REPORT

Focused Corrective Measures Study

Koppers Inc. Wood-Treating Facility Superior, Wisconsin

Beazer East, Inc.
Pittsburgh, Pennsylvania

March 2004

BLASLAND, BOUCK & LEE, INC.
engineers, scientists, economists

Certification

I, Stephen Garbaciak, Jr., hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E 4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch. A-E 8, Wis. Adm. Code; and that, to the best of my knowledge, all information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code.

Stephen Garbaciak, Associate E-34840-006

Signature, Title and P.E. Number

WISCONSIN PROFESSIONAL ENGINEER STEPHEN D. GARBACIAK, JR. E-34840-006 MOKENA IL

P.E. Stamp

Certification

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted, is to the best of my knowledge and belief, true, accurate and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

I, Robert J. Anderson, hereby certify that I am a hydrogeologist as defined in s. NR 600.03, Wis. Adm. Code, and that to the best of my knowledge all information contained in this document is correct.

Robert J. Anderson, P.G., V.P.

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Acronyms and Abbreviations

AMEC	AMEC Earth & Environmental, Inc.
BBL	Blasland, Bouck & Lee, Inc.
CAMU	Corrective Action Management Unit
CAO	Corrective Action Objective
CMI	Corrective Measures Implementation
CMS	Corrective Measures Study
COPC	Constituent of Potential Concern
DNAPL	Dense Non-Aqueous Phase Liquid
DMZ	Design Management Zone
EI	Environmental Indicator
ES	Enforcement Standard
HDPE	High Density Polyethylene
HHRA	Human Health Risk Assessment
KI	Koppers Inc.
LDR	Land Disposal Restrictions
PAH	Polycyclic Aromatic Hydrocarbons
PAL	Preventive Action Limit
RCRA	Resource Conservation and Recovery Act
RETEC	The RETEC Group, Inc.
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
SCM	Site Conceptual Model
SWMU	Solid Waste Management Unit
USEPA	United States Environmental Protection Agency
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System

Executive Summary

As part of the ongoing Resource Conservation and Recovery Act (RCRA) Corrective Action activities at the Koppers Inc. (KI; formerly known as Koppers Industries, Inc., or KII) wood-treating facility in Superior, Wisconsin (Figure 1), this Focused Corrective Measures Study (CMS) Report has been prepared to identify and evaluate corrective action alternatives to address impacted portions of the Site within and adjacent to the facility boundary (referred to as "on-property" areas). Blasland, Bouck & Lee, Inc. (BBL) and AMEC Earth & Environmental, Inc. (AMEC) prepared this report on behalf of Beazer East, Inc. (Beazer), who retains certain environmental liabilities as a result of historical property ownership and business transactions.

The areas targeted by this Focused CMS Report include on-property soils, the on-property portion of the Outfall 001 drainage ditch (to the first culvert downstream from the facility boundary), and on-property groundwater. The specific soil areas were developed based on the findings of the *Post-Remediation Human Health Risk Assessment* (Post-Remediation HHRA; AMEC, 2004), which is summarized in Section 4.3 and provided as Appendix A to the Focused CMS Report. The targeted portion of the Outfall 001 drainage ditch was identified as a proactive measure. Specifically, in anticipation of the potential for future corrective action activities in downstream portions of the Outfall 001 drainage ditch (to be evaluated separately), corrective action for the on-property portion of the ditch is contemplated to mitigate the potential future migration of impacted soils and/or potentially mobile dense, non-aqueous phase liquids (DNAPL) that might be present in this area.

This CMS Report is termed "focused" in that it does not extensively evaluate a broad range of potentially applicable corrective action technologies. Rather, based on Beazer's 20-plus years of experience at evaluating and implementing corrective action alternatives at numerous sites impacted by wood-treating operations across the country, the CMS focuses on technologies and alternatives that are known to be successful at addressing similar conditions at other wood-treating sites. This results in a focused set of potential corrective action alternatives for soils and for the portion of the Outfall 001 drainage ditch addressed by this CMS. With respect to groundwater, this report is "focused" in that it does not include identification and evaluation of multiple alternatives. Instead, it reiterates and supports the use of a monitoring-based approach as previously described in the *RCRA Facility Investigation Report, Soil and Groundwater, Koppers Industries, Inc., Superior, Wisconsin* (Phase III RFI Report; Fluor Daniel GTI, 1997).

The Site-specific Corrective Action Objectives (CAOs) applicable to the portions of the Site addressed within this Focused CMS Report are summarized as follows:

On-Property Soils

- Mitigate direct contact by potential receptors to surface soil containing constituents of potential concern (COPCs) at concentrations that may affect human health; and
- Minimize potential offsite migration of COPCs through dissolved phase transport (groundwater) or erosion (surface water).

On-Property Portion of the Outfall 001 Drainage Ditch

- Minimize the potential for direct contact with drainage ditch materials containing COPCs; and
- Minimize the potential for downstream migration of COPCs via the Outfall 001 drainage ditch.

On-Property Groundwater

- Demonstrate, through groundwater monitoring at the downgradient property boundary in the discontinuous sand lenses and bedrock, that COPCs are not migrating offsite at concentrations exceeding an appropriate Prevention Action Limit (PAL) or Enforcement Standard (ES).

Considering the Site Conceptual Model, Site-specific CAOs, the findings of the Post-Remediation HHRA, and the results of a technology screening, three corrective action alternatives were developed for on-property soils, and three alternatives were developed to address the on-property portion of the Outfall 001 drainage ditch. In addition, support for the monitoring-based program originally proposed in the Phase III RFI Report to address on-property groundwater is provided. The corrective action alternatives developed for evaluation in this report are as follows:

Alternative	Key Components
Alternatives for On-Property Soils	
Alternative S-1 – Surface Cover	• Install a surface cover over the targeted soil areas; • Conduct periodic post-construction inspections and maintenance; and • Establish institutional controls, including the baseline deed restriction (described in Section 5.4 of the Focused CMS Report) and measures to provide for the continued integrity of the surface cover.
Alternative S-2 – Excavation with Onsite Corrective Action Management Unit (CAMU) Disposal	• Construct a CAMU containment cell in a designated area of the Site (as described in Section 5.5 of the Focused CMS Report); • Excavate impacted soils in the targeted area; • Consolidate excavated materials within the CAMU containment cell; • Backfill and restore the excavation areas to re-establish original surface grades and uses; • Conduct periodic post-construction inspections and maintenance; and • Establish institutional controls, including the baseline deed restriction (described in Section 5.4 of the Focused CMS Report) and additional alternative-specific measures to provide for the continued integrity of the alternative.
Alternative S-3 – Excavation with Offsite Disposal at a Commercial Facility	• Excavate impacted soils in the targeted area; • Transport excavated materials to an appropriately permitted offsite commercial land disposal facility; • Backfill and restore the excavation areas to re-establish original surface grades and uses; • Conduct periodic post-construction inspections and maintenance; and • Establish the baseline deed restriction as described in Section 5.4.
Alternatives for the On-Property Portion of the Outfall 001 Drainage Ditch	
Alternative D-1 – Culverting the Existing Ditch	• Install a high permeability zone (e.g., crushed stone) with periodic sumps along the bottom of the existing ditch; • Install a culvert along the bottom of the on-property portion of the Outfall 001 drainage ditch; • Conduct periodic post-construction inspections to verify the continued effectiveness of the performance of the remedy; and • Establish institutional controls, including the baseline deed restriction (described in Section 5.4 of the Focused CMS Report) and additional alternative-specific measures to provide for the continued integrity of the alternative (as necessary).

Alternative	Key Components
Alternative D-2 – Excavation and Disposal of Drainage Ditch Materials	• Excavate impacted materials along the on-property portion of the Outfall 001 drainage ditch; • Restore excavated channel area to re-establish existing grades and function; • Conduct periodic post-construction inspections to verify the performance of the remedy; and • Establish institutional controls, including the baseline deed restriction (described in Section 5.4 of the Focused CMS Report) and additional alternative-specific measures to provide for the continued integrity of the alternative (as necessary).
Alternative D-3 – Ditch Relocation with DNAPL Migration Control Measures	• Relocate the on-property portion of the Outfall 001 drainage ditch to the north of its existing location; • Install a DNAPL collection system in the existing ditch; • Conduct periodic post-construction inspections to verify the performance of the remedy; and • Establish institutional controls, including the baseline deed restriction (Section 5.4) and additional alternative-specific measures to provide for the continued integrity of the alternative (as necessary).
Groundwater	• Groundwater monitoring at the downgradient property boundary and decommissioning A-zone monitoring wells that are not part of the monitoring network.

These alternatives, which are described in Section 5, were evaluated relative to the six criteria defined in Sections NR 722.07(4) and NR 722.09(2) of the Wisconsin Administrative Code: long-term effectiveness; short-term effectiveness; implementability; restoration time frame; economic feasibility; and compliance with environmental laws, standards, and permitting requirements. The result of this evaluation was the selection of an overall corrective approach for the on-property portion of the Site. The selected alternative for each area and medium targeted for corrective action are as follows:

- Installing a surface cover to address targeted on-property soils (Alternative S-1);
- Culverting the targeted portion of the Outfall 001 drainage ditch (Alternative D-1);
- Conducting groundwater monitoring focused at the downgradient facility boundary; and
- Establishing institutional controls, including the baseline deed restriction plus alternative-specific controls associated with the use of a surface cover to address soils.

Taken together, installing a surface cover over on-property surface soils targeted for corrective action, culverting the on-property portion of the Outfall 001 drainage ditch, and conducting a groundwater monitoring program focused at the downgradient property boundary will achieve all the Site-specific CAOs and the risk-based objectives established in the Post-Remediation HHRA. Further, this approach is effective over both the short and long term, is implementable, can be completed in a reasonable time frame for a reasonable cost, and can meet the requirements outlined in applicable environmental laws, standards, and permits. Therefore, this approach meets the alternative selection requirements of NR 722.09.

Following approval of the selected corrective action approach by the Wisconsin Department of Natural Resources (WDNR), Beazer will conduct additional activities and investigations to provide the necessary information to design and implement the corrective action approach. The corrective action activities will then be designed, the appropriate permits and approvals will be sought, and pertinent design and implementation details will be presented to the WDNR in a Corrective Measures Implementation (CMI) Plan. It is Beazer's overall goal for the Site, consistent with their pledge to meet the United States Environmental Protection Agency's environmental indicators (EI) for human health and groundwater, to complete the on-property corrective actions by the end of 2005.

1. Introduction

1.1 Purpose and Scope

This Focused Corrective Measures Study (CMS) Report has been prepared as a component of the ongoing Resource Conservation and Recovery Act (RCRA) Corrective Action activities at the Koppers Inc. (KI; formerly known as Koppers Industries, Inc., or KII) wood-treating facility in Superior, Wisconsin (Figure 1). While operated by KI, Beazer East, Inc. (Beazer) retains certain environmental liabilities as a result of historical property ownership and business transactions. On behalf of Beazer, this Focused CMS Report has been prepared by Blasland, Bouck & Lee, Inc. (BBL) and AMEC Earth and Environmental, Inc. (AMEC) for submittal to the Wisconsin Department of Natural Resources (WDNR).

This Focused CMS Report is based upon the findings of various investigations conducted at the facility since 1981, including the RCRA Facility Investigation (RFI) activities conducted in 1990 and 1996. Among other pertinent findings, the previous investigations indicate the presence of wood-treating-related compounds in certain environmental media at the facility (i.e., within the property owned by KI), as well as within and adjacent to a downgradient ditch and creek on nearby properties. The facility and the affected downgradient areas are collectively referred to herein as "the Site." Based on the findings of previous investigations, the primary constituents of potential concern (COPCs) with respect to the Site are polycyclic aromatic hydrocarbons (PAHs) and pentachlorophenol.

The purpose of this Focused CMS Report is to identify and evaluate potential corrective action alternatives to address impacted portions of the Site and, ultimately, to identify a recommended corrective action approach. To this end, various potential corrective action alternatives are identified in consideration of previous investigation data, current and future land uses, Site-specific factors, corrective action objectives (CAOs) that have been established for the Site, and previous coordination with the WDNR. The scope of the corrective action alternatives is also based on the findings of the Post-Remediation Human Health Risk Assessment (Post-Remediation HHRA; AMEC, 2004), which is further discussed within this Focused CMS Report and provided as Appendix A. The evaluation of corrective action alternatives was performed using criteria established in Section NR 722 of the Wisconsin Administrative Code (Standards for Selecting Remedial Actions).

While previous investigations indicate potential wood-treating-related impacts both within and downgradient of the facility boundaries, this focused CMS addresses only that portion of the Site within and immediately adjacent to the facility boundary (hereafter referred to as "on-property" areas). This is based on the consideration that sufficient information exists for this portion of the Site upon which to identify and evaluate potential corrective action alternatives. By comparison, additional investigations are anticipated in the off-property areas to supplement the existing data and facilitate a more thorough evaluation of those areas. In lieu of delaying corrective actions for the on-property areas pending further investigation of the off-property areas, this Focused CMS Report has been prepared to specifically address only the on-property portions of the Site. Off-property portions of the Site will be separately addressed. This approach was discussed with and approved by the WDNR during a November 21, 2003 meeting with Beazer (BBL, 2003c).

This CMS Report is termed "focused" in that it does not extensively evaluate a broad range of potentially applicable corrective action technologies. Rather, it focuses on technologies and alternatives that are known to be successful at addressing similar conditions at other wood-treating sites. This is reflective of Beazer's 20-plus years of experience at evaluating and implementing corrective action alternatives at numerous sites impacted by wood-treating operations across the country. Many potential alternatives have previously been discussed, reviewed, and/or attempted at some scale at other wood-treating sites in the past, and, based on that experience, have not been considered in this Focused CMS Report. This results in a focused set of potential corrective action alternatives for soils and for the portion of the Outfall 001 drainage ditch addressed herein (see Section 4.4). With respect to groundwater, this report is "focused" in that it does not include identification and evaluation of multiple alternatives. Instead, it reiterates and supports the use of a monitoring-based approach as previously described in the *RCRA Facility Investigation Report, Soil and Groundwater, Koppers Industries, Inc., Superior, Wisconsin* (Phase III RFI Report; Fluor Daniel GTI, 1997). This approach to limiting the scope of corrective action options considered was presented to and discussed with the WDNR at meetings in 1996 and 2000, and was specifically described in the Phase III RFI Report. Most recently, it was discussed with and agreed upon by the WDNR at a November 21, 2003 meeting between Beazer and WDNR (BBL, 2003c).

1.2 Report Organization

The remaining sections of this Focused CMS Report, which are supported with tables, figures, and appendices, are organized as follows.

Section 2 – Site Description and Use – This section describes the physical setting and Site history, and summarizes previous investigations pertinent to the identification, evaluation, and selection of corrective action alternatives for the Site.

Section 3 – Site Conceptual Model – This section describes geologic and hydrogeologic conditions, potential source areas, distribution of COPCs, migration pathways, and potential exposure pathways.

Section 4 – Corrective Action Goals and Objectives – This section presents the Site-specific CAOs established for on-property soils, the on-property portion of the Outfall 001 drainage ditch, and on-property groundwater, followed by a summary of the Post-Remediation HHRA (and a discussion of the areas of the Site targeted for corrective action.

Section 5 – Identification of Corrective Action Alternatives – In this section, a variety of potential corrective action technologies and process options are identified and screened based on considerations of Site-specific feasibility and effectiveness. The retained technologies and process options are then assembled into potential corrective action alternatives to target achievement of the site-specific CAOs.

Section 6 – Evaluation of Corrective Action Alternatives – This section presents a comparative evaluation of the potential alternatives for each medium with respect to the criteria described in NR 722.07 of the Wisconsin Administrative Code.

Section 7 – Selected Corrective Action Approach – This section identifies the selected corrective action alternatives for on-property soils, the on-property portion of the Outfall 001 drainage ditch, and on-property groundwater. Rationale for selecting these alternatives is also provided.

Section 8 – Future Activities and Schedule – This section outlines the anticipated future activities and schedule associated with completing CMS-related activities and performing detailed design of and implementing the selected corrective action approach.

2. Site Description and Land Use

2.1 Physical Setting

The Site is located in a rural, sparsely populated setting in northwestern Wisconsin, approximately five miles southeast of the City of Superior, Douglas County, at the junction of County Roads A and Z (Figure 1). The facility property is approximately 112 acres and is zoned for industrial use. As shown on the Site Plan (Figure 2), the eastern property boundary generally parallels County Road A, and the northern property boundary parallels Hammond Avenue. The wood-treating operations are located at the north end of the property and the remaining operational portions of the property are primarily used for the storage of treated and untreated wood. Wetland assessment and delineation activities performed in 2002 identified approximately 26 acres of wetlands within the Site's 112-acre property limits (Figure 2).

The area surrounding the facility, which has remained relatively unchanged for more than 60 years, is predominantly undeveloped and vegetated with trees, shrubs, and grasses. The area to the north, west, and northeast of the facility is zoned as a Resource Conservation District. National Wetland Inventory maps indicate that the property is primarily surrounded by wetlands, with the exception of an area zoned for agricultural use located south and southeast of the facility. No county parks, state parks, or fish hatcheries have been identified within a one-mile radius of the facility. Some private residences are located near the southeast portion of the facility on County Road A, and to the north and northeast of the facility along Hammond Avenue and County Road A. A series of railroad tracks run immediately north, west, and south of the facility. Crawford Creek, a tributary to the Nemadji River (which discharges to Lake Superior), is located approximately one half mile northwest of the facility. Surface water runoff from the majority of the facility drains to Crawford Creek via the Outfall 001 drainage ditch.

