CMS PLAN AND TASK I REPORT

FORMER NEPERA PLANT SITE

Prepared for

Rutherford Chemicals, LLC

41 Arden House Road

Harriman, New York 10926

November, 2007

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1. INTRODUCTION

The New York State Department of Environmental Conversation (NYSDEC) in a letter dated July 10, 2007, issued comments on the Resource Conservation Recovery Act (RCRA) Facility Investigation (RFI) Report submitted by Rutherford Chemicals LLC (RC) for the Former Nepera Facility (Site) located in Harriman, New York. The letter was issued pursuant to the 6 NYCRR Part 373 Hazardous Waste Management Permit (HWM Permit) issued to Nepera Inc. (EPA ID#: NYD002014595) by the NYSDEC dated July 1999 (NYSDEC, 1999), which was subsequently transferred to Rutherford Chemicals LLC, the present owner of the Site. In the July 10, 2007 letter, the NYSDEC required preparation of: "a Corrective Measures Plan that will list the various alternatives to be examined in the Corrective Measures Study".

In accordance with the NYSDEC guidelines for a Corrective Measure Study (CMS), which are listed in Appendix III-C of the HWM Permit, a CMS consists of the following four tasks:

- Task I: Identification and Development of the Corrective Measure Alternative or Alternatives
- Task II: Evaluation of the Corrective Measure Alternative or Alternatives
- Task III: Justification and Recommendation of the Corrective Measure or Measures
- Task IV: Reports: Progress and Final

The CMS Plan shall provide:

- A description of the general approach to investigating and evaluating potential corrective measures;
- A definition of the overall objectives of the study;
- The specific plans for evaluating corrective measures to ensure compliance with corrective measure standards;
- The schedules for conducting the study; and
- The proposed format for the presentation of information.

The CMS Plan must address, at a minimum, all necessary activities to complete Tasks II and III required by the CMS Scope of Work included in Appendix III-C of HWM Permit Module III.

Task I of the CMS typically is completed in parallel with preparation of the CMS Plan and includes the following:

- Description of current situation;
- Establishment of corrective action objectives;
- Screening of corrective measure technologies; and
- Identification of the corrective measures alternative or alternatives.

The July 10, 2007 letter also requires preparation of Phase II RFI Work Plan. The stated purpose of the Phase II RFI is: "to further delineate some areas of contamination that are not surrounded by sample locations without elevated levels of contaminants of concern." Given that the RFI is not yet complete, it would be premature to identify the corrective measure alternatives to be evaluated in Tasks II and III of the CMS. Additionally, the NYSDEC has not yet provided notice specifying the hazardous constituents and target cleanup levels to be evaluated in the CMS. Accordingly, this submittal presents those portions of CMS Task I that can be performed at this juncture along with a CMS Plan for completing the full CMS.

The current situation of the Site has been described in the RFI report and is summarized in Section 2. Corrective action objectives are described in Section 3. Those objectives are considered preliminary and will be finalized upon completion of the Phase II RFI and receipt of the notification from the NYSDEC specifying the hazardous constituents and target cleanup levels in accordance with HWM Permit Module III, Section E.9.(a).

Corrective measure technologies are identified in Section 4 and screened to eliminate inapplicable technologies based on site characteristics, waste characteristics and technology limitations. Section 5 describes the general approach to identifying corrective measure alternatives that will be followed once the RFI is complete and corrective action objectives are finalized.

The specific plans for evaluating corrective measure alternatives (CMS Tasks II and III) are presented in Section 6. A preliminary schedule for completing the CMS is provided in Section 7. The proposed format for the presentation of information is described in Section 8.

2. DESCRIPTION OF THE CURRENT SITUATION

2.1 Site Location and Description

The Site is located on NY Route 17 in the village of Harriman, Orange County, New York. The Southwest corner of the Site is in the Town of Monroe. The Site is bounded to the Northwest by Route 17, to the northeast by the West Branch of the Ramapo River and to the south by undeveloped land. The Site is divided into two parcels. The administrative offices and the wastewater lagoon are located on the 9.74 acre parcel located to the northeast of Arden House Road. The manufacturing facilities are located on the 18.64 acre parcel southwest of Arden House Road. Figure 2-1 illustrates the site map and location.

The Site location is within the Hudson Highlands portion of the New England physiographic province. The Site is situated on a floodplain near the confluence of the main and west branches of the Ramapo River, and has relatively low topographic relief. Surface runoff from precipitation drains mainly north to Arden House Road or east. A small part of the southeastern portion of the Site is within the 100-year flood plain (Figure 2-2).

The overburden of the Site, consisting of a complex sequence of glacially-derived deposits, ranges in thickness from less than 30 feet along the western side of the Site, to over 100 feet along the east side of the Site, adjacent to the Ramapo River. In general, dense glacial till deposits are overlain by less dense sand and gravel kames and outwash deposits. These are in turn overlain by silt, clay and fine sand glaciolacustrine deposits. These overburden deposits are underlain by grey dolomite of the Wappinger Group. The shallow borings conducted for the RFI encountered mostly fill material. The deep boring conducted around lagoon berm and around the berm of Building 21 also encountered mostly fill material.

2.2 Site History

The Site was used to manufacture pharmaceutical and specialty chemicals from 1942 to 2005. Chemical byproducts (organic compounds) were incinerated on Site from September 1945 through May 1957. This activity was conducted on a regular basis in two areas. During the mid-1940s, a “burn pit” apparently was located near the former blind lagoon and the current SPDES lagoon. From the late 1940s until 1957, a second “burn pit” was located near where the cyano reactor now stands.

From the late 1940s to approximately 1953, calcium-sulfate sludge was disposed of on the Site, primarily in a low lying area where the administration building and parking lot are now located. The calcium-sulfate sludge contained mercury, which was used as a catalyst in the manufacturing of niacinamide.

Drum burial occurred in an area near Buildings 67 and 75 and in an area near the southern boundary of the Site. Drum removal from these areas was conducted during the mid-1980s.

The wastewater lagoon, constructed in the mid 1960s, is located southeast of the parking lot. It is reportedly approximately 12-feet deep, lined with compacted clay, stores approximately 5.5 million gallons of water, derived from storm water runoff and treated groundwater, and previously received boiler blowdown and non-contact cooling water prior to cessation of operations. Water from the lagoon is discharged to the west branch of the Ramapo River under a State Pollutant Discharge Elimination System (SPDES) Permit. As such, it is commonly referred to as the SPDES lagoon. Prior to its recent/current use, the lagoon served as a settling pond for aluminum hydroxide and magnesium silicate precipitates from manufacturing operations.

The former blind lagoon (previously located where the SPDES lagoon currently is situated) was used to drain fire-system sprinkler (deluge) water, which was conveyed via gravity flow through underground pipes. The water is now collected in a 20,000-gallon underground storage tank, and periodically pumped to an above-ground 300,000-gallon storage tank.

2.3 Remedial Activities Implemented under the ROD

Prior to the issue of the HWM Permit, the Site was listed as an Inactive Hazardous Waste Site (No. 336006) by the NYSDEC Division of Environmental Remediation. The NYSDEC issued a Record of Decision (ROD) in March 1997 (NYSDEC, 1997). The ROD set certain remedial goals for the Site and remedial actions have been implemented to achieve these goals.

The remedial goals as stated in the ROD for the Site consisted of the following:

- To the maximum extent practicable, reduce the potential for direct human contact with the contaminated soils at the Site;
- To the maximum extent practicable, remove the source of the groundwater plumes on site;
- Provide protection to public and private drinking water supplies in the vicinity of the Site;
- Mitigate the migration (or introduction) of mercury into the river ecosystem; and
- The protection of biota in the West Branch of the Ramapo River.

The selected remedy stated in the ROD consisted of the following remedial actions:

- Design and implementation of a soil vapor extraction system for remediating the continuing source of groundwater contamination;
- Design and implementation of a drum removal program in Area F;
- Design and implementation of a groundwater remediation program to contain the groundwater plume on site;
- Design and implementation of a sediment excavation program on the Avon Parcel (Area K);
- An evaluation, and if required, the design and construction of erosion controls or other appropriate remedies to mitigate the migration of mercury into the Ramapo River;
- Restrictions regarding the use of groundwater at the Site incorporated into a deed notice; and
- Design and implementation of a long-term groundwater and surface-water monitoring program.

Since the March 1997 ROD, the following remedial actions have been undertaken:

- Soil vapor extraction was pilot tested and found to be ineffective (ARCADIS, 2001a);
- Drum removal from Area F was completed (ARCADIS, 2001b);
- Drum removal in the area of the B-53 tank farm was completed (ARCADIS, 2001b);
- Sediment excavation at Area K was completed (ARCADIS, 2001b); and
- Groundwater remediation by biosparging and groundwater containment by extraction pumping, which are ongoing (ARCADIS, 2006).

The asphalt parking lot has been maintained as a cover over the calcium-sulfate sludge material in Study Area B to minimize infiltration of rainwater and resultant erosion.

The NYSDEC completed a Documentation of Environmental Indicator Determination RCRA Corrective Action Environmental Indicator (EI) RCRIS code (CA725) Current Human Exposures "Under Control" document for the site on September 22, 2005 (NYSDEC 2005). The report concluded that the Current Human Exposures are "Under Control."

2.4 RCRA Facility Investigation Summary

The RFI was implemented from October 2006 to March 2007, in accordance with the approved RFIWP, and is documented in the report entitled RCRA Facility Investigation Report, Former Nepera Plant Site, Harriman, New York dated April 2007 (Brown and Caldwell, 2007a). The NYSDEC issued comments on the RFI Report in a letter dated July 10, 2007. An Addendum to the RFI Report, dated October 8, 2007, was submitted to the NYSDEC by Nepera as a response to the RFI Report Comment Letter.

The RFIWP included the collection of soil samples beneath the Inaccessible SWMUs, TSD Units, and underground sewers. Locations adjacent to the Inaccessible SWMUs or elsewhere on the Site where historic knowledge indicated the potential for environmental impacts were also investigated. Solids samples were collected from the SPDES Lagoon.

A total of 354 soil samples were collected from 219 borings. Soil samples were collected continuously during the drilling of each of the soil borings. The soils were scanned with a PID for VOCs. Of the 354 samples, 150 were collected from the first 2 feet below grade, and 202 samples were collected from greater then 2 feet below grade. Each soil sample was analyzed for VOCs, SVOCs (including pyridine and alpha- and beta-picoline), PCBs, TAL metals and ammonia. Eight samples were selected for sequential extraction and methyl mercury analyses.

A detailed presentation of the RFI field activities and investigation results is presented in the RFI Report, including analytical data summary tables and distribution maps in which the data are compared to the Remediation Technical Administrative Guidance Memorandum #4046 (TAGM 4046), Determination of Soil Cleanup Objectives and Cleanup Levels as well as the 6 NYCRR Subpart 375.6 Remedial Program Soil Cleanup Objectives (Subpart 375.6). The RFI Addendum includes additional figures that display isoconcentration contours for mercury, benzene and PCBs. A summary of the RFI findings is presented below. The RFI Report should be referred to for further details.

