



A Report Prepared For:

California Regional Water Quality Control Board
San Francisco Bay Region
1515 Clay Street, Suite 1400
Oakland, California 94612

Attention: Mr. Alec W. Naugle, P.G.

**SUMMARY OF REMEDIAL INVESTIGATIONS,
FEASIBILITY STUDY AND REMEDIAL ACTION PLAN
NAPA PIPE FACILITY
1025 KAISER ROAD
NAPA, CALIFORNIA**

**VOLUME 3
SITE 4 – FORMER PIPE MILL BUILDING, MAINTENANCE GARAGE,
AND PAINT STORAGE BUILDING**

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1.0 INTRODUCTION

This Volume 3 of this Summary of Remedial Investigations, Feasibility Study and Remedial Action Plan (RI/FS/RAP) has been prepared by PES Environmental, Inc. (PES) on behalf of Napa Redevelopment Partners, LLC (NRP) to address soil and groundwater affected primarily by petroleum hydrocarbons and volatile organic compounds (VOCs) at Site 4 (the Site). Site 4 is located in the west central portion of the Napa Pipe Facility, located at 1025 Kaiser Road in Napa, California (hereafter, the Facility). The Site and Facility locations are shown on Plates 1 and 2. The Facility is divided into seven environmental sites (refer to Plate 2): Site 1, Site 2/3, Site 4, Site 5, Site 6, Site 7 and Other Areas. As noted on Plate 2, Volumes 2, 4, and 5 of this RI/FS/RAP address cleanup of soil and groundwater at Site 2/3, Site 6, and Other Areas, respectively. Volume 1 provides an overview of the RI/FS/RAP for the Facility, including an executive summary.

As discussed in Volume 1, soil and groundwater investigations at Site 5, Site 7, and portions of Site 2/3 (the former Pipe Storage Areas) have indicated that these areas are absent of substantial environmental impacts. Accordingly, active remedial action measures are not anticipated for those portions of the Facility at this time. Nor are those portions of the Facility subject to on-going regulatory oversight. Site 7 is hydrogeologically upgradient of the other six sites and was previously chosen as a “background” site (James M. Montgomery, Consulting Engineers, Inc. [JMM], 1990a). Site 1 is permitted and maintained as a Class II Waste Management Unit (WMU).

As shown on Plate 3, the area of Site 4 west of the railroad tracks that bisect the Facility includes the former Pipe Mill Building (PMB), and the area east of the railroad tracks includes the former Maintenance Garage and Paint Storage Building and other small buildings in their vicinity. The Internal Coating Building and former wastewater treatment pond (WWTP) also lie within the Site 4 boundary (see Plate 2 and 3), but are not included in this Volume 3 of the RI/FS/RAP. However, data collected within the Internal Coating Building during PES’s supplemental remedial investigation are discussed in the Other Areas RI/FS/RAP (i.e., Volume 5). Data collected on the west and northwestern sides of the Internal Coating Building are discussed in this RI/FS/RAP. The western portion of the former WWTP shown on Plate 3 was clean-closed by the California Regional Water Quality Control Board – San Francisco Bay Region (RWQCB) under Waste Discharge Requirement (WDR) Order No. 89-070. Details of the WWTP excavation performed in this area by American Environmental Management Corporation are presented in the *As-Built Report for Impoundment Closure* (American Environmental Management Corporation, 1990).

The Facility contains both former and current steel pipe fabricating buildings. The tenant that leases the Fabrication Buildings and adjoining buildings, which are located in the northwestern portion of Facility (Plate 2), is currently conducting steel fabrication. The previous Facility owner (i.e., Napa Pipe Corporation, a wholly-owned subsidiary of Oregon Steel Mills, Inc.) removed equipment and materials from the remaining buildings after the purchase of the Facility by NRP.

The primary remedial action objective for Site 4 was previously defined as monitored natural attenuation (MNA) of chemicals of interest (COI) in groundwater (Montgomery Watson Harza [MWH], 2003). As indicated in MWH's MNA program proposal, MNA would proceed over a period of approximately 20 years to remediate the VOCs in groundwater at Site 4.

When remedial action plans were developed in 2003 (and continuing through 2005), the Napa Pipe Facility was an active industrial site. At this time, plans are underway to redevelop the Facility for mixed residential, commercial and open space uses; consequently the remedial action objectives are being modified via this RI/FS/RAP to remediate soil and groundwater to levels consistent with intended land uses. This report presents new data collected to further characterize Site 4, and develops and evaluates remedial alternatives for cleanup in accordance with the remedial action objectives, and recommends a cleanup alternative for Site 4.

1.1 Regulatory Context and Cleanup Level Selection

This document has been prepared in accordance with: (1) discussions between NRP representatives and staff of the RWQCB, and (2) the existing RWQCB orders for the Facility, Order No. 90-147 and Order No. R2-2205-0012. The RWQCB's Environmental Screening Levels (ESLs) (RWQCB, 2005) have been used as screening tools (with modifications discussed below) and are proposed in this RAP as cleanup levels for the Site/Facility. The ESLs are intended to provide conservative screening values such that the presence of chemicals in soil, soil gas, or groundwater at concentrations below the corresponding ESL can be assumed not to pose a significant, long-term (chronic) threat to human health and the environment.

ESLs were developed by the RWQCB to address environmental protection goals presented in the Water Quality Control Plan for the San Francisco Bay Basin (Basin Plan). These goals include:

Surface Water and Groundwater:

- Protection of drinking water resources;
- Protection of aquatic habitats;
- Protection against vapor intrusion into buildings; and
- Protection against nuisance conditions.

Soil:

- Protection of human health (direct-exposure);
- Protection against vapor intrusion into buildings;

- Protection against leaching and subsequent impacts to groundwater;
- Protection of terrestrial biota; and
- Protection against nuisance conditions.

Through the use of standard risk assessment assumptions and methodology, the RWQCB's ESLs are protective of each of the above factors. Because the soil and groundwater data for the Site were compared to the conservative and protective ESLs, and because cleanup to those levels is proposed in this RAP, a site-specific risk assessment is not included in this RI/FS/RAP¹.

The final ESLs defined in the RWQCB's ESL document were adjusted to account for two site specific factors: (1) shallow groundwater is not a current or potential source of drinking water²; and (2) groundwater gradients are relatively flat, and groundwater plumes are stable and do not show migration; consequently, there is no pathway for discharge of groundwater plumes to the aquatic resources of the Napa River. Because of these factors, ESLs protective of drinking water and aquatic habitats do not apply and the next lowest default ESLs were used³. A summary of the ESLs used for the Facility is provided in Table 1. Note that some of the constituents listed on the table were not detected at Site 4. The table is intended to be comprehensive and inclusive of all of the constituents detected in soil and groundwater at Sites 2/3, 4, 6, and the Other Areas. As discussed in Section 6.0, only a few chemicals at the Site are chemicals of concern that require soil and groundwater remediation. The final cleanup levels for these chemicals are listed in Section 6.1.4 and are the same as the ESLs for these chemicals.

In applying ESLs for the Site, since residential land use is anticipated for the Site, soils data are compared to the residential ESLs (see Table 1). Shallow soil samples (collected from less than 3 meters, about 10 feet) are compared to the Shallow Soil ESLs. Deep soil samples (greater than 3 meters) are compared to the Deep Soil ESLs.

¹ See the RWQCB's ESL website (<http://www.swrcb.ca.gov/rwqcb2/esl.htm>) for complete discussion of the ESL development process. As noted in the ESL document, additive risk due to the potential presence of multiple chemicals with similar target health effects are addressed through the use of conservative exposure assumptions and target risk levels. Also, while the ESLs do not specifically address potential synergistic effects, as noted in the ESL document, "Synergistic effects are primarily of concern for exposure to multiple chemicals at concentrations significantly higher than those expressed in the direct-exposure ESLs. Conservative target risk goals (e.g., target excess cancer risk of 10⁻⁶) and exposure parameters used to develop screening levels further reduce this concern." Note also that the bulk of the soil and groundwater contamination is from relatively low toxicity petroleum hydrocarbons with only a few carcinogenic compounds present.

² The average Facility-wide electrical conductivity (EC) of water samples collected from wells screened within the shallow and deep aquifers (see Section 2.3 for definitions of these aquifers) is 5,114 microSiemens/cm (µS/cm). By the State Water Resources Control Board Resolution 88-63 definition of sources of drinking water (i.e., water with EC less than 5,000 µS/cm), the two shallowest groundwater aquifers at the Facility are not considered sources of drinking water. As such, the non-drinking water ESLs are applicable to the Facility.

³ The specific pathway is the protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water.

As indicated on Table 1, two Shallow Soil ESLs exist for the total petroleum hydrocarbons (TPH) middle distillates and TPH residual fuels parameters. For the shallowest soils (0 to 3 feet below ground surface [bgs]⁴) the lower of the two values (100 milligrams per kilogram [mg/kg] for TPH middle distillates and 500 mg/kg residual fuels) is selected to conservatively address nuisance odor issues.

1.2 Objectives of RI/FS/RAP

The objectives of the RI/FS/RAP are to: (1) identify remediation strategies that will meet the Remedial Action Objectives (prevent adverse impact to human health and avoid further degradation of groundwater quality); and (2) present a program for remediation of soil and groundwater affected by VOCs and petroleum hydrocarbons at the Site. The RI/FS/RAP:

1. Summarizes previous environmental investigations conducted at the Site;
2. Presents the results of the supplemental remedial investigation conducted by PES in September through November 2006;
3. Summarizes the chemicals of concern, specifies the chemicals to be remediated and associated Site cleanup levels, and defines the extent of soil and groundwater media that will require remediation;
4. Identifies and evaluates applicable remedial technologies and alternatives;
5. Recommends a preferred remedial alternative; and
6. Outlines the tasks to implement the recommended remedial action.

1.3 Organization

The RI/FS/RAP includes the following sections:

Section 1.0 – Introduction. The introduction presents a general explanation of the objectives and organization of the RI/FS/RAP.

Section 2.0 – Site Background. This section provides a description of the Site, summarizes current and historical Site uses, discusses the geology and hydrogeology of the Site, and summarizes previous remedial investigations conducted at the Site.

⁴ To be conservative, samples collected from 3 to 3.5 feet bgs are considered “shallowest soil” in this report because the laboratory may have analyzed soil from the very top of the soil liner, which would be more representative of 3 feet bgs rather than 3.5 feet bgs.

Section 3.0 – Supplemental Remedial Investigation. This section presents the methodologies and results of the supplemental remedial investigation recently conducted at the Site by PES.

Section 4.0 – Nature and Extent of Contamination. This section discusses the nature and extent of soil and groundwater contamination at the Site and presents a conceptual site model (CSM).

Section 5.0 – Contaminant Fate and Transport. This section discusses contaminant fate and transport including a discussion of potential routes of migration, degradation mechanisms, and transport mechanisms.

Section 6.0 – Chemicals of Concern and Remediation Extent. This section summarizes the chemicals of concern identified during the numerous investigations conducted at Site 4, specifies the chemicals to be remediated and associated Site cleanup levels and defines the extent of soil and groundwater media that will require remediation.

Section 7.0 – Feasibility Study Scoping. This section defines the scope of the feasibility study, the applicable and relevant and appropriate requirements, the remedial action objectives, and specifies the proposed cleanup levels.

Section 8.0 – Identification and Screening of Remedial Technologies. This section identifies and screens potentially applicable technologies for remediating soil and groundwater to meet the remedial action objectives.

Section 9.0 – Development of Remedial Alternatives. This section assembles technologies into remedial alternatives, describes them, and presents costs to implement the alternative.

Section 10.0 – Evaluation of Remedial Alternatives. This section evaluates each alternative individually and comparatively, in terms of the remedial action objectives and regulatory evaluation criteria. A preferred remedial alternative is identified.

Section 11.0 – Remedial Action Plan Implementation. This section presents the procedures for implementation of the preferred remedial alternative for the Site and presents a schedule for remedial action implementation and reporting.

2.0 SITE BACKGROUND

A physical description of the Site and discussion of current and historical Site uses are presented below.

2.1 Site Description

Site 4 is located in the central portion of the Facility and is bisected by a north-south trending railroad right-of-way that is owned and operated by California Northern Railroad Corporation (MWH, 2005). The former Maintenance Garage and Paint Storage Building and various other small buildings and structures are located on the east side of the tracks and the former PMB is located on the west side of the tracks (Plate 3).

The former PMB is approximately 223,200 square feet in size and is void of equipment and materials related to its former use as a pipe fabricating facility. It includes multiple buildings that are abutted against one another and interconnected. Through time the original footprint of the PMB has been expanded. As shown on Plate 2, the former PMB consisted of Pipe Mill A, Pipe Mill B (oldest portion of building), the Forming Line Bay, the Plate Handling area and a westward extension, and the Shot Blaster Bay. All of the industrial equipment and materials have been removed from the PMB.

The westernmost portion of the PMB is currently being leased by Apex Bulk Commodities (Apex). Apex's business consists of receiving and temporarily storing crushed pumice (a vesicular volcanic rock) that they use in the manufacturing of stone products at an offsite production facility (MWH, 2005). The remainder of the PMB is vacant.

Structures, site features, and above and below ground utilities present in and around the PMB are shown on Plate 3. As shown on this plate, numerous pits that once housed large machinery used in the fabrication of steel pipe are present inside the PMB. The main utilities lines in the vicinity of the PMB are related to the sanitary and storm drain systems, and the wastewater system. For the most part, the floor of the PMB is covered by concrete or asphalt. PES observed surface staining throughout most of Pipe Mills A and B. Limited amounts of staining were seen in the western portions of the PMB. The area surrounding the PMB is mostly asphalt paved. Stained areas surrounding the PMB building were found mainly on its eastern and northern sides.

The former Maintenance Garage and Paint Storage Building are approximately 3,200 and 2,700 square feet in size, respectively. The Maintenance Garage is currently being leased to Commercial Power Sweep, Inc., a street/parking lot cleaning company. Frontier Contracting, Inc. is currently leasing the former Paint Storage Building. Utility lines related to the sanitary and storm drain systems, and the wastewater system are also present in the vicinity of these buildings. In addition, a north-south trending 66-inch diameter Napa Sanitation District (NSD) trunk sewer line is located to the east of the railroad tracks approximately 80 feet west of these buildings (see Plate 3).

2.2 Site History

According to MWH's 2005 *Phase I Environmental Site Assessment* (ESA), the existing north-south railroad corridor that cuts through the Facility and bisects Site 4 was constructed

sometime prior to 1905 and exists today in its original location (MWH, 2005). Summarized in the bullet list below is a summary of the Site 4 ownership and operational history obtained from Montgomery Watson's (MW's) *Site 4 Characterization and Remedial Action Plan* report (MW, 2000), and other sources.

- **Late 1940s** – Basalt Rock Company pipe mills built. The portion of Site 4 east of the railroad tracks was unused;
- **Early to Mid 1950s** – Buildings on the east side of the railroad tracks (i.e., Maintenance Garage, Paint Storage Building, etc.) constructed. A 7,500-gallon gasoline underground storage tank (UST) and a 1,000-gallon diesel UST, and the WWTP were also installed during this period of time (see Plate 3 for the location of these former site features);
- **1955** – Kaiser Steel purchases the entire Facility from Basalt Rock Company;
- **1958** – The WWTP reached its greatest extent of approximately 100,000 square feet. At this time, the eastern extent of the WWTP was within about 200 feet of the property boundary (MW, 1990a). The WWTP was originally used to hold process water for evaporation;
- **1966** – NSD installs a trunk line through Site 4;
- **1967** – The WWTP is reduced in size by 25% because the Facility began discharging process water to the NSD trunk line;
- **Late 1986 to 1987** – USTs at Site 4 investigated and removed. Replaced with clean backfill. The removal of the USTs is discussed in more detail in Section 2.5 (i.e., Summary of Interim Remedial Actions);
- **October 1987** – Gilmore Steel (now Oregon Steel Mills) purchased the entire Facility from Kaiser Steel, which ceased manufacturing operations by the end of 1986 and filed for bankruptcy in 1987. Production resumed in October 1987 through Napa Pipe Corporation (NPC) (at the time, a wholly owned subsidiary of Gilmore Steel);
- **1989** – NPC installs a wastewater treatment plant and ceased discharge to the WWTP;
- **1990** – WWTP clean-closed under WDR Order No. 89-070. (WDR Order No. R2-2005-0012, which was adopted at a RWQCB meeting on April 20, 2005, rescinded Order No. 89-070.);
- **2004** – NPC operations were idled in July 2004. The decision to permanently close the Facility was made in December 2004. Cleanup and restoration work at the Facility was completed in February, March, and April 2005; and

- **December 2005** – Facility purchased by NRP. NPC leases portions of the Facility, including the PMB, through September 2006. Equipment dismantling and cleanup operations in the former PMB continued through September 2006.

The former Maintenance Garage was historically used to service the motorized vehicles that operated at the Facility (MW, 2000). According to MWH's *Phase I ESA* (MWH, 2005), the former Paint Storage Building has historically been used as a combined equipment storage and hazardous materials/hazardous waste staging and storage area. Activities in and around these buildings included the storage and/or use of solvents and oils.

Equipment and processes involved in the operations at the former PMB are summarized on the diagram included in Appendix A. As shown on this diagram and Plate 2, the westernmost portion of the PMB was used for the storage of steel plates prior to sending them along the Forming Line Bay. Hydraulically operated "U" and "O" presses along the Forming Line Bay shaped the steel plates into cylindrical pipes, which were then sent to the pipe washer before they were moved into the main PMB. Once in the main PMB, the pipe passed through face mills and internal and external welders. The pipe then continued eastward through the building, where it passed through a hydraulic expander for stressing by water pressure, and past quality assurance/quality control activities and inspections, and weigh stations before emerging through the eastern portion of the building near the railroad tracks.

According to MWH's *Phase I ESA* (MWH, 2005) an approximately 45- by 50-foot pit is present in Pipe Mill B that reportedly originally served as a "pickling" pit during the Kaiser operational period. According to NPC personnel interviewed as part of the Phase I ESA, the pickling pit contained acid that cleaned the surface of the pipe.

Also, two pits in the northeastern portion of the PMB that are filled with soil (see Plate 3) were formerly used as pipe cleaning pits (personal communication [2006] with Jim Swindle, who has worked at the Facility since the mid-1960s). According to Mr. Swindle, hot pressurized water was used to clean the pipe. Mr. Swindle also indicated that prior to revamping the equipment in the PMB in the late 1960s, diesel engines were used to run the machinery.

2.3 Geology and Hydrogeology

The following sections discuss the Facility-wide and Site 4-specific geology and hydrogeology. Some of the information presented in this section was obtained from MW's *Site 4 Characterization and Remedial Action Plan* report (MW, 2000).

2.3.1 Facility-Wide Hydrostratigraphy

Hydrostratigraphic units present at the Napa Pipe Facility include, from youngest (structurally shallowest) to oldest (structurally deepest), fill, younger alluvium, older alluvium, and the bedrock volcanics (MW, 2000). These units are described below.

2.3.1.1 Fill

According to MW, fill material placed in many low-lying areas along the Napa River floodplain have ranged from dredging spoils to imported engineered fill (MW, 2000).

2.3.1.2 Younger Alluvium

Younger alluvium is characterized as a thin veneer of unconsolidated clay, silt, sand, and gravel that locally may yield water to wells if a sufficient thickness of the unit is saturated (Kunkel and Upson, 1960).

2.3.1.3 Older Alluvium

The older alluvium overlies the bedrock volcanics and is characterized by poorly sorted mixtures of clays, silts, sands, and gravels. A hardpan (cemented) horizon is commonly found in the uppermost part of this unit. Regionally, the older alluvium yields good quality water and is considered a source of potable groundwater (Kunkel and Upson, 1960).

2.3.1.4 Bedrock Volcanics

Tuff, breccia, and agglomerate, with locally interbedded volcanic flows characterize the bedrock volcanics. Depth to bedrock beneath the Facility is greater than approximately 380 feet bgs. Aquifers within tuff and breccia zones are usually confined and typically yield good quality water; wells completed in these zones are used for domestic, agricultural, and industrial water supply (Kunkel and Upson, 1960).

2.3.2 Site-Specific Hydrogeology

Site-specific geologic and hydrogeologic information was compiled based on data obtained during previous remedial investigations, the Facility-wide groundwater monitoring program (see Section 2.4), and PES's investigations conducted in September through November 2006 (discussed in Section 3.0). Lithologic logs for PES's investigations are included in Appendix B.

Plates 4 and 5 are hydrogeologic cross sections A-A' and B-B'; the locations of these cross sections relative to the PMB are shown on Plate 3. Geologic cross sections prepared by MW as part of the *Site 4 Characterization and Remedial Action Plan* report (MW, 2000) are included in Appendix C.

Lithologic logs and monitoring well completion diagrams from previous Site 4 investigations are included in Appendix D. Appendix D also includes lithologic logs for some of the borings completed during geotechnical investigations associated with various expansions of the PMB. The geotechnical lithologic logs included in this appendix are the ones included on cross

sections A-A' and B-B' (Plates 4 and 5, respectively). The sources for the geotechnical lithologic logs are referenced on Plate 3.

MW previously identified three hydrostratigraphic units in the vicinity of the Site 4 (MW, 2000). From uppermost (youngest) to lowermost (oldest), these units are:

- Fill Unit;
- Silt/Clay Unit (Younger Alluvium); and
- Partially Cemented Silt/Sand Unit (Older Alluvium).

The results from PES's September through November 2006 investigations confirmed the presence of these units at the Site. The following sections describe each of these units.

2.3.2.1 Fill Unit

The fill is the uppermost unit encountered at the Site and is heterogeneous. As shown on the cross sections (Plates 4 and 5, and Appendix C), the thickness of the fill varies across Site 4. In the portion of the Site east of the PMB the fill material is generally less than 4 to 7 feet thick, except in the vicinity of the former WWTP where the excavation backfill material is approximately 9 feet thick.

Fill material beneath and in the vicinity of a majority of the PMB is generally at least 6 feet thick and in many places thicker. However, fill thicknesses in the northeast portion of the PMB are generally less than 5 feet thick. Borings drilled adjacent to machinery pits within the PMB suggest that the fill thickens in these area (see Plates 4 and 5). As shown on cross sections A-A' and B-B', fill thicknesses of up to 13 to 14 feet have been found near the machinery pits. A possible explanation is that excavations conducted during the installation of the pits removed the upper portions of the underlying silt/clay unit and then fill material was placed beneath and around the pits during their construction.

The fill unit at Site 4 can be characterized as a heterogeneous mixture of predominantly sand and gravel with various proportions of silt and clay. Typically, the fill is varying shades of gray and brown, dry to wet (almost exclusively water-bearing in its lower portions), loose to dense. Debris such as wood chunks, burnt wood, concrete, steel, and brick was found in the fill unit in some of the borings and wells (e.g., borings GP-16 and PM64, and well MW-63) completed outside the northeastern portion of the PMB. Thick heavy oil was also encountered in this area in the lowermost portions of the fill unit in borings PM20 and PM64. As shown on cross sections A-A' and B-B' (see Plates 4 and 5), separate-phase product or hydrocarbon sheens were encountered in the fill unit and in the uppermost portions of the silt/clay unit in various places within the PMB. The presence of separate-phase floating product or hydrocarbon sheens in borings and wells completed at Site 4 is discussed in detail in Section 4.2.1 of this RI/FS/RAP.

2.3.2.2 Silt/Clay Unit

The silt/clay unit, which correlates with the younger alluvium, is located stratigraphically below the fill unit and is underlain by the partially cemented silt/sand unit (i.e., the older alluvium). As shown on cross section B-B' (Plate 5), the silt/clay unit is interpreted to pinch out in the vicinity of the railroad tracks on the east side of the PMB and is again present east of the railroad tracks in the vicinity of the former Maintenance Garage and Paint Storage Building (see cross sections in Appendix C). Based on a review of topographic maps showing this area prior to construction of the PMB, it appears that a topographic high (i.e., a small hill) was present in this area that prevented the deposition of fine, organic rich, marshland silts and clays.

The silt/clay unit is heterogeneous, mottled blue/greenish gray to black (organic rich), moist to wet, and soft to medium stiff. The unit contains plant fragments, rootlets, and wet fibrous peat stringers of varying thicknesses. Also, organic clay lenses and peat horizons, and clayey to silty sand lenses or layers are present in this unit. However, the silty sand lenses appear to be mostly confined to the portion of the Site east of the railroad tracks. In places, this unit grades to a soft to medium stiff, clayey to sandy silt. In general, the interbedded sand lenses and wet fibrous peat stringers are the groundwater producing zones in this unit.

