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OGDEN, UT
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FINAL RECORD OF DECISION AND RESPONSIVENESS SUMMARY FOR OPERABLE UNIT 4
DEFENSE DISTRIBUTION DEPOT OGDEN, UTAH

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Defense Distribution Depot
Ogden, Utah
Operable Unit 4

Declaration for the Record of Decision

DDOU OPERABLE UNIT 4

DECLARATION
FOR THE
RECORD OF DECISION

Site Name and Location

Defense Distribution Depot Ogden, Utah
Ogden, Weber County, Utah
Operable Unit 4 - Burial Sites 4-A through 4-E

Statement of Basis and Purpose

This decision document presents the remedial action for Defense Distribution Depot Ogden, Utah (DDOU) Operable Unit 4 (OU 4), selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for DDOU OU 4.

The State of Utah Department of Environmental Quality (UDEQ) and the US Environmental Protection Agency (EPA) concur on the selected remedy presented in this Record of Decision (ROD).

Assessment of the Site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

Operable Unit 4 consists of five burial areas in the northern portion of DDOU. The remedy for OU 4 addresses the principal threats posed by contaminated soil in these burial areas, and ground-water contamination underlying these areas. The remedy will remove these principal threats by excavating and disposing of the contaminated soil and removing the ground- water contaminants through treatment. The water purification tablet bottles encountered in Burial Site 4-D, while not a source of ground-water or soil contamination, could be a health risk to future residents. This area will also be excavated to remove this potential threat.

The selected remedy for DDOU OU 4 will remove these principal threats by the following actions:

- Excavate and transport approximately 4,500 cubic yards of contaminated soil and debris off site for disposal in a RCRA permitted hazardous waste landfill.
- Excavate and transport approximately 400 cubic yards of water purification tablets off site for disposal in a RCRA permitted industrial landfill.
- Extract contaminated ground water, treat by air stripping and carbon adsorption, and reinject into the shallow aquifer.

Ground-water monitoring will be conducted to ensure the effectiveness of the ground-water treatment alternative.

This alternative will control potential future exposures and risks associated with contaminated shallow ground water such that the site will not require any long-term management.

Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. Because treatment of soils was not found to be practicable, the disposal of soils off site does not satisfy the statutory preference for treatment as a principal element. This remedy utilizes permanent solutions and treatment technologies to the maximum extent practicable for ground-water remediation and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. In order to ensure that groundwater treatment continues to provide adequate protection of human health and the environment, a review will be conducted by DDOU within five years after commencement of the remedial action.

Defense Distribution Depot
Ogden, Utah
Operable Unit 4

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DECISION SUMMARY FOR THE RECORD OF DECISION

1.0 SITE NAME, LOCATION, AND DESCRIPTION

Defense Distribution Depot Ogden, Utah (DDOU) is located at 1200 South Street and 500 West in the northwest part of the City of Ogden, Weber County, Utah as depicted in Figure 1. The DDOU facility has been a key installation in the Department of Defense (DOD) supply system since September 15, 1941.

Situated in a semi-rural setting with the small communities of Harrisville (population 2,500) 1.5 miles to the north, Farr West (population 1,750) 3 miles to the northwest, numerous small ranches and a few small businesses located to the west, east, and south, DDOU covers approximately 1,100 acres within the Great Salt Valley. A residential area is located approximately one-quarter mile west of Operable Unit 4 (OU 4), and the Walquist Junior High School is located approximately one-half mile west of OU 4. Mill and Four Mile Creeks drain the topographically flat area of the Installation and flow from east to west.

The Depot is underlain by unconsolidated lacustrine and alluvial deposits of Quaternary and Recent age. An unused shallow water table aquifer, ranging in thickness from approximately 15 to 25 feet, underlies OU 4 in the northern portion of the Depot (Figure 1). The shallow aquifer is classified by the State of Utah as a Class II Aquifer, a potential future source of drinking water. Ground-water flow in the shallow aquifer underlying OU 4 is toward the southwest. A deeper, confined aquifer has been encountered at a depth of approximately 110 to 125 feet below the ground surface at OU 4. Where encountered, this aquifer exhibits artesian conditions with water levels in the wells rising above the ground surface. Regional studies indicate that there may be some hydraulic connection between the shallow and deep aquifers. The strong upward gradient which currently exists could potentially change in the future as a result of excessive pumping of ground water from the deeper aquifers.

In the past, both liquid and solid materials have been disposed of at DDOU. Oily liquid materials and combustible solvents were burned in pits, and solid materials were buried, burned, or taken off site for disposal. Several waste disposal areas have been identified on property currently or formerly controlled by DDOU. These areas have been divided into four operable units. This ROD addresses Operable Unit 4.

Operable Unit 4 is composed of Burial Sites 4-A through 4-E. Analysis of soil samples revealed that the soil in Burial Site 4-E is the primary source of ground-water contamination. Burial Site 4-A is considered a potential secondary source. Investigations in the other burial sites did not reveal any evidence that the materials disposed of at those locations are contaminating the shallow ground water or the soil. In general, the following materials or chemicals which are or may be harmful to humans and animals have been found in Burial Site 4-E soils: volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), hydrocarbons, dioxins, and furans. The same groups of contaminants have also been found in soils sampled from Burial Site 4-A. However, fewer compounds within each group were detected in the Burial Site 4-A soil samples, and their concentrations were generally lower.

Ground-water monitoring results indicate the presence of a VOC contaminant plume that originates from the vicinity of Burial Site 4-E. The most commonly detected compounds within this plume are vinyl chloride (VCL) and cis-1,2-dichloroethene (cis-1,2-DCE). These compounds are chemical degradation products of solvents known to have been disposed of in Burial Site 4-E. Of the compounds detected in ground water beneath OU 4, vinyl chloride, cis-1,2-dichloroethene, trichloroethene (TCE), benzene, and PCBs exceed their respective maximum contaminant level (MCL). The MCL for vinyl chloride is 2 micrograms per liter (µg/L), while that of cis-1,2-DCE is 70 µg/L. The MCLs for TCE, benzene, and PCBs are 5 µg/L, µg/L, and 0.5 µg/L, respectively.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 HISTORY

Burial Site 4-A. Burial Site 4-A is enclosed by a 320-foot by 220foot airfield mat fence and lies near the northern boundary of the Depot (Figure 1). Analysis of aerial photographs reveal that activity in Burial Site 4-A began during the 1950s and continued through 1975. Within this area were two east west trending burning pits that measured approximately 250 feet long, 20 to 30 feet wide, and 10 feet deep. A records search indicates that solid materials including wood, crating materials, paper, medical waste, and other debris were burned in open trenches that were excavated to the water table. Approximately 14,000 pounds of material was disposed of in Burial Site 4-A each month. In addition, used oils from the motor vehicle maintenance area and greases collected from degreasing operations were disposed of in Burial Site 4-A. Approximately 40 gallons of waste oils per day were collected in drums and disposed of in this way.

Burial Site 4-B. Fluorescent tubes were reportedly buried in Burial Site 4-B. Although site investigation activities have not confirmed the presence of fluorescent tubes in Burial Site 4-B, debris similar to that encountered in Burial Site 4-E have been observed. This indicates that the disposal activities at Burial Site 4-B were either disturbed by the oil holding/burning pit (Burial Site 4-E), or were conducted in the same pit. Because fluorescent tube debris has not been observed in this area, Burial Site 4-B has been included as part of Burial Site 4-E for cleanup purposes.

Burial Site 4-C. Burial Site 4-C, which lies approximately 50 feet south of Burial Site 4-A (Figure 1), was operated as a sanitary landfill from 1969 to 1972. Depot records indicate that cans of jelly and jam and other sanitary waste were buried in four east-west trending trenches measuring approximately 80 feet in length and 30 feet in width. However, inspection of an aerial photograph taken in 1971 indicates that these trenches may have been as long as 200 to 250 feet. Site investigations confirmed the presence of large numbers of jam and jelly cans in this disposal area.

Burial Site 4-D. Burial Site 4-D is a rectangular area, measuring approximately 50 feet by 40 feet. Although methyl bromide cylinders were reportedly disposed of in Burial Site 4-D, only large quantities of halazone water purification tablets contained in bottles were encountered during the site investigation activities. This does not preclude the presence of methyl bromide cylinders in this location. Activity in Burial Site 4-D is believed to have begun during the mid-1940s and continued through the mid-1960s.

Burial Site 4-E. Burial Site 4-E was used as an oil holding/burning pit for waste oils and spent solvents produced from various processes on the Depot from the mid-1950s to the mid-1960s. Aerial photographs indicate a trench of similar dimensions to those in Burial Site 4-A at this location. A records search indicates that prior to the current disposal practices employed at DDOU, which were started in the mid-1960s, refuse, waste oils, combustible solvents, and industrial wastes were disposed of several times a year in the oil holding/burning pit located at Burial Site 4-E. Solvents known to have been used at DDOU include safety solvent FO-128 (containing methylene chloride, tetrachloroethene, petroleum hydrocarbons), trichloroethene (TCE), 1,1,1-trichloroethane (1,1,1-TCA), ethyl acetate, toluene, naphthalene, and turpentine. Stoddard solvent, a mixture of C_7 through C_{12} hydrocarbons, was also used extensively at the Depot. No records of the volumes of these materials disposed of in Burial Site 4-E are available. The wastes were set on fire to provide training for the DDOU fire department as well as to dispose of the wastes.

2.2 SCOPE AND ROLE OF OPERABLE UNIT 4

Defense Distribution Depot Ogden, Utah, with concurrence from the State of Utah DEQ and EPA, has elected to divide the contaminated areas of DDOU into four operable units which have common disposal activities or types of contamination. The remedial actions planned at these four operable units are, to the extent practicable, independent of one another. Remedies have already been selected for OU 1 and OU 2. The ROD for OU 1 is under review, while the remedy for OU 2 is being implemented. The ROD for OU 3 is being prepared. With respect to OU 4, the role of the remedial action to be undertaken is to reduce the principal threat posed by contaminated soil and shallow ground water that may occur as a result of future exposure of residents or on-Depot workers. The remedy for OU 4 is the third final response action for this NPL site.

2.3 ENFORCEMENT HISTORY

A records search in 1979 by the US Army Toxic and Hazardous Materials Agency identified four locations where hazardous materials might have been used, stored, treated, or disposed of. DDOU was proposed for inclusion on the National Priorities List (NPL) in 1984 and the decision was finalized in July of 1987. As a result, the Defense Logistics Agency (DLA) conducted a study to determine the location of any past disposal sites and the potential for ground-water contamination resulting from those sites. On June 30, 1986, DDOU entered into a Memorandum of Agreement with the State of Utah Department of Health (UDOH) and the EPA to undertake a remedial investigation/feasibility study

(RI/FS) under the Installation Restoration Program. In November of 1989, DDOU entered into a Federal Facilities Agreement (FFA) between DDOU, EPA, and UDOH. The purpose of the agreement was to establish a procedural framework and schedule for developing, implementing, and monitoring appropriate response actions at DDOU in accordance with existing regulations. The FFA requires the submittal of several primary and secondary documents for each of the four operable units at DDOU. This ROD concludes all of the RI/FS requirements for OU 4 defined under the FFA. In accordance with the FFA, remedial design documents will be prepared using the selected remedy presented in this document.