2.4.1 Summary of Field Observations and Measurements

In general the soils encountered were a mix of fill and sandy silt. Clay was occasionally encountered near the terminus of some of the deeper borings. Wet soils were encountered at various depths across the Site, usually determined by the elevation of the boring location. Wet soils were encountered at depths as shallow as less than 2 feet near the center of the Site in the area of Buildings 2, 28 and 29, and as deep as 16 feet along the railroad tracks at the southern boundary of the Site.

No separate phase liquids of any kind were observed. No drums were encountered. Occasional petroleum-like odors were noticed, particularly in samples from the area of Tank Farms 18 and 31. Occasional elevated PID readings were observed in the soils from those areas, as well. The soil borings occasionally encountered a white fill material which was visually consistent with the material in Area B beneath the parking lot. This material is reported to be calcium-sulfate sludge from a former manufacturing process. This material was encountered south of Arden House Road, in the area of the "contractor's gate", and in several borings adjacent to the parking lot and in back of the SPDES Lagoon.

2.4.2 Summary of VOC Data

The petroleum compounds benzene, toluene, ethylbenzene and xylenes (BTEX) were the primary VOC compounds detected at concentrations above the TAGM 4046 values. The highest concentrations of VOCs were found in the soils beneath Tank Farm 18 and in a few borings around adjoining tank farms. Each of these compounds was detected at similar or lower concentrations as those previously reported in the RI. The RFI data are not indicative of any new or previously unidentified releases attributable to the Inaccessible SWMUs, TSD Units, underground sewers or other areas. Benzene was the only constituent detected within the Tank Farm 18 area at concentrations above either the Commercial or Industrial Use Subpart 375.6 values. Outside of the Tank Farm 18 area, benzene was the only constituent detected at a concentration that exceeded the Restricted Residential Subpart 375.6 values and in only one sample (A-B-06, 9.3 mg/kg).

2.4.3 Summary of SVOC Data

A number of polycyclic aromatic hydrocarbon (PAH) compounds, including benzo(a)anthracene, chrysene and fluoranthene, as well as bis(2-ethyhexyl)phthalate, were detected at concentrations above the TAGM 4046 values. These compounds were found at concentrations similar to those reported in the RI. Pyridine and alpha- and beta-picoline (for which there are no TAGM 4046 or Subpart 375.6 values) were also found to be present at concentrations similar to those reported in the RI. The data are not indicative of any new or previously unidentified releases attributable to the Inaccessible SWMUs, TSD Units, underground sewers, or other areas.

2.4.4 Summary of PCB Data

One PCB congener (Aroclor 1254) was detected at concentrations above the TAGM 4046 value for Total PCBs. The average Aroclor 1254 concentration for the RFI samples (0.442 mg/kg) is similar to the RI data (0.378 mg/kg). One sample (I-B002, 51.7 mg/kg) was reported to contain Aroclor 1254 at a concentration above the Subpart 375.6 Industrial value of 25 mg/kg. The data are not indicative of any new or previously unidentified releases attributable to the Inaccessible SWMUs, TSD Units, underground sewers, or other areas.

2.4.5 Summary of Metals Data

While a number of metals were detected at concentrations above the TAGM 4046 values, the results were consistent with the RI and the EI Report which found that: "No inorganic trends were evident in the data; exceedances were dispersed randomly throughout the site" (NYSDEC 2005). Several of these compounds (barium, beryllium, selenium, and iron) were detected at concentrations that are comparable to the background. Mercury and arsenic were the only metals that exceeded the Industrial Use Subpart 375.6 values. The arsenic exceedances were limited (two samples collected from 0-2 feet bgs and six samples collected from greater than 2 feet bgs, all within Study Area A), whereas mercury was more widely distributed with the highest concentrations generally corresponding to locations at which the calcium-sulfate sludge-like material was observed. The average mercury concentration for the RFI data (43 mg/kg) is similar to the RI data (30 mg/kg). The data are not indicative of any new or previously unidentified releases attributable to the Inaccessible SWMUs, TSD Units, underground sewers, or other areas.

As noted in the ROD, it has been determined that the mercury present at the Site exists in a relatively immobile form. This determination was based on the data generated during the RFI, sampling events at other locations within the Village of Harriman, and a review of the process chemistry in which mercury was used. The fate and transport and potential bioavailability characteristics of mercury in soil were further evaluated through a series of separation and analytical procedures known as sequential extraction. The pattern of fractionation demonstrated variability of mercury fractionation biased to the later-extracting fractions, indicating low environmental mobility. The bioavailable fractions represented a very low proportion of total mercury present. A very low portion of total mercury was present as methyl mercury, with a maximum of 0.035% in sample A-B-012. In general, no particular relationship between the proportion of methyl mercury and the fractionation pattern is evident.

2.4.6 Summary of Ammonia Data

Ammonia was frequently detected in the soil samples. The maximum concentration in the samples collected from 0-2 feet bgs was 113 mg/kg and the maximum concentration in the samples collected from greater than 2 feet bgs was 520 mg/kg. The data are not indicative of any new or previously unidentified releases attributable to the Inaccessible SWMUs, TSD Units, underground sewers, or other areas.

2.4.7 Summary of Lagoon Solids Samples

The lagoon solids material encountered was very fine, black, and nearly colloidal with a very high water content (approximately 90%). VOCs and PCBs were not detected; SVOCs and metals were detected in the samples. None of the lagoon solids samples exhibited any of the characteristics of a hazardous waste.

3. CORRECTIVE ACTION OBJECTIVES AND CATEGORIES

Corrective action objectives and general categories of corrective action are described in this section. The corrective action objectives are considered preliminary because a Phase II RFI has yet to be completed. The corrective action objectives will be finalized upon completion of the Phase II RFI and receipt of the notification from the NYSDEC specifying the hazardous constituents and target cleanup levels in accordance with HWM Permit Module III, Section E.9.(a).

As noted in the RFI Work Plan and RFI Report, and discussed in meetings with the NYSDEC, the focus of RCRA Corrective Action is soils associated with the previously inaccessible SWMUs and adjacent areas. Groundwater remediation is being performed under the ROD. Site-related impacts to surface water or sediment in the Ramapo River also are addressed in the ROD. The ROD required remedial measures are summarized in Section 2.3.

3.1 Preliminary Corrective Action Objectives

As described in Appendix III-C of the HWM Permit, site-specific objectives shall be based on public health and environmental criteria, information gathered during the RFI, USEPA and New York State guidance, and the requirements of any applicable federal and state statutes. A comparison of soil sampling results to the TAGM 4046 Soil Cleanup Objectives and Cleanup Levels and the 6 NYCRR Subpart 375.6 Remedial Program Soil Cleanup Objectives is provided in the RFI Report.

The planned future use of the Site is an important consideration in developing corrective action objectives. Institutional and/or engineering controls may be deployed to limit the activities and uses of the Site and eliminate or control potential exposure pathways. At this time the future use of the Site is uncertain. Therefore, the CMS will consider a range of potential future uses including commercial, industrial and residential.

Site and constituent specific considerations also are important in developing corrective action objectives and evaluating corrective measure alternatives. As noted in the ROD, it has been determined that the mercury present at the Site exists in a relatively immobile form. This determination was based on the data generated during the RFI, sampling events at other locations within the Village of Harriman, and a review of the process chemistry in which mercury was used. The fate and transport and potential bioavailability characteristics of mercury in soil were further evaluated in the RFI through a series of separation and analytical procedures known as sequential extraction. The test results confirmed the prior conclusion that the mercury at the Site exists in a relatively immobile form.

Based on the results of the RFI, the preliminary site-specific corrective action objectives are as follows.

Where not otherwise addressed by the remedial measures required by and being implemented pursuant to the ROD and as necessary to comply with applicable standards, criteria and guidelines:

- Eliminate or control the potential for direct human contact with hazardous constituents in soils;
- Eliminate or control the potential for migration of hazardous constituents from soil to groundwater, which can occur via infiltration through impacted soils with subsequent leaching and transport of constituents from the vadose zone into the saturated zone;

- Eliminate or control the potential for migration of hazardous constituents from soil to adjacent surface water bodies or lands, which can occur via surface water runoff or soil erosion;
- Eliminate or control the potential for migration of hazardous constituents in ambient air, which can occur through volatilization or through dust when impacted soils are disturbed; and
- Eliminate or control the potential for migration of hazardous constituents into occupied structures through vapor intrusion.

3.2 General Categories of Corrective Action

General categories of corrective action were identified based on the objectives described in Section 3.1. The general categories include:

- No action
- Containment
- Groundwater extraction and ex-situ treatment
- Soil removal and ex-situ treatment
- In situ treatment
- Institutional and engineering controls

As mentioned earlier groundwater remediation is being performed under the ROD and is not addressed in the RFI and CMS. Accordingly, the groundwater extraction and treatment category is not discussed further.

3.2.1 No Action

No action is used as a background measuring tool for the other technologies. Typically it includes some form of monitoring, but no specific corrective action.

3.2.2 Containment

Containment actions are designed to isolate impacted media from their surrounding environment. In this regard, containment technologies could potentially satisfy the corrective action objectives by limiting constituent migration and restricting direct contact exposure. Containment technologies include vertical or horizontal cutoff walls, which contain and direct groundwater movement; and caps or covers, which control surface water infiltration, migration via erosion or dust, and/or direct contact exposure.

3.2.3 Soil Removal and Ex-Situ Treatment

Soil removal and treatment involves the physical removal of impacted soils from the site. Once removed, soil may be treated by one or more physical/chemical, biological or thermal treatment technologies, disposed of in a landfill, or reused. This action is generally applicable to source areas since removal of large quantities of soil with low to moderate levels of constituents is not cost-effective. This action has the potential to satisfy the corrective action objectives provided that the quantity of soil to be removed is manageable and adequate treatment or disposal plans exist for the soil once it is removed.

Soil removal can be categorized as complete or partial. Complete removal would involve the excavation of all impacted areas to meet acceptable levels for the constituents of concern. Partial removal is potentially applicable where discrete source areas (hot spots) can be delineated and addressed separately from surrounding areas. Soil removal is followed by disposal or treatment prior to disposal or reuse. The type of disposal facility and type of treatment, if needed, depend on the soil properties, constituent concentrations and waste classification.

3.2.4 In-Situ Treatment

In-situ treatment of impacted soil or waste addresses the material in place. In situ technologies act by transforming the constituents of concern (COCs) into non-hazardous or less hazardous products (e.g., chemical oxidation, bioremediation), removing the COCs from the medium (e.g. surfactant flushing, soil vapor extraction) or stabilizing the constituents in place (e.g. stabilization/solidification, vitrification). In situ treatment can potentially satisfy the corrective action objectives provided that the technologies can be effectively applied taking site conditions into account.