MW interpreted the silt/clay unit as floodplain and tidal marsh deposits and the interbedded sand stringers as likely representing deposits by small stream channels that drained the area (MW, 1993).

2.3.2.3 Partially Cemented Silt/Sand Unit

This unit is located stratigraphically below the silt/clay unit and correlates with the older alluvium. The unit typically consists of weakly to moderately cemented silt and sand layers interbedded with softer silt and clay. In places, the silts and clays contain varying amounts of sand and gravel. Lenses of non-cemented sands and gravels are also present in the unit. The non-cemented sand and gravels within the unit are generally water-bearing and were considered by MW to comprise the Deep Groundwater Zone.

As shown on the cross section B-B' (see Plate 5), the depth to the top of the partially cemented silt/sand unit is approximately 4 to 5 feet bgs east of the PMB in the vicinity of the railroad tracks where the silt/clay unit is not present (see discussion above). The depth to this unit increases away from this area. As indicated on the cross sections in Appendix C, the depth to the unit is just over 20 feet bgs in the portion of the Site east of the railroad tracks and approximately 25 feet bgs throughout most of the PMB and its surroundings (see Plates 4 and 5).

As discussed by MW and confirmed during the supplemental remedial investigation, the uppermost several feet of the partially cemented silt/sand unit is heterogeneous, yellowish to olive brown or greenish gray, dry to moist, stiff to very stiff, commonly well cemented silt or

clayey silt (hardpan), and generally non-water bearing due to low hydraulic conductivity (MW, 2000). However, according to the geotechnical boring B-1 presented on cross section A-A' (see Plate 4) the top of this unit in the southwestern portion of the PMB consists of sands and gravels that are water-bearing (see lithologic log for boring B-1 in Appendix D).

2.3.3 Site 4 Groundwater Occurrence and Flow Directions

The occurrence of groundwater beneath Site 4 can generally be divided into two groundwater zones:

- The Shallow Groundwater Zone (beginning approximately 2 to 6 feet bgs) – Encompasses water-bearing soils within the fill and silt/clay units; and
- The Deep Groundwater Zone (beginning approximately 20 to 25 feet bgs) – Encompasses water-bearing soils within the partially cemented silt/sand unit.

As interpreted by MW (MW, 2000) a distinct aquitard (partially cemented hardpan silts and clays) is present in the eastern portion of Site 4 as shown on the cross sections in Appendix C. However, as discussed above and shown on cross section A-A' (see Plates 4), this silt to clay hardpan is not present at the top of the partially cemented silt/sand unit in the southwestern portion of the PMB. A discussion of the occurrence of groundwater in each zone is discussed below.

2.3.3.1 Shallow Groundwater Zone

Water level measurements at Site 4 are conducted on a semiannual basis as part of the Facility-wide groundwater monitoring program discussed in Section 2.4.6 of this RI/FS/RAP.

Groundwater within the Shallow Zone at Site 4 is unconfined, and generally occurs at a depth of approximately 2 to 6 feet bgs; water levels vary seasonally. As expected, groundwater elevations were generally higher in the May 16, 2006 water level measurement event (end of wet season) than in the October 3, 2006 event (end of dry season). The exception is in the vicinity of well MW-17 and MW-18 where water levels were slightly higher (up to 0.23 feet higher) in the October 3, 2006 event. Water levels in the remainder of Site 4 generally ranged from 0.7 to 1.25 feet higher in the May 16, 2006 event.

Flow directions in the Shallow Groundwater Zone at Site 4 are shown on the potentiometric surface maps for May 16, 2006 and October 3, 2006 (see Plates 6 and 7, respectively). These water-level measurement events are intended to show variations in groundwater elevation and flow direction between the end of the wet and end of dry seasons, respectively. The water level survey data for the May 16, 2006 and October 3, 2006 events are summarized on Tables 2 and 3, respectively.

Based on these potentiometric surface maps, a review of historic water-level data for Site 4, and discussions presented in the *Groundwater Monitoring Program Report Number 67, April – June 2006, Former Napa Pipe Facility, 1025 Kaiser Road, Napa, California* report (PES,

2006a), the primary flow direction in the Shallow Groundwater Zone at Site 4 is generally in a southwest to northwest direction, toward the Napa River.

The horizontal gradients for the May 16, 2006 measurement event were approximately:

- 0.004 feet/foot (ft/ft) on the east side of the railroad tracks in the vicinity of monitoring wells MW-17 and MW-15; and
- 0.011 ft/ft on the west side of the railroad tracks in the vicinity of monitoring wells MW-58 and MW-65.

The horizontal gradients for the October 3, 2006 measurement event were approximately:

- 0.013 ft/ft on the east side of the railroad tracks in the vicinity of monitoring wells MW-17 and MW-15; and
- 0.009 ft/ft on the west side of the railroad tracks in the vicinity of monitoring wells MW-58 and MW-65.

2.3.3.2 Deep Groundwater Zone

Groundwater in the Deep Zone at Site 4 is encountered in coarser-grained sand and gravel lenses within the partially cemented silt/sand unit. Two Deep Groundwater Zone wells, wells DW-2 and DW-6, are located at Site 4 on the east side of the railroad tracks (see Plate 3 for well locations). Well DW-2 is screened at 32 to 37 feet bgs and well DW-6 is screened 31 to 36 feet bgs (see Tables 2 and 3). The groundwater in each well is confined, rising to approximately 2 to 4 feet bgs. Potentiometric surface maps have not historically been prepared for the zone, but MW (MW, 2000) indicated “the Deep Zone may be inferred to have a similar groundwater gradient direction as the Shallow Zone because the two zones share a similar depositional environment.”

MW (MW, 2000) used co-located wells MW-17 (Shallow Zone) and DW-6 (Deep Zone) to assess the vertical gradient at Site 4 on the east side of the railroad tracks. The vertical gradient between the two zones was calculated by dividing the difference in water level elevations measured for these wells in September 1998 by the difference in well screen midpoint elevations. The calculated gradient between these zones was 0.0165 ft/ft downward. Using the same method and wells to calculate the vertical gradients for the most recent monitoring events, an upward gradient of 0.0332 ft/ft for May 2006 and a downward gradient of 0.0036 ft/ft for October 2006 were obtained. The most recent data suggests that both upward and downward vertical gradients exist in the vicinity of this well cluster. The vertical gradient appears to change seasonally with an upward gradient during the wet season and downward gradients during the dry season.

2.3.4 Aquifer Testing

Results for limited aquifer testing conducted at Site 4 are presented in the *Site 4 Characterization and Remedial Action Plan* (MW, 2000). The aquifer testing involved short-duration semi-quantitative pumping tests at shallow wells MW-4, MW-15, MW-17, and MW-34 located east of the railroad tracks (see Plate 3). However, the pumping test for well MW-34 could not be completed because the well dewatered. In summary, results of the pumping tests indicated the following hydraulic conductivities:

- **MW-4 and MW-15:** 1.1×10^{-3} to 1.3×10^{-3} centimeters per second (cm/sec) range; and
- **MW-17:** 1.6×10^{-3} cm/sec.

Historically, MW also calculated an approximate groundwater flow velocity for the Shallow Groundwater Zone of 7.2×10^{-5} cm/sec (i.e., 0.2 feet per day or 72 feet per year) using a groundwater gradient of 0.015 ft/ft, an average hydraulic conductivity of 1.2×10^{-3} cm/sec, and an effective porosity of 0.25. They indicated that this approximate groundwater flow velocity was considered an upper range for Site 4 and that the actual hydraulic conductivities are likely much lower because the pumping tests conducted on the Shallow Groundwater Zone wells did not correct for inputs to the well casing from the filter pack.

Using the same average hydraulic conductivity of 1.2×10^{-3} cm/sec and effective porosity of 0.25, and the horizontal gradients in the vicinity of monitoring wells MW-17 and MW-15 for the May 16 and October 3, 2006 measurement event (see Section 2.3.3.1), the current flow velocity for the Shallow Groundwater Zone are estimated to be:

- 1.92×10^{-5} cm/sec (approximately 0.05 feet per day or 18 feet per year) for the May 16, 2006 measurement event; and
- 6.24×10^{-5} cm/sec (approximately 0.18 feet per day or 66 feet per year) for the October 3, 2006 measurement event.

2.4 Previous Investigations

The following section discusses the previous investigations conducted at Site 4. Pertinent tables and plates associated with these investigations are presented in the appendices referenced below. The results for each investigation are compared to the applicable residential ESLs discussed in Section 1.0 and presented on Table 1. The TPH soil results and selected groundwater results from these investigations, along with the current data presented in Section 3.0, are incorporated into the nature and extent of contamination discussion presented in Section 4.0. The results of these investigations are also discussed in Section 6.0 (Chemicals of Concern and Remediation Extent).

The analytical method for the TPH results discussed in Sections 2.4.1 and 2.4.2 did not specifically identify the type of petroleum hydrocarbon; the reported concentration for these

results are for TPH as diesel (TPH-d) and TPH as motor oil (TPH-mo) combined. As indicated in Sections 2.4.1 and 2.4.2, the borings associated with these TPH results, with the exception of boring BH-3 (located outside the northeast portion of the former PMB; see Plate 3), are located in the portion of the Site east of the railroad tracks where the TPH constituent of concern has previously been identified as TPH-d (MW, 2000). Therefore, the TPH results discussed in Sections 2.4.1 and 2.4.2 are compared to the ESLs for diesel (i.e., TPH middle distillates; see Table 1), which are more conservative than the ESLs for motor oil (i.e., TPH residual fuels; see Table 1).

The following information is provided to clarify which ESLs presented on Table 1 are used as a screening tools for the various petroleum hydrocarbon soil and groundwater results discussed below:

- TPH gasoline ESLs are used for TPH as gasoline (TPH-g) results;
- TPH middle distillates ESLs are used for TPH-d/TPH-mo combined and TPH-d results; and
- TPH residual fuels ESLs are used for TPH-mo and Oil & Grease (O&G) results.

2.4.1 Soil and Groundwater Testing at the Kaiser Steel Corporation Pipe Mill and Fabrication Facility in Napa California (1987)

In September 1987 JMM conducted a Facility-wide soil and groundwater investigation for Kaiser Steel Corporation. The results of this investigation are documented in the *Report of Soil and Groundwater Testing at the Kaiser Steel Corporation Pipe Mill and Fabrication Facility in Napa California* (JMM, 1987). A small portion of the investigation was conducted in what is now called Site 4.

As part of the investigation, seven soil borings (BH-3, BH-4, BH-5, BH-6, BH-19, BH-20, BH-21; see the plate in Appendix E, and Plate 3 for boring locations) were advanced to depths ranging between 6 and 30 (thirty) feet bgs. The lithologic logs for these borings are included in Appendix D. BH-3 lies on the western side of the railroad tracks, outside the northeast portion of the former PMB. The remaining borings are scattered around the buildings on the eastern side of the railroad tracks.

Two soil samples were collected from borings BH-3 and BH-6 and only one from the remaining borings. Grab groundwater samples were collected from borings BH-3, BH-4, BH-5, BH-6, and BH-20. Soil and groundwater samples collected from boring BH-3, BH-4, BH-5, and BH-6 were analyzed for VOCs, TPH⁵, pH, and California Administrative Manual (CAM) 17 metals (i.e., Title 22 California Code of Regulation metals) including hexavalent chromium. The soil samples from borings BH-19, BH-20, and BH-21, and groundwater

⁵ Reported as TPH-d and TPH-mo combined.

sample from boring BH-20 were analyzed for VOCs and semivolatile organic compounds (SVOCs). The soil and groundwater analytical results are included in Appendix E.

In summary, TPH was detected in soil borings BH-3, BH-4, BH-5, and BH-6 at a maximum concentration of 71 mg/kg; these concentrations are below ESLs. TPH was also detected at concentrations of 1.7, 1.5, 7.0, and 0.8 milligrams per liter (mg/l) in the groundwater samples collected from borings BH-3, BH-4, BH-5, and BH-6, respectively. The highest concentration of 7.0 mg/l is the only detection above the ESL. The TPH soil results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

A number of VOCs were detected in the groundwater samples collected from borings BH-3, BH-4, BH-5, BH-6, and BH-20 (see the tables in Appendix E). However, none of the compounds were detected above their corresponding ESLs.

The only VOC detected in soil was toluene at 60 micrograms per kilogram ($\mu\text{g}/\text{kg}$) in boring BH-3 at 7 feet bgs and boring BH-6 at 5 feet bgs. Both of these detections were below the ESL for toluene (100 mg/kg). Laboratory results for these samples are included in Appendix E.

No SVOCs were detected in groundwater samples collected during this sampling event. SVOCs were detected in the soil sample collected from boring BH-21. This boring contained low levels of bis(2-ethylhexyl)phthalate, chrysene, fluoranthene, phenanthrene, and pyrene. None of the chemicals detected exceeded their corresponding ESL values.

The only metal detected above its corresponding ESL was hexavalent chromium in boring BH-3 at 7 feet bgs. None of the metals detected in groundwater exceeded their corresponding ESL values. The metals results for this investigation are summarized on tables included in Appendix E.

2.4.2 Site Investigation Report for the Napa Pipe Corporation Facility (1990)

From August to November of 1989 JMM conducted an extensive Facility-wide soil and groundwater investigation for Napa Pipe Corporation. The results of this investigation are documented in the *Site Investigation Report for the Napa Pipe Corporation Facility* (JMM, 1990a). As part of this investigation, seven soil borings (4A, 4B, 4C, 4G, 4H, 4I, and 4J; see the plate in Appendix F and Plate 3 for boring locations) were drilled on the east side of the railroad tracks in the vicinity of the Internal Coating Building⁶ (i.e., former Midwestern Pipeline Services Building), the Maintenance Garage, and Drum Drainage area. The lithologic logs are included in Appendix D. Samples collected from various depths in each boring ranged from 2.5 to 15 feet bgs. These samples were analyzed for VOCs, TPH⁷, and O&G.

⁶ As indicated in Section 1.0, the interior of the Internal Coating Building is discussed in the Other Areas RI/FS/RAP (Volume 5).

⁷ Reported as TPH-d and TPH-mo combined.

In summary, TPH and O&G were detected in many of the soil samples. The sample collected at 2.5 feet bgs from boring 4H had the highest detections of TPH (37,000 mg/kg) and O&G (40,000 mg/kg); these values exceed the ESLs for TPH-d (100 mg/kg) and TPH-mo (500 mg/kg), respectively. The TPH result of 430 mg/kg for the sample collected at 7 feet bgs in boring 4C also exceeded the ESL value. The TPH and O&G results are summarized on the tables in Appendix F. The TPH soil results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0. Fourteen different VOCs were detected in the 25 soil samples analyzed (see the tables in Appendix F); none of the detected VOCs exceeded its corresponding ESL value.

In an effort to determine the extent of the contamination before monitoring wells were installed, a groundwater screening program was implemented in August of 1989 by JMM. Groundwater sampling probes were advanced to depths of approximately 6 to 7.5 feet bgs at twenty-one (21) locations in the eastern portion of Site 4 (G-1 through G-12, G-14 through G-18, G-21, and G-23 through G-25; see the plate in Appendix F for locations). Locations G-4, G-5, G-17, and G-21 did not produce groundwater, and therefore were not sampled. Groundwater samples were collected from the remaining locations and analyzed for VOCs. The results of this analysis are summarized on the tables in Appendix F. In summary, samples collected from locations G-2, G-3, G-6, G-8, and G14 contained several VOCs. The highest concentrations were detected at location G-3 where chloroethane, 1,1-dichloroethane (DCA), 1,2-DCA, 1,1-dichloroethene (DCE), trans-1,2-DCE, and trichloroethylene (TCE) were detected at concentrations of 120, 1,500, 7.8, 4.1, 27, and 46 micrograms per liter ($\mu\text{g/l}$), respectively. The concentration of 1,1-DCA at this location is the only constituent detected above its ESL value.

Based on the findings of the groundwater screening program, eleven shallow wells (MW-4, MW-5, MW-14, MW-15, MW-16, MW-17, MW-18, MW-19, MW-25, MW-26, and MW-27; see Plate 3 for well locations) and one deep well (DW-2; see Plate 3 for well location) were installed. The lithologic and well completion logs for these wells are included in Appendix D. During the installation, soil samples were collected between 4 and 24 feet bgs in all of the wells except MW-4 and MW-5. All of the samples were analyzed for VOCs, and the samples from wells MW-18 and MW-19 were also analyzed for TPH and O&G. VOCs were detected in many of the samples, but none of the concentrations exceed ESL values. TPH was detected in the samples from wells MW-18 and MW-19 at 170 mg/kg and 66 mg/kg, respectively and O&G was detected at 170 mg/kg and 120 mg/kg, respectively. These concentrations are below their corresponding ESL values. The TPH soil results are incorporated into the nature and extent of contamination discussion in Section 4.0.

Groundwater samples collected from these wells were analyzed for metals, VOCs, TPH, and O&G. TPH (at 4.8 mg/l) and O&G (at 5 mg/l) were detected in well MW-19 at concentrations above ESLs. The results are summarized on tables included in Appendix F.

2.4.3 June and July 1990 Investigation

From June to July, 1990 JMM conducted a Facility-wide soil and groundwater investigation for Napa Pipe Corporation. This investigation was a follow up to the 1989 investigation discussed above. The results for this investigation are included in the *Corrective Action Plan for the Napa Pipe Mill* (JMM, 1990b). As part of this investigation, shallow monitoring wells MW-32, MW-33, MW-34, and MW-35 and deep well DW-6 were installed (see Plate 3 for well locations) at Site 4. Lithologic and well completion logs are included in Appendix D.

The only soil samples collected were from monitoring well MW-33 at depths of 6.5 and 7.5 feet bgs; the samples were analyzed for metals only. The four new monitoring wells and the deep well were included in a sampling event in July of 1990 in which groundwater samples were collected from MW-4, MW-17, MW-32, MW-33, MW-34, MW-35, DW-2 and DW-6. These groundwater samples were analyzed for VOCs.

In summary, a number of VOCs were detected in the groundwater samples collected from monitoring wells MW-4, MW-17, MW-32, and MW-34; the only detection above its corresponding ESL was 1,1-DCA in well MW-17 (see the tables in Appendix G). The remaining shallow and deep monitoring wells sampled during this event had no detections. The highest detected VOCs in the wells were as follows:

- 1,1-DCA in MW-17 at 1,200 $\mu\text{g/l}$;
- 1,1- DCE in MW-34 at 450 $\mu\text{g/l}$;
- 1,1,1-trichloroethane (TCA) in MW-34 at 200 $\mu\text{g/l}$;
- TCE in MW-17 at 61 $\mu\text{g/l}$;
- Xylenes in MW-17 at 470 $\mu\text{g/l}$; and
- Trans-1,2-DCE in MW-17 at 59 $\mu\text{g/l}$.

Metals that exceeded their corresponding ESL values in the soil samples from well MW-33 included:

- Arsenic in the 6.5 and 7.5 feet bgs samples at concentrations of 20 and 15 mg/kg, respectively; and
- Cadmium in the 6.5 and 7.5 feet bgs samples at concentrations of 11 and 7 mg/kg, respectively.

However, the only metal result greater than the estimated upper threshold values (background level) developed by MW (MW, 1990b) was arsenic at 20 mg/kg in the 6.5 feet soil sample.

The background level for arsenic is 15.3 mg/kg. The metals results table is included in Appendix G.

2.4.4 Site 4 Characterization and Remedial Action Plan (January 2000)

In June and July of 1998 MW conducted a soil and groundwater investigation at Site 4 for the Napa Pipe Corporation. The results of this investigation are documented in the *Site 4 Characterization and Remedial Action Plan* (MW, 2000).

As part of the investigation, fifteen soil borings (GP-1 through GP-15; see Plate 3 for boring locations) were advanced on the east side of the railroad tracks to characterize the extent of TPH in soil in the shallow subsurface. A limited number of soil samples from these borings were analyzed for total organic carbon (TOC) to quantify the retardation coefficients for Site 4. In addition, borings GP-16, GP-17, and GP-18 (see Plate 3) were completed on the western side of the railroad tracks (i.e., on the east side of the PMB) to characterize VOC groundwater conditions downgradient (i.e., westward) of wells MW-15 and MW-34, which had historically contained low concentrations (i.e., less than 50 $\mu\text{g}/\text{l}$) of 1,1-DCA (the predominant chlorinated VOC detected to date at Site 4). The lithologic logs for these borings are included in Appendix D. The results of this investigation are summarized on the tables and plates included in Appendix H. The tables and plates included in this appendix also summarize the TPH and VOC results from the groundwater sampling event conducted at the existing Site 4 wells in September 1998. This monitoring event is not discussed below because the current Site 4 groundwater conditions are presented in Sections 3.0 (Supplemental Remedial Investigation) and 4.0 (Nature and Extent of Contamination) of this RI/FS/RAP.

In summary, TPH-g was detected in 3 of the 4 soil samples analyzed for this constituent. The highest concentration was 670 mg/kg in the soil sample collected at 2.5 feet bgs from boring GP-10. This concentration is above the ESL for TPH-g. The concentrations of the remaining two TPH-g detections were less than 10 mg/kg. TPH-d was detected in each of the 15 soil samples analyzed for this constituent. Five of the results were at concentrations above the TPH-d ESL; concentrations ranged from 16 to 930 mg/kg. The highest concentration of 930 mg/kg was detected in the soil sample from boring GP-14 at 2.5 feet bgs. TOC concentrations ranged from 5,200 to 52,800 mg/kg. The TPH-d soil results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

The groundwater samples collected from borings GP-17 and GP-18 contained 1,1-DCA at concentrations of 1,300 and 4,300 $\mu\text{g}/\text{l}$, respectively, and 1,1-DCE at concentrations of 320 and 1,000 $\mu\text{g}/\text{l}$, respectively. The ESLs for 1,1-DCA and 1,1-DCE are 1,000 and 6,300 $\mu\text{g}/\text{l}$, respectively. VOCs were not detected in the groundwater sample collected from boring GP-16.

2.4.5 Final Addendum - Site 4 Characterization/ Remedial Action Plan (November 1999 and June 2000)

In November 1999 and June 2000 the following investigations were conducted at Site 4:

- Two (2) new monitoring wells (MW-58 and MW-59; see Plate 3 for well locations) were installed in the area west of the railroad tracks in November 1999 to evaluate groundwater conditions on the west side of the railroad tracks where elevated VOCs were detected in groundwater in the investigation discussed above. The wells were subsequently sampled in December 1999, February 2000, May 2000, and December 2000.
- Grab groundwater samples were collected from borings GP-19 through GP-23 (see Plate 3 for boring locations) in June 2000 to evaluate the extent of elevated VOCs found in Well MW-58.

The results of these investigations are documented in the *Final Addendum - Site 4 Characterization/ Remedial Action Plan* (MWH, 2001).

Borings GP-19 through GP-23 were advanced to depths ranging between 16 and 17 feet bgs. The lithologic logs for these borings are included in Appendix D. Grab groundwater samples were collected from the borings and analyzed for VOCs. The results of this investigation are summarized on the tables and plates included in Appendix I. Monitoring wells MW-58 and MW-59 and ten other wells were also sampled for VOCs. The monitoring well analytical results are also included in Appendix I.

In summary:

- Groundwater collected from well MW-58 contained chloroethane, 1,1-DCA, and 1,1-DCE at concentrations above ESLs in each of the monitoring events listed above, and vinyl chloride above its ESL in the first two monitoring events. The following concentrations ranges were detected for these VOCs during these monitoring events: nondetect (less than 1,000 $\mu\text{g/l}$) to 4,500 $\mu\text{g/l}$ for chloroethane; 13,000 to 24,000 $\mu\text{g/l}$ for 1,1-DCA; 6,500 to 22,000 $\mu\text{g/l}$ for 1,1-DCE; nondetect (less than 0.5 $\mu\text{g/l}$) to 2,500 $\mu\text{g/l}$ for vinyl chloride;
- VOCs were either not detected or detected at concentrations below 11 $\mu\text{g/l}$ in well MW-59 during the sampling events indicated above. None of the detected concentrations are above their ESL values; and
- 1,1-DCA was detected in borings GP-19 and GP-23 at concentrations of 130 $\mu\text{g/l}$ and 2.0 $\mu\text{g/l}$, respectively. 1,1-DCE was detected in borings GP-19 and GP-23 at concentrations of 130 $\mu\text{g/l}$ and 2.0 $\mu\text{g/l}$, respectively. None of these concentrations are above their respective ESLs. VOCs were not detected in groundwater from borings GP-20 through GP-22.