2.4 INVESTIGATION HISTORY

In 1981, ten shallow monitoring wells were installed at DDOU, including four wells in the vicinity of OU 4. Analysis of the ground water sampled from these wells indicated the presence of VOCs. In 1985 and 1986, an investigation and evaluation of the hydrogeology and delineation of hazardous waste disposal areas of the various DDOU sites was conducted. Six additional monitoring wells and one soil boring were installed in the vicinity of OU 4. Analysis of the ground water sampled from both sets of wells indicated the presence of VOCs in some samples. VOCs are relatively mobile in ground water when compared to semi-volatiles and long chain organic hydrocarbons. Samples of surface water and sediment were taken from Four Mile Creek during the spring of 1985 to determine surface water and sediment quality in the vicinity of OU 4. A second set of samples was taken in January of 1990. Analyses for both sets of samples did not detect any contaminant that could be attributed to disposal activities at OU 4.

During the summer and fall of 1988, site characterization activities included a soil-gas investigation, drilling and sampling of shallow and deep soil borings, installation of shallow ground-water monitoring wells, and sampling and analysis of all monitoring wells installed at DDOU. Site characterization included a water well survey and development of a list of potential human, plant, and animal receptors which was used in the preparation of an endangerment assessment. In general, results indicated the presence of VOCs in the soil gas and ground water underlying the site.

Further site characterization activities conducted during November and December of 1989 and January of 1990 included excavation and sampling of test pits, drilling and sampling of additional shallow soil borings, installation and sampling of several shallow ground-water monitoring wells, surface soil sampling and analysis, and installation and sampling of deep ground-water monitoring wells. Results of the site characterization activities confirmed the presence of VOCs in the shallow ground water underlying OU 4 as far as 2,000 feet downgradient of the burial areas. No contamination was detected in samples from the deep ground-water monitoring wells.

Additional site characterization activities were conducted in July and August of 1990, with the installation of more shallow ground-water monitoring wells and soil borings. PCBs, dioxins, and furans were detected in soil samples from Burial Sites 4-A and 4-E. These compounds are relatively immobile and generally adsorb strongly to soil particles. Volatile organic compounds, PCBs, dioxins, and furans were detected in shallow ground-water samples. An air monitoring survey was conducted in the closest downwind building to OU 4. No contaminants were detected in air samples that could be attributed to contaminants detected in the ground water at OU 4.

Site characterization activities conducted in April of 1991 included installation and sampling of shallow monitoring wells, soil borings, and sampling of selected shallow monitoring wells in the vicinity of OU 4. Volatile organic compounds, petroleum hydrocarbons, dioxins, and furans were detected in the soil samples. The results of this investigation confirmed the presence, extent, and source of ground-water contamination at OU 4.

2.5 COMMUNITY RELATIONS HISTORY

The RI/FS Report and the Proposed Plan for OU 4 were released to the public on September 27, 1991 and December 6, 1991, respectively. These documents were made available to the public in both the Administrative Record and an information repository maintained at the Weber County Library. The notice of availability for these two documents was published in the Salt Lake Tribune, the Deseret News, and the Ogden Standard Examiner on December 6, 7, and 8, 1991.

A public comment period (December 6, 1991 through January 6, 1992) and a public meeting held on December 17, 1991 provided the public with opportunities to comment on the Proposed Plan. At the public meeting, representatives from DDOU, EPA, and the State of Utah answered questions. A court reporter prepared a transcript of the meeting, a copy of which has been placed in the Administrative Record along with all written comments received during the comment period. In addition, copies of the transcript were sent to all of the meeting attendees who requested one. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD. This decision document presents the selected remedial action for OU 4, chosen in accordance with CERCLA, as amended by SARA and, to the extent practicable, the NCP. The decision on the selected remedy for this site is based on the Administrative Record.

3.0 SITE CHARACTERIZATION

3.1 NATURE AND EXTENT OF CONTAMINATION

This section presents a concise and comprehensive summary of analytical data gathered during the investigation of OU 4.

3.1.1. Nature and Extent of Soil Contamination

Burial Site 4-A. Results of soil sample analyses indicate that a wide variety of contaminants are present in the soil and debris within the burn pits at Burial Site 4-A. Contaminants detected include VOCs, SVOCs, PCBs, pesticides, hydrocarbons, metals, dioxins, and furans. The only VOCs detected were trans-1,2-DCE at concentrations of up to 0.04 milligrams per kilogram (mg/kg). Semi-volatile organic compounds detected included naphthalene, phenanthrene, 2-methylphenol, 4-methylphenol, and benzoic acid were detected at concentrations in the range of 0.4 to 2.2 mg/kg. The pesticides dichlorodiphenyl-dichloroethane (DDD), dichlorodiphenyl dichloroethene (DDE), and dichlorodiphenyl-trichloroethane (DDT) were detected in samples from Burial Site 4-A (0.02 to 0.3 mg/kg) as well as in soils where there was no evidence of disturbance or buried materials in the vicinity of this burial area. PCBs were also detected at concentrations up to 2.9 mg/kg.

Elevated levels of some metals were also detected in Burial Site 4A soils. Arsenic, barium, cadmium, chromium, lead, mercury, silver, and zinc exceeded background concentrations established for the DDOU area. Zinc was detected at the highest concentration (2,600 mg/kg). Analyses of the extract from the Extraction Procedure (EP) Toxicity test detected only barium but at concentrations less than the EP Toxicity limit of 100 milligrams per liter (mg/L).

Oil and grease were detected in soil samples at concentrations ranging from 140 to 530 mg/kg. Dioxin and furan isomers were detected at concentrations reported in picograms per gram (pg/g) or parts per trillion. The source of dioxins and furans in the test pits is most likely a result of combustion of wood and paper products, plastics, and plastic insulation on electrical wiring disposed of at Burial Site 4-A.

Toxicity Characteristics Leaching Procedure (TCLP) analyses indicate that the soil and debris in Burial Site 4-A do not exhibit the Resource Conservation and Recovery Act (RCRA) toxicity characteristics, and do not exceed F001-F005 listed waste treatment standards. The volume of contaminated soil in Burial Site 4-A is estimated at 3,000 cubic yards based on the known dimensions of the burial site and depth of contamination.

Burial Site 4-C. The material encountered in Burial Site 4-C is consistent with the reported use of Burial Site 4-C as a sanitary landfill. The VOCs cis-1,2-DCE and 1,1-DCE were detected in soil samples at concentrations less than 0.01 mg/kg. The only SVOC detected was di-n-butylphthalate. The pesticides DDE and DDT were detected at concentrations similar to background levels. Barium, cadmium, lead, mercury, silver, and zinc were detected at concentrations above background levels. Zinc was detected at the highest concentration (350 mg/kg). Analyses of the extract from the EP Toxicity test detected only barium but at concentrations below the EP Toxicity limit for barium.

On the basis of the interpretation of the soil and ground-water analytical data obtained during the site investigations, the soils in this area were not considered to be a source of the ground-water contamination observed at OU 4. Burial Site 4-D. Test pit excavations at this site revealed large quantities of water purification tablet bottles located approximately 4 to 6 feet below the ground surface. No VOCs, BNAEs, PCBs, or pesticides were detected. No methyl bromide cylinders were observed, despite the reported disposal of these items in Burial Site 4-D. Only arsenic exceeded its background concentration. EP toxicity analyses detected only barium but at concentrations well below its EP Toxicity limit.

On the basis of this information, Burial Site 4-D was not considered a potential source of contaminants found in the ground water beneath OU 4. The volume of material containing water purification tablets is unknown at this time. However, based on the area of Burial Site 4-D and assuming the bottles are in a two foot thick layer, the volume of material could be approximately 400 cubic yards.

Burial Site 4-E. Oil-covered sands and silts were encountered from 6 to 8 feet and elevated organic vapor readings were measured in this material. Contaminants detected in the soil and debris in Burial Site 4-E include benzene, ethylbenzene, tetrachloroethene, cis-1,2-DCE, toluene, trichloroethene (TCE), m,p-xylene, and o-xylene at concentrations up to 82 mg/kg. The SVOCs naphthalene, 2-methylnaphthalene, phenanthrene, and 1,2,4trichlorobenzene were also detected at concentrations in the mg/kg range. The pesticides DDD and DDE were detected at concentrations similar to those in background samples. The PCB Arochlor 1260 was also detected at concentrations up to 15 mg/kg.

Background concentrations were exceeded for some metals, namely cadmium, lead, mercury, nickel, and zinc. Lead was detected at the highest concentration (1,400 mg/kg). Beryllium was also analyzed because of its association with the fluorescent tubes suspected of being disposed of in Burial Site 4B. Although beryllium was detected in two samples, it was also detected at similar levels in background soil samples. EP Toxicity analyses detected only barium but at concentrations less than the EP Toxicity limit.

Petroleum hydrocarbons were analyzed to investigate the observed hydrocarbon staining of soils. Hydrocarbons were detected at concentrations of up to 43,000 mg/kg.

Dioxin and furan isomers were detected at concentrations in the picogram per gram (pg/g) or part per trillion range in Burial Site 4-E samples. These compounds probably originated as residue from burned debris and chlorinated organics in the burn pit. In terms of an equivalent concentration of 2, 3, 7, 8 tetrachlorodibenzo-p-dioxin (TCDD), all the dioxin and furan isomers detected in the most contaminated sample produced a concentration of 0.067 ug/kg using the EPA 1987 total equivalency factors.

Some samples from Burial Site 4-E were analyzed for TCLP toxicity and F001- F005 listed waste TCLP extract contaminants. Only ethylbenzene (0.14 mg/L) and xylene (0.47 mg/L) were detected at concentrations in excess of the TCLP extract limit for this constituent for F001-F005 listed wastes. Dioxins and furans were also analyzed in the TCLP extract but were not detected. The volume of contaminated soil in Burial Site 4-E is estimated at 1,500 cubic yards based on the known dimensions of the burial site and depth of contamination.

3.1.2 Nature and Extent of Ground-Water Contamination.

No contaminants were detected in ground-water sampled from monitoring wells installed in the deep aquifer. A zone of elevated vinyl chloride and cis- 1,2-DCE concentrations appears to be centered around Burial Sites 4-A and 4- E, the major sources of contaminants in shallow ground water at OU 4. No evidence of a dense non-aqueous phase liquid (DNAPL) was detected in the shallow aquifer beneath OU 4. The nature and extent of contaminants detected in ground water is discussed below.

Volatile Organic Compounds. The most widespread contaminants detected in the shallow ground water at OU 4 are the VOCs vinyl chloride and cis-1,2- dichloroethene. Both compounds were detected at concentrations in excess of their respective MCL (2 ug/L for vinyl chloride and 70 ug/L for cis-1,2- DCE). The total areal extent of the zone of ground water containing vinyl chloride at concentrations above 2 ug/L is depicted in Figure 2 and is estimated to be 50 acres. The total volume of ground water within this area is estimated to be approximately 65 million gallons based on the assumption that the entire saturated thickness of the aquifer is contaminated within the defined area. The volume of ground water contaminated by cis-1,2-DCE in excess of its MCL is depicted in Figure 3 and is contained within the vinyl chloride plume.

Trichloroethene concentrations exceeded the MCL of 5 ug/L in only one sample (17 ug/L) and benzene was detected in two samples at a concentration exceeding its MCL of 5 ug/L (up to 30 ug/L). Other VOCs detected in shallow ground water at OU 4 include ethylbenzene (150 ug/L), toluene (34 ug/L), trans-1,2dichloroethene (0.7 ug/L), 1,2-dichlorobenzene (up to 36 ug/L), 1,4dichlorobenzene (up to 31 ug/L), 1,1-dichloroethane (0.8 ug/L), and o- xylene (150 ug/L). All these contaminants were detected within the vinyl chloride plume described above.