2.2 Site History

Constructed by the National Lumber and Creosoting Company, the facility has been in operation since 1928. The property changed hands through a series of transactions between 1938 and 1988, when Beazer, which then owned the property, sold it to KI. While the facility is currently owned by KI, Beazer retains certain environmental responsibilities related to past operations.
Pressure-treated railroad cross ties, bridge timbers, switch ties, and crossing panels are produced at the KI facility. Creosote with a number 6 fuel oil carrier has been the primary preservative used at the plant; however, pentachlorophenol with a petroleum oil carrier was also used as a preservative between 1955 and 1979. Four non-RCRA wastewater impoundments were constructed in 1977 and closed in 1982. Two clay-lined RCRA surface impoundments were constructed in 1982 to store wastewater from the wood-treating process, following pre-treatment via oil/water separation. The two RCRA surface impoundments were closed in August 1988. Closure certification was submitted to the WDNR in November 1989. Currently, wastewater from the treating process is treated via oil/water separation, biological activity, and aeration, and treated water is evaporated in an evaporation unit.

In September 1988, the United States Environmental Protection Agency (USEPA) issued a RCRA Part B Corrective Action Permit for the Site, which expired in September 1998. In December 1990, a Hazardous Waste Facility Operation License (License) was issued for the Site by the WDNR. The License, which expires in 2020, governs long-term care of the closed RCRA surface impoundments. Although it does not specifically address corrective action requirements for the remainder of the Site, the License has been the WDNR's primary mechanism for managing corrective action activities at the Site since the RCRA Part B Corrective Action Permit expired in 1998.

2.3 Previous Investigations

From 1981 to the present, various investigations have been performed at the Site. Prior to 1987, the investigation activities were primarily related to groundwater monitoring associated with the RCRA surface impoundments. In 1987, Site-wide investigations began with the USEPA conducting a RCRA Facility Assessment (RFA), followed by RFI activities conducted by Beazer in 1990 and 1996. Additional investigations both within and beyond the property boundary depicted on Figure 2 – including groundwater monitoring and investigations of the Outfall 001 drainage ditch and Crawford Creek – have been performed from 1996 to the present. Table 1 summarizes the scope and findings of the previous investigations and provides references to the various reports in which the scope and findings of the investigations were presented. All referenced documents have been provided to the WDNR.

In addition to the investigations summarized in Table 1, groundwater sampling has been performed at the Site since 1982 for detection and compliance monitoring (during both the operational and post-closure monitoring phases of the RCRA surface impoundments). From 1982 to 2002, groundwater monitoring was performed on a quarterly basis. In 2002, several modifications were made to the groundwater monitoring program based on the consistency of results since monitoring was initiated, including reducing the frequency of monitoring from quarterly to semiannually, modification of certain analytical parameters and methods and field sampling procedures, and reducing the number of wells subject to sampling. The modifications, which represent the scope of the current groundwater monitoring program, were documented in an April 19, 2002 letter from BBL to the WDNR (BBL, 2002) and the *Groundwater Monitoring Sampling and Analysis Plan* (RETEC, 2002). The WDNR indicated their approval of the Groundwater Sampling and Analysis Plan in a letter to Beazer dated October 29, 2002 (WDNR, 2002).

A brief data summary report is prepared following each groundwater monitoring event. The report is submitted to the WDNR within 60 days of completing the field work. In addition, an annual groundwater monitoring report is submitted to the WDNR by March 1 of each year. The annual report summarizes the scope, procedures, and results of the semiannual groundwater monitoring performed during the previous year. As indicated in the *2003 RCRA Annual Groundwater Monitoring Report* (RETEC, 2004), the extent of groundwater impacted with COPCs potentially released from the closed RCRA surface impoundments is not expanding and concentrations of COPCs are generally stable.

3. Site Conceptual Model

3.1 Overview

The Site Conceptual Model (SCM) is a set of hypotheses about the processes that govern the presence, migration pathways, and routes of potential exposure of COPCs in the on-property soil, Outfall 001 drainage ditch materials, and groundwater. Those hypotheses are drawn from the results of the various phases of the RFI and the other investigations conducted since 1981. The overall goals of the environmental investigations carried out at the Site have been to gather the appropriate information to develop the SCM and this Focused CMS Report. The factors affecting potential source areas, distribution of COPCs, potential migration pathways, and potential exposure pathways are summarized below. This information serves as the basis for establishing CAOs for the Site (Section 4.2) and, in conjunction with the findings of the Post-Remediation HHRA (Section 4.3), for developing and evaluating potential corrective action alternatives for the Site (Sections 5 and 6, respectively).

Based on the findings of the RFI activities, an initial SCM was developed and presented in the Phase III RFI Report. That initial SCM is still representative of the current understanding of Site conditions, and serves as the basis for the SCM presented below. However, where appropriate, modifications have been made to reflect the findings of various investigations that have been performed since the Phase III RFI Report was submitted (Table 1). The SCM is illustrated graphically on Figure 3.

3.2 Geology and Hydrogeology

In general, glaciolacustrine deposits – consisting primarily of low permeability clay – underlie the Site. The upper 15 feet of this clay contain fractures filled with silt and clay. Using the groundwater zone designations established during the RFI, the shallow (A) and intermediate (B) zones consist primarily of clay with little to no sand or gravel. In some areas of the Site, primarily in the vicinity of the process area and tank farm, a thin layer (up to two feet) of fill material is present above the clay at the ground surface. Discontinuous deposits of fine- to coarse-grained sand and silt, at depths varying from 35 to 50 feet below ground surface (bgs), represent the C zone at the Site. The clay unit continues beneath the discontinuous sand and silt deposits to the top of the Precambrian Superior Sandstone, the uppermost bedrock at the Site. The Precambrian Superior Sandstone occurs beneath the Site at a depth of approximately 170 feet bgs, and represents the bedrock (D) zone at the Site. The bottom of the screened interval occurs at 13 to 15.5 feet bgs for wells in the A zone and at 30 to 35 feet for wells in the B zone.

Groundwater exists beneath the Site in an unconfined state within the low permeability clay (A and B zones). Groundwater is generally encountered at depths of five feet bgs or less. Groundwater may be retained, temporarily, in a perched form within the surficial fill layer, where present. In addition, groundwater is present in a confined state within the discontinuous silts and sands of the C zone and within the sandstone bedrock (D zone). Historically, groundwater elevation data consistently support a generally northward flow direction in all four stratigraphic zones.

Hydraulic conductivity values were measured in 21 monitoring wells as part of the Phase II RFI activities and the associated data were presented in both the Phase II and Phase III RFI Reports. The following table summarizes the maximum, minimum, and average hydraulic conductivity values measured for the A, B, and C zones.

Zone	# of Wells Tested	Hydraulic Conductivity (cm/s)		
		Maximum	Minimum	Average
“A” Zone Wells	10	7.16×10^{-7}	8.93×10^{-8}	3.33×10^{-7}
“B” Zone Wells	4	1.27×10^{-5}	8.35×10^{-8}	3.26×10^{-6}
“C” Zone Wells	7	2.40×10^{-2}	4.54×10^{-5}	1.07×10^{-2}

Source: *Phase III RCRA Facility Investigation Report, Soil and Ground Water* (Fluor Daniel GTI, Inc., 1997)

Because of the very low permeability of the clay (A and B zones) and the discontinuity of the sand lenses (C zone), groundwater containing COPCs has little potential for migrating significantly from source areas, either horizontally or vertically. Any COPCs that do enter the discontinuous sand lenses are not likely to, and have not been determined to, migrate past the edge of the sand lenses because of the surrounding low-permeability clay soils. Findings reported in the *2003 RCRA Annual Groundwater Monitoring Report* (RETEC, 2004) indicate that temporal trends of concentrations of COPCs are stable or decreasing. Further, available data indicate there have been no detections of COPCs above Enforcement Standards (ESs), and no COPCs have been detected in offsite, downgradient supply wells.

3.3 Potential Source Areas and Distribution of COPCs

RFI-related activities included the investigation of nine solid waste management units (SWMUs) at the Site that were identified by USEPA in the 1987 RFA. As a result of those investigations, six potential source areas were identified. These areas are shown on Figure 2 and are described as follows:

Former Unlined Landfarm/Landfill (Area A)

The former unlined landfarm/landfill area, designated as “Area A” during the RFA, is located in the southeastern portion of the facility (Figure 2). Soils removed from a former loading dock area, which was dismantled during the construction of the concrete drip pad, were placed in this area. Metal banding used to bind wood stacks and wooden “stickers” used to separate individual pieces of wood in stacks were also placed in this area, as were cutoffs (scraps of untreated wood from sizing operations).

Treatment Area (Area B)

The treatment area, designated as “Area B” during the RFA, is located near the northeastern corner of the facility (Figure 2). The treatment area includes existing and former locations of work tanks, underground storage tanks, the treatment building, and a closed RCRA container storage facility.

Closed Surface Impoundments (Area C)

The closed surface impoundments area, designated as “Area C” during the RFA, is located west of the treatment area (Figure 2). The four former impoundments were constructed in 1977 to store wastewater, and were closed in 1982. Two replacement impoundments (RCRA surface impoundments), which are south of and overly a portion of the former impoundments, were constructed in 1982 and closed in August 1988. The closed RCRA surface impoundments are not included as part of Area C.

Drip Track Area (Area F)

The drip track area, designated as “Area F” during the RFA, includes the railroad track adjacent to and south of the treatment building in the central portion of the facility (Figure 2). The drip tracks associated with the wood-treatment operations and the adzing and boring mill comprise Area F. The drip track adjacent to the treatment building was retrofitted in 1976 or 1977 with a concrete drip pad, which has sumps to collect wastewater. Prior to that time, the area of the concrete-lined drip track adjacent to the treatment building, was occupied by an unlined drip track/loading dock. According to available information, this unlined drip track/loading dock was used since the plant began operation in 1928. This area is now a RCRA-regulated hazardous waste management unit pursuant to Subpart W of 40 CFR 264.

Straw Bales Area (Area G)

The straw bales area, designated as "Area G" during the RFA, is located near the south end of the facility (Figure 2). Straw bales that had been used to absorb pentachlorophenol from a surface discharge were placed in this area from approximately 1978 to 1980.

Lead Track Landfill (Area H)

The lead track landfill area, designated as "Area H" during the RFA, is located south of the spray irrigation field, along the railroad track known as the lead track (Figure 2). Materials placed on the ground surface in this area include crossties, metal banding, wood stickers, and process materials. The date that materials were first placed in this area is unknown, but it is believed to have been in use until the early 1980s. The area was bulldozed over after its use was discontinued.

These areas are inactive with the exception of the treating area (Area B) and the drip track area (Area F). The drip tracks have been lined and are maintained and monitored by KI in accordance with RCRA 40 CFR Subpart W requirements. During construction of the drip track liner system, visibly impacted soils were excavated and sent offsite for disposal. Sludges and visibly impacted soils were also removed for offsite disposal as part of the closure of the non-RCRA surface impoundments. The closure of the RCRA surface impoundments was performed as a hybrid closure where the sludges and soils were removed before the construction of the RCRA cap. The straw bales have been removed from the straw bales area and this area is no longer used for disposal purposes of any kind.

The results of sampling and visual characterizations performed for the various phases of the RFI indicate that impacts to soil and groundwater are generally limited to the immediate vicinity of the various source areas. Groundwater within the clay aquitard beneath the former unlined landfarm/landfill area, the treatment area, the closed surface impoundments, and the straw bales area contains COPCs, primarily PAHs, at shallow depths. Groundwater within the discontinuous sand lenses was found to be unaffected by COPCs, with the exception of isolated areas near the treating area and closed impoundments. Groundwater monitoring also indicates that groundwater impacted with COPCs has not migrated beyond the facility boundary. Residential wells in the area were identified and sampled, and results indicate that these wells are not affected by COPCs. Furthermore, periodic sampling of bedrock monitoring wells installed at the Site in 1999 indicates non-detect to low levels of COPCs at the downgradient property boundary with generally decreasing concentration trends.

According to the Phase III RFI Report dense non-aqueous phase liquid (DNAPL) was observed in three shallow (A-zone) monitoring wells at the Site. DNAPL thicknesses of up to 1.5 feet were observed in well W-27A (located in the treatment area) between 1990 and 1995, when the well was abandoned. Trace amounts of DNAPL have also been periodically detected in wells W-8A and W-30A (located near the closed surface impoundment area). DNAPL in these three wells is attributed to the well bore intersecting the silty pockets of residual DNAPL near the surface, and resultant vertical migration and collection in the well. Based on available records, for at least the past five years, DNAPL has not been observed in W-8A, W-30A or at any of the other monitoring well locations that are part of the current monitoring network. The potential for deeper migration of DNAPL is limited because of the unfractured nature of the deeper clay and because a lack of ongoing sources prevents DNAPL head accumulations that serve as a driving force. The high capillary pressure of the clay and non-wetting nature of the DNAPL inhibit its entry into or migration through the small aperture spaces of the clay matrix. As a result, residual DNAPL and staining are limited to larger aperture spaces (i.e., cracks, fissures, etc.) in the near-surface soils.

3.4 Potential Migration Pathways

Potential migration pathways include the limited movement of dissolved COPCs through groundwater and entrainment of suspended soils in surface water flowing over source areas. In those areas where COPCs were detected in unsaturated soils (former unlined landfarm/landfill, treatment area, closed surface impoundments, drip track area, straw bales area, and lead track landfill), COPCs may be transported to surface water drainages through erosion and subsequent transport of soil onto which constituents have adsorbed. Surface water transport of dissolved constituents is not considered a primary migration mechanism, because the higher ring molecular structure of PAHs favors adsorption over dissolution. In addition, there is limited potential for leaching of COPCs from soil to groundwater due to the low permeability clay soils at the Site.

With respect to the presence of residual DNAPL in shallow soils, fractures in the clay matrix and higher permeability fill areas (where present) represent potential migration pathways. Although limited head (driving force) is likely to exist due to the shallow nature of these materials, groundwater gradients may induce DNAPL migration in instances where sufficient residual DNAPL exists to be potentially mobile. This is the likely migration pathway resulting in the visual observation of isolated seams of creosote-like product in fractures within shallow soils adjacent to the on-property portion of the Outfall 001 drainage ditch. Specifically, residual DNAPL in adjacent source areas (i.e., the closed impoundments and treatment area) may have been induced to migrate with the groundwater gradient to this area. However, the extent to which this represents a significant migration pathway is limited by the low hydraulic gradients, limited residual quantity of product, lack of ongoing sources, and the extremely low migration rates through the clay soils.

3.5 Potential Exposure Pathways

There is no exposure point for COPCs in shallow groundwater; the clays beneath the Site are relatively impermeable, the sand lenses are discontinuous, and on-property groundwater is not used as a source of drinking water. Groundwater in the sandstone aquifer is used as a drinking water source offsite; however, analytical data for bedrock wells at the Site do not indicate the potential presence of COPCs in offsite bedrock groundwater at concentrations exceeding ESs. In addition, samples collected from offsite private wells during the Phase III RFI did not contain COPCs.

In those areas where COPCs were detected in unsaturated soils (former unlined landfarm/landfill, treatment area, closed surface impoundments, drip track area, straw bales area, and lead track landfill), COPCs may be contacted directly, or may be transported to surface water drainage areas through erosion and subsequent transport of soil onto which constituents have adsorbed. A variety of potential exposure pathways to impacted on-property soils and potential receptors associated with Site use were evaluated in the Post-Remediation HHRA, which is further discussed in Section 4.3 and included as Appendix A.

The SCM and theoretical transport and exposure pathways are depicted on Figure 3. The depths to the water table and to bedrock, locations of various wells, and the primary groundwater migration pathway are shown in cross-sectional view. In addition, the interconnections among the elements contributing to theoretical transport and exposure pathways are presented and potential receptors are identified. The transport and exposure pathways are further considered in the Post-Remediation HHRA (Section 4.3).

4. Corrective Action Goals and Objectives

4.1 Overview

This section identifies the various corrective action goals and objectives for those portions of the Site addressed in this Focused CMS Report. This includes a summary of the Site-specific CAOs that have been established for the various media, as well as a summary of the conclusions of the Post-Remediation HHRA that was performed to identify those areas of the Site requiring corrective action to achieve risk-based objectives. The CAOs and risk-based objectives serve as a basis for the development of potential corrective action alternatives (Section 5.3).

The areas targeted for corrective action, which were established based on the findings of the Post-Remediation HHRA, the SCM, and the results of previous investigations, are described in Section 4.4. A summary of the basis for a monitoring-based approach for on-property groundwater, as previously identified in the Phase III RFI Report, is also presented in Section 4.4.

4.2 Corrective Action Objectives

In accordance with NR 720 (soil cleanup standards) and NR 140 (groundwater standards) of the Wisconsin Administrative Code, CAOs have been established for the Site. The generic CAOs for soils from NR 720 require remediation of impacted soils to restore the environment to the extent practicable, minimize harmful effects to lands and waters of the state, and protect public health and the environment. The generic CAOs for groundwater, listed at NR 140.24, address constituents exceeding Preventive Action Limits (PALs) or ES, and include the effects of exposure to groundwater on public health and the environment, and the probability that a PAL or ES will be exceeded at an appropriate point of standards application, as defined in NR 140.

