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OPERATION AND MAINTENANCE INSPECTION GUIDE

(RCRA Ground-Water Monitoring Systems)

FINAL

RCRA Enforcement Division
Office of Waste Programs Enforcement
U.S. Environmental Protection Agency

March 1988

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PREFACE

The 1988 RCRA Implementation Plan introduces the Operation and Maintenance Inspection (RCRA Ground-Water Monitoring Systems) as a new type of inspection. This guidance manual has been written for EPA and state enforcement staff. It describes the Operation and Maintenance (O&M) Inspection, explains how it fits into EPA's overall enforcement effort, and explains how to plan and conduct an O&M inspection.

The manual has been organized and written to conform to the steps enforcement officials would follow in planning and conducting O&M inspections.

Section One discusses the regulatory basis for O&M inspections, describes the enforcement objectives underlying O&M inspections, and explains how the O&M inspection relates to EPA's overall RCRA enforcement program.

Section Two explains how to prepare for the O&M inspection. It describes what should be done in the office prior to conducting the field inspection and explores the relationship of the enforcement official and the field inspector.

Section Three describes how to conduct an O&M inspection. A generic O&M field inspection report form is included as an appendix to help the inspector focus field activities and record field observations to support potential enforcement actions.

Section Four describes how to review the inspection report form and decide if there is direct evidence of violations or whether the possibility exists that the owner/operator is in violation of the RCRA requirements.

The Appendices include the generic operation and maintenance inspection form, an example of permit language for operation and maintenance programs, a guide to operation and maintenance of gas displacement bladder pumps, and a list of questions and answers. The reader may wish to refer to the question and answer section (Appendix D) to obtain a quick overview of this guidance manual.

SECTION ONE

OVERVIEW OF THE OPERATION AND MAINTENANCE INSPECTION

1.1 Enforcement Objectives of the Operation and Maintenance Inspection

The 1988 RCRA Implementation Plan introduces the Operation and Maintenance (O&M) Inspection as a new type of inspection. The O&M inspection adds a new perspective and focus to EPA's efforts to ensure the proper implementation of the RCRA ground-water monitoring regulations.

By the end of FY 1988, enforcement officials will have conducted Comprehensive (Ground Water) Monitoring Evaluations (CMEs) at all RCRA land disposal facilities. The CMEs conducted to date have focused heavily on site characterization and on the design of ground-water monitoring systems. Enforcement actions have been taken to promote the timely issuance of RCRA land disposal permits. Through these enforcement and/or permitting actions, EPA and the states will have had the opportunity to scrutinize the design of every active ground-water monitoring system regulated under RCRA.

The focus of the enforcement program in FY 1988 and beyond is now shifting from design review to the review of facility operations—particularly those facility operations related to the generation of ground-water monitoring data. In general, the O & M inspection focuses on how owners/operators operate and maintain their ground-water monitoring systems. Specifically, EPA has designed the O&M inspection to achieve the following enforcement objectives.

- Determine that the owner/operator's personnel who collect ground-water samples are collecting them properly:
  - in accordance with the owner/operator's Part 265 (interim status) Sampling and Analysis plan or
  - in accordance with conditions associated with the sampling and analysis section of the owner/operator's RCRA permit.

- Determine that the owner/operator's sampling devices are in working order and that the owner/operator is abiding by maintenance provisions as outlined in the Sampling and Analysis Plan (interim status) or in the RCRA permit (permit status).

- Determine that individual monitoring wells and piezometers/observation wells within a ground-water monitoring system continue to yield representative ground-water samples and reliable ground-water samples and reliable hydrologic data.

- Identify flagrant violations in operation and maintenance programs, and/or trigger a more thorough scrutiny of the owner/operator's ground-water monitoring program (i.e., trigger a Case Development Inspection).

- Identify issues or concerns that the enforcement staff should assess in a future Comprehensive (Ground Water) Monitoring Evaluation.

- Collect ground-water elevation data; determine direction(s) of ground-water flow; and assess, generally the viability of past decisions made by the owner/operator regarding the number and placement of monitoring wells.

1.2 Regulatory Basis for the Operation and Maintenance Inspection

The authority of EPA to require an owner/operator to implement an O&M program and the authority of the enforcement official to take actions against poor O&M programs is firmly rooted in regulations under Sections 265, 264, and 270 of RCRA. **Table 1** lists those regulations which give EPA the authority to take enforcement actions related to ground-water monitoring O&M programs.

TABLE 1

SUMMARY OF REGULATIONS RELATED TO OPERATION AND MAINTENANCE PROGRAMS

Interim Status	Description
265.15(b)(1)	"The owner/operator must develop and follow a written schedule for inspecting all monitoring equipment,... and operating and structural equipment... that are important to preventing, detecting, or responding to environmental or human health hazards."
265.15(b)(2)	"He must keep this schedule at the facility."
265.15(b)(3)	"The schedule must identify the types of problems (e.g. malfunctions or deterioration) which are to be looked for during the inspection..."
265.15(b)(4)	"The frequency of inspection...should be based on the rate of possible deterioration of the equipment...."
265.15(d)	"The owner or operator must record inspections in an inspection log or summary. He must keep these records for at least three years from the date of inspection. At a minimum, these records must include the date and time of inspection, the name of the inspector, a notation of the observations made, and the date and nature of any repairs or other remedial actions."
265.73(a)	"The owner or operator must keep a written operating record at his facility."
265.73(b)	"The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility:..." (5) "Records and results of inspections..." (6) "Monitoring, testing, or analytical data..."
265.74(a)	"All records, including plans, required under this part must be furnished upon request, and made available at reasonable times for inspection..."
	"[The owner or operator must report to the Regional Administrator] Ground-water contamination and monitoring data as specified in §265.93 and 265.94..."

TABLE 1

Interim Status	Description
265.90(a)	"...the owner or operator of a surface impoundment, landfill, or land treatment facility ... must implement a ground-water monitoring program capable of determining the facility's impact on the quality of groundwater in the uppermost aquifer..."
265.92(a)	"The owner or operator must obtain and analyze samples from the installed ground-water monitoring system. The owner or operator must develop and follow a ground-water sampling and analysis plan..."
265.92(a)	"...The plan must include procedures and techniques for: (1) Sample collection; (2) Sample preservation and shipment; (3) Analytical procedures; and (4) Chain of custody control.
265.94(a)(1)	"[The owner or operator must] keep records of the received analyses..., the associated ground-water surface elevations..."
265.94(a)(2)	"[The owner or operator must] report the following ground-water monitoring information to the Regional Administrator:" [annual reports of required ground-water monitoring results including ground-water elevation data].
Permit Status	**Description**
264.15(a)	"The owner or operator must inspect his facility for malfunctions and deterioration, operator errors, and discharges..."
264.15(b)(1)	"The owner or operator must develop and follow a written schedule for inspecting monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment..."
264.15(b)(2)	"He must keep this schedule at the facility."
264.15(b)(3)	"The schedule must identify the types of problems (e.g. malfunctions or deterioration) which are to be looked for during the inspection..."
264.15(b)(4)	"The frequency of inspection...should be based on the rate or possible deterioration or the equipment." "The owner or operator must record inspections in an inspection log or summary. He must keep these records for at least three years from the date of the inspection. At a minimum, these records must include the date and time of the inspection, the name of the inspector, a notation of

TABLE 1

Permit Status	Description
	the observations made, and the date and nature of any repairs or other remedial actions."
264.73(a)	"The owner or operator must keep a written operating record at his facility."
264.73(b)	"The following information must be recorded, as it becomes available, and maintained in the operating record until closure of the facility: "(5) Records and results of inspections... "(6) Monitoring, testing, or analytical data..."
264.74(a)	"All records, including plans, required under this part must be furnished upon request and made available at reasonable times for inspection...."
264.77(c)	"[The owner or operator must report to the Regional Administrator] As... required by Subpart F..."
264.97(a)(2)	"[The ground-water monitoring system must] represent the quality of groundwater passing the point of compliance."
264.97(d)	"The ground-water monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide a reliable indicaton of groundwater quality below the waste management area. At a minimum, the program must include procedures and techniques for: (1) Sample collection; (2) Sample preservation and shipment; (3) Analytical procedures; and (4) Chain of custody control."
264.97(e)	"The ground-water monitoring program must include sampling and analytical methods that are appropriate for groundwater sampling and that accurately measure hazardous constituents in ground-water samples."
264.97(f)	"The ground-water monitoring program must include a determination of the groundwater surface elevation each time ground-water is sampled."
264.98(d)	"The owner or operator must determine ground-water quality at each

TABLE 1

Permit Status	Description
	monitoring well at the compliance point at least semi-annually [when conducting a detection monitoring program]..."
264.98(e)	"The owner or operator must determine the ground-water flow rate and direction in the uppermost aquifer at least annually [when conducting a detection monitoring program]."
264.98(f)	"The owner or operator must use procedures and methods for sampling and analysis that meet the requirements of §264.97 (d) and (e).
264.99(d)	"The owner or operator must determine the concentration of hazardous constituents in ground-water at each monitoring well at the compliance point at least quarterly [when conducting a compliance monitoring program]..."
264.99(e)	"The owner or operator must determine the ground-water flow rate and direction in the uppermost aquifer at least annually (when conducting a compliance monitoring program)."
264.100(g)	"The owner or operator must report in writing to theRegional Adminitrator on the effectiveness of the corrective action program. The owner or operator must submit these reports semi-annually."
270.30(e)	"In conjunction with a corrective action program, the owner or operator must establish and implement a ground-water monitoring program to demonstrate the effectiveness of the corrective action program. Such a monitoring program may be based on the requirement for a compliance monitoring program under §264.99..."
270.30(j)(1)	"The owner or operator must report in writing to the Regional Administrator on the effectiveness of the corrective action program. The owner or operator must submit these reports semi-annually."
270.14(c)(4)	The owner/operator must describe "...any plume of contamination that has entered the ground-water..."
270.30(e)	"Proper operation and maintenance. The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training,..."

