Rec 11/10/14 put on BRPTS 11/10/14 (43)

REGION 5 RAC2

REMEDIAL ACTION CONTRACT FOR

Remedial, Enforcement Oversight, and
Non-Time Critical Removal Activities at Sites of Release
or Threatened Release of Hazardous Substances in Region 5

FINAL LONG-TERM REMEDIAL ACTION REPORT
PENTA WOOD PRODUCTS SUPERFUND SITE
Town of Daniels, Wisconsin

WA No. 132-LRLR-05WE/Contract No. EP-S5-06-01

November 2014

PREPARED FOR

U.S. Environmental Protection Agency

PREPARED BY

CH2M HILL

FOR OFFICIAL USE ONLY

Comments received from the Wisconsin Department of Natural Resources (WDNR) on September 17, 2014, for the draft of the long term remedial action report (LTRA) dated August 2014.

<u>Specific Comments</u>

Section 2.3, Remedial Action Summary—After soil removal and consolidation in the CAMU, post-excavation site grading is not well-documented in the 2000 RA Report (Appendix A). It is not clear to what extent clean fill may have been placed or the site graded. Please provide a brief summary describing what activities occurred post-excavation. Without this information, we don't really know if contaminated soil is exposed at the surface, or if it is covered by clean fill materials (or under what depth of clean material).

Included in Appendix E are the designs for the grading of the site and the corrective action management unit (CAMU) where contaminated soils were consolidated beneath a 2-foot clean soil cover.

Also, it is not clear at what depths the post-excavation confirmation soil samples were taken. Please include a table of post-remediation soil samples that includes sample location, sample depth, and concentration, and indicate through bold or italic which sample location concentrations exceed the site specific cleanup goals (1.2 ppm As, 2.1 ppm PCP).

The samples in the figures are surface soil samples and do not have a documented elevation in the remedial action (RA) records. The results from the samples can be reviewed in Appendixes B through E of the original RA, which is Appendix A of the LTRA.

Figure 2—Property boundary location appears to be mislabeled (curved line is labeled as property boundary).

The label is the presumed boundary of historical operations at the site. It has been removed from the figure to prevent confusion.

Soil concentrations—Need to have separate soil maps that depict both As concentrations and PCP concentrations. Would be helpful to have areas where concentrations exceed site specific clean up goals (1.2 ppm As, 2.1 ppm PCP) highlighted or encircled.

The soil map in the LTRA was completed to put the areas from the RA in spatial context. The figure was only meant to augment the figures from the RA. Concentrations for arsenic and pentachlorophenol (PCP) for each area are located on individual maps in the RA.

According to the RA report, each area was sampled along a grid and the samples results were calculated using the 95% upper confidence level (UCL). Elevated results were excavated until the mean of the samples collected from an area fell below the 95% UCL for arsenic (1.2 milligrams per kilogram [mg/kg]) and PCP (2.1 mg/kg). The results leave individual sampling points above the cleanup levels, but the 95% UCLs of the areas are below the cleanup goal.

Concerns about off-site soil impacts—PCP map depicts an area of higher concentration (exceed cleanup goal) downgradient of gully that appears to be off-site (Area 29). Also, "Section 4.2.3.1 Area 29 – Wetland" in the 2000 RA Report describe this area as a wetland, with the highest PCP

concentration of 4.6ppm, but the map in the LTRA shows a sample with 6.1 ppm PCP (PW043-03) and another with 9 ppm PCP (PW043-02). Is it known if the sample locations were excavated/re-excavated? Were these all sediment samples or were some soil? What's the current status of this wetland area? Was follow up done to determine if the wetland was re-established?

In the fifth sentence in Section 4.2.3.1, it is noted that an additional round of sampling occurred after material washed into the wetlands after a storm. The elevated samples were collected from material that slumped into the wetlands from the site, and therefore they are presumed to be soil samples. As noted in the report, the elevated PCP samples from this additional sampling event were excavated. The wetland has re-established itself although a formal wetland survey has not been completed.

Final Long-term Remedial Action Report

Penta Wood Products Superfund Site
Town of Daniels, Wisconsin

WA No. 132-LRLR-05WE/Contract No. EP-S5-06-01

Prepared for

United States Environmental Protection Agency

November 2014

CH2MHILL®

Penta Wood Products Superfund Site
Town of Daniels, Wisconsin
Final Long-term Remedial Action Report

The U.S. Environmental Protection Agency Region 5 approves the Long-term Remedial Action Report submitted by CH2M HILL on September 12, 2014, for the Penta Wood Products Superfund Site in accordance with the Remedial Action Contract 2 Work Assignment Nos. 056-RARA-05BW and 132-LRLR-05WE. The long-term remedial actions include operation and maintenance of the following systems: bioventing, light nonaqueous phase liquid recovery, groundwater extraction, and treatment. The remedial action was completed in accordance with the Record of Decision dated September 1998, as well as the design specifications, with modifications noted in this report. A final inspection was completed, and the remedy is operational and functional.

Approved: ______________________________ ______________

Thomas Short
Director, Superfund Division
EPA Region 5

Date

Contents

Section **Page**

Abbreviations and Acronyms ..... **v**

1 Introduction **1-1**
1.1 Document Organization 1-1

2 Background **2-1**
2.1 Setting 2-1
2.2 Penta Wood Products Past Operations 2-1
2.3 Remedial Action Summary 2-2
2.4 Chronology of Remedial Activities at the Site 2-3
2.5 Current Remedial Action System Description 2-5
2.5.1 System Buildings 2-5
2.5.2 Groundwater Extraction and Treatment and LNAPL Recovery 2-5
2.5.3 Bioventing System 2-9

3 Modifications to the LTRA **3-1**
3.1 Pretreatment Upgrade Bench and Pilot Study 3-1
3.2 Pretreatment Upgrade Design and Construction 3-2
3.3 Supplemental Extraction Well Installation 3-3

4 Performance Standards, Quality Control, and Inspections **4-1**

5 Operations and Performance Validation **5-1**
5.1 Groundwater Quality Improvements 5-1
5.1.1 Groundwater Monitoring Processes 5-1
5.1.2 Capture Zone Analysis 5-3
5.1.3 Pentachlorophenol Concentration Changes 5-3
5.1.4 Other Chemicals of Concern 5-6
5.2 Bioventing 5-6
5.2.1 Bioventing System Summary 5-6
5.3 Groundwater Extraction and Treatment System 5-10
5.4 Operation and Maintenance 5-13
5.4.1 Bioventing System Operation and Maintenance 5-13
5.4.2 Groundwater Treatment System Operation and Maintenance 5-13
5.4.3 LNAPL Extraction Wells Operation and Maintenance 5-13
5.4.4 Hazardous Waste Disposal 5-13
5.5 Contact Information 5-14
5.6 Project Team Roles and Responsibilities 5-15

6 Summary of Post Remedial Action Project Costs **6-1**

7 Photograph Log **7-1**

8 References **8-1**

Appendixes

A Remedial Action Report 2000 (included on CD)
B Photograph Log
C Annual Reports 2003–2013 (included on CD)
D Technical Report of Well Installations and Testing 2000 (included on CD)
E Site Preparation Earthwork Drawings (included on CD)
F Record Drawings—Pretreatment 2004 (included on CD)
G Record Drawings—Additional Extraction Well Install 2010
H WPDES Permit
I Field Reports—Pretreatment Construction 2003 (included on CD)
J Extraction/LNAPL Recovery Well and Conveyance System Installation—Construction Report 2011 (included on CD)
K Database of Analytical Samples (included on CD)

Tables

2-1 Summary of Monitoring Wells Screen Intervals
2-2 Summary of Extraction Well/LNAPL Recovery and Bioventing Wells Screen Intervals
2-3 Summary of Soil Gas Wells Screen Intervals
5-1 Shallow Depth Analytical Results
5-2 Intermediate Depth Analytical Results
5-3 Deep Depth Analytical Results
5-4 PCP Removed with the Groundwater Extraction System
5-5 PCP Removed from the Free Product Recovery System
5-6 PCP Influent Concentrations
5-7 Hazardous Waste Generation Summary
5-8 Penta Wood Products Services Contact Information
6-1 Costs for Operation and Maintenance September 2014 through September 2014

Charts

1 Historical LNAPL Thickness
2 Water Elevations in Unconfined Wells
3 MW-05 PCP Concentration
4 MW-12 PCP Concentration
5 MW-19 PCP Concentration

Figures

1 Site Location Map
2 Surface Soil Confirmation Map
3 Process Flow Diagram (Pretreatment)
4 Current Process Flow Diagram
5 Site Plan
6 Unconfined Groundwater Elevation - October 2013
7 Semiconfined Groundwater Elevation - October 2013
8 Unconfined PCP Plume - 1000 μg/L
9 Unconfined PCP Plume - 1.0 μg/L
10 Semiconfined PCP Plume - 1000 μg/L
11 Semiconfined PCP Plume - 1.0 μg/L
12 LNAPL/Soil Boring Locations

Abbreviations and Acronyms

AZCA	ammonia, zinc, copper II oxide, and arsenate
BTEX	benzene, toluene, ethylbenzene, and xylene
CAMU	Corrective Action Management Unit
COC	chemical of concern
DAF	dissolved air flotation
DRO	diesel range organics
EPA	U.S. Environmental Protection Agency
EW	extraction well
FS	feasibility study
GAC	granular activated carbon
HVAC	heating, ventilation, and air-conditioning
LNAPL	light nonaqueous phase liquid
LTRA	long-term removal action
µg/L	micrograms per liter
MW	monitoring well
NAPL	nonaqueous phase liquid
O&M	operation and maintenance
PAL	Preventive Action Limits
PCP	pentachlorophenol
PWP	Penta Wood Products
RA	remedial action
RAC	Remedial Action Contract
RCRA	Resource Conservation and Recovery Act
RDVF	rotary drum vacuum filter
RI	remedial investigation
ROD	Record of Decision
scfm	standard cubic feet per minute
TPH	total petroleum hydrocarbons
WA	work assignment
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System

SECTION 1

Introduction

This long-term remedial action (LTRA) report describes the activities completed under the U.S. Environmental Protection Agency (EPA) Contract No. EP-S5-06-01, Work Assignment (WA) No. 132-LRLR-05WE, at the Penta Wood Products (PWP) Superfund Site in Siren, Wisconsin. It also provides a general description of the operation of the groundwater extraction and treatment system during the prior WAs for the site.

With this document, CH2M HILL certifies that the site has been operational and functional according to Comprehensive Environmental Response, Compensation, and Liability Act Section 104(c)(6) for 10 years and has been transferred to the Wisconsin Department of Natural Resources (WDNR) for operation and maintenance (O&M) on September 1, 2014.

This report was prepared as specified in the Statement of Work for WA No. 132-LRLR-05WE under Contract No. EP-S5-06-01, dated March 15, 2011. Activities completed at the site were performed under multiple WAs, as follows:

- Under Remedial Action Contract (RAC) 2, Contract Number EP-S5-05-01:
  - WA No. 132-LRLR-05WE from March 15, 2011 to November 30, 2014
  - WA No. 004-LRLR-05WE from April 11, 2006, to March 14, 2011
- Under RAC Contract Number 68-W6-0025:
  - WA No. 201-LRLR-05WE from September 30, 2003 to March 31, 2006.
  - WA No. 101-RALR-05WE from September 30, 2000 to September 29, 2003

1.1 Document Organization

Two guidance documents were followed in preparing this report. Remedial action (RA) reports are intended to document construction of the remedy, as described in *Closeout Procedures for National Priorities List Sites* (EPA 2011). The Statement of Work for WA No. 132-LRLR-05WE dated March 15, 2011, directs CH2M HILL to follow the outline of *Remedial Action Report, Documentation for Operable Unit Completion*, Publication 9355.0-39FS (EPA 1992).

According to the Office of Solid Waste and Emergency Response Directive 9329.2-22, the LTRA phase of a fund-lead project such as Penta Wood begins after the RA report is prepared by the constructing contractor (CH2M HILL). CH2M HILL completed an interim RA report in December of 2000 (CH2M HILL 2000) documenting construction activities for demolition, consolidation of contaminated soils into a Corrective Action Management Unit (CAMU), and a bioventing/groundwater extraction and treatment system as it was originally designed. A copy of the December 2000 RA report is included in Appendix A.

This LTRA report presents construction changes to the site implemented after the 2000 RA report, and describes O&M of the system during the 10-year period of EPA operation. The facility was officially accepted as operational and functional on August 15, 2004, triggering the 10-year LTRA period and setting the date when the plant was to be transferred to the State of Wisconsin for O&M as September 1, 2014.

The document is organized into the following additional sections:

- **Section 2—Background** presents an overview of the site with a brief description of the historical wood treatment operations, subsurface conditions, land use, as well as a description of the remedial action objectives and a chronology of events.
- **Section 3—Modifications to the LTRA**
  - **3.1 Pretreatment Upgrade Bench and Pilot Study** describes the pilot study conducted in 2001.

  - **3.2 Pretreatment Upgrade Design and Construction** describes the treatment system upgrades that were designed by CH2M HILL in 2002 and constructed and installed in 2003.
  - **3.3 Supplemental Extraction Well Installation** describes the new monitoring wells, extraction wells, and associated conveyance line that were installed in 2010 and 2011.
- **Section 4—Performance Standards, Quality Control, and Inspections** summarizes the standards that were met throughout the RA and the controls that were implemented.
- **Section 5—Operations and Performance Validation**
  - **5.1 Groundwater Quality Improvements** presents groundwater sampling results throughout the RA.
  - **5.2 Bioventing** describes the bioventing O&M throughout the RA.
  - **5.3 Groundwater Extraction and Treatment System** summarizes the treatment system O&M and summarizes the waste generation and disposal offsite.
  - **5.4 Operation and Maintenance** describes 10 years of repairs and upkeep during the LTRA.
  - **5.5 Contact Information** includes contact information for subcontractors and operators.
  - **5.6 Project Team Roles and Responsibilities** includes roles of the personnel on the project.
- **Section 6—Summary of Post-Remedial Action Project Costs** summarizes and totals the costs to date for operation, maintenance, and monitoring at the site since September 2000.
- **Section 7—Photograph Log**
- **Section 8—References**

SECTION 2

Background

2.1 Setting

The PWP site was a wood-treating facility located on Daniels 70 (former State Route 70) in Burnett County, Wisconsin. It is located approximately 78 miles northeast of Minneapolis, Minnesota, and 60 miles south of Duluth, Minnesota (Figure 1). The Village of Siren, Wisconsin, is approximately 2 miles east of the site.

The PWP property currently consists of approximately 82 acres that were used for wood-treating activities and originally included 122 acres; however, 40 undeveloped, forested acres were sold after the facility closed. The property is located in a rural agricultural and residential setting and is bordered to the east, west, and north by forested land. There are 5 residences within 1,500 feet of the site that use private wells. With the exception of a narrow 8-acre parcel on the west end of the site, Daniels 70 forms the southern property boundary (Figure 1).

The PWP site is situated on a plateau with a 110-foot drop in elevation near the northern boundary. Precipitation falling on the site typically infiltrates into the ground surface or runs off to the north. There are no flowing streams at the site. Wetlands are located at the northern edge of the site at the bottom of the steep incline, downgradient of the CAMU. The ground surface on the site is generally grass-covered to resist soil erosion, except in the areas where trees were planted on the east and west sides of the site following construction to assist with erosion control.

The site stratigraphy below the ground surface is generally characterized in three layers: an upper sand layer, a silt and clay layer that is not continuous throughout the site, and a lower sand layer. The upper sand layer extends to a depth of approximately 90 to 120 feet below the ground surface. The glacial till layer consisting of silt and clay layer is approximately 3 to 45 feet thick where it has been encountered. The lower sand aquifer beneath the silt and clay extends to an undetermined depth.

The depth to groundwater is typically 100 feet or more from the ground surface. The silt and clay layer serves as a confining layer where it is present. Groundwater occurs both in a thin, unconfined aquifer in the sand above the silt and clay layer, and within the semiconfined sand aquifer beneath the silt and clay layer. The regional groundwater flow direction is to the north, although local groundwater flows radially away from the site, when the groundwater extraction pumps are not in service.

Surface water from the site drains to the north and may collect in one or more of the nearby wetlands or ponds, but none has shown signs of negative impact from the site. A number of surface water bodies are present north and east of the site. Doctor Lake and an unnamed lake are located 2,000 feet east and northeast of the site, respectively. Approximately 2,140 acres of lakes, 94 acres of bogs, and 7,500 acres of wetland are located within a 4-mile-radius of the site. A wetland is located within 130 feet of the northern property boundary.

2.2 Penta Wood Products Past Operations

PWP operated from 1953 to 1992. Raw timber was cut into posts and telephone poles and treated with one of the following: either a 5- to 7-percent pentachlorophenol (PCP) solution in a No. 2 fuel oil carrier or with a waterborne salt treatment called Chemonite consisting of ammonia, zinc, copper II oxide, and arsenate (AZCA). During its 39 years of operation, PWP discharged wastewater from an oil/water separator down a gully into a lagoon on the northeast corner of the property where the oils and water typically infiltrated into the sandy soils beneath the site. Process wastes were discharged onto a wood-chip pile in the northwestern portion of the property. Ash from a boiler was used to berm a cooling pond. Beginning in the 1970s, WDNR investigators noted several large spills, stained soils, fires, and poor operating practices.

Environmental investigations and RAs have been occurring at the PWP site since 1987. PWP began an environmental investigation in 1987, and in 1988, the onsite production well was closed for potable use when it was found to contain 2,700 micrograms per liter (µg/L) of PCP. The State of Wisconsin Department of Justice filed a preliminary injunction against PWP in 1991, citing Wisconsin Pollutant Discharge Elimination System (WPDES) violations and violations of other state statutes regarding storage of raw materials, and waste-handling practices. Wood treatment operations ceased when the facility was abandoned in May 1992.