The Site-specific objectives relate to the mitigation of potential human exposures to impacted media. The results of the RFI indicate that the primary potential for exposure to COPCs is by contact with surface soils. Because the clay beneath the Site acts as an aquitard, the likelihood of potential exposure to groundwater containing COPCs is low. The potential for exposure to materials within the Outfall 001 drainage ditch is similar to that of soils, but of lesser magnitude given the limited potential for human exposure to these materials relative to soils.

In consideration of the generic CAOs (established by NR 720 and NR 140.24) and the potential exposure routes, Site-specific CAOs have been established for each area and medium targeted for corrective action at the Site. The CAOs for on-property soils and on-property groundwater have been presented in several documents previously submitted to the WDNR, including in the Phase III RFI Report. The CAOs for the Outfall 001 drainage ditch were described in the *Supplemental Surface Water and Streambed Sediment Investigation Report* (BBL, 2000b). Those CAOs were developed for the entirety of the drainage ditch, including the portions beyond the property boundary depicted on Figure 2 Accordingly, for the purposes of this Focused CMS Report, the wording of the previously identified ditch-related CAOs has been modified slightly to focus more specifically on the on-property portion of the ditch. In summary, the Site-specific CAOs are as follows:

On-Property Soils

- Mitigate direct contact by potential receptors to surface soil containing COPCs at concentrations that may affect human health; and
- Minimize potential offsite migration of COPCs through dissolved phase transport (groundwater) or erosion (surface water).

On-Property Groundwater

- Demonstrate, through groundwater monitoring at the downgradient property boundary in the discontinuous sand lenses and bedrock, that COPCs are not migrating offsite at concentrations exceeding an appropriate PAL or ES.[1]

On-Property Portion of the Outfall 001 Drainage Ditch

- Minimize the potential for direct contact with drainage ditch materials containing COPCs; and
- Minimize the potential for downstream migration of COPCs via the Outfall 001 drainage ditch.

The final CAO listed above is intended to address the observed presence of creosote-like material in isolated soil fractures adjacent to the ditch, as observed during a May 2003 investigation and reported to the WDNR in a letter dated October 2, 2003. It should be noted, however, that potential impacts to the ditch resulting from the presence of this material in adjacent soils has not been confirmed by Site investigations. Further, previous monitoring performed by KI at Outfall 001 has not indicated the downstream transport of constituents above Wisconsin Pollutant Discharge Elimination System (WPDES) permitted levels. Nonetheless, as a proactive measure, Beazer has elected to identify and evaluate potential corrective action alternatives to mitigate the potential future occurrence of such migration. This is based on the potential for future corrective action activities in the portion of the Outfall 001 drainage ditch beyond the property boundary (to be evaluated in a separate CMS report pending further investigation and evaluation of this area), and the desire to eliminate the potential for on-property areas to impact downstream portions of the ditch in the future.

4.3 Risk-Based Objectives: Summary of Post-Remediation HHRA

A Post-Remediation HHRA was conducted to identify areas of the Site that could be targeted for corrective action such that Site-specific CAOs for on-property soils would be met and to confirm that, if implemented, any proposed corrective action would result in acceptable levels of potential carcinogenic and non-carcinogenic health risk. The Post-Remediation HHRA addresses the Site-specific CAOs for on-property soils only. CAOs for the on-property groundwater and the on-property portion of the Outfall 001 drainage ditch are described above and addressed within other sections of this Focused CMS Report. The complete Post-Remediation HHRA is summarized below; the entire report is provided in Appendix A of this Focused CMS Report.

To evaluate CAOs for the on-property soils, the following approach was implemented in the risk assessment:

- Conduct a Site-wide Post-Remediation HHRA to evaluate the potential receptors and potential exposures at the Site; and

[1] Relative to the 1997 Phase III RFI, the wording of this CAO has been modified to reflect monitoring in the bedrock zone and reference to standards to which the data will be compared to assess potentially unacceptable offsite migration.

- Evaluate surface water quality and human health direct contact risk from potential exposure to COPCs in surface water (in the Outfall 001 Drainage Ditch and Crawford Creek) due to erosion and runoff of onsite soils following corrective action at the targeted soil areas.

Potential health risks were calculated first to identify areas of the Site subject to corrective action and then to estimate potential risk under post-implementation Site conditions. The following receptors were evaluated:

- KI Process Area Workers[2];
- KI Non-Process Area Workers;
- Local Resident Trespassers;
- Construction Workers; and
- Utility Workers.

All potential receptors were assumed to contact COPCs in soil at the Site via incidental ingestion, dermal contact, inhalation of volatiles migrating from soil to ambient air, and inhalation of soil-derived dust in ambient air. Area-weighted exposure point concentrations for the three major contributors to potential Site risk (benzo(a)pyrene toxic equivalents [BaP-TE], naphthalene, and pentachlorophenol) were derived using geostatistical techniques (i.e., Thiessen polygons). Non-area-weighted concentrations were used for all other compounds evaluated. The Post-Remediation HHRA report (Appendix A) provides details regarding calculation of area-weighted (using Thiessen polygons) and non-area-weighted exposure point concentrations.

Possible corrective action scenarios were evaluated in an iterative manner assuming that exposure to BaP-TE, naphthalene, and pentachlorophenol in various locations was eliminated. Locations, defined by Thiessen polygons, were iteratively removed from the dataset (as if exposure to surface soil in that polygon was eliminated to a depth of 1 foot) to determine the extent of soils requiring action to meet the WDNR carcinogenic risk limit of $1x10^{-5}$ for KI workers potentially exposed to surface soil in the Process and Non-Process Areas. This analysis, detailed in Appendix A, indicates that elimination of exposure to polygons BB-01, BB-03, BB-04, and BB-07 in the Non-Process Area and polygons BB-01, BB-03, BB-04, BB-07, and portions of BB-09 and BB-12 in the Process Area, all to a depth of 1 foot, results in potential risk estimates that meet USEPA and WDNR risk limits ($1x10^{-5}$ for potential carcinogenic risks and a Hazard Index ≤ 1 for potential noncarcinogenic risks). Therefore, performing corrective action for soils within these limits would achieve the Site-specific CAOs for on-property soils. These areas are illustrated on Figure 5 of this Focused CMS Report and Figure 9 of the Post-Remediation HHRA report (Appendix A).

4.4 Targeted Corrective Action Areas

As previously discussed, this Focused CMS Report addresses the on-property soils, the on-property portion of the Outfall 001 drainage ditch, and on-property groundwater. These areas have been targeted in consideration of the SCM, the findings of the Post-Remediation HHRA, and the results of previous investigations. The specific limits associated with each area/medium are described in the following subsections.

[2] For the purposes of the Post-Remediation HHRA, the Process Area is defined as the area encompassing and surrounding the drip-track and treatment building. The Non-Process Area is defined as the entire active portion of the Site minus the Process Area (e.g., wood storage area, spray irrigation field, office, etc.). Refer to Figure 1 of the Post-Remediation HHRA report (Appendix A).

4.4.1 On-Property Soils

The extent of on-property soils targeted for corrective action activities was determined based on the conclusions of the Post-Remediation HHRA (Section 4.3, Appendix A). Specifically, to achieve risk-based goals for the on-property portion of the Site, the Post-Remediation HHRA concluded that corrective action would be required for soils located within six Theissen polygon areas developed as part of the risk assessment process (BB-01, BB-03, BB-04, BB-07; and portions of BB-09 and BB-12 in the Process Area). The specific polygon areas are illustrated in the figures provided with the Post-Remediation HHRA (Appendix A) and the resulting targeted soil areas are shown on Figure 4. These areas comprise an area of approximately 1.9 acres along the drip track and adjacent to the treatment building. Because the Post-Remediation HHRA indicates that hypothetical exposure to surface soils is the scenario that drives the risk-based goals, only the surface soils (i.e., 0- to 1-foot below grade) within this area are targeted for corrective action. Based on these limits, the approximate volume of soils targeted for corrective action activities is estimated to be approximately 3,100 in-situ cubic yards.

4.4.2 On-Property Portion of the Outfall 001 Drainage Ditch

The drainage ditch along which Outfall 001 is located originates on the east side of County Road A. The ditch flows through a culvert beneath County Road A and through another culvert on the KI facility east of the treatment area. Following a short reach of open channel east of the treatment area, the ditch flows through a culvert beneath the treatment area and drip track, and re-emerges into an open channel to the west of the treatment area. From this point, the ditch flows west through an open channel toward Outfall 001, passing through two additional culverts beneath active railroad tracks. At Outfall 001, the ditch turns toward the northwest, crosses the facility property line, and enters a series of culverts beneath railroad tracks and Hammond Avenue north of the facility. The course of the ditch is shown on Figure 2.

The portion of the Outfall 001 drainage ditch considered within this Focused CMS Report extends from the outlet of the first culvert west of the treatment area downstream to the point at which the ditch enters a culvert beneath the railroad tracks near the northwest corner of the property (approximately 95 feet downstream of Outfall 001). This area, shown on Figure 4, includes approximately 620 linear feet of the ditch and generally corresponds to the areas where impacted materials have been observed during previous investigations. The upstream limit of this reach was established based on the fact that the short stretch of open channel immediately upstream of this culvert is associated with the targeted soil area and there are no known or suspected source areas to open channels upstream of that point (i.e., a culvert minimizes the potential for impacts to the portion of the ditch traversing the treatment area and areas further upgradient are in an unused portion of the facility and undeveloped areas east of County Road A). The downstream limit was established as a practical demarcation between the on-property portion of the ditch (addressed by this Focused CMS Report) and the off-property portion of the ditch (to be separately addressed).

4.4.3 Groundwater

The current approach to groundwater at the Site is consistent with the approach proposed in the Phase III RFI Report. The corrective action goals and objectives for groundwater are focused on groundwater at the downgradient boundary of the facility. This focus is appropriate considering the following key points:

- Hydraulic conductivity at the Site is low;
- The potential for migration of COPCs in groundwater is limited;

- There is currently no exposure pathway for groundwater and future exposure is not expected to occur;
- Impacted groundwater at the Site is not used or expected to be used as a potable source[3];
- Impacted groundwater at the Site has been shown to be limited with no evidence of migration beyond the facility boundary at levels above ESs;
- No COPCs have been detected in offsite, downgradient private wells; and
- Intrinsic remediation is an ongoing process that will lead to decreased concentrations of COPCs in groundwater over time.

Results of previous investigations have shown that shallow groundwater is impacted by COPCs in the immediate vicinity of the former unlined landfill/landfarm, the treatment area, the closed surface impoundments, and the straw bales area. However, the areas of impacted groundwater have been shown to be localized with respect to each of these areas and limited in horizontal and vertical extent. The area of groundwater targeted for corrective action will be at the downgradient facility property boundary in the sand lenses and bedrock. This is established based on the location of the treatment area and closed surface impoundment area near the downgradient property boundary. Downgradient groundwater in the shallow clay is not being specifically targeted due to the extremely low migration potential. Groundwater will continue to be monitored at the design management zone (DMZ) established for the closed RCRA surface impoundments.

To ensure that CAOs are achieved, groundwater in the sand lenses and in bedrock at the facility boundary will be monitored and compared to the criteria at NR 140.24 and NR 140.26, relating to exceedance of the State's PALs or ESs.

[3] Groundwater at the Site is used in bathrooms at the facility for non-potable purposes (i.e., handwashing and bathing), but the water used for these purposes is drawn from two unimpacted wells. Periodic sampling of these wells is conducted to verify that COPCs are not present above the State's PALs or ESs.

5. Identification of Corrective Action Alternatives

5.1 General

As described in Section 1.1, this CMS Report is termed “focused” in that it does not extensively evaluate a broad range of potentially applicable corrective action technologies. Rather, it focuses on technologies and alternatives that are known to have been used successfully to address similar conditions at other wood-treating sites. This is reflective of Beazer’s 20-plus years of experience at evaluating and implementing corrective action alternatives at numerous sites impacted by wood-treating operations across the country. Many potential alternatives have previously been discussed, reviewed, and/or attempted at some scale at other wood-treating sites in the past, and, based on that experience, have not been considered in this Focused CMS Report. This results in a focused set of potential corrective action alternatives for soils and for the portion of the Outfall 001 drainage ditch addressed herein (see Section 4.4). With respect to groundwater, this report is “focused” in that it does not include identification and evaluation of multiple alternatives. Instead, it reiterates and supports the use of a monitoring-based approach as previously described in the Phase III RFI Report. This approach to limiting the scope of corrective action options considered was presented to and discussed with the WDNR at meetings in 1996 and 2000, and was specifically described in the Phase III RFI Report. Most recently, it was discussed with and agreed upon by the WDNR at a November 21, 2003 meeting between Beazer and WDNR (BBL, 2003c).

With respect to on-property soils and the on-property portion of the Outfall 001 drainage ditch, the development of potential corrective action alternatives involved a multi-step process. First, in consideration of previous discussions with the WDNR, Beazer’s experience at similar sites, and the focused nature of this evaluation, a list of potentially applicable technologies was identified and screened. Retained technologies were then assembled into corrective action alternatives considered potentially capable of achieving the established CAOs. Separate corrective action alternatives were developed for the on-property soils and for the on-property portion of the Outfall 001 drainage ditch. The technology screening process and assemblage of corrective action alternatives is further discussed below.

With respect to groundwater, a monitoring-based approach was previously identified and supported in the Phase III RFI. Because monitoring performed since that time has not indicated that groundwater conditions or migration potential of COPCs are different than previously characterized, that approach remains valid and is reiterated below. Based on the prior justification provided to support that approach, other potential approaches for groundwater are not identified or evaluated within this Focused CMS Report.

Two additional items related to the range of potential corrective action alternatives are also discussed in this section: institutional controls (Section 5.4) and the proposed establishment of a Corrective Action Management Unit (CAMU; Section 5.5). Based on the assumptions applied in the Post-Remediation HHRA (Section 4.3 and Appendix A), namely the fact that the property will remain in industrial use, the “baseline” institutional control that will be necessary is a deed restriction to ensure that future Site uses are consistent with this assumption. Such controls will be required regardless of the corrective action alternatives implemented at the Site. In anticipation of the potential need for cost-effective disposition of materials excavated during corrective action activities, a proposal to establish a CAMU at the Site was previously submitted to and approved by the WDNR.[4] The CAMU could be used for onsite consolidation and long-term management of materials excavated from

[4] *Request for Modification of the Closure and Long-Term Care Plan Approval and Corrective Action Management Unit (CAMU) Demonstration* (BBL, 2000).

various areas of the Site, and is therefore applicable to all alternatives that involve excavation of soils and/or ditch materials. Because the baseline institutional controls and the CAMU relate to several or all of the various alternatives presented and evaluated here, they are discussed separately below.

5.2 Initial Screening of Corrective Action Technologies

In accordance with NR 722.07, an initial screening was performed to identify technologies potentially applicable for the targeted soils and Outfall 001 drainage ditch area, and upon which corrective action alternatives may be developed. The focused lists of technologies that were considered for the targeted soils and on-property portion of the Outfall 001 drainage ditch are listed in Tables 2 and 3, respectively. These focused lists were developed in consideration of various factors, including:

- Beazer's 20-plus years of experience at evaluating and implementing corrective action alternatives at numerous sites impacted by wood-treating operations across the country;
- Site-specific considerations such as the shallow depth to groundwater, geology, COPCs, location and volume of materials targeted for corrective action, and the nature of ongoing Site operations;
- A focus on readily implementable and proven corrective action technologies;
- Expected continued use of the property as an industrial facility; and
- Previous discussions and coordination with the WDNR.

The focused lists of potentially applicable technologies were then screened on the basis of Site-specific feasibility, including applicability to the types of constituents present, target areas/media, and Site characteristics. As appropriate, the degree of effectiveness and relative cost-effectiveness were also considered in the screening process to further differentiate among the various technologies.

The results of the initial screening are summarized in Tables 2 and 3. Because the list was focused to begin with (as previously discussed), only a few options were screened from further consideration. In particular, treatment technologies (both in-situ and ex-situ) were eliminated from further evaluation. While a number of treatment technologies exist that are potentially applicable to the types of constituents present at the Site, Beazer's experience at evaluating and/or applying such technologies at other similar sites suggests they are not applicable to this Site based on a variety of considerations. These technologies are rarely as effective at full-scale as they are in laboratory- or bench-scale testing, extensive bench- or pilot-scale tests are typically required, and the costs are typically high. From a Site-specific perspective, the nature of the clay matrix and climatic conditions would also hinder the effectiveness of certain technologies (e.g., bioremediation), while the shallow groundwater table and other factors preclude other technologies (e.g., thermal treatment, chemical extraction, etc.). In contrast, the retained options have been implemented successfully at a wide range of other sites across the country, have proven to be both technically effective and a cost-effective means of addressing similar constituents in similar media, and are appropriate given the limited and specific areas addressed in this CMS.

The technologies/process options retained for further consideration for the targeted areas of on-property soils and the on-property portion of the Outfall 001 drainage ditch are listed below.