TABLE 1

Permit Status	Description
270.30(h)	"The permittee shall furnish....within a reasonable time... copies of records required to be kept by this permit."
270.30(i)(2)	"Inspection and entry. The permittee shall allow the Director...to...have access to and copy, at resonable times... any records that must be kept under the conditions of this permit."
270.30(j)(1)	"Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity."
270.30(j)(2)	"The permittee shall retain records of all monitoring information, including all calibration and maintenance records,... copies of all reports required by this permit,...for a period of at least three years from the date of the sample...." "The permittee shall maintain records from all ground-water monitoring wells and associated ground-water surface elevations for the active life of the facility, and for disposal facilities for the post-closure care period as well."
270.30(j)(3)	"Records for monitoring information shall include: (i) The date, exact place, and time of sampling or measurements; (ii) The individual(s) who performed the sampling or measurements; (iii) The date(s) analyses were performed; (iv) The analytical techniques or methods used; and (v) The results of such analyses."
270.30(l)(1)	"Planned changes. The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility."
270.30 (l)(4)	"Monitoring efforts. Monitoring results shall be reported at the intervals specified elsewhere in this permit."

It is important to note that these regulations should not be read and applied individually. They were written to be applied in a conjunctive manner. Some of the regulations listed in Table 1 are broad in nature whereas some are very specific as to actions or conditions that are required of the owner/operator. When taken as a whole, these regulations require owner/operators to design and implement a comprehensive operation and maintenance program for ground-water monitoring systems. They also give EPA the authority to take action against those owner/operators who fail to do so. Section Five in this guide, describes how these specific regulations relate to "Compliance Decision-making" violations EPA is likely to encounter.

1.3 Relationship of the Operation and Maintenance Inspection to Other RCRA Inspections

There are four types of RCRA compliance inspections that exist in addition to the O&M inspection. They are: the Comprehensive (Ground Water) Monitoring Evaluation (CME); the RCRA Compliance Evaluation Inspection (CEI); the RCRA Case Development Inspection (CDI); and the RCRA Laboratory Audit Inspection (LAI). Each of these inspections (with the exception of the LAI) is described in the FY 1988 RCRA Implementation Plan.

Section 1.1 described, in general, the relationship between the CME and the O&M inspection. The O&M inspection is less resource-intensive than the CME, is conducted more frequently, focuses on less detail than the CME, and often acts as a trigger for additional enforcement actions in the form of a Case Development Inspection. All RCRA land disposal facilities will receive either a CME or an O&M inspection each year. All RCRA land disposal facilities which accept wastes from Superfund sites must receive a CME each year. Up to one-third of the RCRA land disposal facilities in total will receive a CME each year. The rest of the population of land disposal facilities will receive an O&M inspection.

A Case Development Inspection is a comprehensive effort to compile evidence to support litigation or administrative enforcement actions against an owner/operator or to establish the need for such actions. Case Development Inspections are often performed on an as-needed basis in response to the results from other RCRA inspections (e.g., O&M, CEI, CME). The O&M inspection may, thus, act as a trigger for CDI.

A Compliance Evaluation Inspection is an examination of all aspects of a facility's compliance with the RCRA regulations. CEIs are conducted more

frequently than O&M inspections and are more general in their scope and application.

EPA has designed the RCRA Laboratory Audit Inspection (LAI) to ensure that ground-water samples are analyzed properly in the laboratory and that the laboratory produces high quality analytical data. The RCRA O&M inspection focuses heavily on the field performance of the owner/operator's staff in collecting ground-water samples and on the evaluation of the integrity of the owner/operator's monitoring system. Thus, the O&M inspection focuses on those activities and procedures which ensure the collection of representative ground-water samples. The LAI focuses on those activities and procedures which ensure the generation and reporting of high quality analytical data.

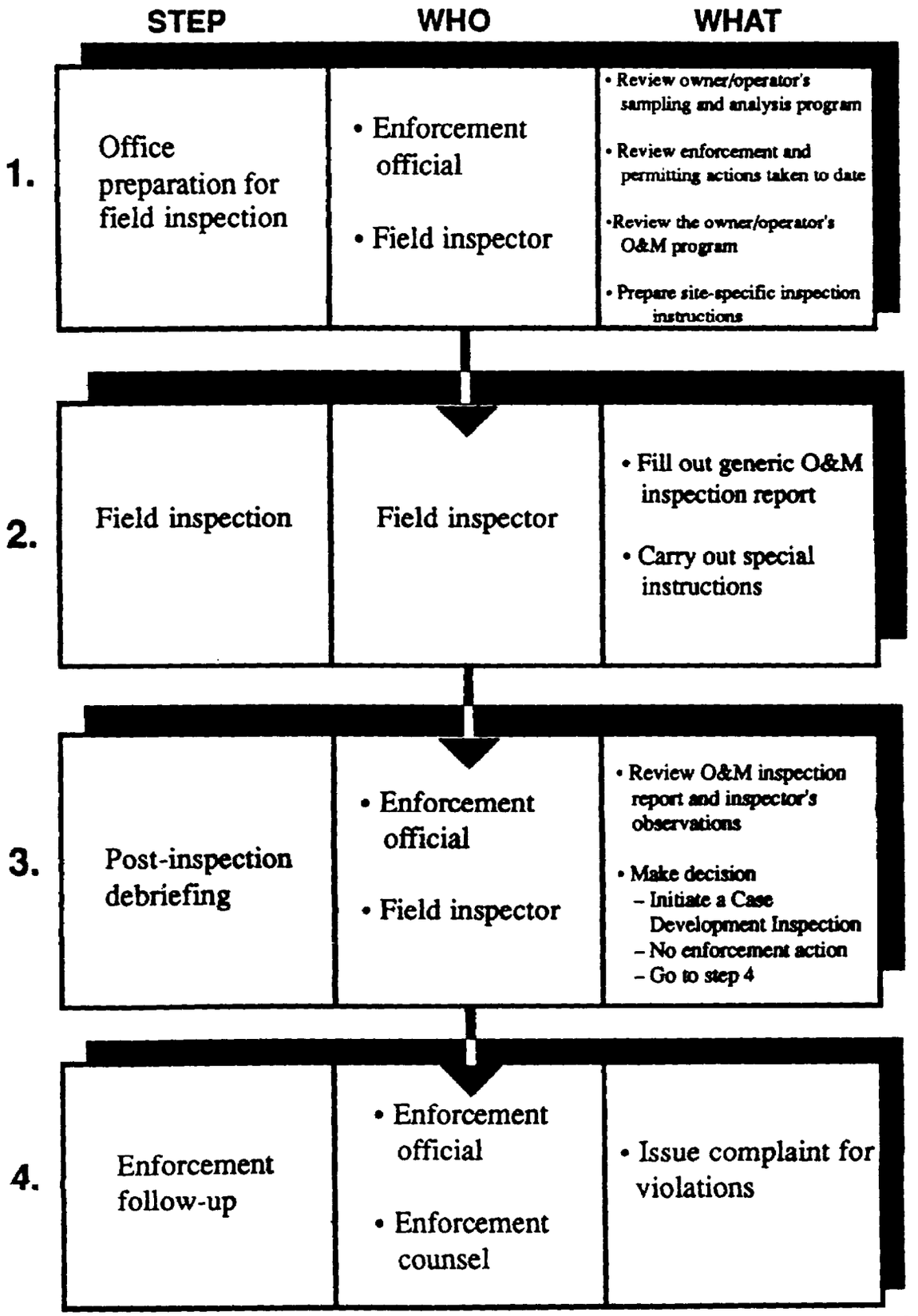
1.4 The Operation and Maintenance Inspection Process

The Operation and Maintenance inspection requires the participation of a variety of persons including: field inspectors; enforcement officials (chemists, hydrogeologists, and/or engineers); and enforcement counsel. Table 2 illustrates the generic process regions and states follow in conducting an O&M inspection. It is important to note the regions and states may, in fact, use variants of the generic process. The process is not as limited as illustrated in **Table 2.**

In Step 1, the field inspector and the enforcement official will meet. The purpose of their meeting is to plan out the field portion of the O&M inspection. They will review the owner/operator's sampling and analysis program, review enforcement and permitting actions taken to date at the facility, review the owner/operator's operation and maintenance program, and prepare a list of site-specific observations the field inspector should make at the facility. In addition to planning out site-specific activities during Step 1, the inspector should make a decision as to the type and level of health and safety protection that is needed during the inspection (refer to the *RCRA Inspection Manual* for guidance). After completion of Step 1, the field inspector will be prepared to conduct the field portion of the O&M inspection.

In Step 2, the field inspector will visit the facility. The field inspector will complete the O&M inspection report form and carry out any special instructions generated during Step 1.

TABLE 2
Overview of the
Operation And Maintenance Inspection



In Step 3, the field inspector and the enforcement official will meet again. They will review the O&M inspection report form and discuss the inspector's observations. The enforcement official will make a decision to pursue one of the following actions:

- initiate a Case Development Inspection,
- issue a compliant, or
- take no further action.

If enforcement action is warranted, the enforcement official will meet with counsel. They will prepare and issue a complaint to the owner/operator for violations detected through the O&M inspection.

SECTION TWO

OFFICE PREPARATION FOR THE FIELD INSPECTION

The field inspector and the enforcement official work together in preparation for the O&M field inspection. There are four tasks the field inspector and the enforcement official must complete prior to the field inspection. They are:

1. Review and summarize the enforcement and permitting actions taken to date at the facility.

2. Review and summarize owner/operator's sampling and analysis program.

3. Review and summarize owner/operator's O&M program.

4. Prepare site-specific inspection objectives.

The field inspector and the enforcement official will use Part One of the Operation and Maintenance Inspection Form (RCRA Ground-Water Monitoring Systems) to guide them through the tasks listed above. It has been written so that when the field inspector and the enforcement official complete it, they will know:

- the number and location of monitoring wells and piezometers at the facility;

- the procedures and techniques the owner/operator uses to collect ground-water samples;

- the details of the owner/operator's operation and maintenance program in place at the facility; and

- the existence and nature of any permitting or enforcement action which may affect the field inspection.

SECTION THREE

THE FIELD INSPECTION

The field inspector will complete four tasks during the field inspection. They are:

1. Review the operating record to identify evidence of deficiencies in the owner/operator's sampling and/or operation and maintenance program.

