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RCRA, Superfund & EPCRA Call Center Training Module

Introduction to:

**Groundwater Monitoring
(40 CFR Parts 264/265, Subpart F)**

Updated October 2001

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GROUNDWATER MONITORING

CONTENTS

1. Introduction	1
2. Regulatory Summary	2
2.1 Permitted Facility Groundwater Monitoring	6
2.2 Interim Status Groundwater Monitoring	18

1. INTRODUCTION

This module presents the requirements for groundwater monitoring at interim status and permitted treatment, storage, and disposal facilities (TSDFs) under the Resource Conservation and Recovery Act (RCRA). The groundwater monitoring regulations are found in 40 CFR Part 264/265, Subpart F. TSDFs managing hazardous waste in certain land-based units are required to implement a groundwater monitoring program so that releases of hazardous waste from these units to groundwater are detected and measures are implemented to remediate the contamination as soon as possible.

The goal of this module is to explain the standards and specific requirements for groundwater monitoring programs at interim status and permitted facilities. When you have completed this module you will be able to:

- ☒ Describe the groundwater monitoring criteria for interim status and permitted facilities
- ☒ Explain monitoring well placement
- ☒ Understand the three stages of the groundwater monitoring program for permitted facilities.

Use this list of objectives to check your knowledge of this topic after you complete the training session.

2. REGULATORY SUMMARY

The groundwater monitoring regulations in Part 264/265, Subpart F, are one part of an overall strategy to reduce the likelihood of environmental contamination resulting from hazardous waste treatment, storage, and disposal. This strategy includes restrictions on disposal of untreated hazardous waste, unit-specific standards for land-based hazardous waste management units, and monitoring groundwater below these units. The land disposal restrictions program requires the treatment of hazardous wastes prior to disposal to reduce the mobility or toxicity of hazardous constituents. The unit-specific standards for land-based hazardous waste management units seek to prevent the release of hazardous waste to the environment. Groundwater monitoring is the final link in this strategy to prevent environmental contamination. Owners and operators of all land-based units must institute a groundwater monitoring program that is able to detect and characterize any releases of hazardous waste or hazardous constituents to the groundwater underlying the facility. Should the other elements of the strategy fail, groundwater monitoring will detect the release so it can be remedied.

The regulations in Subpart F of Part 264/265 are general requirements, establishing performance-based standards that state what a successful groundwater monitoring program must accomplish; they do not dictate specific technical standards. Each facility's groundwater monitoring program is unique because no two TSDFs are exactly the same. Individual groundwater monitoring programs are based on site-specific conditions, including the underlying geology and hydrology, as well as the properties of wastes managed on site.

The groundwater monitoring regulations for interim status facilities were promulgated in the May 19, 1980, Federal Register (45 FR 33232) and codified in Part 265, Subpart F. These regulations were designed to supply background data on facilities before permitting, as well as to act as a warning system to detect any releases to groundwater prior to permit issuance.

The groundwater monitoring regulations for permitted facilities were promulgated in the July 26, 1982, Federal Register (47 FR 32350) and are found in Part 264, Subpart F. These regulations pertain to any land-based facility seeking a Part B permit that received waste after July 26, 1982, or that certified closure after January 26, 1983. Part 264, Subpart F, establishes a three-stage program designed to detect and remediate any releases from regulated units.

Although the groundwater monitoring programs in Part 264 and Part 265 are different, they do have some common technical and environmental performance standards. The technical standards establish an engineering objective and allow a permit applicant to develop a design or set of practices to achieve certain goals established in the groundwater monitoring requirements under Subpart F. The

environmental performance standards specify limits on the levels of contamination that may be released into the environment before remediation is required.

Groundwater is water found below the land surface in the zone of saturation, meaning that part of the earth's crust in which all voids are filled with water. An important source of groundwater is the aquifer, which is a geologic formation, group of formations, or part of a formation capable of yielding a significant amount of groundwater to wells or springs. There are two types of aquifers: confined and unconfined. Confined aquifers are under pressure, unconfined aquifers are not (Figure 1).

The Subpart F programs protect groundwater that is found in the uppermost aquifer, which is the water-bearing geologic formation nearest the natural ground surface (260.10). Also included in this definition are any and all deeper aquifers that are hydraulically interconnected with the uppermost aquifer within the facility's property boundary. These interconnected aquifers are zones of saturation that present a potential pathway for contamination to reach human beings (Figure 2).

Although the statute does not limit EPA's regulatory authority to only the uppermost aquifer, the groundwater monitoring regulations only require that the uppermost aquifer be monitored. The groundwater monitoring regulations of Subpart F do not address other aquifers or any other groundwater resources which are not in or connected to the uppermost aquifer (§264.90-264.100 and §265.90-265.94). Contamination in such areas can be addressed by other mechanisms such as authority under RCRA §3004(u) and (v) (for facilities seeking a permit, codified in §264.101); RCRA §3008(h) (for interim status facilities); RCRA §7003; the Comprehensive Environmental Remediation, Compensation, and Liability Act (CERCLA); the Safe Drinking Water Act (SDWA); or state or local enforcement authorities.

