RCRA CME Handbook

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RCRA
Comprehensive Ground-Water Monitoring Evaluation (CME) Handbook

To Be Utilized in Conjunction With
The Comprehensive Ground-Water Monitoring Evaluation
Operation & Maintenance
CME/O&M
Training Program 1990

PREPARED FOR

U.S. Environmental Protection Agency
Region 5
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and
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Comprehensive Ground Water Monitoring Evaluation Handbook

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Notice

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Chapter 1

1.0 INTRODUCTION

This Comprehensive Ground Water Monitoring Evaluation (CME) Handbook is based on the RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD), the RCRA Ground Water Monitoring Compliance Order Guidance (COG), and the RCRA CME Guidance Document. The TEGD describes in detail the essential components of an efficient ground water monitoring system that would be consistent with the regulatory requirements of the Resource Conservation and Recovery Act (RCRA), as set forth by the U.S. Environmental Protection Agency in 40 CFR Parts 264, 265 and 270. It should be noted that while the TEGD does not specifically discuss 40 CFR 264, the technical approach presented for ground water *still applies.* While the TEGD constitutes guidance rather than regulatory requirements, the TEGD and SW-846, Volume Two, Chapter 11 should continue to be the main references used when evaluating the technical aspects of a ground water monitoring system.

The COG is a companion guidance document to the TEGD. Its purpose is to guide enforcement officials in developing administrative orders to correct interim status ground water monitoring violations in a manner that is consistent with the RCRA permitting process. The technical guidance set forth in the TEGD and the COG were condensed to develop the checklists in the RCRA Comprehensive Ground Water Monitoring Evaluation Document (RCRA CME Document). This guidance document is one of three found in the RCRA Ground Water Monitoring Systems Manual, which is being used as the manual for this training course. The other two documents in the manual are the Operation and Maintenance (O&M) Inspection Guide and the RCRA Laboratory Audit Inspection (LAI) Guidance.

This CME Handbook has been developed as a training addendum to the RCRA Ground Water Monitoring Systems Manual, particularly to the RCRA CME Document. We are attempting to provide flexible guidance where little or no official policy exists. Prepared by EPA Headquarters and Regional Staff, as well as contractor personnel, it is intended for use by EPA, State, and contractor personnel involved in the planning and implementation of successful RCRA CME efforts.

1.1 Purpose of the CME

A CME requires the performance of an independent, detailed evaluation to determine whether an owner/operator has in place a groundwater monitoring system which is adequately designed, operated, and maintained to detect releases, and which will be able to define the rate and extent of contaminant migration from a RCRA regulated unit. In special cases, a CME may be required to evaluate groundwater corrective action under 40 CFR 264, Subpart F. A regulated unit is defined as a landfill, waste pile, surface impoundment, or land treatment facility as described in 40 CFR Parts 264, 265 and 270.

A CME begins in the office as an extensive evaluation of all available relevant information. This aspect of a CME is discussed in Sections 2.0 and 3.0 in this handbook. The second portion of a CME is the field inspection, which is utilized to evaluate the operation of ground water monitoring systems. Field inspections are discussed thoroughly in Sections 4.0 and 5.0 in this handbook. The final step in completing a thorough CME is the compilation of a report which presents all relevant information, as well as an evaluation of data gaps which could effect the overall evaluation of the ground water monitoring system. CME reporting requirements are addressed in Section 6.0 of this handbook.

The CME report is a legal document used as a foundation for the development of regulatory actions concerning permitting or corrective action associated with a facility's ground water monitoring system. Because these regulatory actions may be based on the findings of the CME, reporting must be factual, objective, complete, and well documented.

1.2 Relationship of the CME to Other RCRA Inspections

A CME is required for the evaluation of a facility's RCRA compliance with 40 CFR Parts 264 and 265 Subparts F, and 40 CFR 270. Specifically, it requires an evaluation of a facility's ground water monitoring system first in the office and then in the field. A CME can be part of other types of RCRA inspections, or the impetus for initiating enforcement action against a facility. Other RCRA inspections in addition to the CME are as follows:

- <u>A Compliance Evaluation Inspection (CEI)</u> is an on-site evaluation of the compliance of a generator, transporter or treatment, storage or disposal (TSD) facility with RCRA regulations and permits. This type of inspection is intended to gather necessary information to compel a facility's compliance with the regulations, or to support an enforcement action. A CEI performed at a facility which has land-based RCRA units includes a cursory check for compliance with ground water requirements. For example, the inspector confirms that a ground water monitoring system is place and notes any deficiencies. Any problems concerning ground water monitoring noted during the CEI would be deferred to the appropriate RCRA staff for a future CME. A person who is anticipating conducting a CME may wish to go along on the CEI to familiarize him/herself with the facility. It is often well worth seeing the location of the monitoring wells and the conditions at the site. This information may greatly aid in the effectiveness of the office assessment.

- A Case Development Inspection (CDI) is an intensive investigation based on agency files and data gathered on-site. The intent is to gather sufficient information to support an enforcement action. A case development inspection usually does not address ground water monitoring issues as this can be directly addressed under the permitting authority. However, there are some cases where specific regulatory issues could be in question regarding ground water monitoring, and a CDI subsequently implemented.

- An Operation and Maintenance Inspection (O&M) is a periodical inspection of how well a ground water monitoring system continues functioning once it is in place. Although not covered directly in this training addendum, the O&M process is a subset of the CME process. Consequently, anything addressed during an O&M Inspection will also be addressed during a CME. This type of inspection requires an in-house review of past CME reports, as well as a field evaluation. Conducted between CMEs, it is performed in order to evaluate whether the ground water monitoring system is being operated properly in the field. The O&M also evaluates whether deficiencies identified in the previously performed CME have been addressed by the owner/operator. However, many static items, such as hydrogeology and site history, may not need re-evaluation during an O&M. A CME or an O&M is currently required at one-third of land disposal facilities every year, according to the *Fiscal Year 1990 Agency Operating Guidance.* This is subject to change under future operating guidance.

- o A Laboratory Audit Inspection (LAI) is a review of the owner/operator's laboratory analytical program. This type of inspection is designed to ensure reliable analytical data is provided by the laboratory performing the analyses of the samples collected as a part of the facility's ground water monitoring program. An LAI may be recommended if questions arise from a CME concerning either analytical results or laboratory integrity. This inspection closes the loop on guidance that is needed by enforcement officials to review the design and operation of a RCRA ground water monitoring system.

- o A Land Disposal Restrictions Inspection (LDR) is a type of CEI inspection intended to ensure compliance with 40 CFR Part 268. This type of inspection has no direct relationship with a CME.

One question that often arises when performing a CME concerns its relationship to releases from Solid Waste Management Units (SWMUs) to groundwater, or activities under the RCRA Corrective Action Program. Although the hydrogeological data from SWMU ground water monitoring systems or other programs is extremely useful in performing a CME, inspectors should not directly evaluate their adequacy. A CME directly addresses ground water monitoring systems required for regulated units at RCRA interim status and permitted facilities; if you are inspecting a permitted facility, you are conducting your CME under those specific permit conditions. However, other ground water monitoring systems should be discussed as part of the CME, and the data should be utilized as it relates to CME interpretations, conclusions or recommendations. While conducting a CME, keep in mind that the information you are gathering, and the monitoring system you are evaluating or recommending, may impact other areas which could undergo investigation later at the facility. Your actions or recommendations may provide information to facilitate other activities at the site, such as a RCRA Facility Assessment.

1.3 CME Training Versus TEGD/COG Training

This training course focuses specifically on the procedures for conducting a successful RCRA CME, whereas alternative TEGD/COG training provides technical guidance which supports the RCRA CME effort. The TEGD provides specific guidance on the following technical elements of a CME:

- o Characterization of site hydrogeology

- o Location and number of ground water monitoring wells
- o *Design, construction,* and development of ground water wells
- o Content and implementation of the sampling and analysis plan
- o Statistical analysis or other data interpretation of ground water monitoring data(Statistical analysis has been updated since the publication of the TEGD [U.S. EPA, Office of Solid Waste, April, 1989]).
- o The content and implementation of the assessment plan

The COG provides guidance on the relationship between technical ground water monitoring inadequacies and the regulatory requirements of 40 CFR, Part 265 Subpart F, and Part 270. A summary of this concept is found in Figure 4.3 in the COG, *Relationship* of Technical Inadequacies to Ground Water Performance Standards in the RCRA CME Document.

This CME training course is directed towards helping compliance and enforcement personnel develop a complete evaluation of a RCRA facility's topography, geology, hydrogeology, waste management practices and ground water monitoring systems, in order to assess the adequacy of that groundwater monitoring system. This course will concentrate on the following elements:

- o The scope of the CME
- o Office evaluation of available facility information
- o Technical assessment of available information from other independent sources
- o Pre-planning of a field inspection
- o Conducting the field inspection
- o Requirements for preparing and completing a CME report

1.4 References

U.S. EPA, 1985, RCRA Ground Water Monitoring Compliance Order Guidance (COG) Document, Final August 1985.

U.S. EPA, 1986, RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD), Final September 1986, OSWER 9950.1.

U.S. EPA, 1988, RCRA Ground Water Monitoring Systems, Final September 1988, OSWER 9950.2-.4, which includes the CME, O&M and LAI guidances.

SW-846, Test Methods for Evaluating Solid Wastes, Volumes One and Two, 1986.

U.S. EPA, Office of Solid Waste, April 1989, Statistical Analyses of Ground Water Monitoring Data at RCRA Facilities, Interim Final.

2.0 SCOPE OF THE CME

The scope of a CME requires the completion of the following processes:

- Office evaluation
- Field sampling and analysis audits
- Report preparation

The team conducting the CME should have a substantial knowledge of the following disciplines:

- Hydrogeology
- Well design
- Construction of monitoring systems
- Ground water sampling
- Chemistry
- Waste characteristics
- Fate and transport in ground water
- RCRA regulations and enforcement authorities

2.1 Office Evaluation

Prior to conducting the field audit, information is collected from EPA and State files, as well as from other sources and subjected to an evaluation. Page six of the RCRA CME Document lists seven elements for which a technical evaluation must be conducted during an office evaluation. These areas include the evaluation of an owner/operator's interpretation of the site hydrogeology, as well as an evaluation of the design, installation, and operation and maintenance of their ground water monitoring system.

You will need to ask co-workers for their knowledge of facility information when such material is not in the file room. **Remember**, personnel from various sections such as RCRA Permits, Enforcement, Environmental Services Division (ESD), National Pollution Discharge and Elimination System (NPDES), and Comprehensive Environmental

Response Compensation and Liability Act (CERCLA) may have the key information you need for the CME . . . Ask around. In some states, both the U.S. Geological Survey or State Geological Surveys, or the State and Federal Oil and Gas Commissions, Land Boards, etc. may have key site specific information.

The ten steps which should be undertaken when conducting an office evaluation are as follows:

STEP 1: Collect and document all the information in the file which relates to the RCRA status of the facility and the design, installation, and past performance of the monitoring system(s).

