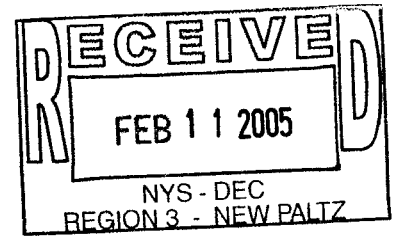


STERLING

Sterling Environmental Engineering, P.C.



FOCUSED FEASIBILITY STUDY CIRCLE M WOOD TREATING SITE

**TOWN OF FISHKILL
DUTCHESS COUNTY, NEW YORK**

NYSDEC SITE #3-14-083

Prepared For:

New York State Department of Environmental Conservation
21 South Putt Corners Road
New Paltz, New York 12561

Prepared By:

Conrad Geoscience Corp.
8 Raymond Avenue
Poughkeepsie, New York 12603

and

Sterling Environmental Engineering, P.C.
24 Wade Road
Latham, New York 12110

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FOCUSED FEASIBILITY STUDY

CIRCLE M WOOD TREATING

NYSDEC SITE #3-14-083

EXECUTIVE SUMMARY

This report is a Focused Feasibility Study (FFS) prepared by Conrad Geoscience Corp. and Sterling Environmental Engineering, P.C. for the Circle M Wood Treating (Circle M) site (NYSDEC Site #3-14-083), as stipulated by the June 27, 1997 Order on Consent.

In January 2004, AVR Realty Company of Yonkers, New York purchased the 58-acre Chelsea Industrial Park with the intention of demolishing the existing industrial buildings, including the Circle M facility, and constructing a multi-phase residential development. This FFS incorporates remedial measures consistent with the proposed project. Remediation of this site, coupled with residential development, will convert an industrial property to a use that is entirely consistent with adjacent residential land uses, and will eliminate potential exposure to metal residues left behind by the former Circle M lumber treatment business that occupied one of the buildings.

The metals copper, chromium and arsenic are present in surface soil beneath the former Circle M building and in adjacent outdoor areas that were used for storage of treated lumber. Chromium, copper and arsenic are the primary constituents of chromated copper arsenate (CCA), a lumber preservative. The Circle M lumber treatment operation resulted in spills and chronic drippage of CCA prior to 1990.

Based on the FFS analysis and intended use of the property, the recommended remedy for the Circle M site consists of soil management controls, including capping in place with soil or pavement, that will: 1) Minimize human exposure to surface soils; 2) Minimize infiltration and leaching of metals into groundwater and surface water; and 3) Stabilize surface soil to control wind erosion and dust generation. These soil management controls will be addressed in the remedial design.

Soil containing elevated concentrations of CCA will remain on-site in designated areas. In addition to capping, institutional controls will also be employed to prevent future exposure to contaminated soils. Periodic groundwater and surface water monitoring will also continue.

The proposed remedy will be designed to permanently cap contaminated surface soil beneath new pavement or clean soil. Soil capping and management measures are the appropriate remedy at Circle M because remedial actions can be incorporated into site development projects now being designed and planned. AVR proposes to cap soils known to contain chromium, copper or arsenic exceeding the site cleanup objectives established by the State, specifically: Arsenic (13 ppm); Chromium (25 ppm); Copper (25 ppm).

On-site management of contaminated soil has been endorsed by the New York State Department of Environmental Conservation for properties with significant contamination by heavy metals, such as similar wood preservation sites and orchard land. On those sites, which typically exhibit much higher concentrations of metals than are present at Circle M, contaminated soil is encapsulated under roads and parking areas, or covered so that human exposure to the soil is minimized. Such remedial measures are commonly employed,

even when the future use of the property is residential.

Current development plans call for rezoning to allow residential development and construction of a multi-phased residential development project. The initial phase will temporarily maintain the current Chelsea Industrial Park and its current tenants. As an interim remedial measure, areas of impacted soil within the industrial park will be stabilized to minimize soil erosion by storm runoff and wind. Upon successful rezoning of the property, "Phase 1" residential units will be constructed in unaffected areas of the industrial park. As existing tenants relocate, industrial buildings will be demolished and impacted soils will be capped in place with a 1-foot thick layer of clean soil, and additional (Phase 2) residential development will occur. Soil excavated for building foundations and utilities will be consolidated on-site, and covered with clean soil.

1 PREVIOUS INVESTIGATIONS

This FFS is based primarily on the results of the September 2002 Focused Remedial Investigations (FRI) report prepared by Conrad Geoscience Corp., and earlier site investigations.

1.1 Site Description & Background

Chelsea Industrial Park consists of a 58.6-acre parcel at the end of Brockway Road in the Town of Fishkill, Dutchess County, New York (Figure 1). The industrial park is located east of the railroad tracks along the east bank of the Hudson River at an elevation approximately 55 feet above mean sea level, and 50 feet above the Hudson River mean water level. The former Circle M Wood Treating facility was located within Chelsea Industrial Park, and occupied approximately 8 acres of the industrial park. Circle M operated from the eastern half of a 18,500 square foot building. For the purposes of this FFS, an area of approximately 21 acres has been designated as "the Site", which includes the former Circle M building and surrounding acreage (Figure 2).

The Circle M facility has been vacant during most of the period since 1990, and is now occupied by a pavement maintenance company. Much of the Site is covered by the Circle M building, an adjoining 90 x 150-foot concrete drip pad, paved driveways, and concrete pads. Large sections of the Site are unpaved. Concrete pads north of the Circle M building are associated with former buildings not associated with the Circle M operation.

The industrial park and surrounding lands are supplied with water from the Rombout Water District, which is supplied primarily from the City of Beacon water system.

1.1.1 Circle M Wood Treating Site

The Circle M facility was operated by Circle M Wood Treating Corp. from 1986 to 1990. Circle M was a lumber treatment business that produced pressure-treated, insect-resistant wood. The Circle M treatment process utilized chromated copper arsenate (CCA), a blend of arsenic acid (As_2O_5), chromic acid (CrO_3), and copper oxide (CuO), all in a solution of water.

While in operation, the facility was cited by the New York State Department of Environmental Conservation (NYSDEC) for repeated violations of the federal Resource Conservation & Recovery Act (RCRA). To determine whether groundwater had been affected by releases of CCA, five on-site monitoring wells were installed by the operator as a result of NYSDEC enforcement. When first sampled in 1987, none of the monitoring wells contained arsenic (As), chromium (Cr) or copper (Cu) at concentrations exceeding applicable standards. When resampled in November 1987, however, chromium exceeded groundwater standards, and copper was also detected.

In 1988 and 1989, samples collected from the uppermost 6 inches of soil on the Circle M parcel revealed that As, Cr and Cu were present at concentrations exceeding background levels (Dunn, 1989). Soil contaminants were presumed to have resulted from discharges of CCA from storage tanks or piping, and from improper outdoor storage of treated lumber, which was stored in piles at various locations on the subject property.

Circle M vacated the premises in spring 1990. At approximately that time, water mixed with CCA was released to the surface of the property. The NYSDEC responded to the spill and recovered approximately 3,000 gallons of CCA solution. Several other removal activities were conducted between 1990 and the beginning of the

Remedial Investigation/Feasibility Study (RI/FS) in 1997, including removal and recycling of more than 12,000 gallons of liquid waste recovered by NYSDEC contractors during removal and remediation activities, and more than 18,000 gallons of liquid waste stored in tanks. In addition, periodic groundwater monitoring was conducted by NYSDEC between 1990 and 1996.

1.1.2 Focused Remedial Investigation

In 1997, the NYSDEC issued an Order on Consent, which set forth requirements for the respondents to voluntarily undertake a Focused Remedial Investigation (FRI) and Focused Feasibility Study (FFS). The consent order was effective in June 1997.

Conrad Geoscience Corp. was retained to conduct the FRI, which included: 1) Installation of a monitoring well immediately south of the Circle M concrete drip pad; 2) Collection of groundwater samples from the new monitoring well and the five pre-existing on-site monitoring wells; and 3) Stream sediment sampling. Results of this work are summarized in the FRI report dated September 9, 1998 (Conrad, 1998).

The FRI report concludes that samples from the six on-site monitoring wells contain copper, chromium and arsenic at concentrations exceeding NYSDEC standards. Filtered samples from Monitoring Wells MW-1, MW-3 and MW-7 contained no detectable As, Cr or Cu, indicating that the majority of metals in groundwater are adsorbed to particulate matter. Stream sediments contained lower concentrations of As, Cr and Cu than previously measured, but the 1998 FRI concentrations still remained above NYSDEC standards.

Based on measurements of static water levels in on-site monitoring wells, local groundwater flow is to the southeast, toward the small stream that runs along the eastern boundary of Chelsea Industrial Park.

1.1.3 Supplemental Field Investigations

In January 1999, Conrad Geoscience was authorized by NYSDEC to begin the Focused Feasibility Study. In a letter from NYSDEC dated January 29, 1999, it was stipulated that additional field investigations should be completed as part of the FFS. Supplemental field investigations included: 1) Soil sampling and analysis to delineate the vertical distribution of As, Cr and Cu within the uppermost 6 feet of soil; and 2) Completion of a Biological Resource Inventory & Impact Assessment to determine whether on-site receptors, including stream flora and fauna, show signs of impact from metals. Results of these field investigations are summarized in the draft FFS dated October 1999.