Figure 1
SCHEMATIC OF CONFINED AND UNCONFINED AQUIFERS

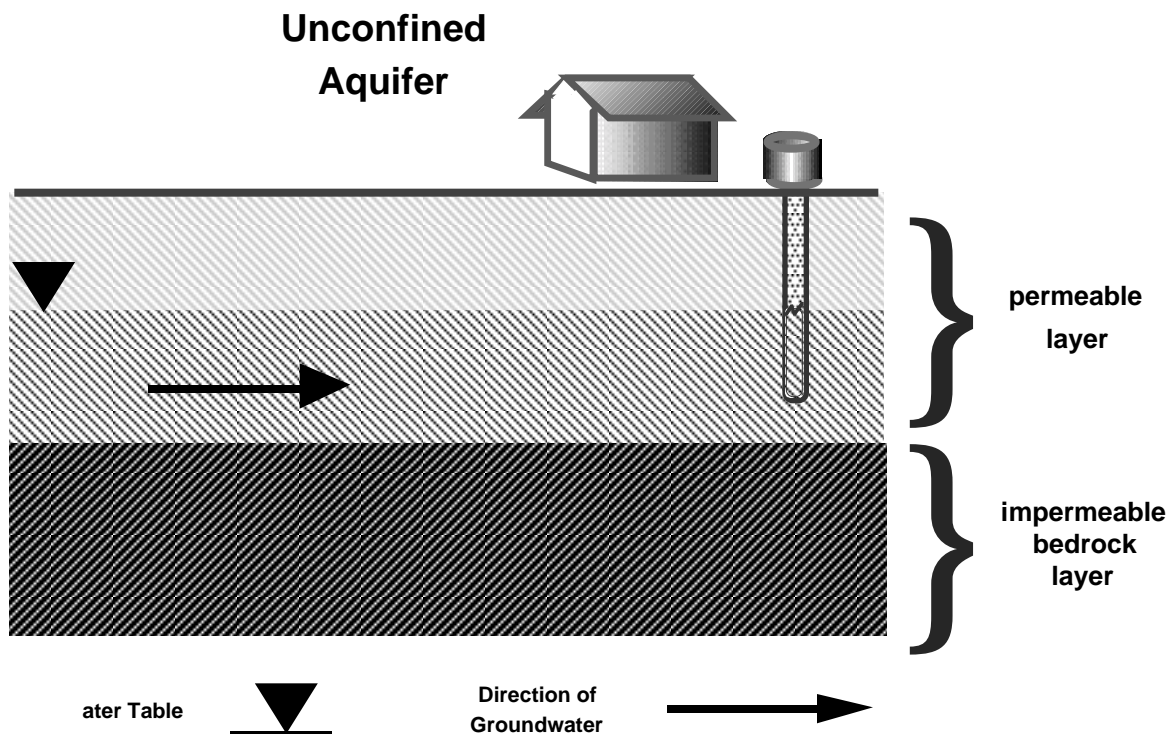
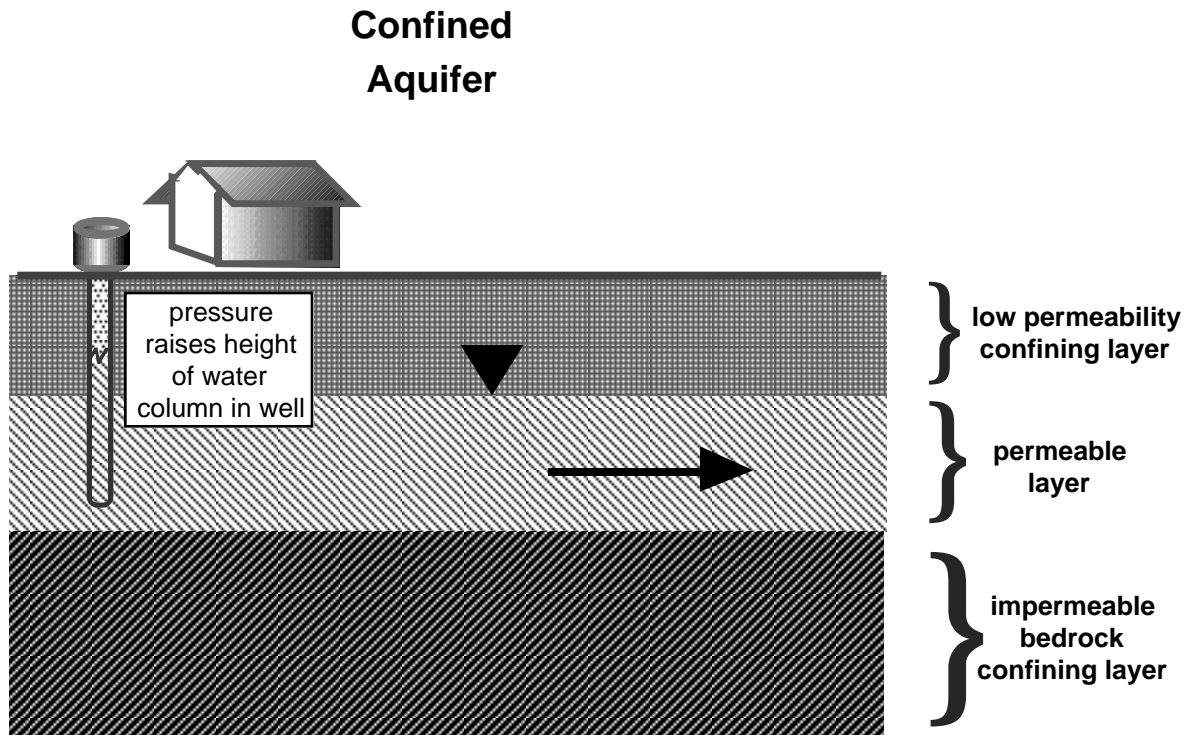
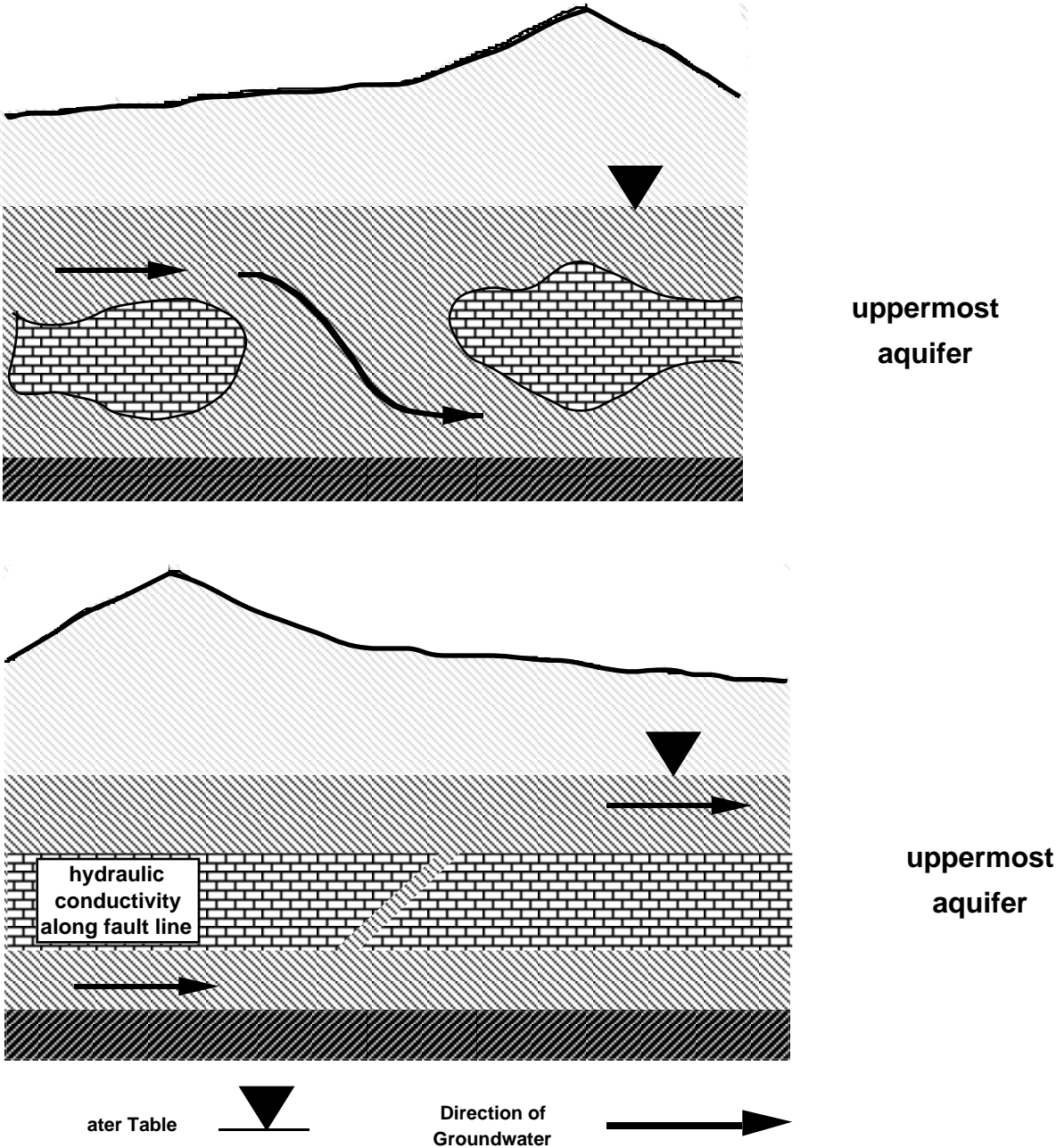


Figure 2
SCHEMATICS OF AN UPPERMOST AQUIFER



2.1 PERMITTED FACILITY GROUNDWATER MONITORING

EPA has the authority to require the owner and operator of a TSDf to remediate releases of hazardous waste or hazardous constituents to the environment. All permitted facilities must comply with Part 264, Subpart F, for releases from solid waste management units (SWMUs). This module addresses the regulations pertaining to releases to the uppermost aquifer from regulated units, a subset of SWMUs. See the module entitled RCRA Corrective Action for a discussion of the regulations that apply to other types of releases from SWMUs. Facilities with permitted regulated units—landfills, surface impoundments, waste piles, or land treatment units—must conduct groundwater monitoring to detect, characterize, and respond to releases of hazardous waste or hazardous waste constituents into the uppermost aquifer. There are three stages to the Part 264, Subpart F, groundwater monitoring and follow-up activities:

- ☒ Detection monitoring - to detect if a release has occurred
- ☒ Compliance monitoring - to determine if the Groundwater Protection Standard (GWPS) has been exceeded once a release has occurred
- ☒ Corrective action - to remediate a release to the uppermost aquifer.

Section 264.97 sets out the basic requirements that apply to all groundwater monitoring programs under Part 264, Subpart F. The specific requirements that apply to each of the three phases of groundwater monitoring are found in §§264.98, 264.99, and 264.100.

APPLICABILITY, WAIVERS, AND EXEMPTIONS

Owners and operators of TSDfS with regulated units must comply with the groundwater monitoring requirements of Subpart F during the active life of the regulated unit. There are, however, limitations to this applicability, expressed in the regulations as waivers and exemptions. The owner/operator of a regulated unit is not subject to Subpart F monitoring regulations if he or she can meet any of the conditions for a waiver or exemption (§264.90(b)). These waivers or exemptions apply to units for which any of the following apply:

- ☒ The unit is exempt from Part 264 under §264.1 (§264.90(b)(1))
- ☒ The unit does not receive free liquids, it is an engineered structure, the unit has inner and outer containment layers, it has a leak detection system between containment layers, and the design prevents run-on and run-off (§264.90(b)(2))
- ☒ The land treatment unit is not releasing hazardous constituents to the environment as determined by the Regional Administrator (RA) (this exemption applies only during the post-closure period) (§264.90(b)(3))
- ☒ The unit has no potential for migration of liquids from the regulated unit(s) as certified by a qualified geologist or geotechnical engineer (§264.90(b)(4))

- ☞ The waste pile is designed and operated in accordance with 264.250(c) (264.90(b)(5)).

