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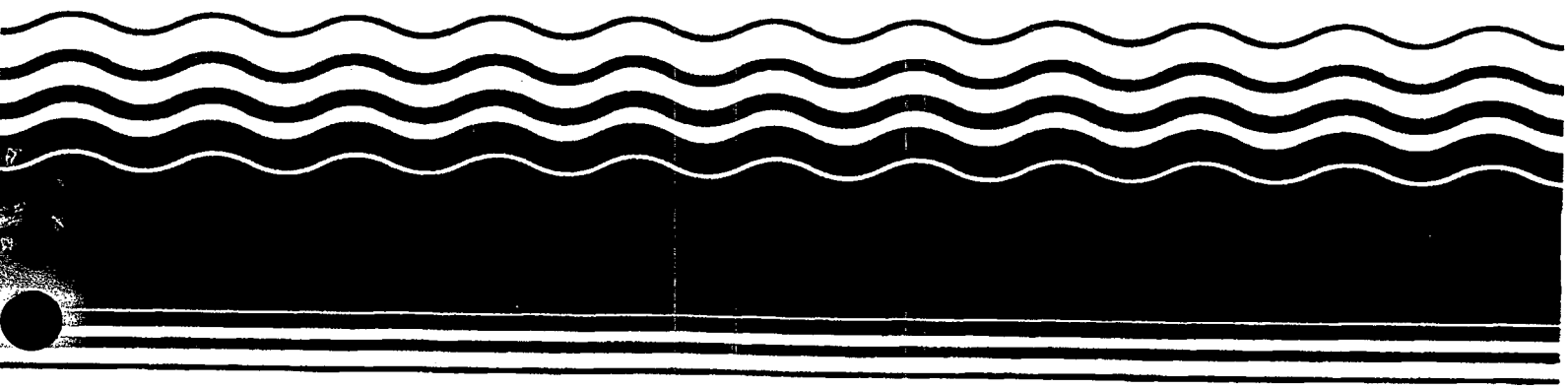
EPA Superfund
Record of Decision:

Ralston Site
Cedar Rapids, IA
9/30/1999



RECORD OF DECISION

RALSTON SITE
CEDAR RAPIDS, IOWA

Prepared by:

U.S. Environmental Protection Agency
Region VII
901 North 5th Street
Kansas City, Kansas 66101

September 1999

RECORD OF DECISION
DECLARATION

SITE NAME AND LOCATION

Ralston Site
Cedar Rapids, Iowa

STATEMENT OF BASIS AND PURPOSE

The U.S. Environmental Protection Agency (EPA) has prepared this decision document to present the selected remedial action for the Ralston site located in Cedar Rapids, Iowa. This decision was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for this site. The Administrative Record file is located in the following information repositories:

Cedar Rapids Public Library
500 1st Street S.E.
Cedar Rapids, Iowa

U.S. Environmental Protection Agency
901 North 5th Street
Kansas City, Kansas

The EPA has coordinated selection of this remedial action with the Iowa Department of Natural Resources. The state of Iowa concurs with the selected remedy.

ASSESSMENT OF THE SITE

The response action selection in the Record of Decision (ROD) is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy prevents exposure to contaminated ground water, restores the ground water to drinking water quality outside of the disposal area, and maintains site conditions which prevent exposure to contaminated soil. The selected remedy includes the following components:

- Monitored natural attenuation of ground water;
- Continued ownership of the fenced-in area, including the disposal area;
- Continued listing of the site on the Registry of Hazardous Waste or Hazardous Substance Disposal Sites pursuant to Iowa Administrative Code 455B.426;
- Continued designation of a protected ground water source area surrounding the site pursuant to Iowa Administrative Code 567–53.7(455B);
- Maintenance of the disposal area cap; and
- Maintenance of the Dry Run Creek bank stabilization.

In order to accelerate the cleanup of the disposal area, a removal action was completed. It included capping of the former disposal area; stabilizing the bank of Dry Run Creek; installation and operation of a dual vapor extraction and treatment system, which resulted in the removal and treatment of more than 4,800 pounds of volatile organic compounds; extraction and treatment of shallow ground water north of Dry Run Creek; and implementation of institutional and engineering controls.

The selected remedy continues to prevent exposure to contaminated soil through maintenance of the cap and creek bank stabilization and the implementation of institutional controls. The selected remedy prevents exposure to contaminated ground water through monitored natural attenuation continuing to decrease the concentrations of the contaminants and controlling the withdrawal of ground water in the protected source area.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent possible. Treatment of the ground water was not found to be practical; therefore, this remedy does not satisfy the statutory preference for treatment as a principal element of the remedy.

Because this remedy will result in hazardous substances remaining on site above levels that allow for unlimited use and unrestricted exposure, a review will be conducted within five years after initiation of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the *Decision Summary* section of this Record of Decision. Additional information can be found in the Administrative Record file for this site.

- Chemicals of concern (COCs) and their respective concentrations
- Baseline risk represented by the COCs

- Cleanup levels established for COCs and the basis for the levels
- Current and future land and ground water use assumptions used in the baseline risk assessment and the ROD
- Land and ground water use that will be available at the site as a result of the selected remedy
- Estimated capital, operation and maintenance, and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected
- Decisive factors that led to selecting the remedy

Michael J. Sanderson
Director
Superfund Division
U.S. EPA, Region VII

9/30/99
Date

RECORD OF DECISION
DECISION SUMMARY

1.0 Site Name, Location, and Description

This Record of Decision (ROD) has been developed by the United States Environmental Protection Agency (EPA) to select a remedial alternative at the Ralston site in Cedar Rapids, Iowa (herein, the "Site"). The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the site is IAD980632491. The EPA is the lead agency for enforcement of the activities taking place at the Ralston site and Rockwell Collins Inc. (Rockwell) is the responsible party conducting the work at the site.

The Ralston site is located north of 228 Blairs Ferry Road in northern Cedar Rapids, Iowa. Access to the site is by way of a gravel road north of Blairs Ferry Road. A 1½ acre portion of the site is referred to as the "source area" because this is where the disposal activities occurred. Figure 1 is a map of the Ralston site, including the location of monitoring wells.

From about 1956 to 1958, the Ralston site was used by Rockwell as a disposal area for wastes generated from a pilot gold-plating operation and other industrial sources. The amount of solid and liquid wastes that were disposed at the site is not known; however, it has been estimated that 60,000 gallons of liquid waste may have been disposed of during the years of plating operation. The wastes were typically burned and spread in layers, as necessary, to accommodate additional wastes. The types of wastes disposed at the site by Rockwell included solvents, paint sludge, and general industrial refuse, including scrap metal, office furniture, and construction and demolition debris. The Ralston disposal site was not restricted solely for Rockwell use and other local businesses or citizens likely disposed of other solid waste at the site.

In addition to the industrial-type wastes already mentioned, the Ralston site was also used for the disposal of cyanide waste (salts of ferrocyanide compounds) from the plating operation. The cyanide wastes were initially placed in 5-gallon containers. Two 5-gallon containers were then placed in a 55-gallon drum and encapsulated in concrete. An undetermined number of concrete-encapsulated cyanide drums were disposed at the site.

2.0 Site History and Enforcement Activities

In December 1981, Rockwell submitted a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 103(c) notice to the EPA which listed hazardous substances disposed at the Ralston site as solvents, paint sludge, and buried drums of concrete-encapsulated cyanide. Rockwell estimated that 60, 000 gallons of liquid wastes were

generated and disposed of during the years of its plating operation, and an undetermined number of concrete-encapsulated cyanide drums were buried at the site.

In May 1985, a contractor for the EPA conducted a preliminary assessment of the Ralston site. The assessment indicated that ground water and surface water contamination may have resulted from the previous disposal activities and a site inspection was recommended.

In 1989, Rockwell removed and properly disposed of two drums of concrete-encapsulated cyanide. No other drums were located.

In November 1990, Rockwell conducted additional investigation at the site under the oversight of an EPA contractor. Six trenches were excavated and shallow soil borings were installed on a 50-foot by 50-foot grid system for the purpose of collecting soil samples for laboratory analyses of volatile organic compounds (VOCs) and metals. The results of this investigation were reported in a document entitled "Report for Investigation of the Ralston Site, Blairs Ferry Road, January 1991."

On December 4, 1991, Rockwell and the EPA, Region 7, entered into an Administrative Order on Consent to conduct a Remedial Investigation and Feasibility Study (RI/FS) at the Ralston site. The goal of the RI/FS was to investigate the extent of soil and ground water contamination at the site and to determine an appropriate remedy or remedies.

In order to accelerate the cleanup of the disposal area and shallow ground water, on January 22, 1993, Rockwell and the EPA entered into a second Administrative Order on Consent to conduct a Removal Site Evaluation, Engineering Evaluation/Cost Analysis (EE/CA), and a removal action. The removal action took place while work continued on the RI/FS.

The removal actions implemented at the Ralston site included the following:

- Capping of the former disposal area;
- Stabilizing the bank of Dry Run Creek to prevent erosion at the site;
- Installation and operation of a dual vapor extraction (DVE) and treatment system; and
- Extracting and treating alluvial (shallow) ground water located north of Dry Run Creek.

Capping of the disposal area and stabilization of the creek bank were completed in December 1995. The DVE system began full-time operation in April 1995 and operated periodically until June 1997, at which time it was determined that it was no longer effectively removing more of the source contamination. More than 4,800 pounds of VOCs were removed and treated with the DVE and treatment system.

The RI Report and other documents in the Administrative Record file may be reviewed for a more complete source of information regarding the history of the site.

3.0 Community Participation

Throughout the time that investigation and removal activities have taken place at the site, numerous community involvement activities have occurred. These include the distribution of fact sheets, meetings with the public, and media interviews. The EE/CA was made available for public comment in 1994, prior to the EPA making a final decision regarding the removal action. A Community Relations Plan was prepared for the site in 1994 as well.

The EPA issued a Proposed Plan for the Ralston site on June 15, 1999. A 30-day public comment period occurred from July 1 to August 2, 1999. A public meeting was held on July 6, 1999, at the Cedar Rapids Water Department in Cedar Rapids, Iowa, to present the Proposed Plan and solicit comments from the public. Additionally, the EPA established an Administrative Record which contains supportive documents for this decision. The Administrative Record is available for review during normal business hours at the following locations:

Cedar Rapids Public Library
500 1st Street S.E.
Cedar Rapids, Iowa

U.S. Environmental Protection Agency
901 N. 5th Street
Kansas City, Kansas

4.0 Scope and Role of Response Action

During the RI, a removal action was conducted to accelerate the clean up of the soil and shallow ground water in the vicinity of the disposal area. All of the work associated with the removal action was completed in 1997.

The remedy selected in this ROD is the only remedial action planned for this site. This remedial action includes components to ensure that steps taken during the removal action continue to be protective. Specifically, measures are included to ensure that the disposal area cap and creek bank stabilization are maintained and that institutional controls, which have been initiated, remain in place.

5.0 Site Characteristics

The Ralston site is located north of 228 Blairs Ferry Road in northern Cedar Rapids, Linn County, Iowa. The disposal area occupies 1½ acres and is enclosed with a fence.

The topography of the disposal area is characterized by the steeply sloping banks of Dry Run Creek to the north and a railroad embankment to the south. The removal actions discussed previously have modified the general site topography by raising and leveling the disposal area. A minimum of two feet of compacted clay and two feet of topsoil were placed as a cap over the surface of the former disposal area to prevent precipitation infiltration. Terraces, drainage

channels, and an access road were subsequently constructed on top of the cap to prevent cap erosion and improve access.

The topography of the southern creek bank of Dry Run Creek, which forms the northern boundary of the disposal area, was also modified by removal actions implemented at the site. A total of 13,400 square feet of geomembrane liner and 17,840 square feet of cable-concrete mats were placed on the creek bank to protect the site and clay cap from surface water erosion associated with the creek. Cable-concrete mats were also placed under the creek crossing to provide a resistant and stable surface upon which to cross the creek.

The geology of the site vicinity generally consists of unconsolidated Quaternary-age alluvial deposits overlying Devonian and Silurian carbonate bedrock. Unconsolidated deposits at the site near Dry Run Creek consist of a thin layer of topsoil and clayey to sandy silt overlying fine to medium sand.

Three principal aquifers are present at the site: 1) the Quaternary alluvial aquifer; 2) the Devonian aquifer; and 3) the Silurian aquifer. The alluvial aquifer at the Ralston site is approximately 10 feet to 15 feet thick and consists of ground water flow in the alluvial sands and gravel near Dry Run Creek. Under normal conditions, shallow ground water flow from the disposal area is oriented primarily to the northeast toward the creek. North of the disposal area, shallow ground water flow is radially southward from upland areas toward the channel of Dry Run Creek.

At a depth below the ground surface of approximately 20 to 50 feet, Devonian-age dolomite bedrock of the Otis and Bertram formations is encountered. In the Devonian aquifer the ground water flow is in both the northeast and southeast directions from the site.

The Silurian-age Scotch Grove formation is encountered throughout the site vicinity at a depth below the ground surface of approximately 110 to 140 feet. Ground water flow in the Silurian aquifer is predominantly horizontal with little or no component of vertical ground water flow. The horizontal direction of ground water flow is generally southward with some variation.

Downward vertical gradients were measured between nested wells installed in the alluvial, Devonian, and Silurian aquifers. Near the creek channel, more pronounced vertical solution weathering in the bedrock aquifers may indicate an area of increased downward migration of contaminants.

Several private and public water supply wells exist within two miles of the site. Six private wells within one mile of the site have been sampled on a routine basis since RI activities began. Available well construction information indicates most of these water-supply wells are greater than 150 feet deep, cased through the unconsolidated and upper bedrock deposits, and are open to lower Devonian and/or Silurian rocks. The city of Marion utilizes two wells which tap the Silurian aquifer approximately one mile east of the Ralston site.

The RI for the Ralston site was conducted using a phased approach. Between 1992 and 1996, five phases of investigation were conducted at the site. The results of the first two phases indicated that soil and ground water contamination existed above the bedrock surface in the disposal area, and shallow ground water contamination extended north of the site. In order to accelerate remediation of the disposal area and shallow ground water, Rockwell agreed to perform the Removal Site Evaluation, EE/CA, and removal action mentioned previously, while continuing to investigate the extent of ground water contamination in the bedrock aquifer. Concurrent with the removal activities, the nature and extent of ground water contamination in the underlying Devonian and Silurian aquifers was characterized during RI Phases 3, 4, and 5.

Soil and ground water contaminants detected at the site have been attributed to historical disposal of solvents and other wastes at the site. The primary contaminants at the site which pose a threat to ground water are chlorinated VOCs. The VOCs found at the site include trichloroethene (TCE) and its associated degradation products cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride. The VOCs are detected in three primary zones: the alluvial shallow soil and ground water; the Devonian aquifer, and the Silurian aquifer. The highest concentrations of VOCs were historically detected in shallow ground water in the disposal area. Elevated concentrations have also been detected in the two bedrock water-bearing zones. The highest concentrations in the Devonian aquifer include TCE at 2200 micrograms per liter (μg/L), cis-1,2-DCE at 4800 μg/L, and vinyl chloride at 2100 μg/L. The highest concentrations in the Silurian aquifer have been detected in a low-permeability layer that is somewhat hydraulically isolated from other zones. Contaminants detected include cis-1,2-DCE at 73,200 μg/L and vinyl chloride at 9000 μg/L. The VOCs in the Devonian and Silurian aquifers appear to extend approximately 800 to 1000 feet downgradient of the disposal area. Periodic ground water monitoring has indicated very little variation of concentrations in the two bedrock zones and, accordingly, the plume is considered to be at steady-state. Ground water monitoring began in 1992 and continued throughout the RI.

During the course of the investigations at the site information was gathered to determine the extent to which natural attenuation of contaminants was occurring. Natural attenuation refers to naturally occurring processes in the environment that act to reduce the mass, toxicity, mobility, volume, or concentration of contaminants in various media. These in situ processes include biodegradation, dispersion, dilution, adsorption, volatilization, and chemical or biological stabilization or destruction of contaminants.

At the Ralston site, natural attenuation involves two main components: (1) physical attenuation processes consisting primarily of aquifer dilution, dispersion, and diffusion; and (2) intrinsic bioremediation. Intrinsic bioremediation is the process by which contaminants are transformed from toxic to nontoxic by-products through biologically mediated reactions that occur naturally in the ground water system. Whereas physical attenuation processes reduce the contaminant concentrations and their overall toxicity in ground water, intrinsic bioremediation includes biological and chemical processes that destroy contaminant mass in the aquifer. Loss of

contaminant mass will reduce the volume of contaminants present and result in overall plume shrinkage.

Data from the Ralston site indicates that intrinsic bioremediation is occurring in the disposal area and areas downgradient in the alluvial, Devonian, and Silurian aquifers. Natural attenuation is sufficient to cause a stable or shrinking plume. The data indicate that ground water conditions are sufficiently anaerobic for reductive dechlorination of the contaminants of concern to occur. Electron acceptors (dissolved oxygen, nitrate, manganese, iron, sulfate, and methane) are depleted in areas of active biodegradation and other geochemical conditions are enriched (chloride and alkalinity.) Data from the site indicates that much of the original TCE mass has been degraded to cis-1,2-DCE, vinyl chloride, and ethene along the ground water flow pathways, and these breakdown products, as well as inorganic chloride, form overlapping plumes in the aquifer. The evaluation of intrinsic bioremediation at the Ralston site is discussed fully in the FS Report, Appendix A, which is entitled "Evidence for Intrinsic Bioremediation at the Ralston Site."

The high concentrations of VOCs that were found in the soil and ground water in the disposal area during the RI suggest that some contaminants may be present in that area as dense nonaqueous phase liquids (DNAPLs). A DNAPL is a chemical that is a liquid in its pure form that is heavier than water and does not readily mix with water, but does slowly dissolve in water. Residual DNAPL or elevated VOC concentrations adsorbed into site soil, or debris, are a continuing source for release of VOCs to ground water. Ground water which comes in contact with the waste materials in the disposal area is impacted by possible DNAPL contamination and various contaminants of concern.

Elevated concentrations of some metals were found in samples taken from monitoring wells in the disposal area during the first phase of investigation. Ground water samples were not analyzed for metals during any subsequent phase of the investigation.

Six privately owned water wells near the Ralston site have also been sampled periodically. Two of these private wells have exhibited detectable VOC concentrations. These wells are no longer used as private drinking water supplies because the residences were connected to a public water supply. No VOCs have been detected in any other private drinking water supply wells. Concentrations in the two private wells which did exhibit contamination have remained constant or decreasing over time, further indicating that the ground water contamination plume is stable or decreasing.

The residential wells were sampled for metals during the first phase of the investigation. Metals concentrations were not found in these wells at levels which posed a threat to human health.

A conceptual model of the site was developed to depict how contamination in the disposal area has potentially led to the exposure of several receptor populations. This conceptual model is illustrated in Figure 2.

During the course of the response actions taken to date at the Ralston site, institutional and engineering controls have also been implemented. Institutional controls are non-engineering methods intended to affect human activities in such a way as to prevent or reduce exposure to hazardous substances. Engineering controls are physical barriers to exposure. The institutional and engineering controls are expected to reduce the potential for contamination affecting current or future receptors. These institutional and engineering controls greatly limit the excess risks that additional actions need to address. The institutional controls include the following:

- New wells cannot be installed within a one-mile radius of the former disposal area without approval by the Iowa Department of Natural Resources (IDNR);
- The disposal area and immediate vicinity were purchased by Rockwell; and
- The site has been listed on the State Abandoned or Uncontrolled Site Registry such that it cannot be sold or transferred without the approval of the IDNR.

The following is an engineering control which has been implemented at the Ralston site:

- All private residences with wells containing detectable levels of VOCs have been connected to a public water supply.

6.0 Current and Potential Future Site and Resource Uses

6.1 Land Uses

The disposal area is fenced and will continue to be fenced. It is accessible through a locked gate. Rockwell has stated that it will continue to own this property in the future and will restrict access to the disposal area to those who have a need to monitor and maintain it.

The area immediately surrounding the disposal area is zoned for agricultural use. There are commercial properties within 500 feet of the disposal area and residences within 1000 feet. It is possible that there will be further commercial and residential development in areas outside of the disposal area. The cities of Cedar Rapids and Marion, Iowa, are considering the future development of a greenway that could pass outside of the disposal area.

6.2 Surface Water Uses

Surface water from the site flows north and discharges into Dry Run Creek. Dry Run Creek is an intermittent stream that flows into Indian Creek about one-mile downstream and it in turn flows into the Cedar River 11½ miles downstream of the site. Indian Creek and the Cedar

River are primarily used for recreational (fishing) purposes and golf course irrigation. It is not anticipated that the uses will change.

6.3 Ground Water Uses

There are six private wells within one mile of the site but the two wells which have exhibited detectable levels of VOCs are no longer used for drinking water. The other private wells continue to be used for drinking water purposes. The city of Marion utilizes two wells which tap the Silurian aquifer and are located approximately one mile east of the site. It is anticipated that these ground water uses will not change in the future.

Since a one mile area around the site has been designated as a protected source area pursuant to Iowa Administrative Code 567–53.7(455B), any changes to the use of ground water in that area must be approved by the state.

It is the goal of the remedial action at this site to control exposure to, and prevent the spread of, contamination. Ground water monitoring will be used to ensure that the remedy is effective in addressing the contamination in the ground water. The goal of the remedy is to restore the ground water to drinking water quality outside of the disposal area.

7.0 Summary of Site Risks

CERCLA requires the EPA to seek permanent solutions to protect human health and the environment from hazardous substances to the extent practicable. These solutions provide for removal, treatment, or containment of dangerous chemicals so that any remaining contamination does not pose an unacceptable health risk to those who might come into contact with the contaminants. Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present a current or potential threat to public health, welfare, or the environment.

7.1 Summary of Human Health Risk Assessment

The baseline risk assessment estimates what risks the site poses if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedial action. This section of the ROD summarizes the results of the baseline risk assessment for this site.

The EPA prepared a baseline risk assessment using the data collected during the RI. However, the report entitled Final Baseline Risk Assessment, dated October 21, 1994, was completed before the removal actions and institutional controls were implemented at the site. The Final Baseline Risk Assessment report may be found in the Administrative Record file.

In general, the EPA requires or undertakes remedial actions for Superfund sites when the excess carcinogenic (cancer) risk exceeds 10^{-4}. A risk of 10^{-4} represents an increase of one in ten thousand, or 1/10,000, for a reasonable maximum exposure (RME). This risk represents the lifetime risk of developing cancer as a result of releases from the site.

Remedial actions may also be conducted at Superfund sites when the hazard index (HI) equals or exceeds one for the RME scenario. The HI is a numeric expression of the noncarcinogenic risk to human health resulting from releases from the site.