2.3 Remedial Action Summary

The site was put on the National Priorities List as a fund-lead site, was included in the Superfund Accelerated Cleanup Model pilot program in 1993, and was officially listed in the National Priorities List on June 17, 1996. Removal actions were conducted by EPA from 1994 to 1996. During this period, the AZCA treatment building and half of the oil/water separator building were demolished and disposed of offsite with chemicals and sludge remaining from the operation. Soil showing signs of gross PCP- and metals-contamination were also excavated and disposed of offsite. Soils containing high concentrations of heavy metals were excavated and mixed onsite with cement to form a 3-acre concrete biopad. EPA's Emergency Removal Team characterized groundwater and soil contamination by collecting hundreds of soil samples and installing monitoring wells. Emergency erosion control measures were taken in 1998 in an effort to reduce washout of contaminated wood debris from the bank of the onsite lagoon (now buried beneath the CAMU) from flowing downhill toward wetlands on an adjacent property.

A remedial investigation (RI)/feasibility study (FS) was conducted by CH2M HILL in 1997–1998 (CH2M HILL 1998a,b), culminating in the issuance of a Record of Decision (ROD) in September 1998 (EPA 1998). The RI/FS determined that chemicals of concern (COCs) at the site include the following:

- In groundwater: PCP, arsenic, copper, zinc, benzene, toluene, ethylbenzene, and xylene (BTEX), and naphthalene
- In soil: PCP, diesel range organics (DRO), total petroleum hydrocarbons (TPH), and chloride
- In wetlands and sediment: PCP, arsenic, copper, and zinc

The ROD specifies that the RA for the PWP site must meet the following RA objectives:

- Reduce or eliminate the potential risk to human health and ecological receptors associated with exposure to PCP and fuel oil components in surface water and groundwater, and PCP/fuel oil components and metals in the soil and sediment.
- Reduce or control the source of contaminants.
- Meet the ARARs, including reducing contaminant concentrations in the groundwater beneath the site to below WDNR's Preventive Action Limits (PALs).

To accomplish the RA objectives, EPA selected Alternative 3 from the FS. Alternative 3 includes the following:

- Soil consolidation and cover (in an onsite CAMU)
- Groundwater extraction to lower the groundwater surface and expose the light nonaqueous phase liquid (LNAPL) smear zone to in situ biological degradation
- Bioventing to improve subsurface conditions to enhance biological degradation of LNAPL above the groundwater surface
- LNAPL collection and disposal to remove source material
- Treatment of the collected groundwater so it meets discharge limits set for the infiltration lagoon
- Monitored natural attenuation of groundwater

CH2M HILL performed initial remedial design activities between March and November 1999 (CH2M HILL 1999) and constructed the RA from February to October 2000 (CH2M HILL 2000). Soil, wood chips, sediment and other selected site debris from areas around the site were excavated and placed in the CAMU in 2000. The post-excavation surfaces were sampled and analyzed for PCP and arsenic to show that the excavation had reached the target limits. Figure 2 shows the soil removal areas with the results measured at that time. Operation and maintenance of the original treatment system began in October 2000. An interim RA report was prepared in December 2000 to document the effort with the expectation that the system would function as designed. The RA report is provided in Appendix A, and it includes copies of the record drawings that show the different treatment processes as they were designed. Photographs of the site that were taken after initial construction of the RA are included in Appendix B.

Initial operation of the groundwater and LNAPL extraction and treatment system showed that emulsified oil was present in the groundwater and created a problem that had not been expected. Emulsified oil in the groundwater fouled the granular activated carbon and prevented the treatment system from meeting the required discharge standards.

After review of the situation, it was decided that additional pretreatment would be required to remove the emulsified oil before the existing system could work properly. CH2M HILL conducted treatability studies and a pilot test in 2001 and 2002 to determine site-specific design parameters before designing a pretreatment facility. Figure 3 is a process flow diagram that shows the revisions to the treatment system. Design work was completed, and construction started in 2003. The process flow diagram shown in Figure 4 represents the upgraded treatment system that began operating in March 2004 and has been in operation ever since. Photographs of the plant during operation are included in Appendix B.

A bioventing system was also constructed in 2000 to promote natural degradation of the petroleum hydrocarbons and PCP on the water table by injecting air into the unsaturated zone above the groundwater surface. The bioventing system started operating in 2007. Monitoring of the subsurface conditions have shown that the bioventing system increases the oxygen levels in the unsaturated zone as designed. Concentrations of PCP and the other COCs from this site that are present outside the capture zone of the groundwater extraction system are decreasing by natural attenuation.

Effects of the continued operation of the groundwater extraction wells, LNAPL recovery, and bioventing system on the extent of contamination were monitored through semiannual groundwater sampling events. Soil gas parameters have been measured to monitor oxygen uptakes, and soil samples have been collected in an attempt to evaluate whether contamination is reducing in soils at the site. The results of the monitoring were presented in annual reports to EPA. The data show that the groundwater quality has improved; the biological breakdown of PCP concentrations in soil beneath the ground surface has made some progress but does not yet show signs of significant removal of PCP from the soil; the progress is discussed in detail in Section 5. The treatment system has functioned well removing contaminants efficiently from the groundwater. Copies of the annual reports from 2003 through 2013 are presented in Appendix C.

In 2010, an evaluation of alternatives that would either accelerate the site cleanup activities and/or reduce the long-term O&M costs associated with continued operation was performed. It was determined that with the installation of three additional extraction wells, the amount of PCP removed from the subsurface could be accelerated and potentially bring the site closer to achieving cleanup objectives by the time the site operations transferred to the state of Wisconsin in September 2014. Three new dual-phase groundwater and LNAPL extraction well pairs were installed in 2011. There has been an increase in LNAPL removal as well as an expansion of the capture zone due to the well installation.

2.4 Chronology of Remedial Activities at the Site

O&M of the extraction wells and treatment plant included typical activities that generally occurred each month. The activities included, but were not limited to, the following:

- Inspection and monitoring of extraction wells, biovent wells, monitoring wells, and product recovery wells
- Inspection and monitoring of the infiltration basin
- Removal, cleaning, and servicing of pumps in extraction and product recovery wells
- Maintenance and repair of the treatment plant (grease motors, check emergency safety equipment, general housekeeping, operating rotary drum vacuum filter [RDVF], cleaning in-plant lines, solving alarms, and collecting discharge monitoring water samples).

The activities in the previous list and other tasks occurred many times over the years of operation. Annual activities and reviews of the progress made towards achieving the remedial goals are generally described in the annual reports (Appendix C). There were also several milestones at the site that are summarized in the following chronology:

- Milestones described in the RA report from 2000:
  - September 1998—ROD for the site was signed. EPA and the State of Wisconsin agreed the state will take over the site 10 years after the groundwater treatment system is operational and functional.
  - October 1999—Remedial design was completed.
  - January 31 to September 27, 2000—Demolition of the existing buildings, consolidation of contaminated soils and other materials into the CAMU, and construction of the groundwater extraction and treatment facility with bioventing system. Operations begin September 27, 2000.
- Events completed prior to construction completion, after the majority of RAs were complete:
  - September 2001—Treatment system shut down to allow for pilot testing and plant modifications
  - January 21-25, 2002—Jar testing (part of pilot test)
  - February 22-April 16, 2002—Dissolved air flotation (DAF) pilot test
  - September 2003—New potable well installed at the site (WI Well No SX303)
  - March 2003-February 2004—Upgrades to the treatment system (construction of a building annex and installation of the pretreatment system)
  - February 27, 2004—Treatment system restarted
  - February 27-mid-July 2004—Treatment system operated consistently
  - August 15, 2004—Construction complete; facility declared operational and functional. Begin the 10-year LTRA period of O&M by CH2M HILL on behalf of EPA
- Milestones completed during the 10-year LTRA
  - 1994—Groundwater sampling events were started.
  - April 2005—Installation of the backwash system for the granular activated carbon (GAC) prefilter was completed.
  - May-June 2005—Major soil erosion repair was conducted, including installing rip rap in ditches, installing additional check dams, and general grading.
  - September 24, 2007—Groundwater monitoring shows that groundwater elevations were depressed, exposing portions of the smear zone, and bioventing was initiated.
  - June 2008—Biovent operation was modified to reduce the operating time to 5 days per month, only running in the summer months.
  - Spring 2008—Semiannual groundwater sampling events were started to provide additional information for consideration with annual sampling (including water level and LNAPL measurements).

- Spring 2008—Trees were planted on the east side of the property.
- 2010—Three additional extraction wells (groundwater and LNAPL) and their conveyance lines to the system building were installed (EW-12, EW-13, and EW-14).
- Spring 2011—Three additional extraction wells began operation (EW-12, EW-13, and EW-14).
- 2011—Two new monitoring wells were installed (MW-27 and MW-28).
- Spring 2011—Red and white pine trees were planted on the west side of the site and final site restoration performed.
- November-December 2013—Intact soil cores were collected for LNAPL analysis and soil sampling.
- September 1, 2014—WDNR takes over operation of the site.

2.5 Current Remedial Action System Description

The PWP treatment system consists of the following subsystems:

- Groundwater extraction and treatment with discharge to onsite infiltration basin
- LNAPL recovery
- Bioventing

Groundwater extraction and treatment and LNAPL recovery are operated continually, whereas bioventing is operated for 5 straight days per month during the spring, summer, and fall. Note that EPA and WDNR determined that LNAPL, filter cake, spent carbon, and other miscellaneous debris generated at the site are F032-listed hazardous waste. The PCP wood-treating waste also carries a secondary designation of F027 waste code in Wisconsin only. Details concerning the management of the wastes are in the waste handling plan (CH2M HILL 2013).

2.5.1 System Buildings

The current treatment building configuration was constructed in two phases. The original treatment building was constructed to house the initial groundwater treatment and free-product recovery system. The building addition was constructed to house the pretreatment equipment. The pretreatment section of the building is divided into five separate areas: control room (including computers and a restroom), treatment room, storage area on the mezzanine, laboratory, and the RDVF room, and is attached to the original building by a breezeway.

To minimize the potential for LNAPL or groundwater to threaten human health and the environment, both the original treatment and pretreatment buildings have been designed with secondary containment.

2.5.2 Groundwater Extraction and Treatment and LNAPL Recovery

The groundwater extraction and LNAPL recovery system consists of the following components, shown in plan view in Figure 5):

- 11 groundwater extraction wells (EW-02 to EW-07 and EW-10 to EW-14)
- 10 LNAPL recovery wells (EW-02 to EW-07, EW-10 to EW-12, and EW-14)
- Well pumps
- Connecting piping

The depth of each well screen was selected to remediate or monitor conditions in the different subsurface zones defined at the site (unsaturated, unconfined aquifer, and semiconfined aquifer). Table 2-1 shows the depth to the well screen for the groundwater monitoring wells, Table 2-2 presents the depth to well screen for the groundwater extraction, LNAPL, extraction, and bioventing wells, and Table 2-3 presents the depth to the well screen for soil gas monitoring wells.

TABLE 2-1
Summary of Monitoring Wells Screen Intervals
Penta Wood Products Site

		Well Construction			
Well ID	Aquifer	Top of Casing Elevation (December 2000)	Depth to Top of Screen (ft)[a]	Depth to Bottom of Screen (ft)[a]	Screen Length (ft)
MW-01	UC	1072.32	93.39	98.39	5
MW-02	UC	1064.85	80.80	85.80	5
MW-03	SC	1129.50	178.63	183.63	5
MW-04	SC	1087.81	181.53	186.53	5
MW-05	UC	1071.73	113.01	118.01	5
MW-06S	UC	1108.63	108.91	128.91	20
MW-07	SC	1096.39	165.32	170.32	5
MW-08	SC	1091.28	157.00	162.00	5
MW-09	UC	1020.71	47.02	57.02	10
MW-10	SC	1089.74	133.25	138.25	5
MW-10S	UC	1090.43	94.94	114.94	20
MW-11	SC	1085.58	142.07	157.07	15
MW-12	SC	1081.99	122.75	136.75	14
MW-13	UC	1006.10	19.95	28.95	9
MW-14	SC	1078.50	161.23	176.23	15
MW-15	SC	1127.22	156.13	171.13	15
MW-16	UC	1081.92	89.95	104.95	15
MW-17	SC	1084.50	127.07	137.07	10
MW-18	UC	1072.44	93.70	113.70	20
MW-19	UC	1088.17	94.87	114.87	20
MW-20	UC	1097.76	109.47	119.47	10
MW-21	UC	1095.70	104.57	114.57	10
MW-22	UC	1084.70	93.86	103.86	10
MW-23	SC	1017.57	117.12	127.12	10
MW-24	UC	1084.10	98.68	108.68	10
MW-25	UC	1095.24	107.90	117.90	10
MW-26	UC	1087.07	128.00	143.00	15
MW-27	UC	1111.00	115.00	135.00	20
MW-28	SC	1083.10	115.00	135.00	20

[a]Depths are referenced to the December 2000 top of casing elevation
SC = semiconfined aquifer
UC = unconfined aquifer

TABLE 2-2
Summary of Extraction Well/LNAPL Recovery and Bioventing Wells Screen Intervals
Penta Wood Products Site

Well ID	Aquifer	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)	Screen Length (ft)
Extraction Wells				
EW-02 (GW)	SC	125.00	145.00	20.00
EW-02 (LNAPL/Biovent)	UC	12.00	115.00	103.00
EW-03 (GW)	SC	133.00	153.00	20.00
EW-03 (LNAPL/Biovent)	UC	12.00	123.00	111.00
EW-04 (GW)	SC	145.00	165.00	20.00
EW-04 (LNAPL/Biovent)	UC	13.00	135.00	122.00
EW-05 (GW)	SC	121.00	141.00	20.00
EW-05 (LNAPL/Biovent)	UC	12.00	111.00	99.00
EW-06 (GW)	SC	126.00	146.00	20.00
EW-06 (LNAPL/Biovent)	UC	12.00	116.00	104.00
EW-07 (GW)	SC	130.00	150.00	20.00
EW-07 (LNAPL/Biovent)	UC	12.00	120.00	108.00
EW-10 (GW)	SC	133.00	153.00	20.00
EW-10 (LNAPL/Biovent)	UC	12.00	123.00	111.00
EW-11 (GW)	SC	90.00	110.00	20.00
EW-11 (LNAPL/Biovent)	UC	20.00	80.00	60.00
EW-12 (GW)	SC	130.00	150.00	20.00
EW-12 (LNAPL)	UC	95.00	125.00	30.00
EW-13 (GW)	SC	135.00	155.00	20.00
EW-13 (LNAPL)	UC	95.00	125.00	30.00
EW-14 (GW)	SC	133.00	153.00	20.00
EW-14 (LNAPL)	UC	98.00	128.00	30.00
Bioventing Wells				
BV-08	UC	12.00	27.00	15.00
BV-09	SC	12.00	27.00	15.00

SC = semiconfined aquifer
UC = unconfined aquifer

TABLE 2-3
Summary of Soil Gas Wells Screen Intervals

Well ID	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)	Screen Length (ft)
Soil Gas Wells			
SG-04 (shallow)	6.00	8.00	2.00
SG-04 (intermediate)	46.00	48.00	2.00
SG-04 (deep)	86.00	88.00	2.00
SG-05 (shallow)	8.00	10.00	2.00
SG-05 (intermediate)	41.00	43.00	2.00
SG-05 (deep)	87.00	89.00	2.00
SG-06 (shallow)	8.00	10.00	2.00
SG-06 (intermediate)	50.00	52.00	2.00
SG-06 (deep)	92.00	94.00	2.00
SG-07 (shallow)	6.00	8.00	2.00
SG-07 (intermediate)	64.00	66.00	2.00
SG-07 (deep)	105.00	107.00	2.00
SG-22 (shallow)	6.00	8.00	2.00
SG-23	6.00	8.00	2.00
SG-24	6.00	8.00	2.00
SG-25	6.00	8.00	2.00
SG-26	6.00	8.00	2.00

SC = semiconfined aquifer
UC = unconfined aquifer

Additional dimensions and construction details of the systems are presented in construction drawings included in the following appendixes:

- Appendix A—Drawings of the system prior to installation of pretreatment 2000 (Appendix K of the RA report)
- Appendix D—Technical Report of Well Installations and testing 2000
- Appendix E—Site Preparation Earthwork Drawings 1999
- Appendix F—Record drawings - pretreatment 2004
- Appendix G—Record drawings – additional extraction install 2010

The groundwater treatment system consists of the following components shown on the process flow diagram (Figure 4):

- Oil/water separator
- A free-product storage tank
- Equalization tank
- Chemical conditioning to achieve coagulation and flocculation

- DAF unit
- DAF pump tank
- DAF float management system
- Bag filters
- Prefilter vessel (currently filled with GAC for use as a particulate filter)
- GAC treatment
- A neutralization tank
- Controls
- Discharge piping

The treated water is discharged to an infiltration basin located northwest of the treatment building (Figure 5). The infiltration basin was designed so water seeps from the basin at a rate that matches the pumping capacity of the groundwater wells (120 to 160 gallons per minute). Use of the infiltration basin to receive the treated water is approved under WPDES Permit No. WI-0061531-01-0. A copy of the permit is included in Appendix H.

2.5.3 Bioventing System

The objective of bioventing is to enhance aerobic degradation of PCP-contaminated soil between the ground surface and the groundwater by injecting air into the unsaturated zone above the groundwater table. The bioventing system consists of nine injection wells, connecting piping, blower, and the associated controls. Eight of the bioventing wells are dual-purpose wells screened through the vadose zone (for bioventing) and within the smear zone below the groundwater table to allow for LNAPL recovery.

The target depth of treatment extends to between approximately 90 and 120 feet below ground surface depending on groundwater. The groundwater collection system is used to lower the water table to expose the LNAPL smear zone at the current water table to the air supplied by the bioventing system.

SECTION 3

Modifications to the LTRA

Section 3 describes the changes made in the LTRA system after the original design was constructed. The bench- and pilot-scale tests conducted to determine the system changes to remove emulsified oil from the groundwater are briefly described, followed by an overview of the selected pretreatment processes that were subsequently designed and constructed. New monitoring wells and extraction wells added to the system in 2011 are also described.

