, and using a small video camera.

During the yearly pipe integrity testing, the perimeter lines (between the manholes and their respective terminal cleanouts) will be inspected to document free-flow conditions. Listed below are the manholes and their respective terminal cleanouts:

<u>LMH-1</u>
South Perimeter (East)
East Perimeter (South)
<u>LMH-2</u>
South Perimeter (West)
West Perimeter (South)
<u>LMH-3</u>
Northwest Perimeter (North)
Northwest Perimeter (South)
<u>LMH-4</u>
North Perimeter (East)
East Perimeter (North)
<u>LMH-5</u>
West Perimeter
South Perimeter (West)
<u>LMH-6</u>
North Perimeter (West)
North Perimeter (East)
<u>LMH-7</u>
East Perimeter
South Perimeter (East)

3.1.4 Leachate Collection System Observation Points

The LCRS was constructed to include cleanouts for performance of routine maintenance activities. Each of these cleanouts plus the LCRS manholes provides an observation point for inspection and determination of leachate levels within the containment units. The WCU includes twenty cleanouts and six pipe entry points within three manholes (26 total observation points) while the ECU includes twenty-nine cleanouts and nine pipe entry points within four manholes (38 total observation points).

Inspection of LCS observation points will be performed quarterly. During the yearly pipe integrity testing, the perimeter lines (between the manholes and their respective terminal cleanouts) will be inspected to document free-flow conditions. On a quarterly basis (during the hydraulic monitoring events), leachate free-flow conditions will be confirmed by: a) leachate elevations will be below the inlets in the manholes; and b) the associated terminal cleanouts for each manhole will be checked with a water level meter to ensure that they are dry. If the associated terminal cleanouts are not dry, additional inspections will be implemented within 30 days to determine if the line (or a portion of it) is blocked and not in a free-flow condition.

The elevations for the inlets in the manholes and the associated terminal cleanouts will be based on the as-built elevations, not a water level meter measurement. Additionally, during weekly inspections, the leachate manholes will be observed to ensure that leachate levels within the manholes have not reached a high level condition. The purpose of the inspection will be determination of leachate levels within LCS piping, and whether the pipes are in a free-flow condition. Observations of leachate levels within the LCS pipes will be recorded, along with associated elevations and measurement, and utilized for demonstration of an inward gradient.

3.1.5 Post-Closure Monitor Well/Piezometer Network

The post-closure monitor well/piezometer network includes fourteen separate shallow monitor wells around the perimeter of the containment units. Eight of the post-closure monitor wells (PCW) are associated with the ECU. Six of the PCW's are associated with the WCU. These wells were installed outside of the cutoff wall around the perimeter of each containment unit. PCWs were installed with the tip elevation at the top of the lacustrine clay (or glacial till clay, if lacustrine clay is not present). ECU bottom of well screen elevations vary from approximately 554 to 556 and WCU bottom of well screen elevations vary from approximately 554 to 560.

The post-closure monitor well/piezometer network also includes twenty separate piezometers. Eleven of the post-closure piezometers (PCP) are associated with the ECU. Eight of the PCPs are associated with the WCU. These piezometers were installed with the bottom of screen elevation five feet below the level of the leachate collection system, which is an elevation of approximately 553 to 554 for the ECU and approximately 556 for the WCU. The twentieth PCP was installed outside of the containment units in bedrock, with a bottom of screen elevation of approximately 486, to identify the general bedrock aquifer elevation. Each piezometer was installed in accordance with the Post Closure Groundwater Sampling and Analysis (SAP).

The general layout of the post-closure monitor well/piezometer network is reflected on Figure 2, Site Plan. Post-closure monitor wells PCW-1 through PCW-8 are associated with the ECU while PCW-9 through PCW-14 are associated with the WCU. Piezometers PCP-1 through PCP-8, PCP-15 through PCP-17, and PCL-1 through PCL-3 are associated with the ECU while PCP-9 through PCP-14, PCL-4 and PCL-5 are associated with the WCU. Piezometer PCP-3(Deep) is the bedrock piezometer. Hydraulic monitoring data collected from the post-closure monitor well/piezometer network will be utilized for demonstration of an inward and upward gradient.

3.1.6 Ground Water Investigation Monitoring Well

Monitor wells were installed as part of the ground water investigation required by the License in accordance with the SAP (Appendix A). The purpose of the ground water investigation was to characterize ground water beneath the facility and identify sources of impact to ground water. The focus of the investigation was on the additional solid waste management units (SWMUs) identified at the site. A total of twenty monitor wells were installed as part of this effort and remedial investigation activities. The location of the ground water investigation wells (GW) is reflected on Figure 2, Site Plan.

Ford will measure static water level in monitor wells GW-1 through GW-20, and surface water monitor stations, on a quarterly basis. Hydraulic monitoring data collected from the GW wells will be used for demonstration of an inward gradient.

3.1.7 Ground Water Model

Ford has performed comprehensive ground water modeling for the facility. This modeling is documented within the December 17, 2002, *Ground Water Flow Model Report*. The ground water model (Model) was developed utilizing historic data contained within the License and the construction certification report and was calibrated against fourteen quarterly monitoring events of data collected from the post-closure monitor well/piezometer network and the ground water investigation monitor well and surface water points. The Model successfully predicts an inward and upward gradient for both of the containment units.

A total of fifty-two points were identified for calibration purposes. These points included post-closure wells (PCW-1 through PCW-4 and PCW-6 through PCW-14), piezometers (PCP-1 through PCP-14 and PCL-1 through PCL-5), ground water investigation wells (GW-1 through GW-7, GW-9 and GW-12 through GW-16), and surface gauges (SG-1 through SG-6). The Model predicted ground water or leachate level was compared to the average level encountered as determined from the fourteen separate quarterly monitoring events. The calibration target, identified by the MDEQ, was for the Model predicted ground water or leachate level to be within one standard deviation of the average for the fourteen quarterly monitoring events. The calibration target was achieved for fifty of the fifty-two points, a success rate of 96%. For two points where the calibration target was not achieved the ground water level predicted by the Model was within 1½ inches of the calibration target. The reason the target was not achieved for the two points was attributed to the scarcity of historic information within the area of the North Marsh and along the western side of the WWTF.

Ford proposes to utilize the Model to support the demonstration of an inward gradient. Subsequent quarterly data collected from the fifty-two calibration points will be incorporated into the existing data and the average and standard deviation will be recalculated. The Model output will then be compared to the revised calibration target (i.e., the new average and standard deviation). Demonstration that the Model remains in calibration will be valuable support for the demonstration of an inward hydraulic gradient.

3.1.8 Demonstration Of Compliance For Inward and Upward Gradient

In order to demonstrate compliance with the License for inward and upward gradients, hydraulic monitoring will include quarterly measurement of ground water elevations at the existing post-closure ground water monitoring network, observation points for the LCRS within the containment units, as well as the monitoring wells and surface water monitoring stations dedicated to SWMU ground water quality assessment. Specifically, the points of measurement will include the following:

- Ground water elevations at monitoring wells PCW-1 through PCW-14, and piezometers PCP-1 through PCP-14, PCP-3 (deep) and PCL-1 through PCL-5.
- Ground water elevations at monitoring wells GW-1 through GW-20.
- Water levels in leachate collection system manholes for the ECU (LMH-1 through LMH-4) and WCU (LMH-5 through LMH-7).
- Water levels within leachate collection system cleanouts for the ECU and WCU.

<u>Inward Hydraulic Gradient</u>
Demonstration of an inward gradient is contingent upon the leachate collection system being in a free flow condition as demonstrated by the inspection and maintenance requirements specified in this Post-Closure Plan. Table 1, Hydraulic Monitoring Locations, lists all of the aforementioned hydraulic monitoring locations, including their horizontal coordinates. Table 2, Gradient

Compliance Points, details the individual monitoring points, to which comparisons will be made to the post-closure monitoring well locations at the ECU and WCU that will be used to demonstrate inward gradients. Additional monitoring locations, if deemed necessary, will be identified and proposed for mutual agreement between MDEQ and Ford. Also, Table 3, Leachate System Elevation Calculations, is an example showing how the interpolated leachate elevations will be calculated during each hydraulic monitoring event, and how these elevations will be used to verify inward gradients at the ECU and WCU. Table 4 is the Field Sheet used for collecting hydraulic monitoring data.

Upward Hydraulic Gradient

For demonstration of an upward gradient at the ECU and WCU, the level in the bedrock piezometer, PCP-3(Deep), will be compared to the leachate collection system elevation. The License requires the potentiometric surface of the bedrock aquifer to be above the leachate collection system elevation to demonstrate the presence of an upward gradient. The base leachate collection system elevation for the ECU is 558.1 and for the WCU it is 560.1. The highest point of the leachate collection system within either of the units will be used to compare to PCP-3(Deep).

3.1.9 Hydraulic Monitoring Reporting

To date, Ford has provided hydraulic monitoring reports to document the existing inward and upward hydraulic gradient and to document compliance with the license. For future hydraulic monitoring, Ford will provide a hydraulic monitoring report on a quarterly basis to the Michigan Department of Environmental Quality (MDEQ), Office of Waste Management and Radiological Protection within 60 days of the hydraulic monitoring. This report will document whether an inward hydraulic gradient is being maintained and whether an upward gradient continues to exist in the bedrock aquifer beneath the containment units. The report will incorporate all of the hydraulic monitoring elements presented herein. Specifically, the report contents will include those items listed below:

a) Report text
b) As-built documentation of containment units
c) Updated leachate generation records
d) Graphical comparison of leachate generation rates and ground water levels
e) Leachate levels in perimeter and lateral leachate collection pipes
f) Leachate levels in post-closure piezometers
g) Ground water levels in post-closure wells and ground water investigation wells
h) Ground water contour maps developed using all collected information
i) Ground Water Model comparison to collected historic data to confirm calibration
j) Conclusions regarding the hydraulic gradient conditions present
k) Certification of review and evaluation by a Certified Professional Geologist
l) Certification of review and evaluation by a State of Michigan Licensed Professional Engineer

If hydraulic monitoring indicates that an inward gradient is not being contained at the either of the containment units, and or that an upward gradient no longer exists in the bedrock aquifer beneath the containment unit(s), then Ford will do the following take the necessary actions as described in section 2.1 of the SAP.

3.2 GROUND WATER QUALITY MONITORING

The post-closure monitoring program includes sampling of the 14 monitoring wells (PCW-1 through PCW-14). Sampling began immediately upon installation of the wells. During the first two years, all 14 monitoring wells were sampled quarterly with replicate samples taken during each event. The resulting 16 samples at each location were used to establish base line conditions of water quality. Because the leachate collection system and cutoff wall significantly altered ground water flow conditions in the vicinity of the containment units, a two-year background period was necessary to adequately characterize natural variation in ground water quality.

The RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (September 1986) recommends establishing background concentrations by sampling quarterly for a period of one year and obtaining four replicate samples for each sampling event. The two-year background period was selected to obtain a better representation of the impacts of seasonal variations and changes in flow direction as steady-state ground water flow conditions were re-established following facility closure. Two replicate samples were collected during each sampling event to provide a sample population size equal to that recommended by the EPA and large enough to perform statistical analyses. The background data was evaluated to determine if variability in site ground water conditions is adequately addressed.

After completion of the baseline period, a detection monitoring program was instituted. During detection monitoring, ground water samples are collected from the wells on a semi-annual basis (i.e., two sets of samples per year) in accordance with the SAP and the resulting data will be analyzed according to the statistical procedure described in SAP.

3.2.1 Ground Water Quality Reporting

To date, Ford has provided an Environmental Monitoring Report to document compliance with the License. For future detection monitoring, Ford will provide an Environmental Monitoring report to the MDEQ, Office of Waste Management and Radiological Protection within 90 days after sample collection. The report will incorporate analytical data from the sampled wells and a statistical evaluation of monitoring parameters as specified in the SAP. Specifically, the report contents will include those items listed below:

a) Report text including procedure
b) Laboratory Analytical Results
c) Summary of Group I Analytes
d) Shewart CUSUM Charts/Parametric Prediction Interval Analysis Charts
e) Statistical evaluation conclusion

Within 90 days after each sampling of each monitoring well, Ford will determine if a statistically significant increase has occurred compared to background levels for each parameter listed in Tables 1 and 2 of the SAP. For Group 1 ground water monitoring parameters determined from the Detection Monitoring Phase (Section 8.1.2 of the SAP), any occurrence above the laboratory detection limit(s) for the parameter(s) will be considered statistically significant. If ground water quality monitoring evaluation results in a statistically significant increase, then Ford will take the necessary actions as described in section 8.2 of the SAP.

3.3 Leachate Collection and Removal System (LRCS)

3.3.1 Sediment Containment Unit (Scu)

3.3.1.1 Leachate Management

Leachate level monitoring in the SCU has been performed monthly since the final drawdown was completed in February 1999. Post-closure leachate monitoring began on March 15, 2000. Annual leachate monitoring reports have been submitted to the MDEQ. On a monthly basis, the elevation of leachate in the sump is determined using a water probe by measuring from the lower edge of the riser pipe down. The known elevation of the lower edge of the riser pipe is 600.7. The water probe reading can be converted to a sump water level elevation using the sump sketch (Figure 8, Sediment Containment Unit – Details, Drawing 63 of 65 from As-Built Details). Using Figure 8, the leachate elevation can be utilized to determine the quantity of leachate present in the sump. Leachate levels are maintained so that the leachate head above the geomembrane liner does not exceed one foot. The results of leachate level monitoring are maintained in the on-site post-closure monitoring file.

3.3.1.2 Analytical Monitoring

In order to define and characterize the chemical constituents of the leachate in the SCU over time and insure that the detection monitoring parameters are appropriate, analysis for VOCs, SVOCs, Part 201 regulated metals, cyanide, and hexavalent chromium will be conducted every five (5) years. In addition, the field parameters of pH, sulfate, and conductivity will be measured. This analysis will be used to determine whether adding or removing testing parameters for the post-closure well sampling is justified.

3.3.1.3 Leachate Treatment and Disposal

A leachate sample will be collected for analytical testing for off-site disposal or discharge to the POTW of all parameters required by the treatment and disposal facility or POTW, including polychlorinated biphenyls, during each pumping event (if necessary). The leachate sample is collected from the sump using a sampling pump or bailer. Associated chain of custody and analytical test results are kept in the on-site post-closure monitoring file. Results of leachate analysis will be included in the Annual Leachate Monitoring Reports (if conducted).

If required, leachate is treated and disposed of at an appropriate on-site or off-site treatment and disposal facility. If polychlorinated biphenyls are detected the leachate is transported to an off-site treatment and disposal facility. If polychlorinated biphenyls are not detected the leachate is transported to the on-site wastewater treatment plant for treatment and disposal in accordance with the City of Monroe sewer discharge permit or transported to an off-site treatment and disposal facility. The leachate volume treated and disposed of and the treatment/disposal location are maintained in the on-site post-closure monitoring file. Ford will continue to monitor operation of the LCRS as described above, in accordance with the License.

3.3.2 Eastern & Western Containment Unit

3.3.2.1 Leachate Management

The closure design requires the continuous collection and disposal of leachate during the post-closure period. The design consists of a network of slotted piping, which collects leachate and ground water flow in the eastern and western containment units, and conveys it to collection manholes. Collected liquids are pumped from the manholes to the on-site wastewater treatment plant prior to discharge to the POTW. All sewer discharges are made in accordance with the RRW sewer discharge permit and local sewer use ordinance. On-site personnel will monitor the volume of leachate discharged from the containment units at the site. A monthly summary of the discharge volumes will be maintained in the on-site post-closure monitoring file. On an annual basis, the leachate collection and removal system (LCRS), specifically, the 6" perforated corrugated polyethylene (CPE) pipe will be completely inspected to ensure that the integrity and capacity of the systems are being maintained. The LCRS inspection is limited to those components of the system that can be observed without damage to the structure. Potential items of concern include the manholes (pumps, wiring, piping, etc.), insulation or heating coils (where appropriate), and perimeter and lateral collection piping.

Water jet testing of perimeter and lateral collection pipes (described in section 3.1.3 of this plan) will be performed using a ¾-inch diameter water jet at 1,000 psi pressure to verify pipe integrity and free flow conditions.

3.3.2.2 Analytical Monitoring

In order to define and characterize the chemical constituents of the leachate in the ECU and WCU over time and insure that the detection monitoring parameters are appropriate, analysis for VOCs, SVOCs, Part 201 regulated metals, cyanide, and hexavalent chromium will be conducted every five (5) years. In addition, the field parameters of pH, sulfate, and conductivity will be measured. This analysis will be used to determine whether adding or removing testing parameters for the post-closure well sampling is justified.

3.3.2.3 Leachate Treatment and Disposal

To determine the appropriate level of pretreatment required, if any, prior to discharge to the City of Monroe POTW, a composite leachate sample from the two containment units will be analyzed for the applicable parameters as listed in the RRW sewer discharge permit, cyanide, mercury and PCBs. Testing frequency will be in accordance with the RRW sewer discharge permit. Following each sampling round, the analytical results will be compared with the requirements of the RRW sewer discharge permit and with local sewer use ordinance and the need for pretreatment of the leachate will be addressed.

3.3.3 LRCS Reporting

The licensee shall submit an annual leachate monitoring report to the MDEQ, Office of Waste Management and Radiological Protection by March 1 of the following years for each year during the post-closure care period. The annual leachate monitoring report will include results from the LCRS pipe integrity inspection and specifically include:

1. Leachate volume calculations;
2. Graphical presentation of the monthly and yearly quantities of leachate being generated and pumped from the containment units;
3. Graphical comparison of leachate quantities pumped/generated during the reported year and quantities pumped/generated from previous years;
4. Calculated leachate generation from each separate unit (ECU and WCU) and notation of any significant changes in leachate generation observed at individual manholes within the two containment units.
5. Possible reasons for leachate quantity increases/decreases; and

6. Historical pipe integrity verification summary
7. Results of current year's water jet testing
8. An evaluation of the status of the leachate collection and removal system
9. Summary of analytical results of leachate monitoring and recommendations for additions or deletions of testing parameters.

Annual leachate monitoring reports and LCRS pipe Integrity Reports have previously been submitted to the MDEQ since the March 15, 2000 commencement of post-closure leachate monitoring activities. Future annual leachate reports will incorporate the LCRS pipe integrity monitoring results and evaluation.

The licensee shall submit a leachate characterization report to the MDEQ, Office of Waste Management and Radiological Protection every five years during the post-closure care period, 90 days after the completion of leachate characterization sampling. The leachate characterization report shall include:

1. Report Text
2. Leachate Summary Analytical Results
3. Conclusions of monitoring and recommendations for additions or deletions of monitoring parameters.

Any parameter that is detected at an elevated concentration during leachate monitoring will be evaluated as to whether or not is should be included on the list of groundwater monitoring parameters specified in the SAP.

3.4 INSPECTION ACTIVITIES

3.4.1 Leachate Collection System

The leachate collection system was designed with pump system warning lights. On a weekly basis during the post-closure period, the warning lights on the leachate collection system manholes will be checked for indications of pump system failure. This will be recorded on the Inspection Log (Attachment C). The weekly frequency will detect system failure before accumulated leachate volume exceeds the storage capacity of the manholes and piping. If the light indicates a failure, the pump system will be inspected immediately and repaired to bring the system back to full operation as soon as possible. The licensee will retain these records on-site throughout the post-closure period.

On a monthly basis, leachate sediment within the manholes will be measured for indications of leachate volume and monitoring for storage capacity. In addition, the Sediment Containment Unit (SCU) leachate level will be measured and compared to the as-built elevations for indications of leachate accumulation within the SCU. Measurements will be recorded on the Inspection Log (Attachment C).

These and other items to be inspected are included on an Inspection Log to be filled out by the person performing the inspection. The licensee will retain these records on site throughout the post-closure period.

If during the semi-annual or annual inspections, any items that are found to be damaged or otherwise nonfunctional, corrections will be conducted in accordance with sound engineering practice. Maintenance activities will be recorded on the Maintenance Log, a copy of which is attached in Attachment C. Also included in Attachment C is a schedule that details the date and type of each inspection, as well as other post-closure deliverables.

3.4.2 Inspection Reporting

The licensee shall submit an annual inspection and maintenance report to the MDEQ, Office of Waste Management and Radiological Protection by March 1 of the following year for each year during the post-closure care period, in accordance the License. The annual inspection and maintenance report shall include:

a) Weekly and monthly inspection logs
b) Semi-Annual and annual Inspection logs
c) Maintenance logs
d) Summary of maintenance items performed to maintain the integrity of the landfill and to maintain the final cover such as erosion repair.

Annual inspection and maintenance reports which include the above items have been submitted to the MDEQ, Office of Waste Management and Radiological Protection since the 2000 commencement of post-closure monitoring activities.

3.4.3 Surveys

Benchmarks and final cover configuration surveys will be performed every five years. Ford has submitted three reports, the latest biennial final cover and benchmark survey was submitted to the MDEQ in 2012. Each survey report will be submitted to the MDEQ 90 days after the completion of the survey.

3.4.4 Cover System Integrity

Inspections on a weekly basis ensure the cover system is properly maintained. Items to be inspected are listed in Attachment C and include surface water drainage ways, access roads, and vegetative cover. Inspection logs will be submitted in an annual inspection and maintenance report as described in section 3.4.1 of this plan.

4.0 POST-CLOSURE NOTICES

In accordance with the requirements of 40 CFR §265.119, within 60 days of certified closure the licensee submitted certification that the RRW was closed in accordance with the previously approved Closure Plan to the Director of the MDEQ. Also within 60 days of certified closure, the license submitted to the local zoning authority a survey plat showing the locations and dimensions of the containment units at the site and containing a note stating the licensee's obligation to restrict the disturbance of the containment units. Within 60 days of certified closure, the licensee submitted to the local zoning authority and to the Director of the MDEQ a record of the type, location, and quantity of wastes disposed of on the property. Also within 60 days of certified closure, the licensee recorded a notation on the property deed stating that hazardous waste has been disposed of on the property and future use is restricted.

5.0 DOCUMENTS TO BE MAINTAINED AT THE FACILITY

Ford will maintain at the facility the following documents and amendments required by the license, until post closure is completed, certified by an independent registered professional engineer, and the facility is released from financial assurance requirements for post closure by the director:

- Hazardous Waste Management Facility Operating License
- Post Closure Plan
- Sampling and Analysis Plan
- Facility Engineering Plans and Specifications
- Site Security Plan

- Record Keeping Procedures
- Environmental Monitoring Data and Statistical Records including Reports
- Post Closure Notices

6.0 FINANCIAL ASSURANCE MECHANISM

A copy of the licensee's financial assurance mechanism is located in Attachment D.

7.0 POST-CLOSURE COST ESTIMATE

A copy of the licensee's post-closure estimate is located in Attachment E.

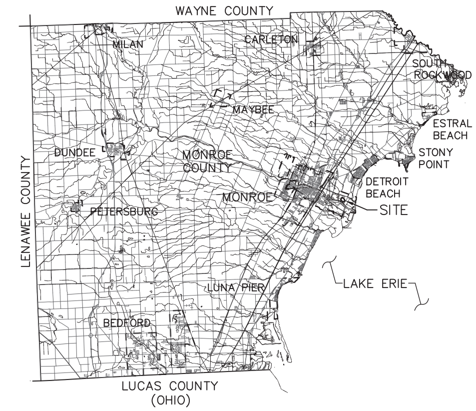
FIGURES

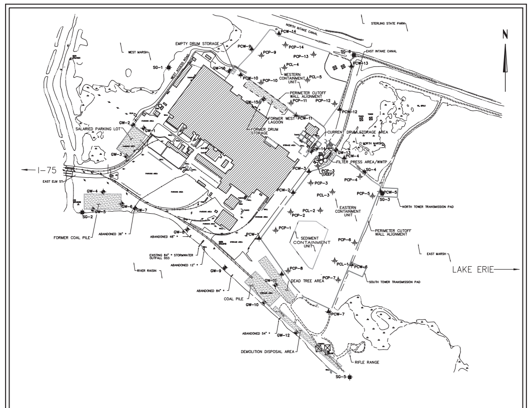
PROJ. NO. FORD0112
DRAWING NO. 1

FORD MOTOR COMPANY
MONROE PLANT

MID 005 057 005
MONROE, MICHIGAN

SITE LOCATION MAP





SITE LOCATION MAP

PREPARED FOR:

FORD MOTOR COMPANY
ENVIRONMENTAL QUALITY OFFICE

Suite 800, Fairlane Plaza North
290 Town Center Drive
Dearborn, Michigan 48126

PREPARED BY:

Mannik Smith GROUP
2365 HAGGERTY ROAD S.
CANTON, MICHIGAN 48188
TEL: (734) 397-3100
FAX: (734) 397-3131
www.MannikSmithGroup.com

INDEX OF DRAWINGS

	DRAWING
SITE LOCATION MAP/TITLE SHEET	1

10/6/2016

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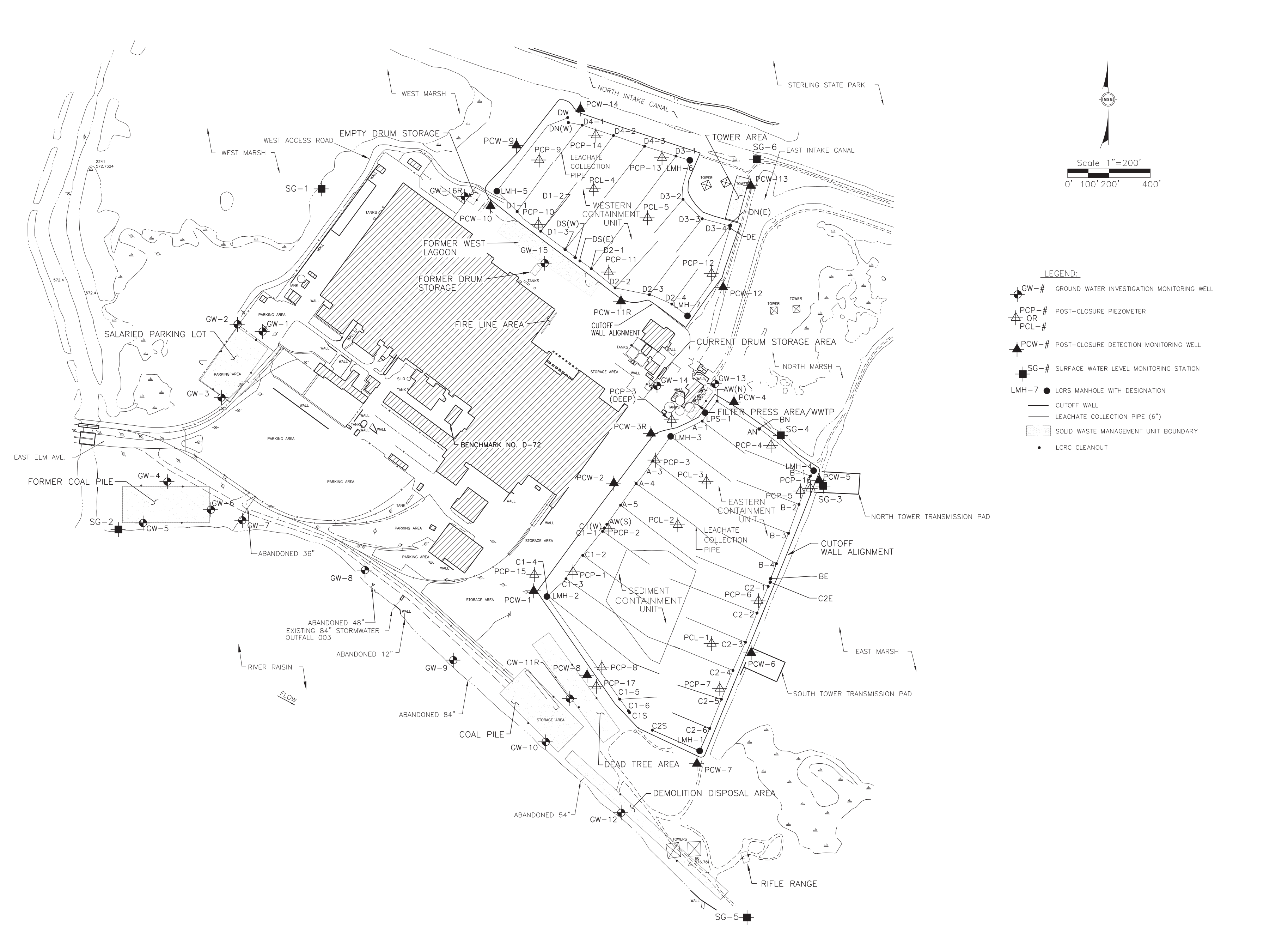
DRAWING NO.	1
PROJ. NO.	FORD0112



NO.	DATE	BY	DESCRIPTION

PROJECT DATE: 11/07/2011
PROJECT NO.: FORD0102
DRAWN BY: HMW
CHECKED BY: TEP

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PREPARED FOR:
FORD MOTOR COMPANY

MONROE PLANT
MONROE, MICHIGAN

GENERAL LAYOUT

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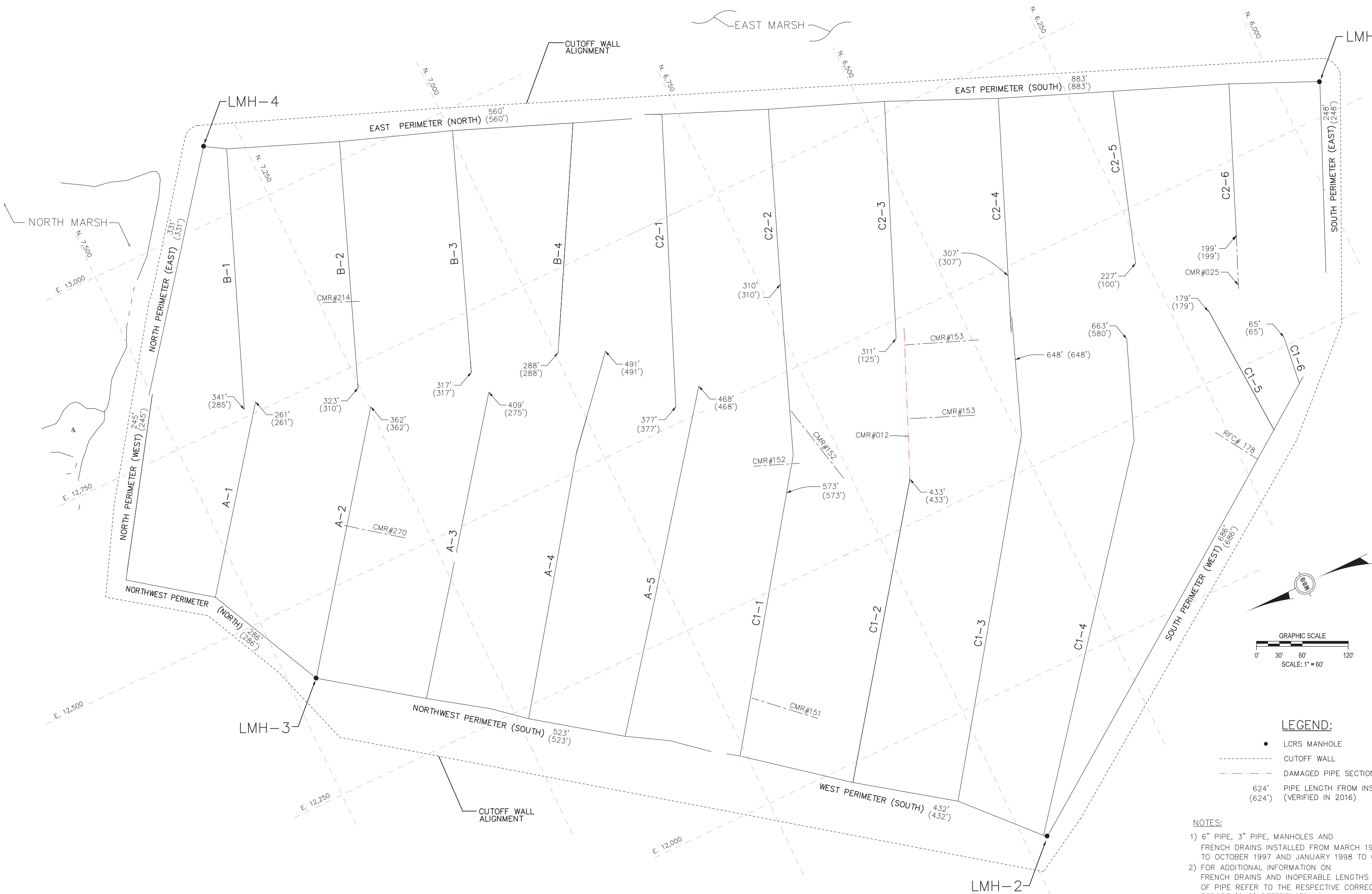

LEGEND:

- LCRS MANHOLE
- CUTOFF WALL
- DAMAGED PIPE SECTION
- 624' (624') PIPE LENGTH FROM INSTALLATION (VERIFIED IN 2016)

NOTES:

1) 6" PIPE, 3" PIPE, MANHOLES AND FRENCH DRAINS INSTALLED FROM MARCH 1997 TO OCTOBER 1997 AND JANUARY 1998 TO OCTOBER 1998.
2) FOR ADDITIONAL INFORMATION ON FRENCH DRAINS AND INOPERABLE LENGTHS OF PIPE REFER TO THE RESPECTIVE CORRECTIVE MEASURE REPORT (CMR) REFERENCED.
3) LCRS PIPE INTEGRITY VERIFICATION PERFORMED ON 9/22/16 AND 9/23/16.

NO.	DATE	BY	DESCRIPTION
1	10/09/2014	CJB	FILE UPDATES

PROJECT DATE: 9/29/2016
PROJECT NO.: FORD0136
DRAWN BY: SAH
CHECKED BY: TEP

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FORD MOTOR COMPANY

EASTERN CONTAINMENT UNIT PIPE INTEGRITY VERIFICATION 2016

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LEGEND:

- LCRS MANHOLE
- CUTOFF WALL
- DAMAGED PIPE SECTION
- 624' (624') PIPE LENGTH FROM INSTALLATION (VERIFIED IN 2016)

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3) LCRS PIPE INTEGRITY VERIFICATION PERFORMED ON 9/22/16 AND 9/23/16.

NO.	DATE	BY	DESCRIPTION
1	10/09/2014	CJB	FILE UPDATES

PROJECT DATE: 9/29/2016
PROJECT NO.: FORD0136
DRAWN BY: SAH
CHECKED BY: TEP

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PREPARED FOR:

FORD MOTOR COMPANY

WESTERN CONTAINMENT UNIT PIPE INTEGRITY VERIFICATION 2016

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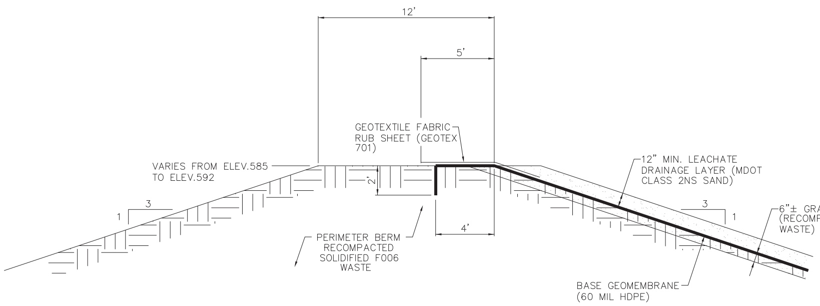
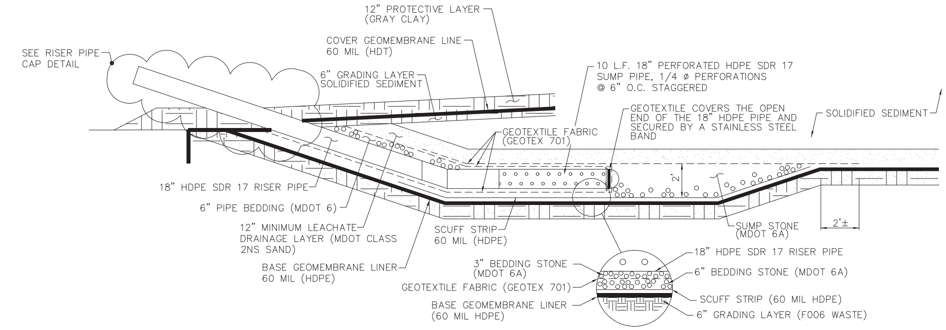
DWG. NO. 63 OF 65
PROJ. NO. F66A3N



BASE GEOMEMBRANE PROTECTION
N.T.S.



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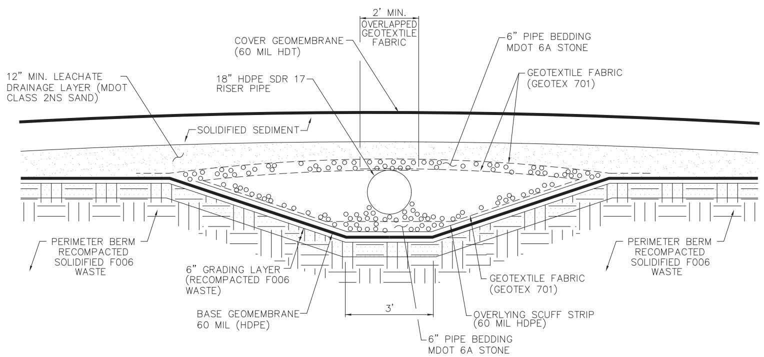
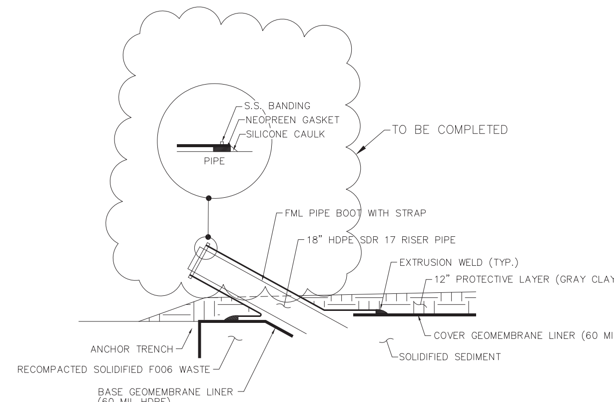
N.T.S.



RISER PIPE CROSS SECTION
N.T.S.



RISER PIPE CAP DETAIL
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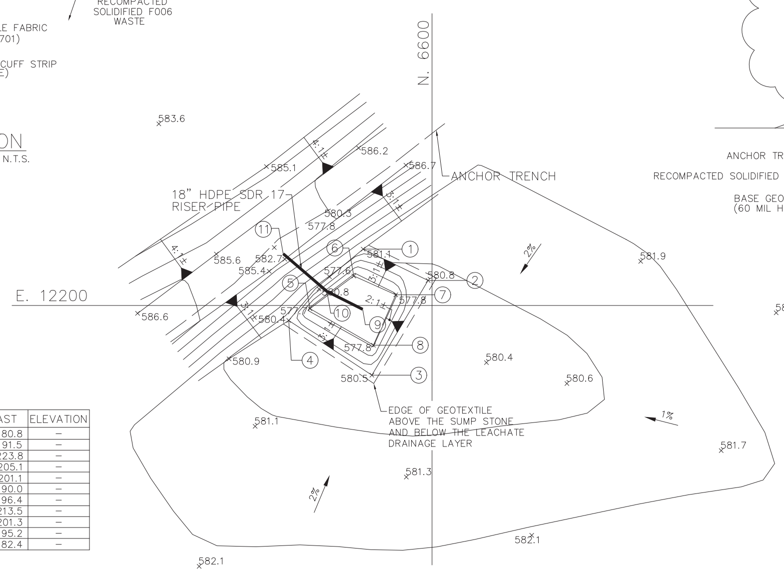


POINT NO.	NORTH	EAST	ELEVATION
1	6576.5	12180.8	–
2	6598.6	12191.5	–
3	6579.5	12223.8	–
4	6551.1	12205.1	–
5	6558.4	12201.1	–
6	6573.3	12190.0	–
7	6587.6	12196.4	–
8	6580.0	12213.5	–
9	6576.3	12201.3	–
10	6564.1	12195.2	–
11	6549.2	12182.4	–

SUMP PLAN VIEW
SCALE: 1"=20'

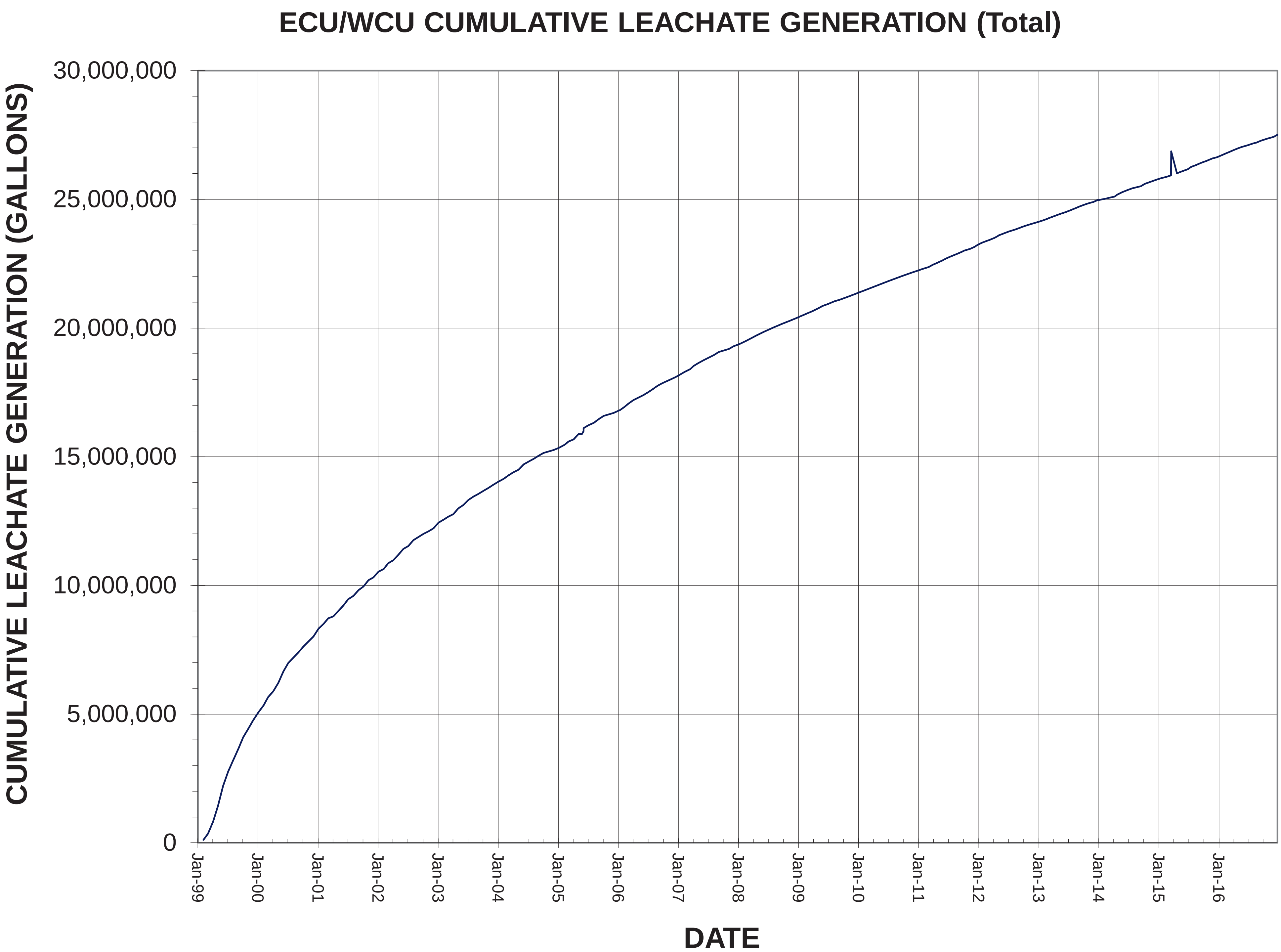
Visteon

REV.	BY	CHK'D	DESCRIPTION
1			AS-BUILT DETAILS NTH PLATE 4

MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
(313) 563-6326
DEARBORN, MICHIGAN

TITLE: VISTEON CORPORATION – MONROE PLANT
SEDIMENT CONTAINMENT UNIT DETAILS

DRAWN: BMC DATE 2/98	SCALE: AS NOTED	DRAWING NO. 63 OF 65	REV. NO.
DESIGNED: BMC DATE 2/98	REVIEWED: BMC DATE 2/98		1
APPROVED: . DATE .	PROJECT NO. F66A3N	CADD FILE: F66A3N06	



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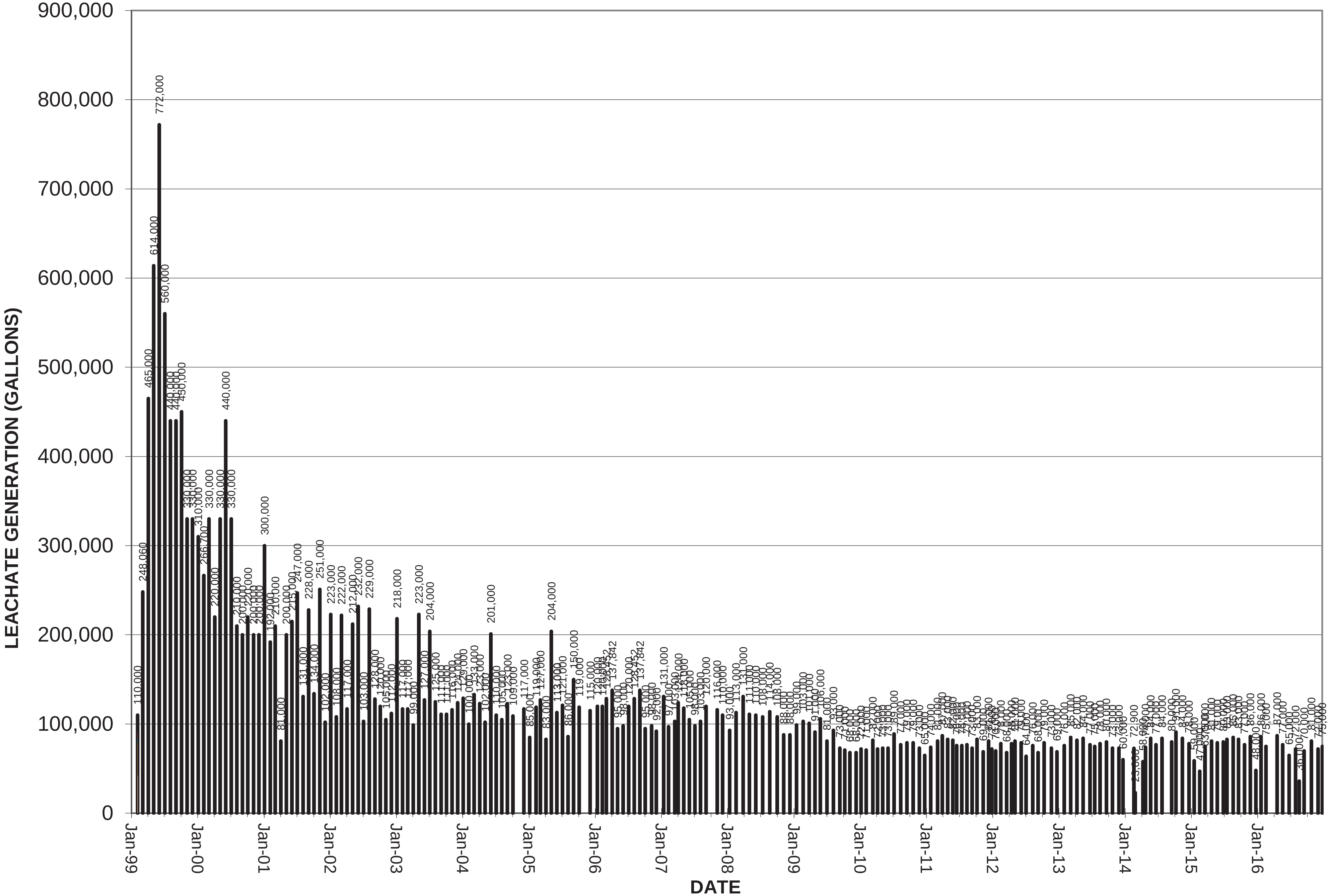
ECU/WCU MONTHLY LEACHATE GENERATED (Total)



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TABLES

TABLE 1
HYDRAULIC MONITORING LOCATIONS
FORD RIVER RAISING WAREHOUSE

NORTH	EAST	PIEZOMETER
6,809.70	11,930.10	PCP-1
7,020.10	12,100.10	PCP-2
7,349.70	12,328.70	PCP-3
7,421.00	12,887.90	PCP-4
7,201.00	13,030.10	PCP-5
6,669.70	12,827.00	PCP-6
6,246.00	12,639.70	PCP-7
6,349.30	12,069.70	PCP-8
8,800.30	11,766.80	PCP-9
8,498.20	11,762.70	PCP-10
8,258.40	12,102.90	PCP-11
8,250.90	12,600.20	PCP-12
8,811.10	12,360.50	PCP-13
8,920.40	12,040.60	PCP-14
6,755.88	11,764.97	PCP-15
7,198.93	13,099.87	PCP-16
6,301.91	11,999.35	PCP-17
7,544.40	12,407.30	PCP-3 (DEEP)
6,450.50	12,600.20	PCL-1
7,036.90	12,451.70	PCL-2
7,247.10	12,575.10	PCL-3
8,661.11	12,030.17	PCL-4
8,520.90	12,290.54	PCL-5
7,238.60	12,127.60	PCW-2
7,488.00	12,317.00	PCW-3R
7,630.80	12,708.40	PCW-4
6,418.30	12,791.70	PCW-6
5,882.80	12,529.50	PCW-7
8,870.90	11,656.80	PCW-9
8,577.50	11,531.60	PCW-10
8,117.80	12,162.30	PCW-11
8,184.80	12,654.50	PCW-12
8,676.00	12,789.80	PCW-13
9,046.90	11,965.90	PCW-14
7,971.40	10,429.60	GW-1
8,006.40	10,308.60	GW-2
7,652.20	10,230.90	GW-3
7,246.00	9,969.10	GW-4
7,046.20	9,851.80	GW-5
7,110.20	10,179.20	GW-6
7,059.10	10,331.30	GW-7
6,818.20	10,924.70	GW-8
6,383.10	11,351.70	GW-9
5,988.30	11,798.20	GW-10
6,186.00	11,928.10	GW-11R
5,645.90	12,163.20	GW-12
7,718.60	12,617.20	GW-13
7,709.50	12,336.30	GW-14
8,301.70	11,793.30	GW-15
8,666.71	11,453.80	GW-16R
7,021.65	9,683.75	SG-1
7,021.65	9,683.75	SG-2
7,226.10	13,139.30	SG-3
7,469.40	12,935.60	SG-4
5,139.10	12,770.80	SG-5
8,803.60	12,819.60	SG-6
5,944.50	12,542.70	LMH-1
6,690.80	11,803.90	LMH-2
7,464.70	12,402.20	LMH-3

TABLE 1
HYDRAULIC MONITORING LOCATIONS
FORD RIVER RAISING WAREHOUSE

7,299.00	13,093.50	LMH-4
8,649.60	11,561.80	LMH-5
8,798.80	12,495.00	LMH-6
8,046.80	12,483.60	LMH-7
7,538.40	12,554.60	A-1
line empties directly into manhole		A-2
7,346.60	12,316.70	A-3
7,236.80	12,235.10	A-4
7,132.80	12,160.10	A-5
7,273.00	13,077.70	B-1
7,135.80	13,022.80	B-2
6,993.10	12,972.30	B-3
6,849.50	12,913.60	B-4
7,008.10	12,072.10	C1-1
6,889.90	11,977.50	C1-2
6,776.20	11,896.40	C1-3
6,694.50	11,807.90	C1-4
6,194.40	12,156.80	C1-5
6,137.70	12,203.00	C1-6
6,739.70	12,873.90	C2-1
6,611.20	12,820.00	C2-2
6,469.70	12,764.00	C2-3
6,333.60	12,703.60	C2-4
6,194.30	12,647.50	C2-5
6,053.10	12,591.00	C2-6
7,498.90	12,829.50	AN
7,039.70	12,093.60	AW (S)
7,634.30	12,625.20	AW (N)
7,503.20	12,830.40	BN
6,776.80	12,885.90	BE
6,759.90	12,883.30	C2E
6,044.70	12,313.70	C2S
6,130.10	12,203.60	C1S
7,022.60	12,082.30	C1W
8,551.60	11,660.10	D1-1
8,455.90	11,774.20	D1-2
8,367.00	11,892.80	D1-3
8,275.30	12,018.90	D2-1
8,182.00	12,133.60	D2-2
8,149.20	12,299.60	D2-3
8,104.10	12,408.20	D2-4
8,819.00	12,428.10	D3-1
8,610.20	12,462.10	D3-2
8,516.50	12,555.40	D3-3
8,482.10	12,685.80	D3-4
8,968.60	11,974.50	D4-1
8,918.60	12,125.90	D4-2
8,866.70	12,276.50	D4-3
8,981.40	11,908.00	DN (W)
8,482.10	12,690.80	DN (E)
9,004.90	11,906.90	DW
8,330.30	11,940.80	DS (W)
8,315.20	11,962.10	DS (E)
8,469.30	12,688.10	DE

TABLE 2
GRADIENT COMPLIANCE POINTS
FORD RIVER RAISIN WAREHOUSE

Post-Closure Compliance Point	Northing	Easting	Water Elevation	Compliance Point	As-Built Elevation or Liquid Level Measurement	Northing	Easting	Verified at this Monitoring Location?
PCP-15	6756	11765	585.03	CI-4*	563	6694.5	11807.9	YES
PCW-2	7238.6	12127.6	580.87	A-5*	564.8	7133	12160	YES
PCW-3R	7478.4	12307	572.54	A-1*	565.9	7538	12555	YES
PCW-4	7630.8	12708.4	579.8	AN*	565.1	7499	12830	YES
PCP-16	7199	13100	578.53	B-1*	566.3	7273	13077.7	YES
PCW-6	6418.3	12791.7	575.71	C2-3*	565.8	6470	12764	YES
PCW-7	5882.8	12529.5	572.93	C2-6*	565.6	6053	12591	YES
PCP-17	6302	11999	581.57	C1-5*	566.1	6194	12157	YES
PCW-9	8870.9	11656.8	572.81	DN(W)*	566	8981	11908	YES
PCW-10	8577.5	11531.6	579.26	D1-1*	565.6	8552	11660	YES
PCW-11	8117.8	12162.3	579.2	D2-2*	567.1	8182	12134	YES
PCW-12	8184.8	12654.5	577.59	DE**	566.1	8469	12688	YES
PCW-13	8676	12789.8	576.16	D3-2*	567.4	8610.2	12462.1	YES
PCW-14	9046.9	11965.9	571.95	D4-1*	567.6	8969	11975	YES
Post-Closure Compliance Point***	Northing	Easting	Water Elevation	Compliance Point	Ground Water Elevation	Northing	Easting	Verified at this Monitoring Location?
PCL-1	6450.5	12600.2	568.4	PCP-3 (Deep)	579.96	7544.4	12407.3	YES
PCL-2	7036.9	12451.7	571.41	PCP-3 (Deep)	579.96	7544.4	12407.3	YES
PCL-3	7247.1	12575.1	571.25	PCP-3 (Deep)	579.96	7544.4	12407.3	YES
PCL-4	8661.11	12030.17	572.34	PCP-3 (Deep)	579.96	7544.4	12407.3	YES
PCL-5	8520.9	12290.54	579.95	PCP-3 (Deep)	579.96	7544.4	12407.3	YES

* Leachate elevation based on as-built documentation
** Leachate elevation based on liquid measurement
*** The ground water elevation of PCP-3 (deep) will be compared to PCL-1 through PCL-5

TABLE 3
HYDRAULIC MONITORING FIELD SHEET
FORD RIVER RAISIN WAREHOUSE

Post-Closure Piezometers	Top of Casing Elevation (Feet)	Bottom of Screen Elevation (Feet)	Total Depth (Feet TOC)	Depth to Water (feet)	Water Elevation (Feet)	Notes
PCP-1	585.94	554.00				
PCP-2	586.48	553.30				
PCP-3	586.33	553.00				
PCP-4	589.99	553.20				
PCP-5	588.54	552.90				
PCP-6	587.45	553.00				
PCP-7	588.09	552.50				
PCP-8	589.14	554.20				
PCP-9	592.65	556.00				
PCP-10	590.19	555.90				
PCP-11	590.37	555.70				
PCP-12	590.56	555.80				
PCP-13	592.92	556.00				
PCP-14	592.64	555.80				
PCP-15	585.98	585.98				Flush-mount
PCP-16	588.64	588.64				
PCP-17	588.76	588.76				
PCP-3 (DEEP)	582.24	486.50				
PCL-1	595.45	553.30				
PCL-2	612.63	552.90				
PCL-3	609.25	553.00				
PCL-4	601.62	556.00				
PCL-5	601.98	555.80				
Post-Closure Wells	**Top of Casing Elevation (Feet)**	**Bottom of Screen Elevation (Feet)**	**Total Depth (Feet TOC)**	**Depth to Water (feet)**	**Water Elevation (Feet)**	**Notes**
PCW-2	580.97	555.70				Flush-mount
PCW-3R	580.38	555.90				Flush-mount
PCW-4	583.45	555.70				
PCW-6	582.52	553.90				
PCW-7	582.24	555.20				
PCW-9	578.44	555.80				
PCW-10	582.89	560.40				Flush-mount
PCW-11	582.60	556.10				Flush-mount
PCW-12	584.08	556.10				
PCW-13	582.74	554.40				
PCW-14	582.77	556.40				
GW Wells	**Top of Casing Elevation (Feet)**	**Bottom of Screen Elevation (Feet)**	**Total Depth (Feet TOC)**	**Depth to Water (feet)**	**Water Elevation (Feet)**	**Notes**
GW-1	580.53	571.60				Flush-mount
GW-2	582.31	571.30				
GW-3	581.41	570.90				
GW-4	581.40	571.90				
GW-5	580.15	570.80				
GW-6	579.74	570.20				
GW-7	580.52	570.90				
GW-8	583.07	572.50				
GW-9	580.44	569.80				
GW-10	582.48	569.80				
GW-11R	580.23	569.70				Flush-mount
GW-12	580.87	566.10				
GW-13	583.70	564.10				
GW-14	578.48	559.90				Flush-mount
GW-15	582.69	570.00				Flush-mount
GW-16R	583.35	565.30				
GW-17	574.81	567.11				
GW-18	578.40	565.11				
GW-19	575.93	566.93				
GW-20	582.08	547.08				Flush-mount
LCS Components	**Top of Clean Out Elevation (Feet)**	**Bottom of LCS Component Elevation (Feet)**	**Total Depth (Feet)**	**Depth to Liquid (feet)**	**Water Elevation (Feet)**	**Notes**
A-1	588.55	565.90				
A-3	582.45	563.50				
A-4	581.94	564.20				
A-5	583.33	564.80				
AN	585.30	565.10				North Perimeter (West)
AW(N)	588.15	563.10				Northwest Perimeter (North)
AW(S)	582.69	565.00				Northwest Perimeter (South)
B-1	585.00	566.30				
B-2	584.80	565.80				
B-3	586.40	566.80				
B-4	586.20	568.10				
BE	586.30	567.40				East Perimeter (North)
BN	584.80	564.90				North Perimeter (East)
C1-1	584.10	566.00				
C1-2	584.10	565.80				
C1-3	583.23	565.80				
C1-4	583.13	563.00				
C1-5	586.89	566.10				
C1-6	586.20	566.30				
C1S	586.00	566.30				South Perimeter (West)
C1W	582.90	564.70				West Perimeter (South)
C2-1	586.28	566.00				
C2-2	586.35	565.80				
C2-3	586.53	565.80				
C2-4	586.12	567.60				
C2-5	586.61	563.80				
C2-6	585.85	565.60				
C2E	586.10	565.00				East Perimeter (South)
C2S	585.40	563.00				South Perimeter (East)
D1-1	588.95	565.60				
D1-2	588.40	567.00				
D1-3	588.73	567.00				
D2-1	587.75	567.10				
D2-2	586.18	567.10				
D2-3	588.00	566.90				
D2-4	589.30	566.10				
D3-1	587.35	564.40				
D3-2	589.30	567.40				
D3-3	593.38	566.60				See above - level is 7.68 ft below PCW-13 and 9.112 ft below PCW-12
D3-4	587.95	567.50				
D4-1	589.85	567.60				
D4-2	589.53	565.30				
D4-3	590.05	565.60				See above - level is .78 ft below PCW-14 and 4.99 ft below PCW-13
DE	589.25	566.10				
DN(E)	588.53	564.90				North Perimeter (East)
DN(W)	590.69	566.00				North Perimeter (West)
DS(E)	587.95	567.10				South Perimeter (East)
DS(W)	588.50	565.00				South Perimeter (West)
DW	588.47	565.00				West Perimeter

APPENDIX A

POST-CLOSURE GROUND WATER SAMPLING AND ANALYSIS PLAN

Post-Closure Groundwater Sampling and Analysis Plan

Ford River Raisin Warehouse

Ford Motor Company

October 18, 2021

→ **The Power of Commitment**

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1. Introduction

This document presents the Post-Closure Groundwater Sampling and Analysis Plan (SAP) for the Ford River Raisin Warehouse located at 3200 East Elm Avenue in Monroe, Michigan. This SAP has been prepared/updated on behalf of the Site owner/operator by GHD Services, Inc. (GHD) and previously prepared/submitted by Mannik & Smith Group (MSG) in July 2006 and updated May 2017. This updated SAP has been prepared in response to the 2017 Hazardous Waste Management Facility Operative License Renewal Application.

This SAP has been developed to meet detection monitoring requirements of applicable local, State and Federal regulations. The objectives and protocol included within the SAP meet the performance requirements of 40 CFR 264.97(d) and R299.9611 of Part 111, Act 451, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 111).

2. Monitoring Well and Piezometer Installation Procedures

All drilling operations will be performed by an experienced drilling subcontractor, with the full-time supervision of a field engineer/geologist. All wells will be installed and abandoned (when appropriate and approved by Michigan Department of Environment, Great Lakes, and Energy (EGLE) in accordance with procedures specified in R299.9612(1)(b). Prior to arrival on site, the drill rig, drill rods, augers, tools, and equipment will be thoroughly steam-cleaned. The sampling and drilling equipment will also be steamed-cleaned between borings to minimize the potential for cross-contamination.

Under this program, the licensee shall operate and maintain a groundwater monitoring system consisting of monitoring wells labeled PCW-1 through PCW-14, and piezometers labeled PCP-1 through PCP-14, PCL-1 through PCL-5, & PCP-3 Deep, and ground water monitor wells labeled GW-1 through GW-20 as shown on *Figure 1, General Layout*. The monitoring wells were installed at the base of the near-surface groundwater unit, which is approximately the top of the lacustrine clay deposit. The monitoring wells were expected to be between 10 and 25 feet deep.

To install future monitoring wells, a soil boring will be advanced with 8-inch outside-diameter hollow-stem augers to the top of the first clay layer. After reaching the clay, a well assembly consisting of 2-inch diameter PVC casing equipped with a 5-foot PVC, 10-slot screen will be lowered to the bottom of the boring through the center of the auger. At this point, the augers will be withdrawn from the shallow boring as the annular space between the well casing and the borehole is filled with silica sand to an elevation approximately one foot above the top of the well screen. A bentonite seal will be placed above the sandpack, and a non-shrinking cement-bentonite grout backfilled to ground surface.

For protection a steel cover secured with a padlock will be placed over the top of each well casing and cemented in place. A label designating the well number and top of PVC elevation shall be placed near each monitoring well. Prior to undertaking monitoring well and piezometer replacement or repair, written approval of the Waste Management Division shall be obtained. Polyvinyl chloride (PVC) was selected as the well screen and well casing material due to its relatively low cost and structural strength. PVC has been used extensively in groundwater wells, in many instances for 30 or more years, and has proved to be a durable well material. PVC is also expected to be the most suitable casing material with respect to the chemical parameters of concern in post-closure groundwater monitoring for the subject site.

A number of researchers have investigated the sorptive and/or desorptive potentials of various well casing materials such as PVC, stainless steel and tetrafluoroethylene (Teflon).

Sykes et al[1] concluded that there was no statistically significant difference in the degree of absorption of organic compounds between PVC, Teflon of stainless steel. Parker et al[2], examined the sorption/desorption differences of PVC, Teflon, and two stainless steel materials with respect to both inorganic and organic analytes. They concluded re groundwater samples are to be analyzed for both metals and organic compounds, PVC would be the most suitable well material.

