

**Table 6.1: Offpost Operable Unit Groundwater Chemicals of Concern**

Chemicals of Concern	Exposure Point Concentration ( $\mu\text{g/l}$ ) <sup>*</sup>					
	Zone 1	Zone 2	Zone 3	Zone 4	Zone 5	Zone 6
Aldrin	0.029*	0.045*	0.050*	0.12*	0.039*	0.030*
Arsenic	2.15	1.63		2.78*	2.68*	---
Atrazine	2.87	5.31*	12.9*	7.36*	---	4.48*
Benzene	0.61	0.64	0.75	0.93	---	---
Carbon tetrachloride	---	0.76*	---	---	---	---
Chlordane	---	0.18*	0.19*	0.54*	---	---
Chloride	120,000	205,000	487,000*	660,000*	262,000*	191,000
Chlorobenzene	1.02	1.78	1.77	4.51	1.09	1.27
Chloroform	0.68	67.5*	5.01	1.51	12.0*	3.33
CPMSO	---	14.5	10.4	7.68	---	---
CPMSO <sub>2</sub>	---	4.35	6.63	5.09	---	---
Dibromochloropropane	---	0.44*	0.14	0.15	0.10	---
1,2-Dichloroethane	---	0.77*	0.92*	7.32*	---	---
Dicyclopentadiene	---	3.64	163*	66.6*	---	---
DDE	0.029	0.029	0.22*	0.085	---	---
DDT	0.037	0.033	0.11*	0.10	---	---
Dichlorobenzene	---	5.1	---	2.9	---	---
DIMP	63.3*	713*	590*	4950*	7.68	4.67
Dieldrin	0.034*	0.035*	0.21*	0.055*	0.071*	0.039*
Dithiane	---	---	1.97	4.22	---	---
Endrin	0.033	0.037	0.73*	0.058	---	---
Ethylbenzene	---	---	---	0.57	---	---
Fluoride	1830	2210*	3510*	3290*	1810	2230*
Hexachlorocyclopentadiene	0.029	0.033	0.044	0.043	0.035	---
Isodrin	0.028	0.035	0.047	0.057	---	0.040
Malathion	---	0.26	0.38	0.32	---	---
Manganese	---	1580	---	1250	670	---
Oxathiane	---	---	1.32	2.21	---	---
Sulfate	340,000*	636,000*	909,000*	1,118,000*	148,000	213,000
Tetrachloroethene	0.70	10.1*	20.7*	6.09*	0.75	1.67
Toluene	---	---	1.28	1.18	---	---
Trichloroethene	---	0.64	0.51	2.70	---	4.04*
Xylene	0.75	---	---	1.11	---	---

- Not a chemical of concern in this zone
- CPMSO 4-chlorophenylmethylsulfoxide
- CPMSO<sub>2</sub> 4-chlorophenylmethyl sulfone
- DDE 2,2-bis(p-chlorophenyl)-1,1-dichloroethene
- DDT 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane
- DIMP Diisopropylmethyl phosphonate
- $\mu\text{g/l}$  Micrograms per liter

\* Exceeds groundwater containment system remediation goal listed in Tables 7.1, 7.2, and 7.3.  
 \* All exposure point concentrations represent the upper 95 percent confidence limit on the arithmetic mean of measured concentrations in monitoring and private wells.

**Table 6.2: Offpost Operable Unit Surface-Water Chemicals of Concern**

Chemicals of Concern	Exposure Point Concentration ( $\mu\text{g}/\text{l}$ ) <sup>*</sup>	
	First Creek	Irrigation Canals
Arsenic	18	NE
Chlordane	0.18	NE
Chloride	206,000	NE
Dicyclopentadiene	10	NE
DDE	0.089	NE
DDT	0.046	NE
Dieldrin	2.6	NE
DIMP	230	20
Fluoride	2550	970
Sulfate	438,000	NE

DDE 2,2-bis(p-chlorophenyl)-1,1-dichloroethene  
 DDT 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane  
 DIMP Diisopropylmethyl phosphonate  
 NE Chemical not significantly elevated above background levels in the irrigation canals  
 $\mu\text{g}/\text{l}$  Micrograms per liter

\* All exposure point concentrations represent the upper 95 percent confidence limit on the arithmetic mean of measured concentrations in unfiltered surface-water samples.

**Table 6.3: Offpost Operable Unit Sediment Chemicals of Concern in First Creek**

<b>Chemicals of Concern</b>	<b>Exposure Point Concentration (mg/kg)<sup>a</sup></b>
Aldrin	0.011
Dibromochloropropane	0.099
Dieldrin	0.134
Endrin	0.0038
DDE	0.0005
DDT	0.0084

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DDE 2,2-bis(p-chlorophenyl)-1,1-dichloroethene  
DDT 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane  
mg/kg Milligrams per kilogram

\* All exposure point concentrations represent the upper 95 percent confidence limit on the arithmetic mean of measured concentrations in sediment.

