RECORD OF DECISION AMENDMENT

FOR

OPERABLE UNIT 2 (OU2)

SITE C-2

NEW BRIGHTON/ARDEN HILLS SUPERFUND SITE
ARDEN HILLS, MINNESOTA

June 2007

RECORD OF DECISION AMENDMENT

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June 2007

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Site Name and Location

Operable Unit 2
New Brighton/Arden Hills Superfund Site
Arden Hills, Minnesota
CERCLIS # MN7213820908

Statement of Basis of Purpose

This decision document amends the 1997 Record of Decision (ROD) for Operable Unit 2 (OU2). This decision document presents the new and amended selected remedial actions for Site C at the New Brighton/Arden Hills Superfund Site, also known as the Twin Cities Army Ammunition Plant (TCAAP). This decision document was developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), the Minnesota Environmental Response and Liability Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) promulgated in Title 40 of the Code of Federal Regulations (CFR) Part 300 (40 CFR 300). Specifically, this decision document has been prepared in compliance with CERCLA Section 117 and the NCP in 40 CFR 300.435(c)(2)(ii). This decision is based on the Administrative Record file for OU2 within the New Brighton/Arden Hills Superfund Site.

The United States Environmental Protection Agency (EPA), the Minnesota Pollution Control Agency (MPCA), and the United States Army (Army), pursuant to the Federal Facilities Agreement among the three parties, agree on the selected remedies in this ROD Amendment.

Assessment of the Site

The selected response actions, as described in this ROD Amendment, are necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances from Site C that present an imminent and substantial endangerment to public health or welfare.

Description of the New and Amended Selected Remedies

OU2 of the New Brighton/Arden Hills Superfund Site consists of affected soil and water within the boundaries of the TCAAP facility that have been impacted by waste materials such as volatile organic compounds, heavy metals, corrosive materials, and explosives. OU2 consists of shallow soil sites, dumps, deep soil sites, shallow groundwater sites, and deep groundwater. The amended remedy is specific to shallow soil at Site C-2. In addition, new remedies are specific to sediments, surface water, and shallow groundwater at Site C-2. The net present value of the

estimated capital and operating cost for all four remedies for a 30-year period is approximately $3.5 million.

Site C-2 – Shallow Soil

The remedy selected for Site C shallow soil consisted of excavation and offsite disposal of soil with concentrations of antimony, arsenic, beryllium, lead, manganese, or thallium exceeding the cleanup levels identified in Table 1. Site C is divided into two areas: C-1 and C-2. Area C-2 is the subject of this ROD Amendment and is referred to as Site C-2. During the excavation process at Site C-2, groundwater was encountered at shallow depths. Excavation of soil was stopped at groundwater. Confirmation samples (to determine if the remaining soil is clean) were not collected when groundwater was encountered. Initially, shallow groundwater was encountered in a few small areas but as the area of concern expanded from 0.33 acres to about 5 acres, shallow groundwater was encountered more often. About forty-five percent of the area excavated during the 2000 through 2002 field seasons encountered groundwater during the excavation process. In 2002, it was determined that Site C could not be approved for response completion following the remedy implementation because a large number of grids were being excavated to groundwater without characterization data and these grids likely contain contaminated soils below groundwater.

Amended remedy alternatives were evaluated in response to the fundamental change involving the scope, performance, and cost to the selected remedy. The major components of the amended selected remedy include the following:

- In several areas, a combination of limited excavation of contaminated soils and backfill with clean soil to create a minimum 4-foot-thick soil cover between the surface and the contaminated soil remaining in place.
- Land use controls (LUCs) to maintain the integrity of the soil cover and prohibit unauthorized disturbance to underlying shallow soils.
- LUCs that restrict area without soil cover to site-specific industrial use.

Site C-2 – Sediments

In response to concerns about potentially contaminated sediment, an investigation conducted in the two ditches at Site C-2 reported elevated levels of arsenic and lead in these ditches. In April 2004, the Army, EPA, and MPCA agreed to include sediment remedial actions under the framework of the TCAAP Federal Facilities Agreement.

The major components of the selected remedy include the following:

- Backfilling the two ditches with clean soil to create a minimum 4-foot-thick soil cover between the surface and the contaminated sediment remaining in place.
- Creating new wetland within the TCAAP facility to replace the loss of existing wetland when backfilling the ditches.
- LUCs to maintain the integrity of the soil cover and prohibit unauthorized disturbance to underlying sediment.

Site C-2 – Groundwater

A 1997 field demonstration project to phytoremediate lead-contaminated soil unexpectedly enhanced the mobility of lead, resulting in impacts to the shallow groundwater. Corrective actions, including extraction and treatment of groundwater, were executed in response to the MPCA's Notice of Violation (NOV). In April 2004, the Army, EPA, and MPCA agreed to include groundwater remedial actions under the framework of the TCAAP Federal Facilities Agreement.

The major components of the selected remedy include the following:

- Extraction, treatment, and monitoring of the groundwater.
- LUCs to protect the extraction, treatment and monitoring systems.
- LUCs to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer, which is considered shallow groundwater.

Site C-2 – Surface Water

As part of the NOV-related corrective actions for the phytoremediation demonstration project, surface water monitoring has been conducted in the two ditches at Site C-2 and in nearby Rice Creek. In April 2004, the Army, EPA, and MPCA agreed to include surface water remedial actions under the framework of the TCAAP Federal Facilities Agreement. A majority of the Site C-2 ditches will be backfilled as part of the Site C-2 – Sediment selected remedy. The remaining Site C-2 ditch and nearby Rice Creek will remain as part of the Site C-2 – Surface Water remedial action.

The major components of the selected remedy include the following:

- Backfilling the two ditches with clean soil to create a minimum 4-foot-thick soil cover between the surface and the contaminated sediment remaining in place

- Monitoring with contingency plan for collection and treatment of contaminated surface water where necessary.

Statutory Determinations

The new and amended selected remedies for Site C-2 are protective of human health and the environment, comply with federal and state requirements that are applicable or relevant and appropriate to the remedial action, and are cost effective. Given the type of waste present at the sites, these remedies use permanent solutions (e.g., treatment) to the maximum extent practicable. Because the remedies for Site C-2 will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a review consistent with CERCLA 121(c) will be conducted after initiation of remedial actions to ensure that the remedies continue to be protective of human health and the environment.

ROD Data Certification Checklist

The following information is included in the Decision Summary section of this ROD Amendment:

- COCs and their respective concentrations;
- Cleanup levels established for COCs;
- Estimated capital, operating and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected; and
- Key factors that led to selecting the remedies.

This ROD Amendment does not include the following information, since it is included in the original OU2 ROD:

- Baseline risk represented by the COCs;
- The basis for the clean-up levels established for the COCs; and
- Current and future land and groundwater use assumptions used in the baseline risk assessment.

Declared by:

JAMES B. BALOCKI — 22-JUN-07
Colonel, GS — Date
Chief, Base Realignment & Closure Division

Richard C Karl, Director — 7/25/07
Date
Superfund Division
U.S. Environmental Protection Agency, Region V

Kathryn Sather, Director — Date
Remediation Division
Minnesota Pollution Control Agency

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Richard C Karl, Director — Date
Superfund Division
U.S. Environmental Protection Agency, Region V

Kathryn Sather, Director — Date: 7-17-07
Remediation Division
Minnesota Pollution Control Agency

2.0 PART 2: SUMMARY FOR THE RECORD OF DECISION AMENDMENT – SITE C-2

2.1 SITE NAME, LOCATION, AND DESCRIPTION

The New Brighton/Arden Hills Superfund Site consists of a 25-square-mile area located in Ramsey County, Minnesota (see Figure 1). This includes the 4-square-mile area of the original Twin Cities Army Ammunition Plant (TCAAP) facility and portions of seven nearby communities: New Brighton, Arden Hills, St. Anthony, Shoreview, Mounds View, Columbia Heights, and Minneapolis. TCAAP is an inactive small arms ammunition manufacturing plant.

The New Brighton/Arden Hills Superfund Site has been divided into three Operable Units (OU). OU1 consists of the North Plume of off-TCAAP contaminated groundwater. OU2 consists of affected soil and groundwater on the original TCAAP facility and the surface water and sediments at Site C-2. OU3 consists of the South Plume of off-TCAAP contaminated groundwater.

The United States Army (Army), the United States Environmental Protection Agency (EPA), and the Minnesota Pollution Control Agency (MPCA) entered into a Federal Facility Agreement for the investigation and remediation of the site. The Army is the federal lead agency for the New Brighton/Arden Hills Superfund Site.

2.2 POST-ROD SITE HISTORY AND ENFORCEMENT ACTIVITIES

In 1997, the Record of Decision (ROD) documenting the selected remedies and cleanup levels (U.S. Army Environmental Center, Environmental Restoration Division [USAEC], 1997) was issued. OU2 consists of shallow soil sites (Sites A, C, E, H, 129-3, and 129-5), dumps (Sites B and 129-15), deep soil sites (Sites D and G), shallow groundwater sites (Sites A, I, and K), and deep groundwater. Figure 2 shows the location of the OU2 site. Detailed information regarding the site history, previous enforcement activities, previous studies including remedial investigations (RIs), and previous interim remedial and removal actions can be found in the OU2 ROD (USAEC, 1997). Previous actions and/or additional investigations for Site C conducted after the OU2 ROD was signed are discussed in this section.

The remedy selected for Site C is to excavate and dispose of shallow soil with contaminant levels in excess of the cleanup levels identified in Table 1, which are based on a site-specific industrial land use scenario. The contaminants of concern (COCs) for Site C shallow soil include antimony, arsenic, beryllium, lead, manganese, and thallium with cleanup levels at 67.2 milligrams per kilogram (mg/kg), 10 mg/kg, 0.7 mg/kg, 1,200 mg/kg, 2,503 mg/kg, and 11.8 mg/kg, respectively.

Site C is located immediately east of Mounds View Road within the central portion of TCAAP; this road forms the west boundary of the site. The northern boundary of Site C is approximately 0.5 mile south of the northern plant boundary. Site C is divided into two areas, C-1 and C-2. Area C-2 is the subject of this ROD Amendment and is referred to as Site C-2. Two ditches are found within Site C-2 and are commonly referred to as the east-west and north-south ditches. Both the original OU2 ROD and this ROD Amendment assumes the current and future land use

to be site-specific industrial (see the original ROD for discussion of the baseline risk assessment and land use scenarios).

Surface drainage from TCAAP is tributary, either directly or indirectly, to Rice Creek. TCAAP is included in the Rice Creek watershed, which is a tributary to the Mississippi River. Surface waters in the Rice Creek basin are not currently used for drinking water, although Rice Creek discharges into the Mississippi River upstream of the water supply intake for the city of Minneapolis.

Hydrological units at the site correspond to the geological units. Aquifers are contained in Units 1, 3, and 4. Unit 2 is considered an aquitard. Groundwater in Unit 1 is in an unconfined shallow aquifer and is generally considered perched and discontinuous. The direction of the groundwater flow in Unit 1 at Site C-2 is towards the north, then northwest towards Rice Creek.

Remediation activities for the shallow soil at Site C-2 occurred during the 2000, 2001, 2002, and 2003 field seasons. Additional characterization investigations were conducted on the shallow soil and on the sediment in the two ditches. A phytoremediation demonstration plot at Site C-2 unexpectedly enhanced the mobility of lead, resulting in impacts to the groundwater and adversely affecting the quality of the surface water. The ditch orientation, phytoremediation plot, monitoring wells, extraction wells, and surface water sample locations at Site C are shown in Figure 3.

The following subsections contain descriptions of the post ROD activities (i.e., since 1997) for the shallow soil, sediment, groundwater, and surface water media of concern.

2.2.1 Remedial Action for Shallow Soil During 2000 - 2003

The initial area of concern for Site C-2 in 2000 included 65 grids or about 0.33 acre. The general remedial action excavation process involved the removal of contaminated soils until the contaminant concentrations were less than the cleanup goals or until groundwater was encountered, whichever occurred first. Excavation was carried out in 6-inch lifts in 15-foot-by-15-foot sized grids. Following excavation, a confirmation sample was collected from each grid to verify that the remaining soil was clean. Ordnance screening was also conducted by visual inspection at Site C. As remedial work began and additional characterization activities were employed, the number of grids grew to 988 for an area of concern of 5 plus acres. Consequently, the work effort and the time frame required to remediate the site also increased.

During the 2000 and 2001 field seasons, a total of 326 grids were excavated at Site C-2. Out of the 326 total grids, 144 were excavated to groundwater (or about 44 percent of the grids were excavated to groundwater). A total of 11,800 cubic yards (cy) of contaminated soil was excavated, stabilized, and disposed of off site during the 2000 and 2001 field seasons. A majority of the excavated areas were backfilled with clean soil.

During the 2002 field season, 4,600 cy of contaminated soil were excavated, stabilized, and disposed of off site. Unseasonably high rainfall occurred, as observed in the climatological data for the Minneapolis/St. Paul, MN area for the months of June, July, and August 2002 (http://climate.umn.edu/doc/twin_cities/twin_cities.htm), and resulted in the groundwater being elevated at Site C-2. About half of the excavated grids were excavated to groundwater. Nearly

all contaminated soils in grids where groundwater was encountered were excavated to a minimum of 2 feet below ground surface (bgs). The excavation and sampling activities were halted on July 3, 2002, based on concerns expressed from MPCA and EPA that the current field sampling method would not provide adequate characterization to satisfy closeout requirements. A majority of the excavated areas were backfilled with clean soil.

Additional characterization activities were conducted in November 2002 to document the general location and extent of contamination in excess of the cleanup levels remaining in place at Site C-2. The depth of contamination in the soil ranged from the surface to 12 feet bgs. Isolated layers of soil with arsenic concentrations slightly greater than the cleanup level were identified at depths ranging from 7 to 16 feet bgs. Approximately 10,400 in-place cy of contaminated soils remained including 900 cy associated with the arsenic layers. The contamination remaining in place can be divided into three areas of the site: (1) southern area, (2) middle area, and (3) northern area. The majority of the contamination (over half) is found in the middle area of the site.

Limited excavation and offsite disposal of contaminated soil were conducted at Site C-2 during the 2003 field season. The southern area of the site was selected for continued remediation because soil concentrations greater than the cleanup goals were identified at consistent, shallow depths of approximately 1 to 2 feet bgs. Approximately 2,500 cy of stabilized soil were transported and disposed of off site. A majority of the excavated areas were backfilled with clean soil.

A total of 18,900 cy of contaminated soil has been excavated from Site C-2, stabilized, and disposed of off site at Resource Conservation and Recovery Act (RCRA) Subtitle D landfills (either Waste Management Landfill in Elk River, Minnesota or Onyx, formerly Superior Landfill, in Buffalo, Minnesota). Approximately 9,000 in-place cy of contaminated soils remain at Site C-2. Figure 4 shows the status of Site C-2 as of November 2003.

2.2.2 Ditch Sediment Sampling and Characterization in 2003

During a September 3, 2003 meeting with the Army, EPA, MPCA, and the U.S. Army Corps of Engineers (USACE) regarding the Site C alternatives, MPCA and EPA expressed concern about potential contamination levels in the two adjacent ditches and the potential impact, if any, to the ecology.

In response to the concern about potential contamination levels in the two adjacent ditches, sediment samples were collected from 10 locations in the north-south and east-west ditches at the surface to a depth of 30 inches bgs. The sampling results showed concentrations of arsenic and/or lead greater than Sediment Quality Target Levels (SQT), which are conservative sediment screening levels, and shallow soil cleanup goals (Shaw, 2006). Figure 4 also shows the 10 sediment sample locations.

2.2.3 Groundwater and Surface Water

Beginning in 1997, the Army Environmental Center sponsored a field demonstration project to phytoremediate lead-contaminated soil using ethylenediaminetetraacetic acid (EDTA) at Site C-2. This project was conducted at TCAAP as an experimental site, but this activity was not

required under the OU2 ROD. The project operated for 2 years. EDTA was applied to a 90-foot by 90-foot plot at Site C-2 to solubilize lead from the soil for plant uptake. Figures 3 and 4 show the location of the phytoremediation plot. Implementation of the EDTA application resulted in enhanced mobilization of lead and EDTA to the shallow groundwater table beneath the demonstration plot. Elevated concentrations of lead (up to 988,000 micrograms per liter [µg/L]) and of EDTA (up to 4,190 milligrams per liter [mg/L]) were measured in the groundwater beneath the demonstration plot at Site C in April 2000 (Stone & Webster, 2000).

In August 2000, MPCA issued a Notice of Violation (NOV) regarding the Site C Phytoremediation Research Project (MPCA, 2000). Fourteen corrective actions were issued by the Army to respond to the NOV, including Corrective Action No. 6 – "contain and remediate groundwater and prevent groundwater from discharging into surface water above regulatory limits" and Corrective Action No. 13 – "install and make operational the complete groundwater containment system at Site C based on the plan approved by MPCA" (MPCA, 2000). Corrective actions were performed starting from the year 2000 to contain, extract, and treat groundwater containing elevated concentrations of lead. These actions are ongoing.

In response to the NOV issued by MPCA, corrective actions were executed to contain and remediate groundwater and prevent groundwater from discharging into surface water above regulatory limits. The corrective actions included temporary, interim, and implemented measures. The success of the corrective action is measured by both the monitoring well results and the surface water results meeting the MPCA surface water chronic standards.

The implemented corrective action included a groundwater extraction and treatment system that consisted of three groundwater extraction wells and an associated onsite treatment system. The treated effluent discharges into the sanitary sewer system. The onsite treatment system is only used, if needed, to pre-treat the extracted groundwater to the sanitary sewer discharge criteria.

The monitoring activities associated with the response of the NOV included collecting and analyzing samples from 16 monitoring wells, 8 surface water locations, and 3 extraction wells, which are shown on Figure 3.

2.2.4 NOV Contingency Plan

An NOV contingency plan was prepared in 2002 by the Army as required by MPCA in the event that the groundwater was not contained or the surface water at two locations (SW-6 and SW-8) was impacted by elevated concentrations of lead (Stone & Webster, 2002a).

Groundwater

The triggers for implementation of the contingency plan are:

- When the groundwater sample results from monitoring wells MW-6, MW-12, and MW-16 at the north end of the site are above the surface water chronic standard during the same sampling event, or

- When the groundwater sample results from monitoring wells MW-4, MW-8, MW-9, MW-10, and MW-11 are above the surface water chronic standard during the same sampling event.

If one of the groundwater triggers is reached, the extraction system will be modified to increase the total volume of water extracted. The extraction and treatment system will continue to operate in the contingency plan mode (i.e., increased extracted water) until the hydraulic containment is re-evaluated. The contingency plan for groundwater has never been implemented.

Surface Water

Implementation of the surface water contingency is triggered when the average concentrations of the 3-day monthly sampling event at sample location SW-6 and/or SW-8 are above the surface water chronic standards (6.9 µg/L and 4.0 µg/L, respectively) for one quarter (i.e., three consecutive months).

If either surface water trigger is met, then the surface water at SW-6 would be contained and collected. Collected surface water would be treated, if necessary, and discharged to the sanitary sewer. The surface water at SW-6 would continue to be contained and collected until the average concentration of the 3-day monthly sampling event at that location is below the surface water chronic standard for one quarter (i.e., three consecutive months). The contingency plan for surface water has never been implemented.

Contingency Plans

The contingency plans presented below will be implemented immediately upon receiving indications that the trigger(s) have been met.

Contingency Plans for the Containment Remedy -- If the trigger discussed for groundwater containment is met, the extraction system will be modified to increase the total volume of water extracted. The extraction and treatment system will continue to operate in the contingency plan mode (i.e., increased extracted water) until the hydraulic containment is re-evaluated.

Contingency Plan for Surface Water Sample Location SW-6 and/or Location SW-8 -- If the trigger in Section 2.2.4 of this ROD Amendment document is met, then the surface water at SW-6 will be contained and collected. Collected surface water will be treated, if necessary, and discharged to the sanitary sewer. The surface water at SW-6 will continue to be contained and collected until the average concentration of the 3-day monthly sampling event at sample location SW-6 is below the current surface water chronic standard for one quarter (i.e., three consecutive months).

2.3 HIGHLIGHTS OF COMMUNITY PARTICIPATION

Compliance with the public participation requirements of Section 113(k)(2)(i-v) of Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act (CERCLA/SARA) has been achieved for the New Brighton/Arden Hills Superfund Site by the following activities for this ROD Amendment:

- The Army has compiled an update to the Administration Record. The Administrative Record is located at 4700 Highway 10, Building 105, Arden Hills, Minnesota.
- The Army placed a formal advertisement in the Minnesota Star Tribune on March 7, 2007, and in the Arden Hills/New Brighton Bulletin, the Shoreview-Arden Hills Bulletin, and Fridley Focus on March 8, 2007 announcing the availability of the Proposed Plan.
- The public comment period was held from March 7, 2007 to April 9, 2007.
- A public meeting was held on March 27, 2007 at the Twin Cities Army Ammunition Plant. Representatives of the Army, the EPA, and the MPCA answered questions about the site and the changes to and additional remedial alternatives.
- A transcript of the public meeting was made available to the public and placed in the Administrative Record.
- Response to the one written comment received during the public comment period is included in the Responsiveness Summary, which is part of this ROD Amendment, and is designated as Appendix A.

2.4 RATIONALE FOR AMENDING THE RECORD OF DECISION

The need for this ROD Amendment is based upon an increased area of concern for the shallow soil at Site C and the results of additional investigations at Site C. Based on the new information, the remedies selected for the Site C shallow soil in the OU2 ROD required fundamental change. In addition to amending the selected remedy for the shallow soil at Site C-2, the sediment, groundwater, and surface water media of concern were included under the framework of the TCAAP Federal Facilities Agreement through a Stipulation Agreement (MPCA et al., 2004). Each of the four media of concern at Site C-2 is discussed in the following subsections.

2.4.1 Site C-2 Shallow Soil

Remedial action efforts were made during the 2000 through 2003 field seasons to fulfill the selected remedy identified in the OU2 ROD to excavate and dispose of soil with contaminant levels in excess of the cleanup levels. The Site C-2 area of concern increased by 14 times from the initial areal extent identified in the OU2 FS (MW, 1997). Unlike the other shallow soil sites at TCAAP, groundwater at Site C-2 is relatively shallow and its level fluctuates during the course of the year. The shallow groundwater elevation within Site C-2 affected the sampling and excavation depths during remedial action efforts conducted during the 2000 through 2002 field seasons, resulting in the potential for contamination remaining in place below groundwater. Remediation work ceased in 2002 and additional characterization was performed to define the boundary of Site C-2 and to determine the nature and extent of contaminants remaining in place above and below groundwater.

Limited remediation work was performed during the 2003 field season. Contaminated soil from 129 grids in the southern area was excavated (at depths ranging from 1 to 2 feet), stabilized, and disposed of off site. A total of nearly 16,500 cy of soil have been excavated, stabilized and disposed of off site during the 2000 through 2003 field seasons.

Based on the outcome of the remedial action efforts at Site C, it was concluded that the selected remedy will be technically infeasible to complete as planned and will no longer be cost-effective to implement. As a result, a determination was made to re-evaluate the remedial action.

2.4.2 Site C-2 Sediments

Sediment sampling was conducted in 2003 in two ditches at Site C-2, commonly referred to as the east-west and north south ditches, to a depth of 30 inches bgs. For characterization purposes, the analytical results were compared to the shallow soil cleanup goals and Sediment Quality Targets (SQTs). Analytical results indicated arsenic and lead exceedances of the shallow soil cleanup goals at 3 of the 10 sample locations and exceedances of SQTs at 5 of the 10 sample locations.

In April 2004, the Army, EPA, and MPCA agreed to include sediment remedial actions under the framework of the TCAAP Federal Facilities Agreement through a Stipulation Agreement (MPCA et al., 2004).

2.4.3 Site C-2 Groundwater

Although there has been a decline in lead concentrations in the groundwater since implementation of the extraction and treatment system, a lead-contaminated groundwater plume still exists at Site C. At the beginning of the containment system, the total lead concentration in groundwater samples from EW-3 increased to a high of 13,000µg/L in June 2003. One month later in July 2004, total lead was detected at concentrations of more than half of the highest level. Total lead concentrations have been declining since June 2003. For the year 2005, the highest lead concentration detected from EW-3 was 2,550 µg/L in May, which exceeded the EPA groundwater action level of 15 µg/L and the MPCA surface water chronic standard of 6.9 µg/L. The groundwater plume appears to be located from about MW-13 (south end) to the extraction wells, EW-02 and EW-03 (north end). The estimated capture zone appears to be located at the three extractions wells, EW-01 through EW-03.