2. Visually inspect each well and piezometer for evidence of damage or deterioration.

3. Obtain site data (i.e., depth to water and depth to bottom of well) for each well and piezometer.

4. Visually observe the owner/operator's sampling crew as they collect ground-water samples.

The field inspector will use Part Two of the Operation and Maintenance Inspection Form (RCRA Ground-Water Monitoring Systems) to guide him/her through the tasks listed above. Part Two has been written so when completed, the field inspector will have:

- assessed whether the owner/operator's sampling crew departed from written sampling and analysis procedures contained in the owner/operator's sampling and analysis plan (interim status) or in the owner/operator's RCRA permit (permit status);

- identified deficiencies in the owner/operator's program to ensure ongoing maintenance of sampling devices and monitoring wells/piezometers;

- identified deficiencies in the owner/opertor's operating record; and

- collected field data that will allow the enforcement official to construct potentiometric maps and assess the viability of individual wells.

SECTION FOUR

COMPLIANCE DECISION-MAKING

The field inspector and the enforcement official will meet after the field inspection and review Parts One and Two of the Operation and Maintenance Inspection Form (RCRA Ground-Water Monitoring Systems). With the inspector's help, the enforcement official will complete three tasks. The enforcement official will:

1. Construct a potentiometric map using data collected by the field inspector and compare the map to those generated by the owner/operator.

2. Identify violations in the owner/operator's sampling program and/or operation and maintenance program (use table as a guide).

3. Identify wells with siltation problems or other problems which may compromise the integrity of the wells.

After the enforcement official has completed the tasks above, he/she will choose one of following four options:

1. By virtue of the evidence collected by the field inspector, there are sufficient grounds to issue a complaint: work with enforcement counsel to develop and issue the complaint.

2. By virtue of the evidence collected by the field inspector, there may be sufficient grounds to pursue an enforcement action: initiate a Case Development Inspection.

3. The field inspection has not indicated compliance problems at the facility or problems are minor in nature: do not pursue additional enforcement action.

4. There is cause for concern that the owner/operator may need to redesign all or a portion of the monitoring system. Concern is not great enough, however, to prompt the initiation of a Case Development Inspection. Prepare detailed notes for the file describing how the next CME at the facility should be focused.

APPENDIX A
Example of Permit Conditions for an Operation and Maintenance Program

APPENDIX A

EXAMPLE OF PERMIT CONDITIONS FOR AN OPERATION AND MAINTENANCE PROGRAM

The following are excerpts of conditions for a land disposal facility in detection monitoring. The facility manages a variety of wastes with organic constituents. The owner/operator was required to install 32 new stainless steel/PVC wells (i.e., stainless steel in the saturated zone) to supplement 11 existing PVC wells in the monitoring system. The permit writer ordered the owner/operator to install dedicated gas displacement bladder pumps in existing and new wells. The permit writer also ordered the owner/operator to:

- collect ground-water samples and water level data on a semi-annual basis (§264.98);
- test the structural integrity of PVC/stainless steel wells every fifth year and the integrity of PVC wells on an annual basis (§264.15);
- implement a written operation and maintenance plan and document its implementation (§264.15, §264.97, §264.98, 270.30).

The permit conditions below relate to the specific requirements written into the permit by the permit writer. The enforcement official would base enforcement actions upon the conditions below.

I. Well/Piezometer Installation or Replacement

A. The Permittee shall construct, develop, and equip all new monitoring wells (32 wells total), as required by permit conditions xxx through xxx (i.e., permit conditions related to design and construction), within 270 calendar days after the effective date of this permit. If a monitoring well must be replaced for any reason during the term of this permit, it shall be replaced within 30 calendar days of the date taken out of service. The Permittee shall provide, in the operating record and in the next annual report, information regarding the new well including the well construction log and site location.

B. Any replacement piezometers that may be required during the life of this permit shall be installed as close as practicable to the piezometer

being taken out of service and, to the extent possible, shall be installed in accordance with the design and specifications of the piezometer being taken out of service. If a piezometer must be replaced for any reason during the term of this permit, it shall be replaced within 30 calendar days of the date taken out of service. The Permittee shall provide, in the operating record and in the next annual report, information regarding the new piezometer including the construction log and site location.

II. Monitoring Program Operation

A. The Permittee shall include all monitoring wells as required by permit conditions xxx and xxx in the detection monitoring program. Additionally, each piezometer as required by permit condition xxx shall be included in the detection monitoring program, for the purpose of determining direction and rate of flow.

B. The Permittee shall obtain water level (or piezometric head) measurements from all monitoring wells and from all piezometers for which water level elevations (or piezometric heads) have stabilized after construction, prior to each sampling event. Measurements for each monitoring well shall be obtained prior to purging of the well. The Permittee shall use this data to determine the rate and direction of ground-water flow annually, as required by 40 CFR §264.98(e). The Permittee shall use these data, adjusted for barometric efficiency at each well, to construct water table elevation (or piezometric surface) contour maps for Level 1 and Level 2 of the xxx Aquifer. These maps shall be maintained in the operating record and shall be submitted to the Director and the Administrator with the annual report of ground-water sample results. Additionally, the Permittee shall submit, with the contour maps, a written review of the adequacy of the ground-water monitoring system relative to observed ground water flow directions.

C. The Permittee shall begin sampling of each new ground-water monitoring well at the next semi-annual sampling event following completion of construction of that well, irrespective of the construction status of other new monitoring wells.

III. Monitoring Well/Piezometer Maintenance

A. The Permittee shall prepare a written inventory of all sampling equipment and sampling devices in use at the facility. The Permittee will also follow written operating, calibration, and maintenance procedures for each piece of equipment. Documentation of implementation of procedures will be kept in the operating record.

B. The Permittee will remove all dedicated pumps from the wells in the monitoring system at least once per year in order to (1) visually inspect the mechanism and service it, if necessary, and (2) to measure the total depth of the well. The Permittee will notify the Director of the date upon which this activity will commence. The maintenance of pumps shall not interfere with the collection of samples. The results of this inspection are to be documented and maintained in the operating record.

Further, any additional maintenance recommended by the manufacturer shall be documented in the operation and maintenance record and followed by the Permittee. Malfunctioning pumps are to be serviced or replaced at once so as not to interfere with the collection of water quality samples or data pertaining to aquifer characteristics. The Permittee shall have available either additional pumps or alternatives (e.g. bailers). Malfunctioning pumps are to be reported within seven days to the Director, and recorded in the operation and maintenance record. (Refer to Appendix C for detailed operation and maintenance procedures for dedicated gas displacement bladder pumps.)

C. The Permittee shall inspect the integrity of the casing and screen of each PVC well (wells 1-11) once every year using a down-the-hole camera; calipers or; if applicable, electrical techniques. The results of this testing shall be maintained in the operating record. Should casing and/or screen sustain such damage or strain as to expose the interior of the well or prevent introduction of sampling devices from above, the well shall be decommissioned. Prior to the decommissioning, the Permittee shall apprise the Director of the rationale for the decision. At that time, a schedule for replacement of the well shall be prepared and implemented. Replacement shall occur before the subsequent scheduled sampling. All well repairs and/or replacements shall be documented in the operating record.

To summarize:

1. Identify the problem;
2. Apprise the Director/submit schedule for repair/replacement;
3. Implement repair/replacement; and
4. Resume regularly scheduled sampling.

D. The Permittee shall maintain borehole integrity of each monitoring well and piezometer, as required by 40 CFR §264.97(c). The Permittee shall sound each well and piezometer on a routine basis every year, beginning with the first sampling event after the completion of construction of all new monitoring wells which are specified in permit condition xxx. The Permittee shall maintain records of the depth of well measurements and the silt/sediment accumulation in the operation and maintenance record for the term of this permit.

E. The Permittee shall redevelop any monitoring well or piezometer when either of the following two conditions occur:

1. Silt or sediment is determined to have entered the well or piezometer and has accumulated to a depth of one foot, or 20% of the screen length, whichever is less* ; or

2. Yield from the well or piezometer is noted to have significantly decreased or recovery time has significantly increased, indicating clogging of the screen and/or sand filter.

F. The Permittee shall maintain all monitoring wells and piezometers in good working order, making necessary repairs in a timely manner so that the sampling program is not hindered or delayed in any way. The Permittee shall maintain an adequate supply of replacement parts and repair equipment to ensure that each sampling event proceeds on schedule.

G. The Permittee shall follow the procedures in the Inspection Plan. Table xx and Figure xx, which are included in Attachment x of this

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* This permit condition is applicable to conditions at this site. Requirements such as this should be written to meet site specific conditions.

permit for routine inspection of monitoring wells and piezometers. Visual evidence of damage to, or deterioration of wells or piezometers must be noted in the operating record.

H. The Permittee shall name a suitably qualified individual to implement the operation and maintenance program at the facility.

APPENDIX B
Generic Operation and Maintenance Inspection Form

Part One—Pre-Inspection Planning Guide
Part Two—Field Inspection Guide
Part Three—Compliance Decision Making

APPENDIX B
Part One

Pre-Inspection Planning Guide

PART ONE

The field inspector and the enforcement official will meet and complete four tasks. Those tasks are: 1) review enforcement and permitting actions taken to date at the facility, 2) review the owner/operator's sampling and analysis program, 3) review the owner/operator's O&M program, and 4) prepare site-specific inspection objectives.

1. Facility identification number _____

2. Name of facility contact _____
   phone number ( ) _____

3. Address of facility _____
   _____
   _____

4. Does the facility have:
   Interim Status? (go to 5a)
   - detection monitoring
   - assessment monitoring
   - corrective action (§3008(h))

   Permit Status? (go to 5b)
   - detection monitoring
   - compliance monitoring
   - corrective action

5a. Past actions taken at facility (interim status)

Type	Date(s)
Operation and Maintenance Inspection	_____
Comprehensive (Ground-Water)	_____
Monitoring Evaluation	_____
Case Development Inspection	_____
RCRA Facility Assessment	_____
Compliance Evaluation Inspection	_____
Ground-Water Task Force Investigation	_____

Complete the following questions in regard to the actions listed on the previous page:

- Do you have a copy of completed inspection reports or site studies? Yes ___ No ___

- For each, summarize deficiencies identified in the owner/operator's sampling program and/or the owner/operator's operation and maintenance program.

Go to 6a.

5b. Actions taken at the facility (permit status)

Type	Date
• Permit Issuance	_____
• Operation and Maintenance Inspection	_____
• Comprehensive (Ground-Water)	_____
• Monitoring Inspection	_____
• Case Development Inspection	_____
• Compliance Evaluation Inspection	_____
• Other	_____

Complete the following in regard to the actions listed above:

- Do you have a copy of the permit and copies of inspection reports completed after permit issuance? Yes ___ No ___

- Summarize deficiencies identified after permit issuance regarding the owner/operator's operation and maintenance program.