**Table 6.4: Offpost Operable Unit Soil Chemicals of Concern**

Chemicals of Concern	Exposure Point Concentration (mg/kg)*	
	Zone 3	Outside Zone 3
Aldrin	0.014	0.0021
Chlordane	0.049	ND
Dieldrin	0.112	0.018
Endrin	0.032	0.0042
DDE	0.024	0.015
DDT	0.063	0.030

DDE 2,2-bis(p-chlorophenyl)-1,1-dichloroethene  
DDT 2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane  
mg/kg Milligrams per kilogram  
ND Chlordane not detected in soil outside zone 3

\* All exposure point concentrations represent the upper 95 percent confidence limit on the arithmetic mean of measured concentrations in soil.

**Table 6.5: Summary of Land- Use Scenarios and Exposure Routes by Zone**

<b>Scenario</b>	<b>Zone</b>	<b>Exposure Routes Quantified</b>
Rural residential	1,2,6	Dermal, soil Inhalation, groundwater Oral, dairy Oral, eggs Oral, groundwater Oral, meat Oral, soil Oral, vegetables
Urban residential	3,4	Dermal, soil Dermal, sediment Dermal, surface water Inhalation, groundwater Oral, groundwater Oral, sediment Oral, soil Oral, vegetables
Commercial and industrial	5	Dermal, soil Inhalation, groundwater Oral, groundwater Oral, soil

**Table 6.6: Reference Doses and Slope Factors for Chemicals of Concern**

Chemicals of Concern	Noncarcinogenic Chronic RfD (mg/kg/day)		Carcinogenic Slope Factor (mg/kg/day) <sup>-1</sup>		Carcinogenic Weight-of-Evidence
	Oral	Inhalation	Oral	Inhalation	
Aldrin	3E-5	NE	1.7E+1	1.7E+1	B2
Arsenic	3E-4	NE	1.75	5.0E+1	A
Atrazine	5E-3	NE	2.2E-1	NE	C
Benzene	2E-2	NE	2.9E-2	2.9E-2	A
Carbon tetrachloride	7E-4	NE	1.3E-1	5.3E-2	B2
Chlordane	6E-5	NE	1.3	1.3	B2
Chloride	7.1	NE	NA	NA	NA
Chlorobenzene	2E-2	5E-3	NA	NA	NA
Chloroform	1E-2	NE	6.1E-3	8.1E-2	B2
CPMSO	2E-2 <sup>a,b</sup>	NE	NA	NA	NA
CPMSO <sub>2</sub>	2E-2 <sup>a,b</sup>	NE	NA	NA	NA
Dibromochloropropane	5E-3	5.7E-5	1.4	2.4E-3	B2
Dichlorobenzenes (as 1,2-)	9E-2	4E-2	2.4E-2	NE	C
DDE	5E-4	NE	3.4E-1	3.4E-1	B2
DDT	5E-4	NE	3.4E-1	3.4E-1	B2
1,2-Dichloroethane	7E-2	NE	9.1E-2	9.1E-2	B2
Dicyclopentadiene	3E-2	6E-5	NA	NA	NA
Dieldrin	5E-5	NE	1.6E+1	1.6E+1	B2
DIMP	8E-2 <sup>c</sup>	NE	NA	NA	NA
1,4-Dithiane	3E-1 <sup>a</sup>	NE	NA	NA	NA
Endrin	3E-4	NE	NA	NA	NA
Ethylbenzene	1E-1	3E-1	NA	NA	NA
Fluoride	6E-2	NE	NA	NA	NA
Hexachlorocyclopentadiene	7E-3	NE	NA	NA	NA
Isodrin	7E-5 <sup>a</sup>	NE	NA	NA	NA
Malathion	2E-2	NE	NA	NA	NA
Manganese	1E-1	1.1E-4	NA	NA	NA
1,4-Oxathiane	3E-1 <sup>a</sup>	NE	NA	NA	NA
Sulfate	1.1E+1	NE	NA	NA	NA
Tetrachloroethene	1E-2	1E-2	5.1E-2	1.8E-3	B2
Toluene	2E-1	1.1E-1	NA	NA	NA
Trichloroethene	4E-1 <sup>a</sup>	4E-1	1.1E-2	1.7E-2	B2
Xylene	2	8.6E-2	NA	NA	NA

## Weight of Evidence Classification

A = Human carcinogen

B1 or B2 = Probable human carcinogen. B1 indicates that limited human data are available. B2 indicates sufficient evidence in animals and inadequate or no evidence in humans.