7.1.1 Identification of Chemicals of Concern

Tables 3.2 through 3.10 (attached) present chemicals of potential concern (COPCs) and exposure point concentrations for each of the COPCs detected in each of the media sampled at the site. These tables come from the Final Baseline Risk Assessment. The tables include the range of concentrations detected for each COPC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected), the exposure point concentration, and the 95% Upper Confidence Limit on the arithmetic mean of the concentrations.

The COPCs were carried throughout the baseline risk calculations for this site; however, the subset of these chemicals which drive the need to perform a remedial action are of primary concern. They are referred to as the chemicals of concern (COC). As stated previously, a removal action was implemented after the baseline risk assessment was prepared. As a result of these actions and the implementation of institutional and engineering controls, the only contaminated media which continues to pose an unacceptable level of threat is ground water. The only COCs which will be discussed further in the section are the COCs for ground water.

The COCs in ground water include TCE and compounds commonly associated as TCE degradation products. The TCE degradation products include cis-1,2-DCE and vinyl chloride. Benzene and 1,1-dichloroethene are also COCs.

7.1.2 Exposure Assessment

The RME scenarios are developed using current exposure pathways given existing land uses and also exposures which might reasonably be predicted based upon expected or logical future land use assumptions. During preparation of the Final Baseline Risk Assessment for the Ralston site there were three RME scenarios which were determined to be appropriate prior to implementation of the removal action and the institutional and engineering controls. The RME scenarios and the exposure pathways for each of these scenarios are as follows:

RME Scenario 1

Current land use for a 6- to 12-year-old trespasser

- Ingestion of contaminants in surface soil, sediment, and surface water
- Dermal absorption of contaminants in surface soil, sediment, and surface water
- Inhalation of contaminants in fugitive dust

RME Scenario 2

Current land use for an off site resident

- Inhalation of contaminants in fugitive dust
- Ground water ingestion
- Inhalation of vapors while showering

RME Scenario 3

Future land use for an on site resident

- Ingestion of contaminants in surface soil, sediment, surface water, and ground water
- Dermal absorption of contaminants in surface soil, sediments, and surface water
- Inhalation of contaminants in fugitive dust
- Inhalation of vapors while showering

Due to the implementation of the removal actions and institutional and engineering controls, the only exposure pathways which are still considered viable are ingestion of ground water and inhalation of vapors during household use of the ground water for the resident. However, this is contingent upon continued maintenance of the cap, creek bank stabilization, and institutional controls. These are elements of all of the remedial alternatives except the no action alternative. Should these elements of the remedy not remain in place, the risks posed by the site could include all of those identified in the Final Baseline Risk Assessment.

7.1.3 Toxicity Assessment

Benzene is a colorless volatile liquid which is soluble in water. Benzene is classified by the EPA as a Group A known human carcinogen. This classification is based on several epidemiological studies which demonstrate an increased incidence of non-lymphocytic leukemia from occupational exposure.

1,1-Dichloroethene, as called vinylidene chloride or more commonly 1,1-DCE, is a colorless liquid that evaporates quickly at room temperature. It has a mild, sweet odor and is flammable. 1,1-DCE is classified by the EPA as a Group C possible human carcinogen. 1,1-DCE has toxic effects on the lungs, liver, and kidneys.

1,2-Dichloroethylene, also called 1,2-dichloroethene, 1,2-DCE, acetylene dichloride, or dichloracetylene occurs as two isomers, cis and trans, with variations in physical properties and toxicity between the two isomers. 1,2-DCE is commonly used as a general solvent for organic materials, dye extraction, lacquers, and organic synthesis. The cis-isomer is apparently the more

common isomer formed as a result of biodegradation. 1,2-DCE has toxic effects by ingestion and skin contact and may be an irritant and cause narcotic effects in high concentrations, affecting the respiratory system, skin, eyes, and central nervous system.

Trichloroethylene, also called trichloroethene, TCE, or ethanol trichloride, is a colorless nonflammable volatile liquid with a chloroform-like odor and is commonly used as a degreasing agent. TCE in high concentrations can have a narcotic effect and can damage the respiratory system, heart, liver, and kidneys. TCE is classified by the EPA as a Group B2 probable human carcinogen.

Vinyl chloride, also called chloroethene, is a colorless gas with a mild, sweet odor. At this site its presence is probably due to the degradation of other chlorinated solvents. Vinyl chloride has toxic effects by ingestion and inhalation, affecting the liver, central nervous system, and peripheral circulation and nerves. Vinyl chloride is classified by the EPA as a Group A known human carcinogen.

Tables 4.1 and 4.2 from the Final Baseline Risk Assessment, which are attached, list the toxicity values and potential noncarcinogenic effects and toxicity values and carcinogenic effects, respectively, for the COCs.

7.1.4 Risk Characterization

For carcinogens, risks are generally expressed as the incremental probability of an individual's developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk is calculated from the following equation:

$$Risk = CDI \times SF$$

where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual's developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as $(mg/kg\text{-}day)^{-1}$.

These risks are probabilities that usually are expressed in scientific notation (e.g., 1×10^{-6}). An excess cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an "excess lifetime cancer risk" because it would be in addition to the risks of cancer individuals face from other causes such as smoking or exposure to too much sun. The chance of an individual's developing cancer from all other causes has been estimated to be as high as one in three. The EPA's generally acceptable risk range for site-related exposures is 10^{-4} to 10^{-6}.

In the Final Baseline Risk Assessment excess cancer risk was calculated for each of the three RME scenarios described previously and are as follows:

Excess Cancer Risks for RME Scenarios

RME	Cancer Risk
RME Scenario 1	1.38×10^{-6}
RME Scenario 2	
Childhood (1-6 years)	3.47×10^{-7}
Lifetime	5.77×10^{-7}
RME Scenario 3	
Childhood (1-6 years)	2.18×10^{-2}
Lifetime	3.89×10^{-2}

RME Scenario 3, the future on site resident, presents an unacceptable level of cancer risk. This information is presented in greater detail in Tables 5.6 through 5.8 from the Final Baseline Risk Assessment (attached).

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period (e.g., lifetime) with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ less than one indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The Hazard Index (HI) is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI less than one indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than one indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

Non-cancer HQ = CDI/RfD

where: CDI = chronic daily intake
RfD = reference dose.

CDI and RfD are expressed in the same units and represent the same exposure period (i.e., chronic, subchronic, or short-term).

In the Final Baseline Risk Assessment noncarcinogenic risks were calculated for each of the three RME scenarios described previously and are as follows:

Noncarcinogenic Risks for RME Scenarios

RME	Health Index
RME Scenario 1	0.04
RME Scenario 2	
Childhood (1-6 years)	0.29
Lifetime	0.19
RME Scenario 3	
Childhood (1-6 years)	87.3
Lifetime	104

The Health Index for RME Scenario 3, the future on site resident, indicates that site-related exposures may present a risk to human health. This information is presented in greater detail in Tables 5.1 through 5.5 from the Final Baseline Risk Assessment.

7.2 Summary of Ecological Risk Assessment

The Final Baseline Risk Assessment also includes a qualitative Ecological Risk Assessment (ERA). This was prepared prior to implementation of the removal actions and institutional controls. Although potential ecological risks to site vegetation, the terrestrial food web, and the aquatic life of Dry Run Creek were identified, the uncertainties of any such risks were very high due to the qualitative nature of the ERA. However, subsequent to the preparation of the ERA, the removal actions that took place at the site, particularly capping of the former disposal area and stabilization of the creek bank, have significantly reduced or eliminated any threat to site vegetation, the terrestrial food web, or the aquatic life of Dry Run Creek.

8.0 Remediation Objectives

Remedial Action Objectives (RAOs) provide a general description of what the clean up will accomplish. The RAOs are most often general objectives such as: prevention of exposure to contaminants; prevention of plume migration; restoration of the ground water to drinking water quality, etc. These objectives are based on available information and standards such as applicable or relevant and appropriate requirements (ARARs) of other environmental laws and risk-based levels established in the risk assessment. The two contaminated media present at this site include ground water and soil. RAOs are established for each.

The RAOs for this action are to prevent exposure to ground water containing contaminants that represent an unacceptable risk to human health or the environment; to contain the contaminated ground water plume; to restore the ground water to drinking water quality outside of the disposal area; and to maintain site conditions which prevent exposure to residual soil contaminants that could pose an unacceptable risk to human health or the environment.

The RAO which is protective of human health for ground water involves the prevention of ingestion of or direct contact with ground water having a carcinogenic risk in excess of 10^{-4} and/or a hazard index for noncarcinogens greater than one. The EPA's Maximum Contaminant Levels (MCLs) from the Safe Drinking Water Act for public water supplies are identified as ARARs for this site. MCLs represent levels which are considered safe for human consumption. The ground water cleanup levels for actions involving treatment of ground water are equivalent to the MCLs which may be associated with the release of VOCs at the site. The MCLs for each of these VOCs are presented as follows.

EPA's Maximum Contaminant Levels
in μg/L

Contaminant	MCL
Benzene	5
1,1-Dichloroethene	7
cis-1,2-Dichloroethene	70
Trichloroethene	5
Vinyl chloride	2

Achieving MCLs in the disposal area may not be possible. It is likely that the contaminants are present in this area as a DNAPL.

The RAO which is protective of human health and the environment for soil involves the prevention or minimization of direct contact exposures (inhalation, dermal contact, ingestion, etc.) with soil having a carcinogenic risk in excess of 10^{-4} or a hazard index for noncarcinogens greater than one. Specific soil cleanup criteria were not established for this site because the removal action has eliminated exposure to soil which exceeds the threshold for carcinogenic or noncarcinogenic risk.

9.0 Description of Alternatives

A feasibility study was conducted to develop and evaluate remedial alternatives for the site. Remedial alternatives were assembled from applicable remedial process options and were initially evaluated for effectiveness, implementability, and cost. The alternatives meeting these criteria were further evaluated and compared to the nine criteria required by the National Contingency Plan (NCP). In addition to the remedial alternatives, the NCP requires that a no action alternative be considered. The no action alternative serves primarily as a point of

comparison for the other alternatives. Four alternatives in addition to the no action alternative are considered. Alternatives 3, 4, and 5 all involve ground water extraction and treatment, but vary with the emphasis placed on different aquifer units or pumping strategies. All of the alternatives, with the exception of the no action alternative, include institutional controls, monitoring, and maintenance of the cap and creek bank. An explanation of the common elements of the remedial alternatives follows.

Each of the alternatives, except the no action alternative, includes maintaining the institutional controls which are already in place at the Ralston Site. These include:

(1) continued ownership by Rockwell of the fenced-in area, including the disposal area. The area is zoned for agricultural use. The only access to the disposal area is through a locked gate, thus restricting access by trespassers;

(2) continued listing of the site on the Registry of Hazardous Waste or Hazardous Substance Disposal Sites pursuant to Iowa Administrative Code 455B.426. According to Iowa Administrative Code 148.6(5), written approval of the director of the IDNR is required prior to any substantial change in the use of the listed site. In addition, written approval is also required to sell, convey, or transfer title of the listed site; and

(3) any new wells in an area specially designated around the site must be approved by state authorities. A one-mile area surrounding the site has been designated as a protected source area pursuant to Iowa Administrative Code 567--53.7(455B). According to the promulgated rule, "any new application for a permit to withdraw ground water or to increase an existing permitted withdrawal of ground water from within the protected water source area will be restricted or denied, if necessary, to preserve public health and welfare or to minimize movement of ground water contaminants from the Ralston site."

All of the alternatives, except the no action alternative, include monitored natural attenuation of the ground water. Previously in this ROD, in the Section entitled Site Characteristics, the process of natural attenuation was described as was the fact that data collected at the site indicates that intrinsic bioremediation of the contaminants of concern is occurring in the disposal area and areas downgradient in the alluvial, Devonian, and Silurian aquifers. This information in presented in Appendix A of the Feasibility Study Report. The data from the site also suggests that intrinsic biodegradation will occur at a predictable rate in the future and degrade TCE and associated breakdown products by fifty percent every one-half to two years. Also included in this remedial option is the collection of ground water samples from appropriate monitoring wells and private wells and the analysis of these water samples for VOCs as well as other constituents to determine the continued effectiveness of the bioremediation processes.

For each of the alternatives that include ground water extraction and treatment, the process would involve piping the extracted water to the existing treatment building through underground piping. The water would be treated by air stripping with the off-gas from the air stripper being directed through the existing catalytic oxidation unit for destruction of the VOC

contaminants. Treated water would then be conveyed through underground piping to Dry Run Creek for discharge.

All of the alternatives, except the no action alternative, include maintenance of the cap and creek bank. The cap and creek bank would be visually inspected periodically to verify the integrity and performance of the materials. The cap and creek bank would be regularly maintained, including mowing, revegetation, and repair, to ensure long-term reliability.

Alternative 1: No action

The NCP requires that the EPA consider a no action alternative against which other remedial alternatives can be compared. Under this alternative, no further action would be taken to monitor, control, or remediate the soil or ground water contamination. The existing cap and bank stabilization would remain in place; however, no inspections or maintenance would take place to ensure their future effectiveness. Institutional controls have been implemented at the site, as discussed previously. However, compliance with these institutional controls would not be ensured under this no action alternative. Natural attenuation of the ground water contamination is occurring at the site. Under the no action alternative, no monitoring would take place to determine that these natural attenuation processes continue to be effective in the future or to determine where the concentration of contaminants has effectively been reduced below health-based levels. There are no capital or operating costs associated with this alternative.

The expected outcome of this alternative would be that natural attenuation of the ground water would continue for some period of time but the effectiveness would be undetermined. The cap and creek bank stabilization could be expected to fail in some locations resulting in the possibility of direct contact exposure with contaminants, infiltration of precipitation into the disposal area, and the movement of contaminants into Dry Run Creek.

Alternative 2: Monitored natural attenuation with institutional controls, maintenance of the cap and creek bank stabilization

With this alternative, the ground water would be allowed to remediate through natural attenuation processes. Monitoring of the ground water would be done periodically to confirm that these processes continue to be effective and to determine where the concentration of contaminants has been reduced below health-based levels outside of the disposal area. The institutional controls mentioned previously, which have already been implemented, would be maintained. The cap and creek bank would be inspected periodically to ensure the integrity and performance of the materials and they would be maintained to ensure long-term reliability. The estimated annual operation and maintenance costs of this alternative are $32,780 and the estimated present net worth is $566,800.

The expected outcome of this alternative is that the concentration of contaminants in the ground water will be reduced below health-based action levels in areas outside of the disposal

area and there will be no consumption of contaminated ground water in the future. There will be no direct contact with contaminated soil that remains beneath the cap and no discharge of contaminated ground water or soil into Dry Run Creek via the stabilized creek bank.

Alternative 3: Monitored natural attenuation with institutional controls, maintenance of the cap and creek bank stabilization, and Devonian aquifer ground water extraction near disposal area and treatment

This alternative includes all of the components of Alternative 2 as well as pumping ground water from wells in the Devonian aquifer near the disposal area. The extracted water would be treated by air stripping and the off-gas from the air stripper directed through the catalytic oxidizer in the existing treatment facility. Treated water would then be discharged in Dry Run Creek under the required permits. The estimated capital cost for implementation of this alternative is $96,140. The estimated annual operation and maintenance costs are $352,500 and the estimated present net worth is $6,192,000.

The expected outcome of this alternative is that the contamination in the ground water will be reduced at about the same rate as Alternative 2. There will be no consumption of contaminated ground water in the future. There will be no direct contact with contaminated soil that remains beneath the cap and no discharge of contaminated ground water or soil into Dry Run Creek via the stabilized creek bank.

Alternative 4: Monitored natural attenuation with institutional controls, maintenance of the cap and creek bank stabilization, Devonian aquifer ground water extraction near disposal area and treatment, and Silurian aquifer ground water extraction near disposal area and treatment

This alternative would include all of the components of Alternative 3 as well as pumping ground water from the Silurian aquifer near the disposal area. The extracted ground water would be treated by air stripping and the off-gas from the air stripper directed through the catalytic oxidizer in the existing treatment facility. Treated water would then be discharged in Dry Run Creek under the required permits. The estimated capital cost for implementation of this alternative is $223,600. The estimated annual operation and maintenance costs are $407,700 and the estimated present net worth is $7,274,000.

The expected outcome of this alternative is that the contamination in the ground water will be reduced at a rate somewhat more rapidly than Alternative 2. There will be no consumption of contaminated ground water in the future. There will be no direct contact with contaminated soil that remains beneath the cap and no discharge of contaminated ground water or soil into Dry Run Creek via the stabilized creek bank.

Alternative 5: Monitored natural attenuation with institutional controls, maintenance of the cap and creek bank stabilization, Devonian aquifer and Silurian aquifer ground water extraction and treatment over entire area of VOC plume

This alternative would include all of the components of Alternative 4 with the addition of ground water extraction wells in the Devonian and Silurian aquifers downgradient from the disposal area so that the entire plume of contaminated water could be captured. The extracted ground water would be conveyed to the existing treatment building to be treated by air stripping. The treatment facility would have to be reconfigured and equipped for larger treatment capacity. Off-gas from the air stripping process would be directed through the existing catalytic oxidizing unit. Treated water would then be discharged in Dry Run Creek under the required permits. The estimated capital cost for implementation of this alternative is $801,300. The estimated annual operation and maintenance costs are $492,800 and the estimated present net worth is $9,324,000.

The expected outcome of this alternative is that the contamination in the ground water will be reduced at a faster rate than all other alternatives. There will be no consumption of contaminated ground water in the future. There will be no direct contact with contaminated soil that remains beneath the cap and no discharge of contaminated ground water or soil into Dry Run Creek via the stabilized creek bank.

10.0 Summary of Comparative Analysis of Alternatives

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy. The nine evaluation criteria are (1) overall protection of human health and the environment; (2) compliance with applicable, relevant and appropriate requirements (ARARs); (3) long-term effectiveness and permanence; (4) reduction of toxicity, mobility, or volume of contaminants through treatment; (5) short-term effectiveness; (6) implementability; (7) cost; (8) state/support agency acceptance; and (9) community acceptance. This section of the ROD profiles the relative performance of each alternative against the nine criteria, noting how it compares to the other options under consideration. The nine evaluation criteria are discussed below. The "Detailed Analysis of Alternatives" can be found in the FS Report.

10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through institutional controls, engineering controls, and/or treatment.

All of the alternatives, except the no action alternative, would provide adequate protection of human health and the environment by eliminating, reducing or controlling risk by one or more of the following: through treatment, engineering controls, and institutional controls.

The designation of a Protected Source Area will prevent unrestricted future use of ground water within a one mile radius of the site. The ground water monitoring program that is to be implemented as a part of Alternatives 2 through 5 will ensure that exposure to ground water contaminants from the site will not occur that would represent an unacceptable human health or environmental risk because the migration of contamination will be detected. Alternatives 3, 4, and 5 are more protective than Alternative 2 since these alternatives include ground water extraction and treatment designed to hydraulically control and capture contaminated ground water. The effectiveness of any such system cannot be predicted with certainty because the site area is a complex hydrogeologic setting. Alternative 5 would be the most protective because it includes downgradient pumping to ensure that contaminants do not migrate beyond the present area of contamination.

Alternatives 2 through 5 include periodic inspection and maintenance of the cap and creek bank to ensure that there is no exposure to residual soil contamination in the future. These alternatives also include the continued listing of the site on the Registry of Hazardous Waste or Hazardous Substance Disposal Sites pursuant to Iowa Administrative Code 455B.426.

Because the no action alternative is not protective of human health and the environment, it was eliminated from consideration under the remaining eight criteria.

10.2 Compliance with ARARs

Section 121(d) of CERCLA requires that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA Section 121(d)4.

Applicable requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law that specifically address hazardous substances, the remedial action to be implemented at the site, the location of the site, or other circumstances present at the site. Relevant and appropriate requirements are those substantive environmental protection requirements, criteria, or limitations promulgated under federal or state law which, while not applicable to the hazardous materials found at the site, the remedial action itself, the site location, or other circumstances at the site, nevertheless address problems or situations sufficiently similar to those encountered at the site that their use is well suited to the site.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes or provides a basis for invoking a waiver.

All alternatives, except the no action alternative, would comply with the MCLs promulgated under the Safe Drinking Water Act for the contaminants of concern in areas found

not to contain DNAPL. It may not be possible to achieve the MCLs in DNAPL zones. If such DNAPL zones are located, a technical impracticability waiver under CERCLA will be sought to waive MCLs as ARARs for these areas.

The Protected Source Area, which has already been implemented in an area surrounding the site, is an ARAR for Alternatives 2 through 5.

Construction of the ground water extraction system for Alternatives 3 through 5 would potentially have to comply with requirements of the Clean Water Act and state of Iowa statutes related to construction in flood plains. Operation of the ground water treatment system would require compliance with air emission standards. Discharge of treated ground water to surface water would require permitting in accordance with the National Pollution Discharge Elimination System requirements and other water quality effluent restrictions.

Alternatives 2 through 5 would meet their respective ARARs from federal and state laws. Appendix B of the Feasibility Study Report provides a comprehensive listing of all ARARs.

10.3 Long-term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk and the adequacy and reliability of controls.

Alternatives 2 through 5 would be effective in the long-term by reducing contaminant concentrations in ground water. Natural attenuation processes will continue to decrease the concentrations of contaminants in the aquifers, eventually transforming them to non-toxic by-products through intrinsic bioremediation. Evidence suggests that natural attenuation processes have resulted in a steady-state contaminant plume at the Ralston site and have reduced the contaminant mass loading to the aquifers by reductively dechlorinating VOCs to non-toxic by-products. This evidence is presented in detail in Appendix A of the Feasibility Study Report. The monitoring program included in all of the alternatives is needed to document the degree to which natural attenuation is occurring and to identify whether ground water flow directions, gradients, or plume boundaries have changed.

Alternatives 3, 4, and 5 include ground water extraction and treatment to further reduce contaminant residuals. One concern with these alternatives is that the potential impact of ground water extraction on natural biodegradation processes occurring in the aquifers is not known. There is evidence to suggest that ground water extraction may have a negative effect on biodegradation processes. Both the ground water extraction and treatment systems would require on-going maintenance to prevent operational problems and to continue their effectiveness.

Alternatives 2 through 5 include periodic inspection and maintenance of the cap and creek bank to ensure that there is no exposure to residual soil contamination in the future.

The Protected Source Area designation would be an adequate and reliable control for preventing future withdrawal of, and exposure to, ground water in the future but it does not prevent current ground water users within the one-mile radius from exposure. The two residences near the site with private drinking water wells which exhibited detectable levels of VOCs were connected to a public water supply. These wells are no longer used for drinking water by the residents. Alternatives 2 through 5 include a ground water monitoring program to ensure that existing private wells near the site are not impacted by site contamination.

Reviews at least every five years, as required, would be necessary to evaluate the effectiveness of all of these alternatives because hazardous substances would remain on site in concentrations above health-based levels.