Go to 6b

6a. Identify enforcement actions issued to the facility in regard to interim status violations.

Action	Date(s)
• §3008(a) complaint/order	_____
• §3013 complaint/order	_____
• §3008(h) complaint/order	_____
• §7003 complaint/order	_____
• Referral for litigation	_____
• Other	_____

Complete the following regarding the actions listed above:

- For each, identify if the enforcement action is focused on the owner operator's sampling and analysis program and/or the owner/operator's operation and maintenance program. Summarize relevant requirements imposed on the owner/operator.

Go to 7

6b. Identify enforcement actions issued to the facility after the permit issuance date.

Action	Date(s)
• §3008(a) complaint/order	_____
• §3013 complaint/order	_____
• §3008(h) complaint/order	_____
• §7003 complaint/order	_____
• Referral for litigation	_____
• Other	_____

Complete the following regarding the actions listed above:

- For each, identify if the enforcement action focused on the owner/operator's sampling and analysis program and/or the owner/operator's operation and maintenance program. Summarize relevant requirements imposed on the owner/operator.

Go to 7

7. Review and summarize the owner/operator's sampling and analysis plan. (Note: Revise or add to the table if permit conditions dictate a different requirement the owner/operator must follow.) Does the Sampling and Analysis Plan:	**Y/N**
Include provisions for the measurement of static water elevations in each well prior to each sampling event?	
Specify the device to be used for measuring water level elevations?	
Specify the procedure for measuring water levels?	
Provide for the measurement of depth to standing water and depth to the bottom of the well to 0.01 feet?	
Explain whether dedicated or non-dedicated sampling equipment is used and the type of sampling equipment?	
Describe procedures for evacuating wells?	
Provide for the use of sampling devices constructed of inert materials such as fluorocarbon resin or stainless steel?	
Provide for dedicated sampling devices for each well or alternately provide for decontamination of sampling devices and the collection of blanks between wells?	
Provide for the collection and containerization of samples in the order of volatilization potential?	
Identify the preservation methods and sample containers the owner/operator will use?	
Describe procedures for transferring samples to off-site laboratories?	
Describe a chain-of-custody program which includes the use of sample labels, sample seals, field logbooks, chain-of-custody records, sample analysis request sheets, and laboratory logbooks?	
Include provisions for collection of field, trip, and equipment blanks?	
Include an inventory of sampling equipment and sampling devices used as part of the monitoring program?	
Include detailed operating, calibration, and maintenance procedures for each sampling device?	

(Continued)

(Continued from previous page)	Y/N
Include maintenance schedules for sampling equipment? (Refer to Appendix D for discussion of maintenance techniques for gas bladder pumps.)	
Include decision criteria to be used to replace or repair sampling equipment and/or monitoring wells?	
*Describe in detail sample handling procedures in place at the owner/operator's laboratory (refer to RCRA Laboratory Audit Inspection Guide for more detail)?	
*Describe in detail the procedures that will be used to perform analyses in the owner/operator's laboratory (refer to RCRA Laboratory Audit Inspection Guide for more detail)?	
*Describe in detail quality assurance/quality control procedures in place? (refer to RCRA Laboratory Audit Inspection Guide for more detail.)	

*NOTE: *The RCRA Laboratory Audit Inspection Guide (RCRA Ground-Water Monitoring Systems)* describes the information the owner/operator should include in the Sampling and Analysis Plan regarding the owner/operator's laboratory program. The inspector may want to supplement the checklist in this manual with the checklist in the *RCRA Laboratory Audit Inspection Guide* while planning an operation and maintenance inspection.

Go to 8

COMMENTS ON SAMPLING AND ANALYSIS PLAN

8. Complete the following table. Use a separate entry for each well and piezometer in the monitoring system:

Identification Number	Type of Well Sampling Equipment (pump or bailer)	Depth to Water Last Inspection (if available)	Depth to Bottom Last Inspection (if available)	Notes/Comments
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				

After working through Part One, the enforcement official and the field inspector should know:

- the number and location of monitoring wells and piezometers at the facility;
- the procedures and techniques the owner/operator uses to collect ground-water samples;
- the details of the owner/operator's operation and maintenance program in-place at the facility; and
- the existence and nature of any permitting or enforcement action which may affect the field inspection.

The inspector will need the following equipment to conduct the field inspection:

- facility map with locations of wells and piezometers
- bound field notebook
- camera
- weighted tape measure or electronic water level indicator (made of inert material),
- deionized water, hexane (or laboratory strength cleaner), and sterile, disposable paper towels or gauze for decontamination of tape measure or probe
- surveyor's chain

(Note: additional equipment will be needed if the inspector wishes to obtain a split sample from the owner/operator.)

APPENDIX B
Part Two

Field Inspection Guide

PART TWO

The field inspector will complete four tasks during the field inspection. They are: 1) review the operating record to identify evidence of deficiencies in the owner/operator's sampling and/or operation and maintenance programs; 2) visually inspect each well and piezometer for evidence of damage or deterioration; 3) obtain measurements from the operations record of depths of water levels and well depths for each well and piezometer; and 4) visually observe the owner/operator's field crew as they collect ground-water samples.

Name of inspector(s)_____

Date(s) of inspection _____

1. Review the operating record of the facility. Does the operating record:	**Y/N**
Include annual reports of ground-water monitoring results including ground-water level data from each well and piezometer in the monitoring system?	
Include an inventory of all sampling devices and purging equipment in use at the facility and information on model number, serial number and manufacurers name?	
Include detailed operating, calibration and maintenance procedures for each sampling device?	
Describe decision criteria to be used to replace or repair sampling equipment and/or monitoring wells?	
Include schedules for performing operation and maintenance activities related to the ground-water monitoring system?	
Include records for ground-water monitoring which provide information on 1) the date, exact place and time of sampling or measurements; 2) the individual(s) who performed the sampling or measurements; 3) the date(s) analyses were performed; 4) the analytical techniques or methods used; and 5) the results of such analyses?	
Include records of all monitoring information including all calibration and maintenance records?	
Include records of monitoring information including determination of ground-water surface elevations?	
Include a determination of ground-water flow rate and direction(s) in the uppermost aquifier on an annual basis (e.g., prepare a potentiometric map annually using data collected during the year)?	
Provide for more frequent and intensive inspection of wells constructed of non-inert casing such as PVC? (Refer to Appendix A for permit example.)	

COMMENTS ON OPERATING RECORD

2. Visually inspect each well and piezometer and complete the table below (one line entry for each well or piezometer):

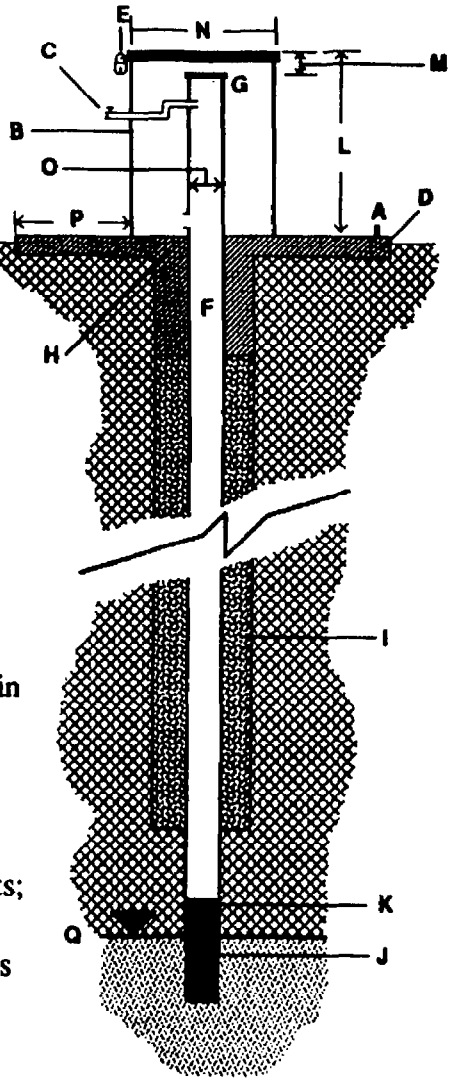
Well/ Piezometer	Survey Mark Present?	Standing or Ponded Water?	Evidence of Collision Damage?	Evidence of Frost Heaving?	Evidence of Casing De-gradation?	Lock in Place?	Evidence of Well Sub-sidence?	Photograph Taken?

3. Obtain data on depth to standing water and depth to the bottom of each monitoring well and piezometer in the owner/operator's monitoring system. Record depth measurements to the nearest 0.01 feet. Record the measurements

Date	Well/ Piezometer I.D. No.	Depth to Water (0.01')	Depth of Well/ Piezometer (0.01')

Key:

A - survey elevation mark
B - protective outer casing
C - gas vent
D - concrete apron
E - fitted lock
F - primary casing material
G - cap for primary casing
H - bore hole seal
I - annular space seal
J - well screen
K - filter pack
L - height of riser
M - elevation difference
N - diameter of outer casing
O - diameter of primary casing
P - radius of apron
Q - water level below surface



1. The field inspector has several options in collecting ground water elevation data. The inspector may:
   a. obtain past data from the operating record;and/or
   b. take his/her own depth measurements; and/or
   c. obtain data from the owner/operator's sampling crew.

4. Observe the owner/operator's staff as they collect ground-water samples at several wells. Complete the following table for each well (Note: revise or add to the table if permit conditions dictate a different requirement the owner/operator must follow):

Position/Title	Name	Sampling Experience (years and type)

Well Identification Number _____	Y/N	Photograph Taken Y/N
Did the sampling crew measure static water levels in the well and well depths prior to the sampling event?		
Did the sampling crew use a steel tape or electronic device totake depth measurements?		
Did the sampling crew record depths to +/– 0.01 feet?		
Did the sampling crew follow these procedures: 1. remove locking and protective cap; 2. sample the air in the well head for organic vapors; 3. determine the static water level; and 4. lower an interface probe into the well to detect immiscible layers.		
If immiscible samples were collected, were they collected prior to well purging?		
Did the sampling crew evacuate low yielding wells to dryness prior to sampling?		
Did sampling crew evacuate high yielding wells so that at least three casing volumes were removed?		
Did the sampling crew collect the purge water for storage and analysis or for shipment off-site to a RCRA treatment facility?		
Were sampling devices constructed of fluorocarbon resins or stainless steel?		

