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Office of
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# HANDBOOK OF GROUNDWATER POLICIES FOR RCRA CORRECTIVE ACTION (updated 4/20/2000)

## for Facilities Subject to Corrective Action Under Subtitle C of the Resource Conservation and Recovery Act



Issued by

Office of Solid Waste
Corrective Action Programs Branch

Note: This document provides guidance to EPA and states regarding groundwater at facilities subject to RCRA Corrective Action. It also provides guidance to the public and the regulated community on how EPA intends to exercise its discretion in implementing its statutory authorities and regulations. The document does not, however, substitute for EPA's statutes or regulations, nor is it regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA may change this guidance in the future as appropriate.

# Handbook Overview

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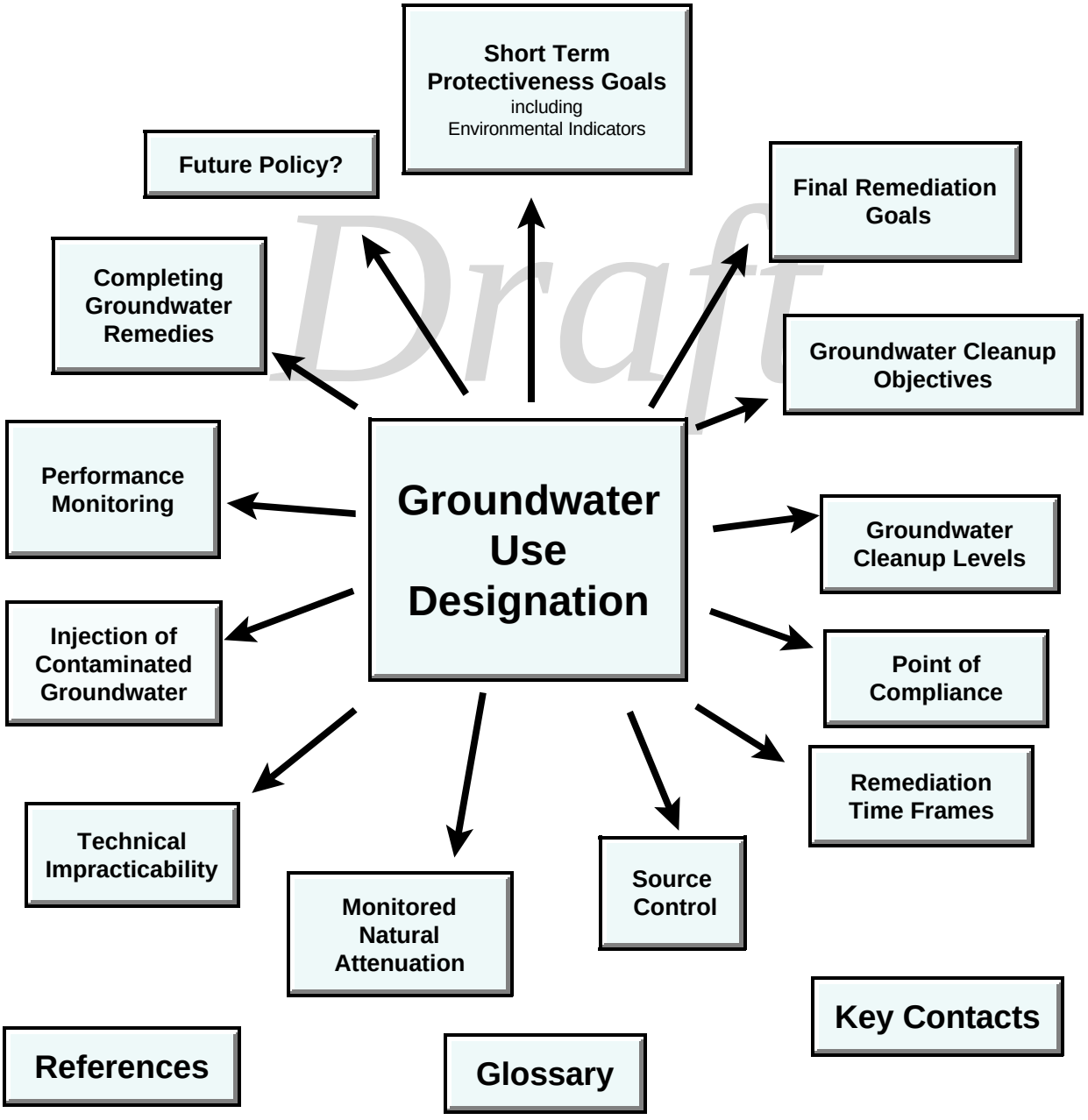

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# Overview

## *What does this Handbook do?*

This Handbook is designed to help you as a regulator, member of the regulated community or the public to find and understand EPA policies on groundwater use and the protection and clean up of groundwater at Resource Conservation and Recovery Act (RCRA) corrective action facilities. This Handbook is also designed to encourage individual states to take a lead role in protecting their groundwater resources, thus preserving the national interest in this vital resource.

EPA wrote this Handbook to put together in a single document EPA's current policies concerning groundwater at facilities subject to corrective action under Subtitle C of RCRA[1] . This Handbook is one part of the RCRA Cleanup Reforms (refer to http://www.epa.gov/reg5oopa/rcraca/rcra-reform.pdf ) that EPA announced on July 8, 1999. The objective of the Reforms is to promote faster, focused, and more flexible cleanups[2]. EPA's goal for this Handbook is to reduce time-consuming uncertainties and confusion about EPA's policies concerning groundwater protection and cleanup. This Handbook also emphasizes flexibility in EPA's policies by describing how current and reasonably expected future groundwater use should be considered in the protection and cleanup of groundwater.

### Why is groundwater important?

Groundwater is the source of about 40% of the water used for drinking water in the United States. It provides drinking water for more than 97% of the rural population who do not have access to public water-supply systems. Between 30% and 40% of the water used for agriculture comes from groundwater. Withdrawals of groundwater are expected to rise in the coming century as the population increases and available sites for surface reservoirs become more limited. Groundwater is also critical because it supplies roughly 40% of the average annual flow in United States surface water bodies; these surface water bodies provide the balance of drinking water to those areas that do not rely on groundwater as their primary source for drinking water. (http://www.epa.gov/safewater/protect.html and EPA, 1999c)

This Handbook contains policies. Unlike regulations, recommendations contained in policies are not enforceable requirements unless they are incorporated into a permit or order. EPA is issuing this Handbook to communicate what EPA believes should generally occur at RCRA facilities to protect human health and the

[1] RCRA primarily addresses three areas - solid waste, hazardous waste, and underground storage tanks. The Subtitle C program governs the management of hazardous waste (for more information, see see RCRA Orientation Manual available at http://www.epa.gov/epaoswer/general/orientat/index.htm ).

[2] The term "cleanup" or the phrase "cleaning up" refers to the range of activities that could occur in the context of addressing environmental contamination at RCRA facilities. For example, cleanup activities could include removing waste or contaminated media (e.g., excavation, pumping groundwater, etc.), in-place treatment of the waste or contaminated media (e.g., bioremediation), containment of the waste or contaminated media (e.g., barrier walls, low-permeable covers, liners, etc.), or various combinations of these approaches. The term "cleanup" is often used interchangeably with the term "remediate" or "remediation."

environment. Therefore, these policies could help facilities currently undergoing RCRA corrective action. In addition, EPA advises facilities that intend to begin cleanup in advance of specific direction under a RCRA authority to consult these policies as well.

## *Who should use this Handbook?*

This Handbook is designed to help anyone wanting to better understand EPA's groundwater cleanup policies at RCRA facilities. We wrote this Handbook for State and EPA regulators, owners and operators of facilities subject to RCRA Corrective Action, and members of the public. Throughout the rest of this Handbook we will refer to these three groups as regulators, facilities, and the public, respectively. Sometimes, we will refer to all three groups collectively as "stakeholders."

## *How will this Handbook help me?*

If you are a regulator, the Handbook can help clarify key groundwater-related policies which you should use, where appropriate, to manage investigations and cleanups at your assigned facilities (via permits, orders or voluntary actions). EPA encourages you to use this Handbook to do your part in promoting a technically sound, reasonable, and consistent approach to protecting and cleaning up our nation's groundwater.

If you represent a facility, the Handbook can help you reduce your uncertainties about the actions a regulator will likely require you to do. This Handbook can also help you in your financial planning. Clarity in EPA's general expectations will allow you to phase your investigation and remediation strategy in a manner consistent with the RCRA Corrective Action Program priorities.



If you are a member of the public, this Handbook can help you understand what EPA generally expects regulators and facilities to do during an investigation and cleanup of contaminated groundwater at a RCRA facility. EPA encourages you to use this Handbook as a tool in your interaction with regulators or facilities. In essence, EPA wrote this Handbook to help you influence decisions related to groundwater at RCRA corrective action facilities.

If you are relatively new to RCRA corrective action, you can learn more about how EPA and states implement the program by referring to Appendix 1 of this Handbook and reading the History of Corrective Action Fact sheet available at www.____.

## *How do these policies apply to States authorized to implement the RCRA Corrective Action Program?*

As of the most recent update of this Handbook, EPA has authorized 33 states and territories to implement facility-wide corrective action through their state hazardous waste programs in lieu of EPA. EPA refers to those states as "authorized" for RCRA corrective action. EPA's authorization of a state corrective action program is based on an evaluation that the state is capable of implementing corrective action equivalently to EPA, and in a manner consistent with applicable federal statutes, regulations and guidance. EPA expects these authorized states to have the primary responsibility for corrective action at hazardous waste treatment, storage and disposal facilities (TSDFs) in lieu of EPA, which includes making decisions dealing with the policies in this Handbook. As such, EPA also expects that states will consider this guidance carefully in implementing their authorized programs. Also, as allowed for by the federal RCRA statute, states could take an approach that is more stringent than how EPA would implement

the program. Therefore, it is important that Handbook users consult with the state cleanup program prior to conducting corrective action.

### *What topics does this Handbook discuss?*

EPA selected the topics in this Handbook because they are very often the subject of questions and some confusion. The topics addressed in this Handbook apply to facilities undergoing facility-wide corrective action under the Hazardous and Solid Waste Amendments to RCRA. In addition, the policy on groundwater cleanup levels answers some questions unique to corrective action at RCRA regulated units[3]. Users of this Handbook should be aware that EPA specifies groundwater monitoring and corrective action requirements for RCRA regulated units in 40 CFR 264, Subpart F.[4]

**TOPICS PRESENTED***

- Groundwater Use Designation
- Short-Term Protectiveness Goals
- Final Remediation Goals
- Groundwater Cleanup Objectives
- Groundwater Cleanup Levels
- Point of Compliance
- Remediation Time Frames
- Source Control
- Monitored Natural Attenuation
- Technical Impracticability
- Performance Monitoring
- Injection of Contaminated Groundwater
- Completing Groundwater Remedies

* See below discussion (or click here) to see how EPA intends keep this Handbook current.

The first topic "Groundwater Use Designation" serves as the foundation for the rest of the Handbook; this topic also includes a detailed discussion of EPA's expectations regarding the factors States should consider in making groundwater use designations. While some of the other topics deal with broader issues, this Handbook focuses on groundwater. For example, the point of compliance policy only discusses groundwater even though EPA has guidance for the point of compliance in other media.

Note that key topics mentioned within the text are underlined and "hyperlinked". This feature allows you to recognize topics that are expanded elsewhere in the Handbook, and allow you to quickly go to that topic should you desire.



3 Regulated Units are defined in 40 CFR 264.90 as surface impoundments, waste piles, land treatment units, and landfills that received hazardous wastes after July 26, 1982.

4 A recent rulemaking (Post-Closure Regulations , 63 FR 56710, October 22, 1999) would provide flexibility to states, which become authorized for the rule (or parts of the rule), to allow alternative requirements for groundwater monitoring and corrective action for releases to groundwater if (1) the regulated unit is situated among solid waste management units (SWMUs) or areas of concern (AOCs) that appear to have contributed to the same release and (2) the alternative requirements will protect human health and the environment (see 264.90(f)). EPA encourages states to adopt and seek authorization for this provision, either separately or as part of the full post-closure rule. Pending authorization for this portion of the post-closure rule, states authorized for corrective action would be able to implement the provision if they could do so as a matter of state law, and they implemented it in a way that was no less stringent than federal requirements. For more detail on authorization for the post-closure rule see the preamble to the rule. The Post-Closure regulation, including the preamble is available at http://www.epa.gov/fedrgstr/EPA-WASTE/1998/October/Day-22/f28221.pdf .