In accordance with the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (September 1986), the monitoring wells will be developed to restore the natural hydraulic conductivity of the formation and to remove all foreign sediment to ensure turbid-free groundwater samples. Development will be performed using a clean, disposable, plastic bailer, or submersible pump to purge the well. This technique involves alternately agitating the water in the well to suspend the sediment and then removing water from the well along with the suspended sediment.

Development will be considered complete when samples obtained are relatively sediment-free and register stable pH and specific conductance measurements, which will be obtained with calibrated field instruments. Monitoring well sampling procedures are described below in Section 4.0.

A total of 14 piezometers were installed within the interior of the closure units, across the cutoff wall from each monitoring well. In addition, five leachate piezometers were installed in the interior of the containment units and one bedrock piezometer outside the cutoff. The interior piezometers are set at a depth approximately 5 feet below the lowest point in the leachate collection system of each respective closure unit. All piezometers can be viewed in *Figure 1, General Layout*.

For installation of each piezometer, a boring was advanced through the stabilized sludge with an 8-inch outside-diameter hollow-stem auger. Note that the drill cuttings generated during piezometer installation were left within the limits of the respective closure unit.

After drilling to approximately 1 foot below the desired tip placement elevation, the augers were partially retracted and silica sand was poured into the bottom of the borehole until the sand backfill reached the desired tip elevation. The piezometer was then inserted through the auger, and the screened annulus of the borehole was filled with sand as the augers were withdrawn from the boring.

A bentonite seal was placed above the sand, and the remainder of the bore hole annulus was grouted to the top of the solidified sludge with non-shrinking cement-bentonite grout. For protection, a steel cover secured with a padlock was placed over the top of each piezometer casing and cemented in place. A label designating the identification number and top of PVC elevation was placed near each piezometer.

Following installation of all on-Site monitoring wells and piezometers, the top-of-casing elevations were determined by a registered land surveyor. These elevations are referenced to the nearest USGS datum.

3. Monitoring Frequency

3.1 Hydraulic Monitoring

The licensee shall measure static water levels in post-closure monitor wells PCW-1 through PCW-14, shallow piezometers PCP-1 through PCP-14, PCL-1 through PCL-5, ground water monitor wells GW-1 through GW-20 and Leachate Collection System (LCS) components excluding the leachate manholes on a quarterly basis. Static water elevations will be measured to the nearest 0.01 foot, using a water level indicator, and will be measured from a reference point on the rim of the well casing established during the top-of-casing survey. These water levels will then be referenced to the USGS datum for use in assessing the groundwater flow behavior. If hydraulic monitoring indicates that an inward gradient is not being maintained at the containment unit(s), and/or that the artesian condition no longer exists in the bedrock aquifer beneath the containment unit(s) for the potentiometric leachate collection system elevation, then the licensee shall do all of the following:

a. Immediately notify the EGLE Materials Management Division (MMD), or in the event of their unavailability, the 24-hour EGLE Pollution Emergency Alerting System (PEAS) at (800) 292-4706.
b. Provide follow-up notification to the EGLE MMD in writing within five calendar days of the telephone call in accordance with Condition I.E.13 of this license. The notification shall include the monitor well(s), piezometer(s), and area(s) of the containment unit(s) at which the inward gradient is not detected.
c. Adjust the detection monitoring frequency at the affected containment unit(s) to quarterly.
d. Confirm the static water level in the bedrock aquifer within 30 days of the measurement that indicates the artesian condition no longer exists. If the loss of the artesian condition is confirmed, submit a bedrock aquifer groundwater monitoring plan (chemical and hydraulic) to the EGLE MMD within 90 days of the confirmation, and upon approval, implement the bedrock aquifer groundwater monitoring plan.

If measurements indicate that an inward hydraulic gradient is not being maintained for the containment unit(s), appropriate corrective action will be taken to correct the situation.

3.2 Analytical Monitoring

The post-closure monitoring program will include sampling of the 14 monitoring wells (designated PCW-1 through PCW-14) installed as described in the previous section. Sampling began immediately upon installation of the wells. During the first two years, all 14 monitoring wells were sampled quarterly with replicate samples taken during each event. The resulting 16 samples at each location were used to establish base line conditions of water quality. Because groundwater flow conditions in the vicinity of the containment units will be significantly altered by the leachate collection system and cutoff wall, a two-year background period was necessary to adequately characterize natural variation in groundwater quality.

The RCRA Ground-water Monitoring Technical Enforcement Guidance Document (September 1986) recommends establishing background concentrations by sampling quarterly for a period of one year and obtaining four replicate samples for each sampling event. The two-year background period was selected to obtain a better representation of the impacts of seasonal variations and changes in flow direction as steady- state groundwater flow conditions are re-established following facility closure. Two replicate samples were collected during each sampling event to provide a sample population size equal to that recommended by the EPA and large enough to perform the statistical analyses described in Section 8.0. The background data was evaluated to determine of variability in site groundwater conditions are adequately addressed.

After completion of the two-year baseline period, the detection monitoring program was instituted. During detection monitoring, groundwater samples are collected from the wells on a semi-annual basis (i.e., two sets of samples per year) and the resulting data is analyzed according to the statistical procedure described below in Section 9.0.

3.2.1 Analytical Requirements

The purpose of obtaining and analyzing groundwater samples from the shallow groundwater unit is to provide early detection of potential migration of hazardous waste constituents from the containment units. Analytical test parameters have therefore been selected based upon previous sampling data and general knowledge of the waste present in the containment units. Accordingly, samples collected from the wells adjacent to the Eastern Containment (PCW-1 through PCW-8) will be analyzed for the parameters listed in Table 1.

Samples collected from wells adjacent to the Western Containment (PCW-9 through PCW-14) will be analyzed for the parameters listed in Table 1.

4. Groundwater Sample Collection

4.1 Water Level Measurement

During each sampling event, the water level in each monitoring well will be measured before the well is purged. The water level will be measured to the nearest 0.01 foot, using a water level indicator, and will be measured from a reference point on the rim of the well casing established during the top-of-casing survey. These water levels will then be referenced to the USGS datum for use in assessing the groundwater flow behavior and the performance of the containment unit leachate collection systems.

4.2 Well Purging

Water purged from the monitoring wells will be discharged to the ground away from the well to avoid recycling of the flow.

During purging, 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 will be monitored using a flow-through cell apparatus. 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 will 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 specified by the U.S. EPA document *EQASOP-GW-4* titled *"Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater of Groundwater Samples from Monitoring Wells.*"

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 centimetre (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

The field measurement devices will be rinsed with deionized water and calibrated at the beginning of each day in the field prior to use. Additionally, each field measurement device will be rinsed with deionized water prior to sampling at each individual monitoring well. The pH and specific conductance meters will be calibrated according to manufacturer's specified procedures. In general, the pH meter is calibrated at two points that bracket the expected pH of the groundwater samples. The specific conductance meter is calibrated by checking the conductance of a standard. These calibration points are produced using stock calibrant solutions of known pH or conductance. Calibration data for the pH and specific conductance meters will be recorded on calibration record sheets. Field parameters will be measured in a sample container separate from the laboratory containers. All field measurements, purging, and sampling information will be recorded on a Field Sampling Form – an example is included in Appendix A1.

4.3 Groundwater Sampling

Groundwater samples will be collected directly after the water pH and specific conductance has stabilized. In case of low-yield wells that are incapable of yielding three casing volumes, the wells will be evacuated to dryness once. Wells that are purged to dryness will be left to sufficiently recover and sampled as soon as possible (i.e. when sufficient ground water is available for sampling). If possible, this period will not exceed 24 hours. The groundwater samples will be collected and containerized in the order of parameter stability and volatilization sensitivity. The samples will be collected in the following order:

a. Volatile organic compounds (VOCs);

b. Base neutral PNAs;

c. Cyanides;

d. Sulfates; and

e. Dissolved metals (field-filtered using a 0.45 um filter)

The groundwater samples will be withdrawn from each monitoring well using disposable polyethylene bailers with polypropylene rope, or a peristaltic pump with well-dedicated polyethylene tubing. This standard sampling equipment is consistent with industry protocols and previous EGLE recommendations. If non-dedicated sampling equipment is utilized, field blanks will be collected at a rate of 1 per 20 samples. After cleaning with an Alconox® or equivalent soap solution, the equipment will be rinsed to remove all soap, and a sample of a second rinse will be submitted to the laboratory as the field blank sample.

Groundwater samples to be analyzed for volatile organic compounds will be collected first after all appropriate field measurements have been completed. The bailer or dedicated sampling device will be gently lowered into the water; and samples collected for volatile analysis will be gently poured into glass vials, filled just to overflowing, ensuring that no air bubbles pass through the sample as the vial is being filled. If a peristaltic pump is used to collect ground water samples for volatile analysis, a low-flow rate of 0.1 to 0.5 liters per minute will be used to minimize volatilization. Random duplicate samples will be collected during the sampling events at a rate of 1 per 20 samples and analyzed for the full set of parameters.

4.4 Leachate Sampling

In order to define and characterize the chemical constituents of the leachate over time and insure that the detection monitoring parameters are appropriate, an analysis of the leachate for VOCs, SVOCs, Part 201 regulated metals, cyanide, and hexavalent chromium will be conducted every five (5) years. In addition, the field parameters of pH, sulfate, and conductivity will be measured. This analysis will be used to determine whether adding or removing testing parameters for the post-closure well sampling is justified.

5. Sample Preservation and Shipment

Samples collected as part of post-closure monitoring will be stored in containers and with preservatives as specified by 40 CFR Part 136.3. The preservation and storage requirements related to the parameters specific to this post-closure groundwater monitoring program are identified on Table 2.

Samples will be stored in an iced cooler (or refrigerator) until delivery to the analytical laboratory. Groundwater samples will be delivered to the analytical laboratory within 24 hours after collection.

In order to minimize the possibility of misidentification of the samples, identification labels will be affixed to the sample containers. Sample containers will be marked by the laboratory what type of preservative is in each sample bottle. All sample labels will be filled out with indelible ink to prevent sample information loss. The labels include the following information:

- Sample identification number
- Date and time of collection
- Parameters to be analyzed

Other information pertinent to the sample being collected (i.e. sample location, type of preservative, etc.) will be noted by the sampler on the field sampling record, a copy of which will be maintained with the post-closure monitoring files.

6. Analytical Procedures

The groundwater samples will be analyzed in accordance with the appropriate USEPA approved methods. The analytical methods are summarized on Table 3. All methods and associated detection limits for the USEPA analytical methods shown on Table 3 will be compliance with EGLE MMD Operational Memo Gen-8, Rev. 7, November 21, 2005 (or more recent updates).

7. Chain-of-Custody

Sample custody will be controlled using strict chain-of-custody procedures. Prior to submittal of the sample to the analytical laboratory, custody of the samples will be the responsibility of the sampler. Custody will become the responsibility of the analytical laboratory upon receipt of the samples. The original chain-of-custody record will remain with the sample; the copies will be retained by the sampler and by Ford.

Information recorded on the Chain-of-Custody form will include:

- Unique chain-of-custody number;
- Sample identification number;
- Number of samples for each sample ID number;
- Requested analyses for each sample ID;
- Sampler's signature;
- Sampling date and time;
- Laboratory receipt date; and
- Signature of laboratory clerk.

8. Quality Assurance/Quality Control Programs

8.1 Quality Assurance/Quality Control – Field Procedures

For quality control during groundwater sampling, a pump blank (if necessary) will be submitted for analysis along with each set of water samples. The pump blank is prepared by passing deionized water through the decontaminated silicone pump tubing. The water is then transferred into laboratory-prepared containers and stored in the iced cooler along with other samples. This pump blank assures the compatibility of the sampling materials with the parameters to be analyzed and verifies that no cross-contamination occurs. The pump blank is to be analyzed for the same parameters as the groundwater samples. As stated above, if non-dedicated sampling equipment is utilized, field blanks will be collected at a rate of 1 per 20 samples. After cleaning with an Alconox or equivalent soap solution, the equipment will be rinsed to remove all soap, and a sample of a second rinse will be submitted to the laboratory as the field blank sample.

8.2 Quality Assurance/Quality Control – Laboratory Procedures

As an additional quality control procedure, the analytical laboratory will furnish quality assurance/quality control (QA/QC) data with all chemical analysis reports. The data supplied by the analytical laboratory includes information on blanks, laboratory duplicates, spike recoveries, and parameter control limits.

The laboratory QA/QC data will be evaluated to determine the acceptability of the results. The laboratory results are considered acceptable if the following conditions hold:

a. Reported method blank results are not higher than reported detection limits;

b. Laboratory duplicates have a relative percent difference of 20% or less; and

c. Results of recovery analyses have a percent recovery of between 80% and 120%.

9. Rationale for Statistical Procedure Selection

The selection of the statistical procedure described below has taken into account the inherent characteristics of the groundwater data collected since 1982 from the surface impoundment monitoring well network. Analysis of the existing groundwater data indicated two factors which must be considered in selecting a statistical procedure: The distribution of the data and the extent of censorship (i.e., number of values below detection limit) in the data set for each parameter. The effects of these two factors on the statistical procedure selection process are described in the following paragraphs.

As in all statistical evaluations, the underlying distribution of the data is an important consideration. In order to use parametric statistics, the underlying population must be normally distributed. In other cases, the lack of an underlying normal distribution for the data may force the use of non-parametric statistical techniques, which do not assume an underlying distribution.

Review of the groundwater monitoring data collected since 1982 indicates that the amount of censored data is significant. In general, individual organic parameters and some of the dissolved metals have been repeatedly non-detectable. Other parameters have been intermittently detected during the monitoring period. In addition, certain groundwater monitoring analytes that have been selected for post-closure monitoring (Table 1) such as sulfate and pH, have been consistently detected during the interim monitoring program.

Based on the percentage of the values measured in the past which have been reported as below the detection limits (i.e., the degree of censorship), three probable groups of parameters have been identified. The first group is heavily censored; i.e., 98 to 100% of the values measured were reported as below the detection limit (BDL). This group will be referred to as Group I and will likely include some of the heavy metals and the organic compounds. The second group (Group II) may include parameters whose percentage of BDL values ranges from approximately 50 to 98%. The last group (Group III) includes parameters that are rarely BDL. This includes parameters like pH, specific conductance and sulfate, which are commonly found in groundwater. An initial review of available statistical methods indicates that the applicability of the various tests is highly dependent on the degree to which the data set being analyzed is censored. Therefore, separate tests were considered for each of the three parameter groups described above.

Another important consideration when selecting an appropriate statistical procedure is a proper balance between the rate of false positives (detecting a significant increase when none has occurred) and the rate of false negatives (failing to detect a significant increase when it has occurred). The power of a statistical test is defined as the probability of correctly identifying a significant increase. The optimum statistical test is one that maintains power while yielding a low rate of false positives. The rate of false positives is theoretically chosen by the investigator (i.e., 1% or 5%), but in reality depends on the applicability of the data for the statistical test. Ford has attempted to choose statistical procedures that are applicable to the various monitoring parameters and that minimize false positives, while maintaining good power to detect significant changes in the monitoring parameters. Ford has also utilized the collection of a baseline data set large enough to maintain proper power.

9.1 Summary of Statistical Procedure

Groundwater quality data collected during the post-closure monitoring period has been analyzed in two phases. The initial phase involved establishing baseline water quality conditions at each monitoring well. The second phase involves routine sampling and analysis to detect significant deviations from baseline conditions using an intra-well comparison procedure.

The rationale for using the intra-well procedure is based on the groundwater flow behavior that is expected to develop around the containment units. As explained in the Post-Closure Plan, the leachate collection systems are designed to maintain leachate levels within the containment units lower than the water levels in the surrounding natural groundwater strata. Because the potential for inward flow will be induced by the leachate collection systems, all the monitoring wells are installed to be up gradient of the enclosed waste. This configuration precludes the traditional use of an upgradient well for background groundwater quality comparison. A description if this procedure is described below and presented in Appendices 2 through 7.

Each of the two data analysis phases is discussed in the following subsections.

9.1.1 Baseline Data Collection Phase

The statistical analysis procedures for the baseline data collection phase are summarized in the seven separate steps given below.

STEP 1 Baseline Groundwater Sampling – To establish baseline groundwater quality data for the monitoring system, samples from the fourteen monitoring wells on a quarterly basis for a period of two years were collected. This sampling schedule yielded a total of 16 samples for each sampling location. Samples from wells PCW-1 through PCW- 8 will be analyzed for the parameters listed on Table 1. Samples from wells PCW-9 through PCW-14 will be analyzed for the parameters listed on Table 1. A two-year baseline data collection period is necessary to have sufficient data to properly characterize the underlying statistical distribution and to select the proper statistical method for data analysis during detection monitoring. Use of a two-year baseline period will provide more inclusive data accounting for seasonal variations or variations based on differing rainfall conditions in the two-year period. In addition, by collecting replicate samples on a quarterly basis for two years, the possibility for time dependence between samples should be less than if quadruplicate samples were tested quarterly for one year.

STEP 2 Evaluation of Degree of Censorship – In order to determine the most appropriate statistical procedure, determine determination of the degree of censorship within the baseline data set for each parameter will occur at the end of the two-year period. This was determined by evaluating the percentage of each of the parameter's values which are BDL. This information is used as the basis for selecting the appropriate statistical procedure, as described in the next subsection.

STEP 3 Determination of Underlying Statistical Distribution – For each parameter found to be in Group II or Group III, a determination as to whether the baseline data is drawn from a normally distributed population. This determination was conducted by a two-step procedure. First, the coefficient of variation will be computed and then a normal probability plot was constructed. If the coefficient of variation and normal probability plot regression analysis strongly suggests that the background data set is not normally distributed, the data will be transformed to determine if the data is log-normally distributed. or log-normally distributed, the data will be transformed to determine if the data is log-normally distributed. If the data is log-normally distributed, Ford will evaluate the data using the Shewhart-CUSUM Control Charts to determine whether or not a statistically significant increase has occurred at each monitoring well (see 9.2). If the data is not normally or log-normally distributed, Ford will use non- parametric statistical analysis to evaluate the data.

STEP 4 Inspection of the Baseline Data Set for Outliers – Identified erroneous values (i.e., outliers) within the baseline data set for any parameter with less than 50% of its values BDL and a known distribution. An outlier will be defined as a value for any parameter, which is more than three standard deviations smaller or larger than the mean value for the parameter. The mean and standard deviation values of the baseline data collected at each well will recomputed after all corrections, as described above, have been made.

STEP 5 Establishment of Analytical Precision for the Detection Limits – At the conclusion of the baseline monitoring period, an analytical precision was established for the detection limit of any of the monitoring parameters which are found to be heavily censored (Group I). This analytical precision was based on the laboratory quality control information, which will be the collected by the laboratory at each quarterly sampling during the baseline period. This analytical precision is critically important in statistically evaluating the Group I data sets.

STEP 6 Identification of Seasonal Cycles, Long-term Trends, and Serial Correlation – The baseline data was analyzed to determine whether or not a serial dependence or seasonal trend exists in the data. This was determined by examining a graph of the concentration of each parameter plotted as a function of time. The data was considered to have a seasonal trend if the concentration values for any parameter show a repetitive periodicity during the baseline period. If a seasonal influence was indicated in the baseline data, the removal of the seasonal effect was completed.

STEP 7 Calculation of Means and Standard Deviations - At the conclusion of the baseline monitoring period, a mean and standard deviation for each monitoring parameter at each individual monitoring well was established.

9.1.2 Detection Monitoring Phase

The detection monitoring program began after the completion of the 2-year baseline data collection period. During detection monitoring, samples are and will continue to be collected on a semi- annual basis, as described in the Post-Closure Plan. For each sampling event intra-well statistical comparisons using the methods described below is and will be made for each monitoring parameter at each monitoring well.

The statistical procedures described below are keyed to the percentage of BDL values in the baseline data collection period. The parameters will be separated into three groups based on the percentage of BDL values. The statistical test, which will be used to determine whether or not a statistically significant increase has occurred at a monitoring well for each sampling event, will be different for each of the three groups. Each of the three statistical methods is described below.

GROUP I Procedures When All Baseline Data Are Below the Detection Limit – For Group I parameters, evaluation as to whether or not a statistically significant increase has occurred at each well if the value for the parameter at the well in question is above the EGLE-approved detection limit. If it is not, Ford will conclude that no increase has occurred.

GROUP II Procedures When More Than 50% of the Baseline Data Are Below the Detection Limit

And

GROUPIII Procedures When Less than 50% of the Baseline Data Are Below the Detection Limit – For II and III parameters, Ford will construct combined Shewhart-CUSUM Control Charts to determine whether or not a statistically significant increase has occurred at each monitoring well. The Shewhart Control chart is a graph of time of sampling versus the sample mean for the parameter being monitored. An upper control limit is established based on a selected level of significance and on the standard deviation of the baseline data. When a point falls above an upper control limit the increase is regarded as significant. The CUSUM (for cumulative summation) Control Chart makes use of the information in the present sample, as well as previous samples, in reaching decisions as to whether the parameter has undergone a significant change. The combined procedure takes advantage of the Shewhart chart's ability to detect large shifts the mean and the CUSUM chart's ability to detect small but persistent changes.

Group II and III will be individually evaluated to determine the underlying data distribution. As recommended by USEPA, Shewhart-CUSUM Control Charts are ideally used for data that is normally distributed. However transformation of the data (log-transformation or square-root transformation) is recommended for data that is not normally distributed. If the results of the transformation does not indicate a normal distribution, and the Shewhart-CUSUM Control Chart procedure cannot be applied, the critical value for exceedance will be the highest concentration of the given parameter for that well.

Data collected during the detection monitoring period will be managed using the commercially- available software CHEMPOINT and CHEMSTAT. CHEMPOINT is an environmental sampling database management application developed to track ground-water data and CHEMSTAT is used for statistical analysis of ground-water monitoring data at RCRA subtitle C and D sites. Analysis methods in CHEMSTAT comply with 1989 and 1992 US EPA statistical guidance documents (Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities).

9.2 Measures to be Instituted of Statistically Significant Change is Detected

If a statistically significant increase (and/or pH decrease) is detected at any time in any monitoring well, the licensee shall notify the EGLE MMD by telephone within one working day and arrange a re-sampling as soon as possible to confirm a statistically significant increase (and/or pH decrease). Resampling must include not less than four replicate samples at the well(s) for the parameter in question. For data collected from non-parametric tests, if 2 of the 4 replicate samples are detected over the EGLE-approved detection limit (Group 1) or highest previous detection (Group II), or if 1 of 4 is detected at 5 times the EGLE-approved detection limit or previous detection, then the exceedance is confirmed. For confirming exceedances using the Shewhart-CUSUM control charts, the mean of the 4 replicate samples will be used as the concentration to be evaluated for confirmation.

If the licensee determines that a statistically significant increase (and/or pH decrease) has occurred, the licensee shall do all of the following:

A. Notify the Director within one working day by calling the Michigan Department of Environment, Great Lakes and Energy, Materials Management Division, or in the event of unavailability, the EGLE 24-hour emergency response operator at 1-800-292-4706.
B. Provide follow-up notification to the EGLE Materials Management Division in writing with seven calendar days of the telephone call. The notification shall indicate what parameters or constituents have shown statistically significant changes and the well(s) in which the changes have occurred.
C. As soon as possible, sample the groundwater in all monitoring wells located at the same containment unit as the monitor well that had the statistically significant increase and determine the concentration of all constituents identified in Appendix IX of 40 CFR Part 264 that are present in groundwater and for which approved analysis methods exist. The licensee may resample within one month and repeat the analysis for those Appendix IX compounds that were detected. Constituents detected in the first Appendix IX sampling or confirmed by the resampling will form the basis for compliance monitoring.
D. Immediately take steps to determine the cause of the change and eliminate the source of discharge.
E. Within 90 days of the determination, submit to EGLE an application for a license modification to establish a compliance monitoring and corrective action program meeting the requirements of R 299.9612 and 40 CFR

§264.99, which is adopted by reference in R 299.11003. The application shall include the following information:

a) An identification of the concentration of all Appendix IX constituents found in the groundwater.
b) Any proposed changes to the groundwater monitoring system at the facility necessary to meet the requirements of R 299.9612 and 40 CFR §264.99.
c) Any proposed changes to the monitoring frequency, sampling and analysis procedures or methods, or statistical procedures used at the facility necessary to meet the requirements of R 299.9612 and 40 CFR §264.99.

F. Within 180 days, submit to the EGLE a detailed description of corrective actions that will achieve compliance with applicable laws and rules, including a schedule of implementation. Corrective action must also meet the requirements of 40 CFR §264.100, which is adopted by reference in R 299.11003, and include a plan for a groundwater monitoring program that will demonstrate the effectiveness of the corrective action. Such a groundwater-monitoring program may be based on a compliance-monitoring program developed to meet the requirements of 40 CFR §26499. Nothing in this condition shall be construed as prohibiting the licensee from requesting an alternate or maximum concentration limit under R 299.9612.

G. During the period prior to a license modification requiring a compliance monitoring and corrective action program, the licensee shall provide the EGLE MMD, or his or her designee, with weekly telephone updates and written reports every two weeks regarding the progress to date in determining the cause of contamination and eliminating the discharge. The licensee shall include in the written report the results of all samples from the environmental monitoring conducted by the licensee.

If the licensee determines pursuant to Conditions III.A.6. and 7. of the existing license that a statistically significant increase (and/or pH decrease) in hazardous constituents has occurred in groundwater, the licensee may demonstrate that a source other than the licensed facility caused the increase (and/or pH decrease) or that the increase (and/or pH decrease) resulted from error in sampling, analysis or evaluation. Although the licensee may make a demonstration under this condition in addition to, or in lieu of, submitting a license modification application within the time specified in Condition III.A.8. (e) of this existing license, the licensee is not relieved of the requirement to submit a license modification application within the time specified unless the demonstration made under this condition successfully shows that a source other than the licensed facility caused the increase (and/pH decrease) resulted from error in sampling, analysis, or evaluation. In making a demonstration under this condition, the licensee shall:

A. Notify EGLE within seven days of the determination that it intends to make a demonstration under this condition.
B. Within 90 days of the determination, submit a report to EGLE that demonstrates that a source other than the licensed facility solely caused the increase (and/or pH decrease), or that the increase (and/or pH decrease) was caused by error in sampling, analysis, or evaluation.
C. Within 90 days of the determination, submit to EGLE an application for a license modification to make any appropriate changes to the groundwater monitoring program at
D. Continue to monitor groundwater in compliance with this license.

10. Recordkeeping and Reporting

During the first two years of detection monitoring, results of the quarterly sampling used to establish baseline groundwater quality were reported to the EGLE MMD. These reports include tables showing the analytical results and groundwater elevations.

Throughout the post-closure care period, Ford will maintain records of the groundwater analyses, the associated groundwater surface elevations, statistical analyses, and interpretations. These records are to be maintained as part of the facility operating record, and will be submitted for review, as specified by the EGLE MMD. During each semi-annual monitoring event, a semi-annual report of monitoring activities including the following information will be submitted to the EGLE MMD.

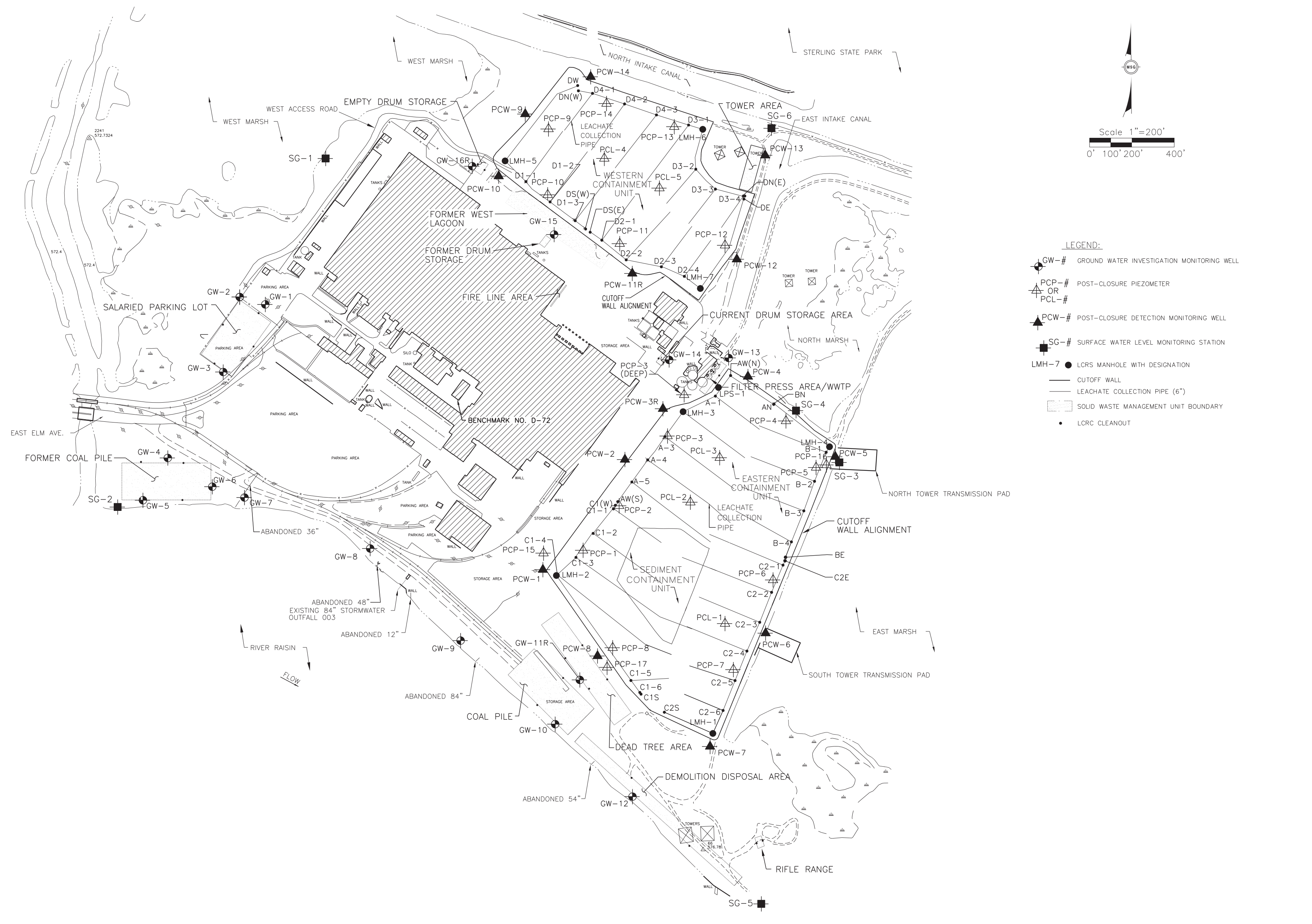
a. Certification statement

b. A brief narrative of the sampling event; difficulties, etc.
c. The results of the statistical evaluation of the data and reporting of any significant increase
d. Copies of all field sampling forms
e. A copy of the analytical laboratory data report that should include the following
    i. Sample identification
    ii. Detection Limits
    iii. Date samples were received, analyzed, and reported
    iv. Methods used for laboratory analysis for each parameter
f. Tabular data summaries
g. Site map with groundwater monitoring locations summarizing groundwater analytical data
h. A brief descriptive summary of the overall quality of the analytical data and QA/QC results, including:
    i. Holding time requirements
    ii. Matrix interference occurrences
    iii. Detection limit issues
    iv. Surrogate recovery quality
    v. Matrix spike/matrix spike duplicates (MS/MSD) data relative to method requirements
    vi. Any other significant problems
i. A summary of on-going Operation and Maintenance issues related to the groundwater monitoring program
j. Electronic Data Deliverables (EDDs) that comply with the United States Environmental Protection Agency (USEPA) Region 5 submittals

The licensee shall submit the results of all environmental monitoring required by this license in the form of an Environmental Monitoring Report to the EGLE MMD within 90 days of the sample collection or within 7 days of receipt of the analytical results, whichever is sooner.

11. References

1. Sykes, A.L., R.A. Mc Allister, and J.B. Homolya. 1986 Sorption of Organics by Monitoring Well Construction Materials. Groundwater Monitoring Review, Fall 1986.
2. Parker, Louise V., Allan D. Hewitt and Thomas F Jenkins. 1990 Influence of Casing Materials on Trace–Level Chemicals on Well water. Groundwater Monitoring Review, Spring 1990.



NO. | DATE | BY | DESCRIPTION

PROJECT DATE: 11/07/2011
PROJECT NO.: FORD0102
DRAWN BY: HMW
CHECKED BY: TEP

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GENERAL LAYOUT

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Table 1 Groundwater Sample Test Parameters

Monitoring Wells PCW-1 Through PCW-8	Monitoring Wells PCW-9 Through PCW-14
pH	pH
Sulfate	Sulfate
Specific Conductance	Specific Conductance
Total Cyanide	Total Cyanide
Volatile Aromatic Organic Compounds	Volatile Aromatic Organic Compounds
Halogenated Volatile Organic Compounds	Halogenated Volatile Organic Compounds
Base Neutral PNAs	Base Neutral PNAs
Sulfate	Sulfate
Cadmium (Dissolved)	Cadmium (Dissolved)
Chromium (Dissolved)	Chromium (Dissolved)
Chromium VI (Dissolved)	Chromium VI (Dissolved)
Copper (Dissolved)	Copper (Dissolved)
Nickel (Dissolved)	Nickel (Dissolved)
Lead (Dissolved)	

Table 2 Sample Container and Preservation Requirements

Parameter	Container	Preservative	Holding Time
Dissolved Metals	HDPE	No Preservative, 4°C	6 Months
Dissolved Cr VI	HDPE	No Preservative, 4°C	24 Hours
Sulfate	HDPE	No Preservative, 4°C	28 Days
Total Cyanide	HDPE	NaOH to pH>12, 4°C	14 Days
Volatile Organic Compounds	Glass VOA Vial with Teflon Lined Septa	HCl to pH<2, 4°C	14 Days
Base Neutral PNAs	Glass Amber	No Preservative, 4°C	7 Days

Notes:

1. Size of container to be determined and provided by analytical laboratory
2. Dissolved metals will be accomplished by field filtering sample using a 0.45 um filter

Table 3 Analytical Methods

Parameter	EPA Analytical Method
Cadmium	200.8
Chromium	200.8
Hexavalent Chromium	3500-CrB
Copper	200.8
Lead	200.8
Nickel	200.8
Total Cyanide	9010B335.4/4500
pH	***
Specific Conductance	***
Sulfate	300.0
Halogenated Volatile Organic Compounds	8260
Aromatic Volatile Organic Compounds	8260
Base Neutral PNAs	8270

Notes:

*** - Field measurement, performed according to manufacturer’s application

Appendices

Appendix A

Field Sampling Form

Well No.: PCW-13 Sampling Event: June 2021 SSOW Code: Monitoring Well Record for Low-Flow Purging

Project Name: Monroe warehouse Ref. No.: Personnel: Dillon Antulis GHD Date: 6/9/2021 12:12:50 PM

Monitoring Well Data

Well Diameter: Constructed Well Depth: Measured Well Depth:

Screen Material: Water Column Length:

Screen Start Depth: Ref Point Elev:

Screen End Depth: Static Water Depth: Measurement Type:

Screen Length: Static Water Elev: Sampling Method:

Time	Pumping Rate (ml/min)	Depth to Water ()	Drawdown from Initial Water Level (ft)	Temperature °F	Conductivity (µS/cm)	Turbidity NTU	DO (mg/L)	pH	ORP (mV)	Volume Purged, Vp (gal)	No. of Well Screen Volumes Purged
			Precision Required	±% 10	±% 10	< 10 Or % 10	±% 10	± 0.1	±% 10		

Field Parameters:	Primary:								Total Volume Purged (gal):
Iron:			And	Or	Or				
Sulfide:	Secondary:								

Sample ID	Type	Matrix	Comp/Grab	DateTime	Filtered	Analysis	Container #

Time	Pumping Rate (ml/min)	Depth to Water ()	Drawdown from Initial Water Level (ft)	Temperature °F	Conductivity (µS/cm)	Turbidity NTU	DO (mg/L)	pH	ORP (mV)	Volume Purged, Vp (gal)	No. of Well Screen Volumes Purged

Project Data:

Project Name: ______________________ **Date:** ______________________

Ref. No.: ______________________ **Personnel:** ______________________

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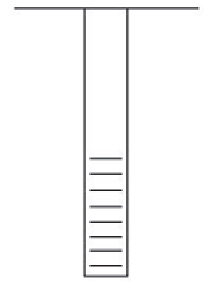


Monitoring Well Data:

Well No.: ______________________

:(Vapour PID (ppm ______________________ **:(Saturated Screen Length (m/ft** ______________________

:Measurement Point ______________________ **:(Depth to Pump Intake (m/ft)(1** ______________________

Constructed Well Depth (m/ft ______________________ **:(Well Diameter, D (cm/in** ______________________

:(Measured Well Depth (m/ft ______________________ **:(Well Screen Volume, V_S (L)(2** ______________________

:(Depth of Sediment (m/ft ______________________ **:(Initial Depth to Water (m/ft** ______________________

Time	Pumping Rate (mL/min)	Depth to Water (m/ft)	Drawdown from Initial Water Level(3) (m/ft)	Temperature °C	Conductivity (mS/cm)	Turbidity NTU	DO (mg/L)	pH	ORP (mV)	Volume Purged, Vp (L)	No. of Well Screen Volumes Purged(4)
			:(Precision Required(5	±3 %	±0.005 or 0.01(6)	±10 %	±10 %	±0.1 Units	±10 mV		

Sample ID: ______________________ **:Sample Time** ______________________

Notes:

(1) The pump intake will be placed at the well screen mid-point or at a minimum of 0.6 m (2 ft) above any sediment accumulated at the well bottom.

(2) The well screen volume will be based on a 1.52 metres (5-foot) screen length (L). For metric units, $V_S = \pi * (r^2) * L$ in mL, where r (r=D/2) and L are in cm.
For Imperial units, $V_S = \pi * (r^2) * L * (2.54)^3$, where r and L are in inches

(3) The drawdown from the initial water level should not exceed 0.1 m (0.3 ft). The pumping rate should not exceed 500 mL/min.

(4) Purging will continue until stabilization is achieved or until 20 well screen volumes have been purged (unless purge water remains visually turbid and appears to be clearing, or unless stabilization parameters are varying slightly outside of the stabilization criteria and appear to be stabilizing), No. of Well Screen Volumes Purged= Vp/Vs.

(5) For conductivity, the average value of three readings <1 mS/cm ±0.005 mS/cm or where conductivity >1 mS/cm ±0.01 mS/cm.

Appendix B

Method for Determining Whether the Background Data was Drawn from a Normal or Lognormal Distribution and Adjustments for Lognormal Character

APPENDIX 1.0 METHOD FOR DETERMINING WHETHER THE BACKGROUND DATA WAS DRAWN FROM A NORMAL OR LOGNORMAL DISTRIBUTION AND ADJUSTMENTS FOR LOGNORMAL CHARACTER

A. TESTING FOR NORMALITY

Case I. No Background Data are Below the Detection Limit

If none of the data are BDL the evaluation of the distribution of background data will be conducted by a two step procedure. The first step is to compute the coefficient of variation (COV) which is the standard deviation divided by the mean:

$$s_b/\bar{x}_b$$

where for each parameter, s_b = the standard deviation of the background
$\bar{x}_b$ = the mean of the background

The analysis of the COV calculations are divided into three categories, which are detailed below.

I) If the COV is > 1.0, then it is very unlikely that the data came from a normal distribution and some adjustment of the data for the non-normality must be undertaken before the data is used in statistical procedures. In this situation the data should be examined for lognormal character (see below). If the mean and variance can be adjusted for lognormality, these values can be used in a parametric statistical procedure.

II) If the COV is > 0.50 and < 1.0, the data should be further examined to determine whether it comes from a normal distribution. If the covariance is in this range, then a normal probability plot will be constructed and regression analysis will be performed. The regression analysis must include the calculation of the standard parameters such as the correlation coefficient, the slope and intercept, and the corrected sum of the squares. The normal probability plot is constructed by the following steps:

1. Rank order the data (x_i) from smallest to largest.

2. Assign the (x_i) values ranks (r_i) from 1 to N, where N is the number of independent background observations.

3. Divide the ranks (r_i) by the total sample size (N) plus one (i.e. N + 1) to obtain the plotting positions F. For example:

$$F_1 = r_1 / (N + 1), \quad F_2 = r_2 / (N + 1)$$

4. Compute the normal score (Z) corresponding to each value of F by the following equation (Gilliam and Helsel, 1986):

$$Z_i = 4.91 * [F_i^{.14} - (1 - F_i)^{.14}]$$

5. Plot the ordered data values (x_i) as a function of the normal scores (Z_i), with the normal scores on the x-axis. Then perform a linear regression analysis of the x_i values on the Z_i values. Obtain the value for the correlation coefficient, ^r, for the line fitted to the data.

The plot of x as a function of Z is a normal probability plot which can be examined visually to determine if the data points approximate a straight line relationship. A straight line indicates normality and, conversely, a highly non-linear relationship is an indication of non-normality.

If the linearity of the normal probability plot is questionable, the probability that the data are from a normal distribution can be tested by comparing the correlation coefficient (^r) to a critical value, $\hat{}r_c$, from table 1., using the following steps:

6. For the desired level of alpha (such as 0.05), enter the table at N, the number of values in the data set, and determine the critical value, $\hat{}r_c$.

7. The correlation coefficient from the regression, ^r, is compared to the critical value ^r. The possible results are:

   i. ^r > $\hat{}r_c$. In this case the hypothesis that the data is normally distributed is accepted for the significance level chosen (ie. alpha = 0.05).

   ii. $\hat{}r_c$ > ^r . In this case there is reason to question the hypothesis that the data are normal. The deviation from normality is not serious enough to prevent the use of this data in parametric statistics, as there is some tolerance for non-normality. However, the data should be checked for lognormal character, and if there is strong evidence for lognormal character, the data should be adjusted appropriately (see Part B., below).

III) <u>If the COV is less than 0.5</u>, the data should be regarded as coming from a normal distribution and can be used in parametric statistical procedures.

Case II. The Data Contain Below Detection Limit Values

In the case where there are below detection limit values in the background data set, the coefficient of variation should not be calculated because the mean and variance can be calculated only from the ADL data and thus are only estimates. The distribution should be determined from a regression analysis of the above detection limit (ADL) data.

The steps in this procedure is as follows:

1. Identify the number of BDL values. Label this quantity n_1.

2. Rank order the above detection level data (x_2) from smallest to largest.

3. Assign the ADL values ranks (r_i) using a method which accounts for the n_1 values of the data set that are below detection. The values for r are calculated by the following equation:

$$r_1 = n_1 + 1, \ r_2 = n_1 + 2, \ \ldots\ldots \ r_N = N$$

4. Divide the ranks (r_i) by the total sample size (N) plus one (i.e. N + 1 = ADL + BDL + 1) to obtain the plotting positions F. For example:

$$F_1 = r_1 \ / \ (N + 1), \ F_2 = r_2 \ / \ (N + 1)$$

5. Compute the normal score (Z) corresponding to each value of F by the equation:

$$Z_i = 4.91 * [\ F_i^{.14} - (1 - F_i)^{.14} \ ]$$

6. Plot the ordered ADL values (x_2) as a funtion of the normal scores (Z_i), with the normal scores on the x-axis. Perform a regression analysis of the x_2 values on the Z values. Obtain the value of the correlation coefficient, ^r, for the line fitted to the data.

The determination of normality is then made using visual inspection, and if necessary, the correlation coefficient test as in steps 6 and 7 above (except that the value of N in step 6 is the number of ADL values). If the data are found to be non-normally distributed, they should then be checked for a lognormal distribution using the steps below.

B. TRANSFORMATION OF LOGNORMAL DATA TO NORMALITY

If the coefficient of variation or normal probability plot regression analysis strongly suggest that a background data set was not normally distributed, the data should be evaluated for lognormal character. The lognormal distribution is apparently a common distribution for groundwater data. The check for lognormality is conducted as follows:

1. Transform the above detection limit (ADL) data, x_i, to natural logarithms: $y_i = \ln(x_i)$
2. The transformed data, y_i, are then used in steps 1-5 above for the appropriate case (I or II), to construct a normal probability plot and perform a linear regression analysis of y_i on Z_i.
3. The normal probability plot is then analyzed visually for a linear trend of the data, and the correlation coefficient can be tested at the significance level chosen (i.e. alpha = 0.05) as described above.

If the results of this test indicate the log-transformed data are now normally distributed, an adjustment of the mean and variance must be made to take into account the lognormal character. Because power is lost by use of log-transformed data, and because the use of transformed data can result in difficulty in understanding the results of a statistical test, the direct use of log-transformed data in a parametric statistical test is not recommended. However an adjusted mean and variance can be calculated from the log-transformed data. The sequence of calculations depend on whether the data is censored or not, and hence the adjustment for lognormality is given for each case separately.

Case I. No BDL Data

When there is no BDL data, a non-log mean and variance can be estimated from the log-transformed data with the following equations:

4) $\bar{x}_{yb} = \exp(\bar{y}_b + ((w_{yb})^2/2))$

5) $s^2_{yb} = (\bar{x}_{yb})^2(\exp(w_{yb})^2 - 1)$

where $\bar{x}_{yb}$ = mean of lognormal distribution estimated from the log-tranformed values

s^2_{yb} = variance of lognormal distribution estimated from the log-transformed values

$\bar{y}_b$ = mean of log-transformed values

w_{yb} = standard deviation of log transformed values

These non-log parameters, $\bar{x}_{yb}$ and s_{yb}^{2} represent the estimate of the mean and variance of the data which take into consideration the lognormal character. Because this is not the same as transforming the data to normality, it should be understood that if there is a very large deviation from normality, it still may not be entirely appropriate to use parametric statistics.

Case II. Data Contain BDL Values

If the data contain BDL values (i.e. the data are censored) the mean and variance of the log-transformed data must be adjusted using the methods in Appendix 2.0. Once the new mean ($\bar{y}_b{}'$) and variance $(w_{yb}{}')^2$ have been estimated, they can be used in the equations in steps 6 and 7 below:

6) $\bar{x}_{yb}{}' = \exp(\bar{y}_b{}' + ((w_{yb}{}')^2/2))$

7) $s^2_{yb}{}' = (\bar{x}_{yb}{}')^2\ (\exp(w_{yb}{}')^2 - 1)$

where $\bar{x}_{yb}{}'$ = the mean of the lognormal distribution estimated from the adjusted log-transformed values.

$s^2_{yb}{}'$ = the variance of the lognormal distribution estimated from the adjusted log-transformed values.

$\bar{y}_b{}'$ = the mean of the adjusted log-transformed values

$w_{yb}{}'$ = the standard deviation of the adjusted log-transformed values

In this case the values for the parameters $\bar{x}_{yb}{}'$ and $s_{yb}{}'$ are now suitably adjusted for use in parametric statistical procedures.

Appendix C

Methods for Estimating the Mean and Variance of Censored Data

APPENDIX 2.0 METHOD FOR ESTIMATING THE MEAN AND VARIANCE OF CENSORED DATA

If the background data set contains below detection level (BDL) data, the mean and variance of the above detection level (ADL) data must be adjusted, or estimated to account for the proportion BDL. Also, the sample size of the background data (N) must be adjusted to an effective sample size (N_{eff}), which takes into consideration the lack of information due to the BDL values. The following procedure may be used on either raw or log-transformed ADL data.

A. Estimation of Mean and Standard Deviation

The estimation of the mean and standard deviation of censored data can be obtained from the regression analysis of the ADL data described in Case II, Part A., Appendix 1.0, in the following steps:

1. Use steps 1-5 from Case II, Part A., Appendix 1.0 to perform the regression of x_i (or the log-transformed values, y_i) on Z_i.

2. From the regression analysis, the y-intercept (value of x_i (or y_i) where Z=0) is the new estimate of the mean, called $\bar{x}_b$'(or $\bar{y}_b$'if the data were log-transformed). The slope of the regression line is the estimate for the standard deviation, s_b' (or w_b' if the data were log-transformed).

The regression estimates, $\bar{x}_b$' and s_b', are parameters suitable for use in parametric statistical procedures. If the regression was performed on log-transformed data, these values of $\bar{y}_b$' and w_b' must be used to estimate non-log parameters by the use of the equations in steps 6 and 7 in Case II, Part B, Appendix 1.0.

B. Estimation of Effective Sample Size

The effective sample size, N_{eff} can be estimated by the following procedure. The first step is the calculation of the variance of the mean [VARX]. This is accomplished in the following steps:

3. calculate the mean of the normal scores, $\bar{z}$, which were computed in steps 1-4 in Case II, Part A., of Appendix 1.0.

4. perform another regression analysis of the normal scores, Z_i, on the plotting positions, F_i, (computed in steps 1-3, Case II, Part A., Appendix 1.0). The purpose of this regression analysis is to obtain a term called the total corrected sum of the squares, $s(z^2)$ which is defined as:

$$s(z^2) = \sum z_i^2 - n_2\bar{z}^2$$

where: $\sum z_i^2$ = the sum of the squares of the normal scores

n_2 = the number of ADL values

$\bar{z}^2$ = the mean of the normal scores squared

5. calculate the standard deviation of the ADL values, s_2, by the standard equation for standard deviation:

$$s_2 = [(\sum(x_i - x_2)^2) / (n_2 - 1)]^{0.5}$$

where: $\bar{x}_2$ = the mean of the ADL values
n_2 = the number of ADL values

If the data have been log-transformed, the equation is:

$$s_2 = [(\sum(y_i - y_2)^2) / (n_2 -1)]^{0.5}$$

where: $\bar{y}_2$ = the mean of the log-transformed ADL values

6. calculate [VARX] from the equation:

$$[VARX] = [\ (1/n_2) + (\bar{z}^2/s(z^2)\ ]\ s_2^2$$

where: n_2 = number of ADL values

$\bar{z}$ = the mean of the normal scores, z (step 3 above)

$s(z^2)$ = corrected sum of the squares (step 4 above)

s_2 = standard deviation of ADL values (step 5)

7. the effective sample size, N_{eff}, is then calculated from the equation:

$$N_{eff} = s^2_b{}'/[VARX]$$

where: $s_b{}'$ = the estimated standard deviation (step 2 above). This is $w_b{}'$ if the data were log-transformed.

[VARX] = variance of the mean (step 6 above)

The effective sample size N_{eff} is the value which represents the number of independent background observations in the average replicate t-test and should be used to calculate the degrees of freedom. Because the regression method is a means of estimating the variance of the mean, [VARX], and assumes the data are normally distributed, the parameter N_{eff} is also only an estimate. In general, N_{eff} should not be larger than the total sample size or smaller than the number of ADL values. If N_{eff} exceeds the upper limit, N_{eff} will be set to the total sample size. If N_{eff} is smaller than the number of ADL values, it will be set at the number of ADL values.

EXAMPLE OF ADJUSTING BACKGROUND MEAN AND VARIANCE FOR DEVIATION TO NORMAL DISTRIBUTION AND CENSORSHIP

In the following example a statistical software package was used which contained the following features: 1) a data editor which has rank ordering capabilities, 2) a summary statistics routine which includes mean and standard deviation, and 3) a linear regression routine which includes plotting capabilities and can produce a printout of parameters such as slope, intercept, correlation coefficient and the total corrected sum of the squares. A package of this type greatly facilitates the implementation of the statistical procedures.

<u>Example Adjustment of Background Data: Iron</u>

To date, 5 quarters of background data for iron has been collected at upgradient wells OB-18, OB-19 and OB-31. These 15 independent observations will be used as a completed background data set in this example.

A. Testing for Normality

Because 2 of the 15 background values were below detection, case II from Appendix 1.0 is applicable to this example. Thus the first step is the regression of the ADL data on the normal scores. This is done in the following steps:

1. The ADL data, x_2, are rank ordered from smallest to largest. This is shown on figure 1.

2. The ADL data are assigned ranks (R_i), taking into account the 2 BDL values. Thus x_1 has a rank of 3, x_2 has a rank of 4, etc. This data is shown in fiqure 1, second column.

3. The plotting positions (F_i) are calculated by dividing each value (R_i) by N + 1, which in this example is 16. The plotting positions are shown in column 3, figure 1.

4. The normal scores (z_i) are calculated from the F_i values with the equation:

$$z_i = 4.91 * (F_i{}^{.14} - (1 - F_i)^{.14})$$

5. The ordered ADL values, x_2, are then regressed on the normal scores. The probability plot and regression results are shown on figure 2.

6. The plot is then visually examined for linearity. As seen from figure 2, the data plot in a highly non-linear manner suggesting the data are not normally distributed.

7. This subjective interpretation is then checked by comparing the correlation coefficient from the regresssion ($\hat{r}$ = 0.766), to a critical value from table 1. From the table, using α = 0.05 and N = 15, the critical value ($\hat{r}_c$) is 0.938. Since $\hat{r}_c >> \hat{r}$ the data do not appear to have been drawn from a normal distribution (i.e. hypothesis of normality is rejected).

The next step is to evaluate the possibility that the data are lognormally distributed.

B. Testing for Lognormality

To test for an underlying lognormal distribution, the ordered ADL data is first log-transformed:

$$y_i = \ln(x_i)$$

Then steps 2-4 above are repeated to prepare for the regression of y on z (i.e. columns 2-4 on figure 1 are also used in the present regression analysis). The columns 1-4 for the current regression analysis are shown in figure 4.

The log-transformed values, y_i, are then regressed on the normal scores, z_i. The resulting probability plot and regression parameters are shown on figure 5. From this normal probability plot it can be seen the the log-transformed data now have a strong linear trend. This is good evidence for a lognormal distribution. The correlation coefficient, $\hat{r}$, is 0.987, which is greater than the critical value of 0.938 (see above). Thus the hypothesis that the log-transformed values are normally distributed cannot be rejected. In other words, the data appear to have been drawn from a lognormal distribution.

Before estimating the mean and variance of the lognormal distribution, the data must be adjusted for censorship, as there were 2 BDL values in the iron example.

C. Adjustment of Mean and Variance for Censored Data

From the regression analysis of y_i on z_i completed above, a new estimate of the mean and variance has been determined which take into account the BDL values. The estimate of the mean, labelled $\bar{y}_b'$, is the y-intercept of this regression analysis, -0.963 (from figure 5). The estimate of the standard deviation, labelled w_{yb}', is the slope of the regression analysis, 1.912 (from figure 5).

The remaining step is the calculation of the effective sample size, N_{eff}. This requires the calculation of the standard deviation of the ADL values and an estimate of the variance of the mean [VARX]. The standard deviation of the log-tranformed ADL values is 1.41 (shown in figure 6). The calculation of [VARX] is done with the following equation:

$$[VARX] = \{(1/n_2) + (\bar{z}^2/s(z^2))\}\ s_2{}^2$$

where: n_2 = number of samples above the detection limit

$\bar{z}^2$ = square of the average normal score (from figure 7)

$s(z^2)$ = corrected sum of the squares from the regression of z on F (from figure 8)

s_2 = standard deviation calculated from the log-transformed ADL values (computed in the summary statistics shown on figure 6)

In this example:

$$[VARX] = \{(1/13) + (.207^2/6.319)\}\ 1.405^2$$
$$= 0.1653$$

The effective sample size is then calculated from:

$$N_{eff} = (w_{yb}')^2/[VARX]$$

where: w_{yb}' = the estimated standard deviation from the regression of y_i on z shown above.

In the iron example, w_{yb}' was 1.912 (see figure 5). Thus:

$$N_{eff} = 1.912^2/\ 0.1635$$
$$= 22$$

Since 22 is greater than the total sample size of 15, N_{eff} is assigned the value of 15. The adjusted log-transformed parameters are:

$$\bar{y}_b' = -.963$$
$$w_{yb}' = 1.912$$
$$N_{eff} = 15$$

D. Estimation of Mean and Variance of Lognormal Distibution

The above log-transformed parameters should not be used in a statistical test. A new mean and variance based on the above log-transformed estimates must first be computed. In this final step, an estimate of the mean and variance that are not log-transformed, but take into account the lognormal character of the data, are computed. This is done in the following equations:

$$\bar{x}_{yb}' = \exp(\bar{y}_b' + ((w_{yb}')^2/2))$$

$$s^2{}_{yb}' = (\bar{x}_{yb}')^2(\exp(w_{yb}')^2 - 1)$$

So in this example:

$$\bar{x}_{yb}' = \exp(-.963 + (1.912^2/2))$$
$$= 2.37 \text{ mg/l}$$

$$s^2_{yb}' = 2.37^2 (\exp(1.912^2) - 1)$$
$$= 211.6$$

$$s_{yb}' = 14.5 \text{ mg/l}$$

The resulting mean and standard deviation to be used in the average replicate t-test are:

$$\bar{x}_{yb}' = 2.37 \text{ mg/l}$$

$$s_{yb}' = 14.5 \text{ mg/l}$$

DETERMINATION OF NORMALITY

Figure 1.

X	R	F	z
0.06	3	0.1875	-0.885123
0.13	4	0.25	-0.672345
0.15	5	0.3125	-0.486919
0.29	6	0.375	-0.317299
0.34	7	0.4375	-0.156612
0.36	8	0.5	0
0.37	9	0.5625	0.156612
0.52	10	0.625	0.317299
0.83	11	0.6875	0.486919
1.5	12	0.75	0.672345
2.4	13	0.8125	0.885123
2.7	14	0.375	1.14921
9.6	15	0.9375	1.53537

Figure 3.

NUMBER OF OBSERVATIONS = 13
SAMPLE AVERAGE = 1.48077
SAMPLE VARIANCE = 6.70197
SAMPLE STANDARD DEVIATION = 2.58882

MINIMUM VALUE = 0.06 MAXIMUM = 9.6
LOWER AND UPPER QUARTILES = 0.29 1.5
INTERQUARTILE RANGE = 1.21
MEDIAN = 0.37

Figure 2.

Simple Regression of FEBKGND on Z

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	0.91646	0.502798	1.82272	0.0956151
Slope	2.73265	0.691469	3.95195	2.2651E-3

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio
Model	47.188181	1	47.188181	15.617933
Error	33.235511	11	3.021410	
Total (Corr.)	80.423692	12		

Correlation Coefficient = 0.765993
Stnd. Error of Est. = 1.73822

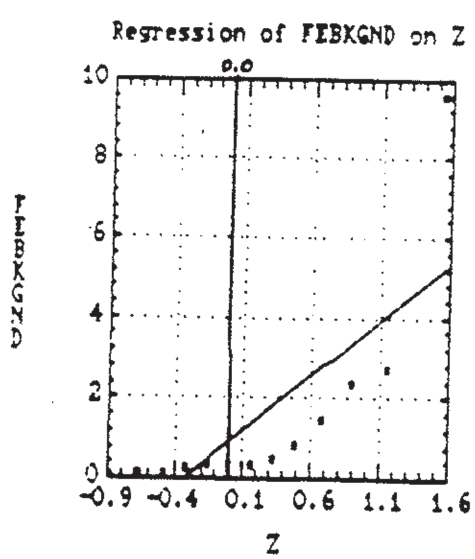


Figure 4.

Y	R	F	z
-2.81341	3	0.1875	-0.8351
-2.04022	4	0.25	-0.6723
-1.89712	5	0.3125	-0.4869
-1.23787	6	0.375	-0.3172
-1.07881	7	0.4375	-0.1556
-1.02165	8	0.5	
-0.994252	9	0.5625	0.1566
-0.653926	10	0.625	0.3172
-0.18633	11	0.6875	0.4369
0.405465	12	0.75	0.67234
0.875469	13	0.8125	0.8351
0.993252	14	0.875	1.1492
2.26176	15	0.9375	1.5353

Figure 6.

UMBER OF OBSERVATIONS = 13
SAMPLE AVERAGE = -0.56828
SAMPLE VARIANCE = 1.9752
SAMPLE STANDARD DEVIATION = 1.40542

MINIMUM VALUE = -2.81341 MAXIMUM = 2.26176
LOWER AND UPPER QUARTILES = -1.23787 0.405465
INTERQUARTILE RANGE = 1.64334
MEDIAN = -0.994252

Figure 5.

Simple Regression of LOGFE on Z

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	-0.963065	0.0679662	-14.1698	2.07216E-8
Slope	1.91173	0.09347	20.4529	4.20246E-10

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio
Model	23.09507	1	23.09507	418.32156
Error	.607298	11	.055209	
Total (Corr.)	23.702369	12		

Correlation Coefficient = 0.987106
Stnd. Error of Est. = 0.234966

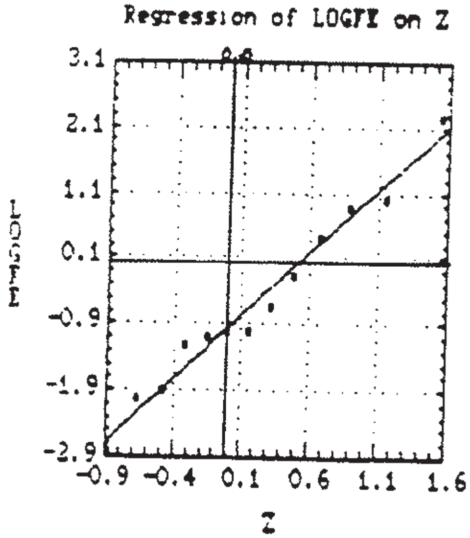


Figure 7.

```
ENTER THE NAME OF THE VARIABLE CONTAINING YOUR DATA:  Z
NUMBER OF OBSERVATIONS = 13   (0 MISSING VALUES EXCLUDED)
SAMPLE AVERAGE = 0.206506
SAMPLE VARIANCE = 0.526603
SAMPLE STANDARD DEVIATION = 0.725674

MINIMUM VALUE = -0.885123   MAXIMUM = 1.53537   RANGE = 2.42049
LOWER AND UPPER QUARTILES = -0.317299 0.672345
INTERQUARTILE RANGE = 0.989644
MEDIAN = 0.156612

COEFF. OF SKEWNESS = 0.251442   STANDARDIZED VALUE = 0.370113
COEFF. OF KURTOSIS = 2.12124   STANDARDIZED VALUE = -0.646749
```

Figure 8.

Simple Regression of Z on F

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	-1.45959	0.0624062	-23.3886	9.91074E-11
Slope	2.96195	0.102444	28.9129	9.95892E-12

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio
Model	6.23716	1	6.23716	835.95705
Error	.082072	11	.007461	
Total (Corr.)	6.319237	12		

Correlation Coefficient = 0.993485
Stnd. Error of Est. = 0.0863777

Appendix D

Methods for Reducing the Effect of Seasonality, Trend and Serially Influenced Data

APPENDIX 3.0 METHODS FOR REDUCING THE EFFECT OF SEASONALITY, TREND AND SERIALLY INFLUENCED DATA

After the background data for a group III parameter has been collected, it must be evaluated for seasonal cycles, long term trends and serial dependence as any of these properties can result in an increased rate of false positives, and may hinder the ability of the statistical program to detect real changes in groundwater quality. If any of these properties can be shown to occur, steps must be taken to reduce their effects on the statistical procedures. Because two years of data represents a minimum time period for detecting seasonality, trends or serial correlation, the analysis presented below should continue throughout the detection monitoring program as the background is updated. Steps for determining and correcting for these properties are given below.

A. DETERMINING AND CORRECTING FOR SEASONALITY

To determine whether the data show seasonal cycles, the background data are plotted as a function of time (i.e. a time series plot) and examined for repeated cycles. If there are recurrent highs or lows during one or more particular season (quarter), it is concluded that a seasonal cycle may exist. An adjustment for seasonality can be attained by the following correction to the background data set:

1. Average the quarterly values for the two years of background collection (i.e. the 1st quarter of year one, plus the 1st quarter of year two, divided by 2). This is the quarterly mean, $\bar{x}_q$.

2. Compute a seasonally corrected value, x_s, by subtracting the appropriate quarterly mean from each quarterly value and adding on the mean for the entire data set $\bar{x}_b$. For adjusting the first quarter of data the equation is:

$$x_{s1} = x_1 - \bar{x}_q + \bar{x}_b$$

3. Use these seasonally corrected values to perform a trend analysis (see below).

If the background data are adjusted for seasonality, then all of the values of the parameter in question must also be corrected using the approriate seasonal correction. During detection monitoring, the semi-annual samples are adjusted for the appropriate season. This seasonal correction will be most valid if these semi-annual samples are collected on dates corresponding to two of the quarterly dates used to establish background.

B. DETERMINING AND CORRECTING TRENDS

From the time series plot from part A above, any pattern of decreasing or increasing concentration with time should be evident. If there is an indication of such a trend, the strength of the trend can be determined with the following test:

1. Perform a linear regression of the time series plot (ie. regression of concentration on time).

2. From the regression analysis determine the F statistic which is defined as:

$$F = MSR/MSE$$

where: MSR = Regression Mean Square
MSE = Error Mean Square

3. Compare this F statistic to a critical value, F_c, at a chosen significance level (0.05), which is determined from Table 2. This critical value is determined from $\nu_1 = 1$ and $\nu_2 = n-2$ where n is the number of independent observations. If $F > F_c$ the hypothesis that the slope of the regression line is zero is rejected, hence a trend exists in the data.