(Continued)

Well Identification Number _____	Y/N	Photograph Taken Y/N
If the sampling crew used dedicated samplers, did they disassemble and thoroughly clean the devices between samples?		
If samples are collected for organic analyses, did the cleaning procedure include the following steps: 1. non phosphate detergent wash 2. tap water rinse 3. distilled/deionized water rinse 4. acetone rinse 5. pesticide-grade hexane rinse?		
If samples are collected for inorganic analyses, does the cleaning procedure include the following steps: 1. dilute acid rinse (HNO_3 or HCL) 2. distilled/de-ionized water rinse?		
Did the sampling crew take trip blanks, field blanks and equipment blanks?		
If the sampling crew used bailers, were they bottom valve bailers?		
If the sampling crew used bailers, was "teflon" coated wire, single strand stainless steel wire or monofilament used to raise and lower the bailer?		
If the sampling crew used bailers, did they lower the bailer slowly to the well?		
If the sampling crew used bailers, were the bailer contents transferred to the sample container to minimize agitation and aeration?		
Did the sampling crew take care to avoid placing clean sampling equipment, hoses, and lines on the ground or other contaminated surfaces prior to insertion in the well?		
If the sampling crew used dedicated bladder pumps: Was the compressed gas from an oilless compressor certified quality commercial compressed gas cylinder? If not, was a suitable oil removal purification system installed and maintained?		
Was the bladder pump controller capable of throttling the bladder pump discharge flow to 100 ml/min or less for continuous periods of at least 20-30 seconds without restricting liquid discharge?		

(Continued)

Well Identification Number _____	Y/N	Photograph Taken Y/N
Were samples taken from the bladder pump discharge tube, and not from any purge device discharge tube?		
Was the bladder pump discharge flow checked for the presence of gas bubbles before each sample collection, as a test for bladder integrity?		
Was bladder pump flow performance monitored regularly for dropoff in flow rate and discharge volume per cycle?		
Was the bladder pump incorporated in a combination sample-purge pump design which can expose the bladder pump interior and discharge tubing to the pump drive gs? If so, were operating procedures established and followed to prevent at all times the entry of drive gas into the sample flow or into the bladder pump interior?		
Did the sampling crew collect and containerize samples in the order of the volatilization sensitivity of the parameters?		
Did the sampling crew measure the following parameters in the field: pH, temperature; specific conductane?		
Did the sampling crew sample background wells before sampling downgradient wells?		
Did the sampling crew use fluorocarbon resin or polyethylene containers with polypropylene caps for samples requiring metals analysis?		
Did the sampling crew use glass bottles with fluorocarbon resin-lined caps for samples requiring metals analysis?		
If metals were the analytes of concern, did the sampling crew use containers cleaned with nonphosphate detergent and water, and rinsed with nitric acid, tap water, hydrochloric acid, tap water and finally Type II water?		
If organics were the analytes of concern, did the sampling crew use containers cleaned with nonphosphate detergent, rinsed with tap water, distilled water, acetone, and finally pesticide quaility hexane?		
Did the sampling crew filter samples requiring analysis for organics?		

COMMENTS ON SAMPLING PROGRAM

After working through Part Two, the field inspector will have:

- assessed whether the owner/operator's sampling crew departed from written sampling and analysis procedures as contained in the owner/operator's sampling and analysis plan (interim status) or in the owner/operator's RCRA permit (permit status);

- identified deficiencies in the way the owner/operator's sampling crew collected ground-water samples;

- identified deficiencies in the owner/operator's program to ensure on-going maintenance of sampling devices and monitoring wells/piezometers;

- identified deficiencies in the owner/operator's operating record (Does theoperating record have all the information in it that is required?); and

- collected field data that will allow the enforcement official to construct potentiometric maps and assess the viability of individual wells.

APPENDIX B
Part Three

Compliance Decision-Making

PART THREE

The field inspector and enforcement official will meet after the field inspection and review Parts One and Two. The enforcement official will construct a potentiometric or water table contour map using data collected by the field inspector. The enforcement official will compare ground-water flow directions (as indicated on the potentiometric map) by the owner/operator. (Note: the enforcement official will find owner/operator generated maps in the Part B permit application, in annual reports and/or from on-site records collected by the field inspector.) Significant differences in direction of flow may trigger a closer look at the owner/operator's data. The enforcement official will also identify evidence of violations in the owner/operator's sampling or operation and maintenance program. After completion of this exercise, the enforcement official will take one of the following actions:

- issue a complaint in conjunction with enforcement counsel for violations uncovered by the field inspector;
- initiate a Case Development Inspection to gather additional information;
- take no follow-up action (no evidence of violations); or
- take no follow-up action but prepare instructions to guide a future CME at the facility.

1. Construct a potentiometric (or water level contour) map using water level data collected by the field inspector. Does the direction of ground-water flow match owner/operator generated information? Y/N

   If yes, go to 2.
   If no, go to 1a.

1a. Use all past water level information generated by the owner/operator and redraw the potentiometric map(s). Does the direction of ground-water flow match information on the owner/operator's map(s)? Y/N

   If yes, go to 2.
   If no, consider initiating a Case Development Inspection.

2. Compare well depth information collected by the field inspector to design specifications of each well in the system. Identify wells with siltation problems. For wells with siltation problems, consider issuing an order to the owner/operator requiring the redevelopment or abandonment of the well.

3. Use Table 3 and check violations (or possible violations) uncovered by the field inspector.

4. Choose one of the following options:

   - By virtue of the evidence collected by the field inspector, there are sufficient grounds to issue a complaint. Work with enforcement counsel to develop and issue the complaint. Go to 5.

   - By virtue of the evidence collected by the field inspector, there may be sufficient grounds to pursue an enforcement action. Initiate a Case Development Inspection.

   - The field inspection has not indicated compliance problems at the facility or problems are minor in nature. Do not pursue additional enforcement action.

   - There is cause for concern that the owner/operator may need to redesign all or a portion of the monitoring system. Concern is not great enough, however, to prompt the initiation of a Case Development Inspection. Prepare detailed notes for the file describing how the next CME at the facility should be focused.

Table 3

Relationship of Technical Inadequacies to Ground-Water Standards

This table illustrates examples of situations which may constitute noncompliance on the part of the owner/operator. The enforcement official should apply this table in determining if an enforcement action is warranted on a site-specific basis.

Regulatory Objectives	Examples of Technical Inadequacies That May Constitute Violations	Regulatory Citations
1. Owner/Operator must follow specified procedures for collecting ground-water samples	• Failure of owner/operator's sampling crew to follow written sampling and analysis plan for collecting ground-water samples (interim status)	265.92(a)
	• Failure of owner/operator's sampling crew to follow permit conditions related to the collection of ground water samples (permit status)	264.97(d) 264.97(e) 264.98(f) 264.99(g)
2. Owner/Operator must maintain an operating record	• Failure of owner/operator to keep a written operating record	264.73(a) 265.73(a)
	• Failure of owner/operator to keep the operating record on- site	264.73(b) 265.73(b) 270.30(j)(2)
	• Failure of the owner/operator to maintain an operating record which covers all O&M activities for the prior three years (i.e., gaps in the operating record)	264.73(b) 265.73(b) 270.30(j)(2)
	• Inability of owner/operator to produce a complete operating record at the time of inspections	264.74(a) 265.74(a) 270.30(h) 270.30(i)(2)h
3. Owner/Operator must implement a suitable operation and maintenance program for ground-water monitoring systems	• Failure of owner/operator to develop an inventory of all sampling devices and purging equipment in use at the facility including information on model number, serial number and manufacturer's name	265.15(b)(1) 264.15(b)(1)
	• Failure of owner/operator to develop detailed operating, calibration and maintenance procedures for each sampling device	270.30(j)(2) 264.15(b) 265.15(b) 270.30(e)

(Continued)

TABLE 3

Regulatory Objectives	Examples of Technical Inadequacies that May Constitute Violations	Regulatory Citations
3. Owner/operator must implement a suitable operation and maintenance program for ground water monitoring systems (continued)	• Failure of owner/operator to describe decision criteria to be used to replace or repair sampling equipment and/or monitoring wells	270.30(e) 264.15(b)(3) 265.15(b)(3)
	• Failure of owner/operator to maintain schedules for performing operation and maintenance activities related to the ground-water monitoring system	264.15(b) 265.15(b)
	• Failure of the owner/operator to maintain records for ground-water monitoring which provide information on 1) the date, exact place, and time of sampling or measurement; 2) the individual(s) who performed the sampling or measurement; 3) the date(s) analyses were performed; 4) the analytical techniques or methods used; and 5) the results of such analyses	264.73(b)(6) 264.15(b)(2) 270.30(j)(2) 270.30(j)(3) 265.73(b)(5) 265.73(b)(6)
	• Failure of the owner/operator to maintain records of all monitoring information including all calibration and maintenance records	270.30(j)(2)
	• Failure of the owner/operator to maintain records of monitoring information including determination of ground-water surface elevations	270.30(j)(2) 265.73(b) 264.73(b)(6) 265.74(a) 264.74(a) 265.94(a)(1) 264.97(f)
	• Failure of the owner/operator to assess ground-water flow rate and direction(s) in the uppermost aquifer on an annual basis (e.g., each year draw potentiometric maps(s) using data collected during the year)	265.94(a)(1) 264.98(e) 264.99(e)
	• Failure of the owner/operator to develop procedures to assess degradation of well casing (refer to Appendix A and question #13 in Appendix D)	270.30(e) 264.15(b)(1) 265.15(b)(1) 264.15(b)(3) 265.15(b)(3) 264.15(b)(4) 265.15(b)(4)

(Continued)