3.1 Pretreatment Upgrade Bench and Pilot Study

In September 2001, the treatment system was shut down due to premature fouling of the GAC in the treatment system. Testing of the groundwater showed that chemically emulsified oils were present in the groundwater. Emulsified oil in the groundwater was not expected in design of the original groundwater treatment processes at PWP. It was determined that pretreatment was required to reduce levels of PCP and oils in the groundwater to a point where the GAC could effectively treat the groundwater prior to discharge.

In late 2001, a bench-scale study was performed to select the chemistry and effectiveness of coagulants, flocculants, and acidification for stripping emulsified oil from the water. A series of jar tests were conducted to select specific chemistries and dosages of chemicals. The following chemistries were evaluated:

- Coagulants: ferric sulfate and sodium aluminate
- Flocculant: high-charge anionic polymer
- Acidification: sulfuric acid

Samples of influent and jar test effluent were analyzed for oil and grease, total organic carbon, and total suspended solids.

The results of the jar test indicated that ferric sulfate was a more effective coagulant than sodium aluminate. The following observations also were made:

- The difference in PCP concentrations was not statistically significant between the different coagulants investigated.
- Ferric sulfate resulted in lower solids generation than sodium aluminate, which could reduce disposal costs.
- Filtrate from sodium aluminate had significantly higher total suspended solids, which could indicate fragile flocculation that would make filtration more difficult.

The bench study was followed by a pilot study from February 22 to April 16, 2002, to further refine the pretreatment processes. The pilot study was conducted at the PWP site using a pilot-scale-size portable DAF unit with GAC filters (Model IPF005E). The DAF process works by injecting air into the water and collecting the froth that forms at the top of the treatment unit. It was selected as the main process because it is effectively used throughout the refining and manufacturing industry to remove oil from water. Ferric sulfate was selected as the coagulant to separate the emulsified oil from the water, and an anionic polymer was selected to create flocculation to aid in the effectiveness of the process. Two different methods were evaluated for dewatering the froth collected at the top of the unit: RDVF and belt filter press.

The pilot test focused on the following outcomes:

1. Assess the removal efficiency of a DAF system.
2. Develop design criteria for the full-scale DAF unit and float management system.

3. Gather information about the performance of the GAC system to predict the PCP breakthrough point.
4. Understand the capability of the treatment process to remove PCP and develop the following design criteria for the full-scale treatment system with DAF pretreatment:
   - The pilot study concluded that the DAF process with an RDVF was an effective method for preparing the water before treatment by the originally designed GAC system. Ferric sulfate was shown to be an effective coagulant, and the anionic polymer produced a sturdy floc that was durable enough to survive the DAF conditions and be dewatered on the RDVF. The RDVF was compared to a belt-filter press system and found to produce an effluent with lower suspended solids.

3.2 Pretreatment Upgrade Design and Construction

Design of the pretreatment upgrade was based on the conclusions of the pilot study, coupled with predicted PCP and LNAPL concentrations in the water being treated. Process flow rate of water from one unit to the next was determined and used to size pipes, pumps, and treatment vessels. The system was originally designed with a maximum flow rate of 160 gallons per minute, which was set as the target of the upgraded system.

Process changes were designed so that water from the LNAPL recovery wells (coalescing oil water separator subnatent) and water from the groundwater extraction wells is prepared for treatment through the upgraded pretreatment system. Ferric sulfate and anionic polymer are added to the water stream and passed through the DAF unit. The float that forms at the top of the DAF unit is collected and then dewatered using the RDVF. Solids removed from the RDVF are containerized and shipped offsite for proper disposal. Effluent from the RDVF is cycled back into the pretreatment system, and the filtrate from the DAF flows into the original treatment works. Note also that a new step was added to the process. After the treated water exits the GAC vessel, the pH is adjusted for discharge to the infiltration basin. The process flow diagram for the upgrades to the plant are shown in Figure 3.

Structural changes were also required. A new building was designed to house the pretreatment system. The building contains the DAF, RDVF, materials handling, office, plumbing, and other facilities to support the operation. It was designed to manage vapors and maintain a safe working environment for the plant operator. External tanks to store the chemicals for pretreatment and pH adjustment were also designed. Construction drawings for the upgrade are shown in Appendix F.

Design drawings and specifications were prepared, and contracts were awarded to three different contractors in 2003 to construct the system upgrades. Each of the following were subcontracted:

- New Potable Well: This subcontract was awarded to Layne-Northwest to install and develop a new well to provide potable water for the site.
- Pretreatment Upgrade: This subcontract was awarded to Clearwater Technologies to install foundations and erect the new building, provide and install new equipment, relocate existing equipment, and provide startup services.
- Erosion Control and Landscaping: This subcontract was awarded to Darcy Brust, a small local contractor to place rip rap for erosion control and gravel for road surfacing, plus topsoil and vegetative cover over the area disturbed by the work.

Construction of the treatment plant upgrades began in July 2003 and ended in early February 2004. Mobilization of the contractors occurred in late July and early August. Site work and installation of a new potable water well was underway by early August. Initial activities for the pretreatment upgrade included foundation work with installation of the piping beneath the floor of the new building for plumbing, and piping. Foundation work was completed in early September, and the building was erected shortly after that. Erection of interior walls and other work inside the building began by the end of September.

Work on the interior of the building proceeded from October through December. Clearwater and its associated subcontractors installed the safety features (shower; bathroom; and heating, ventilation, and air-conditioning [HVAC]) first. As the different pieces of equipment arrived, they were also installed. The RDVF and DAF units with associated pumps, valves, pipes, and control equipment were installed in November and December. Site grading and erosion protection continued during this period, along with conversion of the overhead electrical service to underground service.

Final work on the building interior, mechanical, electrical, and HVAC systems, plus system controls was completed in January 2004. Final activities included pulling electrical wire through conduits between the motor control center and equipment. Process piping and equipment placement was completed in January. The final coats of paint, railings, and cleanup also occurred. The motor control center arrived and was installed in late January.

Clearwater and its subcontractor worked with CH2M HILL specialists to program and debug the system control program beginning in early February, with startup activities beginning on February 9, 2004. Brief descriptions of field activities during the construction are included in Appendix I.

Initial startup activities consisted of testing flow and function using clean water. Water-level switches and alarms were first set and adjusted using clean water, thus allowing workers to avoid concern about contact with the system when adjustments were made. Valves were operated, and the system control programming was fine-tuned to function as designed.

Startup activities continued until the system was functioning smoothly and treating water so that it met the discharge limits set in the WPDES permit. Initial runs of the system with groundwater from the site had difficulty meeting the discharge limits because it was difficult to determine the correct dosage of additives. The process was further slowed because the polymer was not being removed entirely from the DAF effluent and was plugging the GAC filters. An additional filter backwash system was required so the carbon could be cleaned regularly. Trouble-shooting is a normal activity during startup, but it slowed progress while the problem was diagnosed and resolved. Eventually, the dosage of coagulant and polymer were balanced and adjusted so that the system operated smoothly.

The system began operating for a final shakedown period beginning in May 2004 and was subsequently determined to be functional and operational on August 14, 2004, thus beginning the 10-year period through which EPA would operate the system.

3.3 Supplemental Extraction Well Installation

In 2010, the decision was made to design and install three new wells to extract more groundwater and recover more LNAPL from the portion of the site with floating LNAPL and high PCP concentrations in the groundwater. The following subsections briefly describe the design and construction effort. A full description of the activities is in the construction report located in the 2011 annual report and included in Appendix J for completeness. The installation of the three new dual-phase extraction wells is a result of the optimization study completed in 2010 as part of the five-year review (CH2M HILL 2010). The objective of the installation was to decrease the time required for groundwater quality to improve and reach cleanup levels. CH2M HILL designed the system modifications associated with installing and connecting three additional groundwater extraction and LNAPL recovery wells. The design was completed using similar construction to the existing extraction wells and conveyance system, which has been used successfully at the site to date.

The extraction wells were installed within the area where LNAPL was known to be present historically. Locations selected for the new wells (EW-12, EW-13, and EW-14) corresponded with monitoring wells with elevated levels of PCP and measurable amounts of LNAPL. New monitoring wells MW-27 and MW-28 were installed to help delineate the edges of the PCP plume.

The work was subdivided into two subcontracts to provide the opportunity for more participation by local and small contractors in the project. Copies of the drawings and technical specifications are included in Appendix G. Individual subcontracts were prepared and awarded for the drilling and the earthwork.

The work to install the three new dual-phase extraction wells was completed in two phases: installation of the wells and installation of the conveyance piping.

Three soil borings were installed to determine the proper well screen intervals for the well installations. The wells were developed, groundwater pumps were installed into the groundwater wells, and pneumatic pumps were installed into the recovery wells. Additionally, two monitoring wells were installed to help delineate the edge of the PCP contamination at the site.

Once the dual-phase extraction wells were installed, HIS Constructors mobilized to the site, buried the conveyance piping below the CAMU, installed the three vaults, and connected the piping and electrical to the wellheads. The conveyance piping was extended to the treatment system with dual-containment piping in compliance with Resource Conservation and Recovery Act (RCRA) requirements for listed hazardous waste. Controls and meters for monitoring the system were installed in the treatment building in accordance with the design.

SECTION 4

Performance Standards, Quality Control, and Inspections

The PWP site was subject to a range of regulations that were required to manage the O&M of the site. The following is a list of the standards, quality control, and inspections that were followed and met at the site:

- The WPDES permit was met for effluent throughout the LTRA, no exceedances have been detected since 2009. Discharge limits set by the permit for effluent into the infiltration basin noted in the WPDES permit is included in Appendix H.
- The system has treated groundwater continually since it was restarted in 2004, except for minor shut downs for repairs or routine maintenance.
- Hazardous waste considered F032-listed waste (filter cake, spent carbon, and LNAPL) was stored, shipped, labeled, manifested, and disposed of in accordance with RCRA regulations.
- Listed hazardous waste from the site has been incinerated at an RCRA-approved disposal facility.
- Hazardous waste annual reports and Tier II reports have been submitted to WDNR and EPA, respectively, each year in accordance with the site classification as a Large Quantity Generator.
- Routine inspections of the treatment facility were completed in accordance with the approved O&M plan.
- Groundwater and discharge samples were collected in compliance with the approved quality assurance project plan.
- The groundwater was monitored twice yearly showing that the contaminated groundwater is being captured and the plume size continues to reduce.
- The plant was operated by a treatment specialist that held a special K certification for the operation of a treatment plant in Wisconsin.
- The Occupational Safety and Health Administration safety requirements were met and monitored annually by CH2M HILL safety personnel.
- Design and construction activities met local building code, electrical code, and associated construction standards set by ASTM International.
- Well installations and borings were completed in compliance with applicable regulations set by WDNR.

SECTION 5

Operations and Performance Validation

O&M of the PWP site addressed three main performance objectives over the 10 years of LTRA operation. Section 5 describes the O&M activities associated with cleanup validation of groundwater and soil, as well as the treatment of groundwater. The data show that the groundwater quality has improved, the biological breakdown of PCP concentrations in soil beneath the ground surface does not yet show signs of significant improvement, and the treatment plant is functioning very well.

5.1 Groundwater Quality Improvements

The following subsections summarize the data that shows groundwater quality has improved beneath large portions of the site. The groundwater monitoring process is briefly discussed, followed by analysis of the capture zone as defined by groundwater elevations, and the reductions in the concentration of the COCs in groundwater.

5.1.1 Groundwater Monitoring Processes

Groundwater quality monitoring conducted over the 10 years of the LTRA shows that this system has made improvements in quality. Groundwater sampling events with analysis for the COCs have occurred semiannually since 2008 (prior to that, they occurred annually in the fall). The spring sampling event was added to assess seasonal variability. The groundwater monitoring network at the site consists of 28 monitoring wells (Figure 5) and 5 residential wells (Figure 1). The presence of nonaqueous phase liquid (NAPL) at any given location was also of interest relative to groundwater water quality, so the thickness of NAPL floating on the groundwater was measured and reported.

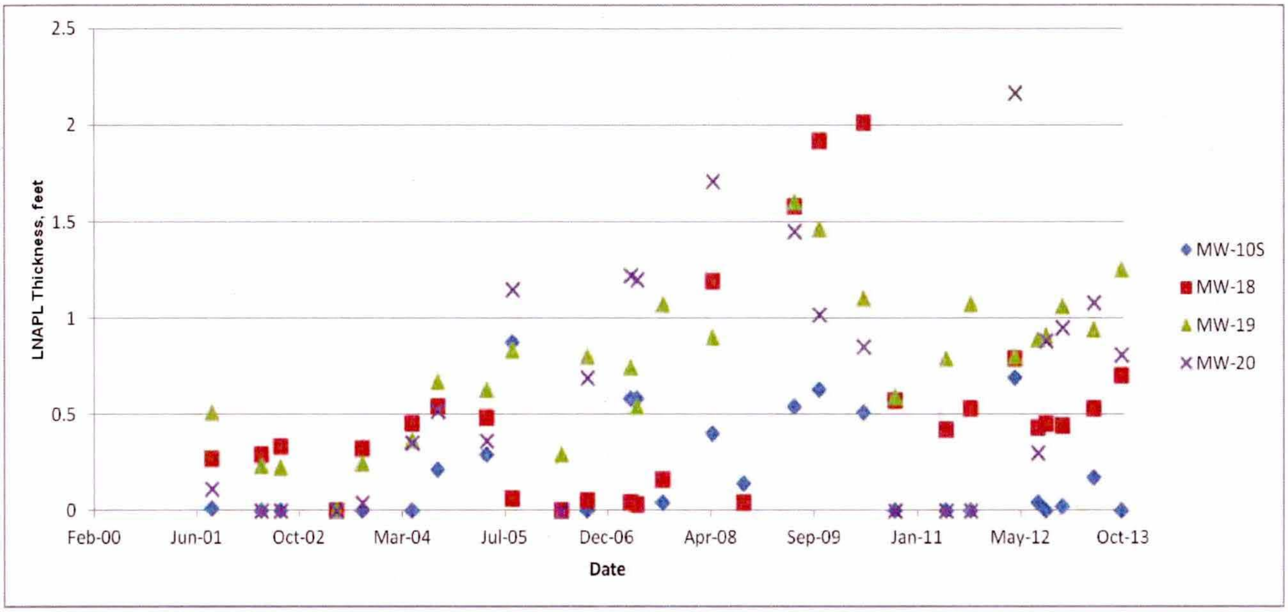
The number of wells sampled per seasonal event varied. The following were sampled during the semiannual (or spring) event: five monitoring wells (MW-12, MW-15, MW-19, MW-22, and MW-26), five residential wells (RW-01 through RW-05), and one onsite potable well. Static water level measurements were also collected at all monitoring wells, as well as measurement of LNAPL thickness, where present. The annual (fall) groundwater sampling event consists of sampling 15 monitoring wells (MW-02, MW-03, MW-05, MW-06S, MW-07, MW-09, MW-10, MW-12, MW-15, MW-16, MW-17, MW-19, MW-22, MW-26, and MW-28), 5 residential wells (RW-01 through RW-05), and 1 onsite potable well. The following sampled wells are in the unconfined aquifer: MW-02, MW-05, MW-06S, MW-09, MW-16, MW-19, MW-22, and MW-26. The following sampled wells are in the semiconfined aquifer: MW-03, MW-07, MW-10, MW-12, MW-15, MW-17, and MW-28.

During the groundwater sampling events, samples were collected and shipped to an analytical laboratory for analysis. Parameters that were analyzed include the following COCs: PCP, naphthalene, BTEX, dissolved metals, and natural attenuation parameters. Results of the annual groundwater sampling are summarized each year in the annual report. Copies of each report are presented in Appendix C.

Water surface elevations and LNAPL thickness measurements were collected to determine the amount of LNAPL remaining in the ground and the groundwater flow direction(s) in the unconfined and semiconfined aquifers. Groundwater elevations, oil/water interface measurement data, historical LNAPL thickness data, and other observations are also included in the annual reports in Appendix C.

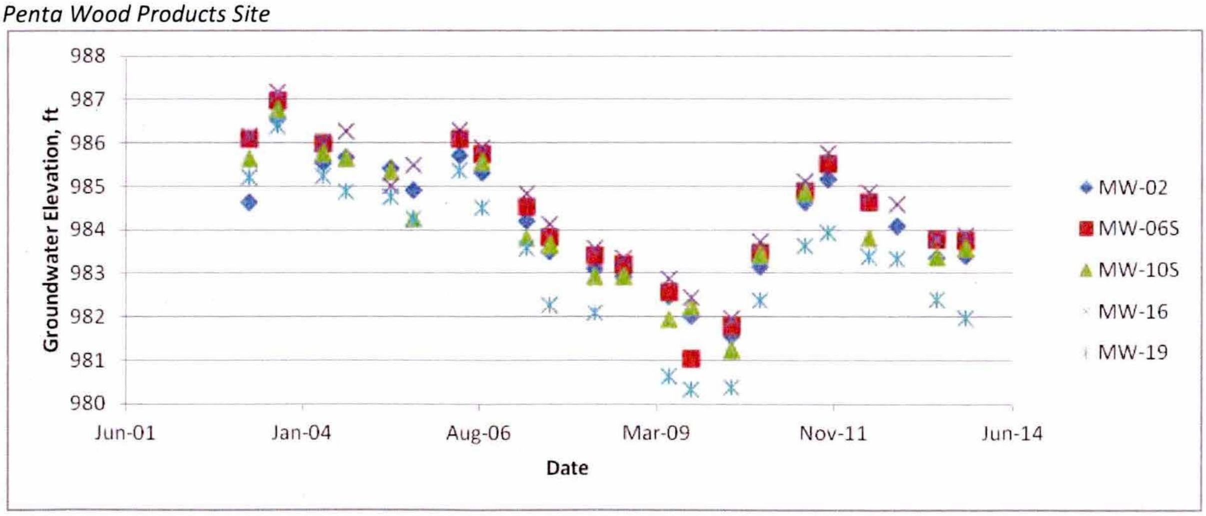
LNAPL was historically observed in four monitoring wells during the annual and semiannual sampling events (MW-10s, MW-18, MW-19, and MW-20). A water level indicator was used to measure the distance from the top of the inner well casing to the water surface. In wells where LNAPL was present, the depth to the LNAPL surface and water surface were measured from the top of the inner well casing using an oil/water interface probe. The observed LNAPL thicknesses are plotted by measurement date for each of the four wells in Chart 1.