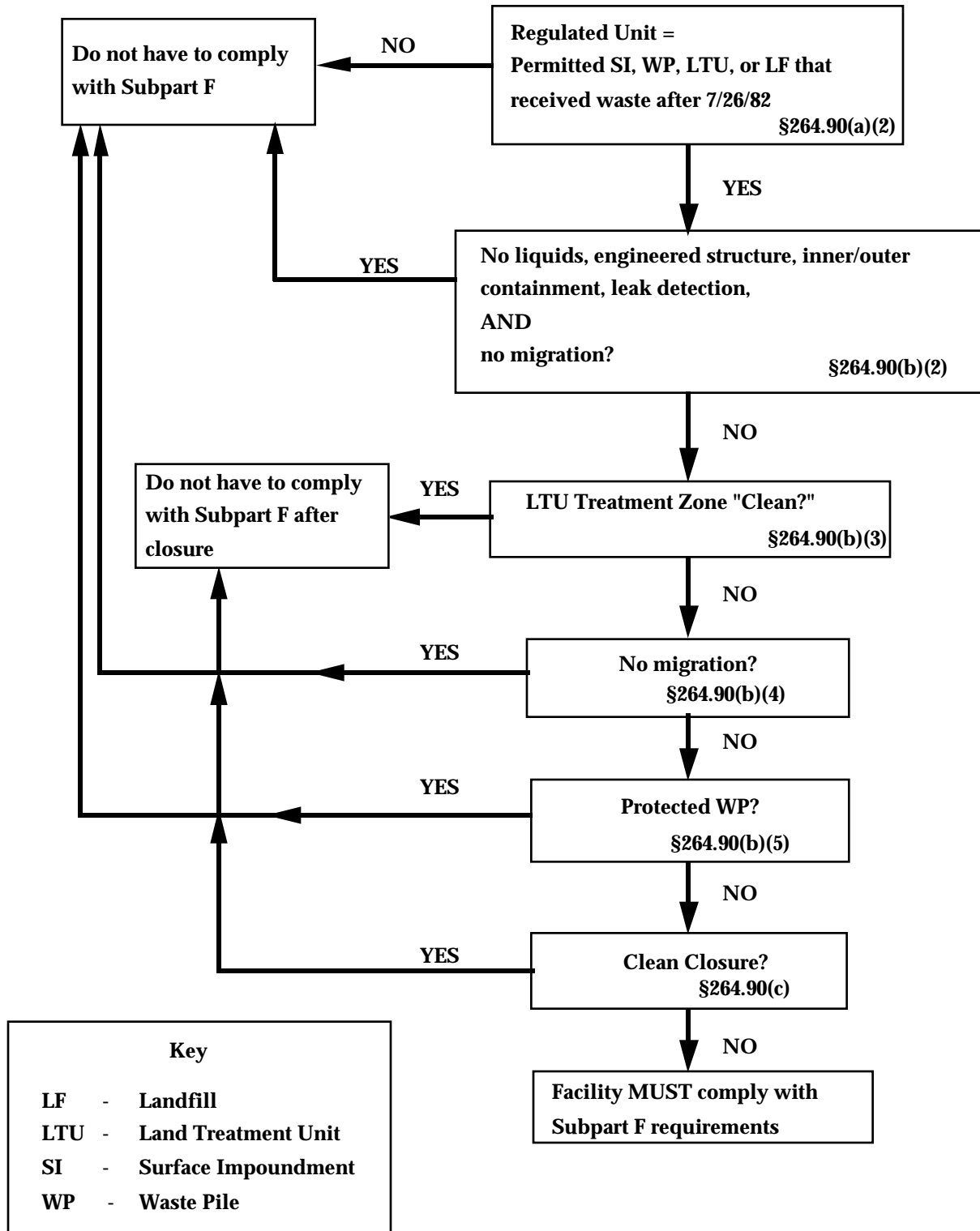
Owners/operators of regulated units must also conduct groundwater monitoring in accordance with Subpart F during the post-closure period. Post-closure is a period of time after the active life of the facility during which certain maintenance and monitoring activities must be conducted in order to ensure that no releases will occur from the units and to remediate releases from these units. Certain units, however, are exempt from the groundwater monitoring requirements after closure if they are able to demonstrate clean closure, which involves removal or decontamination of all waste, waste residues, contaminated containment system components, and contaminated subsoils (264.90(c)(1)). Subpart F cannot be waived during post-closure care if a detection monitoring program is being conducted under 264.98, or if the facility is conducting groundwater monitoring during the compliance period (264.90(c)(2) and (3)). A summary of the 264.90, Subpart F, groundwater monitoring applicability requirements is given in Figure 3.

GENERAL GROUNDWATER MONITORING REQUIREMENTS

The general requirements for groundwater monitoring programs at permitted facilities are found in 264.97. These general requirements apply to all three phases of groundwater monitoring: detection monitoring, compliance monitoring, and corrective action. A groundwater monitoring program established pursuant to Part 264, Subpart F, must have a sufficient number of monitoring wells, installed at appropriate locations and depths, to yield water samples that:

- ☞ Represent the background conditions of the site (groundwater quality not contaminated by leakage from an RU)
- ☞ Represent the quality of groundwater passing the point of compliance
- ☞ Detect any contamination of the uppermost aquifer at the point of compliance.

**Figure 3
SUMMARY OF GROUNDWATER MONITORING
APPLICABILITY REQUIREMENTS**



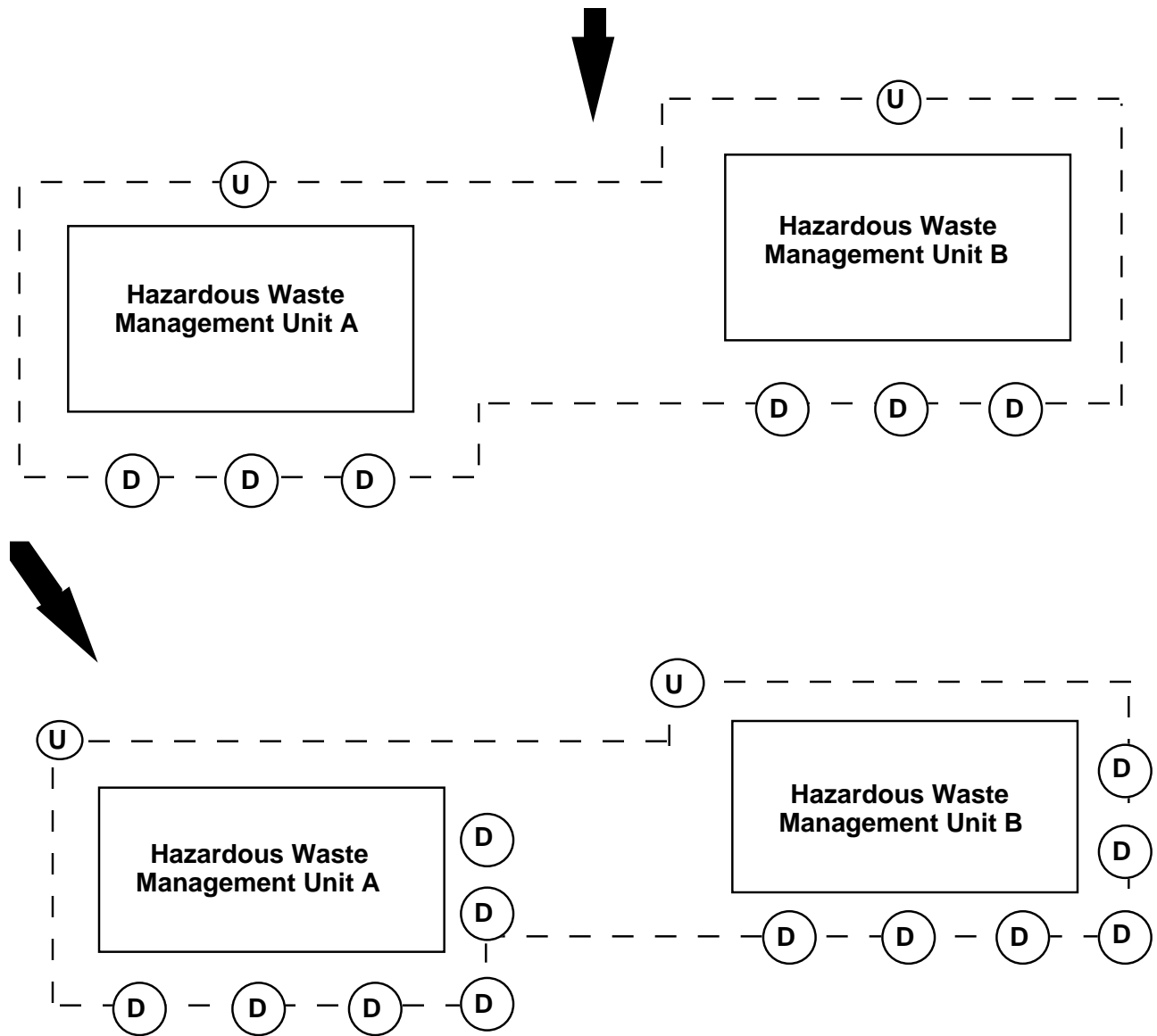
If the facility has more than one regulated unit, the owner/operator has the option of installing one groundwater monitoring system for the entire waste management area. The groundwater monitoring system for the entire area can be thought of as an imaginary line circumscribing the group of regulated units, including liners, dikes, or barriers forming the containment area for such units, rather than for each individual regulated unit within the waste management area, provided that contamination from any of the regulated units can be detected at the point of compliance (264.97(b)). Figure 4 shows examples of groundwater monitoring systems for facilities with multiple regulated units. Groundwater monitoring system configurations are established on a site-specific basis and are detailed in the facility permit.