Semi-Volatile Organic Compounds. Although several SVOCs were detected in shallow ground water at OU 4, none of the contaminants exceed their respective MCLs. Compounds detected include 1,2-dichlorobenzene (up to 30 ug/L), 1,3-dichlorobenzene (up to 28 ug/L), and 1,4-dichlorobenzene (up to 26 ug/L). Naphthalene (up to 92 ug/L), phenanthrene (up to 36 ug/L), 1,2,4trichlorobenzene (up to 26 ug/L), and 2-methylnaphthalene (up to 150 ug/L) were also detected. Pentachlorophenol (40 ug/L), 2-methylphenol (up to 97 ug/L), 4methylphenol (up to 77 ug/L), 2-4 dimethylphenol (15 ug/L), and dibenzofuran (12 ug/L) were also detected.

PCBs. Polychlorinated biphenyls were detected at levels above the MCL of 0.5 ug/L in ground water. The concentrations detected (up to 130 ug/L) are greater than the solubility limit for PCBs, estimated to be 0.4 ug/L to 3.0 ug/L for PCB Arochlor 1260. This suggests that the PCBs may actually be adsorbed on the particulates contained in the ground-water samples, rather than dissolved in the ground water. This conclusion is supported by the lack of PCBs in low turbidity samples collected during a subsequent sampling round.

Dissolved Metals. Dissolved metals detected in the shallow ground water underlying OU 4 include arsenic, barium, lead, and zinc, but the only metal to exceed its MCL of 0.01 mg/L was cadmium (0.029 mg/L) and only in one sample.

Hydrocarbons. Petroleum hydrocarbons were detected in ground water at concentrations of up 43,000 ug/L near Burial Site 4-E.

Dioxins and Furans. Dioxins and furans were detected in sediment laden ground-water samples at concentrations of up to 0.000085 ug/L equivalent concentration of TCDD. The detection of dioxins and furans in ground-water samples has been attributed to adsorption of the dioxins and furans to silt particles in the shallow aquifer that were entrained in the turbid samples.

3.2 PUBLIC HEALTH AND ENVIRONMENTAL IMPACTS

A baseline risk assessment was conducted for OU 4 following completion of the site characterization activities. The purpose of the assessment was to determine the most significant contaminants present at OU 4, the different ways by which people, plants, and animals would potentially come into contact with the contaminants, and the probability of any harmful effects occurring as a result of that contact. Based on the results of the baseline risk assessment, the media of concern for OU 4 were determined to be the ground water underlying OU 4 and the soil and debris within Burial Sites 4-A and 4-E. Surface water was not considered a medium of concern for OU 4. The most recent round of sampling analytical results indicated that there is not a significant difference between upstream and downstream contaminant concentrations in surface water and sediments. The upstream sampling point was outside the Depot.

3.2.1 Contaminant Identification

The initial step of the risk assessment was the selection of contaminants of concern. Contaminants of concern were selected for each potential route of exposure and according to their potential for causing carcinogenic and non- carcinogenic health effects. The contaminants of concern were selected on the basis of an index calculated as the product of their maximum measured concentrations in the medium of concern and their toxicity. Toxicity was measured by the slope factor and the reciprocal of the reference dose for carcinogenic and noncarcinogenic health effects, respectively. Also included as a criterion was the frequency of detection. The contaminants of concern in soil for OU 4 are PCB Arochlor 1260, naphthalene, benzene, cis-1,2dichloroethene, tetrachloroethene, trichloroethene, arsenic, barium, cadmium chromium, lead, mercury, zinc, and TCDD. The contaminants of concern for shallow ground water are vinyl chloride, benzene, cis-1,2-DCE, PCB Arochlor 1260, TCDD, and arsenic.

3.2.2 Exposure Assessment

There are no current exposure pathways that are considered complete at OU 4. The only significant potential future exposures to OU 4 contaminants are for off-site and on-site residents who may use shallow ground water from a well installed in the OU 4 groundwater contaminant plume or on-site residents who may consume crops or livestock exposed to contaminated ground water through the food chain. Potentially complete future exposure scenarios for soil include exposure of construction workers to dioxins, furans, and metals during excavation activities in soil and debris from Burial Sites 4-A and 4-E. Although ingestion of soil by future residents, including children, was not quantitatively evaluated, this exposure scenario could potentially be significant.

Contaminant concentrations and chronic daily intakes have not been reported here because the remedy for OU 4 has been selected on the basis of ARARs for ground water and the prevention of future ground-water contamination for soil, rather than on the results of the risk assessment. Consequently, these details are not considered relevant to this ROD. However, the contaminants of concern, maximum concentrations, and associated risks for soil and ground water at OU 4 are presented in Appendix A.

3.2.3 Toxicity Assessment

Cancer slope factors have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. Reference doses have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects. Slope factors were available for all carcinogens except for PCB Arochlor 1260 and TCDD, which did not have inhalation slope factors for use in evaluating the risks associated with construction workers inhaling contaminated dust. No reference doses were available for lead, PCB Arochlor 1260, and TCDD. In addition, no inhalation reference doses were available for tetrachloroethene, trichloroethene, cis-1,2-dichloroethene, naphthalene, arsenic, cadmium, mercury, and zinc. Reference doses, slope factors, and their sources are not presented in this document because the selected remedy was not based on the risk assessment results.

3.2.4 Risk Characterization

Excess lifetime cancer risks (sometimes referred to as carcinogenic risks) are determined by multiplying the intake by the cancer slope factor. These risks are probabilities that are generally expressed in scientific notation (e.g., 1 x 10[-6]). An excess lifetime cancer risk of 1 x 10[-6] indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of chronic site-related exposure to carcinogens over a 70-year lifetime under the specific exposure conditions at the site. According to the NCP, the target risk level for a site is 1 x 10[6], although a value in the range of 1 x 10[-4] to 1 x 10[-6] is acceptable.

Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient. The hazard quotient is the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose. By adding the hazard quotients for all contaminants within a medium and across all media to which a given population may reasonably be exposed, a hazard index can be generated. A total hazard index greater than 1 indicates that there may be a concern for potential health effects, while a total hazard index less than 1 indicates that the concern for potential health effects is low.

The potential carcinogenic risk to future off-site residents who use the shallow ground water at the western boundary of the Depot for 30 years is on the order of 3 x 10[-3], if the center of the current plume moves close to the boundary. The total hazard index for noncarcinogenic effects to those future off-site residents under these conditions is on the order of 70. These are worst case estimates based on all contaminants detected in ground water. The calculations assume contaminant concentrations in excess of MCLs. The estimated carcinogenic risk to potential future on-site residents is on the order of 8 x 10[-3], and the total hazard index is estimated as 300. These are significant risks. The potential carcinogenic and non-carcinogenic risks to future on depot construction workers who become exposed to contaminated soils in Burial Sites 4-A and 4-E over a period of two years are 1 x 10[-5] and 0.1 respectively.

In addition to potential exposure to contaminants in the soil at OU 4, there exists a potential for future exposure to the contents of the water purification tablet bottles in Burial Site 4-D. The risk associated with this exposure was evaluated qualitatively because tablets are contained in sealed glass bottles and are not present in the soil. Because the tablets are intended to be used with drinking water, health effects would not be expected from low doses. However, the future health risk due to exposure to the contents of the water purification tablet bottles could cause illness or death in a child. For this reason, remedial alternatives developed for OU 4 included the water purification tablet bottles in Burial Site 4-D to remove this potential exposure pathway.

No current significant environmental threats appear to be associated with OU 4. The only area where ecological receptors could possibly come into contact with contaminants is through the water and sediments of Four Mile Creek. Concentrations of metals in Four Mile Creek sediments and surface water are similar in samples taken upstream and downstream of OU 4, and the contaminants associated with disposal activities at OU 4 have not been detected in surface water or sediments. It appears that contaminants present at OU 4 have not affected Four Mile Creek. Therefore, this media was not considered during development of the remedy for OU 4.

3.2.5 Uncertainties

The primary uncertainty associated with the exposure pathway of greatest concern, use of ground water by future on-site or off-site residents, is whether or not the pathway will become complete in the future. A second uncertainty is associated with the fact that all of the estimates of the total hazard index for exposure through ground water are incomplete, and therefore potentially low due to a lack of reference doses for some compounds. Additional uncertainty is related to the assumption that on-site contaminant concentrations will remain constant with time and unknowns associated with dermal uptake of some contaminants of concern. With respect to exposure to contaminated soil, there is uncertainty associated with the estimate of dust inhalation and ingestion rates, and the bioavailability of contaminants. In addition, the relative risks under the residential scenario may be greater than those calculated under the construction worker scenario. The irrigation exposure scenario considered the uptake of dioxins and furans into meat and milk but not into vegetables because biotransfer factors for uptake in vegetables could not be located.

3.2.6 Summary of Site Risks

There are no current significant risks to human health and the environment from exposure to soil or ground water at OU 4, nor are significant risks likely to develop in the future as long as the Depot remains in existence. Under future resident site use conditions, risks may exceed EPA's point of departure of 10[-6] cancer risk or total hazard index of 1. In addition, Burial Sites 4-A and 4-E are the source of the contamination detected in the shallow ground water. Consequently, actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may present an imminent and substantial danger to public health, welfare, or the environment.

4.0 ALTERNATIVES EVALUATION

As part of the DDOU OU 4 feasibility study, five soil and two ground water remedial alternatives were developed. Under Section 121 of SARA, the selected remedial action must be protective of human health and the environment, cost effective, and attain Federal and State applicable or relevant and appropriate requirements (ARARs). The selected alternative must also use permanent solutions and alternative treatment or resource recovery technologies to the maximum extent practicable. Remedies that employ treatment which permanently and significantly reduces the mobility, toxicity, or volume of hazardous substances is a statutory preference. This section summarizes how the remedy selection process for OU 4 addressed these requirements.

4.1 DEVELOPMENT OF PRELIMINARY ALTERNATIVES

The principal threats posed by OU 4 are the potential exposure of future residents or construction workers to contaminants in Burial Sites 4-A and 4- E, the water purification tablets in Burial Site 4-D, and ground water contaminated by VOCs.

Therefore, the primary concern for soil remediation is to remove, reduce or control these principal threats. Preliminary alternatives that represent the range of available remediation options for soil and ground water were developed starting with the no action alternative. Subsequent alternatives represented an increased degree of technical complexity.

The main features of the preliminary alternatives for soil were:

1. No Action - No remedial action would be taken to reduce the levels of contamination in the soil at OU 4.

2. Institutional Controls - Legal and administrative actions would be imposed to limit potential exposure under both current and future use scenarios. For example, construction or excavation within the contaminated areas would not be permitted.

3. Containment - The potential for migration of contaminants from soil to ground water would be reduced by controlling infiltration through installation of a cap over the soils and debris in Burial Sites 4-A and 4-E, and containment by a slurry cut-off wall intercepting the aquitard underlying the shallow ground-water aquifer at OU 4. A second method of achieving containment of the contaminated soil and water purification tablet bottles would be to excavate these materials and place them in an on-site Resource Conservation and Recovery Act (RCRA) hazardous waste landfill.

4. Off-Site Soil Disposal - Contaminated soil and water purification tablet bottles would be excavated and transported off site for incineration or for disposal in a RCRA permitted landfill in compliance with land disposal restrictions.

5. On-Site Soil Treatment - Contaminated soil would be excavated and treated on site using chemical or incineration technologies and then returned to the excavation if the treatment residue is suitable for this mode of disposal. If not, the residue would be removed, along with the water purification tablets, to an off-site RCRA permitted landfill.

6. In-Situ Soil Treatment - Contaminated soil would be immobilized in place using soil vitrification technology. Water purification tablets would be excavated and placed in the treatment area.

Removal of the VOCs vinyl chloride and cis-1,2-DCE is the primary concern for groundwater remediation. If contaminants including PCBs, dioxins, and furans are detected in the effluent from the treatment process at levels that present a total excess cancer risk greater than one in one million, they will be removed.