C = Possible human carcinogen

**Table 6.6 (continued)**

CPMSO	4-chlorophenylmethyl sulfoxide
CPMSO <sub>2</sub>	4-chlorophenylmethyl sulfone
DDE	2,2-bis(p-chlorophenyl)-1,1-dichloroethene
DDT	2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane
DIMP	Diisopropylmethyl phosphonate
mg/kg/day	Milligrams per kilogram per day
NA	Not applicable
NE	Not established
RfD	Reference dose

- a. Derived from scientific literature or obtained from agencies other than EPA.
- b. Subsequent to this assessment, a Region VIII Health Advisory was issued (see letter dated January 27, 1994). This Health Advisory has not been reviewed by the other parties. The other parties may provide comments to this Health Advisory in the future. Reference to these values from EPA Region VIII's Health Advisory in this document does not constitute agreement by other parties. The Region VIII Health Advisory values are as follows:

**10-Day Longer-term**

Child	0.2 mg/l	0.02 mg/l
Adult	0.6 mg/l	0.06 mg/l

- c. This RfD is taken from the 1989 EPA Health Advisory for DIMP.

**Table 6.7: Summary of Reasonable Maximum Exposure Carcinogenic Risks by Zone and Exposure Route**

Exposure Assessment Zone	Exposure Route			Total
	Ingestion	Inhalation	Dermal	
1A*	1.1E-4	8.7E-7	1.0E-7	1.1E-4
1B*	1.3 E-4	8.7 E-7	1.0E-7	1.3 E-4
1C*	1.1E-4	8.7E-7	1.0E-7	1.1E-4
2	1.6 E-4	6.6E-5	1.0E-7	2.3 E-4
3	2.5 E-4	6.5 E-6	1.3 E-6	2.6 E-4
4	2.1E-4	1.0E-5	7.3 E-7	2.2E-4
5	2.4E-5	3.4E-6	6.7E-8	2.7E-5
6	6.9 E-5	4.0E-6	1.0E-7	7.3 E-5

\* Zone 1 is subdivided on the basis of the presence of surface water and whether the ditch water used for irrigation is collected upstream or downstream of the mouth of First Creek.

**Table 6.8: Summary of Adult Reasonable Maximum Exposure Noncarcinogenic Hazard Indices by Target Organ and Exposure Assessment Zone**

Target Organ	Exposure Assessment Zone							
	1A	1B	1C	2	3	4	5	6
Blood	1.7E-3	1.8 E-3	1.7 E-3	1.9E-3	2.4E-3	2.9E-3	---	---
Cardiovascular	1.6 E-2	2.0E-2	1.6 E-2	3.8 E-2	9.0E-2	5.4E-2	---	2.5E-2
CNS	2.4E-2	2.6 E-2	2.3 E-2	8.4E-1	2.4E-1	2.4E+0	6.6E-2	1.6 E-3
Gastrointestinal	1. 5E-4	3.1E-4	1.5 E-4	3.5 E-4	4.3E-4	4.2E-4	4.9E-5	---
Hepatic	1.8 E-1	2.1E-1	1.8 E-1	1.1E+0	1.3E+0	9.0E-1	7.2E-2	2.0E-1
Ocular	---	---	---	---	3.1E-4	2.8E-4	---	---
Renal	7.0E-3	7.4E-3	7.0E-3	2.3 E-1	8.1E-2	1.1E-1	2.0E-2	8.8 E-1
Respiratory	2.4E-4	2.4E-4	2.4 E-4	2.3 E-4	5.8E-4	2.8E-3	---	---
Skin	2.0E-1	2.3 E-1	2.0E-1	1.7 E-1	2.3E-2	3.1E-1	8.7E-2	---

