



State of Ohio Environmental Protection Agency

STREET ADDRESS:

Lazarus Government Center
122 S. Front Street
Columbus, Ohio 43215

TELE: (614) 644-3020 FAX: (614) 644-3184
www.epa.state.oh.us

MAILING ADDRESS:

P.O. Box 1049
Columbus, OH 43216-1049

March 23, 2005

Re: Ohio Hazardous Waste Permit Renewal
Von Roll America, Inc.
U.S. EPA ID No.: OHD 980 613 541
Ohio ID No.: 02-15-0589

CERTIFIED MAIL

Mr. Fred Sigg
Von Roll America, Inc.
1250 Saint George Street
East Liverpool, Ohio 43920

Dear Mr. Sigg:

Here is the renewed Ohio Hazardous Waste Facility Installation and Operation Permit (Permit) for Von Roll America, Inc. I have also enclosed a copy of the responsiveness summary Ohio EPA prepared in response to written comments the Agency received concerning the Part B permit application. The Permit is effective today, March 23, 2005. The date-stamped, page-numbered copy of the Part B permit application is also enclosed.

Please remember that according to Rule 3745-50-36 of the Ohio Administrative Code your annual hazardous waste permit fee of \$11,700 will be due on March 23, 2006. Ohio EPA will try to notify you before this fee is due, but it is your responsibility to make sure it gets paid on time.

As a party to this permit proceeding, you may appeal this Permit to the Environmental Review Appeals Commission (ERAC) no later than 30 days after the public notice (See Ohio Revised Code § 3745.04). You may file your appeal with ERAC at the following address: Environmental Review Appeals Commission, 309 South Fourth Street, Room 222, Columbus, Ohio 43215.

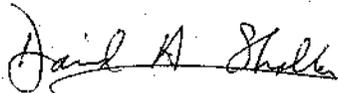
If you file an appeal, you must put it in writing. Your appeal must explain why you are appealing the action and the grounds you are using for your appeal. You must send a copy of the appeal to the director of the Ohio Environmental Protection Agency no later than three (3) days after you file it with ERAC.

Bob Taft, Governor
Bruce Johnson, Lieutenant Governor
Joseph P. Koncelik, Director

Mr. Fred Sigg
Von Roll America, Inc.
March 23, 2005
Page Two

If you have any questions concerning compliance, do not hesitate to call Patricia Natali of Ohio EPA's Northeast District Office at (330) 385-8447.

Sincerely,



for Pamela S. Allen, Manager
Regulatory and Information Services
Division of Hazardous Waste Management

Attachments

cc: Edwin Lim, Mgr., ERAS, DHWM
Jeremy Carroll/John Nyers, ERAS, DHWM
Harriet Croke, US EPA, Region V
Frank Popotnik/Patricia Natali, DHWM, NEDO
Mike Settles, Public Interest Center, Ohio EPA
file

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Here is the link to the [Responsiveness Summary](#). Be aware the file is 12 Mb and will take time to fully download.

OHIO ENVIRONMENTAL PROTECTION AGENCY
OHIO HAZARDOUS WASTE FACILITY
INSTALLATION AND OPERATION PERMIT RENEWAL

OHIO E.P.A.
MAY 23 2005
ENTERED DIRECTOR'S JOURNAL

Permittee: Von Roll America, Inc.
Mailing Address: Von Roll America, Inc.
1250 Saint George Street
East Liverpool, OH 43920-3400
Owner: Von Roll America, Inc.
1250 Saint George Street
East Liverpool, OH 43920-3400
Operator: Von Roll America, Inc.
1250 Saint George Street
East Liverpool, OH 43920-3400
Location: Von Roll America, Inc.
1250 Saint George Street
East Liverpool, OH 43920-3400

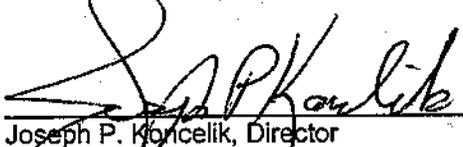
Ohio Permit No.	02-15-0589
US EPA ID	OH0980613541
Issue Date	March 23, 2005
Effective Date	March 23, 2005
Expiration Date	March 23, 2010

AUTHORIZED ACTIVITIES

In reference to the application of Von Roll America, Inc. for an Ohio Hazardous Waste Facility Installation and Operation Renewal Permit under Ohio Revised Code (ORC) Chapter 3734 and the record in this matter, you are authorized to conduct at the above-named facility the following hazardous waste management activities:

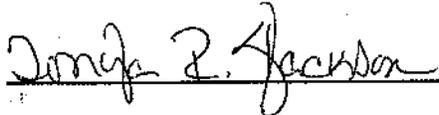
- ◆ Storage in containers and tanks
- ◆ Treatment in containers, tanks, miscellaneous units and by incineration
- ◆ Corrective Action

PERMIT APPROVAL

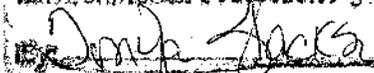

Joseph P. Korcelik, Director
Ohio Environmental Protection Agency

This permit approval is based upon the record in this matter which is maintained at the offices of the Ohio Environmental Protection Agency. The Director has considered the application, accompanying information, inspection reports of the facility, a report regarding the facility's compliance or noncompliance with the terms and conditions of its permit and rules adopted by the Director under this chapter, and such other information as is relevant to the operation of the facility. The Director has determined that the facility under the existing permit has a history of compliance with ORC Chapter 3734, rules adopted under it, the existing permit, or orders entered to enforce such requirements that demonstrate sufficient reliability, expertise, and competency to operate the facility henceforth under this chapter, rules adopted under it, and the renewal permit.

Entered into the Journal of the Director this 23 day of March, 2005.

By  of the Ohio Environmental Protection Agency.

I hereby file to be a true and correct copy of the
Ohio Environmental Protection Agency's
Environmental Protection Agency.

 3-23-05

A. GENERAL PERMIT CONDITIONS

A.1. Effect of Permit

ORC Sections 3734.02 (E) and (F) and 3734.05
OAC Rule 3745-50-58(G)

- (a) The Permittee is authorized to store hazardous waste in containers and tanks and to treat hazardous waste in containers and tanks, miscellaneous units and by incineration in accordance with the terms and conditions of this permit, ORC Chapter 3734, all applicable Ohio hazardous waste rules, all applicable regulations promulgated under the Resource Conservation and Recovery Act (RCRA), as amended, and the approved hazardous waste facility installation and operation permit renewal application, as such application has been revised and supplemented and as such application may be modified pursuant to the hazardous waste rules. The approved permit application as submitted to Ohio EPA on July 20, 1994 and any subsequent amendment thereto, and last updated on January 15, 2003 is hereby incorporated into this permit. In the instance of inconsistent language or discrepancies between the above, the language of the more stringent provision shall govern.
- (b) Any management of hazardous waste not authorized by this permit is prohibited, unless otherwise expressly authorized or specifically exempted by law. Issuance of this permit does not convey property rights of any sort or any exclusive privilege; nor does it authorize any injury to persons or property, or invasion of other private rights. Compliance with the terms and conditions of this permit does not obviate Permittee's obligation to comply with other applicable provisions of law governing protection of public health or the environment including but not limited to the Community Right to Know law under ORC Chapter 3750.

A.2. Permit Actions

OAC Rule 3745-50-58(F)

This permit may be modified, revoked, suspended, or renewed as specified by Ohio law. The filing of a request for a permit modification, revision, revocation, suspension, or renewal 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 term or condition.

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A.3. Permit Effective/Expiration Date
OAC Rule 3745-50-54

The effective date of this permit is the date the permit is entered into the Director's Journal. The permit expiration date is five years after the date of journalization of this permit.

A.4. 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.

A.5. Duty to Comply
OAC Rule 3745-50-58(A)

The Permittee shall comply with all applicable provisions of ORC Chapter 3734, all applicable Ohio hazardous waste rules and all terms and conditions of this permit, except to the extent and for the duration such noncompliance is authorized by the laws of the State of Ohio. Any permit noncompliance, other than noncompliance authorized by the laws of the State of Ohio, constitutes a violation of ORC Chapter 3734 and the rules adopted thereunder and is grounds for enforcement action, suspension, revocation, modification, denial of a permit renewal application or other appropriate action.

A.6. Duty to Reapply and Permit Expiration
OAC Rules 3745-50-40(D); 3745-50-58(B); 3745-50-56 and ORC Section 3734.05(H)

- (a) If the Permittee wishes to continue an activity allowed by this permit after the expiration date of this permit, the Permittee must submit a completed application for a hazardous waste facility installation and operation permit renewal and any necessary accompanying general plans, detailed plans, specifications, and such information as the Director may require, to the Director no later than one hundred eighty (180) days before the expiration date of this permit or upon approval of the Director a later date prior to the expiration date if the Permittee can demonstrate good cause for late submittal.

- (b) The Permittee may continue to operate in accordance with the terms and condition of the expired permit until a renewal permit is issued or denied if:
 - (i) the Permittee has submitted a timely and complete application for a renewal permit under OAC Rule 3745-50-40; and
 - (ii) through no fault of the Permittee, a new permit has not been issued pursuant to OAC Rule 3745-50-40 on or before the expiration date of this permit.
- (c) The corrective action obligations contained in this permit will continue regardless of whether the facility continues to operate or ceases operation and closes. The Permittee is obligated to complete facility-wide corrective action under the conditions of this permit regardless of the operational status of the facility. The Permittee must submit an application for permit reissuance at least 180 days before the expiration date of this permit pursuant to OAC Rule 3745-50-40(D) unless: a) the permit has been modified to terminate the corrective action schedule of compliance and the Permittee has been released from the requirements for financial assurance for corrective action; or b) permission for a later date has been granted by the Director. The Director shall not grant permission for applications to be submitted later than the expiration date of the existing permit.

A.7. Need to Halt or Reduce Activity Not a Defense
OAC Rule 3745-50-58(C)

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

A.8. Duty to Mitigate
OAC Rule 3745-50-58(D)

The Permittee shall expeditiously take all reasonable steps necessary to minimize or correct any adverse impact on the environment or to public health resulting from noncompliance with this permit.

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A.9. Proper Operation and Maintenance
OAC Rule 3745-50-58(E)

The Permittee shall at all times properly operate and maintain the facility (and related appurtenances) to achieve compliance with the terms and conditions of this permit. Proper operation and maintenance includes, but is not limited to, effective management practices, adequate funding, adequate operator staffing and training, and where appropriate, adequate laboratory and process controls, including appropriate quality assurance/quality control procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the terms and conditions of this permit.

A.10. Duty to Provide Information
OAC Rule 3745-50-58(H)

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

A.11. Inspection and Entry
OAC Rules 3745-50-58(I), 3745-50-30 and ORC Section 3734.07

- (a) The Permittee shall allow the Director, or an authorized representative, upon stating the purpose and necessity of the inspection and upon proper identification to:
- (i) 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 terms and conditions of this permit;
 - (ii) have access to and copy, at reasonable times, any records required to be kept under the terms and conditions of this permit;
 - (iii) inspect and photograph at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under the terms and conditions of this permit; and

- (iv) sample, document, or monitor, at reasonable times, for the purposes of assuring permit compliance or as otherwise authorized by ORC Chapter 3734 and the rules adopted thereunder, any substances or parameter at any location.
- (b) Any record, report or other information obtained under the hazardous waste rules or Chapter 3734 of the Revised Code shall not be available to the public upon the Permittee's satisfactorily showing to Ohio EPA that all or part of the information would divulge methods or processes entitled to protection as trade secrets pursuant to Ohio Trade Secret Law and OAC Rule 3745-50-30.

A.12. Monitoring and Records
OAC Rule 3745-50-58(J)

- (a) Any sample and measurement taken for the purpose of monitoring shall be a representative sample or measurement, as such term is defined and used in the Ohio hazardous waste rules. The method used to obtain a representative sample of the waste to be analyzed must be the appropriate method from Appendix I of OAC Rule 3745-51-20, Laboratory Methods. Laboratory methods must be those specified in Test Methods for the Evaluation of Solid Waste: Physical /Chemical Methods; SW-846:Third Edition, November 1992; and additional supplements or editions thereof; Standard Methods for the Examination of Water and Wastewater: Seventeenth Edition, 1989; or an equivalent method as specified in the approved waste analysis plan, Section C of the approved Part B permit application or as such term is defined and used in the Ohio hazardous waste rules.
- (b) Records of monitoring information shall specify the:
 - (i) date(s), exact place(s), and time(s) of sampling or measurements;
 - (ii) individual(s) who performed the sampling or measurements;
 - (iii) date(s) analyses were performed;
 - (iv) individual(s) who performed the analyses;
 - (v) analytical technique(s) or method(s) used; and
 - (vi) results of such analyses.

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A.13. Signatory Requirement and Certification of Records
OAC Rules 3745-50-58(K) and 3745-50-42

All applications, reports or information shall be properly signed and certified in accordance with OAC Rule 3745-50-58(K).

A.14. Retention of Records
OAC Rules 3745-50-40(G), 3745-50-58(J), 3745-50-58(M) and 3745-50-58(N)

- (a) The Permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports and records required by this permit (e.g., A.12(b), A.28, B.2, B.5, B.6, B.14(c), B.23, B.42, B.44(b), D.5(f), D.7, D.9(a), I(A).3, I(A).5 and I(A).8), the certification required by paragraph B(9) of rule 3745-54-73 of the Administrative Code, and records of all data used to complete the application for this permit, for a period of at least three years from the date of the sample, measurement, report, certification, or application.
- (b) The record retention period may be extended by request of the Director at any time and are automatically extended during the course of any unresolved enforcement action regarding the facility.
- (c) The Permittee shall maintain, in accordance with the Ohio hazardous waste rules, records of all data used to complete the Part B permit application and any amendments, supplements, modifications, or revisions, of such application and shall retain a complete copy of the application for the life of the facility.
- (d) The Permittee shall maintain records from all ground water monitoring wells and associated ground water surface elevations for the active life of the facility, and for disposal facilities for the post-closure care period as well.
- (e) Corrective action records must be maintained at least three years after all corrective action activities have been completed.

A.15. Planned Changes
OAC Rules 3745-50-51 and 3745-50-58(L)(1)

The Permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility or any planned revisions to the permit. All such changes must be made in accordance with OAC Rule 3745-50-51.

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A.16. Waste Shipments

OAC Rule 3745-53-11, ORC Section 3734.15(C)

The Permittee shall only use properly registered transporters of hazardous waste to remove hazardous waste from the facility, in accordance with all applicable laws and rules.

A.17. Anticipated Noncompliance

OAC Rule 3745-50-58(L)(2)

The Permittee shall give advance notice to the Director of any planned changes in the permitted facility or operations which may result in noncompliance with the terms and conditions of this permit. Such notification does not waive the Permittee's duty to comply with this permit pursuant to Condition A.5.

A.18. Transfer of Permits

OAC Rules 3745-50-52; 3745-50-58(L)(3) and 3745-54-12

- (a) This permit is not transferable to any person except after notice of the Director.
- (b) The permit may be transferred to a new owner or operator only if such transfer is conducted in accordance with ORC Chapter 3734 and the rules adopted thereunder. This permit may be transferred by the Permittee to a new owner or operator only if the permit has been modified under OAC Rule 3745-50-51. Before transferring ownership or operation of the facility the Permittee shall notify the new owner or operator in writing of the requirements of ORC Chapter 3734 and the rules adopted thereunder (including all applicable corrective action requirements).

- (c) The Permittee's failure to notify the new owner or operator of the requirements of the applicable Ohio law or hazardous waste rules does not relieve the new owner or operator of its obligation to comply with all applicable requirements.

A.19. Compliance Reports

OAC Rules 3745-50-58(L)(5) and 3745-50-50

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule (developed in accordance with OAC Rule 3745-50-50) of this permit shall be submitted to the Director no later than fourteen days following each scheduled date.

A.20. Immediate Reporting of Noncompliance

OAC Rule 3745-50-58(L)(6)

- (a) The Permittee shall report orally to Ohio EPA's East Liverpool field office and the Division of Emergency and Remedial Response within twenty-four hours from the time the Permittee becomes aware of any noncompliance with this permit, ORC Chapter 3734 or the rules adopted thereunder, which endangers human health or the environment, including:
 - (i) information concerning the release of any hazardous waste that may cause an endangerment to public drinking water supplies; and
 - (ii) any information of a release or discharge of hazardous waste or a fire or explosion from the hazardous waste facility, which could threaten human health or the environment.
- (b) The report shall consist of the following information (if such information is available at the time of the oral report):
 - (i) name, address, and telephone number of the owner or operator;
 - (ii) name, address, and telephone number of the facility;
 - (iii) date, time, and description of incident including the name and quantity of material(s) involved;
 - (iv) the extent of injuries, if any;
 - (v) an assessment of actual or potential hazards to the environment and human health, where this is applicable;

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- (vi) any monitoring results;
- (vii) a description of response efforts as well as the estimated quantity and disposition of recovered material that resulted from the incident; and
- (viii) a list of other agencies notified of the incident, as applicable.

A.21. Follow-Up Written Report of Noncompliance
OAC Rule 3745-50-58(L)(6)(c)

- (a) A written report shall also be provided to Ohio EPA's Division of Emergency and Remedial Response and the Division of Hazardous Waste Management Northeast District Office within five days of the time the Permittee becomes aware of the circumstances reported in Condition A.20.
- (b) The written report shall address the items in Condition A.20 and shall contain a description of such noncompliance and its cause; the period(s) 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 minimize the impact on human health and the environment and to reduce, eliminate, and prevent recurrence of the noncompliance.
- (c) The Permittee need not comply with the five day written report requirement if the Director, upon good cause shown by the Permittee, waives that requirement and the Permittee submits a written report within fifteen days of the time the Permittee becomes aware of the circumstances.

A.22. Other Noncompliance
OAC Rules 3745-50-58(L)(10) and 3745-50-58(L)(4)

The Permittee shall report to the Director, all other instances of noncompliance not provided for in Condition A.20. These reports shall be submitted within a month of the time at which the Permittee is aware of such noncompliance. Such reports shall contain all information set forth within Condition A.20 of this permit.

A.23. Certification of Construction or Modification
OAC Rule 3745-50-58(L)(2)

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Pursuant to OAC Rule 3745-50-58(L)(2) the Permittee may not commence storage or treatment of hazardous waste in any modified portion of the facility until the Permittee has submitted to the Director, by certified mail or hand delivery, a letter signed by the Permittee and a qualified registered professional engineer stating that the facility has been constructed, or modified in compliance with the permit; and

- (a) the Director has inspected the modified or newly constructed facility and finds it is in compliance with the conditions of the permit; or
- (b) the Director has either waived the inspection or has not within fifteen days of the date of the submittal of the letter, notified the Permittee of his intent to inspect.

A.24. Other Information
OAC Rule 3745-50-58(L)(11)

If at any time the Permittee becomes aware that it failed to submit any relevant facts, or submitted incorrect, misleading, or incomplete information to the Director, the Permittee shall promptly submit such facts, information, or corrected information to the appropriate entity.

A.25. Confidential Information
OAC Rule 3745-50-30

In accordance with ORC Chapter 3734 and the rules adopted thereunder, the Permittee may request confidentiality of any information required to be submitted by the terms and conditions of this permit. Including any information obtained by the Director, or an authorized representative, pursuant to the authority provided under condition A.11 of this permit.

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A.26. Ohio Annual Permit Fee
OAC Rule 3745-50-36

The annual permit fee, calculated pursuant to OAC Rule 3745-50-36 and payable to the Treasurer of the State, shall be submitted to the Director on or before the anniversary of the date of issuance during the term of the permit. For the purpose of the payment of the Ohio Annual Permit Fee, the date of issuance is the date the permit was entered into the Journal of the Director of Ohio EPA.

A.27. Compliance Schedule - Documents
OAC Rules 3745-50-50 and 3745-50-51

- (a) To-be-constructed portions of the facility. Regarding future systems and to-be-constructed portions of the facility described in the Permittee's permit application, prior to construction, detailed plans must be submitted to the Ohio EPA for review to ensure the plans are consistent with the existing permit. If the plans are inconsistent with or not authorized by the existing permit, a permit modification in accordance with OAC Rule 3745-50-51 will be required prior to construction.
- (b) The Permittee shall not manage hazardous waste in any modified or newly constructed portions of the facility until compliance is achieved with the Ohio hazardous waste rules, the terms and conditions of this permit, and with the following:
 - (i) Documents required by this condition shall be submitted as follows:
 - a) At least thirty days prior to commencing construction at the facility, the Permittee shall submit to Ohio EPA all relevant detailed final design and construction plans as approved by the Building Official in accordance with OAC Rule 4101:2-1-23 (including ancillary equipment, blue prints, material of the construction, etc.) covering each aspect of the proposed construction. The final design and construction plans mean final design and specifications necessary for the commencement of the construction.
 - b) A schedule of new construction including the estimated starting and completion dates.

- (ii) If the final plans, as submitted, are inconsistent with the conceptual and/or preliminary plans contained in the approved permit application and with the terms and conditions of this permit, such submittal may be considered by Ohio EPA as information constituting a change to the permitted facility and thus require submission of a permit modification.
 - (iii) Upon completion of construction, the Permittee shall submit to Ohio EPA, when applicable, by certified mail or hand delivery, a "certificate of use and occupancy" issued by the Building Official in accordance with OAC Rule 4101:2-1-27 [for tank systems, the Permittee shall provide a tank installation certification in accordance with OAC Rule 3745-55-92(B)] and a certification stating that the construction was completed in compliance with applicable rules, the terms and conditions of this permit, applicable state building codes (e.g., codes for fire, electrical service, and plumbing), and the approved permit application.
 - (iv) Within sixty days after completion of new construction, "as built" drawings shall be submitted to Ohio EPA. If the submitted "as built" drawings appear inconsistent with the construction design plans submitted under Permit Condition A.27(b)(i), such submittal may be considered by Ohio EPA as information constituting a change to the permitted facility and thus require submission of a permit modification.
 - (v) No hazardous waste shall be managed at the newly constructed portion(s) of the facility until Ohio EPA, in accordance with OAC Rule 3745-50-58(L), has inspected such portion(s) of the facility and finds that it is in compliance with all applicable rules, the terms and conditions of this permit, and the approved permit application.
 - (vi) At least sixty (60) days prior to the receipt of hazardous waste in any modified or newly constructed portions of the facility, the Permittee shall submit updated financial requirements for closure of the facility and liability requirements. This includes the cost estimate for closure as required by OAC Rule 3745-55-42, financial assurance for facility closure as required by OAC Rule 3745-55-43, and liability insurance as required by OAC Rule 3745-55-47.
- (c) RESERVED

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- (d) The Permittee shall submit for approval to the Ohio EPA within thirty days after permit journalization:
- (i) An amended permit application updated for changes resulting from permit modifications approved between the dates of issuance of the draft renewal permit and issuance of the final renewal permit. The updated permit application is to be submitted as a Class 1 modification requiring director's prior approval in accordance with OAC rule 3745-50-51.
 - (ii) A permit modification to change the applicable sections in the approved Part B permit application to include new language regarding principal organic hazardous constituents (POHCs). The updated permit application is to be submitted as a Class 1 modification requiring director's prior approval in accordance with OAC rule 3745-50-51.
 - (iii) A permit modification to change the applicable sections in the approved Part B permit application to include new language regarding dioxin-bearing waste. This modification shall also include language restrictions for wastes carrying the codes, F032, F039, K043, and K099. The updated permit application is to be submitted as a Class 1 modification requiring director's prior approval in accordance with OAC rule 3745-50-51.
 - (iv) A permit modification to change the applicable sections in the approved Part B permit application to include new language regarding restricted wastes. The updated permit application is to be submitted as a Class 1 modification requiring director's prior approval in accordance with OAC rule 3745-50-51.
- (e) The Permittee shall submit a written RFI Workplan to Ohio EPA within 90 days after the effective date of this permit according to Permit Condition E.5(a).

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- (f) Unless specified otherwise, the Permittee shall submit a copy of all documents to the following locations:

Ohio Environmental Protection Agency
Division of Hazardous Waste Management
Attn: Regulatory and Information Services
P.O. Box 1049
122 S. Front Street
Columbus, Ohio 43216-1049

Ohio Environmental Protection Agency
Division of Hazardous Waste Management
Northeast District Office
2110 East Aurora Road
Twinsburg, OH 44087

A.28. Information to be Maintained at the Facility
OAC Rule 3745-54-74

- (a) The Permittee shall maintain at the facility, until closure is completed and certified by a qualified, independent, registered professional engineer, pursuant to OAC Rule 3745-55-15, and until the Director releases the Permittee from financial assurance requirements pursuant to OAC Rule 3745-55-47, the following documents (including amendments, revisions, and modifications):

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- (i) waste analysis plan, as found in Section C of the approved Part B permit application, developed and maintained in accordance with OAC Rule 3745-54-13 and the terms and conditions of this permit;
 - (ii) contingency plan, Section G of the approved Part B permit application, developed and maintained in accordance with OAC Rule 3745-54-53 and the terms and conditions of this permit;
 - (iii) closure plan, Section I of the approved Part B permit application, developed and maintained in accordance with OAC Rule 3745-55-12 and the terms and conditions of this permit;
 - (iv) cost estimate for facility closure developed and maintained in accordance with OAC Rule 3745-55-42 and the terms and conditions of this permit;
 - (v) personnel training plan, Section H of the approved Part B permit application, and the training records, as developed and maintained in accordance with OAC Rule 3745-54-16 and the terms and conditions of this permit;
 - (vi) operating record required by OAC Rule 3745-54-73 and the terms and conditions of this permit;
 - (vii) inspection schedules, Section F of the approved Part B permit application, developed in accordance with OAC Rules 3745-54-15 , 3745-55-74, and 3745-55-95 and the terms and conditions of this permit;
 - (viii) annually-adjusted cost estimate for facility closure, as required by OAC Rules 3745-55-42 and 3745-55-44 and this permit;
 - (ix) all other documents required by this permit, e.g., Permit Conditions A.12, sampling and analysis; B.41, groundwater monitoring; and B.43, riverbank and fill material monitoring.
- (b) All amendments, revisions, and modifications to any plan required by the terms and conditions of this permit or the Ohio hazardous waste rules shall be submitted to the Director. No such change shall be made unless the Permittee has received approval in accordance with the Ohio hazardous waste rules.

- (c) The Permittee shall maintain copies of all inspection logs at the facility for a period not less than three years from the date of inspection.
- (d) Corrective action reports and records, as required by the terms and conditions of this permit, must be maintained for at least three years after all corrective action activities have been completed.

A.29. Waste Minimization Report
OAC Rules 3745-54-73 and 3745-54-75

- (a) The Permittee shall submit a Waste Minimization Report describing the waste minimization program required by OAC Rules 3745-54-75(H), (I), and (J); 3745-54-73(B)(9); and 3745-52-20(B) at least once every two years. The provision of OAC Rules 3745-54-75(H), (I), and (J); and 3745-54-73(B)(9) must be satisfied annually.
- (b) In completing this report, the Permittee should refer to the following information: instructions prepared by Ohio EPA for completing the Waste Minimization Annual Report required by OAC Rules 3745-54-75(H), (I), and (J); the Federal Register notice of May 28, 1993, vol. 58, p. 31114, "Interim Final Guidance: Guidance to Hazardous Waste Generators on the Elements of a Waste Minimization Program"; and U.S. EPA's "Facility Pollution Prevention Guide" including planning and organization, assessment, feasibility analysis, implementation, measuring progress, and maintaining the program.
- (c) The Permittee shall submit the Waste Minimization Report to the Technical Assistance Section, Office of Pollution Prevention within one hundred eighty days of journalization of this permit, and shall submit updates to this report biennially thereafter.

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B. GENERAL FACILITY CONDITIONS

B.1. Design, Maintenance and Operation of Facility
OAC Rule 3745-54-31

- (a) The Permittee shall design, construct, maintain, and operate the facility to minimize the possibility of a fire, explosion, or any unplanned sudden or non-sudden release of hazardous waste constituents to air, soil, and ground or surface waters which could threaten human health or the environment.
- (b) The Permittee is limited to treating the following quantities of hazardous waste in any one calendar year from any off-site sources during the life of the permit, until such time as this Condition is modified, renewed, or revised. This is a facility wide limitation and includes all units.
 - (i) The two incinerators (1 existing, 1 not yet constructed) may treat a combined total of 176,000 tons per year of hazardous waste. Each individual incinerator may treat 88,000 tons per year;
 - (ii) The Inorganic Waste Treatment System (not yet constructed) may treat 83,000 tons per year of hazardous waste; and
 - (iii) The General Wastewater Treatment System (not yet constructed) may treat up to ten percent of the total waste received at the facility. This ten percent limitation will be subject to revision as required by any agreements between the facility and the city of East Liverpool.

B.2. Required Notices
OAC Rule 3745-54-12

- (a) The Permittee shall notify the Director in writing at least four weeks in advance of the date the Permittee expects to receive hazardous waste from a foreign source, as required by OAC Rule 3745-54-12(A). Notice of subsequent shipments of the same waste from the same foreign source is not required.

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(b) Hazardous Waste from Off-Site Sources

When the Permittee is to receive hazardous waste from an off-site source (except where the Permittee is also the generator), (s)he must inform the generator in writing that (s)he has the appropriate permits and will accept the waste the generator is shipping. The Permittee must keep a copy of this written notice as part of the operating record.

B.3. General Waste Analysis Plan
OAC Rule 3745-54-13

- (a) The Permittee shall submit waste profile sheets (WPS) to the Ohio EPA for review and approval prior to acceptance of the first shipment of waste from each WPS. Waste codes not permitted in the approved Part A permit application shall not be stored or treated at the facility until the Permittee has received approval in accordance with the Ohio hazardous waste rules.
- (b) The Permittee shall follow the procedures described in the approved waste analysis plan found in Section C of the approved Part B permit application and the terms and conditions of this permit. The Permittee shall verify the analysis of each waste stream annually as part of its quality assurance program, in accordance with Test Methods for Evaluating Solid Waste: Physical/Chemical Methods, EPA Publication SW-846, or equivalent methods approved by the Director. At a minimum, the Permittee shall maintain proper functional instruments, use approved sampling and analytical methods, verify the validity of sampling and analytical procedures, and perform correct calculations. If the Permittee uses a contract laboratory to perform analyses, then the Permittee shall inform the laboratory in writing that it must operate under the waste analysis conditions set forth in this permit including all requirements found in the facility's quality control/quality assurance plan. All outside contracted laboratories must be audited and their quality control/quality assurance plan evaluated prior to the laboratory performing services for the Permittee. The results of the audits must be maintained as part of the facility's operating record.
- (c) The Permittee shall ensure that all phenolic wastes received for treatment at the facility will be treated by incineration.
- (d) The Permittee shall ensure that all organic wastes not covered by Condition B.3.(c) will be incinerated unless other treatment methods are provided or specified in the approved Part B permit application.

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B.4. Security

OAC Rule 3745-54-14

- (a) The Permittee shall comply with the security provisions of OAC Rule 3745-54-14(B) and (C), the terms and conditions of this permit, and all applicable sections of the approved Part B permit application, e.g., Section F, Inspection Plan.
- (b) The Permittee shall continuously monitor the entrance gates to the facility while open either by the use of facility personnel or by monitoring equipment such as cameras.

B.5. General Inspection Requirements

OAC Rules 3745-54-15 and 3745-54-73

The Permittee shall follow the inspection schedule set out in the inspection plan, Section F of the approved Part B permit application, the terms and conditions of this permit, and the requirements of OAC Rules 3745-54-15(C) and (D). The Permittee shall remedy any deterioration or malfunction discovered by an inspection, as required by OAC Rule 3745-54-15(C) or as required by the approved Part B permit application. Records of inspection shall be kept for a minimum of three years from the date of inspection or as required by the approved Part B permit application and the terms and conditions of this permit.

B.6. Personnel Training

OAC Rule 3745-54-16

The Permittee shall conduct personnel training as required by OAC Rule 3745-54-16. This training program shall contain at least the elements set forth in Section H of the approved Part B permit application. The Permittee shall maintain training documents and records as required by OAC Rules 3745-54-16(D) and (E).

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B.7. General Requirements for Ignitable, Reactive, or Incompatible Waste
OAC Rule 3745-54-17

- (a) The Permittee shall comply with the requirements of OAC Rule 3745-54-17 and shall follow the procedures for handling ignitable, reactive, and/or incompatible wastes set forth in the approved Part B permit application (e.g. Sections C, D, F, and G) and the terms and conditions of this permit.
- (b) The Permittee shall provide electrical grounding for all containers, tanks, and transport vehicles during all operations involving the handling of ignitable or reactive wastes.
- (c) The Permittee shall provide, and require the use of, spark proof tools during all operations involving the handling of all ignitable and/or reactive wastes.
- (d) The Permittee shall prohibit smoking and open flames in each area where ignitable, reactive, and/or incompatible hazardous wastes are managed, as well as other active areas on-site, and shall post appropriate signs.
- (e) All wiring and electrical equipment at the to-be-constructed portions of the facility shall meet the National Fire Protection Association's standards for hazardous locations (See National Fire Protection Association, "National Electric Code" National Fire Codes, 1985 Edition, Vol. 3, Chapter 5, Special Occupancies, Articles 500-503, pp. 176 through 189).

B.8. Location Standards
OAC Rule 3745-54-18

- (a) The Permittee shall construct, operate, and maintain the facility to prevent washout of any hazardous waste as required by OAC Rule 3745-54-18(B) and as specified in Section B of the approved Part B permit application.
- (b) On a semi-annual basis, the facility will have a survey conducted to take measurements and record data relating to the site grade and fill. These inspections will ensure that fill material and underlying soils remain stable and that no movement occurs which may compromise the integrity of the foundation at the facility. This is in accordance with Permit Condition B.44, Inspection of Riverbank and Fill Material.

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B.9. Required Equipment
OAC Rule 3745-54-32

At a minimum, the Permittee shall maintain at the facility all the equipment required by OAC Rule 3745-54-32 and all applicable sections of the approved Part B permit application including the equipment set forth in the approved contingency plan contained in Section G.

B.10. Testing and Maintenance of Equipment
OAC Rule 3745-54-33

The Permittee shall inspect, test, and maintain the equipment required by Permit Condition B.9. as necessary to assure its proper operation in time of emergency, as specified in OAC Rule 3745-54-33, and the applicable sections of the approved Part B permit application, such as Sections F and G, and the terms and conditions of this permit.

B.11. Access to Communications or Alarm System
OAC Rule 3745-54-34

The Permittee shall maintain access to the communications and alarm systems as required by OAC Rule 3745-54-34, applicable sections of the approved Part B permit application, such as Sections F and G, and the terms and conditions of this permit.

B.12. Required Aisle Space
OAC Rule 3745-54-35

At a minimum, the Permittee shall maintain aisle space to allow the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment to any area of facility in an emergency as required by OAC Rule 3745-54-35, applicable sections of the approved Part B permit application, and terms and conditions of this permit.

The required aisle space in permitted process and storage areas at the facility is described in Section D of the approved Part B permit application. For example, aisle space in Building A (Drum Warehouse in the Container Processing Building) shall be maintained at a minimum of five feet.

B.13. Arrangements with Local Authorities
OAC Rule 3745-54-37

- (a) The Permittee shall comply with the requirements of OAC Rule 3745-54-37 (A) by making a diligent effort to:
- (i) familiarize all emergency response agencies, which are likely to respond in an emergency, with the location and layout of the facility, properties of hazardous waste managed at the facility and associated hazards, places where facility personnel will normally be working, entrances to and roads inside the facility, and possible evacuation routes as depicted and explained in the Contingency Plan, Section G of the approved Part B permit application;
 - (ii) inform such agencies of safety equipment, supplies, and proper emergency safety procedures that are applicable to the facility and any further requirements related to emergency response imposed by terms and conditions of this permit; and
 - (iii) familiarize the local police and fire departments, hospitals, and any other local emergency service, with the properties of hazardous waste managed at the facility and the types of injuries or illness which could result from incidents such as fires, explosions, or releases at the facility, and exposure to the hazardous waste constituents.
 - (iv) abide with the agreement between VRA and the East Liverpool Fire Department regarding the primary emergency authority and support to the primary emergency authority. This agreement can be found in Section G, Contingency Plan, of the approved Part B permit application.
- (b) When a State or local agency declines to enter into the arrangements set forth in OAC Rule 3745-54-37(A), the Permittee shall document the refusal in the operating record as required by OAC Rule 3745-54-37(B).
- (c) The Permittee shall, in accordance with OAC Rule 3745-54-53, submit a copy of its contingency plan, including all amendments, revisions, or changes, to the local authorities designated in the contingency plan. The Permittee shall notify the local authorities, in writing, within ten days of the effective date of any amendments, revisions, or changes to the contingency plan.

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- (d) Records of agreements and arrangements with local authorities shall be maintained as part of the facility's operating record.

B.14. Implementation of Contingency Plan
OAC Rules 3745-54-51 and 3745-54-56

- (a) The Permittee shall immediately carry out the provisions of the approved contingency plan and follow the emergency procedures described in OAC Rule 3745-54-56, whenever there is a fire, explosion, or release of hazardous waste or hazardous waste constituents which threatens, or could threaten, human health or the environment.
- (b) In regard to spills and related toxic gas releases, the plan must describe the criteria to be used by the emergency coordinator to determine when the plan will be implemented. At a minimum, the plan must be implemented in the following situations:
 - (i) any fire involving hazardous waste; or
 - (ii) any explosion involving hazardous waste; or
 - (iii) any uncontrolled hazardous waste reaction that produces, or has the potential to produce, hazardous conditions, including noxious, poisonous, flammable, and/or explosive gases, fumes, or vapors; harmful dust; or explosive conditions; or
 - (iv) any hazardous waste release, outside of a secondary containment system, that causes, or has the potential to cause, off-site soil and/or surface water contamination; or
 - (v) any hazardous waste release that produces, or has a potential to produce, hazardous conditions, including noxious, poisonous, flammable and/or explosive gases, fumes, or vapors; harmful dust; or explosive conditions.
- (c) The Permittee shall comply with the requirements of OAC Rule 3745-54-56(J) as it relates to recording implementation of the contingency plan.

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B.15. Content of the Contingency Plan
OAC Rule 3745-54-52

The Permittee shall comply with OAC Rule 3745-54-52, all relevant terms and conditions of this permit, and the contingency plan, as set forth in Section G of the approved Part B permit application.

B.16. Contingency Plan - Released Material and Emergency Response Material and By-products
OAC Rule 3745-54-56(G)

All liquid or solid material resulting from fire, explosion, released material, or emergency response material and by-products that the Permittee is required to evaluate to determine whether such material is hazardous waste in accordance with OAC Rule 3745-52-11, shall be collected and managed as a hazardous waste until such time as the Permittee can demonstrate that such waste is not hazardous in accordance with OAC Rules 3745-51-03 (C) and (D).

B.17. Amendments to Plan
OAC Rule 3745-54-54

The Permittee shall review the approved contingency plan at least annually and upon the occurrence of any event listed in OAC Rule 3745-54-54. If necessary or appropriate, the Permittee shall amend the contingency plan as required by OAC Rule 3745-54-54 in accordance with OAC Rule 3745-50-51.

B.18. Copies of Plan
OAC Rule 3745-54-53

- (a) The Permittee shall comply with the requirements set forth in OAC Rule 3745-54-53 regarding contingency plan distribution.
- (b) The Permittee shall, in accordance with OAC Rule 3745-54-53, submit a copy of the approved contingency plan, to all local police departments, fire departments, hospitals, and local emergency response teams that may be called upon to provide emergency services. The Permittee shall notify such agencies and the local authorities, in writing, within ten days of the effective date of any amendments of, revisions to, or modifications to the contingency plan.

- (c) The Permittee shall, in accordance with OAC Rule 3745-54-53, submit a copy of the approved contingency plan to the Ohio Environmental Protection Agency's Division of Emergency and Remedial Response.

B.19. Emergency Coordinator
OAC Rule 3745-54-55

The Permittee shall comply with the requirements set forth in OAC Rule 3745-54-55 and the Contingency Plan, Section G, of the approved Part B permit application regarding the emergency coordinator.

B.20. Emergency Procedures
OAC Rule 3745-54-56

- (a) The Permittee shall comply with the requirements set forth in OAC Rule 3745-54-56, all applicable sections of the approved Part B permit application, e.g., the contingency plan, Section G, and the conditions of this permit regarding emergency procedures.
- (b) The Permittee's emergency response teams shall, to the extent possible, assist and advise local community response organizations in responding to transportation incidents involving hazardous wastes in transit to or from the VRA facility.

B.21. Availability, Retention, and Disposition of Records
OAC Rule 3745-54-74

The Permittee shall furnish upon Ohio EPA request and retain all records at the facility in accordance with OAC Rule 3745-54-74, the approved Part B permit application, and all terms and conditions of this permit.

B.22. Operating Record
OAC Rule 3745-54-73

The Permittee shall comply with the requirements set forth in OAC Rule 3745-54-73 and all applicable sections of the approved Part B permit application regarding an operating record, including information to be recorded and the maintenance thereof.

B.23. Contingency Plan Records
OAC Rules 3745-54-73 and 3745-54-56-(J)

The Permittee shall note in the operating record the time, date, and details of any incident that requires the implementation of the contingency plan. Within fifteen days of any such incident, the Permittee shall submit to the Director a written report of the incident containing the elements set forth in OAC Rule 3745-54-56(J).

B.24. Manifest System
OAC Rules 3745-54-70, 3745-54-71, 3745-54-72 and 3745-54-76

- (a) In the management of waste at the facility, the Permittee shall comply with the provisions of OAC Chapter 3745-52 and OAC Rules 3745-54-71, 3745-54-72 and 3745-54-76 with regard to the manifest system.
- (b) Manifest discrepancy report. If a significant discrepancy in a manifest is discovered, the Permittee must attempt to reconcile the discrepancy. If the discrepancy is not resolved within fifteen (15) days after receiving the waste, the Permittee must submit a report, including a copy of the manifest, to the Director in accordance with OAC Rule 3745-54-72.
- (c) Unmanifested waste report. This report must be submitted to the Director within fifteen days of receipt of unmanifested waste, which waste is not excluded from the manifest requirements by OAC Rule 3745-51-05, and include the information required under OAC Rule 3745-54-76.

B.25. Annual Reports and Additional Reports
OAC Rules 3745-54-77 and 3745-54-75

The Permittee shall comply with the annual report requirements set forth in OAC Rule 3745-54-75 and the additional report requirements set forth in OAC Rule 3745-54-77.

B.26. Closure Performance Standard
OAC Rule 3745-55-11

During facility closure, the Permittee shall implement the provisions of the approved closure plan, Section I of the approved Part B permit application, in such manner as to achieve compliance with OAC Rule 3745-55-11. Compliance with OAC Rule 3745-55-11 will be facilitated by referring to the Division of Hazardous Waste Management's most recent Closure Plan Review Guidance for RCRA facilities.

B.27. Closure Plan
OAC Rules 3745-55-10, 3745-55-11, and 3745-55-13

The Permittee shall implement those procedures detailed within Section I of the approved Part B permit application, in accordance with OAC Rules 3745-55-10 through 3745-55-20.

B.28. Amendment of Closure Plan
OAC Rules 3745-55-12 and 3745-50-51

Should a change in the facility closure plan become necessary, the Permittee shall amend the approved closure plan in accordance with OAC Rule 3745-55-12 (C) and 3745-50-51.

B.29. Content of Closure Plan
OAC Rule 3745-55-12

The Permittee shall maintain the approved closure plan at the facility which contains the elements set forth in OAC Rule 3745-55-12 and all elements required by the approved Part B permit application and the terms and conditions of this permit.

B.30. Notification of Closure
OAC Rule 3745-55-12

The Permittee shall notify the Director in writing at least forty five days prior to the date on which he expects to begin final closure of a facility, as required by OAC Rule 3745-55-12(D).

B.31. Time Allowed For Closure

OAC Rule 3745-55-13

Within ninety days of receipt of the final volume of hazardous waste, the Permittee shall remove from the facility or treat on site, all hazardous waste in accordance with the approved closure plan. The Director may approve a longer period if the Permittee complies with all applicable requirements for requesting a modification to the permit as set forth in OAC Rule 3745-55-13(A).

The permittee shall complete all closure activities within one hundred eighty days, in accordance with OAC Rule 3745-55-13. The Director may approve a longer closure period if the Permittee complies with all applicable requirements for requesting a modification to the permit as set forth in OAC Rule 3745-55-13 (B).

B.32. Disposal or Decontamination of Equipment, Structures, and Soils

OAC Rule 3745-55-14

- (a) The Permittee shall decontaminate and/or dispose of all contaminated facility equipment, structures, and soils, as required by OAC Rule 3745-55-14, the approved closure plan and the terms and conditions of this permit.
- (b) The Permittee shall notify the Ohio EPA Northeast District Office within seven working days prior to all rinseate and soil sampling events.

B.33. Certification of Closure

OAC Rule 3745-55-15

The Permittee and an independent, qualified, registered professional engineer shall certify that each hazardous waste management unit or the facility has been closed in accordance with the specifications in the approved closure plan and the terms and conditions of this permit, as required by OAC Rule 3745-55-15. The Permittee shall furnish to the Director, upon request, documentation supporting the certification.

B.34. Reserved.

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B.35. Reserved.

B.36. Cost Estimate for Facility Closure
OAC Rules 3745-55-42 and 3745-55-44

- (a) The Permittee's most recent closure cost estimate, prepared in accordance with OAC Rules 3745-55-42, 3745-55-44, 3745-55-97(C)(3) & (5), 3745-56-28(C)(3) and 3745-56-58(C)(2) is specified and included in Section I of the approved Part B permit application.
- (b) The Permittee must adjust the closure cost estimate for inflation within 60 days prior to the anniversary date of the establishment of the financial instrument used to comply with OAC Rule 3745-55-43 and Permit Condition B.39.
- (c) The Permittee must revise the closure cost estimate whenever there is a change in the facility's Closure Plan that increases the cost of closure, as required by OAC Rule 3745-55-42(C).
- (d) The Permittee must submit to the Ohio EPA, and keep at the facility, the latest closure cost estimate as required by OAC Rule 3745-55-42(D).

B.37. Financial Assurance for Facility Closure
OAC Rules 3745-55-43 and 3745-55-51

The Permittee shall maintain continuous compliance with OAC Rule 3745-55-43 and provide documentation of financial assurance, which meets the requirements of OAC Rule 3745-55-51, in at least the amount of the cost estimates required by Permit Condition B.36.

B.38. Liability Requirements
OAC Rules 3745-55-47 and 3745-55-47(B)

The Permittee shall maintain continuous compliance with the requirement of OAC Rule 3745-55-47 and the documentation of liability by providing liability coverage which meets the requirements of OAC Rule 3745-55-51 for sudden accidental occurrences in the amount required by the applicable rules, exclusive of the legal defense costs.

B.39. Incapacity of Owners or Operators, Guarantors, or Financial Institutions
OAC Rule 3745-55-48

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The Permittee shall comply with requirements set forth in OAC Rule 3745-55-48 regarding the incapacity of owners, operators, guarantors, or financial institutions.

B.40. General Requirements for Land Disposal Restrictions
OAC Chapter 3745-270

The Permittee shall comply with all applicable regulations regarding land disposal prohibitions and restrictions as required by OAC Chapter 3745-270.

B.41. Transportation of Waste to the Facility.

- (a) The Permittee shall advise all transporters in transit to the facility with hazardous waste shipments of the current weather, road, and traffic conditions on a continuing basis. Operators of trucks equipped with citizen band communication equipment shall be advised to contact the facility or to monitor a specific channel on which the facility can be contacted to advise and assist the transporter with respect to current weather, road and traffic information, and other information pertinent to safe delivery. Transporters not equipped to communicate with the facility in transit or monitor information provided by the facility in accordance with this condition, shall obtain such information by telephoning VRA from a point not less than 25 miles distant from the East Liverpool corporation limits.
- (b) The Permittee shall use its best efforts to arrange with the appropriate local law enforcement agencies and the State Highway Patrol for timely access to weather, road and traffic information, and other pertinent information.
 - (i) The Permittee shall use its best efforts to encourage transporters to use routes, as described in Section B of the approved Part B permit application and designated by VRA, in order to minimize the risk of transportation related incidents.

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- (ii) The Permittee shall use its best efforts to encourage transporters to schedule arrival at the facility during periods when roads in the East Liverpool area are not in peak traffic use (e.g., early morning and late evening rush hour).
- (c) If the Ohio EPA determines the need for action based upon observations of the existing traffic plan and routes, the Permittee shall use its best efforts to work with the appropriate local authorities to so alter the traffic plan and routes to the facility so as to increase the safety of the public and decrease the risk of transportation accidents.
- (d) If the Ohio EPA determines that transport trucks en route to VRA do not comply with applicable hazardous waste/material transportation rules, including but not limited to manifest requirements, placarding, labeling, leakage, and registration, or transport trucks are not using preferred routes, or not obeying traffic regulations, the Ohio EPA shall notify the Permittee in writing of such occurrence.

Should such transporter noncompliance continue, the Ohio EPA may take such measure as may be necessary to protect public health, safety and the environment, including but not limited to ordering the Permittee to refuse to accept hazardous waste from any such truck transportation company.

B.42. Groundwater Monitoring and Reporting.

The Permittee shall conduct groundwater monitoring in accordance with the requirements set forth in the approved groundwater monitoring plan and all subsequent revisions and modifications to the plan and the approved Part B permit application. Groundwater monitoring, including sampling and analysis, will be conducted on a semi-annual basis and submitted to the Ohio EPA, Division of Hazardous Waste Management, for review. Ground water monitoring results shall be maintained as part of the facility's operating record. The approved groundwater monitoring plan is attached to the permit terms and conditions as Attachment 6.

B.43. Solid or Semi-Solid Treatment Residue Generated by Von Roll America, Inc.

All solid or semi-solid treatment residue generated by VRA shall be considered hazardous until specifically delisted. All waste generated by the facility will be managed in accordance with the approved Part B permit application. Treatment residues generated by the Permittee shall be sampled and analyzed in accordance with Section C of the approved Part B permit application.

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B.44. Inspection of Riverbank and Fill Material

- (a) The inspection procedures, schedules, and criteria for riverbank and fill material shall follow the outline in Section F of the approved Part B permit application and shall include the following:
 - (i) a visual evaluation of the effects of erosion along the bank of the Ohio River adjacent to the facility;
 - (ii) an inspection of the soil integrity in the area of the installed sheet pile wall through visual inspections and standard surveying techniques; and
 - (iii) at a minimum, visual inspections shall be conducted on a monthly basis and surveying inspections shall be conducted once every six months.
- (b) Monitoring shall be conducted in accordance with Section F of the approved Part B permit application and Permit Conditions B.8.(b) and B.44.(a). The results shall be maintained as part of the facility's operating record.
- (c) The Permittee shall take corrective action as necessary to remediate any conditions detected through the inspection procedures outlined in Permit Conditions B.8.(b) and B.44.(a) and Section F of the approved Part B permit application which may cause deterioration of the integrity of the facility's foundation.

B.45. Stack Height

The height of each of the exhaust stacks shall be 150 feet. The elevation at the base of the stacks shall be, at a minimum, 695 feet above sea level. The outlet of the stacks shall not be greater than 850 feet above sea level unless approved according to the Ohio Hazardous Waste Rules and the Ohio EPA Division of Air Pollution Control.

B.46. Prohibition of Shipping Hazardous Waste to VRA/WTI Using the Ohio River.

No hazardous waste will be shipped to the facility by way of the Ohio River.

C. CONTAINER STORAGE AND TREATMENT

General Overview

Containerized waste, generated from off-site as well as on-site, is stored at several locations throughout the facility as described in Section D of the approved Part B permit application. All container storage areas are located in buildings with bases constructed of reinforced concrete treated to resist chemical attack. All container storage areas are equipped with automated fire detection and suppression systems, secondary containment, liquid collection systems, and berms to control run-on/run-off. Most storage areas are fully enclosed and equipped with forced air ventilation to prevent the accumulation of vapors and fumes. Container processing areas have vapor collection points that are tied into the vapor recovery system which is described in Section D of the permit application. Aisle space is maintained to allow for the unobstructed movement of personnel, fire protection equipment, spill control equipment, and decontamination equipment. Aisle space specific to each container storage area is described in Section D of the permit application. All stored containers will be placed on a pallet or other appropriate means to keep the bottom of the container above the concrete surface to facilitate identification of leaking containers. The permitted container storage areas are Building A (Drum Warehouse of the Container Processing Building), Building B (External Truck Wash), Building C (Lab Pack Building); and Container Holding Building (Slag Canopy). In all cases, containers are inspected for integrity prior to storage and on a daily basis.

Building A is located in the northern-most section of the facility's Container Processing Building. The building is 100' x 210' with racks installed to store a variety of containers equivalent to approximately 6,000 fifty-five gallon drums. The permitted storage capacity for this building is 510,000 gallons. The waste is segregated according to waste types with incompatible waste stored in areas with separate spill collection systems. Total secondary containment in this building is 79,497 gallons and is described in Section D of the permit application. The building is equipped with forced air ventilation.

Building B, also known as the External Truck Wash, is 25' x 70' with racks installed to store up to 15,180 gallons in a variety of container types and sizes. Total secondary containment in this building is 10,000 gallons. The building is permitted for storage in racks, a wash station for containers and equipment, and processing of specific waste streams (described in Section D). Containers will only be located on the floor during processing or staging activities. A minimum of five (5) feet of aisle space will be maintained between pallets of containerized waste when they are on the floor to be processed. All waste stored or processed in Building B will be compatible. The building is equipped with forced air ventilation. Fugitive emissions from processing activities are captured by the vapor recovery system.

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Building C, also known as the Lab Pack Building, is 56' x 60' with racks installed to store up to 13,200 gallons in a variety of container types and sizes. Total secondary containment in this building is 11,200 gallons. The building is used primarily for the storage and management of lab pack and loose pack waste as well as processing third party waste as described in Permit Condition C.1(d) and Section C in the permit application. The building is also used for other processing activities as described in Section D of the permit application. Containers processed or staged in Building C will be no more than five (5) cubic yards in size. The building is equipped with forced air ventilation, a breathing airline, and vapor recovery collection points used during processing activities.

The Container Holding Building, also known as the Slag Canopy, is 50' x 50' with a storage capacity of 100,000 gallons. The building is enclosed on three sides to minimize the accumulation of storm water. Total secondary containment is 10,520 gallons. Containers, greater than 85 gallons, can be stored on the floor and in heavy duty racks installed on the east and west side of the building. Waste stored in this building must be non-reactive and compatible. Processing of waste for use in the Bucket Hoist may be conducted in this building (see Section D-2e(4) of the permit application).

The amount of waste stored in each area will not exceed the permitted capacity at any time. All waste stored, processed, or treated will ultimately be fed to the incineration system for thermal treatment with the exception of third party waste as described in Permit Condition C.1(d). Treatment processes currently permitted at the facility will not render the waste non-hazardous. The Permittee is not permitted to store Class 1A Flammable Liquids, defined by National Fire Protection Association (NFPA) codes as liquids with a flashpoint <73 degrees Fahrenheit and a boiling point <100 degrees Fahrenheit anywhere on-site. The Permittee may treat Class 1A Flammable Liquids through the Direct Organic Tanker South Unit.

Container types received at the facility may include, but are not limited to, drums, pails, boxes, totes, cylinders, consumer packages, lab packs, rolloffs, tanker trucks, and refrigerated trucks. Containers that may be received, stored, and processed at the facility are composed of materials such as steel, wood, fiber, and plastic. Sizes and volumes of waste containers vary from millimeter vials in lab packs to cubic yard boxes, tanker trucks, and end dump trailers.

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The volume of all wastes received and stored is limited by storage capacity as defined in this permit; the total volume of waste treated is limited by the permitted process flow of the incineration system. Additional treatment processes employed at the facility, or permitted as future activities, prior to incineration include: (1) polymerization of isocyanates with a permitted treatment capacity of 1,000 gallons per day; (2) blending of wastes; (3) consolidation of waste in the facility's bucket hoist and in containers; (4) splitting of waste; (5) addition of absorbent material; (6) size reduction; (7) steam heating in the facility's drum heater; and (8) slurrification of some waste streams.

Several types of mechanical processing are included in the Part A permit application, all of which are described in Section D of the permit application. These include (1) extrusion of waste at a rate of 18,000 pounds per hour per extruder; and (2) extruding (or pushing) of solid waste from drums at a rate of 18,000 pounds per hour using a pusher. One of two permitted extruders currently exists and one is planned for construction in the future. The pusher unit has not been constructed.

The facility is permitted to accept lab packs in containers less than 85 gallons in size. Lab packs typically are received in drums of varying composition, pails, and fiber boxes. Currently, every lab pack is audited by the Permittee and compared to the generator's inventory sheet. The facility also accepts waste in containers described as loose packs. Loose pack waste constitutes the consolidation of consumer packaged waste. Management of loose pack and lab pack waste is described in Section C of the permit application.

C.1. Process Capacity/Annual Quantity Limitation
OAC Rule 3745-50-43(A)(7)

- (a) The Permittee shall not store more than 638,380 total gallons of containerized waste at any given time in the permitted container storage areas and waste staging areas at the facility. Waste staging areas at the facility are described in Section D of the approved permit application. Container storage areas are listed below:

Building A (Drum Warehouse)	510,000 gallons
Building B (External Truck Wash Building)	15,180 gallons
Building C (Lab Pack Building)	13,200 gallons
Container Holding Building (Slag Canopy)	100,000 gallons

The Permittee shall store hazardous waste in the types of containers (size and type) described in Sections C and D of the approved Part B permit application. The Permittee may not store waste for more than one year in any storage area unless such storage is solely for the purpose of accumulation of such quantities of hazardous waste as are necessary to facilitate proper recovery, treatment, or disposal.

- (b) For the purpose of compliance with the capacity limitation of this permit, each container will be considered to be storing an amount of hazardous waste equal to its capacity, regardless of the actual quantity stored in the container.
- (c) Conditions C.1(a) and C.2 shall not apply to the Permittee's activities as a generator accumulating hazardous waste on-site in compliance with the provisions of OAC Rule 3745-52-34(A).

However, when accumulating waste within permitted container storage areas, in accordance with OAC Rule 3745-52-34(A), the Permittee shall not, for the total amount of hazardous waste stored and accumulated, exceed the maximum container storage inventory established under this Condition.

- (d) The Permittee may receive and store waste in containers without intending to treat this waste on-site (third party waste). The Permittee may transfer waste to another permitted facility for additional treatment, storage or disposal. The Permittee will handle this waste in accordance with the practices and procedures in Sections C and D of the approved Part B permit application.
- (e) The Permittee shall not operate as an off-site facility for treatment in containers without first submitting a permit modification. Waste managed at the facility in containers may undergo pretreatment processes such as polymerization, blending, consolidation, splitting, size reduction, steam heating, or the addition of absorbent prior to treatment by the incineration system. All wastes subjected to container treatment activities will be sent to the incinerator for further treatment prior to being sent off-site.

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C.2. Waste Identification

ORC Sections 3734.02(F) and 3734.05(H); and OAC Rule 3745-50-43

The Permittee shall store and treat in containers only the hazardous waste codes listed in the Part A permit application. The Permittee shall conduct only the permitted treatment activities described in the approved Part B permit application and the terms and conditions of this permit.

C.3. Condition of Containers

OAC Rule 3745-55-71

If a container holding hazardous waste is not in good condition (e.g., severe rusting, apparent structural defects) or if it begins to leak, the Permittee shall transfer the hazardous waste from such container to a container that is in good condition or otherwise manage the waste in accordance with the terms and conditions of this permit or the hazardous waste facility chapters of the OAC.

C.4. Compatibility of Waste with Containers

OAC Rule 3745-55-72

The Permittee shall use containers that are compatible with the hazardous waste to be stored.

C.5. Management of Containers

OAC Rule 3745-55-73

- (a) All container storage shall be conducted within the container storage units as described in Condition C.1. of this permit and Section D of the approved Part B permit application.
- (b) The Permittee shall keep all containers closed during storage, except when it is necessary to add or remove waste, and shall not open, handle, or store containers in a manner which may rupture the container or cause it to leak.
- (c) Lab-packs that are generated on-site (from the facility's on-site laboratory) shall be handled in accordance with applicable storage requirements and in accordance with the conditions described below:

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- (i) lab pack containers must be transferred to processing and/or storage areas by the end of each day shift;
 - (ii) containers must be on pallets;
 - (iii) containers must have hazardous waste labels which include information such as the type of waste and the date the lab pack was generated; and
 - (iv) containers must be covered and secured (at a minimum, plastic covers with elastic or rubber bands).
- (d) In the event lab-pack wastes are sent off-site for disposal, they shall be packaged in containers with absorbent material that is compatible with the waste and further managed as described in OAC Rule 3745-57-16.
- (e) The Permittee shall place all containers on pallets when staged or stored. This is not necessary while the waste or the container is being processed.

C.6. Containment Systems.

OAC Rule 3745-55-75; ORC Section 3734.05(H)

- (a) The Permittee shall maintain the containment system in accordance with the plans and specifications contained in Section D of the Part B permit application. Any additional containment systems shall be constructed and maintained in a similar manner as existing systems and, if applicable, information regarding design details and storm water management will be submitted to the Ohio EPA in the form of a permit modification in accordance with OAC Rule 3745-50-51.
- (b) The Permittee shall maintain the containment system as described in the approved Part B permit application, designed with sufficient capacity to contain ten percent of the total volume of the containers or the volume of the largest container, whichever is greater. The containment system shall be free of cracks and gaps and sufficiently impervious to contain leaks and spills and accumulated precipitation until the collected material is detected and removed. The Permittee shall ensure that the coating(s) utilized in lining the secondary containment systems are compatible with each waste stored in the permitted container storage areas. For those hazardous wastes that are

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deemed incompatible with the liner material, the Permittee shall install a separate secondary containment structure, located within the existing structure, possessing the appropriate liner in order to withstand any degrading effects imposed through initial and/or prolonged contact (e.g., twenty four hours) with released waste materials.

- (c) Spilled or leaked waste and accumulated precipitation shall be removed from the sump or collection area in a timely manner. This time period is not to exceed twenty four hours from the time spilled and/or leaked waste is discovered in the containment system.

C.7. Reserved.

C.8. Inspection Schedules and Procedures
OAC Rules 3745-54-15, and 3745-54-73

As required by OAC Rule 3745-54-15, the Permittee shall inspect all container storage areas in accordance with the inspection schedule contained in Section F of the approved Part B permit application, to detect leaking containers and deterioration of containers and the containment system caused by corrosion or other factors. The Permittee shall note the results of these inspections in the inspection log along with any remedial action taken in accordance with the procedures contained in Section F of the approved Part B permit application. On days when containerized waste are added to, or removed from, any of the permitted storage areas, the Permittee shall conduct an inspection as described in Section F of the approved Part B permit application, and maintain the inspection results in the facility operating record.

C.9. Record Keeping
OAC Rule 3745-54-73

The Permittee shall comply with all record keeping requirements of OAC Rule 3745-54-73 and Permit Conditions, such as A.14 and A.28, as part of the facility's operating record and maintain documentation showing compliance with the requirements of Permit Condition C.13. and OAC Rules 3745-54-17(B) and 3745-55-77.

C.10. Special Container Provisions for Ignitable or Reactive Waste
OAC Rules 3745-54-17 and 3745-55-76

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- (a) The Permittee shall not locate containers holding ignitable or reactive waste within fifteen meters (50 feet) of the facility's property line.
- (b) The Permittee shall take precautions to prevent accidental ignition or reaction of ignitable or reactive waste and shall follow the storage and processing procedures specified in Section D of the approved Part B permit application and Permit Condition B.7.

C.11. Special Container Provisions for Incompatible Waste
OAC Rules 3745-55-77 and 3745-54-17

- (a) The Permittee shall not store incompatible waste except in accordance with OAC Rules 3745-54-17(B) and 3745-55-77.
- (b) The Permittee shall not place hazardous waste in an unwashed container that previously held an incompatible waste or material.
- (c) The Permittee shall separate containers of incompatible wastes from each other.
- (d) The Permittee shall not place incompatible wastes in the same container during consolidation activities.

C.12. Reserved.

C.13. Closure and Post-Closure
OAC Rules 3745-55-10 through 3745-55-20, and 3745-55-78

- (a) At closure of any or all of the container storage areas, the Permittee shall remove all hazardous waste and hazardous waste residues from the containment system, in accordance with the procedures in the closure plan set forth in Section I of the approved Part B permit application.
- (b) If the Permittee demonstrates that not all contaminated soils can be practically removed or decontaminated in accordance with the closure plan, the Permittee shall close the unit and perform post-closure care following a plan approved by the Director of Ohio EPA.

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C.14. Container Staging

- (a) Containers in the Container Processing Building (CPB) shall be staged and processed within twenty-four (24) hours of receipt. Up to seventy-two (72) hours is acceptable under certain circumstances when the Ohio EPA on-site inspectors are informed of the situation.
- (b) Containers staged for processing at other locations will be processed within 24 hours. Time over this period must be brought to the attention of Ohio EPA on-site inspectors.
- (c) Containers awaiting discrepancy resolution, not related to manifest discrepancies, may be placed in designated locations in the Container Processing Building. A holding period up to 120 hours is permitted. Time over this period must be brought to the attention of Ohio EPA on-site inspectors.
- (d) Off-site generated waste in containers greater than > 85 gallons may be stored in the Container Holding Building, Building B, and Building C. Containers of waste designated as direct feed waste (not to be stored on-site) will be processed within 24 hours. Bulk containers of direct feed waste may be staged, if necessary in areas of the facility which are covered, have automatic fire detection and suppression systems, and are in "C" storm water management areas. Locations include Truck Holding and Sampling Bays, Organic Tanker Unloading Bays, Direct Organic Tanker Unloading Areas, Container Receiving Unloading Docks.
- (e) The Permittee shall remove all containers being staged for processing and treatment and place them in permitted storage areas within 24 hours of beginning a scheduled or unscheduled outage. The Permittee may begin staging of waste 24 hours prior to the end of an outage.

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D. TANK STORAGE, TREATMENT AND MANAGEMENT

General Overview

The Permittee is authorized for tank storage and treatment activities associated with organic and inorganic waste treatment operations, laboratory processes, internal and external truck washes, and general wastewater treatment. These activities are described below. Construction has not been started or is only partially completed for many of the permitted operations. Additional specific details for tank systems, including piping and instrumentation diagrams (P&IDs), are provided in Section D of the permit application.

(A) Organic Waste Treatment Operations

Organic waste treatment operations include bulk solid waste storage tanks, an organic tank farm, pump-out tanks, and flue gas scrubber effluent treatment. The bulk solid waste storage tanks are located in the Incinerator Feed Building. These tanks are utilized to process loose solid waste received in containers, end-dumps and roll off boxes. Four tanks with a total capacity not to exceed 2,400 cubic yards of waste are permitted. Two of these have been installed. The installed tanks are each 18 feet by 33 feet and hold up to 600 cubic yards each of waste. The tanks are reinforced concrete, in-ground, open-topped tanks. There are no pumps, piping, bypass systems, or pressure relief devices associated with these tanks. Waste destined for the bulk solid waste storage tanks cannot carry RCRA waste codes of D002 and D003 or contain any free liquids.

The installed portion of the organic tank farm is located in a building at the southeast end of the facility. It contains 18 aboveground tanks with a capacity of 288,000 gallons. The Permittee is authorized to eventually store a total capacity of 612,300 gallons of waste in 52 tanks. The purpose of the Organic Waste Tank Farm is to receive, blend, and store bulk liquid and sludge waste prior to treatment in the Incineration System. Blending (treatment) in tanks at the organic tank farm and in container pump-out tanks is limited by the capacity of the Incineration System. Existing tanks have secondary containment sized to contain the volume of the largest tank in each group. Tanks are equipped with level and temperature alarms, safety cutoffs, bypass systems, pressure and vacuum relief safety devices, and inert gas blanketing. Section D of the permit application describes each tank as well as the material of construction and the tank specifications.

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The pump-out tanks are located in an enclosed building attached to the south wall of the Drum Processing Building. There are currently 5 pump-out tanks, PT-1 through PT-4, PT-6 associated with the extruder, and one overflow tank PT-5. Pump-out Tanks PT-1 through PT-3 receive waste from the container pump-out stations. Tank PT-4 is used as a blending tank for wastes from PT-1 through PT-3 and PT-6 before waste is pumped to the incineration system or the organic waste tank farm. Tanks are aboveground and constructed of carbon steel. Tanks PT-1, PT-2, and PT-3 have a volume capacity of 2,500 gallons; PT-4 has a capacity of 7,000 gallons; PT-5 and PT-6 are 300 and 500 gallons, respectively. The facility is permitted for an additional system of pump-out tanks with a total capacity of 10,500 gallons of waste, to be constructed with the second Incineration system. The secondary containment has a capacity of 11,200 gallons, which exceeds the volume of the largest pump-out tank. Tanks are equipped with level and temperature alarms, safety cutoffs, bypass systems, pressure and vacuum relief safety devices, and inert gas blanketing.

The permittee is authorized to construct and operate a flue gas scrubber effluent treatment system. This unit is partially installed. When completed, this treatment system will include metal precipitation tanks, clarifier thickener, in-line mixer, rapid sand filter and filter press and be capable of treating 190 gallons per minute of scrubber effluent. Tanks W-6 and W-7 have been installed and are used to store water from the scrubber, which typically has a low pH. Tanks W-6 and W-7, each with a capacity of 30,000 gallons, are constructed of fiberglass reinforced plastic. These tanks are provided with secondary containment. Scrubber liquor is generally treated by neutralization and evaporated in the Spray Dryer.

(B) Inorganic Waste Treatment Operations

The permittee is authorized to construct and operate an Inorganic Waste Treatment Operation. This operation is not currently installed, but permitted for future installation. The Inorganic Waste Tank Farm will consist of holding tanks, reaction vessels (reception basins), flow equalization and overflow tanks. Treatment will consist of chemical reactions for metal precipitation, neutralization, oxidation, cyanide destruction, and chrome reduction. The Inorganic Waste Treatment Tank Farm will have a total volume capacity of 613,200 gallons. When constructed, secondary containment will be of the same specifications as currently existing at the facility. Section D of the permit application describes the controls, alarms, temperature and pressure indicators and safety equipment associated with each tank as well as the materials of construction and the tank specifications.

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Wastewater from the Inorganic Waste Treatment Operation will be treated on site as described in Section D of the approved permit application. The permitted maximum flow rate of treated wastewater from the wastewater treatment system designed for treating wastewater from the Inorganic Waste Treatment Operation is one hundred ninety thousand gallons per day.

(C) General Wastewater Treatment System

The permittee is authorized to construct and operate a large scale General Wastewater Treatment System at the facility. Several components of this system are partially installed. The system includes process water holding tanks, flow equalization tanks, overflow tank, mixer flocculator, clarifier, contact chamber, in-line mixer, rapid sand filter, filter press, and carbon filter. It will be sized to treat up to 9,000 gallons per hour. Two process water holding tanks, W-4 and W5, with a total capacity of 500,000 gallons are installed and in use. The process water holding tanks are constructed of carbon steel and are used to collect and store liquids from clean-up activities and/or spills, or storm water collected from active process areas (C-water sumps). The water in Tank W-4 is used as process water at the facility and may be used as make-up water in the four-stage wet scrubber or in the DeNOx system. Treated wastewater can be recycled in the facility, incinerated, or discharged to the East Liverpool Sanitary Sewer or the Ohio River after it has been tested and judged suitable for discharge and is in compliance with appropriate permits from the City, State, and Federal Agencies. These tanks are open to the atmosphere. Tanks are equipped with high level alarms and safety cutoffs. Each of the tanks are provided with secondary containment. Three other tanks from the General Wastewater Treatment System also have been installed and are currently in use. They are the back wash settling tank (W-8) with a capacity of 6,000 gallons, the rapid sand filter (W-9) with a capacity of 150 gallons per minute and the carbon filter (W-10) with a capacity of 150 gallons per minute. These tanks are currently used in the treatment of liquids collected in W-5 prior to transfer to W-4, if treatment is deemed necessary. In the future, they will be used in the General Wastewater Treatment System.

(D) Internal and External Truck Wash Systems

The permittee is authorized to construct and operate Internal and External Truck Wash systems. Truck wash equipment is not currently installed. The Internal Truck Wash system will be used to clean the interior compartments of waste-hauling vehicles. It is intended to be installed in the vicinity of the Organic Tanker Unload Stations and utilize the secondary containment in the unloading area. The Internal

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Truck Wash will use solvent, water or a solvent water mixture to accomplish cleaning activities. The Internal Truck Wash system is planned to consist of eight aboveground tanks which include three accumulation tanks, three reuseable solvent tanks, one recirculation tank, and one overflow tank with a total capacity of 16,900 gallons.

The External Truck Wash system will be used to clean the exterior of vehicles and to decontaminate various pieces of facility equipment and will be located in Building B as described in Section D of the permit application. Water, steam, and/or detergents, as well as solvents, may be used in the cleaning activities. The floor of the building is constructed of reinforced concrete treated to resist chemical attack. The surface inside the building is sloped toward a concrete sump. The contoured surface and sump is designed to contain up to ten thousand gallons. The future system will include two aboveground steel tanks, a holding tank with a capacity of 15,000 gallons, and an overflow tank with a capacity of 300 gallons.

(E) Laboratory Tanks

Laboratory personnel perform various analyses on incoming waste, waste residues, and waste generated on site. Wastewater generated in the laboratory, primarily from the cleaning of glassware, is collected in a 1,000 gallon storage tank. The laboratory tank is an aboveground, fiberglass-reinforced plastic tank, located in a concrete vault directly south of the lab. To prevent overflowing, a high level alarm is installed on the tank. Also, a level gauge is located on the top of the tank. A second laboratory tank is permitted, but not yet installed. The second tank will be a 4,000 gallon aboveground tank operated in essentially the same manner as the current tank.

Section D of the approved Part B permit application includes Tables D.1, D.2, D.3, and D.4, which provide a list of the existing permitted tanks, tank volumes, secondary containment capacities, tank location, material of construction, and dimensions. Section D also describes in detail the general design criteria, safety devices and systems, alarm systems and overfill protection, the inert gas blanketing and tank venting precautions, and the tank charging operations. Specific details regarding each tank, including piping and instrumentation diagrams (P&IDs), are provided in attachments to Section D in the Part B permit application. In the management of incompatible wastes, the Permittee shall adhere to all applicable hazardous waste rules, terms and conditions of this permit such as Permit Condition B.7, and the approved Part B permit application. In general, wastes that are incompatible will not be combined in the same tank. Standard Operating Procedures (SOPs) have been developed and are utilized to identify, segregate, and handle pumpable

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waste that is ignitable, reactive, or incompatible with other waste. If waste is to be placed in a tank that already contains waste, these procedures will be followed to verify the compatibility of the wastes before they are combined.

D.1. Process Capacity/Annual Limitation/Waste Identification
ORC Section 3734.02(F) and OAC Rule 3745-50-43

- (a) The Permittee is permitted for no more than 134 aboveground tanks with a design capacity of 2,926,100 gallons for pumpable liquid waste, four in-ground tanks with a design capacity of 600 cubic yards each (2,400 cubic yards total) of non-reactive, loose solid waste, and five aboveground tanks with a design capacity of 180 cubic yards for solid treatment residue.

Currently, there are eighteen existing tanks located in the Organic Waste Tank Farm for receiving, blending and storing 288,000 gallons of hazardous waste. There are five existing Pump-out Tanks located in the PT Tank Farm adjacent to the Container Processing Building for blending and storing 14,800 gallons of hazardous waste. There is one Pump-out Tank associated with the facility's Extruder for blending and storing 500 gallons of hazardous waste. A rapid sand filter and carbon filter (both of which are in tanks) may be used to treat contaminated storm water and liquids collected in the facility's C-Areas, described in Section B of the permit application. Liquids from clean-up activities and/or spills, or storm water collected from active process area "C" water sumps are transferred to the Facility's wastewater storage tank (W-5). If analytical of this water indicates the water is in need of treatment, the water may be incinerated, sent off-site for treatment, or transferred through the carbon and sand filters to Tank W-4. Water in this storage tank is considered "recycled" water and may be used as make-up water for, but not limited to, the Four-Stage Wet Scrubber or in the DeNOx System mixed with ammonia and injected into the Secondary Combustion Chamber. Process water from the incinerator train is stored in two existing tanks (TANKS W-6 AND W-7) with a total capacity of 60,000 gallons (each tank holds 30,000 gallons). There are two existing in-ground tanks located in the Incinerator Feed Building for storing 600 cubic yards of bulk, loose, non-reactive, solid waste (1,200 cubic yards total). These tanks are subject to the terms of this Permit and the approved Part B permit application, and as follows:

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Tank No.	Capacity (Gallons)	Dimensions of Tank	Secondary Containment Required	Description of Hazardous Waste
T-1 (1220):	20,000	12' diam x 22'5"	Yes - in place	fuel oil
T-2 (1302):	10,000	12' diam x 10'7"	Yes - in place	organic waste
T-3 (1385):	2,000	6' diam x 8'10"	Yes - in place	organic waste
T-4 (1303):	20,000	12' diam x 22'5"	Yes - in place	high-BTU organic waste
T-5 (1301):	20,000	12' diam x 22'5"	Yes - in place	high-BTU organic waste
T-6 (1202):	20,000	12' diam x 22'5"	Yes - in place	sludges
T-7 (1201):	20,000	12' diam x 22'5"	Yes - in place	sludges
T-8 (1105):	7,000	8' diam x 16'6"	Yes - in place	organic wastes
T-9 (1101):	7,000	8' diam x 16'6"	Yes - in place	organic wastes
T-10 (1212):	20,000	12' diam x 20'3"	Yes - in place	organic liquids and sludges
T-11 (1211):	20,000	12' diam x 20'3"	Yes - in place	organic liquids and sludges
T-12 (1216):	20,000	12' diam x 20'3"	Yes - in place	organic liquids
T-13 (1215):	20,000	12' diam x 20'3"	Yes - in place	organic liquids
T-14 (1210):	20,000	12' diam x 20'3"	Yes - in place	organic liquids and sludges
T-15 (1207):	20,000	12' diam x 20'3"	Yes - in place	organic liquids and sludges
T-16 (1206):	20,000	12' diam x 20'3"	Yes - in place	organic liquids and sludges
T-17 (1205):	20,000	12' diam x 20'3"	Yes - in place	organic liquids and sludges
T-18 (1380):	2,000	6' diam x 8'10"	Yes - in place	organic wastes
PT-1 (1231):	2,500	7' diam x 8'	Yes - in place	organic and inorganic hazardous wastes
PT-2 (1232):	2,500	7' diam x 8'	Yes - in place	organic and inorganic hazardous wastes
PT-3 (1233):	2,500	7' diam x 8'	Yes - in place	organic and inorganic hazardous wastes

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Tank No.	Capacity (Gallons)	Dimensions of Tank	Secondary Containment Required	Description of Hazardous Waste
PT-4 (1102):	7,000	9' diam x 13'9"	Yes - in place	organic and inorganic hazardous wastes
PT-5 (0660):	300	3' diam x 5'4"	Yes - in place	organic and inorganic hazardous wastes
PT-6 (1304):	500	5' diam x 5'1"	Yes - in place	organic and inorganic hazardous wastes
L-1 (1050):	1,000	4' diam x 10'6"	Yes - in place	lab waste
S-1 (1501):	600 cubic yards	18' x 33'	no	bulk, loose, non-reactive hazardous solid wastes
S-2 (1502):	600 cubic yards	18' x 33'	no	bulk, loose, non-reactive hazardous solid wastes
W-4 (1400):	250,000	33' diam x 40'	Yes - in place	spill, clean-up, potentially contaminated storm water
W-5 (1500):	250,000	33' diam x 40'	Yes - in place	spill, clean-up, potentially contaminated storm water
W-8 (3100):	6,000	10' diam x 10'	Yes - in place	process water
W-9 (3000):	1,700	7' diam x 6'	Yes - in place	process water
W-10 (3300):	7,000	10' diam x 12'	Yes - in place	process water
W-6 (2000):	30,000	12' diam x 36'	Yes - in place	process water
W-7 (2100):	30,000	12' diam x 36'	Yes - in place	process water

- (b) During any calendar year, the Permittee shall not manage, through tank storage, hazardous waste in excess of the maximum annual quantity set forth in Condition B.1(b) of this permit.
- (c) The Permittee may conduct blending (treatment) in tanks at the organic tank farm or in the container pumpout tanks to facilitate treatment of the waste by incineration and for the purpose of off-site transfer or fuels blending.
- (d) The Permittee is prohibited from storing or treating hazardous waste that is not identified in the facility's Part A permit application. Section C of the approved Part B permit application, the Waste Characteristics and Waste Analysis Plan (WAP), describes wastes which are prohibited from being accepted by the facility and those which are restricted once accepted due to

handling, processing, or treatment considerations.

D.2. Design and Installation of New Tank Systems or Components
OAC Rule 3745-55-92

- (a) The Permittee shall construct any future new tank system(s) in accordance with Section D-9 of the approved Part B permit application.
- (b) Prior to operation of the newly constructed tank system, the Permittee shall submit the certification of installation of the tank system in accordance with OAC Rule 3745-55-92(B) to ensure that proper handling procedures were adhered to in order to prevent damage to the system during installation.

D.3. Containment and Detection of Releases
OAC Rule 3745-55-93

The Permittee shall construct and operate the secondary containment system in accordance with requirements of OAC Rules 3745-55-93(B) through (F), and Section D and F of the approved Part B permit application.