## *Where do the policies in this Handbook come from?*

Each topic in this Handbook is already addressed in an EPA guidance document, directive or memorandum. This Handbook serves to summarize our current guidance and recommendations, and provides further clarification of EPA's policies. Many of the policies come from the the Advanced Notice of Proposed Rulemaking ("ANPR"), May 1, 1996 (http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf ). EPA issued the ANPR based on the expectation that detailed procedural and substantive requirements, outlined in proposed regulations for corrective action (Subpart S, July 27 1990), would become final. However, in response to comments on the ANPR, EPA opted against finalizing these regulations because the Agency decided it was not necessary for successful implementation of the program. In fact, since a majority (33) of the states and territories were already authorized to implement facility-wide corrective action in lieu of EPA, and several others were seeking authorization, EPA decided that promulgating corrective action regulations would be unnecessarily disruptive. In an October 7, 1999 Federal Register Notice, EPA announced its withdrawal of most of the provisions of corrective action regulations. In this notice, EPA stated that rather than issuing a rule to achieve consistency at all facilities, we believe it would be more appropriate to develop guidance and training to promote consistency, where appropriate. This Handbook is an example of such guidance. The October 7, 1999 notice also recognized that the ANPR should serve as the primary corrective action implementation guidance. For that reason, the ANPR, especially Section III, of the ANPR, is a key reference for many of the topics in this Handbook. Section IV of the ANPR requested comments on a number of topics addressed in this Handbook, such as the point of compliance. This Handbook does not foreclose further discussion of issues raised for comment in the ANPR, and EPA intends to update this Handbook as the Corrective Action program continues to evolve.



You may notice that the choice of words to describe a policy in this Handbook may differ from the words in the ANPR or original source of the policy. There are two primary reasons for this difference. First, we wrote this document in "plain language" and second, the terminology in RCRA is evolving.

In a June 1, 1998 memorandum (http://www.npr.gov/library/direct/memos/memoeng.html), President Clinton directed federal agencies to write all new documents in plain language. Plain language uses everyday words, active voice and shorter sentences. This style makes documents easier to read and more understandable to the public. However, it may appear at times that EPA has changed its position on a topic, because EPA selected different words, but in fact the policy is the same. For example, the Handbook lists several factors for assessing use, value and vulnerability of groundwater. These factors are the same factors as those listed in the Comprehensive State Groundwater Protection Program ("CSGWPP") Guidance (1997), except we modified the words to meet the goals of plain language.

Another source of perceived change stems from the maturing of RCRA Corrective Action terminology. As the program has evolved, so have RCRA definitions. For example RCRA's early guidance, proposed Subpart S, referred to achievement of "media cleanup standards" as a criterion for remedy selection. However, it also used that term interchangably with "media cleanup levels." The Advanced Notice or Proposed Rulemaking later clarified that the remedy selection criterion "media cleanup standard" is broader than just the contaminant levels, but also includes where you measure the levels, "point of compliance," and the time frame to achieve the levels, "remediation time frame." To capture this broader interpretation, EPA replaced the term "media cleanup standards" with "media cleanup objectives," and distinguished "media cleanup levels" as one component of the "media cleanup objectives."

Generally, this Handbook uses the most current term. If you are uncertain of a term's meaning, you should refer to the glossary in Appendix 2.

## *Are the policies for RCRA Corrective action contained in this Handbook consistent with the Superfund cleanup program?*

The basic approaches described in this Handbook for groundwater cleanup and the remedial goals it promotes are the same as those under Superfund. Much of the Handbook is derived from guidiances developed jointly by EPA's cleanup programs (e.g., Use of Monitored Natural Attenuation at Superfund, RCRA and Underground Storage Tank Sites). This Handbook, therefore, is consistent with EPA's long-standing goal for EPA's cleanup programs to yield similar remedies in similar circumstances. To learn more about RCRA-CERCLA coordination issues, you should refer to, "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities" (EPA, 1996b) available at http://www.epa.gov/swerffrr/doc/924memo.htm) and the RCRA-CERCLA deferral policy found in 54 FR 41004-41006 (October 4, 1989b).

EPA developed this Handbook specifically for RCRA corrective action. Consequently, it differs in certain minor respects from analogous Superfund guidance because of differences in program priorities, terminology, and legal authority. For example, a RCRA Facility Investigation is virtually analogous to a Superfund Remedial Investigation; however, this Handbook uses RCRA terms. For more information regarding Superfund terms and Superfund policies pertaining to groundwater, you should refer to "Rules of Thumb for Superfund Remedy Selection" which is available at http://www.epa.gov/superfund/resources/rules/rulesthm.pdf .



## *How will I know that the policies in this Handbook are current?*

EPA intends to update this Handbook as necessary to add new topics, new policies, or to change or clarify existing policies. Therefore, if you are reading a printed copy of this Handbook, we urge you to access the electronic version available via the Internet at www.____ which EPA will keep up to date. The front page of the Internet version will indicate the most recent date EPA revised the Handbook (e.g., Updated _____"). Additionally, the top of each policy includes the date of the most recent revision. You should compare this date to the Internet version to ensure that you are reading the Agency's most current statements on the particular topic. Updates to the Internet verison of the guidance will be based on written updates that are signed by appropriate EPA management and maintained in a hard-copy file.

## *How can I get further information about the policies in this Handbook?*

You can get further information on policies in this Handbook in one of two ways. First, you could refer to the references provided at the end of the discussion of each policy; a complete list of all the references is also found at the end of the Handbook. Note that most references provide a Internet Web address and a "hotlink" which allows you to directly access the document of interest. Second, you could get more information by contacting one of the "Key EPA Regional Contacts" that are provided in Appendix 3 of this Handbook. These contacts will be updated periodically to make sure they are still available for questions concerning groundwater policy issues for RCRA corrective action.

## *Key References:*


EPA, 1999b. Corrective for Solid Waste Management Units at Hazardous Waste Management Facilities (64 FR 54604, October 7). Available at http://www.epa.gov/epaoswer/hazwaste/ca/partwith.htm.

EPA, 1999c. Safe Drinking Water Act, Section 1429 Groundwater Report to Congress. EPA-816-R-99-016; October, 1999. Available at http://www.epa.gov/ogwdw000/gwr/finalgw.pdf .

EPA, 1999d. RCRA Cleanup Reforms (EPA530-F-99-018). For more information, refer to http://www.epa.gov/reg5oopa/rcraca/rcra-reform.pdf .

EPA, 1998a. RCRA Orientation Manual (EPA530-R-98-004). Available at http://www.epa.gov/epaoswer/general/orientat/index.htm .

EPA, 1998b. Plain Language in Government Writing (June 1). Available at http://www.npr.gov/library/direct/memos/memoeng.html .

EPA, 1998d. Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities: Post-Closure Permit Requirement and Closure Process; Final Rule (63 FR 56710). Available at http://www.epa.gov/fedrgstr/EPA-WASTE/1998/October/Day-22/f28221.pdf .

EPA, 1997a. Memorandum from Elliott P. Laws and Steven A. Herman to RCRA/CERCLA Senior Policy Managers titled, "Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance" (January 17). Available at www._____.

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant pages: 19448-52.

EPA, 1996b. Memorandum from Steven A. Herman and Elliott P. Laws to RCRA/CERCLA Senior Policy Managers titled, "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities" (September 24). Available at http://www.epa.gov/swerffrr/doc/924memo.htm.

EPA, 1989b. National Priorities List for Uncontrolled Hazardous Waste Sites - Final Rule Covering Sites Subject to the Subtitle C Corrective Action Authorities of the Resource Conservation and Recovery Act (commonly referred to as the RCRA Deferral Policy). Available in Section V which appears on 54 FR 41004-41006.

# Groundwater Use Designations

(Updated 4/20/00)

## *What is a groundwater use designation?*

A groundwater use designation is a determination of reasonably expected use, resource value (e.g., priority), and/or vulnerability of groundwater in a particular area. EPA considers protective groundwater use designation systems to be those that: (1) are based on an overall goal which is no less protective than EPA's groundwater protection goal[1]; (2) are applied consistently to all groundwaters of a state; (3) consider the key factors listed in the adjacent box; and (4) are developed with thorough public participation. EPA and States can use the designation as a factor in determining the maximum[2] (highest) beneficial use of the groundwater in order to establish facility-specific groundwater cleanup objectives for RCRA corrective action.

### Factors for Groundwater Use Designations

- vulnerability to contamination
- hydrogeologic regimes (recharge and discharge areas)
- flow patterns
- quantity and potential yield
- ambient and/or background quality
- wide-spread contamination
- current use (including public water supply systems and private drinking water supply wells)
- reasonably expected future uses (based on demographics and availability of alternative water supplies)
- connections to surface waters and associated ecological receptors
- value attributed to groundwater resource, including public opinion
- governmental and legal boundary considerations (e.g., groundwater migrating across state boundaries)

## *How can groundwater use designations enhance flexibility for RCRA cleanups?*

Regulators can modify groundwater cleanup levels and remediation time frames based on groundwater use designations while still protecting human health and the environment. This flexibility allows regulators to focus their resources on protecting and restoring highly valued groundwaters and provides more cleanup options to facilities. For example, regulators may allow a facility an extended remediation time frame to clean up groundwater when the facility overlies groundwater designated as a future drinking water source, but which no one is currently using. For groundwater designated for use other than drinking water use, groundwater cleanup levels would not necessarily be drinking water standards. Regulators could establish groundwater cleanup levels based on current or other reasonably expected exposures to contaminants from groundwater.

At a facility-specific level, there may be uses of groundwater or exposures to contaminants from groundwater which may not be considered in a State groundwater use designation. When

[1] EPA's overall groundwater protection goal is to prevent adverse effects to human health and the environment and to protect the environmental integrity of the nation's groundwater resources.

[2] Within the range of reasonably expected uses, the maximum beneficial groundwater use is the one which that warrants the most stringent groundwater cleanup levels.

developing facility-specific groundwater cleanup levels, you should consider other common uses of and exposures to groundwater such as: industrial uses, cooling water, car washes, livestock watering, and agricultural irrigation. Furthermore, exposures to contaminants from groundwater could occur even when there is no direct use of the groundwater. For example, groundwater may recharge to adjacent or underlying aquifers that are used for drinking water, or discharge to surface water to support aquatic life, recreation, drinking water, etc. Additionally, exposure to contaminants in indoor air could result from underlying groundwater contaminated with volatile chemicals. Regulators should identify the various uses of and exposures to contaminants in groundwater to develop protective groundwater cleanup levels for a facility. These non-drinking water cleanup levels could be less stringent and may facilitate redevelopment of facilities (e.g. brownfields - http://www.epa.gov/swerosps/bf/new.htm ) that might otherwise remain unused. However, non-drinking water exposures could also result in more stringent groundwater cleanup levels; for example, surface water quality standards may be lower than drinking water standards for some chemicals. Therefore, it is important to evaluate various uses and exposures on a facility-specific basis.

Regardless of the groundwater use designation, facilities should comply with all State and Federal laws for preventing new releases of contamination, and do their part to minimize hazardous waste generation.

### Rationale
### for Groundwater Use Designations

EPA believes that states should have the primary responsibility for managing and protecting their groundwater resources. Therefore, EPA prefers, where appropriate, to rely on state groundwater use designations as a factor in corrective action decision making. In addition, EPA believes it has an important role in providing input to state groundwater use designations because of the national interest in protecting this valuable resource and because groundwater often migrates across state boundaries. EPA's support of a State groundwater use designation promotes a consistent and comprehensive approach to groundwater protection within a State. EPA's support also indicates that the State has assessed its groundwaters and developed a method to prioritize groundwater based on varying groundwater characteristics. EPA's primary interest is to promote approaches for groundwater use designations that are protective of both the current as well as reasonably expected uses of groundwater. For example, EPA wants to avoid inappropriate groundwater use designations and associated cleanup decisions that would rely on the lack of current drinking water use at a particular facility as the only justification for a non-drinking water use designation.

