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RCRA Corrective Action Plan

Final

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May 1994

RCRA CORRECTIVE ACTION PLAN

(Final)

Office of Waste Programs Enforcement
Office of Solid Waste

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.

EPA-R5-2017-010506_0004623

Table of Contents

Foreword v

Chapter I: Corrective Action Process Update 1

Chapter II: Interim Measures To Achieve Stabilization 11

Chapter III: RCRA Facility Investigation 17
- Introduction 17
- Release Assessment *[optional phase]* 18
- Section I: Description of Current Conditions 22
- Section II: RFI Workplan 26
- Section III: Facility Investigation 33
- Section IV: Preliminary Evaluation of Corrective Measure Technologies by Laboratory or Bench-Scale Studies *[optional]* . . . 48
- Section V: Investigation Results and Analysis 49
- Section VI: Progress Reports 52
- Section VIII: Proposed Schedule 53

Chapter IV: Corrective Measures Study 55
- Introduction 55
- Section I: Corrective Measures Study Workplan 60
- Section II: Corrective Measures Study Report 60
- Section III: Progress Reports 68
- Section IV: Proposed Schedule 69

Chapter V: Corrective Measures Implementation 70
- Introduction 70
- Section I: Conceptual Design (15% Design Point) 75
- Section II: Operation and Maintenance Plan 77
- Section III: Intermediate Plans and Specifications (30, 50, 60, 90 and/or 95% Design Point) 80
- Section IV: Final Plans and Specifications (100% Design Point) 81
- Section V: Construction Workplan 81
- Section VI: Construction Completion Report 84
- Section VII: Corrective Measure Completion Report 85
- Section VIII: Health and Safety Plan 85
- Section IX: Public Involvement Plan 87
- Section X: Progress Reports 88
- Section XI: Proposed Schedule 88

Appendix A - Corrective Action Reference List..... 90

Appendix B - Chapter One of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", EPA Publication SW-846 [Third Edition as amended by Update I (July 1992)]..... 94

Appendix C - Definitions..... 127

Appendix D - Corrective Action Stabilization Questionnaire..... 129

Appendix E - Example Scope of Work for Interim/Stabilization Measures..... 138

Appendix F -Summary of Important Geologic Information..... 147

Appendix G - Sources of Information on Human Health and Ecological Risk Assessments..... 149

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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).

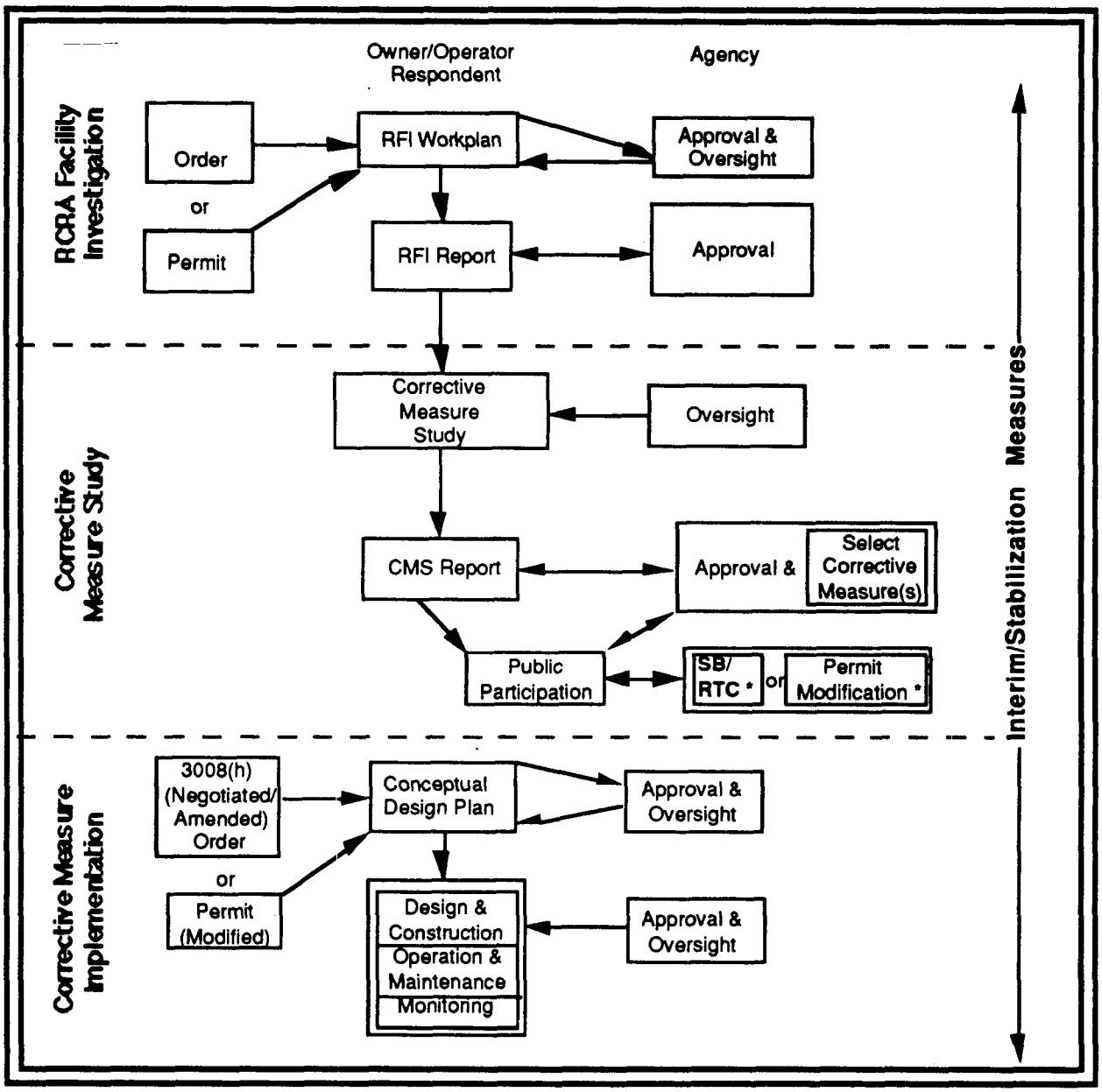
Limitations exist on the release or discussion of information during the enforcement process (particularly during negotiations or if a case is referred to the Department of Justice). However, respondents that are issued RCRA §3008 (h) administrative orders have the right to request a hearing concerning 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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