The range of information that must be collected from the facility is very broad; it includes any information that increases our understanding of the facility's operation and the owner/operator's assessment of the site's geology and hydrogeology, including identification and description of the uppermost aquifer, potentiometric surface, vertical and horizontal gradients, and hydraulic conductivity. Information must also be obtained on the owner/operator's design, installation, and operation and maintenance of the ground water monitoring system. During this step you should identify for further evaluation any solid waste management units (SWMUs) of concern.

Information which is critical to understanding the hydrology and geology of the facility and the design, installation, and past performance of the monitoring system must be included in the CME report in an narrative and/or by inclusion of relevant diagrams, figures, and tables.

STEP 2: Collect and document any other available information such as regional hydrogeologic information which relates to the adequacy of the monitoring system.

You want to be able to answer these two questions before the office evaluation portion of the CME report can be completed:

o Has the owner/operator collected enough information to: (1) have a sufficient understanding to identify potential contaminant pathways; (2) support the placement of wells capable of determining the facility's impact on the uppermost aquifer; and (3) adequately characterize the site-specific hydrogeology?

- o Did the owner/operator use appropriate techniques to collect and interpret the information on the site's hydrogeology used to support well placement?

STEP 3: Evaluate the adequacy of the information the owner/operator relied on in designing the monitoring system.

- o The TEGD stresses that it is not possible to ensure that a monitoring system is adequately designed unless a thorough hydrogeologic investigation has been made. It is therefore critical that the adequacy of the hydrogeological and geological information developed by the owner/operator be assessed during a CME and that the CME report concludes with a clear determination as to the adequacy of this inspection.

The owner/operator must have adequately evaluated and relied on the hydrogeological information s/he obtained during design of the monitoring system. You must review the owner/operator's interpretation and use of the geologic information available to him, and report the findings of this review in the CME report. You may determine that the owner/operator's interpretation is inadequate or incorrect. In any case, you should also develop your own interpretation of the data (to the extent that the data allow) and present that interpretation in the CME report as well. Chapter One of the TEGD describes data interpretation techniques the owner/operator and the reviewing geologist may use in interpreting and presenting the geologic information that is gathered.

STEP 4: Evaluate whether the site stratigraphy has been defined to the required detail, interpreted, and presented in the proper format.

The site stratigraphy must be defined in adequate detail as a result of the owner/operator's investigation program to give the reviewing geologist a high degree of confidence that the subsurface at the site is understood well enough to design a monitoring well system that will sample all potential contaminant pathways. This information must be presented clearly and concisely, with no apparent inconsistencies or unjustified extrapolations of data. The method of presentation of the stratigraphy may vary, but should include:

- o Geologic maps at a scale that will show all units present at the facility
- o Geologic cross-sections at a scale that will show the thickness of all units present beneath the facility in sufficient detail to explain any geologic features unique to each bed (faults, folds, solution cavities, collapse features, intrusions, truncations, excavations, etc.).

STEP 5: Evaluate the owner/operator's identification of the uppermost aquifer (as defined by EPA regulations, 40 CFR Part 260.10) and judge the correctness of his/her conclusions. Independently identify and evaluate the uppermost aquifer, and evaluate possible intercommunication with other ground water flow systems. Identify, if possible, the uppermost confining layer beneath the uppermost aquifer.

The most important points here are to determine whether the owner/operator understands the EPA definition of uppermost aquifer and whether or not he/she has correctly identified the uppermost aquifer. The latter depends on the owner/operator having collected sufficient relevant information to enable him to correctly identify the uppermost aquifer. There are three steps that you must take to make this determination:

- o Evaluate the adequacy of the information the owner/operator relied on in identifying the uppermost aquifer.
- o Evaluate the owner/operator's identification of the uppermost aquifer and judge the correctness of his/her conclusions.
- o Independently identify, if necessary and based only on readily available information, the uppermost aquifer and the uppermost confining layer beneath that aquifer, and include those determinations in the CME report.

STEP 6: Evaluate the owner/operator's determination of the direction, rate, and seasonal variation of groundwater flow at the facility, and judge the correctness of his conclusions.

Derive, if possible, an independent determination of the direction, rate and seasonal and artificially induced variations of groundwater flow at the facility. Note that this can only be done by constructing potentiometric maps.

The TEGD states that the owner/operator must have:

- o Established the direction of groundwater flow (including both horizontal and vertical components of flow).
- o Established the seasonal, temporal, and any artificially induced (i.e., off-site production well pumping, agricultural use) variations in groundwater flow.
- o Determined the hydraulic conductivities of the hydrogeologic units underlying their site.

Other factors relating to groundwater flow (horizontal direction, rate, variations, and hydraulic conductivities) must be determined by the owner/operator. When conducting the CME you must examine the owner/operator's evaluation of these parameters and report his/her findings in the CME report. If the owner/operator's determinations are inadequate, you must make your own independent determinations of these factors (horizontal direction, rate, variations, and hydraulic conductivities), to the extent the available data allow, and report his/her determinations in the CME report.

STEP 7: Identify, locate on a site map, and describe each regulated unit at the facility which is subject to ground water monitoring requirements. Specify for each regulated unit the regulatory status which requires detection, assessment, or permit monitoring. Locate on a map other facility components which may affect ground water quality (e.g., leaking tanks or process lines).

The summary of the regulated units should be based on relevant information collected with other information compiled during STEP 1. The intent is to collect all of the information which relates to the regulated units and other facility components so that it can be summarized in a single narrative and depicted on a single drawing. Specifically, the team conducting the CME should evaluate the owner/operator designation of the type of ground water monitoring system in place and determine if the system is appropriate based on regulatory requirements.

STEP 8: Locate on a site map, present the drilling logs (if available), and describe the construction details of each monitoring well, either in-place or proposed.

The summary of the monitoring wells is based on information which should also be gathered in STEP 1. Frequently this information is contained in contractors' reports, loose drilling logs, and other drawings and narratives. The intent is to collect all of the information so that it can be presented in a consistent format.

STEP 9: Evaluate the owner/operator's rationale for the placement and construction details of the upgradient well(s), and judge the adequacy of the well(s) installed or proposed. Independently determine, if possible, appropriate locations and design for upgradient wells at the facility.

Adequacy of the monitoring system(s) (installed or proposed) is the key determination of a CME. All other information gathering and analyses in the CME lead up to this one major conclusion. It is critical that this determination and the basis for it, both use of facts and use of your professional judgment, be explained in full. It is not sufficient to include in the CME report only the conclusion of adequacy or inadequacy. What is adequate about the system (and why), and what is not adequate about the system (and why), must be explained in detail.

STEP 10: Evaluate the owner/operator's rationale for the placement and construction (including construction materials) of the downgradient wells, and judge the adequacy of the wells, as installed or proposed. Independently identify and evaluate probable appropriate locations and design for downgradient wells at the facility.

The TEGD contains, in Chapters Two and Three, much useful information on proper placement, design and construction of downgradient wells. This guidance document also notes several design parameters for downgradient well networks which are highly desirable.

Determine the regulatory status of the facility being examined, because this determines the regulations which apply and thus the purpose of the monitoring system. Some scenarios are:

- o *Interim status facility; in operation prior to November 8, 1985; no suspected releases; detection system required (40 CFR 265.90-92); detection system in place. (This is the simplest type of situation).*
- o *Interim status facility; no wells in place; interim status terminated November 8, 1985; closure plan submitted (intending to clean close); ground water monitoring system required to assess any impact on ground water.*
- o *Interim status facility; several units; detection systems (40 CFR 265.90-92) in all units; one unit in assessment monitoring in 40 CFR 265.93; assessment plan submitted; assessment wells not yet installed.*
- o *Interim status; detection system (40 CFR 265.90-92) in place; Part B application submitted (40 CFR 270.14), including proposed or existing monitoring system.*

For permitted facilities seeking permits, the ground water monitoring systems either in place or proposed are more complex and specific than systems outlined under interim status (40 CFR 265). These systems include detection (40 CFR 264.98), compliance monitoring (40 CFR 264.99) and corrective action (40 CFR 264.100).

For permitted facilities, the design and operation of the system will be outlined, under the owner/operator's permit. It is this permit that should be the guidance for evaluation of ground water monitoring requirements in addition to the TEGD.

Once the scope of the CME is determined, the evaluation of the in-place and proposed downgradient wells can be undertaken. The wells must be evaluated for number, placement, spacing, clustering, depth, screen length, screen position (relative to significant stratigraphic features), construction materials, and other construction details. Adequacy of the system with regard to these site-specific variables, as well as the justification for this system based on site-specificity, is a matter that will be left to the professional judgment of the team conducting the CME. However, Chapter Three of the TEGD provides general guidelines to consider when determining the adequacy of the well design and construction.

Other points raised in the TEGD which must be explicitly evaluated during the conduct of the CME are:

1) Number of wells. The TEGD notes that three downgradient wells is rarely, if ever, enough. The team conducting the CME must evaluate the number of wells in the system, and reach a conclusion on adequacy of the number of wells, considering all site-specific factors. The conclusion on adequacy/inadequacy along with the rationale which supports it, must be documented and supported in the CME report.

2) Location of the downgradient wells. When conducting the CME you must evaluate the placement of the downgradient wells relative to the regulated unit. For detection systems, the detection wells should be placed as near as practicable to the regulated unit [40 CFR 265.91(a)(2), 40 CFR 264.95(a), 40 CFR 264.98(b) and 40 CFR 264.99(b)]. The team conducting the CME must assess the location of the actual or proposed placement of the wells and their effectiveness in detection of contaminants emanating from the regulated unit. For assessment systems, wells are required to be placed so they are able to determine the "rate and extent of migration of hazardous waste and hazardous waste constituents in the ground water" [40 CFR 265.93(a)(2)]. You must evaluate the adequacy of the assessment well system relative to this standard and site-specific conditions, and assess the effectiveness of the actual or proposed placement of the assessment wells and their effectiveness in assessing contaminant migration.

3) Screen length. The length of the well screen must be determined based on site-specific conditions. During the CME, you should assess the adequacy of the screen length used, given the geologic setting of the particular facility, the probable behavior of potential contaminants, and the extraction capabilities of the purging/sampling device. The team conducting the CME must explain in the CME report the basis for the determination of adequacy or inadequacy.

4) Depth of screened intervals. Chapter Two of the TEGD suggests that screens be placed in order to monitor the appropriate horizons to provide immediate detection of a release. It also stresses that it

is extremely important that upgradient and downgradient wells be screened in the same stratigraphic horizon(s) for comparison purposes. The team conducting the CME should assess the screened intervals to determine whether or not the wells will adequately monitor all stratigraphic horizons which may serve as contaminant pathways. Conclusions on this matter must be recorded in the CME report.

5) Use of cluster wells. The TEGD discusses at length the geologic/contaminant scenarios which should "prompt the owner/operator to use well clusters." The team conducting the CME should assess the need for and use of cluster wells to adequately monitor the ground water up or downgradient of the regulated units. The CME should provide conclusions on the use or proposed use of cluster wells at the facility.

