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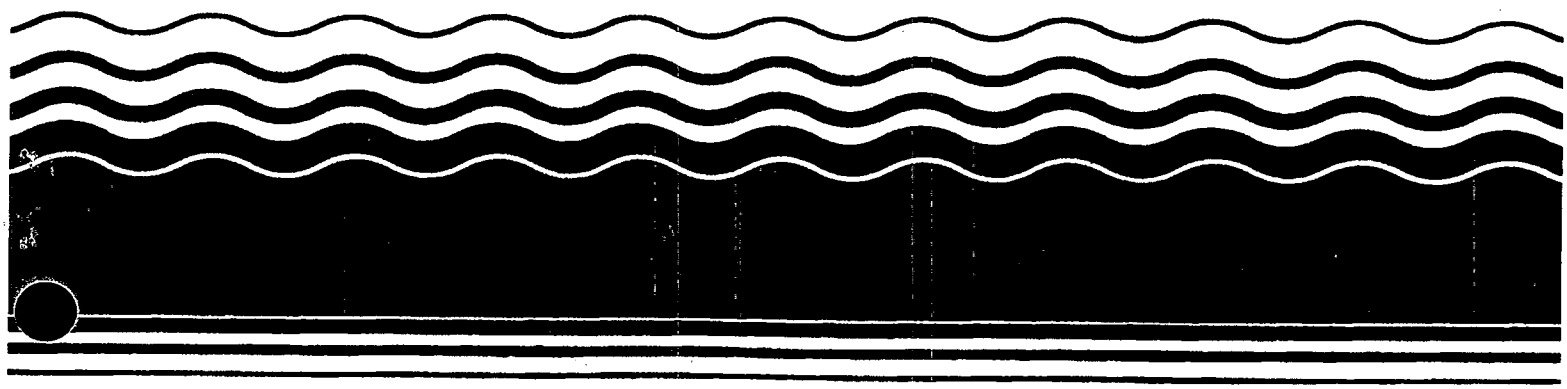
Record of Decision:

Ace Services Site
Colby, KS
5/5/1999



RECORD OF DECISION

Ace Services Site
Colby, Kansas

Prepared by:

U.S. Environmental Protection Agency
Region VII

Kansas City, Kansas

April 1999

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Abbreviations and Acronyms

ARARs	Applicable or Relevant and Appropriate Requirements
AWQC	Ambient Water Quality Criteria
ATSDR	Agency for Toxic Substances and Disease Registry
BGS	Below Ground Surface (bgs)
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	Contaminant of Concern
Cr	Chromium
Cr(III)	Trivalent Chromium
Cr(VI)	Hexavalent Chromium
DO	Dissolved Oxygen
ECP	Electrochemical Precipitation
Eh	Oxidation/Reduction Potential
EPA	U.S. Environmental Protection Agency
EP&RB	Emergency Planning and Response Branch
EX	Extraction Well
FS	Feasibility Study
FT	Feet (ft)
GPM	Gallons Per Minute (gpm)
HBSL	Health-Based Screening Levels
HDPE	High Density Polyethylene
HP	Horsepower
IRIS	Integrated Risk Information System
KDHE	Kansas Department of Health and Environment
MCL	Maximum Contaminant Level
MG/KG	Milligram Per Kilogram (mg/kg)
MPW	Multiport Well
MW	Monitoring Well
NCP	National Contingency Plan
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
O&M	Operation and Maintenance
OSHA	Occupational Safety and Health Administration

Abbreviations and Acronyms (Continued)

OSWER	Office of Solid Waste and Emergency Response
PEL	Permissible Exposure Level
PA/SI	Preliminary Assessment and Scanning Site Investigation
pH	Log Concentration of Hydrogen Ions
POTW	Publicly Owned Treatment Works
PLC	Programmable Logic Controller
PVC	Polyvinyl Chloride
PWS	Public Water Supply
RAO	Remedial Action Objective
RBC	Risk Based Concentration
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
RW	Residential Well
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SSW	Shallow Sampling Well
TBC	To Be Considered
TCLP	Toxicity Characteristic Leaching Procedure
μg/L	Micrograms Per Liter
USC	United States Code
WWT	Wastewater Treatment

I. DECLARATION

Declaration for the Record of Decision

Ace Services Site

Colby, Kansas

Site Name and Location

The Ace Services Site, CERCLIS identification number KSD046746731, is located in Colby, Kansas. Colby, Kansas, is an agricultural community in the central section of Thomas County, about 350 miles west of Kansas City, Kansas.

Statement of Basis and Purpose

This decision document presents the selected remedial action for the Ace Services Site, in Colby, Kansas, which was chosen by the United States Environmental Protection Agency in accordance with 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), 40 C.F.R. Part 300. This decision is based on the administrative record for this site. The state of Kansas concurs with the selected remedy.

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 Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of Selected Remedy

This ROD addresses contaminated groundwater and contamination within on-site buildings. Evaluation of soil data has determined that removal actions performed at the

site have eliminated health concerns from exposure to contaminated surface soils at the site. The principal threat at this site is metals contamination in the on-site buildings; another major threat is metals contamination in groundwater. The specific metals which have been identified as contaminants of concern (COCs) are hexavalent chromium [Cr(VI)] and lead.

The presence of hexavalent chromium in the groundwater at the site presents a threat to any future on-site or off-site resident users of groundwater. The major components of the selected remedy for groundwater include the following:

- Institutional controls including deed restrictions, as permitted by law, to prevent use of contaminated groundwater.
- Active restoration of the aquifer by pumping and treating the contaminated groundwater.
- Treatment of contaminated groundwater by electrochemical reduction and precipitation techniques.
- Discharge of treated groundwater to the on-site tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater will be discharged to the local Colby publically owned treatment works (POTW) and, at the option of state and local authorities, the treated groundwater may be beneficially reused rather than discharged.
- In-situ bioremediation of contaminated groundwater is possible, as indicated by the results of treatability studies during design.
- Groundwater monitoring and periodic review of results.

The presence of lead in dust in on-site buildings and contamination on interior surfaces poses potential health concerns for industrial or commercial uses. The major components of the selected remedy for on-site buildings include the following:

- Institutional controls, as permitted by law, to prevent residential use of the site and buildings and to prevent removal of floors and soils beneath the building.
- Removal of contaminated interior concrete surfaces by grit blasting.
- Decontamination of building interiors by dusting, vacuuming, and wiping.
- Disposal of decontamination debris as appropriate, if necessary at a Resource Conservation and Recovery Act (RCRA) facility.

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, is cost-effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. This remedy also satisfies the statutory preference for remedies that employ treatment as a principal element (i.e., reduce toxicity, mobility, or volume of contaminants through treatment). Because hazardous substances above health-based levels are expected to continue to be on-site in 5 years, a review will be conducted within 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Data Certification Checklist

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

- Contaminants of concern (COCs) and their respective concentrations.
- Baseline risk represented by the COCs.
- Cleanup levels established for COCs and the basis for the levels.
- Current and future land use assumptions from the baseline risk assessment.
- Land use that will be available at the site as a result of the selected remedy.
- Estimated capital, operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected.
- Decisive factors that lead to selecting the remedy.

Authorizing Signature

Michael J. Sanderson
Director
Superfund Division
U.S. Environmental Protection Agency
Region VII

May 5, 1999
Date

II. DECISION SUMMARY

Decision Summary

1.0 Site Name, Location, and Description

This Record of Decision (ROD) was developed by the U.S. Environmental Protection Agency (EPA), as lead agency, with support from the Kansas Department of Health and Environment (KDHE).

The Ace Services site (EPA Identification No. KSD046746731) contains the Ace Services property and includes the chromium groundwater plume for the area where chromium concentrations are greater or equal to 100 micrograms per liter (μg/L). The Ace Services property is located at 345 Convesse Avenue in Colby, Kansas, Thomas County. The site lies in the southeast 1/4 of Section 31, Township 7 South, Range 33 West. The geographic coordinates are approximately 100° 2' 10" west longitude and 39° 23' 47" north latitude. A location map is presented as Figure 1. A site map is presented as Figure 2. The approximate site boundary as indicated by the 100 μg/L Cr(VI) contour plume is illustrated on Figure 3.

2.0 Site History and Enforcement Activities

The Ace Services facility was a plating shop where chrome plating was applied to sickle bar knives used on farm equipment. The facility currently includes two buildings (a former plating shop and a former machine shop/office building), an inactive groundwater recovery well, and an area of soil and concrete rubble fill at the location of the former lagoon. The former plating shop contained three concrete/cinder block troughs where vats of plating solutions were located during former business operations. A 1,000-square-foot building that was attached to the east side of the plating shop housed a wastewater treatment (WWT) facility, used by Ace Services. The WWT annex had four concrete basins that contained fluids during the wastewater treatment process. A 200-square-foot cinder block building that was located directly south of the WWT building contained an acetylene generator used by Ace for welding operations. The WWT building and acetylene generator/chemical storage building were demolished during an EPA removal action in 1994. The machine shop is immediately south of the plating shop.

The KDHE records indicate that a chrome plating facility has operated at the present location of the Ace Services facility from approximately 1954 to 1990. The facility was owned and operated by a company known as Northwest Manufacturing from approximately 1954 until 1969, when Ace Services was formed and began operations at the facility. Prior to the chrome plating operations, a brick making plant may have been located at the site in the early 1900s.

The contaminants at the Ace Services facility were released as a result of chromium electroplating operations. The source of chromium was the chromic acid solution in the plating vats. Lead was also present, probably as lead chromate, which is formed when lead anodes are used in the plating process. Both contaminants entered the environment from leaks and spills during plating operations, and from discharges of the faulty wastewater treatment system.

The treatment system inadequately treated wastes and resulted in discharges from the facility exceeding wastewater effluent limitations. The facility added a surface impoundment, or lagoon, to the system to control discharges to the unnamed tributary of Prairie Dog Creek east of the site. Resulting sludges from the surface impoundment and the underlying soils were found to be contaminated with lead and chromium; groundwater in the area has been found to be contaminated with chromium.

The KDHE and EPA involvement with the site began in 1971 after KDHE received a citizen complaint reporting that Ace Services was discharging wastewater to the ground and the nearby unnamed tributary of Prairie Dog Creek. The Ace Services site was first identified for investigation under the Superfund program in 1980 by KDHE. A Preliminary Assessment and Scanning Site Investigation (PA/SI) was performed by KDHE in 1989. A Listing Site Investigation was performed by KDHE in 1991 which included the installation of three groundwater monitoring wells. Removal actions were performed by KDHE in 1981 and 1992 for contaminated sludges and remaining process wastes, and by EPA in 1994 for contaminated soils and contaminated building debris. The site was added to the National Priorities List (NPL) in September 1995. In 1996, EPA continued remedial investigation activities for groundwater and also conducted surface soil and building media sampling.

3.0 Community Participation

The Human Health Baseline Risk Assessment, the Remedial Investigation (RI) Report, the Final Feasibility Study (FS) Report, and supporting documentation in the Administrative Record were made available to the public for a public comment period which began on December 4, 1998, and ended on January 4, 1999. The documents were available at EPA Region VII Headquarters in Kansas City, Kansas, and the Pioneer Memorial Library in Colby, Kansas. The notice of the availability of these documents and the time and location of the public meeting was published in the *Colby Free Press* on December 4, 1998. A fact sheet summarizing the proposed plan and preferred alternative was mailed to residents and local authorities on December 2, 1998. A public meeting was held during the public comment period at Colby, Kansas, on December 16, 1998. At the meeting, the conclusions of the Remedial Investigation/Feasibility Study (RI/FS) of the site were presented to highlight the reasons for recommending the preferred remedial alternative and public comments were received.

Comments received at the public meeting, as well as written comments submitted during the comment period, are addressed in the Responsiveness Summary Section of this ROD, the document which formalizes the selection of the remedy.

4.0 Site Characteristics

An RI was conducted to determine the nature and extent of contamination at the site and potential contaminant fate and transport scenarios. Also, KDHE and EPA have performed removal actions at the site. The following sections present brief descriptions of the site characteristics based on the previous investigations and removal actions at the site.

4.1 Groundwater

The Ogallala Aquifer is the aquifer below the site that has been contaminated by releases at the site. Groundwater at the site flows predominantly to the east.

Groundwater sampling and analysis efforts have been performed at the site since 1980. The KDHE performed extensive groundwater sampling and analysis in 1996. This investigation was followed by a Phase 1 Remedial Investigation (RI) for groundwater that was conducted by EPA in 1996 and a Phase 2 RI conducted in 1997. During the KDHE investigation and the EPA RI, chromium contamination of the groundwater was identified.

The nature and extent of contamination in groundwater at the site were evaluated during the RI by sampling 13 wells and developing a groundwater model using MODFLOW and MODPATH. Analytical results of the groundwater samples indicate the presence of chromium in the groundwater; lead was not present above detection limits in the groundwater. Comparing results of the total chromium (Cr) and hexavalent chromium (Cr(VI)) analyses indicates that most or all of the total chromium is in the hexavalent state. Furthermore, comparing total analyte results with dissolved analyte results indicate all chromium present is in the dissolved state, i.e., hexavalent chromium. The extent of hexavalent chromium contamination in the groundwater is presented in Figures 3 and 4.

4.2 Exterior Soils

Contaminated soils were identified at the site in 1980. Sediment samples collected from the unnamed tributary of Prairie Dog Creek during the PA/SI by KDHE in 1989 were found to be below site action levels, selected by EPA in consulatation with KDHE, for total chromium and lead (1,500 mg/kg and 500 mg/kg, respectively). A removal action for chromium and lead contaminated soil from the Ace Services site was completed by EPA Region VII Emergency Planning and Response Branch (EP&RB) in 1994. Following the removal of contaminated soil based on the action levels, the excavated areas of the lagoon and former location of the wastewater treatment building were backfilled with clean soils. The areas were seeded, watered, and covered with straw prior to de-mobilization. The risk assessment re-evaluated exterior soils by comparing concentrations of remaining contaminants to current industrial action levels. The re-evaluation concluded there is adequate protection of human health and the environment for an industrial setting from exposure to contaminated soils.

4.3 On-site Buildings

The 1994 removal action remediated the buildings for chromium and lead contaminated concrete, cinder blocks, associated soils, and dust. The plating vat troughs and the underlying soil in the plating shop were excavated and disposed. Following the removal of contaminated soil based on the action levels, the plating troughs excavation area was backfilled with clean soil. The troughs were capped with a 4- to 6-inch layer of concrete in order to complete the floor inside the plating shop. To prevent the building from collapsing, contaminated soil was not removed from around the building support piers.

After excavation, chromium-colored staining was observed collecting at the excavation face. This was believed to be caused by chromium-contaminated water in the soil moving to the open face due to the low humidity. These issues were discussed with the Agency for Toxic Substances and Disease Registry (ATSDR). The ATSDR concurred with EPA's evaluation that the removal action continues to be protective of human health.

The decision was also made that a deed restriction or some other type of institutional control be placed on the property to keep a future property owner from disturbing any contamination that might remain beneath the concrete and fill material. The deed restriction or other control will be put in place with the cooperation of the property owner; or if necessary, EPA will seek through the legal process to impose such deed restrictions or other institutional controls as may be imposed by legal process without the cooperation of the property owner. In addition to the contamination found in the soil and trough concrete, there was evidence of contamination in the concrete floors in the plating shop. The concrete floor was treated to remove the chromium contamination.

Near the end of the EPA removal action in 1994, particulate air samples were collected from the interior of the plating shop. The results of the indoor air sampling and analysis were below cleanup levels established for interior air for the removal action.

Additional indoor air and indoor dust sampling was performed by EPA in both buildings during a site visit in 1996. Results from this sampling event were also below

cleanup levels for indoor air; however, lead concentrations in indoor dust samples from both buildings were above health-based screening levels established for indoor dust. The risk levels for indoor air and indoor dusts were evaluated in the Baseline Risk Assessment prepared for the site.

5.0 Current and Potential Future Site and Resource Uses

The site is currently used as a storage facility and is surrounded by residential and commercial areas. Future use of the site is to continue to be industrial or commercial. Comments presented by the community did not include concern for use of the site as anything other than these uses. The proposed remedy proposes institutional controls to prevent future use of the site as residential.

The Ogallala aquifer below the site is used as a primary potable water resource for the region, and specifically is a municipal source for Colby, Kansas, and for individual residences in the site area that are not connected to the municipal water system of Colby. A Colby municipal water supply well has been contaminated and has been taken out of service because of the contamination. The community has expressed a strong interest in being able to return the well to service in the near future.

6.0 Summary of Site Risks

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

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.

