# CITIZENS' SUPERFUND WORKSHOP

**U.S. EPA**
**Region VIII**

*Missoula, Montana*
*May 5, 1990*

# CITIZENS' SUPERFUND WORKSHOP

# AGENDA

- EPA'S MISSION
- OVERVIEW OF THE SUPERFUND PROGRAM
- IMPLEMENTATION OF SUPERFUND
- CITIZEN INVOLVEMENT DURING SUPERFUND
- REMEDIAL INVESTIGATION/FEASIBILITY STUDY CASE STUDY

## EPA'S MISSION

## NOTES

- **Creation of EPA**
- **Protection of the Environment**
- **Enforcement of Environmental Laws**

## THE SUPERFUND PROGRAM

## NOTES

- Introduction
- Pre-remedial Activities
- Remedial Response
- Other Superfund Goals

## Introduction

- To Investigate and Cleanup Abandoned or Uncontrolled Hazardous Waste Sites
- 1980 Comprehensive Environmental Response, Compensation, and Recovery Act (CERCLA)
- 1986 Superfund Amendments and Reauthorization Act (SARA)
- National Oil and Hazardous Substances Contingency Plan (NCP)

NOTES

## Pre-remedial Activities

- Preliminary Assessment/Site Investigation (PA/SI)
- Hazard Ranking System (HRS) Scoring
- Placement on the National Priorities List (NPL)

## Preliminary Assessment/ Site Investigation (PA/SI)

- Review of Site History (PA)
- Inspection of Soil, Stream Sediment, Surface Water, Groundwater, and Air (SI)

## Hazard Ranking System (HRS)

- Sites scored from 1-100

- Based On Nature and Extent of Hazardous Release

  -- Probability of release X Nature of the Materials that might be releases X Potential Targets = Relative Threat (not risk)

  -- Four Pathways of Exposure: Ground Water, Surface Water, Air, and On-Site Exposure

## Hazard Ranking System (continued)

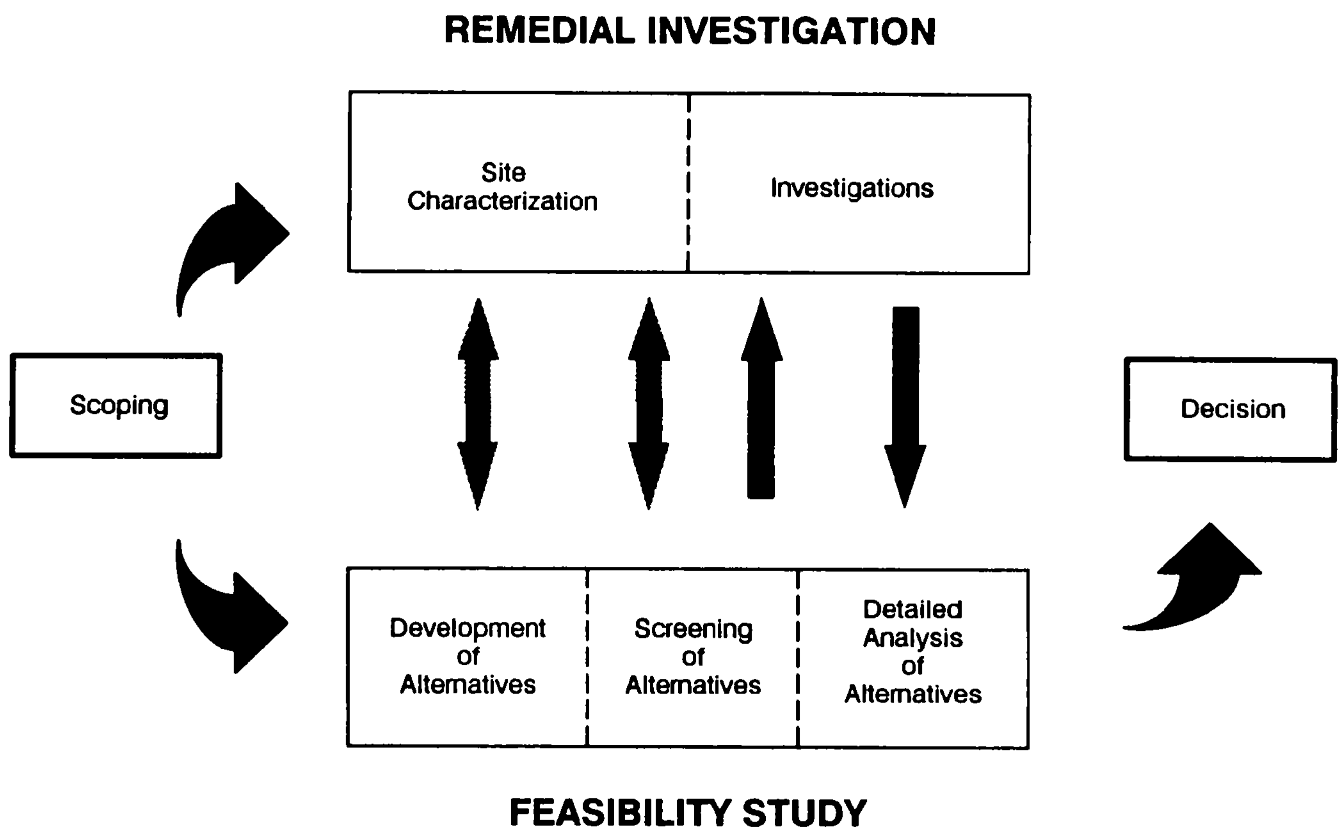
- Score of 28.5 or More Warrants Placement on NPL

## National Priorities List (NPL)

- List of the Nation's Worst Uncontrolled/Abandoned Hazardous Waste Sites

## Remedial Response

- Remedial Investigation (RI)
- Feasibility Study (FS)
  - -- Record of Decision (ROD)
- Remedial Design (RD)
- Remedial Action (RA)
- Operation and Maintenance (O&M)