In April 2000, NYSDEC requested additional sampling, including areas not previously sampled (under the Circle M floor and all outdoor lumber storage areas). Conrad Geoscience developed an expanded FRI sampling plan. This Supplemental RI work plan was approved by NYSDEC on April 26, 2001. In May 2001, Conrad Geoscience completed additional sampling and analysis of soil, stream sediments and groundwater, concentrating on outdoor lumber storage areas as well as soil and groundwater quality directly beneath the Circle M building. Results of these field investigations are summarized in the Supplemental RI report dated July 6, 2001. Following review of the FRI report, NYSDEC issued a letter dated July 23, 2001 directing that the FFS be prepared. The FFS was submitted to NYSDEC in September 2001 and revised in December 2001.

The NYSDEC subsequently indicated that additional soil sampling would be necessary in order to more fully delineate the area of Chelsea Industrial Park affected by past releases of chromated copper arsenate (CCA). In

response to that request, Conrad Geoscience conducted two rounds of additional soil sampling and analysis in February and April 2002: GB-27 through GB-60, and GB-61 through GB-71, respectively. These samples were collected from in and near known outdoor lumber storage areas to determine whether residual copper, chromium or arsenic were present in shallow soils. Samples were collected from four discrete depths within the upper 2 feet of soil: 0-6 inches, 6-12 inches, 12-18 inches, and 18-24 inches. Each sample was analyzed for total copper, chromium and arsenic.

1.1.3.1 Results of Supplemental Soil Sampling

Surficial material consists primarily of fill from 0 to 4 feet below grade, including crushed rock fragments, cobbles, bricks, and wood debris. Soils below the fill material consist of dense gray clay with some mottling, and no sand.

Metal concentrations in soil were originally compared to site background levels established by Leggett, Brashears and Graham (LBG) in 1987 and by Dunn Geoscience (DGC) in 1989 using the higher of differing background values for each metal: Copper background = 35 ppm; Chromium background = 23 ppm; Arsenic background = 25 ppm. More recently, NYSDEC has established the following cleanup objectives for the Site's on-site soils: Copper = 25 ppm; Chromium = 25 ppm; and Arsenic = 13 ppm.

Based on soil results to date, copper, chromium and arsenic are present beneath the former Circle M building and in outdoor lumber storage areas at concentrations exceeding cleanup objectives.

Excluding soil beneath the Circle M building, the footprint of maximum contaminated soil is an area approximately 52,000 square feet, including and surrounding the concrete drip pad that adjoins the building. Of 12 soil samples submitted for TCLP analysis from the 2 - 4 foot horizon, only one sample contained detectable target metals, and none exceeded the maximum contaminant level. Based upon these reported concentrations, the soil does not exceed the threshold for classification as hazardous waste.

Of the four soil sample locations inside the Circle M building, three locations contain elevated arsenic, chromium or copper at depths of 6 to 24 inches, indicating that CCA solution was discharged into the ground through the floor of the Circle M plant. Seepage could have occurred through cracks in the concrete floor, or may be attributable to leakage from drain pipes or sub-floor pits. Releases from the Circle M building may explain the elevated concentrations of arsenic, chromium and copper in Monitoring Wells MW-1 (west of the building) and MW-8 (inside the building.)

Many of the soil samples collected from outside the footprint of the Circle M building contain elevated chromium, arsenic and copper. Most sample locations exhibiting elevated metals are within former outdoor lumber storage areas or adjacent to paved access roads, and most of these exceedences occur within the upper 12 inches of soil, although metals persist to a depth of 24 inches in some sample locations. Metals may have been transported to the identified outlying locations via windborne deposition, surface water runoff, or vehicle tires.

Groundwater flow is toward the un-named stream and away from the Hudson River. Contribution of metals to the streambed through base flow is likely. Other contributions to the stream may be attributable to past discharges via drainage pipes and surface runoff.

Surface water in the stream appears to have been unaffected by releases of CCA at the Circle M facility. Stream sediments exhibit measurable, but not severe, effects.

1.1.3.2 Biological Resource & Impact Assessment

In May and July, 1999, Matthew D. Rudikoff Associates, under contract to Conrad Geoscience, conducted a Biological Resource Inventory and Impact Assessment at the former Circle M site. There is no gross morphological evidence or other indications of environmental stress to site flora and fauna. Cover types on the subject property are indistinguishable from those observed elsewhere on uncontaminated but similarly open, chronically disturbed, compacted gravel fill areas devoid of topsoil. Stream biota are not considered to have been affected by release of metal contaminants from the former Circle M facility. There is no evidence of a substantial difference in macrobenthic invertebrate diversity. All aquatic biota examined were normal in external appearance and movement. There is nothing in the appearance, diversity or condition of site biota that would indicate an adverse effect from metal contaminants in soil, sediment and groundwater samples at the subject property.

1.2 Contaminant Mobility

Chromium, arsenic and copper are present in Circle M soils at concentrations moderately exceeding established site cleanup objectives. Total metal concentrations (the sum of chromium, arsenic and copper) were most elevated in shallow soil samples collected from 0 - 0.5 feet and 0 - 2 feet below grade; from beneath the former drip pad; and immediately adjacent to the drip pad. Samples collected from 2-4 and 4-6 feet below grade contained slightly elevated concentrations of chromium and copper, but not arsenic. TCLP results for these samples did not indicate that metals have the potential to leach into groundwater beneath the site. Locally, groundwater flows toward the adjacent stream, and, presumably, discharges upward through the bed of the stream.

1.3 Exposure Analysis

Arsenic, chromium and copper are the contaminants of concern addressed in this FFS. The human health risk associated with these metals depends upon the potential for a person to be exposed to soil or groundwater containing the metals of concern. Exposure can only occur when a mechanism, or exposure pathway, exists.

At the Circle M site, there are three affected media that represent potential exposure risks: 1) Surface and subsurface soil; 2) Groundwater; and 3) Stream sediments. There are few pathways by which human exposure is possible. Potential exposure pathways are summarized in Table 1, and are further evaluated below.

Of the affected media and routes of exposure identified, only exposure to soil indicates a significant potential risk. Groundwater, while known to contain metals at elevated concentrations in certain on-site monitoring wells, is not known to have been impacted off-site. Further, groundwater beneath the Circle M site is not used for drinking or any other purpose, thus eliminating the potential for exposure to humans. Although two supply wells (Wells #13 and #16) of the Rombout Water District are present on lands east of Chelsea Industrial Park, these wells are no longer in use, and the Rombout distribution system has been connected to the City of Beacon water supply. The Rombout District wells, therefore, neither influence groundwater flow nor represent a potential route of metals exposure to residents. A well search revealed no other supply wells within a quarter mile radius of the Circle M facility. Significantly, water samples collected from the Rombout water system in

April 1999 did not contain detectable concentrations of arsenic or chromium. Copper was detected, but was well below the drinking water standard.

Stream sediment samples collected from midstream and downstream locations contain elevated concentrations of metals, presumably introduced via overland runoff and/or base flow. This stream segment, however, is not used recreationally, nor do on-site workers come into contact with stream sediments. Access to the stream is further restricted by fencing installed and maintained by the Town of Fishkill on the east side of the stream. Further, the Biological Inventory & Impact Assessment report concludes that sensitive stream biota show no signs of adverse impact from metals present in stream sediments.

For these reasons, on-site soil is the only affected medium included in the screening and evaluation of remedial alternatives. In Table 1, two soil exposure pathways are identified: 1) Ingestion or inhalation of contaminated soil or dust by on-site workers; and 2) Ingestion, inhalation, or dermal contact with contaminated soil or dust by future on-site construction workers.

2 REMEDIAL ACTION OBJECTIVES

The regulatory goal specified in 6 NYCRR Part 375 is to return the site to predisposal conditions, to the extent feasible. In this case, the remedial action will focus upon the identified substances of concern, CCA.

Remedial action objectives developed for the Circle M site reflect results of the FRI and applicable regulatory requirements and guidance, resulting in the establishment of site specific cleanup objectives. Remedial objectives are selected that will be protective of human health and the environment.

2.1 Remedial Goals

The Circle M remedial action objectives are as follows:

- 1) Minimize exposure (inhalation, ingestion, and dermal contact) to soils containing unacceptable levels of arsenic, chromium and copper.
- 2) Prevent degradation of off-site groundwater and stream quality resulting from movement of metals from soil into groundwater and surface water.
- 3) Stabilize surface soil to control wind erosion and dust generation.

2.2 Applicable or Relevant and Appropriate Requirements (ARARs)

Applicable requirements are defined as cleanup standards or standards of control that specifically address a hazardous substance or contaminant detected at a New York State inactive hazardous waste disposal site. NYSDEC defines applicable requirements as all Standards, Guidance and Criteria (SGCs) relevant to the site remedial alternatives. *Relevant and appropriate* requirements are Federal or state requirements that, while not applicable, address problems sufficiently similar to those encountered at CERCLA sites that their application is appropriate.

In addition to ARARs and SGCs, other Federal, state, and local criteria, advisories, or guidances may also apply to the conditions found at the site, and are known as *to-be-considered* (TBC) items. TBCs are not legally binding, but may be useful for assessing site risks and selecting site cleanup goals.

Chemical-specific ARARs provide guidance on acceptable or permissible contaminant concentrations in soil, air and water (Table 2).