SAMPLING

Groundwater monitoring wells must be properly installed so that samples will yield representative results. All monitoring wells must be lined, or cased, in a manner that maintains the integrity of the monitoring well bore hole (264.97(c)). Poorly installed wells may give false results.

Consistent sampling and analytical procedures must be implemented to ensure an accurate representation of the quality of groundwater below the waste management area (264.97(d)). At a minimum, there must be procedures and techniques for sample collection, sample preservation and shipment, analytical procedures, and chain-of-custody control. Sampling and analytical methods must be appropriate for groundwater sampling and accurately measure the hazardous constituents being analyzed. Each time that the groundwater is sampled, a determination of the surface elevation of the uppermost aquifer needs to be made (264.97(f)). The owner and operator must develop an appropriate sampling procedure and interval for each hazardous constituent identified in the facility's permit. This sampling procedure must consist of a sequence of at least four samples taken at an interval that ensures each is an independent sample. The owner and operator may use an alternate procedure if approved by the RA. Requirements and procedures for obtaining and analyzing samples are detailed in the facility permit, usually in a Sampling and Analysis Plan.

Figure 4
EXAMPLES OF GROUNDWATER MONITORING SYSTEMS FOR MULTIPLE
REGULATED UNITS



KEY

- Limit of Waste Management Area
- (U) Upgradient Well
- (D) Downgradient Well
- ▶ Groundwater Flow

STATISTICAL ANALYSIS

The owner/operator has a choice of five different statistical methods for evaluating groundwater monitoring data. The method selected must be appropriate for the type and distribution of chemical constituents detected or suspected to be present in the groundwater. The five statistical method options (which are discussed in detail in /264.97(h)) are:

- ☒ Parametric analysis of variance
- ☒ Nonparametric analysis of variance based on ranks
- ☒ Tolerance or prediction interval procedure
- ☒ A control chart approach
- ☒ Another statistical test method approved by the RA.

Any statistical method selected under /264.97(h) must comply with the performance standards under /264.97(i). These performance standards were established in order to ensure that evidence of a statistically significant increase (SSI) in a hazardous constituent is a true indication of a release and is not due to an error in data analysis. All groundwater monitoring data collected pursuant to /264.97(g) must be maintained in the facility operating record (/264.97(j)). The RA will specify in the facility's permit when the data must be submitted for review.

STAGE I: DETECTION MONITORING PROGRAM

The goal of a detection monitoring program under /264.98 is to detect and characterize any release of hazardous constituents from a regulated unit into the uppermost aquifer. The detection monitoring system must be installed at the point of compliance and adhere to the basic requirements applicable to all groundwater monitoring systems in /264.97(a)(2), (b), and (c) (/264.98(b)). The owner and operator must monitor for certain indicator parameters and any other specific waste constituents or reaction products that would provide a reliable indication of the presence of hazardous constituents in groundwater at the point of compliance (/264.98(a)). The RA will designate in the facility's permit what constituents or parameters must be monitored. These constituents and parameters are monitored to detect potential changes in the groundwater quality above background levels, which represent the quality of groundwater not contaminated by hazardous waste management activity at the site. A sequence of at least four samples from each well (both background and compliance wells) must be collected semiannually and analyzed using the statistical methods discussed above. The RA will specify the frequency for collecting samples and for conducting statistical tests. Results from sampling wells at the point of compliance are then compared to the data on background groundwater quality to determine if there is any statistical evidence of an increase (increase or decrease in the case of pH) over background. Statistically significant changes in indicator parameters may suggest that a release has occurred.

Using the statistical methods in /264.97(h), the owner and operator must determine if there has been an SSI for any chemical or parameter specified in the permit within a reasonable period of time after completion of sampling. The RA will specify in the permit what is considered a reasonable period of time. Evidence of a release is probable if an SSI has occurred. An SSI usually requires that compliance monitoring be initiated, unless the owner and operator can demonstrate that the SSI was due to an error in sampling or analysis, statistical evaluation, or natural variations in groundwater chemistry.

If an SSI does occur, the owner and operator must:

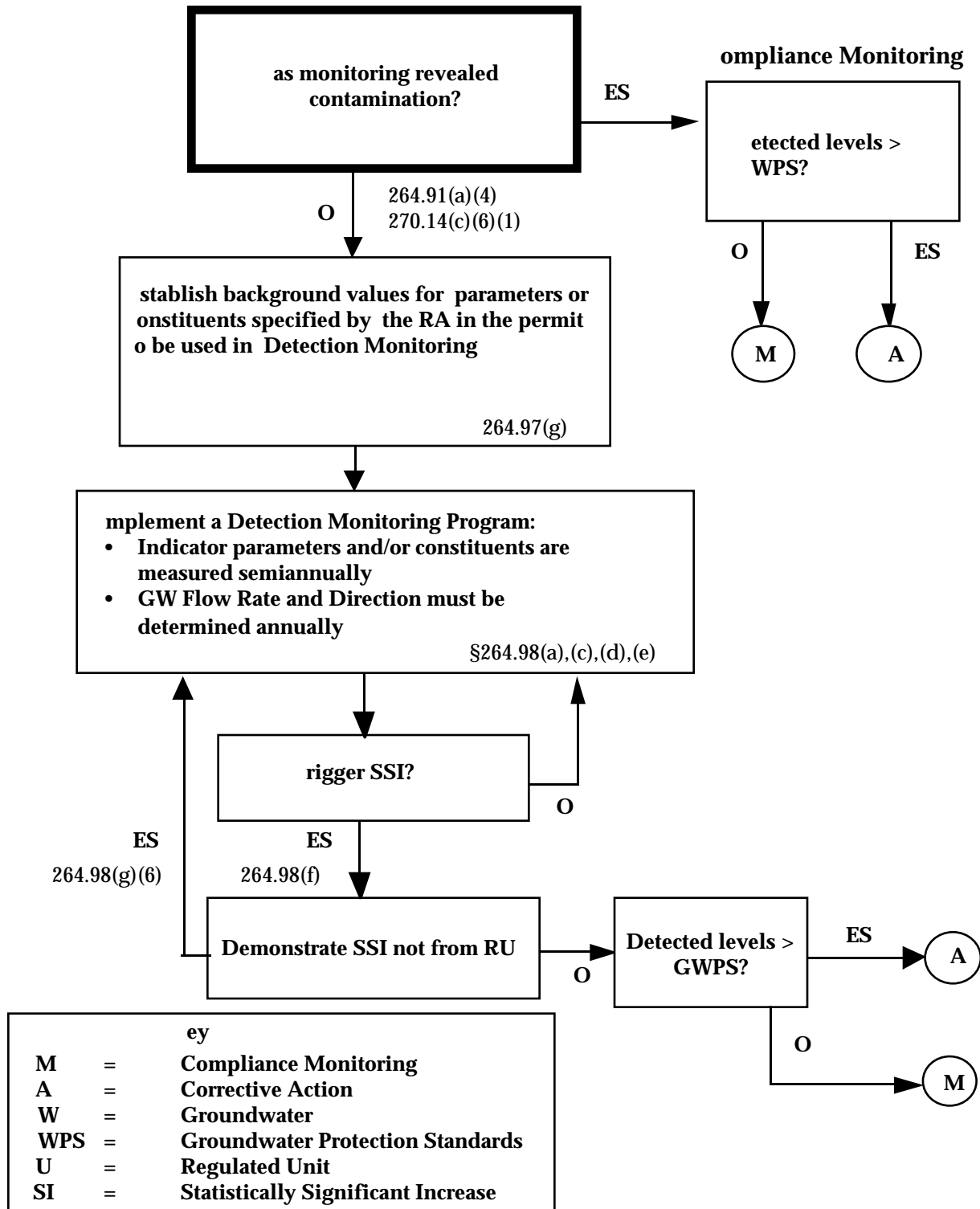
- ☒ Notify the RA within 7 days indicating which parameter(s) or constituent(s) triggered the SSI
- ☒ Immediately sample all wells for Part 264, Appendix IX, constituents (Appendix IX is a list of compounds used to determine the presence of hazardous constituents in groundwater)
- ☒ Determine which Appendix IX constituents are present and at what levels
- ☒ Submit an application for a permit modification within 90 days to establish a compliance monitoring program meeting the requirements of /264.99
- ☒ Submit an engineering feasibility plan for a corrective action program within 180 days, and all data necessary to justify any alternate concentration limit sought under /264.94(b).