### *How does EPA's policy on groundwater use affect States which consider all of their groundwater to be a potential drinking water supply?*

Some states have statutes, regulations, or policies designating all of the groundwater in the State to be a potential drinking water supply, and may require that all groundwater be cleaned up to drinking water standards. None of the policies in this Handbook limit or discourage this approach in any way. However, EPA still encourages such States to develop methods for setting groundwater resource priorities so that clean up actions can be prioritized to focus on facilities in more sensitive areas first. Examples of factors or criteria which States can use to distinguish among potential drinking waters on a facility-specific basis are:

- Expected time frame of future use;
- Likelihood of use within a certain time period (e.g., 30 years);
- Relative priority or value; or
- Relative vulnerability of groundwaters

States are already acquiring this kind of information for other EPA programs. For example, section 1453 of the Safe Drinking Water Act (SDWA) as amended in 1996 requires states to develop and implement Source Water Assessment Programs (SWAP). A state SWAP must provide for assessment of source waters within the state boundaries from which public water systems in the state receive supplies of drinking water. A SWAP will consist of three components:

(1) A delineation of the source water area----that is, the zone contributing water to the system's wells (for ground water systems) or intakes (for surface water systems).

(2) An inventory of potential sources of contaminants in drinking water within the source water area. Such sources could include landfills and underground storage tanks.

(3) A susceptibility analysis, which should provide a well-reasoned and well-supported judgment of the likelihood that a system will actually suffer contamination from any inventoried sources.

States were required to submit their SWAP for approval by February 1999, and have three and a half years to complete the assessment following program approval. Most states should have completed their asessments by November 2002. The results of these assessments must be made available to the public, and may prove to be helpful in identifying areas needing greater protection of groundwater resources. For more information on Source Water Assessment Programs, you should refer to State Source Water Asessment and Protection Programs Guidance, EPA Doc. No. EPA-816-R-97-009 (August 1997). Electronic information is available on the internet at http://www.epa.gov/OGWDW/swp/swappg.html .



## *Who makes groundwater use designations?*

EPA prefers to rely on States to develop groundwater use designations. However, EPA may find it appropriate to use its own guidelines (see below) to make groundwater use designations when (1) EPA has the lead role in implementing corrective action at a facility, and (2) a state designation system is not available or is not in EPA's opinion adequately protective of our nation's groundwater resources.

EPA will generally defer to a State groundwater use designation when it is part of an EPA-endorsed Comprehensive State Groundwater Protection Program ("CSGWPP") that provides for facility-specific decision making in EPA's remediation programs[3]. In the absence of such an

[3] A Comprehensive State Groundwater Protection Program (CSGWPP) is a groundwater management strategy developed by a state. EPA reviews CSGWPPs and "endorses" those that successfully meet six strategic activities. EPA outlined specific criteria for each strategic activity in CSGWPP guidance. In particular, EPA remediation programs review State guidelines in the CSGWPP to prioritize groundwater based upon use, value and vulnerability. In 1997, EPA's Office of Solid Waste and Emergency Response issued a directive encouraging EPA's remediation programs to defer to State determinations of current and future use when based on an EPA-endorsed CSGWPP that has provisions for facility-specific decisions. Go to http://www.epa.gov/OGWDW/csgwpp.html for a map of states with endorsed CSGWPPs.

EPA-endorsed CSGWPP, EPA may, where appropriate, rely on an alternative State groundwater use designation. EPA prefers that such alternative state groundwater use designations comprehensive, be state-wide, be based on use, value and vulnerability, and would lead to achieving EPA's short-term protectiveness goals and final remediation goals.

### *What are EPA's guidelines for making groundwater use designations?*

EPA's guidelines are found in "Guidelines for Groundwater Classification under the EPA Ground-Water Protection Strategy" (EPA, 1986). These guidelines describe three classes of groundwater that represent a hierarchy of groundwater resource values to society: Class I is groundwater which is an irreplaceable source of drinking water and/or ecologically vital, Class II is groundwater currently used or potentially usable as a source of drinking water; and Class III includes groundwater that is not a current or potential source of drinking water. As explained earlier, however, EPA encourages states to make their own groundwater use designations.

### *References:*


EPA, 1997c. State Source Water Assessment and Protection Programs Guidance (August). Available at http://www.epa.gov/OGWDW/source/swpguid.html .

EPA, 1997d. The Role of Comprehensive State Groundwater Protection Programs (CSGWPPS) is OSWER Remediation Programs. OSWER Directive 9283.1-09. Available at http://www.epa.gov/superfund/resources/csgwpp/role.pdf .

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant page stating EPA's expectation for contaminated groundwater on 19448.

EPA, 1992. Final Comprehensive State Groundwater Protection Program Guidance, EPA 100-R-93-001. For more information, refer to http://www.epa.gov/OGWDW/Pubs/06ground.html.

EPA, 1991b. Protecting the Nation's Groundwater: EPA's Strategy for the 1990's. For more information, refer to http://www.epa.gov/OGWDW/Pubs/11ground.html .

EPA, 1986. Guidelines for Groundwater Classification under the EPA Groundwater Protection Strategy.

# Short-Term Protectiveness Goals

(Updated 4/20/00)

## *What are EPA's short-term protectiveness goals for groundwater?*

Short-term goals associated with groundwater include preventing, minimizing, or eliminating: (1) current or near-future unacceptable exposures to humans or ecologic receptors from contaminated groundwater; (2) sources of groundwater contamination; and, (3) the spread of contaminated groundwater above levels of concern[1]. EPA has been emphasizing these short term goals in guidance and training since 1991 when EPA implemented the RCRA "Stabilization Initiative."

## *How do facilities achieve these goals?*

Facilities should, as appropriate, use interim actions, sometimes referred to as stabilization actions, to achieve these goals while pursuing final remedies. Facilities can implement stabilization activities at individual source areas, or parts of a facility.

## *How does EPA know when facilities achieve these goals?*

EPA tracks the implementation of stabilization activities at facilities in a computer database known as RCRIS (RCRA Information System). EPA also developed two facility-wide Environmental Indicators to track short-term goals on a national basis. While EPA continues to track stabilization activities on a unit or area-specific basis, EPA believes that facility-wide measures are important to convey an overall sense of environmental conditions at a RCRA facility. The two Environmental Indicators are called "Current Human Exposures Under Control" and "Migration of Contaminated Groundwater Under Control."

### Rationale for Short-Term Protectiveness Goals

The highest priority of the RCRA Corrective Action Program is to make sure that people are not being exposed to risky levels of contaminants. Another high priority is to protect our nation's groundwater resources. While final remedies remain the RCRA Corrective Action program's long-term objective, EPA developed two environmental indicators to focus resources on early risk reduction and risk communication. EPA is also currently using these indicators as program measures for the Government Performance and Results Act. These indicators track the progress being made nationwide on reducing near terms risks at RCRA facilities.

The RCRA Cleanup Reforms focus on achieving these two environmental indicators at 1,714 RCRA Corrective Action Facilities. The program's specific goals, which are also established under the Government Performance and Results Act, are as follows: by 2005, the States and EPA will verify and document that 95% of the 1,714 facilities (baseline established in 1997) have "Current Human Exposures Under Control" and 70% will have "Migration of Contaminated Groundwater Under Control." You can see the progress toward achieving these goals at http://www.epa.gov/oswfiles/rcraweb/web_reporting/caindicators.htm .

[1] Levels of concern are generally concentrations of each contaminant in groundwater appropriate for the protection of the groundwater resource and its maximum beneficial use.

## *How does a facility achieve an Environmental Indicator?*

For Current Human Exposures Under Control, facilities should be able to demonstrate that there are no current unacceptable human exposures to contamination from the facility. For "Migration of Contaminated Groundwater Under Control," a facility should be able to demonstrate that groundwater contamination above levels of concern is not moving beyond the furthest three-dimensional extent to which a contaminant or contaminants occurring in groundwater have migrated. These two indicators reflect facility-wide conditions for contamination that RCRA Corrective Action can address.

## *Who determines when a facility achieves an Environmental Indicator goal?*

EPA or the State determines when a facility achieves an Environmental Indicator goal. However, facilities or their consultants may assist EPA in the evaluation by providing information on the current environmental conditions.

## *Does a facility need to perform additional investigation or cleanup, once the facility achieves the environmental indicators?*

Achieving the Environmental Indicators is an important interim milestone and does not relieve a facility from meeting investigation objectives or from achieving EPA's final remediation goals. The facility will often need to conduct further investigation to support evaluation and selection of final remedies. Furthermore, the facility may need to conduct remedial actions that might be outside the scope of these two Environmental Indicators to achieve other short-term (e.g., source control) and final remediation goals for groundwater (e.g., restoring contaminated groundwater).



## *How do I consider groundwater use in evaluating "Current Human Exposures Under Control?"*

You should consider whether there is any current human exposure to contaminated groundwater. This determination relies on actual facility conditions rather than on an aquifer's groundwater use designation. In making this environmental indicator determination, the regulator considers all reasonably expected direct and indirect ways humans could be exposed to contaminated groundwater. Some examples of direct routes of exposure include drinking contaminated groundwater or having skin come into contact with contaminated groundwater from bathing. Examples of indirect exposure include breathing contaminated vapors entering buildings from underlying contaminated groundwater, and ingestion of sediments, surface water or fish that are contaminated from groundwater discharged to surface water.

## *How do I consider groundwater use in evaluating the "Migration of Contaminated Groundwater Under Control?"*

Regulators should consider the groundwater use designation when establishing the "levels of concern" in groundwater. Levels of concern are concentrations of each contaminant in groundwater that are appropriate for the protection of the groundwater resource and its maximum beneficial use. The level of concern will define the boundary of a contaminant plume which should not be expanding to meet this indicator. Monitoring locations proximate to the outer perimeter of the plume should demonstrate that the plume is not migrating above levels of

concern. EPA determines levels of concern on a facility-specific basis, but these would commonly be the groundwater clean-up levels developed to be consistent with the groundwater use designation and considering other current routes of exposure from contaminated groundwater. However, a regulator may choose to define the boundary using more conservative levels of concern, because conservative screening levels may be more readily available. For example, early in an investigation, the regulator may choose to use drinking water standards to define the level of concern, because sufficient information is not yet available to develop appropriate facility-specific concentrations. Generally drinking water standards will be acceptable to define the boundary of a plume when evaluating this Environmental Indicator unless more stringent levels are needed based on other actual exposures to contaminated groundwater (e.g., inhalation).

According to EPA's guidance on Environmental Indicators, the Migration of Contaminated Groundwater Under Control Environmental Indicator could be achieved even when the plume is off-site. This position is consistent with the previously stated short-term goal of preventing further migration of contaminated groundwater. However, remediation of the off-site plume will often be a high priority for regulators because facilities typically have less ability to control exposures outside the boundary of the facility.

### *Can a facility achieve the "Migration of Contaminated Groundwater Under Control" when groundwater discharges to surface water?*

Yes. A facility can achieve this indicator once the regulator determines that the current discharge of contaminated groundwater into surface water does not cause unacceptable impacts to surface water, sediments, or eco-systems.



### *Key References:*

EPA, 1999f. Interim Final Guidance for RCRA Corrective Action Environmental Indicators (February 5). Available at http://www.epa.gov/epaoswer/osw/ei_guida.pdf .

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant pages describing the stabilization initiative and environmental indicators on 19436-37, and discussion of interim measures on page 19446-47.

EPA, 1991a. Managing the Corrective Action Program for Environmental Results: The RCRA Stabilization Effort (October 25). Available at http://yosemite.epa.gov/osw/rcra.nsf/d8382df2d09b6466852565280051974 5/27d1baa5c1dbb8f38525670f006be76d?OpenDocument

# Final Remediation Goals

(Updated 4/20/00)

## *What are EPA's final remediation goals for groundwater?*

EPA believes that you should use the following threshold criteria[1] as general goals for cleanup and screening tools for potential final remedies, including final groundwater remedies:

(1) Protect human health and the environment.

(2) Achieve media cleanup objectives appropriate to the assumptions regarding current and reasonably expected land use(s) and current and potential beneficial uses of water resources.

(3) Remediate the sources of releases so as to eliminate or reduce further releases of hazardous wastes or hazardous constituents that may pose a threat to human health and the environment.

**Rationale for**
**Final Remediation Goals**

EPA's policy on final remediation goals recognizes that groundwater is a resource that should be protected and restored. This policy is important to ensure the short- and long-term availability of our Nation's groundwater resources and to preserve and protect hydraulically connected surface water and their ecosystems.