10.4 Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

Alternatives 2 through 5 include natural attenuation to reduce the toxicity of contaminants in the aquifers. Intrinsic biodegradation of the contaminants is reducing the toxicity of site contaminants by completely and irreversibly transforming the chlorinated VOCs from TCE, DCE, and vinyl chloride to non-toxic by-products through reductive dechlorination processes. Alternatives 3, 4, and 5 would remove contaminants from ground water by air stripping and irreversibly destroy the contaminants through the process of catalytic oxidation.

Ground water monitoring would provide information on the movement of contaminants in ground water but would not directly affect the mobility of the contaminants. Ground water extraction associated with Alternative 3, 4, and 5 would reduce contaminant mobility by creating a hydraulic barrier around various areas of contamination. Alternative 3 would reduce contaminant mobility in the Devonian aquifer near the disposal area, Alternative 4 would reduce mobility in the Devonian and Silurian aquifers near the disposal area, and Alternative 5 would reduce contaminant mobility throughout the entire plume.

The mass of contaminants present in the aquifers would be reduced by Alternatives 2 through 5. Based on data collected at the site, it is predicted that for every 1,000 pounds of contaminants entering the aquifers, 500 pounds would be removed during the first six months to two years by natural attenuation. Another 250 pounds of contaminants would be destroyed during the next six months to two years and so on, through natural attenuation. Although natural attenuation is a component of Alternatives 3, 4, and 5, with each additional layer of pumping added, contaminant removal by naturally occurring processes would become less prominent

compared to the removal rates attained by pumping. Based on estimated extraction rates for Alternatives 3, 4, and 5, contaminant mass could be removed from the Devonian and Silurian aquifers at the following rates associated with each alternative:

Alternative	Total Extraction Rate (lbs/day)	Time to Remove 1,000 lbs. of Contamination (yrs.)
3	1.4	2.0
4	1.6	1.7
5	1.8	1.5

The biodegradation process results in complete transformation of chlorinated VOCs to non-toxic residuals, primarily ethene and ethane. These residuals are then readily biodegraded to carbon dioxide and water. Ground water extraction and treatment would remove contaminants from ground water by air stripping and irreversibly destroy the contaminants through the process of catalytic oxidation.

Based upon the information presented above, a comparison may be made between the amount of time it would take to remove an equal amount of the contaminants found in ground water given the use of natural attenuation alone and the alternatives which include pumping and treating ground water. Natural attenuation is estimated to remove the contaminants from the ground water at a rate ranging from about equal to the rate for the least aggressive pump and treat alternative (Alternative 3) to as long as four times the amount of time needed for the most aggressive pumping and treating alternative (Alternative 5).

10.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers and the community during construction and operation of the remedy until cleanup goals are achieved.

In general, the alternatives with the fewest construction activities will pose the lowest risk to site workers and the community during the remedial action. Therefore, Alternative 2 would pose the least risk. Since no one is currently exposed to contaminated ground water, only workers collecting samples from monitoring wells could be exposed to contaminants and this could be minimized by proper use of personal protective equipment. Cap and bank repair could result in exposure to contamination by workers, but once again could be minimized by proper use of health and safety measures and personal protective equipment. Alternatives 3, 4, and 5 also have the possibility of the risks described for Alternative 2, but may have greater risks to workers posed by well drilling, trenching, and construction.

Maintenance or repair of the creek bank would utilize soil erosion and sediment control technologies to protect the surface water in Dry Run Creek. Alternatives 3, 4, and 5 would

involve discharge of treated ground water to Dry Run Creek. This would have to be monitored to ensure that the discharge does not increase the erosion of the channel at the point of entry. Construction of piping near Dry Run Creek would have to be completed in a manner that does not damage the creek.

Air emissions from the ground water treatment processes in Alternatives 3 through 5 would be addressed by engineering controls to ensure that the emissions meet applicable federal or state air emissions standards, mitigating any adverse on or off site impacts.

10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

Alternatives 2 through 5 are technically implementable. Ground water monitoring and sampling equipment and procedures are well developed and available. Maintenance of the cap and bank stabilization would be easily achieved. Ground water extraction and treatment, included in Alternatives 3 through 5, would be technically feasible to implement. However, the complex hydrogeologic conditions and high concentrations of contaminants in low permeability zones could significantly reduce the assumed benefits of ground water extraction. A treatment system has already been constructed on site, but it would require major modifications to treat the high water flow rates associated with Alternative 5.

All of the alternatives have few associated administrative difficulties.

10.7 Cost

Cost includes estimated capital and operation and maintenance costs as well as present worth costs. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

The estimated costs associated with Alternatives 1 through 5 are summarized in Table 2. The present net worth costs were calculated using an assumed life of 30 years and a three percent discount rate. Alternatives 2 through 5 all involve the same operation and maintenance costs associated with maintaining the cap and creek bank stabilization. Alternatives 3 through 5 are considerably more costly than Alternative 2 because of the significant capital and operation and maintenance costs associated with the installation and maintenance of a ground water pump and treat system.

10.8 State/Support Agency Acceptance

The IDNR has actively participated in the oversight activities for the Ralston site, including review of the RI and FS Reports. The I DNR has expressed its support for Alternative 2.

10.9 Community Acceptance

During the public comment period, the community expressed its support for the EPA's preferred alternative. One written comment was received which clarified Rockwell's plans for future ownership of the property in the vicinity of the disposal area.

11.0 Principal Threat Wastes

The NCP establishes an expectation that the EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur.

The contamination remaining in the subsurface soil in the disposal area could be considered a principal threat waste. The completed removal actions utilized the process of dual vapor extraction to remove as much of the contamination as possible. The cap that was constructed over the disposal area eliminates the possibility that exposure to these contaminants will occur through direct contact and minimizes mobilization of the contamination by reducing the infiltration of precipitation. All of the alternatives considered for this site, with the exception of the no action alternation, include the continued maintenance of the disposal area cap.

There is the possibility that contaminants exist in the ground water as DNAPLs, which may also be considered principal threat wastes. None of the alternatives include actions specifically designed to address this possible contamination as the locations of areas of DNAPL have not been identified with any certainty.

12.0 Selected Remedy

The Preferred Alternative for cleaning up the Ralston Site is Alternative 2. Alternative 2 provides for monitored natural attenuation of ground water with institutional controls and maintenance of the cap and creek bank stabilization.

As has been discussed in earlier sections of this ROD, data has been gathered and analyzed which indicates that intrinsic bioremediation of the contaminants of concern is occurring at this site in the disposal area and in areas downgradient in the alluvial, Devonian, and Silurian aquifers. This information is presented in Appendix A of the Feasibility Study Report.

Monitoring of the ground water would be done periodically to confirm that the natural attenuation processes continue to be effective and to determine where the concentration of contaminants has been reduced below health-based cleanup levels outside of the disposal area. The appropriate locations for monitoring the ground water in all three aquifers will be selected based on ground water monitoring data which continues to be collected at the site and will be modified as required in the future. Modifications will likely be required as the contaminated ground water plume changes.

The health-based action levels for the ground water at this site are based upon the MCLs from the Safe Drinking Water Act for public water supplies, which was identified as an ARAR for this site. The action levels for each of the chemicals of concern are as follows:

Ground Water Action Levels
in μg/L

Contaminant	MCL
Benzene	5
1,1-Dichloroethene	7
cis-1,2-Dichloroethene	70
Trichloroethene	5
Vinyl chloride	2

Achieving MCLs in the disposal area may not be possible. It is likely that the contaminants are present in this area as a DNAPL. In the future, if it is determined that MCLs cannot be achieved in the disposal area, it may be appropriate to consider a technical impracticability waiver. A technical impracticability waiver may be used when compliance with an ARAR is not feasible from an engineering standpoint or because of excessive cost, particularly in relation to performance.

Several institutional controls, which have already been implemented, will be maintained at the site. Currently, Rockwell owns 27.93 acres, including the former disposal area. The disposal area is fenced. Rockwell has stated its intention to retain ownership of the property within the fence, at a minimum. The fence will remain and be maintained to restrict access.

The site will continue to be listed on the Registry of Hazardous Waste or Hazardous Substance Disposal Sites pursuant to Iowa Administrative Code 455B.426. According to Iowa Administrative Code 148.6(5), written approval of the director of the IDNR is required prior to any substantial change in the use of the listed site. In addition, written approval is also required to sell, convey, or transfer title of the listed site.

A one-mile area surrounding the site has been designated as a protected source area pursuant to Iowa Administrative Code 567--53.7(455B). Therefore, any new wells in the designated area must be approved by state authorities. According to the promulgated rule, "any

new application for a permit to withdraw ground water or to increase an existing permitted withdrawal of ground water from within the protected water source area will be restricted or denied, if necessary, to preserve public health and welfare or to minimize movement of ground water contaminants from the Ralston site."

The cap and creek bank stabilization, which were implemented during the removal action, will continue to be inspected periodically and maintained. Specific plans for the inspections and maintenance will be developed. They will include the schedule for inspections, plans for mowing and revegetation, and other items determined necessary to ensure the long-term reliability of these structures.

Additional ground water sampling will be done to determine whether the elevated levels of metals found in the disposal area continue to exist and to determine whether they have migrated beyond the disposal area and pose an unacceptable level of risk to human health. A plan for the appropriate monitoring wells to be sampled will be developed. The metals which will be analyzed include all of those which were originally included in the RI. If it is determined by the EPA that there are concentrations of these analytes which pose an unacceptable level of risk to human health, it may be necessary to modify this remedial action in the future to address this risk.

Tables 2 and 3 provide details of a cost estimate for implementation of the preferred remedy. There are no capital expenditures planned for this remedy. The discount rate used in calculation of the present net worth costs is three percent. The information in this cost estimate summary table is based on the best available information regarding the anticipated scope of the remedial alternative. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

The expected outcome of this alternative is that the concentration of contaminants in the ground water will be reduced below health-based action levels in areas outside of the disposal area and there will be no consumption of contaminated ground water in the future. There will be no direct contact with contaminated soil that remains beneath the cap and no discharge of contaminated ground water or soil into Dry Run Creek via the stabilized creek bank.

The Preferred Alternative was selected over other alternatives because it is expected to achieve substantial reduction of the risks posed by contaminated ground water and maintains the measures already in place to prevent future exposure to currently contaminated ground water and soil at a substantially lower cost than the other alternatives. Although the time frame for reducing the risks may be longer for the preferred alternative, the expected time frame is not unreasonably long. Therefore, the Preferred Alternative is believed to provide the best balance of trade-offs among alternatives, with respect to the evaluation criteria.

13.0 Statutory Determinations

Under its legal authority, the EPA's primary responsibility at Superfund sites is to ensure that remedial actions achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws, unless a statutory waiver is justified. The selected remedy also must be cost effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, and mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedy will protect human health and the environment by achieving the remedial action objectives established for the site. Levels of contaminants in the ground water will be reduced to levels considered by the EPA to be safe for human consumption. In the short-term, protection is provided by ground water use restrictions which will prevent exposures to the contaminated ground water.

13.2 Compliance With ARARs

The selected remedy is expected to comply with ARARs. The MCLs established under the Safe Drinking Water Act are considered relevant and appropriate for the monitored natural attenuation component of the remedy for the chemicals of concern. However, if DNAPL zones are located at the site, a waiver of ARARs may be sought based on the technical impracticability of achieving MCLs in DNAPL zones. Chapter 133 of the Iowa Administrative Code contains "action levels" for contaminants in ground water. The IDNR has acknowledged that cleanup actions have been implemented at the Ralston site that constitute compliance with this state ARAR.

There are two location-specific ARARs in place at the Ralston site. The site is on the Registry pursuant to Iowa Administrative Code 567-148(455B). The site cannot be sold, conveyed, or transferred without written approval of the IDNR. The Protected Source Area designation pursuant to Iowa Administrative Code 567--53.7(455B) will require the IDNR to evaluate all proposed new or increased uses of ground water from wells within a one-mile radius of the Ralston site.

Requirements of the Occupational Safety and Health Act (OSHA) will be complied with; however, OSHA requirements are not ARARs because OSHA is not an "environmental" law.

13.3 Cost Effectiveness

The EPA believes that the selected remedy is cost effective because it will provide overall effectiveness proportional to its costs. The selected remedy is the least costly of the alternatives considered for this site.

13.4 Utilization of Permanent Solutions and Alternative Treatment Technology to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment can be utilized in a cost-effective manner at this site. Of the alternatives that are protective of human health and the environment and comply with ARARs, the EPA has determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness, reduction of toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, and cost. Additional considerations include the statutory preference for treatment as a principal element as well as state and community aceptance.

All of the alternatives which met the threshold criteria provided long-term effectiveness. Since the selected remedy does not include treatment, long-term effectiveness is achieved through monitoring of the ground water. Treatment was found to be impracticable due to significantly higher costs because it did not provide significantly more protection. Short-term effectiveness was not a major concern with any of the alternatives considered. While all of the alternatives which included extraction and treatment of ground water were implementable, it was not certain to what degree the complex hydrogeologic conditions at the site would negatively impact implementation of this technology.

13.5 Preference for Treatment as a Principal Element

The selected remedy at this site does not meet the preference for treatment as a principal element. Treatment was found to be impracticable as it did not provide significantly more protection for the significantly higher costs. A ground water monitoring program is included to monitor contaminant levels over time and confirm the adequacy of natural attenuation to reduce contaminant levels.

13.6 Five-Year Review Requirements

If there are hazardous substances, pollutants, or contaminants remaining at a site above levels that would allow for unlimited use and unrestricted exposure, pursuant to Section 121(c) of CERCLA and NCP §300.430(f)(5)(iii)(C), the EPA shall conduct a review of such remedial action no less often than each five years after the initiation of the remedial action to assure that human health and the environment are being protected. The Ralston site will require a statutory five-year review.

14.0 Documentation of Significant Changes

The Proposed Plan for the Ralston site was released for public comment in July 1999. The Proposed Plan identified Alternative 2, monitored natural attenuation, maintenance of cap and creek bank stabilization, and institutional controls, as the preferred alternative. The EPA reviewed the written comment submitted during the public comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

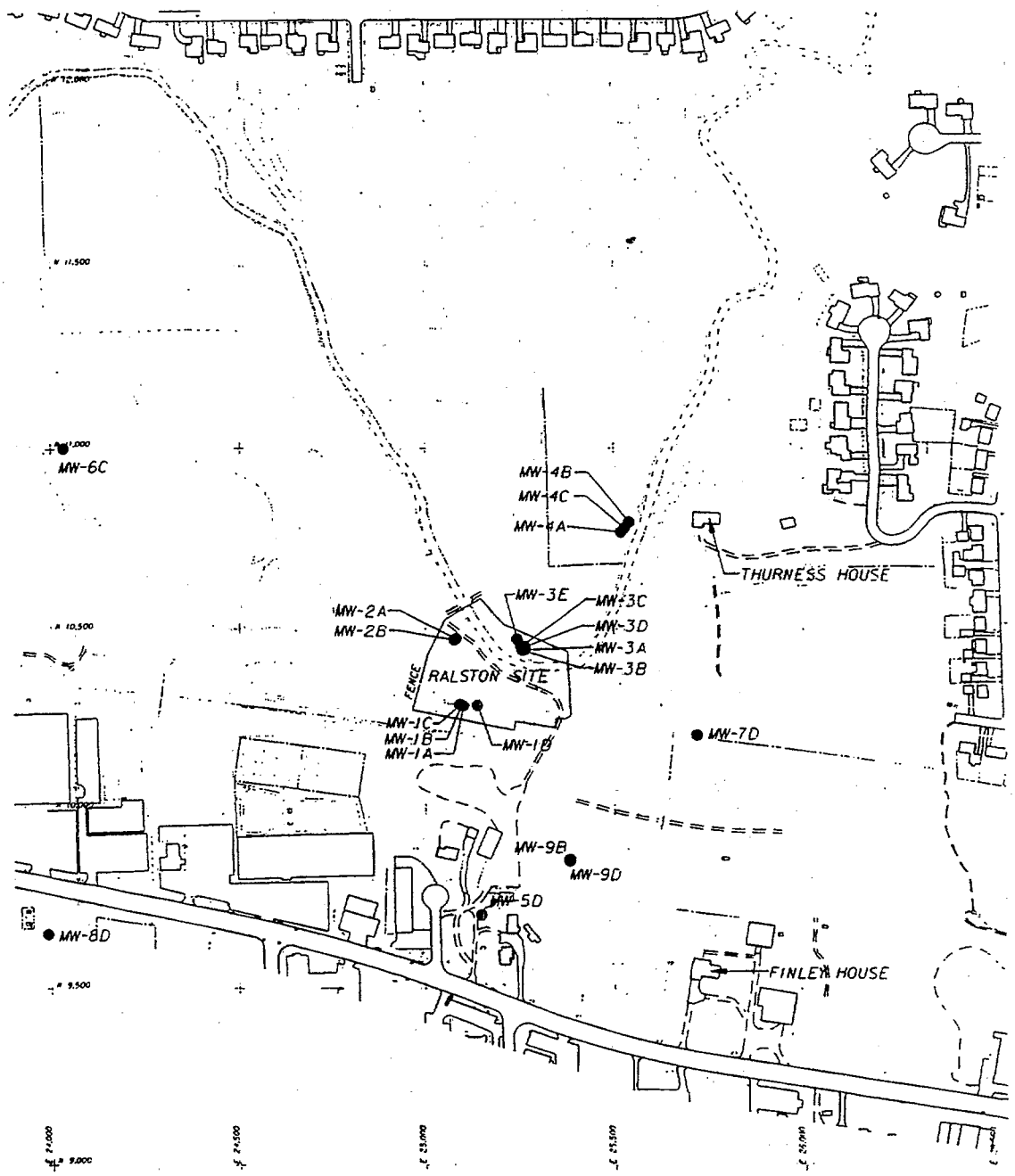
RESPONSIVENESS SUMMARY

Ralston Site
Cedar Rapids, Iowa

The public comment period on the Preferred Alternative began on July 1, 1999, and ended on August 2, 1999. A public hearing was held in Cedar Rapids, Iowa, on July 6,1999, with several members of the public in attendance. No comments were received at this meeting regarding the Preferred Alternative.

One written comment was received during the public comment period. The written comment was from Rockwell Collins, Inc. regarding clarification of their plans for property ownership in the area near the disposal area. The Record of Decision includes the information provided by Rockwell that they will continue to own the fenced-in area, including the disposal area.

The written comment is included in the Administrative Record file.



LEGEND:

● MONITORING WELL

N

0 300

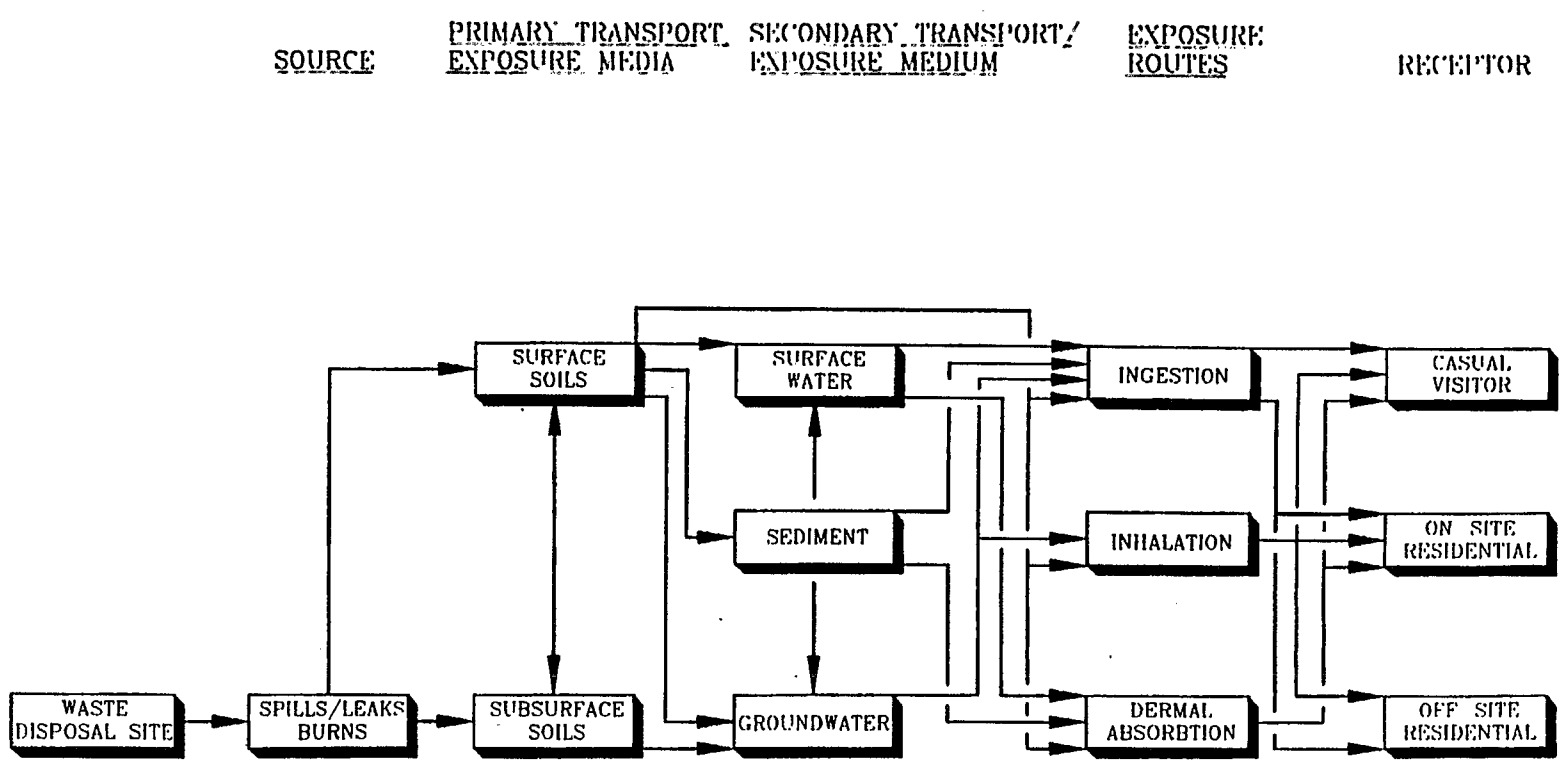
SCALE IN FEET

ROCKWELL INTERNATIONAL
CEDAR RAPIDS, IA

MONITORING WELL LOCATIONS

MONTGOMERY WATSON

FIGURE 1



SITE CONCEPTUAL MODEL
FORMER RALSTON WASTE DISPOSAL SITE
LINN COUNTY, IOWA

CDM FEDERAL PROGRAMS CORPORATION
a subsidiary of Camp Dresser & McKee Inc.