3.2.5 Institutional/Engineering Controls

Institutional measures can include site access control, employee training, and restrictions on certain site uses and activities. In general institutional controls are considered with other actions such as partial removal or containment. A deed notice is an example of an institutional control that is applied with containment or partial removal. Engineering controls can include installation of fencing to isolate an area, installation of vapor barriers under buildings, and implementation of dust monitoring program.

4. TECHNOLOGY SCREENING

A technology screening was performed for on-site soils and is presented in this section. The first step of the technology screening involves identification of the corrective measures technologies that are potentially applicable to the Site media and constituents of concern. The technologies are then screened to select the technologies that will be used in developing corrective measure alternatives for the Site.

4.1 Identification of Corrective Measure Technologies

The various corrective measure technologies that are potentially applicable to the COCs at the Site are listed in Table 4-1. The technologies are grouped according to the general categories of correction action described in Section 3.2.

As previously discussed, the medium of interest for the CMS is contaminated soil associated with the previously inaccessible SWMUs and adjacent areas. Thus, technologies that are applicable to environmental media other than soils are not included in Table 4-1. Examples of such technologies include cutoff walls, groundwater extraction wells, and in situ treatment technologies that are applied within the saturated zone (e.g., air sparging).

For each technology listed in Table 4-1, the types of constituents to which it applies are noted. The COCs include metals, PCBs, VOCs and SVOCs. Mercury is most prevalent among the metals and is discussed in detail in the RFI Report. Mercury is listed separately from other metals in Table 4-1 as some technologies are more or less applicable based on the differing properties of mercury. Arochlor 1254 is the only PCB congener detected in the soil samples. Benzene is the VOC of greatest concern at the Site. SVOCs include pyridine and alpha- and beta-picoline. Polynuclear aromatic hydrocarbons (PAHs) were detected at relatively low concentrations as described in the RFI Report and discussed further in the RFI Addendum.

4.1.1 No Action

No action means that no corrective measures are implemented as a result of the CMS. No action is included to provide a baseline for comparison purposes. For this Site, no further action includes continued implementation of the ROD remedial measures.

4.1.2 Containment Technologies

Containment technologies, in general, act by isolating the impacted areas from their surrounding environment. Containment technologies applicable to soil include caps or cover.

Caps/Covers: Caps may be constructed of various earthen or geosynthetic materials. Examples include: soil, geomembranes, geosynthetic clay liners, asphalt pavement, concrete, and buildings or other structures. Caps create a layer or layers above impacted soil to control direct contact exposure, as well as migration via erosion or dust. Low permeability caps also restrict infiltration through impacted soil to control migration of COCs from soil into groundwater. The term cover is sometimes used to differentiate between a permeable cap that is designed primarily to act as a barrier to direct contact exposure and a low permeability cap that also serves to restrict infiltration. Caps/covers are potentially applicable to all classes of COCs.

Low permeability caps are designed with a specific hydraulic conductivity. Hydraulic conductivity is a design parameter that is determined based on the constituent concentration, the site geography, and the constituent physical properties related to its solubility. Different types of caps allow flexibility in the design to reach the desired conductivity. Hydraulic conductivity of soil can range from very high (sand) to impermeable (clay). Geomembranes are synthetic fabrics that are often used in conjunction with soil covers as a part of a cap design with a specific hydraulic conductivity.

Structural development can act as cap and may include buildings, concrete surfaces or slabs, and asphalt pavement. These structures provide varying degrees of infiltration control and require surface water collection systems to control runoff.

Vapor Barriers: Vapor barriers are a type of cap that is installed under existing or new structures to restrict the upward vapor migration of volatile constituents into those structures. Vapor barriers consist of membranes that are installed under the building foundation in new construction. For existing structures, a vapor barrier can be installed over the existing floor slab using various technologies such as spray applied membranes.

4.1.3 Soil Excavation and Ex Situ Treatment

Soil excavation involves the physical removal of impacted soil for treatment, disposal or reuse. A variety of treatment technologies are available for treatment of excavated soil.

Complete or Partial Soil Excavation: Complete soil excavation involves the removal of all (or almost all) of the soils that exceed applicable cleanup criteria. Partial excavation involves the excavation of discrete areas of higher constituent concentrations (i.e. source areas or hot spots) that can be delineated and addressed separately from the surrounding areas. Excavation is potentially applicable to all classes of COCs.

Disposal: Disposal options for excavated soils are dependent upon the waste characteristics and other considerations such as distance to the facilities. Waste classification and characterization analysis determine whether treatment is required prior to landfill disposal or reuse. The disposal and reuse options are more limited for soils that are classified as listed or characteristic hazardous waste as they are subject to land disposal restrictions and treatment standards. A broader array of treatment options is available for non-hazardous waste soils. Additionally, non-hazardous waste soils can sometimes be recycled in asphalt batching plants or used as daily cover at landfills. On-site consolidation may be appropriate based on the planned future use of the site. For example, soils may be excavated from an area where a new building will be constructed and placed in another area that will become paved parking lot.

Soil Washing: Soil washing is an ex situ technology that takes advantage of the behavior of some contaminants to preferentially adsorb onto the fines fraction. The impacted soils are suspended in a wash solution and the fines are separated from the suspension, thereby reducing the contaminant concentration in the remaining soil. Soil washing may include some or all the following steps: (1) mechanical screening to remove various oversize material; (2) crushing to reduce oversized particles to suitable dimensions for treatment; (3) physical processes to liberate weakly bound agglomerates followed by size classification to generate coarse grained and fine grained soils for further treatment; (4) treatment of the coarse grained soils; (5) treatment of the fine grained soils; (6) treatment of the generated wash water; and (7) management of the generated residual.

Ex Situ Thermal Desorption: Thermal desorption is an ex situ technology that involves the use of heat to increase the volatilization of the constituents in the excavated soils; it does not involve oxidation of the constituents. A carrier gas or vacuum is used to transport the desorbed compounds. It is usually followed by vapor collection and treatment. This latter step involves particulate filtration and vapor/gas treatment. Examples of gas treatment include carbon adsorption or catalyst oxidation. Heat desorption requires efficient heat transfer between the heat source and the particle whole minimizing the fine particles in the off-gas. Three types of thermal desorption that are commonly used vary in their heat transfer method: (1) Direct Fired in which the purpose of the fire is to desorb constituents which some of them maybe oxidized; (2) Indirect Fired in which a direct-fired rotary dryer heats an air stream which, by direct contact, desorbs water and organic contaminants from the soil; and (3) Indirectly Heated in which an externally fired rotary dryer volatilizes the water and organics from the contaminated media into an inert carrier gas stream. Pretreatment of the soil might be needed to remove the large debris or pulverize the large particles. Fine particles are not desirable because they become entrained in the gas flow.

Incineration: Incineration is a process that involves high temperature combustion of contaminated materials in the presence of oxygen. Commonly used incineration methods include: Circulating Bed Combustor (CBC), Circulating Fluidized Bed (CFB), Infrared Combustion, and Rotary Kilns. Rotary kilns are the most commonly used type. The rotary kiln is a refractory-lined, slightly-inclined, rotating cylinder that serves as a combustion chamber and operates at temperatures up to 980 °C (1,800 °F). Off gases and combustion residuals usually require treatment. In general, incineration is considered for RCRA hazardous wastes subject to land disposal restrictions and PCB wastes that are regulated under the Toxic Substances Control Act (TSCA).

Stabilization Solidification: Stabilization/solidification (S/S) technology usually is applied by mixing impacted soils with a physical binding agent to form a crystalline, glassy, or polymeric framework surrounding the waste particles. This process reduces the mobility of the particles, reduces permeability and resists leaching. Solidification is a physical process where constituents are bound or enclosed within a mass. Stabilization is a chemical reaction between the stabilizing agent and constituents to immobilize them. The most common S/S methods are cement-based solidification, amalgamation, and asphalt encapsulation.

Cement-based S/S involves mixing impacted material with an appropriate ratio of cement and possibly water and specialty additives. Off-gas treatment, if volatiles are present, may be necessary. Portland cement is the most common material used in this process.

Amalgamation is a physical immobilization technology unique to elemental mercury, in which another metal (e.g. copper) forms a semisolid alloy with mercury.

Encapsulation includes application of thermoplastic or thermosetting resins. Potential candidate resins for thermoplastic encapsulation include bitumen (asphalt), polyethylene, paraffins, waxes, and sulfur cement. Of these candidate thermoplastic resins, asphalt is the least expensive and the most commonly used.

Soil Leaching: Soil leaching is an ex situ chemical separation technology that is based upon the reactivity of the COCs. Solution leaching may be used to remove a variety of COCs including both elemental and inorganic forms of mercury. Impacted soils are mixed with an extraction solution which could be an acid or a surfactant. Constituents are transferred into a concentrated liquid phase. After the mixing step, the soil and the extraction liquid are separated. The soil is rinsed to remove the remaining extraction solution and can also be neutralized with lime to remove any remaining acid. The extraction solution and rinse water are usually regenerated using common precipitants.

Soil Bioremediation: Ex situ soil bioremediation involves the bio-oxidation of organic contaminants. This can be performed by land farming or in soil piles/cells. Various processes involve the addition of oxygen, moisture, nutrients and/or microorganisms.

4.1.4 In-Situ Treatment

In situ soil treatment consists of technologies that treat the soil in place. The paragraphs below list and describe the technologies that were identified as possible candidates to achieve one or more of the corrective action objectives.

Electrokinetic Separation: Electrokinetic separation (EK) is an electric separation process that induces the migration of subsurface contaminants in an imposed electric field. An electric field is imposed in the impacted soils through two arrays of ceramic electrodes: Cathodes and Anodes. Positively charged species including metal ions, ammonium, and positively charged organics move toward the cathode and negatively charged species including chloride, cyanide, fluoride, nitrate, and negatively charged organic compounds move toward the anode. The remediation of the mobilized constituents is performed by "Enhanced Removal" or by "Treatment without Removal." Enhanced Removal involves electrokinetic transport of constituents to the electrodes where they become concentrated followed by removal for ex-situ treatment. Removal at the electrodes includes: water pumping, electroplating and precipitation and coprecipitation. "Treatment without Removal" is achieved by electro-osmotic transport of contaminants through treatment zones placed between electrodes. The polarity of the electrodes is reversed periodically, which reverses the direction of the constituents back and forth through treatment zones.