If the data is shown to contain a trend, the trend can be removed by subtracting the regression line equation out of the data and adding the resulting value to the overall mean. For example, the first quarter data is adjusted as follows:

$$x_{t1} = x_1 - (y + mt) + \bar{x}_b$$

where: x_{t1} = trend corrected first quarter data
x_1 = original first quarter data
y = intercept of regression line
m = slope of regression line
t = time (such as the number of quarterly samples since the trend began)
$\bar{x}_b$ = overall mean of the data set

Each parameter sampled during detection monitoring which has a trend in the background data, must also be adjusted with the above equation, if the trend is shown to continue. It is very important to re-evaluate the trend in the background data with each sampling subsequent to background.

C. DETERMINING AND CORRECTING FOR SERIAL CORRELATION

The test for serial correlation is an autocorrelation function. This process requires a computer package to implement. It is not a powerful technique unless many years of data have been collected. Fortunately, published analyses have shown that serial correlation is unlikely in samples collected on a quarterly basis. The adjustment for serial correlation is complex. The easiest remedy is to use data collected at larger time intervals.

Appendix E

The Critical Value Method

APPENDIX 4.0 THE CRITICAL VALUE METHOD

The critical value method is for evaluating Group I parameters (i.e. parameters with background data all below detection limit) in cases where the concentration is above the detection limit in a downgradient well during routine semi-annual detection monitoring. The "critical value" method is a test of confidence that any measured value is actually above the detection limit. The critical value represents an estimate of the 95th percentile for a laboratory analysis of a sample which is at the detection limit. Hence, the critical value is a kind of tolerance limit which will be established based on the detection limit of the lab method used to measure the concentration and the analytical precision, rather than by the population distribution. When a measured value exceeds the critical value, it is concluded that the increase is significant and is not due to lab error. If the precision of the analytical method is very good, the critical value will be very close to the detection limit.

The critical value (CV) is given by:

$$CV = DL + S_p Z$$

where:
- DL = method detection limit
- S_p = standard error of lab analysis representing the test precision
- Z = normal variate corresponding to the pth percentile (eg for p=95, Z=1.645)

The "test" consists of comparing the downgradient value with the critical value. If the critical value is exceeded, then it is concluded that the detection limit has been exceeded and indicates that a significant increase in concentration has occurred at the downgradient well. This method assumes only that the laboratory errors are normally distributed, but requires no information on the distribution of the parameter data.

EXAMPLE OF CRITICAL VALUE METHOD

As a first approximation, it was recommended that analytical precision be assigned a value of one-half the detection limit.

Example: The critical value of Benzene

Necessary information:

Method Detection Limit (DL) = 5.0 ppb
Analytical Precision (S_p) = 2.5 ppb
Normal Variate for 95th Percentile (Z) = 1.645

Equation for Critical Value (CV):

$$CV = DL + S_p Z$$

Results:

$$CV = 5.0 + (2.5)(1.645)$$
$$= 9.1 \text{ ppb}$$

Any measured concentration of benzene over 9 ppb would be considered a significant increase over upgradient background where the detection limit for benzene was 5.0 ppb.

Appendix F

The Proportions Test with the Tolerance Limits Default

APPENDIX 5.0 THE PROPORTIONS TEST WITH THE TOLERANCE LIMITS DEFAULT

The proportions test with the tolerance limits default is a two-step procedure for testing for a significant increase in Group II parameters (parameters with a high proportion of below detection limit data). Step 1 is the proportions test and step 2 is a tolerance limit comparison test. Both tests should be performed during detection monitoring. A failure of either test results in the conclusion that a significant increase has occurred.

A. The Proportions Test

The proportions test is a non-parametric procedure to be used on Group II parameters. This test addresses the following question: are the concentrations in the downgradient well more likely to be above the detection limits than the concentrations in the background well(s). In this relatively simple procedure, the first step is to compute the proportion of the above detection level (ADL) values, P_b of the background data. After establishment of background, the proportion of ADL values, P_m, is tabulated for each downgradient well, throughout the detection monitoring program. Thus, the downgradient proportions are cumulative and several measurements are required before the test becomes applicable.

The statistical test is performed as follows:

1. the Z^* statistic is computed from the equation:

$$Z^* = \frac{P_m - P_b}{[\, p(1-p)(1/N_m + 1/N_b)]^{.5}}$$

where: P_m = proportion of ADL values since background (i.e. downgradient)
P_b = proportion of background ADL values
N_m = total number of samples since background (i.e. downgradient)
N_b = total number of background samples
p = a weighted proportion, defined as:

$$p = \frac{n_m + n_b}{N_m + N_b}$$

where: n_m = number of ADL downgradient
n_b = number of ADL background

2. The approximation is made that Z^* is normally distributed (i.e. the estimates of the proportions are normally distributed, not the actual data set) and then Z^* is

compared to a critical value, Z_c, corresponding to the desired level of significance (e.g. $Z_c = 1.645$ for 0.05 level of significance). The hypothesis states that if the computed value $Z^* > Z_c$, then it is concluded that the higher proportion of downgradient ADL values is significant.

The strength of this test is that it does not require that the data follow any particular distribution. The weaknesses of this method are that several detection monitoring measurements are necessary before the test is valid, and if an extremely high concentration of the parameter were to appear, the concentration itself is not evaluated, only the fact that it is ADL.

B. The Tolerance Limit Default

To guard against these problems, a tolerance limit will be established for each parameter in this category. It must be noted that this a parametric statistical method which requires the condition of normality. Hence the proper adjustments for non-normality (Appendix 1.0) and the adjustment of the mean and variance of censored data (Appendix 2.0) must be implemeted before the tolerance limit can be calculated. The tolerance limit (TL) is established by the equation:

$$TL = \bar{x}_b + Ks_b$$

where: $\bar{x}_b$ = the estimated background mean
s_b = the estimated background standard deviation
K = a tolerance factor

The tolerance factor, K, depends on the desired percentile of background distribution (e.g. 95th percentile) and the number of independent background samples. For the 95% confidence limit, K can be determined from Table 3. The test is then very simple: if the downgradient concentration exceeds the tolerance limit, then the concentration at the downgradient well represents a significant increase over the background concentration.

The tolerance limit default takes care of both weaknesses in the proportions test in that the tolerance limit is established upon completion of background and will pick up very high values as they occur.

EXAMPLE OF PROPORTIONS TEST WITH TOLERANCE LIMITS DEFAULT

For an example of the proportions test with the tolerance limits default, the background data for nitrate was used because 67% of the 12 background samples (4 each from wells OB-18, OB-19 and OB-31) were below detection levels; hence nitrate is a group II parameter.

A. Proportions Test

Because the proportions test is non-parametric, the only information required is as follows:

Proportion of backgound samples ADL (P_b) = 0.33
Proportion of downgradient samples ADL (P_m) = .50 to 1.0
Number of background samples (N_b) = 12
Number of downgradient samples since background (N_m) = 4

It is assumed that 4 downgradient samples have been taken since the establishment of background and the test will be conducted assuming 2, 3 and 4 of these samples are above the detection limit.

For P_m = 2/4 = 0.5, the Z statistic is calculated as:

1. $$p = \frac{2 + 4}{4 + 12} = .375$$

2. $$Z^* = \frac{.50 - .33}{[.375(1-.375)(.25 + .083)]^{.5}} = 0.60$$

For P_m = 3/4 = .75, Z^* = 1.47

For P_m = 4/4 = 1.0, Z^* = 2.32

At a significance level of 0.05, the critical Z_c statistic is 1.645 as determined from a normal distribution table. So for the three cases the results are as follows:

For P_m = 0.5, $Z^* \ll Z_c$ so there is no significant increase in the downgradient concentration

For P_m = 0.75 $Z^* \ll Z_c$ so there is no significant increase in the downgradient concentration

For P_m = 1.0 $Z^* \gg Z_c$ so it is concluded that the higher proportion of ADL values downgradient is significant and there is a significant increase in the downgradient concentration.

B. The Tolerance Limits Default

For the parametric tolerance limits test, the distribution of the nitrate data was first tested for normality. A regression analysis was performed on this data (Appendix 1.0). This analysis showed the condition of normality could not be rejected at the 0.05 significance level, and no transformation was necessary. The regression analysis was also used to adjust the mean, variance and effective sample size to take into account the BDL values. The results of the regression analysis were as follows:

$$\bar{x}_b = 0.135 \text{ mg/l}$$
$$s_b = 0.268 \text{ mg/l}$$
$$N_{eff} = 4$$

Using the above data and the tolerance factor (K) of 5.14 for $\alpha = 0.05$ (from Table 3), the tolerance limit is calculated as:

$$\begin{aligned} TL &= \bar{x}_b + Ks_b \\ &= 0.0135 + (5.14)(.268) \\ &= 1.39 \text{ mg/l} \end{aligned}$$

Thus, based on the tolerance limit default, WDI would conclude that a significant increase in the downgradient concentration had occurred, if a nitrate concentration greater than 1.39 mg/l were measured downgradient, regardless of the results of the proportions test.

Appendix G
The ShewHart-CUSUM Control Chart

APPENDIX 6.0 THE SHEWHART-CUSUM CONTROL CHART

(Excerpted from USEPA Guidance Document: Statistical Analysis of Groundwater Monitoring Data)

7.3 COMBINED SHEWHART-CUSUM CONTROL CHARTS FOR EACH WELL AND CONSTITUENT

Control charts are widely used as a statistical tool in industry as well as research and development laboratories. The concept of control charts is relatively simple, which makes them attractive to use. From the population distribution of a given variable, such as concentrations of a given constituent, repeated random samples are taken at intervals over time. Statistics, for example the mean of replicate values at a point in time, are computed and plotted together with upper and/or lower predetermined limits on a chart where the x-axis represents time. If a result falls outside these boundaries, then the process is declared to be "out of control"; otherwise, the process is declared to be "in control." The widespread use of control charts is due to their ease of construction and the fact that they can provide a quick visual evaluation of a situation, and remedial action can be taken, if necessary.

In the context of ground water monitoring, control charts can be used to monitor the inherent statistical variation of the data collected within a single well, and to flag anomalous results. Further investigation of data points lying outside the established boundaries will be necessary before any direct action is taken.

A control chart that can be used on a real time basis must be constructed from a data set large enough to characterize the behavior of a specific well. It is recommended that data from a minimum of eight samples within a year be collected for each constituent at each well to permit an evaluation of the consistency of monitoring results with the current concept of the hydrogeology of the site. Starks (1988) recommends a minimum of four sampling periods at a unit with eight or more wells and a minimum of eight sampling periods at a unit with less than four wells. Once the control chart for the specific constituent at a given well is acceptable, then subsequent data points can be plotted on it to provide a quick evaluation as to whether the process is in control.

The standard assumptions in the use of control charts are that the data generated by the process, when it is in control, are independently (see Section 2.4.2) and normally distributed with a fixed mean μ and constant variance σ^2. The most important assumption is that of independence; control charts are not robust with respect to departure from independence (e.g., serial correlation, see glossary). In general, the sampling scheme will be such that the possibility of obtaining serially correlated results is minimized, as noted in Section 2. The assumption of normality is of somewhat less concern, but should be investigated before plotting the charts. A transformation (e.g., log-transform, square root transform) can be applied to the raw data so as to obtain errors normally distributed about the mean. An additional situation which may decrease the effectiveness of control charts is seasonality in the data. The problem of seasonality can be handled by removing the seasonality effect from the data, provided that sufficient data to cover at least two seasons of the same type are available (e.g., 2 years when monthly or quarterly seasonal effect). A procedure to correct a time series for seasonality was shown above in Section 7.2.

PURPOSE

Combined Shewhart-cumulative sum (CUSUM) control charts are constructed for each constituent at each well to provide a visual tool of detecting both trends and abrupt changes in concentration levels.

PROCEDURE

Assume that data from at least eight independent samples of monitoring are available to provide reliable estimates of the mean, μ, and standard deviation, σ, of the constituent's concentration levels in a given well.

Step 1. To construct a combined Shewhart-CUSUM chart, three parameters need to be selected prior to plotting:

h - a decision internal value
k - a reference value
SCL - Shewhart control limit (denoted by U in Starks (1988))

The parameter k of the CUSUM scheme is directly obtained from the value, D, of the displacement that should be quickly detected; k = D/2. It is recommended to select k = 1, which will allow a displacement of two standard deviations to be detected quickly.

When k is selected to be 1, the parameter h is usually set at values of 4 or 5. The parameter h is the value against which the cumulative sum in the CUSUM scheme will be compared. In the context of groundwater monitoring, a value of h = 5 is recommended (Starks, 1988; Lucas, 1982).

The upper Shewhart limit is set at SCL = 4.5 in units of standard deviation. This combination of $k = 1$, $h = 5$, and SCL = 4.5 was found most appropriate for the application of combined Shewhart-CUSUM charts for groundwater monitoring (Starks, 1988).

Step 2. Assume that at time period T_i, n_i concentration measurements $X_1, \ldots, X_{n_i}$, are available. Compute their average $\bar{X}_i$.

Step 3. Calculate the standardized mean

$$Z_i = (\bar{X}_i - \mu)\sqrt{n_i}/\sigma$$

where μ and σ are the mean and standard deviation obtained from prior monitoring at the same well (at least four sampling periods in a year).

Step 4. At each time period, T_i, compute the cumulative sum, S_i, as:

$$S_i = \max\{0, (Z_i - k) + S_{i-1}\}$$

where max {A, B} is the maximum of A and B, starting with $S_0 = 0$.

Step 5. Plot the values of S_i versus T_i on a time chart for this combined Shewhart-CUSUM scheme. Declare an "out-of-control" situation at sampling period T_i if for the first time, $S_i \geq h$ or $Z_i \geq$ SCL. This will indicate probable contamination at the well and further investigations will be necessary.

REFERENCES

Lucas, J. M. 1982. "Combined Shewhart-CUSUM Quality Control Schemes." *Journal of Quality Technology*. Vol. 14, pp. 51-59.

Starks, T. H. 1988 (Draft). "Evaluation of Control Chart Methodologies for RCRA Waste Sites."

Hockman, K. K., and J. M. Lucas. 1987. "Variability Reduction Through Subvessel CUSUM Control." *Journal of Quality Technology*. Vol. 19, pp. 113-121.

EXAMPLE

The procedure is demonstrated on a set of carbon tetrachloride measurements taken monthly at a compliance well over a 1-year period. The monthly means of two measurements each ($n_i = 2$ for all i's) are presented in the third column of Table 7-2 below. Estimates of μ and σ, the mean and standard deviation of carbon tetrachloride measurements at that particular well were obtained from a preceding monitoring period at that well; $\mu = 5.5$ µg/L and $\sigma = 0.4$ µg/L.

TABLE 7-2. EXAMPLE DATA FOR COMBINED SHEWHART-CUSUM CHART--
CARBON TETRACHLORIDE CONCENTRATION (µg/L)

Date	Sampling period T_i	Mean concentration, X_i	Standardized $\bar{X}_i$, Z_i	$Z_i - k$	CUSUM, S_i
Jan 6	1	5.52	0.07	-0.93	0
Feb 3	2	5.60	0.35	-0.65	0
Mar 3	3	5.45	-0.18	-1.18	0
Apr 7	4	5.15	-1.24	-2.24	0
May 5	5	5.95	1.59	0.59	0.59
Jun 2	6	5.54	0.14	-0.86	0.00
Jul 7	7	5.49	-0.04	-1.04	0.00
Aug 4	8	6.08	2.05	1.05	1.05
Sep 1	9	6.91	4.99[a]	3.99	5.04[b]
Oct 6	10	6.78	4.53[a]	3.53	8.56[b]
Nov 3	11	6.71	4.28	3.28	11.84[b]
Dec 1	12	6.65	4.07	3.07	14.91[b]

Parameters: Mean = 5.50; std = 0.4; k = 1; h = 5; SCL = 4.5.

[a] Indicates "out-of-control" process via Shewhart control limit ($Z_i > 4.5$).

[b] CUSUM "out-of-control" signal ($S_i > 5$).

Step 1. The three parameters necessary to construct a combined Shewhart-CUSUM chart were selected as h = 5; k = 1; SCL = 4.5 in units of standard deviation.

Step 2. The monthly means are presented in the third column of Table 7-2.

Step 3. Standardize the means within each sampling period. These computations are shown in the fourth column of Table 7-2. For example, $Z_1 = (5.52 - 5.50)*\sqrt{2}/0.4 = 0.07$.

Step 4. Compute the quantities S_i, $i = 1, \ldots, 12$. For example,

$S_1 = \max\{0, -0.93 + 0\} = 0$
$S_2 = \max\{0, -0.65 + 0\} = 0$
.
.
.
$S_5 = \max\{0, 0.59 + S_4\} \quad = \max\{0, 0.59 + 0\} = 0.59$
$S_6 = \max\{0, -0.86 + S_5\} \quad = \max\{0, -0.86 + 0.59) = \max\{0, -0.27\} = 0$
.
etc.

These quantities are shown in the last column of Table 7-2.

Step 5. Construct the control chart. The y-axis is in units of standard deviations. The x-axis represent time, or the sampling periods. For each sampling period, T_i, record the value of $\bar{X}_i$ and S_i. Draw horizontal lines at values h = 5 and SCL = 4.5. These two lines represent the upper control limits for the CUSUM scheme and the Shewhart control limit, respectively. The chart for this example data set is shown in Figure 7-2.

The combined chart indicates statistically significant evidence of contamination starting at sampling period T_9. Both the CUSUM scheme and the Shewhart control limit were exceeded by S_9 and Z_9, respectively. Investigation of the situation should begin to confirm contamination and action should be required to bring the variability of the data back to its previous level.

INTERPRETATION

The combined Shewhart-CUSUM control scheme was applied to an example data set of carbon tetrachloride measurements taken on a monthly basis at a well. The statistic used in the construction of the chart was the mean of two measurements per sampling period. (It should be noted that this method can be used on an individual measurement as well, in which case $n_i = 1$). Estimates of the mean and standard deviation of the measurements were available from previous data collected at that well over at least four sampling periods.

The parameters of the combined chart were selected to be k = 1 unit, the reference value or allowable slack for the process; h = 5 units, the decision interval for the CUSUM scheme; and SCL = 4.5 units, the upper Shewhart control limit. All parameters are in units of σ, the standard deviation obtained from the previous monitoring results. Various combinations of parameter values can be selected. The particular values recommended here appear to be the best for the initial use of the procedure from a review of the simulations and recommendations in the references. A discussion on this subject is given by Lucas (1982), Hockman and Lucas (1987), and Starks (1988). The choice of the parameters h and k of a CUSUM chart is based on the desired performance of the chart. The criterion used to evaluate a control scheme is the average number of samples or time periods before an out-of-control signal is obtained. This criterion is denoted by ARL or average run length. The ARL should be large when the mean concentration of a hazardous constituent is near its target value and small when the mean has shifted too far from the target. Tables have been developed by simulation methods to estimate ARLs for given combinations of the parameters (Lucas, Hockman and Lucas, and Starks). The user is referred to these articles for further reading.

7.4 UPDATE OF A CONTROL CHART

The control chart is based on preselected performance parameters as well as on estimates of μ and σ, the parameters of the distribution of the measurements in question. As monitoring continues and the process is found to be in control, these parameters need periodic updating so as to incorporate this new information into the control charts. Starks (1988) has suggested that in

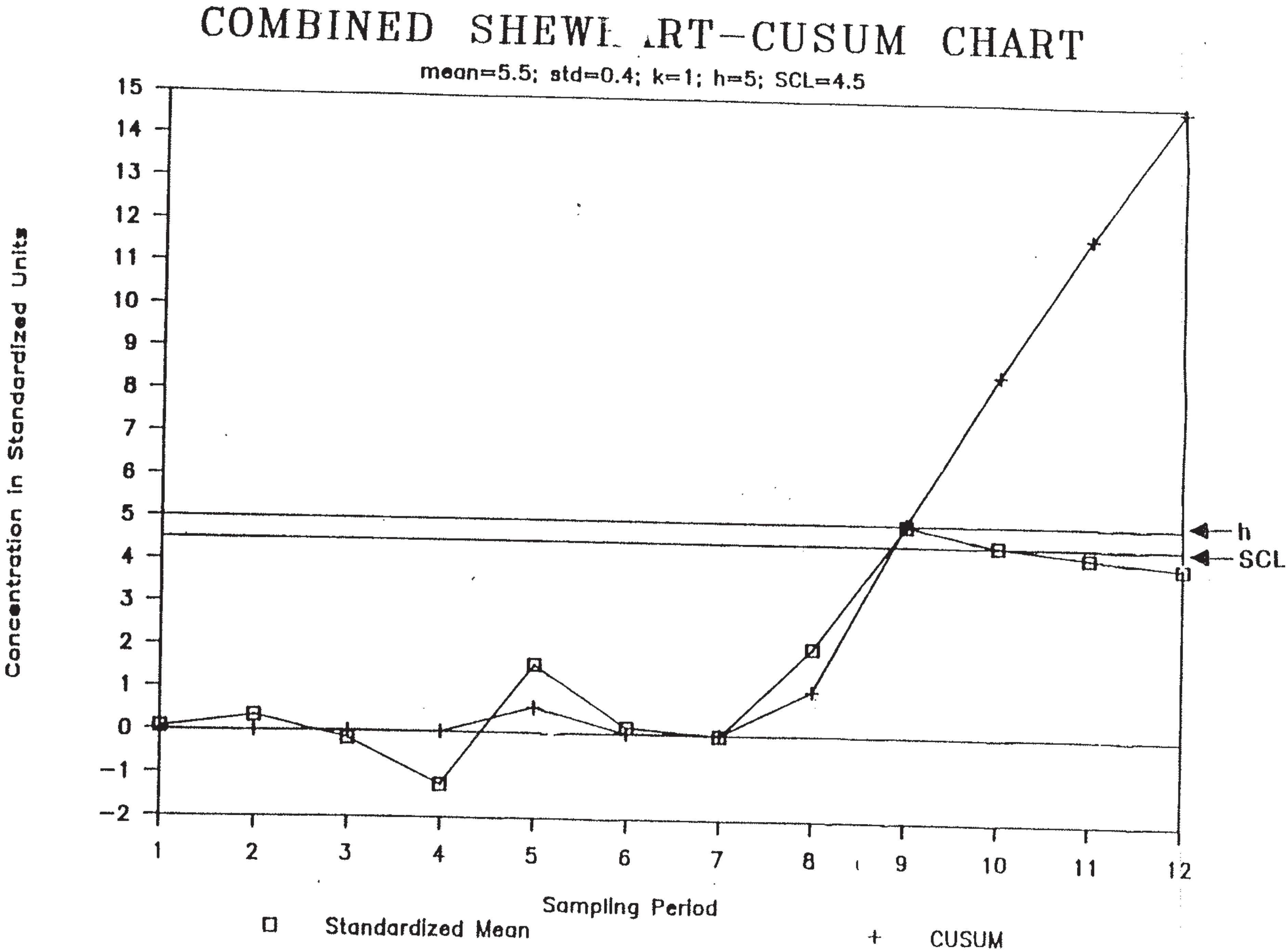


Figure 7-2. Combined Shewhart-CUSUM chart.

general, adjustments in sample means and standard deviations be made after sampling periods 4, 8, 12, 20, and 32, following the initial monitoring period recommended to be at least eight sampling periods. Also, the performance parameters h, k, and SCL would need to be updated. The author suggests that h = 5, k = 1, and SCL = 4.5 be kept at those values for the first 12 sampling periods following the initial monitoring plan, and that k be reduced to 0.75 and SCL to 4.0 for all subsequent sampling periods. These values and sampling period numbers are not mandatory. In the event of an out-of-control state or a trend, the control chart should not be updated.

Table 1. Critical Values of ^r.

N	alpha 0.10	alpha 0.05	alpha 0.01
4	.8951	.8734	.8318
5	.9033	.8804	.8320
10	.9347	.9180	.8804
15	.9506	.9383	.9110
20	.9600	.9503	.9290
25	.9662	.9582	.9408
30	.9707	.9639	.9490
40	.9767	.9715	.9597
50	.9807	.9764	.9664
60	.9835	.9799	.9710
75	.9865	.9835	.9757

From, "Minitab Manual"

Table 2. Critical Values of F.

Level of Significance = 0.05

$\nu_2 \backslash \nu_1$	1	2	3	4	5	6	8	12	15	20	30	60	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	238.9	243.9	245.9	248.0	250.1	252.2	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.37	19.41	19.43	19.45	19.46	19.48	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.85	8.74	8.70	8.66	8.62	8.57	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.04	5.91	5.86	5.80	5.75	5.69	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.82	4.68	4.62	4.56	4.50	4.43	4.36
6	5.99	5.14	4.76	4.53	4.39	4.28	4.15	4.00	3.94	3.87	3.81	3.74	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.73	3.57	3.51	3.44	3.38	3.30	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.44	3.28	3.22	3.15	3.08	3.01	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.23	3.07	3.01	2.94	2.86	2.79	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.07	2.91	2.85	2.77	2.70	2.62	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	2.95	2.79	2.72	2.65	2.57	2.49	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.85	2.69	2.62	2.54	2.47	2.38	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.77	2.60	2.53	2.46	2.38	2.30	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.70	2.53	2.46	2.39	2.31	2.22	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.64	2.48	2.40	2.33	2.25	2.16	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.59	2.42	2.35	2.28	2.19	2.11	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.55	2.38	2.31	2.23	2.15	2.06	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.51	2.34	2.27	2.19	2.11	2.02	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.48	2.31	2.23	2.16	2.07	1.98	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.45	2.28	2.20	2.12	2.04	1.95	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.42	2.25	2.18	2.10	2.01	1.92	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.40	2.23	2.15	2.07	1.98	1.89	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.37	2.20	2.13	2.05	1.96	1.86	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.36	2.18	2.11	2.03	1.94	1.84	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.34	2.16	2.09	2.01	1.92	1.82	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.32	2.15	2.07	1.99	1.90	1.80	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.31	2.13	2.06	1.97	1.88	1.79	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.29	2.12	2.04	1.96	1.87	1.77	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.28	2.10	2.03	1.94	1.85	1.75	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.27	2.09	2.01	1.93	1.84	1.74	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.18	2.00	1.92	1.84	1.74	1.64	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.10	1.92	1.84	1.75	1.65	1.53	1.39
120	3.92	3.07	2.68	2.45	2.29	2.17	2.02	1.83	1.75	1.66	1.55	1.43	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	1.94	1.75	1.67	1.57	1.46	1.32	1.00

From, "Handbook of Mathematical Functions", by Abromowitz and Stegun, (1972)

Table 3. Values of Tolerance Factor, K.

One-Sided Tolerance Limit Factors for a Normal Distribution

	Values of k for γ = 0.90 and n = f + 1						Values of k for γ = 0.95 and n = f + 1					
n	0.900	0.950	0.975	0.990	0.999		n	0.900	0.950	0.975	0.990	0.999
2	10.253	13.090	15.586	18.500	24.582		2	20.581	26.260	31.257	37.094	49.276
3	4.258	5.311	6.244	7.340	9.651		3	6.155	7.656	8.986	10.553	13.857
4	3.188	3.957	4.637	5.438	7.129		4	4.162	5.144	6.015	7.042	9.214
5	2.744	3.401	3.983	4.668	6.113		5	3.413	4.210	4.916	5.749	7.509
6	2.494	3.093	3.621	4.243	5.556		6	3.008	3.711	4.332	5.065	6.614
7	2.333	2.893	3.389	3.972	5.201		7	2.756	3.401	3.971	4.643	6.064
8	2.219	2.754	3.227	3.783	4.955		8	2.582	3.188	3.724	4.355	5.689
9	2.133	2.650	3.106	3.641	4.771		9	2.454	3.032	3.543	4.144	5.414
10	2.066	2.568	3.011	3.532	4.628		10	2.355	2.911	3.403	3.981	5.204
11	2.012	2.503	2.936	3.444	4.515		11	2.275	2.815	3.291	3.852	5.036
12	1.966	2.448	2.872	3.371	4.420		12	2.210	2.736	3.201	3.747	4.900
13	1.928	2.403	2.820	3.310	4.341		13	2.155	2.670	3.125	3.659	4.787
14	1.895	2.363	2.774	3.257	4.274		14	2.108	2.614	3.060	3.585	4.690
15	1.866	2.329	2.735	3.212	4.215		15	2.068	2.566	3.085	3.520	4.607
16	1.842	2.299	2.700	3.172	4.164		16	2.032	2.523	2.956	3.463	4.534
17	1.819	2.272	2.670	3.137	4.118		17	2.002	2.486	2.913	3.414	4.471
18	1.800	2.249	2.643	3.106	4.078		18	1.974	2.453	2.875	3.370	4.415
19	1.781	2.228	2.618	3.078	4.041		19	1.949	2.423	2.840	3.331	4.364
20	1.765	2.208	2.597	3.052	4.009		20	1.926	2.396	2.809	3.295	4.319
21	1.750	2.190	2.575	3.028	3.979		21	1.905	2.371	2.781	3.262	4.276
22	1.736	2.174	2.557	3.007	3.952		22	1.887	2.350	2.756	3.233	4.238
23	1.724	2.159	2.540	2.987	3.927		23	1.869	2.329	2.732	3.206	4.204
24	1.712	2.145	2.525	2.969	3.904		24	1.853	2.309	2.711	3.181	4.171
25	1.702	2.132	2.510	2.952	3.882		25	1.838	2.292	2.691	3.158	4.143
30	1.657	2.080	2.450	2.884	3.794		30	1.778	2.220	2.608	3.064	4.022
35	1.623	2.041	2.406	2.833	3.730		35	1.732	2.166	2.548	2.994	3.934
40	1.598	2.010	2.371	2.793	3.679		40	1.697	2.126	2.501	2.941	3.866
45	1.577	1.986	2.344	2.762	3.638		45	1.669	2.092	2.463	2.897	3.811
50	1.560	1.965	2.320	2.735	3.604		50	1.646	2.065	2.432	2.863	3.766
60	1.532	1.933	2.284	2.694	3.552		60	1.609	2.022	2.384	2.807	3.695
70	1.511	1.909	2.257	2.663	3.513		70	1.581	1.990	2.348	2.766	3.643
80	1.495	1.890	2.235	2.638	3.482		80	1.560	1.965	2.319	2.733	3.601
90	1.481	1.876	2.217	2.618	3.456		90	1.542	1.944	2.295	2.706	3.567
100	1.470	1.861	2.203	2.601	3.435		100	1.527	1.927	2.276	2.684	3.539
120	1.452	1.841	2.179	2.574	3.402		120	1.503	1.899	2.245	2.649	3.495
145	1.436	1.821	2.158	2.550	3.371		145	1.481	1.874	2.217	2.617	3.455
300	1.386	1.765	2.094	2.477	3.280		300	1.617	1.800	2.133	2.522	3.335
500	1.362	1.736	2.062	2.442	3.235		500	1.385	1.763	2.092	2.475	3.277
∞	1.282	1.645	1.960	2.326	3.090		∞	1.282	1.645	1.960	2.326	3.090

From, "Handbook of Statistical Tables", by
D.B. Owen, (1962)

APPENDIX C

INSPECTION AND MAINTENANCE LOGS

FORD MOTOR COMPANY

INSPECTION LOG

Weekly Monthly Semi-Annual Annual

Inspection Performed On: Date: ___________ Time: ___________

Inspection Performed By: Name: ______________________________

Company: ______________________________

Directions:

Along the right side of the form is an indication of when each item is to be inspected (see type of inspection above). After inspecting the following items as described, check the appropriate box. For those items where a problem is noted, provide a detailed written description of the problem in the space provided at the end of the form. If more space is needed, attach additional sheets along with sketches, photographs, etc. Be sure to number each page, including any attached pages.

Part A - Security System (Existing Site Security)	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1. Guard on duty at plant entrance.				**W**,M,S,A
2. Perimeter landfill fencing in place and gates locked, locks in good shape.				**W**,M,S,A

Part B - Groundwater Monitoring System (see attached sketch)

1. All wells/piezometers accessible.				M,S,A
2. Protective covers secure and locked, locks in good shape (operable).				M,S,A
3. Protective covers functioning.				M,S,A
4. No evidence of standing water at surface of well/piezometer.				M,S,A
5. Each well/piezometer labeled clearly and correctly.				M,S,A
6. No evidence of standing water at surface of well/piezometer.				M,S,A
7. Surface seal at each well/piezometer intact and functional.				M,S,A
8. Cap secure on each well/piezometer.				M,S,A
9. No unusual obstruction apparent in well/piezometer.				M,S,A
10. No evidence of sediment build-up in well/piezometer, based on comparison of expected and measured total depths.				M,S,A
11. No evidence of screen clogging, based on comparison of expected and actual recovery rates at individual wells/piezometers.				M,S,A
12. No other problems which may cause the monitoring system to perform ineffectively.				M,S,A

FORD MOTOR COMPANY

INSPECTION LOG

Inspection Performed On: Date: ___________

	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
Part C - Miscellaneous Inspection Items				
1. On-site monuments located and intact (see attached sketches).				M,S,A
2. Any repairs made to correct problems since the last site inspection appear to have been acceptable and problem(s) alleviated.				**W**,M,S,A
3. All problems noted on previous inspection report have been corrected.				**W**,M,S,A
4. No other evidence of hazardous waste discharge or leakage from the containment units or other possible sources were noted in the containment unit areas, other than those noted in this report.				**W**,M,S,A
Part D - Eastern Containment Unit Cover				
1. Vegetative cover maintained (mowed) and free of bare spots.				**W**,M,S,A
2. Cover free of undesirable plant species.				**W**,M,S,A
3. No evidence of burrowing animals.				**W**,M,S,A
4. No visible surface erosion, soft, wet or unstable areas noted on cover.				**W**,M,S,A
5. No evidence of standing surface water.				**W**,M,S,A
6. No areas of settlement/subsidence noted.				**W**,M,S,A
7. No cracks in cover soils.				**W**,M,S,A
8. Cover free of any other apparent problems which may lead to malfunction.				**W**,M,S,A
9. Gravel toe drain stable and free of clogging vegetation.				**W**,M,S,A
10. Stormwater inlets/outlets are free of sediment and debris and are functional.				**W**,M,S,A
11. Access road intact and functional.				**W**,M,S,A
12. Asphalt pavement above cover intact and functional.				**W**,M,S,A
Part E - Western Containment Unit Cover				
1. Vegetative cover maintained (mowed) and free of bare spots.				**W**,M,S,A
2. Cover free of undesirable plant species.				**W**,M,S,A
3. No evidence of burrowing animals.				**W**,M,S,A
4. No visible surface erosion, soft, wet or unstable areas noted on cover.				**W**,M,S,A
5. No evidence of standing surface water.				**W**,M,S,A
6. No areas of settlement/subsidence noted.				**W**,M,S,A
7. No cracks in cover soils.				**W**,M,S,A
8. Cover free of any other apparent problems which may lead to malfunction.				**W**,M,S,A
9. Gravel toe drain stable and free of clogging vegetation.				**W**,M,S,A
10. Stormwater inlets/outlets are free of sediment and debris and are functional.				**W**,M,S,A
11. Access road intact and functional.				**W**,M,S,A
12. Asphalt pavement above cover intact and functional.				**W**,M,S,A

FORD MOTOR COMPANY

INSPECTION LOG

Inspection Performed On: Date: ____________

Part F - Eastern Containment Unit Leachate Collection System

	Item	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1.	Manhole covers securely in place, locked, locks in good shape (see sketch).				**W**,M,S,A
2.	Leachate pumps are properly positioned and functional.				**W**,M,S,A
3.	Manhole sumps have less than three inches of sediment.				M,S,A
4.	Pump warning lights indicate system is functional.				**W**,M,S,A
5.	Secondary containment pipe free of liquids.				M,S,A
6.	Perimeter and interior pipe cleanouts are accessible, intact, and locked, locks in good shape.				**W**,M,S,A
7.	Collection piping cleaned within the last 12 months (as-built summary of pipe lengths attached).				A

Part G - Western Containment Unit Leachate Collection System

	Item	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1.	Manhole covers securely in place, locked, locks in good shape (see sketch).				**W**,M,S,A
2.	Leachate pumps are properly positioned and functional.				**W**,M,S,A
3.	Manhole sumps have less than three inches of sediment.				M,S,A
4.	Pump warning lights indicate system is functional.				**W**,M,S,A
5.	Secondary containment pipe free of liquids.				M,S,A
6.	Perimeter and interior pipe cleanouts are accessible, intact, and locked, locks in good shape.				**W**,M,S,A
7.	Collection piping cleaned within the last 12 months (as-built summary of pipe lengths attached).				A

Part H - Sediment Containment Unit Leachate Collection System

	Item	ACCEPTABLE	NOT ACCEPTABLE	NOT APPLICABLE	TYPE OF INSPECTION
1.	Riser pipe cover securely in place and locked, lock in good shape.				**W**,M,S,A
2.	Leachate level checked within the last month and is at an acceptable level ($\leq$ 581.4).				M,S,A

Inspector's Signature ____________________ Client Representative's Signature ____________________

FORD MOTOR COMPANY

INSPECTION LOG

Inspection Performed On: Date: __________

Notes:

FORD MOTOR COMPANY

MAINTENANCE LOG

Maintenance Performed On: Date: ____________ Time: ____________

Maintenance Performed By: Name(s): ______________________________

Company: ______________________________

Describe the items(s) repaired or replaced: ______________________________

Date(s) item(s) was/were last inspected: ______________________________

Is this a recurring problem? When did it first occur? ______________________________

Describe in detail the repairs/corrections that have been made. Attach reports, plans sketches, photographs, or any other documentation as appropriate.

______________________________ Inspector's Signature

______________________________ Client Representative's Signature

Attachment 5

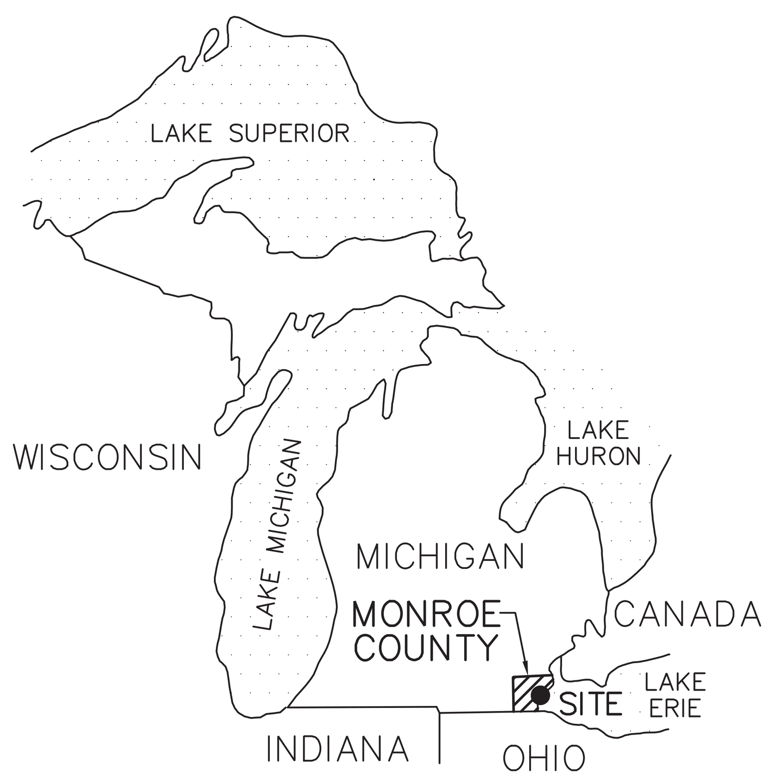
Engineering Plans

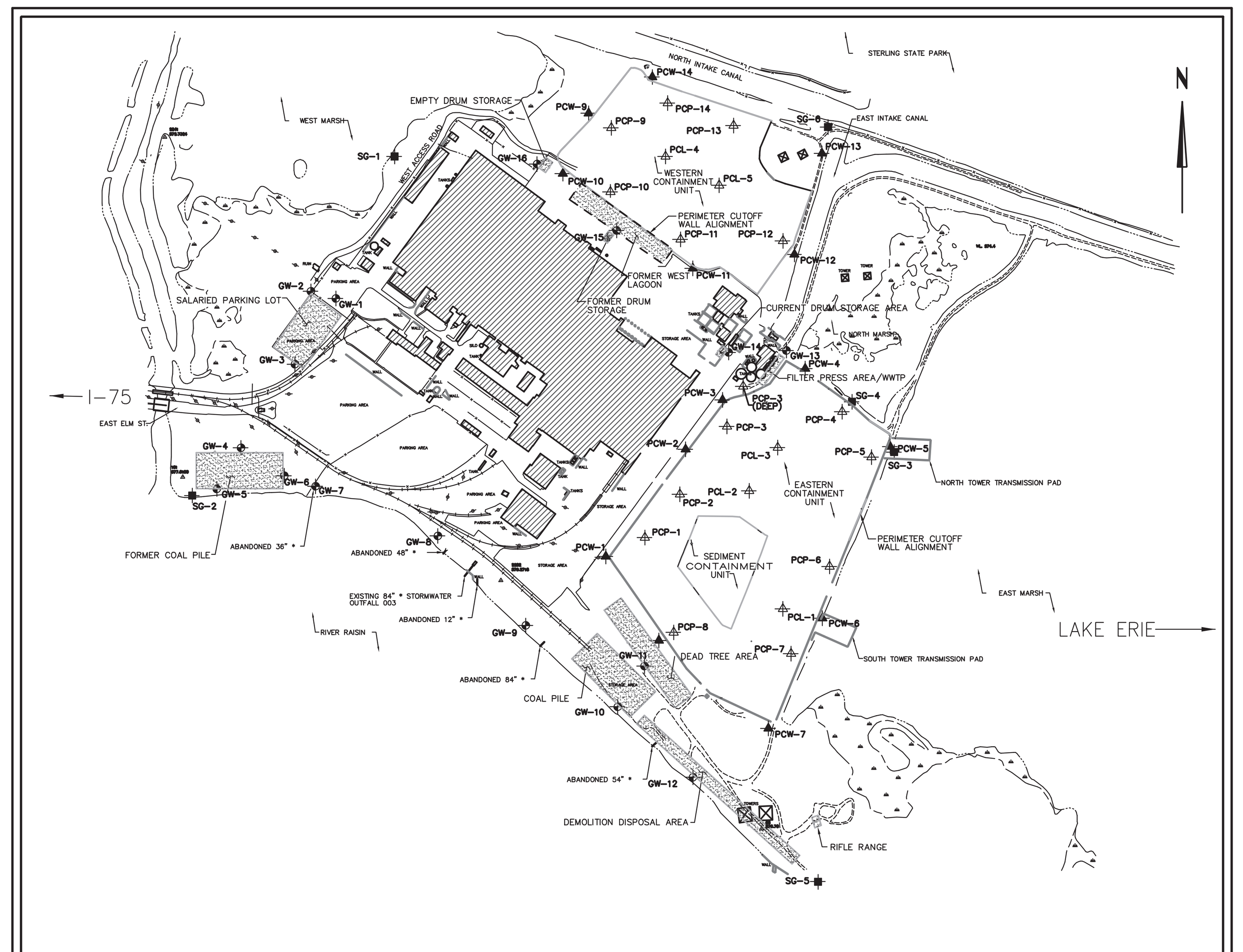
DRAWING NO. 1
PROJ. NO. FORD0112

FORD MOTOR COMPANY
MONROE PLANT

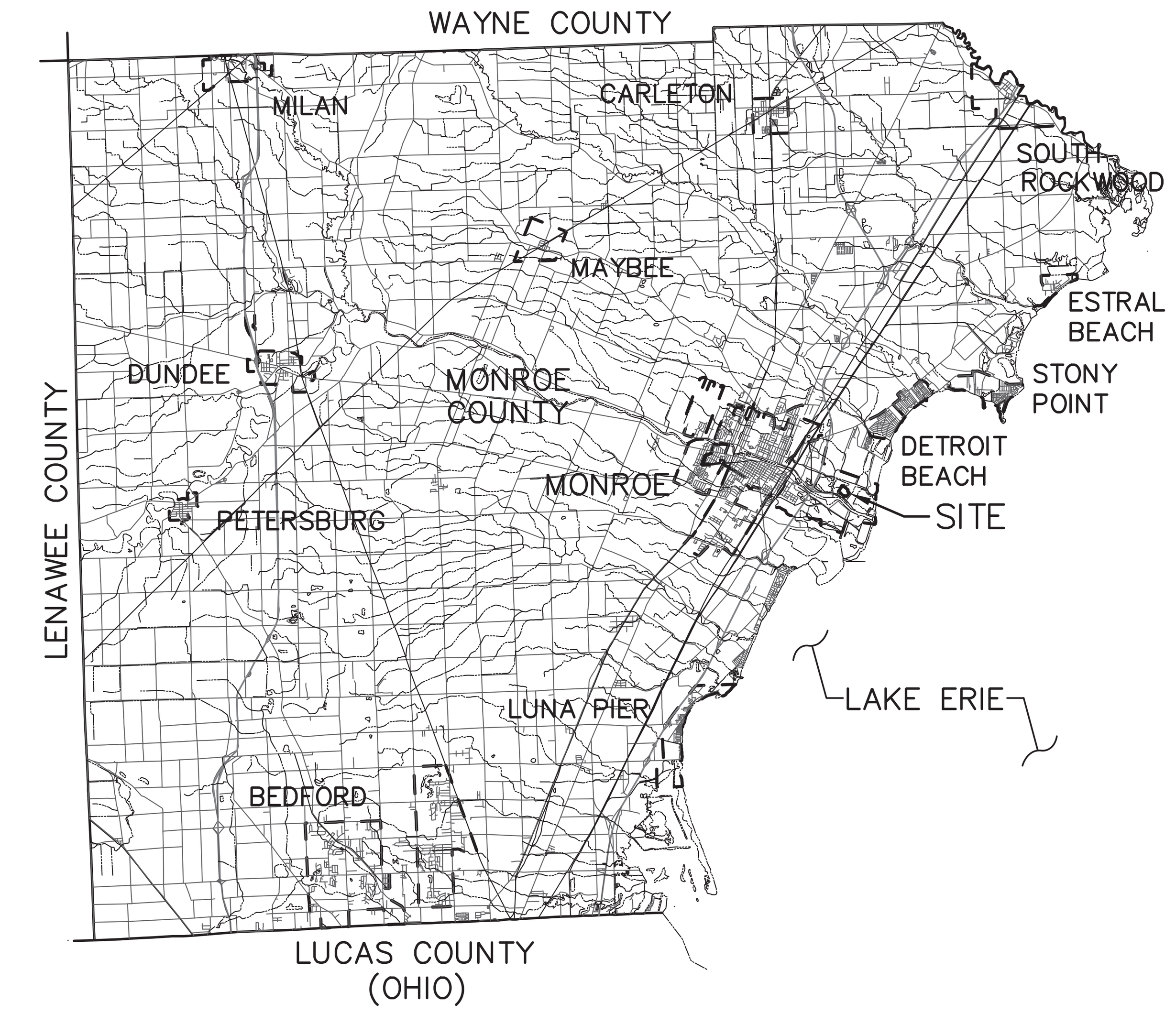
MID 005 057 005
MONROE, MICHIGAN

SITE LOCATION MAP





SITE LOCATION MAP



PREPARED FOR:

FORD MOTOR COMPANY
ENVIRONMENTAL QUALITY OFFICE

Suite 800, Fairlane Plaza North
290 Town Center Drive
Dearborn, Michigan 48126

PREPARED BY:

Mannik Smith GROUP
2365 HAGGERTY ROAD S.
CANTON, MICHIGAN 48188
TEL: (734) 397-3100
FAX: (734) 397-3131
www.MannikSmithGroup.com

INDEX OF DRAWINGS

	DRAWING
SITE LOCATION MAP/TITLE SHEET	1

10/6/2016

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DATE	SEP 2016
DRAWING NO.	1
PROJ. NO.	FORD0112

NO.	DATE	BY	DESCRIPTION
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PROJECT DATE: 11/07/2011
PROJECT NO.: FORD0102
DRAWN BY: HMW
CHECKED BY: TEP

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FORD MOTOR COMPANY

MONROE PLANT
MONROE, MICHIGAN

GENERAL LAYOUT

1 / 1

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LEGEND:

- LCRS MANHOLE
- CUTOFF WALL
- DAMAGED PIPE SECTION
- 624' (624') PIPE LENGTH FROM INSTALLATION (VERIFIED IN 2016)

NOTES:

1) 6" PIPE, 3" PIPE, MANHOLES AND FRENCH DRAINS INSTALLED FROM MARCH 1997 TO OCTOBER 1997 AND JANUARY 1998 TO OCTOBER 1998.
2) FOR ADDITIONAL INFORMATION ON FRENCH DRAINS AND INOPERABLE LENGTHS OF PIPE REFER TO THE RESPECTIVE CORRECTIVE MEASURE REPORT (CMR) REFERENCED.
3) LCRS PIPE INTEGRITY VERIFICATION PERFORMED ON 9/22/16 AND 9/23/16.

NO.	DATE	BY	DESCRIPTION
1	10/09/2014	CJB	FILE UPDATES

PROJECT DATE: 9/29/2016
PROJECT NO.: FORD0136
DRAWN BY: SAH
CHECKED BY: TEP

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PREPARED FOR:

FORD MOTOR COMPANY

EASTERN CONTAINMENT UNIT PIPE INTEGRITY VERIFICATION 2016

1 / 2

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LEGEND:

- LCRS MANHOLE
- CUTOFF WALL
- DAMAGED PIPE SECTION
- 624' (624') PIPE LENGTH FROM INSTALLATION (VERIFIED IN 2016)

NOTES:

1) 6" PIPE, 3" PIPE, MANHOLES AND FRENCH DRAINS INSTALLED FROM MARCH 1997 TO OCTOBER 1997 AND JANUARY 1998 TO OCTOBER 1998.
2) FOR ADDITIONAL INFORMATION ON FRENCH DRAINS AND INOPERABLE LENGTHS OF PIPE REFER TO THE RESPECTIVE CORRECTIVE MEASURE REPORT (CMR) REFERENCED.
3) LCRS PIPE INTEGRITY VERIFICATION PERFORMED ON 9/22/16 AND 9/23/16.

NO.	DATE	BY	DESCRIPTION
1	10/09/2014	CJB	FILE UPDATES

PROJECT DATE: 9/29/2016
PROJECT NO.: FORD0136
DRAWN BY: SAH
CHECKED BY: TEP

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PREPARED FOR:

FORD MOTOR COMPANY

WESTERN CONTAINMENT UNIT PIPE INTEGRITY VERIFICATION 2016

2 / 2

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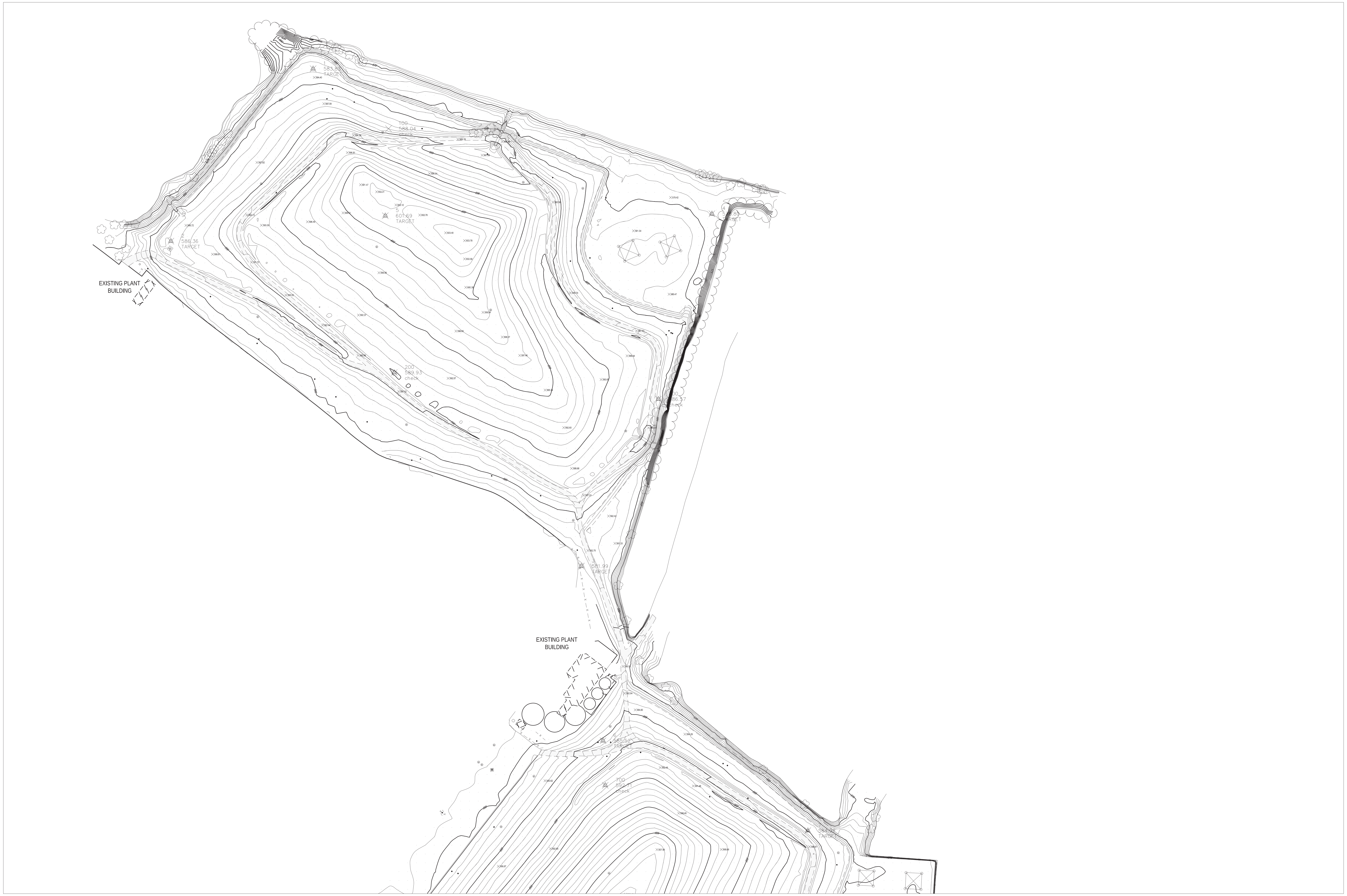

NOTE:
This plan is in Michigan State Plane Coordinates, South Zone, Int'l Foot

Horizontal & Vertical Control Performed by Mannik & Smith Group
Aerial Survey Performed By Drone View Technologies

NORTH

TOPOGRAPHICAL SURVEY
SCALE: 1:100

0 50 100 200 Feet
1" = 100'

FORD MOTOR COMPANY

FORD MONROE PLANT
005-057-005

FINAL COVER SURVEY
EASTERN CONTAINMENT UNIT
WESTERN CONTAINMENT UNIT

MONROE MONROE MI

SITE CODE: __
MSG PROJECT NUMBER: FORD0166

TECHNICAL SKILL. CREATIVE SPIRIT.
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DATE		ISSUED FOR
10-19-17	1	TOPO SURVEY

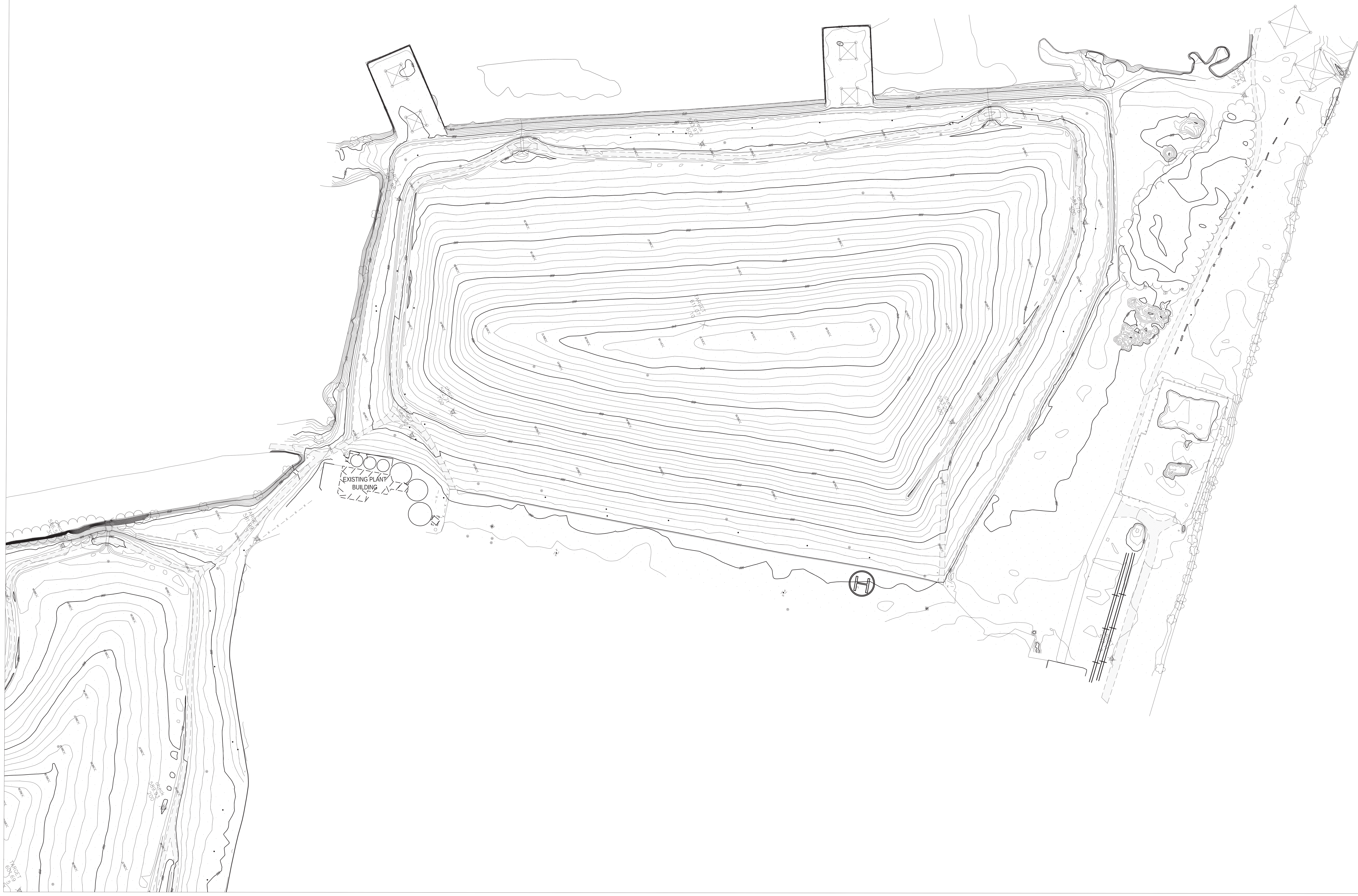
IN CHARGE:	T. PETERS
DRAWN BY:	P. MURPHY
DESIGNED BY:	P. MURPHY
CHECKED BY:	B. BRAUN
APPROVED BY:	T. PETERS

SHEET TITLE
FINAL COVER SURVEY

FORD DWG NO. __

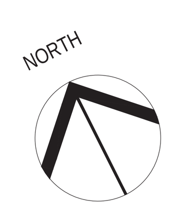
SHEET NUMBER
1

PLOT DATE: 10/18/2017 11:25:22 AM SAVE DATE:10/18/2017 11:09:57 AM PETER J. MURPHY W:\Projects\Projects F-J\FORD0166\CAD\SURVEYBASE\FORD0166 BMET.dwg



NOTE:
This plan is in Michigan State Plane Coordinates, South Zone, Int'l Foot

Horizontal & Vertical Control Performed by Mannik & Smith Group
Aerial Survey Performed By Drone View Technologies



TOPOGRAPHICAL SURVEY

SCALE: 1:100

FORD MOTOR COMPANY

FORD MONROE PLANT

005-057-005

FINAL COVER SURVEY
EASTERN CONTAINMENT UNIT
WESTERN CONTAINMENT UNIT

MONROE MONROE MI

SITE CODE:
MSG PROJECT NUMBER: FORD0166

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DATE	ISSUED FOR
10-19-17	1 TOPO SURVEY

IN CHARGE:	T. PETERS
DRAWN BY:	P. MURPHY
DESIGNED BY:	P. MURPHY
CHECKED BY:	B. BRAUN
APPROVED BY:	T. PETERS

SHEET TITLE

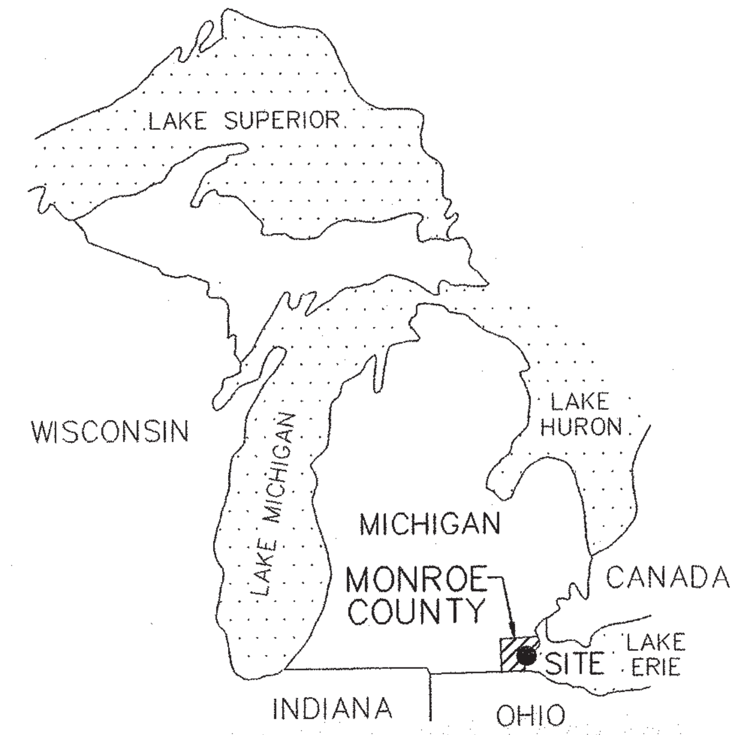
FINAL COVER SURVEY

FORD DWG NO.