6.1 Human Health Risk Assessment

A human health baseline risk assessment was prepared for the Ace Services site. This summary presents an overview of the risk assessment prepared for the site. The complete risk assessment may be consulted in the administrative record file for a more detailed evaluation of the site risks.

Risk assessment is an analysis of the potential adverse health effects that may result from human exposure to chemical contaminants present at the site. The primary COC's at the Ace Services site are hexavalent chromium in groundwater and lead in indoor building dust. These metals may pose adverse health effects at relatively high concentrations or exposures. Exposures to contaminated groundwater from ingestion and dermal contact while bathing were evaluated. Pathways of exposure to contaminated soil and dust were also evaluated. Hexavalent chromium is considered to be a probable human carcinogen only if inhaled, however, these effects are only typical to plating facility workers because the plating equipment caused greater volatilization of contaminants into the air. The volatilization of chromium dissolved in groundwater should not occur during typical residential use. Consequently, exposure to hexavalent chromium from inhalation was not evaluated.

To ensure protection of human health, the risk assessment assumes that no action has been taken at the site to remove the contamination, and the highest exposure that may reasonably be expected to occur at the site was evaluated. For the Ace Services risk assessment it was assumed that a future Colby resident drills a new well within the area of the groundwater contamination and then drinks and bathes with contaminated groundwater.

To evaluate the potential for adverse health effects, excluding cancer, a hazard index is used. The evaluation of noncarcinogenic risks for current downgradient residents and future onsite and offsite residents through the groundwater exposure pathway resulted in hazard indices of 0.42 and 20.0, respectively. A hazard index calculated for a site in excess of 1.0 indicates that potential adverse health effects may occur from exposure to the site contaminants. For the Ace Services site, the hazard index exceeded 1.0 for future residents drinking and bathing in groundwater contaminated with hexavalent chromium.

In other words, there is a potential for adverse health effects to occur when the contaminated water is ingested or comes in contact with the skin. Carcinogenic risk has not been established for dermal contact and ingestion of hexavalent chromium.

The risk evaluation for exterior surface soils, indoor dust, and indoor air consisted of comparing the post-removal action concentrations of hexavalent chromium, lead, and other heavy metals in these media to accepted industrial health-based screening levels. These health-based screening levels included applicable or relevant and appropriate requirements, risk-based concentrations, and other published exposure limits. The evaluation found that only the lead level in indoor dust continues to be a potential health concern for industrial and commercial uses. In addition, it is recognized that the contaminants deposited in and on the interior building materials are the likely source of dust contamination.

The EPA has assumed that this site will continue to be used for industrial or commercial purposes. The levels of contamination remaining on site render the property unsuitable for other land uses, such as residential.

6.2 Ecological Risk Assessment

The lack of any substantial contact of groundwater with flora or fauna and the absence of threatened and endangered species critical habitat in the area indicate that an imminent and substantial threat to the surface environment no longer exists. Therefore, further actions taken solely to protect surface environmental receptors are unnecessary.

7.0 Remediation Objectives

The primary focus of the remedial actions is to remediate the contaminated groundwater and on-site building interiors, which are the major risks posed from the site, and limit future use of the facility to industrial or commercial purposes.

Remedial action objectives developed for contaminated groundwater are to prevent ingestion, inhalation, or direct contact with groundwater having chromium concentrations

in excess of current regulatory drinking water standards and to prevent further migration of chromium to prevent further degradation of natural resources.

Remedial action objectives developed for contaminated soil are to maintain prevention of exposure to soils having total chromium or lead concentrations in excess of current action levels and to prevent migration of chromium and lead that would result in groundwater contamination.

Remedial action objectives developed for the contaminated buildings are to prevent exposure to indoor air or interior dusts/concrete having total chromium, hexavalent chromium lead, arsenic, cadmium, manganese, or nickel concentrations in excess of industrial health-based screening levels and to prevent migration of chromium and lead that could result in groundwater contamination.

The EPA has assumed that this facility will continue to be used for industrial or commercial purposes. The cleanup levels have been determined to allow future use of the facility as an industrial or commercial facility. The levels of contamination remaining on site render the property unsuitable for other land uses, such as residential. Access restrictions would be implemented during remediation efforts to minimize exposure to humans.

8.0 Description of Alternatives

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires that the selected site response action alternative be protective of human health and the environment, be cost effective, comply with other environmental laws, and utilize permanent solutions, alternative treatment technologies, and resource recovery alternatives to the maximum extent practicable. In addition, the statute includes a preference for the use of permanent treatment as a principal element for the reduction of toxicity, mobility, or volume of the hazardous substances versus leaving the waste untreated.

The EPA's November 1998 Feasibility Study (FS) Report evaluated in detail remedial alternatives for addressing the contamination associated with the groundwater

plume, on-site buildings, and exterior soils at the site. This evaluation included consideration of the no action alternative. The alternatives for remediating the buildings and exterior surface soil are independent of the alternatives for remediating the groundwater. Implementation of the remedial efforts for groundwater will be complex compared to the remedial efforts for the buildings and soil. To allow the remedial alternative evaluation to be more effective, the groundwater alternatives were developed separately from the buildings and soil alternatives. The FS considered six alternatives for remediating the groundwater plume and five alternatives for remediating the on-site buildings/soil. The groundwater alternatives are discussed in Section 8.1, and the building and soil alternatives are discussed in Section 8.2. As part of the process of choosing a remedy, the remedial alternatives from the FS are compared and evaluated using nine criteria that appear in the NCP (these are discussed in Section 9 below).

For the purpose of analyzing and comparing the remedial alternatives, EPA estimated costs of the alternatives by making certain assumptions to allow costs to be estimated, such as estimating the remediation time for pumping and treating groundwater. The EPA Superfund policy is to try to estimate costs within +50/-30 percent accuracy.

The present worth cost of each alternative, a summary measure of cost that, for comparison purposes, turns a stream of payments or costs over a future period of years into the equivalent of a single lump sum in the present, was calculated for all alternatives assuming a 5 percent discount rate for up to 30 years. The cost estimates, as discussed above, are conceptual, with an estimated +50 percent to -30 percent level of accuracy. The alternatives from the FS report are described below in the remainder of Section 8. Section 9 compares the alternatives. Section 10 discusses the selected alternative. Section 10 also discusses several additional measures that will be taken as part of the selected remedy, including remedial design activities.

8.1 Groundwater Alternatives

8.1.1 Groundwater Alternative 1: No Action

Capital Cost: $0
Present Worth of Annual O&M Cost: $41,700
Total Present Worth Cost: $41,700

Construction time: 0
Cleanup time: Indefinite, unknown
Pump rate: N/A
Number of monitoring wells: N/A

Alternative 1 would not involve any remedial actions, and the site would remain in its present condition. This alternative is a baseline alternative against which the effectiveness of the other alternatives can be compared, as required by the National Contingency Plan (NCP) and CERCLA. Under the no action alternative, the site is left "as is" and no funds would be expended for monitoring, control, or cleanup of the contaminated groundwater. However, 5-year reviews of the site would be required under CERCLA, and accordlingly, the computed "total present worth" cost was estimated to include funds that would be expended to conduct the 5-year reviews.

8.1.2 Groundwater Alternative 2: Containment/Reduction/ Precipitation/Coagulation-Flocculation

Capital Cost: $1,398,500
Present Worth of Annual O&M Costs: $2,241,400
Total Present Worth Cost: $3,639,900
Construction time: 19 months
Cleanup time: 32 years
Pump rate: 80 gallons per minute total
Number of extraction wells: One 3-well nest

Groundwater Alternative 2 entails extraction of contaminated groundwater at the containment rate, treatment of contaminated groundwater by electrochemical reduction/precipitation/coagulation-flocculation, discharge of treated groundwater, and focused groundwater monitoring.

The extraction wells would be pumped at a rate resulting in establishment of a hydraulic barrier to prevent migration of the contaminant plume. One extraction well nest (EX-1) would be located near the downgradient edge of the 100 μg/L chromium contamination contour. The extraction well nest would consist of three wells at various depths to address shallow, intermediate, and deep groundwater. The shallow extraction

well would be screened from the water table (approximately 100 feet below ground surface (bgs) to 20 feet below the water table, the second (intermediate) well would be screened from approximately 150 to 170 feet bgs, and the third (deep) well would be screened from the bedrock surface up 20 feet (approximately 200 to 220 feet bgs). To achieve containment, the total groundwater extraction rate would be approximately 80 gallons per minute (gpm). Pumping rates from each extraction well would be optimized to capture the maximum amount of contaminants. Extracted groundwater would be pumped to an on-site treatment system by double containment underground piping. If shallow sampling well SSW-1 is found to be contaminated above 100 μg/L total Cr, the contaminated groundwater would be periodically recovered from this well also. Groundwater would be collected with a submersible pump and placed in a portable tank. The collected groundwater from well SSW-1 is estimated to be less than 200 gallons and would be discharged into the treatment system for treatment.

In addition to the extraction well nests, four additional observation well nests would be installed along the downgradient edge of the 100 μg/L contour. The observation well nests would consist of three wells and would be constructed in the same manner as the extraction wells. One well would be screened in the shallow zone, one in the intermediate zone, and one in the deep zone. This configuration would allow simultaneous monitoring of drawdown in each zone and would provide information to verify the chromium contamination capture zone of the extraction wells. Proposed well locations are shown on Figure 5.

Groundwater monitoring would be performed to evaluate the aquifer's ability to lower contaminant concentrations through natural attenuation. A detailed sampling and quality assurance plan would need to be prepared. The sampling and quality assurance plans would include the sampling locations, frequency, procedures, analysis methods, and documentation. New monitoring wells would be added to the existing network if the contaminant plume migrates further to the east or if further definition of the plume is required. Any additional wells would be installed using the techniques described above.

Five additional multiport sampling wells and one shallow sampling well would be installed. The multiport sampling wells would be constructed of 4-inch PVC casing, the

observation wells would be constructed using 2-inch PVC, and the extraction wells would be constructed using 6-inch PVC casing.

The multiport sampling wells would be located near MW-2, PWS-8, north of PWS-8, south of PWS-8, and between residential well RW-1 and PWS-8. Each multiport sampling well would be screened at three different intervals. The first screen would be set from the static water level (approximately 100 feet bgs to 20 feet below the water table). The next screen would be installed from 150 to 170 feet bgs with the final screen installed from the bedrock surface (approximately 220 feet bgs) and up 20 feet.

A shallow sampling well (SSW-1) would be installed in the area of the perched aquifer identified by KDHE during its September 1980 site investigation and would allow for monitoring of the perched aquifer. This well would be installed to approximately 30 feet bgs with the screen interval from 20 to 30 feet bgs. The proposed locations of the new monitoring wells are shown on Figure 5. The locations were selected to monitor the effectiveness of the remedial efforts.

The new and previously sampled monitoring and residential wells would be sampled quarterly for the first year and semi-annually thereafter until remedial action objectives are attained. Frequency of the monitoring would be reevaluated and modified based upon the effectiveness of the alternative.

The results of the sample analysis would be used with screening models to evaluate the rate of natural attenuation and the migration of contaminants. If monitoring results indicate that natural attenuation is occurring at an acceptable rate, further remediation may not be necessary after the more concentrated portion of the Cr(VI) plume is extracted.

Institutional controls would be implemented to ensure that exposure pathways are not completed where the contaminant concentrations are above cleanup goals. Access restrictions would consist of deed restrictions, permits, and public education. Deed restrictions as permitted by law would be placed on properties within or near the contaminant plume to prevent use of the contaminated groundwater as a potable water supply. Installation of new wells would be for nonpotable uses only and would be

allowed by permit only. Public education would be performed to inform the public of the potential hazards associated with the contaminated groundwater and discourage the use of it for drinking or bathing. Public education would be conducted through informational meetings and flyers.

An electrochemical reduction process would be used to treat the contaminated groundwater in this alternative (and all alternatives subsequently discussed). This treatment process would involve a reduction process. A packaged treatment system using electrochemical reduction would chemically change (reduce) the hexavalent chromium to trivalent chromium and coprecipitate the trivalent chromium as chromium hydroxide along with iron oxide. A treatability study would be performed as part of remedial design efforts. The groundwater treatment system would be a packaged electrochemical reduction/precipitation/coagulation-flocculation system that would be delivered to the site.

Treated groundwater would be discharged on-site to the unnamed tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater would be discharged to the local Colby POTW and, at the option of state and local authorities, the treated groundwater may be beneficially reused rather than discharged. Discharged water would meet National Pollutant Discharge Elimination System (NPDES) requirements. The discharge would occur on-site so a NPDES permit would not be required, but limitations for contaminant discharge would be met.

Residual wastes (solids) generated by the chemical reduction/precipitation/ coagulation-flocculation process would be analyzed using EPA's Toxicity Characteristic Leaching Procedure (TCLP). Residual wastes would then be disposed of as either a hazardous or nonhazardous waste depending on the results of the TCLP analysis.

8.1.3 Groundwater Alternative 3: Active Restoration/Reduction/ Precipitation/Coagulation-Flocculation

Capital Cost: $2,170,900
Present Worth of Annual O&M Costs: $2,222,600
Total Present Worth Cost: $4,393,500
Construction time: 20 months

Cleanup time: 17 years
Pump rate: 210 gpm total
Number of extraction wells: Two 3-well nests and PWS Well #8

Groundwater Alternative 3 entails extraction of contaminated groundwater at the active restoration rate, treatment of contaminated groundwater by electrochemical reduction/precipitation/coagulation-flocculation, discharge of treated groundwater, and focused groundwater monitoring.

Five multiport sampling wells and one shallow sampling well would be installed. The groundwater would be sampled and analyzed to evaluate natural attenuation as described in Groundwater Alternative 2.

Two extraction well nests would be installed and used in conjunction with PWS Well #8 to achieve remediation goals. The turbine pump in PWS Well #8 would be removed and replaced with a submersible pump capable of pumping 70 gpm. Each extraction well nest would be pumped at an approximate rate of 70 gpm for a total flow of 210 gpm. Pumping rates from each individual extraction well and well nest would be optimized to capture the maximum amount of contaminants. One extraction well nest (EX-2) would be located near MW-2. The well nest would include the installation of shallow and intermediate-depth extraction wells to complete the extraction well nest. The other extraction well nest (EX-1) would be located at the downgradient edge of the 100 μg/L chromium contamination plume contour. Four observation well nests would be installed as described in Groundwater Alternative 2, with the addition of two more observation well nests installed in the same manner to evaluate the capture zone of the upgradient extraction well nest EX-2. The additional observation well nests would be located approximately 120 feet north and 150 feet southeast of extraction well EX-2, respectively. If shallow sampling well SSW-1 is found to be contaminated above 100 μg/L total Cr, the contaminated groundwater would be extracted from this well as described in Groundwater Alternative 2. Proposed well locations are shown on Figure 6.

Contaminated groundwater would be pumped to an on-site treatment system by double containment underground piping similar to that in Groundwater Alternative 2. Hexavalent chromium would be reduced to trivalent chromium by electrochemical

precipitation. Trivalent chromium would then be co-precipitated out of solution as chromium hydroxide along with iron oxide. The treatment process for this alternative is similar to the process described for Groundwater Alternative 2.

Treated groundwater would then be discharged on-site to the unnamed tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater would be discharged to the local Colby Publicly Owned Treatment Works (POTW), and at the option of state and local authorities, the treated groundwater may be beneficially reused rather than discharged. Discharged water would meet NPDES requirements. The discharge would occur on-site so a NPDES permit would not be required, but limitations for contaminant discharge would be met.

Residual wastes (solids) generated by the electrochemical reduction/precipitation process would be analyzed using EPA's TCLP analysis procedure. Residual waste would then be disposed of as either a hazardous or nonhazardous waste based on the results of the TCLP analysis.

Institutional controls would be implemented at the site as described under Groundwater Alternative 2.

8.1.4 Groundwater Alternative 4: Containment/Ion Exchange

Capital Cost: $1,581,900
Present Worth of Annual O&M Costs: $2,348,800
Total Present Worth Cost : $3,930,700
Construction time: 19 months
Cleanup time: 32 years
Pump rate: 80 gpm total
Number of extraction wells: One 3-well nest

Groundwater Alternative 4 entails extraction of contaminated groundwater at the containment rate, treatment of contaminated groundwater by ion exchange, discharge of treated groundwater and focused groundwater monitoring.

The number, location, size, and depth of extraction, observation, and sampling wells for this alternative are as described in Groundwater Alternative 2 and as illustrated on Figure 5.

The groundwater treatment system would be a packaged ion exchange system that would be delivered to the site. A treatability study would be performed as part of remedial design efforts.