In April 2004, the Army, EPA, and MPCA agreed to include groundwater remedial actions under the framework of the TCAAP Federal Facilities Agreement through a Stipulation Agreement (MPCA et al., 2004).

2.4.4 Site C-2 Surface Water

Results of the 2000 through mid-2005 surface water sampling efforts conducted on a monthly basis at eight locations indicated 58 exceedances of the MPCA surface water chronic standards for lead (6.9 µg/L at ditches and 4.0 µg/L at Rice Creek). About 80 percent of the noted exceedances occurred during 2001 prior to and immediately after the corrective action for groundwater was implemented (April through June and October), primarily at SW-4, SW-5, and SW-6. Three exceedances occurred in April and July 2002 and five exceedances occurred in April and May 2003. No surface water chronic standard exceedances have occurred since May 2003. The contingency plan (Stone & Webster, 2002a) for surface water has never been implemented to date.

The highest concentrations of total lead in surface water were detected in October 2001. Results from SW-4, SW-5, SW-6, and SW-8 indicated total lead concentrations at 12,700 µg/L, 4,290 µg/L, 1,520 µg/L, and 6.3 µg/L, respectively. The exceedances detected in 2002 and 2003 ranged from 7.7 to 63 µg/L for dissolved lead concentrations.

The perched aquifer containing the lead-contaminated groundwater plume is close to the surface and appears to discharge into the ditches on the site, thus posing an uncontrolled exposure pathway. Water levels measured in the ditches match water levels measured in monitoring wells, supporting the hydraulic connection. However, it is possible that some of the lead contamination observed in the ditches was the result of surface water runoff that was in contact with contaminated soils at Site C-2.

In April 2004, the Army, EPA, and MPCA agreed to include surface water remedial actions under the framework of the TCAAP Federal Facilities Agreement through a Stipulation Agreement (MPCA et al., 2004). This decision document, therefore, determines that for the purposes of surface water remediation at Site C-2, remedial action involves monitoring surface water and, when required, collecting and treating contaminated surface water.

2.5 REMEDIAL ACTION OBJECTIVES

The specific remedial action objectives (RAOs) for OU2 address the media and pathways through which exposure to contaminants could occur under the current and most probable future land use (site-specific industrial) scenarios. The cleanup levels of the shallow soil, sediment, groundwater, and surface water media of concern are listed in Table 1. The media-specific RAOs are listed as follows:

Shallow Soil: The following RAOs for Site C-2 are designed to protect human health and the environment from exposure to contaminants in shallow soil (defined as shallow soils 0 to 12 feet bgs) at the TCAAP site:

- Protect human receptors from unacceptable risk associated with ingestion and dermal contact exposure with contaminants in the shallow soils.

Sediment: The following RAOs for Site C-2 are designed to protect human health and the environment from exposure to contaminants in sediments:

- Protect human and environmental receptors from unacceptable risk associated with direct contact exposure to contaminants in the sediments.

Groundwater: The following RAOs for Site C-2 for groundwater are designed to protect human health and the environment from exposure to contaminants in the Unit 1 groundwater:

- Protect human receptors from exposure to contaminated groundwater above acceptable risk levels.
- Reduce potential for contaminated groundwater to discharge into surface water above regulatory limits.
- Reduce concentrations of lead to the clean-up level identified in Table 1.

- Contain and control contaminated groundwater in the shallow Unit 1 groundwater aquifer to prevent further spreading and minimize the level of contaminants through mass removal.

Surface Water: The following RAO for Site C-2 is designed to protect human health and the environment from exposure to contaminants in surface water:

- Protect human and ecological receptors from unacceptable risk associated with ingestion and dermal exposure to surface water above acceptable surface water chronic standards.

2.6 DESCRIPTION OF NEW ALTERNATIVES FOR SITE C-2

This section presents a narrative summary of the alternatives considered in the Proposed Plan for Sites C. Present worth cost estimates are based on a 7 percent discount rate. The following subsections contain a description of the alternatives for each site.

2.6.1 Site C-2 Shallow Soil

Six alternatives were developed for the amended remedy at Site C-2. The alternatives were based on no further action, containment, removal, stabilization (i.e., treatment), and disposal options. The alternatives were developed from either the stand-alone options or a combination of the options at varying degrees.

The following list contains the alternatives developed for Site C-2:

- Alternative S1: No Further Action,
- Alternative S2: No Change to Existing Excavation Procedure,
- Alternative S3: Dewater and Continue Excavation,
- Alternative S4: Excavate During the Dry Season,
- Alternative S5: Soil Cover (No Further Excavation), and
- Alternative S6: Limited Excavation and Four-Foot Soil Cover.

A brief description of the six alternatives, including the cost estimates that were considered in the *Site C-2 Alternatives Evaluation Technical Memorandum* (Shaw, 2006), is provided below. Common to Alternatives S2 through S6 is the inclusion of LUCs to protect the integrity of the soil covers, to prohibit unauthorized disturbance to underlying shallow soils, and to restrict the area without soil cover to site-specific industrial use. General LUCs would include deed restrictions at the time of transfer from Federal control, signage and State Environmental Covenants. Also common to Alternatives S1 through S6 is the inclusion of site reviews that would be conducted every 5 years because contaminants would remain on site above levels that allow for unrestricted use and unlimited exposure.

The onsite borrow source, common to all of the alternatives, is located east of Site C and north of Site 129-5. The onsite borrow source was determined to be an area free of historical or archeological significance by the State of Minnesota, in accordance with the Archeological and Historical Preservation Act, the National Historic Preservation Act, and Title 40 CFR Pars 1500-1508. The borrow source will meet testing requirements set forth in the remedial design documents approved by USEPA and MPCA.

Alternative S1: No Further Action

No further action would take place under this alternative. This is the "no action" alternative required under CERCLA and is used as a baseline against which other alternatives are evaluated.

Alternative S1 would not provide sufficient information to close out Site C because approximately half of the site does not have sufficient sample results to document that the site is clean. A completion report would be prepared.

Capital Costs:		$60,000
Periodic Costs:	5-Year Review	$15,000
Total 30-Year Present Worth:		$92,000
Implementation Time:		Immediate

Alternative S2: No Change to Existing Excavation Procedure

Alternative S2 would continue with the selected remedial action following the previously established grid excavation procedure. Excavation would continue using a 15-foot by 15-foot grid system and in 6-inch lift layers, which is required because of the potential for unexploded ordnance (UXO) (Stone & Webster, 2002b). Excavation of the arsenic layers, which are at depths ranging from 7 to 16 feet, would not be included in this alternative.

It is anticipated that approximately 45 percent of the grids would be excavated to groundwater, which is the same percentage experienced during the 2000 through 2002 field season. Grids would be excavated until clean soil is detected or when groundwater is encountered. A minimum of 2 feet bgs would be excavated regardless of groundwater levels. For the purpose of estimating costs, grids would be excavated to 2 feet bgs. Confirmation sampling would not be conducted for grids excavated to groundwater.

Approximately 1,200 cy of contaminated soils would be excavated, stabilized, and transported to a RCRA Subtitle D landfill for disposal. Backfilling all excavated areas (new and previously excavated grids) would use approximately 4,700 cy of fill, which would come from an onsite borrow area. A layer of topsoil (about 3 inches thick) would be added to the site to help establish new vegetation. At least 2 feet of clean backfill would exist between the surface and any contamination remaining in place. Figure 5 shows the excavation and backfill plan for this alternative.

Capital Costs:	$619,000
Periodic Costs: O & M and 5-Year Review	$20,000
Total 30-Year Present Worth:	$662,000
Implementation Time:	5 weeks (one field season)

Alternative S3: Dewater and Continue Excavation

Alternative S3 would involve the use of coffer dams and dewatering trenches to dewater portions of Site C-2 to allow for complete excavation of soils with concentrations greater than the cleanup levels at depths ranging from 1 to 13 feet bgs. Coffer dams would be installed to enable access to the deeper soils and dewatering trenches would be cut around the perimeter of shallower soils. Figure 6 shows the location of the proposed dewatering system and the excavation depths. The dewatering activities would involve collecting, treating, and discharging water into the sanitary sewer.

The sheet piling for the coffer dams would be driven to approximately 40 feet bgs to penetrate into the clay layer that underlies the site. The water level within the coffer dams would be lowered to the elevation required to access the deepest known contaminated soil. Existing monitoring wells and new wells would be used to dewater the soil inside the coffer dams.

Further evaluation of a plausible dewatering scenario would require the use of a groundwater model. The conceptual dewatering plan assumed that it would take about 2 weeks to lower the groundwater level by 12 feet and to keep the well points operational for an additional 5 days. The 5 days were based on the assumptions that it takes one day to excavate a grid, one day to ship the confirmation sample, and 3 days to receive the analytical results.

Excavation procedures would be revised to excavate those areas that are dewatered to the required depth without sampling each lift. The grid blocks would be excavated for the entire area in 6-inch lifts because the potential for UXO. Confirmation soil samples would be collected in each grid after the contaminated soils are excavated.

All soils within the coffer dams and dewatering trenches would be excavated as contaminated soils. Approximately 16,850 cy of contaminated soils would be excavated, stabilized, and transported to a RCRA Subtitle D landfill for disposal. Backfilling all excavated areas (new and previously excavated grids) would use approximately 18,000 cy of fill, which would come from an onsite borrow area. A layer of topsoil (about 3 inches thick) would be added to the site to help establish new vegetation.

Alternative S3 would result in the removal of most of the contamination with COC concentrations in excess of the cleanup levels. Arsenic layers, which are at depths ranging from 7 to 16 feet, would remain in place.

Capital Costs:	$4.0 million
Periodic Costs: O & M and 5-Year Review	$20,000
Total 30-Year Present Worth:	$4.0 million
Implementation Time:	26 weeks (one field season)

Alternative S4: Excavate During the Dry Season

Alternative S4 would involve excavating contaminated soils during a restricted field season, limited to the dry season. The dry seasons usually occurs mid- to late-summer and fall when the

groundwater is typically at the lowest level. The groundwater would be at least 5 feet bgs before work would commence; this groundwater level should be achievable. For the purpose of estimating costs for this alternative, contaminated soil would be excavated to a depth of 5 feet bgs.

The groundwater level would be monitored at Site C-2 starting in late spring/early summer to help determine the start date for the field season. Mobilization and work effort would assume to start after mid-July. Contracts for excavation crew, analytical laboratories, transportation, and an offsite disposal facility would be prepared to allow for a flexible schedule if the start date was delayed or cancelled due to high groundwater.

Excavation procedures would be revised to excavate grid blocks to the required depth without sampling each lift. The area would be excavated in 6-inch lifts because of the potential for UXO. Confirmation soil samples would be collected in each grid only after the soil is excavated to below the depth of contamination.

An estimated total of 4,000 cy of contaminated soil would be excavated, stabilized, and transported to a RCRA Subtitle D landfill for disposal. Backfilling all excavated areas (new and previously excavated grids) would require approximately 8,600 cy of fill, which would come from an onsite borrow area. A layer of topsoil (about 3 inches thick) would be added to the site to help establish new vegetation.

If the excavation could reach 5 feet bgs without encountering groundwater, at least 5 feet of clean backfill would exist between the surface and any contamination remaining in place. Figure 7 shows the contamination remaining in place for Alternative S4. Arsenic layers, which are at depths ranging from 7 to 16 feet, would remain in place.

Capital Costs:	$1.16 million
Periodic Costs: O & M and 5-Year Review	$21,000
Total 30-Year Present Worth:	$1.2 million
Implementation Time:	2 years (11 weeks over two field seasons)

Alternative S5: Soil Cover (No Further Excavation)

Alternative S5 would include construction of a soil cover to provide a minimum 2-foot-thick layer of clean soil over the contaminated soil and areas without confirmation sampling (i.e., grids excavated to groundwater) to protect human health and the environment from exposure to contaminants. Soil cover construction activities would include backfilling the previously excavated areas and construction of a 2-foot-thick layer of soil at or above existing surface. Because of the scattered locations of the contamination remaining in place, one soil cover would be constructed over 3.1 acres, as shown in Figure 8.

Approximately 10,000 cy of clean fill, which would come from an onsite borrow area, would be needed for the soil cover. A layer of topsoil (about 3 inches thick) would be added to the site to help establish new vegetation. The soil cover would be designed to promote positive drainage and to minimize erosion losses.

Capital Costs:	$758,000
Periodic Costs: O & M and 5-Year Review	$23,000
Total 30-Year Present Worth:	$808,000
Implementation Time:	9 weeks (one field season)

Alternative S6: Limited Excavation and Four-Foot Soil Cover (Selected Remedy)

Alternative S6 would include a combination of limited excavation of contaminated soils and backfill of clean soil to create a minimum 4-foot soil cover between the surface and the contamination remaining in place with concentrations above the cleanup levels. The actual excavation depth would range from 1 to approximately 4 feet. For the purpose of estimating costs for this alternative, it was assumed that contaminated soil would be excavated to a depth of 4 feet.

Excavation procedures would be revised to excavate the contaminated grids to a depth of 1 to approximately 4 feet without sampling each 6-inch lift. The contaminated grids would be excavated for the entire area in 6-inch lifts due to the potential for UXO. The depth of removal would be based on depth of contamination remaining in place, the depth of the current excavation, and the location of each grid. Excavations would continue in areas that would reduce the areal extent of the soil cover. Soil samples would be collected only after the final excavation depth is reached in each grid. Limited excavation would occur mostly over the middle and southern area of the site because these are the noted areas that would require excavation to create a 4-foot-thick backfill layer.

Based on the maximum 4-foot depth, approximately 2,450 cy of contaminated soils would be excavated, stabilized, and transported to a RCRA Subtitle D landfill for disposal. Backfilling all excavated areas (new and previously excavated grids) would require approximately 7,000 cy of fill, which would come from an onsite borrow area. A layer of topsoil (about 3 inches thick) would be added to the site to help establish new vegetation.

Five separate soil covers were identified for those areas where contamination would remain in place. The remaining areas at Site C-2 will be verified clean and not need soil covers. The areal extent of these covers would total 1.6 acres, as shown in Figure 9. Arsenic layers, which are at depths ranging from 7 to 16 feet, would remain in place.

Capital Costs:	$844,000
Periodic Costs: O & M and 5-Year Review	$21,000
Total 30-Year Present Worth:	$888,000
Implementation Time:	6 weeks (one field season)

2.6.2 Site C-2 Sediment

Three alternatives were developed for the sediment remedy at Site C-2. The alternatives were based on no action, excavation, and soil cover. The following alternatives were developed:

- Alternative Sed1: No Action
- Alternative Sed2: Excavate
- Alternative Sed3: Soil Cover

A brief description of the three alternatives including cost estimates that were considered in the *Site C-2 Alternative Evaluation Technical Memorandum* (Shaw, 2006) is provided below.

Alternative Sed1: No Action

Development of the no further action alternative is required by CERCLA. This alternative serves as baseline for comparison with other technologies. Under this alternative, no further action would be taken for the existing sediments with COC concentrations greater than the cleanup levels. In addition, no LUCs would be implemented. Consequently, this alternative would not be protective of human health if the land use at the site was not maintained as restricted. Five-year reviews would be conducted.

Capital Costs:	$5,000
Periodic Costs: O & M and 5-Year Review	$5,000
Total 30-Year Present Worth:	$16,000
Implementation Time:	Immediate

Alternative Sed2: Excavate

Alternative Sed2 would mean the excavation of contaminated sediment from five locations in the east-west and north-south ditches. These five areas to be excavated are based on the results from 2003 sediment characterization efforts, where arsenic and lead concentrations exceeded the sediment RRGs. Figure 4 shows the sediment sample locations, where contaminated sediment would be removed to depths of 1 to 3 feet. A wetlands permit would be obtained prior to working in the ditches. Approximately 500 cy of excavated sediment would be stabilized and transported to a RCRA Subtitle D landfill for disposal. Excavated areas would be backfilled with organic containing soil.

Remedial activities for sediment would be conducted concurrently with the selected amended Site C-2 shallow soil remedy. All costs for mobilization, demobilization, onsite support, and offsite support would be included with the Site C-2 shallow soil remedy. The land in the east-west and north-south ditches could be considered for unrestricted use and would not require LUCs.

Capital Costs:	$60,000
Periodic Costs: O & M and 5-Year Review	$0
Total 30-Year Present Worth:	$60,000
Implementation Time:	2 weeks (one field season)

Alternative Sed3: Soil Cover (Selected Remedy)

Alternative Sed3 would include the construction of a soil cover over the east-west and north-south ditches to cover the contaminated sediment (see Figure 3 for ditch locations). That is, the ditches would be backfilled to create a barrier to protect human health and the environment from exposure to contaminants. The ditches would be backfilled with clean soil to a minimum depth of 4 feet. The east-west ditch would be backfilled from the railroad embankment to a location near Mounds View Road on the west side of the site. The entire north-south ditch at Site C-2 would be backfilled. Backfilling the east-west and north-south ditches would impact approximately 0.9 acres (about 0.45 acres for the east-west ditch and 0.45 acres for the north-south ditch). Remedial activities for sediment would be constructed concurrently with the selected amended Site C-2 shallow soil remedy.

Two options were considered to address surface water drainage at Site C with the backfilled ditches. One option would be to close the weir structure on the east side of the railroad embankment and allow the surface water runoff (on the west side of the railroad embankment) to travel as sheet flow westward towards the culvert under Mounds View Road. Another option would be to bury a culvert to carry the same flow currently carried by the east-west ditch from the railroad embankment on the east side of the site to a location near Mounds View Road on the west side of the site. The final decision and details would be made in conjunction with the permitting authorities. For the purpose of estimating costs, it was assumed that the weir structure on the east side of the railroad embankment would be closed.

Wetland permits would be obtained prior to implementation of the remedy. Compensatory mitigation would be required to ensure the replacement of the lost wetlands. The compensatory mitigation would be completed concurrently with the remedial action. The replacement wetland would be located within the TCAAP facility.

LUCs would be established to protect the integrity of the cover and prohibit unauthorized disturbance to underlying sediment. LUCs would include deed restrictions at the time of transfer from Federal control, signage and State Environmental Covenants. Site reviews would be conducted every 5 years because this alternative allows contaminants to remain on site above levels that allow for unrestricted use and unlimited exposure. Periodic maintenance would be conducted to repair the 4-foot thick soil cover layer, as necessary.

Capital Costs:	$128,000
Periodic Costs: O & M and 5-Year Review	$10,000
Total 30-Year Present Worth:	$149,000
Implementation Time:	2 weeks (one field season)

2.6.3 Site C-2 Groundwater

Four alternatives were developed for the groundwater remedy at Site C-2. The alternatives were based on no further action, extraction and treatment, permeable reactive barrier (PRB), and monitored natural attenuation (MNA). The following alternatives were developed:

- Alternative GW1: No Action,
- Alternative GW2: Extraction and Treatment,
- Alternative GW3: Permeable Reactive Barrier, and
- Alternative GW4: Monitored Natural Attenuation.

A brief description of the four alternatives including the cost estimates that were considered in the *Site C-2 Alternative Evaluation Technical Memorandum* (Shaw, 2006) is provided below.

Alternative GW1: No Action

Development of the no further action alternative is required by CERCLA. This alternative serves as a baseline for comparison with other technologies. Under this alternative, no further action would be taken for the existing groundwater with COC concentrations greater than the cleanup levels. In addition, no LUCs would be implemented to prevent the drilling of supply wells in the Unit 1 aquifer.

The current extraction and treatment system would be shut down and dismantled and the three extraction wells would be abandoned in place. The underground piping would be disconnected and sealed at all ends. The electrical cables would be disconnected and removed. The existing NOV contingency plan would no longer be in effect.

The time to implement this alternative is immediate because no further action will be taken. The monitoring program would be terminated. Dismantling the extraction and treatment system could be accomplished within a two month time frame. A site review would be conducted every 5 years until contaminant concentrations drop below levels that allow for unrestricted use and unlimited exposure. A completion report would be prepared, following the last 5-year review.

Capital Costs:	$111,000
Periodic Costs: 5-Year Review	$15,000
Total 30-Year Present Worth:	$143,000
Implementation Time:	2 weeks of field work

Alternative GW2: Extraction and Treatment (Selected Remedy)

This alternative would involve extraction and treatment of groundwater using the existing system that was installed in 2001. Groundwater and surface water monitoring since start-up has demonstrated that the system is containing the groundwater plume and providing protection of the surface water. The contingency plans established for the NOV for both the groundwater and surface water have not been triggered. Three extraction wells, EW-1 through EW-3, would continue to collect contaminated groundwater from Site C-2. The locations of the extraction wells are shown in Figure 3.

The extracted groundwater would be pre-treated on site (as necessary) to meet the sanitary sewer discharge limit of 1 mg/L for lead. For the purpose of estimating the cost for this alternative, it was assumed that the onsite pre-treatment system would be operational for one more year. Afterwards, the pre-treatment system would be turned off, and the extracted groundwater would

be discharged directly into the sanitary sewer system. The monitoring program would continue to be used and would be revised as needed to ensure that the system is capturing the groundwater plume. The groundwater monitoring program, including new compliance points, would be approved by MPCA and USEPA.

Upon implementation of the remedy, details of the criterion for shutting off the extraction system would be included in the Site C Groundwater Monitoring Plan and would be approved by the MPCA and USEPA. The current version of the Site C Groundwater Monitoring Plan is located in the *FY2004 Annual Performance Report (TWISS, 2005)*. The extraction system would be turned off when the monitoring programs indicate that the lead concentrations are less than the cleanup levels identified in Table 1. After the extraction system is turned off, the groundwater would continue to be monitored for some additional period of time to check for rebound of contaminant levels (assumed to be 2 years for the cost estimate). The existing NOV contingency plan would remain in effect, but with the triggers modified.

LUCs would protect the extraction, treatment, and the monitoring system, and prohibit water supply wells within the contaminated portion of the Unit 1 aquifer. Site reviews would occur every 5 years until contaminant concentrations drop below levels that allow for unrestricted use and unlimited exposure.

At the completion of the extraction and treatment activities and the additional monitoring, the extraction wells and monitoring wells would be abandoned in place. The underground piping would be disconnected and sealed at all ends. The electrical cables would be disconnected and removed.

Capital Costs (including Post Remedial):	$121,000
Periodic Costs: O & M and 5-Year Review	varies from $294,000 to $63,000
Total 30-Year Present Worth:	$1.7 million
Implementation Time:	12 years

Alternative GW3: Permeable Reactive Barrier

Alternative GW3 would consist of a PRB that would remove lead from Site C-2 groundwater. The PRB would be composed of gravel and gravel-sized gypsum and would use the native microbial population. The PRB trench would be approximately 350 feet long, 20 feet deep, and 1.5 feet wide. The anticipated location for the PRB would be at the northern end of Site C-2 as shown in Figure 10.

Based on the results of a microcosm study, it was discovered that these microbes could reduce the lead in the groundwater from the soluble lead-EDTA complex to lead sulfide, which would precipitate out and deposit in the barrier material as the mineral galena (Shaw, 2006). Gypsum would provide the sulfate source necessary for the microbes to convert the lead from a soluble (mobile) form to an insoluble (immobile) form. Additional soil sampling and treatability studies would need to be conducted to further determine the viability of the PRB in this application. If the results of the soil sampling indicate favorable conditions then a column test would be

conducted. The column test would help ensure that the PRB would function properly in the field.

Construction of the PRB would involve a continuous trencher. The groundwater level has been observed to be at 3 to 5 feet bgs in the location of the PRB. The PRB media would be placed into the open trench. Construction of the PRB would not start until after the extraction and treatment system is turned off and the site returns to natural flow conditions (NNEMS, 2005). The excavated soils from the construction of the trench would be stabilized and transported to a RCRA Subtitle D landfill for disposal.

A monitoring program would be implemented to monitor the source elimination effectiveness. The existing NOV contingency plan would remain in effect, but there would be some changes based on the number of monitoring wells and sampling activities. The extraction and treatment system would remain in place during the operation of the PRB and could be put into operation if a groundwater trigger was met. Prior to constructing the PRB, the existing extraction and treatment system would be shut down and the effluent piping would be relocated after the construction of the PRB.

After the monitoring program demonstrates that the dissolved lead concentration in the untreated groundwater has reached the cleanup goals for groundwater, the PRB media would be removed and disposed of as lead-contaminated waste. In addition, the extraction and treatment system would be dismantled. The extraction wells and appropriate monitoring wells would be abandoned in place. The underground piping would be disconnected and sealed at all ends and electrical cables would be disconnected and removed.

LUCs would protect the integrity of the PRB, the extraction and treatment system (which would be in standby mode), and protect the monitoring system, and would prohibit water supply wells within the contaminated portion of the Unit 1 aquifer.

Site reviews would occur every 5 years until contaminant concentrations drop below levels that allow for unrestricted use and unlimited exposure.