2.2.1 Chemical-Specific ARARs and TBCs

New York State Groundwater Standards have been promulgated by NYSDEC and apply to Class GA groundwater, which underlies the site and vicinity: The best usage of Class GA waters is as a source of potable water supply. Class GA waters are fresh groundwaters found in the saturated zone of unconsolidated deposits and consolidated rock or bedrock. Class GA groundwater standards are equivalent to the maximum contaminant levels (MCLs) established by NYSDOH for public drinking water supplies, and are published in the New York Code of Rules and Regulations (NYCRR) Title 10 Chapter I (State Sanitary Code) Subpart 5-1. Class GA standards for the Circle M metals of concern are: Arsenic (25 ppb); Chromium (50 ppb); and Copper (200 ppb).

New York State Recommended Soil Cleanup Objectives are TBCs published by the NYSDEC in Technical and Administrative Guidance Memorandum (TAGM #4046) [NYSDEC 1994]. This guidance outlines the basis and procedure for determining soil cleanup levels at inactive hazardous waste sites. The cleanup objectives apply to unsaturated soils above the water table.

The Occupational Safety and Health Administration (OSHA) has promulgated *permissible exposure limits* (PELs) for workers for a variety of contaminants in the air (29 CFE 1910, Subpart Z). The PELs are *time-weighted average* (TWA) concentrations to which workers may be exposed over an 8-hour exposure period without adverse health effects. PELs and TWAs are intended for adult workers exposed in an occupational setting and are not directly applicable to CERCLA or New York inactive hazardous waste sites. The PELs and TWAs may be used as guidance values to determine whether long-term exposures to contaminants in air pose a potential human health risk.

The National Institute for Occupational Safety and Health (NIOSH) has developed concentrations for contaminants in the air that are *immediately dangerous to life or health* (IDLH) for individuals in occupational settings. The IDLH is the maximum concentration, in the event of respirator failure, that could be tolerated for 30 minutes without experiencing irreversible health effects. The IDLHs are appropriate only for subchronic exposures to noncarcinogenic compounds or effects of compounds in air. These values are not directly applicable to CERCLA or inactive hazardous waste sites; however, they may provide guidance regarding on-site workers. NIOSH also has *recommended exposure limits* (RELs) for each COC. An REL is generally a 10-hour time-weighted average based on toxicological and industrial hygiene data.

The American Conference of Governmental Industrial Hygienists (ACGIH) has developed threshold limit values (TLVs) for occupational settings. The TLV is a time-weighted average concentration of contaminant under which most people can work consistently for 8 hrs per day, day after day, and avoid harmful effects.

2.2.2 Action-Specific ARARs and TBCs

The Resource Conservation and Recovery Act (RCRA) and the *New York State Hazardous Waste Regulations* deal with the treatment and disposal methods of hazardous wastes. Wastes generated on the site must be handled in accordance with the Federal hazardous waste regulations (40 CFR Part 260-268) promulgated under RCRA as well as New York State Hazardous Waste Regulations (6 NYCRR Parts 370-376), if applicable. Disposal to off-site landfills shall be in accordance with Federal and state land disposal restrictions. Determination of the presence and appropriate waste code for any hazardous wastes at the site will be made in accordance with 6 NYCRR Part 371 (Identification and Listing of Hazardous Wastes). If soils need to be removed from the site as hazardous, they will be assigned an appropriate waste classification based on the waste characterization analysis.

6 NYCRR Part 375 describes general provision for inactive hazardous waste disposal sites and remediation thereof. This regulation describes the procedure for conducting *Interim Remedial Measures (IRMs)*.

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), specifically Section 121, Subsections 104 and 106, states that the selected remedial alternative must attain a cleanup level that is protective of human health and the environment.

EPA Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA/540/G-89/004) establishes the methodology that the Superfund program has set up for characterizing the nature and extent of the risks posed by uncontrolled hazardous wastes sites and for evaluating potential remedial options. This TBC would apply if the site were to become an EPA Superfund-listed site.

2.2.3 Site Specific Action Levels

Future use of the property may be considered in developing site-specific action levels. The aforementioned NYS Recommended Soil Cleanup Objectives establishes cleanup guidance values which assume future use with a high likelihood of human exposure, which is appropriate for the future conversion of the property from light industrial to residential.

3 REMEDIAL TECHNOLOGY SCREENING PROCESS

An initial screening is performed to develop a list of potentially applicable remedial technologies applicable to site conditions, contaminants, and contaminated media. Applicable technologies undergo a detailed analysis of alternatives.

3.1 Identification & Screening of Technologies

The screening of technology types and process options is discussed below. This screening was based on the criteria of effectiveness for treating impacted soils, and implementability.

3.1.1 Source Controls

Controls to prevent the continued migration of contaminants from source soils include institutional measures, containment, in-situ treatment, removal, on-site treatment, and disposal. These general response actions and the applicable technology types are described below.

Institutional Measures for addressing soil contamination can include use restrictions and deed restrictions to reduce the possibility of human contact with contaminants. Fencing may deter unauthorized access to contaminated soil/source areas on the site. Signs can be placed on the site to warn utility and construction workers of the contaminated soil and advise calling NYSDEC prior to excavation. Deed restrictions will provide notice to prospective owners that certain uses and/or development of the site may be restricted without further remedial action, in the event the property should be transferred in the future.

Containment of contaminated soils in place will minimize human contact through capping. Much of the site is already paved or covered by buildings. Pavement will divert precipitation away from the contaminated area and reduce infiltration, reducing potential for contaminant leaching into groundwater.

In Situ Treatment technologies include biological, thermal, and physical/chemical treatment processes. Many of these processes are innovative technologies, with unproven effectiveness for sites such as Circle M. As a result, the need for treatability or pilot-scale studies often makes these technologies less economically feasible.

Excavation & Removal of contaminated surficial soil can be accomplished with conventional equipment.

On-site Treatment of contaminated soils is sometimes employed, but is usually only economically feasible if large quantities of soil require treatment.

Disposal options for soil excavated from the Circle M site include on-site consolidation and capping.

3.2 Development of Remedial Alternatives

In accordance with NYSDEC's TAGM HWWR-89-4025, Guidelines for Remedial Investigations/Feasibility Studies (NYSDEC 1989) and HWR- 90-4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites (NYSDEC 1990), preliminary alternatives are evaluated against the criteria of effectiveness and implementability. The development and selection of remedial alternatives which address the New York State and NCP requirements of feasibility studies are presented below.

Alternative 1 is the No Further Action alternative, which will allow contaminated soil at the Circle M site to be left in place. No monitoring of groundwater contaminants will be conducted in the future. This alternative might necessitate institutional controls, such as groundwater and land use restrictions, to minimize human contact with contaminated media. Signs can be posted to warn construction or utility workers to contact NYSDEC before excavating.

Existing pavement and buildings will act as a cap by diverting water away from some areas of contaminated soil, thereby reducing infiltration of surface water.

Alternative 2 consists of Capping and Institutional Controls. Such measures can be incorporated into the design of the proposed development project.

In summary, the initial phase of the project will involve remediation of the site by consolidation, paving or placement of a soil layer over impacted portions of the site. Subject to successful rezoning of the site, construction of the first phase of residential units will commence in unaffected areas. This development area is outside the identified extent of CCA contamination. Prior to residential construction, the CCA impacted soils in the vicinity of the Circle M facility will be stabilized to control erosion by wind and storm water runoff.

Following completion of initial site development, a subsequent phase will include further consolidation and capping of the CCA impacted soil in conjunction with the development of additional residential units. Soil excavated for placement of building foundations and utilities will be consolidated in a designated area on site, and capped. All other surficial soils exceeding cleanup objectives will be capped in place with a 1-foot thick layer of clean soil.

Covering the identified soil contamination with pavement, clean soil or other materials, combined with appropriate stormwater runoff controls, will: 1) Minimize potential contact with contaminated surface soil by on-site workers; 2) Minimize leaching of metals by preventing infiltration of precipitation and stormwater; and 3) Stabilize surface soil to control wind erosion and dust generation.

Under this remedy, all soil exceeding the action level will be covered in-place by clean soil (a 12-inch minimum thickness), asphalt pavement or other material. Paved areas would be used as parking lots and roadways. The Circle M floor slab will remain in place and significant cracks will be sealed, effectively capping contaminated soil. Capping will minimize contact with contaminated soil, and the pavement will be an effective barrier to infiltration of water into underlying soil. Drainage controls will be employed to divert stormwater from coming into contact with contaminated soil. Groundwater use restrictions will be implemented, and deed restrictions will disallow or restrict future construction or other disturbance within designated areas of the site without prior approval of NYSDEC. This alternative also includes ongoing monitoring of on-site groundwater twice annually for at least 2 years.

Two types of institutional controls will be implemented to further reduce contact with contamination: 1) Groundwater use restrictions that would prevent future withdrawal and use of on-site groundwater; and 2) Deed restrictions that would disallow future construction or other disturbance within the capped area without prior approval of NYSDEC.

Alternative 3 includes excavation and off-site disposal of contaminated soil, which will prevent continued leaching of contaminants to groundwater. Soil would be removed to a depth of 2 feet in the identified excavation area. Contaminant concentrations and leachability below this depth have been shown to be within acceptable limits over most of the site. The Circle M floor slab and underlying soil would remain in place.

Excavation would be conducted using conventional earthmoving equipment, such as backhoes, excavators and front-end loaders. For cost estimating purposes, it is assumed that post-excavation samples would be collected from the bottom of the excavation at the rate of two samples per acre. The samples would be analyzed for arsenic, chromium and copper. The excavation would be backfilled with suitable clean fill material, then left unpaved.

This alternative would also include long-term groundwater monitoring. The Circle M building would require institutional controls to prevent future disturbance or exposure to contaminated soils remaining on site.

