



Evaluating Ground Water Plumes Under the Hazard Ranking System

Office of Emergency and Remedial Response
State, Tribal, and Site Identification Center (5204G)

Quick Reference Fact Sheet

This fact sheet provides information on potential National Priorities List (NPL) sites evaluated as contaminated ground water plumes with no identified source of contamination and how such sites are evaluated under the Hazard Ranking System (HRS). It defines steps that should be taken before a ground water plume can be evaluated as a source of contamination and summarizes scoring considerations for sites that consist solely of a ground water plume. Responses to commonly asked questions about evaluating contaminated ground water plumes at potential NPL sites are also presented. This fact sheet provides guidance only and may be amended by EPA on a site-specific basis.

BACKGROUND

The HRS is the primary tool that EPA uses to place hazardous waste sites on the NPL under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). NPL sites are those sites at which releases or potential releases of hazardous substances pose a threat to human health or the environment. For HRS purposes, "site" is defined as:

Area(s) where a hazardous substance has been deposited, stored, disposed or placed, or has otherwise come to be located. (55 FR 51587, December 14, 1990)

In some instances, ground water has become contaminated, and the source of the contamination has not been clearly identified. These sites are referred to as ground water plume sites. While the HRS specifically excludes from the definition of "source" those volumes of air, ground water, surface water, or surface water sediments that have become contaminated through migration, it does make an exception:

"... in the case of either a ground water plume with no identified source or contaminated surface water sediments with no identified source, the plume or contaminated sediments may be considered the source."

A contaminated ground water plume is generated when hazardous substances, pollutants, or contaminants enter an aquifer system. Contaminants can enter and spread horizontally and vertically through the aquifer system by infiltration, migration, interaquifer exchange, and interaction with surface water. This movement of contaminants throughout an aquifer is usually in the direction of ground water flow but can spread against the predominant flow direction. In the case of dense non-aqueous phase liquids (DNAPLs), for example, contaminants may follow a localized geological contour at the bottom of a formation which may not conform to the hydrologic gradient.

The Extent of a Ground Water Plume Site

Since ground water plume boundaries change over time with the introduction of additional contaminants from an unknown source and the dispersion of contaminants through the aquifer, the extent of a plume is difficult to define. For HRS scoring purposes, ground water samples which meet HRS observed release criteria may be used to delineate plume boundaries.

The purpose of listing sites on the NPL is to identify releases and potential releases that are priorities for further evaluation, not to identify the extent of the site. Defining the boundaries of a contaminated ground water plume in precise geographical terms would require more information than is routinely available at the listing stage. The same

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considerations that impact the definition of all sites come into play in defining ground water plume sites.

An NPL site listing encompasses all areas found to be contaminated. Therefore, in evaluating ground water plumes with no identified source, the extent of the plume site is not limited by actual property boundaries. The site, however, is also limited to those areas that are contaminated. Owners of property above aquifers contaminated by migration of hazardous substances from a source outside the property may not be responsible for cleanup if the property owner did not cause, contribute to, or exacerbate the release ("Announcement and Publication of Final Policy Toward Owners of Property Containing Contaminated Aquifers," 60 FR 34790, July 3, 1995). Liability will be assigned to those parties contributing to the plume when those parties are identified.

Naming Ground Water Plume Sites

To avoid confusion, sites consisting of ground water plumes with no identified source generally should be named according to the geographical area in which the plume is located (i.e., XYZ Ground Water Plume), instead of including potentially responsible parties in the site name (i.e., Smith Co. Plant). Regardless, the site as defined by the HRS is neither equal to nor confined by the boundaries of any specific property from which the site name is derived.

EVALUATING A GROUND WATER PLUME AS A SOURCE

The first step in evaluating a plume site is to show the contamination of an aquifer. Generally, contaminant plumes are identified as a result of routine monitoring of drinking water supplies. Additional ground water sampling to confirm the elevated concentrations and establish appropriate background levels will verify that a contaminated ground water plume is present. While the exact extent of the plume may not be defined, all samples used to characterize the ground water plume should meet the criteria for establishing an observed release. Areas lying between such samples should be considered a part of the plume, unless information indicates contamination should not be inferred between these points.

Once ground water contamination is documented, an attempt should be made to identify a source in the area which has caused or contributed to the plume. If hazardous substances in the plume can be attributed to a specific source in the vicinity, the actual plume is not considered the source. In this case, the identified source of the plume is

evaluated as the source and the plume is considered an observed release attributable to that source.

The source of ground water contamination can be designated as unidentified if, within the context of an expanded site investigation (ESI) or equivalent effort which involves sampling, the original source of the ground water contamination has not been documented. The ESI should at least include a site reconnaissance in the vicinity of the observed release samples, record searches, employee interviews, and sampling for information on possible origins of the ground water contamination. The attempt to identify a source should be discussed in the HRS documentation record and potential sources and potentially responsible parties should be identified.

EXHIBIT 1 UNIDENTIFIED VS. UNALLOCATED SOURCES

Under the HRS, the terms *unidentified* and *unallocated* are not equivalent.