SHEET NUMBER

2

DWG. NO. 1 OF 65
PROJ. NO. F66A2C



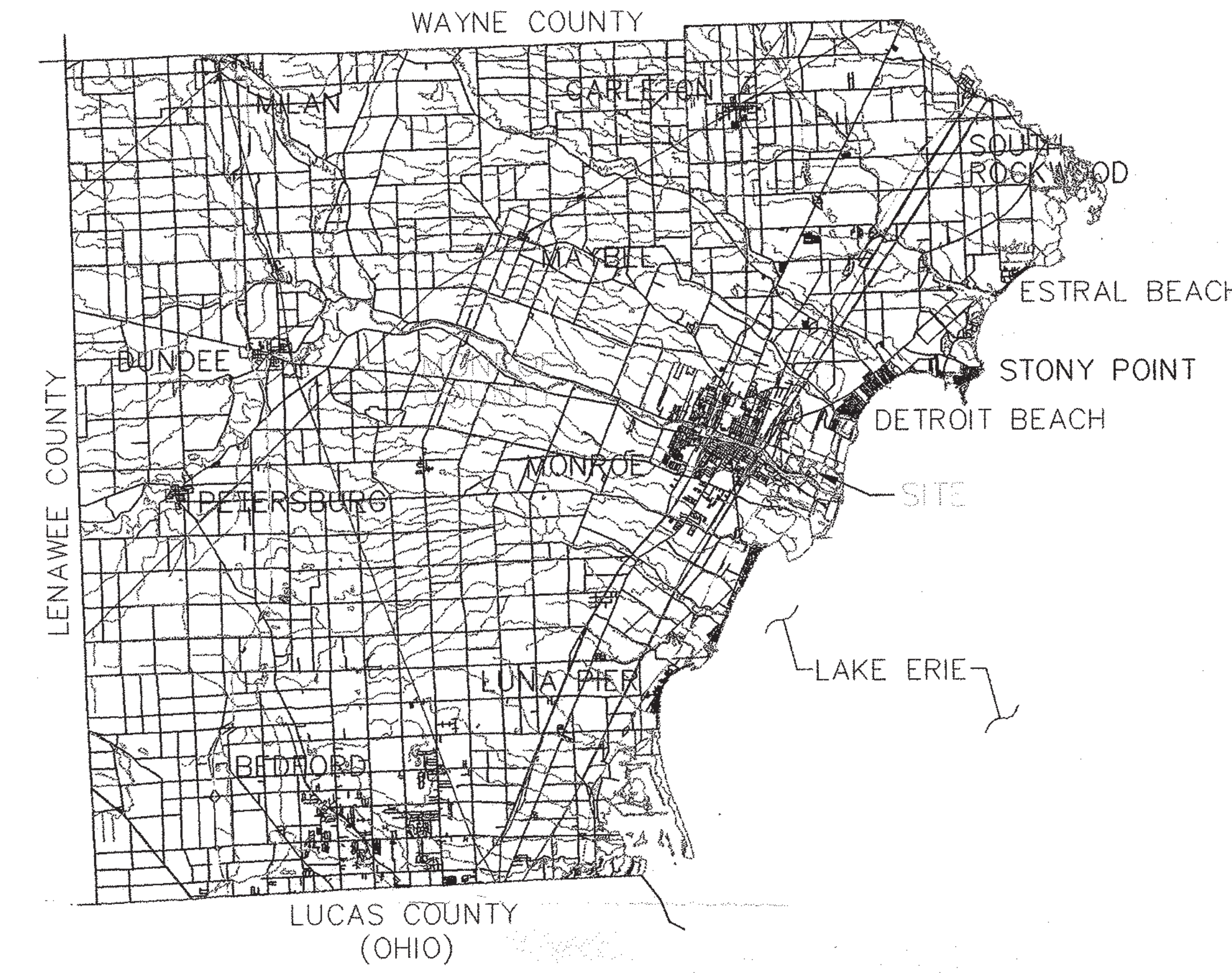
FORD MOTOR COMPANY

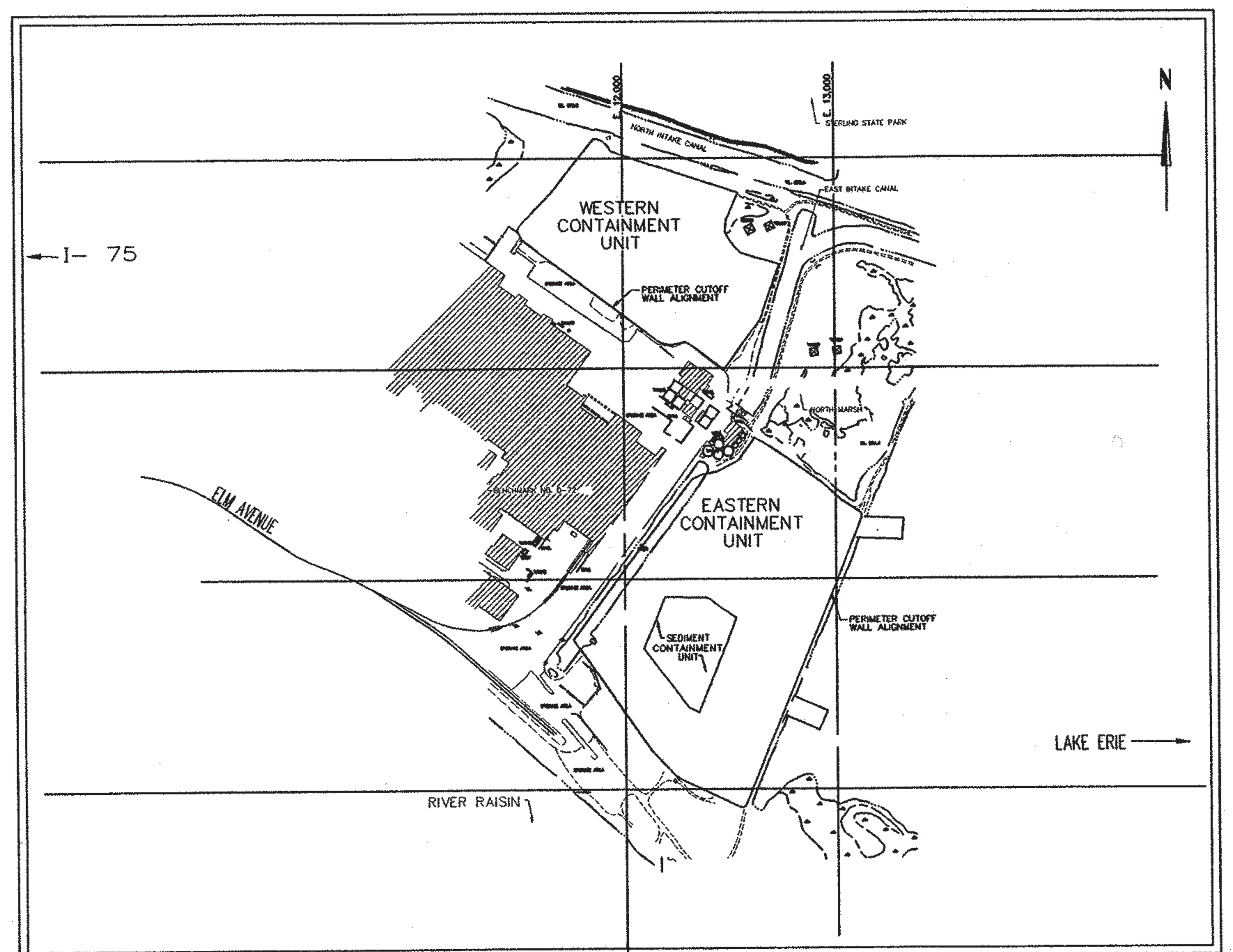
MONROE STAMPING PLANT

MID 005 057 005
MONROE, MICHIGAN

WASTE DISPOSAL
SURFACE IMPOUNDMENT CLOSURE

AS-BUILT DRAWING





LOCATION MAP

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4	North Intake Canal, Area D North, and Area D Tower Closure	F66A2CO3
5	Closure Sample Survey Location Data	F66A2C11
6	Solidified Waste Surface - ECU South	F66A1E11
7	Solidified Waste Surface - ECU North	F66A1E11
8	Waste Surface Survey Verification Data - ECU	F66A1E18
9	Solidified Waste Surface - WCU	F66A1EB
10	Waste Surface Survey Verification Data - WCU	F66A1E14
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12	Clay Surface - ECU North	F66A1E8
13	Clay Surface Survey Verification Data - ECU	F66A1E19
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15	Clay Surface Survey Verification Data - WCU	F66A1E13
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18	Geomembrane Panel Layout - WCU	F66A2C21
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21	Sand Surface Survey Verification Data - ECU	F66A1E20
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24	Cover Soil Surface Layer -ECU South	F66A1E10
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26	Cover Soil Surface Survey Verification Data -ECU	F66A1E21
27	Cover Soil Surface Layer -WCU	F66A1E05
28	Cover Soil Surface Survey Verification Data -WCU	F66A1E16
29	Final Topsoil Grade - ECU South	F66A2E9
30	Final Topsoil Grade - ECU North	F66A2E9
31	Final Topsoil Grade Surface Survey Verification Data - ECU	F66A1E22
32	Final Topsoil Grade - WCU	F66A1E06
33	Final Grade Surface Survey Verification Data - WCU	F66A1E17
34	Cutoff Wall Profile - ECU I	F66A2C13
35	Cutoff Wall Profile - ECU II	F66A2C14
36	Cutoff Wall Profile - ECU III	F66A2C15
37	Cutoff Wall Cross-Section - ECU I	F66A2C19
38	Cutoff Wall Cross-Section - ECU II	F66A2C20
39	Cutoff Wall Profile - WCU I	F66A2C17
40	Cutoff Wall Profile - WCU II	F66A2C18
41	Cutoff Wall Profile - WCU III	F66A2C16
42	Cutoff Wall Cross-Section - WCU I	F66A2C21
43	Cutoff Wall Cross-Section - WCU II	F66A2C23
44	Details I	F66A2C12
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49	Leachate Collection System - ECU II	F66A2C06
50	Leachate Collection System - WCU I	F66A2C04
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59	SCU Geomembrane Base Liner Panel Layout	F66A3N03
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61	SCU Geomembraone Cover Liner Panel Layout	F66A3N02
62	SCU Top of Protective Clay	F66A3N05
63	SCU Details	F66A3N06
64	Eastern Containment Unit Location	F66A2G4
65	Western Containment Unit Location	F66A2G3

PLANS PREPARED FOR:

Ford

FORD ENVIRONMENTAL QUALITY OFFICE
AND
FORD MOTOR LAND SERVICES CORPORATION

PLANS PREPARED BY:

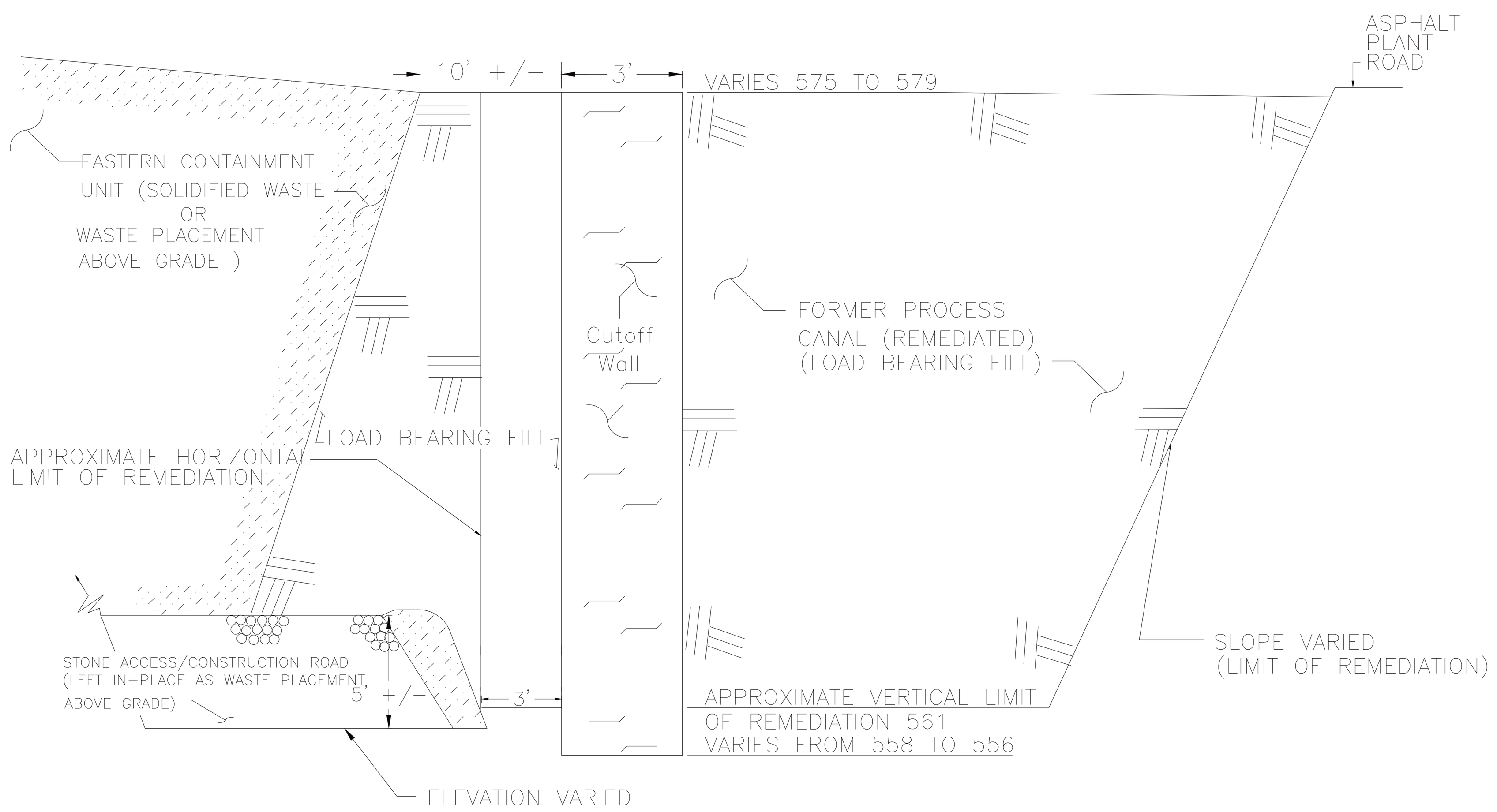
MEC inc.

MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
22720 Michigan Avenue, Suite 306
Dearborn, Michigan 48124
PHONE NO.: (313) 563-6326

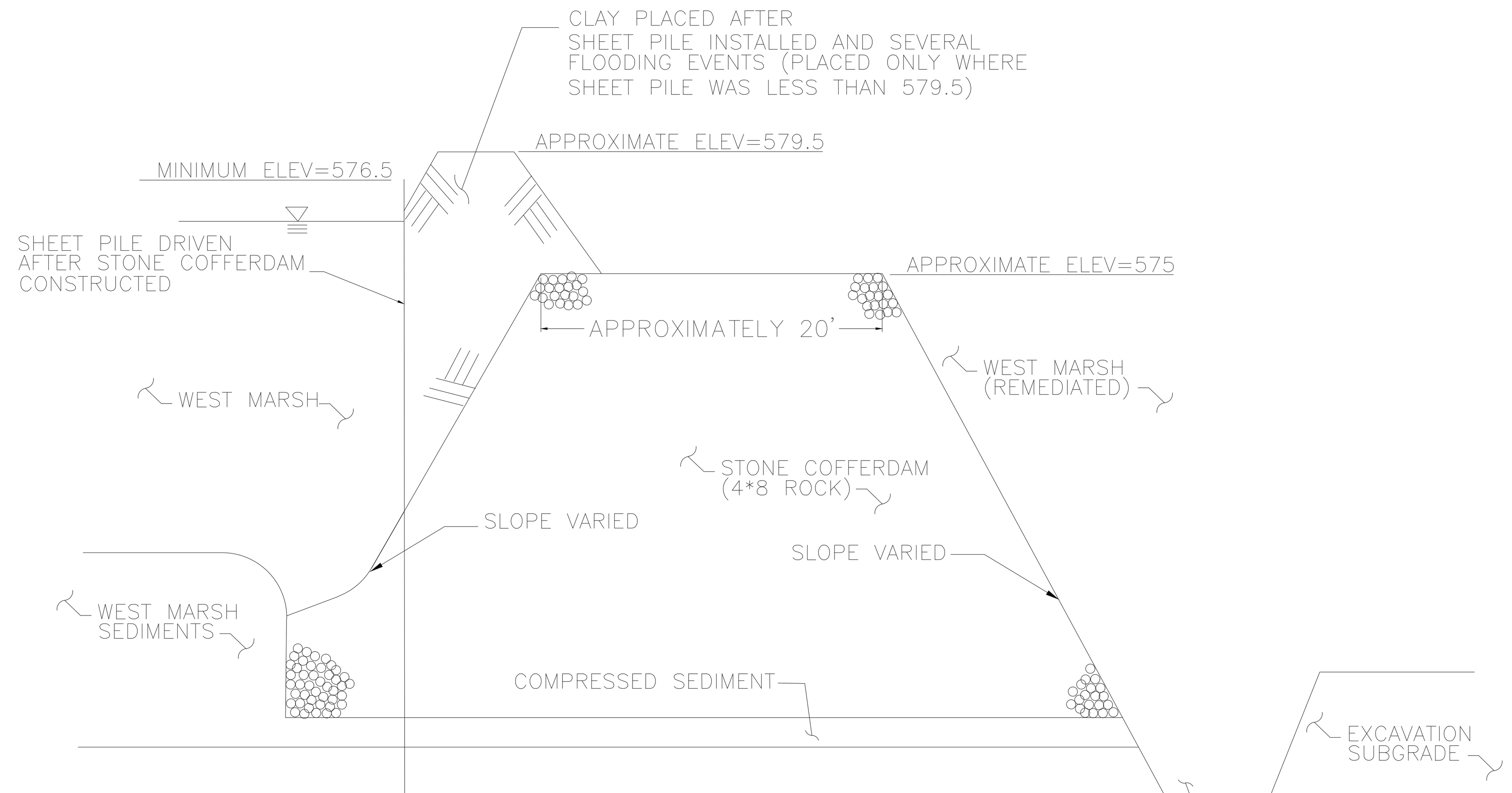
STATE OF MICHIGAN
JOHN S. BROWNING III
ENGINEER
No. 35872
LICENSED PROFESSIONAL ENGINEER

JOHN S. BROWNING III, PE

OCTOBER 1999
DWG. NO. 1 OF 65
PROJ. NO. F66A2C



1/44 PROCESS CANAL CLOSURE LIMIT AT CUTOFF WALL
N.T.S., SEE DRAWING 2



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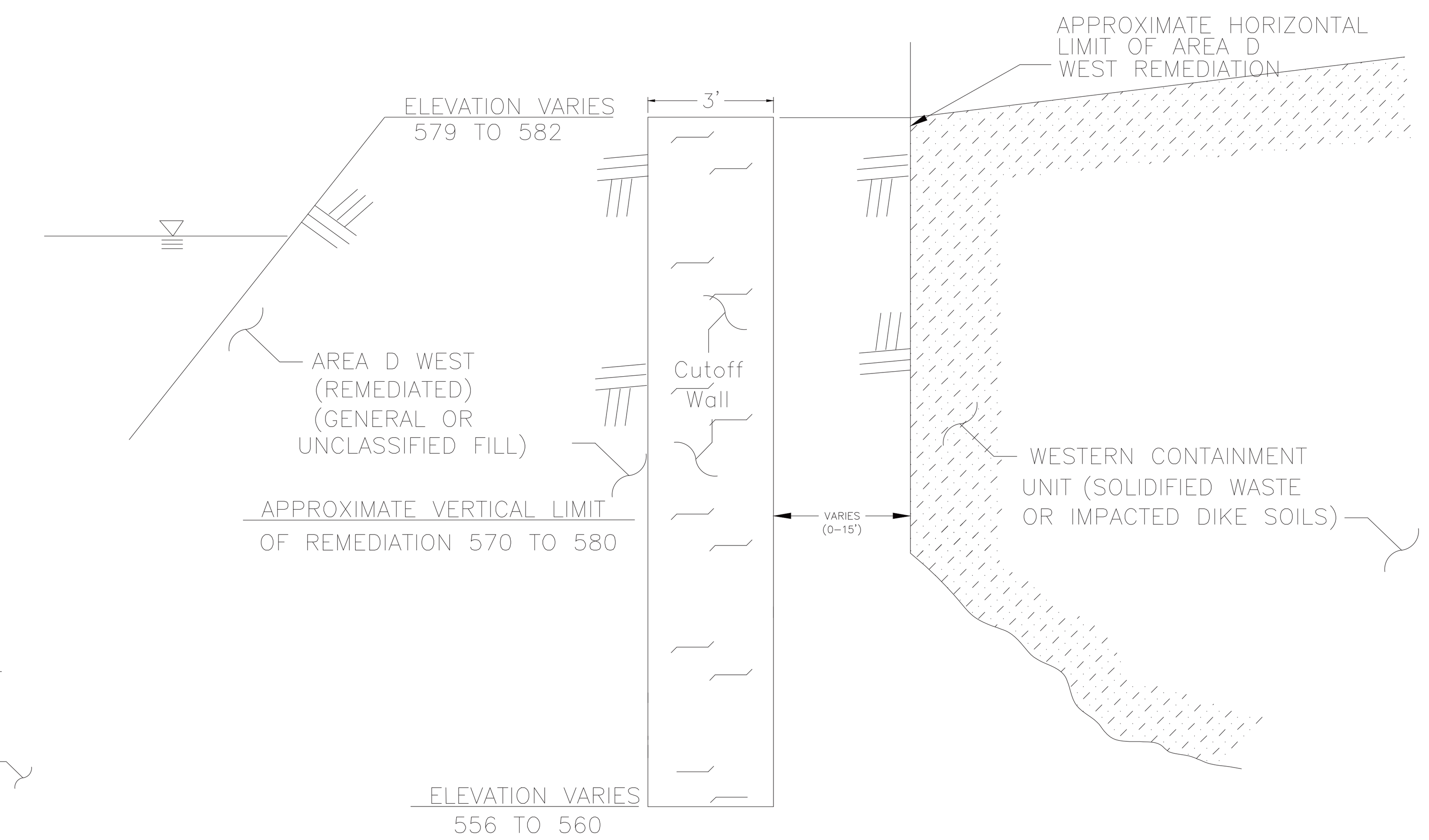
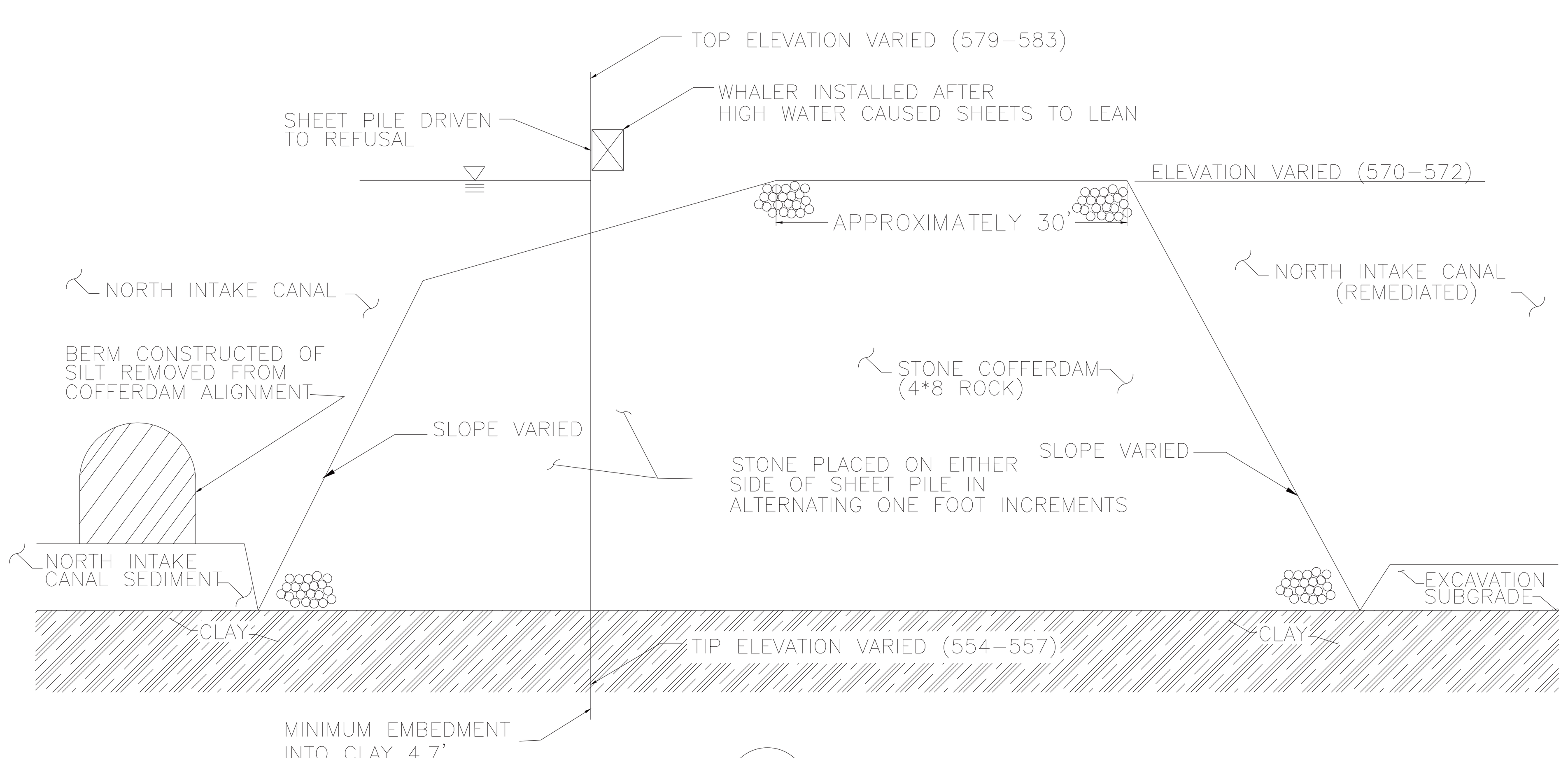
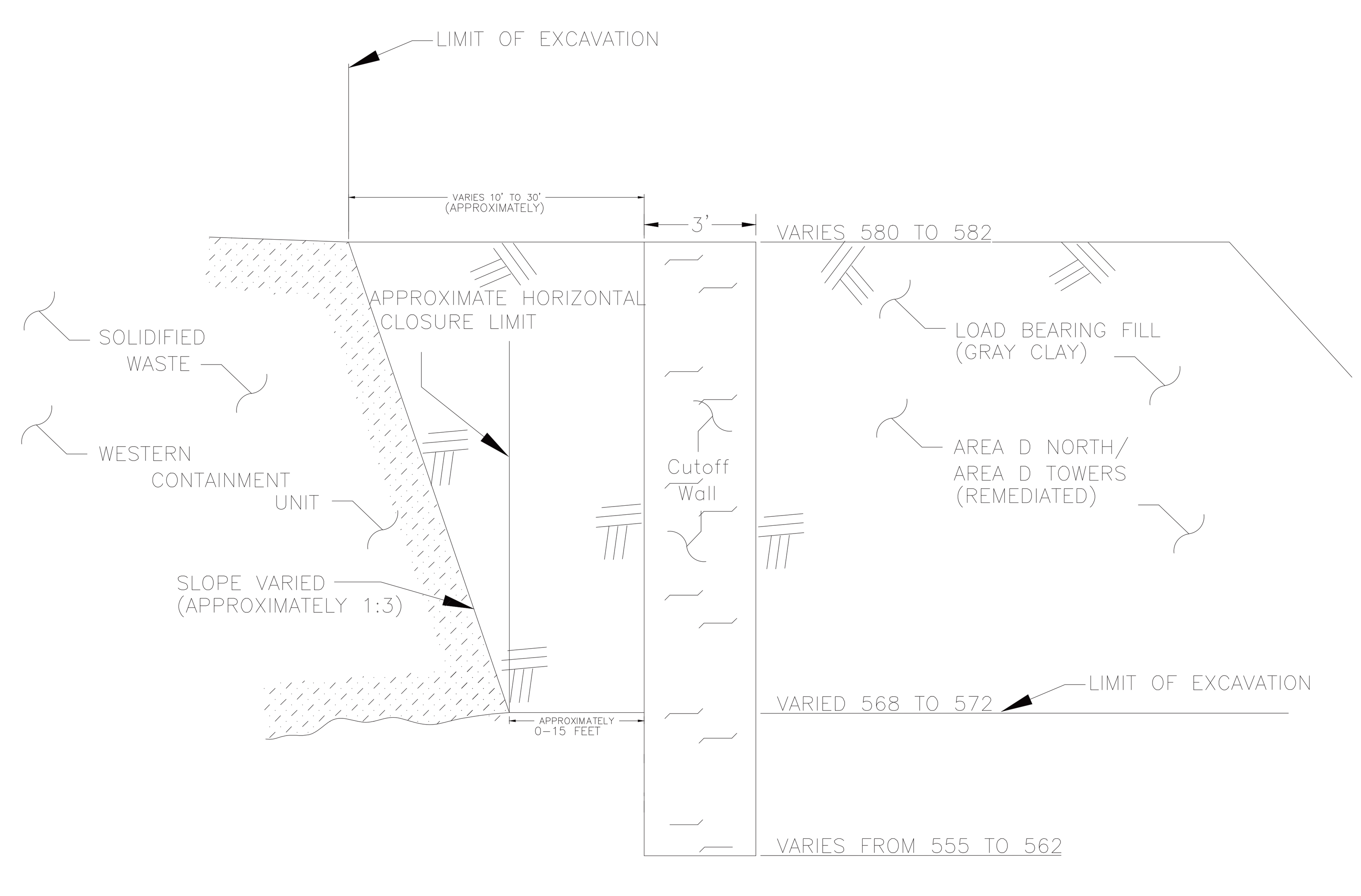


3/44 AREA D WEST CLOSURE AT CUTOFF WALL
N.T.S., SEE DRAWING 3



4/44 NORTH INTAKE CANAL COFFERDAM
N.T.S., SEE DRAWING 4



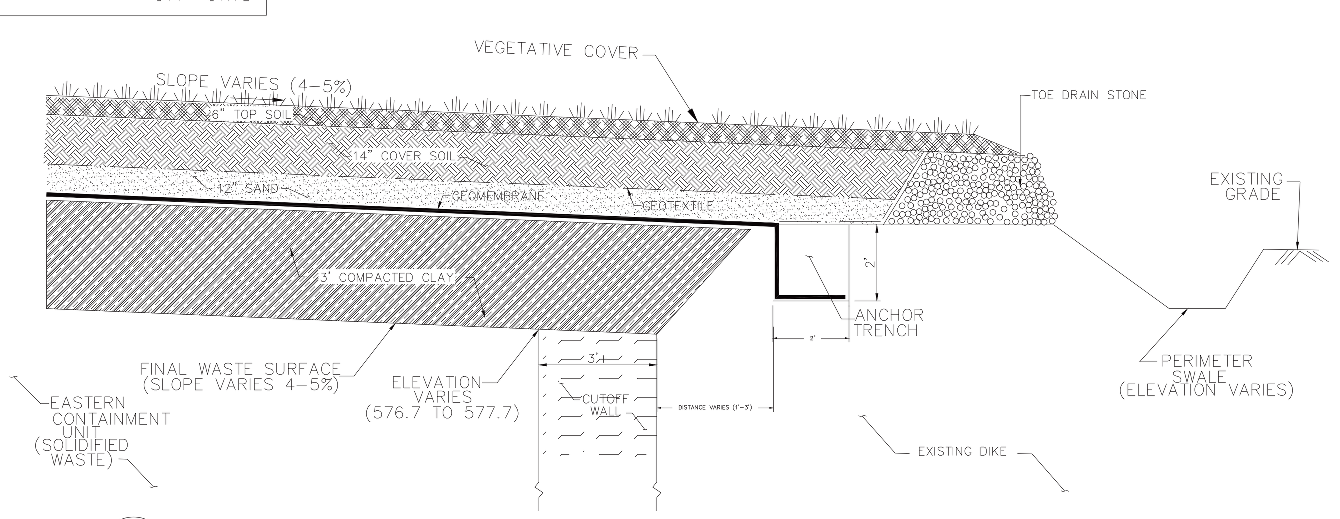
5/44 AREA D NORTH/AREA D TOWER CLOSURE LIMIT AT CUTOFF WALL
N.T.S., SEE DRAWING 4

REV.	BY	CHK'D	DESCRIPTION
1	AS 12/99	LWB 12/99	AS-BUILT DRAWINGS

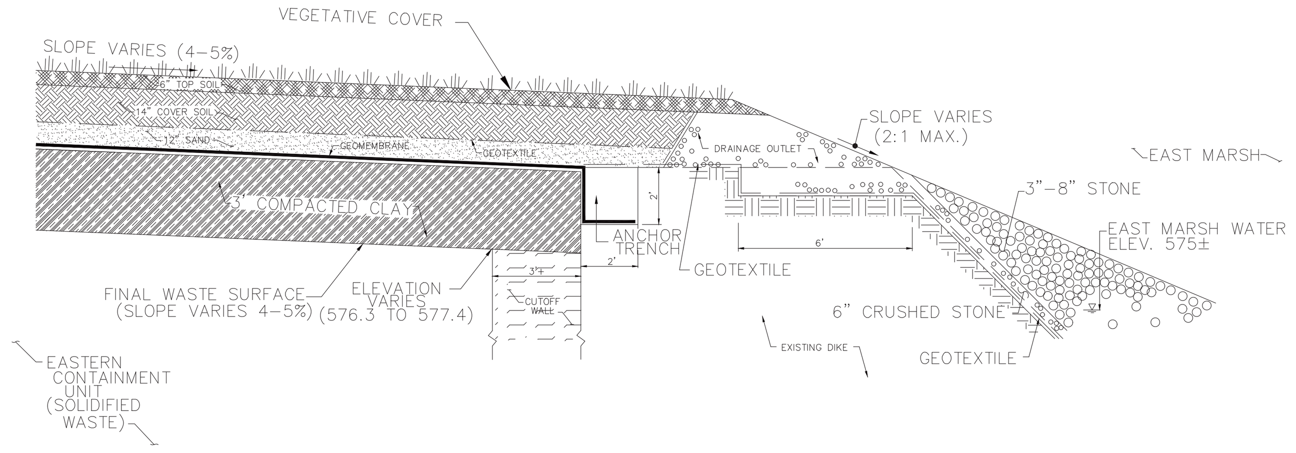
MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
(313) 563-6326
DEARBORN, MICHIGAN

TITLE: VISTEON CORPORATION – MONROE PLANT
WASTE DISPOSAL SURFACE IMPOUNDMENTS
DETAIL 1

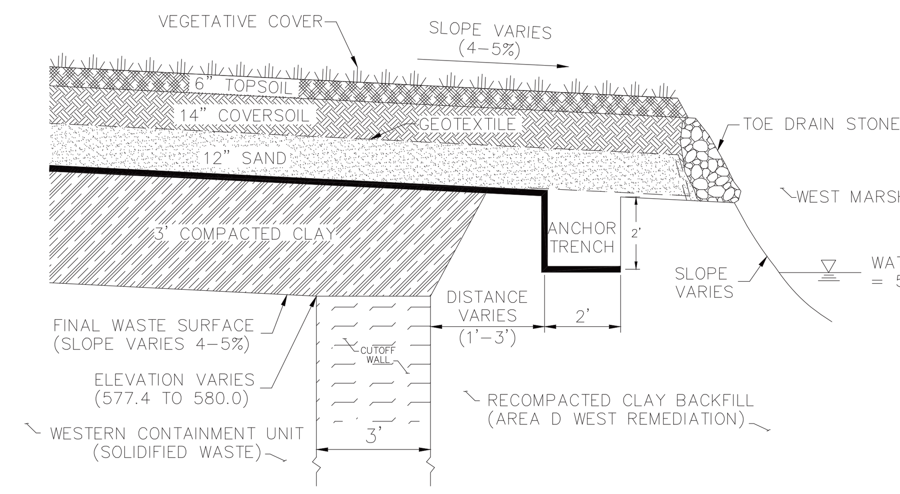
DRAWN: AS DATE 12/99	SCALE: AS NOTED	DRAWING NO. 44 OF 65	REV. NO. 1
DESIGNED: LWB DATE 12/99	REVIEWED: JSB DATE 12/99		
APPROVED: DATE	PROJECT NO. F66A2C	CADD FILE: F66A2C12	



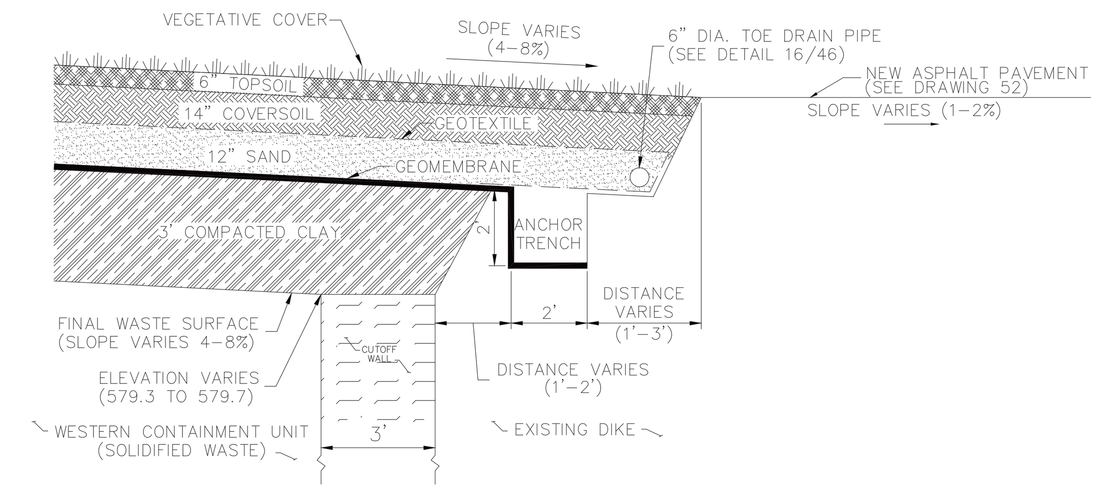
6/45 EASTERN CONTAINMENT UNIT AT SOUTH SIDE PERIMETER
N.T.S., SEE DRAWINGS 6, 11, 16, 19, 24 AND 29



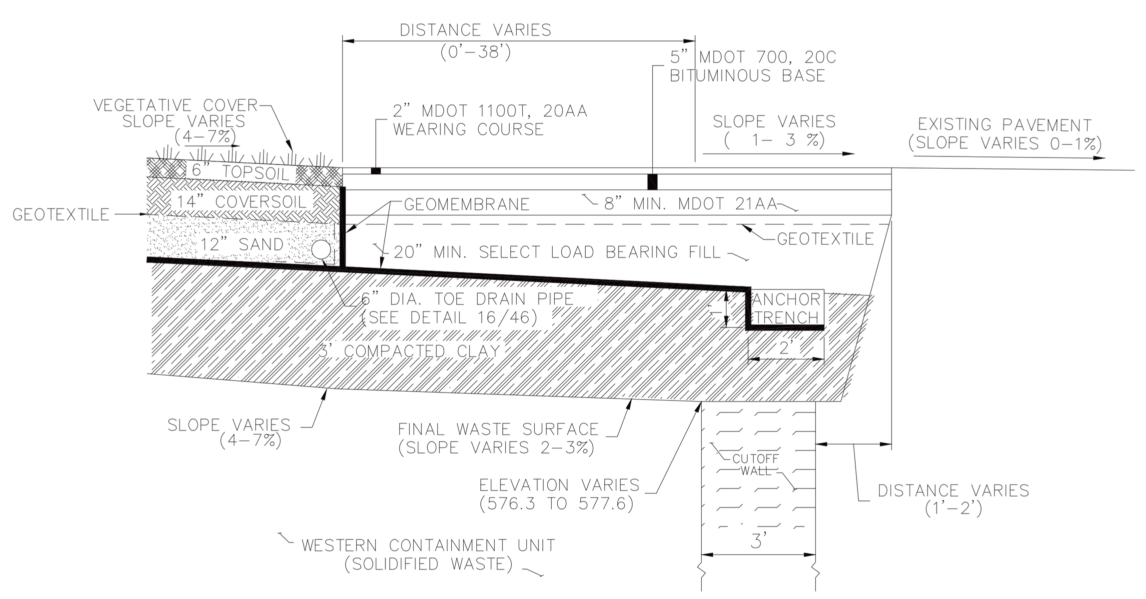
7/45 EASTERN CONTAINMENT UNIT AT EAST SIDE PERIMETER
N.T.S., SEE DRAWINGS 6, 7, 11, 12, 16, 17, 19, 20, 24, 25, 29 AND 30



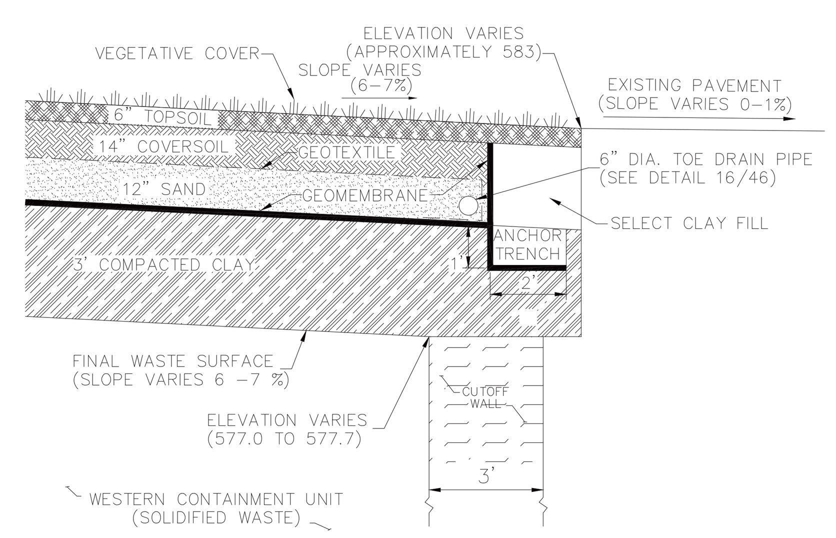
8/45 WESTERN CONTAINMENT UNIT AT WEST PERIMETER
NOT TO SCALE
SEE DRAWINGS 9, 14, 18, 22, 27 & 32



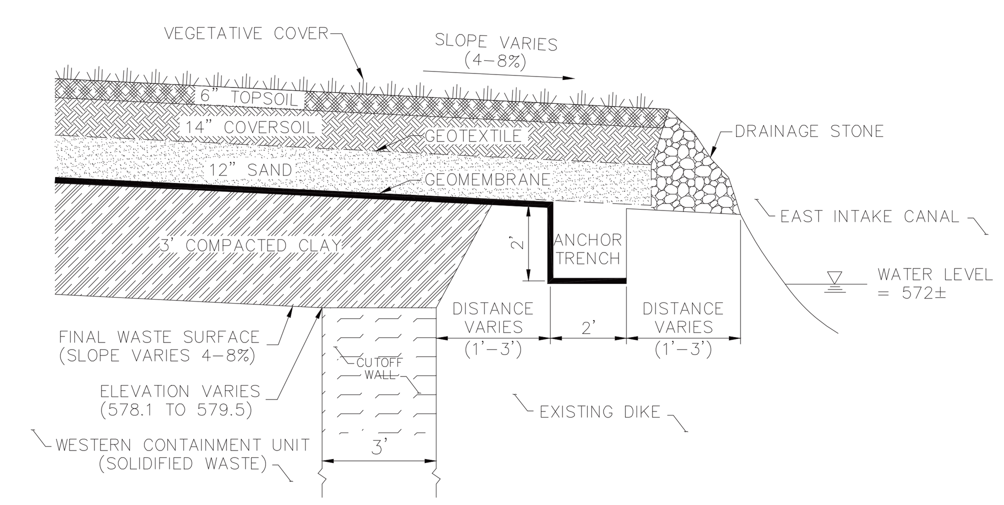
9A/45 WESTERN CONTAINMENT UNIT AT SOUTH PERIMETER
(FROM SOUTHWEST CORNER TO WHERE NEW PAVEMENT IS OVER CUT-OFF WALL)
NOT TO SCALE
SEE DRAWINGS 9, 14, 18, 22, 27, & 32



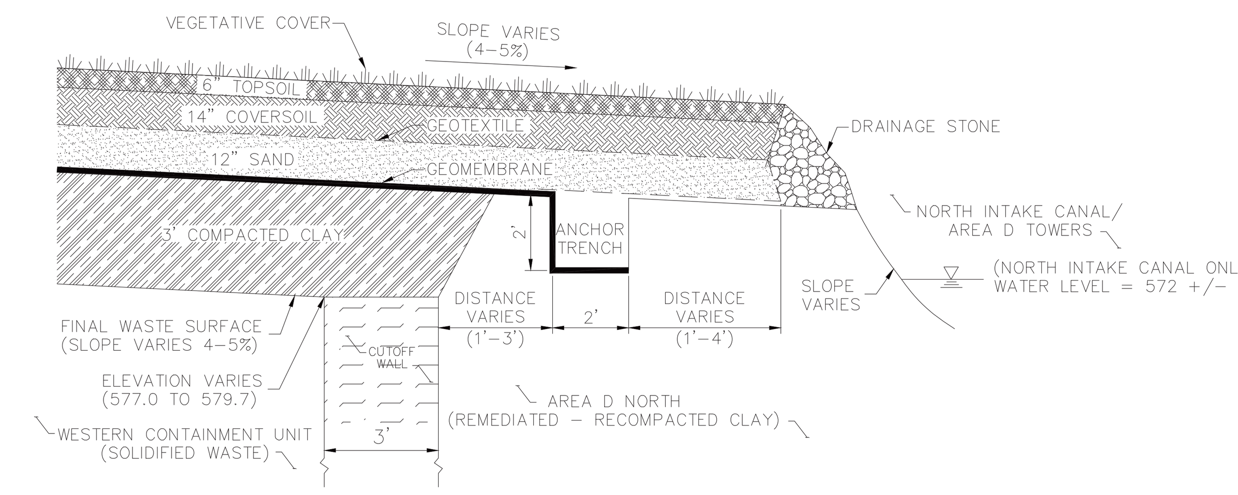
9B/45 WESTERN CONTAINMENT UNIT AT SOUTH PERIMETER
(APPLICABLE WHERE NEW PAVEMENT INSTALLED OVER LANDFILL)
SEE DRAWINGS 9, 14, 18, 22, 27 & 32
NOT TO SCALE



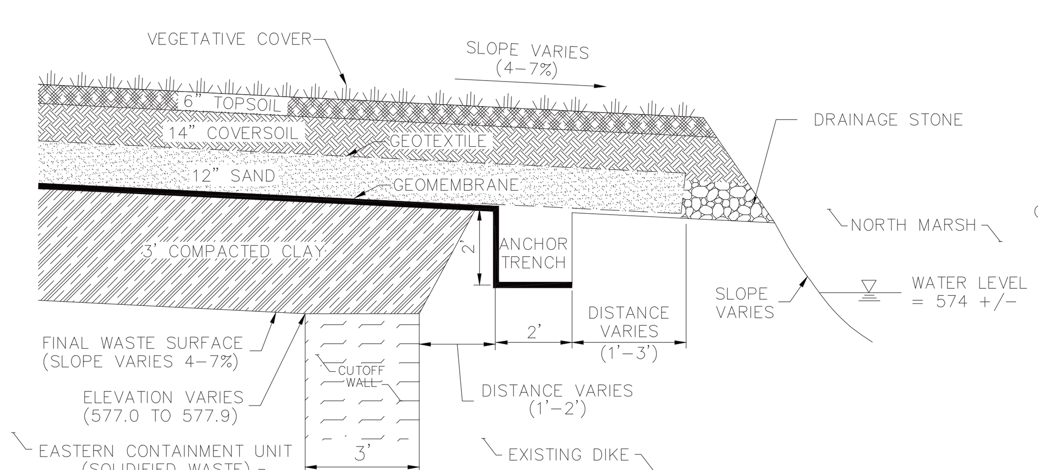
9C/45 WESTERN CONTAINMENT UNIT AT SOUTH PERIMETER
(APPLICABLE FROM SOUTHEAST CORNER TO WHERE NEW PAVEMENT OVER LANDFILL)
SEE DRAWINGS 9, 14, 18, 22, 27 & 32
NOT TO SCALE



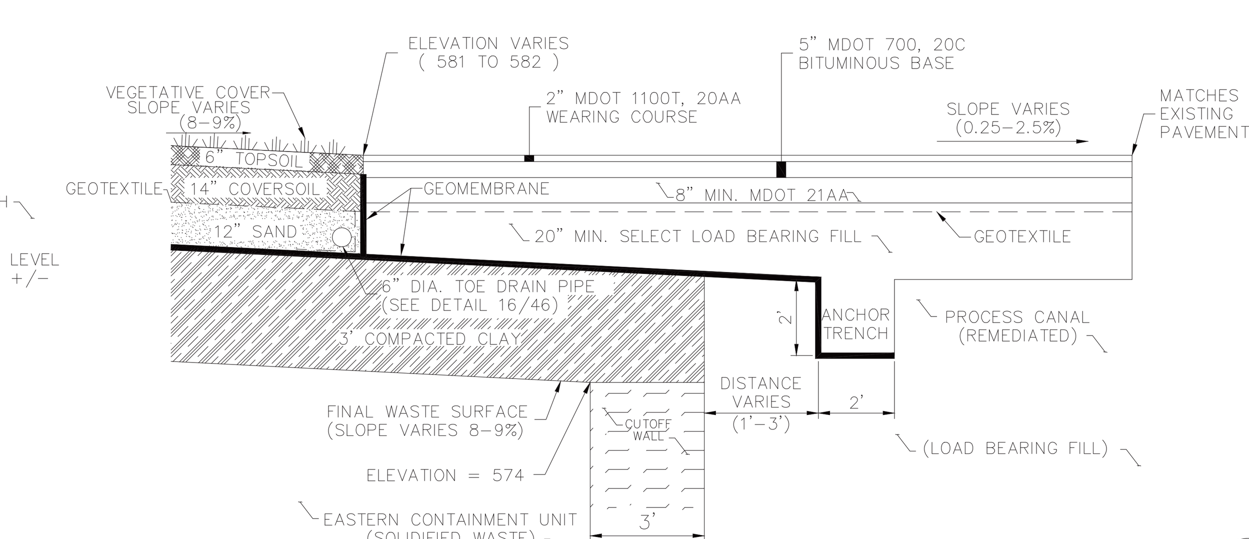
10/45 WESTERN CONTAINMENT UNIT AT EAST PERIMETER
SEE DRAWINGS 9, 14, 18, 22, 27 & 32
NOT TO SCALE



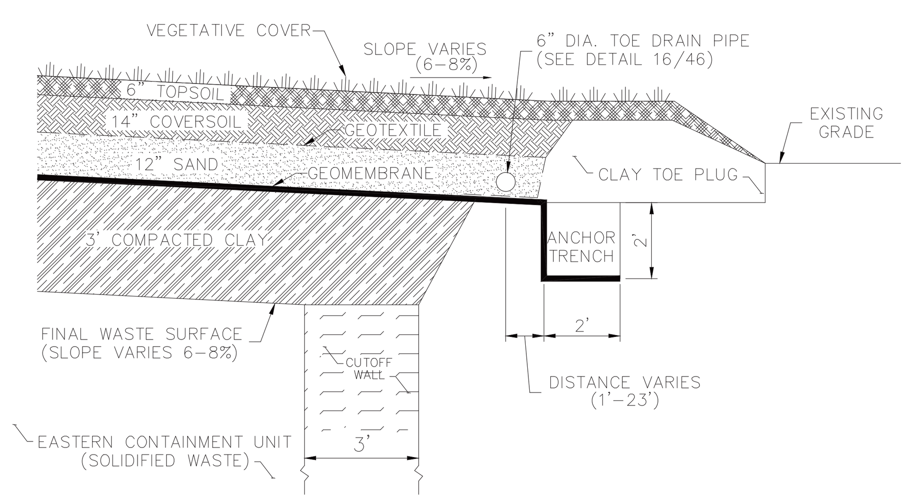
11/45 WESTERN CONTAINMENT UNIT AT NORTH PERIMETER
SEE DRAWINGS 9, 14, 18, 22, 27 & 32
NOT TO SCALE



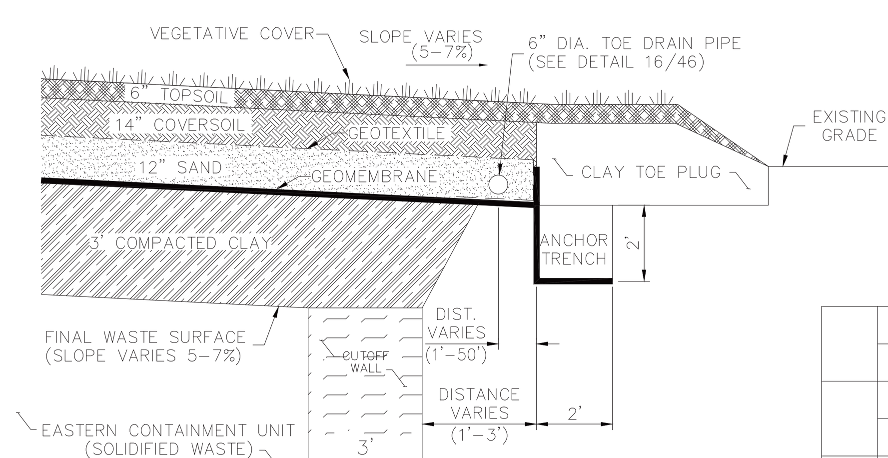
12/45 EASTERN CONTAINMENT UNIT AT NORTH PERIMETER
SEE DRAWINGS 7, 12, 17, 20, 25 & 30
NOT TO SCALE



13A/45 EASTERN CONTAINMENT UNIT AT WEST PERIMETER
(APPLICABLE FROM SOUTHWEST CORNER TO NORTH END OF NEW PAVEMENT)
SEE DRAWINGS 7, 12, 17, 20, 25, 30 & 51
NOT TO SCALE



13B/45 EASTERN CONTAINMENT UNIT AT WEST PERIMETER
(APPLICABLE FROM NORTHWEST CORNER TO ANCHOR TRENCH/GEOMEMBRANE FLAP JUNCTION)
SEE DRAWINGS 7, 12, 17, 20, 25, 30 & 51
NOT TO SCALE



13C/45 EASTERN CONTAINMENT UNIT AT WEST PERIMETER
(APPLICABLE FROM ANCHOR TRENCH/GEOMEMBRANE FLAP JUNCTION TO NORTH END OF NEW PAVEMENT)
SEE DRAWINGS 7, 12, 17, 20, 25, 30 & 51
NOT TO SCALE

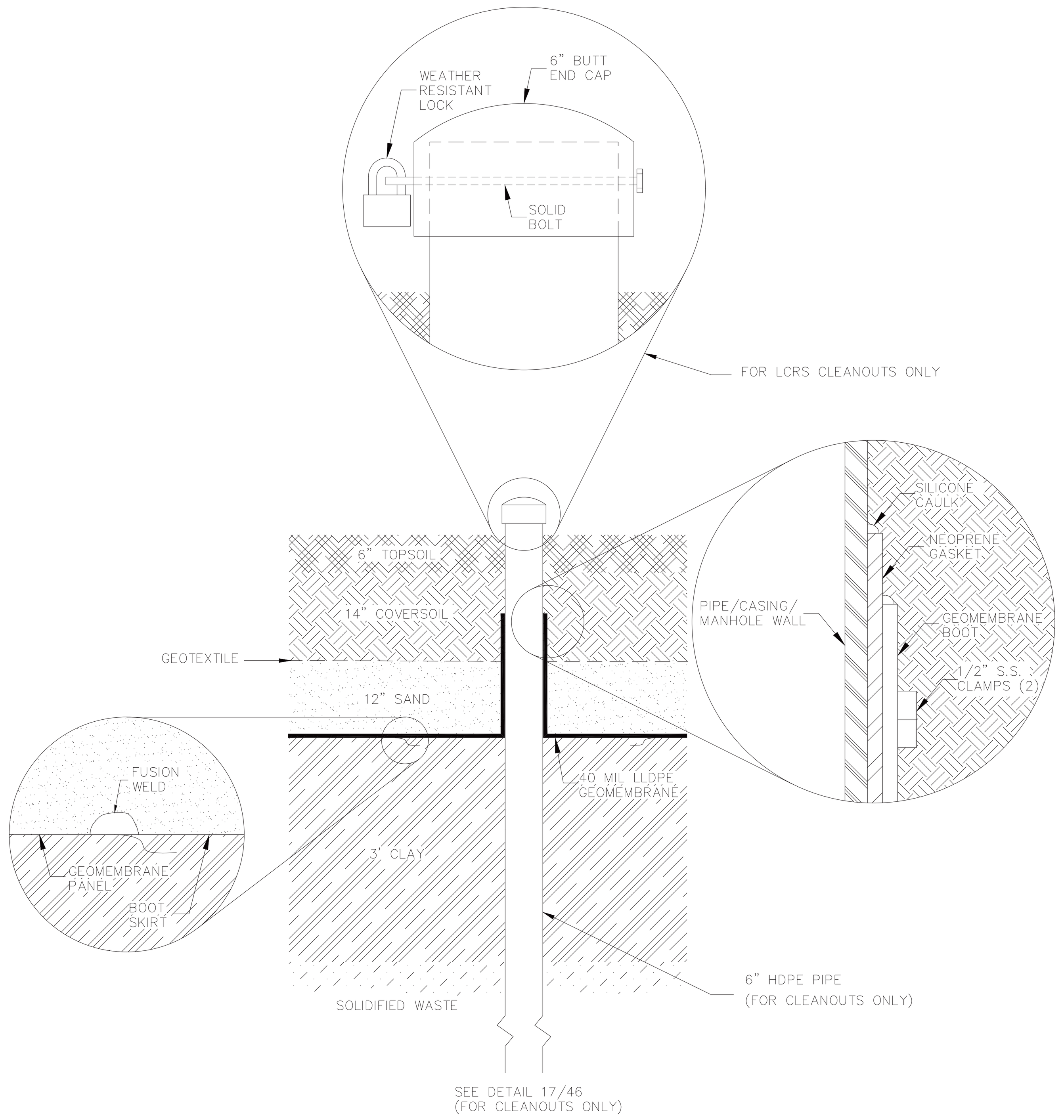
REV.	BY	CHK'D	DESCRIPTION
1	AS 12/99	LWB 12/99	AS-BUILT COVERSOIL SURFACE
REV.	DATE	DATE	DESCRIPTION

MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
(313) 563-6326
DEARBORN, MICHIGAN

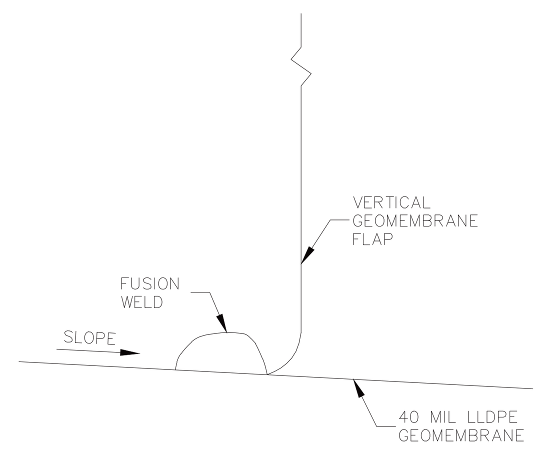
TITLE: VISTEON CORPORATION – MONROE PLANT
DETAILS II

DRAWN: AS/TMB DATE 12/99	SCALE: AS NOTED	DRAWING NO. 45 OF 65	REV. NO. 1
DESIGNED: LWB DATE 12/99	REVIEWED: JSB DATE 12/99		
APPROVED: DATE	PROJECT NO. F66A2C	CADD FILE: F66A2C27	

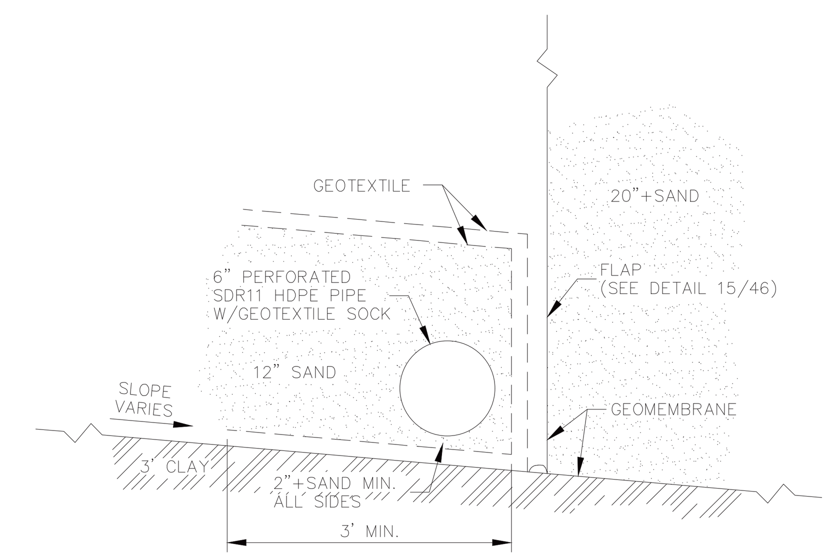
DWG. NO. 46 OF 65
PROJ. NO. F66A2C



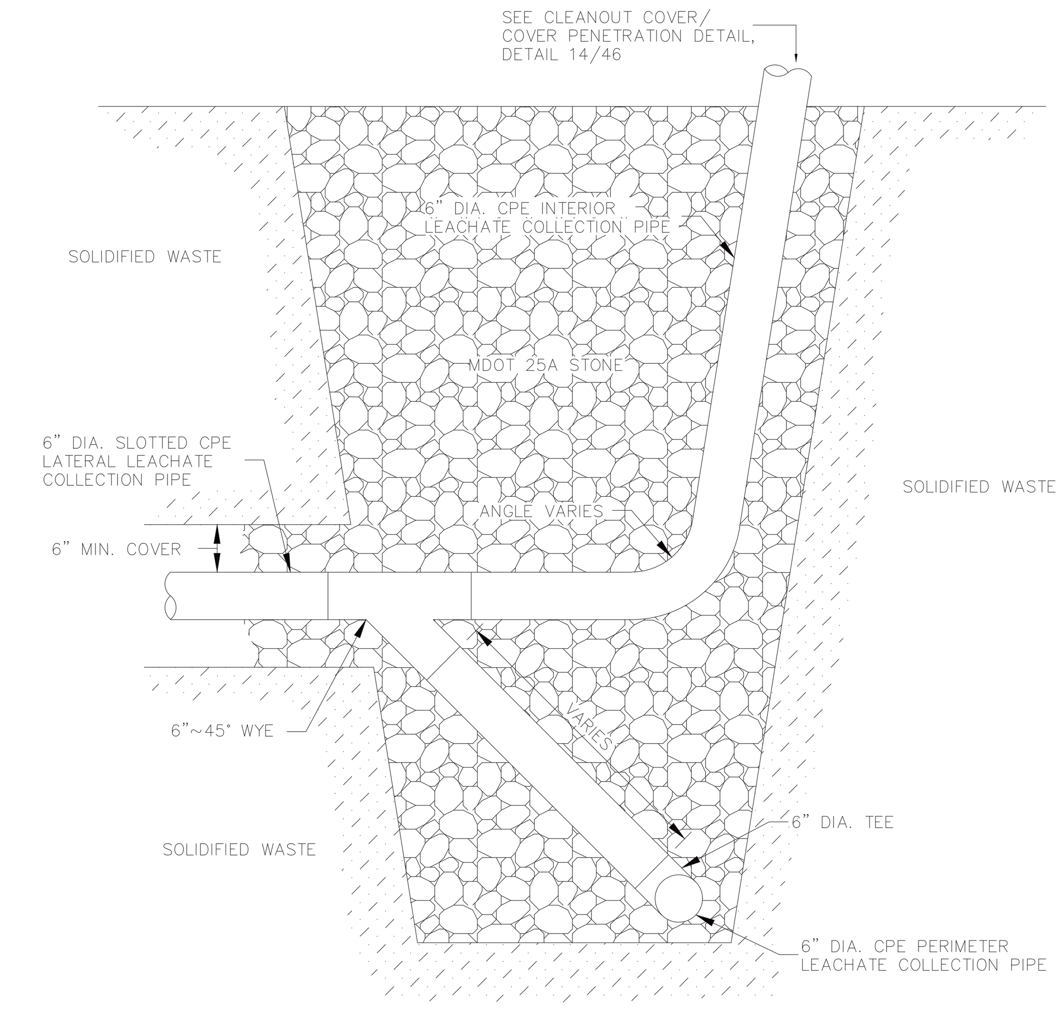
14/46 GEOMEMBRANE BOOT/COVER PENETRATION
NOT TO SCALE
SEE DRAWINGS 48, 49 & 50 AND DETAIL 17/46
NOTE: SKIRT OF BOOT FUSION WELDED TO GEOMEMBRANE PANEL(S)



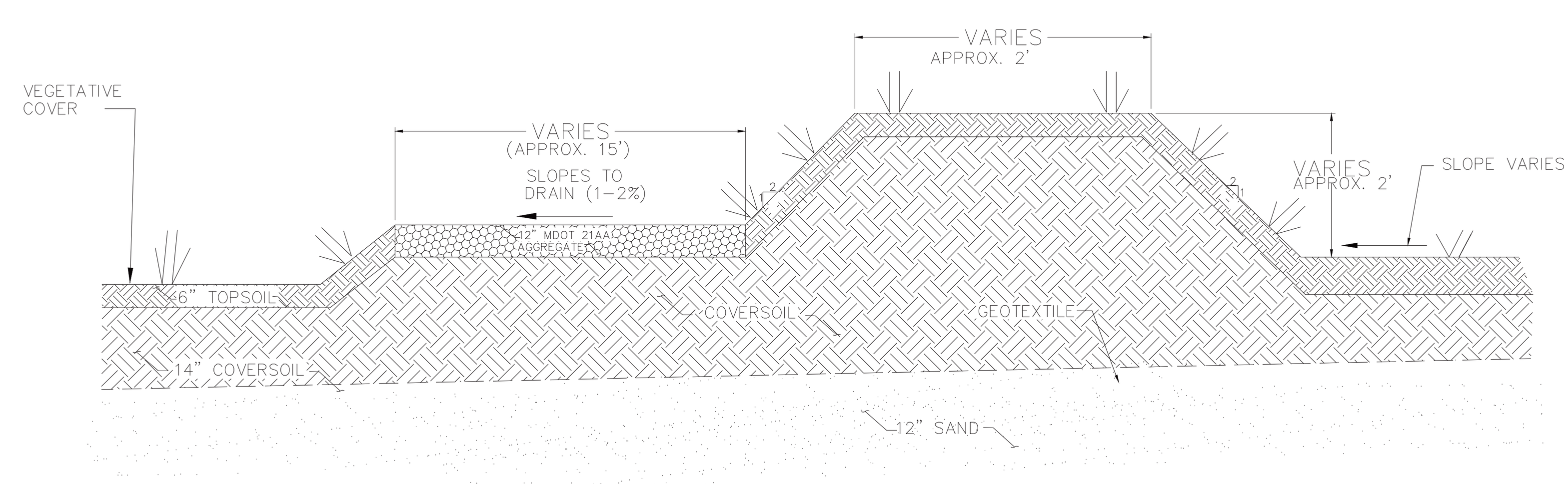
15/46 GEOMEMBRANE FLAP
NOT TO SCALE
SEE DRAWINGS 16, 17 & 18 AND DETAIL 16/46