REMEDIAL INVESTIGATION
Site Characterization
Investigations
Scoping
Decision
Development of Alternatives
Screening of Alternatives
Detailed Analysis of Alternatives
FEASIBILITY STUDY

## Remedial Investigation (RI)

- Collection and Review of all Site-Related Information
- Extensive Sampling of Soil, Surface Water, Groundwater, Stream Sediment, and Air
- Risk Assessment

## Risk Assessment

- Evaluate baseline risk to human health and the environment
  - Quantify current and potential risk posed by the site
- Results used to:
  - Evaluate threats
  - Assist in selecting protective remedies

## Steps in a Baseline Risk Assessment

- Collect and evaluate data
- Exposure Assessment
- Toxicity Assessment

## Feasibility Study (FS)

- Identification and Screening of Cleanup Alternatives
- Analysis of Technology and Costs of Alternatives
- Record of Decision (ROD)

## Evaluation Criteria

### *Threshold*

- **Overall Protection of Human Health and the Environment**

- **Compliance with Applicable or Relevant and Appropriate Requirements (ARARS)**

## Evaluation Criteria (Continued)

*Balancing*

- Long-term Effectiveness
- Reduction of Toxicity, Mobility or Volume
- Short-term Effectiveness
- Implementability
- Cost

## Evaluation Criteria (Continued)

*Modifying*

- State Acceptance
- Community Acceptance

## Remedial Design (RD)

- **Development of Technical Drawings and Specifications**

## Remedial Action (RA)

- **Construction/Implementation of Selected Remedy**

NOTES

## Operation and Maintenance (O&M)

- Activities Subsequent to Response Action

- Five Year Review

# *EXERCISE 1*

## REMOVAL ACTION

## NOTES

- **Response to Immediate Threat/Emergency**
- **Short-term Cleanup**

# IMPLEMENTATION OF SUPERFUND

## IMPLEMENTATION OF SUPERFUND

## NOTES

- **Regional Management**
- **Key Staff**

## Regional Management

- **Enforcement-lead and Fund-lead**
- **Setting Priorities for Remedial Actions**
- **EPA Partnership with Federal Agencies, States, Indian Tribes**

## Enforcement-lead and Fund-lead

- **Enforcement-lead**

  -- **Potentially Responsible Party (PRP) Conducts or Pays for Site Cleanup**

  -- **EPA Retains Oversight**

- **Fund-lead**

  -- **Paid for by Superfund**

  -- **Lead by EPA, other Federal Agencies, States, or Indian Tribes (EPA Retains Oversight Authority)**

## Setting Priorities for Remedial Actions

- **Fund-lead Sites are Prioritized**

- **Worst Sites are Funded First**

## Key Staff

- EPA
  - Regional Administrator
  - Office of Regional Counsel
  - Remedial Project Managers (RPMs)
  - Community Relations Coordinators (CRCs)

## Key Staff (Continued)

- States
- Contractors
- The Agency for Toxic Substance and Disease Registry (ATSDR)

# *EXERCISE 2*

# CITIZEN INVOLVEMENT DURING SUPERFUND

## CITIZEN INVOLVEMENT DURING SUPERFUND

## NOTES

- Requirements during Remedial Responses

- Additional Site Information

- EPA, States and Communities Work Together

## Superfund Requirements

- Community Relations Plan (CRP)
- Information Repository
- Public Notice
- Public Meeting
- Public Comment Period
- Responsiveness Summary

## Additional Site Information

- Fact Sheets
- Superfund Hotline
- Superfund Docket/Information Center

## EPA, States, and Communities Can Work Together

- **Meetings**

- **The Technical Assistance Grant Program (TAG)**

## *EXERCISE 1*

# EXERCISE 1

***Instructions:*** Read the three attached case studies, and in groups of four or five, answer the following questions. Please assign one note taker to report back to the entire class.

1. Which case study presents the worst site? Why? Please give at least two specific reasons.

2. Which case study is of the least concern to you? Why?

3. If you could have one piece of additional information about each case study, what would it be? Please list one for each.

## Case Study A

The Western Railroad site is an old train yard, located in the town of Augland, and bordered on the eastern side by the Vidden River, which flows from North to South. The center of Augland, which is both a residential and commercial area, lies to the west of the yard. From 1976 until 1986, the yard was owned and operated by the Western Railroad Company, and used primarily for locomotive maintenance. A number of predecessors to this railroad company operated the site as a train yard and industrial park from the 1920's until 1976.

An environmental health problem was first suspected in 1986 when the city of Augland took possession of the train yard due to a failure by Western Railroad to pay a large amount in back taxes. The city sought to sell the yard to a private developer for mixed residential and municipal park use. Before the developer's bank would approve the loan necessary to buy the property, the developer had to hire an environmental consulting firm to perform an audit. The firm conducted the audit in May of 1986. The findings from this audit revealed several areas where a number of hazardous contaminants exceeded state standards.

The contaminants identified included a number of heavy metals, such as cadmium, chromium, copper, lead, and zinc (all of which are fairly common in electroplating, and other heavy industrial processes). Additionally, polychlorinated biphenyls (PCBs) (a multipurpose compound used as a transformer coolant, and an industrial lubricant), and tri-chlorethylene (TCE), (a volatile organic compound often used as a degreasing agent in industrial cleaning processes) were identified. As a result of these findings, the bank refused to approve the developer's loan, and consequently the property was not sold, but instead the town's public works director notified the EPA about the results of the audit.

Lead and chromium are toxic at relatively low concentrations, and can cause a variety of human health problems, including cancer and neurological disorders, and both PCBs and TCE have been shown to cause cancer in laboratory animals. Zinc and Copper can adversely affect fish populations.

Potential health problems could be augmented by rain and melting snow washing through the affected areas and contaminating surface water (rivers, lakes, streams, and ponds), specifically the Vidden River, ground water (underground bodies of water also known as aquifers), or both. In 1987 the state drilled wells at the southeast corner of the site, where the ground slopes downward into the Vidden. Samples from one of the wells contained concentrations of TCE that exceed the standard for TCE in drinking water. It, therefore appears that the contamination is moving away from the site into the ground water and toward the river.