Extracted groundwater would be pumped from the extraction well system to the influent holding tank for flow equalization. Groundwater would then be sent to the anion exchanger where hexavalent chromium would be removed by the ion exchange process. Following hexavalent chromium removal, trivalent chromium would be removed in the cation exchanger. Groundwater would then be discharged.

Treated groundwater would then be discharged on-site to the unnamed tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater would be discharged to the local Colby POTW and, at the option of state and local authorities, the treated groundwater may be beneficially reused rather than discharged. Discharged water would meet NPDES requirements. The discharge would occur on-site so a NPDES permit would not be required, but limitations for contaminant discharge would be met.

Residual wastes (solids) generated by the ion exchange process would be analyzed using EPA's TCLP analysis procedure. Residual wastes would then be disposed of as either a hazardous or nonhazardous waste based on the results of the TCLP analysis.

Institutional controls would be implemented at the site as described under Groundwater Alternative 2.

8.1.5 Groundwater Alternative 5: Active Restoration/Ion Exchange

Capital Cost: $2,310,600
Present Worth of Annual O&M Costs: $2,249,700
Present Worth Cost : $4,560,300
Construction time: 20 months

Cleanup time: 17 years
Pump rate: 210 gpm total
Number of extraction wells: Two 3-well nests and PWS Well #8

Groundwater Alternative 5 entails extraction of contaminated groundwater at the active restoration rate, treatment of contaminated groundwater by ion exchange, discharge of treated groundwater, and focused groundwater monitoring.

The number, location, size and depth of the extraction, observation, and sampling wells are identical to those described in Groundwater Alternative 3, including pumping well SSW-1, and as illustrated on Figure 6. The process units and the ion exchange treatment processes would be similar to that described under Groundwater Alternative 4.

Treated groundwater would then be discharged on-site to the unnamed tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater will be discharged to the local Colby POTW and, at the option of state and local authorities, the treated groundwater may be beneficially reused rather than discharged. Discharged water would meet NPDES requirements. The discharge would occur on-site so a NPDES permit would not be required, but limitations for contaminant discharge would be met.

Residual wastes (solids) generated by the ion exchange process would be analyzed using EPA's TCLP analysis procedure. Residual wastes would then be disposed of as either a hazardous or nonhazardous waste based on the results of the TCLP analysis.

Institutional controls would be implemented at the site as described under Groundwater Alternative 2.

8.1.6 Groundwater Alternative 6: Active Restoration/ Reduction/ Precipitation/Coagulation-Flocculation/In-Situ Bioremediation

Capital Cost: $2,552,500
Present Worth of Annual O&M Costs: $1,937,000
Present Worth Cost : $4,489,500
Construction time: 21 months

Cleanup time: 13 years
Pump rate: 210 gpm total
Number of extraction wells: Two 3-well nests and PWS Well #8

Groundwater Alternative 6 entails extraction of contaminated groundwater at the active restoration rate, treatment of contaminated groundwater by electrochemical reduction/precipitation/coagulation-flocculation, discharge of treated groundwater, and in-situ bioremediation.

The number, location, size, and depth of the extraction, observation, and sampling wells are identical to those described in Groundwater Alternative 3, including pumping well SSW-1, and as illustrated on Figure 5. The process units and the reduction/precipitation treatment processes would be similar to that described under Groundwater Alternative 2.

Treated groundwater would be discharged on-site to the unnamed tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater would be discharged to the local Colby POTW and, at the option of state and local authorities, the treated groundwater may be beneficially reused rather than discharged. Discharged water would meet NPDES requirements. The discharge would occur on-site so a NPDES permit would not be required, but limitations for contaminant discharge would be met.

Residual wastes (solids) generated by the chemical reduction/precipitation/ coagulation-flocculation process would be analyzed using EPA's TCLP analysis procedure. Residual wastes would then be disposed of as either a hazardous or nonhazardous waste depending on the TCLP results analysis.

Included in this alternative is in-situ bioremediation which would be implemented to enhance remediation efforts provided successful implementation of the process is demonstrated during the Remedial Design (RD) treatability studies. One criteria for determining successful implementation would be an evaluation as to whether the groundwater remaining in the remediated aquifer zone would be acceptable for possible beneficial reuse after bioremediation was completed. In-situ bioremediation would be used to complement the extraction of contaminated groundwater. In-situ bioremediation

would be implemented provided treatability studies during remedial design show the reduction process to be successful. In-situ bioremediation would help reduce rebound and tailing effects common to pump-and-treat remedial actions. The volume of extracted groundwater would be comparatively less than other alternatives because the estimated number of pore-space flushings needed to remove the chromium would be less.

In-situ bioremediation would consist of two primary components: the process system and the distribution system. The process system would include a carbon source storage tank, mixing tank, potable water supply, and circulation pump. The carbon source would be diluted with water to the desired concentration in the mixing tank and the mixture would be recirculated until injection. The five multiport monitoring wells would be used as the injection wells unless the treatability study indicates that separate wells in a well nest would be needed.

During remedial design, a field scale groundwater treatability study would be performed to confirm microbial reduction of Cr(VI) by the carbon source, determine the optimum concentration of the carbon source, and evaluate potential biofouling affects. The injection rate of the carbon source would initially be estimated through groundwater modeling efforts and would ultimately be determined during the field scale treatability study.

Groundwater would be monitored to detect changes in the migration and reduction of contamination and to assess the effectiveness of the remedial action. The observation wells, monitoring wells, and extraction wells would be monitored and used to evaluate the treatment system.

Parameters included in the monitoring program include total chromium, hexavalent chromium, temperature, pH, specific conductivity, dissolved oxygen, oxidation/reduction potential, and organic carbon.

8.2 Buildings/Soils Alternatives

The buildings to be remediated include both the plating shop and the machine shop as illustrated on Figure 2. Exterior soils media have also been included in the remedial alternatives.

8.2.1 Buildings/Soil Alternative 1: No Further Action

Capital Cost: $0
Present Worth of Annual O&M Costs: $41,700
Present Worth Cost : $41,700
Construction time: N/A
O&M duration: + 30 years

Building/Soil Alternative 1 would not involve any further remedial action for the soil or buildings beyond the efforts performed as part of the removal action. Under the no further action alternative, the site would remain in its present condition. Previous removal action efforts involved washing the interior of the plating shop building, removal of the plating vat troughs A, B, and C and removal of contaminated soil. In addition, the floor was also treated with sulfuric acid and sodium metabisulfite to reduce the hexavalent to trivalent chromium. The no action alternative is a baseline alternative against which the effectiveness of the other alternatives can be compared, and was evaluated as required by the National Contingency Plan (NCP) and CERCLA. The only additional activity would be CERCLA Section 121(c) periodic reviews of the site performed by the EPA as required by the NCP. The CERCLA Section 121(c) periodic reviews are required if a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure.

8.2.2 Buildings/Soil Alternative 2: Limited Action

Capital Cost: $9,700
Present Worth of Annual O&M Costs: $41,700
Present Worth Cost: $51,400
Construction time: N/A
O&M duration: +30 years

Building/Soil Alternative 2 would involve placement of deed restrictions as permitted by law to prevent exposure to contaminants, and also includes 5-year reviews. The deed restrictions would be implemented to notify future owners of the contamination present in the foundation soils beneath the concrete floor of the plating shop building and the exterior soils. Zoning restrictions would be implemented by local authorities to restrict changing the zoning of the site to residential, in addition to limiting the types of industries that could occupy both buildings. Industries such as human health care, child care centers, and food processing/handling businesses would be restricted from using the site.

8.2.3 Buildings/Soil Alternative 3: Surface Cleaning/Disposal

Capital Cost: $83,300
Present Worth of Annual O&M Costs: $163,700
Present Worth Cost: $247,000
Construction time: 2 months
O&M duration: +30 years

Building/Soil Alternative 3 would include the dusting, vacuuming, and wiping of all surfaces in the interior of both buildings, including the floors, walls, ceiling, and exposed trusses. Since these activities may not involve the removal of the source of the lead and chromium contamination in the dust, a deed restriction would still be required to limit future use of the site and buildings as discussed in the previous sections. The debris from the dusting, vacuuming, and wiping would be disposed in a Resource Conservation and Recovery Act (RCRA) hazardous or a solid waste landfill, as required. The deed restrictions described under Building/Soil Alternative 2 are also included under this alternative.

8.2.4 Buildings/Soils Alternative 4: Surface Layer Removal/Disposal

Capital Cost: $228,200
Present Worth of Annual O&M Costs: $41,700
Present Worth Cost: $269,900
Construction time: 4 months
O&M duration: + 30 years

Building/Soil Alternative 4 would involve the decontamination of both buildings by removing the contaminated surface concrete. Wipe samples would be collected at various depths and surfaces prior to and during remedial design to determine the areas requiring removal. The remediation levels would allow the buildings to only be used for industrial or commercial uses.

The surface concrete would be removed by grit blasting. The material to be used and the depth required for complete removal would be determined during the remedial design. Since all surfaces within the buildings are not concrete, other surfaces within the buildings may require additional dusting, vacuuming and wiping to ensure the complete cleaning of all surfaces within the buildings. The cleaning and concrete debris and grit-blasting material would be disposed in roll-off containers. The debris and grit-blasting materials would be analyzed and all materials would be disposed in a RCRA hazardous or a solid waste landfill, as appropriate.

Land use restrictions would be implemented to limit future use of the site to certain industrial or commercial uses as discussed for Building/Soil Alternative 2.

8.2.5 Buildings/Soil Alternative 5: Encapsulation/Disposal

Capital Cost: $127,100
Present Worth of Annual O&M Costs: $177,700
Present Worth Cost: $304,800
Construction time: 4 months
O&M duration: + 30 years

Building/Soil Alternative 5 would prepare the interior surfaces by dusting, vacuuming, and wiping the dust and debris from both buildings for the subsequent application of encapsulation coatings to all interior surfaces in both buildings. Wipe sampling would be conducted on all representative surfaces to determine the need for encapsulation. The specific encapsulation coatings would be determined during the remedial design. The debris from the dusting, vacuuming, and wiping and other encapsulation debris would be disposed in a RCRA hazardous or a solid waste landfill, as appropriate.

Since the contaminants would still be in place, land use restrictions would be implemented to limit future use of the site to certain industrial or commercial uses. A maintenance program would be required as part of the deed restriction to maintain the integrity of the encapsulation and ensure the continued effectiveness of the containment of contaminants.

9.0 Comparative Analysis of Alternatives

During the comparative analysis of the alternatives, each alternative is assessed against nine evaluation criteria. These criteria are: overall protection of human health and the environment; compliance with applicable or relevant and appropriate requirements; long-term effectiveness and permanence; reduction of toxicity, mobility, or volume; short-term effectiveness; implementability; cost; state acceptance and community acceptance.

The following comparative analysis presents the strengths and weaknesses of the alternatives relative to one another with respect to each of the nine criteria, and how reasonable variations of key uncertainties could change the expectations of their relative performance. Under each individual criterion, the alternative(s) that performs the best overall in that category is discussed first, with other alternatives discussed in the relative order in which they perform.

9.1 Groundwater Alternatives

9.1.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Groundwater Alternative 6 would be the most protective of human health and the environment. Not only would all groundwater with contaminant concentrations greater than cleanup levels be actively remediated, the cleanup goals would be reached earlier than all other alternatives. The treatment technology, including reduction and

precipitation, is anticipated to be the most effective treatment option for the extracted contaminated groundwater. In-situ bioremediation would also occur to help reduce contamination.

Groundwater Alternative 1 would not protect human health and the environment from the contaminants in the groundwater in the vicinity of the site. Because no actions would occur under Alternative 1, the groundwater contaminants may continue to migrate and eventually contaminate downgradient residential and public supply wells and produce a larger contaminant plume. Alternatives 2 and 4 would be more protective of human health and the environment than Alternative 1. The containment and treatment system in Alternatives 2 and 4 would be effective in ensuring that further migration of contaminants does not occur; thus, the contaminants would not further contaminate additional wells. However, only some protection of the environment would occur because although groundwater would be extracted and treated, it would not be actively remediated. Thus, groundwater would continue to be contaminated for an extended period

Groundwater Alternatives 3 and 5 would be more protective of human health and the environment than Alternatives 1, 2, and 4 because all groundwater with contaminant concentrations greater than cleanup levels would be actively remediated. The cleanup goals would be reached earlier with Alternatives 3 and 5 than with Alternatives 2 and 4. The technologies used in Alternatives 2 and 3 (extraction and treatment by reduction/ precipitation/coagulation-flocculation) are proven effective for the removal of chromium from groundwater and have been used at numerous sites. The technologies used in Alternatives 4 and 5 (extraction and ion exchange) are also proven effective in the removal of chromium from groundwater.

Other than contamination that remains until cleanup goals are met, no short-term risks would be expected in any of the alternatives. The no action alternative would not address groundwater contamination, and would result in risks.

9.1.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Compliance with ARARs addresses whether or not a remedy would meet all of the applicable or relevant and appropriate requirements of other federal and state environmental statutes and requirements or provide grounds for invoking a waiver.

All alternatives, excluding Alternative 1, would comply with all location- and action-specific ARARs and would be anticipated to comply with all chemical-specific ARARs.

9.1.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup goals have been met.

Groundwater Alternatives 2, 3, 4, 5, and 6 would have less of a long-term risk than Alternative 1. A long-term risk would not be associated with the treated groundwater in Alternatives 2, 3, 4, 5, and 6. However, a long-term risk would remain with the untreated aquifer until cleanup levels would be met. Alternative 6 would offer effectiveness and permanence earlier than all other alternatives because water would be remediated at a faster rate. Alternative 6 is expected to reach cleanup goals in 13 years. Alternatives 3 and 5 would be expected to reach cleanup goals in 17 years. The amount of time to reach cleanup goals if Alternatives 2 or 4 are implemented is estimated to be 32 years.

Because no remedial actions would occur, a long-term risk would be associated with Groundwater Alternative 1 as long as cleanup goals are not met. The possibility exists for the contaminant plume to expand and no mechanism would be in place to monitor whether the plume is expanding so as to threaten additional water wells.

Five-year reviews would be required for all alternatives. Groundwater Alternative 1 would require the greatest number of 5-year reviews because restoration, if achieved, would take the longest. Fewer reviews would be required for Alternatives 3 and 5 than for Alternatives 2 and 4, and the fewest reviews would be required for Alternative 6.

The proposed monitoring plan and treatment technologies in Groundwater Alternatives 2, 3, 4, 5, and 6 should adequately and permanently achieve the performance specifications established in the remedial action objectives. Because no action would

occur in Alternative 1, there would be no mechanism to determine if remedial action objectives would be met.

Long-term management would be required for all the alternatives with the exception of Groundwater Alternative 1. Maintenance, along with a long-term monitoring program, would need to be performed on a regular basis for Groundwater Alternatives 2, 3, 4, 5, and 6. Maintenance would be more involved with Alternatives 3 and 5, and the most involved with Alternative 6 because more wells and equipment would be required. The monitoring program and maintenance for all alternatives would be extensive, but easily implemented. Components of the treatment system such as pumps and valves in Alternatives 2, 3, 4, 5, and 6 may require replacement during site remediation. However, proper maintenance of the equipment should minimize the need for costly repairs and replacements.

9.1.4 Reduction of Toxicity, Mobility, and Volume Through Treatment

Reduction of toxicity, mobility, or volume through treatment is the anticipated performance of the treatment technologies a remedy may employ.

It is unknown if a reduction in toxicity, mobility, or volume would occur in Groundwater Alternative 1. Alternative 1 provides no mechanisms to determine if reduction is occurring. A reduction in toxicity, mobility, and volume would occur in Groundwater Alternatives 2, 3, 4, 5, and 6. The reduction would take much longer under Alternatives 2 and 4 than Alternatives 3 and 5, and would be the shortest period under Alternative 6. The groundwater treatment would permanently remove contamination from groundwater to the extent the system was effective at contaminant removal. Wastes would be produced from Alternatives 2, 3, 4, 5, and 6, except for any portion directly discharged to the POTW. Alternatives 3, 5, and 6 would generate residual waste at a faster rate then Alternatives 2 and 4. However, Alternatives 3, 5, and 6, would require shorter operational times thus residual wastes may be generated faster, but for a shorter duration. All the alternatives except Alternative 1 would meet the statutory preference for treatment as a principal element.

9.1.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to achieve protection and any adverse impacts on human health and the environment that may be posed during the construction and implementation period until cleanup goals are achieved.

Nearby residents may be exposed to contaminated dusts during installation of monitoring and extraction wells. This risk would be controlled by the use of dust suppressants. The risk to workers involved with remediation activities would be controlled by proper use of personal protection equipment and monitoring during site activities.