Capital Costs (includes Post Remedial):	$786,000
Periodic Costs: O & M and 5-Year Review	$81,000
Total 30-Year Present Worth:	$1.5 million
Implementation Time:	30 years

Alternative GW4: Monitored Natural Attenuation

Alternative GW4 would consist of MNA and long-term monitoring. Natural attenuation refers to adsorption and retardation processes occurring in the groundwater and soil to lower contaminant concentrations through physical, chemical, and biological processes. Natural attenuation at this site would reduce the potential risk posed by lead contamination by a reduction in lead mobility and bioavailability through sorption onto the soil or rock matrix. Inorganic speciation of lead in site-specific water would depend on pH, total lead concentration, and the relative and absolute abundances of the major anions: chloride, sulfate, and carbonate.

Implementation of MNA would follow the EPA guidance document and its MNA directives (EPA, 1999), which would include demonstrating the efficacy of MNA through site characterization. Thus, prior to implementing the remedy, additional investigations would be conducted to demonstrate that the plume is stable, to better understand the groundwater flow, and to demonstrate that the geochemical conditions are conducive to MNA. Demonstrating that the plume is stable would involve shutting down the current extraction and treatment system and monitoring the plume movement. It is anticipated that demonstrating the plume stability could take up to 2 years. Demonstrating the geochemical conditions would involve collection of soil samples, for example, to determine if sulfides and total organic carbon are present in the soils and to identify the mechanism of lead removal through MNA.

The lead concentration in the groundwater plume would be monitored by collecting groundwater samples from existing monitoring wells following the existing monitoring program. The existing NOV contingency plan would remain in effect. However, if a groundwater trigger was met, then the extraction and treatment system would be reactivated and operated until the groundwater plume is re-evaluated. A revised contingency plan would also be prepared.

Alternative GW4 would also eliminate the exposure pathway for ecological and human receptors that may come in contact with potentially contaminated surface water. Stability of the groundwater plume, backfilling the two ditches, and if needed, implementation of the NOV contingency plan to contain the groundwater plume would be the main elements used to eliminate the pathway. Backfilling the east-west and north-south ditches at Site C with clean soil at a minimum depth of 4 feet would remove the potential for groundwater to discharge into the surface water. The east-west ditch would be backfilled from the railroad embankment to near Mounds View Road. The entire north-south ditch at Site C-2 would be backfilled. Surface water from the north-south ditch would be redirected as sheet flow or through a buried culvert. Since existing wetlands are located in the north-south ditch, a wetlands permit would be obtained and the replacement wetland would be located within the TCAAP facility.

LUCs would protect the extraction, treatment, and groundwater monitoring system and prohibit water supply wells within the contaminated portion of the Unit 1 aquifer.

Site reviews would occur every 5 years until contaminant concentrations drop below levels that allow for unrestricted use and unlimited exposure. The extraction and treatment system would be dismantled upon completion of the remedy. The extraction wells would be abandoned in place. The underground piping would be disconnected and sealed at all ends. The electrical cables would be disconnected and removed.

Capital Costs (including post Remedial):	$448,000
Periodic Costs: O & M and 5-Year Review	$81,000
Total 30-Year Present Worth:	$1.3 million
Implementation Time:	30 years

2.6.4 Site C-2 Surface Water

Three alternatives were developed for the surface water remedy at Site C-2. The alternatives were based on no further action, monitoring, and collection and treatment. The following alternatives were developed:

- Alternative SW1: No Action
- Alternative SW2: Monitoring
- Alternative SW3: Collection and Treatment

A brief description of the three alternatives, including the cost estimates, which were considered in the *Site C-2 Alternative Evaluation Technical Memorandum* (Shaw, 2006), is provided below. Common to Alternatives SW2 through SW3 is the inclusion of LUCs to restrict access to the ditches to protect the monitoring program and to protect the collected and treatment system. General LUCs would include deed restrictions at the time of transfer from Federal control, signage and State Environmental Covenants.

Alternative SW1: No Action

Development of the no further action alternative is required by CERCLA. This alternative serves as a baseline for comparison with other technologies. Under this alternative, the existing NOV contingency plan would no longer be in effect. A completion report would be prepared, following the completion of the last 5-year review.

Capital Costs:	$60,000
Periodic Costs: 5-Year Review	$15,000
Total 30-Year Present Worth:	$92,000
Implementation Time:	30 years

Alternative SW2: Monitoring (Selected Remedy)

Alternative SW2 would involve monitoring the surface water at Site C-2 for compliance with the cleanup goals. Surface water samples would be collected from the east-west and north-south ditches at six locations (SW-1 through SW-6) and at Rice Creek (SW-7 and SW-8). In lieu of the existing NOV contingency plan, a monitoring plan would be prepared detailing the sampling efforts and the triggers that would activate a temporary collection and treatment system.

Conceptually, the collection system could be a temporary dam located in the east-west ditch on the upstream side of Mounds View Road. The actual design of the temporary surface water collection system would be based on the condition of the ditch, anticipated flow of the surface water, and weather conditions. Operations for treating the collected water could be taken to an offsite treatment facility. For the purpose of estimating this alternative, it was assumed that a temporary collection and treatment system would not be established.

The time frame for completion of surface water monitoring activities would be dependent on the completion of the amended soil remedy, completion of the sediment remedy, and attainment of

the RAOs and cleanup goals in the Site C-2 lead-contaminated groundwater plume. However, for the purpose of preparing a cost estimate, it is assumed that the time to complete this alternative would be 30 years.

Capital Costs:	$209,000
Periodic Costs: O & M and 5-Year Review	$48,000
Total 30-Year Present Worth:	$741,000
Implementation Time:	30 years

Alternative SW3: Collection and Treatment

Under Alternative SW3, all surface water from the east-west and north-south ditches would be collected continuously and treated. Implementation of Alternative SW3 would be immediate and would not be triggered by the NOV contingency plan. The collection system would be set up east of Mounds View Road in the east-west ditch to capture any surface water from Site C-2. At the point where surface water would be collected, the east-west ditch would be blocked so as to stop the surface water from continuing to flow. The culvert that runs under Mounds View Road would remain open so that other surface water from nearby areas could continue to drain.

The collected water would be treated and discharged into the existing sanitary sewer system. The treatment system would be set up similarly to the existing groundwater extraction and treatment system (see Section 2.2.3). Treated water would be monitored in a similar way as the existing groundwater extraction and treatment system.

It would take one field season to construct and begin operation of the surface water collection and treatment system. The operational time frame of the collection and treatment system would be dependent on the completion of the amended soil remedy, completion of the sediment remedy, and attainment of the RAOs and cleanup goals in the Site C-2 lead-contaminated groundwater plume. However, for the purpose of preparing a cost estimate, it is assumed that the time to complete this alternative would be 30 years.

The existing NOV contingency plan would no longer be in effect since all the water flowing in the east-west ditch would be collected and treated.

Capital Costs:	$324,000
Periodic Costs: O & M and 5-Year Review	$278,000
Total 30-Year Present Worth:	$4.0 million
Implementation Time:	30 years

2.7 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

Each of the alternatives considered for the ROD Amendment are evaluated and compared based on the nine National Oil and Hazardous Substances Pollution Contingency Plan (NCP) criteria listed below. The first two criteria, (1) overall protection of human health and the environment and (2) compliance with ARARs, are threshold criteria that must be met for the selected

remedies. The selected remedies must then represent the best balance of the remaining primary balancing and modifying criteria.

The alternatives for shallow soil, sediment, groundwater, and surface water were developed and evaluated independently from each other. The selection of the four remedies for Site C-2 included consideration of the compatibility among the alternatives for each media of concern.

2.7.1 Evaluation and Comparison Criteria

The following sections describe the evaluation and comparison criteria.

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

2. Compliance with ARARs addresses whether or not a remedy will comply with identified federal and state environmental and citing laws and regulations. The ARARs are listed in Table 3.

3. Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on site following remediation and the adequacy and reliability of controls.

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

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

6. Implementability refers to the technical and administrative feasibilities of a remedy, including the availability of materials and services needed to carry out a particular option.

7. Cost evaluates the estimated capital costs, operation and maintenance costs, and present worth costs of each alternative.

8. State acceptance indicates whether the State (MPCA), based on its review of the information, concurs with, opposes, or has no comment on the preferred alternative.

9. Community acceptance is based on whether community concerns are addressed by the selected remedy and whether or not the community has a preference for a remedy.

2.7.2 Evaluating the Alternatives

The comparative analyses for the Site C-2 alternatives for shallow soil, sediment, groundwater, and surface water media of concern are summarized below. Information for this section was obtained from the *Site C-2 Alternatives Evaluation Technical Memorandum* (Shaw, 2006).

A National Environmental Policy Act (NEPA) analysis was conducted for the shallow soil, sediment, groundwater, and surface water media of concern. Details of the NEPA analysis are located in the *Site C-2 Alternatives Evaluation Technical Memorandum* (Shaw, 2006).

Site C-2 Shallow Soil [S6 is selected remedy]

The comparative analysis that was completed for the Site C-2 shallow soil alternatives is summarized below. Table 2 provides a comparison of the six remedial action alternatives for shallow soil. In addition, the selection of the Site C-2 shallow soil remedy considered the compatibility between the sediment, groundwater, and surface water alternatives.

Overall Protection of Human Health and the Environment
Alternatives S2, S3, S4, S5, and S6 provide adequate overall protection because these alternatives would meet the RAOs and would be protective of human health and the environment. Alternative S1 is the only alternative that does not offer protection of human health and the environment, does not meet the RAOs, and, therefore, will not be considered further.

Compliance with ARARs
Alternatives S2, S3, S4, S5, and S6 would comply with the ARARs listed in Table 3.

Long-Term Effectiveness and Permanence
Alternatives S2 through S6 would provide long-term protection to human health and the environment by either completely removing (S3) or partially removing (Alternatives S2, S4, S6) the soils of concern and/or by providing a protective covering for the site (Alternatives S5 and S6).

Alternative S3 would be the most effective in reducing long-term risk and providing permanence because Alternative S3 would allow the possibility to excavate to deeper depths and potentially remove all of the soil with elevated COC concentrations compared with the other five alternatives. Alternative S4 would be the second most effective in reducing long-term risk and providing permanence because more contaminated soil would be excavated compared to Alternatives S2 and S6.

Alternative S6 would provide more long-term permanence than Alternatives S2 and S5 because more contaminated soil would be removed compared to Alternative S2, and the areal extent of the 4-foot cover would be smaller and more manageable compared to the soil cover in Alternative S5. In addition, the minimum cover depth of 4 feet in Alternative S6 would be twice the thickness of the 2-foot soil cover in Alternative S5. The long-term effectiveness of the soil covers for Alternatives S5, and S6, as well as the backfilled areas for Alternatives S2, S3, and S4, would also be dependent on implementation of LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternatives S2, S3, S4, and S6 would include stabilization of the contaminated soils for disposal at the RCRA Subtitle D landfill. The stabilization is a treatment process used to reduce heavy metals mobility to levels that are classified as non-hazardous through characterization per 40 CFR 261.24.

Alternative S3 would also include the treatment of extracted groundwater. The treatment of extracted groundwater would reduce the volume of heavy metals but only during the dewatering activities.

Short-Term Effectiveness

This criterion is based on the degree of community and work protection offered, the potential environmental impacts of the remediation, and the time until the remedial action is completed. The short-term effectiveness would be high for Alternative S5 because there would be minimal risk when constructing a soil cover. Alternatives S2 and S6 would have moderate short-term effectiveness because the risks would be associated with limited excavation for both alternatives. Alternatives S3 and S4 would have the lowest short-term effectiveness because of the increased risk during the longer time frame to excavate contaminated soils for both alternatives and because of the additional dewatering and treatment activities for Alternative S3.

Implementability

There would be moderate to high administrative efforts with Alternative S2 because EPA and MPCA would not grant approval of site closure with the current remedy and, thus, would require continuous administrative effort for the site. Alternative S3 would require considerable administrative effort to coordinate and address the treatment and disposal of extracted groundwater. Alternative S4 would require the greatest administrative effort and would raise implementability issues when trying to determine and to coordinate an optimal time to begin remedial activities when the groundwater levels would be greater than 5 feet bgs; potential schedule delays and possibilities in canceling fieldwork could be costly.

Alternative S5 would be the easiest to technically implement because the alternative would simply involve placing a soil cover without having to excavate, treat, or dispose of contaminated soil. Alternatives S2, S4, and S6 would also be technically implementable since all proposed field activities have been proven to work. Alternative S3 would be the most difficult to technically implement because the dewatering system would involve a potentially complicated design and there is a possibility that the desired dewater depth may not be achievable in a reasonably cost-effective manner.

Alternatives S2 through S6 would require similar administrative efforts to implement LUCs.

Cost

The estimated present worth costs for the alternatives, not including the No Further Action alternative, range from approximately $662,000 to $4.0 million. Alternatives S2, S5, and S6 have similar and the lowest present worth costs at $662,000 (Alternative S2) through $888,000 (Alternative S6). More contaminated soil would be removed and disposed of for Alternative S6 compared to Alternatives S2 and S5. Alternative S3, dewater and excavate, has the highest estimated present worth cost at $4.0 million. The present worth costs for Alternative S4 is much

lower than Alternative S3 but is slightly higher than Alternatives S2, S5, and S6 at $1.2 million. The additional administrative planning and coordination activities needed for Alternative S4 (excavate during the dry season) increased the overall cost to implement the remedy. Cost summaries are presented in Table 2.

State Acceptance
The State has been consulted throughout this process and concurs with the selected alternative.

Community Acceptance
Public comment on the Proposed Plan was solicited during a formal public comment period extending from March 7 to April 9, 2007. The community is supportive of the preferred alternative (Alternative S6 Limited Excavation and Four-Foot Soil Cover).

Site C-2 Sediment [Sed3 is selected remedy]

The comparative analysis for the Site C-2 sediment alternatives is summarized below. Table 4 provides a comparison of the three remedial action alternatives. In addition, the selection of the Site C-2 sediment remedy considered the compatibility between the shallow soil, groundwater, and surface water alternatives.

Overall Protection of Human Health and the Environment
Alternatives Sed2 and Sed3 provide adequate overall protection because these two alternatives would meet the RAOs and would be protective of human health and the environment. Alternative Sed1 is the only alternative that does not offer protection of human health and the environment, does not meet the RAOs and will not be considered further.

Compliance with ARARs
Alternatives Sed2 and Sed3 would comply with the ARARs listed in Table 3.

Long-Term Effectiveness
Alternatives Sed2 and Sed3 would provide long-term effectiveness and permanence to protect human health and the environment by completely removing the sediments of concern (Alternative Sed2) or by providing a protective covering of the contaminated sediment (Alternative Sed3). Alternative Sed2 would provide the most long-term effectiveness and permanence because the contaminated sediment would be removed from the ditches. .The long-term effectiveness of the soil covers for Alternative Sed3 would be dependent on implementation of LUCs.

In addition, the Site C-2 sediment alternatives were also evaluated based on the compatibility when combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water. Backfilling the ditches (Alternative Sed3) and containment of the groundwater plume (Alternative GW2) would reduce, if not eliminate, the concern for surface water with concentrations of lead greater than the cleanup goal (i.e., the MPCA surface water chronic standard).

Reduction of Toxicity, Mobility, or Volume
Alternative Sed2 would include stabilization of the contaminated sediment for disposal at a permitted RCRA Subtitle D landfill. The stabilization is a treatment process used to reduce heavy metal mobility to levels that are classified as non-hazardous through characterization per 40 CFR 261.24 and is irreversible.

Short-Term Effectiveness
Alternative Sed2 would have the highest short-term impacts compared to Alternatives Sed1 and Sed3 because there would be exposure to contaminated sediment during implementation of the alternative. However, the short-term impacts would be minimal for Alternative Sed2 since there is only a small quantity of contaminated sediment.

Implementability
Both Alternatives Sed2 and Sed3 would require administrative effort to coordinate with local, state, and federal regulators to conduct work in wetland. Alternative Sed2 would require more administrative effort to coordinate the specific locations to excavate and remove contaminated sediment. Alternative Sed3 might require additional administrative effort to coordinate with local, state, and federal regulators to backfill the ditches and to create a new compensatory wetland.

Cost
The estimated present worth cost for the sediment alternatives, not including the No Action alternative, ranged from approximately $60,000 to $149,000. For the purpose of this Technical Memorandum and for preparing a cost estimate, it was assumed that implementation of the sediment remedy would be conducted simultaneously with the amended soil remedy. Thus, the costs for mobilization, onsite support, and offsite support would be incurred in the soil remedy. Cost summaries are presented in Table 4.

State Acceptance
The State has been consulted throughout this process and concurs with the selected alternative.

Community Acceptance
Public comment on the Proposed Plan was solicited during a formal public comment period extending from March 7 to April 9, 2007. The community is supportive of the preferred alternative (Alternative Sed3 Soil Cover).

Site C-2 Groundwater [GW2 is selected remedy]

The comparative analysis completed for the Site C-2 groundwater alternatives is summarized below. Table 5 provides a comparison of the four remedial action alternatives. In addition, the selection of the Site C-2 groundwater remedy considered the compatibility between the shallow soil, sediment, and surface water alternatives.

Overall Protection of Human Health and the Environment
Alternatives GW2 and GW3 would provide adequate overall protection because these alternatives would be protective of human health and the environment, and would meet the RAOs. Alternative GW1 does not offer protection of human health and the environment,

because it does not offer any treatment, engineering or land use measures to control the exposure of receptors to groundwater contamination, and does not meet the RAOs. Based on current site conditions, it is unknown if Alternative GW4 would be protective of human health and the environment because of the uncertainty of the plume stability and due to the presence of EDTA.

Compliance with ARARs

Alternatives GW2 and GW3 would comply with the ARARs listed in Table 3. Alternatives GW1 and GW4 would not comply with ARARs. Based on current site conditions, Alternative GW4 would not be able to protect underground waters.

Long-Term Effectiveness

Alternatives GW2 and GW3 would provide protection of human health and the environment by eliminating the exposure pathways to groundwater and surface water by containing the groundwater plume within Site C-2. Alternative GW4 would provide protection of human health and the environment by eliminating the exposure pathway to surface water, but, because the stability of the groundwater plume is uncertain at this time, protection to underground waters would also be uncertain. LUCs under GW2, GW3, and GW4 would prohibit contact by humans by prohibiting water supply wells within the contaminated portion of the Unit 1 aquifer.

Alternative GW2 would include irreversible treatment to reduce contamination and, thus, would be the most effective at reducing long-term risk and providing more permanence compared to Alternatives GW1, GW3, and GW4. Alternative GW3 would provide more long-term effectiveness and permanence compared to Alternatives GW1 and GW4 because the PRB media containing the lead would be removed at the completion of the remedy. However, potential fouling (or reduced effectiveness) of the PRB media over time is an unknown and could reduce the long-term effectiveness in GW3.

Reduction of Toxicity, Mobility, or Volume

Alternative GW2 would reduce the toxicity and mobility of lead in the groundwater because it would remove the lead and immobilize it by the treatment unit and through the sanitary wastewater treatment system. Similarly, the chemistry of Alternative GW3 indicates that the lead would be precipitated out as lead sulfide and would no longer be soluble.

Based on current site conditions, both Alternatives GW1 and GW4 would not reduce the volume and mobility of lead in the groundwater. Implementation of the contingency plan for Alternative GW4, which would include an extraction and treatment system, would reduce the toxicity and mobility of lead.

Short-Term Effectiveness

Alternative GW4 would have the lowest short-term impacts because this alternative would pose minimal short-term risk (i.e., minimal exposure to contaminated soil, sediment, and/or groundwater) to the site workers and community during implementation of the remedy. However, turning off the existing NOV groundwater extraction system to implement Alternative GW4 might cause some effect on the downgradient groundwater if the groundwater plume migrates. Alternative GW3 would have the highest short-term impacts because this alternative may pose the most adverse risk to workers from exposure to potentially contaminated soil during the construction of the PRB and removal of the PRB media upon completion of the remedy. The

short-term impacts of Alternative GW2 would have some risk during operation, maintenance, and dismantlement of the extraction and treatment system but would be most effective in the short term at reducing lead concentrations.

Alternative GW2 would reduce the concentration of lead in the groundwater at a faster rate compared to Alternatives GW1, GW3, and GW4.

Implementation of Alternative GW1 would pose minimal short-term impacts during the dismantling of the extraction and treatment system; otherwise, there would be no impacts.

Implementability

Alternative GW2 would be administratively and technically feasible because implementation involves the use of proven technologies and an extraction and treatment system is currently in use. Operation would require frequent monitoring of the groundwater to assess effectiveness of treatment, as well as close control of operating conditions. These considerations would also apply to Alternative GW3, and are nearly as advantageous, although PRB technology has not been used previously. Additional studies would be required to ensure that the technology would be effective. Backfilling the media, which is lighter than water, could cause construction implementability issues.

Due to the uncertainty of current site conditions, it is unknown if Alternative GW4 could be implemented. Current site conditions would need to be better understood in order to implement Alternative GW4. Groundwater plume stability is currently unknown because of the effects of the existing groundwater extraction and treatment system. Investigating the groundwater plume stability, the presence of EDTA, and the suitability for MNA at the site would provide updated information about the site and provide certainty of MNA implementability.

Alternatives GW2, GW3, and GW4 would require administrative efforts to implement and to maintain LUCs.

Cost

The estimated present worth costs for groundwater alternatives, not including the No Action alternative, ranged from approximately $1.3 million to $1.7 million. Alternatives GW3 and GW4 have similar present work costs at $1.5 million and $1.3 million, respectively. For the purpose of estimating costs, the assumed life of the remedy for Alternatives GW3 and GW4 would be 30 years. Alternative GW3 would require the greatest number of construction activities. Alternative GW2 has the highest estimated present worth cost at $1.7 million and would cost about 13 to 30 percent more to implement compared to Alternatives GW3 and GW4. For the purpose of this Technical Memorandum and for preparing a cost estimate, it was assumed that Alternative GW2 would be completed in 12 years (10 years for extraction and treatment and 2 additional years for monitoring). Cost summaries are presented in Table 5.

State Acceptance

The State has been consulted throughout this process and concurs with the selected alternative.

Community Acceptance

Public comment on the Proposed Plan was solicited during a formal public comment period extending from March 7 to April 9, 2007. The community is supportive of the preferred alternative (Alternative GW2 Extraction and Treatment).

Site C-2 Surface Water [SW2 is selected remedy]

The comparative analysis completed for the Site C-2 surface water alternatives is summarized below. Table 6 provides a comparison of the three remedial action alternatives. In addition, the selection of the Site C-2 surface water remedy considered the compatibility between the shallow soil, sediment, and groundwater alternatives.

Overall Protection of Human Health and the Environment

Alternatives SW2 and SW3 would provide adequate overall protection of human health and the environment because these two alternatives would collect and treat contaminants in the surface water. Thus, both Alternatives SW2 and SW3 would meet RAOs. Alternative SW1 would not offer protection of human health and the environment because this alternative would not monitor or take action if there were elevated levels of lead in the surface water following groundwater discharge. Therefore, Alternative SW1 would not meet the RAOs and will not be considered further.

Compliance with ARARs

Alternatives SW2 and SW3 would comply with ARARs listed in Table 3.

Long-Term Effectiveness

Alternative SW3 would provide the most long-term protection and permanence to human health and the environment by collecting and treating all surface water from Site C-2. However, since there are no recent exceedances in surface water, there is no current indication that continuous collection and treatment is necessary. Alternative SW2 would also provide long-term protection and permanence because surface water would be monitored and lead concentrations greater than the RRG over a pre-determined time frame would trigger a plan to implement a collection and treatment system.

When combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water, the east-west and north-south ditches would be backfilled, thereby eliminating the pathway for the groundwater to discharge into the ditches. Alternative SW3 would not require continuous surface water collection and treatment and would change to the same components as Alternative SW2.

Reduction of Toxicity, Mobility, or Volume

Alternative SW3 would reduce more of the toxicity, mobility, and volume of the COCs in the surface water than Alternative SW2 because the collection and treatment system under Alternative SW3 would be continuous. Collection and treatment efforts for Alternative SW2 would be used on an as needed basis.

When combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water, the east-west and north-south ditches would be backfilled, thereby eliminating the pathway for the groundwater to discharge into the ditches. Alternative SW3 would not require continuous surface water collection and treatment and would change to the same components as Alternative SW2.

Short-Term Effectiveness

Alternative SW2 would have the lowest short-term impacts because this alternative would pose minimal short-term risk to site workers, community, and the environment. Continuous collection and treatment of the surface water in Alternative SW3 would have the most adverse impacts to workers, community, and especially the environment: constant collection efforts in the ditch would significantly reduce the amount of water in the downstream portions of the ditch.