**The Situation:** The site is located about twelve miles north of Chislm, the State capital with a population of 300,000. Approximately 1,400 people live within one quarter mile of the site; approximately 8,000 live within one mile of the site. Within ten miles south of the site are the municipal wells of Chislm, which draw water from a deep aquifer. Within three miles downstream of the Western Railroad site, ten irrigation intakes from the Vidden River supply water to approximately 500 acres of farmland.

## Case Study B

The Old Iron Mill site is a 260 acre area where mill tailings were disposed of for many years. It is located in the small rural town of Bedrock, which was once a veritable gold mine of iron ore. Extraction activity began in Bedrock in the early part of the century, and a smelting and milling operation were added during World War II. The business slowed down over the years and the smelter closed in 1969 and the milling operation closed in 1971. The population of Bedrock, which numbered 5,000 in the 1970 census, has decreased to 500.

In the milling operation, sulfide concentrates of lead, copper, zinc, and other metals were extracted from ore. Rock waste, sometimes called slag, from this process comprise an estimated ten million tons of tailings on the site, which are forty to fifty feet high in places.

A few local residents suspected that the tailings were contaminated, and notified the State Department of Health. Samples taken from the tailings showed traces of cadmium, copper, and zinc, and extremely high concentrations of cyanide, arsenic, and lead. Of these, lead is the most prevalent.

Cyanide is extremely poisonous, and arsenic can cause a variety of problems including cancer and neurological disorders. Lead contamination can result in serious and irreversible intellectual impairment in children.

**The Situation:** Fortunately, many of the residents of Bedrock that lived close to the site moved out of town in the early 60's. Of the 500 remaining residents, five families live within one mile of the site, and most of the others live outside of a ten mile radius of the site. The land on the west side of the tailings across Turtle River, which flows from north to south, was once used for irrigated farming, but has not been touched for over 15 years because the river has been too low. The River was also used as a source of drinking water and as a recreational site at one time, but is now too shallow to extract drinking water or sustain fish. Samplings from private drinking water wells used by the families that live within a mile of the site and air samples from areas just outside site boundaries show dangerously high lead levels.

## Case Study C

The Bottom Fish Bay site, located in an abandoned fishing village called Kniknik, is tucked into the northwestern corner of Kodunk Island. The village operated a successful salmon cannery there from 1910 through 1978, when it was closed for health violations. Throughout its years of operation, the population in Kniknik never exceeded 100, and when the cannery shut down, all of the villagers moved to the adjacent island of Knaknak.

Last year an archeologist that was exploring the village came upon at least 10 dead Ivory Billows, an extremely rare and beautiful bird indigenous to Northwestern Kodunk Island. She contacted the State Environmental Goodness Office to investigate the area. EGO found that hundreds of batteries, transformers, and electric generators from the old cannery had been buried underneath the can shop. Upon further investigation, EGO uncovered hundreds of barrels of solvent that had apparently decayed, and leaked their contents into the soil, where the Ivory Billows nest.

Soil and sediment samples indicated extremely high levels of PCBs and TCE, as well as cadmium, and lead, throughout the better part of the abandoned village. There were practically no signs of Ivory Billows, or any other animals for that matter, near the old cannery, and even more of the endangered Ivory Billows were found on the shores of the bay, dead.

**The Situation:** There are presently no inhabitants of Kniknik, and it is only accessible by plane or boat, therefore the site poses virtually no present threat to human health. However, the concentrations of contaminants are so high that it is uninhabitable, and there is little chance of survival for the Ivory Billows or other small animals.

## *EXERCISE 2*

# EXERCISE 2

***Instructions:*** All three of the sites that you studied in the first exercise have been added to the NPL, but no RIs have begun. Your group must make funding decisions for the Region for the approaching fiscal year. The office of Regional Counsel has given you the following information:

- There is a very good possibility that the PRPs for both the Western Railroad and Old Mill sites will agree to conduct the RI/FS. However, she estimates that the legal bargaining will take time. She expects consent decrees to be signed no sooner than twelve months from now. In addition, should you decide to fund-lead, neither site negotiations nor cost recovery will begin until the comment period on the ROD, which will be in about three years.

- There is not likely to be any viable PRP for the Bottom Fish Bay site (case study C).

The director of the division of hazardous waste has informed you that there are only funds available to begin a fund-lead RI/FS at one of these three sites this year.

Lastly, the five residences in Bedrock (case study B) that have lead in their drinking-water wells are now being provided with bottled water.

1. Where will you start your fund-lead work? Why?

## *RI/FS EXERCISES*

## *CASE STUDY*

**Site Background:** The Western Railroad site is an old train yard, located in the town of Augland, and bordered on the eastern side by the Vidden River, which flows from North to South. The center of Augland, which is both a residential and commercial area, lies to the west of the yard (see site map). From 1976 until 1986, the yard was owned and operated by the Western Railroad Company, and used primarily for locomotive maintenance. A number of predecessors to this railroad company operated the site as a train yard and industrial park from the 1920s until 1976.

**Environmental Problems:** An environmental health problem was first suspected in 1986 when the city of Augland took possession of the train yard due to a failure by Western Railroad to pay a large amount in back taxes. The city sought to sell the yard to a private developer for mixed residential and municipal park use. Before the developer's bank would approve the loan necessary to buy the property, the developer had to hire an environmental consulting firm to perform an audit. The firm conducted the audit in May of 1986. The findings from this audit revealed several areas where a number of hazardous contaminants exceeded state standards. The contaminants identified included a number of heavy metals, such as cadmium, chromium, copper, lead, and zinc. Additionally, polychlorinated biphenyls (PCBs), and trichlorethylene (TCE), a volatile organic compound were identified. As a result of these findings, the bank refused to approve the developer's loan, and consequently the property was not sold, but instead the town's public works director notified the EPA about the results of the audit.