In-Situ Thermal Desorption: Heat is used to increase the temperature of the treated media. Temperature can be raised to increase volatility of certain volatile organics or to reach the boiling point of certain high-boiling compounds such as PAHs and PCBs and increase their mobility. Soil permeability can also be increased due to water vaporization which causes soils to dry out and fracture. Heat generation is performed through four different methods: Electrical Resistance Heating, Radio Frequency/Electromagnetic Heating, Hot/Steam Injection Heating or Heater Wells. Electrical resistance heating consists of installing electrodes in low permeability areas, where heat is generated because of the high soil resistivity. Six-phase soil heating (SPSH) is a typical electrical resistance heating which uses low-frequency electricity delivered to six electrodes in a circular array to heat soils. Radio Frequency Heating (RFH) uses the electromagnetic energy to heat a discrete volume of soils; temperatures can reach up to 300F. Hot Air/Steam Heating are usually injected in the impacted area through injection wells, generally the Hot Air/Steam underground currents heat the soil matrix and act as carriers of the desorbed constituents. Heater wells are installed in arrays around the impacted area. In the vicinity of the heating wells where temperatures can reach more than 1000 F, constituents can oxidize or pyrolize. Different methods may be used to collect and treat mobilized constituents depending on the constituent state and properties. Recovery of free phase high-boiling constituents can be achieved by pumping. Volatile compounds can be recovered by an SVE system.

In-Situ Vitrification: Vitrification applies high temperature treatment aimed primarily at reducing the mobility of metals by incorporation into a chemically durable, leach resistant, vitreous mass. In situ application consists of applying an electric current through the soil. Resistance heating transfers heat to soils which begin to melt. The result is a monolithic mass of soils that is leach resistant.

Phytoremediation: Phytoremediation uses plants to remove, transfer, stabilize, or destroy constituents in soils and groundwater. Phytoremediation applies to all the chemical, physical and biological processes that are influenced by plant activities and that aid in cleanup of the impacted media. In this regard, constituents may be treated through two routes: (1) water dissolved constituents are absorbed by the plant roots; and (2) constituents adsorbed to soils located in close vicinity to the roots are biodegraded by the root bacteria.

In-Situ Stabilization: S/S technologies were previously described under ex-situ treatment technologies. Cement-based S/S acts by stabilizing constituents in a polymeric mass. It has two steps: (1) mixing and (2) off-gas treatment. In situ cement-based S/S is applied through two basic methods: vertical auger mixing and injection grouting. The latter involves forcing a binder containing dissolved or suspended treatment agents into the subsurface, allowing it to permeate the soil.

In-Situ Soil Flushing: Soil Flushing involves the use of water, a solution of chemicals (e.g. surfactants), or an organic extractant (e.g. ethanol) to recover constituents from in situ soils. The constituents are mobilized by solubilization, formation of emulsions, or a chemical reaction with the flushing solutions. Flushing solutions or liquids are usually injected through injection wells and recovered through collection wells or drains.

Recovered flushing fluids require treatment to separate the COCs from the solutions. Further treatment of the water may be needed prior to discharge.

Soil Vapor Extraction (SVE): SVE consists of drawing ambient air through an unsaturated medium (soil or bedrock) by means of vacuum. As air is removed from the medium volatile and some semi-volatiles constituents are also removed. Collected vapors usually require some form of treatment (e.g. adsorption or oxidation) prior to emission. Dewatering may be used in conjunction with vapor stripping to enable stripping from below the saturation zone.

Depressurization Systems: Depressurization systems work on the same principle as SVE. They are usually installed as an engineering control under new or existing buildings to prevent vapor intrusion. They often are installed in conjunction with vapor barriers.

In-Situ Chemical Oxidation (ISCO): ISCO is a process in which constituents are ultimately oxidized to their mineral form (e.g. CO_2, H_2O, and HCl). Chemical oxidation involves the installation of oxidant injection wells or points. Oxidants include sodium or potassium permanganate (Na/KM_nO4), Perchlorate, Ozone, or peroxide (H_2O_2). Treatment is dependent upon achieving contact between the oxidants and the COCs. As such, ISCO is most often applied within the saturated zone. However, it can be applied to the vadose zone under certain conditions. Constituents that may be treated with chemical oxidation include VOCs, SVOCs, and PCBs.

In-Situ Bioremediation: Bioremediation involves enhancing the natural biodegradation activity by the addition of nutrients. Bioremediation can be anaerobic or aerobic.

Aerobic bioremediation is a process where constituents are oxidized and usually requires the addition of oxygen or other electron acceptors. Oxygen supply can be performed either through slowly injecting air in the underground the process is called bioventing or through the addition of oxygen release compounds.

Anaerobic bioremediation is a process in which oxidant are reduced. To enhance the reduction reaction of the constituent electron donors are usually added. A commonly used electron donor is Hydrogen Release Compound (HRC®).

4.2 Screening of Corrective Measure Technologies

As discussed in Section 4.1 a number of technologies were identified as potentially applicable to the COCs in soils at the Site. These technologies were screened to select the technologies that will be used in developing corrective measure alternatives for the Site. The screening process considers the effectiveness and implementability of each technology taking into account the site-specific conditions defined in the RFI.

Effectiveness refers to the degree to which the technology achieves one or more of the corrective action objectives. As this evaluation pertains to individual technologies rather than comprehensive corrective measure alternatives, a technology need not achieve all of the objectives to be considered effective. Effective technologies can be combined with other technologies to form an alternative that will achieve the corrective action objectives. Implementability considers the relative degree of difficulty in implementing the technology at the Site and the time required for implementation taking into account site conditions, availability of contractors, and administrative requirements.

The technology screening is described in the ensuing sections and summarized in Table 4-2.

4.2.1 No Action

No action is retained to serve as a baseline condition against which other technologies can be compared. No action does not involve implementation of any corrective measure and thus an evaluation is not applicable. No further action includes the continued implementation of the ROD required remedial measures.

4.2.2 Containment

The containment technologies identified in Section 4.1 include caps/covers and vapor barriers.

Caps/Covers: Capping is a proven remedial technology to control direct contact exposure and migration via erosion or dust. Low permeability caps also are proven effective to control leaching of COCs from soil to groundwater. Capping has been widely used in full scale applications to effectively achieve the corrective action objectives for a wide range of constituents. Caps/covers are retained for further evaluation. Caps are effective in the short-term because they can be implemented quickly. Once installed caps are generally stable and require minimal maintenance to retain their effectiveness over the long term. The site conditions do not create any major obstacles to installation of a cap/cover. Institutional controls are usually required with caps/covers to restrict certain activities that may jeopardize the integrity of the cap/cover system. Caps/covers are retained for use in developing corrective measure alternatives for the Site.

Vapor Barriers: Vapor barriers are effective in mitigating vapor intrusion. They control vapors migration in the vadose zone. In this regard vapor barriers are effective in limiting exposure to volatile COCs. Vapor barriers are widely applied in new construction and have been effectively installed in existing buildings to control vapor intrusion. Vapor barriers may be an effective engineering control for site redevelopment. Therefore vapor barriers are retained for further evaluation.

4.2.3 Soil Removal and Ex-Situ Soil Treatment

Complete Excavation: Complete soil excavation may be effective in treating discrete source areas or hot spots. Its implementability is highly dependent on the volume of the soils that are generated and the availability of treatment and disposal facilities to accept the material. Large volumes of soil can be limiting not only due to high cost, but also due to the short-term impacts associated with truck traffic, noise, dust and odors. Complete excavation is usually combined with other treatment technologies to form a treatment alternative. Although complete excavation is likely to be infeasible at the Site, it is retained to provide for an alternative that would achieve unrestricted use conditions at the Site.

Partial Excavation: Partial excavation may be effective in removing discrete source areas or hot spots. Treatment and disposal options are similar to complete excavation, but may be less limited based on smaller quantities. Partial excavation targets selected areas, hence other corrective measure technologies may need to be implemented in combination with partial excavation to satisfy the corrective action objectives. Partial excavation is retained for use in developing corrective measure alternatives.

Off-Site Disposal: Landfill disposal is a proven effective technology for the management of a wide variety of wastes. Recycling/reuse options may include asphalt batching and daily landfill cover. As discussed in Section 4.1, disposal options for excavated soils are dependent upon the waste characteristics and other considerations such as distance to the facilities. Waste classification and characterization analysis determine whether treatment is required prior to landfill disposal or reuse. Landfill disposal and soil reuse are retained for the development of alternatives involving excavation.

Thermal Desorption: This technology effectively removes constituents from the soils including mercury, PCBs, VOCs and SVOCs. The product of thermal desorption is clean soils that can be reused on the site or in concrete or asphalt mixes. Thermal desorption is widely used in combination with excavation for non-hazardous waste soils. Thermal desorption can be performed on the site using mobile or temporary units, but most often is done off-site at permanent facilities possessing the required permits. Implementability may be limited by the soil type; dry, sandy soils (humidity less than 25%) are easiest to treat. Thermal desorption is retained as a complimentary technology with excavation.

Incineration: Incineration is a proven effective technology for treating organic and many inorganic COCs in soil. Incineration of soil is costly in comparison to other technologies and generally is reserved for hazardous waste soils that cannot otherwise be managed in compliance with RCRA or TSCA requirements. Incineration is retained as a contingency in combination with excavation in the event that other treatment/disposal options are precluded on the basis of waste classification.

Solidification/Stabilization (S/S): S/S is a proven technology to immobilize a variety of COCs (most metals, PCBs and some SVOCs) in a polymeric mass formed from the mix of the binding molecules and soils. Cement-based S/S can be applied on site or soils can be transported and treated in off-site facilities. Implementability depends on the soil particle distribution. Large quantities of fines in the soil mix can potentially hinder the binding process and large aggregate size might jam the mixer. S/S is usually preceded by a process to create a uniform soil mix. As for other ex-situ treatment technologies, large soil volumes can limit the implementability of this technology. Cement-based S/S is retained as a complimentary technology with excavation.

Amalgamation is a fully developed S/S technology and was identified by the USEPA as Best Demonstrated Available Technology (BDAT) for the treatment of elemental mercury (USEPA 1997). However, mercury at the Site is distributed in the organo-chelated fraction with little to no elemental mercury. Hence, amalgamation is not a viable technology for the treatment of site soils.

Encapsulation is another fully developed S/S technology for metals and PCB immobilization. However, it is not considered a viable option for the Site due to the heterogeneity of the site soils.

Soil Washing: Soil washing is a proven technology that has been successfully used in full-scale applications. It is applicable where COCs are associated with fine-grained particles and can be separated to concentrate the volume of material requiring further treatment. Soil washing is not considered an effective treatment option for the Site due to the heterogeneity of the soils and the presence of multiple COCs which may require different solutions to effectively treat.

Soil Leaching: Soil leaching is a proven technology for separating metals from excavated soils. High clay content in the soil mix might limit the effectiveness of the separation process. The effectiveness of this technology is also dependent on the treatment of the resulting washing solution, which is usually a highly acidic solution with concentrated contaminant content. Soil particle size distribution and debris content can limit effectiveness. Implementability is dependent on the volume of soils to be treated. High volume of soils will result in large amount of treating solutions that need further treatment. Soil leaching is not considered an effective treatment option for the Site due to the heterogeneity of the soils and the presence of multiple COCs which may require different solutions to effectively treat.