In addition, the actual concern for surface water with concentrations of lead greater than the cleanup goal (i.e., the MPCA surface water chronic standard) will be appreciably reduced, if not eliminated, when combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water. Contaminated sediment in the east-west and north-south ditches will be covered and both ditches will be backfilled under the selected sediment alternative (Alternative Sed3), and the groundwater plume will be contained under the selected groundwater alternative (Alternative GW2).

Implementability

Alternatives SW2 and SW3 would both be technically feasible. Alternative SW2 would require some administrative effort to monitor the sampling results and to implement the temporary collection and treatment system, if necessary. Alternative SW3 would require considerable administrative effort to implement and maintain a surface water collection and treatment system in a ditch.

When combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water, the east-west and north-south ditches would be backfilled, thereby eliminating the pathway for the groundwater to discharge into the ditches. Alternative SW3 would not require continuous surface water collection and treatment and would change to the same components as Alternative SW2.

Cost

The estimated present worth costs for the surface water alternatives, not including the No Action alternative, ranged from approximately $741,000 to $4 million. It was assumed that the time frame for implementing the surface water alternative would be the same as for the groundwater alternative, which was 12 to 30 years. Cost summaries are presented in Table 6.

When combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water, the east-west and north-south ditches would be backfilled, thereby eliminating the pathway for the groundwater to discharge into the ditches and reducing the monitoring locations. The estimated present worth costs for Alternative SW2 would be reduced and the costs for Alternative SW3 would also be similar to Alternative SW2.

State Acceptance
The State has been consulted throughout this process and concurs with the selected alternative.

Community Acceptance
Public comment on the Proposed Plan was solicited during a formal public comment period extending from March 7 to April 9, 2007. The community is supportive of the preferred alternative (Alternative SW2 Monitoring).

2.8 PRINCIPAL THREAT WASTES

The NCP establishes an expectation that the EPA will use treatment to address the principal threats posed by the site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identification of principal threat wastes combines the concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, non-principal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The source materials identified include contaminated soil at Site C-2. These source materials are not highly toxic or mobile and as a result do not constitute principal threat wastes; hence, they are considered non-principal threat wastes. Removal and containment of the source materials, and implementation of LUCs, are reliable remedies.

2.9 AMENDED SELECTED REMEDY

Based upon consideration of the requirements for CERCLA and the NCP criteria, the detailed analysis of alternatives, and public comments, the following alternatives were determined to be the appropriate remedies for the five sites within OU2:

- Site C-2 (Shallow Soil) — Alternative S6 – Limited Excavation and Four-Foot Soil Cover
- Site C-2 (Sediment) — Alternative Sed3 – Soil Cover
- Site C-2 (Groundwater) — Alternative GW2 – Extraction and Treatment
- Site C-2 (Surface Water) — Alternative SW2 – Monitoring

These amended selected remedies will be protective of human health and the environment, comply with ARARs and will meet the RAOs described in Section 2.5.

2.9.1 Description of the Amended Selected Remedies

The alternatives for shallow soil, sediment, groundwater, and surface water were developed and evaluated independently from each other. The selection of the four remedies for Site C-2 included the compatibility between the alternatives. Based on the selection of the four remedies, there are some aspects of the selected remedies that will either conflict or result in a duplicated effort.

Specifically, by combining the four recommended alternatives, backfilling the ditches under the recommended sediment remedy would change the approach for the surface water remedy. Monitoring efforts in the east-west and north south ditches for the surface water remedy would be limited to a portion of the east-west ditch and Rice Creek.

Additionally, the cost associated with implementing all four recommended alternatives concurrently would be reduced by eliminating duplicate contractor support efforts and possibly construction efforts (costs for one mobilization and demobilization, for example).

Site C-2 Shallow Soil

Alternative S6 includes a combination of excavating selected areas with soil concentrations above the cleanup levels to a depth of 1 to 4 feet bgs and backfilling/placing clean soil to create a 4-foot soil cover. All areas with soil concentrations above the cleanup levels will have a minimum of 4 feet of clean overlying soil to create a protective barrier between the surface and the contamination remaining in place.

Approximately 116 grids were identified with soil concentrations above cleanup goals to a depth of 1 to approximately 4 feet bgs. The actual excavation depth will be based on the depth of contamination remaining in place, the depth of the current excavation, and the location of each grid. The actual excavation depth (likely ranging from 1 to 4 feet) will be determined during the preparation of the excavation plan. An excavation plan will be developed to identify which areas of the site will be excavated further and which areas will be covered based on the location and status of each grid. For the purpose of estimating construction cost, a maximum of 4 feet was the assumed excavation depth. Assuming that 116 grids are excavated to the depths shown on Figure 9 approximately 2,700 cy of contaminated soils will be excavated, stabilized, and transported to a RCRA Subtitle D landfill for disposal. Excavation of the arsenic layers, which are at depths ranging from 7 to 16 feet, will not be included in this alternative.

Approximately 2,200 cy of contaminated soil will be excavated from the 89 grids that require excavation and backfill to an assumed maximum depth of 4 feet. A portion of these 89 grids includes grids that were previously excavated and now will require additional excavation to the 4-foot depth.

Approximately 28 grids previously backfilled have contamination remaining in place at depths less than 4 feet. Similar to the discussion above, these grids will either be re-excavated or have additional cover material placed. For the purpose of estimating the cost, it was assumed that these 28 grids will have further excavation to an approximate depth of 4 feet to remove 300 cy of contaminated soil. The soil used to backfill the grids after the previous excavation (estimated at 750 cy) will be excavated first and set aside for re-use; however, about 5 percent of this backfill soil will be assumed to be contaminated (50 cy). The remaining 700 cy will be clean and could be reused as clean backfill material.

Once the 1 to 4 feet of contaminated soil has been excavated, confirmation samples will be collected from each grid to determine if COC concentrations in the soil are less than the cleanup levels. If the analytical results indicate that COC concentrations are less than the cleanup levels, then that particular area will be designated as not having any remaining contamination in place.

If COC concentrations are above the cleanup levels, then a combination of further excavation and/or backfilling will be performed to provide a minimum 4-foot soil cover. There might be some places at Site C-2 where excavation to a depth of 4 feet might not be possible; therefore, additional clean fill will be placed above the surface in order to create the minimum 4-foot soil cover.

Excavation procedures will be revised to excavate the contaminated grids without sampling each 6-inch lift. The contaminated grids will be excavated in 6-inch lifts due to the potential for UXO. Soil samples will be collected in each grid only after the soil is excavated to the target depth.

Backfilling activities will include the newly excavated grids (which includes grids that were partially excavated [450cy]), as well as excavated grids from previous remedial activities during the years 2001 through 2003 (99 grids or 3,400 cy). Approximately 7,000 cy yards of clean fill will be needed for backfilling. The fill will come from existing stockpile (1,500 cy), excavated backfill soil (700 cy), and the onsite borrow area (4,800 cy). A layer of topsoil (about 3 inches thick) will be added to the site to help establish new vegetation.

Between backfilling 4 feet and the possible addition of the clean fill above grade, a 4-foot soil cover of clean fill will exist between the surface and any contamination remaining in place that is greater than the cleanup levels. Five separate soil covers were identified for those areas where contamination will remain in place. The areal extent of the five separate 4-foot covers will be over approximately 303 grids or 1.6 acres. The extent of the 4-foot cover is shown on Figure 9. To reduce the total size of the cover area, separate covers were used instead of one large cover (which would be about 3 acres in size). All of Site C-2 would be revegetated at the same time and the separate covers would not be visually distinguishable.

It will take approximately 6 weeks during one field season to implement the selected amended remedy for Site C-2.

LUCs will be established to protect the integrity of the soil covers and to prohibit unauthorized disturbance to underlying shallow soils. In addition, LUCs would be implemented to restrict the area without soil cover as site-specific industrial. General LUCs would include deed restrictions at the time of transfer from Federal control, signage and State Environmental Covenants.

Site C-2 Sediment

Alternative Sed3 includes constructing a soil cover over the east-west and north-south ditches to cover the contaminated sediment. That is, the ditches will be backfilled to create a barrier to protect human health and the environment from exposure to the contaminants. The ditches will be backfilled with clean soil to a minimum depth of 4 feet. The east-west ditch will be backfilled from the railroad embankment to a location near Mounds View Road on the west side of the site. The entire north-south ditch at Site C-2 will be backfilled.

Two options were considered to address surface water drainage at Site C with the backfilled ditches. For the purpose of estimating costs, it was assumed that the weir structure on the east

side of the railroad embankment be closed. The final decision and details will be made in conjunction with the permitting authorities.

In order to conduct any remedial actions within the ditches, a Clean Water Act (CWA) Section 404(b)(1) evaluation would be accomplished by applying for or meeting substantive requirements of the Minnesota General Permits and Letters of Permission (GP/LOP). All backfill activities in the east-west and north-south ditches would be coordinated with EPA, MPCA, USACE, and the Rice Creek Watershed District. Stormwater controls will be used during implementation of Alternative Sed3.

Wetland permits would be obtained prior to implementation of the remedy. Compensatory mitigation would be required to ensure the replacement of the lost wetlands. The compensatory mitigation would be completed concurrently with the remedial action. The replacement wetland would be located within the TCAAP facility.

Remedial activities for sediment will be conducted concurrently with the selected amended soil remedy. All costs for mobilization, demobilization, onsite support, and offsite support efforts will be included with the soil remedy. The estimated construction cost will be for backfilling the ditches, installing a culvert, and creating a compensatory wetland. Site reviews will be conducted every 5 years because this alternative will allow contaminants to remain on site above levels that allow for unrestricted use and unlimited exposure.

LUCs will be established to protect the integrity of the soil covers and to prohibit unauthorized disturbance to underlying sediment. General LUCs would include deed restrictions at the time of transfer from Federal control, signage and State Environmental Covenants.

Site C-2 Groundwater

Alternative GW2 involves extracting and treating groundwater. Because of its effectiveness, the extraction and treatment system established for the NOV corrective action could continue to be used for Alternative GW2.

Three extraction wells, EW-1 through EW-3 (as shown in Figure 3), will continue collecting contaminated groundwater from Site C-2. The extracted groundwater will be pretreated on site (as necessary) to meet the sanitary sewer discharge limit of 1 mg/L for lead. The pretreated groundwater will be discharged into the sanitary sewer. For the purpose of estimating the cost for this alternative, it was assumed that the onsite pretreatment system will be operational for one more year, with the treatment media replaced semiannually. Afterwards, the pretreatment system will be turned off and the extracted groundwater will discharge directly into the sanitary sewer system.

In addition, the actual concern for surface water with concentrations of lead greater than the cleanup goal (i.e., the MPCA surface water chronic standard) will be appreciably reduced, if not eliminated, when combining the four selected alternatives for shallow soil, sediment, groundwater, and surface water. Contaminated sediment in the east-west and north-south ditches will be covered and both ditches will be backfilled under the selected sediment alternative

(Alternative Sed3), and the groundwater plume will be contained under the selected groundwater alternative (Alternative GW2).

The extraction system would be turned off when the monitoring program indicates that the lead concentrations throughout the aquifer are less than the cleanup levels identified in Table 1. Upon implementation of the remedy, details of the criterion for shutting off the extraction system would be included in the new Site C Groundwater Monitoring Plan. After monitoring results indicate that the extraction system can be turned off, then the groundwater will continue to be monitored for some additional period of time to check for rebound of contaminant levels (assumed to be 2 years for the cost estimate).

The existing Site C Groundwater Monitoring Program will be revised as needed. This will include new compliance points, criteria for shutting off the extraction system, and post groundwater extraction monitoring to ensure that the system is capturing the groundwater plume. The new groundwater monitoring program will be based on the existing program. The current version of the Site C Groundwater Monitoring Plan is located in the *FY2004 Annual Performance Report* (TWISS, 2005). The new groundwater monitoring program will be approved by MPCA and USEPA.

A new contingency plan would be prepare and will be based on the existing NOV contingency plan for groundwater but with the triggers modified. If the one of the groundwater triggers is met, then the extraction system will be implemented. The new groundwater contingency plan will be approved by MPCA and USEPA.

At the completion of the extraction and treatment remedy and after the additional years of groundwater monitoring, the extraction and monitoring wells will be abandoned in place. The treatment system will be dismantled. The underground piping will be disconnected and sealed at all ends, and the electrical cables will be disconnected and removed.

Site reviews will occur every 5 years until contaminant concentrations drop below levels that allow for unrestricted use and unlimited exposure. This alternative could be implemented immediately, and there will be no change to the existing extraction, treatment, and monitoring systems. For the purpose of preparing a cost estimate, it is assumed that the treatment system will operate for one more year, the extraction system will operate for a maximum of 10 more years, and groundwater monitoring will continue for 2 years after the extraction system is turned off. Thus, this alternative will take a total of 12 years to complete.

LUCs will be established to protect the groundwater extraction, treatment, and monitoring system and to prohibit the drilling of water supply wells within the contaminated portion of the Unit 1 aquifer.

Site C-2 Surface Water

Alternative SW2 involves the monitoring of the surface water and the collection and treatment of contaminated surface water as needed. The actual concern for surface water with concentrations of lead greater than the cleanup goal (i.e., the MPCA surface water chronic standard) will be appreciably reduced, if not eliminated, when combining the four selected alternatives for shallow

soil, sediment, groundwater, and surface water. Contaminated sediment in the east-west and north-south ditches will be covered and both ditches will be backfilled under the selected sediment alternative (Alternative Sed3), and the groundwater plume will be contained under the selected groundwater alternative (Alternative GW2).

Since the Unit 1 groundwater flow generally reflects the topography, backfilling the ditches (i.e., the low areas within Site C-2) will eliminate the pathway for the groundwater to discharge into the ditches, thus eliminating most of the existing surface water locations. Therefore, monitoring surface water in the east-west will be limited and monitoring in the north-south ditches at Site C-2 (i.e., SW-1 through SW-4) will not be needed, thus, reducing monitoring requirements from the recommended Alternative SW2.

Surface water sampling, however, will be accomplished at SW-5 and SW-6 in the north-south ditch beyond Site C-2 and at Rice Creek (SW-7 and SW-8). A new surface water monitoring plan will be prepared detailing the sampling efforts. Sample results will be compared to the PRGs for the surface water chronic standard for the east-west ditch and for Rice Creek. The new surface water monitoring program will be approved by MPCA and USEPA.

Under the recommended surface water alternative, the existing NOV contingency plan will be altered. The triggers for the surface water portion of the NOV contingency plan will be modified to match the revised surface water sampling location and frequency. Since the ditches will be backfilled under the recommended sediment alternative, the pathway for the lead-contaminated groundwater plume to discharge to the ditches will be eliminated. Thus, the plan to include a temporary collection and treatment system (as discussed in Section 2.1.3) will no longer be needed. If the modified surface water triggers are met, then the contingency will be to increase the total volume of the groundwater extraction system until the surface water triggers are re-evaluated. The new surface water contingency plan will be approved by MPCA and USEPA.

The time frame for completing the surface water monitoring activities will reflect the time to attain the RAOs and PRGs in the Site C-2 lead-contaminated groundwater plume, which was estimated at 12 years for the selected groundwater alternative (Alternative GW3).

Implementation of Alternative SW2 will be immediate. If all four recommended alternatives would be implemented, the present worth cost estimate for the surface water media of concern would decrease because of the reduced sampling efforts and reduced time to complete the remedy.

2.9.2 Summary of the Estimated Remedy Cost

The detailed cost estimate and present worth analysis for the four Site C-2 amended selected remedies are presented in Table 7 through Table 10. The net present value of the estimated capital and operating cost for a 30-year period is approximately $3.5 million for all four remedies. The time frame to implement the remedy is one field season (about 6 weeks in the field).

2.9.3 Expected Outcomes of the Amended Selected Remedies

The amended/selected remedies for the shallow soil and sediment media of concern at Site C-2 will result in soil covers over contamination remaining in place. Exposure of source material will be controlled through LUCs. The soil cover will provide human and environmental protection by preventing direct contact with materials having contaminant concentrations above the risk-based action levels.

The LUCs component of the selected groundwater remedy for Site C-2 will prohibit water wells until contaminant concentrations drop below cleanup levels that allow for unrestricted use and unlimited exposure. Table 1 summarizes the cleanup levels. Exposure until cleanup levels are achieved will be controlled through LUCs.

The selected remedy for Site C-2 surface water media of concern will make the area available for limited and restricted use. With implementation of the selected remedy for sediment media of concern at Site C-2, the Site C-2 ditches will be backfilled, thus, limiting surface water flow through Site C-2. Other portions of the Site C-2 ditches will be restricted to allow for monitoring activities and possible implementation of collection and treatment system. Surface water monitoring will continue until the selected remedy for the Site C-2 groundwater media of concern is completed.

LUCs will be maintained until the concentration of hazardous substances in the soil are reduced to levels that allow for unlimited use and unrestricted exposure. The anticipated LUC area encompasses the area of each site outlined in Figures 8 through 12. The Remedial Design (RD) may include a more detailed map or a descriptive survey plan with specific locations and design details for each LUC. If these sites are subsequently remediated to unrestricted use, the ROD will be changed to remove the LUCs as part of the remedy. CERCLA 121(c) five-year reviews will be conducted to assess the long-term effectiveness of the remedy, including LUCs.

The RD will be submitted in accordance with the remedial design schedule provisions of the FFA and will include a separate LUC RD document (LUCRD) describing the details of LUC implementation and maintenance, including periodic inspections. The Army shall be responsible for implementation, maintenance, annual reporting, and enforcement of LUCs in accordance with the LUCRD. As part of the LUC monitoring and reporting, a written certification will be included in an annual report stating that the LUCs remain in place and are effective. If any of the LUCs are no longer in place or do not remain effective, the process that has been followed to rectify the situation shall also be stated in the annual report.

As a condition of property transfer or lease, the Army may require the transferee or lessee in cooperation with other stakeholders to assume responsibility for various implementation actions. Third party LUC responsibility will be incorporated into pertinent contractual, property and remedial documentation, such as a purchase agreement, deed, lease, and RD addendum. To the extent permitted by law, a transfer deed shall require the LUCs imposed as part of a CERCLA remedy to run with the land and bind all property owners and users.

Since the Army intends to transfer ownership, the Army may, if Federal and/or State law allows, upon transfer of fee title grant the State an environmental covenant or easement that would allow

the State to enforce LUC terms and conditions against the transferee(s), as well as subsequent property owner(s) or user(s) or their contractors, tenants, lessees or other parties. This covenant will be incorporated by reference in the transfer deed and will run with the land in accordance with State realty law. This state enforcement right would supplement, not replace, the Army's right and responsibility to enforce the LUCs.

2.10 STATUTORY DETERMINATIONS

Under CERCLA Section 121, the Army and EPA must select a remedy that is protective of human health and the environment, complies with ARARs, is cost effective, and uses permanent solutions, alternative treatment technologies, or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that include treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous substances as a principal element.

2.10.1 Protection of Human Health and the Environment

The following section summarizes the estimated effectiveness of the amended selected remedies for Sites C-2.

The amended selected remedy for shallow soil will reduce risks presented by the site to human health and the environment by removing contaminated soil greater than the cleanup levels within the top 1 to 4 feet of the site, creating a minimum 4-foot soil cover between the surface and any remaining contaminated soils, and implementing LUCs to prohibit exposure to shallow soils from unauthorized disturbance to underlying shallow soils.

The selected remedy for sediment will reduce risks presented by the site to human health and the environment by creating a minimum 4-foot soil cover between the surface and any remaining contaminated sediments, and implementing LUCs to prohibit exposure to shallow soils from unauthorized disturbance to underlying sediments.

The selected remedy for groundwater will eliminate risks presented by the site to human health and the environment by containing the groundwater plume, extracting and treating contaminated groundwater, and implementing LUCs to prohibit water supply wells within the contaminated portion of the Unit 1 aquifer until cleanup levels are achieved.

The selected remedy for surface water will reduce risks presented by the site to human health and the environment by monitoring surface water as needed until the groundwater remedy is completed. As a result of the selected remedy for sediment, the two surface water ditches at Site C-2 will be backfilled with clean soil, which will eliminate the surface water exposure pathway.

2.10.2 Compliance with ARARs

The amended selected remedies for Site C-2 will comply with all ARARs identified in the OU2 ROD.

2.10.3 Cost-Effectiveness

Section 300.430(f)(ii)(D) of the NCP requires evaluation of cost effectiveness. The amended selected remedies are proportionally cost effective in mitigating the principal risks posed by contaminated soil, sediment, groundwater, and surface water.

2.10.4 Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

The Army has determined that the amended selected remedies represent the maximum practicable extent to which permanent solutions can be used in a cost-effective manner for Site C-2. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Army has determined that the amended selected remedies provide the best balance in terms of long-term effectiveness and permanence, treatment, implementability, cost, and State and community acceptance.

2.10.5 Preference for Treatment as a Principal Element

Various treatment options for contaminated shallow soil were considered early in the FS process; however, due to the nature and quantity of contaminated soil, these options were determined to be either technically impracticable and/or not cost effective. These same treatment options were also considered for sediment and were also determined to be either technically impracticable and/or not cost effective.

The selected remedies for Site C-2 groundwater and surface water satisfy the statutory preference for treatment as a principal element by use of active treatment methods. Extraction groundwater and collected surface water (when required) will be treated by an onsite system, offsite facility, and/or POTW.

2.10.6 Five-Year Review Requirements

Because the shallow soil, sediment, and groundwater remedies for Site C will result in hazardous substances, pollutants, or contaminants remaining on site during or after physical remediation above levels that allow for unlimited use and unrestricted exposure, 5-year review under Section 121(c) of CERCLA and Section 300.430(f)(4)(ii) of the NCP will be conducted. For these sites, the 5-year review will include a review of all monitoring, inspection of the integrity of the soil covers for Site C-2, an evaluation as to how well the amended selected remedies are achieving the RAOs and ARARs that they were designed to meet, and a review to verify that the LUCs are in place and enforced.

2.11 REFERENCES

Minnesota Pollution Control Agency (MPCA). 2001. Web site for Risk Based Guidance for Evaluating the Soil Leaching Pathway located at http//files.pca.state.mn.us/pub/cleanup/slv.xls.

Minnesota Pollution Control Agency (MPCA). 2000. *Notice of Violation, In the Matter of: U.S. Army, Twin Cities Army Ammunition Plant, Arden Hills, Site C, Phytoremediation.* August 10, 2000.

Minnesota Pollution Control Agency, U.S. Environmental Protection Agency, U.S. Army (MPCA et al). 2004. *Stipulation Agreement, Twin Cities Army Ammunition Plant – Phytoremediation Site.* April 9, 2004.

Montgomery Watson and Conestoga Rovers Associates (MW). 1997. *Operable Unit 2 Feasibility Study, Final Report, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota.* Prepared for U.S. Army Environmental Center and Alliant Techsystems, Inc. March 1997.

Shaw Environmental, Inc. (Shaw). 2006. *Technical Memorandum Site C-2 Alternatives Evaluation, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota, Revision 1.* Prepared for the U.S. Army Corps of Engineers, Omaha District.

Stone & Webster Environmental Services & Technology (Stone & Webster). 2000. *Technical Memorandum, Response to Corrective Actions, Notice of Violation for Phytoremediation Demonstration at Sites C and 129-3, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota.* Revision 2. Prepared for U.S. Army Corps of Engineers, Omaha District. October 6, 2000.

Stone & Webster Environmental Services & Technology (Stone & Webster). 2001. *Final Remedial Action Completion and Shallow Soils Sites Close Out Report, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota. Volume I Site A Activities.* Revision 2. Prepared for U.S. Army Corps of Engineers, Omaha District. December 10, 2001.

Stone & Webster, Inc., A Shaw Group Company (Stone & Webster). 2002a. *Contingency Plan, Response to Corrective Actions, Notice of Violation for Phytoremediation Demonstration, Site C, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota.* Prepared for the U.S. Army Corps of Engineers, Omaha District. February 12, 2002.

Stone & Webster, Inc., A Shaw Group Company (Stone & Webster). 2002b. *Final Comprehensive Work Plan and Final Sampling and Analysis Plan, Remedial Design/Remedial Action Activities, Shallow Soil Sites, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota.* Revision 3. Prepared for U.S. Army Corps of Engineers, Omaha District. September 25, 2002.

U.S. Army Center for Health Promotion and Preventative Medicine (CHPPM). 2004. *Tier II Ecological Risk Assessment Report, Twin Cities Army Ammunition Plant, Arden Hills, Minnesota, New Brighton/Arden Hills Superfund Site.* Final Report. December 2004.