Samples taken from several areas throughout the train yard showed that there were three main areas of contamination in locations where maintenance work was once done, and solvents were heavily utilized (indicated on site map as Areas 1, 2, and 3). Areas 1, 2, and 3 showed significant amounts of chromium, copper, lead, zinc and TCE. In addition to heavy metals and TCE, Areas 1 and 3 also showed high levels of PCB contamination.

A large mound (Area 4 on site map), which was an old landfill once used for the disposal of debris from buildings that had been demolished on the site and is now completely covered, did not show any ground contamination.

**Potential Risks:** Lead and chromium can cause a variety of human health problems, including cancer and neurological disorders, and both PCBs and TCE have been shown to cause cancer in laboratory animals. Zinc and Copper can adversely affect fish populations. Potential health problems could be augmented by rain and melting snow washing through the affected areas and contaminating surface water (rivers, lakes, streams, and ponds), specifically the Vidden River, ground water (underground bodies of water also known as aquifers), or both. In 1987 the state drilled wells at the southeast corner of the site (just below Area 1), where the ground slopes downward into the Vidden. Samples from one of the wells contained concentrations of TCE that exceed the standard for TCE in drinking water.

In July 1988, the State Bureau of Air Quality (SBAQ) received complaints from residents of Augland who live on Naples Road between Knight St. and Fillen St. (near Area 4 on the site map) that gusts of westerly wind were bringing fine white snow-like particles over their homes (since it was only July, and the first snowfall does not usually occur until late October, there was much concern). The SBAQ investigated the yard and found that the old landfill (area 4) had begun to show topsoil erosion and signs of asbestos contamination and exposure. Asbestos can cause lung cancer if inhaled. SBAQ placed some soil on top of the landfill, but their report filed in August, states "this remedy is at best, only temporary, and is unlikely to maintain its integrity through the windy months of March and April after the winter snow melts." In 1988 the site was added to the National Priorities List (NPL), making it eligible for cleanup under the Federal Superfund program.

**The Situation:** The site is located about twelve miles north of Chislm, the State capital with a population of 300,000. Approximately 1,400 people live within one quarter mile of the site; approximately 8,000 live within one mile of the site. Within ten miles south of the site are the municipal wells of Chislm, which draw water from a deep aquifer. Within three miles downstream of the Western Railroad site, ten irrigation intakes from the Vidden River supply water to approximately 500 acres of farmland.

## *RI EXERCISE 1*

# REMEDIAL INVESTIGATION EXERCISE 1

***Instructions:*** Below are listed a number of short tasks to undertake as part of preparing a Remedial Investigation. In groups of four, answer the following questions:

1. Make a list of all the possible ways by which contamination can leave the site (These are commonly referred to as routes of migration).

2. Make a complete list of all the concerns that you have regarding this site.

3. What do you view as being the two most serious threats to human health and the environment from this site? Why?

4. What do you view as being the least serious threat to human health and the environment from your list for answer number 2? Why?

5. Do you consider any of the threats that you listed in number 3 to be "imminent" dangers to human health? If so, outline what actions should be taken to address these problems immediately.

***RI EXERCISE 2***

# REMEDIAL INVESTIGATION EXERCISE 2

***Considerations:*** Given the site history, you need to consider the following issues before continuing with the exercise.

- **Risk Assessment:** A full analysis of the impacted population and the level of risk that they are at will be a <u>necessary</u> activity before the final cleanup remedy for this site can be selected.

- **Ground water:** The ground water near the site is known to be contaminated; however, the full range and extent of this contamination is uncertain. No contamination has been found in the area's drinking water, but it is still possible that contamination has reached these wells or may migrate to them over time.

- **Surface Soil:** At this time you have only found contamination in the surface soils in a few isolated areas. However, a full test of the soil has not yet been conducted, thus the possibility exists that the soil contamination may be more severe and extensive than you believe.

- **Air Contamination:** It is unlikely that the characteristics of the contaminants (as far as you know) would in any way lead to an air contamination problem as long as the asbestos pile remains covered. However, the local community has recently been greatly involved with the air emission permitting of a nearby smelter. The EPA Community Relations Coordinator assigned to this site has told you that air contamination is a very serious community concern.

- **Budgetary Issues:** Each EPA Region is given only a limited amount of money to conduct Remedial Investigations at Superfund sites. Your Region has a large number of sites that have not yet undergone the Remedial Investigation stage of the Superfund cleanup process. Due to the number of sites and the limited amount of funds, you will be given a maximum budget of 1.5 million dollars to conduct the Remedial Investigation at the Western Railroad site.

***Instructions:*** Given the description of the site and the issues listed above, please review the following options that can be performed as part of the Remedial Investigation at the site. From the list of options listed below, select which ones you would perform as part of your Remedial Investigation at the site. Remember that you have a limited budget and cannot in any situation spend more money than you have been allocated. At the same time, keep in mind that you are not required to perform tests for ground water, soil, and air contamination. For example, it is possible for you to decide that ground water tests are not necessary and that you will spend your money on a risk assessment, a soil study option, and an air monitoring option. Be prepared to discuss your reasoning for selecting the studies you choose.

## Remedial Investigation Options

**Risk Assessment:** $100,000. The Risk Assessment is required by law and thus you will have to allocate the funds to perform this study.

### *Ground Water*

**Basic Ground Water Analysis:** $200,000. This analysis will put in several wells near the site at one specific depth level. It will accurately tell you if contamination has seeped down to the aquifer below the site, but will not give you much information about whether the contamination has moved further away from the site, or the exact concentration of the contaminants in areas not covered by the monitoring wells.

**Mid-Range Ground Water Analysis:** $400,000. This analysis will put in several wells near the site, and several wells south of the site, which according to United States Geological Survey is the predominant direction ground water flows in this area. It will additionally give accurate estimates of the concentration of the contaminants. This analysis does not, however, perform any tests in the area considered to be upgradient of the site. Your hydrologists tell you that the likelihood of contamination heading in that direction is only one in ten.