Alternative 4 includes treatment of contaminated soil in place (in situ). A variety of in situ treatment technologies have been developed for soils contaminated with metals. Under this approach, metals-contaminated soil would remain in place, and one or more of four soil treatment approaches would be employed: 1) electrokinetic remediation; 2) phytoremediation; 3) soil flushing; and 4) solidification/stabilization.

Electrokinetic techniques rely on the application of low-intensity direct current between electrodes placed in the soil, which mobilizes charged ions, causing them to move toward the electrodes, where they are removed and subsequently treated above ground. Most experience with this technology is limited to bench and pilot scale studies. Because of limited performance data for electrokinetic remediation for metals, and because inadequate soil moisture in the vadose zone can limit its effectiveness, this approach is not considered a viable alternative for the Circle M site.

Phytoremediation techniques include both *phytoextraction*, which relies on uptake of metals and subsequent harvesting, and *phytostabilization*, which relies on plant secretions that form metal complexes with reduced solubility. Phytoremediation for all of the Circle M metals (copper, chromium and arsenic) have not been adequately developed, and for these reasons, phytoremediation is not considered a viable alternative for the Circle M site.

Soil flushing involves extraction of metals from soil using water or other suitable aqueous agents. Leached contaminants are typically recovered from the underlying groundwater via pump-and-treat methods.

Solidification and stabilization involves changes to the physical or chemical properties of the soil in order to immobilize contaminants.

The stabilization technique potentially appropriate for this site utilizes cement dust and/or coal ash, which is spread on and disked into the surficial soil in contaminated areas. The introduction of these materials into the soil reduces the pH of the soil and binds the metals within the soils matrix.

This treatment option may be used for the entire site or, in the case of proposed development projects, may be used in any areas not being considered for roadways, parking areas or buildings.

Alternative 4 would also include long-term groundwater monitoring. The Circle M building and areas designated for in situ treatment might require institutional controls to prevent future disturbance to contaminated soils remaining on site.

Alternative 5 consists of consolidation and capping of outdoor lumber storage areas combined with sub-floor soil excavation and off-site disposal of contaminated soil beneath the Circle M floor slab. Soil exceeding the site specific cleanup objectives would be covered with asphalt pavement or covered with soil, as described in Alternative 2. Before disturbance of the interior floor slab, a soil boring and sampling program would be completed within the footprint of the building to delineate the lateral and vertical extent of residual metals in underlying soils. Depending on the results of sampling, up to 4,000 cubic yards of soil would be removed to a maximum depth of 12 feet from designated areas beneath the floor of the Circle M building to ensure that the

most contaminated soil is removed from beneath former wood treatment areas.

Alternative 6 consists of excavation and off-site disposal of contaminated soil, including sub-floor soil beneath the Circle M building. Alternative 6 includes excavation and off-site disposal of all soil exceeding the site specific cleanup objectives, which would prevent continued leaching of contaminants to groundwater. Soil would be removed to a depth of 2 feet. Contaminant concentrations and leachability below this depth have been shown to be within acceptable limits. Before disturbance of the interior floor slab, a soil boring and sampling program would be completed within the footprint of the building to delineate the lateral and vertical extent of residual metals in underlying soils. Up to 4,000 cubic yards of soil would be removed to a maximum depth of 12 feet from designated areas beneath the floor of the Circle M building to ensure that the most contaminated soil is removed from beneath former wood treatment areas.

4 DETAILED EVALUATION OF ALTERNATIVES

This section presents an evaluation of the remedial alternatives described in Section 3. The purpose of the evaluation is to identify the advantages and disadvantages of each alternative as well as key trade-offs among the alternatives. The criteria used to evaluate the alternatives are specified in the EPA guidance (EPA 1988), which is accepted by the NYSDEC, and are as follows:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility and Volume Through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

Community and State acceptance are also considered after public comments have been received on the focused RI/FS report and proposed remedial action plan. The Record of Decision (ROD) for the site will address community and State acceptance.

4.1 Individual Analysis of Alternatives

4.1.1 Alternative 1: No Further Action

Protection of Human Health and the Environment. The potential exposure to groundwater via drinking water wells has been eliminated with the connection of the Rombout Water District system to the City of Beacon municipal water system. Alternative 1 is protective of human health through the use of institutional measures (groundwater use restrictions) to prevent human contact with the contaminants that will remain at the site and in the groundwater; however, the potential for human exposure to the soil contaminants will remain. Remaining contaminants in surface soil may be inhaled or directly contacted by workers that excavate in this area.

Compliance With ARARs. Chemical-specific ARARs and TBCs for the site, including the New York State soil cleanup objectives and the class GA groundwater standards, will not be achieved.

Long-Term Effectiveness and Permanence. As the no-further-action alternative, Alternative 1 does not provide a high degree of long-term effectiveness and permanence.

Reduction of Toxicity, Mobility and Volume Through Treatment. Implementation of Alternative 1 will not result in a reduction of toxicity, mobility or volume of contamination present at the site.

Short-Term Effectiveness. As the no action alternative, Alternative 1 does not provide a high degree of short-term effectiveness.

Implementability. If institutional controls are implemented, such as groundwater use restrictions, implementability would be relatively straightforward.

Cost. Estimated capital and long-term O&M costs for Alternative 1 are presumed to be zero.

4.1.2 Alternative 2: Consolidation, Capping and Institutional Controls

Protection of Human Health and the Environment. Alternative 2 will eliminate the most direct exposure by placing a permanent soil and/or paved cap over contaminated surface soil. The cap would also be protective of groundwater by preventing stormwater from coming into contact with underlying impacted soils. Alternative 2 is further protective of human health through the use of groundwater use restrictions and deed restrictions to prevent human contact with contaminants that will remain at the site and in the soil and groundwater.

Compliance With ARARs. Chemical-Specific ARARs and TBCs for the site, including the New York State soil cleanup objectives and the Class GA groundwater standards, will not be achieved for unrestricted use where the highest and best use is residential. Site specific cleanup objectives set forth by NYSDEC are expected to be protective of human health and the environment.

Long-Term Effectiveness and Permanence. Alternative 2 provides a high degree of effectiveness and permanence. Institutional controls would ensure that the capped areas and drainage controls are properly maintained, and would prevent future disturbance or construction within the capped area without prior approval of NYSDEC.

Reduction Of Toxicity, Mobility and Volume Through Treatment. Alternative 2 will reduce mobility of subsurface metals by reducing infiltration of water. Impacted surficial soils will also be prevented from erosion by wind and water.

Short-Term Effectiveness. Alternative 2 would be immediately effective, in that the potential for worker exposure to surface soil would be eliminated. Soil disturbance at this site could temporarily result in potential adverse health effects for on-site workers through the generation of contaminated dust and metals emission. Controls would be implemented during the excavation phase to reduce the risk of exposure to contaminants.

Implementability. Alternative 2 is easily implemented. Implementation of remedial measures can be incorporated into future construction. Paving and capping will be done in accordance with municipal codes. Water use restrictions and deed restrictions will be arranged by the owner through the NYSDEC.

Cost. Estimated capital costs for Alternative 2 are presented in Table 3. Long-term monitoring and

maintenance costs include pavement maintenance and groundwater monitoring.

4.1.3 Alternative 3: Soil Excavation and Off-Site Disposal

Protection of Human Health and the Environment. Alternative 3 includes remediation through excavation and off-site disposal of contaminated soils and monitoring groundwater in on-site monitoring wells. This alternative will reduce further leaching of metals into groundwater, and will eliminate the potential health risk posed by human contact with contaminated soil. A major drawback of excavation is the potential exposure of on-site workers and remediation personnel to metals via ingestion and inhalation of airborne dust during excavation, loading and off-site transport. Site access and egress are via Brockway Road, which passes through a residential neighborhood. There is also a high potential for spread of metals via soil erosion. Appropriate measures must be incorporated into any excavation/disposal work plan to prevent human exposure.

For groundwater, Alternative 3 is protective of human health through the use of institutional measures to reduce human contact with the contaminants in groundwater. Long-term ground water monitoring is included in this alternative to assess whether contaminants are moving off-site.

Compliance With ARARs. By removing contaminated soil from the site, Alternative 3 would achieve chemical-specific ARARs and TBCs, including New York State soil cleanup objectives in those areas where soil is excavated. Although some improvement in local groundwater quality may be expected under Alternative 3, Class GA groundwater standards will probably not be achieved.

Long-Term Effectiveness and Permanence. Alternative 3 provides a high degree of effectiveness and permanence.

Reduction of Toxicity, Mobility, and Volume Through Treatment. Alternative 3 will reduce the volume of contaminated soil by virtually 100% in those areas which are excavated.

Short-Term Effectiveness. Alternative 3 would be immediately effective, in that the potential for human exposure to surface soil would be eliminated. Soil excavation at the site during remediation could temporarily result in potential adverse health effects for on-site workers through the generation of contaminated dust and metals emission. Controls would be implemented during the excavation phase to reduce the risk of exposure to contaminants.

Implementability. Excavation and backfilling are commonly applied technologies at hazardous waste sites and do not require special equipment or operators. However, off-site transport of excavated wastes may not be feasible given current market conditions. Recent canvassing of permitted facilities in southern New York indicate that only the Sullivan County Landfill is operating. However, the Sullivan County Landfill is operating at its permitted daily capacity and cannot accept new customers. Until additional disposal capacity becomes available in southern New York, this alternative does not appear feasible. Institutional controls for groundwater use restrictions may be established by the owner in consultation with the NYSDEC. Long-term groundwater monitoring and sampling are also readily accomplished.