D.4. Operating Requirements
OAC Rule 3745-55-94

- (a) The Permittee shall not place hazardous wastes or treatment reagents in the tank system if they could cause the tank, its ancillary equipment, or a containment system to rupture, leak, corrode, or otherwise fail.
- (b) The Permittee shall prevent spills and overflows from the tank or containment systems using the methods described in the approved Part B permit application. The Permittee shall comply with the requirements of OAC Rule 3745-55-96 if a leak or spill occurs in the tank system.
- (c) The Permittee shall operate and manage tanks in accordance with Permit Condition D.1, B.7, and Section D of the Part B permit application. This shall include, for example, temperature and pressure sensors in the tanks, nitrogen blanketing, and rupture disks which release to the facility's vapor recovery system.

D.5. Inspection Schedules and Procedures
OAC Rule 3745-55-95

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- (a) The Permittee shall inspect the tank systems, in accordance with the inspection schedule in Section F of the approved Part B permit application and shall complete the items in Permit Conditions D.5(b) and D.5(c) as part of those inspections.
- (b) The Permittee shall inspect the overfill controls, in accordance with the procedure and schedule in SECTION F OF the approved Part B permit application.
- (c) The Permittee shall inspect the following components of the tank system once each operating day:
 - (i) aboveground portions of the tank system, if any, to detect corrosion or releases of waste;
 - (ii) data gathered from monitoring and leak detection equipment (e.g., pressure or temperature gauges, monitoring wells) to ensure that the tank system is being operated according to its design; and
 - (iii) construction materials and the area immediately surrounding the externally accessible portion of the tank system, including the secondary containment system, to detect erosion or signs of releases of hazardous waste (e.g., wet spots, dead vegetation).
- (d) Reserved.
- (e) The Permittee shall immediately remove from service any permitted tank with a remaining wall thickness that is less than the design minimum wall thickness. The design minimum wall thickness is the total design wall thickness minus the design corrosion allowance. The wall thickness of each active tank shall be inspected and measured on an annual basis and compared to the design wall thickness found in Section D of the approved Part B permit application. Section D also includes the design corrosion allowance for each tank in the relevant attachment to Section D. This procedure will be conducted in order to evaluate the integrity of the tanks.

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- (f) The Permittee shall document compliance with Permit Condition D.5 in the operating record of the facility.

D.6. Response to Leaks or Spills
OAC Rule 3745-55-96

- (a) In the event of a leak or a spill from the tank system, from a secondary containment system, or if a system becomes unfit for continued use, the Permittee shall remove the system from service immediately and complete the following actions:
 - (i) Stop the flow of hazardous waste into the tank system or secondary containment system and inspect the system to determine the cause of the release.
 - (ii) Remove waste and accumulated precipitation from the system within 24 hours of the detection of the leak or at an earlier practicable time to prevent further release and harm to human health and the environment and to allow inspection and repair of the tank/containment system to be performed.
 - (iii) Contain visible releases to the environment. The Permittee shall immediately conduct a visual inspection of all releases to the environment and, based on that inspection: (1) prevent further migration of the leak or spill to soils or surface water and (2) remove and properly dispose of any visible contamination of the soil or surface water.
 - (iv) The Permittee shall report releases in accordance with Permit Conditions A.20 and D.7 and Section G of the approved Part B permit application.
- (b) Unless the requirements of Permit Conditions D.6.(b)(i) through D.6.(b)(vi) are satisfied, the Permittee shall close its tank system in accordance with OAC Rule 3745-55-97 and its approved Closure Plan if there has been a leak or spill from the tank system, from a secondary containment system, or if a system becomes unfit for continual use.

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- (i) For a release caused by a spill that has not damaged the integrity of the system, the Permittee shall remove the released waste and make any necessary repairs to fully restore the integrity of the system before returning the tank system to service.
 - (ii) For a release caused by a leak from the primary tank system to the secondary containment system, the Permittee shall repair the primary system prior to returning it to service.
 - (iii) For a release to the environment caused by a leak from a component of the tank system that is below ground and does not have secondary containment, the Permittee must provide this component with secondary containment that meets the requirements of OAC Rule 3745-55-93 before the component can be returned to service.
 - (iv) Reserved.
 - (v) For a release to the environment caused by a leak from the portion of the tank system component that is not readily available for visual inspection, the Permittee shall provide secondary containment that meets the requirements of OAC Rule 3745-55-93 before the component can be returned to service.
 - (vi) If the Permittee replaces a component of the tank system to eliminate the leak, that component must satisfy the requirements for new tank systems or components in OAC Rules 3745-55-92 and 3745-55-93.
- (c) For all major repairs to eliminate leaks or restore the integrity of the tank system, the Permittee must obtain a certification by an independent, qualified, registered professional engineer in accordance with OAC Rule 3745-50-42(D) that the repaired system is capable of handling hazardous wastes without release for the intended life of the system before returning the system to service. Examples of major repairs are:

installation of an internal liner, repair of a ruptured tank, or repair or replacement of a secondary containment vault.

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D.7. Record keeping and Reporting

OAC Rules 3745-55-96, 3745-55-91(A), and 3745-55-92(G)

- (a) The Permittee shall report to the Director, within twenty four (24) hours of detection, when a leak or spill occurs from the tank system or secondary containment system to the environment. A leak or spill of one pound or less of hazardous waste, that is immediately contained and cleaned-up, need not be reported. Releases that are contained within a secondary containment system need not be reported.
- (b) Within thirty days of detecting a release to the environment from the tank system or secondary containment system, the Permittee shall report the following information to the Director:
 - (i) likely route of migration of the release;
 - (ii) characteristics of the surrounding soil (including soil composition, geology, hydrogeology, and climate);
 - (iii) results of any monitoring or sampling conducted in connection with the release. If the Permittee finds it will be impossible to meet this time period, the Permittee should provide the Director with a schedule of when the results will be available. This schedule must be provided before the required thirty day submittal period expires;
 - (iv) proximity of down gradient drinking water, surface water, and populated areas; and
 - (v) description of response actions taken or planned.
- (c) The Permittee shall submit to the Director all certifications of major repairs to correct leaks within seven days from returning the tank system to use.
- (d) The Permittee shall obtain, and keep on file at the facility, the written statements by those persons required to certify the design and installation of the tank system.
- (e) The Permittee shall keep on file at the facility the written assessment of the tank system's integrity.

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- (f) The Permittee shall maintain at the facility a record of the results of leak tests and integrity tests conducted.

D.8. Closure and Post-Closure Care
OAC Rule 3745-55-97

- (a) At closure of the tank system(s), the Permittee shall follow the procedures in the Closure Plan in Section I of the approved Part B permit application.
- (b) If the Permittee demonstrates that not all contaminated soils can be practically removed or decontaminated, in accordance with the Closure Plan, then the Permittee shall close the tank system(s) and perform post-closure care following the contingent procedures in the Closure Plan and in the Post-Closure Plan.

D.9. Special Tank Provisions for Ignitable or Reactive Wastes
OAC Rule 3745-55-98

- (a) The Permittee shall not place ignitable or reactive waste in the tank system or in the secondary containment system, unless the procedures specified in the approved Part B permit application and Permit Condition B.7 are followed. The Permittee shall document compliance with this condition and place it in the operating record.
- (b) The Permittee shall not place ignitable or reactive waste in the tank system, unless the waste is treated, rendered, or mixed before or immediately after placement in the tank system, so that: (a) the resulting waste, mixture, or dissolved material no longer meets the definition of ignitable or reactive waste in OAC Rules 3745-54-21 or 3745-54-23 and the precautions in OAC Rule 3745-54-17(B) are complied with; (b) the waste is managed in such a way that it is protected from any material or conditions which may cause it to ignite or react; or (c) the tank system is used solely for emergencies.
- (c) The Permittee shall place ignitable or reactive waste only in tanks that:
 - (i) Maintain a nitrogen blanket over volatile organic waste sufficient to prevent air intrusion and maintain internal tank atmosphere under the lower explosive limit;
 - (ii) Are equipped with a vent emission control system which collects

vapors and conveys them to be thermally destroyed by incineration or to be treated by the Regenerable Activated Carbon Adsorption Cleaning System; and

- (iii) Are equipped with flame arresters or equivalent devices as described in Section D of the approved Part B permit application.
- (d) The Permittee shall comply with the requirements for the maintenance of protective distances between the waste management area and any public ways, streets, alleys, or an adjoining property line that can be built upon, as required in Tables 2-1 through 2-6 of the National Fire Protection Association's "Flammable and Combustible Liquids Code" (1991 or most recent edition) incorporated by reference in OAC Rule 3745-50-11.

D.10. Special Tank Provisions for Incompatible Wastes
OAC Rule 3745-55-99

- (a) The Permittee shall not place incompatible wastes, or incompatible wastes and materials, in the same tank system or the same secondary containment system, unless the procedures specified in Sections C and D of the approved Part B permit application and Permit Condition B.7 are followed. The Permittee shall document compliance with this condition and place that documentation into the operating record.
- (b) The Permittee shall not place hazardous waste in a tank system that has not been decontaminated and that previously held an incompatible waste or material, unless the requirements of Permit Condition D.10(a) are met.

D.11. Reserved.

D.12. On-Site Decontamination Procedures

The Permittee shall employ procedures, as described in facility SOPs, in instances where routine and/or non-routine activities or projects result in the potential for transfer of hazardous waste out of a contained area. The Permittee will control the transfer of hazardous waste out of contained areas during decontamination procedures.

The Permittee shall also manage contaminated personal protective equipment, debris, and rinseate generated during decontamination procedures or routine maintenance activities according to standard operating procedures in place at the facility.

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E. CORRECTIVE ACTION REQUIREMENTS

Corrective Action Summary

The River Services Company owned and operated a bulk storage terminal for distributing petroleum products from 1955 to 1981 at the site of the current VRA facility. Between 1980 and 1981 the Charter International Oil Company (Charter Oil) leased the petrochemical terminal from the River Services Company. During operations, the Charter Oil facility received solvents including acetone, toluene, xylene, and "mineral spirits" which were transferred from river transport ships to storage tanks and then to tanker trucks for distribution. The petrochemical terminal consisted of ten (10) above ground storage tanks surrounded by an earthen dike. A known spill history at the Charter Oil facility included:

- (1) a release of approximately 19,000 gallons of xylene in 1983;
- (2) release of approximately 33,000 gallons of mineral spirits in 1984;
- (3) an alleged release of approximately 200,000 gallons of an unidentified substance investigated by Ohio EPA in 1984.

On September 2, 1981, the Port Authority for Columbiana County (CCPA), Ohio acquired the Charter Oil facility through eminent domain. Charter Oil continued to lease the property from the Columbiana County Port Authority until May 31, 1984.

Analytical results collected at the facility in March of 1990 indicated the presence of toluene, ethylbenzene, xylene in the ground water and soil and also found benzene, acetone, and trimethylbenzenes in the ground water.

The CCPA negotiated an Administrative Consent Agreement with Ohio EPA to address ground water contamination at the facility. The work required by this consent agreement was designed to contain, abate and mitigate contamination through an interim measure. This consent agreement was journalized on November 22, 1991.

VRA purchased the facility property from the CCPA in December of 1992. With the purchase of the property from the CCPA, VRA assumed responsibility for the clean up of the Charter Oil Facility Release Area.

PRC Environmental Management, Inc., under contract by U.S. EPA, performed a preliminary assessment and visual site inspection (PA/VI) to identify and assess the existence and likelihood of releases from solid waste management units (SWMU) and

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other areas of concern (AOC) at the VRA facility in East Liverpool, Columbiana County, Ohio. The PA was completed on August 8, 1993 and the VSI was conducted on August 25 and 26, 1993. The PAVSI identified eighteen SWMUs and one AOC at the VRA facility. Descriptions of the SWMUs and AOC given in the PAVSI and updated by Ohio EPA are provided in Attachment 4 to this permit. The AOC is the Former Charter Oil Facility Release Area which is under an Administrative Consent Agreement with Ohio EPA. Except for the AOC, no other releases were documented in the PAVSI.

Transition of corrective action authority from U. S. EPA to Ohio EPA will occur on the date of the state permit issuance.

E.1. Corrective Action at the Facility
OAC Rules 3745-50-10 & 3745-54-101

In accordance with OAC Rule 3745-50-10, "waste management unit" means any discernible unit at which wastes have been placed at any time, irrespective of whether the unit was intended for the management of waste or hazardous waste. Such units include any area at a facility where wastes have been routinely and systematically released. As used in this permit, the term "waste management unit" shall be consistent with, and equivalent to, the term "solid waste management unit" as defined in Section 3004(u) of RCRA. For the purpose of corrective action, facility, is defined as all contiguous property under the control of the owner or operator seeking a permit under Subtitle C of RCRA. The terms Interim Measure (IM), RCRA Facility Investigation (RFI), Corrective Measures Study (CMS) and Corrective Measure Implementation (CMI) are defined in Attachment 5, U.S. EPA's Corrective Action Plan (CAP) and are used herein.

The Permittee must institute corrective action as necessary to protect human health and the environment for all releases of hazardous waste(s) or hazardous constituent(s) from any waste management units (WMUs) at the facility, regardless of the time at which waste was placed in such units.

E.2. Corrective Action Beyond the Facility Boundary
OAC Rule 3745-54-101

The Permittee must implement corrective action(s) beyond the facility property boundary, where necessary to protect human health and the environment, unless the Permittee demonstrates to the satisfaction of Ohio EPA that, despite the Permittee's best efforts, 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

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addressed under the RFI, CMS, and CMI phases, as determined to be necessary on a case-by-case basis.

E.3 Identification Of Waste Management Units (WMUs)
OAC Rules 3745-50-44(D) & 3745-54-101

The 1993 PA/VI documented releases to soil and groundwater at one area of concern (AOC), the former Charter Oil Facility Release Area (COFRA). Interim Measures related to contamination at the former COFRA are ongoing pursuant to a consent agreement with Ohio EPA. This AOC will be addressed through the Corrective Action process. No corrective action is being required at the other WMUs at this time.

See Attachment 4 of this permit for a list and description of all WMUs and AOCs.

E.4 Reserved.

E.5 RCRA Facility Investigation (RFI)
OAC Rule 3745-54-101

The Permittee shall conduct an RFI to thoroughly evaluate the nature and extent of the release of hazardous waste(s) and hazardous constituent(s) from the COFRA area identified in Permit Condition E.3. and any newly identified units per Permit Condition E.10. The major tasks and required submittal dates are shown below. The scope of work for each of the tasks is found in Attachment 5 (U.S. EPA's CAP).

(a) RFI Workplan

The Permittee shall submit a written RFI Workplan to Ohio EPA within 90 days after the effective date of this permit or, in case of a newly discovered waste management unit, on a time frame established by Ohio EPA.

- (i) If necessary, Ohio EPA shall provide written comments on the RFI Workplan to the Permittee.
- (ii) Within forty-five days of receipt of Ohio EPA's comments, the Permittee shall submit either an amended or new RFI Workplan that incorporates Ohio EPA's comments.
- (iii) Ohio EPA shall approve or modify and approve, in writing, the amended or new RFI Workplan. The RFI Workplan, as approved or

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as modified and approved, shall be incorporated into this permit and become an enforceable condition of this permit. Subsequent changes to the approved RFI Work Plan must be authorized by Ohio EPA.

(b) RFI Implementation

The Permittee shall implement the RFI Workplan according to the terms and schedule in the approved RFI Workplan.

(c) RFI Final Report

Within sixty days after the completion of the RFI, the Permittee shall submit an RFI Final Report to Ohio EPA. The RFI Final Report shall describe the procedures, methods, and results of the RFI. The Final Report must contain adequate information to support further decisions concerning corrective action at the facility.

- (i) If necessary, Ohio EPA shall provide written comments on the RFI Report to the Permittee.
- (ii) Within forty-five days of receipt of Ohio EPA's comments, the Permittee shall submit either an amended or new RFI Report that incorporates Ohio EPA's comments.
- (iii) Ohio EPA shall approve or modify and approve, in writing, the amended or new RFI Report. The RFI Report, as approved or as modified and approved, shall be incorporated into this permit and become an enforceable condition of this permit. Subsequent changes to the approved RFI Report must be authorized by Ohio EPA.

E.6 Interim Measure (IM)

The Permittee shall continue to comply with the Director's 1991 Administrative Consent Agreement (Order) regarding interim measures at the former Charter Oil Facility Release Area (COFRA) until the Order has been revised or completed and terminated. The interim measures Order will continue to be implemented with oversight by Ohio EPA Division of Emergency and Remedial Response (DERR).

Based on the RFI Final Report or other information documenting a release of hazardous waste or constituents to the environment, Ohio EPA may require the development and implementation of an additional interim measure (this may include an IM Workplan) at any time during the life of the permit to mitigate or eliminate a

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threat to human health or the environment.

E.7 Determination of No Further Action

(a) Permit Modification

Based on the results of the completed RFI and other relevant information, the Permittee may submit an application to Ohio EPA for a Class 3 permit modification under OAC Rule 3745-50-51 to terminate the corrective action tasks of the Schedule of Compliance. Other tasks identified in the Schedule of Compliance shall remain in effect. This permit modification application must conclusively demonstrate that there are no releases of hazardous waste or constituents from WMUs at the facility that pose a threat to human health and the environment.

If, based upon review of the Permittee's request for a permit modification, the results of the completed RFI, and other information, including comments received during the initial sixty-day public comment period required for Class 3 permit modifications, Ohio EPA determines that releases or suspected releases which were investigated either are nonexistent or do not pose a threat to human health and the environment, Ohio EPA will approve the requested modification.

(b) Periodic Monitoring

A determination of no further action shall not preclude Ohio EPA from requiring continued or periodic monitoring of air, soil, ground water, or surface water, if necessary, to protect human health and the environment, when site-specific circumstances indicate that potential or actual releases of hazardous waste or constituents are likely to occur.

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(c) Further Investigations

A determination of no further action shall not preclude Ohio EPA from requiring further investigations, studies, or remediation at a later date, if new information or subsequent analysis indicates that a release or likelihood of a release from a WMU at the facility is likely to pose a threat to human health or the environment. In such a case, Ohio EPA shall initiate a modification to the terms of the permit to rescind the determination made in accordance with Permit Condition E.7.a. Additionally, in the event Ohio EPA determines that there is insufficient information on which to base a determination, the Permittee, upon notification, will be required to perform additional investigations as needed.

E.8 Corrective Measures Study (CMS)

If Ohio EPA determines, based on the results of the RFI and any other relevant information, that corrective measures are necessary, Ohio EPA will notify the Permittee in writing that the Permittee shall conduct a CMS either as described below or as described in Ohio EPA's notification to the Permittee. The purpose of the CMS will be to develop and evaluate the corrective action alternative(s) and to outline one or more alternative corrective measure(s) that will satisfy the performance objectives specified by Ohio EPA.

(a) CMS Workplan

The Permittee shall submit a written CMS Workplan to Ohio EPA within ninety days from the notification by Ohio EPA of the requirement to conduct a CMS.

- (i) If necessary, Ohio EPA shall provide written comments on the CMS Workplan to the Permittee.
- (ii) Within forty-five days of receipt of Ohio EPA's comments, the Permittee shall submit either an amended or new CMS Workplan that incorporates Ohio EPA's comments.
- (iii) Ohio EPA shall approve or modify and approve, in writing, the amended or new CMS Workplan. The CMS Workplan, as approved or as modified and approved, shall be incorporated into this permit and become an enforceable condition of this permit. Subsequent changes to the approved CMS Workplan must be authorized by Ohio EPA.

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(b) CMS Workplan Implementation

The Permittee shall implement the CMS Workplan according to the terms and schedule in the approved CMS Workplan.

(c) CMS Final Report

Within sixty days after the completion of the CMS, the Permittee shall submit a CMS Final Report to Ohio EPA. The CMS Final Report shall summarize the results of the investigations for each remedy studied and must include an evaluation of each remedial alternative.

- (i) If necessary, Ohio EPA shall provide written comments on the CMS Report to the Permittee.
- (ii) Within forty-five days of receipt of Ohio EPA's comments, the Permittee shall submit either an amended or new CMS Report that incorporates Ohio EPA's comments.
- (iii) Ohio EPA shall approve or modify and approve, in writing, the amended or new CMS Report. The CMS Report, as approved or as modified and approved, shall be incorporated into this permit and become an enforceable condition of this permit. Subsequent changes to the approve CMS Report must be authorized by Ohio EPA.

E.9 Corrective Measure Implementation (CMI)

Based on the results of the CMS, the Permittee shall implement one or more of the corrective measures authorized by Ohio EPA. Ohio EPA shall authorize one or more of the corrective measures in the CMS, and shall notify the Permittee in writing of the decision. The corrective measure selected for implementation must: (1) be protective of human health and the environment; (2) attain media cleanup standards; (3) control the source(s) of releases so as to reduce or eliminate further releases of hazardous waste(s), including hazardous constituent(s); and (4) comply with all applicable standards for management of wastes.

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If two or more of the corrective measures studied meet the threshold criteria set out above, Ohio EPA will authorize the CMI by considering remedy selection factors including: (1) long-term reliability and effectiveness; (2) the degree to which the corrective measure will reduce the toxicity, mobility or volume of contamination (3) the corrective measure's short-term effectiveness; (4) the corrective measure's implementability; and (5) the relative cost associated with the alternative.

In authorizing the proposed corrective measure(s), Ohio EPA may also consider such other factors as may be presented by site-specific conditions.

(a) Permit Modification
OAC Rule 3745-50-51

Ohio EPA will initiate a permit modification, as provided by OAC Rule 3745-50-51 to require implementation of the corrective measure(s) authorized.

The Permittee shall not implement the corrective measure until the permit is modified pursuant to OAC Rule 3745-50-51.

(b) Financial Assurance
OAC Rule 3745-55-011

As part of the modification of this permit to incorporate the CMI, the Permittee shall provide financial assurance in the amount necessary to implement the corrective measure(s) as required by OAC Rules 3745-55-011 (b) and (c).

E.10 Newly Identified Waste Management Units or Releases
OAC Rule 3745-54-101

(a) General Information

The Permittee shall submit to Ohio EPA, within thirty days of discovery, the following information regarding any new WMU identified at the facility:

- (i) the location of the unit on the site topographic map;
- (ii) designation of the type of unit;

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- (iii) general dimensions and structural description (supply any available drawings);
 - (iv) when the unit was operated; and
 - (v) specifications of all waste(s) that have been managed at the unit.
- (b) Release Information

The Permittee shall submit to Ohio EPA, within thirty days of discovery, all available information pertaining to any release of hazardous waste(s) or hazardous constituent(s) from any new or existing WMU.

E.11 Corrective Action for Newly Identified WMUs and Releases
OAC Rule 3745-54-101

The Permittee shall submit a written RCRA Facility Investigation Workplan to Ohio EPA upon a time frame established in written notification by Ohio EPA that further investigations or corrective measures are necessary.

Further investigations or corrective measures will be established by Ohio EPA. Permittee shall make such submittal in accordance with time frames established by Ohio EPA.

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F. TREATMENT IN MISCELLANEOUS UNITS

The Permittee is permitted for nine miscellaneous units, two filter presses, one associated with the Flue Gas Scrubber Effluent Treatment System and one associated with the General Wastewater Treatment System, four shredders, two extruders, and a pusher. The shredders are associated with the Incineration System. Of the nine units, only one of the extruders is currently installed and operating.

The permitted capacity for the filter presses is 600 gallons per hour per unit. Both units will be constructed in areas with secondary containment. A description of the proposed operation of the two filter presses follows. A more thorough description of the Flue Gas Scrubber Effluent Treatment System and the General Wastewater Treatment System is included in Section D-10 of the approved permit application.

Wastewater from the Inorganic Waste Treatment Operation (not yet constructed) will be conveyed to flow equalization tanks in the General Wastewater Treatment System. Wastewater approved for treatment will be conveyed from the flow equalization tanks to the clarifiers for removal of suspended solids. Sludges from the bottom of the clarifier, along with sludge from the bottom of the inorganic waste treatment reaction vessels, will be dewatered in the filter press utilizing up to two hundred pounds per square inch of pressure. The filter cake will be accumulated in a container and transported by an independent licensed hauler to a permitted disposal facility. The filtrate from the filter press will be returned to the inlet of the clarifier.

The Flue Gas Scrubber Effluent Treatment System (not yet constructed) will include tanks for accumulating excess scrubber liquor. Scrubber effluent from the Four Stage Wet Scrubber will be accumulated in tanks where a solution of calcium hydroxide will be added to elevate the pH of the mixture to the level required for precipitation of dissolved metals. The mixture will be agitated to facilitate the precipitation of the metals. Once analysis of the mixture verifies that the desired level of metal precipitation has been achieved, the mixture will be conveyed to the clarifier-thickener. The sludge drained from the bottom of the clarifier-thickener will be transferred to a filter press for separation of suspended solids. The filter press will be selected to dewater the sludge to eighty percent solids using up to two hundred pounds per square inch of dewatering pressure. The filter cake will be accumulated in a container and eventually transported by a licensed hauler to an independent, permitted facility for disposal. The filtrate will be recirculated to the clarifier-thickener.

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The Permittee may install shredders, or a device that is an engineering equal, in close proximity to each of the existing Bulk Solid Waste Storage Tanks which are described in Section D of the approved permit application. The shredders are anticipated to operate in batch mode, shredding large pieces of waste as a pretreatment process. There are no pumps, piping, bypass systems or pressure relief devices associated with the shredders. Construction of the second Incineration System will include two additional Bulk Solid Waste Storage Tanks, each may include shredders.

The existing extruder is located on the second level of the Container Processing Building and is described in detail in Section D of the approved permit application. The extruder removes liquid and semi-solid material from containers at a maximum rate of 18,000 pounds per hour. The unit has secondary containment, automated fire detection and suppression, safety cutoffs, bypass systems, and pressure controls. A continuous nitrogen blanket maintains an inert atmosphere within the unit. The second extruder will be identical to the existing unit and will include secondary containment, automated fire detection and suppression, safety cutoffs, bypass systems, and pressure controls.

The unit referred to as the Pusher will be utilized for extruding (or pushing) bulk solid waste from 55-gallon drums at a maximum rate of 18,000 pounds per hour.

Final construction of the unit will include secondary containment, automated fire detection and suppression, and all applicable safety cutoffs, bypass systems, and pressure controls.

F.1. Modification of Application
OAC Rule 3745-50-51

Prior to construction of the miscellaneous treatment units, the Permittee will submit plans to the Ohio EPA for review to determine consistency with the permit and the approved permit application.

F.2. Process Capacity/Annual Limitation
ORC Section 3734.02(F) and OAC Rule 3745-50-43

The Permittee shall not exceed a maximum process treatment capacity of 600 gallons per hour for each filter press. Each shredder is permitted to process 40,000 pounds of waste per hour. The pusher and each extruder (existing and future) are permitted to process a maximum of 18,000 pounds per hour.

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F.3. Waste Identification
OAC Rule 3745-50-43

The Permittee shall treat in the permitted miscellaneous units, only the hazardous waste codes specified in Part A of the approved permit application for which incineration and wastewater treatment is permissible. Waste restrictions that apply to any of the miscellaneous units are described in Section C of the permit application.

F.4. Assessment/Certification of Miscellaneous Unit
OAC Rule 3745-57-91, 3745-50-42(D)

The Permittee shall obtain and keep on file at the facility, a written statement by a qualified, registered professional engineer that attests that the miscellaneous units were properly designed and installed. The written statement must also include the certification as required by OAC Rule 3745-50-42(D).

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F.5. Containment System
OAC Rule 3745-55-93

The filter presses will be an integral part of the Flue Gas Scrubber Effluent Treatment and the General Wastewater Treatment Systems described in Section D of the approved permit application. Consequently, secondary containment for these miscellaneous treatment units will be part of the containment constructed for the systems. The existing extruder was constructed with secondary containment as detailed in the permit application. The shredders, which are associated with the Incineration System, the future extruder, and the pusher, may require secondary containment depending upon where they are installed. If secondary containment is required, it will be constructed to meet the specifications of existing secondary containment at the facility and in accordance to the following:

- (a) Secondary containment must be designed, installed and operated to prevent any migration of waste or accumulated liquid out of the system to soil, groundwater, or surface water.
- (b) Secondary containment must be capable of detecting and collecting releases and accumulated liquids until the collected materials is removed.
- (c) The secondary containment must meet the requirements of OAC Rule 3745-55-93.

F.6. General Operating Requirements
OAC Rule 3745-55-94

(a) **Filter Press System**

- (1) Hazardous waste or treatment reagents shall not be placed in the filter press system if they could cause the filter press, its ancillary equipment, or the secondary containment system to rupture, leak, corrode, or otherwise fail, as required by OAC Rule 3745-55-94.
- (2) The Permittee must use appropriate controls and practices to prevent spills or overflows from the filter press or containment system.
- (3) The filter press must be maintained and operated in accordance with the procedures and practices in Section D of the approved permit.

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application, manufacturer's instructions, and accepted industry practice.

- (4) The Permittee must comply with the requirements of OAC Rule 3745-55-96 if a leak or spill occurs in the filter press system.

(b) Shredders

- (1) Hazardous waste or treatment reagents shall not be placed in the shredders if they could cause the shredders or the secondary containment system to rupture, leak, corrode, or otherwise fail, as required by OAC Rule 3745-55-94.
- (2) The shredders must be maintained and operated in accordance with the procedures and practices in Section D of the approved permit application, manufacturer's instructions, and accepted industry practice.
- (3) The waste to be shredded will be inspected to verify that it is suitable for placement in the Bulk Solid Waste Storage Tanks and assess the availability of adequate space in the tanks prior to the operation of the shredders.

(c) Pusher

Prior to installation of the pusher, the Permittee must submit a Class 2 permit modification in accordance with OAC Rule 3745-50-51 that details the specific design and operation of the unit to conform with OAC Chapter 3745-57. Prior to operation of the pusher, the Permittee must comply with the requirements of Permit Condition A.23.

(d) Extruders

The general operating requirements for the extruders are described in Section D of the permit application.

F.7. Inspections

OAC Rule 3745-55-95

- (a) The Permittee shall inspect the miscellaneous units daily in accordance with OAC Rule 3745-55-95 and Section F of the approved permit application.
- (b) The Permittee shall document compliance with Condition F.7 (a) in the facility's operating record as required by this permit and the OAC.

F.8. Response to Leaks or Spills and Disposition of Leaking or Unfit for Use Miscellaneous System

OAC Rule 3745-55-96

The hazardous waste miscellaneous units, or secondary containment system from which there has been a leak or spill, or which is unfit for use, must be removed from service immediately and the Permittee must satisfy the following requirements in accordance with OAC Rule 3745-55-96.

(a) Cessation of Use

The Permittee must immediately stop the flow of hazardous waste into the miscellaneous units and/or the secondary containment system and conduct an inspection to determine the cause of the release.

(b) Removal of Waste From the Miscellaneous Unit or Secondary Containment System

- (i) The Permittee must, within twenty-four hours after detection of the leak, remove as much waste as necessary to prevent further release of hazardous waste to the environment and to allow inspection and repair of the system to be performed.
- (ii) If the material released was to a secondary containment system, all released materials must be removed within twenty-four hours to prevent harm to human health and the environment.

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(c) **Containment of Visible Releases to the Environment**

The Permittee shall immediately conduct a visual inspection of the release and based upon that inspection, prevent further migration of the leak or spill to soil or surface water and remove, and properly dispose of, any visible contamination of the soil or surface water.

(d) **Notifications**

Any release to the environment, except as provided in OAC Rule 3745-55-96 (D)(2), must be reported to the director of Ohio EPA within twenty-four hours of detection.

(e) The Permittee shall obtain a certification by an independent, qualified professional engineer that any major repair has been satisfactorily performed and the unit is capable of handling hazardous waste without release for the intended life of the system. The certification must be submitted to the director of Ohio EPA within seven days after returning the system to use.

F.9. Special Requirements
OAC Rules 3745-55-98 and 3745-55-99

(a) Ignitable or Reactive Waste

The Permittee shall not place ignitable or reactive waste in the filter press. The Permittee shall not process reactive waste through the shredders, pusher, or extruders. However, waste carrying the hazardous waste code for ignitability (D001) may be processed through the shredders, pusher, or extruders. The shredders, pusher, or extruder will be designed, installed, and operated in such a manner that the waste will not ignite while being processed.

(b) Incompatible Waste

- (i) The Permittee must not place incompatible waste in the same miscellaneous unit or place hazardous waste in a miscellaneous unit that previously held an incompatible waste or material unless it is done in accordance with OAC Rule 3745-55-99.
- (ii) The Permittee shall document compliance with Condition F.9 (b)(i) of this permit, as required by OAC Rule 3745-55-99, and place this documentation in the operating record.

F.10 Closure and Post-Closure Care
OAC Rules 3745-57-91 and 3745-57-93

At closure of the miscellaneous units, the Permittee shall follow the procedures in Section I of the approved permit application in accordance with OAC Rules 3745-55-10 through 3745-55-40.

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I(A). INCINERATION

I(A).1. Module Highlights

(a) General Description

Wastes are fed to the rotary kiln or primary combustion chamber (PCC) via a variety of feed mechanisms. Solid wastes in the form of slag move slowly from the front wall of the kiln to the discharge end. The slag flows into a slag quench tank located at the base of the secondary combustion chamber (SCC). The flue gas generated in the PCC flows into the SCC for further treatment to complete the combustion process. From the SCC, the flue gas enters the heat recovery boiler which reduces the temperature prior to entry into the spray dryer. The spray dryer unit further cools the flue gas and serves to evaporate neutralized process water from the facility's Four Stage Wet Scrubber. From the spray dryer, the flue gas enters the Electrostatic Precipitator (ESP) which removes the majority of the fly ash entrained in the flue gas. The Four Stage Wet Scrubber is the final flue gas cleaning unit in the incinerator system. It removes acid gas pollutants and fine particulate matter. Stack gas is reheated by the plume suppression system to ensure the stack gases, mostly water vapor and carbon dioxide, will rise to an adequate height above the facility. The stack is the last unit in the system. The height of the exhaust stack for the incinerator is 150 feet. Analyzers are positioned at specific locations within the incineration system to monitor complete combustion of the hazardous waste and ensure compliance with permit emission limits.

A Bailey Distributed Control System (DCS) monitors and controls the incineration system as well as ancillary operations such as waste movements at the facility. Process parameters in critical locations are continuously recorded by the DCS and monitored by the facility's control room operators. The DCS is used to maintain key process parameters such as feed rates and operating conditions such as combustion zone temperature and process flow within permitted ranges. The DCS will automatically stop waste feeds if certain process and operation parameters fall outside the allowable operating range.

Waste handling, feed systems, and systems ancillary to the incineration system are fully described in Section D of the approved permit application.

This section also includes information about the facility's vapor recovery system used for controlling fugitive emissions during processing and storage of waste on-site and to supply combustion air to the incineration system.

Permitted staging, processing, and storage locations are also described in Section D of the approved permit application. Section D includes descriptions of receiving procedures and the procedures in place for sampling, processing, storing, and tracking wastes on-site. Section B details the times and days the facility can receive waste.

(b) Operating Parameters

Key operating parameters for the incineration system include, but are not limited to:

- (i) combustion temperature for the PCC (minimum and maximum) and the SCC (minimum) to ensure complete combustion;
- (ii) negative pressure in the SCC to prevent fugitive emissions;
- (iii) combustion fan operation and steam, air, or oxygen pressure at the nozzles in the SCC to ensure turbulence;
- (iv) Carbon monoxide concentration in the outlet of the ESP, as an indicator of complete combustion;
- (v) outlet temperature of the spray dryer/inlet temperature of ESP, as a control for dioxin/furan formation;
- (vi) oxygen concentration at the outlet of the ESP, to ensure complete combustion;
- (vii) operation of all three fields of the ESP, to control particulate matter emissions;
- (viii) scrubber water flow to the third stage (or second packed bed) of the scrubber, to control acid gas removal from the flue gas;
- (ix) scrubber pH at the third stage, to control acid gas removal from the

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flue gas;

- (x) carbon feed rate to the enhanced carbon injection system (ECIS) which collect dioxins/furans that may have formed during the incineration process;
- (xi) RESERVED
- (xii) total hydrocarbon concentration (THC) in the stack, as an indicator of complete combustion;
- (xiii) hydrogen chloride (HCl) concentration in the stack, as an indicator of acid gas removal;
- (xiv) opacity measurements at the stack, an indicator of particulate matter;
- (xv) heat release (97.8 MMBTU (million Btu) per hour on a three hour rolling average) or system load of the incineration system, to ensure complete combustion;
- (xvi) feed restrictions to the system, to ensure permit limits are not exceeded;
- (xvii) process flow through the system, to ensure complete combustion;
- (xviii) adequate primary or combustion air to the incinerator, to ensure complete combustion.

Operating limits for the incineration system were based on: (1) the trial burn conducted by the facility in 1993 and 1994, (2) manufacturer's recommendations and specifications, and (3) results of performance testing conducted at the facility are described in Section D of the approved permit application and listed in Attachment 1 and 3 to this permit.

(c) Description of Waste Feed Cut-Off System

The facility's waste feed cut-off (WFCO) system is part of the Bailey distributed control system (DCS). The system is utilized to terminate waste feed to the incineration system when a triggering event such as excess carbon monoxide detected by the continuous emissions monitors (CEMs) analyzer(s) occurs. Operating parameters which have been demonstrated through testing to be indicators of complete combustion, minimal emissions,

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and efficient operation of the incineration train are listed in Attachment 1 to this permit. When the DCS detects any of these parameters not being met, it is programmed to automatically terminate all hazardous waste feeds to the incineration system, an automatic WFCO occurs. In addition to those operating limit parameters which result in an AWFCO, there are also parameters (see Attachment 1) that, when the DCS or an operator detects the parameters not being met, require a manual WFCO.

In addition to the parameters listed in Attachment 1 to this permit, several other events trigger the suspension of waste feed to the incineration system. Examples of these parameters are listed below:

- (i) interruption of scrubber water circulation to any of the four stages;
 - (ii) malfunction of the primary or combustion air fan;
 - (iii) water level in the boiler deficient as monitored by the level of water in the steam drum;
 - (iv) failure of the evaporative quench or spray dryer;
 - (v) general loss of electrical power/power failure;
 - (vi) any of the monitoring equipment not operating properly. For example, the monitoring equipment and analyzers for CO, O₂, HCl, THC, total feed rate including the waste feed rate and the auxiliary fuel to the PCC, temperatures in the PCC, SCC, and the inlet to the ESP, process flow, heat release from the system (in MMBTU/HR), pressure in the SCC, pH probe in the scrubber, air, steam, oxygen pressure at the nozzles in the SCC, natural gas burner blower in the SCC.
- (d) Types of Wastes to be Burned

Wastes in a variety of chemical compositions and physical states possessing a wide range of BTU values are scheduled for receipt Monday through Friday at the facility. Hazardous waste codes approved for acceptance, storage, and treatment are listed in the Part A of the permit application. Prohibited and restricted wastes are described in Section C of the permit application. The wastes received at the facility range from consumer-packaged materials, for which the composition and characteristics of the wastes are well known, to materials derived from clean-up sites where the

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wastes are described in broad compositional ranges. Wastes are received in a variety of container sizes and in bulk form as solids, liquids, slurries, sludges, and solid/liquid mixtures. The wastes may be fed to the incineration system via several feed mechanisms which are described in Section D of the approved permit application. Waste accepted for thermal treatment will have a thermal stability class ranking equal to or higher than Class 1 chemicals as found on the Principal Hazardous Organic Constituent Thermal Stability Index developed at the University of Dayton Research Institute (UDRI).

(e) Principal Organic Hazardous Constituent (POHC) Selected and Rationale

Ohio EPA has adopted the position that if a facility selects a POHC, ranked Class 1 on the thermal stability ranking index developed at the UDRI, and achieves the required destruction and removal efficiency (DRE), that demonstrates the facility can burn chemicals characterized as Class 1 or greater on the index. Because Class 1 contains the most difficult-to-incinerate organic hazardous constituents, the Permittee would not be restricted from feeding organic hazardous constituents to the incinerator listed in the Appendix to OAC Rule 3745-51-11 of the Administrative Code. VRA/WTI has used monochlorobenzene (MCB) which is a liquid, Class 1 compound as the POHC for their annual performance tests for the past several years and successfully achieved DRE. In addition, MCB is a compound with a low heat of combustion which means it is difficult to incinerate as determined in the Heat of Combustion System.

I(A).2. Identification Criteria for Permitted, Restricted, and Prohibited Waste
OAC Rule 3745-57-44 and 3745-57-43

Unless otherwise authorized, the Permittee may incinerate the following hazardous wastes, as specified in this permit and only under the terms of this permit. The Permittee may only feed the hazardous wastes as identified below at the facility subject to Permit Conditions I(A).3. through I(A).5., and I(A).8.

- (a) The following criteria must be adhered to when determining the acceptability of wastes at the facility for storage and/or treatment:
- (i) The wastes must be approved by the Ohio EPA, Division of Hazardous Waste Management, in accordance with the conditions set forth in Section C of the approved Part B permit application.
 - (ii) The Permittee must not feed any hazardous waste containing any organic hazardous constituents listed in the Appendix to Rule 3745-

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- 51-11 of the Administrative Code unless the constituent has a thermal stability class ranking equal to or higher than Class 1.
- (iii) According to Section C, the total chlorine content of the materials fed to the incinerator system shall not exceed 2700 pounds per hour (three operating hour average). This would include the second incineration system if and when it is constructed.
 - (iv) The physical state of the waste feed shall be liquid, solid, slurry or sludge. Compressed gases are prohibited from being fed to the incineration system with the exception of gases that may be used as propellant in aerosol cans (see Section C).
 - (v) The Permittee shall not incinerate or treat any State-recognized hazardous waste whose current Ohio EPA hazardous waste code does not appear in the approved Part A permit application or any waste listed in Section C of the approved Part B permit application categorized as being prohibited from incineration or any waste for which the facility is not designed to receive, handle, store, or treat. Permittee may treat federally approved codes the state has not yet promulgated.
 - (vi) The total feed rate, including the waste feed rate and auxiliary fuel to the incineration system, is limited to the range between 49 million BTU/hr and 97.8 million BTU/hr heat input (three hour operating average).
- (b) Throughout operation, the Permittee shall conduct sufficient analysis in accordance with Section C of the approved Part B permit application to verify that waste received by the facility conforms with the waste scheduled. Analysis will be conducted to ensure that the waste fed to the incinerator is within the physical and chemical composition limits specified in this permit and the approved Part B permit application.
- (c) Wastes, in accordance with Section C of the approved Part B permit application, that are prohibited from acceptance on-site include:
- (i) waste containing polychlorinated biphenyls (PCBs) in excess of 50 parts per million or, waste that is, or was at one time, regulated by TSCA, 40 CFR 761;
 - (ii) waste containing asbestos;

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- (iii) dioxin bearing waste: waste requiring specific treatment technology, i.e., destruction and removal efficiency (DRE) of 99.9999%; waste assigned federal hazardous waste codes F020 through F024, F026, and F027;
- (iv) infectious waste;
- (v) chemical warfare agents (CWA) and other chemical weapons or debris generated from the manufacture and/or cleanup of CWAs;
- (vi) radioactive wastes;
- (vii) compressed gases with the exception of gases used as propellant in aerosol cans;
- (viii) other prohibited wastes as described in Section C.

Additional information regarding the prohibited wastes listed above can be found in C-1a(1) in Section C of the approved Part B permit application.

- (d) Wastes that are restricted at the facility are described in Section C of the approved Part B permit application. Examples of restricted wastes include:
 - (i) wastes that may require special handling and/or storage requirements;
 - (ii) wastes with treatment restrictions; and
 - (iii) wastes that carry any of the federal hazardous waste codes that are required to meet LDR treatment standard for dioxins and furans, such as F032, F039, K043, and/or K099.
- (e) Only waste feed systems specified in Section D of the approved Part B permit application may be used to feed wastes to the incineration system.
- (f) No waste may be fed to the SCC.
- (g) The Permittee shall determine the composition and heat value of any auxiliary fuel used in the incineration of any hazardous waste, during start-up and shut-down procedures, and during upset conditions.

High BTU auxiliary fuel which may be hazardous, but only because it is

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ignitable (EPA waste code D001), may be used if waste analysis performed demonstrates that the waste to be burned as auxiliary fuel contains none of the hazardous constituents listed in the appendix to OAC Rule 3745-51-11.

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I(A).3. Construction, Instrumentation, and Operational Performance Requirements
OAC Rule 3745-57-45

VRA is permitted for two commercial hazardous waste incinerators. One is existing and one has yet to be constructed.

- (a) The Permittee shall construct, operate, and maintain the incinerator in accordance with the design plans and specifications contained in the approved Part B permit application. The Permittee shall not feed hazardous wastes to the newly constructed incinerator until Permit Condition A.23. (Certification of Construction or Modification) has been complied with.
- (b) The Permittee shall design, construct, and maintain the incinerator so that when operated, in accordance with the operating requirements specified in this permit, it will meet the performance standards specified in Permit Conditions I(A).3(d) through I(A).3(h) and OAC Rule 3745-57-43.
- (c) The Permittee shall install, test, operate, and maintain all instrumentation and controls including all associated instrument loops, monitors, analyzers, alarms, and the distributed control system, in accordance with the design plans, performance specifications, and maintenance procedures contained in the approved Part B permit application prior to, and while, handling hazardous wastes in the incineration system.
- (d) The incinerator shall achieve a destruction and removal efficiency (DRE) of 99.99 percent for any principal organic hazardous constituents (POHC) fed to the incineration system.

The designated POHCs, as used in the trial burn to demonstrate a DRE of >99.99%, were (1) carbon tetrachloride, (2) monochlorobenzene, (3) 1,2,4-trichlorobenzene, and (4) trichloroethylene. Annual DRE testing shall include monochlorobenzene or any POHC as defined by Section I(A).1(e) of this permit. The DRE value shall be determined using the method specified in OAC Rule 3745-57-43(A)(1).

- (e) The Permittee shall control hydrogen chloride (HCl) emissions such that the rate of emissions is no greater than the larger of either (1) 1.8 kilograms per hour (four lbs/hr) on a three hour average measured in the stack or (2) 1.0% of the HCl in the stack gas prior to entering any pollution control equipment in accordance with OAC Rule 3745-57-43(B). HCl shall be monitored and recorded in accordance with Attachments 1 and 3 to this permit.

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- (f) The Permittee shall comply with annual and hourly emission limits for twelve metals: barium, mercury, silver, thallium, nickel, selenium, antimony, arsenic, beryllium, cadmium, chromium and lead; as listed in Attachment 2 to this permit.
- (g) The incinerator shall not emit particulate matter in excess of 180 milligrams per dry standard cubic meter (0.08 grains per dry standard cubic foot (gr/dscf)) when corrected for the amount of oxygen in the stack gas, in accordance with the formula specified in OAC Rule 3745-57-43(C) or 0.05 gr/dscf at 12% CO₂.
 - (i) Opacity, an indicator of particulate matter in the flue gas, monitored as specified in Permit Condition I(A).5 and Attachments 1 and 3 to this permit, shall not exceed 20% on a six minute average.
- (h) The Permittee must test the performance of the incineration system to demonstrate continued polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDD/PCDF) control using the test protocols employed during the October 2002 testing event, or the approved Hazardous Waste Combustion MACT Comprehensive Performance Test Plan, or an equivalent test plan as specifically approved by Ohio EPA.
 - (i) Frequency of testing must include one test six months, eighteen months, thirty months, forty-five months and sixty months after the facility submits its Notice of Compliance (NOC) for MACT. Testing must include at least one condition under normal operating conditions. The Permittee must submit certified test results of each test to the Director or delegated representative within 90 days of the completion of the test event.
 - (ii) To evaluate the incinerator's performance, a rolling average based on five individual test events, will be tracked. The average will be calculated from data collected during the October 2002 Annual Performance Test (two conditions); the CPT (two conditions); and the test performed six months after the completion of the CPT. All data collected from these tests will be averaged and compared to the previously demonstrated average performance level of 0.055 ng/dscm, TEQ basis, corrected to 7% oxygen achieved during the 26 individual stack test runs in 1993 and 1994 subsequent to the installation of the ECIS. All subsequent test data following the CPT will be added to the data grouping and the value from the oldest test period will drop out. If the Permittee demonstrates a performance

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consistent with the average dioxin emission of 0.055 ng/dscm, TEQ basis, corrected to 7% oxygen, the testing frequency will be reduced to that required by the Hazardous Waste Combustion MACT rules. However, at any time when the new rolling average is greater than 0.1 ng/dscm, the Permittee must notify the Director immediately. The Permittee will initiate an evaluation for the cause of the average increase and develop a report as to the possible cause with recommendations for corrective action if warranted. The Ohio EPA may consider any such test results as new "information" under OAC Rule 3745-50-51(A)(2). The comparison of the five test period rolling average with the 1993-1994 ECIS test period average is only to monitor incinerator performance with previously demonstrated emission levels.

The stack emissions of dioxin/furans must not exceed 0.20 ng/dscm corrected to 7% oxygen, expressed as toxic equivalents (TEQs).

Unless otherwise authorized, the Permittee shall only feed the wastes described in Permit Condition I(A).2. to the incinerator: (1) after the waste feed permissives as described in Section D of the approved Part B permit application and these permit conditions have been met and (2) under the following conditions according to OAC Rule 3745-57-45(B).

- (i) The Permittee shall only feed waste into the PCC using the feed mechanisms located in the incinerator feed building and described in Section D of the approved Part B permit application. The waste feed rates are listed below. These feed rates are monitored and recorded in accordance with Attachments 1 and 3 to this permit:
 - (i) Maximum combined sludge and slurry lance feed rates shall not exceed 20,099 lb/hr (one hour average) or 19,602 lb/hr (four hour average). The feed rate of pumpable materials, including waste feed and auxiliary fuel, to the incineration system shall be monitored and recorded on a continuous basis.
 - (ii) Maximum combined container and bulk solids feed rates shall not exceed 16,576 lb/hr (one hour average) or 15,265 lb/hr (four hour average). The feed rate of non-pumpable materials to the incineration system including waste feed and auxiliary fuel must be monitored and logged on a regular basis not to exceed once per charging cycle or once every fifteen minutes, whichever period is greater.

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- (iii) Maximum total waste feed shall not exceed 29,651 lb/hr (one hour average) or 28,565 lb/hr (four hour average).
 - (iv) Annual and hourly feed rates for twelve metals, barium, mercury, silver, thallium, nickel, selenium, antimony, arsenic, beryllium, cadmium, chromium and lead, are listed in Attachment 2 to this Permit. The feed rates shall not be exceeded and shall be monitored and recorded on a continuous basis.
 - (v) The total feed rate, including the waste feed rate and auxiliary fuel to the incinerator, is limited to the range between 49 million BTU/hr to 97.8 million BTU/hr heat input (three hour rolling average).
- (j) The combustion zone, defined as midway down the PCC to midway up the secondary combustion chamber (SCC), is the region in the incineration system where volatilized organic compounds are thermally destroyed. The temperature is monitored as specified in Permit Condition 1(A).5. and Attachments 1 and 3 to this permit, and shall be maintained as follows:
- (i) maximum temperature in the PCC shall not exceed 2,200°F instantaneous and 2,174°F on a four hour rolling average;
 - (ii) minimum temperature in the PCC shall not drop below 1,800°F instantaneous and 1,830°F on a four hour rolling average;
 - (iii) minimum temperature in the SCC shall not drop below 1600°F.
- (k) The Permittee shall control fugitive emissions from the combustion zone of the incineration system by:
- (i) maintaining a constant negative pressure/draft throughout the incineration system and associated heat recovery and flue gas cleaning equipment via the induced draft (ID) fan and ID fan discharge volume damper as monitored and recorded in accordance with Attachments 1 and 3 to this permit; and
 - (ii) the maintenance of the shroud system which includes shrouds at both seal mechanisms located at the inlet to the PCC and at the intersection between the PCC and the SCC. The shroud system is described in Section D of the approved Part B permit application.

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- (l) Atomization fluid pressure (e.g., steam, air) to the front wall lances shall be no less than 45 psig and monitored and recorded in accordance with Attachments 1 and 3 to this permit. The limit of 45 psig was recorded during the Permittee's initial trial burn and will be maintained until and unless additional testing demonstrates that complete combustion can be achieved at atomization pressures other than 45 psig.

If the atomization pressure for any of the feed lances at the front wall fall below 45 psig, the feed for that lance will be cutoff until such time the pressure can be maintained.

- (m) The following conditions apply to the Secondary Combustion Chamber (SCC):
 - (i) The pressure in the SCC will be maintained below atmospheric pressure (below 0 inches water column) at all times and shall be monitored and recorded on a continuous basis in accordance with Attachments 1 and 3 to this permit.
 - (ii) The water level in the slag quench tank at the base of the SCC shall be maintained automatically by a level probe and automatic valve. A visible and audible alarm shall warn the operator if the water level falls below the bottom edge of the outlet in the bottom of the SCC.
 - (iii) Pressure at the steam, air, or oxygen nozzles in the SCC shall be maintained at greater than or equal to 100 psig and monitored and recorded in accordance with Attachments 1 and 3 to this permit.
 - (iv) The natural gas burner blower in the SCC shall operate at all times when waste is in the incineration system. The fan damper will be opened at those times, greater than or equal to ten (10%) percent and monitored and recorded in accordance with Attachments 1 and 3 to this permit.
- (n) The outlet temperature of the spray dryer (inlet temperature of the ESP) must be between 250°F and 450°F at all times waste is in the incineration system and shall be monitored and recorded on a continuous basis and in accordance with Attachments 1 and 3 to this permit.
- (o) The following conditions apply to the Electrostatic Precipitator (ESP):

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- (i) The ESP shall be maintained at its design particulate removal efficiency and in automated computer control mode whenever hazardous waste is being fed to the incineration system. The Permittee shall be required to utilize a "Digicon Optipulse" controller or equivalent, as determined by the Director, to control the electrical fields of the ESP.
- (ii) The controller will monitor, for each of the three ESP fields, at a minimum, the following parameters:
 - a) primary voltage - must be $> 90\text{v AC}$ and at least 50% of the rated primary current;
 - b) ESP fields 1 and 2 must be in the range of 0 to 100 amps;
 - c) ESP field 3 must be in the range of 0 to 150 amps; and
 - d) spark rate must be < 200 sparks per minute.
- (iii) All three fields of the ESP will be energized when burning hazardous waste and monitored and recorded in accordance with Attachments 1 and 3 to this permit.
- (iv) Whenever the ESP is out of service for more than seventy two hours, start up procedures, as specified by the manufacturer, shall be successfully completed and documented prior to resumption of hazardous waste feed to the incineration system.
- (p) Oxygen concentration in the flue gas leaving the ESP shall be greater than 3% percent by dry volume basis and shall be monitored and recorded on a continuous basis in accordance with Attachments 1 and 3 to this permit.
- (q) Carbon monoxide concentration in the flue gas leaving the ESP shall not exceed 100 ppm by volume on a dry basis over a one hour rolling average. This operating parameter shall be monitored as specified in Permit Condition I(A).5 and Attachments 1 and 3 to this permit.
- (r) The enhanced carbon injection system (ECIS) must be operating at all times waste is in the incineration system and will be monitored and recorded in accordance with Attachments 1 and 3 to this permit. The Permittee shall continue to feed activated carbon at the two injection points in the ECIS at,

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or above, the rates demonstrated during the Comprehensive Performance Test/Trial Burn conducted in September 2003 (Condition 1) and December 2003 (Condition 2). The feed rate for carbon to the ECIS is an average of the feed rate demonstrated by the two mentioned tests.

- (i) The Permittee shall utilize "NORIT PAC 20R" activated carbon, or equivalent, as determined by the Director. Equivalency will be determined by comparing Iodine No. (800 mg/g minimum); ash (15% maximum by weight); moisture (4% maximum by weight as packed); and screen size (65-80%, U.S. Sieve series through 325 mesh).
- (ii) The activated carbon feed rates, used during the performance testing of the incineration system to demonstrate control of dioxins/furans, shall be maintained at all times waste is in the incineration system.
- (iii) The activated carbon feed system must be calibrated monthly to ensure feed rates to the ECIS are maintained in accordance with the requirements of this permit at the two locations described in the June 25, 1993 submittal from WTI in paragraph two (Process Description) of the attachment entitled "Enhanced Carbon Injection System" and as illustrated in the associated drawing, number P-06-2-31001.
- (iv) The results of the calibration shall be recorded in the facility's operating record.
- (s) The following conditions apply to the Four Stage Wet Scrubber:
 - (i) The pH of the scrubbant at the top of the second packed bed (third stage of the scrubber), monitored as specified in Permit Condition I(A).5. and Attachments 1 and 3 to this permit, shall be maintained at a minimum pH of 7.0.
 - (ii) To ensure adequate particulate matter control, the pressure drop across the fourth stage ring jets of the Venturi scrubber, monitored as specified in Permit Condition I(A).5. and Attachments 1 and 3 to this permit, shall be maintained at no less than 13.4 inches water column (one minute average).

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- (iii) RESERVED
- (iv) To ensure proper acid gas removal and the proper liquid to gas ratios, HCl shall be monitored at the stack in accordance with Attachments 1 and 3 to this permit.
- (v) In the event of a malfunction of the HCl monitor in the stack and during daily calibration, a flow rate of 397 gpm (one minute average) in the third stage (second packed bed) shall be maintained and monitored as specified in Permit Condition I(A).5. and Attachments 1 and 3 to this permit.
- (t) The total hydrocarbon (THC) concentration in the flue gas (measured as propane) at the stack and monitored and recorded as specified in permit condition I(A).5. and Attachments 1 and 3 to this permit, shall not exceed 100 ppm (one minute average).
- (u) The maximum total volumetric flow rate through the incineration system, as monitored and recorded on a continuous basis at the induction fan (ID) or other flow monitoring equipment, shall not exceed 65,000 scfm. The volumetric flow rate shall be determined from the calibration chart of the ID fan or by means of other flow monitoring equipment as approved by the Director. This process flow will be monitored and recorded in accordance with Attachments 1 and 3 to this permit.
- (v) The reheat or plume suppression system must be operated continuously while waste is in the incineration system, except during maintenance. The unit may be shut down for up to 24 hours at a time not to exceed ten times in one calendar year. The system will be monitored and recorded in accordance with Attachments 1 and 3 to this permit.
 - (i) Shut down of the plume suppression system for periods greater than 24 hours or more often than ten times during the calendar year while burning hazardous waste shall only be allowed upon written authorization from the Ohio EPA.
- (w) Start-Up and Shut-Down

The Permittee shall comply with the requirements of OAC Rule 3745-57-45(C). In addition, the incineration system will be inspected thoroughly prior to each start-up. This inspection will ensure that the system is in

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proper working condition before the start-up procedure is initiated. Burners in the PCC front wall will be used to heat up the combustion zone gradually. These burners will burn auxiliary fuel, as described in Permit Condition I.(A).2.(g), during the start-up and shutdown procedures. Once the combustion zone reaches the proper temperatures, as listed in Attachment 3 to this permit, and the incineration system is fully operational, waste may be introduced into the PCC.

Shutdown can be initiated automatically by the distributed control system (DCS) or manually by the operator. The shutdown procedure will begin with the termination of waste feed to the system. Except in the case of an emergency shutdown, the system will remain operational in order to complete the combustion of all waste in the incineration system. The burners in the front wall will be used to maintain temperatures in the combustion zone until incineration of the remaining waste is complete.

(x) Cessation of Operation

The Permittee shall comply with the requirements of OAC Rule 3745-57-45(F).

- (y) Requests for changes to the incineration system, associated heat recovery or flue gas cleaning equipment, or operation procedures as detailed in this permit or the approved Part B permit application, which would affect the achievement of the performance standards contained in Permit Condition I.(A).3, OAC Rule 3745-57-43 or any other permit conditions, shall be submitted for evaluation to the Ohio EPA. No such changes shall be made at the facility unless the Permittee has received approval in accordance with the Ohio Hazardous Waste Rules.

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- (z) For purposes of permit enforcement, compliance with the operating requirements specified in this permit and in OAC Rule 3745-57-45 will be regarded as compliance with the required performance standards in this permit and OAC Rule 3745-57-43. However, evidence that compliance with these operating conditions is insufficient to ensure compliance with the performance standards, may justify modification, revocation, or reissuance of the permit pursuant to OAC Rule 3745-50-51, in accordance with OAC Rule 3745-57-43(D).

I(A).4. Inspection Requirements
OAC Rule 3745-57-47

The Permittee shall conduct regular and timely inspections of the facility and its operations in accordance with the Inspection Schedule, found in Section F of the approved Part B permit application, applicable permit conditions, and OAC Rule 3745-57-47, and shall complete the following as part of these inspections. All inspection data shall be recorded and the records must be placed in the operating log in accordance with OAC Rule 3745-57-47(D).

- (a) The Permittee shall thoroughly, visually inspect the incinerator and associated equipment (including pumps, valves, conveyors, pipes, etc.) for leaks, spills, corrosion and deterioration, fugitive emissions, and signs of tampering in accordance with Section F of the approved Part B permit application and OAC Rule 3745-57-47(B).

During start up procedures at the facility, the Permittee shall comply with the requirements of OAC Rule 3745-57-45(C). The incineration system will be inspected thoroughly prior to each start-up. This inspection will ensure that the system is in proper working condition before the start-up procedure is initiated.

- (b) The Permittee shall thoroughly, visually inspect the integrity of the secondary containment, roadways, the containment sumps in the storm water collection "B" and "C" areas (as described in Section B of the approved Part B permit application), and the facility's security fence at a frequency outlined in Section F of the approved permit application.
- (c) The Permittee shall continuously monitor the distributed control

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system (DCS) including the analyzers, monitors, temperature probes, pH meters, scales, micro-motion meters, alarms, etc. for proper operation and recording of data.

- (d) The Permittee shall test the emergency waste feed cut-off system and associated alarms weekly and as specified in Permit Condition I(A).5(a) in order to verify operability in accordance with OAC Rule 3745-57-47(C). The monitoring systems will be tested by simulating an upset condition of each monitoring parameter which will engage the waste feed cutoff system.
- (e) The Permittee shall test the emergency response equipment and communications in accordance with Section F of the approved permit application.
- (f) The inspection records shall be placed in the operating log in accordance with OAC Rule 3745-57-47(D).

I(A).5. Monitoring Requirements
OAC Rule 3745-57-47

- (a) The Permittee shall maintain, calibrate, and operate monitoring equipment at all times while incinerating hazardous waste as specified in the approved permit application, the terms and conditions of this permit, and Attachment 3 to this permit.
- (b) The Permittee shall record the monitoring equipment data while incinerating hazardous waste for all materials fed to the incineration system. The data shall be placed in the operating log in accordance with OAC Rule 3745-57-47(D). This will include:
 - (i) pumpable materials, including by-pass or auxiliary fuels, monitored and recorded on a continuous basis;
 - (ii) nonpumpable materials, monitored continuously and logged on a regular basis not to exceed once per charging cycle or once every fifteen minutes, which ever is greater;
 - (iii) total chlorine content of all material fed to the incineration system, monitored and recorded on a continuous basis (three hour average); and

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- (iv) metal feed rates for twelve metals listed in Attachment 2 to this permit.
- (c) Upon request of the Ohio EPA, the Permittee shall perform sampling and analysis of the waste and exhaust emissions to verify that the operating requirements established in this permit achieve the performance standards in accordance with OAC Rule 3745-57-47(A)(3).
- (d) Periodic Incineration System Testing

The Permittee shall test the incineration system on an annual basis, or more frequently as directed by the Ohio EPA, to verify that the operating requirements established in this permit result in compliance with the performance standards located in OAC Rule 3745-57-43, Attachment 2 to this permit, and all applicable sections of this permit and the approved Part B permit application. Testing may also be conducted to determine whether amendment of the performance standards contained in this permit, or additions thereto, is indicated as necessary.

- (e) Electronic Bulletin Board System (BBS)

The Permittee shall maintain a separate computer interface with Ohio EPA-DHWM in order to provide timely information regarding the operating status of the incineration system using data from the DCS. The electronic bulletin board system (BBS) shall enable DHWM to evaluate compliance with operating limits including, but not limited to: (1) temperatures at specific locations within the incineration system; (2) concentrations (ppm) of carbon monoxide, one minute and hourly averages; (3) concentration of pollutants such as hydrogen chloride, nitrogen oxides, and total hydrocarbons at the stack; (4) oxygen concentrations as measured at the outlet of the ESP; (5) pH in the 3rd stage of the scrubber; (6) negative pressure in the SCC; and (7) AWFCOs, the time of occurrence, the cause, and time at which waste feed was permitted and resumed.

I.(A).6. Waste Feed Cut-Off Requirements
OAC Rule 3745-57-45

- (a) The Permittee shall construct and maintain the systems specified in Section D of the approved Part B permit application and Permit Condition I(A).3. The Permittee shall not feed hazardous wastes

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to the incinerator unless all monitoring systems listed in Permit Condition I(A).3 and Attachments 1 and 3 to this permit are on-line, properly operating, and monitoring according to conditions specified in Attachment 3 to this permit.

- (b) The incineration system shall be operated and maintained to automatically cut off the hazardous waste feed to the incinerator at the levels specified in Attachment 1 to this permit. Hazardous wastes shall be fed to the incinerator only when all instruments required by this condition are on line, operating properly and monitoring the specified parameters according to Attachment 1 and 3 to this permit.
- (c) In case of a malfunction of the automatic waste feed cut-off systems, the Permittee shall perform manual shut downs in accordance with the procedures in the approved Part B permit application and the terms and conditions of this permit, such as I(A).3(x). The Permittee shall not restart the incinerator until the problem causing the malfunction has been located and corrected. At that time, the Permittee shall conduct an inspection of all systems in accordance with Permit Condition I(A).4(a)

I(A).7. Closure
OAC Rule 3745-57-51

The Permittee shall follow the procedures in the Closure Plan in Section I of the approved Part B permit application and the terms and conditions of this permit.

I(A).8. Record keeping

- (a) The Permittee shall record and maintain, in the operating record for the facility, all monitoring and inspection data compiled under the requirements of this permit and in accordance with OAC Rule 3745-57-47(D) and all applicable sections of the approved Part B permit application.
- (b) The Permittee shall record in the operating record for the facility, the date and time of all automatic waste feed cut-offs, including the triggering parameters, reason(s) for the cut-off, and corrective actions taken. The Permittee shall also record all failures of the

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automatic waste feed cut-off system to function properly and corrective actions taken.

I(A).9. Re-generable Activated Carbon Adsorption Cleaning System

The Permittee shall maintain the re-generable activated carbon adsorption cleaning system to ensure a removal of, at a minimum, 95% of the total organic vapors from the exhaust gas prior to being discharged from the system to the atmosphere and in accordance with the terms and conditions of this permit and Section D of the approved Part B permit application.

- (a) Based on calculations performed by the manufacturer of the activated carbon elements or boxes, the boxes should meet the designed absorption removal efficiency for a minimum of sixty continuous days based on the operating conditions at the facility
- (b) The results of the analysis performed on the carbon boxes and the replacement of the carbon boxes shall be recorded in the facility's operating record.

I(A).10 Treatment Residual

Unless the Permittee can show otherwise, per OAC Rule 3745-51-03(D), residue from the incinerator is hazardous waste and the Permittee is considered the generator.

- (a) The Permittee shall sample and analyze the treatment residue generated from the incineration system and all ancillary systems in accordance with the procedures outlined in Section C of the approved Part B permit application.
- (b) The Permittee shall manage the treatment residue generated from the incineration system in accordance with procedures outlined in Section D of the approved Part B permit application and all applicable Ohio hazardous waste regulations.

End of Permit Conditions

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ATTACHMENT 1 - WASTE FEED CUT-OFFS

AUTOMATIC WASTE FEED CUT-OFFS	
PARAMETER	OPERATING LIMIT - TESTED WEEKLY
PCC TEMPERATURE	< 2174 F AND > 1830 F (FOUR HOUR ROLLING AVERAGE)
PCC TEMPERATURE	> 1800 F AND < 2200 F INSTANTANEOUS
SCC TEMPERATURE	MUST BE ABOVE 1600 F
SCC PRESSURE	MUST BE BELOW 0 INWC (TWO SECOND DELAY)
SCC STEAM PRESSURE	> OR = 100 PSIG
SCC COMBUSTION AIR FAN	FAN MUST BE RUNNING
NATURAL GAS BURNER BLOWER	NATURAL GAS BURNER BLOWER SHALL OPERATE AT ALL TIMES WASTE IS BEING INCINERATED. FAN DAMPER OPEN AT THOSE TIMES > OR = 10% SEE I(A).3(m)(iv)
DRY O2 AT ESP OUTLET	> 3% (60 SECOND DELAY)
SPRAY DRYER OUTLET TEMPERATURE	MUST BE ABOVE 250 F AND BELOW 450 F
pH AT SCRUBBER 3RD STAGE	pH MUST BE > 7.0
*FLOW INTO 2ND PACKED BED SCRUBBER (THIRD STAGE)	MUST BE > 397 GPM (ROLLING HOURLY AVERAGE)
THC AT STACK	< 100 PPM (ONE MINUTE AVERAGE)
PROCESS FLOW	< 65,000 SCFM
CO AT ESP OUTLET	< 100 PPM (ONE HOUR AVERAGE)
ESP FIELDS	ALL THREE POWER CONSOLES ON AND OPERATING ACCORDING TO MANUFACTURER'S RECOMMENDATIONS AND PERMIT CONDITION I(A).3.(o)(ii)
INCINERATION PROCESS HEAT RELEASE (SYSTEM LOAD)	MUST BE BELOW 97.8 MMBTU/HR (THREE HOUR ROLLING AVERAGE)
*HCI AT STACK	MUST BE < FOUR LBS/HR (THREE HOUR AVERAGE)
RING JET PRESSURE DROP	MUST BE > 13.4 INWC (ONE MINUTE AVERAGE)
ID FAN SINGLE SPEED MOTOR	MUST BE ON AS INDICATED BY THE DCS AND MAINTAIN A NEGATIVE DRAFT IN THE INCINERATION TRAIN
FRONT WALL LANCES	ATOMIZATION PRESSURE AT LANCES MUST BE > 45 PSIG
* FLOW TO SCRUBBER 2ND PACKED BED BECOMES A PERMIT LIMIT DURING TIMES WHEN THE HCI ANALYZER IS BEING CALIBRATED OR IS MALFUNCTIONING.	

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MANUAL WASTE FEED CUT-OFFS	
PARAMETER	OPERATING LIMIT - TESTED WEEKLY
ECIS	ACTIVATED CARBON FEED RATE AND LOCATION ACCORDING TO PERMIT
PLUME SUPPRESSION REHEAT FAN	MUST BE OPERATING ACCORDING TO PERMIT APPLICATION
FEED RESTRICTION MAXIMUM TOTAL WASTE	29,651 LBS/HR AT ANY TIME; OR 28,565 LBS/HR (FOUR HOUR ROLLING AVERAGE)
FEED RESTRICTION: MAXIMUM SOLIDS FEED RATE, CONTAINERS AND BULK	16,576 LBS/HR AT ANY TIME; OR 15,265 LBS/HR (FOUR HOUR ROLLING AVERAGE)
FEED RESTRICTION: MAXIMUM COMBINED SLUDGE AND SLURRY LANCE FEED RATES	20,099 LBS/HR AT ANY TIME; OR 19,602 LBS/HR (FOUR HOUR ROLLING AVERAGE)
FEED RESTRICTION: CHLORINE FEED	< 2700 LBS/HR (THREE HOUR AVERAGE)
FEED RESTRICTIONS: METALS FEEDS	HOURLY AND ANNUAL FEED RATES FOR TWELVE METALS, SEE ATTACHMENT 2 TO THIS PERMIT
OPACITY AT STACK	<20% (SIX MINUTE AVERAGE)
MONITORING EQUIPMENT FOR SELECT OPERATING PARAMETERS	SELECT MONITORING EQUIPMENT LISTED IN PERMIT CONDITION I(A).6 OPERATING PROPERLY
FACILITY POWER	GENERAL POWER FAILURE
AUXILIARY FUEL	MUST BE AVAILABLE AT ALL TIMES WASTE IS BEING FED TO THE INCINERATOR

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ATTACHMENT 2 - PERMIT CONDITIONS REGARDING THE EMISSIONS OF METALS, INCINERATOR FEED RATE OF METALS, AND THE CONTINUOUS MONITORING OF METALS IN THE FLUE GAS:

A) Metals Emissions and Feed Rates

- 1) The Permittee shall comply with the hourly and annual metals emission rate limitations listed below in Condition A.5. of this Attachment. Until such time as an appropriate method is approved by the Ohio EPA for the continuous or semi-continuous monitoring of metals emissions in the incinerator flue gas, the Permittee shall establish compliance with these limits by tracking the amount of metals contained in the wastes fed into the incinerator. The appropriate metals feed rates are given in Condition A.5. of this Attachment. Compliance shall be tracked and demonstrated on the basis of 60-minute rolling averages, defined as the arithmetic mean of the 60 most recent 1-minute average values, unless an equivalent method is approved by the Director. For the purposes of this Condition, the "amount of metals contained in the waste" includes measured, estimated, and/or default maximum values in accordance with the Permittee's existing waste characterization program.
- 2) If and when the Ohio EPA approves the use of continuous or semi-continuous flue gas metals emission monitoring for demonstrating compliance with the metals emission limits in Condition A.5. of this Attachment, the Permittee shall track and demonstrate compliance with the hourly and annual emission limits shown in Condition A.5. of this Attachment. At such times as the Permittee is demonstrating compliance with the emission limits in this manner, the metals feed limits will not apply. During periods of malfunction of the continuous monitoring system, the Permittee shall use the feed limits to demonstrate compliance, as described in Conditions A.1. and A.4. of this Attachment.
- 3) When demonstrating compliance via the multiple metals continuous emission monitor system, compliance shall be tracked and demonstrated on the basis of hourly rolling averages, based on samples being taken and analyzed once every 2 minutes or less, where each rolling average is calculated as the arithmetic mean of all sample concentration values recorded over the previous 60 minutes, unless otherwise directed by the Director. After sufficient operating data is collected to demonstrate that an alternate time-averaging technique is equivalent, the Permittee may petition the Director to use an equivalent averaging technique.

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- 4) During periods of malfunction of the continuous monitoring system (for the purposes of this permit, "malfunction" includes any period of time when valid emission data cannot be collected), the Permittee shall demonstrate compliance as follows:
- a) For data interruptions of 12 minutes or less, metals emissions will be considered to be equivalent to the value recorded immediately prior to the interruption;
 - b) For interruptions longer than 12 minutes, compliance with the metals emission limits will revert to feed tracking, as described in Condition A.1. of this Attachment, with the first 60-minute rolling average being generated at the 60th minute after the monitor became inoperative.
- 5) The following metals feed or emission limits shall apply, as described in Conditions A.1. and A.2. of this Attachment:

Metal	Hourly Emission Rate	Hourly Feed Rate Limit	Annual Emission Limit	Annual Feed Rate Limit
Ba	1.13 lb/hr	265 lb/hr	682 lbs/yr	2.96 E+5 lbs/yr
Hg	0.65 lb/hr	0.65 lb/hr	355 lbs/yr	355 lbs/yr
Ag	26 lb/hr	26 lb/hr	954 lbs/yr	2.27 E+5 lbs/yr
Tl	0.53 lb/hr	2.65 lb/hr	6.6 lbs/yr	2870 lbs/yr
Ni	156 lb/hr	156 lb/hr	4170 lbs/yr	1.36 E+6 lbs/yr
Se	34.9 lb/hr	34.9 lb/hr	102 lbs/yr	3.4 E+4 lbs/yr
Sb	2.6 lb/hr	9.4 lb/hr	11.1 lbs/yr	82,300 lbs/yr
As	.005 lb/hr	3.8 lb/hr	43.8 lbs/yr	3.3 E+4 lbs/yr
Be	.0091 lb/hr	0.30 lb/hr	2.50 lbs/yr	2630 lbs/yr
Cd	.0122 lb/hr	11.7 lb/hr	107 lbs/yr	1.0 E+5 lbs/yr
Cr	.0018 lb/hr	178 lb/hr	15.8 lbs/yr	1.56 E+6 lbs/yr
Pb	0.029 lb/hr	100 lb/hr	254 lbs/yr	8.7 E+5 lbs/yr

- 6) Compliance with either the hourly and annual metals feed limits or the hourly and annual emission limits, as described in Conditions A.1. through

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A.4. of this Attachment, will be regarded as compliance with the metals requirements of Permit Condition I(A).3.(i) of this permit.

- 7) If the Director determines that any of the 12 metals listed in Condition A.5. of this Attachment are significantly less toxic or carcinogenic than was assumed in the May 1997 U.S. EPA risk assessment for Von Roll America, Inc., also known as Waste Technologies Industries (WTI), the Permittee may petition the Director to relax the relevant metals emission and feed limits.

B) Test Plan for Establishing the Acceptability of the Multiple Metals Continuous Emission Monitor:

- 1) The Permittee shall submit to Ohio EPA for approval a detailed plan describing a proposed sampling and analysis program, including quality assurance elements, to be used to establish the acceptability of performance of the proposed multiple metals continuous emissions monitor. Performance should be related to the requirements of proposed Performance Specification 10 (FR Vol 61, No.77, pp17499- 17502, April 19, 1996) or equivalent, as approved by the Director. The test plan should include a detailed description of the proposed relative accuracy testing, including calculated target spiking rates, expected detection limits, target incineration system operating conditions, planned daily sampling schedule, and a detailed quality assurance plan. The plan will, at a minimum, include the testing of each of the 12 regulated metals listed in Condition A.5. of this Attachment at a concentration detectable by both the reference method and the continuous emission monitor system, and the testing of one metal (not necessarily one of the 12) at multiple concentrations. The plan must also address calibration of the various components of the continuous monitoring system.
- 2) The Permittee shall submit to Ohio EPA detailed drawings of such details as the sampling probe, sample location, and sample interface.
- 3) The Permittee shall submit to Ohio EPA a copy of the operating manual for the multiple metals continuous emissions monitoring system. Such manual must specifically address calibration of the system.
- 4) At such time as Ohio EPA finds the test plan and other submittals required under Conditions B.2. and B.3. of this Attachment acceptable, Ohio EPA will publish a public notice of intent to approve the test plan and

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a copy will be made available in the local library. This Condition does not require that a public comment period be held.

C) Acceptability Testing of the Multiple Metals Continuous Emission Monitor.

- 1) Upon Ohio EPA approval of the Permittee's Test Plan, the Permittee shall schedule dates and times for testing, notify Ohio EPA and other interested agencies of the test schedule, and perform the tests. The Permittee may elect to conduct more than one set of tests.
- 2) The Permittee shall submit copies of the results of the acceptability tests to Ohio EPA and other interested agencies, and to the local library. The Permittee shall certify the results in accordance with Ohio Administrative Code Rule 3745-50-42. The Permittee shall notify the public of the availability of the test report at the library.
- 3) Ohio EPA will analyze the results of the acceptability tests and, within 30-60 days, either approve or disapprove the initial use of the multiple metals continuous emissions monitor for establishing compliance with the applicable metals emission limits.
- 4) If, based on the results of the tests and/or other relevant information, Ohio EPA disapproves the use of the continuous emission monitor for establishing compliance, Ohio EPA will provide the Permittee with the reasons for disapproval and a list of all issues which must be resolved before Ohio EPA will again consider approving the monitor for establishing compliance.

D) Initial Use of Multiple Metals Continuous Emissions Monitor for Establishing Compliance:

- 1) If Ohio EPA approves the use of the multiple metals continuous emissions monitor for establishing compliance with the metals emission limits, as described in Condition C.3., above, the Permittee may begin using the monitor for this purpose at any time after such approval. Such approval will not be regarded as a requirement to use the monitor for compliance purposes.
- 2) During this period, the monitor shall be re-calibrated at least once every 24 hours, and zero drift and calibration drift tests shall be conducted at least every 24 hours.

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- 3) Within a reasonable period of time, the Permittee shall make metals compliance data from the monitoring system available on the facility's electronic bulletin board system. Such data shall include values calculated in units of mass per time similar to the emission limits listed above in Condition A.5. of this Attachment.
 - 4) During this period of time, whenever the continuous emission monitor becomes inoperable, is suspected by the Permittee of producing erroneous data, or is taken out of operation for any other reason, metals compliance determinations shall revert to feed monitoring, as described in Condition A.4. of this Attachment.
 - 5) During this period of time, the Permittee will also collect data regarding monitor downtime, calibration error, zero drift, calibration drift, and other information useful in evaluating the long-term viability of the continuous emission monitor system.
 - 6) During this period of time, the Permittee shall also conduct at least one additional acceptability test, according to the plan approved under Condition C.3 of this Attachment, and submit the results to Ohio EPA. If the Permittee wishes to continue to use the continuous emission monitor for establishing compliance with the metals limits, relative accuracy tests shall be performed at least once per calendar year unless otherwise directed by the Director.
 - 7) During this period of time, if information becomes available which, in the judgement of the Director, indicates that tracking metals compliance via the continuous emission monitor system is not as protective as tracking metals compliance via the feed tracking method of Condition A.1 of this Attachment, the Director reserves the right to withdraw the approval described in Condition D.1 of this Attachment.
- E) Final Approval to Use Continuous Emissions Monitor for Establishing Compliance:
- 1) After a minimum of six months of operation of the continuous emission monitor system, and after a minimum of three months following the approval described in Condition D.1 of this Attachment, the Permittee may petition the Director for final approval to permanently use the device to establish compliance with the applicable metals emission limits.

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- 2) As part of the petition, the Permittee may also request consideration of the use of a minimum data availability requirement in lieu of the specific monitor downtime requirements of Condition A.4. of this Attachment. In evaluating such request, the Director may consider information gathered during the operation of the monitor system, including recorded monitor downtime and other operational records of the monitor system, results of acceptability tests, and data comparing actual recorded metals emission rates to the relevant metals emission limits.

- 3) The Director will either approve or disapprove such petition. If the Director approves such petition, the Ohio EPA will specify any additional permit conditions for the continuous emission monitor system shown to be necessary over the trial period.