Ex Situ Bioremediation: This technology is effective for degrading the VOCs and some of the SVOCs at the Site. Bioremediation of PCBs and mercury are developing technologies. Ex-situ bioremediation is typically applied on-site when time and space are available to accommodate treatment. Considering the availability of other, faster acting technologies and the likelihood of site redevelopment, ex-situ bioremediation is not considered to be a viable option and has been eliminated.

Electrokinetics: EK is a developing technology with pilot-scale applications for mercury and metal treatment. There are limited full-scale data for EK applications. The information and data relative to mercury at the Site demonstrate that it is in a relatively immobile form. Hence, EK has been eliminated.

4.2.4 In-Situ Treatment

In-situ technologies treat soils in place. Their effectiveness is dependent on the physical and chemical properties of the COCs such as, volatility, biodegradability, and reactivity, as well as on site conditions such as soil permeability, particle size distribution, and accessibility to the impacted area.

In-Situ Thermal Desorption (ISTD): ISTD is an effective method for treating volatile and semivolatile COCs under a wide range of site conditions. ISTD is applicable to the vadose zone and also to the saturated zone provided that the rate of groundwater flow is not too high or can be controlled. Vapor recovery and treatment is an integral part of the treatment process. ISTD is retained for further evaluation in the CMS.

In-Situ Vitrification (ISV): ISV is an effective method for immobilizing COCs. Metals are proven to be effectively immobilized in the monolithic mass that results from vitrification. The range of effectiveness for ISV is usually 6-12 feet below ground surface. Hence, surface contaminants are not addressed. ISV implementability is dependent on the soil moisture content, which can be controlled. The presence of VOCs requires the implementation of off-gas treatment technologies. There have been a limited number of applications of ISV and pro)blems, including fires, have occurred. ISV is not conducive to site redevelopment because treated soil may take a long time to cool. Based on these limitations, ISV has been eliminated.

Phytoremediation: Phytoremediation is not considered a viable technology for the Site because the depth of treatment is limited and the time required to achieve objectives is long. It also is not conducive to site redevelopment because the vegetation may pose a hazard to humans and wildlife.

Solidification/Stabilization (S/S): Cement-based S/S is a proven effective technology for immobilizing metals and many other COCs. Mixing can be diminished by high content of fines in the soils, debris, and coarse soil particles. Fines can hinder the binding agent from forming a polymeric mass and coarse particles can potentially jam the mixer. Treatability testing can be performed to assess the effectiveness of S/S for the given matrix. Implementability may be hampered by building slabs or subsurface utilities. Cement-based S/S is retained for further evaluation in the CMS.

In-Situ Soil Flushing: Flushing technology is a fully developed technology for the treatment of VOCs, SVOCs and certain metals. As noted in the discussion of soil washing and soil leaching, the site soils are heterogeneous and the various COCs may require different solution to effectively treat. Perched water conditions and lower permeability silt or clay lenses at the Site further inhibit the application of this technology. Accordingly, soil flushing has not been retained.

Soil Vapor Extraction (SVE): SVE is a proven effective technology for removing VOCs and some SVOCs from the vadose zone. SVE also controls vapor migration in the unsaturated zone and potentially may be used to mitigate vapor intrusion. Mercury on site was found distributed in non-volatile forms. Therefore, treatment of mercury vapor is not a concern. SVE implementation is highly dependent on the soil ability to conduct vapor through the soil. Testing conducted as part of implementation of the ROD remedy demonstrated that SVE is not effective due to the low permeability of site soils and/or the presence of perched water zones. Therefore, SVE has been eliminated.

Depressurization System: Depressurization systems are effective engineering controls that can mitigate or eliminate vapor intrusion in new or existing buildings. They are effective methods in controlling hazardous vapors resulting from the reminiscent of the COCs after the application of a treatment technology. Depressurization systems are widely available. They are often installed with combination with vapor barriers. Depressurization systems are retained as they may be applicable to new building construction during site development if testing indicates that vapor intrusion is a potential concern.

In-Situ Chemical Oxidation (ISCO): ISCO is an effective method for transforming a wide range of organics into their mineral forms. Site VOCs, including benzene, may be oxidized by various chemical oxidants including permanganate, ozone, percholorate, or peroxide. ISCO is most often applied within the saturated zone as treatment is dependent upon achieving contact between the oxidants and the COCs. However, it can be applied to the vadose zone under certain conditions and may be applicable to areas of elevated benzene at the Site. ISCO may have an adverse effect on mercury since oxidation could convert mercury to more mobile forms. ISCO is retained for further evaluation in the CMS.

In-Situ Bioremediation: Aerobic biodegradation is potentially applicable to treat benzene in the vadose zone at the Site. Similar to ISCO, in-situ bioremediation typically is applied within the saturated zone. However, bioventing may be applicable to the vadose zone and this technology has been effectively deployed at the Site as part of the ROD remedial actions. Oxygen release compounds, nutrients and/or microorganisms may be applied within the vadose zone by in-situ mixing or percolation of aqueous solutions. Therefore, in-situ bioremediation is retained for further evaluation in the CMS.

4.2.5 Summary of Technology Screening

The technologies that were retained after screening are listed below. These technologies will be used in developing corrective measure alternatives for the Site upon completion of the Phase II RFI.

<u>Retained Technologies</u>

No Action

Containment:

- Caps/Covers
- Vapor Barriers

Soil Excavation and Ex-Situ Treatment:

- Complete Excavation
- Partial Excavation
- Landfill Disposal
- Soil Recycling/Reuse
- Thermal Desorption
- Incineration
- Solidification/Stabilization (cement-based)

In Situ Treatment:

- Stabilization/Solidification (cement-based)
- Thermal Desorption
- Bioremediation
- Chemical Oxidation
- Sub-Slab Depressurization Systems

5. DEVELOPMENT OF ALTERNATIVES

As previously noted, the corrective action objectives described in Section 3.1 are considered preliminary and will be finalized upon completion of the Phase II RFI and receipt of the notification from the NYSDEC specifying the hazardous constituents and target cleanup levels in accordance with HWM Permit Module III, Section E.9.(a).

Based on discussions with the NYSDEC, it is anticipated that the Phase II RFI sampling will include one or more off-site properties. The results of the Phase II RFI may influence the manner in which the technologies retained after screening are applied to develop alternatives that satisfy the corrective action objectives. Therefore, it would be premature to identify the corrective measure alternatives at this juncture. Once the RFI is complete and corrective action objectives are finalized, an addendum to this report will be prepared to describe the proposed corrective measure alternatives for evaluation in Tasks II and III of the CMS. The alternatives will be developed in accordance with the guidelines provided in Appendix III-C of the HWM Permit.

6. SPECIFIC PLANS FOR EVALUATING ALTERNATIVES

The specific plans for evaluating corrective measure alternatives (CMAs) are described in this section. The procedures correspond to Tasks II and III of the CMS as defined in Appendix III-C of the HWM Permit. The approach involves a detailed analysis of the alternatives. The detailed analysis is followed by a comparative analysis leading to recommendation or the optimum corrective measure alternative.

6.1 Detailed Analysis of Alternatives

The detailed analysis of CMAs will follow the criteria set forth in the Scope of Work for a Corrective Measure Study, which has been provided as Appendix III-C of the HWM Permit. The evaluation will begin with a conceptual design of each alternative developed following Task I of the CMS (Section 5.0 of this study). Each alternative will then be evaluated against the criteria.

6.1.1 Conceptual Design of Alternatives

The conceptual design of each alternative will identify the individual components that comprise the alternative. The conceptual design will be developed to a level sufficient to facilitate the evaluation. Preliminary design sheets, if applicable, as well as preliminary information regarding sizing and type of construction for major elements of an alternative will be included. Utilities will be estimated in rough quantities to enable preparation of operation and maintenance costs. Drawings will be provided as applicable for each alternative. For example, alternatives involving removal would include drawings delineating limits of excavation.

6.1.2 Alternative Evaluation

The evaluation of each corrective measure alternative will be based upon the following criteria:

- Technical
- Environmental
- Human health
- Institutional

Each of these criteria is described further in the following sections.

6.1.2.1 Technical. Each corrective measure alternative will be evaluated based upon the following technical factors:

- Performance
- Reliability
- Implementability
- Safety

Performance

Performance considers the effectiveness and useful life of an alternative. Effectiveness will be evaluated based upon the ability of the corrective measure to perform an intended function, such as containment, diversion, removal, destruction or treatment. Technology specific information in combination with specific waste or site characteristics will be utilized in evaluating the performance of the alternative. The performance evaluation will identify the constituents that the CMA is effective in addressing, as well as identify any residual contamination that may remain. Specific waste or site characteristics that could impede the effectiveness of the alternative will be considered.

The useful life of an alternative is defined as the length of time the level of effectiveness can be maintained. When estimating the useful life of a corrective measure, the projected service life of the component technologies will be assessed. This includes an estimate of the resource availability, as well as the appropriateness of the technology (ies), in the future. Data generated from engineering calculations, field studies and groundwater modeling, if appropriate, will be used in evaluating the performance of the CMA.

Reliability

The assessment of the reliability of each CMA will identify the operation and maintenance (O&M) requirements and provide information on the demonstrated and expected reliability of the alternative. O&M requirements include the complexity of operations and the frequency and complexity of necessary maintenance. Alternatives requiring frequent or complex O&M activities will be regarded as less reliable than those requiring little or straight forward O&M. The availability of labor and materials to meet these requirements will also be considered when evaluating the alternatives' reliability.

Alternatives with demonstrated reliability at similar sites will be considered more reliable than alternatives without such proven track records. Expectations of the reliability of an alternative will consider whether failure of any one technology has an immediate impact on receptors, and whether the corrective measure has the flexibility to deal with uncontrollable changes.

Implementability

Implementability addresses the relative ease of installation (e.g., constructability) and the time required to achieve a given level of response. The constructability of an alternative is determined by factors both internal and external to the facility conditions. Examples of internal factors to be considered include the location of underground utilities, depth of water table, heterogeneity of subsurface materials, and location of the facility (i.e., remote location versus congested area).

Examples of external factors that will be considered include the need for permits or approvals to implement the corrective measure and the availability of services and materials. Included under the availability of services and materials are the following considerations:

- Availability of necessary equipment and specialists required for implementation of the corrective measure;
- Availability of adequate off-site treatment, storage, and disposal services as well as transportation services, if required;
- Availability of services and materials required for implementation of the corrective measure; and
- Availability of prospective technologies to be used in the corrective measure.
- The evaluation of implementability will consider measures to facilitate construction under these conditions.

The time to implement the corrective measure will be estimated based on the internal and external factors discussed above. The time element is comprised of the time required to implement the remedy and the time it takes to achieve the corrective action objectives. Under the implementability criterion, corrective measure alternatives will be evaluated in terms of the most likely construction schedule, based on experience at similar sites or on standard engineering procedures. This evaluation will take into account the specific site conditions, necessary safety precautions, and the time required for special studies and other technical steps.