(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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

Ground Water • Interceptor Trench/Sump/Subsurface Drain • Pump and Treat System (Source Removal and Containment) • Physical Barriers (Covers/Slurry Walls)
Soils • Run-off/Run-on Control (Diversion or Collection Devices) • Cap/Cover • Source Removal (Excavation)
Surface Water Release (Point and Non-Point) • Overflow/Underflow Dams • Filter Fences • Run-off/Run-on Control (Diversion or Collection Devices) • Regrading/Revegetation
Gas Migration Control • Barriers/Collection (e.g., vapor extraction)/Treatment/Monitoring • Evacuation (Buildings)
Particulate Emissions • Truck Wash (Decontamination Unit) • Revegetation • Application of Dust Suppressant • Cover/Cap

EPA-R5-2017-010506_0004623

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) A. Interim Measures Objectives B. Description of Interim Measures and Conceptual Design (may include performance-based design) C. Construction/Implementation (may be phased) D. Operation and Maintenance E. Waste Management (e.g., CAMU/TU)
IV. Sampling and Analysis (if applicable) A. Purpose/Data Quality Objectives (may not be as stringent as for RFI) B. Summary of Sampling Activities C. Field Methods and Sample Analysis 1. Sample Locations and Depths 2. Sample Location Maps 3. Summary Tables including sampling methods, holding times, analytical methods, preservation methods, sample depths, etc. 4. Field Quality Control D. Quality Assurance/Quality Control
V. Project Management A. Project Organization 1. Personnel/Organizational Chart B. Project Schedule C. Reporting Requirements (e.g., Report of Findings)

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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,

EPA-R5-2017-010506_0004623

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))

EPA-R5-2017-010506_0004623

[*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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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-

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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 I);

    - 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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

- 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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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 d 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;

EPA-R5-2017-010506_0004623

- 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

EPA-R5-2017-010506_0004623

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".*]

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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;

EPA-R5-2017-010506_0004623

- 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

EPA-R5-2017-010506_0004623

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;

EPA-R5-2017-010506_0004623

- 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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

- 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, $N0_3$ /$N0_2$, 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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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;

EPA-R5-2017-010506_0004623

- 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.

EPA-R5-2017-010506_0004623

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.]

EPA-R5-2017-010506_0004623

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:

Facility Submission	Due Date
Description of Current Conditions (Section I)	[DATE]

EPA-R5-2017-010506_0004623

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	[MONTHLY, BI-MONTHLY, other]

[see Section VI above for guidance on progress reports.]