CHART 1
Historical LNAPL Thickness
Penta Wood Products Site



The plot of the LNAPL thickness data shows varying thickness over time that is correlated with the rise and fall of the groundwater table (Chart 2). When the water table declines additional smear zone is exposed allowing for more collection of LNAPL in the monitoring wells. Although LNAPL has been continuously collected during the LTRA period steady collection of LNAPL in the wells continues. Although LNAPL core sampling shows that LNAPL migration from the site remains very unlikely, LNAPL still continues to collect due to residual product beneath the CAMU areas. The viscosity of the LNAPL is high which increases the amount of time required to recover the LNAPL. Additional evaluation of the LNAPL is located in the LNAPL recovery and mobility report (CH2M HILL 2014).

CHART 2
Water Elevations in Unconfined Wells
Penta Wood Products Site



5.1.2 Capture Zone Analysis

Lines of evidence considered in the capture zone analysis includes the groundwater surface elevations and the concentration of COCs in the groundwater. The concentrations of COCs have decreased, and the groundwater surface elevations show a distinct cone of depression in the groundwater surface.

The cleanup levels at the site are equal to the Wisconsin PALs although it is acknowledged in the ROD (USEPA 1998) that grossly contaminated water will be remediated using active groundwater extraction. The levels of grossly contaminated groundwater for PCP was established in the feasibility study (CH2M HILL 1998b) at 1,000 μg/L, and below this level natural attenuation will take over to reduce to below the PAL of 0.1 μg/L for PCP. Although historically there have been several COCs exceeding the Wisconsin PALs at the site, as of fall 2013, only PCP exceeds the cleanup levels. The changes in concentration are discussed in the following sections of the report.

The groundwater extraction system at the site was designed to create a depression in the water table, promoting migration of LNAPL and groundwater containing dissolved-phase PCP toward the extraction wells to enhance the LNAPL recovery at the site. Analysis of the data collected at the site shows that the groundwater extraction system has been effectively capturing the contaminated groundwater, resulting in improved groundwater quality. The capture effectiveness was primarily evaluated based on site-specific field data, including potentiometric surface maps and the calculated horizontal gradients The conceptual site model was developed, and the site-specific target capture zone was established as the area of groundwater with PCP levels exceeding 1,000 μg/L. The groundwater contours of the unconfined aquifer are shown in Figure 6, and the semiconfined aquifer groundwater contours are shown in Figure 7.

The capture zone is evaluated each year in the annual report by presenting and discussing horizontal and vertical gradients, potentiometric surface maps, and concentration trends. Additional modeling and calculations have not been included in those reports because the available evidence makes a clear case that contaminated groundwater capture is occurring.

Recent groundwater level elevations regularly showed a depression in the potentiometric surface caused by the groundwater extraction system. Groundwater elevation contours indicate a cone of depression in the groundwater surface that drops more than 1 foot between MW-22 and MW-19. The capture zone is bounded by MW-02 on the north, MW-16 on the west, and MW-22 on the east, as indicated by the lower water level elevations observed in the monitoring wells located within or adjacent to the CAMU. The unconfined aquifer is considered a potentiometric surface due to the presence of LNAPL and the potential for the groundwater surface to be depressed. The semiconfined aquifer shows a similar distinct cone of depression with a drop of 0.5 foot.

5.1.3 Pentachlorophenol Concentration Changes

Changes in PCP concentrations were evaluated by plotting the PCP concentrations for each year and interpolating concentrations between the wells to find the boundary of the contour showing 1,000 μg/L and the contour showing 1 μg/L. The groundwater for the semiconfined and the unconfined aquifers was contoured separately. PCP concentration contours for the unconfined aquifer are presented in Figure 8 (1,000 μg/L) and 11 (1 μg/L). PCP concentration contours for the semiconfined aquifer are presented in Figures 9 (1,000 μg/L) and 10 (1 μg/L). Historical contours are presented to establish a baseline condition before the operation of the groundwater extraction and treatment system. Several previous contours are also presented to show changes in the extent of PCP concentration in groundwater over the last few years. All analytical data collected during the LTRA period is accumulated in a database located in Appendix K.

Large reductions in PCP concentrations in unconfined monitoring wells show that the groundwater extraction system is effectively pulling LNAPL and dissolved-phase PCP-laden groundwater towards the extraction wells. The area within the 1,000-μg/L contour for PCP in the unconfined aquifer has been steadily reducing as the system has been operating. The area beneath the site with PCP concentrations in groundwater exceeding 1,000 μg/L is approximately 60 percent smaller in 2013 than it was in 1994.

As of the 2013 sampling event, it now appears that the 1,000-µg/L PCP contour is generally about the size of the area in which LNAPL is present. Since the area of groundwater contamination has been reduced to the area of the source area, it is unlikely that the aerial extent of the plume will become much smaller until the LNAPL source area becomes smaller. This determination is supported by the difference in plume size from 2012, which did not decrease in area significantly, but the trend will need to be monitored in the future. The 1-µg/L plume in the unconfined aquifer has shrunk significantly since 1994 and currently occupies nearly the same footprint as the 1,000-µg/L plume.

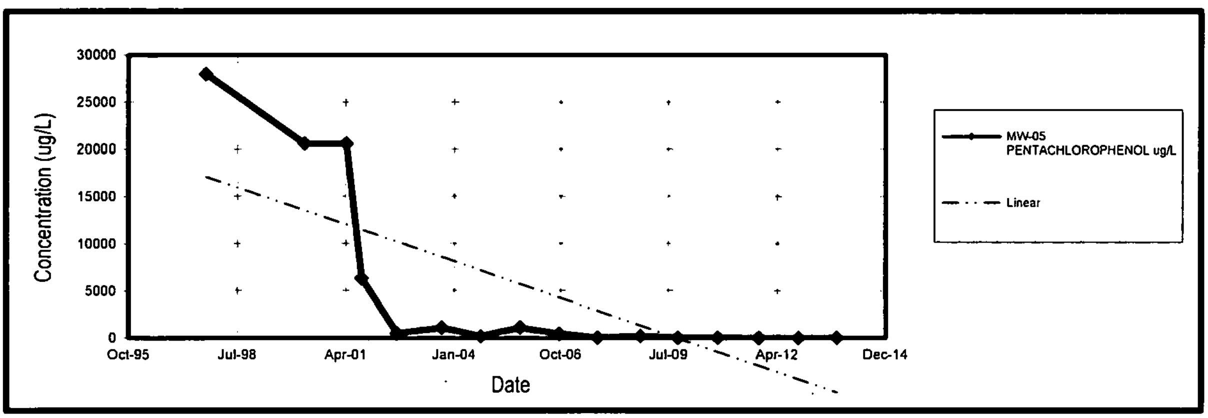
The PCP plume in the semiconfined aquifer was reduced in recent groundwater events, continuing to show that PCP concentrations measured from monitoring wells screened in the semiconfined aquifer have been less than 1,000 µg/L since 2009. The area inside the 1-µg/L contour in the semiconfined aquifer (Figure 11) has decreased significantly over time and now appears only on the CAMU area and extends slightly to the northwest of the CAMU area. The contour boundary for the 1-µg/L PCP plume in the semiconfined aquifer in 2013 was very similar to the plume size and shape in 2012.

5.1.3.1 Selected Trend Analysis

MW-05

The PCP concentration in monitoring well MW-05 dropped 5 orders of magnitude from 20,600 µg/L before groundwater treatment system operation to 0.60 µg/L in the October 2013 (Chart 3) sampling event. PCP concentrations remain low in this area because nearby uncontaminated groundwater is being drawn radially toward extraction wells EW-02 and EW-05. The wells started pumping in February 2004, thereby purging the aquifer of PCP. Free product has not been observed in this well. MW-05 is screened in the unconfined aquifer.

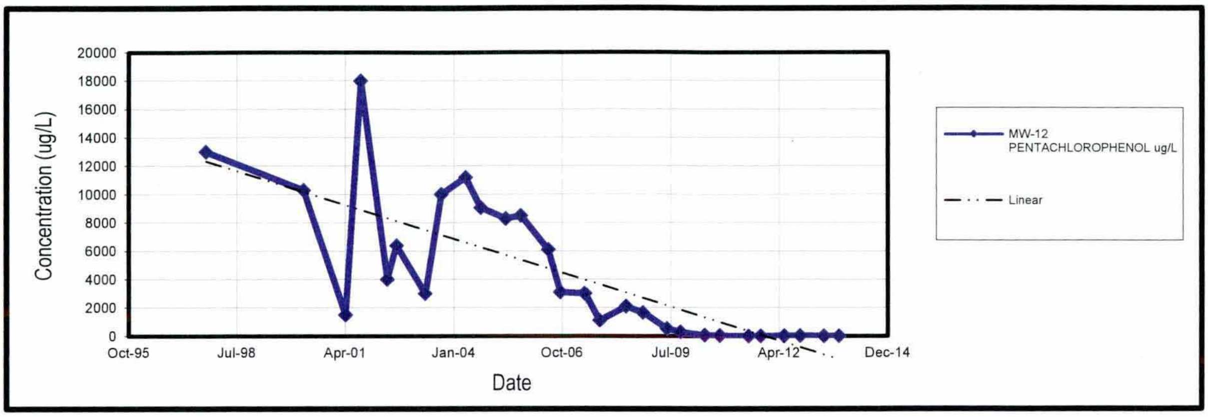
CHART 3
MW-05 PCP Concentration
Penta Wood Products Site



MW-12

Although monitoring well MW-12 has shown fluctuations in PCP between groundwater sampling events, there is an overall decreasing trend in the PCP concentration (Chart 4). MW-12 is screened in the semiconfined aquifer at a depth of 122 feet below ground surface. PCP has declined from the maximum concentration of 18,000 µg/L in September 2001 to 28 µg/L in October 2013. Free product (LNAPL) has not been observed in MW-12.

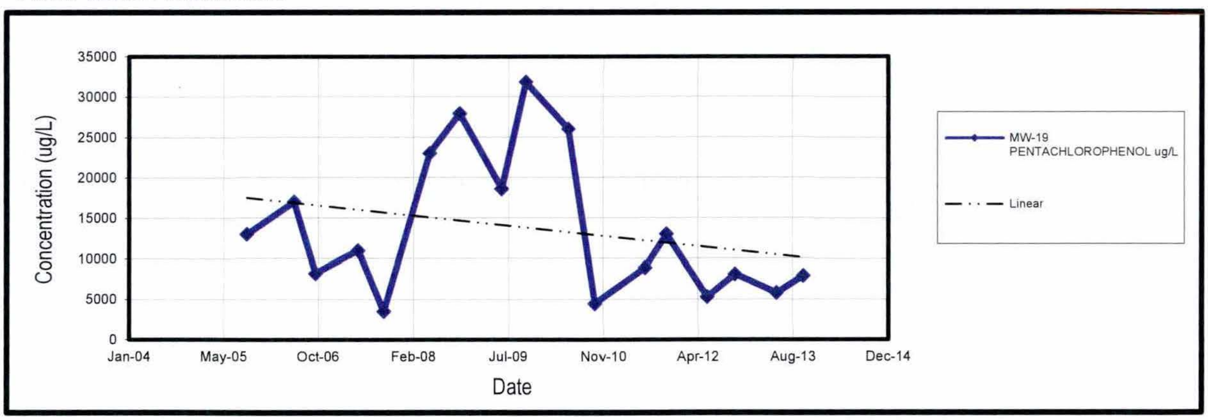
CHART 4
MW-12 PCP Concentration
Penta Wood Products Site



MW-19

LNAPL has been present in MW-19 since monitoring began, and entrainment of LNAPL droplets in the collected groundwater sample have produced notable effects on PCP concentrations (Chart 5). The PCP concentrations were measured at 5,800 µg/L in May 2013 and 7,900 µg/L in October 2013, which is less than what was observed in 2011. Although variability of PCP concentrations in samples collected from wells with LNAPL is expected, in the most recent 3 sampling events, the levels in PCP are lower than the previous 2 years.

CHART 5
MW-19 PCP Concentration
Penta Wood Products Site



MW-15

MW-15 is a semiconfined well and is the southernmost well at the site. It is the last well between the site and adjacent residences, so it is considered a sentinel well. PCP was reported at an estimated concentration of 0.025 µg/L in May 2013 and was not detected in the well in October 2013, which is consistent with historical results. Historical results in MW-15 have been generally nondetected with an occasional detection below the PAL.

5.1.4 Other Chemicals of Concern

Other COCs have been monitored, and the results show that the groundwater quality has improved. The following subsections present brief synopses of the conditions found in the 2013 sampling event.

5.1.4.1 Naphthalene Analytical Results

Naphthalene was detected in monitoring well MW-19 at concentrations of 29 μg/L in May 2013 and 3.0 μg/L in October 2013. The detection of 3.0 μg/L is below the WDNR PAL for naphthalene of 10 μg/L and the WDNR Enforcement Standard of 100 μg/L. The concentration in May 2012 was 50 μg/L and was 8.4 μg/L in October 2012. The concentrations have been continually decreasing from 5,260 μg/L since 2000.

5.1.4.2 BTEX Analytical Results

BTEX has historically been detected in three wells (MW-10, MW-12, and MW-19), but was only detected in MW-19 during 2013. In 2013, none of the measured concentrations of naphthalene and BTEX exceeded the WDNR PAL at the site.

5.1.4.3 Dissolved Metal Analytical Results

Metals concentrations in groundwater were below respective PAL levels during the fall 2013 sampling event. The following dissolved metals were collected from wells sampled for the annual and semiannual events at the site: arsenic, copper, iron, manganese, and zinc. The samples were filtered through 0.54-micron filters while in the field. The results and discussion are included in the annual reports (Appendix C).

5.1.4.4 Natural Attenuation Parameters

Natural attenuation is a remediation approach that relies on natural processes that work to reduce mass and concentration of contaminants in soil and groundwater. Natural attenuation processes include dispersion, dilution, abiotic transformation, volatilization, sorption, and biodegradation. Biodegradation is often the most important process for compounds that can be transformed or reduced by indigenous microorganisms.

Natural attenuation appears to be contributing to the improved condition of groundwater at the site. The annual reports (Appendix C) present and discusses the data related to natural attenuation parameters for each well as measured since 1997.

5.2 Bioventing

The bioventing system was installed to provide oxygen for the aerobic biodegradation of residual diesel fuel petroleum hydrocarbons and PCP in the LNAPL smear zone. As the groundwater extraction system extracts and treats groundwater containing dissolved-phase PCP, the groundwater table is depressed, which exposes more of the LNAPL smear zone to the air supplied by the bioventing system.

5.2.1 Bioventing System Summary

At the time the site was transitioned to WDNR, the bioventing system was being operated only 5 days per month during periods when the ground surface at the site was not frozen. When the system was first started on September 24, 2007, the blowers were on most of the time. Due to the increases of methane and the frozen ground surface (which prevents upward release of the methane and may result in a lateral spreading of the methane to nearby residences), the bioventing system was shut down during the winter months. The system was restarted after the spring ground thaw. In June 2009, the bioventing operation was modified to reduce the operating time to 5 days per month. Evaluation of the monitoring data showed that oxygen levels can reach saturation levels within the first several days of blower operation in the majority of the unsaturated zone and, during 1 month of not operating, only a small decrease of 5 to 8 percent in the oxygen levels were observed. The effectiveness of the bioventing, therefore, is not compromised by this pulsed operation, which has provided a reduction in operation costs through the lowered energy consumption.

5.2.1.1 Soil Gas Monitoring

Since startup of the bioventing system, carbon dioxide and methane levels have decreased in the bioventing wells; however, the oxygen level at SG-07S located within the wood chip area have remained at low percentages relative to the other monitored wells. Intermediate wells, deep wells, and shallow wells located outside of the wood chip area have exhibited similar changes in gas composition, including increasing oxygen levels and decreasing carbon dioxide levels, throughout the months of bioventing activity. The methane levels do rise slightly in monitoring wells during bioventing but are not present throughout the CAMU area. The levels can be explained by the rapid in situ degradation of methane.

Oxygen has generally stabilized for each well at approximately 20 percent. Methane has been detected at low concentrations in only a few wells after the initial startup.

Soil gas well SG-22 was replaced in December 2013 after it was noticed that the well was clogged with a clay-type material, and other rehabilitation methods did not work. Soil gas analytical results are available in the annual reports located in Appendix C.

5.2.1.2 Soil Sampling

Evaluating the effectiveness of the O&M of the bioventing system with time is difficult because of the challenge to gather data that can be compared. Concentrations of PCP or other compounds are extremely location-specific. A sample that is collected less than a foot from a different sample can contain extremely different amounts of different chemicals. Diffusion and dispersion do not work in soil as they do in groundwater to homogenize concentrations. As a result, direct comparisons between samples taken at different locations and times are not directly comparable.

With those limitations in mind, soil samples were collected in 2010 and 2013 to measure the concentration of PCP and TPH from within areas of the unsaturated and groundwater smear zones. The sample locations are shown in Figure 12.

In 2013, the soils were collected from three soil boring locations. The lithology was examined during drilling, and samples were selected. The shallow samples were collected from within identified fill areas or non-native soils near the ground surface. The intermediate samples were collected from 10 to 90 feet below ground surface within the unsaturated zone. The deep samples were collected above the water table from the NAPL smear zone. The sample locations were selected based on high photoionization detector readings within each designated zone. Three samples were collected from each boring location. The soil samples were analyzed for TPH, PCP, gasoline range organics, and DRO. Intact cores were also collected from the smear zone and submitted for mobility analysis. Results are shown in Tables 5-1, 5-2, and 5-3.