- An *unidentified* source is an example of the HRS source type "other." A source may be classified as unidentified when a contaminated ground water plume or surface water sediment contamination exists, but the original source of contamination is unknown and cannot be identified through the appropriate means.
- An *unallocated* source is not an HRS source type. Unallocated sources are used to account for the hazardous waste quantity at a site where the hazardous substances cannot be associated with a specific source. A ground water plume should not be considered an unallocated source.

Source: *The Hazard Ranking System Guidance Manual*, Interim Final, OSWER Publication 9345.1-07, 1992.

After the source of contamination is designated as unidentified, the source for HRS scoring is classified as "ground water plume with no identified source." The ground water plume should be evaluated as the source with an HRS source type of "other." Once the ground water plume has been established as a source, the extent of the plume is generally considered as the extent of the site. An

unidentified source should not be confused with an unallocated source (refer to Exhibit 1).

In summary, make note of the following points before evaluating a ground water plume as a source:

- The area of known ground water contamination has been established by sampling or inference using the observed release criteria outlined in Section 2.3 of the HRS.
- A reasonable search for potential sources of ground water contamination indicates that no definite source of ground water contamination has been identified (the level of effort to identify the original source should be equivalent to an ESI).

HRS SCORING CONSIDERATIONS OF GROUND WATER PLUMES AS SOURCES

As for any site, an HRS score is calculated for the ground water pathway for each aquifer at or below the source at the site or, in this case, the contaminated ground water plume. Assign the highest ground water migration score for an aquifer as the ground water migration pathway score for the site. In general, the aquifer in which the ground water plume has been identified will score higher than an underlying aquifer evaluated for potential release, except when the underlying aquifer is associated with a significantly larger target population. Then the target factor category value must be sufficient to compensate for the lower likelihood of release factor category value.

Evaluating Likelihood of Release

The likelihood of release factor category reflects either an observed release to an aquifer or the potential to release to an aquifer. The presence of a ground water plume with contaminant levels significantly above background in an aquifer constitutes an observed release to that aquifer.

Documenting the presence of a ground water plume involves establishing an observed release by chemical analysis. Establishing an observed release by chemical analysis requires documenting that the concentration of at least one hazardous substance in the ground water plume is significantly increased above its background level. Background samples should be selected to demonstrate that the release cannot reasonably be attributed to any known source. As stated in the HRS, to establish an observed release by chemical analysis at a ground water plume site, no separate attribution is required. As discussed below, only those substances identified as being in the plume are used in selecting toxicity and mobility values.

Data presented in the HRS documentation record to characterize a contaminated ground water plume should be of known and documented quality. Well siting, installation, completion, and development should be performed according to protocols specified in EPA ground water monitoring guidance, in particular, *The Hazard Ranking System Guidance Manual*, Interim Final, OSWER Publication 9345.1-07 (1992). In addition, all guidelines specified in the guidance manual regarding similarity of background and observed release samples should be met. For example, Section 5.2 of the *HRS Guidance Manual*, Selecting Appropriate Background Samples, states that background and release samples should be representative of the same portion of the aquifer that is being evaluated (see *HRS Guidance Manual*, page 67). Once an observed release has been established by chemical analysis, the analytical data used to associate the hazardous substances with the plume may also be used to define the extent of the source and the site for HRS scoring.

As discussed in Section 7.1 of the *HRS Guidance Manual*, Determining Aquifer Boundaries and Number of Aquifers, with multiple aquifers, determining the potential for the release to migrate to an underlying aquifer may also be necessary. In this case, the contaminated ground water plume is evaluated for each of the four potential to release factors (containment, net precipitation, depth to aquifer, and travel time), as for any other source.

Evaluating Waste Characteristics

At a contaminated ground water plume site with no identified source, hazardous substances eligible for consideration in determining the pathway waste characteristics factor category value are those that meet the observed release criteria. Mobility and toxicity should be evaluated for all observed release hazardous substances in the ground water plume.

In evaluating ground water mobility, any hazardous substance meeting the criteria of an observed release by chemical analysis to an aquifer underlying a source is assigned a mobility factor value of one (1), regardless of the aquifer being evaluated. Therefore, a mobility factor value of one (1) is assigned to any hazardous substance in the ground water plume that is used to characterize the contaminated plume (i.e., all substances that meet observed release criteria).

As the extent of ground water plumes are not completely characterized during the site investigation process, a definitive hazardous waste quantity cannot be adequately determined at the listing stage. When evaluating the hazardous waste quantity at sites consisting solely of a

ground water plume, only three of the four hazardous waste quantity tiers apply to the source: hazardous constituent quantity (tier A); hazardous wastestream quantity (tier B); and volume (tier C). The area measure (tier D) cannot be evaluated because the hazardous waste quantity table (HRS Table 2-5) does not provide a divisor for source type "other" in this tier.

