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Agency

Office of Emergency &
Remedial Response
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BACKGROUND INFORMATION
PROPOSED REVISIONS TO HAZARD RANKING SYSTEM

The U.S. Environmental Protection Agency (EPA) is proposing revisions to the Hazard Ranking System (HRS) in response to the Superfund Amendments and Reauthorization Act of 1986 (SARA).

The HRS is the scoring system EPA uses to assess the relative threat associated with the release or potential release of hazardous substances from a waste site. The HRS score is the primary criterion EPA uses to determine whether a site should be placed on the National Priorities List (NPL). The NPL identifies sites that warrant further investigation to determine if they pose risks to public health or the environment. Sites on the NPL are eligible for long-term "remedial action" financed under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by SARA. SARA authorizes a "Hazardous Substances Superfund" totaling $8.5 billion over 5 years to pay costs not assumed by those responsible for problems at a site. The HRS uses data that can be collected relatively quickly and inexpensively, thus allowing most Superfund resources to be directed to remedial actions at sites on the NPL.

SARA requires EPA to revise the HRS to assure that, to the maximum extent feasible, it accurately assesses relative risk. Specifically, EPA is to:

- o Assess how surface water contamination affects the human food chain and recreational use of surface water.
- o Consider potential contamination of ambient air as well as actual contamination.
- o Give a high priority to sites which have contaminated principal drinking water supplies.
- o Consider the toxicity, quantity, and concentrations of hazardous constituents in fly ash wastes.

The current HRS, adopted in 1982, evaluates the relative threat of a site over five pathways. The HRS score is based on the evaluation of three migration pathways--ground water, surface water, and air. The two other pathways, direct contact and fire/explosion, are evaluated to determine the need for immediate removal (emergency) action. HRS scores range from 0 to 100. Sites scoring 28.50 and above on the current HRS are eligible for the NPL.

The proposed revisions (Figure 1-4) retain the same basic approach as the current HRS, while incorporating SARA requirements as well as improvements identified as necessary by EPA. The revisions propose to retain the ground water, surface water, and air pathways, drop the direct contact and fire/explosion pathways, and add a fourth pathway, onsite exposure, which is similar to direct contact.

Proposal of the HRS revisions is followed by a 60-day public comment period. EPA will review and respond to all comments, and change the proposed revisions where appropriate. The revised HRS is expected to be published in the Federal Register in early 1990.

Until that time, the current HRS is in effect. EPA will continue to evaluate potential sites with the current HRS and place them on the NPL if they meet the listing requirements. SARA does not require that sites now on the NPL be re-evaluated with the new HRS. Sites already proposed on the basis of the current HRS can be placed on the final NPL without re-evaluation until the revised HRS takes effect. Based on the current HRS, 797 sites are on the final NPL (2 sites were deleted in September 1988) and an additional 378 have been proposed.

THE MAJOR REVISIONS TO THE HRS PROPOSE TO:

- o Add a fourth pathway, onsite exposure, similar to the direct contact pathway of the current HRS. EPA experience indicates exposure to onsite contaminated soils or wastes is often important in selecting remedial action for a site.

- o Modify the surface water pathway to:

  -- consider contamination of the aquatic human food chain

  -- consider exposure of recreational users

  -- evaluate the potential risk of flooding of the site

- o Modify the air pathway to include the potential of a site to release contaminants to the air. In the current HRS, the air pathway is scored only if an observed release can be documented.

- o Allow the flexibility to use data on concentrations of hazardous constituents in wastes, if available, to calculate the hazardous waste quantity factor. (The current HRS uses only the quantity of hazardous waste as deposited.) A tiered system is proposed that will use constituent data, waste quantity data, volume, and area, providing greater accuracy by allowing use of the best available data.

- o Change the toxicity factor in all four pathways, basing it not only on acute toxicity but carcinogenic and chronic non-carcinogenic toxicity as well.

- o Add mobility factors to the ground water and air pathways to evaluate the ability of specific substances to migrate and reach potential targets. Mobility, in combination with toxicity, should provide a more accurate assessment of the relative risks posed by specific substances.