In summary, the office assessment is the foundation for the CME report and it is where you should spend the majority of your time. Obviously, there are certain components of the office assessment which cannot be completed until the site inspection is completed. It is the purpose of the office assessment, however, to identify these gaps so that they can be answered in the field.

If the office assessment is completed correctly, all pieces to the ground water puzzle should come together upon completion of the field inspection. Details of the office evaluation/technical assessment are contained in Section One of the RCRA CME Document and in Section 3.0 of this handbook. With that in mind, the following discussion below presents the general strategy of the Field Sampling and Analysis audits.

2.2 Field Sampling and Analysis Audit

The field sampling and analysis audit begins with an evaluation of existing information. In this evaluation you should define what field samples have been taken in the past and note the contaminants found at the various monitoring well locations. You should also assess the method in which the monitoring wells were sampled, such as the use of peristaltic, bladder, or submersible pumps, and stainless steel, Teflon, or PVC bailers. The results of your evaluation will enable you to decide whether split samples will be needed. During the field audit, you should focus your attention on the sampling methods and techniques used, parameters analyzed for, preservatives used, field measurements taken, and the integrity of the monitoring wells. This portion of the CME is the assessment of a facility's compliance with their Sampling and Analysis Plan.

As previously discussed, the field sampling and analysis audit is the CME inspector's chance to collect additional data to complete the office assessment. Information such as water level measurements, photoionization measurements of the well headspace, and verification of well locations can also be performed. Observations of surface water bodies (i.e., ground water recharge or discharge areas) or other features which may explain or support hydrogeological interpretations in the office assessment should be addressed.

Additional information on the field sampling and analysis audit is discussed in detail in Sections Two through Four in the RCRA CME Document and in Sections 4.0 and 5.0 of this course handbook.

2.3 Reporting Requirements

Once the information has been received from the facility during the field inspection, all of the data must be re-evaluated. Quite likely you will find new informational gaps that you may be required to assess through your own interpretation. Whenever this occurs, you should document the source of the information and your interpretation of it when preparing the CME report.

The CME report is a stand-alone document. It must address the technical components of the facility's groundwater monitoring system and assess the facility's compliance with 40 CFR Parts 264 or 265 Subpart F and 40 CFR Part 270 requirements.

The CME report must accomplish four goals:

1) A documented assessment of the adequacy of information on which the design of the ground water monitoring system is based.

2) A documented assessment of the adequacy of the design and construction of the ground water monitoring system.

3) A documented evaluation of the facility's operation of the ground water monitoring system.

4) A documented evaluation of the facility's compliance with 40 CFR Parts 264 or 265 Subpart F and 40 CFR Part 270 requirements.

Section 6.0 of this course handbook, Reporting Requirements, will discuss in detail the contents of a CME report, office assessment report, field inspection report, and variations which may be appropriate for the CME report. Chapter 5 of the RCRA Inspector's Manual also discusses reporting requirements. Although the Inspector's Manual generally applies directly to CEIs, the information contained therein has a broad application to other types of RCRA inspections.

2.4 References

U.S. EPA, OSWER, RCRA Inspector's Manual, 9938.2A, Final March 1988.

U.S. EPA, 1985, RCRA Ground Water Monitoring Compliance Order Guidance Document, Final August 1985.

U.S. EPA, 1986, RCRA Ground Water Monitoring Technical Enforcement Guidance Document, Final September 1986, OSWER 9950.1.

U.S. EPA, 1988, RCRA Ground Water Monitoring Systems, Final September 1988, OSWER 9950.2-.4, which includes the CME guidance, O&M and LAI Directives.

3.0 OFFICE EVALUATION

The office evaluation is the portion of the CME process undertaken to determine the adequacy of a facility's ground water monitoring system. It is an in-depth technical evaluation of the ground water monitoring system and the information on which this system is based. Therefore, the team performing a CME must include qualified professionals with expertise in the areas of geology and/or hydrogeology. The team which performs a CME must evaluate the available information as a first step in determining:

- What information must be compiled for inclusion in the final report.
- What technical evaluations of the monitoring system must be conducted and included in the final report.
- What recommendations must be developed and included in the final report.
- What constitutes a complete technical evaluation of the facility's ground water monitoring system.
- What data gaps exist in the available information.
- Which areas the team conducting the CME may lack expertise. (This information should be included in the final report.)

The initial step in the office evaluation process is the accumulation of information about the facility and the surrounding area from a variety of sources. The accumulated information should be reviewed, categorized, interpreted, evaluated, and assembled throughout the entire process and should be used as the basis for making technical decisions, conclusions and recommendations.

Specific information should be obtained about the facility relating to the past and present operations, and the basis for the monitoring system design, construction and performance. This site-specific information will normally be obtained from such sources as the facility itself, EPA files and state agency files. Although the following list is by no means exhaustive, this information should be gathered in order to make an adequate assessment of the facility's potential impact on the ground water system:

- o processes that produce waste(s)
- o nature and volumes of the waste(s) produced
- o past and present treatment, storage and/or disposal practices for the facility's waste(s)
- o history of the regulated unit(s) (e.g., date(s) installed, expanded and/or modified; types of waste(s) managed in each unit; record or evidence of any releases, etc.)
- o facility maps
- o subsurface hydrogeology and geology, including any drilling logs, geophysical data, or regional interpretation
- o land use (nearby factories, homes, etc.,)
- o topography (past and/or present)
- o man-made features which might affect ground water flow
- o regional information collected by the owner/operator
- o previous studies of hydrology and geology
- o design and evaluation of existing monitoring wells
- o laboratory results of physical or chemical characteristics of any soil/rock samples during drilling operations
- o piezometer readings and ground water elevation measurements of on-site or off-site wells
- o laboratory analytical results of ground water samples
- o soil, geophysical, well location, surveys, etc.

A brief discussion of the various components of an office evaluation which should be addressed follows.

3.1 Regulatory Status/History

The ultimate purpose of the office evaluation is to determine the adequacy of a facility's groundwater monitoring system (either installed or proposed) in meeting the regulatory requirements of 40 CFR Parts 264, 265, and/or 270, as applicable. In order to do this, the office evaluation focuses on the evaluation of the adequacy of the information on which the monitoring system was based and of the actual design, construction of, and operation and maintenance procedures for the system.

The facility's compliance with the appropriate groundwater monitoring requirements should be based on the following policies:

- o All in-place (installed) monitoring systems, either for detection or assessment monitoring under interim status (40 CFR 265, Subpart F); should be evaluated based on their intended purpose. If a facility has both detection and assessment monitoring systems, the systems should be evaluated independently as to their adequacy.
- o For facilities with interim status and which require assessment monitoring, any proposed groundwater quality assessment monitoring system (whether or not it has been previously approved and/or is under construction) should be evaluated independently of any in-place detection monitoring system(s).
- o For facilities with no in-place monitoring system, the office evaluation should consist of an evaluation of the proposed system which is as thorough as the available data will allow.
- o Any outline of a groundwater quality assessment program submitted in accordance with 40 CFR 265.93(a) should be evaluated based on the criteria contained in Section 265.93(a) (1)-(3).
- o For facilities that have submitted Part B permit applications, the review of a proposed monitoring program pursuant to 40 CFR 270.14(c) should be conducted as part of the permit application review process. If the permit application review process is underway and the review of a proposed monitoring system has been completed, the review should be utilized as a source document during the office evaluation.
- o For facilities which have submitted Part B permit applications, the proposed groundwater detection compliance and/or corrective action groundwater systems which the owner/operator proposes to operate under 40 CFR 264, Subpart F requirements should be outlined in the Part B application. This proposed system should also be evaluated to determine if the system will be adequate to supply the following requirements:

  1) Whenever contamination is detected in the groundwater monitoring system under the detection program, the

owner/operator must institute a compliance monitoring program.

2) Whenever the groundwater protection standard which will be established at the issuance of the facility's permit is exceeded at the point of compliance, the owner/operator must be able to institute a corrective action program in accordance with 40 CFR 264.100.

3) For facilities which are operating under a Part B permit, the actual permit conditions set forth for groundwater monitoring under 40 CFR 264, Subpart F will outline the appropriate programs. Any changes to the program should be amended in the permit. As part of the CME, the permit conditions for groundwater monitoring and actual compliance with these conditions should be reviewed during the office assessment. Do not assume that the conditions set forth in the permit are the final word for permitted groundwater monitoring systems. Groundwater monitoring is very dynamic, as are the changing laws and guidance on performing groundwater monitoring.

As part of the regulatory status/history evaluation of the office assessment, it is always most useful to make a chronological list of all permitting or compliance activities associated with the groundwater monitoring system. For example, list such dates as installation of detection wells, observation of any statistically significant increases or decreases in analytical parameters (e.g., pH), installation of any additional wells, notification of violations cited by the state or EPA, past CMEs or O&M inspections, and any other pertinent groundwater monitoring events.

The compliance history can be compiled and directly utilized in the CME report. It is a great aid to those utilizing the report to have a summary of the groundwater monitoring history at the site which provides a framework for data used in the CME report. Once this compliance history is compiled, it can be updated thereafter during future CME or O&M inspections and can be an active chronology of events for the facility's groundwater monitoring program.

3.2 Characterization of Site Hydrogeology

Characterization of the subsurface geology. In order to adequately define the subsurface geology of the site (the first step toward designing a monitoring system), the owner/operator should have performed a detailed investigation to identify the lithology and structural characteristics of the subsurface, using direct methods supplemented by indirect methods. In conducting the office evaluation, you should review the investigatory techniques used by the owner/operator to insure that they were adequate to define the subsurface geology of the site.

(1) The following direct techniques must have been included in the investigation as a minimum according to the RCRA CME Document:

- o Soil borings
- o Survey of existing geologic information
- o Material tests (grain size analyses, standard penetration tests, etc.)

(2) The soil boring program must include the following as a minimum:

- o Several borings that are drilled to bedrock or to a low permeability layer defined as a confining layer.
- o Continuous sample corings logged by a qualified geologist for a sufficient fraction of the total borings. You will have to assess, based on your own judgment, whether or not the number of borings which were logged were a sufficient fraction.
- o Accurate and complete boring logs that present all relevant data collected during the drilling process. You should also interpret the data which were generated and compare your interpretation with the interpretation obtained by the owner/operator to assess whether the site geology has been accurately characterized. This can be accomplished by evaluating the adequacy of the presentations of the data generated from the investigations. The preferred methods for data presentation are:

  (A) Narrative description of geology
  (B) Geologic/hydrogeologic cross sections
  (C) Geologic or soil map (suggested)
  (D) Boring logs with description of strata
  (E) Raw data and interpretive analysis of material tests

In most cases, the team conducting the CME will be required to construct cross sections, fence diagrams or other interpretive techniques to evaluate the hydrogeologic setting. Even if the facility has constructed such diagrams, the team performing the CME should either verify the diagrams through an independent evaluation or data or they should independently evaluate data and present diagrams which best present the hydrologic conditions. For example, it may be appropriate to add borings to the cross sections or orient cross sections differently to present different information or interpretations. Also, many times owner/operators or their consultants will try to correlate hydrogeologic data with too little information; this leads to faulty assumptions.

