Occidental Chemical Corporation
Mobile, Alabama
EPA I.D. Number ALD 008 163 388

FACT SHEET

A draft Alabama Hazardous Waste Management and Minimization Act (AHWMMA) post-closure permit has been prepared for the Occidental Chemical Corporation hazardous waste facility located in Mobile, Alabama. This fact sheet has been prepared to briefly advise the public of the principal permitting, legal, and policy issues of the draft permit.

I. PERMIT PROCESS

The purpose of the permitting process is to allow the State and the public to evaluate Occidental-Mobile's ability to comply with the hazardous waste management requirements of the AHWMMA, as amended. Occidental-Mobile must comply with hazardous waste management conditions set forth in the permit during the effective period of the permit, which will be ten (10) years.

II. PROCEDURES FOR REACHING A FINAL DECISION

ADEM Admin. Code R. 335-14-8-.08(6)(b)1. requires that the public be given a 45-day comment period for each draft permit. The comment period will begin on March 2, 2016, which is the date of publication of the public notice in major local newspaper(s) of general circulation, and will end on April 18, 2016. The public notice will also be broadcast over local radio station(s).

Any person interested in commenting on the application or draft permit must do so within the 45-day comment period discussed above.

All persons wishing to comment on any of the permit conditions or the permit application should submit their comments in writing to the Alabama Department of Environmental Management, Permits and Services Division, ATTENTION: Mr. Russell A. Kelly, 1400 Coliseum Blvd. (zip 36110-2059), P.O. Box 301463 (zip 36130-1463) Montgomery, Alabama.

ADEM will consider all written comments received during the comment period while making a permit decision for this facility. When the Department makes its final permit decision, notice will be given to the applicant and each person who has submitted written comments or requested notice of the final permit decision.

III. FACILITY DESCRIPTION

Occidental-Mobile operates as a chlorine (since 1964), sodium hydroxide (1964-1985 and 1991-present) and sodium silicate (since 1974) production plant. The facility operated a 1,500,000-gallon surface impoundment, referred to as the Former Brine Sludge Lagoon from 1974 through 1985 to settle impurities from brine used in the chlorine manufacturing process. In 1986, Occidental-Mobile closed the Lagoon and removed all the brine sludge material and the impacted soil underlying the synthetic liner. A clay cap with a vegetative cover along with a pump-and-treat groundwater protection program were installed in early 1989.

IV. SUMMARY OF PROPOSED MODIFICATIONS

This draft permit modification addresses the Corrective Measures Implementation (CMI) Work Plan submitted on August 31, 2015 and revised on December 21, 2015. The CMI Work Plan addresses the remediation of contaminated groundwater. The groundwater plumes are contaminated with inorganic constituents and chlorinated volatile organics.

V. CHANGES TO THE EXISTING PERMIT

The specific changes to the permit are explained below.

Section/Appendix	Reason
Brown Cover Page	Added modification date
Signature Page	Signature, signature date, and modification 1 date
Table of Contents	Added CMI Plan as one of the documents incorporated by reference
Permit section IV	Updated language in title Table IV.1
Permit section V	Updated table in section V.B.1 with correct CMI Plan by reference

VI. TECHNICAL CONTACT

Metz Duites
Engineering Services Section
Industrial Hazardous Waste Branch
Land Division
Alabama Department of Environmental Management
1400 Coliseum Blvd. (zip 36110-2059)
P.O. Box 301463 (zip 36130-1463)
Montgomery, Alabama
(334) 270-5679
MPD@adem.state.al.us

ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT
HAZARDOUS WASTE POST-CLOSURE PERMIT

Permittee:

OWNER:
Occidental Chemical Corporation
5005 LBJ Freeway
Dallas, Texas 75244-6199

OPERATOR:
Occidental Chemical Corporation
1300 Jarvis Road
Mobile, Alabama 36614-1099
Mobile County

Permit Number: ALD 008 163 388
Identification Number: ALD 008 163 388
Modification 1: XX/XX/XXXX

Pursuant to the Alabama Hazardous Wastes Management and Minimization Act (AHWMMA), Code of Ala. 1975, Section 22-30-1, et. seq., as amended, and attendant regulations promulgated thereunder by the Alabama Department of Environmental Management (ADEM or the Department), a permit is issued to Occidental Chemical Corporation facility located in Mobile, Alabama, at latitude N 30° 45' 015" and longitude W 88° 04' 001".

The Permittee must comply with all terms and conditions of this permit, which consists of the conditions set forth herein (including those in any attachments), and the regulations applicable to the Permittee's facility contained in Chapters 335-14-1, 335-14-2, 335-14-5, 335-14-8, and 335-14-9 of the ADEM Administrative Code of Regulations (hereinafter referred to as the "ADEM Admin. Code r."). Applicable regulations are those which are in effect on the date of issuance of this permit.

This permit is based on the assumption that the information submitted in the permit application attached to the Permittee's letter dated August 9, 2012, as amended on July 22, 2013 (hereby incorporated by reference and hereafter referred to as the Application) is accurate and that the facility will be constructed and operated as specified in the Application. Any inaccuracies found in this information could lead to the termination or modification of this permit in accordance with ADEM Admin. Code r. 335-14-8-.04(2), 335-14-8-.04(3), and 335-14-8-.04(4) and could lead to potential enforcement action. The Permittee must inform ADEM of any deviation from or changes in the information provided in the Application that would affect the Permittee's ability to comply with the applicable regulations or permit conditions.

This permit is effective as of September 24, 2013 and shall remain in effect until September 23, 2023 unless revoked and reissued, or terminated under ADEM Admin. Code r. 335-14-8-.04(2) and 335-14-8-.04(4) or continued in accordance with ADEM Admin. Code r. 335-14-8-.05(2).

Alabama Department of Environmental Management

Date Signed

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Documents Incorporated By Reference:

1. Part B Permit Application submitted on August 9, 2012, amended on July 22, 2013
2. Corrective Measures Implementation Work Plan, dated August 31, 2015, amended on December 21, 2015
3. Sampling and Analysis Plan, dated January 2002, amended on August 2012 & July 2013

PART I

STANDARD AND GENERAL FACILITY CONDITIONS

I.A. EFFECT OF PERMIT

Issuance of this permit does not authorize any injury to persons or property, any invasion of other private rights, or any infringement of state or local law or regulations. Compliance with the terms of this permit does not constitute a defense to any action brought under the AHWMMA, or any other law governing the protection of public health or the environment, for any imminent and substantial endangerment to human health, welfare, or the environment.

I.B. SEVERABILITY

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

I.C. DUTIES AND REQUIREMENTS

1. Duty to Comply

   The Permittee shall comply with all conditions of this permit, except to the extent and for the duration such noncompliance is authorized by an emergency permit. Any permit noncompliance, other than noncompliance authorized by an emergency permit, constitutes a violation of the AHWMMA, and is grounds for enforcement action, permit termination, revocation and reissuance, modification, or denial of a permit renewal application.

2. Duty to Reapply

   a. If the Permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the Permittee must apply for and obtain a new permit.

   b. The Permittee must submit an application for a new permit for both post-closure and Solid Waste Management Unit (SWMU) corrective measures at least 180 calendar days before the expiration of this permit. The Permittee must reapply in order to fulfill the 30-year post-closure care period required by ADEM Admin. Code R. 335-14-5-.07(8)(a)1. The Department may shorten or extend the post-closure care period applicable to the hazardous waste facility in accordance with ADEM Admin. Code r. 335-14-5-.07(8)(a)2. and 335-14-8-.03(1)(b).

3. Need to Halt or Reduce Activity Not a Defense

   It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

4. Duty to Mitigate

In the event of noncompliance with this permit, the Permittee shall take all reasonable steps to minimize releases to the environment, and shall carry out such measures as are reasonable to prevent significant adverse impacts on human health or the environment.

5. Proper Operation and Maintenance

The Permittee shall, at all times, properly operate and maintain all facilities and systems of treatment, monitoring, and control (and related appurtenances) which are installed or used by the Permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance (O&M) includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems only when necessary to achieve compliance with the conditions of this permit.

6. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause as specified in ADEM Admin. Code r. 335-14-8-.04(2), 335-14-8-.04(3) and 335-14-8-.04(4). The filing of a request for a permit modification, revocation and reissuance, or termination, or the notification of planned changes or anticipated noncompliance on the part of the Permittee does not stay the applicability or enforceability of any permit condition.

7. Property Rights

Issuance of this permit does not convey any property rights of any sort, nor any exclusive privilege.

8. Duty to Provide Information

The Permittee shall furnish to the Department, within a reasonable time as determined by the Department, any relevant information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The Permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

9. Inspection and Entry

The Permittee shall allow duly designated officers and employees of the Department, or an authorized representative, upon the presentation of credentials and other documents as may be required by law, to:

a. Enter at reasonable times upon the Permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this permit; and,

d. Sample or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by the AHWMMA, any substances or parameters at any location. The Permittee shall have the opportunity to split samples during sampling.

10. Monitoring and Records

a. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity. The method used to obtain a representative sample of the waste to be analyzed must be the appropriate method from ADEM Admin. Code r. 335-14-2-Appendix I or the methods specified in Section 7.1 of the permit application. Laboratory methods must be those specified in Test Methods for Evaluating Solid Waste: Physical/Chemical Methods SW-846 (latest edition), Methods for Chemical Analysis of Water and Wastes (EPA-600/4-79-020), Standard Methods for the Examination of Water and Wastewater (latest edition), the methods specified in Section 7.1 of the permit application, or an alternative method approved by ADEM. [ADEM Admin. Code r. 335-14-8-.03(1)(j)1.]

b. The Permittee shall maintain at the facility records of all monitoring information, including all calibration and maintenance records, all original strip chart recordings for continuous monitoring instrumentation, the certification required by ADEM Admin. Code r. 335-14-5-.05(4)(b)9., records of all data used to prepare documents required by this permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit for a period of at least three (3) years from the date of the certification, application, sample, measurement, report or record, or until corrective action is completed, whichever date is later. This period may be extended by the Department at any time and is automatically extended during the course of any unresolved enforcement action regarding this facility. [ADEM Admin. Code r. 335-14-5-.05(5)(b) and 335-14-8-.03(1)(j)2.]

c. The Permittee shall maintain at the facility, records of all groundwater monitoring wells, piezometers, and associated groundwater surface elevations throughout the post-closure care period. These records shall include the surveyed location, surveyed elevation, surveyed elevation reference point, total depth, screened interval, construction details, well log, and all other pertinent information for each well and piezometer.

d. Records for monitoring information shall include:

i. The date(s), exact place, and times of sampling or measurements;

ii. The names of individual(s) who performed the sampling or measurements;

iii. The date(s) analyses were performed;

iv. The names of individual(s) who performed the analyses;

v. The analytical techniques or methods used; and,

vi. The results of such analyses.

e. The following documents and information shall be maintained throughout the post-closure care period at the Occidental Chemical Corporation, Mobile facility as required by ADEM Admin. Code r. 335-14-5-.07 and this permit.

i. Complete copy of this permit and the permit application.

ii. Operating record as required by ADEM Admin. Code r. 335-14-5-.05(4) and this permit.

iii. Copies of all plans, reports, inspection schedules, inspection logs as required by ADEM Admin. Code r. 335-14-5 and this permit.

11. Signatory Requirements

All applications, reports or information required by this permit and submitted to the Department shall be signed and certified in accordance with ADEM Admin. Code r. 335-14-8-.02(2) and 335-14-8-.03(1)(k).

12. Reporting Requirements

a. Planned Changes

The Permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted facility and any solid waste management units identified under Part IV of this permit.

b. Anticipated Noncompliance

The Permittee shall give advance notice to the Department of any planned changes in the permitted facility or activity that may result in noncompliance with permit requirements.

c. Transfer of Permits

This permit may be transferred to a new owner or operator only if it is modified or revoked and reissued pursuant to ADEM Admin. Code r. 335-14-8-.04(1) or 335-14-8-.04(3)(a)1.(vii). Before transferring ownership or operation of the facility during its post-closure period, the Permittee shall notify the new owner or operator, in writing, of the requirements of ADEM Admin. Code r. 335-14-5 and 335-14-8 and this permit.

d. Monitoring Reports

Monitoring results shall be reported at the intervals specified elsewhere in this permit.

e. Compliance Schedules

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted to the Department no later than 14 calendar days following each schedule date.

f. Twenty-Four Hour Reporting

i. The Permittee shall report to the Department any noncompliance with this permit that may endanger human health or the environment. Any such information shall be reported orally within 24 hours from the time the Permittee becomes aware of the circumstances. This report shall include, but is not limited to, the following:

(I) Information concerning the release of any hazardous waste which may endanger public drinking water supplies; and,

(II) Information concerning the release or discharge of any hazardous waste, or hazardous waste constituents, or of a fire or explosion at the facility, which could threaten the environment or human health outside the facility.

ii. The description of the occurrence and its cause shall include:

(I) Name, address, and telephone number of the owner or operator;

(II) Name, address, telephone number, and EPA Identification Number of the facility;

(III) Date, time, and type of incident;

(IV) Name and quantity of material(s) involved;

(V) The extent of injuries, if any;

(VI) An assessment of actual or potential hazards to the environment and human health outside the facility, where this is applicable; and,

(VII) Estimated quantity and disposition of recovered material that resulted from the accident.

iii. A written submission shall also be provided within 5 calendar days of the time that the Permittee becomes aware of the circumstances. The written submission shall contain 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.

g. Other Noncompliance

The Permittee shall report to the Department all instances of noncompliance not otherwise required by Permit Conditions I.C.12.d., I.C.12.e., or I.C.12.f. at the time any other reports required by this permit are submitted. The reports shall contain the information required by Permit Condition I.C.12.f.

h. Other Information

Where the Permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Department, it shall promptly submit such facts or information. In addition, upon request, the Permittee shall furnish to the Department any information related to compliance with this permit.

13. Certification of Construction

The Permittee may not commence treatment, storage or disposal of hazardous waste or contaminated media at any new or modified portion of the facility until the Permittee has submitted to the Department, by certified mail or hand-delivery, a letter (together with the certification by the Construction Quality Assurance (CQA) officer required by ADEM Admin. Code r. 335-14-5-.02(10)(d) and any other certifications required by this permit or ADEM Admin. Code r. 335-14) signed by the Permittee and an Alabama-registered professional engineer, stating that the facility has been constructed or modified in compliance with this permit where appropriate; and,

a. The Department has inspected the modified or newly constructed facility and finds it is in compliance with the conditions of this permit; or

b. The Department has either waived the inspection or has not notified the Permittee, within 15 calendar days of the notification from the Permittee, of its intent to inspect. [ADEM Admin. Code r. 335-14-8-.03(1)(1)2.]

14. The Permittee shall assure that all measures necessary to maintain and/or achieve compliance with all applicable requirements of ADEM Admin. Code r. 335-14 are taken during the active life of the facility and throughout the post-closure care period, corrective action period, and the term of this permit.

15. In the event that circumstances beyond the Permittee's control arise to prevent achievement of any deadline set forth by this permit, the Permittee may immediately, upon the occurrence thereof, request an extension by sending a written request to the Department explaining the need for the extension. The Department may, after consideration of the circumstances, grant the extension. Requests for extensions may require a permit modification pursuant to ADEM Admin. Code r. 335-14-8-.04(2) or (3).

I.D. DEFINITIONS

For the purposes of this permit, terms used herein shall have the same meaning as those in ADEM Admin. Code r. 335-14-1, 335-14-2, 335-14-5, and 335-14-8, unless this permit specifically provides otherwise. Where terms are not defined in the regulations or this permit, a standard dictionary reference or the generally accepted scientific or industrial meaning of the term shall define the meaning associated with such terms.

"Area of concern" (AOC), for the purposes of this permit, includes any area having a probable release of a hazardous waste or hazardous constituent which is not from a solid waste management unit and is determined by the Department to pose a current or potential threat to human health or the environment. Such areas of concern may require investigations and remedial action as required under Section 3005(c)(3) of the Resource Conservation and Recovery Act and ADEM Admin. Code r. 335-14-8-.03(3)(b)2. in order to ensure adequate protection of human health and the environment.

"Contamination," for the purposes of this permit, refers to the presence of any hazardous constituent in a concentration that exceeds the naturally occurring concentration of that constituent in the immediate vicinity of the facility (*i.e.*, areas not affected by the facility).

"Extent of contamination," for the purposes of this permit, is defined as the horizontal and vertical areas in which the concentrations of hazardous constituents in the environmental media being investigated are above detection limits or background concentrations indicative of the region, whichever is appropriate as determined by the Department.

"Hazardous constituents," for the purposes of this permit, are those substances listed in ADEM Admin. Code r. 335-14-2-Appendix VIII and/or ADEM Admin. Code r. 335-14-5-Appendix IX and include hazardous constituents released from solid waste, hazardous waste, and hazardous waste constituents that are reaction by-products.

“Land Use Controls,” for the purposes of this permit, is as defined by ADEM Admin. Code r. 335-5-1-.03.

“Method detection limit” (MDL), for the purposes of this permit, means the minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix type containing the analyte.

“Mixed waste,” for the purposes of this permit, means a solid waste that is a mixture of hazardous waste (as defined in ADEM Admin. Code r. 335-14-2-.01(3)) and radioactive waste (as defined in 10 CFR 61.2). The radioactive component of mixed waste is subject to regulation by the Atomic

Energy Act (AEA)/Nuclear Regulatory Commission (NRC). The non-radioactive chemically hazardous component of mixed waste is subject to regulation by the AHWMMA and ADEM Admin. Code r. 335-14.

“Operating day,” for the purposes of this permit, means any day on which hazardous waste is treated, stored, or disposed of in a unit. For example, each day that a hazardous waste storage unit contains hazardous waste is an operating day; as is each day that a disposal unit contains or receives hazardous waste, or each day that hazardous waste is treated in a treatment unit.

"Release," for the purposes of this permit, includes any spilling, leaking, pouring, emitting, emptying, discharging, injecting, escaping, leaching, pumping, or disposing into the environment of any hazardous waste or hazardous constituent.

"Solid waste management unit" (SWMU), for the purposes of this permit, includes any unit that has been used for the treatment, storage or disposal of solid waste at any time, irrespective of whether the unit is or ever was intended for the management of solid waste. RCRA-regulated hazardous waste management units are also solid waste management units. SWMUs include areas that have been contaminated by routine and systematic releases of hazardous waste or hazardous constituents, excluding one-time accidental spills that are immediately remediated and cannot be linked to solid waste management activities (*e.g.*, product or process spills).

“Storm event,” for the purposes of this permit, is defined as a 1-year, 24-hour storm event or rainfall that measures 1-inch or greater in 1 hour or less. Rainfall measurements may be taken at the site, or the closest official weather monitoring station may be used.

I.E. EXPIRATION AND CONTINUATION OF PERMIT

This permit and all conditions herein will remain in effect beyond this permit's expiration date if the Permittee has submitted a new application as required by Permit Condition I.C.2. and, through no fault of the Permittee, the Department has not issued a new permit.

I.F. WASTE MINIMIZATION

1. Certification Requirements

   Pursuant to ADEM Admin. Code r. 335-14-5-.05(4)(b)9., the Permittee must certify, no less often than annually, that:

   a. The Permittee has a program in place to reduce the volume and toxicity of hazardous waste to the degree determined by the Permittee to be economically practicable; and,

   b. The proposed method of treatment, storage or disposal is the most practicable method available to the Permittee and that it minimizes the present and future threat to human health and the environment.

2. Recording Requirements

   The Permittee shall maintain copies of this certification in the facility operating record as required by ADEM Admin. Code r. 335-14-5-.05(4).

I.G. COST ESTIMATES

1. The Permittee shall maintain detailed written cost estimates, in current dollars, at the location specified in Permit Condition I.C.10.e. and on file with ADEM in accordance with ADEM Admin. Code r. 335-14-5-.08(3), (5), and (10).

2. All cost estimates must be updated annually as required by ADEM Admin. Code r. 335-14-5-.08(3)(b), 335-14-5-.08(5)(b), and 335-14-5-.08(10)(b).

3. The cost estimate shall be maintained and submitted in the form designated by the Department.

4. The Permittee must update the cost estimate no later than 30 calendar days after the Department has approved a modification to the Closure Plan, Post-Closure Plan, or Corrective Action Plan, or any other plan required or referenced by this permit, if the change in the plan results in an increase in the amount of the cost estimate.

I.H. FINANCIAL ASSURANCE

1. The Permittee shall demonstrate continuous compliance with ADEM Admin. Code r. 335-14-5-.08 by providing documentation of financial assurance in at least the amount that equals or exceeds the cost estimate. Changes in financial assurance mechanisms must be approved by the Department.

2. The Permittee shall submit itemized statements for all capital expenditures and a complete, revised post-closure (and corrective action) cost estimate to the Department when requesting approval for a reduction in the financial assurance mechanism.

I.I. PERMIT MODIFICATIONS

The Permittee shall request a permit modification whenever changes in operating plans or facility design affect any plan (*e.g.*, closure, groundwater monitoring, post-closure, or corrective action) required or referenced by this permit. The Permittee must submit a written request for a permit modification, pursuant to the requirements of ADEM Admin. Code r. 335-14-8-.04(2), at least 60 calendar days prior to the proposed change in the facility design or operation.

I.J. REPORTS, NOTIFICATIONS, AND SUBMISSIONS TO THE DEPARTMENT

One (two for documents required to be placed on public notice) hard copy and one electronic (an optical character recognition or text-searchable) copy of all reports, notifications, or other submissions that are required by this permit should be sent via certified mail or given to:

Chief, Land Division
Alabama Department of Environmental Management
P.O. Box 301463 (Zip 36130-1463)
1400 Coliseum Boulevard (Zip 36110-2059)
Montgomery, Alabama

and

Director, RCRA Division
USEPA Region 4
Atlanta Federal Center
61 Forsyth Street SW
Atlanta, Georgia 30303-3104

PART II

POST-CLOSURE CARE

II.A. POST-CLOSURE CARE PERIOD

The post-closure care period shall extend for a period of thirty (30) years after the date of issuance of a post-closure permit unless shortened or extended pursuant to ADEM Admin. Code r. 335-14-5-.07(8). The post-closure care period shall automatically extend through the end of the compliance period specified in Part III.B.4. of this permit.

II.B. POST-CLOSURE PROCEDURES AND USE OF PROPERTY

1. Post-Closure Activities

   The Permittee shall conduct post-closure care activities, in accordance with Section 7 of the permit application and as required by ADEM Admin. Code r. 335-14-5-.07 and 335-14-5-.14(11)(d), for each hazardous waste management unit listed in Table II.1. Post-closure care shall commence upon the effective date of this permit and shall continue throughout the post-closure care period.

2. Security

   The Permittee shall comply with the security provisions of ADEM Admin. Code r. 335-14-5-.02(5) and as described in Section 8 of the permit application.

3. Disturbance of Closed Unit(s)

   The Permittee shall not allow the disturbance of the integrity of the final cover, liners, any components of the containment system, or the function of the facility's monitoring systems during the post-closure care period for any unit identified in Table II.1.

4. The Permittee shall:

   a. Maintain the integrity and effectiveness of the landfill’s final cover, including making repairs to the cap, as necessary, to correct the effects of settling, subsidence, erosion, or other events;

   b. Maintain and monitor the groundwater monitoring system and comply with all other applicable requirements of ADEM Admin. Code r. 335-14-5-.06 and Part III of this permit;

   c. Prevent run-on and run-off from eroding or otherwise damaging the final cover; and,

   d. Protect and maintain surveyed benchmarks used in complying with the surveying and recordkeeping requirements of ADEM Admin. Code r. 335-14-5-.14(10).

II.C. INSPECTIONS

1. The Permittee shall inspect the components, structures, and equipment at the site in accordance with the inspection schedule as described in Section 7.4 of the permit application, the post-closure care plan as described in Section 7 of the permit application, and as required by ADEM Admin. Code r. 335-14-5-.07.

2. Monitoring and Inspection

   The Permittee shall inspect the closed hazardous waste management unit listed in Table II.1. at least weekly and after storms to detect any evidence of deterioration or improper operation as described in Section 7.4 of the permit application and as required under ADEM Admin. Code r. 335-14-5-.07 and 335-14-5-.14. The inspections shall specifically include evaluation of the following items:

   a. Integrity of the final cover (erosion, ponding, subsidence, cracking, *etc*.);

   b. Growth and stabilization of vegetative cover;

   c. Run-on and run-off control system;

   d. Groundwater monitoring wells; and,

   e. Survey benchmarks.

TABLE II.1.

POST-CLOSURE CARE UNITS

UNIT NAME	UNIT DESCRIPTION	CLOSED-IN-PLACE CAPACITY (QUANTITY)	DESCRIPTION OF UNIT*	LOCATION OF UNIT*
Brine Sludge Lagoon	Former Brine Sludge Lagoon Closed in Place as a Surface Impoundment	1,500,000 gallons	Section 3.5	Figure 3-9

* Location in permit application containing description (text) and location (figure) of unit.

PART III

GROUNDWATER MONITORING AND CORRECTIVE ACTION

III.A. REQUIRED PROGRAM(S)

1. Groundwater monitoring shall consist of the General Groundwater Monitoring Program of Permit Condition III.B. and the Corrective Action Monitoring Program contained in Permit Condition III.E.

2. The Permittee shall commence groundwater monitoring as required by this permit not later than 120 calendar days after the effective date of this permit.

III.B. GENERAL GROUNDWATER MONITORING PROGRAM

1. Well Location, Installation and Construction

The Permittee shall install and/or maintain a groundwater monitoring system to comply with the requirements of ADEM Admin. Code r. 335-14-5-.06(8), 335-14-5-.06(9), 335-14-5-.06(10), and 335-14-5-.06(11) as applicable and as specified below:

a. The Permittee shall maintain all groundwater monitoring wells at the facility as identified in Table III.1. of this permit, at the locations specified on Figures 3.3 and 7.1 of the permit application, and any other groundwater monitoring wells specified by Permit Condition III.B.1.d.

i. All groundwater monitoring wells shall be maintained in accordance with the plans and specifications presented in Section 7.3.2 of the permit application and in accordance with ADEM Admin. Code r. 335-14-5-.06.

ii. A groundwater monitoring well shall not be removed from any monitoring program specified in this permit without an approved permit modification pursuant to Permit Condition I.I.

iii. If a groundwater monitoring well is damaged, the Permittee shall immediately notify the Department in writing, which includes a description of the well repair activities to be conducted. The well repair procedures must be approved by the Department prior to implementation. Within 30 calendar days after the well is repaired, the Permittee shall submit a written notification to the Department that the well repair activities were conducted in accordance with the approved procedures.

iv. If a groundwater monitoring well is deleted from the monitoring program(s) required by this permit in accordance with Permit Conditions III.B.1.a.ii. and I.I., it shall be abandoned within 90 calendar days after deletion using procedures to be approved by the Department. Within 30 calendar days after the well is abandoned, the Permittee shall submit a written notification to the

Department that the well abandonment activities were conducted in accordance with the approved procedures.

b. Groundwater monitoring wells MW-2, MW-3, MW-4, DW-3 shall define the point of compliance for the Former Brine Sludge Lagoon closed as a landfill.

c. The Permittee shall maintain groundwater monitoring well MW-6 as the background monitoring well for the entire facility as specified in Section 6 of the permit application.

d. The Permittee shall install and maintain additional groundwater monitoring wells as necessary to assess changes in the rate and extent of any plume of contamination or as otherwise deemed necessary to maintain compliance with ADEM Admin. Code r. 335-14-5-.06(6), 335-14-5-.06(8), 335-14-5-.06(9), 335-14-5-.06(10), and 335-14-5-.06(11), as applicable. A plan in the form of a permit modification request specifying the design, location and installation of any additional monitoring wells should be submitted to the Department at least 90 calendar days prior to installation which, at a minimum, shall include:

i. Well construction techniques including casing depths and proposed total depth of well(s);

ii. Well development method(s);

iii. A complete description of well construction materials;

iv. A schedule of implementation for construction; and,

v. Provisions for determining the lithologic characteristics, hydraulic conductivity, grain size distribution, and porosity for the applicable aquifer unit(s) at the location of the new well(s).

2. General Groundwater Monitoring Requirements

a. The Permittee shall determine the groundwater surface elevation from all monitoring wells listed in Table III.1. of this permit at least Semiannually and each time a sampling event is conducted. The results of these determinations should be submitted in accordance with Permit Condition III.B.6. Elevation data should be recorded and reported as mean sea level (MSL) and referenced to an appropriate National Geodetic Vertical Datum (NGVD) benchmark.

b. The Permittee shall determine the groundwater flow rate and direction in the underlying aquifer(s) at least annually and submit the results in accordance with Permit Condition III.B.6.

c. The Permittee shall determine background concentrations of hazardous constituents and other chemical parameters required to be monitored by this permit in accordance with Section 7.1 of the permit application and ADEM Admin. Code r. 335-14-5-.06(8)(g).

3. Groundwater Protection Standard

   a. The groundwater protection standard, as required under ADEM Admin. Code r. 335-14-5-.06(3), shall consist of Table III.3 of this permit which lists the hazardous constituents and their respective concentration limits.

   b. The groundwater protection standard applies to all hazardous waste or hazardous constituent releases as deemed appropriate by the Department to protect human health and the environment.

4. Compliance Period

   a. The compliance period, during which the groundwater protection standard specified in Permit Condition III.B.3. applies, shall begin at the time of the first sampling event of the compliance monitoring program (Permit Condition III.D.), or the corrective action monitoring program (Permit Condition III.E.), whichever is earlier.

   b. The compliance period shall continue (after beginning pursuant to Permit Condition III.B.4.a.) until the groundwater protection standard as defined by Permit Condition III.B.3.a. has not been exceeded for a period of three consecutive years.

   c. If the Permittee is engaged in a corrective action program pursuant to Permit Condition III.E., then the compliance period shall continue as required by ADEM Admin. Code r. 335-14-5-.06(7)(c) until the groundwater protection standard has not been exceeded for a period of three consecutive years after corrective action has been terminated and this permit has been modified, in accordance with Permit Condition I.I., to implement a compliance monitoring program pursuant to Permit Condition III.D. or a detection monitoring program pursuant to Permit Condition III.C., as required by ADEM Admin. Code r. 335-14-5-.06(11)(f).

5. Sampling and Analysis Procedures

   The Permittee shall use the following techniques and procedures when obtaining and analyzing samples from the groundwater monitoring wells described in Permit Condition III.B.1. to provide a reliable indication of the quality of the groundwater as required under ADEM Admin. Code r. 335-14-5-.06(8)(d), (e), and (g):

   a. Samples shall be collected, preserved, and shipped (when shipped off-site for analysis) in accordance with the procedures specified in Section 7.1.2 of the permit application.

   b. Samples shall be analyzed according to the procedures specified in Section 7.1.2 of the permit application, the most recent edition of SW-846 or other appropriate methods approved by the Department. Analytical method detection limits shall be less than or equal to the concentration limits specified in Table III.2 or III.3, unless otherwise approved in writing by the Department.

   c. Samples shall be tracked and controlled using the chain-of-custody procedures specified in Section 7.1.2 of the permit application.

d. Statistical analyses used to evaluate the groundwater monitoring data shall be as described in Section 7.1.3 of the permit application and ADEM Admin. Code r. 335-14-5-.06(8)(h).

e. All samples collected in accordance with this permit shall not be filtered prior to analysis.

6. Recordkeeping and Reporting

a. The Permittee shall keep and maintain all monitoring, testing, and analytical data obtained in accordance with Permit Conditions III.B., III.C., III.D., and III.E. as required by Permit Condition I.C.10.

b. The Permittee shall submit to the Department a written report to include all analytical sampling data, established background values, statistical evaluations, groundwater elevations, associated potentiometric maps, and the annual groundwater flow rate and direction determinations. The analytical method and the method detection limit (MDL) for each constituent must be integrated into all reports of analysis. The report shall be submitted within 60 calendar days after the first sampling event and on an annual basis thereafter. Copies of this report shall be kept at the facility in accordance with Permit Conditions I.C.10.c. and I.C.10.e.

c. **(RESERVED)**

III.C. DETECTION MONITORING PROGRAM (RESERVED)

III.D. COMPLIANCE MONITORING PROGRAM (RESERVED)

III.E. CORRECTIVE ACTION MONITORING PROGRAM

The requirements of this Condition are applicable to the Former Brine Sludge Lagoon. Except as specified otherwise in this permit, the Corrective Action Monitoring Program shall be implemented in accordance with Sections 7.2 and 12.2 of the permit application and ADEM Admin. Code r. 335-14-5-.06(11).

1. Monitoring Systems

In addition to the point of compliance and background monitoring well systems identified in Permit Conditions III.B.1.b. and III.B.1.c., the Permittee shall:

a. Maintain groundwater monitoring wells MW-8S, MW-18S, MW-42S, MW-10I, MW-11I, MW-14I, MW-14D, MW-18D, MW-19D, MW-20D, MW-22D, MW-37D, and MW-42D as boundary wells for the entire facility as specified in Table III.1. of this permit and as shown on Figure 3-3 of the permit application.

b. Maintain groundwater monitoring wells MW-1R, MW-5, MW-7, MW-9S, MW-15S, MW-16S, MW-17S, MW-21S, MW-22S, MW-31S, MW-32S, MW-34S, MW-35S, MW-36S, MW-19I, MW-20I, MW-38I, MW-8D, MW-11D, MW-

12D, MW-13D, MW-15D, MW-16D, MW-17D, MW-33D, MW-38D, MW-39D, MW-43D, MW-46D, DW-1, DW-2, and DW-5 as effectiveness wells as specified in Table III.1. of this permit and as shown on Figure 3-3 of the permit application.

c. Maintain well RS-1 as recovery wells as specified in Table III.1. of this permit and as shown on Figure 3.10 of the permit application.

d. Maintain wells MW-2, MW-3, MW-4, and DW-3 as point of compliance wells as specified in Table III.1. of this permit and as shown on Figure 3.3 of the permit application.

2. Corrective Action Program

a. The Permittee shall conduct a Corrective Action Program, as described in Sections 7.2 and 12.2 of the permit application, to remove or treat in place all hazardous constituents that exceed their respective groundwater protection standards as described in Table III.3. of this permit at the point of compliance, between the point of compliance and the down-gradient facility property boundary, and beyond the facility boundary in accordance with ADEM Admin. Code r. 335-14-5-.06(11)(e)2.

b. Pursuant to ADEM Admin. Code r. 335-14-5-.06(11)(c) and 335-14-5-.06(11)(e)3., the Permittee shall continue to implement the corrective action program as described in Sections 7.2 and 12.2 of the permit application within 120 calendar days after the effective date of this permit.

c. The Permittee shall handle or treat groundwater in accordance with Sections 7.2 and 12.2 of the permit application and with the applicable requirements of NPDES permit number AL0003514 and Air permit numbers 503-5003-Z001, 503-5003-Z002, 503-5003-Z003, 503-5003-Z004, 503-5003-Z005, 503-5003-Z006, and 503-5003-Z007, as issued by the Department.

3. Monitoring Requirements

In addition to the general groundwater monitoring requirements specified in Permit Condition III.B.2., the Permittee shall:

a. Sample all background, point of compliance and effectiveness monitoring wells shown in Table III.1. of this permit and analyze for the constituents listed in Table III.2. of this permit on a Semiannual basis beginning within 120 calendar days of the effective date of this permit and continuing through the end of the compliance period.

b. Sample all background, point of compliance, effectiveness, and boundary monitoring wells shown in Table III.1. of this permit and analyze for the constituents listed in Table III.3. of this permit on an annual basis beginning within 120 calendar days of the effective date of this permit and continuing through the end of the compliance period.

c. Sample all background, point of compliance, effectiveness, and boundary monitoring wells shown in Table III.1. of this permit and analyze for temperature (degrees F or C), specific conductance (Mhos/cm), and pH (standard units) each time the well is sampled. The data obtained should be submitted as raw data in the reports required by Permit Condition III.B.6.

d. When evaluating the monitoring results to determine the effectiveness of the corrective measures, in accordance with Permit Condition III.E.4., the Permittee shall:

   i. Determine if the corrective action system effectively addresses the entire plume of contamination;

   ii. Determine if the concentration of the hazardous constituents are decreasing (pH increasing or decreasing toward neutrality, as applicable) in the effectiveness wells specified in Permit Condition III.A.1.;

   iii. Determine if hazardous waste or hazardous constituents are being released into the environment; and,

   iv. Determine if hazardous constituents have been detected in the boundary wells specified in Permit Condition III.A.1.

4. Reporting and Response Requirements

In addition to the recordkeeping and reporting requirements specified in Permit Condition III.B.6.:

a. The Permittee shall report the effectiveness of the corrective action program annually, as required under ADEM Admin. Code r. 335-14-5-.06(11)(g). These reports shall be submitted to the Department within 60 calendar days of each annual anniversary of this permit after corrective action is initiated and continue until corrective action is completed. The Permittee must provide data from groundwater monitoring along with an analysis of that data and any conclusions regarding the effectiveness of the program in accordance with Permit Condition III.E.3.d. If the analysis of the data warrants any change to the corrective action program, the Permittee must include these revisions in the annual report, which will be followed-up within 90 calendar days with an application for permit modification in accordance with Permit Condition I.I.

b. If corrective action is terminated under Permit Condition III.B.4.c., the Permittee must sample all background, point of compliance, effectiveness and boundary sampling locations for the compounds listed in ADEM Admin. Code r. 335-14-5-Appendix IX. Based upon the sampling results, the Permittee may petition the Department, in accordance with Permit Condition I.I., for a permit modification to implement either a detection monitoring program or a compliance monitoring program.

TABLE III.1.

MONITORING WELL DESIGNATIONS

WELL NUMBER	WELL TYPE*	WELL LATITUDE (deg. min. sec.)	WELL LONGITUDE (deg. min. sec.)	UNIT(S) MONITORED	WELL DEPTH (ft)	GROUND ELEVATION (ft. MSL)	TOP-OF-RISER ELEVATION (ft. MSL)	SCREENED INTERVAL (ft. MSL)	MONITORED ZONE	SAMPLING FREQUENCY
MW-2	POC	30 45 03.528 N	88 03 55.231 W	ALL	32.67	29.90	32.81	10.04 to 0.04	Alluvial (Shallow)	Semiannual
MW-3	POC	30 45 04.526 N	88 03 54.550 W	ALL	32.90	30.14	25.19	9.97 to –0.03	Alluvial (Shallow)	Semiannual
MW-4	POC	30 45 04.469 N	88 03 56.122 W	ALL	32.94	30.35	33.28	10.26 to 0.26	Alluvial (Shallow)	Semiannual
DW-3	POC	30 45 04.896 N	88 03 55.170 W	ALL	57.03	22.07	24.10	-22.93 to –32.93	Alluvial (Deep)	Semiannual
MW-1R	EFF	30 45 03.033 N	88 03 56.150 W	ALL	35.00	30.33	33.30	9.30 to –0.70	Alluvial (Shallow)	Semiannual
MW-5	EFF	30 45 02.168 N	88 03 56.636 W	ALL	32.90	30.34	33.57	10.09 to 0.09	Alluvial (Shallow)	Semiannual
MW-7	EFF	30 45 03.820 N	88 03 52.837 W	ALL	20.22	19.24	21.46	11.24 to 1.24	Alluvial (Shallow)	Semiannual
MW-8D	EFF	30 45 03.934 N	88 03 51.244 W	ALL	40.08	12.90	14.98	-15.10 to –25.10	Alluvial (Shallow)	Semiannual
MW-9S	EFF	30 45 05.182 N	88 03 52.994 W	ALL	20.10	13.52	17.02	7.02 to –2.98	Alluvial (Shallow)	Semiannual
MW-11D	EFF	30 44 57.68060 N	88 03 59.415 W	ALL	106.30	29.17	31.51	-64.3 to –74.3	Alluvial (Deep)	Semiannual
MW-12D	EFF	30 44 59.863 N	88 03 59.415 W	ALL	95.10	24.61	24.24	-60.4 to –70.4	Alluvial (Deep)	Semiannual
MW-13D	EFF	30 45 03.359 N	88 03 59.696 W	ALL	96.60	24.95	24.56	-61.6 to –71.6	Alluvial (Deep)	Semiannual
MW-15D	EFF	30 45 05.602 N	88 03 57.027 W	ALL	90.46	23.87	23.83	-56.1 to –66.1	Alluvial (Deep)	Semiannual
MW-15S	EFF	30 45 05.685 N	88 03 56.920 W	ALL	21.30	23.70	23.51	7.70 to 2.70	Alluvial (Shallow)	Semiannual
MW-16D	EFF	30 45 07.625 N	88 03 56.480 W	ALL	81.50	12.95	15.47	-55.6 to -65.6	Alluvial (Deep)	Semiannual

MW-16S	EFF	30 45 07.467 N	88 03 56.243 W	ALL	15.10	13.54	15.62	8.00 to 3.00	Alluvial (Shallow)	Semiannual
MW17D	EFF	30 45 08.960 N	88 03 53.619 W	ALL	77.50	7.92	10.37	-56.6 to -66.6	Alluvial (Deep)	Semiannual
MW-17S	EFF	30 45 08.864 N	88 03 53.682 W	ALL	20.40	8.06	10.47	-4.40 to –9.40	Alluvial (Shallow)	Semiannual
MW-19I	EFF	30 45 11.660 N	88 03 54.601 W	ALL	25.60	3.51	5.61	-14.50 to –19.50	Alluvial (Shallow)	Semiannual
MW-20I	EFF	30 45 13.382 N	88 03 56.570 W	ALL	26.60	2.53	5.08	-16.00 to –21.00	Alluvial (Shallow)	Semiannual
MW-21S	EFF	30 45 02.889 N	88 03 48.479 W	ALL	19.90	9.30	11.15	8.20 to –3.20	Alluvial (Shallow)	Semiannual
MW-22S	EFF	30 45 16.841 N	88 03 56.247 W	ALL	19.70	4.90	6.61	-7.60 to –12.60	Alluvial (Shallow)	Semiannual
MW-31S	EFF	30 44 59.870 N	88 03 59.647 W	ALL	12.80	24.34	24.18	21.94 to 11.94	Alluvial (Shallow)	Semiannual
MW-32S	EFF	30 45 03.322 N	88 03 59.027 W	ALL	24.70	24.85	24.61	5.55 to 0.55	Alluvial (Shallow)	Semiannual
MW-33D	EFF	30 45 03.484 N	88 03 57.701 W	ALL	50.90	24.67	24.34	-15.93 to -25.93	Alluvial (Deep)	Semiannual
MW-34S	EFF	30 45 01.588 N	88 04 00.562 W	ALL	14.20	25.09	25.26	21.11 to 11.31	Alluvial (Shallow)	Semiannual
MW-35S	EFF	30 45 00471 N	88 03 59.867 W	ALL	14.10	24.53	24.42	20.55 to 10.75	Alluvial (Shallow)	Semiannual
MW-36S	EFF	30 45 01.589 N	88 03 59.969 W	ALL	13.80	24.70	24.55	20.80 to 11.00	Alluvial (Shallow)	Semiannual
MW-38D	EFF	30 44 55.637 N	88 04 03.491 W	ALL	94.20	25.87	25.57	-58.13 to -68.13	Alluvial (Deep)	Semiannual
MW-38I	EFF	30 44 55.582 N	88 04 03.433 W	ALL	20.26	26.19	25.95	11.19 to 6.19	Alluvial (Shallow)	Semiannual
MW-39D	EFF	30 44 57.350 N	88 03 56.613 W	ALL	101.68	29.11	31.29	-59.89 to -69.89	Alluvial (Deep)	Semiannual
MW-43D	EFF	30 45 10.449 N	88 03 51.735 W	ALL	73.15	10.15	9.80	-52.85 to -62.85	Alluvial (Deep)	Semiannual
MW-46D	EFF	30 45 01.052 N	88 03 57.102 W	ALL	103.63	30.22	32.35	-60.78 to -70.78	Alluvial (Deep)	Semiannual
DW-1	EFF	30 45 02.086 N	88 03 56.508 W	ALL	56.00	30.29	32.29	-13.71 to -23.71	Alluvial (Deep)	Semiannual

DW-2	EFF	30 45 03.812 N	88 03 52.877 W	ALL	51.65	19.40	21.05	-20.60 to -30.60	Alluvial (Deep)	Semiannual
DW-5	EFF	30 45 00.296 N	88 03 57.503 W	ALL	68.00	30.49	33.40	-24.11 to –34.11	Alluvial (Deep)	Semiannual
MW-8S	BDY	30 45 51.129 N	88 03 51.129 W	ALL	20.00	12.55	14.93	-0.07 to –5.07	Alluvial (Shallow)	Annual
MW-10I	BDY	30 44 59.264 N	88 04 05.258 W	ALL	24.80	25.90	28.20	8.90 to 3.90	Alluvial (Shallow)	Annual
MW-11I	BDY	30 44 57.804 N	88 03 59.356 W	ALL	27.70	28.47	31.20	9.00 to 4.00	Alluvial (Shallow)	Annual
MW-14D	BDY	30 45 05.073 N	88 04 00.960 W	ALL	82.89	10.56	12.95	-59.4 to –69.4	Alluvial (Deep)	Annual
MW-14I	BDY	30 45 05.082 N	88 04 01.065 W	ALL	25.10	10.55	12.65	-7.00 to –12.00	Alluvial (Shallow)	Annual
MW-18D	BDY	30 45 11.095 N	88 04 00.093 W	ALL	82.90	11.57	13.49	-58.9 to -68.9	Alluvial (Deep)	Annual
MW-18S	BDY	30 45 11.184 N	88 04 00.200 W	ALL	12.90	11.91	14.79	7.40 to 2.40	Alluvial (Shallow)	Annual
MW-19D	BDY	30 45 11.595 N	88 03 54.541 W	ALL	72.70	3.04	6.20	-56.0 to -66.0	Alluvial (Deep)	Annual
MW-20D	BDY	30 45 13.529 N	88 03 56.480 W	ALL	83.20	2.34	5.03	-67.7 to -77.7	Alluvial (Deep)	Annual
MW-22D	BDY	30 45 16.893 N	88 03 56.290 W	ALL	89.90	5.20	7.10	-72.3 to -82.3	Alluvial (Deep)	Annual
MW-37D	BDY	30 44 58.066 N	88 04 04.111 W	ALL	94.18	25.40	25.08	-58.60 to -68.60	Alluvial (Deep)	Annual
MW-42D	BDY	30 45 08.873 N	88 03 48.729 W	ALL	80.27	11.38	11.15	-58.62 to -68.62	Alluvial (Deep)	Annual
MW-42S	BDY	30 45 08.820 N	88 03 48.658 W	ALL	20.74	11.30	11.04	0.80 to –9.20	Alluvial (Shallow)	Annual
MW-6	BKG	30 45 01.946 N	88 03 54.698 W	ALL	26.06	26.31	28.37	12.31 to 2.31	Alluvial (Shallow)	Semiannual
RS-1	REC	30 45 04.454 N	88 03 54.163 W	ALL	29.61	22.23	25.51	12.03 to –3.97	Alluvial (Shallow)	Semiannual

Well Type:

POC - Point of Compliance Wells
PGM - Piezometers and/or General Monitoring Wells
BDY - Boundary Monitoring Wells
EFF - Effectiveness Monitoring Wells
BKG - Background Wells
REC - Recovery Well

TABLE III.2.