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

(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

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

[*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

EPA-R5-2017-010506_0004623

Section III: Progress Reports

Section IV: Proposed Schedule

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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* <u>*RCRA Public Involvement Manual*</u> *[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:

Facility Submission	Due Date
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	[MONTHLY, BI-MONTHLY, other]

[see Section III above for guidance on progress reports.]

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

[*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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

Section X: Progress Reports

Section XI: Proposed Schedule

EPA-R5-2017-010506_0004623

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 that 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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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).

EPA-R5-2017-010506_0004623

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* <u>*RCRA Public Involvement Manual*</u> *(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.

EPA-R5-2017-010506_0004623

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:

EPA-R5-2017-010506_0004623

Facility Submission	Due Date
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	[MONTHLY, BI-MONTHLY, other]

[see Section X above for guidance on progress reports.]

EPA-R5-2017-010506_0004623

Appendix A

Corrective Action Reference List

EPA-R5-2017-010506_0004623

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.

"*Human Health Evaluation Manual, Supplemental Guidance: Standard Default Exposure Factors*," OSWER Directive 9285.6-03, March 25, 1991.

"*Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A)*," Interim Final, EPA/540/1-89/002, December 1989

"*Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual*," Interim Final, EPA/540/1-89/001, March 1989.

"*Final Guidance for Data Useability in Risk Assessment*," (Parts A & B), OSWER Directive 9285.7-09A, April 1992.

"*Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference Document*," EPA 600/3-89/013, March 1989.

"*A Compendium of Superfund Field Operations Methods*," Two Volumes, EPA/540/P-87/001a&b, OSWER Directive 9355.0-14, August 1987.

"*Technical Guidance Document: Construction Quality Assurance for Hazardous Waste Land Disposal Facilities*," EPA 530/SW-86/031, OSWER Directive 9472.003, October 1986.

EPA-R5-2017-010506_0004623

"*Corrective Measures for Releases to Ground Water from SWMUs*," Draft Final, EPA/530-SW-88-020, March 1985.

"*Basics of Pump-and-Treat Groundwater Remediation Technology*," EPA/600/8-90/003, March 1990.

"*Technical Guidance for Corrective Measures--Determining Appropriate Technology and Response for Air Releases*," Draft Final, EPA/530-SW-88-021, March 1985.

"*Air/Superfund National Technical Guidance Study Series*," Volumes I-IV, EPA 450/1-89-001,002,003,004 (1989 and 1990).

"*Corrective Measures for Releases to Soil from SWMUs*," Draft F EPA/530-SW-88-022, March 1985.

"*Technical Guidance for Corrective Measures -- Subsurface Gas*," EPA/530-SW-88-023, March 1985.

"*Guide for Conducting Treatability Studies under CERCLA*," Interim Final, EPA/540/2-89/058.

"*Guide for Conducting Treatability Studies under CERCLA: Aerobic Biodegradation Remedy Screening*", EPA/540/2-91/013B, July 1991.

"*Guide for Conducting Treatability Studies under CERCLA: Chemical Dehalogenation*", EPA/540/R-92/013B.

"*Guide for Conducting Treatability Studies under CERCLA: Soil Vapor Extraction*", EPA/540/2-91/019B, September 1991.

"*Guide for Conducting Treatability Studies under CERCLA: Soil Washing*," EPA/540/2-91/020B, September 1991.

"*Selected Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation*," EPA/540/8-91/092, 1991.

"*Synopses of Federal Demonstrations of Innovative Site Remediation Technologies*," EPA/540/8-91/009, May 1991.

"*Bibliography of Federal Reports and Publications Describing Alternative and Innovative Treatment Technologies for Corrective Action and Site Remediation*," EPA/540/8-91/007, May 1991.

"*Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments*," EPA/530/SW-89/047, July 1989.

"*Handbook on In-Situ Treatment of Hazardous Waste-Contaminated Soils*," EPA/540/2-90/002, 1990.

"*Stabilization/Solidification for CERCLA and RCRA Wastes*," EPA/625/6-89/022, May 1989.

"*Technology Screening Guide for Treatment of CERCLA Soils and Sludges*," EPA/540/2-88/004, September 1988.

EPA-R5-2017-010506_0004623

"*Health and Safety Requirements of Employees Employed in Field Activities*," EPA Order 1440.2, July 12, 1981.