Identification of groundwater pathways. As part of the hydrogeologic investigation conducted to characterize the site, the owner/operator must adequately identify all groundwater flowpaths in addition to characterizing the subsurface geology. You should review the investigatory techniques to insure they were adequate to accurately identify the groundwater flowpaths.

In order to have adequately identified the groundwater flowpaths, the owner/operator must have:

- o Established the direction of groundwater flow including both horizontal and vertical components of flow. Identification of a groundwater flow net and the recommended method for determining vertical and horizontal flowpaths is described in the TEGD on pages 22 through 30.
- o Establish the seasonal, temporal and artificially induced (i.e., off-site production well pumping, agricultural use) variations in groundwater flow (TEGD, pages 30 and 31).
- o Determine the hydraulic conductivities of the hydrogeologic units underlying the site (TEGD, pages 31 through 34).

The following direct techniques must have been included in the investigation as a minimum:

- o Installation of piezometers and water level measurements at different depths for evaluation of groundwater flowpaths.

- o Slug tests and/or pump tests for evaluation of hydraulic conductivity.

You should independently interpret the data generated and compare your interpretation with the interpretation obtained by the owner/operator to insure the groundwater flowpaths under the site have been accurately identified. This should be accomplished by evaluating the presentations of the data generated from the investigation. The preferred methods for data presentation are:

- o Narrative description of groundwater movement with flow patterns described in both the vertical and horizontal direction.
- o Water table or potentiometric maps (plan view) with flow lines.
- o Hydrogeologic cross section.
- o Flow nets.

In defining flow paths or groundwater flow direction, the geologic information gathered during the site characterization plays a very important role in this evaluation. For example, it may be determined that groundwater is flowing in one direction, but contaminated flow paths may be in other directions based on the hydrogeology. In some cases, sands or other permeable strata may have been deposited such that their slope or dip is in the opposite direction of groundwater flow (i.e., beds dip to the south and groundwater flows to the north). In these cases, identification of groundwater flow paths may be highly dependent upon the transport of site specific contaminants. Therefore, when defining potential contaminants or groundwater pathways, geologic, hydrogeologic and geochemical data must all play a part in this interpretation.

<u>Identification of the uppermost aquifer</u>. Since the owner/operator is required to monitor the uppermost aquifer, the adequacy of the owner/operator's identification of the uppermost aquifer must be evaluated. In addition, a determination of whether or not the owner/operator understands the definition of the uppermost aquifer is inherent to this evaluation. On July 26, 1988, the definition of an uppermost aquifer was proposed as, "Groundwater in any saturated zone below the facility that can act as a contaminant transport pathway". This is the current EPA interpretation of the uppermost aquifer and it is what you should consider to be the appropriate definition during your

evaluation. The following five tasks should be accomplished during this evaluation:

- o Determine (either explicitly or implicitly), if possible, the definition of the uppermost aquifer that the owner/operator used in designing the monitoring system.
- o Examine and assess the adequacy of the information the owner/operator relied on in identifying the uppermost aquifer.
- o Examine and judge the correctness (based on your own independent research) of the information the owner/operator relied on in identifying the uppermost aquifer.
- o Examine and judge the correctness of the owner/operator's evaluation of that information and subsequent identification of the uppermost aquifer.
- o Independently identify, if possible, the groundwater in any saturated zone below the facility that can act as a contaminant transport pathway.

To obtain this information, you must do two things. First you must try to extract from the existing documents what the owner/operator has defined as the uppermost aquifer. Do not assume that because the owner/operator wells are in the shallow alluvium that he/she has defined the uppermost aquifer as the shallow alluvium. In hydrogeologic reports, the owner/operator or his/her consultants will probably not come right out and say "this is what we believe to be the uppermost aquifer". Second, you must speak directly with the owner/operator or his/her consultant either over the phone during the office evaluation or during the field inspections and ask him/her directly what he/she considers to be the uppermost aquifer. Before you call, do you homework and consider all other hydrogeologic units which may be hydraulically connected. Find out what the owner/operator's rationale was for not including other units or aquifers which you may feel are hydraulically connected.

Information on the definition and identification of the uppermost aquifer can be found in the TEGD on pages 34 through 43.

3.3 Complex Hydrogeologic Conditions

The TEGD describes several instances where complex hydrogeology may influence the ability of the facility to adequately characterize the uppermost aquifer underlying the site (pages 36 through 43).

Specific instances of complex hydrogeologic conditions which can cause problems in groundwater monitoring include:

- o Bedrock conditions/dipping beds.
- o Structurally controlled groundwater movement; such as faults, folds, fractures, jointing, etc. (i.e., secondary permeability and anisotropic conditions).
- o Karst terrains (limestone).
- o Artificially induced changes in groundwater conditions (e.g., pumping wells, rivers, lakes, flood irrigation, etc.).
- o Confined aquifer conditions

It should be noted that there are no such things as simple hydrogeologic conditions. Even areas where homogeneous conditions appear to exist have complex components. In other words, do not assume that it is as simple as the data appear to dictate.

3.4 Well Design and Installation

The appropriateness of the decisions made by the owner/operator regarding the number and locations of monitoring wells is crucial to determining whether or not the monitoring system is adequate and meets the requirements of the regulations. This determination is the focus of the office evaluation. It is critical that your assessment and the basis for it (e.g., objective, professional judgment, etc.) be explained in detail. Well design and installation is discussed in the TEGD in Chapters Two and Three.

The discussion in the TEGD is general guidance for well design and installation and in no way should be applied directly to a site without careful consideration. Each site is a dynamic set of variables which require specific well design and construction techniques. In order to review and evaluate well design, you must have a clear understanding of the site-specific hydrogeologic conditions and the chemical behavior of the contaminants for which monitoring is required.

Upgradient well(s). In order to determine the appropriateness of the owner/operator's groundwater monitoring system you should:

- o Examine the owner/operator's rationale for placement and design of the upgradient well(s) and judge the adequacy of the horizontal placement and screening of the well(s), either installed or proposed.
- o Independently determine, if possible, your assessment of the appropriate location(s) and design parameters of the upgradient well(s) at the facility.
- o Identify any additional hydrogeologic investigations that should be required before appropriate locations and design parameters can be accurately specified for upgradient wells at the facility.

The following questions should be answered during this evaluation regarding placement and design of upgradient wells:

- o Has the owner/operator located background wells far enough away from waste management areas to prevent contamination from the regulated unit or from other activities at the facility?
- o Has the owner/operator installed enough wells, screened at appropriate depths, to adequately account for spatial variability in background water quality?

While making this evaluation, you should consider the following:

- o It will be an extremely unusual circumstance in which having only one upgradient well would be considered adequate. It will be left to the professional judgment of the team conducting the office evaluation to determine the adequacy of the appropriate number and location of the upgradient wells. The number of background wells needed should be evaluated based on the number required to determine the spatial variability of background water quality.

- o The upgradient well(s) should be screened at depths which correspond to the geologic formations to be sampled in the downgradient wells for comparison purposes.
- o It will not usually be acceptable for the owner/operator to screen upgradient wells over the entire thickness of the uppermost aquifer, as this may allow dilution of contamination that may be present. Appropriate screen lengths must be evaluated by the team conducting the office evaluation, based on the information compiled.
- o It should be determined whether or not the upgradient well(s) are in fact upgradient and secure from being contaminated by the unit(s) being monitored.

Downgradient wells. The evaluation of the placement and design of the downgradient wells (either installed or proposed) should be accomplished based on the purpose of the monitoring system (detection, assessment compliance or corrective action) and assessed as to its compliance with the regulations. In order to assess the adequacy of the placement and design of the downgradient wells, you should:

- o Examine the owner/operator's rationale for the placement and design of the downgradient wells and judge the adequacy of the horizontal placement and screening of the wells, either installed or proposed.
- o Independently determine the appropriate location and design for the downgradient wells at the facility.
- o Identify any additional hydrogeologic investigations that should be required before appropriate locations and design can be accurately specified for the downgradient wells at the facility.

The following specific items regarding downgradient wells will be evaluated as to adequacy based on professional judgment and guidance contained in the TEGD:

- o Number of wells. Although the regulations require only three downgradient as a minimum number of wells, in almost all cases three downgradient wells will not be enough. Only in the simplest of geologic settings with a very shallow aquifer above bedrock and a very small regulated unit, would there be a possibility that three downgradient wells be considered sufficient. Your evaluation of the facility-specific geology and facility's groundwater monitoring plan must include the determination of the adequacy of the number of downgradient wells.

- Spacing of wells. The adequacy of the spacing of the downgradient wells should be determined based on the site specific conditions. You must independently evaluate previously gathered information in order to ultimately determine the adequacy of the spacing of the downgradient wells.

- Location of wells. The placement of the downgradient wells must be evaluated in terms of their location relative to the regulated unit(s) and of their intended purpose; (i.e., detection, compliance assessment or corrective action monitoring). For detection monitoring, the wells should be placed as near as practical to the regulated unit(s). The evaluation as to how close the wells must be placed in relation to the regulated unit(s) must be made by you based on the information on the site which you have been able to obtain. For assessment monitoring, the wells should be placed so that the owner/operator can determine the rate and extent of migration of hazardous waste and hazardous waste constituents in the groundwater. The adequacy of the assessment monitoring system relative to this criterion must be determined.

- Use of cluster wells. Based on the conditions at the site, the need for and use of cluster wells should be evaluated in regard to adequate monitoring of the groundwater in a downgradient direction from the regulated unit(s). A determination of the adequacy or inadequacy of the use of cluster wells, either in place or proposed, must be made.

- Construction materials. The adequacy of the materials used in the construction of the wells should be judged in terms of the effect of the materials on the quality of groundwater samples (such as adsorption, leaching and reaction with groundwater) and the long-term structural integrity of the material.

- Screen length. The adequacy of screen length in the downgradient wells should be determined based on site-specific aquifer and contaminant characteristics. A determination must be made as to whether the wells are screened adequately for detection of contaminants in the aquifer.

- o Depth of screened interval. The adequacy of the screen interval depth must be determined based on site-specific conditions and must insure that the wells will adequately monitor the stratigraphic horizons most likely to serve as pathways for contaminant migration from the regulated unit.
- o Well construction. The adequacy of the well construction techniques should be assessed based on the guidance presented in the TEGD.

Details of the groundwater monitoring system should be obtained and summarized for inclusion with the final report. As a minimum, the monitoring wells should be located on a site map, individual drilling logs should be obtained, if possible, and the construction details of each well should be obtained and evaluated.

3.5 Evaluating Past Analytical Results

As part of the office evaluation, evaluation of past analytical results plays an extremely important role in the evaluation of a groundwater monitoring system, In order to accurately evaluate historical analytical results, the geologist or geochemist must understand several issues. These issues are as follows:

- o Contaminant fate and transport.
- o *Variability of naturally occurring groundwater.*
- o Data interpretation techniques.