GROUNDWATER QUALITY MONITORING CONSTITUENTS*

HAZARDOUS CONSTITUENT	UNIT**
Mercury	Former Brine Sludge Lagoon
Lead	Former Brine Sludge Lagoon
Carbon Tetrachloride (CT)	Former Brine Sludge Lagoon
Tetrachloroethene (PCE)	Former Brine Sludge Lagoon
Chloroform	Former Brine Sludge Lagoon
1,1-Dichloroethane	Former Brine Sludge Lagoon
1,2-Dichloroethane	Former Brine Sludge Lagoon
1,1-Dichloroethene	Former Brine Sludge Lagoon
Cis-1,2-Dichloroethene	Former Brine Sludge Lagoon
Trans-1,2-Dichloroethene	Former Brine Sludge Lagoon
Dichloromethane	Former Brine Sludge Lagoon
1,1,1-Trichloroethane	Former Brine Sludge Lagoon
Trichloroethene	Former Brine Sludge Lagoon
Vinyl Chloride	Former Brine Sludge Lagoon
Chloride	Former Brine Sludge Lagoon

* The constituents listed herein are the subset of the Groundwater Protection Standard listed in Table III.3. for which monitoring is required.

** Identifies the unit(s) at which the given constituent must be monitored.

TABLE III.3

GROUNDWATER PROTECTION STANDARD

HAZARDOUS CONSTITUENT	UNIT*	MAXIMUM CONCENTRATION LIMIT (µg/L)**
Mercury	All	2
Lead	All	15
Carbon Tetrachloride (CT)	All	5
Tetrachloroethene (PCE)	All	5
Chloroform	All	80
1,1-Dichloroethane	All	2.4
1,2-Dichloroethane	All	5
1,1-Dichloroethene	All	7
Cis-1,2-Dichloroethene	All	70
Trans-1,2-Dichloroethene	All	100
Dichloromethane (Methyl Chloride)	All	5
1,1,1-Trichloroethane	All	200
Trichloroethene (TCE)	All	5
Vinyl Chloride	All	2
Chloride	All	250,000

* Identifies the unit(s) at which the given constituent must be monitored.
** Alabama Risk-Based Corrective Action (ARBCA) Guidance Manual (latest edition)

PART IV

SOLID WASTE MANAGEMENT UNIT IDENTIFICATION AND EVALUATION

IV.A. APPLICABILITY

The Conditions of this Part apply to:

1. The solid waste management units (SWMUs) and areas of concern (AOCs) identified in Table IV.1, which require investigation and/or remediation;

2. The SWMUs identified in Table IV.2, which require no further action under this permit at this time;

3. Any additional SWMUs or AOCs discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means; and,

4. Contamination beyond the facility boundary, if applicable. The Permittee shall implement corrective actions beyond the facility boundary where necessary to protect human health and the environment, unless the Permittee demonstrates to the satisfaction of the Department that, despite the Permittee's best efforts, as determined by the Department, the Permittee was unable to obtain the necessary permission to undertake such actions. The Permittee is not relieved of all responsibility to clean up a release that has migrated beyond the facility boundary where off-site access is denied. On-site measures to address such releases will be determined on a case-by-case basis. Assurances of financial responsibility for completion of such off-site corrective action will be required.

IV.B. NOTIFICATION AND ASSESSMENT REQUIREMENTS FOR NEWLY IDENTIFIED SWMUs AND AOCs

1. The Permittee shall notify the Department in writing, within 15 calendar days of discovery, of any additional AOC(s) as described under Permit Condition IV.A.3. The notification shall include, at a minimum, the location of the AOC(s) and all available information pertaining to the nature of the release (*e.g.*, media affected, hazardous constituents released, magnitude of release, *etc.*). If the Department determines that further investigation of an AOC is required, the permit will be modified in accordance with ADEM Admin. Code r. 335-14-8-.04(2).

2. The Permittee shall notify the Department in writing, within 15 calendar days of discovery, of any additional SWMUs as described under Permit Condition IV.A.3.

3. The Permittee shall prepare and submit to the Department, within 90 calendar days of notification, a SWMU Assessment Report (SAR) for each SWMU identified under Permit Condition IV.B.2. At a minimum, the SAR shall provide the following information:

a. Location of unit(s) on a topographic map of appropriate scale such as required under ADEM Admin. Code r. 335-14-8-.02(5)(b)19.

b. Designation of type and function of unit(s).

c. General dimensions, capacities and structural description of unit(s) (supply any available plans/drawings).

d. Dates that the unit(s) was operated.

e. Specification of all wastes that have been managed at/in the unit(s) to the extent available. Include any available data on hazardous constituents in the wastes.

f. All available information pertaining to any release of hazardous waste or hazardous constituents from such unit(s) (to include groundwater data, soil analyses, air, and/or surface water data).

4. Based upon the results of the SAR, the Department shall determine the need for further investigations at the SWMUs covered in the SAR. If the Department determines that such investigations are needed, the Permittee shall initiate an investigation as outlined in Permit Condition IV.D.1 immediately upon receiving notification of the Department's determination.

IV.C. NOTIFICATION REQUIREMENTS FOR NEWLY DISCOVERED RELEASES AT PREVIOUSLY IDENTIFIED SWMUs or AOCs

1. The Permittee shall notify the Department in writing of any newly discovered release(s) of hazardous waste or hazardous constituents discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means, within 15 calendar days of discovery. Such newly discovered releases may be from SWMUs or AOCs identified in Permit Condition IV.A.2 or SWMUs or AOCs identified in Permit Condition IV.A.3 for which further investigation was not required.

2. If the Department determines that further investigation of the SWMUs or AOCs is needed, the Permittee shall initiate an investigation as outlined in Permit Condition IV.D. immediately upon receiving notification of the Department's determination.

IV.D. RCRA FACILITY INVESTIGATION (RFI)

1. The Permittee must perform an RFI for any SWMU and AOC identified by the Department in accordance with Permit Conditions IV.A.1, IV.B.4, and IV.C.2.

2. The RFI must completely identify the concentration of hazardous constituents released from each SWMU and AOC and fully delineate the area where such hazardous constituents have come to be located.

3. The RFI must fully characterize the nature and extent of contamination released from each SWMU or AOC under investigation.

4. The RFI must be performed in a manner consistent with the most recent edition of the Alabama Environmental Investigation and Remediation Guidance (AEIRG).

5. Except as provided by Permit Condition IV.D.6., the RFI must be completed within 180 calendar days from the effective date of this permit or, for SWMUs or AOCs identified pursuant to Permit Condition IV.B. and C., within 180 calendar days from the receipt of notification from the Department that an RFI is required. If, prior to the effective date of this permit, the Department has approved a work plan that includes a schedule for completing the RFI, the RFI shall be completed in accordance with the approved schedule.

6. RFI Schedule of Compliance

    a. For RFIs expected to require greater than 180 calendar days to complete, the Permittee may submit a schedule of compliance subject to Departmental approval and/or modification.

    b. Submittal of an RFI Schedule of Compliance does not delay or otherwise postpone the Permittee's obligation to initiate the RFI.

    c. The Schedule of Compliance must include:

        i. A detailed narrative discussion, which explains why the RFI cannot be completed within 180 days; and,

        ii. A detailed and chronological listing of milestones with estimated durations that provides sufficient information to track the progress of the investigation.

    d. The RFI Schedule of Compliance shall be reviewed by the Department in accordance with Permit Condition IV.G.

    e. The Permittee shall complete the RFI in accordance with the approved RFI Schedule of Compliance.

7. RFI Progress Reports

    a. For an RFI being conducted in accordance with the approved RFI Schedule of Compliance, the Permittee must submit progress reports on a monthly basis.

    b. The RFI Progress Reports must include:

        i. A description of the RFI activities completed during the reporting period;

        ii. Summaries of any problems or potential problems encountered during the reporting period;

        iii. Actions taken to rectify problems;

iv. Changes in relevant personnel;

v. Projected work for the next reporting period;

vi. Any proposed revisions to the RFI Schedule of Compliance. Modifications of the RFI Schedule of Compliance are subject to approval by the Department; and,

vii. A summary of any data collected during the reporting period, including:

A. The location of each sampling point identified on a site map;

B. The concentration of each hazardous constituent detected at each sampling point; and,

C. Submittal of RFI Progress Reports, work plans, or other documents during the RFI does not alter the approved RFI Schedule of Compliance.

8. RFI Reports

a. The Permittee shall prepare and submit to the Department an RFI Report within 60 calendar days from the completion of investigation activities in accordance with the approved RFI Schedule of Compliance, if applicable.

b. The RFI Report must provide a detailed description of all required elements of the investigation as described in the most recent edition of the AEIRG.

c. The RFI Report shall be reviewed by the Department in accordance with Permit Condition IV.G.

IV.E. SELECTION OF CORRECTIVE MEASURES AND PERMIT MODIFICATION

1. The Permittee shall develop and submit to the Department a Corrective Measures Implementation (CMI) Plan for any areas of the Permittee's site where hazardous constituents have come to be located at concentrations exceeding those appropriate for the protection of human health and the environment. The CMI Plan must include all applicable elements of the proposed remedy pursuant to the most recent edition of the AEIRG.

2. The CMI Plan shall be submitted to the Department within 120 calendar days following the Permittee's submittal of the RFI Report indicating that hazardous constituents have come to be located at any area of the Permittee's facility, or beyond the facility, at concentrations exceeding those appropriate for the protection of human health and the environment, or within 120 calendar days following notification from the Department that a CMI Plan is required, whichever occurs earlier.

3. The CMI Plan shall be submitted along with a request for permit modification pursuant to ADEM Admin. Code r. 335-14-8-.04(2), and shall include any applicable fees pursuant to

ADEM Admin. Code r. 335-1-6. This modification will serve to incorporate the proposed final remedy, including all procedures necessary to implement and monitor the remedy, into this permit.

4. Within 120 calendar days after this Permit has been modified in accordance with Permit Condition IV.E.3., the Permittee shall demonstrate financial assurance for completing the approved remedy.

IV.F. INTERIM MEASURES (IM)

1. IM Work Plan(s)

   a. Upon notification by the Department, the Permittee shall prepare and submit an Interim Measures (IM) Work Plan for any SWMU or AOC that the Department determines is necessary. IM are necessary in order to minimize or prevent further migration of contaminants and limit human and environmental exposure to contaminants while long-term corrective measures are evaluated and, if necessary, implemented. The IM Work Plan shall be submitted within 30 calendar days of such notification and shall include the elements listed in Permit Condition IV.F.1.b. Such IM may be conducted concurrently with investigations required under the terms of this permit. The Permittee may initiate IM by submitting an IM Work Plan for approval and reporting in accordance with the requirements under Permit Condition IV.F.

   b. The IM Work Plan shall ensure that the IM are designed to mitigate any current or potential threat(s) to human health or the environment and is consistent with and integrated into any long-term solution at the facility. The IM Work Plan shall include: the IM objectives, procedures for implementation (including any designs, plans, or specifications), and schedules for implementation.

   c. The IM Work Plan must be approved by the Department, in writing, prior to implementation. The Department shall specify the start date of the IM Work Plan schedule in the letter approving the IM Work Plan.

   d. The IM Report shall be reviewed by the Department in accordance with Permit Condition IV.G.

2. IM Implementation

   a. The Permittee shall implement the IM in accordance with the approved IM Work Plan.

   b. The Permittee shall give notice to the Department as soon as possible of any planned changes, reductions or additions to the IM Work Plan.

   c. Final approval of corrective action required under ADEM Admin. Code r. 335-14-5-.06(12), which is achieved through IM, shall be in accordance with ADEM Admin. Code r. 335-14-8-.04(2) and Permit Condition IV.E.

3. IM Reports

   a. If the time required for completion of IM is greater than one year, the Permittee shall provide the Department with Progress Reports at intervals specified in the approved work plan. The Progress Reports shall, at a minimum, contain the following information:

      i. A description of the portion of the IM completed;

      ii. Summaries of any deviations from the IM Work Plan during the reporting period;

      iii. Summaries of any problems or potential problems encountered during the reporting period;

      iv. Projected work for the next reporting period; and,

      v. Copies of laboratory or monitoring data.

   b. The Permittee shall prepare and submit the IM Report to the Department within 90 calendar days of completion of IM conducted under Permit Condition IV.F. The IM Report shall, at a minimum, contain the following information:

      i. A description of IM implemented;

      ii. Summaries of results;

      iii. Summaries of all problems encountered;

      iv. Summaries of accomplishments and/or effectiveness of IM; and,

      v. Copies of all relevant laboratory or monitoring data, *etc.*, in accordance with Permit Condition I.C.10.

IV.G. SUBMITTALS

1. All work plans, reports, schedules, and other documents ("submittals") required by this permit shall be subject to approval by the Department to assure that such submittals and schedules are consistent with the requirements of this Permit and with applicable regulations and guidance. The Permittee shall revise all submittals and schedules as directed by the Department.

2. The Department will review all submittals in accordance with the conditions of this permit. The Department will notify the Permittee in writing of any submittal that is disapproved, and the basis therefore. If the Department disapproves a submittal, the Department shall: (1) notify the Permittee in writing of the submittal's deficiencies and specify a due date for submission of a revised submittal, (2) revise the submittal and notify the Permittee of the

revisions, or (3) conditionally approve the submittal and notify the Permittee of the conditions. Permit Condition IV.H. shall apply only to submittals that have been disapproved and revised by the Department, or that have been disapproved by the Department, then revised and resubmitted by the Permittee, and again disapproved by the Department.

3. All submittals shall be submitted within the time frame specified by the Department and in accordance with the approved schedule of compliance. Extensions of the due date for submittals may be granted by the Department based on the Permittee's demonstration that sufficient justification for the extension exists.

4. All submittals required by this permit shall be signed and certified in accordance with ADEM Admin. Code r. 335-14-8-.02(2).

5. Two (2) copies of all submittals shall be provided by the Permittee to the Department in accordance with Permit Condition I.J.

IV.H. DISPUTE RESOLUTION

Notwithstanding any other provision in this permit, in the event the Permittee disagrees, in whole or in part, with the Department's revision of a submittal or disapproval of any revised submittal required by this Part, the following may, at the Permittee's discretion, apply:

1. In the event that the Permittee chooses to invoke the provisions of this section, the Permittee shall notify the Department in writing within 30 calendar days of receipt of the Department's revision of a submittal or disapproval of a revised submittal. Such notice shall set forth:

    a. The specific matters in dispute;

    b. The position the Permittee asserts should be adopted as consistent with the requirements of this permit;

    c. The basis for the Permittee's position; and,

    d. Any matters considered necessary for the Department's determination.

2. The Department and the Permittee shall have an additional 30 calendar days from the Department's receipt of the notification provided for in Permit Condition IV.H.1. to meet or confer to resolve any disagreement.

3. In the event agreement is reached, the Permittee shall submit and implement the revised submittal in accordance with and within the time frame specified in such agreement.

4. If agreement is not reached within the 30-day period, the Department will notify the Permittee in writing of the decision on the dispute, and the Permittee shall comply with the terms and conditions of the Department's decision in the dispute. For the purposes of this

provision in this permit, the responsibility for making this decision shall not be delegated below the Department's Land Division Chief.

5. With the exception of those conditions under dispute, the Permittee shall proceed to take any action required by those portions of the submission and of this permit that the Department determines are not affected by the dispute.

Table IV.1

The following Solid Waste Management Unit(s) (SWMU) and/or Area(s) of Concern (AOC) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs requiring a RCRA Facility Investigation (RFI):

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA

There are no RFI activities required at this time.

Table IV.2

The following Solid Waste Management Unit(s) (SWMU) and/or Area(s) of Concern (AOC) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs requiring no further action at this time:

SWMU/AOC NUMBER	SWMU/AOC NAME
SWMU 1	Drum Storage Unit
SWMU 2	Spent Sulfuric Acid Storage Tank
SWMU 3	Waste Water Sump
SWMU 4	WWTP Brine Solids Removal Area
SWMU 5	Surge Tanks/Pipe Rack
SWMU 6	Waste Water Treatment Plant (WWTP)
SWMU 7	WWTP Drum Storage Unit
SWMU 8	Waste Pile
SWMU 9	Mercury Retort
SWMU 10	Landfill #1
SWMU 11	Landfill #2
SWMU 12	Landfill#3
SWMU 13	PCB Storage Area
SWMU 15	Brine Sludge Dumpster
SWMU 16	Brine Treatment Tanks
SWMU 17	Brine Treatment Filter Press
SWMU 18	Attenuation Lake
SWMU 19	Mercury Cell Building
SWMU 20	Unidentified Source of Contamination in the Lower Aquifer
SWMU 21	Source of Contamination in the Vicinity of MW-8S
AOC A	Contractor Work Area
AOC B	Raw Materials Storage Area

Table IV.3

The following Solid Waste Management Unit(s) (SWMU) and/or Area(s) of Concern (AOC) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs regulated by Parts II and III of this permit.

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU 14	Former Brine Sludge Lagoon	Closed Surface Impoundment	Soil, Groundwater

PART V

CORRECTIVE MEASURES IMPLEMENTATION

V.A. APPLICABILITY

The conditions of this Part apply to SWMUs and AOCs identified in Table V.1.

V.B. GENERAL CONDITIONS

1. The Permittee is required to perform corrective measures for the SWMUs and AOCs identified in Condition V.A. The approved remedy for these defined units, waterway areas, or land parcels, includes any and all actions set forth in this permit and in the approved Interim Measures Plans, Corrective Measures Studies (CMSs), and Corrective Measures Implementation (CMI) Plans approved by the Department, as noted below:

Applicable SWMU/AOC	CMS/CMI	Approval Date
SWMU 22	CMI Plan	XX/XX/XXXX*

* CMI Plan submitted on August 31, 2015, as modified by subsequent amendments dated December 21, 2015.

2. Remedial Cleanup Levels

   Upon approval, pursuant to Condition 3.0 of the CMI Plan designating applicable cleanup level(s), the cleanup level(s) for the areas specific to the CMI Plan will be deemed to be a condition of this permit.

3. Groundwater Monitoring and Remediation

   Where required pursuant to Conditions V.B.1. and V.C. of this permit, the Permittee shall comply with the general groundwater monitoring requirements of Part III of this permit.

4. Land Use Controls

   Where required pursuant to Conditions V.B.1. and V.C. of this permit, the Permittee shall establish appropriate land use controls to achieve protection of human health and the environment. The Permittee shall comply with Conditions V.B.5. and V.B.6. of this permit when implementing corrective measures requiring land use controls. In the event an off-site property owner does not allow an environmental covenant to be imposed, the Permittee shall notify the Department within 14 calendar days of receipt of such written notification of the refusal by the off-site property owner. If the property owner does not provide a written refusal of the request to allow an environmental covenant to be imposed, the Permittee shall notify the Department within 14 days of delivery of the request to the off-site property owner. In such cases, the Department may allow the Permittee to propose an

alternate area-specific land use control in accordance with ADEM Admin. Code r. 335-5-1-.02(i), subject to the Department's review and approval.

5. Survey Plat

For corrective measures where residual concentrations of contaminants will remain in-place at levels greater than those appropriate for unrestricted land use, or for corrective measures that rely on land use controls, the Permittee must:

a. Within 90 calendar days following the effective date of a permit modification addressing remedy selection, submit to the local zoning authority, or the authority with jurisdiction over local land use, and to the Department, a survey plat indicating the location and dimensions of the SWMUs, AOCs, and capped or partially remediated areas with respect to permanently surveyed benchmarks, the locations of sampling points, and the concentrations of hazardous constituents detected. This plat must be prepared and certified by a professional land surveyor registered in the State of Alabama. The plat must be filed with the local zoning authority or the authority with jurisdiction over local land use and must contain a note, prominently displayed, which states the Permittee's obligation to limit the property to the specified restricted uses.

b. Maintain the survey plat as described in Condition V.B.5.a. of this permit and in the CMI Report until the Permittee has demonstrated, to the satisfaction of the Department, that the levels of hazardous constituents in all contaminated media are within limits appropriate for unrestricted land uses.

6. Environmental Covenant

No later than the submission of the survey plat required in Condition V.B.5., the Permittee must:

a. Record in the probate judges office of the county in which the property is located or a portion thereof an environmental covenant in accordance with ADEM Admin. Code r. 335-5 that will in perpetuity notify any potential purchaser of the property that:

i. The land is contaminated with hazardous constituents in concentrations that exceed unrestricted use standards;

ii. The use of the property is restricted by this permit for certain residential, municipal, or industrial purposes and may lead to an increased risk of exposure to hazardous constituents depending upon the activities initiated at the site. Such activities may yield an increased level of human health risk to the owner;

iii. The potential purchaser or entity that desires to work in the contaminated area should notify the Permittee before mobilizing to the area covered by the land use control.

b. Submit to the Department a certification, signed by the Permittee in accordance with Permit Condition I.C.11., that the environmental covenant specified in this part has

been performed. This certification must include a copy of the document in which the notation has been placed.

c. Maintain the environmental covenant described in Permit Condition V.B.6. until the Permittee has demonstrated, to the satisfaction of the Department, that the levels of hazardous constituents in all contaminated media are within limits appropriate for unrestricted land uses.

7. Security

Security measures, where required by Conditions V.B.1. and V.C. of this permit, will be conducted in accordance with ADEM Admin. Code r. 335-14-5-.02(5) and as prescribed in the approved CMI Plan.

8. Inspection

Where corrective measures addressed in Conditions V.B.1. include provisions to cap in place or partially remediate properties or land areas, whether owned or not owned by the Permittee, the Permittee shall specify inspection protocols on a scheduled basis to ensure continued integrity of the remedy and to ensure that land use remains appropriately restricted per the environmental covenant established pursuant to Permit Condition V.B.6. Inspection provisions shall be as prescribed in the approved CMI Plan

V.C. AREA SPECIFIC CONDITIONS (RESERVED)

V.D. CORRECTIVE MEASURES IMPLEMENTATION (CMI) REPORTS

1. CMI Progress Reports

If the time required to complete implementation of a specific set of corrective measures, as described in the Department-approved CMI Plan, is greater than 180 calendar days, the Permittee shall provide ADEM with progress reports according to the schedule in the ADEM-approved CMI Plan. If no schedule has been approved as part of the associated plan, progress reports shall be submitted at least quarterly. The progress reports shall, at a minimum, contain the following information:

a. A description of the portion of CMI Plan completed;

b. Summaries of and deviations from the approved CMI Plan during the reporting period;

c. Summaries of current and potential problems, including recommended solutions and alternatives as well as corrective actions undertaken;

d. Any monitoring data (soil, air, dust, water) collected for any reason during the construction period for the purposes of monitoring potential for human and ecological exposure; and,

e. Projected work for the next period and impacts to the approved schedule.

2. Final CMI Reports

Upon completion of construction of corrective measures systems, implementation of land use controls, interim removal actions, or other short-term activities required by this permit and/or the approved CMI Plan, the Permittee shall submit to the Department a Final CMI Report containing, at a minimum, the following:

a. A description of activities completed;

b. For cap and cover remedies, as-built construction drawings presenting the final in-place three-dimensional location of contaminated material. A plan view of the remediated areas shall be presented in addition to a cross section of the in-place capped areas;

c. Hazardous waste manifests indicating the handling of any excavated material that has been shipped off-site to a Department-approved, certified landfill;

d. For remedies involving land use controls, a copy of the survey plat and environmental covenant required by Condition V.B. of this permit;

e. Monitoring data (soil, air, dust, water) collected for any reason during the construction period for the purposes of monitoring potential for human and ecological exposure; and

f. Certification, prepared in accordance with ADEM Admin. Code r. 335-14-8-02 (2)(d) by the Permittee and an independent professional engineer registered in the State of Alabama, that the corrective measures implementation phase (*i.e.*, construction) required by this permit is complete and that the approved system and/or facilities are ready for operation in accordance with the intended design (*i.e.*, CMI Plan).

3. Corrective Measures (CM) Effectiveness Reports

a. For corrective measures that have been fully implemented and where the corrective measures system must operate for a period of time to achieve cleanup goals or levels, the Permittee shall submit CM Effectiveness Reports annually, unless otherwise approved by the Department, beginning 180 calendar days following the Department's approval of the Final CMI Report for the initial Corrective Measures system subject to this permit condition. The overall CM Effectiveness Reports shall include, at a minimum, the following information for each SWMU and/or AOC included in the report:

i. A detailed narrative presenting an evaluation of the effectiveness of the selected remedy;

ii. Summaries of compliance with and progress toward achieving cleanup goals;

iii. Any significant revisions, adjustments, or proposed modifications to the selected remedy;

iv. Tabulated environmental sampling and monitoring data including, but not limited to, groundwater quality, elevation data, and a graphical representation of all constituents detected during each sampling event from recovery wells, monitoring wells, drinking water wells, and other locations;

v. Chain of custody, field reports, and laboratory data sheets to include the date of collection, the date the sample was extracted, and the date of sample analysis for samples collected during the reporting period;

vi. Any monitoring data (soil, air, dust, water) collected for any reason during the post-construction period for the purposes of monitoring potential for human and ecological exposure;

vii. Isoconcentration maps depicting the distribution of parameters for each sampling event;

viii. Time versus concentration plots for each monitoring parameter for each recovery well and a representative number of effectiveness wells;

ix. Tabulated volumetric data on groundwater pumped and pumping rates (monthly and cumulative) for each recovery well;

x. Records of any groundwater recovery system operation time, including shutdown periods, not including any minor (less than 24 hours) shutdowns for repairs, maintenance, etc.;

xi. Potentiometric surface maps;

xii. Description of land use during the reporting period at the designated area requiring corrective measures; and,

xiii. Findings of the Permittee's investigation into the continued effectiveness of land use controls per Condition V.B.

b. If, at any time, the Permittee determines that any remedy selection specified in Condition V.B or V.C. of this permit no longer satisfies the applicable requirements of ADEM Admin. Code r. 335-14-5-.06(12) or this permit for releases of hazardous waste or hazardous constituents originating from SWMUs or AOCs, the Permittee must, within 90 calendar days, submit an application for a permit modification, pursuant to Permit Condition I.I, to make any appropriate changes to the CMI Plan.

c. The application for changes in the CMI Plan, including changes in inspection and monitoring provisions of the CMI Plan, shall be submitted as an application for a

permit modification pursuant to the requirements of ADEM Admin. Code r. 335-14-8-.04.

4. Final Report of Corrective Measures

Within 90 calendar days following attainment of cleanup levels or goals as outlined in this Permit and the approved CMI Plan, the Permittee shall submit to the Department a Final Report of Corrective Measures (FRCM). The FRCM shall contain a certification by the Permittee and an Alabama-registered independent professional engineer that all remedial measures required by this permit and the approved CMI Plan have been completed. The FRCM shall outline any procedures and schedules for dismantling of corrective measures systems, groundwater monitoring or recovery systems, removal of land use controls, and any other remedial systems or controls required by this permit or the approved CMI Plan.

Table V.1.

The following Solid Waste Management Unit(s) (SWMUs) and/or Area(s) of Concern (AOCs) numbers and descriptions correspond with those noted in the RCRA Facility Assessment (RFA) Report. Where discrepancies exist, the permit will take precedence.

List of SWMUs and AOCs requiring Corrective Measures.

SWMU/AOC NUMBER	SWMU/AOC NAME	UNIT COMMENT	POTENTIALLY AFFECTED MEDIA
SWMU 22	Newly Identified Area of Contamination	Organic Contamination – Primarily CCL_4 and PCE	Soil/Groundwater

PART VI

SUMMARY OF DEADLINES

The summary information provided herein is intended only as a guide to the requirements of this permit. It is not intended to be all inclusive, nor is it intended to be used as a substitute for the full text of this permit.

PERMIT CONDITION	ITEM	DUE DATE
I.C.2.b.	Reapply for a renewal	180 calendar days before the expiration of the current permit.
I.C.12.	Give notice to the Department of any planned physical alterations or additions to the permitted facility and any solid waste management units.	As soon as possible
I.C.12.	Report any noncompliance with this permit that may endanger human health or the environment.	Orally within 24 hours from the time the Permittee becomes aware of the circumstances. Written submission shall also be provided within 5 calendar days of the time that the Permittee becomes aware of the circumstances
I.F.	Waste Minimization Certification	Annually
I.G.	Update cost estimates	No later than 30 calendar days after the Department has approved a modification to the Closure Plan, Post-Closure Plan, or Corrective Action Plan, or any other plan required or referenced by this permit, if the change in the plan results in an increase in the amount of the cost estimate and annually as required by ADEM Admin. Code r. 335-14-5-.08(3)(b), (5)(b), and (10)(b)
I.I.	Submit a written request for a permit modification pursuant to the requirements of ADEM Admin. Code r. 335-14-8-.04(2).	At least 60 calendar days prior to a proposed change in facility design or operation.
II.C.2	Inspect closed unit(s).	At least weekly, after storms, and in accordance with the inspection schedule.
III.B.1.a.iii.	Notification of damaged groundwater monitoring wells.	Immediately in writing. The well must be repaired within 30 calendar days of damage, and repair report must be submitted within 30 calendar days of repair.
III.B.1.d.	Install additional groundwater monitoring wells	As necessary to assess changes in the rate and extent of any plume of contamination, or as otherwise deemed necessary. Note: a permit modification request must be submitted within 90 calendar days prior to installation of additional groundwater monitoring well(s).

PERMIT CONDITION	ITEM	DUE DATE
III.B.2.a.	Determine groundwater surface elevation.	Semiannually and each time a well is sampled.
III.B.2.b.	Determine groundwater flow rate and direction.	At least annually.
III.B.6.b.	Submit groundwater monitoring report	Within 60 calendar days of the first sampling event and annually thereafter.
III.D.1.a.	Sample all point of compliance wells and background wells and analyze for the constituents listed in Table III.3. of this permit.	Semiannually beginning within 120 calendar days of the effective date of this permit.
III.D.1.b.	Sample and analyze for temperature (degrees F or C), specific conductance (Mhos/cm), and pH (standard units), at all background and point of compliance monitoring well locations.	Each time the well is sampled.
III.D.1.c.	Sample all point of compliance and background wells and analyze, in accordance with Permit Condition III.B.5., for the constituents listed in ADEM Admin. Code r. 335-14-5-Appendix IX	At the beginning of the compliance period and annually thereafter throughout the compliance period.
III.E.2.b.	Implement corrective action plan	No later than 120 calendar days after the effective date of this permit.
III.E.4.a.	Submit corrective action effectiveness reports.	Annually within 60 calendar days of each annual anniversary of this permit after corrective action is initiated and until corrective action is completed.
IV.B.1.	Notify the Department, in writing, of the discovery of any additional AOCs	Within 15 calendar days of discovery
IV .B.2.	Notify the Department, in writing, of the discovery of any additional SWMUs	Within 15 calendar days of discovery
IV.B.3.	Submit a SWMU Assessment Report (SAR) for each SWMU identified under IV.B.2.	Within 90 calendar days of notification.
IV.C.1.	Notify the Department, in writing, of any newly discovered release(s) of hazardous waste or hazardous constituents from SWMUs or AOCs discovered during the course of groundwater monitoring, field investigations, environmental audits, or other means.	Within 15 calendar days of discovery
IV.D.7.	Submit RFI Progress Reports.	Monthly beginning in the second month following the initiation of the RFI
IV .D.8.	Submit RFI Report	Within 60 calendar days from the completion of investigation activities.

PERMIT CONDITION	ITEM	DUE DATE
IV.E.2.	Submit CMI Plan	Within 120 calendar days following the Permittee's submittal of the RFI Report indicating that hazardous constituents have come to be located at any area of the Permittee's facility, or beyond the facility, at concentrations exceeding those appropriate for the protection of human health and the environment, or within 120 calendar days following notification from the Department that a CMI Plan is required, whichever occurs earlier.
IV.E.4.	Demonstrate financial assurance for completing the approved remedy.	Within 120 calendar days after this Permit has been approved.
IV.F.1.	Submit IM Work Plan	Within 30 calendar days upon notification by the Department.
IV.F.3.	Submit IM Report	Within 90 calendar days of completion of IM.
V.B.5.a.	Submit to the local zoning authority, or the authority with jurisdiction over local land use, and to the Department, a survey plat indicating the location and dimensions of the SWMUs, AOCs, and capped or partially remediated areas with respect to permanently surveyed benchmarks, the locations of sampling points, and the concentrations of hazardous constituents detected	Within 90 calendar days following the effective date of a permit modification addressing remedy selection.
V.B.6.a.	Record environmental covenant	No later than the submission of the survey plat required in Condition V.B.5.
V.B.6.b.	Submit to the Department a certification that the environmental covenant has been performed.	No later than the submission of the plat required in Condition V.B.5.
V.B.6.d.	Submit fees in accordance with ADEM Admin. Code r. 335-5-1-.06	No later than the submission of the survey plat required in Condition V.B.5.
V.D.3.	Submit Corrective Measures Effectiveness Reports	Annually beginning 180 calendar days following the Department's approval of the Final CMI Report
V.D.4.	Submit a Final Report of Corrective Measures (FRCM)	Within 90 calendar days following attainment of cleanup levels or goals

GLENN SPRINGS HOLDINGS, INC.
5005 LBJ Freeway, Suite 1350, Dallas, TX 75244
A Subsidiary of Occidental Petroleum Corporation

Suda Arakere
Director Operations

Telephone (972) 687-7526
Facsimile (713) 985-1287

August 31, 2015

Mr. Vernon H. Crockett, Chief
Industrial Hazardous Waste Branch, Land Division
Alabama Department of Environmental Management
1400 Coliseum Boulevard
Montgomery, AL 36110-2059

RE: Occidental Chemical Corporation - Mobile, Alabama
Corrective Measures Implementation Work Plan
ID No. ALD 008 163 388

Dear Mr. Crockett:

Enclosed please find two copies of the above referenced Corrective Measures Implementation Work Plan. An electronic copy has also been sent via email.

If you have any questions or comments on this matter, do not hesitate to contact me at (972) 687-7526.

Sincerely,

Suda Arakere

Enclosure: Report (2 copies)

cc: Metz Duites, ADEM (electronic copy)
Charmaine Roche, ADEM (electronic copy)
Gina Cox, OCC (electronic copy)
David Flint, OCC
Robert Spencer, STRATA, LLC

WORK PLAN

Occidental Chemical Company

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

Mobile, Alabama

March 2008

1st Revision – September 30, 2008

2nd Revision – August 28, 2015

STRATA, LLC
PO Box 446
Fairhope, Alabama 36533

EXECUTIVE SUMMARY

This Corrective Measures Implementation (CMI) Work Plan for the Occidental Chemical Corporation (OxyChem) facility in Mobile, Alabama ~~is~~was originally submitted in accordance with the post-closure RCRA permit issued by the Alabama Department of Environmental Management (ADEM) to OxyChem on February 5, 2003. Since renewal of the RCRA Permit on September 24, 2013, modifications to on-going corrective measures requires revision of this CMI Work Plan. The revision was requested by ADEM in a letter dated December 19, 2014 following a request by OxyChem to terminate groundwater extraction at the Former Brine Sludge Lagoon interceptor trench.

Due to past plant activities, the site presently has plumes of inorganic constituents (mercury and lead) and chlorinated volatile organics, primarily tetrachloroethene (PCE) and carbon tetrachloride (CT), in groundwater zones defined as the Intermediate Zone (wells typically 45 to 55 feet deep) and the Lower Zone (wells typically 60 to 90 feet deep). Minor detections of these compounds have also been observed in a shallow Upper Zone.

~~Since discovering the plumes,~~ OxyChem and Glenn Springs Holdings, Inc. (GSHI) have conducted several interim corrective measures (ICMs) under multiple~~several~~ ICM Work Plans and amendments. Significant progress in cleanup has been accomplished during the ICM phase. ~~at the OxyChem site in Mobile, Alabama.~~ Efforts were focused on three main areas of the site: Boundary Control in the northeastern (downgradient) area, Central Plume area at the Salt Pad and the Source Area at SWMU 22. These efforts continued under the CMI Work Plan approved in 2008.

Since 2004, c~~C~~ontrol of the groundwater plume has been achieved at the downgradient property boundary in the Lower Zone by operating ~~the aerator~~ extraction wells ~~for the past four years~~. Concentrations and total ~~plume~~ mass in this portion of the plume have been significantly reduced and continue to decline as a result of these controls. ~~, now at a fraction of the mass observed in 2003.~~ Based on the trend of improvement, the boundary area control system is expected to remain effective in reducing plume concentrations and mass. When asymptotic responses become evident, one or more supplemental remedial measures (see below) are available to be implemented to enhance the recovery of ~~the~~ groundwater upon termination of the current controls. Boundary control in the Intermediate Zone ~~is expected to continue for a longer period of time, having just been initiated in the~~began in the fall of 2007; however, was terminated in November 2013 to prevent the acceleration of the plumes towards the Barge Canal.

Several corrective measures are available to supplement the extraction, treatment and re-injection controls at the Boundary Area. These include enhanced reductive dechlorination (ERD) or Monitored Natural Attenuation (MNA). Either of these may be used to address lower concentrations of VOCs remaining in the groundwater. above the state MCL groundwater concentrations. ERD was successful in reducing the highest concentrations in the Lower Zone to levels below the MDLs. MNA uses a combination of naturally occurring degradation (essentially the same processes enhanced in the ERD system), along with physic-chemical attenuation and reduction in the aquifer media as the groundwater travels in the absence of a source. Specific applications of these supplemental measures will be defined in Corrective Measures Implementation design elements as discussed in this Work Plan.

GSHI may also performed a Human Health Risk Assessment (HHRA) and submitted the results to ADEM in November 2014. The HHRA was evaluate the development of Risk Based Target Levels (RBTLs) to performed to provide a more site specific analysis of potential receptors and effects from concentrations of VOCs remaining after other treatments are completed to ensure human health and the environment are adequately protected. Approval of the HHRA was received from ADEM in a letter dated May 26, 2015. That letter also granted an extension of the submittal of this revised CMI Work Plan to August 31, 2015.

The original Source Area at SWMU 22 was treated using Dual Phase Vapor Extraction (DPVE) and significant mass was removed. Since the DPVE unit has been decommissioned, some rebound of CT and PCE has been observed. Direct source removal is not an option due to the location of plant process equipment. Currently, a small pilot program is being planned using a combination of air sparging and vacuum extraction is conducted in the Intermediate Zone at SWMU 22. The goal is to prevent the formation of a new volatile plume that could potentially migrate down-gradient and renew the need for boundary control.

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1.0 INTRODUCTION

1.1 Purpose

The purpose of this work plan is to document the groundwater remedial activities and the results performed~~on groundwater~~ under the Interim Corrective Measures (ICM) program and the original CMI Work Plan (dated March 2008), ~~during the past five years~~ and describe the modified ~~selected~~ remedial technologies for Corrective Measures Implementation (CMI). This CMI Work Plan addresses organic and inorganic constituents in groundwater at the Occidental Chemical Corporation (OxyChem) facility in Mobile, Alabama (see Figure 1-1, Site Vicinity~~Location~~ Map). The data collection activities were performed in accordance with the Interim Corrective Measures Work Plan Addendum (dated April 2003) and the CMI Work Plan, and has included various groundwater sampling events, aerator wells operation, dual phase vacuum extraction (DPVE) and enhanced reductive dechlorination (ERD).

With the completion of the various field tasks outlined in the ICM Work Plans~~,~~ and implementation of the selected remedies, it was possible to perform an analysis of site conditions and specify application of various remedial measures to address the ~~groundwater~~ inorganics and volatile organics plumes in groundwater. During this evaluation, the conceptual model of site hydrogeology and contaminant fate and transport has been refined leading to selection and application of appropriate remedial technologies that have been tested and proven effective in full-scale operations.

1.2 Background

Due to past plant activities, the site presently has plumes of inorganic constituents (mercury and lead) and chlorinated volatile organics, primarily tetrachloroethene (PCE) and carbon tetrachloride (CT), in groundwater zones defined as the Intermediate Zone (wells typically 45 to 55 feet deep) and the Lower Zone (wells typically 60 to 90 feet deep). Minor detections of these compounds have also been observed in a shallow Upper Zone, where that zone is present. The activities that resulted in these plumes have been discontinued and no observation of nonaqueous phase liquids has been made at the site.

Since discovering the plumes, OxyChem and GSHI have conducted interim corrective measures (ICMs) under several ICM Work Plans and amendments (May 1997, May 1998, August 2000, ~~and~~ April 2003 and March 2008). As the ICM and facility groundwater monitoring have proceeded, additional information has been collected that has impacted the direction of the ICM.

The ICM Work Plan identified three main goals: the removal/stabilization of the source, the control of constituent migration, and the protection of receptors from exposures. These formed the remedial action objectives under the ICM program. The selection and application of a Corrective Measure needed to consider not only the efficacy of the remedy in attaining the remedial objectives, but the impact of the remedy on the migration of constituents.

To meet these objectives, GSHI developed Corrective Measures that were~~could be~~ implemented within a short time frame (on the order of a year) and ~~could be~~ expanded into a full scale remedy once the pilot test was completed. The ICM Work Plan Addendum ~~submitted in~~ (April 2003), and subsequent CMI Work Plan (2008), outlined modifications to the original ICM and addressed three areas: 1) Site Boundary Area control, 2) Source Area treatment and 3) Off-site plume assessment. Figure 1-2 is a Site Plan showing key features related to this work plan.

1.3 ORGANIZATION

GSHI on behalf of OxyChem has prepared this revised CMI Work Plan to provide documentation of the corrective measures performed at the site and revised~~final~~ remedy selection. This revised CMI Work Plan was requested by the Alabama Department of Environmental Management (ADEM) in a letter dated May 26, 2015~~accordance with the RCRA Corrective Action Permit issued February 13, 2003~~ (see Section 2.1). The plan describes the site hydrogeology and plume movement (Section 2.2), ICM Program design (Section 2.3), and results and ongoing corrective action needs of IM (Section 2.4). Section 3.0 presents the corrective measures ~~selection~~ modifications and specifics of the implementation and schedule.

2.0 BACKGROUND AND SETTING

2.1 *REGULATORY HISTORY*

Regulatory activities at the facility were initiated by closure of the Former Brine Sludge Lagoon (FBSL) in 1986 (see Figure 1-2, Site Plan) followed by detection of mercury in groundwater at this unit. USEPA issued a request for a Part B Post-Closure Care Permit on the Former Brine Sludge Lagoon (FBSL) in 1986. This application was submitted in late 1986 and the Permit (Hazardous Waste Facility Permit No. ALD 008 163 388 for Post-Closure Care and Groundwater Corrective Action) was issued on May 31, 1989. A minor modification was made to this Permit on December 14, 1992 to accommodate some changes to the monitoring well network and data evaluation procedures.