The main features of the preliminary alternatives for ground water were:

1. No Action - Ground-water monitoring would be continued (this is an element common to all alternatives), but no remedial actions would be taken to reduce the levels of contamination in the shallow ground water.

2. Institutional Controls - Legal and administrative actions would be taken, as necessary, to limit potential exposures under both the current and future use scenarios. For example, steps would be taken to block out water rights for on-Depot and off-Depot areas downgradient of OU 4 to prevent the possible future use of shallow ground water.

3. Containment - Contaminant migration potential would be reduced by controlling ground-water movement by installing upgradient subsurface barriers at the northeast end of the contaminant plume.

4. Granulated Activated Carbon (GAC) - Ground water would be pumped to a GAC treatment facility to remove VOCs, PCBs, dioxins, and furans. Treated water would be reinjected into the shallow aquifer along the plume perimeter.

5. Air Stripping/GAC - Ground water would be pumped to an air stripper to remove VOCs followed by GAC treatment, if necessary, to remove PCBs, dioxins, and furans. Treated water would be reinjected into the shallow aquifer around the plume perimeter.

6. Steam Stripping/GAC - Ground water would be pumped to a steam stripper to remove VOCs, followed by GAC treatment, if necessary, to remove PCBs, dioxins, and furans. Treated water would be reinjected into the shallow aquifer around the plume perimeter.

7. UV/Ozone - Ground water would be treated in a UV/ozone reactor. Treated water would be reinjected into the shallow aquifer around the plume perimeter.

4.2 INITIAL SCREENING OF PRELIMINARY ALTERNATIVES

Preliminary alternatives were screened using three broad criteria: effectiveness, implementability, and cost. The purpose of this screening was to reduce the number of alternatives requiring detailed analysis. Comparisons were made among those alternatives that offered similar functions or extent of remediation. Tables 1 and 2 indicate how each alternative compared with the three major criteria for soil and ground-water remediation, respectively, and which of the alternatives were selected to undergo a detailed analysis. Remediation alternatives were formulated by combining selected soil and ground-water remediation alternatives. All of the remediation alternatives share continued monitoring of ground-water quality as a common element. The remediation alternatives for OU 4 are listed below:

Alternative 1 - No Action.

Alternative 2 - Containment of Contaminated Soil and GroundWater Treatment
by Air Stripping and GAC.

Alternative 3a - Off-Site Soil Disposal and Ground-Water Treatment by Air Stripping and GAC.

Alternative 3b - Off-Site Soil Incineration and Ground-Water Treatment by Air
Stripping and GAC.

Alternative 4a - On-Site Soil Treatment by Dechlorination and Ground-Water Treatment by Air Stripping and GAC.

Alternative 4b - On-Site Soil Treatment by Incineration and Ground-Water Treatment by Air Stripping and GAC.

Alternative 5 - Containment of Contaminated Soil and GroundWater Treatment
by UV/Ozone.

Alternative 6a - Off-Site Soil Disposal and Ground-Water Treatment by UV/Ozone.

Alternative 6b - Off-Site Soil Incineration and Ground-Water Treatment by UV/Ozone.

Alternative 7a - On-Site Soil Treatment by Dechlorination and Ground-Water Treatment by UV/Ozone.

Alternative 7b - On-Site Soil Treatment by Incineration and Ground-Water Treatment by UV/Ozone.

4.3 DESCRIPTION OF ALTERNATIVES

4.3.1. Alternative 1 - No Action

The only activity that would occur under the no action alternative is monitoring of groundwater quality. Annual ground-water samples would be collected from 10 wells at OU 4 and analyzed for VOCs, PCBs, and total hydrocarbons for a period of at least 20 years. Samples from three of the 10 wells would also be analyzed for dioxins and furans. Alternative 1 does not reduce the principal threats to human health and the environment at OU 4. The no action alternative is not required to comply with ARARs. The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3, as are estimates of present net worth costs. Based on a 20 year monitoring period and a statutory review every five years, the present net worth of this alternative is $286,000.

4.3.2. Alternative 2 - Containment of Contaminated Soil and Ground-Water Treatment by Air Stripping and GAC

Approximately 4,500 cubic yards of contaminated soil in Burial Sites 4-A and 4-E, and water purification tablets from Burial Site 4-D, would be excavated and placed in an on-site RCRA hazardous waste landfill. Excavation would continue until soils remaining on site contain less than 25 mg/kg of PCBs as recommended by EPA Directive 9355.4-01FS, less than 1 ug/kg total equivalent 2,3,7,8, tetrachlorodibenzo-p-dioxin as recommended by the Dioxin Disposal Advisory Group, and present a health risk of less than one in ten thousand, with a target of one in one million. If methyl bromide cylinders were encountered in Burial Site 4-D, they would be removed, treated, and disposed of by a commercial operator. The excavations would be backfilled with clean fill, top soiled and revegetated. This remedial action would be completed within 15 to 24 months after the ROD is signed.

Land disposal would comply with the RCRA land disposal restrictions (40 CFR Part 268) for F001 through F005 listed wastes, the requirements of 40 CFR Part 761 for PCBs and the requirements of Utah Administrative Code (UAC) Rule 450 that are considered relevant and appropriate. During excavation of the soils, TCLP tests would be performed periodically to confirm the characteristics of the waste and compliance with land disposal restrictions. If soils fail the treatment standard for F001 through F005 listed wastes, they will be treated to achieve compliance by aeration or stabilization/fixation prior to land disposal. The RCRA listing for dioxin wastes or treatment residue would not apply to the soils in OU 4 because the dioxin and furan contamination did not originate from any of the sources listed in 40 CFR Part 261. However, it is relevant and appropriate to adopt the treatment standards for dioxin and furan listed wastes because these soils contain dioxins and furans. The soil and debris would be monitored to ensure that dioxin and furan concentrations in the TCLP extract are less than 1 ug/kg for each of the tetra, penta, and hexa-dioxin and furan isomers prior to land disposal as recommended for dioxin listed wastes in 40 CFR 268. The construction and operation of the landfill would comply with 40 CFR Part 264 and the equivalent State regulations defined in Utah Administrative Code (UAC) Rule 450. Closure and post closure would be in accordance with the requirements of 40 CFR Part 264 and the equivalent State regulation (UAC Rule 450). All activities carried out as part of the remedial action would comply with the requirements of the Occupational Safety and Health Act (29 CFR 1910) and the equivalent State regulation in UAC Rule 500.

Ground water in the Class II shallow aquifer at OU 4 would be extracted through a sufficient number of extraction wells to achieve a flow rate of up to 150 gallons per minute. The ground water would then be pumped to an air stripper to remove vinyl chloride, cis-1,2-DCE, benzene, and TCE to levels below their MCLs. If PCB concentrations in the effluent exceed the MCL for PCBs of 0.5 ug/L, or if dioxins and furans exceed the proposed MCL for dioxins and furans of 5 x 10[-5] ug/L, a GAC unit would be added for removal of these contaminants. Treated ground water would be reinjected into the aquifer around the perimeter of the contaminant plume using injection wells or infiltration galleries. The extraction and reinjection system would comply with the Federal underground injection regulations (40 CFR Parts 144-147) and the State well drilling standards of UAC Rule 625-4.

Ground-water remediation would eventually reduce the health-based risks to one in ten thousand with a target level of one in one million and achieve MCLs which are considered to be ARARs within the area of attainment defined by the 2 ug/L vinyl chloride concentration contour. The time frame required for compliance with ground-water cleanup criteria is estimated to be a minimum of five years, assuming treatment of a minimum of five pore volumes (approximately 330 million gallons) will be necessary to attain ARARs. However, the ability of the pump and treat approach to achieve very low residuals (less than 2 ug/L for vinyl chloride) in ground water may be limited, as evidenced by EPA experience with other sites where standard extraction systems are often not suitable for removing all of the contaminants present in the aquifer material.

The air stripper vapor emissions are expected to be less than the Utah ARAR for air emissions which is 1.5 tons of total VOCs per year (Utah Administrative Code Rule 446-1). In addition to the Utah regulations, air stripper emissions must also comply with the 10 parts per million vinyl chloride emission requirements of the National Emission Standards for Hazardous Air Pollutants (NESHAPS) as defined in 40 CFR Part 61. The concentrations of vinyl chloride in the air stripper emissions are expected to comply with this ARAR. However, due to interference effects of other contaminants detected in ground water near the source, no information on vinyl chloride concentrations in this area is available. If emissions exceed NESHAPS requirements as a result of higher than expected vinyl chloride concentrations near the source, a temporary GAC treatment unit or other treatment technologies would be used to control emissions to ensure vinyl chloride emissions are in compliance with this ARAR.

Wastes from the ground-water treatment process would be transported off site for incineration or land disposal depending upon how the wastes are classified under RCRA. The disposal of any spent GAC would comply with the land disposal restrictions ARAR by testing the GAC to determine whether it contains VOCs above treatment standards or other contaminants that may exhibit hazardous characteristics under TCLP. If test results indicate that spent GAC contains VOCs above treatment standards or that the spent GAC exhibits hazardous characteristics and treatment by fixation/stabilization fails to achieve compliance, the spent GAC would be incinerated off-site prior to disposal in a RCRA hazardous waste landfill. Similarly, if the GAC fails the TCLP treatment standards for dioxins it would be incinerated off-site, if a facility permitted for dioxin destruction becomes available.

The indirect, capital, and operation and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth cost of this alternative has been assessed based on both 5-year and 10-year ground-water remediation time frames. The costs have been estimated at $3.0 million and $3.9 million, respectively.

4.3.3. Alternative 3a - Off-Site Soil Disposal and Ground-Water Treatment by Air Stripping and GAC

Approximately 4,500 cubic yards of contaminated soil in Burial Sites 4-A and 4-E would be excavated and transported off-site for placement in a RCRA hazardous waste landfill. Water purification tablets from Burial Site 4-D would be transported off-site for placement in a RCRA industrial landfill because this material is neither a RCRA listed hazardous or characteristic waste. Excavation would continue until soils remaining on site contain less than 25 mg/kg of PCBs as recommended by EPA Directive 9355.4-01FS, less than 1 ug/kg total equivalent 2,3,7,8, tetrachlorodibenzo-p-dioxin as recommended by the Dioxin Disposal Advisory Group, and present a health risk of less than one in ten thousand, with a target of one in one million. If methyl bromide cylinders are encountered in Burial Site 4-D, they will be removed, treated, and disposed of by a commercial operator. The excavations would be backfilled with clean fill, topsoiled, and revegetated. This remedial action would be completed within 15 to 24 months after the ROD is signed, and would result in clean closure of the site.

Land disposal of material from Burial Sites 4-A and 4-E would comply with the RCRA land disposal restrictions (40 CFR Part 268) for F001 through F005 listed wastes, the requirements of 40 CFR Part 761 for PCBs, and the requirements of UAC Rule 450 that are considered applicable. During excavation of the soils, TCLP tests will be performed periodically to confirm the characteristics of the waste and compliance with land disposal restrictions for F001 through F005 listed wastes. If treatment is required to achieve compliance with treatment standards, this would be carried out by the receiving facility. The soil and debris would also be sampled to ensure that dioxin and furan concentrations in the TCLP extract are less than 1 ug/kg for each of the tetra, penta, and hexa-dioxin and furan isomers prior to land disposal that is required for dioxin wastes under 40 CFR Part 268. If soils fail this criteria, the failing material would be transported to a commercial incineration facility for treatment in compliance with 40 CFR Part 264, Subpart O, prior to landfill disposal. While no incineration facilities are currently permitted for destruction of material containing dioxins and furans, storage of material at the facility can be undertaken until permitting is completed. Land disposal of the water purification tablets would be in compliance with 40 CFR Part 241.