Protecting human health and the environment is the mandate from the RCRA statute and regulations; therefore, it is appropriate to include this goal as the first threshold criteria for final RCRA corrective action remedies. This threshold criterion also serves to ensure that remedies include protective activities (e.g., providing an alternative drinking water supply) that would not necessarily be needed to achieve the other criteria. However, EPA also believes that remedies should meet the second and third criteria as a means to demonstrate progress toward achieving the overall mandate to protect human health and the environment.

For groundwater remedies, EPA's goal is to protect human health and the environment, which includes protection of our nation's groundwater resources. In determining appropriate protection and remediation strategies, EPA will consider the use, value and vulnerability of the resource. In support of these overall groundwater goals, EPA expects that final remedies, for facilities subject to RCRA Corrective Action, will return usable groundwaters to their maximum beneficial use, wherever practicable, within a time frame that is reasonable given the particular circumstances of the facility. Where restoration of groundwater to appropriate cleanup levels is not practicable, EPA expects facilities to prevent or minimize the further migration of a plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction. EPA also expects facilities to control or eliminate surface and subsurface sources of groundwater contamination. In controlling sources, EPA prefers approaches that lead to permanent reductions in toxicity, mobility, or volume. Additionally, EPA typically expects that treatment will be used to address source materials considered to be "principal threats," i.e., materials that are highly toxic or highly mobile that

[1] The 1996 ANPR lists four remedy threshold criteria. EPA no longer believes that the criterion "complying with applicable standards for waste management" is necessary since complying with applicable waste management standards is automatically required under existing RCRA Subtitle C and D regulations.

generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. For a complete list of EPA's expectations for final remedies, you should refer to page 19448 of the May 1, 1996 ANPR. (http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf ).

### *How does groundwater use affect the final remediation goal?*

Current and reasonably expected groundwater use is a critical factor in determining the final groundwater remediation goal because EPA's expectation is to "return usable groundwaters to their maximum beneficial uses." The groundwater use designation should serve as a starting point for determining the maximum beneficial use of the groundwater. You should refer to the groundwater use designation policy in this Handbook to help you determine whether the use at a facility will be based on a State designation or the Federal guidelines. To identify other important aspects of how groundwater use affects final remedies, you should refer to other topics in this Handbook such as groundwater cleanup objectives (which includes groundwater cleanup levels, point of compliance and remediation time frames), source control, technical impracticability, performance monitoring, and completing groundwater remedies.

### *Key Reference:*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant pages: 19448-52.

EPA, 1991b. Protecting the Nation's Groundwater: EPA's Strategy for the 1990's. Office of the Administrator. Washington, D.C. For more information, refer to http://www.epa.gov/OGWDW/Pubs/11ground.html .

EPA, 1991c. A Guide to Principal Threats an Low Level Threat Wastes. Superfund Publication 9380.3-06FS (November). Available at http://www.epa.gov/oerrpage/superfund/resources/gwdocs/threat.pdf .

# Groundwater Cleanup Objectives

(updated 4/20/00)

## *What are groundwater cleanup objectives?*

EPA's general expectation for groundwater remediation is to "return usable groundwaters to their maximum beneficial uses." EPA recommends that you use clear and concise groundwater cleanup objectives to help focus evaluation, selection and implementation of remedies aimed at meeting this expectation. Groundwater cleanup objectives are best expressed in terms of three components: groundwater cleanup levels, point of compliance, and remediation time frames. Groundwater cleanup levels represent specific concentrations of chemicals designed to be protective of the groundwater use and other possible routes of exposure. Point of compliance represents the locations where the groundwater cleanup levels should be achieved at the conclusion of the groundwater remedy. Remediation time frames typically include both the time it would take to implement the remedy and the estimated time to achieve the groundwater cleanup levels at the point of compliance.

### Rationale for Groundwater Cleanup Objectives

Groundwater cleanup objectives should quantify the scope of cleanup required and create performance measures to determine whether a remedy is working. EPA defines groundwater cleanup levels, point of compliance, and remediation time frames as the three specific and measurable components of generic groundwater cleanup objectives. For each component, EPA recommends the specific approaches in this Handbook to ensure protection of human health and the environment, now and in the future.



## *Who specifies groundwater cleanup objectives?*

Facilities should recommend groundwater cleanup objectives, including all three components. Regulators should consider a facility's recommendation when developing groundwater cleanup objectives to be included in a final remedial decision.

## *How do groundwater use designations affect groundwater cleanup objectives?*

Groundwater use designations generally should influence groundwater cleanup levels and might affect remediation time frames, but generally should not affect the point of compliance. You should consider the groundwater use designation when identifying groundwater cleanup objectives, because those objectives will focus the cleanup on achieving the final remediation goal of returning contaminated groundwater to its maximum beneficial use(s). The relationship between the three components of groundwater cleanup objectives and groundwater use is more fully described in the next three policy discussions in this Handbook.

## *What is the role of groundwater use in developing facility-specific groundwater cleanup objectives?*

First, you should verify that the groundwater use designation is valid. For example, even if the State designation defines the aquifer as a non-drinking water resource, regulators and facilities should verify that no one is drinking the groundwater and that no other unacceptable exposure to contaminants from groundwater is occurring.

Second, once verified, the groundwater use designation may serve as a starting point for establishing facility-specific groundwater cleanup objectives. The facility-specific cleanup objectives should at least be consistent with the groundwater use designation, but should also consider all known or reasonably expected groundwater uses and potential exposures through cross-media transfer, such as volatilization into buildings and hydraulic connections to surface waters and other aquifers. For example, a designation may identify groundwater in a particular area as not a source of drinking water, but the groundwater discharges into an adjacent surface water body. In this example, the regulator should establish groundwater cleanup objectives designed to protect the surface water body.

At a facility-specific level, there may be uses of groundwater or exposures to contaminants from groundwater which may not be considered in a State groundwater use designation. For example, other uses of and exposures to groundwater could include: industrial uses, cooling water, car washes, livestock watering, land irrigation. For example, where groundwater is used for lawn irrigation, sprinklers could cause unacceptable exposure to children through contact of contaminated groundwater to their skin or from breathing contaminants that have volatilized from the groundwater. Furthermore, exposures to contaminants from groundwater could occur even when there is no direct use of the groundwater. For example, groundwater may recharge to adjacent or underlying aquifers that are used for drinking water, or discharge to surface water to support aquatic life, recreation, drinking water, etc. Additionally, exposure to contaminants in indoor air could result from underlying groundwater contaminated with volatile chemicals.



After determining all of the current and reasonably expected uses of groundwater at and around the facility, regulators should make cleanup decisions based on the maximum beneficial use. Within the range of reasonably expected uses, the maximum beneficial groundwater use is the one which that warrants the most stringent groundwater cleanup levels.

## *Key Reference:*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant pages: 19449-52.

# Groundwater Cleanup Levels

(updated 4/20/00)

### *What are groundwater cleanup levels?*

Groundwater cleanup levels are facility-specific chemical concentrations in groundwater that a final remedy should achieve for the remedy to be considered complete. Groundwater cleanup levels should consider groundwater use designations and protect human health and the environment. Additionally, groundwater cleanup levels often serve as the basis for identifying the "level of concern" used for the Migration of Contaminated Groundwater Under Control environmental indicator.

### *How should groundwater cleanup levels be developed?*

Groundwater cleanup levels for human health should typically either be developed by using existing cleanup standards (e.g. drinking water standards) or developed based on the degree of actual or potential exposure to a groundwater contaminant (resulting in an estimate of dose) and the toxicity of the contaminant resulting in an estimate of risk. Once an appropriate exposure scenario is determined, groundwater cleanup levels are calculated to fall within generally acceptable levels of risk. EPA recommends that regulators choose risk-based cleanup levels as follows:

**Rationale**
**for Groundwater Cleanup Levels**

Groundwater cleanup levels provide clear numerical targets. These targets are important to measure both progress and completion of a groundwater cleanup. The selection of groundwater cleanup levels based on the current use as well as the groundwater use designation allows stakeholders to recognize various uses of the groundwater. This approach ensures current as well as future protection of human health and the environment.

1. For known or suspected carcinogens, regulators should establish groundwater cleanup levels at concentrations which represent an excess upper bound lifetime risk[2] to an individual of between $1x10^{-4}$ and $1x10^{-6}$ (commonly referred to as EPA's risk range). Note that EPA prefers cleanup levels at the more protective end of the risk range. For facilities with multiple contaminants or exposure pathways, cleanup levels should generally be set so that cumulative (total) excess upper bound lifetime risk from all contaminants still falls within the risk range.

2. For toxicants associated with adverse effects other than cancer, groundwater cleanup levels should be established at concentrations to which human populations, including sensitive subgroups could be exposed on a daily basis without appreciable risk of negative effect during a lifetime. Such levels are generally interpreted as equal to or

[2] EPA expresses cancer risk in terms of the likelihood that a person might develop cancer from exposure to contaminants from a facility. For example, a risk assessment might say that a receptor has an upper bound excess cancer risk of $1x10^{-4}$. The numerical estimate means that if 10,000 people received this level of exposure averaged over a 70-year lifetime, no more than one would have a probability of developing cancer. Depending on facility-specific factors, EPA's threshold of acceptable cancer risk ranges from $1 \times 10^{-6}$ to $1 \times 10^{-4}$, or from one in one million to one in ten thousand. Screening values are generally set at a cancer risk of $1x10^{-6}$.

below a hazard quotient of one[3]. For facilities with multiple contaminants or exposure pathways, groundwater cleanup levels should generally be equal to or below a hazard index of one[4].

In addition to protecting human health, groundwater cleanup levels should protect unacceptable cross-media transfer and unacceptable risks to ecologic receptors. For additional guidance on ecologic risk issues, you should refer to numerous resources developed by EPA's Superfund Program avalable at http://www.epa.gov/oerrpage/superfund/programs/risk/ecolgc.htm .

### *What is the role of groundwater use in setting cleanup levels?*

The groundwater use designation is typically the starting point for determining the appropriate exposure scenarios to evaluate risks and identify cleanup levels. For groundwater that is currently used or designated as a current or reasonably expected source of drinking water, regulators should select cleanup levels protective for residential use. For constituents with maximum contaminant levels (MCLs) promulgated under the Safe Drinking Water Act, regulators generally establish groundwater cleanup levels as MCLs. For constituents for which no MCLs have been promulgated, regulators may rely on other established drinking water standards or a risk assessment incorporating standard residential exposure assumptions (for example, ingestion rate of 2 liters/day, exposure frequency of 350 days/year, etc.) to estimate contaminant dose, derive risk estimates, and determine groundwater cleanup levels.



### *What is the cleanup level if no one is drinking the groundwater?*

Even if no one is currently drinking the groundwater, the cleanup level may still be based on drinking water use if the aquifer is considered by EPA or the State to be a reasonably expected future source of drinking water. Stakeholders should consider State groundwater use designations when deciding whether an aquifer is a reasonably expected future source of drinking water.

### *What is the cleanup level if the groundwater use is designated as non-drinking water?*

For a non drinking water groundwater use designation, the cleanup level might not be based on drinking water, but should be protective for other uses and exposures that could occur under its designation. Such uses and exposures could include: sanitary purposes at an industrial facility (including showering), industrial cooling water, car washing, agricultural uses and irrigation. Furthermore, exposures to contaminants from groundwater could occur even when there is no direct use of the groundwater. For example, groundwater may recharge adjacent or underlying aquifers that are used for drinking water or may discharge to surface

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[3] EPA expresses non-cancer health risk as a ratio, known as the Hazard Quotient (HQ), which is defined as the calculated exposure from a single contaminant in a single medium divided by a reference dose. The reference dose is the level of exposure that EPA believes will be without adverse effect in human populations, including sensitive individuals. Note that some chemicals may be associated with both carcinogenic as well as non-carcinogenic effects (such as liver or kidney disease); both should be considered when setting the cleanup level.