Safety

Each corrective measure alternative will be evaluated regarding safety during the construction and operation phases. The evaluation will assess potential threats to the safety of nearby communities and environs as well as those to workers during implementation. Examples of factors that may be considered include fire, explosion, and exposure to hazardous substances.

6.1.2.2 Human Health. Each alternative will be assessed with regard to protection of human health, both during and after implementation of the corrective measures. The human health assessment will focus on the site conditions and the pathways of contamination addressed (i.e., eliminated, reduced or controlled) by the CMA. The assessment will describe the following:

- Levels and characterizations of the contaminants;
- Potential exposure routes;
- Potentially affected populations; and
- Residual contamination, if applicable.

Data generated in the RFI (May 2007) and that will be generated in RFI Phase II, will be utilized in the evaluation. Each alternative will be assessed in terms of the level of exposure to contaminants and the reduction over time. Where applicable, residual levels will be compared with established criteria, standards, or guidelines.

6.1.2.3 Environmental. An environmental assessment will be conducted for each CMA. As for the human health assessment, the environmental assessment will focus on the site conditions and the pathways of contamination addressed by the alternative.

The evaluation will consider the following factors:

- Short term beneficial and adverse effects of the CMA;
- Long term beneficial and adverse effects of the CMA;
- Potential adverse effects of the alternative on environmentally sensitive areas; and
- Analysis of measures to mitigate adverse effects.

Data generated in the RFI will be utilized in the environmental assessment. Where applicable, residual levels of contamination will be compared with established criteria, standards, or guidelines. Agency guidance on conducting environmental assessments will be consulted, as appropriate, in assessing environmental impacts and the extent to which each alternative mitigates adverse effects on environmental receptors.

6.1.2.4 Institutional. An assessment of the relevant institutional needs of each alternative will be conducted. The institutional evaluation will consider the following:

- Applicable federal, state, and local environmental regulations, standards, and guidance (requirements may be chemical-specific, action-specific, and/or location-specific);
- Public health standards and advisories;
- Local ordinances; and
- Community relations.

The evaluation will describe the institutional considerations for each alternative and how well the alternative satisfies the requirements or concerns.

6.1.3 Cost Estimate

A cost estimate will be prepared for each corrective measure alternative. In estimating costs, a distinction will be made between capital and O&M costs. Capital costs will include direct and indirect costs. Direct costs include expenditures necessary to install corrective measures and may include construction costs (materials, labor, and equipment), equipment purchase costs, land and site-development costs, buildings and service costs, relocation expenses, and disposal costs. Indirect costs may include engineering expenses, license or permit costs, startup and shakedown costs, contingency allowances, and other costs that are not part of actual construction but are necessary to complete the installation.

O&M costs will include post-construction costs necessary for the continued effectiveness of a corrective measure. O&M cost components may include operating labor costs, maintenance materials and labor costs, auxiliary materials and energy, disposal of residues, purchased services, administrative costs, costs for permit renewals, insurance costs, rehabilitation costs, costs for inspection and reporting, and contingency funds. Cost estimates will be based on vendor estimates, standard costing guides, and/or experience from similar projects. Appropriate cost indices will be consulted if updating of cost estimates becomes necessary.

A net present value (NPV) analysis will be conducted to evaluate expenditures that occur over different time periods. This analysis will be based on a discount rate of 5 percent before taxes and after inflation. The period of performance for costing purposes will be 30 years or less, depending on the implementation times of the alternatives. The NPV analysis will allow the cost of each alternative to be compared on an equivalent datum (i.e., maintenance intensive alternatives can be directly compared to capital intensive alternatives).

The accuracy of the cost estimates will be consistent with the available data base and the level of alternative development attained in the CMS. Typically, the cost estimates will provide an accuracy of + 50 percent to -30 percent. However, it may not be realistic to achieve this accuracy in all cases. If there is sufficient uncertainty concerning specific assumptions, a sensitivity analysis may be performed to assess the effect that variations in specific assumptions can have on the estimated cost. This is especially important where a small change in a parameter for which there is a high degree of uncertainty can significantly change the overall cost of an alternative. After completing the sensitivity analysis, the most probable value for the parameter will be selected and the rationale for its selection will be documented in the CMS report.

6.2 Comparative Analysis of Alternatives

A summary table that includes the identified CMA will be prepared. Tradeoffs among health risks, environmental effects, and other pertinent factors will be highlighted. The CMA evaluation presented in the previous section will be highlighted in the table. The table will include a summary of the following criteria:

- Technical:
  - Performance
  - Reliability
  - Implementability
- Safety
- Human Health
- Environmental

7. SCHEDULE AND SUBMITTALS

The schedule for conducting the CMS is shown in the table below. The schedule takes effect upon receipt of the Phase II RFI Report and CMS Plan approvals. The estimated timeframes to complete each task of the CMS are shown. The estimates do not include time associated with NYSDEC reviews and responding to comments. Task I has been partially completed in CMS Plan. Corrective action objectives will be finalized and corrective measure alternatives identified upon completion of Phase II RFI and receipt of notification from NYSDEC specifying the hazardous constituents to be evaluated in the CMS and target cleanup levels. An addendum to the CMS Plan and Task I Report will be submitted to the NYSDEC for review and approval.

Once the CMS Plan and Task I Report are approved, work on Task II of the CMS will commence. A 90-day period has been estimated to perform the detailed analysis of alternatives. If deemed necessary for the CMS, pilot and/or bench testing may be proposed for one or more technologies to assess their effectiveness and implementability. Depending upon the nature and duration of such testing, the schedule for Task II may need to be extended.

The comparative analysis of alternatives (CMS Task III) will be performed after completing Task II. A 45-day timeframe has been estimated for the completion of this task.

The reports task (Task IV) includes progress reports and the final report. The progress reports will include a description of work completed during the reporting period, summaries of all changes made, summaries of all contacts made with local community and public interest groups, changes in managing personnel conducting the activities during the reporting period and projected work for the next reporting period. The final report will document Tasks II and III of the CMS and include the recommended corrective measures. The format and content of this report is described in following section.

Activity	Pre-requisite Activities	Estimated Duration
Complete CMS Task I[1]	1. NYSDEC Approval of Phase II RFI Report 2. NYSDEC Approval of CMS Plan	60 days
CMS Task II	NYSDEC Approval of Task I	90 days
CMS Task III	CMS Task II[2]	45 days
CMS Task IV	CMS Task III[3]	45 days[3]

Notes:

1. Partial CMS Task I Report submitted with CMS Plan. Corrective action objectives to be finalized and corrective measure alternatives identified upon completion of Phase II RFI and receipt of notification from NYSDEC specifying the hazardous constituents to be evaluated in the CMS and target cleanup levels.
2. CMS Task II and III to be addressed in monthly progress reports pursuant to Module III, Section B.8 of the Hazardous Waste Management Permit.
3. As required by Module III, Section E.11 of the Hazardous Waste Management Permit.

8. REPORT FORMAT

The CMS report will present the detailed and comparative evaluations performed under Tasks II and III of the CMS. Each alternative will be described in sufficient detail to support the evaluation. A conceptual design will be presented using a combination of drawings, tables and/or text. The detailed evaluation will be summarized in tabular format and described in the text. The cost estimate for each alternative will be presented in a separate table, which will include the capital cost, operation and maintenance costs, and assumptions made to estimate the costs. The comparative analysis of alternatives (Task III) will be summarized in tabular format and described in the text. Supporting information such as product information, treatability data or modeling output (if performed), technical publications and cost references will be appended to the report.

CMS PLAN & TASK I REPORT FORMER NEPERA PLANT SITE

9. REFERENCES

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TABLES

TABLE 4-1
IDENTIFICATION OF CORRECTIVE MEASURE TECHNOLOGIES
NEPERA SITE – HARRIMAN, NEW YORK

Technology	Constituent Type Hg	M	PCB	VOC	SVOC	Development Status
No Action						
Containment						
Caps/Covers						
1. Soil/clay	A	A	A	A	A	X
2. Membrane	A	A	A	A	A	X
3. Composite	A	A	A	A	A	X
4. Concrete, Asphalt, & Soil Cement	A	A	A	A	A	X
Vapor Barrier	S	I	-	A	S	X
Soil Excavation and Ex-Situ Treatment						
Soil Excavation:						
1. Complete soil removal	A	A	A	A	A	X
2. Partial soil removal (“hot spots”)	A	A	A	A	A	X
Ex–Situ Soil Treatment/Disposal:						
Land Disposal	A	A	A	A	A	X
Recycling/Reuse	A	A	A	A	A	X
Soil Washing	A	A	A	A	A	X
Thermal Desorption	A	S	A	A	A	X
Incineration	A	S	A	A	A	X
Solidification/Stabilization						
1. Amalgamation	S	I	I	-	-	X
2. Encapsulation	A	A	A	-	S	X
3. Cement based	A	A	A	-	S	X
Soil Leaching						
1. Acid (Oxidizing Acids: HNO_3, $HClO$, H_2SO_4)	A	A	-	-	-	X
2. Iodine/Iodide	A	A	-	-	-	X
Soil Bioremediation	-	-	-	A	A	X
In-Situ Treatment						
Electrokinetic Separation	A	A	-	-	-	Y
Vitrification	S	A	I	-	-	Y
Thermal Desorption	S	-	I	A	S	X
Phytoremediation	S	S	I	I	I	X
Stabilization/Solidification (cement-based)	A	A	I	I	I	X
Soil Flushing	-	S	A	A	A	Y
Soil Vapor Extraction	-	-	-	A	S	X
Depressurization Systems	-	-	-	A	S	X
Chemical Oxidation	I	I	A	A	A	X
Bioremediation:						
Aerobic(Oxygen Release Compound, Bioventing)	-	S	-	S	S	X
Anaerobic (HRC®, Molasses)	-	S	I	S	S	X

A = applies, S = applies to some compounds of this class, I = indirect or partial benefit.
Development Status: X = fully developed, reported full scale applications; Y = Developing: has been applied at full scale but still needs improvement;
Z = Not fully implemented but has been tested (pilot and bench) and appears promising.
Hg: Mercury; M: Metal; PCB: Polychlorinated Biphenyls; VOC: Volatile Organic Compound; SVOC: Semi Volatile Organic Compound.