USEPA subsequently initiated a RCRA Facility Assessment (RFA), which identified twenty-one Solid Waste Management Units (SWMUs) and two Areas of Concern (AOC). The RFA Report was published in 1988. USEPA and ADEM determined that an RFI was required on eight of the SWMUs and the two AOCs. This RFI was conducted from 1991-1992. As the RFI was being completed, organic constituents were detected in subsurface groundwater below process areas where chlorine was liquefied and tail gas from that process was scrubbed for further chlorine recovery. Tetrachloroethene was also used in this area as a heat transfer medium for the liquefaction process. A Supplemental RFA/RFI was conducted and completed in late 1998. ADEM later required the preparation of an ICM Work Plan to address controls for the aqueous organic groundwater plume

The RCRA Permit issued in 1989 provided for the monitoring of groundwater at the FBSL, the periodic evaluation of the effectiveness of Corrective Action, and for investigation and Corrective Action of other SWMUs. The Permit also provided for Interim Measures by the applicant, with appropriate notice to and approval by ADEM.

An application for renewal of the RCRA Permit was submitted in December 1998 in anticipation of the expiration of the ten year permit (date of May 31, 1999). Comments were received from ADEM and a revised Permit application was submitted on January 31, 2000. ADEM issued the new permit effective February 12, 2003. That permit expired~~and with and expiration date of~~ February 11, 2013 and was renewed on September 24, 2013. GSHI performed a Human Health Risk Assessment (HHRA) and submitted the results to ADEM in August 2014 and also requested permission to terminate groundwater extraction at the Former Brine Sludge Lagoon (FBSL) groundwater interceptor trench. The HHRA was approved by ADEM in a letter dated May 26, 2015; however, the approval to terminate the FBSL groundwater extraction was denied since this change would require a permit modification and revision of the original CMI Work Plan.

2.2 *GROUNDWATER CONCEPTUAL MODEL*

2.2.1 Hydrogeology

Information on the vertical and horizontal movement of groundwater at the plant site was derived from water levels, in-situ hydraulic conductivity tests, gamma logging, pumping tests and laboratory permeability tests. Groundwater conditions are described below in terms of the Upper Zone, Intermediate Zone and Lower Zone.

A geologic cross-section has been constructed along the major axis of the VOC plume to illustrate the primary geologic units of interest at the site (see Figure 2-1). Two main water bearing units have been defined, a shallow fine-grained unit, or "Upper Zone," and a coarser grained deeper unit that collectively includes an "Intermediate" and "Lower Zone."

The Upper Zone is separated from the Intermediate and Lower Zone by a confining unit consisting of clay, sandy to silty clay and peat. This clay is absent beneath the main plant process area (SWMU 22) and the Upper Zone is either absent or grades directly into the shallow portion of the Intermediate Zone. Recharge to the Upper Zone is from direct precipitation and groundwater discharges to Gales Branch (west side of process area), the Barge Canal (east side of process area), and to lower groundwater zones. The direction of groundwater flow is toward low areas and surface water bodies, and is locally affected by pumping from recovery well RS-1. A groundwater contour map of the Upper Zone is presented in Figure 2-2. As seen from the figure, the pattern of heads in this Upper Zone unit exhibits a mounding effect coinciding with the topographic highs with some flow to Gales Branch and some to the north and discharging at the Barge Canal.

The Intermediate and Lower Zones consist of sand and silty sand. Separating the two zones is a seam of clay, or sandy clay, that was identified from gamma logs obtained from wells on site. This clayey zone ranges in thickness from less than one foot to approximately 10 feet and is present throughout most of the site, although it thins and even disappears in some areas. The direction of groundwater flow in both zones is consistently to the north and northeast; however, flow in the Intermediate Zone appears controlled more by the Barge Canal, and Lower Zone groundwater appears to be influenced by waterways further east (possibly Chickasaw Creek). Groundwater potentiometric maps for both the Intermediate and Lower Zones are illustrated in Figures 2-3 and 2-4. In general, the Intermediate Zone is thinner and more lithologically complex than the Lower Zone. Borings in the Intermediate Zone reveal lenses of alternating sand/clay layers throughout most of the 10 to 24 foot thickness across the site. The Intermediate Zone thins and pinches-out northward in the vicinity of the Attenuation Pond and IP Spoils basin around MW-42D. Similar thinning or termination is possible eastward; however, data is lacking east of wells MW-40D and MW-41D.

Transmissivity was determined from pumping tests conducted in the Lower Zone (included both Intermediate and Lower Zones test as a single unit) during the ICM Pilot test in 1998. Values obtained range from 2062 ft^2/day to 5285 ft^2/day. Based on a thickness of 24 (for the Intermediate Zone), the hydraulic conductivity ranges from 86 to 220 feet/day. Using these values for hydraulic conductivity, a hydraulic gradient of 0.00078 and an effective porosity of 0.30,

groundwater flow rates range from 0.22 to 0.57 ft/day in the main plant area. As groundwater approaches the Barge Canal, groundwater gradient increases to approximately 0.0068 yielding a velocity range of 1.95 to 4.99 ft/day.

Additional aquifer testing was conducted following installation of aerator well AE-1 in the vicinity of MW-17D. The well is 8-inch diameter, screened in the Lower Zone and was pumped 83 gpm. The Cooper-Jacob distance-drawdown plot for observations from the pumping well yielded a transmissivity value of 9200 ft^2/day. Based on a thickness of 50 feet for the Intermediate and Lower Zones combined, hydraulic conductivity is estimated at 6.5 x 10^{-2} cm/s. The Lower Zone at this location is 30 feet thick and, based on the aquifer test, the transmissivity is estimated at 5520 ft^2/day. Based on lithologic samples and plume movement observations, the Lower Zone displays higher conductivities.

2.2.2 *Impacts to Groundwater*

The original source of VOC release has been identified in the SWMU 22 area and, to a lesser degree, the area around the maintenance shop and PCE drum storage area south of the maintenance shop building. To provide a better indication of the original extent of VOC distribution and the success of corrective measures, plume maps in this section represent conditions observed from the November 2003 sampling event prior to longer term ICM activitiesand from the most recent sampling event in March 2015.

VOC distribution is negligible in the Upper Zone since this zone does not extend southward to beneath SWMU 22 and due to the limited potential for lateral migration in this silty zone. Figure 2-5 illustrates the distribution of carbon tetrachloride in the Upper Zone in 2003 and in 2007 (Figure 2-5b represents data from 2015); Figure 2-6 depicts plumes for PCE in the Upper Zone in 2003 and 2007 (Figure 2-6b represents data from 2015).

The majority of lateral movement has been in the Intermediate and Lower Zone, where more groundwater flow occurs. The clay lens between the Intermediate and Lower Zones had an apparent influence on the movement of VOCs, with a corresponding shift of the plumes in the Intermediate and Lower Zones. The Intermediate Zone plume is oriented toward its expected discharge zone at the Barge Canal, and the Lower Zone plume is oriented in a slightly more northerly direction toward Chickasaw Creek. Figures 2-7 illustrates plume maps of CT in 2003 and 2007 (Figure 2-7b represents data from 2015) and Figures 2-8 the PCE in 2003 and 2007 (Figure 2-8b represents data from 2015) plume delineations for the Intermediate Zone and Figures 2-9 and 2-10 depict the same information for the Lower Zone (Figures 2-9b and 2010b represent data from 2015). ~~The 2003 and~~

~~2007 plumes contrast the widest distribution and highest concentrations of CT and PCE observed at the site with current conditions.~~

Inorganic constituents of concern in the groundwater include lead and mercury. The source of mercury is the chlorine cell building/brine area (where mercury cell technology was used prior to October 1990) and the FBSL. Mercury has been monitored in all three primary aquifers and Figures 2-11 to 2-13 illustrate the distribution of mercury detections in these three zones in 2003 and 2007 (Figures 2-11b, 2-12b and 2-13b represent data from 2015).

Lead has been detected primarily in the Upper Zone and the source is believed to be from impurities in the salt used in the chlorine manufacturing process. Salt was formerly stored in open piles on the Salt Pad area to the north of the cell building and brine area. Some lead has been detected above the MCL of 15 ug/l in the Intermediate Zone at wells DW-1 and MW-33D. Figure 2-14 illustrates the lead concentrations in the Upper Zone in 2003 and 2007 prior to initiation of ICM activities (Figure 2-14b represents data from 2015).

2.3 *ICM PROGRAM DESIGN*

The ICM Program (based on ICM Work Plans and amendments submitted in May 1997, May 1998, August 2000 and April 2003) ~~has~~ consisted of four areas where remedial activities have been evaluated at the site. These include:

- Boundary Control
- Source Area Recovery
- Central Plume Remediation
- Upper Zone Trench at the FBSL

2.3.1 *Boundary Control Using Aerator Wells*

The concept for boundary control was to extract groundwater, strip volatiles using in-well aerators and re-inject into injection wells. Treated groundwater re-injection was designed to support the extraction wells in containing the width of the Boundary Area. Groundwater modeling was performed by Services Environmental, Inc. to simulate various pumping and re-injection scenarios. The final selection is illustrated in Figure 2-15 which shows the predicted capture zone using two extraction wells and two injection wells. A third aerator well (AE-3) was added in March 2006 to ensure plume capture in the vicinity of the property boundary (in vicinity of monitoring well MW-42D).

The re-injection of groundwater into the aquifer required an Underground Injection Control Permit from ADEM. An application was submitted to ADEM

and the permit was issued effective January 7, 2004 (Permit No.: ALS19949671) allowing the re-injection of treated groundwater in two pair of injection wells. Frequent sampling ~~has been~~was conducted to evaluate the performance of the aerators and some modifications ~~have been~~were performed to ensure removal of volatile compounds to below the permit limits. The results have been included in the monthly UIC reports submitted to ADEM.

Three aerator wells (AE-1, AE-2 and AE-3) were originally equipped with upper and lower aerators. ~~(AE-2 has been dismantled as described below and AE-1, due to iron fouling, has been refitted with only the lower aerator).~~ Compressed air was~~is~~ supplied by a Keiser 100 HP compressor located within the fenced area of the plant. The air was~~is~~ delivered through piping to the controls located within the locked, metal control box at each well. Three one-inch diameter rubber hoses exited the top of the well and attached to the control manifold that consisted of a valve, pressure gauge and flow meter for each hose. One set controlled the air lift pump, the second controlled the lower aerators and the third controlled the upper aerators. A ¼" hose was ~~is~~ attached to a small pressure control valve that inflated a packer assembly in the well to separate the upper from the lower aerator~~. A piping and instrumentation diagram is shown on Figure 2-16.~~

~~The air lift pump is operated at a pressure and flow rate of 30 psi and 15-20 scfm and is adjusted to provide a groundwater flow rate of 15-20 gpm as determined by the inline flow meter on the groundwater discharge line. The upper and lower aerators are operated at a pressure and flow rate of 40 psi and 30-40 scfm.~~

Start-up of the boundary control in-well aerators occurred on July 1, 2004 and operation has continued to-date with occasional interruptions to make modifications to the system. Shortly following start-up, mercury was detected in the effluent in concentrations above the UIC permit limit and GSHI began to operate with pilot scale aqueous phase carbon units. Aqueous phase carbon is often an effective technology for removal of mercury and chlorinated VOCs from water. Initially, a pair of drums filled with aqueous phase carbon was connected to the discharge from the aerator well and testing was performed to verify the removal of mercury. Initial testing of this arrangement indicated that MCLs were being attained for both VOCs and mercury in the discharge from the aerator wells.

GSHI installed full-scale carbon treatment systems at AE-1 and AE-2 in September 2005 to provide treatment of aerated groundwater as it discharges from the aerator wells prior to injection back into the aquifer through the injection wells. Water recovered from the aerator wells was~~is~~ gravity-fed into a holding tank. A pneumatic double-diaphragm pump conveyed~~s~~ the groundwater from the holding tank through a bag filter assembly to remove

solids from the water stream. The filtered water was~~is~~ then forced through two-2000 pound carbon vessels to ensure removal of mercury and VOCs to below their respective permit limits. Effluent from the carbon vessels is discharged to injection wells.

Beginning in the autumn of 2006, biosolids began appearing at AE-1 and soon thereafter at AE-2 as a result of molasses injections in the Salt Pad area of the plant (see Section 2.3.3). The solids began plugging the bag filter assemblies and iron precipitation began occurring at AE-2. The iron fouling resulted in plugging of the aerator tips in AE-2. The aerator assembly was removed and rebuilt; however, within a short time the aerators were fouled again and the well was shut down. Preparations were made at that time to replace the in-well aerators at AE-2 with an aboveground shallow-tray stripper. The stripper was installed in July 2007 and testing and startup occurred in August and September.

Modified Boundary Control System

Chronic iron fouling of the wells and aerator assemblies has required modifications to the groundwater extraction system. Well AE-1 progressively became plugged and efforts to rehabilitate proved unsuccessful. Pumping from this well was terminated in March 2014. Well AE-3, located off-site, was terminated due to declining groundwater concentrations and to prevent acceleration of plume movement down gradient of AE-2. Currently, AE-2 has been equipped with a centrifugal pump and the extracted groundwater is conveyed directly to the air stripper. Following aeration to remove the VOAs, the groundwater is pumped through the carbon vessels and into the injection wells as described above. A revised piping and instrumentation diagram is shown on Figure 2-16.

Since the original groundwater modeling effort simulated the operation of extraction wells AE-1 and AE-2 and injection wells I-1a,b and I-2a,b (see Figure 2-15), monitoring of groundwater levels has been performed routinely to evaluate the effectiveness of plume capture utilizing only extraction well~~s~~ ~~AE-1 and~~ AE-2~~3~~. Figure 2-17 is a potentiometric map with groundwater flow lines illustrating the effective capture of the Lower Zone plume under current pumping conditions.

2.3.2 Source Area Recovery

A Dual Phase Vacuum Extraction (DPVE) unit was installed in the main plant area (SWMU 22) in the vicinity where known releases of CT and PCE had occurred (see Figure 2-18). The unit operated from January 15, 2004 to December 31, 2006 for a total of 8000 hours with an average air flow rate of 226 acfm. An air

treatment system operated to strip volatile organic compounds (VOCs) from the off gases from the liquid ring vacuum pump and consisted of a carbon regeneration unit containing two carbon vessels: one vessel was used at a time and the second vessel held in reserve. Once the calculated breakthrough time expired, the spent carbon vessel was removed and the air stream directed to the clean carbon bed. While off-line, the spent carbon was regenerated using plant steam. The concentrated liquid, containing carbon tetrachloride and PCE, was diverted to containers for off-site treatment and disposal and manifested as hazardous waste.

Air sampling was performed periodically and consisted of collection of vapor samples from the liquid ring vacuum pump (LRVP) stack gases influent stream (Pre-Carbon) and the post-treatment carbon vessel that is vented to the atmosphere. Each sample was analyzed for VOAs using EPA Method 8021/8015mod.

The DPVE unit was discontinued in December 2006 as a result of diminishing VOC removal rates. Final notice of termination of DPVE activities was made to ADEM in the semiannual air report submitted to the Air Division on March 1, 2007 and noted in Quarterly and Corrective Action Effectiveness Reports submitted in 2007. Results are discussed in Section 2.4.2.

Following removal of the DPVE unit in 2006, VOC concentrations began rebounding in the Intermediate Zone aquifer beneath SWMU 22. The CMI Work Plan (2008) included a proposal to use air sparging to reduce concentrations in the aquifer. The air sparging system consists of the measured injection of an air stream into the groundwater through existing piezometers TPZ-14, TPZ-15 and TPZ-16 and measurement of the passive exhaust air driven out of the subsurface by the pressure differential created from the injection. The existing four-inch diameter well (SVE-3) is used to vent the sparged vapors out of the subsurface.

Routine air sparging began on September 22, 2010. Air exhaust samples are collected monthly from the vent pipe using Suma canisters for analysis of VOCs using EPA Method TO-15. The analytical results combined with daily air flow measurements permit an estimate of VOC emissions to be calculated and reported to ADEM in semiannual air reports. To date, 441 lb of PCE and 899 lb of carbon tetrachloride has been removed. As expected the rate of mass removal has decreased.

2.3.3 Central Plume Remediation With ERD

Groundwater in the Central Plume Area (Former Salt Pad) was treated by an in situ Enhanced Reductive Dechlorination (ERD) process to help reduce

downgradient plume concentrations. This process involved the addition of certain food grade additives to encourage natural biodegradation of the constituents, by sequential removal of chlorine atoms from the volatile organic compound molecules. This process is very well understood, with numerous case studies in the past decade demonstrating that anaerobic, reduced conditions facilitate the reductive dechlorination of organics. The goal of the ICM was to create these reduced conditions in the intermediate and lower zones and, thereby, effect the dechlorination of the constituents, ultimately reducing the concentration of chlorinated volatile organics arriving at the Boundary Area. This work was conducted under the authority of an ADEM UIC permit.

The ERD system was comprised of two injection well arrays and a monitoring well network (see Figure 2-19). The first array consists of six injection wells screened in the Intermediate Zone (approximately 50-60 feet bgs). The second array consists of 18 injection wells screened in the Lower Zone. These 18 wells are arranged in pairs at nine locations with one well screened from 60-75 feet bgs and the second screened from 75-90 feet bgs.

Between January 2005 and June 2006, a total of 15 injection events were conducted as reported in the May 2007 CAE Report submitted in October 2007. During each injection event, approximately 44,500 gallons of molasses solution (2 to 10 percent molasses content by volume) were injected into the subsurface (approximately 1,000 to 2,000 gallons of molasses solution per injection well). Based on data collected between January and December 2005, it appeared that the naturally low pH in the groundwater was inhibiting the growth of the necessary microbial community. Beginning in December 2005, sodium hydroxide (NaOH) was added to the molasses solution to raise the pH of the injectate to between 8 and 10 s.u. Upon injection, the pH-adjusted solution was diluted to a groundwater pH closer to neutral in the aquifer.

Groundwater monitoring was conducted to evaluate and optimize system performance. Common groundwater analyses included VOCs, biogeochemical parameters, total organic carbon, and dissolved gases. In addition, field parameters (pH, DO, oxidation-reduction potential, temperature, conductivity) were collected as needed. Results are discussed in Section 2.4.3.

2.3.4 Upper Zone Trench at FBSL

Brine sludge from chlorine production electrolytic cells was historically managed in a lagoon (FBSL) in the northern portion of the active process area at the plant. The brine sludge was removed in 1989, and the lagoon was backfilled with native soil and capped with a clay cover. A Part B Post-Closure Permit application, including a corrective action plan, was subsequently prepared for the FBSL. This was

required to address elevated concentrations of mercury found in groundwater samples from water table (Upper Zone) monitor wells surrounding the FBSL in 1985 and 1986. A groundwater recovery system was installed and began operation in March 1989.

The groundwater recovery system consists of an interception trench (approximately 20-25 feet deep and 250 feet long), a recovery sump (RS-1), three piezometers (PZ-1, PZ-2, and PZ-3), pumps, piping, and a holding tank. The two legs of the interception trench are perpendicular to each other on the downgradient sides of the former lagoon and intersect at the recovery sump (Figure 2-20). The interceptor trench is backfilled with a gravel aggregate, providing a highly permeable flow path to the sump. Groundwater is pumped from the recovery sump to a holding tank and from the tank to the plant wastewater treatment system. The treatment system uses sulfide precipitation to remove the low concentrations of mercury from the water. The solids are removed in the filter press and have passed TCLP for disposal as non-hazardous. The water is discharged with the treated plant process wastewater through the plant's permitted NPDES outfall.

2.4 *RESULTS OF ICM AND CMI ACTIVITIES AND CURRENT CONDITIONS*

2.4.1 Boundary Control in Lower Zone

Significant progress has been accomplished since Boundary Control activities began in July 2004. As of ~~December 31, 2007~~July 31, 2015 a total of more than 74.9~~23~~ million gallons have been extracted, treated and re-injected providing control of the plume at the property boundary. Table 2-1 summarizes quantities of groundwater pumped through ~~the end of 2007~~July 2015. Concentrations at monitoring well MW-42D located just off-site along the axis of the plume has declined from a high of 4000 ug/l CT and 3000 ug/l PCE (sampled in December 2003) to <1~~3.8~~ ug/l and 27~~92~~ ug/l, respectively, in ~~November 2007~~September 2014. ~~The most recent plume monitoring event in January 2008 reveals a continued decline in volatile organics concentrations at the aerator wells.~~ Table 2-2 summarizes concentrations at the plume monitoring wells in the vicinity of the aerator wells. Wells STPZ-10, STPZ-19 and STPZ-22 represent groundwater being pulled into aerator wells AE-1, AE-2 and AE-3, respectively. Graphs have also been prepared (see Figure 2-21) illustrating the effectiveness of boundary control. Concentrations of CT at STPZ-10 (AE-1) have declined from a high of 10,000 ug/l in October 2005 to <1~~18~~ ug/l in ~~January 2008~~March 2015 and PCE has declined from a high of 4200 ug/l in November 2005 to 49~~60~~ ug/l in ~~January 2008~~March 2015. Similar reductions have been observed at STPZ-19 (AE-2). CT has declined from 2900 ug/l in November 2004 to <1~~7.6~~ ug/l in ~~January 2008~~March 2015 and PCE has declined from 920 ug/l in November 2004 to 160~~280~~ ug/l in ~~January 2008~~March 2015. CT is below~~approaching~~ the MCL of 5 ug/l at all three aerator wells and PCE is less than 100 ug/l at AE-1 and AE-3.

The total area of the plume (based on concentrations exceeding the MCL of 5 ug/l) in the Lower Zone, prior to pumping, was 913,150 sq. ft. (21 acres) for carbon tetrachloride and 1,652,749 sq. ft. (38 acres) for PCE. As pumping began, the offsite plume beneath the IP Spoils Basin area was reduced to below MCL levels. In combination with the ERD activities (see discussion of results in Section 2.4.4), the CT and PCE plumes upgradient of the extraction wells have been reduced. Figures 2-9 and 2-10 illustrate ~~changes in~~ the LZ CT and PCE plumes based on the March 2015 sampling event. ~~(as of November 2007 and January 2008 plume delineation sampling) since boundary control was initiated.~~ The greatest reductions in plume areas have been with concentrations >100 ug/l. A graph of changes in plume areas is presented in Figure 2-22. The CT plume in the lower zone does not currently display concentrations in excess of the MCL of 5 ~~100~~ ug/l. ~~and t~~The PCE plume exceeding 100 ug/l has shrunk to ~~less than 38,600~~ 44,340 sq. ft. (approximately~~less than~~ an acre) from an original value of 242,359 sq. ft. (5.5 acres) in November 2003.

2.4.2 *Boundary Control in Intermediate Zone*

The volatile plumes in the IZ, as described in Section 2.2.2, are oriented toward the Barge Canal. Actual flux to the canal is expected to be minimal as evidenced by the small changes observed in plume movement in the area. Pumping at P-3I began in September 2007 to effect some reductions in concentrations prior to movement into the Barge Canal area and as of end of ~~August 2008~~November 2013; approximately 16 million gallons have been removed and treated through the stripper. Based on plume monitoring from April 2007 through ~~April 2008~~November 2013 (when pumping was terminated), the following changes have occurred:

	P-3I		**STPZ-7**		**MW-8D**	
Month	CT	PCE	CT	PCE	CT	PCE
Apr 2007	350	890	410	850		
May 2007					520	970
July 2007	670	1700	520	950		
Oct 2007	600	1600	380	510		
Nov 2007					310/320*	370/410*
Jan 2008	540	1000	310	400	400	530
Apr 2008	910	2100	470	750	240	200
Nov 2013	<10	2700	<20	1800	<5	1500

Notes:

Concentrations in ug/l

* Duplicate sample results

Increases in PCE concentrations at these wells indicated that pumping from P-3I may have accelerated the migration of the plume toward the Barge Canal. Based on this observation, pumping of P-3I was terminated in November 2013.
~~Monitoring will be conducted quarterly for these wells to provide data for observing reducing trends, especially at MW-8D and STPZ-7, to indicate that groundwater extraction is effective in reducing plume magnitude in this area.~~

2.4.3 *Source Area*

Operation of the DPVE resulted in the removal of a significant quantity of CT and PCE from the original source area. Approximately 12 feet of the silty and clayey soil from the surface to the top of the Intermediate Zone, was impacted with CT and PCE. Concentration of CT in the shallow groundwater at piezometer TPZ-1 was 48,000 ug/l prior to operation of the DPVE unit and, as vacuum was applied to the formation during the eight hour pilot test,

concentration of CT increased dramatically to 250,000 ug/l as the compounds were mobilized from the clayey overburden. Concentrations dropped off rapidly but fluctuated between non-detect to as high as 17,000 ug/l and, as of April 2007, the concentration at TPZ-1 was 1200 ug/l CT and 120 ug/l PCE. Table 2-3 summarizes groundwater sampling data over the course of the DPVE operation.

Air sampling was periodically performed to assess the mass of organics being extracted from the subsurface. These data were used to prepare semiannual air emissions reports submitted to ADEM Air Division. Calculation of mass was performed using the results from sampling and applying to a constant withdrawal rate of 226 cfs. Extraction rates were interpolated between sampling dates to obtain an estimate of total pounds removed. As discussed in Section 2.4.3~~2~~ the bulk of the mass was adsorbed to carbon then stripped using steam and collected in drums for off-site disposal. Cumulative mass removed was estimated at 6445 lbs of CT and 1080 lbs of PCE as shown on Figure 2-23. A total of thirty one 55-gallon drums of concentrated liquid were removed from the site over the course of the DPVE operation.

The potential for DNAPL migration at SWMU-22 has been evaluated and no evidence of DNAPLs has been observed. A cross-section at SWMU-22 is illustrated in Figure 2-24 showing the concentrations of CT and PCE prior to DPVE operation and Figure 2-25 represents concentrations in 2015~~again in 2008 (Figure 2-25)~~. As shown, concentrations diminish downward. An explanation for the movement of organics into the Lower Zone is provided in Figure 2-26 which is a cross-section showing the equipotential lines as indicated by groundwater levels at SWMU-22. As indicated, a downward potential does not exist but organic constituents entering the surface of the Intermediate Zone would migrate with the natural flow of groundwater and be carried downward into the Lower Zone farther downgradient. If DNAPLs had migrated down to the base of the aquifer, an expected "smearing" would be visible by higher concentrations downward.

2.4.4 Central Plume ERD

Results of ERD injections have been reported to ADEM in the May 2007 CAE Report submitted in October 2007. Based on a detailed evaluation of the performance monitoring data collected through June 2006, the findings are summarized as follows:

Intermediate Zone ERD:

Adequate TOC concentrations were observed in monitoring wells PM-3I, PM-4I, PM-5I, and MW-33D located within 185 feet downgradient of the intermediate zone injection array to promote ERD indicating that molasses solution was migrating from the injection points. The addition of NaOH to the intermediate treatment zone was sufficient to maintain the groundwater pH at levels above 5 s.u. in portions of the treatment zone.

The presence of organic carbon and optimal pH drove the biogeochemical system from mildly-reducing to strongly-reducing conditions. These conditions indicated that a mature ERD system developed during the injections in areas immediately downgradient of the injection system.

ERD was observed in the intermediate zone as indicated by a decreasing trend in parent compound concentrations. Over the final three sampling events in 2006, VOC concentrations at monitoring wells (PM-3I, PM-4I, and PM-5I – located downgradient from injection array) decreased. PCE and CT concentrations at MW-33D (located off-center from injection array) did not exhibit significant trends. A summary of analytical data for the Intermediate Zone ERD monitoring wells is included in Table 2-4.

Lower Zone ERD:

Optimal TOC concentrations were observed in monitoring wells (MW-13D, PM-4L, and MW-15D) located within 300 feet downgradient of the lower zone injection array to promote ERD. The addition of NaOH to the lower treatment zone maintained the groundwater pH at levels above 5 s.u. The presence of organic carbon and optimal pH drove the biogeochemical system from mildly-reducing to strongly-reducing conditions. These conditions indicate that a mature ERD system developed during the injections.

ERD was observed in the lower zone as indicated by a decreasing VOC trends. Significant VOC concentration decreases were observed during the injection activities demonstrating the treatment of VOC contamination. A summary of analytical data for the Lower Zone ERD monitoring wells is also included in Table 2-4.

In conclusion, the ERD injection program at the Salt Pad has appeared to effect a reduction in concentrations of CT and PCE in the groundwater at this portion of the site. Additional injections may be incorporated in the LZ Boundary Area, and/or the IZ as a supplemental final remedy at the site as described in Section 3.0 following termination of pump and treat activities.

2.4.5 Upper Zone FBSL

The groundwater flow rate in the Upper Zone in the vicinity of the former lagoon was estimated for the recovery system design, and the results were presented in the permit application. Based on a hydraulic conductivity of 11.33 ft/day (4.0×10^{-3} cm/sec), a hydraulic gradient of 0.006 ft/ft, and given a projection of the two legs of the trench of 180 feet normal to a northeasterly flow, and a wetted depth of approximately 10 feet, an estimated 900 gallons per day (GPD), or 0.625 gallon per minute (GPM), would pass the trench alignment under pre-pumping conditions.

The corrective action system for the FBSL continues to function as designed. Groundwater recovery rates for the previous 18~~0~~ years are summarized below. With the exception of 2002, the averaged daily withdrawal rate exceeded the required 900 gallons/day. Withdrawal rates began declining prior to 2002 due to mechanical problems with the submersible pump in RS-1. A white precipitate routinely clogged the pump and piping causing the pump to burn up. ~~The electrical submersible pump was replaced in January 2003 with a pneumatic diaphragm pump.~~ Since February 2003, extraction rates have far exceeded the required 900 gpd, thus, groundwater flow across the FBSL is intercepted by the trenches and recovered at a rate sufficient to capture flow in the area of the unit.

The total yearly and average daily rates since 1997 are shown below:

Year	Gallons per Year	Gallons per Day
1997	934,071	2,559
1998	989,658	2,711
1999	391,724	1,073
2000	453,887	1,244
2001	369,360	1,012
2002	294,423	807
2003	1,924,826	5,273
2004	1,522,320	4,171
2005	1,757,380	4,815
2006	2,925,970	8,016
2007	2,749,653	7,533
2008	745,950	2,043
2009	509,570	1,396
2010	634,250	1,738
2011	630,700	1,728
2012	492,288	1,349
2013	717,995	1,967
2014	409,394	1,122
2015*	246,745	1,164

*Through July 2015

Total mercury concentrations in the monitor wells in the Upper Zone are lower than they were 17~~0~~ years ago when total mercury analyses were initiated. Mercury concentrations have remained consistently low (with some minor fluctuations) since the end of 1992. Mercury concentrations have consistently been below the MCL of 2 ug/L in the recent years in the Upper Zone at the FBSL. The highest values detected in March 2015 at the FBSL are found in MW-2 (~~4.9~~1.1 ug/L) and MW-3 (~~2.2~~1.7 ug/L), both screened in the Upper Zone and within the capture zone of RS-1.

Lead concentrations were detected in groundwater samples primarily from the Upper Zone. The plume is centered beneath the FBSL with highest values measured in March 2015 in MW-4 (~~125~~ 89 ug/L), MW-1R (~~123~~ 42 ug/L) and MW-2 (36~~5~~ ug/L). As with the mercury plume, the groundwater recovery system is

pulling groundwater past MW-2 and MW-3 toward the interceptor trenches, therefore, higher concentrations are expected here.

Termination of pumping at the FBSL was proposed in letter dated August 28, 2014 ~~Continued need for pumping is being evaluated~~ based on declining trends (see Figure 2-27) in wells at the FBSL. From 1989 through July 2015, over 31 million gallons of water and 2.25 lb (1.02 kg) of mercury have been recovered. The rate of mass removal has dropped significantly. For example, in the recent ten years only 0.27 lb (0.12 kg) of mercury has been recovered. This is consistent with the sharp reduction in the concentration of mercury in the UZ wells, specifically, MW-2, MW-3, MW-4, and RS-1 presented in Figures 2-27(a) through 2-27(d) (excerpted from the HHRA Report).

3.0 *CORRECTIVE MEASURES SELECTION AND IMPLEMENTATION*

The proposed plan for corrective measures addresses the current Intermediate and Lower Zone Boundary Control activities, FBSL, and Source Area treatment. Existing, proven methods will continue as described below. Table 3-1 summarizes the planned and proposed corrective actions at the various portions of the site and includes a schedule for implementation and duration.

3.1 *REMEDIAL GOALS*

3.1.1 *Remedial Goal Framework*

GSHI performed a Human Health Risk Assessment (HHRA), which was submitted to ADEM in November 2014. Approval of the HHRA was received from ADEM in a letter dated May 26, 2015. One of the objectives of the HHRA was to compile all relevant soil, groundwater, surface water, and soil vapor data collected at the site and to summarize the remedial activities conducted to date. This compilation and analysis of data constituted the site conceptual model (SCM). The SCM was used as a basis for the risk assessment (RA) conducted in accordance with the *Alabama Risk-Based Corrective Action (ARBCA) Guidance Manual* (ADEM, April 2008).

The objective of the HHRA was to estimate the current and future potential future risks to human health and the environment. The result of this HHRA is used to identify the need for corrective actions for this site. Key conclusions are as follows:

- Cumulative carcinogenic risk to the current and future office, maintenance, shift worker; and future construction worker are below the acceptable target risk level of 1×10^{-5}.
- Cumulative non-carcinogenic risk to the current and future office and shift worker are below the acceptable hazard index of 1.0. Cumulative non-carcinogenic risk to current and future maintenance worker and future construction worker exceeded the hazard index of 1.0, when the 95% UCL was used as the representative concentrations.

The HHRA also presented a sensitivity analysis using the average concentrations that resulted in acceptable risks for all the receptors. In addition to the risk calculated, the potential impacts to the Barge Canal and the Chickasaw Creek were evaluated per the *April 2008, ARBCA Guidance Manual*. In particular, soil and groundwater concentrations protective of these surface water bodies were back calculated and compared with the representative concentrations for RM-1

and RM-2 evaluation. Under RM-1, the point of exposure (POE) is at the point of discharge and under RM-2, the POE was located at the downstream edge of the mixing zone. Using the target concentration at the POE, i.e. the allowable stream concentration per *ADEM Water Quality Program Volume I Division 335-6*, the acceptable concentrations in soil and groundwater were back calculated.

The results of this evaluation indicate that representative concentrations exceeded the RM-1 target levels for Barge Canal and Chickasaw Creek. However, none of the representative concentrations exceeded the RM-2 target levels developed for Barge Canal and Chickasaw Creek.

The significance of these findings and how it impacts corrective measures in the various groundwater zones and source area are discussed below.

~~The default remedial goals for groundwater in Alabama are drinking water standards (MCLs). For the constituents of concern, these are:~~

~~Carbon Tetrachloride~~	~~5 ug/L~~
~~Tetrachloroethene (PCE)~~	~~5 ug/L~~
~~cis-1,2-Dichloroethene~~	~~70 ug/L~~
~~Trichloroethene~~	~~5 ug/L~~
~~Vinyl Chloride~~	~~2 ug/L~~
~~Mercury~~	~~2 ug/L~~
~~Lead~~	~~15 ug/L~~

~~At present, the remedial goals for the Final Corrective Measures are the MCLs. However, given the relative isolation of the Site and downgradient area, the long distances for Lower Zone groundwater travel until discharge, GSHI may elect to develop site-specific Remedial Cleanup Levels. It is not uncommon for groundwater cleanup to progress to a point where reduction in constituent concentrations reaches an asymptote above the respective MCL. In many such cases, continued extraction and treatment of groundwater is not necessary to protect human health or the environment.~~

~~Risk-Based Target Levels (RBTLs) would be developed in accordance with the document: "Alabama Risk-Based Corrective Action Guidance Manual, April 2008-Revision 2" (or more current version if available at that time). Consistent with that document, "RBTLs are developed to be applied by the user as a guide or goal during the remediation process to aid the site in the achievement of appropriate cumulative risk levels protective of human health and the environment". To meet this objective, the site-specific exposure conditions, i.e., potential exposure pathways are identified and incorporated into the chemical intake and risk estimation algorithms for RBTL development. GSHI has~~

~~performed a preliminary evaluation of these pathways, which are summarized in Table 3-2 for each affected groundwater zone. This summary provides a preliminary conclusion that RBTLs can be justified.~~

~~As noted above, MCLs will be the initial remediation goal for the Final Corrective Measures program. As remediation progresses to that default goal, the trend of system performance and recovery will be evaluated.~~

3.1.2 Upper Zone

The UZ groundwater impact is confined to the FBSL area and the plume is stable or declining. Further, the concentrations of the COCs in the UZ well near the Barge Canal (MW-9S, MW-8S and MW-21S) were non detect. Therefore, the potential impact to the Barge Canal due to impacts in the UZ is not likely.

In order to demonstrate that the interceptor groundwater pumping system can be terminated at the FBSL without rebound of mercury, GSH is proposing to temporarily shutdown pumping from RS-1. Prior to the temporary shutdown, a baseline sampling event will be completed in wells MW-1R, MW-2, MW-3, MW-4 and RS-1. Following shutdown, the same wells will be monitored monthly for three months then semiannually as required by the RCRA permit. The samples will be analyzed for mercury using EPA Test Method 7471A. Groundwater levels will be measured during each sampling event to document changes in the groundwater surface. The groundwater data from sampling of the wells will be evaluated relative to historic concentrations. If there is a material rebound, the pumping from RS-1 will be resumed.

It is OxyChem's intent, and as required by the current RCRA permit, RS-1 will continue to operate until a permit modification is in place that eliminates the requirement of groundwater pumping at the FBSL.

~~Maintenance of the recovery system at the FBSL will continue as required by the RCRA permit until groundwater MCLs or alternative RBTL goals are met. Significant mass of mercury and lead have been removed and migration past the interception trenches has been prevented. Prior to renewal of the Permit in 2013, the FBSL groundwater extraction system will be evaluated to determine if continued operation will be required. It is anticipated that passive treatment, or justification of no further action will be evaluated.~~

3.1.3 Intermediate Zone

The IZ groundwater intersects the Barge Canal and an RM-1 and RM-2 evaluation was conducted. These evaluations require the back calculation of allowable concentrations at (i) the soil source, (ii) groundwater source, (iii) sentry well, and (iv) point of discharge protective of the Barge Canal.

The comparison of the allowable concentrations with the representative concentrations at the (i) soil source, (ii) groundwater source,(iii) sentry well, and (iv) point of discharge indicates the exceedance of allowable concentrations for carbon tetrachloride, chloroform PCE, TCE, vinyl chloride, and mercury at various locations.

For the RM-2 evaluation, the allowable soil source, groundwater source, sentry well, and point of discharge groundwater concentrations protective of the Barge Canal are presented in Table 7-3. None of the representative concentrations are exceeded.

The IZ plumes have been observed to be relatively static compared to the Lower Zone plumes. ERD injections have not been demonstrated as effective in the application at the Salt Pad area due to the heterogeneity of the lithology and lower overall transmissivity. For these same reasons, groundwater extraction is not widely applicable throughout the IZ at the site. Offsite migration has not been documented although the plume is delineated close to the Barge Canal at MW-8D (migration toward offsite surface water bodies are inferred).

~~Thus, although MCLs will be used as the initial remedial goal, RBTLs may be developed to account for the very slow rate of groundwater flow in the IZ and the limited impact of potential discharges on the large volume of water in the Barge Canal and its drainageway.~~ As discussed below in Section 3.2, combinations of corrective measures will be used to reduce groundwater organic and inorganic constituents.

3.1.4 Lower Zone

Lower Zone groundwater moves to the northeast in the direction of Chickasaw Creek more than 9000 feet from the OxyChem property. There are no receptors identified in the interval between OxyChem and the Creek, and access to the area is strictly controlled. Incidental concentrations of VOCs would be expected to dissipate through advection/dispersion and natural attenuation.

An RM-1 and RM-2 evaluation was conducted for the LZ groundwater intercepting Chickasaw Creek. The representative concentrations of soil source,

groundwater source, sentry well, and point of discharge groundwater were calculated using the maximum concentrations with the following additional considerations:

- Representative concentrations for the soil source were calculated using the soil data collected up to the bottom of the lower zone.
- Representative concentrations were calculated using the groundwater data from the lower zone monitoring wells.
- For the sentry well, groundwater data collected from monitoring well STPZ-15 was used.

For the RM-1 evaluation, the comparison of the allowable concentrations with the representative concentrations at the (i) soil source, (ii) groundwater source, (iii) sentry well, and (iv) point of discharge indicates no exceedances except for mercury concentrations at the source.

For the RM-2 evaluation, the allowable soil source, groundwater source, sentry well, and point of discharge groundwater concentrations protective of the Chickasaw Creek indicate that none of the representative concentrations are exceeded.

~~As noted above, the MCLs will serve as the initial remedial goals for the Final Corrective Measures; however the long downstream pathway to surface water discharge, the lack of exposure over the intervening distance, and the very large flow of water at the discharge point will justify the development of RBTLs if necessary. Corrective Measures will be applied on the Lower Zone groundwater to address the organic and inorganic constituents to attain the MCLs or alternate RBTLs, if developed.~~

3.2 BOUNDARY CONTROL BY INTERCEPTION AND TREATMENT

3.2.1 Remedial Goals

A primary goal for the implementation of the ~~Final~~ modified Corrective Measures is to intercept and reduce very elevated concentrations of constituents of concern prior to their downgradient migration off site. After mass reduction is achieved, the goal transitions to maintaining groundwater quality fit for intended use of the groundwater resource in accordance with the HHRA findings~~; i.e.; meeting the MCLs (or RBTLs)~~. Both stages of remediation need not be attained using the same technology, and in fact may not be achievable through only one means, as noted below.

The initial goal of groundwater control is attained via mass containment or reduction at key locations. To date, the ICM and CMI activities performed at the Source Control Area, the Central Plume Area and the Boundary Control Area have been successful in reducing the mass of VOCs migrating with the LZ groundwater toward off site discharge points. As this work has proceeded under the original CMI Work Plan, secondary effects of remediation have been identified in the iron fouling of downgradient boundary control wells, even as concentrations continue to decrease. This observed effect is identified as resulting from the biogeochemical effect of carbon donor injections in the Central Plume Area. The extraction, treatment and re-injection of the LZ in the Boundary Area ~~remains~~ has been effective~~ and the corrective measure of choice at this time~~, but may require supplemental measures as described below. ~~In the case of the IZ extraction, treatment and re-injection system, that technology is expected to prove very effective in removing mass from the VOC plume in the boundary area for some time, given the effective separation of the LZ and IZ in the downgradient portion of the site.~~ Further background on the corrective measures implementation on the IZ and LZ~~se two~~ zones, and proposed future operation as Final Corrective Measures, are presented below.

3.2.2 Groundwater Controls System

Lower Zone

The Boundary Control system has been operating since 2004 and, absent alternative corrective measures, its continued operation is required to manage the remaining organics plume (see Figures 2-5 and 2-6). As shown on the schedule in Table 3-1, boundary control is performed utilizing Lower Zone well~~s AE-1 and AE-3 (~~AE-2 (wells AE-1 and AE-3 are~~is~~ not currently used). The current recovery well system has demonstrated the ability to capture and control the organics plumes in the Lower Zone. An average extraction rate of 15-25 gpm from ~~each aerator~~ well AE-2 has been demonstrated to provide adequate capture and removal of the LZ volatiles and metals plumes (see Figure 2-17, Capture Zone of AE-2). As discussed in Section 2.3.1, the ~~aerated~~ groundwater is passed through an air stripper followed by carbon beds and re-injected into the Lower Zone using the existing injection wells I-1a,b and I-2a,b. Monthly UIC reports and semiannual air emission reports are required until the system is terminated.