"*Handbook of RCRA Ground-Water Monitoring Constituents: Chemical and Physical Properties*," EPA/530/R-92/022, September 1992.

"*RCRA Ground-Water Monitoring: Draft Technical Guidance*," EPA/530/R-93/001, November 1992.

"*Statistical Training Course for Ground-Water Monitoring Data Analysis*," EPA/530/R-93/003, 1992.

"*Literature Survey of Innovative Technologies for Hazardous Waste Site Remediation: 1987 - 1991*," EPA/542/B-92/004, July 1992.

"*Characterizing Heterogeneous Wastes: Methods and Recommendations*," EPA/600/R-92/033, Feb. 1992.

"*Handbook of Suggested Practices for the Design and Installation of Ground-Water Monitoring Wells*," EPA/600/4-89/034, April 1989.

Quality Assurance

"*Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans*," QAMS-005/80, December 29, 1980.

GENERAL INFORMATION:

"*OSWER Directives - System Catalog*," OSWER Directive 9013.15-3D, March 1992. (Provides a list of OSWER Directives published through March 1991.)

"*Technical Support Services for Superfund Site Remediation and RCRA Corrective Action*," (third edition), EPA/540/8-91/091, March 1992.

"*Accessing Federal Data Bases for Contaminated Site Clean-Up Technologies*," EPA/540/8-91/008, May 1991.

"*Memorandum on the Use of Supplemental Environmental Projects, Amendment to GM 22*," James M. Strock, February 12, 1991.

"*Catalog of Office of Waste Programs Enforcement Publications*," EPA/540/8-90/016, November 1990.

"*A Catalogue of Hazardous and Solid Waste Publications*," EPA 530-SW-91-013, May 1991.

USEFUL TELEPHONE NUMBERS:

RCRA/CERCLA/UST Hotline: (800) 424-9346
ORD Publications Office, Center for Environmental Research Information (CERI): (513) 569-7562
National Technical Information Service (NTIS): (703) 487-4650

EPA-R5-2017-010506_0004623

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)]

EPA-R5-2017-010506_0004623

CHAPTER ONE
TABLE OF CONTENTS

Section		Page
1.0	INTRODUCTION	1
2.0	QA PROJECT PLAN	1
2.1	DATA QUALITY OBJECTIVES	2
2.2	PROJECT OBJECTIVES	2
2.3	SAMPLE COLLECTION	3
2.4	ANALYSIS AND TESTING	3
2.5	QUALITY CONTROL	3
2.6	PROJECT DOCUMENTATION	3
2.7	ORGANIZATION PERFORMING FIELD OR LABORATORY OPERATIONS	4
2.7.1	Performance Evaluation	5
2.7.2	Internal Assessment by QA Function	5
2.7.3	External Assessment	5
2.7.4	On-Site Evaluation	5
2.7.4.1	Field Activities	5
2.7.4.2	Laboratory Activities	6
2.7.5	QA Reports	7
3.0	FIELD OPERATIONS	8
3.1	FIELD LOGISTICS	8
3.2	EQUIPMENT/INSTRUMENTATION	9
3.3	OPERATING PROCEDURES	9
3.3.1	Sample Management	9
3.3.2	Reagent/Standard Preparation	9
3.3.3	Decontamination	9
3.3.4	Sample Collection	10
3.3.5	Field Measurements	10
3.3.6	Equipment Calibration And Maintenance	10
3.3.7	Corrective Action	10
3.3.8	Data Reduction and Validation	11
3.3.9	Reporting	11
3.3.10	Records Management	11
3.3.11	Waste Disposal	11
3.4	FIELD QA AND QC REQUIREMENTS	11
3.4.1	Control Samples	11
3.4.2	Acceptance Criteria	12
3.4.3	Deviations	12
3.4.4	Corrective Action	12
3.4.5	Data Handling	12
3.5	QUALITY ASSURANCE REVIEW	13
3.6	FIELD RECORDS	13

EPA-R5-2017-010506_0004623

TABLE OF CONTENTS
(continued)