U.S. Army Environmental Center, Environmental Restoration Division (USAEC). 1997. *Twin Cities Army Ammunition Plant, New Brighton/Arden Hills, Superfund Site, Operable Unit 2 Record of Decision.* December 1997.

U.S. Environmental Protection Agency (USEPA). 1999. *Use of Monitored Natural Attenuation as Superfund, RCRA Corrective Action, and Underground Storage Tank Sites.* OSWER Directive 9200.4-17P. April 1999.

FIGURES

FIGURES

NOTES

LEGEND

LEGEND

ORIGINAL TCAAP LOCATION

N

DRAWING NOT TO SCALE

REVISION	DESCRIPTION			CHKD	APPR	DATE
A	ISSUED TO ARMY			ERC	PSM	09/08/05

	BY	DATE		BY	DATE		BY	DATE		BY	DATE
DSGN	ERC	09/06/05	DRAWN	MEC	09/06/05	CHKD	ERC	09/07/05	APPR	PSM	09/07/05

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

TWIN CITIES ARMY AMMUNITION PLANT

FIGURE NUMBER 1

SITE LOCATION MAP

Shaw™ Environmental, Inc.

PROJECT NO.	REV.	FILE NAME
10100.1116	A	10100N12A

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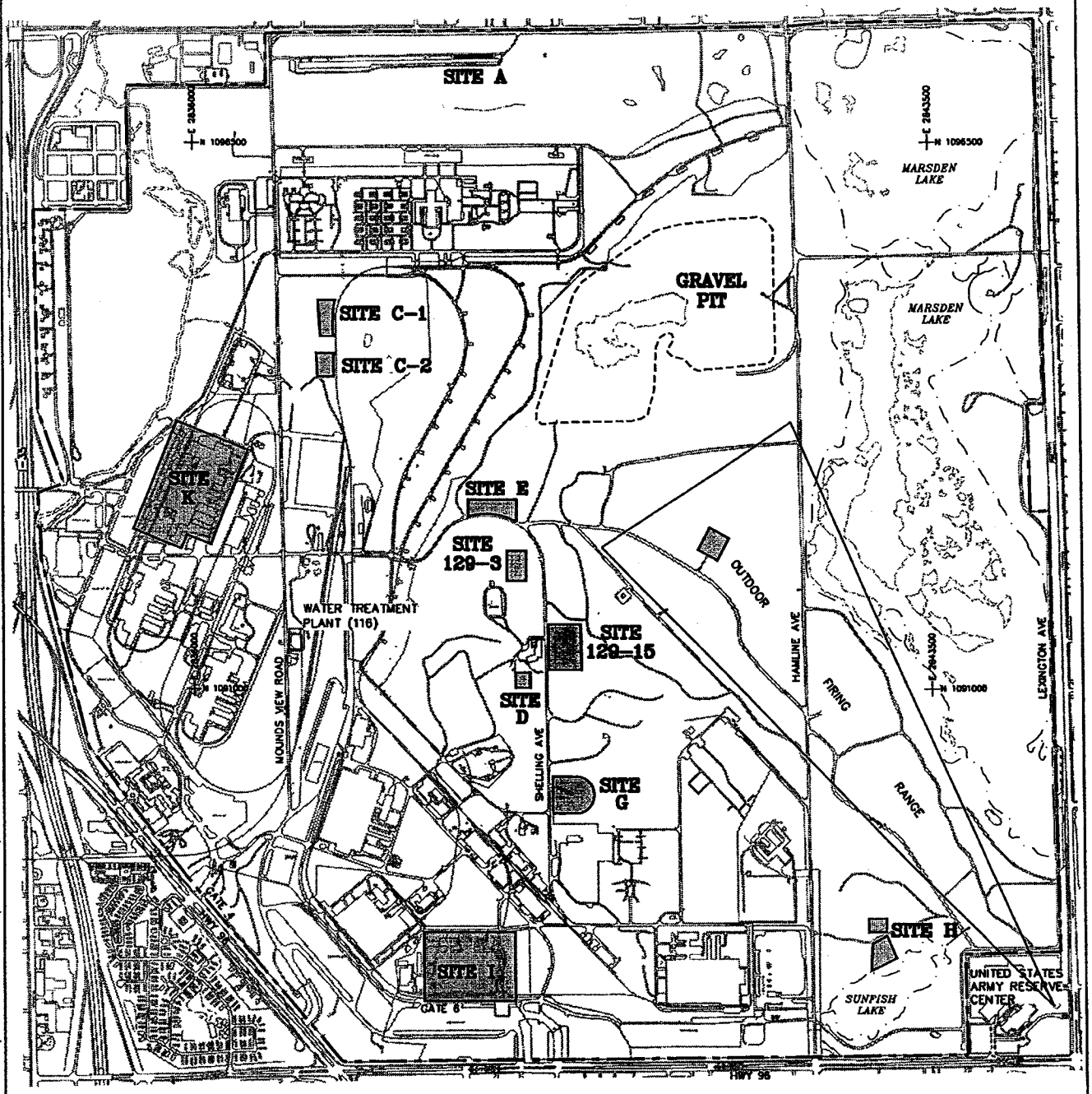

LEGEND

— · — · — WATER EDGE

N

0 1500 3000

SCALE: 1" = 1500'

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

TWIN CITIES ARMY AMMUNITION PLANT

FIGURE NUMBER 2

TCAAP SITE LAYOUT

REVISION	DESCRIPTION	CHKD	APPR	DATE
A	ISSUE TO ARMY	ERC	PSM	01/20/06

	BY	DATE		BY	DATE		BY	DATE		BY	DATE
DSGN	ERC	01/20/06	DRAWN	MEC	01/20/06	CHKD	ERC	01/20/06	APPR	PSM	01/20/06

Shaw Environmental, Inc.

PROJECT NO.	REV.	FILE NAME
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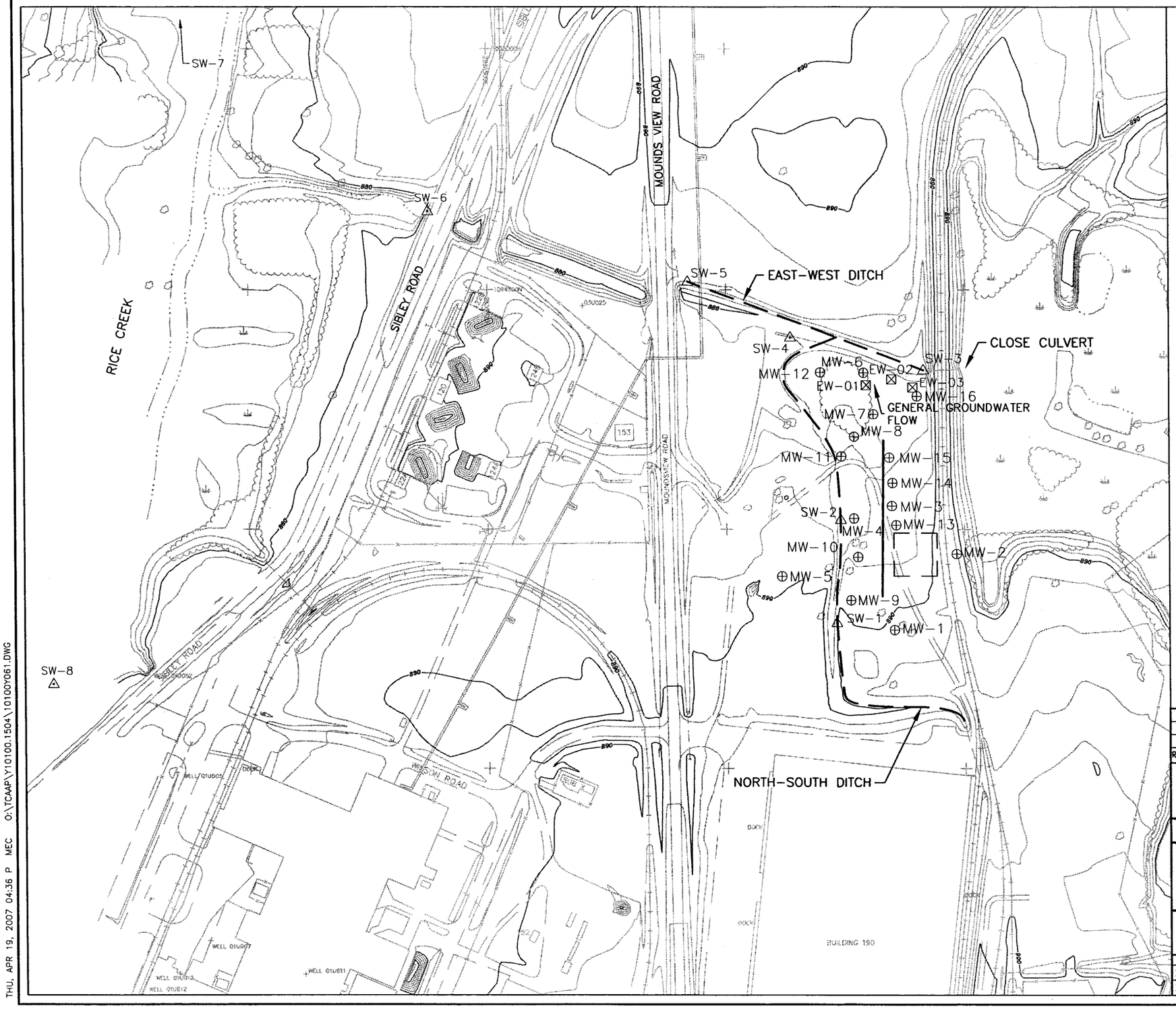

NOTE

1. SW-7 IS IN RICE CREEK LOCATED NEAR WEST PATROL ROAD. COORDINATE LOCATION N-1093676.43, E- 2835584.41.

LEGEND

- MONITORING WELL
- SURFACE WATER SAMPLE LOCATION
- APPROXIMATE LOCATION OF EXTRACTION WELL
- FIELD PHYTOREMEDIATION DEMONSTRATION PLOT
- EXTRACTION TRENCH
- DITCH

N

0 100 200

SCALE: 1" = 200'

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
1	ISSUED TO AGENCIES	ERC	PSM	04/19/07
0	ISSUED TO AGENCIES	ERC	PSM	10/18/06

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TWIN CITIES ARMY AMMUNITION PLANT

FIGURE NUMBER 3

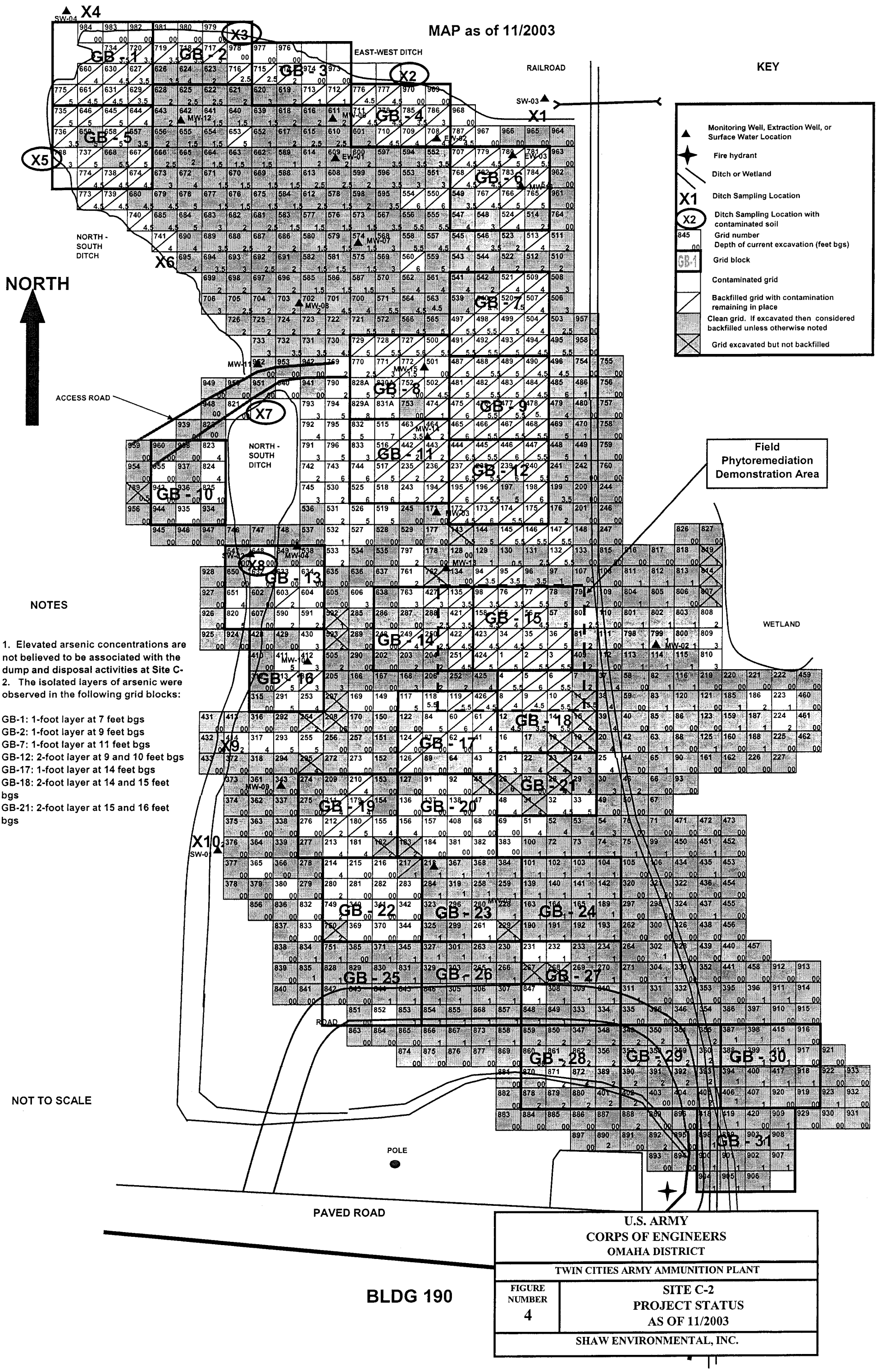
SITE C WELL AND DITCH ORIENTATION

Shaw™ Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSND	ERC	10/18/06	CHKD	ERC	10/18/06	10100.1504	1	10100Y061
DRAWN	MEC	10/18/06	APPR	PSM	01/20/06			

THU, APR 19, 2007 04:36 P MEC O:\TCAAP\Y10100.1504\10100Y061.DWG

MAP as of 11/2003



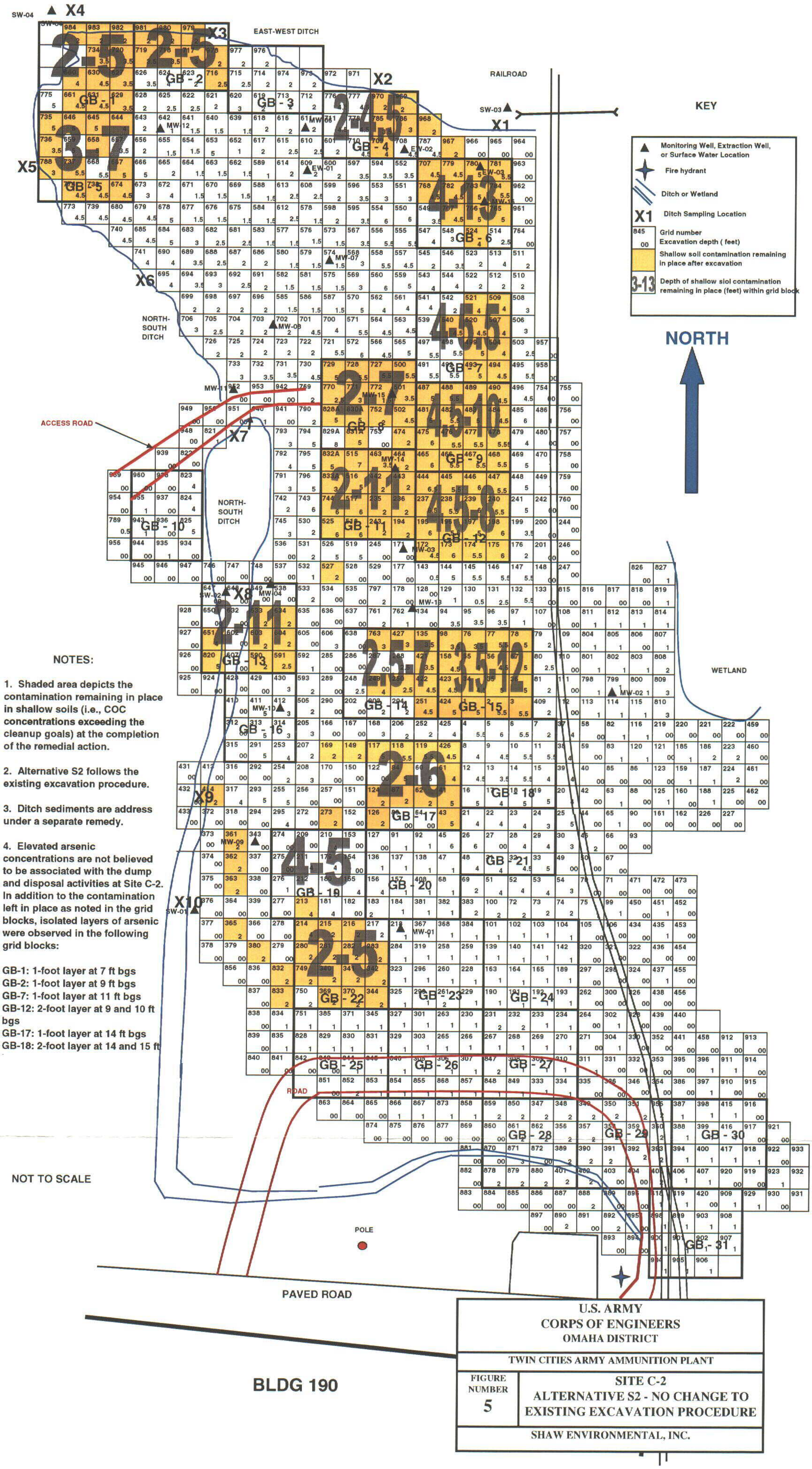
NOTES

1. Elevated arsenic concentrations are not believed to be associated with the dump and disposal activities at Site C-2. The isolated layers of arsenic were observed in the following grid blocks:

GB-1: 1-foot layer at 7 feet bgs
GB-2: 1-foot layer at 9 feet bgs
GB-7: 1-foot layer at 11 feet bgs
GB-12: 2-foot layer at 9 and 10 feet bgs
GB-17: 1-foot layer at 14 feet bgs
GB-18: 2-foot layer at 14 and 15 feet bgs
GB-21: 2-foot layer at 15 and 16 feet bgs

NOT TO SCALE

U.S. ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
TWIN CITIES ARMY AMMUNITION PLANT	
FIGURE NUMBER 4	SITE C-2 PROJECT STATUS AS OF 11/2003
SHAW ENVIRONMENTAL, INC.	


SW-04
X4
X3
X2
X1
X5
X6
X7
X8
X9
X10
EAST-WEST DITCH
RAILROAD
SW-03
NORTH-SOUTH DITCH
ACCESS ROAD
NORTH-SOUTH DITCH
WETLAND
ROAD
POLE
PAVED ROAD
BLDG 190
GB - 1
GB - 2
GB - 3
GB - 4
GB - 5
GB - 6
GB - 7
GB - 8
GB - 9
GB - 10
GB - 11
GB - 12
GB - 13
GB - 14
GB - 15
GB - 16
GB - 17
GB - 18
GB - 19
GB - 20
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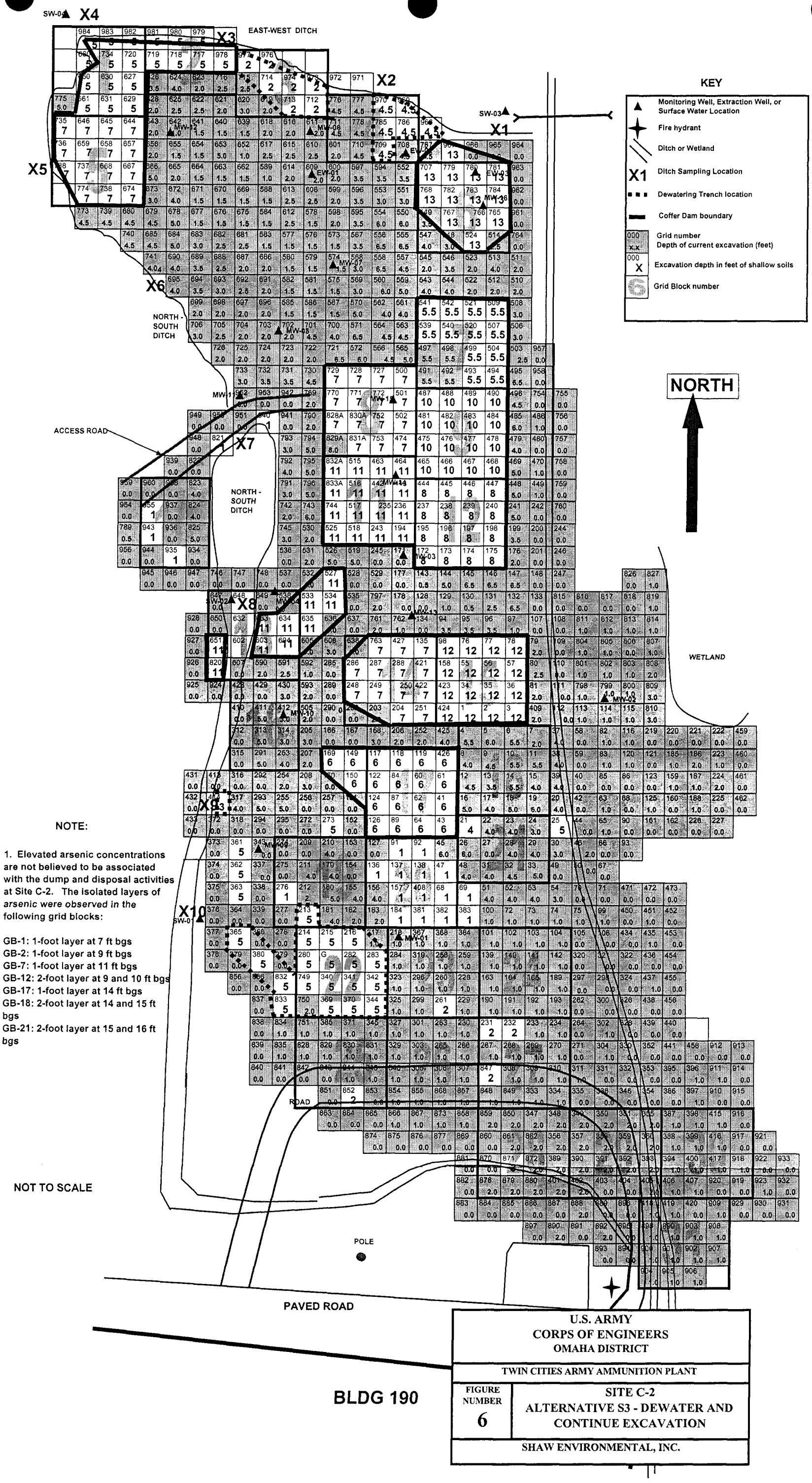
GB - 22
GB - 23
GB - 24
GB - 25
GB - 26
GB - 27
GB - 28
GB - 29
GB - 30
GB - 31
2.5
2.5
3.7
2.4
4.13
4.55
2.7
4.10
2.11
4.8
2.11
2.7
3.12
2.6
4.5
2.5
KEY
Monitoring Well, Extraction Well, or Surface Water Location
Fire hydrant
Ditch or Wetland
X1 Ditch Sampling Location
845 00 Grid number Excavation depth (feet)
Shallow soil contamination remaining in place after excavation
3-13 Depth of shallow siol contamination remaining in place (feet) within grid block
NORTH
NOTES:
1. Shaded area depicts the contamination remaining in place in shallow soils (i.e., COC concentrations exceeding the cleanup goals) at the completion of the remedial action.
2. Alternative S2 follows the existing excavation procedure.
3. Ditch sediments are address under a separate remedy.
4. Elevated arsenic concentrations are not believed to be associated with the dump and disposal activities at Site C-2. In addition to the contamination left in place as noted in the grid blocks, isolated layers of arsenic were observed in the following grid blocks:
GB-1: 1-foot layer at 7 ft bgs
GB-2: 1-foot layer at 9 ft bgs
GB-7: 1-foot layer at 11 ft bgs
GB-12: 2-foot layer at 9 and 10 ft bgs
GB-17: 1-foot layer at 14 ft bgs
GB-18: 2-foot layer at 14 and 15 ft
NOT TO SCALE
U.S. ARMY
CORPS OF ENGINEERS
OMAHA DISTRICT
TWIN CITIES ARMY AMMUNITION PLANT
FIGURE NUMBER 5
SITE C-2
ALTERNATIVE S2 - NO CHANGE TO EXISTING EXCAVATION PROCEDURE
SHAW ENVIRONMENTAL, INC.