Based on these results, MWH concluded that elevated concentrations of VOCs in groundwater in the vicinity of MW-58 were likely from a separate source compared to those observed in the eastern portion of the Site. They also indicated that the extent of the high concentrations of VOCs found in MW-58 “appear to be restricted to the area immediately in front of the finishing mills.”

2.4.6 Site 4 Monitored Natural Attenuation Program Implementation and Results of Initial Sampling Event (April 2003)

In April of 2003 MWH conducted a soil and groundwater investigation for Napa Pipe Corporation. The results of this investigation are documented in the *Site 4 Monitored Natural Attenuation Program Implementation and Results of Initial Sampling Event* report (MWH, 2003). This investigation involved the following work:

- Four soil borings (GP-24 through GP-27; see Plate 3 for boring locations) were advanced to depths ranging between 10 and 16 feet bgs to further assess the extent of chlorinated VOCs in groundwater on the west side of the railroad tracks and to evaluate if there was a continuing source of VOCs in the shallow soils. One soil sample and one groundwater sample from each boring was tested for VOCs;
- Two soil borings (GP-28 and GP-29; see Plate 3 for boring locations) were advanced to evaluate potential subsurface utility conduits. Boring GP-28 was advanced near the water and fiber optic utility lines along the railroad tracks and boring GP-29 was advanced on the western side of the NSD trunk line. A groundwater sample was collected from each boring and tested for VOCs; and
- Wells MW-60 through MW-65 (see Plate 3 for locations) were installed on the eastern side of the PMB as part of the MNA program.

The lithologic logs for the borings and monitoring wells are included in Appendix D. The analytical results from this report are presented on the tables and plates included in Appendix J.

In summary, VOCs were detected in three of the four soil samples from this sampling event. Acetone was detected in boring GP-25 at 3.5 feet bgs, in boring GP-26 at 3.5 feet bgs, and in boring GP-27 at 3.5 feet bgs at concentrations of 82 $\mu\text{g}/\text{kg}$, 20 $\mu\text{g}/\text{kg}$, and 42 $\mu\text{g}/\text{kg}$, respectively. Methylene chloride was detected in boring GP-25 at 3.55 feet bgs and boring GP-27 at 3.5 feet bgs at concentrations of 19 $\mu\text{g}/\text{kg}$ and 25 $\mu\text{g}/\text{kg}$, respectively. 2-butanone was also detected in boring GP-25 at 3.5 feet bgs at a concentration of 19 $\mu\text{g}/\text{kg}$. None of these concentrations exceed their respective ESL values.

A few VOCs were detected above their respective ESL values in the grab groundwater samples collected from borings GP-25 and GP-26. The sample collected from boring GP-25 contained 1,1-DCA (5,900 $\mu\text{g}/\text{l}$) and chloroethane (1,400 $\mu\text{g}/\text{l}$) above their respective ESL values, and

the sample collected from boring GP-26 contained 1,1-DCA (1,200 $\mu\text{g/l}$) and vinyl chloride (65 $\mu\text{g/l}$) above their respective ESL values.

During the initial sampling event for the MNA program, 23 of the 25 wells that existed on Site 4, including the six wells installed during this phase of work, were sampled to assess the extent of the VOC contamination. High concentrations of 1,1-DCE and 1,1-DCA were found on the eastern side of the PMB. In addition, elevated concentrations of methyl-tert-butyl ether (MTBE) were found in the vicinity of the former Maintenance Garage. The results from this sampling event are summarized on the tables presented in Appendix J.

Regarding the migration of the groundwater plumes and data trends on the east and west sides of the railroad tracks, MWH indicated that:

- Historical data indicates that the concentrations of primary compounds of concerns (1,1,1-TCA and TCE) on the eastern side of the railroad tracks have been decreasing since 1991; and
- The plume on the west side of the track appears to be stable and undergoing reductive dehalogenation. They indicated that wells MW-65 and MW-63 had further delineated the plume and results from these wells showed that the plume was not expanding west into the pipe mills or north of Site 4⁸. MWH also indicated that data collected since 1999 in well MW-58 showed a decrease in the concentration of the primary compounds of concern (1,1,1-TCA).

2.4.7 Phase II Site Investigation by Shaw Environmental Inc.

In 2005, Shaw Environmental Inc. (Shaw) conducted a Phase II site investigation of the Napa Pipe Facility prior to NRP's acquisition of the Facility. The results were documented in the *Phase II Site Investigation at Napa Pipe Facility, 1025 Kaiser Road in Napa, CA* report (Shaw, 2005).

As part of the Phase II investigation, eight soil borings (PM-01, PM-02, PM-03, PM-04, PM-05, PM-06, PM-07, PM-09; see the plate in Appendix K and Plate 3 for boring locations) were drilled within and around the PMB. Soil borings PM-01, PM-03, PM-05, and PM-06 and were completed outside the PMB, while the rest of the borings were completed inside of the building. A ninth boring (PM-08) was attempted inside the PMB but refusal was encountered at a 1.5 feet bgs. Lithologic logs for the borings are included in Appendix D.

A total of eighteen soil samples were collected from the borings at depths between 2 and 11 feet bgs. In addition, one grab groundwater sample was collected from each boring. Groundwater samples were also collected from monitoring well MW-65 and a sump near the office. The soil and grab groundwater samples were analyzed for TPH-d, TPH-mo, VOCs,

⁸ Subsequent groundwater sampling conducted by PES (see Section 3.0) identified new areas of VOC contamination in groundwater that appear to be from other sources within the PMB.

polychlorinated biphenyls (PCBs), and polynuclear aromatic hydrocarbons (PAHs). The groundwater sample from sump was analyzed for TPH only, and MW-65 was analyzed for PCBs only. The analytical results tables for the soil and groundwater samples are included in Appendix K.

In summary, soil samples taken from borings PM-02 at 4 feet bgs and PM-07 at 3 and 8 feet bgs contained concentrations of TPH-d and TPH-mo above their respective ESL values. The only VOC to exceed its ESL value in soil was 1,1-DCA in boring PM-02 at 4 feet bgs. No PCBs or PAHs were detected in the soil samples. TPH-d (in borings PM-02, PM-03, PM-07 and PM-09), TPH-mo (in borings PM-02, PM-07 and PM-09), and vinyl chloride (in boring PM-02) were the only constituents in groundwater that were above their respective ESL values. The TPH soil results, and the TPH and VOC groundwater results from this investigation are incorporated into the nature and extent of contamination discussion presented in Section 4.0.

2.4.8 Facility-Wide Groundwater Monitoring Program

A Facility-wide groundwater monitoring program has been ongoing at the Napa Pipe Facility since April 1989. The scope of the sampling has been revised and updated with approval from the RWQCB several times since its inception. To date, sixty-eight monitoring events have been conducted at the Facility (PES, 2007). Facility-wide groundwater monitoring events are conducted semi-annually during the second and fourth quarters of each year. Water-level measurements are collected from all monitoring wells during these events, but only selected wells are sampled. Currently, 48 of the 71 monitoring wells that exist at the Facility are sampled as part of this program; some of these wells are sampled semi-annually and others annually. Groundwater sample analyses vary, but one or more of the following analyses are performed on the samples: VOCs; TPH-d; TPH-extractables (TPH-E); or metals (including aluminum, arsenic, barium, chromium, copper, lead, selenium, and zinc). In addition, several wells at Site 4 are analyzed for a variety of MNA parameters.

At Site 4, 18 of 25 on-site monitoring wells are sampled; 12 wells (MW-5, MW-14, MW-15, MW-34, MW-58, MW-59, MW-60, MW-61, MW-62, MW-63, MW-64, and MW-65) are sampled semi-annually and 6 wells (MW-4, MW-17, MW-19, MW-27, DW-2, and DW-6) are sampled annually. Well MW-5 is considered a background well and is sampled for metals and TPH-E. Well DW-2 is sampled for VOCs only, and the remaining monitoring wells are sampled for VOCs and MNA parameters. However, as indicated on Table 4, 23 of the 25 monitoring wells were also sampled for TPH-mo and TPH-d wells during the fourth quarter 2006 event to assess current TPH groundwater concentrations at Site 4. With the exception of the samples from wells MW-5, and MW-62 through MW-65, these wells were also sampled for TPH-g (see Table 4). The VOC groundwater results for the second and fourth quarter 2006 monitoring events are summarized on Table 5 and the metals results for well MW-5 are included on Table 6. TPH-mo, TPH-d, and various chlorinated VOCs results for the fourth quarter 2006 event are included on the groundwater concentration maps discussed in Section 4.0 (nature and extent of contamination).

The Site 4 MNA Program implemented in 2003 (see discussion in Section 2.4.6) was discussed in *Groundwater Monitoring Program Report Number 68, July – December 2006* (PES, 2007). PES indicated that data collected during the October 2006 monitoring event were similar to historical results, and suggest that when all MNA is considered together, the significance of daughter and final metabolic products in the source areas and the presence of strongly reducing environments supports the conclusion for the implementation program, and continues to suggest MNA is a viable interim solution for Site 4. This report also stated that in the monitoring events since the MNA implementation program began, a possible decreasing trend for VOCs concentrations over time in the western plume area (i.e., in the vicinity of well MW-58) is indicated.

2.5 Summary of Interim Remedial Actions

Interim remedial actions have been ongoing at Site 4 since 1987. Interim remedial actions at the Site have included:

- The removal of a 7,500-gallon gasoline UST and 1,000-gallon diesel UST located on the north side of the former Maintenance Garage, and the removal of a 550-gallon waste oil sump on the east side of this building (see Plate 3 for locations); and
- Implementation of the MNA Program discussed in Sections 2.4.6 and 2.4.8.

The gasoline and diesel USTs and waste oil sump located adjacent to the former Maintenance Garage were removed in 1987 under the jurisdiction of the Napa County Department of Environmental Health. Upon removal, the USTs were inspected and a hole was discovered in the diesel UST.

Initially, separate excavations existed for each UST, and two confirmation soil samples and a grab groundwater sample were collected from each excavation. Confirmation soil samples 428-A and 428-B, and the grab groundwater sample identified as “Diesel Pit” were collected from the diesel UST excavation. Confirmation soil samples 428-C and 428-D, and the grab groundwater sample identified as “Gas Pit” were collected from the gasoline UST excavation. Confirmation soil samples 428-A and 428-B were collected on the east and west walls of the diesel excavation at depths of 5.5 and 4.5 feet bgs, respectively. Confirmation soil samples 428-C and 428-D were collected on the north and west walls of the gasoline UST excavation at depths of 7.5 and 7 feet bgs, respectively. The soil samples were analyzed for benzene, toluene, xylenes, TPH-d, and TPH-g, and the groundwater samples were analyzed for all of these constituents except TPH-d. The results for these samples are summarized on the tables included in Appendix L and the sample locations are shown on the plates in this appendix.

As shown on the tables in Appendix L, an elevated TPH-d concentration of 18,000 mg/kg was detected in sample 428-B (collected on the west wall of the diesel excavation at a depth of 4.5 feet bgs). TPH-g was detected in the grab groundwater sample from the “Diesel Pit” at an elevated concentration of 37,000 $\mu\text{g}/\text{l}$. Comparing these initial confirmation samples results to

the ESLs on Table 1, the TPH-d results for soil sample 428-B and TPH-g result for the grab groundwater sample from the “Diesel Pit” would exceed their respective ESLs.

Based on the elevated TPH-d soil result, the excavation was extended to remove additional soil that appeared to be impacted by petroleum hydrocarbons. The extent of the excavation at the completion of this removal action is shown on the plates in Appendix L and on Plate 3. As shown on these plates, one large excavation now existed in this area. Confirmation soil samples 55-1 through 55-4 were collected at various locations on the north wall of this excavation. These samples were collected at depths of 4.5, 3, 7, and 4 feet bgs, respectively. Samples 55-1, 55-2, and 55-4 were analyzed for TPH-d; sample 55-3 was kept on hold at the laboratory and never analyzed. As shown on the tables in Appendix L, TPH-d was not detected in soil sample 55-1, and was detected at concentrations of 11 and 48 mg/kg in samples 55-2 and 55-4. These concentrations are below the TPH-d ESL. Based on these results the excavation was backfilled with approximately 308 cubic yards of clean drain rock. The TPH soil results from samples 428-C, 428-D, 55-1, 55-2, and 55-4 are incorporated into the nature and extent of contamination discussion in Section 4.0. The results for soil samples 428-A and 428-B are not incorporated into the discussion in Section 4.0 because the soil representing these samples was removed during excavation activities.

Limited information exists for the removal of the 550-gallon waste oil sump, but based on the information obtained it appears that the waste oil sump was removed in June 1987. Following its removal, a confirmation sample was collected in the soil at the bottom of the hole and a grab groundwater sample was collected from the water that accumulated in the hole. These samples were analyzed for VOCs and O&G. Results for these samples are shown on the tables included in Appendix L and the location of the former sump is shown on the plates in this appendix and on Plate 3. As shown on the tables in Appendix L, an elevated O&G concentration of 9,045 mg/kg was detected in the soil sample and elevated toluene at a concentration of 420 $\mu\text{g/l}$ was detected in the grab groundwater. These are the only results detected at concentrations above their respective ESLs.

3.0 SUPPLEMENTAL REMEDIAL INVESTIGATION

The following sections present the field activities and methods (Section 3.1) and analytical results (Section 3.2) for the supplemental remedial investigation conducted by PES in September through November 2006.

3.1 Field Activities and Methods

Prior to conducting the supplemental remedial investigation, PES reviewed historical Site documents and prepared a workplan that was submitted to RWQCB staff for review. The RWQCB approved the work plan in early September 2006. The workplan, titled *Supplemental Remedial Investigation Workplan, Site 4* (PES, 2006b), recommended that a subsurface investigation be conducted to address the following data gaps:

- The lateral and vertical extent of VOC and petroleum hydrocarbon contamination in soil and groundwater within and in the vicinity of the former PMB;
- The sources of chlorinated VOCs in groundwater beneath the eastern portion of the PMB; and
- The lateral extent of TPH-d in soil in the vicinity of the former Maintenance Garage and Paint Storage building.

During the initial phase of work for the supplemental remedial investigation, PES completed the following work (see Plate 3 for boring locations):

- Forty-one (41) borings in the vicinity of the PMB (PM1 through PM41);
- One boring in the vicinity of the former Maintenance Garage (MG1); and
- Three borings in the vicinity of the former Paint Storage building (PS1 through PS3).

A summary of the samples collected from these borings and the analyses performed on the samples is provided in Table 7. As indicated on this table, soil and groundwater samples were collected from each of these borings.

Based on the results of the September 2006 supplemental remedial investigation, a second phase of work was conducted at Site 4 in November 2006. The purpose of this investigation was to:

- Further define the extent of VOCs and petroleum hydrocarbon contamination in soil and groundwater beneath and around the PMB;
- Further assess the extent and amount of separate-phase hydrocarbons (i.e., separate-phase product) beneath the footprint of the PMB, in particular, near the machinery pits;
- Assess whether 1,4-dioxane (a solvent preservative) is present in groundwater in the vicinity of the PMB (as requested by the RWQCB in an October 2006 site visit); and
- Conduct a soil gas survey to identify the source(s) of chlorinated VOCs in groundwater beneath the eastern portion of the PMB. In addition, sediment samples were collected from two storm drain manholes and one catch basin on the eastern side of the PMB to evaluate if chlorinated VOCs were present locally in the storm drain system in the vicinity of the elevated VOCs in groundwater.

During the second phase of work for the supplemental remedial investigation, PES completed the following: (1) advanced thirty-one (31) borings (PM42 through PM72; see Plate 3); (2) collected soil gas samples from 20 locations (PMSG1 through PMSG20; see Plate 8) in the vicinity of well MW-58; (3) collected sediment samples from three storm drain/catch basin

locations (PMSD1 through PMSD3; see Plate 8 for locations) in the vicinity of MW-58; and (4) sample three wells (MW-58, MW-64, and MW-65) and groundwater from five borings (PM48, PM49, PM50, PM51, and PM60) for 1,4-dioxane.

A summary of the samples collected from these borings and the analyses performed on the samples is provided in Table 7. As indicated on Table 7, other than two soil samples from boring PM59 and a groundwater sample from PM60, samples were not collected from borings PM52 through PM72 because the main purpose of these borings was to further assess the extent and amount of free-phase hydrocarbons beneath the footprint of the PMB. The soil gas and storm drain sediment samples were analyzed for VOCs only.

The pre-field activities, and sampling and analytical methods used for the September through November investigations are discussed in Sections 3.1.1 through 3.1.3. The monitoring wells sampled for 1,4-dioxane were purged and sampling following the same procedures used during the Facility-wide *Groundwater Monitoring Program* (PES, 2006a). All drilling and sampling activities were conducted with oversight by a California Professional Geologist.

3.1.1 Pre-Field Activities

Drilling permits were obtained from the Napa County Department of Environmental Management prior to all phases of drilling. PES contacted Underground Service Alert more than 48 hours before beginning exterior drilling activities, and retained California Utility Surveyors, a private utility locating company, to clear all boring locations for subsurface utilities. A Site-specific Health and Safety Plan was prepared for all sampling activities.

3.1.2 Sampling Methods

3.1.2.1 Soil/Groundwater Borings

RSI Drilling (RSI) of Woodland, California, under subcontract to PES, utilized a direct-push drilling rig to advance the borings to the desired depth, which ranged between 7 and 16 feet bgs. Either a single- or dual-walled sampling system equipped with a clear acetate liner was used to collect continuous soil cores from the borings. Soil samples for VOC analysis were collected with an Encore™ sampling device.

A PES geologist observed the borehole drilling and prepared a lithologic log of the borings using the Unified Soil Classification System (USCS). The soil cores were screened for VOCs using a photoionization detector (PID) and the results were recorded on the lithologic log. Lithologic logs are presented in Appendix B. A lithologic log was not created for borings PM42 and PM43 because these locations were sampled for groundwater only. Therefore, soil cores for logging and sampling purposes were not collected.

To facilitate groundwater sampling, a 1-inch diameter schedule 40 polyvinyl chloride (PVC) well casing fitted with a 10- to 15-foot section of factory-slotted PVC well screen was lowered

into the boring selected for groundwater sampling. Groundwater samples were collected from the PVC casing with a peristaltic pump. New tubing was used at each sampling location. The samples were collected in appropriate laboratory-provided sample containers.

Sample containers were labeled to indicate project location, job number, boring number, sample number, and time and date collected. The samples were immediately placed in a thermally-insulated cooler containing ice. The samples were picked up daily by a courier who transported them under chain of custody protocol to Curtis & Tompkins, LTD (C&T) of Berkeley, California. C&T is certified by the State of California for the requested analyses.

Downhole drilling and sampling equipment was cleaned via pressure washing or using a non-phosphate detergent and double-rinsed with potable water prior to use. Borings were backfilled with cement grout. Drill cuttings, equipment rinsate, and purged groundwater were containerized and stored at the Napa Pipe Facility pending proper disposal.

3.1.2.2 Soil Gas Samples

Soil gas samples were collected on November 7 and 8, 2006 following the Department of Toxic Substances Control (DTSC) and the California Regional Water Quality Control Board – Los Angeles Region (LARWQCB) *Advisory - Active Soil Gas Investigations* document (LARWQCB, 2003). RSI utilized a direct-push drilling rig to advance stainless steel soil gas sampling probes to approximately 3.5 to 4 feet bgs at twenty (20) locations (PMSG1 through PMSG20; see Plate 8). The probe and associated tubing were allowed to equilibrate with the surrounding soil for a minimum of 30-minutes prior conducting the purging and sampling activities discussed below.

A step purge tests of one (1), three (3), and seven (7) purge volumes (i.e., 1-volume equivalent to the inside of the tubing plus the volume of the screened portion of the borehole) was conducted at location PMSG1 to determine the purge volume to be applied during the sampling event. The results of the purge volume test are shown on Table 13 (i.e., sample identifications PMSG1-1 [1 purge volume], PMSG1-3 [3 purge volume], PMSG1-7 [7 purge volume]). The results for PMSG1-3 were the highest so 3 purge volumes were removed at each location prior to collecting a soil gas sample. As recommended in the document referenced above, a purging and sampling rate of approximately 150 milliliters per minute (ml/min) was used. Prior to and during sample collection, a leak detection compound containing propane was applied in areas where ambient air could enter the sample train, such as tubing fittings and the probe surface seal.

The soil gas samples were collected in a laboratory-supplied, pre-cleaned syringe and then transported to Mobile Chem Labs, Inc.'s (Mobile Chem) onsite mobile laboratory for immediate analysis.

3.1.2.3 Sediment Samples

Sediment sample PMSD2 was collected with an Encore™ sampling device because the catch basin that it was obtained from was shallow and void of standing water. Sediment samples PMSD1 and PMSD3 were collected from 4- to 5-foot deep manholes that contained 1 to 2 feet of standing water. To obtain a sample from these locations, a clear acetate liner was pushed into the sediment and then the wet sediment in the liner was transferred into 40-milliliter (ml) VOA vials.

3.1.3 Analytical Methods

3.1.3.1 Soil, Sediment, and Groundwater Samples

All soil, sediment, and groundwater samples delivered to C&T were accompanied by a completed sampler's chain of custody form. The following test methods were used to perform the analyses indicated in Table 7:

- VOCs by United States Environmental Protection Agency (USEPA) Test Method 8260B;
- Total extractable hydrocarbons (i.e., reported as diesel [C10-C24] and motor oil [C24-C36]) by USEPA Test Method 8015B; a silica gel cleanup was included with this analysis;
- 1,4-dioxane by USEPA Test Method 8270C-SIM; and
- CAM 17 Metals (i.e., also referred to as California Code of Regulations [CCR] Title 22 metals) by USEPA Test Method 6010B or 7471A (for mercury).

3.1.3.2 Soil Gas Samples

Soil gas samples delivered to the Mobile Chem's onsite mobile laboratory were accompanied by a sampler's chain of custody. The samples were analyzed for VOCs by USEPA Test Method 8260B.

3.2 Analytical Results

Analytical results for soil matrix and groundwater samples are presented in Tables 8 through 12. Plate 3 shows site features, and soil boring and monitoring well locations. Laboratory analytical reports and chain of custody forms for samples analyzed by C&T are presented in Appendix M. The soil gas and sediment analytical results are presented in Tables 13 and 14, respectively. Plate 8 shows the soil gas and sediment sampling locations. Laboratory analytical reports and chain of custody forms for soil gas samples analyzed by Mobile Chem Labs, Inc. are presented in Appendix N.

Plates 9 through 11 provide a graphical presentation of soil sampling results for TPH-mo in the vicinity of the PMB; Plates 12 through 14 provide a graphical presentation of soil sampling results for TPH-d in the vicinity of the PMB; and Plates 15 through 17 provide a graphical presentation of soil sampling results for TPH-d for the portion of Site 4 east of the railroad tracks. Selected groundwater results from the October 2006 monitoring event are shown on Plates 18 through 21. The nature and extent of contamination shown on these soil and groundwater plates, which also show selected results from previous investigations conducted at Site 4, are discussed in Section 4.0.

The soil and groundwater results presented on Tables 8 through 12 are compared to the applicable residential ESLs discussed in Section 1.0 and presented on Table 1. The soil gas results presented on Table 13 are compared to RWQCB residential ESLs (RWQCB, 2005) for shallow soil gas screening levels for evaluation of potential vapor intrusion concerns.

3.2.1 Soil Results

3.2.1.1 Petroleum Hydrocarbons

As shown in Table 8, TPH-d was detected in 108 of 115 soil samples analyzed for this constituent. Detected concentrations of TPH-d ranged from 1.1 mg/kg (2 to 2.5 feet sample from boring PM2) to 28,000 mg/kg (2.5 to 3 feet sample from boring PM32). Results for thirty (30) soil samples were at concentrations greater than the ESL for TPH-d. Results for the following eight samples were at concentrations greater than 5,000 mg/kg:

- Boring PM29 at 3 to 3.5 and 6.5 to 7 feet = 5,100 and 7,100 mg/kg, respectively;
- Boring PM59 at 0 to 0.5 feet = 5,300 mg/kg;
- Boring PM37 at 3 to 3.5 feet = 6,300 mg/kg;
- Boring PM9 at 2.5 to 3 feet. = 7,700 mg/kg;
- Boring PM21 at 6.75 to 7.25 feet = 7,900 mg/kg;
- Boring PM33 at 3 to 3.5 feet = 14,000 mg/kg; and
- Boring PM32 at 2.5 to 3 feet = 28,000 mg/kg.