The owner/operator should have some type of data management program in place which he utilizes to monitor or interpret data from each quarter, or another pre-determined frequency, but this is not always the case.

Contaminant Fate and Transport. The first and foremost important issue in evaluating past analytical results is the understanding of the types of wastes managed in the regulated units which are being monitored by groundwater monitoring systems.

We must fully understand the waste characteristics, such as specific gravity, density, immiscibility or solubility, volatility (Henry's law constant) and degradation products so that we know in what chemical state each constituent will exist in the groundwater. In order to understand this approach, it is best that we present several examples:

Example 1: Petroleum Refinery

At a petroleum refinery where API separator sludges were managed in a pit, a groundwater monitoring system is in place. We know that the hazardous waste constituents associated with these sludges include volatile and semi-volatile organics, lead and hexavalent chromium. We also know that both light phase immiscible oils and potentially heavy ended petroleum distillates may be present. Lead and chromium mobility is dependent upon both soils and the effects of pH of the soil water or the groundwater. A lower pH (acidic) could increase solubility of the metals and thus increase mobility.

Based on this knowledge of the waste constituents, monitoring wells should be placed accordingly. For example, shallow wells should be completed to intercept the top portion of the water table and to detect light immiscibles and deeper wells should be completed to detect heavier constituents.

Example 2: Silicon Chip Manufacturer

At this chip manufacturing company, trichloroethylene (TCE) and hydrochloric acid are utilized to clean silicon cylinders prior to and after cutting chip disks. The waste water which contains waste TCE and neutralized hydrochloric acid is managed in a surface impoundment prior to being treated in the facility's waste water treatment plant.

We know that TCE is extremely mobile in aqueous environments due to its ionic charge and inability to absorb in soils or aquifer media. In many cases it travels at rates greater than groundwater velocities. Also, the density of TCE is such that it will sink, or is a "sinker", if found in fairly high concentrations. In the case of indicator parameters, we know that both TOC and TOX will show increased levels if TCE is present due to the chlorinated carbon chains and halogenated organic structures.

For hydrochloric acid, we know that corrosivity is the major waste characteristic such that pH indicators in groundwater may detect the *presence of this acid. Also, hydrochloric acid in solution will show extremely high chloride concentrations in groundwater if leached, thus chlorides provide for a good indicator of releases to groundwater.*

In siting monitoring wells, we need to be concerned with dense phase immiscible or soluble TCE and the detection of chlorides. Thus, monitoring wells should be placed at depth in the aquifer and in predominant contaminant or groundwater pathways.

In summary, you can see from these examples that fate and transport of contaminants dictates how the wells are designed, at what depths they are completed and what constituents or indicator parameters we would expect to be elevated from releases of wastes from a regulated unit.

Variability of Naturally Occurring Groundwater. Because downgradient water quality is also compared to background or upgradient water quality, it is important to understand variations in concentrations and what may be contributing to these variations.

This interpretation can become extremely complex if the upgradient groundwater is contaminated and you are trying to determine if a release has occurred from a regulated unit by evaluating concentrations of contaminants in downgradient wells versus those in upgradient wells. This often requires some type of fingerprinting investigations.

When evaluating upgradient or background groundwater quality there are several interpretative methods which can be employed. These include:

- o Evaluating seasonal or cyclic trends
  - plots of concentrations versus time
  - plots of variance(s) between each quarter or other sampling events
  - analyzing summary tables
- o Statistical Evaluations
  - calculating arithmetic means
  - standard deviations or variances
  - ranges of data; i.e., high/low

In order to understand variations or seasonal or cyclic trends in data, you should look for repeated patterns during certain periods of time. These data can be plotted against water level data also and you can evaluate whether or not concentration fluctuations can be attributed to variations in water levels.

Obviously, you should first evaluate how the owner/operator has established background concentrafions in order to compare them with downgradient wells. Then the team performing the CME can review the owner/operator's data and can independently evaluate the data using their own interpretation.

Data Interpretation Techniques. The techniques previously discussed for evaluating the variability of naturally occurring groundwater are also applicable here. Generally, under the detection groundwater monitoring programs (40 CFR 264 and 265 Subparts F) the owner/operator will have determined statistical analytical methods for interpreting whether statistically significant increases in groundwater quality are occurring, or have occurred. In most cases, you should review the statistical methods and calculations performed by the owner/operator to confirm the quality of his/her calculations. You should then independently calculate statistics for one or two downgradient wells to verify the owner/operator's data.

If an owner/operator is in an assessment, compliance or corrective action program for groundwater monitoring, the data analysis techniques are somewhat different and are left up to the owner/operator to implement. Groundwater analytical results are meaningless unless they are interpreted so that conclusions can be drawn on these data.

The following is a list of several data interpretation techniques which should be utilized by the owner/operator to present/interpret data, or by the team performing the CME to independently evaluate the owner/operator data.

- Data plots of concentrations
- Summary statistical tables
  - Tabulated data

- Calculated arithmetic mean
- Standard deviation or variance
- Range

o Trend analysis using linear regression

o Comparison Plots
  - Downgradient well concentrations versus upgradient well(s)
  - Downgradient well concentrations versus regulatory standards

o Geostatistics
  - Kriging
  - Others

A thorough analysis of past analytical results is critical, as groundwater data interpretation will ultimately dictate the regulatory direction that the owner/operator's groundwater program takes.

3.6 Defining Regulatory Versus Technical Deficiencies

Figure 4.3 in the RCRA CME Document (pages A-26 through A-31) gives examples of how technical inadequacies, such as not fully characterizing the uppermost aquifer, relates to the regulatory requirements of 40 CFR Parts 265 and 270. Also, while you are summarizing deficiencies identified during the office assessment, you should complete the checklist in Appendix A of the RCRA CME Document in as much detail as possible prior to performing the field inspection. The Groundwater Monitoring Compliance Order Guidance (COG) Document explains in further detail the types of information the CME inspector must document to support a regulatory citation.

Many EPA Regions require that conclusions in CMEs distinguish between regulatory and technical deficiencies in the groundwater monitoring systems. Other Regions take this one step further and include all deficiencies under a regulatory citation. In many cases the COG makes this possible, but the level of detail required to document a regulatory citation versus a technical deficiency as defined in guidance documents (i.e., TEGD) can be very cumbersome.

In certain cases, it will not be possible to relate a technical deficiency to a regulatory citation. For example, it may be determined that photoionization measurements provide useful data at the well head at sites where volatile organics occur. This recommendation or technical deficiency can not be related to a regulatory citation.

In Figure 4-3 in the CME Guidance document, the groundwater requirements under 40 CFR 264 Subpart F are not discussed, nor are technical versus regulatory citations summarized for these regulations. You must rely on the regulations in general, and interpretations from Regions or Headquarters on the intent of each subpart and section. You may also wish to reference the Memorandum dated December 21, 1987 from the Assistant Administrator, EPA Headquarters, to Regional Administrators concerning policy on when enforcement actions must be taken. This policy is also known as the "Timely and Appropriate Document".

3.7 Available Information Sources

Site specific information should be obtained from the facility's files. Other sources which may be tapped to gain additional information to augment the site-specific information obtained from or about the facility are in Table 1. Examples of commonly available information are:

- USGS topographic maps
- aerial photographs
- hydrogeologic information from the USGS water resources, state geological survey state groundwater associations, independent studies such as theses at universities, etc.
- regional geologic studies and information
- well logs from water wells or other borings in the area near the facility obtained from the state engineers office or other sources.

The EPA, State and local environmental/health agencies may have the most useful site-specific information. It helps to check various sections/departments within one agency to gather all pertinent material relating to your site.

TABLE 1

DATA COLLECTION INFORMATION SOURCES*

Information Source	Facility-Specific Information	Hydrogeology/Geology Information Source
U.S. EPA Files	x	x
Site Visit Reports	x	
Photographs	x	
Preliminary Assessment Report	x	x
Field Investigation Analytical Data	x	x
FIT/TAT Reports	x	x
Site Inspection Report	x	x
Owner/Operator Files	x	x
Permit Applications	x	x
Academic Institutions		x
U.S. Geological Survey		x
U.S. DOA - Soil Conservation Service		x
U.S. DOA - Agricultural Stabilization and Conservation Service		x
U.S. DOI - Bureau of Reclamation	x	x
U.S. Army Corps of Engineers	x	x
Federal Emergency Management Agency		x
U.S. DOD Installation Restoration Program	x	x

* Adapted from: U.S. EPA, Guidance on Remedial Investigations Under CERCLA, EPA/540/G-85/002

TABLE 1 CONTINUED

DATA COLLECTION INFORMATION SOURCES*

Information Source	Facility-Specific Information	Hydrogeology/Geology Information Source
State Environmental Protection or Public Health Agencies	x	x
State Geological Survey		x
State Highway Department		x
Local Planning Boards		x
County or City Health Depts.	x	x
Town Engineer or Town Hall	x	
Local Chamber of Commerce	x	
Local Library		x
Local Well Drillers		x
Regional Geologic and Hydrologic Publications		x
Court Records of Legal Action	x	
Department of Justice Files	x	
State Attorney General Files	x	
Facility Records	x	
Facility Owners and Employees**	x	x
Citizens Residing Near Site**	x	x
Waste Haulers and Generators**	x	

* Adapted from: U.S EPA, Guidance on Remedial Investigation Under CERCLA, EPA/540/G-85/002.

** Interviews require EPA concurrence.

3.8 References

EPA, 1988, RCRA Comprehensive Groundwater Monitoring Evaluation Document, Final September 1988.

EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, Final September 1986.

EPA, 1985, RCRA Groundwater Monitoring Compliance Order Guidance Document, Final 1985.

"Timely and Appropriate Document", U.S. EPA Assistant Administrator to Regional Administrators, Memorandum on Enforcement Response Policy, December 21, 1987.

4.0 FIELD INSPECTION PRE-PLANNING

The second phase of a CME is the field sampling inspection, during which the facility is evaluated as to the adequacy of their sampling procedures, and their compliance with their Sampling and Analysis Plan. This is also when the integrity of the monitoring wells in the monitoring system can be assessed.

Before the visit to the facility, you must determine whether or not collection of split samples is desired and, if so, what monitoring wells the splits will be collected from. The preparation for the facility visit must include the preparation of a Health and Safety Plan, a Quality Assurance Project Plan and Sampling and Analysis Plan (if split sampling is to be conducted), arrangements with the laboratory must be made (if necessary), the facility must be notified of your inspection, and the necessary equipment and supplies must be gathered.

Another important component of field inspection pre-planning is the evaluation of the data gaps identified in the office evaluation and the determination of what information may be readily obtained at the facility. In most cases the CME inspector will have a list of information that he/she must either request or obtain from the owner/operator or his/her groundwater monitoring consultant.

Remember, use this pre-planning stage to organize your thoughts and inspection strategy, such that the field inspection goes smoothly and you take up as little time as possible from the owner/operator's busy schedule.