Transportation of material off site would comply with the requirements of 40 CFR Part 263, 49 CFR Parts 107, 171 through 177. Operation of the RCRA hazardous waste and industrial landfills would comply with 40 CFR Part 264 and the State equivalent regulations defined in UAC Rule 450 which are considered applicable. Land disposal of the water purification tablets from Burial Site 4D would be comply with the requirements of 40 CFR 241, Title 19: Chapter 6 of the Utah Code Annotated, and UAC Rule 450-301. The time frame for this remedial action would be in the order of a few weeks to a few months after commencement of the remedial action and would be complete within 15 to 24 months after the ROD is signed.

Ground water would be pumped to an air stripper to remove VOCs, and to a GAC unit, if necessary, for removal of PCBs, dioxins, and furans as described for Alternative 2. The implementation of this ground-water remediation alternative would eventually reduce the health-based risks to between one in ten thousand and one in one million. Compliance with ground-water and air emissions ARARs has been discussed under Alternative 2. The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth of this alternative has been estimated based on both a 5-year and 10-year ground-water remediation time frame at $3.8 million and $4.5 million, respectively.

4.3.4. Alternative 3b - Off-Site Soil Incineration and GroundWater Treatment by Air Stripping and GAC

Contaminated soil in Burial Sites 4-A and 4-E would be excavated as described under Alternative 3a and transported to an off-site facility for incineration. Water purification tablets from Burial Site 4-D would be excavated and transported to an off-site facility for placement in a RCRA industrial landfill as described under Alternative 3a. The incinerator would be permitted for dioxin and furan destruction and achieve 99.9999 percent destruction and removal efficiency. It is not applicable to classify these soils as RCRA dioxin-listed wastes or treatment residues because the dioxin and furan contamination did not originate from any of the sources listed in 40 CFR Part 261. Although it is relevant and appropriate to use the best available demonstrated technology (BDAT) for the destruction of dioxins, which is incineration, it is not relevant and appropriate to use the 99.9999 percent treatment standard for soils that contain F001 through F005 listed wastes. However, because no incineration facilities are currently permitted to receive and destroy dioxin and furan containing material, incineration cannot be implemented at this time, nor can a time frame for this alternative be assessed.

Ground water would be treated as described for Alternative 2. The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth of this alternative has been estimated based on both a 5-year and 10-year ground-water remediation time frame at $18 million and $19 million, respectively.

4.3.5. Alternative 4a - On-Site Soil Treatment by Dechlorination and Ground-Water Treatment by Air Stripping and GAC

Contaminated soil in Burial Sites 4-A and 4-E would be excavated as described under Alternative 2 and treated on site using the Alkaline Polyethlene Glycol (APEG) dechlorination treatment technology. Water purification tablets from Burial Site 4-D would be excavated and transported off site for placement in a RCRA industrial landfill, as described under Alternative 3a. The treated soil would be returned to the excavation. Residues from the dechlorination unit would be required to comply with land disposal restrictions (40 CFR 268) for F001 through F005 listed wastes, dioxins, and furans prior to placement in the excavation. The treated residue may be disposed of on site after passing the TCLP treatment standards for F001 through F005 listed wastes and dioxins and delisting as a hazardous waste. The excavations would be backfilled with clean fill if necessary, topsoiled and revegetated. This remedial action would be completed within two to three years after the ROD is signed.

Ground water would be treated as described for Alternative 2. The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth value of this alternative has been assessed based on a 5-year and 10-year ground-water remediation time frame. The present worth has been estimated at $6.8 million and $7.6 million, respectively.

4.3.6. Alternative 4b - On-Site Soil Treatment by Incineration and Ground- Water Treatment by Air Stripping and GAC

Contaminated soil in Burial Sites 4-A and 4-E would be excavated and treated in an on site incinerator prior to replacement in the excavation. This unit would be mobilized, operated, and closed in accordance with the requirements of 40 CFR Part 264, Subpart O which is considered relevant and appropriate. Subject to satisfactory treatability study results, incineration would comply with ARARs for soil treatment. Residues from incineration would be required to comply with land disposal restrictions (40 CFR 268). The treated residue may be disposed of on site after passing the TCLP treatment standards and delisting as a hazardous waste. The incinerator must comply with the technical requirements of the State of Utah clean air regulations (UAC Rule 446-12) and the 99.9999 percent destruction and removal efficiency requirements of RCRA (40 CFR Part 268). However, as no mobile incineration facilities have been permitted for dioxin and furan destruction, this alternative cannot be implemented, nor can a time frame be assessed. The water purification tablets from Burial Site 4-D would be excavated and transported to an off site RCRA industrial landfill as described under Alternative 3a.

Ground water would be treated as described under Alternative 2. The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth value of this alternative has been assessed based on a 5-year and 10-year ground-water remediation time frame. The present worth has been estimated at $7.0 million and $7.8 million respectively.

4.3.7. Alternative 5 - Containment of Contaminated Soil and Ground-Water Treatment by UV/Ozone

Contaminated soil in Burial Sites 4-A and 4-E, and water purification tablets from Burial Site 4-D, would be excavated and placed in an on-site landfill as described for Alternative 2. Compliance with ARARs for soils are discussed in Alternative 2. This remedial action would be completed within 15 to 24 months after the ROD is signed.

Ground water would be extracted as described under Alternative 2 and pumped to an on-site UV/ozone treatment facility. Treated ground water would be reinjected around the perimeter of the contaminant plume using injection wells or infiltration galleries. Any sludge generated by the UV/Ozone process would be treated in a similar manner as that described for waste from the ground-water treatment process under Alternative 2. The advantage of UV/Ozone technology over air stripping and GAC treatment is that the contaminants would be destroyed rather than transferred to another medium and there would be no air emissions that would trigger ARARs. However, the wide range of contaminants present in the ground water may make technical implementation of this technology difficult and the presence of oil and grease in the ground water at OU 4 may minimize the efficiency of the process. In addition, it would be necessary to carry out a treatability study to determine destruction efficiency of the UV/Ozone system. Alternative 5 would comply with ground-water ARARs, assuming MCLs could be achieved and maintained. The extraction and reinjection system would comply with the Federal underground injection regulations (40 CFR Parts 144-147) and the State well drilling standards of UAC Rule 625-4.

Ground-water remediation would eventually reduce the health-based risks to one in ten thousand with a target level of one in one million and achieve MCLs that are considered to be ARARs. The time frame required for compliance with ground-water cleanup criteria is estimated to be a minimum of five years, assuming treatment of a minimum of five pore volumes (approximately 330 million gallons) will be necessary to attain ARARs. However, the ability of the pump and treat approach to achieve very low residuals (less than 2 ug/L for vinyl chloride) in ground water may be limited.

The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. It should be noted that pretreatment of ground water may be required, which could add significant costs to this alternative. However, without a treatability study and a pilot scale plant those costs cannot be adequately determined.

Due to the uncertainty associated with the ground-water remediation time frame, the present worth of this alternative has been estimated based on a 5-year and 10-yearground-water remediation time frame at $3.1 million and $3.9 million, respectively.

4.3.8. Alternative 6a - Off-Site Soil Disposal and Ground-Water Treatment by UV/Ozone

Contaminated soil in Burial Sites 4-A and 4-E would be excavated and transported to an off-site facility for placement in a RCRA hazardous waste landfill and water purification tablets from Burial Site 4-D would be excavated and transported to a RCRA industrial landfill for disposal, as described in Alternative 3a. Ground water would be extracted and pumped to an on-site UV/ozone treatment facility as described in Alternative 5. Compliance with ARARs for soil is discussed in Alternative 3a. Compliance with ground-water ARARs is discussed in Alternative 5.

The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation-time frame, the present worth of this alternative has been estimated based on a 5-year and 10-year ground-water remediation time frame at $3.9 million and $4.6 million, respectively.

4.3.9. Alternative 6b - Off-Site Soil Incineration and GroundWater Treatment by UV/Ozone

Contaminated soil in Burial Sites 4-A and 4-E would be excavated and transported to an off-site facility for incineration, as described in Alternative 3b. Water purification tablets from Burial Site 4-D would be excavated and transported to an off-site facility for disposal in a RCRA industrial landfill, as described in Alternative 3a. Ground water would be extracted and pumped to an on-site UV/ozone treatment facility, as described in Alternative 5. Compliance with ARARs for soil was discussed in Alternative 3b and for ground water it was discussed in Alternative 5.

The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth of this alternative has been estimated based on a 5 year and 10-year ground-water remediation time frame at $18 million and $19 million, respectively.

4.3.10. Alternative 7a - On-Site Soil Treatment by Dechlorination and Ground-Water Treatment by UV/Ozone

Contaminated soil in Burial Sites 4-A and 4-E would be excavated and treated on site using dechlorination, as described in Alternative 4a. The treated soil would be returned to the excavation. Ground water would be pumped to an on-site UV/ozone treatment facility and the treated ground water would be reinjected around the perimeter of the contaminant plume using injection wells or infiltration galleries, as described in Alternative 5. The compliance of the dechlorination treatment technology with ARARs is discussed in Alternative 4a. Compliance of the UV/Ozone ground-water treatment system with ARARs is discussed in Alternative 5.

The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth of this alternative has been estimated based on a 5-year and 10-year ground-water remediation time frame at $6.9 million and $7.6 million, respectively.

4.3.11. Alternative 7b - On-Site Soil Treatment by Incineration and Ground-Water Treatment by UV/Ozone

Contaminated soil in Burial Sites 4-A and 4-E would be excavated and treated in an on site incinerator prior to replacement in the excavation, as described in Alternative 4b. The treated soil would be returned to the excavation. The water purification tablets from Burial Site 4-D would be excavated and transported to an off site RCRA industrial landfill, as described under Alternative 3a. However, as no mobile incineration facilities have been permitted for dioxin and furan destruction, this alternative cannot be implemented, nor can a time frame be assessed.

Ground water would be pumped to an on-site UV/ozone treatment facility and the treated ground water would be reinjected around the perimeter of the contaminant plume using injection wells or infiltration galleries, as described in Alternative 5. Compliance with ground-water ARARs will be achieved and is also discussed in Alternative 5.

The indirect, capital, operating and maintenance costs associated with this alternative are presented in Table 3. Due to the uncertainty associated with the ground-water remediation time frame, the present worth of this alternative has been estimated based on a 5-year and 10-year ground-water remediation time frame at $7.1 million and $7.8 million respectively.

4.4 COMPARATIVE ANALYSIS OF REMEDIATION ALTERNATIVES

During the detailed analysis for OU 4, each alternative was assessed against the nine evaluation criteria defined under CERCLA. These criteria have been developed to address the technical and policy considerations that have proven important for selecting among remedial alternatives and serve as the basis for the detailed analysis and the subsequent selection of an appropriate remedial action. In assessing alternatives, all must meet criteria numbers 1 and 2, which are the threshold criteria. Those alternatives satisfying the threshold criteria are compared using the five balancing criteria. The final two modifying criteria can change the preferred alternative selected as a result of applying the balancing criteria. The evaluation criteria are:

Threshold Criteria

1. Overall Protection of Human Health and the Environment - The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment.

2. Compliance with ARARs - The assessment against this criterion describes how the alternative complies with ARARs or, if a waiver is required, how it is justified. The assessment also addresses other information from advisories, criteria, and guidance documents that the parties have agreed is "to be considered."

Balancing Criteria

3. Long-term Effectiveness and Permanence - The assessment of alternatives against this criterion evaluates the long-term effectiveness of each alternative in protecting human health and the environment after the response objectives have been met.