If the owner and operator can prove, pursuant to /264.98(g)(6), that the contamination did not result from his or her regulated unit, or that the SSI is due to an error in sample analysis or natural variations in groundwater geochemistry, the owner and operator will be released from the requirements to conduct compliance monitoring or to submit a permit modification. The owner and operator must be able to provide adequate supporting documentation to be released from these requirements. Figure 5 gives an overview of the detection monitoring program.

STAGE II: COMPLIANCE MONITORING PROGRAM

Once it is established that a release has occurred, the owner and operator must institute a compliance monitoring program. The goal of the compliance monitoring program is to ensure that the amount of hazardous constituents released into the uppermost aquifer does not exceed acceptable levels. Once those levels are exceeded, the owner and operator must initiate corrective action. The compliance monitoring program establishes routine monitoring (at least semiannually) to determine if the GWPS has been exceeded.

Figure 5
SUMMARY: DETECTION MONITORING PROGRAM (264.98)



	ey
M	= Compliance Monitoring
A	= Corrective Action
W	= Groundwater
WPS	= Groundwater Protection Standards
U	= Regulated Unit
SI	= Statistically Significant Increase

Groundwater Protection Standard

The GWPS is used to indicate when corrective action is necessary to control plumes of contamination from regulated units (264.92). When a facility submits an application for a permit modification to establish compliance monitoring, the RA specifies the GWPS in the permit. The GWPS consists of four elements:

- ☒ A list of hazardous constituents (264.93)
- ☒ The concentration limits for each of the hazardous constituents (264.94)
- ☒ The point of compliance (264.95)
- ☒ The compliance period during which the GWPS applies (264.96).

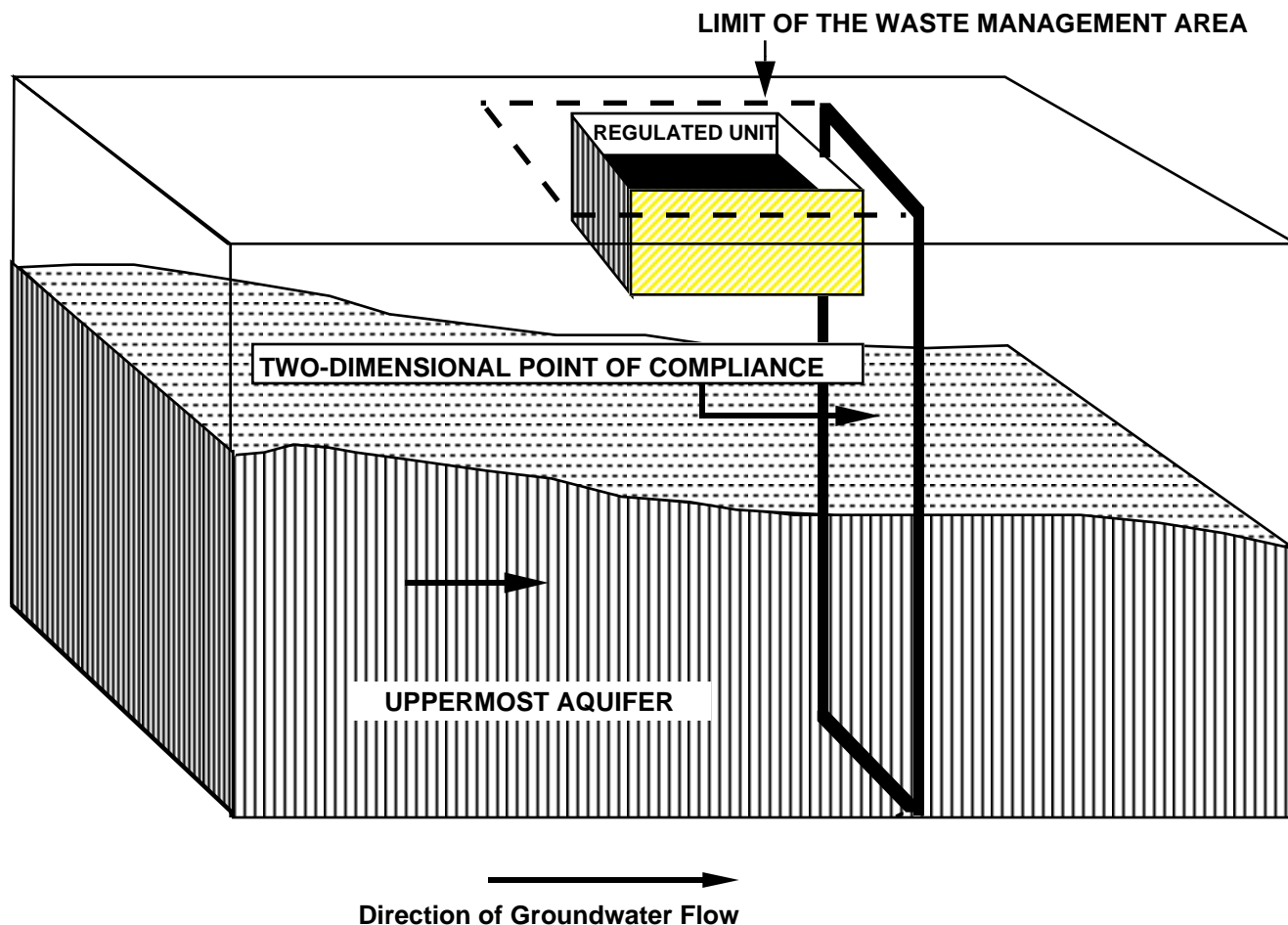
The hazardous constituents identified in the GWPS are those constituents from Part 261, Appendix VIII, which have been detected in the uppermost aquifer and are reasonably expected to be in or derived from the waste contained in a regulated unit. Concentration limits are the levels of hazardous waste or hazardous waste constituents allowed to be present in the groundwater. The concentration levels can be drawn from one of three sources:

- ☒ Background levels
- ☒ Maximum concentration limits (MCLs) identified in Table 1 of 264.94(a)(2) if the background level of the constituent is below the value given in Table 1
- ☒ Alternate concentration levels (ACLs) established by the RA under 264.94(b).

The RA will also identify in the permit the compliance period (264.96) and the point at which the GWPS applies, known as the point of compliance (264.95). The point of compliance is the vertical surface at which the owner and operator must monitor the uppermost aquifer to determine if the GWPS has been exceeded (Figure 6). A proposed point of compliance is incorporated into the Part B permit as required by 270.14(c)(3). The compliance period is the length of time during which the owner and operator must conduct compliance or corrective action monitoring, equal to the active life of the waste management area, including any waste management activity prior to permitting and the closure period. This period begins when a permitted facility begins compliance monitoring. In compliance monitoring, the owner and operator must determine whether the regulated units are in compliance with the GWPS at the point of compliance during the compliance period.

The owner and operator must determine whether there is any evidence of increased contamination for any of the hazardous constituents specified in the permit. This is accomplished by comparing data on samples collected at the point of compliance to the concentration limits set in the GWPS. The owner and operator must collect a minimum of four samples from the background and compliance wells at least semiannually during the compliance period. The RA will specify the frequency for collecting samples and the statistical method appropriate to determine if an SSI has

Figure 6
SCHEMATIC OF POINT OF COMPLIANCE



occurred. The uppermost aquifer flow rate and direction must also be determined at least annually (§264.99(d)-(f)).

The owner and operator must analyze samples from compliance wells for all Part 264, Appendix IX constituents at least annually to determine if any additional constituents are present that are not specified in the permit. If additional constituents are found, they must be added to the list of constituents to be monitored.

Appendix IX constituents which are not contained in Appendix VIII of Part 261, may be included as hazardous constituents into the GWPS of a facility's permit by the Regional Administrator using the omnibus authority of §270.32(b)(2) and RCRA §3005(c)(3). For further information on the omnibus authority, see the module entitled Permits and Interim Status.

If the GWPS is exceeded, the owner and operator must notify the RA in writing within seven days. The owner and operator must indicate which concentration limits have been exceeded,

submit a permit modification within 180 days to establish a corrective action program, and continue to monitor in accordance with the compliance monitoring program (264.99(h)).