Finally, make sure that if you are collecting split samples that you make arrangements with the owner/operator well in advance and schedule a date, time, and plan for confirmation phone calls.

4.1 Split Sampling

As stated in the RCRA CME Document, split samples should be taken during the field audit if contamination of the wells has been determined or is suspected, or if there is a question of the validity of the analytical results. Taking split samples during the facility's sampling event enables the inspector to check the facility's field measurement techniques and equipment, their preservation and sample handling techniques, and the adequacy of their sampling equipment decontamination as well as the adequacy of the laboratory used by the facility. Since the sample collection and handling procedures are critical for generating data that are valid and truly representative of the in-situ groundwater, the consistency of the methods, equipment and procedures is essential and should be thoroughly evaluated. EPA or the State Enforcement Section may also collect samples from the facility's monitoring wells at any time, without waiting for the facility's scheduled sampling event. However, this does not allow the inspector to compare data obtained from the sampling with the facility's data, nor does it afford the opportunity to assess the facility's adherence to the Sampling and Analysis Plan and the adequacy of their sampling techniques.

4.2 Choosing Monitoring Wells and Analytes for Sampling

Monitoring well sampling. The specific monitoring wells to be sampled (i.e., samples split with the facility for comparative analyses) should be determined based on the total number of wells in the monitoring network. A monitoring network must contain a minimum of one upgradient well and three downgradient wells from the regulated unit, but in actuality probably will consist of considerably more wells. For monitoring networks consisting of the minimum number of wells (i.e., four wells), it is recommended that split samples be obtained from all of the wells.

In choosing the wells to split sample, careful consideration should be given to the following:

- Evaluate the wells' hydraulic locations (upgradient versus downgradient) and review the completion details to ensure that representative groundwater samples can be obtained. (This should be completed during the office evaluation.)
- After reviewing and evaluating which wells will yield representative samples, utilize information from your review during the office evaluation of past analytical results and determine which wells, if any, are showing signs of degradation. It is those wells where contamination exists or where critical regulatory decisions will be made that split samples should be collected.
- Wells containing hard-to-sample parameters (e.g., volatile organics) are preferable, since they require special sampling techniques to

maintain sample integrity. This will allow evaluation of the facility's sampling techniques for such special conditions.

Sample parameters. The specific parameters to be analyzed for, from the samples collected, need to be established in order to inform the laboratory so that space can be reserved for quick turnaround of the analysis, and so that you can obtain the necessary sample containers, preservatives, and equipment for taking field measurements, and prepare the necessary documentation for use during the sampling effort (e.g., field sheets, sample tags, chain-of-custody forms). The specific parameters to be sampled for during any inspection are established based on the regulatory requirements. For comparability purposes, it is often desirable to analyze for all of the constituents for which the facility is analyzing.

Using the rationale above for selection of wells and analytes, you may choose the wells from which to split samples with the facility in the following manner:

Surface Impoundment No. 1.

There are five RCRA designated wells installed for detection monitoring. The wells chosen for split sampling activities, along with the rationale for which each well was chosen, are described below.

MW 4 — *Located hydraulically downgradient and situated east of the surface impoundment. Past sampling results have shown the presence of elevated total organic carbon (TOC), specific conductivity and slightly elevated sodium and manganese concentrations. Additionally, this well is completed in unconsolidated material which appears to be representative of the uppermost shallow aquifer.*

MW 5 — *Located hydraulically upgradient and situated west of the surface impoundment. Past sampling results have shown the presence of elevated TOX and pH. No geologic data are available.*

MW 6 — *Located hydraulically downgradient, at the northeast corner of the surface impoundment. Past sampling results show the presence of elevated TOX, specific conductivity, and manganese.*

This well is completed in shale bedrock and appears to provide good representation of water in the bedrock aquifer.

4.3 Identifying Required Field Verification

Since the field inspectors are likely to be very busy while conducting the sampling audit, it is desirable to outline before the site visit any items which must be verified while at the site. Some of the things which may be required to be field-verified are the locations and integrity of the monitoring wells, the accuracy of any facility maps which may be referenced during the CME, and the general site conditions.

Any other issues concerning site-specific information which were unresolved as a result of the office evaluation should be verified while at the facility. Additional information should be collected while at the facility to support your findings in the office evaluation or to fill any data gaps which you have identified. This is also the time to check the facility's records, so any data gaps for which information may be in the facility's files should also be determined before the site visit.

4.4 Contacting the Facility

Inspections should be scheduled to coincide with the facility's regularly scheduled sampling events. Contact with the facility should be made as soon as possible after the facility has been identified for a CME in order to confirm that the sampling event will occur during the quarter and so you may determine the anticipated dates that the work will be done.

The facility should be informed as to the purpose of the site visit, the authorities under which the CME is being conducted, the procedures the inspectors will be following, and the information the inspectors expect to obtain at the facility. The facility should be informed that the inspector will be taking split samples and conducting field measurements, and that photographs will be taken of the monitoring wells and the sampling procedures, bottle filling, sample filtering and field measurement techniques.

The inspector should determine the individual(s) to contact upon arrival at the facility and should ask about the facility's health and safety requirements (hard hat, respirator, ear plugs, etc.).

If the facility does not have a date set upon which the sampling will be conducted, a date should be established with them at this time. You should not leave the sampling date open-ended, as the facility may conduct the sampling without informing you far enough in advance for you to prepare adequately for the field.

4.5 References

EPA, 1988, RCRA Comprehensive Groundwater Monitoring Evaluation Document, Final September 1988.

EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, Final September 1986.

5.0 FIELD INSPECTIONS

The inspection process will normally consist of the following major elements: initial conference, general site evaluation, pre-sampling activities, sampling activities and exit conference. The inspection checklist as found in Appendix A of the RCRA CME Document (September 1988), or a Region-authorized version should be completed during the inspection process to insure that specific items are addressed and all the necessary information is obtained. You may also wish to consult SW-846, Test Methods for Evaluating Solid Wastes, Chapter 11, which discusses groundwater monitoring systems.

Initial Conference. Upon arrival at the facility, as prearranged with facility representatives, you should contact the responsible official and properly identify yourself by presenting EPA/State credentials, even if these are not asked for. The initial conference should be conducted with the facility's participants to outline the purpose and scope of the CME.

- A tentative schedule to accomplish the inspection tasks should be discussed and agreed upon to preclude any problems arising during the inspection process.
- Any specific concerns or requirements of the facility, (e.g., signing in or out of the facility, visitors' passes, delineations of restricted areas, limitations on the use of cameras, health and safety concerns, etc.), should be discussed, clarified and resolved.
- A copy of the facility's sampling and analysis plan should be obtained (if not available prior to the inspection), reviewed, discussed and critiqued with the facility representatives. Specific procedural deficiencies should be pointed out for correction. Don't get bogged down here. You want the sampling to proceed as planned. Major points of contention should be saved for the exit conference.
- Information obtained during CME preparation should be verified for correctness and completeness. Any specific issues requested to be addressed by the person(s) who conducted the office evaluation should be discussed as appropriate.

5.1 CME Versus O&M Inspection

As stated in the RCRA CME Document (September 1988), a CME is performed to assess the adequacy of a facility's groundwater monitoring system based on design and installation, operation, and maintenance of the monitoring wells in order to detect the rate and extent of contaminant migration from a regulated unit. An Operation and Maintenance Inspection (O&M) is an interim (in between CMEs) inspection set up to evaluate how well the facility's monitoring system is operating and is a subset of a CME, therefore is a less resource intensive inspection than a CME. One-third of the commercial land disposal RCRA facilities are to have a CME or an O&M every year. The frequency of CMEs for a land disposal unit may be once every three years with an O&M yearly in between. A land disposal unit which receives CERCLA wastes must receive a CME or an O&M within the year prior to the receipt of CERCLA wastes. For current requirements for CMEs and O&Ms, refer to the Fiscal Year 1990 Agency Operating Guidance (OSWER, March 1989) which is revised yearly.

The field inspection portion of either type of inspection may be the same, except during the O&M any activities that have been completed since the last CME should be evaluated (e.g., any new monitoring wells installed). Split samples may be collected for either type of inspection, depending upon the results obtained from the last CME (e.g., if the facility's sampling and analysis plan was deficient).

5.2 Sampling and Analysis Audits

The sampling and analysis audit should focus on the facility sampling personnel's field procedure, their adherence to the sampling and analysis plan, their field measurement techniques, sample documentation, and sample preservation and handling. The following are also components of the field audit:

Measurement of well head space. As soon as the monitoring well is uncapped, the head space should be monitored for volatile organics with a field instrument such as a photoionization detector(PID, e.g. HNu) or a flame ionization detector (FID, e.g., OVA). Volatile components are often concentrated in the well head space. This measurement allows the inspector to both evaluate health and safety protocol and assess whether volatiles are likely to be found in the groundwater.

Static water level measurements. Prior to pre-sampling evacuation of each well, the water level in the well must be determined by actual measurement. The measurements should be to the nearest 0.01 foot. The measurements must be taken on all of the wells prior to any purging. In some cases, the waste constituents at a site may require the owner/operator to measure for immiscible phases (i.e., light oils or gasoline, or dense oils such as creosotes or pentachlorophenol) during the time of water level measurements. Even if the owner/operator does not measure for immiscibles and the waste constituents suggest that an immiscible phase could be present, the CME inspector should obtain such a measurement prior to well evacuation. This measurement should be obtained with an oil/water interface probe such as the Interface Probe manufactured by Groundwater Recovery Systems Inc. (R). At this time, there are very few such instruments on the market. In order to evaluate the adequacy of the water level measurements, for your logbook documentation you should:

- Observe the procedures used to make these measurements and note the type of water level measurement device used.
- Make an independent water level measurement of the monitoring wells, utilizing your own equipment for comparison.
- Determine if reference elevations of the ground surface at the well or at the top of the well casings have been established by a reliable survey to the nearest 0.01 foot. All of the reference elevations should be obtained for converting water levels to elevations such that potentiometric maps can be constructed for inclusion in the CME report.
- Determine the adequacy of the decontamination procedures. The parts of the water level measurement device that come into contact with the groundwater during use must be thoroughly cleaned and decontaminated between wells to avoid cross-contamination. As a matter of practice, the water level measurements should be made sequentially from the non-contaminated or least contaminated well to the most contaminated well.
- Determine the adequacy of the maintenance and calibration procedures (if any) and when the last calibration was performed for the water level measurement device.

Well depths/sediment accumulation. Well depths should be measured by sounding the bottoms with a weighted stainless steel measuring tape or other suitable measuring device. The differences in as-built depths and measured depths of the monitoring wells generally indicate sediment accumulation resulting from improperly designed and/or constructed wells. Properly designed and constructed wells contain graded filter pack materials and well screens with openings sized to preclude sediment accumulation.