**Maximum Ground Water Analysis:** $600,000. This analysis will ring the site with wells at varying depths, and would provide you with a very complete picture of the level of ground water contamination at the site and accurate information on any migration of the contaminants that has occurred. It won't miss a thing.

### *Soil*

**Basic Soil Analysis:** $200,000. This analysis will allow "grab samples" to be taken on the site in the area surrounding each of the identified contamination areas. It will accurately tell you if contamination exists in these areas and at what depths it can be found, but will not provide you with information about any soil contamination that may be present in areas further away from those areas already identified.

**Maximum Soil Analysis:** $400,000. This analysis will allow soil samples to be taken over the entire site and in a few selected off-site locations. It will provide you with a very thorough picture of the amount of soil contamination at the site and accurate information on the exact geology of the site.

## *Air*

**Basic Air Monitoring:** $100,000 This analysis will place air monitoring stations around each of the four identified areas for the period of time that any ground water and soil studies are being performed. It will provide information on the concentration of contaminants that escape into the air around these areas, but will not provide any indication of air pollution that may result away from these four areas.

**Maximum Air Monitoring:** $300,000 This analysis will place air monitoring stations throughout the entire site and in the most heavily populated off-site locations. It will provide a very complete picture of the level of air contamination caused by the site and where this contamination is being carried once it is off the site.

## *Surface Water*

**Surface Water Sampling:** $100,000 This analysis will sample the Vidden river at three locations, north of the site, parallel to the site, and downstream from the site near the intake wells for irrigation.

## *Sediment*

**Sediment Sampling:** $100,000 This analysis will sample sediments at the bottom of the Vidden river at three locations: north of the site, parallel to the site, and downstream from the site near the intake wells for irrigation.

## *FS EXERCISE*

# FEASIBILITY STUDY EXERCISE

You completed your Remedial Investigation of the Western Railroad site a few months ago. The results indicated the following facts:

- **Ground Water:** You installed nine ground water monitoring wells in the area to analyze ground water quality, and to map ground water depth, flow rates and direction. Your studies conclude that there are two aquifers in the area -- a shallow, and a deep aquifer -- that do not connect to one another. The shallow aquifer beneath the site contains some hazardous substances including lead, cadmium and high levels of TCE from the site. The water in this aquifer is moving off site, toward the Vidden River. No wells are currently drawing water from this aquifer, but the Vidden is a major water source for downriver irrigation. Your studies do not show any contamination in the deeper aquifer.

- **Soil Samples:** You took 60 soil samples from the site and from three additional locations within the study area ( areas nearby, but not actually on the site). Soil samples revealed that only the soils directly on the site were contaminated. The samples from areas 1,2 and 3 indicated high concentrations of TCE in topsoil and in the soil up to ten feet beneath the affected areas. Additionally, heavy metals (cadmium, chromium, copper, lead and zinc) were found in the surface soils in areas 1 and 2. PCB was found in the surface soil, and sub surface soil in area 3.

- **Air:** You collected 124 air samples from four air monitoring locations to map wind patterns in the area and whether contamination from the site is affecting air quality nearby. You found that air quality standards are presently being met, but that in the event of the severe Chinook winds, when gusts can be up to 40 miles per hour, the landfill containing asbestos could pose a very serious health threat by releasing thousands of tiny asbestos particles into the air.

- **Surface Water and Sediment:** You took 10 surface water and 6 sediment samples from the Vidden River to see if hazardous substances from the site were affecting surface water quality or collecting in the sediment. Surface water samples showed no contamination above federal water quality standards.

***Instructions:*** The cleanup options listed below are those recommended as possible methods for cleaning up the site in the Feasibility Study. Review these options and choose the one that you feel is the best method for addressing the contamination problems at this site. Following the descriptions of each of the cleanup alternatives is a list of the nine criteria EPA uses in evaluating alternatives. We reviewed these criteria this morning. Please use these criteria and your own judgement to select the remedy you feel is best suited for addressing the problem at the site. Please be prepared to discuss your reasons for choosing this remedy.

## OPTION 1: DO NOTHING

**Description:**

By law a "no action" alternative must be used as a baseline to compare all other options against. A no action alternative would allow, however, for continued monitoring of site conditions, so that action could be taken should the situation change. "No action" constitutes fencing in the contaminated area, along with putting up signs indicating potential health hazards.

**Pros:**

Because the deep aquifer is unconnected to the shallow aquifer, there is no drinking water which is threatened, and funds can be prioritized to more needing sites.

Direct contact with the contamination is prevented by containment inside of the fence.

**Cons:**

Contamination is not addressed in any way.

**Cost:**

$300,000 in 1990 dollars

**OPTION 2: CAPPING THE SITE (To address both soil and ground water)**

**Description:**

Capping the site involves constructing a series of impermeable layers over the existing contamination. Such a cap is usually made up of various man-made and natural materials such as clay and plastic that has an overall effect of greatly reducing the amount of water that can permeate through and reach contamination beneath the cap. In so doing, a cap, while not removing or neutralizing the contamination, keeps it from migrating down into the water table, and contaminating water sources.

**Pros:**

Caps have been used at a number of sites -- they are a proven technology.

Caps can be constructed in a reasonably short period of time, thereby effectively addressing the site promptly.

Caps are inexpensive compared to other technologies, and with proper maintenance can last a long time.

A cap has a good possibility of keeping the contamination plume in the shallow aquifer from further migrating toward the river, and cover the contaminated soil, effectively "killing two birds with one stone."

**Cons:**

Caps do not neutralize or eliminate the contamination.

While caps do work most of the time, they require monitoring and maintenance.

Caps put constraints on the site's re-use, because to properly maintain the cap, nothing can be built on top of it.

**Cost:**

$1.5 million in 1990 dollars.