On-Property Soils	*On-Property Portion of the Outfall 001 Drainage Ditch*
Institutional controls (deed restrictions)	Institutional controls (deed restrictions)
Monitoring (field observation)	Monitoring (field observation)
Surface cover	Engineered cap
Excavation	Culverting
Onsite CAMU disposal of excavated soils	Channel relocation
Offsite disposal of excavated soils	Excavation
	NAPL collection
	Onsite CAMU disposal of excavated materials
	Offsite disposal of excavated materials

The basis for retaining each of these technologies/process options is summarized in Tables 2 and 3.

5.3 Corrective Action Alternatives

The retained technologies/process options were assembled into various alternatives potentially capable of achieving the established Site-specific CAOs (Section 4.2). Potential alternatives addressing the targeted soils and portion of the Outfall 001 drainage ditch are described below; the proposed approach for on-property groundwater is also described. Cost estimates associated with each alternative are also presented. These alternatives are evaluated in detail in Section 6 relative to the criteria described in NR 722.07(4).

5.3.1 On-Property Soils

To address the presence of COPCs in soils in the areas of the Site targeted for corrective action, three alternatives have been developed. The scope and estimated cost associated with each alternative is summarized below.

5.3.1.1 Alternative S-1 – Surface Cover

This alternative generally includes the placement of a surface cover over the targeted soil areas to eliminate the potential for exposure to existing surface soils exceeding risk-based goals. The key components of this alternative include the following:

- Install a surface cover over the targeted soil areas;
- Conduct periodic post-construction inspections and maintenance; and
- Establish institutional controls, including the baseline deed restriction (Section 5.4), plus measures to provide for the continued integrity of the surface cover.

Under this alternative, a surface cover would be installed over the approximately 1.9-acre area identified in the Post-Remediation HHRA (Section 4.3; Figure 5). The surface cover would isolate the impacted surface soils from direct contact by potential receptors, and minimize potential offsite migration of COPCs from the covered area. The surface cover would be constructed of suitable materials and of suitable thickness (i.e., 1 foot) to isolate the subject soils from exposure by current or potential future Site workers (i.e., those potential receptors that, according to the Post-Remediation HHRA, drive the risk-based objectives).

Because the area targeted for corrective action is in and around active wood-treating operations, regrading may be necessary in certain areas prior to installation of the surface cover. Specifically, regrading may be necessary such that, once the surface cover materials are placed, appropriate access to building doors, railroad tracks, etc. is maintained, and suitable working surfaces continue to exist.

Following regrading, a layer of geotextile would be installed across the targeted area to separate impacted materials from cover materials. Surface cover materials would then be installed on top of the geotextile and appropriately graded and compacted. While the specific type(s) of surface cover materials would be determined during detailed design in consideration of the anticipated uses within the cover area (e.g., vehicle transport, material staging, grass cover, wetland restoration, etc.), the likely materials would include soil fill, topsoil, hydric soil, gravel, concrete, and/or asphalt. For example, active roadways may be covered with gravel or asphalt to allow for operation of vehicles on top of the cover materials. Unused open spaces may be covered with soil fill and topsoil and seeded to re-establish a vegetative cover.

Post-installation monitoring and maintenance of the surface cover would be performed to verify that an appropriate thickness and integrity of cover material remains in place. For example, inspections would be performed to verify that asphalt surfaces remain intact to prevent exposure to the underlying soils. In the case of a soil cover, inspections would be performed to verify that a minimum cover thickness is maintained. As necessary, maintenance activities would be performed based on these inspections. This may include periodic patching or resurfacing of asphalt areas or placement of supplemental fill in areas of soil and/or gravel cover.

Alternative-specific institutional controls would be a necessary component of this approach. In addition to the deed restriction established to limit future use of the Site to industrial purposes (Section 5.4), the following controls would be necessary to provide long-term protection of human health and minimize the potential for offsite migration of COPCs: a requirement to maintain the surface cover at the designed thickness and a prohibition on excavation or other types of surface disturbance in the targeted area without an appropriate health and safety plan and a soil management plan.

The estimated cost associated with this alternative is $371,000. In accordance with NR 722.07(4)(b), this includes estimated capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs associated with this alternative. It does not include the cost for establishing the baseline institutional control (deed restriction), which is an additional cost applicable to all alternatives regardless of the selected approach. The alternative-specific cost is summarized in Table 4 and a detailed estimate is provided in Appendix B, Table B-1.

5.3.1.2 Alternative S-2 – Excavation with Onsite CAMU Disposal

This alternative generally includes excavation of the targeted soils, disposal of those materials in a containment cell to be established within an onsite CAMU, and restoration of the excavation areas. The primary components of this approach are as follows:

- Construct a CAMU containment cell in a designated area of the Site (as described in Section 5.5).
- Excavate impacted soils in the targeted area;
- Consolidate excavated materials within the CAMU containment cell;
- Backfill and restore the excavation areas to re-establish original surface grades and uses;
- Conduct periodic post-construction inspections and maintenance; and
- Establish institutional controls, including the baseline deed restriction (Section 5.4), plus additional alternative-specific measures to provide for the continued integrity of the alternative.

Under this alternative, soils would be excavated to a depth of 1 foot within the approximately 1.9-acre area identified in the Post-Remediation HHRA (Section 4.3; Figure 5). This represents a total removal volume of approximately 3,100 in-situ cubic yards. Excavation would provide permanent removal of those soils exceeding risk-based goals, prevent direct contact by potential receptors, and minimize potential offsite migration of COPCs from the targeted area.

Excavation would be performed using standard earthmoving equipment (e.g., excavators, loaders, etc.). In certain areas (e.g., around tanks, railroad tracks, etc.), manual soil removal may be required. Because the soils subject to removal are shallow surface soils located above the water table, it is anticipated that dewatering, stabilization, or solidification of the excavated materials would not be necessary prior to consolidation in the onsite CAMU containment cell. Once the CAMU containment cell is constructed and ready to accept materials, the excavated soils would be transported via an onsite route to the CAMU area and consolidated within the containment cell. After all materials subject to CAMU disposal have been placed and consolidated, the containment cell would be closed, managed, inspected, and maintained as described in Section 5.5.

Prior to backfilling the excavation, a layer of geotextile would be placed to segregate the fill materials from the underlying soils. The excavated area would then be backfilled with clean fill to re-establish the original grades within the area. Fill materials may include locally-obtained soil borrow and/or crushed stone/gravel, and impacted wetland areas will be restored as appropriate. The specific type(s) of fill materials would be determined during detailed design in consideration of the anticipated uses of the excavation area.

Post-implementation monitoring of the excavated/backfilled area would be performed in the short-term to verify that the backfilled and restored areas are performing adequately, excessive settlement/erosion does not occur, and vegetation becomes re-established in seeded areas. While additional fill would be placed in areas of settlement/erosion, routine supplements to the fill materials are not anticipated because substantial long-term erosion to the fill materials is not anticipated to occur. Specifically, because the fill material will re-establish existing grade, and because existing Site activities do not and are not expected to include substantial disruption of surface soils, it is anticipated that the backfill materials will remain in place without routine maintenance.

Alternative-specific institutional controls would be required under this approach. In addition to the deed restriction established to limit future use of the Site to industrial purposes (Section 5.4), CAMU-specific restrictions would also be required. The nature of such restrictions is further discussed in Section 5.5.

The estimated cost associated with this alternative is $2.30 million. In accordance with NR 722.07(4)(b), this includes estimated capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs associated with this alternative. It also includes estimated costs associated with the construction, operation, and maintenance of the CAMU ($1.7 million). It does not include the cost for establishing the baseline institutional control (deed restriction), which is an additional cost applicable among all alternatives regardless of the selected approach. The alternative-specific cost is summarized in Table 4 and a detailed summary of the estimated cost is provided in Appendix B Table B-2. Table B-8 of Appendix B provides a detailed summary of costs associated with construction, operation, and maintenance of the CAMU containment cell.

5.3.1.3 Alternative S-3 – Excavation with Offsite Disposal at a Commercial Facility

This alternative is similar to Alternative S-2, except that the excavated soils would be disposed of at an appropriately permitted offsite land disposal facility rather than in an onsite CAMU. This approach includes the following key components:

- Excavate impacted soils in the targeted area;
- Transport excavated materials to an appropriately permitted offsite commercial land disposal facility;
- Backfill and restore the excavation areas to re-establish original surface grades and uses;
- Conduct periodic post-construction inspections and maintenance; and
- Establish the baseline deed restriction as described in Section 5.4.

Under this alternative, soils would be excavated to a depth of 1 foot within the approximately 1.9-acre area identified in the Post-Remediation HHRA (Section 4.3; Figure 5). This represents a total removal volume of approximately 3,100 in-situ cubic yards. Excavation would provide permanent removal of those soils exceeding risk-based goals, prevent direct contact by potential receptors, and minimize potential offsite migration of COPCs from the targeted area.

Excavation would be performed using standard earthmoving equipment (e.g., excavators, loaders, etc.). In certain areas (e.g., around tanks, railroad tracks, etc.), manual soil removal may be required. Because the soils subject to removal are shallow surface soils located above the water table, it is anticipated that dewatering, stabilization, or solidification of the excavated materials would not be necessary prior to offsite transport. Accordingly, excavated materials would be loaded directly into vehicles/containers to be used for offsite transport of the materials to the commercial disposal facility. All vehicles/containers used for offsite transport would be appropriately manifested and labeled in accordance with Department of Transportation and RCRA requirements.

Materials subject to excavation and offsite disposal under this alternative may contain RCRA-listed F032 and F034 wastes. F032 waste is described as wastewater, process residuals, preservative drippage, and spent formulations from wood-preserving processes generated at plants that currently use, or have previously used chlorophenolic formulations. F034 waste is described as wastewater, process residuals, preservative drippage, and spent formulations from wood-preserving processes at plants that use creosote formulations. Due to the potential presence of such materials, land disposal of such materials in the United States would be subject to the RCRA Land Disposal Restrictions (LDRs; 40 CFR 268)[5]. Since the materials targeted for excavation are soils, the LDRs would require that these materials either be treated to meet the waste-code-specific treatment standards of 40 CFR 268.40 or the alternative soil treatment standards of 40 CFR 268.49. The alternative soil treatment standards would require treatment for all constituents listed at 40 CFR 268.48 to achieve either a 90 percent reduction in constituent concentrations or a maximum concentration no greater than 10 times the universal treatment standards specified in 40 CFR 268.48 (whichever is greater). In either case, it is anticipated that treatment would be required prior to land disposal in a Subtitle C hazardous waste disposal facility. Based on the required levels of treatment and the variety of organic constituents potentially present, the likely means of treatment would be soil incineration. In addition, because the F032 and F034 treatment standards include inorganic constituents, it is also possible that the incinerated soils may require further treatment (e.g., stabilization) to achieve inorganic treatment standards prior to land disposal.

To avoid the potentially prohibitive costs associated with offsite treatment and disposal in accordance with RCRA LDRs, Beazer anticipates that offsite land disposal, if selected, would occur at a commercial disposal facility in Canada. Specifically, for this type of material, Beazer typically utilizes the Clean Harbors “Sarnia” facility located in Corruna, Ontario, Canada. This provides for a more cost-effective alternative for offsite disposal of excavated soils.

[5] It is possible that the materials could be disposed off site as “CAMU-eligible waste.” However, it is uncertain whether the requisite regulatory and facility approvals could be obtained for offsite disposal as “CAMU-eligible waste” or that any significant cost reduction would result, so this approach is not evaluated herein.

Prior to backfilling the excavation, a layer of geotextile would be placed to segregate the fill materials from the underlying soils. The excavated area would then be backfilled with clean fill to re-establish the original grades within the area. Fill materials may include locally-obtained soil borrow and/or crushed stone/gravel, and impacted wetland areas will be restored as appropriate. The specific type(s) of fill materials would be determined during detailed design in consideration of the anticipated uses of the excavation area.

Post-implementation monitoring of the excavated/backfilled area under this alternative would be the same as that described for Alternative S-2. As described in Section 5.3.1.2, this would generally include short-term post-construction inspections to verify that the backfilled and restored areas are performing adequately, excessive settlement/erosion does not occur, and vegetation becomes re-established in seeded areas.

The estimated cost associated with this alternative is $2.25 million. In accordance with NR 722.07(4)(b), this includes estimated capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs associated with this alternative. It does not include the cost for establishing the baseline institutional control (deed restriction), which is an additional cost applicable among all alternatives regardless of the selected approach. The alternative-specific cost is summarized in Table 4 and a detailed summary of the estimated cost is provided in Appendix B, Table B-3.

5.3.2 On-Property Portion of the Outfall 001 Drainage Ditch

As summarized in an October 2, 2003 letter report to the WDNR (BBL, 2003b), creosote-like product was observed in isolated seams in the soil matrix within and adjacent to the on-property portion of the Outfall 001 drainage ditch. The potential for impacts to the ditch resulting from the presence of these materials has not been documented and monitoring performed by KI has not indicated that the creosote-like product is migrating downstream at concentrations above WPDES-permitted levels. Nevertheless, Beazer anticipates that proactive measures will be taken to mitigate the potential for current or future discharges from subsurface soils to the on-property portion of the Outfall 001 drainage ditch. In lieu of further evaluation of the potential for such discharges, Beazer has elected to identify and evaluate potential corrective action alternatives to mitigate direct contact with and potential migration of COPCs in drainage ditch materials. This is based on the anticipation of future corrective action activities in the portion of the Outfall 001 drainage ditch beyond the property boundary (which is to be separately evaluated in pending further evaluation of this area), and the desire to eliminate the potential for on-property areas to impact downstream portions of the ditch in the future. To address the presence of COPCs within and adjacent to the Outfall 001 drainage ditch, three alternatives have been developed. The scope of each alternative is described below.

5.3.2.1 Alternative D-1 – Culverting the Existing Ditch

Alternative D-1 involves installing a culvert pipe to convey surface water flow through the on-property portion of the Outfall 001 drainage ditch. The culvert pipe would eliminate direct contact between the surface water and the adjacent bank soils. It would also eliminate the potential for erosion of bank soils under higher flow conditions in the channel. As a proactive measure to address the potential presence of potentially mobile DNAPL, this alternative also includes a permeable trench and sumps beneath portions of the culvert to monitor for DNAPL accumulation and, if necessary, provide a means for DNAPL removal. The components of this alternative are as follows:

- Install a high permeability zone (e.g., crushed stone) with periodic sumps along the bottom of the existing ditch;

- Install a culvert along the bottom of the on-property portion of the Outfall 001 drainage ditch;
- Conduct periodic post-construction inspections to verify the continued effectiveness of the performance of the remedy; and
- Establish institutional controls, including the baseline deed restriction (Section 5.4) plus additional alternative-specific measures to provide for the continued integrity of the alternative (as necessary).

For the purposes of this CMS, culverting was selected as the representative in-situ containment/isolation technology based on the technology screening summarized in Table 3. However, an engineered cap was also retained as a potentially applicable technology that could accomplish the same objective as the culvert. While the culverting approach is specifically evaluated here, the use of an engineered cap in lieu of a culvert may be further evaluated during detailed design. The culvert-based approach is conceptually illustrated on Figure 6.

Under this alternative, a shallow (e.g., 2 feet or less) permeable trench would be installed along the bottom of the targeted portion of the Outfall 001 drainage ditch. At approximately three locations along the trench, slightly wider and deeper excavation would be performed to create collection sumps. Each sump would be separated from downstream sections by installing anti-seep collars along the culvert pipe. A riser pipe would be installed in each sump to provide a means for monitoring the potential accumulation of DNAPL that may enter the permeable medium and flow downgradient into the collection sumps. The purpose of this permeable zone, which is illustrated conceptually on Figure 6, is to provide a means to collect any potentially mobile DNAPL that may be present in the vicinity of the ditch, and thereby minimize the potential for adverse migration under the modified hydraulic conditions resulting from the culvert installation.

Following installation of the permeable medium, approximately 620 linear feet of culvert pipe would be installed along the ditch (i.e., on top of the permeable medium). This pipe would be connected to the existing culvert at the point where the ditch passes beneath the railroad track. To minimize the potential for the development of a preferential migration pathway along the culvert pipe, migration control barriers (i.e., anti-seep collars, bentonite walls, and/or other measures) will be installed at locations corresponding to the sumps installed in the permeable medium beneath the culvert pipe.

Catch basins would be installed at the points where existing tributaries (i.e., adjacent ditches) enter the Outfall 001 drainage ditch. As needed, catch basins would also be installed at various points along the culvert to allow for surface water runoff to enter the culvert piping and be conveyed from the Site. Following installation of the culvert pipe, the ditch would be partially backfilled with bedding material (i.e., compacted soil fill) to create a shallower ditch capable of collecting and conveying surface water runoff from the immediate vicinity of the ditch to the catch basins. That shallower ditch would be restored with a 6-inch surficial layer of hydric soils and planted with native wetland species to reestablish the wetland nature of the existing ditch area.

Given the relatively low flows in the ditch, installation of the permeable medium, sumps, culvert pipe, and associated appurtenances would be performed "in the dry" using standard earthmoving equipment (e.g., excavators, loaders, etc.). To accomplish this, a bypass pumping system would be established to collect surface water flows at an upstream point and pump them to a discharge point in the ditch downstream of the work area. Excavated materials (approximately 190 cubic yards) would be dewatered and placed in the onsite CAMU containment cell or transported to an offsite, appropriately permitted offsite commercial disposal facility. The selected method for disposition of excavated materials would likely be made in conjunction with the selected approach for targeted soils.