Cost. Estimated capital costs for Alternative 3 are presented in Table 4. Long-term monitoring and maintenance costs include groundwater monitoring.

4.1.4 Alternative 4: In Situ Soil Treatment

Protection of Human Health and the Environment. This alternative will reduce further leaching of metals into groundwater, and will eliminate the potential health risk posed by human contact with contaminated soil. Phytoextraction techniques could lead to ingestion of contaminated plants by herbivores. Applicability of soil flushing is site specific, and is not applicable on sites where contamination might spread via groundwater movement.

For groundwater, Alternative 4 is protective of human health through the use of institutional measures to reduce human contact with the contaminants in groundwater. Long-term ground water monitoring is included in this alternative to assess whether contaminants are moving off-site.

Compliance With ARARs. Because most in situ remediation techniques do not remove metals from the soil, it is questionable whether Alternative 3 would achieve chemical-specific ARARs and TBCs, including New York State soil cleanup objectives. Although some improvement in local groundwater quality may be expected under Alternative 4, Class GA groundwater standards will probably not be achieved.

Long-Term Effectiveness and Permanence. Long-term effectiveness and permanence for most in situ remediation techniques are unproven or inconclusive and would need bench and pilot scale studies.

Reduction of Toxicity, Mobility, and Volume Through Treatment. Alternative 4 is designed to significantly reduce the mobility of contaminated soil. The toxicity may not be significantly reduced. Volume will not be reduced.

Short-Term Effectiveness. Alternative 4 would be immediately effective, in that the potential for metal mobility would be significantly reduced. Exposure to soils during remediation could temporarily result in potential adverse health effects for on-site workers through the generation of contaminated dust and metals emission. Controls would be implemented during the excavation phase to reduce the risk of exposure to contaminants.

Implementability. Most in situ remediation techniques have not been available commercially for very long. Because all in situ methods are highly site-specific, bench or pilot scale tests would precede full-scale remediation. This would significantly delay the remediation of the site.

Institutional controls for groundwater use restrictions may be established by the owner in consultation with the NYSDEC. Long-term groundwater monitoring and sampling are also readily accomplished.

Cost. Estimated capital costs for stabilization vary with cleanup objective. Table 5 presents the cost for remediation to site background conditions. Long-term monitoring and maintenance costs include groundwater monitoring.

4.1.5 Alternative 5: Consolidation, Capping, Sub-Floor Soil Excavation and Off-Site Disposal Removal

Protection of Human Health and the Environment. Alternative 5 will eliminate the most direct exposure by placing clean soil or a permanent, paved cap over contaminated surface soil. This alternative also includes excavation and off-site disposal of an additional 4,000 cubic yards (6,000 tons) of contaminated soil that may be present beneath the floor of the Circle M building. The cap would also be protective of groundwater by restricting stormwater from coming into contact with underlying metals. Removal of pockets of more highly contaminated soil from beneath the building floor may further protect groundwater quality. Alternative 5 is further protective of human health through the use of groundwater use restrictions and deed restrictions to prevent human contact with contaminants that will remain at the site and in the soil and groundwater.

A major drawback of excavation is the potential exposure of on-site workers and remediation personnel to metals via ingestion and inhalation of airborne dust during excavation, loading and off-site transport. Site access and egress are via Brockway Road, which passes through a residential neighborhood. Appropriate measures must be incorporated into any excavation/disposal work plan to prevent human exposure.

Long-term ground water monitoring is included in this alternative to assess whether contaminants are moving off-site.

Compliance With ARARs. Chemical-Specific ARARs and TBCs for the site, including the New York State soil cleanup objectives and the Class GA groundwater standards, will not be achieved for unrestricted use where the highest and best use is residential. By removing contaminated soil from the site, Alternative 5 would achieve chemical-specific ARARs and TBCs, including New York State soil cleanup objectives in those areas where soil is excavated. Although some improvement in local groundwater quality may be expected under Alternative 5, Class GA groundwater standards will probably not be achieved.

Long-Term Effectiveness and Permanence. Alternative 5 provides a high degree of effectiveness and permanence. Institutional controls would ensure that the encapsulated areas and drainage controls are properly maintained, and would prevent future disturbance or construction within the capped area.

Reduction Of Toxicity, Mobility and Volume Through Treatment. Alternative 5 will reduce mobility of subsurface metals by reducing infiltration of water. Impacted surficial soils will also be prevented from erosion by wind and water. Alternative 5 will reduce the volume of contaminated soil by virtually 100% in those areas which are excavated.

Short-Term Effectiveness. Alternative 5 would be immediately effective, in that the potential for worker exposure to surface soil would be eliminated. Soil disturbance at this site could temporarily result in potential adverse health effects for on-site workers through the generation of contaminated dust and metals emission. Controls would be implemented during the excavation phase to reduce the risk of exposure to contaminants. Soil excavation at the site during remediation could temporarily result in potential adverse health effects for on-site workers through the generation of contaminated dust and metals emission. Controls would be implemented during the excavation phase to reduce the risk of exposure to contaminants.

Implementability. Alternative 5 is easily implemented. A new residential project is now being planned. The proposed remedy will be integrated into redevelopment of the property, however implementation cannot

proceed until all necessary approvals have been obtained, including site plan approval from the Town of Fishkill. Paving will be done in accordance with municipal codes. Water use restrictions and deed restrictions will be arranged by the owner through the NYSDEC.

Excavation and backfilling are commonly applied technologies at hazardous waste sites and do not require special equipment or operators. However, off-site transport of excavated wastes may not be feasible given current market conditions. Recent canvassing of permitted facilities in southern New York indicate that only the Sullivan County Landfill is operating. However, the Sullivan County Landfill is operating at its permitted daily capacity and can not accept new customers. Until additional disposal capacity becomes available in southern New York, this alternative does not appear feasible. Long-term groundwater monitoring and sampling are also readily accomplished.

Cost. Estimated capital costs for Alternative 5 vary with cleanup objective. Table 6 summarizes costs to remediate to site background. Long-term monitoring and maintenance costs include pavement maintenance and groundwater monitoring.

4.1.6 Alternative 6: Excavation, Off-Site Disposal and Sub-Floor Soil Removal

Protection of Human Health and the Environment. Alternative 6 includes remediation through excavation and off-site disposal of contaminated soils and monitoring groundwater in on-site monitoring wells. As an expanded version of Alternative 3, this alternative includes excavation and off-site disposal of an additional 4,000 cubic yards (6,000 tons) of contaminated soil that may be present beneath the floor of the Circle M building. This alternative will reduce further leaching of metals into groundwater, and will eliminate the potential health risk posed by human contact with contaminated soil. A major drawback of excavation is the potential exposure of on-site workers and remediation personnel to metals via ingestion and inhalation of airborne dust during excavation, loading and off-site transport. Site access and egress are via Brockway Road, which passes through a residential neighborhood. There is also a high potential for spread of metals via soil erosion. Appropriate measures must be incorporated into any excavation/disposal work plan to prevent human exposure.

For groundwater, Alternative 6 is protective of human health through the use of institutional measures to reduce human contact with the contaminants in groundwater. Long-term ground water monitoring is included in this alternative to assess whether contaminants are moving off-site.

Compliance With ARARs. By removing contaminated soil from the site, Alternative 6 would achieve chemical-specific ARARs and TBCs, including New York State soil cleanup objectives in those areas where soil is excavated. Although some improvement in local groundwater quality may be expected under Alternative 6, Class GA groundwater standards will probably not be achieved.

Long-Term Effectiveness and Permanence. Alternative 6 provides a high degree of effectiveness and permanence.

Reduction of Toxicity, Mobility, and Volume Through Treatment. Alternative 6 will reduce the volume of contaminated soil by virtually 100% in those areas which are excavated.

Short-Term Effectiveness. Alternative 6 would be immediately effective, in that the potential for human exposure to surface soil would be eliminated. Soil excavation at the site during remediation could temporarily result in potential adverse health effects for on-site workers through the generation of contaminated dust and metals emission. Controls would be implemented during the excavation phase to reduce the risk of exposure to contaminants.

Implementability. Excavation and backfilling are commonly applied technologies at hazardous waste sites and do not require special equipment or operators. However, off-site transport of excavated wastes may not be feasible given current market conditions. Recent canvassing of permitted facilities in southern New York indicate that only the Sullivan County Landfill is operating. However, the Sullivan County Landfill is operating at its permitted daily capacity and can not accept new customers. Until additional disposal capacity becomes available in southern New York, this alternative does not appear feasible. Institutional controls for groundwater use restrictions may be established by the owner in consultation with the NYSDEC. Long-term groundwater monitoring and sampling are also readily accomplished.

Cost. Estimated capital costs for Alternative 6 vary with cleanup objective. Table 7 provides a cost summary for remediation to site background conditions. Long-term monitoring and maintenance costs (groundwater monitoring) are estimated to be \$8,000 annually.

4.2 Comparative Analysis of Alternatives

In the previous section, each of the remedial alternatives was individually evaluated with respect to seven criteria. In this section the comparative performance of the alternatives is discussed where common elements exist among alternatives.