4. Reduction of Mobility, Toxicity, and Volume Through Treatment The assessment against this criterion evaluates the anticipated performance of the specific treatment technologies an alternative may employ.

5. Short-term Effectiveness - The assessment against this criterion examines the

effectiveness of alternatives in protecting human health and the environment during the construction and implementation of a remedy and until the response objectives have been met.

6. Implementability - The assessment against this criterion evaluates the technical and administrative feasibility of the alternatives and the availability of the goods and services needed to implement them.

7. Cost - The assessment against this criterion evaluates the capital, indirect, and operation and maintenance costs of each alternative. Cost can only be a deciding factor for alternatives equally protective of human health and the environment.

Modifying Criteria

8. State Acceptance - This criterion reflects the State's preferences among or concerns about alternatives.

9. Community Acceptance - This criterion reflects the community's preferences among or concerns about alternatives.

The results of the assessment of alternatives against the nine criteria were arrayed in Table 3 to compare the alternatives and identify the key tradeoffs among them. A comparative analysis of alternatives was then conducted to evaluate the alternatives with respect to their relative performance according to the threshold and balancing criteria. The objective of the comparison is to assess the relative advantages and disadvantages among the alternatives. The results of this comparison are presented below.

Overall Protection of Human Health and the Environment. Assuming that present land practices at DDOU remain unchanged, all the remedial alternatives presented in this detailed analysis would be equally protective of human health and the environment because there are currently no exposure pathways to contaminated soil or ground water at OU 4. Under all remedial alternatives and present land use practices, the risk to human health due to exposure to soil contaminated with PCBs, dioxins, and furans is less than one in one million. Under Alternative 1, the no action alternative, lack of action may result in off-site migration of contaminated ground water. While there is currently no domestic or on-Depot use of the shallow ground-water aquifer in the vicinity of OU 4, the future risk to the public would increase under these conditions. All other alternatives would prevent off- Depot migration of the ground water and would reduce risks associated with potential future use of on-Depot shallow ground water. Therefore, Alternative 1 fails to meet the criterion, and Alternatives 2 through 7 comply with it.

Compliance with ARARs. Alternatives 2 through 7 would comply with ARARs relating to soil treatment and disposal. However, failure to remove the source under Alternative 1 would not comply with UAC Rule 450-101. Alternatives that use landfilling of dioxin and furan contaminated soils (Alternatives 2, 3a, 5, and 6a) would comply with ARARs if soils pass the TCLP treatment standards for dioxins and furans and those for F001 through F005 listed wastes. If soils fail the TCLP, they would be treated to achieve compliance with ARARs. The no action alternative (Alternative 1) would fail to meet ARARs for ground water. All other alternatives would result in compliance with ARARs for ground water, given the limitations of pump and treat technology. The time frame for compliance with ground-water ARARs may be greater than 10 years and would depend on actual response of the aquifer during remediation. If the treatment method fails to achieve or maintain MCLs in the ground water, the treatment method and cleanup levels should be reviewed and revised if necessary. Alternatives 4a, 4b, 7a, 7b and the incineration option in Alternatives 3b and 6b would provide the greatest degree of compliance due to the complete removal and destruction of the source and remediation of the aquifer that would be achieved.

Long-Term Effectiveness and Permanence. The no action alternative would provide the least compliance with this criterion. The permanence of landfilling of contaminated soils under Alternatives 2, 3a, 5, and 6a would rate lower than the complete destruction of contaminants achieved through treatment in Alternatives 4a, 4b, 7a, and 7b and the incineration option in Alternatives 3b and 6b. Therefore, Alternatives 4a, 4b, 7a, and 7b and the incineration option in Alternatives 3b and 6b would rate highest under this criterion.

Reduction in Mobility, Toxicity, and Volume Through Treatment. Alternative 1 rates lowest against this criterion because no action would be taken to remediate contaminated soil and ground water. The lack of treatment to reduce toxicity, mobility, or volume under the landfilling options in Alternatives 2, 3a, 5, and 6a would result in a lower rating than alternatives that use treatment. Alternatives 4a, 4b, 7a, and 7b, and the incineration option in Alternatives 3b and 6b, therefore rate higher due to the complete destruction of contaminants in the soil that would occur under those alternatives. However, treatability studies would be required to confirm the efficiency of the dechlorination, on-site incineration, and UV/Ozone technologies.

Short-Term Effectiveness. With the exception of the no action alternative, all of the alternatives compare equally under this criterion. As no action would be taken under Alternative 1, there are no short term risks. All other alternatives involve similar risks created by the methods used to extract and treat the contaminated soil and ground water. Therefore Alternatives 2 through 7 rate lower than Alternative 1 under this criterion.

Implementability. Technically, the no action alternative would be the easiest alternative to implement but would not be implementable administratively due to the need to meet ground-water MCLs. On-site landfilling of soils and debris under Alternatives 2 and 5 would be difficult to implement due to the long-term administrative requirements associated with such a facility. The incineration alternatives for soil destruction under Alternatives 3b, 4b, 6b, and 7b would require compliance with technical permitting requirements of RCRA and State and Federal air emission regulations. However, no incineration facilities have been permitted for dioxin and furan destruction in the United States, thereby preventing the implementation of any of the incineration alternatives at this time. Dechlorination would require a treatability study to confirm the ability of this technology to treat PCB, dioxin, and furan-contaminated soils and wastes from OU 4. UV/Ozone treatment of ground water under Alternatives 5, 6a, 7a, and 7b may be the easiest to implement administratively due to the lack of treatment by-products and air emissions, when compared to air stripping and GAC treatment. However, as an innovative technology, technical implementability would have to be proven by a treatability study and the presence of oil and grease in the OU 4 ground water may minimize the efficiency of the oxidation process. Assuming treatability studies are successful, Alternatives 3b and 6b rate lowest for this criterion, followed by Alternatives 2, 4b, 5, and 7b. Landfill disposal under Alternative 6a is rated slightly higher, while landfill disposal under Alternative 3a rates highest with respect to implementability.

Cost. The indirect, capital, operation and maintenance costs, and net present worths of remediation alternatives are presented in Table 3. The no action alternative (Alternative 1) has the lowest cost of all the alternatives considered, with a present worth of $287,000 for a 20-year monitoring period. Alternatives 2 and 5 (on-site soil landfilling with air stripping/GAC or UV/Ozone, respectively) both have 10-year present worths of about $3.9 million. The dechlorination soil treatment options in Alternatives 4a and 7a have a 10 year present worth of about $7.6 million, followed by the on-site soil incineration treatment options of Alternatives 4b and 7b at about $7.8 million.

Alternatives 3a and 6a, both of which employ off-site soil landfilling as treatment, have 10-year present worths of $4.5 million and $4.6 million, respectively. The off-site incineration options of Alternatives 3b and 6b have 10-year present worth of $19 million each.

State Acceptance. The State has been involved in each step of the RI/FS process and the presentation of a preferred alternative in the Proposed Plan. Therefore, this criteria has been addressed in the development of a remedy for OU 4. The State is supportive of the selected remedy but had a preference for off-site incineration of all soil and debris. However, as stated under the description of alternatives that employ incineration, this is not currently implementable.

Community Acceptance. Community acceptance is implicitly analyzed for the selected remedy in the Responsiveness Summary at the end of this document. All comments received during the public comment period have been addressed and the alternatives altered, if necessary. Only one comment was received from the public that indicated a preference for on-site treatment rather than off-site disposal. Therefore, public concerns regarding the selection of a remedy for OU 4 have been addressed.

5.0 SELECTED REMEDY

The selected remedy for DDOU Operable Unit 4 is Alternative 3a, off-site landfill disposal of soil and debris and on-site ground-water treatment using air stripping and GAC, if necessary. This remedy was presented as the preferred alternative in the Proposed Plan for OU 4. A detailed description of the selected alternative, including the remediation goals, cleanup levels, and the costs associated with each component of the remedy is presented in the following discussion.

5.1 DESCRIPTION OF THE SELECTED REMEDY

Under this alternative, contaminated soil in Burial Sites 4-A and 4-E will be excavated and placed in an off-site RCRA hazardous waste landfill. Water purification tablets from Burial Site 4-D will be placed in an offsite RCRA industrial landfill. A commercial operator will remove, treat, and dispose of methyl bromide cylinders if they are encountered. During excavation of the soil and debris, TCLP tests will be performed periodically (with a frequency to be determined during the remedial design) to confirm the characteristics of the waste and its suitability for land disposal. If a soil sample fails the TCLP criteria for F001 through F005 listed wastes, the soil volume represented by this sample will be treated by the receiving facility using granulated activated carbon or other stabilization/fixation methods to achieve compliance. If treatment is unsuccessful in achieving treatment standards for land disposal of dioxins, the failing material will be transported to a commercial incineration facility for thermal treatment. While no facilities are currently permitted for dioxin destruction, storage of material at the facility can be undertaken until permitting is completed. Based on TCLP analyses carried out on soils from Burial Sites 4-A and 4-E, it is unlikely that incineration will be necessary.

Ground water will be remediated using a well extraction, treatment, and reinjection system. Ground water will enter an air stripper tower treatment system to remove vinyl chloride, cis-1,2-DCE and other VOCs present in ground water at OU 4. The air stripper will reduce vinyl chloride concentrations to less than 2 ug/L and cis-1,2-DCE concentrations to a practicably attainable level that is less than the MCL of 70 ug/L. If PCB concentrations in the effluent from the air stripper exceed the MCL of 0.5 ug/L, or if dioxin and furan isomers exceed the proposed MCL of 3×10^{-5} ug/L for total equivalent TCDD, a GAC treatment unit will be added to reduce contaminant concentrations to these levels. Air emissions from the air stripper tower will be monitored to ensure compliance with Utah air quality regulations of 1.5 tons of total

VOCs per year and the NESHAPs requirements for vinyl chloride of 10 parts per million. If emission levels threaten or exceed these criteria, air emission controls such as GAC or some other effective technology will be employed. Wastes from the ground-water treatment process, including silt collected by gravity separation in the air stripper or pretreatment units, will be transported offsite for incineration or land disposal, depending on how the wastes are classified under RCRA as described in Section 4.3.2. Treated ground water will be reinjected into the shallow aquifer using injection wells or infiltration galleries.

The ground-water treatment system will be operated either continuously, by pulsing the system, turning off individual wells, or pumping alternate wells to vary ground-water flow patterns. Such measures will be taken to reduce the remediation time frame where practicable, while ensuring compliance with ground-water and air emissions ARARs. The ground-water treatment system will be operated until the remediation goals for ground water outlined below have been met and maintained for one year in all compliance monitoring wells. When contaminants have been maintained below MCLs for one year, the treatment system will be shut down and compliance monitoring will continue until the next scheduled statutory five year review. If remediation goals are exceeded during this time in any compliance monitoring well, ground-water treatment will recommence and this procedure will be repeated. If compliance is maintained until the next scheduled statutory review the remedy will be considered complete. The Performance and Compliance Monitoring Plan is presented in Appendix B of this document.

During construction of the extraction and reinjection wells, well tests will be conducted on each well to determine the yield that can be expected during production. The number, spacing, and pumping rate of wells will be adjusted according to the results of these tests. The process components of this alternative and pertinent information and assumptions on sizing, concentrations, flow rates, etc., are presented in Table 4. It should be noted that some changes may be made to this remedy as a result of the remedial design and construction process.