9.1.6 Implementability

Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

Because no actions would be taken during Alternative 1, this criteria is not applicable. Groundwater Alternatives 2, 3, 4, 5, and 6 include installation of 5 multiport sampling wells and a groundwater sampling program, and also require the installation of observation and extraction wells and more extensive treatment system components. Alternatives 2 and 4 (containment) would be easier to implement than Alternatives 3, 5, and 6 (active restoration) because fewer extraction and observation wells would be required. Alternative 6 also includes implementation of the in-situ bioremediation efforts. The groundwater treatment system components (pumps, piping, treatment unit, etc.) for Alternatives 3, 5, and 6 would also be substantially larger and may require more maintenance than Alternatives 2 and 4.

Groundwater Alternatives 2 and 3 (reduction/precipitation/coagulation-flocculation) offer more flexibility for treating variable influent contaminant concentrations than Alternatives 4 and 5 (ion exchange). It is assumed that in Alternatives 2 and 3, replacement of the electrodes would be required on a monthly basis. This can be done quickly and inexpensively. Alternatives 4 and 5 do not require monthly replacements of components but would require replacement of the ion exchange resin at some point in

time. It is difficult to anticipate the schedule for replacement of the resin, but when needed it would require a more substantial effort than replacement of the electrodes.

Groundwater Alternative 6 would be the most difficult to implement since it consists of the active restoration extraction and treatment system equipment and the in-situ bioremediation system. Implementability of in-situ bioremediation will be evaluated during remedial design treatability studies. One criteria for determining successful implementation would be an evaluation as to whether the groundwater remaining in the remediated aquifer zone would be acceptable for possible beneficial reuse after bioremediation was completed. The in-situ bioremediation system would require additional injection equipment that would need to be installed, including batch-mixing equipment, discharge lines, and associated equipment. More intensive operation and maintenance of the system would also be required.

The necessary equipment and personnel required to implement each alternative would be readily available. A treatability study would be required for Groundwater Alternatives 2, 3, 4, 5, and 6. More than one vendor is available for each alternative to provide a competitive bid.

9.1.7 Cost

Cost includes estimated capital and operation and maintenance costs, and net present worth costs. The cost comparisons for the alternatives includes the detailed cost estimates for each alternative.

A cost comparison for the groundwater alternatives includes the detailed cost estimates for each alternative.

The sole costs associated with Groundwater Alternative 1 would be O&M costs converted to a total present worth. The total present worth of Groundwater Alternative 1 would be the lowest at a cost of $41,700. The total present worth cost of Groundwater Alternative 5 would be the greatest at a cost of $4,560,300. The total present worth costs of Groundwater Alternatives 2, 3, 4, and 6 are $3,639,900, $4,393,500, $3,930,700 and

$4,489,500 respectively. In general, the cheaper the alternative, the lesser its effectiveness at meeting cleanup goals and the longer the period of time to achieve cleanup goals.

9.1.8 State Acceptance

State acceptance indicates whether, based on its review of the RI and FS reports and Proposed Plan, the state concurs, opposes, or has no comment on the preferred alternative.

The state of Kansas has been involved with this site since the beginning of closure activities and has reviewed the RI Report, the FS Report, and the Proposed Plan. The state of Kansas prefers that a permanent solution, with low O&M costs, be selected. The State has indicated its support of the selected remedy.

9.1.9 Community Acceptance

Community acceptance of the selected remedy is discussed in detail in the Responsiveness Summary of this ROD. In general, the community has supported the conclusions of the FS and the preferred alternative presented in the Proposed Plan. The public comments concentrated on consideration of reuse of the treated groundwater rather than discharge, because this water is a valuable resource in western Kansas.

9.2 Buildings/Soils Alternative Analysis

For each Buildings/Soils Alternative, the soils around the foundation of the plating shop building would remain in place. It has been assumed that deed restrictions proposed for Buildings/Soil Alternatives 2, 3, 4, and 5 would prevent exposure to contaminated soil. Removal of the contaminated soil could not be performed without jeopardizing the structural integrity of the building.

9.2.1 Overall Protection of Human Health and the Environment

Buildings/Soil Alternative 4 would be most protective of human health and the environment because contaminants would be removed during cleaning and remaining contaminants within the building materials would also be removed. Deed restrictions would prohibit residential and certain commercial uses of the site.

Buildings/Soil Alternative 1 would not protect human health and the environment from the contamination in the buildings and exterior soils of the site. Since no action would be conducted with Buildings/Soil Alternative 1, the potential for exposure to the contaminants left on-site would exist if further development, or re-zoning of the property occurred. Uses that include more exposure to the building interior than a few hours a week could result in harmful exposure to the contaminants.

Although no remediation would occur with Buildings/Soil Alternative 2, this alternative would be more protective than Alternative 1. Buildings/Soil Alternative 2 would restrict the use of the property to certain commercial uses and prohibit the removal of the concrete floor without the prior modification of the deed restrictions by EPA. The protectiveness of this alternative would be limited due to the presence of the contaminants on site, although, the exposure would be limited only to workers.

Buildings/Soil Alternatives 3 and 5 would be more protective of human health and the environment than the previous alternatives, since they would actually clean and/or remove contaminated dust and debris from the buildings. However, the contaminated soil and materials within the concrete floor would remain on site. The deed restriction to maintain the encapsulation and a dust control procedure would provide some additional protection to any worker in the buildings. Proper maintenance of the encapsulation would prevent exposure to the workers.

9.2.2 Compliance with ARARs

Buildings/Soil Alternatives 1 and 2 do not comply with chemical-specific ARARs. Only Buildings/Soil Alternatives 3, 4, and 5 would comply with chemical-specific ARARs. There would be no location-specific ARARs associated with Buildings/Soil Alternatives 2 through 5. There would be several action-specific ARARs which require compliance for Buildings/Soil Alternatives 3 through 5.

9.2.3 Long-Term Effectiveness and Permanence

Buildings/Soil Alternative 4 would remove contaminants from within the buildings and would likely be the most effective and permanent remedial action for the buildings and remaining contaminated soils. A long-term risk would be associated with Buildings/Soil Alternative 1 because no remedial actions would occur. Buildings/Soil

Alternatives 2 through 5 would provide deed restrictions to assist in the protectiveness of the specific alternative. The long-term effectiveness of the deed restriction would be dependent on the state and community acceptance of the restriction and assistance in enforcement. Alternative 3 would clean all of the surfaces and minimize the dust levels. Alternative 4 would remove some of the contaminants from the site and reduce the dust levels. Alternative 5 would immobilize the contaminants, however, use of the buildings with Alternative 5 would be more restricted than with the other alternatives due to the continuous maintenance requirements and the inspection and protection procedures for the encapsulation coating. The estimated life expectancy of the coatings would be 30 years.

9.2.4 Reduction of Toxicity, Mobility, and Volume

Buildings/Soil Alternative 4 would be the most effective at removing contaminants from the buildings. The contaminants would remain at the current levels for Alternatives 1 and 2. Buildings/Soil Alternative 3 would remove some of the contaminants from the site. Alternative 5 would immobilize the contaminants, provided the maintenance procedures would be correctly implemented.

9.2.5 Short-Term Effectiveness

There is no short-term risk to community and the environment for Buildings/Soil Alternatives 1 and 2 during remediation, since no action is taken at the site. Of course, exposures would occur if the buildings were to be used. All other alternatives would have some worker exposure to the dust during implementation of the remedial actions. Buildings/Soil Alternatives 3, 4, and 5 would reduce the exposure to the contaminated dust and debris with the implementation of proper personal protection, Level C or B, depending on the dust levels monitored. During implementation for these alternatives, site access would be restricted only to the workers, thereby minimizing the exposure to community and the environment.

9.2.6 Implementability

Buildings/Soil Alternative 1 is not evaluated for implementability. All other alternatives would be considered to be technically feasible with varying degrees of administrative oversight required for implementation due to the deed restrictions. The deed restrictions may need to undergo a review by the community and the state to ensure

acceptance and assist in the enforcement of the restrictions. The necessary equipment and personnel required to implement Buildings/Soil Alternatives 3, 4, and 5 would be readily available. The effort required to implement Buildings/Soil Alternatives 3 and 4 would be approximately the same since the surface cleaning would need to be conducted on the walls and ceiling for both alternatives. Implementation of Buildings/Soil Alternative 5 would require some additional effort based on the surface preparation requirements for each of the encapsulation coatings required for concrete and metal.

9.2.7 Cost

A cost comparison for the buildings/soil alternatives includes the detailed cost estimates for each alternative.

The O&M costs for the periodic reviews converted to a total present worth are the only cost for Buildings/Soil Alternative 1. No capital costs would be associated with Buildings/Soil Alternative 1. The total present worth cost for Alternative 1 would be the lowest at a cost of $41,700. The total present worth cost for Buildings/Soil Alternative 5 would be the greatest at a cost of $304,800. The total present worth costs for Buildings/Soil Alternatives 2, 3, and 4, would be $51,400, $247,000, and $269,900, respectively.

9.2.8 State Acceptance

State acceptance indicates whether, based on its review of the RI and FS reports and Proposed Plan, the state concurs, opposes, or has no comment on the preferred alternative.

The state of Kansas has been involved with this site since the beginning of closure activities and has reviewed the RI Report, the FS Report, and the Proposed Plan. The state of Kansas prefers that a permanent solution, with low O&M costs, be selected. The State has indicated its support of the selected remedy.

9.2.9 Community Acceptance

Community acceptance of the selected remedy is discussed in detail in the Responsiveness Summary of this ROD. In general, the community has supported the

conclusions of the FS and the preferred alternative presented in the Proposed Plan. Public comment centered on reuse of the buildings.

10.0 Selected Remedy

The selected remedy for the Ace Services Site will consist of Groundwater Alternative 6 (Active Restoration/Reduction/Precipitation/Coagulation-Flocculation/ In-situ Bioremediation) and Buildings/Soil Alternative 4 (Surface Layer Removal (Grit Blasting)/Disposal). These alternatives will provide the best balance of trade-offs among alternatives with respect to the evaluating criteria. The EPA believes Groundwater Alternative 6 and Buildings/Soil Alternative 4 will be protective of human health and the environment, will comply with ARARs, will be cost effective, and will utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The remedy also will meet the statutory preference for the use of treatment as a principal element.

10.1 Description of Selected Remedy

10.1.1 Groundwater

The preferred remedy for groundwater entails extraction of contaminated groundwater at the active restoration rate, treatment of contaminated groundwater by electrochemical reduction/precipitation/coagulation-flocculation, discharge of treated groundwater, and in-situ bioremediation.

Extraction

Two extraction well nests will be installed and used in conjunction with Public Water Supply (PWS) Well #8 to achieve remediation goals. The turbine pump in PWS Well #8 will be removed and replaced with a submersible pump capable of pumping 70 gallons per minute (gpm). Each extraction well nest will be pumped at an approximate rate of 70 gpm for a total flow of 210 gpm. Each extraction well nest would consist of three wells at various depths to respectively address shallow, intermediate, and deep groundwater. The shallow extraction well would be screened from the water table (approximately 100 feet below ground surface (bgs)) to 20 feet below the water table, the second (intermediate) well would be screened from approximately 150 to 170 feet bgs,

and the third (deep) well would be screened from the bedrock surface up 20 feet (approximately 200 to 220 feet bgs). Pumping rates from each individual extraction well and well nest will be optimized to capture the maximum amount of contaminants. One extraction well nest (EX-2) will be located as part of Well MW-2. This well nest will include the installation of shallow and intermediate-depth extraction wells to complete the extraction well nest. The other extraction well nest (EX-1) will be located at the downgradient edge of the 100 μg/L chromium contamination plume contour.

Four observation well nests will be installed as described in Groundwater Alternative 2, with the addition of two more observation well nests installed in the same manner to evaluate the capture zone of the upgradient extraction well nest EX-2. The additional observation well nests will be located approximately 120 feet north and 150 feet southeast of extraction well EX-2, respectively. If shallow sampling well SSW-1 is found to be contaminated above 100 μg/L total Cr, the contaminated groundwater would be periodically recovered from this well also. Groundwater would be collected with a submersible pump and placed in a portable tank. The collected groundwater from well SSW-1 is estimated to be less than 200 gallons and would be discharged into the treatment system for treatment. Proposed well locations are shown on Figure 6.

Treatment

An electrochemical reduction process will be used to treat the contaminated groundwater in the preferred alternative. This process option was selected for the following reasons.

- Process is not pH sensitive.
- Requires less operator interaction.
- Flocculation and sedimentation steps are more easily completed.
- Treats a wider concentration range of Cr(VI) in the influent.

A packaged treatment system using electrochemical reduction will chemically change (reduce) the hexavalent chromium to trivalent chromium and coprecipitate the trivalent chromium as chromium hydroxide along with iron oxide. A treatability study will be performed as part of remedial design efforts.

The packaged electrochemical reduction/precipitation/coagulation-flocculation system that will be used to treat the groundwater will be delivered to the site. The packaged system will consist of the following process units.

- Influent holding tank.
- Electrochemical precipitation unit.
- Flash/Floc tank.
- Degas tank.
- Polymer feed system.
- Inclined plate settler.
- Sand filter.
- Effluent holding tank.
- Sludge holding tank.
- Filter press.
- Mix tanks and surge tanks.
- Filtrate tank.
- Pumps.

Extracted groundwater will be pumped from the extraction well system to the influent holding tank for flow equalization. Groundwater will then be pumped to the electrochemical precipitation (ECP) unit. In the ECP unit, iron is put into solution using charged carbon steel electrodes. As the hexavalent chromium is passed through the charged electrodes, it is chemically changed to trivalent chromium. Hydrogen gas and hydroxide ions are also produced as water passes by the charged electrodes. The trivalent chromium and iron subsequently coprecipitate as solid chromium hydroxide and iron hydroxide. Following the ECP unit, the groundwater is passed through a degas tank to vent off the hydrogen and then through a flash/floc tank where a polymer is added to aid flocculation. Any chromium and iron hydroxide solid that settles in the flash/floc tank are pumped directly to the sludge storage tank. The groundwater is then passed through an inclined plate settler to remove the chromium and iron hydroxide solids and then through a continuous backwash type sand filter to remove any remaining fine solids. The treated groundwater is pumped to the effluent holding tank prior to being discharged. The water backwash stream will be routed to the flash/floc tank. Chromium hydroxide precipitate from the inclined plate settler will be pumped to the sludge holding tank.

Periodically, sludge in the sludge holding tank will be dewatered using a filter press before off-site disposal. Liquid generated during the sludge dewatering process will be pumped back to the influent holding tank.

Treated groundwater will be discharged on-site to the unnamed tributary to Prairie Dog Creek. Alternatively and as appropriate, treated and untreated groundwater will be discharged to the local Colby POTW, and at the option of the state and local authorities, the treated groundwater may be beneficially reused rather than discharged. However, the cost estimate for the alternative was based on discharge of the treated groundwater to the on-site unnamed tributary to Prairie Dog Creek; a more detailed cost estimate will be prepared during remedial design. Other discharge options may require additional efforts and equipment not included in the cost estimate for the alternative. Discharged water will meet NPDES requirements. The discharge will occur on-site so a NPDES permit will not be required, but limitations for contaminant discharge will be met.

Residual wastes (solids) generated by the chemical reduction/precipitation/ coagulation-flocculation process will be analyzed using EPA's Toxicity Characteristic Leaching Procedure (TCLP). Residual wastes will then be disposed of as either a hazardous or nonhazardous waste depending on the results of the TCLP analysis.

Monitoring

Groundwater will be monitored to detect changes in the migration and reduction of contamination and to assess the effectiveness of the remedial action. A detailed sampling and quality assurance plan will be prepared. The sampling and quality assurance plans will include the sampling locations, frequency, procedures, analysis methods, and documentation. New monitoring wells will be added to the existing network if the contaminant plume migrates or if further definition of the plume is required. Additional wells will be installed using conventional techniques.

Five additional multiport sampling wells and one shallow sampling well will be installed. The multiport sampling wells will be constructed of 4-inch PVC casing, the observation wells will be constructed using 2-inch PVC, and the extraction wells will be constructed using 6-inch PVC casing.

The multiport sampling wells will be located near MW-2, PWS-8, north of PWS-8, south of PWS-8, and between residential well RW-1 and PWS-8. Each multiport sampling well will be screened at three different intervals. The first screen will be set from the static water level (approximately 100 feet bgs) to 20 feet below the water table. The next screen will be installed from 150 to 170 feet bgs with the final screen installed from the bedrock surface (approximately 220 feet bgs) and up 20 feet.