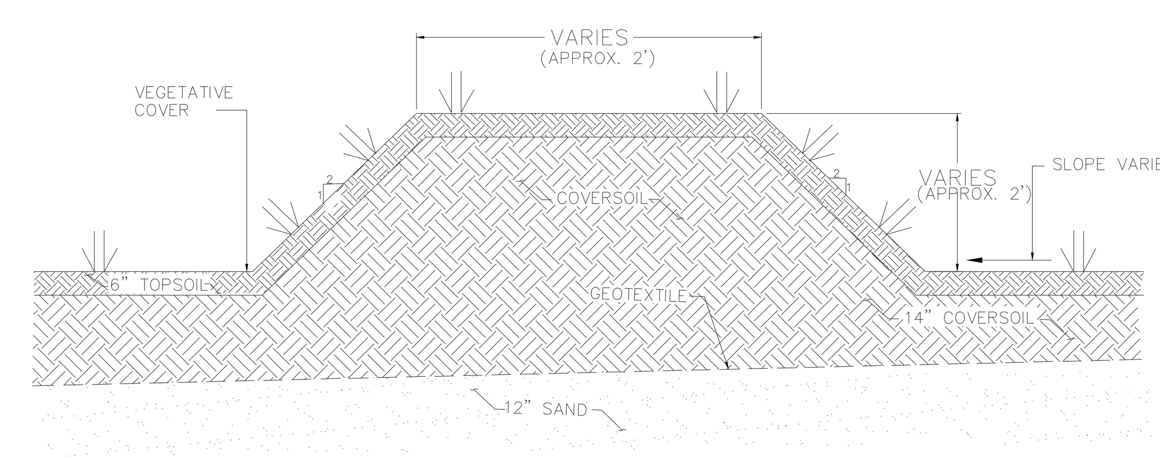
16/46 TOE DRAIN PIPE
NOT TO SCALE
SEE DRAWING 45



17/46 LATERAL/PERIMETER LEACHATE COLLECTION PIPE CONNECTION DETAIL
NOT TO SCALE
SEE DRAWINGS 48, 49 & 50 AND DETAIL 14/46



18/46 DIVERSION BERM/ ACCESS ROAD
NOT TO SCALE
SEE DRAWINGS 29, 30 AND 32



19/46 DIVERSION BERM
NOT TO SCALE
SEE DRAWINGS 29, 30 AND 32

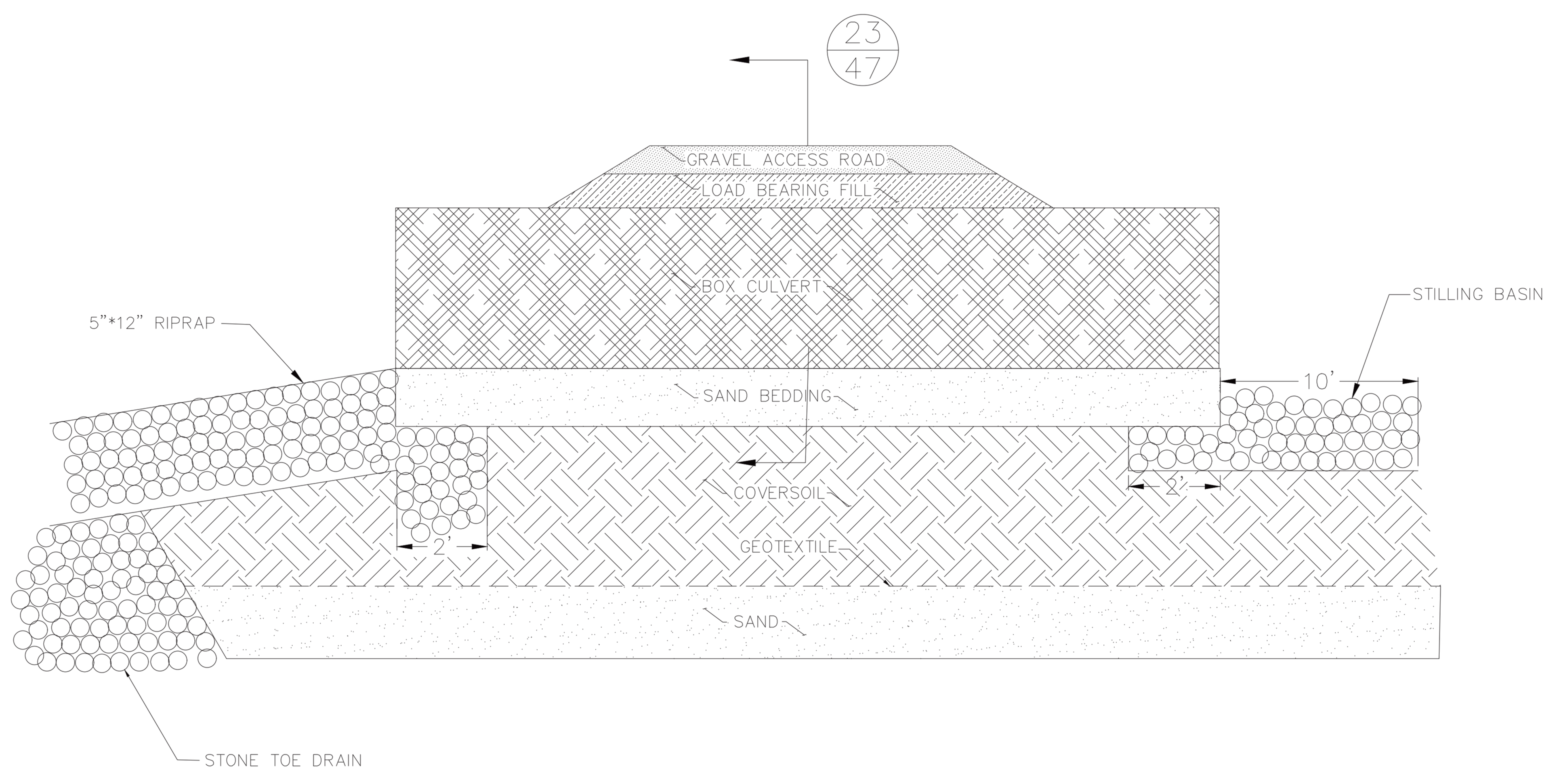
REV.	BY / DATE	CHK'D / DATE	DESCRIPTION
1	AS 11/99	LWB 11/99	AS-BUILT COVERSOIL SURFACE

MIDWEST ENVIRONMENTAL CONSULTANTS, INC. (313) 563-6326
DEARBORN, MICHIGAN

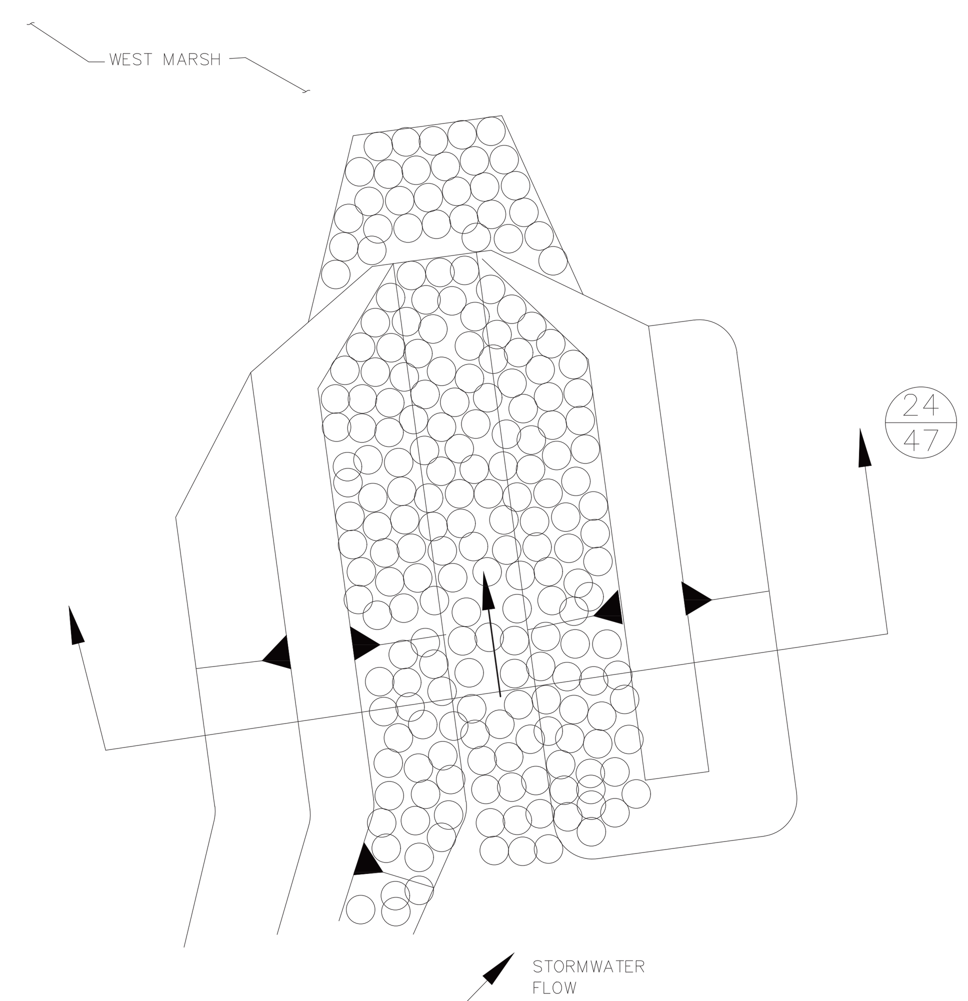
Visteon

TITLE: VISTEON CORPORATION – MONROE PLANT
DETAILS III

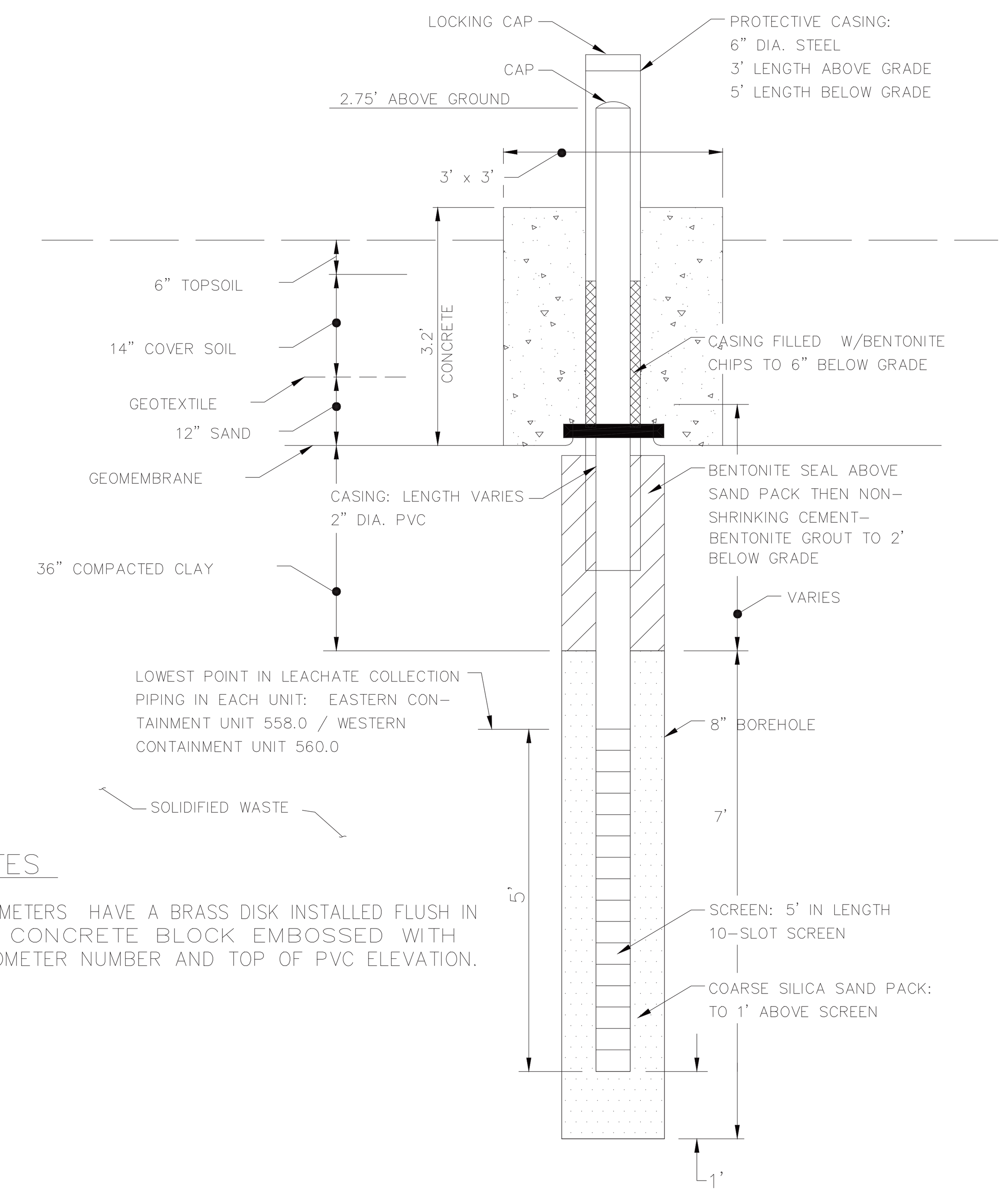
DRAWN: AS/TMB DATE 11/99	SCALE: AS NOTED	DRAWING NO. 46 OF 65	REV. NO. 1
DESIGNED: LWB DATE 11/99	REVIEWED: JSB DATE 11/99		
APPROVED: DATE	PROJECT NO. F66A2C	CADD FILE: F66A2C30	



20/47 OUTFALL
NOT TO SCALE
SEE DRAWINGS 29, 30 AND 32



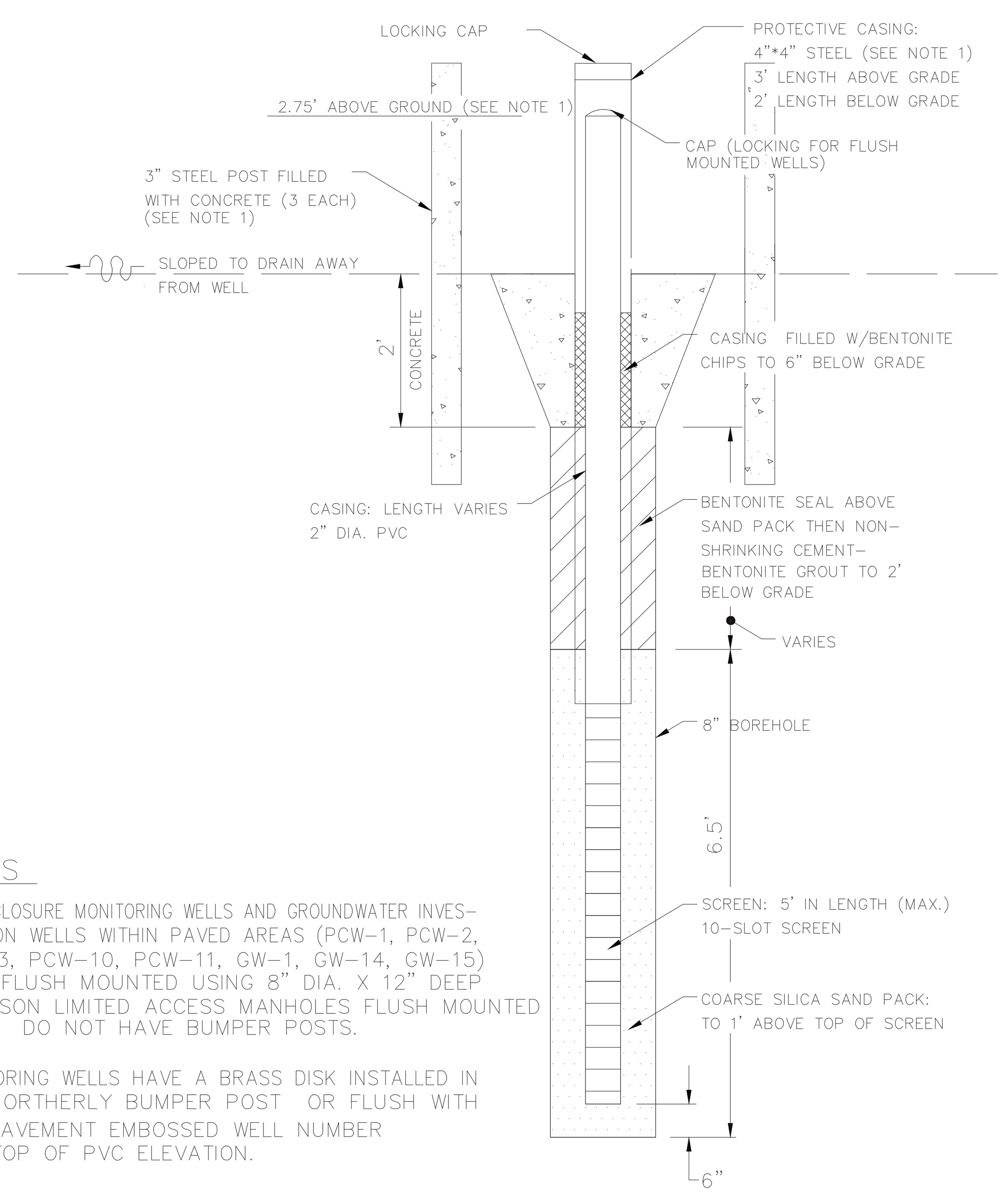
21/47 WEST MARSH OUTFALL
NOT TO SCALE
SEE DRAWINGS 32



NOTES

1. PIEZOMETERS HAVE A BRASS DISK INSTALLED FLUSH IN THE CONCRETE BLOCK EMBOSSED WITH PIEZOMETER NUMBER AND TOP OF PVC ELEVATION.

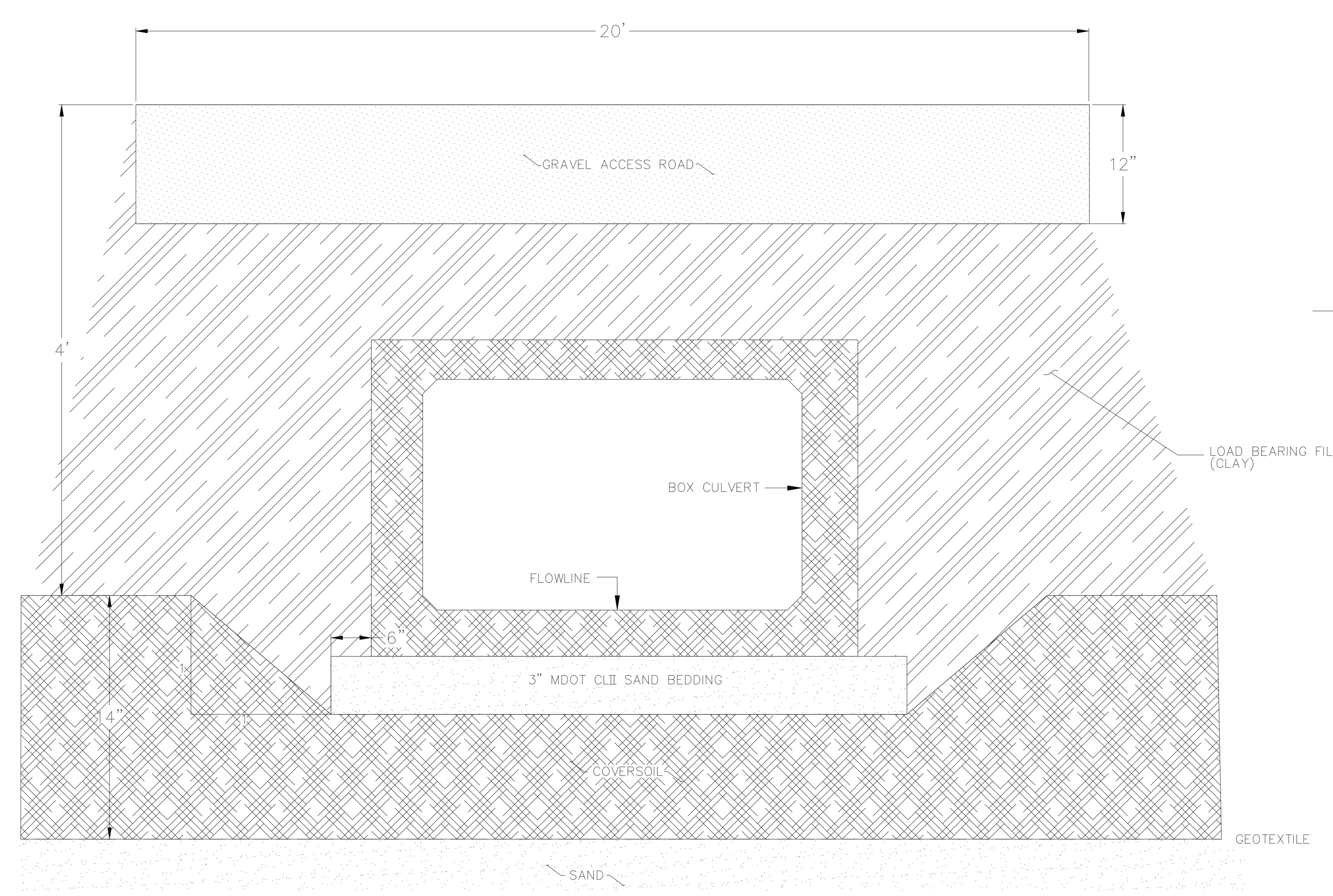
22/46 POST-CLOSURE PIEZOMETER
NOT TO SCALE
SEE DRAWINGS 29, 30, 32, 55 AND 56



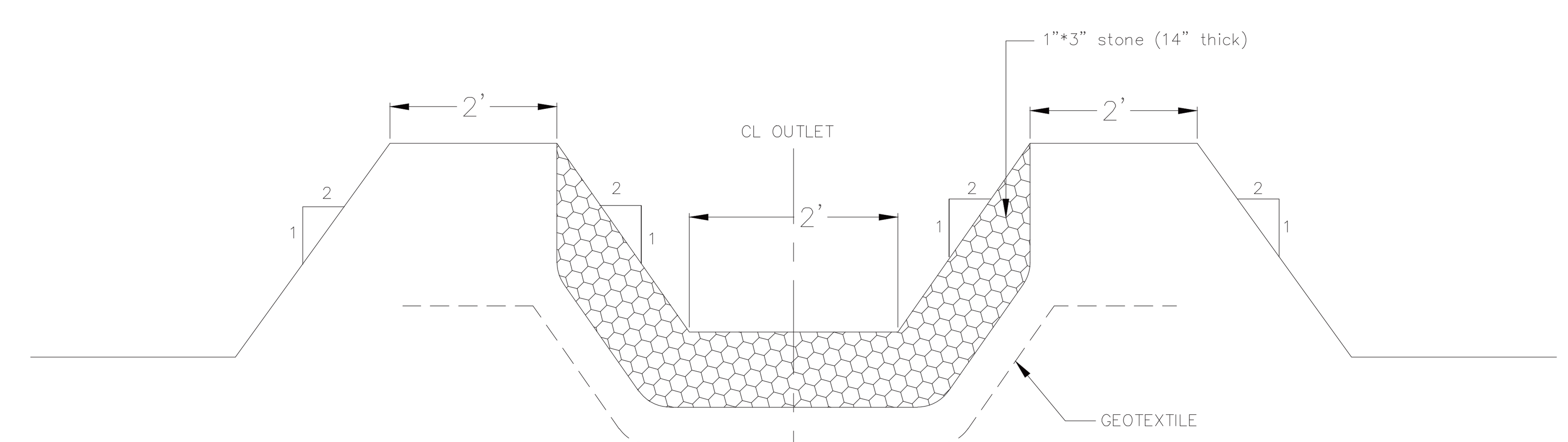
NOTES

1. POST-CLOSURE MONITORING WELLS AND GROUNDWATER INVESTIGATION WELLS WITHIN PAVED AREAS (PCW-1, PCW-2, PCW-3, PCW-10, PCW-11, GW-1, GW-14, GW-15) ARE FLUSH MOUNTED USING 8" DIA. X 12" DEEP MORRISON LIMITED ACCESS MANHOLES FLUSH MOUNTED WELLS DO NOT HAVE BUMPER POSTS.
2. MONITORING WELLS HAVE A BRASS DISK INSTALLED IN THE NORTHERLY BUMPER POST OR FLUSH WITH THE PAVEMENT EMBOSSED WELL NUMBER AND TOP OF PVC ELEVATION.

22A/47 POST CLOSURE DETECTION MONITORING WELL AND GROUND WATER MONITORING WELL
NOT TO SCALE
SEE DRAWINGS 29, 30, 32, 55 AND 56



23/47 OUTFALL CROSS-SECTION
NOT TO SCALE
SEE DETAIL 20/47



24/47 WEST MARSH OUTFALL CROSS-SECTION
NOT TO SCALE
SEE DETAIL 21/47

REV.	BY / DATE	CHK'D / DATE	DESCRIPTION
1	AS 12/99	LWB 12/99	AS-BUILT DRAWINGS

MEC inc — MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
DEARBORN, MICHIGAN
(313) 563-6326

TITLE: VISTEON CORPORATION – MONROE PLANT
WASTE DISPOSAL SURFACE IMPOUNDMENTS
DETAIL 4

DRAWN: AS DATE 12/99	SCALE: AS NOTED	DRAWING NO.	REV. NO.
DESIGNED: LWB DATE 12/99	REVIEWED: JSB DATE 12/99	47 OF 65	1
APPROVED: DATE	PROJECT NO. F66A2C	CADD FILE: F66A2C32	

Visteon

EAST MARSH
NORTH MARSH
NOTES:
1. CONDUIT UTILIZED WAS 1/2" PVC.
2. ELEVATIONS SHOWN ARE TOP OF CONDUIT OR TOP OF JUNCTION BOX.
3. DEPTH OF CONDUIT COVER IN THE LANDFILL IS APPROXIMATELY 6"–12". DEPTH OF CONDUIT COVER OUTSIDE OF THE LANDFILL IS APPROXIMATELY 12"–18" DEPTH OF COVER FOR THE NEW LIGHT CONDUIT UNDERNEATH THE PAVEMENT IS APPROXIMATELY 2FT.
4. PUMP CONTROL WIRING FROM THE MANHOLE TO THE CONTROL PANEL IS IN THE SAME TRENCH AS THE ELECTRICAL SUPPLY FROM THE MANHOLE TO THE CONTROL PANEL.
LEGEND:
CUTOFF WALL ALIGNMENT
LEACHATE COLLECTION SYSTEM MANHOLE
CONTROL PANEL (LMH–# CP)
UNDERGROUND ELECTRICAL CONDUIT LINE
NEW LIGHT UNDERGROUND ELECTRICAL CONDUIT
ELECTRICAL CONDUIT BOX
LIGHT POLE
E. 13,000
E. 12,500
E. 12,000
N. 6,000
N. 6,500
N. 7,000
N. 7,500
EASTERN CONTAINMENT UNIT
TO WCU (SEE DRAWING NO 52)
W.W.T.P.
CUTOFF WALL ALIGNMENT
NEW ASPHALT PAVEMENT
EXISTING ASPHALT PAVEMENT
SCALE 1"= 60'
0' 30' 60' 120'
DWG. NO. 53 OF 65
PROJ. NO. F66A2C
1 AS 12/99 LWB 12/99 AS-BUILT ELECTRICAL SERRVICE
REV. BY DATE CHK'D DATE DESCRIPTION
MEC inc
MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
(313) 563-6326
DEARBORN, MICHIGAN
THIS DRAWING IS CONFIDENTIAL AND SHALL NOT BE USED OR REPRODUCED IN ANY PART WITHOUT WRITTEN CONSENT OF THE FACILITY OWNER.
Visteon
TITLE: VISTEON CORPORATION – MONROE PLANT
ELECTRICAL SERVICE – ECU
DRAWN: AS DATE 12/99
DESIGNED: LWB DATE 12/99
APPROVED: DATE
SCALE: AS NOTED
REVIEWED: JSB DATE 12/99
PROJECT NO.
DRAWING NO. 53 OF 65
CADD FILE: F66A2C09
REV. NO. 1

LEGEND:

CUTOFF WALL ALIGNMENT
LEACHATE COLLECTION SYSTEM MANHOLE
CONTROL PANEL (LMH-# CP)
ELECTRICAL CONDUIT BOX
UNDERGROUND ELECTRICAL CONDUIT LINE

NOTES:

1. CONDUIT UTILIZED WAS 1/2" PVC.
2. ELEVATIONS SHOWN ARE TOP OF CONDUIT OR TOP OF JUNCTION BOX.
3. DEPTH OF CONDUIT COVER IN THE LANDFILL IS APPROXIMATELY 6"-12". DEPTH OF CONDUIT COVER OUTSIDE OF THE LANDFILL IS APPROXIMATELY 12".
4. PUMP CONTROL WIRING FROM THE MANHOLE TO THE CONTROL PANEL IS IN THE SAME TRENCH AS THE ELECTRICAL SUPPLY FROM THE MANHOLE TO THE CONTROL PANEL.

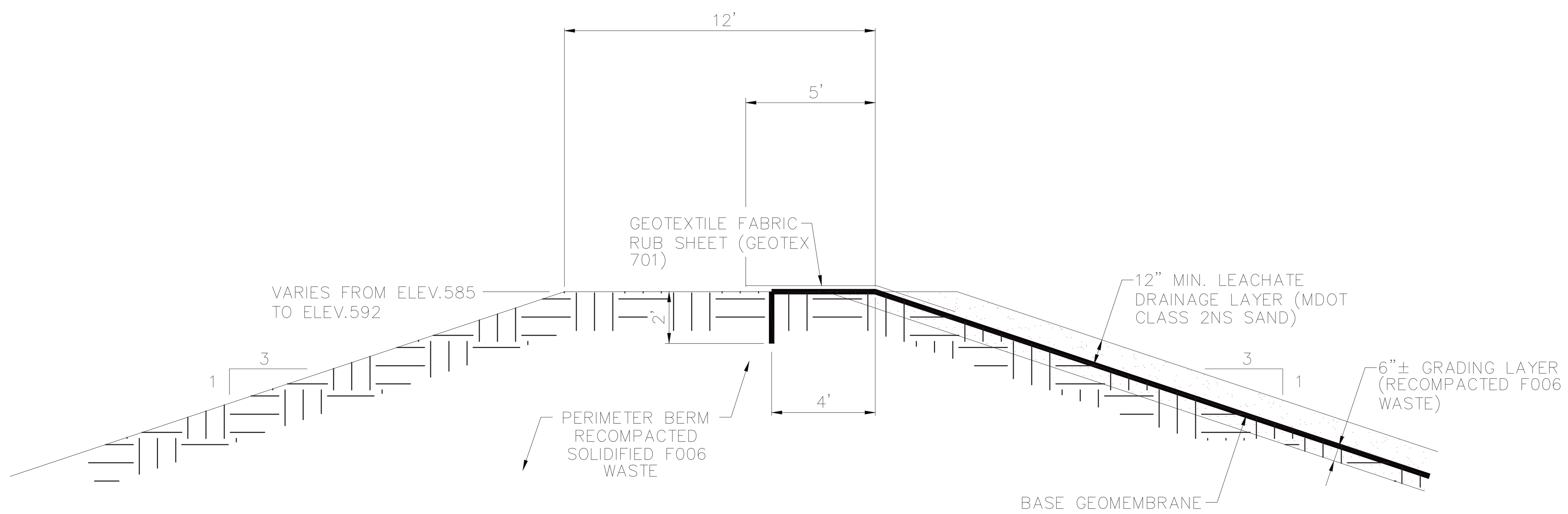
REV.	BY / DATE	CHK'D / DATE	DESCRIPTION
1	AS 12/99	LWB 12/99	AS-BUILT ELECTRICAL SERVICE

MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
DEARBORN, MICHIGAN
(313) 563-6326

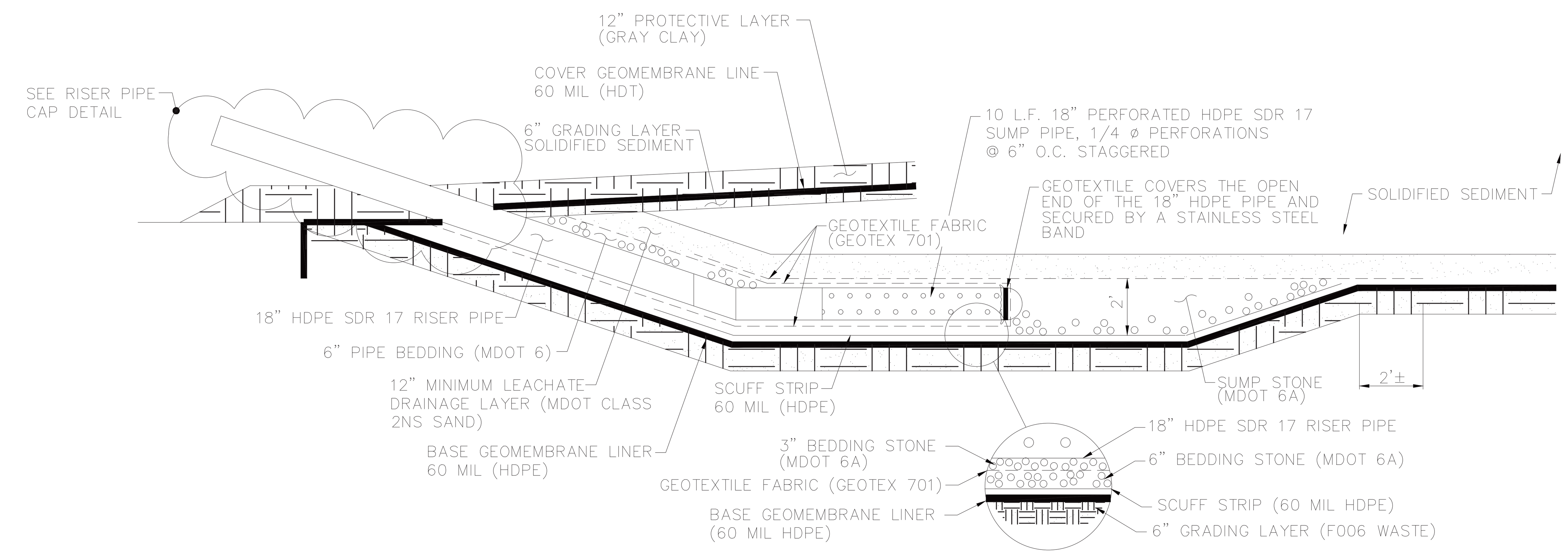
TITLE: VISTEON CORPORATION – MONROE PLANT
ELETRICAL SERVICE – WCU

DRAWN: AS 12/99	SCALE: AS NOTED	DRAWING NO. 54 OF 65	REV. NO. 1
DESIGNED: LWB 12/99	REVIEWED: JSB 12/99		
APPROVED:	PROJECT NO. F66A2C	CADD FILE: F66A2C31	

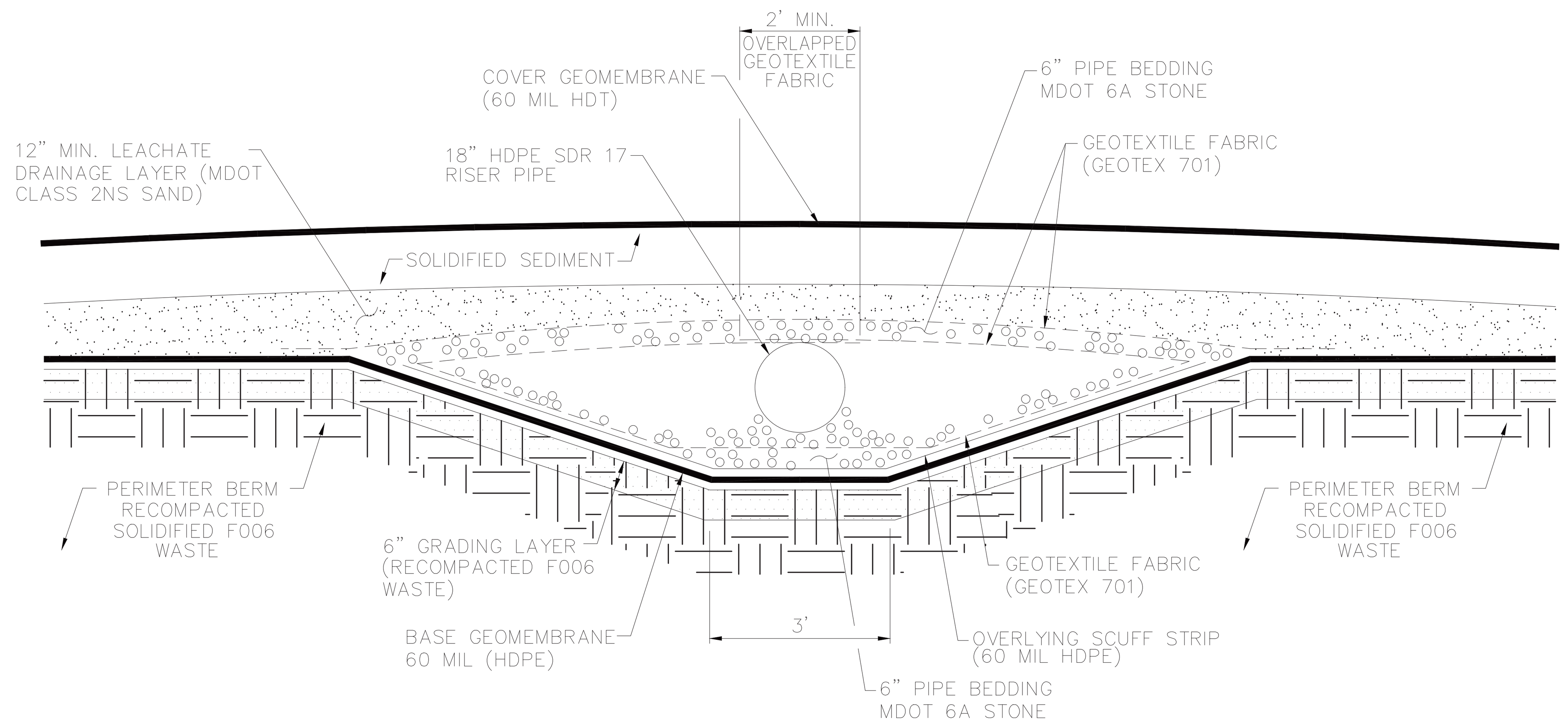
DWG. NO. 63 OF 65
PROJ. NO. F66A3N



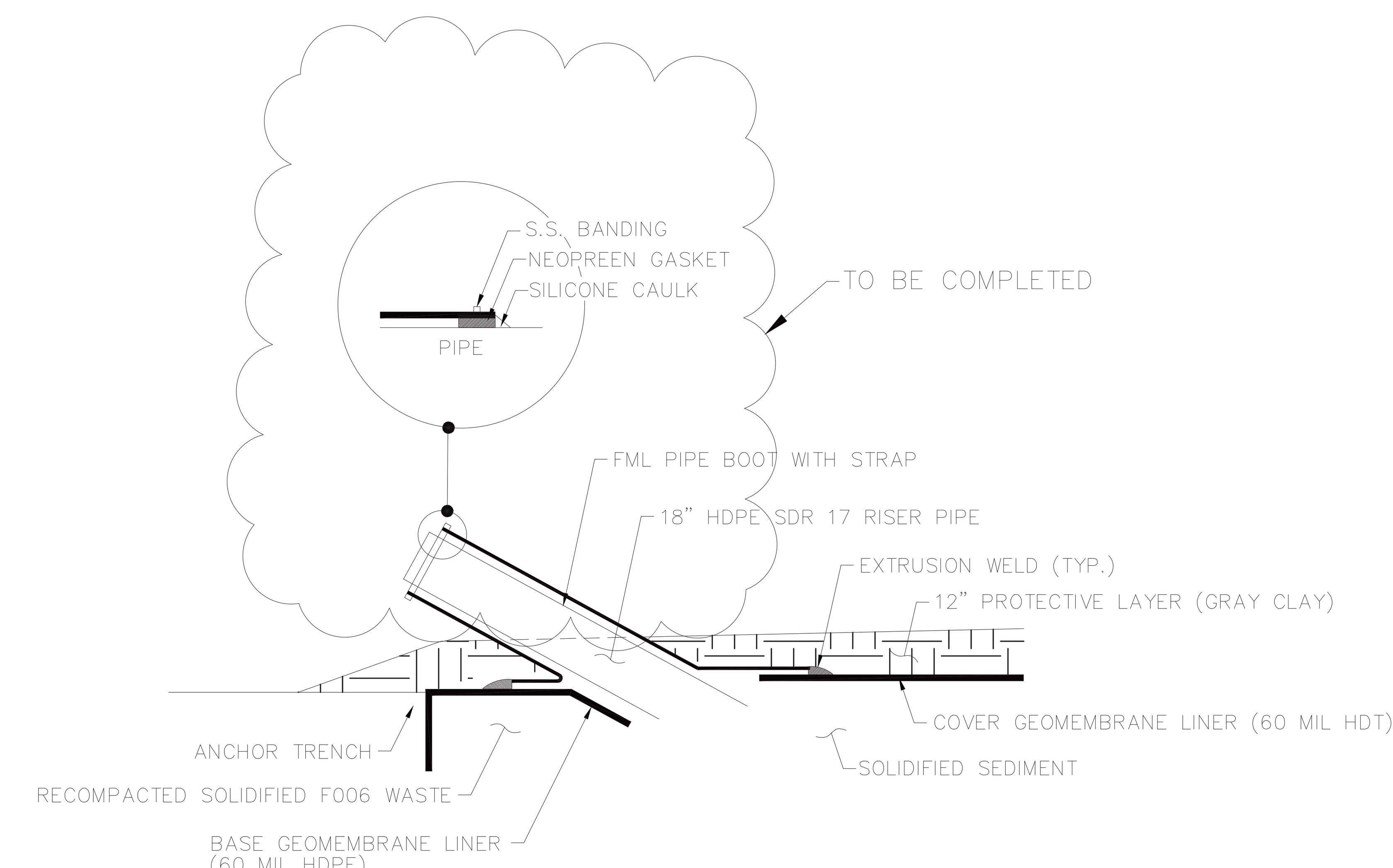
BASE GEOMEMBRANE PROTECTION
N.T.S.



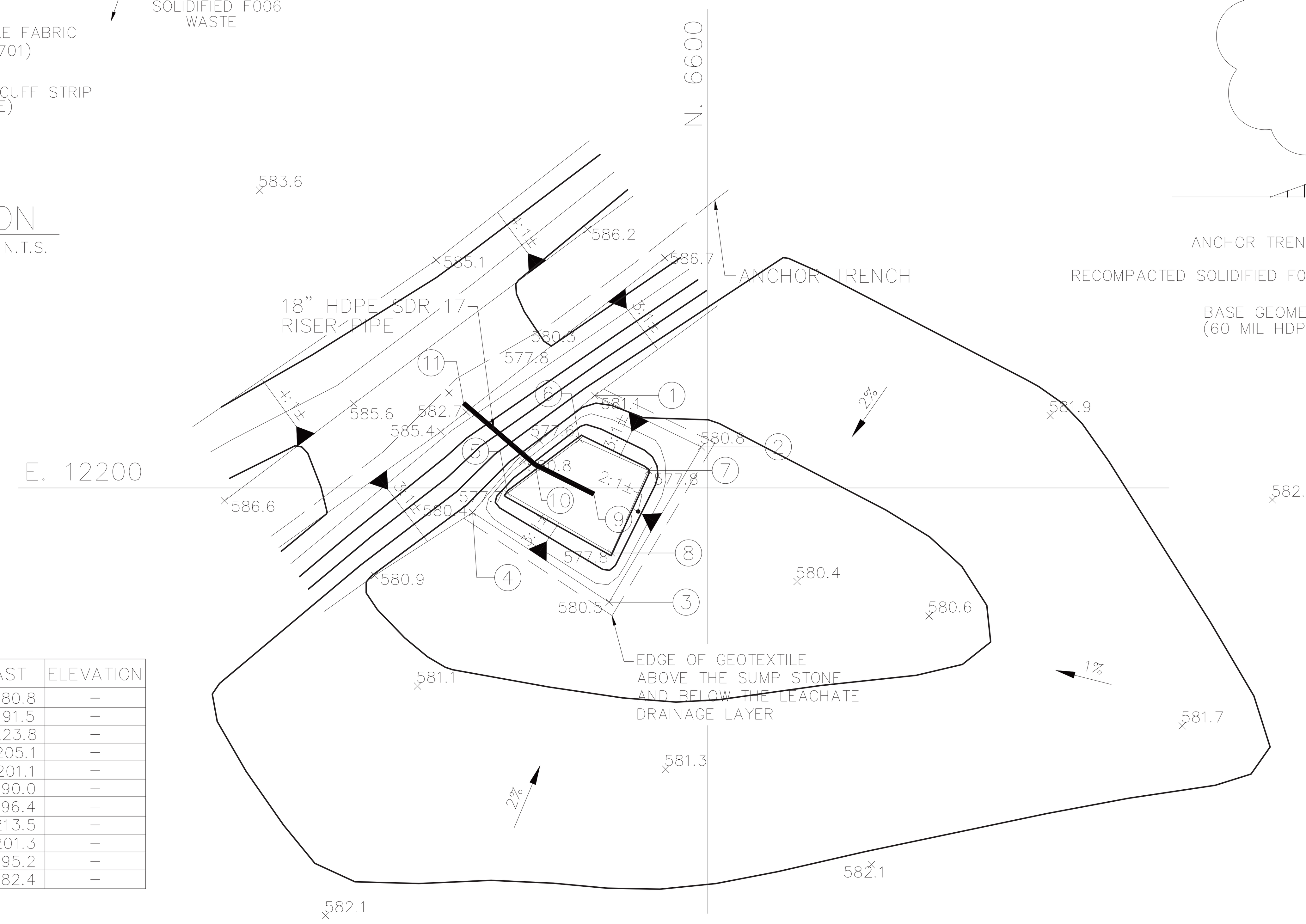
RISER PIPE CROSS SECTION
N.T.S.



RISER PIPE CROSS SECTION
N.T.S.



RISER PIPE CAP DETAIL
N.T.S.



POINT NO.	NORTH	EAST	ELEVATION
1	6576.5	12180.8	–
2	6598.6	12191.5	–
3	6579.5	12223.8	–
4	6551.1	12205.1	–
5	6558.4	12201.1	–
6	6573.3	12190.0	–
7	6587.6	12196.4	–
8	6580.0	12213.5	–
9	6576.3	12201.3	–
10	6564.1	12195.2	–
11	6549.2	12182.4	–

SUMP PLAN VIEW
SCALE: 1"=20'

Visteon

REV.	BY	CHK'D	DESCRIPTION
1			AS-BUILT DETAILS NTH PLATE 4

MEC inc
MIDWEST ENVIRONMENTAL CONSULTANTS, INC.
DEARBORN, MICHIGAN
(313) 563-6326

TITLE: VISTEON CORPORATION – MONROE PLANT
SEDIMENT CONTAINMENT UNIT DETAILS

DRAWN: BMC DATE 2/98 | SCALE: AS NOTED | DRAWING NO. 63 OF 65 | REV. NO. 1
DESIGNED: BMC DATE 2/98 | REVIEWED: BMC DATE 2/98
APPROVED: DATE | PROJECT NO. F66A3N | CADD FILE: F66A3N06

Attachment 6

Postclosure Groundwater Sampling and Analysis Plan

Post-Closure Groundwater Sampling and Analysis Plan

Ford River Raisin Warehouse

Ford Motor Company

October 18, 2021

The Power of Commitment

GHD 11224408

26850 Haggerty Road,

Farmington Hills, Michigan 48331, United States

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Printed date	7/25/2022 11:59:00 AM
Last saved date	February 21, 2022
File name	Groundwater Sampling and Analysis Plan
Author	Kristen Aspinall
Project manager	David Canfield
Client name	Ford Motor Company
Project name	Michigan O&M Projects
Document title	Post-Closure Groundwater Sampling and Analysis Plan | Ford River Raisin Warehouse
Revision version	Rev [00]
Project number	11224408

Document status

Status Code	Revision	Author	Reviewer		Approved for issue		
			Name	Signature	Name	Signature	Date
S0	00	K Aspinall	D Canfield				
[Status code]							
[Status code]							
[Status code]							
[Status code]							

The Power of Commitment

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Figure index

Table index

Appendices

1. Introduction

This document presents the Post-Closure Groundwater Sampling and Analysis Plan (SAP) for the Ford River Raisin Warehouse located at 3200 East Elm Avenue in Monroe, Michigan. This SAP has been prepared/updated on behalf of the Site owner/operator by GHD Services, Inc. (GHD) and previously prepared/submitted by Mannik & Smith Group (MSG) in July 2006 and updated May 2017. This updated SAP has been prepared in response to the 2017 Hazardous Waste Management Facility Operative License Renewal Application.

This SAP has been developed to meet detection monitoring requirements of applicable local, State and Federal regulations. The objectives and protocol included within the SAP meet the performance requirements of 40 CFR 264.97(d) and R299.9611 of Part 111, Act 451, Hazardous Waste Management, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 111).

2. Monitoring Well and Piezometer Installation Procedures

All drilling operations will be performed by an experienced drilling subcontractor, with the full-time supervision of a field engineer/geologist. All wells will be installed and abandoned (when appropriate and approved by Michigan Department of Environment, Great Lakes, and Energy (EGLE) in accordance with procedures specified in R299.9612(1)(b). Prior to arrival on site, the drill rig, drill rods, augers, tools, and equipment will be thoroughly steam-cleaned. The sampling and drilling equipment will also be steamed-cleaned between borings to minimize the potential for cross-contamination.

Under this program, the licensee shall operate and maintain a groundwater monitoring system consisting of monitoring wells labeled PCW-1 through PCW-14, and piezometers labeled PCP-1 through PCP-14, PCL-1 through PCL-5, & PCP-3 Deep, and ground water monitor wells labeled GW-1 through GW-20 as shown on *Figure 1, General Layout*. The monitoring wells were installed at the base of the near-surface groundwater unit, which is approximately the top of the lacustrine clay deposit. The monitoring wells were expected to be between 10 and 25 feet deep.

To install future monitoring wells, a soil boring will be advanced with 8-inch outside-diameter hollow-stem augers to the top of the first clay layer. After reaching the clay, a well assembly consisting of 2-inch diameter PVC casing equipped with a 5-foot PVC, 10-slot screen will be lowered to the bottom of the boring through the center of the auger. At this point, the augers will be withdrawn from the shallow boring as the annular space between the well casing and the borehole is filled with silica sand to an elevation approximately one foot above the top of the well screen. A bentonite seal will be placed above the sandpack, and a non-shrinking cement-bentonite grout backfilled to ground surface.

For protection a steel cover secured with a padlock will be placed over the top of each well casing and cemented in place. A label designating the well number and top of PVC elevation shall be placed near each monitoring well. Prior to undertaking monitoring well and piezometer replacement or repair, written approval of the Waste Management Division shall be obtained. Polyvinyl chloride (PVC) was selected as the well screen and well casing material due to its relatively low cost and structural strength. PVC has been used extensively in groundwater wells, in many instances for 30 or more years, and has proved to be a durable well material. PVC is also expected to be the most suitable casing material with respect to the chemical parameters of concern in post-closure groundwater monitoring for the subject site.

A number of researchers have investigated the sorptive and/or desorptive potentials of various well casing materials such as PVC, stainless steel and tetrafluoroethylene (Teflon).

Sykes et al[1] concluded that there was no statistically significant difference in the degree of absorption of organic compounds between PVC, Teflon of stainless steel. Parker et al[2], examined the sorption/desorption differences of PVC, Teflon, and two stainless steel materials with respect to both inorganic and organic analytes. They concluded re groundwater samples are to be analyzed for both metals and organic compounds, PVC would be the most suitable well material.

In accordance with the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (September 1986), the monitoring wells will be developed to restore the natural hydraulic conductivity of the formation and to remove all foreign sediment to ensure turbid-free groundwater samples. Development will be performed using a clean, disposable, plastic bailer, or submersible pump to purge the well. This technique involves alternately agitating the water in the well to suspend the sediment and then removing water from the well along with the suspended sediment.

Development will be considered complete when samples obtained are relatively sediment-free and register stable pH and specific conductance measurements, which will be obtained with calibrated field instruments. Monitoring well sampling procedures are described below in Section 4.0.

A total of 14 piezometers were installed within the interior of the closure units, across the cutoff wall from each monitoring well. In addition, five leachate piezometers were installed in the interior of the containment units and one bedrock piezometer outside the cutoff. The interior piezometers are set at a depth approximately 5 feet below the lowest point in the leachate collection system of each respective closure unit. All piezometers can be viewed in *Figure 1, General Layout*.

For installation of each piezometer, a boring was advanced through the stabilized sludge with an 8-inch outside-diameter hollow-stem auger. Note that the drill cuttings generated during piezometer installation were left within the limits of the respective closure unit.

After drilling to approximately 1 foot below the desired tip placement elevation, the augers were partially retracted and silica sand was poured into the bottom of the borehole until the sand backfill reached the desired tip elevation. The piezometer was then inserted through the auger, and the screened annulus of the borehole was filled with sand as the augers were withdrawn from the boring.

A bentonite seal was placed above the sand, and the remainder of the bore hole annulus was grouted to the top of the solidified sludge with non-shrinking cement-bentonite grout. For protection, a steel cover secured with a padlock was placed over the top of each piezometer casing and cemented in place. A label designating the identification number and top of PVC elevation was placed near each piezometer.

Following installation of all on-Site monitoring wells and piezometers, the top-of-casing elevations were determined by a registered land surveyor. These elevations are referenced to the nearest USGS datum.

3. Monitoring Frequency

3.1 Hydraulic Monitoring

The licensee shall measure static water levels in post-closure monitor wells PCW-1 through PCW-14, shallow piezometers PCP-1 through PCP-14, PCL-1 through PCL-5, ground water monitor wells GW-1 through GW-20 and Leachate Collection System (LCS) components excluding the leachate manholes on a quarterly basis. Static water elevations will be measured to the nearest 0.01 foot, using a water level indicator, and will be measured from a reference point on the rim of the well casing established during the top-of-casing survey. These water levels will then be referenced to the USGS datum for use in assessing the groundwater flow behavior. If hydraulic monitoring indicates that an inward gradient is not being maintained at the containment unit(s), and/or that the artesian condition no longer exists in the bedrock aquifer beneath the containment unit(s) for the potentiometric leachate collection system elevation, then the licensee shall do all of the following:

a. Immediately notify the EGLE Materials Management Division (MMD), or in the event of their unavailability, the 24-hour EGLE Pollution Emergency Alerting System (PEAS) at (800) 292-4706.
b. Provide follow-up notification to the EGLE MMD in writing within five calendar days of the telephone call in accordance with Condition I.E.13 of this license. The notification shall include the monitor well(s), piezometer(s), and area(s) of the containment unit(s) at which the inward gradient is not detected.
c. Adjust the detection monitoring frequency at the affected containment unit(s) to quarterly.
d. Confirm the static water level in the bedrock aquifer within 30 days of the measurement that indicates the artesian condition no longer exists. If the loss of the artesian condition is confirmed, submit a bedrock aquifer groundwater monitoring plan (chemical and hydraulic) to the EGLE MMD within 90 days of the confirmation, and upon approval, implement the bedrock aquifer groundwater monitoring plan.

If measurements indicate that an inward hydraulic gradient is not being maintained for the containment unit(s), appropriate corrective action will be taken to correct the situation.

3.2 Analytical Monitoring

The post-closure monitoring program will include sampling of the 14 monitoring wells (designated PCW-1 through PCW-14) installed as described in the previous section. Sampling began immediately upon installation of the wells. During the first two years, all 14 monitoring wells were sampled quarterly with replicate samples taken during each event. The resulting 16 samples at each location were used to establish base line conditions of water quality. Because groundwater flow conditions in the vicinity of the containment units will be significantly altered by the leachate collection system and cutoff wall, a two-year background period was necessary to adequately characterize natural variation in groundwater quality.

The RCRA Ground-water Monitoring Technical Enforcement Guidance Document (September 1986) recommends establishing background concentrations by sampling quarterly for a period of one year and obtaining four replicate samples for each sampling event. The two-year background period was selected to obtain a better representation of the impacts of seasonal variations and changes in flow direction as steady- state groundwater flow conditions are re-established following facility closure. Two replicate samples were collected during each sampling event to provide a sample population size equal to that recommended by the EPA and large enough to perform the statistical analyses described in Section 8.0. The background data was evaluated to determine of variability in site groundwater conditions are adequately addressed.

After completion of the two-year baseline period, the detection monitoring program was instituted. During detection monitoring, groundwater samples are collected from the wells on a semi-annual basis (i.e., two sets of samples per year) and the resulting data is analyzed according to the statistical procedure described below in Section 9.0.

3.2.1 Analytical Requirements

The purpose of obtaining and analyzing groundwater samples from the shallow groundwater unit is to provide early detection of potential migration of hazardous waste constituents from the containment units. Analytical test parameters have therefore been selected based upon previous sampling data and general knowledge of the waste present in the containment units. Accordingly, samples collected from the wells adjacent to the Eastern Containment (PCW-1 through PCW-8) will be analyzed for the parameters listed in Table 1.

Samples collected from wells adjacent to the Western Containment (PCW-9 through PCW-14) will be analyzed for the parameters listed in Table 1.

4. Groundwater Sample Collection

4.1 Water Level Measurement

During each sampling event, the water level in each monitoring well will be measured before the well is purged. The water level will be measured to the nearest 0.01 foot, using a water level indicator, and will be measured from a reference point on the rim of the well casing established during the top-of-casing survey. These water levels will then be referenced to the USGS datum for use in assessing the groundwater flow behavior and the performance of the containment unit leachate collection systems.

4.2 Well Purging

Water purged from the monitoring wells will be discharged to the ground away from the well to avoid recycling of the flow.

During purging, 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 will be monitored using a flow-through cell apparatus. 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 will 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 specified by the U.S. EPA document *EQASOP-GW-4* titled *“Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater of Groundwater Samples from Monitoring Wells.*”

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 centimetre (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

The field measurement devices will be rinsed with deionized water and calibrated at the beginning of each day in the field prior to use. Additionally, each field measurement device will be rinsed with deionized water prior to sampling at each individual monitoring well. The pH and specific conductance meters will be calibrated according to manufacturer’s specified procedures. In general, the pH meter is calibrated at two points that bracket the expected pH of the groundwater samples. The specific conductance meter is calibrated by checking the conductance of a standard. These calibration points are produced using stock calibrant solutions of known pH or conductance. Calibration data for the pH and specific conductance meters will be recorded on calibration record sheets. Field parameters will be measured in a sample container separate from the laboratory containers. All field measurements, purging, and sampling information will be recorded on a Field Sampling Form – an example is included in Appendix A1.

4.3 Groundwater Sampling

Groundwater samples will be collected directly after the water pH and specific conductance has stabilized. In case of low-yield wells that are incapable of yielding three casing volumes, the wells will be evacuated to dryness once. Wells that are purged to dryness will be left to sufficiently recover and sampled as soon as possible (i.e. when sufficient ground water is available for sampling). If possible, this period will not exceed 24 hours. The groundwater samples will be collected and containerized in the order of parameter stability and volatilization sensitivity. The samples will be collected in the following order:

a. Volatile organic compounds (VOCs);
b. Base neutral PNAs;
c. Cyanides;
d. Sulfates; and
e. Dissolved metals (field-filtered using a 0.45 um filter)

The groundwater samples will be withdrawn from each monitoring well using disposable polyethylene bailers with polypropylene rope, or a peristaltic pump with well-dedicated polyethylene tubing. This standard sampling equipment is consistent with industry protocols and previous EGLE recommendations. If non-dedicated sampling equipment is utilized, field blanks will be collected at a rate of 1 per 20 samples. After cleaning with an Alconox® or equivalent soap solution, the equipment will be rinsed to remove all soap, and a sample of a second rinse will be submitted to the laboratory as the field blank sample.

Groundwater samples to be analyzed for volatile organic compounds will be collected first after all appropriate field measurements have been completed. The bailer or dedicated sampling device will be gently lowered into the water; and samples collected for volatile analysis will be gently poured into glass vials, filled just to overflowing, ensuring that no air bubbles pass through the sample as the vial is being filled. If a peristaltic pump is used to collect ground water samples for volatile analysis, a low-flow rate of 0.1 to 0.5 liters per minute will be used to minimize volatilization. Random duplicate samples will be collected during the sampling events at a rate of 1 per 20 samples and analyzed for the full set of parameters.

4.4 Leachate Sampling

In order to define and characterize the chemical constituents of the leachate over time and insure that the detection monitoring parameters are appropriate, an analysis of the leachate for VOCs, SVOCs, Part 201 regulated metals, cyanide, and hexavalent chromium will be conducted every five (5) years. In addition, the field parameters of pH, sulfate, and conductivity will be measured. This analysis will be used to determine whether adding or removing testing parameters for the post-closure well sampling is justified.

5. Sample Preservation and Shipment

Samples collected as part of post-closure monitoring will be stored in containers and with preservatives as specified by 40 CFR Part 136.3. The preservation and storage requirements related to the parameters specific to this post-closure groundwater monitoring program are identified on Table 2.

Samples will be stored in an iced cooler (or refrigerator) until delivery to the analytical laboratory. Groundwater samples will be delivered to the analytical laboratory within 24 hours after collection.

In order to minimize the possibility of misidentification of the samples, identification labels will be affixed to the sample containers. Sample containers will be marked by the laboratory what type of preservative is in each sample bottle. All sample labels will be filled out with indelible ink to prevent sample information loss. The labels include the following information:

– Sample identification number
– Date and time of collection
– Parameters to be analyzed

Other information pertinent to the sample being collected (i.e. sample location, type of preservative, etc.) will be noted by the sampler on the field sampling record, a copy of which will be maintained with the post-closure monitoring files.

6. Analytical Procedures

The groundwater samples will be analyzed in accordance with the appropriate USEPA approved methods. The analytical methods are summarized on Table 3. All methods and associated detection limits for the USEPA analytical methods shown on Table 3 will be compliance with EGLE MMD Operational Memo Gen-8, Rev. 7, November 21, 2005 (or more recent updates).

7. Chain-of-Custody

Sample custody will be controlled using strict chain-of-custody procedures. Prior to submittal of the sample to the analytical laboratory, custody of the samples will be the responsibility of the sampler. Custody will become the responsibility of the analytical laboratory upon receipt of the samples. The original chain-of-custody record will remain with the sample; the copies will be retained by the sampler and by Ford.

Information recorded on the Chain-of-Custody form will include:

– Unique chain-of-custody number;
– Sample identification number;
– Number of samples for each sample ID number;
– Requested analyses for each sample ID;
– Sampler’s signature;
– Sampling date and time;
– Laboratory receipt date; and
– Signature of laboratory clerk.

8. Quality Assurance/Quality Control Programs

8.1 Quality Assurance/Quality Control – Field Procedures

For quality control during groundwater sampling, a pump blank (if necessary) will be submitted for analysis along with each set of water samples. The pump blank is prepared by passing deionized water through the decontaminated silicone pump tubing. The water is then transferred into laboratory-prepared containers and stored in the iced cooler along with other samples. This pump blank assures the compatibility of the sampling materials with the parameters to be analyzed and verifies that no cross-contamination occurs. The pump blank is to be analyzed for the same parameters as the groundwater samples. As stated above, if non-dedicated sampling equipment is utilized, field blanks will be collected at a rate of 1 per 20 samples. After cleaning with an Alconox or equivalent soap solution, the equipment will be rinsed to remove all soap, and a sample of a second rinse will be submitted to the laboratory as the field blank sample.