FIGURE 2

TABLE 3.2
FORMER RALSTON DISPOSAL SITE
SURFACE SOIL SAMPLES
DETECTED CHEMICALS STATISTICS
(Results in ug/kg unless otherwise specified)

CHEMICAL	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Anthracene	2/3	42 - 72	100	75	227	72
Arsenic (mg/kg)	7/7	3.2 - 13.1	7	3	10	9.6
Barium (mg/kg)	7/7	88.5 - 1570	435	533	827	827
Benzo(a)Anthracene	3/3	120 - 360	203	136	432	360
Benzo(a)Pyrene	3/3	120 - 360	203	136	432	360
Benzo(b)Fluoranthene	3/3	130 - 470	247	193	573	470
Benzo(g,h,i)Perylene	3/3	99 - 360	190	148	439	360
Benzo(k)Fluoranthene	3/3	120 - 360	207	133	431	360
bis(2-Ethylhexyl)Phthalate	2/3	400 - 1400	717	617	1,757	1,400
Butylbenzylphthalate	1/3	86 - 86	157	62	261	86
Cadmium (mg/kg)	7/7	2 - 77.2	21	28	42	41.8
Chloroform	1/7	6 - 6	9	8	15	6
Chromium (mg/kg)	7/7	11.2 - 544	142	201	289	289
Chrysene	3/3	140 - 390	227	142	465	390
Copper (mg/kg)	7/7	10.3 - 19400	4,159	7,230	9,468	9,468
Dichloroethene, Cis-1,2-	6/7	3 - 110	25	38	53	53
Fluoranthene	3/3	260 - 640	390	217	755	640
Hexachlorobenzene	1/3	65 - 65	145	69	262	65
Indeno(1,2,3-cd)Pyrene	3/3	86 - 310	169	123	376	310
Lead (mg/kg)	7/7	11.3 - 1910	557	732	1,095	1,095
Methylene Chloride	1/7	11 - 11	7	2	8	8
Naphthalene	1/3	62 - 62	144	71	264	62
Nickel (mg/kg)	7/7	10.9 - 446	135	189	273	273
Phenanthrene	3/3	130 - 340	220	108	402	340
Pyrene	3/3	230 - 760	420	295	918	760
Silver (mg/kg)	6/7	0.67 - 202	52	80	111	111
Tetrachloroethene	6/7	1 - 94	22	34	47	47
Toluene	3/7	2 - 8	9	9	15	8
Trichloroethane, 1,1,1-	2/7	1 - 4	8	9	15	4
Trichloroethene	6/7	14 - 580	132	206	283	283
Xylene (total)	1/7	4 - 4	9	9	15	4
Zinc (mg/kg)	7/7	39.2 - 4130	1,068	1,553	2,209	2,209

TABLE 3.3
FORMER RALSTON DISPOSAL SITE
MONITORING WELL SUBSURFACE SOIL SAMPLES
DETECTED CHEMICALS STATISTICS
(Results in ug/kg unless otherwise specified)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Arsenic (mg/kg)	5	5/5	1.2 - 4.1	2.8	1.3	4	4
Barium (mg/kg)	5	5/5	32.8 - 187	102	68	167	167
Benzene	5	1/5	2 - 2	4.9	1.6	6	2
Cadmium (mg/kg)	5	5/5	1.6 - 8	3.5	2.5	6	6
Chromium (mg/kg)	5	5/5	5.9 - 36.2	16	11.8	27	27
Copper (mg/kg)	5	5/5	6 - 1,290	265	573	811	811
Lead (mg/kg)	5	5/5	7.2 - 467	100	205	296	296
Nickel (mg/kg)	5	5/5	8.3 - 67.8	21	26	46	46
Silver (mg/kg)	1	1/1	26.2 - 26.2	26.2	Statistics not calculated for single sample		
Tetrachloroethene	5	1/5	4 - 4	5.3	0.76	6	4
Trichloroethene	5	1/5	6 - 19	8.3	6.0	14	14
Xylene (total)	5	1/5	2 - 6	4.9	1.6	6	6
Zinc (mg/kg)	5	5/5	18.7 - 494	124	207	321	321

TABLE 3.4
FORMER RALSTON DISPOSAL SITE
SOIL BORING SUBSURFACE SOIL SAMPLES
DETECTED CHEMICALS STATISTICS
(METALS, VOCs)
(Results in ug/kg unless otherwise specified)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Acetone	8	1/8	11 - 14	194,023	547,898	561,106	14
Arsenic (mg/kg)	5	5/5	2.8 - 9.1	4	3	7.0	7.0
Barium (mg/kg)	5	5/5	106 - 1,160	330	464	772.7	773
Cadmium (mg/kg)	5	5/5	4 - 300	64	132	189.7	190
Chloroform	8	1/8	11 - 720,000	90,272	254,449	260,749	260,749
Chromium (mg/kg)	5	5/5	16.1 - 474	112	203	304.8	305
Copper (mg/kg)	5	5/5	8.8 - 15,400	3,225	6,810	9,718.6	9,719
Dichloroethene, Cis-1,2-	8	5/8	2 - 20,000	196,878	546,788	563,217	20,000
Ethylbenzene	8	1/8	11 - 5,700	194,560	547,684	561,499	5,700
Lead (mg/kg)	5	5/5	8.2 - 3,000	629	1,326	1,893.2	1,893
Nickel (mg/kg)	5	5/5	14.1 - 937	202	411	593.6	594
Silver (mg/kg)	5	3/5	0.68 - 250	51	111	157.0	157
Tetrachloroethene	8	5/8	2 - 1,800,000	225,621	636,147	651,829	651,829
Toluene	8	6/8	1 - 6,300,000	792,378	2,225,448	2,283,392	2,283,392
Trichloroethane, 1,1,1-	8	1/8	2 - 2	194,022	547,898	561,105	2
Trichloroethene	8	8/8	3 - 17,000,000	2,125,652	6,010,145	6,152,350	6,152,350
Vinyl Chloride	8	1/8	11 - 660	194,011	547,903	561,097	660
Xylene (total)	8	3/8	11 - 700,000	90,407	246,444	255,521	255,521
Zinc (mg/kg)	5	5/5	38.1 - 4,650	1,071	2,009	2,986.0	2,986

TABLE 3.5
FORMER RALSTON DISPOSAL SITE
SOIL BORING SUBSURFACE SOIL SAMPLES
DETECTED CHEMICALS STATISTICS
(SEMI-VOLATILES, PCBs, PESTICIDES)
(Results in ug/kg unless otherwise specified)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
alpha-Chlordane	3	1/3	9.6 - 82	62	51	148	82
Aroclor-1260 (mg/kg)	3	1/3	190 - 4,200	1,495	2,343	5,445	4,200
Benzo(a)Anthracene	2	1/2	62 - 62	124	87	512	62
Benzo(a)Pyrene	3	2/3	100 - 120	135	44	210	120
Benzo(b)Fluoranthene	3	2/3	110 - 130	142	39	207	130
Benzo(g,h,i)Perylene	3	1/3	130 - 130	168	33	224	130
Benzo(k)Fluoranthene	3	2/3	64 - 87	112	64	220	87
bis(2-Ethylhexyl)Phthalate	3	2/3	370 - 650	408	233	801	650
Butylphthalate, Di-n-	3	3/3	85 - 140	118	29	168	140
Chrysene	3	3/3	58 - 120	93	32	146	120
DDD, 4,4'-	3	1/3	19 - 340	180	165	459	340
DDE, 4,4'-	3	2/3	19 - 110	62	50	147	110
DDT, 4,4'-	3	2/3	14 - 400	201	193	527	400
Endrin aldehyde	3	1/3	19 - 140	56	73	179	140
Fluoranthene	3	2/3	82 - 150	139	52	227	150
gamma-Chlordane	3	1/3	9.6 - 78	61	50	145	78
Heptachlor	3	1/3	3.8 - 3.8	36	55	129	3.8
Heptachlor epoxide	3	1/3	9.6 - 10	38	54	129	10
Hexachlorobenzene	3	1/3	90 - 90	155	56	250	90
Indeno(1,2,3-cd)Pyrene	3	2/3	88 - 100	124	53	213	100
Phenanthrene	3	1/3	60 - 60	145	74	269	60
Pyrene	3	2/3	110 - 240	178	65	288	240

TABLE 3.6
FORMER RALSTON DISPOSAL SITE
MONITORING WELL GROUNDWATER SAMPLES
DETECTED CHEMICALS STATISTICS
(Results in ug/L)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC
Aluminum	7	7/7	200 - 21,100	9,363	8,618	15,692	21,100
Antimony	7	4/7	30 - 94.5	48	34	73	94.5
Arsenic	7	5/7	3 - 7.2	4.2	2.4	6.0	7.2
Barium	7	7/7	66.7 - 304	174	93	242	304
Benzene	7	3/7	1 - 27	8.9	12	18	27
Beryllium	7	3/7	1 - 2.5	1.1	0.8	1.7	2.5
Bromodichloromethane	7	1/7	2 - 6	2.6	2.1	4.1	6
Butylphthalate, Di-n-	7	1/7	2 - 2	4.6	1.1	5.4	2
Cadmium	7	2/7	3 - 4.3	2.3	1.3	3.2	4.3
Calcium	7	7/7	85,500 - 661,000	261,786	203,756	411,421	661,000
Chloroform	7	1/7	2 - 500	73	188	211	500
Chromium	7	5/7	3 - 31	14	13	23	31
Cobalt	7	6/7	5 - 68.2	29	24	46	68.2
Copper	7	6/7	3 - 155	41	57	83	155
Dichloroethane, 1,1-	7	2/7	0.7 - 12	3.4	4.1	6.4	12
Dichloroethene, 1,1-	7	6/7	1 - 270	77	129	171	270
Dichloroethene, Cis-1,2-	7	6/7	2 - 18,000	3,419	6,637	8,293	18,000
Dichloroethene, Trans-1,2-	7	6/7	0.5 - 32	8.8	11	17.1	32
Ethylbenzene	7	2/7	0.6 - 0.6	1.7	1.6	2.9	0.6
Iron	7	7/7	384 - 39,400	13,088	14,021	23,384	39,400
Lead	7	6/7	2 - 68.6	27	28	48	68.6
Magnesium	7	7/7	19,600 - 179,000	72,743	57,733	115,141	179,000
Manganese	7	7/7	51.3 - 1,910	711	698	1,224	1,910
Methylene Chloride	7	7/7	0.3 - 10	2.6	3.5	5.2	10
Nickel	7	6/7	6 - 40.4	20	15	31	40.4
Potassium	7	7/7	631 - 6,900	3,330	2,216	4,957	6,900
Selenium	7	2/7	2 - 4.8	1.8	1.5	2.9	4.8
Silver	7	1/7	3 - 4.9	2.0	1.3	2.9	4.9
Sodium	7	7/7	5,530 - 23,600	11,889	6,586	16,725	23,600
Tetrachloroethene	7	5/7	0.6 - 14	4.6	4.7	8.1	14
Toluene	7	2/7	2 - 7	3.6	2.7	5.6	7
Trichloroethene	7	6/7	2 - 5,200	1,138	1,955	2,573	5,200
Vanadium	7	3/7	8 - 51	13	17	26	51
Vinyl Chloride	7	5/7	2 - 2,100	691	965	1,400	2,100
Xylene (total)	7	2/7	2 - 3	2.4	1.4	3.5	3
Zinc	7	7/7	9.7 - 253	103	97	174	253

TABLE 3.7
FORMER RALSTON DISPOSAL SITE
SOIL BORING GROUNDWATER SAMPLES
DETECTED CHEMICALS STATISTICS
(Results in ug/L)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Acetone	8	4/8	2 - 200,000	26,601	70,150	73,600	200,000
Benzene	8	2/8	2 - 170	1,335	3,506	3,683	170
Butanone, 2-	8	1/8	2 - 360,000	46,313	126,796	131,265	360,000
Butylphthalate, Di-n-	3	1/3	1 - 1	19	27	64	1
Carbon Disulfide	8	1/8	0.6 - 0.6	1,376	3,492	3,715	1
Chloroform	8	1/8	2 - 5,300	1,976	3,725	4,471	5,300
Dichlorobenzene, 1,2-	3	3/3	2 - 150	53	84	195	150
Dichloroethane, 1,1-	8	1/8	0.2 - 0.2	1,376	3,492	3,715	0
Dichloroethene, 1,1-	8	5/8	1 - 480	1,348	3,501	3,693	480
Dichloroethene, Cis-1,2-	8	7/8	0.9 - 230,000	68,930	97,753	134,423	230,000
Dichloroethene, Trans-1,2-	8	5/8	2 - 400	1,348	3,500	3,693	400
Dichloropropane, 1,2-	8	1/8	0.4 - 0.4	1,376	3,492	3,715	0
Diethylphthalate	3	1/3	1 - 1	19	27	64	1
Dimethylphenol, 2,4-	3	2/3	2 - 14	7	6	18	14
Ethylbenzene	8	3/8	0.9 - 730	1,358	3,501	3,704	730
Isophorone	3	1/3	7 - 7	21	25	63	7
Methylene Chloride	8	1/8	2 - 16,000	3,313	6,193	7,462	16,000
Methylnaphthalene, 2-	3	1/3	4 - 5	20	26	64	5
Methylphenol, 2-	3	3/3	5 - 260	99	140	335	260
Methylphenol, 4-	3	3/3	10 - 300	115	160	386	300
Naphthalene	3	1/3	4 - 4	20	26	64	4
Nitrophenol, 2-	3	1/3	11 - 20	25	23	63	20
Nitrophenol, 4-	3	1/3	12 - 18	56	64	164	18
Pentanone, 4-Methyl-2-	8	2/8	2 - 2,100	1,529	3,499	3,874	2,100
Phenol	3	3/3	4 - 170	88	83	228	170
Tetrachloroethene	8	4/8	0.4 - 3,000	1,681	3,517	4,037	3,000
Toluene	8	5/8	0.6 - 39,000	9,626	14,889	19,601	39,000
Trichlorobenzene, 1,2,4-	3	1/3	11 - 45	34	24	75	45
Trichloroethane, 1,1,2-	8	2/8	0.5 - 1,100	1,451	3,477	3,780	1,100
Trichloroethene	8	7/8	2 - 1,000,000	135,518	350,236	370,170	1,000,000
Vinyl Chloride	8	5/8	2 - 29,000	6,193	10,496	13,225	29,000
Xylene (total)	8	3/8	0.3 - 3,000	1,688	3,514	4,043	3,000

TABLE 3.8
FORMER RALSTON DISPOSAL SITE
RESIDENCE WELLS GROUNDWATER SAMPLES
DETECTED COMPOUNDS STATISTICS
(Results in ug/L)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Acetone	7	3/7	2 - 4	1.7	1.1	2.5	4
Barium	7	7/7	67.1 - 182	123	38	151	182
Butylphthalate, Di-n-	7	1/7	2 - 2	4.6	1.1	5.4	2
Chromium	7	1/7	3 - 3	2.0	0.65	2.5	3
Copper	7	7/7	7.4 - 55	19	17	31	55
Dichloroethene, Cis-1,2-	7	1/7	2 - 2	1.1	0.38	1.4	2
Lead	7	5/7	2 - 5.4	3.0	1.7	4.2	5.4
Methylene Chloride	7	1/7	0.2 - 0.2	0.89	0.30	1.1	0.2
Nickel	7	1/7	6 - 6.2	3.5	1.2	4.3	6.2
Tetrachloroethene	7	1/7	0.8 - 0.8	0.97	0.076	1.0	0.8
Trichloroethane, 1,1,1-	7	2/7	0.2 - 0.2	0.77	0.39	1.1	0.2
Trichloroethene	7	2/7	1 - 6	1.7	1.9	3.1	6
Zinc	7	7/7	21.4 - 213	79	67	128	213

TABLE 3.9
FORMER RALSTON DISPOSAL SITE
DRY RUN CREEK SURFACE SEDIMENT
DETECTED CHEMICALS STATISTICS
(Results in ug/kg unless otherwise specified)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Acetone	4	1/4	11 - 23	10	8.6	20	20
Anthracene	4	1/4	40 - 40	156	79	249	40
Arsenic (mg/kg)	4	4/4	1.1 - 1.5	1.4	0.17	1.6	1.5
Barium (mg/kg)	4	4/4	18 - 78	46	28	79	78
Benzo(a)Anthracene	3	1/3	140 - 140	177.	38	240	140
Benzo(a)Pyrene	4	2/4	69 - 120	145	64	220	120
Benzo(b)Fluoranthene	4	3/4	40 - 140	124	73	210	140
Benzo(k)Fluoranthene	4	2/4	57 - 84	133	75	220	84
Cadmium (mg/kg)	4	4/4	1.4 - 2	1.7	0.30	2.0	2
Chromium (mg/kg)	4	4/4	3.2 - 5.3	4.2	1.1	5.5	5.3
Chrysene	3	2/3	37 - 130	127	89	277	130
Copper (mg/kg)	4	4/4	2 - 5.1	3.0	1.4	4.7	4.7
Dichloroethene, Cis-1,2-	4	2/4	4 - 14	7.4	4.5	13	13
Fluoranthene	4	3/4	77 - 340	206	108	332	332
Indeno(1,2,3-cd)Pyrene	4	1/4	44 - 44	157	77	248	44
Lead (mg/kg)	4	4/4	3.7 - 17	8.3	6.1	15	15
Nickel (mg/kg)	4	4/4	3.2 - 5.1	4.5	0.89	5.6	5.1
Phenanthrene	4	3/4	38 - 160	128	76	218	160
Pyrene	4	3/4	66 - 320	198	104	321	320
Trichloroethene	4	1/4	2 - 2	5.0	2.0	7.4	2
Zinc (mg/kg)	4	4/4	14.4 - 20.9	17	2.8	20	20

TABLE 3.10
FORMER RALSTON DISPOSAL SITE
SURFACE WATER
DETECTED CHEMICALS STATISTICS
(Results in ug/L)

CHEMICAL	TOTAL SAMPLE NUMBER	FREQUENCY OF DETECTION	RANGE OF DETECTED CONCENTRATIONS	MEAN	STD DEV	UPPER 95% ONE-SIDED CONF. LIM.	EXPOSURE POINT CONC.
Acetone	7	7/7	2 - 11	5.6	3.2	7.9	7.9
Barium	7	7/7	35.4 - 195	95	64	141	141
Cadmium	7	2/7	3 - 8	2.7	2.4	4.4	4.4
Carbon Disulfide	7	1/7	0.4 - 0.4	0.91	0.23	1.1	0.4
Copper	7	6/7	3 - 16.1	11	4.7	15	15
Dichloroethene, 1,1-	7	1/7	0.4 - 0.4	0.91	0.23	1.1	0.4
Dichloroethene, Cis-1,2-	7	6/7	0.3 - 92	23	32	47	47
Dichloroethene, Trans-1,2-	7	1/7	0.9 - 0.9	1.0	0.038	1.0	0.9
Lead	7	7/7	2.4 - 12.8	7.2	3.4	9.7	9.7
Nickel	7	2/7	6 - 8.1	4.3	2.2	5.9	5.9
Tetrachloroethene	7	2/7	0.4 - 0.7	0.87	0.24	1.0	0.7
Toluene	7	1/7	0.9 - 0.9	1.0	0.038	1.0	0.9
Trichloroethane, 1,1,1-	7	1/7	0.3 - 0.3	0.90	0.26	1.1	0.3
Trichloroethene	7	4/7	1 - 7	2.0	2.2	3.6	3.6
Vinyl Chloride	7	5/7	2 - 20	5.9	6.7	11	11
Xylene (total)	7	1/7	0.3 - 0.3	0.90	0.26	1.1	0.3
Zinc	7	7/7	26.1 - 64.2	42	12	51	51

TABLE 4.1
TOXICITY VALUES
POTENTIAL NONCARCINOGENIC EFFECTS

CHEMICAL	CHRONIC RfD	SUBCHRONIC RfD*	CONFIDENCE LEVEL	CRITICAL EFFECTS	RfD SOURCE/ RfD BASIS	UNCERTAINTY/ MODIFYING FACTORS	date online
Oral Route	(mg/kg-day)						
acetone	1.00E-01	1.00E+00	low	increased liver/ kidney weight	gavage/IRIS	1000	12/1/90
aluminium	data inadequate for quantitative risk assessment				/HEAST		
anthracene	3.00E-01	3.00E+00	low	NOEL	gavage/IRIS	3000	7/1/91
antimony	4.00E-04	4.00E-04	low	longevity, blood glucose	oral/IRIS	1000	2/1/91
arsenic	3.00E-04	3.00E-04	medium	hyperpigmentation, etc.	epidemiology/IRIS	3	10/1/91
barium	7.00E-02	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	8/1/90
benz(a)anthracene	no data				/IRIS		
benzene	pending				/IRIS		
benzo(a)pyrene	no data				/IRIS		
benzo(b)fluoranthene	no data				/IRIS		
benzo(g,h,i)perylene	no data				/IRIS		
benzo(k)fluoranthene	no data				/IRIS		
beryllium	5.00E-03	5.00E-03	low	NOAEL	water/IRIS	100	9/1/90
bis(2-ethylhexyl)phthalate	2.00E-02	2.00E-02	medium	increased liver weight	food/IRIS	1000	5/1/91
bromodichloromethane	2.00E-02	2.00E-02	medium	renal cytomegaly	gavage/IRIS	1000	3/1/91
butanone, 2-	6.00E-01	5.00E-01	low	decreased fetal birth weight	water/IRIS	3000	5/1/93
butyl benzylphthalate	2.00E-01	2.00E+00	low	increased liver weight	food/IRIS	1000	8/1/91
butylphthalate, di-n-	1.00E-01	1.00E+00	low	increased mortality	food/IRIS	1000	8/1/90
cadmium (in food)	1.00E-03				/IRIS	10	
cadmium (in water)	5.00E-04		high	proteinuria	epidemiology/IRIS	10	10/1/89
calcium							
carbon disulfide	1.00E-01	1.00E-01	medium	fetal toxicity/malformations	inhalation/IRIS	100	9/1/90
Chlordane, alpha	6.00E-05	6.00E-05	low	liver hypertrophy	food/IRIS	1000	7/1/89
Chlordane, gamma							
chloroform	1.00E-02	1.00E-02	medium	fatty cysts-liver	oral capsule/IRIS	1000	7/1/92
chromium(VI)	5.00E-03	2.00E-02	low	NOAEL	water/IRIS	500	3/1/88
chrysene	data inadequate for quantitative risk assessment				/HEAST		3//92
cobalt							
copper	data inadequate for quantitative risk assessment				/HEAST		3//92
DDD	no data				/IRIS		
DDE	no data				/IRIS		
DDT	5.00E-04	5.00E-04	medium	liver lesions	food/IRIS	100	9/30/87
dichlorobenzene, 1,2-	9.00E-02	9.00E-01	low	NOAEL	gavage/IRIS	1000	3/1/91
dichloroethane,1,1-	1.00E-01	1.00E+00		NOAEL	inhalation/HEAST	1000	3//92
dichloroethene, 1,1-	9.00E-03	9.00E-03	medium	liver lesions	water/IRIS	1000	4/1/89
dichloroethene, cis-1,2-	1.00E-02	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	3//92
dichloroethene, trans-1,2-	2.00E-02	2.00E-01	low	increase serum alk. phosphatase	/IRIS	1000	1/1/89
dichloropropane, 1,2-	no data				/IRIS		
diethylphthalate	8.00E-01	8.00E+00	low	decreased growth rate	food/IRIS	1000	8/1/91
dimethylphenol, 2,4-	2.00E-02	2.00E-01	low	lethargy,prostration, etc.	gavage/IRIS	3000	11/1/90
endrin aldehyde							