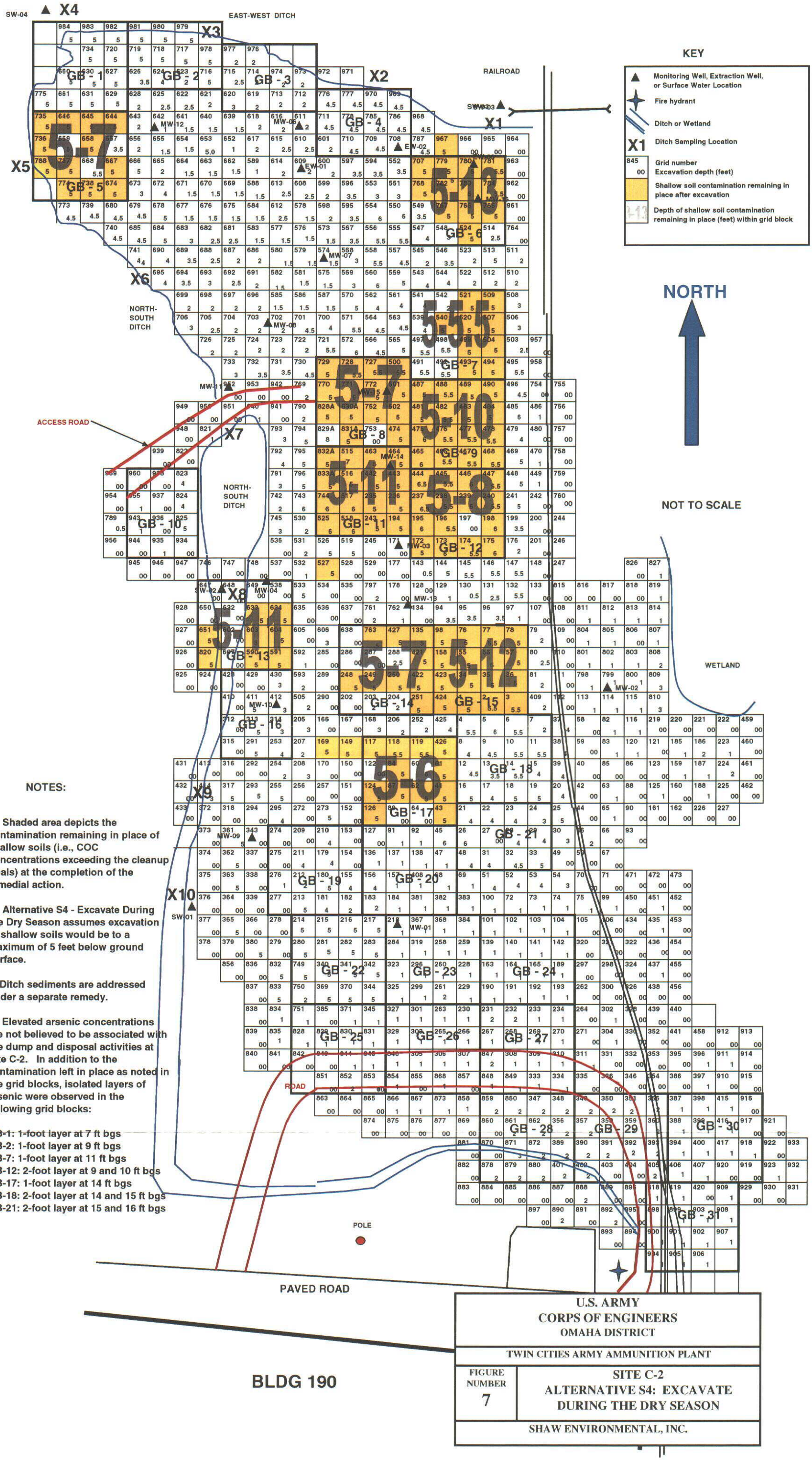
NOTE:

1. Elevated arsenic concentrations are not believed to be associated with the dump and disposal activities at Site C-2. The isolated layers of *arsenic were observed in the* following grid blocks:

GB-1: 1-foot layer at 7 ft bgs
GB-2: 1-foot layer at 9 ft bgs
GB-7: 1-foot layer at 11 ft bgs
GB-12: 2-foot layer at 9 and 10 ft bgs
GB-17: 1-foot layer at 14 ft bgs
GB-18: 2-foot layer at 14 and 15 ft bgs
GB-21: 2-foot layer at 15 and 16 ft bgs

NOT TO SCALE

U.S. ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
TWIN CITIES ARMY AMMUNITION PLANT	
FIGURE NUMBER 6	SITE C-2 ALTERNATIVE S3 - DEWATER AND CONTINUE EXCAVATION
SHAW ENVIRONMENTAL, INC.	



NOTES:

1. Shaded area depicts the contamination remaining in place of shallow soils (i.e., COC concentrations exceeding the cleanup goals) at the completion of the remedial action.

2. Alternative S4 - Excavate During the Dry Season assumes excavation of shallow soils would be to a maximum of 5 feet below ground surface.

3. Ditch sediments are addressed under a separate remedy.

4. Elevated arsenic concentrations are not believed to be associated with the dump and disposal activities at Site C-2. In addition to the contamination left in place as noted in the grid blocks, isolated layers of arsenic were observed in the following grid blocks:

GB-1: 1-foot layer at 7 ft bgs
GB-2: 1-foot layer at 9 ft bgs
GB-7: 1-foot layer at 11 ft bgs
GB-12: 2-foot layer at 9 and 10 ft bgs
GB-17: 1-foot layer at 14 ft bgs
GB-18: 2-foot layer at 14 and 15 ft bgs
GB-21: 2-foot layer at 15 and 16 ft bgs

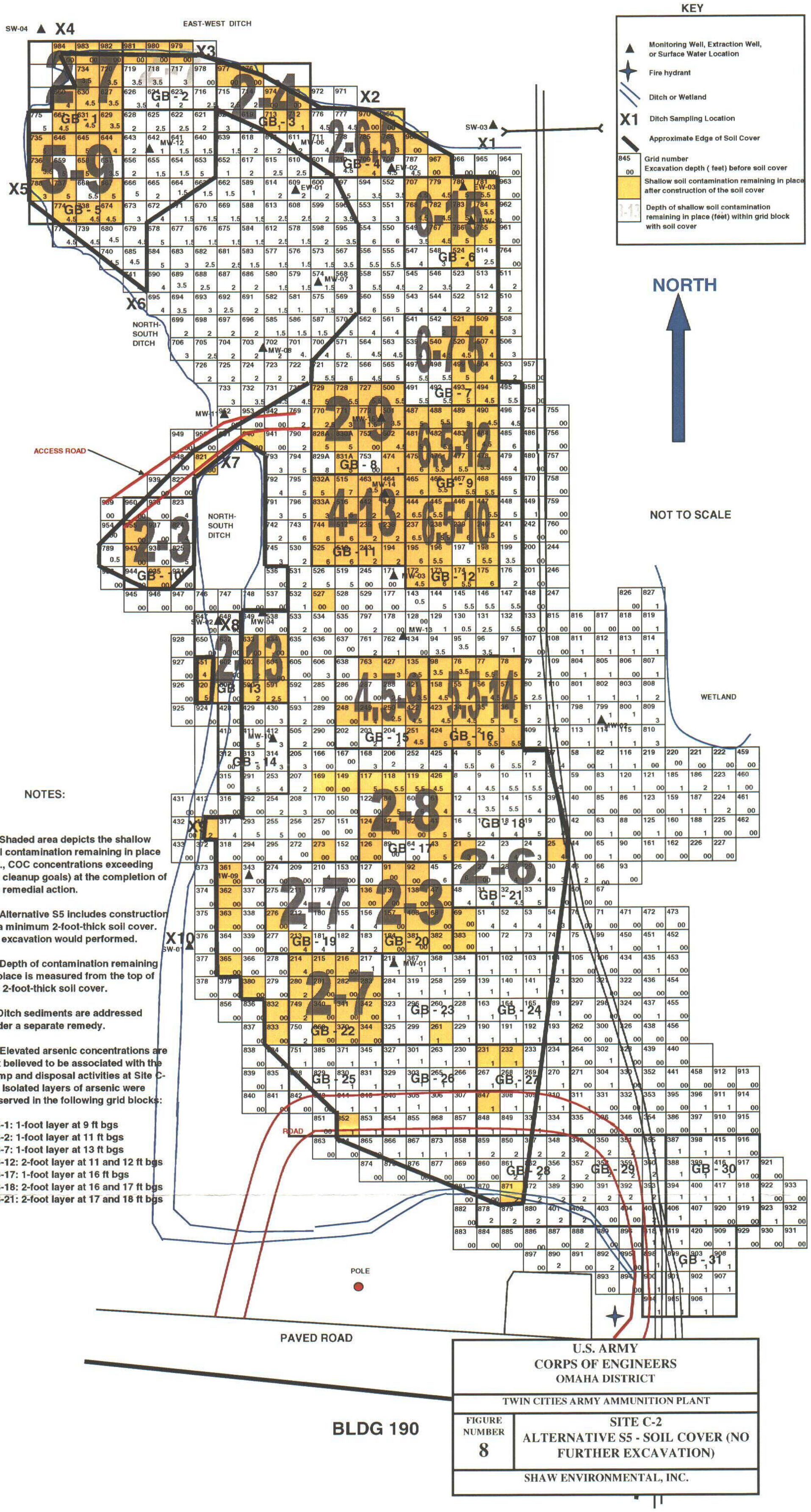
U.S. ARMY
CORPS OF ENGINEERS
OMAHA DISTRICT

TWIN CITIES ARMY AMMUNITION PLANT

FIGURE NUMBER 7

SITE C-2
ALTERNATIVE S4: EXCAVATE DURING THE DRY SEASON

SHAW ENVIRONMENTAL, INC.



NOTES:

1. Shaded area depicts the shallow soil contamination remaining in place (i.e., COC concentrations exceeding the cleanup goals) at the completion of the remedial action.

2. Alternative S5 includes construction of a minimum 2-foot-thick soil cover. No excavation would performed.

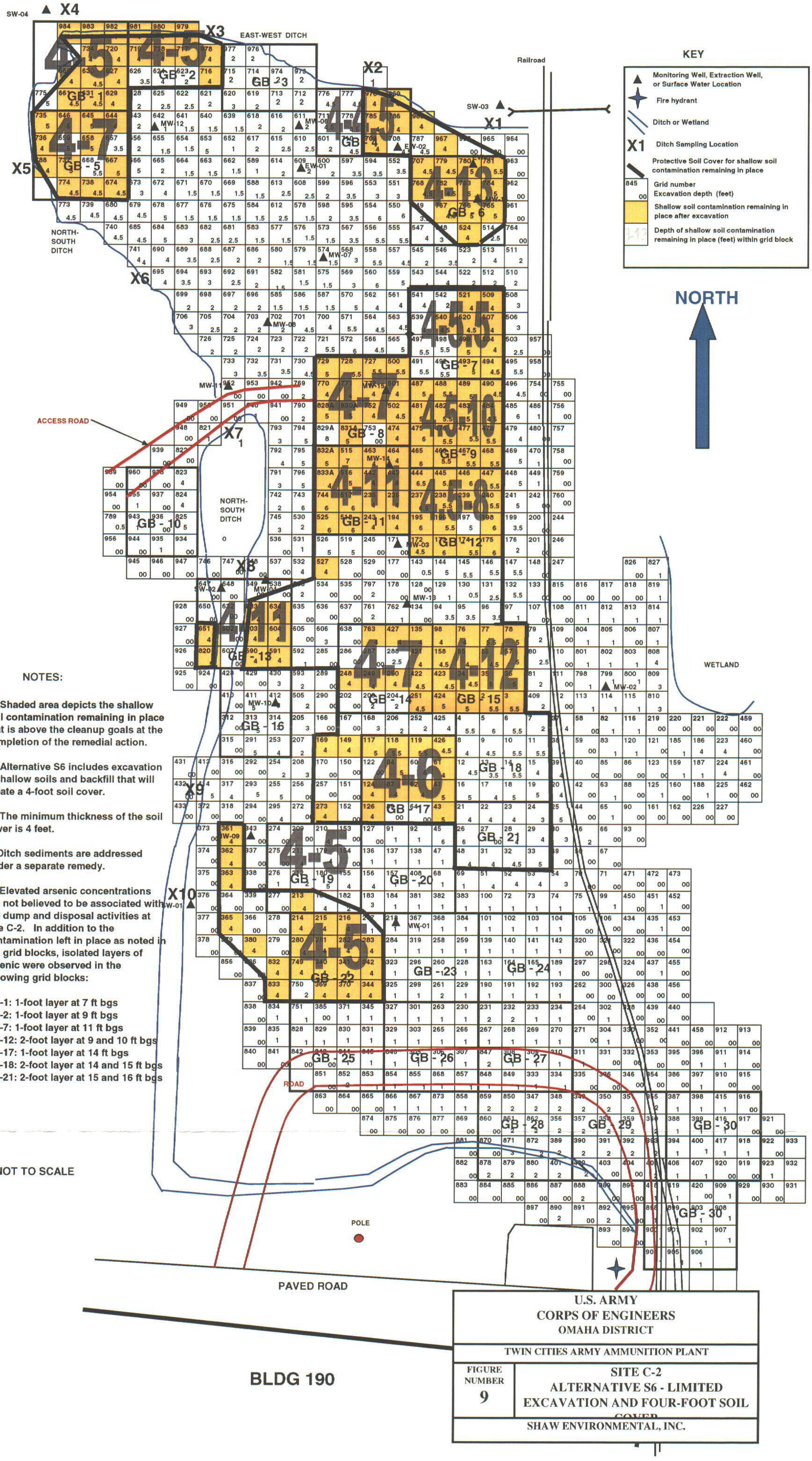
3. Depth of contamination remaining in place is measured from the top of the 2-foot-thick soil cover.

4. Ditch sediments are addressed under a separate remedy.

5. Elevated arsenic concentrations are not believed to be associated with the dump and disposal activities at Site C-2. Isolated layers of arsenic were observed in the following grid blocks:

GB-1: 1-foot layer at 9 ft bgs
GB-2: 1-foot layer at 11 ft bgs
GB-7: 1-foot layer at 13 ft bgs
GB-12: 2-foot layer at 11 and 12 ft bgs
GB-17: 1-foot layer at 16 ft bgs
GB-18: 2-foot layer at 16 and 17 ft bgs
GB-21: 2-foot layer at 17 and 18 ft bgs

U.S. ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
TWIN CITIES ARMY AMMUNITION PLANT	
FIGURE NUMBER 8	SITE C-2 ALTERNATIVE S5 - SOIL COVER (NO FURTHER EXCAVATION)
SHAW ENVIRONMENTAL, INC.	



NOTES:

1. Shaded area depicts the shallow soil contamination remaining in place that is above the cleanup goals at the completion of the remedial action.

2. Alternative S6 includes excavation o shallow soils and backfill that will create a 4-foot soil cover.

3. The minimum thickness of the soil cover is 4 feet.

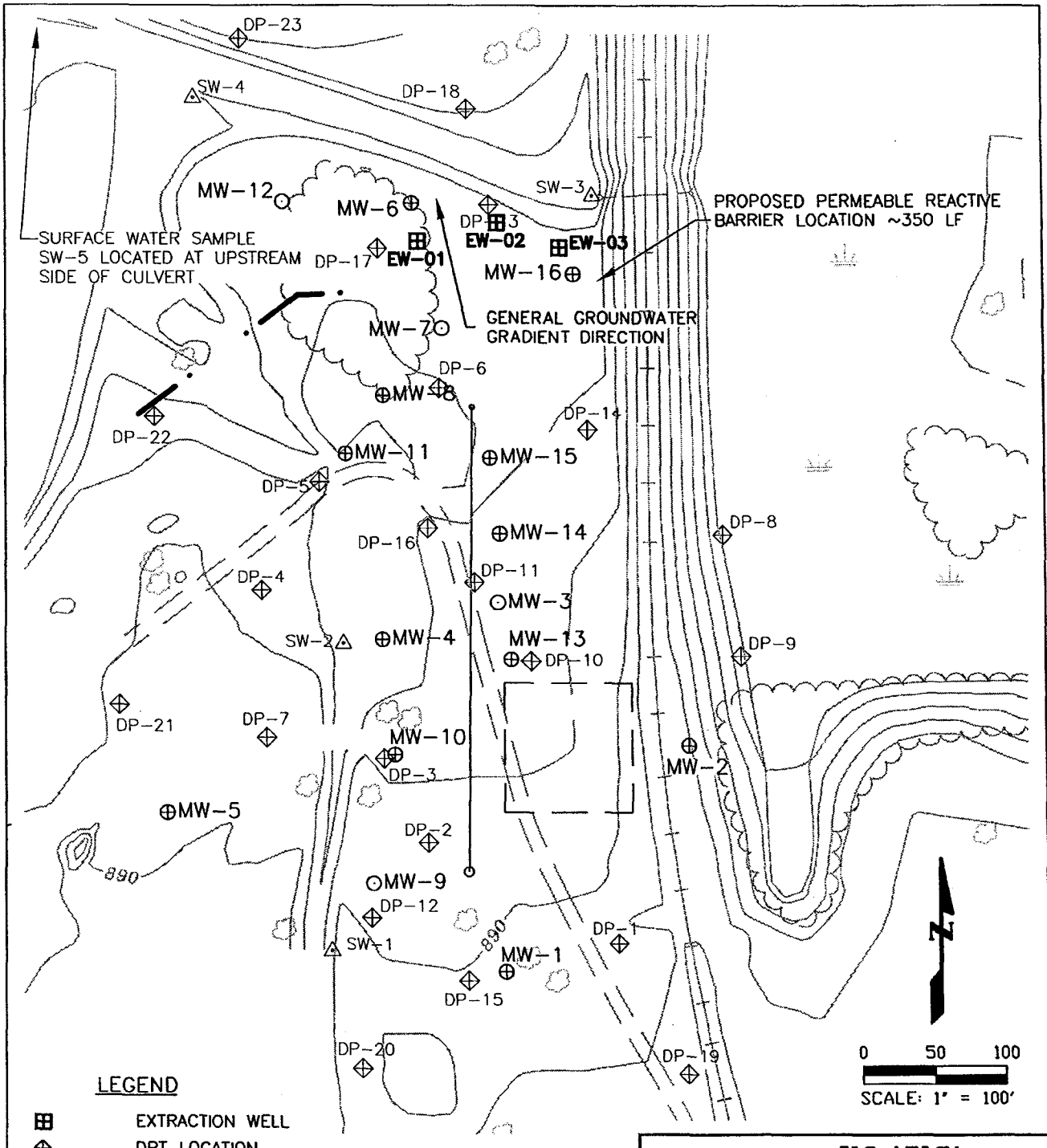
4. Ditch sediments are addressed under a separate remedy.

4. Elevated arsenic concentrations are not believed to be associated with the dump and disposal activities at Site C-2. In addition to the contamination left in place as noted in the grid blocks, isolated layers of arsenic were observed in the following grid blocks:

GB-1: 1-foot layer at 7 ft bgs
GB-2: 1-foot layer at 9 ft bgs
GB-7: 1-foot layer at 11 ft bgs
GB-12: 2-foot layer at 9 and 10 ft bgs
GB-17: 1-foot layer at 14 ft bgs
GB-18: 2-foot layer at 14 and 15 ft bgs
GB-21: 2-foot layer at 15 and 16 ft bgs

NOT TO SCALE

U.S. ARMY CORPS OF ENGINEERS OMAHA DISTRICT	
TWIN CITIES ARMY AMMUNITION PLANT	
FIGURE NUMBER 9	SITE C-2 ALTERNATIVE S6 - LIMITED EXCAVATION AND FOUR-FOOT SOIL COVER
SHAW ENVIRONMENTAL, INC.	



LEGEND

- EXTRACTION WELL
- DPT LOCATION
- MONITORING WELL
- SURFACE WATER SAMPLE LOCATION
- FIELD PHYTOREMEDIATION DEMONSTRATION PLOT
- EXTRACTION TRENCH
- PROPOSED PERMEABLE REACTIVE BARRIER

POINTMAP FILE: SITEC-1.DWG DATE 6/9/00

REVISION	DESCRIPTION	CHKD	APPR	DATE
A	ISSUED TO ARMY	ERC	PSM	01/20/06

	BY	DATE		BY	DATE		BY	DATE		BY	DATE
DSGN	NV	01/20/06	DRAWN	MEC	01/20/06	CHKD	ERC	01/20/06	APPR	PSM	01/20/06

U.S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

TWIN CITIES ARMY AMMUNITION PLANT

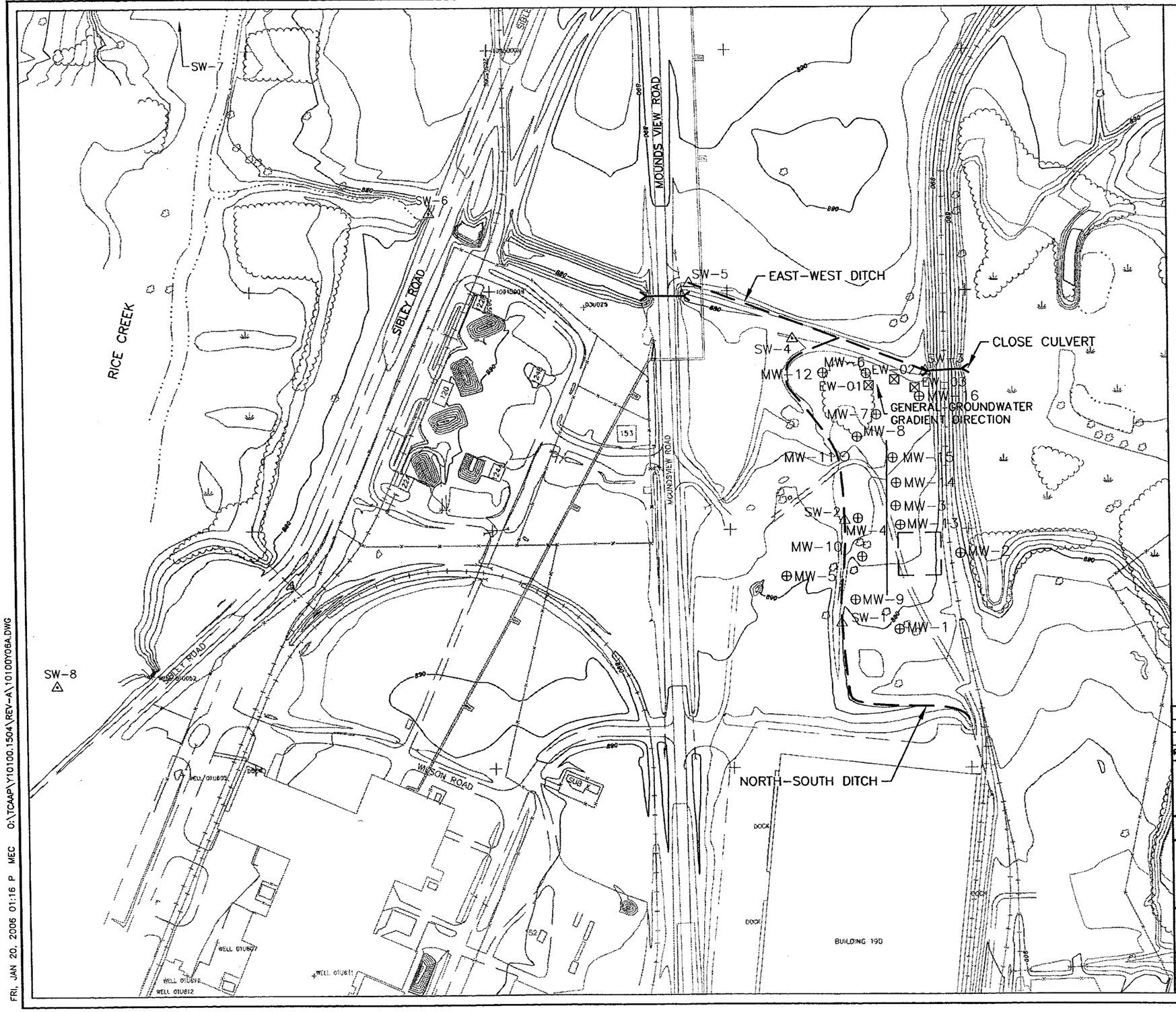
FIGURE NUMBER 10

SITE C-2 ALTERNATIVE GW3 - PERMEABLE REACTIVE BARRIER

Shaw Environmental, Inc.