There is no indication that DNAPL currently accumulates in the ditch; therefore, significant DNAPL accumulations are not anticipated in the trench under this approach. This is particularly true given the fact that hydraulic gradients (a primary driving force for DNAPL) from the current bank soils toward the ditch would be reduced as a result of this alternative. Nonetheless, any potentially mobile DNAPL in the vicinity of the culvert would accumulate in the permeable trench and be conveyed to the collection sumps/monitoring points. Periodic monitoring of these locations would be performed to determine whether and to what extent DNAPL accumulation may occur. If and as necessary, future measures could be identified and implemented to address any DNAPL accumulations that might occur (e.g., periodic removal, etc.). However, because significant DNAPL accumulations are not anticipated based on current conditions, such measures are not included as part of this alternative.

Periodic post-construction inspections would be performed on a short term basis (e.g., for a period of three years following construction) to verify that the vegetative cover in the restored area becomes sufficiently established and to confirm that a wetland character is re-established in this area. In addition, periodic inspections at the collection sumps/monitoring points would be conducted to assess whether any DNAPL accumulation is occurring.

The estimated cost associated with this alternative ranges from $362,000 to $472,000. In accordance with NR 722.07(4)(b), this includes estimated capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs associated with this alternative. The range reflects the varying disposal methods contemplated under this alternative (i.e., onsite CAMU disposal versus offsite commercial land disposal), which would likely be selected in conjunction with the selected corrective action approach for soils. The estimated cost for this alternative does not include estimated costs associated with the construction, operation, and maintenance of the CAMU; CAMU disposal would only be selected for the ditch materials if selected for the targeted soil areas, and the CAMU-related costs are included with the associated soil alternative (Alternative S-2). The estimate also does not include the cost for establishing the baseline institutional control (deed restriction), which is an additional cost applicable among all alternatives regardless of the selected approach. The alternative-specific cost is summarized in Table 4 and a detailed estimate is provided in Appendix B, Table B-4.

5.3.2.2 Alternative D-2 – Excavation and Disposal of Drainage Ditch Materials

Alternative D-2 involves the excavation and on- or offsite disposal of impacted materials along the targeted portion of the Outfall 001 drainage ditch. Excavation of these materials would eliminate their potential for erosion and their ability to serve as a potential source of COPCs to surface water within the ditch. The components of this alternative, which is illustrated conceptually on Figure 7, are as follows:

- Excavate impacted materials along the on-property portion of the Outfall 001 drainage ditch;
- Restore excavated channel area to re-establish existing grades and function;
- Conduct periodic post-construction inspections to verify the performance of the remedy; and
- Establish institutional controls, including the baseline deed restriction (Section 5.4) plus additional alternative-specific measures to provide for the continued integrity of the alternative (as necessary).

Based on existing data, it is assumed that impacted materials targeted for removal under this alternative would include ditch and bank soils extending horizontally up to 16.5 feet on either side of the channel and vertically to a depth of approximately 3.5 feet over a 620-linear foot section of the channel (approximately 2,900 cy). These limits are based on visual observations made during a May 2003 reconnaissance (BBL, 2003b), and would be subject to refinement prior to implementation if this alternative is selected.

Given the relatively low flows in the ditch, excavation would be performed "in the dry" using standard earthmoving equipment (e.g., excavators, loaders, etc.). To accomplish this, a bypass pumping system would be established to collect surface water flows at an upstream point and pump them to a discharge point in the ditch downstream of the work area. Excavated materials would be dewatered and placed in the onsite CAMU containment cell or transported to an appropriately permitted offsite commercial disposal facility. The selected method for disposition of excavated materials would likely be made in conjunction with the selected approach for targeted soils.

Following excavation, the ditch would be backfilled to within six inches of pre-excavation grades with clean fill. Six inches of hydric soils and wetland plantings would then be placed along the bottom and side slopes of the ditch to reestablish the wetland nature of the existing ditch area.

Specific to the ditch area, it is anticipated that periodic post-construction inspections would be performed on a short-term basis (e.g., for a period of three years following construction) to verify that the restored area is functioning properly, that the vegetative cover in the restored area becomes sufficiently established, and to confirm that a wetland character is re-established in this area. In the event that the onsite CAMU is selected as the disposition method for excavated materials, CAMU-related inspections, maintenance, and institutional controls would be required as described in Section 5.5.

The estimated cost associated with this alternative ranges from $727,000 to $2.40 million. In accordance with NR 722.07(4)(b), this includes estimated capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs associated with this alternative. The range reflects the varying disposal methods contemplated under this alternative (i.e., onsite CAMU disposal versus offsite commercial land disposal), which would likely be selected in conjunction with the selected corrective action approach for soils. The estimated cost for this alternative does not include estimated costs associated with the construction, operation, and maintenance of the CAMU; CAMU disposal would only be selected for the ditch materials if selected for the targeted soil areas, and the CAMU-related costs are included with the associated soil alternative (Alternative S-2). The estimate also does not include the cost for establishing the baseline institutional control (deed restriction), which is an additional cost applicable among all alternatives regardless of the selected approach. The alternative-specific cost is summarized in Table 4 and a detailed summary of the estimated cost is provided in Appendix B, Table B-5.

5.3.2.3 Alternative D-3 – Ditch Relocation with DNAPL Migration Control Measures

Alternative D-3 involves relocation of a portion of the Outfall 001 drainage ditch such that it no longer flows through the area of impacted subsurface soils. It also includes measures to mitigate the potential for migration of potentially mobile DNAPL toward the new channel under the modified hydrogeologic conditions. The specific components of this alternative, which is illustrated conceptually on Figure 8, are as follows:

- Relocate the on-property portion of the Outfall 001 drainage ditch approximately 200 feet north of its existing location;
- Install a DNAPL collection system in the existing ditch;
- Conduct periodic post-construction inspections to verify the performance of the remedy; and
- Establish institutional controls, including the baseline deed restriction (Section 5.4), plus additional alternative-specific measures to provide for the continued integrity of the alternative, as needed.

Under this alternative, a new ditch would be constructed to convey flow through an unimpacted portion of the facility from the point of the existing culvert discharge west of the treatment area to the point the ditch enters the culvert beneath the railroad tracks along the northwest portion of the facility. The preliminary route of the new ditch is illustrated on Figure 8. This configuration is approximately 700 linear feet in length, and would require the excavation of approximately 780 cy of materials to create the channel. It also requires the installation of a new culvert at the point where the proposed route crosses an existing railroad track in the northern portion of the facility (Figure 8). In addition, adjacent ditches converging with the Outfall 001 drainage ditch within the reach subject to relocation would need to be modified/extended so that they drain into the relocated Outfall 001 drainage ditch. Culverts would be installed at the points where these ditches cross the existing portion of the Outfall 001 drainage ditch so water does not preferentially enter and flow through the backfilled ditch.

The new ditch would be similar in shape and character to the existing ditch and capable of conveying anticipated flows consistent with the existing channel. The banks and slopes of the new channel would be established by placing a six-inch thick layer of hydric soils which would be planted with native wetland species to re-establish a wetland character in the new channel similar to that of the existing channel.

Under this alternative, measures would also be implemented along a portion of the existing Outfall 001 drainage ditch channel to minimize the potential for DNAPL migration toward the new channel under the modified hydraulic conditions. Specifically, perforated collection piping would be installed in the bottom of the existing channel and the ditch would be partially filled with granular fill within the portion of the ditch extending from the culvert discharge west of the treatment area to the current Outfall 001 location. From the top of the permeable fill to surrounding grade, and within the portion of the relocated ditch channel where permeable fill is not placed (i.e., downstream of Outfall 001), the existing channel would be backfilled with soil fill and topsoil to match surrounding grade. A layer of geotextile would be placed between the granular fill and the soil to provide stability and prevent the soil from settling into the fill layer.

Prior to installing the perforated collection piping, approximately six inches of material/vegetation would be removed from the bottom of the ditch. Given the relatively low flows in the ditch, excavation would be performed "in the dry" using standard earthmoving equipment (e.g., excavators, loaders, etc.). To accomplish this, a bypass pumping system would be established to collect surface water flows at an upstream point and pump them to a discharge point in the ditch downstream of the work area. Excavated materials (approximately 40 cubic yards) would be dewatered and placed in the onsite CAMU containment cell or transported to an appropriately permitted offsite commercial disposal facility. The selected method for disposition of excavated materials would likely be made in conjunction with the selected approach for targeted soils. Following removal of the ditch bottom materials, the ditch bottom would be graded and compacted to create a suitable base and slope for the collection pipe.

At the approximate location of the current Outfall 001, the collection piping would terminate in a manhole. Using this approach, the high-permeability fill material would intercept any potentially mobile DNAPL that might be induced to flow toward the new channel with the modified hydraulic gradient. Such DNAPL, if any, would drop to the bottom of the permeable fill and be conveyed through the collection pipe to the manhole, where it would settle to the bottom of the manhole. The outlet to the manhole would be established at an elevation that would allow any water collected by the system to flow back to the Outfall 001 drainage ditch. A shallow surface drainage swale would be provided to convey effluent from the manhole to the relocated ditch (Figure 8).

Based on the elevation of the outflow from the manhole structure, the groundwater level in the backfilled portion of the Outfall 001 drainage ditch would be maintained at a higher elevation than the current water level in the ditch. Accordingly, the hydraulic gradient from the surrounding soils into the permeable fill would be less than currently exists from those soils into the ditch. Because the hydraulic gradient is a primary component in potential DNAPL migration, the reduced gradient corresponds directly to a reduced likelihood of DNAPL migration into the permeable fill. Therefore, because current conditions do not suggest DNAPL accumulations in the ditch, significant DNAPL accumulations are not anticipated in the permeable fill under this approach. Nonetheless, any DNAPL collected within the permeable fill would ultimately be conveyed to the manhole structure. Periodic monitoring of the manhole would be performed to determine whether and to what extent

DNAPL accumulation may occur. If and as necessary, future measures could be identified and implemented to address any DNAPL accumulations that might occur (e.g., periodic removal, placement of treatment media in the manhole, etc.). However, because significant DNAPL accumulations are not anticipated based on current conditions, such measures are not included as part of this alternative.

Periodic post-construction inspections would be performed on a short-term basis (e.g., for a period of three years following construction) to verify that the restored areas are functioning properly, that the vegetative cover in the restored area becomes sufficiently established, and to confirm that a wetland character is re-established along the new channel route. In addition, periodic inspections would be made to assess whether any DNAPL accumulations occur within the collection manhole.

Apart from the baseline institutional control (Section 5.4), additional alternative-specific institutional controls are not anticipated for this alternative. However, in the event that DNAPL accumulations occur within the collection manhole at some point in the future, additional institutional controls (e.g., deed restrictions) may be established to prohibit site activities that may affect the integrity or performance of the collection system.

The estimated cost associated with this alternative ranges from $419,000 to $442,000. In accordance with NR 722.07(4)(b), this includes estimated capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs associated with this alternative. The range reflects the varying disposal methods contemplated under this alternative (i.e., onsite CAMU disposal versus offsite commercial land disposal), which would likely be selected in conjunction with the selected corrective action approach for soils. The estimated cost for this alternative does not include estimated costs associated with the construction, operation, and maintenance of the CAMU; CAMU disposal would only be selected for the ditch materials if selected for the targeted soil areas, and the CAMU-related costs are included with the associated soil alternative (Alternative S-2). The estimate also does not include the cost for establishing the baseline institutional control (deed restriction), which is an additional cost applicable among all alternatives regardless of the selected approach. The alternative-specific cost is summarized in Table 4 and a detailed summary of the estimated cost is provided in Appendix B, Table B-6.

5.3.3 Groundwater

The corrective action approach proposed for on-property groundwater is a monitoring-based program. This approach has been identified in consideration of the following factors:

- COPCs have limited migration potential in the subsurface;
- Exposure to impacted groundwater is not occurring;
- Impacted groundwater is neither used nor anticipated to be used as a potable source;
- Impacted groundwater at the site has been shown to be limited with no evidence of migration beyond the facility boundary at levels above ESs;
- There is no evidence of COPCs in groundwater in offsite private wells; and
- There is no active source of COPCs to groundwater.

In the *2003 RCRA Annual Groundwater Monitoring Report* (RETEC, 2004), support was provided for following a monitoring-based approach for groundwater near the closed RCRA surface impoundments because a Site-wide corrective action plan was being pursued. It is appropriate to continue to monitor groundwater during and after implementation of on-property corrective action to assess the potential for off-property migration and to assess the occurrence of improving groundwater quality following implementation of the selected remedial approach. The proposed corrective action approach for on-property groundwater therefore includes monitoring at the downgradient property boundary and decommissioning A-zone monitoring wells that are not part of the monitoring network (to eliminate their potential to serve as vertical migration pathways). Details regarding this approach (e.g., number of wells, monitoring frequency, etc.) will be developed during detailed design once the alternatives for on-property soils and the on-property portion of the Outfall 001 drainage ditch have been selected. Rationale supporting the proposed groundwater approach is presented below.

The estimated cost associated with the proposed monitoring-based approach for groundwater is $1.0 million. This amount reflects the proposed decommissioning of approximately 15 A-zone monitoring wells plus implementation of a long-term annual groundwater monitoring program. This estimate is presented in Table 4 and a breakdown of the cost is provided in Table B-7 in Appendix B. Note that the estimated cost for the groundwater monitoring component is based on Beazer's current annual costs for implementation and reporting of the semiannual monitoring program for the closed surface impoundment area. Because the scope of the Site-wide corrective action monitoring program would include additional monitoring locations relative to the current program, the cost of the Site-wide monitoring was increased by 40 percent relative to the current program. For the purposes of the cost estimate, it is assumed that this program would be performed on an annual basis for a period of 30 years (the actual duration may vary).

5.3.3.1 Rationale for Proposed Approach

Site hydrogeologic conditions support the monitoring-based approach. This includes the nature, thickness, and permeability of the unconsolidated material; depth to the water table; groundwater flow gradients; and the potential and present groundwater use in the Site vicinity. The unconsolidated zone extends to approximately 170 feet bgs at the Site and consists of a low permeability clay, with occasional, discontinuous sand lenses.

Because of the very low permeability of the clay (A and B zones) and the discontinuity of the sand lenses (C zone), groundwater containing COPCs has little potential for migrating significantly from source areas, either horizontally or vertically. Any COPCs that do enter the discontinuous sand lenses are not likely to, and have not been determined to, migrate past the edge of the sand lenses because of the surrounding low-permeability clay soils. Findings reported in the *2003 RCRA Annual Groundwater Monitoring Report* indicate that temporal trends of concentrations of COPCs are stable or decreasing. Further, available data indicate there have been no detections of COPCs above ESs near the downgradient property boundary, and no COPCs have been detected in offsite, downgradient supply wells.

The current extent of COPCs in groundwater is anticipated to be the limit of potential migration because of the lack of an active source, the extremely low hydraulic conductivities and intrinsic remediation, which will control the constituents' fate by attenuation and microbial degradation. Impacted groundwater at the Site is not currently used or anticipated to be used in the future as a potable water source. Additionally, potential migration to offsite private wells is not demonstrated or anticipated due to the hydrogeologic characteristics of the Site and area.

The location of the shallow A-zone wells has been within or proximal to identified SWMUs. In many cases, observations of COPCs are noted within the boring logs for the A-level wells. The A-zone wells may be acting as preferred flow pathways for the COPCs to the depths of the wells, where under normal conditions, the tight clay would limit the migration of the COPCs. Because of the shallow water table at the Site, these wells are completed at extremely shallow depths; the sandpack/screened interval is, on average, within two feet of the ground surface. The wells' sandpack/screen location within or near shallow soils that contain visual evidence of COPCs is the reason constituents are periodically detected in these wells. This remains a surface phenomenon, however, because of the low hydraulic conductivity clay below these shallow affected soils. The A-zone wells are likely to be affected by the climatic effects on the clay, such as swelling/shrinking and freeze/thaw, which may enhance the migration of constituents within the shallow clay to the depths of the wells (approximately 15 feet bgs), which would otherwise be attenuated within the upper portion of the shallow clay.

Because the shallow groundwater at the Site is not used as a potable water source, there is no exposure to affected groundwater onsite. Additionally, previous investigation data do not indicate the potential for offsite migration of COPCs above ESs. The need to comply with human health-based standards within the A-level wells is not demonstrated, and their presence only serves to enhance the vertical migration of COPCs within the shallow clay at the Site. For these reasons, A-zone wells that are not part of the proposed monitoring program will be abandoned. This approach is consistent with NR 140.24(4), Table 5, number 10 and NR 140.26(2), Table 6, number 6, which requires "remedial action to prevent or minimize the further discharge or release of the substance to groundwater."

Supplemental to the abandonment of the A-zone wells is an exemption based on the demonstrated lack of human health risk posed by the COPCs present in the clay aquitard. This is consistent with NR 140.28(2)(d), wherein it is stated that an exemption can be granted for exceedances of the PAL and/or ES if "Any existing or projected increase in the concentration of the substance above the background concentration does not present a threat to public health or welfare."