TABLE 4.1
TOXICITY VALUES
POTENTIAL NONCARCINOGENIC EFFECTS

CHEMICAL	CHRONIC RfD	SUBCHRONIC RfD*	CONFIDENCE LEVEL	CRITICAL EFFECTS	RfD SOURCE/ RfD BASIS	UNCERTAINTY/ MODIFYING FACTORS	date online
ethyl benzene	1.00E-01	1.00E+00	low	liver/kidney toxicity	gavage/IRIS	1000	6/1/91
fluoranthene	4.00E-02	4.00E-01	low	liver weights, etc.	gavage/IRIS	3000	7/1/91
heptachlor	5.00E-04	5.00E-04	low	NOEL	/IRIS	300	3/1/91
heptachlor epoxide	1.30E-05	1.30E-05	low	increased liver weight	food/IRIS	1000	3/1/91
hexachlorobenzene	8.00E-04	8.00E-04	medium	liver effects	food/IRIS	100	4/1/91
indeno(1,2,3-c,d)pyrene	no data				/IRIS		
iron	data inadequate for quantitative risk assessment				/HEAST		3//92
isophorone	2.00E-01	2.00E+00	low	NOEL	oral capsules/IRIS	1000	1/1/91
lead	(USE INTEGRATED UPTAKE/BIOKINETIC MODEL)						
magnesium							
manganese	1.00E-01	1.00E-01	medium	CNS effects	epidemiology/IRIS	1	8/1/90
methylene chloride (dichlorom	6.00E-02	6.00E-02	medium	liver toxicity	water/IRIS	100	3/1/88
methylnaphthalene, 2-							
methylphenol, 2-	5.00E-02	5.00E-01	medium	decreased body weight, etc.	gavage/IRIS	1000	9/1/90
methylphenol, 4- (p-cresol)	5.00E-02	5.00E-01		decreased weight gain	gavage/HEAST	1000	3//92
naphthalene	withdrawn				gavage/HEAST		3/1/93
nickel	2.00E-02	2.00E-02	medium	decreased body weight	food/IRIS	300	1/1/92
nitrophenol, o- (nitrophenol, 2-	data inadequate for quantitative risk assessment				/HEAST		
nitrophenol, p- (nitrophenol, 4-	pending				/IRIS		
PCBs	no data				/IRIS		
pentanone, 4-methyl 2-	5.00E-02	5.00E-01		liver and kidney effects	/HEAST	1000	3//92
phenanthrene	data inadequate for quantitative risk assessment				/HEAST		3//92
phenol	6.00E-01	6.00E-01	low	low fetal body weight	gavage/IRIS	100	2/1/90
potassium							
pyrene	3.00E-02	3.00E-01	low	decreased kidney weights	gavage/IRIS	3000	7/1/91
selenium	5.00E-03	5.00E-03	high	selenosis	epidemiology/IRIS	3	9/1/91
silver	5.00E-03	5.00E-03	low	argyria	epidemiology/IRIS	3	12/1/91
sodium							
tetrachloroethene	1.00E-02	1.00E-01	medium	hepatotoxicity	gavage/IRIS	1000	3/1/88
toluene	2.00E-01	2.00E+00	medium	liver and kidney weights	gavage/IRIS	1000	8/1/90
trichlorobenzene, 1,2,4-	1.00E-02	1.00E-02	medium	increased adrenal weights	water/IRIS	1000	5/1/92
trichloroethane, 1,1,1-	9.00E-02	9.00E-01		liver toxicity	oral/HEAST	1000	3//92
trichloroethane, 1,1,2-	4.00E-03	4.00E-02	medium	liver effects	water/IRIS	1000	8/1/90
trichloroethene	6.00E-03				/ECAO		
vanadium (pentoxide)	9.00E-03	9.00E-03	low	decreased hair cystine	food/IRIS	100	6/30/88
vinyl chloride							
xylenes	2.00E+00	4.00E+00	medium	hyperactivity, etc.	gavage/IRIS	100	9/30/87
zinc	3.00E-01		medium	blood anemia	/IRIS	3	3/1/94

TABLE 4.1
TOXICITY VALUES
POTENTIAL NONCARCINOGENIC EFFECTS

CHEMICAL	CHRONIC RfD	SUBCHRONIC RfD*	CONFIDENCE LEVEL	CRITICAL EFFECTS	RfD SOURCE/ RfD BASIS	UNCERTAINTY/ MODIFYING FACTORS	date online
Inhalation Route	(mg/m3)						
acetone	no data				/IRIS		
aluminium	data inadequate for risk assessment				/HEAST		3//92
anthracene	no data				/IRIS		
antimony	no data				/IRIS		
arsenic	no data				/IRIS		
barium	5.00E-04	5.00E-03		fetotoxicity	inhalation/HEAST	1000	3/1/93
benz(a)anthracene	no data				/IRIS		
benzene	pending				/IRIS		
benzo(a)pyrene	no data				/IRIS		
benzo(b)fluoranthene	no data				/IRIS		
benzo(g,h,i)perylene	no data				/IRIS		
benzo(k)fluoranthene	no data				/IRIS		
beryllium	no data				/IRIS		
bis(2-ethylhexyl)phthalate	no data				/IRIS		
bromodichloromethane	no data				/IRIS		
butanone, 2-	1.00E+00		low	decreased fetal birth weight	inhalation/IRIS	3000	7/1/92
butyl benzylphthalate	no data				/IRIS		
butylphthalate, di-n-	data inadequate for verification of inhalatation RfC				/IRIS		10/1/90
cadmium	pending				/IRIS		
cadmium	no data						
calcium							
carbon disulfide	1.00E-02	1.00E-02		fetus toxicity	/HEAST	1000	3//92
Chlordane, alpha	pending				/IRIS		
Chlordane, gamma							
chloroform	pending				/IRIS		
chromium(VI)	pending				/IRIS		
chrysene	no data				/HEAST		3//92
cobalt							
copper	no data				/IRIS		
DDD	no data				/IRIS		
DDE	no data				/IRIS		
DDT	no data				/IRIS		
dichlorobenzene, 1,2-	2.00E-01	2.00E+00		decreased weight gain	inhalation/HEAST	1000	3/1/93
dichloroethane, 1,1-	1.00E-01	1.00E+00		NOEL	inhalation/HEAST	1000	3/1/93
dichloroethene, 1,1-	pending				/IRIS		
dichloroethene, cis-1,2-	no data				/IRIS		
dichloroethene, trans-1,2-	no data				/IRIS		
dichloropropane, 1,2-	4.00E-03	1.30E-02	medium	hyperplasia of the nasal mucosa	inhalation/IRIS	300	12/1/91
diethylphthalate	no data				/IRIS		
dimethylphenol, 2,4-	no data				/IRIS		
endrin aldehyde							

TABLE 4.1
TOXICITY VALUES
POTENTIAL NONCARCINOGENIC EFFECTS

CHEMICAL	CHRONIC RfD	SUBCHRONIC RfD*	CONFIDENCE LEVEL	CRITICAL EFFECTS	RfD SOURCE/ RfD BASIS	UNCERTAINTY/ MODIFYING FACTORS	date online
ethyl benzene	1.00E+00	1.00E+00	low	developmental toxicity	inhalation/IRIS	300	3/1/91
fluoranthene	no data				/IRIS		
heptachlor	no data				/IRIS		
heptachlor epoxide	no data				/IRIS		
hexachlorobenzene	data inadequate for derivation of inhalation RfC				/IRIS		3/1/91
indeno(1,2,3-c,d)pyrene	no data				/IRIS		
iron	data inadequate for quantitative risk assessment				/HEAST		3/1/93
isophorone	data inadequate for derivation of inhalation RfC				/IRIS		3/1/91
lead	no data				/IRIS		
magnesium							
manganese	4.00E-04	4.00E-04	medium	increased respiratory symptoms	epidemiology/IRIS	900	12/6/90
methylene chloride (dichlorom	3.00E+00	3.00E+00		liver toxicity	/HEAST	100	3//92
methylnaphthalene, 2-							
methylphenol, 2- (o-cresol)	data inadequate for derivation of inhalation RfC				/IRIS		4/1/92
methylphenol, 4- (p-cresol)	data inadequate for derivation of inhalation RfC				/IRIS		4/1/92
naphthalene	no data				/IRIS		
nickel	pending				/IRIS		
nitrophenol, o- (nitrophenol, 2-	data inadequate for quantitative risk assessment						
nitrophenol, p- (nitrophenol, 4-	data inadequate for derivation of inhalation RfC				/IRIS		10/1/91
PCBs	no data				/IRIS		
pentanone, 4-methyl, 2-	8.00E-02	8.00E-01		increased liver weight	/HEAST	1000	3//92
phenanthrene	no data				/HEAST		3//92
phenol	data inadequate for derivation of inhalation RfC				/IRIS		3/1/91
potassium							
pyrene	no data				/IRIS		
selenium	no data				/IRIS		
silver	no data				/IRIS		
sodium							
tetrachloroethene	no data				/IRIS		
toluene	4.00E-01	2.00E+00	medium	CNS effects	/HEAST	300	3//92
trichlorobenzene, 1,2,4-	9.00E-03	9.00E-02		liver porphyria	inhalation/HEAST	1000	3/1/93
trichloroethane, 1,1,1-	1.00E+00	1.00E+01		liver toxicity	oral/HEAST	1000	3/1/92
trichloroethane, 1,1,2-	pending				/IRIS		
trichloroethene	pending				/IRIS		
vanadium (pentoxide)	no data				/IRIS		
vinyl chloride							
xylenes (mixture)	pending				/IRIS		
zinc	no data				/IRIS		

TABLE 4.2
TOXICITY VALUES
POTENTIAL CARCINOGENIC EFFECTS

CHEMICAL	Slope Factor	Drinking Water Unit Risk	Weight of Evidence Classification	Type of Cancer (A)	SF Basis/ SFSource	date online
Oral Route	(mg/kg-day)-1	(ug/L)				
acetone	no data		D		/IRIS	12/1/90
aluminium						
anthracene	inadequate data		D		/IRIS	1/1/91
antimony	no data				/IRIS	
arsenic (calculated from unit risk)	1.75E+00	5.00E-05	A	lung/skin	water: inhalation/EPA	1988
barium	no data				/IRIS	
benz(a)anthracene (BaP equivalent)	7.30E-01		B2		/IRIS	12/1/90
benzene	2.90E-02	8.30E-07	A	leukemia	epidemiology/IRIS	4/1/92
benzo(a)pyrene	7.30E+00	2.10E-04	B2		food/gavage, etc./IRIS	7/1/92
benzo(b)fluoranthene (BaP equivalent)	7.30E-01		B2		/IRIS	12/1/90
benzo(g,h,i)perylene	inadequate data		D		/IRIS	12/1/90
benzo(k)fluoranthene (BaP equivalent)	7.30E-02		B2		/IRIS	11/1/90
beryllium	4.30E+00	1.20E-04	B2		inhalation/IRIS	1/1/91
bis(2-ethylhexyl)phthalate	1.40E-02	4.00E-07	B2		food/IRIS	8/1/91
bromodichloromethane	1.30E-01	3.70E-06	B2		gavage/IRIS	7/1/92
butanone, 2-	inadequate data		D		/IRIS	12/1/89
butyl benzylphthalate			C		/IRIS	8/1/91
butylphthalate, di-n-	no data		D		/IRIS	8/1/91
cadmium			B1		/IRIS	6/1/92
calcium						
carbon disulfide	no data				/IRIS	
Chlordane, alpha	1.30E+00	3.70E-05	B2		/IRIS	1/1/91
Chlordane, gamma						
chloroform	6.10E-03	1.70E-07	B2		gavage/IRIS	3/1/91
chromium(VI)			A	lung	epidemiology/IRIS	3/1/91
chrysene (BaP equivalent)	7.30E-03		B2		/IRIS	12/1/90
cobalt						
copper	inadequate data		D		/IRIS	8/1/91
DDD	2.40E-01	6.90E-06	B2		Food/IRIS	8/22/88
DDE	3.40E-01	9.70E-06	B2		food/IRIS	8/22/88
DDT	3.40E-01	9.70E-06	B2		food/IRIS	5/1/91
dichlorobenzene, 1,2-	inadequate data		D		/IRIS	1/1/91
dichloroethane, 1,1-	inadequate data		C		/IRIS	10/1/90
dichloroethene, 1,1-	6.00E-01	1.70E-05	C		inhalation/IRIS	2/1/91
dichloroethene, cis-1,2-	no data		D		/IRIS	12/1/90
dichloroethene, trans-1,2-	no data				/IRIS	
dichloropropane, 1,2-	6.80E-02	1.90E-06	B2		gavage/HEAST	3/92
diethylphthalate	inadequate data		D		/IRIS	8/1/91
dimethylphenol, 2,4-	no data				/IRIS	
endrin aldehyde						
ethyl benzene	no data		D		/IRIS	8/1/91
fluoranthene	inadequate data		D		/IRIS	12/1/90
heptachlor	4.50E+00	1.30E-04	B2		/IRIS	1/1/91
heptachlor epoxide	9.10E+00	2.60E-04	B2		food/IRIS	4/1/92
hexachlorobenzene	1.60E+00	4.60E-05	B2		/IRIS	4/1/92
indeno(1,2,3-c,d)pyrene (BaP equivalent	7.30E-01		B2		/IRIS	12/1/90
iron						
isophorone	4.10E-03	1.20E-07	C		gavage/IRIS	5/1/92
lead	not available		B2		food/IRIS	5/1/91
magnesium						
manganese	inadequate data		D		/IRIS	8/1/90
methylene chloride (dichloromethane)	7.50E-03	2.10E-07	B2		water/IRIS	1/1/91
methylnaphthalate, 2-						
methylphenol, 2-	inadequate data		C		/IRIS	8/1/91

TABLE 4.2
TOXICITY VALUES
POTENTIAL CARCINOGENIC EFFECTS

CHEMICAL	Slope Factor	Drinking Water Unit Risk	Weight of Evidence Classification	Type of Cancer (A)	SF Basis/ SFSource	date online
methylphenol, 4-	inadequate data		C		/IRIS	8/1/91
naphthalene	inadequate data		D		/IRIS	9/1/92
nickel	(soluble salts not evaluated)				/IRIS	
nitrophenol, o- (nitrophenol, 2-)						
nitrophenol, p- (nitrophenol,4-)	no data				/IRIS	
PCBs	7.70E+00	2.20E-04	B2		food/IRIS	1/1/90
pentanone, 4-methyl 2-	no data				/IRIS	
phenanthrene	inadequate data		D		/IRIS	12/1/90
phenol	inadequate data		D		/IRIS	11/1/90
potassium						
pyrene	inadequate data		D		/IRIS	1/1/91
selenium	inadequate data		D		/IRIS	6/1/91
silver	inadequate data		D		/IRIS	6/1/89
sodium						
tetrachloroethene	pending				/IRIS	
toluene	inadequate data		D		/IRIS	8/1/90
trichlorobenzene, 1,2,4-	inadequate data		D		/IRIS	3/1/91
trichloroethane, 1,1,1-	inadequate data		D		/IRIS	9/1/90
trichloroethane, 1,1,2-	5.70E-02	1.60E-06	C		gavage/IRIS	1/1/91
trichloroethene	1.10E-02				/ECAO	
vanadium (pentoxide)	(to be evaluated)				/IRIS	6/30/88
vinyl chloride	1.90E+00	5.40E-05	A	lung; liver	food/HEAST	3/92
xylenes	inadequate data		D		/IRIS	3/1/91
zinc	inadequate data		D		/IRIS	2/1/91
Inhalation Route	(mg/kg-day)-1	(ug/m3)				
acetone	no data		D		/IRIS	12/1/90
aluminium						
anthracene	no data		D		/IRIS	1/1/91
antimony	no data				/IRIS	
arsenic	5.00E+01	4.30E-03	A	lung; skin	inhalation; water/IRIS	2/1/91
barium	no data				/IRIS	
benzene	2.90E-02	8.30E-06	A	leukemia	epidemiology/IRIS	4/1/92
benz(a)anthracene	no data		B2		/IRIS	12/1/90
benzo(a)pyrene	withdrawn		B2		/IRIS	7/1/92
benzo(b)fluoranthene	no data		B2		/IRIS	12/1/90
benzo(g,h,i)perylene	no data		D		/IRIS	12/1/90
benzo(k)fluoranthene	no data		B2		/IRIS	11/1/90
beryllium	8.40E+00	2.40E-03	B2		inhalation/IRIS	1/1/91
bis(2-ethylhexyl)phthalate	no data		B2		food/IRIS	8/1/91
bromodichloromethane	no data		B2		gavage/IRIS	7/1/92
butanone, 2-	inadequate data		D		/IRIS	12/1/89
butyl benzylphthalate	no data		C		/IRIS	8/1/91
butylphthalate, di-n-	no data		D		/IRIS	8/1/91
cadmium	6.10E+00	1.80E-03	B1		inhalation/IRIS	6/1/92
calcium						
carbon disulfide	no data				/IRIS	
Chlordane, alpha	1.30E+00	3.70E-04	B2		/IRIS	1/1/91
Chlordane, gamma						
chloroform	8.10E-02	2.30E-05	B2		gavage/IRIS	3/1/91
chromium(VI)	4.10E+01	1.20E-02	A	lung	epidemiology/IRIS	3/1/91
chrysene	no data		B2		/IRIS	12/1/90
cobalt						
copper	inadequate data		D		/IRIS	8/1/91
DDD	no data		B2		Food/IRIS	8/22/88

TABLE 4.2
TOXICITY VALUES
POTENTIAL CARCINOGENIC EFFECTS

CHEMICAL	Slope Factor	Drinking Water Unit Risk	Weight of Evidence Classification	Type of Cancer (A)	SF Basis/ SFSource	date online
DDE	no data		B2		food/IRIS	8/22/88
DDT	3.40E-01	9.70E-05	B2		food/IRIS	5/1/91
dichlorobenzene, 1,2-	no data		D		/IRIS	1/1/91
dichloroethane, 1,1-	inadequate data		C		/IRIS	10/1/90
dichloroethene, 1,1-	1.20E+00	5.00E-05	C		inhalation/IRIS	2/1/91
dichloroethene, cis-1,2-	no data		D		/IRIS	12/1/90
dichloroethene, trans-1,2-	no data				/IRIS	
dichloropropane, 1,2-	no data		B2		gavage/HEAST	3/92
diethylphthalate	no data		D		/IRIS	8/1/91
dimethylphenol, 2,4-	no data				/IRIS	
endrin aldehyde						
ethyl benzene	no data		D		/IRIS	8/1/91
fluoranthene	inadequate data		D		/IRIS	12/1/90
heptachlor	4.50E+00	1.30E-03	B2		/IRIS	1/1/91
heptachlor epoxide	9.10E+00	2.60E-03	B2		food/IRIS	4/1/92
hexachlorobenzene	1.60E+00	4.60E-04	B2		/IRIS	4/1/92
indeno(1,2,3-c,d)pyrene	no data		B2		/IRIS	12/1/90
iron						
isophorone	inadequate data		C		gavage/IRIS	5/1/92
lead	no data		B2		food/IRIS	5/1/91
magnesium						
manganese	inadequate data		D		/IRIS	8/1/90
methylene chloride (dichloromethane)		4.70E-07	B2		inhalation/IRIS	1/1/91
methylnaphthalene, 2-						
methylphenol, 2-	inadequate data		C		/IRIS	8/1/91
methylphenol, 4-	inadequate data		C		/IRIS	8/1/91
naphthalene	no data		D		/IRIS	9/1/92
nickel	(soluble salts not evaluated)				/IRIS	
nitrophenol, o- (nitrophenol, 2-)	no data					
nitrophenol, p- (nitrophenol, 4-)	no data				/IRIS	
PCBs	no data		B2		/IRIS	1/1/90
pentanone, 4-methyl 2-	no data				/IRIS	
phenanthrene	no data		D		/IRIS	12/1/90
phenol	inadequate data		D		/IRIS	11/1/90
potassium						
pyrene	no data		D		/IRIS	1/1/91
selenium	no data		D		/IRIS	6/1/91
silver	inadequate data		D		/IRIS	6/1/89
sodium						
tetrachloroethene	pending				/IRIS	
toluene	inadequate data		D		/IRIS	8/1/90
trichlorobenzene, 1,2,4-	no data		D		/IRIS	3/1/91
trichloroethane, 1,1,1-	inadequate data		D		/IRIS	9/1/90
trichloroethane, 1,1,2-	5.70E-02	1.60E-05	C		gavage/IRIS	1/1/91
trichloroethene	6.00E-03				/ECAO	
vanadium (pentoxide)	(to be evaluated)				/IRIS	6/30/88
vinyl chloride	3.00E-01	8.40E-05	A	liver	/HEAST	3/92
xylenes	inadequate data		D		/IRIS	3/1/91
zinc	inadequate data		D		/IRIS	2/1/91