- o More accurately assess target populations and sensitive environments by giving greater weight in the ground water and surface water pathways to:

  -- those exposed to documented contamination from the site than those potentially exposed. (The current HRS treats potential and actual contamination equally.)

  and

  -- those exposed to contamination above health-based benchmarks (for example, Federal drinking water standards) or ecologically-based benchmarks

- o Weight target populations and sensitive environments in the ground water, air and onsite pathway based on distance so that the people and environments closest to the site receive the highest score, with scores decreasing as distance from the site decreases.

- o Increase the number of sensitive environments evaluated and the weights given them in the surface water, air, and onsite pathways.

Figure 1

Ground Water Migration Pathway

Current HRS

Release	X	Waste Characteristics	X	Targets
Observed Release or Route Characteristics ❑ Depth to Aquifer of Concern ❑ Net Precipitation ❑ *Permeability of Unsaturated Zone* ❑ *Physical State* ❑ Containment		❑ Hazardous Waste Quantity ❑ Toxicity/*Persistence*		❑ Ground Water Use ❑ *Distance to Nearest Well*/Population Served

Revised HRS

Likelihood of Release	X	Waste Characteristics	X	Targets
Observed Release or Potential to Release ❑ Depth to Aquifer/ HYDRAULIC CONDUCTIVITY ❑ Net Precipitation ❑ SORPTIVE CAPACITY ❑ Containment		❑ Hazardous Waste Quantity* ❑ Toxicity/MOBILITY		❑ Ground Water Use* ❑ Population* ❑ MAXIMALLY EXPOSED INDIVIDUAL ❑ WELL HEAD PROTECTION AREA

Items in italic under Current HRS have been dropped or replaced.
Items in caps under Revised HRS are new. Most items not in caps have been revised significantly.

****Factor based on several sub-factors.***

Figure 2

Surface Water Migration Pathway

Current HRS

Release	X	Waste Characteristics	X	Targets
Observed Release or Route Characteristics ❑ *Facility Slope/ Intervening Terrain* ❑ *One Year, 24 Hour Rainfall* ❑ *Physical State* ❑ Distance to Nearest Surface Water ❑ Containment		❑ Hazardous Waste Quantity ❑ Toxicity/Persistence		❑ Surface Water Use ❑ Population Served/ *Distance to Nearest Intake Downstream* ❑ Distance to a Sensitive Environment

Revised HRS

Drinking Water Threat

Likelihood of Release	X	**Waste Characteristics**	X	**Targets**
Observed Release or Potential to Release OVERLAND FLOW ❑ Containment ❑ RUNOFF* ❑ Distance to Surface Water POTENTIAL TO RELEASE BY FLOOD ❑ CONTAINMENT (FLOOD) ❑ FLOOD FREQUENCY		❑ Hazardous Waste Quantity* ❑ Toxicity/Persistence		❑ Surface Water Use* ❑ Population* ❑ MAXIMALLY EXPOSED INDIVIDUAL

Human Food Chain Threat

Likelihood of Release	X	**Waste Characteristics**	X	**Targets**
(same as above)		❑ Hazardous Waste Quantity* ❑ Toxicity/Persistence/ BIOACCUMULATION		❑ FISHERY USE ❑ POPULATION*

Recreational Threat

Likelihood of Release	X	**Waste Characteristics**	X	**Targets**
(same as above)		❑ Hazardous Waste Quantity* ❑ Toxicity/Persistence/DOSE ADJUSTING FACTOR		❑ POPULATION*

Environmental Threat

Likelihood of Release	X	**Waste Characteristics**	X	**Targets**
(same as above)		❑ Hazardous Waste Quantity* ❑ ECOSYSTEM TOXICITY/Persistence		❑ Sensitive Environments

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Items in caps under Revised HRS are new. Most items not in caps have been revised significantly.

Factor based on several sub-factors.