8.2 Quality Assurance/Quality Control – Laboratory Procedures

As an additional quality control procedure, the analytical laboratory will furnish quality assurance/quality control (QA/QC) data with all chemical analysis reports. The data supplied by the analytical laboratory includes information on blanks, laboratory duplicates, spike recoveries, and parameter control limits.

The laboratory QA/QC data will be evaluated to determine the acceptability of the results. The laboratory results are considered acceptable if the following conditions hold:

a. Reported method blank results are not higher than reported detection limits;

b. Laboratory duplicates have a relative percent difference of 20% or less; and

c. Results of recovery analyses have a percent recovery of between 80% and 120%.

9. Rationale for Statistical Procedure Selection

The selection of the statistical procedure described below has taken into account the inherent characteristics of the groundwater data collected since 1982 from the surface impoundment monitoring well network. Analysis of the existing groundwater data indicated two factors which must be considered in selecting a statistical procedure: The distribution of the data and the extent of censorship (i.e., number of values below detection limit) in the data set for each parameter. The effects of these two factors on the statistical procedure selection process are described in the following paragraphs.

As in all statistical evaluations, the underlying distribution of the data is an important consideration. In order to use parametric statistics, the underlying population must be normally distributed. In other cases, the lack of an underlying normal distribution for the data may force the use of non-parametric statistical techniques, which do not assume an underlying distribution.

Review of the groundwater monitoring data collected since 1982 indicates that the amount of censored data is significant. In general, individual organic parameters and some of the dissolved metals have been repeatedly non-detectable. Other parameters have been intermittently detected during the monitoring period. In addition, certain groundwater monitoring analytes that have been selected for post-closure monitoring (Table 1) such as sulfate and pH, have been consistently detected during the interim monitoring program.

Based on the percentage of the values measured in the past which have been reported as below the detection limits (i.e., the degree of censorship), three probable groups of parameters have been identified. The first group is heavily censored; i.e., 98 to 100% of the values measured were reported as below the detection limit (BDL). This group will be referred to as Group I and will likely include some of the heavy metals and the organic compounds. The second group (Group II) may include parameters whose percentage of BDL values ranges from approximately 50 to 98%. The last group (Group III) includes parameters that are rarely BDL. This includes parameters like pH, specific conductance and sulfate, which are commonly found in groundwater. An initial review of available statistical methods indicates that the applicability of the various tests is highly dependent on the degree to which the data set being analyzed is censored. Therefore, separate tests were considered for each of the three parameter groups described above.

Another important consideration when selecting an appropriate statistical procedure is a proper balance between the rate of false positives (detecting a significant increase when none has occurred) and the rate of false negatives (failing to detect a significant increase when it has occurred). The power of a statistical test is defined as the probability of correctly identifying a significant increase. The optimum statistical test is one that maintains power while yielding a low rate of false positives. The rate of false positives is theoretically chosen by the investigator (i.e., 1% or 5%), but in reality depends on the applicability of the data for the statistical test. Ford has attempted to choose statistical procedures that are applicable to the various monitoring parameters and that minimize false positives, while maintaining good power to detect significant changes in the monitoring parameters. Ford has also utilized the collection of a baseline data set large enough to maintain proper power.

9.1 Summary of Statistical Procedure

Groundwater quality data collected during the post-closure monitoring period has been analyzed in two phases. The initial phase involved establishing baseline water quality conditions at each monitoring well. The second phase involves routine sampling and analysis to detect significant deviations from baseline conditions using an intra-well comparison procedure.

The rationale for using the intra-well procedure is based on the groundwater flow behavior that is expected to develop around the containment units. As explained in the Post-Closure Plan, the leachate collection systems are designed to maintain leachate levels within the containment units lower than the water levels in the surrounding natural groundwater strata. Because the potential for inward flow will be induced by the leachate collection systems, all the monitoring wells are installed to be up gradient of the enclosed waste. This configuration precludes the traditional use of an upgradient well for background groundwater quality comparison. A description if this procedure is described below and presented in Appendices 2 through 7.

Each of the two data analysis phases is discussed in the following subsections.

9.1.1 Baseline Data Collection Phase

The statistical analysis procedures for the baseline data collection phase are summarized in the seven separate steps given below.

STEP 1 Baseline Groundwater Sampling – To establish baseline groundwater quality data for the monitoring system, samples from the fourteen monitoring wells on a quarterly basis for a period of two years were collected. This sampling schedule yielded a total of 16 samples for each sampling location. Samples from wells PCW-1 through PCW- 8 will be analyzed for the parameters listed on Table 1. Samples from wells PCW-9 through PCW-14 will be analyzed for the parameters listed on Table 1. A two-year baseline data collection period is necessary to have sufficient data to properly characterize the underlying statistical distribution and to select the proper statistical method for data analysis during detection monitoring. Use of a two-year baseline period will provide more inclusive data accounting for seasonal variations or variations based on differing rainfall conditions in the two-year period. In addition, by collecting replicate samples on a quarterly basis for two years, the possibility for time dependence between samples should be less than if quadruplicate samples were tested quarterly for one year.

STEP 2 Evaluation of Degree of Censorship – In order to determine the most appropriate statistical procedure, determine determination of the degree of censorship within the baseline data set for each parameter will occur at the end of the two-year period. This was determined by evaluating the percentage of each of the parameter’s values which are BDL. This information is used as the basis for selecting the appropriate statistical procedure, as described in the next subsection.

STEP 3 Determination of Underlying Statistical Distribution – For each parameter found to be in Group II or Group III, a determination as to whether the baseline data is drawn from a normally distributed population. This determination was conducted by a two-step procedure. First, the coefficient of variation will be computed and then a normal probability plot was constructed. If the coefficient of variation and normal probability plot regression analysis strongly suggests that the background data set is not normally distributed, the data will be transformed to determine if the data is log-normally distributed. or log-normally distributed, the data will be transformed to determine if the data is log-normally distributed. If the data is log-normally distributed, Ford will evaluate the data using the Shewhart-CUSUM Control Charts to determine whether or not a statistically significant increase has occurred at each monitoring well (see 9.2). If the data is not normally or log-normally distributed, Ford will use non- parametric statistical analysis to evaluate the data.

STEP 4 Inspection of the Baseline Data Set for Outliers – Identified erroneous values (i.e., outliers) within the baseline data set for any parameter with less than 50% of its values BDL and a known distribution. An outlier will be defined as a value for any parameter, which is more than three standard deviations smaller or larger than the mean value for the parameter. The mean and standard deviation values of the baseline data collected at each well will recomputed after all corrections, as described above, have been made.

STEP 5 Establishment of Analytical Precision for the Detection Limits – At the conclusion of the baseline monitoring period, an analytical precision was established for the detection limit of any of the monitoring parameters which are found to be heavily censored (Group I). This analytical precision was based on the laboratory quality control information, which will be the collected by the laboratory at each quarterly sampling during the baseline period. This analytical precision is critically important in statistically evaluating the Group I data sets.

STEP 6 Identification of Seasonal Cycles, Long-term Trends, and Serial Correlation – The baseline data was analyzed to determine whether or not a serial dependence or seasonal trend exists in the data. This was determined by examining a graph of the concentration of each parameter plotted as a function of time. The data was considered to have a seasonal trend if the concentration values for any parameter show a repetitive periodicity during the baseline period. If a seasonal influence was indicated in the baseline data, the removal of the seasonal effect was completed.

STEP 7 Calculation of Means and Standard Deviations - At the conclusion of the baseline monitoring period, a mean and standard deviation for each monitoring parameter at each individual monitoring well was established.

9.1.2 Detection Monitoring Phase

The detection monitoring program began after the completion of the 2-year baseline data collection period. During detection monitoring, samples are and will continue to be collected on a semi- annual basis, as described in the Post-Closure Plan. For each sampling event intra-well statistical comparisons using the methods described below is and will be made for each monitoring parameter at each monitoring well.

The statistical procedures described below are keyed to the percentage of BDL values in the baseline data collection period. The parameters will be separated into three groups based on the percentage of BDL values. The statistical test, which will be used to determine whether or not a statistically significant increase has occurred at a monitoring well for each sampling event, will be different for each of the three groups. Each of the three statistical methods is described below.

GROUP I Procedures When All Baseline Data Are Below the Detection Limit – For Group I parameters, evaluation as to whether or not a statistically significant increase has occurred at each well if the value for the parameter at the well in question is above the EGLE-approved detection limit. If it is not, Ford will conclude that no increase has occurred.

GROUP II Procedures When More Than 50% of the Baseline Data Are Below the Detection Limit

And

GROUPIII Procedures When Less than 50% of the Baseline Data Are Below the Detection Limit – For II and III parameters, Ford will construct combined Shewhart-CUSUM Control Charts to determine whether or not a statistically significant increase has occurred at each monitoring well. The Shewhart Control chart is a graph of time of sampling versus the sample mean for the parameter being monitored. An upper control limit is established based on a selected level of significance and on the standard deviation of the baseline data. When a point falls above an upper control limit the increase is regarded as significant. The CUSUM (for cumulative summation) Control Chart makes use of the information in the present sample, as well as previous samples, in reaching decisions as to whether the parameter has undergone a significant change. The combined procedure takes advantage of the Shewhart chart's ability to detect large shifts the mean and the CUSUM chart's ability to detect small but persistent changes.

Group II and III will be individually evaluated to determine the underlying data distribution. As recommended by USEPA, Shewhart-CUSUM Control Charts are ideally used for data that is normally distributed. However transformation of the data (log-transformation or square-root transformation) is recommended for data that is not normally distributed. If the results of the transformation does not indicate a normal distribution, and the Shewhart-CUSUM Control Chart procedure cannot be applied, the critical value for exceedance will be the highest concentration of the given parameter for that well.

Data collected during the detection monitoring period will be managed using the commercially- available software CHEMPOINT and CHEMSTAT. CHEMPOINT is an environmental sampling database management application developed to track ground-water data and CHEMSTAT is used for statistical analysis of ground-water monitoring data at RCRA subtitle C and D sites. Analysis methods in CHEMSTAT comply with 1989 and 1992 US EPA statistical guidance documents (Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities).

9.2 Measures to be Instituted of Statistically Significant Change is Detected

If a statistically significant increase (and/or pH decrease) is detected at any time in any monitoring well, the licensee shall notify the EGLE MMD by telephone within one working day and arrange a re-sampling as soon as possible to confirm a statistically significant increase (and/or pH decrease). Resampling must include not less than four replicate samples at the well(s) for the parameter in question. For data collected from non-parametric tests, if 2 of the 4 replicate samples are detected over the EGLE-approved detection limit (Group 1) or highest previous detection (Group II), or if 1 of 4 is detected at 5 times the EGLE-approved detection limit or previous detection, then the exceedance is confirmed. For confirming exceedances using the Shewhart-CUSUM control charts, the mean of the 4 replicate samples will be used as the concentration to be evaluated for confirmation.

If the licensee determines that a statistically significant increase (and/or pH decrease) has occurred, the licensee shall do all of the following:

A. Notify the Director within one working day by calling the Michigan Department of Environment, Great Lakes and Energy, Materials Management Division, or in the event of unavailability, the EGLE 24-hour emergency response operator at 1-800-292-4706.
B. Provide follow-up notification to the EGLE Materials Management Division in writing with seven calendar days of the telephone call. The notification shall indicate what parameters or constituents have shown statistically significant changes and the well(s) in which the changes have occurred.
C. As soon as possible, sample the groundwater in all monitoring wells located at the same containment unit as the monitor well that had the statistically significant increase and determine the concentration of all constituents identified in Appendix IX of 40 CFR Part 264 that are present in groundwater and for which approved analysis methods exist. The licensee may resample within one month and repeat the analysis for those Appendix IX compounds that were detected. Constituents detected in the first Appendix IX sampling or confirmed by the resampling will form the basis for compliance monitoring.
D. Immediately take steps to determine the cause of the change and eliminate the source of discharge.
E. Within 90 days of the determination, submit to EGLE an application for a license modification to establish a compliance monitoring and corrective action program meeting the requirements of R 299.9612 and 40 CFR

§264.99, which is adopted by reference in R 299.11003. The application shall include the following information:

a) An identification of the concentration of all Appendix IX constituents found in the groundwater.
b) Any proposed changes to the groundwater monitoring system at the facility necessary to meet the requirements of R 299.9612 and 40 CFR §264.99.
c) Any proposed changes to the monitoring frequency, sampling and analysis procedures or methods, or statistical procedures used at the facility necessary to meet the requirements of R 299.9612 and 40 CFR §264.99.

F. Within 180 days, submit to the EGLE a detailed description of corrective actions that will achieve compliance with applicable laws and rules, including a schedule of implementation. Corrective action must also meet the requirements of 40 CFR §264.100, which is adopted by reference in R 299.11003, and include a plan for a groundwater monitoring program that will demonstrate the effectiveness of the corrective action. Such a groundwater-monitoring program may be based on a compliance-monitoring program developed to meet the requirements of 40 CFR §26499. Nothing in this condition shall be construed as prohibiting the licensee from requesting an alternate or maximum concentration limit under R 299.9612.

G. During the period prior to a license modification requiring a compliance monitoring and corrective action program, the licensee shall provide the EGLE MMD, or his or her designee, with weekly telephone updates and written reports every two weeks regarding the progress to date in determining the cause of contamination and eliminating the discharge. The licensee shall include in the written report the results of all samples from the environmental monitoring conducted by the licensee.

If the licensee determines pursuant to Conditions III.A.6. and 7. of the existing license that a statistically significant increase (and/or pH decrease) in hazardous constituents has occurred in groundwater, the licensee may demonstrate that a source other than the licensed facility caused the increase (and/or pH decrease) or that the increase (and/or pH decrease) resulted from error in sampling, analysis or evaluation. Although the licensee may make a demonstration under this condition in addition to, or in lieu of, submitting a license modification application within the time specified in Condition III.A.8.(e) of this existing license, the licensee is not relieved of the requirement to submit a license modification application within the time specified unless the demonstration made under this condition successfully shows that a source other than the licensed facility caused the increase (and/pH decrease) resulted from error in sampling, analysis, or evaluation. In making a demonstration under this condition, the licensee shall:

A. Notify EGLE within seven days of the determination that it intends to make a demonstration under this condition.
B. Within 90 days of the determination, submit a report to EGLE that demonstrates that a source other than the licensed facility solely caused the increase (and/or pH decrease), or that the increase (and/or pH decrease) was caused by error in sampling, analysis, or evaluation.
C. Within 90 days of the determination, submit to EGLE an application for a license modification to make any appropriate changes to the groundwater monitoring program at
D. Continue to monitor groundwater in compliance with this license.

10. Recordkeeping and Reporting

During the first two years of detection monitoring, results of the quarterly sampling used to establish baseline groundwater quality were reported to the EGLE MMD. These reports include tables showing the analytical results and groundwater elevations.

Throughout the post-closure care period, Ford will maintain records of the groundwater analyses, the associated groundwater surface elevations, statistical analyses, and interpretations. These records are to be maintained as part of the facility operating record, and will be submitted for review, as specified by the EGLE MMD. During each semi-annual monitoring event, a semi-annual report of monitoring activities including the following information will be submitted to the EGLE MMD.

a. Certification statement

b. A brief narrative of the sampling event; difficulties, etc.
c. The results of the statistical evaluation of the data and reporting of any significant increase
d. Copies of all field sampling forms
e. A copy of the analytical laboratory data report that should include the following
    i. Sample identification
    ii. Detection Limits
    iii. Date samples were received, analyzed, and reported
    iv. Methods used for laboratory analysis for each parameter
f. Tabular data summaries
g. Site map with groundwater monitoring locations summarizing groundwater analytical data
h. A brief descriptive summary of the overall quality of the analytical data and QA/QC results, including:
    i. Holding time requirements
    ii. Matrix interference occurrences
    iii. Detection limit issues
    iv. Surrogate recovery quality
    v. Matrix spike/matrix spike duplicates (MS/MSD) data relative to method requirements
    vi. Any other significant problems
i. A summary of on-going Operation and Maintenance issues related to the groundwater monitoring program
j. Electronic Data Deliverables (EDDs) that comply with the United States Environmental Protection Agency (USEPA) Region 5 submittals

The licensee shall submit the results of all environmental monitoring required by this license in the form of an Environmental Monitoring Report to the EGLE MMD within 90 days of the sample collection or within 7 days of receipt of the analytical results, whichever is sooner.

11. References

1. Sykes, A.L., R.A. Mc Allister, and J.B. Homolya. 1986 Sorption of Organics by Monitoring Well Construction Materials. Groundwater Monitoring Review, Fall 1986.
2. Parker, Louise V., Allan D. Hewitt and Thomas F Jenkins. 1990 Influence of Casing Materials on Trace–Level Chemicals on Well water. Groundwater Monitoring Review, Spring 1990.

NO.	DATE	BY	DESCRIPTION

PROJECT DATE: 11/07/2011
PROJECT NO.: FORD0102
DRAWN BY: HMW
CHECKED BY: TEP

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FORD MOTOR COMPANY

MONROE PLANT
MONROE, MICHIGAN

GENERAL LAYOUT

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Table 1 Groundwater Sample Test Parameters

Monitoring Wells PCW-1 Through PCW-8	Monitoring Wells PCW-9 Through PCW-14
pH	pH
Sulfate	Sulfate
Specific Conductance	Specific Conductance
Total Cyanide	Total Cyanide
Volatile Aromatic Organic Compounds	Volatile Aromatic Organic Compounds
Halogenated Volatile Organic Compounds	Halogenated Volatile Organic Compounds
Base Neutral PNAs	Base Neutral PNAs
Sulfate	Sulfate
Cadmium (Dissolved)	Cadmium (Dissolved)
Chromium (Dissolved)	Chromium (Dissolved)
Chromium VI (Dissolved)	Chromium VI (Dissolved)
Copper (Dissolved)	Copper (Dissolved)
Nickel (Dissolved)	Nickel (Dissolved)
Lead (Dissolved)	

Table 2 Sample Container and Preservation Requirements

Parameter	Container	Preservative	Holding Time
Dissolved Metals	HDPE	No Preservative, 4°C	6 Months
Dissolved Cr VI	HDPE	No Preservative, 4°C	24 Hours
Sulfate	HDPE	No Preservative, 4°C	28 Days
Total Cyanide	HDPE	NaOH to pH>12, 4°C	14 Days
Volatile Organic Compounds	Glass VOA Vial with Teflon Lined Septa	HCl to pH<2, 4°C	14 Days
Base Neutral PNAs	Glass Amber	No Preservative, 4°C	7 Days

Notes:

1. Size of container to be determined and provided by analytical laboratory
2. Dissolved metals will be accomplished by field filtering sample using a 0.45 um filter

Table 3 Analytical Methods

Parameter	EPA Analytical Method
Cadmium	200.8
Chromium	200.8
Hexavalent Chromium	3500-CrB
Copper	200.8
Lead	200.8
Nickel	200.8
Total Cyanide	9010B335.4/4500
pH	***
Specific Conductance	***
Sulfate	300.0
Halogenated Volatile Organic Compounds	8260
Aromatic Volatile Organic Compounds	8260
Base Neutral PNAs	8270

Notes:

*** - Field measurement, performed according to manufacturer’s application

Appendices

Appendix A

Field Sampling Form

Well No.: PCW-13 **Sampling Event:** June 2021 **SSOW Code:** **Monitoring Well Record for Low-Flow Purging**

Project Name: Monroe warehouse **Ref. No.:** **Personnel:** Dillon Antulis GHD **Date:** 6/9/2021 12:12:50 PM

Monitoring Well Data

Well Diameter: Constructed Well Depth: Measured Well Depth:

Screen Material: Water Column Length:

Screen Start Depth: Ref Point Elev:

Screen End Depth: Static Water Depth: Measurement Type:

Screen Length: Static Water Elev: Sampling Method:

Time	Pumping Rate (ml/min)	Depth to Water ()	Drawdown from Initial Water Level (ft)	Temperature °F	Conductivity (µS/cm)	Turbidity NTU	DO (mg/L)	pH	ORP (mV)	Volume Purged, Vp (gal)	No. of Well Screen Volumes Purged
			Precision Required	±% 10	±% 10	< 10 Or % 10	±% 10	± 0.1	±% 10		

Field Parameters:	Primary:								Total Volume Purged (gal):
Iron:			And	Or	Or				
Sulfide:	Secondary:								

Sample ID	Type	Matrix	Comp/Grab	DateTime	Filtered	Analysis	Container #

Time	Pumping Rate (ml/min)	Depth to Water ()	Drawdown from Initial Water Level (ft)	Temperature °F	Conductivity (µS/cm)	Turbidity NTU	DO (mg/L)	pH	ORP (mV)	Volume Purged, Vp (gal)	No. of Well Screen Volumes Purged

Project Data:

Project Name: ______________________ Date: ______________________

Ref. No.: ______________________ Personnel: ______________________

____

Monitoring Well Data:

Well No.: ______________________

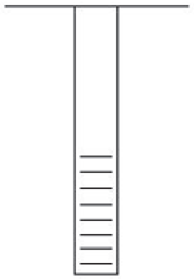
:(Vapour PID (ppm ______________________ :(Saturated Screen Length (m/ft ______________________

:Measurement Point ______________________ :(Depth to Pump Intake (m/ft)(1 ______________________

Constructed Well Depth (m/ft ______________________ :(Well Diameter, D (cm/in ______________________

:(Measured Well Depth (m/ft ______________________ :(Well Screen Volume, V_S (L)(2 ______________________

:(Depth of Sediment (m/ft ______________________ :(Initial Depth to Water (m/ft ______________________



Time	Pumping Rate (mL/min)	Depth to Water (m/ft)	Drawdown from Initial Water Level[3] (m/ft)	Temperature °C	Conductivity (mS/cm)	Turbidity NTU	DO (mg/L)	pH	ORP (mV)	Volume Purged, Vp (L)	No. of Well Screen Volumes Purged[4]
			:(Precision Required(5	±3 %	±0.005 or 0.01[6]	±10 %	±10 %	±0.1 Units	±10 mV		

Sample ID: ______________________ **:Sample Time** ______________________

Notes:

(1) The pump intake will be placed at the well screen mid-point or at a minimum of 0.6 m (2 ft) above any sediment accumulated at the well bottom.

(2) The well screen volume will be based on a 1.52 metres (5-foot) screen length (L). For metric units, $V_S=\pi*(r^2)*L$ in mL, where r (r=D/2) and L are in cm.
For Imperial units, $V_S=\pi*(r^2)*L*(2.54)^3$, where r and L are in inches

(3) The drawdown from the initial water level should not exceed 0.1 m (0.3 ft). The pumping rate should not exceed 500 mL/min.

(4) Purging will continue until stabilization is achieved or until 20 well screen volumes have been purged (unless purge water remains visually turbid and appears to be clearing, or unless stabilization parameters are varying slightly outside of the stabilization criteria and appear to be stabilizing), No. of Well Screen Volumes Purged= Vp/Vs.

(5) For conductivity, the average value of three readings <1 mS/cm ±0.005 mS/cm or where conductivity >1 mS/cm ±0.01 mS/cm.

Appendix B

Method for Determining Whether the Background Data was Drawn from a Normal or Lognormal Distribution and Adjustments for Lognormal Character

APPENDIX 1.0 METHOD FOR DETERMINING WHETHER THE BACKGROUND DATA WAS DRAWN FROM A NORMAL OR LOGNORMAL DISTRIBUTION AND ADJUSTMENTS FOR LOGNORMAL CHARACTER

A. TESTING FOR NORMALITY

Case I. No Background Data are Below the Detection Limit

If none of the data are BDL the evaluation of the distribution of background data will be conducted by a two step procedure. The first step is to compute the coefficient of variation (COV) which is the standard deviation divided by the mean:

$$s_b/\bar{x}_b$$

where for each parameter, s_b = the standard deviation of the background
$\bar{x}_b$ = the mean of the background

The analysis of the COV calculations are divided into three categories, which are detailed below.

I) If the COV is > 1.0, then it is very unlikely that the data came from a normal distribution and some adjustment of the data for the non-normality must be undertaken before the data is used in statistical procedures. In this situation the data should be examined for lognormal character (see below). If the mean and variance can be adjusted for lognormality, these values can be used in a parametric statistical procedure.

II) If the COV is > 0.50 and < 1.0, the data should be further examined to determine whether it comes from a normal distribution. If the covariance is in this range, then a normal probability plot will be constructed and regression analysis will be performed. The regression analysis must include the calculation of the standard parameters such as the correlation coefficient, the slope and intercept, and the corrected sum of the squares. The normal probability plot is constructed by the following steps:

1. Rank order the data (x_i) from smallest to largest.

2. Assign the (x_i) values ranks (r_i) from 1 to N, where N is the number of independent background observations.

3. Divide the ranks (r_i) by the total sample size (N) plus one (i.e. N + 1) to obtain the plotting positions F. For example:

$$F_1 = r_1 / (N + 1), \quad F_2 = r_2 / (N + 1)$$

4. Compute the normal score (Z) corresponding to each value of F by the following equation (Gilliam and Helsel, 1986):

$$Z_i = 4.91 * [F_i^{.14} - (1 - F_i)^{.14}]$$

5. Plot the ordered data values (x_i) as a function of the normal scores (Z_i), with the normal scores on the x-axis. Then perform a linear regression analysis of the x_i values on the Z_i values. Obtain the value for the correlation coefficient, ^r, for the line fitted to the data.

The plot of x as a function of Z is a normal probability plot which can be examined visually to determine if the data points approximate a straight line relationship. A straight line indicates normality and, conversely, a highly non-linear relationship is an indication of non-normality.

If the linearity of the normal probability plot is questionable, the probability that the data are from a normal distribution can be tested by comparing the correlation coefficient (^r) to a critical value, $\hat{}r_c$, from table 1., using the following steps:

6. For the desired level of alpha (such as 0.05), enter the table at N, the number of values in the data set, and determine the critical value, $\hat{}r_c$.

7. The correlation coefficient from the regression, ^r, is compared to the critical value ^r. The possible results are:

   i. ^r > $\hat{}r_c$. In this case the hypothesis that the data is normally distributed is accepted for the significance level chosen (ie. alpha = 0.05).

   ii. $\hat{}r_c$ > ^r . In this case there is reason to question the hypothesis that the data are normal. The deviation from normality is not serious enough to prevent the use of this data in parametric statistics, as there is some tolerance for non-normality. However, the data should be checked for lognormal character, and if there is strong evidence for lognormal character, the data should be adjusted appropriately (see Part B., below).

III) <u>If the COV is less than 0.5</u>, the data should be regarded as coming from a normal distribution and can be used in parametric statistical procedures.

<u>Case II</u>. The Data Contain Below Detection Limit Values

In the case where there are below detection limit values in the background data set, the coefficient of variation should not be calculated because the mean and variance can be calculated only from the ADL data and thus are only estimates. The distribution should be determined from a regression analysis of the above detection limit (ADL) data.

The steps in this procedure is as follows:

1. Identify the number of BDL values. Label this quantity n_1.

2. Rank order the above detection level data (x_2) from smallest to largest.

3. Assign the ADL values ranks (r_i) using a method which accounts for the n_1 values of the data set that are below detection. The values for r are calculated by the following equation:

$$r_1 = n_1 + 1,\ r_2 = n_1 + 2,\ \ldots\ldots\ r_N = N$$

4. Divide the ranks (r_i) by the total sample size (N) plus one (i.e. N + 1 = ADL + BDL + 1) to obtain the plotting positions F. For example:

$$F_1 = r_1 / (N + 1),\ F_2 = r_2 / (N + 1)$$

5. Compute the normal score (Z) corresponding to each value of F by the equation:

$$Z_i = 4.91 * [\ F_i^{.14} - (1 - F_i)^{.14}\ ]$$

6. Plot the ordered ADL values (x_2) as a funtion of the normal scores (Z_i), with the normal scores on the x-axis. Perform a regression analysis of the x_2 values on the Z values. Obtain the value of the correlation coefficient, ^r, for the line fitted to the data.

The determination of normality is then made using visual inspection, and if necessary, the correlation coefficient test as in steps 6 and 7 above (except that the value of N in step 6 is the number of ADL values). If the data are found to be non-normally distributed, they should then be checked for a lognormal distribution using the steps below.

B. TRANSFORMATION OF LOGNORMAL DATA TO NORMALITY

If the coefficient of variation or normal probability plot regression analysis strongly suggest that a background data set was not normally distributed, the data should be evaluated for lognormal character. The lognormal distribution is apparently a common distribution for groundwater data. The check for lognormality is conducted as follows:

1. Transform the above detection limit (ADL) data, x_i, to natural logarithms: $y_i = \ln(x_i)$
2. The transformed data, y_i, are then used in steps 1-5 above for the appropriate case (I or II), to construct a normal probability plot and perform a linear regression analysis of y_i on Z_i.
3. The normal probability plot is then analyzed visually for a linear trend of the data, and the correlation coefficient can be tested at the significance level chosen (i.e. alpha = 0.05) as described above.

If the results of this test indicate the log-transformed data are now normally distributed, an adjustment of the mean and variance must be made to take into account the lognormal character. Because power is lost by use of log-transformed data, and because the use of transformed data can result in difficulty in understanding the results of a statistical test, the direct use of log-transformed data in a parametric statistical test is not recommended. However an adjusted mean and variance can be calculated from the log-transformed data. The sequence of calculations depend on whether the data is censored or not, and hence the adjustment for lognormality is given for each case separately.

Case I. No BDL Data

When there is no BDL data, a non-log mean and variance can be estimated from the log-transformed data with the following equations:

4) $\bar{x}_{yb} = \exp(\bar{y}_b + ((w_{yb})^2/2))$

5) $s^2_{yb} = (\bar{x}_{yb})^2(\exp(w_{yb})^2 - 1)$

where $\bar{x}_{yb}$ = mean of lognormal distribution estimated from the log-tranformed values

s^2_{yb} = variance of lognormal distribution estimated from the log-transformed values

$\bar{y}_b$ = mean of log-transformed values

w_{yb} = standard deviation of log transformed values

These non-log parameters, $\bar{x}_{yb}$ and s_{yb}^2 represent the estimate of the mean and variance of the data which take into consideration the lognormal character. Because this is not the same as transforming the data to normality, it should be understood that if there is a very large deviation from normality, it still may not be entirely appropriate to use parametric statistics.

Case II. Data Contain BDL Values

If the data contain BDL values (i.e. the data are censored) the mean and variance of the log-transformed data must be adjusted using the methods in Appendix 2.0. Once the new mean ($\bar{y}_b'$) and variance $(w_{yb}')^2$ have been estimated, they can be used in the equations in steps 6 and 7 below:

6) $\bar{x}_{yb}' = \exp(\bar{y}_b' + ((w_{yb}')^2/2))$

7) $s^2_{yb}' = (\bar{x}_{yb}')^2 \, (\exp(w_{yb}')^2 - 1)$

where $\bar{x}_{yb}'$ = the mean of the lognormal distribution estimated from the adjusted log-transformed values.

s^2_{yb}' = the variance of the lognormal distribution estimated from the adjusted log-transformed values.

$\bar{y}_b'$ = the mean of the adjusted log-transformed values

w_{yb}' = the standard deviation of the adjusted log-transformed values

In this case the values for the parameters $\bar{x}_{yb}'$ and s_{yb}' are now suitably adjusted for use in parametric statistical procedures.

Appendix C

Methods for Estimating the Mean and Variance of Censored Data

APPENDIX 2.0 METHOD FOR ESTIMATING THE MEAN AND VARIANCE OF CENSORED DATA

If the background data set contains below detection level (BDL) data, the mean and variance of the above detection level (ADL) data must be adjusted, or estimated to account for the proportion BDL. Also, the sample size of the background data (N) must be adjusted to an effective sample size (N_{eff}), which takes into consideration the lack of information due to the BDL values. The following procedure may be used on either raw or log-transformed ADL data.

A. Estimation of Mean and Standard Deviation

The estimation of the mean and standard deviation of censored data can be obtained from the regression analysis of the ADL data described in Case II, Part A., Appendix 1.0, in the following steps:

1. Use steps 1-5 from Case II, Part A., Appendix 1.0 to perform the regression of x_i (or the log-transformed values, y_i) on Z_i.
2. From the regression analysis, the y-intercept (value of x_i (or y_i) where Z=0) is the new estimate of the mean, called $\bar{x}_b$'(or $\bar{y}_b$'if the data were log-transformed). The slope of the regression line is the estimate for the standard deviation, s_b' (or w_b' if the data were log-transformed).

The regression estimates, $\bar{x}_b$' and s_b', are parameters suitable for use in parametric statistical procedures. If the regression was performed on log-transformed data, these values of $\bar{y}_b$' and w_b' must be used to estimate non-log parameters by the use of the equations in steps 6 and 7 in Case II, Part B, Appendix 1.0.

B. Estimation of Effective Sample Size

The effective sample size, N_{eff} can be estimated by the following procedure. The first step is the calculation of the variance of the mean [VARX]. This is accomplished in the following steps:

3. calculate the mean of the normal scores, $\bar{z}$, which were computed in steps 1-4 in Case II, Part A., of Appendix 1.0.

4. perform another regression analysis of the normal scores, Z_i, on the plotting positions, F_i, (computed in steps 1-3, Case II, Part A., Appendix 1.0). The purpose of this regression analysis is to obtain a term called the total corrected sum of the squares, $s(z^2)$ which is defined as:

$$s(z^2) = \sum z_i^2 - n_2\bar{z}^2$$

where: $\sum z_i^2$ = the sum of the squares of the normal scores

n_2 = the number of ADL values

$\bar{z}^2$ = the mean of the normal scores squared

5. calculate the standard deviation of the ADL values, s_2, by the standard equation for standard deviation:

$$s_2 = [(\sum(x_i - x_2)^2) / (n_2 - 1)]^{0.5}$$

where: $\bar{x}_2$ = the mean of the ADL values

n_2 = the number of ADL values

If the data have been log-transformed, the equation is:

$$s_2 = [(\sum(y_i - y_2)^2) / (n_2 - 1)]^{0.5}$$

where: $\bar{y}_2$ = the mean of the log-transformed ADL values

6. calculate [VARX] from the equation:

$$[VARX] = [\ (1/n_2) + (\bar{z}^2/s(z^2)\ ]\ s_2^2$$

where: n_2 = number of ADL values

$\bar{z}$ = the mean of the normal scores, z (step 3 above)

$s(z^2)$ = corrected sum of the squares (step 4 above)

s_2 = standard deviation of ADL values (step 5)

7. the effective sample size, N_{eff}, is then calculated from the equation:

$$N_{eff} = s^2_b{}'/[VARX]$$

where: s_b' = the estimated standard deviation (step 2 above). This is w_b' if the data were log-transformed.

[VARX] = variance of the mean (step 6 above)

The effective sample size N_{eff} is the value which represents the number of independent background observations in the average replicate t-test and should be used to calculate the degrees of freedom. Because the regression method is a means of estimating the variance of the mean, [VARX], and assumes the data are normally distributed, the parameter N_{eff} is also only an estimate. In general, N_{eff} should not be larger than the total sample size or smaller than the number of ADL values. If N_{eff} exceeds the upper limit, N_{eff} will be set to the total sample size. If N_{eff} is smaller than the number of ADL values, it will be set at the number of ADL values.

EXAMPLE OF ADJUSTING BACKGROUND MEAN AND VARIANCE FOR DEVIATION TO NORMAL DISTRIBUTION AND CENSORSHIP

In the following example a statistical software package was used which contained the following features: 1) a data editor which has rank ordering capabilities, 2) a summary statistics routine which includes mean and standard deviation, and 3) a linear regression routine which includes plotting capabilities and can produce a printout of parameters such as slope, intercept, correlation coefficient and the total corrected sum of the squares. A package of this type greatly facilitates the implementation of the statistical procedures.

Example Adjustment of Background Data: Iron

To date, 5 quarters of background data for iron has been collected at upgradient wells OB-18, OB-19 and OB-31. These 15 independent observations will be used as a completed background data set in this example.

A. Testing for Normality

Because 2 of the 15 background values were below detection, case II from Appendix 1.0 is applicable to this example. Thus the first step is the regression of the ADL data on the normal scores. This is done in the following steps:

1. The ADL data, x_2, are rank ordered from smallest to largest. This is shown on figure 1.

2. The ADL data are assigned ranks (R_i), taking into account the 2 BDL values. Thus x_1 has a rank of 3, x_2 has a rank of 4, etc. This data is shown in fiqure 1, second column.

3. The plotting positions (F_i) are calculated by dividing each value (R_i) by N + 1, which in this example is 16. The plotting positions are shown in column 3, figure 1.

4. The normal scores (z_i) are calculated from the F_i values with the equation:

$$z_i = 4.91 * (F_i^{.14} - (1 - F_i)^{.14})$$

5. The ordered ADL values, x_2, are then regressed on the normal scores. The probability plot and regression results are shown on figure 2.

6. The plot is then visually examined for linearity. As seen from figure 2, the data plot in a highly non-linear manner suggesting the data are not normally distributed.

7. This subjective interpretation is then checked by comparing the correlation coefficient from the regresssion ($\hat{}r$ = 0.766), to a critical value from table 1. From the table, using α = 0.05 and N = 15, the critical value ($\hat{}r_c$) is 0.938. Since $\hat{}r_c$ >> $\hat{}r$ the data do not appear to have been drawn from a normal distribution (i.e. hypothesis of normality is rejected).

The next step is to evaluate the possibility that the data are lognormally distributed.

B. Testing for Lognormality

To test for an underlying lognormal distribution, the ordered ADL data is first log-transformed:

$$y_i = \ln(x_i)$$

Then steps 2-4 above are repeated to prepare for the regression of y on z (i.e. columns 2-4 on figure 1 are also used in the present regression analysis). The columns 1-4 for the current regression analysis are shown in figure 4.

The log-transformed values, y_i, are then regressed on the normal scores, z_i. The resulting probability plot and regression parameters are shown on figure 5. From this normal probability plot it can be seen the the log-transformed data now have a strong linear trend. This is good evidence for a lognormal distribution. The correlation coefficient, $\hat{}r$, is 0.987, which is greater than the critical value of 0.938 (see above). Thus the hypothesis that the log-transformed values are normally distributed cannot be rejected. In other words, the data appear to have been drawn from a lognormal distribution.

Before estimating the mean and variance of the lognormal distribution, the data must be adjusted for censorship, as there were 2 BDL values in the iron example.

C. Adjustment of Mean and Variance for Censored Data

From the regression analysis of y_i on z_i completed above, a new estimate of the mean and variance has been determined which take into account the BDL values. The estimate of the mean, labelled $\bar{y}_b'$, is the y-intercept of this regression analysis, -0.963 (from figure 5). The estimate of the standard deviation, labelled w_{yb}', is the slope of the regression analysis, 1.912 (from figure 5).

The remaining step is the calculation of the effective sample size, N_{eff}. This requires the calculation of the standard deviation of the ADL values and an estimate of the variance of the mean [VARX]. The standard deviation of the log-tranformed ADL values is 1.41 (shown in figure 6). The calculation of [VARX] is done with the following equation:

$$[VARX] = \{(1/n_2) + (\bar{z}^2/s(z^2))\}\ s_2{}^2$$

where: n_2 = number of samples above the detection limit
$\bar{z}^2$= square of the average normal score (from figure 7)
$s(z^2)$= corrected sum of the squares from the regression of z on F (from figure 8)
s_2 = standard deviation calculated from the log-transformed ADL values (computed in the summary statistics shown on figure 6)

In this example:

$$[VARX] = \{(1/13) + (.207^2/6.319)\}\ 1.405^2$$
$$= 0.1653$$

The effective sample size is then calculated from:

$$N_{eff} = (w_{yb}')^2/[VARX]$$

where: w_{yb}'= the estimated standard deviation from the regression of y_i on z shown above.

In the iron example, w_{yb}' was 1.912 (see figure 5). Thus:

$$N_{eff} = 1.912^2/\ 0.1635$$
$$= 22$$

Since 22 is greater than the total sample size of 15, N_{eff} is assigned the value of 15. The adjusted log-transformed parameters are:

$\bar{y}_b'$ = -.963
w_{yb}'= 1.912
N_{eff}= 15

D. Estimation of Mean and Variance of Lognormal Distibution

The above log-transformed parameters should not be used in a statistical test. A new mean and variance based on the above log-transformed estimates must first be computed. In this final step, an estimate of the mean and variance that are not log-transformed, but take into account the lognormal character of the data, are computed. This is done in the following equations:

$$\bar{x}_{yb}' = \exp(\bar{y}_b' + ((w_{yb}')^2/2))$$

$$s^2{}_{yb}' = (\bar{x}_{yb}')^2(\exp(w_{yb}')^2 - 1)$$

So in this example:

$$\bar{x}_{yb}' = \exp(-.963 + (1.912^2/2))$$
$$= 2.37 \text{ mg/l}$$

$$s^2_{yb}' = 2.37^2 \ (\exp(1.912^2) - 1)$$
$$= 211.6$$

$$s_{yb}' = 14.5 \text{ mg/l}$$

The resulting mean and standard deviation to be used in the average replicate t-test are:

$$\bar{x}_{yb}' = 2.37 \text{ mg/l}$$

$$s_{yb}' = 14.5 \text{ mg/l}$$

DETERMINATION OF NORMALITY

Figure 1.

x	R	F	z
0.06	3	0.1875	-0.885123
0.13	4	0.25	-0.672345
0.15	5	0.3125	-0.486919
0.29	6	0.375	-0.317299
0.34	7	0.4375	-0.156612
0.36	8	0.5	0
0.37	9	0.5625	0.156612
0.52	10	0.625	0.317299
0.83	11	0.6875	0.486919
1.5	12	0.75	0.672345
2.4	13	0.8125	0.885123
2.7	14	0.375	1.14921
9.6	15	0.9375	1.53537

Figure 3.

NUMBER OF OBSERVATIONS = 13
SAMPLE AVERAGE = 1.48077
SAMPLE VARIANCE = 6.70197
SAMPLE STANDARD DEVIATION = 2.58882

MINIMUM VALUE = 0.06 MAXIMUM = 9.6
LOWER AND UPPER QUARTILES = 0.29 1.5
INTERQUARTILE RANGE = 1.21
MEDIAN = 0.37

Figure 2.

Simple Regression of FEBKGND on Z

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	0.91646	0.502798	1.82272	0.0956151
Slope	2.73265	0.691469	3.95195	2.2651E-3

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio
Model	47.188181	1	47.188181	15.617933
Error	33.235511	11	3.021410	
Total (Corr.)	80.423692	12		

Correlation Coefficient = 0.765993
Stnd. Error of Est. = 1.73822

Regression of FEBXGND on Z

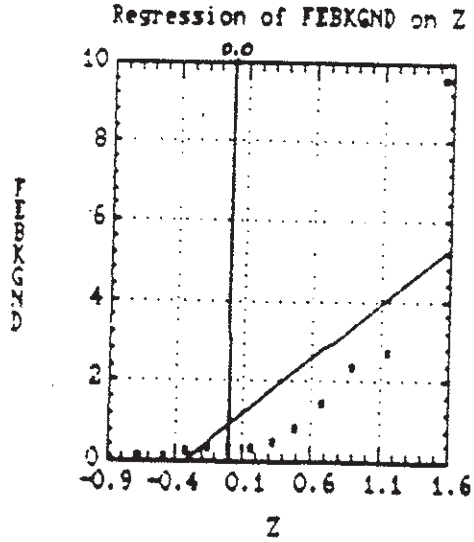


Figure 4.

Y	R	F	z
-2.81341	3	0.1875	-0.8351
-2.04022	4	0.25	-0.6723
-1.89712	5	0.3125	-0.4869
-1.23787	6	0.375	-0.3172
-1.07881	7	0.4375	-0.1556
-1.02165	8	0.5	
-0.994252	9	0.5625	0.1566
-0.653926	10	0.625	0.3172
-0.18633	11	0.6875	0.4369
0.405465	12	0.75	0.67234
0.875469	13	0.8125	0.8351
0.993252	14	0.875	1.1492
2.26176	15	0.9375	1.5353

Figure 6.

```
 UMBER OF OBSERVATIONS = 13
SAMPLE AVERAGE = -0.56828
SAMPLE VARIANCE = 1.9752
SAMPLE STANDARD DEVIATION = 1.40542

MINIMUM VALUE = -2.81341    MAXIMUM = 2.26176
LOWER AND UPPER QUARTILES = -1.23787 0.405465
INTERQUARTILE RANGE = 1.64334
MEDIAN = -0.994252
```

Figure 5.

Simple Regression of LOGFE on Z

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	-0.963065	0.0679662	-14.1698	2.07216E-8
Slope	1.91173	0.09347	20.4529	4.20246E-10

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio
Model	23.09507	1	23.09507	418.32156
Error	.607298	11	.055209	
Total (Corr.)	23.702369	12		

Correlation Coefficient = 0.987106
Stnd. Error of Est. = 0.234966

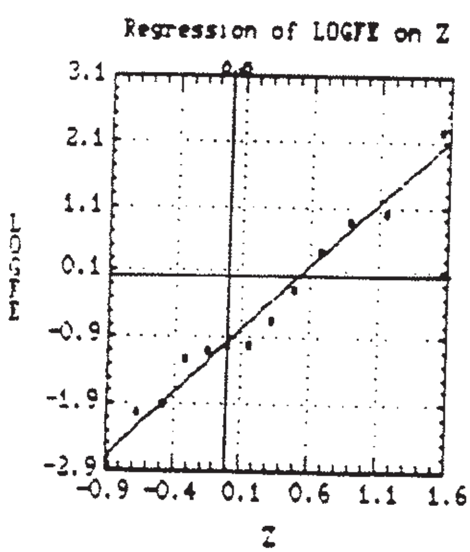


Figure 7.

ENTER THE NAME OF THE VARIABLE CONTAINING YOUR DATA: Z
NUMBER OF OBSERVATIONS = 13 (0 MISSING VALUES EXCLUDED)
SAMPLE AVERAGE = 0.206506
SAMPLE VARIANCE = 0.526603
SAMPLE STANDARD DEVIATION = 0.725674

MINIMUM VALUE = -0.885123 MAXIMUM = 1.53537 RANGE = 2.42049
LOWER AND UPPER QUARTILES = -0.317299 0.672345
INTERQUARTILE RANGE = 0.989644
MEDIAN = 0.156612

COEFF. OF SKEWNESS = 0.251442 STANDARDIZED VALUE = 0.370113
COEFF. OF KURTOSIS = 2.12124 STANDARDIZED VALUE = -0.646749

Figure 8.

Simple Regression of Z on F

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	-1.45959	0.0624062	-23.3886	9.91074E-11
Slope	2.96195	0.102444	28.9129	9.95892E-12

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio
Model	6.23716	1	6.23716	835.95705
Error	.082072	11	.007461	
Total (Corr.)	6.319237	12		

Correlation Coefficient = 0.993485
Stnd. Error of Est. = 0.0863777

Appendix D

Methods for Reducing the Effect of Seasonality, Trend and Serially Influenced Data

APPENDIX 3.0 METHODS FOR REDUCING THE EFFECT OF SEASONALITY, TREND AND SERIALLY INFLUENCED DATA

After the background data for a group III parameter has been collected, it must be evaluated for seasonal cycles, long term trends and serial dependence as any of these properties can result in an increased rate of false positives, and may hinder the ability of the statistical program to detect real changes in groundwater quality. If any of these properties can be shown to occur, steps must be taken to reduce their effects on the statistical procedures. Because two years of data represents a minimum time period for detecting seasonality, trends or serial correlation, the analysis presented below should continue throughout the detection monitoring program as the background is updated. Steps for determining and correcting for these properties are given below.

A. DETERMINING AND CORRECTING FOR SEASONALITY

To determine whether the data show seasonal cycles, the background data are plotted as a function of time (i.e. a time series plot) and examined for repeated cycles. If there are recurrent highs or lows during one or more particular season (quarter), it is concluded that a seasonal cycle may exist. An adjustment for seasonality can be attained by the following correction to the background data set:

1. Average the quarterly values for the two years of background collection (i.e. the 1st quarter of year one, plus the 1st quarter of year two, divided by 2). This is the quarterly mean, $\bar{x}_q$.

2. Compute a seasonally corrected value, x_s, by subtracting the appropriate quarterly mean from each quarterly value and adding on the mean for the entire data set $\bar{x}_b$. For adjusting the first quarter of data the equation is:

$$x_{s1} = x_1 - \bar{x}_q + \bar{x}_b$$

3. Use these seasonally corrected values to perform a trend analysis (see below).

If the background data are adjusted for seasonality, then all of the values of the parameter in question must also be corrected using the approriate seasonal correction. During detection monitoring, the semi-annual samples are adjusted for the appropriate season. This seasonal correction will be most valid if these semi-annual samples are collected on dates corresponding to two of the quarterly dates used to establish background.

B. DETERMINING AND CORRECTING TRENDS

From the time series plot from part A above, any pattern of decreasing or increasing concentration with time should be evident. If there is an indication of such a trend, the strength of the trend can be determined with the following test:

1. Perform a linear regression of the time series plot (ie. regression of concentration on time).

2. From the regression analysis determine the F statistic which is defined as:

   $$F = MSR/MSE$$

   where: MSR = Regression Mean Square
   MSE = Error Mean Square

3. Compare this F statistic to a critical value, F_c, at a chosen significance level (0.05), which is determined from Table 2. This critical value is determined from $\nu_1 = 1$ and $\nu_2 = n-2$ where n is the number of independent observations. If $F > F_c$ the hypothesis that the slope of the regression line is zero is rejected, hence a trend exists in the data.

If the data is shown to contain a trend, the trend can be removed by subtracting the regression line equation out of the data and adding the resulting value to the overall mean. For example, the first quarter data is adjusted as follows:

$$x_{t1} = x_1 - (y + mt) + \bar{x}_b$$

where:
x_{t1} = trend corrected first quarter data
x_1 = original first quarter data
y = intercept of regression line
m = slope of regression line
t = time (such as the number of quarterly samples since the trend began)
$\bar{x}_b$ = overall mean of the data set

Each parameter sampled during detection monitoring which has a trend in the background data, must also be adjusted with the above equation, if the trend is shown to continue. It is very important to re-evaluate the trend in the background data with each sampling subsequent to background.

C. DETERMINING AND CORRECTING FOR SERIAL CORRELATION

The test for serial correlation is an autocorrelation function. This process requires a computer package to implement. It is not a powerful technique unless many years of data have been collected. Fortunately, published analyses have shown that serial correlation is unlikely in samples collected on a quarterly basis. The adjustment for serial correlation is complex. The easiest remedy is to use data collected at larger time intervals.

Appendix E

The Critical Value Method

APPENDIX 4.0 THE CRITICAL VALUE METHOD

The critical value method is for evaluating Group I parameters (i.e. parameters with background data all below detection limit) in cases where the concentration is above the detection limit in a downgradient well during routine semi-annual detection monitoring. The "critical value" method is a test of confidence that any measured value is actually above the detection limit. The critical value represents an estimate of the 95th percentile for a laboratory analysis of a sample which is at the detection limit. Hence, the critical value is a kind of tolerance limit which will be established based on the detection limit of the lab method used to measure the concentration and the analytical precision, rather than by the population distribution. When a measured value exceeds the critical value, it is concluded that the increase is significant and is not due to lab error. If the precision of the analytical method is very good, the critical value will be very close to the detection limit.

The critical value (CV) is given by:

$$CV = DL + S_p Z$$

where: DL = method detection limit
S_p = standard error of lab analysis representing the test precision
Z = normal variate corresponding to the pth percentile (eg for p=95, Z=1.645)

The "test" consists of comparing the downgradient value with the critical value. If the critical value is exceeded, then it is concluded that the detection limit has been exceeded and indicates that a significant increase in concentration has occurred at the downgradient well. This method assumes only that the laboratory errors are normally distributed, but requires no information on the distribution of the parameter data.

EXAMPLE OF CRITICAL VALUE METHOD

As a first approximation, it was recommended that analytical precision be assigned a value of one-half the detection limit.

Example: The critical value of Benzene

Necessary information:

Method Detection Limit (DL) = 5.0 ppb
Analytical Precision (S_p) = 2.5 ppb
Normal Variate for 95th Percentile (Z) = 1.645

Equation for Critical Value (CV):

$$CV = DL + S_p Z$$

Results:

$$CV = 5.0 + (2.5)(1.645)$$
$$= 9.1 \text{ ppb}$$

Any measured concentration of benzene over 9 ppb would be considered a significant increase over upgradient background where the detection limit for benzene was 5.0 ppb.

Appendix F
The Proportions Test with the Tolerance Limits Default

APPENDIX 5.0 THE PROPORTIONS TEST WITH THE TOLERANCE LIMITS DEFAULT

The proportions test with the tolerance limits default is a two-step procedure for testing for a significant increase in Group II parameters (parameters with a high proportion of below detection limit data). Step 1 is the proportions test and step 2 is a tolerance limit comparison test. Both tests should be performed during detection monitoring. A failure of either test results in the conclusion that a significant increase has occurred.

A. The Proportions Test

The proportions test is a non-parametric procedure to be used on Group II parameters. This test addresses the following question: are the concentrations in the downgradient well more likely to be above the detection limits than the concentrations in the background well(s). In this relatively simple procedure, the first step is to compute the proportion of the above detection level (ADL) values, P_b of the background data. After establishment of background, the proportion of ADL values, P_m, is tabulated for each downgradient well, throughout the detection monitoring program. Thus, the downgradient proportions are cumulative and several measurements are required before the test becomes applicable.

The statistical test is performed as follows:

1. the Z^* statistic is computed from the equation:

$$Z^* = \frac{P_m - P_b}{[\,p(1-p)(1/N_m + 1/N_b)\,]^{.5}}$$

where: P_m = proportion of ADL values since background (i.e. downgradient)
P_b = proportion of background ADL values
N_m = total number of samples since background (i.e. downgradient)
N_b = total number of background samples
p = a weighted proportion, defined as:

$$p = \frac{n_m + n_b}{N_m + N_b}$$

where: n_m = number of ADL downgradient
n_b = number of ADL background

2. The approximation is made that Z^* is normally distributed (i.e. the estimates of the proportions are normally distributed, not the actual data set) and then Z^* is

compared to a critical value, Z_c, corresponding to the desired level of significance (e.g. $Z_c = 1.645$ for 0.05 level of significance). The hypothesis states that if the computed value $Z^* > Z_c$, then it is concluded that the higher proportion of downgradient ADL values is significant.

The strength of this test is that it does not require that the data follow any particular distribution. The weaknesses of this method are that several detection monitoring measurements are necessary before the test is valid, and if an extremely high concentration of the parameter were to appear, the concentration itself is not evaluated, only the fact that it is ADL.

B. The Tolerance Limit Default

To guard against these problems, a tolerance limit will be established for each parameter in this category. It must be noted that this a parametric statistical method which requires the condition of normality. Hence the proper adjustments for non-normality (Appendix 1.0) and the adjustment of the mean and variance of censored data (Appendix 2.0) must be implemeted before the tolerance limit can be calculated. The tolerance limit (TL) is established by the equation:

$$TL = \bar{x}_b + Ks_b$$

where: $\bar{x}_b$ = the estimated background mean
s_b = the estimated background standard deviation
K = a tolerance factor

The tolerance factor, K, depends on the desired percentile of background distribution (e.g. 95th percentile) and the number of independent background samples. For the 95% confidence limit, K can be determined from Table 3. The test is then very simple: if the downgradient concentration exceeds the tolerance limit, then the concentration at the downgradient well represents a significant increase over the background concentration.

The tolerance limit default takes care of both weaknesses in the proportions test in that the tolerance limit is established upon completion of background and will pick up very high values as they occur.

EXAMPLE OF PROPORTIONS TEST WITH TOLERANCE LIMITS DEFAULT

For an example of the proportions test with the tolerance limits default, the background data for nitrate was used because 67% of the 12 background samples (4 each from wells OB-18, OB-19 and OB-31) were below detection levels; hence nitrate is a group II parameter.

A. Proportions Test

Because the proportions test is non-parametric, the only information required is as follows:

Proportion of backgound samples ADL (P_b) = 0.33
Proportion of downgradient samples ADL (P_m) = .50 to 1.0
Number of background samples (N_b) = 12
Number of downgradient samples since background (N_m) = 4

It is assumed that 4 downgradient samples have been taken since the establishment of background and the test will be conducted assuming 2, 3 and 4 of these samples are above the detection limit.

For P_m = 2/4 = 0.5, the Z statistic is calculated as:

1. $$p = \frac{2 + 4}{4 + 12} = .375$$

2. $$Z^* = \frac{.50 - .33}{[.375(1-.375)(.25 + .083)]^{.5}} = 0.60$$

For P_m = 3/4 = .75, Z^* = 1.47

For P_m = 4/4 = 1.0, Z^* = 2.32

At a significance level of 0.05, the critical Z_c statistic is 1.645 as determined from a normal distribution table. So for the three cases the results are as follows:

For P_m = 0.5, $Z^* << Z_c$ so there is no significant increase in the downgradient concentration

For P_m = 0.75 $Z^* << Z_c$ so there is no significant increase in the downgradient concentration

For P_m = 1.0 $Z^* >> Z_c$ so it is concluded that the higher proportion of ADL values downgradient is significant and there is a significant increase in the downgradient concentration.

B. The Tolerance Limits Default

For the parametric tolerance limits test, the distribution of the nitrate data was first tested for normality. A regression analysis was performed on this data (Appendix 1.0). This analysis showed the condition of normality could not be rejected at the 0.05 significance level, and no transformation was necessary. The regression analysis was also used to adjust the mean, variance and effective sample size to take into account the BDL values. The results of the regression analysis were as follows:

$$\bar{x}_b = 0.135 \text{ mg/l}$$
$$s_b = 0.268 \text{ mg/l}$$
$$N_{eff} = 4$$

Using the above data and the tolerance factor (K) of 5.14 for $\alpha = 0.05$ (from Table 3), the tolerance limit is calculated as:

$$\begin{aligned} TL &= \bar{x}_b + Ks_b \\ &= 0.0135 + (5.14)(.268) \\ &= 1.39 \text{ mg/l} \end{aligned}$$

Thus, based on the tolerance limit default, WDI would conclude that a significant increase in the downgradient concentration had occurred, if a nitrate concentration greater than 1.39 mg/l were measured downgradient, regardless of the results of the proportions test.

Appendix G

The ShewHart-CUSUM Control Chart

APPENDIX 6.0 THE SHEWHART-CUSUM CONTROL CHART

(Excerpted from USEPA Guidance Document: Statistical Analysis of Groundwater Monitoring Data)

7.3 COMBINED SHEWHART-CUSUM CONTROL CHARTS FOR EACH WELL AND CONSTITUENT

Control charts are widely used as a statistical tool in industry as well as research and development laboratories. The concept of control charts is relatively simple, which makes them attractive to use. From the population distribution of a given variable, such as concentrations of a given constituent, repeated random samples are taken at intervals over time. Statistics, for example the mean of replicate values at a point in time, are computed and plotted together with upper and/or lower predetermined limits on a chart where the x-axis represents time. If a result falls outside these boundaries, then the process is declared to be "out of control"; otherwise, the process is declared to be "in control." The widespread use of control charts is due to their ease of construction and the fact that they can provide a quick visual evaluation of a situation, and remedial action can be taken, if necessary.

In the context of ground water monitoring, control charts can be used to monitor the inherent statistical variation of the data collected within a single well, and to flag anomalous results. Further investigation of data points lying outside the established boundaries will be necessary before any direct action is taken.

A control chart that can be used on a real time basis must be constructed from a data set large enough to characterize the behavior of a specific well. It is recommended that data from a minimum of eight samples within a year be collected for each constituent at each well to permit an evaluation of the consistency of monitoring results with the current concept of the hydrogeology of the site. Starks (1988) recommends a minimum of four sampling periods at a unit with eight or more wells and a minimum of eight sampling periods at a unit with less than four wells. Once the control chart for the specific constituent at a given well is acceptable, then subsequent data points can be plotted on it to provide a quick evaluation as to whether the process is in control.

The standard assumptions in the use of control charts are that the data generated by the process, when it is in control, are independently (see Section 2.4.2) and normally distributed with a fixed mean μ and constant variance σ^2. The most important assumption is that of independence; control charts are not robust with respect to departure from independence (e.g., serial correlation, see glossary). In general, the sampling scheme will be such that the possibility of obtaining serially correlated results is minimized, as noted in Section 2. The assumption of normality is of somewhat less concern, but should be investigated before plotting the charts. A transformation (e.g., log-transform, square root transform) can be applied to the raw data so as to obtain errors normally distributed about the mean. An additional situation which may decrease the effectiveness of control charts is seasonality in the data. The problem of seasonality can be handled by removing the seasonality effect from the data, provided that sufficient data to cover at least two seasons of the same type are available (e.g., 2 years when monthly or quarterly seasonal effect). A procedure to correct a time series for seasonality was shown above in Section 7.2.

PURPOSE

Combined Shewhart-cumulative sum (CUSUM) control charts are constructed for each constituent at each well to provide a visual tool of detecting both trends and abrupt changes in concentration levels.

PROCEDURE

Assume that data from at least eight independent samples of monitoring are available to provide reliable estimates of the mean, μ, and standard deviation, σ, of the constituent's concentration levels in a given well.

Step 1. To construct a combined Shewhart-CUSUM chart, three parameters need to be selected prior to plotting:

h - a decision internal value
k - a reference value
SCL - Shewhart control limit (denoted by U in Starks (1988))

The parameter k of the CUSUM scheme is directly obtained from the value, D, of the displacement that should be quickly detected; k = D/2. It is recommended to select k = 1, which will allow a displacement of two standard deviations to be detected quickly.

When k is selected to be 1, the parameter h is usually set at values of 4 or 5. The parameter h is the value against which the cumulative sum in the CUSUM scheme will be compared. In the context of groundwater monitoring, a value of h = 5 is recommended (Starks, 1988; Lucas, 1982).

The upper Shewhart limit is set at SCL = 4.5 in units of standard deviation. This combination of $k = 1$, $h = 5$, and SCL = 4.5 was found most appropriate for the application of combined Shewhart-CUSUM charts for groundwater monitoring (Starks, 1988).

Step 2. Assume that at time period T_i, n_i concentration measurements $X_1, \ldots, X_{n_i}$, are available. Compute their average $\bar{X}_i$.

Step 3. Calculate the standardized mean

$$Z_i = (\bar{X}_i - \mu) \sqrt{n_i}/\sigma$$

where μ and σ are the mean and standard deviation obtained from prior monitoring at the same well (at least four sampling periods in a year).

Step 4. At each time period, T_i, compute the cumulative sum, S_i, as:

$$S_i = \max\{0, (Z_i - k) + S_{i-1}\}$$

where max {A, B} is the maximum of A and B, starting with $S_0 = 0$.

Step 5. Plot the values of S_i versus T_i on a time chart for this combined Shewhart-CUSUM scheme. Declare an "out-of-control" situation at sampling period T_i if for the first time, $S_i \geq h$ or $Z_i \geq$ SCL. This will indicate probable contamination at the well and further investigations will be necessary.

REFERENCES

Lucas, J. M. 1982. "Combined Shewhart-CUSUM Quality Control Schemes." *Journal of Quality Technology*. Vol. 14, pp. 51-59.

Starks, T. H. 1988 (Draft). "Evaluation of Control Chart Methodologies for RCRA Waste Sites."

Hockman, K. K., and J. M. Lucas. 1987. "Variability Reduction Through Subvessel CUSUM Control." *Journal of Quality Technology*. Vol. 19, pp. 113-121.

EXAMPLE

The procedure is demonstrated on a set of carbon tetrachloride measurements taken monthly at a compliance well over a 1-year period. The monthly means of two measurements each ($n_i = 2$ for all i's) are presented in the third column of Table 7-2 below. Estimates of μ and σ, the mean and standard deviation of carbon tetrachloride measurements at that particular well were obtained from a preceding monitoring period at that well; $\mu = 5.5$ µg/L and $\sigma = 0.4$ µg/L.

TABLE 7-2. EXAMPLE DATA FOR COMBINED SHEWHART-CUSUM CHART--
CARBON TETRACHLORIDE CONCENTRATION (µg/L)

Date	Sampling period T_i	Mean concentration, $\bar{X}_i$	Standardized $\bar{X}_i$, Z_i	$Z_i - k$	CUSUM, S_i
Jan 6	1	5.52	0.07	-0.93	0
Feb 3	2	5.60	0.35	-0.65	0
Mar 3	3	5.45	-0.18	-1.18	0
Apr 7	4	5.15	-1.24	-2.24	0
May 5	5	5.95	1.59	0.59	0.59
Jun 2	6	5.54	0.14	-0.86	0.00
Jul 7	7	5.49	-0.04	-1.04	0.00
Aug 4	8	6.08	2.05	1.05	1.05
Sep 1	9	6.91	4.99[a]	3.99	5.04[b]
Oct 6	10	6.78	4.53[a]	3.53	8.56[b]
Nov 3	11	6.71	4.28	3.28	11.84[b]
Dec 1	12	6.65	4.07	3.07	14.91[b]

Parameters: Mean = 5.50; std = 0.4; k = 1; h = 5; SCL = 4.5.