**OPTION 3: CAP, AIR-STRIPPING TOWER (pumping and extraction), AND CHEMICAL PRECIPITATION**

**Description:**

This option uses a cap to address the soil contamination, and ground water extraction and treatment to address the contamination in the shallow aquifer. Air-stripping requires that a large tower be assembled on the site and that a number of extraction wells be dug in areas that intercept the plume. Contaminated ground water is pumped from the aquifer to the top of the tower. The water then cascades from the top of the tower into a collection area at the tower's base. As the water falls the volatile contaminants in the water evaporate and rise up through the air in the tower. At the top of the tower is a charcoal filter device that traps the volatilized compounds and releases clean air into the environment. The water collected at the bottom of the tower in the aeration basin is then treated to remove heavy metals by a process called chemical precipitation. The heavy metals are separated from the water by mixing chemicals such as lime and sodium sulfate with the contaminated water. When added to the contaminated water, metal hydroxides are formed and precipitate out of the solution. This precipitated sludge can be easily removed by filtration. The treated water is then pumped back into the environment, so that no water is lost in the process.

**Pros:**

This technology effectively removes all contamination from the shallow aquifer in a reasonably short period of time.

This technology doesn't "pass the buck" by shipping the contamination somewhere else, but addresses it where it is.

An air-stripper is relatively easy to operate.

**Cons:**

The air-stripping tower needs to be carefully monitored to ensure that any contamination released into the air be within state standards.

Air-stripping is 90% removal efficient.

**Cost:**

$5 million in 1990 dollars.

## OPTION 4: CAP, PUMPING AND TREATING WITH CHEMICAL PRECIPITATION, AND CARBON ADSORPTION

**Description:**

As in option 3, a cap is used to address the soil contamination. Also as in option 3, ground water extraction wells pump the contaminated water to the surface to be treated. Instead of an air-stripping tower, however, VOCs are removed by a process called carbon adsorption. The contaminated ground water is pumped through a series of tanks that are packed with activated carbon (treated material that attracts the contaminants). The contaminants cling to the carbon and the water, free of volatile contaminants, and leave the system. Sampling of water discharge would determine when the carbon materials need to be replaced. After the carbon is used, it is regenerated or disposed of in a permitted landfill. Water that is free of volatile contaminants would then be treated by chemical precipitation, as in option 3, to remove the heavy metals.

**Pros:**

Treating the VOCs by carbon adsorption will not pose an air contamination threat.

Carbon adsorption is 99% removal efficient.

This technology effectively removes all contamination from the shallow aquifer in a reasonably short period of time.

This technology doesn't "pass the buck" by shipping the contamination somewhere else, but addresses it where it is.

**Cons:**

Carbon adsorption is most effective when used for low concentrations of organic compounds (less than 1 percent).

The contaminated carbon resulting from carbon adsorption must be disposed of.

**Cost:**

$6 million in 1989 dollars.

**OPTION 5: INCINERATION, AIR-STRIPPING TOWER (pumping and extraction), AND CHEMICAL PRECIPITATION**

**Description:**

In this option the ground water would be treated in exactly the same way as it is in option 3. To treat the contaminated surface soils, however, this option would excavate the contaminated areas and burn the soils at extremely high temperatures in a mobile on-site incinerator. This would effectively destroy the TCE, and PCB contamination. The remaining ash, which would contain heavy metals, would be stabilized and then shipped off-site to a federally approved landfill.

**Pros:**

This option would leave the site "clean" and available for re-use by the removal of surface soils.

The incinerator will destroy at least 99.9999% of the organic (burnable) contaminants.

This technology effectively removes all contamination from the shallow aquifer in a reasonably short period of time.

An air-stripper is relatively easy to operate.

**Cons:**

There are stringent permitting requirements for operating an incinerator.

Health risks have been associated with hazardous emissions from incinerators, and careful monitoring is essential.

There is often public resistance to incineration.

Treatment residuals from the incinerator will have to be managed/disposed of.

This technology requires a substantial amount of expertise to properly run the machinery.

The air-stripping tower needs to be carefully monitored to ensure that any contamination released into the air be within state standards.

Air-stripping is 90% removal efficient.

**Cost:**

$8 million in 1990 dollars

**OPTION 6: INCINERATION, PUMPING AND CHEMICAL PRECIPITATION, AND CARBON ADSORPTION**

**Description:**

Contaminated surface soils are treated by incineration (as in option 5), and the ground water is treated by pumping and both chemical precipitation and carbon adsorption (as in option 4).

**Pros:**

This option would not only leave the site clean and available for re-use , but would allow the ground water to be cleaned in a shorter period of time than air stripping.

Treating the VOCs by carbon adsorption does not pose an air contamination threat.

The incinerator will destroy at least 99.9999% of the organic (burnable) contaminants in the soil.

This technology effectively removes all contamination from the shallow aquifer in a reasonably short period of time.

Carbon adsorption is 99% removal efficient.

**Cons:**

There are stringent permitting requirements for operating an incinerator.

Health risks have been associated with hazardous emissions from incinerators, and careful monitoring is essential.

There is often public resistance to incineration.

Treatment residuals from the incinerator will have to be managed/disposed of.

This technology requires a substantial amount of expertise to properly run the machinery.

Carbon adsorption is most effective when used for low concentrations of organic (burnable) contaminants in the soil.

The contaminated carbon resulting from carbon adsorption must be disposed of.

**Cost:**

$7 million in 1990 dollars

## OPTION 7: COMPLETE EXCAVATION AND REMOVAL, AIR STRIPPING TOWER, AND CHEMICAL PRECIPITATION

### Description:

Complete excavation and removal involves digging up and shipping the contaminated soil to an off-site hazardous waste facility. Ground water contamination is treated with chemical precipitation and air stripping (as in options 3 and 5).

### Pros:

The waste is removed completely in a very short period of time leaving no future maintenance.

An air-stripper is relatively easy to operate.

### Cons:

Removal requires the movement of trucks through town.

This does not treat contamination on-site, but passes it along to somewhere else.

There is a risk in digging up contamination of something going wrong and exposing the public to contaminants through air contamination (this is a very low risk, however).