~~Chronic iron fouling has been observed at AE-2, and is beginning to be observed at AE-1. This observation, as reported in ICM Effectiveness Reports to ADEM, was made f~~ Following the completion of the Central Plume Area Enhanced Reductive Dechlorination ICM in 2006, chronic iron fouling has impacted operation of the LZ boundary wells. This iron fouling appears to have resulted from the mobilization of native iron from the aquifer under the reduced conditions created by the

injection of molasses. As the water with low Eh migrated through the LZ downgradient to the Boundary Area, the iron became soluble and was carried downgradient until captured by the aerator wells. The iron then precipitated when the air lift and in-well aeration raised the Eh. The iron precipitate has fouled aerator tips, piping, and treatment media. As a result of fouling, groundwater from AE-2 was pumped to the above-ground stripper for treatment prior to passing through the carbon vessels. Fouling of bag filters in the treatment train from AE-2 has required daily or twice daily filter changes. ~~The extraction rate attainable at AE-2 has reduced somewhat. Consequently, the well has been deactivated, and pumping at AE-3 is used to provide containment on the northeast side of the control area.~~

Similar maintenance problems at AE-1 have resulted in iron deposits plugging the well screen. Efforts to rehabilitate the well have proved unsuccessful and the well was shutdown in March 2014.~~reduced efficiency of treatment at this well somewhat.~~ AE-3 is located offsite on International Paper Company property and was shutdown in November 2013 to reduce potential migration of the plume down gradient of AE-2. ~~However, AE-1 and AE-3 are controlling the plume and AE-2 is not critical as shown by the potentiometric and flowline map in Figure 2-17 (and discussed in Section 2.3.1).~~ Based on the findings in the HHRA, c~~C~~ontinued operation of the boundary control well~~s AE-1 and~~ AE-2~~3~~ is not necessary and may have the potential to ~~is still believed to be the best option for treating the Lower Zone plume~~ induce downward migration of the IZ plume. Therefore, operation of this well is anticipated to be terminated once a feasible solution for the IZ plume is in place. ~~Operation of boundary wells is anticipated to continue up to the point that either MNA is initiated or RBTLs are developed.~~

Despite these operational difficulties, in recent months concentrations are approaching MCLs in the Boundary Area. As noted in Section 2.4.1, the maximum carbon tetrachloride detection in the LZ in March~~January~~ 2015~~08~~ was <1~~69~~ ug/L at STPZ-21 between AE-1 and AE-2. The remaining concentrations above the MCL were clustered in the area at or between these two points. PCE also reduced significantly, to a maximum of 160~~280~~ ug/L at STPZ-19 and <1 ug/L, ~~with the next highest concentration~~ at STPZ-21. These concentrations mark reductions from concentrations in the mg/L~~ppm~~ range in 2003 prior to instituting the ICM pumping.

The ERD injections in the central portion of the plume proved effective in reducing VOC concentrations and metals, in some cases, to below detection. Additional ERD programs may be used in the future to assist in removing any remaining volatile organic or inorganic mass. As discussed above, extraction and treatment of groundwater has been successful; however, some residual low-level

concentrations may remain that could easily be treated using injections of a food grade carbohydrate solution or other technology.

~~If ERD application is used as a supplemental Corrective Measure technology in the Boundary Area, injections of food grade carbon donor material, such as the molasses, sodium or potassium lactates, bean oils and similar materials permitted currently in the site UIC permit would likely be made in wells AE-1, AE-2 and AE-3, as these are closest to the remaining elevated concentrations in the boundary area LZ. Supplemental injection wells could also be installed between or around the AE wells to focus treatment on remaining hot spots.~~ The details of ERD design would be presented in the UIC permit revision application, a copy of which would be submitted to the RCRA Corrective Action Manager for review.

Another supplemental Corrective Measure technology will likely be monitored natural attenuation. The MNA process embodies contaminant degradation processes from naturally occurring reductive and aeration processes, native carbon compound attenuation of organics, phytodegradation effects where present, volatilization, dispersion and advection. At some juncture, such natural conditions will be sufficient to provide a final attainment of ~~MCLs or RCLs for specific constituents in certain areas.~~ concentrations protective of human health and environment as determined in the HHRA.

Intermediate Zone

Several options are currently being evaluated for the IZ. These include operation of pumping wells on a limited basis to control the plume near the Barge Canal and/or injection of substance to degrade the plume in-situ. GSHI currently evaluating alternatives which will be submitted as a CMI Work Plan Addendum when the evaluation has concluded.

~~Pumping from the Intermediate Zone was just initiated in late 2007, so extraction from the intermediate zone and treatment with re-injection is expected to continue through 2008 and possibly 2009. Pumping from the intermediate zone utilizes the air stripper and activated carbon treatment system that discharges to the I-2a,b injection wells near MW-8D. This system will be used as currently situated regardless of LZ corrective measures, although the removal of LZ extraction waters would provide additional capacity from the IZ.~~

~~As pumping of P-3I continues, the effects will be monitored to determine the impact of pumping on groundwater levels and plume concentrations. Figure 3-1 is an example of recent groundwater level measurements during pumping at P-3I and illustrates the relative capture zone of this well pumping at approximately~~

~~8.5 gpm. Hydraulic capture zone analysis will be performed, combined with plume monitoring and actual water level data, to provide the basis for determining the appropriate path forward for controlling and treating the IZ plumes.~~

3.2.3 Monitoring

As noted above, monitoring of the LZ Boundary Area Corrective Measures system will employ the STPZ monitoring network in the area of the facility. Monitoring points, frequency and parameters will be as currently defined in the UIC permit and RCRA Corrective Action Permit and will be used to assess effectiveness of the injections in meeting the final cleanup goals in addition to ensuring protectiveness of the groundwater resource under the UIC program.

Monitoring of effluent from the carbon vessels is performed, at a minimum, monthly in compliance with the UIC Permit. Samples are collected at the point where groundwater enters the injection wells. Routinely, samples are collected on, or around, the 15th of each month. Carbon breakthrough is monitored by collecting samples at the following points on the carbon systems: influent (before vessels), between vessels, and effluent (after vessels). The samples are sent to a GSHI approved lab for analysis.

The current RCRA Permit requires sampling of sitewide monitoring wells on a semiannual basis. Of particular interest in monitoring groundwater quality at the northeast and east property boundary will be MW-8D, MW-21D, MW-42D and MW-43D. Additional temporary wells (designated as "Plume Monitoring Wells") will continue to be monitored semiannually~~quarterly~~ until the facility and ADEM are in agreement that these wells are no longer necessary. Table 3-1 summarizes monitoring wells sampled as part of the Boundary Control evaluation.

3.2.4 O & M Requirements

Well Performance

Well performance may be compromised by chemical incrustation, biofouling, aquifer formation plugging by fine-grained particles, deterioration of the well screen, and aerator system performance. The need for well maintenance is indicated by reduced flow over time. It is anticipated that injection wells will require more frequent servicing due to the aeration of inorganic constituents in the recovered groundwater, which may form precipitates that could foul the injection well screen interval. In either case, a decrease in groundwater

production rate~~, at the typical air lift flow,~~ or a decrease in the rate of water injection (increased heads in the injection well at the same flow rate), a servicing of the well will be scheduled. The well requiring service will be redeveloped by over-pumping, air lift or surge block techniques.

~~***Aerator Well Operation***~~

~~Since iron fouling has presented maintenance issues in operating the aerators, this technology would cease operation if continued operation to maintain containment of the plume becomes infeasible. The final Corrective Measures plan is to continue the operation of the aerator systems at AE-1 and AE-3. Aerator assembly removal and cleaning is performed by the operations and maintenance personnel, where practical. When such servicing is necessary, the aerator well is carefully disassembled and each tubing train is inspected for signs of blockage. Worn or leaking fittings are replaced during servicing.~~

Liquid-Phase Activated Carbon System

When the measured concentration of contaminants in the initial liquid-phase vessel reaches breakthrough (i.e. a reliable detection of the presence of the constituent at concentrations above the quantitation limit), a carbon change out is required and will be scheduled. Carbon breakthrough will be monitored as described above.

A contracted carbon supplier is used to remove the spent carbon and replace it with either virgin or regenerated carbon. The spent carbon has been tested and is non-hazardous and is disposed at an approved landfill. Spent carbon disposal is in accordance with all federal, state and local laws and regulations.

3.2.5 Implementation and Anticipated Completion

AE-2~~1 and AE-3~~ will continue to operate at the target extraction rate of 15-25~~20 to 30~~ gpm ~~(combined)~~ to effect containment of the plume and provide treatment of the extracted water prior to re-injection under the UIC permit. This operation will stop in either of the following situations:

1. Attainment of the remediation goals~~-~~as determined in the HHRA~~(MCL or RBTLs)~~
2. Reaching asymptotic conditions where further improvement in groundwater quality is not expected, or
3. Geochemical fouling of the ~~aerated~~ treatment processes ~~(aerator tips or air stripper)~~ prevents reliable operation of the extraction systems sufficient to contain the remaining plume.

In the second and third cases noted above, either supplemental corrective measures of ERD or MNA will be employed ~~or the application of RBTLs~~ that demonstrate adequate protection of human health and the environment under the current conditions. GSHI anticipates that this~~ese~~ well~~s~~ will continue to operate until any alternate corrective measures are implemented.

Extraction of groundwater from the Intermediate Zone ~~(at well P-3I) is ongoing and will be continued as noted~~may be initiated in the future. ~~This corrective measure is designed~~ The objective would be to reduce concentrations by removing mass in the IZ~~area near the Barge Canal~~. Attainment of that goal will also have a positive impact on groundwater quality in the Lower Zone since some downward migration from the IZ has been observed. ~~Following the reduction of concentrations around P-3I and the MW-8D area, e~~Evaluations of supplemental controls (such as ERD and/or MNA) will also be made to assess whether they would be effective in the IZ~~; RCLs may also be developed as noted above for the LZ~~.

As previously discussed, Monitored Natural Attenuation is another potential supplemental Corrective Measure technology. At some juncture, natural conditions will be sufficient to provide a final attainment of concentrations protective of human health and environment as developed in the HHRA~~MCLs or RBTLs for specific constituents in certain areas~~. In such cases MNA will be the primary supplemental corrective measure. Transitions to MNA will be fully justified and approved by ADEM prior to implementation.

3.2.6 Estimated Costs for Future Activities

A detailed cost estimate is included in Appendix A. ~~Most of the capital costs represent actual monies spent in the construction and installation of existing equipment. Three to four years of operating costs and experience in operating the Central Plume ERD ICM provide a sound basis for the estimate for 2008 and beyond.~~

3.3 SOURCE AREA

3.3.1 Remedial Goal

Groundwater monitoring in the source area (SWMU 22) has continued following removal of the DPVE unit to evaluate potential rebound and to determine remaining mass of CT and PCE. The removal of residual contamination will have a long term effect on groundwater quality and reduce the need for boundary control actions in the future. ~~Based on the last sampling event~~

~~completed in October 2007, values of CT and PCE have rebounded demonstrating that residual CT and PCE may still exist in the clay overburden at SWMU 22.~~ Groundwater quality is summarized on Table 2-3 and discussed in Section 2.4.2. Currently, as discussed in Section 2.3.2, ~~Additional removal actions are being evaluated such as~~ air sparging with passive vapor venting has been operating since September 2010. Alternate removal actions such as groundwater ~~recovery,~~ pump and treat and soil excavation may be considered. These are briefly discussed below. The goal of corrective measures would be to prevent the movement of a newly formed plume that would migrate toward the boundary and require action in the future to prevent off-site migration.

3.3.2 Corrective Measures

Air Sparging ~~***With Vapor Recovery***~~***With Passive Vapor Venting***

Air sparging with passive vapor venting will continue at SWMU. The data will be evaluated annually to identify if this remedial activity has reached asymptotic levels in which case it would be terminated or operated intermittently.

~~has been tested at SWMU 22 to determine if this is a viable option for treating VOCs entering the groundwater. The cross-section in Figure 3-2 illustrates the existing wells and lithology at SWMU 22. Below ground surface is approximately eight feet of clayey soils that are suspected to be impacted by PCE and CT. The fine sand of the Intermediate Zone lies directly beneath the clay; however, groundwater level is eight feet deeper in the immediate area of SWMU 22, which provides an unsaturated, sandy zone there. The concept will be to inject compressed air into the aquifer into one (or more) of the deeper one-inch wells (TPZ-14, 15 or 16) and extract vapors from the four-inch DPVE well (SVE-3). When tested, vapors were emitted through SVE-3 without vacuum assistance. Use of a blower or vacuum pump will assist movement of VOC vapors out of the subsurface.~~

~~A brief pilot test was performed to evaluate the effectiveness of this approach. A standard vacuum motor designed to fit on the top of a 55-gallon drum was used to pull vapors from well SVE-3 (the former DPVE extraction well). The drum has an exhaust of approximately 105 SCFM (according to the manufacturer's specifications). The connection to SVE-3 was fitted with a valve that could be opened to allow different quantities of bleed air. Testing was performed by introducing filtered compressed air into piezometer TPZ-16 (see Figure 3-1) and extracting vapors through SVE-3. Air samples were collected with increasingly more percentage of bleed air to reduce potential emissions.~~

~~The results from air sampling indicate that opening the valve to allow between 25 to 50% of bleed air maintains emissions below the permissible 0.1 lbs/hour/constituent. Groundwater results were also encouraging. As shown on Table 2-3, the results from February 2008 reveal that CT at TPZ-1 dropped from 12,000 ug/L to 240 ug/L. PCE dropped from 3700 ug/L to 230 ug/L.~~

~~Several issues will need to be addressed such as: management of vapors to prevent exceeding 2.4 lbs/day, accumulation of any contaminated water, and location and height of the stack for vapors to prevent exposure to workers in the area.~~

~~Additionally, elevated concentrations of CT and PCE are observed upgradient of SWMU-22 in the vicinity south and east of the maintenance building (at wells TPZ-5 and TPZ-4, respectively). During the testing and operation of the sparging and vapor recovery at SWMU-22, evaluation of effectiveness in the area upgradient will also be performed. The evaluation will consist of continued groundwater monitoring, as described in Section 3.3.3 and Table 3-1, and possible testing of sparging in those areas.~~

Direct Source Removal of Contaminated Soils

Direct removal of impacted soils, such as by excavation, treatment and off site disposal, is not feasible due to the presence of process equipment located in the area. The surface is concreted and equipment such as a compressor, boiler assembly and chlorine storage tanks are located there.

Pumping of Groundwater

Another option would be to install a pump in well SVE-3 (or newly installed well) and transfer groundwater to a stripper for treatment. The feasibility of this option is limited due to the extremely limited amount of space for even extraction equipment and treatment equipment, as well as the distance to a discharge point.

3.3.3 Monitoring and Termination

The goal of CM activities in SWMU 22 is to prevent the generation of new groundwater plumes that could, in time, migrate beyond the property boundary. Wells located in the SWMU 22 area will be monitored as noted on Table 3-1.

3.3.4 Estimated Costs for Future Activities

A detailed cost estimate is included in Appendix A. ~~A for the installation and operation of air sparging and vacuum extraction~~.

3.4 *INORGANICS IN GROUNDWATER*

3.4.1 Remedial Goal

Currently, there are no inorganics plumes (mercury and lead) observed to be migrating off-site. Remedial goals for inorganics are primarily to prevent movement of these constituents off-site and, in turn, pose risk to human health or the environment. ~~RBTLs may be developed for these constituents given the relatively low on site concentrations, lack of mobility and distance to receptors. RBTL development will likely coincide with any RBTL development for organic compounds, or after organics otherwise meet their remedial goals.~~

3.4.2 Management

Lead is primarily observed in the Upper Zone at wells MW-2, MW-3 and MW-4. Concentrations have been declining and groundwater is captured and treated by means of the trenches and recovery well RS-1 at FBSL. Mercury in the Upper Zone is also centered beneath the FBSL and is controlled by the same extraction system. The recovery system at the FBSL will continue to operate as specified in the RCRA permit until permission is granted by ADEM to terminate. ~~pending any detailed evaluation of the need for continued operation via the collection of new groundwater data and/or the development of RBTLS that may indicate that current conditions are sufficiently protective.~~

Lead and mercury have been observed in the Intermediate Zone primarily in wells DW-1, DW-3, DW-5 and MW-33D. Off-site migration has not been observed, and the HHRA has established guidelines ~~development of RBTLs may be~~ appropriate for these constituents in the IZ plume. ~~Some additional investigation is planned to determine the potential source(s) of mercury in the IZ. Figure 3-3 has been prepared showing the most recent IZ mercury plume and proposed temporary wells. Exact locations and number of wells will depend on access in this area and results from the initial placement and sampling of the wells.~~

3.4.3 Monitoring and Termination

Site-wide monitoring is required by the RCRA permit and additional plume monitoring is being performed quarterly as described in Section 3.2.4. The plume

monitoring wells located on IP property are sampled only for VOCs as requested by IP. No metals sampling is performed except at MW-42S, MW-42D and at AE-3 (using STPZ-22).

3.4.4 Estimated Costs for Future Activities

Cost for management of inorganics is included with the ERD costs and monitoring costs associated with plume delineation monitoring.

4.0 SUMMARY

Significant progress in cleanup has been accomplished during the ICM and subsequent CMI phases at the Oxychem site in Mobile, Alabama. Various technologies have been tested to determine the most appropriate remedy at the site. Efforts were focused on three main areas of the site: Boundary Control in the northeastern area, Central Plume area at the Salt Pad and the Source Area at SWMU 22. Shallow Zone controls have also been in place in the FBSL area for mercury and other metals.

Boundary control has been achieved in the Lower Zone by operating the aerator wells for the past 11~~four~~ years. This technology has been very effective in lowering concentrations of VOCs in the Boundary Area by extraction of mass and treatment prior to re-injection downgradient of the area. As noted above, the continued operation of the system may be stressed by the geochemical effects of reduced conditions and iron precipitation at recovery wells and in the aeration treatment system. If continued operation of the existing extraction, treatment and reinjection system at the Boundary Area is not effective due to geochemical fouling effects, or reaches declining performance due to asymptotic responses from continued pumping, then supplemental corrective measures (ERD and/or MNA)~~ or RBTLs will be evaluated and employed~~.

The original Source Area at SWMU 22 was treated using DPVE and significant mass was removed. Since the DPVE unit has been terminated, some rebound of CT and PCE has been observed. Removal of potentially impacted soils is not an option due to the location of plant process equipment. Currently, ~~a small pilot program is being planned using a combination of~~ air sparging and passive vapor venting~~vacuum extraction~~ has been operating since September 2010. The goal has been~~is~~ to prevent the formation of a new volatile plume that could migrate down-gradient and renew the need for boundary control.

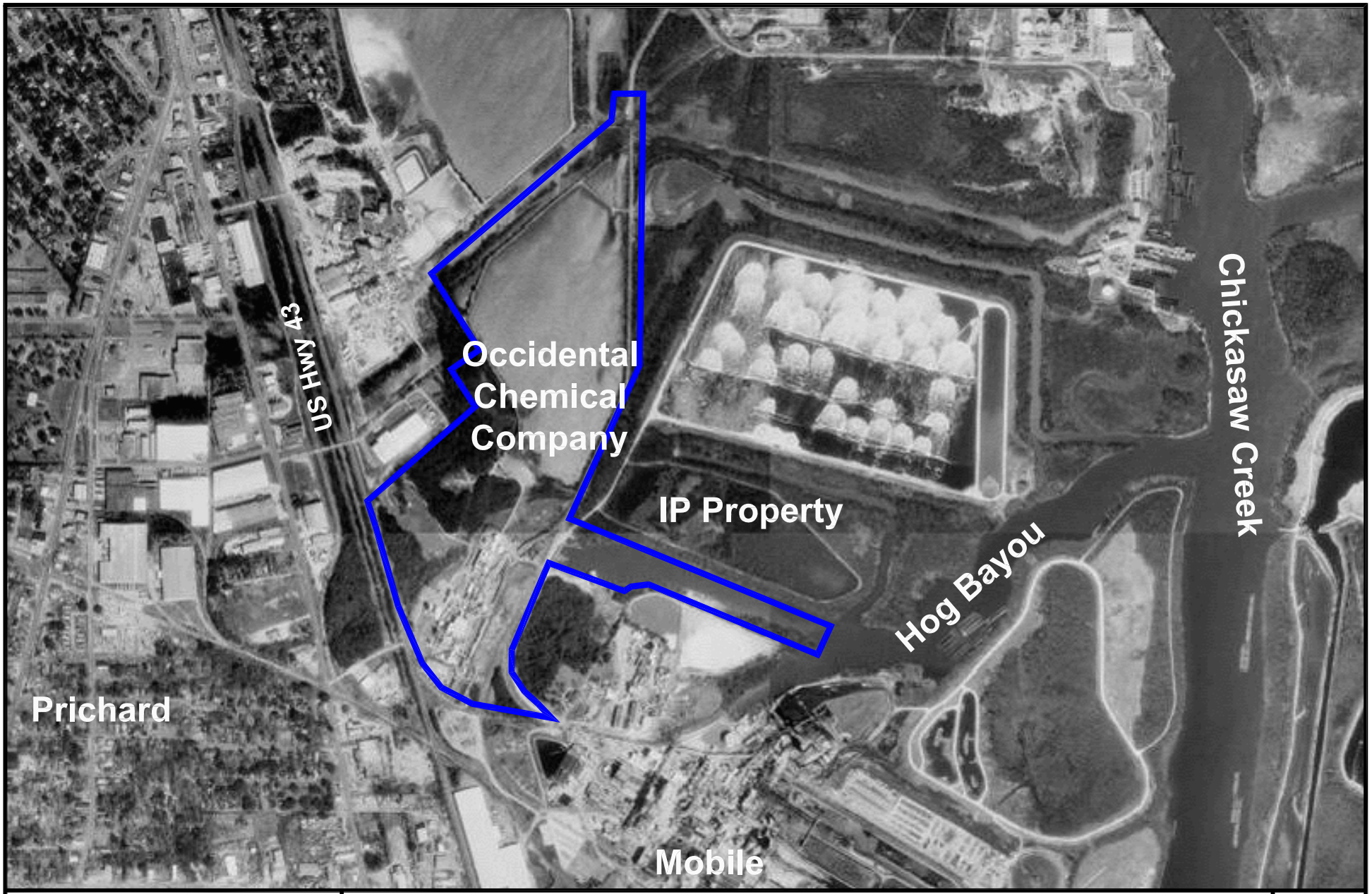
5.0 REPORTING

CMI Effectiveness reports will be submitted on an ~~semi~~annual basis as implementation proceeds. The effectiveness reports will include:

- A detailed narrative presenting an evaluation of the effectiveness of the selected remedy;
- Summaries of compliance with the progress toward achieving cleanup goals;
- Any significant revisions, adjustments, or proposed modifications to the selected remedy;
- Tabulated environmental sampling and monitoring data;
- Field and laboratory data collected;
- Any ambient monitoring data collected for any reason during the construction period for the purpose of monitoring potential for human and ecological exposure;
- Isoconcentration maps depicting the distribution of parameters for each sampling event and time versus concentration plots for parameters of concern;
- Tabulated volumetric data on groundwater pumped for each recovery well;
- Records of recovery system operation time, including shut-down periods;
- Potentiometric surface maps; and,
- Projected work for the next period and impacts to approved schedule.

Following attainment of cleanup goals as outlined in this Work Plan, a Report of Corrective Measures (RCM) will be submitted to ADEM. The RCM will contain a certification by OxyChem and an independent professional engineer registered in the State of Alabama that all remedial measures required by this permit and the approved CMI Work Plan have been completed. The RCM will outline the procedures and schedules for dismantling of corrective measures systems, groundwater monitoring/recovery systems, abandonment of injection and recovery wells, and any other remedial systems/controls as may be installed and operated.

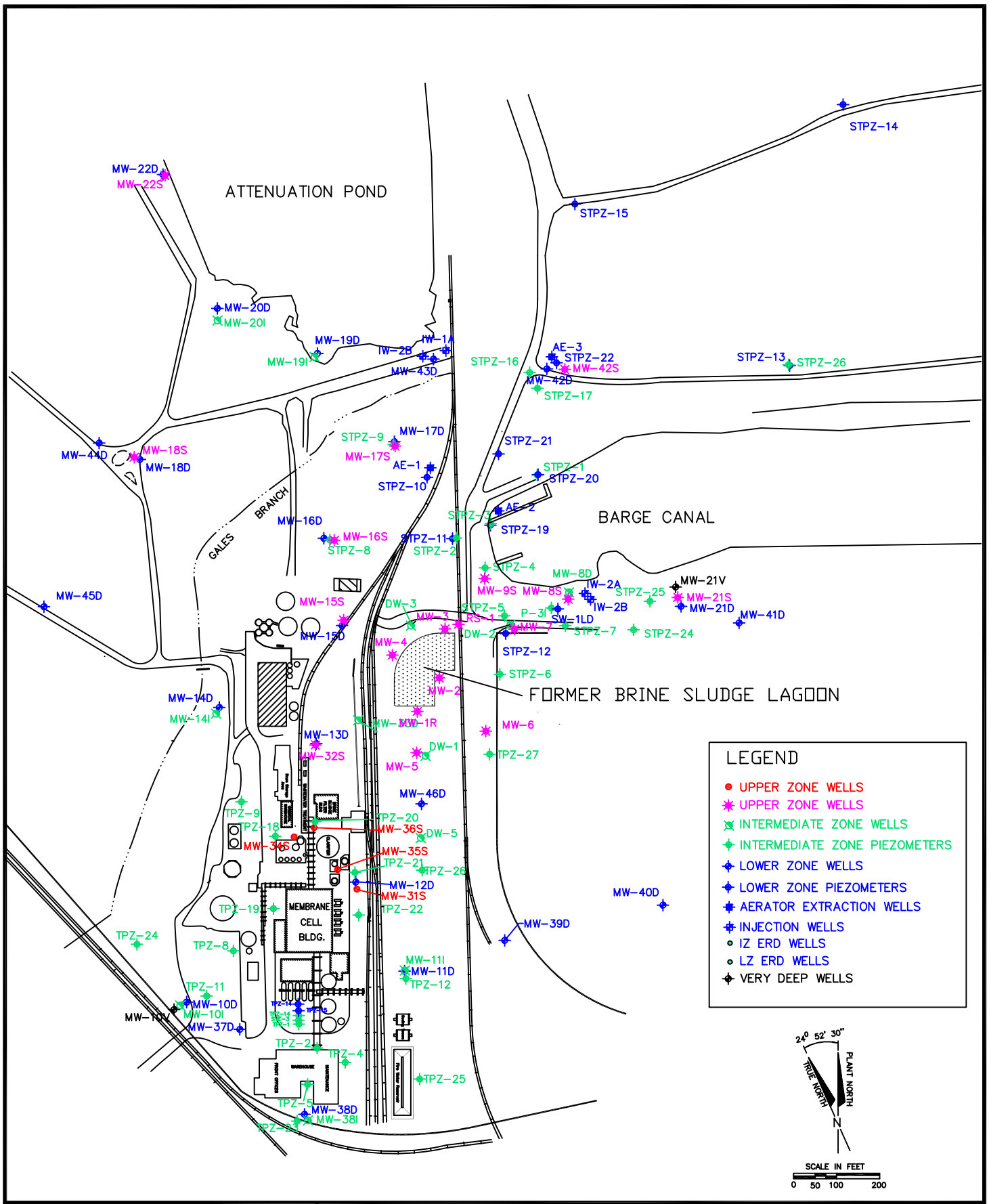
FIGURES



STRATA L.L.C.

SITE VICINITY MAP
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
Occidental Chemical Corporation
Mobile, Alabama

FIGURE
1—1

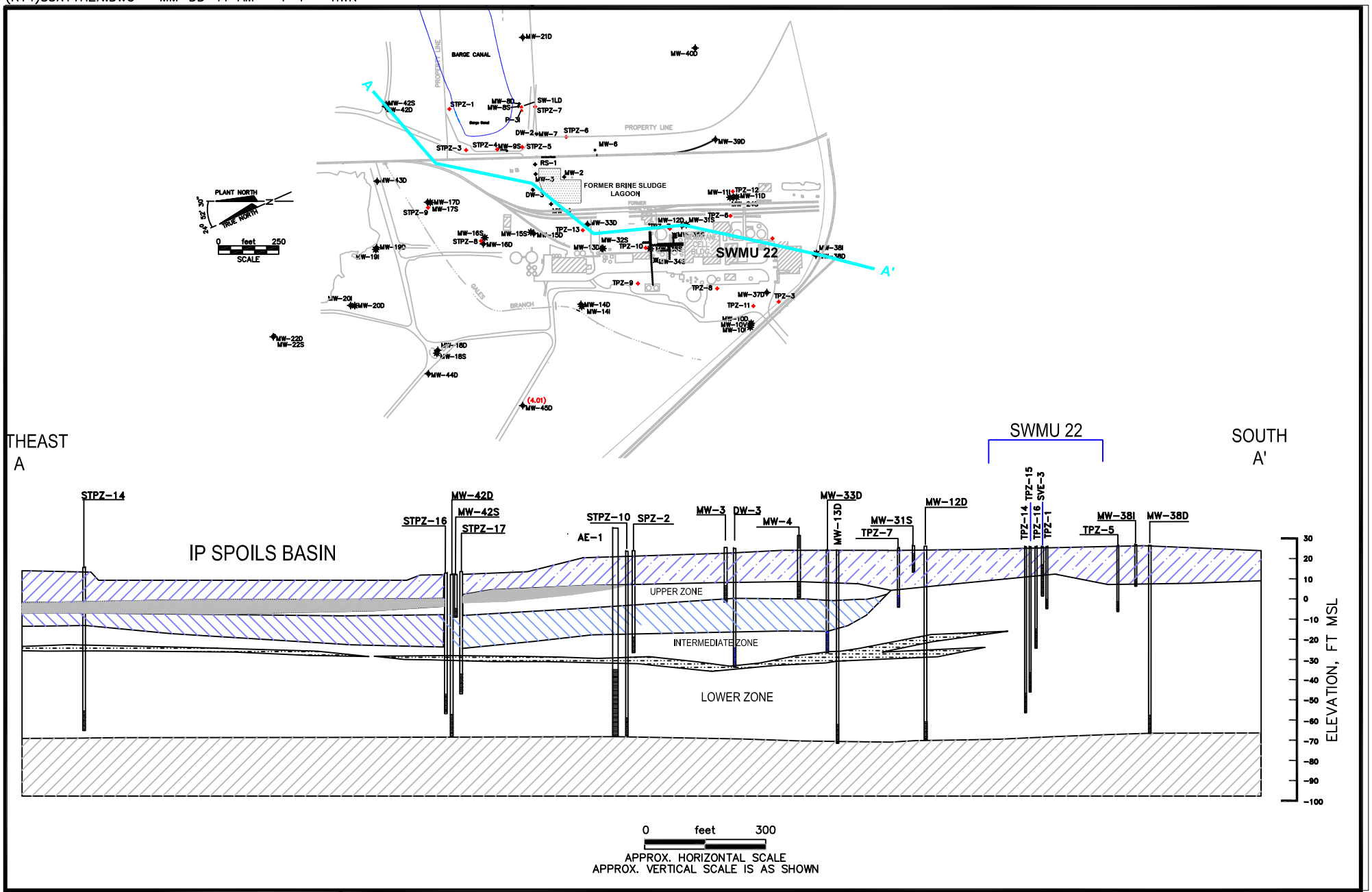


STRATA L.L.C.

SITE PLAN
CORECTIVE MEASURES IMPLEMENTATION WORK PLAN
OCCIDENTAL CHEMICAL CORPORATION
MOBILE, ALABAMA

FIGURE
1-2

(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK

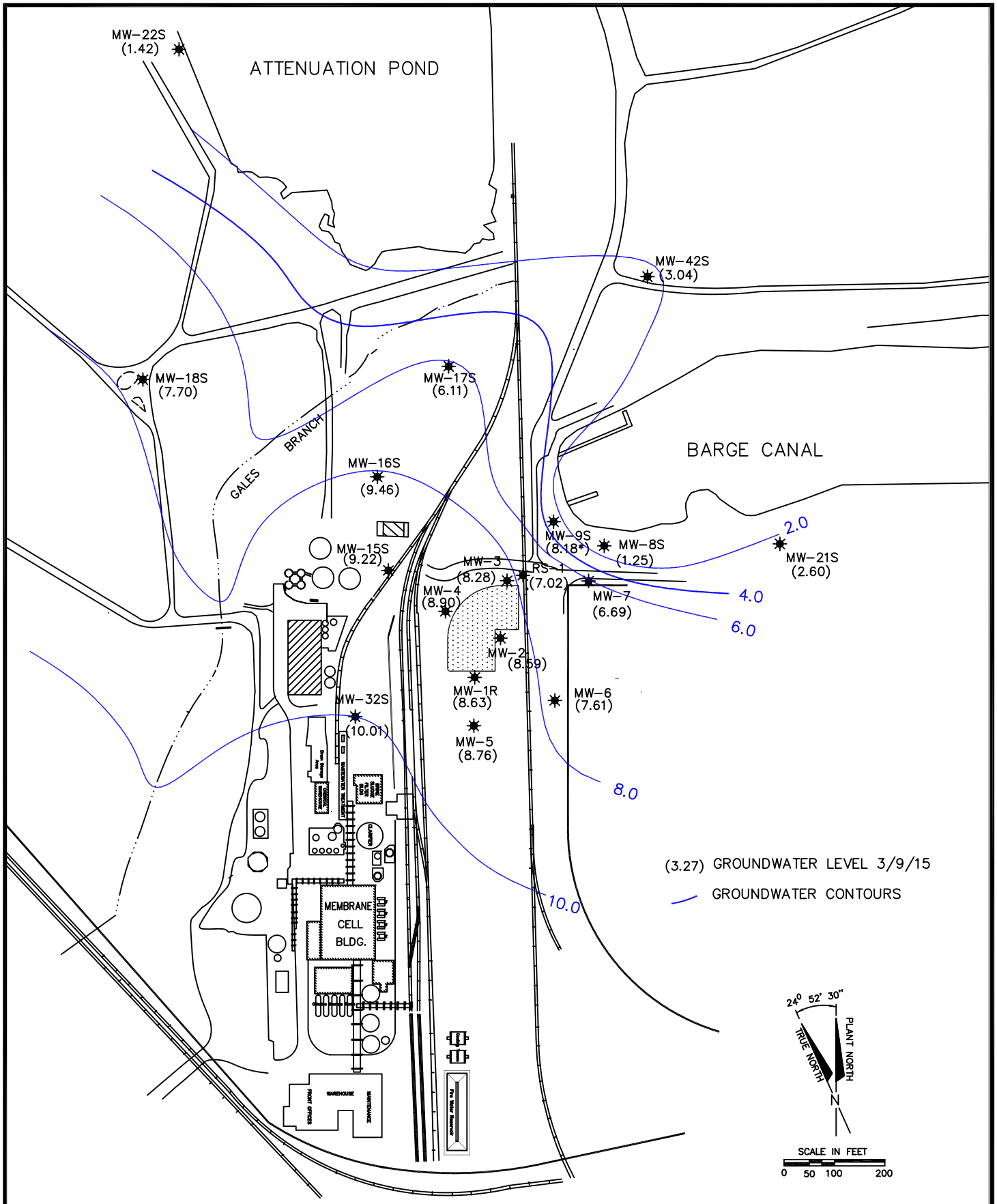


STRATA L.L.C.

GEOLOGIC CROSS-SECTION

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
Occidental Chemical Corporation
Mobile, Alabama

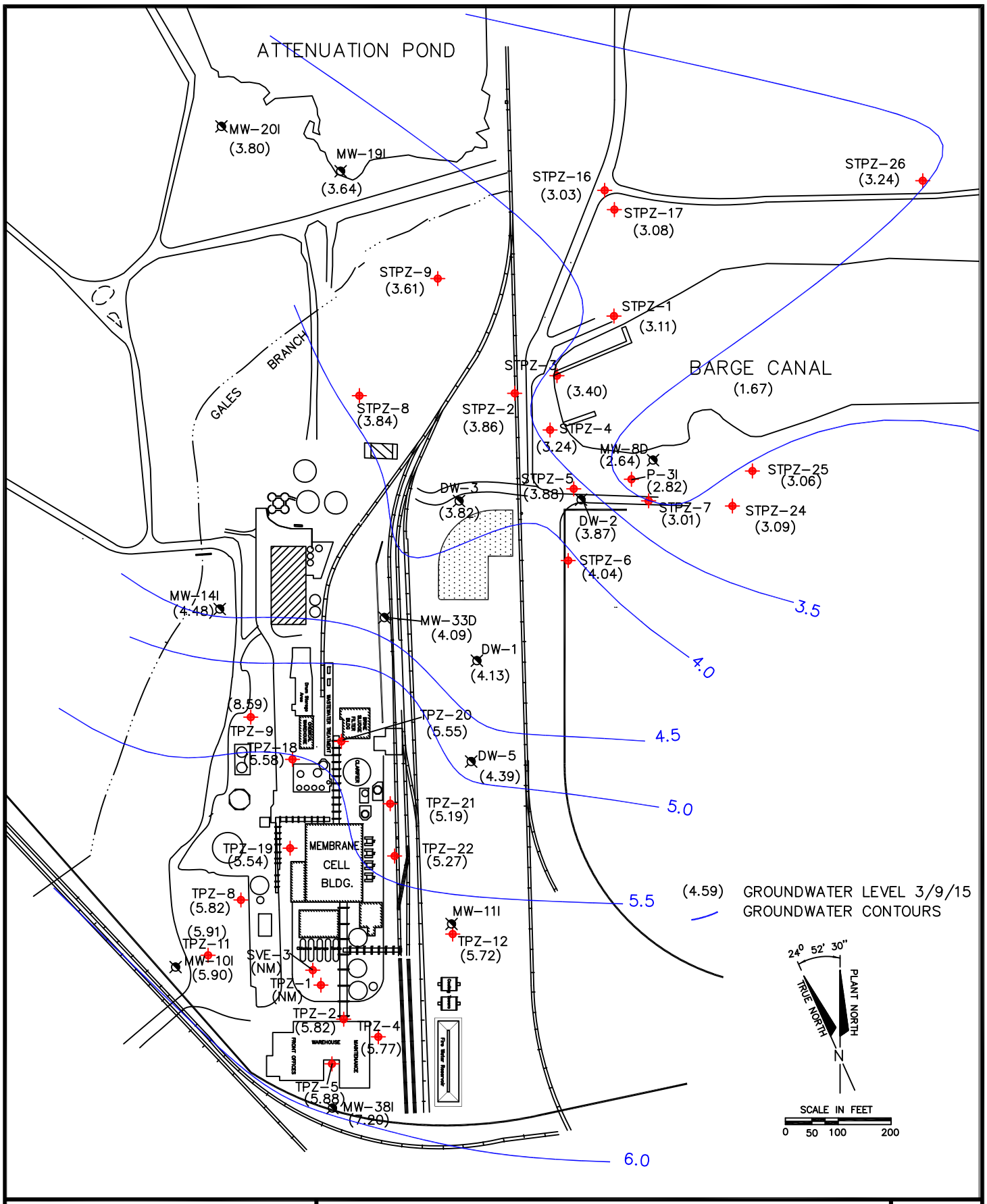
FIGURE
2-1



STRATA L.L.C.

UPPER ZONE GROUNDWATER CONTOURS
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
OCCIDENTAL CHEMICAL CORPORATION
MOBILE, ALABAMA

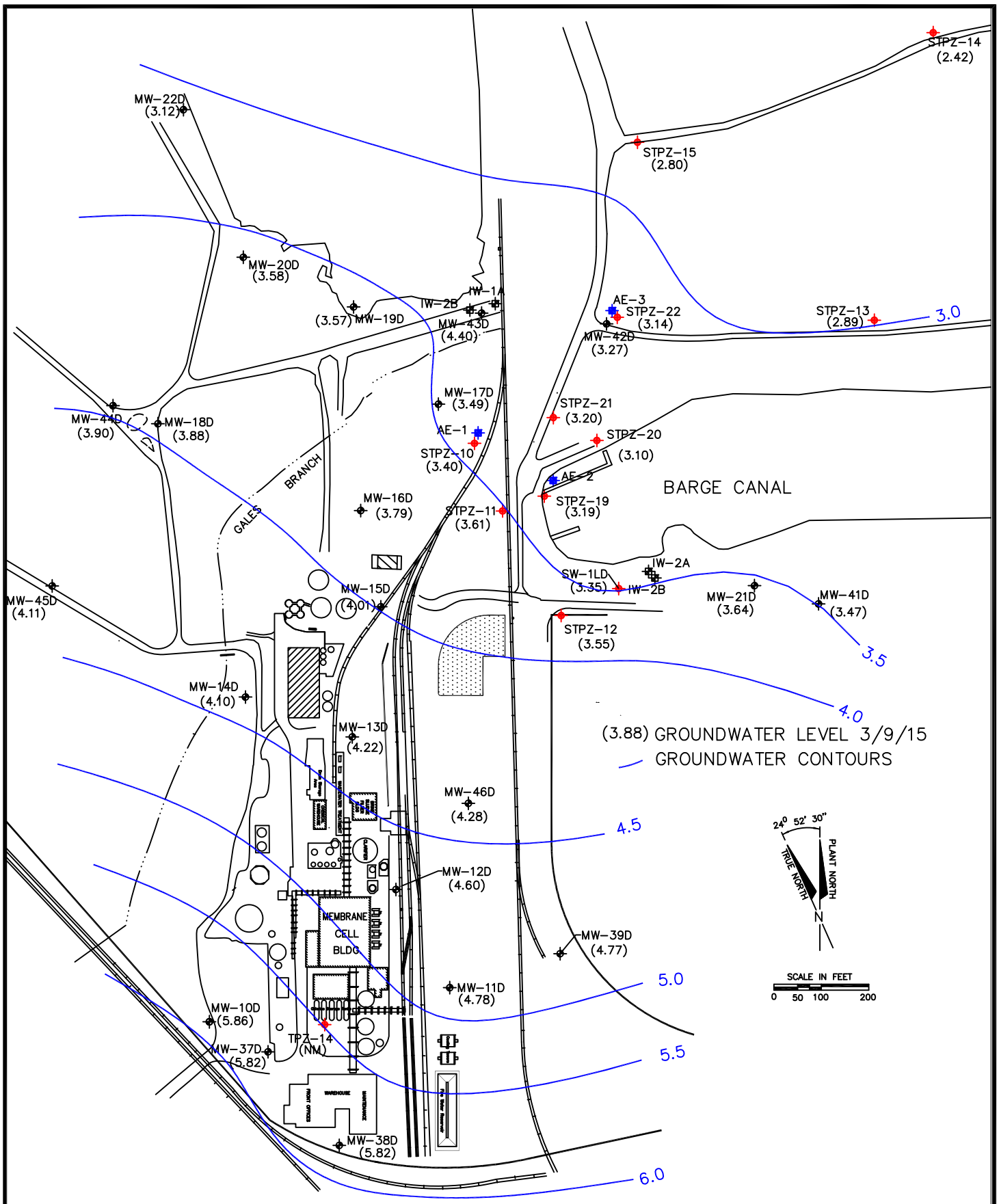
FIGURE
2-2



STRATA L.L.C.