[4] The hazard index (HI) assesses potential for toxicity following exposure to multiple contaminants. It is equal to the sum of the hazard quotients. However, where information is available to identify the critical toxic effect for non-carcinogens, only hazard quotients with associated with similar critical effects (target organs) are combined.

water to support aquatic life, recreation, or drinking water, etc. Additionally, exposure to contaminants in indoor air could result from underlying groundwater contaminated with volatile chemicals. Facilities should identify the various uses and exposures (i.e. pathways) to contaminants from groundwater to develop protective groundwater cleanup levels for the facility. To estimate dose, you should evaluate all current and potential routes of exposure within each pathway, such as inhalation, dermal contact, and inadvertent ingestion. EPA does not currently have standard exposure assumptions for most non-residential uses of groundwater. Facilities, in consultation with the regulators, generally should quantify facility-specific exposure assumptions for all expected pathways by collecting facility-specific or other relevant data to develop an appropriate numerical value for those exposures. These exposure values along with toxicity values for each contaminant are then used to calculate contaminant-specific concentrations (groundwater cleanup levels) to achieve protective risk levels (i.e. an excess upper bound lifetime cancer risk of $1x10^{-4}$ to $1x10^{-6}$ or a hazard index of one).

Some States have established generic cleanup levels for groundwater in non-drinking water aquifers. In those states, facilities and regulators should consider these levels when appropriate.

## *Are there any situations where the levels described above might not be appropriate?*



Yes. For example, groundwater cleanup levels that are higher or lower than the levels described above, might be appropriate in the two following circumstances, provided such cleanup levels protect human health and the environment:

(1) Higher cleanup levels may be appropriate, for a given facility, when groundwater is also contaminated by hazardous constituents that are naturally occurring[5], or have originated from a source not associated with the subject facility, and those hazardous constituents are present in concentrations such that remediation of the release would not provide significant reduction in risks to actual or potential receptors.

(2) Lower groundwater cleanup levels may be necessary because of unacceptable risks to human receptors from combined effects of hazardous wastes or hazardous constituents, or to protect potential receptors exposed through cross media transfer, or to protect ecologic receptors.

## *Are there any situations where I don't need to set a groundwater cleanup level?*

Yes. In some cases, the groundwater will already be at acceptable levels for its designated use(s). In other situations, regulators might not establish specific groundwater cleanup levels if: the contaminated groundwater is within a designated non-drinking water aquifer; has no current or foreseeable beneficial use; does not discharge to surface water or to a drinking water aquifer at levels that could cause concern; and does not cause other exposures through media transfer (e.g., indoor air). However, the regulator may still require you to conduct monitoring to ensure continued protection of human health and the environment. Other EPA policies dealing with issues, such as source control, would still likely apply in this situation.

[5] Naturally occurring substance in its unaltered form, or altered solely through naturally occurring processes or phenomena, [in] a location where it is naturally found (Superfund, Section 104(a)(3)(A)).

## *Do alternate concentration limits apply to setting groundwater cleanup levels for facility-wide corrective action?*

Alternate Concentration Limits (ACLs) apply to corrective action at RCRA regulated units[6], and, therefore, would not typically apply to facility-wide corrective action. ACLs are levels that can be used, as appropriate, to establish groundwater protection standards[7] for RCRA regulated land based units (i.e., all surface impoundments, waste piles, land treatment units, and landfills that received hazardous waste after July 26, 1982). These units are subject to groundwater monitoring and corrective action requirements contained in 40 CFR Part 264, Subpart F. ACLs, which are established in 40 CFR 264.94(b), allow for groundwater protection standards developed based on risk rather than background, and allow decision makers to consider natural attenuation processes in remediating groundwater contamination from RCRA regulated units, where appropriate. Both of these concepts (i.e., risk-based standards and natural attenuation approaches) are available for facility-wide corrective action as explained in other policies discussed in this Handbook. If you have a regulated unit and want to use ACLs, you should read the Alternate Concentration Limit Guidance, July 1987 and call the overseeing regulator.

Under limited circumstances specified in CERCLA 121(d)(2)(B)(ii), ACLs may also be used at Superfund sites. Guidance for using Superfund ACLs is found in the "Rules of Thumb for Superfund Remedy Selection" (EPA, 1997).

## *What are my cleanup levels for groundwater if I am clean closing a RCRA regulated unit?*



To achieve "clean closure," facilities should remove or decontaminate all hazardous waste, liners and environmental media contaminated by releases from the unit. However, hazardous constituents may remain at some level in environmental media, such as groundwater, after clean closure provided the constituents are below levels that may pose a risk to human health or the environment. In 1998, EPA issued a memorandum broadening the interpretation of acceptable levels of residual constituents. This expanded interpretation allows the use of non-residential exposure assumptions to be incorporated into the development of closure standards (i.e. the concentrations that each medium should achieve for the unit to be clean closed.) When the groundwater protection standards are based on a groundwater use designation other than drinking water standards, EPA or the State should be confident that the exposure assumed remains valid (e.g., periodic evaluations of actual use, zoning and/or easements to third parties) since no further regulatory control will be required under subtitle C. For more information on risk based closure, you should read the *Risk-Based Clean Closure* Memorandum and call your overseeing regulator.

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[6] Regulated units are defined in 40 CFR 264.90 as surface impoundments, waste piles, land treatment units, and landfills that received hazardous waste after July 26, 1982.

[7] Groundwater protection standards are constituent concentrations established in permits which trigger corrective action and demonstrate satisfaction of closure requirements.

### *References:*

EPA, 1998c. Memorandum from Elizabeth Cotsworth to RCRA Senior Policy Advisors titled, Risk-Based Clean Closure (March 16). Available at http://www.epa.gov/epaoswer/hazwaste/ca/ .

EPA, 1997b. Rules of Thumb for Superfund Remedy Selection (EPA 540-R-97-013). Available at http://www.epa.gov/superfund/resources/rules/rulesthm.pdf

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant pages: 19448-52.

EPA, 1987. Alternate Concentration Limit Guidance (EPA/530-SW-87017).

# Point of Compliance

(Updated 4/20/00)

## *What is the groundwater point of compliance for RCRA Corrective Action?*

The point of compliance for groundwater, in the context of RCRA corrective action, represents where the facility should meet groundwater cleanup levels within a contaminated aquifer at the conclusion of a final remedy (i.e., the facility has achieved its final remediation goals). Facilities should generally meet groundwater cleanup levels throughout the area where groundwater is contaminated above the cleanup level(s), or, when waste is left in place, throughout the plume beyond the boundary of the waste management area encompassing the original source(s) of groundwater contamination. EPA typically refers to this approach as the "throughout-the-plume/unit boundary" point of compliance. This definition of point of compliance is consistent with "area of attainment" (EPA, 1988) and "point of compliance" (EPA, 1997) for groundwater remedies under the Superfund cleanup program.

### Rationale
### for Point of Compliance

The "throughout-the-plume/unit boundary" point of compliance for groundwater represents current EPA policy because it is consistent with EPA's final remediation goal by not allowing the spread of contamination, and by restoring more of the nation's groundwater resources to beneficial use. For example, if the remedial goal is to restore the groundwater to be suitable for drinking water, the throughout-the plume/unit boundary point of compliance will help you to determine when restoration of all of the contaminated groundwater has been attained so that no further controls are necessary.

EPA's policy on the groundwater point of compliance avoids the need to install groundwater monitoring devices through waste, such as in a landfill, that is left in place as part of a final remedy.

EPA recognizes that achieving groundwater cleanup levels at the point of compliance in many circumstances may take a considerable length of time. Therefore, facilities and regulators may want to consider establishing other interim milestones by which progress can be measured. Examples of such other milestones could include the time when a facility documents that the remedy has been constructed and it is operating successfully.

Factors to consider when developing a facility-specific groundwater point of compliance include proximity of sources and technical practicability of groundwater remediation.

## *What is the point of compliance when a facility has more than one source of groundwater contamination?*

If waste is left in place in multiple areas in close proximity to each other, the point of compliance should be throughout the plume beyond the boundary of a "waste management area" encompassing all of these sources. If the sources are not close each other, the point of compliance should be established throughout the plume beyond the boundaries of the individual areas where waste is left in place as part of a final remedy.

### *How does a technical impracticability determination affect the point of compliance?*

The "throughout-the-plume/unit boundary" point of compliance for groundwater would generally apply even in the context of a technical impracticability (TI) determination (see discussion in this Handbook on Technical Impracticability). However, the goal of achieving groundwater cleanup levels should apply outside the spatial area (TI zone) identified by the facility and approved by the regulator in a TI determination. This TI zone is similar to a waste management area described previously in this policy, and the point of compliance for groundwater should be throughout the plume beyond the limit of the TI zone. The facility in this context would generally not be responsible for achieving groundwater cleanup levels within the TI zone as long as the regulator agrees that the TI determination remains valid. It is important to remember that even if a remedy achieves cleanup levels outside the TI zone, a facility's corrective action obligations for implementing, maintaining and monitoring the containment within the TI zone should continue (1) as long as these obligations are necessary to protect human health and the environment, or (2) until such time that cleanup within the TI zone becomes technically practicable and the cleanup levels are achieved throughout the entire plume (i.e., even within the formerly identified TI zone).

### *What is the role of groundwater use in establishing a point of compliance for groundwater?*

Under RCRA Corrective Action, the groundwater use designation should not affect the point of compliance[1]. However, the groundwater use designation may affect groundwater cleanup levels that the facility attains at the point of compliance**,** and may also affect remediation time frames.



### *Key Reference:*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant page: 19450.

EPA, 1988. OSWER Directive 9283.1-2, "Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites," (December 1).

[1] The May 1, 1996 ANPR recommended that groundwater vulnerability, use and likely exposures be considered as factors in establishing a groundwater point of compliance. EPA generally believes that vulnerability, use and likely exposures should be considered when establishing groundwater cleanup levels and remediation time frames, but they should not generally affect the point of compliance. Retaining the throughout the plume/unit boundary point of compliance, regardless of groundwater use, provides a means for a facility to demonstrate that cleanup levels based on the designated groundwater use have been achieved throughout the facility, and that they have fulfilled all corrective action obligations concerning contaminated groundwater. EPA, however, remains interesting in comments on this issue.

# Remediation Time Frame

(Updated 4/20/00)

## *What is the remediation time frame?*

The remediation time frame for groundwater is the facility-specific schedule for a groundwater remedy. It includes the time frame to construct the remedy and an estimate of the time frame to achieve groundwater cleanup levels at the point of compliance. EPA believes that remediation time frame should be reasonable based on facility-specific conditions and consider the following factors where appropriate:

- groundwater use designation
- nature and extent of contamination
- reliability of exposure controls
- capabilities of technologies
- availability of treatment and/or disposal capacity of remediation wastes
- costs for alternative water supplies
- when the groundwater might be used
- community preferences
- financial resources of the facility

### Rationale
### for Remediation Time Frame

EPA's policy on remediation time frame provides flexibility that can maintain protectiveness while improving cost effectiveness. Recognizing a longer-remediation time frame can provide a greater range of possible cleanup options. For example, monitored natural attenuation might be appropriate where a longer remediation time frame is acceptable. By accepting reasonable remediation time frames, the RCRA Corrective Action program can direct its resources on achieving short-term protectiveness goals at more facilities, while maintaining its long-term goals.

## *What is the role of groundwater use in determining remediation time frames?*

Groundwater use is an important factor in estimating time frames. For example, if no one is currently drinking the groundwater, a longer remediation time frame may be acceptable. However, a regulator is more likely to accept a long time frame when the contaminant plume is not expanding, source control measures are implemented, there is adequate monitoring, and controls are in place to prevent exposure (e.g., drinking water wells are prohibited).

## *In what types of situations might specific remediation time frames not be defined?*

An estimate of the remediation time frame needed to achieve groundwater cleanup levels might not be necessary when the facility-specific groundwater cleanup objective does not include a specific goal of returning the contaminated groundwater to its designated use (e.g., technical impracticability). However, even in this circumstance, you should include a remediation time frame associated with how long it will take to implement the alternative remedial strategy (e.g, containment system) and achieve its goals.

## *Key Reference :*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant page: 19450.

# Source Control

(Updated 4/20/00)

## *What does source control mean?*

Source control refers to a range of actions (e.g. removal, treatment in place, containment, etc.) designed to protect human health and the environment from sources of contamination. EPA considers source control as an important element in final remedies (see Final Remediation Goals).

### Rationale for Source Control

EPA's continuing emphasis on source control reflects the Agency's strong preference for remedies that are protective in the long term. For groundwater, source control is critical to return our nation's contaminated groundwaters to their maximum beneficial uses in a reasonable time frame, and to ensure that uncontaminated groundwater is available for future generations. Controlling sources of contamination is also consistent with the Agency's long-standing policies dealing with pollution prevention; it is generally easier to deal with the contamination at the source than to clean up wide-spread contamination.