Figure 3

Air Migration Pathway

Current HRS

Release	X	Waste Characteristics	X	Targets
Observed Release		❑ Hazardous Waste Quantity ❑ Toxicity ❑ *Reactivity and Incompatibility*		❑ Land Use ❑ Population Within 4-Mile Radius ❑ Distance to Sensitive Environment

Revised HRS

Likelihood of Release	X	**Waste Characteristics**	X	**Targets**
Observed Release or POTENTIAL TO RELEASE ❑ SOURCE TYPE ❑ SOURCE MOBILITY* ❑ SOURCE CONTAINMENT		❑ Hazardous Waste Quantity* ❑ Toxicity/MOBILITY*		❑ Land Use ❑ Population ❑ MAXIMALLY EXPOSED INDIVIDUAL ❑ Sensitive Environments

Items in italic under Current HRS have been dropped or replaced.
Items in caps under Revised HRS are new. Most items not in caps have been revised significantly.

****Factor based on several sub-factors.***

Figure 4

ONSITE EXPOSURE PATHWAY

REVISED HRS*

RESIDENT POPULATION THREAT		
LIKELIHOOD OF EXPOSURE	**WASTE CHARACTERISTICS**	**TARGETS**
❑ OBSERVED CONTAMINATION	❑ TOXICITY	❑ HIGH RISK POPULATION ❑ TOTAL RESIDENT POPULATION ❑ TERRESTRIAL SENSITIVE ENVIRONMENTS

NEARBY POPULATION THREAT		
LIKELIHOOD OF EXPOSURE	**WASTE CHARACTERISTICS**	**TARGETS**
❑ ACCESSIBILITY/ FREQUENCY OF USE ❑ HAZARDOUS WASTE QUANTITY	❑ TOXICITY	❑ POPULATION WITHIN 1 MILE

**The current HRS includes a direct contact pathway, but that pathway is not used in calculating the overall HRS migration score.*

SARA REQUIREMENTS

SARA requires that EPA modify the HRS so that, "to the maximum extent feasible, [it] accurately assesses the relative degree of risk to human health and the environment posed by sites." Several specific requirements are spelled out.

Section 105 requires EPA to:

- o Assess human health risks associated with contamination or potential contamination of surface waters, either directly or as a result of run-off. This assessment should take into account the use of these waters for recreation and the potential migration of any contaminant through surface water to downstream sources of drinking water.

- o Evaluate damage to natural resources that may affect the human food chain.

- o Assess contamination or potential contamination of ambient air.

Section 118 requires EPA to:

- o Give a high priority to sites where contamination has resulted in the closing of drinking water wells, or has contaminated a principal drinking water supply.

Section 125 requires EPA to:

- o Revise the HRS to assure appropriate consideration of sites that contain substantial volumes of wastes described in Section 3001(b)(3)(A)(i) of the Solid Waste Disposal Act, also known as the Resource Conservation and Recovery Act (RCRA). These wastes include fly ash, bottom ash, slag, and waste from control of flue gas emissions, all generated primarily by combustion of coal or other fossil fuels. The assessment must consider:

  - -- quantity, toxicity, and concentrations of hazardous constituents present in such wastes

  - -- extent of, and potential for, release of such constituents into the environment

  - -- degree of risk to human health and the environment posed by such constituents

DEVELOPMENT PROCESS

EPA's Office of Emergency and Remedial Response (OERR), which is responsible for revising the HRS, undertook a number of activities in the course of developing these revisions:

- o Analyzed specific issues identified since the current HRS was adopted in 1982.
- o Established an EPA-wide Work Group consisting of representatives from Regional and Headquarters offices, as well as State agencies.
- o Published an Advance Notice of Proposed Rulemaking on April 9, 1987 (52 FR 11513). EPA received 46 comments totaling 600 pages in the 30-day comment period after publication.
- o Held a public meeting in Arlington, Virginia, on May 7-8, 1987, to hear comments on revising the HRS. Formal comments were presented by the American Mining Congress and New York State.
- o Worked with a committee from EPA's Science Advisory Board (SAB), a public advisory group structured to provide a balanced expert assessment of scientific issues related to problems facing EPA. The SAB committee held six 2-day public meetings on technical aspects of the current HRS, including three specific issues:
  - -- to develop options for revising the way toxicity of hazardous substances is evaluated and scored in the HRS
  - -- to determine if the HRS is biased against sites with mining wastes and other high-volume wastes, including issues related to the use of data on concentrations of hazardous substances instead of just data on total waste quantities
  - -- to determine the appropriate target distance over which population exposure to air pollution is assessed
- o Developed a revised HRS option that was subsequently refined by the Work Group and incorporated SAB's recommendations.