INTERMEDIATE ZONE GROUNDWATER CONTOURS
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
OCCIDENTAL CHEMICAL CORPORATION
MOBILE, ALABAMA

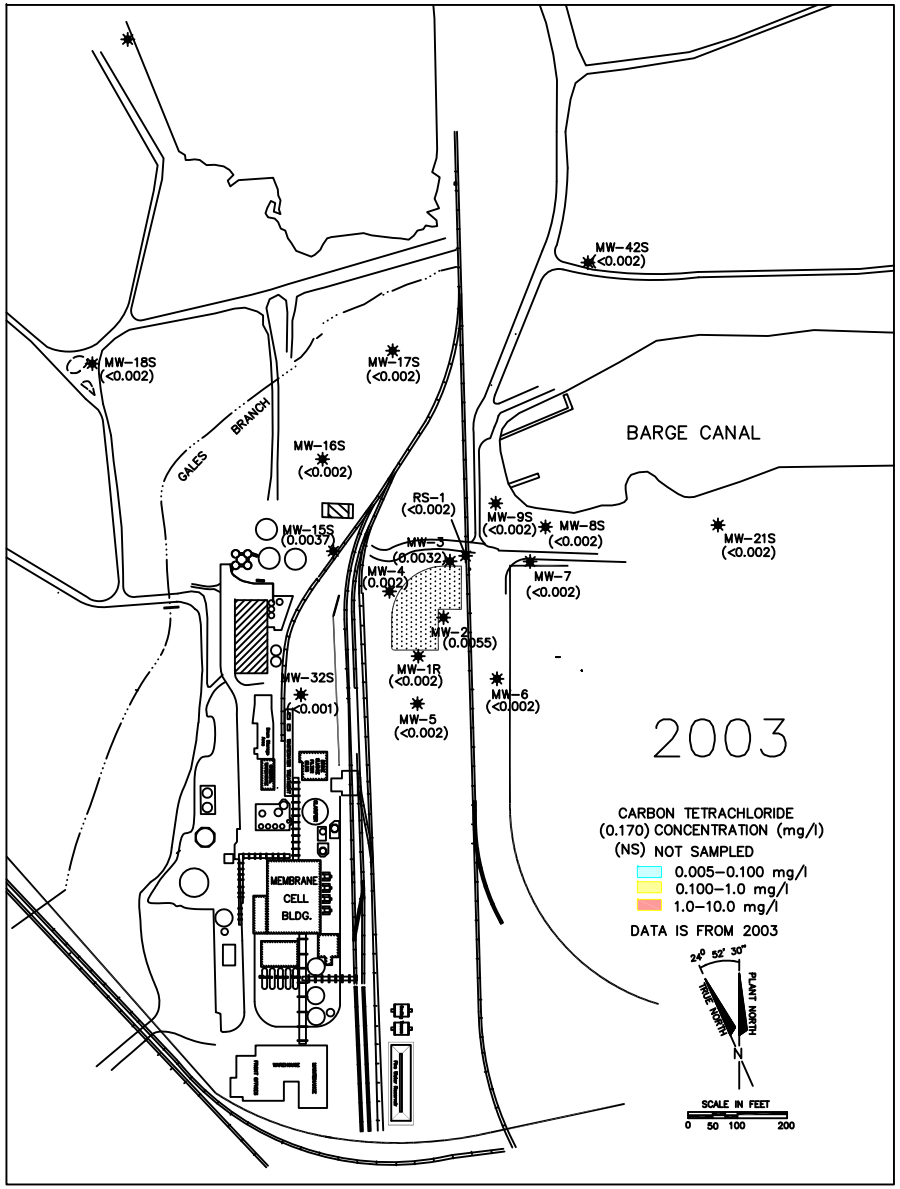
FIGURE
2-3

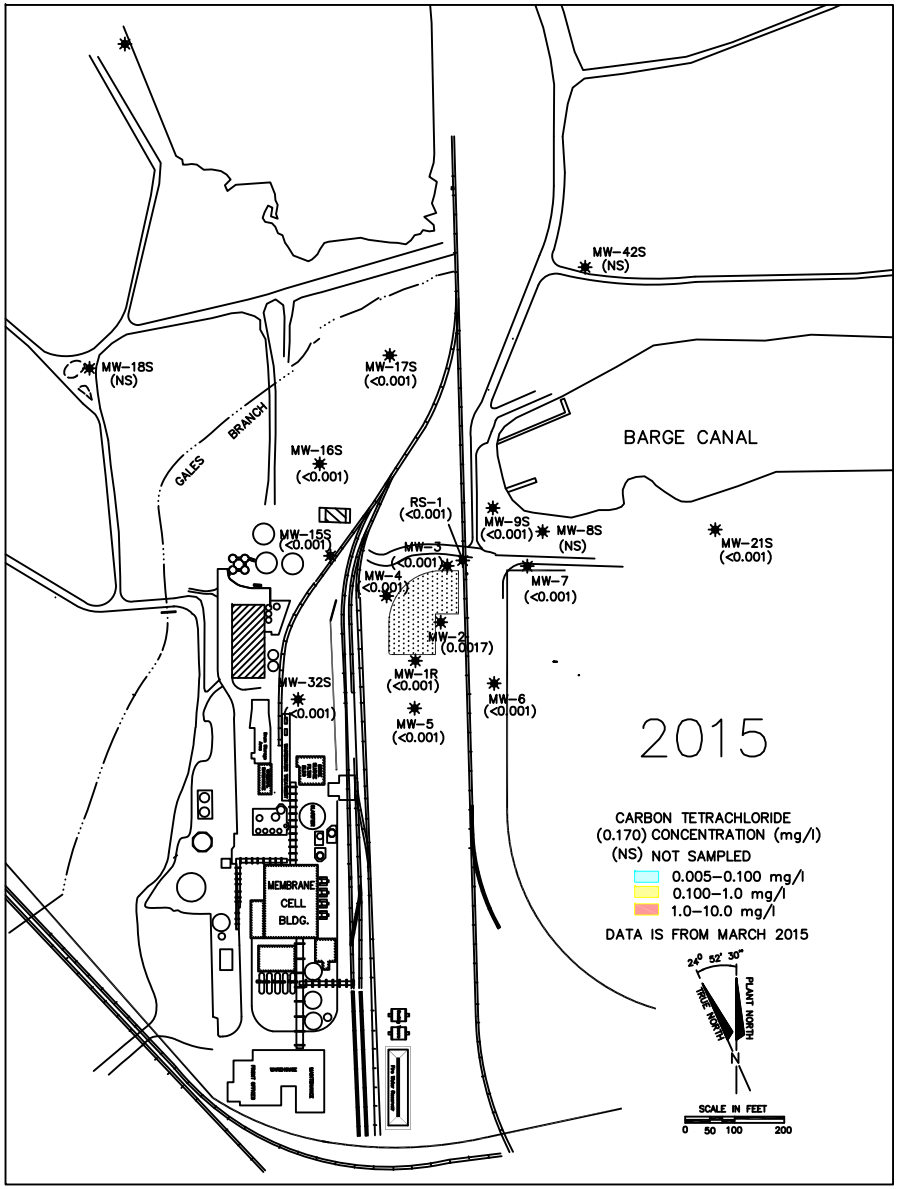


STRATA L.L.C.

LOWER ZONE GROUNDWATER CONTOURS, MARCH 2015
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
OCCIDENTAL CHEMICAL CORPORATION
MOBILE, ALABAMA

FIGURE
2-4





STRATA L.L.C.

UPPER ZONE CARBON TETRACHLORIDE PLUMES 2003 AND 2015

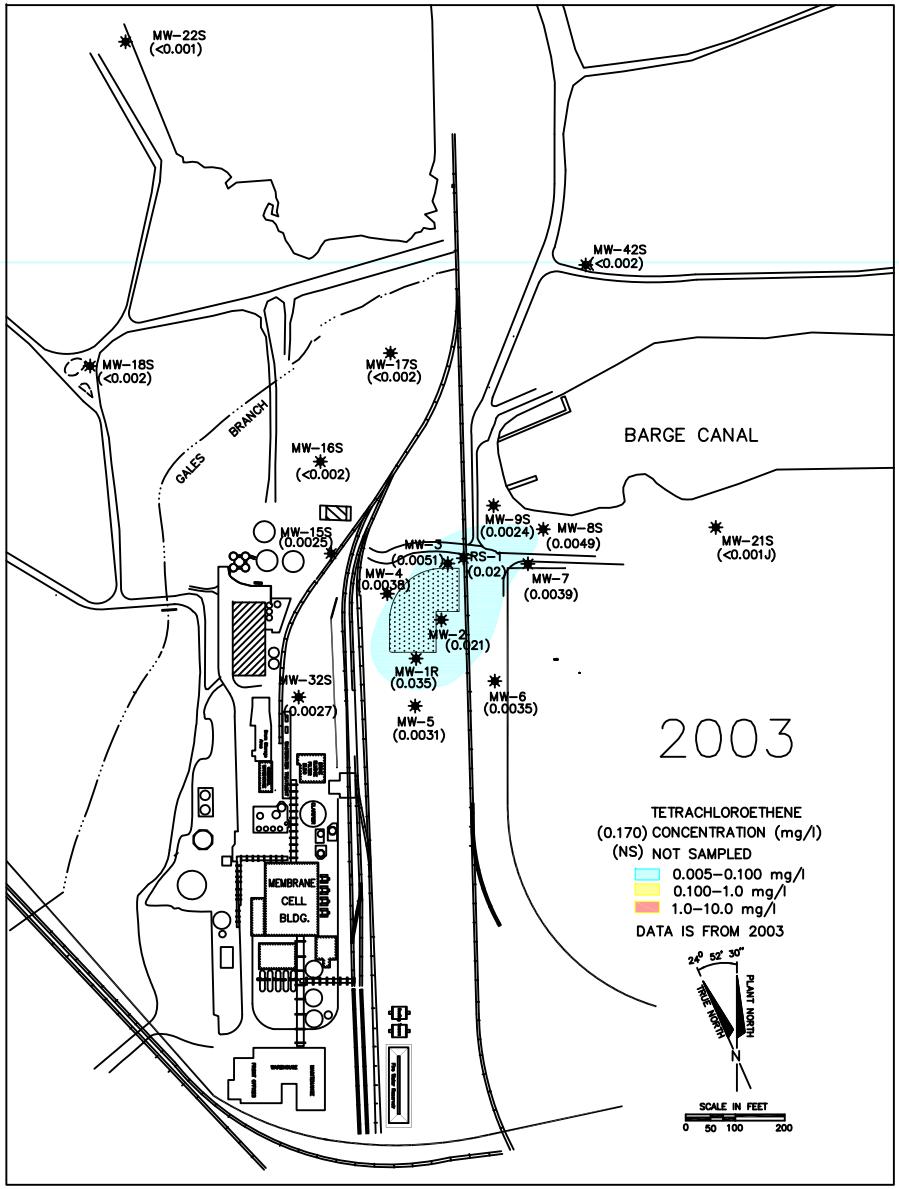
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

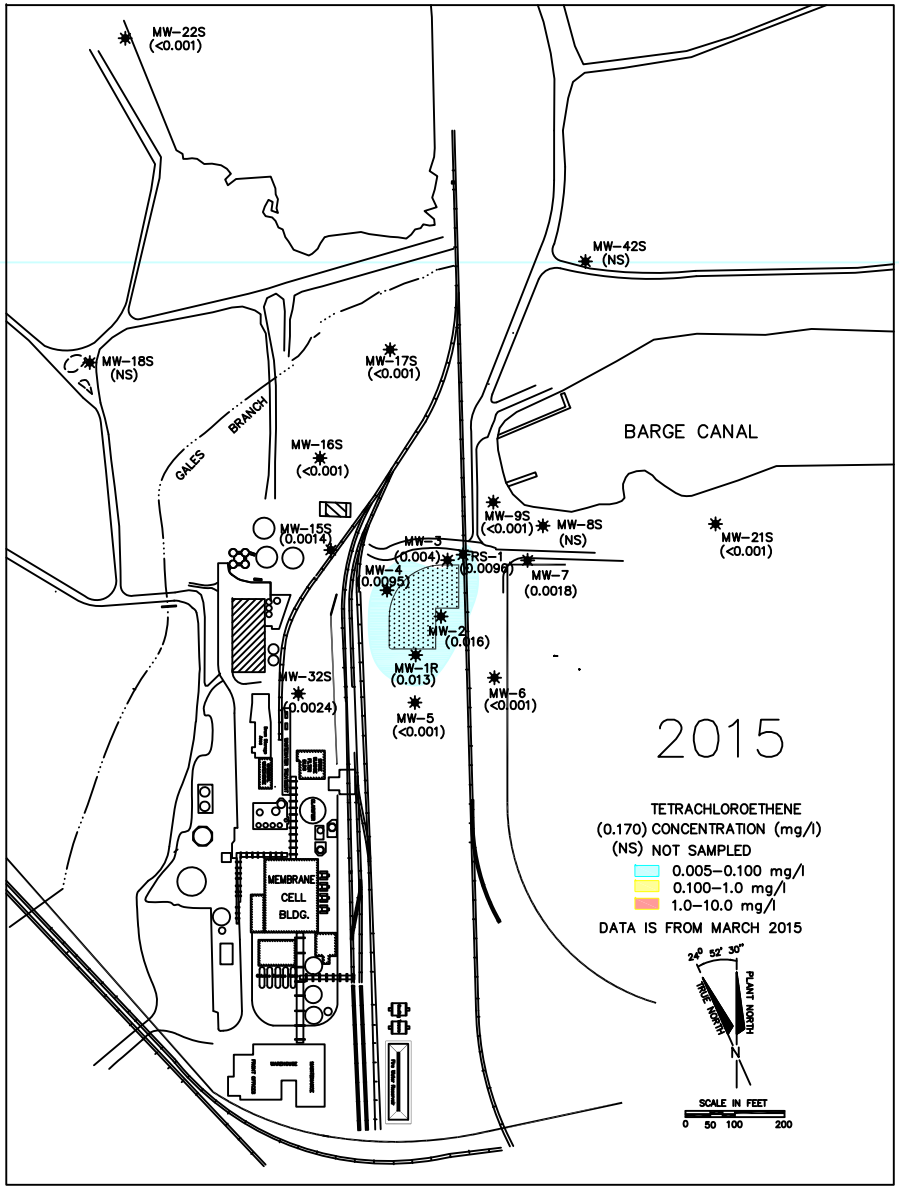
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–5





STRATA L.L.C.

UPPER ZONE TETRACHLOROETHENE PLUMES 2003 AND 2015

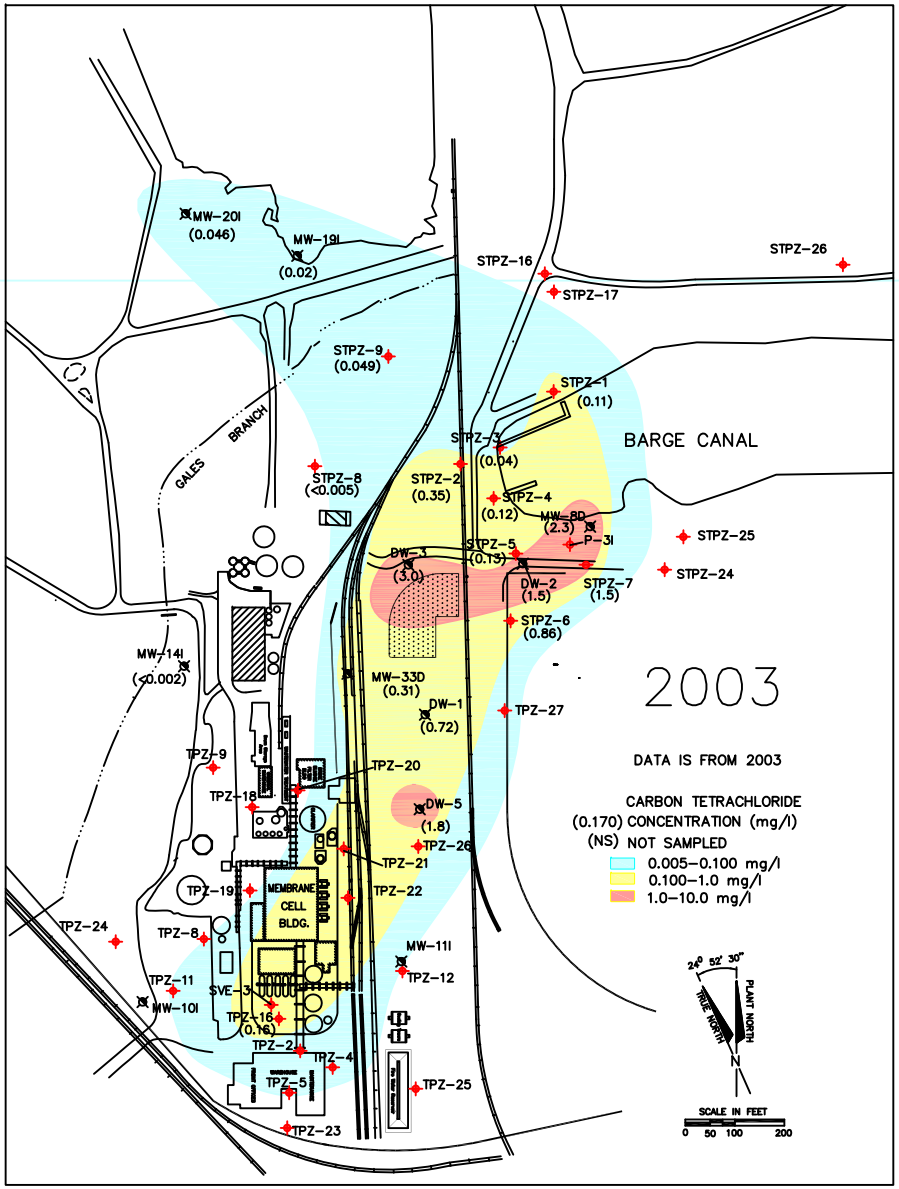
CORRECTIVE MEASURES IMPLEMENTAION WORK PLAN

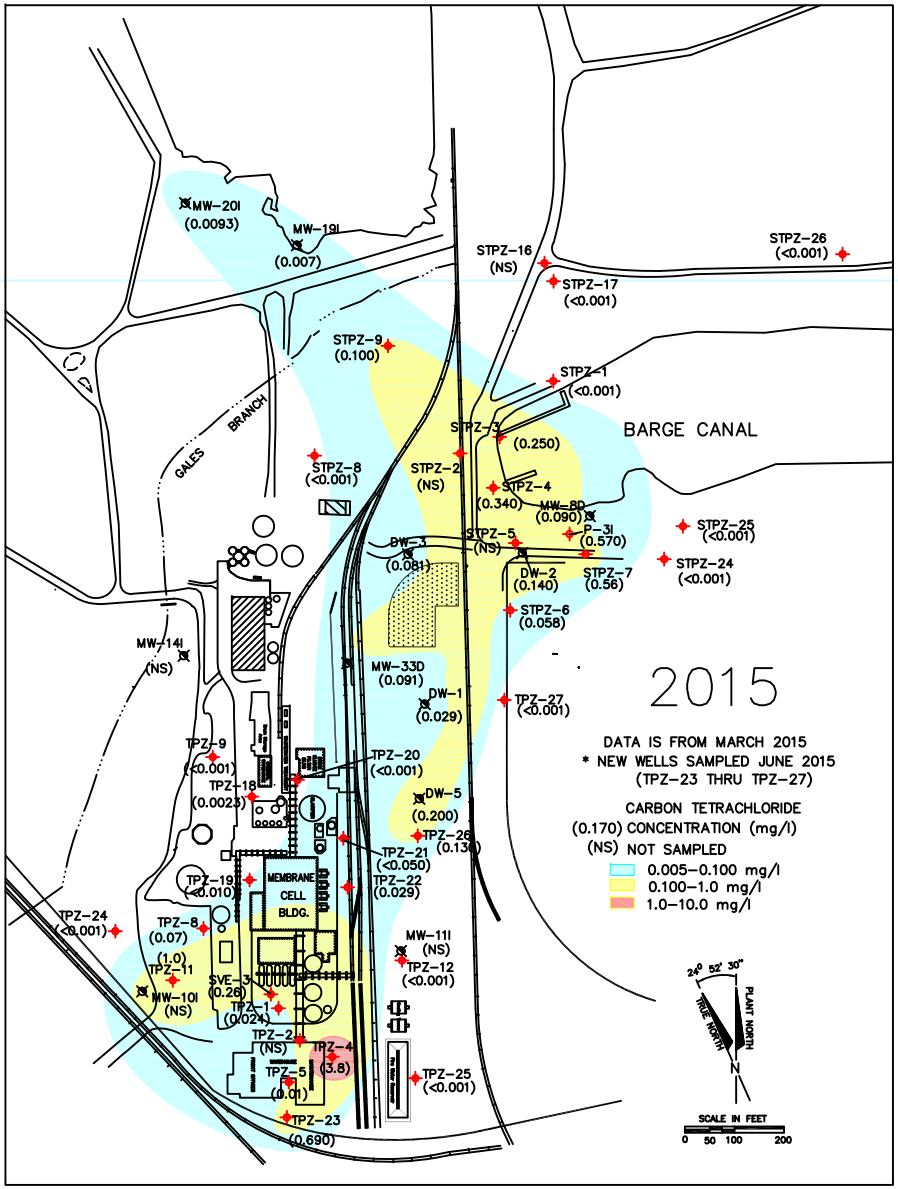
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–6





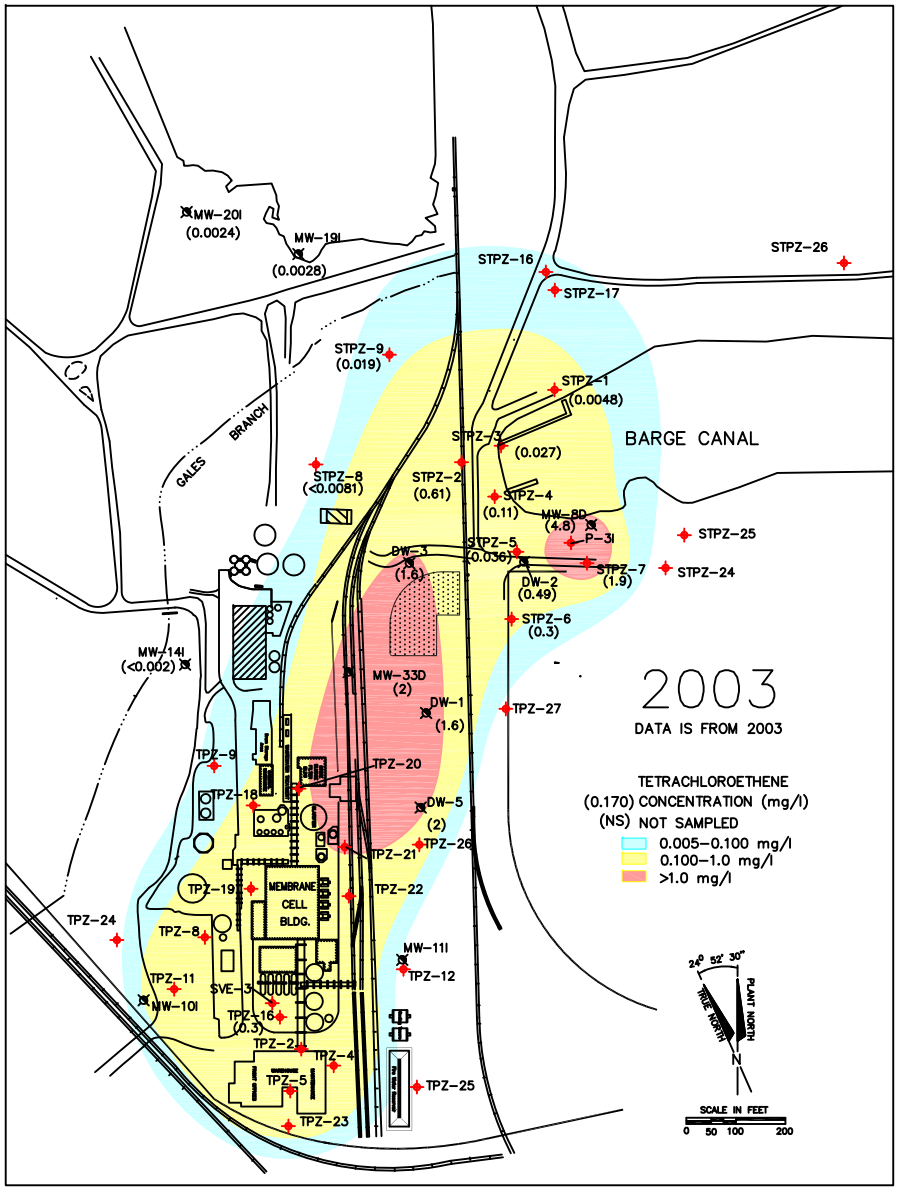
STRATA L.L.C.

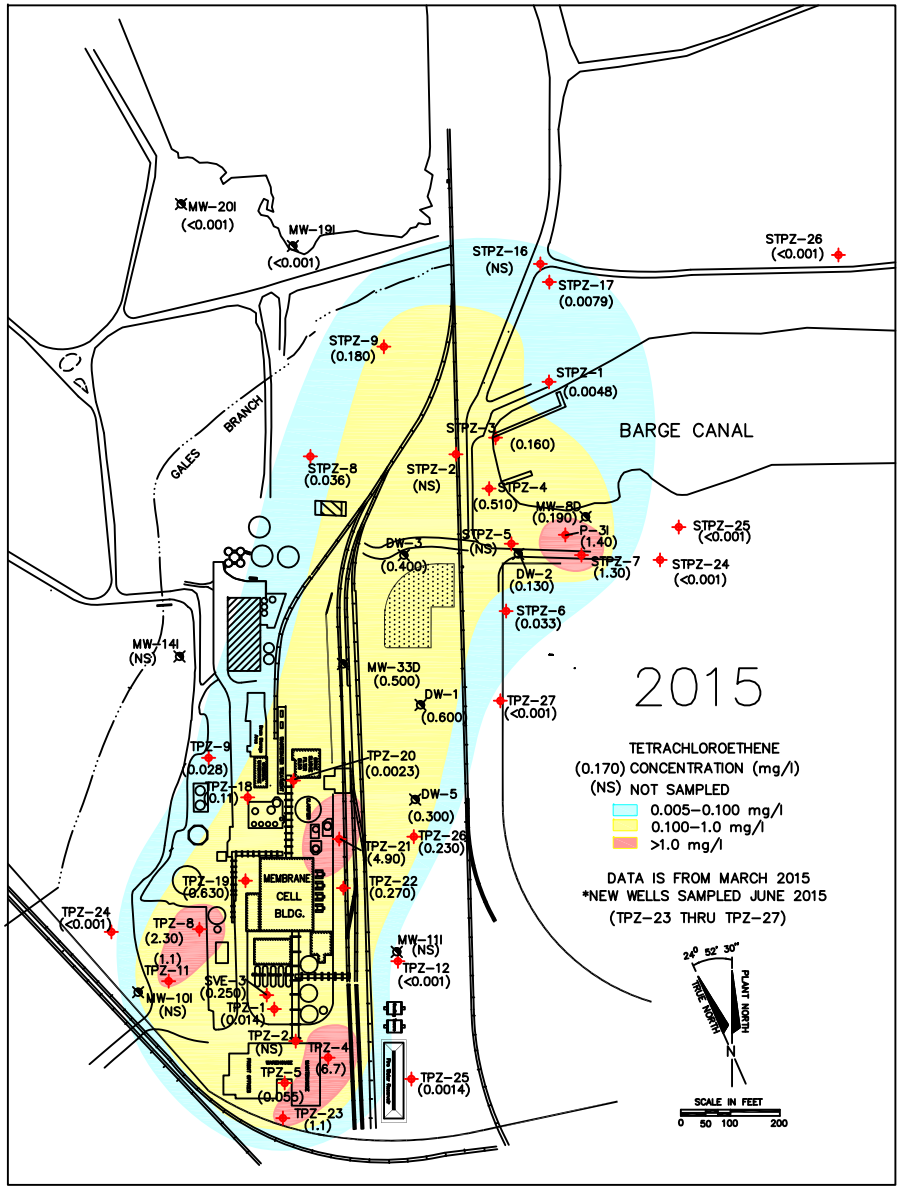
INTERMEDIATE ZONE CT PLUMES 2003 AND 2015

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

Occidental Chemical Corporation
Mobile, Alabama

FIGURE
2–7





STRATA L.L.C.

INTERMEDIATE ZONE PCE PLUMES 2003 AND 2015

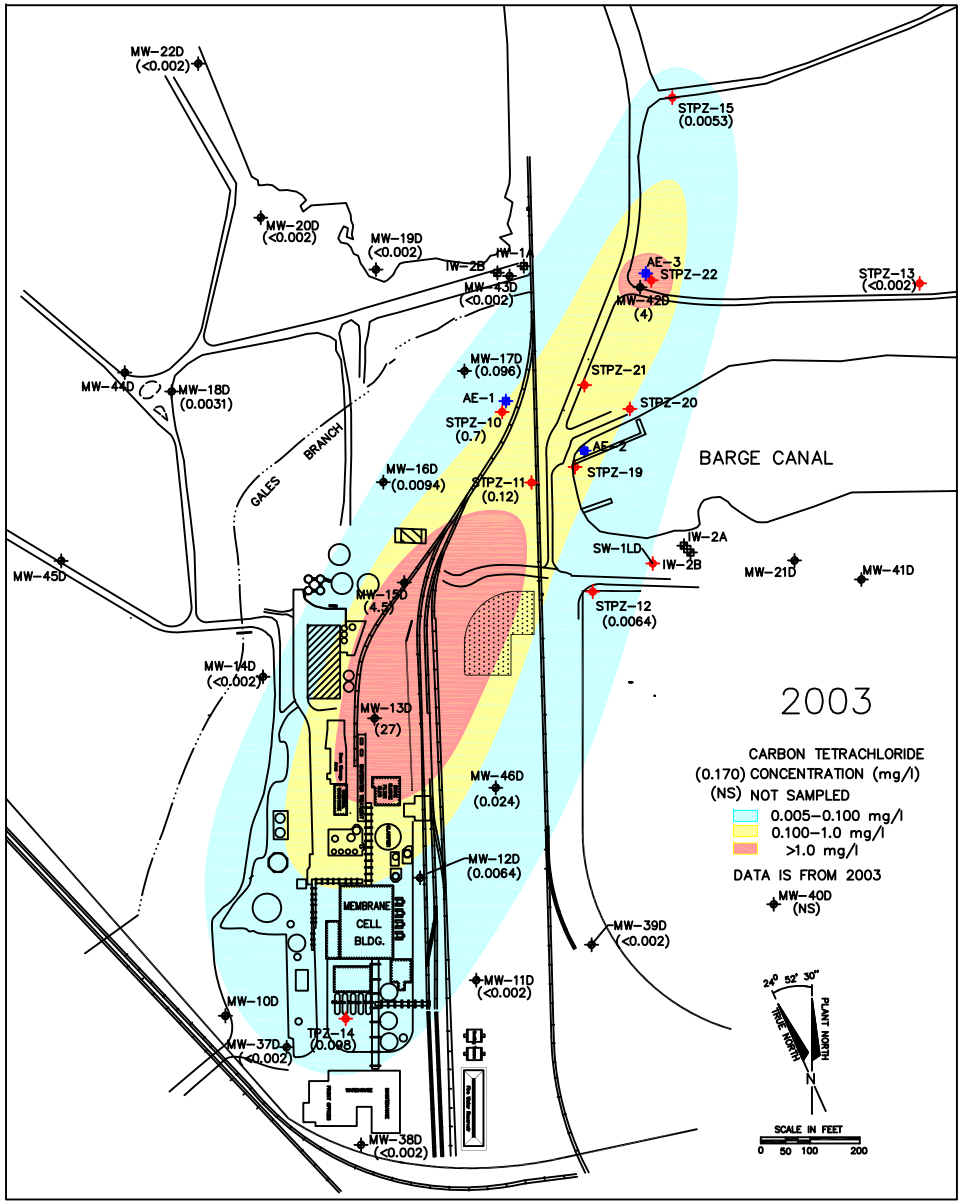
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

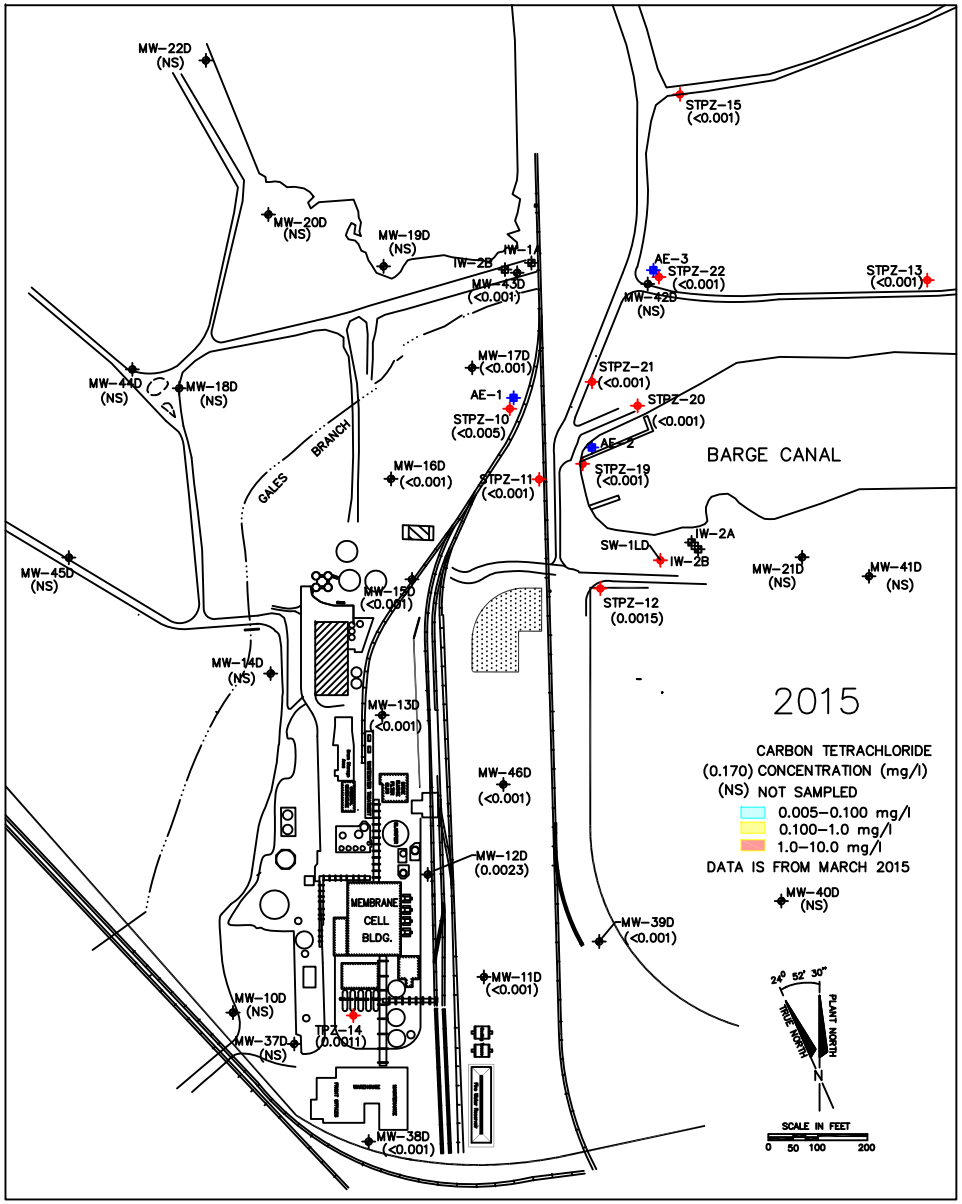
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–8





STRATA L.L.C.

LOWER ZONE CARBON TETRACHLORIDE PLUMES 2003 AND 2015

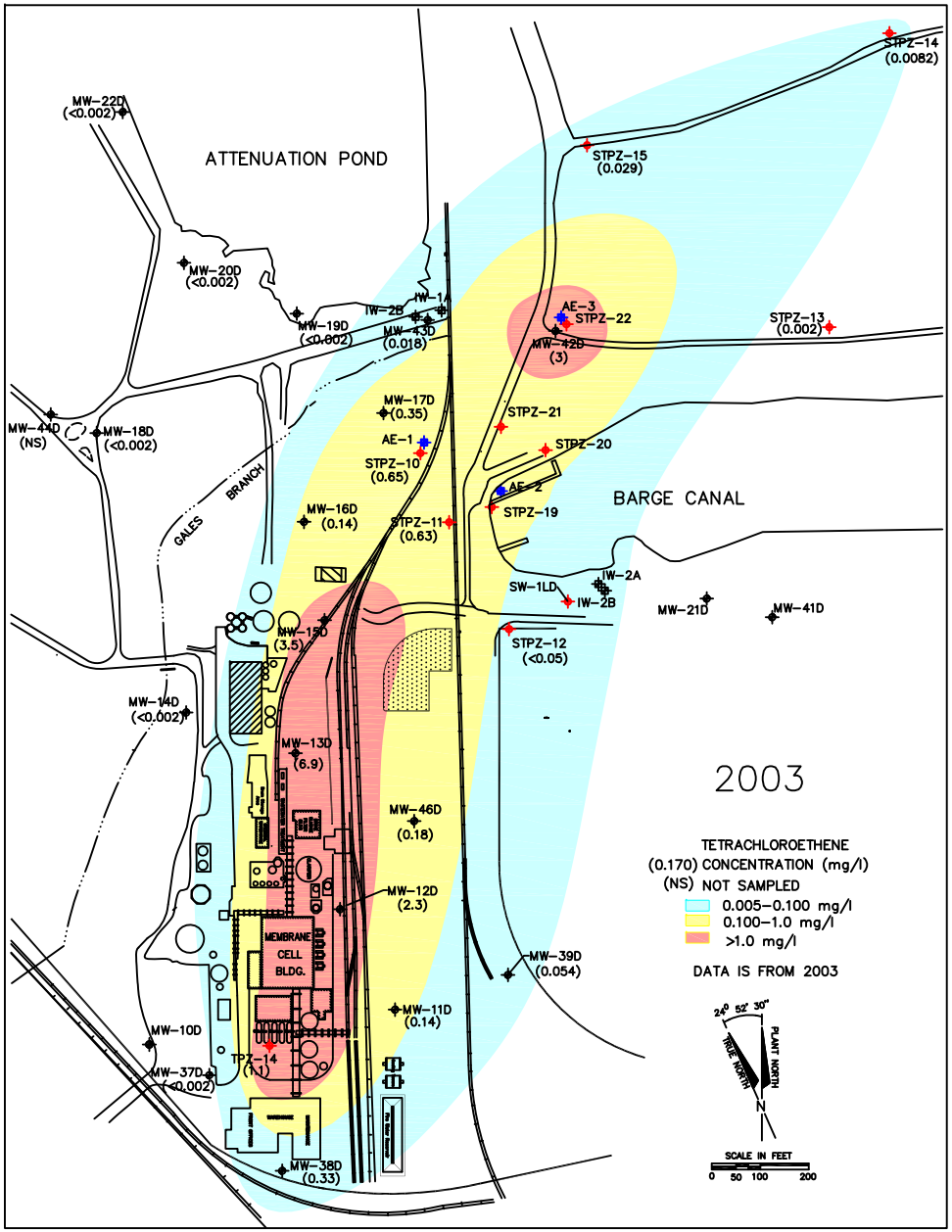
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

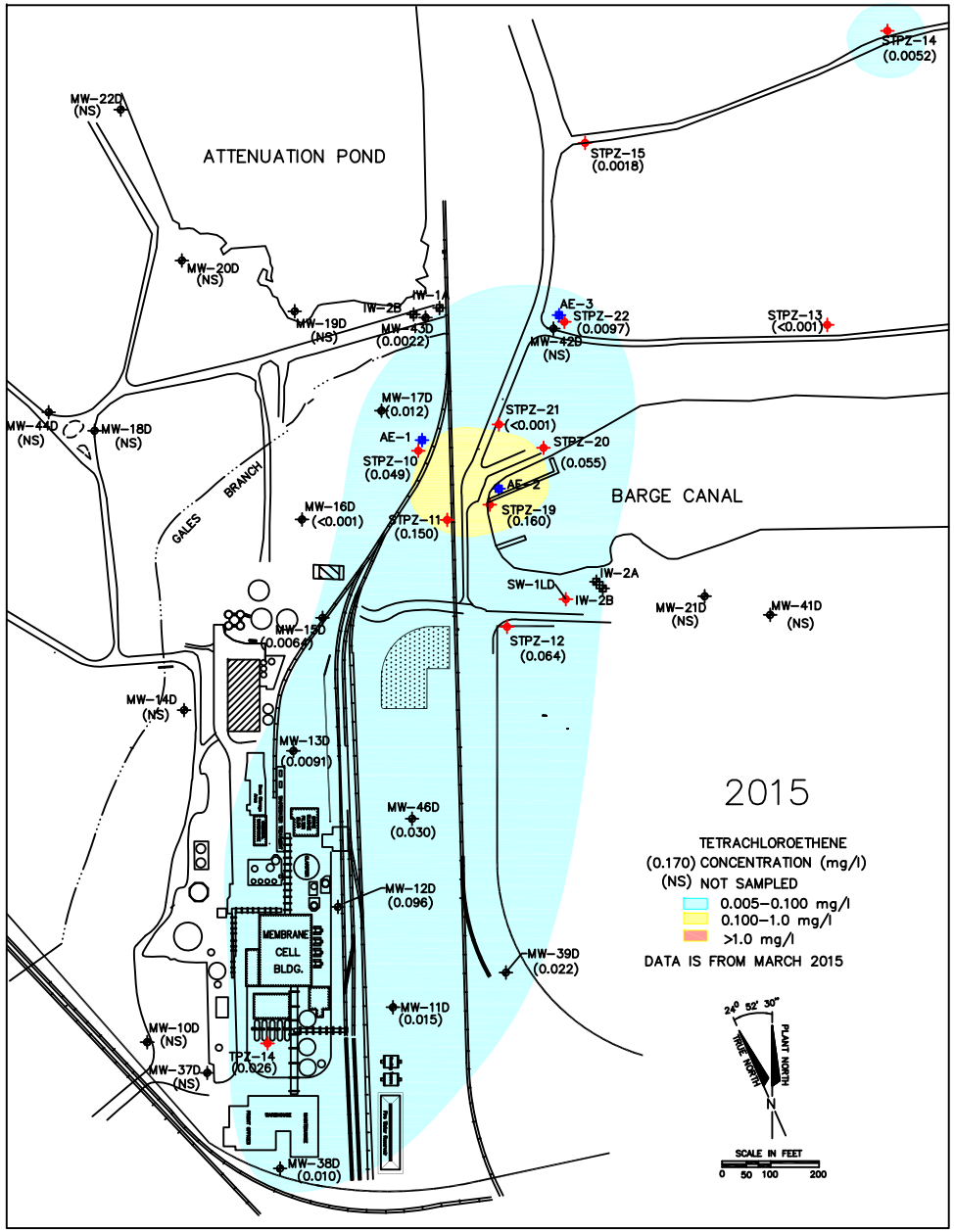
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–9





STRATA L.L.C.

LOWER ZONE TETRACHLOROETHENE PLUMES 2003 AND 2015

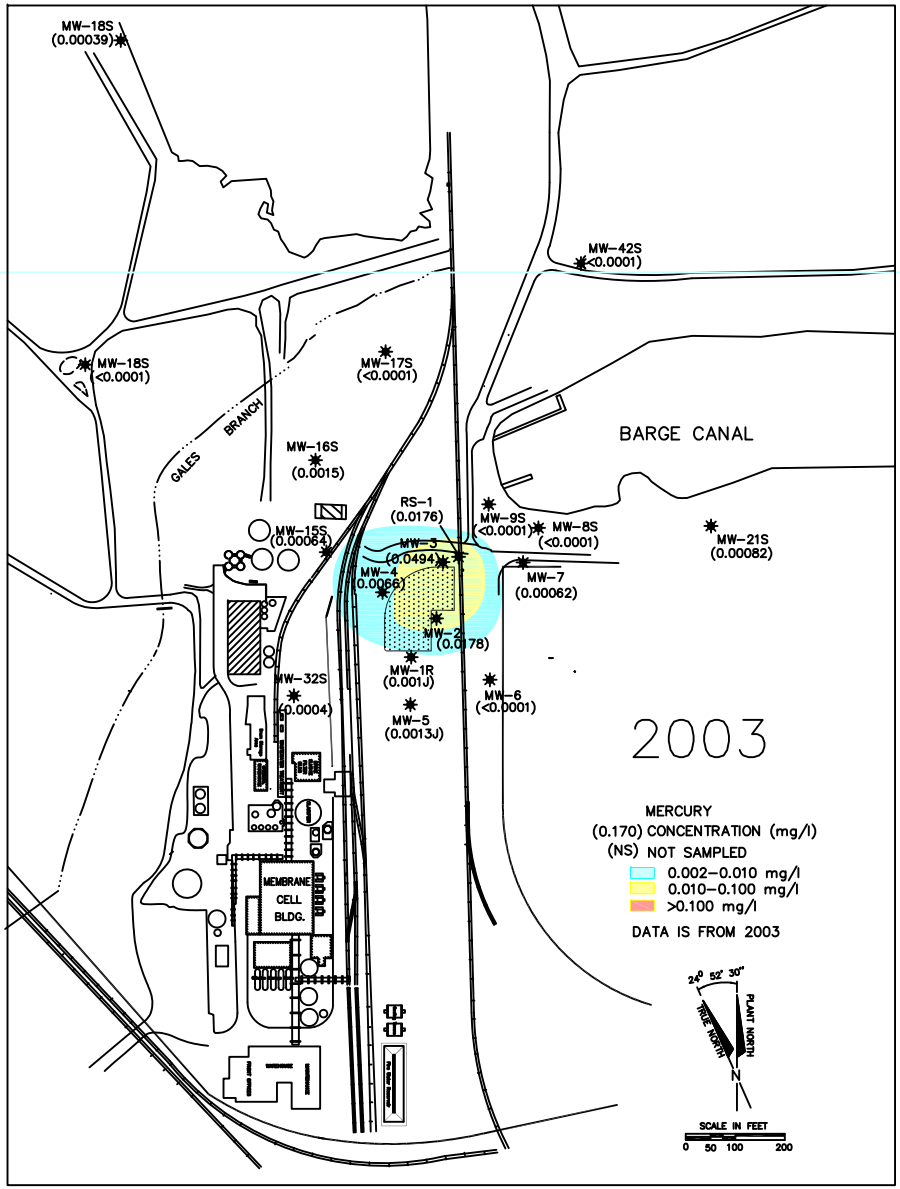
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

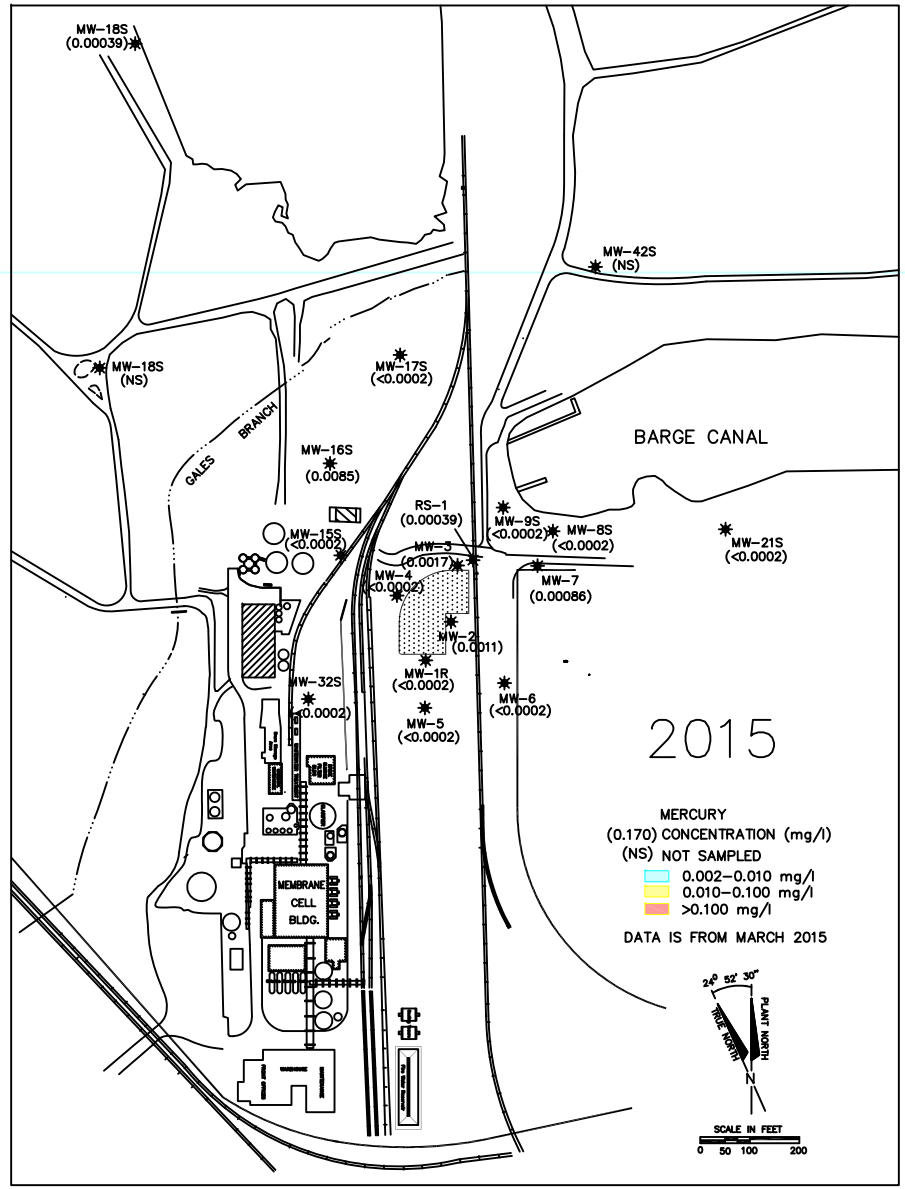
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–10





STRATA L.L.C.