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ATTACHMENT 3 - INCINERATION SYSTEM OPERATION PARAMETERS

System Parameter	Instrument (DCS Tag #) and Monitoring System	Operating Limit and Monitoring Frequency	Calibration Frequency	Back-up System
Front Wall Lances	FI-3110, 3120, 3130, 3140, 3150, 3160 Pressure switches	Atomizing steam, air or oxygen pressure > 45 psi Monitored continuously	annually or as needed	WFCO
Primary Air Fan	FI-3410A Flow meter	Must be operating Monitored continuously	NA	WFCO
PCC Temperature	TI - 4300, Redundant thermocouples	Must be < 2174 F and > 1830 F (four hour rolling average), and > 1800 F and < 2200 F instantaneous Recorded continuously	every 5 weeks	WFCO
SCC Temperature	TI - 4310, Redundant thermocouples	Must be above 1600 F Recorded continuously	every 5 weeks	WFCO
SCC Pressure	PI - 4300, Pressure transmitter	Must be below 0 inwc (2 second delay) Recorded continuously	every 5 weeks	WFCO
SCC Steam Pressure	PI - 4500a PI - 4500b, Pressure transmitter	> or = to 100 psi Recorded continuously	annually or as needed	WFCO
SCC Combustion Air Fan (Natural Gas Burner Blower)	HS - 4001, DCS Switch	Natural Gas Burner Blower Fan on and damper open > or = to 10% Monitored continuously	NA	WFCO
Slag Quench Tank	LI-4610, Level indicator	water level in tank monitored continuously	annually or as needed	none
Boiler	LI-5010, Level indicator FI-5010B FI-5010A, Flow indicators	Drum level Feed water flow Steam flow Monitored continuously	annually or as needed	Level switch for drum
ESP Fields	EI - 6700, 6710, 6720, ESP Optipulse Controller	See Permit Condition I(A).3.(o) Monitored continuously	NA	WFCO
CO at ESP Outlet	AI - 6652B, CO analyzer	One hour average <100 ppm Recorded continuously	daily annual RATA	WFCO
Dry O2 at ESP Outlet	AI-6651-56, O2 analyzer	> 3 % (60 second delay) Recorded continuously	daily annual RATA	WFCO

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System Parameter	Instrument (DCS Tag #) and Monitoring System	Operating Limit and Monitoring Frequency	Calibration Frequency	Back-up System
Spray Dryer Outlet Temperature/ ESP Inlet Temperature	TI - 6002, Redundant thermocouples	Must be above 250 F; and Must be below 450 F Recorded continuously	every 5 weeks	WFCO
Scrubber Liquid Flows	FI-7001 FI-7204 FI-7304 FI-7404, Flow meter	1 st stage, quench flow 2 nd stage, 1 st packed bed flow 3 rd stage, 2 nd packed bed flow* 4 th stage, ring jet flow Monitored continuously	annually or as needed	Pump pressure transmitter and WFCO (see Attachment 1, flow to 3 rd stage)
pH of Scrubber at 3 rd Stage	AI - 7307, pH probe	> 7 pH Monitored continuously	as needed	WFCO
Ring Jet Pressure Drop, 4 th Stage Scrubber	PDI-7405, Pressure transmitter	Must be > 13.4 inwc Recorded continuously	monthly	WFCO
THC at Stack	AI - 7850, THC analyzer	< 100 ppm (one minute average) Recorded continuously	daily annual RATA	WFCO
HCl at Stack	AI - 7820, HCl analyzer	Must be < 4 lbs/hr Recorded continuously	daily annual RATA	*Flow rate to the 3 rd stage of the scrubber
Opacity at Stack	AI - 7815, Opacity analyzer	<20% (six minute average) Recorded continuously	daily annual RATA	None
Process Flow	FI - 7805, Flow meter	< 65,000 scfm Recorded continuously	daily	WFCO
Incineration Process Heat Release (system load)	HI-7610 AVG2, Distributed control system (DCS)	Must be below 97.8 MMBTU/HR on a 3 hour rolling average; Recorded continuously	yearly	WFCO
ID Fan	HS - 7610, Distributed control system (DCS)	Must be operating Monitored continuously	NA	WFCO
ECIS	HS-5740 HS-7140 Manual check	Activated carbon feed rate Recorded regularly	monthly	WFCO

System Parameter	Instrument (DCS Tag #) and Monitoring System	Operating Limit and Monitoring Frequency	Calibration Frequency	Back-up System
Feed Restriction	Micro-motion meters, positive displacement pumps, and scales	Total feed rate, 29,651 lbs/hr (one hour average) or 28,565 lbs/hr (four hour average) Monitored and recorded continuously	Monthly and/or according to manufacturer's recommendation	WFCO
Feed Restriction	Scales	Solid waste feed rate, 16,576 lbs/hr (one hour average) or 15,265 lbs/hr (four hour average) Monitored and recorded continuously	According to manufacturer's recommendation	WFCO
Feed Restriction	Real Time Monitor	Chlorine feed rate 2700 lbs/hr (three hour average) Monitored and recorded continuously	NA	WFCO
Feed Restriction	Real Time Monitor	Metal feed rates as listed in Attachment 2 Monitored and recorded continuously	NA	WFCO
Plume Suppression (Reheat Fan)	HS - 7710, DCS	Plume suppression must be operated continuously except during maintenance	NA	Manual reset
By-Pass or Auxiliary Fuel	Front wall gas burners, HS-3520; auxiliary fuel, HS-3120	Must be available at all times waste is being fed to the incinerator	According to manufacturer's recommendation	WFCO

* FLOW TO SCRUBBER 2ND PACKED BED BECOMES A PERMIT LIMIT DURING TIMES WHEN THE HCl ANALYZER IS BEING CALIBRATED OR IS MALFUNCTIONING.

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ATTACHMENT 4 - WASTE MANAGEMENT UNITS

- A) **WMU 1: Incinerator System** - The incinerator system treats organic hazardous waste by thermal oxidation. This unit consists of the following elements: (1) rotary kiln incinerator, (2) secondary combustion chamber, (3) heat recovery boiler, (4) spray dryer, (5) electrostatic precipitator, (6) four stage wet scrubber, (7) induced-draft fan, (8) reheat system, and (9) stack. The incineration system thermally oxidizes bulk liquid, bulk solid, and containerized wastes received from off site generators and waste generated on-site through processing activities. Wastes generated on site include used brick from annual relining of the incineration system, contaminated debris and PPE, laboratory wastes, and wastewater. Incinerator slag and ash, which constitutes treatment residual, is collected at generation points within the incinerator system for disposition off site. Slag from the incineration system is conveyed to roll off or end dump trailers and incinerator ash from the boiler, electrostatic precipitator, and spray dryer is conveyed to pneumatic tank truck. Generated waste is either treated through the incineration system or sent off site for disposition at permitted facilities. Wastes to be sent off-site are covered, labeled and stored in < 90 storage areas on-site.

The incinerator system is located on concrete within the facility's "C" water containment system as described in Sections B and C of the approved Part B permit application. Curbs, contoured surfaces, and containment sumps for this area are designed to contain up to 176,000 gallons. Air emissions from the system are continuously monitored according to permit requirements. The induced-draft fan maintains a negative pressure within the incineration system; therefore, if leakage occurs at any seals or openings, air leaks into the incinerator rather than the combustion products leaking to the atmosphere. The facility also has installed a shroud at both ends of the primary combustion chamber to further reduce the potential for fugitive emissions. The potential for release to ground water, surface water, on-site soils, and air is low.

- B) **WMU 2 : Organic Waste Tank Farm** - The Organic Tank Farm manages pumpable organic wastes unloaded from tank trucks and/ or portable tanks prior to thermal treatment at WMU 1. The tanks in this unit are within a 52 foot by 162 foot building with a concrete floor and containment dikes and sumps. The following 18 closed-top vertical, waste management tanks are located in this WMU: six 20,000 gallon carbon steel organic liquid storage tanks: one 7,000 gallon carbon steel organic liquid storage tank, two 20,000 gallon carbon steel sludge tanks; one 7,000 gallon carbon steel sludge storage tank, two 20,000 gallon epoxy-phenolic lined carbon steel aqueous liquid storage tanks, two 20,000 gallon epoxy-phenolic lined carbon steel blending tanks, one 10,000

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gallon epoxy-phenolic lined carbon steel blending tank, two 2,000 gallon carbon steel overflow tanks, and one 20,000 gallon carbon steel fuel oil storage tank. The unit is divided into two containment areas by a raised concrete aisle running east to west lengthwise down the center of the building, separating the unit into two tank groups, nine in each group.

The floor of this unit is constructed of reinforced concrete that has been treated to resist chemicals that are managed in this unit. The entire combined containment area is surround by an exterior concrete dike wall. Each separate containment area, including sumps, has a containment capacity of about 21,500 gallons. Organic vapors from this unit are vented to a vapor recovery system which is described in Section D of the approved Part B permit application. This unit manages bulk liquid wastes generated off-site and liquid wastes generated on-site before transfer to the incinerator system for treatment. There has been one release from this unit on December 29, 1999. The Contingency Plan was activated and the area was remediated. Approximately 50 gallons of a mixture of waste solvent and water was released to the gravel/soil area adjacent to, and on the west side of, the Organic Waste Tank Farm. A total of 87,061 pounds of gravel and clay were excavated and removed. The potential for release to ground water, surface water, on-site soils, and air is low.

- C) **WMU 3: Organic Tanker Unload Station** - This unit is a 60 foot by 75 foot, building used to unload bulk liquid waste from tank trucks after the waste shipment has been approved. It is adjacent to, and north of, the Organic Waste Tank Farm (WMU 2). The unit is divided into three stations separated by fire walls. The east station is used to direct feed aqueous waste to the incineration system. The floor of this unit is constructed of reinforced concrete that has been treated to resist chemicals. A combination of 7.5 inch speed bumps, and 8 inch curbs surrounds each unloading station. The paved surface in each station is sloped toward a reinforced concrete sump. Each separate containment area, including sumps, curbs contoured surfaces, speed bumps has a containment capacity of about 10,000 gallons. Each station is facilitized to collect vapors that may be emitted during off loading procedures. These fugitive emissions are transferred to the facility's vapor recovery system. This unit manages tank trucks containing bulk liquid wastes generated off-site. Wastes are unloaded from tank trucks at this WMU into the Organic Waste Tank Farm (WMU 2). There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- D) **WMU 4: Truck Sample and Hold Area**- This unit is a 60 foot by 96 foot open-sided, roofed area used to hold and sample incoming trucks containing bulk

liquid or solid waste. Trucks are held at this unit until sample analyses are completed and the shipment has been approved or rejected. The unit is divided into six stations. The floor of this unit is constructed of reinforced concrete that has been treated to resist chemicals that are managed in this unit. A combination of 6 inch speed bumps and 6 inch curbs surround the unit. The paved surface of the unit is sloped toward a reinforced concrete sump. This unit has a containment capacity of approximately 31,000 gallons. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.

- E) WMU 5: Building B (External Truck Wash)- This unit is a 25 foot by 70 foot building that is used for storage and processing of wastes. This enclosed unit has a reinforced concrete floor that has been treated to resist chemicals that are managed and stored in this unit. Four inch speed bumps are located at the entrance and exit of the building. The paved surface inside the unit is sloped toward a reinforced concrete sump and trench. The contoured floor surface, sump, and trench have a containment capacity of about 7,000 gallons. The building is facilitized to collect vapors that may be released during processing activities. These fugitive emissions are transferred to the facility's vapor recovery system. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- F) WMU 6- Wastewater Treatment- This unit, which consists of a sand and carbon filter and a back wash settling tank, is used to treat liquids from clean-up activities and/or spills, or storm water collected from "C" and rejected "B" containment systems. The storm water collection systems, "A", "B" and "C" are described in Section B of the approved Part B permit application. Liquids from the "C" containment areas at the facility are transferred to Tank W-5 in the Storm Water Storage Tank Farm (WMU 7). From Tank W-5, the water is transferred to Tank W-4 where it may be incinerated at WMU 1 or used as make-up water for, but not limited to, the scrubber or in the DeNox System. If analytical of this water indicates it is in need of treatment prior to reuse, it is piped through the sand filter followed by the carbon filter. The filter system is occasionally back washed to a tank within the Process Water Tanks (WMU 8). The Wastewater Treatment System is located in an indoor 25 foot by 60.33 foot concrete containment area with a 3.66 foot high berm, a concrete sump and a reinforced concrete floor that has been treated to resist chemicals that are managed in this unit. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- G) WMU 7- Storm Water Storage Tank Farm- This unit is a 46.5 foot by 202 foot

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concrete tank farm used to store storm water from "C" and "B" containment areas. The storm water collection systems, "A", "B" and "C" are described in Section B of the approved Part B permit application. This water, with the exception of "A" areas, has the potential for contamination as it is collected from active storage and process areas and roadways where waste is transported. The water is stored in five open top vertical tanks: three 200,000 gallon carbon steel tanks storing "B" water, one 250,000 gallon carbon steel tank storing "C" water, Tank W-5; and one 250,000 gallon carbon steel tank for storing the treated "C" water, Tank W-4. The area under the tanks is paved with reinforced concrete treated to resist chemicals that are managed in this unit, and it is surrounded by a 6.67 foot high reinforced concrete dike. An intermediate reinforced concrete wall 3 inches lower than the surrounding dike separates the "B" and "C" collection water tanks. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.

- H) WMU 8- Process Water Tanks- This unit is an approximately 50 foot by 25 foot concrete tank farm used to store scrubber water and filter system backwash water from the Wastewater Treatment System (WMU 6). The tank farm contains two 30,000 gallon fiberglass-reinforced plastic tanks (W-6 and W-7) for storing scrubber water and one approximately 6,000 gallon carbon-steel tank (W-8) for backwash water from WMU 6. The area under the tanks is paved with reinforced concrete treated to resist chemicals that are managed at this unit, and it is surrounded by a 3.67 foot high reinforced concrete dike with a containment capacity of 38,000 gallons. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- I) WMU 9- Laboratory Waste Storage Tank- This unit is a 1,000 gallon fiberglass-reinforced horizontal plastic tank located in a covered concrete containment vault. The vault has been treated to resist chemicals that are managed in this unit and is covered with a steel top. The facility's laboratory wastes are piped directly from the laboratory to this tank before being transferred to the Organic Waste Tank Farm (WMU 2) via vacuum truck and ultimately incinerated at SMU 1. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- J) WMU 10- Container Processing Building- This unit is a 100 foot by 237 foot area in a building located between the Organic Waste Tank Farm (WMU 2) and the incineration system (WMU 1). WMU 10 is designed to receive containerized waste from off site and prepare it for incineration at WMU 1. The unit is located

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on the south side of an enclosed building with operations on three levels. Level one is the ground floor of the unit and slopes to area sumps. Level two is the intermediate conveyor floor and slopes to area floor drains that discharge to sumps on level one. Level three is the conveyor gallery with a curbed floor to contain spill. The floors are constructed of reinforced concrete treated to resist chemicals that are managed in this unit. This unit is surrounded by a six inch high reinforced concrete curb with 1.5 inch speed bumps located at interior doors and at the unloading platform. The floor area is sloped towards three reinforced concrete sumps. The contained areas and sumps for this unit have a capacity of about 50,000 gallons. Organic vapors from specific process areas in this unit are vented to a vapor recovery system.

Activities within WMU 10 include off-loading, weighing, sampling, labeling, and palletizing containers; container pump-out stations, a station for splitting of materials into smaller charges, consolidation of wastes into superpacks, filling bucket hoist hoppers and heating of waste in drums. Containers may be transferred from this unit to: (1) the incineration system; (2) any of the four container storage areas; (3) direct drum feed unit in the Incinerator Feed Building; (4) Building B (External Truck Wash) for processing; (5) Building C (Lab Pack Building) for processing; (6) the extruder; (7) directly to the bucket hoist feed mechanism. Within WMU 10, containers of waste are moved by means of a conveyor system or by fork lift. Containerized wastes generated on site such as contaminated debris and PPE are also managed in this unit. There have been no documented releases from WMU 10. The potential for release to ground water, surface water, on-site soils, and air is low.

- K) WMU 11- Building A Storage Area (Drum Warehouse of the Container Processing Building) - This unit constitutes the north side of the Container Processing Building (WMU 10). WMU10 and WMU 11 are separated by a concrete fire wall and doors. The dimensions are 100 foot by 210 foot. Building A is designed to store containerized waste from on-site and off-site sources before incineration at WMU 1. Containers are placed on pallets and stored on racks. The unit has the capacity to store approximately six thousand 55-gallon drums or the equivalent of any combination of different sized containers. The permitted storage capacity is 510,000 gallons. The storage area has been designed to have separate concrete containment curbs for each set of racks and waste is segregated according to compatibilities. The entire combined containment area is surrounded on three sides by exterior concrete walls. The fourth side, consists of a fire wall with three doors that have 1.5 inch high speed bumps. The floor is constructed of reinforced concrete treated to resist chemicals that are managed in this unit. The floor in each area is sloped toward

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a reinforced concrete sump. The total containment capacity is 79,497 gallons (see Section D of the approved Part B permit application, Attachment D.14 for the calculation of the secondary containment). Forced air ventilation prevents the accumulation of vapors and fumes. Containers are inspected for integrity prior to storage and on a daily basis during facility inspections. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.

- L) WMU 12- PT Tank Farm- This unit is an approximately 16 foot by 55 foot building which houses a tank farm used to store liquid wastes pumped from containers in the Container Processing Building (WMU 10) and from the Extruder Unit (WMU 13). It is located adjacent to, and southwest of, the Container Processing Building. Waste from the Organic Waste Tank Farm (WMU 2) can also be pumped to this unit. WMU 12 contains: three 2,500 gallon carbon steel tanks for liquid waste, PT-1, PT-2, and PT-3; one 7,000 gallon carbon steel tank, PT-4 which can receive waste from PT-1 through PT-3, from the Organic Waste Tank Farm, or from the pumpout tank (PT-6) associated with the Extruder; and one 300 gallon carbon steel overflow tank, PT-5. The area under the tanks is paved with reinforced concrete that has been treated to resist chemicals that are managed in this unit. The area is also surrounded by a 1.5 foot high reinforced concrete dike and enclosed by walls and roof. The paved area within the concrete dike is sloped toward a reinforced concrete sump. This unit has a containment capacity of 11,200 gallons. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- M) WMU 13- Extruder- This unit is located adjacent to, and southwest of, the Container Processing Building (WMU 10). It is enclosed and houses the facility's drum extruder, which is used to remove and blend the contents of drums that cannot be charged directly into the incineration system (WMU 1) or processed through the PT tank stations. The unit also includes a pump out tank, one 500 gallon above-ground carbon steel tank, PT-6, which blends the waste and then transfers it to PT-4 in the PT Tank Farm (WMU 12) or directly to the incinerator (WMU 1). The area is paved with reinforced concrete treated to resist chemicals that are managed in the unit and is surrounded by a six inch high curb. The paved area within the curb is sloped toward a concrete sump. The containment capacity of the curbed area and concrete sump is about 9,000 gallons. Organic vapors are vented to a vapor recovery system. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.

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- N) WMU 14- Container Receiving Area (unloading docks) - This unit consists of two covered truck unloading docks that abut the northeast side of the Container Processing Building (WMU 10). The unloading docks are paved with reinforced concrete treated to resist chemicals that are managed in this unit. A reinforced concrete containment wall and speed bump border the north and east edges of the unit along the two sides not bordered by the Container Processing Building (WMU 10). A reinforced concrete containment trench is located along the south side of each unloading station. The paved surface of each dock is sloped toward these trenches. This unit manages containerized wastes generated off-site. The wastes are subsequently unloaded to the Container Processing Building (WMU 10). There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- O) WMU 15- Container Holding Building (Slag Canopy)- This unit is a 50 foot by 50 foot structure used to store containers larger than 85 gallons of nonreactive, compatible waste. Examples include roll-off boxes, tanker trucks, cubic yard boxes, and totes. Processing of some waste streams, e.g., consolidation of consumer packaged waste into skip hoist hoppers, also may occur in this building. WMU 15 is located just north of the incineration system (WMU 1). The unit has a roof and is enclosed on three sides to minimize the accumulation of storm water. The floor of this unit is constructed of reinforced concrete treated to resist chemicals that are managed at this unit, and is bordered by a six inch high speed bump on two sides and a six inch high curb on the other two sides. The paved surface within the speed bumps and curbs is sloped towards a concrete sump. The curb and speed bumps of this covered unit have a containment capacity of 10,520 gallons. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- P) WMU 16- Less than 90 Day Accumulation Areas - These units are currently sited at the following locations: (1) east of the Building B (External Truck Wash) (WMU 5), and (2) along the utility bridge north of the Organic Waste Unloading Area (WMU 3). The areas store wastes generated on-site, typically containers holding slag and flyash (the treatment residuals from the incineration process), slag quench water, used refractory brick, and spent activated carbon. They are uncovered and located over reinforced concrete in containment areas. Curbing, sumps, and sloped berms control run-on and are part of the containment system. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.

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- Q) WMU 17- Bulk Solid Waste Storage Tanks- This unit consists of two reinforced concrete tanks located inside the Incinerator Feed Building. The units are open topped tanks separated by a center wall to prevent the co-mingling of waste. The total capacity of the two existing tanks is approximately 1,200 cubic yards. Bulk solid waste is unloaded from trucks or roll-offs into the tanks through doors located on the east side of the tanks. The waste is blended and transferred via an overhead crane from the tanks to the incineration system (SWMU 1) for treatment. Vapors released from the waste are collected by vapor recovery vents in the tank area and conveyed to the vapor recovery system. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.
- R) WMU 18- Building C (Lab Pack Building)- Building C is located east of the Container Processing Building (WMU 10). The building is fully enclosed with exterior containment curbing. The base of the interior of the building is sloped to a sump located in the northwest corner. The containment capacity of this building is 11,200 gallons. Containers of waste stored in this building are placed on pallets (or equivalent) and /or in heavy duty storage racks to prevent contact with the building floor. This area has two-level racks with the ability to store an equivalent of 240 fifty five gallon drums or 13,200 gallons. The primary use for this unit is for auditing lab packs but other processing activities and the storage of lab packs are also permitted. The unit is connected to the vapor recovery system and is used during auditing lab packs or other waste processing activities when there is a potential for the release of vapors or fugitive emissions. There have been no documented releases from this unit. The potential for release to ground water, surface water, on-site soils, and air is low.

Area Of Concern (AOC) - Former Charter Oil Facility Release Area

The property where VRA is located was formerly occupied by Charter Oil. The Charter Oil facility included approximately 7.2 acres of property which consisted of a building, the barge off-loading pier which extended into the Ohio River and a petrochemical terminal. The petrochemical terminal, approximately two acres, consisted of ten large capacity above ground storage tanks surrounded by an earthen dike, a metal transfer pipeline ten inches in diameter and a tanker truck terminal. The transfer pipeline connected the storage tanks to a barge terminal in the Ohio River, and also to a truck load-out area north of the storage tank area. The petrochemical terminal and tanks have since been removed. Additional information regarding Charter Oil can be found in Section E of this permit.

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A spill history at the Charter Oil facility included large releases of hazardous materials. In the Spring of 1983, approximately 19,000 gallons of xylene released into the environment when a crack developed in the side of a storage tank located within the storage tank farm. In April of 1985, a site investigation report was prepared by Weston-Sper, a consultant for U.S. EPA. The report identified a suspected release into the environment of 33,000 gallons mineral spirits from the Charter Oil facility in early 1984. This release allegedly occurred through a storage tank leak. An alleged third release of an unidentified material of approximately 200,000 gallons into the environment was reported to have occurred at the Charter Oil facility in June of 1984. A federal investigation was conducted in response to an alleged theft of solvents from Charter Oil facility. Such investigations revealed that the pipelines leading from the storage tanks to the truck loading area were severely corroded, thus indicating the possibility of numerous releases. This alleged release was never confirmed.

As a result of past documented releases at the facility, ground water and soil contamination exists at the facility. According to March 1990 analytical data, the facility has ground water contamination of benzene, toluene, ethylbenzene, xylene, acetone, trimethylbenzenes, trichloroethene, and total petroleum hydrocarbons. Remedial actions related to contamination at the Former Charter Oil Facility Release Area are ongoing pursuant to Interim Orders with Ohio EPA.

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ATTACHMENT 5 - RCRA CORRECTIVE ACTION PLAN

ORIG: E. DHWM

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ATTACHMENT 5

OSWER Directive 9902.3-2A
May 1994

RCRA CORRECTIVE ACTION PLAN

(Final)

Office of Waste Programs Enforcement
Office of Solid Waste

OHIO EPA D-1111

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NOTICE: The policies set out in this document are not final agency action, but are intended solely as guidance. They are not intended, nor can they be relied upon, to create any rights enforceable by any party in litigation with the United States. EPA officials may decide to follow the guidance provided in this document, or to act at variance with the guidance, based on an analysis of specific site circumstances. The agency also reserves the right to change this guidance at any time without public notice.

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Foreword

This document was issued by Bruce M. Diamond, Director, Office of Waste Programs Enforcement, and Michael Shapiro, Director, Office of Solid Waste, in May, 1994 as the RCRA Corrective Action Plan Guidance (Final), OSWER Directive Number 9902.3-2A replacing the RCRA Corrective Action Plan Guidance (Interim Final), OSWER Directive 9902.3, dated June, 1988. The interim final guidance was updated with the help of a workgroup made up of representatives from several States and EPA Headquarters and Regions. The updated guidance reflects the experience the Regions and States have gained and changes that have occurred in the corrective action program. In addition, new technical information has been added.

The purpose of the RCRA Corrective Action Plan (CAP) is to aid Regions and States in determining and directing the specific work that a Permittee/Respondent must perform, as part of a complete corrective action program. The CAP will assist the Regions and States in developing corrective action requirements in permits under §3004(u) and (v) and §3005(c)(3) (omnibus) and corrective action orders under §3008(h) and §7003.

The CAP provides a framework for developing a site-specific schedule of compliance to be included in a permit or a corrective action order. It does so by laying out scopes of work for the four main components of a corrective action program. These four components and their objectives are as follows:

- *Interim/Stabilization Measures (ISMs)* - to control or abate threats to human health and/or the environment from releases and/or to prevent or minimize the further spread of contamination while long-term remedies are pursued.
- *RCRA Facility Investigation (RFI)* - to evaluate thoroughly the nature and extent of the releases of hazardous waste and hazardous constituents and to gather necessary data to support the Corrective Measures Study and/or interim/stabilization measures.
- *Corrective Measures Study (CMS)* - to develop and evaluate a corrective measure alternative or alternatives and to recommend the final corrective measure(s).
- *Corrective Measures Implementation (CMI)* - to design, construct, operate, maintain and monitor the performance of the corrective measure(s) selected.

A chapter on interim/stabilization measures (Chapter II) has been added in the final CAP. This optional phase is generally the first phase of corrective action but may be conducted at any time in the process. The term "interim/stabilization measures" is being used in this document to encourage the use of interim measures to achieve stabilization. Interim/stabilization measures are actions to achieve the goal of stabilization, which is stated above and in Chapter II.

Another optional phase, the Release Assessment or Phase I RFI, could be performed by the Permittee/Respondent before an RFI (or as a first phase of an RFI) and after a RCRA Facility Assessment (RFA) to determine whether interim/stabilization measures are necessary and/or to focus an RFI. A release assessment should be used to minimize corrective action activities (i.e., by focusing the RFI) and not to add another step in the process. See section III.D. ("Phasing of Activities") of Chapter I and the beginning of Chapter III for further discussion and a model scope of work for release assessments.

The CAP provides an overall model for the corrective action process. The scopes of work contained in the CAP should not be considered boilerplate; rather, they should be considered as a menu of possible activities to be required on a site-specific basis. The model scopes of work in the CAP are intended to foster timely, concise, and technically adequate submissions by the Permittee/Respondent. Therefore, when modifying these scopes of work with site-specific information, only information that is necessary for the subject facility should be required, in order to minimize the number and length of Permittee/Respondent submissions and implementing agency review time. The implementing agency decides which components will be included in the permit or order.

Chapter I: Corrective Action Process Update

Since the interim final CAP was published in June 1988, several changes have occurred in the RCRA corrective action program. New philosophies and strategies were expressed in the July 1990, RCRA Implementation Study (RIS), and new technical information has become available. The revised CAP reflects these changes, as well as the experience of the Regions and States in implementing the corrective action program. Some of the key changes are discussed below following an introduction to the corrective action program and an explanation of how to use the CAP.

I. Introduction

The objective of a Corrective Action Program at a hazardous waste management facility is to evaluate the nature and extent of the releases of hazardous waste or constituents; to evaluate facility characteristics; and to identify, develop, and implement an appropriate corrective measure or measures to protect human health and environment. The following components are necessary to ensure a complete corrective action program. It should be recognized that the detail required in each of these steps will vary depending on the facility and its complexity; only those tasks appropriate for a specific site should be imposed on the Permittee/Respondent.

1. Locate the source(s) of the release(s) of contaminants (e.g., regulated units, solid waste management units, and other source areas).
2. Characterize the nature and extent of contamination that is both within the facility boundary and migrating beyond the facility boundary. This would include defining the pathways and methods of migration of the hazardous waste or constituents, including the media affected, the extent, direction and speed of the contaminants, complicating factors influencing movement, concentration profiles, etc.
3. Identify areas and populations threatened by releases from the facility.
4. Determine actual and potential threats of releases from the facility to human health and/or the environment in both the short and long term.
5. Identify and implement an interim/stabilization measure or measures to abate the further spread of contaminants, control the source of contamination, or otherwise control the releases themselves.
6. Evaluate the overall integrity of containment structures and activities at the site intended for long-term containment.

7. Identify, develop, and implement a corrective measure or measures to prevent and remediate releases of hazardous waste or constituents from the facility.
8. Design a program to monitor the maintenance and performance of any interim or final corrective measure(s) to ensure that human health and the environment are being protected.

The four main components of a complete corrective action program and their objectives are as follows:

- *Interim/Stabilization Measures (ISMs)* - to control or abate threats to human health and/or the environment from releases and/or to prevent or minimize the further spread of contamination while long-term remedies are pursued.
- *RCRA Facility Investigation (RFI)* - to evaluate thoroughly the nature and extent of the releases of hazardous waste and hazardous constituents and to gather necessary data to support the Corrective Measures Study and/or interim/stabilization measures.
- *Corrective Measures Study (CMS)* - to develop and evaluate a corrective measure alternative or alternatives and to recommend the final corrective measure(s).
- *Corrective Measures Implementation (CMI)* - to design, construct, operate maintain and monitor the performance of the corrective measure(s) selected.

As discussed in section VI of this chapter, all of the components may be streamlined or phased, and alternatives to the "traditional" corrective action process (i.e., RFI → CMS → CMI) may be appropriate.

A RCRA Facility Assessment (RFA) or equivalent assessment will have been conducted at the facilities that are to receive permits and for some facilities that are issued §3008(h) Orders. The results of the RFA should be used as the basis for focusing the RCRA Facility Investigation (RFI) for individual sites and should provide the necessary data to complete the "background information" components of the CAP. In some cases, a Release Assessment (Phase I RFI) may be needed to further focus the RFI or to determine whether ISMs are necessary.

Exhaustive characterization and studies of a facility during the RFI/CMS, in the sense of completely eliminating uncertainty, are generally not required to achieve environmentally protective results. Therefore, it is important for the

implementing agencies to clearly define scopes of work to be performed that require the appropriate amount of information to characterize contamination and identify the cleanup alternative(s) without "going overboard." Reasonable time frames should be set for activities such as gathering data and conducting studies.

II. How to Use the CAP

Users of the CAP should understand that it is designed to identify actions that facility Permittees/Respondents may be required to undertake as part of a corrective action program. It does not identify the steps that are the responsibility of the implementing agency. However, some guidance language is provided in the CAP for such agencies and is indicated by brackets ([]) and italics. Additional guidance language is found at the beginning of Chapters II, III, IV, and V, and before the model scopes of work. Specifying conditions that will be placed in orders and permits is one key area of responsibility for implementing agencies. The CAP incorporates certain provisions that are already required by statute or regulations. If the required information is already present in permits or permit applications, the implementing agency may allow the Permittee to reference the appropriate sections of such documents. The remainder of the CAP is guidance, not a rule, and has not gone through public comment; therefore, use of provisions in the CAP should be justifiable and tailored to fit site-specific conditions.

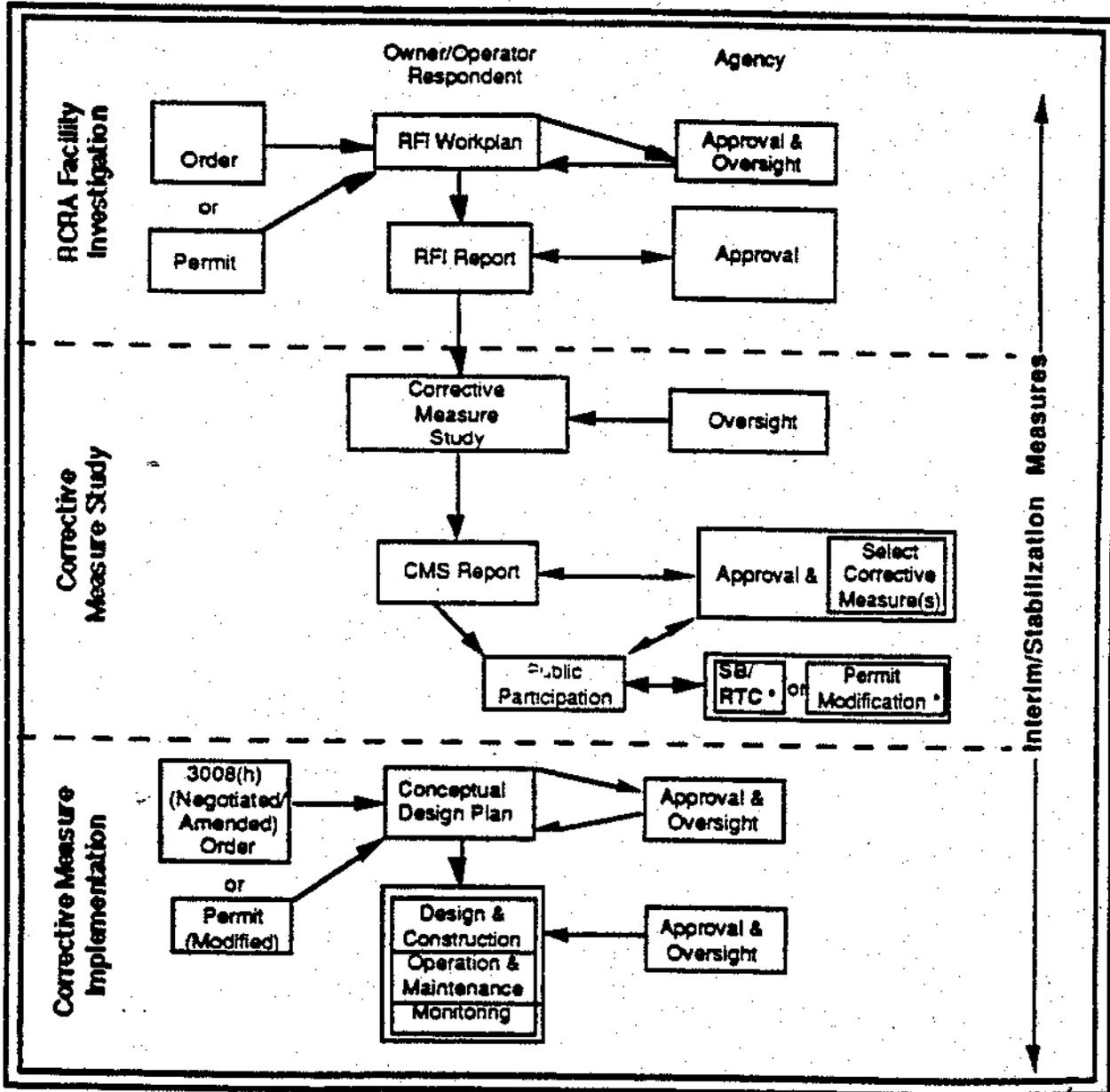
Regions and States should incorporate the appropriate provisions of the corrective action plan in a draft permit. If public comments are received on these provisions, the implementing agency's response to comments should include a site-specific justification for the provisions in question, with supporting data as appropriate. For guidance on public involvement for corrective action under permits and RCRA §3008 (h) orders, see the *RCRA Public Involvement Manual* (EPA530-R-93-006, September 1993).

Limitations exist on the release or discussion of information during the enforcement process (particularly during negotiations or if a case is referred to the Department of Justice). However, respondents that are issued RCRA §3008 (h) administrative orders have the right to request a hearing concerning any material fact in the order or the terms of the order which may include scopes of work derived from the CAP. Respondents to §3008 (h) orders may request informal settlement conferences. Agencies are encouraged to settle such enforcement actions through informal discussions.

Traditional risk assessment techniques may be a significant factor in designing RFI, CMS, and ISMs work plans. Risk management decisions should be used in selecting corrective measures and ISMs, along with current and future land use scenarios, background levels, health-based and technology-based standards.

To clarify the interaction between the agency and the facility Permittee/Respondent, a flow chart of Permittee/Respondent submittals that may be imposed and the agency actions for the stages of the CAP is represented in Figure 1 below. It is important to note that this is the "traditional" model and many variations of the process are possible (see "Alternate Corrective Action Models" section VI.F. on page nine).

Figure 1. RCRA Corrective Action Process



* The Statement of Basis/Response to Comments (SB/RTC) or permit modification documents the selected corrective measure(s).

III. Modifications of CAP Scopes of Work

The CAP scopes of work should not be considered boilerplate. The scopes of work in the CAP are models that should be modified based on site-specific situations. Information generated from investigations such as RCRA Facility Assessments (RFAs) should be used to tailor the scope of work to address facility-specific situations. The following are some examples of situations where modification to the CAP model scopes of work would be appropriate.

- If the contamination problem at a facility is small or simple (e.g., a small soil contamination problem), then the implementing agency may decide to scale down the CAP accordingly. The agency could require excavation and removal by ISMs or by corrective measures after approving a streamlined CMS (e.g., with only the one alternative evaluated).
- If the contamination problem at a facility is complicated, the Health and Safety Plan and Public Involvement Plans may need to be comprehensive. However, in less complicated contamination situations, these plans may be very brief.
- If site-specific conditions require more detail than what has been scoped out in any particular section of the CAP, then these requirements should be enhanced accordingly.
- If there is information on air releases at a site which is sufficient to suggest a remedy which would prevent such an air release, then it would not be necessary to require the Permittee/Respondent to perform an air contamination characterization. The air contamination characterization work under the RFI should be deleted.
- If interim/stabilization measures are underway, scheduled or contemplated at a facility, then the interim/stabilization measures section under the RFI should be modified to specifically reference such measures.
- If possible, the CAP should focus the Permittee/Respondent on specific solid waste management units (SWMUs) and other areas of interest, as well as known waste management activity areas (e.g., waste recycling units).
- If only one corrective measure alternative is appropriate for a given situation, and it would not be necessary to require the

Permittee/Respondent to further investigate the possibility of other corrective measure alternatives, then the scopes of work contained in this document should be modified to reflect this situation.

IV. Available Guidance

The Regions and States are encouraged to make available to the Permittee/Respondent existing model plans that are relevant to RCRA activities. For example, the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities Operating Safety Guidelines* contains a model that can be used for the Health and Safety Plan outlined in the CAP. In addition, guidance documents such as the RCRA Facility Investigation (RFI) Guidance; Interim Final (May 15, 1989, document number PB89-200-299, four volumes available from NTIS, phone number (703) 487-4650) may be referenced. Other corrective action guidance documents and sources of related information are provided in Appendix A.

V. Tailoring the Work to be Performed for the Site

It is necessary to stress the importance of site-specific technical detail in developing corrective action orders, permits, and, particularly, scopes of work. Each facility has unique characteristics and circumstances that need to be considered and incorporated into any requirements for corrective action. Without this up-front detail, many Permittees/Respondents will provide deficient submittals that lack the technical detail necessary to perform a thorough corrective measure program. In addition to providing a detailed scope of work, the implementing agency should also establish a site-specific time frame for completing the work. Enforcement of permit conditions or an order is always easier when specific detail is included. These documents should contain schedules for submittals such as reports and work plans. Without a detailed schedule of compliance in a corrective action permit or a corrective action order, submittals and actions may be delayed or untimely.

VI. New Developments in Corrective Action

A. Streamlining the Corrective Action Process

The introductory remarks in the original CAP (June 1988) stressed the importance of concise submissions based on site-specific detail and that the scopes of work contained in the CAP should not be considered boilerplate. The revised CAP continues to emphasize this policy as well as an overall goal of streamlining the process in an effort to expedite cleanups. Of course, this goal must be balanced with the goal of maintaining the technical integrity of the program. Decisions concerning how and when to streamline the process are to be made at the discretion of the implementing agency.

The revised CAP encourages using alternatives to the traditional sequential approach (e.g., the use of interim measures to achieve stabilization). It presents a menu of options that are to be tailored to individual sites, taking into account site-specific conditions. In addition, some steps have been combined or eliminated to reduce redundancy.

B. Addition of Interim Measures to Achieve Stabilization (Chapter II)

The following chapter, *Interim Measures to Achieve Stabilization* has been added to the CAP as an optional phase to be conducted at the discretion of the implementing agency. The 1990 RIS suggested that the RCRA corrective action program needed to adjust its longtime program emphasis. While final cleanup remains the long-term goal of the corrective action program, the RIS recommended more frequent use, where appropriate, of interim/stabilization measures in the early stages of corrective action to achieve near term environmental protection at facilities with the most serious problems. This approach, which may also be appropriate during later phases of the process, emphasizes controlling sites by stabilizing identified releases to prevent the further spread of contamination and degradation of the environment. Note that the term "interim/stabilization measures" is being used in this document to encourage the use of interim measures to achieve stabilization.

C. Corrective Action Management Units (CAMUs) and Temporary Units (TUs)

The February 16, 1993, Federal Register (58 FR 8658) finalized provisions for Corrective Action Management Units (CAMUs) and Temporary Units (TUs) under subpart S of 40 CFR Part 264. These units function solely to manage remediation wastes generated at a RCRA facility as a result of required corrective action activities. EPA recognized that the existing regulatory structure of RCRA Subtitle C (e.g., permitting, land disposal restrictions), when applied to management of hazardous wastes for remedial purposes, can often impede the ability to select and implement effective remedies. CAMUs/TUs were developed to expedite hazardous waste cleanups by reducing or eliminating certain waste management requirements of the current RCRA Subtitle C regulations. The use of TUs at a site does not in any way preclude the need for a final remedy to eventually be implemented at the site; whereas CAMUs may be included in a final remedy.

The final CAMU/TU provisions are intended to provide flexibility for decision-makers in implementing protective, reliable, and cost-effective remedies. The CAMU/TU regulations provide the Regional Administrator (RA) with the authority to designate and approve such units if the RA determines criteria specified in 40 CFR § 264.552(c) will be met. If the remediation wastes are managed in accordance with these provisions, remediation waste (as opposed to process or "as-generated" waste) will not be subject to the RCRA land disposal restrictions

(LDRs) and the minimum technology requirements (MTRs). The CAMU/TU regulations apply to corrective action implemented under RCRA permits and Section 3008(h) orders.

D. Phasing of Activities

A phased approach to corrective action may be appropriate where a variety of releases (or threats of releases) exist, particularly if some of the releases or threats can be stabilized. Under this approach, the initial investigation should first focus on the areas that pose the greatest threats to human health and the environment and then focus on lower priority areas. Stabilization for the high priority units may be required before focusing the investigation on the lower priority units. Phasing may also be appropriate when determining the extent of contamination if it is believed that substantial migration of contaminants has occurred.

Release Assessments (Phase I RFIs), or other RFI phasing activities are also intended to streamline the corrective action process. They may be required to determine whether interim measures/stabilization are necessary and/or to focus an RFI. A release assessment may be performed between the RFA and RFI and may be desirable if there is some uncertainty about releases (e.g., due to subsequent activities) at a facility after the RFA. Note that RFAs are conducted by implementing agencies and release assessments or Phase I RFIs are conducted by Permittees/Respondents. The release assessment should be viewed as a way of focusing an RFI or determining whether interim/stabilization measures are necessary prior to the RFI.

It is important to note that a release assessment is generally used to minimize corrective action activities (i.e., by focusing or streamlining the RFI) and not to add another step in the process. See the beginning of Chapter III for further discussion and a model scope of work for release assessments.

The CMS may be phased as discussed in the CMS section of the document; however, all elements of the facility that are of concern eventually should be addressed in a CMS. Eventually, the CMS will most likely result in a comprehensive evaluation of corrective measures to be implemented at the entire site, even if the study is most logically conducted in phases.

E. Quality Assurance Project Plans and Data Quality Objectives

A fundamental requirement of the RCRA corrective action program is the collection of environmental data that can be documented and are of adequate quality to support decision making. To meet this requirement, data quality objectives (DQOs) should be established through the quality assurance project planning process. A July 7, 1993, memorandum transmitted to the EPA Regions from Sylvia

Lowrance, OSW Director, and H. Matthew Bills, Office of Modeling, Monitoring Systems and Quality Assurance Director within the Office of Research and Development, discusses the application of the DQO process to the ground-water monitoring and corrective action program. As a follow-up to the memorandum, the two offices are developing examples of Quality Assurance Project Plans (QAPjPs). These examples are intended to demonstrate that QAPjPs can be of varying complexity depending upon their associated DQOs and that review and approval of QAPjPs designed to achieve less complex DQOs can be expedited in certain cases.

As stated in the July 7, 1993, memorandum, "The overall level of uncertainty that a decision maker is willing to accept in this decision making process is known as a DQO." The memorandum also explains that QAPjPs are used as a management control to ensure that DQOs are defined and documented. QAPjPs may vary in complexity (e.g., in certain cases, sampling and analysis plans may substitute for and be the equivalent of QAPjPs), but the minimum elements of a quality assurance program for all data collection activities in RCRA are outlined in Chapter One (Quality Assurance) of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA SW-846 Third Edition as amended by Update One, July 1992). For this reason, Chapter One of SW-846 is included as an appendix (Appendix B) to the CAP. References to this appendix also are made in Chapter Three (RFI) and Chapter Five (CMI).

F. Alternate Corrective Action Models

The following sample alternatives to the traditional corrective action model (i.e., RFI → CMS → CMI) are provided as examples. Note that an RFA would precede these activities. Except for use in the term "Interim/Stabilization Measures," the slashes indicate that activities may be conducted concurrently. In addition, more than one scenario may be taking place at a site at one time.

- 1) Release Assessment → No further action
- 2) Release Assessment → Streamlined RFI → No further action
- 3) Release Assessment → Streamlined RFI → CMS → CMI
- 4) Interim/Stabilization Measures → RFI → CMS → CMI
- 5) Interim/Stabilization Measures → RFI → Interim/Stabilization Measures → CMS → CMI
- 6) RFI → Interim/Stabilization Measures → CMS → CMI

- 7) RFI/CMS → CMI
- 8) RFI/CMS/Interim/Stabilization Measures → CMI
- 9) RFI → Streamlined CMS → CMI
- 10) Phased RFI/CMS → CMI
- 11) Phased RFI/CMS/Interim/Stabilization Measures → CMI
- 12) Phased RFI/CMS/CMI

This is not intended to be an exhaustive list but rather examples of some possible scenarios. The following chapter provides more guidance on phasing interim measures to achieve stabilization.

G. Reimbursement of Oversight Costs

EPA is examining various options for recovering oversight costs in the RCRA program. The Agency may issue guidance on this issue in the future.

H. Definitions

To facilitate use of the CAP, a Definitions Section has been added as an appendix (Appendix C). For additional guidance on technical terms used in the Corrective Action Program, the U.S. EPA issued the "Corrective Action Glossary" (OSWER Directive Number 9902.3-1a) in July, 1992. The Glossary is available through NTIS, phone number (703) 487-4650.

Chapter II: Interim Measures To Achieve Stabilization

Introduction

The RIS recommended using interim actions to achieve near-term environmental results at facilities with the most serious problems. The overall goal of this process, termed "stabilization," is to control or abate threats to human health and/or the environment from releases and/or to prevent or minimize the further spread of contamination while long-term remedies are pursued. Since 1992, the U.S. EPA and the States have been implementing a major initiative to achieve this goal. Interim/stabilization measures (ISMs) are the actions used to achieve the goal of stabilization.

The stabilization effort builds on work that has already been initiated at many corrective action sites. Many of the ISMs implemented at numerous RCRA facilities across the country were undertaken to address actual or imminent threats to human health or the environment. Guidance on implementing ISMs was provided in the original CAP, the *RCRA Corrective Action Interim Measures Guidance* (OSWER Directive 9902.4, June 1988), the proposed subpart S rule (55 FR 30880, July 27, 1990), and more recently in the RCRA Stabilization Strategy transmitted to the EPA Regions in a memorandum from Sylvia Lowrance, OSW Director, and Bruce Diamond, OWPE Director (October 25, 1991). The subpart S proposal generally constitutes EPA's most authoritative policy statement on corrective action. As discussed in these guidance documents, a release or threat of a release, need only be potential (i.e., it does not have to be actual or imminent) to require the Permittee/Respondent to implement ISMs.

Although intended to be implemented more quickly than traditional remedial measures, ISMs may be short-term or long-term. Examples of ISMs include: providing bottled water, erecting a fence around heavily contaminated soil, hydraulic containment of a contaminated ground-water plume, and excavating and removing heavily contaminated soil.

To a large extent, the stabilization effort builds on work that has been ongoing in the Regions and States. These agencies historically have required facility Permittee/Respondents to undertake interim measures to address obvious environmental problems, particularly where actual or imminent exposure of human or environmental populations has been identified. However, these actions have often been pursued in conjunction with the final, comprehensive remedy for a facility.

The stabilization initiative focuses limited agency resources on near-term activities to control or abate threats and/or to prevent or minimize the further

spread of contamination across many facilities rather than following the traditional process of pursuing final, comprehensive remedies at a few facilities. By imposing such expeditious actions, the extent and incidence of continued environmental degradation from existing releases should be significantly reduced. In addition, the environmental benefit gained by taking this early action should enable greater efficiency in final remedies undertaken.

Timing of Stabilization Activities

Interim/stabilization measures are used to achieve the goal of stabilization and allow the implementing agency to redirect its resources or defer some corrective action activities to address the worst sites (or parts of sites) first.

In many cases, it will be possible to identify early in the corrective action process the need for interim measures. The implementing agency may identify such a need through the combination of the RFA, the facility's rank (using the National Corrective Action Prioritization System (NCAPS)), and stabilization evaluation. Individual solid waste management units (SWMUs) with the worst releases and presenting the most imminent threats can also be identified by using these tools. A phased approach may be taken during the initial RFI information gathering stage to focus the investigation on collecting data to design, implement, and monitor interim measures at high priority SWMUs. The facility-wide RFI (and CMS) can be done concurrently or be put on a slower track while interim measures are implemented at the worst SWMUs first. Although the CMS will generally not be completed when deciding on interim measures, potential final remedies should be under consideration because the interim measures taken to achieve stabilization should be consistent with the final remedy. In cases where they will deviate due to the interim nature of the actions, the interim measures should at a minimum not conflict with the final remedy.

Conditions Appropriate for Stabilization

Several conditions should exist at a facility (or part of a facility) for stabilization to be appropriate. Generally, interim measures are most effective when a specific aspect of the overall contamination at the facility can be isolated. As discussed earlier, exposure threats to humans or ecosystems should be present. If these receptors could be exposed to contaminants within five to 10 years or interim measures could reduce the present or near-term (e.g., less than two years) risks, then this criterion has been met. Addressing releases expeditiously through interim measures may prevent further significant contamination of environmental media. If contaminants are migrating off site, stabilization may be appropriate to stop or slow the migration. Also, if previously implemented interim measures have been unsuccessful in preventing the further spread of contamination, new or modified measures may be needed. Sufficient information about the contaminants and the

facility's environmental setting (e.g., site hydrogeology) must be known for stabilization to be a viable option. Finally, a decision to proceed with stabilization activities should be made only if appropriate technologies are available to deal with the known contaminants.

Examples of Interim Measures to Achieve Stabilization

Stabilization can be achieved through a variety of interim measures that are based on site-specific conditions. Stabilization can include source control, contaminated media cleanup, and/or limiting exposure to contamination. As an ecological example of interim measures to limit exposure, migrating waterfowl could be prevented from using open surface impoundments, ponds, etc., with contaminants of ecological concern by placing a temporary cap over the surface impoundments or removing the hot spot contamination from such units.

As another example of a facility that has implemented interim measures to achieve stabilization, consider the following: The initial screening at a chemical manufacturing plant identified dioxin contamination in superficial soils and trichlorobenzene non-aqueous phase liquid (NAPL) in the bedding of the facility's sewer system. Both of the contaminated areas were located near the facility boundary and posed a threat to a nearby residential area. Interim measures included installing a fence to prevent access, capping the dioxin-contaminated soil and installing a grout wall for hydraulic isolation, and initiating a free-product removal program to eliminate the source and prevent continued NAPL migration along the sewer system.

As a third example, investigations at a wood treating facility identified past releases from unlined impoundments, which resulted in considerable quantities of creosote being present in the ground water as a dense NAPL or DNAPL. Dissolved hazardous waste constituents were present both on and off site in the underlying Karst aquifer. The facility installed a downgradient ground-water extraction trench with extraction sumps to remove free product and contaminated ground water. The extraction system was expanded throughout the stages of corrective action. Early action to remove product and contaminants and to limit the plume's extent was particularly important at this facility because of the uncertain flow patterns associated with many Karst aquifer systems.

The U.S. EPA has developed guidance documents to facilitate implementation of the stabilization initiative. One such document, Stabilization Technologies for RCRA Corrective Actions (EPA/625/6-91/026, August 1991) is a handbook which provides guidance on identifying the types of environmental settings that are amenable to stabilization, various technical approaches to accelerate data gathering, and phasing the RFI. This guidance document also includes a Corrective Action Stabilization Questionnaire (see Appendix D) that can be used

immediately after an NCAPS ranking as a first step to gather stabilization-related information. The questionnaire examines individual solid waste management units (SWMUs). In addition, stabilization fact sheets are under final review by the U.S. EPA and should be released in the near future.

The following table provides examples of interim measures that may be implemented for specific media. Note that these may also be used for final remedies.

Example Interim Measures

<p><u>Ground Water</u></p> <ul style="list-style-type: none"> • Interceptor Trench/Sump/Subsurface Drain • Pump and Treat System (Source Removal and Containment) • Physical Barriers (Covers/Slurry Walls)
<p><u>Soils</u></p> <ul style="list-style-type: none"> • Run-off/Run-on Control (Diversion or Collection Devices) • Cap/Cover • Source Removal (Excavation)
<p><u>Surface Water Release (Point and Non-Point)</u></p> <ul style="list-style-type: none"> • Overflow/Underflow Dams • Filter Fences • Run-off/Run-on Control (Diversion or Collection Devices) • Regrading/Revegetation
<p><u>Gas Migration Control</u></p> <ul style="list-style-type: none"> • Barriers/Collection (e.g., vapor extraction)/Treatment/Monitoring • Evacuation (Buildings)
<p><u>Particulate Emissions</u></p> <ul style="list-style-type: none"> • Truck Wash (Decontamination Unit) • Revegetation • Application of Dust Suppressant • Cover/Cap

Interim Measures for Stabilization Scope of Work Outline

The following scope of work outline may be used as a model for the items that could be included to address stabilization activities at a facility. An example of a detailed scope of work for implementing ISMs is provided in Appendix E.

INTERIM MEASURES FOR STABILIZATION SCOPE OF WORK

I.	Introduction/Executive Summary - A brief description of any interim/stabilization measures that are being recommended in Section 3 below to achieve stabilization.
II.	Current Conditions - A brief description of the current conditions at the site including a review of any interim measures that are underway at the site.
III.	Interim Measures for Stabilization (implementing agency will choose applicable requirements) <ul style="list-style-type: none">A. Interim Measures ObjectivesB. Description of Interim Measures and Conceptual Design (may include performance-based design)C. Construction/Implementation (may be phased)D. Operation and MaintenanceE. Waste Management (e.g., CAMU/TU)
IV.	Sampling and Analysis (if applicable) <ul style="list-style-type: none">A. Purpose/Data Quality Objectives (may not be as stringent as for RFI)B. Summary of Sampling ActivitiesC. Field Methods and Sample Analysis<ul style="list-style-type: none">1. Sample Locations and Depths2. Sample Location Maps3. Summary Tables including sampling methods, holding times, analytical methods, preservation methods, sample depths, etc.4. Field Quality ControlD. Quality Assurance/Quality Control
V.	Project Management <ul style="list-style-type: none">A. Project Organization<ul style="list-style-type: none">1. Personnel/Organizational ChartB. Project ScheduleC. Reporting Requirements (e.g., Report of Findings)

VI. Other Submittals

- A. Health & Safety Plan**
- B. Public Involvement Plan (optional at implementing agency's discretion)**
- C. Final Report on the Success of the ISMs in meeting stated goal of stabilization.**

Chapter III: RCRA Facility Investigation

Introduction

As stated in Chapter I, the objective of the RFI is to evaluate thoroughly the nature and extent of the releases of hazardous waste and hazardous constituents and to gather necessary data to support the CMS and/or interim/stabilization measures (ISMs). The RFI may be focused specifically on ISMs data needs. Alternatively, environmental threats may be discovered or other situations may arise that warrant the implementation of ISMs during the RFI.

The RFI model scopes of work (SOWs) are intended to provide guidance for determining the specific work to be performed by the Permittee/Respondent and to foster timely, concise, and technically adequate submissions by Permittees/Respondents. The model scopes of work are also intended to assist in streamlining the corrective action process. To achieve these goals, it is important when using the model scopes of work to consider facility-specific conditions.

Based on facility-specific circumstances some data collection steps may not be necessary. The implementing agency should endeavor to minimize unnecessary and unproductive investigations, and to focus resources on characterizing actual environmental problems at facilities. For example, for inactive units that do not contain substantial volumes of volatile organic compounds, RFIs will rarely need to address air releases. In addition, RFIs may be phased to avoid unnecessary investigations where a concern can be quickly eliminated. These determinations will be made at the discretion of the implementing agencies.

The information collected during the RFI will be used to either determine the need for the next step in the corrective action process - the CMS and/or ISMs - or alternatively, used to support the recommendation for no further action. If, as a result of the RFI, a CMS (or ISMs) is determined to be necessary, data collected during the RFI (and release assessment, if performed), should be used to support the decision-making process for identifying potential technologies to be considered during the CMS (or ISMs). Appendix F presents typical geologic data needs for standard technologies, which may be considered during the CMS or ISMs. These scopes of work should be modified as necessary at the discretion of the implementing agency to require *only* that information necessary to complete the RFI.

The RFI stage of the corrective action process requires ongoing interaction between the Permittee/Respondent and the implementing agency. At various times during the RFI, there are requirements to submit reports to the implementing agency. At the end of the following sections, where appropriate, the required report submissions are noted in detail. At the end of this chapter, a proposed

schedule is presented, which would indicate where in the RFI process each required report would need to be submitted to the implementing agency.

Release Assessment [optional phase]

A release assessment may be performed as the first phase of an RFI. This step would take place between the RFA and RFI. The release assessment (or Phase I RFI) may serve as an update to the RFA if there is some uncertainty about releases after the RFA. Some examples of when the release assessment might be appropriate include when the implementing agency believes confirmatory sampling is needed or when new waste management activities have begun at a facility. In addition, it may help determine if there has been a release to ecological/living resources.

The release assessment may help determine if the RFI should focus on one area before another and/or if interim/stabilization measures are necessary. Therefore, the release assessment should be viewed as an optional step to minimize corrective action activities (i.e., by focusing or streamlining the RFI) and not as an added step in the process.

The following scope of work may be used as a model for a release assessment. Note that it serves as an outline, and additional detail may be obtained from the appropriate section of the RFI Scope of Work that follows it.

Release Assessment Scope of Work

1. Release Assessment Investigation
 - 1.1 Objectives
 - Release Assessment Investigation Objectives
 - Rationale for this Release Assessment Investigation
 - 1.2 Description of Current Conditions
 - Facility Background (include findings from RFA--address, at a minimum, each SWMU and AOC identified in the RFA)
 - Summary of previous field conditions/investigations (if any)
 - 1.3 Project Description/Workplan
 - 1) Objectives of Workplan
 - 2) Field Investigation (sample locations map, media to be sampled, number and location of samples to be taken, etc.)
 - 3) Field Sample Collection Procedures
 - 4) Field Measurements
 - 5) QA/QC Procedures
 - 6) Sample Analysis: Methods, Laboratories
 - 7) Data Management: Data Records, Display Format (Tabular,

Graphical)

8) Schedule

-Dates to submit Progress Reports (if necessary)

-Dates to submit Findings Report

9) Health and Safety Plan

10) Public Involvement Plan (optional at implementing agency's discretion)

2. Findings Report

2.1 Overview

-Confirmation of Adherence to Workplan

-Identification and Logging of all Sample Locations

-Summary of findings

2.2 Data Analysis and Determination of Further Action

1) Analysis of all facility assessments and results

2) Assessment of type and known extent of contamination at each SWMU or area of concern (AOC)

3) Recommendation for further action (implementing agency makes decisions)

-RFI

-Phase 2 Release Assessment (conducted under rare or unusual circumstances)

-Interim Measures to achieve stabilization

-CMS

-CMI

-Combinations of the above

-No Further Action

2.3 Provide a Description of the Selected Recommendation

-Rationale/Objectives

-Process/Technology/Actions

3. Schedule for next phase (addressing major step(s))

[NOTE: With certain exceptions, the provisions set out in Sections I through VII are intended as guidance, and these provisions should be justifiable and tailored to site-specific conditions when incorporated into permits or orders. The exceptions are certain provisions which are based on specific regulatory or statutory requirements applicable to permitting. Regulatory and statutory requirements are binding and do not require site-specific justification. Applicable requirements include: public notice requirements specified in 40 CFR subpart D, requirements in 40 CFR §264.101, and applicable information requirements in 40 CFR § 270.14, including information requirements for SWMUs in § 270.14(d).]

Scope of Work for a RCRA Facility Investigation (RFI)

Purpose

The purpose of the RCRA Facility Investigation (RFI) is to determine the nature and extent of releases of hazardous waste or constituents from regulated units, solid waste management units, and other source areas at a facility and to gather all necessary data to support a Corrective Measures Study. The Permittee/Respondent shall furnish all personnel, materials, and services necessary for, or incidental to, performing the RFI.

Scope

The RCRA Facility Investigation is one step in the corrective action program. The RFI consists of the following components, which for clarity have been designated as sections.

[NOTE: The implementing agency may choose to combine or eliminate some of the sections below. Some typical examples include combining sections III, IV, and V into one "RFI Report" and eliminating section IV.]

Section I: Description of Current Conditions

- A. Facility Background
- B. Preliminary Assessment of Nature and Extent of Contamination
- C. Implementation of Interim/Stabilization Measures

Section II: RFI Workplan

- A. Purpose/Objectives

- B. Project Management
- C. Data Collection/Quality Assurance
- D. Data Management and Reporting
- E. Health and Safety Plan
- F. Public Involvement Plan
- G. Schedule for Facility Investigation

Section III: Facility Investigation

- A. Purpose/Objectives
- B. Environmental Setting
- C. Source Characterization
- D. Contamination Characterization
- E. Potential Receptor Identification

Section IV: Preliminary Evaluation of Corrective Measure Technologies by Laboratory or Bench-Scale Studies *[optional]*

Section V: Investigation Results and Analysis

- A. Data Analysis
- B. Media Cleanup Standards *[where applicable]*
- C. Analysis of Risk *[optional]*

Section VI: Progress Reports

Section VII: Proposed Schedule

Section I: Description of Current Conditions

The Permittee/Respondent shall submit, for implementing agency approval, a report (as set forth below) providing the background information on the facility, contamination, and interim measures. The Permittee/Respondent shall indicate in the applicable section if some of this information is not available. This report shall contain information that is consistent with the data gathered during the RFA (and the release assessment, if performed). The current condition report shall be submitted prior to, or concurrently with, the submission of the RFI to allow the implementing agency time to review it.

[NOTE: The RFA (and the release assessment, if performed) may be submitted as the current conditions report, with updates when applicable. The implementing agency also may allow the Permittee/Respondent to reference the appropriate sections of the RFA or other such documents (i.e., permit application or permit). For example, if map information is already present in a permit application, the agency may allow the Permittee to reference the appropriate provisions of the application.]

A. Facility Background

The Permittee's /Respondent's report shall summarize the regional location, pertinent boundary features, general facility physiography, hydrogeology, and historical use of the facility for the treatment, storage, or disposal of solid and hazardous waste. The Permittee's/Respondent's report shall include:

1. Map(s). For permitted facilities, all maps shall be consistent with the requirements set forth in 40 CFR §270.14 and be of sufficient detail and accuracy to locate and report all current and future work performed at the site. (Aerial photographs should be included with SWMUs and AOCs superimposed on them.) Maps shall depict the following (to the extent not already included in map requirements under 40 CFR §270.14 (b)(19) for permitted facilities):

- General geographic location;
- Property lines, with the owners of all adjacent property clearly indicated;
- Topography and surface drainage (with a contour interval of [number] feet and a scale of 1 inch = 100 feet) depicting all waterways, wetlands, flood plains, water features, drainage patterns, and surface-water containment areas;
- All tanks, buildings, utilities, paved areas, easements, rights-of-

way, and other features;

- All solid or hazardous waste treatment, storage, or disposal areas active after November 19, 1980;
 - All known past solid or hazardous waste treatment, storage or disposal areas regardless of whether they were active on or after November 19, 1980;
 - All known past and present product and waste underground tanks or piping;
 - Surrounding land uses (residential, commercial, industrial, agricultural, recreational);
 - The location of all production and groundwater monitoring wells on the facility and within a 2-mile radius of the facility boundary. These wells shall be clearly labeled and ground and top of casing elevations and construction details included (these elevations and details may be included as an attachment); and
 - Wind rose and meteorology.
2. A history and description of ownership and operation, solid and hazardous waste generation, treatment, storage and disposal activities at the facility.
 3. Approximate dates or periods of past product and waste spills, identification of the materials spilled, the amount spilled, the location where spilled, and a description of the response actions conducted (local, state, or federal response units or private parties), including any inspection reports or technical reports generated as a result of the response.
 4. A summary of past permits applied for and/or received, any enforcement actions and their subsequent responses and a list of documents and studies prepared for the facility. This may include information from previous owner/operators, if available.

B. Preliminary Assessment of Nature and Extent of Contamination

The Permittee/Respondent shall prepare and submit, for implementing agency approval, a preliminary report describing the existing information on

the nature and extent of contamination.

1. The Permittee's/Respondent's report shall summarize all possible source areas of contamination. This, at a minimum, shall include all RCRA-regulated units, solid waste management units, spill areas, and other suspected source areas of contamination. For each area, the Permittee/Respondent shall identify the following:
 - Location of unit/area (to be depicted on facility map provided in Section D);
 - Quantities of solid and hazardous wastes (both managed and spilled or released);
 - Type of Hazardous waste or constituents (both causing or potentially causing contamination), to the extent known;
 - Identification of areas where additional information is necessary; and
 - The results of both the RCRA Facility Assessment (RFA) and a summary of suggested further actions for all SWMUs and Areas of Concern (AOCs) and the release assessment (if performed).

2. The Permittee/Respondent shall prepare a preliminary assessment and description of the existing degree and extent of contamination. This shall include:
 - For each medium where the permit or order identifies a release (e.g., soil, ground water, surface water, air, etc.), a description of the existing extent of contamination. This description must include all available monitoring data and qualitative information on the locations and levels of contamination at the facility (both onsite and offsite). Include biodata (e.g., fishkills, distressed vegetation, abnormal individuals of a species, carcasses, tissue studies, etc.). Include a general assessment of the data quality, a map showing the location of all existing sampling points and potential source areas and contour maps showing any existing ground water plumes at the facility (if ground water release). Highlight potential ongoing release areas that would warrant use of interim corrective measures (see Paragraph C. Implementation of

Interim/Stabilization Measures).

- A list and brief description of all previous investigations that have occurred at the facility, who they were conducted for (i.e., agency) and agency contacts.
3. The Permittee/Respondent shall prepare a preliminary assessment and description of potential migration pathways. This shall include:
- All potential migration pathways including information on geology, pedology, hydrogeology, physiography, hydrology, water quality, foodwebs, meteorology, and air quality;
 - Physical properties of contaminants; and
 - An assessment of whether off-site migration of contaminants has occurred; (may include a conceptual model of contaminant migration).
4. The Permittee/Respondent shall describe the potential impact(s) on human health and the environment, including demography, identification of possible sensitive subpopulations (e.g., schools, homes for the elderly, hospitals and ecosystems), ground water and surface water use, and land use.

C. Implementation of Interim/Stabilization Measures

[NOTE: See Chapter II for more guidance and a model scope of work]

The Permittee's/Respondent's report shall document past, present, or proposed interim/stabilization measures at the facility. This shall include:

- Objectives of the interim/stabilization measures: how the measure is mitigating a potential threat to human health and the environment and/or is consistent with and integrated into any long-term solution at the facility;
- Design, construction, operation, and maintenance requirements;
- Schedules for design, construction and monitoring;
- Schedule for progress reports; and

- Data in support of the potential need for future interim measures or related to any assessment undertaken to determine the need for future interim/stabilization measures.

Section II: RFI Workplan

[NOTE: The implementing agency will review the RFI Workplan to determine its technical accuracy and completeness and to determine its effectiveness toward conducting a sound, comprehensive investigation of all contamination at the facility.]

A. Purpose/Objectives

The Permittee/Respondent shall prepare an RFI Workplan. The purpose of the RFI Workplan is to present to the implementing agency the Permittee's/Respondent's specific plans to characterize the nature and extent of contamination. This RFI Workplan shall include the development of several plans, which shall be prepared concurrently. During the RCRA Facility Investigation, it may be necessary to revise the RFI Workplan to increase or decrease the detail of information collected to accommodate facility-specific situations.

[NOTE: The implementing agency generally will require the Permittee/Respondent to test media to determine the presence and levels of hazardous constituents. The implementing agency may use Appendix IX to 40 CFR part 264 - Ground-Water Monitoring List for ground water. For purposes of establishing a list for other media, the implementing agency may use Appendix XI - Concentration-Based Exemption Criteria for Media from the Hazardous Waste Identification Rule (HWIR) proposed rule (57 FR 21450, May 20, 1992). This appendix lists constituents for which analytical methods are available. To streamline the list of constituents requiring analysis, the implementing agency may use other information (e.g., lists of chemicals used at a facility) as appropriate.]

B. Project Management

The Permittee/Respondent shall prepare a Project Management Plan, which will include a discussion of the technical approach, schedules, (including submittal of the CMS Workplan, if required), budget, and personnel. The Project Management Plan will also include a description of qualifications of personnel performing or directing the RFI, including contractor personnel. This plan shall also document the overall management approach to the RFI.

C. Data Collection/Quality Assurance

To ensure that all information, data and resulting decisions are technically sound, statistically valid, and properly documented, the Permittee/Respondent shall prepare a Quality Assurance Project Plan (QAPjP) to document all monitoring procedures, sampling, field measurements and sample analyses performed during the investigation to characterize the environmental setting, source, and contamination. The Permittee/Respondent shall use quality assurance, quality control, and chain-of-custody procedures approved by the implementing agency.

These procedures are described in the soon to be released EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5), which will replace Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, (QAMS-005/80, December 29, 1980). The minimum elements of a quality assurance program for data collection activities are in Chapter One of SW-846 [see Appendix B] and are outlined below.

1.0 INTRODUCTION

2.0 QA PROJECT PLAN

- 2.1 Data Quality Objectives
- 2.2 Project Objectives
- 2.3 Sample Collection
- 2.4 Analysis and Testing
- 2.5 Quality Control
- 2.6 Project Documentation
- 2.7 Organization Performing Field or Laboratory Operations
 - 2.7.1 Performance Evaluation
 - 2.7.2 Internal Assessment by QA Function
 - 2.7.3 External Assessment
 - 2.7.4 On-Site Evaluation
 - 2.7.4.1 Field Activities
 - 2.7.4.2 Laboratory Activities
 - 2.7.5 QA Reports

3.0 FIELD OPERATIONS

- 3.1 Field Logistics
- 3.2 Equipment/Instrumentation
- 3.3 Operating Procedures
 - 3.3.1 Sample Management
 - 3.3.2 Reagent/Standard Preparation

- 3.3.3 Decontamination
- 3.3.4 Sample Collection
- 3.3.5 Field Measurements
- 3.3.6 Equipment Calibration and Maintenance
- 3.3.7 Corrective Action
- 3.3.8 Data Reduction and Validation
- 3.3.9 Reporting
- 3.3.10 Records Management
- 3.3.11 Waste Disposal
- 3.4 FIELD QA AND QC REQUIREMENTS
 - 3.4.1 Control Samples
 - 3.4.2 Acceptance Criteria
 - 3.4.3 Deviations
 - 3.4.4 Corrective Action
 - 3.4.5 Data Handling
- 3.5 QUALITY ASSURANCE REVIEW
- 3.6 FIELD RECORDS
- 4.0 LABORATORY OPERATIONS
 - 4.1 FACILITIES
 - 4.2 EQUIPMENT/INSTRUMENTATION
 - 4.3 OPERATING PROCEDURES
 - 4.3.1 Sample Management
 - 4.3.2 Reagent/Standard Preparation
 - 4.3.3 General Laboratory Techniques
 - 4.3.4 Test Methods
 - 4.3.5 Equipment Calibration and Maintenance
 - 4.3.6 QC
 - 4.3.7 Corrective Action
 - 4.3.8 Data Reduction and Validation
 - 4.3.9 Reporting
 - 4.3.10 Records Management
 - 4.3.11 Waste Disposal
 - 4.4 LABORATORY QA AND QC PROCEDURES
 - 4.4.1 Method Proficiency
 - 4.4.2 Control Limits
 - 4.4.3 Laboratory Control Procedures
 - 4.4.4 Deviations
 - 4.4.5 Corrective Action
 - 4.4.6 Data Handling
 - 4.5 QUALITY ASSURANCE REVIEW
 - 4.6 LABORATORY RECORDS

D. Data Management and Reporting

The Permittee/Respondent shall develop and initiate a Data Management Plan to document and track investigation data and results. This plan shall identify and establish data documentation materials and procedures, project file requirements, and project-related progress reporting procedures and documents. The plan shall also provide the format to be used to present the raw data and conclusions of the investigation.

1. Data Record

The data record shall include the following:

- Unique sample or field measurement code;
- Sampling or field measurement location and sample or measurement type;
- Sampling or field measurement raw data;
- Laboratory analysis ID number;
- Property or component measured; and
- Result of analysis (e.g., concentration).

2. Tabular Displays

The following data shall be presented in tabular displays:

- Unsorted (raw) data;
- Results for each medium or for each constituent monitored;
- Data reduction for statistical analysis;
- Sorting of data by potential stratification factors (e.g., location, soil layer, topography); and
- Summary data.

3. Graphical Displays

The following data shall be presented in graphical formats (e.g., bar graphs,

line graphs, area or plan maps, isopleth plots, cross-sectional plots or transects, three dimensional graphs, etc.):

- Sampling location and sampling grid;
- Boundaries of sampling area, and areas where additional data are required;
- Levels of contamination at each sampling location;
- Geographical extent of contamination;
- Contamination levels, averages, and maxima;
- Changes in concentration in relation to distance from the source, time, depth or other parameters;
- Features affecting intramedia transport; and
- Potential receptors.

E. Health and Safety Plan

The Permittee/Respondent shall submit a Health and Safety Plan for all field activity, although it does not require review and approval by the implementing agency. The Health and Safety Plan shall be developed as a stand alone document but may be submitted with the RFI Workplan.

1. Major elements of the Health and Safety Plan shall include:
 - Facility description including availability of resources such as roads, water supply, electricity, and telephone service;
 - Description of the known hazards and evaluation of the risks associated with each activity conducted;
 - A list of key personnel and alternates responsible for site safety, response operations, and protection of public health;
 - Delineation of work area;
 - Description of protective clothing or other protective items to be worn by personnel in work area;

- Procedures to control site access;
- Description of decontamination procedures for personnel and equipment;
- Site emergency procedures;
- Emergency medical care needed for injuries and toxicological problems;
- Description of requirements for an environmental surveillance program;
- Routine and special training required for response personnel; and
- Procedures for protecting workers from weather-related problems.

2. The Facility Health and Safety Plan shall be consistent with:

- NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985);
- EPA Order 1440.1 - Respiratory Protection;
- EPA Order 1440.3 - Health and Safety Requirements for Employees engaged in Field Activities;
- Facility Contingency Plan;
- EPA Standard Operating Safety Guide (1984);
- OSHA regulations particularly in 29 CFR 1910 and 1926;
- State and local regulations; and
- Other applicable EPA guidance as provided.

F. Public Involvement Plan

[NOTE: It is strongly recommended that the implementing agency oversee Permittee's /Respondent's public involvement activities. Public involvement is an important part of RCRA corrective action. The public must be notified of significant changes to permits and orders regarding corrective action. In some

cases, they also must be provided with the opportunity to review and comment on the changes. Notice requirements for permits are set out at 40 CFR Part 270 subpart D. Further guidance on this process is in the CMS, and in the document entitled RCRA Public Involvement Manual (EPA/530-R-93-006, September, 1993).]

All Public Involvement Plans prepared by the Permittee/Respondent shall be submitted to the implementing agency for comment and approval prior to use. Permittees/Respondents must never appear to represent or speak for the implementing agency before the public, other government officials, or the media.

Public Involvement activities that may be required of the Permittee/Respondent include the following:

1. Conducting an open house or informal meeting (i.e., availability session) in a public location where people can talk to agency officials and Permittee/Respondent on a one-to-one basis;
2. Preparing fact sheets summarizing current or proposed corrective action activities (all fact sheets should be reviewed by the implementing agency prior to public distribution);
3. Communicating effectively with people who have vested interest in the corrective action activities, (e.g., providing written or verbal information in the foreign language of a predominantly non-English-speaking community); and
4. Maintaining an easily accessible repository (such as a town hall or public library or the facility itself, in some limited circumstances) of information on the facility-specific corrective action program, including the order or permit, approved workplans, and/or other reports.

A schedule for community relations activities shall be included in the Public Involvement Plan.

G. Schedule for Facility Investigation

[NOTE: Schedules should be as detailed as possible, but can be represented as a series of contingent activities (e.g., sampling beginning within 30 days of RFI Workplan approval). This schedule may be required or revised during the next section entitled "Facility Investigation".]

1. Sampling
2. Analysis
3. Reports
4. Public Involvement Activities
5. Laboratory or Bench-Scale Studies

Section III: Facility Investigation

A. Purpose/Objectives

The Facility Investigation phase of an RFI is the first step of the *implementation* process. Prior to this implementation phase, all documentation and reports for the Description of Current Conditions and RFI Workplan are drafted and submitted to the implementing agency for review and approval. The Permittee/Respondent must have approval prior to implementing the procedures outlined in the RFI Workplan. Throughout the RFI implementation phase, it is critical that the Permittee/Respondent comply with report submission requirements. The Permittee/Respondent shall submit both progress reports and a draft RFI Report, which must be submitted to the implementing agency for review. At the direction of the implementing agency, the Permittee/Respondent shall develop in final format the RFI Report, which will incorporate any comments received on the draft report.

The Permittee/Respondent shall conduct those investigations (including sampling) as approved in the RFI Workplan with all modifications to: characterize the facility (Environmental Setting); define the source (Source Characterization); define the degree and three dimensional extent of contamination (Contamination Characterization); and identify actual or potential receptors.

The investigations should result in data of adequate technical quality to support the development and evaluation of the corrective measure alternative(s) during the Corrective Measures Study (CMS) and/or ISMs.

[NOTE: As discussed in the 40 CFR part 264 subpart S proposed rule (55 FR 30875-30876, July 27, 1990), the implementing agency may require the Permittee/Respondent to conduct a CMS whenever concentrations of hazardous constituents in an aquifer, surface water, soils, or air exceed action levels for any environmental medium. Action levels are health- and environmental-based

levels determined by the agency to be indicators for protection of human health and the environment. EPA's recommended action levels are set out in the subpart S proposed rule. EPA currently is working on revisions to the recommended levels and will provide notice of any changes to the subpart S recommendations.]

The site investigation activities (including sampling) shall follow the plans set forth in the RFI Workplan.

[NOTE: The implementing agency may require the investigation to be phased (e.g., by media or SWMU/Area of Contamination), the amount of information collected to be limited, and/or the level of detail to be reduced.]