4.2.1 Protection of Human Health and the Environment

Alternative 1 provides the least protection of human health, as workers that excavate contaminated soil may be exposed to metal contaminants. Airborne dust will also remain a potential threat. Institutional measures may be implemented to prevent human exposure to contaminants in the area of concern. In comparison to Alternative 1, Alternatives 2 and 5 provide more protection to the community by eliminating the potential for direct exposure to contaminated soil, and by minimizing contact between stormwater and contaminated soil, thereby protecting groundwater. Alternatives 3, 4, 5 and 6 will also eliminate exposure pathways to contaminants in soil and minimize leaching of metals into groundwater and stream water. Alternatives 3 and 5, however, will entail complete disturbance of contaminated soil over a period of many weeks while soil is excavated, loaded and transported off-site, which will create significant exposure potential for on-site workers.

4.2.2 Compliance With ARARs

Alternatives 1, 2 and 4 would not result in compliance with chemical-specific ARARs and TBCs for New York State Soil cleanup objectives, however Alternatives 2 and 5 will effectively eliminate potential exposure pathways of soil and groundwater ingestion, dermal contact and dust inhalation. Alternatives 3 and 6 (off-site soil disposal) will result in compliance with ARARs and TBCs. Alternative 5, which calls for off-site disposal of soil from beneath the building floor, will achieve partial compliance with ARARs and TBCs for the area excavated.

4.2.3 Long-Term Effectiveness and Permanence

Alternative 1 provides the least long-term effectiveness and permanence. Alternatives 2 and 5 provide immediate effectiveness by eliminating all potential on-site exposure pathways. Incorporating remedial measures into the proposed development of the site ensures that the remedy is consistent with the proposed future use of the site. Alternatives 3, 5 and 6 provide immediate effectiveness by transporting metal contaminants off site. The long-term effectiveness of Alternative 4 is less certain, and will depend, in part, on soil characteristics and on selection of the most appropriate treatment/immobilization methods indicated by pre-remediation pilot studies.

4.2.4 Reduction of Toxicity, Mobility and Volume Through Treatment

Alternatives 1, 2 and 5 do not achieve a reduction in the toxicity or volume of contamination, but Alternatives 2 and 5 will reduce mobility of metals in soil by preventing infiltration of water, thereby reducing the potential for leaching. Alternatives 3 and 6, and to a lesser extent, Alternative 5, will reduce the volume of contaminants. Alternative 4 will reduce contaminant mobility, but not toxicity or volume.

4.2.5 Short-Term Effectiveness

Alternatives 2, 3, 4, 5 and 6 will all be immediately effective by eliminating direct exposure pathways affecting on-site receptors. Institutional controls, once implemented, would also prevent exposure short-term and long-term. No short-term adverse impacts will result from the implementation of Alternative 1. Alternatives 2, 4, 5 and 6 will have minimal potential short-term adverse impacts, but only for a short period during active handling of contaminated soil in preparation for paving (Alternatives 2 and 5) or during treatment of surface soil (Alternative 4). Alternative 3 will have the most significant adverse effects in the short term as the potential for airborne dust movement will extend over the entire period of soil excavation, loading and transport.

4.2.6 Implementability

Alternative 1 is the easiest alternative to implement. Alternative 2 is the next easiest alternative to implement as it involves standard materials, techniques and equipment. Alternative 5 is similar, but would require special equipment, including specialized health and safety equipment, to permit interior excavation. Alternatives 2 and 5 would require long-term maintenance of new paved surfaces and drainage features. Alternatives 2, 3, 5 and 6 involve standard techniques and equipment, but would require extensive monitoring and control of fugitive dust, stormwater and sediment during the remediation process. Alternative 4 involves specialized equipment for mixing and applying stabilizing agents to the soil. Alternative 4 would also be preceded by bench- or pilot-scale tests to determine the applicability and effectiveness of various soil treatment methods.

4.2.7 Cost

Alternative 1, the no further action alternative, has an estimated capital cost of zero. The capital costs for each alternative vary with cleanup objective. Tables 2 through 7 provide a summary of the costs.

5 RECOMMENDED REMEDIAL ALTERNATIVE

Based on the FFS analysis and intended use of the property, the recommended remedy for the Circle M site is Alternative 2, consisting of soil management controls, including capping, that will: 1) Minimize human exposure to surface soils; 2) Minimize infiltration and leaching of metals into groundwater and surface water and 3) Stabilize surficial soil to control wind erosion and dust generation. These soil management controls will be addressed in the remedial design.

Soil exhibiting elevated CCA will remain on-site in designated areas. In addition to capping, institutional controls will also be employed to prevent future exposure. Periodic groundwater monitoring will also continue.

Soil management measures are appropriate to Circle M because remedial actions as such can be incorporated into any future site development projects.

On-site management of contaminated soil has been endorsed by the NYSDEC for properties with significant contamination by heavy metals, such as orchard land. On those sites, which typically exhibit higher concentrations of metals than are present at Circle M, contaminated soil is capped under roads and parking areas, or covered so that human exposure to the soil is minimized. These remedial measures are commonly employed when the future use of the property is residential.

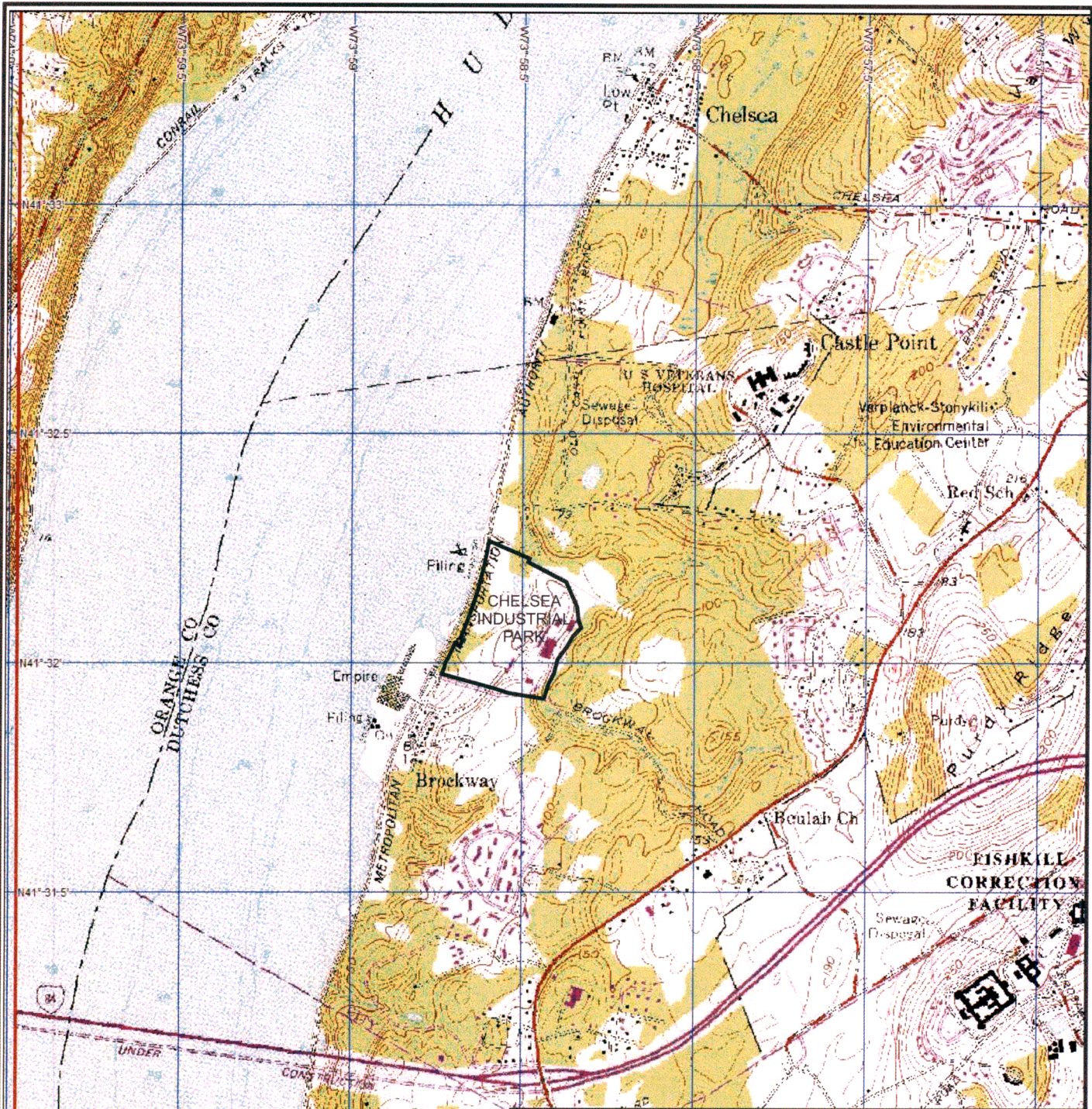
At Circle M, the proposed remedy addresses all areas where soil sampling shows that target metals exceed the NYSDEC cleanup objectives for copper, arsenic, or chromium within the uppermost 24 inches. Alternative 2 will improve groundwater quality over time by reducing percolation of precipitation through CCA-impacted soils. Nearby residences are served by a central water system supplied by the Town of Fishkill, and are not, therefore, exposed to any CCA-impacted groundwater.

Stream sediments have been affected by surface runoff from the Circle M property, however metal concentrations in stream sediments are only slightly elevated, and the Biological Inventory and Impact Assessment indicates that there has been no observable impact to on-site flora or fauna. Capping contaminated soil beneath permanent parking lots and buildings will eliminate erosion of contaminated surface soil, which will provide sufficient stream protection.