UPPER ZONE MERCURY PLUMES 2003 AND 2015

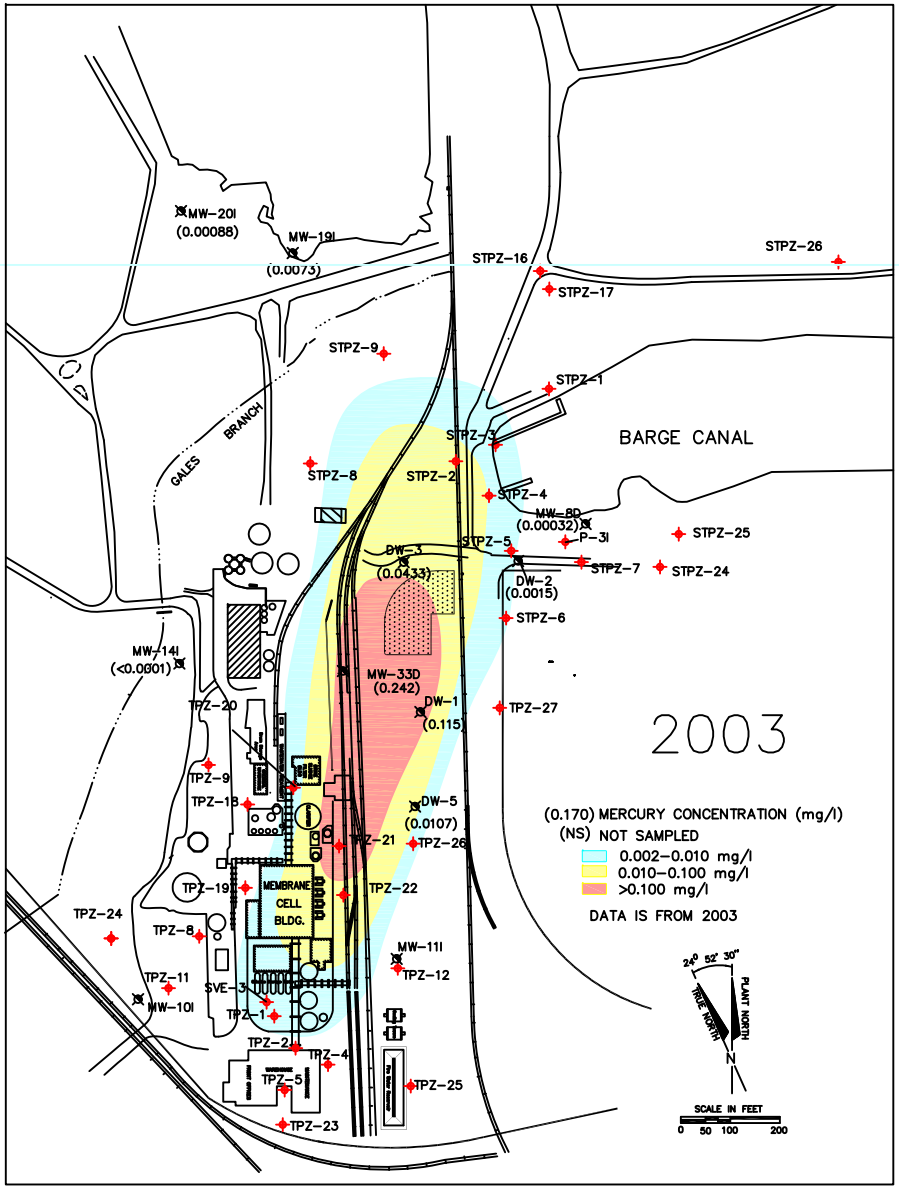
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

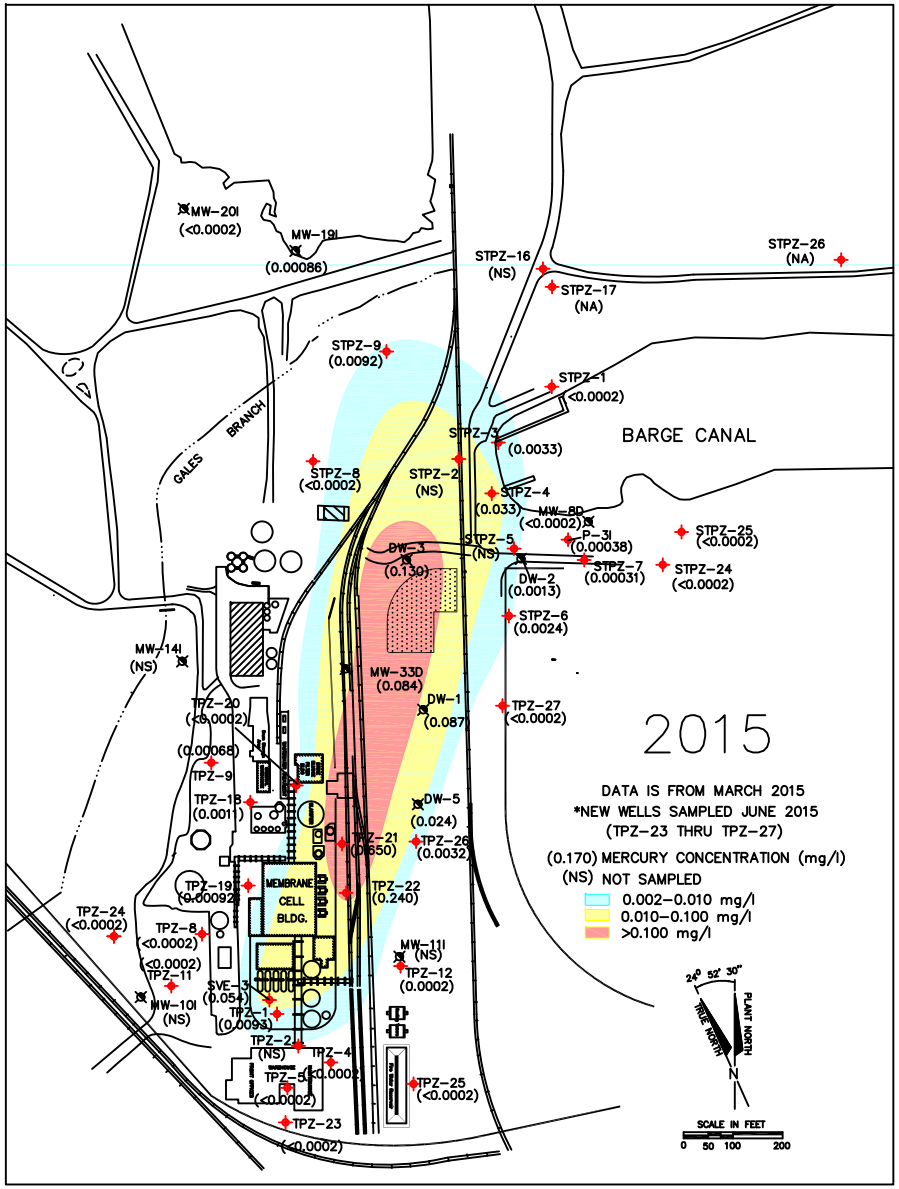
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–11





STRATA L.L.C.

INTERMEDIATE ZONE MERCURY PLUMES 2003 AND 2015

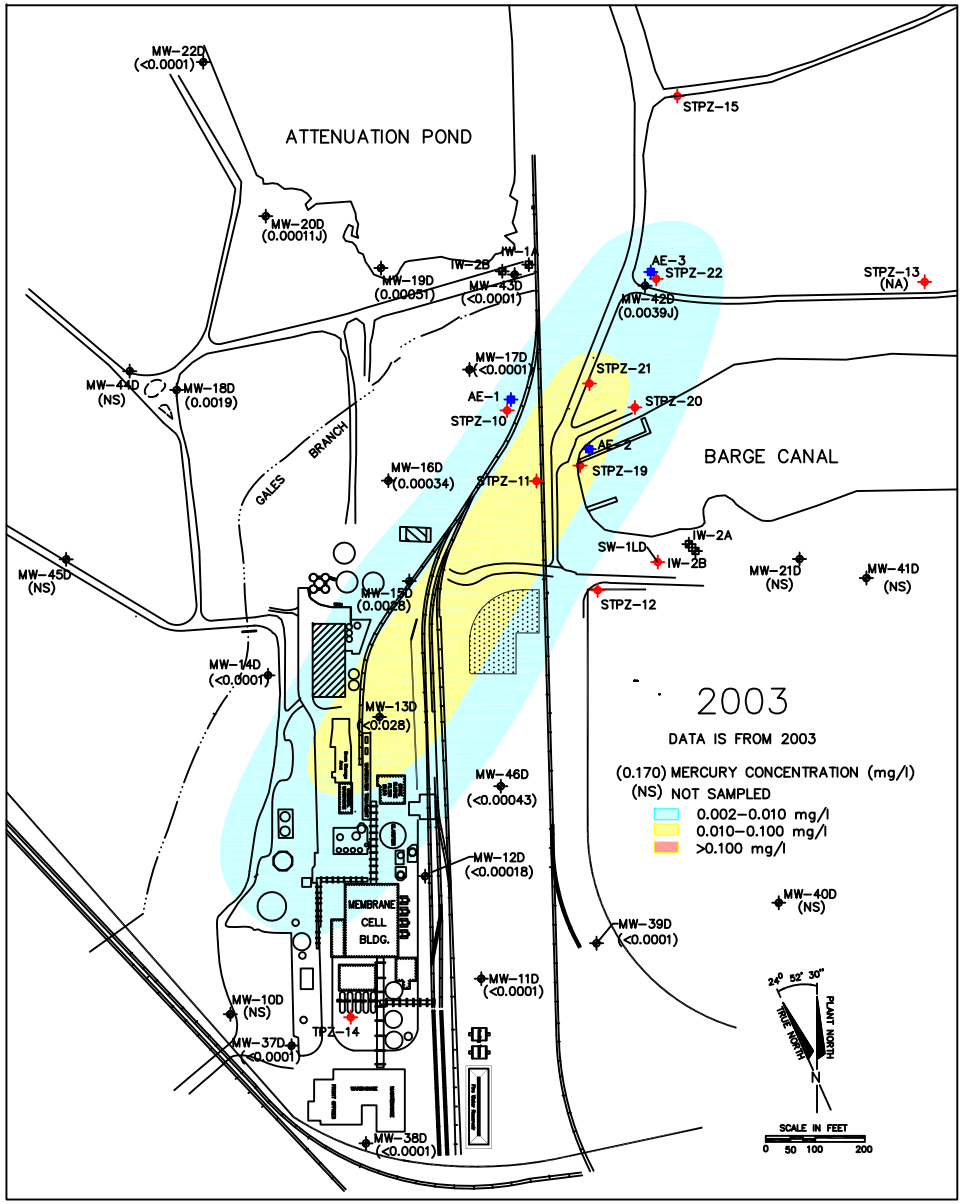
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

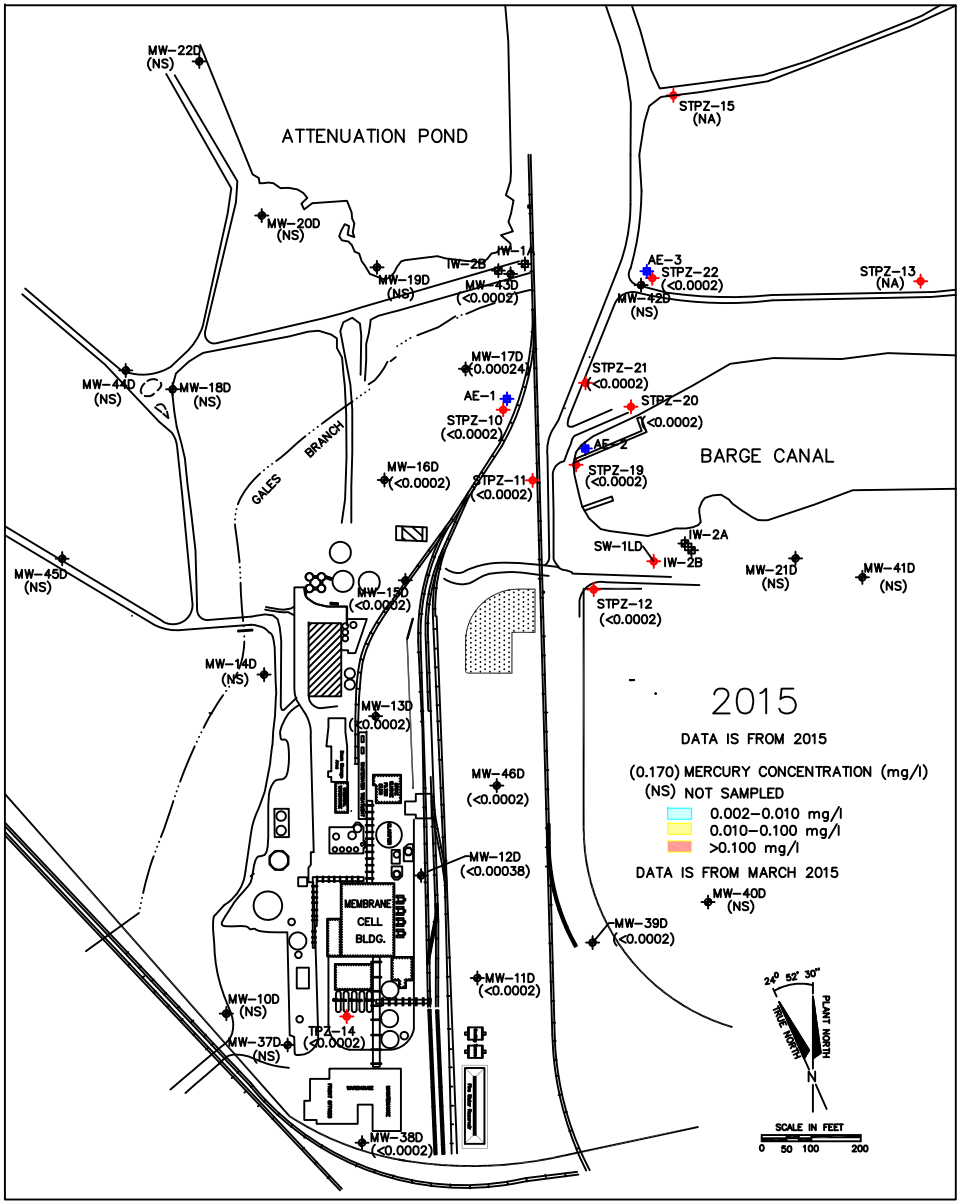
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–12





STRATA L.L.C.

LOWER ZONE MERCURY PLUMES 2003 AND 2015

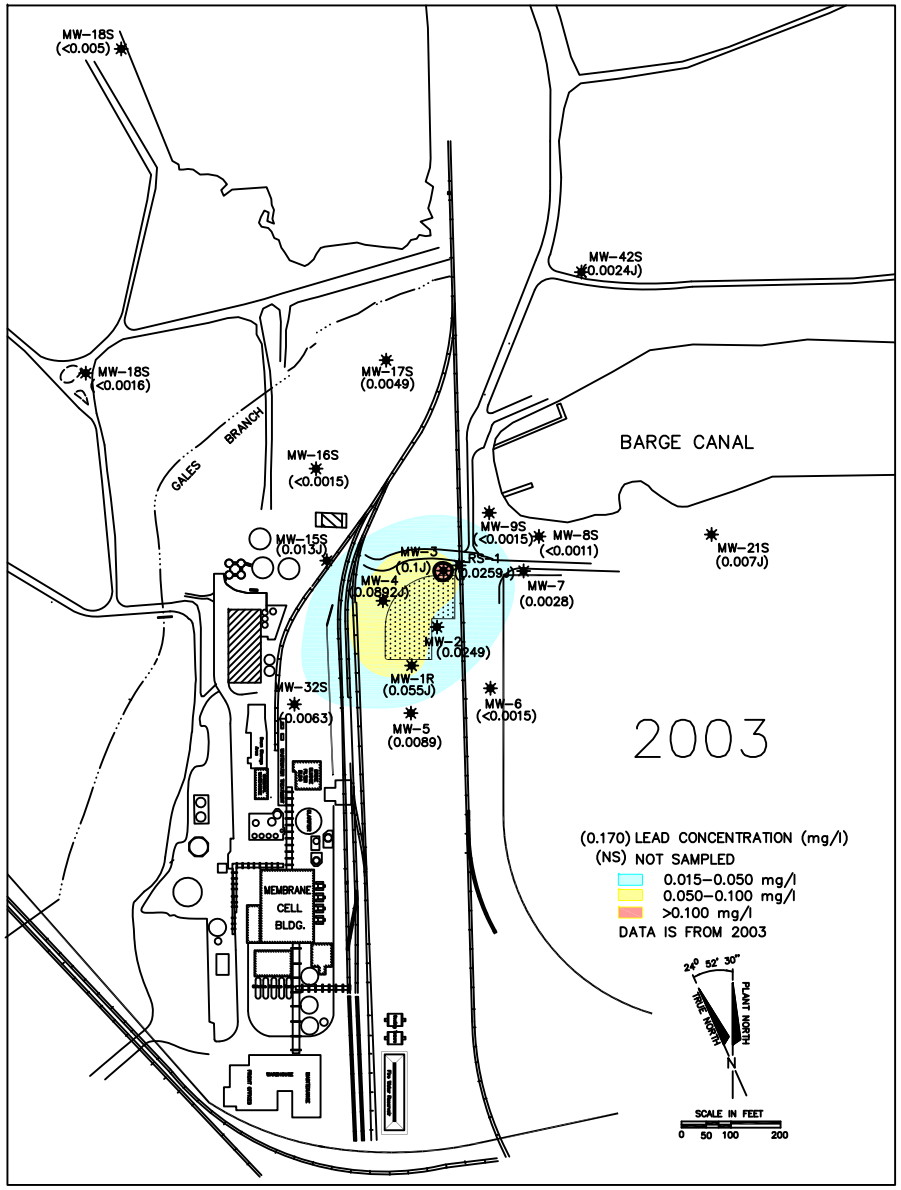
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

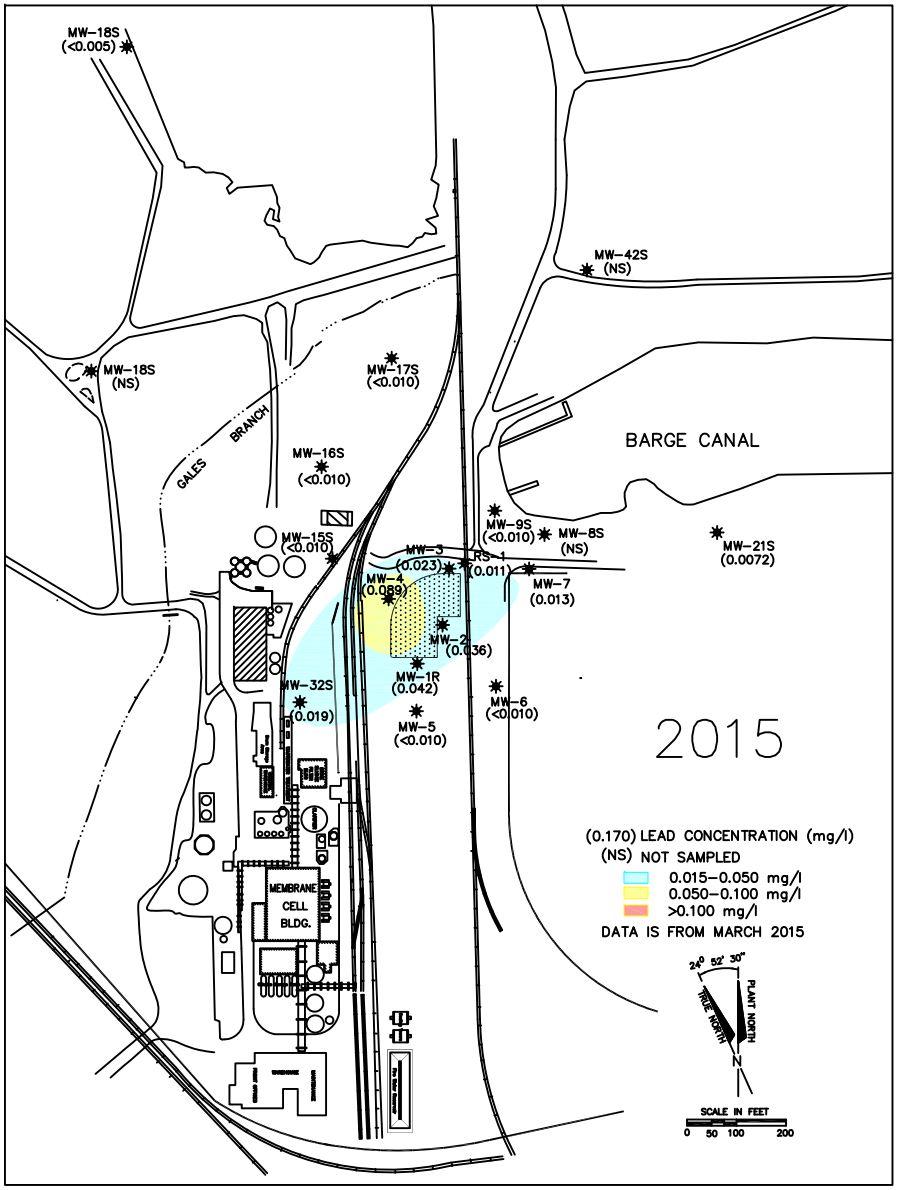
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–13





STRATA L.L.C.

UPPER ZONE LEAD PLUMES 2003 AND 2015

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

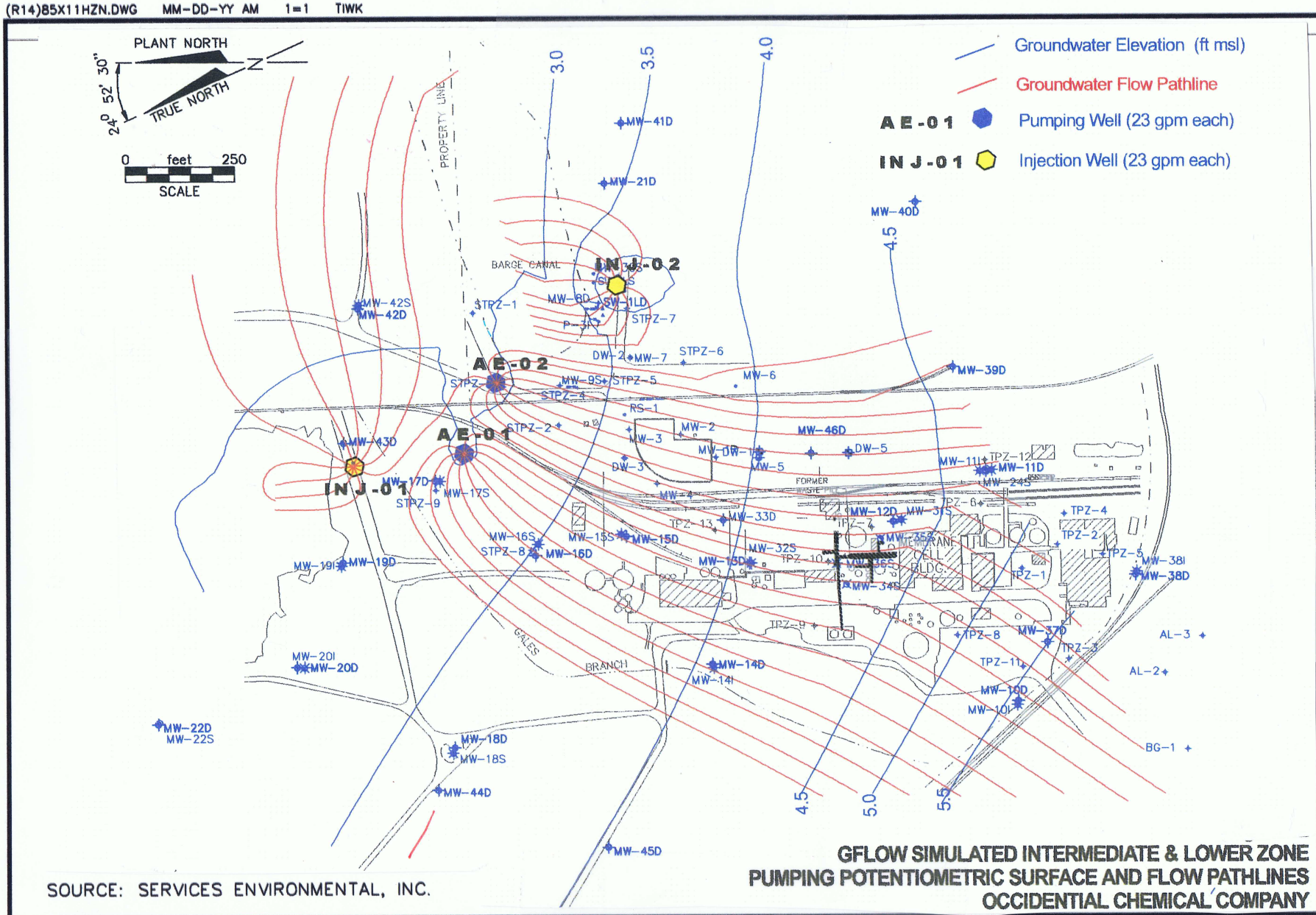
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2–14

(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK



SOURCE: SERVICES ENVIRONMENTAL, INC.

GFLOW SIMULATED INTERMEDIATE & LOWER ZONE PUMPING POTENTIOMETRIC SURFACE AND FLOW PATHLINES
OCCIDENTIAL CHEMICAL COMPANY

STRATA L.L.C.

MODEL SIMULATION OF AERATOR WELLS CAPTURE ZONE

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

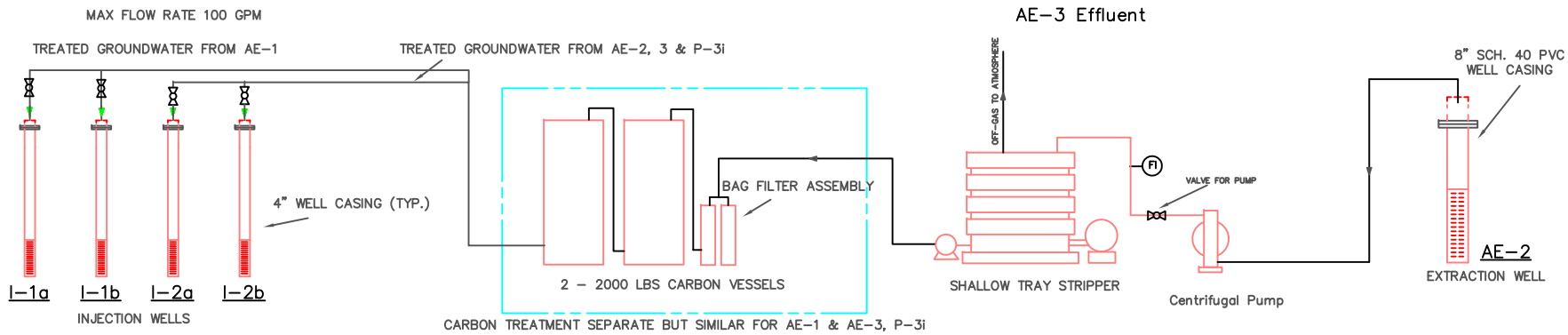
Occidental Chemical Corporation

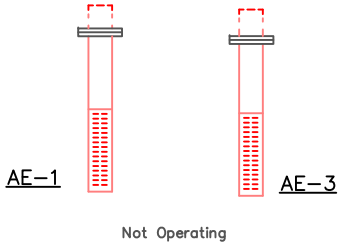
Mobile, Alabama

FIGURE

2-15

MODIFIED BOUNDARY WELL CONTROL AND SHALLOW TRAY STRIPPER SYSTEM
PROCESS FLOW DIAGRAM
Occidental Chemical Corp.
Mobile, Alabama





NOTES:

1. VALVE DESIGNATIONS

	GLOBE
	BALL, FULL PORT
	GATE
	REDUCER
PI	PRESSURE INDICATOR
FI	FLOW INDICATOR
PRV	PRESSURE RELIEF VALVE
PCV	PRESSURE CONTROL VALVE
PSHL	PRESSURE SWITCH HIGH LOW

ERM

D00EZ.00.01-TJB-04-13-01/F01-A.DWG

STRATA L.L.C.

MODIFIED PROCESS FLOW DIAGRAM
CORRECTIE MEASURES IMPLEMENTATION WORK PLAN
Occidental Chemical Corporation
Mobile, Alabama

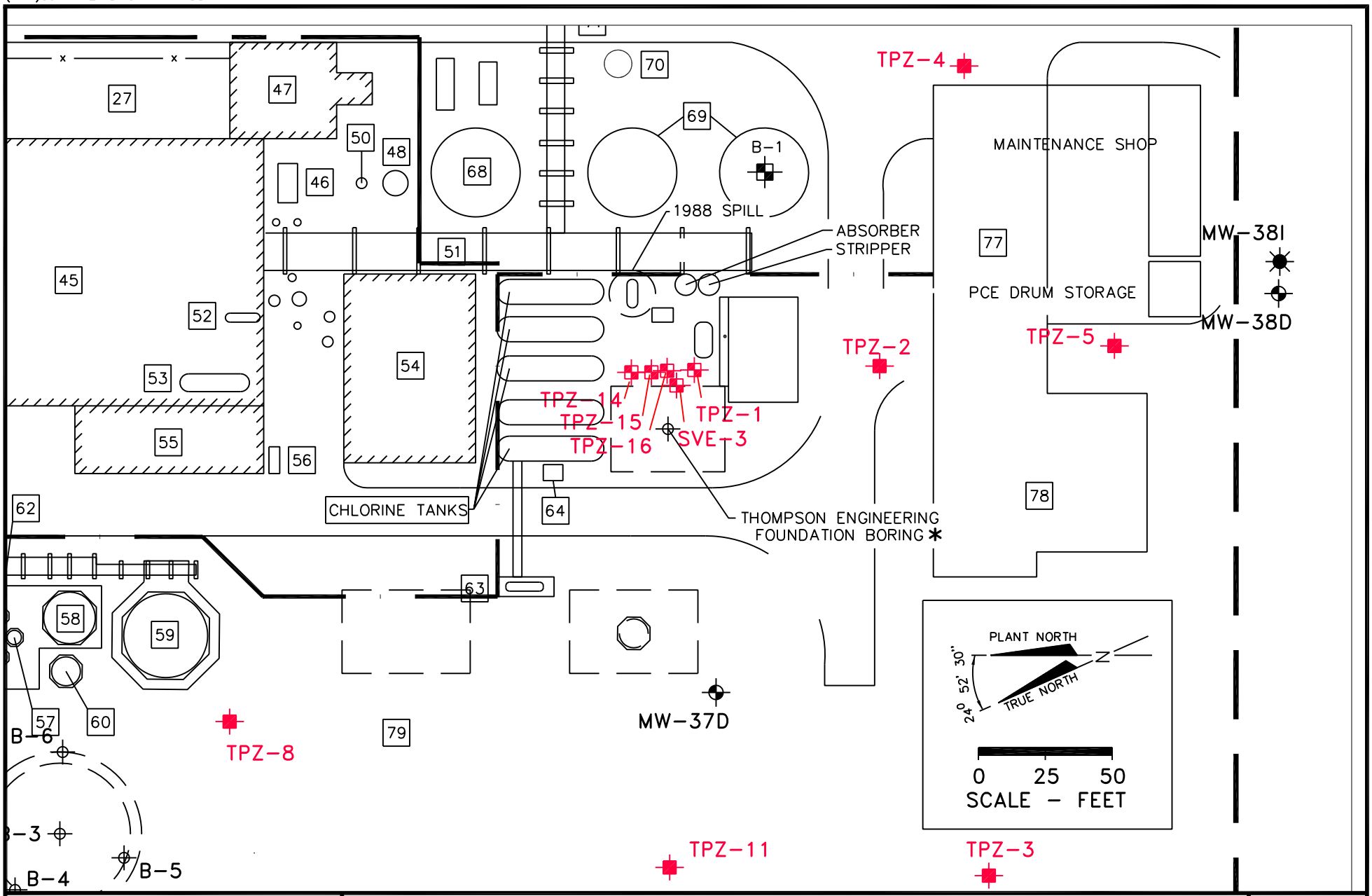
FIGURE
2-16

FIGURE 2-17

CAPTURE ZONE OF AE-2 PUMPING AT 25 GPM

Groundwater Levels Measured August 6, 2015

(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK



STRATA L.L.C.

SWMU-22 SITE FEATURES

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

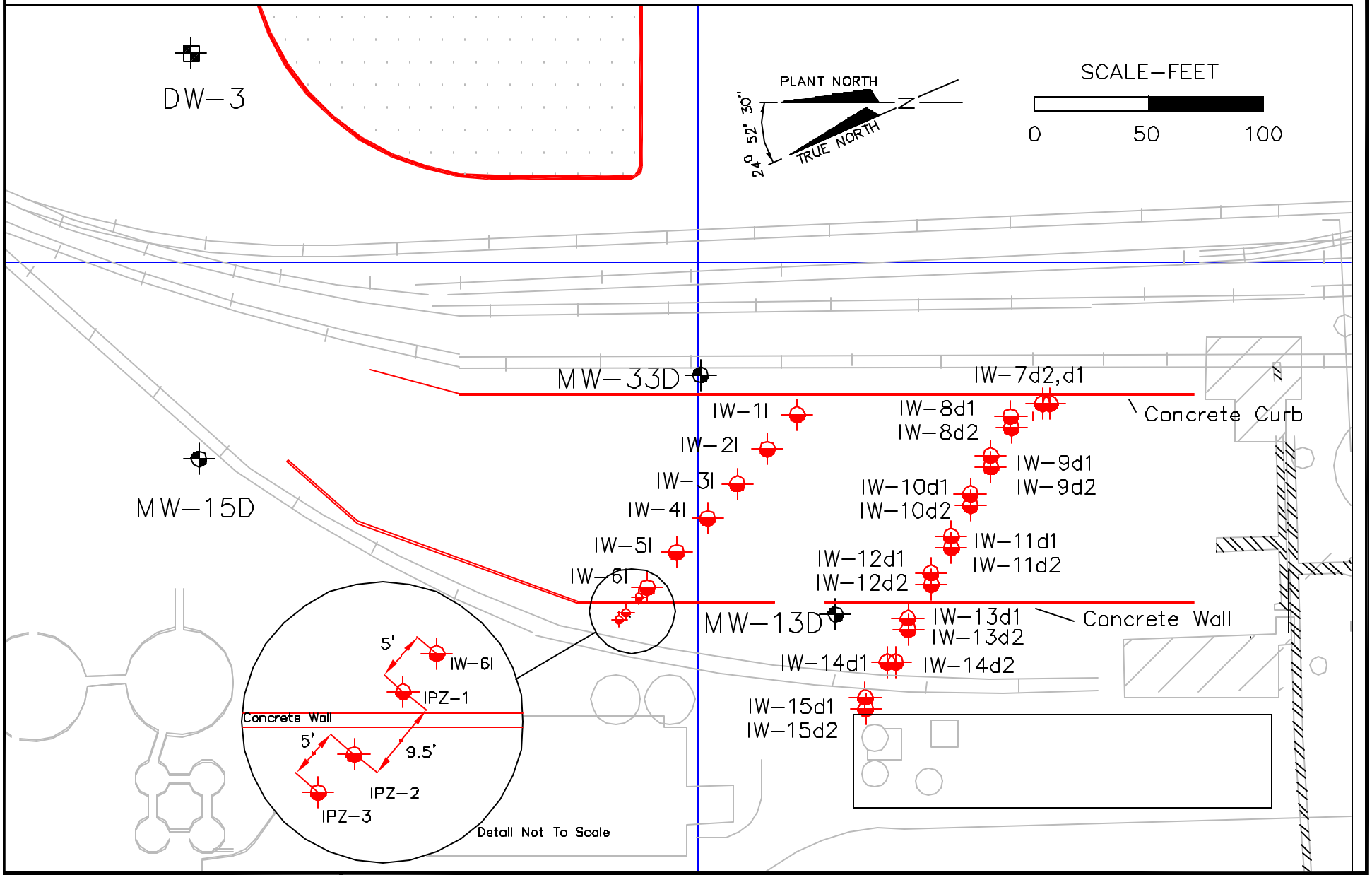
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2-18

(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK



STRATA LLC.