Evacuation of monitoring wells. The purpose of well evacuation prior to sample withdrawal is to remove stagnant water which may not be representative of in-situ groundwater quality. Changes in chemical characteristics that may occur in water standing in a monitoring well are well documented in published literature; therefore, it is critical that this procedure be accomplished in an acceptable manner prior to sample collection. In order to assure the collection of samples that are representative of the in-situ groundwater quality, pre-sampling evacuation of all standing water is preferred (any immiscible layers should be sampled prior to evacuation). If the recovery rate is sufficient, the well should be completely evacuated a second time and allowed to recover prior to sampling. Complete evacuation may not be possible from wells installed in high yield aquifers; therefore, the adequacy of the evacuation procedures should include the evaluation of several factors, including the type of equipment used for evacuating the wells (bailers or pump), the discharge rate of the pump, and the location of the intake for the pump in the well (above or within the screened interval). As a general rule, three to five casing volumes should be evacuated or the well should be evacuated until the measurements for pH, specific conductivity and temperature have stabilized, and the well should be allowed to recover prior to sampling. The inspector should observe the evacuation procedures and record the following information:

- Type of evacuation equipment and types of materials of which it is constructed, including delivery lines or lines used to lower equipment into the well.
- Whether or not wells are completely evacuated, and, if so, the number of times they are evacuated.
- Volumes evacuated from all wells.
- Methods used to determine volumes evacuated.
- Procedures for collection, management and disposal of evacuated water.

- o Whether or not individual wells have dedicated evacuation equipment, and the identification of this equipment.
- o Decontamination and cleaning procedures for equipment used in more than one well.
- o Physical properties of evacuated water; i.e., color, odor, turbidity and presence of oil and grease.

The TEGD discusses well evacuation on pages 102 through 104.

Sampling Activities. The inspector should observe sampling procedures, obtain split samples (if necessary) for comparative analyses and perform field measurements.

Sample Withdrawal. The major consideration for sample withdrawal procedures is insuring that samples are not altered or contaminated during the process. Sampling equipment must be constructed of materials compatible with known or suspected (potential) contaminants. These materials must neither leach nor absorb constituents of interest. Sampling equipment must be dedicated to individual wells or be capable of being fully disassembled and decontaminated between wells. Lines used to lower equipment into the well, as well as discharge piping, must also be constructed of materials compatible with contaminants. Sample withdrawal may be accomplished with bailers or pumps. Bailers are simple to operate, inexpensive, require no external power source, and may be constructed from fluorocarbon resin or stainless steel, as recommended in the TEGD (page 106). Pumps are available in a wide variety of types and may or may not be suitable for particular monitoring well sample withdrawal operations. The TEGD recommends the use of a bladder pump for withdrawal of a sample (page 106). The inspector should observe sample withdrawal and record the following information in the field logbook:

- o Type of sampling device.
- o Type of materials of which sampling device, lowering lines and discharge piping are constructed.
- o Depths at which samples are recovered.
- o Whether or not sampling equipment is dedicated to individual wells.

- o Decontamination procedures for equipment used in more than one well.
- o Whether or not samples are withdrawn and collected to minimize absorption, agitation (aeration) and volatilization.
- o Physical characteristics of samples; e.g., color, odor, turbidity and presence of oil and grease.
- o Sequence in which samples are collected.
- o Sequence in which wells are sampled.

Sample containers/preservation. The type of sample container used for each parameter to be analyzed must be made of materials compatible with the parameter. The preservation of the samples taken for analysis of specific parameters must be in accordance with established procedures as outlined in the RCRA CME Document (Table 1) or EPA SW-846. At a minimum, you should document the sample containers and preservatives used for each constituent for which the sample is to be analyzed.

Field measurements. You should observe the procedures used by the facility personnel when performing measurements. You should also perform independent field measurements (i.e., pH, specific conductance and temperature) for comparison of results.

In regard to field measurements performed by facility personnel, you should insure that the analytical method is an accepted procedure for analysis of each parameter and that it is performed in an acceptable manner. The type of field instrument utilized and the adequacy of the calibration and maintenance procedures should also be noted. Independent instantaneous determinations of pH, temperature, and specific conductance should be performed on as many well samples as time allows during the sampling event. These determinations should be performed on a portion of the same representative aliquot that the facility uses. These samples should be discarded after the determinations are made and are not intended to be sent to the laboratory for analysis. The values obtained by the inspector and the facility should both be recorded in the field logbook.

Decontamination. Equipment and/or equipment components used in well measurements, well evacuation or sample withdrawal should be decontaminated between wells to preclude contamination and/or cross-contamination of wells. The inspector should observe and record the decontamination procedures. Recommended decontamination procedures are found in the RCRA CME Document on page 20. To avoid the inadvertent contamination of the equipment, it should not be permitted to come in contact with the ground after cleaning or prior to use. Some type of protection such as plastic-lined buckets or plastic sheeting (e.g., polyethylene) should be placed on the ground for use as the work surface for sampling and measurement operations.

Documentation. The facility should maintain documents to adequately record information obtained during a groundwater monitoring sampling event. The inspector should review and evaluate the documents utilized by the facility for their completeness and consistency with the sampling and analysis plan. Copies of the specific documents relating to field procedures and measurements should be obtained for inclusion with the final CME report to be prepared in the office.

Specific chain-of-custody procedures and documentation should adequately provide for a record which traces the possession and handling of individual samples from the time of collection through laboratory analysis. Chain-of-custody procedures are required to preserve the integrity of individual samples.

The facility should maintain adequate field records to describe the sampling event. The facility's completed field log book should contain the following information:

- Identification of well
- Well depth
- Static water level depth and measurement techniques
- Presence of immiscible layers and detection method
- Well yield; i.e., high or low
- Collection method for samples of immiscible layers and sample identification numbers
- Well evacuation procedures/equipment
- Sample withdrawal procedures/equipment

- o Decontamination procedures (if using non-dedicated equipment)
- o Date and time of well evacuation and sample collection
- o Well sampling sequence
- o Types of sample containers used and sample identification numbers
- o Preservatives used
- o Parameters requested for analyses
- o Field analytical methods and results
- o Laboratory used and transporter of samples to lab
- o Field observations during sampling event
- o Name(s) of sample collector(s)

Sample Analysis. The facility should analyze the samples or have the samples analyzed by a private laboratory in accordance with EPA approved analytical methods for each parameter. One method should be specified for each parameter in the facility's sampling and analysis plan. EPA, 1986, Test Methods for Evaluating Solid Wastes (SW-846) should be used for determining the adequacy of the analytical methods used. Note that when analyzing and comparing split samples, it is imperative that analytical methodologies be identified between the owner/operator and the inspector.

If the samples are sent to a private laboratory for analyses, the inspector should obtain information about sample shipment, analytical methods, etc., to insure that proper procedures are followed. The name and address of the private laboratory should be recorded in the field logbook.

Quality Assurance. You should evaluate the adequacy of the quality control/quality assurance procedures incorporated into the sampling event. Specifically, the facility should include field blanks, duplicate samples and other quality control samples as needed, such as equipment blanks if non-dedicated sampling equipment is used. In addition to evaluating the facility's field procedures, you may wish to use audit samples to check laboratory accuracy for specific parameters. Although this can be included as part of a CME, this procedure is most often performed as part of an LAI.

Exit Conference. Upon completion of all of the tasks involved in conducting the inspection, an exit conference should be held with the facility representatives as a means of providing them with a summary of the preliminary findings of the inspection. Some of the things you should accomplish during the exit conference or briefing are:

- o A receipt for samples and documents should be prepared and signed. You should keep a copy of the completed form for inclusion in your final CME Sampling and Analysis Report.

- o Critique the facility's field measurement and sampling procedures, documentation, and other issues pertinent to the groundwater sampling process. Specific technical recommendations should be presented as a means of enhancing the quality of the facility's program. Any specific regulatory requirements not being met by the facility should be discussed, but you should point out that additional compliance issues may result from further evaluation of their procedures, following the inspection.

You should establish with the facility how you are going to obtain their analytical results from the sampling event. All of the raw analytical data from the analyses of the field samples, quality control samples and any audit samples should be obtained in order to completely evaluate the quality of the results. In addition, if you have not obtained them during the inspection, you should obtain all of the facility's results from the field measurements at this time.

5.3 Collecting Split Samples

If you plan to take split samples, you should supply the containers for your own samples. These containers should be in accordance with those required by the laboratory to which you are sending your containers and with SW-846. The containers and preservatives should be specified in your Sampling and Analysis Plan.

During the sampling event, you should request that any samples taken for volatile organic analyses (VOAs) be collected first, without alternating of the sample containers, so that agitation and volatilization will be minimized. These samples should be collected in 40 milliliter VOA vials and should be filled so that a meniscus is formed on the neck of the bottle. The bottles should be carefully capped and inverted, then tapped to inspect for air bubbles. If air bubbles are detected, the bottle should be emptied and the sample taken again in the same manner until no air bubbles are present in the sample.

The remainder of the samples should be taken so that the samples are collected in order of most volatile to least volatile (i.e., VOA, total organic halogen (TOX), Base Neutral/Acid Extractables (BNAs)), then the rest of the parameters in any order. These samples should be split in the following manner (note: volatile parameters - VOA's and TOX should be filled independently and not by this method):

> Both the facility's and your own sample containers should be ready for sample collection. The facility should fill their containers for a specific parameter from one-half of the bailer, then you should fill your container with the second half. The second bailer should be used to first fill your container, then the facility's and so on. The bailers should be alternated in this manner until all of the containers are filled.

Field measurements should be taken at the same time the facility collects theirs, and the analyses should be conducted immediately, since the field parameters are temperature dependent.

Your samples should be preserved according to the method specified by the laboratory for the specific analytical method. This method should be in accordance with Table 1, Sampling and Preservation Procedures for Detection Monitoring found in the RCRA CME Document.

5.4 Collection of Additional Field Data

Additional information should be obtained while in the field in order to evaluate the integrity of the monitoring system and its ability to adequately detect groundwater contamination at the facility. This is also a chance to verify some of the information discovered during the office evaluation, specifically any information which may have been previously supplied by the facility.

General Site Evaluation. During the course of the inspection, you should conduct a general evaluation of the site and regulated units to provide further information and/or indications of actual or potential releases of hazardous material from regulated units. The specific details will depend on the type of regulated unit(s), but the following items should be observed:

- o Evidence of leakage through impoundment dikes or landfill covers (e.g., seeps).
- o Evidence of seepage, (e.g., damp or wet spots or pools of standing liquid, absent, dead or dying vegetation in isolated areas, unusually lush vegetation growth, aquatic vegetation growth in perennial seeps).
- o Evidence of impoundment overflowing, (e.g., insufficient freeboard dikes and/or areas downstream denuded of vegetation, erosion of dikes and/or downstream areas).
- o Vegetation stress, (e.g., dead or dying trees and other vegetation) over general area which may indicate contamination of the unsaturated zone.
- o Excessive erosion of landfill covers, of impoundment dikes, and from active portions of land treatment facilities.
- o Slope instability and/or failures in impoundment dikes and landfill trench excavations.
- o Surface water degradation.