[a] Indicates "out-of-control" process via Shewhart control limit ($Z_i > 4.5$).

[b] CUSUM "out-of-control" signal ($S_i > 5$).

Step 1. The three parameters necessary to construct a combined Shewhart-CUSUM chart were selected as h = 5; k = 1; SCL = 4.5 in units of standard deviation.

Step 2. The monthly means are presented in the third column of Table 7-2.

Step 3. Standardize the means within each sampling period. These computations are shown in the fourth column of Table 7-2. For example, $Z_1 = (5.52 - 5.50)*\sqrt{2}/0.4 = 0.07$.

Step 4. Compute the quantities S_i, $i = 1, \ldots, 12$. For example,

$S_1 = \max\{0, -0.93 + 0\} = 0$
$S_2 = \max\{0, -0.65 + 0\} = 0$

.
.
.

$S_5 = \max\{0, 0.59 + S_4\} \quad = \max\{0, 0.59 + 0\} = 0.59$
$S_6 = \max\{0, -0.86 + S_5\} \quad = \max\{0, -0.86 + 0.59) = \max\{0, -0.27\} = 0$

.

etc.

These quantities are shown in the last column of Table 7-2.

Step 5. Construct the control chart. The y-axis is in units of standard deviations. The x-axis represent time, or the sampling periods. For each sampling period, T_i, record the value of $\bar{X}_i$ and S_i. Draw horizontal lines at values h = 5 and SCL = 4.5. These two lines represent the upper control limits for the CUSUM scheme and the Shewhart control limit, respectively. The chart for this example data set is shown in Figure 7-2.

The combined chart indicates statistically significant evidence of contamination starting at sampling period T_9. Both the CUSUM scheme and the Shewhart control limit were exceeded by S_9 and Z_9, respectively. Investigation of the situation should begin to confirm contamination and action should be required to bring the variability of the data back to its previous level.

INTERPRETATION

The combined Shewhart-CUSUM control scheme was applied to an example data set of carbon tetrachloride measurements taken on a monthly basis at a well. The statistic used in the construction of the chart was the mean of two measurements per sampling period. (It should be noted that this method can be used on an individual measurement as well, in which case $n_i = 1$). Estimates of the mean and standard deviation of the measurements were available from previous data collected at that well over at least four sampling periods.

The parameters of the combined chart were selected to be k = 1 unit, the reference value or allowable slack for the process; h = 5 units, the decision interval for the CUSUM scheme; and SCL = 4.5 units, the upper Shewhart control limit. All parameters are in units of σ, the standard deviation obtained from the previous monitoring results. Various combinations of parameter values can be selected. The particular values recommended here appear to be the best for the initial use of the procedure from a review of the simulations and recommendations in the references. A discussion on this subject is given by Lucas (1982), Hockman and Lucas (1987), and Starks (1988). The choice of the parameters h and k of a CUSUM chart is based on the desired performance of the chart. The criterion used to evaluate a control scheme is the average number of samples or time periods before an out-of-control signal is obtained. This criterion is denoted by ARL or average run length. The ARL should be large when the mean concentration of a hazardous constituent is near its target value and small when the mean has shifted too far from the target. Tables have been developed by simulation methods to estimate ARLs for given combinations of the parameters (Lucas, Hockman and Lucas, and Starks). The user is referred to these articles for further reading.

7.4 UPDATE OF A CONTROL CHART

The control chart is based on preselected performance parameters as well as on estimates of μ and σ, the parameters of the distribution of the measurements in question. As monitoring continues and the process is found to be in control, these parameters need periodic updating so as to incorporate this new information into the control charts. Starks (1988) has suggested that in

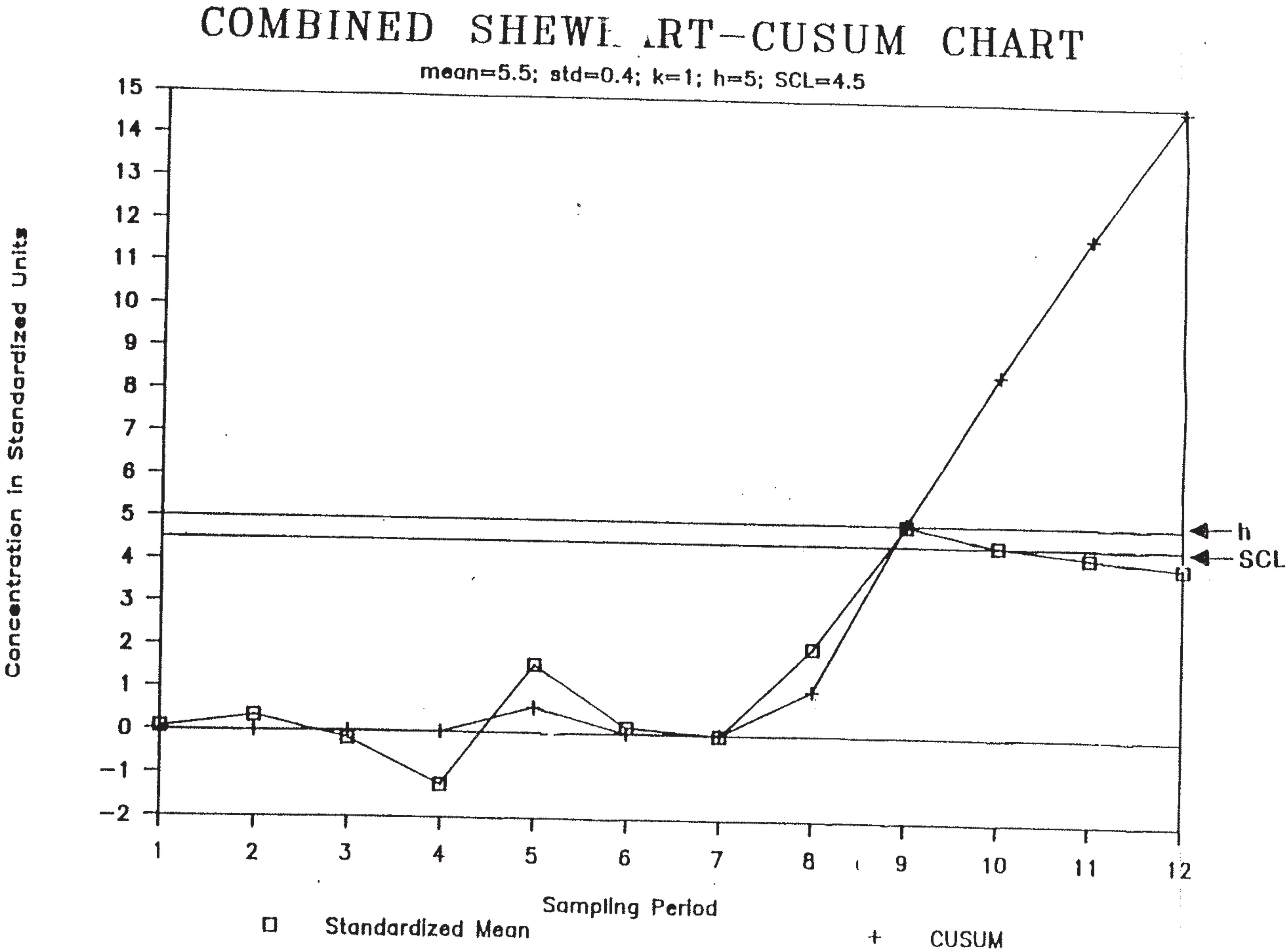


Figure 7-2. Combined Shewhart-CUSUM chart.

general, adjustments in sample means and standard deviations be made after sampling periods 4, 8, 12, 20, and 32, following the initial monitoring period recommended to be at least eight sampling periods. Also, the performance parameters h, k, and SCL would need to be updated. The author suggests that h = 5, k = 1, and SCL = 4.5 be kept at those values for the first 12 sampling periods following the initial monitoring plan, and that k be reduced to 0.75 and SCL to 4.0 for all subsequent sampling periods. These values and sampling period numbers are not mandatory. In the event of an out-of-control state or a trend, the control chart should not be updated.

Table 1. Critical Values of ^r.

N	alpha 0.10	alpha 0.05	alpha 0.01
4	.8951	.8734	.8318
5	.9033	.8804	.8320
10	.9347	.9180	.8804
15	.9506	.9383	.9110
20	.9600	.9503	.9290
25	.9662	.9582	.9408
30	.9707	.9639	.9490
40	.9767	.9715	.9597
50	.9807	.9764	.9664
60	.9835	.9799	.9710
75	.9865	.9835	.9757

From, "Minitab Manual"

Table 2. Critical Values of F.

Level of Significance = 0.05

$\nu_2 \backslash \nu_1$	1	2	3	4	5	6	8	12	15	20	30	60	∞
1	161.4	199.5	215.7	224.6	230.2	234.0	238.9	243.9	245.9	248.0	250.1	252.2	254.3
2	18.51	19.00	19.16	19.25	19.30	19.33	19.37	19.41	19.43	19.45	19.46	19.48	19.50
3	10.13	9.55	9.28	9.12	9.01	8.94	8.85	8.74	8.70	8.66	8.62	8.57	8.53
4	7.71	6.94	6.59	6.39	6.26	6.16	6.04	5.91	5.86	5.80	5.75	5.69	5.63
5	6.61	5.79	5.41	5.19	5.05	4.95	4.82	4.68	4.62	4.56	4.50	4.43	4.36
6	5.99	5.14	4.76	4.53	4.39	4.28	4.15	4.00	3.94	3.87	3.81	3.74	3.67
7	5.59	4.74	4.35	4.12	3.97	3.87	3.73	3.57	3.51	3.44	3.38	3.30	3.23
8	5.32	4.46	4.07	3.84	3.69	3.58	3.44	3.28	3.22	3.15	3.08	3.01	2.93
9	5.12	4.26	3.86	3.63	3.48	3.37	3.23	3.07	3.01	2.94	2.86	2.79	2.71
10	4.96	4.10	3.71	3.48	3.33	3.22	3.07	2.91	2.85	2.77	2.70	2.62	2.54
11	4.84	3.98	3.59	3.36	3.20	3.09	2.95	2.79	2.72	2.65	2.57	2.49	2.40
12	4.75	3.89	3.49	3.26	3.11	3.00	2.85	2.69	2.62	2.54	2.47	2.38	2.30
13	4.67	3.81	3.41	3.18	3.03	2.92	2.77	2.60	2.53	2.46	2.38	2.30	2.21
14	4.60	3.74	3.34	3.11	2.96	2.85	2.70	2.53	2.46	2.39	2.31	2.22	2.13
15	4.54	3.68	3.29	3.06	2.90	2.79	2.64	2.48	2.40	2.33	2.25	2.16	2.07
16	4.49	3.63	3.24	3.01	2.85	2.74	2.59	2.42	2.35	2.28	2.19	2.11	2.01
17	4.45	3.59	3.20	2.96	2.81	2.70	2.55	2.38	2.31	2.23	2.15	2.06	1.96
18	4.41	3.55	3.16	2.93	2.77	2.66	2.51	2.34	2.27	2.19	2.11	2.02	1.92
19	4.38	3.52	3.13	2.90	2.74	2.63	2.48	2.31	2.23	2.16	2.07	1.98	1.88
20	4.35	3.49	3.10	2.87	2.71	2.60	2.45	2.28	2.20	2.12	2.04	1.95	1.84
21	4.32	3.47	3.07	2.84	2.68	2.57	2.42	2.25	2.18	2.10	2.01	1.92	1.81
22	4.30	3.44	3.05	2.82	2.66	2.55	2.40	2.23	2.15	2.07	1.98	1.89	1.78
23	4.28	3.42	3.03	2.80	2.64	2.53	2.37	2.20	2.13	2.05	1.96	1.86	1.76
24	4.26	3.40	3.01	2.78	2.62	2.51	2.36	2.18	2.11	2.03	1.94	1.84	1.73
25	4.24	3.39	2.99	2.76	2.60	2.49	2.34	2.16	2.09	2.01	1.92	1.82	1.71
26	4.23	3.37	2.98	2.74	2.59	2.47	2.32	2.15	2.07	1.99	1.90	1.80	1.69
27	4.21	3.35	2.96	2.73	2.57	2.46	2.31	2.13	2.06	1.97	1.88	1.79	1.67
28	4.20	3.34	2.95	2.71	2.56	2.45	2.29	2.12	2.04	1.96	1.87	1.77	1.65
29	4.18	3.33	2.93	2.70	2.55	2.43	2.28	2.10	2.03	1.94	1.85	1.75	1.64
30	4.17	3.32	2.92	2.69	2.53	2.42	2.27	2.09	2.01	1.93	1.84	1.74	1.62
40	4.08	3.23	2.84	2.61	2.45	2.34	2.18	2.00	1.92	1.84	1.74	1.64	1.51
60	4.00	3.15	2.76	2.53	2.37	2.25	2.10	1.92	1.84	1.75	1.65	1.53	1.39
120	3.92	3.07	2.68	2.45	2.29	2.17	2.02	1.83	1.75	1.66	1.55	1.43	1.25
∞	3.84	3.00	2.60	2.37	2.21	2.10	1.94	1.75	1.67	1.57	1.46	1.32	1.00

From, "Handbook of Mathematical Functions", by Abromowitz and Stegun, (1972)

Table 3. Values of Tolerance Factor, K.

One-Sided Tolerance Limit Factors for a Normal Distribution

Values of k for $\gamma = 0.90$ and $n = f + 1$						Values of k for $\gamma = 0.95$ and $n = f + 1$					
n	0.900	0.950	0.975	0.990	0.999	n	0.900	0.950	0.975	0.990	0.999
2	10.253	13.090	15.586	18.500	24.582	2	20.581	26.260	31.257	37.094	49.276
3	4.258	5.311	6.244	7.340	9.651	3	6.155	7.656	8.986	10.553	13.857
4	3.188	3.957	4.637	5.438	7.129	4	4.162	5.144	6.015	7.042	9.214
5	2.744	3.401	3.983	4.668	6.113	5	3.413	4.210	4.916	5.749	7.509
6	2.494	3.093	3.621	4.243	5.556	6	3.008	3.711	4.332	5.065	6.614
7	2.333	2.893	3.389	3.972	5.201	7	2.756	3.401	3.971	4.643	6.064
8	2.219	2.754	3.227	3.783	4.955	8	2.582	3.188	3.724	4.355	5.689
9	2.133	2.650	3.106	3.641	4.771	9	2.454	3.032	3.543	4.144	5.414
10	2.066	2.568	3.011	3.532	4.628	10	2.355	2.911	3.403	3.981	5.204
11	2.012	2.503	2.936	3.444	4.515	11	2.275	2.815	3.291	3.852	5.036
12	1.966	2.448	2.872	3.371	4.420	12	2.210	2.736	3.201	3.747	4.900
13	1.928	2.403	2.820	3.310	4.341	13	2.155	2.670	3.125	3.659	4.787
14	1.895	2.363	2.774	3.257	4.274	14	2.108	2.614	3.060	3.585	4.690
15	1.866	2.329	2.735	3.212	4.215	15	2.068	2.566	[illegible]	3.520	4.607
16	1.842	2.299	2.700	3.172	4.164	16	2.032	2.523	2.956	3.463	4.534
17	1.819	2.272	2.670	3.137	4.118	17	2.002	2.486	2.913	3.414	4.471
18	1.800	2.249	2.643	3.106	4.078	18	1.974	2.453	2.875	3.370	4.415
19	1.781	2.228	2.618	3.078	4.041	19	1.949	2.423	2.840	3.331	4.364
20	1.765	2.208	2.597	3.052	4.009	20	1.926	2.396	2.809	3.295	4.319
21	1.750	2.190	2.575	3.028	3.979	21	1.905	2.371	2.781	3.262	4.276
22	1.736	2.174	2.557	3.007	3.952	22	1.887	2.350	2.756	3.233	4.238
23	1.724	2.159	2.540	2.987	3.927	23	1.869	2.329	2.732	3.206	4.204
24	1.712	2.145	2.525	2.969	3.906	24	1.853	2.309	2.711	3.181	4.171
25	1.702	2.132	2.510	2.952	3.882	25	1.838	2.292	2.691	3.158	4.143
30	1.657	2.080	2.450	2.884	3.794	30	1.778	2.220	2.608	3.064	4.022
35	1.623	2.041	2.406	2.833	3.730	35	1.732	2.166	2.548	2.994	3.934
40	1.598	2.010	2.371	2.793	3.679	40	1.697	2.126	2.501	2.941	3.866
45	1.577	1.986	2.344	2.762	3.638	45	1.669	2.092	2.463	2.897	3.811
50	1.560	1.965	2.320	2.735	3.604	50	1.646	2.065	2.432	2.863	3.766
60	1.532	1.933	2.284	2.694	3.552	60	1.609	2.022	2.384	2.807	3.695
70	1.511	1.909	2.257	2.663	3.513	70	1.581	1.990	2.348	2.766	3.643
80	1.495	1.890	2.235	2.638	3.482	80	1.560	1.965	2.319	2.733	3.601
90	1.481	1.874	2.217	2.618	3.456	90	1.542	1.944	2.295	2.706	3.567
100	1.470	1.861	2.203	2.601	3.435	100	1.527	1.927	2.276	2.684	3.539
120	1.452	1.841	2.179	2.574	3.402	120	1.503	1.899	2.245	2.649	3.495
145	1.436	1.821	2.158	2.550	3.371	145	1.481	1.874	2.217	2.617	3.455
300	1.386	1.765	2.094	2.477	3.280	300	1.417	1.800	2.133	2.522	3.335
500	1.362	1.736	2.062	2.442	3.235	500	1.385	1.763	2.092	2.475	3.277
∞	1.282	1.645	1.960	2.326	3.090	∞	1.282	1.645	1.960	2.326	3.090

From, "Handbook of Statistical Tables", by
D.B. Owen, (1962)

Attachment 7

Corrective Action Information

FORM EQP 5111 ATTACHMENT TEMPLATE B2
CORRECTIVE ACTION INFORMATION

The administrative rules promulgated pursuant to Part 111, Hazardous Waste Management, of Michigan's Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451) R 299.9504(1)(c), R 299.9508(1)(b), R 299.9525, R 299.9629, R 299.9635, and R 299.9636; §§324.11115a and 324.11115b of Act 451; and Title 40 of the Code of Federal Regulations (CFR) §270.14(d) and Part 264, Subpart F, establish requirements for submitting corrective action information and implementing a corrective action program for hazardous waste management facilities. All references to 40 CFR citations specified herein are adopted by reference in R 299.11003.

This license application template addresses requirements for corrective action information for the waste management units (WMU) at the *River Raisin Warehouse* facility in *Monroe,* Michigan. This template includes facility background information, current conditions, and release assessment requirements for operating license applications. This template supplies information to support the corrective action program specified in R 299.9629. In this template, applicants must include appropriate justification for the proposed elimination of any WMU from the corrective action program under Part 111 of Act 451.

(Check as appropriate)

Applicant for Operating License for Existing Facility:

☒ R 299.9629 Corrective Action

☐ Elimination from corrective action requirements proposed for one or more units

☞ *More than one box may be checked, if one or more WMUs are proposed for elimination from corrective action requirements*

Applicant for Operating License for New, Altered, Enlarged, or Expanded Operating License:

☐ R 299.9629 Corrective Action

☐ Elimination from corrective action requirements proposed for one or more units

B2.A FACILITY BACKGROUND

B2.A.1 History and Description of Ownership and Operation

Site description and history along with site operations, site ownership, regulatory history and previous investigations are described in Attachments *A1, General Facility Description and A11, Post-Closure Plan.*

B2.A.2 Environmental Setting

The environmental setting is described in *Attachments* A1, General Facility Description and A11, Post-Closure Plan.

B2.A.2(a) Climate

General meteorological information for Monroe County, presented within this section, is excerpted from the United States Department of Agricultural Soil Survey of Monroe County.

In the winter the average temperature is 27.6ºF, and the average daily minimum temperature is 20.2ºF. In summer the average temperature is 71.6ºF, and the average daily maximum temperature is 81.9ºF.

The total annual precipitation is 31 inches. Of this, 17.91 inches, or 58 percent, usually falls in April through September. In 2 years out of 10, the rainfall in April through September is less than 14.7 inches. Thunderstorms occur about 42 days each year, and most occur in June and July. Average seasonal snowfall is 32.9 inches. On an average of 34 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

Average relative humidity at Detroit Metropolitan Airport in mid-afternoon is about 60 percent. Humidity is higher at night and near Lake Erie. The average at dawn is about 82 percent. The sun shines 67 percent of the time possible in summer and 38 percent in winter. Prevailing wind is from the southwest. Average wind speed is highest, 11.8 miles per hour, in March, and in January, February, and April it is more than 11.6 miles per hour.

From 1995 to 1999 daily meteorological measurements were collected at the RRW. The readings included precipitation, temperature, wind speed, and wind direction. This data was presented within the Closure Certification Report, dated September 1999, but is not included herein.

B2.A.2(b) Topography

A topographic map can be seen in *Attachment II, Topographic Map*.

B2.A.2(c) Hydrogeology

Ground water at the site occurs in both shallow soils and bedrock underlying the site. A native deposit of saturated lacustrine clay and glacial clay till separates the two ground water units. Above the saturated clay, ground water is encountered within the marsh sediments and discontinuous sand deposits. This shallow ground water unit is not an aquifer since it is incapable of yielding sufficient quantities of ground water to wells. Groundwater in the shallow sediments is hydraulically connected to surface water at the site, as evidenced by the close agreement between water elevations in shallow monitoring wells and the surrounding surface water bodies.

Groundwater in the bedrock aquifer beneath the site exists under confined conditions; that is, the piezometric surface is above the contact between the rock formation and the overlying glacial clay. Upward ground water flow is restricted by the clay deposit, which exhibits a laboratory measured hydraulic conductivity on the order of 10-8 centimeters per second (RCRA/MI Act 64 Post-Closure Operating License Application, NTH, 1994). Although this upward flow is restricted, the piezometric surface of the bedrock aquifer is near or above the ground surface at the site. This piezometric level has been measured historically at the site and on a quarterly basis during the last year. This confirmed upward hydraulic gradient, the key component of the on-site containment unit design, mitigates the possibility of the downward migration of chemical constituents from potentially impacted areas on-site.

Based upon historic ground water elevation measurements from deep observation wells located on-site, the horizontal direction of ground water flow in the bedrock aquifer is from north to south under a flow gradient of 0.0006 to 0.004.

B2.A.2(d) Soil

Five principal geologic strata have been identified at the site. These strata include: 1) surface fill deposits; 2) lacustrine and glacial clay; 3) relatively continuous marsh deposits; 4) a number of discontinuous sand deposits; and 5) bedrock. Each of these principal features is described in detail below.

Surface Fill is present within the RRW operational area. This fill has been placed in conjunction with RRW operation over the extended facility history. This fill is widely varied across the site and can consist of soil, aggregate, coal, foundry sand, or demolition debris. Fill deposits within the two on-site containment units is estimated to vary from 10 to 40 feet thick. Fill outside of the containment units within theRRW operational area is estimated to vary from 0 to 15 feet thick.

Native Clays are estimated to be 2 to 24 feet thick. Two distinct native clay units medium to stiff mottled brown and gray silty clay with occasional reddish clay inclusions. This deposit varies in thickness from 0 to 8 feet. A deposit of glacial till underlies the lacustrine clay. This till is generally hard to very hard and consists of a silty clay matrix containing varying amounts of coarser materials (fine sand to cobbles). The glacial till appears to occur throughout the site, and varies in thickness from 2 to 20 feet.

Marsh Deposits are estimated to be up to 8 feet thick. These deposits consist of sediments, with occasional organic matter such as shells, and peat. The sediments are typically light gray in color with a clayey silt soil texture. The peat is fibrous in texture and is typically present as seams within the sediment deposits. This stratum is present in the marsh areas around the RRW but is not present within the RRW operational area.

Discontinuous Sand Deposits approximately 5 to 9 feet thick reportedly lie below portions of the surface fill materials within the area of the closed containment units. Two separate sand deposits have been identified at the facility. One sand deposit is located in the south central portion of ECU (former Area C), and one sand deposit is located in the northwest portion of the WCU (former Area D). These sand deposits may represent buried stream channel deposits. The sand deposits contain significant quantities of shells, and may be located in the vicinity of stream channels identifiable on historical aerial photographs.

Bedrock in the vicinity of the facility was encountered at an elevation ranging from 536 to 559, based upon auger refusal during drilling around the perimeter of the containment units. These bedrock elevations are 21 feet to 44 feet below the typical site elevation of 580.

Bedrock at the site is classified as the Bass Island Group. The Bass Island Group consists of dolomites deposited in the late Silurian age and includes River Raisin and underlying Put-in-Bay dolomites. A review of the bedrock surface topography map provided in the SMGD report indicates that the bedrock surface is generally encountered at an elevation ranging from 520 feet to 550 feet above mean sea level across the site. The elevation increases in a northwesterly direction, away from Lake Erie and the River Raisin.

Raisin River Dolomite underlies the glacial till at the site. Test borings indicate that this dolomite occurs in association with a layer of soft blue-gray shale. The shale and dolomite are often highly fractured or brecciated. Reportedly, at one location in the southwest portion of the WCU, a seam of gravely coarse sand was encountered below approximately 9 feet of shale breccia. Groundwater within the bedrock is under confined conditions.

B2.A.2(e) Surface Water

The predominant hydrologic feature in the area is Lake Erie, located approximately 0.75 miles west of the RRW operational area. Water levels within Lake Erie vary dependent upon multiple factors including recharge from the various rivers feeding the lake, discharge from the Niagara River at the eastern terminus (controlled by the United States Army Corps of Engineers), evaporation, rainfall, and wind direction. Variations in the water levels of Lake Erie impact surface water flow around the facility. In other words, as water levels increase in Lake Erie, the flow gradient to the lake is decreased and water within surface water bodies adjoining the RRW operational area increase; likewise, when water levels in Lake Erie decrease the flow gradient to the lake is increased and water within surface water bodies adjoining the RRW operational area decrease.

Several surface water bodies surround the RRW operational area. These include: the Raisin River along the southern boundary; the West Marsh along the west boundary; the North Intake Canal along the northern boundary; the East Intake Canal and North Marsh northeast of the RRW operational area; and the East Marsh east of the RRW operational area between the RRW and Lake Erie. Surface water levels within these bodies vary dependent upon evaporation, rainfall, and Lake Erie water levels.

Surface water levels within the River Raisin, North Intake Canal, and East Intake Canal generally correlate closely to Lake Erie water levels. This is due to the direct connection between these water bodies and Lake Erie. There is also a general correlation between the West Marsh and River Raisin due to the direct connection between these two water bodies. The North Marsh and East Marsh are surrounded by perimeter berms that restrict interaction between the marshes and other adjacent water bodies.

With the exception of evaporation and infiltration, precipitation at the site typically enters directly into one of the on-site surface water bodies or onto the ground surface where it may travel via overland flow to one of the surrounding water bodies. The exception to this general surface water flow pattern is within the active RRW operational area. Precipitation that falls onto the active RRW operational area typically falls onto a hard surface (concrete or asphalt) and flows to the storm water management system. The storm water management system conveys the water to the on-site wastewater treatment system for management and discharge via either the City of Monroe publicly owned treatment works (POTW) or the 002 Outfall, as appropriate.

B2.A.2(f) Surrounding Land Uses

Review of the United States Department of Interior - Geological Survey (USGS) Topographical map, Stony Point Quadrangle, indicates that the RRW, along with properties to the immediate north, south and west, are located within the corporate limits of the City of Monroe. The eastern corporate limits extend to Lake Erie, along the eastern edge of the property. Frenchtown Charter Township is located approximately 0.23-miles to the north and 0.25-miles to the south of the RRW property, respectively.

MSG obtained current zoning maps from the City of Monroe and Frenchtown Charter Township. The City of Monroe zoning map indicates that the RRW property is currently zoned I-2, General Industrial District. A copy of the City of Monroe zoning map for the RRW property is presented as Drawing 1. Properties to the north (sections of Sterling State Park and the adjacent marsh), south and west (adjacent marshland to I-75 Expressway and beyond) are also currently zoned General Industrial District. A small strip of property situated between East Elm Avenue and the River Raisin to the west of the RRW to I-75 Expressway is currently zoned Waterfront Commercial District (WC). The property is currently partially undeveloped and partially being used as a RV campground/boat storage.

Review of the Frenchtown Charter Township Zoning Map indicates that the properties to the north of the City of Monroe near the RRW are currently zoned as Public Service (PS), i.e. Sterling State Park and adjacent marsh, and Agricultural (A). A strip of single family residential zoning is located between the A and PS areas, approximately 600 feet north of City of Monroe Corporate Limit.

B2.A.2(g) Critical Habitats and Endangered Species

As stated previously, the RRW is situated near large bodies of water and there are several large tracts of wooded land on and surrounding the site. A variety of wildlife and vegetation thrive in the vicinity of the site. Wildlife observed near the RRW on a regular basis includes: deer, muskrat, squirrel, raccoon, rabbit, fox, snake, wood duck, Canada geese, swan, turtle and bald eagles. In fact, as outlined in RCRA Post Closure Permit conditions, a study was performed by Eagle Environmental of Haslett, Michigan to identify bald eagle protective measures. The United States

Fish and Wildlife Service (FWS) as well as the Michigan Department of Natural Resources (MDNR) were involved in the evolution of the plan that was prepared using current FWS guidelines. During the course of the remediation project (containment unit closure and closure of areas outside of containment), the eagle management plan was implemented. Due to the success of the eagle management plan, the eagles can still be found nesting on RRW property.

The marshes, which surround the RRW to the east and west, provide a wide variety of vegetation. Types of vegetation that can be seen include marsh lily, grass, dogwood, and American Lotus. Of particular note is the protected species, American Lotus, which blooms in August in the East Marsh. The concentration of lotus in this area is among the highest in the state. In addition, vegetation was planted in disturbed areas outside of the containment units and on the top of the closed containment units to protect the cap system by reducing erosion.

B2.A.3 Characterization of Potential or Actual Sources of Contamination [R 299.9504(c) and 40 CFR §270.14(d)]

This section describes actual or potential sources of contamination at the River Raisin that are subject to the corrective action requirements of Part 111 of Act 451. These sources include WMUs that are discernible units at which contaminants have been placed at any time, or at which contaminants have been released, or at which there is a threat of release regardless of the intended use of such unit. These sources also include areas of concern that are those units which do not meet the definition of WMU, but which may have released contaminants to the environment on a non-routine basis, or which may present an unacceptable risk to public health, safety, welfare, or the environment,

B2.A.3(a) Salaried Parking Lot (SPL)

B2.A.3(a)(1) Unit Characteristics

The SPL is a 200 by 300-foot asphalt parking lot constructed in 1971, with a 6-inch base reportedly composed of a mixture of F006 hazardous waste sludge and fly ash. The parking lot operated from 1971 until present.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(a)(2) Waste Characteristics and Management

For the SPL, GSI Protection Criteria was exceeded for selenium and mercury, and Residential Soil Direct Contact and Residential/Industrial Drinking Water Protection Criteria was exceeded for arsenic. Site specific criteria for PCBs (9,000 ug/kg) was also exceeded in spots within the SPL. The source of the contaminants in this unit are unknown.

B2.A.3(a)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(b) Coal Pile (CP)

B2.A.3(b)(1) Unit Characteristics

The CP Area is a 175-foot by 400-foot area adjacent to the River Raisin and DTA. The USEPA identified coal as the material of concern at this location, although coal is not a solid waste as defined by RCRA. Coal piles were once stored in this area with no containment or liners. This area was covered by an asphalt pad as part of remediation activities associated with the Raisin River Area of Concern.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(b)(2) Waste Characteristics and Management

Sampling of this area was performed as part of the SWMU investigation in February of 1999. Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: arsenic (As), barium (Ba), Cd, Cr, Cu, lead (Pb), mercury (Hg), selenium (Se), silver (Ag), Zn and polynuclear aromatics (PNAs). The additional soil sampling and analysis was conducted in June 2001. For the CP Area, GSI Protection Criteria was exceeded for selenium, naphthalene, phenanthrene, and mercury and Residential Soil Direct Contact was exceeded for arsenic.

B2.A.3(b)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(c) Former Coal Pile (FCP)

B2.A.3(c)(1) Unit Characteristics

The FCP is a 150-foot by 425-foot area adjacent to the River Raisin, which is no longer used for coal storage.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(c)(2) Waste Characteristics and Management

Sampling of this area was performed as part of the SWMU investigation in March of 1998. Results of this sampling were presented in the SWMU report.

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan, specifically As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn and PNAs. The additional soil sampling and analysis was conducted in June 2001. For the FCP, GSI Protection Criteria was exceeded for selenium and mercury.

B2.A.3(c)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(d) Rifle Range (RRE)

B2.A.3(d)(1) Unit Characteristics

The RRE is a 35-foot by 50-foot area near the River Raisin and East Marsh. Reportedly, F006 hazardous waste sludge was stored in this area before it was removed and filled in with clay.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(d)(2) Waste Characteristics and Management

Sampling of this area was performed as part of the SWMU investigation in June of 1998. Results of this sampling were presented in the SWMU report.

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. Additional soil samples at this SWMU were collected and an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan, specifically Cd, Cr, Cu, Ni, Zn and TCN was conducted. For the RRE, GSI Protection Criteria was exceeded for selenium, copper, mercury, and nickel. Residential Soil Direct Contact was exceeded for arsenic. Residential/Industrial Drinking Water Protection Criteria was exceeded for nickel.

B2.A.3(d)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(e) Demolition Disposal Area (DDA)

B2.A.3(e)(1) Unit Characteristics

The DDA is a 50-foot by 1,015-foot area along the River Raisin shoreline previously used to store demolition debris for erosion protection. Visual evidence of oil-like materials in this area was reported in the RCRA facility Assessment (RFA). No soil samples were collected during the RFA review. Demolition debris (approximately 16,000 yd^3) was removed during the summer and fall of 1997 and placed within the ECU. Sampling of this area was performed as part of the SWMU investigation in February of 1999. Results of sampling were presented in the SWMU report.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(e)(2) Waste Characteristics and Management

Additional soil samples at this SWMU were collected and an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan, specifically As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn, volatile organic compounds (VOCs), polychlorinated biphenyls (PCBs), PNAs and phthalate esters. The additional soil sampling and analysis was conducted in June 2001. For the DDA, GSI Protection Criteria was exceeded for selenium, mercury, total cyanide, phenanthrene, fluoranthene, naphthalene, fluorene, and pyrene. Residential Soil Direct Contact was exceeded for benzo(a)pyrene, and dibenzo(a,h)anthracene. Industrial Soil Direct Contact was exceeded for PCBs. Residential/Industrial Drinking Water Protection Criteria was exceeded for vinyl chloride and total cyanide. Residential/Industrial Soil Volatilization to Indoor Air Inhalation Criteria was exceeded for vinyl chloride.

B2.A.3(e)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(f) Empty Drum Storage Area (EDSA)

B2.A.3(f)(1) Unit Characteristics

The EDSA is a 40-foot by 60-foot area previously used for the storage of drums containing waste oil, solvents, paint wastes and diesel fuel. A diesel fuel storage tank was also located in this area. Visual evidence of black-stained concrete and staining of adjacent soils was reported in the USEPA's RFA. The RCRA Post-Closure License reports that "sampling indicates the presence of heavy metal and organics in soils." Sampling of this area was performed as part of the SWMU investigation in March of 1999. Results of this sampling were presented in the SWMU report.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(f)(2) Waste Characteristics and Management

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn, VOCs, PCBs and PNAs. The additional soil sampling and analysis was conducted in June and September 2001. For the EDSA, GSI Protection Criteria was exceeded for selenium, copper, mercury, total cyanide, vinyl chloride, cadmium, zinc, xylenes, ethylbenzene, silver, 1,1,1-trichloroethane, 1,1-dichloroethylene, and cis-1,2-dichloroethylene. Residential Soil Direct Contact was exceeded for total cyanide and arsenic. Industrial Soil Direct Contact was exceeded for PCBs. Industrial Drinking Water Protection Criteria was exceeded for copper, cadmium, 1,1-dichloroethylene, ethylbenzene, total cyanide, 1,1,1-trichloroethane, 1,1,2-trichloroethane, trichloroethylene, vinyl chloride, and total cyanide. Residential Drinking Water Protection Criteria was exceeded for 1,1-dichloroethane and zinc. Residential/Industrial Soil Volatilization to Indoor Air Inhalation Criteria was exceeded for vinyl chloride and 1,1-dichloroethylene.

B2.A.3(f)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(g) Former Drum Storage Area (FSDA)

B2.A.3(g)(1) Unit Characteristics

The FDSA is a 30-foot by 50-foot area previously used for less than 90-day storage of compactor wastes, oil and coil spring dust and slag. Oily waste from this area was drained via a sump to storage tanks. No samples were collected during the USEPA RFA. Sampling of this area was performed as part of the SWMU investigation in March of 1999. Results of this sampling were presented in the SWMU report.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(g)(2) Waste Characteristics and Management

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn, VOCs, PCBs and PNAs. The additional soil sampling and analysis was conducted in June and September 2001. For the FDSA, GSI Protection Criteria was exceeded for selenium, copper, mercury, phenanthrene, naphthalene, and fluoranthene. Industrial Soil Direct Contact was exceeded for PCBs and benzo(a)pyrene.

B2.A.3(g)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(h) Current Drum Storage Area (CDSA)

B2.A.3(h)(1) Unit Characteristics

At the time of the RFA, the CDSA, which measured 5-foot by 30-foot, was used for less than 90-day storage of oily waste, compactor waste, coil spring dust, and slag. This area was active from 1987 until 1998. No soil samples were collected during the RFA. Sampling of this area was performed as part of the SWMU investigation in March of 1999. Results of this sampling were presented in the SWMU report.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(h)(2) Waste Characteristics and Management

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn, VOCs, PCBs and PNAs. The additional soil sampling and analysis was conducted in June 2001. For the CDSA, GSI Protection Criteria was exceeded for selenium and xylenes. Industrial Soil Direct Contact was exceeded for PCBs. Residential Soil Volatilization to Indoor Air Inhalation Criteria was exceeded for 1,1-dichloroethylene.

B2.A.3(h)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(i) Filter Press Area (FPA)

B2.A.3(i)(1) Unit Characteristics

The FPA is a 200-foot by 50-foot area at the wastewater treatment plant. Visual evidence of staining in this area was reported in the RFA. The RCRA Post Closure License reported that "sampling in this area indicated the presence of heavy metals and organics in the soils." Sampling of this area was performed as part of the SWMU investigation in June of 1998. Results of this sampling were presented in the SWMU report.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(i)(2) Waste Characteristics and Management

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn, VOCs, PCBs and PNAs. The additional soil sampling and analysis was conducted in June and September 2001. For the FPA, GSI Protection Criteria was exceeded for selenium and copper.

B2.A.3(i)(3) History of Releases or Potential to Release

Due to a malfunction in the filter press equipment, F006 sludge material leaked out of the east side of the treatment plant building and spilled onto the outside soils. There are no filter press equipment remaining diminishing the potential for additional release.

B2.A.3(j) Dead Tree Area (DTA)

B2.A.3(j)(1) Unit Characteristics

The DTA was a 100-foot by 600-foot natural ground depression adjacent to the River Raisin containing dead trees. Standing water in this depression likely killed the trees. Natural depressions in this area containing coal, construction debris, and fine-grained oily material were reported during the RFA. No soil samples were taken during the RFA. From 1995 to 1997, approximately 1,000 cubic yards of construction debris and soil were removed from this area and placed within the on-site ECU landfill. Sampling of this area was performed as part of the SWMU investigation in January, April and June of 1996. Results of this sampling were presented in the SWMU report.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(j)(2) Waste Characteristics and Management

Based upon the SWMU Report and the February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Se, Ag, Zn, VOCs, PCBs, PNAs and phthalate esters. The additional soil sampling and analysis was conducted in June and September 2001. For the DTA, GSI Protection Criteria was exceeded for selenium, copper, mercury, phenanthrene, fluoranthene, trichloroethylene, and silver. Industrial Soil Direct Contact was exceeded for PCBs. Residential Soil Direct Contact was exceeded for benzo(a)pyrene.

B2.A.3(j)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(k) Tower Area (TWA)

B2.A.3(k)(1) Unit Characteristics

The TWA is a section of the RRW outside of the WCU that was remediated as part of the post-closure construction activities. All sludge and impacted soil was excavated from this area, solidified, and disposed of within the on-site containment units, except for impacted soils beneath the bearing area of the tower foundations and within the dike adjacent to the East Intake Canal. Verification sampling was performed in 1997 in accordance with the MDEQ verification sampling guidance. A drawing showing verification sample locations, discussion of verification sampling procedures, and verification sample results was presented within the Certification Report. Closure criteria identified within the Act 64 Post-Closure Operating Permit (MID 005 057 005) were not achieved beneath the towers and within the dike adjacent to the East Intake Canal. Therefore, further evaluation of this area was included as part of the RFI.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(k)(2) Waste Characteristics and Management

Based upon the sample results presented within the Certification Report and subsequent February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG collected additional soil samples at this SWMU and conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Zn, and TCN. The additional soil sampling and analysis was conducted in June 2001. For the TWA, GSI Protection Criteria was exceeded for selenium, copper, mercury, nickel, silver, and zinc. Residential/Industrial Drinking Water Protection Criteria was exceeded for arsenic, mercury, and nickel. Residential Direct Contact Criteria was exceeded for arsenic and copper.

B2.A.3(k)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(l) West Lagoon (WLA)

B2.A.3(l)(1) Unit Characteristics

The WLA is located on a portion of land north of the main plant building and south of the WCU. It is currently covered by asphalt pavement and used for storage of metal part racks. The former West Lagoon is approximately 512 feet long, 64 feet wide and 10 feet deep.

The former West Lagoon was closed in 1984 in accordance with an USEPA-approved Closure Plan. Subsequently, MDEQ requested that the closure of the former West Lagoon be re-evaluated as part of the review process for other surface impoundments at the Monroe Plant. As part of this re-evaluation, further subsurface investigation activities were conducted at the former West Lagoon. Further discussion of this investigation was included in the Closure Report.

The reviewed documents indicate that the WLA was previously used as an effluent settling pond for the settling of treated plating sludge and the storage of the settled wastewater treatment sludge until approximately 1956. It was then converted into a surface impoundment for the storage of RCRA sludge. The WLA remained in service until approximately 1984. At that time, it was taken out of service and closed in accordance with the RCRA closure requirements in effect. Prior to closure, the stored sludge and selected soils were excavated and disposed of at an off-site facility. Soil samples were collected at the completion of the excavation activities, and the closure of the WLA was approved by the USEPA on July 27, 1984.

As part of closure activities for remaining surface impoundments, the MDEQ requested that re-evaluation of the WLA be included as part of the closure activities for the remaining surface impoundments located on-site. Accordingly, a WLA investigation was conducted. A total of 66 soil samples from 20 boring locations were collected from the WLA during 1995 as part of a limited subsurface investigation titled *Investigation Report of Former West Lagoon.* This investigation was conducted by NTH Consultants LTD to satisfy Post-Closure Operating License requirements.

Results of this investigation were provided to MDEQ as part of the *Closure Certification Report.*

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(l)(2) Waste Characteristics and Management

Based upon the sample results presented within the *Closure Certification Report*, dated September 9, 1999 and subsequent February 29, 2000 comments by MDEQ, additional evaluation of this SWMU was necessary. MSG has conducted an exposure pathway evaluation for the compounds of concern identified in the RFI Work Plan: As, Ba, Cd, Cr, Cu, Pb, Hg, Ni, Se, Ag, Zn, and TCN. Additional soil sampling and analysis was not performed, but the existing data indicates that GSI Protection Criteria was exceeded for selenium. Residential/Industrial Drinking Water Protection Criteria was exceeded for selenium. Residential Direct Contact Criteria was exceeded for arsenic.

B2.A.3(l)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(m) Process Canal

B2.A.3(m)(1) Unit Characteristics

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(m)(2) Waste Characteristics and Management

The source of the contaminants in this unit are unknown.

B2.A.3(m)(3) History of Releases or Potential to Release

The history of releases in this unit are unknown.

B2.A.3(n) Fire Line Area

B2.A.3(n)(1) Unit Characteristics

In February, 2003 a leak in the building perimeter fire line occurred in the north parking area, north of the main manufacturing building at the RRW. During excavation to determine the status of the fire line, drum fragments and fill soils were discovered. This material was removed to a lined and covered 20-yd^3 roll-off container pending waste characterization sampling and results.

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(n)(2) Waste Characteristics and Management

The VOCs and SVOCs analyzed for were all below detection limits. Zinc and barium had results above detection limits, 17 and 1.4 mg/L respectively, and all other analyzed metals were below detection limits. Aroclor 1248 had a concentration of 1,000 mg/kg while all other Aroclors were below detection limits.

Based on the laboratory results of the soil removed in February 2003, all soil and ground water encountered during the repair activities were containerized. Soil removed from the excavation was placed in lined and covered 20-yd^3 roll-off containers prior to disposal at EQ. Water from the excavation was placed in a 10,000-gallon tank prior to disposal at EQ. The total amount of soil and ground water removed from the site and disposed of was 89 tons and 116,325 gallons, respectively. Remedial investigation activities for the Fire Line area are currently ongoing.

B2.A.3(n)(3) History of Releases or Potential to Release

The history of releases in this unit is unknown.

B2.A.3(o) SB01-06 Area

B2.A.3(o)(1) Unit Characteristics

As part of an independent investigation being conducted for the River Raisin, the United States Environmental Protection Agency (USEPA) advanced six (6) soil borings (SB01 through SB06) and completed one (1) test pit (TP01) on the shore adjacent to the River Raisin on the Monroe Plant property, collected soil samples, and submitted these soil samples for analytical testing

Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site.

B2.A.3(o)(2) Waste Characteristics and Management

Laboratory results of the soil samples collected from SB03 and SB06 exhibited elevated polychlorinated biphenyl (PCB) concentrations ranging from 1.5 to 330 milligrams per kilograms (mg/kg). Remedial investigation activities for the SB01-06 A area are currently ongoing.

B2.A.3(o)(3) History of Releases or Potential to Release

The history of releases in this unit are unknown.

B2.B FACILITY'S ASSESSMENT OF KNOWN NATURE AND EXTENT OF CONTAMINATION

B2.B.1 Groundwater

B2.B.1(a) Characterization History

Potential ground water impacts from the identified on-site solid waste management units (SWMUs) have been investigated in accordance with the MDEQ approved *Ground water Investigation Work Plan (GIWP)*, dated September 1, 1998, and the Act 64 Post-Closure Operating License (MID 005 057 005). This investigation effort is detailed in the *Final Ground Water Investigation Report* dated July 26, 2002.

The purpose of the Final Ground Water Investigation Report (FGWIR) was to document hydraulic monitoring conducted at the site, and ground water sampling associated with the SWMUs. The ground water sampling included twelve (12) monitoring wells dedicated to SWMU ground water quality assessment. The hydraulic monitoring included measurement of ground water elevations at sixteen (16) monitoring wells dedicated to SWMU ground water quality assessment, as well as the existing post-closure ground water monitoring network.

The FGWIR presented the results of ground water sampling conducted in January/February 2001, May 2001, August 2001 and December 2001 at the downgradient monitoring wells. Sample parameters included the following.

- Volatile Organic Compounds (VOCs) using USEPA Method 8260
- Semi-Volatile Organic Compounds (SVOCs) using USEPA Method 8270
- Polychlorinated Biphenyls (PCBs) using USEPA Method 8082
- Pesticides using USEPA Method 8081
- Herbicides using USEPA Method 8051
- Total Cyanide (TCN) using USEPA Method 9010B
- Seventeen (17) Metals using USEPA Methods 6010 and 7470
- Dioxins using USEPA Method 1613A

Completion of the sampling provided data to determine ground water quality downgradient of each SWMU. Furthermore, three of the ground water monitoring wells (GW-7, GW-8, and GW-9), not associated with SWMUs at the site were sampled. These monitoring wells are located at the southern boundary of the site along the River Raisin, and were included in the sampling program to investigate ground water quality downgradient of the main plant area. The GW wells that were sampled, associated with each SWMU, are shown in the following table.

SWMU	Wells	Downgradient Well
Salaried Parking Lot	GW-1, GW-2, GW-3	GW-2
Former Coal Pile	GW-4, GW-5, GW-6	GW-5
Dead Tree Area	GW-10, GW-11R, GW-12	GW-10, GW-11R, GW-12

Coal Pile	GW-10, GW-11R, GW-12	GW-10, GW-11R, GW-12
Demolition Disposal Area	GW-10, GW-11R, GW-12	GW-10, GW-11R, GW-12
Filter Press Area	GW-13, GW-14	GW-13
Current Drum Storage Area	GW-13, GW-14, GW-15	GW-14
Former Drum Storage Area	GW-14, GW-15	GW-15
Empty Drum Storage Area	GW-15, GW-16	GW-16

Hydraulic monitoring conducted during the Final Ground Water Investigation verified the down gradient ground water wells associated with each SWMU, and data indicated that inward and upward hydraulic gradients were established and maintained at the ECU and WCU.

Prior to the collection of samples for laboratory analysis, the field parameters of temperature, pH, and specific conductivity were recorded at each monitoring well location. Ground water temperatures ranged from 4.4 to 21.5 degrees Celsius, and the specific conductivity measurements ranged from 0.53 to 4.91 mS/cm. The pH measurements at the ground water monitoring wells ranged from 6.1 to 7.8.

The results from the GW wells were evaluated against all MDEQ Part 201 criteria. Concentrations above Residential Drinking Water (RDW) and Ground Water-Surface Water Interface (GSI) criteria constituted the majority of exceedances. Concentrations were compared with all Part 201 criteria and any criteria exceedance other than RDW and GSI are noted on the tables in Section B3.

There were no herbicides, pesticides or dioxins detected in any of the ground water well samples during all of the sampling periods and the levels of total cyanide and SVOCs measured in the ground water samples were consistently lower than all established criteria. Silver, tin and beryllium were never detected at the GW wells. Barium, cobalt, thallium and zinc were detected but never exceeded any criteria at any of the GW wells.

Antimony RDW exceedances were recorded at each GW well during January and/or May 2001. However, antimony was not detected at any well during the September or December 2001 sampling periods. The only mercury detection and exceedance occurred at GW-16 in May. No other detections of mercury were recorded. All selenium concentrations above GSI criteria at the down gradient SWMU wells were subjected to trend analyses and shown to be non-significant. Monitoring well GW-15 was the only location that had a nickel exceedance.

During each of the four sampling rounds, samples collected from GW-11R exceeded both GSI and RDW criteria for arsenic. However, GW-10, which did not have any reported arsenic exceedances, is located down gradient from GW-11R.

PCBs were detected and exceeded RDW and GSI criteria during each sampling period at GW-16. Monitoring well GW-16 is the only GW well where PCBs were detected.

Vinyl Chloride exceedances occurred during each of the four sampling periods for ground water wells GW-11R, GW-12, GW-15, and GW-16 with the exception of the May sampling round for

GW-15. All noted exceedances were above both GSI and RDW criteria with the exception of the May and December sampling rounds for GW-11R (only a RDW criteria exceedance), and the December sampling round for GW-16 (also a RDW criteria exceedance). Vinyl chloride was not detected at any other well during any of the sampling periods. GW-15 also had exceedances for several VOCs that were not detected at any of the other GW wells.

B2.B.1(b) Description of Horizontal and Vertical Extent of Plume(s)

There are no plumes at the site.

B2.B.1(c) Horizontal and Vertical Direction of Contaminant Movement

There are no plumes at the site.

B2.B.1(d) Velocity of Groundwater Contaminant Movement

There are no plumes at the site.

B2.B.1(e) Factors Influencing Plume Movement

There are no plumes at the site.

B2.B.1(f) Extrapolation of Future Contaminant Movement

There are no plumes at the site.

B2.B.1(g) Recommendations or Established Requirements for Additional Investigations

Remedial Investigation (RI) for supplemental investigation activities associated with RCRA Facility Investigation (RFI) and the Final Ground Water Investigation at the River Raisin Warehouse are currently ongoing. These activities were discussed between the MDEQ, Ford, and MSG in multiple correspondence (both written and verbal), and were ultimately approved by the Michigan Department of Environmental Quality (MDEQ) in a June 6, 2014 letter to Ford.

B2.B.2 Soil

B2.B.2(a) Characterization History

The Waste Disposal Surface Impoundment Closure Project at the Ford River Raisin Warehouse (RRW) in Monroe, Michigan was undertaken by Ford Motor Company (Ford) to properly close on-site waste management units. Work for this project was performed in accordance with the Act 64 Post-Closure Operating License and the Resource Conservation and Recovery Act (RCRA) Permit (MID 005 057 005), dated March 27, 1995. This closure involved construction of two final on-site containment units, the Western Containment Unit (ECU) and the Western Containment Unit (WCU), that encompassed six separate surface impoundments (Areas A, B, C, D, the Polishing Lagoon, and the North Lagoon). In addition, six areas outside the boundary of the two on-site containment units were cleaned to applicable standards, the contents placed within the two on-site containment units, and closed (Area D-West, Area D-North, North Intake Canal, West Marsh, Area D Towers and the Process Canal). Also, an on-site sediment containment unit was built to hold sediments dredged during the River Raisin Sediment Removal project. Finally, several other on-site waste management areas were remediated and the contents disposed of within the on-site containment units as part of the activities within the corrective action management unit (CAMU).

In addition to the construction and closure of the ECU and WCU other corrective action activities were conducted at the RRW. A summary of the corrective action activities is contained below.

On March 24, 2000, MDEQ issued an Amendment, Amendment #2, to the Act 64 Post-Closure Operating License. This Amendment included several corrective action conditions. Essentially, the corrective action conditions that were formally part of the USEPA RCRA Post-Closure Permit were incorporated into the MDEQ Permit and the MDEQ assumed the lead role for corrective action at the site. As part of the Amendment, Permit Condition V.C.2 required submittal of a RCRA Facility Investigation (RFI) Work Plan. This Permit Condition also identified sixteen separate areas for evaluation under the RFI Work Plan and included the original ten EPA designated SWMUs and an additional six evaluation areas listed as numbers eleven through sixteen below. A seventeenth SWMU has been added based upon MDEQ direction in an April 18, 2003 letter.

1. Salaried Parking Lot (SPL)
2. Coal Pile (CP)
3. Former Coal Pile (FCP)
4. Rifle Range (RRE)
5. Demolition Disposal Area (DDA)
6. Empty Drum Storage Area (EDSA)
7. Former Drum Storage Area (FDSA)
8. Current Drum Storage Area (CDSA)
9. Filter Press Area (FPA)
10. Dead Tree Area (DTA)
11. West/West Marsh Area (Area D West/West Marsh Area)
12. North/North Intake Canal - Grid 1 (Area D North/North Intake Canal-Canal 1)
13. North/North Intake Canal - Grid 2 (Area D North/North Intake Canal-Canal 2)
14. Tower Area (TWA)
15. West Lagoon (WLA)
16. Process Canal
17. Fire Line Area

The USEPA originally identified ten SWMUs during completion of a RCRA Facility Assessment

(RFA) conducted at the RRW. The SWMUs identified by USEPA are the first ten areas in the above list. The ten SWMUs were identified by USEPA in the 1995 RCRA Post-Closure Operating Permit (MID 005 057 005), and a release assessment investigation was required as a condition of said permit. A RAW-QAPP dated June 27, 1995 was prepared and submitted to USEPA. A revision of the RAW-QAPP was developed and submitted to USEPA on February 25, 1998. This RAW-QAPP addressed the ten SWMUs identified by USEPA. The Mannik & Smith Group, Inc. (MSG) implemented the RAW-QAPP in 1999. The results of this investigation effort are presented in the Soil Investigation Report of Solid Waste Management Units (SWMU Report), dated October 1999. Figure 1 - Site Location Map, included in Attachment A-11 indicates the location of the RRW relative to existing roads and other features. Figure 2 - Site Plan, included in Attachment A-11 details the locations of the CAMUs and existing SWMUs at the site. Each SWMU is also shown on Topographic Site Plan contained in Section A13.

As previously mentioned, several other on-site waste management areas were remediated as part of the activities within the corrective action management unit which included the DTA, DDA, FCP, and CP. Corrective actions for the DTA, DDA, FCP, and CP were conducted prior to the implementation of the RAW-QAPP during closure construction activities and a brief explanation of corrective actions is provided below.

As mentioned above, as part of an independent investigation being conducted for the River Raisin, the United States Environmental Protection Agency (USEPA) advanced six (6) soil borings (SB01 through SB06) and completed one (1) test pit (TP01) on the shore adjacent to the River Raisin on the Monroe Plant property, collected soil samples, and submitted these soil samples for analytical testing.

B2.B.2(b) Description of Horizontal and Vertical Extent of Contamination

Remedial investigation activities are currently ongoing.

B2.B.2(c) Description of Soil and Contaminant Properties

Remedial investigation activities are currently ongoing.

B2.B.2(d) Velocity and Direction of Contaminant Movement

Remedial investigation activities are currently ongoing.

B2.B.2(e) Extrapolation of Future Contaminant Movement

Remedial investigation activities are currently ongoing.

B2.B.2(f) Recommendations or Established Requirements for Additional Investigations

Remedial Investigation (RI) for supplemental investigation activities associated with RCRA Facility Investigation (RFI) and the Final Ground Water Investigation at the River Raisin Warehouse are currently ongoing. These activities were discussed between the MDEQ, Ford, and MSG in multiple correspondence (both written and verbal), and were ultimately approved by the Michigan Department of Environmental Quality (MDEQ) in a June 6, 2014 letter to Ford.

B2.B.3 Surface Water and Sediment

B2.B.3(a) Characterization History

No surface water and or sediment characterization has been necessary as part of the current investigation activities.

B2.B.3(b) Description of Horizontal and Vertical Extent of Any Contamination

No surface water and or sediment horizontal and vertical contamination description has been necessary as part of the current investigation activities.

B2.B.3(c) Velocity of Contaminant Movement

No surface water and or sediment velocity investigation has been necessary as part of the current investigation activities.

B2.B.3(d) Description of Sediment Characteristics

No sediment characterization has been necessary as part of the current investigation activities.

B2.B.3(e) Description of Physical, Biological, and Chemical Factors That May Influence Contaminant Movement and Their Effects

No surface water and or sediment characterization has been necessary as part of the current investigation activities.

B2.B.3(f) Proposed or Final Mixing Zone Determinations for Any On-Site Contamination Venting to a Surface Water Body

No surface water and or sediment characterization has been necessary as part of the current investigation activities.

B2.B.3(g) Recommendations or Established Requirements for Additional Investigations

No surface water and or sediment characterization has been necessary as part of the current investigation activities.

B2.B.4 Air

B2.B.4(a) Characterization History

MSG conducted ambient air monitoring during the Interim Response activities. The results of the air monitoring were submitted to MDEQ-WHMD during the Interim Response activities.

In addition, during RI activities, it was determined that soils associated with the Fire Line Area extended underneath a portion of the plant building. Sub slab vapor pins were installed in the portion of the building where impacted soils exist underneath the concrete slab floor. These sub slab vapor pins along with several indoor ambient air locations are currently being investigated for VOC's and SVOC's.

B2.B.4(b) Description of Horizontal and Vertical Direction and Velocity of Contaminant Movement

Air investigation is currently ongoing.

B2.B.4(c) Rate and Amount of Release

Air investigation is currently ongoing.

B2.B.4(d) Recommendations or Established Requirements for Additional Investigations

Sub slab vapor and indoor ambient air investigation has been added to the Remedial Investigation (RI) for supplemental investigation activities associated with RCRA Facility Investigation (RFI) and the Final Ground Water Investigation at the River Raisin Warehouse. These activities regarding air sampling were discussed between the MDEQ, Ford, and MSG in multiple correspondence (both written and verbal), and were ultimately approved by the Michigan Department of Environmental Quality (MDEQ).

B2.B.5 Subsurface Gas Contamination

B2.B.5(a) Characterization History

In addition, during RI activities, it was determined that soils associated with the Fire Line Area extended underneath a portion of the plant building. Sub slab vapor pins were installed in the portion of the building where impacted soils exist underneath the concrete slab floor. These sub slab vapor pins along with several indoor ambient air locations are currently being investigated for VOC's and SVOC's.

B2.B.5(b) Description of Horizontal and Vertical Extent of Subsurface Gas Contamination Migration

Subsurface gas investigation is currently ongoing.

B2.B.5(c) Rate, Amount, and Density of Gases Being Emitted

Subsurface gas investigation is currently ongoing.

B2.B.5(d) Recommendations or Established Requirements for Additional Investigations

Subsurface gas investigation is currently ongoing.

B2.C FACILITY'S EXPOSURE ASSESSMENT

Soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.C.1 Human Exposure and Threats

B2.C.1(a) Exposure Pathway

See B2.B for summary of RFI soil and ground water results. RI activities for soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.C.1(b) Actual or Potential Receptors

See B2.B for summary of RFI soil and ground water results. RI activities for soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.C.1(c) Evidence of Exposure

See B2.B for summary of RFI soil and ground water results. RI activities for soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.C.2 Environmental Exposure and Threats

B2.C.2(a) Exposure Pathway

See B2.B for summary of RFI soil and ground water results. RI activities for soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.C.2(b) Actual or Potential Receptors

See B2.B for summary of RFI soil and ground water results. RI activities for soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.C.2(c) Evidence of Exposure

See B2.B for summary of RFI soil and ground water results. RI activities for soil, ground water, ambient air and subsurface gas investigation is currently ongoing. Based on initial investigation, there is no immediate risk.

B2.D INTERIM MEASURES

Based on the results of the October 1999 SWMU investigation and the data collected during the 2001 RFI, interim soil corrective measures were implemented to minimize exposure potential. Specifically, the RRW has implemented engineering and operational controls to eliminate exposures for direct contact, and potential exposures to ground water and surface water bodies. Ford has procedures in place to notify all RRW personnel of the locations of all of the identified SWMUs, the containment units, and the ground water investigation and post-closure monitoring wells. This procedure also includes a warning not to disturb, in any manner, the identified areas and appurtenances and to report any unusual activities in these areas. Ford repeats this notification periodically to ensure all RRW personnel, including new employees, are aware of the procedures.

Ford has also posted signs at selected areas that remain under evaluation. These areas include the CP, FCP, DDA, EDSA, FPA, RRE, and the DTA. Additionally, several of the SWMUs are partially or completely covered by asphalt or concrete, or have been isolated by means of fencing or other barriers.

B2.D.1 Ford Outfall Site

B2.D.1(a) Objective of the Measure

The River Raisin Sediment and Soil Removal portions of the Removal Action at the Ford Outfall Site Project was initiated in April 1997 and consisted of dredging PCB (polychlorinated biphenyls) impacted sediments from a portion of the River Raisin adjacent to the RRW.

B2.D.1(b) Design and Construction

The estimated final volume of removed storm sewer material was 350-400 CY of material and disposed of in the on site Sediment Containment Unit (SCU). Dredged sediments were subsequently solidified and placed into the on-site SCU specifically constructed for the Ford Outfall Site project. Approximately 30,000 cubic yards of sediment were dredged from the Raisin River and disposed of in the SCU.

B2.D.1(c) Operation, Monitoring, and Maintenance

Not applicable.

B2.D.1(d) Evaluation of Measure Effectiveness

Confirmation samples were collected after interim measures were completed to ensure the effectiveness of the measure.

B2.D.1(e) Proposed or Required Schedules for Continued Operation or Future Changes in the Measure

Not applicable.

B2.E ENVIRONMENTAL INDICATORS

The two EIs (EI725 and IE750 have been completed for the facility. The EI725 was submitted on August 28, 2001 and the EI750 was submitted on March 25, 2005. Each form (EI725 and EI750 are provided below as attachment B2.E.1 of this attachment.