ERD WELL LOCATIONS

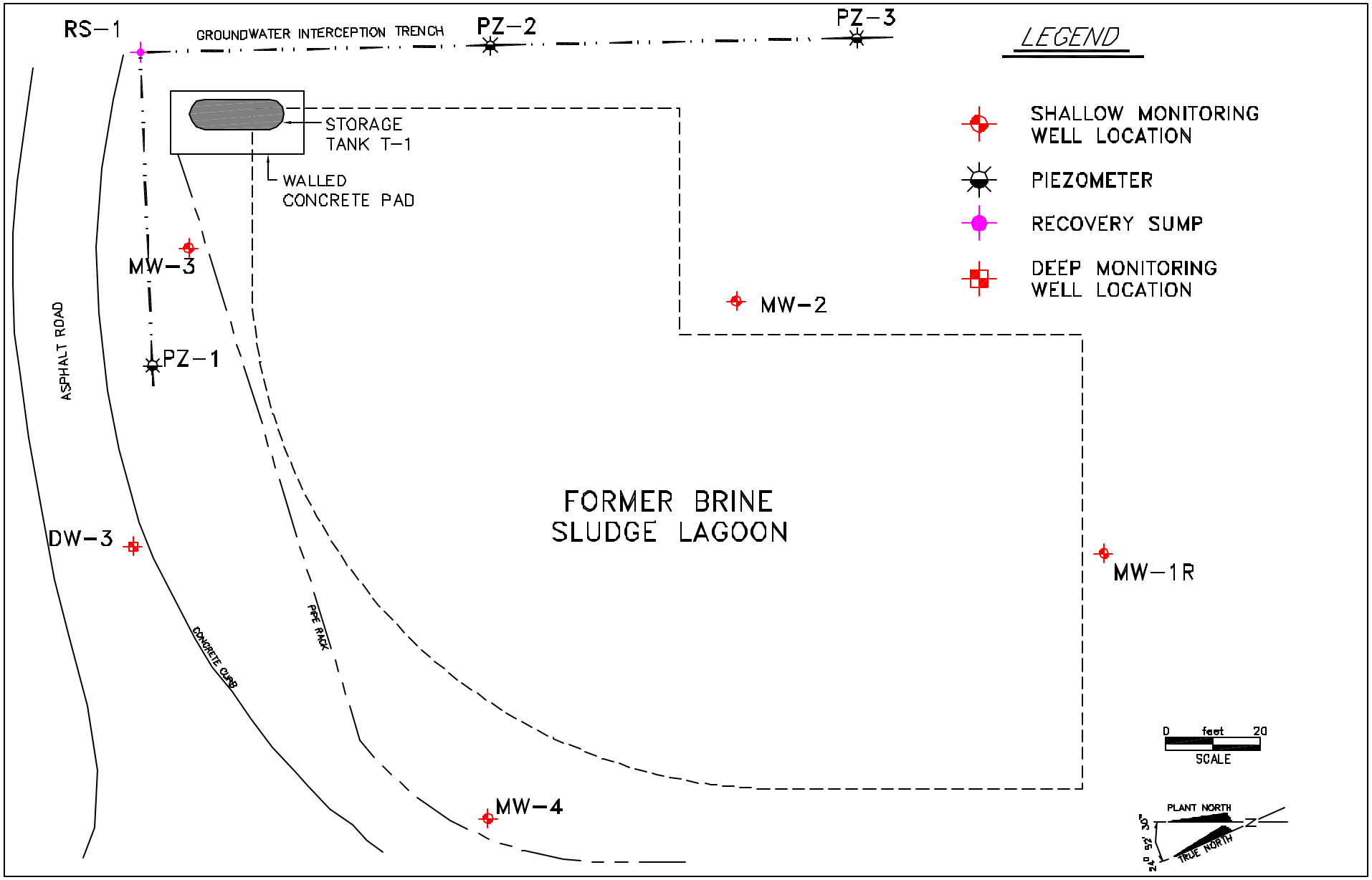
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2-19



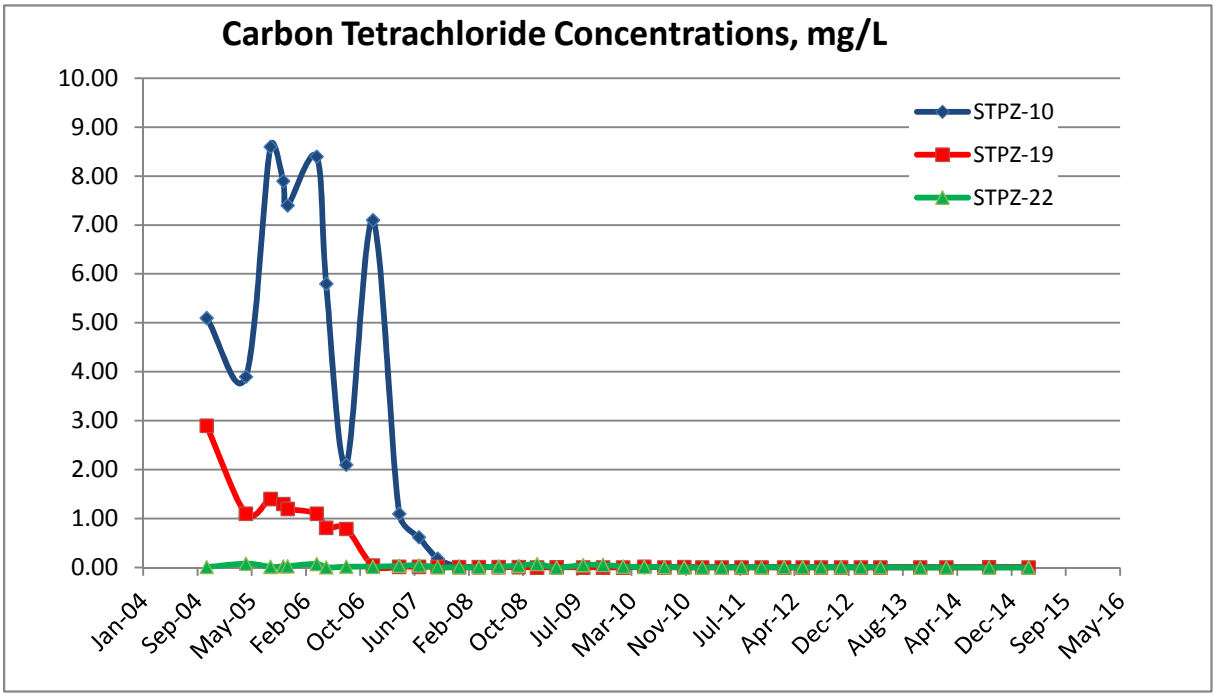
STRATA LLC

FBSL AND RECOVERY WELL AND TRENCHES
CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN
OCCIDENTAL CHEMICAL CORPORATION
MOBILE, ALABAMA

FIGURE
2-20

FIGURE 2-21

GRAPHS OF CT AND PCE CHANGES IN BOUNDARY CONTROL WELLS



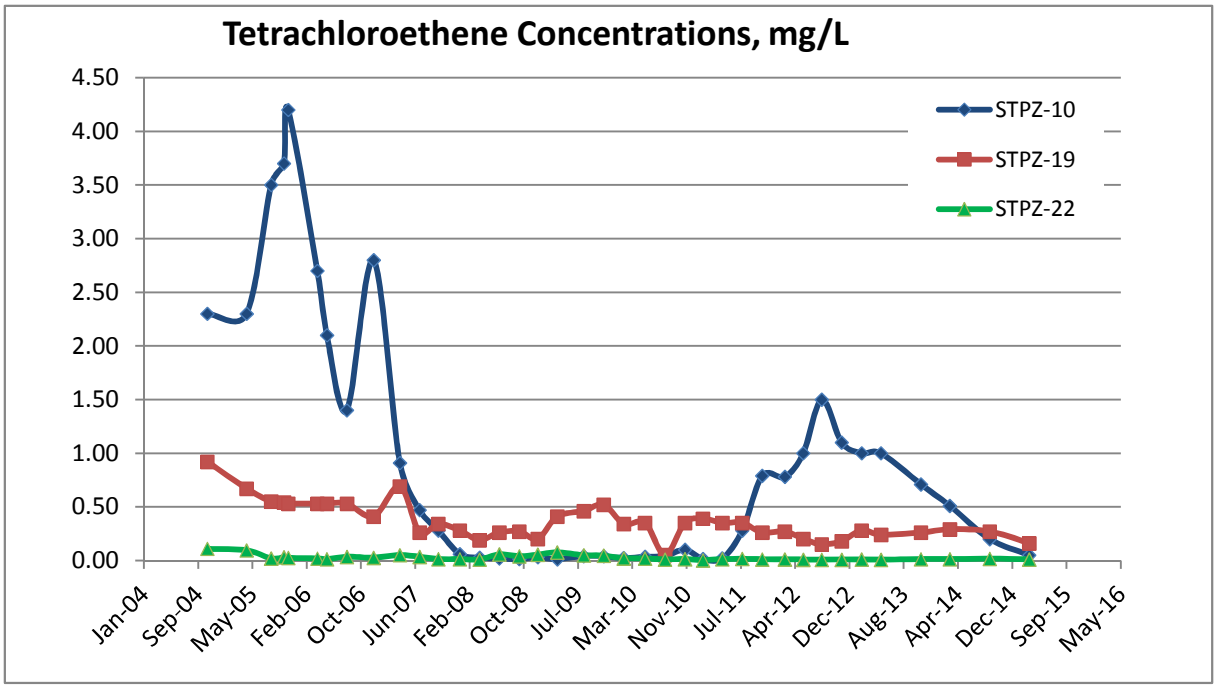
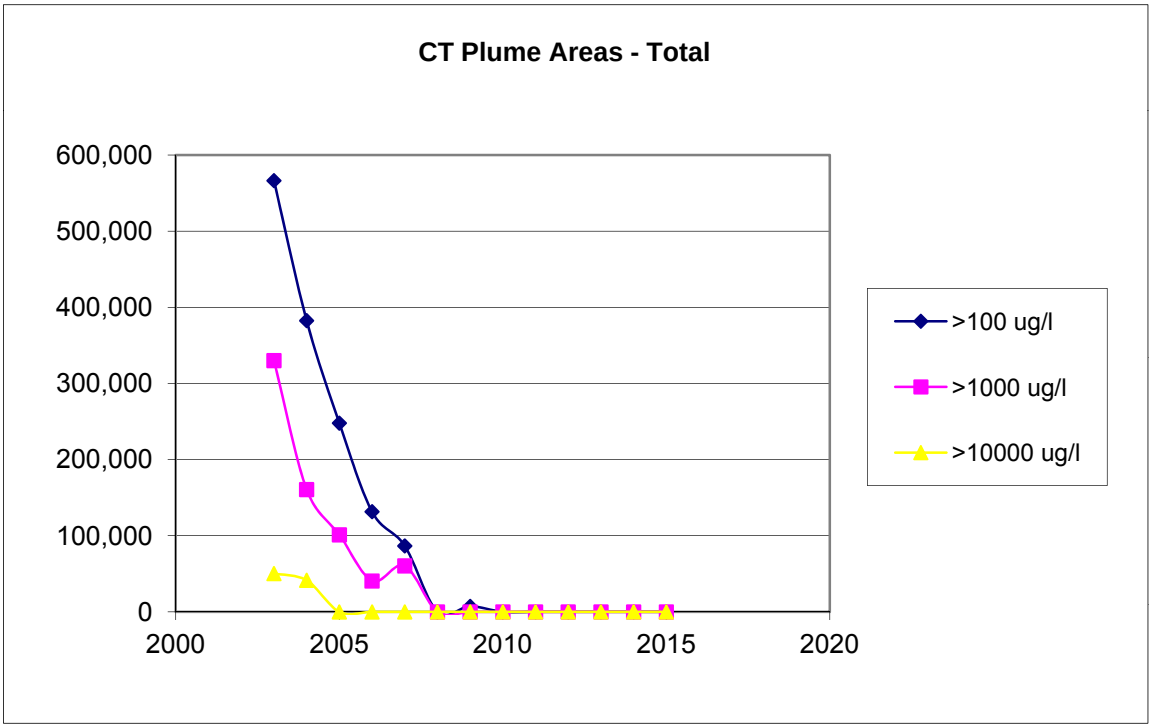


FIGURE 2-22

CHANGES IN PLUME AREAS - LOWER ZONE



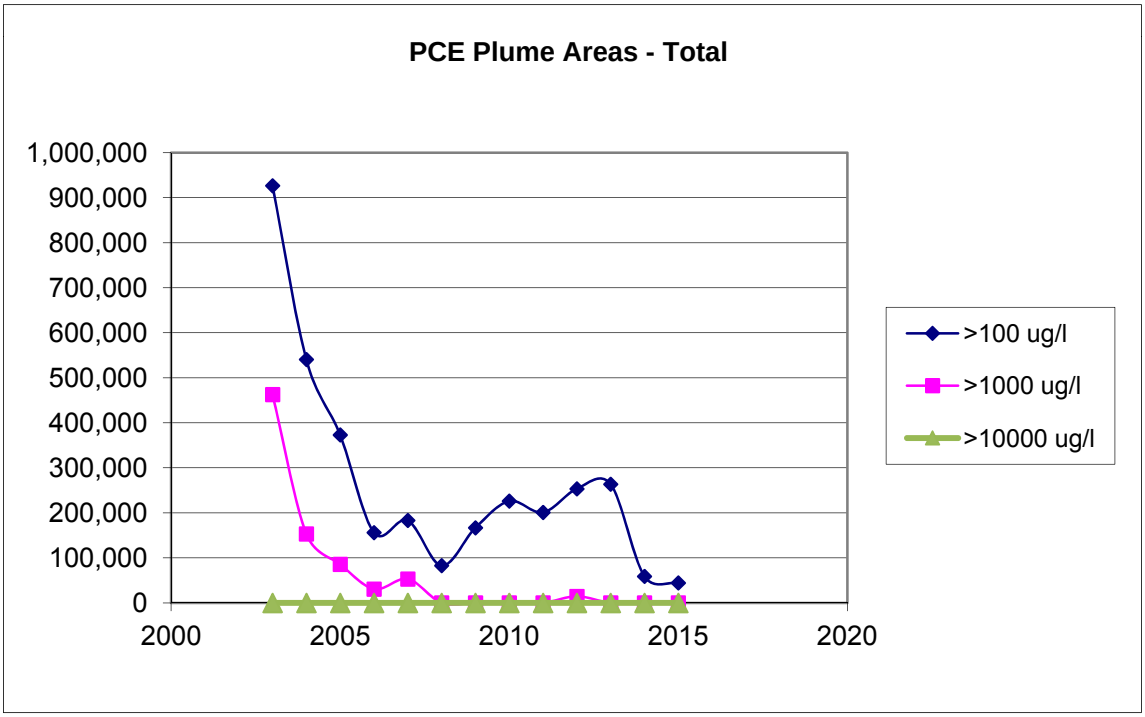
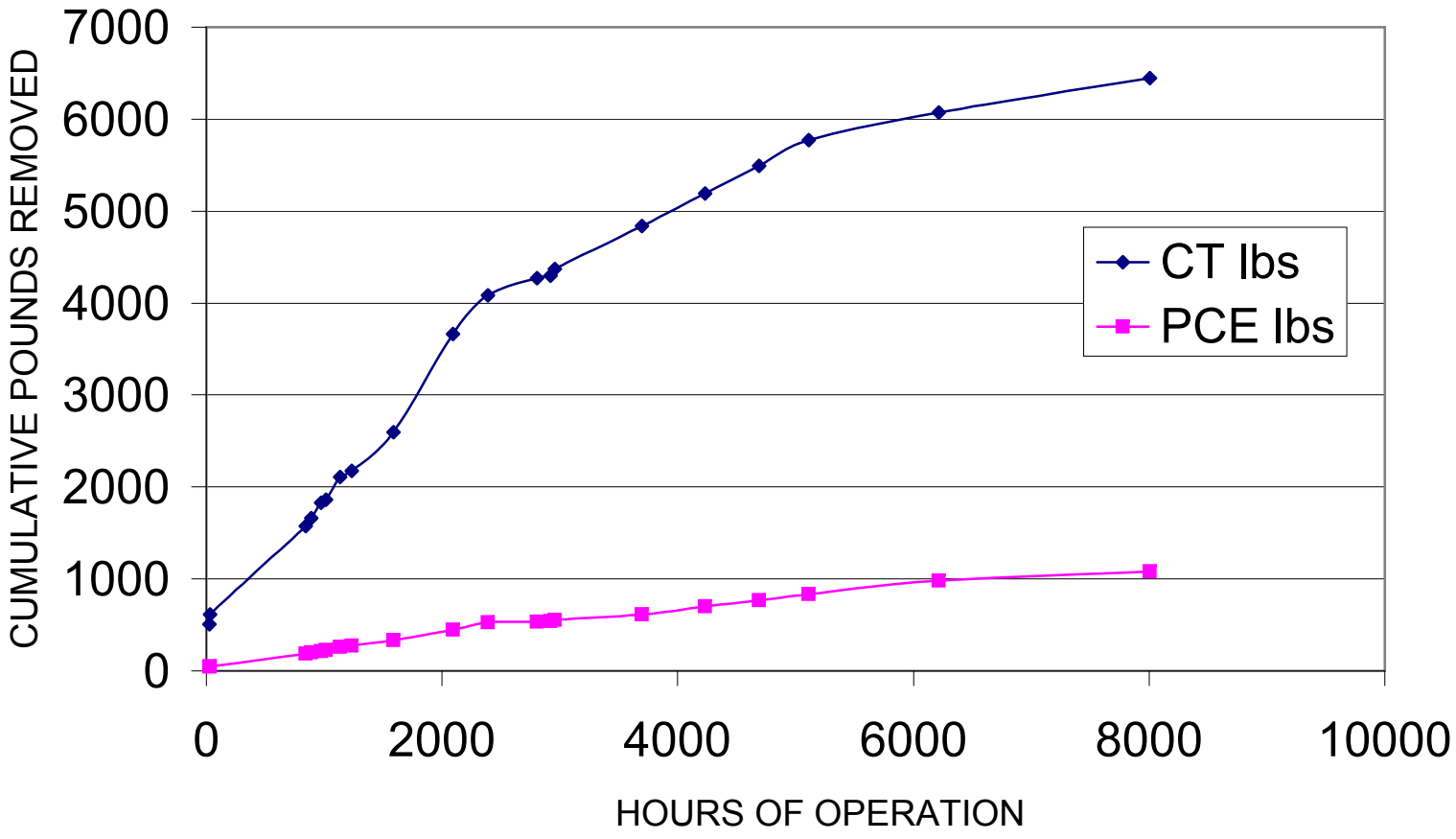
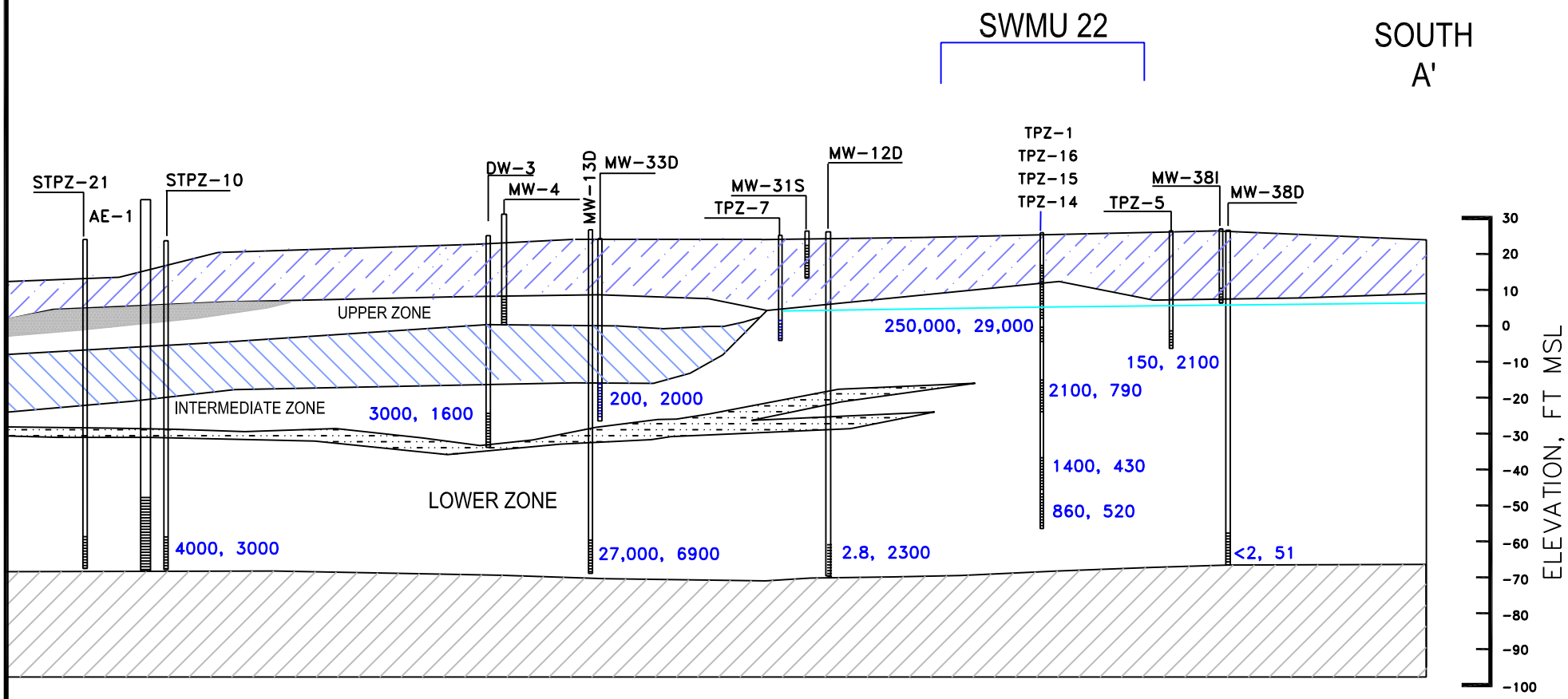


FIGURE 2-23
CUMMULATIVE MASS REMOVED BY DPVE UNIT



(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK



0 feet 300

APPROX. HORIZONTAL SCALE
APPROX. VERTICAL SCALE IS AS SHOWN

STRATA L.L.C.

CT AND PCE CONCENTRATIONS AT SWMU-22, JAN. 2004

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

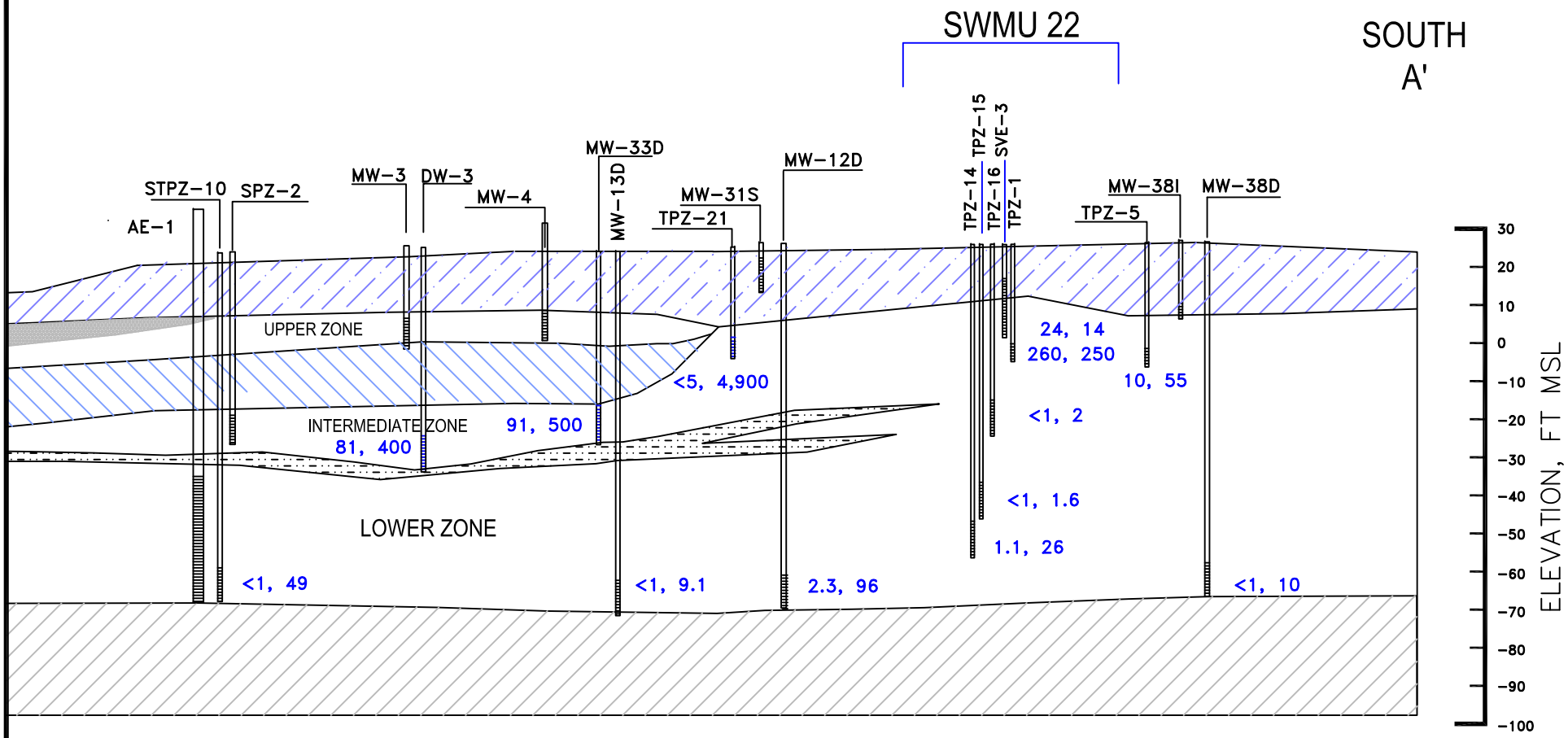
Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2-24

(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK



0 feet 300

APPROX. HORIZONTAL SCALE
APPROX. VERTICAL SCALE IS AS SHOWN

NOTES: <1, 1.6 = CT, PCE Concentration, March 2015

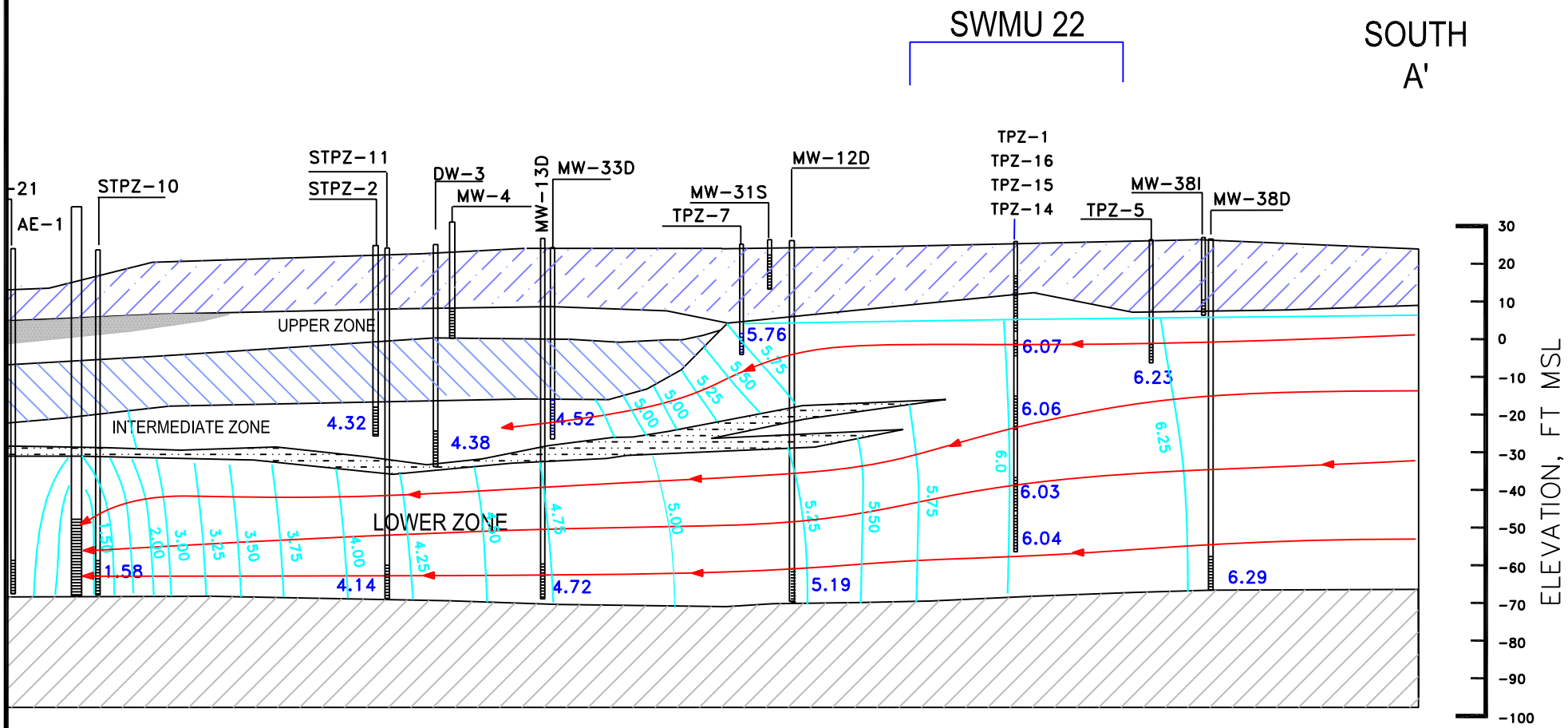
STRATA L.L.C.

CT AND PCE CONCENTRATIONS AT SWMU 22, MARCH 2015

CORRECTIVE MEASURES IMPLEMENTATION REPORT
Occidental Chemical Corporation
Mobile, Alabama

FIGURE
2-25

(R14)85X11HZN.DWG MM-DD-YY AM 1=1 TIWK



0 feet 300

APPROX. HORIZONTAL SCALE
APPROX. VERTICAL SCALE IS AS SHOWN

STRATA L.L.C.

EQUIPOTENTIAL LINES AT SWMU-22 9/16/2008

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN

Occidental Chemical Corporation

Mobile, Alabama

FIGURE

2-26

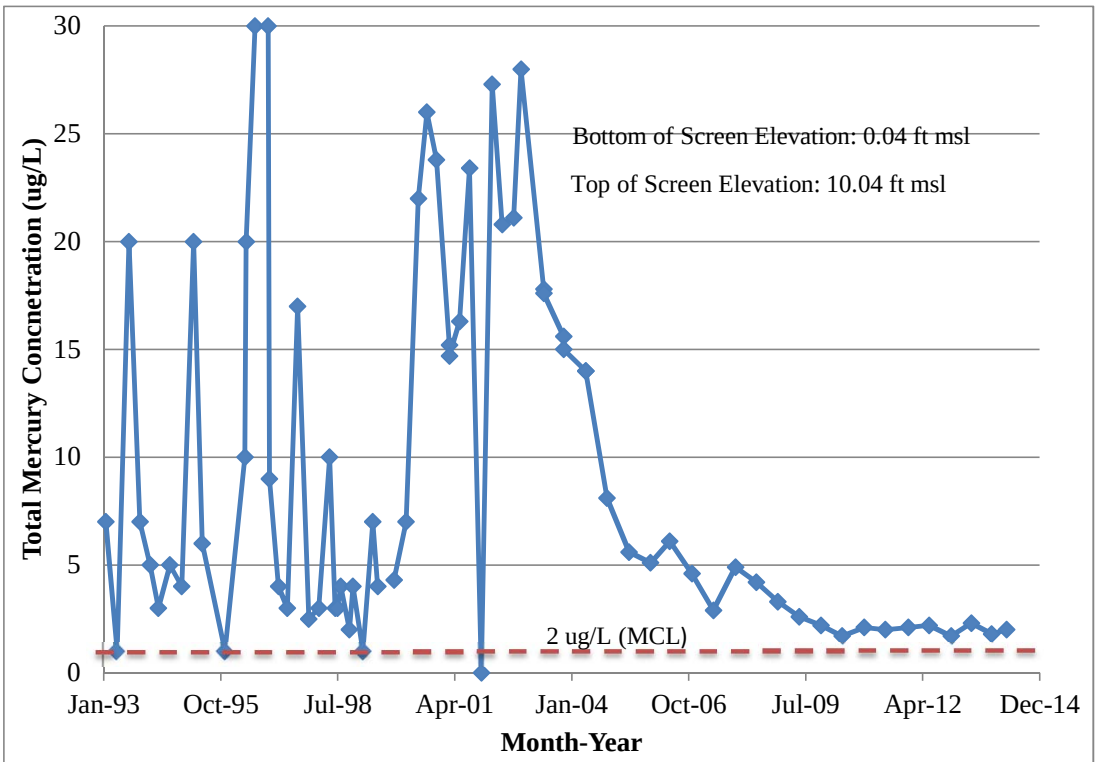


Figure 2-27a: Time Series Plot for Mercury in Groundwater for MW-2 (Data plotted from 1993-Mar 2014)

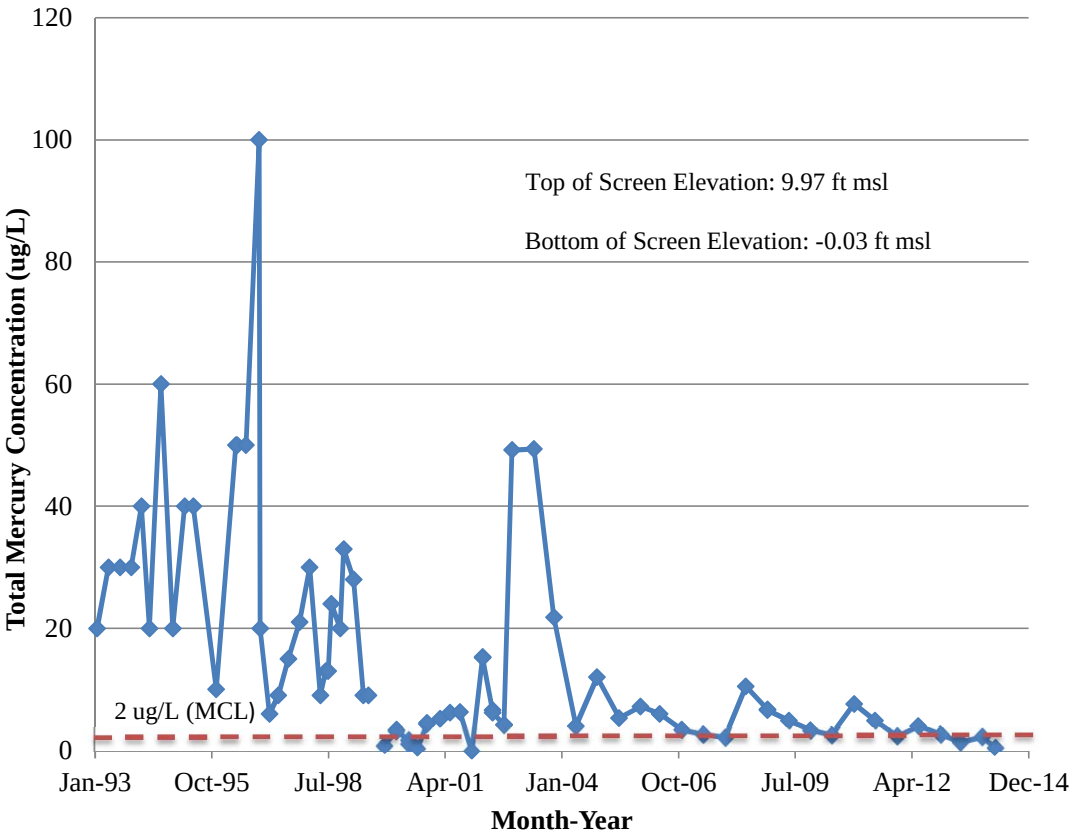


Figure 2-27b: Time Series Plot for Mercury in Groundwater for MW-3 (Data plotted from 1993- Mar 2014)

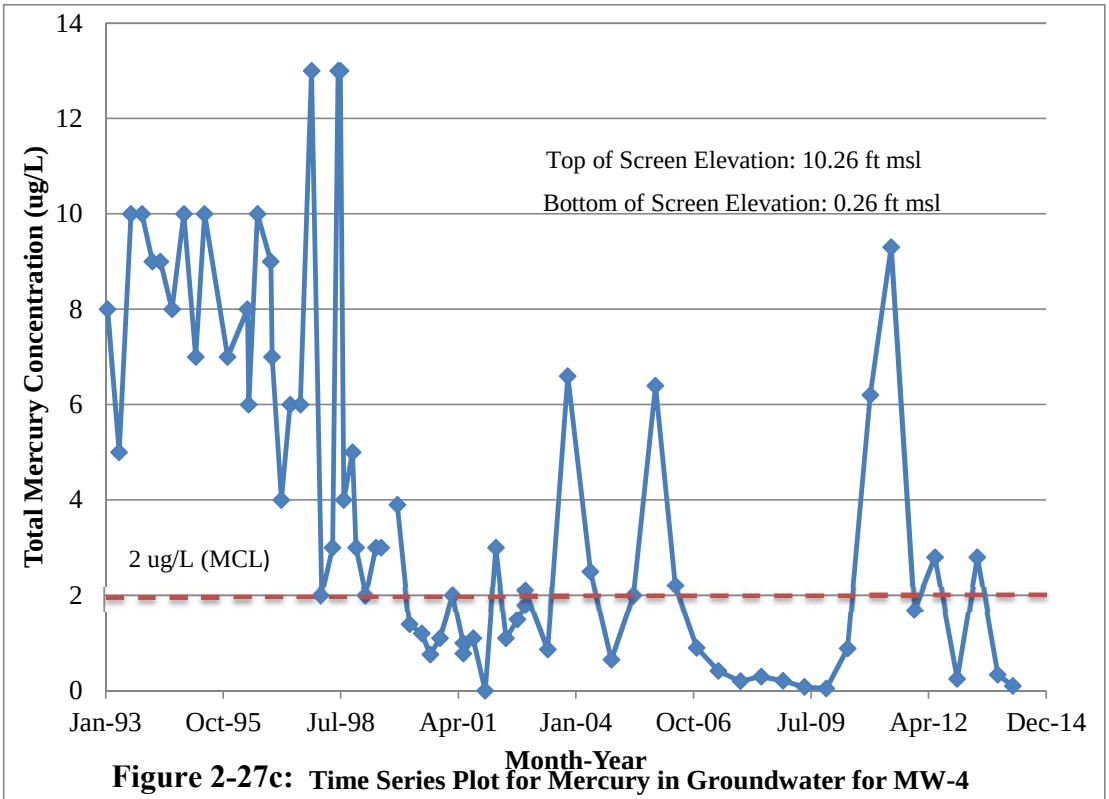


Figure 2-27c: Time Series Plot for Mercury in Groundwater for MW-4 (Data plotted from 1993- Mar 2014)

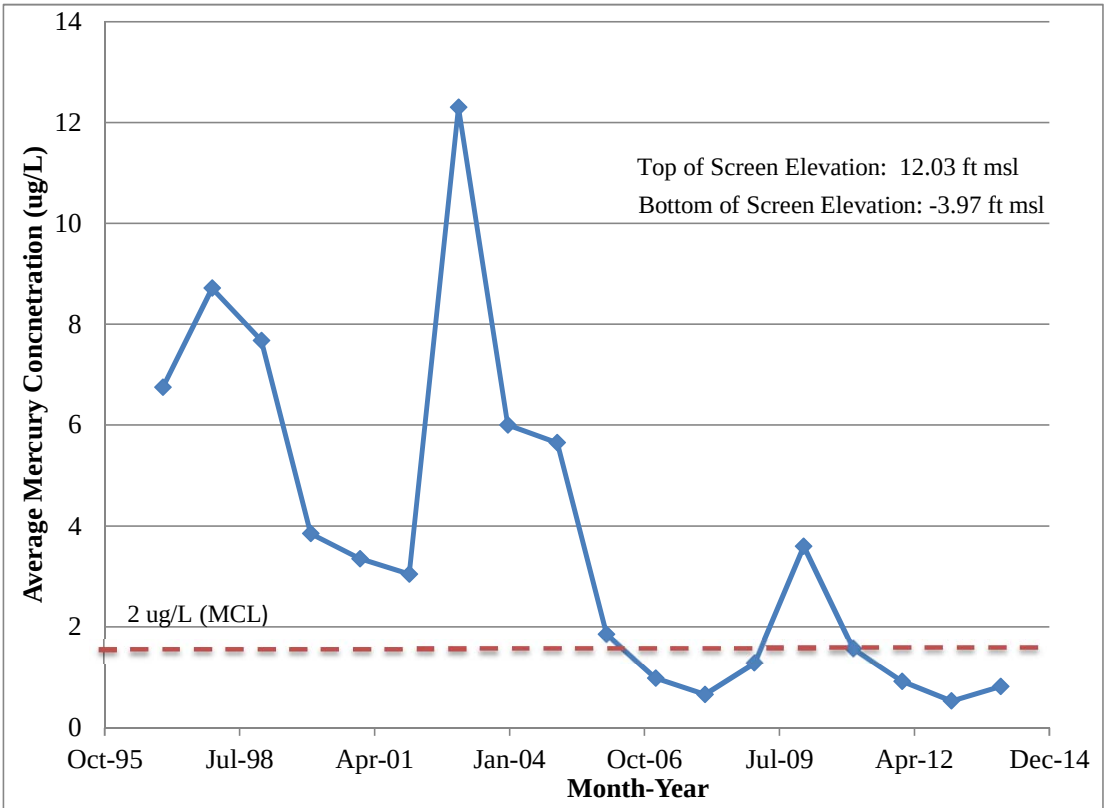


Figure 2-27d: Time Series Plot for Mercury in Groundwater for RS-1

TABLES

TABLE 2-1
BOUNDARY CONTROL PUMPING SUMMARY

Month and Year	AE-1	AE-2 & AE-3	P-3I
	Gallons	**Gallons**	**Gallons**
Jul-04	326,414	600,336	
Aug-04	869,811	622,790	
Sep-04	541,607	375,080	
Oct-04		26,467	
Nov-04			
Dec-04		19,700	
Total 2004	**1,737,832**	**1,644,373**	
Jan-05		78,200	
Feb-05	13,752		
Mar-05	280,470	555,590	
Apr-05	88,770	345,167	
May-05	433,746	682,505	
Jun-05	38,356	94,135	
Jul-05	0	0	
Aug-05	200,545	369,771	
Sep-05	1,629	0	
Oct-05	7,120	0	
Nov-05	322,960	0	
Dec-05	251,624	79,895	
Total 2005	**1,638,972**	**2,205,263**	
Jan-06	679,776	626,210	
Feb-06	795,460	514,880	
Mar-06	0	543,455	
Apr-06	0	1,398,765	
May-06	1,207,132	262,277	
Jun-06	692,327	319,727	
Jul-06	483,183	197,536	
Aug-06	264,199	745,080	
Sep-06	164,579	176,545	
Oct-01	1,801	0	
Nov-06	0	0	
Dec-06	0	0	
Total 2006	**4,288,457**	**4,784,475**	
Jan-07	0	651,290	
Feb-07	0	626,840	
Mar-07	179,050	279,003	
Apr-07	378,550	307,632	
May-07	322,000	346,405	
Jun-07	378,550	307,632	**P-3I**
Jul-07	349,365	84,488	
Aug-07	284,410	224,901	
Sep-07	217,910	403,738	126,720
Oct-07	204,225	318,213	288,360
Nov-07	271,300	649,950	151,650
Dec-07	64,010	365,080	280,649
Total 2007	**2,649,370**	**4,565,172**	**847,379**
Jan-08	240,100	106,379	126,531
Feb-08	230,100	253,000	248,090
Mar-08	249,700	240,190	128,350
Apr-08	300,500	69,170	270,230
May-08	314,000	411,910	276,590

TABLE 2-1
BOUNDARY CONTROL PUMPING SUMMARY

Month and Year	AE-1	AE-2 & AE-3	P-3I
	Gallons	Gallons	Gallons
Jun-08	235,000	665,300	200,238
Jul-08	333,800	132,008	133,492
Aug-08	592,500	221,323	196,777
Sep-08	790,300	768,187	296,213
Oct-08	532,300	591,902	238,820
Nov-08	386,340	384,153	180,345
Dec-08	188,460	329,365	195,115
Totals for 2008	**4,393,100**	**4,172,887**	**2,490,791**
Jan-09	411,800	460,130	290,470
Feb-09	327,900	534,530	239,870
Mar-09	221,100	627,960	265,040
Apr-09	239,100	677,390	280,410
May-09	232,620	74,130	166,270
Jun-09	232,080	407,020	118,780
Jul-09	287,900	404,120	223,880
Aug-09	279,800	278,790	151,010
Sep-09	84,400	457,420	265,480
Oct-09	240,100	323,580	182,220
Nov-09	239,900	159,710	78,490
Dec-09	274,200	220,930	164,570
2009 Total	**3,070,900**	**4,625,710**	**2,426,490**
Jan-10	182,100	6,600	11,040
Feb-10	32,300	110,690	103,110
Mar-10	16,400	363,880	76,320
Apr-10	0	321,540	51,660
May-10	0	391,680	69,120
Jun-10	0	388,520	68,980
Jul-10	0	367,250	112,410
Aug-10	0	410,365	99,875
Sep-10	55,900	312,820	164,780
Oct-10	426,500	197,070	148,430
Nov-10	393,100	0	0
Dec-10	377,200	161,820	169,680
2010 Totals	**1,483,500**	**3,032,235**	**1,075,405**
Jan-11	290,600	316,710	148,690
Feb-11	205,200	193,280	105,220
Mar-11	270,300	231,730	149,670
Apr-11	274,100	406,400	259,300
May-11	171,400	119,120	120,580
Jun-11	284,600	172,540	157,060
Jul-11	254,400	135,150	54,650
Aug-11	155,600	219,790	210
Sep-11	109,300	183,960	143,040
Oct-11	173,600	156,500	260,700
Nov-11	221,100	218,600	259,200
Dec-11	245,500	303,900	356,400
2011 Totals	**2,655,700**	**2,657,680**	**2,014,720**
Jan-12	201,000	262,800	496,800
Feb-12	286,300	635,100	583,200
Mar-12	240,300	154,800	626,400
Apr-12	248,300	368,300	403,200

TABLE 2-1
BOUNDARY CONTROL PUMPING SUMMARY

Month and Year	AE-1	AE-2 & AE-3	P-3I
	Gallons	Gallons	Gallons
May-12	273,380	494,501	31,680
Jun-12	229,220	465,300	72,000
Jul-12	211,800	626,200	446,400
Aug-12	200,700	249,600	316,800
Sep-12	305,000	482,700	432,000
Oct-12	374,400	256,500	244,800
Nov-12	217,700	209,700	244,800
Dec-12	172,300	245,700	216,000
2012 Totals	**2,960,400**	**4,451,201**	**4,114,080**
Jan-13	243,200	556,720	542,880
Feb-13	181,400	542,960	483,840
Mar-13	273,300	687,500	446,400
Apr-13	307,900	603,700	432,000
May-13	378,400	498,600	475,200
Jun-13	456,800	595,200	345,600
Jul-13	436,000	434,160	224,640
Aug-13	412,100	496,980	357,120
Sep-13	453,000	461,700	475,200
Oct-13	393,000	612,460	95,040
Nov-13	214,700	349,300	0
Dec-13	408,600	770,400	0
2013 Totals	**4,158,400**	**6,609,680**	**3,877,920**
Jan-14	126,000	225,700	0
Feb-14	165,700	175,500	0
Mar-14	63,500	320,400	0
Apr-14	0	256,200	0
May-14	0	74,700	0
Jun-14	0	96,500	0
Jul-14	0	291,800	0
Aug-14	0	462,700	0
Sep-14	0	730,100	0
Oct-14	0	341,700	0
Nov-14	0	201,100	0
Dec-14	0	384,400	0
2014 Totals	**355,200**	**3,560,800**	**0**
Jan-15	0	625,400	0
Feb-15	0	0	0
Mar-15	0	0	0
Apr-15	0	0	0
May-15	0	0	0
Jun-15	0	0	0
Jul-15	0	0	0
Aug-15	0	0	0
Sep-15	0	0	0
Oct-15	0	0	0
Nov-15	0	0	0
Dec-15	0	0	0
2015 Totals	**0**	**625,400**	**0**
Grand Totals	**29,391,831**	**42,934,876**	**16,846,785**
Aerator Total	**72,326,707**		
AE1, AE2, AE3			

TABLE 2-2
HISTORICAL GROUNDWATER CONCENTRATIONS IN THE LOWER ZONE BOUNDARY CONTROL AREA
(Concentrations in ug/l)

Date	STPZ-10		STPZ-19		STPZ-20		STPZ-21		STPZ-22		MW-42D	
	CT	PCE	CT	PCE	CT	PCE	CT	PCE	CT	PCE	CT	PCE
Nov-02	1500	1400	NI	NI	NI	NI	NI	NI	NI	NI	1500	1400
Jan-03	1300	1100	NI	NI	NI	NI	NI	NI	NI	NI	1300	
Dec-03	4000	3000	NI	NI	NI	NI	NI	NI	NI	NI	4000	3000
May-04	3400	2500	NI	NI	NI	NI	NI	NI	NI	NI	3400	2500
Nov-04	5100	2300	2900	920	680	620	500	470	110	110	49	820
May-05	3900	2300	1100	670	1700	990	1100	940	78	95	18	150
Aug-05	8600	3500	1400	550	1200	610	92	98	17	19	NS	NS
Oct-05	10000	3700	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Nov-05	7400	4200	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Dec-05	NS	NS	1000	550	2600	1000	780	390	16	31	14	220
Mar-06	8400	2700	1100	480	2700	990	80	290	75	18	NS	NS
May-06	5800	2100	810	530	760	590	600	580	4.4	12	NS	NS
Aug-06	2100	1400	790	530	1800	870	39	160	19	34	NS	NS
Dec-06	7100	2800	42	410	1600	980	1500	800	16	26	0.88	59
Apr-07	1100	910	17	690	5500	3100	2000	1400	38	50	NS	NS
Jul-07	620	470	17	260	240	290	940	390	44	34	NS	NS
Oct-07	180	280	13	340	25	85	350	820	7	13	3.8	92
Jan-08	18	60	7.6	280	<60	48	69	200	5.3	12	NS	NS
Apr-08	4.9	26	<20	190	<100	30	5.1	35	5	8.6	NS	NS
Jul-08	5.5	19	<20	260	<20	170	4.1	24	20	52	NS	NS
Oct-08	<40	13	9.2	270	<20	53	<25	14	37	40	1.1	2
Oct-08	<20	13	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Jan-09	3.7	31	0.71	400	3.1	60	1.7	11	70	54	NS	NS
Apr-09	NS	NS	<4	410	<4	47	<2	<13	110	76	NS	NS
May-09	<2	<15	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
May-09	<2	<12	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Aug-09	<5	47	<2	460	<2	71	<2.2	9.6	60	48	NS	NS
Nov-09	1.3	40	1.6	520	0.53	96	2.2	19	55	45	2.0	4.9
Feb-10	3.7	23	0.53	340	0.76	65	2.9	11	21	20	NS	NS
May-10	<5.6	<35	18	350	<4	64	60	60	16	<19	NS	NS
Aug-10	<2	43	<2	52	0.85	64	0.55	4.2	10	9	NS	NS
Nov-10	<2	100	6.7	350	6.9	100	<2	6.8	<2	13	3.1	2.6