CURRENT HRS

The current HRS uses a structured value analysis approach to scoring sites. This approach assigns numerical values to factors that relate to or indicate risk based on conditions at the site. The factors are grouped into three categories--observed release/route characteristics, waste characteristics, and targets--and are combined to obtain category scores. Each category has a maximum value, as does each component factor.

The category scores in the current HRS are then multiplied together within each of the migration pathways (ground water, surface water, and air) and normalized to obtain a pathway score. Finally, the scores for the three pathways (gw, sw, a) are combined using a root-mean-square approach. The final HRS score is the square root of the sum of the squares of the pathway scores divided by a factor, 1.73, which puts all final scores on a scale of 0-100:

$$\text{HRS Score} = \sqrt{\frac{S^2_{gw} + S^2_{sw} + S^2_a}{1.73}}$$

If all migration pathway scores are low, the HRS score will be low. However, the HRS score can be relatively high even if only one pathway score is high. This is an important requirement for HRS scoring because some extremely dangerous sites pose threats through only one migration pathway. For example, buried leaking drums of hazardous substances can contaminate drinking water wells but -- if the drums are deep enough and the substances not very volatile -- not air or surface water.

PROPOSED HRS REVISIONS

The proposed HRS retains the three migration pathways. An EPA analysis of remedial actions at NPL sites indicates that some significant risks from direct contact may not have been completely addressed by removal actions, and these risks should be of concern in determining priorities for remedial action. Therefore, a fourth pathway, "onsite exposure," is now included in the total site score. The pathway assesses direct human exposure to hazardous substances or contaminated soil. The fire/explosion pathway has been deleted.

The essential structural features of the proposed HRS generally remain the same as those of the current HRS--that is, relative risks continue to be evaluated using pathways, factor categories, and factors--and the root-mean-square method is retained. However, every factor has been revised or is new in the proposed revisions. A few factors are eliminated, either because they do not discriminate among sites or because they are replaced by more accurate measures.

Revisions Affecting Multiple Pathways

A number of major proposed revisions to the HRS involve more than one of the four migration pathways. They are summarized before the individual pathways are discussed.

Observed Release. The current HRS scores an observed release if the measured concentration of the hazardous substance is significantly above the background level and if that concentration can reasonably be attributed to the site. EPA is retaining this approach to scoring observed releases in all four pathways but is proposing criteria for determining when a release is significantly above background.

Hazardous Waste Quantity. Hazardous wastes, in addition to including hazardous substances, almost always include nontoxic substances. When the current HRS was developed, EPA judged that the cost during initial investigations (preliminary assessments and site inspections) of reliably determining the amount of hazardous constituents within the hazardous waste is prohibitive and, in some cases, not feasible. Therefore, the current HRS uses the total quantity of waste containing hazardous substances (as defined in CERCLA Section 101), excluding any wastes that are contained so that they cannot migrate.

After considering a number of alternatives to the current method and presenting several to SAB, EPA is proposing a tiered approach to determining the hazardous waste quantity factor. Hazardous constituent concentration data, quantity of wastes as deposited, volume of waste, or surface area or volume of the source could be used. This approach provides the flexibility to use the best data available.

Toxicity. Toxicity, a factor in the waste characteristics category for all four proposed pathways, is intended to represent the relative potential of a substance to cause adverse health effects.

The current HRS assigns a toxicity factor value from 0 to 3 based on the toxicity ratings developed by N. I. Sax or the National Fire Protection Association rating scheme. Both ratings primarily emphasize acute toxicity of a substance. However, EPA's experience has been that adverse health effects at hazardous waste sites may result from carcinogenic and chronic noncarcinogenic exposures as well as acute exposures.