B. Environmental Setting

The Permittee/Respondent shall collect information to supplement and verify existing information on the environmental setting at the facility (when information already submitted to the implementing agency is not sufficient). The implementing agency may request additional information not included on the following lists. The Permittee/Respondent shall characterize the following areas (the implementing agency should require characterization of some or all of the following areas depending on the specifics of the site):

1. Hydrogeology

The Permittee/Respondent shall conduct a program to evaluate hydrogeologic conditions at the facility. This program shall provide the following information:

- A description of the regional and facility-specific geologic and hydrogeologic characteristics affecting ground-water flow beneath the facility, including:
 - Regional and facility-specific stratigraphy including: description of strata including strike and dip, and identification of stratigraphic contacts;
 - Structural geology including: description of local and regional structural features (e.g., folding, faulting, tilting, jointing, etc.);
 - Depositional history;
 - Areas and amounts of recharge and discharge;

- Influence of tidal actions on groundwater flow regimes near coastal areas or large rivers;
 - Regional and facility-specific ground-water flow patterns; and
 - Seasonal variations in the ground-water flow regime.
- An analysis of any topographic features that might influence the ground-water flow system. (Note: Stereographic analysis of aerial photographs may aid in this analysis.)
 - A representative and accurate classification and description of the hydrogeologic units based on field data, tests, and cores that may be part of the migration pathways at the facility (i.e., the aquifers and any intervening saturated and unsaturated zones), including, but not limited to:
 - Hydraulic conductivity, intrinsic permeability (particularly when non-aqueous phase liquids (NAPLs) are present), and porosity (total and effective);
 - Lithology, grain size, sorting, degree of cementation;
 - An interpretation of hydraulic interconnections between saturated zones; and
 - The attenuation capacity and mechanisms of the natural earth materials (e.g., ion exchange capacity, organic carbon content, mineral content, etc.).
 - Based on field studies and cores, structural geology and hydrogeologic cross sections showing the extent (depth, thickness, lateral extent) of hydrogeologic units that may be part of the migration pathways identifying:
 - Sand and gravel in unconsolidated deposits;
 - Zones of fracturing or channeling in consolidated and unconsolidated deposits;
 - Zones of higher permeability or low permeability that might direct and restrict the flow of contaminants;

- The uppermost aquifer: geologic formation, group of formations, or part of a formation capable of yielding a significant amount of ground water to wells or springs;
 - Water-bearing zones above the first confining layer that may serve as a pathway for contaminant migration, including perched zones of saturation; and
 - All other geologic formations, or parts thereof, yielding a significant amount of ground water.
- Based on data obtained from ground-water monitoring wells and piezometers installed upgradient and downgradient of the potential contaminant source, a representative description of water level or fluid pressure monitoring including:
 - Water level contour and/or potentiometric maps;
 - Hydrologic cross sections showing vertical flow gradients;
 - The flow system, including the vertical and horizontal components of flow; and
 - Any temporal changes in hydraulic gradients, (due to tidal or seasonal influences, etc.)
 - A description of man-made influences that may affect the hydrogeology of the site, identifying:
 - Active and inactive local water-supply and production wells with an approximate schedule of pumping; and
 - Man-made hydraulic structures (pipelines, french drains, ditches, unlined ponds, septic tanks, NPDES outfalls, retention areas, etc.).

2. Soils

[NOTE: Soil characterization includes the chemical, physical, and mineralogical analysis of soils. The implementing agency may vary the required level of characterization based on data needs for the CMS/ISMs. Where removal of contaminated soil is the logical remedial action, limited physical information may be required. Where in-situ soil

treatment may be the remedial action, a full characterization may be appropriate. Where an estimation of contaminant transport is necessary, some type of intermediate level characterization may be required.]

The Permittee/Respondent shall conduct a program to characterize the soil and rock units potentially affected by contaminant release(s). Such characterization shall include, but not be limited to, the following information:

- Where remediation by removal of soils is the only corrective measure option, provide map(s) and perpendicular cross sections showing:
 - The extent of contamination;
 - Depth of groundwater; and
 - The consistency and distribution of soils (using the Unified Soil Classification System (USCS) (ASTM D 2487));

[NOTE: The above information is important for stability of cuts. If such factors are not considered when excavating, piling, or sloping material, the stability of surrounding walls and piles of material may be compromised.]

- Where remediation by removal is the likely option, and it is necessary to determine the extent of migration (e.g., to assess the mobility of wastes from an unlined surface impoundment or landfill), provide the following in addition to the requirements immediately above:
 - Depth to bedrock and the characteristics of the bedrock including discontinuities such as faults, fissures, joints, fractures, sinkholes, etc.;
 - A detailed soil survey conducted according to USDA Soil Conservation Service (SCS) procedures including:
 - USDA Textural Soil Classification and soil profiles showing stratifications or zones which may affect or direct the subsurface flow;
 - Hydraulic conductivity and the SCS hydrologic group classification of A, B, C or D;

- Relative permeability (only if the waste may have changed the soil's hydraulic conductivity, such as concentrated organics);
 - Storage capacity (if excavated soil will be stored);
 - Shrink-swell potential (where extreme dry weather could lead to the formation of cracks);
 - Potential for contaminant transport via erosion, using the Universal Soil Loss Equation;
 - Soil sorptive capacity;
 - Cation exchange capacity;
 - Soil organic content; and
 - Soil pH.
- The following contaminant characteristics must be included:
 - Physical state;
 - Viscosity;
 - pH;
 - pKa;
 - Density;
 - Water solubility;
 - Henry's Law Constant;
 - K_{ow} ;
 - Biodegradability; and
 - Rates of hydrolysis, photolysis and oxidation.

- Where in-situ soil treatment will likely be the remediation, the

above information and the following additional information must be provided:

- Bulk density;
- Porosity;
- Grain size distribution;
- Mineral content;
- Soil moisture profile;
- Unsaturated hydraulic conductivity;
- Effect of stratification on unsaturated flow; and
- Infiltration and evapotranspiration.

3. Surface Water and Sediment

The Permittee/Respondent shall conduct a program to characterize the surface water bodies likely to be affected by releases from the facility. Such characterization shall include the following activities and information:

- Description of the temporal and permanent surface water bodies including:
 - For lakes and estuaries: location, elevation, surface area, inflow, outflow, depth, temperature stratification, and volume;
 - For impoundments: location, elevation, surface area, depth, volume, freeboard, and purpose of impoundment;
 - For streams, ditches, drains, swamps and channels: location, elevation, flow, velocity, depth, width, seasonal fluctuations, and flooding tendencies (i.e., 100-year event);
 - For wetlands obtain any available delineation;
 - Containment measures in place (e.g., levees, concrete lining, etc.)
 - Drainage patterns; and

- Evapotranspiration rates.
- Description of the chemistry of the natural surface water and sediments. This includes determining:
 - pH;
 - total dissolved solids;
 - total suspended solids;
 - biological oxygen demand;
 - alkalinity;
 - conductivity;
 - dissolved oxygen profiles;
 - nutrients (NH_3 , NO_3 / NO_2 , PO_4^{3-});
 - chemical oxygen demand;
 - total organic carbon; and
 - specific contaminant concentrations.
- Description of sediment characteristics including:
 - Deposition area;
 - Thickness profile; and
 - Physical and chemical parameters (e.g., grain size, density, organic carbon content, ion exchange capacity, pH, etc.).

4. Air

The Permittee/Respondent shall provide information characterizing the climate in the vicinity of the facility. Such information shall include:

- A description of the following parameters:
 - Annual and monthly rainfall averages;

- Monthly temperature averages and extremes;
 - Wind speed and direction;
 - Relative humidity/dew point;
 - Atmospheric pressure;
 - Evaporation data;
 - Development of inversions; and
 - Climate extremes that have been known to occur in the vicinity of the facility, including frequency of occurrence.
- A description of topographic and man-made features that affect air flow and emission patterns, including:
 - Ridges, hills, or mountain areas;
 - Canyons or valleys;
 - Surface water bodies (e.g., rivers, lakes, bays, etc.);
 - Wind breaks and forests; and
 - Buildings.

[NOTE: The above descriptions should be updated to include any air modeling that is performed.]

C. Source Characterization

[NOTE: The implementing agency may focus source characterization on the specific units, disposal areas, or other areas (e.g., exposure pathways) that have been identified by the agency to be of concern.]

The Permittee/Respondent shall collect analytical data to characterize the wastes and the areas where wastes have been placed, collected or removed including: type; quantity; physical form; disposition (containment or nature of disposal); and any facility characteristics that may affect or have affected a release (e.g., facility security, engineered barriers). This shall include quantification of the following specific characteristics, at each source area:

1. Unit/Disposal Area/Area of Concern Characteristics:
 - Location of unit/disposal area;
 - Type of unit/disposal area;
 - Design features;
 - Operating practices (past and present) including the history of releases;
 - Period of operation;
 - Age of unit/disposal area;
 - General physical conditions; and
 - Method used to close the unit/disposal area.
2. Waste Characteristics:
 - Type of waste placed in the unit;
 - Hazardous classification (e.g., flammable, reactive, corrosive, oxidizing or reducing agent);
 - Quantity; and
 - Chemical composition.
 - Physical and chemical characteristics;
 - Physical form (solid, liquid, gas);
 - Physical description (e.g., powder, oily sludge);
 - Temperature;
 - pH;
 - General chemical class (e.g., acid, base, solvent);
 - Molecular weight;
 - Density;

- Boiling point;
- Viscosity;
- Solubility in water;
- Cohesiveness of the waste;
- Vapor pressure; and
- Flash point.
- Migration and dispersal characteristics of the waste;
 - Sorption;
 - Biodegradability, bioconcentration, biotransformation;
 - Photodegradation rates;
 - Hydrolysis rates; and
 - Chemical transformations.

The Permittee/Respondent shall document the procedures used in making the above determinations.

D. Contamination Characterization

The Permittee/Respondent shall collect analytical data on ground water, soils, surface water, sediment, air, and subsurface gas likely to be affected by releases from the facility. This data shall be sufficient to define the extent, origin, direction, and rate of movement of contaminant plumes. Data shall include:

- time and location of sampling;
- media sampled;
- concentrations found;
- conditions during sampling; and
- the identity of the individuals performing the sampling and analysis.

The Permittee/Respondent shall address the following types of contamination at the facility:

1. Groundwater Contamination

The Permittee/Respondent shall conduct a groundwater investigation to characterize any plumes of contamination at the facility. This investigation shall, provide the following information:

- A description of the horizontal and vertical extent of any immiscible or dissolved plume(s) originating from the facility;
- The horizontal and vertical direction of contaminant movement;
- The velocity of contaminant movement;
- The horizontal and vertical concentration profiles of Appendix IX constituents in the plume(s);
- An evaluation of factors influencing the plume movement; and
- An extrapolation of future contaminant movement over the time period specified by the implementing agency.

The Permittee/Respondent shall document the procedures used in making the above determinations (e.g., well design, well construction, geophysics, modeling, etc.).

[NOTE: It may be helpful for the Permittee/Respondent to refer to applicable guidance documents such as "RCRA Ground-water Monitoring Technical Enforcement Guidance Document (TEGD)," OSWER Directive 9950.1, September 1986.]

2. Soil Contamination

The Permittee/Respondent shall conduct an investigation to characterize the contamination of the soil and rock units above the water table in the vicinity of the contaminant release. The investigation shall include the following information:

- A description of the vertical and horizontal extent of contamination;
- A description of contaminant and soil chemical properties within the contaminant source area and plume. This includes contaminant

solubility, speciation, adsorption, leachability, exchange capacity, biodegradability, hydrolysis, photolysis, oxidation and other factors that might affect contaminant migration and transformation;

- Specific contaminant concentrations;
- Velocity and direction of contaminant movement; and
- An extrapolation of future contaminant movement over the time period specified by the implementing agency.

The Permittee/Respondent shall document the procedures used in making the above determinations.

[NOTE: Analytical data collected under Section III.C. "Source Characterization", Number 2. "Waste Characteristics" may be relevant to this section. This data may be used to supplement this section or elements of the two sections regarding waste characteristics may be combined.]

3. Surface Water and Sediment Contamination

The Permittee/Respondent shall conduct a surface water investigation to characterize contamination in surface water bodies resulting from contaminant releases at the facility. The Permittee/Respondent may also be required to characterize contamination from storm water runoff.

The investigation shall include the following information:

- A description of the horizontal and vertical extent of any immiscible or dissolved plume(s) originating from the facility, and the extent of contamination in underlying sediments;
- The horizontal and vertical direction of contaminant movement;
- The contaminant velocity;
- An evaluation of the physical, biological, and chemical factors influencing contaminant movement;
- An extrapolation of future contaminant movement over the time period specified by the implementing agency; and
- A description of the chemical and physical properties of the contaminated surface waters and sediments. This includes

determining the pH, total dissolved solids, specific contaminant concentrations, etc.

The Permittee/Respondent shall document the procedures used in making the above determinations.

4. Air Contamination

The Permittee/Respondent shall conduct an investigation to characterize the particulate and gaseous contaminants released into the atmosphere. This investigation shall provide the following information:

- A description of the horizontal and vertical direction and velocity of contaminant movement;
- The rate and amount of the release; and
- The chemical and physical composition of the contaminants(s) released, including horizontal and vertical concentration profiles.

The Permittee/Respondent shall document the procedures used in making the above determinations.

5. Subsurface Gas Contamination

The Permittee/Respondent shall conduct an investigation to characterize subsurface gases emitted from buried hazardous waste and hazardous constituents in the ground water. This investigation shall include the following information:

- A description of the horizontal and vertical extent of subsurface gas migration;
- The chemical composition of the gases being emitted;
- The rate, amount, and density of the gases being emitted; and
- Horizontal and vertical concentration profiles of the subsurface gases emitted.

The Permittee/Respondent shall document the procedures used in making the above determinations.

E. Potential Receptor Identification

The Permittee/Respondent shall collect data describing the human populations and environmental systems that currently or potentially are at risk of contaminant exposure from the facility. Chemical analysis of biological samples may be needed. Data on observable effects in ecosystems may also be required by the implementing agency. The following characteristics shall be identified:

1. Local uses and possible future uses of ground water:
 - Type of use (e.g., drinking water source: municipal or residential, agricultural, domestic/non-potable, and industrial) and
 - Location of ground water users including wells and discharge areas.
2. Local uses and possible future uses of surface waters characterized in the "Environmental Setting" or "Contamination Characterization" Sections above:
 - Domestic and municipal (e.g., potable and lawn/gardening watering);
 - Recreational (e.g., swimming, fishing);
 - Agricultural;
 - Industrial; and
 - Environmental (e.g., fish and wildlife propagation).
3. Authorized or unauthorized human use of or access to the facility and adjacent lands, including but not limited to:
 - Recreation;
 - Hunting;
 - Residential;
 - Commercial;

- Zoning; and
 - Relationship between population locations and prevailing wind direction.
4. A demographic profile of the people who use or have access (authorized or unauthorized) to the facility and adjacent land, including, but not limited to: age; sex; sensitive subgroups; and environmental justice concerns.
 5. A description of the ecology of the facility and adjacent areas, including habitat and species present and expected to be present.
 6. A description of the biota in surface water bodies on, adjacent to, or affected by the facility.
 7. A description of any state and federal endangered or threatened species (both proposed and listed) near the facility.

Section IV: Preliminary Evaluation of Corrective Measure Technologies by Laboratory or Bench-Scale Studies *[optional]*

The Permittee/Respondent may conduct laboratory and/or bench scale studies to determine the applicability of a corrective measure technology or technologies to facility conditions. These studies may be conducted at any time during the RFI; the intent is to collect information that will be useful in evaluating potential technologies and to conduct additional studies when sufficient data is available and useful. The Permittee/Respondent shall analyze the technologies, based on literature review, vendor contracts, and past experience to determine the testing requirements.

[NOTE: Appendix F presents standard geologic data requirements for consideration in the technology decision process, and Appendix A provides references for technical assistance (e.g., "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" - Chapter 5).]

The Permittee/Respondent shall develop a testing plan identifying the type(s) and goal(s) of the study or studies, the level of effort needed, and the procedures to be used for data management and interpretation.

Upon completion of the testing, the Permittee/Respondent shall evaluate the testing results to assess the technology or technologies with respect to the site-specific questions identified in the test plan.

The Permittee/Respondent shall prepare a report summarizing the testing program and its results (if studies are performed), both positive and negative.

Section V: Investigation Results and Analysis

The Permittee/Respondent shall prepare an analysis and summary of all facility investigations and their results. The investigation data should be sufficient in quality (e.g., quality assurance procedures have been followed) and quantity to describe the nature and extent of contamination, potential threat to human health and/or the environment, and to support the Corrective Measures Study and/or ISMs.

A. Data Analysis

The Permittee/Respondent shall analyze all facility investigation data outlined in Section III and prepare a report on the type and extent of contamination at the facility including sources and migration pathways. The report shall describe the extent of contamination (qualitative/quantitative) in relation to background levels indicative for the area.

B. Media Cleanup Standards

The Permittee/Respondent shall provide information as required by the implementing agency to support the agency's selection/development for media cleanup standards of any releases that may have adverse effects on human health and the environment due to migration of waste constituents. Media cleanup standards are to contain such terms and provisions as necessary to protect human health and the environment, including, the provisions stated below.

[NOTE: Implementing agencies should determine which of the following items under 1 through 4 below are necessary on a site-specific basis.]

1. Ground-water Cleanup Standards

The Permittee/Respondent shall provide information to support the implementing agency's selection/development of ground-water cleanup standards for all of the Appendix IX constituents found in the ground water during the Facility Investigation (Section III). The implementing agency may require the following information:

- For any constituents for which an MCL has been promulgated under the Safe Drinking Water Act, the MCL value;

- Background concentration of the constituent in the ground water; or
- An alternate standard (e.g., an alternate concentration limit (ACL) for a regulated unit) to be approved by the implementing agency.

2. Soil Cleanup Standards

The Permittee/Respondent shall provide information to support the implementing agency's selection/development of soil cleanup standards. The implementing agency may require the following information:

- The volume and physical and chemical characteristics of the wastes in the unit;
- The effectiveness and reliability of containing, confining, and collecting systems and structures in preventing contaminant migration;
- The hydrologic characteristics of the unit and the surrounding area, including the topography of the land around the unit;
- The patterns of precipitation in the region;
- The existing quality of surface soils, including other sources of contamination and their cumulative impacts on surface soils;
- The potential for contaminant migration and impact to the underlying groundwater;
- The patterns of land use in the region;
- The potential for health risks caused by human exposure to waste constituents; and
- The potential for damage to domestic animals, wildlife, food chains, crops, vegetation, and physical structures caused by exposure to waste constituents.

3. Surface Water and Sediment Cleanup Standards

The Permittee/Respondent shall provide information to support the

implementing agency's selection/development of surface water and sediment cleanup standards. The implementing agency may require the following information:

- The volume and physical and chemical characteristics of the wastes in the unit;
- The effectiveness and reliability of containing, confining, and collecting systems and structures in preventing contaminant migration;
- The hydrologic characteristics of the unit and the surrounding area, including the topography of the land around the unit;
- The patterns of precipitation in the region;
- The quantity, quality, and direction of ground-water flow;
- The proximity of the unit to surface waters;
- The current and potential uses of nearby surface waters and any water quality standards established for those surface waters;
- The existing quality of surface waters, including other sources of contamination and their cumulative impacts on surface waters;
- The potential for damage to domestic animals, wildlife, food chains, crops, vegetation and physical structures caused by exposure to waste constituents;
- The patterns of land use in the region; and
- The potential for health risks caused by human exposure to waste constituents.

4. Air Cleanup Standards

The Permittee/Respondent shall provide information to support the implementing agency's selection/development of air cleanup standards. The implementing agency may require the following information:

- The volume and physical and chemical characteristics of the

wastes in the unit, including its potential for the emission and dispersal of gases, aerosols and particulates;

- The effectiveness and reliability of systems and structures to reduce or prevent emissions of hazardous constituents to the air;
- The operating characteristics of the unit;
- The atmospheric, meteorological, and topographic characteristics of the unit and the surrounding area;
- The existing quality of the air, including other sources of contamination and their cumulative impact on the air;
- The potential for health risks caused by human exposure to waste constituents; and
- The potential for damage to domestic animals, wildlife, crops, vegetation, and physical structures caused by exposure to waste constituents.

5. Other Relevant Cleanup Standards

The Permittee/Respondent shall identify all relevant and applicable standards for the protection of human health and the environment (e.g., National Ambient Air Quality Standards, Federally approved state water quality standards, etc.).

C. Analysis of Risk *[optional]*

The implementing agency may require the Permittee/Respondent to prepare an analysis of risk at the facility. This analysis may include ecological as well as human health risk. Generally a baseline risk assessment would be conducted during the RFI stage with further analysis occurring during the CMS stage.

[NOTE: While some implementing agencies may require the Permittee/Respondent to conduct a risk assessment, the policy on conducting risk assessments in the corrective action program is evolving. Currently, their use is optional at the discretion of the implementing agency and should be based on site-specific conditions. Appendix G presents a list of available guidance for conducting risk assessments.]

Section VI: Progress Reports

The Permittee/Respondent will, at a minimum, provide the implementing agency with signed [monthly, bimonthly, or quarterly] progress reports. These reports may be required to contain the following information, but agency requirements are not limited to this list:

1. A description and estimate of the percentage of the RFI completed;
2. Summaries of *all* findings in the reporting period, including results of any sampling and analysis;
3. Summaries of *all* changes made in the RFI during the reporting period;
4. Summaries of *all* contacts with representative of the local community, public interest groups or State government during the reporting period;
5. Summaries of *all* contacts made regarding access to off-site property;
6. Summaries of *all* problems encountered during the reporting period;
7. Actions being taken to rectify problems;
8. Changes in relevant personnel during the reporting period;
9. Projected work for the next reporting period; and
10. Copies of daily reports, inspection reports, laboratory/monitoring data, etc.

Section VIII: Proposed Schedule

The Permittee/Respondent will provide the implementing agency with RFI reports according to the following schedule:

<u>Facility Submission</u>	<u>Due Date</u>
Description of Current Conditions (Section I)	[DATE]

RFI Workplan (Section II)	[DATE]
Draft RFI Report (Sections III and V)	[NUMBER] days after RFI Workplan Approval
Final RFI Report (Sections III and V) comments on Draft RFI of approval submittal of the CMS required,)	[NUMBER] days after the implementing agency Report, (date may be tied to this Workplan, if
Laboratory and Bench- Scale Studies (Section IV)	Concurrent with Final RFI Report
Progress Reports on Sections I through V <i>[see Section VI above for guidance on progress reports.]</i>	[MONTHLY, BI- MONTHLY, other]

Chapter IV: Corrective Measures Study

Introduction

The purpose of the Corrective Measures Study (CMS) portion of the RCRA corrective action process is to identify and evaluate potential remedial alternatives for the releases that have been identified at a facility. The scope and requirements of the CMS, however, need to be balanced with the expeditious initiation of remedies and rapid restoration of contaminated media, both major goals of the RCRA corrective action program. In keeping with these goals, the implementing agency may allow a streamlined approach to remedy selection, enabling a facility to move from facility investigation to corrective measures implementation more rapidly. Information gathered during the implementation of ISMs should be used to augment the CMS and avoid duplicative efforts. Aspects of the implemented ISMs may be viewed as an early and focused CMS. In some cases, the ISMs may substitute for the final CMS/CMI after review and approval by the implementing agency. The Permittee/Respondent shall furnish all personnel, materials, and services necessary for, or incidental to, performing the CMS.

It is anticipated that Permittees/Respondents of larger sites with complex environmental problems may need to evaluate several alternative remedial approaches in determining the most appropriate remedy for the facility. For other RCRA facilities, however, it may be appropriate for the implementing agency to allow the Permittee/Respondent to evaluate only one alternative.

Studies needed for developing sound, environmentally protective remedies may be relatively straightforward at some RCRA facilities, and may not require extensive evaluation of a number of remedial alternatives. Such "streamlined" CMS's can be tailored to fit the complexity and scope of the remedial situation presented by the facility. For example, if the environmental problems at a facility were limited to a small area of soils with low-level contamination, the CMS might be limited to a single treatment approach that is known to be effective for such types of contamination. In a different situation, such as with a large municipal-type landfill, it may be obvious that the source control element of the CMS should be focused on containment options, while contaminated media remediation may require more extensive study. It is anticipated that a streamlined or highly focused CMS may be appropriate in the following types of situations:

1. "Low risk" facilities. Facilities where environmental problems are relatively small, and where releases present minimal exposure concerns. Such facilities might have limited on-site soil contamination.
2. High quality remedies proposed by the Permittee/Respondent. The Permittee/Respondent may propose a remedy which is highly protective

(such as an action which would remediate to non-detectable levels) and which is consistent with all other remedial objectives.

3. Facilities with straightforward remedial solutions. For some contamination problems, standard engineering solutions can be applied that have proven effective in similar situations. An example might be cleanup of soils contaminated with PCBs by excavation, removal and treatment, then disposal.
4. Phased remedies. At some facilities the nature of the environmental problem will dictate development of the remedy in phases, which would focus on one aspect (such as groundwater remediation) of the remedy, or one area of the facility that requires immediate measures to control further environmental and human exposure problems. In these situations, the CMS could be focused on that specific element of the overall remedy, with follow-up studies as appropriate to deal with the remaining remedial needs at the facility. Such studies should be documented in later CMS phases. For particularly large facilities, several phases should be designated.

It is also recognized that, in contrast to the above situations, some facilities with very extensive or highly complex environmental problems will likely require an assessment of a number of alternative remedial technologies or approaches. The following are examples of situations which would likely need relatively extensive studies to be done to support sound remedy selection decisions:

1. "High risk" facilities with complex remedial solutions. Such facilities might have large volumes of both concentrated wastes and contaminated soils, for which several treatment technologies could be applied to achieve varying degrees of effectiveness (such as reduction of toxicity or volume), in conjunction with different types of containment systems for residuals.
2. Contaminant problems for which several different approaches are practicable. There may be several, quite distinct technical approaches for remediating a problem at a facility, each of which offers varying degrees of long-term reliability, and could be implemented over different time frames. In such cases, remedy selection decisions will necessarily involve a difficult balancing of competing goals and interests. Such decisions must be supported with adequate information.
3. Facilities for which innovative treatment technologies may be viable.

In addition to the above examples of situations calling for either a limited, or relatively complex CMS, other studies will fall in the middle of that range. Given

the wide range of possibilities for structuring the CMS, this guidance encourages the implementing agency to focus the evaluation on appropriate remedies, tailoring the scope and substance of the study to fit the complexity of the situation. It will also be the responsibility of the implementing agency to determine what level of evaluation and documentation is necessary in order to support the ultimate remedy selection for the facility.

The implementing agency has the discretion to not require sections of the plan and/or report that are specified in this guidance, in those site-specific situations where all the requirements may not be appropriate. The implementing agency also may require the Permittee/Respondent to conduct additional studies beyond what is discussed in the scope of work in order to support the CMS. The Permittee/Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

[NOTE: With certain exceptions, the provisions set out in sections I through IV are intended as guidance, and these provisions should be justifiable and tailored to site-specific conditions when incorporated into permits or orders. The exceptions are certain provisions which are based on specific regulatory or statutory requirements applicable to permitting. Regulatory and statutory requirements are binding and do not require site-specific justification. Applicable requirements include: public notice requirements specified in 40 CFR subpart D and requirements in 40 CFR §264.101. The following Scope of Work (SOW) for the Corrective Measures Study is intended to be a flexible document capable of addressing both simple and complex site situations.]

Scope of Work for a Corrective Measures Study (CMS)

Purpose

The purpose of the Corrective Measures Study (CMS) portion of the RCRA corrective action process is to identify and evaluate potential remedial alternatives for the releases that have been identified at a facility.

Scope

A Corrective Measures Study Workplan and Corrective Measures Study Report are, unless otherwise specified by the implementing agency, required elements of the CMS. The CMS consists of the following components:

Section I: Corrective Measures Study Workplan

Section II: Corrective Measures Study Report

- A. Introduction /Purpose
- B. Description of Current Conditions
- C. Corrective Action Objectives
- D. Identification, Screening and Development of Corrective Measure Alternatives
- E. Evaluation of A Final Corrective Measure Alternative
- F. Recommendation by a Permittee/Respondent for a Final Corrective Measure Alternative
- G. Public Involvement Plan

Section III: Progress Reports

Section IV: Proposed Schedule

Section I: Corrective Measures Study Workplan

The Corrective Measures Study (CMS) Workplan may be required by the implementing agency. If required, it shall include the following elements:

1. A site-specific description of the overall purpose of the Corrective Measure Study;
2. A description of the corrective measure objectives, including proposed target media cleanup standards (e.g., promulgated federal and state standards, risk derived standards) and points of compliance or a description of how a risk assessment will be performed (e.g., guidance documents);
3. A description of the specific corrective measure technologies and/or corrective measure alternatives which will be studied;
4. A description of the general approach to investigating and evaluating potential corrective measures;
5. A detailed description of any proposed pilot, laboratory and/or bench scale studies;

[NOTE: Appendix A provides references for technical assistance (e.g., "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" - Chapter 5.)]

6. A proposed outline for the CMS Report including a description of how information will be presented; and
7. A description of overall project management including overall approach, levels of authority (include organization chart), lines of communication, project schedules, budget and personnel. Include a description of qualifications for personnel directing or performing the work.

Section II: Corrective Measures Study Report

The Corrective Measures Study (CMS) Report shall include the following elements:

A. Introduction/Purpose

The Permittee/Respondent shall describe the purpose of the document and provide a summary description of the project.

B. Description of Current Conditions

The Permittee/Respondent shall include a brief summary/discussion of any new information that has been discovered since the RFI current conditions report was finalized. This discussion should concentrate on those issues which could significantly affect the evaluation and selection of the corrective measures alternative(s).

[NOTE: The implementing agency may allow the Permittee/Respondent to reference the RFI current conditions report in lieu of additional discussion in this section.]

C. Media Cleanup Standards

The Permittee/Respondent may propose media cleanup standards. The standards must be based on promulgated federal and state standards, risk derived standards, all data and information gathered during the corrective action process (e.g., from interim measures, RCRA Facility Investigation, etc.), and/or other applicable guidance documents. If no other guidance exists for a given contaminant and media, the Permittee/Respondent shall propose and justify a media cleanup standard.

[NOTE: The implementing agency may set cleanup standards before the CMS stage. The information to support the agency's decision may be submitted by the Permittee/Respondent as part of the investigation analysis (see Section V of the RFI scope of work). The Permittee/Respondent may propose to modify the media cleanup standards during the CMS. As a result of this or other new information, the implementing agency may modify the cleanup standards. Final media cleanup standards are determined by the implementing agency when the remedy is selected and are documented in the Statement of Basis/Response to Comments (SB/RTC) or permit modification.]

D. Identification, Screening, and Development of Corrective Measure Alternatives

1. Identification: List and briefly describe potentially applicable technologies for each affected media that may be used to achieve the corrective action objectives. The Permittee/Respondent should consider including a table that summarizes the available technologies. Depending on the site-specific situation, the implementing agency may require the Permittee/Respondent to consider additional technologies.

The Permittee/Respondent should consider innovative treatment

technologies, especially in situations where there are a limited number of applicable corrective measure technologies. Innovative technologies are defined as those technologies utilized for remediation other than incineration, solidification/stabilization, and pumping with conventional treatment for contaminated groundwater [see Appendix C]. Innovative treatment technologies may require extra effort to gather information, to analyze options, and to adapt the technology to the site-specific situation. Treatability studies and on-site pilot scale studies may be necessary for evaluating innovative treatment technologies.

2. Screening [optional]: When the Permittee/Respondent is required to, or chooses to, evaluate a number of corrective measures technologies, the Permittee/Respondent will evaluate the technology limitations to show why certain corrective measures technologies may prove unfeasible to implement given existing waste and site-specific conditions.

Likewise, if only one corrective measure alternative is being analyzed, the Permittee/Respondent must indicate any technological limitations given waste and site-specific conditions at the facility for which it is being considered. The Permittee/Respondent should consider including a table that summarizes these findings.

3. Corrective Measure Development [optional]: As required by the implementing agency, the Permittee/Respondent shall assemble the technologies that pass the screening step into specific alternatives that have potential to meet the corrective action objectives for each media. Options for addressing less complex sites could be relatively straight-forward and may only require evaluation of a single or limited number of alternatives.

Each alternative may consist of an individual technology or a combination of technologies used in sequence (i.e., treatment train). Depending on the site specific situation, different alternatives may be considered for separate areas of the facility. List and briefly describe each corrective measure alternative.

E. Evaluation of a Final Corrective Measure Alternative

For each remedy which warrants a more detailed evaluation, including those situations when only one remedy is being proposed, the Permittee/Respondent shall provide detailed documentation of how the

potential remedy will comply with each of the standards listed below. These standards reflect the major technical components of remedies including cleanup of releases, source control and management of wastes that are generated by remedial activities. The specific standards are provided below.

1. Protect human health and the environment.
2. Attain media cleanup standards set by the implementing agency.
3. Control the source of releases so as to reduce or eliminate, to the extent practicable, further releases that may pose a threat to human health and the environment.
4. Comply with any applicable standards for management of wastes.
5. Other Factors.

In evaluating the selected alternative or alternatives the Permittee/Respondent shall prepare and submit information that documents that the specific remedy will meet the standards listed above. The following guidance should be used in completing this evaluation. This guidance provides examples of the types of information that would be supportive; the implementing agency may require additional information.

1. **Protect Human Health and the Environment**

Corrective action remedies must be protective of human health and the environment. Remedies may include those measures that are needed to be protective, but are not directly related to media cleanup, source control, or management of wastes. An example would be a requirement to provide alternative drinking water supplies in order to prevent exposures to releases from an aquifer used for drinking water purposes. Another example would be a requirement for the construction of barriers or for other controls to prevent harm arising from direct contact with waste management units. Therefore, the Permittee/Respondent shall include a discussion on what types of short term remedies are appropriate for the particular facility in order to meet this standard. This information should be provided in addition to a discussion of how the other corrective measure alternatives meet this standard.

2. **Attain Media Cleanup Standards Set by the Implementing Agency**

Remedies will be required to attain media cleanup standards set by the implementing agency which may be derived from existing state or federal regulations (e.g. groundwater standards) or other standards. The media cleanup standards for a remedy will often play a large role in determining

the extent of and technical approaches to the remedy. In some cases, certain technical aspects of the remedy, such as the practical capabilities of remedial technologies, may influence to some degree the media cleanup standards that are established.

As part of the necessary information for satisfying this requirement, the Permittee/Respondent shall address whether the potential remedy will achieve the preliminary remediation objective as identified by the implementing agency as well as other, alternative remediation objectives that may be proposed by the Permittee/Respondent. The Permittee/Respondent shall also include an estimate of the time frame necessary for each alternative to meet these standards.

3. Control the Sources of Releases

A critical objective of any remedy must be to stop further environmental degradation by controlling or eliminating further releases that may pose a threat to human health and the environment. Unless source control measures are taken, efforts to clean up releases may be ineffective or, at best, will essentially involve a perpetual cleanup. Therefore, an effective source control program is essential to ensure the long-term effectiveness and protectiveness of the corrective action program.

The source control standard is not intended to mandate a specific remedy or class of remedies. Instead, the Permittee/Respondent is encouraged to examine a wide range of options. This standard should not be interpreted to preclude the equal consideration of using other protective remedies to control the source, such as partial waste removal, capping, slurry walls, in-situ treatment/stabilization and consolidation.

[NOTE: When evaluating potential alternatives, further releases from sources of contamination are to be controlled to the extent practicable. This qualifier is intended to account for the technical limitations that may in some cases be encountered in achieving effective source control. For some very large landfills, or large areas of widespread soil contamination, engineering solutions such as treatment or capping to prevent further leaching may not be technically practicable, to eliminate further releases above health-based contamination levels. In such cases, source controls may need to be combined with other measures, such as plume management or exposure controls, to ensure an effective and protective remedy.]

As part of the CMS Report, the Permittee/Respondent shall address the issue of whether source control measures are necessary, and if so, the type of actions that would be appropriate. Any source control measure

proposed should include a discussion on how well the method is anticipated to work given the particular situation at the facility and the known track record of the specific technology.

4. Comply With Any Applicable Standards for Management of Wastes.

The Permittee/Respondent shall include a discussion of how the specific waste management activities will be conducted in compliance with all applicable state or federal regulations (e.g., closure requirements, land disposal restrictions).

5. Other Factors

There are five general factors that will be considered as appropriate by the implementing agency in selecting/approving a remedy that meets the four standards listed above. These factors represent a combination of technical measures and management controls for addressing the environmental problems at the facility. The five general decision factors include:

- a. Long-term reliability and effectiveness;
- b. Reduction in the toxicity, mobility or volume of wastes;
- c. Short-term effectiveness;
- d. Implementability; and
- e. Cost.

The implementing agency may request the Permittee/Respondent to provide additional information to support the use of these factors in the evaluation of viable remedial alternatives. Examples of the types of information that may be requested are provided below:

a. Long-term Reliability and Effectiveness

Demonstrated and expected reliability is a way of assessing the risk and effect of failure. The Permittee/Respondent may consider whether the technology or a combination of technologies have been used effectively under analogous site conditions, whether failure of any one technology in the alternative would have an immediate impact on receptors, and whether the alternative would have the flexibility to deal with uncontrollable changes at the site (e.g., heavy rain storms, earthquakes, etc.).

Most corrective measure technologies, with the exception of destruction, deteriorate with time. Often, deterioration can be

slowed through proper system operation and maintenance, but the technology eventually may require replacement. Each corrective measure alternative should be evaluated in terms of the projected useful life of the overall alternative and of its component technologies. Useful life is defined as the length of time the level of effectiveness can be maintained.

b. Reduction in the Toxicity, Mobility or Volume of Wastes

As a general goal, remedies will be preferred that employ techniques, such as treatment technologies, that are capable of eliminating or substantially reducing the inherent potential for the wastes in SWMUs (and/or contaminated media at the facility) to cause future environmental releases or other risks to human health and the environment. There may be some situations where achieving substantial reductions in toxicity, mobility or volume may not be practical or even desirable. Examples might include large, municipal-type landfills, or wastes such as unexploded munitions that would be extremely dangerous to handle, and for which the short-term risks of treatment outweigh potential long-term benefits.

Estimates of how much the corrective measures alternatives will reduce the waste toxicity, volume, and/or mobility may be helpful in applying this factor. This may be done through a comparison of initial site conditions to expected post-corrective measure conditions.

c. Short-term Effectiveness

Short-term effectiveness may be particularly relevant when remedial activities will be conducted in densely populated areas, or where waste characteristics are such that risks to workers or to the environment are high and special protective measures are needed. Possible factors to consider include fire, explosion, exposure to hazardous substances and potential threats associated with treatment, excavation, transportation, and redisposal or containment of waste material.

d. Implementability

Implementability will often be a determining variable in shaping remedies. Some technologies will require state or local approvals prior to construction, which may increase the time necessary to

implement the remedy. In some cases, state or local restrictions or concerns may necessitate eliminating or deferring certain technologies or remedial approaches from consideration in remedy selection. Information to consider when assessing implementability may include:

1. The administrative activities needed to implement the corrective measure alternative (e.g., permits, rights of way, off-site approvals, etc.) and the length of time these activities will take;
2. The constructibility, time for implementation, and time for beneficial results;
3. The availability of adequate off-site treatment, storage capacity, disposal services, needed technical services and materials; and
4. The availability of prospective technologies for each corrective measure alternative.

e. **Cost**

The relative cost of a remedy may be an appropriate consideration, especially in those situations where several different technical alternatives to remediation will offer equivalent protection of human health and the environment, but may vary widely in cost. However, in those situations where only one remedy is being proposed, the issue of cost would not need to be considered. Cost estimates could include costs for: engineering, site preparation, construction, materials, labor, sampling/analysis, waste management/disposal, permitting, health and safety measures, training, operation and maintenance, etc.

F. **Recommendation by Permittee/Respondent for a Final Corrective Measure Alternative**

In the CMS Report, the Permittee/Respondent may recommend a preferred remedial alternative for consideration by the implementing agency. Such a recommendation should include a description and supporting rationale for the proposed remedy, consistent with the remedial standards and the decision factors discussed above. Such a

recommendation is not required and the implementing agency still retains the role of remedy selection.

G. Public Involvement Plan

After the CMS has been performed by the Permittee/Respondent and the implementing agency has selected a preferred alternative for proposal in the Statement of Basis, it is the agency's policy to request public comment on the Administrative Record and the proposed corrective measure(s). Changes to the proposed corrective measure(s) may be made after consideration of public comment. The implementing agency may also require that the Permittee/Respondent perform additional corrective measures studies. If the public is interested, a public meeting may be held. After consideration of the public's comments on the proposed corrective measure, the agency develops the Final Decision and Response to Comments (RTC) to document the selected corrective measure, the agency's justification for such selection, and the response to the public's comment. Additional public involvement activities may be necessary, based on facility specific circumstances.

[NOTE: Notice requirements for permits are set out at 40 CFR Part 270 subpart D. See RCRA Public Involvement Manual [EPA/530-R-93-006, September 1993 for further guidance.]

Section III: Progress Reports

The Permittee/Respondent will, at a minimum, provide the implementing agency with signed [monthly, bimonthly, or quarterly] progress reports. These reports may be required to contain the following information, but agency requirements are not limited to this list:

1. A description and estimate of the percentage of the CMS completed;
2. Summaries of *all* findings in the reporting period, including results of any pilot studies;
3. Summaries of *all* changes made in the CMS during the reporting period;
4. Summaries of *all* contacts with representative of the local community, public interest groups or State government during the reporting period;
5. Summaries of *all* contacts made regarding access to off-site property;
6. Summaries of *all* problems encountered during the reporting period;

7. Actions being taken to rectify problems;
8. Changes in relevant personnel during the reporting period;
9. Projected work for the next reporting period; and
10. Copies of daily reports, inspection reports, laboratory/monitoring data, etc.

Section IV: Proposed Schedule

The Permittee/Respondent will provide the implementing agency with CMS reports according to the following schedule:

<u>Facility Submission</u>	<u>Due Date</u>
CMS Workplan (Section I)	[DATE]
Draft CMS Report (Section II)	[NUMBER] days after CMS Workplan Approval
Final CMS Report (Sections II)	[NUMBER] days after the implementing agency comments on Draft CMS Report
Progress Reports on Sections I and II <i>[see Section III above for guidance on progress reports.]</i>	[MONTHLY, BI- MONTHLY, other]

Chapter V: Corrective Measures Implementation

Introduction

The purpose of the Corrective Measures Implementation (CMI) portion of the RCRA corrective action process is to design, construct, operate, maintain and monitor the performance of the corrective measure(s) selected by the implementing agency. Thus far in the corrective action program, the CMI process generally entailed a conceptual design phase for the selected remedy, a detailed review of intermediate plans and specifications by the implementing agency, and the development of final plans and specifications.

The new CAP encourages implementing agencies to make the process more flexible and streamlined. Intermediate design plans may or may not be required at specific design points (30, 50, 60, 90, and/or 95% are given as examples). Other sections may be combined or eliminated.

For example, a CMI Workplan may be submitted to the implementing agency rather than the Conceptual Design (Section I), Intermediate Plans and Specifications (Section III), and Construction Workplan (Section V). The implementing agency may approve (or conditionally approve with comments) the CMI Workplan and not require submittal of Final Plans and Specifications (Section IV) and Construction Workplan (Section V). A Health and Safety Plan (Section VIII) and Public Involvement Plan (Section IX) also may be included in a CMI Workplan. Implementing agencies may consider other approaches to expedite the process and initiate implementation of corrective measure(s) more quickly.

As discussed in Chapter II, one such approach involves initiating ISMs prior to the CMI. Plans submitted for ISMs (e.g., health and safety plans, public involvement plans) may be used or updated during the CMI, particularly since ISMs should be compatible with final corrective measures. In most cases this will be true, with the only changes being an expansion/adjustment of the ISMs to constitute a final remedy.

Another approach to expedite the CMI process involves setting final remedial (or stabilization) media cleanup standards but not specifying the process by which the standards would be attained. This performance-based approach should lower oversight by the implementing agency and promote faster cleanup. The implementing agency should give special consideration to the types of progress reports (see Section X) it will require from the Permittee/Respondent so that it can monitor progress toward achieving the media cleanup standards if this approach is taken.

[NOTE: With certain exceptions, the provisions set out in sections I through XI are intended as guidance, and these provisions should be justifiable and tailored to site-specific conditions when incorporated into permits or orders. The exceptions are certain provisions which are based on specific regulatory or statutory requirements applicable to permitting. Regulatory and statutory requirements are binding and do not require site-specific justification. Applicable requirements include: financial responsibility requirements in RCRA sections 3004(u) and 3004(v) and 40 CFR § 264.101.]

Scope of Work for Corrective Measures Implementation

Purpose

The purpose of the Corrective Measures Implementation (CMI) program is to design, construct, operate, maintain and monitor the performance of the corrective measure or measures selected by the implementing agency. Corrective measures are intended to protect human health and/or the environment from releases from the facility. The Permittee/Respondent will furnish all personnel, materials and services necessary to implement the corrective measures program.

Scope

The documents required for Corrective Measures Implementation are, unless the implementing agency specifies otherwise, a Conceptual Design, Operation and Maintenance Plan, Intermediate Plans and Specifications, Final Plans and Specifications, Construction Workplan, Construction Completion Report, Corrective Measure Completion Report, Health and Safety Plan, Public Involvement Plan, and Progress Reports. The scope of work (SOW) for each document is specified below. The SOW's are intended to be flexible documents capable of addressing both simple and complex site situations. If the Permittee/Respondent can justify, to the satisfaction of the implementing agency, that a plan and/or report or portions thereof are not needed in the given site-specific situation, then the implementing agency may waive that requirement.

The implementing agency may require the Permittee/Respondent to conduct additional studies beyond what is discussed in the SOW's in order to support the CMI program. The Permittee/ Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

[NOTE: See introduction for discussion on streamlining sections of the CMI Scope of Work.]

The CMI consists of the following components, which for clarity are designated as sections in this Scope of Work.

Section I: Conceptual Design (15% Design Point)

- A. Introduction/Purpose**
- B. Corrective Measures Objectives**
- C. Conceptual Model of Contaminant Migration**
- D. Description of Corrective Measures**
- E. Project Management**
- F. Project Schedule**
- G. Design Criteria**
- H. Design Basis**
- I. Waste Management Practices**
- J. Required Permits**
- K. Long-lead Procurement Considerations**
- L. Appendices**

Section II: Operation and Maintenance Plan

- A. Introduction/Purpose**
- B. Project Management**
- C. System Description**
- D. Personnel Training**
- E. Start-up Procedures**
- F. Operation and Maintenance Procedures**
- G. Replacement Schedule for Equipment and Installed Components**
- H. Waste Management Practices**

- I. Sampling and Analysis
 - J. Corrective Measure Completion Criteria
 - K. Operation and Maintenance Contingency Procedures
 - L. Data Management and Documentation Requirements
- Section III: Intermediate Plans and Specifications (30, 50, 60, 90 and/or 95% Design Point)
- Section IV: Final Plans and Specifications (100% Design Point)
- Section V: Construction Workplan
- A. Introduction/Purpose
 - B. Project Management
 - C. Project Schedule
 - D. Construction Quality Assurance/Quality Control Programs
 - E. Waste Management Procedures
 - F. Sampling and Analysis
 - G. Construction Contingency Procedures
 - H. Construction Safety Procedures
 - I. Documentation Requirements
 - J. Cost Estimate/Financial Assurance
- Section VI: Construction Completion Report
- Section VII: Corrective Measure Completion Report
- Section VIII: Health and Safety Plan
- Section IX: Public Involvement Plan

Section X: Progress Reports

Section XI: Proposed Schedule

Section I: Conceptual Design (15% Design Point)

The Permittee/Respondent shall prepare a Conceptual Design (CD) that clearly describes the size, shape, form, and content of the proposed corrective measure; the key components or elements that are needed; the designer's vision of the corrective measure in the form of conceptual drawings and schematics; and the procedures and schedules for implementing the corrective measure(s). It should be noted that more than one conceptual design may be needed in situations where there is a complex site with multiple technologies being employed at different locations. The implementing agency may require approval of the CD prior to implementation. The CD must, at a minimum, include the following elements:

- A. **Introduction/Purpose:** Describe the purpose of the document and provide a summary description of the project.
- B. **Corrective Measures Objectives:** Discuss the corrective measure objectives including applicable media cleanup standards.
- C. **Conceptual Model of Contaminant Migration:** Present a conceptual model of the site and contaminant migration. The conceptual model consists of a working hypothesis of how the contaminants may move from the release source to the receptor population. The conceptual model is developed by looking at the applicable physical parameters (e.g., water solubility, density, Henry's Law Constant, etc.) for each contaminant and assessing how the contaminant may migrate given the existing site conditions (geologic features, depth to groundwater, etc.). Describe the phase (water, soil, gas, non-aqueous) and location where contaminants are likely to be found. This analysis may have already been done as part of earlier work (e.g., Current Conditions Report). If this is the case, then provide a summary of the conceptual model with a reference to the earlier document.
- D. **Description of Corrective Measures:** Considering the conceptual model of contaminant migration, qualitatively describe what the corrective measure is supposed to do and how it will function at the facility. Discuss the feasibility of the corrective measure and its ability to meet the corrective measure objectives.
 1. **Data Sufficiency:** Review existing data needed to support the design effort and establish whether or not there is sufficient accurate data available for this purpose. The Permittee/Respondent must summarize the assessment findings and specify any additional data needed to complete the corrective

measure design. The implementing agency may require or the Permittee/Respondent may propose that sampling and analysis plans and/or treatability study workplans be developed to obtain the additional data. Submittal times for any new sampling and analysis plans and/or treatability study workplans will be determined by the implementing agency and will be included in the project schedule.

- E. **Project Management:** Describe the management approach including levels of authority and responsibility (include organization chart), lines of communication and the qualifications of key personnel who will direct the corrective measure design and the implementation effort (including contractor personnel).
- F. **Project Schedule:** The project schedule must specify all significant steps in the process and when all CMI deliverables (e.g., Operation and Maintenance Plan, Corrective Measure Construction Workplan, etc.) are to be submitted to the implementing agency.
- G. **Design Criteria:** Specify performance requirements for the overall corrective measure and for each major component. The Permittee/Respondent must select equipment that meets the performance requirements.
- H. **Design Basis:** Discuss the process and methods for designing all major components of the corrective measure. Discuss the significant assumptions made and possible sources of error. Provide justification for the assumptions.
 - 1. Conceptual Process/Schematic Diagrams.
 - 2. Site plan showing preliminary plant layout and/or treatment area.
 - 3. Tables listing number and type of major components with approximate dimensions.
 - 4. Tables giving preliminary mass balances.
 - 5. Site safety and security provisions (e.g., fences, fire control, etc.).
- I. **Waste Management Practices:** Describe the wastes generated by the construction of the corrective measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

- J. Required Permits: List and describe the permits needed to construct and operate the corrective measure. Indicate on the project schedule when the permit applications will be submitted to the applicable agencies and an estimate of the permit issuance date.
- K. Long-Lead Procurement Considerations: The Permittee/Respondent shall prepare a list of any elements or components of the corrective measure that will require custom fabrication or for some other reason must be considered as long-lead procurement items. The list must include the reason why the items are considered long-lead items, the length of time necessary for procurement, and the recognized sources of such procurement.
- L. Appendices including:
 - 1. Design Data - Tabulations of significant data used in the design effort;
 - 2. Equations - List and describe the source of major equations used in the design process;
 - 3. Sample Calculations - Present and explain one example calculation for significant or unique design calculations; and
 - 4. Laboratory or Field Test Results.

Section II: Operation and Maintenance Plan

The Permittee/Respondent shall prepare an Operation and Maintenance (O&M) Plan that outlines procedures for performing operations, long term maintenance, and monitoring of the corrective measure. A draft Operation and Maintenance Plan shall be submitted to the implementing agency simultaneously with the draft Plans and Specifications (see Section III). A final Operation and Maintenance Plan shall be submitted to the implementing agency simultaneously with the final Plans and Specifications. The O&M plan shall, at a minimum, include the following elements:

- A. Introduction/Purpose: Describe the purpose of the document and provide a summary description of the project.
- B. Project Management: Describe the management approach including levels of authority and responsibility (include organization chart), lines of communication and the qualifications of key personnel who will operate and maintain the corrective measures (including contractor personnel).

- C. System Description: Describe the corrective measure and identify significant equipment.
- D. Personnel Training: Describe the training process for O&M personnel. The Permittee/Respondent shall prepare, and include in the technical specifications governing treatment systems, the contractor requirements for providing: appropriate service visits by experienced personnel to supervise the installation, adjustment, start up and operation of the treatment systems, and training covering appropriate operational procedures once the start-up has been successfully accomplished.
- E. Start-Up Procedures: Describe system start-up procedures including any operational testing.
- F. Operation and Maintenance Procedures: Describe normal operation and maintenance procedures including:
1. Description of tasks for operation;
 2. Description of tasks for maintenance;
 3. Description of prescribed treatment or operation conditions; and
 4. Schedule showing frequency of each O&M task.
- G. Replacement Schedule for Equipment and Installed Components.
- H. Waste Management Practices: Describe the wastes generated by operation of the corrective measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.
- I. Sampling and Analysis: Sampling and monitoring activities may be needed for effective operation and maintenance of the corrective measure. To ensure that all information, data and resulting decisions are technically sound, statistically valid, and properly documented, the Permittee/Respondent shall prepare a Quality Assurance Project Plan (QAPjP) to document all monitoring procedures, sampling, field measurements and sample analyses performed during these activities. The Permittee/Respondent shall use quality assurance, quality control, and chain-of-custody procedures approved by the implementing agency. These procedures are described in the soon to be released EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5), which will replace Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980.
- J. Corrective Measure Completion Criteria: Describe the process and

criteria (e.g., groundwater cleanup goal met at all compliance points for 1 year) for determining when corrective measures have achieved media cleanup goals. Also describe the process and criteria for determining when maintenance and monitoring may cease. Criteria for corrective measures such as a landfill cap must reflect the need for long-term monitoring and maintenance. Satisfaction of the completion criteria will trigger preparation and submittal of the Corrective Measures Completion Report.

K. O&M Contingency Procedures:

1. Procedures to address system breakdowns and operational problems including a list of redundant and emergency back-up equipment and procedures;
2. Alternate procedures to be implemented if the corrective measure suffers complete failure. The alternate procedures must be able to prevent release or threatened releases of hazardous wastes or constituents which may endanger human health and/or the environment or exceed media cleanup standards;
3. The O&M Plan must specify that, in the event of a major breakdown and/or complete failure of the corrective measure (includes emergency situations), the Permittee/Respondent will orally notify the implementing agency within 24 hours of the event and will notify the implementing agency in writing within 72 hours of the event. Written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on human health and/or the environment; and
4. Procedures to be implemented in the event that the corrective measure is experiencing major operational problems, is not performing to design specifications and/or will not achieve the cleanup goals in the expected time frame. For example, in certain circumstances both a primary and secondary corrective measure may be selected for the Facility. If the primary corrective measure were to fail, then the secondary would be implemented. This section would thus specify that if the primary corrective measure failed, then design plans would be developed for the secondary measure.

L. Data Management and Documentation Requirements: The O&M Plan shall specify that the Permittee/Respondent collect and maintain the

following information:

1. Progress Report Information
2. Monitoring and laboratory data;
3. Records of operating costs; and
4. Personnel, maintenance and inspection records.

This data and information should be used to prepare Progress Reports and the Corrective Measure Completion Report.

[NOTE: See Section X for guidance on what kind of information may be required in progress reports.]

Section III: Intermediate Plans and Specifications (30, 50, 60, 90 and/or 95% Design Point)

[NOTE: The Permittee/Respondent may propose or the implementing agency may require the submittal of several intermediate plans and specifications (e.g., at the 60% Design Point) or none at all.]

The Permittee/Respondent shall prepare draft Plans and Specifications that are based on the Conceptual Design but include additional design detail. A draft Operation and Maintenance Plan and Construction Workplan shall be submitted to the implementing agency simultaneously with the draft Plans and Specifications. The draft design package must include drawings and specifications needed to construct the corrective measure. Depending on the nature of the corrective measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:

- General Site Plans
- Process Flow Diagrams
- Mechanical Drawings
- Electrical Drawings
- Structural Drawings
- Piping and Instrumentation Diagrams
- Excavation and Earthwork Drawings
- Equipment Lists
- Site Preparation and Field Work Standards
- Preliminary Specifications for Equipment and Material

General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the project specifications to the implementing agency, the Permittee/Respondent shall:

- Proofread the specifications for accuracy and consistency with the conceptual design and
- Coordinate and cross-check the specifications and drawings.

Section IV: Final Plans and Specifications (100% Design Point)

The Permittee/Respondent shall prepare Final Plans and Specifications that are sufficient to be included in a contract document and be advertised for bid. A final Operation and Maintenance Plan and Construction Workplan shall be submitted to the implementing agency simultaneously with the final Plans and Specifications. The final design package must consist of the detailed drawings and specifications needed to construct the corrective measure. Depending on the nature of the corrective measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:

- General Site Plans
- Process Flow Diagrams
- Mechanical Drawings
- Electrical Drawings
- Piping and Instrumentation Diagrams
- Structural Drawings
- Excavation and Earthwork Drawings
- Site Preparation and Field Work Standards
- Construction Drawings
- Installation Drawings
- Equipment Lists.
- Detailed Specifications for Equipment and Material

General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the final project specifications to the implementing agency, the Permittee/Respondent shall proofread the specifications for accuracy and consistency with the preliminary design; and coordinate and cross-check the specifications and drawings.

Section V: Construction Workplan

The Permittee/Respondent shall prepare a Construction Workplan which documents the overall management strategy, construction quality assurance procedures and schedule for constructing the corrective measure. A draft Construction Workplan shall be submitted to the implementing agency simultaneously with the draft Plans and Specifications and draft Operation and Maintenance Plan. A final Construction Workplan shall be submitted to the

implementing agency simultaneously with the final Plans and Specifications and final Operation and Maintenance Plan. Upon receipt of written approval from the implementing agency, the Permittee/Respondent shall commence the construction process and implement the Construction Workplan in accordance with the schedule and provisions contained therein. The Construction Workplan must be approved by the implementing agency prior to the start of corrective measure construction. The Construction Workplan must, at a minimum, include the following elements:

- A. **Introduction/Purpose:** Describe the purpose of the document and provide a summary description of the project.
- B. **Project Management:** Describe the construction management approach including levels of authority and responsibility (include organization chart), lines of communication and the qualifications of key personnel who will direct the corrective measure construction effort and provide construction quality assurance/quality control (including contractor personnel).
- C. **Project Schedule:** The project schedule must include timing for key elements of the bidding process, timing for initiation and completion of all major corrective measure construction tasks as specified in the Final Plans and Specifications, and specify when the Construction Completion Report is to be submitted to the implementing agency.
- D. **Construction Quality Assurance/Quality Control Programs:** The purpose of construction quality assurance is to ensure, with a reasonable degree of certainty, that a completed corrective measure will meet or exceed all design criteria, plans, and specifications. The Construction Workplan must include a complete Construction Quality Assurance Program to be implemented by the Permittee/Respondent.
- E. **Waste Management Procedures:** Describe the wastes generated by construction of the corrective measure and how they will be managed.
- F. **Sampling and Analysis:** Sampling and monitoring activities may be needed for construction quality assurance/quality control and/or other construction related purposes. To ensure that all information, data and resulting decisions are technically sound, statistically valid, and properly documented, the Permittee/Respondent shall prepare a Quality Assurance Project Plan (QAPjP) to document all monitoring procedures, sampling, field measurements and sample analysis performed during these activities. The Permittee/Respondent shall use quality assurance, quality control, and chain-of-custody procedures approved by the implementing agency.

These procedures are described in the soon to be released EPA Requirements for Quality Assurance Project Plans for Environmental Data Operations (EPA QA/R-5), which replaces Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans, QAMS-005/80, December 29, 1980.

G. Construction Contingency Procedures:

1. Changes to the design and/or specifications may be needed during construction to address unforeseen problems encountered in the field. Procedures to address such circumstances, including notification of the implementing agency, must be included in the Construction Workplan;
2. The Construction Workplan must specify that, in the event of a construction emergency (e.g. fire, earthwork failure, etc.), the Permittee/Respondent will orally notify the implementing agency within 24 hours of the event and will notify the implementing agency in writing within 72 hours of the event. The written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on human health and/or the environment; and
3. Procedures to be implemented if unforeseen events prevent corrective measure construction. For example, in certain circumstances both a primary and secondary corrective measure may be selected for the Facility. If the primary corrective measure could not be constructed, then the secondary would be implemented. This section would thus specify that if the primary corrective measure could not be constructed, then design plans would be developed for the secondary measure.

H. Construction Safety Procedures: Construction safety procedures should be specified in a separate Health and Safety Plan. [See Section VIII]

I. Documentation Requirements

The Permittee/Respondent shall describe how analytical data and results will be evaluated, documented, and managed.

[See Appendix B]

J. Cost Estimate/Financial Assurance

[NOTE: See 40 CFR § 264.101]

Financial assurance for corrective measure construction and operation may be required by an enforcement order, facility permit, or permit modification. The Construction Workplan must include a cost estimate and specify which financial mechanism will be used and when the mechanism will be established. The cost estimate shall include both construction and operation and maintenance costs. An initial cost estimate shall be included in the draft Construction Workplan and a final cost estimate shall be included in the final Construction Workplan. The financial assurance mechanism may include a performance or surety bond, a trust fund, a letter of credit, financial test and corporate guarantee equivalent to that in 40 CFR, § 265.143 or any other mechanism acceptable to the implementing agency.

Financial assurance mechanisms are used to assure the implementing agency that the Permittee/Respondent has adequate financial resources to construct and operate the corrective measure.

Section VI: Construction Completion Report

The Permittee/Respondent shall prepare a Construction Completion (CC) Report which documents how the completed project is consistent with the Final Plans and Specifications. A CC Report shall be submitted to the implementing agency when the construction and any operational tests have been completed. The CC Report shall, at a minimum, include the following elements:

1. Purpose;
2. Synopsis of the corrective measure, design criteria, and certification that the corrective measure was constructed in accordance with the Final Plans and Specifications;
3. Explanation and description of any modifications to the Final Plans and Specifications and why these were necessary for the project;
4. Results of any operational testing and/or monitoring, indicating how initial operation of the corrective measure compares to the design criteria;
5. Summary of significant activities that occurred during construction. Include a discussion of problems encountered and how they were addressed;
6. Summary of any inspection findings (include copies of key inspection documents in appendices);

7. As built drawings or photographs; and
8. Schedule indicating when any treatment systems will begin full scale operations.

Section VII: Corrective Measure Completion Report

The Permittee/Respondent shall prepare a Corrective Measure Completion (CMC) Report when the Permittee/Respondent believes that the corrective measure completion criteria have been satisfied. The purpose of the CMC Report is to fully document how the corrective measure completion criteria have been satisfied and to justify why the corrective measure and/or monitoring may cease. The CMC Report shall, at a minimum, include the following elements:

1. Purpose;
2. Synopsis of the corrective measure;
3. Corrective Measure Completion Criteria: Describe the process and criteria for determining when corrective measures, maintenance and monitoring may cease. Corrective measure completion criteria were given in the final Operation and Maintenance (O&M) Plan;
4. Demonstration that the completion criteria have been met. Include results of testing and/or monitoring, indicating how operation of the corrective measure compares to the completion criteria;
5. Summary of work accomplishments (e.g., performance levels achieved, total hours of treatment operation, total treated and/or excavated volumes, nature and volume of wastes generated, etc.);
6. Summary of significant activities that occurred during operations. Include a discussion of problems encountered and how they were addressed;
7. Summary of inspection findings (include copies of key inspection documents in appendices); and
8. Summary of total operation and maintenance costs.

Section VIII: Health and Safety Plan

The Permittee/Respondent shall submit a Health and Safety Plan for all field activity, although it does not require review and approval by the implementing

agency. The Health and Safety Plan shall be developed as a stand alone document but may be submitted with the CMI Workplan. The Health and Safety Plan must, at a minimum, include the following elements:

1. **Objectives:** Describe the goals and objectives of the health and safety program (must apply to on-site personnel and visitors). The health and safety plan must be consistent with the Facility Contingency Plan, OSHA Regulations, NIOSH Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (1985), all state and local regulations and other implementing agency guidance as provided.
2. **Hazard Assessment:** List and describe the potentially hazardous substances that could be encountered by field personnel during construction and/or operation and maintenance activities. Discuss the following:

- Inhalation Hazards
- Dermal Exposure
- Ingestion Hazards
- Physical Hazards
- Overall Hazard Rating

Include a table that, at a minimum, lists: known contaminants, highest observed concentration, media, symptoms/effects of acute exposure.

3. **Personal Protection/Monitoring Equipment**
 - Describe personal protection levels and identify all monitoring equipment for each operational task.
 - Describe any action levels and corresponding response actions (i.e., when will levels of safety be upgraded).
 - Describe decontamination procedures and areas.

4. **Site Organization and Emergency Contacts**

List and identify all contacts (include phone numbers). Identify the nearest hospital and provide a regional map showing the shortest route from the facility to the hospital. Describe site emergency procedures and any site safety organizations. Include evacuation procedures for neighbors (where applicable).

Include a facility map showing emergency station locations (first aid, eye wash areas, etc.).

Section IX: Public Involvement Plan

[NOTE: It is strongly recommended that the implementing agency oversee the Permittee's/Respondent's public involvement activities. Public involvement is an important part of RCRA corrective action. The public must be notified of significant changes to permits and orders regarding corrective action. In some cases, they also must be provided with the opportunity to review and comment on the changes. Further guidance on this process is in the document entitled RCRA Public Involvement Manual (EPA/530-R-93-006, September 1993).]

All Public Involvement Plans prepared by the Permittee/Respondent shall be submitted to the implementing agency for comment and approval prior to use. Permittees/Respondents must never appear to represent or speak for the implementing agency before the public, other government officials, or the media.

Public Involvement activities that may be required of the Permittee/Respondent include, the following:

1. Conducting an open house or informal meeting (i.e., availability session) in a public location where people can talk to agency officials and Permittee/Respondent on a one-to-one basis;
2. Preparing fact sheets summarizing current or proposed corrective action activities (all fact sheets should be reviewed by the implementing agency prior to public distribution);
3. Communicating effectively with people who have vested interest in the corrective action activities, (e.g., providing written or verbal information in the foreign language of a predominantly non-English-speaking community); and
4. Maintaining an easily accessible repository (such as a town hall or public library or the facility itself, in some limited circumstances) of information on the facility-specific corrective action program, including the order or permit, approved workplans, and/or other reports.

A schedule for community relations activities shall be included in the Public Involvement Plan.

Section X: Progress Reports

The Permittee/Respondent will, at a minimum, provide the implementing agency with signed [monthly, bimonthly, or quarterly] progress reports during corrective measure design, construction, operation and maintenance. The implementing agency may adjust the frequency of progress reporting to address site-specific needs. For example, more frequent progress reports may be needed to track critical activities such as corrective measure construction and start-up. Progress reports must, at a minimum, include the following elements:

1. A description of significant activities (e.g., sampling events, inspections, etc.) and work completed/work accomplishments (e.g., performance levels achieved, hours of treatment operation, treated and/or excavated volumes, concentration of contaminants in treated and/or excavated volumes, nature and volume of wastes generated, etc.) during the reporting period;
2. Summary of system effectiveness. Provide a comparison of system operation to predicted performance levels (applicable only during operation of the corrective measure);
3. Summaries of all findings (including any inspection results);
4. Summaries of all contacts with representatives of the local community, public interest groups or State government during the reporting period;
5. Summaries of all problems or potential problems encountered during the reporting period;
6. Actions being taken and/or planned to rectify problems;
7. Changes in personnel during the reporting period;
8. Projected work for the next reporting period; and
9. If requested by the implementing agency, the results of any sampling tests and/or other data generated during the reporting period.

Section XI: Proposed Schedule

The Permittee/Respondent will provide the implementing agency with CMI reports according to the following schedule:

<u>Facility Submission</u>	<u>Due Date</u>
Conceptual Design (Section I)	[DATE]
Operation and Maintenance Plan (Section II)	[DATE]
Intermediate Plans and Specifications (Section III)	[NUMBER] days after Conceptual Design Approval
Final Plans and Specifications (Sections IV)	[NUMBER] days after the implementing agency comments on Intermediate Plans and Specifications (date of approval may be tied to submittal of the CMI Workplan, if required)
Construction Workplan (Section V)	Concurrent with Final Plans and Specifications (or approval thereof)
Construction Completion Report (Section VI)	[DATE]
Corrective Measure Completion Report (Section VII)	[DATE] (based on when completion criteria are believed to have been satisfied)
Health and Safety Plan (Section VIII)	[DATE]
Public Involvement Plan (Section IX)	[DATE]
Progress Reports on Sections I through IX <i>[see Section X above for guidance on progress reports.]</i>	[MONTHLY, BI- MONTHLY, other]

Appendix A
Corrective Action Reference List

REFERENCE LIST

The following list comprises guidance documents and other information sources which may be useful in implementing corrective action. Contacts for additional information are included at the end of this list.

"*Handbook: Stabilization Technologies for RCRA Corrective Actions*," EPA/625/6-91/026, August 1991.

"*Interim Final RCRA Facility Investigation (RFI) Guidance*," Volumes I-IV, EPA/530/SW-89-031, May 1989.

"*Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*," Interim Final EPA/540/G-89/004, OSWER Directive 9355.3-01, October 1988.

"*RCRA Ground-water Monitoring Technical Enforcement Guidance Document (TEGD)*," OSWER Directive 9950.1, September 1986.

"*Handbook: Ground Water*," Volumes I and II, EPA/625/6-90/016 (a&b), September 1990 and July 1991.

"*Ground-Water Modeling: An Overview and Status Report*," EPA/600/2-89/028, December 1988.

"*Statistical Analysis of Ground-Water Monitoring Data at RCRA Facilities*," Interim Final, EPA/530/SW-89/026, April 1989.

"*Data Quality Objectives for Remedial Response Activities*," EPA/540/G-87/003 & 004, OSWER Directive 9335.0-7B, March 1987.

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Appendix B

Chapter One of SW-846,

**"Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"
[Third Edition as amended by Update I (July 1992)]**

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CHAPTER ONE QUALITY CONTROL

1.0 INTRODUCTION

It is the goal of the U.S. Environmental Protection Agency's (EPA's) quality assurance (QA) program to ensure that all data be scientifically valid, defensible, and of known precision and accuracy. The data should be of sufficient known quality to withstand scientific and legal challenge relative to the use for which the data are obtained. The QA program is management's tool for achieving this goal.

For RCRA analyses, the recommended minimum requirements for a QA program and the associated quality control (QC) procedures are provided in this chapter.

The data acquired from QC procedures are used to estimate the quality of analytical data, to determine the need for corrective action in response to identified deficiencies, and to interpret results after corrective action procedures are implemented. Method-specific QC procedures are incorporated in the individual methods since they are not applied universally.

A total program to generate data of acceptable quality should include both a QA component, which encompasses the management procedures and controls, as well as an operational day-to-day QC component. This chapter defines fundamental elements of such a data collection program. Data collection efforts involve:

1. design of a project plan to achieve the data quality objectives (DQOs);
2. implementation of the project plan; and
3. assessment of the data to determine if the DQOs are met.

The project plan may be a sampling and analysis plan or a waste analysis plan if it covers the QA/QC goals of the Chapter, or it may be a Quality Assurance Project Plan as described later in this chapter.

This chapter identifies the minimal QC components that should be used in the performance of sampling and analyses, including the QC information which should be documented. Guidance is provided to construct QA programs for field and laboratory work conducted in support of the RCRA program.

2.0 QA PROJECT PLAN

It is recommended that all projects which generate environment-related data in support of RCRA have a QA Project Plan (QAPJP) or equivalent. In some instances, a sampling and analysis plan or a waste analysis plan may be equivalent if it covers all of the QA/QC goals outlined in this chapter. In addition, a separate QAPJP need not be prepared for routine analyses or activities where the procedures to be followed are described in a Standard

Operating Procedures manual or similar document and include the elements of a QAPJP. These documents should be available and referenced in the documentation and/or records for the analysis activities. The term "QAPJP" in this chapter refers to any of these QA/QC documents.

The QAPJP should detail the QA/QC goals and protocols for a specific data collection activity. The QAPJP sets forth a plan for sampling and analysis activities that will generate data of a quality commensurate with their intended use. QAPJP elements should include a description of the project and its objectives; a statement of the DQOs of the project; identification of those involved in the data collection and their responsibilities and authorities; reference to (or inclusion of) the specific sample collection and analysis procedures that will be followed for all aspects of the project; enumeration of QC procedures to be followed; and descriptions of all project documentation. Additional elements should be included in the QAPJP if needed to address all quality related aspects of the data collection project. Elements should be omitted only when they are inappropriate for the project or when absence of those elements will not affect the quality of data obtained for the project (see reference 1).

The role and importance of DQOs and project documentation are discussed below in Sections 2.1 through 2.6. Management and organization play a critical role in determining the effectiveness of a QA/QC program and ensuring that all required procedures are followed. Section 2.7 discusses the elements of an organization's QA program that have been found to ensure an effective program. Field operations and laboratory operations (along with applicable QC procedures) are discussed in Sections 3 and 4, respectively.

2.1 DATA QUALITY OBJECTIVES

Data quality objectives (DQOs) for the data collection activity describe the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data. This uncertainty is used to specify the quality of the measurement data required, usually in terms of objectives for precision, bias, representativeness, comparability and completeness. The DQOs should be defined prior to the initiation of the field and laboratory work. The field and laboratory organizations performing the work should be aware of the DQOs so that their personnel may make informed decisions during the course of the project to attain those DQOs. More detailed information on DQOs is available from the U.S. EPA Quality Assurance Management Staff (QAMS) (see references 2 and 4).

2.2 PROJECT OBJECTIVES

A statement of the project objectives and how the objectives are to be attained should be concisely stated and sufficiently detailed to permit clear understanding by all parties involved in the data collection effort. This includes a statement of what problem is to be solved and the information required

in the process. It also includes appropriate statements of the DQOs (i.e., the acceptable level of uncertainty in the information).

2.3 SAMPLE COLLECTION

Sampling procedures, locations, equipment, and sample preservation and handling requirements should be specified in the QAPJP. Further details on quality assurance procedures for field operations are described in Section 3 of this chapter. The OSW is developing policies and procedures for sampling in a planned revision of Chapter Nine of this manual. Specific procedures for groundwater sampling are provided in Chapter Eleven of this manual.

2.4 ANALYSIS AND TESTING

Analytes and properties of concern, analytical and testing procedures to be employed, required detection limits, and requirements for precision and bias should be specified. All applicable regulatory requirements and the project DQOs should be considered when developing the specifications. Further details on the procedures for analytical operations are described in Section 4 of this chapter.

2.5 QUALITY CONTROL

The quality assurance program should address both field and laboratory activities. Quality control procedures should be specified for estimating the precision and bias of the data. Recommended minimum requirements for QC samples have been established by EPA and should be met in order to satisfy recommended minimum criteria for acceptable data quality. Further details on procedures for field and laboratory operations are described in Sections 3 and 4, respectively, of this chapter.

2.6 PROJECT DOCUMENTATION

Documents should be prepared and maintained in conjunction with the data collection effort. Project documentation should be sufficient to allow review of all aspects of the work being performed. The QAPJP discussed in Sections 3 and 4 is one important document that should be maintained.

The length of storage time for project records should comply with regulatory requirements, organizational policy, or project requirements, whichever is more stringent. It is recommended that documentation be stored for three years from submission of the project final report.

Documentation should be secured in a facility that adequately addresses/minimizes its deterioration for the length of time that it is to be retained. A system allowing for the expedient retrieval of information should exist.

Access to archived information should be controlled to maintain the integrity of the data. Procedures should be developed to identify those individuals with access to the data.

2.7 ORGANIZATION PERFORMING FIELD OR LABORATORY OPERATIONS

Proper design and structure of the organization facilitates effective and efficient transfer of information and helps to prevent important procedures from being overlooked.

The organizational structure, functional responsibilities, levels of authority, job descriptions, and lines of communication for all project activities should be established and documented. One person may cover more than one organizational function. Each project participant should have a clear understanding of his or her duties and responsibilities and the relationship of those responsibilities to the overall data collection effort.

The management of each organization participating in a project involving data collection activities should establish that organization's operational and QA policies. This information should be documented in the QAPjP. The management should ensure that (1) the appropriate methodologies are followed as documented in the QAPjPs; (2) personnel clearly understand their duties and responsibilities; (3) each staff member has access to appropriate project documents; (4) any deviations from the QAPjP are communicated to the project management and documented; and (5) communication occurs between the field, laboratory, and project management, as specified in the QAPjP. In addition, each organization should ensure that their activities do not increase the risk to humans or the environment at or about the project location. Certain projects may require specific policies or a Health and Safety Plan to provide this assurance.

The management of the participating field or laboratory organization should establish personnel qualifications and training requirements for the project. Each person participating in the project should have the education, training, technical knowledge, and experience, or a combination thereof, to enable that individual to perform assigned functions. Training should be provided for each staff member as necessary to perform their functions properly. Personnel qualifications should be documented in terms of education, experience, and training, and periodically reviewed to ensure adequacy to current responsibilities.

Each participating field organization or laboratory organization should have a designated QA function (i.e., a team or individual trained in QA) to monitor operations to ensure that the equipment, personnel, activities, procedures, and documentation conform with the QAPjP. To the extent possible, the QA monitoring function should be entirely separate from, and independent of, personnel engaged in the work being monitored. The QA function should be responsible for the QA review.

2.7.1 Performance Evaluation

Performance evaluation studies are used to measure the performance of the laboratory on unknown samples. Performance evaluation samples are typically submitted to the laboratory as blind samples by an independent outside source. The results are compared to predetermined acceptance limits. Performance evaluation samples can also be submitted to the laboratory as part of the QA function during internal assessment of laboratory performance. Records of all performance evaluation studies should be maintained by the laboratory. Problems identified through participation in performance evaluation studies should be immediately investigated and corrected.

2.7.2 Internal Assessment by QA Function

Personnel performing field and laboratory activities are responsible for continually monitoring individual compliance with the QAPJP. The QA function should review procedures, results and calculations to determine compliance with the QAPJP. The results of this internal assessment should be reported to management with requirements for a plan to correct observed deficiencies.

2.7.3 External Assessment

The field and laboratory activities may be reviewed by personnel external to the organization. Such an assessment is an extremely valuable method for identifying overlooked problems. The results of the external assessment should be submitted to management with requirements for a plan to correct observed deficiencies.

2.7.4 On-Site Evaluation

On-site evaluations may be conducted as part of both internal and external assessments. The focus of an on-site evaluation is to evaluate the degree of conformance of project activities with the applicable QAPJP. On-site evaluations may include, but are not limited to, a complete review of facilities, staff, training, instrumentation, procedures, methods, sample collection, analyses, QA policies and procedures related to the generation of environmental data. Records of each evaluation should include the date of the evaluation, location, the areas reviewed, the person performing the evaluation, findings and problems, and actions recommended and taken to resolve problems. Any problems identified that are likely to affect data integrity should be brought immediately to the attention of management.

2.7.4.1 Field Activities

The review of field activities should be conducted by one or more persons knowledgeable in the activities being reviewed and include evaluating, at a minimum, the following subjects:

Completeness of Field Reports -- This review determines whether all requirements for field activities in the QAPJP have been fulfilled, that complete records exist for each field activity, and that the procedures

specified in the QAPJP have been implemented. Emphasis on field documentation will help assure sample integrity and sufficient technical information to recreate each field event. The results of this completeness check should be documented, and environmental data affected by incomplete records should be identified.

Identification of Valid Samples -- This review involves interpretation and evaluation of the field records to detect problems affecting the representativeness of environmental samples. Examples of items that might indicate potentially invalid samples include improper well development, improperly screened wells, instability of pH or conductivity, and collection of volatiles near internal combustion engines. The field records should be evaluated against the QAPJP and SOPs. The reviewer should document the sample validity and identify the environmental data associated with any poor or incorrect field work.

Correlation of Field Test Data -- This review involves comparing any available results of field measurements obtained by more than one method. For example, surface geophysical methods should correlate with direct methods of site geologic characterization such as lithologic logs constructed during drilling operations.

Identification of Anomalous Field Test Data -- This review identifies any anomalous field test data. For example, a water temperature for one well that is 5 degrees higher than any other well temperature in the same aquifer should be noted. The reviewer should evaluate the impact of anomalous field measurement results on the associated environmental data.

Validation of Field Analyses -- This review validates and documents all data from field analysis that are generated in situ or from a mobile laboratory as specified in Section 2.7.4.2. The reviewer should document whether the QC checks meet the acceptance criteria, and whether corrective actions were taken for any analysis performed when acceptance criteria were exceeded.

2.7.4.2 Laboratory Activities

The review of laboratory data should be conducted by one or more persons knowledgeable in laboratory activities and include evaluating, at a minimum, the following subjects:

Completeness of Laboratory Records -- This review determines whether: (1) all samples and analyses required by the QAPJP have been processed, (2) complete records exist for each analysis and the associated QC samples, and that (3) the procedures specified in the QAPJP have been implemented. The results of the completeness check should be documented, and environmental data affected by incomplete records should be identified.

Evaluation of Data with Respect to Detection and Quantitation Limits -- This review compares analytical results to required quantitation limits. Reviewers should document instances where detection or quantitation limits

exceed regulatory limits, action levels, or target concentrations specified in the QAPjP.

Evaluation of Data with Respect to Control Limits -- This review compares the results of QC and calibration check samples to control criteria. Corrective action should be implemented for data not within control limits. The reviewer should check that corrective action reports, and the results of reanalysis, are available. The review should determine whether samples associated with out-of-control QC data are identified in a written record of the data review, and whether an assessment of the utility of such analytical results is recorded.

Review of Holding Time Data -- This review compares sample holding times to those required by the QAPjP, and notes all deviations.

Review of Performance Evaluation (PE) Results -- PE study results can be helpful in evaluating the impact of out-of-control conditions. This review documents any recurring trends or problems evident in PE studies and evaluates their effect on environmental data.

Correlation of Laboratory Data -- This review determines whether the results of data obtained from related laboratory tests, e.g., Purgeable Organic Halides (POX) and Volatile Organics, are documented, and whether the significance of any differences is discussed in the reports.

2.7.5 QA Reports

There should be periodic reporting of pertinent QA/QC information to the project management to allow assessment of the overall effectiveness of the QA program. There are three major types of QA reports to project management:

Periodic Report on Key QA Activities -- Provides summary of key QA activities during the period, stressing measures that are being taken to improve data quality; describes significant quality problems observed and corrective actions taken; reports information regarding any changes in certification/accreditation status; describes involvement in resolution of quality issues with clients or agencies; reports any QA organizational changes; and provides notice of the distribution of revised documents controlled by the QA organization (i.e., procedures).