A shallow sampling well (SSW-1) will be installed in the area of the perched aquifer identified by KDHE during their September 1980 site investigation and will allow for monitoring of the perched aquifer. This well will be installed to approximately 30 feet bgs with the screen interval from 20 to 30 feet bgs. The proposed locations of the new monitoring wells are shown on Figure 5. The locations were selected to monitor the effectiveness of the remedial efforts.

The new and previously sampled monitoring and residential wells will be sampled quarterly for the first year and semi-annually thereafter until remedial action objectives are attained. Frequency of the monitoring will be reevaluated and modified based upon the effectiveness of the alternative. Analytical parameters include:

- Total chromium
- Hexavalent chromium
- Dissolved oxygen
- pH
- Temperature
- Oxidation/Reduction potential (Eh)
- Total organic carbon
- Total dissolved solids

The shallow sampling well will also be analyzed for lead.

Institutional controls

Institutional controls as allowed by law will be implemented to ensure that exposure pathways are not completed where the contaminant concentrations are above cleanup goals. Access restrictions will consist of deed restrictions, permits, and public education. Deed restrictions will be placed on properties within or near the contaminant plume to prevent use of the contaminated groundwater as a potable water supply. This will be

done in association with the local authorities. Installation of new wells will be monitored to ensure that they are for nonpotable uses only and will be allowed by permit only, via restrictions by local authorities. Public education will be performed to inform the public of the potential hazards associated with the contaminated groundwater and discourage the use of it for drinking or bathing. Public education will be conducted through informational meetings and flyers.

In-Situ Bioremediation

Included in this alternative is in-situ bioremediation which will be implemented to enhance remediation efforts provided successful implementation of the process is demonstrated during the Remedial Design treatability studies. One criteria for determining successful implementation would be an evaluation as to whether the groundwater remaining in the remediated aquifer zone would be acceptable for possible beneficial reuse after bioremediation was completed. In-situ bioremediation will be used to complement the extraction of contaminated groundwater. In-situ bioremediation will be implemented provided that treatability studies during remedial design show the reduction process to be successful. In-situ bioremediation will help improve the consistency of the remedy over that of standard pump-and-treat remedial actions. The volume of extracted groundwater will be reduced because the estimated number of pore-space flushings needed to remove the chromium is reduced.

In-situ bioremediation will consist of two primary components: the process system and the distribution system. The process system will include a carbon source storage tank, mixing tank, potable water supply, and circulation pump. The carbon source will be diluted with water to the desired concentration in the mixing tank and the mixture will be recirculated until injection. The process system will be housed in the treatment building.

The five multiport monitoring wells will be used as the injection wells unless the treatability study indicates that separate wells in a well nest will be needed. Discharge lines will be connected from the treatment building to the injection wells. A separate line will be used for three separate depths of injection into the screens of the multi-port well.

A programmable logic controller (PLC) will be used to monitor and control the system. The PLC will control the feed rate and frequency of the carbon-source feed and

solution feed pumps, as well as timing of the solenoid valve network that will control the metered flow to the injection wells.

During remedial design, a field scale groundwater treatability study will be performed to confirm microbial reduction of Cr(VI) by the carbon source, determine the optimum concentration of the carbon source, and evaluate potential biofouling affects. The injection rate of the carbon source will initially be estimated through groundwater modeling efforts and will ultimately be determined during the field scale treatability study.

The EPA will periodically revisit the remedy in order to evaluate its ongoing effectiveness and to allow an examination of any new technologies that may arise and which may be appropriate in substitution of the original remedy that has been selected. Five-year reviews are required for this remedy. There is some uncertainty regarding the impact of contaminated subsurface soils in the former lagoon area on the chromium concentrations in the groundwater. The EPA will conduct additional groundwater monitoring and soil analysis near the impoundment area during remedial design and remedial action to address this question. The question of the impact of the contaminated soils will be addressed before or during the initial 5-year review.

If a change in remedy is needed at a later date, EPA would follow the procedures required by the NCP to amend the ROD, if a fundamentally different remedy or alternative is selected. The EPA would publish an "explanation of significant differences" for any significant changes to the remedy that do not amount to a fundamental change to the remedy.

The EPA believes at the present time that the Preferred Alternative will provide the best balance of trade-offs among alternatives with respect to the evaluation criteria. The EPA believes that the preferred alternative will be protective of human health and the environment, will comply with ARARs, will be cost effective, and will utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. The remedy meets the statutory preference for the use of treatment as a principal element.

The proposed locations, pumping rates, depth, and size for the extraction wells will be selected during early phases of the remedial design efforts. The initial phase of the remedial design will include the installation and sampling of the proposed and existing monitoring wells (multiport or nested) to confirm plume extent and groundwater flow direction. To confirm pumping rate estimates, a 72-hour pump test will be performed following installation of extraction well EX-1 and associated observation wells. Contaminated groundwater extracted during the pump test will be discharged to the POTW or treated and discharged to the unnamed tributary to Prairie Dog Creek.

Treatability studies will also be performed during the initial phases of remedial design efforts. A treatability study will be performed to determine specific design criteria for removal of hexavalent chromium from contaminated groundwater. A pilot scale treatability study will be performed to determine specific design criteria for inducing anaerobic conditions in the subsurface for in-situ bioremediation. The pilot scale treatability study will determine required carbon concentration of the injection source, biofouling effects, injection rate, and reductive zone of the injection wells.

Contaminated groundwater will be pumped to an on-site electrochemical reduction treatment system. The groundwater treatment system will be a packaged system that will be delivered to the site. The treatment system will be housed in a prefabricated structure to reduce noise, improve appearance, insulate the treatment process, and protect equipment. The prefabricated structure will be placed on a concrete foundation. A chain link security fence will be constructed around the treatment facility to limit general accessibility to the facility and the potential for public exposure. Piping, controls, valves, and pumps will be housed within the building for year-round operation. Power lines will be connected, and wiring will be installed to operate pumps, fans, lighting, and other equipment. Signs will be posted to prevent unknowing entry into the building, and security measures, such as alarms, will be implemented.

The treatment building will also house the process system for the injection system for the in-situ bioremediation efforts. The process system includes the carbon source storage tank, mixing tank, potable water supply, and circulation pump. Discharge lines will be connected from the treatment buildings to the multiport monitoring wells or

monitoring well nests which will serve as injection wells. A separate line will be used for up to three separate injection depths.

10.1.2 Buildings/Soil

The EPA's preferred remedy for the buildings/soil is Buildings/Soil Alternative 4. This alternative involves decontamination of both the plating shop and machine shop buildings by removal of the concrete floor surfaces and dusting/vacuuming/wiping of all other interior surfaces. The decontamination debris will be disposed of at an off-site RCRA hazardous waste landfill or a RCRA solid waste landfill, depending on sampling results. Buildings/Soil Alternative 4 will permanently remove contamination within the buildings, thereby significantly reducing O&M efforts as compared to the other alternatives.

After removing all obstructions, the contaminated areas of the concrete floors of both buildings will be grit-blasted where testing shows it is necessary. The contaminated surface will be spray-blasted with an abrasive material using a combined grit-blasting/vacuum head. The grit used to blast will be reused, when possible, throughout the decontamination process. Approximately 1,600 square feet of surface area will be grit-blasted per day. Approximately 2 weeks will be needed to grit-blast the floors. Each worker will wear self-contained breathing apparatus (Level B personal protection) throughout the process. Decontamination debris will be collected in roll-off containers. It is estimated that approximately 45 cubic yards of grit and floor dust will be accumulated and have to be disposed of. The concrete debris will be analyzed to determine if it should be classified as a RCRA hazardous waste. If the debris is classified as a RCRA hazardous waste, it will be disposed of in an off-site RCRA hazardous waste landfill. The landfill will be selected during the remedial action design after determination that the landfill is in compliance with regulatory requirements. If the debris is not classified as a RCRA hazardous waste, it will be disposed of in a RCRA solid waste landfill as a special waste.

After grit-blasting is completed, the interior surfaces will be dusted/vacuumed/wiped. Confirmation samples will then be collected from the concrete surfaces to determine whether the action levels had been achieved. Surface samples will be used to assess the effectiveness of the concrete decontamination. Surface samples will be collected by

grinding off a portion of the concrete surface and analyzing it for the contaminants of concern. If analytical results show that contamination above the established remedial action levels is still present in the concrete, grit-blasting will be continued. If the remedial action levels cannot be obtained, then the area where contamination of concern remains will be encapsulated with a durable coating. However, it has been assumed that all areas can be remediated to remedial action levels.

Deed restrictions, as permitted by law, limiting the use of the site will also be implemented. The deed restrictions will be implemented to restrict the buildings to industrial and commercial use. The soils around the foundation of the plating shop building will remain in place. The deed restrictions, if properly followed and enforced, will prevent exposure to the soil. Removal of the contaminated soil could not be performed without jeopardizing the structural integrity of the buildings.

The deed restrictions necessary under this alternative will be less restrictive than the other alternatives because a majority of the contaminants will be removed. It is anticipated that a wider range of industries would be allowed to occupy the buildings because of the contaminant removal. The Preferred Alternative will not allow for unlimited use and unrestricted exposure; therefore, CERCLA Section 121(c) periodic reviews conducted by the EPA will need to be conducted.

10.2 Summary of Estimated Costs

The estimated present worth cost for the remedy is $4,759,400 assuming a 5 percent discount rate. The estimated present worth cost for the groundwater alternative is $4,489,500 and for the buildings/soil alternative $269,900. The estimated capital cost for the remedy is $2,780,700. The estimated present worth cost of annual O&M costs is $1,978,700. Detailed breakouts of the costs are presented in Tables 1 and 2.

10.3 Cleanup Levels

Final cleanup levels were established for both groundwater and soils at the site. The final cleanup levels are presented in Table 3. The cleanup level for groundwater will restore the groundwater to drinking water quality, with respect to chromium

contamination, and will restore the use of the building for industrial and commercial purposes, with respect to specific contaminants.

10.4 Expected Outcomes of the Selected Remedy

The site aquifer is expected to be available as a drinking water resource and the on-site buildings are expected to be available for industrial or commercial use as a result of successful completion of the remedy. Contaminant fate and transport modeling has predicted attainment of the groundwater cleanup levels in approximately 13 years using the extraction scenario described for the alternative. A primary factor that may increase remediation time includes poor contaminant recovery from the aquifer. This uncertainty, however, could be minimized using data obtained during the treatability study which will be conducted as part of the remedy design.

Remediation efforts for the on-site buildings and soils will allow the buildings and site to be used for industrial or commercial purposes. The remediation efforts will require approximately 2 weeks. Deed restrictions limiting use of the buildings and site to industrial and commercial purposes will be in place for an indefinite period of time.

11.0 Statutory Determinations

Under CERCLA Section 121, EPA must select remedies that are protective of human health and the environment, comply with applicable or relevant and appropriate requirements (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element. The following sections discuss how the selected remedy meets these statutory requirements.

11.1 Protection of Human Health and the Environment

The selected remedial action will protect human health and the environment. Hydraulic extraction of contaminated groundwater, and subsequent treatment and

disposal of the extracted groundwater and treatment residue will eliminate the groundwater pathways through which contaminants pose risks. Removal of contaminated surface concrete and contaminated dusts to established cleanup levels from on-site buildings will allow industrial and commercial use of the buildings within accepted health-based exposure standards. Restricting future use of the site to industrial and commercial purposes by deed restriction will provide written notice of the remaining contamination to protect against inadvertent use of the site for residential purposes.

11.2 Compliance with ARARs

Section 121(d)(2) of CERCLA, 42 U.S.C. §9621(d)(2), requires that cleanup actions conducted under CERCLA achieve a degree or level of cleanup which, at a minimum, attains "any standard, requirement, criteria or limitation under any federal environmental law...or any promulgated standard, requirement, criteria, or limitation under a state environmental or facility siting law that is more stringent than any federal standard...[which] is legally applicable to the hazardous substance or pollutant or contaminant concerned or is relevant and appropriate under the circumstances of the release or threatened release of such hazardous substance or pollutant of contaminant...." The identified standards, requirements, criteria, or limitations thus adopted from other environmental laws , which govern on-site cleanup activities at this site, are referred to as "applicable or relevant and appropriate requirements", or "ARARs."

For on-site cleanup activities, under Section 121(e)(1) of CERCLA, EPA is not required to obtain any federal, state or local permits for actions conducted on site, but must comply with the substantive (non-administrative) requirements of the identified federal and state laws. For cleanup activities that will occur off site, both the substantive as well as the administrative requirements of such laws will apply to cleanup activities.

This section identifies the ARARs which will apply to the on-site cleanup activities for this site. (The many laws and regulations which apply to off-site cleanup or disposal activities are not called "ARARs" and are not enumerated here.)

FEDERAL ARARs

Clean Air Act of 1963, as amended (42 U.S.C. §§7401-7671q)

40 Code of Federal Regulations (CFR) Part 50

Part 50 (containing national ambient air quality standards) is pertinent to excavation and materials handling activities. These standards would be applicable for controlling fugitive emissions.

Clean Water Act of 1977, as amended (33 U.S.C. §§1251-1376)

40 CFR Parts 122 - 125

The National Pollutant Discharge Elimination System (NPDES) was established to control discharge of pollutants from any point source into waters of the United States. A permit will not be required since the site is being remediated as part of the Superfund program and the discharge point is on site; however, the substantive requirements of the regulation must be met. This regulation applies to the discharge of treated groundwater and process water to surface water.

Discharge limits for chromium will be established during remedial design and will be consistent with the requirements of the NPDES program. If established surface water discharge limits are not met, provisions for alternate effluent limits can be found in this part.

Under the Clean Water Act, states must establish ambient water quality criteria for the protection of surface water based on use classifications and the criteria stated under Section 304(a) of the Clean Water Act. These criteria are applicable (see the discussion under "State ARARs," below) and will be used to establish discharge limits for treated groundwater and process water.

Safe Drinking Water Act of 1986, as amended (40 U.S.C.§§300)

40 CFR Part 141

Primary Drinking Water Standards are established by this part. The Safe Drinking Water Act's Maximum Contaminant Levels (MCLs) are health-based standards for chemicals that may be found in public water supplies. The MCL for chromium would be applicable or relevant and appropriate if the treated water is beneficially reused for human consumption.

The discharge of treated groundwater or process water will otherwise not impact drinking water in a public water supply directly. However, the potential for residual contaminants percolating to groundwater exists. The NCP requires consideration of MCLs, where they exist, as relevant and appropriate to groundwater cleanup standards when the aquifer is a current or potential source of drinking water. The MCL for chromium is relevant and appropriate for establishing cleanup standards to be met during implementation of the remedy because the aquifer beneath the site is a drinking water source.

40 CFR Part 144-148

The substantive requirements of the underground injection regulations apply to any injected water or material, including any injection for bioremediation purposes.

Resource Conservation and Recovery Act (RCRA) of 1976, as amended (42 U.S.C. §§6901-6987)

40 CFR Part 261

The criteria set forth in this part will be used to determine if solid wastes excavated, created through treatment, or otherwise generated during the implementation of the remedy are hazardous or non-hazardous.

40 CFR Part 262.11

The methods for determining whether a solid waste is hazardous are set forth in this part. All generators of solid wastes are required to determine if a waste is hazardous. Wastes determined to be hazardous will be managed in accordance with the rules applicable to hazardous wastes.

40 CFR Part 262.34

The accumulation of hazardous waste on site is addressed by this part. In the event any of the solid wastes excavated, created through treatment, or otherwise generated during the implementation of the remedy are hazardous, these regulations will apply.

The RCRA regulations that apply to facilities for the treatment, storage or disposal of hazardous waste were determined not to be applicable or relevant and appropriate at this site.

STATE ARARs

Kansas Public Quality Standards (KAR 28-15-13). This regulation establishes state MCLs.

Kansas Surface Water Quality Standards (KAR 28-16-28). This regulation provides surface water quality standards to protect water resources of the state.

Hazardous Waste Management Regulations (KAR 28-31). This regulation specifies requirements for managing hazardous waste within the state of Kansas.

Solid Waste Management (KAR 28-29 Part II). This regulation specifies requirements for managing solid waste within the state of Kansas.

Injection Well Regulations (KAR 28-46, Parts 1-44). This regulation specifies requirements for injection wells within the state of Kansas.

Kansas Ambient Air Quality Standards and Air Pollution Control Regulations (KAR 28-19). This regulation specifies requirements for managing discharges to the air within the state of Kansas.