--- Chemicals for this target organ not detected in this zone

CNS Central nervous system

**Table 7.1: Containment System Remediation Goals for the  
Offpost Groundwater Intercept and Treatment System**

Analyte	CSRG ( $\mu\text{g/l}$ )	Source	PQL <sup>a</sup>	Rural Residential Hypothetical Cancer Risk <sup>b</sup>
1,2-Dichloroethane	0.4	CBSG	1.0 <sup>c</sup>	9.1 x 10 <sup>-7</sup>
1,3-Dichlorobenzene	6.5	HBC		NA
1,4-Oxathiane	160	HBC		NA
Aldrin	0.002	CBSG	0.05 <sup>d</sup>	4.0 x 10 <sup>-7</sup>
Atrazine	3	MCL, CBSG		NA
Benzene	3	HBC		2.0 x 10 <sup>-6</sup>
Carbon tetrachloride	0.3	CBSG	0.99 <sup>d</sup>	7.9 x 10 <sup>-7</sup>
Chlordane	0.03	CBSG	0.095 <sup>d</sup>	5.7 x 10 <sup>-7</sup>
Chlorobenzene	25	HBC		NA
Chloroform	6	CBSG		6.4 x 10 <sup>-6</sup>
CPMS	30	HBC		NA
CPMSO	36	HBC		NA
CPMSO2	36	HBC		NA
DBCP	0.2	MCL, CBSG		3.8 x 10 <sup>-6</sup>
DCPD	46	HBC		NA
DDE	0.1	CBSG		8.5 x 10 <sup>-7</sup>
DDT	0.1	CBSG		4.1 x 10 <sup>-7</sup>
Dieldrin	0.002	CBSG	0.05 <sup>d</sup>	1.2 x 10 <sup>-6</sup>
DIMP	8	CBSG		NA
Dithiane	18	HBC		NA
Endrin	0.2	CBSG		NA
Ethylbenzene	200	HBC		NA
Hexachlorocyclopentadiene	0.23	HBC		NA
Isodrin	0.06	HBC		NA
Malathion	100	HBC		NA
NDMA	0.007	(e)	0.033	1.0 x 10 <sup>-5</sup>
Tetrachloroethylene	5	MCL, CBSG		4.0 x 10 <sup>-6</sup>
Toluene	1,000	MCL, CBSG		NA
Trichloroethylene	3	HBC		9.9 x 10 <sup>-7</sup>
Xylenes	1,000	HBC		NA
Arsenic	2.35	HBC		5.6 x 10 <sup>-5</sup>
Chloride	250,000 <sup>f</sup>	CBSG		NA
Fluoride	2,000	CBSG		NA
Sulfate	250,000 <sup>g</sup>	CBSG		NA
Total <sup>h</sup>				8.8 x 10 <sup>-5</sup>

**Table 7.1 (continued)**

The following chemical have ARARs that were adjusted downward to reduce overall risk: arsenic, benzene, chlorobenzene, 1,3-dichlorobenzene, trichloroethylene, and xylene.

CBSG	Colorado Basic Standards for Groundwater
CPMS	4-chlorophenylmethyl sulfide
CPMSO	4-chlorophenylmethyl sulfoxide
CPMSO <sub>2</sub>	4-chlorophenylmethyl sulfone
CSRG	Containment system remediation goal
DBCP	Dibromochloropropane
DPCPD	Dicyclopentadiene
DDE	2,2-bis(p-chlorophenyl)-1,1-dichloroethene
DDT	2,2-bis(p-chlorophenyl)-1,1,1-trichloroethane
DIMP	Diisopropylmethyl phosphonate
HBC	Health-based criteria
MCL	Maximum containment level
NA	Not applicable
NDMA	N-nitrosodimethylamine
PQL	Practical quantitation limit
µg/l	Micrograms per liter

- a. Practical quantitation limit; presented only when the PQL is greater than the CSRG.
- b. Based on the CSRG.
- c. PQL listed in the CBSG standards
- d. PQL attainable by the U.S. Army
- e. The remediation goal for NDMA was established at 0.007 parts per trillion (ppt) in the Conceptual Remedy Agreement. The current PQL readily available is 0.033 ppt. The estimated risk associated with NDMA is based on a 70-year residential exposure duration.
- f. Inorganic standard for chloride will be met by natural attenuation consistent with the onpost remedial action.
- g. Inorganic standard for sulfate may be the natural background concentration, which will be established and met by natural attenuation consistent with onpost remedial action.
- h. Because of the variability in contaminant distribution and concentration, the maximum risk associated with the groundwater cleanup concentrations is not expected to occur at any one location.

**Table 7.2: Containment System Remediation Goals for the North Boundary Containment System**

Analyte	CSRG ( $\mu\text{g/l}$ )	Source	PQL <sup>a</sup>	Rural Residential Hypothetical Cancer Risk <sup>b</sup>
1,2-Dichloroethane	0.4	CBSG	1.0 <sup>c</sup>	$9.1 \times 10^{-7}$
1,2-Dichloroethylene	70	CBSG		NA
1,4-Oxathiane	160	HBC		NA
Aldrin	0.002	CBSG	0.05 <sup>d</sup>	$4.0 \times 10^{-7}$
Atrazine	3	MCL, CBSG		NA
Benzene	3	HBC		$2.0 \times 10^{-6}$
Carbon tetrachloride	0.3	CBSG	0.99 <sup>d</sup>	$7.9 \times 10^{-7}$
Chloroform	6	CBSG		$6.4 \times 10^{-6}$
CPMS	30	HBC		NA
CPMSO	36	HBC		NA
CPMSO <sub>2</sub>	36	HBC		NA
DBCP	0.2	MCL, CBSG		$3.8 \times 10^{-6}$
DCPD	46	HBC		NA
Dieldrin	0.002	CBSG	0.05 <sup>d</sup>	$1.2 \times 10^{-6}$
DIMP	8	CBSG		NA
Dithiane	18	HBC		NA
Endrin	0.2	CBSG		NA
Isodrin	0.06	HBC		NA
Malathion	100	HBC		NA
Methylene chloride	5.0	MCL, CBSG		NA
NDMA	0.007	(e)	0.033	$1.0 \times 10^{-5}$
Tetrachloroethylene	5	MCL, CBSG		$4.0 \times 10^{-6}$
Toluene	1,000	MCL, CBSG		NA
Trichloroethylene	3	HBC		$9.9 \times 10^{-7}$
Xylenes	1,000	HBC		NA
Arsenic Chloride	2.35	HBC		$5.6 \times 10^{-5}$
Fluoride	250,000 <sup>f</sup>	CBSG		NA
Sulfate	2,000	CBSG		NA
	250,000 <sup>g</sup>	CBSG		NA
Total <sup>h</sup>				$8.0 \times 10^{-5}$