In 2010, the soils were collected at the extraction well locations installed to examine the soils and lithology prior to installation of the new extraction wells. The samples were collected from each location in a similar manner as in 2013; however, the shallow samples also targeted woodchips, if present. The soil samples were analyzed for TPH and PCP.

In 1998, initial soils samples were collected prior to the excavation and construction of the CAMU but within the final CAMU footprint. Soil samples were also taken from soil gas monitoring wells that have since been abandoned and reinstalled in different locations. Soil gas wells SG-01, SG-02, SG-04, SG-05, SG-07, and SG-08 were located very close to where the new extraction wells are located. Following the initial soil sampling, the CAMU was constructed; therefore, comparison of historical soil samples to current soil samples needs also to consider the changes in top of ground surface elevation.

The construction of the CAMU included placement of wood chips over native soils. The shallow soil samples collected in 1998 were collected from within the native soils, while the shallow soil samples collected in 2010 were collected from within the woodchip fill. A depth of 5 feet in 1998 more properly corresponds to a depth of approximately 15 feet in 2010 and 2013 post-construction. Because the samples collected are from different soils, the results from the 1998 and 2010 shallow soil samples are not considered directly comparable.

The results for shallow samples, intermediate samples, and deep samples are summarized in Tables 5-1, 5-2, and 5-3, respectively.

TABLE 5-1
Shallow Depth Analytical Results
Penta Wood Products Site

Location	Date	Depth Below Ground Surface (feet)	% Moisture	PCP (µg/kg)	Diesel Range Organics (mg/kg)
2013 Analytical Results					
SB001	Dec-13	08–10	--	54,000	11,000
SB001 (duplicate)	Dec-13	08–10	--	85,000	3,400
SB002	Dec-13	05–06	--	86,000	3,300
SB003	Dec-13	03–05	--	21,000	2,100
2010 Analytical Results					
EW-12	Dec-10	06–07	16.8	96,900	1,510
EW-13	Dec-10	06–07	12.9	6,350	406
EW-14	Dec-10	04–05	18.3	<45	<23.9
1998 Analytical Results					
SG-1	Feb-98	5	--	1,300,000	18,000
SG-4	Feb-98	5	--	160,000	1,100
SG-7	Feb-98	5	--	970,000	19,000
SG-1	Apr-98	5	22.7	1,290,000	18,000
SG-4	Apr-98	5	7.6	157,000	1,100
SG-7	Apr-98	5	41.1	973,000	19,000

Note: 1998 shallow soil samples were collected from native soils. 2010 and 2013 shallow soil samples were collected from within the CAMU woodchip fill soils.
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

TABLE 5-2
Intermediate Depth Analytical Results
Penta Wood Products Site

Location	Date	Depth Below Ground Surface (feet)	% Moisture	PCP (µg/kg)	Diesel Range Organics (mg/kg)	Gasoline Range Organics (mg/kg)
2013 Analytical Results						
SB001	Dec-13	16–18	--	440,000	12,000	180
SB002	Dec-13	12–13	--	97,000	3,200	49
SB003	Dec-13	20–22	--	36,000	2,100	77
2010 Analytical Results						
EW12	Dec-10	68–69	2.29	1,770	95.1	8.49
EW12 (duplicate)	Dec-10	68–69	13.4	114,000	1,660	185

TABLE 5-2
Intermediate Depth Analytical Results
Penta Wood Products Site

Location	Date	Depth Below Ground Surface (feet)	% Moisture	PCP (µg/kg)	Diesel Range Organics (mg/kg)	Gasoline Range Organics (mg/kg)
EW13	Dec-10	55–54	8.1	<30	<11.3	<2.54
EW14	Dec-10	76–77	67.1	2530	<58.1	<11.8
1998 Analytical Results						
SG-2	Feb-98	40	--	180,000	1,000	--
SG-5	Feb-98	40	--	160,000	1,900	--
SG-8	Feb-98	40	--	350,000	6,800	--
SG-2	Apr-98	40	7.4	179,000	1,000	--
SG-5	Apr-98	40	6.5	155,000	1,900	--
SG-8	Apr-98	40	4.4	317,000	7,300	--

µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

Comparison of the results was not expected to provide a clear picture of what is occurring beneath the ground surface, but there are some conclusions that can be developed.

The 2013 data indicate that some areas of the smear zone continue to have high concentrations of PCP present.

The data from 2010 indicate that the subsurface soils are not saturated with PCP or hydrocarbons from the ground surface to the water table.

TABLE 5-3
Deep Depth Analytical Results
Penta Wood Products Site

Location	Date	Depth Below Ground Surface (feet)	% Moisture	PCP (µg/kg)	Diesel Range Organics (mg/kg)	Gasoline Range Organics (mg/kg)
2013 Analytical Results						
SB001	Dec 13	114.0–115.9	--	330,000	9,800	200
SB002	Dec 13	107.0–107.5	--	18,000	1,100	45
SB003	Dec 13	90.2–90.6	--	120,000	4,500	200
2010 Analytical Results						
EW12	Dec-10	96–97	8.91	23,900	151	96
EW13	Dec-10	100–101	5.43	6,250	105	16.7
EW14	Dec-10	103–104	5.78	<39.4	<20.2	<4.78

Note: Deep samples were not taken in 1998.
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

The PCP concentrations measured in 2013 in the smear zone are higher than the 2010 PCP concentrations in many areas but are somewhat lower than 1998 overall.

5.3 Groundwater Extraction and Treatment System

The treatment system at the PWP site consists of groundwater extraction and treatment, LNAPL recovery, and bioventing. The groundwater extraction system extracts and treats groundwater containing dissolved-phase PCP and depresses the groundwater table to contain groundwater contamination and allows LNAPL to collect near the extraction wells. The depressed groundwater also exposes additional LNAPL smear zone. The bioventing system was installed to provide oxygen for the aerobic biodegradation of residual diesel fuel petroleum hydrocarbons and PCP in the LNAPL smear zone.

Groundwater treatment system discharge monitoring is performed in accordance with the WPDES permit dated November 2007. Standards for discharge of water to the infiltration basin allow no more than 0.1 µg/L of PCP.

This section describes the groundwater extraction system performance, which includes the estimates of groundwater and PCP extracted, operational and maintenance items, and a discussion of the LNAPL and groundwater extraction wells.

The total volume of groundwater extracted from this site by the system was estimated as 225,604,657 gallons between the initial start in September 2000 and the end of 2013. The volume is estimated because there is some uncertainty in the values recorded for discharge prior to 2004. The estimated PCP mass removed from the groundwater through that period is based on the average PCP concentration and a removal to an effluent concentration of 0.1 µg/L. This reduction leads to an estimate of 8,813 pounds of PCP removed within the groundwater since the groundwater extraction began in 2000 (Table 5-4).

In addition to the PCP mass removed through groundwater extraction, PCP mass is removed through the extraction of LNAPL. The volume of liquid waste that was extracted through the LNAPL recovery system can be used to make a rough estimate of the mass of PCP removed by LNAPL extraction. The plant recovered approximately 53,841 gallons of liquid waste in the separator through 2013. Before 2008, approximately one-half of the liquid waste was water. Continued optimization of the system resulted in less water in the waste oil storage tank. The estimated amount of LNAPL extracted from the subsurface is based on the volume accumulated in the storage tank through the year. In 2013, approximately 3,950 gallons of LNAPL were recovered. Assuming an LNAPL density of 0.84 gram per cubic centimeter and a PCP concentration of 5 percent, the volume equates to about 1,384 pounds of PCP present in LNAPL removed in 2013 (Table 5-5). LNAPL recovery rates increased in 2013 from 2012. The increase is likely because the LNAPL extraction system was running more effectively with three more recovery wells operating than in previous years.

TABLE 5-4
PCP Removed with the Groundwater Extraction System
Penta Wood Products Site

Operation Period	Volume of Groundwater Extracted (gallons)	Average PCP Influent Concentration (µg/L)	PCP Removed (lbs)
09/27/00 to 12/18/00	11,712,960[a]	12,535	1,224
02/02/01 to 02/08/01	691,200[a]	12,535	72
03/16/01 to 06/10/01	9,288,000[a]	10,356	802
06/15/01 to 09/27/01	6,822,720[a]	7,535	429
		Total PCP Removed from 2000 to 2001	**2,527**
02/27/04 to 12/31/04	18,548,154	9,227	1,427[b]
01/01/05 to 12/31/05	21,374,796	7,300	1,301[b]
01/01/06 to 12/31/06	14,759,392	6,425	791[b]
01/01/07 to 12/31/07	16,551,336	3,557	491
01/01/08 to 12/31/08	18,118,696	3,255	492

TABLE 5-4
PCP Removed with the Groundwater Extraction System
Penta Wood Products Site

Operation Period	Volume of Groundwater Extracted (gallons)	Average PCP Influent Concentration (µg/L)	PCP Removed (lbs)
01/01/09 to 12/31/09	18,533,648	2,883	445
01/01/10 to 12/31/10	18,561,632	1,948	301
01/01/11 to 12/31/11	17,796,668	1,985	295
01/01/12 to 12/31/12	23,051,892	2,125	408
01/01/13 to 12/31/13	29,793,563	1,350	335
01/01/14 to 8/31/14	11,416,048	1,833	174
Total Gallons Extracted	237,020,705	**Total PCP Removed 2000 to 2014**	**8,987**

[a] Volumes are estimated.
[b] Values were revised based on measured volumes. Values previously reported were based on estimated volumes.

TABLE 5-5
PCP Removed from the Free Product Recovery System
Penta Wood Products Site

Operation Period	Amount of Liquid Extracted (gallons)	Amount of LNAPL Extracted (gallons)	Amount of Fuel Oil Removed[c] (gallons)	Amount of PCP Removed[d] (gallons)	Amount of PCP Removed[d] (lbs)
2004	7,640	3,820[a]	3,629	191	1,338
2005	3,404	1,702[a]	1,617	85	596
2006	7,550	3,775[a]	3,586	189	1,322
2007	11,079	5,540[a]	5,263	277	1,940
2008	4,002	4,002[b]	3,802	200	1,402
2009	5,090	5,090[b]	4,836	255	1,783
2010	4,987[e]	4,987[b]	4,738	249	1,747
2011	2,500	2,500[b]	2,375	125	876
2012	3,639	3,639[b]	3,457	182	1,277
2013	3,890	3,890[b]	3,696	195	1,363
2014	**3,224**	3,224[b]	**3,063**	**161**	**1,128**
Total	**57,005**	**42,169**	**40,060**	**2,108**	**14,769**

[a]Assumes 50 percent of the extracted liquid is LNAPL.
[b]Assumes 100 percent of the extracted liquid is LNAPL based on system optimization and observations of waste in storage tank.
[c]Assumes LNAPL is 95 percent of the fuel oil.
[d]Assumes LNAPL is 5 percent PCP.
[e]Includes LNAPL recovered with absorbent socks.

In accordance with the WPDES permit, PCP concentrations in the influent were measured quarterly and are summarized in Table 5-6. Influent concentrations have continued to decrease each year.

TABLE 5-6
PCP Influent Concentrations
Penta Wood Products Site

Date	Influent PCP Concentration (µg/L)
02/27/2004 to 12/31/2004*	9,227
01/01/2005 to 12/31/2005*	7,300
01/01/2006 to 12/31/2006*	6,425
01/01/2007 to 12/31/2007*	3,557
01/01/08 to 12/31/08*	3,255
March 2009	3,560
July 2009	3,140
September 2009	2,800
December 2009	2,030
March 2010	2,050 J
June 2010	1,970
September 2010	1,830
December 2010	1,940
March 2011	2,470
June 2011	2,170
August 2011	1,700
October 2011	1,600
February 2012	2,600
May 2012	2,200
July 2012	1,900
October 2012	1,800
February 2013	1,100
May 2013	1,100
July 2013	1,800
October 2013	1,400
February 2014	1,800
May 2014	1,600
August 2014	2,100

* Average PCP influent concentration for that time period. Quarterly measurements began in 2009.

As a result of the system operation, there has been over an 80 percent reduction in the annual average PCP influent concentrations since the system was initially started in 2004 (result in November 2004 was 9,140 µg/L). Since the system was restarted in 2004, the system has extracted over 224 million gallons of groundwater, or approximately 11 pore volumes.

5.4 Operation and Maintenance

5.4.1 Bioventing System Operation and Maintenance

Process measurements, such as air injection well flow rates and pressures, and vacuum before and pressure after the air injection blower are monitored periodically during the bioventing operation. Measured pressures in each well stabilize at approximately 1 pound per square inch. Air flow rates for the deep bioventing wells (BV-02, BV-03, BV-04, BV-05, BV-06, BV-07, and BV-11) were set between 300 and 430 standard cubic feet per minute (scfm). Air flow rates for each of the shallow bioventing wells (BV-08 and BV-09) were set at approximately 160 scfm. Deep wells were designed for a maximum flow of 500 scfm and shallow wells for a maximum of 200 scfm.

Bioventing well SG-22 became clogged in spring 2013. It was replaced with an identical well in December 2013 and will be sampled in 2014. The bioventing system blower broke at the end of 2013 and was replaced in April 2014.

5.4.2 Groundwater Treatment System Operation and Maintenance

Continued groundwater treatment system optimization has led to a reduction in carbon changeout frequency, eliminating the need for partial carbon changeouts, and decreasing disposal costs. Optimization of the dosage and monitoring of the pretreatment chemical addition resulted in reduced solids loading to the carbon vessels and extended the operating time between carbon changeouts. The treatment system can operate 20 to 24 weeks and treat approximately 10 to 12 million gallons of water before requiring a changeout of the lead carbon vessel.

5.4.3 LNAPL Extraction Wells Operation and Maintenance

LNAPL removal performance was improved by routinely adjusting the LNAPL pump depth to account for water level fluctuations. The LNAPL pumps have the intake at the top of the pumps and, if the water level changes significantly, the pump depth may be too deep and pump only water or too shallow and not pump at all. Therefore, the LNAPL pumps were raised or lowered monthly in the spring, summer, and fall of 2011, 2012, and 2013, so the pump was at the appropriate depth within the extraction well.

The three new LNAPL recovery pumps were put into service in 2011 The pumps are adjusted on the same schedule as the current pumps.

In August 2013, the submersible pump located in well EW-02 failed and was replaced. Silt had built up in the drop piping and clogged the pump, and it is the first instance of this problem at the site.

5.4.4 Hazardous Waste Disposal

This site was a large-quantity generator of listed hazardous waste. The filter cake, LNAPL, spent carbon, and other items that come into contact with the listed waste were disposed of offsite in approved facilities in compliance with the applicable regulations. Table 5-7 present a summary of the wastes disposed each year. CH2M HILL maintained a subcontract with companies that were approved for managing and transporting the material to the appropriate facilities for destruction. North Shore Environmental was the most recent company to manage this material.

All waste is considered a F032 listed hazardous waste with an additional F027 code in Wisconsin. All waste is transported under a hazardous waste manifest and is incinerated at the approved disposal facility. Additional information is contained within the annual reports (Appendix C).

TABLE 5-7
Hazardous Waste Generation Summary
Penta Wood Products Site

Date	Filter Cake (lbs)	Misc. Debris (lbs)	Carbon (lbs)	LNAPL (lbs)	Water (gallons)	Yearly Total (lbs)
2000	0	200	6,000	5,009*	0	11,209
2001	0	400	56,100	6,166*	0	62,666
2002	0	1,400	48,000	10,790*	27,756	87,946
2003	0	600	0	3,083*	1,376	5,059
2004	155,960	3,200	102,000	53,522*	0	314,682
2005	178,784	1,290	104,860	23,847*	0	308,924
2006	112,640	1,200	136,520	52,892*	0	303,252
2007	174,020	2,200	245,377	77,615*	0	517,387
2008	211,402	3,176	70,007	28,036	0	312,621
2009	233,840	1,116	49,757	35,659	0	320,372
2010	210,940	0	81,227	34,937	0	327,104
2011	292,903	0	74,247	0	0	367,150
2012	182,280	0	65,420	25,493	0	273,193
2013	156,760	0	46,571	27,252	0	230,582
2014**	86,840	19,820	41,960	9,808	0	158,428

*Volume shows the amount of waste disposed of offsite and is estimated to be approximately 50 percent LNAPL and 50 percent mixture of water and emulsified LNAPL.

**2014 values are for the period of January 1 through September 30.

5.5 Contact Information

The PWP site was operated and managed by EPA, rather than potentially responsible parties. The following list presents the contact information for the three key people leading the project when it transitioned to control by the State of Wisconsin.

Site Location
Penta Wood Superfund Site
8682 Daniels 70
Siren, Wisconsin 54872

EPA Work Assignment Manager
Ms. Linda Martin
EPA – Region 5
77 W. Jackson Boulevard SR-6J
Chicago, Illinois 60604
312-866-3854
Martin.LindaB@epamail.epa.gov

WDNR Project Manager
Mr. Phillip Richard
WDNR
875 S. 4th Avenue
Park Falls, WI 54552
715-762-1352
philip.richard@wisconsin.gov

CH2M HILL Site Manager
Mr. Mike Niebauer
CH2M HILL
135 S. 84th Street Suite 400
Milwaukee, Wisconsin 53214
608-298-7770
mike.niebauer@ch2m.com

5.6 Project Team Roles and Responsibilities

CH2M HILL operated the site with a full-time CH2M HILL operator supported by engineers and scientists from its Milwaukee office. The operations team was filled out by contract agreements with multiple subcontractors that provided services, equipment, and materials. Table 5-8 shows the entities that made up the external project team, along with contact information and the services provided.