TO BE CONSIDERED

To be considered (TBC) are non-promulgated advisories or guidance documents issued by federal or state governments. The TBC were used at the Acé Services site as

part of the risk assessment to set protective cleanup levels for soil and for indoor air and dust. The TBC used at the site are listed below.

Permissible Exposure Level: Occupational Safety and Health Act (OSHA) (29CFR 1910.1000).

EPA Removal Cleanup Levels: EPA Action Memorandum, Ace Services Site, March 29, 1994.

EPA Region III Risk-Based Concentration: EPA Integrated Risk Information System (IRIS) Reference Dose and Slope Factors.

EPA OSWER Directive 9355.4-02, 1989, Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

11.3 Cost Effectiveness

The selected remedial action is cost-effective, providing overall effectiveness proportional to its costs. The selected remedy will be effective in the long-term, providing a significant and permanent reduction of the toxicity, mobility, and volume of contaminated groundwater and interior building contaminants.

11.4 Utilization of Permanent Solutions and Innovative Treatment Technologies to the Maximum Extent Practicable

The EPA has determined and the state of Kansas has concurred with EPA's determination that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner for the Ace Services Site. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA and the state have determined that this selected remedy provides the best balance of trade-offs in terms of the five balancing criteria, while also considering the statutory preference for treatment as a principal element and considering state and community acceptance. The selected remedy treats the

principal threat posed by the buildings and the major threat posed by the groundwater, achieving significant chromium and lead reductions.

Although EPA emphasizes treatment to reduce the "toxicity, mobility or volume" and "long term effectiveness" criteria (as provided in the NCP), the most significant difference among groundwater actions was with regard to the long-term effectiveness and implementability. The most significant difference among the buildings/soil actions was with regard to the long-term effectiveness and the reduction of contaminants. The preferred alternatives reduce the risk within a more reasonable time frame and at a lesser cost than any of the other alternatives. In addition, the selected remedy does not present any substantive or uncontrollable short-term risks to the community or on-site workers.

11.5 Preference for Treatment which Reduces Toxicity, Mobility, or Volume

By hydraulically containing and extracting groundwater and removing contaminated materials from the buildings containing COCs greater than the final cleanup goals, the selected remedial action addresses one of the principal threats posed by the site. The selected remedy also satisfies the statutory preference for remedial actions that employ treatment to significantly reduce toxicity, mobility, or volume of contaminants.

12.0 Documentation of Significant Changes

The selected remedy has not been significantly changed from the preferred alternative presented in the Proposed Plan.

III. RESPONSIVENESS SUMMARY

ACE SERVICES SITE, COLBY, KANSAS

RESPONSIVENESS SUMMARY
TO
COMMENTS FROM PUBLIC MEETING AND WRITTEN COMMENTS

Comment 1: The Colby City Manager expressed concern about the loss of the public water supply well shut down in 1980. She projected that the city water supply would be limited in the near future because the water rights have been effectively reduced by the shutdown of the well. She asked for (1) help on obtaining additional water rights or (2) consideration of reuse of the treated water from the U.S. Environmental Protection Agency's (EPA) remedial action for city drinking water purposes versus disposal of the treated water. Several other commenters also expressed a desire for EPA to incorporate reuse of the treated groundwater for city drinking water supply and to consider the value of the water in our determination. Consideration of blending of treated and other water supplies was recommended by one person.

Response 1: The EPA's preferred remedy called for the discharge of treated water to a tributary of Prairie Dog Creek or to the Colby Publicly Owned Treatment Works (POTW) with the water being monitored to ensure compliance with the substantive requirements of the Clean Water Act and the parallel State regulations. The EPA is willing to make the water available for beneficial reuse, provided it is understood that any such arrangements would necessarily be the responsibility of the appropriate state and local authorities, and that EPA is not in a position to treat the water to remove other possible contaminants (e.g., nitrates, or other common groundwater contaminants not within the scope of this cleanup), or to guarantee that the water is safe for any particular use. For example, despite removal of the contaminant of concern (chromium) to concentrations below drinking water standards, the water may not be potable if other common contaminants are present. The Record of Decision (ROD) provides that if local, regional or state authorities can come up with a beneficial reuse plan in a timely way (i.e., by the due date for the preliminary design), the remedial design for the remedy could take account of such a plan. In any event, the piping for the remedy will include a hookup point to accommodate beneficial reuse, to avoid the need to retrofit such a link. The ability to blend treated water with city drinking water would be dependent on the city's water distribution system capabilities and would be handled by the local authorities.

The effluent water from the on-site treatment plant is expected to have elevated concentrations of total dissolved solids (TDS) and iron (Fe) as residuals from the treatment process. If the elevated TDS and Fe are undesirable, an ion exchange treatment option (evaluated in the feasibility study (FS) report) will provide effluent that would be more suitable for reuse as drinking water. However, at influent concentrations above 1 milligram per liter (mg/L) total chromium, the treatment

cost for ion exchange is considerably higher than the proposed electrochemical precipitation method. The most appropriate treatment option will be resolved during the design phase.

The EPA has contacted the Kansas Department of Health and Environment (KDHE) about the issue of Colby's water rights, and EPA will continue to pursue this issue during the design. According to the Kansas Department of Agriculture (KDA), there will need to be an application for a term permit for water rights before remediation commences. At this point, KDA believes the water rights for Colby have not been reduced because Public Water Supply Well 8 was shut down. Every reasonable effort will be made by EPA to accommodate the city's use of the treated water effluent from the site if such use is pursued by the local authorities.

Comment 2: One commenter asked if the proposed pumping wells would be pumped continuously, 24 hours per day.

Response 2: The answer is yes, the wells will be continuously pumped, except for periods of maintenance, until the cleanup is completed.

Comment 3: The same commenter asked if the withdrawal of groundwater in the remedial action would affect the city's water rights.

Response 3: The EPA expects that a permit for remediation withdrawal rights will be granted. Remediation water rights should not impact the city's water rights.

Comment 4: The Colby City Mayor asked whether use of the buildings has to be postponed until the completion of the groundwater cleanup.

Response 4: As soon as the buildings have been cleaned and declared suitable for use, they may be used. Use of the buildings does not have to await the end of the groundwater treatment period. Anticipated uses for the buildings are for commercial and industrial purposes.

Comment 5: Another commenter asked about the boundaries of the site, as defined in the proposed plan. He specifically mentioned the gas station area, and reported his belief that the gas station tanks remain buried at the site.

Response 5: The site is defined by EPA to include the two buildings, surrounding soils, and the contaminated groundwater plume area where the amount of chromium in the groundwater is greater than 100 micrograms per liter (ug/l) chromium. It does not include the gas station area. The KDHE representative at the meeting agreed to report the information to the State Underground Tank Program concerning the alleged underground storage tanks. The KDHE's Storage Tank Section, Bureau of Remediation, will conduct an investigation of the site when access to the property is granted.

Comment 6: One person asked if there was a further need to clean up under the buildings.

Response 6: The EPA and KDHE plan some further investigation of the subsurface soils beneath both the buildings and the old lagoon area. This investigation will begin during remedial design work, and will continue after the groundwater extraction program has begun, so that EPA may judge the effectiveness of the extraction, and then determine if the soils have a continuing source impact on the groundwater quality. A decision will be made before or during the 5-year review, which occurs five years after the implementation of the remedy at the site. The ROD also provides that deed restrictions will be implemented to prevent excavation of the contaminated soil remaining beneath the buildings and to prevent removal of the concrete floors of the buildings.

Comment 7: A commenter who leases the machine shop asked about the plans for this building, and wondered about the impact on his lease and business activities.

Response 7: This building should be currently suitable for the limited industrial/commercial uses described by this commenter. The EPA plans to sample the buildings first, to better delineate the areas in each that may need cleaning. If the samples in the machine shop show no need for cleaning, no disruption of the current use as a storage building will be necessary. If the samples demonstrate the need for cleaning, it should be possible to schedule this work so as not to disrupt the lessee's business operations.

Comment 8: A commenter asked about the legal owner of the property, and how a clear deed would be given. She also asked about any lien on the property, any release of that lien, and if there was a time frame on the lien. Another commenter followed up with questions about procedures if there are more than one lien on a site, what is the hierarchy?

Response 8: Under CERCLA the EPA is allowed to recover its costs from responsible parties. Responsible parties may include both persons and corporations responsible for the release of contamination and the owner or owners of the property where the contamination was released. The EPA is allowed to file a CERCLA lien against a property under appropriate circumstances as a means of encumbering property with respect to which the EPA has incurred response costs. The EPA to date has not filed a lien against the Ace Services property. The EPA will seek to recover the costs it has incurred at the Ace Services Site from a responsible party or parties if possible. The EPA generally does not comment on the status of specific ongoing enforcement actions; accordingly, with respect to EPA's specific enforcement actions to be taken in connection with the Ace Services Site, EPA has no further comment.

Comment 9: A commenter stated that the state of Kansas Maximum Contaminant Level (MCL) for protection of drinking water is 50 ug/l for chromium instead of the 100 ug/l

ug/l level utilized in the proposed plan. The KDHE sent EPA a similar comment on December 24, 1998. Subsequently, in a letter dated January 13, 1999, KDHE informed EPA that the 100 ug/l standard was correct, reversing the incorrect information in the December 24, 1998 letter.

Response 9: The EPA will continue to use the 100 ug/l standard as a cleanup level for groundwater.

Comment 10: One commenter encouraged EPA to use Public Water Supply Well 8 if it could effectively aid in the extraction program.

Response 10: The EPA intends to utilize this well if during the remedy design, it is determined that the well can be effectively used in the groundwater remediation process.

Comment 11: A commenter asked if additional problems had been caused at the site by the requirement to install lagoons and other treatment measures in the 1970s and 1980s.

Response 11: The EPA believes there would have been worse problems at the site had these measures not been installed. In the days before the lagoon and treatment system, wastes were discharged directly to the ground or into the tributary to Prairie Dog Creek. At least some of the contaminants were removed in the treatment system, and the lagoon probably retarded the migration of contaminants into the groundwater and/or prevented the contamination from being more widespread in nature.

Comment 12: The KDHE commented that the acceptable level of contamination that could be discharged to the receiving stream would be lower than referenced in the proposed plan, and that this fact will result in higher treatment costs should this discharge option be chosen.

Response 12: The EPA acknowledges the Kansas limits. The remedy design will meet the Kansas discharge limits if the final design calls for discharge to the receiving stream. More detailed cost estimates will be developed during remedial design.

Comment 13: The KDHE recommended that the in-situ bioremediation system not be installed unless assurances can be provided that (1) the reduced conditions would not persist past the remediation phase, (2) all reduced groundwater would be captured by the extraction system, and (3) approval is received for the injection of the carbon (carbohydrate) source. Regarding the public comments favoring reuse of the treated groundwater, KDHE also questioned the in-situ bioremediation system's impact on drinking water quality.

Response 13: Application of in-situ bioremediation at the site will depend on results of treatability studies which will be performed as part of the initial remedial design.

Unless the treatability studies indicate the technique will be appropriate, helpful and worth the added expense, it will not be implemented. In addition, if EPA determines during remedial design that reuse of the treated groundwater will occur, we will strongly consider deletion of the bioremediation technology unless it is demonstrated that reuse of the water will not be limited.

If bioremediation is implemented, the following comments apply:
1) The current concept for the in-situ bioremediation system includes containment of the reduced groundwater within the capture zone of the extraction wells. However, once the cleanup level for chromium is achieved, the groundwater pumps will be turned off, thus leaving the remediated portion of the aquifer in a chemically reduced condition. It will require an unknown period of time for the aquifer to return to its original state of unreduced conditions.

2) The artificial, chemically reduced condition of the aquifer will most likely remain for a period of time once injection of the carbohydrate source is terminated. The process for the aquifer to restore itself is complex and depends on dispersional flow properties and geochemical properties of the aquifer. The amount of time it will take for the aquifer to return to equilibrium has currently not been evaluated and could not be made with much certainty.

3) Injection of the carbohydrate source will be performed in accordance to Kansas regulations KAR 28-16 (Underground Injection Control Regulations), Federal regulations 40 CFR Parts 144-147 concerning underground injection wells, and EPA's Water Division and KDHE/Bureau of Water.

In summary, if in-situ bioremediation is implemented at the site the remediated portion of the aquifer will be in a chemically reduced condition. It will require a period of time for the aquifer to return to its original state of equilibrium. The reduced water will be lacking in oxygen and may have unpleasant odors and discoloration. Hydrogen sulfide and methane may be released from the reduced portion of the aquifer. However, the quality of the chemically reduced groundwater extracted and treated as part of the remedial action should improve during the treatment process.

Comment 14: The KDHE requested a more detailed explanation of the Operation and Maintenance Costs, as well as a clarification of the funding of these costs, the time periods of that funding, and a description of any other circumstances regarding the funding source of the project..

Response 14: Operation and Maintenance (O&M) costs for the preferred remedy were prepared in accordance with EPA guidance criteria (EPA/540/G-89/004). The estimate was prepared based on the current understanding of site conditions using engineering experience and judgement. During ROD preparation, electrical costs for the O&M of each groundwater remedy were revised to include plant treatment costs. All total present worth costs in this ROD reflect electrical cost revisions. The present worth

for the capital and O&M costs was provided in detail in Table B-6 (groundwater alternative component) and Table C-4 (building/soil alternative component) of the Final Feasibility Study Report (November 1998) and will also be provided in the Record of Decision for the site. A more detailed cost estimate will be prepared during remedial design.

Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA funds the cost of O&M on groundwater remedies for up to 10 years after the remedy becomes operational and functional. Any O&M costs after the 10-year period would be the responsibility of the state.

Comment 15: The KDHE recommended that if the city of Colby agrees to reuse the treated groundwater, EPA should consider entering into an arrangement to train city personnel to operate the treatment system and to operate the system for the remainder of the project.

Response 15: The EPA would consider this approach and other options to involve city personnel in future work at the site.

Comment 16: The KDHE recommended that continued monitoring of the downgradient residential wells be included in the remedial action.

Response 16: The EPA will include such monitoring in the project.

Comment 17: The KDHE requested additional groundwater monitoring downgradient of the site to determine the horizontal and vertical limits of chromium contamination.

Response 17: The selected remedy includes the additional groundwater monitoring requested by KDHE. Five additional multiport wells and one shallow well will be installed and monitored at the site. These wells will be near MW-2, PWS-8, north of PWS-8, south of PWS-8, between RW-1 and PWS-8, and just downgradient of the site.