The laboratory qualifiers “H” (i.e., heavier hydrocarbons contributed to the quantitation) and “Y” (i.e., sample exhibits chromatographic pattern which does not resemble standard) have been assigned to all the TPH-d results, with the exception of the sample collected from boring PM46 at 3 to 3.5 feet, which was not assigned an “H” qualifier. The “H” qualifier suggests that a heavier hydrocarbon, likely a hydraulic oil based on its use in the machinery historically used at the former PMB, contributed to the result for many of the samples.

TPH-mo was detected in 98 of 115 soil samples analyzed for this constituent (Table 8). Detected concentrations of TPH-mo range from 5.5 mg/kg (3 to 3.5 feet sample from boring PM14) to 61,000 mg/kg (2.5 to 3 feet sample from boring PM32). Results for the same thirty (30) soil samples that exceeded the ESL for TPH-d also exceeded the ESL for TPH-mo; twenty-five (25) of the TPH-mo results were at concentrations above 5,000 mg/kg. TPH-mo results for the following 10 samples were at concentrations greater than 25,000 mg/kg:

- Boring PM11 at 2.5 to 3 and 5.5 to 6 feet = 32,000 and 25,000 mg/kg, respectively;
- Boring PM21 at 6.75 to 7.25 feet = 26,000 mg/kg;
- Boring PM31 at 5.5 to 6 feet = 28,000 mg/kg;
- Boring PM15 at 2.5 to 3 feet = 29,000 mg/kg;
- Boring PM23 at 2 to 2.5 feet = 35,000 mg/kg;
- Boring PM29 at 6.5 to 7 feet = 42,000 mg/kg;
- Boring PM33 at 3 to 3.5 feet = 45,000 mg/kg;
- Boring PM59 at 0 to 0.5 feet = 56,000 mg/kg; and
- Boring PM32 at 2.5 to 3 feet = 61,000 mg/kg.

In most cases the TPH-mo results are higher than the TPH-d results (Table 8). Exceptions occur in the vicinity of the pits in the Forming Line Bay (i.e., borings PM4, PM6, PM7, and PM8), and in boring PM15 and PM44 where TPH-d results are higher.

3.2.1.2 Volatile Organic Compounds

Twenty-one (21) different VOCs were detected in the soil samples collected during the supplemental remedial investigation (Table 9). However, only 1,1-DCA, naphthalene, tetrachloroethylene (PCE), and TCE exceeded their respective ESLs. These constituents exceeded their respective ESLs in the following samples:

- 1,1-DCA: Detected above the ESL in boring PM12 (580 µg/kg in the 3 to 3.5 feet sample);
- Naphthalene: Detected above the ESL in boring PM15 (6,800 µg/kg in the 7 to 7.5 feet sample);
- PCE: Detected above the ESL in boring PM31 (130 µg/kg in the 5.5 to 6 feet sample); and
- TCE: Detected above the ESL in boring PM31 (890 µg/kg in the 5.5 to 6 feet sample).

3.2.1.4 Metals

Fourteen (14) different metals were detected in the soil samples collected during the supplemental remedial investigation (Table 10). However, the only metal that exceeded its ESLs was arsenic (ESL=5.5 mg/kg), which was detected at 10 mg/kg in the 6 to 6.5 feet sample from boring PM39.

3.2.2 Groundwater Results

3.2.2.1 Petroleum Hydrocarbons

TPH-d was detected in 45 of 51 groundwater samples analyzed for this constituent (Table 11). Twenty-three (23) of the detections were greater than the ESL for diesel (2,500 µg/l). Boring locations that had groundwater concentrations greater than 10,000 µg/l were as follows:

- Boring PM9 = 14,000 µg/l;
- Boring PM23 = 15,000 µg/l;
- Boring PM15 = 16,000 µg/l;
- Boring PM18 = 19,000 µg/l;
- Boring PM33 = 19,000 µg/l;
- Boring PM12 = 20,000 µg/l;
- Boring PM29 = 22,000 µg/l;
- Boring PM22 = 40,000 µg/l;
- Boring PM32 = 44,000 µg/l;
- Boring PM21 = 74,000 µg/l;
- Boring PM24 = 190,000 µg/l;
- Boring PM11 = 300,000 µg/l; and
- Boring PM16 = 340,000 µg/l.

TPH-d was detected at 42,000,000 µg/kg in the product sample collected from PM13 (Table 11). Attempts to collect a groundwater sample from this boring were unsuccessful due to the thick layer of separate-phase floating product in this boring.

As was the case with TPH-d in soil, the laboratory qualifiers “H” (i.e., heavier hydrocarbons contributed to the quantitation) and “Y” (i.e., sample exhibits chromatographic pattern which does not resemble standard) were assigned to most of the TPH-d groundwater results. The “H” qualifier suggests that a heavier hydrocarbon, likely hydraulic oil based on its use in the machinery historically used at the former PMB, contributed to the result for many of the groundwater samples.

TPH-mo was detected in 33 of 51 groundwater samples analyzed for this constituent (Table 11). Twenty-three (23) detected concentrations were greater than the ESL for motor oil (2,500 µg/l). Nineteen (19) of the detected concentrations were greater than 10,000 µg/l. In general the higher TPH-mo results correlate with the higher TPH-d results (see Table 11). Boring locations with concentrations equal to or greater than 50,000 µg/l were as follows:

- Boring PM17 = 50,000 µg/l;
- Boring PM27 = 60,000 µg/l;
- Boring PM33 = 62,000 µg/l;
- Boring PM32 = 68,000 µg/l;
- Boring PM34 = 84,000 µg/l;
- Boring PM23 = 110,000 µg/l;
- Boring PM29 = 120,000 µg/l;
- Boring PM18 = 130,000 µg/l;
- Boring PM12 = 190,000 µg/l;
- Boring PM21 = 210,000 µg/l;
- Boring PM22 = 260,000 µg/l;
- Boring PM24 = 740,000 µg/l;
- Boring PM16 = 760,000 µg/l; and
- Boring PM11 = 3,800,000 µg/l.

TPH-mo was detected at 380,000,000 µg/kg in the product sample collected from PM13 (Table 11).

3.2.2.2 Volatile Organic Compounds

As shown on Table 12, 32 different VOCs were detected in the forty-nine (49) grab groundwater samples collected at Site 4 during the supplemental remedial investigation. As summarized below, only chloroethane and vinyl chloride were detected at concentrations above their respective ESLs:

- Chloroethane: Detected above the ESL (160 µg/l) in borings PM12 (390 µg/l), PM21 (370 µg/l), and PM49 (240 µg/l); and
- Vinyl chloride: Detected above the ESL (3.8 µg/l) in borings PM21 (14 µg/l), PM26 (14 µg/l), and PM49 (4.7 µg/l).

3.2.2.3 1,4-Dioxane

Groundwater from five borings (PM48, PM49, PM50, PM51, and PM60) completed during the supplemental remedial investigation and three monitoring wells (MW58, MW-64, and MW-65) were analyzed for 1,4-dioxane (Table 12). As indicated on Table 12, this compound was detected in 3 of the 5 borings at concentrations ranging between 10 and 42 µg/l, and in two of the monitoring wells (MW-58 and MW-64 at 110 and 160 µg/l, respectively). None of these concentrations exceed the ESL of 50,000 µg/l for 1,4-dioxane.

3.2.3 Soil Gas Results

As shown on Table 13, VOCs were detected at 7 of 20 soil gas locations sampled during the supplemental remedial investigation. In all, six different VOCs were detected in the soil gas samples (Table 13). However, only four VOCs were detected at concentrations exceeded their respective ESLs for shallow soil gas screening levels. VOCs detected at concentrations greater than the ESL were as follows:

- 1,1,2,2-TCA: Detected above the ESL (0.043 µg/l) at 3 of 20 locations (maximum concentration of 7.3 µg/l in soil gas boring PMSG11);
- Chloroethane: Detected above the ESL (2.9 µg/l) at 4 of 20 locations (maximum concentration of 120 µg/l in soil gas boring PMSG1);
- 1,1-DCA: Detected above the ESL (1.5 µg/l) at 4 of 20 locations (maximum concentration of 70 µg/l in soil gas boring PMSG13); and
- Vinyl chloride: Detected above the ESL (0.032 µg/l) at 3 of 20 locations (maximum concentration of 41 µg/l in soil gas boring PMSG1).

3.2.4 Sediment Sample Results

As shown on Table 14, the only VOCs detected in the sediment samples were xylenes at 0.5 µg/l in PMSD3, and toluene at 0.6 µg/l in PMSD1 and PMSD3.

4.0 NATURE AND EXTENT OF CONTAMINATION

The nature and extent of TPH and VOCs in soil and groundwater at Site 4 as identified from the various investigations is summarized below. TPH and VOCs have regularly been detected at Site 4 and are considered to be the chemicals of interest.

4.1 Nature and Extent of Contamination in Soil

The soil distribution maps presented on Plates 9 through 17 incorporate TPH data from the previous investigations discussed in Section 2.4, and from the recently conducted supplemental remedial investigation.

The following discussion of the nature and extent of petroleum hydrocarbon contamination in soil has been divided into separate discussions for TPH-mo and TPH-d. Furthermore, the discussion for TPH-mo only presents the nature and extent of this constituent on the western side of the railroad tracks in the vicinity of the PMB because the TPH constituent of interest on the east side of the railroad tracks in the vicinity of the former Maintenance Garage and Paint Storage Building is mainly TPH-d.

4.1.1 Petroleum Hydrocarbons

4.1.1.1 TPH as Motor Oil

The distribution of TPH-mo in soil beneath and surrounding the PMB is shown in the following three depth intervals on Plates 9 through 11: (1) 0 to 4 feet bgs interval (Plate 9); (2) 4 to 10 feet bgs interval (Plate 10); and (3) 10 to 13.5 feet bgs interval (Plate 11). In general, results posted for the shallow depth interval correlate with the fill unit, those posted for the intermediate depth interval correlate either with lower portions of the fill unit or the upper portion of the silt/clay unit, and those posted for the deep depth interval generally correlate with the upper portion of the silt/clay unit. As shown in the explanation for each plate, the posted color dots represent various concentration ranges for TPH-mo, relative to the ESL and orders of magnitude factors of the ESL.

As shown on Plates 9, 10, and 11, higher concentrations of TPH-mo are generally detected in borings completed in the vicinity of the machinery pits at the PMB. Lower TPH-mo concentrations in soil are generally found in borings completed outside the PMB or in the more southern and western portions of the PMB. Areas where elevated TPH-mo was detected in soil that are not associated with the pits:

- In the vicinity of borings PM24, PM27, and PM29;
- In the vicinity of borings PM33 and PM34;
- In the vicinity of boring PM32;
- In the vicinity of boring PM13⁹; and
- The area in the vicinity of borings PM16, PM49, PM-02, PM15, PM51, and PM17.

In general, the highest concentrations of TPH-mo in soil and the greatest extent of this constituent at concentrations above the ESL are found in the 0 to 4 feet bgs interval (Plate 9). As shown on Plates 9 through 11, TPH-mo concentrations generally decrease with depth. Exceptions to this general trend are in the following areas:

- In the vicinity of borings PM24, PM27, and PM29;
- In boring PM18; and
- In the borings on the eastern side of the expander and up-ender pits in the central portion of the PMB.

A possible explanation for the higher TPH-mo concentrations at depth may be associated with the presence of separate-phase product or stained soils in these areas as illustrated on cross sections A-A' and B-B' (see Plates 4 and 5) and Plates 9 through 11.

The highest TPH-mo concentration in the 10 to 13.5 feet bgs interval (i.e., interval that generally correlate with the upper portion of the silt/clay unit) is found in boring PM22. The concentration in this boring is 3,100 mg/kg (see Plate 11), which is below the TPH-mo ESL of 5,000 for deep soil. As shown on the lithologic log for this location (see Appendix B), the soil sample in this interval was collected in fill material just above the top of the silt/clay unit. As was the case with other samples collected in the silt/clay unit, TPH-mo concentrations likely decreases significantly in the upper portion of this unit (i.e. 0.5 to 1 feet into unit) in this area.

Based on the locations where elevated concentrations of TPH-mo occur on Plates 9 through 11, suspected sources of TPH in PMB include:

- The machinery pits;
- Activities associated with the customer inspection and weigh stations areas in the eastern portion of the PMB (see diagram in Appendix A);

⁹ Concentrations of THP-mo were not elevated in the soil samples collected from this boring, but a significant amount of separate-phase product was encountered at depths below the lowermost soil sample – see lithologic log in Appendix B.

- The former pipe cleaning pits; and
- Near the sump pump end of the wash pit on the southern side of the PMB.

Areas where elevated TPH-mo was detected in soil that are not associated with the sources listed above include:

- In the vicinity of borings PM33 and PM34;
- In the vicinity of boring PM32; and
- The area in the vicinity of borings PM16, PM49, PM-02, PM15, PM51, and PM17.

In general, elevated TPH-mo concentrations in the borings listed above were detected in the shallow (i.e., 0 to 4 feet interval); concentrations in the deeper samples from these borings generally decrease significantly. Possible releases of TPH in these areas may have been associated with poor housekeeping and/or chemical handling practices, improper waste storage, and equipment malfunction and leakage. Once released to the asphalt or concrete floor, TPH likely migrated through the slab via cracks, and/or naturally-occurring pore spaces in the asphalt and concrete.

Other potential sources of TPH in the PMB include releases from utility lines running beneath the PMB, in particular, lines related to the wastewater system. According to Mr. Jim Swindle (personal communication, 2006), the abundance of separate-phase floating product in boring PM13 might be associated with hydraulic lines that previously existed in this area. Mr. Swindle indicated that the hydraulic lines were likely buried, but did not know how deep.

4.1.1.2 TPH as Diesel

Portion of Site West of Railroad Tracks (i.e., Former Pipe Mill Building)

The distribution of TPH-d in soil beneath and surrounding the PMB is shown on Plates 12 through 14 using the same depth intervals as previously described for the distribution of TPH-mo. When comparing the TPH-d and TPH-mo maps it can be seen that the distributions are similar for each interval.

As discussed in Section 3.2.1, the laboratory qualifiers “H” (i.e., heavier hydrocarbons contributed to the quantitation) and “Y” (i.e., sample exhibits chromatographic pattern which does not resemble standard) have been assigned to most of the TPH-d results for the supplemental remedial investigation. The “H” qualifier suggests that a heavier hydrocarbon, likely a hydraulic oil based on its use in the machinery historically used at the former PMB, contributed to the quantitation for many of the TPH-d results.

The higher TPH-mo results generally correlate with the higher TPH-d results, but in most cases the TPH-mo results are significantly higher than the TPH-d results (see Table 8 and Plates 9 through 14).

Portion of Site East of Railroad Tracks (i.e., Former Paint Storage and Maintenance Garage)

The distribution of TPH-d in soil on the east side of the railroad tracks is shown in the following three depth intervals on Plates 15 through 17: (1) 0 to 4 feet bgs interval (Plate 15); (2) 4 to 10 feet bgs interval (Plate 16); and (3) 10 to 15 feet bgs interval (Plate 17). As was the case on the west side of the railroad tracks, results posted for the shallow depth interval correlate with the fill unit; those posted for the intermediate depth interval correlate either with lower portions of the fill unit or the upper portion of the silt/clay unit; and those posted for the deep depth interval generally correlate with the upper portion of the silt/clay unit. As shown in the explanation for each plate, the posted color dots represent various concentration ranges for TPH-d.

In general, the highest concentrations of TPH-d and the greatest extent of this constituent at concentrations above the ESL are present in the 0 to 4 feet bgs interval (Plate 15). As shown on this plate, concentrations of TPH-d above the ESL occur mainly in vicinity of the former Paint Storage Building and former Drum Drainage area on the southeastern side of this building. Elevated TPH-d concentrations are also present: (1) on the western side of the former Maintenance Garage in boring GP-10; and (2) on the southwestern side of the former WWTP in boring GP-12. The only elevated TPH-d concentration in the two deeper intervals is found on the east side of the former Maintenance Garage in boring 4C (430 mg/kg in the 4 to 10 feet bgs interval; see Plate 16).

As shown on Plate 15, the previously undefined extent of TPH at concentrations above the ESL in the area east of the former Paint Storage building (with the exception of boring 4F located further east) was defined by supplemental investigation borings PS1 through PS3 and the extent of TPH in the area west of the former Maintenance Garage was defined by supplemental investigation boring MG1.

Numerous potential sources of TPH exist in the area of Site 4 east of the railroad tracks, including (see Plate 15 for location of sources):

- The former 7,500-gallon gasoline UST and 1,000-gallon diesel UST;
- The former Maintenance Garage;
- The former Paint Storage building;
- The former Oil Storage area;
- The former Drum Drainage area;

- The former Tire Storage area; and
- The former WWTP that was clean-closed by the RWQCB.

4.1.1.3 TPH as Gasoline

Soil samples collected on the portion of the Site west of the railroad were not analyzed for TPH-g during previous investigations or PES's investigations discussed in Sections 2.4 and 3.0, respectively. In the portion of the Site east of the railroad tracks, six soil samples collected during previous investigation were analyzed for TPH-g (see Sections 2.4 and 2.5 for details of these investigations). The maximum concentration of TPH-g detected in these samples was 670 mg/kg, which is above the TPH-g ESL. This sample was collected at 2.5 feet bgs from boring GP-10, which was completed approximately 40 feet west of the former gasoline UST during the MW June/July 1998 soil and groundwater investigation. In the remaining samples, TPH-g was either not detected or detected at a concentration below the ESL.

4.1.2 Volatile Organic Compounds

Portion of Site West of Railroad Tracks (i.e., Former Pipe Mill Building)

As discussed in Section 3.2, VOCs in soil at concentrations above ESLs were limited. As indicated by the previous investigations (see Section 2.4) and by the results presented on Table 9, VOCs in soil in the vicinity of the PMB were not frequently detected and were generally detected at low concentrations. However, elevated concentrations of 1,1-DCA, naphthalene, PCE, and TCE were detected in the following areas:

- 1,1-DCA: Detected above the ESL in boring PM12 (580 µg/kg in the 3 to 3.5 feet sample);
- Naphthalene: Detected above the ESL in boring PM15 (6,800 µg/kg in the 7 to 7.5 feet sample);
- PCE: Detected above the ESL in boring PM31 (130 µg/kg in the 5.5 to 6 feet sample); and
- TCE: Detected above the ESL in boring PM31 (890 µg/kg in the 5.5 to 6 feet sample).

These soil results suggest that VOC sources may be associated with the following:

- Releases associated with the pits (i.e., expander and up-ender pits) in the central portion of the PMB;
- Releases associated with the end square pits in the northeastern portion of the PMB; and

- The detections of elevated naphthalene (i.e., a component of diesel) in boring PM15 may be associated with the elevated TPH-d detected in groundwater at this location (see discussion below). Therefore, the source of naphthalene is likely from a diesel release in the vicinity of this boring.

A VOC source area was not found in the vicinity of well MW-58 during the supplemental remedial investigation. The highest concentrations of VOCs in groundwater at Site 4 have historically been detected in this well. Soil samples collected from borings PM25, PM26, and PM30, which were completed during the supplemental investigation in the vicinity of this well, had either low concentrations of VOCs or VOCs were not detected.

The results of the soil gas investigations performed in the vicinity of well MW-58 did not locate a source area that would account for the VOC concentrations present in this well (see Plate 8 and Table 13). Also, sediment samples collected from the storm drain system in the vicinity of this well were nondetect for VOCs (See Table 14).

Portion of Site East of Railroad Tracks (i.e., Former Paint Storage and Maintenance Garage)

VOCs in soil were detected infrequently and at low concentrations in borings completed during previous investigations conducted on the east side of the railroad tracks (see discussion in Section 2.4). Based on these results VOCs are not considered a COI in soil east of the railroad tracks.

4.2 Nature and Extent of Contamination in Groundwater

The posted TPH-mo, TPH-d, VOC groundwater concentrations shown on Plates 18 through 21 are results obtained from the more recent investigations conducted at Site 4. The posted results were obtained from either: (1) the site assessment conducted by Shaw (Shaw, 2005) in October 2005 (i.e., borings PM-01 through PM-07, and PM-09); (2) the supplemental remedial investigation conducted by PES in September through November 2006 (i.e., the PM1 through PM72 designated borings); or (3) the most recent Facility-wide groundwater monitoring event conducted by PES in October 2006 (i.e., monitoring well results). Groundwater results for samples collected from borings completed during investigations in the late 1980s, 1990s and early 2000 (see Section 2.4 for discussions of these investigations) were taken into consideration when drawing the contours, especially in areas of the Site 4 where limited data exists, such as the area within and just west of the railroad corridor. However, because of natural attenuation processes, these historical results likely do not represent current conditions.

4.2.1 Petroleum Hydrocarbons

Site 4 groundwater is primarily affected by elevated concentrations of TPH and VOCs. TPH in groundwater in the western portion of Site 4 has historically been found as a separate-phase floating product near well MW-65. The following sections discuss the extent of separate-phase product and dissolved TPH in groundwater.

4.2.1.1 Separate-Phase Product

Separate-phase floating product has historically been detected in well MW-65. However, product was not detected in this well in the May 16, 2006 measurement event, but 0.74 feet of product was detected in the October 3, 2006 measurement event (see Tables 2 and 3). Jim Swindle (personal communication, 2006), who oversees the operation and maintenance at Site 4, indicated that product continually accumulates on the oil absorbent socks that are changed-out weekly in well MW-65.

The presence of a petroleum hydrocarbon sheen or separate-phase product in borings and wells completed on the west side of the railroad tracks at Site 4 is indicated on Plates 9 through 11. The information presented on these plates was obtained from the lithologic logs created during the supplemental investigation and by others during previous investigations at Site 4 (see Appendices B and D, respectively). Information pertaining to the presence of a petroleum hydrocarbon sheen, staining, or separate-phase product is also presented on cross sections A-A' and B-B' (Plates 4 and 5). Petroleum hydrocarbon sheens or separate-phase product was not observed in borings and wells completed on the east side of the railroad tracks.

On the west side of tracks within and around the PMB, separate-phase product was observed in the following borings:

- **0 to 4 feet bgs interval (see Plate 9):** PM11, PM15, PM53, PM54, PM56, PM57, and PM58; and
- **4 to 10 feet bgs interval (see Plate 10):** PM9, PM11, PM13, PM16, PM18, PM20, PM22, PM32, PM61, PM62, and PM64.

All of these borings except PM20 and PM64 are located within the PMB. All of the borings are located within the 5,000 µg/l contour shown on Plate 18, and many are within the 50,000 or 100,000 µg/l contours.

A “green staining” was noted in all of the Shaw borings (i.e., borings PM-01 through PM-07, and PM-09) completed within or surrounding the PMB. However, Shaw did not indicate the presence of a petroleum hydrocarbon sheen or separate-phase product in these borings. In PES’s opinion, the presence of “green staining” alone does not indicate the presence of petroleum hydrocarbons. Furthermore, petroleum hydrocarbon soil and groundwater results for borings PM-01, PM-04, PM-05, and PM-06 were either below ESLs or non-detect, and these borings are distantly located from suspected source areas. Therefore, the presence of “green staining” in the Shaw borings is not indicated on Plates 9 and 10.

4.2.1.2 Dissolved-Phase Petroleum Hydrocarbons

Portion of Site West of Railroad Tracks (Former Pipe Mill Building)

The distribution of TPH-mo in groundwater in the vicinity of the PMB is shown on Plate 18. As shown on this plate, concentrations greater than the ESL of 2,500 µg/l are present beneath much of the PMB. Concentrations of TPH-mo below 2,500 µg/l are found: (1) in the southernmost portion of the PMB; (2) in the western portion of the PMB, including the Forming Line Bay; and (3) in most of the areas outside the PMB. TPH-g was not detected in monitoring wells MW-58, MW-59, MW-61, and MW-65 during the October 2006 monitoring event.

The highest concentrations of TPH-mo in groundwater are defined by the 100,000 µg/l contour, which is present in the following four areas on Plate 18:

- An area that encompasses well MW-65, and borings PM24 and PM29. The maximum concentration in this area is found in well MW-65 (6,400,000 µg/l);
- An area in the central portion of the PMB that extends from northernmost end facing pit in the central portion of the PMB westward toward borings PM21 and PM16. The maximum concentration in this area is found in boring PM16 (760,000 µg/l);
- An area in the immediate vicinity of the southernmost end facing pit in the central portion of the PMB. Boring PM23, with a concentration of 110,000 µg/l is within this area; and
- An area in the northeastern portion of the PMB in the vicinity of the end square pits and the pit formally used for pipe cleaning. The maximum concentration in this area is found in boring PM11 (3,800,000 µg/l).