B2.F FACILITY'S ASSESSMENT OF KNOWN OR PROPOSED CONSTITUENTS OF CONCERN

[R 299.9629(3)(a)(i) and (3)(b)(i)]

Solid Waste Management Unit (SWMU) Corrective Measures		
Unit/Area Name	**Result of RFI Implementation**	**Most Likely Case Remedy**
Salaried Parking Lot	GSI Protection Criteria was exceeded for Se, and Residential Soil Direct Contact and Residential/Industrial Drinking Water Protection Criteria was exceeded for As.	Groundwater monitoring ; Dead restriction
Coal Pile	GSI Protection Criteria was exceeded for Se, naphthalene, phenanthene, and Hg and Residential Soil Direct Contact was exceeded for As.	Engineering controls; groundwater monitoring; deed restriction
Former Coal Pile	GSI Protection Criteria was exceeded for Se and Hg.	Engineering controls; groundwater monitoring; deed restriction
Rifle Range Pile	GSI Protection Criteria was exceeded for Se, Cu, Hg, and Ni. Residential Soil Direct Contact was exceeded for As. Residential/Industrial Drinking Water Protection Criteria was exceeded for Ni.	Deed restriction DESIGN COMPLETE
Demolition Disposal Area	GSI Protection Criteria was exceeded for Se, Hg, CN, phenanthrene, fluoranthene, napthalene, fluorene, pyrene. Residential Soil Direct Contact was exceeded for benzo(a)pyrene, and dibenzo(a,h)anthracene. Residential/Industrial Drinking Water Protection Criteria was exceeded for vinyl chloride and total cyanide. Residential/Industrial Soil Volatilization to Indoor Ai Inhalation Criteria was exceeded for vinyl chloride.	Engineering controls; groundwater monitoring; deed restriction
Empty Drum Storage Area	GSI Protection Criteria was exceeded for Se, Cu, Hg, phenanthrene, napthalene, fluoranthene. Residential Soil Direct Contact was exceeded for CN and As, 1,1,1-TCA, 1,1-DCE, and cis 1,2-DCE. Industrial Drinking Water Protection Criteria was exceeded for Cu, Cd, 1,1,1-DCE, ethylbenzene, 1,1,1-TCA, 1,1,2-TCA, vinyle chloride, and total cyanide. Residential/Industrial Drinking Water Protection Criteria was exceeded for 1,1-DCA and Zn. Residential/Industrial Soil Volatilization to Indoor Ai Inhalation Criteria was exceeded for 1,1-DCE.	Removal of impacted soil limits composed by plan engineer controls; groundwater deed restriction—interim measures/reports of these finding were created.
Former Drum Storage Area	GSI Protection Criteria was exceeded for Se, Cu, Hg, phenanthrene, napthalene, fluoranthene. Industrial Soil Direct Contact was exceeded for PCBs benzo(a)pyrene.	Groundwater monitoring; deed restricting
Current Drum Storage Area	GSI Protection Criteria was exceeded for Se and xylenes. Industrial Soil Direct Contact was exceeded for PCBs. Residential/Industrial Soil Volatilization to Indoor Ai Inhalation Criteria was exceeded for 1,1-DCE.	Groundwater monitoring; deed restricting
Filter Press Area	GSI Protection Criteria was exceeded for Se and Cu.	Groundwater monitoring; deed restricting
Dead Tree Area	GSI Protection Criteria was exceeded for Se, Cu, Hg, phenanthrene, fluoranthene, trichloroethylene, and Ag. Residential Soil Direct Contact was exceeded for benzo(a)pyrene	Engineering controls; groundwater monitoring; deed restriction
Former Area D Tower Area	GSI Protection Criteria was exceeded for Se, Cu, Hg, Ni, Ag, Zn. Residential/Industrial Drinking Water Protection Criteria was exceeded for As, Hg, Ni. Residential Direct Contact Criteria was exceeded for As and Cu.	Groundwater monitoring; deed restriction
West Lagoon	GSI Protection Criteria was exceeded for Se. Residential/Industrial Drinking Water Protection Criteria was exceeded for Se. Residential Direct Contact Criteria was exceeded for As.	Deed restriction
SB01-06 Area	Site Specific Direct Contact Criteria was exceeded for PCBs.	Removal of impacted soil limits composed by plan engineer controls; groundwater deed restriction

B2.G ESTABLISHED OR PROPOSED CLEANUP CRITERIA
[R 299.9629(3)(a)(ii) and (iii) and R 299.9629(3)(b)(ii) and (iii)]

Remedial investigation activities are currently ongoing. Established criteria for comparison of analytical data will be the Michigan Department of Environmental Quality PA 451 Part 201 Nonresidential Generic Cleanup Criteria (December 30, 2013). Some site specific criteria have also been developed.

B2.H ESTABLISHED OR PROPOSED COMPLIANCE POINTS AND PERIODS
[R 299.9629(3)(a)(iv) and (v) and R 299.9629(3)(b)(iv) and (v)]

No compliance points and or periods have been proposed or established as investigations currently ongoing.

B2.I OFF-SITE ACCESS

No information available,

B2.J PUBLIC INVOLVEMENT PLAN

No information available.

B2.K HEALTH AND SAFETY PLAN

A Health and Safety Plan related to conducting Remedial Investigation at the Ford Monroe River Raisin Warehouse has been completed and a copy is held at the River Raisin Warehouse.

B2.L NOTICE REQUIREMENTS
[R 299.9525]

A restrictive covenant for the River Raisin Warehouse was recorded by the Monroe County Register of Deeds. See Attachment B9, Restrictive Covenant.

B2.M JUSTIFICATION FOR PROPOSED ELIMINATION OF ANY WASTE MANAGEMENT UNIT FROM THE CORRECTIVE ACTION PROGRAM OR INTENT TO PROCEED WITH CORRECTIVE ACTIONS

Investigation activities for the SWMU's are ongoing. Once investigation activities are complete, a report detailing findings from remedial investigation activities will be developed and submitted to the MDEQ. It is anticipated that future corrective actions will be conducted with United States Environmental Protection Agency (USEPA) in accordance with the self-implementing cleanup procedures outlined in 40 CFR 761.61.

ATTACHMENT B2.E.1

ENVIRONMENTAL INDICATOR FORMS

DOCUMENTATION OF ENVIRONMENTAL INDIC DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRIS Code (CA 750)

Migration of Contaminated Groundwater Under Control

Facility Name:	Visteon Monroe
Facility Address:	3200 East Elm Avenue, Monroe, Michigan
Facility EPA ID #[1]:	MID 005 057 005

1. Has all available relevant/significant information on known and reasonably suspected releases to the groundwater media, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated United (RU), and Areas of Concern (AOC)), been **considered** in this EI determination?

   ☒ If yes - check here and continue with #2 below.

   _____ If no - re-evaluate existing data, or

   _____ If data are not available, skip to #8 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Migration of Contaminated Groundwater Under Control" EI

A positive "Migration of Contaminated Groundwater Under Control" EI determination ("YE" status code) indicates that the migration of "contaminated" groundwater has stabilized, and that monitoring will be conducted to confirm that contaminated groundwater remains within the original "area of contaminated groundwater" (for all groundwater "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Migration of Contaminated Groundwater Under Control" EI pertains ONLY to the physical migration (i.e., further spread) of contaminated groundwater and contaminants within groundwater (e.g., non-aqueous phase liquids or NAPLs). Achieving this EI does not substitute for achieving other stabilization or final remedy requirements and expectations associated with sources of contamination and the need to restore, wherever practicable, contaminated groundwater to be suitable for its designated current and future uses.

Duration/Applicability of EI Determination

EI Determination status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

Migration of Contaminated Groundwater Under Control
Environmental Indicator (EI) RCRTS code (CA750)

2. Is **groundwater** known or reasonably suspected to be "**contaminated**"[1] above appropriately protective "levels" (i.e., applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action, anywhere at, or from, the facility?

- ☒ If yes - continue after identifying key contaminants, citing appropriate "levels," and referencing supporting documentation.
- ____ If no - skip to #8 and enter "YE" status code, after citing appropriate "levels," and referencing supporting documentation to demonstrate that groundwater is not "contaminated."
- ____ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

The Visteon Monroe Plant is located in the City of Monroe, Monroe County, Michigan. Figure 1 (attached) depicts the location of the Monroe Plant relative to the major topographic landforms and nearby roadways. Figure 2 (attached) shows the site layout in more detail, including the location of monitoring wells, piezometers, and stream gage reference points. As can be seen in the figures, the site is located on and adjacent to wetlands areas, approximately 0.75 miles west of the western shore of Lake Erie, and north of the mouth of the River Raisin. The River forms the southern boundary of the site, while an intake canal forms the northern boundary. Sterling State Park is located immediately north of the intake canal. Wetlands border the site to the east and west. The nearest residential properties are located approximately 0.5 miles to the north of the site. Figure 2 also provides groundwater piezometric elevation data from September 2004. As can be seen in the figure, groundwater flow at the facility is generally radially outward from the center of the plant or topographically high area towards the surrounding surface water bodies or topographically low areas.

On March 27, 1995, the facility was issued a Post-Closure Operating License by the Michigan Department of Environmental Quality that specified post-closure care procedures for the on-site Corrective Action Management Unit (CAMU). The Post-Closure Operating License also contained corrective action requirements the facility had to comply with, including conducting a RCRA Facility Investigation and Site-Wide Groundwater Investigation. Drafts of those Reports were completed in 2002, and those investigations provide the basis for the data referenced in this Environmental Indicator Form. Corrective Action activities at the site are currently still on-going.

The appropriate regulatory standards implemented for the above-referenced on-going site investigations and this Environmental Indicator determination are the risk-based media specific criteria promulgated in State of Michigan's Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Act 451).

Table 1 (attached) summarizes the Part 201 drinking water protection and groundwater surface water interface (GSI) criteria exceedances in the facility's monitoring wells. There are two groundwater monitoring systems at the facility; one is the detection monitoring program associated with the Eastern Containment Unit (ECU) and Western Containment Unit (WCU) CAMU (PCW-1 through PCW-14), and the other is the monitoring system put in as part of the groundwater investigation being undertaken as part of the corrective action program (GW-1 through GW-16). The location of all the monitoring wells is shown in Figure 2. The detection monitoring PCW series wells were sampled in duplicate on a quarterly frequency for two years starting in March of 2000, and since March of 2002 to the present have been sampled on a semi-annual frequency. Twelve of the sixteen GW wells were sampled quarterly in 2001 as part of the RFI. As shown in the table, exceedances were present at all 12 GW-series wells sampled, and all 14 of the PCW-series wells. As also shown in the table, the bulk of the exceedances are for inorganic contaminants (metals and cyanide), with organic contaminants present more sporadically.

References:
1) July 26, 2002 Groundwater Investigation Report [Mannik & Smith Group]
2) July 26, 2003 RCRA Facility Investigation Report [Mannik & Smith Group]
3) July 30, 2004 Environmental Monitoring Report
4) November 10, 2004 Hydraulic Monitoring Report

Footnotes:

1 "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriate "levels" (appropriate for the protection of the groundwater resource and its beneficial uses).

Migration of Contaminated Groundwater Under Control
Environmental Indicator (EI) RCRIS code (CA750)

3. Has the **migration** of contaminated groundwater **stabilized** (such that contaminated groundwater is expected to remain within "existing area of contaminated groundwater"[2] as defined by the monitoring locations designated at the time of this determination)?

☒ If yes - continue, after presenting or referencing the physical evidence (e.g., groundwater sampling/measurement/migration barrier data) and rationale why contaminated groundwater is expected to remain within the (horizontal or vertical) dimensions of the "existing area of groundwater contamination"[2]).

_____ If no (contaminated groundwater is observed or expected to migrate beyond the designated locations defining the "existing area of groundwater contamination"[2]) - skip to #8 and enter "NO" status code, after providing an explanation.

_____ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

As shown in Table 1 (attached), the concentrations of contaminants in the "GW" and "PCW" series wells are present above Part 201 drinking water protection and groundwater surface water interface (GSI) criteria appear to be relatively stable. As mentioned in the response to Question #2 above, the detection monitoring PCW-series monitoring wells were sampled in duplicate on a quarterly frequency for two years starting in March of 2000, and since March of 2002 to the present have been sampled on a semi-annual frequency. Twelve of the sixteen GW-series monitoring wells were sampled four times (quarterly) in 2001 as part of the RFI.

With respect to the PCW-series wells, Table 1 summarizes eleven separate sampling events representing the time period from March 2000 to the present. None of the wells reveal any parameter exceedance above Part 201 criteria in more than four of the eleven sampling events, most exceedances are present only once or twice in a given well over the approximate four year monitoring time-frame, and only PCW-1 had an exceedance in the most recent 12 months of monitoring. As shown in Table 1, cyanide was detected at 33 ug/L in June of 2004 (most recent sampling event for which data is available); however it was only detected one other time previous to that (3/12/02 at 6 ug/L). This data indicates that none of the wells reveal a significant increasing concentration trend versus time for any parameter. It should be noted that as part of the construction of the ECU and WCU CAMU units, approximately one million cubic yards of source material associated with the former lagoon WWTP system were excavated and placed in the ECU and WCU, leaving little source material present in the vicinity of the ECU and WCU. It should also be noted that the ECU and WCU were designed such that the direction of groundwater flow in the vicinity of the units was inward (i.e. toward the units). Although documentation regarding compliance with this design specification is still under development, the presence of an inward gradient toward the units will tend to stabilize any potential migration of contaminated groundwater.

With respect to the GW-series wells, it should be noted that only four sets of samples were taken over an approximately one year time frame; therefore, it is difficult to obtain any long-term trend information from the data. Additional data will be collected as part of the on-going corrective action activities in the area. However, based on the data collected and summarized in Table 1, it appears that relatively stable concentrations of detected contaminants are present. Nine of the twelve monitoring wells sampled had sporadic exceedances without any single parameter present above Part 201 criteria in every sampling event; and most exceedances were present in only one or two of the sampling events without any significant increasing concentration trend. In the three monitoring wells where a parameter was present above Part 201 criteria in all four sampling events (GW-11R, GW-15, and GW-16), it also appears that relatively stable concentrations are present without any significant increasing concentration trend. This is shown graphically in Figures 3, 4, and 5 where concentration versus time plots are shown for the most significant contaminants present in monitoring wells GW-11R, GW-15, and GW-16, respectively. This data indicates that none of the wells reveal a significant increasing concentration trend versus time for any parameter. In addition, it should be noted that 18,000 cubic yards of source material associated with the Former Empty Drum Storage Area (EDSA) were excavated and disposed of off-site as an Interim Corrective Measure as part of the on-going corrective action at the facility. The removal of this source material should also promote stabilization of groundwater contamination concentrations downgradient from its former location in the vicinity of GW-16. The data from GW-16 in Table 1 is prior to the excavation of source material; therefore, current and future concentrations are expected to be significantly reduced. Monitoring Well GW-16 was required to be abandoned during excavation activities. However, a new downgradient monitoring well has been installed in the area; results from its initial sampling are pending.

This data indicates that the migration of contaminated groundwater has stabilized at the facility, due in large part to the implementation of significant source removal and control activities. Implementation of final corrective measures to remediate existing groundwater contamination on-site consistent with all State and Federal law will continue as part of the facility's corrective action program being conducted under the authority of the Post-Closure Operating License.

References:
1) July 26, 2002 Groundwater Investigation Report [Mannik & Smith Group]
2) July 26, 2003 RCRA Facility Investigation Report [Mannik & Smith Group]
3) July 30, 2004 Environmental Monitoring Report
4) November 10, 2004 Hydraulic Monitoring Report

2 "existing area of contaminated groundwater" is an area (with horizontal and vertical dimensions) that has been verifiably demonstrated to contain all relevant groundwater-contamination for this determination, and is defined by designated (monitoring) locations proximate to the outer perimeter of "contamination" that can and will be sampled/tested in the future to physically verify that all "contaminated" groundwater remains within this area, and that the further migration of "contaminated" groundwater is not occurring. Reasonable allowances in the proximity of the monitoring locations are permissible to incorporate formal remedy decisions (i.e., including public participation) allowing a limited area for natural attenuation.

Migration of Contaminated Groundwater Under Control
Environmental Indicator (EI) RCRIS code (CA750)

4. Does "contaminated" groundwater **discharge** into **surface water** bodies?

☒ If yes - continue after identifying potentially affected surface water bodies.

_____ If no - skip to #7 (and enter a "YE" status code in #8, if #7 = yes) after providing an explanation and/or referencing documentation supporting that groundwater "contamination" does not enter surface water bodies.

_____ If unknown - skip to #8 and enter "IN" status code.

Rationale and Reference(s):

Contaminants discharging to surface water above MDEQs Groundwater Surface Water Interface (GSI) Criteria are summarized in Table 2 (attached). This table differs from Table 1 in that only wells located directly adjacent to water bodies are included in the table, and only exceedances above the GSI are included in the data summary. The table also indicates what surface water body a given well is located adjacent to and assumed to be venting groundwater to. The location of the monitoring wells is shown in Figure 2 (attached). As shown in the table, exceedances above GSI criteria were noted in nine of the PCW-series monitoring wells, and nine of the GW-series monitoring wells. As also shown in the table, the bulk of the exceedances are for inorganic contaminants (metals and cyanide), with organic contaminants present more sporadically.

References:
1) July 26, 2002 Groundwater Investigation Report [Mannik & Smith Group]
2) July 26, 2003 RCRA Facility Investigation Report [Mannik & Smith Group]
3) July 30, 2004 Environmental Monitoring Report
4) November 10, 2004 Hydraulic Monitoring Report

5. Is the **discharge** of "contaminated" groundwater into surface water likely to be "**insignificant**" (i.e., the maximum concentration[3] of each contaminant discharging into surface water is less than 10 times their appropriate groundwater "level," and there are no other conditions (e.g., the nature, and number, of discharging contaminants, or environmental setting), which significantly increase the potential for unacceptable impacts to surface water, sediments, or eco-systems at these concentrations)?

☒ If yes - skip to #7 (and enter "YE" status code in #8 if #7 = yes), after documenting: 1) the maximum known or reasonably suspected concentration[3] of key contaminants discharged above their groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) provide a statement of professional judgment/explanation (or reference documentation)- supporting that the discharge of groundwater contaminants into the surface water is not anticipated to have unacceptable impacts to the receiving surface water, sediments, or eco-system.

If no - (the discharge of "contaminated" groundwater into surface water is potentially significant) - continue after documenting: 1) the maximum known or reasonably suspected concentration[3] of each contaminant discharged above its groundwater "level," the value of the appropriate "level(s)," and if there is evidence that the concentrations are increasing; and 2) for any contaminants discharging into surface water in concentrations[3] greater than 100 times their appropriate groundwater "levels," the estimated total amount (mass in kg/yr) of each of these contaminants that are being discharged (loaded) into the surface water body (at the time of the determination), and identify if there is evidence that the amount of discharging contaminants is increasing.

____ If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

All of the exceedances detected above Part 201 GSI criteria (Table 2) are present at concentrations less than 10 times the GSI criteria with the exception of mercury detected at 0.3 ug/L in GW-16 in May 2001. Therefore, all of the GSI exceedances with the exception of the mercury in GW-16 are likely to be insignificant. With respect to the mercury detection in GW-16, it was not detected in any of the other three sampling events conducted at GW-16; therefore, its presence has not been confirmed and its presence is not considered significant at this time. As mentioned in the response to Question #3 above, it should be noted that approximately one million cubic yards of source material associated with the former lagoon WWTP system were excavated and placed in the ECU and WCU, and approximately 18,000 cubic yards of source material associated with the Former Empty Drum Storage Area (EDSA) were excavated and disposed of off-site as an Interim Corrective Measure as part of the on-going corrective action at the facility. The removal of this source material appears to have promoted stabilization of groundwater contamination concentrations, including the discharge of contaminated groundwater to surface water. As also mentioned in the response to Question #3 above, it should be noted that the ECU and WCU were designed such that the direction of groundwater flow in the vicinity of the units was inward (i.e, toward the units). Although documentation regarding compliance with this design specification is still under development, the presence of an inward gradient toward the units will tend to stabilize any potential migration of contaminated groundwater to surface water. With respect to groundwater contamination associated with the Former Empty Drum Storage Area, the data from downgradient monitoring well GW-16 in Table 1 and 2 is prior to the excavation of source material; therefore, current and future concentrations are expected to be significantly reduced. Monitoring Well GW-16 was required to be abandoned during excavation activities. However, a new downgradient monitoring well has been installed in the area and results from its initial sampling are pending.

As mentioned previously, the site-wide RCRA Facility Investigation is still on-going at the facility. Therefore, a final remedy to address the discharge of contaminated groundwater above the Part 201 GSI criteria to the surrounding surface water bodies has not been developed. In terms of the EI determination, the current discharge of contaminated groundwater to the surrounding surface water bodies is thought to be acceptable and protective of receiving surface water, sediments, and ecosystems until such time that a final remedy can be implemented. As part of a final remedy to eliminate contaminated groundwater discharges above GSI criteria, it is expected that a mixing zone determination will be implemented. It is also possible that some type of flow barrier/groundwater collection system may be necessary.

References:
1) July 26, 2002 Groundwater Investigation Report [Mannik & Smith Group]
2) July 26, 2003 RCRA Facility Investigation Report [Mannik & Smith Group]
3) July 30, 2004 Environmental Monitoring Report
4) November 10, 2004 Hydraulic Monitoring Report

3 As measured in groundwater prior to the groundwater-surface water/sediment interaction (e.g., hyphorheic) zone.

Migration of Contaminated Groundwater Under Control
Environmental Indicator (EI) RCRIS code (CA750)

6. Can the **discharge** of "contaminated" groundwater into surface water be shown to be "**currently acceptable**" (i.e., not cause impacts to surface water, sediments or eco-systems that should not be allowed to continue until a final remedy decision can be made and implemented[4])?

_____ If yes - continue after either: 1) identifying the Final Remedy decision incorporating these conditions, or other site-specific criteria (developed for the protection of the site's surface water, sediments, and eco-systems), and referencing supporting documentation demonstrating that these criteria are not exceeded by the discharging groundwater; OR
2) providing or referencing an interim-assessment,[5] appropriate to the potential for impact, that shows the discharge of groundwater contaminants into the surface water is (in the opinion of a trained specialists, including ecologist) adequately protective of receiving surface water, sediments, and eco-systems, until such time when a full assessment and final remedy decision can be made. Factors which should be considered in the interim-assessment (where appropriate to help identify the impact associated with discharging groundwater) include: surface water body size, flow, use/classification/habitats and contaminant loading limits, other sources of surface water/sediment contamination, surface water and sediment sample results and comparisons to available and appropriate surface water and sediment "levels," as well as any other factors, such as effects on ecological receptors (e.g., via bio-assays/benthic surveys or site-specific ecological Risk Assessments), that the overseeing regulatory agency would deem appropriate for making the EI determination.

_____ If no - (the discharge of "contaminated" groundwater can not be shown to be "**currently acceptable**") - skip to #8 and enter "NO" status code, after documenting the currently unacceptable impacts to the surface water body, sediments, and/or eco-systems.

_____ If unknown - skip to 8 and enter "IN" status code.

Rationale and Reference(s):

4 Note, because areas of inflowing groundwater can be critical habitats (e.g., nurseries or thermal refugia) for many species, appropriate specialist (e.g., ecologist) should be included in management decisions that could eliminate these areas by significantly altering or reversing groundwater flow pathways near surface water bodies.

5 The understanding of the impacts of contaminated groundwater discharges into surface water-bodies is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration to be reasonably certain that discharges are not causing currently unacceptable impacts to the surface waters, sediments or eco-systems.

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7 Will groundwater **monitoring**/measurement data (and surface water/sediment/ecological data, as necessary) be collected in the future to verify that contaminated groundwater has remained within the horizontal (or vertical, as necessary) dimensions of the "existing area of contaminated groundwater?"

☒ If yes-continue after providing or citing documentation for planned activities or future sampling/measurement events. Specifically identify the well/measurement locations which will be tested in the future to verify the expectation (identified in #3) that groundwater contamination will not be migrating horizontally (or vertically, as necessary) beyond the "existing area of groundwater contamination.

_____ If no - enter "NO" status code in #8.

_____ If unknown - enter "IN" status code in #8.

Rationale and Reference(s):

On-going semi-annual monitoring of the PCW-series of monitoring wells will be conducted as part of the detection monitoring program required by the facility's Post-Closure Operating License. Additional future sampling of selected GW-series monitoring wells will be required as part of the on-going Groundwater Investigation being conducted as part of corrective action activities at the facility. Corrective action is also authorized by the facility's Post-Closure Operating License.

References:

1) July 26, 2002 Groundwater Investigation Report [Mannik & Smith Group]
2) July 26, 2003 RCRA Facility Investigation Report [Mannik & Smith Group]
3) July 30, 2004 Environmental Monitoring Report
4) November 10, 2004 Hydraulic Monitoring Report

Migration of Contaminated Groundwater Under Control
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8. Check the appropriate RCRIS status codes for the Migration of Contaminated Groundwater Under Control EI (event code CA750), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (attach appropriate supporting documentation as well as a map of the facility).

☒ YE - Yes, "Migration of Contaminated Groundwater Under Control" has been verified. Based on a review of the information contained in this EI determination, it has been determined that the "Migration of Contaminated Groundwater" is "Under Control" at the Visteon Monroe facility, EPA ID # MID 005 057 005, located at 3200 East Elm Avenue, Monroe, Michigan. Specifically, this determination indicates that the migration of "contaminated groundwater" is under control, and that monitoring will be conducted to confirm that contaminated groundwater remains within the "existing area of contaminated groundwater". This determination will be re-evaluated when the Agency becomes aware of significant changes at the facility.

____ NO - Unacceptable migration of contaminated groundwater is observed or expected.

____ IN - More information is needed to make a determination.

Completed by (signature) Joe Rogers Date **March 25, 2005**
(print) Joseph Rogers
(title) Sr. Geologist

Supervisor (signature) David Slayton Date **March 25, 2005**
(print) David Slayton
(title) Acting Technical Support Unit Chief
(EPA Region or State) **State of Michigan, DEQ**

Location where References may be found:
MICHIGAN DEPARTMENT OF ENVIRONMENTAL QUALITY, WASTE AND HAZARDOUS MATERIALS DIVISION, CONSTITUTION HALL, ATRIUM LEVEL, NORTH TOWER, 525 WEST ALLEGAN STREET, LANSING, MICHIGAN 48933.

Contact telephone and e-mail numbers

(name) Joseph Rogers
(phone#) 517-373-9897
(e-mail) rogersjt@michigan.gov

Table 1 - Visteon Monroe Groundwater Part 201 Exceedances Summary - GW Series Monitoring Wells

GW Wells	Parmeter/Concentration	Date	201 Exceedances
GW-2	Antimony - 13 ug/L Copper - 33 ug/L Antimony - 8.3 ug/L Bis (2-Ethylhexyl) Phthalate - 16 ug/L	January 31, 2001 January 31, 2001 May 24, 2001 December 5, 2001	Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (25 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L)
GW-5	Selenium-5.4 ug/L Antimony - 9.3 ug/L Antimony - 7.7 ug/L Vanadium - 14 ug/L	January 31, 2001 January 31, 2001 May 23, 2001 August 28, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (12 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (4.5 ug/L)
GW-7	Selenium-27 ug/L Antimony - 6.1 ug/L Antimony - 10 ug/L	February 1, 2001 February 1, 2001 May 23, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
GW-8	Selenium-6.9 ug/L Antimony - 42 ug/L	February 1, 2001 February 1, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
GW-9	Selenium-6.7 ug/L Antimony - 17 ug/L	February 2, 2001 February 2, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
GW-10	Selenium-12 ug/L Antimony - 9.7 ug/L Antimony - 12 ug/L	February 1, 2001 February 1, 2001 May 16, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
GW-11R	Arsenic - 130 ug/L Copper - 130 ug/L Lead - 42 ug/L Selenium 12 ug/L Vanadium - 32 ug/L Vinyl Chloride - 47 ug/L Antimony - 24 ug/L Arsenic - 180 ug/L Selenium-14 ug/L Vinyl Chloride - 14 ug/L Arsenic - 218 ug/L Vinyl Chloride - 18 ug/L Arsenic - 63 ug/L Vinyl Chloride - 11 ug/L Bis (2-Ethylhexyl) Phthalate - 59 ug/L	February 5, 2001 February 5, 2001 February 5, 2001 February 5, 2001 February 5, 2001 February 5, 2001 May 23, 2001 May 23, 2001 May 23, 2001 May 23, 2001 August 29, 2001 August 29, 2001 December 7, 2001 December 7, 2001 December 7, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (50 ug/L) Groundwater Surface Water Interface Criteria (25 ug/L) Residential, Commercial, and Industrial Drinking Water Criteria (4 ug/L) Groundwater Surface Water Interface Criteria (5 ug/L) Groundwater Surface Water Interface Criteria (12 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (4.5 ug/L) Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (150 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (50 ug/L) Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Groundwater Surface Water Interface Criteria (150 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (50 ug/L) Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Residential, Commercial, and Industrial Drinking Water Criteria (50 ug/L) Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Groundwater Surface Water Interface Criteria (32 ug/L)/Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L)
GW-12	Selenium-9.4 ug/L Antimony - 13 ug/L Vinyl Chloride-59 ug/L Selenium-8.2 ug/L Vinyl Chloride-22 ug/L Vinyl Chloride-66 ug/L Vinyl Chloride-57 ug/L	February 1, 2001 February 1, 2001 February 1, 2001 May 23, 2001 May 23, 2001 August 29, 2001 December 7, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Groundwater Surface Water Interface Criteria (5 ug/L) Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L) Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
GW-13	Selenium-10 ug/L Antimony - 7.1 ug/L Selenium-6.3 ug/L Bis (2-Ethylhexyl) Phthalate - 22 ug/L	February 2, 2001 February 2, 2001 May 16, 2001 December 7, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L)
GW-14	Selenium-6.9 ug/L Antimony - 16 ug/L Antimony - 10 ug/L	February 6, 2001 February 6, 2001 May 16, 2001	Groundwater Surface Water Interface Criteria (5 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L) Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)

Table 1 (cont.) - Visteon Monroe Groundwater Part 201 Exceedances Summary - GW Series Monitoring Wells

GW Wells	Parmeter/Concentration	Date	201 Exceedances
GW-15	Selenium - 11 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Antimony - 10 ug/L	February 6, 2001	Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
	Vinyl Chloride-170 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	Chloroethane - 1800 ug/L	February 6, 2001	Residential Drinking Water Criteria (430 ug/L), Commercial & Industrial Drinking Water Criteria (1700 ug/L)
	1,1-Dichloroethene - 5600 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (65 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (7 ug/L)
	Methylene Chloride - 630 ug/L	February 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1-Dichloroethane - 18000 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (740 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (880 ug/L)
	cis-1,2-Dichloroethene - 170 ug/L	February 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (70 ug/L)
	1,2-Dichloroethane - 61 ug/L	February 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1,1-Trichloroethane - 140000	February 6, 2001	Groundwater Surface Water Interface Criteria (200 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (200 ug/L)
	Trichloroethene - 41 ug/L	February 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1,2-Trichloroethane - 93 ug/L	February 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	Toluene - 320 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (140 ug/L)
	Ethylbenzene - 210 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (18 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (74 ug/L)
	Total Xylenes - 1100 ug/L	February 6, 2001	Groundwater Surface Water Interface Criteria (35 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (280 ug/L)
	Selenium - 11 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Antimony - 10 ug/L	May 24, 2001	Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
	Nickel - 110 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (100 ug/L)
	Chloroethane - 2200 ug/L	May 24, 2001	Residential Drinking Water Criteria (430 ug/L), Commercial & Industrial Drinking Water Criteria (1700 ug/L)
	1,1-Dichloroethene - 7000 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (65 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (7 ug/L)
	Methylene Chloride - 730 ug/L	May 24, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1-Dichloroethane - 18000 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (740 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (880 ug/L)
	cis-1,2-Dichloroethene - 170 ug/L	May 24, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (70 ug/L)
	1,2-Dichloroethane - 140 ug/L	May 24, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1,1-Trichloroethane - 150000	May 24, 2001	Groundwater Surface Water Interface Criteria (200 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (200 ug/L)
	Toluene - 370 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (140 ug/L)
	Ethylbenzene - 300 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (18 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (74 ug/L)
	Total Xylenes - 1500 ug/L	May 24, 2001	Groundwater Surface Water Interface Criteria (35 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (280 ug/L)
	Selenium - 11 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Vanadium - 14 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (12 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (4.5 ug/L)
	Vinyl Chloride 60 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	Chloroethane - 1900 ug/L	August 28, 2001	Residential Drinking Water Criteria (430 ug/L), Commercial & Industrial Drinking Water Criteria (1700 ug/L)
	1,1-Dichloroethene - 6000 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (65 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (7 ug/L)
	1,1-Dichloroethane - 13000 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (740 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (880 ug/L)
	cis-1,2-Dichloroethene - 210 ug/L	August 28, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (70 ug/L)
	1,1,1-Trichloroethane - 74000	August 28, 2001	Groundwater Surface Water Interface Criteria (200 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (200 ug/L)
	1,2-Dichloropropane - 11 ug/L	August 28, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	Trichloroethene - 38 ug/L	August 28, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1,2-Trichloroethane - 100 ug/L	August 28, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	Toluene - 500 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (140 ug/L)
	Ethylbenzene - 240 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (18 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (74 ug/L)
	1,1,2,2-Tetrachloroethane - 15 ug/L	August 28, 2001	Residential Drinking Water Criteria (8.5 ug/L)
	Total Xylenes - 1600 ug/L	August 28, 2001	Groundwater Surface Water Interface Criteria (35 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (280 ug/L)
	Selenium - 5.4 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Vinyl Chloride-200 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	Chloroethane - 1500 ug/L	December 6, 2001	Residential Drinking Water Criteria (430 ug/L), Commercial & Industrial Drinking Water Criteria (1700 ug/L)
	1,1-Dichloroethene - 4000 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (65 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (7 ug/L)
	Methylene Chloride - 600 ug/L	December 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1-Dichloroethane - 14000 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (740 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (880 ug/L)
	cis-1,2-Dichloroethene - 170 ug/L	December 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (70 ug/L)
	Chloroform - 80 ug/L	December 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (80 ug/L)
	1,1,1-Trichloroethane - 65000	December 6, 2001	Groundwater Surface Water Interface Criteria (200 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (200 ug/L)
	Trichloroethene - 42 ug/L	December 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	1,1,2-Trichloroethane - 190 ug/L	December 6, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (5 ug/L)
	Toluene - 210 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (140 ug/L)
	Ethylbenzene - 190 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (18 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (74 ug/L)
	Total Xylenes - 1400 ug/L	December 6, 2001	Groundwater Surface Water Interface Criteria (35 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (280 ug/L)
GW-16	Selenium-15 ug/L	February 2, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	PCBs (1248) - 2 ug/L	February 2, 2001	Groundwater Surface Water Interface Criteria (0.5 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (0.2 ug/L)
	Vinyl Chloride-55 ug/L	February 2, 2001	Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	Antimony - 21 ug/L	May 23, 2001	Residential, Commercial and Industrial Drinking Water Criteria (6 ug/L)
	Selenium - 19 ug/L	May 23, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Mercury - 0.50 ug/L	May 23, 2001	Groundwater Surface Water Interface Criteria (0.0013 ug/L)
	Vinyl Chloride-25 ug/L	May 23, 2001	Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	PCBs (1248) - 2.4 ug/L	May 23, 2001	Groundwater Surface Water Interface Criteria (0.5 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (0.2 ug/L)
	Selenium-6.7 ug/L	September 6, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Vinyl Chloride-28 ug/L	September 6, 2001	Groundwater Surface Water Interface Criteria (15 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	PCBs (1248) - 0.8 ug/L	September 6, 2001	Groundwater Surface Water Interface Criteria (0.5 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (0.2 ug/L)
	Selenium-5.2 ug/L	December 21, 2001	Groundwater Surface Water Interface Criteria (5 ug/L)
	Vinyl Chloride-11 ug/L	December 21, 2001	Residential, Commercial, and Industrial Drinking Water Criteria (2 ug/L)
	PCBs (1248) - 1.7 ug/L	December 21, 2001	Groundwater Surface Water Interface Criteria (0.5 ug/L); Residential, Commercial, and Industrial Drinking Water Criteria (0.2 ug/L)

Table 1 (cont.) - Visteon Monroe Groundwater Part 201 Exceedances Summary - PCW Series Monitoring Wells

PCW Wells	Parameter/Concentration	Date	201 Exceedances
PCW-1	Cadmium - 23.3 ug/L Cadmium - 7.3 ug/L Bis (2-Ethylhexyl) Phthalate - 24 ug/L Di-N-Butylphthalate - 25 ug/L Total Cyanide - 6 ug/L Total Cyanide - 31 ug/L	April 11, 2000 August 14, 2000 August 16, 2000 September 10, 2001 March 12, 2002 June 7, 2004	Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (8.2 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (9.7 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-2	Bis (2-Ethylhexyl) Phthalate - 7.3 ug/L Cadmium - 7.3 ug/L Cadmium - 7.8 ug/L Total Cyanide - 12 ug/L Total Cyanide - 7 ug/L	March 24, 2000 August 10, 2000 May 30, 2001 May 30, 2001 June 11, 2003	Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-3	Total Cyanide - 11.5 ug/L Total Cyanide - 7 ug/L Di-N-Butylphthalate - 10 ug/L Copper - 74 ug/L	May 31, 2001 March 1, 2002 September 10, 2001 December 8, 2003	Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (9.7 ug/L) Groundwater Surface Water Interface Criteria (29 ug/L)
PCW-4	Total Cyanide - 10 ug/L Total Cyanide - 6 ug/L Di-N-Butylphthalate - 23 ug/L	May 31, 2001 December 19, 2001 September 11, 2001	Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (9.7 ug/L)
PCW-5	Cadmium - 7.8 ug/L Copper - 30 ug/L Copper - 30 ug/L Total Cyanide - 10 ug/L Di-N-Butylphthalate - 41 ug/L Total Cyanide - 6 ug/L	February 1, 2001 February 1, 2001 May 29, 2001 December 20, 2001 September 11, 2001 December 27, 2002	Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (29 ug/L) Groundwater Surface Water Interface Criteria (29 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (9.7 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-6	Bis (2-Ethylhexyl) Phthalate - 9.7 ug/L Total Cyanide - 6 ug/L Total Cyanide - 6 ug/L Total Cyanide - 6 ug/L	March 21, 2000 May 29, 2001 September 6, 2001 February 26, 2002	Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-7	Total Cyanide - 7 ug/L Total Cyanide - 6 ug/L	June 5, 2002 June 11, 2003	Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-8	Total Cyanide - 6 ug/L Total Cyanide - 7 ug/L Total Cyanide - 7 ug/L Vinyl Chloride - 3.2 ug/L	May 30, 2001 September 17, 2001 December 21, 2001 March 30, 2000	Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (2 ug/L)
PCW-9	Total Cyanide - 59 ug/L Bis (2-Ethylhexyl) Phthalate - 6.9 ug/L Total Cyanide - 6 ug/L Total Cyanide - 19.5 ug/L Nickel - 115 ug/L Di-N-Butylphthalate - 22.6 ug/L Total Cyanide - 6 ug/L Naphthalene - 28 ug/L Phenanthrene - 18 ug/L Fluoranthene - 6.6 ug/L Bis (2-Ethylhexyl) Phthalate - 9.1 ug/L	March 24, 2000 January 24, 2001 May 31, 2001 September 11, 2001 September 11, 2001 September 11, 2001 December 19, 2001 December 19, 2001 December 19, 2001 December 19, 2001 December 19, 2001	Groundwater Surface Water Interface Criteria (5.2 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (100 ug/L) Groundwater Surface Water Interface Criteria (9.7 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (13 ug/L) Groundwater Surface Water Interface Criteria (2.4 ug/L) Groundwater Surface Water Interface Criteria (1.6 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L)
PCW-10	Bis (2-Ethylhexyl) Phthalate - 39 ug/L Cadmium - 10 ug/L Cadmium 18 ug/L Cadmium 11 ug/L Total Cyanide - 8 ug/L Bis (2-Ethylhexyl) Phthalate - 29 ug/L	March 29, 2000 August 9, 2000 January 24, 2001 May 30, 2001 May 30, 2001 December 30, 2002	Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L) Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (8.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L)
PCW-11	Bis (2-Ethylhexyl) Phthalate - 38 ug/L Total Cyanide - 8 ug/L Total Cyanide - 8 ug/L	May 30, 2001 December 20, 2001 February 28, 2002	Groundwater Surface Water Interface Criteria (32 ug/L)/Residential, Commercial, and Industrial Drinking Water Protection Criteria (6 ug/L Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-12	Total Cyanide - 7 ug/L Total Cyanide - 7 ug/L	December 19, 2001 February 20, 2002	Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-13	Total Cyanide - 10 ug/L Di-N-Butylphthalate - 18 ug/L Total Cyanide - 6 ug/L Total Cyanide - 8 ug/L	September 10, 2001 September 10, 2001 December 19, 2001 January 2, 2003	Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (9.7 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)
PCW-14	Copper - 30 ug/L Total Cyanide - 9 ug/L Total Cyanide - 9 ug/L	March 31, 2000 December 19, 2001 January 2, 2003	Groundwater Surface Water Interface Criteria (29 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L) Groundwater Surface Water Interface Criteria (5.2 ug/L)

Table 2 - Visteon Monroe Groundwater Part 201 GSI Exceedances Summary

GW Wells	Parmeter/Concentration	Date	201 Exceedances	Venting Water Body
GW-2	Copper - 33 ug/L	January 31, 2001	Groundwater Surface Water Interface Criteria - 29 ug/L	West Marsh
GW-5	Selenium-5.4 ug/L Vanadium - 14 ug/L	January 31, 2001 August 28, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 12 ug/L	River Raisin
GW-7	Selenium-27 ug/L	February 1, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L	River Raisin
GW-8	Selenium-5.9 ug/L	February 1, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L	River Raisin
GW-9	Selenium-6.7 ug/L	February 2, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L	River Raisin
GW-10	Selenium-12 ug/L	February 1, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L	River Raisin
GW-12	Selenium-9.4 ug/L Vinyl Chloride-59 ug/L Selenium-9.2 ug/L Vinyl Chloride-22 ug/L Vinyl Chloride-66 ug/L Vinyl Chloride-57 ug/L	February 1, 2001 February 1, 2001 May 23, 2001 May 23, 2001 August 29, 2001 December 7, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L	River Raisin
GW-13	Selenium-10 ug/L Selenium-6.3 ug/L	February 2, 2001 May 16, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 5 ug/L	North Marsh
GW-18	Selenium-15 ug/L PCBs (1248) - 2 ug/L Vinyl Chloride-39 ug/L Selenium-19 ug/L Mercury-0.30 ug/L Vinyl Chloride-25 ug/L PCBs (1248) - 2.4 ug/L Selenium-6.7 ug/L Vinyl Chloride-28 ug/L PCBs (1248) - 0.9 ug/L Selenium-5.2 ug/L PCBs (1248) - 1.7 ug/L	February 2, 2001 February 2, 2001 February 2, 2001 May 23, 2001 May 23, 2001 May 23, 2001 May 23, 2001 September 6, 2001 September 6, 2001 September 6, 2001 December 21, 2001 December 21, 2001	Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 0.5 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 0.0013 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L Groundwater Surface Water Interface Criteria - 0.5 ug/L Groundwater Surface Water Interface Criteria 5 ug/L Groundwater Surface Water Interface Criteria - 15 ug/L Groundwater Surface Water Interface Criteria - 0.5 ug/L Groundwater Surface Water Interface Criteria - 5 ug/L Groundwater Surface Water Interface Criteria - 0.5 ug/L	West Marsh
PCW Wells				
PCW-4	Total Cyanide - 10 ug/L Total Cyanide - 6 ug/L Di-N-Butylphthalate - 23 ug/L	May 31, 2001 December 19, 2001 September 11, 2001	Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 9.7 ug/L	North Marsh
PCW-5	Cadmium - 7.8 ug/L Copper - 30 ug/L Copper - 30 ug/L Total Cyanide - 10 ug/L Di-N-Butylphthalate - 41 ug/L Total Cyanide - 6 ug/L	February 1, 2001 February 1, 2001 May 29, 2001 December 26, 2001 September 11, 2001 December 27, 2002	Groundwater Surface Water Interface Criteria - 6.2 ug/L Groundwater Surface Water Interface Criteria - 29 ug/L Groundwater Surface Water Interface Criteria - 29 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 9.7 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	East Marsh
PCW-6	Total Cyanide - 6 ug/L Total Cyanide - 6 ug/L Total Cyanide - 9 ug/L	May 29, 2001 September 6, 2001 February 26, 2002	Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	East Marsh
PCW-7	Total Cyanide - 7 ug/L Total Cyanide- 8 ug/L	June 6, 2002 June 11, 2003	Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	East Marsh
PCW-9	Total Cyanide - 55 ug/L Total Cyanide - 6 ug/L Total Cyanide - 19.5 ug/L Di-N-Butylphthalate - 22.5 ug/L Total Cyanide - 6 ug/L Naphthalene - 28 ug/L Phenanthrene - 18 ug/L Fluoranthene - 6.6 ug/L	March 24, 2000 May 31, 2001 September 11, 2001 September 11, 2001 December 19, 2001 December 19, 2001 December 19, 2001 December 19, 2001	Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 9.7 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 13 ug/L Groundwater Surface Water Interface Criteria - 2.4 ug/L Groundwater Surface Water Interface Criteria - 1.6 ug/L	West Marsh
PCW-10	Cadmium - 10 ug/L Cadmium 18 ug/L Cadmium 11 ug/L Total Cyanide - 9 ug/L	August 9, 2000 January 24, 2001 May 30, 2001 May 30, 2001	Groundwater Surface Water Interface Criteria - 6.2 ug/L Groundwater Surface Water Interface Criteria - 6.2 ug/L Groundwater Surface Water Interface Criteria - 6.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	East Marsh
PCW-12	Total Cyanide - 7 ug/L Total Cyanide - 7 ug/L	December 19, 2001 February 26, 2002	Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	East Intake Canal
PCW-13	Total Cyanide - 10 ug/L Di-N-Butylphthalate - 16 ug/L Total Cyanide - 8 ug/L Total Cyanide - 9 ug/L	September 10, 2001 September 10, 2001 December 19, 2001 January 2, 2003	Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 9.7 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	East/North Intake Canal
PCW-14	Copper - 30 ug/L Total Cyanide - 9 ug/L Total Cyanide - 9 ug/L	March 31, 2000 December 19, 2001 January 2, 2003	Groundwater Surface Water Interface Criteria - 29 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L Groundwater Surface Water Interface Criteria - 5.2 ug/L	North Intake Canal

Figure 3 - GW-11R Concentration Vs. Time Plots

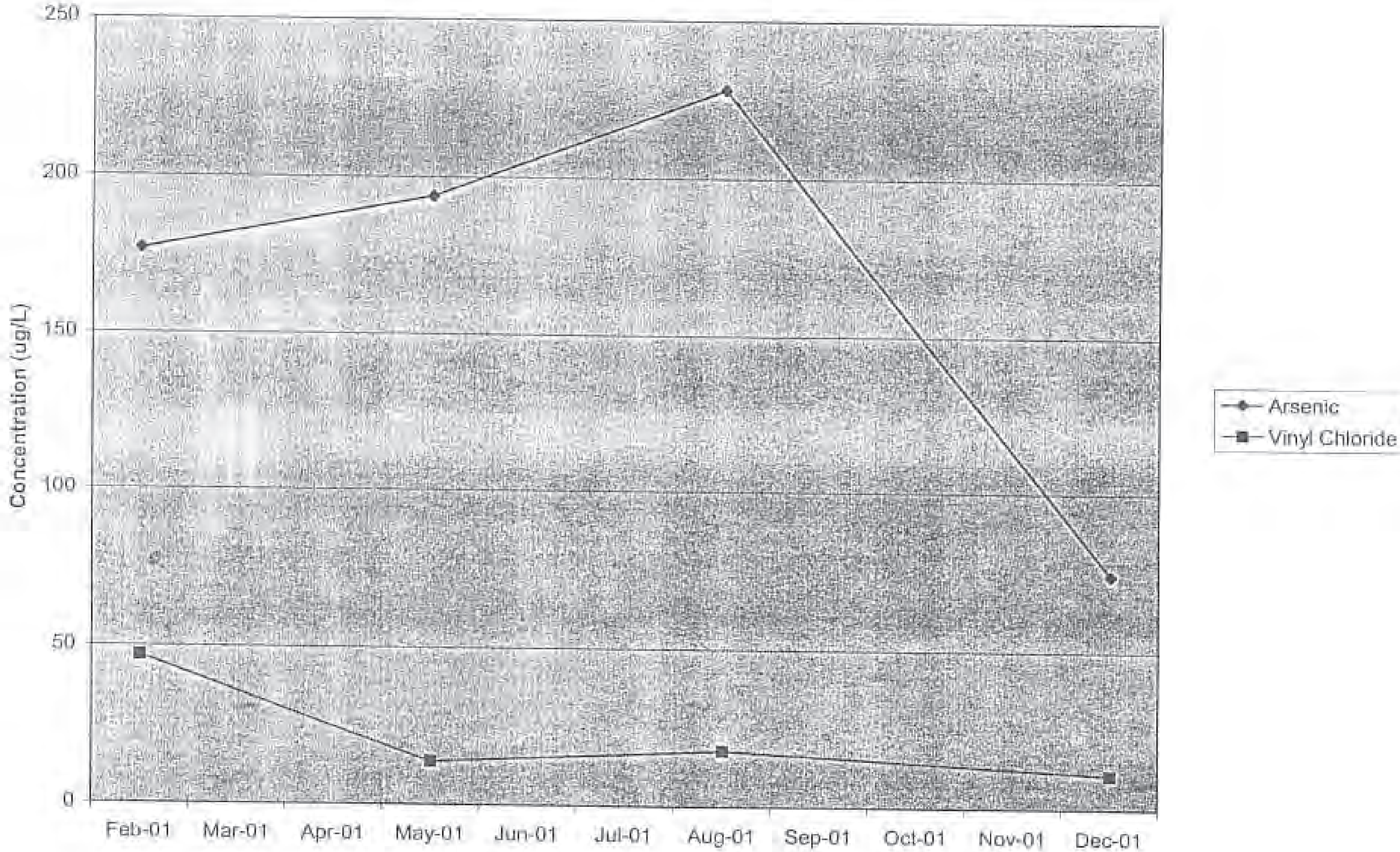


Figure 4 - GW-15 Concentration Vs. Time Plots

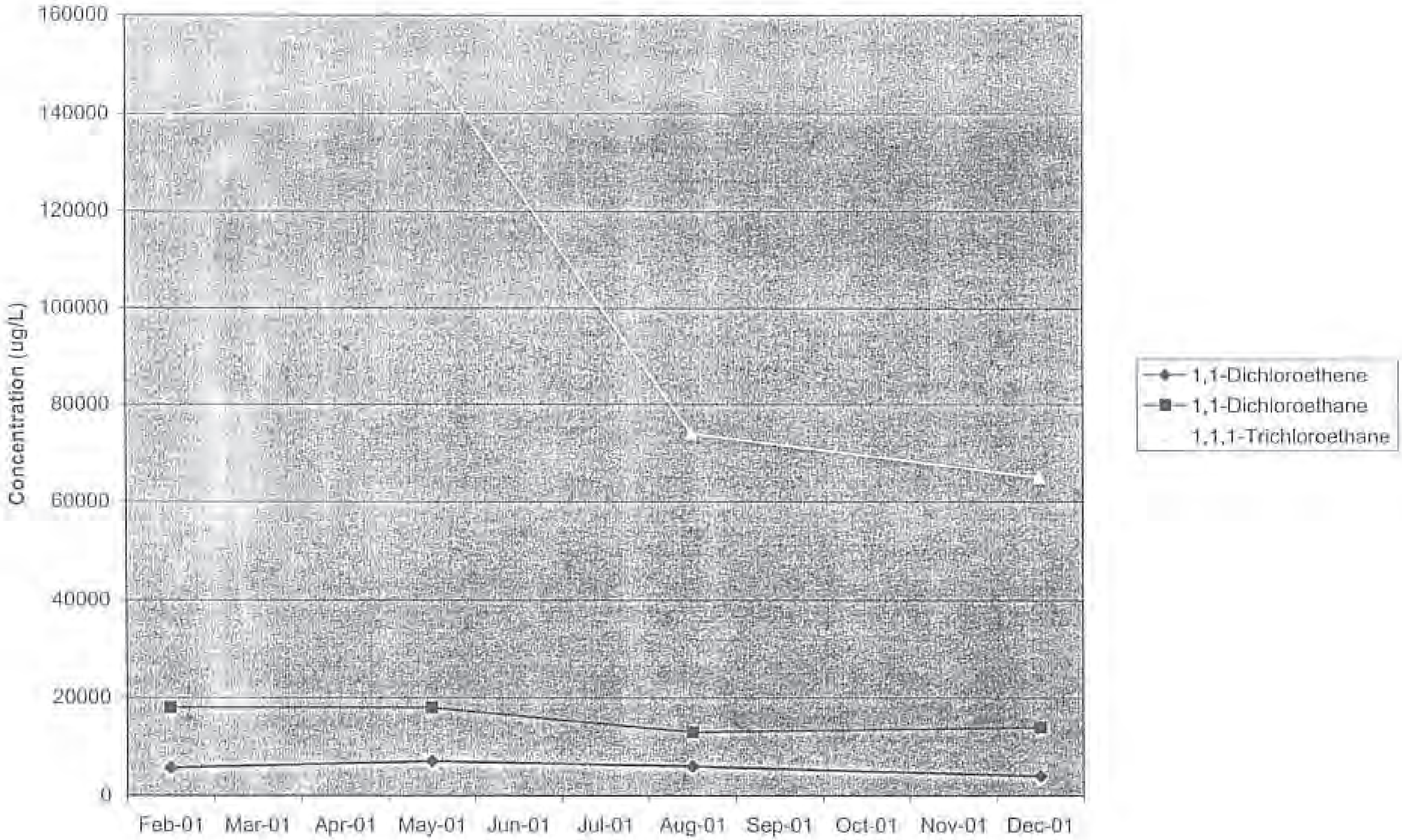
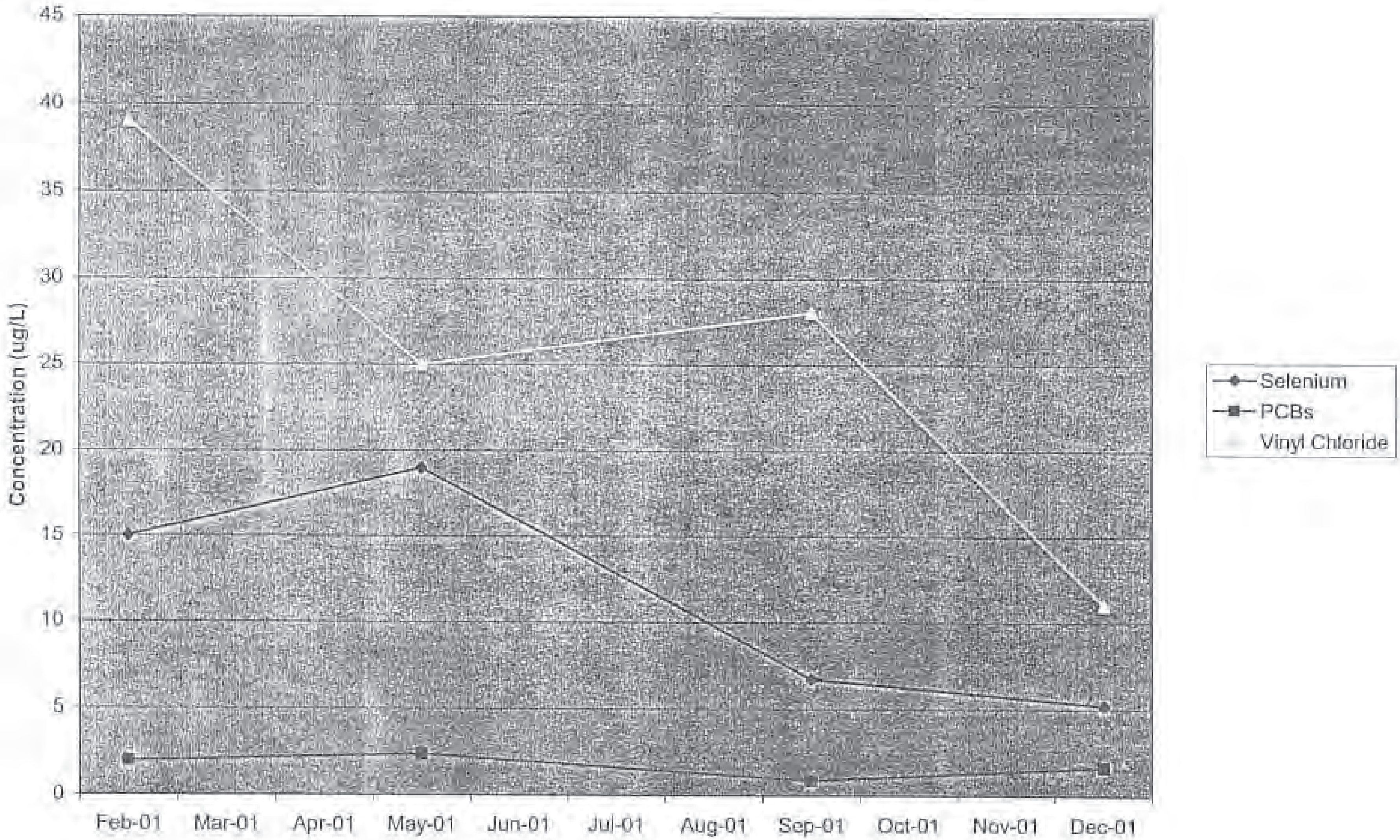


Figure 5 - GW-16 Concentration Vs. Time Plots



CA FILE ..-005

CA 725
Human Exposures Controlled Determination
Data Entry Form

FACILITY NAME:	VISTEON CORP MONROE STAMPING PLT		
MID NUMBER:	MID 005 057 005	CONTROLLED?:	Yes
STREET ADDRESS:	3200 E ELM AVE	EVALUATION DATE:	09/28/2001
CITY:	MONROE	LEAD AGENCY:	WMD
COUNTY:	MONROE	GPRA UNIVERSE(S)	CA, PC

Has all information on releases to the following media been considered	Yes
Is Indoor Air contaminated above selected Part 201 land-use based criteria?	No
Is Surface Soil (<2 ft. bgs) contaminated above selected Part 201 land-use based criteria	Yes
Is Surface Water contaminated above selected Part 201 land-use based criteria?	No
Are Sediments contaminated above selected Part 201 land-use based criteria?	No
Is Subsurface Soil (>2 ft. bgs) contaminated above selected Part 201 land-use based criteria	Yes
Is Outdoor Air contaminated above selected Part 201 land-use based criteria?	No
Is Groundwater contaminated above selected Part 201 land-use based criteria?	Yes
Are any media contaminated above selected Part 201 land-use based criteria?	Yes

List the Key Contaminants associated with each media contaminated above Part 201 criteria her

Please see attached list and Mannik & Smith July 25, 2001, "Documentation of Environmental indicator Determination" Report and a Michigan Department of Environmental Quality list of parameters that exceed Part 201 criteria

List any Complete Pathways for contaminants and human receptors.	GW, Surf Soil, Subsurf Soil
List the Human Receptors that may be affected by contamination	W, T
Are exposures from complete pathways expected to be significant?	No
Are significant exposures from complete pathways within acceptable limits	Yes

Provide a rationale and references justifying answers to the above questions here

Potential surface soil exposures (direct contact and/or particulate soil inhalation exceedances) are controlled by barriers and signage restricting access. Potential sub-surface soil exposures (direct contact and/or particulate soil inhalation exceedances) are controlled via a Standard Operating Procedure (SOP) in place restricting disturbance of soils without prior approval from environmental department (a copy attached). The Health and Safety Plan (HASP) implemented to address any potential exposure will be given to all contractors who will work at any Solid Waste Management Units (SWMUs) (a copy attached).

Potential groundwater exposures (drinking water criteria) controlled since impacted groundwater not used as a drinking water source. A deed restriction will be placed on the land upon completion of the remediation and corrective action at the SWMUs.

Provide the physical location of any references cited here (file name, library, etc.

All references attached. Additional details provided in Project Files and HWPS Library documents.

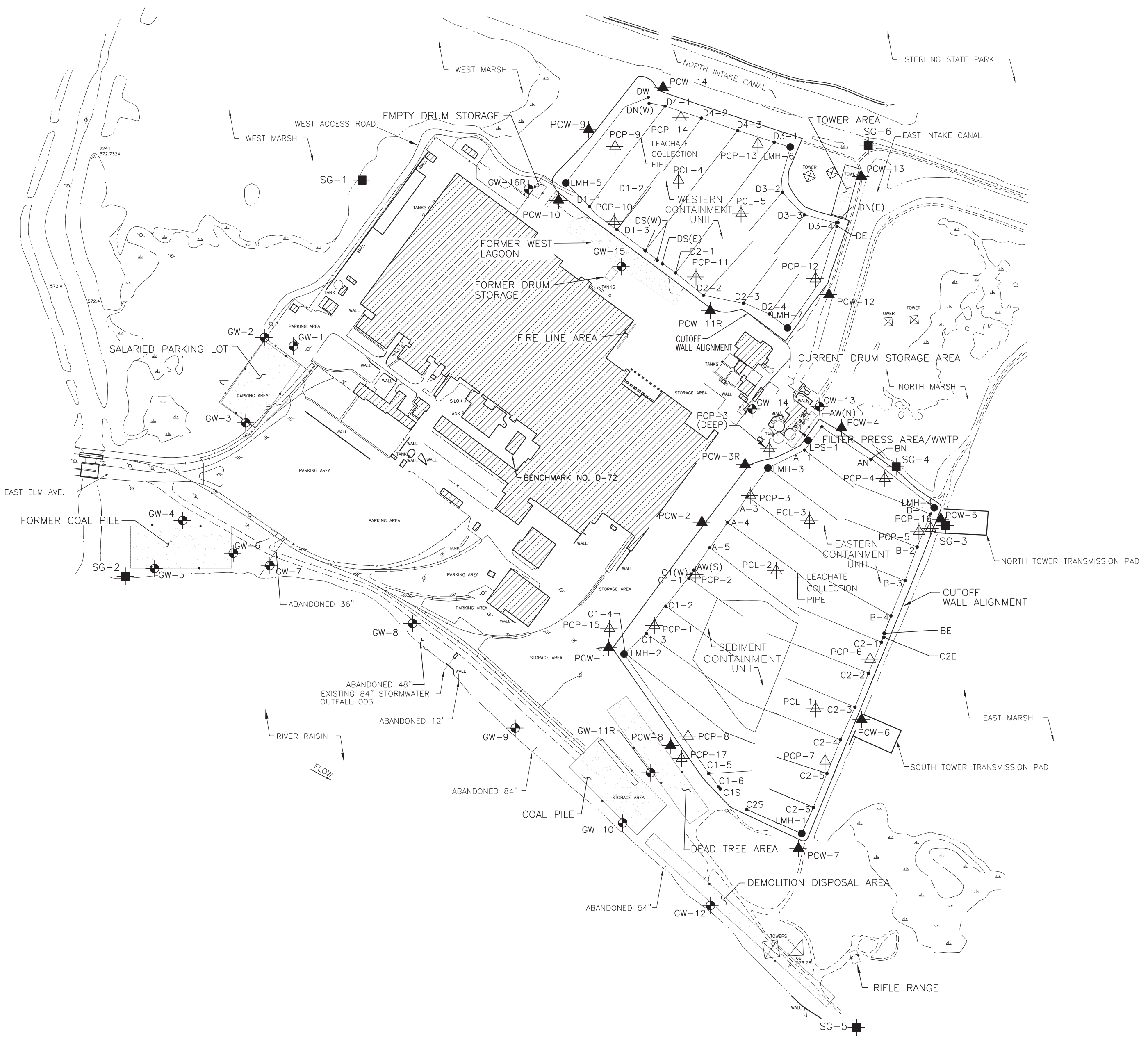
PROJECT STAFF:

HWPS SUPERVISOR:	
STATE PERMIT ENGINEER:	Steve Sliver
STATE GEOLOGIST:	Joe Rogers
EPA STAFF:	Todd Gmitro, Waste
EPA Contact Phone:	
EPA Contact e-mail:	
EPA Program:	

Save Record

Return to Main Menu

Sharleen Gettchorne



Scale 1"=200'

0' 100' 200' 400'

LEGEND:

- GW-# GROUND WATER INVESTIGATION MONITORING WELL
- PCP-# OR PCL-# POST-CLOSURE PIEZOMETER
- PCW-# POST-CLOSURE DETECTION MONITORING WELL
- SG-# SURFACE WATER LEVEL MONITORING STATION
- LMH-7 LCRS MANHOLE WITH DESIGNATION
- CUTOFF WALL
- LEACHATE COLLECTION PIPE (6")
- SOLID WASTE MANAGEMENT UNIT BOUNDARY
- LCRC CLEANOUT

NO.	DATE	BY	DESCRIPTION

PROJECT DATE: 11/07/2011
PROJECT NO.: FORD0102
DRAWN BY: HMW
CHECKED BY: TEP

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FORD MOTOR COMPANY

MONROE PLANT
MONROE, MICHIGAN

GENERAL LAYOUT

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