## *What are sources of contamination?*

EPA defines sources as contaminated material that acts as a reservoir for the continued migration of contamination to surrounding environmental media (i.e. soil, groundwater, surface water, sediment, or air), or provides a direct threat to a receptor. Sources are not always stationary, but can migrate from a location, such as a landfill or surface impoundment, where the contamination was originally released. For example, dense non-aqueous phase liquids (DNAPLs) may be present as a "mobile" phase that continues to migrate deeper into the subsurface, migrate along a subsurface feature, or accumulate in a subsurface feature, such as a depression in a low permeable layer of clay.



## *What are EPA's general expectations for source control regarding groundwater?*

EPA generally expects facilities to control or eliminate surface and subsurface sources of groundwater contamination. Facilities should implement source controls as necessary to achieve short-term protectiveness goals. For example, placing a temporary cover over highly contaminated soils may be appropriate to prevent leaching of the contaminants to underlying groundwater in the short-term while a facility pursues long-term remedies. EPA believes that source control is also a key element of final remedies that are selected to achieve final remediation goals. As such, EPA questions whether final remedies that fail to include source control would meet the overall RCRA statutory mandate to protect human health and the environment.

## *When should I consider source control measures?*

You should consider source control measures as early as possible to: (1) evaluate whether source controls are necessary to achieve short-term protectiveness goals; (2) establish investigation data needs; and, (3) develop cleanup options to achieve final remediation goals.

### *When can I contain the sources rather than treat them?*

EPA prefers approaches that use treatment to address wastes and contaminated media that EPA considers "principal threats." EPA considers sources or "source materials" to be principal threats when they are highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. EPA expects to use engineering controls, such as containment, for wastes and contaminated media which can be reliably contained, pose relatively low long-term threats, or for which treatment is impracticable. The exact balance between treating, removing, and containing the source is best determined on a case-by-case basis during remedy evaluation and selection. Along with identifying principal threats, you should also generally consider other factors such as long-term reliability, short-term risks, and community acceptance when evaluating the right balance between containment and treatment.

In some situations, it may be appropriate to contain rather than treat even principal threat wates due to difficulties in treating the wastes. For example, the following situations (EPA, 1997) could justifiably lead a regulator to decide that containment rather than treatment would be acceptable for principal threat wastes:

- Treatment technologies are not technically feasible or are not available within a reasonable time frame;
- The extraordinary volume of materials or complexity of the site may make implementation of the treatment technologies impracticable (e.g., large landfills);
- Implementation of a treatment-based remedy would result in greater overall risk to human health and the environment due to risks posed to workers, the surrounding community, or impacted ecosystems during implementation (to the degree that these risks cannot be otherwise addressed through implementation measures); and
- Implementation of the treatment technology would have severe effects across environmental media.



### *How does groundwater use affect source control?*

EPA generally expects facilities to control the sources of contamination regardless of the current groundwater use or the groundwater use designation. However, the current use and reasonably expected future uses of groundwater may impact the urgency for implementing source control measures.

### *Why should I control sources when I've already achieved Environmental Indicators?*

Environmental Indicators are only a milestone on the way to meeting final remediation goals and completing corrective action. In most cases, source control will be necessary to restore groundwater to its maximum beneficial use within a reasonable time frame.

### *Key References:*

EPA, 1997b. Rules of Thumb for Superfund Remedy Selection, OSWER Directive No. 9355.0-69 (August). Available at http://www.epa.gov/oerrpage/superfund/resources/rules/index.htm . Particularly relevant pages pertaining to applicability to RCRA Corrective Action on page 1, and on Treatment of Principal Threat Wastes on pages 11 and12.

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant pages: 19448.

EPA, 1991c. A Guide to Principal Threats an Low Level Threat Wastes. Superfund Publication 9380.3-06FS (November). Available at http://www.epa.gov/oerrpage/superfund/resources/gwdocs/threat.pdf .

# Monitored Natural Attenuation

(Updated 4/20/00)

## *What is monitored natural attenuation?*

The term "monitored natural attenuation" refers to an approach to clean up environmental contamination by relying on natural processes and monitoring. Natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contaminants in groundwater.

## *When is monitored natural attenuation a likely cleanup option?*

MNA may be an acceptable cleanup option when the facility can demonstrate that the remedy is capable of achieving the overall RCRA statutory mandate to protect human health. In addition, EPA looks more favorably on those MNA proposals that would where:

- the facility can demonstrate that MNA will be able to achieve groundwater cleanup objectives;
- measures for source control of groundwater contamination are already in-place;
- the dominant natural attenuation processes cause degradation or destruction of contaminants as opposed to those processes that merely dilute contamination or prevent its movement;
- the contaminant plume(s) is already stable or shrinking in extent; and,
- the facility uses MNA in conjunction with an active remedial system or as a follow-up measure.



### Rationale for Monitored Natural Attenuation

This policy reflects EPA's commitment to groundwater protection, and promotes responsible use of monitored natural attenuation remedies. This policy also reflects advancements in EPA's understanding of how natural attenuation processes can be part of effective remedial strategies. Monitored natural attenuation is not a "no action" remedial alternative. Appropriate use of monitored natural attenuation supports EPA's remediation objectives which include source control, prevention of plume migration, and restoration of contaminated groundwaters to maximum beneficial uses.

## *Is monitored natural attenuation acceptable when contaminated groundwater is off-site?*

The April 21, 1999 EPA Policy Directive on monitored natural attenuation does not distinguish between on-site and off-site contaminated groundwater. Therefore, using a monitored natural attenuation remedy for off-site contaminated groundwater would not be in conflict with EPA policy provided that the remedy is consistent with the rest of EPA's guidance. For example, if a plume is already off-site, regulators might accept a monitored natural attenuation remedy when no one is currently exposed to the contaminated groundwater and it meets EPA's short-term protectiveness goals. Other very important factors for relying on monitored natural attenuation for off-site contamination include thorough public participation, and the ability to conduct long-term monitoring and prevent exposures.

### *How long should a facility monitor a Monitored Natural Attenuation Remedy?*

A facility should monitor until the groundwater cleanup levels are met at the point of compliance. EPA specifically added the term "monitored" to the name of this remedial alternative to emphasize the importance of long-term performance monitoring. EPA's Policy Directive states, "Performance monitoring should continue until remediation objectives have been achieved, and longer if necessary to verify that the facility no longer poses a threat to human health or the environment." However, the Directive also emphasizes that it is important to include flexibility sufficient to adjust the frequency (more frequent or less frequent) of monitoring as the situation warrants.

### *How does groundwater use influence a monitored natural attenuation remedy?*

Current use and the groundwater use designation are important to consider when evaluating a monitored natural attenuation remedy. Stakeholders should be aware of the current uses of groundwater in the vicinity of the facility and be confident that the contaminated groundwater does not represent an unacceptable threat to those users. Stakeholders should also consider other possible ways exposure from the contaminated groundwater could occur. For example, certain chemicals present in groundwater could volatilize, migrate as a gas into structures and expose humans to unacceptable concentrations of indoor air contamination. Contaminants could also migrate from groundwater into surface water resulting in unacceptable exposures to humans and or ecologic receptors using that surface water. Stakeholders should recognize that a potential drinking water designation does not by itself preclude a protective monitored natural attenuation remedy. For example, monitored natural attenuation might be a good remedial option for groundwater that is designated as a potential source of drinking water, but not expected to be used for that purpose in the near future. Stakeholders considering monitored natural attenuation should refer to the discussion of the various uses of groundwater in the groundwater use designation policy contained in this Handbook, and make sure that the remedy will be adequately protective.



## Key References:

EPA, 1999e. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites (April 21). OSWER Policy Directive 9200.4-17P. Available at http://www.epa.gov/swerust1/directiv/d9200417.htm . Other helpful links regarding MNA available at http://www.epa.gov/swerust1/mna/index.htm and http://www.epa.gov/swerust1/oswermna/mnalinks.htm .

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf. Particularly relevant pages: 19451-52.

# Technical Impracticability

(Updated 4/20/00)

## *What does technical impracticability mean?*

Technical impracticability (TI) refers to a situation where achieving groundwater cleanup objectives is not possible from an "engineering perspective." The phrase "engineering perspective" refers to how factors such as feasibility, reliability, scale and safety influence the ability to achieve groundwater cleanup objectives. For example, a certain cleanup approach might be technically possible, but the scale of the operation might be of such magnitude, that it was not technically practicable.

## *What are the primary causes that might lead to a technical impracticability determination?*

Reasons for technical impracticability generally fall into one of two categories:

(1) Hydrogeologic factors
(2) Contaminant-related factors

Examples of limiting hydrogeologic factors could include very low-permeable or highly heterogeneous soils, or complex fractures or solution cavities in bedrock. An example of a contaminant-related factor could be presence of residual non-aqueous phase liquids (NAPLs), although there have been many advancements in NAPL remediation in recent years.

### Rationale
### for Technical Impracticability

Technical impracticability determinations offer a realistic approach to address those situations where currently there are limitations to groundwater restoration. EPA believes that it is appropriate to openly discuss technology limitations rather than establishing unrealistic goals. By recognizing technical impracticability where scientifically justified, we can focus resources on an alternative remedial strategy that is practicable.

Poor cleanup performance due to inadequate remedial design is not sufficient justification for a technical impracticability determination. Design inadequacies could stem from, for example, inadequate characterization, insufficient pumping rates, improper well placement, or selecting inappropriate technologies.

## *Is the mere presence of non-aqueous phase liquids (NAPLs) sufficient to justify a technical impracticability determination?*

No. The presence of NAPL is just one of many factors you should consider when evaluating technical impracticability. Other factors to consider are the type, amount, and location of NAPL, as well as the technologies that are available to clean up the NAPL. Facilities should avoid basing their technical impracticability demonstration on just the presence of NAPL or the apparent inability of any one technology (e.g., pump-and-treat). A technical impracticability determination should be based on a good understanding of hydrogeologic factors, chemical characteristics, and conventional as well as innovative technologies.

## *When should a facility recommend Technical Impracticability?*

Considering technical impracticability early in corrective action (e.g., during facility characterization) is a good idea if you believe a facility has hydrogeologic or chemical-related cleanup limitations. The facility should submit a technical impracticability demonstration along with a recommendation for a final remedy. However, we suggest you do not devote resources on a technical impracticability demonstration until you've achieved the short-term protectiveness goals (e.g., environmental indicators).

## *Who decides whether cleanup of the groundwater is technically impracticable?*

The facility should develop and submit a technical report demonstrating that achieving the groundwater cleanup objectives is technically impracticable. The regulator makes the technical impracticability determination when selecting a final remedy.

## *What should facilities include in a technical impracticability demonstration?*

EPA's guidance (EPA, 1993) on technical impracticability suggests the following:

- Spatial area (the TI zone) over which the TI decision would apply;
- Specific groundwater cleanup objectives that are considered technically impracticable to to achieve;
- Conceptual site model that describes geology, hydrology, groundwater contamination sources, transport and fate;
- Evaluation of the "restoration potential" of the TI zone;
- Cost estimates;
- Any additional information EPA or the State program deems necessary; and
- Description of an alternative remedial strategy.



## *If I get a technical impracticability determination, have I completed corrective action for groundwater?*

No. When the regulator determines that achieving groundwater objectives is technically impracticable, the facility should implement an "alternative remedial strategy." That strategy must protect human health and the environment and should:

- be technically practicable;
- control the sources of contamination and prevent migration of contamination beyond the zone associated with the technical impracticability determination;
- achieve the groundwater cleanup objectives outside the zone associated with the technical impracticability determination; and,
- be consistent with the overall cleanup goals for the facility.

### *How much facility investigation do I have to conduct within the technical impracticability zone?*

You should characterize your facility within the TI zone to: (1) support the technical impracticability demonstration; (2) identify sources that you should control, even within the TI zone; (3) evaluate the potential for cross-media transfer of contamination that may need to be managed (e.g., from groundwater to air) as part of an alternative remedial strategy; and (4) support the development of an alternative remedial strategy as discussed above. The circumstances of the facility will govern the amount of characterization needed to accomplish these objectives.

### *Why should I control sources within the technical impracticability zone?*

Source control is generally an important part of an acceptable alternative remedial strategy and is one of the three recommended threshold criteria for final remedies. Source control prevents the continued input of contamination into surrounding environmental media and can help improve the likelihood that the alternative remedial strategy will be effective in the long-term. Controlling sources within the technical impracticability zone will help to limit the amount of contamination you will need to address if and when achieving the groundwater cleanup objectives becomes technically practicable in the future.