TABLE 2-2
HISTORICAL GROUNDWATER CONCENTRATIONS IN THE LOWER ZONE BOUNDARY CONTROL AREA
(Concentrations in ug/l)

Date	STPZ-10		STPZ-19		STPZ-20		STPZ-21		STPZ-22		MW-42D	
	CT	PCE	CT	PCE	CT	PCE	CT	PCE	CT	PCE	CT	PCE
Feb-11	<2	14	<2	390	<2	120	<2	2.1	1.1	1.7	NS	NS
May-11	<2	20	<2	350	<2	120	<2	29	2.6	12	NS	NS
Aug-11	<10	280	<2	350	<2	150	<2	20	5.3	15	NS	NS
Nov-11	<1	790	<1	260	<1	150	<1	39	3.8	11	<1	4
Feb-12	<10	750	<1	270	<1	130	<1	93	7.7	9.2	NS	NS
Feb-12	<10	780	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
May-12	<5	1000	<1	200	<1	130	<1	150	6.9	8.1	NS	NS
Aug-12	<5	1500	<1	150	<1	110	<1	200	7.5	7.5	NS	NS
Nov-12	<10	1100	<2	180	<1	78	<2	210	8.2	7.5	<1	<1
Feb-13	<5	1000	<1	280	<1	130	<1	260	5.7	9.1	NS	NS
May-13	<1	1000	<2	240	<1	160	<2	380	5.3	6.5	NS	NS
Nov-13	<2	710	3.2	260	<1	350	<1	490	<1	12	<1	1.3
Mar-14	<5	510	<2	290	<2	320	<1	380	<1	12	NS	NS
Sep-14	<5	200	<1	270	<1	150	<1	16	<1	16	<1	27
Mar-15	<1	49	<1	160	<1	55	<1	55	<1	9.7	NS	NS

NI = Well not installed at time of sampling
NS = Not Sampled

TABLE 2-3
GROUNDWATER QUALITY AT SWMU 22

Carbon Tetrachloride - ug/l

	SVE-3	TPZ-1	TPZ-2	TPZ-4	TPZ-5	TPZ-14	TPZ-15	TPZ-16	TPZ-23
Jul-02	NS	12000	7.9	3400	28	NS	NS	NS	NS
Dec-02	NS	7100	17	750	14	NS	NS	NS	NS
Oct-03	37000	48000	NS	NS	590	NS	NS	NS	NS
Jan-04	86000	250000	290	2400	150	860	1400	2100	NS
Feb-04	28000	540	4.4	2000	<2	57	<2	<2	NS
Mar-04	34000	1100	5.5	1500	<2	18	4	4	NS
Apr-04	100000	1600	12	2600	<2	6.4	2.5	2.1	NS
May-04	56000	2500	19	4100	12	10	3.4	4.9	NS
Jun-04	5100	<15	<59	3900	<10	<4.4	<2.2	<2	NS
Jul-04	5000	<380	<18	2600	<5	<3.8	<2.4	<2	NS
Aug-04	11000	17000	<8	2300	<2	<2	<2	<2	NS
Sep-04	31000	560	<8	2000	<2	<2	<2	<2	NS
Feb-05	2100	26	8.6	1900	4.1	5.3	3	2.2	NS
Mar-05	1500	8.5	<10	2200	<10	2.9	<2	<2	NS
Apr-05	1700	7.3	17	1800	<10	3.2	<2	<2	NS
Jan-06	2400	3100	<20	1000	<40	<10	<2	<2	NS
Aug-06	18000	120	11	28	810	2.6	34	39	NS
Jan-07	510	2200	<20	1100	<40	<10	<2.3	<2	NS
Apr-07	1600	1200	9.7	1200	6.5	<10	<2	<2	NS
Oct-07	6900	12000	8.1	670	59	<2	<2	<2	NS
Feb-08	1500	240	8.3	550	<100	2.9	1.5	<10	NS
Aug-08	5200	2700	3.3	360	<100	<6	1	19	NS
Apr-09	1200	25000	<19	<250	<0.53	<1.3	<1.1	<1	NS
Aug-09	10000	6200	<34	<430	<10	<2	<2	<2	NS
May-10	2300	4500	8.8	580	8.8	6.1	5.2	9.4	NS
May-10	15000	11000	NS	NS	NS	NS	NS	NS	NS
Nov-10	570	<6.5	<7.3	820	<5.9	<13	<1.9	<6.4	NS
Feb-11	3600	120	5.3	1000	1.6	1	6.3	0.31	NS
May-11	840	1.2	5.3	1600	<1	0.91	<1	<1	NS
Aug-11	340	0.5	3.2	2000	0.37	0.21	0.28	<1	NS
Nov-11	220	2.5	<5	1300	<1	22	1.1	<1	NS
Feb-12	200	<1	<2.5	1500	<2	1.1	2	<1	NS
May-12	79	<1	11	1200	2.2	<1	1.5	<1	NS
Sep-12	87	2.2	16	1400	<5	<1	1.5	1	NS
Nov-12	120	<1	<5	870	<10	16	3.8	1	NS
Feb-13	160	3.1	10	860	8.1	<1	<1	8.3	NS
May-13	130	11	21	630	<5	<1	<1	<1	NS
Nov-13	NS	18	NS	1200	7	NS	NS	NS	NS
Apr-14	210	<1	NS	1200	16	<1	<1	<1	NS
Sep-14	73	<1	NS	2500	16	<1	<1	<1	NS
Mar-15	260	24	NS	3800	10	1.1	<1	<1	NS
Jun-15	NS	NS	NS	NS	NS	NS	NS	NS	690

TABLE 2-3
GROUNDWATER QUALITY AT SWMU 22

Tetrachloroethene - ug/l

	SVE-3	TPZ-1	TPZ-2	TPZ-4	TPZ-5	TPZ-14	TPZ-15	TPZ-16	TPZ-23
Jul-02	NS	1000	330	2200	130	NS	NS	NS	NS
Dec-02	NS	640	220	770	200	NS	NS	NS	NS
Oct-03	20000	5200	NS	NS	940	NS	NS	NS	NS
Jan-04	24000	29000	390	1300	2100	520	430	790	NS
Feb-04	9100	290	320	1100	1300	220	150	250	NS
Mar-04	4900	120	140	600	490	180	86	170	NS
Apr-04	15000	230	360	780	760	240	150	290	NS
May-04	11000	260	540	1100	670	270	140	190	NS
Jun-04	960	<110	640	1600	570	180	180	<36	NS
Jul-04	1800	<52	<51	730	850	360	<100	<130	NS
Aug-04	1400	390	740	760	<250	<120	<130	<74	NS
Sep-04	6000	87	620	610	150	97	110	83	NS
Feb-05	640	28	750	920	590	70	81	25	NS
Mar-05	540	85	790	760	660	69	69	29	NS
Apr-05	830	140	570	530	570	59	70	23	NS
Jan-06	1000	1200	150	300	450	5.4	4.5	3.3	NS
Aug-06	2800	<6.7	<25	1000	190	<10	<2	<2	NS
Jan-07	240	200	180	250	230	<12	<5.8	<5.4	NS
Apr-07	610	120	340	420	470	4.5	2.8	2	NS
Oct-07	3100	3700	230	230	890	7	0.66	15	NS
Feb-08	1100	230	180	240	1200	40	4.4	110	NS
Aug-08	4000	1200	45	200	1400	40	11	260	NS
Apr-09	810	4200	<110	<230	610	<26	<8.6	310	NS
Aug-09	9200	1900	<160	<230	<220	<35	<6.5	<200	NS
May-10	2700	2300	26	130	510	15	9.1	530	NS
May-10	8200	4700	NS	NS	NS	NS	NS	NS	NS
Nov-10	810	<29	340	460	<49	<70	<6.5	<19	NS
Feb-11	1800	35	440	600	88	11	0.97	0.53	NS
May-11	920	3.6	770	740	240	13	0.14	0.4	NS
Aug-11	350	1	590	910	230	13	1	0.44	NS
Nov-11	290	1.2	450	650	390	19	6.3	2.4	NS
Feb-12	140	<1	470	690	250	8.3	5.8	21	NS
May-12	88	<1	220	470	460	4.6	4.7	92	NS
Sep-12	69	<1	260	760	940	4	6.6	100	NS
Nov-12	150	<1	320	680	630	13	4.6	120	NS
Feb-13	110	1.4	350	550	350	2.8	1.1	98	NS
May-13	350	46	370	390	850	4.5	<1	3.8	NS
Nov-13	NS	3.4	NS	1000	720	NS	NS	NS	NS
Apr-14	270	1.1	NS	1000	670	8.3	<1	<1	NS
Sep-14	61	<1	NS	3500	570	4.4	<1	<1	NS
Mar-15	250	14	NS	6700	55	26	1.6	2	NS
Jun-15	NS	NS	NS	NS	NS	NS	NS	NS	1100

TABLE 2-4
PHASE I ERD PERFORMANCE MONITORING RESULTS
Occidental Chemical, Mobile, Alabama

Well	Screened Interval	Distance From Array	Sample Date	TOC	pH	Chlorinated Methanes			Chlorinated Ethenes				Metals	
						CT	CF	MC	PCE	TCE	cis-DCE	VC	Hg (Total)	Hg (Dissolved)
	ft bgs	feet		mg/L	SU	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L	ug/L
Intermediate Zone														
PM-2I	45 to 55	-25 upgradient	4/14/2006	5.5	4.75	460	68	<30	260	21J	12J	<30	0.15	<0.2
			5/8/2006	5.6	5	580	39	<30	180	17J	14J	<30	NA	NA
			6/6/2006	1.4	4.58	420	16J	<30	110	11J	10J	<30	0.21	<0.2
PM-3I	45 to 55	30	4/12/2006	24.8	5.48	170	100	<20	240	17J	15J	<20	<0.2	<0.2
			5/8/2006	34.1	5.4	230	80	<20	250	18J	16J	<20		
			6/6/2006	169	5.82	89	46	<10	120	12	66	<10	0.052	<0.2
MW-33D	41 to 51	35 off-center	1/14/2005	<1U	4.04	160	28	<10	1100	140	220	<10		
			4/14/2006	279	4.46	170	13J	<100	1500	110	180	60J	80.5	53
			5/11/2006		4.75	150	39J	<100	740	72J	120	<100	64.1	
			5/11/2006	543	4.75	190	41J	<100	1100	82J	140	38J		
			6/7/2006	998	3.84									
PM-4I	45 to 55	60	4/13/2006	93	5.64	180	160	<20	270	16J	15J	1.9J	<0.2	<0.2
			5/9/2006	184	5.91	120	170	<20	230	19J	74	<20		
			6/5/2006	70.8	5.77	100	130	<20	190	16J	67	<20	0.067	<0.2
PM-5I	45 to 55	185	4/12/2006	26	5.41	460	430	<50	370	28J	18J	4.2J	0.14	<0.2
			5/4/2006	20	5.4	300	700	11J	320	35J	29J	<50		
			6/5/2006	11.8	5.79	32	53	<20	230	17J	15J	2.8J	<0.2	<0.2
DW-1	46 to 56	200 cross-gradient	5/25/2005		3.61	1500	61J	<200	380	<200	37J	<200	72.8	
			3/7/2006	<1U	3.69	2600	51J	<300	830	45J	83J	<300	103	105
			4/14/2006	<1U	3.85	2000	47J	<200	730	37J	65J	<200	102	94.5
			5/22/2006		3.71	1800	35J	<200	720	38J	65J	<200	112	
DW-3	45 to 55	275	1/14/2005	<1U	4.36	760	46	<20	1100	53	64	<20		
			3/7/2006	<1U	3.55	2900	83J	<200	1200	60J	89J	<200	62.5	
			4/14/2006	4.6	3.87	2800	78J	<200	940	52J	75J	<200	62.8	56.9
			5/11/2006		4.25	3600	91J	<200	1000	50J	71J	<200	59	
			5/11/2006	1.4	4.25	3800	98J	<400	1100	48J	75J	<400		
Lower Zone														
PM-1L	85 to 95	-25 upgradient	4/12/2006	<1	4.7	0.95J	0.86J	<2	5.9	5.1	11	<2	0.08	0.052
			5/4/2006	<1	4.4	5.2	5.3	0.44J	17	19	35	<2		
			6/5/2006	<1	4.27	3.4	1.4J	<2	14	15	30	<2	0.2	0.2
MW-13D	87 to 97	40	1/13/2005	<1	4.09	20000	360	<40	4200	100	130	<40		
			4/14/2006	1660	5.2	4.2J	26	<20	140	27	54	<20	1.3	0.43
			5/11/2006		5.14	<10	21	<10	95	22	45	<10	2.5	
			5/11/2006	2190	5.14	4.7J	24	<20	150	31	54	<20		
			6/7/2006	1850	5.15	3.8J	26	<20	140	25	60	<20	2.4	0.26
PM-4L	41 to 51	165	4/12/2006	34.4	6.4	<20	<20	<20	<20	<20	150	<20	<0.2	<0.2
			5/8/2006	75.6	6.39	<20	<20	<20	<20	<20	190	<20		
			6/5/2006	28.1	6.39	<20	1.3J	<20	<20	<20	210	<20	0.048	<0.2
MW-15D	82 to 92	300 off-center	1/14/2005	1.1	4.66	11000	310	<100	3500	<100	110	<100		
			4/13/2006	429	6.47	<20	<20	<20	270	38	240	7J	0.71	0.34
			5/11/2006		6.49	<20	2.7J	<20	220	43	210	7.3J	0.57	
			5/11/2006	398	6.49	<25	4.1J	<25	260	50	230	8.4J		
			6/7/2006	246	6.58	<20	1.8J	<20	240	79	320	11J	0.52	0.33

TABLE 3-1
CORRECTIVE MEASURES SELECTION MATRIX

AREA	CORRECTIVE MEASURE	SCHEDULE	MONITORING
Upper Zone	FBSL Interceptor Trench - Continue operation of recovery well RS-1 and existing equipment. Evaluate potential rebound of plumes and atlernate treatment options.	Terminate upon approval from ADEM	As required by existing Permit
Boundary Control			
Lower Zone	Pump, Treat and Re-inject - Continue extraction from AE-2 until corrective measure is in-place for Intermediate Zone. Possibly follow with ERD injections to treat residual low concentrations remaining in the groundwater	Estimated 1-2 years. Undetermined.	As required by existing Permit
Intermediate Zone	Evalute potential operation of extraction wells Possibly follow with ERD injections to treat residual low concentrations remaining in the groundwater	Estimated 2-3 years. Undetermined.	As required by existing Permit
Source Area (SWMU-22)			
	Air Sparging with Passive Vapor Venting Possibly follow with ERD injections to treat residual mass remaining in the groundwater.	1-2 years	As required by existing Permit

APPENDIX A

COST ESTIMATE

CORRECTIVE MEASURES IMPLEMENTATION WORK PLAN COST ESTIMATE SUMMARY

Facility Name: **Occidental Chemical Corporation**

Location: **Mobile, Alabama**

Permit Number: **Alabama Hazardous Waste Permit No. ALD 008 163 388**

A detailed cost estimate has been prepared for each of the following items. These are included in the following pages. A summary of costs is shown below.

Item	Activity	Cost
1	Boundary Control by Interception and Treatment	$ 667,920.00
2	Enhanced Reductive Declorination (ERD)	N/A
3	SWMU-22 Source Removal	$ 70,900.00
4	Former Brine Sludge Lagoon RS-1 Sump	$ 75,000.00
	Total Cost	**$ 813,820.00**

Notes:

N/A: Not Applicable (Currently discontinued with no future planned activities).

Boundary Control by Interception and Treatment

Facility Name: **Occidental Chemical Corporation**

Location: **Mobile, Alabama**

Permit: **Alabama Hazardous Waste Permit No. ALD 008 163 388**

Capital Costs					**Total**
	Construction Costs				
	Construction completed in 2004				$0
	Equipment Costs				
	Extraction wells & equipment - previously installed				$0
	Air Stripper - previously installed				$0
	Buildings and Service Costs				
	Compressor Building existing				$0
Indirect Capital Costs		**Monthly**	**Yearly**	**Three Years**	
	Engineering Expenses				
	Labor Expense	$ 1,305.00	$ 15,660.00	$ 46,980.00	$46,980
	Direct Expense	$ 65.00	$ 780.00	$ 2,340.00	$2,340
	Legal Fees, License and Permits				
	None required	$ -	$ -	$ -	$0
	Start-up and Shakedown Costs				
	Completed in 2004	$ -	$ -	$ -	$0
	Contingency Allowances	$ -	$ -	$ -	$0
Operating and Maintenance Costs					
	Labor Expense	$ 10,000.00	$ 120,000.00	$ 360,000.00	$360,000
	Direct Expense	$ 2,250.00	$ 27,000.00	$ 81,000.00	$81,000
	Auxiliary Materials and Energy				
	Alabama Power for Compressor	$ 2,500.00	$ 30,000.00	$ 90,000.00	$90,000
	Purchased Services				
	Sampling Labor Expense	$ 1,500.00	$ 18,000.00	$ 54,000.00	$54,000
	Sampling Direct Expense	$ 600.00	$ 7,200.00	$ 21,600.00	$21,600
	Laboratory	$ -	$ -	$ -	$0
	Disposal and Treatment Costs				
	Carbon Disposal	$ -	$ 4,000.00	$ 12,000.00	$12,000
	Administrative Costs				
	Insurance, taxes and licensing Costs				
	Maintenance reserve and contingency funds				
Grand Total					**$667,920**

SWMU-22 Source Removal

Facility Name: **Occidental Chemical Corporation**

Location: **Mobile, Alabama**

Permit: **Alabama Hazardous Waste Permit No. ALD 008 163 388**

Capital Costs					**Total**
	Construction Costs				
	System Installation - previously installed				$0
	Equipment Costs				
	Piping and Electrical				$2,500
	Buildings and Service Costs				
	None				$0
Indirect Capital Costs		**Monthly**	**Yearly**	**Two Years**	
	Engineering Expenses				
	Labor Expense	$ 500.00	$ 6,000.00	$ 12,000.00	$12,000
	Direct Expense	$ 100.00	$ 1,200.00	$ 2,400.00	$2,400
	Legal Fees, License and Permits				$0
	None required	$ -	$ -	$ -	$0
	Start-up and Shakedown Costs				$0
	None required	$ -	$ -	$ -	$0
	Contingency Allowances	$ -	$ -	$ -	$0
Operating and Maintenance Costs					
	Labor Expense	$ 1,500.00	$ 18,000.00	$ 36,000.00	$36,000
	Direct Expense	$ 250.00	$ 3,000.00	$ 6,000.00	$6,000
	Auxiliary Materials and Energy				
	Plant Power	$ -	$ -	$ -	$0
	Purchased Services				
	Sampling Labor Expense	$ 250.00	$ 3,000.00	$ 6,000.00	$6,000
	Sampling Direct Expense	$ 50.00	$ 600.00	$ 1,200.00	$1,200
	Laboratory	$ 200.00	$ 2,400.00	$ 4,800.00	$4,800
	Disposal and Treatment Costs				
	None	$ -	$ -	$ -	$0
	Administrative Costs	$ -	$ -	$ -	$0
	Insurance, taxes and licensing Costs	$ -	$ -	$ -	$0
	Maintenance reserve and contingency funds	$ -	$ -	$ -	$0
Grand Total					**$70,900**

Former Brine Sludge Lagoon RS-1 Sump

Facility Name: **Occidental Chemical Corporation**

Location: **Mobile, Alabama**

Permit: **Alabama Hazardous Waste Permit No. ALD 008 163 388**

Capital Costs					**Total**
	Construction Costs				
	Existing Equipment				$0
	Equipment Costs				
	Existing Equipment				$0
	Buildings and Service Costs				
Indirect Capital Costs		**Monthly**	**Yearly**	**Five Years**	
	Engineering Expenses				
	Existing Equipment	$ -	$ -	$ -	$0
	Direct Expense	$ -	$ -	$ -	$0
	Legal Fees, License and Permits				
	None required	$ -	$ -	$ -	$0
	Start-up and Shakedown Costs				
	None required	$ -	$ -	$ -	$0
	Contingency Allowances	$ -	$ -	$ -	$0
Operating and Maintenance Costs					
	Labor Expense	$ 1,000.00	$ 12,000.00	$ 60,000.00	$60,000
	Direct Expense	$ 250.00	$ 3,000.00	$ 15,000.00	$15,000
	Auxiliary Materials and Energy				
	Plant Power	$ -	$ -	$ -	$0
	Purchased Services				
	None	$ -	$ -	$ -	$0
	Disposal and Treatment Costs				
	None[1]	$ -	$ -	$ -	$0
	Administrative Costs	$ -	$ -	$ -	$0
	Insurance, taxes and licensing Costs	$ -	$ -	$ -	$0
	Maintenance reserve and contingency funds	$ -	$ -	$ -	$0
Grand Total					**$75,000**

Note:

[1]: Water treated in plant wastewater treatment plant

Glenn Springs Holdings, Inc.
A Subsidiary of Occidental Petroleum Corporation

Frank R. Barone
Project Manager
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Dallas, TX 75244
Fax (962) 687-7524

December 21, 2015

Austin Pierce
Engineering Services Section
Land Division
Alabama Department of Environmental Management
Post Office Box 301463
Montgomery, Alabama 36130-1463

RE: Responses to CMI WP Review
Occidental Chemical Corporation Mobile Facility
Facility ID: ALD 008 163 388

Dear Mr. Pierce:

Occidental Chemical Company (OxyChem) is pleased to submit one copy of our responses to your comments on the Corrective Measures Implementation Work Plan received by email dated October 7, 2015. Our responses to ADEM's comments are included in Table 1 below and copies of the corrected pages are included with this submittal.

If you have any questions or comments on this matter do not hesitate to contact me at (972) 687-7527 or Bob Spencer at (251) 654-2319.

Sincerely,

Frank R. Barone
Project Manager

cc: David Flint, OxyChem – Mobile
Robert Spencer, STRATA, LLC

TABLE 1
RESPONSES TO ADEM COMMENTS

ADEM Comment No.	ADEM Comment	OXYCHEM Responses
1	Section 2.2.2 states, "Some lead has been detected above the MCL of 15 µg/l in the Intermediate Zone at wells DW-1 and MW-33D." There does not appear to be a plan to address this.	The lead plume is co-mingled with the mercury and volatile compounds plumes. The final remedy for the Intermediate Zone will also address the presence of lead.
2	Section 2.3.2 states, "The DPVE unit was discontinued in December 2006 as a result of diminishing VOC removal rates. Final notice of termination of DPVE activities was made to ADEM in the semiannual air report submitted to the Air Division on March 1, 2007 and noted in Quarterly and Corrective Action Effectiveness Reports submitted in 2007. Results are discussed in Section 2.4.2." The results for the operation of the DPVE unit are discussed in Section 2.4.3, instead of Section 2.4.2.	The reference has been changed as noted above.
3	Section 2.3.3 states, "Groundwater monitoring was conducted to evaluate and optimize system performance. Common groundwater analyses included VOCs, biogeochemical parameters, total organic carbon, and dissolved gases. In addition, field parameters (pH, DO, oxidation-reduction potential, temperature, conductivity) were collected as needed. Results are discussed in Section 2.4.3." The results of the central plume ERD are discussed in Section 2.4.4, instead of Section 2.4.3.	The reference has been changed as noted above.

4	Section 3.1.2 discusses monitoring for the Upper Zone, in which groundwater samples will be analyzed for mercury using EPA Test Method 7471A. Lead should be analyzed along with mercury in the Upper Zone samples. Section 2.4.5 shows that concentrations of lead were detected above the MCL of 15 µg/L in wells MW-4 (89 µg/L), MW-1R (42 µg/L), and MW-2 (36 µg/L).	The sentence has been modified to read: "The samples will be analyzed for mercury using EPA Test Method 7471A and for lead using EPA Test Method 6010C."
5	Section 3.1.3 is referencing Table 7-3, which does not exist in the CMI Plan. If this is referencing the Risk Assessment, please include that reference. Additionally, this section does not mention the RM-1 results for the Intermediate Zone/Barge Canal.	A sentence has been added at the end of the first paragraph to read: "A summary of the RM-1 and RM-2 evaluations for the Barge Canal are presented in Table 7-2 and Table 7-3, respectively, of the Risk Assessment document."
6	The "Lower Zone" section of Section 3.2.2 is referencing Figures 2-5 and 2-6. These two figures show the distribution of carbon tetrachloride and PCE in the Upper Zone, instead of the Lower Zone.	The reference has been changed to Figures 2-9 and 2-10.
7	The "Lower Zone" section of Section 3.2.2 states, "As the water with low Eh migrated through the LZ downgradient to the Boundary Area, the iron became soluble and was carried downgradient until captured by the aerator wells. The iron then precipitated when the air lift and in-well aeration raised the Eh." The term "Eh" should be changed to "pH."	The discussion describes the changes in the Oxygen Reduction Potentential (ORP) which is sometimes referred to as Eh. The purpose of the molasses injection was ultimately to lower the oxygen levels in the aquifer in order to convert from an aerobic to an anerobic environment (lower Eh) to enhance the desorption of the chlorinated solvent compounds. The text has been changed from Eh to ORP to avoid confusion.

8	Section 3.3.1 states, "Groundwater quality is summarized on Table 2-3 and discussed in Section 2.4.2." Groundwater quality for the source area (SWMU 22) is discussed in Section 2.4.3, instead of Section 2.4.2.	The reference has been changed to Section 2.4.3.
9	Section 3.4.3 states, "Site-wide monitoring is required by the RCRA permit and additional plume monitoring is being performed quarterly as described in Section 3.2.4." Site-wide monitoring is described in Section 3.2.3, instead of Section 3.2.4. Also, the additional plume monitoring was changed to semi-annually in Section 3.2.3. Please make sure these sections are consistent.	The reference has been changed to Section 3.2.3 and plume monitoring to "semiannually".
10	Section 4.0 states, "If continued operation of the existing extraction, treatment and reinjection system at the Boundary Area is not effective due to geochemical fouling effects, or reaches declining performance due to asymptotic responses from continued pumping, then supplemental corrective measures (ERD and/or MNA)." This is not a complete sentence. Also, please provide a brief summary of the Central Plume area at the Salt Pad and the FBSL in Section 4.0.	The end of the sentence had been inadvertently deleted. The sentence has been modified to read: "If continued operation of the existing extraction, treatment and reinjection system at the Boundary Area is not effective due to geochemical fouling effects, or reaches declining performance due to asymptotic responses from continued pumping, then supplemental corrective measures (ERD and/or MNA) will be evaluated and employed."

treatment system operated to strip volatile organic compounds (VOCs) from the off gases from the liquid ring vacuum pump and consisted of a carbon regeneration unit containing two carbon vessels: one vessel was used at a time and the second vessel held in reserve. Once the calculated breakthrough time expired, the spent carbon vessel was removed and the air stream directed to the clean carbon bed. While off-line, the spent carbon was regenerated using plant steam. The concentrated liquid, containing carbon tetrachloride and PCE, was diverted to containers for off-site treatment and disposal and manifested as hazardous waste.

Air sampling was performed periodically and consisted of collection of vapor samples from the liquid ring vacuum pump (LRVP) stack gases influent stream (Pre-Carbon) and the post-treatment carbon vessel that is vented to the atmosphere. Each sample was analyzed for VOAs using EPA Method 8021/8015mod.

The DPVE unit was discontinued in December 2006 as a result of diminishing VOC removal rates. Final notice of termination of DPVE activities was made to ADEM in the semiannual air report submitted to the Air Division on March 1, 2007 and noted in Quarterly and Corrective Action Effectiveness Reports submitted in 2007. Results are discussed in Section 2.4.3.

Following removal of the DPVE unit in 2006, VOC concentrations began rebounding in the Intermediate Zone aquifer beneath SWMU 22. The CMI Work Plan (2008) included a proposal to use air sparging to reduce concentrations in the aquifer. The air sparging system consists of the measured injection of an air stream into the groundwater through existing piezometers TPZ-14, TPZ-15 and TPZ-16 and measurement of the passive exhaust air driven out of the subsurface by the pressure differential created from the injection. The existing four-inch diameter well (SVE-3) is used to vent the sparged vapors out of the subsurface.

Routine air sparging began on September 22, 2010. Air exhaust samples are collected monthly from the vent pipe using Suma canisters for analysis of VOCs using EPA Method TO-15. The analytical results combined with daily air flow measurements permit an estimate of VOC emissions to be calculated and reported to ADEM in semiannual air reports. To date, 441 lb of PCE and 899 lb of carbon tetrachloride has been removed. As expected the rate of mass removal has decreased.

2.3.3 Central Plume Remediation With ERD

Groundwater in the Central Plume Area (Former Salt Pad) was treated by an in situ Enhanced Reductive Dechlorination (ERD) process to help reduce

downgradient plume concentrations. This process involved the addition of certain food grade additives to encourage natural biodegradation of the constituents, by sequential removal of chlorine atoms from the volatile organic compound molecules. This process is very well understood, with numerous case studies in the past decade demonstrating that anaerobic, reduced conditions facilitate the reductive dechlorination of organics. The goal of the ICM was to create these reduced conditions in the intermediate and lower zones and, thereby, effect the dechlorination of the constituents, ultimately reducing the concentration of chlorinated volatile organics arriving at the Boundary Area. This work was conducted under the authority of an ADEM UIC permit.

The ERD system was comprised of two injection well arrays and a monitoring well network (see Figure 2-19). The first array consists of six injection wells screened in the Intermediate Zone (approximately 50-60 feet bgs). The second array consists of 18 injection wells screened in the Lower Zone. These 18 wells are arranged in pairs at nine locations with one well screened from 60-75 feet bgs and the second screened from 75-90 feet bgs.

Between January 2005 and June 2006, a total of 15 injection events were conducted as reported in the May 2007 CAE Report submitted in October 2007. During each injection event, approximately 44,500 gallons of molasses solution (2 to 10 percent molasses content by volume) were injected into the subsurface (approximately 1,000 to 2,000 gallons of molasses solution per injection well). Based on data collected between January and December 2005, it appeared that the naturally low pH in the groundwater was inhibiting the growth of the necessary microbial community. Beginning in December 2005, sodium hydroxide (NaOH) was added to the molasses solution to raise the pH of the injectate to between 8 and 10 s.u. Upon injection, the pH-adjusted solution was diluted to a groundwater pH closer to neutral in the aquifer.

Groundwater monitoring was conducted to evaluate and optimize system performance. Common groundwater analyses included VOCs, biogeochemical parameters, total organic carbon, and dissolved gases. In addition, field parameters (pH, DO, oxidation-reduction potential, temperature, conductivity) were collected as needed. Results are discussed in Section 2.4.~~3~~4.

2.3.4 Upper Zone Trench at FBSL

Brine sludge from chlorine production electrolytic cells was historically managed in a lagoon (FBSL) in the northern portion of the active process area at the plant. The brine sludge was removed in 1989, and the lagoon was backfilled with native soil and capped with a clay cover. A Part B Post-Closure Permit application, including a corrective action plan, was subsequently prepared for the FBSL. This was

~~performed a preliminary evaluation of these pathways, which are summarized in Table 3-2 for each affected groundwater zone. This summary provides a preliminary conclusion that RBTLs can be justified.~~

~~As noted above, MCLs will be the initial remediation goal for the Final Corrective Measures program. As remediation progresses to that default goal, the trend of system performance and recovery will be evaluated.~~

3.1.2 Upper Zone

The UZ groundwater impact is confined to the FBSL area and the plume is stable or declining. Further, the concentrations of the COCs in the UZ well near the Barge Canal (MW-9S, MW-8S and MW-21S) were non detect. Therefore, the potential impact to the Barge Canal due to impacts in the UZ is not likely.

In order to demonstrate that the interceptor groundwater pumping system can be terminated at the FBSL without rebound of mercury, GSH is proposing to temporarily shutdown pumping from RS-1. Prior to the temporary shutdown, a baseline sampling event will be completed in wells MW-1R, MW-2, MW-3, MW-4 and RS-1. Following shutdown, the same wells will be monitored monthly for three months then semiannually as required by the RCRA permit. The samples will be analyzed for mercury using EPA Test Method 7471A and for lead using EPA Test Method 6010C. Groundwater levels will be measured during each sampling event to document changes in the groundwater surface. The groundwater data from sampling of the wells will be evaluated relative to historic concentrations. If there is a material rebound, the pumping from RS-1 will be resumed.

It is OxyChem's intent, and as required by the current RCRA permit, RS-1 will continue to operate until a permit modification is in place that eliminates the requirement of groundwater pumping at the FBSL.

~~Maintenance of the recovery system at the FBSL will continue as required by the RCRA permit until groundwater MCLs or alternative RBTL goals are met. Significant mass of mercury and lead have been removed and migration past the interception trenches has been prevented. Prior to renewal of the Permit in 2013, the FBSL groundwater extraction system will be evaluated to determine if continued operation will be required. It is anticipated that passive treatment, or justification of no further action will be evaluated.~~

3.1.3 Intermediate Zone

The IZ groundwater intersects the Barge Canal and an RM-1 and RM-2 evaluation was conducted. These evaluations require the back calculation of allowable concentrations at (i) the soil source, (ii) groundwater source, (iii) sentry well, and (iv) point of discharge protective of the Barge Canal. A summary of the RM-1 and RM-2 evaluations for the Barge Canal are presented in Table 7-2 and Table 7-3, respectively, of the Risk Assessment document.

The comparison of the allowable concentrations with the representative concentrations at the (i) soil source, (ii) groundwater source,(iii) sentry well, and (iv) point of discharge indicates the exceedance of allowable concentrations for carbon tetrachloride, chloroform PCE, TCE, vinyl chloride, and mercury at various locations.

For the RM-2 evaluation, the allowable soil source, groundwater source, sentry well, and point of discharge groundwater concentrations protective of the Barge Canal. None of the representative concentrations are exceeded.

The IZ plumes have been observed to be relatively static compared to the Lower Zone plumes. ERD injections have not been demonstrated as effective in the application at the Salt Pad area due to the heterogeneity of the lithology and lower overall transmissivity. For these same reasons, groundwater extraction is not widely applicable throughout the IZ at the site. Offsite migration has not been documented although the plume is delineated close to the Barge Canal at MW-8D (migration toward offsite surface water bodies are inferred).

~~Thus, although MCLs will be used as the initial remedial goal, RBTLs may be developed to account for the very slow rate of groundwater flow in the IZ and the limited impact of potential discharges on the large volume of water in the Barge Canal and its drainageway.~~ As discussed below in Section 3.2, combinations of corrective measures will be used to reduce groundwater organic and inorganic constituents.

3.1.4 Lower Zone

Lower Zone groundwater moves to the northeast in the direction of Chickasaw Creek more than 9000 feet from the OxyChem property. There are no receptors identified in the interval between OxyChem and the Creek, and access to the area is strictly controlled. Incidental concentrations of VOCs would be expected to dissipate through advection/dispersion and natural attenuation.

The initial goal of groundwater control is attained via mass containment or reduction at key locations. To date, the ICM and CMI activities performed at the Source Control Area, the Central Plume Area and the Boundary Control Area have been successful in reducing the mass of VOCs migrating with the LZ groundwater toward off site discharge points. As this work has proceeded under the original CMI Work Plan, secondary effects of remediation have been identified in the iron fouling of downgradient boundary control wells, even as concentrations continue to decrease. This observed effect is identified as resulting from the biogeochemical effect of carbon donor injections in the Central Plume Area. The extraction, treatment and re-injection of the LZ in the Boundary Area ~~remains~~ has been effective~~ and the corrective measure of choice at this time~~, but may require supplemental measures as described below. ~~In the case of the IZ extraction, treatment and re-injection system, that technology is expected to prove very effective in removing mass from the VOC plume in the boundary area for some time, given the effective separation of the LZ and IZ in the downgradient portion of the site.~~ Further background on the corrective measures implementation on the IZ and LZ~~se two~~ zones, and proposed future operation as Final Corrective Measures, are presented below.

3.2.2 Groundwater Controls System

Lower Zone

The Boundary Control system has been operating since 2004 and, absent alternative corrective measures, its continued operation is required to manage the remaining organics plume (see Figures 2-9~~5~~ and 2-10~~6~~). As shown on the schedule in Table 3-1, boundary control is performed utilizing Lower Zone well~~s AE-1 and AE-3 (~~AE-2 (wells AE-1 and AE-3 are~~is~~ not currently used). The current recovery well system has demonstrated the ability to capture and control the organics plumes in the Lower Zone. An average extraction rate of 15-25 gpm from ~~each aerator~~ well AE-2 has been demonstrated to provide adequate capture and removal of the LZ volatiles and metals plumes (see Figure 2-17, Capture Zone of AE-2). As discussed in Section 2.3.1, the ~~aerated~~ groundwater is passed through an air stripper followed by carbon beds and re-injected into the Lower Zone using the existing injection wells I-1a,b and I-2a,b. Monthly UIC reports and semiannual air emission reports are required until the system is terminated.

~~Chronic iron fouling has been observed at AE-2, and is beginning to be observed at AE-1. This observation, as reported in ICM Effectiveness Reports to ADEM, was made f~~ Following the completion of the Central Plume Area Enhanced Reductive Dechlorination ICM in 2006, chronic iron fouling has impacted operation of the LZ boundary wells. This iron fouling appears to have resulted from the mobilization

of native iron from the aquifer under the reduced conditions created by the injection of molasses. As the water with low ORP~~Eh~~ migrated through the LZ downgradient to the Boundary Area, the iron became soluble and was carried downgradient until captured by the aerator wells. The iron then precipitated when the air lift and in-well aeration raised the ORP~~Eh~~. The iron precipitate has fouled aerator tips, piping, and treatment media. As a result of fouling, groundwater from AE-2 was pumped to the above-ground stripper for treatment prior to passing through the carbon vessels. Fouling of bag filters in the treatment train from AE-2 has required daily or twice daily filter changes. ~~The extraction rate attainable at AE-2 has reduced somewhat. Consequently, the well has been deactivated, and pumping at AE-3 is used to provide containment on the northeast side of the control area.~~

Similar maintenance problems at AE-1 have resulted in iron deposits plugging the well screen. Efforts to rehabilitate the well have proved unsuccessful and the well was shutdown in March 2014.~~reduced efficiency of treatment at this well somewhat.~~ AE-3 is located offsite on International Paper Company property and was shutdown in November 2013 to reduce potential migration of the plume down gradient of AE-2. ~~However, AE-1 and AE-3 are controlling the plume and AE-2 is not critical as shown by the potentiometric and flowline map in Figure 2-17 (and discussed in Section 2.3.1).~~ Based on the findings in the HHRA, c~~C~~ontinued operation of the boundary control well~~s AE-1 and~~ AE-2~~3~~ is not necessary and may have the potential to ~~is still believed to be the best option for treating the Lower Zone plume~~ induce downward migration of the IZ plume. Therefore, operation of this well is anticipated to be terminated once a feasible solution for the IZ plume is in place. ~~Operation of boundary wells is anticipated to continue up to the point that either MNA is initiated or RBTLs are developed.~~

Despite these operational difficulties, in recent months concentrations are approaching MCLs in the Boundary Area. As noted in Section 2.4.1, the maximum carbon tetrachloride detection in the LZ in March~~January~~ 2015~~08~~ was <1~~69~~ ug/L at STPZ-21 between AE-1 and AE-2. The remaining concentrations above the MCL were clustered in the area at or between these two points. PCE also reduced significantly, to a maximum of 160~~280~~ ug/L at STPZ-19 and <1 ug/L, ~~with the next highest concentration~~ at STPZ-21. These concentrations mark reductions from concentrations in the mg/L~~ppm~~ range in 2003 prior to instituting the ICM pumping.

The ERD injections in the central portion of the plume proved effective in reducing VOC concentrations and metals, in some cases, to below detection. Additional ERD programs may be used in the future to assist in removing any remaining volatile organic or inorganic mass. As discussed above, extraction and treatment of groundwater has been successful; however, some residual low-level

~~completed in October 2007, values of CT and PCE have rebounded demonstrating that residual CT and PCE may still exist in the clay overburden at SWMU 22.~~ Groundwater quality is summarized on Table 2-3 and discussed in Section 2.4.3~~2~~. Currently, as discussed in Section 2.3.2, ~~Additional removal actions are being evaluated such as~~ air sparging with passive vapor venting has been operating since September 2010. Alternate removal actions such as groundwater ~~recovery,~~ pump and treat and soil excavation may be considered. These are briefly discussed below. The goal of corrective measures would be to prevent the movement of a newly formed plume that would migrate toward the boundary and require action in the future to prevent off-site migration.

3.3.2 Corrective Measures

Air Sparging ~~***With Vapor Recovery***~~***With Passive Vapor Venting***

Air sparging with passive vapor venting will continue at SWMU. The data will be evaluated annually to identify if this remedial activity has reached asymptotic levels in which case it would be terminated or operated intermittently.

~~has been tested at SWMU 22 to determine if this is a viable option for treating VOCs entering the groundwater. The cross-section in Figure 3-2 illustrates the existing wells and lithology at SWMU 22. Below ground surface is approximately eight feet of clayey soils that are suspected to be impacted by PCE and CT. The fine sand of the Intermediate Zone lies directly beneath the clay; however, groundwater level is eight feet deeper in the immediate area of SWMU 22, which provides an unsaturated, sandy zone there. The concept will be to inject compressed air into the aquifer into one (or more) of the deeper one-inch wells (TPZ-14, 15 or 16) and extract vapors from the four-inch DPVE well (SVE-3). When tested, vapors were emitted through SVE-3 without vacuum assistance. Use of a blower or vacuum pump will assist movement of VOC vapors out of the subsurface.~~

~~A brief pilot test was performed to evaluate the effectiveness of this approach. A standard vacuum motor designed to fit on the top of a 55-gallon drum was used to pull vapors from well SVE-3 (the former DPVE extraction well). The drum has an exhaust of approximately 105 SCFM (according to the manufacturer's specifications). The connection to SVE-3 was fitted with a valve that could be opened to allow different quantities of bleed air. Testing was performed by introducing filtered compressed air into piezometer TPZ-16 (see Figure 3-1) and extracting vapors through SVE-3. Air samples were collected with increasingly more percentage of bleed air to reduce potential emissions.~~

Site-wide monitoring is required by the RCRA permit and additional plume monitoring is being performed ~~quarterly~~ semiannually as described in Section 3.2.3~~4~~. The plume monitoring wells located on IP property are sampled only for VOCs as requested by IP. No metals sampling is performed except at MW-42S, MW-42D and at AE-3 (using STPZ-22).

3.4.4 Estimated Costs for Future Activities

Cost for management of inorganics is included with the ERD costs and monitoring costs associated with plume delineation monitoring.

4.0 SUMMARY

Significant progress in cleanup has been accomplished during the ICM and subsequent CMI phases at the Oxychem site in Mobile, Alabama. Various technologies have been tested to determine the most appropriate remedy at the site. Efforts were focused on three main areas of the site: Boundary Control in the northeastern area, Central Plume area at the Salt Pad and the Source Area at SWMU 22. Shallow Zone controls have also been in place in the FBSL area for mercury and other metals.

Boundary control has been achieved in the Lower Zone by operating the aerator wells for the past 11~~four~~ years. This technology has been very effective in lowering concentrations of VOCs in the Boundary Area by extraction of mass and treatment prior to re-injection downgradient of the area. As noted above, the continued operation of the system may be stressed by the geochemical effects of reduced conditions and iron precipitation at recovery wells and in the aeration treatment system. If continued operation of the existing extraction, treatment and reinjection system at the Boundary Area is not effective due to geochemical fouling effects, or reaches declining performance due to asymptotic responses from continued pumping, then supplemental corrective measures (ERD and/or MNA)~~ or RBTLs~~ will be evaluated and employed.

The original Source Area at SWMU 22 was treated using DPVE and significant mass was removed. Since the DPVE unit has been terminated, some rebound of CT and PCE has been observed. Removal of potentially impacted soils is not an option due to the location of plant process equipment. Currently, ~~a small pilot program is being planned using a combination of~~ air sparging and passive vapor venting~~vacuum extraction~~ has been operating since September 2010. The goal has been~~is~~ to prevent the formation of a new volatile plume that could migrate down-gradient and renew the need for boundary control.