The 100,000 and 50,000 µg/l contours on the TPH-mo plate roughly correlates with the 50,000 and 10,000 µg/l contours on the TPH-d plate (Plate 19). The 50,000 µg/l contour defines the areas of highest concentrations on the TPH-d plate. As indicated by these contours and the analytical results on Table 11, the higher TPH-mo concentrations generally correlate with the higher TPH-d concentrations, but the TPH-mo concentrations are generally higher than the TPH-d concentrations. Exceptions occur in the vicinity of the pits in the Forming Line Bay (i.e., borings PM4, PM6, PM7, and PM8), and in borings PM15 and PM44 where the TPH-d concentrations are higher. As indicated by Mr. Swindle (see discussion in Section 2.2), prior to revamping the equipment in the PMB in the late 1960s, diesel engines were used to run the machinery. Based on this evidence, the TPH-d in groundwater in the vicinity of the Forming Line Bay and borings PM15 and PM44 may be related to releases from the former diesel engines.

As was the case with TPH-d in soil, the laboratory qualifiers “H” (i.e., heavier hydrocarbons contributed to the quantitation) and “Y” (i.e., sample exhibits chromatographic pattern which does not resemble standard) were assigned to most of the TPH-d groundwater results. The “H” qualifier suggests that a heavier hydrocarbon, likely hydraulic oil based on its use in the machinery historically used at the former PMB, contributed to the quantitation for many of the TPH-d groundwater samples.

Based on the locations where elevated concentrations of TPH occur in groundwater, suspected sources are the same as those discussed above for TPH in soil.

Portion of Site East of Railroad Tracks (Former Paint Storage Building and Garage)

The distribution of TPH-d and TPH-mo in groundwater in the portions of Site 4 east of the railroad tracks is shown on Plates 18 and 19, respectively. As shown on Plate 18, the only detection of TPH-mo is in well MW-25 at a concentration of 380 $\mu\text{g/l}$, which is below the ESL of 2,500 $\mu\text{g/l}$ for TPH-mo. Well MW-25 is located on the east side of the former Oil Storage area.

TPH-d in this area was detected at maximum concentrations of 760 $\mu\text{g/l}$ and 200 $\mu\text{g/l}$ in wells MW-25 and MW-16, respectively. These concentrations are below the TPH-d ESL of 2,500 $\mu\text{g/l}$. Well MW-16 is located on the southern side of the former diesel UST (Plate 19).

During the October 2006 monitoring event, TPH constituents were not detected in well MW-19, which is located in the easternmost portion of Site 4 in the area of the former WWTP (see Plate 15 for the location of this well) or in Deep Groundwater Zone well DW-2 (see Table 4). TPH-g was detected in 1 of 13 wells (12 shallow wells and one deep well [well DW-2]) analyzed for this constituent during the October 2006 monitoring event. The detected concentration of 110 $\mu\text{g/l}$ in well MW-16 is below the TPH-g ESL.

Well MW-16 is located just south of the UST excavation area (see Plate 3) where TPH-g was detected at 37,000 $\mu\text{g/l}$ in the grab groundwater sample collected from the “diesel pit” (see discussion in Section 2.5). The recent TPH-g results for well MW-16, and other wells in the vicinity of the UST excavation (i.e., MW-4, MW-32, and MW-33) indicate that TPH-g groundwater concentrations in this area are well below the ESL of 5,000 $\mu\text{g/l}$. It is also important to note that after collecting the groundwater sample, the excavation was extended deeper to remove contaminated soil (see Section 2.5).

4.2.2 Volatile Organic Compounds

Shallow Groundwater Zone

The extent of various chlorinated VOCs in groundwater is shown on Plates 20 and 21. Plate 20 shows the extent of 1,1-DCA, which is the chlorinated VOC with the greatest extent

and highest concentrations in groundwater at Site 4. Plate 21 shows the estimated distribution of various chlorinated VOCs in groundwater at the Site.

As shown on Plate 20, 1,1-DCA is present on both the east and west sides of the railroad tracks. However, the concentrations present in groundwater on the east side of the tracks are much lower and below the ESL of 1,000 µg/l. The maximum 1,1-DCA concentration detected in groundwater on the east side of the tracks during the October 2006 monitoring event was 15 µg/l in well MW-4.

The highest concentrations of 1,1-DCA on the west side of the railroad tracks have historically been detected in well MW-58. In the October 2006 monitoring event, 1,1-DCA was detected in this well at a concentration of 7,200 µg/l, which is the highest concentration detected at Site 4 during this monitoring event. As shown on Plate 20, groundwater in the immediate vicinity of well MW-58 is impacted by 1,1-DCA at concentrations above the ESL of 1,000 µg/l. Based on the most current groundwater data, this is the only area impacted by 1,1-DCA at concentrations above the ESL. As discussed in Section 4.1.2, attempts to find a source for the VOCs in the vicinity of MW-58 were not successful.

Plate 21 shows the estimated distribution of various chlorinated VOCs in groundwater at Site 4. The chlorinated VOCs on this plate include: (a) the parent compounds 1,1,1-TCA and TCE; (b) the degradation products 1,1-DCA, 1,1-DCE, and cis-1,2-DCE; and (c) the final by-products vinyl chloride and chloroethane. As shown on this plate, high concentrations of 1,1-DCE are also present in groundwater in the vicinity of well MW-58 (6,700 µg/l). However, based on concentrations of 1,1-DCE in surrounding wells and borings it appears that the extent of this constituent at concentrations above its ESL (6,300 µg/l) is limited to the immediate vicinity of well MW-58 (see Plate 21).

The final by-product chloroethane is present in groundwater throughout most of the northern half of the PMB, but at generally lower concentrations than 1,1-DCA. However, the concentrations of this constituent in the vicinity of the expander and up-ender pits in the central portion of the PMB and in the vicinity of the end square pits in the northeastern portion of the PMB are similar to those of 1,1-DCA. The estimated extent of groundwater in these areas that is impacted by chloroethane at concentrations above its ESL (160 µg/l) is shown on Plate 21.

As shown on Plate 21, vinyl chloride is fairly wide spread and elevated (relative to its ESL of 3.8 µg/l) between wells MW-58 and MW-64 on the eastern side of the PMB and in the vicinity of the expander and up-ender pits in the central portion of the PMB (Plate 21). The remaining VOCs shown on Plate 21 are of limited extent in groundwater and detected below their respective ESLs.

The concentrations of VOCs in groundwater (as measured at monitoring wells) appear to be decreasing overtime as previously discussed in Sections 2.4.6 and 2.4.8 of this report. Furthermore, VOC concentrations measured in groundwater samples collected from

monitoring wells indicate that the Site 4 plumes are stable and not migrating (see discussions in Sections 2.4.6 and 2.4.8).

As discussed in Section 3.2.2, 1,4-dioxane was detected in 3 of the 5 borings at concentrations ranging between 10 and 42 µg/l, and in two of the monitoring wells (MW-58 and MW-64 at 110 and 160 µg/l, respectively) sampled for this constituent as part of the supplemental remedial investigation. All of the detections are below the ESL of 50,000 µg/l for 1,4-dioxane (Table 12). In addition, 1,4-dioxane was detected in 2 of 11 Site 4 monitoring wells analyzed for this constituent during the second quarter 2006 monitoring event. As indicated on Table 5, 1,4-dioxane was detected at concentrations of 80 µg/l and 290 µg/l in wells MW-34 and MW-61, respectively. These results indicated that this constituent is present in groundwater at Site 4, but at concentrations below the ESL.

Deep Groundwater Zone

In the Deep Groundwater Zone, toluene was detected in well DW-6 in the fourth quarter 2006 monitoring event at concentrations at a concentration of 490 µg/l, which is slightly above its ESL of 400 µg/l (see Table 5). VOCs were not detected in well DW-2, located approximately 60 feet west (inferred downgradient direction; see discussion in Section 2.3.3) during this monitoring event. Benzene (at 7.7 µg/l), ethylbenzene (at 67 µg/l), MTBE (at 98 µg/l), and xylenes (at 570 µg/l) were also detected in well DW-6 in the fourth quarter 2006 monitoring event, but at concentrations below ESLs (see Table 5). Based on a review of available historical data for these deep wells, it appears that toluene and xylenes were detected at concentrations of 130 and 64 µg/l in well DW-6 the fourth quarter 2005 monitoring event; benzene, ethylbenzene, and MTBE were not detected; VOCs were not detected in well DW-2. Data from the 2004 monitoring events was not available for PES's review. Historically, only low concentrations of 1,1-DCA, 1,1-DCE, and cis-1,2-DCE have been detected in the deep wells prior to 2004. A maximum concentration 20 µg/l of 1,1-DCA was detected in well DW-6 in the June 1998 monitoring event. However, in recent monitoring events these chlorinated VOCs have not been detected in the deep wells.

As discussed in Section 2.3.3 both upward and downward vertical gradients have been calculated in the vicinity of deep well DW-6 and shallow well MW-17. The vertical gradient in this area might fluctuate seasonally.

4.3 Conceptual Site Model

Portion of Site West of Railroad Tracks (Former Pipe Mill Building)

Based on the data from Site 4 investigations to date, various suspected sources exist for the separate-phase product, and TPH and VOC contamination found within and surrounding the PMB. Suspected sources include:

- The machinery pits;
- Activities associated with the customer inspection and weigh stations areas in the eastern portion of the PMB (see diagram in Appendix A);
- The former pipe cleaning pits;
- Near the sump pump end of the wash pit on the southern side of the PMB;
- Releases associated with poor housekeeping and/or chemical handling practices, improper waste storage, and equipment malfunction and leakage. These release likely migrated through the slab via cracks, and/or naturally-occurring pore spaces in the asphalt and concrete; and
- Releases from utility lines running beneath the PMB, in particular, lines related to the wastewater system.

Surface releases likely migrated vertically through the more permeable fill unit and then laterally outward along the water-bearing portions of the fill unit and along the contact between the fill and silt/clay units. Releases from the deeper pits and some of the utility lines may have occurred below the water table. In these cases, some upward migration of contaminants might have also occurred. Product released from the deeper portions of the pits probably migrated downgradient along permeable water-bearing zones within the fill surrounding the pits and also floated to the top of the water table immediately adjacent to the pits (see cross sections presented on Plates 4 and 5). Secondary porosity features such as root holes, and more permeable lenses of peat and sands within the upper portions of the silt/clay unit may have also contributed to the migration of TPH and VOCs. However, based on the deeper TPH soil results (see Plates 11 and 14), the silt/clay unit appears to have significantly impeded the downward migration of TPH-mo and TPH-d. Contaminants likely also migrated along unknown and unobserved preferential pathways in the subsurface, such as the backfill of utility lines.

Once released to groundwater, the TPH and VOC constituents have generally not migrated and are confined to the footprint of the building based on the distribution of contaminants in groundwater (see Plates 18 through 21). The lack of plume migration can likely be attributed to flat gradients, the low permeable nature of the silt/clay unit, and natural attenuation. The plumes shown on Plates 18 through 21 likely represent coalescing plumes from multiple sources.

The highest concentrations of chlorinated VOCs in groundwater at Site 4 have historically been detected in well MW-58. However, as discussed in Section 4.1.2, attempts to find a source for the VOCs in the vicinity of MW-58 were not successful.

Dumping of some debris during the filling process appears to have occurred outside the northeastern portion of the PMB based on the presence of wood chunks, burnt wood, concrete,

steel, and brick found in some of the borings and wells completed in this area (i.e., borings GP-16 and PM64, and well MW-63). Thick heavy oil was also encountered in the lowermost portions of the fill unit in this area at borings PM20 and PM64.

Deep Groundwater Zone wells are not present on the west side of the railroad tracks. Therefore, potential impacts from Shallow Groundwater Zone contamination has not been assessed in the vicinity of the PMB. However, based on the thickness of the silt/clay unit, which is approximately 25 feet thick in the vicinity of the PMB, and the lack of permeable zones encountered in this upper portions of this unit during the supplemental remedial investigation (see lithologic logs in Appendix B), it is not likely that the Deep Groundwater Zone has been significantly impacted by historical releases of TPH and VOCs at the PMB.

Portion of Site East of Railroad Tracks (Former Paint Storage Building and Garage)

Various suspected sources exist for the TPH and VOC contamination in the area of Site 4 east of the railroad tracks, including (see Plate 15 for location of sources):

- The former 7,500-gallon gasoline UST and 1,000-gallon diesel UST;
- The former Maintenance Garage;
- The former Paint Storage building;
- The former Oil Storage area;
- The former Drum Drainage area;
- The former Tire Storage area; and
- The former WWTP.

In general, the highest concentrations of TPH-d and the greatest extent of this constituent at concentrations above the ESL are present in the 0 to 4.5 feet bgs interval in the area east of the railroad tracks (Plates 15 through 17). Elevated concentrations of TPH-d above the ESL occur mainly in vicinity of the former Paint Storage Building and former Drum Drainage area on the southeastern side of this building.

Based on the most recent TPH and VOCs results for the Shallow Groundwater Zone, limited groundwater contamination is present in this zone on the east side of the railroad tracks (see Plates 18 through 21). The highest concentrations of VOCs in groundwater were found in the wells just east of the tracks, but at concentrations below ESLs. The source of VOCs in the wells just east of the tracks is not known, but is suspected to be the same as that for well MW-58. As mentioned above, attempts to find a VOC source in the vicinity of well MW-58 was not successful.

Once released, the TPH and VOC constituents have generally not migrated significantly, as was the case for these constituents on the west side of the railroad tracks. The lack of plume migration can likely be attributed to flat gradients, the low permeable nature of the silt/clay unit, and natural attenuation.

The Deep Groundwater Zone in the vicinity of DW-6 has been impacted by elevated concentrations of toluene, slightly above the ESL. However, the extent of contamination in this zone appears to be limited based on the absence of these constituents in deep well DW-2, which is located approximately 60 feet west (inferred downgradient direction; see discussion in Section 2.3.3). As discussed in Section 2.3.3 both upward and downward vertical gradients have been calculated in the vicinity of deep well DW-6. The vertical gradient in this area might fluctuate seasonally.

5.0 CONTAMINANT FATE AND TRANSPORT

As part of the *Site 4 Characterization and Remedial Action Plan* (MW, 2000), MW discussed chemical fate and transport for the compounds of interest (i.e., TPH-d, TPH-g, 1,1-DCE, and 1,1-DCA) at Site 4. PES has reviewed the chemical fate and transport section of this report (i.e., Section 4.3 – Migration of Compounds of Interest in Groundwater) and generally concurs with the information presented. Therefore, Section 4.3 of MW's report is included in Appendix O because it is considered applicable to the current conditions at the Site 4, including other areas of the PMB besides the area immediately east of the PMB that was included in the report reference above.

In summary, MW indicated that constituent migration at Site 4 is induced primarily in the downgradient direction by the convective flow of groundwater (i.e., the natural movement of groundwater as represented by the average groundwater velocity). They also indicated constituent migration is slower than the groundwater because their migration is retarded by mechanisms of adsorption and biodegradation.

Based on their analysis, MW indicated that adsorption onto the soil matrix may reduce constituent migration rates at Site 4 by the following retardation factors (e.g., a retardation factor of 5 indicates that the migration of constituents is occurring at one-fifth of the groundwater velocity):

- VOCs: An estimated retardation factor of 2 was considered reasonable for the migration of VOCs in the silt/clay unit at Site 4; and
- TPH: MW selected xylene, a compound present in TPH, as an indicator compound to model the retardation factor for TPH. The estimated retardation factor for xylenes is 8.

MW indicated that dissolved-phase concentrations at Site 4 would also be decreased by biodegradation, in addition to retardation. They indicated that biodegradation of TPH occurs primarily under aerobic conditions (in the presence of oxygen) and biodegradation of

chlorinated VOCs (such as 1,1-DCE and 1,1-DCA) occurs more rapidly under anaerobic conditions (i.e., without oxygen). Biodegradation transforms (i.e., biodegrades) chlorinated VOCs into other chlorinated VOCs, which in turn are transformed, until eventually innocuous compounds such as carbon dioxide, water, and ethanol are formed (i.e., these innocuous compounds are formed after the degradation of the by-products chloroethane and vinyl chloride). Plate 21 illustrates the concentrations of chlorinated VOCs in Site 4 groundwater, including: the parent compounds (i.e., 1,1,1-TCA and TCE); the degradation products (i.e., 1,1-DCA, 1,1-DCE, and cis-1,2-DCE); and the final by-products (i.e., vinyl chloride and chloroethane).

MW concluded that given a retardation factor of 2 for the migration of 1,1-DCA and 1,1-DCE in the silt/clay soils beneath Site 4, the biodegradation potential in the subsurface (i.e., elevated TOC concentrations and the presence of inorganic nutrients), and groundwater velocities of less than 10 feet per year, it was likely that the rate of natural attenuation of VOCs at the Site would prevent migration of the plume to the nearest receptor (Napa River). They also indicated that because TPH is less mobile and biodegrades quicker than VOCs, the potential for TPH to migrate to the Napa River was low.

The fate and transport summary presented above supports the conceptual site model discussed in Section 4.3, which indicates that: (1) the TPH and VOC constituents in the PMB have generally not migrated and are confined to the footprint of the building based on the distribution of contaminants in groundwater (see Plates 18 through 21); and (2) the lack of plume migration can likely be attributed to flat gradients, the low permeable nature of the silt/clay unit, and natural attenuation.

6.0 CHEMICALS OF CONCERN AND REMEDIATION EXTENT

This section summarizes the chemicals of concern (COC) identified during the previous investigations conducted at Site 4, specifies the chemicals to be remediated and associated Site cleanup levels and defines the extent of soil and groundwater media that will require remediation (i.e., the areas that exceed the cleanup levels).

6.1 Chemicals of Concern

Chemicals of concern for soil and groundwater were selected on the basis of the following primary factors:

- Chemicals previously identified in cleanup plans (e.g., MW, 2000) as COCs were retained;
- Frequency of detection. Chemicals detected at a frequency greater than 5% were further evaluated for possible retention as a COC;

- Exceedance of ESLs. If a chemical was frequently detected and soil or groundwater concentrations were above an ESL, the chemical was retained as a COC; and
- For metals, if detections were below background conditions, the metal was not retained as a COC.

6.1.1 Soil

6.1.1.1 Organic Constituents in Soil

As noted above and in MW's *Site 4 Characterization and Remedial Action Plan* (MW, 2000) petroleum hydrocarbons and VOCs are the primary chemicals of concern in both soil and groundwater. For soil, TPH-mo and TPH-d are considered the primary petroleum hydrocarbons requiring remediation. Table 15 summarizes the occurrence of petroleum hydrocarbons detected in soil samples collected from the Site including their frequency of detection and number of detections above ESLs. Although other petroleum hydrocarbon compounds were tested for in prior investigations (i.e., TPH, O&G, and TPH-g), these chemicals are not specifically treated as COCs because either: (1) the analytical method did not specifically identify the type of petroleum hydrocarbon (TPH¹⁰ and O&G); (2) they were infrequently tested for and their presence is likely an artifact of chromatogram overlap of TPH-d or TPH-mo (i.e., TPH-g and TPH as hydraulic oil [TPH-ho]); or (3) they will be addressed as part of other TPH excavations (i.e., the boring GP-10 location). For TPH, the results were considered to represent TPH-d results and were compared to the more conservative TPH-d ESL, as noted on Table 15. For O&G and TPH-ho data, the results were considered to represent TPH-mo and were compared to the TPH-mo ESL. TPH-d and TPH-mo are retained as COCs in soil.

For VOCs, although a number of VOCs were detected (see Table 16), only 1,1-DCA, 1,2,4-trimethylbenzene (TMB), acetone, toluene, and xylenes were frequently detected (i.e., using a 5% frequency of detection as the criterion). Of these, only 1,1-DCA exceeded its respective ESL. Therefore, 1,1-DCA is the only VOC retained as a COC in soil.

Prior studies at the Site sampled for SVOCs. Of the SVOCs detected in soil (see summary Table 17), none were frequently detected or exceeded their respective ESL. Therefore, SVOCs in soil are not retained as COCs.

6.1.1.2 Metals in Soil

For metals, the following constituents were detected above their respective ESL (see Table 18):

- Arsenic – Detected in 8 samples above its ESL;
- Cadmium – Detected in two samples above its ESL;

¹⁰ Reported as TPH-d and TPH-mo combined.

- Chromium – Detected in one sample above its ESL; and
- Chromium VI – Detected in one sample above its ESL.

Table 18 summarizes the maximum and minimum concentration for each metal along with the frequency of detection, the number of detections above the ESL and the background concentrations for each metal (as available)¹¹. With the exception of the maximum arsenic detection of 20 mg/kg, the arsenic, chromium, and cadmium detections do not exceed their respective background concentrations (see Table 18).

For chromium VI, five soil samples were analyzed for this compound and one detection (5.2 mg/kg¹²) is above the ESL (1.8 mg/kg; see Table 18). No Facility-specific background concentration has been established for chromium VI in soil. For comparison, the 95th percentile of chromium VI in background soils collected from California soils is 2 mg/kg¹³. Because of the slight exceedance of the ESL and the likelihood that this represents a background condition within the native soils, chromium VI is not retained as a COC.

Chromium was detected in 18 of 23 samples, but only one concentration, 65 mg/kg, is above the ESL (58 mg/kg). This concentration is below the background value of 98 mg/kg that has been established for chromium in soil at the Facility (Table 18). Because of the slight exceedance of the ESL in only one sample and the likelihood that the detected chromium concentrations represent background conditions, chromium is not retained as a COC.

Eight arsenic detections were above the ESL of 5.5 mg/kg, but only one concentration was above the background value of 15.3 mg/kg that has been established for arsenic in soil at the Facility (Table 18). Studies of California soils have identified background arsenic concentrations that range from 0.6 to 11 mg/kg¹⁴ or, in terms of the 95th percentile derived from (Department of Toxic Substances Control's (DTSC's) study, 12.7 mg/kg¹⁵. As was done in the ESL document (RWQCB, 2005), metals were compared to background concentrations in soil at the Lawrence Berkeley Laboratory (Berkeley Lab, 2002). The background concentrations established for arsenic (i.e., for units other than the Great Valley Group) at the

¹¹ Background metals concentrations in soil were developed by James M. Montgomery in a Corrective Action Plan prepared for the Facility in 1990 (JMM, 1990b).

¹² Sample was collected from boring BH-3 (see plate 3 for location) at 7 to 8 ft bgs. The soil at this depth is a greenish gray sandy silt that represents the native silt/clay unit (see boring log in Appendix D). No "distinct odors or stains" were noted in this boring.

¹³ Hunter, Philip M., Davis, Brian K. and Frank Roach, 2005. *Inorganic Chemicals in Ground Water and Soil: Background Concentrations At California Air Force Bases*. Presented at: 44th Annual Meeting of the Society of Toxicology, New Orleans, Louisiana. March 10. Available on DTSC's website at http://www.dtsc.ca.gov/AssessingRisk/upload/Metals_Handout.pdf

¹⁴ Kearney Foundation of Soil Science, 1996. *Background Concentrations of Trace and Major Elements in California Soils*. March.

¹⁵ Hunter, Philip M., Davis, Brian K. and Frank Roach, 2005. *Inorganic Chemicals in Ground Water and Soil: Background Concentrations At California Air Force Bases*. Presented at: 44th Annual Meeting of the Society of Toxicology, New Orleans, Louisiana. March 10. Available on DTSC's website at http://www.dtsc.ca.gov/AssessingRisk/upload/Metals_Handout.pdf

Lawrence Berkeley Laboratory is 24 mg/kg. By comparison with the available California studies and the background value established for the Facility, the arsenic is considered to represent a background condition and is not carried forward as a COC.

Cadmium was detected in 4 of 23 samples; two of the detected concentrations are above the ESL of 1.7 mg/kg. All of the detected concentrations, however, are below the background value of 13.7 mg/kg that has been established for cadmium in soil at the Facility (Table 18). Because of the exceedance of the ESL in only two samples and the likelihood that the detected cadmium concentrations represent background conditions, cadmium is not retained as a COC.

6.1.2 Groundwater

Tables 19 through 22 summarize the detections, frequency of detection and number of detections above ESLs for petroleum hydrocarbons, VOCs, SVOCs, and metals. Unless otherwise noted, the groundwater results summarized in the tables are for the most recent groundwater sampling results from the fourth quarter 2006 monitoring event and recent grab groundwater sampling investigations.