TABLE 3

Regulatory Objectives	Examples of Technical Inadequacies that May	Regulatory Citations
4. Owner/Operator must ensure the continued integrity of individual wells in the monitoring system	• Wells in monitoring system are silted in • Wells in monitoring system are cracked, corroded, or degraded • Wells show high levels of pH • Wells show evidence of frost heaving, subsidence, or collision damage • Wells show evidence of biolgical fouling • The hydraulic performance characteristic(s) of wells changes • Ground-water elevation data collected by field inspector indicate wells are improperly placed • Owner/operator does not replace wells which have failed	265.91(a) 265.91(c) 264.97(a) 264.97(c)
5. Owner/Operator's ground-water monitoring system must continue to satisfy its design objectives	• Ground-water elevation data collected by field inspector indicate wells are improperly placed • Owner/operator does not replace wells which have failed	270.30(e) 265.91(a) 265.91(c) 264.97(a)
6. Owner/Operator must collect ground-water samples properly	• Failure to evacuate stagnant water from the well before sampling • Failure to sample wells within a reasonable amount of time after well evacuation • Improper decisions regarding iltering or non-filtering of samples prior to analysis (e.g., use of filtration on samples to be analyzed for volatile organics)	265.90(a) 265.92(a) 265.93(d)(4) 270.14(c)(4)

(Continued)

TABLE 3

Regulatory Objectives	Samples of Technical Inadequacies that May	Regulatory Citations
6. Owner/Operator must collect ground-water samples properly	• Use of an inappropriate sampling device • Use of improper sample preservation techniques • Samples collected with a device that is constructed of materials that interfere with sample integrity • Samples collected with a non-dedicated sampling device that is not cleaned between sampling events • Improper use of a sampling device such that sample quality is affected (e.g., degassing of sample caused by agitation of bailer) • Improper handling of samples (e.g., failure to eliminate headspace from containers of samples to be analyzed for volatiles) • Failure of the sampling plan to establish procedures for sampling immiscibles (i.e., "floaters" and "sinkers") • Failure to follow appropriate QA/QC procedures	(See previous page)

(Continued)

TABLE 3

Regulatory Objectives	Examples of Technical Inadequacies that May	Regulatory Citations
6. Owner/Operator must collect ground-water samples properly	• Failure to ensure sample integrity through the use of proper chain-of-custody procedures • Failure to demonstrate suitability of methods used for sample analysis other than those specified in SW-846 • Failure to perform analysis in the field on unstable parameters or constituents (e.g., pH, Eh, specific conductance, alkalinity, dissolved oxygen) • Use of sample containers that may interfere with sample quality (e.g., synthetic containers used with volatile samples) • Failure to make proper use of sample blanks	(See previous page)

5. Keep the following questions in mind as you write the complaint:

   - What specific regulatory violations do you plan to cite in the complaint?
   - Is the evidence (i.e., field observations) collected by the field inspector unassailable?
   - What do you want the owner/operator to change or add to the operation and maintenance program?
   - What do you want the owner/operator to change or add to the sampling program?

APPENDIX C
Guide to the Operation and Maintenance of Gas Displacement Bladder Pumps

The RCRA Ground-Water Monitoring Technical Enforcement Guidance Document (TEGD) strongly endorses the use of dedicated gas displacement bladder pumps at RCRA facilitities. Appendix C describes important operation and maintenance considerations regarding gas displacement bladder pumps.

APPENDIX C

BLADDER PUMP SAMPLING SYSTEM OPERATION

I. Introduction

Bladder pumps are pneumatically operated pumps specifically designed to deliver ground-water samples with minimal alteration of the sample's chemical and physical properties. The bladder is the critical element in the pump, as it serves to isolate the sample from the drive gas and any contaminants the gas itself may convey. In the first half of the pumping cycle (see Figure 1), compressed gas is used to squeeze the bladder and force the sample out the top of the pump and up into the discharge tubing. In the second part of the pumping cycle, the compressed gas is exhausted to atmosphere (see Figure 1), allowing fresh well water to refill the pump bladder through the bottom inlet. The discharge and refill cycle sequence is then repeated for continued pumping, usually through use of an automatic pump cycle controller.

In addition to bladder pumps, wells are often equipped with separate purge pumps to achieve higher pumping rates than sampling pumps are designed to deliver. Gas displacement purge pumps (see Figure 2) operate similarly to bladder pumps but do not include a bladder and therefore are not appropriate for actual sample collection.

II. Operating Instructions

Safety, sample quality, and pump flow performance are important considerations in the selection of compressed gas source used to operate bladder pumps and gas displacement purge pumps. The compressed gas source should not exceed the pressure rating of the pump controller, pump, or tubing. The gas source should be free of cross contaminants, such as lubricating oils, which could enter the well through leakage from the bladder pump tubing. Finally, the gas source flow rate should be high enough to achieve the expected flow rates.

Figure 1
Bladder Pump Operating Sequence

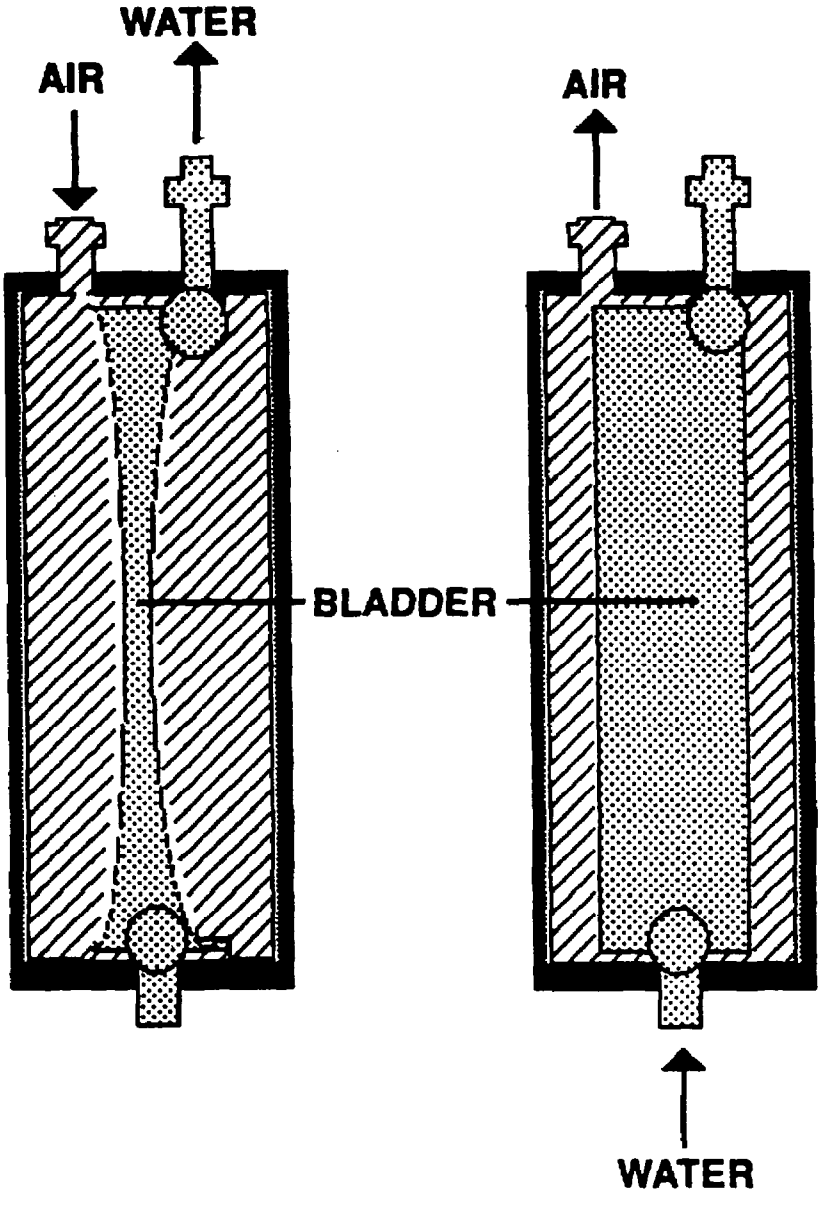
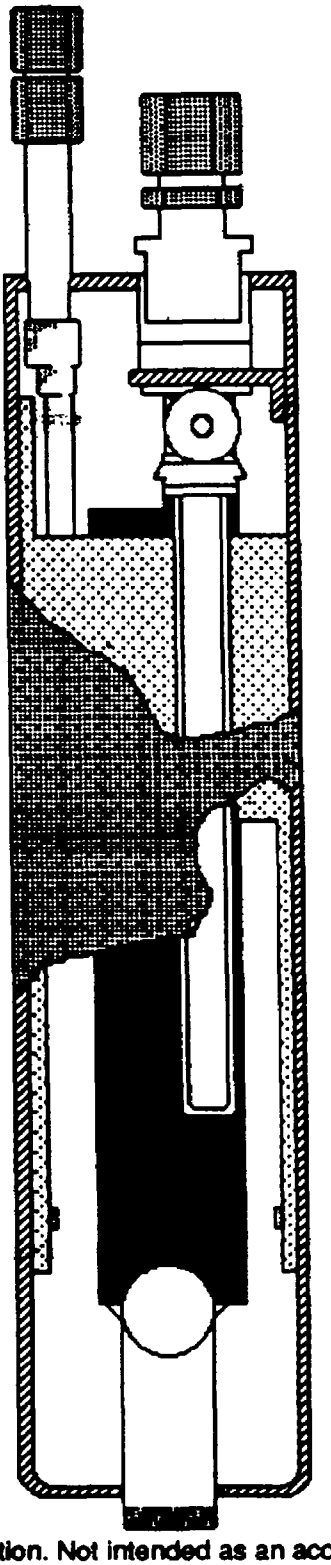


Figure 2
Gas Displacement Purge Pump



Only a representation. Not intended as an accurate technical drawing.

Well Purging

1. Connect the compressed gas source to the pump controller, and the pump controller to the bladder pump air fitting on the pump cap, using the instruction and hoses provided by the manufacturer.

2. Activate the compressed gas source to begin pumping. A number of pump discharge-refill cycles are normally required before the water fills the discharge tubing and flows to the surface.

3. Typical pump operating cycles have a duration of 6-8 seconds for both discharge and refill. To achieve maximum flow rate for purging, follow the sequence below.

    a. Adjust the controller flow throttle to maximum pressure, normally by turning fully clockwise.

    b. Adjust the refill and discharge cycles for maximum length, such as 15 seconds each, and measure the water volume discharged in a single discharge cycle.

    c. Shorten the refill cycle until the volume discharged per cycle is five to ten percent less than the maximum determined in step b. Common volumes of commercial bladder pumps range from 300 to 500 ml.

    d. Shorten the discharge cycle until the end of the discharge cycle just begins to coincide with the end of water flow from the bladder pump discharge tube.