PROJECT NO.	REV.	FILE NAME
10100.1504	1	10100Y02A

FRI, JAN 20, 2006 10:43 A MEC C:\TCAAP\Y10100.1504\REV-A\10100Y02A.DWG



NOTE

1. SW-7 IS IN RICE CREEK LOCATED NEAR WEST PATROL ROAD. COORDINATE LOCATION N-1093676.43, E- 2835584.41.

LEGEND

- ⊕ MONITORING WELL
- △ SURFACE WATER SAMPLE LOCATION
- ⊠ APPROXIMATE LOCATION OF EXTRACTION WELL
- FIELD PHYTOREMEDIATION DEMONSTRATION PLOT
- EXTRACTION TRENCH
- DITCH

N

0 100 200

SCALE: 1" = 200'

REVISION	DESCRIPTION	CHECKED	APPROVED	DATE
A	ISSUED TO ARMY	ERC	PSM	0/120/06

U.S. ARMY
CORPS OF ENGINEERS
OMAHA DISTRICT

TWIN CITIES ARMY AMMUNITION PLANT

FIGURE NUMBER 11

SITE C-2
ALTERNATIVE GW4 -
MONITORED NATURAL ATTENUATION

Shaw™ Environmental, Inc.

	BY	DATE		BY	DATE	PROJECT NO.	REV.	FILE NAME
DSND	ERC	02/04/05	CHKD	ERC	02/04/05	10100.1504	A	10100Y06A
DRAWN	MEC	02/04/05	APPR	PSM	02/04/05			

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TABLES

TABLES

TABLE 1
CLEANUP LEVELS FOR SITE C-2 CONTAMINANTS OF CONCERN
OPERABLE UNIT 2
TWIN CITIES ARMY AMMUNITION PLANT

CONTAMINANT OF CONCERN	SOIL OR SEDIMENT CLEANUP LEVEL milligrams per kilogram (mg/kg)	GROUNDWATER OR SURFACE WATER CLEANUP LEVEL micrograms per liter (µg/L)	BASIS FOR CLEANUP LEVEL
SITE C Shallow Soil			
Antimony	67.2	*None*	Human Health (HH) Risk Assessment
Arsenic	10		HH Risk Assessment
Beryllium	0.7		HH Risk Assessment
Lead	1,200		Health goal [1]
Manganese	2,503		HH Risk Assessment
Thallium	11.8		HH Risk Assessment
SITE C-2 Sediment			
Antimony	25	*None*	Ecological Risk Assessment (ERA) Level II Sediment Quality Target (SQT) (CHPPM, 2004)
Arsenic	10		HH Risk Assessment
Beryllium,	0.7		HH Risk Assessment
Lead	91.3		ERA Level II SQT (CHPPM, 2004)
Manganese	2,503		HH Risk Assessment
Thallium	11.8		HH Risk Assessment
SITE C-2 Groundwater			
Lead	*none*	15	EPA National Primarry Drinking Water Standards
SITE C-2 Surface Water			
Lead at site ditches	*none*	6.9	Minnesota Pollution Control Agency (MPCA) surface water chronic standard
Lead at Rice Creek		4.0	MPCA surface water chronic standard

1. *Twin Cities Army Ammunition Plant, New Brighton/Arden Hills Superfund Site, OU2 Record of Decision, October 1997.*

TABLE 2
SITE C-2
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SHALLOW SOILS
TWIN CITIES ARMY AMMUNITION PLANT

EVALUATION CRITERIA	ALTERNATIVE S1 NO FURTHER ACTION	ALTERNATIVE S2 NO CHANGE TO EXISTING EXCAVATION PROCEDURE	ALTERNATIVE S3 DEWATER AND CONTINUE EXCAVATION	ALTERNATIVE S4 EXCAVATE DURING THE DRY SEASON	ALTERNATIVE S5 SOIL COVER (NO FURTHER EXCAVATION)	ALTERNATIVE S6 LIMITED EXCAVATION AND FOUR-FOOT SOIL COVER
Overall Protection of Human Health and the Environment	Not protective of human health and the environment. Does not meet RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.
Compliance with ARARs	Does not comply with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.	Complies with ARARs.
Long-Term Effectiveness and Permanence	Not effective and no permanence.	Low to moderate effectiveness and permanence.	Highest effectiveness and permanence.	Moderate effectiveness and permanence.	Moderate to high effectiveness and permanence.	High effectiveness permanence.
Reduction of Toxicity, Mobility, or Volume through Treatment	Alternative does not include treatment.	Excavated soil would be stabilized for disposal.	Excavated soil would be stabilized for disposal. Groundwater needs testing and possible treatment.	Excavated soil would be stabilized for disposal.	Alternative does not include treatment.	Excavated soil would be stabilized for disposal.
Short-Term Effectiveness	No short-term impacts.	Moderate short-term impacts.	High short-term impacts.	High short-term impacts.	Low short-term impacts.	Moderate short-term impacts.
Implementability	Readily implementable. High administrative effort. Remedy would not be completed.	Readily implementable. High administrative effort because remedy would not be acceptable for closure. Remedy would include land use controls.	Difficulties associated with large volume of water to be dewatered to reach the needed depth. Would require coordination effort. Moderate to high administrative effort. Remedy would include land use controls.	Difficulties with determining the start date and possible delays. High administrative effort. Remedy would include land use controls.	Readily implementability. Moderate administrative effort. Remedy would include land use controls.	Good to moderate implementability. Moderate administrative effort. Remedy would include land use controls.
Present Worth Cost	$92,000	$662,000	$4.0 million	$1.2 million	$808,000	$888,000
State Acceptance		Alternative not preferred by the State.	Alternative not preferred by the State.	Alternative not preferred by the State.	Alternative not preferred by the State.	Alternative preferred by the State.
Community Acceptance	Alternative not preferred by the community.	Alternative not preferred by the community.	Alternative not preferred by the community.	Alternative not preferred by the community.	Alternative not preferred by the community.	Alternative preferred by the community.

TABLE 3
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Chemical-Specific					
Safe Drinking Water Act – Maximum Contaminant Level Goals	40 Code of Federal Regulations (CFR) Parts 141 and 142.	Establishes drinking water quality goals set at levels of no known or anticipated adverse health affects, with an adequate margin of safety.	Relevant & Appropriate	The U.S. Environmental Protection Agency (USEPA) action level for lead in drinking water has been exceeded.	This standard does not directly apply because Site C groundwater is not used as a source of drinking water.
Clean Water Act – NPDES Storm Water Regulations	40 CFR Part 122	Establishes requirements for discharge of stormwater.	Applicable	Applicable during excavation activities to address any storm water from precipitation events that would require collection, treatment, and discharge from open excavation to meet substantive requirements.	If required, surface water would be collected and treated prior to discharging,
Clean Air Act – Ambient Air Quality Standards	42 U.S. Code (USC) Section 4201, et. seq, as amended	National primary and secondary ambient air quality standards.	Applicable	National ambient air quality standards are implemented through the New Source Review Program and State Implementation Plan (SIP). The federal New Source Review Program addresses only major sources. Emissions associated with earth moving activities during remedial actions. The activities would not constitute a major source.	See Minnesota Ambient Air Quality Standards concerning applicability of requirements implemented through the SIP.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Chemical-Specific (Continued)					
Clean Air Act – Nation Emissions Standards for Hazardous Air Pollutants	40 CFR Parts 60 and 61, Subpart A	Establishes regulatory standards for specific hazardous air pollutants	Relevant & Appropriate	Not applicable because a major emissions source is not part of this work.	Perimeter air for lead would be performed during all activities that could result in airborne dust.
Minnesota Ambient Air Quality Standards	Minn. Rules Chapter 7009	Primary and secondary standards for PM10 in ambient air.	Applicable		Compliance with ambient air standards would be achieved by adhering to a fugitive emissions control plan.
Minnesota Residential Lead Abatement	Minn. Rules Chapter 4761.2510, Subpart 3	Bare soil on residential or playgrounds must not contain lead exceeding 100 parts per million (ppm) or more by weight.	Not Applicable or Relevant & Appropriate	This standard applies to residential lead abatement, not to work on TCAAP, may be used as guidance to be considered (TBC) only.	Not applicable, guidance TBC only.
Waters of the State	Minn. Rules Chapter 7050.0222	Water quality standards for class 2 water of the state.	Applicable	The ditch is a receiving stream for contaminated surface water from Site C. The lead concentration for surface water standard has been exceeded.	Groundwater extraction, permeable reaction barrier, and filling of the ditches would eliminate discharge of lead-contaminated groundwater to surface waters.
Chemical-Specific (continued)					

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Metropolitan Council discharge criteria	Minn. Stat. Chapter 115	Municipal districts may establish standards necessary to protect water quality, including allowed concentrations in sanitary sewers to the local publicly owned treatment works.	Applicable	Alternatives include discharging extracted groundwater or collected surface water into the sanitary sewer.	Water would be tested and treated as necessary to meet the sanitary sewer discharge limit of 1 milligram per liter (mg/L) of lead.
Minnesota Pollution Control Agency (MPCA) Risk Based Site Evaluation Manual	www.pca.state.mn.us/cleanup/pubs/intro.pdf	Outlines a risk-based approach to decision making during site investigation and remedy selection under the state's Superfund and Voluntary Investigation and Cleanup Program.	Relevant & Appropriate	Applies to sediment, surface water, and groundwater medias of concern.	May be used as guidance TBC only.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Location-Specific					
Clean Water Act (CWA)	CWA Section 404, 33 CFR 320, 322, 323, 325-330	Wetland protection requirements.	Applicable	U.S. Army Corps of Engineers (USACE) St. Paul District has rescinded the Nationwide Permit No. 38 in Minnesota and developed a combination of General Permits and Letters of Permission (GP/LOP). The GP/LOP includes similar CWA Section 404 authorization for cleanup of hazardous and toxic waste as might be authorized under Nationwide Permit 38. The GP/LOP applies to activities required to contain, stabilize, or remove hazardous and toxic waste. Alternatives would include excavation of contaminated soil and/or backfill in ditches.	Meet the substantive requirements of the GP/LOP. Work would be coordinated work with the MPCA, USEPA, Rice Creek Watershed District, USACE St. Paul District, Minnesota Department of Natural Resources (DNR), and Ramsey County.
Protection of Wetlands	Exec. Order 11990 40 CFR Part 6.302(a), Appendix A	Requires federal agencies to minimize destruction, loss or degradation of wetlands.	Applicable	Excavation of contaminated soil and backfill in a ditch is considered work within a wetland.	Work would be coordinated with the MPCA, USEPA, Rice Creek Watershed District, USACE St. Paul District, DNR, and Ramsey County.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Location-Specific (continued)					
National Historic Preservation Act of 1966 (NHPA)	16 USC Section 470 et. seq	Expands historic preservation programs; requires preservation of resources included in or eligible for listing on the National Register of Historic Places.	Relevant & Appropriate	No cultural resources on TCAAP are currently listed in the National Historic Preservation Act (NRP).	Compliance with the requirements would be addressed if archeological/cultural resources are encountered.
National Archeological and Historical Preservation Act of 1974	16 USC Section 469	Provides procedures for preservation of historical and archaeological items when terrain is altered as a result of federal or federally licensed construction activity.	Relevant & Appropriate	No cultural resources on TCAAP are currently listed in the NRP.	Prior to constructing replacement wetland, a cultural resource determination or survey would be conducted as stipulated in the TCAAP Cultural Resources Management Plan (Geo-Marine, 1996)
Archeological Resources Protection Act of 1979	16 USC Section 470 aa-mm	Requires a permit for any excavation or removal of archaeological resources from public lands or Indian lands.	Relevant & Appropriate	May be relevant and appropriate if archeological resources encountered during remedial activities.	Compliance with the requirements would be addressed if archeological resources are encountered.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Location-Specific (continued)					
Native American Graves and Repatriation Act of 1990	25 USC Section 3001 et seq.	Provides requirements for the protection of Native American cultural items that are excavated or discovered on federal or tribal lands	Relevant & Appropriate		Prior to constructing replacement wetland, a cultural resource determination or survey would be conducted as stipulated in the TCAAP Cultural Resources Management Plan (Geo-Marine, 1996)
Fish and Wildlife Coordination Act	16 USC Section 661 et seq.	Requirements for discharges of pollutants into a body of water or wetland	Relevant & Appropriate	Actions that result in control or structural modification of Rice Creek are not planned.	Review and approval remedial actions are planned.
Endangered Species Act	16 USC Section 1531 et seq,	Provides protection for endangered species and habitat	none	Excavations are not planned near the marshy areas inhabited by the Blanding's turtle, which is near Site A.	
Waters of the State	Minn. Rules Chapter 7050.0185	Non-degradation for all Waters	Applicable	Assess significance of actions and protects water from significant degradation from point and nonpoint sources and wetland alterations.	Best management practices would be used to prevent discharges of sediment or pollutants to water during construction activities.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Location-Specific (continued)					
Waters of the State	Minn. Rules Chapter 7050.0185, Subpart 9	Physical Alteration of Wetlands	Applicable	Requires non-degradation of all waters. Need permit for significant adverse impact to a wetland. Alternatives would include backfilling ditches.	Work would be coordinated work with the MPCA, EPA, Rice Creek Watershed District, DNR, and Ramsey County to meet the requirements.
Waters of the State	Minn. Rules Chapter 7050.0186	Wetland Mitigation	Applicable	Wetland mitigation to maintain non-degradation of wetland designated uses.	For areas adjacent to wetland replacement, work would be conducted in accordance with erosion control and construction best management practices.
Wetland Conservation Act	Minn. Rules Chapter 8420	Requirements for allowing impacts to a wetland.	Applicable	Administered by Rice Creek Watershed District. Sediment sample results indicated that lead and arsenic levels exceeded the human health risk-based recommended remediation goals and exceeded the sediment quality target levels.	A plan would be submitted for wetland replacement.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Location-Specific (continued)					
Wetland Conservation Act	Minn. Rules 8420.0546	Requires replacement of jurisdictional wetland values lost at a minimum of a 1:1 ratio. The Wetland Conservation Act has explicit replacement ratios for the Local Unit of Government decisions.	Applicable	This rule is for the Local Unit of Government (Rice Creek Watershed District) to apply the state Wetland Conservation Act. Alternatives would include backfilling ditches.	For each acre of jurisdictional wetland lost, a minimum of one acre would be created in accordance with a wetland replacement plan.
Public Water Resources	Minn. Statute Chapter 103G Minn. Rules Chapter 6115.0190, Subpart 5	Permit required for placement of fill in public waters.	Applicable.	Due to this being a CERCLA action, permit not required, but substantive compliance is necessary.	Work would be coordinated with MPCA, the Rice Creek Water District, EPA, and USACE to meet the designated standards to protect water quality.
Water Pollution Control	Minn. Statute Chapter 115.03	MPCA has authority to establish rules and standards for water quality.	Applicable	Need to ensure water quality standards are not exceeded during work in the ditches at Site C.	Work would be conducted using practices that minimize downstream impacts to water quality.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Location-Specific (continued)					
Waters of the State	Minn. Rules Chapter 7050.0210, Subpart 13a	General standards for discharges to waters of the state	Applicable	Wetland pollution prohibition – prevent significant adverse impact to wetlands.	Work adjacent to wetlands would be conducted in accordance with the wetland management plan and best management practices.
Action-Specific					
Air Quality Controls	Minn. Rules-Chapters 7009.0020, 7009.0080, and 7009.0150.	Precautions and control of emissions during excavation to eliminate potential for emissions beyond the property boundary.	Applicable	Due to Site C location and TCAAP fencing, release of emissions beyond the property boundary and public access are unlikely.	Dust levels monitored at the start of each prior excavation. Levels have been minimal and continual monitoring determined to not be warranted. A similar practice would be used in the future.
Generation of Hazardous Wastes	40 CFR Part262.11 Minn. Rules Chapters 7045.0214-.0218	Waste evaluation required to determine if hazardous.	Applicable if hazardous waste is generated during actions.	Soil would be sampled and stockpiled while awaiting test data. If hazardous, soil would be stabilized, tested and disposed.	Excavated soil, waste ordnance, and materials would be sampled and tested in accordance with approved procedures.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Action-Specific (continued)					
Minnesota's National Pollutant Discharge Elimination System (NPDES)	Minn. Statutes Chapters 115 and 116 Minn. Rules Chapter 7001	Discharge Storm Water Associated with a Construction Activity	Applicable	The disturbance of more than one acre after March 10, 2003 needs to follow the substantive requirements of the MPCA's storm water program. Alternatives would disturb about 5 acres.	Temporary and permanent erosion and sediment control plans would be developed similar to a Storm Water Pollution Prevention Plan. Submit General Storm Water Permit for Construction Activity (MN R100001).
Management of Hazardous Wastes	40 CFR Part 262 Minn. Rules Chapters 7045.0205, .0208, .0270, .0292, .0294	Generator standards, including pre-transport, storage, and record-keeping requirements.	Applicable if hazardous waste is generated	If hazardous, soil would be stabilized, tested and disposed.	Excavated soil and debris would be managed as hazardous waste while awaiting transport.
Management of Hazardous Wastes	40 CFR Part 262.23 Minn. Rules Chapters 7045.0261-.0265	Preparation and use of hazardous waste manifests.	Applicable if hazardous waste is transported off-site		Manifests would be prepared and approved by the Army prior to shipment offsite.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Action-Specific (continued)					
Management of Hazardous Wastes	40 CFR Part 268 Minn. Rules Chapters 7045.0214, .1300	Restrictions on land disposal of hazardous wastes.	Applicable	Based on contaminants of concern, 7045.1309 (applicable to characteristic wastes) are the most likely "Applicable" requirements.	Waste would be evaluated to determine if waste is restricted. If determined to be restricted from land disposal, waste would be stabilized and managed as required.
Management of Hazardous Wastes	40 CFR Part 268.3; Minn. Rules Chapter 7045.1305	Land Disposal Restrictions. Dilution prohibited as a substitute for treatment.	Relevant & Appropriate	Following excavation, waste soil would be stabilized with agent and tested.	Procedures limit actions to stockpiling excavated soils prior to testing.
Procedures for planning and implementing offsite actions.	40 CFR Part 300.440	Hazardous substances, pollutants, or contaminants transferred offsite must be transferred to acceptable facilities.	Applicable	Applicable if hazardous substances, pollutants, or contaminants are transferred offsite.	Selection of offsite facilities would be coordinated with the appropriate USEPA Regional Office and authorized state.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Action-Specific (continued)					
Hazardous Materials Transportation Act	49 USC Sections 1801 – 1813 49 CFR Parts 107, 171-177	Regulates transportation of hazardous materials	Potentially Applicable	Proposed remedial actions would not entail off-site transportation of hazardous materials.	Rules and regulations would be followed if hazardous materials are transported off site.
Well Abandonment	Minn. Rules Chapters 4725.3850, 3875, .7450	Standards for monitoring well and dewatering well abandonment.	Applicable	Alternatives require closure of monitoring and extraction wells.	Care would be taken during site activities to avoid destruction of existing wells. Closure would be in accordance with requirements.
Wells and Borings	Minn. Rules Chapters 4725.1825 .6150, 3150	Dewatering Well Permitting and Installation	Applicable	Permits for well construction (Chapter 4725.1825), and well standards (Chapters 4725.6150 and .3150). Applicable under Alternative S2 for dewatering well.	Permits would be obtained prior to construction. Well design and installation would be in accordance with regulations.
Institutional Controls	Minn. Statute Chapter 115B.16 subdivision 1	Use of property of a closed disposal facility	Relevant & Appropriate	Cannot use property that would disturb the integrity of any containment system.	Site C-2 is not considered a disposal facility but the soil covers would be part of a containment system.

TABLE 3 (Continued)
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

Standard, Requirement, Criteria, or Limitation	Citation	Description of Requirement	ARAR Status	Comments	Method of Attainment
Action-Specific (continued)					
Institutional Controls	Minn. Statute Chapter 115B.16 subdivision 2	Recording of affidavit	Relevant and Appropriate		A legal description of the property disclosing the condition of the site would be recorded on an affidavit with the Ramsey County before any transfer of ownership of the property.
Reporting Requirements for Property Transfer	40 CFR Part 373	Requires Federal agencies to report hazardous waste activity when transferring property.	Applicable	Would apply, since the duration (one year) and reportable quantity released to the environment exceed the reportable quantity.	Upon property transfer, Army must report when hazardous substances have been stored greater than one year, or disposed if specific quantities were exceeded.

Notes:

For a listing of ARARs in the original OU2 ROD, refer to the October 1997 Record of Decision for the "Twin Cities Army Ammunition Plant New Brighton/Arden Hills Superfund Site Operable Unit 2" (USACE, 1997).

TABLE 4
SITE C-2
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SEDIMENT
TWIN CITIES ARMY AMMUNITION PLANT

EVALUATION CRITERIA	ALTERNATIVE SED1 NO ACTION	ALTERNATIVE SED2 EXCAVATE	ALTERNATIVE SED3 SOIL COVER
Overall Protection of Human Health and the Environment	Not protective of human health and the environment. Does not meet RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.
Compliance with ARARs	Does not comply with ARARs.	Complies with ARARs.	Complies with ARARs.
Long-Term Effectiveness and Permanence	Not effective and no permanence.	High effectiveness and permanence.	High effectiveness and permanence.
Reduction of Toxicity, Mobility, or Volume	Alternative does not include treatment.	Excavated sediment would be stabilized for disposal.	Alternative does not include treatment.
Short-Term Effectiveness	No short-term impacts.	Low short-term impacts.	Low short-term impacts.
Implementability	Readily implementable. High administrative effort. Remedy would not be completed.	Readily implementable. Moderate administrative effort. Remedy would include coordination effort to work in wetlands.	Readily implementable. Moderate administrative effort. Remedy would include coordination effort to work in wetlands, to create new compensatory wetland, and land use controls.
Present Worth Cost	$16,000	$60,000	$149,000
State Acceptance	Alternative not preferred by the State.	Alternative not preferred by the State.	Alternative preferred by the State.
Community Acceptance	Alternative not preferred by the community.	Alternative not preferred by the community.	Alternative preferred by the community.

TABLE 5
SITE C-2
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER
TWIN CITIES ARMY AMMUNITION PLANT

EVALUATION CRITERIA	ALTERNATIVE GW1 NO ACTION	ALTERNATIVE GW2 EXTRACTION AND TREATMENT	ALTERNATIVE GW3 PERMEABLE REACTIVE BARRIER	ALTERNATIVE GW4 MONITORED NATURAL ATTENUATION
Overall Protection of Human Health and the Environment	Not protective of human health and the environment. Does not meet RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.	At this time, may not be protective of human health and the environment. May not meet RAOs.
Compliance with ARARs	Does not comply with ARARs.	Complies with ARARs.	Complies with ARARs.	May not comply with ARARs based on current site conditions.
Long-Term Effectiveness and Permanence	Low effectiveness and permanence.	Highest effectiveness and permanence.	Moderate effectiveness and permanence.	Low effectiveness and permanence. Unsure of groundwater plume stability.
Reduction of Toxicity, Mobility, or Volume	Mobility would be contained.	Extracted groundwater would reduce toxicity, volume, and mobility.	Groundwater would be treated reducing toxicity, mobility, and volume.	Mobility may not be contained at this time. Surface water pathway would be eliminated.
Short-Term Effectiveness	Low short-term impacts.	Moderate short-term impacts.	High short-term impacts.	Low short-term impacts.
Implementability	Readily implementable. High administrative effort. Remedy would not be completed.	Readily implementable. High administrative effort. Remedy would include monitoring, O&M, and land use controls.	Implementable but additional studies would be required. High administrative effort. High construction effort; possible installation problems. Remedy would include long-term monitoring, contingency plan, and land use controls.	Not implementable at this time. Additional studies would be required. Very high administrative effort. Remedy would include long-term monitoring, contingency plan, and land use controls.
Present Worth Cost	$143,000	$1.7 million	$1.5 million	$1.3 million
State Acceptance	Alternative not preferred by the State.	Alternative preferred by the State.	Alternative not preferred by the State.	Alternative not preferred by the State.
Community Acceptance	Alternative not preferred by the community.	Alternative preferred by the community.	Alternative not preferred by the community.	Alternative not preferred by the community.