TABLE 5-8
Penta Wood Products Services Contact Information
Siren, Wisconsin

Company	Contact Name	Phone Number	Service Provided
Prime Contractor			
CH2M HILL	Mike Niebauer	414-847-0254	Site Manager
Services			
Austin Lake	Kyle Werdler	715-866-7261	Landscaping
Test America	John McFadden	330-497-9396	Analytical services
Applied Air Systems	John Staber	952-985-0865	Air compressor service
Mauer Power	Bruce Mauer	715-349-2832	Electrical and plumbing services
Hedlund Gas	Philip J. Hedlund	715-349-2255	Liquid Propane
A-1 Septic		715-656-7007	Pump out septic tank
North Shore Environmental	Mark Norris	262-255-4468	Hazardous waste removal (spent GAC, filter cake, drums of LNAPL)
Siemens Water Technology	Jed Hoffman	847-226-4514	Removed and bagged GAC and provided and placed fresh GAC
Equipment and Materials			
Glacier Pure	Terry Alsworth	847-902-0319	Ferric and caustic (typically provided 10,000 gallons per year of Ferric Sulfate; 4,000 gallons per year of caustic)
US Water Services	Kevin Hines	612-859-1874	Polymer (typically provided 30 gallons per year)
Alar Chemicals	Robert Gorski	708-479-6100	Diatomaceous earth (typically provided 3,600 pounds per year)
Anderson Pump and Process	Brad Strum	715-303-8109	Pump parts and service plus bag filters (typically 24 bag filters per month)
Burnett Co. Co-op		715-689-2467	Fuel for "Bobcat" skid-steer

SECTION 6

Summary of Post Remedial Action Project Costs

A detailed breakdown of costs for O&M of the PWP site LTRA from September, 2001 through September 2014 is presented in Table 6-1. Descriptions of the tasks completed during each year are documented in annual reports submitted to EPA (Appendix C).

TABLE 6-1
Costs for Operation and Maintenance September 2014 through September 2014
Penta Wood Products Superfund Site

Task No.	Task Description	WA 201 ($)	WA 004 ($)	WA 132 ($)
1	CH2M HILL		1,084,411	868,927.00
2	Waste Disposal		1,536,281	1,142,501.00
3	Chemicals		315,778	386,588.85
4	Laboratory		158,571	120,950.00
5	Utilities		391,531	114,096.06
6	Carbon Changeout		361,500	298,891.00
7	Data Management		2,509	5,336.63
8	Erosion/Trees/Landscape		39,274	29,195.70
9	Misc O&M expenses		271,768	243,147.43
10	Electrical repairs		99,964	36,000.00
Special Projects				
9	Pilot Study		-	-
10	Pretreatment Installation		-	-
11	LNAPL Coring		-	58,140.00
13	Additional Extraction Wells (2011)		564,664	19,205.00
14	Vessel repairs		32,812	63,360.00
15	Heater Repairs		8,838	-
Pretreatment Installation				
16	New Pretreatment Building	316,821.00		
17	Site Civil Work	22,814.00		
18	Site Civil Work	22,180.00		
19	Pretreatment System Design	315,671.00		
20	Pretreatment System Design	88,134.00		
21	Pretreatment System	336,596.41		

TABLE 6-1
Costs for Operation and Maintenance September 2014 through September 2014
Penta Wood Products Superfund Site

Task No.	Task Description	WA 201 ($)	WA 004 ($)	WA 132 ($)
22	Pretreatment System	1,163,184.59		
23	Pretreatment System - Change Order	49,034.00		
24	CH2M HILL Resident Inspection	50,545.86		
25	CH2M HILL Resident Inspection	94,721.65		
	Total	**2,459,702.51**	**4,867,900.50**	**3,386,338.67**
	LTRA Total Cost			**10,713,941.65**

SECTION 7

Photograph Log

See Appendix B.

SECTION 8

References

CH2M HILL. 1998a. *Remedial Investigation Report, Penta Wood Products.*

CH2M HILL. 1998b. *Feasibility Study Report, Penta Wood Products.*

CH2M HILL. 1999. *Remedial Design Report, Penta Wood Products.*

CH2M HILL. 2000. *Sampling and Analysis Plan.* Revised April 2001.

CH2M HILL. 2010. *Penta Wood Remedial Action Optimization Evaluation.*

CH2M HILL. 2013. *Waste Handling Plan.*

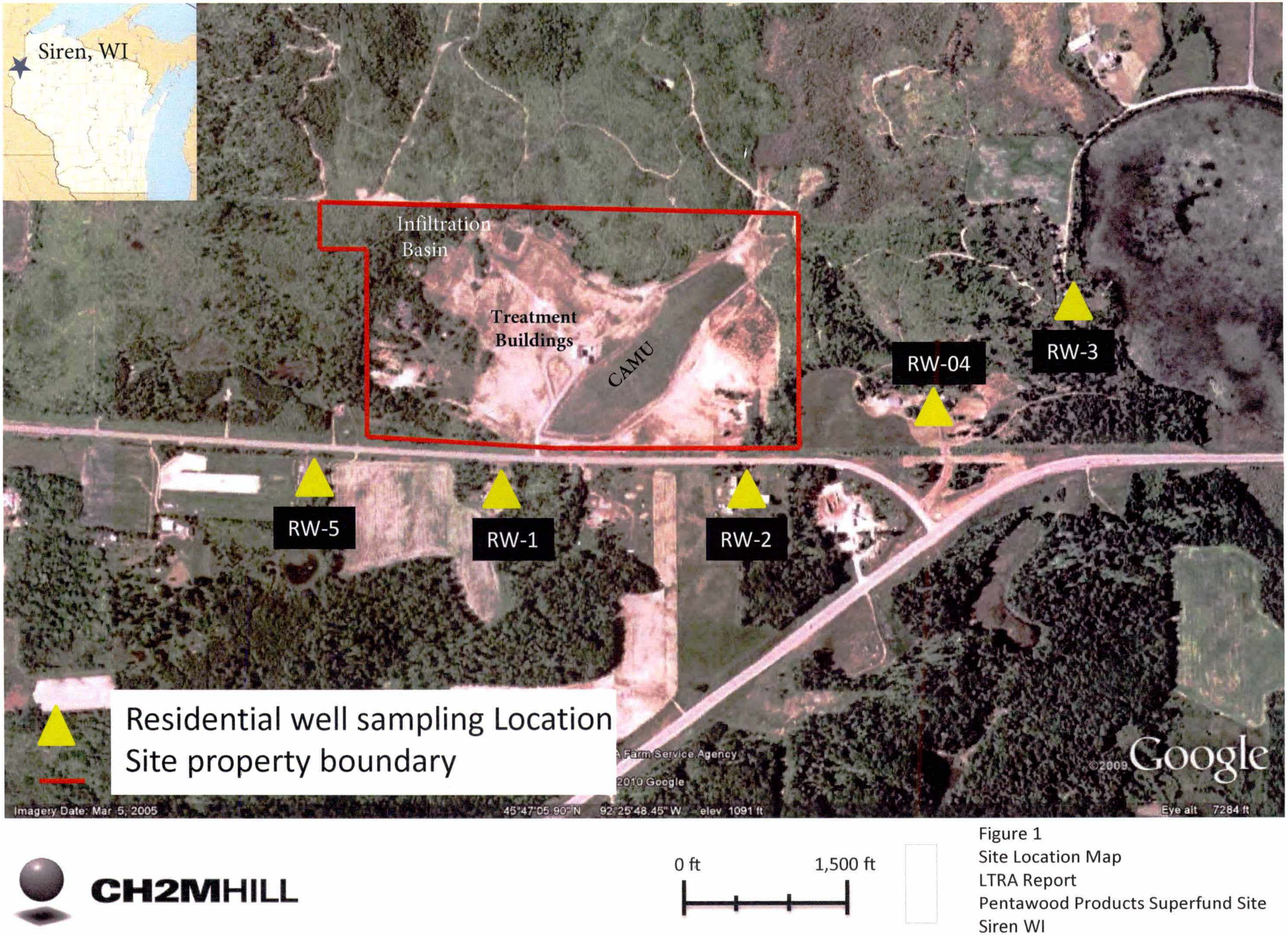
CH2M HILL. 2014. LNAPL mobility and recoverability report, In progress.

U.S. Environmental Protection Agency (EPA). 1992. R*emedial Action Report, Documentation for Operable Unit Completion, Publication 9355.0-39FS*. June.

U.S. Environmental Protection Agency (EPA). 1998. *Penta Wood Products; Record of Decision, R05-98/094.* September.

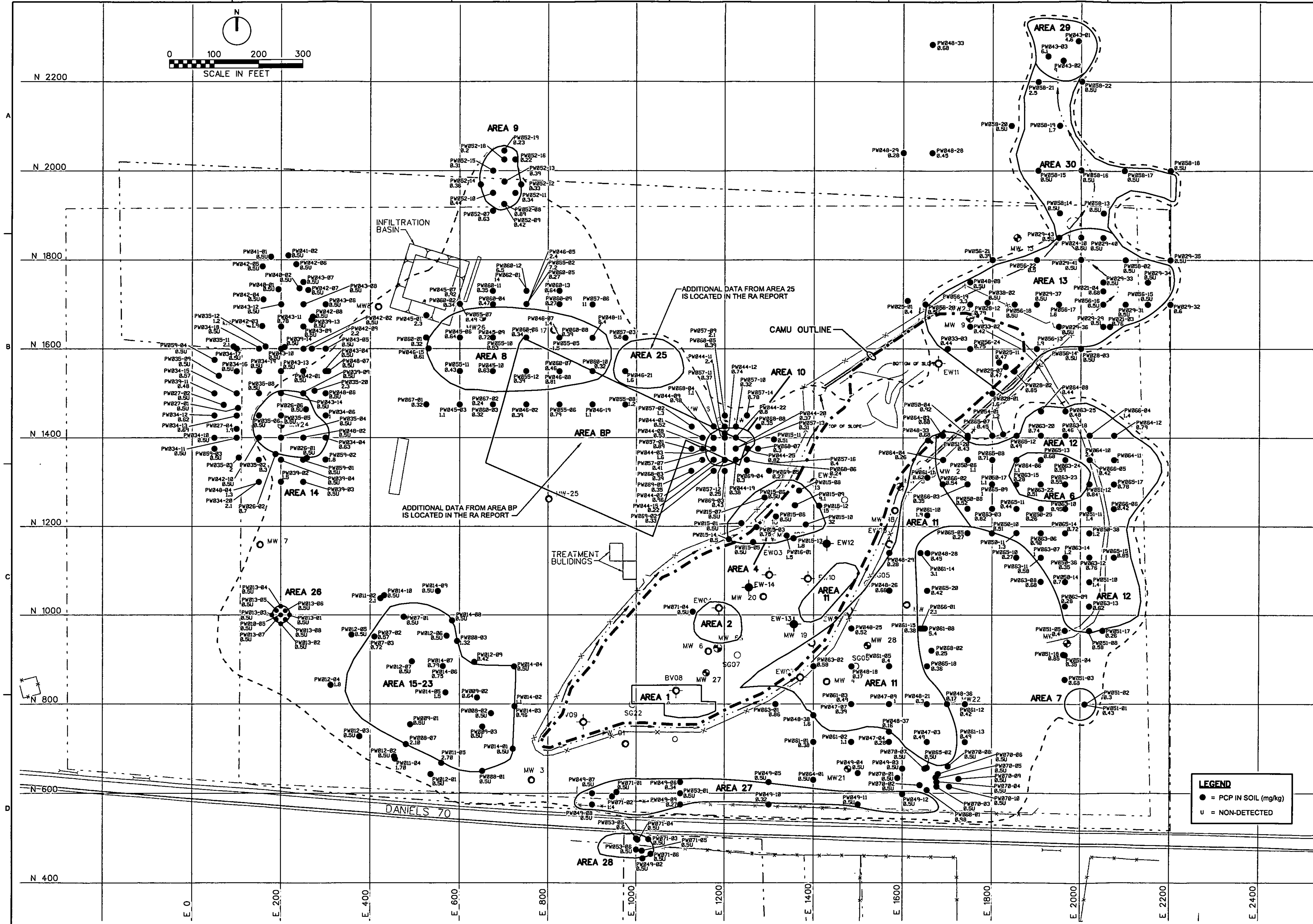
U.S. Environmental Protection Agency (EPA). 2011. Closeout Procedures for National Priorities List Sites (OSWER Directive 9329.2-22). May.

Figures



CH2MHILL

Figure 1
Site Location Map
LTRA Report
Pentawood Products Superfund Site
Siren WI



REUSE OF DOCUMENTS: THIS DOCUMENT, AND THE IDEAS AND DESIGNS INCORPORATED HEREIN, AS AN INSTRUMENT OF PROFESSIONAL SERVICE, IS THE PROPERTY OF CH2M HILL AND IS NOT TO BE USED, IN WHOLE OR IN PART, FOR ANY OTHER PROJECT WITHOUT THE WRITTEN AUTHORIZATION OF CH2M HILL.

NO.	DATE	REVISION	BY	APVD

DSGN MP NIEBAUER | DR MA REICHERT | CHK | APVD

PENTA WOOD PRODUCTS SITE LTRA
USEPA
TOWN OF DANIELS, WISCONSIN

SURFACE SOIL CONFIRMATION MAP REMEDIAL ACTION (2000)

CH2MHILL

PRELIMINARY

VERIFY SCALE
BAR IS ONE INCH ON ORIGINAL DRAWING.
0 1"

DATE	JANUARY 2014
PROJ	344511
DWG	C-1
SHEET	1

FILENAME: 005-C-001a_419801.dgn PLOT DATE: 10/22/2014 PLOT TIME: 10:09:21 AM

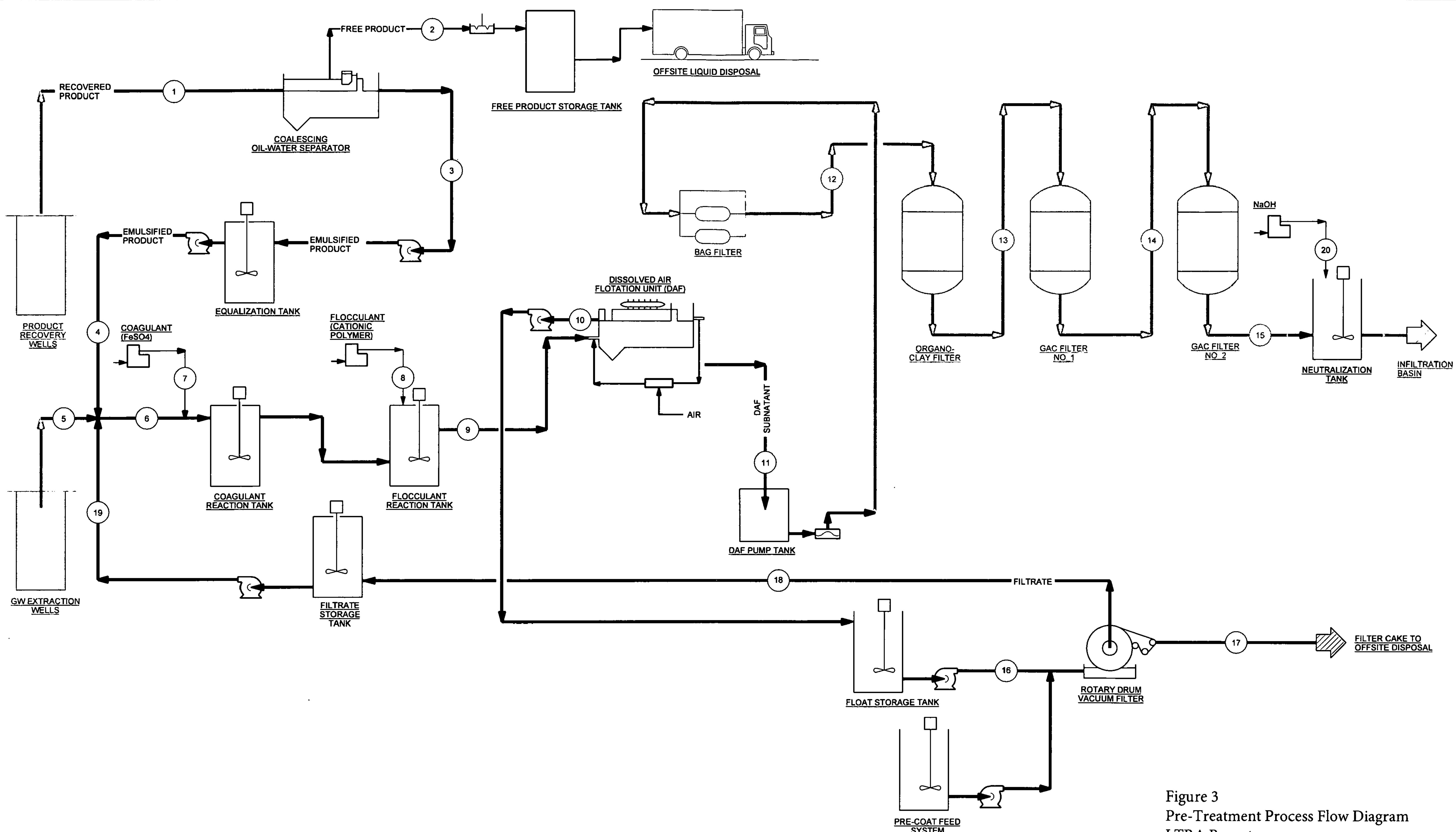


Figure 3
Pre-Treatment Process Flow Diagram
LTRA Report
Penta Wood Site
Siren, Wisconsin

DSGN K.McKENNA					VERIFY SCALE	BIOVENTING/GROUNDWATER TREATMENT FACILITY MODIFICATIONS	PACKAGE 2 GENERAL
DR P.YOUNG					BAR IS ONE INCH ON ORIGINAL DRAWING. 0 1"	PENTA WOOD PRODUCTS SITE LTRA ENGINEERING SUPPORT TOWN OF DANIELS, WISCONSIN	PROCESS FLOW DIAGRAM, CHEMICAL FEED, MASS AND HYDRAULIC BALANCE SUMMARIES
CHK K.McKENNA					IF NOT ONE INCH ON THIS SHEET, ADJUST SCALES ACCORDINGLY.		
APVD R.A.YOLO	NO.	DATE	REVISION	BY	APVD		