Report on Measurement Quality Indicators -- Includes the assessment of QC data gathered over the period, the frequency of analyses repeated due to unacceptable QC performance, and, if possible, the reason for the unacceptable performance and corrective action taken.

Reports on QA Assessments -- Includes the results of the assessments and the plan for correcting identified deficiencies; submitted immediately following any internal or external on-site evaluation or upon receipt of the results of any performance evaluation studies.

3.0 FIELD OPERATIONS

The field operations should be conducted in such a way as to provide reliable information that meets the DQOs. To achieve this, certain minimal policies and procedures should be implemented. The OSW is considering revisions of Chapter Nine and Eleven of this manual. Supplemental information and guidance is available in the RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD) (Reference 3). The project documentation should contain the information specified below.

3.1 FIELD LOGISTICS

The QAPJP should describe the type(s) of field operations to be performed and the appropriate area(s) in which to perform the work. The QAPJP should address ventilation, protection from extreme weather and temperatures, access to stable power, and provision for water and gases of required purity.

Whenever practical, the sampling site facilities should be examined prior to the start of work to ensure that all required items are available. The actual area of sampling should be examined to ensure that trucks, drilling equipment, and personnel have adequate access to the site.

The determination as to whether sample shipping is necessary should be made during planning for the project. This need is established by evaluating the analyses to be performed, sample holding times, and location of the site and the laboratory. Shipping or transporting of samples to a laboratory should be done within a timeframe such that recommended holding times are met.

Samples should be packaged, labelled, preserved (e.g., preservative added, iced, etc.), and documented in an area which is free of contamination and provides for secure storage. The level of custody and whether sample storage is needed should be addressed in the QAPJP.

Storage areas for solvents, reagents, standards, and reference materials should be adequate to preserve their identity, concentration, purity, and stability prior to use.

Decontamination of sampling equipment may be performed at the location where sampling occurs, prior to going to the sampling site, or in designated areas near the sampling site. Project documentation should specify where and how this work is accomplished. If decontamination is to be done at the site, water and solvents of appropriate purity should be available. The method of accomplishing decontamination, including the required materials, solvents, and water purity should be specified.

During the sampling process and during on-site or in situ analyses, waste materials are sometimes generated. The method for storage and disposal of these waste materials that complies with applicable local, state and Federal regulations should be specified. Adequate facilities should be provided for the collection and storage of all wastes, and these facilities should be operated so

as to minimize environmental contamination. Waste storage and disposal facilities should comply with applicable federal, state, and local regulations.

The location of long-term and short-term storage for field records, and the measures to ensure the integrity of the data should be specified.

3.2 EQUIPMENT/INSTRUMENTATION

The equipment, instrumentation, and supplies at the sampling site should be specified and should be appropriate to accomplish the activities planned. The equipment and instrumentation should meet the requirements of specifications, methods, and procedures as specified in the QAPjP.

3.3 OPERATING PROCEDURES

The QAPjP should describe or make reference to all field activities that may affect data quality. For routinely performed activities, standard operating procedures (SOPs) are often prepared to ensure consistency and to save time and effort in preparing QAPjPs. Any deviation from an established procedure during a data collection activity should be documented. The procedures should be available for the indicated activities, and should include, at a minimum, the information described below.

3.3.1 Sample Management

The numbering and labeling system, chain-of-custody procedures, and how the samples are to be tracked from collection to shipment or receipt by the laboratory should be specified. Sample management procedures should also specify the holding times, volumes of sample required by the laboratory, required preservatives, and shipping requirements.

3.3.2 Reagent/Standard Preparation

The procedures describing how to prepare standards and reagents should be specified. Information concerning specific grades of materials used in reagent and standard preparation, appropriate glassware and containers for preparation and storage, and labeling and record keeping for stocks and dilutions should be included.

3.3.3 Decontamination

The procedures describing decontamination of field equipment before and during the sample collection process should be specified. These procedures should include cleaning materials used, the order of washing and rinsing with the cleaning materials, requirements for protecting or covering cleaned equipment, and procedures for disposing of cleaning materials.

3.3.4 Sample Collection

The procedures describing how the sampling operations are actually performed in the field should be specified. A simple reference to standard methods is not sufficient, unless a procedure is performed exactly as described in the published method. Methods from source documents published by the EPA, American Society for Testing and Materials, U.S. Department of the Interior, National Water Well Association, American Petroleum Institute, or other recognized organizations with appropriate expertise should be used, if possible. The procedures for sample collection should include at least the following:

- Applicability of the procedure,
- Equipment required,
- Detailed description of procedures to be followed in collecting the samples,
- Common problems encountered and corrective actions to be followed, and
- Precautions to be taken.

3.3.5 Field Measurements

The procedures describing all methods used in the field to determine a chemical or physical parameter should be described in detail. The procedures should address criteria from Section 4, as appropriate.

3.3.6 Equipment Calibration And Maintenance

The procedures describing how to ensure that field equipment and instrumentation are in working order should be specified. These describe calibration procedures and schedules, maintenance procedures and schedules, maintenance logs, and service arrangements for equipment. Calibration and maintenance of field equipment and instrumentation should be in accordance with manufacturers' specifications or applicable test specifications and should be documented.

3.3.7 Corrective Action

The procedures describing how to identify and correct deficiencies in the sample collection process should be specified. These should include specific steps to take in correcting deficiencies such as performing additional decontamination of equipment, resampling, or additional training of field personnel. The procedures should specify that each corrective action should be documented with a description of the deficiency and the corrective action taken, and should include the person(s) responsible for implementing the corrective action.

3.3.8 Data Reduction and Validation

The procedures describing how to compute results from field measurements and to review and validate these data should be specified. They should include all formulas used to calculate results and procedures used to independently verify that field measurement results are correct.

3.3.9 Reporting

The procedures describing the process for reporting the results of field activities should be specified.

3.3.10 Records Management

The procedures describing the means for generating, controlling, and archiving project-specific records and field operations records should be specified. These procedures should detail record generation and control and the requirements for record retention, including type, time, security, and retrieval and disposal authorities.

Project-specific records relate to field work performed for a project. These records may include correspondence, chain-of-custody records, field notes, all reports issued as a result of the work, and procedures used.

Field operations records document overall field operations and may include equipment performance and maintenance logs, personnel files, general field procedures, and corrective action reports.

3.3.11 Waste Disposal

The procedures describing the methods for disposal of waste materials resulting from field operations should be specified.

3.4 FIELD QA AND QC REQUIREMENTS

The QAPjP should describe how the following elements of the field QC program will be implemented.

3.4.1 Control Samples

Control samples are QC samples that are introduced into a process to monitor the performance of the system. Control samples, which may include blanks (e.g., trip, equipment, and laboratory), duplicates, spikes, analytical standards, and reference materials, can be used in different phases of the data collection process beginning with sampling and continuing through transportation, storage, and analysis.

Each day of sampling, at least one field duplicate and one equipment rinsate should be collected for each matrix sampled. If this frequency is not appropriate for the sampling equipment and method, then the appropriate changes

should be clearly identified in the QAPJP. When samples are collected for volatile organic analysis, a trip blank is also recommended for each day that samples are collected. In addition, for each sampling batch (20 samples of one matrix type), enough volume should be collected for at least one sample so as to allow the laboratory to prepare one matrix spike and either one matrix duplicate or one matrix spike duplicate for each analytical method employed. This means that the following control samples are recommended:

- Field duplicate (one per day per matrix type)
- Equipment rinsate (one per day per matrix type)
- Trip blank (one per day, volatile organics only)
- Matrix spike (one per batch [20 samples of each matrix type])
- Matrix duplicate or matrix spike duplicate (one per batch)

Additional control samples may be necessary in order to assure data quality to meet the project-specific DQOs.

3.4.2 Acceptance Criteria

Procedures should be in place for establishing acceptance criteria for field activities described in the QAPJP. Acceptance criteria may be qualitative or quantitative. Field events or data that fall outside of established acceptance criteria may indicate a problem with the sampling process that should be investigated.

3.4.3 Deviations

All deviations from plan should be documented as to the extent of, and reason for, the deviation. Any activity not performed in accordance with procedures or QAPJPs is considered a deviation from plan. Deviations from plan may or may not affect data quality.

3.4.4 Corrective Action

Errors, deficiencies, deviations, certain field events, or data that fall outside established acceptance criteria should be investigated. In some instances, corrective action may be needed to resolve the problem and restore proper functioning to the system. The investigation of the problem and any subsequent corrective action taken should be documented.

3.4.5 Data Handling

All field measurement data should be reduced according to protocols described or referenced in the QAPJP. Computer programs used for data reduction should be validated before use and verified on a regular basis. All information used in the calculations should be recorded to enable reconstruction of the final result at a later date.

Data should be reported in accordance with the requirements of the end-user as described in the QAPJP.

3.5 QUALITY ASSURANCE REVIEW

The QA Review consists of internal and external assessments to ensure that QA/QC procedures are in use and to ensure that field staff conform to these procedures. QA review should be conducted as deemed appropriate and necessary.

3.6 FIELD RECORDS

Records provide the direct evidence and support for the necessary technical interpretations, judgments, and discussions concerning project activities. These records, particularly those that are anticipated to be used as evidentiary data, should directly support current or ongoing technical studies and activities and should provide the historical evidence needed for later reviews and analyses. Records should be legible, identifiable, and retrievable and protected against damage, deterioration, or loss. The discussion in this section (3.6) outlines recommended procedures for record keeping. Organizations which conduct field sampling should develop appropriate record keeping procedures which satisfy relevant technical and legal requirements.

Field records generally consist of bound field notebooks with prenumbered pages, sample collection forms, personnel qualification and training forms, sample location maps, equipment maintenance and calibration forms, chain-of-custody forms, sample analysis request forms, and field change request forms. All records should be written in indelible ink.

Procedures for reviewing, approving, and revising field records should be clearly defined, with the lines of authority included. It is recommended that all documentation errors should be corrected by drawing a single line through the error so it remains legible and should be initialed by the responsible individual, along with the date of change. The correction should be written adjacent to the error.

Records should include (but are not limited to) the following:

Calibration Records & Traceability of Standards/Reagents -- Calibration is a reproducible reference point to which all sample measurements can be correlated. A sound calibration program should include provisions for documentation of frequency, conditions, standards, and records reflecting the calibration history of a measurement system. The accuracy of the calibration standards is important because all data will be in reference to the standards used. A program for verifying and documenting the accuracy of all working standards against primary grade standards should be routinely followed.

Sample Collection -- To ensure maximum utility of the sampling effort and resulting data, documentation of the sampling protocol, as performed in the field, is essential. It is recommended that sample collection records contain, at a minimum, the names of persons conducting the activity, sample number, sample location, equipment used, climatic conditions, documentation of adherence to protocol, and unusual observations. The

actual sample collection record is usually one of the following: a bound field notebook with prenumbered pages, a pre-printed form, or digitized information on a computer tape or disc.

Chain-of-Custody Records -- The chain-of-custody involving the possession of samples from the time they are obtained until they are disposed or shipped off-site should be documented as specified in the QAPJP and should include the following information: (1) the project name; (2) signatures of samplers; (3) the sample number, date and time of collection, and grab or composite sample designation; (4) signatures of individuals involved in sample transfer; and (5) if applicable, the air bill or other shipping number.

Maps and Drawings -- Project planning documents and reports often contain maps. The maps are used to document the location of sample collection points and monitoring wells and as a means of presenting environmental data. Information used to prepare maps and drawings is normally obtained through field surveys, property surveys, surveys of monitoring wells, aerial photography or photogrammetric mapping. The final, approved maps and/or drawings should have a revision number and date and should be subject to the same controls as other project records.

QC Samples -- Documentation for generation of QC samples, such as trip and equipment rinse blanks, duplicate samples, and any field spikes should be maintained.

Deviations -- All deviations from procedural documents and the QAPJP should be recorded in the site logbook.

Reports -- A copy of any report issued and any supporting documentation should be retained.

4.0 LABORATORY OPERATIONS

The laboratory should conduct its operations in such a way as to provide reliable information. To achieve this, certain minimal policies and procedures should be implemented.

4.1 FACILITIES

The QAPJP should address all facility-related issues that may impact project data quality. Each laboratory should be of suitable size and construction to facilitate the proper conduct of the analyses. Adequate bench space or working area per analyst should be provided. The space requirement per analyst depends on the equipment or apparatus that is being utilized, the number of samples that the analyst is expected to handle at any one time, and the number of operations that are to be performed concurrently by a single analyst. Other issues to be considered include, but are not limited to, ventilation, lighting,

control of dust and drafts, protection from extreme temperatures, and access to a source of stable power.

Laboratories should be designed so that there is adequate separation of functions to ensure that no laboratory activity has an adverse effect on the analyses. The laboratory may require specialized facilities such as a perchloric acid hood or glovebox.

Separate space for laboratory operations and appropriate ancillary support should be provided, as needed, for the performance of routine and specialized procedures.

As necessary to ensure secure storage and prevent contamination or misidentification, there should be adequate facilities for receipt and storage of samples. The level of custody required and any special requirements for storage such as refrigeration should be described in planning documents.

Storage areas for reagents, solvents, standards, and reference materials should be adequate to preserve their identity, concentration, purity, and stability.

Adequate facilities should be provided for the collection and storage of all wastes, and these facilities should be operated so as to minimize environmental contamination. Waste storage and disposal facilities should comply with applicable federal, state, and local regulations.

The location of long-term and short-term storage of laboratory records and the measures to ensure the integrity of the data should be specified.

4.2 EQUIPMENT/INSTRUMENTATION

Equipment and instrumentation should meet the requirements and specifications of the specific test methods and other procedures as specified in the QAPJP. The laboratory should maintain an equipment/instrument description list that includes the manufacturer, model number, year of purchase, accessories, and any modifications, updates, or upgrades that have been made.

4.3 OPERATING PROCEDURES

The QAPJP should describe or make reference to all laboratory activities that may affect data quality. For routinely performed activities, SOPs are often prepared to ensure consistency and to save time and effort in preparing QAPJPs. Any deviation from an established procedure during a data collection activity should be documented. It is recommended that procedures be available for the indicated activities, and include, at a minimum, the information described below.

4.3.1 Sample Management

The procedures describing the receipt, handling, scheduling, and storage of samples should be specified.

Sample Receipt and Handling -- These procedures describe the precautions to be used in opening sample shipment containers and how to verify that chain-of-custody has been maintained, examine samples for damage, check for proper preservatives and temperature, and log samples into the laboratory sample streams.

Sample Scheduling -- These procedures describe the sample scheduling in the laboratory and includes procedures used to ensure that holding time requirements are met.

Sample Storage -- These procedures describe the storage conditions for all samples, verification and documentation of daily storage temperature, and how to ensure that custody of the samples is maintained while in the laboratory.

4.3.2 Reagent/Standard Preparation

The procedures describing how to prepare standards and reagents should be specified. Information concerning specific grades of materials used in reagent and standard preparation, appropriate glassware and containers for preparation and storage, and labeling and recordkeeping for stocks and dilutions should be included.

4.3.3 General Laboratory Techniques

The procedures describing all essentials of laboratory operations that are not addressed elsewhere should be specified. These techniques should include, but are not limited to, glassware cleaning procedures, operation of analytical balances, pipetting techniques, and use of volumetric glassware.

4.3.4 Test Methods

Procedures for test methods describing how the analyses are actually performed in the laboratory should be specified. A simple reference to standard methods is not sufficient, unless the analysis is performed exactly as described in the published method. Whenever methods from SW-846 are not appropriate, recognized methods from source documents published by the EPA, American Public Health Association (APHA), American Society for Testing and Materials (ASTM), the National Institute for Occupational Safety and Health (NIOSH), or other recognized organizations with appropriate expertise should be used, if possible. The documentation of the actual laboratory procedures for analytical methods should include the following:

Sample Preparation and Analysis Procedures -- These include applicable holding time, extraction, digestion, or preparation steps as appropriate to the method; procedures for determining the appropriate dilution to

analyze; and any other information required to perform the analysis accurately and consistently.

Instrument Standardization -- This includes concentration(s) and frequency of analysis of calibration standards, linear range of the method, and calibration acceptance criteria.

Sample Data -- This includes recording requirements and documentation including sample identification number, analyst, data verification, date of analysis and verification, and computational method(s).

Precision and Bias -- This includes all analytes for which the method is applicable and the conditions for use of this information.

Detection and Reporting Limits -- This includes all analytes in the method.

Test-Specific QC -- This describes QC activities applicable to the specific test and references any applicable QC procedures.

4.3.5 Equipment Calibration and Maintenance

The procedures describing how to ensure that laboratory equipment and instrumentation are in working order should be specified. These procedures include calibration procedures and schedules, maintenance procedures and schedules, maintenance logs, service arrangements for all equipment, and spare parts available in-house. Calibration and maintenance of laboratory equipment and instrumentation should be in accordance with manufacturers' specifications or applicable test specifications and should be documented.

4.3.6 QC

The type, purpose, and frequency of QC samples to be analyzed in the laboratory and the acceptance criteria should be specified. Information should include the applicability of the QC sample to the analytical process, the statistical treatment of the data, and the responsibility of laboratory staff and management in generating and using the data. Further details on development of project-specific QC protocols are described in Section 4.4.

4.3.7 Corrective Action

The procedures describing how to identify and correct deficiencies in the analytical process should be specified. These should include specific steps to take in correcting the deficiencies such as preparation of new standards and reagents, recalibration and restandardization of equipment, reanalysis of samples, or additional training of laboratory personnel in methods and procedures. The procedures should specify that each corrective action should be documented with a description of the deficiency and the corrective action taken, and should include the person(s) responsible for implementing the corrective action.

4.3.8 Data Reduction and Validation

The procedures describing how to review and validate the data should be specified. They should include procedures for computing and interpreting the results from QC samples, and independent procedures to verify that the analytical results are reported correctly. In addition, routine procedures used to monitor precision and bias, including evaluations of reagent, equipment rinsate, and trip blanks, calibration standards, control samples, duplicate and matrix spike samples, and surrogate recovery, should be detailed in the procedures. More detailed validation procedures should be performed when required in the contract or QAPJP.

4.3.9 Reporting

The procedures describing the process for reporting the analytical results should be specified.

4.3.10 Records Management

The procedures describing the means for generating, controlling, and archiving laboratory records should be specified. The procedures should detail record generation and control, and the requirements for record retention, including type, time, security, and retrieval and disposal authorities.

Project-specific records may include correspondence, chain-of-custody records, request for analysis, calibration data records, raw and finished analytical and QC data, data reports, and procedures used.

Laboratory operations records may include laboratory notebooks, instrument performance logs and maintenance logs in bound notebooks with prenumbered pages; laboratory benchsheets; software documentation; control charts; reference material certification; personnel files; laboratory procedures; and corrective action reports.

4.3.11 Waste Disposal

The procedures describing the methods for disposal of chemicals including standard and reagent solutions, process waste, and samples should be specified.

4.4 LABORATORY QA AND QC PROCEDURES

The QAPJP should describe how the following required elements of the laboratory QC program are to be implemented.

4.4.1 Method Proficiency

Procedures should be in place for demonstrating proficiency with each analytical method routinely used in the laboratory. These should include procedures for demonstrating the precision and bias of the method as performed by the laboratory and procedures for determining the method detection limit

(MDL). All terminology, procedures and frequency of determinations associated with the laboratory's establishment of the MDL and the reporting limit should be well-defined and well-documented. Documented precision, bias, and MDL information should be maintained for all methods performed in the laboratory.

4.4.2 Control Limits

Procedures should be in place for establishing and updating control limits for analysis. Control limits should be established to evaluate laboratory precision and bias based on the analysis of control samples. Typically, control limits for bias are based on the historical mean recovery plus or minus three standard deviation units, and control limits for precision range from zero (no difference between duplicate control samples) to the historical mean relative percent difference plus three standard deviation units. Procedures should be in place for monitoring historical performance and should include graphical (control charts) and/or tabular presentations of the data.

4.4.3 Laboratory Control Procedures

Procedures should be in place for demonstrating that the laboratory is in control during each data collection activity. Analytical data generated with laboratory control samples that fall within prescribed limits are judged to be generated while the laboratory was in control. Data generated with laboratory control samples that fall outside the established control limits are judged to be generated during an "out-of-control" situation. These data are considered suspect and should be repeated or reported with qualifiers.

Laboratory Control Samples -- Laboratory control samples should be analyzed for each analytical method when appropriate for the method. A laboratory control sample consists of either a control matrix spiked with analytes representative of the target analytes or a certified reference material.

Laboratory control sample(s) should be analyzed with each batch of samples processed to verify that the precision and bias of the analytical process are within control limits. The results of the laboratory control sample(s) are compared to control limits established for both precision and bias to determine usability of the data.

Method Blank -- When appropriate for the method, a method blank should be analyzed with each batch of samples processed to assess contamination levels in the laboratory. Guidelines should be in place for accepting or rejecting data based on the level of contamination in the blank.

Procedures should be in place for documenting the effect of the matrix on method performance. When appropriate for the method, there should be at least one matrix spike and either one matrix duplicate or one matrix spike duplicate per analytical batch. Additional control samples may be necessary to assure data quality to meet the project-specific DQOs.

Matrix-Specific Bias -- Procedures should be in place for determining the bias of the method due to the matrix. These procedures should include preparation and analysis of matrix spikes, selection and use of surrogates for organic methods, and the method of standard additions for metal and inorganic methods. When the concentration of the analyte in the sample is greater than 0.1%, no spike is necessary.

Matrix-Specific Precision -- Procedures should be in place for determining the precision of the method for a specific matrix. These procedures should include analysis of matrix duplicates and/or matrix spike duplicates. The frequency of use of these techniques should be based on the DQO for the data collection activity.

Matrix-Specific Detection Limit -- Procedures should be in place for determining the MDL for a specific matrix type (e.g., wastewater treatment sludge, contaminated soil, etc).

4.4.4 Deviations

Any activity not performed in accordance with laboratory procedures or QAPjPs is considered a deviation from plan. All deviations from plan should be documented as to the extent of, and reason for, the deviation.

4.4.5 Corrective Action

Errors, deficiencies, deviations, or laboratory events or data that fall outside of established acceptance criteria should be investigated. In some instances, corrective action may be needed to resolve the problem and restore proper functioning to the analytical system. The investigation of the problem and any subsequent corrective action taken should be documented.

4.4.6 Data Handling

Data resulting from the analyses of samples should be reduced according to protocols described in the laboratory procedures. Computer programs used for data reduction should be validated before use and verified on a regular basis. All information used in the calculations (e.g., raw data, calibration files, tuning records, results of standard additions, interference check results, and blank- or background-correction protocols) should be recorded in order to enable reconstruction of the final result at a later date. Information on the preparation of the sample (e.g., weight or volume of sample used, percent dry weight for solids, extract volume, dilution factor used) should also be maintained in order to enable reconstruction of the final result at a later date.

All data should be reviewed by a second analyst or supervisor according to laboratory procedures to ensure that calculations are correct and to detect transcription errors. Spot checks should be performed on computer calculations to verify program validity. Errors detected in the review process should be referred to the analyst(s) for corrective action. Data should be reported in accordance with the requirements of the end-user. It is recommended that the supporting documentation include at a minimum:

- Laboratory name and address.
- Sample information (including unique sample identification, sample collection date and time, date of sample receipt, and date(s) of sample preparation and analysis).
- Analytical results reported with an appropriate number of significant figures.
- Detection limits that reflect dilutions, interferences, or correction for equivalent dry weight.
- Method reference.
- Appropriate QC results (correlation with sample batch should be traceable and documented).
- Data qualifiers with appropriate references and narrative on the quality of the results.

4.5 QUALITY ASSURANCE REVIEW

The QA review consists of internal and external assessments to ensure that QA/QC procedures are in use and to ensure that laboratory staff conform to these procedures. QA review should be conducted as deemed appropriate and necessary.

4.6 LABORATORY RECORDS

Records provide the direct evidence and support for the necessary technical interpretations, judgements, and discussions concerning project activities. These records, particularly those that are anticipated to be used as evidentiary data, should directly support technical studies and activities, and provide the historical evidence needed for later reviews and analyses. Records should be legible, identifiable, and retrievable, and protected against damage, deterioration, or loss. The discussion in this section (4.6) outlines recommended procedures for record keeping. Organizations which conduct field sampling should develop appropriate record keeping procedures which satisfy relevant technical and legal requirements.

Laboratory records generally consist of bound notebooks with prenumbered pages, personnel qualification and training forms, equipment maintenance and calibration forms, chain-of-custody forms, sample analysis request forms, and analytical change request forms. All records should be written in indelible ink.

Procedures for reviewing, approving, and revising laboratory records should be clearly defined, with the lines of authority included. Any documentation errors should be corrected by drawing a single line through the error so that it remains legible and should be initialed by the responsible individual, along with the date of change. The correction is written adjacent to the error.

Strip-chart recorder printouts should be signed by the person who performed the instrumental analysis. If corrections need to be made in computerized data, a system parallel to the corrections for handwritten data should be in place.

Records of sample management should be available to permit the re-creation of an analytical event for review in the case of an audit or investigation of a dubious result.

Laboratory records should include, at least, the following:

Operating Procedures -- Procedures should be available to those performing the task outlined. Any revisions to laboratory procedures should be written, dated, and distributed to all affected individuals to ensure implementation of changes. Areas covered by operating procedures are given in Sections 3.3 and 4.3.

Quality Assurance Plans -- The QAPjP should be on file.

Equipment Maintenance Documentation -- A history of the maintenance record of each system serves as an indication of the adequacy of maintenance schedules and parts inventory. As appropriate, the maintenance guidelines of the equipment manufacturer should be followed. When maintenance is necessary, it should be documented in either standard forms or in logbooks. Maintenance procedures should be clearly defined and written for each measurement system and required support equipment.

Proficiency -- Proficiency information on all compounds reported should be maintained and should include (1) precision; (2) bias; (3) method detection limits; (4) spike recovery, where applicable; (5) surrogate recovery, where applicable; (6) checks on reagent purity, where applicable; and (7) checks on glassware cleanliness, where applicable.

Calibration Records & Traceability of Standards/Reagents -- Calibration is a reproducible reference point to which all sample measurements can be correlated. A sound calibration program should include provisions for documenting frequency, conditions, standards, and records reflecting the calibration history of a measurement system. The accuracy of the calibration standards is important because all data will be in reference to the standards used. A program for verifying and documenting the accuracy and traceability of all working standards against appropriate primary grade standards or the highest quality standards available should be routinely followed.

Sample Management -- All required records pertaining to sample management should be maintained and updated regularly. These include chain-of-custody forms, sample receipt forms, and sample disposition records.

Original Data -- The raw data and calculated results for all samples should be maintained in laboratory notebooks, logs, benchsheets, files or other sample tracking or data entry forms. Instrumental output should be stored in a computer file or a hardcopy report.

QC Data -- The raw data and calculated results for all QC and field samples and standards should be maintained in the manner described in the preceding paragraph. Documentation should allow correlation of sample results with associated QC data. Documentation should also include the source and lot numbers of standards for traceability. QC samples include, but are not limited to, control samples, method blanks, matrix spikes, and matrix spike duplicates.

Correspondence -- Project correspondence can provide evidence supporting technical interpretations. Correspondence pertinent to the project should be kept and placed in the project files.

Deviations -- All deviations from procedural and planning documents should be recorded in laboratory notebooks. Deviations from QAPjPs should be reviewed and approved by the authorized personnel who performed the original technical review or by their designees.

Final Report -- A copy of any report issued and any supporting documentation should be retained.

5.0 DEFINITIONS

The following terms are defined for use in this document:

- ACCURACY** The closeness of agreement between an observed value and an accepted reference value. When applied to a set of observed values, accuracy will be a combination of a random component and of a common systematic error (or bias) component.
- BATCH:** A group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit (see Section 3.4.1 for field samples and Section 4.4.3 for laboratory samples). For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.
- BIAS:** The deviation due to matrix effects of the measured value ($x_s - x_u$) from a known spiked amount. Bias can be assessed by comparing a measured value to an accepted reference value in a sample of known concentration or by determining the recovery of a known amount of contaminant spiked into a sample (matrix spike). Thus, the bias (B) due to matrix effects based on a matrix spike is calculated as:

$$B = (x_s - x_u) - K$$

where:

x_s = measured value for spiked sample,
 x_u = measured value for unspiked sample, and
 K = known value of the spike in the sample.

Using the following equation yields the percent recovery (%R).

$$\%R = 100 (x_s - x_u) / K$$

- BLANK:** see Equipment Rinsate, Method Blank, Trip Blank.
- CONTROL SAMPLE:** A QC sample introduced into a process to monitor the performance of the system.
- DATA QUALITY OBJECTIVES (DQOs):** A statement of the overall level of uncertainty that a decision-maker is willing to accept in results derived from environmental data (see reference 2, EPA/QAMS, July 16, 1986). This is qualitatively distinct from quality measurements such as precision, bias, and detection limit.
- DATA VALIDATION:** The process of evaluating the available data against the project DQOs to make sure that the objectives are met. Data validation may be very rigorous, or cursory, depending on project DQOs. The available data reviewed will include analytical results, field QC data and lab QC data, and may also include field records.
- DUPLICATE:** see Matrix Duplicate, Field Duplicate, Matrix Spike Duplicate.
- EQUIPMENT BLANK:** see Equipment Rinsate.
- EQUIPMENT RINSATE:** A sample of analyte-free media which has been used to rinse the sampling equipment. It is collected after completion of decontamination and prior to sampling. This blank is useful in documenting adequate decontamination of sampling equipment.
- ESTIMATED QUANTITATION LIMIT (EQL):** The lowest concentration that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions. The EQL is generally 5 to 10 times the MDL. However, it may be nominally chosen within these guidelines to simplify data reporting. For many analytes the EQL analyte concentration is selected as the lowest non-zero standard in the calibration curve. Sample EQLs are highly matrix-dependent. The EQLs in SW-846 are provided for guidance and may not always be achievable.

FIELD DUPLICATES: Independent samples which are collected as close as possible to the same point in space and time. They are two separate samples taken from the same source, stored in separate containers, and analyzed independently. These duplicates are useful in documenting the precision of the sampling process.

LABORATORY CONTROL SAMPLE: A known matrix spiked with compound(s) representative of the target analytes. This is used to document laboratory performance.

MATRIX: The component or substrate (e.g., surface water, drinking water) which contains the analyte of interest.

MATRIX DUPLICATE: An intralaboratory split sample which is used to document the precision of a method in a given sample matrix.

MATRIX SPIKE: An aliquot of sample spiked with a known concentration of target analyte(s). The spiking occurs prior to sample preparation and analysis. A matrix spike is used to document the bias of a method in a given sample matrix.

MATRIX SPIKE DUPLICATES: Intralaboratory split samples spiked with identical concentrations of target analyte(s). The spiking occurs prior to sample preparation and analysis. They are used to document the precision and bias of a method in a given sample matrix.

METHOD BLANK: An analyte-free matrix to which all reagents are added in the same volumes or proportions as used in sample processing. The method blank should be carried through the complete sample preparation and analytical procedure. The method blank is used to document contamination resulting from the analytical process.

For a method blank to be acceptable for use with the accompanying samples, the concentration in the blank of any analyte of concern should not be higher than the highest of either:

(1) The method detection limit, or

(2) Five percent of the regulatory limit for that analyte, or

(3) Five percent of the measured concentration in the sample.

METHOD DETECTION LIMIT (MDL): 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.

For operational purposes, when it is necessary to determine the MDL in the matrix, the MDL should be determined by multiplying the appropriate one-sided 99% t-statistic by the standard deviation obtained from a minimum of three analyses of a matrix spike containing the analyte of interest at a concentration three to five times the estimated MDL, where the t-statistic is obtained from standard references or the table below.

<u>No. of samples:</u>	<u>t-statistic</u>
3	6.96
4	4.54
5	3.75
6	3.36
7	3.14
8	3.00
9	2.90
10	2.82

Estimate the MDL as follows:

Obtain the concentration value that corresponds to:

a) an instrument signal/noise ratio within the range of 2.5 to 5.0, or

b) the region of the standard curve where there is a significant change in sensitivity (i.e., a break in the slope of the standard curve).

Determine the variance (S^2) for each analyte as follows:

$$S^2 = \frac{1}{n-1} \left[\sum_{i=1}^n (x_i - \bar{x})^2 \right]$$

where x_i = the i th measurement of the variable x
and \bar{x} = the average value of x ;

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Determine the standard deviation (s) for each analyte as follows:

$$s = (S^2)^{1/2}$$

Determine the MDL for each analyte as follows:

$$MDL = t_{(n-1), \alpha = .99}(s)$$

where $t_{(n-1), \alpha = .99}$ is the one-sided t-statistic appropriate for the number of samples used to determine (s), at the 99 percent level.

**ORGANIC-FREE
REAGENT WATER:**

For volatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water. Organic-free reagent water may also be prepared by boiling water for 15 minutes and, subsequently, while maintaining the temperature at 90°C, bubbling a contaminant-free inert gas through the water for 1 hour.

For semivolatiles and nonvolatiles, all references to water in the methods refer to water in which an interferant is not observed at the method detection limit of the compounds of interest. Organic-free reagent water can be generated by passing tap water through a carbon filter bed containing about 1 pound of activated carbon. A water purification system may be used to generate organic-free deionized water.

PRECISION:

The agreement among a set of replicate measurements without assumption of knowledge of the true value. Precision is estimated by means of duplicate/replicate analyses. These samples should contain concentrations of analyte above the MDL, and may involve the use of matrix spikes. The most commonly used estimates of precision are the relative standard deviation (RSD) or the coefficient of variation (CV),

$$RSD = CV = 100 S/\bar{x}$$

where:

\bar{x} = the arithmetic mean of the x_i measurements, and S = variance; and the relative percent difference (RPD) when only two samples are available.

$$RPD = 100 [(x_1 - x_2) / ((x_1 + x_2) / 2)].$$

- PROJECT:** Single or multiple data collection activities that are related through the same planning sequence.
- QUALITY ASSURANCE PROJECT PLAN (QAPJP):** An orderly assemblage of detailed procedures designed to produce data of sufficient quality to meet the data quality objectives for a specific data collection activity.
- RCRA:** The Resource Conservation and Recovery Act.
- REAGENT BLANK:** See Method Blank.
- REAGENT GRADE:** Analytical reagent (AR) grade, ACS reagent grade, and reagent grade are synonymous terms for reagents which conform to the current specifications of the Committee on Analytical Reagents of the American Chemical Society.
- REAGENT WATER:** Water that has been generated by any method which would achieve the performance specifications for ASTM Type II water. For organic analyses, see the definition of organic-free reagent water.
- REFERENCE MATERIAL:** A material containing known quantities of target analytes in solution or in a homogeneous matrix. It is used to document the bias of the analytical process.
- SPLIT SAMPLES:** Aliquots of sample taken from the same container and analyzed independently. In cases where aliquots of samples are impossible to obtain, field duplicate samples should be taken for the matrix duplicate analysis. These are usually taken after mixing or compositing and are used to document intra- or interlaboratory precision.
- STANDARD ADDITION:** The practice of adding a known amount of an analyte to a sample immediately prior to analysis. It is typically used to evaluate interferences.
- STANDARD CURVE:** A plot of concentrations of known analyte standards versus the instrument response to the analyte. Calibration standards are prepared by successively diluting a standard solution to produce working standards which cover the working range of the instrument. Standards should be prepared at the frequency specified in the appropriate

section. The calibration standards should be prepared using the same type of acid or solvent and at the same concentration as will result in the samples following sample preparation. This is applicable to organic and inorganic chemical analyses.

SURROGATE: An organic compound which is similar to the target analyte(s) in chemical composition and behavior in the analytical process, but which is not normally found in environmental samples.

TRIP BLANK: A sample of analyte-free media taken from the laboratory to the sampling site and returned to the laboratory unopened. A trip blank is used to document contamination attributable to shipping and field handling procedures. This type of blank is useful in documenting contamination of volatile organics samples.

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Control Sample 11, 12, 18, 19, 23, 24
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Surrogate 18, 20, 22, 29
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* Definition of term.

Appendix C

Definitions

DEFINITIONS

Alternate Concentration Limits: A concentration limit--in lieu of an MCL--established by the implementing agency for a hazardous constituent based on a finding that the constituent does not pose a substantial present or potential hazard to human health or the environment as long as the alternate concentration limit is not exceeded.

Corrective Action Management Unit (CAMU): An area within a facility that is designated by the Regional Administrator under part 264 subpart S, for the purpose of implementing corrective action requirements under §264.101 and RCRA section 3008(h). A CAMU shall only be used for management of remediation wastes pursuant to implementing such corrective action requirements at the facility.

Facility: (1) All contiguous land, and structures, other appurtenances, and improvements on the land, used for treating, storing, or disposing of hazardous waste. A facility may consist of several treatment, storage, or disposal operational units (e.g., one or more landfills, surface impoundments, or combinations of them). (2) For the purpose of implementing corrective action under §264.101, all contiguous property under the control of the owner or operator seeking a permit under RCRA subtitle C. This definition also applies to facilities implementing corrective action under RCRA § 3008(h).

Innovative Treatment Technologies: Those technologies for treatment of soil, sediment, sludge and debris other than incineration or solidification/stabilization and those technologies for treatment of groundwater contamination that are alternatives to pump and treat. Pump and treat in this instance refers to pumping with conventional treatments like air stripping, UV oxidation.

Maximum Contaminant Level (MCL): Under Section 141 of the Safe Drinking Water Act, as amended, the maximum permissible level of a contaminant in water delivered to any user of a public water system. MCLs reflect health factors and the technical and economic feasibility of recovering contaminants from the water supply.

Permittee/Respondent: Any person owning or operating a facility or conducting activity subject to regulation under RCRA and subject to a permit or order requiring corrective action.

Solid Waste Management Unit (SWMU): Any discernible unit at which solid wastes have been placed at any time, irrespective of whether the unit was intended for the management of solid or hazardous waste. Such units include any area at a facility at which solid wastes have been routinely and systematically released.

Stabilization: The goal or philosophy of controlling or abating threats to human health and/or the environment from releases and/or preventing or minimizing the further spread of contaminants while long-term remedies are pursued.

Temporary Unit (TU): A unit used for the storage or treatment of hazardous wastes that originate during corrective action activities at a facility.

[NOTE: For additional guidance on technical terms used in the corrective action program, see the "Corrective Action Glossary" (OSWER Directive Number 9902.3-1a, July, 1992)]

Appendix D

Corrective Action Stabilization Questionnaire

INTRODUCTION TO THE CORRECTIVE ACTION STABILIZATION QUESTIONNAIRE

Decision Strategy

The question of whether to implement stabilization measures at a RCRA facility undergoing some phase of corrective action should be answered based upon a series of policy and technical judgments. Many of these individual judgments are difficult to quantify and, therefore, must be based upon the professional judgment of Federal and State environmental regulators responsible for implementing the RCRA corrective action program. These judgments, as a group, should form a basis upon which the relative benefits to be gained through stabilization at a particular facility are weighed. The types of benefits envisioned through facility stabilization include limited contaminant migration, reduced volume of contaminated media, and lowered risk to human health and the environment.

The attached questionnaire attempts to prompt the decision making process by asking both policy and technical questions regarding stabilization of a facility. For each question, a short discussion of the importance and relevance of the answer is provided below. It may be useful to refer to these short discussions as the questionnaire is completed.

Background Facility Information

Question 1 Is this checklist being completed for one solid waste management unit (SWMU), several SWMUs, or the entire facility? Explain.

A strategy for stabilization may be considered or implemented for either an entire facility, a specific SWMU, or a group of SWMUs. Stabilization activities, while addressing releases from one or more SWMUs, are likely to concentrate on a specific environmental medium, such as ground water, surface water, air, or soil. The SWMU(s) and media being considered for stabilization should be recorded in the spaces provided.

Status of Corrective Action Activities at the Facility

Question 2 What is the current status of HSWA corrective action activities at the facility?

The current status of HSWA corrective action activities is a major factor for consideration when deciding whether and when to implement a stabilization strategy at a particular facility. Stabilization should be considered an option at a facility up until the point where it becomes more expedient and cost-effective to implement the final corrective measures. Generally, the immediate implementation of final corrective measures, rather than stabilization measures, becomes more efficient after the Corrective Measures Study (CMS) is completed, because the effort and resources that might be used to plan, design, and construct stabilization structures may be more effectively spent on Corrective Measures Implementation (CMI).

Interim measures may be implemented at any point in the corrective action process, and if they have been implemented, they should be noted on the questionnaire in addition to the other activities listed.

Question 3 If corrective action activities have been initiated, are they being carried out under a permit or an enforcement order?

Corrective action activities are usually carried out under the authority of either a RCRA operating or post-closure permit, or under a RCRA §3008(h) administrative order. The authority used for an ongoing corrective action project at a particular facility will affect the ease with which a stabilization strategy can be incorporated into an existing compliance schedule. The extra time needed for public comment, State concurrence, and other administrative requirements associated with modifying or revising either a permit or an order (to incorporate stabilization) should be taken into account when considering whether stabilization is appropriate for a given facility because as the time required to address procedural requirements increases, the benefits potentially derived from stabilization decrease.

Question 4 Have interim measures, if required or completed [See Question 2], been successful in preventing the further spread of contamination at the facility?

If interim measures have been implemented at a facility and they have been successful in preventing the further spread of contamination from all significant releases, stabilization has, in effect, been accomplished. In this case, additional stabilization measures should not be required. Conversely, if interim measures have not been carried out, or if they have not been successful in limiting the spread of contamination, stabilization measures should eventually be considered for this facility.

EPA is currently evaluating facilities for stabilization based upon the priority ranking a facility receives under the RCRA National Corrective Action Prioritization System. At this time, the Agency is only evaluating those facilities that have been ranked as "high" priorities. Therefore, the attached questionnaire need only be completed when evaluating those facilities ranked as high priorities and where interim actions are not yet under way or have been unsuccessful in preventing the further spread of contamination at the facility.

Facility Releases and Exposure Concerns

Question 5 To what media have contaminant releases from the facility occurred or been suspected of occurring?

Releases of hazardous materials to any environmental media are a serious concern. Stabilization measures are generally technically feasible for any of the four environmental media (ground water, surface water, air, or soils), and stabilization should be considered wherever this type of action could limit the further spread of contaminant migration.

Question 6 Are contaminant releases migrating off-site?

Off-site migration of contaminants generally indicates the need for some stabilization measure to limit contaminant movement until final corrective measures can be implemented.

Questions 7a and 7b

Are humans currently being exposed to contaminants released from the facility?

Is there a potential for human exposure to the contaminants released from the facility over the next five to 10 years?

The actual occurrence, or the near- to mid-term (i.e., within five to 10 years) potential, of human exposure to released contaminants is a factor supporting the implementation of stabilization measures. The type of exposure that has occurred is an important consideration in determining the type of stabilization measure employed for a facility or SWMU. The stabilization measure considered should eliminate or significantly reduce the human exposure levels at and near the facility.

The make-up of the exposed population (e.g., facility employees, nearby home owners, school children, nursing home residents) and the duration of exposure are factors that should be considered when determining the type of stabilization or corrective measure to be implemented. Exposure of high-risk populations, such as children, may require the implementation of "real-time" stabilization measures, perhaps even emergency measures, to immediately reduce the contaminant levels near that population sooner than may be possible with final corrective measures.

The potential short-term and long-term effects of human exposure to released contaminants should be considered when determining the need for stabilization measures. Any significant exposure concern is a factor in favor of implementing stabilization measures.

Questions 8a and 8b

Are environmental receptors currently being exposed to contaminants released from the facility?

Is there a potential that environmental receptors could be exposed to the contaminants released from the facility over the next five to 10 years?

The existence of potential threats to the environment from the release of hazardous constituents is to be considered a factor in favor of implementing stabilization measures. Environmental receptors include terrestrial and aquatic organisms, food chain plants and animals, vital ecology or potential natural resources, and Class I or other aquifers. The time frame over which these threats may materialize (i.e., will the threat materialize before final corrective measures can be implemented) should be used to determine the immediacy of the need for stabilization measures.

Anticipated Final Corrective Measures

Question 9

If already identified or planned, would final corrective measures be able to be implemented in time to adequately address any existing or short-term threat to human health and the environment?

Final corrective measures, which sometimes can be identified early in the RFI, should always be designed to reduce or eliminate, to the degree practicable, both short-term and long-term risks posed by the release of hazardous constituents. If final corrective measures are currently being planned or constructed, it is unlikely that any relatively new stabilization measures could be implemented fast enough to be more effective in reducing short-term threats to human health and the environment. Therefore, if final corrective measures have reached the planning stages, it should be considered a factor against the implementation of stabilization measures.

Questions 10 and 11 Could a stabilization initiative at this facility reduce the present or near-term (e.g., less than two years) risks to human health and the environment?

If a stabilization activity were not begun, would the threat to human health and the environment significantly increase before final corrective measures could be implemented?

If it can be determined that a "fast-track," or quickly implementable, stabilization measure could significantly reduce the present or near-future risks to human health and the environment, stabilization measures should be favorably considered. Similarly, if it can be determined that the absence of stabilization measures would result in a significantly greater risk to human health and the environment, stabilization measures should be favorably considered.

Technical Ability to Implement Stabilization Activities

Question 12 In what phase does the contaminant exist under ambient site conditions?

The physical phase of a contaminant will affect the technical practicability of stabilization. See Attachment A for a preliminary analysis of types of waste constituents that may be stabilized by various remediation technologies.

Question 13 Are one or more of the following major chemical groupings of concern at the facility?

Some contaminants are more amenable to stabilization techniques than others. See Attachment A for a preliminary analysis of types of waste constituents that may be stabilized by various remediation technologies.

Question 14 Are appropriate stabilization technologies available to prevent the further spread of contamination, based on contaminant characteristics and the facility's environmental setting? [See Attachment A for a listing of potential stabilization technologies.]

The implementation of stabilization measures is, of course, dependent upon the availability of appropriate technologies and techniques. Attachment A lists a series of hazardous waste site remediation technologies and techniques that have potential applicability for stabilization of certain wastes under certain conditions. If there are no identified technologies appropriate for stabilizing contamination at this facility, this evaluation is complete and the rest of this questionnaire need not be completed.

Question 15 Has the RFI, or another environmental investigation, provided the site characterization and waste release data needed to design and implement a stabilization activity? If No, can these data be obtained faster than the data needed to implement the final corrective measures?

Stabilization measures should not be considered for implementation until adequate site characterization and waste release data are available. Gathering data specifically for stabilization is not a worthwhile endeavor if the data for a final corrective measure are more readily available or quicker to obtain.

Timing and Other Procedural Issues Associated with Stabilization

Question 16 Can stabilization activities be implemented more quickly than the final corrective measures?

Generally, stabilization measures should not be implemented unless they can be put in place more quickly and/or more efficiently, or will be effective significantly sooner than final corrective measures.

Question 17 Can stabilization activities be incorporated into the final corrective measures at some point in the future?

Stabilization measures should generally be amenable to incorporation into the final corrective action project. Measures that cannot be successfully integrated into the overall site remediation should be able to significantly and predictably reduce threats to human health or the environment, or produce some other beneficial effects deemed important by the Administrator.

Conclusion

Question 18 Is this facility an appropriate candidate for stabilization activities?

The decision of whether or not to implement stabilization measures at a facility is a professional judgment that should be based upon a careful weighing of factors such as those described above. There may also be other site-specific factors that enter into the decision, and these factors and their consequences should be documented in an appropriate manner.

In most cases, stabilization should only be implemented if it offers some clear advantages (in terms of protecting human health and the environment) over waiting for the implementation of final corrective measures. The stabilization measure used at a facility should be at least a part of the final corrective measure, with changes in timing and short-term goals (limiting contaminant movement versus contaminant cleanup) being the major points setting it apart from the final measures.

CORRECTIVE ACTION STABILIZATION QUESTIONNAIRE

Completed by: _____
Date: _____

Background Facility Information

Facility Name _____
EPA Identification No. _____
Location (City, State) _____
Facility Priority Rank: _____

1. Is this checklist being completed for one solid waste management unit (SWMU), several SWMUs, or the entire facility? Explain.

Status of Corrective Action Activities at the Facility

2. What is the current status of HSWA corrective action activities at the facility?

() No corrective action activities initiated

() RCRA Facility Assessment (RFA) or equivalent completed

() RCRA Facility Investigation (RFI) completed

() Corrective Measures Study (CMS) completed

() Corrective Measures Implementation (CMI) begun or completed

() Interim Measures begun or completed

3. If corrective action activities have been initiated, are they being carried out under a permit or an enforcement order?

() Operating permit

() Post-closure permit

() Enforcement order

4. Have interim measures, if required or completed [see Question 2], been successful in preventing the further spread of contamination at the facility?

() Yes

() No

() Uncertain; still underway

CONTINUE TO QUESTION 5 ONLY IF THE FOLLOWING CONDITIONS ARE MET:

- The facility ranks "High" on the National Corrective Action Prioritization System. AND
- Interim Measures have not been initiated or if initiated, have not been successful in preventing the further spread of contamination at the facility.

Facility Releases and Exposure Concerns

5. To what media have contaminant releases from the facility occurred or been suspected of occurring?

() Ground water

() Surface water

() Air

() Soils

6 Are contaminant releases migrating off-site?

Yes, indicate media, concentrations, and level of certainty

- No
 Uncertain

7a Are humans currently being exposed to contaminants released from the facility?

- Yes
 No
 Uncertain

7b Is there a potential for human exposure to the contaminants released from the facility over the next five to 10 years?

- Yes
 No
 Uncertain

8a Are environmental receptors currently being exposed to contaminants released from the facility?

- Yes
 No
 Uncertain

8b Is there a potential that environmental receptors could be exposed to the contaminants released from the facility over the next five to 10 years?

- Yes
 No
 Uncertain

Anticipated Final Corrective Measures

9 If already identified or planned, would final corrective measures be able to be implemented in time to adequately address any existing or short-term threat to human health and the environment?

- Yes
 No
 Uncertain

Additional explanatory notes:

10 Could a stabilization initiative at this facility reduce the present or near-term (e.g., less than two years) risks to human health and the environment?

- Yes
 No
 Uncertain

Additional explanatory notes:

11 If a stabilization activity were not begun, would the threat to human health and the environment significantly increase before final corrective measures could be implemented?

- Yes
 No
 Uncertain

Additional explanatory notes:

Technical Ability to Implement Stabilization Activities

12. In what phase does the contaminant exist under ambient site conditions?

- Solid
- Light non-aqueous phase liquids (LNAPLs)
- Dense non-aqueous phase liquids (DNAPLs)
- Dissolved in ground water or surface water
- Gaseous
- Other _____

13. Are one or more of the following major chemical groupings of concern at the facility?

- Volatile organic compounds (VOCs) and/or semi-volatiles
- Polynuclear aromatics (PAHs)
- Pesticides
- Polychlorinated biphenyls (PCBs) and/or dioxins
- Other organics
- Inorganics and metals
- Explosives
- Other _____

14. Are appropriate stabilization technologies available to prevent the further spread of contamination, based on contaminant characteristics and the facility's environmental setting? [See Attachment A for a listing of potential stabilization technologies.]

- Yes; Indicate possible course of action.

- No; Indicate why stabilization technologies are not appropriate; then go to Question 19.

15. Has the RF, or another environmental investigation, provided the site characterization and waste release data needed to design and implement a stabilization activity?

- Yes
- No

If No, can these data be obtained faster than the data needed to implement the final corrective measures?

- Yes
- No

Timing and Other Procedural Issues Associated with Stabilization

16. Can stabilization activities be implemented more quickly than the final corrective measures?

- Yes
- No
- Uncertain

Additional explanatory notes:

17. Can stabilization activities be incorporated into the final corrective measures at some point in the future?

- Yes
- No
- Uncertain

Additional explanatory notes:

Appendix E

Example Scope of Work for Interim/Stabilization Measures

EXAMPLE
SCOPE OF WORK FOR INTERIM MEASURES IMPLEMENTATION

PURPOSE

Interim measures are actions to control and/or eliminate releases of hazardous waste and/or hazardous constituents from a facility prior to the implementation of a final corrective measure. Interim measures must be used whenever possible to achieve the goal of stabilization which is to control or abate threats to human health and/or the environment, and to prevent or minimize the spread of contaminants while long-term corrective action alternatives are being evaluated.

SCOPE

The documents required for Interim Measures (IM) are, unless the Implementing Agency specifies otherwise, an IM Workplan, an Operation and Maintenance Plan and IM Plans and Specifications. The scope of work (SOW) for each document is specified below. The SOW's are intended to be flexible documents capable of addressing both simple and complex site situations. If the Permittee/Respondent can justify, to the satisfaction of the Implementing Agency, that a plan or portions thereof are not needed in the given site specific situation, then the Implementing Agency may waive that requirement.

The scope and substance of interim measures should be focused to fit the site specific situation and be balanced against the need to take quick action.

The Implementing Agency may require the Permittee/Respondent to conduct additional studies beyond what is discussed in the SOW's in order to support the IM program. The Permittee/Respondent will furnish all personnel, materials and services necessary to conduct the additional tasks.

A. Interim Measures Workplan

The Permittee/Respondent shall prepare an IM Workplan that evaluates interim measure options and clearly describes the proposed interim measure, the key components or elements that are needed, describes the designers vision of the interim measure in the form of conceptual drawings and schematics, and includes procedures and schedules for implementing the interim measure(s). The IM Workplan must be approved by the Implementing Agency prior to implemen-

tation. The IM Workplan must, at a minimum, include the following elements:

1. Introduction/Purpose

Describe the purpose of the document and provide a summary of the project.

2. Conceptual Model of Contaminant Migration

It is important to know where the contaminants are and to understand how they are moving before an adequate interim measure can be developed. To address this critical question, the Permittee/Respondent must present a conceptual model of the site and contaminant migration. The conceptual model consists of a working hypothesis of how the contaminants may move from the release source to the receptor population. The conceptual model is developed by looking at the applicable physical parameters (e.g., water solubility, density, Henry's Law Constant, etc.) for each contaminant and assessing how the contaminant may migrate given the existing site conditions (geologic features, depth to groundwater, etc.). Describe the phase (water, soil, gas, non-aqueous) and location where contaminants are likely to be found. This analysis may have already been done as part of earlier work (e.g., Current Conditions Report). If this is the case, then provide a summary of the conceptual model with a reference to the earlier document.

3. Evaluation of Interim Measure Alternatives

List, describe and evaluate interim measure alternatives that have the potential to stabilize the facility. Propose interim measures for implementation and provide rationale for the selection. Document the reasons for excluding any interim measure alternatives.

4. Description of Interim Measures

Qualitatively describe what the proposed interim measure is supposed to do and how it will function at the facility.

5. Data Sufficiency

Review existing data needed to support the design effort and establish whether or not there is sufficient accurate data available for this purpose. The Permittee/Respondent must summarize the assessment

findings and specify any additional data needed to complete the interim measure design. The Implementing Agency may require or the Permittee/Respondent may propose that sampling and analysis plans and/or treatability study workplans be developed to obtain the additional data. Submittal times for any new sampling and analysis plans and/or treatability study workplans must be included in the project schedule.

6. Project Management

Describe the levels of authority and responsibility (include organization chart), lines of communication and a description of the qualifications of key personnel who will direct the interim measure design and implementation effort (including contractor personnel).

7. Project Schedule

The project schedule must specify all significant steps in the process, when any key documents (e.g., plans and specifications, operation and maintenance plan) are to be submitted to the Implementing Agency and when the interim measure is to be implemented.

8. Design Basis

Discuss the process and methods used to design all major components of the interim measure. Discuss the significant assumptions made and possible sources of error. Provide justification for the assumptions.

9. Conceptual Process/Schematic Diagrams.

10. Site plan showing preliminary plant layout and/or treatment area.

11. Tables listing number and type of major components with approximate dimensions.

12. Tables giving preliminary mass balances.

13. Site safety and security provisions (e.g., fences, fire control, etc.).

14. Waste Management Practices

Describe the wastes generated by the construction of the interim measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will

be managed.

15. Required Permits

List and describe the permits needed to construct the interim measure. Indicate on the project schedule when the permit applications will be submitted to the applicable agencies and an estimate of the permit issuance date.

16. Sampling and monitoring activities may be needed for design and during construction of the interim measure. If sampling activities are necessary, the IM Workplan must include a complete sampling and analysis section which specifies the following information:

- a. Description and purpose of monitoring tasks;
- b. Data quality objectives;
- c. Analytical test methods and detection limits;
- d. Name of analytical laboratory;
- e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
- f. Sample collection procedures and equipment;
- g. Field quality control procedures:
 - * duplicates (10% of all field samples)
 - * blanks (field, equipment, etc.)
 - * equipment calibration and maintenance
 - * equipment decontamination
 - * sample containers
 - * sample preservation
 - * sample holding times (must be specified)
 - * sample packaging and shipment
 - * sample documentation (field notebooks, sample labeling, etc);
- h. Criteria for data acceptance and rejection; and
- i. Schedule of monitoring frequency.

The Permittee/Respondent shall follow all EPA guidance for sampling and analysis. The Implementing Agency may request that the sampling and analysis section be a separate document.

17. Appendices including:

Design Data - Tabulations of significant data used in the design effort;

Equations - List and describe the source of major equations used in the design process;

Sample Calculations - Present and explain one example

calculation for significant calculations; and
Laboratory or Field Test Results.

B. Interim Measures Operation and Maintenance Plan

The Permittee/Respondent shall prepare an Interim Measures Operation and Maintenance (O&M) Plan that includes a strategy and procedures for performing operations, maintenance, and monitoring of the interim measure(s). An Interim Measures Operation and Maintenance Plan shall be submitted to the Implementing Agency simultaneously with the Plans and Specifications. The O&M plan shall, at a minimum, include the following elements:

1. Purpose/Approach

Describe the purpose of the document and provide a summary of the project.

2. Project Management

Describe the levels of authority and responsibility (include organization chart), lines of communication and a description of the qualifications of key personnel who will operate and maintain the interim measure(s) (including contractor personnel).

3. System Description

Describe the interim measure and identify significant equipment.

4. Personnel Training

Describe the training process for O&M personnel. The Permittee/Respondent shall prepare, and include in the technical specifications governing treatment systems, contractor requirements for providing: appropriate service visits by experienced personnel to supervise the installation, adjustment, start up and operation of the treatment systems, and training covering appropriate operational procedures once the start-up has been successfully accomplished.

5. Start-Up Procedures

Describe system start-up procedures including any operational testing.

6. Operation and Maintenance Procedures

Describe normal operation and maintenance procedures including:

- a. Description of tasks for operation;
 - b. Description of tasks for maintenance;
 - c. Description of prescribed treatment or operation conditions; and
 - d. Schedule showing frequency of each O&M task.
7. Replacement schedule for equipment and installed components.

8. Waste Management Practices

Describe the wastes generated by operation of the interim measure and how they will be managed. Also discuss drainage and indicate how rainwater runoff will be managed.

9. Sampling and monitoring activities may be needed for effective operation and maintenance of the interim measure. If sampling activities are necessary, the O&M plan must include a complete sampling and analysis section which specifies the following information:

- a. Description and purpose of monitoring tasks;
- b. Data quality objectives;
- c. Analytical test methods and detection limits;
- d. Name of analytical laboratory;
- e. Laboratory quality control (include laboratory QA/QC procedures in appendices)
- f. Sample collection procedures and equipment;
- g. Field quality control procedures:
 - * duplicates (10% of all field samples)
 - * blanks (field, equipment, etc.)
 - * equipment calibration and maintenance
 - * equipment decontamination
 - * sample containers
 - * sample preservation
 - * sample holding times (must be specified)
 - * sample packaging and shipment
 - * sample documentation (field notebooks, sample labeling, etc);
- h. Criteria for data acceptance and rejection; and
- i. Schedule of monitoring frequency.

The Permittee/Respondent shall follow all EPA guidance for sampling and analysis. The Implementing Agency may request that the sampling and analysis section be a separate document.

10. O&M Contingency Procedures:

- a. Procedures to address system breakdowns and operational problems including a list of redundant and emergency back-up equipment and procedures;
- b. Should the interim measure suffer complete failure, specify alternate procedures to prevent release or threatened releases of hazardous substances, pollutants or contaminants which may endanger public health and/or the environment or exceed cleanup standards; and
- c. The O&M Plan must specify that, in the event of a major breakdown and/or complete failure of the interim measure (includes emergency situations), the Permittee/Respondent will orally notify the Implementing Agency within 24 hours of the event and will notify the Implementing Agency in writing within 72 hours of the event. The written notification must, at a minimum, specify what happened, what response action is being taken and/or is planned, and any potential impacts on human health and the environment.

11. Data Management and Documentation Requirements

Describe how analytical data and results will be evaluated, documented and managed, including development of an analytical database. State the criteria that will be used by the project team to review and determine the quality of data.

The O&M Plan shall specify that the Permittee/Respondent collect and maintain the following information:

a. Progress Report Information

- * Work Accomplishments (e.g., performance levels achieved, hours of treatment operation, treated and/or excavated volumes, concentration of contaminants in treated and/or excavated volumes, nature and volume of wastes generated, etc.).
- * Record of significant activities (e.g., sampling events, inspections, problems encountered, action taken to rectify problems, etc.).

- b. Monitoring and laboratory data;
- c. Records of operating costs; and
- d. Personnel, maintenance and inspection records.

The Implementing Agency may require that the Permittee, Respondent submit additional reports that evaluate the effectiveness of the interim measure in meeting the stabilization goal.

C. IM Plans and Specifications

[Note - The decision to require the submittal of plans and specifications should be based on the site specific situation. The requirement for plans and specifications should be balanced against the need to quickly implement interim measures at a facility.]

The Permittee/Respondent shall prepare Plans and Specifications for the interim measure that are based on the conceptual design but include additional detail. The Plans and Specifications shall be submitted to the Implementing Agency simultaneously with the Operation and Maintenance Plan. The design package must include drawings and specifications needed to construct the interim measure. Depending on the nature of the interim measure, many different types of drawings and specifications may be needed. Some of the elements that may be required are:

- General Site Plans
- Process Flow Diagrams
- Mechanical Drawings
- Electrical Drawings
- Structural Drawings
- Piping and Instrumentation Diagrams
- Excavation and Earthwork Drawings
- Equipment Lists
- Site Preparation and Field Work Standards
- Preliminary Specifications for Equipment and Material

General correlation between drawings and technical specifications is a basic requirement of any set of working construction plans and specifications. Before submitting the project specifications to the Implementing Agency, the Permittee/Respondent shall:

- a. Proofread the specifications for accuracy and consistency with the conceptual design; and
- b. Coordinate and cross-check the specifications and drawings.

Appendix F

Summary of Important Geologic Information

Summary of Important Geologic Information
Appropriate Collection Methods

Information Needed	Purpose or Rationale	Primary	Secondary
Structural Features			
• Folds, faults	Determine natural flow barriers or controls	Existing geologic maps, field surveys	Remote sensing, aerial photography, geophysical techniques
• Joints, fractures, interconnected voids	Predict major boundaries, avenues of groundwater flow	Existing geologic profiles, pump tests	Borehole logging and mapping, geophysical techniques (limited)
Stratigraphic Characteristics			
• Thickness, areal extent, correlation of units; extent (horizontal and vertical) of aquifers and confining units	Determine geometry of aquifers and confining layers, aquifer recharge and discharge	Existing geologic maps, observation wells	Borehole logging and mapping, geophysical techniques (limited)
• Mineral composition, permeability and porosity, grain-size, distribution, in situ density, moisture content	Determine groundwater quality, movement, occurrences, productivity	Laboratory analyses, existing geologic literature	
Groundwater Occurrence			
• Aquifer boundaries and locations	Define flow limits and degree of aquifer confinement	Existing literature, water resource	Existing literature
• Aquifer ability to transmit water	Determine potential quantities and rates for treatment options	Pumping and injection tests of monitor wells	Borehole logging, regional water level measurements
Groundwater Movement			
• Direction of flow	Identify most likely pathways of contaminant migration	Existing hydrologic literature	Water level measurements in monitor wells
• Rate of flow	Determine maximum potential migration rate and dispersion of contaminants	Existing hydrologic literature	Hydraulic gradient permeability, and effective porosity from water level contours, pump test results, and laboratory analyses
Groundwater Recharge/Discharge			
• Location of recharge/discharge areas	Determine interception points for withdrawal options, areas or capping	Existing site data, hydrologic literature site inspection	Comparison of water levels in observation wells, piezometers, lakes, and streams
• Rate			
Groundwater Quality			
• pH, total dissolved solids, salinity, specific contaminant concentrations	Determine variability of loading to treatment options	Existing literature	Water balance calculations added by geology and soil data
	Determine exposure via groundwater, define contaminant plume for evaluation of interception methods	Existing site data	Analysis of groundwater samples from observation wells, geophysics

Appendix G

Sources of Information on Human Health and Ecological Risk Assessments

SOURCES OF INFORMATION ON HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENTS

HUMAN HEALTH

- Integrated Risk Information System (IRIS)
- Resource, Conservation and Recovery Act (RCRA) - Statute - Amended by Hazardous and Solid Waste Amendments (HSWA) of 1984
- Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities (Subpart S) [NOTE: Proposed Regulation - 55 FR S0798, July 24, 1990]
- RCRA Facility Investigation Guidance [Interim Final], (OSWER Directive 9502.00-6D (4 vols.))
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part A) [Interim Final] (EPA/540/1-89/002, OSWER Publication 9285.7-01A)
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part B) [Interim Final] (OSWER Publication 9285.7-01B)
- Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation Manual (Part C) [Interim Final] (OSWER Publication 9285.7-01C)
- Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors [Interim Final] (OSWER Publication 9285.6-03)
- Superfund Exposure Assessment Manual (EPA/540/1-88/001)
- Exposure Factors Handbook (EPA/600/8-89/043)
- Health Effects Assessment Summary Tables Annual FY 1992 (HEAST) (OSWER Publication 9200.6-303)

ECOLOGICAL

- Resource, Conservation and Recovery Act (RCRA) - Statute - Amended by Hazardous and Solid Waste Amendments (HSWA) of 1984
- Corrective Action for Solid Waste Management Units at Hazardous Waste Management Facilities (Subpart S) [NOTE: Proposed Regulation -55 FR 30798, July 23, 1990]
- RCRA Facility Investigation Guidance [Interim Final], (OSWER Directive 9502.00-6D (4 vols.))

- Risk Assessment Guidance for Superfund, Volume 2, Environmental Evaluation Manual [Interim Final] (EPA/540/1-89/001)
- Role of Acute Toxicity Bioassays Report in the Remedial Action Process at Hazardous Waste Sites - Report
- Summary of Ecological Risks, Assessment Methods, and Risk Management Decisions in Superfund and RCRA - Report
- Quantifying Effect in Ecological Site Assessments: Biological and Statistical Considerations (EPA/600/D-90/152)
- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference - Guidance - (EPA/600/3-89/013)
- Summary Report on Issues in Ecological Risk Assessments - Report - (EPA/625/3-91/018)
- ECO Update: Ecological Assessment of Superfund Sites: An Overview, Volume 1, Number 2 (OSWER Publication 9345.0-05I)
- ECO Update: The Role of BTAGS in Ecological Assessment, Volume 1, Number 1 (OSWER Publication 9345.0-05I)

ATTACHMENT 6 - GROUNDWATER MONITORING PLAN

JN/jms

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OHIO EPA DHWM

MAR 23 2005

**GROUNDWATER MONITORING PROGRAM
AND WORK PLAN FOR THE WTI FACILITY**

SUBMITTED BY

WASTE TECHNOLOGIES INDUSTRIES
East Liverpool, Ohio

PREPARED BY

ENGINEERING-SCIENCE

Atlanta, Georgia

MARCH 1992

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WASTE MGT.

OHIO EPA-DHWM

MAR 23 2005

ENGINEERING-SCIENCE

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**GROUNDWATER MONITORING PROGRAM
AND WORK PLAN FOR THE WTI FACILITY**

SUBMITTED BY

WASTE TECHNOLOGIES INDUSTRIES
East Liverpool, Ohio

PREPARED BY

ENGINEERING-SCIENCE, INC.
57 Executive Park South, N.E.
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RECEIVED
MAR 12 1992
OHIO EPA-N.E.D.O.

March 1992

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SECTION 1 INTRODUCTION

Waste Technologies Industries (WTI) is constructing and will operate a hazardous waste incinerator in East Liverpool, Ohio (Figure 1.1). A RCRA Part B and an Ohio Environmental Protection Agency (OEPA) hazardous waste treatment permits were issued to WTI in 1983. These permits require a groundwater monitoring program be implemented. The groundwater monitoring program that WTI is implementing is in accordance with the OEPA hazardous waste treatment permit and will also be implemented in general accordance with RCRA requirements (40 CFR 264 and OAC).

The groundwater monitoring plan for the WTI Facility will be strongly influenced by the groundwater corrective measures (pump-and-treat system) taken by the Port Authority for Columbiana County (Port Authority) in response to previous site activities. Previous site background and current activities are discussed in Section 1.2.3. This work plan will have been prepared by Engineering-Science, Inc. (ES) under authorization from WTI.

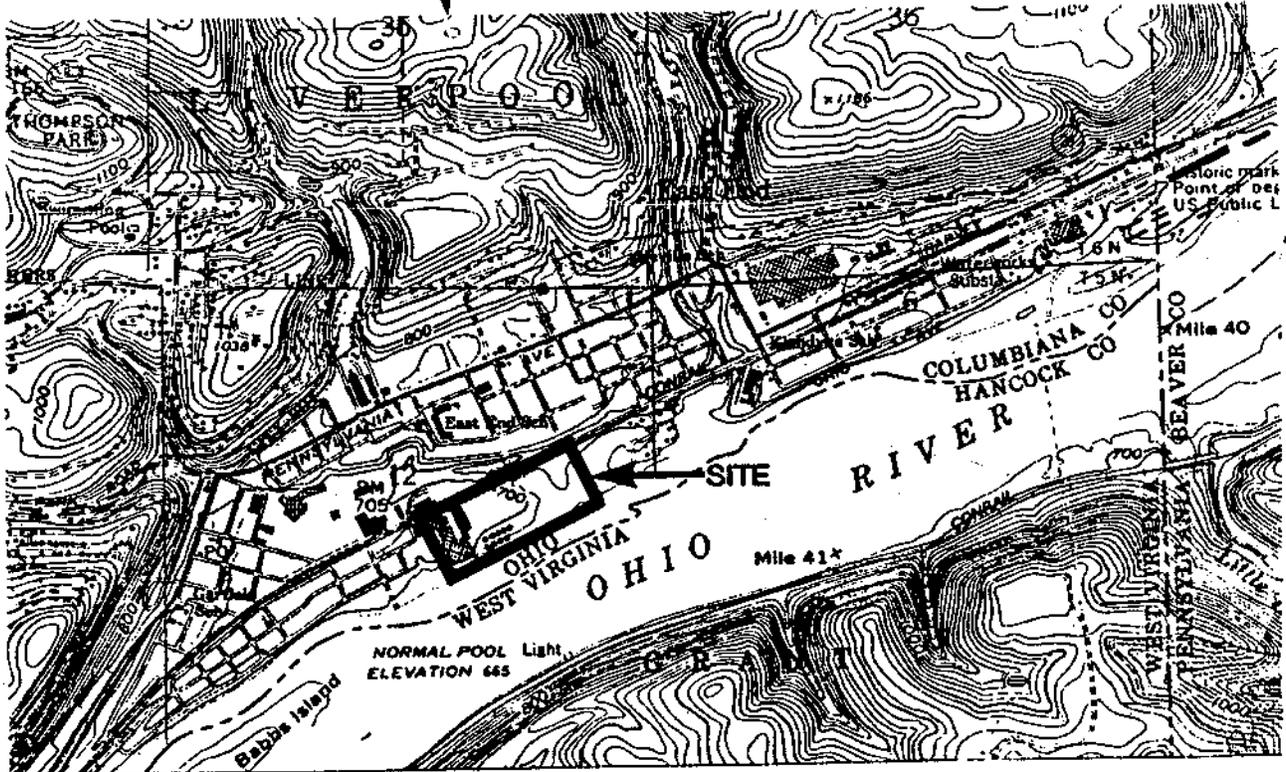
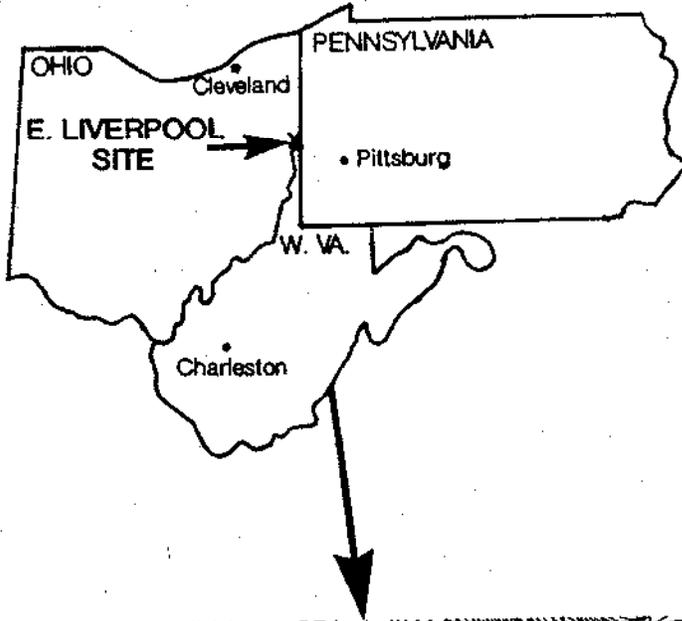
1.1 PURPOSE

The purpose of this document is to present a groundwater monitoring plan for the WTI hazardous waste incinerator site (herein referred to as the site) that generally complies with conditions stated in federal regulation 40 CFR 264, Subpart F, and the EPA RCRA Groundwater Monitoring Technical Enforcement Guidance Document. The plan is based on the hydrogeologic understanding of the site and the location of facility waste units. The hydrogeologic site model is based on data collected in previous subsurface investigations. The summary of conclusions from these reports and associated references are summarized in the hydrogeologic section of this report (Section 1.2.5).

This plan presents the following:

- a brief description of the site, site background and history, previous subsurface studies, and facility operations;
- a description of site hydrogeology;
- a description of the proposed groundwater monitoring program;
- location and procedures for installing monitoring wells;
- analytical and groundwater sampling procedures;
- data management procedures including laboratory Quality Assurance/Quality Control (QA/QC);

LOCATION MAP EAST LIVERPOOL SITE



- description of data evaluation including statistical procedures used in sample analysis; and
- health and safety plan.

1.2 SITE DESCRIPTION

This section is a brief summary of the site history including site location, background, previous investigation activities, nature of identified contamination, nature of proposed facility wastes, and site hydrogeology.

1.2.1 Site Location

The WTI facility is located along the Ohio River in East Liverpool, Columbiana County, Ohio (Figure 1.1). The site covers an area of 17 acres with a surface area of approximately 900 feet \times 1,200 feet.

The layout of the site is shown on Figure 1.2. Current waste processing buildings consist of a hazardous waste rotary kiln incinerator, an organic waste tank farm, a drum processing area, an wastewater treatment and tank farm building and a truck wash area.

1.2.2 Site Background

The WTI plant site has been used in the past for a variety of activities. In a period from the early 1920s to late 1930s, the site was used for foundry operations. The site was relatively inactive to 1955, although illegal dumping of construction debris and rubble fill was reported during this period. From 1955 to 1984, the site was used by Charter Oil Company as a bulk storage terminal for distributing a wide range of petroleum products. The bulk storage terminal consisted of 10 large capacity, above-ground storage tanks and a metal transfer pipeline 10 inches in diameter. The transfer pipeline connected the storage tanks to a barge terminal in the Ohio River and also a truck load-out terminal north of the tank area (Figure 1.3).

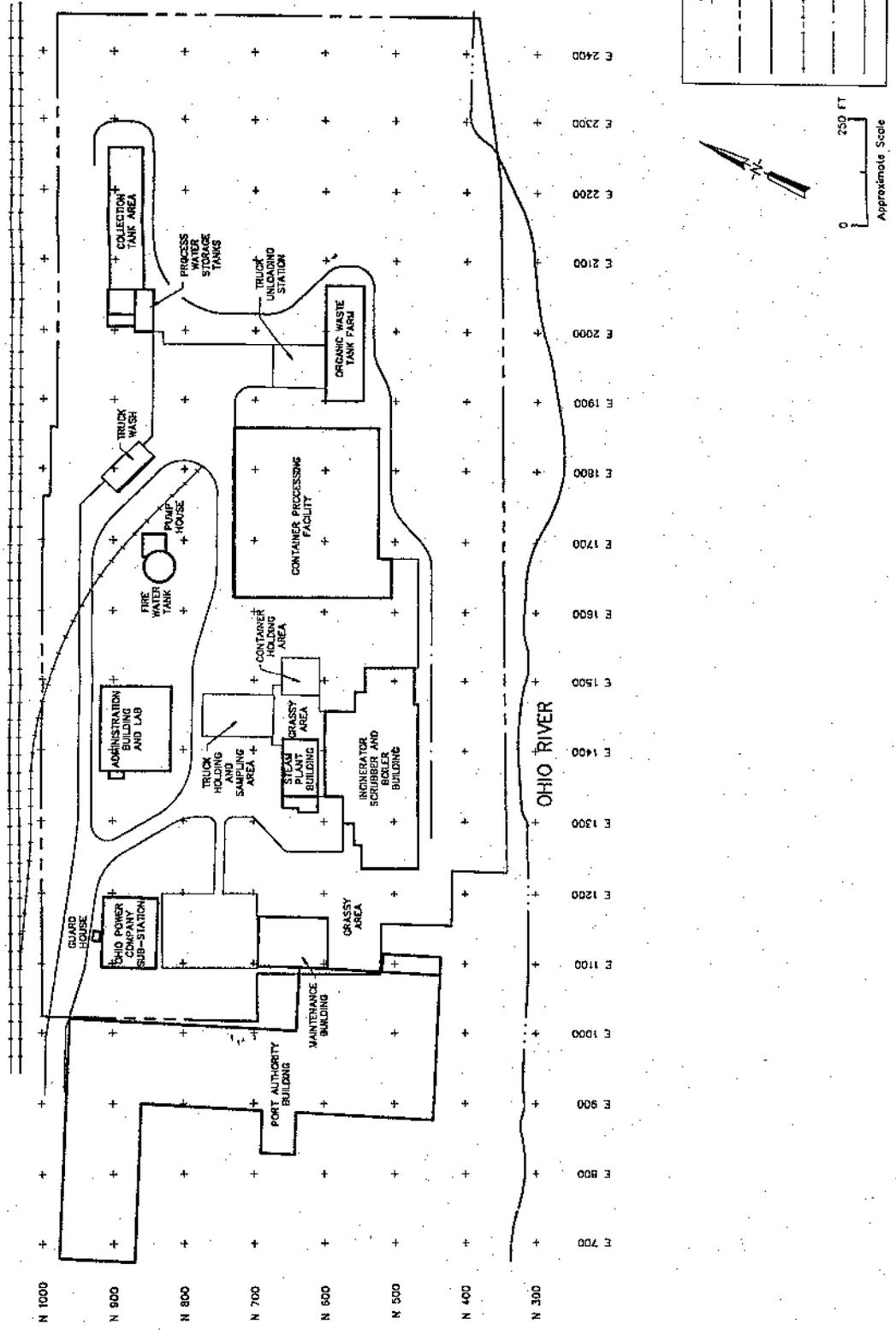
In 1983, 19,000 gallons of xylene were reportedly spilled at the site. The spill is thought to have originated from a xylene storage tank. In 1984, the FBI investigated a 200,000 gallon chemical loss at the site, which had been reported by the Charter Oil Company, the tenant, as a theft. During the investigation, pipelines leading from the storage tanks to the truck load-out area were found to be badly corroded. During an interview, a Charter Oil employee indicated an additional spill may have occurred in 1984. The alleged spill was believed to have consisted of 30,000 gallons of acetone.

Subsequent site investigations have identified an area of soil and groundwater contamination that roughly corresponds to the immediate area formerly occupied by the storage tanks and transfer pipelines.