After evaluating a number of methods to characterize and score toxicity, EPA presented several options to SAB. The option chosen for the proposed HRS is based on three measures of toxicity:

- o Carcinogenicity, based on two factors that EPA's Carcinogen Assessment Group has developed for a variety of substances:
  - -- cancer potency factors derived from experimental animals or human epidemiologic data, if available
  - -- qualitative weight-of-evidence--that is, the overall strength of the data indicating potential carcinogenicity
- o Chronic noncarcinogenic toxicity, based on verified Reference Doses (RfDs), the estimated amount of a substance to which the human population (including sensitive subgroups) can be exposed on a daily basis over a lifetime without an appreciable risk of harmful noncancer effects. RfDs undergo a formal EPA-wide review and verification.

- Acute toxicity, based on the LD_{50} or LC_{50} (lethal dose or lethal concentration at which 50 percent of experimental animals exposed die.)

Targets (People and **Sensitive** Environments). In the current HRS, the people actually exposed to contamination do not count more than those potentially exposed, nor is the level of exposure considered. To more accurately assess risks, EPA is giving greater weight to actual exposures. EPA proposes to:

- Add factors to the ground water, surface water, and air pathways reflecting risks to the maximally exposed individual (MEI) -- that is, the person who is closest to the site and so is expected to be exposed to the highest concentration of contaminants.

- Give greater weight to people whose drinking water is contaminated (or, for the onsite pathway, people living or going to school on contaminated soil). The evaluation of exposed target populations in both the ground water and surface water pathways would include a weighting factor based on the Federal primary drinking water standards, or some other health-based benchmark if no standard exists.

- Give greater weight to actual contamination in the human food chain and recreational subpathways of the surface water pathway.

Where no actual exposure has been documented, the people potentially exposed are distance weighted in the ground water and air pathways and dilution weighted in the surface water pathway.

Environmental Threats. In developing the current HRS, EPA decided, given the need to set priorities for spending of limited monies, to place greater weight on sites that posed threats to public health rather than to the environment. EPA's past experience, however, suggests that a number of sites posing a serious threat to the environment are not scoring high enough to be on the NPL, and that some of the most serious threats clearly warrant remedial action. Therefore, the proposed HRS gives greater weight than the current HRS to impacts on sensitive environments (wetlands, for example) in the surface water and air pathways. Sensitive environments are also considered in the onsite pathway. Relative risks to human health, however, are still weighted more heavily than sensitive environments. In addition, the revised HRS expands significantly the types of sensitive environments evaluated at a site.

Ground Water Pathway

The ground water migration pathway in both the current and revised HRS (Figure 1) evaluates the likelihood that hazardous substances at a site or facility will migrate through the ground below and contaminate aquifers (underground formations holding usable amounts of water) and any drinking water wells that draw on those aquifers.

The proposed revisions provide the same general structure as the current HRS. However, every factor of the ground water pathway is revised. The most significant revision assigns weights to the target population based on distance from the site to account for dilution in the aquifer. In addition, the area (target distance limit) in which drinking water wells are considered is expanded. A new factor, sorptive capacity, is added to the potential-to-release calculations. In the waste characteristics category, EPA is proposing to consider the mobility of each hazardous substance rather than persistence, as in the current ground water pathway.

The current HRS does not consider the direction of ground water flow in determining which populations or environments may be affected by the migration of hazardous substances at the site. The targets category gives equal weight to the entire population in drawing water within 3 miles of the site.

After evaluating several options for considering ground water or contaminant flow direction, EPA is proposing to retain the current system based on cost and technical considerations. Accurately determining local flow within the target distance would require considerable expenditure of time and public funds, which EPA believes is justified only at the nation's highest priority sites--that is, those already on the NPL. However, where there is known contamination, the target populations are weighted higher than those only potentially exposed. Thus, the proposed revisions indirectly consider direction of substance migration by assigning weights to people drinking water contaminated either above or below health-based benchmarks and by using the MEI factor.

Likelihood of Release. The proposed potential-to-release to ground water is comparable to the route characteristics/containment portion of the current HRS. EPA is proposing a number of changes in how potential releases are scored. In the current HRS, values for depth to aquifer, net precipitation, permeability, and physical state are added, then multiplied by the value of a fifth factor, containment. The proposed HRS uses four factors:

- o Depth to aquifer/hydraulic conductivity, which provides a measure of the time required for a contaminant to reach the underlying aquifer.
- o Net precipitation, which indicates the amount of water available to infiltrate into ground water.
- o Sorptive capacity, which measures the potential of geologic materials to slow the migration of contaminants to aquifers.
- o Containment, which measures the means taken to minimize or prevent releases of contaminants at a site into ground water.