TABLE 4-2
SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES
NEPERA SITE – HARRIMAN, NEW YORK

GENERAL RESPONSE ACTION	TECHNOLOGY	CONSTITUENT(S) ADDRESSED	REMEDIAL CONSIDERATIONS	RETAIN/ELIMINATE (BASIS)
I. No Action	N/A	N/A	N/A	For comparative purposes only
II. Containment	A. Capping (Permeable) 1. Soil 2. Asphalt 3. Concrete 4. Structures	norganics, SVOCs, PCBs, and VOCs	– Limits direct contact and migration via erosion or dust – Some materials (e.g., asphalt, concrete) also reduce infiltration minimizing leaching of constituents from the vadose zone – Institutional and engineering controls are usually implemented along with cover	**Retain** – Technology addresses site constituents and media of concern
	B. Capping (Low Permeability) 1. Clay 2. Membrane 3. Composite	Inorganics, SVOCs, PCBs, and VOCs	– Limits direct contract and migration via erosion or dust – Restricts infiltration minimizing leaching of constituents from the vadose zone – Restricts upward movement of vapors – Institutional and engineering controls are usually implemented along with capping	**Retain** – Technology addresses site constituents and media of concern
	C. Vapor Barriers	VOCs, Volatile Inorganics	– Controls vapor intrusion into developments and structures – Easier to apply with new building construction, but can be applied to existing buildings in many cases – Often used in combination with depressurization system	**Retain** – Consideration for site redevelopment
III. Soil Removal and Ex-Situ Treatment/ Disposal	A. Excavation 1. Complete Excavation	Inorganics, SVOCs, PCBs, and VOCs	– Addresses source area, but requires location for final disposition of a very large quantity of material – Treatment of excavated material might be required prior to land disposal – Measures to control runoff and soil erosion would be needed during excavation activities – Measures may also be needed to control release of volatiles or contaminated dust	**Retain** – Technology addresses site constituents and media of concern – Permit Module III requires evaluation of at least one alternative that treats or removes all soil with constituent concentrations above unrestricted use standards

TABLE 4-2
SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES
NEPERA SITE – HARRIMAN, NEW YORK

GENERAL RESPONSE ACTION	TECHNOLOGY	CONSTITUENT(S) ADDRESSED	REMEDIAL CONSIDERATIONS	RETAIN/ELIMINATE (BASIS)
	2. Partial Excavation		– Applicable only if definable hot spots exist that can be separately addressed – Institutional and engineering controls are usually implemented with partial excavation	**Retain** – Potentially applicable to PCBs and VOCs; mercury and SVOCs are not present as isolated hot spots at the site
	B. Ex-Situ Treatment/Disposal 1. Land Disposal a. Landfill b. Recycling/Reuse		– Requires waste characterization to determine the regulatory classification of the waste – May require treatment prior to disposal or recycling/reuse – Feasibility of transport and disposal is dependent on the volume of the waste generated	**Retain** – Retained for combination with excavation
	2. Soil Washing	Inorganics, SVOCs, PCBs, and VOCs	– Wide variety of constituents may result in difficult formulation of washing fluid – Technology reduces the volume of contaminants, but results in fines with high concentrations of contaminants – Washing fluid would require further treatment – Technology more efficient when contamination is concentrated in a relatively small volume of soil (not widely dispersed).	**Eliminate** – Heterogeneous fill material would hinder the separation and washing processes – Inefficient for high material volume with relatively low constituent concentrations
	3. Thermal Desorption/ Retorting	Volatile Inorganics, SVOCs, PCBs, and VOCs	– Usually preceded by a physical process to produce a uniform feed material – Might require concentrating or diluting the feed before processing in the thermal unit – High levels of chlorine or chlorinated organics may hinder the process treatment or result in the formation of acidic gases – Requires off-gas treatment	**Retain** – Retained for combination with excavation
	4. Incineration	Inorganics, SVOCs, PCBs, and VOCs	– Applicable to RCRA hazardous wastes or TSCA PCB wastes that otherwise cannot be treated by thermal desorption	**Retain** – Retained as contingency in combination with excavation in the event that other options (thermal desorption, landfill disposal) are not permitted based on waste characterization

TABLE 4-2
SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES
NEPERA SITE – HARRIMAN, NEW YORK

GENERAL RESPONSE ACTION	TECHNOLOGY	CONSTITUENT(S) ADDRESSED	REMEDIAL CONSIDERATIONS	RETAIN/ELIMINATE (BASIS)
	5. Solidification/Stabilization a. Cement based b. Encapsulation: bitumen (Asphalt) c. Amalgamation	Inorganics, SVOCs, PCBs, and VOCs	– Requires uniform mixing of the soil with the solidifying agent – Soil sizes that are very fine might hinder the binding of the agent and large soil aggregates might jam the mixer; debris separation step may be required – Off-gas treatment may be required for VOCs or mercury – Amalgamation was selected by EPA as Best Demonstrated Available Technology (BDAT) for elemental mercury	**Retain (Cement Based)** – Retained for combination with excavation if required for land disposal or reuse of excavated materials **Eliminate (Encapsulation)** – Heterogeneity of site soils could be a major limiting factor **Eliminate (Amalgamation)** – Mercury at the site is not present in the elemental form
	6. Soil Leaching a. Acid b. Iodide	Inorganics	– Technology separates metal species from soils into a solution – Additional steps are needed to separate metal species from resulting solution; if acid is used neutralization would be needed – Physical processing prior to chemical treatment might be needed to create a uniform material	**Eliminate** – Heterogeneous fill material would hinder the separation and washing processes – Inefficient for high material volume with relatively low contaminant concentrations
	7. Bioremediation a. Soil Pile b. Land Farming	SVOCs and VOCs	– Technology creates conditions that enhance natural degradation processes by adding oxygen, moisture, nutrients and/or specific microorganisms – Typically performed on site when space and time are available to accommodate treatment	**Retain** – Retained for combination with excavation; potentially applicable for treatment of BTEX and some SVOCs
IV. In-Situ Treatment	A. Electrokinetic Separation	Inorganics	– Technology often combined with other separation/removal methods, e.g., Lasagna ®, excavation – Highly dependent on the moisture content of the soils – Mobility and solubility of constituents may limit the application of the technology	**Eliminate** – Limited track record of full-scale applications – Mercury is in a relatively immobile form

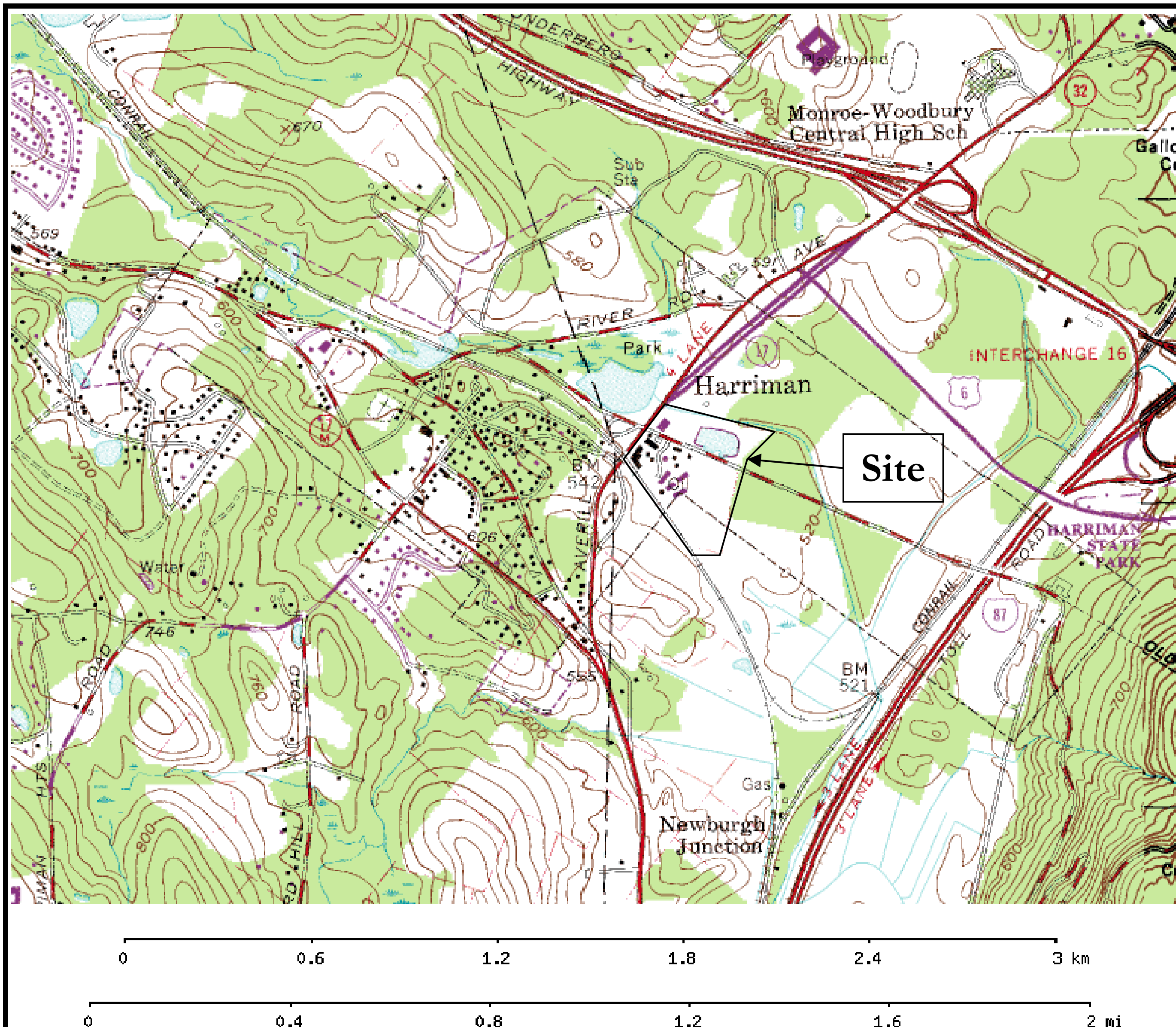
TABLE 4-2
SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES
NEPERA SITE – HARRIMAN, NEW YORK