1.2.3 Previous and Current Activities

Numerous investigations have been conducted as a result of the alleged spills at the Charter Oil Facility. These investigations are presented and summarized in the Description of Current Conditions Report (ES, 1991). In November 1991 a consent order

WTI SITE PLAN EAST LIVERPOOL, OHIO



OHIO EPA D/H/W/M
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LEGEND	
---	WTI Lease
---	Building Outlines
---	Railroad
---	Barrm
---	Paved Areas

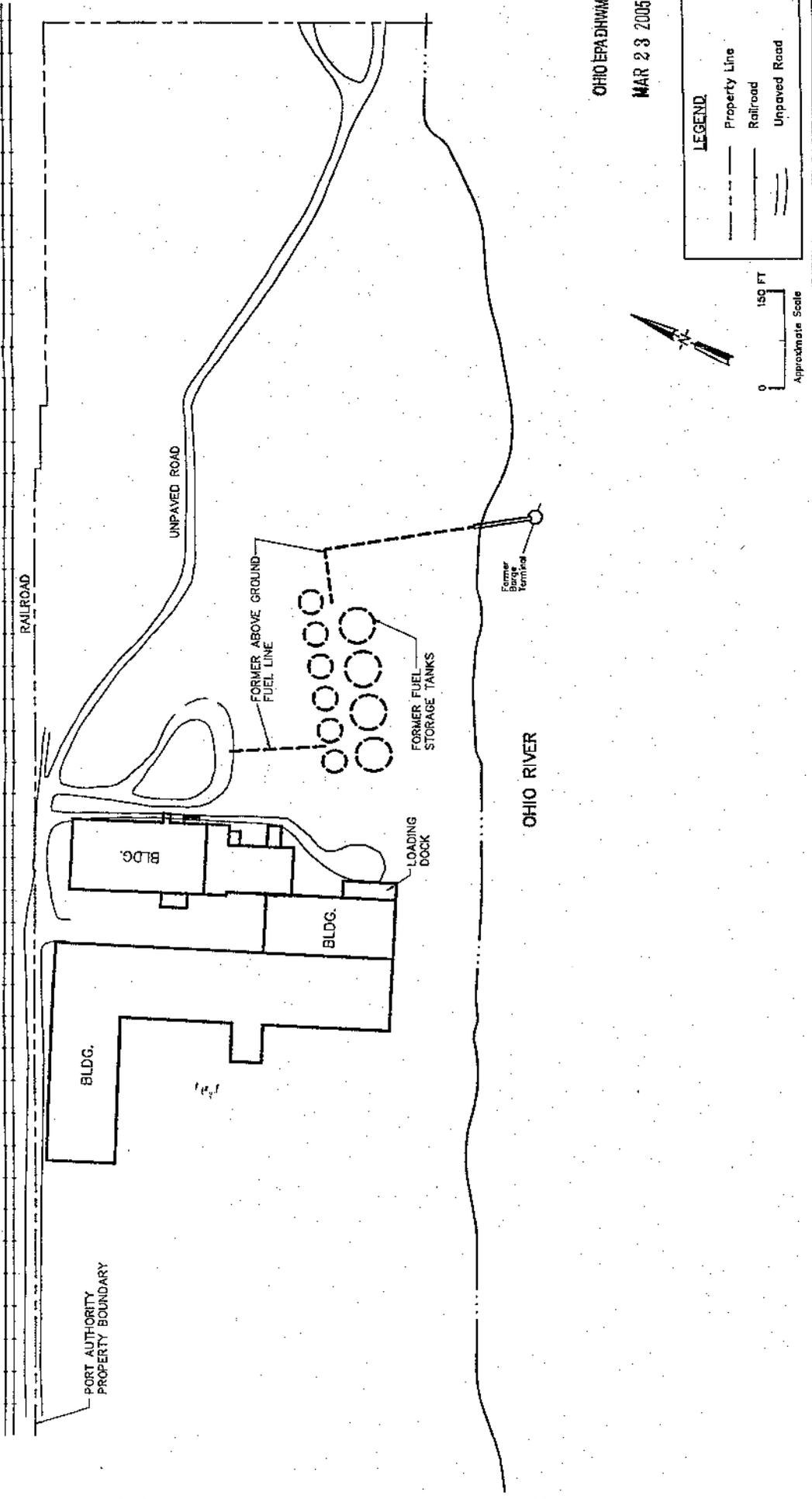


ES ENGINEERING--SCIENCE

1-4

SITE MAP

EAST LIVERPOOL, OHIO



OHIO EPADNWM
MAR 23 2005

LEGEND

- Property Line (dashed line)
- Railroad (double line)
- Unpaved Road (solid line)



150 FT
Approximate Scale

1-5
ES ENGINEERING-SCIENCE

was signed between the Port Authority and the OEPA (OEPA, 1991). The consent order requires the Port Authority to develop an interim groundwater gradient control system to contain groundwater contamination resulting from the Charter Oil releases. The Investigation Work Plan for the Charter Oil Site is currently being finalized.

1.2.4 Nature of Proposed Facility Wastes

It is not possible to describe in detail the chemical and physical properties of the actual waste that will be treated at the WTI Facility because of the following:

- The WTI Facility will serve as a regional commercial waste management facility that will serve the waste treatment needs of a broad range of waste-generating industries in the Ohio River Valley. The identity of the generators will remain unknown until the Facility begins normal operations. Once the Facility begins normal operations, the list of waste generators who choose to use the Facility and the chemical and physical composition of the specific waste these generators choose to send the Facility is expected to change occasionally.
- New regulations that govern the transportation and treatment of waste are causing significant changes in the chemical and physical composition of waste. New processes and products also contribute to the dynamic nature of the composition of waste to be treated at the Facility, thereby making it difficult to predict what wastes will be handled at the WTI Facility.

During the operation of the Facility, WTI is required to identify all waste streams and analyze waste before the waste is to be treated at the Facility. All waste acceptable for treatment will be sampled and analyzed in accordance with 40 CFR Section 264.13 (a) (3) and (4). Comprehensive records of waste analyses will be compiled for reference as required by the facility operating procedures and in accordance with 40 CFR Section 264.13 (a) (2).

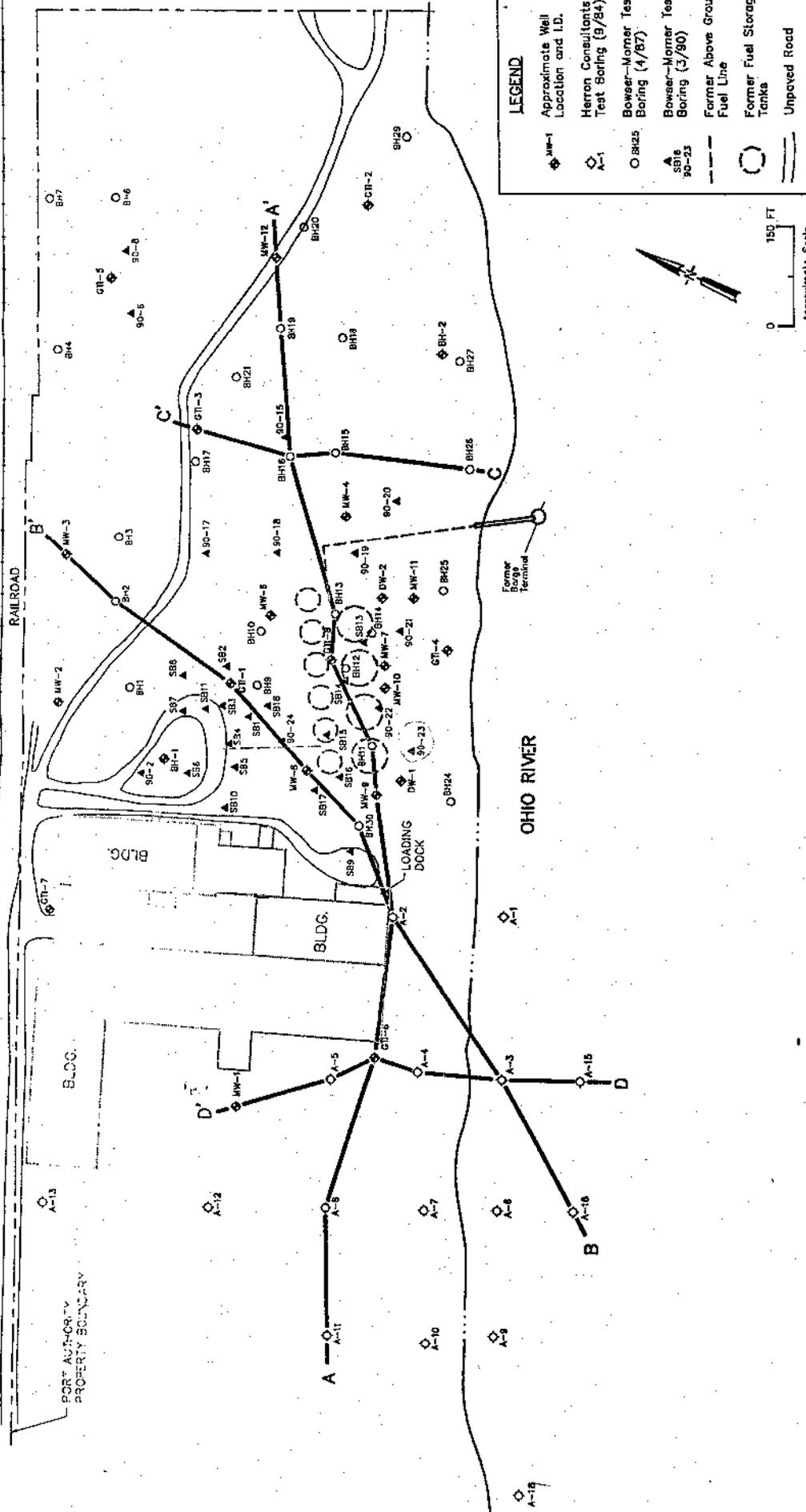
1.2.5 Site Geology and Hydrogeology

Current geologic and hydrogeologic conditions at the WTI Facility are developed from existing data including the analyses of 58 test borings, water level measurements from 23 monitoring wells, sieve analysis of selected soil cores, and two slug tests. The location of the monitoring wells and test borings are shown in Figure 1.4. The monitoring wells presented in Figure 1.4 were plugged during the construction of the WTI Facility and are no longer present on the site.

The site is underlain by river alluvium consisting of clay, silt, sand, and gravel. These sediments are non-uniform in grain size with average grain size coarsening downward and may be divided on the basis of lithology into two relatively lithologic distinct units. Near the ground, surface a dense silt and sand to clayey-silt unit occurs and ranges in thickness from 1 to 35 feet. This unit thickens abruptly towards the river as shown on the geologic cross sections presented in Figures 1.4 through 1.8. Underlying the silt and sand unit is an alluvial Sand-and-Gravel Aquifer with a thickness ranging from 25 to 80 feet which overlies the sandstone bedrock. Near the Ohio River, the base of the silt and sand formation has

GEOLOGIC CROSS-SECTION LOCATION MAP
EAST LIVERPOOL, OHIO

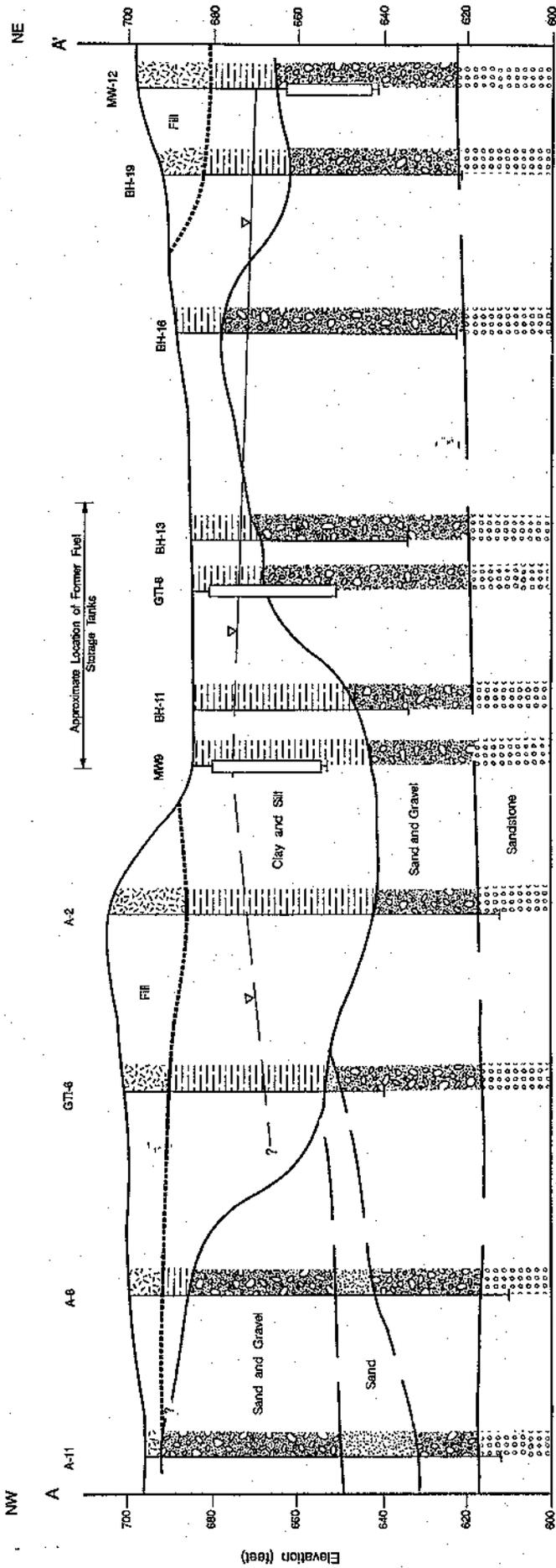
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CHARTER OIL SITE

GEOLOGIC CROSS-SECTION A-A' CHARTER OIL SITE



LEGEND

- Silt
- Fill
- Silt & Clay
- Sand & Gravel
- Sand
- Sandstone
- Water level, 3/15/90

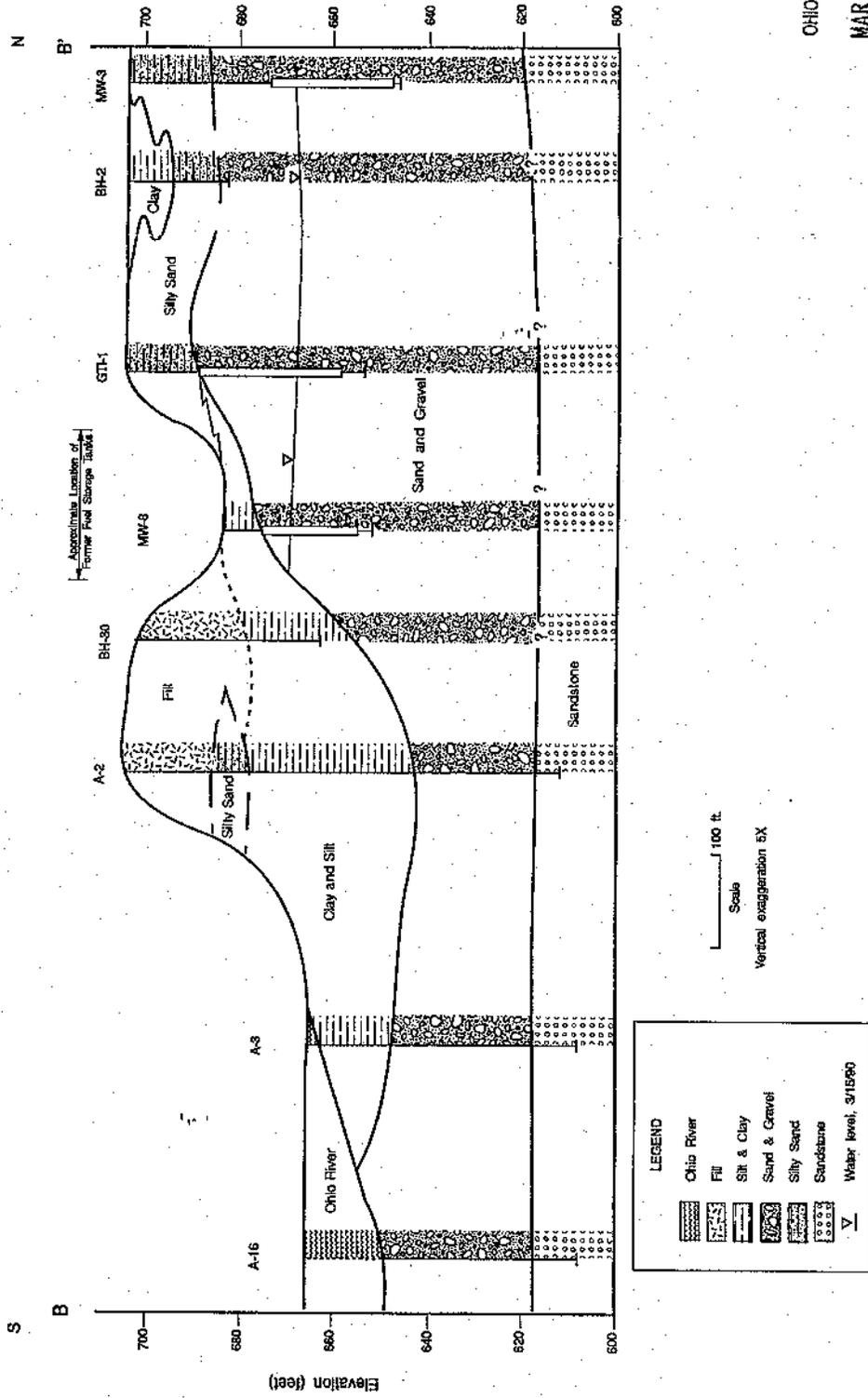
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Vertical exaggeration 5X

OHIO EPADHMM
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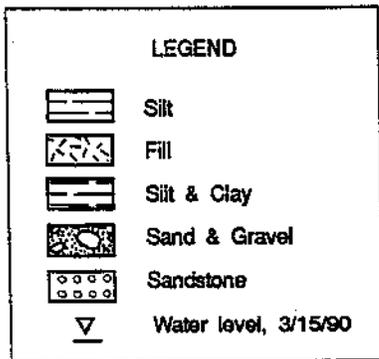
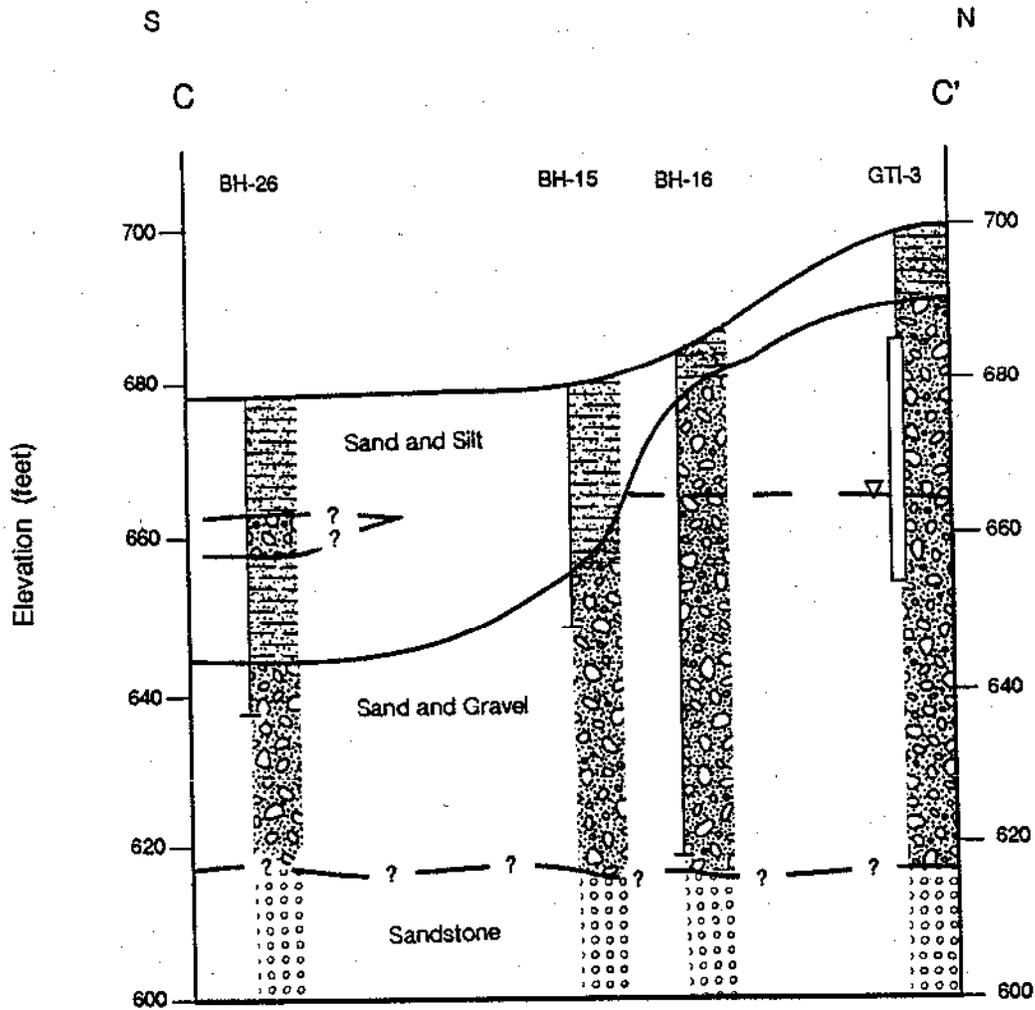
GEOLOGIC CROSS-SECTION B-B' CHARTER OIL SITE



OHIO E&A/DHWM
MAR 23 2005

GEOLOGIC CROSS-SECTION C-C'

CHARTER OIL SITE



Scale
 Vertical exaggeration 5X

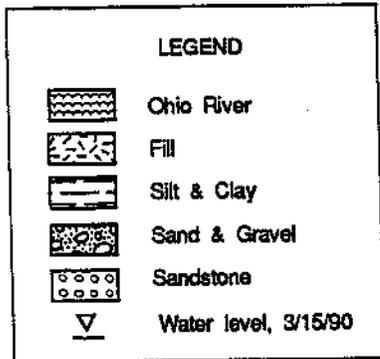
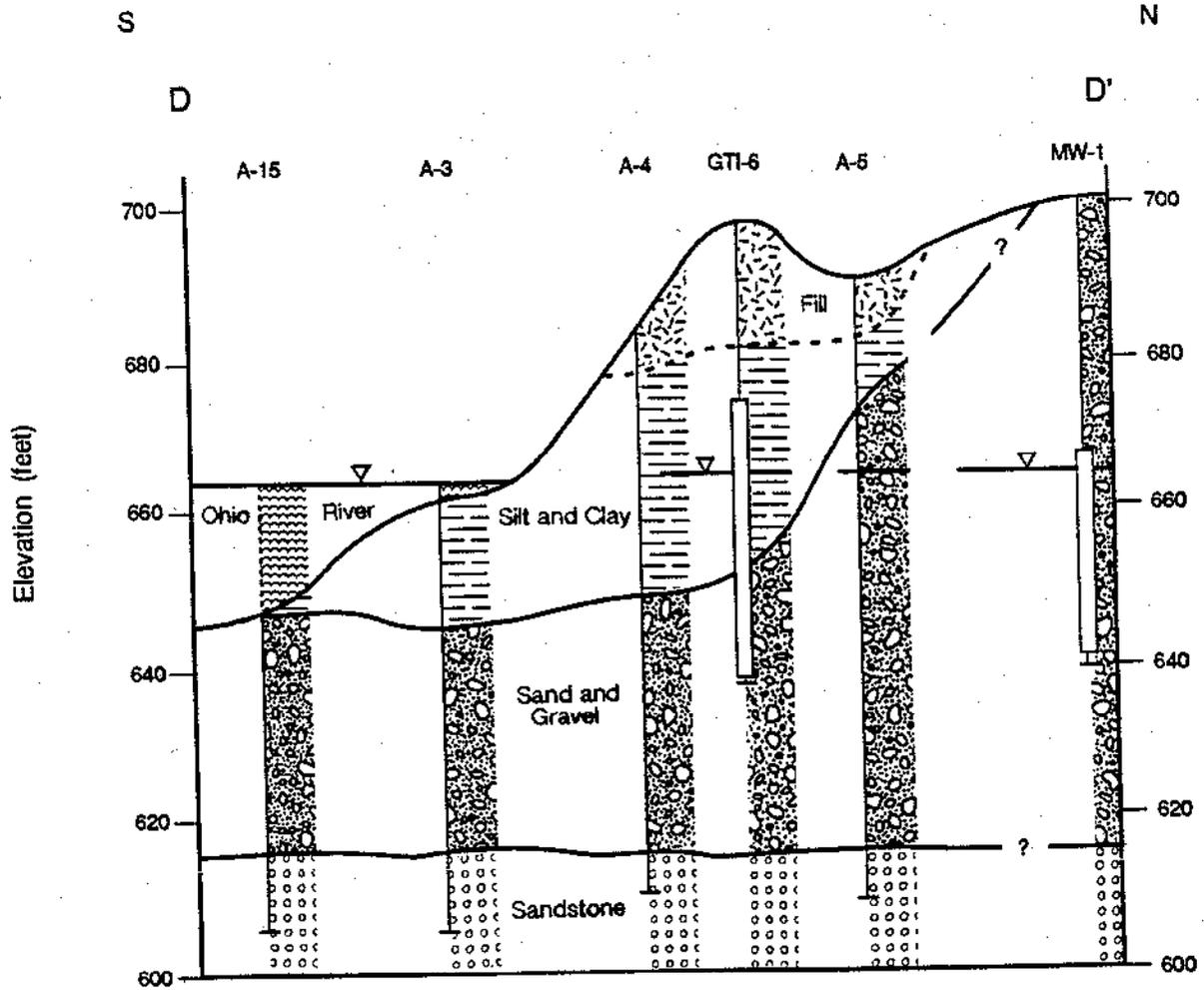
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GEOLOGIC CROSS-SECTION D-D'

CHARTER OIL SITE



Scale
 Vertical exaggeration 5X

OHIO EPA DHWM

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cut into the underlying Sand-and-Gravel Aquifer forming an angular unconformity. This erosional feature is shown in Cross-Section B-B' (Figure 1.6) and is believed to influence the direction and rate of groundwater movement in the sand-and-gravel aquifer.

The bedrock underlying the site consists of a coarse-grained sandstone which is probably part of the uppermost Allegheny formation (Pennsylvanian). The depth of bedrock is approximately 80 feet.

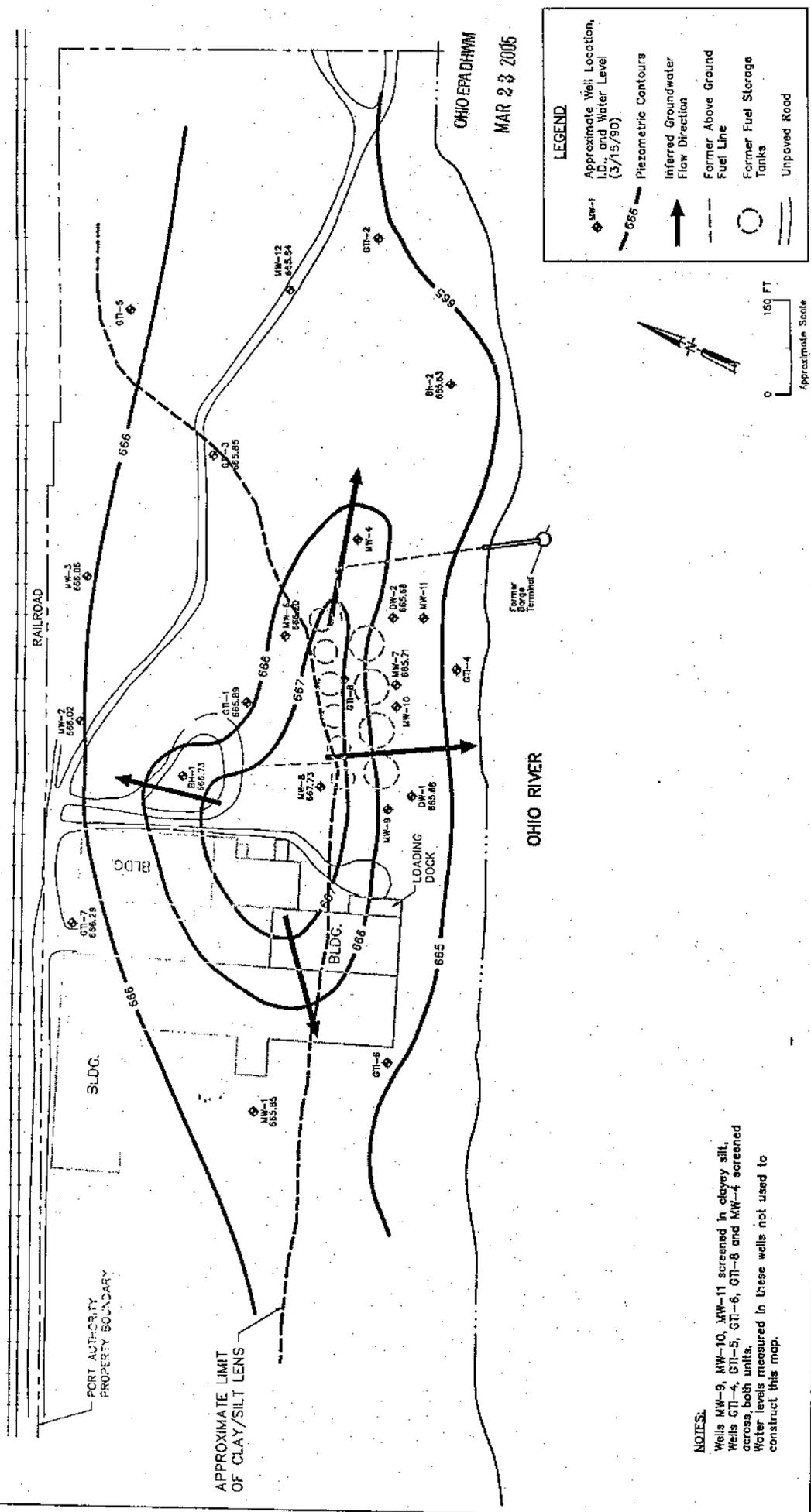
Groundwater at the WTI, East Liverpool site occurs primarily in the sand-and-gravel formation. In some areas, the overlying silt and sand unit was found to be water-bearing. Groundwater was measured in 1990 at depths of 6 to 40 feet below the ground surface. Water level elevations ranged from 665 to 675 feet NGVD-29. Groundwater levels in the silt and sand unit are generally higher than in the Sand-and-Gravel aquifer indicating that groundwater movement is primarily downward. Vertical gradients between the two units at paired wells MW-7/MW-10, DW-2/MW-11, and DW-2/MW-9 were calculated to be 0.29, 0.16, and 0.15 foot/foot respectively. The horizontal gradient in the silt and sand is about 0.02. This difference in the vertical versus horizontal gradient suggests that water in the silt and sand is predominantly downward into the Sand-and-Gravel Aquifer. The water found in the silt and sand unit is believed to be the result of perched conditions resulting from surface recharge from precipitation.

Water level data collected in 1990 from monitoring wells completed in the Sand-and-Gravel Aquifer indicate groundwater movement towards the Ohio River (Figure 1.9). As shown in Figure 1.9, there is a groundwater mound in the vicinity of MW-8 and BH-1. A relationship between the groundwater mound and a low permeable silt-clay lens in the silt and sand formation is also presented in Figure 1.9. In 1990, when these water levels were recorded, the area where the storage tanks used to be located were surrounded on the south, east, and west by a soil berm. During periods of precipitation, runoff from the site would collect within this berm area. This water would percolate into the Sand-and-Gravel Aquifer where the silt-clay lens is missing, causing the formation of the observed groundwater mound.

The site preparation for the WTI plant included raising all operational areas to a minimum elevation of 695 feet NGVD-29 and controlling storm runoff. Fill soil used for elevating the site was specified to have a hydraulic conductivity of less than 1.76×10^{-4} cm/sec. Storm runoff will be controlled by grading, installing curbs, and paving operational areas with reinforced concrete. These site activities are expected to reduce or eliminate the amount of recharge into the silt and sand formation thereby, lowering water levels in the silt and sand unit.

No aquifer pumping tests have been performed at the site, thus, the hydraulic properties of the Sand-and-Gravel Aquifer are only estimated. The hydraulic conductivity has been estimated from laboratory and slug testing and from sieve analysis on soil samples taken during well installation. These methods estimate hydraulic conductivities ranging from 1.5×10^{-3} cm/sec to 2.0×10^{-2} cm/sec. As required by the consent order, an aquifer pumping test will be completed to determine the hydraulic properties of the aquifer.

CHARTER OIL SITE PIEZOMETRIC CONTOURS – SAND AND GRAVEL AQUIFER EAST LIVERPOOL, OHIO



LEGEND

- MW-1 Approximate Well Location, ID, and Water Level (3/15/90)
- 666 Piezometric Contours
- Inferred Groundwater Flow Direction
- Former Above Ground Fuel Line
- Former Fuel Storage Tanks
- Unpaved Road

NOTES:
 Wells MW-9, MW-10, MW-11 screened in clayey silt.
 Wells CT-4, CT-5, CT-6, CT-8 and MW-4 screened across both units.
 Water levels measured in these wells not used to construct this map.

1.2.6 Migration Pathways

Contaminants released from the regulated facility would most likely be contained and collected by the stormwater runoff collection system. If contaminants were released to the subsurface, contaminants may migrate through the low permeable fill material and vertically through the silt and sand unit into the underlying Sand-and-Gravel Aquifer. Potential contaminants that reach the Sand-and-Gravel Aquifer may migrate laterally towards the Ohio River from the facility. The downgradient movement of groundwater in the Sand-and-Gravel Aquifer is restricted by the silt-clay lens discussed in the previous section.

Once groundwater recovery operations are initiated as specified in the consent order, the direction of groundwater flow will be strongly influenced by the rates of pumping and well locations. As specified in the consent order, monitoring wells will be installed as part of the groundwater recovery system. There is a planned overlap of wells between the two programs.

SECTION 2 PROPOSED MONITORING SYSTEM

2.1 TECHNICAL APPROACH

The recommended program includes the installation of three background and two downgradient monitoring wells. One monitoring well will also be located in the vicinity of the contamination resulting from the Charter Oil activities. The OEPA hazardous waste treatment permit requires a minimum of two wells be installed at the site. The purpose of the monitoring program will be to locate wells in areas near the regulated facility to detect potential releases to groundwater resulting from operations and to identify background conditions.

2.2 BACKGROUND MONITORING WELLS

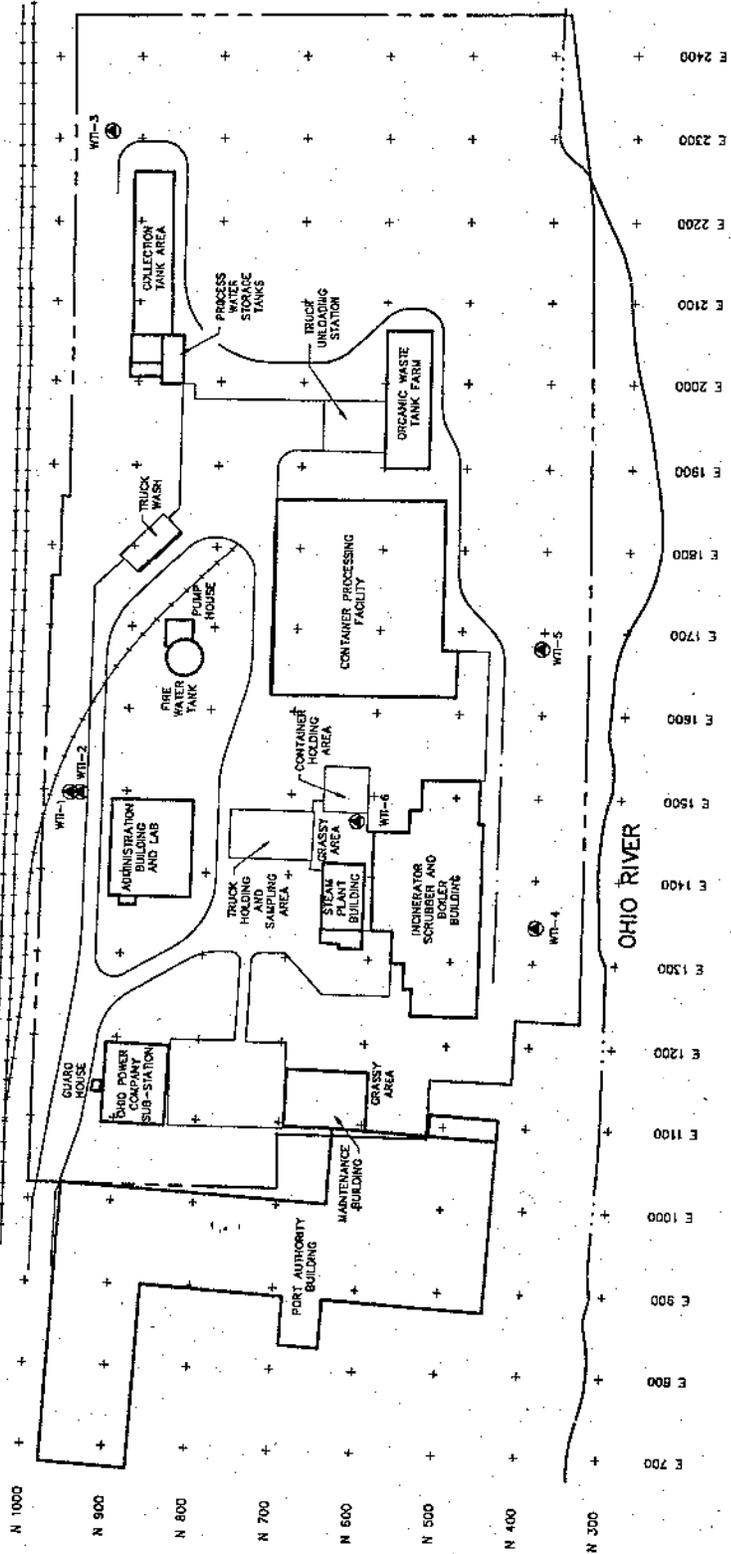
Three background wells will be located upgradient of the facility operations. The purpose of these wells will be to monitor groundwater quality as it enters the site and provide general groundwater quality. The three background wells will consist of two shallow wells installed with well screens located at the top of the water table. At one of these locations, a deep well will be installed with a 5-foot screen zone. The deep well screen will be located at the sandstone bedrock-alluvial contact. The purpose of the deep monitoring well will be to monitor groundwater quality in the deeper portion of the water table aquifer. In addition, one shallow monitoring well will be located in an area identified by past investigations as being representative of the contamination resulting from the Charter Oil operations.

2.3 DOWNGRAIDENT MONITORING WELLS

Two downgradient monitoring wells shown on Figure 2.1 will be used in the detection monitoring program. One of the two wells will be located between the Ohio River and the incinerator facility. The second downgradient well will be located between the drum processing facility and the Ohio River. These monitoring wells will contain a 5- to 10-foot screen zone located at the contact between the silt and sand unit and Sand-and-Gravel Aquifer.

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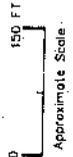
WTI SITE PLAN WITH PROPOSED WELL LOCATIONS EAST LIVERPOOL, OHIO



LEGEND

- WT-1 Proposed Monitoring Well Location And ID
- WT Building Outlines
- Railroad
- Berm
- Paved Areas

OHIO EPA/DHWM
MAR 23 2005



SECTION 3 MONITORING PROGRAM

3.1 GENERAL

The parameters to be monitored in the Detection Monitoring Program will be selected in stages starting with a comprehensive list and gradually focusing to include only those parameters that are found in the baseline groundwater sampling period. The list of parameters that will be monitored in the Detection Monitoring Program are presented in Section 3.2. This list of parameters will be modified as the program progresses. Methods and rationale for modifying the list of parameters are presented in the following sections.

3.2 DETECTION MONITORING PROGRAM

The major phases in the Detection Monitoring Program are presented in the flow diagram in Figure 3.1. These phases include baseline monitoring, background monitoring, and detection monitoring. Each phase is discussed in detail below.

3.2.1 Baseline Monitoring

Baseline monitoring will commence once monitoring wells are installed and developed. Both the upgradient and downgradient monitoring wells will be sampled. Due to the past history of the site and the presence of contaminated groundwater, a 1-year baseline monitoring program will be developed. The purpose of the baseline monitoring will be to establish existing levels of contamination. Monitoring wells will be sampled on a quarterly basis for the following parameters:

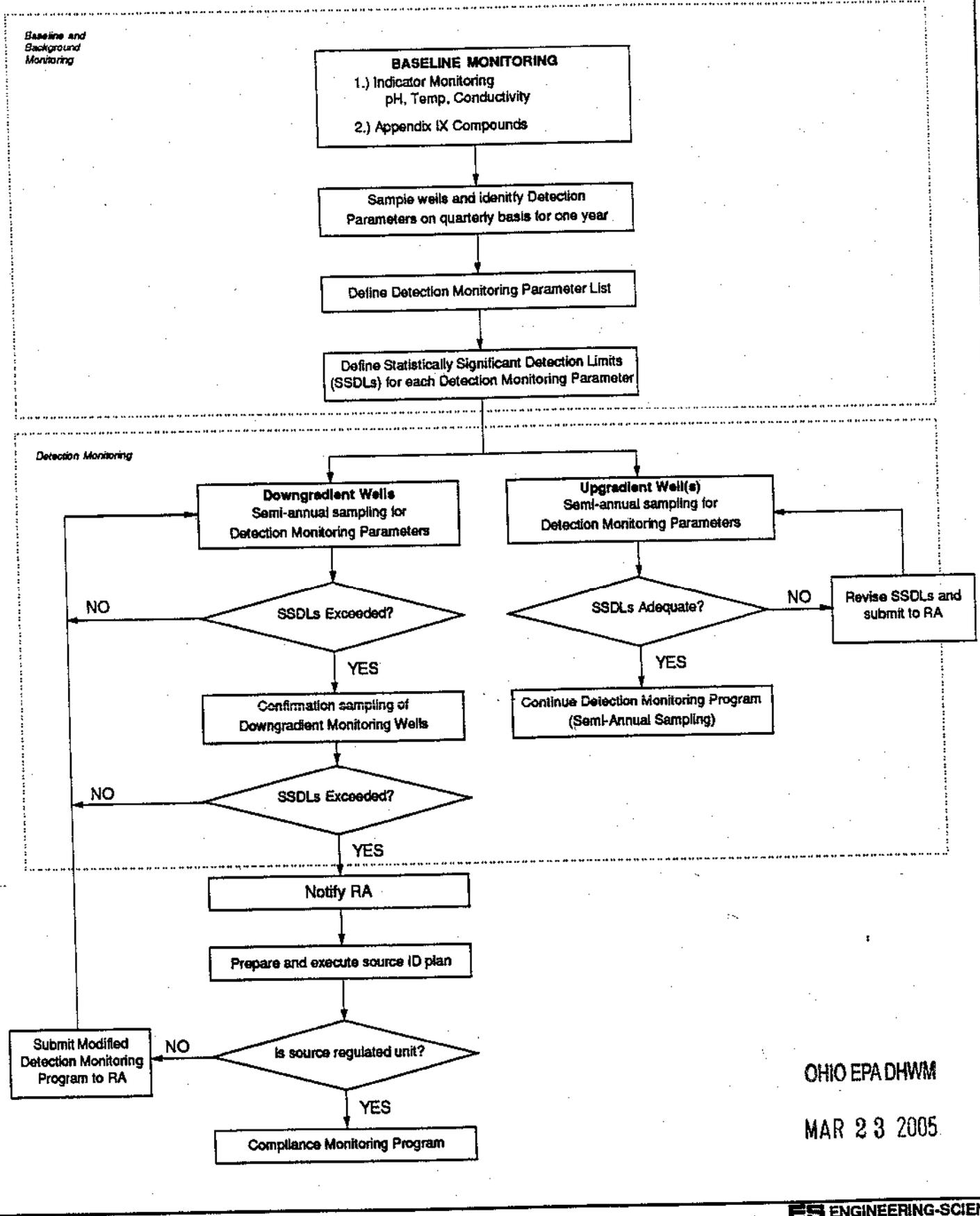
- Indicator parameters: pH, temperature, conductivity and selected ions.
- 40 CFR 264 Appendix IX compounds plus up to the first 40 peaks identified by GC/MS methods. The parameters and analytical methods are listed in Appendix A.

Once the results from the 1-year baseline monitoring are complete, the detection monitoring parameters will be defined. This list of parameters will include the indicator parameters and a combination of volatile (SW8240) and/or semivolatile organic compounds (SW8270) and/or pesticide/PCBs (SW8080) depending on the results of the baseline results. Statistically significant detection limits (SSDLs) will be developed using the methods described in Section 4.8. The determined SSDLs will be used in the detection monitoring program to determine whether differences in detection monitoring parameters are statistically different than the baseline concentrations.

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DETECTION MONITORING PROGRAM



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3.2.2 Detection Monitoring

Detection monitoring will begin following the completion of the baseline monitoring program. Detection monitoring will be conducted through the life of the facility. The general flow diagram for the Detection Monitoring Program is illustrated in Figure 3.1. Detection monitoring will consist of the following steps:

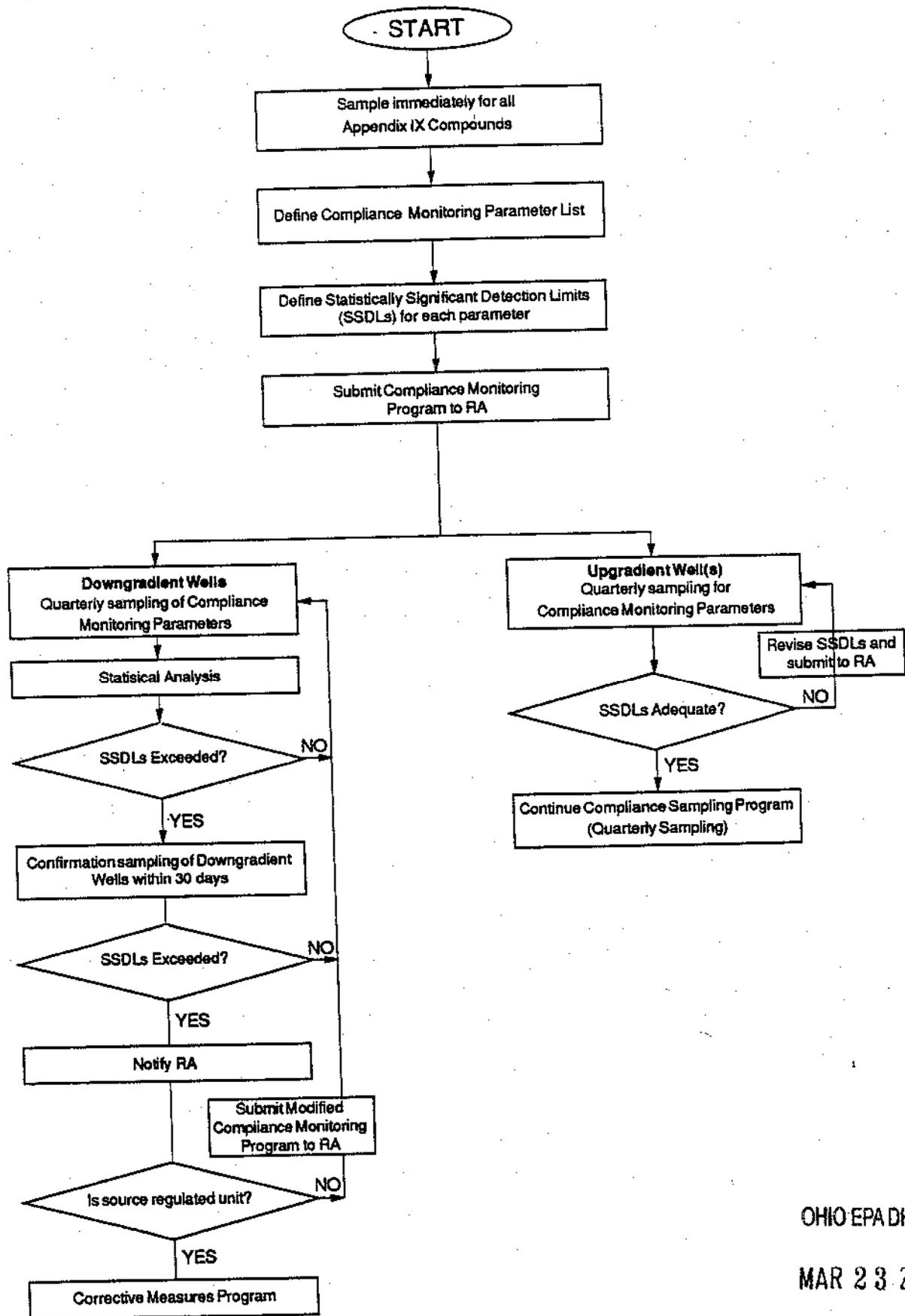
1. Submit proposed SSDLs, from baseline monitoring program, to regional administrator (RA).
2. Sample the upgradient and downgradient wells for the detection monitoring list developed in the baseline monitoring program. Wells will be sampled on a semi-annual basis.
3. Evaluate SSDLs based on upgradient well concentrations. Submit revised SSDLs if appropriate.
4. Evaluate the analytical results from the sampling of downgradient wells.
5. If the evaluation of the analytical data indicates that no statistically significant change in the detection parameters is found then continue detection monitoring program.
6. If the results indicate a statistically significant increase over the established background concentration for any of the detection monitoring parameters, a confirmation sampling round will be initiated. If the results are confirmed the appropriate regulatory agency will be notified.
7. If the results are confirmed a source identification plan will be prepared to evaluate potential sources of the parameters exceeding SSDLs.
8. If the source is identified to be other than the regulated facility, then the Detection Monitoring Program will be modified to account for the source.
9. If the source is not identified to be other than the regulated unit, then the Compliance Monitoring Program will be implemented.

3.3 COMPLIANCE MONITORING PROGRAM

The Compliance Monitoring Program will commence once the Detection Monitoring Program has determined that compounds have been detected above the SSDLs and are determined to be related to the regulated facility. A flow diagram of the Compliance Monitoring Program is presented in Figure 3.2. The Compliance Monitoring Program will consist of the following steps:

1. Sample all wells in the groundwater monitoring system for 40 CFR 264 Appendix IX compounds immediately.
2. Determine Compliance Monitoring Parameters based on analytical results of groundwater samples.

COMPLIANCE MONITORING PROGRAM



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3. Based on the statistical procedures developed in Section 4.8, SSDLs levels will be established for each parameter and submitted to the RA.
4. Sample the upgradient and downgradient wells for the Compliance Monitoring Parameters. Wells will be sampled on a semi-annual basis.
5. Evaluate SSDLs based on background well concentrations. Submit revised SSDLs to RA.
6. Evaluate the analytical results from the sampling of downgradient wells.
7. If the evaluation of the analytical data indicates no statistically significant change in the Compliance Monitoring Parameters is found, then continue Compliance Monitoring Program.
8. If the results indicate a statistically significant increase over the established SSDLs for any of the Compliance Monitoring Parameters, a confirmation sampling round will be initiated. If the results are confirmed the appropriate regulatory agency will be notified.
9. If the results are confirmed, a source identification plan will be prepared to evaluate potential sources of the parameters exceeding SSDLs.
10. If the source is identified to be other than the regulated facility, then the Compliance Monitoring Program will be modified to account for the source.
11. If the source is not identified to be other than the regulated unit, then a Corrective Action Plan will be submitted to the RA.

SECTION 4

WELL INSTALLATION AND SAMPLING PROCEDURES

This section includes details on monitoring well construction, completion, development, purging, and sampling techniques. Procedures for well abandonment are also discussed. In general, the groundwater sampling process, from construction through actual sampling, will be done in order from potentially the least contaminated site to the most contaminated.

4.1 MONITORING WELL INSTALLATION

Three upgradient and two downgradient 2-inch stainless-steel monitoring wells will be installed. Boreholes for installation of monitoring wells will be drilled using hollow-stem auger or rotary methods and will be of sufficient diameter to permit a minimum of 2 inches of annular space when the well is installed. The depth of the monitoring wells will be determined by the on-site geologist and will be completed at various depths in the Sand-and-Gravel Aquifer depending on the sampling objective of the well.

Continuous split-spoon samples will be collected starting at the ground surface. The physical characteristics of the samples obtained will be described in detail on lithologic logs using the United Soil Classification System (USCS).

The shallow monitoring wells will be constructed using 5 to 10 feet of new 2-inch diameter stainless-steel factory slotted or continuously wrap stainless-steel well screen. The well screen will be flush threaded and will be connected to stainless-steel casing extending to approximately 2 feet above ground.

The annular space between the borehole and screen will be filled with uniformly graded silica sand from the bottom of the hole to approximately 2 feet above the top of the well screen. A minimum 2 feet thick bentonite seal will be placed above the filter pack in each well to prevent downward migration of cement grout. The remaining annular space above the bentonite will be sealed by pressure grouting with cement grout to land surface. The cement grout will consist of a mixture of Portland Type I cement and water in the proportion not to exceed 7 gallons of clean water per bag of cement (94 pounds). Additionally, 3 to 5 percent by weight of bentonite powder shall be added to the grout to prevent shrinking.

The well casing will extend 2 to 3 feet above grade and will be surrounded by a larger diameter, protective steel casing set into a concrete pad. The steel casing will have a lockable cap. Three steel guard posts will be equally spaced around each well and

cemented into the ground to a depth of approximately 3 feet. A typical shallow monitoring well is presented in Figure 4.1.

Upon completion of monitoring wells, detailed well construction logs will be prepared for each well. Sample lithologic logs are presented in Figure 4.2.

One borehole for deep monitoring wells will be drilled using hollow-stem augers. Initially, a 12-inch diameter borehole will be completed to a depth specified by the on-site geologist. A 8- to 10-inch surface conductor steel or PVC casing will be installed and grouted in-place. The grout used in cementing the conductor casing will meet the same requirements as described for shallow wells. After allowing the grout to set for at least 24 hours, a 6-inch boring will be drilled to the required depth. The well construction will be similar to the shallow well construction. A typical deep monitoring well is presented in Figure 4.3.

The wells will be surveyed for location and elevation and a permanent identification (ID) plate will be attached to each well. Information that will be marked on each well installed during this field effort will include:

- Project name;
- Well ID;
- Date installed;
- Depth of the well;
- Screen interval;
- Measuring point elevation; and
- Ground surface elevation.

4.2 WELL DEVELOPMENT

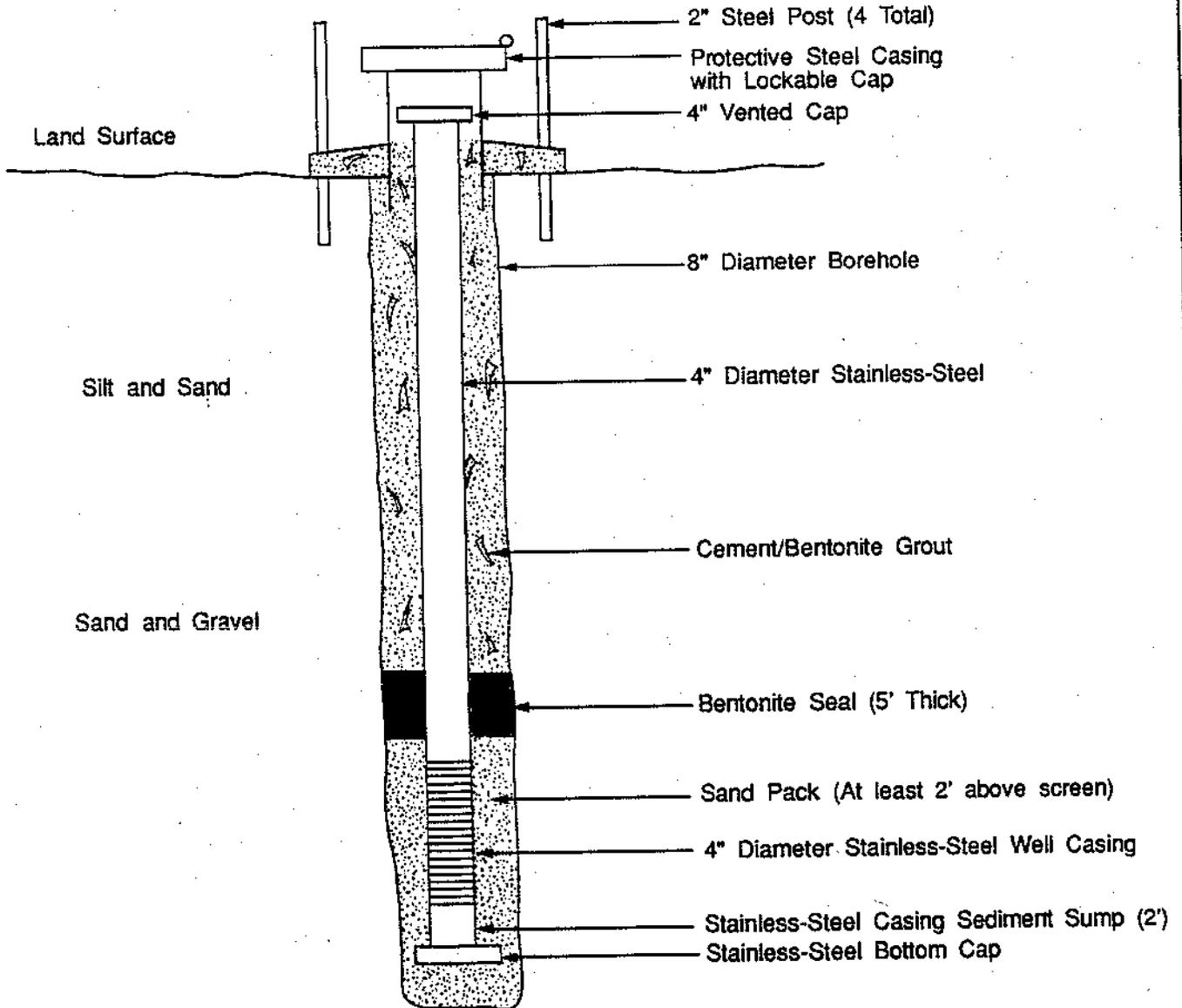
After the completion of each monitoring well, well development will be completed. The wells will be developed by mechanically surging and pumping and bailing. Purging will be accomplished by bailing or by using a low-volume pump (such as a KECK™ pump). Development will continue until the groundwater discharge is relatively free of sediment, or until it is determined that further development will not provide and significant improvement of the turbidity. The water in the well will then be allowed to recover to near its original water level before samples are collected. Water samples will be obtained within 24 hours of purging. The water quality criteria parameters temperature, conductivity, and pH will be recorded during the well development procedure and recorded on a well development log.

4.3 GROUNDWATER SAMPLING

Groundwater sampling will consist of well purging, water sampling, sample ID and sample handling. During the purging process three to five well volumes will be purged

PROPOSED SHALLOW MONITORING WELL

WTI FACILITY



Not To Scale

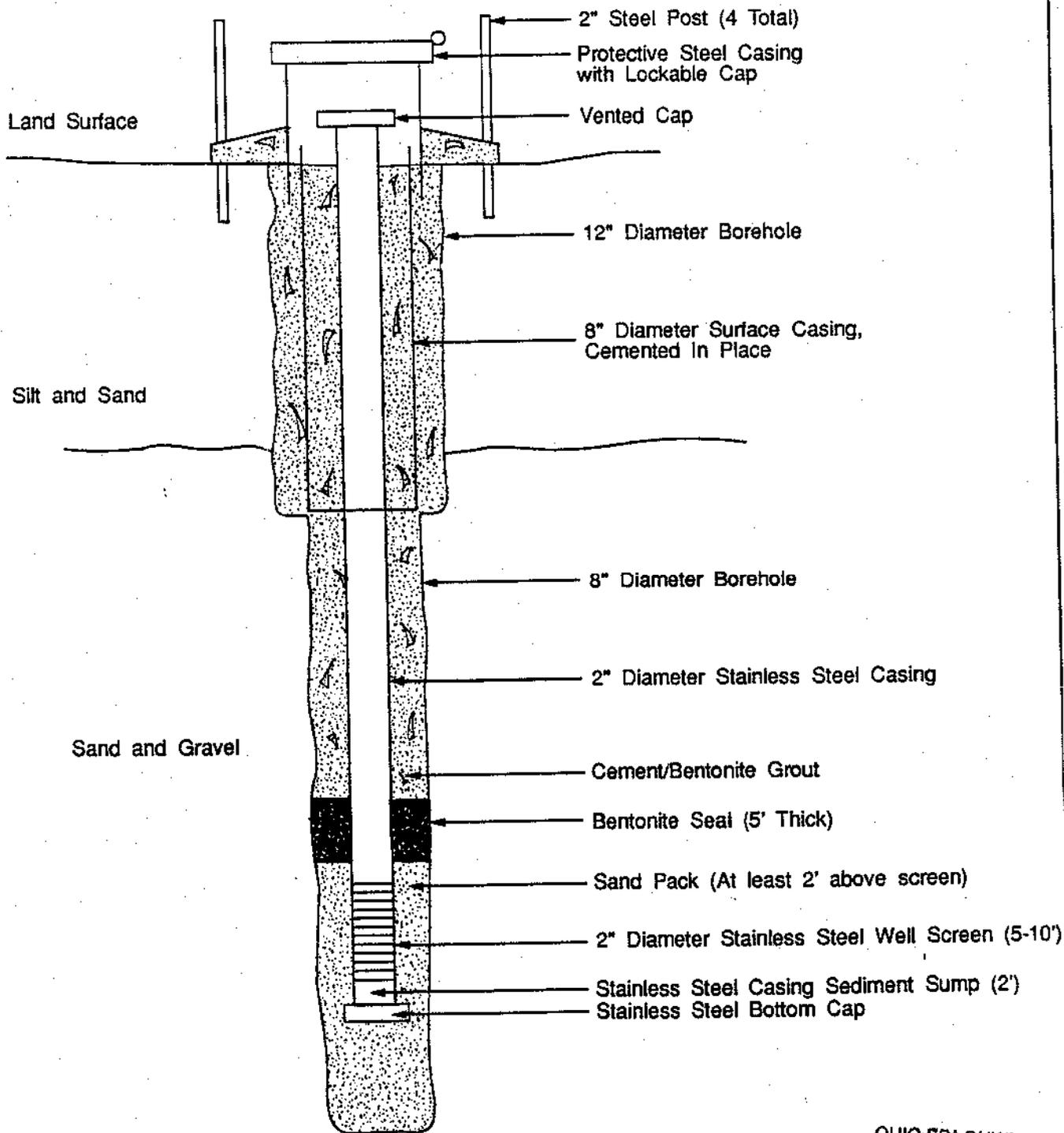
OHIO EPA DHWM

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PROPOSED DEEP MONITORING WELL DESIGN

WTI FACILITY



Not To Scale

OHIO EPA DHWM

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from the well. Temperature, conductivity, and pH will be monitored during the purge process. The well will be considered purged when groundwater parameters have stabilized, the water is relatively free of sediment, or five well volumes have been purged.

Groundwater samples will be taken within 24 hours after the monitoring well has been purged. The groundwater samples will be collected using a Teflon[®] or stainless steel bailer. Samples collected for volatile analysis will be collected immediately. The remaining bottles will be filled by placing an aliquot from each bailer into the sample bottles until they are full.

A sample numbering system will be used to develop the ID for each groundwater sample taken during the field investigation. The numbering system will provide a tracking procedure to allow retrieval of information on a particular well. Each sample ID number will consist of a project ID code, a well source ID code and a sampling event ID code. WTI will be the project ID for Waste Technologies Industries and will be followed immediately by the well ID code. A sample event code will be used to identify one of a potential multiple of samples collected from the same location. The following is an example of the code to be used:

Sample Number	Description
WTI-1-01	Waste Technologies Industries, monitoring well 1, round 1

Quality assurance samples will be identified as follows:

Type	Code
Trip Blank	WTI-TB#-#
Equipment Rinseate	Equipment Rinseates will receive coded ID that is recorded only in the sample logbook.
Duplicates	Duplicates will receive coded ID that is recorded only in the sample logbook.

Groundwater samples will be placed in the appropriate precleaned sample bottles containing the required preservatives (see Table 5.1). After the samples are collected they will be stored on ice in a insulated shipping cooler. A sealed chain-of-custody will be enclosed with the shipping container. The shipping container will be securely sealed and shipped overnight to the analytical laboratory.

4.4 SITE SURVEY

All monitoring wells will be surveyed and located on maps. The horizontal locations of monitoring wells will be surveyed in reference to a U.S. Geological Survey or U.S. Geodetic survey benchmark to an accuracy of ± 1 foot. Elevations of all new and existing monitoring wells will be surveyed to ± 0.01 foot. The monitoring wells will have a brass survey pin installed in the concrete pad plus a permanent measuring point marked on the well casing.

4.5 SITE CLEANUP

Following completion of all work at a site, the site will be restored as close as possible to its pre-investigation condition. All drilling and sampling equipment will be removed from the drilling site upon completion of the drilling work. Cuttings from boreholes will be placed on plastic sheeting, then covered with plastic sheeting, and weighted by available material. If the cuttings are suspected of being contaminated, they will be drummed. Visual observation and screening of the cuttings with an organic vapor detector during drilling operations will be used by ES personnel to judge the necessity for drumming the cuttings. TCLP testing will be used to determine if the drummed cuttings are hazardous. Hazardous cuttings will be disposed of by WTI in accordance with environmental regulations. If the cuttings are determined to be non-hazardous at the time of drilling, or later by testing, they will be spread around the site or moved to a location designated by WTI.

During development of the groundwater monitoring wells, the development water will be screened using an organic vapor detection meter. If the presence of organic vapors in the headspace of water samples obtained during development exceeds 5 parts per million (ppm), then this groundwater will be contained in drums until results from sampling and analysis are received. If the water is determined to contain contaminants at levels of concern, methods of disposal will be evaluated by ES and the water will be disposed of properly. Otherwise the water will be disposed of onsite.

WTI will be responsible for all hazardous materials generated during this investigation. WTI's contractor will arrange for the transportation and disposal of all hazardous materials if requested. WTI will be responsible for signing all manifests concerning the transportation and disposal of all hazardous materials.

4.6 SAMPLE CUSTODY

The sample custody and documentation procedures described in herein will be followed during sample collection. Each person involved with sample handling will be trained in chain-of-custody procedures prior to the implementation of the field program. To reduce the chance for error, the number of personnel handling the samples will be limited. A standard chain-of-custody form is presented in Figure 4.4.

All samples will be accompanied by a completed chain-of-custody record. A chain-of-custody record will accompany the sample during shipment to the laboratory and through the laboratory. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will accompany each split sample. When transferring samples, the individuals relinquishing and receiving the samples will sign, date and note the time on the record.

The original of this record will accompany the samples to the laboratory. The laboratory maintains one file copy, and the completed original will be returned to the project manager as a part of the final analytical report. This record will be used to document sample custody transfer from the sampler to the laboratory.

Shipments will be sent by air express courier and a bill of lading will be used. Bills of lading will be retained as part of the permanent documentation.

A sample is under custody if:

- It is in your actual possession; or
- It is in your view, after being in your physical possession; or
- It was in your physical possession and then you locked it up to prevent tampering; or
- It is in a designated and identified secure area.

4.6.1 Sample Custody in The Field

The following procedures will be used to document, establish and maintain custody of field samples:

- Sample labels will be completed for each sample, using waterproof ink, making sure that the labels are legible and affixed firmly to the sample container.
- All sample related information will be recorded in the project log books.
- The field sample custodian will retain the custody of the samples until they are transferred or properly dispatched.
- During the course and at the end of the field work, the field supervisor will determine whether these procedures have been followed, and if additional samples are required.

4.6.2 Transfer of Custody and Shipment

The following procedures will be used in transferring and shipping samples:

- Samples will be accompanied by a chain-of-custody record at all times. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, or to the laboratory.
- Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed chain-of-custody record enclosed in each sample box or cooler. Shipping containers will be custody-sealed for shipment to the laboratory by overnight express.
- Whenever samples are split with a facility or government agency, a separate chain-of-custody record will be prepared for those samples and marked to indicate with whom the samples are being split.
- All packages will be accompanied by the chain-of-custody record showing identification of the contents. The original record will accompany the shipment, and a copy will be retained by the field supervisor.
- If sent by common carrier, a bill of lading will be used. Receipts of bill of lading will be retained as part of the permanent documentation.

4.7 DECONTAMINATION PROCEDURES

All reusable equipment will be decontaminated prior to reuse. If possible, there will be enough of each type of sampling equipment available so each piece is only used once per day. At the end of each day, all reusable equipment will be decontaminated and allowed to dry overnight. All sampling equipment will be decontaminated using the following procedure:

- Steam clean to remove gross contamination (if required).
- Wash in potable water with laboratory-grade non-phosphate detergent and scrub with a stiff brush.
- Rinse with potable water.
- Rinse with deionized organic-free water.
- Allow to air dry.

It may be necessary to incorporate the use of pesticide-grade methanol into the decontamination procedure if contamination is encountered. The use of methanol will be used to prevent cross-contamination.

The decontamination area will be located in an area unaffected by site activities that may cause contamination of equipment. Clean plastic sheeting will be placed on the ground or on a table where decontamination is performed. Portable water will be collected from a supply system located on the facility.

4.8 DATA EVALUATION AND STATISTICAL PROCEDURES

Groundwater sampling is performed to evaluate whether a release of hazardous constituents has occurred from a regulated unit that may pose a threat to human health and the environment. Regulations in 40 CFR 264 require the use of statistical procedures to determine whether background values or concentration limits have been exceeded in any of the monitoring wells during a sampling event. The US EPA has developed guidelines for using statistical methods for analysis of groundwater monitoring data at RCRA Facilities (EPA, 1989). These guidelines will be used to evaluate groundwater data collected during the monitoring program.

The major considerations in developing a statistical procedure for the WTI Facility are:

1. A large number of factors may contribute to the apparent variability of the results for a particular sample during detection monitoring. These include a) natural variability, b) sampling procedures, c) laboratory error, and d) human error. These factors are likely present in both the upgradient and downgradient samples, although their relative contribution to each type of sample may differ.
2. The data from each downgradient well represent only a single measurement of a single sampling event carried out at a single point of time. Thus, the only valid

statistical evaluation that can be made is to determine, with a significant confidence level, that this sample does not belong to the background population.

3. A number of previous releases are suspected at the site and may contribute a number of compounds to the downgradient well concentrations and may be absent in the upgradient wells. These detections although significant may not be indicative of potential release from the regulated facility.
4. According to the Consent Order between the Port Authority and the OEPA, a groundwater pump-and-treat system is to be installed during the monitoring period. The pump-and-treat system will have significant effect on groundwater movement and of existing site contaminants.

Based on these considerations, the statistical procedure will employ multiple criteria to provide reasonable confidence of the detection of a leakage from operations at the facility. The criteria are:

1. **Concentration-based.** The concentration of a detected compound will be compared against a SSDL. The SSDL is both parameter and laboratory specific and takes into various factors contributing to the background variation. The SSDL is the concentration limit at the upper bound of the prediction interval within which a sample belonging to the baseline population may be expected to fall.
2. **Multiple Occurrence.** Each detection will be compared with its recent past sampling events to determine whether there is a persistent occurrence of the same parameter or constituents. The concentration level will be compared to its past levels to determine if there is a statistically significant increase from baseline conditions.

The procedure for establishing SSDL and baseline Concentrations are described in the next section.

4.8.1 Statistically Significant Detection Limit and Baseline Concentrations

The baseline monitoring will be used to establish contamination levels resulting from the Charter Oil releases. The SSDL is both parameter and laboratory specific. It is the concentration that corresponds to the upper bound of the prediction interval of the baseline population at 95 percent confidence level.

Baseline concentrations will be established in the first year of monitoring and continually assessed over time using data from the three upgradient monitoring wells and the downgradient wells themselves. The statistical evaluation of upgradient monitoring wells will be designed to detect possible increases in upgradient monitoring well as a result of off-site contamination sources.

Downgradient to upgradient monitoring well comparisons will be designed to detect whether compliance samples exhibit statistically significant differences from baseline concentration levels, and if so, where these differences occur.

The statistical test procedures will include Parametric Analysis of Variance (ANOVA), nonparametric ANOVA, or the Test of Proportions. As explained below, the method to be used will be selected depending on data attributes.

If less than 50 percent data samples are non-detects, than the statistical tests will be conducted using ANOVA procedures. Parametric ANOVA will be applied if the data from each well are normal and exhibit equal variances. Data normality will be tested by the Chi-Square or the Kolmogorov-Smirnov test; variance homogeneity will be assessed using Bartlett's Tests. Parametric ANOVA will be applied even when the data are not normal but can be normalized via a suitable transformation (e.g., by taking the logarithms of the actual data values). If the data cannot be normalized and/or exhibit significant variance differences, the tests will be conducted using the non-parametric ANOVA procedure (also known as the Kruskal-Wallis Test). If the data samples include more than 50 percent non-detects, the statistical analysis will be conducted using the Test of Proportions.

A detailed discussion of the above-mentioned statistical procedures with examples and references is included in Appendix A. The statistical analysis proposed are consistent with recommended EPA methods at RCRA facilities (EPA, 1989).

4.8.2 Procedure for Statistical Evaluation

The statistical evaluation procedure for detection or compliance monitoring is based on the methods described above. The major steps are described below:

1. **Concentration Test.** The concentration of each parameter detected will be compared against its SSDL. If all the parameters detected satisfy the concentration criteria and are normally present in background or baseline samples, then the sample has passed the concentration test and proceed to step 2. If its concentration exceeds the SSDL, then the sample has failed to meet the concentration criteria and proceed to step 3.
2. **Multiple Occurrence Test.** If any of the non-background parameters detected has not been detected in the same monitoring well for the past two monitoring wells then the sample has passed the multiple occurrence test and the statistical evaluation of this sample is complete. Otherwise proceed to step 3.
3. The QA/QC procedures applied to this sample will be examined along with trip, field and laboratory blanks. If the analytical results can invalidate the sample then there is no significant increase in this sample and the results of the QA/QC investigation will be documented in the annual report.
4. If the QA/QC investigation confirms the validity of the results, then the monitoring well will be resampled immediately and the sample will follow the same statistical evaluation procedure. If the result of subsequent sampling fails either of these tests then a statistically significant increase is confirmed.

SECTION 5 QUALITY ASSURANCE/QUALITY CONTROL

5.1 QUALITY ASSURANCE OBJECTIVES

The quality assurance objectives for all measurement data include considerations of precision, accuracy, completeness, representativeness, and comparability. Parts of this section incorporate by reference US EPA publication, Test Methods for Evaluating Solid Waste, 3rd Edition (SW-846).

5.2 PRECISION

Precision, as defined in SW-846, is the agreement between a set of replicate measurements without assumption or knowledge of the true value. Precision is assessed by duplicate/replicate sample analysis and is expressed in terms of relative percent difference (RFD). The RFD is as follows:

$$\text{RFD} = \frac{V_1 - V_2}{(V_1 + V_2)/2} \times 100$$

where:

FD = relative percent difference

V₁ = first sample value

V₂ = second sample value (replicate)

The selected laboratory will meet or exceed the precision for the applicable analytical methods, as recommended in SW-846. Acceptable levels of precision may vary according to the sample matrix, the specific analytical method, and the analyte concentration.

5.3 ACCURACY

The objective for accuracy of field measurements is to achieve and maintain equipment specifications for the field equipment. The field instruments will be assessed for accuracy based on a comparison of the measured response of the equipment to a known sample, such as a calibration standard. The pH meter and conductivity meters are calibrated with solutions traceable to the National Bureau of Standards (NBS). The HNU® meter will be calibrated daily with the calibration gas.

The laboratory will meet or exceed the accuracy reported for analysis of samples with similar matrix and concentration of contaminants. Accuracy is determined by analyzing a sample and its corresponding matrix spike (MS) sample. Accuracy is expressed as percent recovery (PR)

The PR is calculated as shown below:

$$PR = \frac{S_s - S_o}{S_a} \times 100$$

where:

PR = percent recovery

S_o = Background value, value obtained by analyzing the sample

S_a = Concentration of the spike added to sample

S_s = Value obtained by analyzing the sample with the spike added

The expected PR will confirm to the values specified in SW-846 for the recommended analytical methods. PR is dependent upon the sample matrix, method of analysis, and compound analyzed.

5.4 REPRESENTATIVENESS

Samples taken must be representative of the population. Where appropriate, the population will be statistically characterized to express the degree to which the data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process, or an environmental condition. Sampling devices will be cleaned between sampling points to ensure contamination does not enter the sample. To ensure the sampling equipment has been successfully decontaminated, a rinsate of decontaminated equipment will be collected using deionized, distilled water during each sampling episode.

Trip blanks will be collected. A trip blank will consist of a volatile organic analysis (VOA) vial filled with deionized, distilled water at the laboratory. A trip blank will accompany all VOA samples shipped to the laboratory.

Trip and rinsate will be clearly marked and will not be used for MS/matrix spike duplicate (MSD) or sample duplicate analyses.

The laboratory will make every reasonable effort to assure the samples are adequately homogenized prior to taking aliquots for analysis so the reported results are representative of the sample received. It must be recognized that many means of homogenization expose the sample to significant risk of contamination or loss through volatilization and should be avoided if possible.

5.5 COMPARABILITY

All data will be calculated and reported in units consistent with other organizations reporting similar data. The results of analyses will be able to be compared with analyses by other laboratories because of the following:

- Standard EPA approved methods will be incorporated;
- Results from similar matrices will be reported in similar units;
- Laboratory quality control will be followed within the Laboratory Quality Assurance (QA) Program.

The Laboratory QA Program documents internal performance evaluations including EPA Performance Evaluation Studies.

5.6 COMPLETENESS

The completeness of the data is the amount of valid data obtained from the measurement system (field and laboratory) versus the amount of data expected from the system. At the end of each sampling event, an assessment of the completeness of data will be performed and, if any data omissions are apparent, an attempt will be made to re-sample the parameter in question, if feasible. The specific objective for completeness of this project shall be greater than or equal to 90 percent.

5.7 CALIBRATION PROCEDURES AND FREQUENCY

Instruments and equipment used to gather, generate, or measure environmental data will be calibrated with sufficient frequency and in such a manner that accuracy and reproducibility of results are consistent with the manufacturer's specifications. Calibration of laboratory equipment shall be based on approved written procedures.

5.7.1 Laboratory Equipment

Calibration of instruments and equipment will be performed at approved intervals as specified by the manufacturer or more frequently as conditions dictate. Calibrations may also be performed at the start and completion of each test run. Calibration standards used as reference standards will be traceable to the National Bureau of Standards, when existent.

Analysis of duplicate samples, spiked blanks, and matrix blanks will be performed where possible to document the effectiveness of calibration procedures. The number, frequency, and type of these samples will be sufficient to verify the success of the calibration program (at least 10 percent of all samples).

Records of calibration, repair, or replacement will be filed and maintained by the designated laboratory personnel performing quality control activities. Calibration records of assigned laboratories will be filed and maintained at the laboratory location where the work is performed and subject to QA audit.

5.7.2 Field Equipment

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions dictate. Field instruments will include a pH meter, mercury thermometer, specific conductivity meter, and OVA or HNU®.

The pH meter will be calibrated with standard buffer solutions prior to a field trip. In the field, the meter will be calibrated daily with two buffers before use. Thereafter, the meter will be checked against two buffers as deemed necessary by the field team leader. Fresh NBS traceable buffer solutions will be used for each field trip. Calibration procedures and frequency will be recorded in a field logbook, along with the lot numbers of the buffers. The mercury thermometer is calibrated by the manufacturer. The specific conductivity meter will have its conductivity cells cleaned and checked against known conductivity standards prior to a field trip. In the field, the instrument will be checked daily with NBS traceable standards. The OVA will be checked daily by use of the internal calibration mechanism. The HNU® will be calibrated daily with a gas of known concentration.

5.8 ANALYTICAL PROCEDURES

Analytical procedures will conform to the EPA publication, Test Methods for Evaluating Solid Waste (SW-846), 3rd edition.

5.8.1 Laboratory Analytical Parameters

Analyses of groundwater samples will be conducted for volatile organics, semivolatile organics, pesticides, and metals. Table 5.1 presents a list of analytical methods that will be used during the RCRA groundwater monitoring program.

The organic compounds contained in the list of parameters are Hazardous Substance List constituents that are also Appendix IX constituents. They will be determined using proven instruments and techniques to identify and quantify organic compounds. The estimated quantitation limits (EQLs) for volatile organics (SW8240), semivolatile organics (SW8270), pesticides (SW8080), organophosphorus pesticides (SW8140), chlorinated herbicides (SW8150), cyanides (SW9012), sulfides (SW9030) and dioxins and furans (SW8280) will be based on US EPA SW-846 (3rd Edition, Final Update, November 1990). As stated in SW-846 the EQLs are highly matrix dependent and are provided as guidelines and may not always be achievable.

The laboratory shall achieve the instrument detection limits or the method detection limits as described in SW-846 for methods of analyses of metals. The SW-846 methods selected for analysis of metals are SW6010, SW7060, SW7421, SW7420, SW7740, and SW7841.

TABLE 5.1
 SUMMARY OF SAMPLE CONTAINERS AND SAMPLE
 PRESERVATION METHODS FOR WATER ANALYSES
 WTI GROUNDWATER MONITORING PROGRAM

Analytical Parameters	Analytical Method	Preservation Method	Quantity	Type of Sample Container	Holding Time
Volatile Organics	SW8240	Add HCl, (4 drops) Cool, 4°C	3	40-ml., glass, Teflon®-lined septum cap	14 days
Semivolatile Organics	SW8270	Cool, 4°C	2	1-L., amber, glass	Extract 7 days Analyze 40 days after extraction
Pesticides/PCBs	SW8080	Cool, 4°C	2	1-L., amber, glass	Extract 7 days Analyze 40 days after extraction
Metals, total	SW6010 SW7060 SW7421 SW7740 SW7470/7471	Cool, 4°C HNO ₃ (5 mL)	2	1-L., polyethylene, Teflon®-lined cap	6 months (except Hg) 28 days (Hg only)
Organophosphorus Pesticides	SW8140	Cool, 4°C	1	1-L amber, glass	Extract 7 days Analyze 40 days
Chlorinated Herbicides	SW8150	Cool, 4°C	1	1-L amber, glass	Extract 7 days Analyze 40 days
Dioxins 4 Furans Herbicides	SW8280	Cool, 4°C	1	1-L amber, glass	Extract 7 days Analyze 40 days
Cyanide	SW9012	Cool, 4°C, NaOH to pH > 12, 0.6-q	1	1-L, polyethylene Teflon®-lined cap	14 days
Sulfide	SW9030	Cool, 4°C, add zinc acetate plus sodium hydroxide pH > 9	1	250-mL polyethylene Teflon®-lined cap	7 days

5.8.2 Holding Times

Table 5.1 presents the recommended holding times for each parameter analyzed. The holding times presented were obtained from SW-846 (3rd Edition, Final Update, November 1990).