If the owner and operator can prove contamination resulted from a source other than the regulated unit, or that the SSI is due to an error in sample analysis or natural variations in groundwater geochemistry, he or she must notify the RA in writing within seven days. The owner and operator must also submit documentation proving the claim to the RA within 90 days and submit a permit modification within 90 days to make appropriate changes to the compliance monitoring program. If the contamination is found to have resulted from a regulated unit, the owner and operator must initiate corrective action. Figure 7 presents an overview of the compliance monitoring program.

STAGE III: CORRECTIVE ACTION PROGRAM

The goal of the Subpart F corrective action program is to bring regulated units back into compliance with the GWPS at the point of compliance (264.100(a)). The Subpart F corrective action program seeks to accomplish this goal by requiring that the owner and operator either remove the hazardous constituents or treat them in place (264.100(b)). The RA determines the time period by which the owner and operator must begin corrective action after the GWPS is exceeded (264.100(c)). The specific measures undertaken to achieve corrective action are also specified by the RA and will vary with each facility. Examples of corrective measures include excavation, stabilization, solidification, and source control. The owner and operator must also conduct corrective action to remove or treat in place any hazardous constituents that exceed the GWPS between the point of compliance and the downgradient property boundary, and beyond the facility boundary where necessary to protect human health and the environment (264.100(e)(1) and (2)).

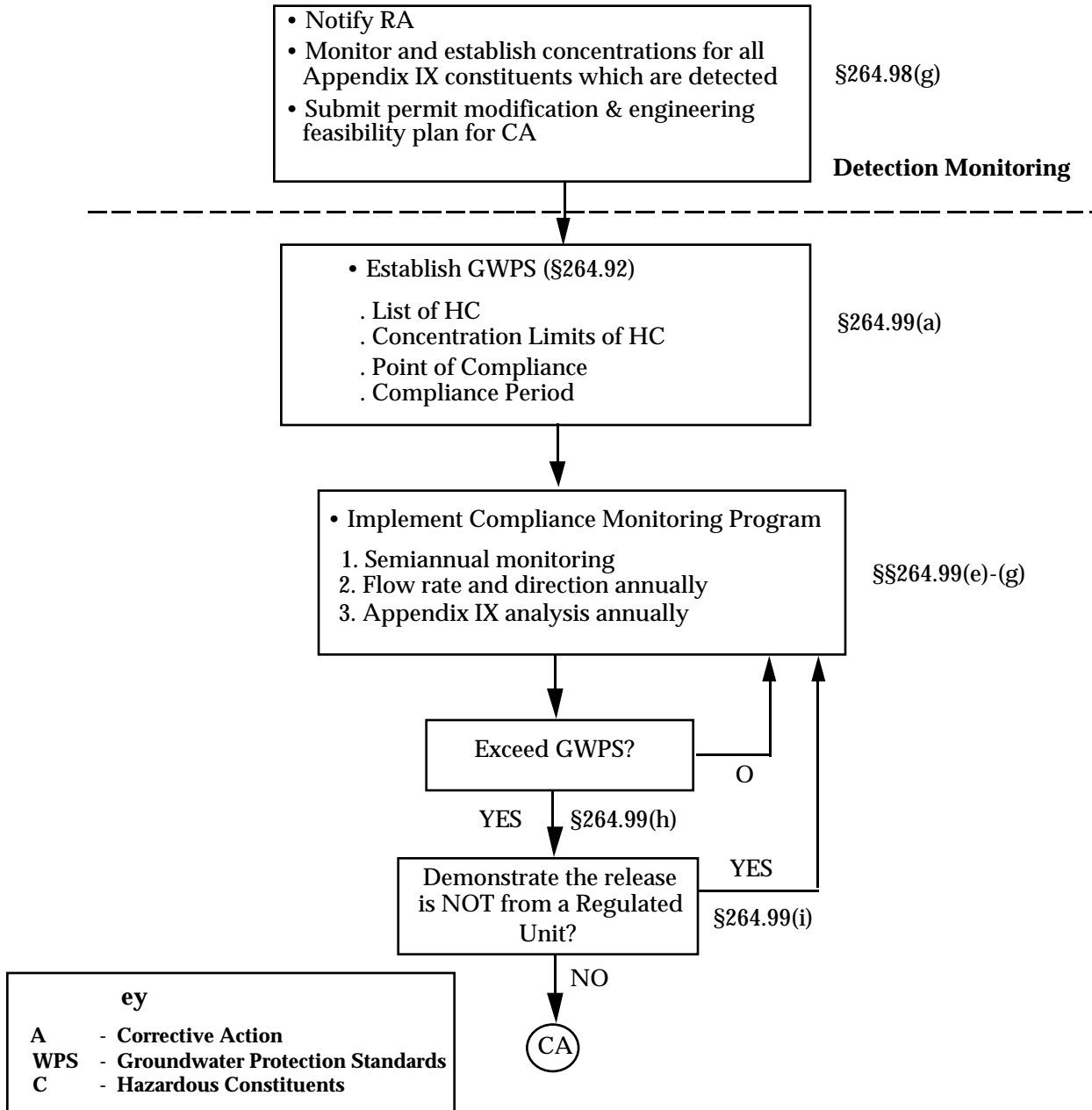
Effectiveness of Program

In addition to corrective action, the owner and operator must establish and implement a groundwater monitoring program to demonstrate the effectiveness of the corrective action program. This program may be based on the requirements for a compliance monitoring program under 264.99 (264.100(d)). A semiannual report on the effectiveness of the corrective action program is required under 264.100(g).

Duration

Corrective action must commence within a reasonable time period after the GWPS is exceeded. During the compliance period, corrective action measures must be continued

Figure 7
COMPLIANCE MONITORING PROGRAM SUMMARY (§264.99)



to the extent necessary to achieve compliance with the GWPS. Once compliance with the GWPS has been achieved, the owner and operator may reinstitute a compliance monitoring program. During the compliance period, facilities might move from compliance monitoring to corrective action, and back again. If the compliance period ends and corrective action is still being conducted, corrective action must continue as long as necessary to achieve the GWPS. The owner and operator can only terminate the corrective action program when the GWPS has not been exceeded for three consecutive years (264.100(f)). If the regulated unit is still in the post-closure period, the owner and operator may then reinstate a detection monitoring program.

A facility may move from one phase of groundwater monitoring to another depending on the status of the groundwater quality. This means a facility may move from:

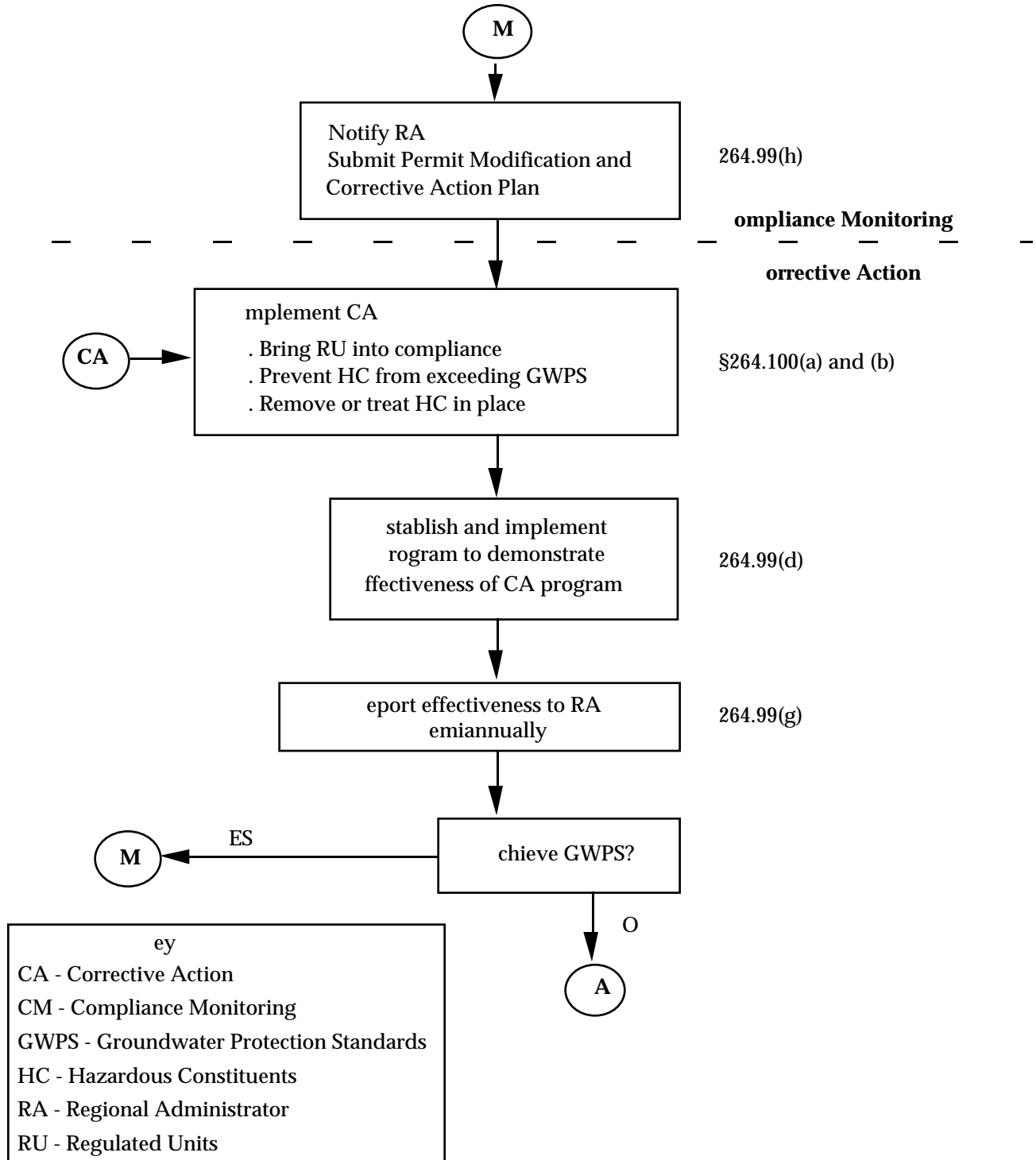
- ☒ Detection to compliance monitoring
- ☒ Detection monitoring to corrective action
- ☒ Compliance monitoring to corrective action
- ☒ Corrective action to compliance monitoring
- ☒ Compliance to detection monitoring (a facility can reinstate a detection monitoring program if it is still in the post-closure period and the compliance period has ended).