### *How does a technical impracticability determination affect the point of compliance?*



The "throughout-the-plume/unit boundary" point of compliance for groundwater would generally apply even in the context of a TI. However, the goal of achieving groundwater cleanup levels should apply outside the spatial area (TI zone) identified by the facility and approved by the regulator in a TI determination. This TI zone is similar to a waste management area described in this Handbook (see point of compliance). Where a regulator has made a TI determination, the point of compliance for groundwater water should be throughout the plume beyond the limit of the TI zone. The facility in this context would generally not be responsible for achieving groundwater cleanup levels within the TI zone as long as the regulator agrees that the TI determination remains valid. It is important to remember that even if a remedy achieves cleanup levels outside the TI zone, a facility's corrective action obligations for implementing, maintaining and monitoring the containment within the TI zone should continue (1) as long as these obligations are necessary to protect human health and the environment, or (2) until such time that cleanup within the TI zone becomes technically practicable and the cleanup levels are achieved throughout the entire plume (i.e., even within the formerly identified TI zone).

### *How long should a technical impracticability determination last?*

Under EPA's technical impracticability guidance (EPA, 1993), for RCRA Corrective Action, technical impracticability determinations at RCRA facilities, and the responsibility of the facility to manage their facility under the alternative remedial strategy, typically should remain in effect until subsequent advances in technology make achievement of the groundwater cleanup objectives technically practicable. Under this guidance, regulators may require facilities to revisit technical impracticability determinations in the future. Revisiting the technical impracticability determination may be appropriate when new information concerning facility conditions or new technologies indicate that the facility can achieve the groundwater cleanup

objectives. Sometimes, a facility might want to revisit the technical impracticability determination on its own. For example, the facility might want try a new technology that has the ability to achieve the cleanup objectives rather than indefinitely paying for operating and maintenance costs associated with the alternative remedial strategy. Technical impracticability determinations are based on current understanding of capabilities and limitations of cleanup technologies. Stakeholders should consider that future advancements in technologies could overcome today's limitations.

## *How does groundwater use affect a Technical Impracticability determination?*

The groundwater use designation affects a technical impracticability determination because:

- You should use the current groundwater use and the groundwater use designation to develop groundwater cleanup objectives; and,

- A successful technical impracticability demonstration should show that facility conditions prevent the facility from achieving groundwater cleanup objectives.

Therefore, regulators should establish groundwater cleanup objectives prior to considering technical impracticability. For example, if the groundwater use designation is not drinking water, then restoring the contaminated groundwater to drinking water standards might not apply. In a situation where drinking water standards do not apply, the technical impracticability determination would then be based on the inability to achieve groundwater cleanup objectives developed to protect non-drinking water use, such as protection of surface water.



You should also account for current and reasonably expected groundwater use when developing a protective alternative remedial strategy. For example, the long-term reliability of containment technologies and the extent of monitoring, operation and maintenance are critical when groundwater near the facility is currently used for drinking.

## *Key References:*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf. Particularly relevant page: 19451.

EPA, 1993. Guidance for Evaluating the Technical Impracticability of Groundwater Restoration EPA/540-R-93-080, (September). Available at http://www.epa.gov/oerrpage/superfund/resources/gwdocs/techimp.htm.

# Injection of Contaminated Groundwater

(Updated 4/20/00)

## *Can I inject groundwater that is contaminated with hazardous wastes back in the subsurface as part of corrective action?*

RCRA section 3020(a) bans hazardous waste disposal by underground injection into or above an underground source of drinking water located within 1/4 mile from an injection well. However, RCRA section 3020(b) exempts from that ban the injection of groundwater contaminated with hazardous wastes provided that certain conditions are met.

**Rationale**
**for Injection of Contaminated Groundwater**

EPA intends to promote more frequent use of in-situ bioremediation and other in-situ treatments where such technologies are protective and offer advantages over other approaches.

## *What are the specific conditions I have to meet prior to injecting groundwater contaminated with hazardous waste into the subsurface?*

The exemption provided by RCRA section 3020(b) will allow you to inject contaminated groundwater, which is contaminated with hazardous wastes, back into the aquifer from which it was withdrawn if the contaminated groundwater is treated to substantially reduce hazardous constituents prior to such injection. Additionally, that injection needs to be part of a response action under section 104 or 106 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), or part of RCRA corrective action intended to cleanup such contamination; and, the cleanup will, upon completion, be sufficient to protect human health and the environment.



## *Can treatment prior to injection include adding nutrients or other products to the contaminated groundwater designed to promote in-situ bioremediation or other in-situ treatment?*

Yes. This approach is consistent with section 3020(b)(2), as long as the hazardous constituents are substantially reduced, either before injection or as a result of subsequent in-situ treatment, and the remedy complies with sections 3020(b)(1) and (3). The substantial reduction should occur in a reasonable period of time (i.e., in a time period consistent with the CERCLA and/or RCRA remedial decision made for the groundwater) and the overseeing regulatory agency should consider whether hydraulic containment measures and groundwater monitoring would be appropriate to ensure protection of the groundwater resource. Furthermore, stakeholders should be aware that while the RCRA statute could allow for such injection, you may also have to comply with requirements of State Underground Injection Control (UIC) programs. Therefore, you should coordinate with your state regulators to obtain, as necessary, variances, waivers, construction permits, approvals, etc.

### *What is the role of groundwater use with regard to this groundwater injection policy?*

You should use the groundwater use designation to determine the groundwater cleanup levels that need to be achieved either before injection or after injection when it is part of an in-situ remediation system.

### *What if I want to inject groundwater that is contaminated with non-hazardous wastes as part of my RCRA corrective action?*

If the groundwater is not contaminated with hazardous wastes then the ban on injecting hazardous wastes described in RCRA Section 3020(a) does not apply to you. However, you should talk with your state regulator because many states have strict groundwater protection laws that could prohibit the injection of any waste, regardless of whether it is hazardous or not. Additionally, the remedy involving injection should be consistent with the EPA's short-term protectiveness goals when the injection is part of a interim action; and, when the injection is part of a final remedy, the injection should be consistent with EPA's final remediation goals.

### *Key References:*

EPA, 2000. Applicability of RCRA Section 3020 to In-Situ Treatment of Ground Water. Memorandum from Elizabeth Cotsworth, Director, Office of Solid Waste to RCRA Senior Policy Advisors (April or May). Will be available when finalized at http://www.epa.gov/epaoswer/hazwaste/ca/ .

EPA, 1999a. Matthew Hale, Deputy Office Director, Office of Solid Waste to Peggy Harris, Chief of Standardized Permitting Section, California Hazardous waste Permitting Program (December 10). Available at http://yosemite.epa.gov/osw/rcra.nsf/d8382df2d09b6466852565280051974 5/4d0d83ef37ba48f88525684800588ea8?OpenDocument

EPA, 1989a. OSWER Directive 9234.1-06, "Applicability of Land Disposal Restrictions to RCRA and CERCLA Groundwater Treatment Reinjection Superfund Management Review: Recommendation No. 26," (November 27).

# Performance Monitoring

(Updated 4/20/00)

## *Why do facilities need to conduct performance monitoring?*

Facilities should conduct performance monitoring to evaluate whether the facility is achieving short-term protectiveness goals or final remediation goals.

## *What should the performance monitoring accomplish?*

Facilities should design performance monitoring programs to:

- Demonstrate that the remedy is performing according to expectations;
- Detect changes in environmental conditions (e.g., hydrogeologic, geochemical, microbiological, or other changes) that may reduce the efficacy of the remedy;
- Identify any potentially toxic and/or mobile transformation products;
- Verify that the plume(s) is not expanding above levels of concern (either downgradient, laterally or vertically);
- Verify no unacceptable impact to down gradient receptors;
- Detect new releases of contaminants to the environment that could impact the effectiveness of the remedy;
- Demonstrate the effectiveness of institutional controls that were put in place to protect potential receptors; and
- Verify attainment of short-term protectiveness or final remediation goals.

### Rationale
### for Performance Monitoring

Properly designed performance monitoring programs are especially important for groundwater remediation because the concentration and distribution of contamination in the subsurface often change with time. Likewise, natural and human factors (e.g., seasonal precipitation or nearby groundwater usage) can influence the ability of remediation systems to control migration of contaminated groundwater.

For groundwater remediation systems, performance monitoring can assess changes in subsurface conditions so that facilities can modify the remedy to ensure maximum efficiency and protectiveness (e.g., by modifying the location and pumping rate at individual extraction wells).

## *What should a performance monitoring program include?*

The performance monitoring program should specify the location, frequency, and type and quality of samples, techniques and measurements. It should also specify the methods (e.g., statistical analysis) that will be used to evaluate the data and support decision making. The performance monitoring program should also include interim milestones to demonstrate progress toward meeting short-term protectiveness goals or final remediation goals.

## *How often should facilities monitor?*

The frequency of monitoring should be adequate to detect, in a timely manner, the potential changes in facility conditions listed above. This means that the rate of groundwater flow and contaminant movement is an important factor to consider when you determine monitoring

frequency. The monitoring plan should include flexibility for adjusting the monitoring requirements over the life of the remedy. For example, it may be appropriate to decrease the monitoring frequency and number of constituents at some point in time, once it has been determined that the remedy is progressing as expected and very little change is observed from one sampling round to the next. In contrast, the monitoring frequency may need to be increased if unexpected conditions (e.g., plume migration or change in groundwater use) occur or to determine the effect of modifications to a interim or final remedy (e.g., changes in pumping rates).

### *How do I decide a remedy is working?*

Facilities should conduct periodic reviews of performance monitoring results to evaluate remedy effectiveness towards meeting short-term protectiveness goals or final remediation goals. If a remedy is not achieving interim milestones, facilities should consider modifying the remedy design or operation.

### *How long should performance monitoring continue?*

Facilities should generally continue performance monitoring for a specified period after the facility achieves final remediation goals. Extending the performance monitoring to this point in time helps to verify that the facility no longer poses a threat to human health or the environment.



### *What is the role of groundwater use in long-term performance monitoring?*

Performance monitoring requirements may need to be more stringent when individuals use the groundwater at or near the facility, or when other actual or potential exposures to human or ecological receptors exist. Monitoring requirements may need to be changed if the groundwater use changes during the remediation period.

### *Key Reference:*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf. Particularly relevant pages: 19452-53.

# Completing Groundwater Remedies

(Update 4/20/00)

## *When does EPA consider groundwater remediation to be complete?*

EPA considers corrective action for groundwater to be complete when all releases to groundwater of hazardous waste and hazardous constituents, including releases from solid waste management units, have been remediated as necessary to achieve: (1) short-term protectiveness goals; (2) final remediation goal; (3) groundwater cleanup objectives; and (4) any facility-specific standards or requirements established by the EPA Regional Administrator or the appropriate individual in an EPA authorized state program.

## *What documentation do I need?*

Facilities should provide documentation which demonstrates that either:

(1) releases and potential releases of hazardous waste and hazardous constituents at the facility to groundwater are non-existent or do not pose unacceptable risks to human health or the environment; or

(2) the facility has properly and completely implemented the groundwater remedy and achieved the groundwater cleanup objectives (i.e., groundwater cleanup levels have been met at the point of compliance), including any facility-specific requirements or standards established by the regulators.

**Rationale**
**for Completing**
**Groundwater Remedies**

If a remedy meets all of the groundwater cleanup objectives and EPA's final remediation goal, then no further action is required to protect human health and the environment from releases to groundwater.



## *What is the role of groundwater use in demonstrating completion?*

Groundwater cleanup objectives are based on the current use and the groundwater use designation, and should be met in order to demonstrate completion of groundwater remedies. If the groundwater use designation changes or new exposures to groundwater contamination occur during the implementation of a remedy, then the stakeholders should re-evaluate the groundwater cleanup objectives to ensure that the current conditions are protective under the new designation or exposure.

## *Key Reference:*

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf . Particularly relevant page: 19453.

# References


EPA, 2000. Applicability of RCRA Section 3020 to In-Situ Treatment of Ground Water. Memorandum from Elizabeth Cotsworth, Director, Office of Solid Waste to RCRA Senior Policy Advisors (April or May). Will be available when finalized at http://www.epa.gov/epaoswer/hazwaste/ca/ .