While occasional exceedances of state standards have occurred at a few C-level wells at the facility, the nature of the discontinuous sand lenses limits the potential for migration of constituents beyond the downgradient property boundary. This has been demonstrated by available data collected from downgradient monitoring at wells located along the property boundary within the C-level sand lenses. Occasional exceedances have also occurred in the bedrock monitoring wells, but the most recent data indicate that concentrations of COPCs in these wells are below ESs and, with one exception, PALs (BBL, 2003a). Consequently, an exemption for PAL or ES exceedances in the C-level and bedrock within the Site is appropriate as there are no impacts to public health from groundwater in these zones. Monitoring the C-level and bedrock wells at the downgradient property boundary is proposed as a long-term monitoring strategy at the Site to be protective of public health and welfare.

5.3.3.2 Monitoring Approach

In considering Site-wide groundwater quality, incorporating the RCRA-unit (the closed RCRA surface impoundments) within the context of Site-wide monitoring will inherently address any potential effects on groundwater quality, if any, caused by the RCRA-unit. Additionally, the duplicative technical and administrative assessment of Site-wide groundwater quality and RCRA-unit groundwater quality will be eliminated. A proposed Site-wide corrective action groundwater monitoring program was submitted to the WDNR for review[6], as required in a WDNR October 24, 1996 Conditional Closure and Long-Term Care Plan Modification Approval. While the proposed Site-wide corrective action monitoring approach was not commented on or approved by the WDNR, the proposed program consisted of monitoring C-zone wells located along the downgradient property boundary. The alternative proposed for groundwater in this Focused CMS Report is consistent with that approach, in that C-zone and bedrock monitoring wells will be monitored to ensure that impacted groundwater is not migrating beyond the property boundary.

Groundwater is not constrained by artificial boundaries such as SWMUs, areas of concern, or the design management zone established as the point of compliance at the RCRA-unit under the state's regulation (NR 140). The proposed corrective action monitoring program would therefore monitor for the potential offsite migration from the facility. This approach for downgradient property boundary corrective action monitoring is

[6] The proposed Site-wide corrective action monitoring approach was identified in a December 20, 1996 letter from Fluor-Daniel GTI to the WDNR.

consistent with the monitoring point of standards application described at NR 140.22(2)(b), in light of the impracticability of responding to an exceedance of the state's standards within the shallow clay aquitard onsite through corrective action or engineering controls, and the ability to respond to exceedances onsite through institutional controls. This approach is consistent with NR 140.24 and 140.26 for exceedances of the state's PALs or ESs, relative to the impracticability of groundwater remediation of the clay aquitard.

5.4 Institutional Controls

As indicated above, a key premise of the Post-Remediation HHRA (Appendix A) is the fact that the facility will remain in industrial use. The exposure scenarios and areas targeted for corrective action were based on the assumption that future use of the Site would be restricted to industrial purposes. To ensure that future Site uses are consistent with this assumption, a "baseline" institutional control requiring a deed restriction is applicable regardless of which of the corrective action alternatives is selected. A deed restriction is a set of requirements registered with the property deed that identify prohibited site activities or uses to be protective of corrective action measures and/or assumptions made in the risk assessment. In this case, the future use of the Site would be restricted to industrial operations to be consistent with the future use scenarios evaluated in the Post-Remediation HHRA (Appendix A).

In accordance with NR 720.11(1)(c), future use of a site may be restricted to industrial as long as the site is currently zoned for industrial use, the site is expected to be used for industrial purposes, more stringent residual contaminant levels are not necessary to protect public health on or off the site, and a deed restriction is recorded within 30 days after corrective action is initiated at the site. The KI wood-treating site is currently zoned and used for industrial purposes, and the risk-based objectives established in the Post-Remediation HHRA – which are based on the Site remaining in industrial use – are sufficient to protect public health. Therefore, establishing a deed restriction requiring the Site remain in industrial use is appropriate, and would be recorded within the time period required by NR 720.11. In addition, in an October 17, 2001 letter, the WDNR acknowledged that a deed restriction limiting future use of the Site to general industrial use would be an appropriate element of a final corrective action for the Site.

In addition to this "baseline" institutional control, certain alternatives described above also include additional controls that would apply only in the event that alternative is selected and implemented. For example, under Alternative S-1, controls would likely be established to prohibit removal of the surface cover without adequate precautions and controls and subsequent replacement of the cover materials. Such alternative-specific controls were identified above and are further discussed and evaluated (Section 6) as components of their respective alternatives. The "baseline" institutional control is applicable regardless of the alternative, and is therefore not a distinguishing factor among the alternatives. Accordingly, it is not point of comparison among alternatives in Section 6.

5.5 Onsite CAMU Disposal

As indicated in the alternative descriptions in Section 5.3, multiple alternatives include provisions for onsite disposal of excavated materials within a containment cell to be established within a CAMU. NR 636.03 and NR 600.03, define a CAMU as "an area of the facility that is designated by the [WDNR] under NR 636 for the purpose of implementing corrective action requirements" and "shall only be used for management of remediation wastes pursuant to implementing such corrective action requirements at the facility." With the expectation that removal-based alternatives may potentially be appropriate for the Site (both for the on-property areas addressed in this Focused CMS Report and the areas beyond the property boundary to be separately addressed), Beazer submitted a *Request for Modification of the Closure and Long-Term Care Plan Approval and Corrective Action Management Unit ("CAMU") Demonstration* (CAMU Demonstration Document; BBL, 2000a) to the WDNR in May 2000. The CAMU Demonstration Document proposed an approach whereby a containment cell would be constructed within a designated CAMU area and used for the long-term management of materials generated during the corrective action activities at the Site. The purpose of the CAMU Demonstration Document was to provide the necessary information to support the designation of a CAMU at the Site, including justification that the proposed approach would provide a reliable, effective, protective, and cost-effective means of managing these materials. The WDNR issued a letter to Beazer dated November 1, 2000 that indicated that the CAMU application was "substantially in the approval process" and therefore "grandfathered" under the 1993 CAMU regulations (NR 636). In accordance with the 1993 CAMU regulations, placement of remediation wastes in a CAMU does not constitute creation of a unit subject to LDRs or minimum technology requirements (MTRs).

While the specific CAMU design parameters are yet to be finalized, the general approach considered for the purposes of this Focused CMS Report includes the construction of a lined, bermed containment cell with a leachate collection system located within a designated CAMU area. Excavated materials would be placed into the containment cell, compacted, and graded to achieve appropriate slopes. Once all of the subject materials are placed, a surface cover (cap) would be installed on top of the consolidated materials. Additional details regarding this approach are as follows:

- Based on the findings of the wetland delineation performed at the Site in 2002 and subsequent discussions with KI and the WDNR, the location of the CAMU proposed in the CAMU Demonstration Document has been modified from the former landfill/landfarm area to an area in the southwest portion of the Site (Figure 4).

- The aerial extent/configuration of the containment cell would be determined during detailed design in consideration of the anticipated volume of materials targeted for consolidation in the CAMU.

- For the purposes of this Focused CMS Report, the containment cell is assumed to meet the landfill design requirements of NR 504. This includes a bottom liner, leachate collection system, and a 5-plus-foot thick multi-layer cap. These design requirements are reflected in the cost estimate provided in Table B-8 of Appendix B. However, these requirements are not specifically applicable to the CAMU design, and are subject to further evaluation and modification as part of the CAMU design and approval process.

In support of the CAMU as a potential component of the selected corrective action approach for the Site, a revised CAMU Demonstration Document will be prepared and submitted to the WDNR as a supplement to this Focused CMS Report. The revised CAMU Demonstration Document would supersede the previous version submitted to the WDNR in May 2000. In doing so, the revised report would reflect the currently proposed CAMU location, address WDNR comments regarding the previous version, and provide conceptual design details for the containment cell. This would also include an assessment of the applicability and appropriateness of landfill siting criteria and performance standards of NR 504.04(4), as suggested by the WDNR in their January 22, 2004 letter to Beazer. The revised CAMU Demonstration Document would therefore serve as a basis for WDNR approval of the proposed CAMU design, and serve as a basis for detailed design of the containment cell.

If constructed, CAMU-specific operation, monitoring, and maintenance activities would be performed. Such activities would depend, in part, on the final design of the containment cell. Examples of potential CAMU-specific operation, maintenance, and monitoring activities include:

- Periodic inspections to verify the integrity of the surface cover and the proper functioning of ancillary components (e.g., surface water diversion measures);
- Periodic mowing of the vegetated cover to prevent the establishment of deep-rooted vegetation that could affect the cover system;
- Repair and reseeding of any areas of excessive settlement or erosion of surface cover materials;
- CAMU-specific groundwater monitoring to satisfy the requirements of NR 636.40(5)(c) (likely performed in conjunction with a Site-wide corrective action monitoring program, as discussed in Section 5.3.3); and
- Operation and maintenance of any leachate collection system that may be a component of the final containment cell design.

Similarly, CAMU-specific institutional controls would be required in the event that a CAMU is constructed at the Site. At a minimum, CAMU-specific institutional controls are expected to include:

- A prohibition on excavation, drilling, construction or other types of disturbance within the CAMU containment cell area (except as may be necessary for maintenance of the CAMU and not without first developing an appropriate health and safety plan and a soil management plan); and
- A requirement for continued operation and maintenance of the CAMU containment cell, including the various operation, maintenance, and monitoring activities indicated above.

As indicated above, onsite disposal of excavated materials in a CAMU containment cell is a component of Alternative S-2 and, potentially, Alternatives D-1, D-2, and D-3. (It is important to note that the selection of a disposal option for excavated drainage ditch materials is likely dependent upon the selected corrective action approach for on-property soils. It is unlikely that a CAMU-based disposal approach would be selected for drainage ditch materials if it is not selected for on-property soils.) Onsite CAMU disposal may also be applicable to corrective action alternatives for the portions of the Site beyond the property boundary (to be addressed separate from this CMS). Accordingly, the CAMU is not specific to a single alternative, and must be considered in context of the overall corrective action approach for the Site. For those alternatives that include onsite disposal of excavated materials in a CAMU, the CAMU component is considered in the detailed evaluation of the alternative, as presented in Section 6. A summary of costs associated with construction, operation, and maintenance of the CAMU containment cell is provided in Appendix B, Table B-8.

6. Evaluation of Corrective Action Alternatives

6.1 General

As required by NR 722.07, this section presents a comparative evaluation of the corrective action alternatives identified and described in Section 5. The evaluation criteria, described in NR 722.07(4) and NR 722.09(2), are identified as follows and further discussed in Section 6.2:

- Long-term effectiveness;
- Short-term effectiveness;
- Implementability;
- Restoration time frame;
- Economic feasibility; and
- Compliance with laws, standards, and permitting requirements.

The purpose of this evaluation is to identify the relative advantages and disadvantages of the various alternatives and thereby support the selection of one or more alternatives as the preferred alternative(s) for the on-property portions of the Site. Specifically, the comparative evaluation is intended to identify which corrective action alternative(s) for on-property soils and the on-property portion of the Outfall 001 drainage ditch "constitutes the most appropriate … combination of technologies to restore the environment, to the extent practicable, within a reasonable period of time…" (NR 722.07(3)(a)). In addition, the monitoring approach for groundwater described in Sections 4 and 5 will be evaluated with respect to the same six criteria to demonstrate its applicability for this Site.

The alternatives for on-property soils and the on-property portion of the Outfall 001 drainage ditch are assessed based on how well each performs relative to the evaluation criteria described in Section 6.2 and relative to the other alternatives considered. Site-specific considerations that affect an alternative's performance relative to the other options are incorporated (for example, although all the alternatives may be technically implementable, factors that impact the relative ease or difficulty of implementability are considered). To aid in assessing the relative performance and in summarizing the results of the comparative evaluation, this Focused CMS Report incorporates a numerical ranking system. For each evaluation criterion, each alternative is assigned a score ranging from 1 to 5 for each criterion, with 1 representing the low end of the performance scale and 5 representing the high end of the performance scale. The scores are intended to reflect the relative comparisons among the alternatives considered, as well as the extent to which an alternative satisfies each criterion. The scores are presented in Table 5 and are supported by the criterion-specific considerations summarized below.

Separate comparative evaluations are provided below for on-property soils (Section 6.3) and the on-property portion of the Outfall 001 drainage ditch (Section 6.4). Justification for the proposed groundwater approach relative to the evaluation criteria is provided in Section 6.5. The results of these evaluations will be used to identify a selected corrective action alternative for both the on-property soils and the on-property portion of the Outfall 001 drainage ditch and provide the final justification for the monitoring approach for groundwater. Based on these evaluations, the proposed overall corrective action approach is identified in Section 7.

6.2 Evaluation Criteria

The comparative evaluation of the various corrective action alternatives is based on an assessment of the performance of the alternatives relative to the technical and economic feasibility criteria identified and described in NR 722.07(4), as well as the NR 722.09(2) requirement for compliance with applicable environmental laws and standards. Based on the parameters outlined in the Wisconsin Administrative Code, the evaluation criteria used in this focused CMS are identified and the factors considered for each are briefly described below.

- **Long-Term Effectiveness [NR 722.07(4)(a)(1)]:** This criterion considers the long-term effectiveness of the alternative, including the degree to which a reduction in toxicity, mobility, and volume of COPCs is achieved and the degree to which the alternative will protect public health, safety, and welfare and the environment over time. It also considers the potential for the alternative to achieve the established CAOs (Section 4.2).

- **Short-Term Effectiveness [NR 722.07(4)(a)(2)]:** This criterion considers the potential for and magnitude of adverse impacts on public health, safety, and welfare and the environment during the alternative's construction and implementation period. Such impacts include, but are not limited to noise, dust generation, disruption to facility operations, potential for releases, and potential risks associated with on- and offsite equipment traffic. Potential impacts on workers and the community are assessed, as well as the length of time the impacts are expected to last and the extent to which engineering and/or operational controls can be used to mitigate potential impacts.

- **Implementability [NR 722.07(4)(a)(3)]:** This criterion considers the relative ease or difficulty of implementing the various corrective action alternatives in consideration of alternative- and Site-specific considerations. Both technical and administrative implementability are considered. Because all of the corrective action alternatives carried through the focused CMS process to this point include proven technologies, no pilot or bench-scale testing will be required and there is a limited possibility for implementation issues to arise strictly due to the choice of technology. Specific implementability considerations included in this evaluation are:

  - The technical feasibility of constructing and implementing the alternative at the Site;
  - The availability of materials, equipment, technologies, and workers needed to conduct the alternative;
  - The potential difficulties and constraints associated with onsite construction or offsite disposal;
  - The difficulties associated with monitoring the effectiveness of the corrective action option;
  - The administrative feasibility of the corrective action option, including activities and time needed to obtain any necessary licenses, permits, or approvals;
  - The presence of any federal or state threatened or endangered species; and
  - The technical feasibility of recycling, treatment, engineering controls, or disposal.

- **Restoration Time Frame [NR 722.07(4)(a)(4)]:** This criterion considers the time required until the CAOs for the various media are achieved. Because no sensitive receptors or threatened/endangered species are present within the areas addressed by this focused CMS, Site conditions are generally not conducive to short-term changes or migration of COPCs, and the targeted corrective action areas are consistent among the alternatives for each area, the qualitative considerations identified in NR 722.07(a)(4)(a-f) are not a point of differentiation among the alternatives considered. Accordingly, this criterion primarily focuses on the construction/implementation timeframe associated with each alternative.

- **Economic Feasibility [NR 722.07(4)(b)]:** This criterion considers the economic feasibility of a corrective action alternative by considering its cost relative to the long-term effectiveness, short-term effectiveness, implementability, and restoration timeframe. Cost components considered include capital costs (including both direct and indirect costs), initial costs (including design and testing costs), and annual operation and maintenance costs.

- **Compliance with Environmental Laws, Standards, and Permitting Requirements [NR 722.09(2)]:** This criterion considers the extent to which the corrective action alternatives are expected to comply with applicable laws, standards, and permits. Table 5 identifies the various environmental laws, standards, and permitting requirements potentially applicable to the alternatives considered within this focused CMS.

6.3 On-Property Soils

The three corrective action alternatives developed to address the presence of COPCs in soils in the areas of the Site targeted for corrective action (S-1 – Surface Cover, S-2 – Excavation with Onsite CAMU Disposal, and S-3 – Excavation with Offsite Disposal at a Commercial Facility) were described in Section 5.3.1. In this section, these alternatives are comparatively evaluated with respect to the six criteria identified in Section 6.2. The results of this analysis will be used as a basis for recommending a corrective action approach for the on-property soils. Scores developed for each alternative (using the numerical system described in Section 6.1) are presented in Table 5.

6.3.1 Long-Term Effectiveness

All three corrective action alternatives developed to address targeted on-property soils would provide adequate protection of public health, safety, and welfare and the environment by eliminating the potential for exposure to targeted surface soils described in the Post-Remediation HHRA. Alternative S-3 (Excavation with Offsite Disposal) provides the highest relative degree of reduced toxicity, mobility, and volume at the Site and also likely affords the best overall protection and effectiveness because the excavated materials would be permanently removed from the Site. Further, there is no potential for any component of Alternative S-3 to fail in the long term following implementation.

Alternatives S-1 and S-2 would both reduce the mobility of COPCs in the targeted soils through isolation/containment either under a surface cover (Alternative S-1) or in an onsite CAMU containment cell (Alternative S-2); however, neither alternative would result in volume reductions at the Site. Toxicity reductions associated with all of the alternatives would be limited to that which occurs over time as a result of ongoing natural attenuation and biodegradation processes.