Any of the above features which are observed during the course of the inspection should be photographed and described in the final CME Sampling and Analysis Audit inspection report.

Pre-Sampling Activities. This portion of the inspection includes verification of the monitoring well locations, observation of the integrity of the monitoring wells, observation of the facility personnel taking their water level measurements and their evacuation procedures, and the taking of your own measurements of water levels and well depths.

Monitoring well descriptions. You should visually inspect all of the monitoring wells for verification of the following:

- o Well casing material type and diameter
- o Condition of surface seal

- o Protective casing material and condition
- o Evidence of damage to the protective casing or well
- o Security measures (Is cap locked? Are guard posts installed around the protective casing?)

Monitoring well locations. The locations of all of the monitoring wells should be verified for correctness. If a detailed facility map showing the well locations and other surface features (including the regulated units) is available, the accuracy of the map should be verified by actual field measurements and observations. If a detailed map is not available, a site map showing the locations of regulated units and wells should be prepared from field measurements and observations. At least two reference measurements are necessary to determine a well's location in the horizontal plane. This can be accomplished by measuring horizontal distances in different directions to fixed surface features, by determining compass bearings to surface features, or by a combination of both methods.

5.5 Documenting the Audit

All of the information gathered during the Sampling and Analysis Audit must be documented. This documentation should include the bound field logbook, the Comprehensive Groundwater Monitoring Evaluation Worksheet (Appendix A of the RCRA CME Document or a Regionally-authorized version), and site photographs.

Field Logbook. Each inspector should keep a separate logbook, which should be bound and have consecutively numbered pages. Each person who makes an entry in the logbook must sign the page containing that entry. All entries must be in indelible ink and any corrections must be made by marking out the mistake with one line and initialling the mark out.

Things which should be recorded in the field logbook:

- o General site conditions
- o Weather
- o Persons present at the sampling
- o Monitoring well placement (measurements)

- o Static water levels (both the facility's and the inspector's)
- o Total depth measurements (both the facility's and the inspector's)
- o Evacuation procedures
- o Field instrument calibration
- o Field measurements and times taken (both the facility's and the inspector's)
- o Sample collection procedures
- o Sample collection order, times taken and preservatives used
- o Field filtering techniques
- o Any discrepancies either the facilitiy's or the inspector's with sampling and analysis plans
- o Well integrity
- o Type of equipment (water level indicator, pH and specific conductivity meters, etc.)
- o Decontamination procedures
- o Type of pump or bailer used for evacuation/sampling of the well

Photographs. Site photographs are an excellent way to document sampling procedures, well integrity, condition of the sample, etc. Photographs should be taken with a 35mm camera with a standard lens (50 mm) or with a Polaroid instant developing camera. Site photographs should be recorded on a photo log or in the field logbook. The following information should be recorded for each photo taken:

- o Facility
- o Date
- o Time
- o Photographer
- o Direction in which photograph was taken
- o Witness to the photograph
- o Camera, focal length of lens, film type and ASA
- o Subject

The checklist should be completed on-site to verify that all the necessary information is gathered and documented. This checklist should be included in the Sampling and Analysis Audit Report.

5.6 Defining Regulatory Versus Technical Deficiencies

Appendix A of the RCRA CME Document (September 1988) contains Figure 4.3, which outlines the technical deficiencies and how they relate to regulatory deficiencies. Item No. 7 (pages A-29 through A-31) concentrates on the regulatory deficiencies that would result from a facility's incorrect field sampling and laboratory analysis procedures. The discussion in Section 3.6 of this handbook regarding regulatory versus technical deficiencies also pertains to this section.

5.7 References

EPA, 1986, Test Methods for Evaluating Solid Wastes - 3rd Edition, Volumes 1a, 1b and 1c and Volume 2, Chapter 11 (SW-846). September, 1986.

EPA, 1988, RCRA Comprehensive Groundwater Monitoring Evaluation Document, Final September 1988.

EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, Final September 1986.

6.0 REPORTING REQUIREMENTS

6.1 The CME Report

The CME Report consists primarily of the Office Assessment Report (Technical Assessment) and the Field Inspection Report (Sampling and Analysis). Included in Appendix A are several example outlines and tables of contents which may be used for future CME reports. Although CME reports may combine the Office Evaluation and the Field Inspection Reports, authorized States should consult with their Regions to agree on a consistent and complete report format in meeting the Region's or State's needs. The CME Guidance Document and the RCRA Inspector's Manual, Chapter 5, may be helpful in such discussions.

6.2 Office Assessment Report

This section of the report must establish the adequacy or inadequacy of the facility's groundwater monitoring system based on their characterization of the site's geology and hydrogeology, the placement of the facility's monitoring wells, the adequacy of the facility's characterization of the uppermost aquifer, and the adequacy of the facility's well design and construction. As can be noted in the example tables of contents (Appendix A), a very important section which must be included in the report is a complete discussion of all incomplete or missing data or information which may be needed to fully evaluate the adequacy of the facility's monitoring system. A section detailing incomplete or missing data must be included for each point which the CME is evaluating. Additional detail which is specific to each region will be discussed during the training course.

6.3 Field Inspection Report

This section of the report should evaluate the facility's compliance with the Sampling and Analysis Plan, and should describe well evacuation, sampling techniques, field measurement techniques, field monitoring equipment calibration, sample preservation, sample handling, chain-of-custody, and decontamination of the sampling equipment. This section is also referred to as the QA/QC Operation Evaluation Report (See Appendix A). Additional detail which is specific to each region will be discussed during the training course.

6.4 Variations of CME Report

The CME report may vary in format, organization, and information detail, depending on the complexity of the site. Any of the outlines presented in Appendix A may be used or a variation of these, as long as the minimal information is presented. The identification of data gaps must be included in the reports in order for the CME to have been adequately completed.

The essential elements of compliance with the groundwater monitoring requirements for RCRA regulated facilities, and which must be included in a CME report at a minimum, are summarized below. These factors represent the current status of required activities as suggested by the Technical Enforcement Guidance Document.

1. Introduction
   a. Facility's operational history
   b. Facility's regulatory history
   c. Facility's current RCRA status

2. Complete Characterization of Site's Geology and Hydrogeology
   a. Subsurface geology.
   b. Vertical and horizontal components of groundwater flow.
   c. Hydraulic conductivity of each formation present beneath the site.
   d. The vertical extent of the uppermost aquifer to the first confining layer beneath the facility.

3. Placement of Monitoring Wells
   a. The number of wells and well clusters adequate to immediately detect any releases or to define the rate and extent of contamination emanating from the regulated unit.
   b. The spacing of the detection monitoring well system must be adequate to immediately detect any release from that regulated unit.

4. Monitoring Well Construction
   a. The type of materials used for the monitoring well system must be adequate to both perform satisfactorily for a period of

at least thirty years and to not interfere with the chemical quality of the groundwater to be analyzed.

b. Proper documentation of the materials and the installation procedures used.

5. Sampling and Analysis Program Evaluation
   a. Sample collection procedures.
   b. Sample preservation and handling.
   c. Chain-of-Custody control.
   d. Analytical procedures.
   e. Field and lab quality assurance/quality control.

6. Assessment Monitoring
   a. Complete hydrogeologic description of the site.
   b. Determination of the vertical and horizontal extent, and rate of migration.
   c. Complete evaluation of the detection monitoring system.

7. Anticipated Action
   a. Identified violations
   b. Recommended enforcement response

6.5 Data Gaps and Missing Information

In order for the CME to be complete, the CME inspection must cover all the information which was discussed and evaluated during the Office Evaluation, as well as the Field Audit. Equally important is the inclusion of a discussion of what information is missing and which may have an impact on the completeness of the CME.

As has been discussed in previous sections, the most effective way to present information in which data were not available is to present these deficiencies in each subsection. For instances, if facility information on the construction of their monitoring wells is unavailable, your evaluation of the adequacy of their monitoring system is not complete. This lack of pertinent information should be discussed in the office evaluation sections of the report.

6.6 References

EPA, 1986, Test Methods for Evaluating Solid Wastes - 3rd Edition, Volumes 1a, 1b and 1c (SW-846). September, 1986.

EPA, 1988, RCRA Comprehensive Groundwater Monitoring Evaluation Document, Final September 1988.

EPA, 1986, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, Final September 1986.

U.S. EPA, OSWER, March 1990, Agency Operating Guidance for Fiscal Year 1990.

U.S. EPA, OSWER, RCRA Inspector's Manual, Final

March 1988.

6.7 Other References

Driscoll, Fletcher G., ed., Groundwater and Wells, Second Edition, Johnson Div, St. Paul, Minn., 1986.

Freeze, R. Allan and John A. Cherry, Groundwater, Prentice-Hall, New Jersey, 1979.

U.S. EPA NEIC, Manual for Groundwater and Subsurface Investigations at Hazardous Waste Sites, EPA 330/9-81-002, July 1981.

U.S. EPA, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance, April 1989.

Illinois State Water Survey, Dept. of Energy and Natural Resources, Guide to the Selection of Materials for Monitoring Well Construction and Groundwater Sampling, August 1983.

U.S. EPA, Robert S. Kerr Environmental Resources Laboratories, Practical Guide to Groundwater Sampling, 600/2-85/104, September 1985.

APPENDIX A

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FOR CME REPORTS

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EXHIBITS

COMPREHENSIVE GROUNDWATER MONITORING EVALUATION
OFFICE ASSESSMENT REPORT

ABC CORPORATION
FLAT ROCK, OKLAHOMA
EPA I.D. NUMBER OK000000000

PREPARED FOR

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1445 ROSS AVENUE
DALLAS, TEXAS 75202

PREPARED BY
CONSULTANTS LTD.
MAIN STREET
ANYTOWN, USA

CONTRACT NO. 68-01-7777
WORK ASSIGNMENT NO. 1

JUNE 1989

OFFICE ASSESSMENT REPORT

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FINAL COMPREHENSIVE GROUNDWATER MONITORING EVALUATION

OIL PATCH REFINERY
DENVER, COLORADO

EPA I.D. NUMBER C00000000000

PREPARED FOR

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18TH STREET, SUITE 1300
DENVER, COLORADO 80202-2405

PREPARED BY
CONSULTANTS LTD.
MAIN STREET
ANYTOWN, USA

CONTRACT NO. 69-01-7777
WORK ASSIGNMENT NO. 2

MARCH 1989

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- depth, areal extent and thickness of water bearing and confining units
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3.3 Adequacy of the Owner/Operator Information (If 3.2 confirms 3.1, leave out section 3.2 and state here that the other background information confirms the owners information) .... 1/2 pg.

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4.1 Owner/Operator Information

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   B. Site Plan
   C. Piezometric Contours
   D. Well Logs
   E. Well Construction Drawings
   F. Geologic Cross-Sections and Profiles

* Summaries of deficiencies and adequacy requirements would be lists of items written so that they could be directly incorporated into NOD's/LOW's, Compliance Orders, etc. by permit or compliance staff.