While Alternative 2 effectively caps contaminated soil exceeding cleanup objectives for the individual metals of concern, disturbance of contaminated areas may necessitate that dust and erosion control measures be incorporated into any site development.

The institutional controls under Alternative 2 will permanently eliminate potential exposure to metals in groundwater and soil on site. For these reasons, Alternative 2 is the preferred remedial option for the Circle M site.

FIGURES



**CONRAD
GEOSCIENCE
CORP.**

8 Raymond Avenue, Poughkeepsie, New York 12603

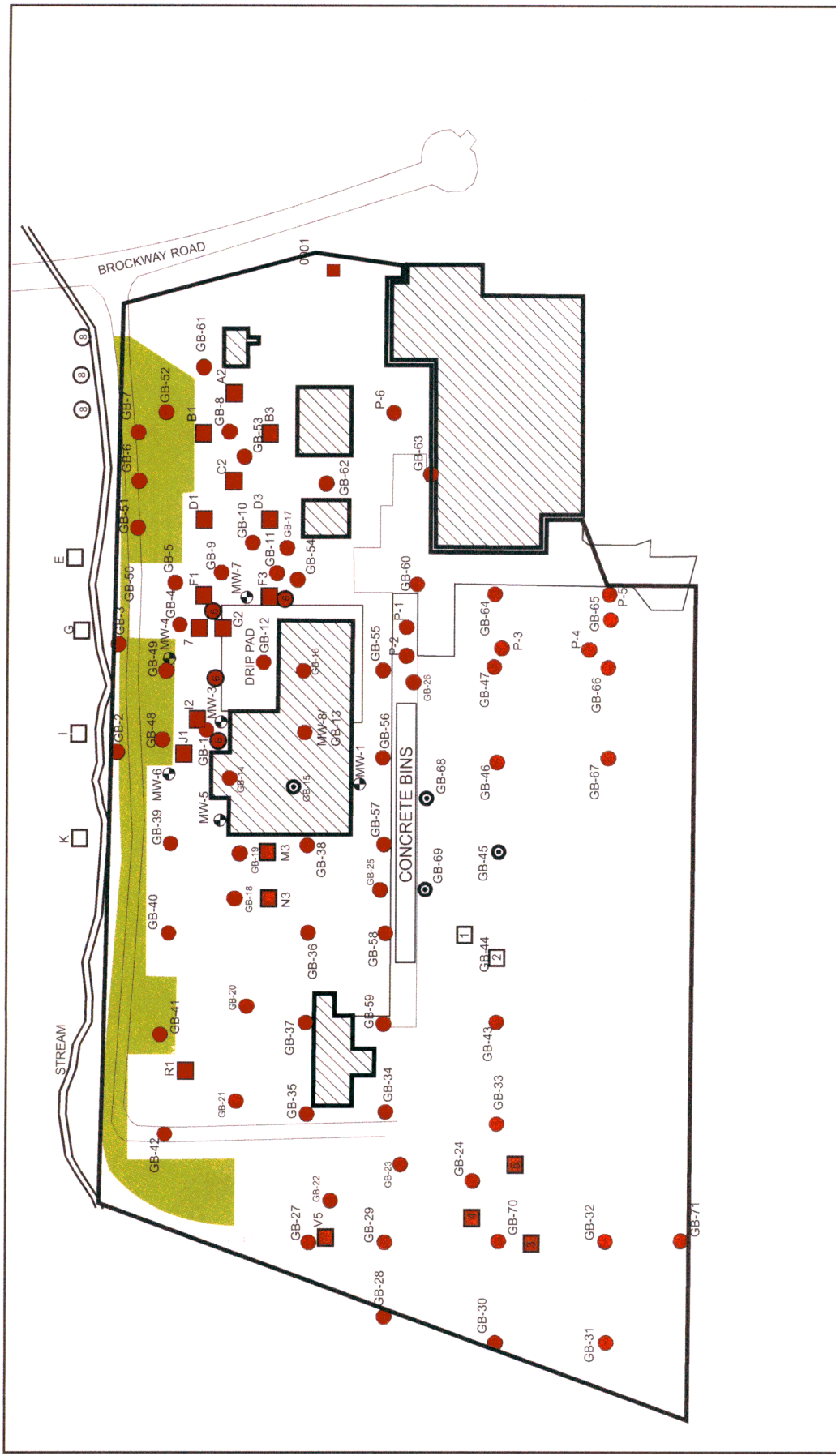



Figure 1

Prepared By:	DJO 03/02
Reviewed By:	CBB 03/02
Revised:	BPG 1/28/05
Approved By:	JAC 1/28/05

SITE LOCATION MAP

CIRCLE M WOOD TREATMENT
Fishkill, New York
CF030290





**CONRAD
GEOSCIENCE
CORP.**
8 Raymond Avenue, Poughkeepsie, New York 12603

Figure 2

**AREA EXCEEDING 13 PPM FOR ARSENIC AND
25 PPM FOR CHROMIUM AND/OR COPPER**

CHELSEA INDUSTRIAL PARK
Fishkill, New York
CF030290

Prepared By:	JJO 05/16/02
Reviewed By:	JAC 05/16/02
Revised By:	BPG 2/10/05
Approved By:	JAC 2/10/05

LEGEND

- INSTITUTIONAL CONTROL SITE BOUNDARY
- ▨ BUILDING FOOTPRINTS
- SOIL BORING LOCATION (UNCONTAMINATED)
- SOIL BORING LOCATION (CONTAMINATED)
- LBG and DUNN SOIL SAMPLE LOCATION
- ⊕ MONITORING WELL LOCATION
- AREA TO BE COVERED WITH GRASS OR ROAD SURFACE FOR EROSION CONTROL

TABLES

TABLE 1

**POTENTIAL EXPOSURE PATHWAYS
CIRCLE M WOOD TREATING SITE**

Potential Receptor	Exposure Route, Contaminated Media, and Point of Exposure	Pathway Selected for Evaluation (Yes/No)	Reason for Selection or Exclusion
Residential	Ingestion of soils on-site	No	Residential development and use will not occur in contaminated soil.
Residential	Ingestion of soils off-site	No	Residential development and use will not occur in contaminated soil.
Residential	Ingestion of groundwater on-site	No	Existing industrial park and proposed development is supplied by municipal water system, which is supplied by City of Beacon.
Residential	Ingestion of groundwater off-site	No	Nearby homes are supplied by municipal water system, which is supplied by City of Beacon.
On-site workers	Ingestion or inhalation of soil or dust	Yes	Surface soils are contaminated with metals.
On-site workers	Ingestion of groundwater on-site	No	Municipal water is supplied to industrial park.
On-site construction workers	Ingestion, inhalation or dermal contact with soils on-site	Yes	Surface & subsurface soils are contaminated with metals. Future construction on-site is possible.
On-site residential or workers	Dermal contact with stream sediments	No	Industrial park stream segment not used recreationally. Biological assessment indicates no adverse impact to stream fauna.

TABLE 2

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS
CIRCLE M WOOD TREATING SITE

Soil and Groundwater Standards			
Standard	Chromium	Arsenic	Copper
NYS Groundwater Standard (Class GA) (ug/L)	50	25	200
NYS Soil Cleanup Objectives (site background) (mg/kg)	13	25	25

Exposure Limits To Be Considered (T.B.C.)

Standard	Chromium			Arsenic	Copper
	Cr (metal)	Cr (VI) Soluble	Cr (VI) Insoluble		
NIOSH IDLH mg/m ³	-	15	-	5 Ca	100
NIOSH - REL/TWA mg/m ³	-	-	-	0.02 C	1
OSHA - PEL mg/m ³	-	0.1	-	0.010	1
ACGIH - TLV mg/m ³	0.5	0.05 A1	0.01 A1	0.01 A1	1

- = Not Available

IDLH = Immediate danger to life or health

REL = Recommended Exposure Limit

TWA = Time Weighted Average

PEL = Permissible Exposure Limit

ACGIH = American Conference of Governmental Industrial Hygienists

TLV = Threshold Limit Value

A1 = Confirmed Human Carcinogen

Ca = Potential Human Carcinogen

C = Ceiling

TABLE 3

**COST ESTIMATE - ALTERNATIVE #2
CONSOLIDATION, CAPPING AND INSTITUTIONAL CONTROLS**

	<u>UNIT COST</u>	<u>QUANTITY</u>	<u>COST</u>
CAPITAL COSTS:			
<u>Direct:</u>			
Groundwater Use Restrictions			Unknown
Site Construction and Use Restrictions			Unknown
Consolidation	\$7.50/cy	12,000 cy	\$90,000
Capping ⁽¹⁾ :			
Asphalt Paving	\$3.50 ft ²	205,000 ft ²	\$717,500
Grading & Subbase Preparation	LS	80,000	\$80,000
Cover Soil	\$16/cy	51,000 cy	\$816,000
Seed, Mulch, Erosion Control	LS	LS	\$40,000
		SUBTOTAL DIRECT COSTS:	\$1,743,500
<u>Indirect:</u>			
Engineering and Design @ 8.5% Direct Costs			\$148,200
Construction Monitoring, Reporting @ 5% Direct Costs			\$87,175
Contingency @ 10%			\$174,350
		SUBTOTAL INDIRECT COSTS:	\$409,725
		TOTAL CAPITAL COST:	\$2,153,225
<u>Operation & Maintenance (O&M) Costs:</u>			
Bi-annual Asphalt Maintenance	\$0.25 ft ² /year	205,000 ft ²	\$51,250/yr
Bi-annual Groundwater Monitoring (7 wells)	\$8,000/year	LS	\$8,000 ⁽²⁾
Annual ECIC Certification	\$2,500/year	LS	\$2,500
		TOTAL ANNUAL O&M COST:	\$61,750
		TOTAL PRESENT WORTH PROJECT COST (30 years @ 5% interest):	<u>\$2,987,500</u>

Notes:

⁽¹⁾ Capping to consist of minimum 24-inch thickness of soil cover asphalt paved roadways, driveways, parking lots, and recreational facilities (i.e. tennis/basketball courts and/or ballfields). Circle M building floor slab to remain.