### Cost:

$20 million in 1990 dollars

**OPTION 8: COMPLETE EXCAVATION AND REMOVAL, PUMPING WITH CHEMICAL PRECIPITATION AND CARBON ADSORPTION**

**Description:**

The contaminated soil is excavated and taken off the site, and the ground water is pumped and treated by chemical precipitation and carbon adsorption (as in options 4 and 6).

**Pros:**

The waste is removed completely in a very short period of time leaving no future maintenance.

This technology effectively removes contamination from the shallow aquifer in a reasonably short period of time.

Carbon adsorption is 99% removal efficient.

**Cons:**

Removal requires the movement of trucks through town.

This does not treat contamination on-site, but passes it along to somewhere else.

There is a risk in digging up contamination that something could go wrong and expose the public through air contamination (this is a very low risk, however).

Carbon adsorption is most effective when used for low concentrations of organic compounds (less than 1 percent).

**Cost:**

$19 million in 1990 dollars

# Feasibility Study Evaluation Criteria

For your reference, listed below are the nine EPA criteria considered in choosing a remedy for a Superfund site:

**Threshold Criteria**

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements

**Balancing Criteria**

- Long-term effectiveness
- Reduction of toxicity, mobility, or volume
- Short-term effectiveness
- Implementability
- Cost

**Modifying Criteria**

- State Acceptance
- Community Acceptance

# GLOSSARY

**Air Stripping:**
A treatment system that removes, or "strips," volatile organic compounds from contaminated ground water or surface water by forcing an airstream through the water and causing the compounds to evaporate.

**Aquifer:**
An underground rock formation composed of materials such as sand, soil, or gravel that can store and supply ground water to wells and springs. Most aquifers used in the United States are within a thousand feet of the earth's surface.

**Asbestos:**
A building and insulating material widely used for years because of its strength and heat-resisting qualities. It has been found to cause certain types of lung cancer and other respiratory difficulties. If not completely sealed in a product, asbestos can break into tiny fibers that float almost indefinitely in the air. These fibers are smaller and more buoyant than ordinary dust particles and therefore are easily inhaled or swallowed.

**Cadmium (Cd):**
A heavy metal used in electroplating, in the manufacture of batteries, and as a pigment. Chronic exposure to cadmium can damage the liver and kidneys.

**Capping:**
The covering of contaminated wastes on site with layers of compacted soils and/or an impermeable synthetic liner. Caps prevent surface water runoff from carrying contaminants off site, minimize airborne transport of contaminants, and prevent direct contact with contaminated soil. Finished caps are covered with topsoil and seeded for erosion control.

**Carbon Adsorption:**
A treatment system where contaminants are removed from ground water or surface water when the water is forced through tanks containing activated carbon, a specially treated material that attracts the contaminants.

**Carcinogen:**
A substance that causes cancer.

**Chromium:**
A heavy metal used in electroplating, in photography, and as a paint pigment. Ingestion of chromium at toxic levels can cause sever hemorrhages of the

gastrointestinal tract. Inhalation of airborne chromium can cause lung and other respiratory cancers.

**Cleanup:**
Actions taken to deal with a release or threatened release of hazardous substances that could affect public health and/or the environment. The term "cleanup" is often used broadly to describe various response actions or phases of remedial responses such as the remedial design/remedial action.

**Comment Period:**
A time period during which the public can review and comment on various documents and EPA actions. For example, a comment period is provided when EPA proposes to add sites to the National Priorities List. Also, a minimum 30-day comment period is held to allow community members to review and comment on a draft feasibility study.

**Community Relations (CR):**
EPA's program to inform and involve the public in the Superfund process and respond to community concerns.

**Community Relations Coordinator (CRC):**
The EPA, State, or Federal facility official in charge of public involvement programs at a Superfund site.

**Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA):**
A Federal law passed in 1980 and amended in 1986 by the Superfund Amendments and Reauthorization Act. The Acts created a Trust Fund, commonly known as Superfund, to investigate and clean up abandoned or uncontrolled hazardous waste sites. Under the program, EPA can either:

- Pay for site cleanup when parties responsible for the contamination cannot be located or are unwilling or unable to perform the work.

- Take legal action to force parties responsible for site contamination to clean up the site or pay back the Federal government for the cost of the cleanup.

**Copper:**
A heavy metal commonly found in many rocks, soils, oceanic clays, and animal and plant life. Primarily used in the electrical industry for conducting electrical current, and in the manufacture of alloys.

**Cost-Effective Alternative:**
The cleanup alternative selected for a Superfund site based on technical feasibility, permanence, reliability, and cost. The selected alternative does not require EPA to choose the least expensive alternative. It requires that if there are several cleanup alternatives available that deal effectively with the problems at a site, EPA must choose the remedy on the basis of permanence, reliability, and cost.

**Cost Recovery:**
A legal process where potentially responsible parties can be required to pay back the Federal government for money it spends on any cleanup actions.

**Endangerment Assessment:**
A study conducted as a supplement to a remedial investigation to determine the nature and extent of contamination at a Superfund site and the risks posed to public health and/or the environment. EPA or State agencies conduct the study when legal action is pending to require potentially responsible parties to perform or pay for the site cleanup.

**Enforcement:**
EPA's efforts, through legal action if necessary, to force potentially responsible parties to perform or pay for a Superfund site cleanup.

**Excavation:**
The removal of all contaminated materials either for secure landfilling on site or for off-site disposal in a licensed hazardous waste facility.

**Feasibility Study:**
See Remedial Investigation/Feasibility Study.

**Ground Water:**
Water found beneath the earth's surface that fills pores between materials such as sand, soil, or gravel. In aquifers, ground water occurs in sufficient quantities that it can be used for drinking water, irrigation and other purposes.

**Hazard Ranking System (HRS):**
A scoring system used to evaluate potential relative risks to public health and the environment from releases or threatened releases of hazardous substances. EPA and States use the HRS to calculate a site score, from 0 to 100, based on the actual or potential release of hazardous substances from a site through air, surface water, or ground water to affect people. This score is the primary factor used to decide if a hazardous waste site should be placed on the National Priorities List.