Further considerations may restrict the application of tiers A and B. Tier B wastestream data, for example, is unlikely because its availability would imply some knowledge of an originating source of contaminants in the plume. If such information is available, the originating source should be evaluated rather than the plume. Tier A is to be used only when the mass of CERCLA hazardous substances "is known or is estimated with reasonable confidence." Given the inherent uncertainty in establishing the extent of ground water plume sites, it is unlikely that sufficient analytical data will be available to characterize most such sites to this degree.

While data for tiers A and B may be available, it is more likely that the volume tier will be the best available means of evaluating the source hazardous waste quantity. For HRS purposes, the areal and vertical extent of the plume as delineated by ground water samples that meet observed release criteria should be used in evaluating the volume measure. Therefore, the hazardous waste quantity for a plume site with no identified source can be determined by measuring the area within all observed release samples with the vertical extent of contamination, to arrive at an estimate of the plume volume.

If the volume of the plume cannot be determined or if it is not cost effective to do so, a volume of greater than zero cubic yards can be used if it is explained that the presence of contaminants in the plume demonstrates the presence of some unknown quantity. In this case, minimum hazardous waste quantity factor values may be assigned. The HRS specifies that if the hazardous constituent quantity is not adequately determined, and if any target is subject to Level I or Level II concentrations, assign a value of 100 as the minimum pathway hazardous waste quantity factor value. If none of the targets are subject to Level I or Level II concentrations, assign a minimum value of 10 as the pathway hazardous waste quantity factor value, if the hazardous constituent quantity cannot be adequately determined (55 FR 51587, December 14, 1990). If the plume is established exclusively with contaminated wells that are not associated with target populations, additional sampling may be advisable to determine whether the extent of contamination can be expanded to encompass target wells. The objective is to characterize the threat posed by

the plume as thoroughly as possible within the limited context of an expanded site inspection. The need for additional sampling will depend on other waste characteristics factor values (i.e., toxicity) and the number of targets involved.

Evaluating Targets

As with all sites, evaluate targets for ground water plumes based on nearest well, actual and potential contamination of the population, resources, and wellhead protection areas. The following are specific factors that should be considered at sites when a ground water plume with no identified source is evaluated:

Ground Water Target Distance Limit

The 4-mile target distance limit and associated distance rings should be measured from the geometric center of the area of observed ground water contamination. The area of contamination should be based on samples that meet observed release criteria.

Establishing Actual Contamination

Actual contamination is established for drinking water wells that meet observed release criteria. Evaluate other drinking water wells within the 4-mile target limit, including those within the area of the plume that do not meet the observed release criteria, under potential contamination. If a drinking water well has been closed due to contamination from the plume being evaluated, classify the pre-closure population associated with the well as subject to actual contamination. Actual contamination cannot be inferred for drinking water wells that are screened within the dimensions of the plume. If none of the drinking water wells are subject to actual contamination, select a nearest well factor value based on the shortest distance to any drinking water well, as measured from the geometric center of the ground water plume (55 FR 51587, December 14, 1990).

QUESTIONS AND ANSWERS

Q: Can a contaminated ground water plume formed by the drainage of leachate from a landfill be evaluated as the source at a site?

A: *If the contaminants in the plume can be attributed to the landfill, the plume should not be scored as the source. In this case, the source at the site should be classified as a landfill.*

Q: If we have data on one or two likely sources, but information shows there are other likely sources as well, can we list the site as a ground water plume?

A: *Yes. The issue is attribution. If data are available that allow definite attribution of contaminants to a particular source, that source should be evaluated independently. If attribution is not possible, the site can be scored as a plume.*

Q: If a ground water plume is conclusively determined to be coming from one large facility that has a single owner, but the exact source of the contamination is not known, should the plume be considered the source?

A: *If the proper effort to identify a source is unsuccessful at the site, then the scorer should consider evaluating the facility as the source under HRS source type "other." This may be done when contamination is attributed to operations or processes at the facility but not to a specific source.*

Q: If two distinct ground water plumes with no identified source commingle and one of the plumes consists of petroleum products and the other contains CERCLA eligible hazardous substances, can the release be listed on the NPL?

A: *The release of any CERCLA eligible hazardous substance may be listed on the NPL. Petroleum products may not be used in scoring under the HRS.*

Q: If a ground water plume with no apparent identified source is documented, but soil-gas samples show contamination at a nearby area with the same substances, should the contaminated soil or the plume be evaluated as the source?

A: *Since soil-gas data do not establish actual soil contamination or ground water contamination at a site, the contaminated ground water plume can be considered a source if observed release samples are available and there is no other information to link the plume with the soil-gas samples. The soil-gas samples, however, should be further investigated to determine if such a linkage exists.*

Q: Do site boundaries correspond to property boundaries at ground water plume sites?

A: *No. Ground water plume sites are defined by the locations of wells showing elevated concentrations of CERCLA hazardous substances. All substances considered to be present in the plume must meet HRS observed release criteria.*

Q: Does site name imply the extent of the site or identify responsible parties?

A: *Not for ground water plume sites. In most cases, the name assigned to such sites will be that of a geographic location. Depending on what is known about the plume, the name selected should be specific enough to indicate the general area of the plume but broad enough so as not to appear to suggest any particular source.*

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