Both TPH-d and TPH-mo are frequently detected in groundwater and often exceeded their respective ESLs (Table 19). Similar to soil, TPH-d and TPH-mo are considered the primary COCs for groundwater. TPH-g was not frequently detected (detected in 1 of 19 samples) in groundwater and did not exceed its respective ESL in this one detection (see Table 19). Therefore, TPH-g is not retained as a COC in groundwater.

In contrast to soil, numerous VOCs including both chlorinated VOCs and gasoline-related constituents (e.g., MTBE and the BTEX compounds) were frequently detected in groundwater. However, only five constituents were detected at concentrations that exceed their respective ESLs (Table 20). These five VOCs, which are considered COCs, include 1,1-DCA, 1,1-DCE, chloroethane, toluene, and vinyl chloride.

As indicated on Table 21, methylnaphthalene was the only SVOC detected in groundwater. This constituent was detected in one (boring ECB-07) out of eight grab groundwater samples collected by Shaw (Shaw, 2005); the detected concentration is below the ESL. Therefore, SVOCs are not retained as COCs in groundwater.

The metals groundwater results from the second and fourth quarter monitoring events for well MW-5 are summarized on Table 22; this is the only Site 4 well that has been sampled recently for metals. This well is sampled for metals as part of the Facility-wide groundwater monitoring program and is considered a metals background well. As shown on Table 22, none of the detected metals exceeded their respective ESLs. As discussed in Section 2.4, none of the groundwater metals results during past investigations exceeded ESL values. Therefore, metals are not retained as COCs in groundwater.

6.1.3 Summary of Chemicals of Concern

Using the sorting process described above, the following chemicals were retained as chemicals of concern for soil and groundwater. As an indication of the relative importance of each COC, a summary of the number of samples exceeding the ESLs is also included.

- Soil
 - TPH-d: 37 samples (includes TPH results treated as TPH-d);
 - TPH-mo: 34 samples (includes O&G results treated as TPH-mo); and
 - 1,1-DCA: 2 samples.
- Groundwater
 - TPH-d: 28 samples;
 - TPH-mo: 27 samples;
 - 1,1-DCA: 1 sample;
 - 1,1-DCE: 1 sample;
 - Chloroethane: 3 samples;
 - Toluene: 1 sample; and
 - Vinyl chloride: 6 samples.

6.1.4 Cleanup Levels for Chemical of Concern

As described in detail in Section 1.1, the ESLs were selected for use as cleanup levels for the Site. For the soil and groundwater COCs at the Site, the cleanup levels are as follows:

Soil:

<u>Parameter</u>	<u>Residential ESL Shallow Soil (0 to 3 feet bgs) (mg/kg)</u>	<u>Residential ESL Shallow Soil (3 to 10 feet bgs) (mg/kg)</u>	<u>Residential ESL Deep Soil (> 10 feet bgs) (mg//kg)</u>
TPH-d	100	400	5,000
TPH-mo	500	1,000	5,000
1,1-DCA	0.32	0.32	0.32

Groundwater:

<u>Parameter</u>	<u>Nondrinking Water ESL</u> <u>(µg/l)</u>
TPH-d	2,500
TPH-mo	2,500
1,1-DCA	1,000
1,1-DCE	6,300
Chloroethane	160
Toluene	400
Vinyl Chloride	3.8

6.2 Areas Requiring Remediation

This section identifies the portions of the Site where soil or groundwater concentrations exceed the applicable cleanup levels and are therefore the target of remedial actions.

6.2.1 Areas and Volumes of Soil Exceeding Cleanup Levels

As described in Section 6.1.1, only TPH-D, TPH-mo, and 1,1-DCA were detected above their respective cleanup levels in soil. 1,1-DCA exceeded its cleanup level at only one location and that location is in an area of TPH contamination above the cleanup levels. Therefore, the areal extent and volume of soil requiring remediation is defined by the soil samples that exceed the cleanup levels for TPH (see Plates 22 through 25).

Portion of Site West of Railroad Tracks (Former Pipe Mill Building)

Unsaturated Soil. For unsaturated soils, the TPH data results presented on Plates 9 and 12 were used to delineate the area where it is likely that TPH concentrations exceed the cleanup levels; this area is shown on Plate 22. This area is approximately 102,000 square feet (sf) in size and, assuming an unsaturated zone thickness of 4 ft, the in-place volume of unsaturated soil that exceeds the cleanup levels in this area is approximately 15,100 cubic yards (cy).

Saturated Soil. For saturated soils, the TPH data presented on Plates 10, 11, 13, and 14 were used to delineate the area where it is likely that TPH concentrations exceed the cleanup levels. In addition to this soil data, information presented on these plates regarding the estimated extent of the separate-phase/sheen area was used to delineate the area where saturated soil likely exceeds the soil cleanup levels; this area is shown on Plate 23. This total area is approximately 78,000 sf in size. As shown on Plates 11 and 14, no samples collected below a depth of 10 ft exceeded the applicable cleanup levels, so it is assumed that the impacted saturated soil zone extends from 4 to 10 feet. Therefore, assuming a saturated thickness of 6 ft, the in-place volume of saturated soil that exceeds the cleanup levels in this area is approximately 17,300 cubic yards (cy).

Portion of Site East of Railroad Tracks (Former Paint Storage Building and Garage)

Unsaturated Soil. For unsaturated soils, the TPH data results presented on Plate 15 were used to delineate the area where it is likely that TPH concentrations exceed the cleanup levels; this area is shown on Plate 24. This area is approximately 11,300 square feet (sf) in size and, assuming an unsaturated zone thickness of 4 feet, the in-place volume of unsaturated soil that exceeds the cleanup levels in this area is approximately 1,800 cubic yards (cy).

Saturated Soil. For saturated soils, the TPH data presented on Plates 16 and 17 were used to delineate the area where it is likely that TPH concentrations exceed the cleanup levels; this area is shown on Plate 25. This total area is approximately 1,300 sf in size. As shown on Plate 17, no samples collected below a depth of 10 feet exceeded the applicable cleanup levels, so it is assumed that the impacted saturated soil zone extends from 4 to 10 feet. Therefore, assuming a saturated thickness of 6 ft, the in-place volume of saturated soil that exceeds the cleanup levels in this area is approximately 140 cubic yards (cy).

Summary of Site 4 Soil Volumes

The total volume of soil exceeding cleanup level for all of Site 4 (i.e., areas on both east and west sides of the railroad tracks) is estimated to be:

- **Unsaturated Soil:** 16,900 cy; and
- **Saturated Soil:** 17,440 cy.

6.2.2 Areas and Volumes of Groundwater Exceeding Cleanup Levels

Portion of Site West of Railroad Tracks (Former Pipe Mill Building)

As described in Section 6.1.2, the primary groundwater COCs that exceed their respective cleanup levels are TPH-D and TPH-mo. There are also several VOCs that exceed their cleanup levels to a more limited extent than the TPH compounds including vinyl chloride, 1,1-DCA, 1,1-DCE, toluene, and chloroethane. The majority of the elevated VOC concentrations are located around MW-58 just to the east of the Pipe Mill building and in the center of the Pipe Mill near borings PM21 and PM49. Therefore, the vast majority of the areal extent and volume of groundwater requiring remediation is defined by the groundwater samples that exceed the cleanup levels for TPH (see Plates 18 and 19), the exception being the area around monitoring well MW-58 where vinyl chloride, 1,1-DCA, and 1,1-DCE exceed their cleanup levels of 3.8 µg/l, 1,000 µg/l, and 6,300 µg/l, respectively (see Plate 21).

As shown on Plate 23, a total area of approximately 202,000 sf has TPH and/or VOC concentrations exceeding the cleanup levels that includes: (1) the 78,000 sf area where saturated soil exceeds the soil cleanup levels; and (2) a 124,000 sf area where only the

groundwater cleanup levels are exceeded. Assuming the same 6 ft thick saturated thickness as for the saturated soils, the total in-place volume of saturated soil in the area exceeding groundwater cleanup levels is 44,800 cy (17,300 cy in the area that also exceeds soil cleanup levels and 27,500 cy in the area where only groundwater cleanup levels are exceeded).

Portion of Site East of Railroad Tracks (Former Paint Storage Building and Garage)

As shown in Plates 18 through 21, there are no locations where recent groundwater sampling data show exceedances of the groundwater cleanup levels for COCs at the Site.

7.0 FEASIBILITY STUDY SCOPING

7.1 Scope of the Feasibility Study

This feasibility study is focused on developing remedial actions that address soil and groundwater affected by COCs identified at the Site, primarily petroleum hydrocarbons and VOCs. As defined in Section 6.2, the areas where soil and groundwater exceed applicable cleanup levels are shown in Plates 22 through 25. For soils, there is approximately 16,900 cubic yards (cy) of unsaturated soil and approximately 17,440 cy of saturated soil that exceed the applicable cleanup levels (primarily TPH-d and TPH-mo). Contaminants in groundwater not only exceed groundwater cleanup levels in the area where saturated soils exceed soil cleanup levels, but also exceed groundwater cleanup levels (primarily for TPH compounds) in an area approximately 124,000 sf in size adjacent to the contaminated soil areas (see Plate 23). This area where only groundwater cleanup levels are exceeded encompasses another approximately 27,500 cy of saturated soil.

This feasibility study specifically addresses the Site, and the conclusions and recommended remedial action can be implemented independently of other remedial actions being considered elsewhere at the Facility. It is important to recognize, however, that the remediation of the Site will potentially be conducted concurrent with the other areas of contamination (e.g., Site 2/3, Site 6) and that although some differences do exist between the various sites, the contaminant types are generally similar from site to site. This similarity in contaminant types leads to the possibility that certain remediation technologies will likely have applicability to more than one site and economies of scale may be recognized. See Volume I for a more detailed discussion of how the remediation activities of the different sites may be integrated.

7.2 Applicable or Relevant and Appropriate Requirements and “To Be Considered” Factors for Impacted Soil and Groundwater

In developing remedial action objectives, Applicable or Relevant and Appropriate Requirements (“ARARs”) must be considered. ARARs are described in 40 CFR Paragraph 300.430(e)(2)(i) and derived from the National Oil and Hazardous Substances Contingency Plan (“NCP”), set forth in 40 CFR Part 300. The selected remedial alternative must comply

with the ARARs. It should also, to the extent practicable, reflect and account for other regulatory policy and criteria that while not necessarily legally applicable, are “to be considered” (TBC) during the development of remedial actions. ARARs and TBCs can be subdivided into three categories:

- **Chemical specific ARARs and TBCs** are health-based or risk-based standards that define the allowable limits of specific chemical constituents detected in or discharged to the environment. Cleanup and discharge levels that determine Site remedial goals can be provided by chemical specific ARARs. The RWQCB’s Environmental Screening Levels (ESLs) are examples of potential chemical specific TBCs;
- **Location-specific ARARs and TBCs** can apply to natural features located on a site, such as the presence of endangered species, seasonal wetlands, or flood plains and to man-made features and institutional factors, including zoning requirements, landfills, and locations of archaeological or historical significance. Location-specific ARARs restrict the types of remedial actions that can be implemented based on the site-specific characteristics or location; and
- **Action-specific ARARs and TBCs** are activity-based or technology-based limitations that can set design and performance restrictions. These ARARs specify engineering controls and permit requirements that must be instituted during site activities, or restrict specific activities. The Federal Occupational Safety and Health Administration (OSHA) regulations regarding worker health and safety requirements, and California OSHA (Cal-OSHA) requirements for noise control and dust control during construction are examples of action specific ARARs.

7.2.1 Potential Chemical-Specific ARARs and TBCs

The primary potential chemical-specific ARARs for the Site are as follows:

- Federal Drinking Water Standards (40 CFR Part 141) and California Drinking Water Standards (22 CCR Section 64435) or MCLs;
- Porter-Cologne Water Quality Control Act, California Water Code, Division 7, Section 13000 et seq.; and
- National Pretreatment Standards (40 CFR Part 403).

The following are the identified potential chemical-specific TBCs for the property:

- RWQCB’s Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater (4th edition, February 2005).

7.2.2 Potential Location-Specific ARARs and TBCs

The National Archeological and Historic Preservation Act (16 USC Section 469, 36 CFR Part 65) is the only location-specific ARAR identified for the Site. Although wetlands are located south and west of the Site, they are not located within or near the areas requiring remediation.

7.2.3 Potential Action-Specific ARARs and TBCs

Identified action-specific ARARs and TBCs for the property are presented below. The following are potential action-specific ARARs for the Site:

- Resource Conservation and Recovery Act (RCRA) regulations (40 CFR Parts 261 through 268; and California Code of Regulations [CCR] Sections 66261 through 66268);
- Land Disposal Unit Criteria (40 CFR Part 264.221, et seq., 22 CCR Section 66264.221, et seq.);
- Clean Water Act (40 CFR Parts 100-149), including National Pollutant Discharge Elimination System (NPDES) Permit Requirements;
- Safe Drinking Water and Toxics Enforcement Act of 1986 (Proposition 65), State of California;
- Hazardous Materials Transportation Regulations (49 CFR Part 107, 171-177);
- Clean Air Act (42 USC Section 7401, et seq.);
- Applicable Napa County Codes and Ordinances;
- Bay Area Air Quality Management District (BAAQMD) Rules and Regulations: Organic Compounds, Regulation 8; and Hazardous Pollutants, Regulation 11;
- Occupational Safety and Health Administration (29 CFR Part 1910.120 et seq.); and
- Cal-OSHA (Title 8).

The following are potential action-specific TBCs for the property:

- San Francisco Bay Basin Plan, Region 2, Water Quality Control Plan.

7.3 Additional Factors for Remedial Action Objective Development

In addition to the regulatory requirements summarized above in Section 7.2, there are several significant non-regulatory considerations that play a role in the evaluation of remedial

technologies and alternatives, and ultimately in the selection of a recommended remedial action plan for Site 4. These additional factors include:

- **Unrestricted Land Use.** Napa County is currently updating its General Plan. Use of substantial portions of the Site for residential purposes is within the range of plans currently being studied. Accordingly, to maximize the long-term protectiveness of remedial alternatives relative to the foreseeable land uses, remedial actions at the Site should, to the extent practicable, achieve cleanup levels without extensive use of institutional or engineering controls to control or limit exposure. In other words, cleanups should remediate soil and groundwater to below risk-based cleanup levels and leave the Site with no, or as few as possible, restrictions or long-term remedial actions (e.g., deed restrictions, monitoring, maintenance of engineering controls) as possible.
- **Need for Clean Imported Soil.** Remedial actions that result in soils being transported off-site will likely require the importing of the same volume of clean soil back onto the Site. In addition, the conceptual redevelopment plan for the Napa Pipe Facility includes raising the ground surface approximately 2 to 3 feet using imported soil. This presents an opportunity for soils excavated from one remedial site to be treated, as necessary, and placed as fill in other portions of the Facility in order to achieve final grade requirements.
- **Timeframe to Achieve Cleanup.** In light of the County's on-going planning process and currently anticipated redevelopment proposals, remedial actions should be completed, and the cleanup objectives for the Site met, in a relatively short timeframe.
- **Available Area for Remedial Actions.** The Napa Pipe Facility is quite large (approximately 150 acres), the majority of which is not known to be contaminated and is available for use in the various remedial actions, including the remediation of the Site. This available land can be used for soil stockpiling, used to locate treatment systems (e.g., thermal treatment systems for soil) or processing areas (e.g., open areas for use as "landfarms"), or as a final location for placement of treated soils. Portions of the Facility, especially the southern portion, are to be zoned commercial within the Napa County Airport flyover zone. Therefore, cleanup standards in those commercially-zoned areas are proposed to be consistent with those uses.

These additional factors will influence the remedial strategies to be considered. For example, use of containment technologies such as capping, slurry walls, or hydraulic control (groundwater extraction) will not meet cleanup levels for groundwater or soil in a timely fashion and thereby would require extensive institutional and engineering controls.

7.4 Remedial Action Objectives

Remedial Action Objectives (RAOs) are goals specific to a facility, area, or to an affected medium (e.g., soil or groundwater) that are developed for protection of the environment and human health. RAOs for affected soil and groundwater are intended to guide remedial actions

that mitigate the identified potential threats to human health and the environment. These objectives should be developed in a manner consistent with reasonably foreseeable future Site uses (i.e., residential and commercial uses). RAOs can address both chemical concentrations and potential exposure pathways. The RAOs for soil and groundwater, described in Sections 7.4.1 and 7.4.2, respectively, were developed based on the conceptual model described in Section 4.3, the cleanup levels defined for the site in Section 6.1.4, the ARARs listed in Section 7.2, and the additional factors described above in Section 7.3.

7.4.1 RAOs for Soil

The following RAOs have been developed for soil:

- Reduce concentrations of COCs in soil to below the lowest applicable cleanup level listed in Section 6.1.4 to the maximum extent practicable; and
- Minimize the use of and reliance on institutional and/or engineering controls to the extent practicable.

7.4.2 RAOs for Groundwater

The following RAOs have been developed for groundwater:

- Reduce concentrations of COCs in groundwater to below the lowest applicable cleanup levels listed in Section 6.1.4 to the maximum extent practicable; and
- Minimize the use of and reliance on institutional and/or engineering controls to the extent practicable.

7.5 General Response Actions

General response actions (GRAs) are broad categories of remedial actions that may be used alone or in combination with other GRAs to achieve the RAOs for the site. The GRAs that are potentially applicable to the remediation of the Site include:

- **No Action:** A “no action” alternative is required to be evaluated as a baseline alternative against which other remedial alternatives are compared. No other remedial action would be conducted;
- **Institutional Controls:** Institutional controls, such as deed restrictions on land or resource restrictions (e.g., water use restrictions), can be used to supplement engineering controls or in conjunction with active remedial alternatives to reduce or limit exposure to hazardous substances. As discussed in Section 10, even though institutional controls are in general not as protective of human health and the environment as active remediation, they will be retained as a GRA;

- **Engineering Controls:** Engineering controls are physical measures that prevent or minimize exposure to hazardous substances or reduce the mobility or migration of hazardous substances and can be combined with institutional controls, as required, to achieve protection of human health and the environment. Although engineering controls typically require long-term maintenance and, as mentioned above for institutional controls, tend to be somewhat less protective than active remediation, they will be retained as a GRA; and
- **Active Remediation:** These remedial actions include a broad range of technologies designed to remove or destroy contaminants in specific media. Active remedial actions typically are more protective of human health and the environment compared to the no action alternative as well as institutional and engineering controls. Active remedial actions are generally preferred because they: (1) provide the best long-term protection of human health and the environment, (2) result in the reduction of the mobility, toxicity, and volume of contaminants, and (3) restore the property to its highest productive use. In this feasibility study, active remedial actions are evaluated for soil and groundwater and each of these categories is further subdivided into: (1) *in situ* remediation options; and (2) *ex situ* remediation options. Active remediation for soil utilizing on-site treatment and off-site disposal are also evaluated.

8.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

Remedial technologies are actions that can be implemented at the site to address one or more of the RAOs. There may be more than one technology and associated processes that could be appropriate for any portion of a remedial site. Once identified, the potentially applicable technologies are screened based on specific criteria to determine if they should be retained for use in development of remedial alternatives. This section describes the process and the results of identifying and screening remedial technologies potentially applicable to achieving the RAO requirements at the Site.

8.1 Preliminary Technology Identification and Screening

8.1.1 Technology Identification

Potentially applicable conventional and innovative remedial technologies and cleanup processes were identified and evaluated to address the RAOs. A preliminary list of potential applicable technologies were identified based on the physical and chemical nature of the Site contaminants (primarily TPH-mo, TPH-d, VOCs), the impacted media (soil and groundwater), the Site conditions (shallow groundwater table, extent of contamination, subsurface lithology), and the RAOs. Tables 23a and 23b list the potentially applicable remediation technologies and processes for soil and groundwater, respectively, that were evaluated to identify those that would be retained for development of the remedial alternatives.

In addition to chemical-specific technology limitations, implementing a remedy at the Site is limited by several constraints including:

- **Buildings and Structures.** Buildings or structures currently occupy a significant portion of the Site. For purposes of this FS, it is assumed that existing structures, including building foundations, will be removed prior to initiating remedial actions;
- **Subsurface Utilities.** Subsurface utilities, including water, gas, electric, and product lines, are likely located throughout the affected area. Because of the age of the Facility, the location and depth of some subsurface piping and utilities is not known with certainty. For purposes of this FS, it is assumed that subsurface utilities will be removed or deemed insignificant for remedial implementation purposes, prior to initiating remedial actions; and
- **Existing Monitoring Well Abandonment** – Existing monitoring wells that are within, or adjacent to, areas where remedial activities could damage the wells, or monitoring wells that will no longer be needed, will be abandoned as part of demolition and site preparation activities prior to initiating remedial actions.

8.1.2 Technology Screening

Screening of the potentially applicable technologies used the following criteria to determine whether a potential remediation technology and process was appropriate for achieving the site RAOs:

- **Effectiveness** – the ability to treat the Site contaminants and meet the RAOs;
- **Implementability** – constraints or difficulties in implementing the technology and verifying effectiveness; and
- **Cost** – estimated costs for construction, operation, and maintenance of the technology to meet the RAOs. Cost is used primarily to differentiate between technologies or process options that had similar effectiveness and implementability but significantly different costs.

Based on the screening criteria, technologies were either retained for use in development of remedial alternatives or eliminated from consideration. The screening process for soil and groundwater technologies is summarized in Tables 23a and 23b, respectively, including the rationale for retaining or eliminating particular technologies. The technologies retained for use in development of remedial alternatives are described in more detail in the sections below.

8.2 Soil Treatment Technologies

The affected soil area and volume at the Site are specified in Section 6.2.1 and shown in Plates 22 through 25. As noted in Section 6.1.1, the primary COCs in the soil at the Site are

TPH-mo and TPH-d, which are present in concentrations that exceed cleanup levels in the unsaturated and saturated zones. Potentially applicable technologies include those that are capable of effectively destroying or removing the contaminants in either zone. The soil remediation technologies can destroy the contaminants *in situ* within the subsurface or *ex situ* following excavation. Reducing contaminant concentrations in the soil will also reduce the potential for migration of contaminants to groundwater, thereby increasing the efficiency of subsequent groundwater cleanup.

Fourteen preliminary soil treatment technologies were identified and screened against the criteria defined above. These include conventional as well as alternative and innovative technologies. The results of the screening process are shown in Table 23a. Of the 14 technologies that were identified, six were retained for further evaluation after initial screening and are described in more detail below.

8.2.1 Excavation

Contaminated soils can be excavated using standard construction techniques and equipment, such as excavators, bulldozers, and scrapers. Excavated soils can then be managed using other remediation technologies depending on contaminant type and concentration, cleanup levels, and regulatory requirements. Limiting factors related to excavation include:

- Excavation of impacted soils may expose potentially volatile contaminants to the atmosphere and may require respiratory protection for workers or other nearby receptors as well as special excavation techniques to limit emissions;
- Excavation of saturated soils may require dewatering with subsequent management of the impacted groundwater generated by the dewatering activities;
- Shoring or other slope stabilization techniques (e.g. lay backs) will likely be required for excavations greater than 4 ft depth, and especially for excavations below the groundwater table; and
- Backfilling of excavations in the saturated zone may require importing engineered fill.

Because excavation is an implementable technology that would effectively remove the contaminated soil from the subsurface thereby eliminating the potential for future exposures and eliminating the potential for the soil to act as a source of groundwater contamination, and because it is a required first step when using *ex situ* treatment and soil management approaches, excavation will be retained for further evaluation.

8.2.2 *Ex Situ* Low Temperature Thermal Desorption

Low Temperature Thermal Desorption (LTTD) is an *ex situ* remedial technology that uses heat to increase the volatility of the contaminants and physically separate them from the soil. The impacted soil is excavated and placed in a thermal desorption unit where it is heated. The

system is designed to separate contaminants from the soil rather than destroy them. A vacuum system is used to convey the volatilized products to a vapor treatment system where the contaminants are treated prior to atmospheric discharge. There are two common thermal desorption types: the rotary dryer and thermal screw.

Rotary dryers are horizontal cylinders that can be indirect or direct fired. Most rotary systems use an inclined rotating metallic cylinder where the soil is heated. For the thermal screw systems, hollow augers transport the soil through a jacketed trough and the soil is indirectly heated. All thermal desorption systems require treatment of the volatilized vapors to remove particulates and contaminants. Particulates are removed by wet scrubbers or fabric filters, and contaminants are removed by carbon adsorption or destroyed in a secondary combustion chamber or catalytic oxidizer.