Table 1
Preferred Groundwater Alternative Present Worth Cost Estimate
Active Restoration/Reduc/Precip/Coag-Flocc/In-situ Bioremediation
Ace Services Site

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
CAPITAL COSTS					
Extraction Wells (2 sets of 3, 6" PVC wells intalled to depths of 120 ft, 170 ft, and 220 ft)	1020	VLF	$45	$45,900	
3 HP Submersible Pump (wire, 2" galvanized drop pipe, flow, and control devices)	2	EA	$4,000	$8,000	
5 HP Submersible Pump (wire, 2" galvanized drop pipe, flow, and control devices)	4	EA	$5,500	$22,000	
7-1/2 HP Submersible Pump (wire, 2" galvanized drop pipe, flow, and control devices)	1	EA	$6,000	$6,000	
Groundwater Collection Double Containment Piping (4" inside 6" HDPE installed, includes bedding and trenching)	1950	LF	$33.43	$65,200	
Chain-Link Fencing (6 ft high w/ 3 strand barbed wire)	120	LF	$13.53	$1,600	
Swing Gate (6 ft high, 12 ft opening w/ 3 strand barbed wire)	1	EA	$400	$400	
Concrete Well Vaults (Extraction wells only)	2	EA	$1,100	$2,200	
Pre-engineered Building	1	EA	$18,000	$18,000	
Purchased Packaged 210 gpm Electrochemical Reduction System delivered to site (includes influent holding tank, electrochemical cell and acid wash system, and degas tank/effluent holding tank)	1	LS	$300,000	$300,000	
Other Direct Costs for Packaged System	1	LS	$738,000	$738,000	
Discharge Piping to Creek (3" PVC installed, includes bedding and trenching)	750	LF	$8	$6,000	
Multiport Sampling Wells, 5 - 4" PVC wells installed to depth 220 ft (screen intervals 120-130 ft, 170-180 ft, and 210-220 ft)	1100	VLF	$30	$33,000	
Observation Wells, 6 sets of 2" PVC wells installed to depths of 120 ft, 170 ft, and 220 ft)	3060	VLF	$22	$67,300	
Shallow Sampling Well , 1 - 4" PVC well installed to depth of 30 ft	30	VLF	$30	$900	
In-situ Bioremediation System: System includes source storage tank, mixing tank, solenoid valves, pumps, PLC, and distribution lines to 5 wells	1	LS	$106,400	$106,400	
Other Direct Costs for In-situ Bioremediation Packaged System	2	LS	$50,000	$100,000	
Treatability Studies (treatment and in-situ bio)	2	LS	$30,000	$60,000	
DIRECT CAPITAL COST SUBTOTAL				$1,580,900	
Bid Contingency (15%)				$237,100	
Scope Contingency (15%)				$237,100	
TOTAL DIRECT CAPITAL COST				$2,055,100	
Permitting and Legal (5%)				$102,800	
Construction Services (10%)				$205,500	
CONSTRUCTION COSTS TOTAL				$2,363,400	
Engineering Design (8%)				$189,100	
TOTAL CAPITAL COST				$2,552,500	

Table 1 (Continued)
Preferred Groundwater Alternative Present Worth Cost Estimate
Active Restoration/Reduc/Precip/Coag-Flocc/In-situ Bioremediation
Ace Services Site

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
ANNUAL O&M COSTS					
Electrical Costs: Pumps (826 KWh/day)	301,500	KWh	$0.08		$24,100
Electrical Costs: Plant (3000 KWh/day)	1,095,000	KWh	$0.08		$87,600
Groundwater Monitoring (Analysis, equipment, shipping)					
Year 1 Monthly sampling of 5 monitoring wells (15 samples) for total and hexavalent chromium (standard turnaround)	180	EA	$200		$36,000
Years 2 through 6 Quarterly sampling of 5 monitoring wells (15 samples) for total and hexavalent chromium (standard turnaround)	60	EA	$200		$12,000
Years 7 through 13 Semi-annual sampling of 5 monitoring wells (15 samples) for total and hexavalent chromium (standard turnaround)	40	EA	$200		$8,000
Groundwater Monitoring (Labor only)					
Year 1 2 Level P1 persons for 2-8 hour days per sampling event	384	HR	$60		$23,000
Drilling subcontractor (pump installation)	12	EA	$3,000		$36,000
Years 2 through 6 2 Level P1 persons for 2-8 hour days per sampling event	128	HR	$60		$7,700
Drilling subcontractor (pump installation)	4	EA	$3,000		$12,000
Years 7 through 13 2 Level P1 persons for 2-8 hour days per sampling event	64	HR	$60		$3,800
Drilling subcontractor (pump installation)	2	EA	$3,000		$6,000
RCRA Sludge Disposal (Assume 1.3 times by weight dewatered sludge)	1020	LBS	$0.45		$500
Electrode Replacement	2800	LBS	$0.50		$1,400
Treatment Plant Effluent Monitoring (Monthly monitoring for total and hexavalent chromium, standard turnaround)	12	EA	$200		$2,400
Preparation of Health and Safety Plan (Year 1 only)	40	HR	$60		$2,400
Preparation of O&M Manual (Year 1 only)	80	HR	$60		$4,800
Preparation of QA/Sampling Plan (Year 1 only)	60	HR	$60		$3,600
Five-Year Review @ 5, 10, and 13 yrs	1	LS	$15,000		$15,000
Maintenance Allowance (12% of purchased equipment delivered)	1	LS	$36,000		$36,000
Operator Requirement (2 hour/day)	730	HR	$25		$18,300
TOTAL PRESENT WORTH O&M COST				$1,937,000	
TOTAL PRESENT WORTH				$4,489,500	

5 percent discount rate used to calculate present worth.

Table 1 (Continued)
Preferred Groundwater Alternative Present Worth Cost Estimate
Active Restoration/Reduc/Precip/Coag-Flocc/In-situ Bioremediation
Ace Services Site

Year	Yearly O&M Cost*	Intermittent O&M Costs	Total Annual O&M Costs	Intermittent O&M Costs Include:
1	$170,300	$105,800	$276,100	Year 1 (plans, monitoring)
2	$170,300	$31,700	$202,000	Years 2-6
3	$170,300	$31,700	$202,000	Years 2-6
4	$170,300	$31,700	$202,000	Years 2-6
5	$170,300	$46,700	$217,000	Years 2-6 and 5 yr review
6	$170,300	$31,700	$202,000	Years 2-6
7	$170,300	$17,800	$188,100	Years 7-13
8	$170,300	$17,800	$188,100	Years 7-13
9	$170,300	$17,800	$188,100	Years 7-13
10	$170,300	$32,800	$203,100	Years 7-13 and 5 yr review
11	$170,300	$17,800	$188,100	Years 7-13
12	$170,300	$17,800	$188,100	Years 7-13
13	$170,300	$32,800	$203,100	Years 7-13 and 5 yr review
Present Worth of Annual O&M			$1,936,971	

* Yearly O&M costs include: electricity, treatment plant effluent monitoring, maintenance, and operator.

Table 2
Preferred Building/Soil Alternative Present Worth Cost Estimate
Grit-Blasting
Ace Services Site

Cost Estimate Component	Quantity	Units	Unit Cost	Capital Cost	Annual Cost
CAPITAL COSTS					
Legal Personnel to Implement Deed Restrictions	60	HR	$140	$8,400	
Mobilization/Demobilization	1	LS	$500	$500	
Predecontaminatin/Confirmation Sampling and Analysis (Wipe)	24	EA	$105.00	$2,500	
Prepare Quality Assurance Project Plan	40	HR	$60.00	$2,400	
Grit Blasting	17695	SF	$4.38	$77,500	
Cleaning w/ HEPA vacuum and wet wipe	72230	SF	$0.54	$39,000	
Load Debris into Roll-Off Containers	45	CY	$3.48	$200	
Transport Debris to Offsite Facility	250	MI	$3	$900	
Disposal Cost	48	Ton	$103	$4,900	
Personnel Decontamination Chamber	400	SF	$5.30	$2,100	
Labor During Decontamination	40	HR	$22	$900	
Other Direct Costs for PPE	1	LS	$2,024	$2,000	
DIRECT CAPITAL COST SUBTOTAL				$141,300	
Bid Contingency (15%)				$21,200	
Scope Contingency				$21,200	
TOTAL DIRECT CAPITAL COST				$183,700	
Permitting and Legal (5%)				$9,200	
Construction Services (10%)				$18,400	
CONSTRUCTION COSTS TOTAL				$211,300	
Engineering Design (8%)				$16,900	
TOTAL CAPITAL COST				$228,200	
ANNUAL O&M COSTS					
Five-Year Review @ 5, 10, 15, 20, 25, 30 yrs	1	LS	$15,000		$15,000
TOTAL PRESENT WORTH O&M COST				$41,700	
TOTAL PRESENT WORTH				$269,900	

5 percent discount rate used to calculate present worth.

Table 2 (Continued)
Preferred Building/Soil Alternative Present Worth Cost Estimate
Grit-Blasting
Ace Services Site

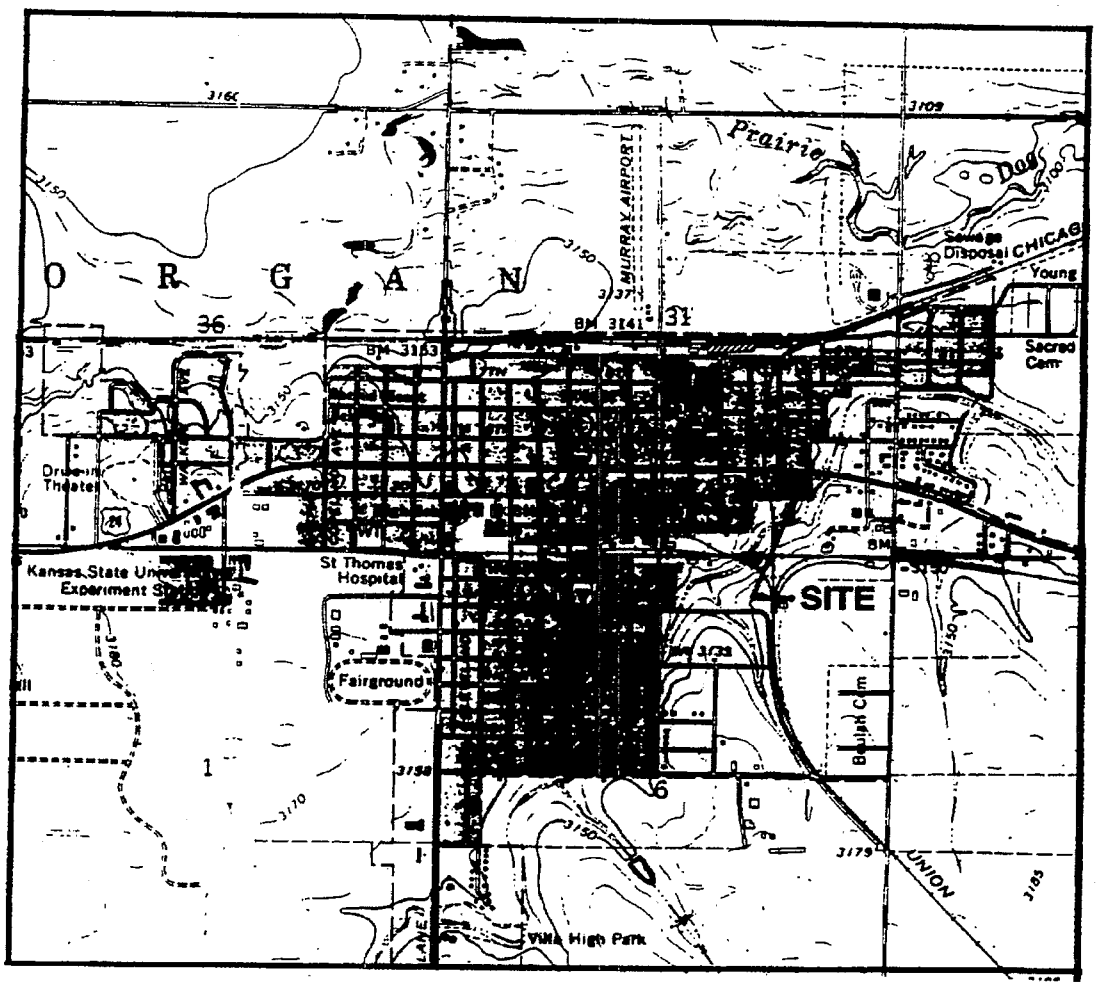
Year	Yearly O&M Cost*	Intermittent O&M Costs	Total Annual O&M Costs	Intermittent O&M Costs Include:
1	$0	$0	$0	
2	$0	$0	$0	
3	$0	$0	$0	
4	$0	$0	$0	
5	$0	$15,000	$15,000	5 yr review
6	$0	$0	$0	
7	$0	$0	$0	
8	$0	$0	$0	
9	$0	$0	$0	
10	$0	$15,000	$15,000	5 yr review
11	$0	$0	$0	
12	$0	$0	$0	
13	$0	$0	$0	
14	$0	$0	$0	
15	$0	$15,000	$15,000	5 yr review
16	$0	$0	$0	
17	$0	$0	$0	
18	$0	$0	$0	
19	$0	$0	$0	
20	$0	$15,000	$15,000	5 yr review
21	$0	$0	$0	
22	$0	$0	$0	
23	$0	$0	$0	
24	$0	$0	$0	
25	$0	$15,000	$15,000	5 yr review
26	$0	$0	$0	
27	$0	$0	$0	
28	$0	$0	$0	
29	$0	$0	$0	
30	$0	$15,000	$15,000	5 yr review
Present Worth of Annual O&M			$41,730	

* Yearly O&M costs include monthly cleaning of the builiding.

Table 3
Final Cleanup Levels:
Groundwater, Interior Air, Interior Dust/Concrete, and Exterior Soil
Ace Services Site

Media	Contaminant	Maximum Onsite Detection	Units	Final Cleanup Level	Reference
Groundwater	Chromium (VI)	2.998	µg/L	100	MCL[1]
Interior Air	Arsenic	0.243	µg/cu m	10	PEL[2]
	Cadmium	0.720	µg/cu m	5	PEL[2]
	Total Chromium	80.8	µg/cu m	100	EPA[3]
	Chromium (VI)	10.8	µg/cu m	100[4]	PEL[2]
	Lead	15.1	µg/cu m	30	EPA[3]
	Manganese	6.38	µg/cu m	5,000	PEL[2]
	Nickel	2.68	µg/cu m	1,000	PEL[2]
Interior Dust/ Concrete	Total Chromium	9,290	mg/kg	10,000[5]	RBC[6]
	Chromium (VI)	213	mg/kg	10,000	RBC[6]
	Lead	2,580	mg/kg	1,000	EPA[7]
Exterior Soils	Total Chromium	690	mg/kg	1500	EPA[3]
	Lead	418	mg/kg	500	EPA[3]

Notes:
1) The MCL for total Cr was used because there is no MCl for Cr(VI).
2) PEL = Permissible Exposure Level, OSHA (USHSS 1994).
3) EPA = USEPA Removal Cleanup Levels (EPA 1994).
4) The OSHA PEL of 100 µg/cu m is expressed as CrO_3 which is equivalent to 50 µg/cu m expressed as Cr.
5) The RBC for Cr(VI) was used because there is no RBC for total Cr.
6) RBC = USEPA Region III Risk-Based Concentration (EPA 1997).
7) EPA = USEPA OSWER Directive 9355.4-02, 1989.



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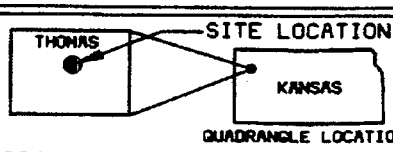