TABLE 6
SITE C-2
SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SURFACE WATER
TWIN CITIES ARMY AMMUNITION PLANT

EVALUATION CRITERIA	ALTERNATIVE SW1 NO ACTION	ALTERNATIVE SW2 MONITORING	ALTERNATIVE SW3 COLLECTION AND TREATMENT
Overall Protection of Human Health and the Environment	Not protective of human health and the environment. Does not meet RAOs.	Protective of human health and the environment. Meets RAOs.	Protective of human health and the environment. Meets RAOs.
Compliance with ARARs	Does not comply with ARARs.	Complies with ARARs.	Complies with ARARs.
Long-Term Effectiveness and Permanence	Not effective and no permanence.	Moderate effectiveness and permanence.	High effectiveness and permanence.
Reduction of Toxicity, Mobility, or Volume	Alternative does not meet criteria.	Collected and treated surface water would reduce toxicity and mobility.	Collected and treated surface water would reduce toxicity and mobility.
Short-Term Effectiveness	No short-term impacts.	Low short-term impacts.	Moderate short-term impacts.
Implementability	Readily implementable. High administrative effort. Remedy would not be completed.	Readily implementable. Moderate administrative effort. Remedy would include monitoring and contingency plan.	Readily implementable. High administrative effort. Remedy would include monitoring and O&M.
Present Worth Cost	$92,000	$741,000	$4.0 million
State Acceptance	Alternative not preferred by the State.	Alternative preferred by the State.	Alternative not preferred by the State.
Community Acceptance	Alternative not preferred by the community.	Alternative preferred by the community.	Alternative not preferred by the community.

TABLE 7
ALTERNATIVE S6: LIMITED EXCAVATION AND FOUR-FOOT SOIL COVER
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

REMEDIAL ACTION COSTS

	Unit	Quantity	Unit Cost	Extension	Total Cost	Comments
FIELD WORK						**Duration: 6 weeks TOTAL, 5 days/week 10 hours/day**
Earthwork Subcontractor						
Mob/Demob						Duration 4 days total
Equipment	Day	4	$475	$1,900		Engineer's estimate
Equipment Mob/Demob Charges	EA	9	$500	$4,500		Engineer's estimate
Labor	Day	4	$4,100	$16,400		Engineer's estimate
Excavation & Loadout						Duration 3.5 weeks total
Equipment (shallow soils)	Day	18	$1,800	$32,400		Excavator, Loader, Haul Truck, Water Truck, Pickups
Labor (shallow soils)	Day	18	$4,200	$75,600		Engineer's estimate
Backfill, Topsoil, Grade, Seed & Mulch						Duration 3 weeks, but sched 2 weeks
Equipment (shallow soils)	Day	11	$2,700	$29,700		Excavator, Loader, Haul Truck, Water Truck, Pickups
Labor (shallow soils)	Day	11	$5,500	$60,500		Engineer's estimate
Subcontractor Office Support	WK	6	$2,100	$12,600		Field work duration (include Sr. Engr, Clerical, and Accounting)
Earthwork Subcontractor Subtotal					**$233,600**	
Other Subcontractors						
QAPP Laboratory						
Confirmation Sampling	Test	128	$170	$21,760		One test per clean grid plus QC samples
Stabilization Sampling	Test	11	$475	$5,225		One test per 250 cubic yards
Offsite Source Sampling	EA	1	$1,020	$1,020		Offsite source for topsoil
Transportation & Disposal	CY	2,700	$40	$108,000		Includes stabilization material, hauling, tipping fees. Added 10% to vol for stab.
Asbestos Monitoring	MD	18	$735	$13,230		One technician, includes expendables
Surveyor	LS	1	$5,000	$5,000		Engineer's estimate
Data Validation	Test	10	$300	$3,000		Engineer's estimate
Medical Surveillance	LS	1	$3,000	$3,000		Engineer's estimate
Other Subcontractor Subtotal					**$160,235**	
Rented/Leased Equipment	WK	6	$2,000	$12,000	**$12,000**	Trailers, toilets, phones, safety equipment, freezer, etc.
Materials						
Fuel	LS	1	$3,300	$3,300		Engineer's estimate
Miscellaneous	LS	1	$40,000	$40,000		Seed, Straw Bales, Silt Fence, Truck Liners, Misc. Expendables
Topsoil	CY	2,400	$18	$43,200		Offsite source, 5.5 acres at 3" thick
Materials Subtotal					**$86,500**	
Contractor Onsite Support	LS	1	75,000	$75,000	**$75,000**	Rem. Mgr., CQA Mgr., Cost/Sched., SSHO includes labor, per diem, travel
Contractor Home Office Support	LS	1	80,000	$80,000	**$80,000**	Mgmt, Engr, etc. during field work
Contractor Procurement	LS	1	35,000	$35,000	**$35,000**	Engineer's estimate
Work Plans/Reports	LS	1	75,000	$75,000	**$75,000**	Engineer's estimate
Land Use Controls						
Land Use Controls Plan	LS	1	$5,000	$5,000		Describes controls and implementation
Land Use Restrictions	LS	1	$5,000	$5,000		Legal Fees
Item Subtotal					**$10,000**	
SUBTOTAL					**$767,335**	
Contingency Costs			10%	$76,734		
TOTAL REMEDIAL ACTION COST					**$844,069**	

PERIODIC COSTS: O&M AND 5-YEAR REVIEW

	Unit	Quantity	Unit Cost	Cost	Comments
O&M	LS	1	$3,500	$3,500	Engineer's estimate to repair erosion or vegetation problems, if any
5-Year Review	LS	1	$15,000	$15,000	Site review and prepare report.
Land Use Controls	LS	1	$3,000	$3,000	Update plan.
TOTAL PERIODIC COST				**$21,500**	

TABLE 7 (Cont.)
ALTERNATIVE S6: LIMITED EXCAVATION AND FOUR-FOOT SOIL COVER
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

PRESENT WORTH ANALYSIS

Year	Remedial Action Costs	Periodic Costs	Total Annual Expenditure	Discount Factor (7%)	Present Worth
0	$844,069	$0	$844,069	1.0000	$844,069
1		$0	$0	0.9346	$0
2		$0	$0	0.8734	$0
3		$0	$0	0.8163	$0
4		$0	$0	0.7629	$0
5		$21,500	$21,500	0.7130	$15,330
6		$0	$0	0.6663	$0
7		$0	$0	0.6227	$0
8		$0	$0	0.5820	$0
9		$0	$0	0.5439	$0
10		$20,000	$20,000	0.5083	$10,166
11		$0	$0	0.4751	$0
12		$0	$0	0.4440	$0
13		$0	$0	0.4150	$0
14		$0	$0	0.3878	$0
15		$20,000	$20,000	0.3624	$7,248
16		$0	$0	0.3387	$0
17		$0	$0	0.3166	$0
18		$0	$0	0.2959	$0
19		$0	$0	0.2765	$0
20		$20,000	$20,000	0.2584	$5,168
21		$0	$0	0.2415	$0
22		$0	$0	0.2257	$0
23		$0	$0	0.2109	$0
24		$0	$0	0.1971	$0
25		$20,000	$20,000	0.1842	$3,684
26		$0	$0	0.1722	$0
27		$0	$0	0.1609	$0
28		$0	$0	0.1504	$0
29		$0	$0	0.1406	$0
30		$20,000	$20,000	0.1314	$2,628
TOTAL PRESENT WORTH					$888,000

TABLE 8
ALTERNATIVE SED3: SOIL COVER
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

REMEDIAL ACTION COSTS

	Unit	Quantity	Unit Cost	Extension	Total Cost	Comments
FIELD WORK						
Earthwork Subcontractor						
Mob/Demob						Included with Soil Alternative
Backfill ditches, Topsoil, Grade, Seed & Mulch						Use onsite borrow source
Equipment	Day	6	$2,700	$16,200		Excavator, Loader, Haul Truck, Water Truck, Pickups
Labor	Day	6	$4,200	$25,200		Engineer's estimate
Create new wetland						1 week
Equipment	Day	4	$2,700	$10,800		Excavator, Loader, Haul Truck, Water Truck, Pickups
Labor	Day	4	$4,200	$16,800		Engineer's estimate
New vegetation	LS	1	$20,000	$20,000		Engineer's estimate
Subcontractor Office Support	WK	0	$2,000	$0		Included with Soil Alterantive
Earthwork Subcontractor Subtotal					**$89,000**	
Other Subcontractors						
QAPP Laboratory						
Confirmation Sampling	Test	0	$170	$0		
Stabilization Sampling	Test	0	$475	$0		
Offsite Source Sampling	EA	0	$1,020	$0		One offsite source (topsoil)
Surveyor	LS	1	$2,500	$2,500		Engineer's estimate
Other Subcontractors Subtotal					**$2,500**	
Rented/Leased Equipment	WK	0	$2,100	$0	**$0**	Included with Soil Alternative
Materials						
Fuel	LS	1	$400	$400		Engineer's estimate
Miscellaneous	LS	1	$500	$500		Seed, Straw Bales, Silt Fence, Misc. Expendables
Close weir	LS	1	$10,000	$10,000		Engineer's estimate
Organic Fill	CY	200	$18	$3,600		Topsoil, top 3 inches
Materials Subtotal					**$14,500**	
Contractor Onsite Support	LS	0	$0	$0	**$0**	Included with Soil Alternative
Contractor Home Office Support	LS	0	0	$0	**$0**	Included with Soil Alternative
Contractor Procurement	LS	0	0	$0	**$0**	Included with Soil Alternative
Work Plans/Reports	LS	0	0	$0	**$0**	Included with Soil Alternative
Land Use Controls						
Land Use Controls Plan	LS	1	$5,000	$5,000		Describes controls and implementation
Land Use Restrictions	LS	1	$5,000	$5,000		Legal Fees
Land Use Controls Subtotal					**$10,000**	
SUBTOTAL					**$116,000**	
Contingency Costs			10%	$11,600		
TOTAL REMEDIAL ACTION COST					**$127,600**	

PERIODIC COSTS: O&M AND 5-YEAR REVIEW

	Unit	Quantity	Unit Cost	Cost	Comments
O&M	LS	1	$2,000	$2,000	Minimal site work.
5-Year Review	LS	1	$5,000	$5,000	Site review and prepare report. Majority of work would be w/Soil Alternative.
Land Use Controls	LS	1	$3,000	$3,000	Update plan. Majority of work would be with the Soil Alternative.
TOTAL PERIODIC COST				**$10,000**	

TABLE 8
ALTERNATIVE SED3: SOIL COVER
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

PRESENT WORTH ANALYSIS

Year	Remedial Action Costs	Periodic Costs	Total Annual Expenditure	Discount Factor (7%)	Present Worth
0	$127,600	$0	$127,600	1.0000	$127,600
1		$0	$0	0.9346	$0
2		$0	$0	0.8734	$0
3		$0	$0	0.8163	$0
4		$0	$0	0.7629	$0
5		$10,000	$10,000	0.7130	$7,130
6		$0	$0	0.6663	$0
7		$0	$0	0.6227	$0
8		$0	$0	0.5820	$0
9		$0	$0	0.5439	$0
10		$10,000	$10,000	0.5083	$5,083
11		$0	$0	0.4751	$0
12		$0	$0	0.4440	$0
13		$0	$0	0.4150	$0
14		$0	$0	0.3878	$0
15		$10,000	$10,000	0.3624	$3,624
16		$0	$0	0.3387	$0
17		$0	$0	0.3166	$0
18		$0	$0	0.2959	$0
19		$0	$0	0.2765	$0
20		$10,000	$10,000	0.2584	$2,584
21		$0	$0	0.2415	$0
22		$0	$0	0.2257	$0
23		$0	$0	0.2109	$0
24		$0	$0	0.1971	$0
25		$10,000	$10,000	0.1842	$1,842
26		$0	$0	0.1722	$0
27		$0	$0	0.1609	$0
28		$0	$0	0.1504	$0
29		$0	$0	0.1406	$0
30		$10,000	$10,000	0.1314	$1,314
TOTAL PRESENT WORTH					$149,000

TABLE 9
ALTERNATIVE GW2: EXTRACTION AND TREATMENT
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

REMEDIAL ACTION COSTS

	Unit	Quantity	Unit Cost	Extension	Total Cost	Comments
Land Use Controls						
Land Use Controls Plan	LS	1	$5,000	$5,000		Describes controls and implementation
Land Use Restrictions	LS	1	$5,000	$5,000		Legal Fees
Item Subtotal					**$10,000**	
TOTAL REMEDIAL ACTION COST					**$10,000**	

PERIODIC COSTS: ANNUAL TREATMENT COSTS

	Unit	Quantity	Unit Cost	Cost	Comments
O&M - Treament	LS	1	$105,000	$105,000	Based on TWISS annual estimate for 2005
Contractor Support	LS	1	$5,000	$5,000	Engineer's estimate
TOTAL PERIODIC COST				**$110,000**	

PERIODIC COSTS: ANNUAL EXTRACTION AND MAINTENANCE COSTS

	Unit	Quantity	Unit Cost	Cost	Comments
O&M - Extraction	LS	1	$86,000	$86,000	Based on TWISS annual estimate for 2005
QAPP Laboratory Sampling/Analysis					
Discharge Monitoring	LS	1	$12,295	$12,295	Based on TWISS annual estimate for 2005
Water Level Monitoring	LS	1	$1,658	$1,658	Based on TWISS annual estimate for 2005
Groundwater Monitoring	LS	1	$29,244	$29,244	Based on TWISS annual estimate for 2005
Data Validation	LS	1	$6,327	$6,327	Based on TWISS annual estimate for 2005
Reporting	LS	1	$20,000	$20,000	Engineer's estimate
Contractor Support	LS	1	$25,000	$25,000	Engineer's estimate
TOTAL PERIODIC COST				**$180,524**	

PERIODIC COSTS: 5-YEAR REVIEW

	Unit	Quantity	Unit Cost	Cost	Comments
5-Year Review	LS	1	$15,000	$15,000	Site review and prepare report.
Land Use Controls	LS	1	$3,000	$3,000	Periodic reporting, project management and annual update of plan
TOTAL PERIODIC COST				**$18,000**	

POST REMEDIAL ACTION GROUNDWATER MONITORING COSTS

	Unit	Quantity	Unit Cost	Cost	Comments
QAPP Laboratory Sampling/Analysis					
Water Level Monitoring	LS	1	$1,658	$1,658	Based on TWISS annual estimate for 2005
Groundwater Monitoring	LS	1	$29,244	$29,244	Based on TWISS annual estimate for 2005
Data Validation	LS	1	$6,000	$6,000	Based on TWISS annual estimate for 2005
Reporting	LS	1	$10,000	$10,000	Engineer's estimate
Contractor Support	LS	1	$12,500	$12,500	Engineer's estimate
TOTAL PERIODIC COST				**$59,402**	

POST REMEDIAL ACTION COSTS

	Unit	Quantity	Unit Cost	Cost	Comments
Dismantle Extraction and Treament System					
Extraction Well Abandonment	LS	3	$1,000	$3,000	Includes mobilization and demobilization costs
Monitoring Well Abandonment	LS	16	$1,000	$16,000	Includes mobilization and demobilization costs
Remove/Dismantle treatment system	LS	1	$5,000	$5,000	Engineer's estimate
Contractor Onsite Support	LS	1	$5,000	$5,000	Engineer's estimate
Contractor Home Office Support	LS	1	$20,000	$20,000	Engineer's estimate
Contractor Procurement	LS	1	$2,000	$2,000	Engineer's estimate
Reports	LS	1	$60,000	$60,000	Work Plan and Completion Report
TOTAL POST RA COST				**$111,000**	

TABLE 9 (Cont.)
ALTERNATIVE GW2: EXTRACTION AND TREATMENT
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

PRESENT WORTH ANALYSIS

Year	Remedial Action Costs	Periodic Costs	Total Annual Expenditure	Discount Factor (7%)	Present Worth
0	$10,000	$290,524	$300,524	1.0000	$300,524
1		$180,524	$180,524	0.9346	$168,718
2		$180,524	$180,524	0.8734	$157,670
3		$180,524	$180,524	0.8163	$147,362
4		$180,524	$180,524	0.7629	$137,722
5		$198,524	$198,524	0.7130	$141,548
6		$180,524	$180,524	0.6663	$120,283
7		$180,524	$180,524	0.6227	$112,412
8		$180,524	$180,524	0.5820	$105,065
9		$180,524	$180,524	0.5439	$98,187
10		$198,524	$198,524	0.5083	$100,910
11		$59,402	$59,402	0.4751	$28,222
12		$59,402	$59,402	0.4440	$26,374
13		$111,000	$111,000	0.4150	$46,065
14		$0	$0	0.3878	$0
15		$18,000	$18,000	0.3624	$6,523
16		$0	$0	0.3387	$0
17		$0	$0	0.3166	$0
18		$0	$0	0.2959	$0
19		$0	$0	0.2765	$0
20		$0	$0	0.2584	$0
21		$0	$0	0.2415	$0
22		$0	$0	0.2257	$0
23		$0	$0	0.2109	$0
24		$0	$0	0.1971	$0
25		$0	$0	0.1842	$0
26		$0	$0	0.1722	$0
27		$0	$0	0.1609	$0
28		$0	$0	0.1504	$0
29		$0	$0	0.1406	$0
30		$0	$0	0.1314	$0
TOTAL PRESENT WORTH					$1,698,000

TABLE 10
ALTERNATIVE SW2: MONITORING
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

REMEDIAL ACTION COSTS

	Unit	Quantity	Unit Cost	Extension	Total Cost	Comments
Contractor Onsite Support	LS	1	$30,000	$30,000	**$30,000**	Engineer's estimate
Contractor Home Office Support	LS	1	$40,000	$40,000	**$40,000**	Engineer's estimate
Contractor Procurement	LS	1	$5,000	$5,000	**$5,000**	Engineer's estimate
Work Plans/Reports	LS	1	$50,000	$50,000	**$50,000**	Engineer's estimate
Land UseControls						
Land Use Controls Plan	LS	1	$5,000	$5,000		Describes controls and implementation
Land Use Restrictions	LS	1	$5,000	$5,000		Legal Fees
Land Use Controls Subtotal					**$10,000**	
SUBTOTAL					**$135,000**	
Contingency Costs			10%	$13,500		
TOTAL REMEDIAL ACTION COST					**$148,500**	

PERIODIC COSTS : ANNUAL O&M

	Unit	Quantity	Unit Cost	Cost	Comments
Quarterly Surface Water Monitoring	LS	1	$15,000	$15,000	Based on TWISS annual estimate for 2005
Data Validation	LS	1	$4,000	$4,000	Engineer's estimate
Reporting	LS	1	$10,000	$10,000	Engineer's estimate
Contrator Support	LS	1	$15,000	$15,000	Engineer's estimate
TOTAL PERIODIC COST				**$44,000**	

PERIODIC COSTS : 5-YEAR REVIEW

	Unit	Quantity	Unit Cost	Cost	Comments
5-Year Review	LS	1	$15,000	$15,000	Site review and prepare report.
Land UseControls	LS	1	$3,000	$3,000	Update plan.
TOTAL PERIODIC COST				**$18,000**	

POST REMEDIAL ACTION COSTS

	Unit	Quantity	Unit Cost	Cost	Comments
Reports (Completion Report)	LS	1	60,000	$60,000	
TOTAL POST RA COST				**$60,000**	

TABLE 10 (Cont.)
ALTERNATIVE SW2: MONITORING
SITE C-2
TWIN CITIES ARMY AMMUNITION PLANT

PRESENT WORTH ANALYSIS

Year	Remedial Action Costs	Periodic Costs	Total Annual Expenditure	Discount Factor (7%)	Present Worth
0	$148,500	$0	$148,500	1.0000	$148,500
1		$44,000	$44,000	0.9346	$41,122
2		$44,000	$44,000	0.8734	$38,430
3		$44,000	$44,000	0.8163	$35,917
4		$44,000	$44,000	0.7629	$33,568
5		$62,000	$62,000	0.7130	$44,206
6		$44,000	$44,000	0.6663	$29,317
7		$44,000	$44,000	0.6227	$27,399
8		$44,000	$44,000	0.5820	$25,608
9		$44,000	$44,000	0.5439	$23,932
10		$62,000	$62,000	0.5083	$31,515
11		$44,000	$44,000	0.4751	$20,904
12		$44,000	$44,000	0.4440	$19,536
13		$44,000	$44,000	0.4150	$18,260
14		$44,000	$44,000	0.3878	$17,063
15		$62,000	$62,000	0.3624	$22,469
16		$44,000	$44,000	0.3387	$14,903
17		$44,000	$44,000	0.3166	$13,930
18		$44,000	$44,000	0.2959	$13,020
19		$44,000	$44,000	0.2765	$12,166
20		$62,000	$62,000	0.2584	$16,021
21		$44,000	$44,000	0.2415	$10,626
22		$44,000	$44,000	0.2257	$9,931
23		$44,000	$44,000	0.2109	$9,280
24		$44,000	$44,000	0.1971	$8,672
25		$62,000	$62,000	0.1842	$11,420
26		$44,000	$44,000	0.1722	$7,577
27		$44,000	$44,000	0.1609	$7,080
28		$44,000	$44,000	0.1504	$6,618
29		$44,000	$44,000	0.1406	$6,186
30		$122,000	$122,000	0.1314	$16,031
TOTAL PRESENT WORTH					$741,000

APPENDIX A

APPENDIX A

PART 3: RESPONSIVENESS SUMMARY

RESPONSIVENESS SUMMARY
FOR
RECORD OF DECISION AMENDMENT
OPERABLE UNIT 2 - SITE C-2
NEW BRIGHTON/ARDEN HILLS SUPERFUND SITE
ARDEN HILLS, MINNESOTA

OVERVIEW

This Responsiveness Summary was prepared to document and respond to issues and comments raised by the public regarding the Proposed Plan for Site C-2 within Operable Unit 2 (OU2) of the New Brighton/Arden Hills Superfund Site. The preferred alternatives and the remedies selected in the OU2 Site C-2 Record of Decision (ROD) Amendment are listed below:

- Site C-2 Shallow Soil's amended remedy includes a combination of excavating selected areas to a depth 1 to 4 feet below ground surface (bgs), backfilling/placed clean soil to create a minimum 4-foot soil cover, and implementing LUCs to protect the soil cover, to prohibit unauthorized disturbance to underlying shallow soils, and to restrict the areas without soil cover as site-specific industrial.
- Site C-2 Sediments's remedy includes backfilling the ditches with clean soil a minimum of 4 feet to create a soil cover and implementing LUCs to protect the soil cover and to prohibit unauthorized disturbance to underlying shallow soils.
- Site C-2 Groundwater's remedy involves extraction and treatment of groundwater and LUCs to protect the extraction, treatment, and monitoring systems and to prohibit water supply wells within the contaminated portion of the Unit 1 aquifer.
- Site C-2 Surface Water's remedy involves monitoring, with collection and treatment of contaminated surface water, if needed.

A public meeting was held on March 27, 2007 at 7:00 p.m. at the Twin Cities Army Ammunition Plant in Arden Hills, Minnesota to present the preferred alternatives to the public. Comments were received during the public comment period, which began on March 7 and ended on April 9, 2007.

This Responsiveness Summary documents includes the following sections:

- Background on recent community involvement,
- Summary of comments received during the public comment period and response, and
- Remaining concerns.

BACKGROUND ON RECENT COMMUNITY INVOLVEMENT

The TCAAP Restoration Advisory Board (RAB) has been involved with the discussions regarding remedies for Site C since 1996. The RAB specifically requested that the alternative with 4-feet of soil cover be considered for the shallow soils at Site C-2.

The Proposed Plan for amended remedies at OU2 was published in March 7, 2007 and describes the preferred cleanup alternatives for Site C-2. Based upon consideration of the National Oil and Hazardous Substance Pollution Contingency Plan (NCP) criteria, the appropriate remedy for Site C-2 are listed as follow:

- Site C-2, Shallow Soil — Alternative S6 – Limited Excavation and Four-Foot Soil Cover
- Site C-2, Sediment — Alternative Sed2 – Soil Cover
- Site C-2, Groundwater — Alternative GW2 – Extraction and Treatment
- Site C-2, Surface Water — Alternative SW2 – Monitoring

SUMMARY OF COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND RESPONSE

There were no oral comments received at the March 27, 2007 Public Meeting. The following written comment was received during the public comment period.

No. 1: *In a letter dated April 8, 2007, Mr. Harold Waldoch expressed his concerns about two locations of buried substandard "live" ammunition, which included .50 caliber ammunition as well as other fire arm ammunition, and one location where lead ingots were stored when the Twin Cities Ordnance Plant was operational. Mr. Waldoh noted that he witnessed the burial and storage locations when he worked at the Twin Cities Ordnance Plant and he provided a map showing these locations.*

Response Although the comment does not relate directly to the proposed amended remedies at Site C-2 and the noted locations are not in vicinity of Site C, the information will be included in the TCAAP project records and passed to the appropriate people.

REMAINING CONCERNS

Based on review of the comments received during the public meeting and public comment period, there are no outstanding issues associated with implementation of the proposed remedial actions.