The maximum temperature is limited by the material properties of the heated components. For LTDD, the soil is heated to between 200 and 600°F. Target contaminants are VOCs and fuels with destruction efficiencies in the vapor phase treatment system of greater than 95 percent. The treated soil retains its physical properties, and unless heated to the higher end of the temperature range, natural organic components are not damaged. Limiting factors include:

- Large particles and debris – adversely impacts material handling, pre-feed requirements, and destruction efficiencies;
- Moisture – adversely impacts material handling, residence time, heating requirements, and destruction efficiencies. At moisture concentrations greater than 20 percent, drying the soil prior to the LTDD is highly recommended;
- Highly abrasive feed (e.g., large gravel and rocks) - adversely impacts desorber operation (may result in damage);
- High contaminant concentrations – adversely impacts desorber operation (may result in overheating and damage), handling requirements (may require blending), and disposal options;
- Heavy metals - adversely impacts treated soil (potentially requiring stabilization) and disposal options; and
- Clay and silty soils - adversely impacts reaction time as a result of contaminant binding or soil sticking to the cylinder.

Because the primary contaminants in soil (TPH-mo, TPH-d) are effectively treated using this technology, and the soil type and overall contaminant concentrations are suitable, and because it is implementable, *ex situ* LTDD was retained for further evaluation.

8.2.3 Biopiling

Biopiles are an *ex situ* remediation technology that involves stockpiling excavated soils into aboveground cells with interlayered process piping and systems to introduce fresh air, nutrients, and moisture as needed to stimulate aerobic biodegradation of the target contaminants. Biopiles are specifically constructed to optimize conditions for aerobic activity. The soils can be blended as needed to increase air permeability, homogeneity, and microbial population and ensure sufficient oxygen, moisture, and nutrients can be supplied throughout the pile. Measures are required to prevent contaminated vapors from being released into the atmosphere or liquids from draining into previously clean soil and groundwater. Additionally, regular monitoring is necessary to ensure optimization of biodegradation rates, track contaminant concentration reductions, and ensure ambient air and groundwater quality are not impacted. Limiting factors include:

- Soils with high percentage of fines and a high degree of saturation – adversely impacts air flowrates;
- Separate phase product – adversely impacts contaminant biodegradation rates (may be toxic to the microorganisms);
- Low contaminant concentrations – adversely impacts contaminant biodegradation rates due to less substrate for the microorganisms;
- High molecular weight compounds – adversely impacts contaminant biodegradation rates;
- Colder, wet climates – adversely impacts contaminant biodegradation rates (may require climate control measures); and
- High contaminant volatility – impacts system operation (may require treatment technology).

Because the primary contaminants in soil (TPH-mo, TPH-d) may be effectively treated using this technology, the treatment costs may be less when compared to *ex situ* LTTD, and it can be implemented in the available space, biopiling was retained for further evaluation.

8.2.4 Landfarming

The technology is the same as described for biopiles except the excavated soils are spread in a thin layer on the ground. Soil aeration is generally accomplished by tilling or plowing rather than by engineered measures such as process piping and air introduction systems. Because of the larger area of the land farm as compared to the biopiles, additional measures may be necessary to prevent soil and wind erosion and control surface water runoff and dust generation.

Because the primary contaminants in soil (TPH-mo, TPH-d) may be effectively treated using this technology, the treatment costs may be less when compared to *ex situ* LTTD or biopiling, and there may be sufficient available space to implement this technology, landfarming was retained for further evaluation.

8.2.5 *In Situ* Chemical Oxidation

This is an *in situ* remedial technology where chemical oxidants are injected into the subsurface to chemically convert contaminants into non-hazardous or less toxic compounds that are more stable, less mobile, and/or inert. For *in situ* soil treatment, this technology is almost exclusively applied to saturated soil; unsaturated soils (i.e., vadose zone) are very difficult to treat *in situ* using this technology due to problems associated with chemical delivery, distribution and contact in the soil.

The chemical oxidants most commonly used include hydrogen peroxide, persulfate, ozone, and permanganate. These oxidants have been able to cause rapid and complete chemical destruction of toxic organic compounds, and other organics have become amenable to subsequent bioremediation. The technology can achieve destruction efficiencies greater than 90% for unsaturated aliphatic compounds (e.g., TCE), aromatic compounds (e.g., benzene), and fuel-related organics with fast reaction rates. Matching the oxidant and delivery method to the contaminants and site conditions is critical to successful implementation and achieving performance goals. Limiting factors include:

- Soils with high percentage of fines – can adversely impact distribution of chemical oxidants within the target treatment zone;
- Soils with highly stratified lithology – adversely impacts the uniform delivery of chemical oxidants;
- The quantities of chemical oxidants required to ensure that target contaminants are oxidized can be large which may adversely impact handling and safety requirements;
- Indiscriminant and rapid reactions with other oxidant-consuming substances (natural organic matter, reduced minerals, carbonate, and other free radical scavengers) increase oxidant demand and can adversely impact contaminant destruction; and
- Inadvertent oxidation induced effects – adversely impacts soil properties (may decrease pH, generate colloids that result in reduced permeability, mobilize sorbed metals, form toxic byproducts, and increase temperatures and contaminated vapors).

Because the primary contaminants for the Site 4 (TPH-mo and TPH-d) are amenable to treatment using this technology, chemical oxidation was retained for further evaluation. Site soils are not ideal for *in situ* technologies such as chemical oxidation, but the relatively shallow distribution of contaminants and thin treatment zone may make implementation of oxidants feasible.

8.2.6 Off-Site Disposal

Impacted soil can be excavated and then disposed of at a permitted off-site landfill. The specific landfill that soil may be taken to will depend in part on the characterization of the soil with respect to state and federal hazardous waste regulations. Given the relatively high cost of off-site disposal, and the additional cost associated with replacing all soils taken off-site with imported fill, it is not anticipated that off-site disposal will be used as the primary approach for managing excavated soil. There may be situations, however, when unusual soil conditions and/or the presence of other contaminant types not currently identified (e.g., metals) are encountered. In these situations, other on-site treatment technologies may not be suitable and off-site disposal may be required. Therefore, off-site disposal was retained for further evaluation.

8.3 Groundwater Treatment Technologies

The affected groundwater area at the Site and volume of saturated soil associated with this affected groundwater are specified in Section 6.2.2 and shown on Plate 23. As noted in Section 6.1.2, the primary COCs in the groundwater at the Site are TPH-mo and TPH-d. VOCs including vinyl chloride, 1,1-DCA, and 1,1-DCE, toluene, and chloroethane also exceed their cleanup levels to a more limited extent than the TPH compounds. The only area where VOCs define the extent of groundwater exceeding a cleanup level (i.e., in areas where TPH do not exceed the cleanup level) is the area around monitoring well MW-58 and MW-64 where vinyl chloride, 1,1-DCA, and 1,1-DCE exceed their cleanup levels (see Plate 21). Other VOCs are also present in groundwater in the Site at concentrations below their ESLs, but at much lower concentrations than the primary COCs and are generally co-located with the primary COCs that are present at much higher concentrations.

Identified potentially applicable technologies include those that are capable of effectively destroying or removing the contaminants. The groundwater remediation technologies can destroy the contaminants *in situ* within the subsurface or *ex situ* following extraction or excavation of the saturated soil.

Ten preliminary groundwater treatment technologies were identified and screened against the criteria defined above. These included conventional as well as alternative and innovative technologies. The results of the screening process are shown in Table 23b. Of the ten technologies that were identified, two *ex situ* technology and two *in situ* technologies were retained for further evaluation after initial screening and are described in more detail below.

8.3.1 *In Situ* Enhanced Bioremediation

This *in situ* technology refers to the addition of oxygen, nutrients, co-substrates, and/or other amendments to the groundwater to increase whatever natural aerobic and/or anaerobic

biodegradation rates that may be ongoing. The existing microorganisms are used to metabolize the organic contaminants in the groundwater. Limiting factors include:

- Soils with high percentage of fines – can adversely impact distribution of oxygen, nutrient, co-substrates, and other amendments within the target zone;
- Excessive localized microorganism growth – adversely impacts system operation (may result in clogging nutrient and water injection wells);
- Soils with highly stratified lithology – adversely impacts delivery of oxygen, nutrients, co-substrates, and other amendments to the microorganisms;
- High contaminant concentrations/separate-phase product – adversely impacts contaminant biodegradation rates (may be toxic to the microorganisms);
- Very low contaminant concentrations – adversely impacts contaminant biodegradation rates due to less substrate for the microorganisms;
- High molecular weight compounds – adversely impacts contaminant biodegradation rates; and
- The possible need for both aerobic and anaerobic conditions/processes to effectively treat the range of contaminants present (e.g., TPH compounds via aerobic processes and chlorinated compounds via anaerobic processes).

The primary COCs in groundwater at the Site (TPH-mo and TPH-d) would be effectively treated using enhanced biodegradation and the technology can be readily implemented at the Site. Saturated Site soils are not ideal for *in situ* technologies such as enhanced bioremediation, but relatively shallow distribution of contaminants makes effective application of amendments more feasible.

8.3.2 *In Situ* Chemical Oxidation

This *in situ* technology uses oxidizing agents to oxidize and destroy organic contaminants. This is a direct chemical reaction involving the application or injection of oxidants into the target zone to destroy or chemically transform the contaminants. Efficient oxidation depends on the reaction potential and the effective contact between oxidant and contaminant. Subsurface heterogeneities, preferential flow paths, and poor mixing in the subsurface may result in inefficient treatment. Additionally, oxidation is non-specific, and the oxidant will be consumed not only by the contaminant, but also by natural demands within the target zone. These include other organic material and reduced-state metals.

There are a number of oxidants that are potentially usable, including ozone, persulfate, hydrogen peroxide, and permanganate. Of these, ozone, persulfate, peroxide, and permanganate are the most widely used and are generally commercially available. Some

oxidants (e.g., ozone and peroxide) are very strong and effective, but also rapidly decompose which can limit the ability to distribute them in the subsurface. Permanganate and persulfate are also strong oxidants and do not decompose as readily as peroxide and ozone and therefore can be easier to distribute in the subsurface. Matching the oxidant and delivery method to the contaminants and site conditions is critical to successful implementation and achieving performance goals. Limiting factors include:

- Saturated soils with high percentage of fines can adversely impact distribution of chemical oxidants within the target treatment zone;
- Saturated soils with highly stratified lithology may present preferential flow pathways that can adversely impact the uniform delivery of chemical oxidants;
- The quantities of chemical oxidants required to ensure target contaminants are oxidized can be large which may adversely impacts handling and safety requirements;
- Indiscriminant and rapid reactions with other oxidant-consuming substances (natural organic matter, reduced minerals, carbonate, and other free radical scavengers) increase oxidant demand and can adversely impact contaminant destruction; and
- Inadvertent oxidation induced effects – adversely impacts soil properties (may decrease pH, generate colloids that result in reduced permeability, mobilize sorbed metals, form toxic byproducts, and increase temperatures and contaminated vapors).

Because chemical oxidation would effectively treat the primary contaminants for the Site (TPH-mo and TPH-d), it was retained for further evaluation. Site conditions are not ideal for *in situ* technologies such as chemical oxidation, but the relatively shallow distribution of contaminants and thin treatment zone may make implementation of oxidants feasible.

8.3.3 Saturated Soil Excavation

This is an *ex situ* technology that involves physically removing the contaminated groundwater by excavating the saturated soil within the groundwater plume boundaries and dewatering, as necessary. Excavation for removal of contaminated soils (i.e., with COCs exceeding soil cleanup levels) is discussed in Section 8.2.1. Excavated saturated soil would be managed on-site through drying, treatment, or other appropriate methods and used as fill. Provisions are necessary to remove and control groundwater within the excavation boundaries. The excavation boundaries will overlap into clean areas to ensure the entire volume of the groundwater plume is removed. Limiting factors include:

- Excavation of saturated soil becomes increasingly more difficult and expensive the deeper contamination extends below the water table;

- High permeability saturated soils may result in excessive amounts of groundwater being generated by dewatering of the excavation, significantly increasing difficulty and cost; and
- Large excavations may require phased implementation.

Because contamination is relatively shallow at the Site and the soils are generally low permeability, excavation of saturated soils is an effective and implementable approach and will quickly remove the groundwater plume.

8.3.4 Existing Wastewater Treatment System

Excavation would require management of contaminated groundwater generated during dewatering activities. The Facility has an existing wastewater treatment system that discharges into the sanitary sewer under a permit with the Napa County Sanitation District. This system includes storage tanks, chemical injection systems (flocculant injection), settling tanks, an oil/water separator, and is maintained and periodically sampled to meet discharge requirements. Groundwater generated during dewatering can be treated using this existing wastewater treatment system and discharged to the sanitary sewer under the existing permit. If additional treatment is required to remove dissolved organic constituents (TPH, VOCs) to below permit limits, a series of granular activated carbon vessels can be added as a polishing step prior to discharge.

8.4 Summary of Retained Remedial Technologies

The technologies retained for use in alternative development include:

- **Soil Technologies**
 - Excavation
 - *Ex Situ* Low Temperature Thermal Desorption
 - Bio-Piling
 - Landfarming
 - Off-Site Disposal
 - *In Situ* Chemical Oxidation
- **Groundwater Technologies**
 - *In Situ* Enhanced Bioremediation
 - *In Situ* Chemical Oxidation
 - Saturated Soil Excavation
 - Existing Wastewater Treatment System

These technologies include *in situ* and *ex situ* technologies for both soil and groundwater. All of the retained technologies are likely to be effective at treating the Site contaminants, are implementable, have costs that are not disproportionate to other retained technologies, and will likely meet the RAOs, but optimizing the manner in which these technologies may be utilized

most effectively (and therefore most cost-effectively) will likely require limited treatability studies during the design process. Based on the results of these treatability studies and the variability in contaminant concentrations present at the Site, it is likely that one technology may be most effective at treating soil and/or groundwater with lower contaminant concentrations whereas another technology may be most effective for higher concentrations.

9.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Remedial alternatives are combinations of technologies designed to meet the RAOs. The technologies retained from the screening process were assembled into the three remedial alternatives described below that could treat the contaminants in soil and groundwater and protect public health. Each remedial alternative is described in the following sections with respect to conceptual design, implementation, effectiveness and performance, estimated cleanup time, and estimated cost. The conceptual design is developed in sufficient detail to conduct the detailed comparative evaluation of the alternatives (Section 10).

The duration of remedy alternatives was estimated using engineering judgment and general knowledge of the remediation technologies. Depending on the nature of the alternative, the duration of the cleanup can be difficult to predict because numerous site conditions and processes impact the effectiveness of the remediation technologies that make up an alternative. Therefore, the alternatives were compared on the basis of the estimated relative effectiveness of the technologies and the likelihood that cleanup could be achieved in a timeframe consistent with the reasonably foreseeable future land use.

The costs of the remedial alternatives discussed below were developed by accounting for capital costs as well as recurring and future costs. Capital costs include workplans, design reports, other agency-required documents, and construction to implement the remedy. Recurring and future costs include groundwater monitoring, operation and maintenance, and reporting.

A contingency of 30 percent was added to each alternative to reflect a level of uncertainty in the estimated costs. The contingency on capital cost reflects uncertainty in construction costs. The contingency on recurring and future costs generally reflects uncertainty of the operation and maintenance costs and the duration of the remedy. These cost estimates should be considered accurate in the range of minus 30 percent to plus 50 percent of the estimated cost consistent with regulatory guidance for preparation of feasibility studies. The cost estimates are rounded to the nearest \$10,000.

9.1 Approach to Developing Remedial Alternatives

The approach to developing remedial alternatives for the Site is based both on the requirements of the RAOs and on the technologies retained based on the screening conducted in Section 8. The RAOs require that the remediation achieve cleanup levels minimizing the use of

institutional or engineering controls after remediation is completed. These requirements are consistent with the general policies of state and federal cleanup regulations and guidance that favor remedial strategies that clean up and restore contaminated sites and that accommodate the range of reasonably foreseeable land uses. Since the anticipated future use of the Site includes residential development, remedial approaches relying on containment or risk-management approaches were not preferred.

The NCP requires that “no action” alternative be evaluated, and one is included in the development and evaluation of alternatives below. Typically, where existing remedial measures have occurred or are ongoing, an alternative is included in the feasibility study that, to varying degrees, maintains the existing remedial actions. At the Site, the existing RWQCB orders (Order No. 90-147 and Order No. R2-2205-0012) require, among other things, groundwater monitoring to document groundwater contaminant levels (refer to Section 2.4.8 for details). At Site 4, monitoring also includes supplemental sampling in 11 wells to document MNA for chlorinated VOCs (Section 2.4.6). While these existing monitoring and MNA activities would not, either by themselves or in conjunction with other similar measures, meet the RAOs for the Site, a remedial alternative based on the existing measures is included for evaluation in the FS.

9.1.1 General Remediation Approaches

Rather than developing separate remedial alternatives to evaluate each of the technologies individually, both the *in situ* and *ex situ* technologies will be retained and evaluated together as separate “tool boxes” for soil and groundwater remediation. The specific “tools” to be used in an alternative are defined in the alternative descriptions below. If an alternative is selected for implementation, the manner in which the tool box technologies would be applied may be optimized during design and in conjunction with the other remedial actions being conducted at other sites within the Napa Pipe Facility.

With respect to developing remedial alternatives that meet the RAOs, this tool box approach leads to the following two general remedial alternatives that will be evaluated:

- An *in situ* approach for groundwater and some soils, excluding the primary source area. Unsaturated soil exceeding the ESLs and highly contaminated soils within the primary source area will be addressed using *ex situ* technologies; and
- An all *ex situ* approach that involves excavation of all soil and groundwater (i.e., saturated soil) exceeding cleanup levels and managing the excavated soils using one of more of the *ex situ* treatment technologies, as needed.

An *in situ* approach for all saturated soil and groundwater, including the primary source area, is not deemed feasible due to the uncertainties about effectively treating the source area soil where separate-phase product may be present and the associated very high costs in attempting this type of treatment.

Additional development of the tool box approach for *in situ* and *ex situ* remediation is provided below, followed by a detailed description of the remedial alternatives to be evaluated in the FS.

9.1.2 *In Situ* Tool Box

The retained technologies for *in situ* remediation of soil and groundwater consists of enhanced bioremediation and chemical oxidation. These technologies can be implemented separately or, depending on the chemistry utilized, together in a complimentary way.

For purposes of this FS, the *in situ* approach would consist of injecting a combination of sodium persulfate and calcium peroxide. Sodium persulfate is a stable, highly soluble, crystalline material, which upon activation generates the sulfate radical, a very strong oxidant, capable of oxidizing a broad range of compounds including fuel hydrocarbons. The calcium peroxide has a dual activating effect on the persulfate by the release of peroxide and by creating alkaline conditions. The degradation of the calcium peroxide would also provide a longer term source of oxygen which would enhance the biodegradation of contaminants. Finally, the sulfates generated by the reaction of persulfate can be also utilized by sulfate bacteria. These sulfate bacteria can assist in the bioremediation of the contaminants when the aquifer is converted from an aerobic system to an anaerobic system following consumption of oxygen by bacteria that aerobically degrade the petroleum hydrocarbons.

This dual chemical blend would be introduced to the subsurface through a series of injections. Geoprobe technology would be used to advance injection rods to the maximum depth of the vertical contaminant treatment zone (e.g., 10 feet bgs). The chemicals will be injected through the bottom of the rods into the surrounding formation as the rods are retracted upwards through the entire length of the vertical contamination zone. The rate and total volume of treatment chemistry injected into the formation would be monitored to ensure an even distribution of treatment chemistry throughout the entire length of the vertical contamination zone. Once injected, the chemicals will disperse into the saturated zone through advective transport and dispersion.

As noted above, this *in situ* approach is best suited to saturated soil and groundwater outside of the primary source area and is not readily applicable to the primary source area or unsaturated soil. The source area and unsaturated soils will be addressed by *ex situ* technologies in all remedial alternatives developed below.

9.1.3 *Ex Situ* Tool Box and Soil Management Protocol

The first step in any *ex situ* remediation approach is removing the affected media from the subsurface so it can be managed using other technologies. For both soil and groundwater, excavation would be the approach used, with groundwater being “excavated” by removing the saturated soil (including the groundwater) as well as by the incidental dewatering that might be required as part of excavating below the water table.

Once removed from the subsurface, the soil would be segregated and managed using the tool box of *ex situ* treatment technologies consistent with a soil management protocol that will be developed during remedial design and documented in a Remedial Design and Implementation Plan (RDIP). The RDIP will be a document that presents a detailed protocol for managing all soil excavated not only at the Site, but for all remedial actions at the Napa Pipe Facility. Included in the protocol will be requirements for confirmation sampling and analysis to confirm excavated (and treated, if necessary) soils have met cleanup levels. With respect to the soils from the Site, the soil management protocol would utilize the *ex situ* treatment technologies retained in Section 8. Based on analytical testing results, soil would be segregated into the general categories listed below and managed by category as follows:

- 1) **Clean Overburden** – Unsaturated soil with contaminant concentrations below the cleanup levels that has to be excavated to access contaminated saturated soils or groundwater below. This soil would be stockpiled near the excavation and then reused as backfill (assuming it is suitable from a geotechnical perspective) after remedial activities are completed.
- 2) **Soil Exceeding Residential ESLs but Below Commercial Cleanup Levels** – Unsaturated or saturated soil that has concentrations of COCs in excess of the residential cleanup levels but below the commercial cleanup levels would be transported to commercially-zoned areas (e.g., the areas south of the ECB), dried as necessary, and used as fill in these areas without further treatment.
- 3) **Soil Exceeding both Residential and Commercial Cleanup Levels** – Unsaturated or saturated soil that has concentrations of COCs in excess of both residential and commercial cleanup levels would be transported to a central stockpile area for contaminated soil and treated using one or more of the treatment technologies in the “tool box”. Soil falling in this general category would likely be further segregated (e.g., unsaturated vs. saturated, total TPH concentrations greater than 30,000 mg/kg) to facilitate effective treatment. Once treated to below cleanup levels (verified through confirmation sampling and analysis), the soil would be used as fill at the Facility.
- 4) **Saturated Soil from Groundwater Plume Areas** – Saturated soils located in areas where concentrations of COCs in groundwater exceed groundwater cleanup levels, but COC concentrations in soil are below soil cleanup levels, would be transported to a stockpile area, dried as necessary, and used as fill at the Facility (residential or commercially-zoned areas) without further treatment.

Three of the four categories (1, 2, and 4) defined above would not require that the excavated soil be treated prior to use as fill at the Facility. For the third category, some treatment of the soil would be required before the soil can be used as fill. One or more of the following retained *ex situ* treatment technologies would be used:

- Biopiling;

- Landfarming; and
- *Ex Situ* Low Temperature Thermal Desorption.

All of these technologies are able to effectively treat the Site contaminants and the manner in which they would be utilized are defined in the alternative descriptions below. During development of the soil management protocol and the RDIP, the implementation approach will be optimized based on a variety of factors including contaminant concentrations of specific soil, the type and quantity of soil being remediated elsewhere at the Facility, the results of treatability studies, and refined cost estimates based on a detailed design.

Finally, off-site disposal is also retained for use as part of the soil management protocol for those situations when unusual soil conditions and/or the presence of other contaminant types not currently identified (e.g., metals) are encountered. In these situations, other on-site treatment technologies may not be suitable and off-site disposal may be required.

9.2 Alternative 1 – No Action

9.2.1 Alternative Description

The “no action” alternative is required by the NCP. In this alternative, no cleanup of soil or groundwater would be conducted and no additional groundwater monitoring would be conducted (the existing groundwater monitoring wells are assumed to be decommissioned during demolition activities).

9.2.2 Cost

There is little or no cost associated with implementing the no action alternative.

9.3 Alternative 2 – Maintain Existing Remedial Actions

9.3.1 Alternative Description

In this alternative, the status quo is maintained via continued groundwater monitoring as specified in the existing RWQCB orders, and monitored natural attenuation (MNA) as specified in the existing remedial plan (MWH, 2003). For cost estimating purposes, groundwater monitoring (including for natural attenuation parameters) is assumed to continue for another 20 years.

9.3.3 Cost

The annual costs for implementing Alternative 2 (i.e., continued groundwater and MNA parameters monitoring) is estimated to be \$80,000. The net present value of the O&M costs

for this alternative over the durations defined above, and assuming a discount rate¹⁶ of 5%, is \$1 million.