GENERAL RESPONSE ACTION	TECHNOLOGY	CONSTITUENT(S) ADDRESSED	REMEDIAL CONSIDERATIONS	RETAIN/ELIMINATE (BASIS)
	B.Thermal Desorption	VOCs, SVOCs, PCBs, and volatile metals	– Effective for treating COCs under a wide range of site conditions	**Retain** – Potentially applicable if discrete areas of higher COC concentrations are to be treated in situ.
	C. In Situ Vitrification	Inorganics, SVOCs, PCBs, and VOCs	– Off-gases released during melting process, containing volatile components and products of combustion and pyrolysis, must be collected and treated – A small path of graphite might need to be placed between electrodes in case of dry soils – Volatility of mercury might be a limiting factor for this technology – Existing utilities within 20 ft must be protected – Not applicable to sites where redevelopment/reuse is planned	**Eliminate** – Technology is not effective for soil in the upper 6 feet – Not conducive to site redevelopment
	D. Phytoremediation	Inorganics, SVOCs, PCBs, and VOCs	– Acts by stabilizing or absorbing the constituents – Can be used to reduce groundwater migration – Generates biomass concentrated with contaminants, which must be disposed of off-site – Limited depth of effectiveness – Slow process – May not be applicable where redevelopment/reuse is planned	**Eliminate** – Cannot treat deeper soils – Slow process that is not conducive to site redevelopment – Groundwater remediation is being performed under the ROD.
	E.Stabilization/Solidification	Inorganics, SVOCs, PCBs, and VOCs	– Technology reduces the mobility of contaminants – Process requires mixing and off-gas treatment; achievement of complete and uniform mixing may be challenging due to heterogeneous fill material and subgrade structures – Soil sizes that are very fine might hinder the binding of the agent and large soil aggregates might jam the mixer	**Retain** – Potentially applicable if areas of higher contaminant mobility are identified or to stabilize low strength materials
	F. In Situ Soil Flushing	Inorganics, SVOCs, PCBs, and VOCs	– Technology will include installation of extraction/injection wells and drainage ditches and treatment of the flushing solution – Has been successfully applied for organics; some pilot-scale tests for metals (chromium) – Treatment of the recirculated flushing solution is needed	**Eliminate** – Heterogenous fill and perched zones limit effectiveness – Mercury is in a relatively immobile form

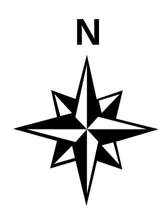
TABLE 4-2
SCREENING OF CORRECTIVE MEASURE TECHNOLOGIES
NEPERA SITE – HARRIMAN, NEW YORK

GENERAL RESPONSE ACTION	TECHNOLOGY	CONSTITUENT(S) ADDRESSED	REMEDIAL CONSIDERATIONS	RETAIN/ELIMINATE (BASIS)
	G. Vapor Extraction 1. Soil Vapor Extraction (SVE)	SVOCs and VOCs	– Technology applicable for volatile constituents within the unsaturated zone – Air/vapor emission control usually required – Pilot test previously conducted under ROD and proved ineffective due to perched groundwater zone – Fracturing methods and/or dewatering can be applied with SVE to enhance effectiveness	**Eliminate** – SVE was demonstrated to be ineffective in pilot testing conducted as part of ROD Remedy implementation
	2. Depressurization Systems	SVOCs and VOCs	– Controls vapor intrusion – Easier to apply with new building construction, but can be installed beneath existing buildings in many cases	**Retain** – Consideration for site redevelopment
	H. Chemical Oxidation	SVOCs, PCBs, and VOCs	– Typically applied in the saturated zone; may be applied for unsaturated zone if contact is established between constituents and oxidant – Site hydrogeologic conditions might be a limiting factor – Potential of transforming mercury into ionic form which is more leachable	**Retain** – Potentially applicable to treat VOCs in vadose zone depending on local conditions (permeability and presence/absence of perched water)
	I. Bioremediation 1. Aerobic (various methods including oxygen release compounds, oxygen diffusion and bioventing/ biosparging)	SVOCs and VOCs	– Technology generally applied to treat constituents in the saturated zone – Some process options have applicability to the vadose zone, but typically are applied ex situ – Bioventing is being applied under the ROD to treat BTEX in central portion of plant site	**Retain** – Potentially applicable to treat VOCs in vadose zone depending on local conditions (permeability and presence/absence of perched water)
	2. Anaerobic (various methods including hydrogen release compounds)	SVOCs, PCBs, and VOCs	– Technology generally applied to treat constituents in the saturated zone – Common application is for reductive dechlorination of VOCs and to reduce certain metals	**Eliminate** – Technology not applicable to site contaminants

FIGURES



Source: Harriman, NY, 7.5' Quadrangle Map, (USGS, 1991)
from www.topozone.com



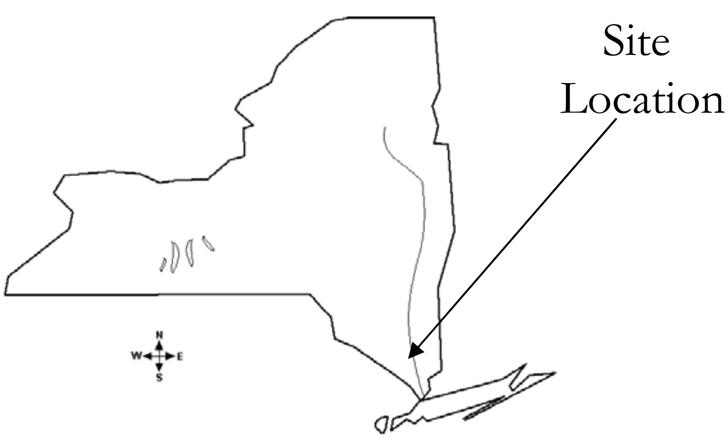


FIGURE 2-1

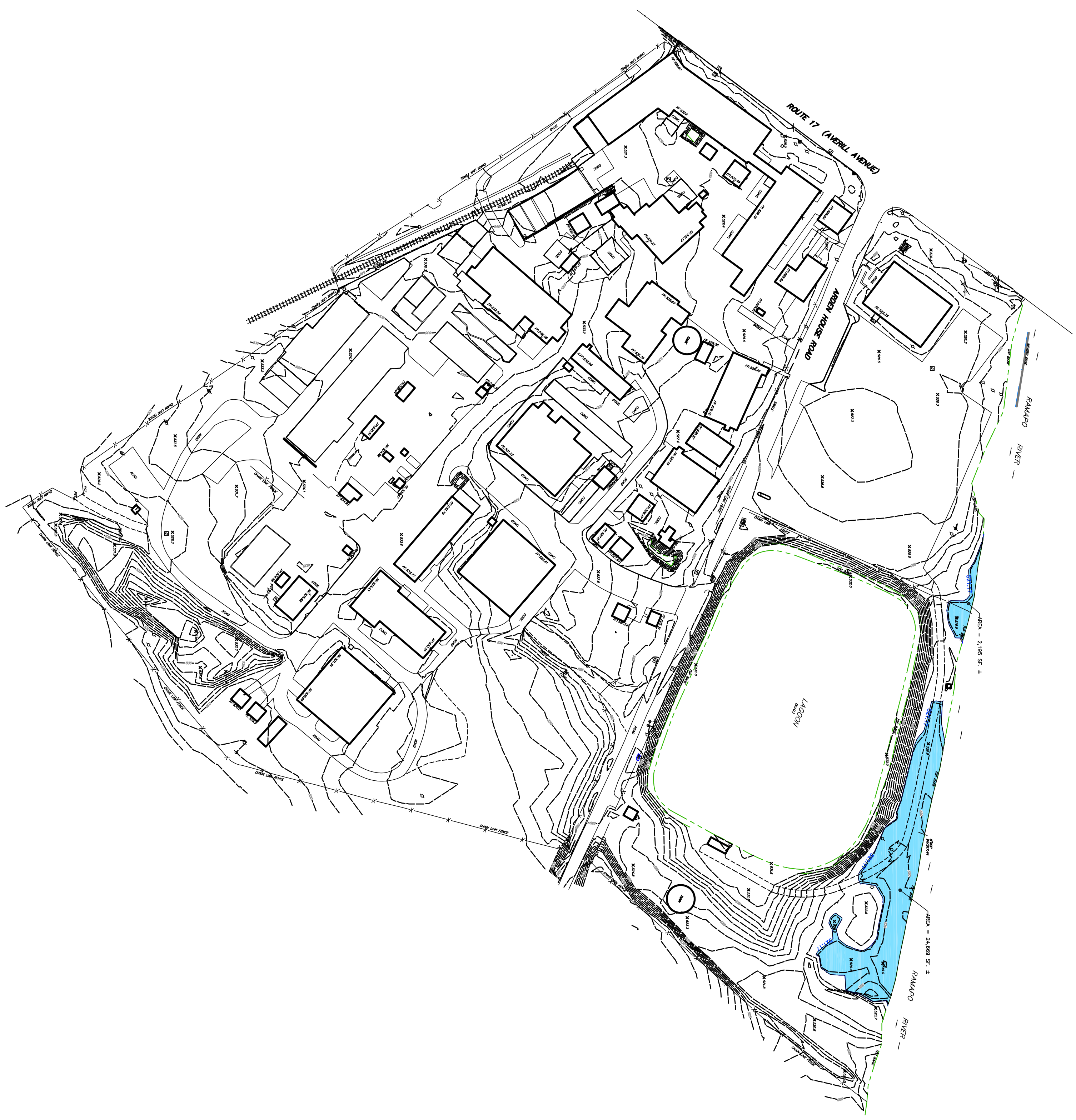
SITE LOCATION

Former Nepera Plant Site
Harriman., Orange Co., New York

BROWN AND CALDWELL

\\bcmah01\projects\^Clients\Nepera\Harriman\130150(RCRA_Closure)\Work_Plan\Figures(Sampling)\Fig1(Site_Loc_Map).ppt

P:\DRAFTING\NEPERA\133664\TOPO_506AL_V2004-100YRFLOOD FIGURE-2-2.DWG 10/19/2007 03:26:57PM By:RJames XREFS: Layout: LAYOUT



LEGEND:

- EXISTING UTILITY POLE
- EXISTING UTILITY POLE W/ LIGHT
- EXISTING BANK
- EXISTING GUIDERAIL
- EXISTING FENCE
- EXISTING MAJOR CONTOUR (520)
- EXISTING MINOR CONTOUR
- 100 YEAR FLOOD PLAIN LIMIT
- EXISTING BUILDING

NOTES:

1. SURVEY AND CONTOUR INFORMATION FROM SITE SURVEY BY THE CHAZEN COMPANIES, APRIL 2007.

2. FLOOD PLAIN ELEVATION PROVIDED BY FEDERAL EMERGENCY MANAGEMENT AGENCY DOCUMENT "FLOOD INSURANCE STUDY, VILLAGE OF HARRIMAN, NEW YORK, ORANGE COUNTY, MARCH 1, 1983.

0 100 200
SCALE IN FEET

BROWN AND CALDWELL ASSOCIATES
ALLENDALE, NEW JERSEY

SUBMITTED: ____________ DATE: ________
PROJECT MANAGER

APPROVED: ____________ DATE: ________
JEFF CAPUTI
BROWN AND CALDWELL

LINE IS 2 INCHES AT FULL SIZE (IF NOT 2" - SCALE ACCORDINGLY)

DESIGNED:
DRAWN:
CHECKED:
CHECKED:
APPROVED:

REVISIONS

ZONE	REV.	DESCRIPTION	BY	DATE	APP.

FIGURE 2-2
100 YEAR FLOOD PLAIN AREA

NEPERA, A DIVISION OF RUTHERFORD CHEMICALS LLC
HARRIMAN, NEW YORK

FILENAME
N/A
BC PROJECT NUMBER
133664.001
CLIENT PROJECT NUMBER
N/A
DRAWING NUMBER
N/A
SHEET NUMBER
1 OF 1