Methylene chloride is a common laboratory contaminant and analytical anomalies are anticipated during compliance monitoring.

The following chemical have ARARs that were adjusted downward to reduce overall risk: arsenic benzene, chlorobenzene, trichloroethylene, and xylene.

**Table 7.2 (continued)**

CBSG	Colorado Basic Standards for Groundwater
CPMS	4-chlorophenylmethyl sulfide
CPMSO	4-chlorophenylmethyl sulfoxide
CPMSO <sub>2</sub>	4-chlorophenylmethyl sulfone
CSRG	Containment system remediation goal
DBCP	Dibromochloropropane
DCPD	Dicyclopentadiene
DIMP	Diisopropylmethyl phosphonate
HBC	Health-based criteria
MCL	Maximum containment level
NA	Not applicable
NDMA	N-nitrosodimethylamine
PQL	Practical quantitation limit
µg/l	Micrograms per liter

- a. Practical quantitation limit; presented only when the PQL is greater than the CSRG.
- b. Based on the CSRG
- c. PQL listed in the CBSG standards
- d. PQL attainable by the U.S. Army
- e. The remediation goal for NDMA was established at 0.007 parts per trillion (ppt) in the Conceptual Remedy Agreement. The current PQL readily available is 0.033 ppt. The estimated risk associated with NDMA is based on a 70-year residential exposure duration.
- f. Inorganic standard for chloride will be met by natural attenuation consistent with the onpost remedial action.
- g. Inorganic standard for sulfate may be the natural background concentration, which will be established and met by natural attenuation consistent with onpost remedial action.
- h. Because of the variability in contaminant distribution and concentration, the maximum risk associated with the groundwater cleanup concentrations is not expected to occur at any one location.

**Table 7.3: Containment System Remediation Goals for the Northwest Boundary Containment System**

Analyte	CSRG ( $\mu\text{g/l}$ )	Source	PQL <sup>a</sup>	Rural Residential Hypothetical Cancer Risk <sup>b</sup>
Chloroform	6	CBSG		$6.4 \times 10^{-6}$
DIMP	8	CBSG		NA
Dieldrin	0.002	CBSG	0.05 <sup>c</sup>	$1.2 \times 10^{-6}$
Endrin	0.2	CBSG		NA
Isodrin	0.06	HBC		NA
NDMA	0.007	(d)	0.033	$1.0 \times 10^{-5}$
Trichloroethylene	3	HBC		$9.9 \times 10^{-7}$
Arsenic	2.35	HBC		$5.6 \times 10^{-5}$
Chloride	250,000 <sup>e</sup>	CBSG		NA
Fluoride	2,000	CBSG		NA
Sulfate	250,000 <sup>f</sup>	CBSG		<u>NA</u>
			Total <sup>g</sup>	$7.5 \times 10^{-5}$

The following chemical have ARARs that were adjusted downward to reduce overall risk: arsenic and trichloroethene.

CBSG Colorado Basic Standards for Groundwater  
DIMP Diisopropylmethyl phosphonate  
HBC Health-based criteria  
MCL Maximum containment level  
NA Not applicable  
NDMA N-nitrosodimethylamine  
PQL Practical quantitation limit  
 $\mu\text{g/l}$  Micrograms per liter

- a. Practical quantitation limit; presented only when the PQL is greater than the CSRG.
- b. Based on the CSRG
- c. PQL attainable by the U.S. Army
- d. The remediation goal for NDMA was established at 0.007 parts per trillion (ppt) in the Conceptual Remedy Agreement. The current PQL readily available is 0.033 ppt. The estimated risk associated with NDMA is based on a 70-year residential exposure duration.
- e. Inorganic standard for chloride will be met by natural attenuation consistent with the onpost remedial action.
- f. Inorganic standard for sulfate may be the natural background concentration, which will be established and met by natural attenuation consistent with onpost remedial action.
- g. Because of the variability in contaminant distribution and concentration, the maximum risk associated with the groundwater cleanup concentrations is not expected to occur at any one location.