**Hazardous Substance:**
Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.

**Heavy Metals:**
Metals including lead, chromium, cadmium, and cobalt that can be toxic at relatively low concentrations.

**Incineration:**
Burning of certain types of solid, liquid, or gaseous materials under controlled conditions to destroy hazardous waste.

**Information Repository:**
A file containing current information, technical reports, and reference documents regarding a Superfund site. The information repository is usually located in a public building that is convenient for local residents, such as public school, city hall, or library.

**Landfill:**
A secure landfill is one that isolates hazardous wastes between an impermeable cap and an impermeable bottom liner. This prevents contact between waste deposits and possible transporting media such as ground water, surface water, or air.

**Leachate:**
A contaminated liquid resulting when water percolates, or trickles, through waste materials and collects components of those wastes. Leaching may occur at landfills and may result in hazardous substances entering soil, surface water, or ground water.

**Monitoring Wells:**
Special wells drilled at specific locations on or off a hazardous waste site where ground water can be sampled at selected depths and studied to determine such things as the direction in which ground water flows and the types and amounts of contaminants present.

**National Oil and Hazardous Substances Contingency Plan (NCP):**
The Federal regulation that guides the Superfund program.

**National Priorities List:**
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites identified for possible long-term remedial response using money from the Trust Fund. The list is based primarily on the Hazard Ranking System. EPA is required

to update the NPL at least once a year.

**On-Scene Coordinator:**
The Federal official who coordinates and directs Superfund removal actions.

**Operation and Maintenance (O&M):**
Activities conducted at a site after a response action occurs, to ensure that the cleanup or containment system is functioning properly.

**Organic Compounds:**
Materials composed of carbon.

**Polychlorinated Biphenyls (PCBs):**
A group of organic compounds used since 1926 in electric transformers as insulators and coolants, as well as in lubricants, carbonless paper, adhesives, and caulking compounds. PCBs degrade very slowly over time and can be accumulated and stored in the fatty tissues of animals and humans. EPA banned the general use of these compounds in 1979. PCBs can cause liver damage and have been shown to cause cancer in laboratory animals.

**Potentially Responsible Party (PRP):**
Any individual(s) or companies(s) (such as owners, operators, transporters, or generators) potentially responsible for, or contributing to, the contamination problems at a Superfund site. Whenever possible, EPA requires PRPs, through administrative and legal actions, to clean up hazardous waste sites they have contaminated.

**Preliminary Assessment (PA):**
The process of collecting and reviewing available information about a known or suspected hazardous waste site or release. EPA or States use this information to determine if the site requires further study. If further study is needed, a site inspection is undertaken.

**Record of Decision (ROD):**
A public document that explains which cleanup alternatives will be used at a Superfund site. The Record of Decision is based on information and technical analysis generated during the remedial investigation/feasibility study and consideration of public comments and community concerns.

**Remedial Action (RA):**
The actual construction or implementation phase that follows the remedial design of the selected cleanup alternative at a Superfund site.

**Remedial Design (RD):**
An engineering phase that follows the Record of Decision when technical drawings

and specifications are developed for the subsequent remedial action at a Superfund site.

**Remedial Investigation/Feasibility Study:**
Two distinct but related studies. They are usually performed at the same time, and are together referred to as the "RI/FS." They are intended to:

- Gather the data necessary to determine the type and extent of contamination at a Superfund site;
- Establish criteria for cleaning up the site;
- Identify and screen cleanup alternatives for remedial action; and
- Analyze in detail the technology and costs of the alternatives.

**Remedial Project Manager (RPM):**
The EPA or State official responsible for overseeing remedial response activities.

**Remedial Response:**
A long-term action that stops or substantially reduces a release or threatened release of hazardous substances that is serious, but does not pose an immediate threat to public health and/or the environment.

**Removal Action:**
An immediate action taken over the short-term to address a release or threatened release of hazardous substances.

**Response Action:**
An action at a Superfund site involving either a short-term removal action or a long-term remedial response that may include, but is not limited to, the following activities:

- Removing hazardous materials from a site to an EPA approved, licensed hazardous waste facility for treatment, containment, or destruction.
- Containing the waste safely on-site to eliminate further problems.
- Destroying or treating the waste on-site to eliminate further problems.
- Identifying and removing the source of ground-water contamination and halting further movement of the contaminants.

**Responsiveness Summary:**
A summary of oral and/or written public comments received by EPA during a comment period on key EPA documents, and EPA's responses to those comments. A responsiveness summary is required as part of a Record of Decision at Superfund sites.

**Risk Assessment:**
An evaluation performed as part of the remedial investigation to assess conditions at a Superfund site and determine the risk posed to public health and/or the environment.

**Site Inspection (SI):**
A technical phase that follows a preliminary assessment designed to collect more extensive information on a hazardous waste site. The information is used to score the site with the Hazard Ranking System to determine whether response action is needed.

**Superfund:**
The common name used for the Comprehensive Environmental Response, Compensation, and Liability Act also referred to as the Trust Fund.

**Superfund Amendments and Reauthorization Act (SARA):**
Modifications to the Comprehensive Environmental Response, Compensation, and Liability Act enacted on October 17, 1986.

**Surface Water:**
Bodies of water that are above ground, such as rivers, lakes, and streams.

**Trichlorethylene (TCE):**
A chemical used as an industrial degreaser; a solvent for oils, paints, and varnishes; a dry-cleaning agent; and anesthetic. TCE is most often found in ground water because of spills at industrial facilities and other locations where TCE is used as a cleaning agent. The chemical is a central nervous-system depressant.

**Trust Fund:**
A fund set up under the Comprehensive Environmental Response, Compensation, and Liability Act.

**Volatile Organic Compound:**
An organic (carbon containing) compound that evaporàtes (volatilizes) readily at room temperature.