There is a potential for failure of the surface cover (Alternative S-1) or the CAMU containment cell (Alternative S-2), although proper design and maintenance of the alternatives would virtually eliminate this possibility. Because impacted materials would remain onsite with implementation of either Alternative S-1 or S-2, there would be an increased level of potential future exposure to or migration of COPCs associated with those materials relative to Alternative S-3. However, proper maintenance and monitoring along with appropriate institutional controls (e.g., for Alternative S-1, a prohibition on excavation or other types of surface disturbance in the targeted area without an appropriate health and safety plan and a soil management plan) would effectively mitigate this potential.

All three alternatives would achieve the Site-specific CAOs established for on-property soils. Alternatives S-1 and S-2 would mitigate direct contact through isolation/containment of the targeted soils, while Alternative S-3 achieves this goal through removal and offsite disposal of the soils. All three also minimize the potential offsite migration of COPCs through dissolved phase transport (groundwater) or erosion (surface water) through isolation/containment and/or removal of targeted materials, although Alternative S-3 would provide a slightly higher degree of migration control because the impacted soils would be permanently removed from the Site. For all the alternatives, proper monitoring and maintenance of the targeted area (and for Alternative S-2, the CAMU containment cell) after implementation will be necessary to maintain the protections afforded by the corrective action over the long term. To this end, Alternative S-1 and the CAMU associated with Alternative S-2 include long-term post-implementation inspections; the excavated areas in Alternatives S-2 and S-3 would be inspected for a period of time following implementation (e.g., three years) to verify that these areas become suitably restored.

Institutional controls would be implemented under each alternative to limit future use of the Site to industrial purposes and verify the corrective action is functioning as intended, adding to the long-term effectiveness and protection of human health, safety, public welfare, and the environment.

In summary, due to the increased level of permanence and protection afforded by Alternative S-3, this alternative was assigned a score of 5. Alternatives S-1 and S-2 were both assigned a score of 4 because, although they are expected to achieve CAOs and be effective in the long-term, impacted soils remain at the Site and the alternatives rely upon a higher degree of engineering and institutional controls relative to Alternative S-3.

6.3.2 Short-Term Effectiveness

Short-term impacts associated with construction/implementation of the selected corrective action exist for all three alternatives and would last for the duration of construction activities. Such impacts potentially include (but are not limited to) the following:

- Working with and around construction equipment;
- Noise generation from operating construction equipment;
- Increased vehicular traffic associated with delivery of equipment/materials and transport (on- or offsite) of excavated materials;
- Dust generation during excavation and backfill activities;
- Potential odor generation from excavation of impacted materials;
- The potential for exposure to soils impacted by COPCs; and
- Potential disruption of KI facility operations.

To the extent possible, such impacts would be minimized by engineering controls and access controls during implementation, use of dust suppression measures (as needed), use of proper health and safety practices, detailed design, and coordination with KI during the planning and implementation stages. Restoration activities associated with each alternative include restoring or creating new wetland areas to replace wetlands affected during construction activities.

Implementation of Alternative S-1 (surface cover) presents the fewest short-term impacts because this alternative requires the least amount of soil handling. Therefore, it will result in the lowest potential for dust generation, transportation- or handling-related releases of impacted materials, and disruption to Site operations. Further, this alternative represents the shortest implementation timeframe (estimated to be approximately

3 weeks, compared to 27 weeks for Alternative S-2 and 8 weeks for Alternative S-3), so the duration of these impacts is also lower compared to other alternatives. By comparison, Alternatives S-2 and S-3 would result in a slightly higher degree of short-term impacts associated with the additional soil handling. Specifically, these alternatives require both excavation of impacted soils and placement of fill material, thus increasing the amount of equipment traffic, project duration, and corresponding disruption to facility operations. Alternative S-3 also includes offsite transport of impacted soils and the corresponding increased local traffic and potential for transportation-related releases. Alternative S-2 includes the additional short-term impacts associated with CAMU construction (e.g., delivery of equipment and materials, access road construction, operation of construction equipment, etc.), as well as the increased implementation period of 19 weeks.

Based on the considerations identified above, Alternative S-1 presents the fewest short-term impacts, and the shortest implementation duration. As a result, Alternative S-1 was assigned a score of 4. Alternative S-3 was assigned a 3 due to the increased level of short-term impacts and timeframe (8 weeks) associated with excavation and offsite disposal. Finally, because construction of the CAMU containment cell would lead to increased impacts associated with containment cell construction and a longer implementation period (27 total weeks), Alternative S-2 was assigned a score of 2.

6.3.3 Implementability

The corrective action alternatives developed and evaluated in this Focused CMS Report include only proven technologies and no pilot or bench-scale testing would be necessary. Further, all the alternatives are technically implementable and all the necessary materials, equipment, and workers are expected to be available regardless of the corrective action alternative selected. Adequate monitoring and maintenance activities can be established for each alternative, and no threatened or endangered species are present (given the active operational nature of the targeted area). Also, because the alternatives are anticipated to comply with applicable environmental laws, standards, and permitting requirements (Section 6.3.6), each alternative is administratively feasible. The implementability issues associated with working in the vicinity of an active facility, establishing staging areas, and excavating or covering soils around buildings or other structures would apply equally to all the alternatives, and could be addressed through coordination efforts with KI. Restoration activities associated with each alternative include restoring or creating new wetland areas to replace wetlands affected during construction activities. Finally, there are no anticipated difficulties associated with the disposal methods contemplated under the various alternatives (e.g., onsite CAMU disposal or offsite commercial disposal).

While there are no factors that preclude the implementability of any alternative, the key differentiating factor with respect to implementability is administrative feasibility. Alternatives S-1 and S-3 are expected to be relatively straightforward in this regard. However, approval of the CAMU associated with Alternative S-2 is expected to require additional administrative efforts, including the development of a revised CAMU Demonstration Document for submittal to the WDNR and a RCRA permit modification associated with the establishment of a CAMU at the Site. Coordination with the WDNR will also be required to establish the design characteristics of the containment cell. Nonetheless, the WDNR has conceptually agreed to the establishment of a CAMU at the Site (WDNR, 2000) such that the administrative requirements are not expected to limit the implementability of this alternative.

In summary, no significant or differentiating implementability concerns exist for Alternatives S-1 and S-3; therefore both these options were assigned a score of 5. A score of 4 was assigned to Alternative S-2 because, while the alternative is implementable, it is expected to require a comparatively higher degree of administrative coordination relative to the other alternatives.

6.3.4 Restoration Time Frame

As discussed in Section 6.2, this criterion effectively relates to the time required to implement each alternative (i.e., the time required until the Site-specific CAOs are achieved). While other factors may affect the timeframe at which construction activities associated with a given alternative could be initiated (e.g., WDNR approval timeframe, construction season, the need for CAMU design, timing of any corrective action activities for off-property areas, etc.), Beazer's overall goal is to implement the selected alternative by the end of the 2005[7] construction season. As a result, the primary differentiating factor with regard to this criterion is the estimated length of time necessary for construction of each alternative. Based on the detailed cost estimates included in Appendix B, Alternative S-1 is estimated to take three weeks, Alternative S-2 would take approximately 27 weeks, and Alternative S-3 could be completed in about eight weeks. Based on these relative timeframes, Alternatives S-1, S-2, and S-3 were assigned scores of 5, 3, and 5, respectively.

6.3.5 Economic Feasibility

Preliminary costs, including capital costs, indirect costs (e.g., pre-design investigation, institutional controls, engineering design, etc.) and post-construction operation and maintenance costs, were developed for each of the alternatives in accordance with NR 722.07(4)(b). The costs are summarized on Table 4, and detailed estimates are provided in Appendix B. Total costs for the three soil alternatives are as follows:

- Alternative S-1: $371,000;
- Alternative S-2: $2.30 million; and
- Alternative S-3: $2.25 million.

Alternative S-1 achieves the CAOs and provides for long- and short-term effectiveness in a short implementation time frame without any substantial implementability issues. It can also be implemented for approximately one-sixth the cost of Alternatives S-2 and S-3; therefore, a score of 5 was assigned for Alternative S-1. Alternatives S-2 and S-3 cost significantly more without achieving notable improvements in long- or short-term effectiveness. Further, both options would take longer (27 weeks for Alternative S-2 and 8 weeks for Alternative S-3) and have an increased level of short-term impacts, and there are potential administrative issues related to design and construction of the CAMU component of Alternative S-2. Since neither Alternative S-2 nor S-3 achieves a level of additional protection or improved performance to justify the increased cost, both alternatives were assigned a score of 1.

6.3.6 Compliance with Environmental Laws, Standards, and Permitting Requirements

Environmental laws and standards that are potentially applicable to implementing corrective actions at the Site are summarized on Table 6. The primary applicable requirement for on-property soils is achievement of the Site-specific soil performance standards established as provided for in NR 720. All three corrective action alternatives developed to address on-property soils would meet these standards and the risk-based objectives described in the Post-Remediation HHRA. Requirements outlined in applicable permits (see Table 6) would be addressed during detailed design of the selected alternative. Accordingly, each of the alternatives was assigned a score of 5.

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[7] This objective is related, in part, to the USEPA's objective to satisfy Environmental Indicator parameters described in interim-final guidance issued by USEPA's Office of Solid Waste on February 5, 1999 (USEPA, 1999).

6.4 On-Property Outfall 001 Drainage Ditch Materials

The three corrective action alternatives developed to address the presence of COPCs within and adjacent to the on-property portion of the Outfall 001 drainage ditch (D-1 – Culverting the Existing Ditch, D-2 – Excavation and Disposal of Drainage Ditch Materials, and D-3 – Ditch Relocation with DNAPL Migration Control Measures) were described in Section 5.3.2. In this section, these alternatives are comparatively evaluated with respect to the six criteria presented in Section 6.2. Scores developed for each alternative are summarized in Table 5. The results of this comparative evaluation are used as a basis for selecting a recommended alternative for the on-property portion of the Outfall 001 drainage ditch (Section 7).

6.4.1 Long-Term Effectiveness

The three alternatives developed to address the on-property portion of the Outfall 001 drainage ditch are capable of achieving Site-specific CAOs, and would result in post-construction conditions that provide for protection of public health, safety, welfare and the environment (particularly given the proactive nature of this corrective action component). With Alternatives D-1 and D-3, the existing ditch would be backfilled, thereby minimizing the potential for direct contact with ditch materials containing COPCs. Also, following implementation, surface water would either flow through a culvert (Alternative D-1) or a new channel in an unimpacted portion of the Site (Alternative D-3), thereby minimizing the potential for future releases of COPCs and/or potentially mobile DNAPL (if present) to the ditch. Similarly, with Alternative D-2, by excavating impacted ditch materials and consolidating in an onsite CAMU or transporting offsite for disposal, the potential for direct contact with COPCs in ditch materials would be reduced, as would the potential for downstream migration of COPCs via the ditch. However, the extent to which this alternative would be effective in the long term is uncertain because the extent of removal associated with Alternative D-2 has not been definitively established and the alternative does not include a barrier to prevent future discharges to the ditch in the event potentially mobile residual materials exist following the removal and replacement of impacted materials.

Alternative D-2 would result in the permanent removal of approximately 2,900 in-situ cubic yards of impacted materials from within and adjacent to the onsite portion of the Outfall 001 drainage ditch, thereby reducing the volume and mobility of COPCs associated with those soils. To a lesser extent, Alternatives D-1 and D-3 also involve removal of impacted materials from the ditch (190 in-situ cubic yards for Alternative D-1 and 40 in-situ cubic yards for Alternative D-3). The reduction of volume and mobility of COPCs would be proportional to the volume of materials removed. In addition, in the event that DNAPL is removed under Alternatives D-1 and D-3, further reduction in the volume and mobility of COPCs would be achieved.

All three alternatives include short-term (e.g., three years) of post-implementation inspections to verify that the impacted areas are sufficiently restored and that the corrective action is functioning as designed. Alternatives D-1 and D-3 include additional long-term operation and maintenance associated with the culvert/catch basins and DNAPL collection sumps (Alternative D-1) and DNAPL collection pipe/manhole (Alternative D-3). Such measures will support the long-term effectiveness of these alternatives.

Institutional controls would also be implemented under each alternative to limit future use of the Site to industrial purposes, adding to the long-term effectiveness and protection of human health, safety, public welfare, and the environment.

In summary, all three drainage ditch alternatives are effective long-term approaches for addressing the presence of COPCs within and adjacent to the on-property portion of the Outfall 001 drainage ditch. Alternative D-2 meets Site-specific CAOs, includes permanent removal of impacted materials from the ditch, and requires only short-term operation and maintenance. Therefore, assuming that the extent of removal is sufficient to remove any potentially mobile DNAPL that may be present in the vicinity of the ditch, Alternative D-2 is the most protective alternative and was assigned a score of 5 with respect to long-term effectiveness. Although Alternatives D-1 and D-3 involve leaving impacted ditch materials in place, the potential for contact with these materials and downstream migration of COPCs would be minimized and Site-specific CAOs would be achieved. However, due to the long-term operation and maintenance requirements necessary to maintain the effectiveness of Alternatives D-1 and D-3, a score of 4 was assigned to these two alternatives.

6.4.2 Short-Term Effectiveness

Potential short-term impacts associated with implementation of any of the three alternatives include (but are not limited to) the following:

- Working with and around construction equipment;
- Noise generation from operating construction equipment;
- Increased vehicular traffic associated with delivery of equipment/materials and transport (on- or offsite) of excavated materials;
- Dust generation during excavation and backfill activities;
- Potential odor generation from excavation of impacted materials;
- The potential for exposure to ditch materials impacted with COPCs;
- Potential disruption of KI facility operations;
- Surface water impacts; and
- Wetland impacts.

To the extent possible, such impacts would be minimized by engineering controls and access controls during implementation, use of dust suppression measures (as needed), use of proper health and safety practices, detailed design, and coordination with KI during the planning and implementation stages. Bypass pumping and erosion/sedimentation controls would be used to minimize the potential for surface water impacts associated with work adjacent to the ditch. Restoration activities associated with each alternative include restoring or creating new wetland areas to replace wetlands affected during construction activities.

The on-property portion of the Outfall 001 drainage ditch is located away from the main work areas of the KI facility. Accordingly, disruptions to KI activities associated with implementing the ditch alternatives is anticipated to be minimal. However, disruption to KI activities associated with on- or offsite transportation of excavated materials (and delivery of backfill materials) under Alternative D-2 would be much greater than under Alternatives D-1 or D-3 due to the relatively large volume of materials subject to removal/disposal (and the volume of fill materials required). Alternative D-3 would involve the temporary dismantling of a KI railroad spur to facilitate installation of a culvert associated with the relocation of the drainage ditch, which may also cause disruptions to KI activities.

The implementation timeframes for Alternatives D-1, D-2, and D-3 are 6 weeks, 8 weeks, and 5 weeks, respectively. Accordingly, Alternative D-2 will result in a slightly longer duration for potential short-term impacts relative to Alternatives D-1 and D-3. In addition, due to the excavation of a much greater volume of impacted soils (2,900 in-situ cubic yards), Alternative D-2 involves a much greater potential for odor generation and exposure to COPC-impacted ditch materials.

Based on these considerations, Alternative D-2 would result in a higher level of short-term impacts (primarily odor generation and potential exposure to COPC-impacted materials) and would require a longer time to implement relative to Alternatives D-1 and D-3. Therefore, Alternative D-2 was assigned a score of 2 with respect to short-term effectiveness. Alternative D-3 would require the less time to implement and involves removal of a smaller volume of impacted materials relative to Alternative D-1, but would result in slightly more disruption to KI activities during installation of the culvert under the KI railroad spur. Accordingly, Alternatives D-1 and D-3 were both assigned a score of 4 for this criterion.

6.4.3 Implementability

The corrective action alternatives developed and evaluated in this Focused CMS Report include only proven technologies and no pilot or bench-scale testing would be necessary. Further, all the alternatives are technically implementable and all the necessary materials, equipment, and workers are expected to be available regardless of the corrective action alternative selected. Adequate monitoring and maintenance activities can be established for each alternative, and no threatened or endangered species are present (given the active operational nature of the targeted area). Also, because the alternatives are anticipated to comply with applicable environmental laws, standards, and permitting requirements (Section 6.3.6), each alternative is administratively feasible. The implementability issues associated with working in the vicinity of an active facility and establishing staging areas would apply equally to all the alternatives, and could be addressed through coordination efforts with KI. Restoration activities associated with each alternative include restoring or creating new wetland areas to replace wetlands affected during construction activities. Finally, there are no anticipated difficulties associated with the disposal methods contemplated under the various alternatives (e.g., onsite CAMU disposal or offsite commercial disposal).

While there are no factors that preclude the implementability of any alternative, the key differentiating factor with respect to this criterion is the Site-specific implementability. Specifically, depending upon certain Site and design characteristics (e.g., culvert depth, achievable culvert slopes, and source flow characteristics), the use of a culvert under Alternative D-1 may present implementability issues associated with proper Site drainage and ice accumulation in the culvert pipe. Given the extent of excavation under Alternative D-2, surface water flow diversion and groundwater management considerations potentially represent additional technical issues associated with this approach. Under Alternative D-3, alternative-specific implementability issues are associated with the need to construct a culvert beneath an active railroad track and the anticipated construction of a portion of the relocated ditch on an adjacent property. These potential implementability issues would be addressed during detailed design of the selected alternative.