**Table 7.4: Groundwater Alternatives for the North and Northwest Plume Groups**

Alternative*		Process Options	Paloochannel	Extractions Wells (total number)	Recharge Wells/Trenches (total number/total length)	Flow Rate (gpm)	Remediation Timeframe (years)	Treatment Facility Location	Residuals Generated
<b>North Plume Group</b>									
N-1	No action	Monitoring site reviews	FC, N	None	None	N/A	Unknown	N/A	None
N-2	Continued operation of the NBCS with improvements as necessary	NBCS operation (soil-bentonite barrier, carbon adsorption)	FC, N	No additional	No additional	240	15 to 30+	NBCS	No additional
N-4	Offpost Intercept and Treatment System	Carbon adsorption NBCS operation	FC N	5 12	6 trenches/1500 feet	180 300	15 to 30	T2S, R67W, NE 1/4 Sec.	Spent carbon
N-5	Expansion of the Offpost Intercept and Treatment System	Carbon adsorption NBCS operation	FC N	7 13	10 trenches/ 2700 feet 2 trenches/600 feet	240 330	10 to 20	T2S, R67W, NE 1/4 Sec.	Spent carbon
<b>Northwest Plume Group</b>									
NW-1	No action	Monitoring site reviews	NW	None	None	N/A	Unknown	N/A	None
NW-2	Continued operation of the NWBCS with improvements as necessary	NWBCS operation	NW	No additional	No additional	850	3 to 8	NWBCS	No additional

FC First Creek  
gpm Gallons per minute  
N/A Not applicable  
N Northern  
NBCS North Boundary Containment System  
NW Northwest  
NWBCS Northwest Boundary Containment System

\* All alternatives include groundwater monitoring and site reviews.

**Table 8.1: Summary of the Detailed Analysis and Ranking of Groundwater Alternatives for the North Plume Group**

Criteria	Alternative N-1 No Action	Alternative N-2 Continued Operation of the North Boundary Containment System With Improvements as Necessary	Alternative N-4 Offpost Intercept and Treatment System	Alternative N-5 Expansion 1 to Interim Response Action A
Overall protection of human health and the environment	This alternative would not provide protection of human health and the environment.	This alternative provides limited overall protection of human health and the environment by preventing migration of contaminants from RMA to the Offpost Study Area north of the NBCS. Potential risk associated with groundwater in the North Plume Group would decrease over time.	This alternative reduces potential risk and provides protection of both human health and the environment by remediating North Plume Group groundwater and groundwater migrating from RMA to the Offpost Study Area.	This alternative reduces potential risk and provides protection of both human health and the environment by remediating North Plume Group groundwater and groundwater migrating from RMA to the Offpost Study Area.
Compliance with ARARs	This alternative is not expected to achieve chemical-specific ARARs.	Chemical-specific ARARs would be attained in approximately 15 to 30-plus years, as estimated by groundwater modeling.	Chemical-specific ARARs would be attained in approximately 15 to 30 years, as estimated by groundwater modeling.	Chemical-specific ARARs would be attained in approximately 10 to 20 years, as estimated by groundwater modeling.
Long-term effectiveness and permanence	This alternative would not reduce the residual risk associated with groundwater exposure pathways.	This alternative would reduce residual risk associated with North Plume Group groundwater by preventing contaminant migration at the NBCS and continuing recharge of treated groundwater to flush contaminants in the North Plume Group.	This alternative would reduce residual risk associated with North Plume Group groundwater, through operation of the NBCS and the Offpost Intercept and Treatment System and improvements to both systems as necessary.	Through treatment, this alternative would reduce residual risk associated with North Plume Group groundwater through operation of the NBCS, the Offpost Intercept and Treatment System, and the Expansion 1 system.
Reduction of mobility, toxicity, or	This alternative would not employ any treatment process options and would not reduce toxicity, mobility, or volume of groundwater within the North Plume Group or groundwater migrating from RMA to the Offpost Study Area.	This alternative would reduce toxicity, mobility, and volume of groundwater migrating from RMA to the Offpost Study Area.	Through treatment, this alternative would reduce toxicity, mobility, and volume of groundwater within the North Plume Group and groundwater migrating from RMA to the Offpost Study Area.	Through treatment, this alternative would reduce the toxicity, mobility, and volume of groundwater within the North Plume Group and groundwater migrating from RMA to the Offpost Study Area.