TABLE 5.1
FORMER RALSTON SITE
SUBCHRONIC HAZARD INDEX ESTIMATES
CURRENT LAND USE - TRESPASSER

CHEMICAL	SDI (mg/kg-day)	SDI Adjusted for Absorption	RfD (subchronic) (mg/kg-day)		Critical Effect	RfD source/ RfD Basis	Modifying Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Incidental Ingestion of Surface Water While Wading										
Acetone	1.95E-06	No	1.00E+00		increased liver/ kidney weight	gavage/HEAST	1000	1.95E-06		
Barium	3.48E-05	No	7.00E-02		NOAEL	epidemiology/HEAST	3	4.98E-04		
Cadmium	1.10E-06	No	5.00E-04	a	proteinuria	epidemiology/HEAST	10	2.19E-03		
Carbon Disulfide	9.86E-08	No	1.00E-01		fetal toxicity/malformations	inhalation/HEAST	100	9.86E-07		
Dichloroethene, 1,1-	9.86E-08	No	9.00E-03		liver lesions	water/HEAST	1000	1.10E-05		
Dichloroethene, Cis-1,2-	1.15E-05	No	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	1.15E-04		
Dichloroethene, Trans-1,2-	2.22E-07	No	2.00E-01		increase serum alk. phosphatase	/HEAST	1000	1.11E-06		
Nickel	1.45E-06	No	2.00E-02		decreased body weight	food/HEAST	300	7.26E-05		
Tetrachloroethene	1.73E-07	No	1.00E-01		hepatotoxicity	gavage/HEAST	1000	1.73E-06		
Toluene	2.22E-07	No	2.00E+00		liver and kidney weights	gavage/HEAST	1000	1.11E-07		
Trichloroethane, 1,1,1-	7.40E-08	No	9.00E-01		liver toxicity	oral/HEAST	1000	8.22E-08		
Trichloroethene	8.98E-07	No	6.00E-03	a		/ECAO		1.50E-04		
Xylene (total)	7.40E-08	No	4.00E+00		hyperactivity, etc.	gavage/HEAST	100	1.85E-08		
Zinc	1.25E-05	No	3.00E-01	a	blood anemia	/IRIS	3	4.15E-05		
Pathway Hazard Index									3.08E-03	
Exposure Pathway: Dermal Absorption from Surface Water While Wading										
Barium	4.24E-06	Yes	7.00E-02		NOAEL	epidemiology/HEAST	3	6.06E-05		
Cadmium	1.33E-07	Yes	5.00E-04	a	proteinuria	epidemiology/HEAST	10	2.67E-04		
Carbon Disulfide	2.88E-07	Yes	1.00E-01		fetal toxicity/malformations	inhalation/HEAST	100	2.88E-06		
Dichloroethene, 1,1-	1.92E-07	Yes	9.00E-03		liver lesions	water/HEAST	1000	2.14E-05		
Dichloroethene, Trans-1,2-	2.70E-07	Yes	2.00E-01		increase serum alk. phosphatase	/HEAST	1000	1.35E-06		
Nickel	1.77E-07	Yes	2.00E-02		decreased body weight	food/HEAST	300	8.84E-06		
Tetrachloroethene	1.01E-06	Yes	1.00E-01		hepatotoxicity	gavage/HEAST	1000	1.01E-05		
Toluene	1.22E-06	Yes	2.00E+00		liver and kidney weights	gavage/HEAST	1000	6.08E-07		
Trichloroethane, 1,1,1-	1.53E-07	Yes	9.00E-01		liver toxicity	oral/HEAST	1000	1.70E-07		
Trichloroethene	1.75E-06	Yes	6.00E-03	a		/ECAO		2.92E-04		
Xylene (total)	7.21E-07	Yes	4.00E+00		hyperactivity, etc.	gavage/HEAST	100	1.80E-07		
Zinc	1.52E-06	Yes	3.00E-01	a	blood anemia	/IRIS	3	5.06E-06		
Pathway Hazard Index									6.70E-04	
Exposure Pathway: Incidental Ingestion of Sediment While Wading										
Acetone	3.33E-09	No	1.00E+00		increased liver/ kidney weight	gavage/HEAST	1000	3.33E-09		
Anthracene	6.58E-09	No	3.00E+00		NOEL	gavage/HEAST	3000	2.19E-09		
Arsenic	2.47E-07	No	3.00E-04		hyperpigmentation, etc.	epidemiology/HEAST	3	8.22E-04		
Barium	1.28E-05	No	7.00E-02		NOAEL	epidemiology/HEAST	3	1.83E-04		
Cadmium	3.29E-07	No	1.00E-03	a	proteinuria	epidemiology/HEAST	10	3.29E-04		
Chromium	8.71E-07	No	2.00E-02		NOAEL	water/HEAST	500	4.36E-05		
Dichloroethene, Cis-1,2-	2.08E-09	No	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	2.08E-08		
Fluoranthene	5.47E-08	No	4.00E-01		liver weights, etc.	gavage/HEAST	3000	1.37E-07		
Nickel	8.38E-07	No	2.00E-02		decreased body weight	food/HEAST	300	4.19E-05		
Pyrene	5.26E-08	No	3.00E-01		decreased kidney weights	gavage/HEAST	3000	1.75E-07		

TABLE 5.1
FORMER RALSTON SITE
SUBCHRONIC HAZARD INDEX ESTIMATES
CURRENT LAND USE - TRESPASSER

CHEMICAL	SDI (mg/kg-day)	SDI Adjusted for Absorption	RfD (subchronic) (mg/kg-day)		Critical Effect	RfD source/ RfD Basis	Modifying Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Exposure Pathway: Incidental Ingestion of Sediment While Wading										
Trichloroethene	3.29E-10	No	6.00E-03	a		/ECAO		5.48E-08		
Zinc	3.32E-06	No	3.00E-01	a	blood anemia	/IRIS	3	1.11E-05		
Pathway Hazard Index									1.43E-03	
Exposure Pathway: Dermal Absorption from Sediment While Wading										
Acetone	2.02E-07	Yes	1.00E+00		increased liver/ kidney weight	gavage/HEAST	1000	2.02E-07		
Dichloroethene, Cis-1,2-	3.80E-09	Yes	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	3.80E-08		
Trichloroethene	6.01E-10	Yes	6.00E-03	a		/ECAO		1.00E-07		
Pathway Hazard Index									3.41E-07	
Exposure Pathway: Incidental Ingestion of Soil										
Anthracene	1.81E-08	No	3.00E+00		NOEL	gavage/HEAST	3000	6.03E-09		
Arsenic	2.40E-06	No	3.00E-04		hyperpigmentation, etc.	epidemiology/HEAST	3	8.01E-03		
Barium	2.08E-04	No	7.00E-02		NOAEL	epidemiology/HEAST	3	2.97E-03		
bis(2-Ethylhexyl)Phthalate	3.52E-07	No	2.00E-02		increased liver weight	food/HEAST	1000	1.76E-05		
Butylbenzylphthalate	2.16E-08	No	2.00E+00		increased liver weight	food/HEAST	1000	1.08E-08		
Cadmium	1.05E-05	No	1.00E-03	a	proteinuria	epidemiology/HEAST	10	1.05E-02		
Chloroform	1.51E-09	No	1.00E-02		fatty cysts-liver	oral capsule/HEAST	1000	1.51E-07		
Chromium	7.26E-05	No	2.00E-02		NOAEL	water/HEAST	500	3.63E-03		
Dichloroethene, Cis-1,2-	1.33E-08	No	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	1.33E-07		
Fluoranthene	1.61E-07	No	4.00E-01		liver weights, etc.	gavage/HEAST	3000	4.02E-07		
Hexachlorobenzene	1.63E-08	No	8.00E-04		liver effects	food/HEAST	100	2.04E-05		
Methylene Chloride	2.07E-09	No	6.00E-02		liver toxicity	water/HEAST	100	3.45E-08		
Nickel	6.86E-05	No	2.00E-02		decreased body weight	food/HEAST	300	3.43E-03		
Pyrene	1.91E-07	No	3.00E-01		decreased kidney weights	gavage/HEAST	3000	6.36E-07		
Silver	2.79E-05	No	5.00E-03		argyria	epidemiology/HEAST	3	5.58E-03		
Tetrachloroethene	1.19E-08	No	1.00E-01		hepatotoxicity	gavage/HEAST	1000	1.19E-07		
Toluene	2.01E-09	No	2.00E+00		liver and kidney weights	gavage/HEAST	1000	1.00E-09		
Trichloroethane, 1,1,1-	1.00E-09	No	9.00E-01		liver toxicity	oral/HEAST	1000	1.12E-09		
Trichloroethene	7.12E-08	No	6.00E-03	a		/ECAO		1.19E-05		
Xylene (total)	1.00E-09	No	4.00E+00		hyperactivity, etc.	gavage/IRIS	100	2.51E-10		
Zinc	5.55E-04	No	3.00E-01	a	blood anemia	/IRIS	3	1.85E-03		
Pathway Hazard Index									3.60E-02	
Exposure Pathway: Dermal Absorption from Soil										
Chloroform	2.75E-09	Yes	1.00E-02		fatty cysts-liver	oral capsule/HEAST	1000	2.75E-07		
Dichloroethene, Cis-1,2-	2.44E-08	Yes	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	2.44E-07		
Hexachlorobenzene	3.98E-07	Yes	8.00E-04		liver effects	food/HEAST	100	4.97E-04		
Methylene Chloride	5.04E-08	Yes	6.00E-02		liver toxicity	water/HEAST	100	8.40E-07		
Tetrachloroethene	2.17E-08	Yes	1.00E-01		hepatotoxicity	gavage/HEAST	1000	2.17E-07		
Toluene	3.67E-09	Yes	2.00E+00		liver and kidney weights	gavage/HEAST	1000	1.84E-09		
Trichloroethane, 1,1,1-	1.84E-09	Yes	9.00E-01		liver toxicity	oral/HEAST	1000	2.04E-09		
Trichloroethene	1.30E-07	Yes	6.00E-03	a		/ECAO		2.17E-05		
Xylene (total)	1.84E-09	Yes	4.00E+00		hyperactivity, etc.	gavage/IRIS	100	4.59E-10		
Pathway Hazard Index									5.20E-04	
Total Exposure Hazard Index										4.17E-02

a =Because no subchronic RfD was available, the chronic RfD was used

TABLE 5.2
FORMER RALSTON DISPOSAL SITE
SUBCHRONIC HAZARD INDEX ESTIMATES
CURRENT LAND USE - OFF SITE RESIDENT CHILDHOOD EXPOSURE

Chemical	SDI (mg/kg-day)	SDI Adj for Absorp	RfD (subchronic) (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/ RfD Source	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Exposure Hazard Index
Childhood Exposure Pathway: Ingestion of Drinking Water										
Acetone	2.40E-04	No	1.00E+00	low	increased liver/ kidney weight	gavage/HEAST	1000	2.40E-04		
Barium	1.09E-02	No	7.00E-02	medium	NOAEL	epidemiology/HEAST	3	1.56E-01		
Butylphthalate, Di-n-	1.20E-04	No	1.00E+00	low	increased mortality	food/HEAST	1000	1.20E-04		
Chromium	1.80E-04	No	2.00E-02	low	NOAEL	water/HEAST	500	8.99E-03		
Dichloroethene, Cis-1,2-	1.20E-04	No	1.00E-01		decreased hematocrit, etc.	gavage/HEAST	3000	1.20E-03		
Methylene Chloride	1.20E-05	No	6.00E-02	medium	liver toxicity	water/HEAST	100	2.00E-04		
Nickel	3.72E-04	No	2.00E-02	medium	decreased body weight	food/HEAST	300	1.86E-02		
Tetrachloroethene	4.79E-05	No	1.00E-01	medium	hepatotoxicity	gavage/HEAST	1000	4.79E-04		
Trichloroethane, 1,1,1-	1.20E-05	No	9.00E-01		liver toxicity	oral/HEAST	1000	1.33E-05		
Trichloroethene	3.60E-04	No	6.00E-03			/ECAO		5.99E-02		
Zinc	1.28E-02	No	3.00E-01	medium	blood anemia	/IRIS	3	4.26E-02		
Pathway Hazard Index									2.88E-01	
Total Exposure Hazard Index										2.88E-01

TABLE 5.3
FORMER RALSTON DISPOSAL SITE
CHRONIC HAZARD INDEX ESTIMATES
CURRENT LAND USE - OFF SITE RESIDENT LIFETIME EXPOSURE

Chemical	CDI (mg/kg-day)	CDI Adj for Absorp	RfD (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/ RfD Source	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Exposure Hazard Index
Lifetime Exposure Pathway: Ingestion of Drinking Water										
Acetone	1.36E-04	No	1.00E-01	low	increased liver/ kidney weight	gavage/IRIS	1000	1.36E-03		
Barium	6.17E-03	No	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	8.82E-02		
Butylphthalate, Di-n-	6.78E-05	No	1.00E-01	low	increased mortality	food/IRIS	1000	6.78E-04		
Chromium	1.02E-04	No	5.00E-03	low	NOAEL	water/IRIS	500	2.03E-02		
Dichloroethene, Cis-1,2-	6.78E-05	No	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	6.78E-03		
Methylene Chloride	6.78E-06	No	6.00E-02	medium	liver toxicity	water/IRIS	100	1.13E-04		
Nickel	2.10E-04	No	2.00E-02	medium	decreased body weight	food/IRIS	300	1.05E-02		
Tetrachloroethene	2.71E-05	No	1.00E-02	medium	hepatotoxicity	gavage/IRIS	1000	2.71E-03		
Trichloroethane, 1,1,1-	6.78E-06	No	9.00E-02		liver toxicity	oral/HEAST	1000	7.53E-05		
Trichloroethene	2.03E-04	No	6.00E-03			/ECAO		3.39E-02		
Zinc	7.22E-03	No	3.00E-01	medium	blood anemia	/IRIS	3	2.41E-02		
Pathway Hazard Index									1.89E-01	
Total Exposure Hazard Index										1.89E-01

TABLE 5.4
FORMER RALSTON SITE
SUBCHRONIC HAZARD INDEX ESTIMATES
FUTURE LAND USE - ON SITE RESIDENTIAL CHILDREN

CHEMICAL	SDI (mg/kg-day)	SDI Adj. for Absorp.	RfD (subchronic) (mg/kg-day)		Confidence Level	Critical Effect	RfD Basis/ RfD Source	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Childhood Exposure Pathway: Ingestion of Drinking Water											
Antimony	5.66E-03	No	4.00E-04		low	longevity, blood glucose	oral/HEAST	1000	1.42E+01		
Arsenic	4.32E-04	No	3.00E-04		medium	hyperpigmentation, etc.	epidemiology/HEAST	3	1.44E+00		
Barium	1.82E-02	No	7.00E-02		medium	NOAEL	epidemiology/HEAST	3	2.60E-01		
Beryllium	1.50E-04	No	5.00E-03		low	NOAEL	water/HEAST	100	3.00E-02		
Bromodichloromethane	3.60E-04	No	2.00E-02		medium	renal cytomegaly	gavage/HEAST	1000	1.80E-02		
Butylphthalate, Di-n-	1.20E-04	No	1.00E+00		low	increased mortality	food/HEAST	1000	1.20E-04		
Cadmium	2.58E-04	No	5.00E-04	a	high	proteinuria	epidemiology/HEAST	10	5.15E-01		
Chloroform	3.00E-02	No	1.00E-02		medium	fatty cysts-liver	oral capsule/HEAST	1000	3.00E+00		
Chromium	1.86E-03	No	2.00E-02		low	NOAEL	water/HEAST	500	9.29E-02		
Dichloroethane, 1,1-	7.19E-04	No	1.00E+00			NOAEL	inhalation/HEAST	1000	7.19E-04		
Dichloroethene, 1,1-	1.62E-02	No	9.00E-03		medium	liver lesions	water/HEAST	1000	1.80E+00		
Dichloroethene, Cis-1,2-	1.08E+00	No	1.00E-01			decreased hematocrit, etc.	gavage/HEAST	3000	1.08E+01		
Dichloroethene, Trans-1,2-	1.92E-03	No	2.00E-01		low	increase serum alk. phosphatase	/HEAST	1000	9.59E-03		
Ethylbenzene	3.60E-05	No	1.00E+00		low	liver/kidney toxicity	gavage/HEAST	1000	3.60E-05		
Manganese	1.14E-01	No	1.00E-01		medium	CNS effects	epidemiology/HEAST	1	1.14E+00		
Methylene Chloride	5.99E-04	No	6.00E-02		medium	liver toxicity	water/HEAST	100	9.99E-03		
Nickel	2.42E-03	No	2.00E-02		medium	decreased body weight	food/HEAST	300	1.21E-01		
Selenium	2.88E-04	No	5.00E-03		high	selenosis	epidemiology/HEAST	3	5.75E-02		
Silver	2.94E-04	No	5.00E-03		low	argyria	epidemiology/HEAST	3	5.87E-02		
Tetrachloroethene	8.39E-04	No	1.00E-01		medium	hepatotoxicity	gavage/HEAST	1000	8.39E-03		
Toluene	4.20E-04	No	2.00E+00		medium	liver and kidney weights	gavage/HEAST	1000	2.10E-04		
Trichloroethene	3.12E-01	No	6.00E-03				/ECAO		5.19E+01		
Vanadium	3.06E-03	No	9.00E-03		low	decreased hair cystine	food/HEAST	100	3.40E-01		
Xylene (total)	1.80E-04	No	4.00E+00		medium	hyperactivity, etc.	gavage/HEAST	100	4.49E-05		
Zinc	1.52E-02	No	3.00E-01	a	medium	blood anemia	/IRIS	3	5.05E-02		
Pathway Hazard Index											8.58E+01

TABLE 5.4
FORMER RALSTON SITE
SUBCHRONIC HAZARD INDEX ESTIMATES
FUTURE LAND USE - ON SITE RESIDENTIAL CHILDREN

CHEMICAL	SDI (mg/kg-day)	SDI Adj. for Absorp.	RfD (subchronic) (mg/kg-day)		Confidence Level	Critical Effect	RfD Basis/ RfD Source	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Childhood Exposure Pathway: Incidental Ingestion of Soil											
Anthracene	7.05E-07	No	3.00E+00		low	NOEL	gavage/HEAST	3000	2.35E-07		
Arsenic	9.37E-05	No	3.00E-04		medium	hyperpigmentation, etc.	epidemiology/HEAST	3	3.12E-01		
Barium	8.10E-03	No	7.00E-02		medium	NOAEL	epidemiology/HEAST	3	1.16E-01		
bis(2-Ethylhexyl)Phthalate	1.37E-05	No	2.00E-02		medium	increased liver weight	food/HEAST	1000	6.86E-04		
Butylbenzylphthalate	8.42E-07	No	2.00E+00		low	increased liver weight	food/HEAST	1000	4.21E-07		
Cadmium	4.09E-04	No	1.00E-03	a	high	proteinuria	epidemiology/HEAST	10	4.09E-01		
Chloroform	5.88E-08	No	1.00E-02		medium	fatty cysts-liver	oral capsule/HEAST	1000	5.88E-06		
Chromium	2.83E-03	No	2.00E-02		low	NOAEL	water/HEAST	500	1.42E-01		
Dichloroethene, Cis-1,2-	5.20E-07	No	1.00E-01			decreased hematocrit, etc.	gavage/HEAST	3000	5.20E-06		
Fluoranthene	6.27E-06	No	4.00E-01		low	liver weights, etc.	gavage/HEAST	3000	1.57E-05		
Hexachlorobenzene	6.37E-07	No	8.00E-04		medium	liver effects	food/HEAST	100	7.96E-04		
Methylene Chloride	8.07E-08	No	6.00E-02		medium	liver toxicity	water/HEAST	100	1.34E-06		
Nickel	2.68E-03	No	2.00E-02		medium	decreased body weight	food/HEAST	300	1.34E-01		
Pyrene	7.44E-06	No	3.00E-01		low	decreased kidney weights	gavage/HEAST	3000	2.48E-05		
Silver	1.09E-03	No	5.00E-03		low	argyria	epidemiology/HEAST	3	2.17E-01		
Tetrachloroethene	4.63E-07	No	1.00E-01		medium	hepatotoxicity	gavage/HEAST	1000	4.63E-06		
Toluene	7.84E-08	No	2.00E+00		medium	liver and kidney weights	gavage/HEAST	1000	3.92E-08		
Trichloroethane, 1,1,1-	3.92E-08	No	9.00E-01			liver toxicity	oral/HEAST	1000	4.35E-08		
Trichloroethene	2.78E-06	No	6.00E-03				/ECAO		4.63E-04		
Xylene (total)	3.92E-08	No	4.00E+00		medium	hyperactivity, etc.	gavage/IRIS	100	9.79E-09		
Zinc	2.16E-02	No	3.00E-01	a	medium	blood anemia	/IRIS	3	7.21E-02		
Pathway Hazard Index											1.40E+00
Childhood Exposure Pathway: Dermal Absorption from Surface Soil											
Chloroform	2.79E-08	Yes	1.00E-02		medium	fatty cysts-liver	oral capsule/HEAST	1000	2.79E-06		
Dichloroethene, Cis-1,2-	2.47E-07	Yes	1.00E-01			decreased hematocrit, etc.	gavage/HEAST	3000	2.47E-06		
Hexachlorobenzene	4.03E-06	Yes	8.00E-04		medium	liver effects	food/HEAST	100	5.04E-03		
Methylene Chloride	5.11E-07	Yes	6.00E-02		medium	liver toxicity	water/HEAST	100	8.51E-06		
Tetrachloroethene	2.20E-07	Yes	1.00E-01		medium	hepatotoxicity	gavage/HEAST	1000	2.20E-06		
Toluene	3.72E-08	Yes	2.00E+00		medium	liver and kidney weights	gavage/HEAST	1000	1.86E-08		
Trichloroethane, 1,1,1-	1.86E-08	Yes	9.00E-01			liver toxicity	oral/HEAST	1000	2.07E-08		
Trichloroethene	1.32E-06	Yes	6.00E-03				/ECAO		2.20E-04		
Xylene (total)	1.86E-08	Yes	4.00E+00		medium	hyperactivity, etc.	gavage/IRIS	100	4.65E-09		
Pathway Hazard Index											5.05E-03
Childhood Exposure Pathway: Incidential Ingestion of Surface Water											
Acetone	1.22E-05	No	1.00E+00		low	increased liver/kidney weight	gavage/HEAST	1000	1.22E-05		
Barium	2.18E-04	No	7.00E-02		medium	NOAEL	epidemiology/HEAST	3	3.11E-03		
Cadmium	6.85E-06	No	5.00E-04	a	high	proteinuria	epidemiology/HEAST	10	1.37E-02		
Carbon Disulfide	6.16E-07	No	1.00E-01		medium	fetal toxicity/malformations	inhalation/HEAST	100	6.16E-06		
Dichloroethene, 1,1-	6.16E-07	No	9.00E-03		medium	liver lesions	water/HEAST	1000	6.85E-05		
Dichloroethene, Cis-1,2-	7.17E-05	No	1.00E-01			decreased hematocrit, etc.	gavage/HEAST	3000	7.17E-04		
Dichloroethene, Trans-1,2-	1.39E-06	No	2.00E-01		low	increase serum alk. phosphatase	/HEAST	1000	6.93E-06		
Nickel	9.08E-06	No	2.00E-02		medium	decreased body weight	food/HEAST	300	4.54E-04		