⁽²⁾ First two (2) years only.

TABLE 4

**COST ESTIMATE - ALTERNATIVE #3
EXCAVATION AND OFF-SITE DISPOSAL**

	<u>UNIT COST</u>	<u>QUANTITY</u>	<u>COST</u>
CAPITAL COSTS:			
<u>Direct:</u>			
Excavation & Loading of Soil	\$13/yd ³	66,000 yd ³	\$858,000
Confirmatory Sampling for As, Cr, Cu	\$130/sample	50 samples	\$6,500
Soil Disposal Fee	\$120/ton	99,000 tons	\$11,880,000
Clean Backfill	\$16/yd ³	66,000 yd ³	\$1,056,000
Place, Grade and Compact	\$13/yd ³	66,000 yd ³	\$858,000
Asphalt Paving	\$3.50/yd ³	\$205,000 yd ³	\$717,500
Seed, Mulch, Erosion Control	LS	40,000 LS	\$40,000
		SUBTOTAL DIRECT COSTS:	\$15,416,000
<u>Indirect:</u>			
Engineering and Design @ 8.5% Direct Costs			\$1,310,360
Construction Monitoring, Reporting @ 5% Direct Costs			\$770,800
Contingency @ 10%			\$1,541,600
		SUBTOTAL INDIRECT COSTS:	\$3,622,760
			<hr/>
		TOTAL CAPITAL COST:	\$19,038,760
<u>Operation & Maintenance (O&M) Costs:</u>			
Twice-Annual Groundwater Monitoring (7 wells)	\$4,000/round	2 rounds	\$8,000 ⁽¹⁾
Bi-annual Asphalt Maintenance	\$0.25 ft ² /year	205,000 ft ²	\$51,250/yr
Annual ECIC Certification	\$2,500/year	LS	\$2,500
		TOTAL ANNUAL O&M COST:	\$61,750
			<hr/>
		TOTAL PRESENT WORTH PROJECT COST (30 years @ 5% interest)	<u>\$19,873,000</u>

Notes:

⁽¹⁾ First two (2) years only.

TABLE 5

**COST ESTIMATE - ALTERNATIVE #4
IN-SITU SOIL TREATMENT**

	<u>UNIT COST</u>	<u>QUANTITY</u>	<u>COST</u>
CAPITAL COSTS:			
<u>Direct:</u>			
Pilot Program and Test Panel Construction, Evaluation, & Monitoring	LS		\$60,000
Site Preparation (grading, clearing/grubbing, soil tilling)	LS		\$540,000
Soil Stabilization (disk/mix in cement dust)	LS		\$975,000 ⁽¹⁾
Topsoil (delivered & placed)	\$19.50/cy	20,000 cy	\$390,000
Pavement	\$3.50/ft ²	205,000 ft ²	\$717,500
Seed, Mulch, Erosion Control	LS		\$24,000
Storm Water Management (during in-situ program)	LS		\$255,000
		SUBTOTAL DIRECT COSTS:	\$2,961,500
<u>Indirect:</u>			
Engineering and Design @ 8.5% Direct Costs			\$251,700
Construction Monitoring, Reporting @ 5% Direct Costs			\$148,100
Contingency @ 10%			\$296,200
		SUBTOTAL INDIRECT COSTS:	\$696,000
		TOTAL CAPITAL COST:	\$3,657,500
<u>Operation & Maintenance (O&M) Costs:</u>			
Bi-annual Groundwater Monitoring (7 wells)	\$8,000/year	LS	\$8,000 ⁽²⁾
Bi-annual Asphalt Maintenance	\$0.25 ft ² /year	205,000 ft ²	\$51,250/yr
Annual ECIC Certification	\$2,500/year	LS	\$2,500
		TOTAL ANNUAL O&M COST:	\$61,750
		TOTAL PRESENT WORTH PROJECT COST (30 years @ 5% interest)	<u>\$4,491,800</u>

Notes:

- (1) Soil stabilization costs may be significantly greater based upon pilot program and selection of soil amendments.
- (2) First two (2) years only.

TABLE 6

**COST ESTIMATE - ALTERNATIVE #5
CONSOLIDATION, CAPPING, SUB-FLOOR SOIL EXCAVATION
AND OFF-SITE DISPOSAL**

	<u>UNIT COST</u>	<u>QUANTITY</u>	<u>COST</u>
CAPITAL COSTS:			
<u>Direct:</u>			
Consolidation and Capping:			
Groundwater Use Restrictions			Unknown
Site Construction and Use Restrictions			Unknown
Consolidation	\$7.50/cy	12,000 cy	\$90,000
Capping:			
Asphalt Paving	\$3.50 ft ²	205,000 ft ²	717,500
Grading & Subbase Preparation	LS	80,000	\$80,000
Cover Soil	\$16/cy	51,000 cy	\$816,000
Seed, Mulch, Erosion Control	LS	LS	\$40,000
			<hr/> \$1,743,500
Soil Excavation / Off-Site Disposal:			
Sub-Floor Metals Delineation			\$80,000
Excavation & Loading of Soil	\$13/yd ³	4,000 yd ³	\$52,000
Confirmatory Sampling for As, Cr, Cu	\$130/sample	40 samples	\$5,200
Soil Disposal Fee	\$120/ton	6,000 ton	\$720,000 ⁽¹⁾
Clean Backfill	\$10/yd ³	4,000 yd ³	\$40,000
Place, Grade and Compact	\$13/yd ³	6,000 yd ³	\$78,000
			<hr/> \$975,200
	SUBTOTAL DIRECT COSTS:		<hr/> \$2,718,700
<u>Indirect:</u>			
Engineering and Design @ 8.5% Direct Costs			\$231,100
Construction Monitoring, Reporting @ 5% Direct Costs			\$136,000
Contingency @ 10%			\$272,000
	SUBTOTAL INDIRECT COSTS:		<hr/> \$639,100
	TOTAL CAPITAL COST:		<hr/> \$3,357,800

Operation & Maintenance (O&M) Costs:

Bi-annual Asphalt Maintenance	\$0.25 ft ² /year	205,000 ft ²	\$51,250/yr
Bi-annual Groundwater Monitoring (7 wells)	\$8,000/year	LS	\$8,000 ⁽²⁾
Annual ECIC Certification	\$2,500/year	LS	\$2,500

TOTAL ANNUAL O&M COST: \$61,750

TOTAL PRESENT WORTH PROJECT COST (30 years @ 5% interest) \$4,192,000

Notes:

- (1) If 6,000 tons of sub-floor soil are classified as hazardous waste, disposal fees of approximately \$250/ton may apply, adding approximately \$800,000 to the cost of Alternative #5.
- (2) First two (2) years only.

TABLE 7

**COST ESTIMATE - ALTERNATIVE #6
EXCAVATION, OFF-SITE DISPOSAL, AND
SUB-FLOOR SOIL REMOVAL**

	<u>UNIT COST</u>	<u>QUANTITY</u>	<u>COST</u>
CAPITAL COSTS:			
<u>Direct:</u>			
Sub-Floor Metals Delineation			\$80,000
Excavation & Loading of Soil	\$13/yd ³	70,000 yd ³	\$910,000
Confirmatory Sampling for As, Cr, Cu	\$130/sample	90 samples	\$11,700
Soil Disposal Fee	\$120/ton	105,000 tons	\$12,600,000
Clean Backfill	\$16/yd ³	70,000 yd ³	\$1,120,000
Place, Grade and Compact	\$13/yd ³	70,000 yd ³	\$910,000
Pavement	\$3.50/ft ²	205,000 ft ²	\$717,500
Seed, Mulch, Erosion Control	LS	LS	\$40,000
		SUBTOTAL DIRECT COSTS:	\$16,389,200
<u>Indirect:</u>			
Engineering and Design @ 8.5% Direct Costs			\$1,393,100
Construction Monitoring, Reporting @ 5% Direct Costs			\$819,500
Contingency @ 10%			\$1,639,000
		SUBTOTAL INDIRECT COSTS:	\$3,851,600
		TOTAL CAPITAL COST:	\$20,240,800
<u>Operation & Maintenance (O&M) Costs:</u>			
Bi-annual Asphalt Maintenance	\$0.25 ft ² /year	205,000 ft ²	\$51,250/yr
Bi-annual Groundwater Monitoring (7 wells)	\$8,000/year	LS	\$8,000 ⁽²⁾
Annual ECIC Certification	\$2,500/year	LS	\$2,500
		TOTAL ANNUAL O&M COST:	\$61,750
		TOTAL PRESENT WORTH PROJECT COST (30 years @ 5% interest)	<u>\$21,075,000</u>

Note:

If 6,000 tons of sub-floor soil are classified as hazardous waste, disposal fees of approximately \$250/ton may apply, adding approximately \$800,000 to the cost of Alternative #6.