For an overview of the corrective action program and the sequences of the groundwater monitoring program, refer to Figure 8.

2.2 INTERIM STATUS GROUNDWATER MONITORING

The requirements for groundwater monitoring programs for interim status TSDFs with regulated units are found in Part 265, Subpart F. This program is designed to determine the facility's impact on the quality of groundwater in the uppermost aquifer underlying the facility (265.90(a)). Part 265, Subpart F, however, does not contain any provisions for corrective action when a release has occurred. If corrective action is required at an interim status facility, it will be addressed under RCRA/3008(h), other cleanup authorities such as RCRA/7003, or in the facility permit when issued. The interim status groundwater monitoring program requires the owner and operator of a surface impoundment, landfill, or land treatment facility used to manage hazardous waste to implement a groundwater monitoring program pursuant to Part 265, Subpart F. These requirements apply to all interim status facilities which have land-based units (except waste piles), unless the units qualify for an exemption under 265.1. Interim status waste piles are not subject to Part 265, Subpart F. The owner and operator can also be exempted by demonstrating that there is a low potential for migration of hazardous waste or hazardous waste constituents to drinking water supply wells (265.90(c)). Owners and operators of surface impoundments that are used only to neutralize corrosive wastes, and contain no other hazardous waste, may also qualify for an exemption. The owner and operator must demonstrate that there is no potential for migration of hazardous wastes from the impoundment (265.90(e)).

Figure 8
OVERVIEW OF THE CORRECTIVE ACTION PROGRAM (264.100)



To comply with Part 265, Subpart F, the owner/operator must install, operate, and maintain a groundwater monitoring system capable of representing the background groundwater quality and detecting any hazardous constituents that have migrated from the waste management area to the uppermost aquifer. Under Part 265, Subpart F, there are two types of groundwater monitoring programs: an indicator evaluation program designed to detect the presence of a release, and a groundwater quality assessment program that evaluates the nature and extent of contamination. Figure 9 illustrates groundwater monitoring applicability for interim status facilities.

GROUNDWATER MONITORING SYSTEM

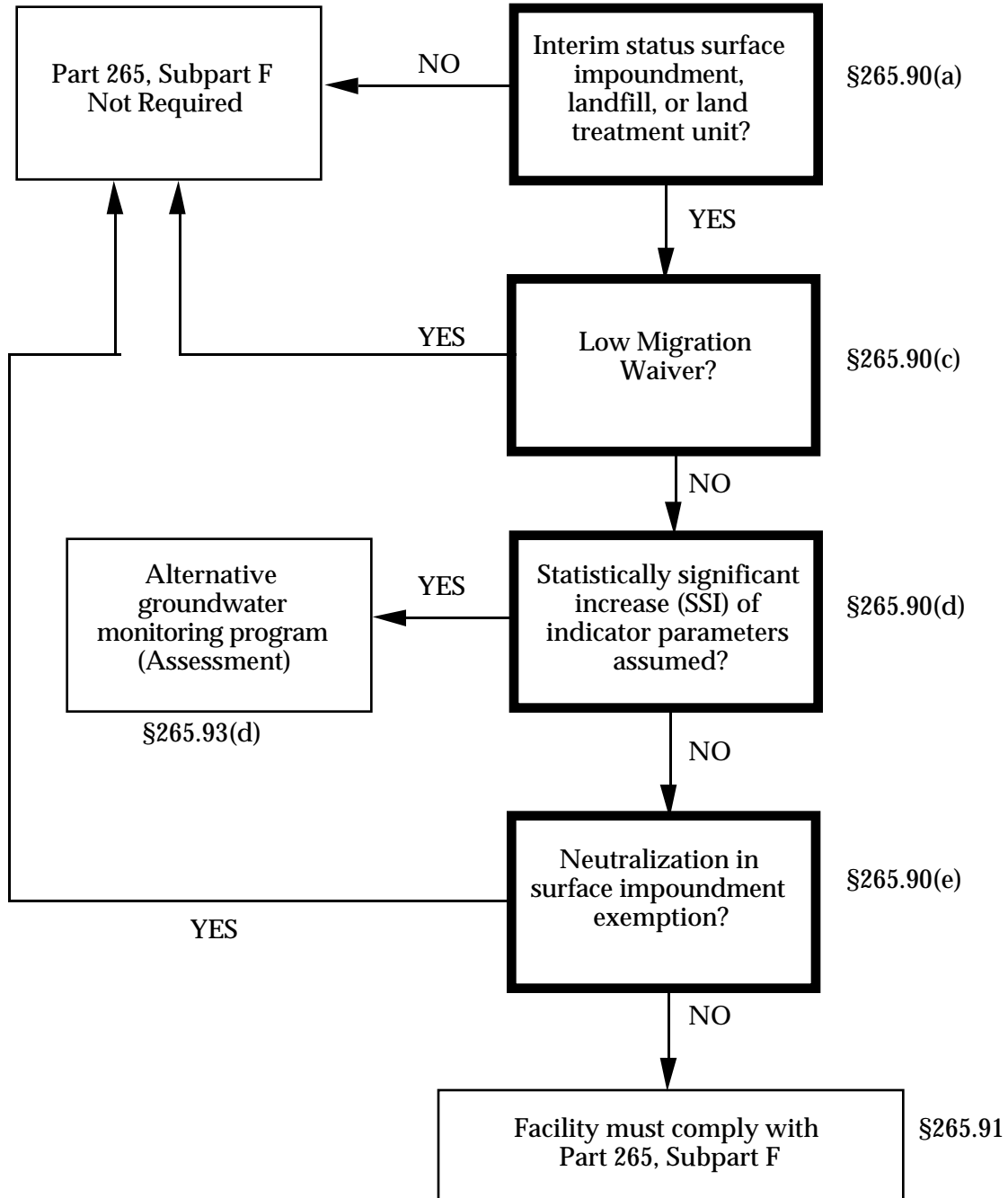
To determine existing groundwater conditions at an interim status facility, the owner and operator must install at least one well hydraulically upgradient from the waste management area. The well(s) must be able to accurately represent the background quality of groundwater in the uppermost aquifer. The owner and operator must install at least three wells hydraulically downgradient at the limit of the waste management area, which are able to immediately detect any statistically significant evidence of a release.

A separate monitoring system for each management unit is not required as long as the criteria in /265.91(a) are met and the system is able to detect any release at the edge of the waste management area.

SAMPLING AND ANALYSIS

Section 265.92 establishes the requirements for the development and implementation of a groundwater sampling and analysis plan to be followed for all groundwater monitoring activities. The plan must specify procedures for sample collection, sample preservation, analytical procedures, and chain-of-custody control (i.e., point of generation to the lab) (265.92(a)).