5.9 LABORATORY DATA REDUCTION, VALIDATION, AND REPORTING

The procedures used for calculations and data reduction are specified in each analysis method referenced previously. The laboratory will enter raw data in bound laboratory notebooks. A separate book will be maintained for each analytical procedure. The data will be entered such that sufficient space remains to enter all subsequent calculations required to arrive at the final (reported) value for each sample. Calculations will include factors such as sample dilution ratios, corrections for blank readings and titrant normality, and conversion to dry-weight basis for solid samples. Instrument chart recordings and calculator print-outs are labeled and attached to their respective pages except for voluminous gas chromatograph recordings that are cross-referenced and stored in a separate filing cabinet.

Data will be reported as micrograms of analyte per liter for aqueous samples. Concentration units will be listed on reports and any special conditions, such as dry weight conversions, will be noted. The data reporting form will include the unique sample number given to each sample, details of sample receipt and report preparation.

5.9.1 Reporting

Reports of analytical results for this project will contain data sheets and the results of analysis of QC samples. The reports will contain the following items.

- Project identification.
- Field sample number.
- Sample matrix description.
- Date and time of sample collection.
- Analytical method description and reference citation.
- Individual parameter results.
- Date of analysis (extraction, first run, and subsequent runs).
- Detection limits achieved.
- Dilution or concentration factors.
- Corresponding QC report.

The QC report will contain level IV reporting requirements consisting of, but not limited to, results of surrogate spikes, MS/MSD samples, method blanks and initial and continuing instrument calibrations.

Quality control results will be reviewed by the laboratory supervisor to determine the accuracy and precision of the analytical results. The laboratory supervisor or the laboratory director will review all final reports and associated quality control data. Approval will be shown by a signature. Results will be recorded on the QC report forms for the appropriate tests and correlated to the analysis results by the QC report number. The QC results will be used to prepare control charts for each test.

Raw GC/MS data will be archived on magnetic tape. Chromatograms and reports from all analyses will be saved in appropriate files.

The flagging of results will consist of the following:

- Value - If the result is a value greater than or equal to the instrument detection limit but less than the quantitation limit, the value is reported in brackets (i.e., [10]). The analytical method used is indicated with P (for ICP), A (for flame AA) or F (for furnace AA).
- U - Indicates element was analyzed for but not detected. Reported with the instrument detection limit value (e.g., 10 U).
- J - Indicates an estimated value.
- B - This flag is used when the analyte is found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

Other specifying flags:

- N - Indicates spike sample recovery is not within control limits.
- * - Indicates duplicate analysis is not within control limits.
- M - Indicate duplicate injection results exceeded control limits.
- NA - Not analyzed.
- S - Spiked compound.

5.10 INTERNAL QUALITY CONTROL

The purpose of internal quality control is to ensure the data generated is of known quality.

5.10.1 Field Activities

During each sampling episode, several quality control (QC) samples will be collected and submitted to the laboratory for analyses. The types of QC samples that will be collected are described in briefly in Sections 5.10.1.1 through 5.10.1.4.

Table 5.2 presents a summary of the data collection plan for the baseline groundwater sampling. Also presented are data types (e.g., volatile organics), analytical method, and number and types of quality control samples.

5.10.1.1 Trip Blank

Trip blanks will be analyzed for volatile organics. The analytical results serve as a baseline measurement of volatile organic contamination that samples may be exposed to during transport and laboratory storage prior to analysis.

Trip blanks originate in the laboratory. They are a sample bottle filled by the laboratory with distilled, deionized water, transported to the site, handled like a sample, but not opened, and returned to the laboratory for analysis. One trip blank will be sent with every container of VOC samples sent to the laboratory.

5.10.1.2 Equipment Rinseate Samples

Equipment rinseate samples are defined as distilled, deionized grade water poured into or pumped through the sampling device, transferred to the sample bottle, then transported to the laboratory for analysis.

One equipment rinseate sample will be collected and analyzed during each quarterly groundwater sampling episode. The equipment rinseate samples are to be analyzed for all laboratory measured parameters.

5.10.1.3 Field Duplicates

A field duplicate is defined as two or more samples collected independently at a sampling location during a single sampling event. The total number of field duplicates varies by sample analysis, but is always equal to 10 percent of the groundwater samples collected, to the next whole number. For example, for 10 samples, one duplicate; but for 11 samples, two duplicates would be required.

Field duplicates shall be indistinguishable by the laboratory from other samples.

5.10.2 Laboratory Quality Control

QC data are necessary to determine precision and accuracy and to demonstrate the absence of interference and/or contamination of glassware and reagents. Laboratory-based QC will constitute at least 10 percent of each data set generated and will consist of blanks, replicates, standards, MSs, surrogate spikes and blanks. Depending upon the particular method used, QC may be more rigorous, but at a minimum, one MS and MSD will be provided at a frequency of one in every 20 samples. EPA recommended matrix spiking solutions will be used for GC/MS parameters. Precision and accuracy data will be based on only these spiking compounds. Surrogates will be added to all samples requiring GC/MS analysis. One method blank will be run for every 20 samples analyzed. Blank samples will be analyzed in order to assess possible contamination and determine what corrective measures need to be taken.

TABLE 5.2
DATA COLLECTION PLAN SUMMARY
WTI GROUNDWATER MONITORING PROGRAM

	Field Samples	Field Duplicates	Trip Blanks	Equipment Rinsates	MS/MSD Duplicate (Water)
Volatle Organics (SW8240)	6	1	1	1	1
Semivolatle Organics (SW8270)	6	1	-	1	1
Pesticides/PCBs (SW8080)	6	1	-	1	1
Metals (1)	6	1	-	1	1
Cyanide (SW9012)	6	1	-	1	-
Indicators/pH, Temperature, Conductivity	6	1	-	-	-
Organophosphorus Pesticides (SW 8140)	6	1	-	1	1
Chlorinated Herbicides (SW8150)	6	1	-	1	1
Dioxins and Furans (SW8280)	6	1	-	1	1
Sulfide (SW9030)	6	1	-	1	1

(1) Metals Methods Include: SW6010, SW7060, 7421, SW7420, SW7740, SW7841

5.10.2.1 Analytical Replicate Analyses

Replicate samples are aliquots of a single sample that are split on arrival at the laboratory or upon analysis. Since it is anticipated that the levels of most parameters will be below the laboratory detection limits, precision data on replicate analyses will largely be derived from matrix spike and MSD data for GC and GC/MS analyses. Significant differences between two replicates that are split in a controlled laboratory environment, will result in flagging the affected analytical results.

5.10.2.3 Calibration Standards

A calibration standard is prepared in the laboratory by dissolving a known amount of a pure compound in an appropriate matrix. The final concentration calculated from the known quantities is the true value of the standard. The results obtained from these standards will be used to generate a standard curve and thereby quantify the level of compound in the environmental sample.

5.10.2.4 Surrogate Spike Analyses

A surrogate spike analysis is used to find the efficiency of recovery of analytes in the sample preparation and analysis. Calculated percentage recovery of the spike is used as a measure of the accuracy of the total analytical method. A surrogate spike is prepared by adding to a sample (before extraction), a known amount of pure compound of similar type to that to be assayed in the sample. Surrogate compounds will be added to all samples, method blanks, duplicate samples, and matrix spikes as recommended in the methods. If the PR does not fall within the limits prescribed by the methods, the corrective actions described in the method will be implemented.

5.11.4 Matrix Spike/Duplicate Spike Analyses

This technique will be used to find the effect of matrix interferences on analysis results. Aliquots of the same sample will be prepared in the laboratory and each aliquot will be treated exactly the same throughout the analytical method. Spikes will be added at concentrations specified in the method. The percent difference between the values of the spiked duplicates will be noted as a measure of the precision of the analytical method.

Selected samples will be spiked to find accuracy as a percentage of the analyte from the sample matrix. These matrix spikes will be prepared using reagent grade salts, pure compounds, or certified stock solutions. Concentrated solutions will be used to minimize differences in the sample matrix resulting from dilution. Samples will be randomly selected and split into identical duplicates, one of which will then be spiked with a known concentration of the analyte to be determined. The final concentration after spiking should be within the same range as the samples being analyzed to avoid the need for dilution, attenuation of instrument outputs, or other required alterations in the procedure that might affect the instrument response and determination of accuracy.

The results of the analyses will be reviewed by the laboratory supervisor. Deviations from the established QC criteria will be noted and reanalyzed or other corrective action will be implemented as necessary.

5.11 PERFORMANCE AND SYSTEM AUDITS

Quality assurance audits will be performed by the laboratory quality assurance officer (QAO) or designated alternate. The QAO will plan, schedule, and approve system and performance audits based upon company procedure customized to the project requirements. These audits will be implemented to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement systems. At times, the QAO may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have participated in nor have responsibility for the direct work associated with the performance audit.

5.12 PREVENTIVE MAINTENANCE OF LABORATORY INSTRUMENTS

All analytical instruments will be serviced at intervals recommended by the manufacturer. Service contracts for regular maintenance and emergency service will be maintained for major instruments. An instrument repair maintenance logbook will be kept for each instrument. Entries will include the date of service, type of problem encountered, corrective action taken, and initials and affiliation of the person providing the service.

Any degradation of instrument performance such as changes in the response factors or sensitivity will be used as indication of potential problems. These will be brought to the attention of the laboratory supervisor and preventative maintenance or service will be scheduled to minimize downtime. Back-up instrumentation and an inventory of critical spare parts will be maintained to minimize delays in completion of analyses.

5.13 DATA ASSESSMENT PROCEDURES

The precision, accuracy, and completeness of measurement data generated during the monitoring will be assessed. The assessment procedures are described in Sections 5.3, 5.4 5.5. The analytical procedures identified in Section 5.8 require quality control checks such as calibration verifications, method blanks internal standards, and interference blanks. These checks are made possible by the inclusion of QC samples into the sample data collection process. Section 5.10 specifies the type and number of QC samples that will be analyzed. The data generated will be used during the data validation process.

5.14 CORRECTIVE ACTION

The following procedures have been established to assure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, evaluated, and corrected.

When a significant condition adverse to quality is noted at a site, laboratory, or subcontractor locations, the cause of the condition will be determined and corrective action taken to preclude repetition. Condition identification, cause, reference documents, and corrective action planned to be taken will be documented and reported to the site investigation team leader, project manager, project QA officer, and involved subcontractor management, as a minimum. Implementation of correction action is verified by follow-up action. All project personnel have the responsibility, as part of the normal work duties, to promptly identify, correct, and report conditions adverse to quality.

Corrective actions may be initiated as a minimum:

- When predetermined acceptance standards are not attained (objectives for precision, accuracy and completeness)
- When procedures or data compiled are determined to be faulty
- When equipment or instrumentation is found faulty
- When samples and test results are questionably traceable
- When designated approvals have been circumvented
- As a result of system and performance audits
- As a result of a management assessment
- As a result of laboratory/inter-laboratory comparison studies

The field investigation team, quality assurance auditors, document and sample control personnel, and laboratory groups, will monitor on-going work performance in the normal course of daily responsibilities. Work at the site will be monitored by the field team leader.

5.15 QUALITY ASSURANCE REPORTS

A QA report will be prepared that includes the following:

- QA/QC activities over the reporting period;
- Any problems/comments associated with the analytical and sampling effort; and
- Any corrective actions taken in the field, results of any audits, and any modifications to laboratory protocols will be discussed.

A summary of QA/QC activities and any problems/resolutions associated with the sampling and analytical effort will be included in the annual monitoring report.

SECTION 6 HEALTH AND SAFETY PLAN

6.1 GENERAL HEALTH AND SAFETY REQUIREMENTS

The purpose of this plan is to identify the health and safety policies, practices, and procedures to be followed during well installation and groundwater sampling at the Waste Technologies Industries (WTI) Plant site in East Liverpool, Ohio. In addition, this plan assigns responsibilities, specifies appropriate personal protective equipment and clothing, outlines site monitoring, and provides for contingencies that may arise during the installation and sampling of monitoring wells at the site. The provisions of this plan are equally applicable to Engineering-Science, Inc. (ES) personnel and personnel working for subcontractors of ES. In addition to the Health and Safety Plan presented here, ES and their subcontractors will follow WTI's contractor safety rules. A Plan Acceptance Form (Figure 6.1) will be signed by all personnel working on the site. Details concerning site location, history and background can be found in Section 1 and 2 of the Work Plan.

6.2 SCOPE OF WORK

Field activities that are to be performed during the groundwater monitoring program include:

- installation of groundwater monitoring wells; and
- groundwater sampling.

6.3 PROJECT TEAM ORGANIZATION

The names of on-site ES project personnel are as follows:

Project Manager: Ed Staes

Field Team Leader: To be announced*

Project Health and Safety Officer: To be announced*

6.3.1 Responsibilities of Project Personnel

The project manager is responsible for the following:

- preparing and organizing the background review of the sites.

* The same individual fulfills both functions due to small level of effort for this project.

**FIGURE 6.1
PLAN ACCEPTANCE FORM**

PROJECT HEALTH AND SAFETY PLAN

I have read and agree to abide by the contents of the Health and Safety Plan for the following project:

**WTI Groundwater Monitoring Program
East Liverpool, Ohio**

Name (print)

Signature

Date

Return to Project Health and Safety Officer before entering site.

- coordinating the preparation and execution of the Work Plan and Health and Safety Plan.
- preparing and organizing the field team.

The field team leader has the authority to direct operations and site activities and his responsibilities include the following:

- managing field operations;
- executing the work plan and schedule;
- coordinating with the project health and safety officer in determining the appropriate protection level;
- enforcing site control;
- documenting field activities and sample collection; and
- serving as a liaison.

The responsibilities of the project H&S officer include the following:

- periodically inspecting protective clothing and equipment;
- ensuring that protective clothing and equipment are properly stored and maintained;
- controlling entry and exit at the access control points;
- confirming each team member's suitability for work based on a physician's recommendation;
- monitoring the work parties for signs of stress, such as cold exposure, heat stress and fatigue;
- implementing the Project Health and Safety Plan;
- conducting periodic inspections to determine if the Project Health and Safety Plan is being followed;
- enforcing the "buddy" system;
- knowing emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department and police department;
- notifying, when necessary, local public emergency officials;
- coordinating emergency medical care;
- setting up decontamination lines and the decontamination solutions appropriate for the type of chemical contamination on site;
- controlling the decontamination of equipment, personnel, and samples from the contaminated areas;

- assuring proper disposal of contaminated clothing and materials;
- ensuring that required equipment is available;
- advising medical personnel of potential exposures and consequences; and
- notifying emergency response personnel by telephone or radio in the event of an emergency;

Project team members involved in this field investigation are responsible for the following:

- taking precautions necessary to prevent injury to themselves and other employees;
- complying with the Project Health and Safety Plan and reporting any deviations from this plan to the field team leader;
- maintaining visual contact between partners (buddy system);
- performing only those tasks they believe they can do safely; and
- immediately reporting any accidents and/or unsafe conditions to the field team leader.

6.4 MEDICAL SURVEILLANCE AND TRAINING REQUIREMENTS

On-site ES personnel and personnel working for ES subcontractors are required to receive 40 hours of initial training in hazardous waste operation prior to participating in this project (29 CFR Part 1910.120[e] and ES Health and Safety Manual, Section 4, 1987 with revisions). Personnel engaged in hazardous waste operations are also required to be enrolled in a medical surveillance program (29 CFR Part 1910.120[f] and ES Health and Safety Manual, Section 4, 1987 with revisions).

6.4.1 Work Site Training

Prior to beginning work on, the project H&S officer will provide a briefing which covers the following topics:

- name of personnel responsible for site safety and health;
- site history;
- safety, health and other hazards at the site;
- work practices by which the employee can minimize risk from hazards;
- acute effects of compounds at the site;
- evacuation procedures and routes to emergency medical treatment facilities; and
- decontamination procedures.

6.4.2 Daily Training Sessions

Each morning before work begins, a short 5- to 10-minute training session will be held covering one of the previous work-site training topics and plans for the days activities. The

project H&S officer is responsible for this training and will record in his logbook the date, time, topics covered, attendees and location of all training.

6.4.3 Medical Surveillance

ES utilizes the services of licensed, local physicians to provide medical surveillance of ES employees. Personnel working for ES subcontractors must also be provided with medical surveillance examinations prior to commencing on-site activities. The content of the examination must be sufficiently detailed to determine an individual's fitness for work, including his ability to work while wearing protective equipment. A letter attesting to each individual's fitness for work must be provided to the ES project manager prior to that individual working in the field.

6.4.4 Site Visitor Policies

All visitors entering the ES work zones must report to the on-site ES representative and state their purpose for entering the area. The ES representative will record the persons name, date and purpose for entering the area in the field logbook.

6.4.4.1 Review of Health and Safety Plan

All persons, including visitors, entering the ES exclusion zone must read the Health and Safety Plan and sign the plan acceptance form (Figure 6.1).

6.4.4.2 Training Requirements

Visitors entering an ES exclusion zone are required to have the same training as ES personnel and ES subcontractors as stated above. In addition, each visitor who goes beyond the site support zone will first receive site-specific training from the field team leader/project H&S officer. This training should include a briefing on site contaminant and physical hazards, required personal protective equipment/clothing, emergency procedures, and site work zone locations. Visitors are required to provide their own protective equipment. If a visitor does not have the required protective equipment or does not comply with site health and safety requirements, the health and safety officer may request they leave the site.

6.5 CHEMICAL HAZARDS

6.5.1 Potential Chemical Hazards for Specific Sites

This section contains site specific information for the site. Included in the site specific section are protective measures, a hazard analysis, site contaminants, and site monitoring requirements. Site history and description are presented in Section 1 of the Work Plan. As a result of the previous investigations at the Site, a number of contaminants have been detected in the environment at this site. These contaminants and their detected concentrations are displayed in Table 6.1.

6.5.2 Protective Measures

The following field activities are planned for the WTI Site:

- installation of groundwater monitoring wells; and
- collection of groundwater samples from monitoring wells.

6.5.3 Hazard Analysis

The chemical contaminants that have been detected at this site are presented in Table 6.2 (along with health hazard information for each chemical compound).

It is not expected that the airborne concentrations of these contaminants will approach concentrations of health significance during field activities due to the relatively low environmental concentrations of these compounds. However, in addition, a number of the contaminants included in Table 6.2 are skin and eye irritants. To protect field personnel from these irritants, impermeable gloves and boots, and eye protection will be worn whenever the potential exists for liquid splashes (e.g., during groundwater sampling or well development). Skin or eye disorders (rashes, conjunctivities, etc.) should be reported immediately to the project H&S officer by all site workers and good personal hygiene (hand washing and showers) and procedures for use of protective clothing must be followed by all site workers.

Based on the foregoing discussion, the following protection levels shall be used at the start of each activity at the WTI site:

Activity	Initial Level of Protection
Groundwater monitoring well installation	D
Collect groundwater samples	D

6.5.4 Air Monitoring

Initial site monitoring will be conducted utilizing level D protection. Site work zones will be established based upon these ambient monitoring results and the type of activities that are to be performed. Monitoring is repeated:

- whenever a different type of operation is initiated, for example, ground-water sampling as opposed to drilling;
- when weather conditions change;
- when work begins on a different portion of the site; and
- at 5-foot intervals during boring activities.

A photoionization detector, combustible gas indicator, and colorimetric indicator tubes will be the primary site monitoring devices used during this investigation.

TABLE 6.2
HEALTH HAZARDS OF POTENTIAL CONTAMINANTS
WTI GROUNDWATER MONITORING PROGRAM

Compound	PEL (1)	TLV ⁽²⁾	IDLH ⁽³⁾	Odor Threshold	Chemical Properties	Health Effects/Symptoms
Acetone	750	750	20,000	2.0	FP = 1.4° VP = 266 mm Hg (77°F) IP = 9.69 eV	Irritant eyes, nose and throat. Can cause headaches and dizziness in high concentrations.
Benzene	1	10	2,000	0.2-2	FP = 12° F VP = 75 mm Hg IP = 9.25 eV	Eye and nose irritant. Chronic exposure has been linked to leukemia.
2-Butanone (Methyl Ethyl Ketone - MEK)	200	200	3,000	5.4-10	FP = 21° F VP = 70.6 mm IP = 9.48 eV	Irritant of eyes, nose, and throat. Can cause headaches and dizziness.
Ethylbenzene	100	100	2,000	2.0	FP = 59° F VP = 7.1 mm IP = 8.76 eV	Irritating to eyes, mucous membranes, and skin. Can also cause headaches, narcosis and even coma.
4-Methyl-2-Pentanone (Methyl Isobutyl Ketone - MIBK)	50	50	3,000	0.5	FP = 73° F VP = 15 mm IP = 9.30 eV	Irritant of eyes and mucous membranes. Can also cause headaches and narcosis.
Petroleum Hydrocarbons (petroleum distillates-naphtha)	400	300	10,000	Less than PEL	FP = -40 to -86° F VP = About 40 mm IP = (a)	Mucous membrane irritant and anesthetic.
Toluene	100	100	2,000	0.2-4.0	FP = 40° F VP = 22 mm Hg IP = 8.82 eV	Fatigue, weakness, confusion, and headache.
Trichloroethylene	50	50	(a)	20	FP = Not combustible VP = 58 mm IP = 9.47 eV	Eye, nose and throat irritant with narcotic effect. Possible carcinogen.

TABLE 6.2--CONTINUED
HEALTH HAZARDS OF POTENTIAL CONTAMINANTS
WII GROUNDWATER MONITORING PROGRAM

Compound	PEL ⁽¹⁾	TLV ⁽²⁾	IDLH ⁽³⁾	Odor Threshold	Chemical Properties	Health Effects/Symptoms
Xylenes	100	50	10,000	0.05-200	FP = 81-90 °F VP = 7.9 mm IP = 8.44-8.56 eV	Dizziness, drowsiness irritant and may cause vomiting and abdominal pain.

- 1 OSHA - enforced average concentration of chemical in the air to which a worker may be exposed for an 8-hour workday without harm. Permissible Exposure Limits are published in 29 CFR 1910.1000.
 - 2 Time weighted average concentration of chemical in the air during an 8-hour workday recommended by the American Conference of Governmental and Industrial Hygienists (ACGIH).
 - 3 Concentration of chemical in the air that an unprotected worker can escape from without debilitating injury or health effects.
- FP = Flashpoint
 VP = Vapor pressure at 68 ° F.
 IP = Ionization potential.
 eV = Electron volt.
 (a) No data available.

References: Federal Register, 1989; ACGIH, 1988; Little, October 1985; NIOSH, September 1985; Sittig, 1985; NIOSH/OSHA, January 1981; and NSC, 1979.

Since potential exposure via inhalation to the volatile compounds in Table 6.3 is a possibility, site air monitoring must be conducted. Work zones and required personal protection for each site will be established based upon air monitoring results. Air monitoring will be conducted using a photoionization detector (PID) with a 10.2 electron volt (eV) lamp and a combustible gas meter. Colorimetric indicator tubes for detection of benzene will also be used on this site and the manufacturer's literature will be consulted for use of these tubes.

6.5.4 Air Monitoring Criteria

During the field activities at this sites, the air monitoring criteria identified below will be used to determine the appropriate level of personnel protection.

PID Reading at Breathing Zone Height	Respiratory Protection Level
0 to 5 ppm	Level D
5 to 50 ppm	Level C

Note: due to the possible presence of benzene, the air monitoring criteria for this site will involve the use of colorimetric indicator tubes to monitor for benzene. If organic vapor monitoring (with the PID) indicates the presence of any vapors above background levels, a benzene colorimetric indicator tube will be used to determine its airborne concentration. The manufacturer's operating instructions will be consulted to ascertain the appropriate operating procedures for the indicator tube used. During the investigation at this site, the air monitoring criteria identified below will be used to determine the appropriate level of personnel protection. If benzene is detected in the air at 1 ppm or greater (based on colorimetric tube readings), the level of protection will be modified as follows:

Draeger Tube Reading at Breathing Zone Height	Respiratory Protection Level
0 to <1 ppm	Level D
> 1 to 50 ppm	Level C

The following criteria will be used to evaluate and take action concerning flammable or explosive vapors:

Lower Explosive Limit	Action
10 to 20 percent	Use non-sparking tools
Greater than 20 percent	Evacuate site and take remedial action

Air monitoring will be performed when:

- a different type of field activity begins;
- weather conditions change;

TABLE 6.3
SIGNS AND SYMPTOMS OF HEAT STRESS⁽¹⁾
WTI GROUNDWATER MONITORING PROGRAM

- **HEAT RASH** may result from continuous exposure to heat or humid air.
- **HEAT CRAMPS** are caused by heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:
 - muscle spasms; and
 - pain in the hands, feet, and abdomen.
- **HEAT EXHAUSTION** occurs from increased stress on various body organs including inadequate blood circulation due to cardio-vascular insufficiency or dehydration. Signs and symptoms include:
 - pale, cool, moist skin;
 - heavy sweating;
 - dizziness;
 - nausea; and
 - fainting.
- **HEAT STROKE** is the most serious form of heat stress. Temperature regulation fails and the body temperature rises to critical levels. Immediate action must be taken to cool the body before serious injury and death occur. Competent medical help must be obtained. Signs and symptoms are:
 - red, hot usually dry skin;
 - lack of or reduced perspiration;
 - nausea;
 - dizziness and confusion;
 - strong, rapid pulse; and
 - coma.

(1) NIOSH/OSHA/USCG/EPA, 1985.

- work begins on a different portion of the site; and
- drilling after each 5-foot interval.

The project H&S officer will be contacted if modification of the level of protection is deemed necessary.

6.6 PHYSICAL HAZARDS

The scope of work for this project involves working outdoors around vehicles and heavy equipment. Any project involving heavy equipment, unimproved work sites, and outside work can present numerous physical hazards to the work force. Training, adherence to work rules and careful housekeeping can prevent many problems or accidents arising from physical hazards. The general rules and preventative measures for this project are as follows. The prevention of accidents on this site is addressed below.

6.6.1 Explosion Hazard

No flammable materials will be brought on site. Concentration of explosive vapor associated with drilling operations will be carefully monitored during drilling operations.

6.6.2 Hoisting Accidents

Employees can have suspended loads dropped on them, be caught behind a load and a stationary object, or be struck by counterweights. Accidents of this type are most likely during drilling operations and can be prevented by safe operation of drilling equipment, wearing of protective equipment including a hard hat and safety boots, and attentiveness to detail by all personnel. Cables, ropes, bolts and clamps used in drilling operations will be inspected and comply with the strength requirements specified by OSHA in 29 CFR 1926.251.

6.6.3 Heavy Equipment

Heavy equipment will be inspected periodically to ensure all safety equipment and devices, including backup alarms, brakes, control levers and fire extinguishers, are operational and ready for immediate use.

6.6.4 Flammable Liquids

Small quantities of flammable liquids will be stored in "safety" cans and labeled according to contents. Open flames will be prohibited within 50 feet of flammable storage areas.

6.6.5 Slip, Trip, and Fall Hazards

Personnel should be constantly aware of the possibility of slips, trips, and falls due to poor and possibly slippery footing in the work areas.

6.6.6 Subsurface Hazards

Prior to any drilling activity, efforts must be made to determine whether underground installations including sewers, telephone, water, fuel, and electric lines, will be encountered

- If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one third.
- 2. Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking).
 - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period.
 - If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following cycle by one-third.
 - Do not permit a worker to wear a semi-permeable or impermeable garment when the oral temperature exceeds 100.6°F (38.1°C).

6.6.9.2 Cold-Related Illness

If work on this project is accomplished during the winter months, thermal injury due to cold exposure becomes a problem for field personnel. Hypothermia and frostbite are the two injuries which can result due to exposure to the cold.

Frostbite is both a general and medical term given to areas of local cold injury. Unlike systemic hypothermia, frostbite rarely occurs unless the ambient temperatures are less than freezing and usually less than 20°F.

Hypothermia is defined as a decrease in the body core temperature below 96°F. The body temperature is normally maintained by a combination of central (brain and spinal cord) and peripheral (skin and muscle) activity. Interferences with any of these mechanisms can result in hypothermia, even in the absence of what normally is considered a "cold" ambient temperature.

The following symptoms appear (in order as listed) as the body loses heat faster than it can be produced.

- Voluntary exercise in order to stay warm
- Involuntary exercise in order to stay warm (shivering)
- Feeling of apathy, listlessness and indifference
- Loses control of the hands

The following steps should be taken to prevent hypothermia:

- educating workers to recognize the symptoms of frostbite and hypothermia;
- ensuring the availability of dry clothes;
- developing a capability for temperature recording at the site; and
- assuring the availability of warm drinks.

Monitoring the oral temperature recording at the job site can be used to monitor for cold related injuries. This should be done at the Project Health and Safety Officers discretion based on the following;

- changes in worker's performance or mental status;
- at the worker's request;
- as a screening measure, two times per shift, when hazardous conditions windchill less than 20°F or a windchill less than 30°F with precipitation exist; and
- as a screening measure whenever any one worker on the site develops hypothermia.

Any person developing moderate hypothermia defined as a core temperature of 92°F cannot return to work for 48 hours.

6.7 PERSONAL PROTECTIVE EQUIPMENT

Based on a review of site history, description, and data, it is anticipated that routine investigation activities at this site will require level d protection. However, level c is also delineated below in case air monitoring or site conditions require additional protection.

6.7.1 Level C Protection

Specific protective equipment for level c personal protection includes:

- full-face air purifying respirator with combination organic vapor and high efficiency particulate filter (HEPA) cartridges;
- chemical resistant clothing (e.g., Saranex™) with hood;
- inner PVC gloves;
- outer butyl rubber gloves;
- chemically resistant safety boots or safety boots with disposable chemically resistant boot covers (chemical resistant layer is to be of butyl rubber); and
- hard hat whenever in the vicinity of heavy equipment.

6.7.2 Level D Protection

Specific level d protective equipment includes:

- safety boots;
- butyl rubber gloves;
- chemical splash goggles for ground-water sampling activities if splash hazard is present; and
- hard hat whenever in the vicinity of heavy equipment.

6.7.3 Protective Equipment Requirements

All personal protective equipment used during the course of this field investigation will meet the following applicable Occupational Safety and Health Administration (OSHA, 1988) requirements:

Type of Protection	Regulation	Source
Eye and face	29 CFR 1910.133	ANSI Z87.1
Respiratory	29 CFR 1910.134	ANSI Z88.1
Head	29 CFR 1910.135	ANSI Z89.1
Foot	29 CFR 1910.136	ANSI Z41.1

ANSI = American National Standards Institute

If level c respiratory protection is used personnel must wear a respirator that has been successfully fitted to the face.

Air purifying respirators cannot be used under the following conditions (NIOSH/OSHA/USCG/EPA, 1985):

- oxygen deficiency;
- immediately dangerous to life or health (IDLH) concentration exists; or
- contaminant levels exceed designated maximum use concentrations.

The action levels used to determine the required levels of protection for work activities and specific measuring instruments are presented in Section 6.5.

6.8 SITE WORK ZONES

To reduce the spread of hazardous materials by workers from the contaminated areas to the clean areas, work zones will be delineated. The establishment of the work zones will help ensure personnel are properly protected against the chemical and physical hazards present in a given area, work activities and contamination are confined to the appropriate areas, and personnel can be located and evacuated in an emergency.

6.8.1 Exclusion Zone

The exclusion zone is an area where contamination does or could occur. An exclusion zone will be established for all drilling and groundwater sampling activities. Access into the exclusion zone will be controlled to ensure that personnel entering the areas are wearing the proper protection. Unprotected onlookers should be located 50 feet upwind of this zone.

6.8.2 Contamination Reduction Zone (For Level C Operations Only)

This will be established by the project H&S officer as a buffer zone between the exclusion zone and the support zone (for level C operations). This zone will not be established for drilling or groundwater sampling which is conducted in level d protection.

The contamination reduction zone will contain the personnel and equipment decontamination stations. The contamination reduction zone should always be located upwind of the exclusion zone in an area devoid of air contaminants.

6.8.3 Support Zone

The support zone will include the remaining areas of the job site. Break areas and operational direction and support facilities will be located in this area. No equipment or personnel will be permitted to enter the support zone from the contamination reduction zone without passing through the personnel or equipment decontamination stations. Eating, smoking, and drinking will be allowed only in this area.

6.9 PERSONNEL DECONTAMINATION

To prevent harmful materials from being transferred into clean areas or from exposing unprotected workers, all field personnel exiting an area of potential contamination will undergo decontamination. The extent of decontamination depends on a number of factors, the most important being the type and concentration of the contaminant involved. Personnel decontamination will be required for work done under level c conditions but not under level d conditions.

Soft-bristled scrub brushes and long-handle brushes will be used to remove contaminants from personnel. Washing and rinsing are done in combination with a sequential doffing of clothing starting at the first decontamination station with the most heavily contaminated article and progressing to the last station with the least contaminated article. Buckets of water or garden sprayers will be used for rinsing. Metal or plastic cans or drums will be used to store contaminated liquids. Large plastic garbage bags will be used to store contaminated clothing (gloves, etc.) and equipment.

6.9.1 Level C Decontamination

Decontamination procedures will be divided into nine stations. level c decontamination will consist of the following:

Station 1: Segregated Equipment Drop

Deposit equipment used on the site such as tools, sampling devices, containers, monitoring instruments, and clipboards on plastic drop cloths or in different containers with plastic liners. Each will be contaminated to a different degree. Segregation at the drop reduces the probability of cross-contamination. Necessary equipment includes:

- containers of various sizes;
- plastic liners; and
- plastic drop cloths.

Station 2: Suit/Safety Boot and Outer-Glove Wash

Thoroughly wash chemically resistant suit, safety boots and outer gloves. Scrub with long-handle, soft-bristle scrub brush and copious amounts ofalconox/water solution. For heavy oil contamination, isopropanol should be used to wash suit, boots, and outer gloves. Analconox water solution wash should follow the isopropanol wash. Repeat as many times as necessary. Necessary equipment includes:

- 30 gallon container;
- alconox/water solution;
- long-handle soft-bristle scrub brushes; and

Station 3: Suit/Safety Boot and Outer-Glove Rinse

Rinse offalconox/water solution using copious amounts of water. Repeat as many times as necessary. Necessary equipment includes:

- 30 gallon container;
- spray unit;
- water; and
- long-handle, soft-bristle scrub brushes.

Station 4: Outer Gloves Removal

Remove the outer gloves and deposit in individually marked plastic bags. Necessary equipment includes:

- plastic bag and
- bench or stool.

Station 5: Cartridge or Respirator Change

If a worker leaves the exclusion zone to change a cartridges or respirator, this is the last step in the decontamination procedures. The worker changes the respirator or cartridges, dons new outer gloves, tapes joints, and returns to duty. Otherwise the worker proceeds to Station 6. Necessary equipment includes:

- cartridges (or respirator);
- tape; and
- gloves.

Station 6: Removal of Chemically Resistant Suit

With assistance of helper, remove suit. Deposit in container with plastic liner. Necessary equipment includes:

- 30 gallon container;
- chair; and

- plastic liner.

Station 7: Inner-Glove Wash and Rinse

Wash and rinse inner gloves withalconox/water solution that will not harm skin. Repeat as many times as necessary. Necessary equipment includes:

- alconox/water solution;
- container; and
- long-handle soft-bristle brushes.

Station 8: Respirator Removal

Remove facepiece. Avoid touching face. Wash respirator in clean, sanitized solution, allow to dry and deposit facepiece in plastic bag. Store in clean area. Necessary equipment includes:

- plastic bags;
- sanitizing solution; and
- cotton.

Station 9: Inner-Glove Removal

Remove inner gloves and deposit in container with plastic liner. Necessary equipment includes:

- container and
- plastic liners.

Modification can be made to the nine station decontamination process depending upon the extent of contamination. The effectiveness of the decontamination process is checked by visual inspection and survey with a photoionization detector.

6.9.2 Decontamination During Medical Emergencies

During some medical emergencies, it is possible that decontamination may aggravate or cause more serious health effects. If prompt life-saving first aid and medical treatment is required, decontamination procedures should be omitted. Whenever possible, personnel should accompany injured personnel to the medical facility to advise on matters involving decontamination.

6.10 CONTINGENCY PLAN FOR EMERGENCIES

6.10.1 Emergency Procedures

In the event that an emergency develops on site, the procedures delineated herein are to be immediately followed. Emergency notification information is contained in Section 6.12. Emergency conditions are considered to exist if any member of the field crew is involved in an accident or experiences any adverse effects or symptoms of exposure while

onsite or a condition is discovered that suggests the existence of a situation more hazardous than anticipated.

6.10.2 Emergency Equipment

In each operative decontamination area, an emergency equipment station will be established with the following: first-aid kit, and a fire extinguisher.

6.10.3 "Buddy" System

All work in the exclusion zone will be done using the "buddy" system. Prior to entering the exclusion zone, buddies will be assigned. Buddies are responsible for ensuring the safety of their respective buddies and should be aware of the potential for exposure to materials found on site and general hazards of the workplace.

6.10.4 Chemical Exposure

If a member of the field crew demonstrates symptoms of chemical exposure, the procedures to be followed are:

- another team member (buddy) should remove the individual from the immediate area of contamination and communicate to the field team leader via two-way radio or hand signals of the chemical exposure;
- the project H&S officer should contact the appropriate emergency response agency;
- precautions should be taken to avoid exposure of other individuals to the chemical;
- if the chemical is on the individual's clothing, the chemical should be neutralized or removed;
- if the chemical has contacted the skin, the skin should be washed with copious amounts of water; and

All chemical exposure incidents must be reported in writing to the office H&S representative. The project H&S officer is responsible for completing an accident report. Copies of this form will be kept on site by the project H&S officer.

6.10.5 Personal Injury

In cases of personal injury at the site, the procedures used are:

- the injured team member's buddy will signal the field team leader via two-way radio or hand signals that a injury has occurred;
- a field team member trained in first aid will administer treatment to the injured worker; and
- the victim will then be transported to the nearest hospital or medical center by ambulance if necessary.

The project H&S officer are responsible for making certain that an accident report form is completed. This form is to be submitted to the office H&S representative. Follow-up action can then be taken to correct the situation that caused the accident.

6.10.6 Evacuation Procedures

The project H&S officer will initiate evacuation procedures by advising all site personnel to leave the site. All personnel in the work area will evacuate the area and meet in the designated area for an accounting of personnel. Further instructions will then be given by the project H&S officer.

6.11 MONITORING EQUIPMENT CALIBRATION AND MAINTENANCE

Monitoring instruments used for assuring work safety must be calibrated and maintained periodically. It is important that the operator ensures the instrument responds properly to the substances it was designed to monitor and that the limitations and possible sources of errors in instrument measurements be understood by the operator.

6.11.1 HNU® Photoionization Detector

A photoionization detector will be used to monitor the level of volatile organics in the air.

The detector must be calibrated each day prior to field use. A calibration gas will be taken into the field to perform this routine calibration check. The procedure for the calibration and maintenance of a photoionization detector is listed in Tables 6.4 and 6.5. The instrument's function may be verified with an organic point source such as a "magic marker" prior to field survey.

6.11.2 Biosensor®II Combustible Gas Indicator

A combustible gas indicator will be used to monitor the concentration of combustible gases in the air.

The combustible gas indicator must be calibrated each week. The procedure for calibrating this instrument is given in Table 6.6.

The combustible indicator uses a 2-volt lead gel cell battery. This battery should be charged daily or as use dictates. The battery cannot be overcharged.

6.12 EMERGENCY CONTACTS

In the event of any unplanned occurrence requiring assistance, the appropriate contact(s) should be made, from the list below. This emergency contacts list must be posted at the site.

TABLE 6.4
CALIBRATION PROCEDURE FOR THE PHOTOIONIZATION METER
WTI GROUNDWATER MONITORING PROGRAM

Step Procedure	Number
1	Attach the probe to the readout unit. Match the alignment key, then turn the connector clockwise until a distinct locking is felt.
2	Turn the FUNCTION switch to the battery check position. Check to ensure that the indicator reads within or beyond the green battery arc on the scale plate. If the indicator is below the green arc, or if the red LED comes on, the battery must be charged prior to using.
3	To zero the instrument, turn the FUNCTION switch to the STANDBY position and rotate the ZERO POTENTIOMETER until the meter reads zero. Wait 15-20 seconds to ensure that the zero adjustment is stable. If not, then re-adjust.
4	Check to see that the SPAN POTENTIOMETER is set at the appropriate setting for the probe being used.
5	Set the FUNCTION switch to the desired parts per million (ppm) range.
6	Listen for fan operation to verify that the fan is working.
7	Connect a sampling hose to the regulator outlet and the other end to the sampling probe of the HNu®.
8	Crack open the regulator valve to the calibration gas.
9	Take reading after 5-10 seconds.
10	If the reading deviates by more than 15 percent from the concentration of the calibration gas, the instrument requires maintenance.
11	Results of calibration should be recorded in the logbook.

TABLE 6.5
SUMMARY OF RECOMMENDED MAINTENANCE
FOR HNU® METER
WTI GROUNDWATER MONITORING PROGRAM

Function	Frequency
Wipe down read-out unit	After each use.
Clean UV light source window	Every month.
Clean ionization chamber.	Every month.
Recharge battery.	Daily or use as dictates.

TABLE 6.6
CALIBRATION PROCEDURE FOR THE
BIOSENSOR® II COMBUSTIBLE GAS INDICATOR
WTI GROUNDWATER MONITORING PROGRAM

Step Procedure	Number
1	Attach the 0.5-liter-per-minute fixed flow rate regulator to the calibration gas cylinder;
2	Attach a sample line from the regulator to the balloon inlet. Attach another sample line from the balloon outlet to the sample draw intake on the instrument;
3	Fill the balloon with calibration gas and allow the sampling pump to draw it over the sensors. <u>DO NOT OVER INFLATE THE BALLOON!</u> Feed more gas into the balloon <u>as needed</u> to keep it <u>partially</u> inflated;
4	Wait for the readings to stabilize. <u>Then</u> , using a small jeweler's screwdriver, adjust the "gas span" pot to obtain a steady reading that corresponds to the calibration gas concentration that is printed on the label of the calibration gas cylinder (normally 50 percent LEL);
5	Remove calibration lines;
6	Let the instrument run for 1 full minute to flush any excess calibration gas and check readings. The combustible sensor should now be reading 000 percent LEL, (\pm 001 percent LEL), in <u>fresh</u> air. Repeat calibration procedures <u>if</u> necessary;
7	Record calibration results in the logbook; and
8	Correlate calibration gas valve to expected on-site explosive contaminants.

Note: The Biosensor® II uses a 2-volt lead gel cell battery. This battery should be charged daily or as use dictates. The battery cannot be overcharged.

Medical Emergencies

East Liverpool City Hospital (216) 385-7200
425 W. 5th Street
East Liverpool, OH 43920

Lifeteam EMS (216) 386-9284
142 West 7 Street
East Liverpool, OH 43920

Poison Control Center 1-800-962-1253

Other Emergency Phone Numbers

Fire Department: (216) 385-1111

Police Department: (216) 385-1234

WTI Environmental Manager

Ms. Deborah Rushin (216) 385-7336
1250 George Street
East Liverpool, OH 43920

ES Contacts

Ed Staes Office: (404) 325-0770
Home: (404) 373-4869

Edward Grunwald Office: (404) 325-0770
Home: (404) 299-9970

Medical Monitoring

Atlanta Occupational Medicine
Dr. James Wheeler
(404)256-1920

Directions to East Liverpool City Hospital

- Leave plant, proceed on St. George Street across railroad tracks to the stop sign.
- Make a right onto Virginia Avenue.
- At the light, go left onto Route 39 West.
- Go approximately 1 mile; at the light, turn right onto Market Street.

- At the second light, make a left onto 5th Street.
- Proceed approximately 4 blocks, hospital is on right immediately before road takes sharp curve to left.

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APPENDIX A
STATISTICAL METHODS

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II. ANALYSIS OF VARIANCE (ANOVA)

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May 1991

OHIO EPA DHWM

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1. ANALYSIS OF VARIANCE (ANOVA)

In a previous section, we discussed tests for comparing the means of two independent samples. ANOVA is a set of statistical tests that can be employed when one is interested to detect differences among the means from several (more than two) samples.

1.1 One Way Parametric ANOVA

Let $X_{i1}, X_{i2}, \dots, X_{in_i}$ be a random sample of size n_i from a normal distribution $N(\mu_i, \sigma^2)$, $i=1,2,\dots,m$. We wish to test the hypothesis that all means are equal; namely, $H_0: \mu_1 = \mu_2 = \dots = \mu_m = \mu$, where μ is unknown, against all possible alternative hypotheses H_1 .

				Means
X_{11}	X_{12}	...	X_{1n_1}	\bar{X}_1
X_{21}	X_{22}	...	X_{2n_2}	\bar{X}_2
.	.		.	.
.	.		.	.
X_{m1}	X_{m2}	...	X_{mn_m}	\bar{X}_m
Grand Mean:				\bar{X}

The sample and grand means above are estimated by

$$\bar{X} = \frac{1}{n} \sum_{i=1}^m \sum_{j=1}^{n_i} X_{ij} \quad \text{and} \quad \bar{X}_i = \frac{1}{n_i} \sum_{j=1}^{n_i} X_{ij} \quad i=1,2,\dots,m.$$

where $n = n_1 + n_2 + \dots + n_m$.

Define the following sum of squares:

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$$SS(TOT) = \sum_{i=1}^m \sum_{j=1}^{n_i} (X_{ij} - \bar{X})^2 \quad : \quad \text{total sum of squares;}$$

$$SS(E) = \sum_{i=1}^m \sum_{j=1}^{n_i} (X_{ij} - \bar{X}_i)^2 \quad : \quad \text{sum of squares within samples;}$$

$$SS(S) = \sum_{i=1}^m n_i (\bar{X}_i - \bar{X})^2 \quad : \quad \text{sum of squares between samples.}$$

It can be shown that $SS(TOT) = SS(E) + SS(S)$ and, therefore,

$$SS(TOT)/\sigma^2 = SS(E)/\sigma^2 + SS(S)/\sigma^2.$$

However, under hypothesis H_0 , $SS(TOT)/(n-1)$ is an unbiased estimator of σ^2 , and $SS(TOT)/\sigma^2$ is a $\chi^2(n-1)$ variable.

Also, independently of H_0 , unbiased estimators of σ^2 can be estimated from each sample by

$$S_i = \frac{\sum_{j=1}^{n_i} (X_{ij} - \bar{X}_i)^2}{n_i - 1}, \quad i=1,2,\dots,m.$$

Since, $(n_i-1)S_i/\sigma^2$ is $\chi^2(n_i-1)$, it follows that

$$\sum_{i=1}^m \frac{(n_i-1)S_i}{\sigma^2} = \frac{SS(E)}{\sigma^2}$$

is also a chi-square variable with $(n_1-1) + (n_2-1) + \dots + (n_m-1) = n-m$ degrees of freedom.

Finally, based on the fact that $SS(E)$ and $SS(S)$ are independent and

$$\frac{SS(TOT)}{\sigma^2} = \frac{SS(E)}{\sigma^2} + \frac{SS(S)}{\sigma^2},$$

$$\chi^2(n-1) \quad \chi^2(n-m)$$

it can be shown that $SS(S)/\sigma^2$ is a $\chi^2(m-1)$ variable and thus, if hypothesis H_0 is true, $SS(S)/(m-1)$ is another unbiased estimator of σ^2 .

If, on the other hand, H_0 is false and the means $\mu_1, \mu_2, \dots, \mu_m$ are generally different, $SS(S)/(m-1)$ usually overestimates σ^2 as indicated by the following fact

$$E\left[\frac{SS(S)}{m-1}\right] = \sigma^2 + \sum_{i=1}^m n_i \frac{(\mu_i - \bar{\mu})^2}{m-1},$$

$$\bar{\mu} = (1/n) \sum_{i=1}^m n_i \mu_i.$$

In summary, a suitable statistic for testing the validity of hypothesis H_0 is the ratio

$$\frac{SS(S)/(m-1)}{SS(E)/(n-m)} = \frac{[SS(S)/\sigma^2]/(m-1)}{[SS(E)/\sigma^2]/(n-m)} = F$$

which follows an F distribution with $(m-1)$ and $(n-m)$ degrees of freedom.

One would generally reject H_0 if the observed value of F is significantly larger than 1, indicating that $SS(S)/(m-1)$ overestimates σ^2 as a result of unequal means.

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Step-by-Step Procedure (One Way Parametric ANOVA)

1. Compute SS(TOT), SS(S), and SS(E) by the following formulas:

$$SS(TOT) = \sum_{i=1}^m \sum_{j=1}^{n_i} X_{ij}^2 - \frac{1}{n} \left[\sum_{i=1}^m \sum_{j=1}^{n_i} X_{ij} \right]^2,$$

$$SS(S) = \sum_{i=1}^m \frac{1}{n_i} \left[\sum_{j=1}^{n_i} X_{ij} \right]^2 - \frac{1}{n} \left[\sum_{i=1}^m \sum_{j=1}^{n_i} X_{ij} \right]^2,$$

$$SS(E) = SS(TOT) - SS(S).$$

where m is the number of samples, and $n = n_1 + n_2 + \dots + n_m$ with $n_i, i = 1, 2, \dots, m$, being the number of data in each sample.

2. Calculate the F statistic:

$$F = \frac{SS(S)/(m-1)}{SS(E)/(n-m)}$$

The results of the ANOVA are usually summarized in a table as follows:

Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F
Between Samples	SS(S)	$m-1$	$MS(S) = SS(S)/(m-1)$	$MS(S)/MS(E)$
Within Samples	SS(E)	$n-m$	$MS(E) = SS(E)/(n-m)$	
Total	SS(TOT)	$n-1$		

3. Compare this statistic to the tabulated F statistic with $(m-1)$ and $(n-m)$ degrees of freedom at a specified significance level (usually 5%). If the calculated F statistic exceeds the tabulated value, reject the hypothesis of equal means. Otherwise, conclude that there is no significant difference between the sample means.

Example: Four lead concentration values at each of six wells are given in the following table. The wells consist of two background and four compliance wells. (The values in the table are actually the natural logarithms of the original lead concentrations.)

Well	Type	Jan 1	Feb 1	Mar 1	Apr 1	Totals	Means
1	b	4.06	3.99	3.40	3.83	15.28	3.82
2	b	3.83	4.34	3.47	4.22	15.86	3.96
3	c	5.61	5.14	3.47	3.97	18.18	4.55
4	c	3.53	4.54	4.26	4.42	16.75	4.19
5	c	3.91	4.29	5.50	5.31	19.01	4.75
6	c	5.42	5.21	5.29	5.08	21.01	5.25
						106.08	4.42

1. Computation of SS(TOT), SS(S), and SS(E):

$$SS(TOT) = 4.06^2 + 3.99^2 + \dots + 5.08^2 - (1/24) 106.08^2 = 11.94$$

$$\text{degrees of freedom} = 24 - 1 = 23$$

$$SS(S) = 1/4 (15.28^2 + \dots + 21.01^2) - (1/24) 106.08^2 = 5.76$$

$$\text{degrees of freedom} = 6 - 1 = 5$$

$$SS(E) = 11.94 - 5.76 = 6.18$$

$$\text{degrees of freedom} = 24 - 6 = 18$$

2. F statistic: $F = (5.76/5)/(6.18/18) = 3.38$

Summary table:

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Source of Variation	Sums of Squares	Degrees of Freedom	Mean Squares	F
Between Samples	5.76	5	$5.76/5 = 1.15$	$1.15/0.34 = 3.38$
Within Samples	6.18	18	$6.18/18 = 0.34$	
Total	11.94	23		

3. The tabulated F value with 5 and 18 degrees of freedom and confidence coefficient $\alpha = 5\%$ is 2.77. Since $3.38 > 2.77$, the hypothesis of equal well concentration means must be rejected.

1.2 A Multiple Comparison Test

If the null hypothesis is rejected in the ANOVA analysis, one may wish to perform a follow-up study to determine which sample exhibits significant difference from the mean of the other samples (or a certain group of samples). For example, in the previous example the investigator may wish to determine which compliance well is contaminated. This can be accomplished via a Bonferroni t -test for each compliance well against the background wells. This procedure is briefly discussed next.

1. Determine the sample size of all background wells b :

$$n_b = \sum_{i=b} n_i$$

2. Compute the average concentration of the background wells:

$$\bar{X}_b = \frac{1}{n_b} \sum_{i=b} n_i \bar{X}_i$$

3. Compute the difference between the average concentration of the compliance well and the average background wells.

$$d_c = \bar{X}_c - \bar{X}_b$$

4. Compute the standard error of each difference by

$$SE_c = \left[MS(E) \left(\frac{1}{n_b} + \frac{1}{n_c} \right) \right]^{1/2}$$

where $MS(E)$ is obtained from the ANOVA table, and n_c is the number of observations at well c .

5. Obtain the t -statistic, $t_{(n-m), (1-\alpha/m_c)}$, from Bonferroni's t -table for a given significance level (usually $\alpha = 5\%$) and $(n-m)$ degrees of freedom. m_c represents the number of compliance wells or, equivalently, the number of comparisons to be performed. If $\alpha = 5\%$ and $m_c > 5$, use $t_{(n-m), (1-0.01)}$.

6. Compute $D_c = SE_c t$. If $d_c > D_c$, the conclusion is that compliance well c has significantly higher concentrations than the average background wells.

Otherwise, this well is not contaminated.

This test should be performed for each compliance well c.

The previous multiple comparison test is based on the following theorem:

Theorem: Let Y_1, \dots, Y_m be normally distributed random variables with means μ_1, \dots, μ_m and variances $\sigma_1^2, \dots, \sigma_m^2$ respectively. The Y_i 's may or may not be independent. Let s_1^2, \dots, s_m^2 be χ^2 estimators of $\sigma_1^2, \dots, \sigma_m^2$ on v_1, \dots, v_m degrees of freedom, respectively; that is, $v_i s_i^2 / \sigma_i^2 \sim \chi_{v_i}^2, i=1, \dots, m$. The s_i^2 's may or may not be independent. However, it is assumed that Y_i is independent of $s_j^2, j=1, \dots, m$, so that $T_i = (Y_i - \mu_i) / s_i, i=1, \dots, m$, has a t distribution with v_i degrees of freedom. Let $t_{v_i, \alpha/2m}, i=1, \dots, m$, be the upper $\alpha/2m$ percentile points (or two-tailed α/m percentile points) of the t distribution with $v_i, i=1, \dots, m$ degrees of freedom, respectively. Then, with probability greater than or equal to $(1-\alpha)$, simultaneously,

$$\mu_i \in \bar{Y}_i \pm t_{v_i, \alpha/2m} S_i, i=1, \dots, m.$$

For each component interval above, the significance level was set at α/m . If some of the intervals should be more sensitive or conservative than others, equal significance levels may be replaced by unequal ones. Any combination $\alpha_1, \dots, \alpha_m$ for which $\alpha_1 + \dots + \alpha_m = \alpha$ will produce the same bound α for the simultaneous probability error rate.

The multiple ANOVA comparison test presented in this section results from the above theorem under the null hypothesis H_0 and the following specifications and facts:

$$Y_i = \bar{X}_i - \bar{X}_b, i=1, \dots, m_c;$$

$$\bar{X}_i \sim N\left(\mu, \frac{\sigma^2}{n_i}\right), \quad \bar{X}_b \sim N\left(\mu, \frac{\sigma^2}{n_b}\right);$$

$$\bar{X}_i - \bar{X}_b \sim N\left(0, \sigma^2\left(\frac{1}{n_i} + \frac{1}{n_b}\right)\right);$$

σ^2 is estimated by $MS(E)$ with $(n-m)$ degrees of freedom;

$\bar{X}_i - \bar{X}_b$ is independent of $MS(E), i=1, \dots, m_c;$

the procedure is applied as one-tailed test.

Example: Test compliance well contamination in the example of the previous section.

1. Sample size of all background wells b:

$$n_b = 4 + 4 = 8$$

2. Average concentration of background wells:

$$\bar{X}_b = \frac{1}{8} [4 \times 3.82 + 4 \times 3.96] = 3.89$$

3. Differences between the average concentration of each compliance well and the background wells.

$$d_3 = \bar{X}_3 - \bar{X}_b = 4.55 - 3.89 = 0.66$$

$$d_4 = 4.19 - 3.89 = 0.3$$

$$d_5 = 4.75 - 3.89 = 0.86$$

$$d_6 = 5.25 - 3.89 = 1.36$$

4. Compute the standard error of each difference by

$$SE_3 = \left[MS(E) \left(\frac{1}{n_b} + \frac{1}{n_3} \right) \right]^{1/2} = \left[0.34 \times \left(\frac{1}{8} + \frac{1}{4} \right) \right]^{1/2} = 0.357 = SE_4 = SE_5 = SE_6$$

5. Obtain the t -statistic, $t_{(n-m), (1-\alpha/m_c)}$ from Bonferroni's t -table for a significance level of $\alpha = 5\%$ and $(n-m) = (24 - 6) = 18$ degrees of freedom. The value of t obtained through linear interpolation is 2.43.

6. Compute $D_3 = SE_3 t = 0.357 \times 2.43 = 0.868 = D_4 = D_5 = D_6$, and compare with the values for d_3, d_4, d_5, d_6 obtained previously. From this comparison, it is seen that only well 6 exhibits statistically significant contamination ($1.36 > 0.868$). However, well 5 is also at the boundary of significance, indicating the possible existence of a contamination plume beginning to affect the compliance surface.

1.3 Remarks on the One Way Parametric ANOVA

As a minimum, at least $m \geq 2$ samples should be available for the ANOVA test. It is recommended that each sample has at least three observations and that the total sample size, n , satisfies $n-m \geq 5$.

The assumptions of normal populations and equal variance are not critical, provided that the data distribution is not highly skewed and the number of observations n_i are equal for each sample i . The normality assumption can be tested by the χ^2 or the K-S tests. If the data exhibit skewness, one could possibly normalize them via a logarithmic transformation and proceed with the analysis. Variance homogeneity may be tested via Bartlett's test.

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1.4 One Way Nonparametric Analysis of Variance (ANOVA)

When the data cannot be normalized or exhibit significant variance non-homogeneity, the comparison of means of several samples may be preformed according to the nonparametric ANOVA, also known as the Kruskal-Wallis test. The null hypothesis H_0 is that the data samples come from the same distributions. The alternative hypothesis is that some of the samples come from different distributions.

As before, let n_i denote the observations in sample i ; m the number of samples; n the total number of all observations; and X_{ij} the j th observation in sample i . The Kruskal-Wallis procedure is based on the fact that under H_0 , the average rank in each sample is a random variable with mean $(n+1)/2$ and variance $(n-n_i)(n+1)/(12 n_i)$. The test is designed to examine the significance of the observed deviations from the theoretical values and is performed as follows:

Step-by-Step Procedure (One Way Non-Parametric ANOVA / Kruskal-Wallis)

1. Rank all n observations of the groups from the one with the least value (rank = 1) to the one with the highest value (rank= n). Let R_{ij} denote the rank of the j th observation in the i th sample. If two or more observations are numerically equal (tied), determine the ranks that the tied observations would have if they had been slightly different from one another, but still in the same places with respect to the rest of the observations. Add these ranks and divide by the number of observations tied at that value to get an average rank. Assign this average rank to each of the tied observations.
2. Add the ranks of the observations in each sample and denote the sum R_i . Also calculate the average rank for each group, $R_i = R_i/n_i$.
3. Compute the Kruskal-Wallis statistic:

$$H = \left[\frac{12}{n(n+1)} \sum_{i=1}^m \frac{R_i^2}{n_i} \right] - 3(n+1)$$

The effect of tied observations is to increase the value of the statistic H . If

there are 50% or less tied observations, adjust the H statistic as follows:

$$H' = \frac{H}{1 - \left(\sum_{i=1}^K \frac{T_i}{(n^3 - n)} \right)}$$

where K is the number of tied observation groups, $T_i = (t_i^3 - t_i)$, and t_i is the number of observations in the tied group i . If the percentage of ties exceeds 50% of the observations, one should use other statistical tests such as the test of proportions.

4. Compare the value of H or H' to the tabulated $\chi^2(m-1)$ statistic for a certain significance level α . Reject the null hypothesis H_0 if the computed value exceeds the tabulated critical value.

If the null hypothesis is rejected, the individual samples can be compared with a base sample by performing the following test:

5. Compute the critical average rank difference for each sample i to the base sample as follows:

$$D_i = Z_{\alpha/m_c} \left[\frac{n(n+1)}{12} \right]^{\frac{1}{2}} \left[\frac{1}{n_b} + \frac{1}{n_i} \right]^{\frac{1}{2}},$$

where Z_{α/m_c} is the upper (α/m_c) -percentile of the standard normal distribution, where m_c represents the number of comparisons to be performed.

6. Determine the differences $d_i = \bar{R}_i - \bar{R}_b$ of the average ranks of each sample to the background and compare them with the critical values D_i calculated previously. If $d_i > D_i$, the conclusion is that sample i exhibits significantly higher median level than the base sample.

Example: The data in the following table represent benzene concentrations in water samples taken at one background and five compliance wells.

Well	Type	Jan 1	Feb 1	Mar 1	Apr 1	n_i	R_i	\bar{R}_i
1	b	1.7 (10)	1.9 (11.5)	1.5 (7.5)	1.3 (5)	4	34	8.5
2	c	11.0 (20)	8.0 (18)	9.5 (19)		3	57	19
3	c	1.3 (5)	1.2 (3)	1.5 (7.5)		3	15.5	5.17
4	c	0.0 (1.5)	1.3 (5)	0.0 (1.5)	2.2 (13)	4	21	5.25
5	c	4.9 (17)	3.7 (16)	2.3 (14)		3	47	15.67
6	c	1.6 (9)	2.5 (15)	1.9 (11.5)		3	35.5	11.83

1 & 2. Except for the actual concentration values, the above table also includes the ranks (adjusted for ties) in parenthesis, the number of observations in each sample, the sum of ranks in each sample, and the average rank in each sample.

3. Compute the Kruskal-Wallis statistic:

$$H = \frac{12}{20(20+1)} \left[\frac{34^2}{4} + \dots + \frac{35.5^2}{3} \right] - 3(20+1) = 14.68$$

Adjustment for ties: There are four groups of ties ($K=4$) in the above data.

$$\begin{aligned} T_1 &= (2^3 - 2) = 6 && \text{for the 2 observations of 1.9} \\ T_2 &= (2^3 - 2) = 6 && \text{for the 2 observations of 1.5} \\ T_3 &= (3^3 - 3) = 24 && \text{for the 3 observations of 1.3} \\ T_4 &= (2^3 - 2) = 6 && \text{for the 2 observations of 0.0} \end{aligned}$$

Thus,

$$\sum_{i=1}^4 T_i = 6 + 6 + 24 + 6 = 42$$

$$H' = \frac{14.68}{1 - \left(\frac{42}{20^3 - 20} \right)} = \frac{14.68}{0.995} = 14.76.$$

which represents a negligible change from 14.68.

4. Compare the value of H' to the tabulated $\chi^2(6-1)$ statistic for a significance level $\alpha = 5\%$. This value is 11.07 and, therefore, the null hypothesis of no contamination is rejected.

5. To compare each compliance well to the background well, we find $Z_{0.05/(6-1)} = 2.33$ from the tables of the standard normal distribution, and compute the critical thresholds D_i for each well i :

$$D_2 = 2.32 \left[\frac{20(21)}{12} \right]^{\frac{1}{2}} \left[\frac{1}{4} + \frac{1}{3} \right]^{\frac{1}{2}} = 10.5$$

$$D_3 = D_5 = D_6 = 10.5$$

$$D_4 = 9.8$$

6. Compute the differences between the average rank of each compliance well and the average rank of the background well:

$$d_2 = 19.0 - 8.5 = 10.5$$

$$d_3 = 5.17 - 8.5 = -3.33$$

$$d_4 = 5.25 - 8.5 = -3.25$$

$$d_5 = 15.67 - 8.5 = 7.17$$

$$d_6 = 11.83 - 8.5 = 3.13$$

Comparing d_i with D_i , one concludes that only well 2 can be considered as being contaminated.

1.5 Remarks on the One Way Non-Parametric ANOVA

It is recommended that there are at least three samples with a minimum of three observations in each sample available. For data sets with more than 30 observations, a good approximation to the above procedure is to replace each observation by its rank and perform the parametric on-way analysis of variance on the ranks.

If there are more than five compliance wells, it is recommended that the value $Z_{0.01}$ from the standard normal distribution be used in step 5 above.

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1.6 Two Way Parametric ANOVA

In the one way ANOVA, the equality of means was tested for observations classified as different samples of one factor (e.g., wells). In this section, this procedure is extended to include a two factor classification. The two factors will be denoted by A and B with α and β distinct levels, respectively. Each level combination (cell) will be assumed to include n observations. This layout is presented in the following table.

It is assumed that X_{ijk} are observations of independent normally distributed random variables which are modelled as follows:

$$X_{ijk} = \mu + \alpha_i + \beta_j + (\alpha\beta)_{ij} + e_{ijk}$$

where

$i = 1, \dots, a, j = 1, \dots, b, k = 1, \dots, n;$

μ = overall or grand mean;

$\alpha_i = \mu_{i.} - \mu$ = effect of row i (level i of factor A);

$\beta_j = \mu_{.j} - \mu$ = effect of column j (level j of factor B);

$(\alpha\beta)_{ij} = \mu_{ij} - (\mu + \alpha_i + \beta_j)$ = interaction of factors A and B at levels i and j;

e_{ijk} = independent normally distributed random errors with zero mean and common variance σ^2 .

The following constraints are also assumed without loss of generality: (They are necessary to yield unique estimates of the above parameters.)

$$\sum_{i=1}^a \alpha_i - \sum_{j=1}^b \beta_j - \sum_{i=1}^a (\alpha\beta)_{ij} - \sum_{j=1}^b (\alpha\beta)_{ij} = 0.$$

Parameters μ , α_i , β_j , and $(\alpha\beta)_{ij}$ can be estimated from the sample data as follows: First the row, column, and overall (grand) means can be computed from

Two Way ANOVA Layout

		Factor B					
		Level 1	...	Level j	...	Level b	Row Means
Factor A	Level 1	X_{111} ⋮ X_{11n}	...	X_{1j1} ⋮ X_{1jn}	...	X_{1b1} ⋮ X_{1bn}	$\bar{X}_{1.}$
	⋮	⋮		⋮		⋮	⋮
	Level i	X_{i11} ⋮ X_{i1n}	...	X_{ij1} ⋮ X_{ijn}	...	X_{ib1} ⋮ X_{ibn}	$\bar{X}_{i.}$
	⋮	⋮		⋮		⋮	⋮
	Level a	X_{a11} ⋮ X_{a1n}	...	X_{aj1} ⋮ X_{ajn}	...	X_{ab1} ⋮ X_{abn}	$\bar{X}_{a.}$
	Column Means	$\bar{X}_{.1}$	...	$\bar{X}_{.j}$	...	$\bar{X}_{.b}$	$\bar{X}_{..}$

$$\begin{aligned}\bar{X}_{ij.} &= \frac{\sum_{k=1}^n X_{ijk}}{n} \\ \bar{X}_{i..} &= \frac{\sum_{j=1}^b \sum_{k=1}^n X_{ijk}}{bn} = \frac{\sum_{j=1}^b \bar{X}_{ij.}}{b} \\ \bar{X}_{.j.} &= \frac{\sum_{i=1}^a \sum_{k=1}^n X_{ijk}}{an} = \frac{\sum_{i=1}^a \bar{X}_{ij.}}{a} \\ \bar{X}_{...} &= \frac{\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n X_{ijk}}{abn} = \frac{\sum_{i=1}^a \bar{X}_{i..}}{a} = \frac{\sum_{j=1}^b \bar{X}_{.j.}}{b}\end{aligned}$$

Then,

$$\hat{\mu} = \bar{X}_{...}, \quad \hat{\alpha}_i = \bar{X}_{i..} - \bar{X}_{...}, \quad \hat{\beta}_j = \bar{X}_{.j.} - \bar{X}_{...}, \quad (\hat{\alpha}\hat{\beta})_{ij} = \bar{X}_{ij.} - \bar{X}_{i..} - \bar{X}_{.j.} + \bar{X}_{...}$$

As in the one way ANOVA procedure, the total sum of squares can be partitioned into terms representing the influence of factors A and B, the interaction between A and B, and the random errors. It can be shown that

$$\begin{aligned}\sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n (X_{ijk} - \bar{X}_{...})^2 &= bn \sum_{i=1}^a (\bar{X}_{i..} - \bar{X}_{...})^2 + an \sum_{j=1}^b (\bar{X}_{.j.} - \bar{X}_{...})^2 \\ &\quad + n \sum_{i=1}^a \sum_{j=1}^b (\bar{X}_{ij.} - \bar{X}_{i..} - \bar{X}_{.j.} + \bar{X}_{...})^2 + \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n (X_{ijk} - \bar{X}_{ij.})^2.\end{aligned}$$

Namely, $SS(T) = SS(A) + SS(B) + SS(AB) + SS(E)$,

where $SS(T)$ is the total sum of squares, $SS(A)$ is the sum of squares due to factor A, $SS(B)$ is the sum of squares due to factor B, $SS(AB)$ is the sum of squares due to the interaction between A and B, and $SS(E)$ is the sum of squares due to random errors.

One is generally interested to test the following hypotheses:

$$H_0: \alpha_1 = \alpha_2 = \dots = \alpha_a = 0$$

H_1 : not all α_i 's are zero

$$H_0: \beta_1 = \beta_2 = \dots = \beta_b = 0$$

H_1 : not all β_i 's are zero

$$H_0: (\alpha\beta)_{11} = (\alpha\beta)_{12} = \dots = (\alpha\beta)_{ab} = 0$$

H_1 : not all $(\alpha\beta)_{ij}$ are zero

It can be shown that under the null hypotheses above,

$$SS(A)/\sigma^2 \text{ is } \chi^2(a-1),$$

$$SS(B)/\sigma^2 \text{ is } \chi^2(b-1),$$

$$SS(AB)/\sigma^2 \text{ is } \chi^2[(a-1)(b-1)],$$

$$SS(E)/\sigma^2 \text{ is } \chi^2[ab(n-1)],$$

the previous random variables are independent.

Thus, one can test the previous hypotheses by forming the appropriate F statistics and comparing them to the tabulated values. The test is summarized on the table shown in the next page. The computation of the various sum of squares can be expedited by using the following formulas:

$$SS(T) = \sum_{i=1}^a \sum_{j=1}^b \sum_{k=1}^n X_{ijk}^2 - abn\bar{X}_{...}^2,$$

$$SS(A) = bn \sum_{i=1}^a \bar{X}_{i..}^2 - abn\bar{X}_{...}^2,$$

$$SS(B) = an \sum_{j=1}^b \bar{X}_{.j.}^2 - abn\bar{X}_{...}^2,$$

$$SS(AB) = n \sum_{i=1}^a \sum_{j=1}^b \bar{X}_{ij.}^2 - abn\bar{X}_{...}^2 - SS(A) - SS(B),$$

$$SS(E) = SS(T) - SS(A) - SS(B) - SS(AB).$$

Two Way ANOVA Procedure

Source of Variation	Sum of Squares, SS	Degrees of Freedom, ν	Mean Square, $MS = SS/\nu$	Expected Mean Square	Test Statistic F
Factor A	SS(A)	a-1	MS(A)	$\sigma^2 + \frac{bn \sum_{i=1}^a \alpha_i^2}{a-1}$	MS(A)/MS(E)
Factor B	SS(B)	b-1	MS(B)	$\sigma^2 + \frac{an \sum_{j=1}^b \beta_j^2}{b-1}$	MS(B)/MS(E)
Interaction	SS(AB)	(a-1)(b-1)	MS(AB)	$\sigma^2 + \frac{n \sum_{i=1}^a \sum_{j=1}^b (\alpha\beta)_{ij}^2}{(a-1)(b-1)}$	MS(AB)/MS(E)
Random Error	SS(E)	abn-ab	MS(E)	σ^2	
Total	SS(T)	abn-1			

Example: The following table reports rye yields (bushels/acre) for two types of seed and three fertilizer levels--low, medium, and high. Are there appreciable yield differences between seeds and/or fertilizer levels?

	Fertilizer				$\bar{X}_{i.}$
		Low	Medium	High	
Seed Type	Seed 1	14.3	18.1	17.6	
		14.5	17.6	18.2	
		11.5	17.1	18.9	
		13.6	17.6	18.2	
	\bar{X}_{1j}	13.475	17.600	18.225	16.433
	Seed 2	12.6	10.5	15.7	
		11.2	12.8	17.5	
		11.0	8.3	16.7	
		12.1	9.1	16.6	
	\bar{X}_{2j}	11.725	10.175	16.625	12.842
$\bar{X}_{.j}$	12.600	13.888	17.425	$\bar{X}_{...} = 14.638$	

The above table except for the observed yields per seed type and fertilizer level also reports the cell, row, column, and overall means. The two-way ANOVA results and comparisons are summarized in the table that follows:

Two Way ANOVA Results

Source of Variation	Sum of Squares, SS	Degrees of Freedom, ν	Mean Square, $MS = SS/\nu$	Test Statistic F
Factor A Seeds	$SS(A) = 77.4$	$a-1 = 1$	$MS(A) = 77.4$	$MS(A)/MS(E) = 63.3$
Factor B Fertilizer	$SS(B) = 99.9$	$b-1 = 2$	$MS(B) = 49.9$	$MS(B)/MS(E) = 40.9$
Interaction	$SS(AB) = 44.1$	$(a-1)(b-1) = 2$	$MS(AB) = 22.1$	$MS(AB)/MS(E) = 18.0$
Random Error	$SS(E) = 22.0$	$abn-ab = 18$	$MS(E) = 1.2$	
Total	$SS(T) = 243.4$	$abn-1 = 23$		

The tabulated F statistic values for a significance level of $\alpha = 0.05$ and degrees of freedom (1,18) and (2,18) are $F_{0.05;1,18} = 4.41$ and $F_{0.05;2,18} = 3.55$. A comparison with the last column of the previous table indicates that significant yield differences do exist between the seed types and the fertilizer levels. Furthermore, the test detects significant interactions between seed types and fertilizer levels.

1.7 Remarks on the Two Way Parametric ANOVA

When only one observation per cell is available, one has to postulate a model with no interactions because there can be estimate of cell error variance. In this special case, the basic model becomes

$$X_{ij} = \mu + \alpha_i + \beta_j + e_{ij}$$

and the ANOVA procedure is depicted on the following table:

Two Way ANOVA Procedure with One Observation per Cell

Source of Variation	Sum of Squares, SS	Degrees of Freedom, v	Mean Square, MS = SS/v	Expected Mean Square	Test Statistic F
Factor A	SS(A)	a-1	MS(A)	$\sigma^2 + \frac{b \sum_{i=1}^a \alpha_i^2}{a-1}$	MS(A)/MS(E)
Factor B	SS(B)	b-1	MS(B)	$\sigma^2 + \frac{a \sum_{j=1}^b \beta_j^2}{b-1}$	MS(B)/MS(E)
Random Error	SS(E)	(a-1)(b-1)	MS(E)	σ^2	
Total	SS(T)	ab-1			

The two way ANOVA requires that each cell has the same number of observations. If some observations are missing, they must first be estimated. The estimates can be obtained as follows:

(1) When one observation X_{ij} is missing from a two way ANOVA data set with one observation per cell, it can be estimated by finding the value which

minimizes the error sum of squares $SS(E)$. The result is given by

$$\hat{X}_{ij} = \frac{ab}{(a-1)(b-1)} (\bar{X}_i + \bar{X}_j - \bar{X}_{..})$$

and the degrees of freedom of the error sum of squares is reduced by one. When more than one observations are missing, one can again obtain estimates by minimizing $SS(E)$. (This involves taking the partial derivatives of $SS(E)$ with respect to all missing observations, setting them equal to zero, and solving the resulting system of equations.) For each estimated observation, the error sum of squares degrees of freedom must be reduced by one.

(2) When the observations per cell are more than one and only a few observations are missing, any missing value can be estimated by the corresponding cell mean \bar{X}_{ij} . For each missing value estimated, the degrees of freedom of the error sum of squares must be reduced by one.

The analysis of variance can be extended to include more than two factors. The associated computations and tests are straightforward generalizations of the two factor case.

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1.8 A Multiple Comparison Test

If the two way ANOVA rejects the stated hypotheses, one may ask whether two particular α_i or β_j levels are equal or whether a specific α_i or β_j is significantly nonzero. Let m be the number of comparisons or tests to be performed at an overall type I error probability α . Then, based on the theorem stated on page 8 (Bonferroni t -tests), one can derive the following tests:

α_i is significantly different from α_{η} , if the interval

$$\bar{X}_{i..} - \bar{X}_{\eta..} \pm t_{ab(n-1), (1-\alpha/2m)} \left(2 \frac{MS(E)}{bn} \right)^{\frac{1}{2}},$$

where $t_{ab(n-1), (1-\alpha/2m)}$ is the tabulated t value with $ab(n-1)$ degrees of freedom and $(1-\alpha/2m)$ confidence level and $MS(E)$ is the estimate of σ^2 derived in the ANOVA procedure, does not include zero.

β_j is significantly different from β_{η} , if the interval

$$\bar{X}_{.j} - \bar{X}_{.\eta} \pm t_{ab(n-1), (1-\alpha/2m)} \left(2 \frac{MS(E)}{an} \right)^{\frac{1}{2}},$$

where $t_{ab(n-1), (1-\alpha/2m)}$ and $MS(E)$ as defined above, does not include zero.

α_i is significantly different from 0, if the interval

$$\bar{X}_{i..} - \bar{X}_{...} \pm t_{ab(n-1), (1-\alpha/2m)} \left(\frac{MS(E)(a-1)}{bn} \right)^{\frac{1}{2}},$$

does not include zero.

β_j is significantly different from 0, if the interval

$$\bar{X}_{.j} - \bar{X}_{...} \pm t_{ab(n-1), (1-\alpha/2m)} \left(\frac{MS(E)(b-1)}{an} \right)^{\frac{1}{2}},$$

does not include zero.

$(\alpha\beta)_{ij}$ is significantly different from 0, if the interval

$$\bar{X}_{ij} - \bar{X}_{i..} - \bar{X}_{.j} + \bar{X}_{...} \pm t_{ab(n-1), (1-\alpha/2m)} \left(\frac{MS(E)(a-1)(b-1)}{abn} \right)^{\frac{1}{2}},$$

does not include zero.

Under the associated null hypothesis H_0 , the probability of committing at least one error in the m pairwise comparisons is bounded above by α .

Example: Let's suppose that in the example of the previous section, one is interested to examine whether (1) the effects of the two seed types are equal and (2) the effects of low and medium fertilizer levels are equal. Then,

$$m=2$$

$$\bar{X}_{1..} = 16.433$$

$$\bar{X}_{2..} = 12.842$$

$$t_{18, (1-0.05/4)} = 2.829$$

$$MS(E) = 1.2$$

$$16.433 - 12.842 \pm 2.829 \left(2 \frac{1.2}{12} \right)^{\frac{1}{2}} = [2.326, 4.856]$$

$$\bar{X}_{.1} = 12.600$$

$$\bar{X}_{.2} = 13.888$$

$$12.600 - 13.888 \pm 2.829 \left(2 \frac{1.2}{12} \right)^{\frac{1}{2}} = [-2.553, -0.023].$$

Since the above intervals do not include zero, the effects of the two seed types and the low and medium fertilizer levels are unequal.

1.9 Two Way Non-Parametric ANOVA (Friedman Test)

Consider a two way ANOVA layout with n observations per cell. The assumption is that X_{ijk} , $i=1,\dots,a$, $j=1,\dots,b$, $k=1,\dots,n$, are independent random variables with distributions whose medians are equal to $(\mu + \alpha_i + \beta_j)$. The hypothesis to be tested is $H_0: \beta_1 = \dots = \beta_b$ versus $H_1: \beta_1, \dots, \beta_b$ not all equal. The test is as follows:

1. Rank the data within each row of cells from the least (rank=1) to the largest (rank= bn). If two or more observations are numerically equal (tied), determine the ranks that the tied observations would have if they had been slightly different from one another, but still in the same places with respect to the rest of the observations. Add these ranks and divide by the number of observations tied at that value to get an average rank. Assign this average rank to each of the tied observations.
2. Compute R_j = the sum of ranks for the j th column of cells for $j=1,\dots,b$.
3. Compute the test statistic

$$K = \left[\frac{12}{abn^2(nb+1)} \sum_{j=1}^b R_j^2 \right] - 3a(nb+1)$$

4. Compare the value of K to the tabulated $\chi^2(b-1)$ statistic for a certain significance level α . Reject the null hypothesis H_0 if the computed value exceeds the tabulated critical value.

If the above test rejects H_0 , the equality of individual pairs (β_j, β_η) can be tested via the following multiple comparison test.

5. Let m be the number of pairwise comparisons to be performed. Declare that β_j is significantly different from β_η at an overall type I error α , if

$$|R_j - R_\eta| \geq Z_{\alpha/2m} \sqrt{abn^2(nb+1)/6},$$

where $Z_{\alpha/2m}$ is the upper $(\alpha/2m)$ -percentile of the standard normal distribution. Under the null hypothesis H_0 , the probability of committing at least one error in the m pairwise comparisons is bounded above by α .

Example: The following table includes quarterly SILVEX concentration observations from two wells. Test the hypothesis that the median levels are time invariant.

	Jan. 1	Apr. 1	Jul. 1	Oct. 1	
Well 1	3.17 (2)	9.50 (13)	5.58 (8)	3.65 (4)	
	2.32 (1)	21.36 (16)	3.39 (3)	6.15 (9)	
	7.37 (11)	5.15 (7)	8.44 (12)	6.94 (10)	
	4.44 (6)	15.70 (15)	10.25 (14)	3.74 (5)	
Well 2	3.52 (6)	8.12 (11)	2.20 (3)	5.93 (8)	
	12.32 (15)	3.36 (5)	0.00 (1.5)	6.39 (9)	
	2.28 (4)	11.02 (14)	9.30 (12)	0.00 (1.5)	
	5.30 (7)	35.05 (16)	10.30 (13)	6.53 (10)	
$R_{.j}$	52	97	66.5	56.5	

1 & 2. The previous table also reports the ranks of each data value within each row and the sum of ranks in each column.