CH2MHILL

SHEET 3
DWG G-3
DATE MARCH 2003
PROJ 159815

FILENAME: pw2g03d_159815.dgn MODIFY DATE: 28-MAR-2003 MODIFY TIME: 13:30:50

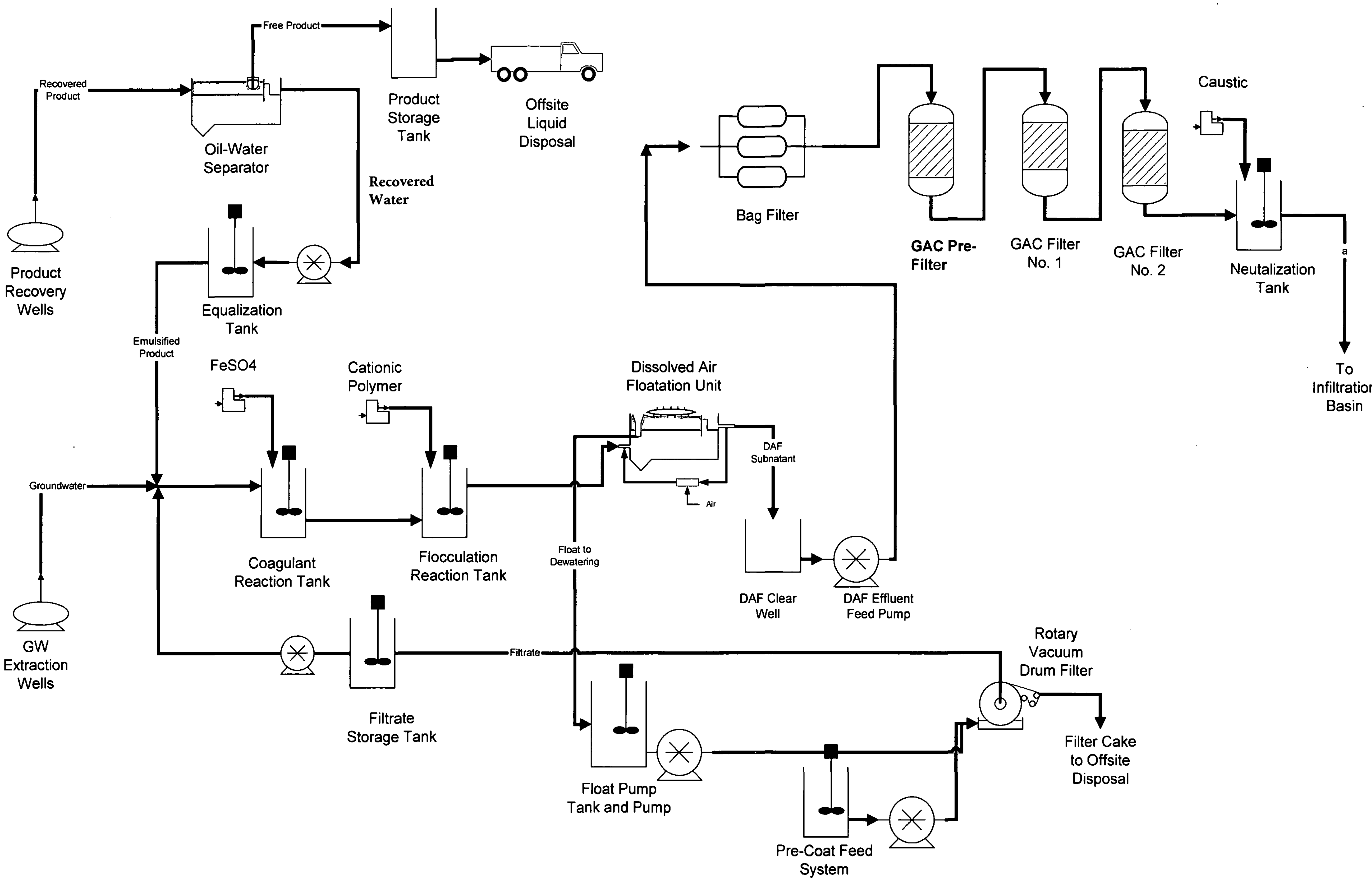
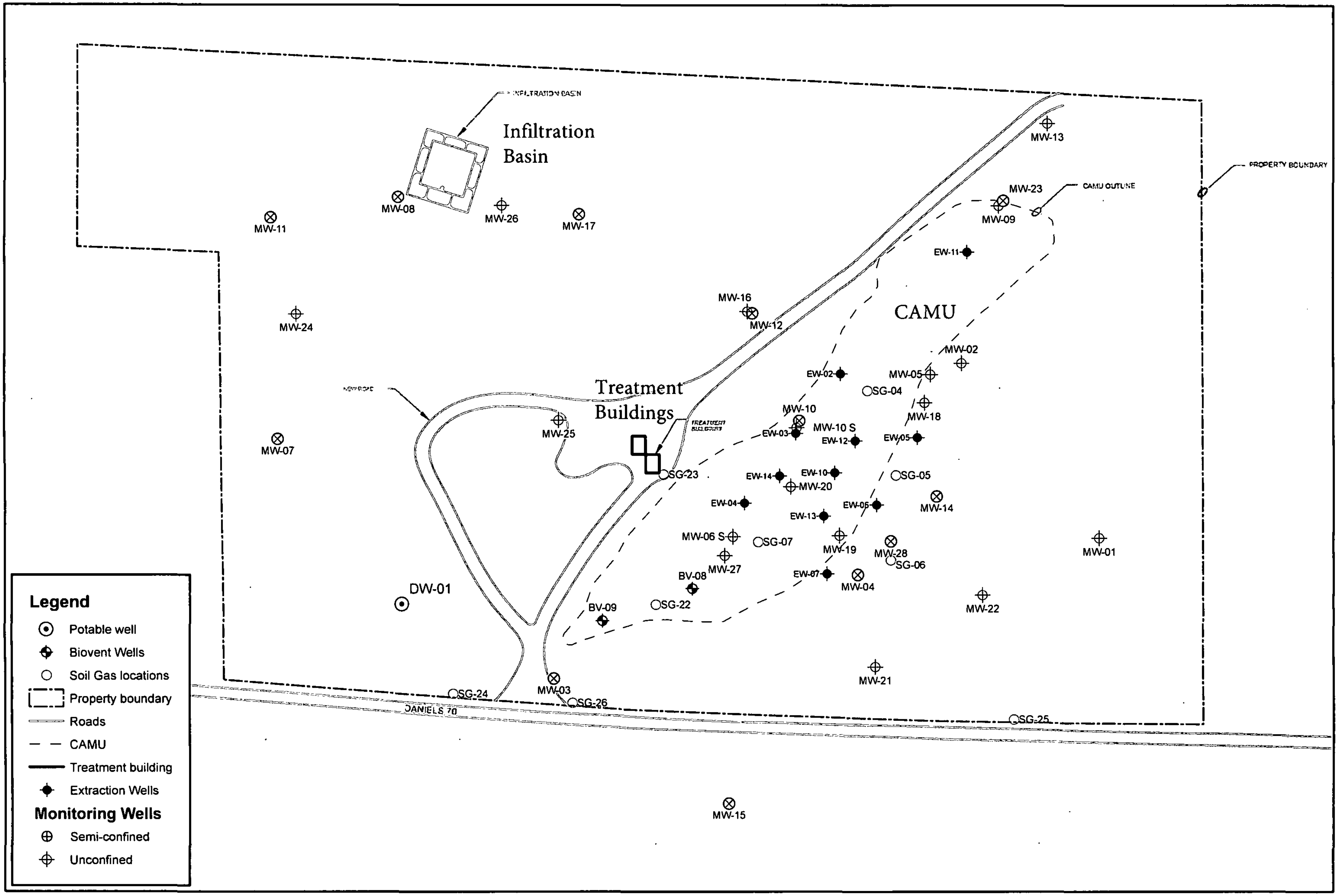


Figure 4
Current Process Flow Diagram
LTRA Report
Penta Wood Products Site
Sitren, WI



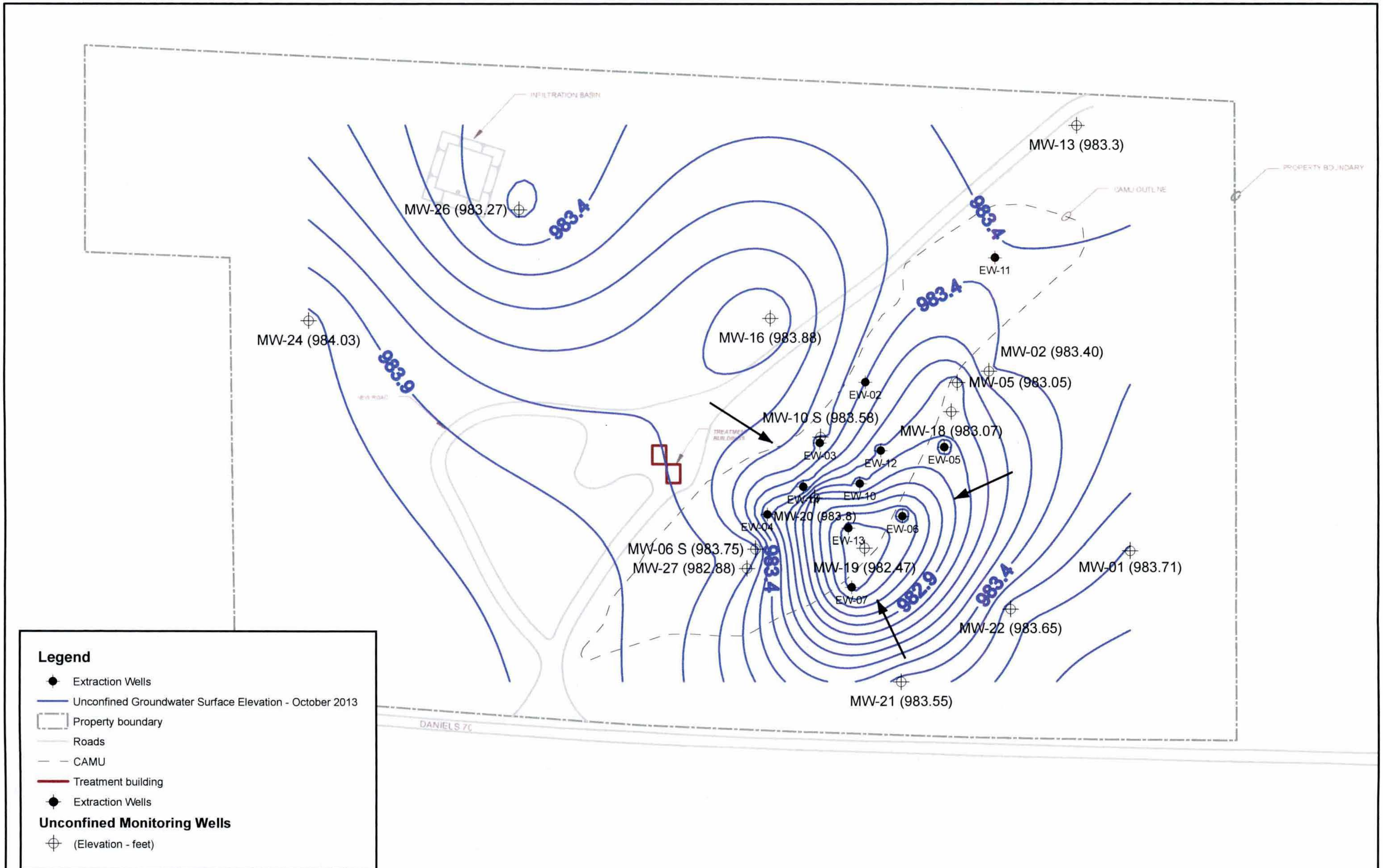
\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2013\Fig_1_Well_location_Map

CH2MHILL

Feet
0 80 160 320 480 640

N

Figure 5
Site Plan
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin



Extraction wells 3,4,5,6,7,10,12,13 and 14 were pumping at 6 gpm during collection of water levels.
Drawdown in the extraction wells was estimated.

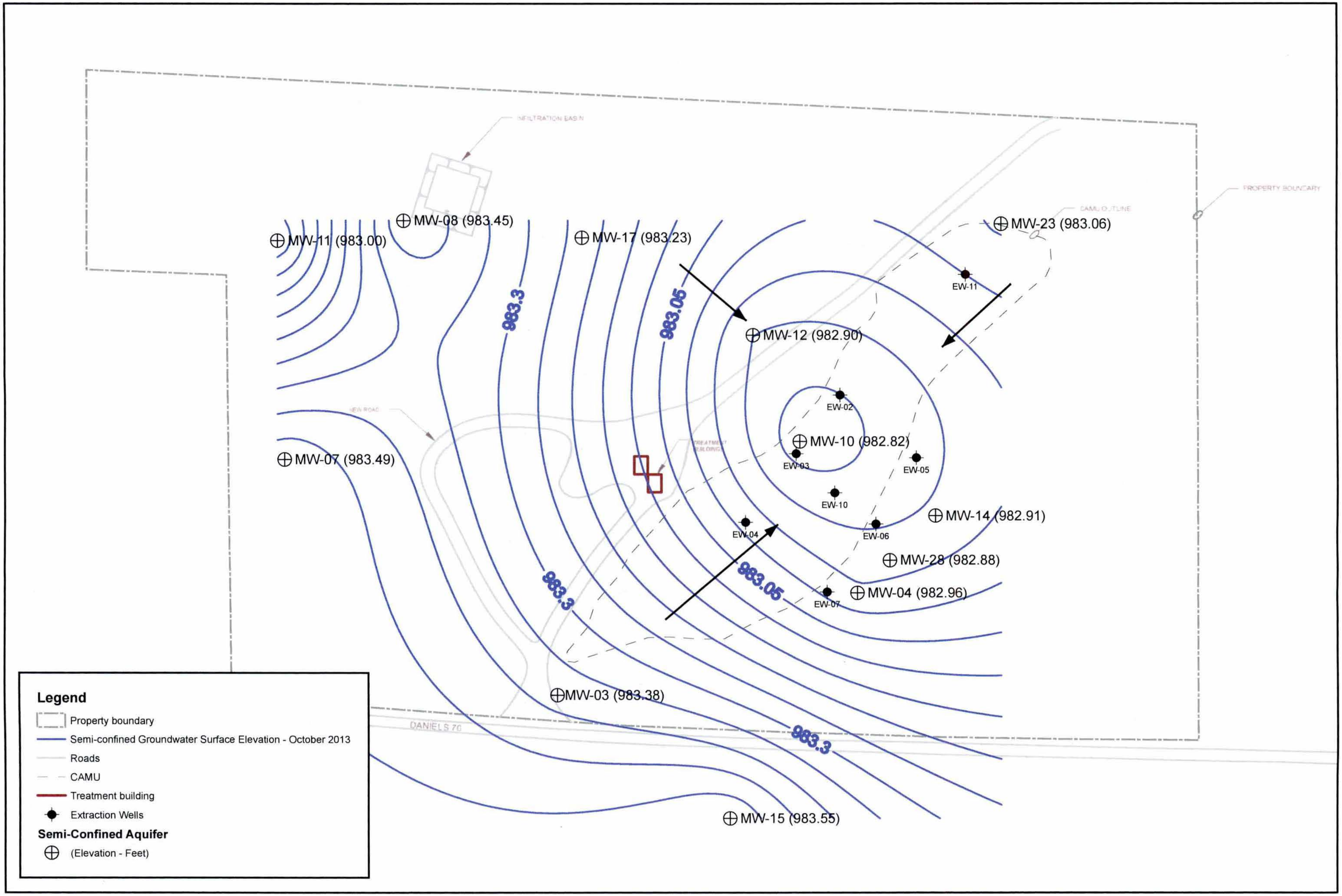
\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2013\Fig_4_PW_UC_GW_10-2013

CH2MHILL

Feet
0 80 160 320 480 640

N

Figure 6
Unconfined Groundwater Elevation - October 2013
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin



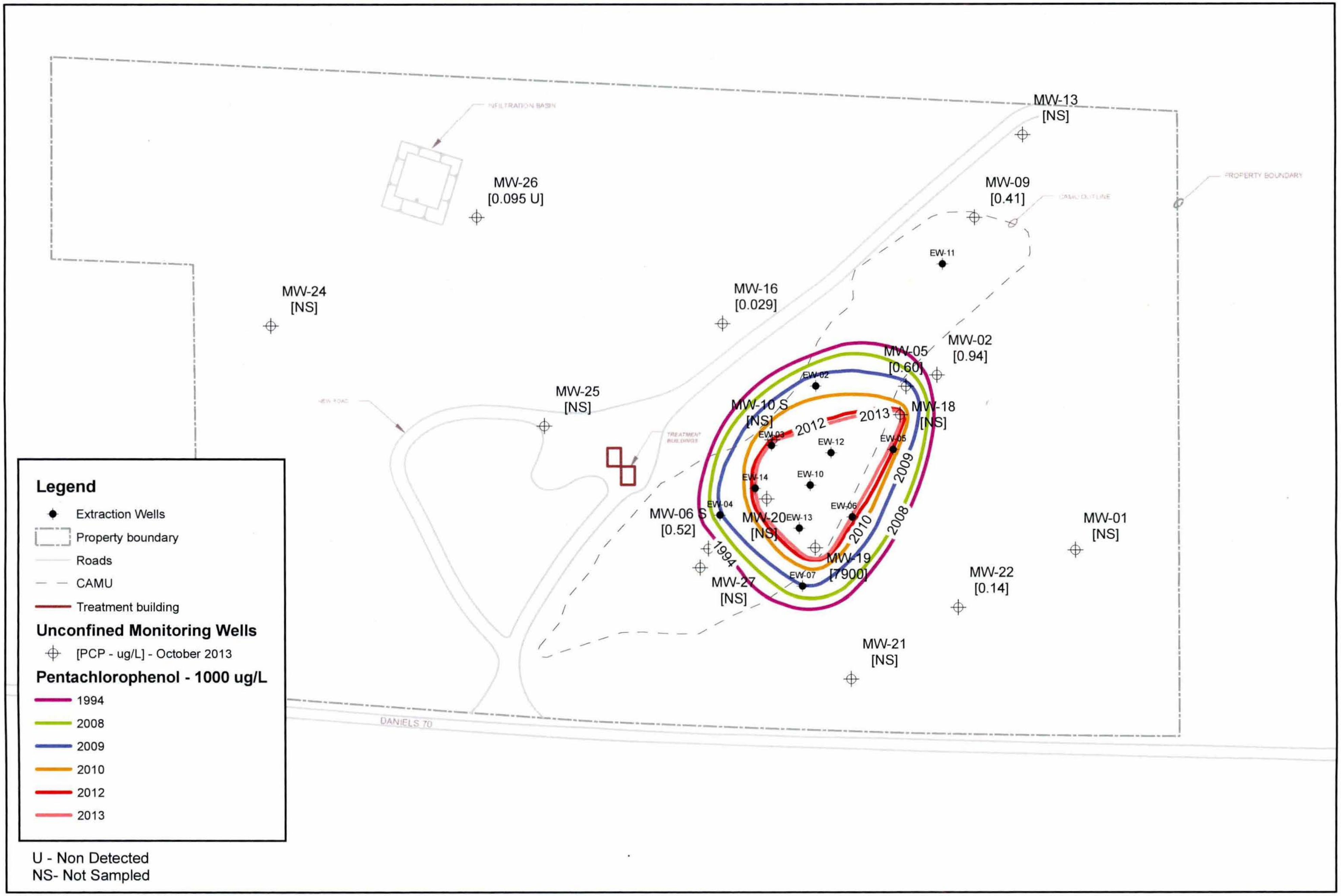
\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2013\Fig_7_PW_SC_10-2013