The potential to release is the sum of the values of the first three factors multiplied by the value for containment.

Waste Characteristics. The current waste characteristics category includes hazardous waste quantity and toxicity/persistence factors. The method used to evaluate persistence, however, is based on biodegradability and is generally not applicable to ground water. In addition to the changes in waste quantity and toxicity, the revised HRS replaces persistence with a mobility factor reflecting the rate at which a substance migrates. Combining mobility with the revised toxicity factor allows for discrimination among highly toxic substances that migrate at very different rates.

Targets. The targets category reflects the population potentially at risk from an actual or potential release of hazardous substances from the site to an aquifer. The proposed revisions expand the target distance limit from 3 to 4 miles. Within that limit, four factors (instead of two) are considered: ground water use, population, maximally exposed individual (MEI), and Wellhead Protection Area.

The ground water use factor in the proposed HRS revisions has been expanded to consider more uses than in the current HRS.

The second factor, population, indicates the number of people actually or potentially at risk from exposure to hazardous substances in drinking water wells. In the current HRS, all the people who drink water from wells within 3 miles of the site are counted equally. The total population is then combined in a matrix with distance to the nearest well to assign a single value. The proposed revisions separate these factors to more clearly reflect individual risks and resource value/population risk. Population served is divided into four groups:

- o People exposed to contamination above health-based benchmarks--for example, Federal drinking water standards.
- o People exposed to contamination not above health-based benchmarks but significantly above background within a certain range.
- o People exposed to contamination not above health-based benchmarks but significantly above background within a lower range than in the previous group.
- o People potentially exposed, weighted for distance.

The population factor is the sum of the four values.

The MEI is a new factor in the targets category and is evaluated by measuring the distance to the nearest drinking water well. In the current HRS, the person using the nearest well--which is, roughly comparable to the MEI--was considered in a matrix with population. The two are now separate factors.

The presence of a Wellhead Protection Area (WHPA), as designated under Section 1428 of the Safe Drinking Water Act, is a new factor in the targets category score. This revision addresses SARA Section 118, which requires a high priority for sites affecting principal drinking water supplies. WHPAs are defined as areas around a well or well field supplying a public water system through which potentially harmful contaminants are likely to move toward and reach the well or well field.

Surface Water Pathway

The surface water migration pathway in both the current and revised HRS (Figure 2) evaluates the likelihood that runoff containing hazardous substances from a site could move through surface water and affect people or the environment. The proposed HRS replaces the route characteristics portion of the current release category with two new groups of factors--overland flow and potential to release by flood. These two factors are added to obtain a score for likelihood of release in each of the four subpathways.

The proposed revisions would divide the surface water pathways into four subpathways representing threats to drinking water, the human food chain, recreational use, and the environment. The total surface water pathway score is the sum of the scores of the four subpathways. This proposed change in structure provides a relatively simple way to account for the different substances and targets that may be important for the different types of potential exposure in the four subpathways.

In the current HRS, the distance to the targets at risk is measured from the probable point where hazardous substances enter the surface water to a point 3 miles downstream of the farthest observed contamination (1 mile in static water). The proposed revisions extend this target distance to 15 miles from the source in all four subpathways. The target values are modified by dilution weighting--that is, a lower value is assigned a larger body of water because the substance is more diluted.

Drinking Water Threat. The drinking water threat in the revised HRS retains the waste quantity and toxicity/persistence factors of the current HRS but evaluates them differently. Persistence is no longer based solely on biodegradation but on four additional decay processes as well (hydrolysis, photolysis, volatilization, and free-radical oxidation). For each hazardous substance in (or likely to be in) surface water, a persistence value is assigned that reflects the time the substance remains in the surface water. The substance with the highest toxicity/persistence value is used, along with the hazardous waste quantity, in calculating the waste characteristics score.