Section		Page
4.0	LABORATORY OPERATIONS	14
4.1	FACILITIES	14
4.2	EQUIPMENT/INSTRUMENTATION	15
4.3	OPERATING PROCEDURES	15
4.3.1	Sample Management	16
4.3.2	Reagent/Standard Preparation	16
4.3.3	General Laboratory Techniques	16
4.3.4	Test Methods	16
4.3.5	Equipment Calibration and Maintenance	17
4.3.6	QC	17
4.3.7	Corrective Action	17
4.3.8	Data Reduction and Validation	18
4.3.9	Reporting	18
4.3.10	Records Management	18
4.3.11	Waste Disposal	18
4.4	LABORATORY QA AND QC PROCEDURES	18
4.4.1	Method Proficiency	18
4.4.2	Control Limits	19
4.4.3	Laboratory Control Procedures	19
4.4.4	Deviations	20
4.4.5	Corrective Action	20
4.4.6	Data Handling	20
4.5	QUALITY ASSURANCE REVIEW	21
4.6	LABORATORY RECORDS	21
5.0	DEFINITIONS	23
6.0	REFERENCES	29
INDEX		30

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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 <u>in situ</u> 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

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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 rinsate 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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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:

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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.

No. of samples:	t-statistic
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 ith measurement of the variable x
and $\bar{x}$ = the average value of x;

EPA-R5-2017-010506_0004623

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

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

EPA-R5-2017-010506_0004623

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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EPA-R5-2017-010506_0004623

INDEX

Accuracy 1, 13, 22, 23*, 24
Batch 12, 19, 21, 23*
Bias 2, 3, 17-20, 22, 23*-25, 28
Blank 11, 12, 14, 18-20, 23*, 24, 25, 28, 29
   Equipment Rinsate 11, 12, 14, 18, 24*
   Method Blank 19, 24, 25*, 28
   Reagent Blank 28*
   Trip Blank 12, 18, 24, 29*
Chain-of-Custody 9, 11, 13, 14, 18, 21, 22
Control Chart 18, 19
Control Sample 11, 12, 18, 19, 23, 24*
Data Quality Objectives (DQO) 1-3, 8, 12, 19, 20, 24*, 28
Decision-maker 2, 24
Duplicate 11, 12, 14, 18-20, 23, 24*, 25, 27, 28
   Field Duplicate 11, 12, 24, 25*, 28
   Matrix Duplicate 12, 19, 20, 24, 25*, 28
   Matrix Spike Duplicate 12, 19, 20, 23, 24, 25*
Equipment Blank 11, 24*
Equipment Rinsate 11, 12, 14, 18, 24*
Estimated Quantitation Limit (EQL) 24*
Field Duplicate 12, 24, 25*, 28
Laboratory Control Sample 19, 25*
Matrix 11, 12, 18-20, 23-25*, 26-28
Matrix Duplicate 12, 19, 20, 24, 25*, 28
Matrix Spike 12, 18-20, 23, 25*, 26, 27
Matrix Spike Duplicate 12, 19, 20, 23, 24, 25*
Method Blank 19, 24, 25*, 28
Method Detection Limit (MDL) 18-20, 22, 24, 25*-27
Organic-Free Reagent Water 27*, 28
Precision 1-3, 17-20, 22, 24, 25, 27*, 28
Project 1-5, 7, 8, 11-14, 17-19, 21, 23, 24, 28*
Quality Assurance Project Plan (QAPjP) 1-9, 11, 12, 14, 15, 18, 20, 22, 23, 28*
RCRA 1, 8, 28*
Reagent Blank 28*
Reagent Grade 28*
Reagent Water 27, 28*
Reference Material 8, 11, 15, 18, 19, 28*
Split Samples 25, 28*
Standard Addition 20, 28*
Standard Curve 26, 28*
Surrogate 18, 20, 22, 29*
Trip Blank 12, 18, 24, 29*

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* Definition of term.

EPA-R5-2017-010506_0004623

Appendix C

Definitions

EPA-R5-2017-010506_0004623

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)*]

EPA-R5-2017-010506_0004623

Appendix D

Corrective Action Stabilization Questionnaire

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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.

EPA-R5-2017-010506_0004623

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 <u>ONLY</u> IF THE FOLLOWING CONDITIONS ARE MET:

- *The facility ranks "High" on the National Corrective Action Prioritization System; <u>AND</u>*
- *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 RFI, 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

EPA-R5-2017-010506_0004623

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-

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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

EPA-R5-2017-010506_0004623

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, aerial 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 contaminates	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 • Rate	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
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

EPA-R5-2017-010506_0004623

Appendix G

Sources of Information on Human Health and Ecological Risk Assessments

EPA-R5-2017-010506_0004623

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.))

EPA-R5-2017-010506_0004623

- 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)

EPA-R5-2017-010506_0004623

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