SOURCE: USGS 7.5' SERIES, COLBY QUADRANGLE, THOMAS COUNTY, KANSAS, 1967

SOURCE: KDHE 1991

FIGURE 1
SITE LOCATION
ACE SERVICES SITE

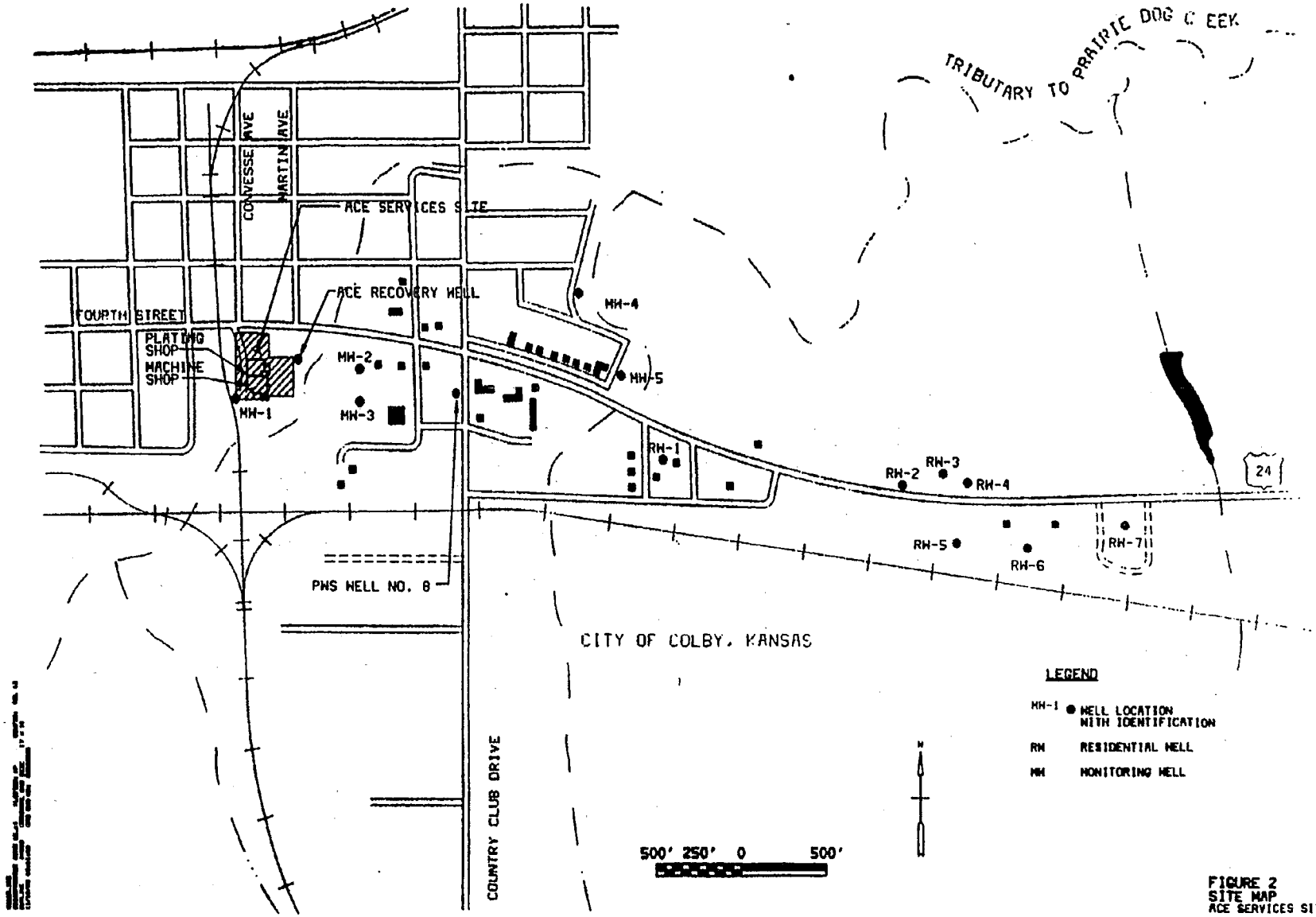

FIGURE 2
SITE MAP
ACE SERVICES SITE

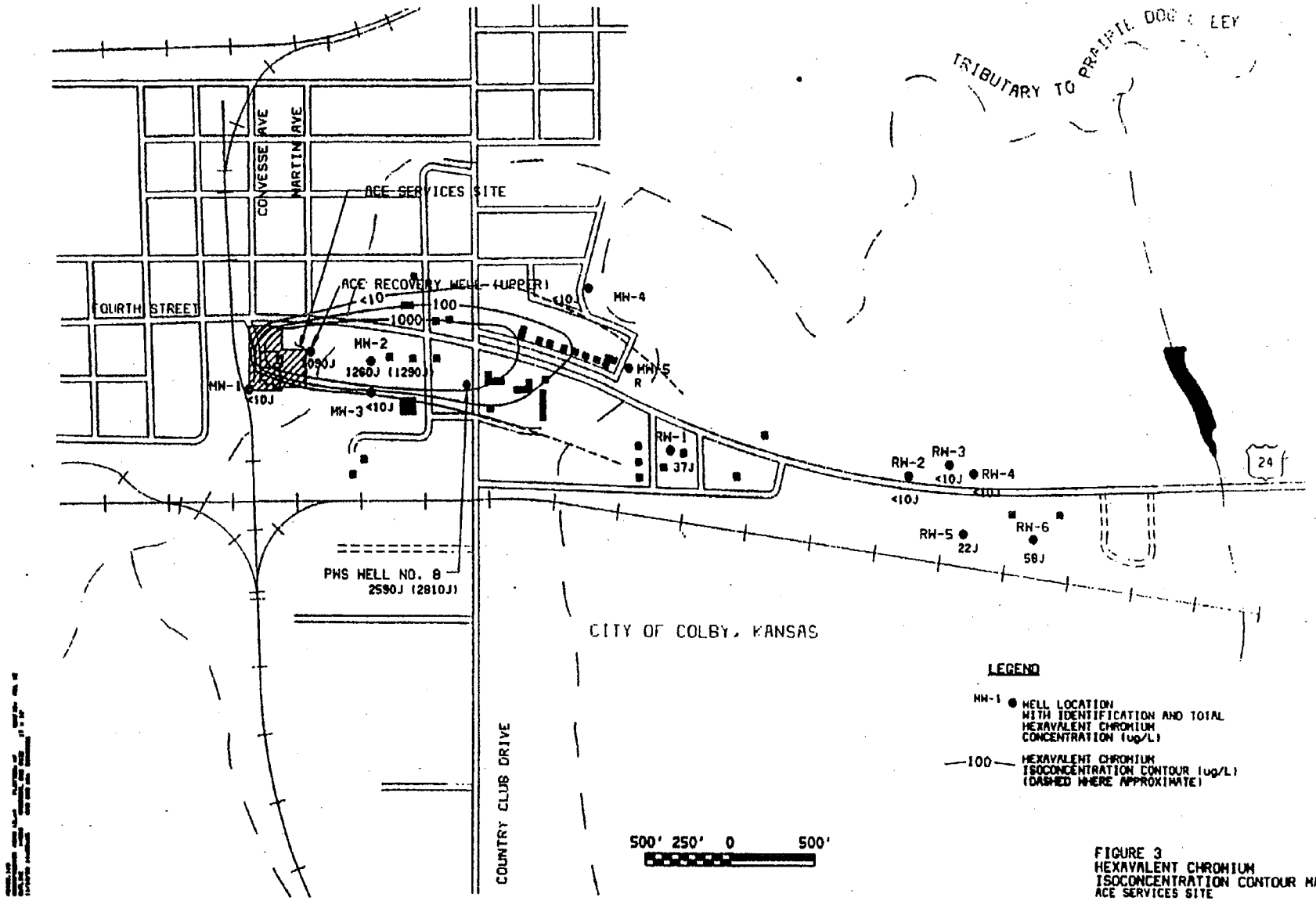

FIGURE 3
HEXAVALENT CHROMIUM
ISOCONCENTRATION CONTOUR MAP
ACE SERVICES SITE

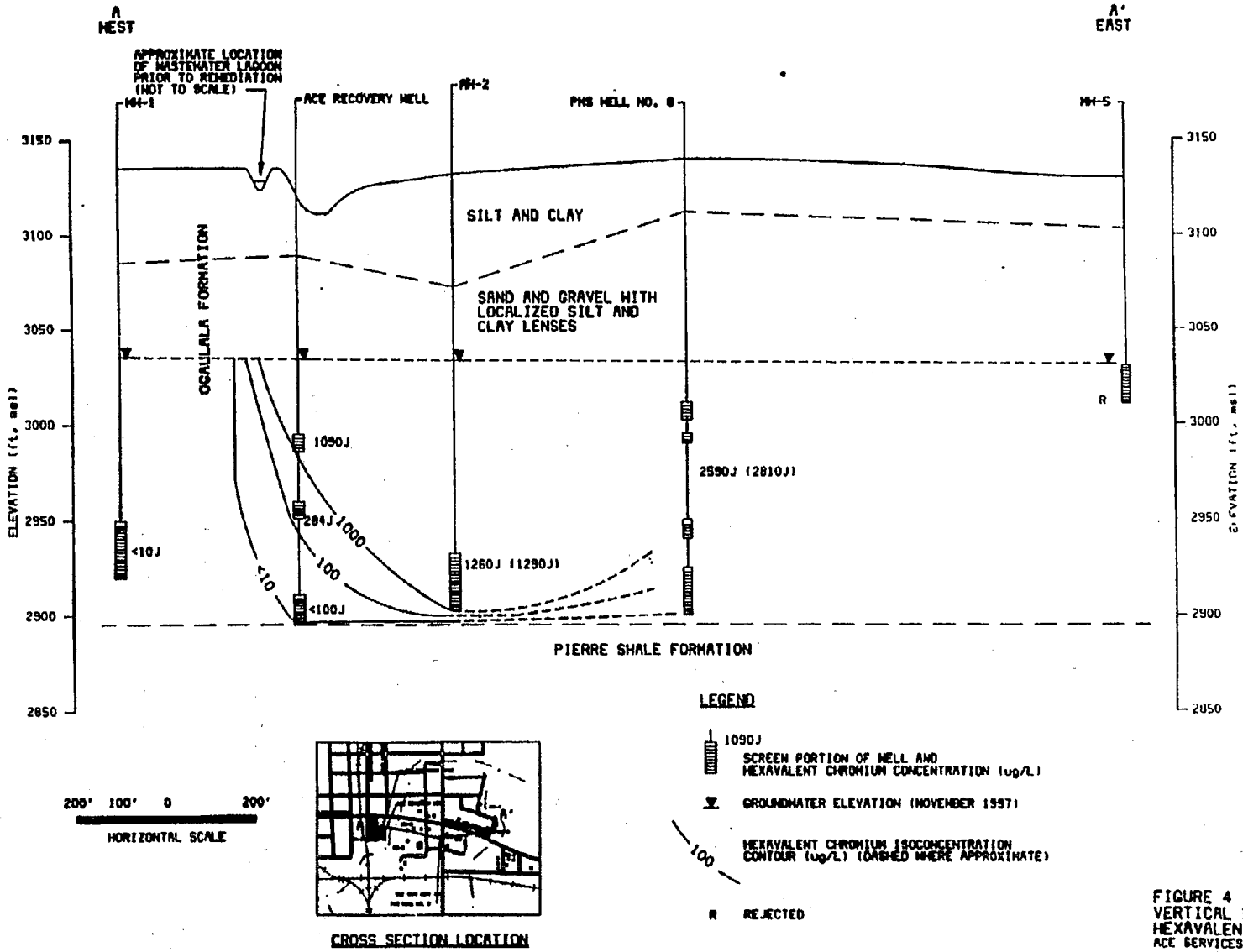

FIGURE 4
VERTICAL EXTENT OF HEXAVALENT CHROMIUM
ACE SERVICES SITE

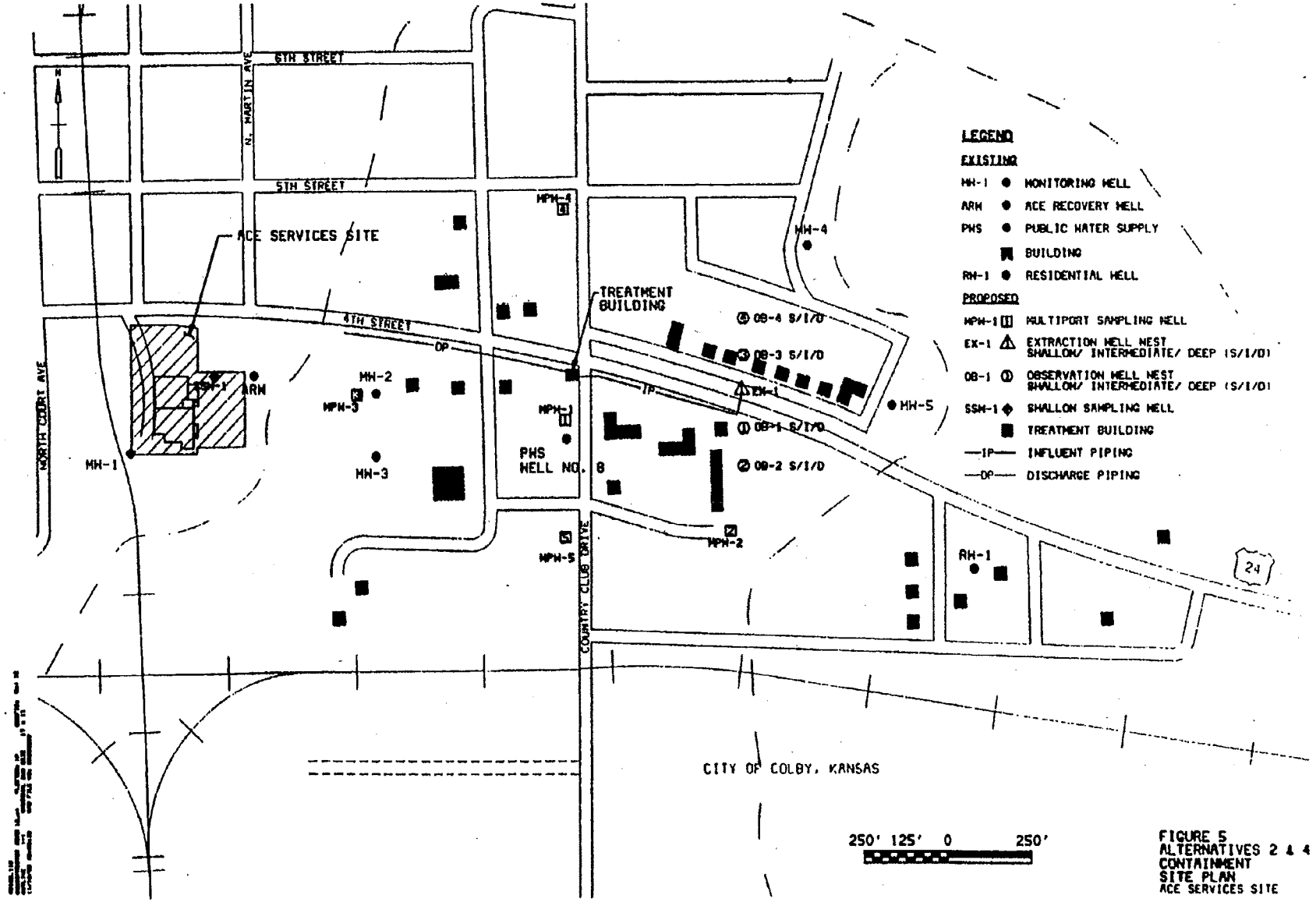

FIGURE 5
ALTERNATIVES 2 & 4
CONTAINMENT
SITE PLAN
ACE SERVICES SITE

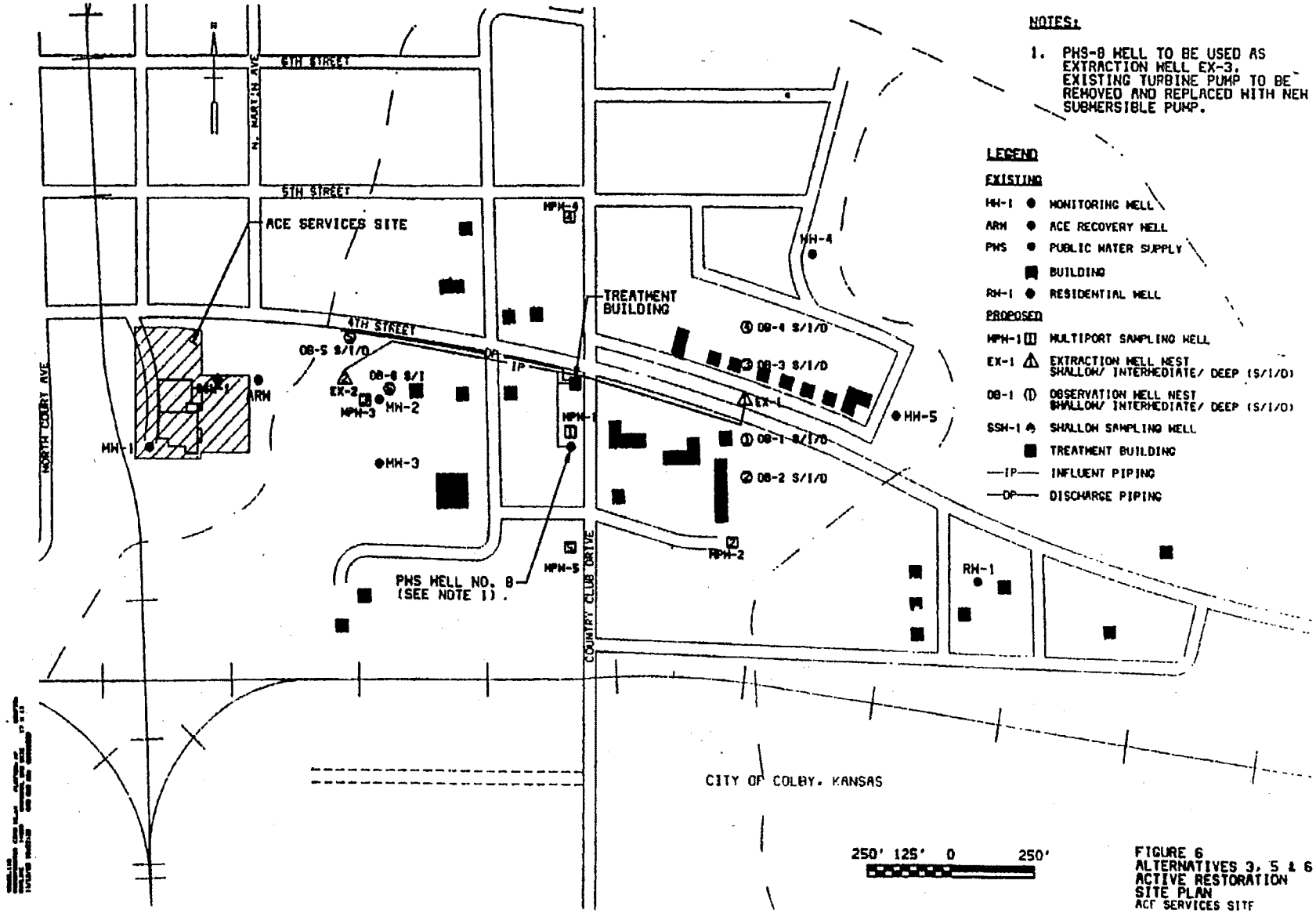

FIGURE 6
ALTERNATIVES 3, 5 & 6
ACTIVE RESTORATION
SITE PLAN
ACE SERVICES SITE

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