The drinking water targets category reflects the human population potentially at risk from an actual or potential release of hazardous substances into surface water.

The drinking water threat in the proposed HRS retains the use and population factors of the current HRS but substantially modifies them. Instead of the four uses in the current HRS use factor, with only the highest assigned a value, two uses (drinking water and other uses) are assigned values, providing a better evaluation of the risk to the resource. The distance to a surface water intake in the current HRS is replaced with an MEI factor that is evaluat-ed separately and is based on dilution at the nearest intake. The population served is evaluated in four groups based on actual and potential exposure, and is the same as in the revised ground water pathway. The population potentially exposed to contamination is weighted based on dilution.

Human Food Chain Threat. SARA Section 105(a)(8)(A) requires EPA, in revising the HRS, to consider the effects of hazardous waste sites on the human food chain. In developing the revisions, EPA determined that the most significant, measurable food chain risks involved contamination of the aquatic food chain. Therefore, the proposed surface water pathway includes evaluation of the human food chain based on potential or observed contamination of aquatic food chain organisms.

In evaluating waste characteristics (and targets as well), a single hazardous substance is selected, on the basis of bioaccumulation potential, toxicity, and persistence, from among those known to be present at the site and available to the surface water pathway. Persistence is determined based on the same five decay processes as in the drinking water threat.

The targets category reflects the threat to people from consumption of fish and shellfish taken from the surface water migration pathway. Fishery use--for example, commercial, subsistence, or sport fishing--is evaluated to give an estimate of resource value. Population is calculated by estimating food chain products harvested from the contaminated surface water. Population is the sum of actual and potential contamination, and is determined based on bioaccumulation and annual production of each fishery in the surface water pathway.

Recreational Threat. SARA Section 105(c)(2) requires EPA to assess health risks from recreational activities in contaminated surface water. EPA concluded that the risks may be significant at some sites and decided to add a separate recreational subpathway to the surface water pathway to address these concerns.

The recreational threat assigns a dose adjusting factor in evaluating toxicity/persistence. The factor estimates the dose an individual receives through the skin (for example, during swimming or wading) inhalation, and ingestion, compared to the dose from drinking the same water.

The population factor consists of two elements:

- o The estimated number of visits to an area that is actually contaminated. This number is based on the populations at different distances from the area (0-5 miles, 5-10 miles, 10-15 miles), accessibility/attractiveness (waterfront parks, boat ramps, designed swimming beaches, etc.), and a recreational dose adjusting factor.

- o The estimated number of visits to an area threatened by contamination. This value is derived as above, adjusted by a dilution weighting factor.

The highest scoring area is used as the population factor value for the recreational threat.

Environmental Threat. In the surface water pathway of the current HRS, sensitive environments are assigned a value in the targets category on the basis of distance to a particular type of sensitive environment--wetlands, for example. The revised HRS places more emphasis on environmental damage and expands the types of environments considered. Ecosystem toxicity is determined

using EPA chronic water quality criteria for the protection of aquatic life (or other measures if the criteria are not available). Ecosystem persistence is evaluated as it is for the drinking water subpathway. The sensitive environments targets are weighted into groups based on ecologically-based benchmarks where sensitive environments are contaminated; otherwise, dilution factors are applied.

Air Pathway

The proposed air pathway (Figure 3) has the same three categories as in the current HRS air pathway, but each is revised. The current air pathway is evaluated only if an observed release of hazardous substances can be documented. As required by SARA Section 105(a)(8)(A), the revised HRS considers characteristics of the site to assess the potential for releases if no release has been documented. The likelihood of release is determined, as well as how many people and sensitive environments could be exposed to hazardous substances carried in the air and the inherent hazard associated with potential exposures. The potential to release is assigned a value based on:

- Source type--containers (including tanks), contaminated soil (including land treatment), fire sites, landfills, surface impoundments, and waste piles.
- Source mobility, which reflects the relative tendency of hazardous substances contained in a source to migrate as a gas or particulates.
- Source containment, which assesses the ability of natural or contructed barriers to inhibit the escape of hazardous substances.