3. The test statistic is computed as follows:

$$K = \left[\frac{12}{2 \cdot 4 \cdot 4^2 (4 \cdot 4 + 1)} (52^2 + 97^2 + 66.5^2 + 56.5^2) \right] - 3 \cdot 2 (4 \cdot 4 + 1) = 6.79.$$

4. The tabulated value of $\chi^2(4-1)$ statistic at $\alpha=0.05$ is equal to 7.815. It follows that the hypothesis of time invariant median levels cannot be rejected.

1.10 Comparison of Proportions

Let m independent data samples be available to compare the proportions of a certain attribute A in the underlying populations.

Sample	Data	Number with A	Proportion with A
1	X_{11}, \dots, X_{1n_1}	n_{1a}	$p_{1a} = n_{1a}/n_1$
2	X_{21}, \dots, X_{2n_2}	n_{2a}	$p_{2a} = n_{2a}/n_2$
\vdots	\vdots	\vdots	\vdots
m	X_{m1}, \dots, X_{mn_m}	n_{ma}	$p_{ma} = n_{ma}/n_m$
Total		n_a	$p_a = n_a/(n_1 + \dots + n_m)$

To test the significance of the differences among the m proportions, one may use the following statistic:

$$\chi^2 = \frac{1}{p_a q_a} \sum_{i=1}^m n_i (p_{ia} - p_a)^2,$$

$$q_a = 1 - p_a,$$

which is distributed according to the $\chi^2(m-1)$ distribution. If the previous statistic is higher than the tabulated $\chi^2(m-1)$ statistic for a given significance level α , the hypothesis of equal proportions in the m samples is rejected.

Example: The following table contains data on cadmium concentrations ($\mu\text{g/L}$) measured in background and compliance wells at a facility. ("BDL" stands for below detection limit.) Compare the proportions of detects (data above the detection limit) at the 5% significance level.

Background**Compliance**

0.1	0.12	BDL	BDL
0.12	0.08	BDL	BDL
BDL	BDL	BDL	BDL
0.26	0.2	0.11	BDL
0.1	BDL	0.06	BDL
BDL	0.1	BDL	0.1
0.014	BDL	0.23	0.04
BDL	0.012	BDL	BDL
BDL	BDL	0.11	BDL
BDL	BDL	BDL	0.1
BDL	BDL	0.031	BDL
BDL	BDL	BDL	0.01
0.12	BDL	BDL	BDL
BDL	0.12	BDL	BDL
0.21	0.07	BDL	BDL
BDL	BDL	BDL	BDL
0.12	0.19	0.12	BDL
BDL	BDL	0.08	
BDL	0.1	BDL	
BDL	BDL	0.26	
BDL	0.01	BDL	
BDL	BDL	0.02	
BDL	BDL	BDL	
BDL	BDL	0.024	

In this case, $m = 2$ (two samples) with $n_1 = 24$ and $n_2 = 65$ observations. The proportion of detects in the background wells is $p_{1a} = 8/24 = 0.333$. The proportion of detects in the compliance wells is $p_{2a} = 24/65 = 0.369$. The overall proportion is $p_a = (8+24)/(24+65) = 0.360$. The critical statistic is computed as follows:

$$q_a = 1 - 0.360 = 0.640,$$

$$\chi^2 = \frac{1}{0.360 \cdot 0.640} (24 (0.333 - 0.360)^2 + 65 (0.369 - 0.360)^2) = 0.0988.$$

The tabulated $\chi^2(2-1;0.05)$ value is 3.841 and, thus, the proportions of detects do not differ significantly in the background and compliance wells.

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MANAGEMENT AND TECHNICAL RESOURCES, INC.

January 22, 2003

VIA OVERNIGHT MAIL

Ms. Patricia M. Natali
Environmental Specialist
Ohio EPA, DHWM
c/o Von Roll America, Inc.
1250 St. George Street
East Liverpool OH 43920-5919

**RE: Addendum II RCRA Groundwater Monitoring Program and Work Plan
Von Roll America, Inc.
East Liverpool, Ohio**

Dear Ms. Natali:

On behalf of Von Roll America, Inc. (VRA), Management and Technical Resources, Inc. (MTR) is pleased to submit one copy of the "Addendum II RCRA Groundwater Monitoring Program and Work Plan" (Addendum II) for the East Liverpool, Ohio facility. Addendum II was prepared in accordance with the Ohio Environmental Protection Agency (OEPA) letter dated December 10, 2002.

The Addendum II includes the agreed upon changes to the currently approved program and also provides two additional proposed modifications. The first modification reflects a reduced analytical program based on the new practice of eliminating constituents from the program if the constituent has not been detected for the last three consecutive years. The second proposed modification is in reference to the metals analytical program. VRA is requesting that all metals, excluding mercury, be analyzed by EPA Method 6010. This method is capable of meeting the existing detection limits and will help in defraying the cost associated with the revised analytical program. These proposed modifications are included in Section 3.0 "Proposed Modification" of the enclosed document.

The first semi-annual groundwater monitoring event for 2003 was completed during the week of January 6, 2003. VRA anticipates incorporating the modified program during the second semi-annual groundwater event in July 2003, if approved by OEPA.

Should you have any questions regarding the enclosed document, please do not hesitate to contact Ms. Carrie Beringer of VRA at (330) 385-7336 or me at (412) 829-9650.

Very truly yours,
Management and Technical Resources, Inc.

Mary Anna Babich
Senior Project Manager

Enclosure

cc: Carrie Beringer – VRA
Gary Victorine, USEPA, Region V
Tammy McConnell – DHWM, CO
Frank Popotnik – DHWM, NEDO
Michelle Tarka – DHWM, NEDO
Rich Kurlich – DDAGW, NEDO

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MANAGEMENT AND TECHNICAL RESOURCES, INC.

**RCRA GROUNDWATER MONITORING PROGRAM
AND WORK PLAN ADDENDUM II**

**VON ROLL AMERICA, INC.
EAST LIVERPOOL, OHIO FACILITY**

January 2003

Prepared for:

**Von Roll America, Inc.
1250 St. George Street
East Liverpool, Ohio 43920**

Prepared by:

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1.0 INTRODUCTION

This document was prepared by Von Roll America, Inc. (VRA) as the second Addendum to the "RCRA Groundwater Monitoring Program and Work Plan for the WTI Facility" (Work Plan, Engineering-Sciences, March 1992). The purpose of this addendum is to revise the existing Work Plan and the "Addendum to the Groundwater Monitoring Program and Work Plan" (Addendum, Fluor Daniel GTI, December 1996) based on the requirements set forth in the Ohio Environmental Protection Agency (OEPA) December 10, 2002 letter.

This, the "Addendum II to the Groundwater Monitoring Program and Work Plan" (Addendum II) also provides minor changes to the current program.

1.1 Background

As stated above, VRA (formerly Waste Technology Industries) submitted the Work Plan to OEPA in March 1992. Based on that Work Plan, a baseline groundwater monitoring program was performed at the VRA facility from April 1992 through February 1993. The results of the baseline monitoring program and a proposed Detection Monitoring Program were provided in the "Groundwater Monitoring Program Baseline Monitoring Report" (Baseline Report) submitted to the OEPA in March 1994. Based on the results of the Baseline Report, information provided in the Work Plan, results of subsequent sampling events and correspondence with the OEPA, the Addendum to the Groundwater Monitoring Program and Work Plan was submitted to the OEPA in December 1996, thus establishing the current RCRA detection monitoring program. The current detection monitoring program is as follows.

Seven monitoring wells (WTI-01, WTI-02, WTI-03, WTI-04, WTI-05, WTI-06 and PA-04) are sampled on a semi-annual basis. Wells WTI-01, WTI-02 and WTI-06 are considered to be upgradient of the process area and wells WTI-03, WTI-04, WTI-05 and PA-04 serve as the downgradient monitoring wells. Figure 1 shows the location of the monitoring well network associated with the RCRA Detection Monitoring Program.

Groundwater samples collected from these wells are analyzed for volatile organic compounds (EPA Method 8260), semi-volatile organics (EPA Method 8270), and total and dissolved arsenic (EPA Method 7060), chromium (EPA Method 6010), lead (EPA Method 7421), mercury (EPA Method 7470), and nickel (EPA Method 6010). Table 1 summarizes the site-specific COIs.

The Division of Drinking and Groundwater (DDAGW) of the OEPA reviewed the August 1999 semi-annual groundwater monitoring reports submitted by VRA. Based on this review and the December 14, 2001 OEPA memorandum, VRA submitted a response to comment letter to OEPA on January 31, 2002. In response to VRA letter and the subsequent review of the "Semi-Annual Groundwater Monitoring Results for July 2002" (Management and Technical Resources, Inc., MTR, October 22, 2002) OEPA issued their December 10, 2002 letter requiring VRA to revise the Work Plan.

2.0 REQUIRED REVISIONS

Based on the OEPA December 10, 2002 letter the following summarizes the deficiency of the current groundwater monitoring program.

2.1 Appendix IX Sampling and Analyses

VRA will collect groundwater samples from downgradient wells PA-4, WTI-3 and WTI-4 on a biennial basis for the Appendix IX constituent list, excluding dioxins and furans. Subsequent to completing the Appendix IX data validation, VRA has the opportunity to confirm any positively identified constituent that is not a site-specific COI. Following confirmatory sampling, a detected constituent will be added to the site-specific COI list. Additionally, if a site-specific COI is not detected for three consecutive years, then the constituent will be deleted from the monitoring program, following concurrence by DDAGW. VRA will initiate Appendix IX sampling in July 2003.

2.2 Action Levels

Detected lead results will be compared to the Statistically Significant Detection Limits (SSDLs), the practical quantitation limit (PQL) and the "action level" for lead (15 ug/L). VRA will initiate the terminology of "action level" for lead in all future reports.

2.3 Chain-of-Custodies

Chain-of-custodies (COC) will identify the preservatives used. This activity will be initiated during the first semi-annual sampling event of 2003.

3.0 PROPOSED MODIFICATIONS

The main objectives of the detection monitoring program are to detect any potential impacts to groundwater from current site operations, to detect any changes to the current constituent concentrations in groundwater within the alluvium, and to ensure that the groundwater downgradient of the facility is protective of human health and the environment. To achieve these objectives, VRA is proposing the following modifications to the Detection Monitoring Program:

- ◆ Reduction in the analytical monitoring program; and
- ◆ Substitution of EPA Method 6010B using ICP trace technology for EPA Methods 7060 and 7421 for arsenic and lead, respectively.

3.1 Constituent Reduction

Pursuant to the Appendix IX requirements summarized above, VRA reviewed the current site-specific COIs to determine if any constituent had not been detected in the previous three consecutive years. Based on a review of the historical data from January 2000 through December 2002 the following site-specific COIs have not been detected:

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- ◆ Dissolved Mercury
- ◆ Total Mercury
- ◆ 1,2-Dichlorobenzene
- ◆ 1,4-Dioxane
- ◆ Trichloroethene

Table 2 summarizes the historical results for these constituents.

Because these site-specific COIs have not been detected for the past three consecutive years (2000 through 2002), VRA is requesting that these constituents be eliminated from the groundwater monitoring program.

3.2 Analytical Methods

VRA proposes to maintain the current analytical methods, with the following exception. EPA Method 6010B will replace EPA Methods 7060 and 7421 for arsenic and lead, respectively. Therefore, total and dissolved arsenic, chromium, lead and nickel will be analyzed by EPA Method 6010B. The reporting limits associated with EPA Method 6010B are below the established PQL, maximum contaminant level (MCL), action levels and/or SSDLs for the facility.

4.0 GROUNDWATER SAMPLING AND ANALYSIS PROGRAM

The proposed Detection Monitoring Program is based on the current detection monitoring program identified in the Work Plan, Addendum, subsequent OEPA correspondences, the OEPA's December 10, 2002 letter and current site conditions. The groundwater sampling and analysis program is provided below.

Field activities will include measurement of water levels and field parameters, well purging, and collection of groundwater samples from monitoring wells WTI-01, WTI-02, WTI-03, WTI-04, WTI-05, WTI-06 and PA-04 on a semi-annual basis during January and July. Water level measurements, total well depths and NAPL thickness, if present, will be determined for each monitoring well sampled. Measurements will be determined from the top of casing reference point using an oil/water interface probe. Prior to sampling, three to five well casing volumes will be purged and groundwater monitored for visual turbidity and stabilization of field parameters in accordance with the Standard Operating Procedures included in the Addendum (Fluor Daniel GTI, December 1996). Groundwater samples will be collected with bailers following purging.

Groundwater samples from the wells listed above will be analyzed for field pH, field temperature, field conductivity, volatile organic compounds (EPA Method 8260B), semi-volatile organic compounds (EPA Method 8270C), and total and dissolved arsenic, chromium, lead, and nickel (EPA Method 6010B). Groundwater samples will also be collected on a biennial basis at downgradient wells PA-4, WTI-3 and WTI-4 and analyzed for the Appendix IX constituent list, excluding dioxin/furans. Following data validation and confirmatory sampling, if necessary, detected constituents will be added to the site-specific COI list. In addition, if any detected site-specific COI is not subsequently detected for three consecutive

- ◆ Dissolved Mercury
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years, then that constituent will be deleted from the program following concurrence and approval by DDAGW. Table 3 summarizes the list of constituents and frequency of analyses.

Groundwater samples will be collected in labeled, appropriately preserved new containers. The method of preservation will be documented on each COC. After filling, sample containers will be placed in an ice-filled cooler. Samples will be shipped to the designated analytical laboratory following the appropriate chain-of-custody procedures outlined in the SOP included in the Addendum (Fluor Daniel GTI, December 1996). Copies of the field documentation will be maintained at the VRA facility.

TABLES

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TABLE 1

Summary of Site-Specific Constituents of Interest

**Von Roll America, Inc.
East Liverpool, Ohio**

VOLATILE ORGANICS	EPA METHOD	FREQUENCY
Benzene	8260B	Semi-Annual
Ethylbenzene	8260B	Semi-Annual
Toluene	8260B	Semi-Annual
Trichloroethene	8260B	Semi-Annual
Xylenes, Total	8260B	Semi-Annual
1,4-Dioxane	8260B	Semi-Annual
SEMIVOLATILE ORGANICS		
1,2-Dichlorobenzene	8270C	Semi-Annual
2,4-Dimethylphenol	8270C	Semi-Annual
2-Methylnaphthalene	8270C	Semi-Annual
Naphthalene	8270C	Semi-Annual
METALS		
Arsenic	7060	Semi-Annual
Chromium	6010	Semi-Annual
Lead	7421	Semi-Annual
Mercury	7470	Semi-Annual
Nickel	6010	Semi-Annual
GENERAL INDICATORS		
Specific Conductance	Field	Semi-Annual
pH	Field	Semi-Annual
Temperature	Field	Semi-Annual

TABLE 2

Summary of Non-Detected Historical Results 2000 - 2002

Von Roll America, Inc.
East Liverpool, Ohio

PARAMETER	UNITS	WTI-01 3/2/2000	WTI-01 8/9/2000	WTI-01 8/9/2000	WTI-01 3/6/2001	WTI-01 Dup 3/6/2001	WTI-01 7/5/2001	WTI-01 Dup 7/5/2001	WTI-01 1/29/2002	WTI-01 7/9/2002
Mercury, dissolved	mg/L	0.0002 U	0.0002 UJ	0.0002 UJ	0.0002 U	0.0002 U				
Mercury, total	mg/L	0.0002 U	0.0002 UJ	0.0002 U	0.0002 U	0.0002 U				
1,2-Dichlorobenzene	ug/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,4-Dioxane	ug/L	500 U	500 U	500 UJ	500 UJ	500 U	500 U	500 U	500 U	500 UJ
Trichloroethene	ug/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

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TABLE 2

Summary of Non-Detected Historical Results 2000 - 2002

Von Roll America, Inc.
East Liverpool, Ohio

PARAMETER	UNITS	WTI-02 3/2/2000	WTI-02 8/9/2000	WTI-02 3/5/2001	WTI-02 7/5/2001	WTI-02 1/29/2002	WTI-02 7/9/2002	WTI-03 3/2/2000	WTI-03 8/10/2000	WTI-03 3/7/2001
Mercury, dissolved	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Mercury, total	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
1,2-Dichlorobenzene	ug/L	5 U	5 U	5 U	5 U	10 U	5 U	5 U	5 U	5 U
1,4-Dioxane	ug/L	500 U	500 UJ	500 UJ	500 UJ	500 UJ				
Trichloroethene	ug/L	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

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TABLE 2

Summary of Non-Detected Historical Results 2000 - 2002

Von Roll America, Inc.
East Liverpool, Ohio

PARAMETER	UNITS	WTI-03 7/5/2001	WTI-03 1/29/2002	WTI-03 7/10/2002	WTI-04 3/2/2000	WTI-04 8/10/2000	WTI-04 3/7/2001	WTI-04 7/5/2001	WTI-04 1/29/2002	WTI-04 7/10/2002
Mercury, dissolved	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Mercury, total	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
1,2-Dichlorobenzene	ug/L	5 U	10 U	5 U	5 U	5 U	5 U	5 U	10 U	5 U
1,4-Dioxane	ug/L	500 U	500 U	500 UJ	500 U	500 UJ	500 U	500 U	500 U	500 UJ
Trichloroethene	ug/L	5 U	5 U	5 U	0.9 J	5 U	5 U	5 U	5 U	5 U

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TABLE 2

Summary of Non-Detected Historical Results 2000 - 2002

Von Roll America, Inc.
East Liverpool, Ohio

PARAMETER	UNITS	WTI-05 3/2/2000	WTI-05 8/10/2000	WTI-05 3/7/2001	WTI-05 7/5/2001	WTI-05 1/29/2002	WTI-05 7/10/2002	WTI-06 3/2/2000	WTI-06 8/9/2000	WTI-06 3/7/2001	WTI-06 7/5/2001
Mercury, dissolved	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
Mercury, total	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U
1,2-Dichlorobenzene	ug/L	5 U	5 U	5 U	5 U	10 U	5 U	5 U	50 U	250 UJ	50 U
1,4-Dioxane	ug/L	500 U	500 UJ	500 U	500 U	500 U	500 UJ	500 U	5000 UJ	5000 U	5000 U
Trichloroethene	ug/L	5 U	5 U	5 U	5 U	5 U	5 U	100 U	500 U	500 U	500 U

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TABLE 2

Summary of Non-Detected Historical Results 2000 - 2002

Von Roll America, Inc.
East Liverpool, Ohio

PARAMETER	UNITS	WTI-06 1/29/2002	WTI-06 7/10/2002	WTI-PA4 1/29/2002	WTI-PA4 7/9/2002	WTI-PA4 3/2/2000	WTI-PA4 8/10/2000	WTI-PA4 3/7/2001	WTI-PA4 7/5/2001	WTI-PA4 1/29/2002	WTI-PA 7/9/2001
Mercury, dissolved	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.000
Mercury, total	mg/L	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.0002 U	0.000
1,2-Dichlorobenzene	ug/L	50 U	5 U	10 U	5 U	5 U	5 U	5 U	5 U	10 U	50
1,4-Dioxane	ug/L	1000 U	500 UJ	500 U	500 UJ	500 U	500 U	500 U	500 U	500 U	500 U
Trichloroethene	ug/L	10 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U

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TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

CURRENT SITE SPECIFIC CONSTITUENTS OF INTEREST		
VOLATILE ORGANIC COMPOUNDS	EPA METHOD	FREQUENCY
Benzene	8260B	Semi-Annual
Ethylbenzene	8260B	Semi-Annual
Toluene	8260B	Semi-Annual
Xylene (total)	8260B	Semi-Annual
SEMI-VOLATILE ORGANIC COMPOUNDS		
2-Methylnaphthalene	8270C	Semi-Annual
Naphthalene	8270C	Semi-Annual
2,4-Dimethylphenol	8270C	Semi-Annual
TOTAL AND DISSOLVED METALS		
Arsenic	6010	Semi-Annual
Chromium	6010	Semi-Annual
Lead	6010	Semi-Annual
Nickel	6010	Semi-Annual
FIELD PARAMETERS		
Specific Conductance	field	Semi-Annual
pH	field	Semi-Annual
Temperature	field	Semi-Annual

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TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

APPENDIX IX CONSTITUENT LIST		
VOLATILE ORGANIC COMPOUNDS	EPA METHOD	FREQUENCY
Acetone	8260B	Biennial
Acetonitrile	8260B	Biennial
Acrolein	8260B	Biennial
Acrylonitrile	8260B	Biennial
Benzene	8260B	Biennial
Bromodichloromethane	8260B	Biennial
Bromoform	8260B	Biennial
Bromomethane	8260B	Biennial
2-Butanone (MEK)	8260B	Biennial
Carbon disulfide	8260B	Biennial
Carbon tetrachloride	8260B	Biennial
Chlorobenzene	8260B	Biennial
2-Chloro-1,3-Butadiene (Chloroprene)	8260B	Biennial
Chloroethane	8260B	Biennial
Chloroform	8260B	Biennial
Chloromethane	8260B	Biennial
3-Chloropropene (allyl chloride)	8260B	Biennial
Dibromochloromethane	8260B	Biennial
1,2-Dibromo-3-chloropropane (DBCP)	8260B	Biennial
Dibromomethane	8260B	Biennial
1,2-Dibromoethane (EDB)	8260B	Biennial
trans-1,4-Dichloro-2-butene	8260B	Biennial
Dichlorodifluoromethane	8260B	Biennial
1,1-Dichloroethane	8260B	Biennial
1,2-Dichloroethane	8260B	Biennial
1,1-Dichloroethene	8260B	Biennial
trans-1,2-Dichloroethene	8260B	Biennial
1,2-Dichloropropane	8260B	Biennial
cis-1,3-Dichloropropene	8260B	Biennial
trans-1,3-Dichloropropene	8260B	Biennial
1,4-Dioxane	8260B	Biennial
Ethylbenzene	8260B	Biennial
Ethyl cyanide (propionitrile)	8260B	Biennial
Ethyl methacrylate	8260B	Biennial
2-Hexanone	8260B	Biennial
Iodomethane	8260B	Biennial
Isobutyl alcohol	8260B	Biennial
Methacrylonitrile	8260B	Biennial
Methylene chloride	8260B	Biennial
Methyl methacrylate	8260B	Biennial
4-Methyl-2-pentanone	8260B	Biennial
Styrene	8260B	Biennial
1,1,1,2-Tetrachloroethane	8260B	Biennial
1,1,2,2-Tetrachloroethane	8260B	Biennial

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TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

APPENDIX IX CONSTITUENT LIST (Continued)		
VOLATILE ORGANIC COMPOUNDS	EPA METHOD	FREQUENCY
Tetrachloroethene	8260B	Biennial
Toluene	8260B	Biennial
1,1,1-Trichloroethane	8260B	Biennial
1,1,2-Trichloroethane	8260B	Biennial
Trichloroethene	8260B	Biennial
Trichlorofluoromethane	8260B	Biennial
1,2,3-Trichloropropane	8260B	Biennial
Vinyl acetate	8260B	Biennial
Vinyl chloride	8260B	Biennial
Xylene (total)	8260B	Biennial
SEMI-VOLATILE ORGANIC COMPOUNDS		
Acenaphthene	8270C	Biennial
Acenaphthylene	8270C	Biennial
Acetophenone	8270C	Biennial
2-Acetylaminofluorene	8270C	Biennial
4-Aminobiphenyl	8270C	Biennial
Aniline	8270C	Biennial
Anthracene	8270C	Biennial
Aramite	8270C	Biennial
Benzo(a)anthracene	8270C	Biennial
Benzo(a)pyrene	8270C	Biennial
Benzo(b)fluoranthene	8270C	Biennial
Benzo(g,h,i)perylene	8270C	Biennial
Benzo(k)fluoranthene	8270C	Biennial
Benzyl alcohol	8270C	Biennial
bis(2-chloroethyl)ether	8270C	Biennial
bis(2-chloroethoxy) methane	8270C	Biennial
bis(2-chloroisopropyl)ether	8270C	Biennial
bis(2-ethylhexyl)phthalate	8270C	Biennial
4-Bromophenyl phenyl ether	8270C	Biennial
Butyl benzyl phthalate	8270C	Biennial
4-Chloroaniline	8270C	Biennial
Chlorobenzilate	8270C	Biennial
2-Chloronaphthalene	8270C	Biennial
4-Chlorophenyl phenyl ether	8270C	Biennial
Chrysene	8270C	Biennial
Diallate	8270C	Biennial
Dibenz[a,h]anthracene	8270C	Biennial
Dibenzofuran	8270C	Biennial
Di-n-butyl phthalate	8270C	Biennial
1,2-Dichlorobenzene	8270C	Biennial
1,3-Dichlorobenzene	8270C	Biennial
1,4-Dichlorobenzene	8270C	Biennial
3,3'-Dichlorobenzidine	8270C	Biennial

TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

APPENDIX IX CONSTITUENT LIST (Continued)		
SEMI-VOLATILE ORGANIC COMPOUNDS	EPA METHOD	FREQUENCY
Diethyl phthalate	8270C	Biennial
O,O-Diethyl-O-2-pyrazinyl phosphorothioate (Thionazin) Dimethoate	8270C	Biennial
p-(Dimethylamino)azobenzene	8270C	Biennial
7,12-Dimethylbenz(a)anthracene	8270C	Biennial
3,3-Dimethylbenzidine	8270C	Biennial
alpha,alpha-Dimethylphenethylamine	8270C	Biennial
Dimethyl phthalate	8270C	Biennial
1,3-Dinitrobenzene	8270C	Biennial
2,4-Dinitrotoluene	8270C	Biennial
2,6-Dinitrotoluene	8270C	Biennial
Di-n-octylphthalate	8270C	Biennial
Dinoseb	8270C	Biennial
Diphenylamine	8270C	Biennial
Disulfoton	8270C	Biennial
Ethyl methanesulfonate	8270C	Biennial
Famphur	8270C	Biennial
Fluoranthene	8270C	Biennial
Fluorene	8270C	Biennial
Hexachlorobenzene	8270C	Biennial
Hexachlorobutadiene	8270C	Biennial
Hexachlorocyclo Pentadiene	8270C	Biennial
Hexachloroethane	8270C	Biennial
Hexachlorophene	8270C	Biennial
Hexachloropropene	8270C	Biennial
Indeno(1,2,3-cd)pyrene	8270C	Biennial
Isodrin	8270C	Biennial
Isophorone	8270C	Biennial
Isosafrole	8270C	Biennial
Kepone	8270C	Biennial
Methapyrilene	8270C	Biennial
3-Methylcholanthrene	8270C	Biennial
Methyl methanesulfonate	8270C	Biennial
2-Methylnaphthalene	8270C	Biennial
Methyl Parathion	8270C	Biennial
Naphthalene	8270C	Biennial
1,4-Naphthoquinone	8270C	Biennial
1-Naphthylamine	8270C	Biennial
2-Naphthylamine	8270C	Biennial
2-Nitroaniline	8270C	Biennial
3-Nitroaniline	8270C	Biennial
4-Nitroaniline	8270C	Biennial
Nitrobenzene	8270C	Biennial
4-Nitroquinoline-1-oxide	8270C	Biennial
N-Nitrosodi-n-propylamine	8270C	Biennial

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TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

APPENDIX IX CONSTITUENT LIST (Continued)		
SEMI-VOLATILE ORGANIC COMPOUNDS	EPA METHOD	FREQUENCY
N-Nitrosodiethylamine	8270C	Biennial
N-Nitrosodimethylamine	8270C	Biennial
N-Nitrosodiphenylamine	8270C	Biennial
N-Nitrosodi-n-butylamine	8270C	Biennial
N-Nitrosomethylethylamine	8270C	Biennial
N-Nitrosomorpholine	8270C	Biennial
N-Nitrosopiperidine	8270C	Biennial
N-Nitrosopyrrolidine	8270C	Biennial
5-Nitro-o-toluidine	8270C	Biennial
Parathion	8270C	Biennial
Pentachlorobenzene	8270C	Biennial
Pentachloroethane	8270C	Biennial
Pentachloronitrobenzene	8270C	Biennial
Phenacetin	8270C	Biennial
Phenanthrene	8270C	Biennial
p-Phenylenediamine	8270C	Biennial
Phorate	8270C	Biennial
2-Picoline	8270C	Biennial
Polychlorinated Dibenzofurans (PCDFs)	8270C	Biennial
Polychlorinated Dibenzop-dioxins(PCDDs)	8270C	Biennial
Pronamide	8270C	Biennial
Pyrene	8270C	Biennial
Pyridine	8270C	Biennial
Safrole	8270C	Biennial
Tetraethyldithiopyro Phosphate (Sulfotepp)	8270C	Biennial
1,2,4,5-Tetrachlorobenzene	8270C	Biennial
2,3,7,8-Tetrachloro-dibenzo-p-dioxin	8270C	Biennial
o-Toluidine	8270C	Biennial
1,2,4-Trichlorobenzene	8270C	Biennial
O,O,O-Triethyl Phosphorothioate	8270C	Biennial
1,3,5-Trinitrobenzene	8270C	Biennial
4-chloro-3-methylphenol	8270C	Biennial
2-Chlorophenol	8270C	Biennial
m-cresol (3-Methylphenol)	8270C	Biennial
o-cresol (2-Methylphenol)	8270C	Biennial
p-cresol (4-Methylphenol)	8270C	Biennial
2,4-Dichlorophenol	8270C	Biennial
2,6-Dichlorophenol	8270C	Biennial
2,4-Dimethylphenol	8270C	Biennial
2,4-Dinitrophenol	8270C	Biennial
4,6-Dinitro-o-cresol	8270C	Biennial
2-Nitrophenol	8270C	Biennial
4-Nitrophenol	8270C	Biennial
Pentachlorophenol	8270C	Biennial
Phenol	8270C	Biennial

TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

APPENDIX IX CONSTITUENT LIST (Continued)		
SEMI-VOLATILE ORGANIC COMPOUNDS	EPA METHOD	FREQUENCY
2,3,4,6-Tetrachlorophenol	8270C	Biennial
2,4,5-Trichlorophenol	8270C	Biennial
2,4,6-Trichlorophenol	8270C	Biennial
Herbicides	8270C	Biennial
2,4-Dichlorophenoxyacetic acid	8270C	Biennial
Silvex (2,4,5-TP)	8270C	Biennial
Trichlorophenoxyacetic acid (2,4,5-T)	8270C	Biennial
PESTICIDES/PCBs		
Aldrin	8081	Biennial
Aroclor 1016	8081	Biennial
Aroclor 1221	8081	Biennial
Aroclor 1232	8081	Biennial
Aroclor 1242	8081	Biennial
Aroclor 1248	8081	Biennial
Aroclor 1254	8081	Biennial
Aroclor 1260	8081	Biennial
alpha-BHC	8081	Biennial
beta-BHC	8081	Biennial
delta-BHC	8081	Biennial
gamma-BHC, lindane	8081	Biennial
Chlordane	8081	Biennial
alpha-Chlordane	8081	Biennial
gamma-Chlordane	8081	Biennial
4-4'-DDD	8081	Biennial
4-4'-DDE	8081	Biennial
4-4'-DDT	8081	Biennial
Dieldrin	8081	Biennial
Endosulfan I	8081	Biennial
Endosulfan II	8081	Biennial
Endosulfan sulfate	8081	Biennial
Endrin	8081	Biennial
Endrin aldehyde	8081	Biennial
Endrin ketone	8081	Biennial
Heptachlor	8081	Biennial
Heptachlor epoxide	8081	Biennial
Methoxychor	8081	Biennial
Toxaphene	8081	Biennial
HERBICIDES		
2,4-Dichlorophenoxyacetic acid	8151	Biennial
Silvex (2,4,5-TP)	8151	Biennial
Trichlorophenoxyacetic acid (2,4,5-T)	8151	Biennial

TABLE 3

Summary of Analytical Monitoring Program

Von Roll America, Inc.
East Liverpool, Ohio

APPENDIX IX CONSTITUENT LIST (Continued)		
METALS	EPA METHOD	FREQUENCY
Antimony	6010	Biennial
Arsenic	6010	Biennial
Barium	6010	Biennial
Beryllium	6010	Biennial
Cadmium	6010	Biennial
Chromium	6010	Biennial
Cobalt	6010	Biennial
Copper	6010	Biennial
Lead	6010	Biennial
Mercury	7470	Biennial
Nickel	6010	Biennial
Selenium	6010	Biennial
Silver	6010	Biennial
Thallium	6010	Biennial
Tin	6010	Biennial
Vanadium	6010	Biennial
Zinc	6010	Biennial
MISCELLANEOUS		
Cyanide	9010	Biennial
Sulfide	9030	Biennial
Phenols	9066	Biennial

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FIGURES

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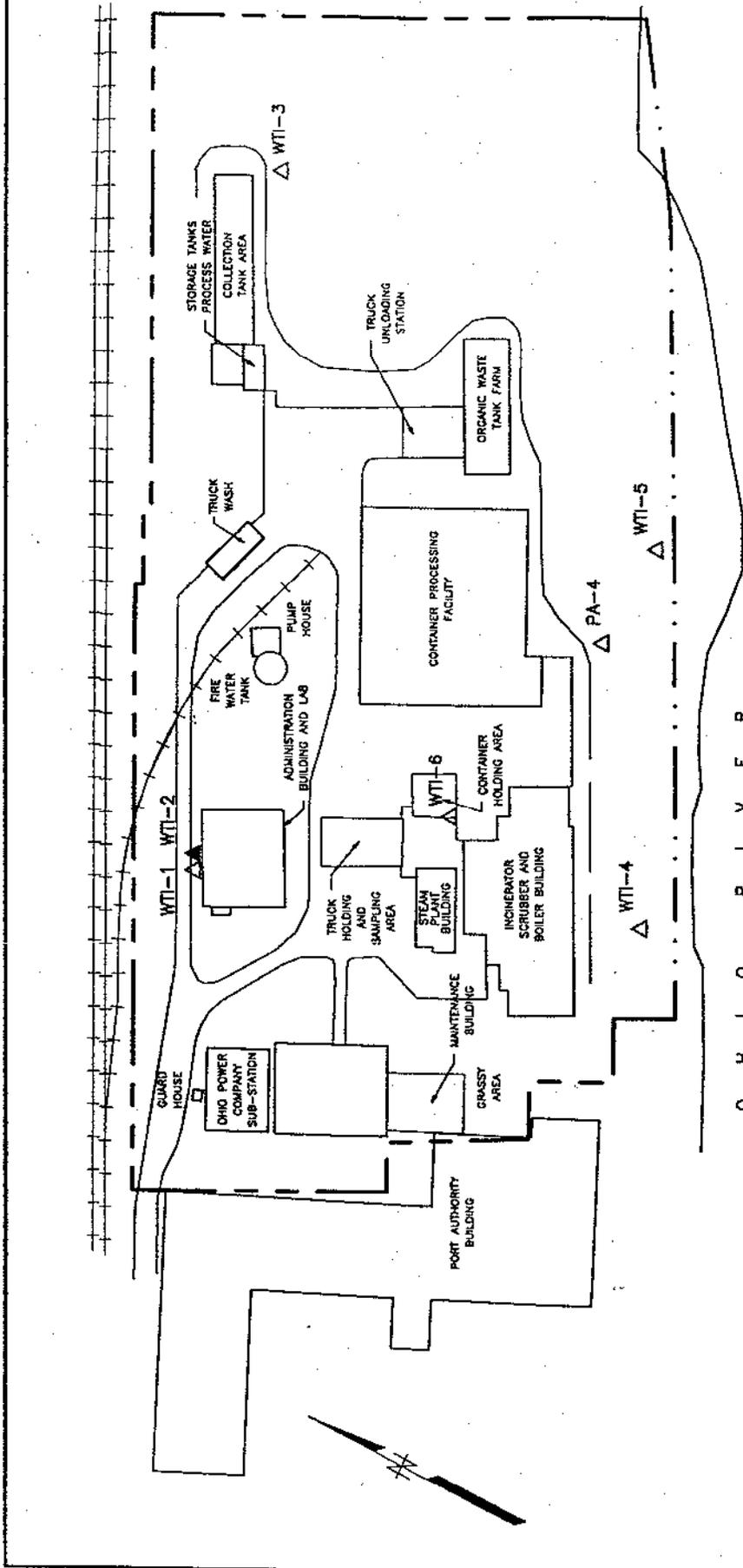


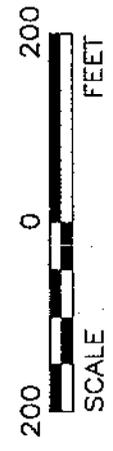
FIGURE 1
FACILITY LAYOUT AND
WELL LOCATION MAP

VON ROLL AMERICA, INC.
 EAST LIVERPOOL, OHIO

DATE: 11/17/99 FILE NAME: 01001001:DWG
 MANAGEMENT AND TECHNICAL RESOURCES, INC.

LEGEND

- ▲ - EXISTING DEEP WELL LOCATION
- △ - EXISTING SHALLOW WELL LOCATION
- WTI LEASE
- - - BUILDING OUTLINES
- - - RAILROAD
- - - BERM
- - - PAVED AREAS



O H I O R I V E R



FLUOR DANIEL GTI

**ADDENDUM TO THE GROUNDWATER MONITORING
PROGRAM AND WORK PLAN
WTI FACILITY, EAST LIVERPOOL, OHIO
OHD980613541**

Fluor Daniel GTI Project 010030709

February 1997

Prepared for:
VON ROLL/WTI
1250 St. George Street
East Liverpool, Ohio 43920-5919

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DEC 13 2004

DIV. OF HAZARDOUS
WASTE MGT.

Prepared by:
Fluor Daniel GTI, Inc.



Rikki Berger
Project Hydrogeologist

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JUN 16 1997

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MAR 23 2005

STANDARD OPERATING PROCEDURE

**TITLE: GROUNDWATER SAMPLING FROM
MONITORING WELLS**

Date: 11/96
Revision No.: 0
SOP No.: 001
Page 1

1.0 PURPOSE

This Standard Operation Procedure (SOP) will be used in preparing for and executing groundwater sampling from wells. The procedures describe recommended methods for obtaining representative groundwater samples for organic, inorganic, other general chemistry parameters. This SOP is based on U.S. EPA and other guidelines and is intended to provide general procedures. State regulations or EPA region-specific procedures may take precedence and should be documented in the Field Sampling and Analysis Plan or project-specific work plan.

This SOP addresses the three major phases for the implementation of a field groundwater sampling program: pre-field or office activities; on-site purging and sampling activities; and post-sampling activities. Each phase is addressed, herein, first by briefly describing the general tasks that must be considered and then by detailing procedures to be followed in implementing each phase.

2.0 RELATED DOCUMENTS

- Backhus, D. A., J. N. Ryan, D. M. Groher, J. K. McFarlane, and P. M. Gshwend, 1993. Sampling Colloids and Colloid-Associated Contaminants in Ground Water. *Ground Water*. Vol. 31, pp. 466-479.
- Barcelona, M. J., H. A. Wehrmann, and M. D. Varljen, 1994. Reproducible Well Purging Procedures and VOC Stabilization Criteria for Ground-Water Sampling. *Ground Water*. Vol 32, pp. 12-32.
- Nielsen, David M., 1991. *Practical Handbook of Ground-water Monitoring*: Lewis Publishers, Chelsea, MI.
- N.J.D.E.P.E., 1992. *Field Sampling Procedures Manual*: New Jersey Department of Environmental Protection and Energy, Trenton, NJ.
- Powell, R. M., and R. W. Puls, 1993. Passive Sampling of Ground-Water Monitoring wells Without Purging: Multilevel Well Chemistry and Tracer Disappearance. *Jour. Contaminant Hydrology*. Vol. 12, pp 51-77.
- Puls, R. W. And R. M. Powell, 1992. Acquisition of Representative Ground Water Quality Samples for Metals. *Ground-Water Monitoring Review*. Vol. 12, pp. 167-176.
- U.S. EPA, 1986. *Test Methods for Evaluating Solid Waste, Volume II: Field Manual, Physical/Chemical Methods*. Office of Solid Waste and Emergency Response. SW-846. November 1986.

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Groundwater Sampling from Monitoring Wells (Cont.)

U.S. EPA, 1992. RCRA Ground-Water Monitoring: Draft Technical Guidance. Office of Solid Waste, EPA/530-R-93-001.

U.S. EPA, 1994. Recommended Procedures for Low-Flow Purging and Sampling of Ground-Water Monitoring Wells. EPA Region III QA Directives, ESD, HWMD, Annapolis, MD.

U.S. EPA, 1995. Ground-Water Sampling - A Workshop Summary. Proceedings from the Dallas, TX November 30 - December 2, 1993 Workshop. US EPA office of Research and Development R. S. Kerr Environmental Research Laboratory. EPA/600/R-94/205, January 1995.

U.S. EPA, 1996. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual. U.S. EPA Region 4, Athens, GA, May 1996.

3.0 PRE-FIELD/OFFICE ACTIVITIES

3.1 Summary of Tasks to be Performed

To aid in the preparation of a field sampling event, a Pre-Field Check List for Sampling Activities (Attachment 1) and an equipment checklist are used. It is the responsibility of the Field Team Leader to ensure that all items on the checklist, whether performed by the Field Team Leader, Project Manager, or Preparation Laboratory Personnel, are completed in a timely manner before the sampling event occurs. Verifying completion of the tasks will be documented by the Field Team Leader or their designee by initialing in the space provided on the equipment checklist.

3.2 Office Activities Procedures

3.2.1 Analytical Laboratory(ies)

Notification of the analytical laboratory(ies) of the sampling event and anticipated schedule is performed by the Project Manager. However, verification should be completed by the Field Team Leader. The Project Manager will complete an analytical request that specifies the project name, schedule, laboratory, sample locations, matrix, number of samples, analytical parameters, QA/QC requirements and frequency, and sample bottle delivery location. Any quality assurance samples requiring laboratory-grade water will be specified. The analytical request form will then be submitted to the laboratory and the Field Team Leader.

To ensure analyses occur within the requisite holding times, the Project Manager is to coordinate with the laboratory to schedule sample receipt, which allows scheduling of field sampling activities, sample



Groundwater Sampling from Monitoring Wells (Cont.)

shipment and delivery. The Project Manger should also determine the frequency of submittal of laboratory-required QA samples, such as matrix spike and matrix spike duplicate samples.

3.2.2 Notification of Facility and Regulatory Agency Personnel

Prior to each sampling event, the Plant Manager (or appropriate person) and appropriate regulatory personnel (when necessary) will be notified, in writing, of the proposed sampling date by the project manager. This notification is to allow scheduling of sampling oversight and any coordination with plant operations.

3.2.3 Project-Specific Plans

Prior to initiating sampling activities, it is the responsibility of all field personnel to review the project-specific Health and Safety Plan, Work Plan, Analytical Request Form and pertinent SOPs to ensure that the objectives of the groundwater monitoring and sampling program are attained in a safe and timely manner. Groundwater sampling personnel should have access to a map showing well locations, and confirm access to well locations (i.e., access agreements, keys to well locations, etc.).

The field team leader will coordinate with plant personnel to determine the methods for handling the investigation derived waste (IDW) generated and procure appropriate containers for purge water.

The following quality assurance/quality control (QA/QC) samples are to be addressed:

Trip Blanks:

At a minimum, one trip blank should be collected per sampling event. The trip blank consists of sample bottles (40-ml vials) filled with laboratory-grade water. Trip blanks are transported to and returned from the sampling location and delivered to the lab in the same manner as containers used for the field samples. At no time are trip blanks to be opened.

Trip blanks are generally analyzed for volatile organic constituents only. Constituents found in the trip blank could be attributed to:

1. Interaction between the sample and the container,
2. Contamination in the laboratory water, or,
3. Handling procedures that alter the sample analysis results.

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Groundwater Sampling from Monitoring Wells (Cont.)

Equipment Blanks:

To ensure that the sampling devices have been appropriately cleaned (in the lab or field), the sampling device should be filled with laboratory-grade water (or water poured through or over), then poured (or transferred) into the containers and delivered to the laboratory for analysis. A minimum of one equipment blank per event should be collected. Equipment blanks may be required for each analyses.

Duplicate Samples

To evaluate the precision of field collection procedures and laboratory analysis reproducibility and compatibility, field duplicate samples should be collected. Field duplicate samples will be analyzed for the same parameters as the samples collected. Typically, duplicate samples are collected at a frequency of 1 per 20 samples, or one per sampling event.

Laboratory QA/QC Requirements

To satisfy the laboratory quality assurance/quality control requirements, MS/MSD and laboratory duplicates will be performed on selected samples. Extra sample volume may be required by the laboratory to perform these analyses. Extra containers will be provided, if required, for project specified analyses at a typical frequency of 1 per 20 samples, or one per sampling event. The frequency and method of collection of the above samples will be determined prior to going to the site.

3.2.4 Sample Bottles and Shipping Containers

The number, type and size of bottles are determined based on the scope of work. The laboratory performing the analyses will provide and ship bottles to the site or other designated location. The laboratory will also provide the appropriate type and amount of preservatives for the analyses to be performed, and laboratory-grade water, as specified in the analytical request. The laboratory is to provide an extra bottle allowance for breakage or additional sampling. The appropriate QA/QC sample bottles should also be included.

3.2.5 Assemble Sampling Equipment

The appropriate quantity and type of equipment will be determined from the project work plan. The field team leader and technicians will perform the function of preparing and checking the equipment. The completed equipment checklist should be reviewed by the Field Team Leader.

Inspection and calibration of meters will be performed prior to use in the field. Once in the field, the meters will be recalibrated. Section 4.2 contains specific information regarding the calibration procedures.

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3.2.6 Project Team Meeting

Prior to initiating field activities, the Project Manager (or his designee) will review project specific considerations with the Field Sampling Team. This will ensure that project goals are attained and the sampling event will be performed in the most cost-effective and appropriate manner possible.

4.0 ON-SITE ACTIVITIES

4.1 Summary of Tasks to be Performed

The procedures for groundwater sampling are presented herein. The tasks highlighted in this section include:

- Well inspection and meter calibration,
- Water level measurement procedures,
- Well purging procedures,
- Groundwater sampling procedures,
- Filtering procedures,
- Field QA/QC requirements,
- Documentation, and
- Safety precautions.

During well purging and sampling activities, there are several basic procedures which must be completed for quality assurance purposes.

- New sampling gloves should be worn at each well location;
- Wells should be sampled in the order of least impacted to most impacted, starting with upgradient wells;
- Equipment should be placed on a new sheet of plastic surrounding or to the side of the well;

4.2 Well Inspection and Calibration of Meters

4.2.1 Well Inspection

Monitoring wells will be inspected during each sampling event. The inspection will include examination of the concrete pad, protective casing, lid, lock, and hinge (or flushmount lid), the well riser cap, and checking for obstructions within the well riser or screen. Any defects or maintenance requirements associated with the current monitoring well network that could impact the integrity of the sampling program will be recorded on the field data sheets and reported to the plant manager or appropriate person. Minor well repairs, such as removal of obstructions or replacement of damaged locks or PVC caps, will be performed upon completion of the inspection. Well repairs requiring specialized

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equipment will be performed following approval of the plant manager as soon as arrangements to obtain the necessary equipment can be made. The results of the well inspection and any maintenance activities completed will be documented in the groundwater monitoring report for each sampling event.

At a minimum, temperature, specific conductance, and pH will be measured during well purging. Since stabilization of these groundwater indicator parameters is used to evaluate the adequacy of the purging procedure, properly calibrated equipment is essential to collect valid data. A specific calibration plan for all field analytical equipment is presented in this section.

4.2.2 Specific Conductance Meter

Conductivity is defined as the ability to conduct or transmit an electrical current. Most specific conductance meters use a conductivity bridge where a voltage is applied, and the current is measured.

Inspection and Calibration of Specific Conductance Meter

Calibration of the specific conductance (conductivity) meter is to be conducted in accordance with the owners manual at the beginning of the day and at the end of the daily sampling. The following steps are used to calibrate the specific conductance meter.

- The conductivity cell is rinsed with distilled water.
- The meter is activated by turning the selector knob, and is first turned to the red line (or other zero-standard). If the meter needle does not move to the red line marker, adjust by turning the red line control knob until a red line reading is accomplished. If a red line adjustment cannot be accomplished, replace batteries and repeat the preceding steps until a red line reading is accomplished.
- Once a red line reading is accomplished, place and immerse conductivity cell in a potassium chloride (KCl) conductivity standard solution of known concentration. Keep the cell from contacting the side and bottom of the container. As conductivity is affected by temperature, measure both the temperature and conductivity of the standard solution.
- Record both the standard solution conductivity concentration and the measured conductivity reading, as well as the temperature.
- Rinse the conductivity cell with deionized water.
- A second standard solution may be used to achieve a two-point calibration. Immerse the conductivity cell in the second standard solution, and record results.

Notes: If the meter is not accurate to within $\pm 10\%$, correct the problem before proceeding.

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Units: Conductivity units are measured in micromhos per centimeter (umhos/cm) or microsiemens per centimeter (uS/cm) at 25°C. Results are reported to the nearest ten (10) units for readings less than 1,000 umhos/cm at 25°C and to the nearest one hundreds (100) units for readings greater than 1,000 umhos/cm at 25°C.

All calibration information is recorded in the site-specific field logbook.

4.2.3 pH Meter

The pH is defined as the negative logarithm of the effective hydrogen ion concentration or hydrogen-ion activity in gram equivalents per liter on a scale which ranges from 0 to 14, with 7 representing neutrality.

Inspection and Calibration of pH Meter

The calibration of the pH meter is to be conducted on a daily basis in the field. At the beginning and end of the day, the meter is to be checked against three standard buffer solutions that span the pH range (e.g., 4.0, 7.0, and 10.0). While in the field, the meter is to be checked against two buffer solutions when moving to a new sampling location.

The pH meter is to be prepared and used in accordance with the owner's manual. The pH meter is to be equipped with automatic temperature compensation. The meter may also have the capability of measuring redox potential. The pH meter may be calibrated by following the procedures:

- Activate the meter by turning the measurement mode switch to the ON position or pH mode.
- Rinse the probe with distilled/deionized water.
- Place electrode into a buffer solution of pH 7.00, and stir moderately.
- After allowing the meter to stabilize, adjust calibration control so that the correct buffer value (7.00) at that temperature is displayed. Record the meter reading.
- Remove electrode and rinse with distilled/deionized water.
- Place electrode into the pH 4.00 buffer solution and stir moderately.
- Allow reading to stabilize and adjust °C/Slope control until correct value of second buffer is displayed. Record the meter reading.
- Remove electrode and rinse with distilled/deionized water.
- Place the electrode into the pH 10.00 buffer solution. Record the meter reading.
- Rinse with analyte-free water and store in a container filled with KCl solution, pH 4.00 buffer solution or tap water.

The meter should be checked against two buffer solutions when conducting field measurements when moving to each new sampling point.



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Recalibration of meters in the field will occur every one in ten samples or at the end of the sampling day/event. All calibration information is to be recorded the site-specific field logbooks.

Units: Units of pH are Standard Units (SU) and should be read in one-hundredth (0.01) of a unit.

4.3 Water Level Measurement

Water levels in monitoring wells must be measured before the wells are purged and sampled. Several methods maybe used when measuring the water levels in wells. Regardless of the method of water level measurement, the upgradient well(s) should be measured prior to the downgradient. When performed in conjunction with decontaminating the measuring device between wells, the potential for cross contamination will be further reduced. Protective gloves are to be worn during water level measurements.

All in-well measurements (depth to water, total well depth) level are referenced from a surveyed point at the top each well casing and measured to an accuracy of .01 feet.

The following methods will obtain accurate water level and depth measurements, and will also minimize the chance of cross contamination.

4.3.1 Electronic Water Level Indicator

This instrument consists of a spool of dual conductor wire, with a probe attached at one end of the wire, and an indicator containing a low voltage electrical source at the other end. The wire is typically sheathed with a graduated measuring tape marked on the tape cover. When the probe comes in contact with water, an electronic circuit is closed, which is indicated by a tone and/or light in the indicator. The total depth of any well measured using a water level indicator should be corrected for any length of the probe that extends below the probe's circuit bridge. All measurements should be recorded to one-hundredth (0.01) of a foot.

Use of electronic water level indicators should be limited to those wells not containing hydrocarbon liquids. The electronic water level indicator can generally be used at most well locations. Groundwater at some locations may have low concentrations of dissolved ions that does not conduct the electrical current emitted by the probe.

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The procedures for using an electronic water level indicator are as follows:

1. Lower the weighted probe into the well casing. When the probe contacts water, a tone will be heard. Observe the calibrated tape to determine the water level.
2. Measure and record the reading to the nearest 0.01 foot.
3. Continue to lower the probe into the well casing to determine the total depth of the well, if needed. The measurement is typically accomplished by determining the point where tension is felt on the tape when raising the probe from resting on the bottom of the well. Measure and record total depth.
4. Decontaminate the probe and submerged portion of tape between each well by rinsing with distilled water and wiping the line with a clean cloth.

4.3.2 Interface Probe

Oil/water interface probes are commonly used to detect the presence of any floating or sinking non-aqueous phase liquid (NAPL) layers as well as the water levels inside wells. An interface probe typically uses an optical sensor to determine when the probe is in NAPL and a conductivity sensor to determine when the probe is submerged in water. Each phase may be measured separately.

When highly volatile vapors may be present, an interface probe with a grounding clamp should be used.

The procedures for using an interface probe are listed below:

1. The probe should be lowered slowly inside each well. If water is detected, the probe will sound a tone (beeping) to signify the beginning of the water level.

When a floating layer is encountered, a different (continuous) tone sounds. After recording the depth of the top of the floating NAPL, continue lowering the probe (observing the calibrated tape) until the steady tone stops at the LNAPL/water interface. Record this depth. The measurements on the drop line between when the steady tone began and when it stopped will determine the thickness of the NAPL layer.

2. The procedure as described above can also be used to determine the presence (and thickness) of dense (sinking) NAPL layers, except that the bottom of the well will indicate the bottom of the layer.

3. All measurements should be recorded to the nearest one hundredth (0.01) of a foot.

4. The probe is decontaminated between each well by rinsing with distilled water, or hexane if NAPL layers are present, and then wiping with a clean cloth.

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4.4 Well Purging

Monitoring wells are purged of water contained in the well prior to sample collection to assure collection of groundwater samples representative of actual water-bearing zone conditions. Two methods for determining adequacy of purging are provided below.

4.4.1 Conventional Well Purging

Using conventional well purging methods, it is typically required that wells be purged of a minimum of three well volumes until a maximum of five well volumes of standing water has been removed or until the pH, conductivity and temperature of the purge water stabilizes. A combination of these methods is typically used, where increments of well volumes are monitored for stabilization.

The flow rate of pumps used for purging should be able to be regulated and maintained at a low rate to avoid causing turbidity in samples. The rate of pumping during purging should be less than the rate used for development. Similarly, the use of a bailer during purging should not cause turbidity, and not allowed to drop to the water surface. Attempts should be made to avoid purging wells to dryness. This can be accomplished by pumping at a low flow rate. If a well is pumped dry, water that enters the well in an evacuated condition may cascade across the well screen and reduce volatile organic compound (VOC) concentrations and/or introduce fine particles into the water column.

In some situations, even with low flow rates, a well will be pumped or bailed dry (i.e. low yield bedrock wells or low permeability sediments). In these situations, this generally constitutes an adequate purge and wells can be sampled following sufficient recovery (i.e. sufficient volume to fill all sample containers). It is not necessary to purge three well volumes. The pH, temperature and specific conductance should be measured during the collection of the sample from the recovered volume as the measurements of record for the sampling event.

To calculate the amount of water to purge from each well, the depth of standing water must be measured. In addition, the well casing diameter and screen length of each well must be known. This information, along with the following appropriate formulas, are used to determine the volume to be purged from each well.

The following formula may be used to determine the volume of any well:

$$V = 5.875 \times C^2 \times H$$

where: V = volume in gallons
C = casing diameter, in feet
H = height of water column, in feet

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Using this formula, the volume per linear foot of well casing of common casing sizes is listed below:

Casing Diameter (inches)	Volume per Linear Foot (gallons)
1.5"	0.092
2.0"	0.163
4.0"	0.563
6.0"	1.469

The minimum purge volume required is three times the standing water volume in the well. Between the purging of three to five well volumes, groundwater purge parameters (pH, specific conductance and temperature) are measured to determine whether adequate purging has occurred through stabilization of purge parameters. Stabilization monitoring should occur during purging at regular intervals of the standing water volume. As a general criteria, three successive readings should be within ± 0.1 for pH and $\pm 3\%$ for conductivity.

To verify the removal of the required water volume during purging, a graduated bucket is used to measure flow rate during pumping or purge water volume. Purge methods are described in Section 3.5. Purge water will be contained as IDW for proper disposal.

4.4.2 Low-Flow Purging and Sampling

The low-flow purging method is an alternative to the conventional method of purging multiple well volumes. Low-flow purging focuses on pumping a monitoring well from the well's screen interval at a flow rate that is less than the recharge capacity of the formation. The rate of pumping is generally specific to the water-bearing unit, but typically does not exceed one liter per minute (or equivalently, 0.26 gallons per minute). By purging at low flow rates, only groundwater that enters through the well screen is purged from the well. Because stagnant water located above the pump intake is not drawn down into the pump, the casing volume would not have to be purged from the well prior to sampling.

Groundwater samples are generally collected during low-flow purging as soon as formation water is determined to be flowing from the well. Therefore, it is important to recognize the difference between stagnant water from casing storage and recharged formation water. The volume of water purged from a well is solely dependent on formation water stabilization rather than predetermined well volumes. Low-flow purging can significantly reduce the volume of water removed during sampling.

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Objective

The overall objective of low-flow purging is to match the purging device intake velocity with the natural groundwater velocity and thereby reduce sample disturbance. This is most easily evaluated by monitoring drawdown in the well and adjusting flow rate to minimize or eliminate that drawdown. Research has shown that purging with various types of pumps (peristaltic, low-speed submersibles, and bladder pumps) does produce low turbidity and high-quality samples (Puls and Barcelona, 1989, Puls et al., 1992; Backhus et al., 1993; Barcelona et al., 1994).

With low-flow purging, the purge volume or purge duration is evaluated through continuous monitoring of water quality parameters, such as specific conductance, oxidation-reduction (redox) potential, dissolved oxygen, pH and turbidity. Upon equilibration of these parameters, it is assumed that formation water is being accessed and sampling can be initiated.

Since the low-flow purging method is based on minimal disturbance, the total depth of the well should be measured after completion of groundwater sampling.

Procedures

All equipment should be laid on clean plastic sheeting placed around or beside the well. The pump or tubing connected to a peristaltic pump is set with the intake at the mid-point of the screen interval, preferably in advance of the sampling event at the well.

Upon initiation of pumping, the flow rate is to be measured using an appropriate graduated container, preferably one-liter or one-quart. The flow rate should be adjusted to approximately one liter per minute. The water level should be checked periodically as a guide to flow rate adjustment. Collect the purge water as IDW.

Optimally, an in-line water quality measurement device should be used to continuously monitor groundwater quality indicator parameters. The water quality indicator parameters can include pH, redox potential, specific conductance, dissolved oxygen (DO) and turbidity. The last three parameters are often most sensitive. Measurements should be taken every three to five minutes if the above suggested rate is used. Stabilization is achieved after all parameters have stabilized. Three successive readings should be within ± 0.1 for pH, $\pm 3\%$ for conductivity, ± 10 mv for redox potential, and $\pm 10\%$ for turbidity and DO. Stabilized purge indicator parameter trends are generally obvious and follow either an asymptotic or exponential change to table valves. Dissolved oxygen and turbidity usually require the longest time for stabilization.

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Upon parameter stabilization, sampling can be initiated. If an in-line device is used to monitor water quality parameters, it should be disconnected or bypassed during sample collection. Sampling flow rate may remain at the established purge rate or altered to minimize aeration, bubble formation, turbulence in sample bottles, or loss of volatile constituents due to extended residence time in tubing. Typically, flow rates less than 0.5 L/min are appropriate. The same device should be used for sampling as was used for purging. Groundwater sampling should proceed by collecting groundwater samples in appropriate containers, and preserving the samples as necessary.

4.5 Conventional Purging and Sampling Methods

Wells may be purged and sampled by either hand bailing or pumping. When possible, all samples are collected using laboratory cleaned bailers. Hand bailing for sample collection is preferred because bailers may be decontaminated more effectively than pumps. Also, degassing of volatile organic compounds may occur through the use of some types of pumps.

If NAPLs are present in the well, pumping with a peristaltic pump will be the preferred purge method. This method should reduce mixing of the NAPL within the water column. The effectiveness of peristaltic pumps is generally limited to wells with water levels less than 25 feet below the top of the casing.

4.5.1 Bailing

The following procedures describe the techniques to be used when wells are purged and samples are extracted using hand bailers.

1. Place plastic sheeting (or garbage bags) around the well casing to create a clean surface for the placement of sampling cord and equipment.
2. Use a separate laboratory cleaned stainless steel bailer or Teflon bailer on each well for the required purging and sampling.
3. Use new surgical or nitrile gloves when working at each well.
4. Use new nylon cord to tie to the top of the bailer. Make sure the knotted cord is securely tied.
5. After fully removing the protective wrapping from the laboratory cleaned or new bailer, lower it into the well until it touches the bottom. It is critical that the bailer be slowly and gently immersed into the top of the water column, allowed to fill and removed. Then remove an additional length of cord and tie it securely to the well head to serve as a safety line for the bailer.

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If an NAPL layer is present, either remove the LNAPL with a bailer or see Section 3.5.2 for purging with a pump. If a sinking NAPL layer exists and pumping is not feasible, lower the bailer so as to avoid mixing of this layer within the well water column; i.e., the bailer will not be lowered into the sinking NAPL layer. If the dense NAPL is to be removed, it should be conducted after groundwater sampling is completed.

6. When raising the bailer, collect the cord on the plastic sheeting or in a plastic-lined five-gallon bucket. Collect the purge water as IDW.
7. A separate laboratory-cleaned stainless steel or Teflon bailer may be used to collect samples from each monitoring well.
 - Samples are collected when the well recharges after purging.
 - All samples are collected according to their order of volatilization (Attachment 2).
 - All volatile organic samples will be collected with a laboratory cleaned, bottom-filling bailer in a manner which will prevent degassification of volatile organic constituents that may be present in the groundwater.
8. Preserve the samples as necessary (Attachment 3) and place them in ice chests and cool to a temperature of 4°C.
9. Before the cooler is sealed a chain-of-custody sheet is completed for each cooler containing samples.
10. Each cooler is sealed, with chain-of-custody tape or a tag, and shipped or delivered to the laboratory for analysis.

4.5.2 Pumping

There are circumstances when pumps are more effective purging devices than bailers. It is preferable to purge wells containing NAPL layer(s) with a pump to help reduce the mixing of this material in the water column. Also, in some instances, pumps are the only means by which samples can be extracted from monitoring wells.

Several pumps which are frequently used to purge and sample wells are discussed below.

Peristaltic Pump

Peristaltic pumps must be operated above ground, next to the well being purged, and are limited to purging depths of 20 to 30 feet below ground surface. The flow rate of peristaltic pumps is typically variable by altering the pump head speed, and may achieve flow rates of 140 to 1700 ml/min. The following procedures are used in operating a peristaltic pump.

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1. New suction line is used on each well being purged. New medical grade silicon pump head tubing will also be used if the pump is utilized for sampling.
2. If the sample is collected directly from the pump discharge, the choice of tubing used to collect the sample will be contingent on the parameters of interest.
 - Standard polyethylene tubing is sufficient to collect the sample for conventional and inorganic parameters.
 - Teflon tubing may be used to collect samples to be analyzed for volatile and/or semi-volatile parameters.
3. Lower the suction line to a depth in the water column that assures continued collection. The intake of the suction line should be placed to avoid disturbing any NAPL layer. If a floating NAPL layer is encountered, this should be either suctioned off with a pump or removed with a bailer, during purging. If a sinking NAPL layer is encountered, the suction line should be placed to avoid this layer regardless of well water drawdown. The suction-line assembly is dedicated for use on one well only. After use, the tubing is wrapped, marked, and stored for future use in the well to which it is dedicated. Otherwise the tubing is discarded as IDW.
4. Monitor the pumping to ensure proper pump operation and assure continuous discharge. If drawdown occurs, lower the tubing deeper into the water column.
5. When the required amount of water is purged from each well, allow for sufficient recovery before sampling. If a floating NAPL was removed during purging, the suction line should be changed for sample collection.

Bladder Pumps

The bladder pump is a gas-operated positive displacement submersible well pump that uses inert compressed gas, e.g., nitrogen, to inflate an internal bladder which pumps water up the discharge line. These pumps can be used when large volumes of water must be purged from monitoring wells or when slow purge rates are desired. Usually these pumps are used on wells with diameters greater than 2 inches and wells with depths up to 150 feet.

The line assembly is dedicated for use on one well only. After use, the tubing is wrapped, marked, and stored for future use in the well to which it is dedicated. Otherwise the tubing is discarded as IDW.

Bladder pumps are primarily used to remove the required amount of water from the monitoring well prior to sampling. When this is accomplished, groundwater may be sampled using the bladder pump or using a laboratory-cleaned stainless steel bailer.

1. Connect the line assembly to the pump by first attaching the cable and then connecting the water and pneumatic lines.

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2. Lower the pump down the well by unrolling the line off the spool. Lower the pump to the desired position inside the well, allowing sufficient room for drawdown of the water column.
3. Secure the cable to hold the pump at the desired depth.
4. Connect the gas line to the control box. The discharge line should be placed in a container (e.g. 55-gallon drum) to collect the purged water as IDW.
5. Connect the gas supply to the control box and adjust the pressure according to the manufacturer's manual.
6. Turn on the control box and adjust the inflate delay to obtain the optimal pumping cycle.
7. The pumping rate should be calculated to determine the length of time the pump should run to purge the well. Field measurements of pH and specific conductance, or the calculation of three casing volumes may be used to determine when a sufficient amount of water has been purged.
8. When the sufficient amount of water has been purged, the well may be sampled using the bladder pump at a low flow rate or using a laboratory-cleaned stainless steel bailer.
9. As noted, the tubing is used on one well only and after each sampling it is packed, sealed, and stored for future use on that well.

Submersible Pumps

For large diameter wells or wells with depths greater than 150 feet, submersible pumps are used to purge the required amount groundwater. The submersible pumping apparatus may be removed to allow for sampling with a bailer, or the submersible pump assembly will remain intact and will be used to collect the sample. The flow rate of submersible pumps may be changed using a pump controller.

When possible, the submersible pumps will be dedicated to each well. However, this may not be economically feasible and the same pump must be used in several wells. In this instance the pump must be decontaminated with a non-phosphate soap and water wash between each well. The pumps may be steam cleaned between well if the equipment is available.

1. Connect the pump to the discharge tubing. The discharge tubing used may be constructed of polyethylene or Teflon, depending on the analytes of interest. The submerged portion of **OHIO EPA DHWM** tubing may need to be of Teflon construction.
2. The submersible pump should be lowered to a depth of approximately the middle of the screened portion of each monitoring well. The safety line should be secured to the well casing.
3. Connect the power cord to the power source (generator) and turn on the pump.

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4. Monitor the pumping rate and lower the line if drawdown of the water column occurs.
5. If the well is pumped dry, allow sufficient time for the well to recover prior to sample collection.

4.6 Sample Collection

Groundwater samples should be decanted from the sample collection device (bailer or tubing) directly into the appropriate sample container. Samples are to be collected in order of volatilization and preserved. New surgical gloves, or the equivalent, must be worn for each well location.

4.7 Sample Filtration

As outlined in the 1986 RCRA Technical Enforcement Guidance Document, filtering will not be performed on samples to be analyzed for organics.

Filtering of samples collected for dissolved metals analyses will be performed using peristaltic pumps with disposable 0.45 micron filters and disposable tubing. New medical grade silicone tubing is used in the pump head for each sample filtered. After filtering, samples requiring preservation are preserved and all containers are securely placed in coolers and chilled to a temperature of 4 ± 2 degrees Celsius ($^{\circ}\text{C}$).

4.8 Quality Assurance/Quality Control Samples

Field Quality Assurance samples are an integral part of a groundwater sampling event. Sample integrity is verified by collecting, duplicate analysis and blank samples (trip and rinsate).

4.9 Documentation

A number of documents must be completed before, during, and after each sampling project. These documents include; field logbooks, site data sheets forms, sample labels, chain-of-custody sheets, field data sheets and any project notes pertaining to the sampling work. Additional documents are used as reference information during each phase of a project and they include; holding time sheets, and sample preservation and containment sheets.

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Site Data Sheets

The site data sheet is completed by the project manager or project engineer/scientist and submitted to the sampling team when requesting sampling work. These sheets contain the specific parameters of interest for which the collected samples will be analyzed. The project manager or field team coordinator must send the site data sheet to the laboratory to obtain the appropriate sample containers.

Field Logbook

A site-specific logbook will be used for documentation while in the field for all notes. It is recommended that each page of the logbook be numbered and dated. The entries should be legible and contain accurate and inclusive and should include, at a minimum, the following information:

- Identification of logbook ownership on the inside front cover, and telephone number.
- Plant location and identifying number;
- Names of field personnel at the site, including daily safety meeting;
- Weather information (general);
- Sample locations and activities;
- Sample collection equipment;
- Calculations, results and calibration data for field sampling equipment, field analytical equipment, and field physical parameters;
- Date, time and method of monitoring well purging;
- Date, time and method of groundwater sampling;
- Diameter of wells;
- Total depth of wells (to 0.01 feet);
- Distance to water in each well (to 0.01 feet) and volume of standing water in each well;
- Detection/amount of product in each well, if any;
- Water quality measurements (field) measured in increments during well volume purging, including, but not limited to:
 - i) pH
 - ii) specific conductance
 - iii) water temperature
- Observations for each well;
 - i) Special procedures to purge and sample
 - ii) Visual observations of the purge/sample water (i.e., turbidity, color)
 - iii) Actual volume removed to purge well
 - iv) Observations of well integrity (i.e., conditions of casing, lid, pad, or lock)
- Collection of field quality assurance samples (i.e., blanks, split samples, or duplicates);
- Maps or sketches of sample locations;
- Regulatory agency personnel observing sampling or obtaining split samples;

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- Documentation of sample shipment dates, time, and carrier tracking (air bill) number; and
- Photograph information, including date and time, and brief description of what the photograph is intended to show.

Sample Identification

A label will be affixed to each sample container (See Attachment 4). Each sample will be identified with a label which is waterproof. The label shall contain the following information:

- Sample designation (as specified in site-specific work plan);
- Date - six digit number, e.g., 07/12/96;
- Time - four digit number, e.g., 0954 for 9:54 a.m.; 1629 for 4:29 p.m.;
- Sample analyses to be completed;
- Preservatives.

Chain-of-Custody Forms

Chain-of-custody forms will accompany all samples shipped to the laboratory (see Attachment 5). This form contain information pertaining to the samples, such as: the project name, the signature of the people collecting the samples, the site of collection, the date and time of collection, the parameters of interest for each sample, remarks or observations of samples if appropriate, the signature of the person relinquishing control of the samples, and the name of the carrier shipping the samples to the laboratory (e.g., Federal Express, UPS, etc.). The original chain-of-custody sheet is sent with the samples, one copy is retained for the project files, and the remaining copy may be left with the client/facility.

Field Data Sheets

The field data sheets (see Attachment 6) serve as a log for information pertaining to each specific project. The basic project information such as the name of the project, the date of sampling, and the name of the people collecting the samples is contained on these forms. These forms are specifically designed for the collection of samples from groundwater monitoring wells. Information pertaining to the wells being sampled is recorded on these forms. Observations are made on the integrity of the wells being sampled and the physical characteristics of the water in the wells. If representatives are on-site to observe sampling activities and or to split samples, the names, positions, and departments of these persons are noted.

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5.0 POST-SAMPLING ACTIVITIES

5.1 Summary of Post-Sampling Activities

The post-sampling activities involve:

- Completion of Field Data Sheets from the Field Notes,
- Completing the Trip Report, and
- Updating the Site-Specific Field Sampling Manual (as necessary)

5.1.1 Field Notes

The Field Team Leader is responsible for generating a field data sheet from information contained in the field log book. All well information is included on this sheet.

5.1.2 Trip Report

The Field Team Leader is responsible for a brief summary of the sampling event, prepared to serve as a cover page for all project specific data, such as:

- Field data sheets,
- Chain of custody sheets, and
- Other pertinent information, as necessary.

5.1.3 Site-Specific Field Sampling Manual

Any new site-specific considerations that need to be updated, to account for equipment/bottle/procedures changes (i.e., a well is damaged and must be sampled with a pump, etc.), will be adjusted in the site-specific manual.

5.1.4 Trip Report

The Field Team Leader is responsible for submitting the Trip Report to the Project Manager, Geologist/Engineer, and other pertinent team members upon completion of the sampling event.



ATTACHMENT 2 AQUEOUS SAMPLE COLLECTION ORDER

The order in which aqueous samples are collected, as prioritized to the sensitivity to volatilization, is as follows:

- Volatile Organics
- Purgeable Organics
- Purgeable Organic Halogens
- Total Organic Halogens
- Total Organic Carbon
- Extractable Organics
- Total Metals
- Dissolved Metals
- Phenols
- Cyanide
- Sulfate and Chloride
- Turbidity
- Nitrate
- Ammonia

There is not an order of preference for the collection of the remaining conventional parameters.

Notes:

1. Recommended in RCRA Groundwater Monitoring Technical Enforcement Guidance Document, September 1986, p. 105.
2. Temperature, pH and specific conductance measurements will be completed in the field.

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**ATTACHMENT 3
HOLDING TIME AND PRESERVATIVE REQUIREMENTS
AQUEOUS MEDIA**

Parameter	Container Type/Volume	Preservation	Maximum Holding Time (1)
Volatile Organics (with preservative)	3-40 mL glass screw cap vials w/Teflon septa (no headspace)	HCl to pH <2; cool to 4° +/- 2 C	14 days
Volatile Organics (without preservative)	3-40 mL glass screw cap vials w/Teflon septa (no headspace)	Cool to 4° +/- 2 C	7 days
Direct Aqueous Injection Volatiles	3-40 mL glass screw cap vials w/Teflon septa (no headspace)	Cool to 4° +/- 2 C	14 days
Semi-Volatile Organics	2-1 liter amber glass w/Teflon lined cap	Cool to 4° +/- 2 C	7 days till extraction; 40 days to inject extract
Organochlorine Pesticides/PCBs	2-1 liter amber glass w/Teflon lined cap	Cool to 4° +/- 2 C	7 days till extraction; 40 days to inject extract
Organo-Phosphate Pesticides	2-1 liter amber glass w/Teflon lined cap	Cool to 4° +/- 2 C	7 days till extraction; 40 days to inject extract
Herbicides	2-1 liter amber glass w/Teflon lined cap	Cool to 4° +/- 2 C	7 days till extraction; 40 days to inject extract
PCDDs/PCDFs	2-1 liter amber glass w/Teflon lined cap	Cool to 4° +/- 2 C	40 days till extraction; 40 days to inject extract
GC Fingerprinting of Fuels	2-1 liter amber glass w/Teflon lined cap	Cool to 4° +/- 2 C	14 days
Fuels (Headspace)	3-40 mL glass screw cap vials w/Teflon septa (no headspace)	Cool to 4° +/- 2 C HCl to pH <2	14 days
Fuels (Extractables)	2-1 liter glass w/Teflon lined cap	Cool to 4° +/- 2 C	14 days
Gasoline Range Organics	3-40 mL glass screw cap vials w/Teflon septa (no headspace)	Cool to 4° +/- 2 C HCl to pH <2	14 days
Diesel Range Organics	2-1 liter glass w/Teflon lined cap	Cool to 4° +/- 2 C	14 days
TPH by GC/FID	2-1 liter glass w/Teflon lined cap	Cool to 4° +/- 2 C	14 days
MTBE	3-40 mL glass w/Teflon lined cap (no headspace)	Cool to 4° +/- 2 C, HCl to pH <2	14 days
Phenolics	1-1 liter glass w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	28 days
Metals	1-1 liter HDPE w/Teflon lined cap	HNO3 to pH <2	6 months, 28 days for mercury
Cyanide (total and free)	1-1 liter HDPE w/Teflon lined cap	NaOH to pH >12; cool to 4° +/- 2 C	14 days
Total Sulfide	1-500 mL HDPE w/Teflon lined cap	Zinc acetate plus NaOH to pH >9; Cool to 4° +/- 2 C	7 days
Total Sulfate	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	28 days
Alkalinity	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	14 days
Ammonia	1-1 liter HDPE w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	28 days
BOD	1-1 liter glass w/Teflon lined cap	Cool to 4° +/- 2 C	48 hours
COD	1-1 liter glass w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	28 days
Hardness	1-500 mL HDPE w/Teflon lined cap	HNO3 to pH <2	6 months
Nitrate	1-500 mL HDPE w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	28 days
Nitrate-N/Nitrite-N	1-500 mL HDPE w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	28 days
Nitrite	1-500 mL HDPE w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	48 hours
TDS	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	7 days

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ATTACHMENT 3 (continued)
HOLDING TIME AND PRESERVATIVE REQUIREMENTS
AQUEOUS MEDIA

Parameter	Container Type/Volume	Preservation	Maximum Holding Time (1)
TVS	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	7 days
TSS	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	7 days
Suspended Volatile Solids	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	7 days
TOC	1-500 mL HDPE w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/- 2 C	28 days
Color	1-100 mL glass w/Teflon lined cap	Cool to 4° +/- 2 C	48 hours
Turbidity	1-100 mL glass w/Teflon lined cap	Cool to 4° +/- 2 C	48 hours
Acidity	1-200 mL glass/plastic w/Teflon lined cap	Cool to 4° +/- 2 C	14 days
Residue	1-200 mL glass/plastic w/Teflon lined cap	Cool to 4° +/- 2 C	NA
Bromide	1-50 mL glass/plastic	Cool to 4° +/- 2 C	28 days
Residual Chlorine	1-200 mL amber glass w/Teflon lined cap	No headspace	Analyze immediately
Iodide	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	28 days
Total Kjeldahl Nitrogen	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	28 days
Phosphorus	1-100 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C; H2SO4 to pH <2	28 days
Sulfite	1-100 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	Analyze immediately
Methylene Blue Active Substances (MBAS)	1-250 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	48 hours
Corrosivity	1-100 mL HDPE w/Teflon lined cap	NA	Analyze immediately
Ignitability	1-100 mL HDPE w/Teflon lined cap	NA	NA
Reactivity	1-100 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	NA
Fecal Coliform	125 mL plastic, sterile	Cool to 4° +/- 2 C, NO2S2O3	6 hours
Standard Plate Count	125 mL plastic, sterile	Cool to 4° +/- 2 C, NO2S2O3	24 hours
Free Liquids Test	1-500 mL glass	NA	NA
Total Organic Halogens	2-250 mL glass	Cool to 4° +/- 2 C; Na2S2O3; H2So4 to pH <2	28 days
Alpha/Beta	2-1 liter plastic	HN03 to pH <2	NA
Alpha Emitting Radium	2-1 liter plastic	HN03 to pH <2	NA
pH	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	24 hours
Specific Conductance	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	28 days
Dissolved Oxygen	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	24 hours
Nitritotriacetic Acid, Trisodium Salt (NTA)	1-500 mL HDPE w/Teflon lined cap	None	24 hours
Orthophosphate	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	48 hours
Fluoride	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	28 days
Chloride	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/- 2 C	28 days

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**ATTACHMENT 3 (continued)
HOLDING TIME AND PRESERVATIVE REQUIREMENTS
AQUEOUS MEDIA**

Parameter	Container Type/Volume	Preservation	Maximum Holding Time (1)
Alpha Emitting Radium	1-1 liter HDPE w/Teflon lined cap	None	6 months
Total Petroleum Hydrocarbons	1-1 liter glass w/Teflon lined cap	1:1 HCl to pH <2; cool to 4° +/-2 C	28 days
Oil & Grease	1-1 liter glass w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/-2 C	28 days
Total Phenols	1-1 liter glass w/Teflon lined cap	H2SO4 to pH <2; cool to 4° +/-2 C	28 days
Hexavalent Chromium	1-500 mL HDPE w/Teflon lined cap	Cool to 4° +/-2 C	24 hours
Specific Gravity	1-500 mL HDPE w/Teflon lined cap	None	NA
Viscosity	1-500 mL HDPE w/Teflon lined cap	None	NA
Density	1-500 mL HDPE w/Teflon lined cap	None	NA

NOTES:

- [1] - Holding times are from date of sample collection.
- [2] - HDPE - High density polyethylene.
- [3] - Many parameters can be combined in one container, if preservation requirements are identical.

REFERENCES:

- 1) Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (SW-846). Third Edition (latest update: January 1995), Table 2-33 and Table 3-1.
- 2) Methods for the Chemical Analysis of Water and Wastes, U.S. EPA Environmental Monitoring and Support Laboratory - Cincinnati, Ohio, March 1983, Table 1.
- 3) Standard Methods for the Examination of Water and Wastewater, 18th Edition, 1992, American Public Health Association.
- 4) Microbiological Methods for Monitoring the Environment, Water and Wastes, U.S. EPA, 1978, 600/8-78-017.
- 5) Methods for the Examination of Waste and Wastewater, U.S. EPA, 1979, 600/4-79-020.
- 6) 40 CFR 136.
- 7) 40 CFR 141.
- 8) Prescribed Procedures for Measurement of Radioactivity in Drinking Water, EPA, 1980, 600/4-80-032.

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ATTACHMENT 4

LABORATORY SAMPLE LABEL

Sampler/Affiliation: _____
Site: _____
Sample ID: _____
Date: _____ Time: _____

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