***

Sample Pumping

Slow flow rates in the range of 100 ml/minute are desired to fill sample containers without aeration or splashing.

1. Set the discharge cycle to maximum length or approximately 20 to 30 seconds.

2. Adjust the flow throttle for reduced flow, normally fully counterclockwise.

3. During the next discharge cycle slowly increase the flow throttle setting, normally clockwise, until the desired slow rate is achieved.

***

General Operating Guidelines

1. Deeper wells require higher drive gas pressures and longer refill and discharge cycles. Collect samples from the bladder pump discharge tube only (not from the gas contact purge pump for wells so equipped).

2. The compressed gas source is applied to the bladder pump to discharge water during the discharge cycle. The pump is vented to atmosphere to refill during the refill cycle.

3. The typical range of useful refill and discharge cycle lengths is approximately 8 to 20 seconds each.

4. Higher compressed gas pressure levels provide higher pumping rates. Lower compressed gas pressure levels pump more water per unit volume of gas.

5. If the pumping rate is unsatisfactory, recheck the cycle lengths according to the three-step procedure. If the pumping rate is still unsatisfactory, check all air fitting connections for leaks.

III. System Troubleshooting

Typical bladder pump failure modes and potential causes are listed below, followed by a system check-out procedure which can be employed prior to sampling.

1. No or Low Flow Rate.

a. Solids obstructing pump bladder or valves. Too close to pump bottom or excessive solids present in well. Pump inlet screens may be advisable.

b. Air leaks in air hoses, tubing, connectors, or at pump. Check system for leaks. Leaks at pump will be indicated by presence of water inside air tube.

c. Controller settings improper. Check flow throttle and cycle control positions.

d. Discharge lines frozen. Check drain down weep hole in pump or tubing for plugging.

2. Bubbles entrained in bladder pump discharge.

a. Bladder puncture. Check pump for signs of sharp or abrasive solids.

***

Bladder Pump System Maintenance Procedures

1. Compressor should be true oilless type or include an oil removal system maintained according to the manufacturer's service schedule, with a visual indicator of effectiveness of oil removal.

   Additionally, any compressor used to operate a bladder pump with a discharge tube common to the gas contact purge pump should incorporate additional vapor and particulate filtration to ensure that sample conveyance surfaces and tubing are not contaminated.

2. Bladder pump controllers should be tested annually for ability to throttle pump flow during sample collection without use of restrictor valves in discharge tubing. The controller should be capable of reducing the output pressure to the bladder pump to zero PSI while maintaining discharge (pressure) cycle duration of approximately 20-30 seconds.

3. Bladder pumps' bladder integrity should be checked before every sample collection by observing whether the sample discharge flow contains gas bubbles. Bladder leaks will result in gas bubbles in the sample, especially if long discharge cycles (20-30 seconds) are employed.

   In the special case of multilayer bladders with non-fluorocarbon layers, the pumps should be removed from the well semi-annually for disassembly and visual inspection of bladder integrity.

   Any bladders with leaks should be replaced immediately prior to further sample collection.

4. Bladder pump operational condition should be monitored by comparing trends in maximum flow rate and discharge volume per cycle, as observed during successive sampling events. Decreases of 20% or more in flow or discharge volume are generally indicative of either solids accumulating in the pump or gas leaks in the system. Pump removal and inspection is required to ascertain the source of the problem.

5. For wells which incorporate gas contact pumps for purging, clear indication must be given that samples are being collected from the bladder pump discharge tube and not from the purge pump discharge tube.

6. For combination sample-purge pumps which house the bladder pump within the gas contact purge pump body, operation of the purge pump should be controlled at all times to avoid drive gas contact with the sample, the bladder pump interior, or the interior of the bladder pump discharge tubing.

APPENDIX D
Questions and Answers

APPENDIX D

QUESTIONS AND ANSWERS

1. What is the purpose(s) of a RCRA Operation and Maintenance Inspection?

In general, EPA has developed the Operation and Maintenance (O&M) Inspection to ensure that owner/operators properly collect ground-water samples and to evaluate the continued viability/integrity of an owner/operator's ground-water monitoring system. Specifically EPA has designed the O&M Inspection to accomplish the following:

- Determine that the owner/operator's personnel are collecting ground-water samples properly. For example,
  - in accordance with the owner/operator's Part 265 (interim status) Sampling and Analysis Plan; or
  - in accordance with conditions associated with the sampling and analysis section of the owner/operator's RCRA permit (permit status).
- Collect ground-water elevation data, determine direction(s) of ground-water flow and assess—in a general sense—the viability of past decisions made by the owner/operator about the number and placement of monitoring wells.
- Determine that individual monitoring wells and piezometers/observation wells within a ground-water monitoring system have not deteriorated such that their ability to yield representative ground-water samples or their ability to yield reliable hydrologic data have not been compromised.
- Determine that the owner/operator's sampling devices are in working order and that the owner/operator is following the maintenance provisions as outlined in the Sampling and Analysis Plan (interim status) or in the RCRA permit (permit status).

- Identify flagrant violations of O&M programs and/or trigger a more thorough scrutiny of the owner/operator's ground-water monitoring program (i.e., trigger a Case Development Inspection).

- identify issues or concerns the enforcement staff should assess in a future Comprehensive (Ground Water) Monitoring Evaluation.

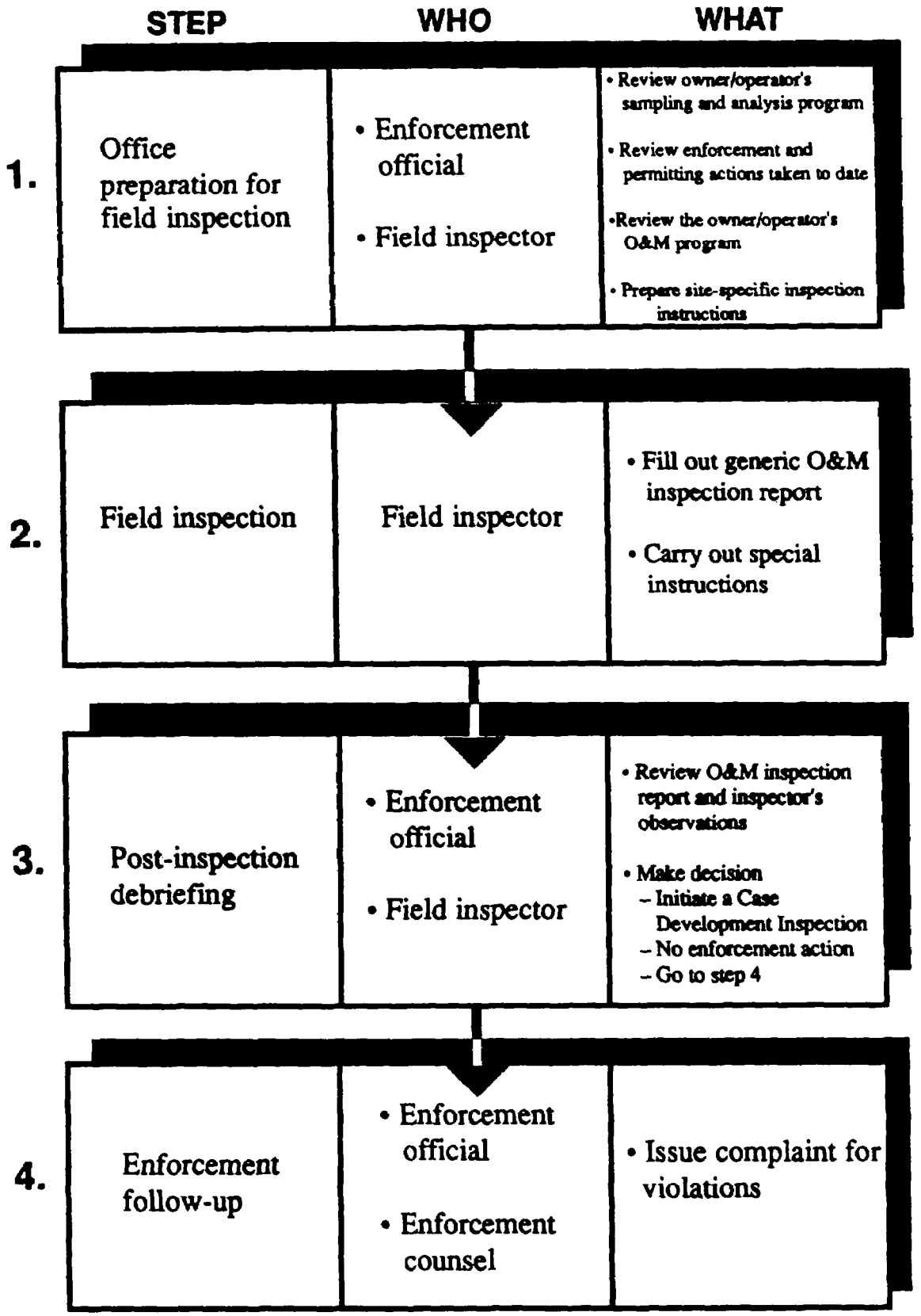
2. What is the difference between a RCRA Comprehensive (Ground Water) Monitoring Evaluation (CME) and a RCRA Ground-Water Monitoring Operation and Maintenance Inspection (O&M)?

By the end of FY 1988, enforcement officials should have conducted Comprehensive (Ground Water) Monitoring Evaluations at all RCRA land disposal facilities. The CMEs conducted to date have focused heavily on site characterization and on the design of ground-water monitoring systems (e.g., number and placement of wells). Enforcement actions have been taken to promote the timely issuance of RCRA land disposal permits.

In general, the O&M Inspection is a less resource intensive effort than the CME. It is conducted more frequently, focuses on less detail than the CME, and often acts as a trigger for additional enforcement scrutiny in the form of a Case Development Inspection (CDI). It also acts to focus CMEs which follow the O&M Inspection in subsequent years.

3. What are the generic phases or steps in an Operation and Maintenance Inspection? What expertise is needed to support preparation, field implementation and compliance decision-making associated with an O&M Inspection?

Overview of the Operation And Maintenance Inspection



4. How often should an Operation and Maintenance Inspection be conducted by enforcement personnel?

All RCRA land disposal facilities will receive either a CME or an O&M Inspection each year. All RCRA land disposal facilities which accept Superfund waste site must receive a CME each year. Up to one third of the RCRA facilities in total will receive a CME each year. The rest of the population of land disposal facilities will receive an O&M Inspection.