EPA, 1999a. Matthew Hale, Deputy Office Director, Office of Solid Waste to Peggy Harris, Chief of Standardized Permitting Section, California Hazardous waste Permitting Program (December 10). Available at http://yosemite.epa.gov/osw/rcra.nsf/d8382df2d09b6466852565280051974 5/4d0d83ef37ba48f88525684800588ea8?OpenDocument

EPA, 1999b. Corrective for Solid Waste Management Units at Hazardous Waste Management Facilities (64 FR 54604, October 7). Available at http://www.epa.gov/epaoswer/hazwaste/ca/partwith.htm.

EPA, 1999c. Safe Drinking Water Act, Section 1429 Groundwater Report to Congress. EPA-816-R-99-016; October, 1999. Available at http://www.epa.gov/ogwdw000/gwr/finalgw.pdf .

EPA, 1999d. RCRA Cleanup Reforms (EPA530-F-99-018; July 1999). For more information, refer to http://www.epa.gov/reg5oopa/rcraca/rcra-reform.pdf.

EPA, 1999e. Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action and Underground Storage Tank Sites (April 21). OSWER Policy Directive 9200.4-17P. Available at http://www.epa.gov/swerust1/directiv/d9200417.htm. Other helpful links regarding MNA available at http://www.epa.gov/swerust1/mna/index.htm and http://www.epa.gov/swerust1/oswermna/mnalinks.htm .

EPA, 1999f. Interim Final Guidance for RCRA Corrective Action Environmental Indicators (February 5). Available at www.epa.gov/epaoswer/osw/ei_guida.pdf .

EPA, 1998a. RCRA Orientation Manual (EPA530-R-98-004). Available at http://www.epa.gov/epaoswer/general/orientat/index.htm .

EPA, 1998b Plain Language in Government Writing (June 1). Available at http://www.npr.gov/library/direct/memos/memoeng.html .

EPA, 1998c. Memorandum from Elizabeth Cotsworth to RCRA Senior Policy Advisors titled, Risk-Based Clean Closure (March 16). Available at http://www.epa.gov/epaoswer/hazwaste/ca/ .

EPA, 1998d. Standards Applicable to Owners and Operators of Closed and Closing Hazardous Waste Management Facilities: Post-Closure Permit Requirement and Closure Process; Final Rule (63 FR 56710). Available at http://www.epa.gov/fedrgstr/EPA-WASTE/1998/October/Day-22/f28221.pdf .

EPA, 1997a. Memorandum from Elliott P. Laws and Steven A. Herman to RCRA/CERCLA Senior Policy Managers titled, “Use of the Corrective Action Advance Notice of Proposed Rulemaking as Guidance” (January 17). Available at www._____.

EPA, 1997b. Rules of Thumb for Superfund Remedy Selection (EPA 540-R-97-013). Available at http://www.epa.gov/superfund/resources/rules/rulesthm.pdf .

EPA, 1997c. State Source Water Assessment and Protection Programs Guidance (August). Available at http://www.epa.gov/OGWDW/source/swpguid.html .

EPA, 1997d. The Role of Comprehensive State Groundwater Protection Programs (CSGWPPS) is OSWER Remediation Programs. OSWER Directive 9283.1-09. Available at http://www.epa.gov/superfund/resources/csgwpp/role.pdf .

EPA, 1996a. Advance Notice of Proposed Rulemaking (61 FR 19432, May 1). Available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf .

EPA, 1996b. Memorandum from Steven A. Herman and Elliott P. Laws to RCRA/CERCLA Senior Policy Managers titled, "Coordination between RCRA Corrective Action and Closure and CERCLA Site Activities" (September 24). Available at http://www.epa.gov/swerffrr/doc/924memo.htm.

EPA, 1993. Guidance for Evaluating the Technical Impracticability of Groundwater Restoration EPA/540-R-93-080, (September). Available at http://www.epa.gov/oerrpage/superfund/resources/gwdocs/techimp.htm

EPA, 1992. Final Comprehensive State Groundwater Protection Program Guidance, EPA 100-R-93-001. For more information, refer to www.epa.gov/OGWDW/Pubs/06ground.html.

EPA, 1991a. Managing the Corrective Action Program for Environmental Results: The RCRA Stabilization Effort (October 25). Available at http://yosemite.epa.gov/osw/rcra.nsf/d8382df2d09b6466852565280051974 5/27d1baa5c1dbb8f38525670f006be76d?OpenDocument .

EPA, 1991b. Protecting the Nation's Groundwater: EPA's Strategy for the 1990's. Office of the Administrator. Washington, D.C. For more information, refer to http://www.epa.gov/OGWDW/Pubs/11ground.html .

EPA, 1991c. A Guide to Principal Threats an Low Level Threat Wastes. Superfund Publication 9380.3-06FS (November). Available at http://www.epa.gov/oerrpage/superfund/resources/gwdocs/threat.pdf .

EPA, 1989a. OSWER Directive 9234.1-06, "Applicability of Land Disposal Restrictions to RCRA and CERCLA Groundwater Treatment Reinjection Superfund Management Review: Recommendation No. 26," (November 27).

EPA, 1989b. National Priorities List for Uncontrolled Hazardous Waste Sites - Final Rule Covering Sites Subject to the Subtitle C Corrective Action Authorities of the Resource Conservation and Recovery Act (commonly referred to as the RCRA Deferral Policy). Available in Section V which appears on 54 FR 41004-41006 (October 4).

EPA, 1988. OSWER Directive 9283.1-2, "Guidance on Remedial Actions for Contaminated Groundwater at Superfund Sites," (December 1).

EPA, 1987. Alternate Concentration Limit Guidance (EPA/530-SW-87017).

EPA, 1986. Guidelines for Ground-water Classification under the EPA Ground-Water Protection Strategy".

# Appendix 1

## How is the RCRA Corrective Action Program Implemented?

The RCRA Corrective Action Program evaluates releases of hazardous wastes and hazardous constituents from hazardous waste treatment, storage and disposal facilities, and develops and guides facilities in facility-wide cleanups to protect human health and the environment. Currently, EPA believes that there are approximately 6,400 facilities subject to RCRA corrective action. Of these, approximately 3,700 facilities have corrective action already underway or will need to implement corrective action as part of the process to obtain a permit to treat, store or dispose of hazardous waste. EPA established specific goals for 1,714 facilities that warrant attention in the near term. These goals correspond to two "Environmental Indicators" that are described in more detail under the policy for Short-Term Protectiveness Goals in this Handbook.

RCRA corrective action is implemented by both EPA and the States. At present, there are 33 states and territories authorized by EPA to carry out RCRA corrective action. EPA or States use a variety of mechanisms such as permits, orders or voluntary agreements to accomplish investigation and cleanup of contamination at corrective action facilities. Under RCRA corrective action authorities, facilities pay for and conduct the investigation and cleanup activities, and the regulators oversee the activities to ensure that the facility performs the work properly.



EPA's authority to require facility-wide corrective action comes from the RCRA statute. Specific sections of that statute that can require corrective action (or aspects of corrective action) include: 3004(u)&(v), 3005(c)(3), 3008(h), 3013, and 7003, EPA's regulatory authority for corrective action at permitted facilities is found in 40 CFR Part 264 Subpart F. EPA provided additional direction through guidance, policy directives and related regulations all of which were designed to increase the effectiveness and efficiency of corrective action. The most recent and comprehensive guidance issued for RCRA corrective action is included in the May 1, 1996 Advance Notice of Proposed Rulemaking (ANPR, 61 FR 19431, available at http://www.epa.gov/docs/fedrgstr/EPA-WASTE/1996/May/Day-01/pr-547.pdf ).

# Appendix 2 - Glossary

**area of attainment** - defines the area over which cleanup levels will be achieved in groundwater. It encompasses the area outside the boundary of any waste remaining in place and up to the boundary of the contaminant plume. Generally, if the source area is removed, the entire plume is within the area of containment. On the other hand, if waste is left in place as part of a final remedy, the groundwater beneath the waste management area encompassing the source(s) is not within the area of attainment. Cleanup levels should be achieved throughout the area of attainment. This definition of area of containment is synonymous with the phrase "point of compliance" used for facility-wide RCRA Corrective Action. (Source - EPA, 1988)

**aquifer** - a water-bearing layer of rock or sediment capable of yielding supplies of water; typically is unconsolidated deposits or sandstone, limestone or granite. Can be classified as confined or unconfined.

**Comprehensive State Groundwater Protection Program (CSGWPP)** - a groundwater management strategy developed by a State. EPA reviews CSGWPPs and "endorses" those that successfully meet six strategic activities. EPA established recommended adequacy criteria for each strategic activity in CSGWPP guidance. In particular, EPA remediation programs review State guidelines in the CSGWPP to prioritize groundwater based upon use, value and vulnerability. In 1997, EPA's Office of Solid Waste and Emergency Response issued a directive encouraging EPA's remediation programs to defer, where appropriate, to State determinations of current and future use when based on an EPA-endorsed CSGWPP that has provisions for facility-specific decisions. (Source - EPA, 1992)



**cleanup** - The term "cleanup" or the phrase "cleaning up" refers to the range of activities that could occur in the context of addressing environmental contamination at RCRA facilities. For example, cleanup activities could include removing waste or contaminated media (e.g., excavation, pumping groundwater, etc.), in-place treatment of the waste or contaminated media (e.g., bioremediation), containment of the waste or contaminated media (e.g., barrier walls, low-permeable covers, liners, etc.), or various combinations of these approaches. The term cleanup is often used interchangeably with the term remediate.

**groundwater** - water occurring in the zone of saturation in an aquifer or soil.

**groundwater use designation** - a determination of reasonably anticipated use, resource value (e.g., priority), and/or vulnerability of groundwater in a particular area.

**groundwater cleanup levels** -Groundwater cleanup levels are facility-specific chemical concentrations in groundwater that a final remedy should achieve for the remedy to be considered complete.

**groundwater cleanup objectives** - Groundwater cleanup objectives include three components: groundwater cleanup levels, point of compliance, and remediation time frames.

**maximum beneficial groundwater use** - Within the range of reasonably expected uses, the maximum (or highest) beneficial groundwater use is the one which that warrants the most stringent groundwater cleanup levels.

**monitored natural attenuation** - The term "monitored natural attenuation" refers to an approach to clean up environmental contamination by relying on natural processes. Natural attenuation processes include a variety of physical, chemical, or biological processes that, under favorable conditions, act without human intervention to reduce the mass, toxicity, mobility, volume or concentration of contaminants in groundwater. (Source - EPA, 1999e)

**principal threats** - Source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. (Source - EPA, 1991c)

**point of compliance** - The point of compliance for groundwater, in the context of RCRA corrective action, represents where the facility should meet groundwater cleanup levels within a contaminated aquifer at the conclusion of a final remedy (i.e., the facility has achieved its final remediation goals). The groundwater point of compliance for RCRA Corrective Action should be throughout the area where groundwater is contaminated above the cleanup level(s), or, when waste is left in place, at and beyond the boundary of the waste management area encompassing the original source(s) of groundwater contamination.

**remediation time frames** - The remediation time frame for groundwater is the facility-specific schedule for a groundwater remedy. It includes the time frame to construct the remedy and an estimate of the time frame to achieve groundwater cleanup levels at the point of compliance.

**RCRA Regulated Units** - Regulated units are defined in 40 CFR 264.90 as surface impoundments, waste piles, land treatment units, and landfills that received hazardous waste after July 26, 1982.



**source control** - Source control refers to a range of actions (e.g. removal, treatment in place, containment, etc.) designed to protect human health and the environment from sources of contamination.

**source materials** - Source material is defined as material that includes or contains hazardous substances, pollutants or contaminants that act as a reservoir [either stationary or mobile] for migration of contamination to groundwater, to surface water, to air, [or other environmental media], or acts as a source for direct exposure. Contaminated groundwater generally is not considered to be a source material although non-aqueous phase liquids (NAPLs [occurring as residual or free-phase]) may be viewed as source materials. (Source - EPA, 1991c).

**technical impracticability** - Technical impracticability (TI) refers to a situation where achieving groundwater cleanup objectives is not possible from an "engineering perspective." The phrase "engineering perspective" refers to how factors such as feasibility, reliability, scale and safety influence the ability to achieve groundwater cleanup objectives. (Source - EPA, 1993)

Note to reviewers of draft: Please identify additional terms you'd like to see included in this glossary.

# Appendix 3 -
# Key EPA Regional Contacts and Internet Addresses