**Table 8.1 (continued)**

Criteria	Alternative N-1 No Action	Alternative N-2 Continued Operation of the North Boundary Containment System With Improvements as Necessary	Alternative N-4 Offpost Intercept and Treatment System	Alternative N-5 Expansion 1 to Interim Response Action A
Short-term effectiveness	Because no remedial action would be performed, there would be no short term impacts. There would be no implementation period.	There would be no short-term impacts because the NBCS is already operating. There would be no implementation period.	Community and workers were protected by adhering to standard health and safety practices. The implementation period is complete and the system is fully operational.	Community and workers would be protected during construction through adhering to standard health and safety practices. The implementation period would be approximately 14 months.
Implementability	Technical feasibility would be high. The administrative feasibility would be low.	This alternative is readily implementable. Technical and administrative feasibility would be high.	This alternative is readily implementable. Technical and administrative feasibility would be high.	This alternative is readily implementable. However, the construction would be conducted in two time periods due to the design phase for the expansion. Technical and administrative feasibility would be high.
Estimated cost	Total Capital Cost = \$ -0-  Total Long-term O&M Cost = \$4.1 to 6.0 million  Total Present Worth Cost = \$4.1 to 6.0 million	Total Capital Cost = \$ -0-  Total Long-term O&M Cost = \$30.6 to 32.5 million  Total Present Worth Cost = \$30.6 to 32.5 million	Total Capital Cost = \$16.7 million  Total Long-term O&M Cost = \$39.8 to 46.4 million  Total Present Worth Cost = \$56.5 to 63.1 million	Total Capital Cost = \$19.4 million  Total Long-term O&M Cost = \$36.9 to 43.6 million  Total Present Worth Cost = \$56.2 to 63 million

ARAR Applicable or relevant and appropriate requirement  
NBCS North Boundary Containment System  
O&M Operation and maintenance  
RMA Rocky Mountain Arsenal

**Table 8.2: Summary of the Detailed Analysis and Ranking of Groundwater Alternatives for the Northwest Plume Group**

Criteria	Alternative NW-1 No Action	Alternative NW-2 Continued Operation of the Northwest Boundary Containment System With Improvements as Necessary
Overall Protection of Human Health and the Environment	This alternative would not provide protection of human health and the environment.	This alternative would provide protection of human health and the environment by preventing migration of contaminants from RMA to the Offpost Study Area north of the NWBCS. Potential risks associated with the Northwest Plume Group groundwater would be substantially reduced through continued operation of the NWBCS and improvements as necessary.
Compliance With ARARs	This alternative is not expected to achieve chemical-specific ARARs.	This alternative is expected to meet or exceed chemical-specific ARARs in approximately three to eight years, as estimated by groundwater modeling.
Long-term Effectiveness and Permanence	This alternative would not reduce the residual risk associated with potential groundwater exposure pathways.	This alternative would reduce residual risk associated with groundwater within the Northwest Plume Group through preventing contaminant migration at the NWBCS and recharging treated groundwater to flush contaminants in the Northwest Plume Group.
Reduction of Toxicity, Mobility, or Volume	This alternative would not employ any treatment process options and would not reduce the toxicity, mobility, or volume of groundwater within the Northwest Plume Group or groundwater migrating from RMA to the Offpost Study Area.	This alternative would reduce toxicity, mobility, and volume of groundwater migrating from RMA to the Offpost Study Area. Groundwater contaminant concentrations would be reduced within the Northwest Plume Group by flushing provided by recharge of treated water at the NWBCS.
Short-term Effectiveness	Because no remedial action would be performed, there would be no short-term impacts. There would be no implementation period.	There would be no short-term impacts. There would be no implementation period.
Implementability	The technical feasibility would be high. The administrative feasibility would be low.	This alternative is readily implementable. Technical and administrative feasibility would be high.
Estimated cost	Total Capital Cost = \$ -0-  Total Long-term O&M Cost = \$0.6 to 1.3 million  Total Present Worth Cost = \$0.6 to 1.3 million	Total Capital Cost = \$ -0-  Total Long-term O&M Cost = \$12.4 to 13.1 million  Total Present Worth Cost = \$12.4 to 13.1 million

**Table 8.2 (continued)**

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ARAR	Applicable or relevant and appropriate requirement
NWBCS	Northwest Boundary Containment System
O&M	Operation and maintenance
RMA	Rocky Mountain Arsenal

**Table 9.1: Estimated Costs of the Offpost Operable Unit Selected Remedy**

Cost Component	Alternative N-4	Alternative NW-2 <sup>a</sup>
<b>Capital Costs</b>		
Monitoring well system	\$ 908,000	NA
Offpost Intercept and Treatment	4,593,000	NA
System extraction/recharge system		
Treatment facility	4,106,000	NA
Startup costs	341,000	NA
Indirect costs	<u>6,715,000</u>	<u>NA</u>
Total estimated capital costs	\$ 16,663,000	\$0
<b>Annual Operation and Maintenance Costs</b>		
Groundwater monitoring	\$ 352,000	\$ 134,000
Site reviews	150,000	150,000
North and northwest boundary system operations	1,724,000	769,000
Offpost Intercept and Treatment	522,000	NA
System facility O&M		
Offpost Intercept and Treatment		
System carbon replacement <sup>b</sup>		
0 to 3/5 years	817,000	NA
3/5 years to system shutdown	227,000	NA
Total estimated Annual O&M Costs		
0 to 3/5 years	\$ 4,618,000	
3/5 years to system shutdown	\$ 4,028,000	\$ 1,053,000
	<u>Nonconservative<sup>c</sup></u>	<u>Conservative<sup>c</sup></u>
Total remedy costs	\$ 68,911,000	\$ 76,143,000