In addition to the changes to waste quantity and toxicity in the waste characteristics category discussed earlier, the reactivity and compatibility factors have been deleted because they have proved not to be applicable to the vast majority of NPL sites; mobility has been added. All hazardous substances at a site are evaluated for gas mobility. Particulate mobility is evaluated based on the local climate. The two values are combined in a matrix to determine the mobility factor.

In the proposed HRS, the three target factors in the current HRS--land use, population, and distance to a sensitive environment--are modified, and a factor added to reflect the risk to the MEI. The 4-mile limit for population in the current HRS is retained; the limit for sensitive environments evaluated would be extended from 2 to 4 miles. In both cases, distance weighting factors are used to represent the reduced concentrations farther away from the site.

Onsite Exposure Pathway

The onsite exposure pathway evaluates the possibility that people or sensitive environments will have direct, physical contact with hazardous wastes or contaminated soil. It is similar to the direct contact pathway, which is scored in the current HRS but is not used to determine if a site should be on the NPL. The revised HRS evaluates the onsite threat by looking at two groups potentially at risk--those living on property with hazardous wastes or contaminated soils and those living nearby with access to the property. The resident population is evaluated based only on presence of contamination and not on

release potential, as in the other pathways, because contaminants do not have to migrate offsite for exposure to occur. Three targets are evaluated in the resident population:

- o High-risk population--children under 7, including those living or going to school or day care on contaminated property.
- o Total population, excluding those counted in the high-risk group.
- o Sensitive terrestrial environments (aquatic environments are considered in the surface water pathway).

The nearby population is evaluated on the basis of:

- o Accessibility/frequency of use, which evaluates the likelihood of exposure, not its severity.
- o Hazardous waste quantity expressed as total areal extent of the site because this factor also evaluates the likelihood of exposure.
- o Population within a 1-mile travel distance of the site.

Additional Considerations

In the preamble to the proposed revisions to the HRS, EPA has also requested comment on two issues:

- o The cutoff score for proposing sites for the NPL.
- o The policy of scoring sites based on current conditions.

These issues are discussed below.

Cutoff Score. EPA chose an HRS score of 28.50 as a cutoff for placing sites on the NPL because it yielded an initial NPL of at least 400 sites as required by CERCLA, not because the EPA had determined that 28.50 represented a threshold of unacceptable risks. Believing that the current cutoff score has been a useful management tool, EPA is proposing that the cutoff score for the revised HRS be functionally equivalent to the current cutoff. However, the rather substantial revisions of the proposed HRS make it necessary to evaluate the practical effects of keeping the cutoff score at 28.50--that is, will that score continue to provide an appropriate set of priorities for management purposes. EPA is examining several approaches for defining "equivalent to 28.50":

- o Use statistical analysis to determine what revised HRS score best corresponds to 28.50 on the current HRS.
- o Select a cutoff that would yield an NPL of the same size as would the current cutoff score.
- o Identify the quantitative risk levels that on the average correspond to a current HRS score of 28.50 and then determine what revised HRS score best corresponds to that risk level.

EPA intends to evaluate various cutoff score analyses and will announce the cutoff score in the final HRS rule.

Scoring on the Basis of Current Conditions. Under the current HRS, EPA generally scores the three migration pathways based on the conditions at the site before any response action has been taken, rather than based on current conditions at the site. In revising the HRS, EPA decided that it may be appropriate to evaluate sites based on current conditions and to consider prior responses in calculating an HRS score. EPA is requesting public comment on consideration of prior response actions.

The existing policy of evaluating sites based on original conditions was based on concerns that it might:

- o Encourage private parties to only take action sufficient to lower the score so the site would not be eligible for the NPL.
- o Discourage public agencies from taking early actions that could lower the score, preventing the site from being on the NPL and therefore eligible for Superfund monies.

EPA is considering two approaches to incorporate current site conditions in the HRS score. Under either approach, EPA would only consider removals prior to a site inspection to avoid continuously updating the score to reflect ongoing cleanup activity. The two approaches are:

- o Consideration of current conditions for certain pathways or factors where appropriate.
- o Consideration of current conditions routinely, but identifying and exempting situations where current conditions will not lead to a more accurate assessment of risks.