The excavation limits associated with Alternative D-2 are based on a limited data set and additional investigation would likely be required prior to implementing this alternative. Such investigations would be required to better define the anticipated removal limits and volumes, and the results could potentially impact the implementability of this alternative. Investigations would also be required prior to implementing Alternative D-3 to verify an appropriate ditch relocation route.

In summary, all three drainage ditch alternatives are technically and administratively implementable. Alternative D-1 results in fewer implementability issues relative to Alternatives D-2 and D-3, and was therefore assigned a score of 4. Due to implementability issues associated with installing a culvert under railroad tracks, obtaining access agreements with Great Northern Railroad, and the need for additional investigations to confirm that the proposed relocation route, Alternative D-3 was assigned a score of 2. Alternative D-2 was also assigned a score of 2 due to the need for additional investigations to confirm the implementability of this alternative and the anticipated increased level of groundwater management during construction.

6.4.4 Restoration Time Frame

Consistent with the evaluation of soil alternatives in Section 6.3.4, this criterion effectively relates to the time required to implement each alternative (i.e., the time required until the Site-specific CAOs are achieved). Therefore, the primary differentiating factor with respect to the restoration timeframe criterion is the length of time required to implement each alternative. Based on the detailed cost estimates included in Appendix B, Alternative D-1 would require approximately 6 weeks to implement, Alternative D-2 would require approximately 8 weeks to implement, and Alternative D-3 would require approximately 5 weeks to implement. Based on these relative timeframes, and because each duration is reasonably short overall, all three alternatives were assigned a score of 4.

6.4.5 Economic Feasibility

Preliminary cost estimates, including capital costs, indirect costs (e.g., pre-design investigations, institutional controls, engineering design, etc.), and post-construction operation and maintenance costs were developed for the three drainage ditch alternatives in accordance with NR 722.07(4)(b). These costs are presented in Table 4 and detailed cost estimate tables are provided in Appendix B. Total costs for the three drainage ditch alternatives are as follows:

- Alternative D-1: $362,000 – $472,000;
- Alternative D-2: $727,000 – $2,396,000; and
- Alternative D-3: $419,000 – $442,000.

Note that the range in costs presented above reflects the range in costs for onsite CAMU disposal (low end) versus offsite disposal (high end) of excavated materials. The low-end cost does not include the cost associated with the CAMU construction, which is included under Alternative S-2. Given the comparatively small removal volumes, it is not anticipated that CAMU disposal would be used for the selected ditch alternative if it is not also selected for the soil alternative.

Since all three alternatives would result in post-implementation conditions that are protective of human health, safety, public welfare, and the environment and would achieve Site-specific CAOs, considering the total costs presented above Alternatives D-1 and D-3 are more economically feasible than Alternative D-2 (particularly if onsite CAMU disposal is not utilized). Accordingly, Alternatives D-1, D-2, and D-3 were assigned scores for economic feasibility of 5, 1, and 5, respectively.

6.4.6 Compliance with Environmental Laws, Standards, and Permitting Requirements

Environmental laws, standards, and permits that are potentially applicable to implementing corrective actions at the Site are summarized in Table 6. All three drainage ditch alternatives would meet the requirements of any applicable laws, standards, and permits; such requirements would be addressed during detailed design of the selected alternative. Accordingly, all three Outfall 001 drainage ditch alternatives were assigned a score of 5 with respect to the criterion for compliance with laws, standards, and permitting requirements.

6.5 Groundwater

As described in Sections 4.4.3 and 5.3.3, the proposed approach for groundwater at the Site is a monitoring-based program, focused on groundwater at the downgradient boundary of the facility. To supplement the rationale provided in those sections and further support this proposed approach, a brief comparison of the monitoring approach to the six evaluation criteria is presented below. No scores were developed for this alterative since no comparative ranking is warranted. Rather, the text summarizes the extent to which the proposed approach satisfies each evaluation criterion.

6.5.1 Long-Term Effectiveness

Implementing a monitoring-based corrective action alternative for groundwater would provide adequate protection of public health, safety, and welfare and the environment and achieve the Site-specific CAO for groundwater. As described in earlier sections, impacted groundwater is localized, the potential for migration of COPCs in groundwater is limited, impacted groundwater at the Site is not used or expected to be used as a potable source[8], no COPCs have been detected in offsite, downgradient supply wells, and concentrations of detected COPCs are stable or decreasing. There is no exposure point for COPCs in shallow groundwater, so there would be no residual risk associated with implementation of this option. To verify continued achievement of the Site-specific CAO, groundwater samples collected from the sand lenses and bedrock at the downgradient facility boundary will be compared to the NR 140 PALs and ESs.

6.5.2 Short-Term Effectiveness

Since implementation of the groundwater monitoring program would not involve any construction activities, there are no short-term impacts associated with the proposed approach.

6.5.3 Implementability

Carrying out the proposed groundwater monitoring program would be both technically and administratively feasible. A number of suitable wells are already in place at the Site, some of which are already monitored as part of the unit-specific monitoring program for the closed surface impoundments. To the extent necessary, additional wells could be installed and/or monitored to provide a suitable network for corrective-action-based monitoring.

6.5.4 Restoration Time Frame

The Site-specific CAO for groundwater is to demonstrate, through groundwater monitoring at the downgradient property boundary in the discontinuous sand lenses and bedrock, that COPCs are not migrating offsite at concentrations exceeding an appropriate PAL or ES. This objective is currently being met; therefore, the

[8] Two active groundwater supply wells are located at the facility and provide water for non-potable purposes (i.e., handwashing and bathing). Those wells are screened in an unimpacted bedrock zone and are periodically sampled to verify that COPCs are not present above the NR 140 PALs or ESs.

monitoring program is designed to verify continued achievement of that objective. The qualitative considerations related to this criterion [per NR 722.07(4)(a)(4)] include current and potential use of the aquifer; magnitude, mobility, and toxicity of contamination; and geologic and hydrogeologic conditions. As discussed in previous sections, the impacted groundwater is primarily present within an aquitard where the low yield minimizes the potential use of this zone as a viable water supply for potable use. Further, the low hydraulic conductivity nature of the clay soils minimizes the potential for significant migration of impacted groundwater beyond its present extent. This limits both the magnitude and mobility of groundwater affected by COPCs. Although not critical to maintaining the effectiveness of this approach, intrinsic remediation factors (e.g., biodegradation and attenuation), will also provide for longer-term reductions in toxicity.

6.5.5 Economic Feasibility

The estimated cost to implement the groundwater monitoring program, which would include semi-annual monitoring for an assumed period of 30 years and periodic maintenance of wells, is approximately $1.0 million (Table B-7 in Appendix B). Because the feasibility of implementing any form of "active" remedial approach for groundwater (e.g., pump and treat, enhanced biodegradation, etc.) is limited by the nature of the soils, any such measures would likely be both expensive and not effective at substantially reducing the need for long-term monitoring. Accordingly, such measures would not be cost-effective relative to a monitoring-based approach.

6.5.6 Compliance with Environmental Laws, Standards, and Permitting Requirements

Continued compliance with the criteria described in NR 140.24 and NR 140.26 at the downgradient property boundary will be verified through implementation of the groundwater monitoring program. There are no other applicable laws, standards, or permits relevant to this approach.

7. Selected Corrective Action Approach

7.1 Overview

The results of the comparative analyses presented in Section 6 were used as a basis for selecting an overall corrective action approach for the on-property portions of the Site that complies with the requirements described in NR 722.09. The approach includes the following components:

- Installing a surface cover to address targeted on-property soils (Alternative S-1);
- Culverting the targeted portion of the Outfall 001 drainage ditch (Alternative D-1);
- Conducting a groundwater monitoring focused at the downgradient facility boundary; and
- Establishing institutional controls, including the baseline deed restriction plus alternative-specific controls associated with the use of a surface cover to address soils.

Based on the comparative evaluation of alternatives, this combination of measures will achieve the Site-specific CAOs and the risk-based objectives established in the Post-Remediation HHRA. The rationale for selecting each component of this approach is summarized below.

7.2 On-Property Soils

As indicated above, Alternative S-1 was identified as the preferred corrective action approach to address the targeted on-property soils. This approach, which is described in Section 5.3.1.1, generally includes installation of a surface cover over the targeted soil areas with periodic post-construction inspection and maintenance of the cover area. It also includes the establishment of institutional controls, including the baseline deed restriction, plus measures to provide for the continued integrity of the surface cover (discussed below).

Selection of Alternative S-1 to address the on-property soils targeted for corrective action is appropriate based on its ability to quickly (a construction period of just three weeks) and cost-effectively (a cost less than one-sixth of the other soil options) achieve the Site-specific CAOs with a minimum of short-term impacts and implementability concerns. Other benefits of this approach include:

- Achieves the Site-specific risk-based objectives established in the Post-Remediation HHRA;
- Minimizes handling of impacted soils relative to the other alternatives;
- Minimizes impacts to KI operations; and
- Meets requirements of applicable laws and standards; permitting requirements will be met during detailed design.

Coordination with KI would be necessary during detailed design to make sure that the final cover grade and construction (i.e., material selection) are appropriate considering the intended use of various portions of the targeted area. Maintaining access to building doors and railroad tracks and creating/maintaining suitable working surfaces (some areas would need to support truck traffic, while others would remain open space) would be a critical component of the final design. Maintenance plans for the covered area would be specified after the final design is established (in consideration of the final cover types). Institutional controls associated with this approach are discussed below.

Although the comparative evaluation presented in Section 6 clearly demonstrates the surface cover alternative to be the preferred approach for targeted on-property soils, Beazer also intends to retain the potential for excavation and onsite CAMU disposal (Alternative S-2) as a potential remedial approach for the targeted on-property soils. Two key reasons associated with the comparatively low ranking of this approach in Section 6 are the high cost and extended construction period relative to other alternatives. The high cost is a function of the assumed design parameters for the containment cell (i.e., consistent with the NR 104 landfill requirements) and the relatively small volume of on-property soils to be excavated and placed within the CAMU (resulting in a high per-cubic-yard cost for the CAMU-based approach). Based on the cost estimates presented in Table 4 and Appendix B, the cost for onsite CAMU disposal is approximately equivalent to the cost of offsite commercial disposal for the 3,100 cubic yards of soil associated with the limits contemplated herein. To the extent that more cost-effective CAMU design parameters can be identified in coordination with the WDNR, the cost associated with onsite CAMU disposal could be substantially decreased. In addition, Beazer anticipates that an onsite CAMU may be the only cost-effective approach for disposing of any materials that may be removed from off-property portions of the Site, pending further evaluation of those areas. In this case, the extended duration associated with CAMU construction would occur regardless of the selected approach for on-property soils. Also, the additional volume associated with those materials would substantially decrease the per-cubic-yard cost for addressing onsite soils provided that all of the materials could be consolidated in a single containment cell. Therefore, in the event that an onsite CAMU containment cell is pursued for disposal of materials removed from off-property areas (pending further evaluation of those areas), the targeted on-property soils would likely be excavated and disposed within the onsite CAMU, consistent with Alternative S-2 presented in this Focused CMS Report. In this case, Beazer would provide an addendum to the WDNR describing the rationale for selecting an alternate corrective action approach.

7.3 On-Property Portion of the Outfall 001 Drainage Ditch

Alternative D-1 was identified as the preferred corrective action approach to address the targeted on-property portion of the Outfall 001 drainage ditch. This approach, which is described in Section 5.3.2.1 and illustrated conceptually on Figure 7, generally includes:

- Installation of a high permeability zone (e.g., crushed stone) with periodic sumps along the bottom of the existing ditch;
- Installation of a culvert along the bottom of the on-property portion of the Outfall 001 drainage ditch;
- Periodic post-construction inspections; and
- Institutional controls (discussed below).

Alternative D-1 is an appropriate selection for the on-property portion of the Outfall 001 drainage ditch based on the fact that it could achieve an appropriate level of long-term effectiveness with a minimum amount of implementability issues and manageable short-term impacts. The necessary construction period of 6 weeks and the cost range of $362,000 to $472,000 are comparable to those for Alternative D-3, and the implementability concerns associated with Alternative D-3 would be avoided. Other benefits of this approach include:

- Achieves Site-specific CAOs;
- Minimizes potential for both direct contact with and downstream transport of impacted ditch materials;
- Presents the most manageable short-term impacts relative to the other alternatives;
- Minimizes disruption to KI activities; and
- Meets requirements of applicable laws and standards; permitting requirements will be met during detailed design.

With respect to this alternative, KI has expressed concerns about the possibility that freezing in the culvert during the winter months could cause water and snow melt to back up into the facility. This potential issue will be further examined and evaluated prior to implementing this approach. If it is determined that drainage issues are likely to occur as a result of the culverting approach, then in-situ containment/isolation of the impacted drainage ditch materials could be accomplished through the installation of an engineered cap within the targeted portion of the ditch. This would functionally serve the same purpose as the culvert (to provide a barrier against the discharge of potentially mobile DNAPL from the adjacent soils into the ditch), and would provide for post-implementation channel conditions consistent with the existing conditions.

Under this approach, periodic post-construction inspections would be performed for a short period following construction (e.g., three years) to verify that the culvert (or engineered cap) is performing as expected. The collection sumps/monitoring points would also be inspected during this period to assess whether any DNAPL accumulation is occurring. If so, an extended monitoring period and/or additional DNAPL removal measures may be warranted. However, because there is no current evidence of significant discharges to the ditch, and because this approach is expected to reduce the hydraulic gradient (driving force) from the adjacent soils into the ditch, significant DNAPL accumulation is not expected to occur in the sumps under this approach.

7.4 Groundwater

The monitoring approach proposed for on-property groundwater has been described and justified in prior documents (including the Phase III RFI Report) and further support for a monitoring-only program is provided in Sections 4.4.3, 5.3.3, and 6.5 of this report. A monitoring program is appropriate for this Site because impacted groundwater is localized; the potential for migration of COPCs in groundwater is limited; impacted groundwater is not used or expected to be used as a potable source; no COPCs have been detected in offsite, downgradient supply wells; and concentrations of detected COPCs are stable or decreasing. Monitoring would be conducted in the discontinuous sand lenses and bedrock at the downgradient property boundary to verify continued achievement of the Site-specific CAO.

7.5 Institutional Controls

Institutional controls are included as part of the selected approach based on two considerations. First, as described in Section 5.4, a deed restriction is necessary to ensure that future Site uses remain industrial, consistent with the assumed exposure scenarios evaluated in the Post-Remediation HHRA (Appendix A). The use of a deed restriction is consistent with NR 720.11(1)(c), NR 722.07(5)(b), and an October 17, 2001 letter from the WDNR to Beazer. The use of the deed restriction would be as described in Section 5.4.

Second, institutional controls may be required to provide for the continued effectiveness of the selected soil alternative. Specifically, institutional controls (e.g., signs and/or deed restrictions) may be used to establish a prohibition on excavation or other disturbances in the surface cover area without an appropriate health and safety plan and a soil management plan. Such controls would also be associated with the property deed to be enforced by future property owners, as needed.

Institutional controls would be established and recorded with the property deed within 30 days after corrective action activities are initiated, in accordance with NR 720.11. To the extent possible, the deed restriction would reflect the post-implementation (as-built) site conditions. The deed restriction would contain specific limitation on future Site activities as specified in NR 726.05 (8)(b), and would be drafted and filed in accordance with NR 726.05 (9).

8. Future Activities and Schedule

This Focused CMS Report, including the recommended corrective action alternatives identified in Section 7, is subject to approval by the WDNR. Following WDNR approval of the recommended corrective action alternatives, certain activities and investigations will be performed to address identified data gaps in support of detailed design activities. Such activities are anticipated to include:

- Field survey to determine invert elevations and diameters of existing culverts and surface grades along the existing Outfall 001 drainage ditch area;
- Evaluation of the potential for surface flooding to occur in the event of frozen culvert pipes (considering grades, anticipated flows, and potential burial depth of the culvert); and
- Coordination with KI to determine appropriate cover materials/design to be used for the surface cover area.

Depending on the required scope of the pre-design investigations, it is anticipated that these activities could be completed within approximately 90 days following WDNR approval of the Focused CMS Report. Once the necessary pre-design investigations have been completed and the data reviewed, detailed design activities would be initiated (including developing the scope of the groundwater monitoring program). As sufficient design details are developed, appropriate permits and approvals would be sought. This is anticipated to include, at a minimum, wetlands-related permits for disturbance of wetland areas and a modification to the WPDES permit to reflect an alternate monitoring point that would be established along the culverted portion of the ditch. Also, a Corrective Measures Implementation (CMI) Plan would be prepared to document basis of design information, summarize the details of a groundwater monitoring program, and identify other implementation-related information. The CMI Plan would require approximately 120 days to prepare and would be submitted to the WDNR prior to implementation.

The overall schedule-related objective is to complete the field construction activities by the end of the 2005 field construction season. Beazer is one of 13 companies that have pledged to meet USEPA's environmental indicators (EI) for human health and groundwater at all of its RCRA Corrective Action facilities on the Government Performance and Reviews Act Baseline by the end of 2005. Therefore, Beazer's overall goal for this Site is to complete implementation of the on-property corrective actions by the end of 2005, consistent with their EI pledge.

Supplemental investigation/evaluation activities associated with the off-property portion of the Site will continue to progress independently of the on-property activities. To the extent that corrective action activities may be required in off-property areas, and pending concurrence by the WDNR and the associated property owners, Beazer will also attempt to target the implementation of corrective action activities for these areas in 2005.

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