5.1.1. Remediation Goals

The point of compliance for soil will be defined by the cleanup criteria described below. The first of these criteria consists of removing all debris and visually contaminated soil from Burial Sites 4-A and 4-E, and removal of water purification tablets from Burial Site 4-D. Visually contaminated soil is defined as any soil containing manufactured or processed material, plant or animal matter, or unnatural discoloration. Samples will then be collected from the soil in the walls and bottom of the excavation and analyzed for VOCs, PCBs, metals, dioxins, and furans. These sample results will be used to confirm that the soils remaining in the excavation:

1. Do not contain more than 25 mg/kg of PCBs as recommended in EPA Directive 9355.4-01FS.

2. Do not contain dioxin and furan concentrations of more than 1 ug/kg total equivalent TCDD as recommended by the Dioxin Advisory Group.

3. Do not contain other contaminants that would present an unacceptable future health risk. Excavation will continue until a total carcinogenic health risk of less than one in ten thousand is achieved in the soils remaining in the excavation. In addition, a target cleanup level of one in one million has been adopted for OU 4 and will be achieved wherever practicable. Similarly, excavation will continue until the hazard index for noncarcinogenic contaminants remaining in the soil is less than one. Contaminant concentrations associated with these risk levels are presented in Table A-2 in Appendix A, assuming a future resident exposure scenario. Risk based cleanup levels are only defined for those

contaminants that do not have specific, defined cleanup levels.

Health based cleanup criteria have been included as remediation goals to ensure that the remedy complies with the NCP recommendation that an excess health based risk of between one in ten thousand and one in one million should be achieved by the remedy, with a risk of one in one million as the goal of the remediation. Confirmation samples will be taken from soils remaining in the excavation to verify compliance with the cleanup criteria. Excavated soil and debris will be periodically tested using appropriate analyses including the Toxic Characteristics Leaching Procedure (TCLP).
This test will ensure proper characterization of the material so that the landfill receiving it can determine if treatment will be necessary prior to landfill disposal and confirm that the waste has been correctly characterized. The existing frequency will be specified in the remedial design.

Ground water will be treated until contaminant concentrations are below their MCLs. Contaminants of concern for ground-water remediation and their associated MCLs are listed in Table A-1 in Appendix A. The point of compliance for ground-water cleanup is defined by the area within the 2 ug/L contour for vinyl chloride.

A Performance and Compliance Monitoring Plan for soil and ground water remediation at OU 4 is presented in Appendix B. This plan summarizes the remediation goals, areas of attainment, restoration time frame, and the performance standards for soil and groundwater remediation.

5.1.2 Costs

The costs associated with remediation of OU 4 using Alternative 3a are listed in Table 4. The total capital cost of the project is estimated at approximately $2.2 million. This includes costs of installing a ground- water extraction and injection system, storage tank, an air stripping system equipped with GAC if necessary, ground-water monitoring, excavation, soil disposal at a RCRA hazardous waste landfill, and reclamation of the site. Indirect costs for administration, engineering, and design services were estimated to be approximately $340,000, while annual operation and maintenance costs are estimated at $230,000. The present worth cost of the project, using a five percent discount value, is estimated at $4.5 million, based on a 12 year duration of treatment and monitoring.

5.2 STATUTORY DETERMINATIONS

The selected remedy for DDOU Operable Unit 4 meets the statutory requirements of Section 121 of CERCLA as amended by SARA. These statutory requirements include protection of human health and the environment, compliance with ARARs, cost effectiveness, utilization of permanent solutions and alternative treatment technologies to the maximum extent practicable, and preference for treatment as a principal element. The manner in which the selected remedy for DDOU OU 4 meet each of these requirements is presented in the following discussion.

5.2.1. Protection of Human Health and the Environment

The selected remedy for DDOU OU 4 protects human health and the environment through the following engineering controls:

- Excavation and removal of all backfilled soil and debris in Burial Sites 4-A and 4-E to comply with the cleanup criteria defined in Section 5.1.1. and removal of the water purification tablet bottles in Burial Site 4-D.

- Extraction and treatment of all ground water until contaminant concentrations are below their MCLs, and total excess cancer risks are less than one in ten thousand with a target of one in one million.

Removal of the soil and debris in Burial Sites 4-A and 4-E will eliminate the source of organic contamination in the ground water and remove the potential for exposure to these contaminants in soil. Removal of the water purification tablet bottles in Burial Site 4-D will remove a potential future exposure pathway to the contents of these bottles. Treatment of contaminated ground water at OU 4 to a level below the MCLs will result in a reduction in the cancer risk to potential future ground-water users by approximately two orders of magnitude. The selected remedy for soil and ground water at OU 4 will not pose an unacceptable short-term risk to human health, the environment, or endangered species and their habitats, nor will the site present any unacceptable risks after completion of the remedy. The selected remedy will also minimize cross-media impacts through the use of air emission controls if necessary. This latter point will be achieved by ensuring compliance with Utah air quality regulations and Federal requirements for vinyl chloride defined by NESHAPS.

5.2.2. Compliance with Applicable or Relevant and Appropriate Requirements

Section 121(d)(1) of CERCLA as amended by SARA, requires that remedial actions must attain a degree of cleanup which assures protection of human health and the environment. In addition, remedial actions that leave any hazardous substances, pollutants, or contaminants on site must, upon completion, meet a level or standard which at least attains legally applicable or relevant and appropriate standards, requirements, limitations, or criteria that are "applicable or relevant and appropriate requirements" (ARARs) under the circumstances of the release. ARARs include Federal standards, requirements, criteria, and limitations and any promulgated standards, requirements, criteria or limitations under State environmental or facility siting regulations that are more stringent than Federal standards.

"Applicable" requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a remedial action site. "Relevant and appropriate" requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that, while not "applicable" to a hazardous substance, pollutant or contaminant, remedial action, location, or other circumstance at a remedial action site, address problems or situations sufficiently similar to those encountered at the site that their use is well-suited to the particular site.

In determining which requirements are relevant and appropriate, the criteria differ depending on the type of requirement under consideration, i.e., chemical-specific, location-specific, or action-specific. According to the NCP, chemical-specific ARARs are usually health or risk-based numerical values which establish the acceptable amount or concentration of a chemical that may remain in, or be discharged to, the ambient environment. Location specific ARARs generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations. Some examples of special locations include floodplains, wetlands, historic places, and sensitive ecosystems or habitats. Action-specific ARARs are usually technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes, or requirements to conduct certain actions to address particular circumstances at a site. Remedial alternatives which involved, for example, closure or discharge of dredged or fill material may be subject to ARARs of RCRA and the Clean Water Act.

The remedial action proposed, the hazardous substances present at the site, the physical characteristics of the site, and the potential receptor population, were all considered when determining which requirements are applicable or relevant and appropriate to the selected remedy for OU 4. Federal and State laws, standards, requirements, criteria, and limitations were reviewed for possible applicability to OU 4. The only State regulations identified that required more stringent requirements than equivalent Federal regulations were the source control regulations in Utah Administrative Code (UAC) Rule 450-101, and the spill reporting requirements in UAC Rule 450-9.

Through careful review of all applicable or relevant and appropriate public health and environmental requirements of Federal or State laws, it has been determined that the remedy selected for OU 4 will meet these ARARs. Therefore, no SARA Section 121(d)(4) waiver will be necessary. A brief discussion of how the selected remedy for OU 4 satisfies the principal ARARs associated with the site is presented below.

Chemical-Specific Requirements. Chemical-specific ARARs set health- or risk-based concentration limits in various environmental media. Ground-water quality ARARs for OU 4 are based on the Safe Drinking Water Act maximum contaminant level (MCL), the maximum permissible level of a contaminant in water that is delivered to any user of a public water system. MCLs are generally relevant and appropriate as cleanup standards for contaminated ground water that is or may be used for drinking. Other applicable requirements include RCRA land disposal restrictions, the Solid Waste Disposal Act, the Clean Air Act, the Occupational Safety and Health Administration (OSHA) regulations, and the Department of Transportation (DOT) hazardous material transportation regulations. The State of Utah public drinking water regulations are also relevant and appropriate to the OU 4 selected remedy. In addition, the Utah ground-water quality protection regulations are applicable to the site. Potential Federal and State chemical-specific ARARs are presented in Tables C-1 and C-2 of Appendix C.

Location-Specific Requirements. Location-specific ARARs set restrictions on remediation activities, depending on the location of a site or its immediate environs. The only location-specific ARAR associated with the selected remedy for OU 4 is the EPA ground-water protection strategy that establishes a ground-water classification system for protecting ground water based on its value to society, use, and vulnerability. This strategy contributes to application of the National Primary Drinking Water Standards as ARARs for the selected remedy. As OU 4 is not located in a wetlands area or floodplain, is not a historic place, and the remedy will not affect any historic place, endangered species, or habitats, regulations pertaining to these concerns are not ARARs.

Action-Specific Requirements. Performance, design, or other action-specific requirements set controls or restrictions on certain kinds of remedial activities related to management of hazardous substances, pollutants, and contaminants. Federal action-specific ARARs that are relevant to the remediation activities at OU 4 include Federal Underground Injection Control Regulations, RCRA Land Disposal and Closure Regulations, the Solid Waste Disposal Act, and the Occupational Safety and Health Act (OSHA). State requirements include the Utah State Engineer's regulations for well construction and pumping activities, the Utah Corrective Action Cleanup Standards Policy for cleanup levels, and the Utah Air Quality Regulations. Potential Federal and State action-specific ARARs are presented in Tables C- 3 and C-4 of Appendix C.

To Be Considered Requirements. In implementing the selected remedy for OU 4, DDOU has agreed to consider requirements that are not legally binding. The only requirements to be considered (TBC) for the selected remedy at DDOU OU 4 were the adoption of the recommendations of the Dioxin Disposal Adversary Group regarding pentachlorophenol waste and dioxin and furan contamination and the recommended cleanup level for PCBs on industrial sites presented in EPA Directive 9355.4-01FS. These TBCs are included in the Federal chemical-specific ARARs presented in Table C-1.

5.3 COST EFFECTIVENESS

Overall cost-effectiveness can be defined as the reduction in threat to human health and the environment per dollars expended on a remedy. The selected remedy for DDOU OU 4 is the most cost-effective alternative because it provides the maximum effectiveness proportional to cost of any of the alternatives analyzed. The selected remedy is an order of magnitude less in costs than the off-site incineration alternative, and provides a greater degree of protectiveness of human health and the environment when compared to the on-site remediation alternatives. The selected remedy will also be protective in the long term because it removes the source of ground-water contaminants from the site, and allows clean closure of the site in a cost effective manner.

5.4 UTILIZATION OF PERMANENT SOLUTIONS

This section briefly describes the rationale for the selected remedy and explains how the remedy provides the best balance of tradeoffs among all the alternatives with respect to the five balancing criteria described in Section 4.4.

EPA, the State of Utah, and DDOU have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner for the final source control and ground-water remediation at OU 4. While the selected alternative does not provide the highest degree of protectiveness afforded by alternatives that use incineration of soils, it will significantly reduce the inherent hazards posed by contaminated soils and their potential to act as a continuing source of ground-water contamination. In addition, at this time there are no incineration facilities in the United States that are permitted to receive and incinerate dioxin contaminated material. This limitation prevents implementation of incineration alternatives for OU 4. Therefore, Alternatives 3b, 4b, 6b, and 7b could not be implemented.

The greatest degree of reduction in mobility, toxicity, and volume would be achieved by alternatives that used dechlorination or incineration of soils. However, because the soils from Burial Sites 4-A and 4-E and the water purification tablets can be land disposed in compliance with RCRA, mobility will be controlled but toxicity and volume will be unaffected under the selected alternative. Because the selected remedy does not destroy the contaminants in soil or ground water, it does not rate as high against this criteria as alternatives that use dechlorination for soil treatment or UV/Ozone for ground-water treatment. However, the presence of oil and grease in OU 4 ground water may minimize the effectiveness of UV/Ozone to reduce mobility, toxicity, and volume.