5. What resources (e.g., person loading) are associated with an average Operation and Maintenance Inspection?

The average O&M Inspection will take approximately 25 person-days to perform.

6. What is the difference between a RCRA O&M Inspection and a RCRA Lab Audit Inspection (LAI)?

The RCRA O&M Inspection focuses heavily on the field performance of the owner/operator's staff in collecting ground-water samples and on the evaluation of the integrity of the owner/operator's monitoring system. The O&M Inspection will help EPA and the states ensure that owner/operators collect representative ground-water samples. The RCRA Lab Audit Inspection (LAI) focuses on ensuring that ground-water samples are analyzed properly and that analytical data is reported properly. Thus, the O&M Inspection focuses on those activities and procedures which ensure the collection of representative ground-water samples. The LAI focuses on those activities and procedures which ensure the generation and reporting of high quality analytical data.

7. Is an Operation and Maintenance Inspection primarily the responsibility of field inspection personnel, office personnel (such as engineers, geologists, chemists), or a shared responsibility?

The O&M Inspection is a shared responsibility between field and office personnel. Any inspection may ultimately lead to a decision by enforcement officials to initiate and pursue an enforcement action against an owner/operator. The O&M Inspection involves the review of documents which describe the owner/operator's sampling program, collection of field

data, review of on-site records, and analysis of field data in the context of compliance decision-making. The work may involve the talents of field inspection personnel, office personnel (such as engineers, geologists, chemists), and enforcement counsel.

8. Should Operation and Maintenance Inspections normally be scheduled to coincide with an owner/operator's sampling event?

Yes. One of the major objectives of the O&M Inspection is to ensure that the owner/operator's field personnel collect ground-water samples properly. The inspector will observe the owner/operator's field personnel as they collect samples from several wells. The inspector will watch to ensure that the owner/operator's field personnel sample wells using techniques and procedures as described in the owner/operator's Sampling and Analysis Plan (interim status) or the owner/operator's RCRA Permit (permit status). Departures from the techniques/procedures described in these documents could become the basis of an administrative order issued by an enforcement official.

9. What is the relationship between an owner/operator's operation and maintenance program and the owner/operator's ground-water sampling and analysis program?

During interim status, the owner/operator must prepare and implement a written *Sampling and Analysis Plan*. This plan should include provisions for sampling of wells along with provisions for the ongoing maintenance of sampling equipment and individual wells within a monitoring system. RCRA land disposal permits should also include similar provisions for the operation and maintenance of monitoring systems.

10. What are examples of violations that may be uncovered in the course of conducting an Operation and Maintenance Inspection?

Examples of possible violations which may be uncovered in the course of conducting an O&M Inspection include the following:

- Failure of the owner/operator to have a written Sampling and Analysis Plan (interim status) which includes suitable operation and

- Failure of the owner/operator's Sampling and Analysis Plan to include provisions for:

  – maintenance of sampling equipment;

  – detection and correction of problems related to the integrity of individual wells in the system;

  – schedules related to Inspection and maintenance of sampling equipment; and

  – recordkeeping to document adherence to the operation and maintenance program.

- Failure of the owner/operator's field personnel to follow procedures described in the Sampling and Analysis Plan (interim status) or the RCRA permit (permit status).

- Failure to replace wells which have failed in a timely or appropriate manner.

- Failure to implement procedures to prevent or minimize deterioration of wells in a monitoring system.

- Failure or inability of owner/operator to produce as-built drawings of individual wells.

- Use of data by the owner/operator from wells which do not yield representative samples for analysis.

- Failure to maintain records which document the implementation of the owner/operator's operation and maintenance program.

11. What are examples or circumstances which would prompt an enforcement official to decide an individual well within a monitoring system has failed (i.e. is unable to produce a representative ground-water sample and/or reliable hydrologic data)?

Examples of situations which would lead the enforcement official to decide a monitoring well is not producing representative samples and/or reliable hydrologic data include:

- visual evidence of physical degradation of casing material (cracks, corrosion, dissolving);
- high pH levels in ground-water data (grout contamination);
- significant change in recovery time or other hydraulic characteristics of the well;
- highly turbid samples;
- excessive siltation of a well;
- subsidence or frost heaving of casing or riser;
- evidence of collision or impact damage to the well; or
- biological fouling of the well.

12. At a facility with a large number of wells in the RCRA monitoring system, does the Operation and Maintenance Inspection require scrutiny of every well in the system, or may a targeted population of wells be selected for closer scrutiny?

It is not necessary for the inspector to observe the owner/operator's field personnel taking ground-water samples at every well within the system. The field inspector should, however, take depth measurements (to ground water and to bottom of the well) at all wells in the monitoring system.

13. In reviewing the viability and integrity of individual wells in a monitoring system, should the Operation and Maintenance Inspection address construction material choices made by the owner/operator? For example, if some of the wells in an owner/operator's ground-water monitoring system are not constructed of inert materials and the owner/operator disposes of (or may dispose of) wastes with organic constituents, should the owner/operator's operation and maintenance program be designed to detect and assess physical degradation of casing materials?

Yes. Some casing and screen materials may degrade upon contact with hazardous constituents. Current research on how different well construction materials will stand up to exposure to varying levels of contaminants over time is not conclusive. Until research is more definitive, it is appropriate for enforcement officials (and permit writers) to insist on a higher standard for an owner/operator's operation and maintenance program if that owner/operator's wells are constructed of less inert materials. An operation and maintenance program to assess degradation of well casing due to attacks by chemicals may include periodic inspection of the well by the owner/operator using instruments such as borehole cameras or well calipers. (Refer to Appendix A for an example of permit conditions.)

14. Is special equipment needed to conduct an Operation and Maintenance Inspection?

Usually, special equipment is not required to conduct an O&M Inspection. Equipment the inspector will normally take into the field will include a water level measurement device (electronic or steel tape) and instruments to take field readings such as pH, specific conductance, and temperature of ground-water samples. If collection of samples is deemed necessary by the enforcement official, the inspector will normally obtain a split sample from the owner/operator. In some cases, the enforcement official may be concerned about the physical integrity of individual monitoring wells and/or piezometers. More sophisticated equipment may be required to assess these wells including borehole television cameras and well calipers. The enforcement official may rely on the Technical Enforcement Support (TES) Contract to obtain these services or, if warranted, could insist the owner/operator collect this information as an on-going activity in an O&M program or as a special study effort to prove or disprove degradation of the monitoring system (e.g. issue a Section 3013 order to compel the owner/operator to conduct the study).

15. Are there field measurements that the inspector will or could make independently of the owner/operator's field personnel?

Yes. The inspector will normally take depth measurements at all or a majority of monitoring wells within the owner/operator's ground-water monitoring system during an O&M Inspection. The inspector will measure:

a) depth to ground water from an established datum point on the well casing, and

b) depth to the bottom of the well.

Measurements of depth to ground water will allow enforcement officials to construct potentiometric maps to illustrate the direction of ground-water flow. This will allow the enforcement official to assess—in a general sense—the viability of past decisions made by the owner/operator on the number and placement of monitoring wells. Measurement of depth to the bottom of a well will allow the enforcement officials to determine if an individual monitoring well is silting in. In addition, the inspector may choose to conduct pump or slug tests at individual wells to assess the hydraulic performance of wells.

16. What type of documentation should the field inspector/enforcement official produce after completing an Operation and Maintenance Inspection?

The field inspector should complete the *Operation and Maintenance Field Inspection Form* enclosed in the *Operation and Maintenance Inspection Guide*. In addition, the inspector will document observations unique to the facility at hand. The field inspection and the enforcement official will meet prior to the field visit and decide how the inspection will differ from the generic inspection guide and will meet after the inspection to review the inspector's observations. The enforcement official will rely on the field inspector's observations to decide if additional enforcement scrutiny of the facility is warranted.

17. What is an example of a situation which could lead the enforcement official to suspect that the owner/operator's original design assumptions for the existing ground-water monitoring system are no longer valid?

Perhaps the easiest check of the continued viability of an owner/operator's system design is the collection and graphical presentation of ground-water level data (e.g., construction of potentiometric maps). If ground-water flow directions have shifted (or appear to have shifted) the owner/operator's original system design may no longer be sufficient to detect or assess the leakage of hazardous waste or constituents to ground water. Additional scrutiny of the system design may be necessary via a Case Development Inspection or a future CME.

18. In cases where the enforcement official suspects that individual wells in a monitoring system have degraded, does the enforcement official have the authority to order the owner/operator to undertake a study to prove or disprove that degradation has occurred?

Yes. The enforcement official may use Section 3013 authority to order such a study.

19. If an owner/operator is unable to supply "as-built" drawings of an individual well within a monitoring system or the "as-built" drawings do not coincide with field observations, is the enforcement official justified in insisting that the well not be used as part of the owner/operator's RCRA ground-water monitoring system?

Yes. Moreover, the enforcement official may wish to pursue an enforcement action against the owner/operator in this case.

20. What should an owner/operator include in a ground-water monitoring operation and maintenance program?

An operation and maintenance program should minimally include the following:

- an inventory of sampling equipment and sampling devices used as part of the owner/operator's monitoring program;

- detailed written operating, calibration, and maintenance procedures for each piece of equipment used in the monitoring program;

- periodic checks on past design decisions (i.e. number and placement of wells) through the collection and graphical representation of water level data;

- an annual maintenance schedule describing what will be done on a routine basis to ensure sampling devices are operating properly and to ensure that individual monitoring wells remain as viable components of the owner/operator's monitoring system;

- written decision criteria the owner/operator will use to replace or repair sampling devices or monitoring wells;

- a written record of completed repairs, replacement, and calibration of sampling devices and monitoring wells;

- the appointment of a program manager to oversee the implementation of the owner/operator's operation and maintenance program.

21. What records or data generated or held by the owner/operator will the enforcement official review in the course of an Operation and Maintenance Inspection?

The primary source of information the inspector will look for on-site is the owner/operator's operating record. An owner/operator is required to have an operating record as per the requirements of Section 265.73 (interim status) and Section 264.73 (permit status). Question 20 described the items the owner/operator should include in an operation and maintenance program. Proof that the owner/operator has, in fact, properly carried out the operation and maintenance program can be found in the operating record.