CH2MHILL

0 80 160 320 480 640 Feet

N

Figure 7
Semi-confined Groundwater Elevation - October 2013
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin



\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2013\Fig_9_PW_UC_PCP1000_2013

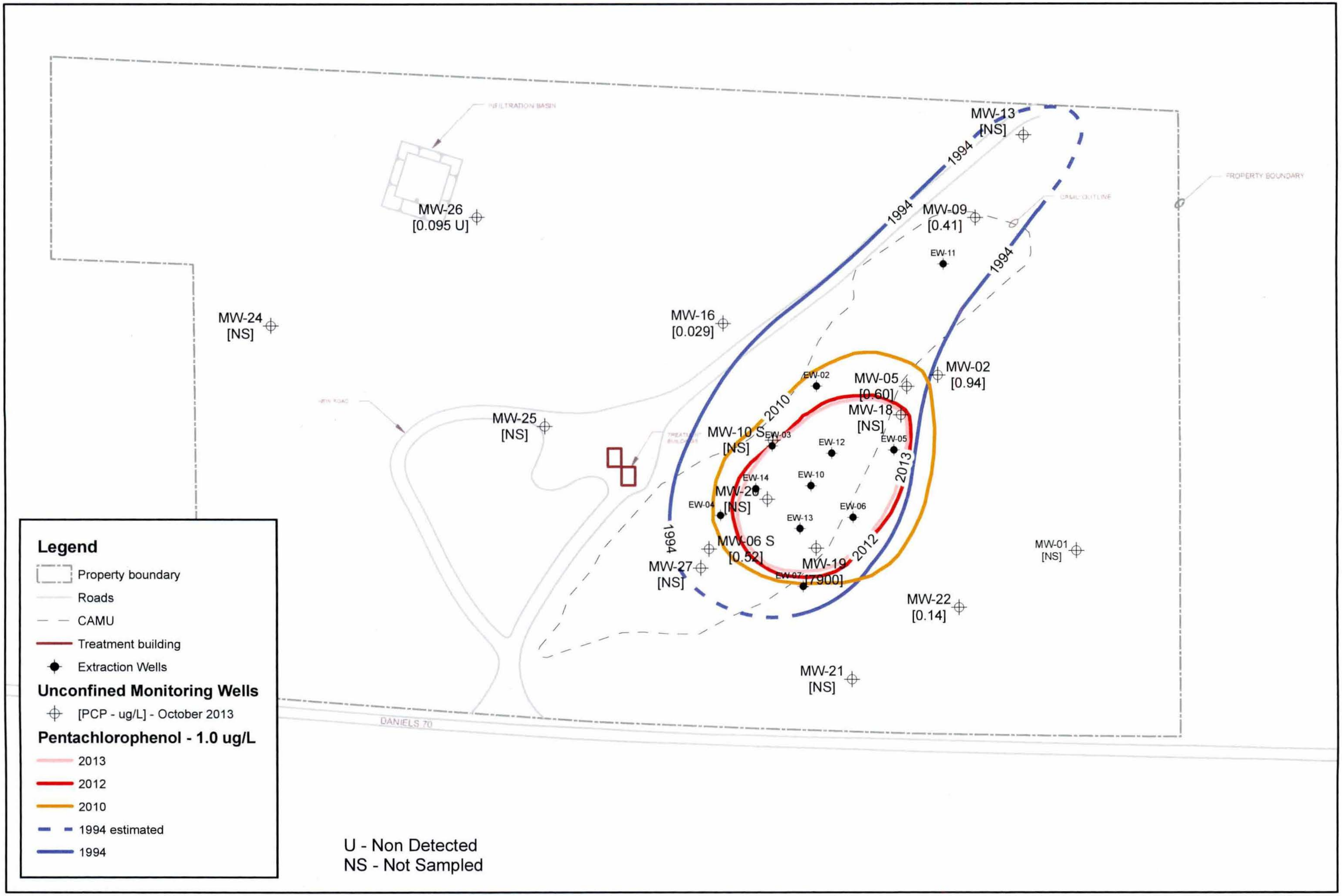
CH2MHILL

0 80 160 320 480 640 Feet

N

Figure 8

Unconfined PCP Plume - 1000 ug/L
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin



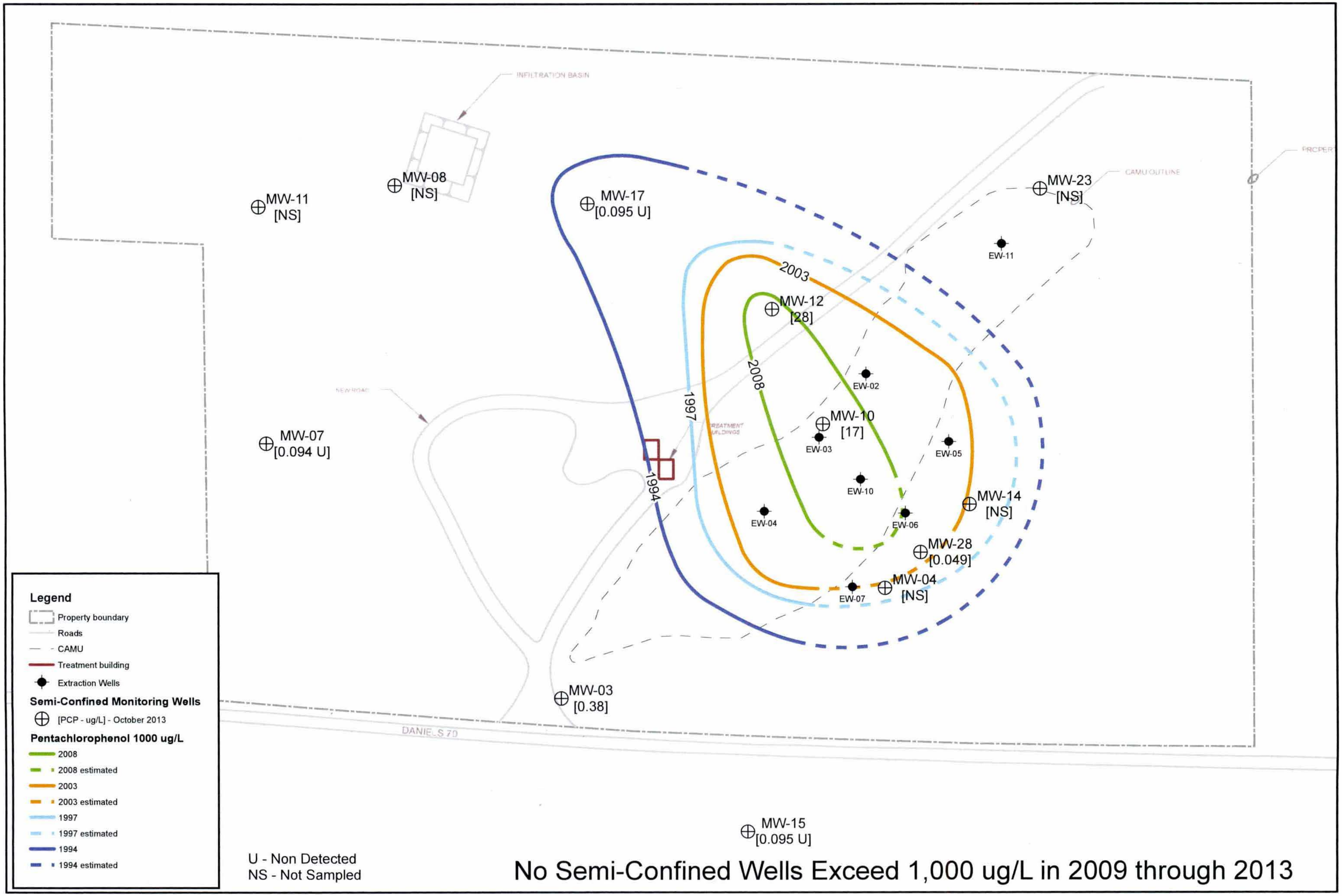
\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2013\Fig_10_PW_UC_PCP1.0_2013

CH2MHILL

0 80 160 320 480 640 Feet

N

Figure 9
Unconfined PCP Plume - 1.0 ug/L
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin



\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2013\Fig_11_PW_SC_PCP1000_2013

CH2MHILL

0 75 150 300 450 600 Feet

N

Figure 10
Semi-Confined PCP Plume - 1000 ug/L
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin

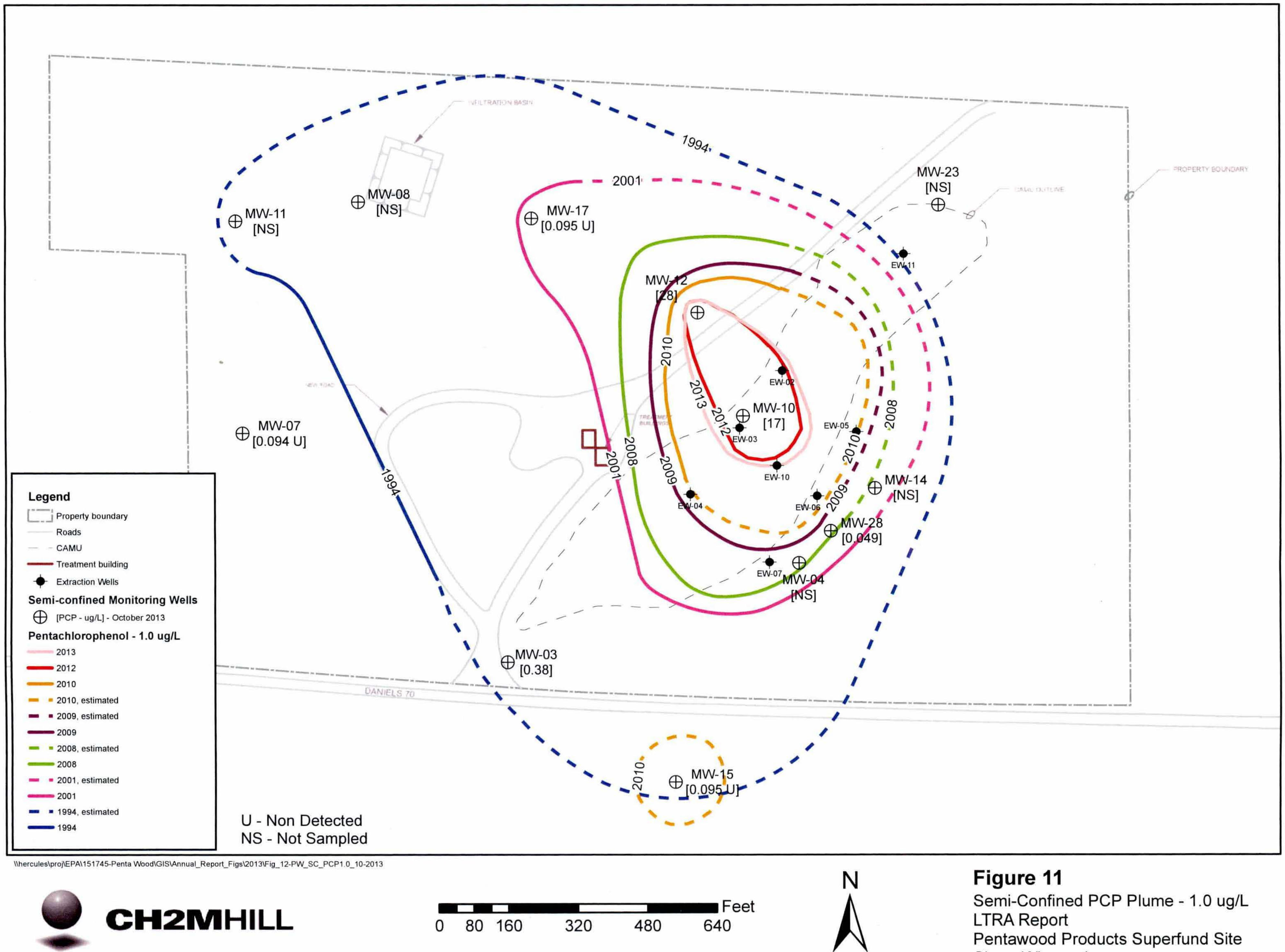
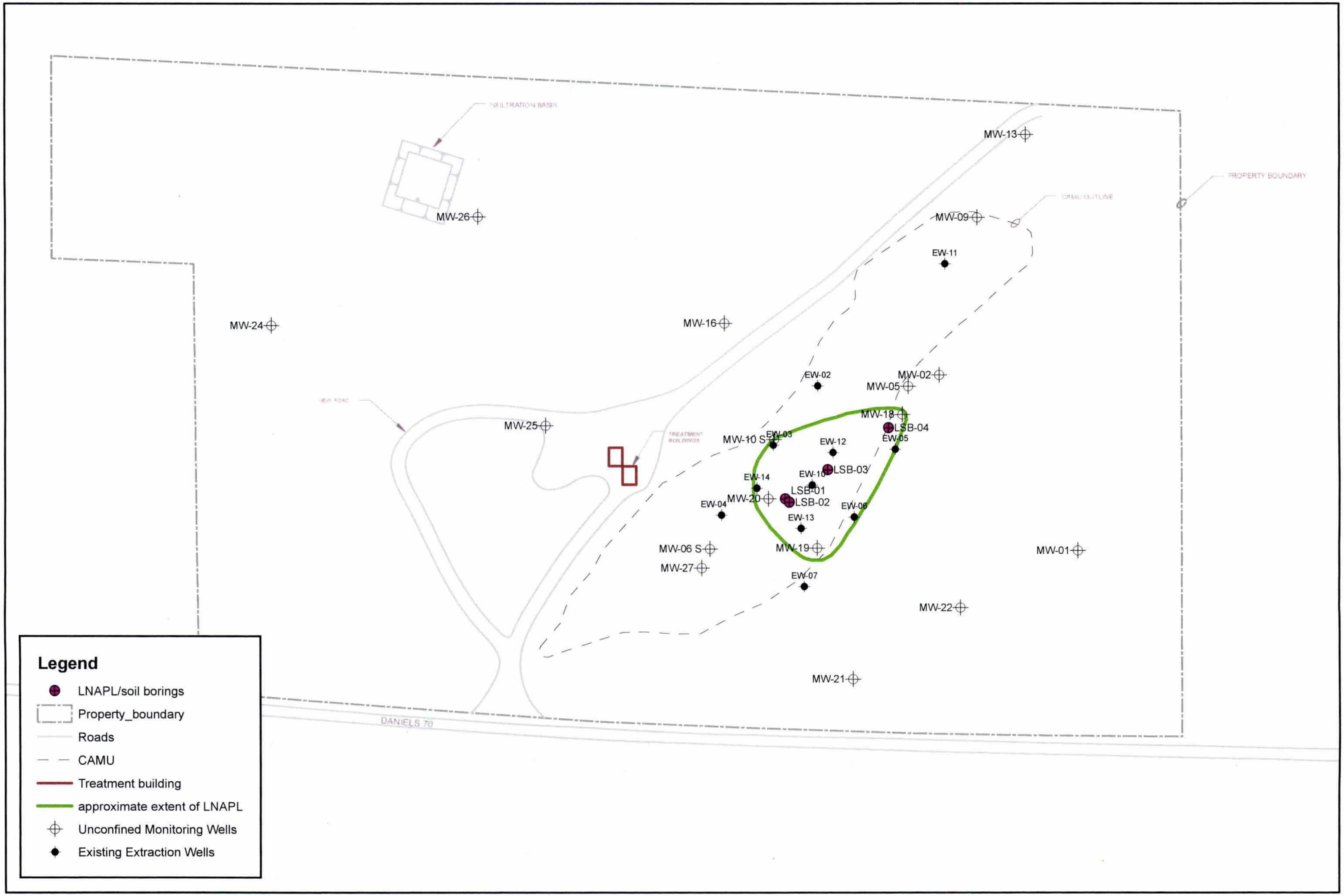


Figure 11
Semi-Confined PCP Plume - 1.0 ug/L
LTRA Report
Pentawood Products Superfund Site
Siren, Wisconsin



\\hercules\proj\EPA\151745-Penta Wood\GIS\Annual_Report_Figs\2012\Fig_1_LNAPL_soil_borings_2013 MPN 6/19/2014

CH2MHILL

Feet
0 80 160 320 480 640

N

Figure 12
LNAPL/Soil Boring Locations
LTRA Report
Pentawood Superfund Site
Siren, Wisconsin