DIMP Diisopropylmethyl phosphonate  
 NA Not applicable  
 O&M Operation and maintenance

- a. There are no capital costs for Alternative NW-2 because the remedial systems are currently operational.
- b. The carbon usage rate is assumed to decrease over time as a result of expected decreases in influent DIMP concentration. The duration of time before a decrease in carbon usage rate is expected to occur within three to five years.
- c. A range of total costs has been estimated on the basis of the range of expected remediation timeframes as estimated by the groundwater model results.

**Table 10.1: Summary Evaluation of Chemical-specific and Other Applicable or Relevant and Appropriate Requirements for the Off post Operable Unit**

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate Requirement	Comment
<b>Chemical-specific ARARs</b>				
Safe Drinking Water Act	40 CFR Part 141	Establishes primary MCLs for public water-supply systems.	No/Yes	Groundwater in the vicinity of the site is being used or may be used as a source of water for public water system or private supply wells. Therefore, those primary MCLs that are more stringent than the Colorado Primary Drinking Water Regulations (because Colorado has primary enforcement authority) are relevant and appropriate.
	40 CFR Sections 14150 and 14151	Establishes MCLGs (nonenforceable health goals) for public water systems.	No/Yes	Groundwater in the vicinity of the site is being used or may be used as a source of water for a public water system or private supply wells. Therefore, in accordance with the NCP, nonzero MCLGs are considered to be relevant and appropriate.
<b>Other ARARs</b>				
Colorado Basic Standards for Groundwater; Colorado Basic Standards and Methodologies for Surface Water	5 CCR 1002-8 Section 3.11.0 et seq.; Section 3.1.0 et seq.	Establishes statewide standards for waters of the state.	Yes/No	State standards that are more stringent than federal standards are considered applicable.

**Table 10.2: Summary Evaluation of Action-specific Applicable or Relevant and Appropriate Requirements for the Offpost Operable Unit**

Standard, Requirement, Criterion, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate Action-specific Requirement	Comment
<b>Federal ARARs</b>				
Safe Drinking Water Act	42 USC Sections 300h to 300h-7			
Underground Injection Control Regulations	40 CFR Parts 144 to 147	Establishes standards for construction and operation of injection wells/trenches	Yes/No	Applicable if reinjection wells/trenches are used for discharge of treated water; relevant and appropriate if some other method of reinjection is used.  Under the provisions of 40 CFR 144.13(l), EPA has determined that the reinjection wells/trenches used in conjunction with the barrier treatment system do not endanger underground sources of drinking water. The level of treatment prior to reinjection, offpost alternative water supplies, and other remedies are sufficient to meet the requirements of the UIC program.
Colorado Air Quality Standards	CRS Sections 25-7-101 to 25-7-806			
Odor Emission Regulations	Colorado Air Quality Control Regulation No. 2	Sets limits on emission of odorous air contaminants	Yes/No	Applicable to remedial action for the Offpost OU.

ARAR    Applicable or relevant and appropriate requirement  
 CFR    Code of Federal Regulations  
 CRS    Colorado Revised Statutes  
 OU    Operable unit  
 EPA    U.S. Environmental Protection Agency  
 UIC    \_\_\_\_\_  
 USC    United States Code  
 VOC    Volatile organic compound

**Table 10.3: Summary Evaluation of Location-specific Applicable or Relevant and Appropriate Requirements for the Offpost Operable Unit**

Standard, Requirement Criteria, or Limitation	Citation	Description	Applicable/ Relevant and Appropriate Location-specific Requirements	Comment
Federal ARARs Executive Order 11988 - Flood Plain Management	40 CFR Part 6, Appendix A	Directs federal agencies to avoid long- or short-term impacts associated with occupancy and modification of a floodplain.	Yes/No	Requires a 500-year floodplain to be identified and considered in scoping any remedial actions.
Executive Order 11990	40 CFR Part 6, Appendix A	Minimizes the destruction, loss, or degradation of wetlands.	Yes/No	Requirements associated with this order would be applicable to any remedial actions that could affect the existing wetlands.

ARAR    Applicable or relevant and appropriate requirement  
 CFR     Code of Federal Regulations