The short term effect associated with soil remediation under each alternative is the potential exposure of workers and nearby residents to contaminated dust. This can be controlled by the use of appropriate protective equipment and dust control measures. There is also a short term exposure generated by alternatives that use air strippers and GAC for ground-water treatment and incineration of soils. This exposure potential will be controlled by compliance with State and Federal air emission regulations. Alternatives that employ UV/Ozone would not have this short term exposure potential. Therefore, the selected alternative is rated higher than alternatives that employ incineration but lower than those that use UV/Ozone under this criterion.

Because the soils in Burial Sites 4-A and 4-E contain dioxins and furans, alternatives that employ incineration of soils are impossible to implement, as described above. The administrative and technical implementability of constructing, operating, and maintaining an on-site RCRA hazardous waste landfill was considered less satisfactory than using an existing commercial facility off site. Dechlorination is an innovative technology that would require treatability testing to determine its effectiveness on the

range of contaminants found at OU 4, and the suitability of the treated soils for replacement in the excavation on site. If treatability tests were not satisfactory, or treated soils could not be backfilled on site, the alternative would not achieve any greater reduction in mobility, toxicity, or volume, or long term effectiveness than the selected alternative. Similarly, the air stripping and GAC treatment system for ground water in the selected alternative are proven technologies that are technically implementable, commercially available, and administratively implementable.
The technical implementability of the UV/Ozone technology would be subject to the results of a treatability study which makes this system less implementable than the air stripping and GAC system used in the selected alternative.

The cost of alternatives that employed off-site incineration were significantly greater than alternatives that employed on-site solutions or offsite landfilling. In addition, alternatives that employed on-site or off-site landfilling were less expensive than those that employed on-site treatment.

Of those alternatives that were carried through the detailed analysis, the selected remedy provides the best balance of tradeoffs in terms of the balancing criteria listed above. The major tradeoffs that provide the basis for this selection decision are implementability, long term effectiveness, and cost. The selected remedy can be implemented more quickly, with less difficulty, and at less cost than the other treatment alternatives while providing the same degree of protectiveness. Therefore, Alternative 3a was selected as the most appropriate solution for remediating the contaminated soils and ground water at OU 4.

5.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy does not use treatment for remediating soils. The potential for employing treatment as a principal element of source area remediation is limited by administrative restrictions associated with the presence of dioxins in the contaminated soils and debris, and the lack of a proven technology for treating the range of contaminants encountered at OU 4. The selected remedy does however employ treatment as a principal element for remediation of contaminated ground water. Ground water will be treated through an air stripping system that may include GAC for adsorption of organics that cannot be removed by air stripping.

5.6 DOCUMENTATION OF NO SIGNIFICANT CHANGES

The Proposed Plan for DDOU OU 4 was released for public comment in December 1991. The Proposed Plan identified Alternative 3a, Off-Site Landfill Disposal of Soil and Ground-Water Treatment by Air Stripping/GAC, as the preferred alternative. All written and verbal comments submitted during the comment period were reviewed. The conclusion of this review was that no significant changes to the remedy, as identified in the Proposed Plan, were necessary.

APPENDIX A

SOIL AND GROUND-WATER REMEDIATION CRITERIA

This appendix describes the remediation criteria for soil and ground water at Operable Unit 4 (OU 4). Criteria for ground-water contaminants must be met in each compliance monitoring well. Confirmational soil samples will be collected after removing debris and visibly contaminated soil from Burial Sites 4-A and 4-E. Results of these sample analyses will be used to confirm that all material contaminated above the cleanup levels has been removed from the excavation.

Ground-Water Remediation Criteria

Contaminants of concern for ground-water remediation for OU 4 include benzene, cis-1,2-dichloroethene (cis-1,2-DCE), vinyl chloride, polychlorinated biphenyls (PCBs), and TCDD. The remediation criteria for these compounds are their respective drinking water maximum contaminant levels (MCLs) of 5,70, 2, 0.5 and 0.00003 ug/L.

Table A-1 summarizes the cleanup criteria for each contaminant of concern in ground water, the potential cancer risk and hazard quotient associated with each contaminant at current concentrations, and the potential cancer risk and hazard quotient associated with each contaminant at the cleanup concentrations. These risks have been estimated assuming future use of the ground water as a residential source of drinking and shower water.

Soil Remediation Criteria

Contaminants of concern for soil remediation include arsenic, lead, PCBs, dioxins, furans, benzene, cis-1,2-DCE, and vinyl chloride. The "to be considered" (TBC) remediation criterion for PCBs of 25 mg/kg is based on EPA Directive 9355.4-01FS, "A Guide on Remedial Actions at Superfund Sites with PCB Contamination." The TBC criterion for dioxins and furans of 0.001 mg/kg was derived from the "General Approach Used by the Dioxin Disposal Advisory Group (DDAG) Regarding Pentachlorophenol Waste (also PCBs)" by P. des Rosiers, November 1988. Remediation criteria for benzene and vinyl chloride of 210 and 3.2 mg/kg, respectively, correspond to cancer risks of 1 x 10[-5] under a future residential soil ingestion scenario. The remediation criterion for cis-1,2-DCE is 700 mg/kg, which corresponds to a hazard quotient of 0.1 under this scenario. The criterion for arsenic of 35 mg/kg corresponds to a cancer risk of 1 x 10[-4]. An arsenic concentration that corresponds to a potential cancer risk of 1 x 10[-5] (3.5 mg/kg) is not practical at OU 4 because that concentration would be below naturally occurring background concentrations present at DDOU, whereas, the proposed criterion can be clearly distinguished from background levels. There is no reference dose or slope factor for lead, so a cleanup criterion corresponding to a hazard quotient of 0.1 or a cancer risk of 1 x 10[-5] cannot be established. The criterion for lead of 500 mg/kg is a typical remediation criterion for residential soils at CERCLA sites.

Risks for soil contaminants were calculated under a residential ingestion scenario where a person was assumed to be exposed as a 15 kg child ingesting 200 mg of soil per day for six years, and also as a 70 kg adult ingesting 100 mg of soil per day for 24 years. (This scenario was developed for the establishment of remediation criteria. It was not part of the baseline risk assessment for OU 4, and therefore results of this scenario were not included in Section 3.2 of the Decision Summary of this ROD.) Table A-2 summarizes the remediation criteria, baseline risks, and post-remediation risks.

It should be noted that most of the remediation criteria for the contaminants of concern exceed the baseline concentrations detected in soil samples collected from Burial Sites 4-A and 4-E. While there is no risk- based reason for remediating the soil at OU 4, remediation criteria are necessary should hot spots be encountered where contaminant concentrations exceed previously detected concentrations.

APPENDIX B
PERFORMANCE AND COMPLIANCE MONITORING PLAN
PERFORMANCE AND COMPLIANCE MONITORING FOR REMOVAL OF OU 4 SOIL AND DEBRIS

Remediation Goals

Remediation goals for soil are defined in Section 5.1.1 of the ROD.

Area of Attainment

The area of attainment for remediation goals is the soil and debris in Burial Sites 4-A, 4-D, and 4-E. The volume of soil and debris requiring remediation is therefore 4,500 to 5,000 cubic yards. This estimate assumes the one or two feet of clean fill overlying the contaminated material in each burial area will be replaced in the excavation. Volume estimates may be revised during the RD/RA based on soil sampling results.

Restoration Time Frame

The restoration time frame for this action is estimated to be approximately six months after commencement of work on site, and will be completed within 15 months to 24 months after the ROD is signed.

Performance Standards

Specific performance standards used to ensure attainment of the remediation goals for soil are:

- Reduce contaminant concentrations in soils within the area of attainment to comply with the remediation goals specified in Section 5.1.1 of the ROD

- Meet all ARARs identified in the ROD for soil

- The soil will be remediated in a timely manner in compliance with the selected remedy presented in the ROD to achieve remediation goals as soon as practicable.

Completion of Remediation

Remediation shall be considered complete after the soil remediation goals have been attained in all samples taken from the perimeter of the excavation. Samples to be used for compliance monitoring will be specified during Remedial Design (RD) in the Performance and Compliance Sampling Program. Sample locations will be approved by EPA and UDEQ during the RD. The number and location of samples to be taken may be modified during remediation to ensure compliance with remediation goals. The frequency of sampling will be determined during the RD. Any statistical methods to average soil concentrations areally or vertically shall be specified during the RD. The guidance entitled "Methods for Evaluating the Attainment of Cleanup Standards-Volume 1. Soils and Solid Media" (EPA 230/02-89-042) will be consulted when establishing the Performance and Compliance Sampling Program.

Performance and Compliance Monitoring Program

A Performance and Compliance Monitoring Program will be implemented during the remedial action to monitor performance and compliance with remediation goals. This program will be developed during the RD and will include locations of performance monitoring points within Burial Sites 4-A and 4-E, frequency of monitoring, analytical parameters, sampling methods, analytical methods, and statistical methods for evaluating data. The Performance and Compliance Monitoring Program will be included as part of the remedial design but may be modified during the remedial action to account for changed conditions.

PERFORMANCE AND COMPLIANCE MONITORING FOR REMEDIATION OF SHALLOW GROUND WATER

Remediation Goals
Remediation goals for shallow ground water are defined in Section 5.1.1 of the ROD.

Area of Attainment

The area of attainment for remediation goals is defined as the volume of ground water containing vinyl chloride above its MCL of 2 ug/L and includes ground water contaminated by cis-1,2-DCE, benzene, TCE, and PCBs at concentrations greater than their MCLs of 70 ug/L, 5 ug/L, 5 ug/L, and 0.5 ug/L, respectively. The volume of contaminated ground water within this plume is estimated at 65 million gallons.

Restoration Time frame

The restoration time frame for this action is estimated to be approximately five years after commencement of work on site.

Performance Standards

Specific performance standards used to ensure attainment of the remediation goals for ground water are:

- Reduce contaminant concentrations in ground water within the area of attainment to comply with the remediation goals specified in Section 5.1.1 of the ROD
- Meet all ARARs identified in the ROD for ground water
- The ground water will be remediated in a timely manner, in compliance with the selected remedy presented in the ROD, to achieve remediation goals as soon as practicable.

Completion of Remediation

As described in Section 5.1 of the ROD, remediation of the ground water in the shallow aquifer will be considered complete when contaminant concentrations are maintained below MCLs for a period of one year, whereupon the treatment system can be turned off. Monitoring of compliance wells will continue until the next statutory five year review. If MCLs are exceeded within this time, ground-water treatment will recommence. Compliance monitoring well locations will be specified during RD in the Performance and Compliance Monitoring Plan and will be approved by EPA and UDEQ. The frequency of sampling may be modified during remediation to ensure compliance with remediation goals.

Performance and Compliance Monitoring Program

A Performance and Compliance Monitoring Program will be implemented during the remedial action to monitor performance and compliance with remediation goals. This program will be developed during the RD and will include locations of performance monitoring points within the vinyl chloride plume, frequency of monitoring, analytical parameters, sampling methods, analytical methods, and statistical methods for evaluating data. The Performance and Compliance Monitoring Program will be designed to provide information that can be used to evaluate the effectiveness of the selected remedy with respect to the following:

- Horizontal and vertical extent of the plume
- Contaminant concentration gradients

- Rate and direction of contaminant migration
- Changes in contaminant concentrations or distribution over time
- Containment of the plume
- Concentrations of contaminants in the treatment system influent and effluent.

The Performance and Compliance Monitoring Program may be modified during the remedial action to account for changed conditions.

APPENDIX C

FEDERAL AND STATE CHEMICAL AND
ACTION-SPECIFIC ARARs