TABLE 5.4
FORMER RALSTON SITE
SUBCHRONIC HAZARD INDEX ESTIMATES
FUTURE LAND USE - ON SITE RESIDENTIAL CHILDREN

CHEMICAL	SDI (mg/kg-day)	SDI Adj. for Absorp.	RfD (subchronic) (mg/kg-day)		Confidence Level	Critical Effect	RfD Basis/ RfD Source	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Childhood Exposure Pathway: Incidental Ingestion of Surface Water											
Tetrachloroethene	1.08E-06	No	1.00E-01		medium	hepatotoxicity	gavage/HEAST	1000	1.08E-05		
Toluene	1.39E-06	No	2.00E+00		medium	liver and kidney weights	gavage/HEAST	1000	6.93E-07		
Trichloroethane, 1,1,1-	4.62E-07	No	9.00E-01			liver toxicity	oral/HEAST	1000	5.14E-07		
Trichloroethene	5.61E-06	No	6.00E-03				/ECAO		9.35E-04		
Xylene (total)	4.62E-07	No	4.00E+00		medium	hyperactivity, etc.	gavage/HEAST	100	1.16E-07		
Zinc	7.78E-05	No	3.00E-01	a	medium	blood anemia	/IRIS	3	2.59E-04		
Pathway Hazard Index										1.93E-02	
Childhood Exposure Pathway: Dermal Absorption from Surface Water											
Barium	1.64E-05	Yes	7.00E-02		medium	NOAEL	epidemiology/HEAST	3	2.34E-04		
Cadmium	5.15E-07	Yes	5.00E-04	a	high	proteinuria	epidemiology/HEAST	10	1.03E-03		
Carbon Disulfide	1.11E-06	Yes	1.00E-01		medium	fetal toxicity/malformations	inhalation/HEAST	100	1.11E-05		
Dichloroethene, 1,1-	7.42E-07	Yes	9.00E-03		medium	liver lesions	water/HEAST	1000	8.24E-05		
Dichloroethene, Trans-1,2-	1.04E-06	Yes	2.00E-01		low	increase serum alk. phosphatase	/HEAST	1000	5.22E-06		
Nickel	6.83E-07	Yes	2.00E-02		medium	decreased body weight	food/HEAST	300	3.41E-05		
Tetrachloroethene	3.89E-06	Yes	1.00E-01		medium	hepatotoxicity	gavage/HEAST	1000	3.89E-05		
Toluene	4.69E-06	Yes	2.00E+00		medium	liver and kidney weights	gavage/HEAST	1000	2.35E-06		
Trichloroethane, 1,1,1-	5.91E-07	Yes	9.00E-01			liver toxicity	oral/HEAST	1000	6.57E-07		
Trichloroethene	6.75E-06	Yes	6.00E-03				/ECAO		1.13E-03		
Xylene (total)	2.78E-06	Yes	4.00E+00		medium	hyperactivity, etc.	gavage/HEAST	100	6.95E-07		
Zinc	5.85E-06	Yes	3.00E-01	a	medium	blood anemia	/IRIS	3	1.95E-05		
Pathway Hazard Index										2.58E-03	
Childhood Exposure Pathway: Incidental Ingestion of Sediment while Wading											
Acetone	4.16E-08	No	1.00E+00		low	increased liver/ kidney weight	gavage/HEAST	1000	4.16E-08		
Anthracene	8.22E-08	No	3.00E+00		low	NOEL	gavage/HEAST	3000	2.74E-08		
Arsenic	3.08E-06	No	3.00E-04		medium	hyperpigmentation, etc.	epidemiology/HEAST	3	1.03E-02		
Barium	1.60E-04	No	7.00E-02		medium	NOAEL	epidemiology/HEAST	3	2.29E-03		
Cadmium	4.11E-06	No	1.00E-03	a	high	proteinuria	epidemiology/HEAST		4.11E-03		
Chromium	1.09E-05	No	2.00E-02		medium	fatty cysts-liver	oral capsule/HEAST	1000	5.45E-04		
Dichloroethene, Cis-1,2-	2.60E-08	No	1.00E-01			decreased hematocrit, etc.	gavage/HEAST	3000	2.60E-07		
Fluoranthene	6.83E-07	No	4.00E-01		low	liver weights, etc.	gavage/HEAST	3000	1.71E-06		
Nickel	1.05E-05	No	2.00E-02		medium	decreased body weight	food/HEAST	300	5.24E-04		
Pyrene	6.58E-07	No	3.00E-01		low	decreased kidney weights	gavage/HEAST	3000	2.19E-06		
Trichloroethene	4.11E-09	No	6.00E-03				/ECAO		6.85E-07		
Zinc	4.15E-05	No	3.00E-01	a	medium	blood anemia	/IRIS	3	1.38E-04		
Pathway Hazard Index										1.79E-02	
Childhood Exposure Pathway: Dermal Absorption from Sediment while Wading											
Acetone	7.81E-07	Yes	1.00E+00		low	increased liver/ kidney weight	gavage/HEAST	1000	7.81E-07		
Dichloroethene, Cis-1,2-	1.47E-08	Yes	1.00E-01			decreased hematocrit, etc.	gavage/HEAST	3000	1.47E-07		
Trichloroethene	2.32E-09	Yes	6.00E-03				/ECAO		3.86E-07		
Pathway Hazard Index										1.31E-06	
Total Exposure Hazard Index											8.73E+01

a=Subchronic RfD not reported; Chronic RfD substituted

TABLE 5.5
FORMER RALSTON SITE
CHRONIC HAZARD INDEX ESTIMATES
FUTURE LAND USE - LIFETIME ON SITE RESIDENT

CHEMICAL	CDI (chronic) (mg/kg-day)	CDI Adj. for Absorp.	RfD (chronic) (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/RfD Sou	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Lifetime Exposure Pathway: Ingestion of Groundwater										
Antimony	3.20E-03	No	4.00E-04	low	longevity, blood glucose	oral/IRIS	1000	8.01E+00		
Arsenic	2.44E-04	No	3.00E-04	medium	hyperpigmentation, etc.	epidemiology/IRIS	3	8.14E-01		
Barium	1.03E-02	No	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	1.47E-01		
Beryllium	8.48E-05	No	5.00E-03	low	NOAEL	water/IRIS	100	1.70E-02		
Bromodichloromethane	2.03E-04	No	2.00E-02	medium	renal cytomegaly	gavage/IRIS	1000	1.02E-02		
Butylphthalate, Di-n-	6.78E-05	No	1.00E-01	low	increased mortality	food/IRIS	1000	6.78E-04		
Cadmium	1.46E-04	No	5.00E-04	high	proteinuria	epidemiology/IRIS	10	2.92E-01		
Chloroform	1.70E-02	No	1.00E-02	medium	fatty cysts-liver	oral capsule/IRIS	1000	1.70E+00		
Chromium	1.05E-03	No	5.00E-03	low	NOAEL	water/IRIS	500	2.10E-01		
Dichloroethane, 1,1-	4.07E-04	No	1.00E-01		NOAEL	inhalation/HEAST	1000	4.07E-03		
Dichloroethene, 1,1-	9.15E-03	No	9.00E-03	medium	liver lesions	water/IRIS	1000	1.02E+00		
Dichloroethene, Cis-1,2-	6.10E-01	No	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	6.10E+01		
Dichloroethene, Trans-1,2-	1.08E-03	No	2.00E-02	low	increase serum alk. phosphatase	/IRIS	1000	5.42E-02		
Ethylbenzene	2.03E-05	No	1.00E-01	low	liver/kidney toxicity	gavage/IRIS	1000	2.03E-04		
Manganese	6.48E-02	No	1.00E-01	medium	CNS effects	epidemiology/IRIS	1	6.48E-01		
Methylene Chloride	3.39E-04	No	6.00E-02	medium	liver toxicity	water/IRIS	100	5.65E-03		
Nickel	1.37E-03	No	2.00E-02	medium	decreased body weight	food/IRIS	300	6.85E-02		
Selenium	1.63E-04	No	5.00E-03	high	selenosis	epidemiology/IRIS	3	3.25E-02		
Silver	1.66E-04	No	5.00E-03	low	argyria	epidemiology/IRIS	3	3.32E-02		
Tetrachloroethene	4.75E-04	No	1.00E-02	medium	hepatotoxicity	gavage/IRIS	1000	4.75E-02		
Toluene	2.37E-04	No	2.00E-01	medium	liver and kidney weights	gavage/IRIS	1000	1.19E-03		
Trichloroethene	1.76E-01	No	6.00E-03			/ECAO		2.94E+01		
Vanadium	1.73E-03	No	9.00E-03	low	decreased hair cystine	food/IRIS	100	1.92E-01		
Xylene (total)	1.02E-04	No	2.00E+00	medium	hyperactivity, etc.	gavage/IRIS	100	5.09E-05		
Zinc	8.58E-03	No	3.00E-01		blood anemia	/HEAST	10	2.86E-02		
Pathway Hazard Index										1.04E+02

TABLE 5.5
FORMER RALSTON SITE
CHRONIC HAZARD INDEX ESTIMATES
FUTURE LAND USE - LIFETIME ON SITE RESIDENT

CHEMICAL	CDI (chronic) (mg/kg-day)	CDI Adj. for Absorp.	RfD (chronic) (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/RfD Sou	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Lifetime Exposure Pathway: Incidental Ingestion of Surface Soil										
Anthracene	2.06E-07	No	3.00E-01	low	NOEL	gavage/IRIS	3000	6.85E-07		
Arsenic	2.73E-05	No	3.00E-04	medium	hyperpigmentation, etc.	epidemiology/IRIS	3	9.11E-02		
Barium	2.36E-03	No	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	3.37E-02		
bis(2-Ethylhexyl)Phthalate	4.00E-06	No	2.00E-02	medium	increased liver weight	food/IRIS	1000	2.00E-04		
Butylbenzylphthalate	2.45E-07	No	2.00E-01	low	increased liver weight	food/IRIS	1000	1.23E-06		
Cadmium	1.19E-04	No	1.00E-03	high	proteinuria	epidemiology/IRIS	10	1.19E-01		
Chloroform	1.71E-08	No	1.00E-02	medium	fatty cysts-liver	oral capsule/IRIS	1000	1.71E-06		
Chromium	8.26E-04	No	5.00E-03	low	NOAEL	water/IRIS	500	1.65E-01		
Dichloroethene, Cis-1,2-	1.52E-07	No	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	1.52E-05		
Fluoranthene	1.83E-06	No	4.00E-02	low	liver weights, etc.	gavage/IRIS	3000	4.57E-05		
Hexachlorobenzene	1.86E-07	No	8.00E-04	medium	liver effects	food/IRIS	100	2.32E-04		
Methylene Chloride	2.35E-08	No	6.00E-02	medium	liver toxicity	water/IRIS	100	3.92E-07		
Nickel	7.80E-04	No	2.00E-02	medium	decreased body weight	food/IRIS	300	3.90E-02		
Pyrene	2.17E-06	No	3.00E-02	low	decreased kidney weights	gavage/IRIS	3000	7.23E-05		
Silver	3.17E-04	No	5.00E-03	low	argyria	epidemiology/IRIS	3	6.34E-02		
Tetrachloroethene	1.35E-07	No	1.00E-02	medium	hepatotoxicity	gavage/IRIS	1000	1.35E-05		
Toluene	2.28E-08	No	2.00E-01	medium	liver and kidney weights	gavage/IRIS	1000	1.14E-07		
Trichloroethane, 1,1,1-	1.14E-08	No	9.00E-02		liver toxicity	oral/HEAST	1000	1.27E-07		
Trichloroethene	8.09E-07	No	6.00E-03			/ECAO		1.35E-04		
Xylene (total)	1.14E-08	No	2.00E+00	medium	hyperactivity, etc.	gavage/IRIS	100	5.71E-09		
Zinc	6.30E-03	No	3.00E-01		blood anemia	/HEAST	10	2.10E-02		
									5.33E-01	
Lifetime Exposure Pathway: Dermal Absorption from Surface Soil										
Chloroform	1.06E-08	Yes	1.00E-02	medium	fatty cysts-liver	oral capsule/IRIS	1000	1.06E-06		
Dichloroethene, Cis-1,2-	9.39E-08	Yes	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	9.39E-06		
Hexachlorobenzene	1.53E-06	Yes	8.00E-04	medium	liver effects	food/IRIS	100	1.92E-03		
Methylene Chloride	1.94E-07	Yes	6.00E-02	medium	liver toxicity	water/IRIS	100	3.24E-06		
Tetrachloroethene	8.36E-08	Yes	1.00E-02	medium	hepatotoxicity	gavage/IRIS	1000	8.36E-06		
Toluene	1.41E-08	Yes	2.00E-01	medium	liver and kidney weights	gavage/IRIS	1000	7.07E-08		
Trichloroethane, 1,1,1-	7.07E-09	Yes	9.00E-02		liver toxicity	oral/HEAST	1000	7.86E-08		
Trichloroethene	5.01E-07	Yes	6.00E-03			/ECAO		8.35E-05		
Xylene (total)	7.07E-09	Yes	2.00E+00	medium	hyperactivity, etc.	gavage/IRIS	100	3.54E-09		
Pathway Hazard Index									2.02E-03	
Lifetime Exposure Pathway: Incidental Ingestion of Surface Water										
Acetone	2.65E-06	No	1.00E-01	low	increased liver/ kidney weight	gavage/IRIS	1000	2.65E-05		
Barium	4.75E-05	No	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	6.79E-04		
Cadmium	1.49E-06	No	5.00E-04	high	proteinuria	epidemiology/IRIS	10	2.99E-03		
Carbon Disulfide	1.35E-07	No	1.00E-01	medium	fetal toxicity/malformations	inhalation/IRIS	100	1.35E-06		
Dichloroethene, 1,1-	1.35E-07	No	9.00E-03	medium	liver lesions	water/IRIS	1000	1.50E-05		
Dichloroethene, Cis-1,2-	1.56E-05	No	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	1.56E-03		
Dichloroethene, Trans-1,2-	3.03E-07	No	2.00E-02	low	increase serum alk. phosphatase	/IRIS	1000	1.51E-05		
Nickel	1.98E-06	No	2.00E-02	medium	decreased body weight	food/IRIS	300	9.91E-05		

TABLE 5.5
FORMER RALSTON SITE
CHRONIC HAZARD INDEX ESTIMATES
FUTURE LAND USE - LIFETIME ON SITE RESIDENT

CHEMICAL	CDI (chronic) (mg/kg-day)	CDI Adj. for Absorp.	RfD (chronic) (mg/kg-day)	Confidence Level	Critical Effect	RfD Basis/RfD Source	Uncertainty Factor	Hazard Quotient	Pathway Hazard Index	Total Hazard Index
Lifetime Exposure Pathway: Incidental Ingestion of Surface Water										
Tetrachloroethene	2.35E-07	No	1.00E-02	medium	hepatotoxicity	gavage/IRIS	1000	2.35E-05		
Toluene	3.03E-07	No	2.00E-01	medium	liver and kidney weights	gavage/IRIS	1000	1.51E-06		
Trichloroethane, 1,1,1-	1.01E-07	No	9.00E-02		liver toxicity	oral/HEAST	1000	1.12E-06		
Trichloroethene	1.23E-06	No	6.00E-03			/ECAO		2.04E-04		
Xylene (total)	1.01E-07	No	2.00E+00	medium	hyperactivity, etc.	gavage/IRIS	100	5.05E-08		
Zinc	1.70E-05	No	3.00E-01		blood anemia	/HEAST	10	5.66E-05		
Pathway Hazard Index									5.68E-03	
Lifetime Exposure Pathway: Dermal Absorption from Surface Water										
Barium	3.52E-06	Yes	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	5.03E-05		
Cadmium	1.11E-07	Yes	5.00E-04	high	proteinuria	epidemiology/IRIS	10	2.21E-04		
Carbon Disulfide	2.39E-07	Yes	1.00E-01	medium	fetal toxicity/malformations	inhalation/IRIS	100	2.39E-06		
Dichloroethene, 1,1-	1.59E-07	Yes	9.00E-03	medium	liver lesions	water/IRIS	1000	1.77E-05		
Dichloroethene, Trans-1,2-	2.24E-07	Yes	2.00E-02	low	increase serum alk. phosphatase	/IRIS	1000	1.12E-05		
Nickel	1.47E-07	Yes	2.00E-02	medium	decreased body weight	food/IRIS	300	7.33E-06		
Tetrachloroethene	8.37E-07	Yes	1.00E-02	medium	hepatotoxicity	gavage/IRIS	1000	8.37E-05		
Toluene	1.01E-06	Yes	2.00E-01	medium	liver and kidney weights	gavage/IRIS	1000	5.04E-06		
Trichloroethane, 1,1,1-	1.27E-07	Yes	9.00E-02		liver toxicity	oral/HEAST	1000	1.41E-06		
Trichloroethene	1.45E-06	Yes	6.00E-03			/ECAO		2.42E-04		
Xylene (total)	5.98E-07	Yes	2.00E+00	medium	hyperactivity, etc.	gavage/IRIS	100	2.99E-07		
Zinc	1.26E-06	Yes	3.00E-01		blood anemia	/HEAST	10	4.19E-06		
Pathway Hazard Index									6.46E-04	
Lifetime Exposure Pathway: Incidental Ingestion of Sediment While Wading										
Acetone	9.45E-09	No	1.00E-01	low	increased liver/ kidney weight	gavage/IRIS	1000	9.45E-08		
Anthracene	1.87E-08	No	3.00E-01	low	NOEL	gavage/IRIS	3000	6.23E-08		
Arsenic	7.01E-07	No	3.00E-04	medium	hyperpigmentation, etc.	epidemiology/IRIS	3	2.34E-03		
Barium	3.64E-05	No	7.00E-02	medium	NOAEL	epidemiology/IRIS	3	5.20E-04		
Cadmium	9.35E-07	No	1.00E-03	high	proteinuria	epidemiology/IRIS		9.35E-04		
Chromium	2.48E-06	No	5.00E-03	medium	fatty cysts-liver	oral capsule/IRIS	1000	4.95E-04		
Dichloroethene, Cis-1,2-	5.92E-09	No	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	5.92E-07		
Fluoranthene	1.55E-07	No	4.00E-02	low	liver weights, etc.	gavage/IRIS	3000	3.88E-06		
Nickel	2.38E-06	No	2.00E-02	medium	decreased body weight	food/IRIS	300	1.19E-04		
Pyrene	1.50E-07	No	3.00E-02	low	decreased kidney weights	gavage/IRIS	3000	4.98E-06		
Trichloroethene	9.35E-10	No	6.00E-03			/ECAO		1.56E-07		
Zinc	9.43E-06	No	3.00E-01		blood anemia	/HEAST	10	3.14E-05		
Pathway Hazard Index									4.45E-03	
Lifetime Exposure Pathway: Dermal Absorption from Sediment while Wading										
Acetone	1.91E-07	Yes	1.00E-01	low	increased liver/ kidney weight	gavage/IRIS	1000	1.91E-06		
Dichloroethene, Cis-1,2-	3.59E-09	Yes	1.00E-02		decreased hematocrit, etc.	gavage/HEAST	3000	3.59E-07		
Trichloroethene	5.67E-10	Yes	6.00E-03			/ECAO		9.45E-08		
Pathway Hazard Index									2.36E-06	
Total Exposure Hazard Index										1.04E+02

CANCER RISK ESTIMATES
CURRENT LAND USE - TRESPASSER

CHEMICAL	CDI (mg/kg-day)	CDI adj. for Absorp.	SF (mg/kg-day)-1	Weight of Edivence	Type of Cancer	SF Basis/SF Source	Chemical-Specific Risk	Total Pathway Risk	Total Exposure Risk
Exposure Pathway: Incidental Ingestion of Soil									
Arsenic	2.06E-07	No	1.75E+00	A	lung/skin	water; inhalation/IRIS	3.61E-07		
Benzo(a)Anthracene	7.75E-09	No	7.30E-01	B2		/IRIS	5.66E-09		
Benzo(a)Pyrene	7.75E-09	No	7.30E+00	B2		food/gavage, etc./IRIS	5.66E-08		
Benzo(b)Fluoranthene	1.01E-08	No	7.30E-01	B2		/IRIS	7.39E-09		
Benzo(k)Fluoranthene	7.75E-09	No	7.30E-02	B2		/IRIS	5.66E-10		
bis(2-Ethylhexyl)Phthalate	3.01E-08	No	1.40E-02	B2		food/IRIS	4.22E-10		
Chloroform	1.29E-10	No	6.10E-03	B2		gavage/IRIS	7.88E-13		
Chrysene	8.40E-09	No	7.30E-03	B2		/IRIS	6.13E-11		
Hexachlorobenzene	1.40E-09	No	1.60E+00	B2		/IRIS	2.24E-09		
Indeno(1,2,3-cd)Pyrene	6.67E-09	No	7.30E-01	B2		/IRIS	4.87E-09		
Methylene Chloride	1.77E-10	No	7.50E-03	B2		water/IRIS	1.33E-12		
Trichloroethene	6.10E-09	No	1.10E-02			/ECAO	6.71E-11		
	Total Pathway Risk							4.38E-07	
Exposure Pathway: Inhalation of Fugitive Dust									
Arsenic	8.90E-18	No	5.00E+01	A	lung; skin	inhalation; water/IRIS	4.45E-16		
Cadmium	3.88E-17	No	6.10E+00	B1		inhalation/IRIS	2.37E-16		
Chloroform	5.58E-21	No	8.10E-02	B2		gavage/IRIS	4.52E-22		
Chromium	2.69E-16	No	4.10E+01	A	lung	epidemiology/IRIS	1.10E-14		
Hexachlorobenzene	6.04E-20	No	1.60E+00	B2		/IRIS	9.67E-20		
Trichloroethene	2.63E-19	No	6.00E-03			/ECAO	1.58E-21		
	Total Pathway Risk							1.17E-14	
Exposure Pathway: Dermal Absorption from Soil									
Chloroform	2.36E-10	Yes	6.10E-03	B2		gavage/IRIS	1.44E-12		
Hexachlorobenzene	3.41E-08	Yes	1.60E+00	B2		/IRIS	5.45E-08		
Methylene Chloride	4.32E-09	Yes	7.50E-03	B2		water/IRIS	3.24E-11		
Trichloroethene	1.11E-08	Yes	1.10E-02			/ECAO	1.23E-10		
	Total Pathway Risk							5.47E-08	
Exposure pathway: Incidental Ingestion of Surface Water while Wading									
Dichloroethene, 1,1-	8.45E-09	No	6.00E-01	C		inhalation/IRIS	5.07E-09		
Trichloroethene	7.70E-08	No	1.10E-02			/ECAO	8.47E-10		
Vinyl Chloride	2.28E-07	No	1.90E+00	A	lung; liver	food/HEAST	4.33E-07		
	Total Pathway Risk							4.39E-07	
Exposure pathway: Dermal Absorption from Surface Water while Wading									
Dichloroethene, 1,1-	1.65E-08	Yes	6.00E-01	C		inhalation/IRIS	9.89E-09		
Trichloroethene	1.50E-07	Yes	1.10E-02			/ECAO	1.65E-09		
Vinyl Chloride	2.02E-07	Yes	1.90E+00	A	lung; liver	food/HEAST	3.85E-07		
	Total Pathway Risk							3.96E-07	
Exposure pathway: Incidential Ingestion of Sediment while Wading									
Arsenic	2.11E-08	No	1.75E+00	A	lung/skin	water; inhalation/IRIS	3.70E-08		
Benzo(a)Anthracene	1.97E-09	No	7.30E-01	B2		/IRIS	1.44E-09		
Benzo(a)Pyrene	1.69E-09	No	7.30E+00	B2		food/gavage, etc./IRIS	1.23E-08		
Benzo(b)Fluoranthene	1.97E-09	No	7.30E-01	B2		/IRIS	1.44E-09		
Benzo(k)Fluoranthene	1.18E-09	No	7.30E-02	B2		/IRIS	8.64E-11		
Chrysene	1.83E-09	No	7.30E-03	B2		/IRIS	1.34E-11		
Indeno(1,2,3-cd)Pyrene	6.20E-10	No	7.30E-01	B2		/IRIS	4.53E-10		
Trichloroethene	2.82E-11	No	1.10E-02			/ECAO	3.10E-13		
	Total Pathway Risk							5.28E-08	
Exposure pathway: Dermal Absorption from Sediment while Wading									
Trichloroethene	5.15E-11	Yes	1.10E-02			/ECAO	5.66E-13		
	Total Pathway Risk							5.66E-13	
Total Exposure Risk									1.38E-06