Figure 9
APPLICABILITY OF GROUNDWATER MONITORING FOR INTERIM STATUS FACILITIES



Owners and operators must establish concentrations for the three sets of parameters listed in /265.92(b) in both upgradient and downgradient wells. Sampling for these parameters must be conducted at the following frequencies:

TYPE	TESTING FREQUENCY	
	<u>first year only</u>	<u>after first year</u>
Appendix III Constituents*	quarterly	no further sampling required
Groundwater Quality Parameters (Chloride, Iron, Manganese, Phenols, Sodium, Sulfate)	quarterly	annually
Groundwater Contamination Indicator Parameters (pH, Specific Conductance, Total Organic Carbon, Total Organic Halogen)	quarterly	semi-annually

* Part 265, Appendix III is a list of EPA Interim Primary Drinking Water Standards taken from the Safe Drinking Water Act. Appendix III is used to determine the suitability of an aquifer as a drinking water supply.

Initial background concentrations are established during the first year by monitoring all wells (upgradient and downgradient) for the three groups of constituents listed in /265.92(b). After the first year, the owner and operator must continue to monitor all wells for the groundwater quality parameters and groundwater contamination indicator parameters. This is known as the indicator evaluation program. The data on the groundwater contamination parameters collected from downgradient wells are compared to data on background water quality to determine if any contamination of the uppermost aquifer has occurred. As discussed earlier, statistically significant changes in the indicator parameters indicate a potential release. Groundwater elevation must also be determined each time a sample is taken.

If an owner/operator assumes or already knows that contamination of the uppermost aquifer has occurred, he or she may initiate an assessment monitoring program as described below in lieu of an indicator evaluation program (/265.90(d)).

GROUNDWATER ASSESSMENT PROGRAM

In addition to the basic program of at least one upgradient and three downgradient wells under /265.91, owners and operators must prepare an outline of a more detailed groundwater monitoring program (/265.93). This program must be able to determine whether hazardous waste or hazardous waste constituents have leached into the uppermost aquifer in a quantity that would cause a significant change in groundwater quality. This additional program is often referred to as a groundwater assessment program. The groundwater assessment program must be implemented when there has been an SSI (increase or decrease for pH) of an indicator parameter over background levels. The groundwater assessment program is designed to determine whether hazardous constituents have entered the groundwater. Once the owner and operator make this determination, they have to establish the rate, extent of migration, and the concentrations of

constituents in the plume.

Statistically Significant Increase (SSI)

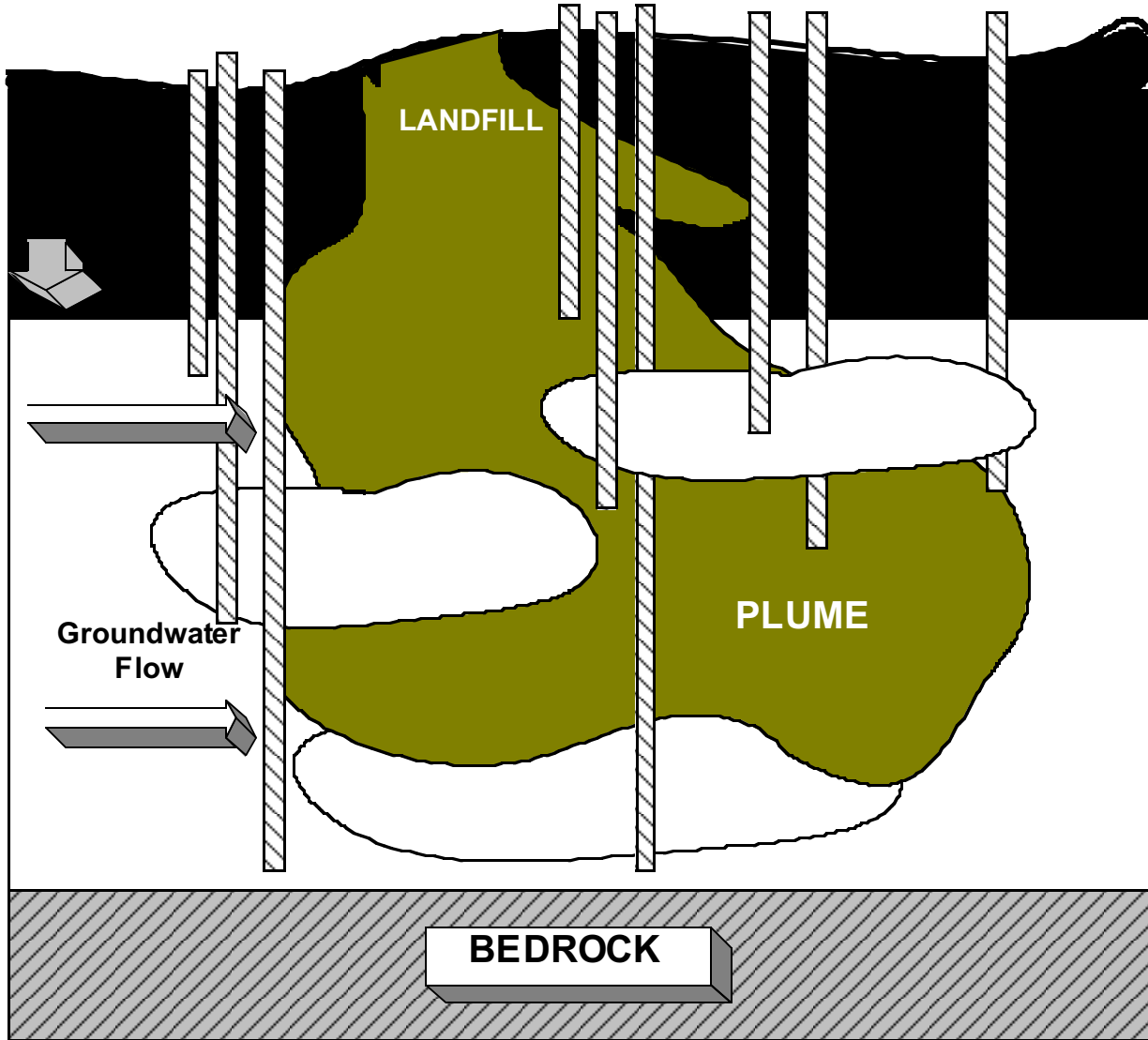
If variations in groundwater quality are detected by evidence of statistically significant differences in concentrations of any of the indicator parameters between the downgradient wells and background data, the regulations require the owner and operator to obtain additional samples (265.93(c)(2)). If the assessment monitoring indicates that no hazardous constituents have entered the groundwater, then the owner and operator may reinstate the basic indicator evaluation program. If the analyses performed on the second round of samples confirms an SSI, the owner and operator must notify the RA within seven days. Examples of variations that would require additional sampling include a significant increase or decrease in pH or a significant increase in any of the groundwater contamination parameters (e.g., total organic carbon) being monitored. Within 15 days after the initial notification, a written monitoring assessment plan must be developed by the owner and operator and submitted to the RA. The assessment plan must include the number of groundwater monitoring wells, the intended sampling, analytical, and evaluation procedures, and an implementation schedule. The plan must be designed to determine the rate and extent of migration of hazardous waste constituents and their concentration (265.93(d)(4)). Information gathered from assessment monitoring must be submitted within 15 days after it is collected. The owner and operator must repeat the groundwater assessment at least quarterly until final closure of the facility (265.93(d)(7)).

An interim status facility's groundwater monitoring program can move from:

- ☒ Indicator evaluation to assessment monitoring
- ☒ Assessment to indicator evaluation monitoring
- ☒ Assessment monitoring through final closure.

To meet the requirements of the groundwater assessment program, the owner and operator may need to install additional wells at various locations and depths. Additionally, wells are required to pinpoint the exact location of a contaminated plume. Schematic examples of the placement of wells for meeting the requirements of the interim status groundwater monitoring assessment program are given in Figure 10. Notice that wells of various depths are sometimes placed in "clusters" at a single location, thereby allowing for an assessment of the groundwater at various depths.

Figure 10
SAMPLE OF ASSESSMENT PHASE MONITORING WELL PLACEMENT



Recordkeeping and Reporting Requirements

Owners and operators of interim status TSDFs conducting groundwater monitoring must comply with the recordkeeping and reporting requirements of /265.94.

At a facility in the indicator evaluation phase (i.e., no release has occurred), the owner and operator must keep all records of analyses required by //265.92(c), (d), and (e), and /265.93(b). The owner and operator must also report the results of the following to the RA (/265.94(a)(2)).

What	When
☞ Background concentrations in all monitoring wells for parameters under /265.92(b)(1)	Quarterly for first year
☞ Concentrations of parameters under /265.92(b)(3)	Annually
☞ Groundwater surface evaluation under /265.93(f)	Annually

When a release has occurred and the uppermost aquifer is monitored pursuant to /265.93(d)(4), the owner and operator must keep all records of analyses and evaluations required under /265.93(d)(3) on-site and submit an annual report to the RA on the status of the groundwater quality assessment program.