TABLE 5.7
FORMER RALSTON DISPOSAL SITE
CANCER RISK ESTIMATES
CURRENT LAND USE - OFF SITE RESIDENTS

CHEMICAL	CDI (mg/kg-day)	CDI adj for Absorp.	SF (mg/kg-day)-1	Weight of Evidence	Type of Cancer	SF Basis/SF Source	Chemical Specific Risk	Total Pathway Risk	Total Exposure Risk
Childhood Exposure Pathway: Ingestion of Drinking Water									
Methylene Chloride	1.03E-06	No	7.50E-03	B2		water/IRIS	7.71E-09		
Trichloroethene	3.08E-05	No	1.10E-02			/ECAO	3.39E-07		
	Total Pathway Risk							3.47E-07	
Childhood Exposure Pathway: Inhalation of fugitive dust									
Arsenic (mg/kg)	1.39E-16	No	5.00E+01	A	lung; skin	inhalation; water/IRIS	6.94E-15		
Cadmium (mg/kg)	6.06E-16	No	6.10E+00	B1		inhalation/IRIS	3.70E-15		
Chloroform	8.71E-20	No	8.10E-02	B2		gavage/IRIS	7.05E-21		
Chromium (mg/kg)	4.20E-15	No	4.10E+01	A	lung	epidemiology/IRIS	1.72E-13		
Hexachlorobenzene	9.43E-19	No	1.60E+00	B2		/IRIS	1.51E-18		
Trichloroethene	9.43E-19	No	6.00E-03			/ECAO	5.66E-21		
	Total Pathway Risk							1.83E-13	
Total Exposure Risk									3.47E-07
Lifetime Exposure Pathway: Ingestion of Drinking Water									
Methylene Chloride	1.71E-06	No	7.50E-03	B2		water/IRIS	1.28E-08		
Trichloroethene	5.13E-05	No	1.10E-02			/ECAO	5.64E-07		
	Total Pathway Risk							5.77E-07	
Lifetime Exposure Pathway: Inhalation of fugitive dust									
Arsenic (mg/kg)	1.55E-16	No	5.00E+01	A	lung; skin	inhalation; water/IRIS	7.73E-15		
Cadmium (mg/kg)	6.75E-16	No	6.10E+00	B1		inhalation/IRIS	4.12E-15		
Chloroform	9.70E-20	No	8.10E-02	B2		gavage/IRIS	7.85E-21		
Chromium (mg/kg)	4.67E-15	No	4.10E+01	A	lung	epidemiology/IRIS	1.92E-13		
Hexachlorobenzene	1.05E-18	No	1.60E+00	B2		/IRIS	1.68E-18		
Trichloroethene	4.58E-18	No	6.00E-03			/ECAO	2.75E-20		
	Total Pathway Risk							2.03E-13	
Total Exposure Risk									5.77E-07

TABLE 5.8
FORMER RALSTON SITE
CANCER RISK ESTIMATES
FUTURE LAND USE - ON SITE RESIDENTS

CHEMICAL	CDI (mg/kg-day)	CDI Adj. for Absorp.	SF (mg/kg-day)-1	Weight of Evidence	Type of Cancer	SF Basis/SF Source	Chemical Specific Risk	Total Pathway Risk	Total Exposure Risk
Childhood Exposure Pathway: Ingestion of Drinking Water									
Arsenic	3.70E-05	No	1.75E+00	A	lung/skin water;	inhalation/IRIS	6.47E-05		
Benzene	1.39E-04	No	2.90E-02	A	leukemia	epidemiology/IRIS	4.02E-06		
Beryllium	1.28E-05	No	4.30E+00	B2		inhalation/IRIS	5.52E-05		
Bromodichloromethane	3.08E-05	No	1.30E-01	B2		gavage/IRIS	4.01E-06		
Chloroform	2.57E-03	No	6.10E-03	B2		gavage/IRIS	1.57E-05		
Dichloroethene, 1,1-	1.39E-03	No	6.00E-01	C		inhalation/IRIS	8.32E-04		
Methylene Chloride	5.14E-05	No	7.50E-03	B2		water/IRIS	3.85E-07		
Trichloroethene	2.67E-02	No	1.10E-02			/ECAO	2.94E-04		
Vinyl Chloride	1.08E-02	No	1.90E+00	A	lung; liver	food/HEAST	2.05E-02		
Total Pathway Risks								2.18E-02	
Childhood Exposure Pathway: Incidental Ingestion of Soil									
Arsenic	8.03E-06	No	1.75E+00	A	lung/skin water;	inhalation/IRIS	1.41E-05		
Benzo(a)Anthracene	3.02E-07	No	7.30E-01	B2		/IRIS	2.21E-07		
Benzo(a)Pyrene	3.02E-07	No	7.30E+00	B2		food/gavage, etc./IRIS	2.21E-06		
Benzo(b)Fluoranthene	3.95E-07	No	7.30E-01	B2		/IRIS	2.88E-07		
Benzo(k)Fluoranthene	3.02E-07	No	7.30E-02	B2		/IRIS	2.21E-08		
bis(2-Ethylhexyl)Phthalate	1.18E-06	No	1.40E-02	B2		food/IRIS	1.65E-08		
Chloroform	5.04E-09	No	6.10E-03	B2		gavage/IRIS	3.07E-11		
Chrysene	3.27E-07	No	7.30E-03	B2		/IRIS	2.39E-09		
Hexachlorobenzene	5.46E-08	No	1.60E+00	B2		/IRIS	8.73E-08		
Indeno(1,2,3-cd)Pyrene	2.60E-07	No	7.30E-01	B2		/IRIS	1.90E-07		
Methylene Chloride	6.92E-09	No	7.50E-03	B2		water/IRIS	5.19E-11		
Trichloroethene	2.38E-07	No	1.10E-02			/ECAO	2.62E-09		
Total Pathway Risks								1.71E-05	
Childhood Exposure Pathway: Inhalation of Fugitive Dust									
Arsenic	1.39E-16	No	5.00E+01	A	lung; skin	inhalation; water/IRIS	6.94E-15		
Cadmium	6.06E-16	No	6.10E+00	B1		inhalation/IRIS	3.70E-15		
Chloroform	8.71E-20	No	8.10E-02	B2		gavage/IRIS	7.05E-21		
Chromium	4.20E-15	No	4.10E+01	A	lung	epidemiology/IRIS	1.72E-13		
Hexachlorobenzene	9.43E-19	No	1.60E+00	B2		/IRIS	1.51E-18		
Trichloroethene	4.11E-18	No	6.00E-03			/ECAO	2.47E-20		
Total Pathway Risks								1.83E-13	
Childhood Exposure Pathway: Dermal Absorption from Soil									
Chloroform	2.39E-09	Yes	6.10E-03	B2		gavage/IRIS	1.46E-11		
Hexachlorobenzene	3.45E-07	Yes	1.60E+00	B2		/IRIS	5.53E-07		
Methylene Chloride	4.38E-08	Yes	7.50E-03	B2		water/IRIS	3.28E-10		
Trichloroethene	1.13E-07	Yes	1.10E-02			/ECAO	1.24E-09		
Total Pathway Risks								5.54E-07	
Childhood Exposure Pathway: Incidental Ingestion of Surface Water while Wading									
Dichloroethene, 1,1-	5.28E-08	No	6.00E-01	C		inhalation/IRIS	3.17E-08		

TABLE 5.8
FORMER RALSTON SITE
CANCER RISK ESTIMATES
FUTURE LAND USE - ON SITE RESIDENTS

CHEMICAL	CDI (mg/kg-day)	CDI Adj. for Absorp.	SF (mg/kg-day)-1	Weight of Evidence	Type of Cancer	SF Basis/SF Source	Chemical Specific Risk	Total Pathway Risk	Total Exposure Risk
Childhood Exposure Pathway: Incidental Ingestion of Surface Water while Wading									
Trichloroethene	4.81E-07	No	1.10E-02			/ECAO	5.29E-09		
Vinyl Chloride	1.42E-06	No	1.90E+00	A	lung; liver	food/HEAST	2.70E-06		
Total Pathway Risks								2.74E-06	
Childhood Exposure Pathway: Dermal Absorption from Surface Water while Wading									
Dichloroethene, 1,1-	6.36E-08	Yes	6.00E-01	C		inhalation/IRIS	3.81E-08		
Trichloroethene	5.79E-07	Yes	1.10E-02			/ECAO	6.37E-09		
Vinyl Chloride	7.81E-07	Yes	1.90E+00	A	lung; liver	food/HEAST	1.48E-06		
Total Pathway Risks								1.53E-06	
Childhood Exposure Pathway: Incidental Ingestion of Sediments while Wading									
Arsenic	2.64E-07	No	1.75E+00	A	lung/skin water; inhalation/IRIS		4.62E-07		
Benzo(a)Anthracene	2.47E-08	No	7.30E-01	B2		/IRIS	1.80E-08		
Benzo(a)Pyrene	2.11E-08	No	7.30E+00	B2		food/gavage, etc./IRIS	1.54E-07		
Benzo(b)Fluoranthene	2.47E-08	No	7.30E-01	B2		/IRIS	1.80E-08		
Benzo(k)Fluoranthene	1.48E-08	No	7.30E-02	B2		/IRIS	1.08E-09		
Chrysene	2.29E-08	No	7.30E-03	B2		/IRIS	1.67E-10		
Indeno(1,2,3-cd)Pyrene	7.75E-09	No	7.30E-01	B2		/IRIS	5.66E-09		
Trichloroethene	3.52E-10	No	1.10E-02			/ECAO	3.87E-12		
Total Pathway Risks								6.60E-07	
Childhood Exposure Pathway: Dermal Absorption from Sediments while Wading									
Trichloroethene	1.99E-10	Yes	1.10E-02			/ECAO	2.19E-12		
Total Pathway Risks								2.19E-12	
Total Exposure Risks									2.18E-02
Lifetime Exposure Pathway: Ingestion of Drinking Water									
Arsenic	6.15E-05	No	1.75E+00	A	lung/skin water; inhalation/IRIS		1.08E-04		
Benzene	2.31E-04	No	2.90E-02	A	leukemia	epidemiology/IRIS	6.69E-06		
Beryllium	2.14E-05	No	4.30E+00	B2		inhalation/IRIS	9.18E-05		
Bromodichloromethane	5.13E-05	No	1.30E-01	B2		gavage/IRIS	6.66E-06		
Chloroform	4.27E-03	No	6.10E-03	B2		gavage/IRIS	2.61E-05		
Dichloroethene, 1,1-	2.31E-03	No	6.00E-01	C		inhalation/IRIS	1.38E-03		
Methylene Chloride	8.54E-05	No	7.50E-03	B2		water/IRIS	6.41E-07		
Trichloroethene	4.44E-02	No	1.10E-02			/ECAO	4.89E-04		
Vinyl Chloride	1.79E-02	No	1.90E+00	A	lung; liver	food/HEAST	3.41E-02		
Total Pathway Risks								3.62E-02	
Lifetime Exposure Pathway: Inhalation of Vapors while Showering (adult only)									
Benzene	7.04E-05	No	2.90E-02	A	leukemia	epidemiology/IRIS	2.04E-06		
Chloroform	1.30E-03	No	8.10E-02	B2		gavage/IRIS	1.06E-04		
Dichloroethene, 1,1-	7.04E-04	No	1.20E+00	C		inhalation/IRIS	8.45E-04		
Trichloroethene	1.36E-02	No	6.00E-03			/ECAO	8.14E-05		
Vinyl Chloride	5.48E-03	No	3.00E-01	A	liver	/HEAST	1.64E-03		
Total Pathway Risks								2.68E-03	
Lifetime Exposure Pathway: Incidental Ingestion of Soil									
Arsenic	4.55E-06	No	1.75E+00	A	lung/skin water; inhalation/IRIS		7.95E-06		
Benzo(a)Anthracene	1.71E-07	No	7.30E-01	B2		/IRIS	1.25E-07		

TABLE 5.8
FORMER RALSTON SITE
CANCER RISK ESTIMATES
FUTURE LAND USE - ON SITE RESIDENTS

CHEMICAL	CDI (mg/kg-day)	CDI Adj. for Absorp.	SF (mg/kg-day)-1	Weight of Evidence	Type of Cancer	SF Basis/SF Source	Chemical Specific Risk	Total Pathway Risk	Total Exposure Risk
Lifetime Exposure Pathway: Incidental Ingestion of Soil									
Benzo(a)Pyrene	1.71E-07	No	7.30E+00	B2		food/gavage, etc./IRIS	1.25E-06		
Benzo(b)Fluoranthene	2.23E-07	No	7.30E-01	B2		/IRIS	1.63E-07		
Benzo(k)Fluoranthene	1.71E-07	No	7.30E-02	B2		/IRIS	1.25E-08		
bis(2-Ethylhexyl)Phthalate	6.65E-07	No	1.40E-02	B2		food/IRIS	9.31E-09		
Chloroform	2.85E-09	No	6.10E-03	B2		gavage/IRIS	1.74E-11		
Chrysene	1.85E-07	No	7.30E-03	B2		/IRIS	1.35E-09		
Hexachlorobenzene	3.09E-08	No	1.60E+00	B2		/IRIS	4.94E-08		
Indeno(1,2,3-cd)Pyrene	1.47E-07	No	7.3E-1	B2		/IRIS	1.07E-07		
Methylene Chloride	3.91E-09	No	7.50E-03	B2		water/IRIS	2.93E-11		
Trichloroethene	1.35E-07	No	1.10E-02			/ECAO	1.48E-09		
Total Pathway Risks								9.67E-06	
Lifetime Exposure Pathway: Inhalation of Fugitive Dust									
Arsenic	1.55E-16	No	5.00E+01	A	lung; skin	inhalation; water/IRIS	7.73E-15		
Cadmium	6.75E-16	No	6.10E+00	B1		inhalation/IRIS	4.12E-15		
Chloroform	9.70E-20	No	8.10E-02	B2		gavage/IRIS	7.85E-21		
Chromium	4.67E-15	No	4.10E+01	A	lung	epidemiology/IRIS	1.92E-13		
Hexachlorobenzene	1.05E-18	No	1.60E+00	B2		/IRIS	1.68E-18		
Trichloroethene	4.58E-18	No	6.00E-03			/ECAO	2.75E-20		
Total Pathway Risks								2.03E-13	
Lifetime Exposure Pathway: Dermal Absorption fromSoil									
Chloroform	2.20E-09	Yes	6.10E-03	B2		gavage/IRIS	1.34E-11		
Hexachlorobenzene	3.18E-07	Yes	1.60E+00	B2		/IRIS	5.09E-07		
Methylene Chloride	4.03E-08	Yes	7.50E-03	B2		water/IRIS	3.02E-10		
Trichloroethene	1.04E-07	Yes	1.10E-02			/ECAO	1.14E-09		
Total Pathway Risks								5.10E-07	
Lifetime Exposure Pathway: Incidental Ingestion of Surface Water while Wading									
Dichloroethene, 1,1-	1.44E-08	No	6.00E-01	C		inhalation/IRIS	8.66E-09		
Trichloroethene	1.31E-07	No	1.10E-02			/ECAO	1.45E-09		
Vinyl Chloride	3.89E-07	No	1.90E+00	A	lung; liver	food/HEAST	7.39E-07		
Total Pathway Risks								7.49E-07	
Lifetime Exposure Pathway: Dermal Absorption from Surface Water while Wading									
Dichloroethene, 1,1-	1.65E-08	Yes	6.00E-01	C		inhalation/IRIS	9.89E-09		
Trichloroethene	1.50E-07	Yes	1.10E-02			/ECAO	1.65E-09		
Vinyl Chloride	2.03E-07	Yes	1.90E+00	A	lung; liver	food/HEAST	3.85E-07		
Total Pathway Risks								3.96E-07	
Lifetime Exposure Pathway: Incidental Ingestion of Sediments while Wading									
Arsenic	8.18E-08	No	1.75E+00	A	lung/skin	water; inhalation/IRIS	1.43E-07		
Benzo(a)Anthracene	7.64E-09	No	7.30E-01	B2		/IRIS	5.57E-09		
Benzo(a)Pyrene	6.55E-09	No	7.30E+00	B2		food/gavage, etc./IRIS	4.78E-08		
Benzo(b)Fluoranthene	7.64E-09	No	7.30E-01	B2		/IRIS	5.57E-09		
Benzo(k)Fluoranthene	4.58E-09	No	7.30E-02	B2		/IRIS	3.34E-10		
Chrysene	7.09E-09	No	7.30E-03	B2		/IRIS	5.18E-11		
Indeno(1,2,3-cd)Pyrene	2.40E-09	No	7.30E-01	B2		/IRIS	1.75E-09		
Trichloroethene	1.09E-10	No	1.10E-02			/ECAO	1.20E-12		
Total Pathway Risks								2.04E-07	
Lifetime Exposure Pathway: Dermal Absorption from Sediments while Wading									
Trichloroethene	7.51E-11	Yes	1.10E-02			/ECAO	8.26E-13		
Total Pathway Risks								8.26E-13	
Total Exposure Risks									3.89E-02

TABLE 1

SUMMARY OF COSTS FOR REMEDIAL ALTERNATIVES
FORMER RALSTON DISPOSAL SITE- CEDAR RAPIDS, IOWA

Alternative No.	Description	Capital Cost	O&M Cost	PNW Cost
1	No Action	$ 0	$ 0	$ 0
2	Natural Attenuation with Institutional Controls, Monitoring, and Maintenance of the Cap and Creek Bank Stabilization	$ 0	$ 32,780	$ 566,800
3	Natural Attenuation with Institutional Controls, Monitoring, and Maintenance of the Cap and Creek Bank Stabilization, Devonian Groundwater Extraction and Treatment	$ 96,140	$352,500	$6,192,000
4	Natural Attenuation with Institutional Controls, Monitoring, and Maintenance of the Cap and Creek Bank Stabilization, Devonian and Silurian Groundwater Extraction and Treatment	$223,600	$407,700	$7,274,000
5	Natural Attenuation with Institutional Controls, Monitoring, and Maintenance of the Cap and Creek Bank Stabilization, Devonian and Silurian Groundwater Extraction and Treatment Over Entire Area of VOC Plume	$801,300	$492,800	$9,324,000

O&M = Operation and Maintenance
PNW = Present Net Worth

TABLE 2

ALTERNATIVE 2
OPERATION AND MAINTENANCE COSTS
FORMER RALSTON DISPOSAL SITE- CEDAR RAPIDS, IOWA

Item	Quantity	Unit	Unit Cost	Extended Cost
A. Monitoring				
1. Sampling and Analysis	1	Lump Sum	$ 15,000	$ 15,000
2. Replace Pumps (estimate 1/year)	1	Lump Sum	$ 1,500	$ 1,500
B. Cap Maintenance				
1. Routine Maintenance	1	Lump Sum	$ 2,500	$ 2,500
2. Repair Fence, Gate, Etc.	1	Lump Sum	$ 1,500	$ 1,500
3. Erosion Repair, Reseeding	1	Lump Sum	$ 3,000	$ 3,000
C. Reporting	1	Lump Sum	$ 5,000	$ 5,000
			Subtotal	$ 28,500
			15% Contingency	$ 4,275
			TOTAL	$ 32,780

Notes:

Lump Sum costs for one year.

Total extended cost rounded to four significant digits.

TABLE 3

ALTERNATIVE 2
PRESENT NET WORTH COSTS
FORMER RALSTON DISPOSAL SITE- CEDAR RAPIDS, IOWA

Year	Capital Cost	O&M Costs	Total	P/W Factor	Present Net Worth
0	$0	$ 0	$ 0	1	$ 0
1	$0	$ 32,775	$ 32,775	0.9615	$ 31,513
2	$0	$ 32,775	$ 32,775	0.9245	$ 30,300
3	$0	$ 32,775	$ 32,775	0.889	$ 29,137
4	$0	$ 32,775	$ 32,775	0.8548	$ 28,016
5	$0	$ 32,775	$ 32,775	0.8219	$ 26,938
6	$0	$ 32,775	$ 32,775	0.793	$ 25,991
7	$0	$ 32,775	$ 32,775	0.76	$ 24,909
8	$0	$ 32,775	$ 32,775	0.7307	$ 23,949
9	$0	$ 32,775	$ 32,775	0.7026	$ 23,028
10	$0	$ 32,775	$ 32,775	0.6756	$ 22,143
11	$0	$ 32,775	$ 32,775	0.6496	$ 21,291
12	$0	$ 32,775	$ 32,775	0.6246	$ 20,471
13	$0	$ 32,775	$ 32,775	0.6006	$ 19,685
14	$0	$ 32,775	$ 32,775	0.5774	$ 18,924
15	$0	$ 32,775	$ 32,775	0.5553	$ 18,200
16	$0	$ 32,775	$ 32,775	0.5339	$ 17,499
17	$0	$ 32,775	$ 32,775	0.5133	$ 16,823
18	$0	$ 32,775	$ 32,775	0.4936	$ 16,178
19	$0	$ 32,775	$ 32,775	0.4746	$ 15,555
20	$0	$ 32,775	$ 32,775	0.4564	$ 14,959
21	$0	$ 32,775	$ 32,775	0.4388	$ 14,382
22	$0	$ 32,775	$ 32,775	0.422	$ 13,831
23	$0	$ 32,775	$ 32,775	0.4057	$ 13,297
24	$0	$ 32,775	$ 32,775	0.3901	$ 12.786
25	$0	$ 32,775	$ 32,775	0.3751	$ 12,294
26	$0	$ 32,775	$ 32,775	0.3607	$ 11,822
27	$0	$ 32,775	$ 32,775	0.3468	$ 11,366
28	$0	$ 32,775	$ 32,775	0.3335	$ 10,930
29	$0	$ 32,775	$ 32,775	0.3206	$ 10,508
30	$0	$ 32,775	$ 32,775	0.3083	$ 10,105
				TOTAL	$566,800

Note: Total extended cost rounded to four significant digits.

P/W = Present Worth
O&M = Operation and Maintenance

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