9.4 Alternative 3 – Ex Situ Source Area Soil and Groundwater Treatment and In situ Groundwater Plume Remediation

9.4.1 Alternative 3 Description

Alternative 3 consists of two major components: (1) excavation and *ex situ* treatment of source area saturated and unsaturated soils and groundwater and (2) *in situ* treatment of groundwater exceeding cleanup levels but outside of the source area. The excavation of the source area would be conducted first in order to both remove the source contaminants and also to induce hydraulic gradients from the surrounding plume areas toward the excavation through dewatering activities. The dewatering would not only remove some of the contaminated groundwater for treatment, but the increased hydraulic gradients may assist in the distribution of the chemical oxidants to be used in the *in situ* treatment phase of the remediation.

Excavation and Ex Situ Treatment of Source Area Soil and Groundwater. For purposes of this FS, the source area of the Site is defined as including: (1) unsaturated soils exceeding the cleanup levels (see Plates 22 and 24) and (2) the saturated soil and groundwater located in the area where saturated soils exceed the soil cleanup levels (Plates 23 and 25). As described in Section 6.2, these two areas include 16,900 cy and 17,440 cy of soil, respectively, for a total excavation volume of approximately 34,340 cy.

The approach for managing the excavated soil is described above in Section 9.1.3, with the soil being segregated into categories based on contaminant levels and managed consistent with a soil management protocol. Where treatment is required to achieve cleanup levels, technologies in the “tool box” would be utilized as defined below. The initial excavation would be the unsaturated soils exceeding cleanup levels and the clean overburden required to be removed to access the underlying saturated zone soils. The clean overburden would be stockpiled nearby for later use as backfill, and the soil exceeding the cleanup levels would be segregated by contaminant level and taken to the appropriate stockpile and/or treatment area for processing as defined below.

Next, the source area saturated zone would be excavated. Excavating the saturated zone would involve some form of dewatering. Groundwater generated during excavation dewatering, which will contain elevated contaminant levels, would be collected and transported to the existing wastewater treatment system for pretreatment prior to discharging to the sanitary sewer under the Facility’s existing permit. It is assumed that granular activated carbon (GAC) adsorption vessels would be added to the existing treatment system to reduce the dissolved organic level prior to discharge. As with the unsaturated soils, the excavated saturated soils would be segregated by contaminant level and taken to the appropriate stockpile and/or

¹⁶ Discount rate equals interest rate minus inflation rate.

treatment area for processing. If these saturated soils require the additional step of drying before they can be further treated, they would be spread and dried in a separate area designed such that water draining from the soil can be collected and treated on site.

The technologies retained in the “tool box” for managing soil *ex situ* include biopiling, landfarming, low temperature thermal desorption, and off-site disposal. Based on the available information and for purposes of developing a cost estimate for this FS, it is assumed that excavated soils would be managed as follows:

- Approximately 3,400 cy (10 percent) would have contaminant levels below commercial cleanup levels (verified through confirmation sampling and analysis) and can be used directly as fill in the commercially-zoned areas (after drying if necessary);
- Approximately 10,300 cy of the soil (30 percent), generally those with low to moderate contaminant levels (verified through confirmation sampling), would be treated directly using biopiling techniques to at least commercial cleanup levels and used as fill in the commercially-zoned areas;
- Approximately 17,100 cy of the soils (50 percent), generally those with moderate to high contaminant levels, would be treated using low temperature thermal desorption, sampled to confirm cleanup levels have been met, and then used as fill; and
- Approximately 3,400 cy of the soil (10 percent) would require off-site disposal.

The above percentages are based on general technology limitations and available contaminant distribution information and are intended to be representative of technologies retained in the “tool box”. As noted above, during development of the soil management protocol and the RDIP, the implementation approach will be optimized based on a variety of factors as well as detailed analysis of COC concentrations or specific requirements for individual technologies.

Verification soil samples would be collected from the excavation areas using a hand sampler and earthmoving equipment to evaluate whether the target cleanup levels have been met. Verification sample analyses would likely be performed utilizing an expedited laboratory turn-around schedule, or an on-site mobile laboratory, in order to reduce the likelihood for significant delays to affect the remedial action schedule. In addition to verification soil sampling, it is anticipated that soil gas samples would be collected from shallow soil to confirm that residual contamination that may be present at depth, although below applicable soil or groundwater ESL values, is not causing an exceedance of a soil gas ESL. Should laboratory analytical results indicate that the cleanup level has not been attained, additional excavation will be performed.

Once the excavation is completed, it would be backfilled using a combination of recycled concrete (generated during demolition of the existing Facility building foundations) and imported granular fill to the approximate elevation of the water table and then using clean overburden, clean imported fill, or potentially soils treated to below the residential ESLs. In

order to prevent the recontamination of the clean backfill in the saturated zone, amendments may be added to the backfill to promote enhanced biodegradation of contaminants in groundwater that flow back into the former excavation.

In Situ Treatment of Groundwater Outside of the Source Area. The area where groundwater exceeds cleanup levels outside the source area is shown on Plate 24. As described in Section 6.2, this area comprises approximately 2.9 acres and contains an estimated 27,500 cy of saturated soil. The general approach to the *in situ* treatment of the groundwater in this area is described above in Section 9.1.2 and consists of *in situ* chemical oxidation and enhanced bioremediation using a sodium persulfate/calcium peroxide blend. For cost estimating, it is assumed that the blend would consist of a 5 to 1 mix of 25 percent sodium persulfate and 25 percent calcium peroxide.

Based on the existing information, the sodium persulfate/calcium peroxide mixture would be injected using Geoprobe technology. For cost estimating, it is assumed the injection points would be spaced approximately 10 ft apart, and with an assumed average radius of influence of approximately 6 ft, this should provide overlap of the coverage provided by each injection point. With this assumed spacing, it would take approximately 1,100 injection locations to effectively treat the target area.

Monitoring the effectiveness of the *in situ* treatment would be accomplished through a network of monitoring wells installed in the treatment area before the injections occur. Several pre-injection monitoring events would be conducted to establish pre-treatment baseline concentrations. Post-treatment monitoring would be conducted to confirm that cleanup levels have been achieved and that no “rebound” of contaminant concentrations is occurring. A typical post-treatment monitoring program would consist of a round of sampling 2 weeks after injection, 6 weeks after injection, 3 months after injection, and then quarterly for three events to provide a year of monitoring data. If cleanup levels in certain areas are not met initially, or concentrations “rebound”, additional injections of oxidant would be required.

In addition to the groundwater monitoring described above, it is anticipated that soil gas samples would be collected from shallow soil to confirm that residual groundwater contamination, although below their respective soil or groundwater cleanup levels, is not causing an exceedance of a soil gas ESL.

9.4.2 Cost

The costs associated with implementing Alternative 3 are shown in Table 24. The capital costs for Alternative 3 include excavation and treatment of soils, *in situ* treatment of groundwater, placing treated soil as fill, amending the backfill to promote biodegradation of residual contaminants, and managing groundwater generated during dewatering. Operations and maintenance (O&M) costs associated with Alternative 3 are limited to short-term post-treatment monitoring of the *in situ* treatment area.

The estimated capital costs for Alternative 3 range from a low of \$3.62 million to a high of \$6.46 million, with an average capital cost of \$5.04 million. Average O&M costs are estimated at \$177,000 assuming one year of post-treatment monitoring. Total remediation costs for Alternative 3, using the average capital and O&M costs, are estimated at \$5.22 million. It is assumed that implementation of Alternative 3 would begin in 2008 and that all capital costs will be incurred during 2008, although some *ex situ* soil treatment activities could extend into 2009. O&M costs (groundwater monitoring) would extend into 2009.

9.5 Alternative 4 – Ex Situ Soil and Groundwater Remediation

9.5.1 Alternative Description

Alternative 4 consists of the excavation and *ex situ* treatment of all saturated and unsaturated soils and groundwater that exceed their respective cleanup levels. The areas that would be excavated are defined in Plates 22 through 25. As described in Section 6.2, the estimated volume of soil exceeding cleanup levels includes 16,900 cy of unsaturated soil and 17,440 cy of saturated soil. The area where only groundwater exceeds cleanup levels (Plate 14) contains an additional 27,500 cy of saturated soil. The total estimated volume of soil to be excavated in Alternative 4 is 61,840 cy.

The approach for managing the excavated soil is described above in Section 9.1.3, with the soil being segregated into categories based on contaminant levels and managed consistent with a soil management protocol. Where treatment is required to achieve cleanup levels, technologies in the “tool box” would be utilized as defined below. The initial excavation would be the unsaturated soils exceeding cleanup levels and the clean overburden required to be removed to access the underlying saturated zone soils. The clean overburden would be stockpiled nearby for later use as backfill, and the soil exceeding the cleanup levels would be segregated by contaminant level and taken to the appropriate stockpile and/or treatment area for processing as defined below.

Next, the saturated zone would be excavated as described above for Alternative 3, with dewatering activities used as necessary and the groundwater generated collected and treated onsite using the existing wastewater treatment system prior to discharging to the sanitary sewer under the Facility’s existing permit. The excavated saturated soils would be segregated by contaminant level and taken to the appropriate stockpile, dried as necessary prior to reuse or treatment, and then managed as defined below.

Similar to Alternative 3, the “tool box” of *ex situ* soil treatment technologies would be used to manage the excavated soil. Based on the available information and for purposes of developing a cost estimate for this FS it is assumed that excavated soils would be managed as defined in Alternative 3 with the exception that all of the 27,500 cy of soil being excavated to remove the areas where groundwater exceeds cleanup levels (but soil concentrations are below cleanup levels), would have soil concentrations below residential cleanup levels and could be used as

fill without additional treatment beyond drying. With these assumptions, the excavated soil in Alternative 4 would be managed as follows:

- Approximately 30,900 cy (50 percent) would have contaminant levels below commercial cleanup levels (verified through confirmation sampling and analysis) and could be used directly as fill in the commercially-zoned areas (after drying if necessary);
- Approximately 10,300 cy of the soil (17 percent), generally those with low to moderate contaminant levels, would be treated directly using biopiling techniques to at least commercial cleanup levels (verified through confirmation sampling and analysis) and could be used as fill in the commercially-zoned areas;
- Approximately 17,100 cy of the soils (28 percent), generally those with the highest contaminant levels, would be treated using low temperature thermal desorption, sampled to confirm cleanup levels have been met, and then used as fill; and
- Approximately 3,400 cy of the soils (5 percent) would require off-site disposal.

Once the excavation is completed, it would be backfilled using a combination of recycled concrete (generated during demolition of the current building foundations) and imported granular fill to the approximate elevation of the water table and then using clean overburden, clean imported fill, or potentially soils treated to below the residential cleanup levels. In order to prevent the recontamination of the clean backfill in the saturated zone, amendments may be added to the backfill to promote enhanced biodegradation of contaminants in groundwater that flow back into the former excavation.

As described above for Alternative 3, verification soil and soil gas samples would be collected to evaluate whether the target cleanup levels have been met. Should verification results indicate that the cleanup levels has not been attained, additional excavation would be performed.

9.5.2 Cost

The costs associated with implementing Alternative 4 are shown in Table 25. The capital costs for Alternative 4 would include excavation and treatment of soils, placing treated soil as fill, amending the backfill to promote biodegradation of residual contaminants, and managing groundwater generated during dewatering. There are no ongoing O&M costs associated with Alternative 4.

The estimated capital costs (and total remediation costs since there are no O&M costs) for Alternative 4 range from a low of \$3.26 million to a high of \$5.98 million, with an average capital cost of \$4.62 million. It is assumed that implementation of Alternative 4 would be conducted in 2008 and that all capital costs will be incurred during 2008, although some *ex situ* soil treatment activities could extend into 2009.

10.0 EVALUATION OF REMEDIAL ALTERNATIVES

The following section: (1) summarizes the criteria for evaluation of remedial alternatives; (2) evaluates the four remedial alternatives against the evaluation criteria and RAOs; (3) presents a comparative evaluation of the four alternatives against each other with respect to the evaluation criteria and RAOs; and (4) recommends a preferred remedial alternative for implementation to address soil and groundwater contamination at the Site.

10.1 Criteria for Evaluation

In addition to the RAOs developed in Section 7.4, each remedial alternative will be evaluated against the nine evaluation criteria set forth in the NCP and accompanying USEPA guidance documents (NCP, 1990 and USEPA, 1998). These nine criteria are divided into three categories: “Threshold Criteria,” “Primary Balancing Criteria,” and “Modifying Criteria.”

In accordance with USEPA guidance in the NCP, the selected alternative is required to meet the two threshold criteria. The five primary balancing criteria provide comparisons between the alternatives and identify tradeoffs between them. The two modifying criteria consider acceptance by the State and by the local community. The nine evaluation criteria are described below.

10.1.1 Threshold Criteria

1. **Overall Protection of Human Health and the Environment.** This criterion addresses whether a remedial alternative is protective of human health and the environment considering long-term and short-term site-specific characteristics. The remedy’s short-term effectiveness, long-term effectiveness and permanence, and ability to reduce chemical toxicity, mobility, and volume affect the evaluation under this criterion. This criterion considers the degree of certainty that an alternative can meet the site-specific remedial action goals.
2. **Compliance with Applicable or Relevant and Appropriate Requirements.** RAOs for the site are developed by considering, among other things, ARARs. The remedial alternatives must comply with ARARs, which are presented in Section 7.2.

10.1.2 Balancing Criteria

1. **Long-Term Effectiveness and Permanence.** This criterion addresses how well a remedy maintains protection of human health and the environment after the site-specific remedial goals have been met to the extent feasible. Components to be addressed include the magnitude of residual risk, the adequacy and long-term reliability of institutional controls and containment systems, and potential consequences should the remedy or some portion of it fail.

2. **Reduction of Mobility, Toxicity, or Volume.** Under this criterion, the anticipated amount of the chemical of concern destroyed or treated and the amount remaining at the site are assessed, along with the degree of expected reduction in chemical mobility, toxicity, or volume.
3. **Short-Term Effectiveness.** This criterion concerns protection of human health and the environment during construction and implementation of the remedy.
4. **Implementability.** Implementability considers both the technical and administrative feasibility of implementation. The criterion also considers the ability to construct and operate remedial facilities, ease of undertaking additional remedial actions, ability to monitor remedial effectiveness, and the ability to obtain necessary approvals and permits.
5. **Cost.** The costs to be assessed include the capital cost, annual operation and maintenance costs.

10.1.3 Modifying Criteria

1. **State Acceptance.** The State Acceptance criterion incorporates input from state agencies to modify the alternative selection process. This input can be obtained via formal comments received during the project comment period.
2. **Community Acceptance.** This criterion addresses reaction from the local citizenry.

The NCP requires that an environmental evaluation of sensitive or critical habitats be conducted. In this Site 4 setting, there are no sensitive or critical habitats requiring environmental evaluation. While wetlands/the Napa River are present to the south and west of Site 4, these areas are not adjacent to the areas requiring remediation. Furthermore, through stormwater controls implemented during the rainy season, surface water runoff from the excavation area and/or ex-situ treatment or stockpile areas would be controlled to prevent contaminants from being released to sensitive environmental receptors.

10.2 Detailed Evaluation of Alternatives

The evaluation of the remedial alternatives against the NCP criteria and the RAOs is presented in Table 26, and summarized below for each alternative.

10.2.1 Alternative 1 – No Action

There is little or no cost associated with Alternative 1.

Alternative 1 does not meet either of the threshold NCP criteria – (1) protection of human health and the environment and (2) compliance with ARARs. It does not meet the RAOs described in Section 7.4. Therefore, Alternative 1 is judged not to be acceptable.

10.2.2 Alternative 2 – Maintain Existing Remedial Actions

Alternative 2 has an estimated cost of \$1 million.

In light of the range of foreseeable land uses for the Site, Alternative 2 does not meet either of the threshold NCP criteria – (1) protection of human health and the environment and (2) compliance with ARARs. It does not meet the RAOs described in Section 7.4. Therefore, Alternative 2 is judged not to be acceptable and active remediation is required.

10.2.3 Alternative 3 – *Ex Situ* Source Area Soil and Groundwater Treatment and *In Situ* Groundwater Remediation

Because it reduces contaminant concentrations to below risk-based cleanup levels, Alternative 3 is protective of human health and the environment and meets the first threshold requirement. This alternative should also comply with ARARs. In general, Alternative 3 also performs well on the five balancing criteria, with the possible exception of technical implementability. Specifically, potential difficulties associated with uniformly distributing the chemical oxidant throughout the relatively low permeability soils of the treatment zone would need to be addressed prior to implementation. Treatability studies can be conducted to help address this issue.

Alternative 3 has an estimated cost of \$5.21 million, almost all of which are capital costs related to treatment of the soil and groundwater during the first year this alternative is implemented. The major uncertainties associated with this cost are related to unit costs for soil and groundwater treatment. Information developed during treatability studies conducted during design would help refine these unit costs and reduce the cost uncertainty.

10.2.4 Alternative 4 – *Ex Situ* Soil and Groundwater Remediation

The evaluation of Alternative 4 is very similar to that of Alternative 3, except there are no implementability concerns related to *in situ* chemical oxidation for Alternative 4. This alternative meets all of the NCP criteria with a relatively high degree of certainty.

Alternative 4 has an estimated cost of \$4.62 million, all of which are capital costs related to excavation and treatment of the soil and groundwater during the first year this alternative is implemented. As with Alternative 3, the major uncertainties associated with this cost are related to unit costs for soil and groundwater treatment, which can be refined based on treatability studies conducted during design.

10.3 Summary of Comparison of Remedial Alternatives

The comparative evaluation of the alternatives against each of the criteria is also shown in Table 26. Alternatives 1 and 2 compare poorly against the other two alternatives in all criteria (except cost) and, as such, are not acceptable alternatives for meeting the RAOs.

Comparing Alternatives 3 and 4, they are very similar in their ability to meet the cleanup objectives. Both compare favorably to the evaluation criteria, and both meet the RAOs for the Site. Although the estimated cost of Alternative 4 is approximately \$600,000 less than Alternative 3, these alternatives have somewhat similar costs given the accuracy of the estimates. The most significant difference between the two alternatives is related to the *in situ* chemical oxidation component of Alternative 3. As described in Table 26, given the relatively low permeability and potentially stratified nature of the soils in the saturated zone, there may be some difficulties in effectively distributing the chemical oxidant throughout the treatment zone. Uniform distribution of treatment chemicals is critical to effectively treat the entire affected area. Failure to uniformly distribute the oxidant could lead to partially treated, or even untreated, areas that could lead to a “rebound” effect for contaminant levels in groundwater. If post-treatment monitoring indicated that a rebound in concentrations was occurring, supplemental injections of oxidant would be required to polish the residual contaminants and meet cleanup levels.

10.4 Recommended Remedial Alternative

Based on the evaluation of the three alternatives against the NCP criteria and the RAOs, Alternative 4 is superior in terms of long-term effectiveness, permanence, and implementability. Although Alternative 3 would also likely achieve the cleanup objectives in a timely manner, the higher level of certainty associated with Alternative 4 and a lower cost compared to Alternative 3 leads to the recommendation of Alternative 4.

11.0 REMEDIAL ACTION PLAN IMPLEMENTATION

This section discusses the conceptual design of the recommended remedial action. A preliminary schedule for remedial action implementation and reporting is also presented.

11.1 Conceptual Remedial Design

Alternative 4 is described in Section 9.5 and generally consists of the excavation of a total of approximately 61,900 cy of saturated and unsaturated soils and groundwater that exceed their respective cleanup levels. The excavated soil would be segregated into categories and managed consistent with a soil management protocol. Where treatment is required to achieve cleanup levels prior to use of the soil as fill, technologies in the “tool box” would be utilized. The soil management protocol would be prepared as part of the RDIP and would document the detailed

protocol for managing all soil excavated not only at the Site, but for remedial actions at Site 2/3, Site 6 and Other Areas at the Facility.

11.1.1 Remediation Procedures and the Soil Management Protocol

The detailed approach for conducting the excavation at the Site will be developed during design in consultation with potential remediation contractors. In general, the initial excavation would be the unsaturated soils exceeding residential cleanup levels and the clean overburden followed by the saturated zone. Groundwater generated during required dewatering activities would be collected and treated onsite using the existing wastewater treatment system prior to discharging to the sanitary sewer under the Facility's existing permit. The overall approach for handling the excavated soil is described above in Section 9.1.3, with the soil being segregated into categories based on contaminant levels and managed consistent with the soil management protocol.

Soil samples would be collected and submitted for chemical analysis to evaluate which category specific soil falls into and therefore how it will be managed. Soil samples to characterize the soil would be collected at a frequency specified in the RDIP. For soils requiring treatment prior to being used as backfill, the technologies retained in the "tool box" for treating soil *ex situ* include biopiling, landfarming, low temperature thermal desorption, and off-site disposal.

Following completion of excavation activities and confirmation, via sampling and analysis, that cleanup levels have been met, backfilling would proceed using a combination of recycled concrete and imported granular fill to the approximate elevation of the water table and then using clean overburden, clean imported fill, or potentially soils treated to below the residential cleanup levels. Note that per the RWQCB, soils proposed for reuse within five feet of the ground surface in residential areas must meet the residential nuisance ESLs for TPH (middle distillates) and TPH (residual fuels) of 100 and 500 mg/kg, respectively. Amendments may be added to the backfill to promote enhanced biodegradation of contaminants in groundwater that flows back into the former excavation to prevent the recontamination of the clean backfill in the saturated zone.

11.1.2 Permitting and Contractor Health and Safety

The work will be conducted in accordance with applicable federal, state and local regulations. These include, but are not limited to:

- National Fire Protection Association (NFPA) NFPA 30 Flammable and Combustible Liquids;
- Occupational Safety and Health Administration (OSHA), Title 29 Code of Federal (CFR) 1910.120. Regulations applicable to hazardous waste site operations (HAZWOPER);
- Health and Safety Code Division 20, Chapters 6.5 and 6.8;

- Title 8 California Code of Regulations (CCR) General Industry Safety Orders (GISO) 5192 Hazardous Materials Storage Ordinance, and Title 8 CCR 1532.1;
- Title 22, CCR Sections 66261.2 and 66261.3;
- Napa County Grading and Construction Ordinances;
- Napa Sanitation District Discharge Limitations;
- Napa County Ordinance No. 1240, Stormwater Management and Discharge Control;
- Napa County Code, Section 13.12 (specifies that permits must be obtained prior to drilling and installing certain soil borings and groundwater wells); and
- Bay Area Air Quality Management District (BAAQMD) Rules and Regulations: Organic Compounds, Regulation 8; and Hazardous Pollutants, Regulation 11.

The excavation and soil handling would be conducted by a qualified, HAZWOPER-trained, contractor using conventional earthwork equipment. The contractor would prepare a Site Specific Health and Safety Plan (HSP), which will address identification of hazards, hazard mitigation, safe work practices and emergency response procedures for the project. The site-specific HSP would be prepared to comply with 29 CFR 1910.120 and Title 8 CCR GISO 5192. Additionally, any remediation subcontractors selected to perform remedial work on-Site would be required to prepare a HSP for its activities.

11.1.3 Site Preparation

Prior to conducting the proposed remedial activities, it is assumed that all structures including buildings, foundations and floor slabs, paving, and materials stored or stockpiled in or near the Site would be demolished and/or removed. In addition, it is assumed underground utilities would be removed or abandoned as appropriate.

In addition to removing the structures, foundations, utilities, and existing groundwater monitoring wells in and near the excavation, areas of the Facility that would be utilized to implement the remedial action would be cleared of obstructions and otherwise prepared for use. This would include preparation of equipment lay down and staging areas, soil stockpile areas, soil treatment areas, and areas where treated soil will be used as fill. Because soil stockpiling, soil treatment, and overall site filling would also be conducted at the other areas of the Facility, these activities would be coordinated with the remedial actions proposed for the other sites.

11.1.4 Verification Sampling

Verification soil samples will be collected from the excavation areas using a hand sampler and earthmoving equipment to evaluate whether the cleanup levels have been met. Detailed

descriptions of the verification sampling procedures and analytical program will be provided in the Verification Sampling and Analysis Plan (VSAP) that will be included as part of the RDIP. The VSAP will specify the number of sidewall and excavation bottom soil samples that will be collected and the depth intervals where samples are to be collected. Sample locations and the number of samples collected may be adjusted in the field if necessary. Verification sample analyses will likely be performed utilizing an expedited laboratory turn-around schedule, or an on-site mobile laboratory, to reduce the likelihood for significant delays to affect the remedial action schedule.

In addition to verification soil sampling, it is anticipated that soil gas samples will be collected from shallow soil to confirm that residual contamination that may be present at depth, although below their respective soil or groundwater cleanup levels, is not causing an exceedance of a soil gas ESL. Should laboratory analytical results indicate that the cleanup level has not been attained, additional excavation will be performed.

11.1.5 Dust and Odor Control

During shallow excavation activities, depending on soil conditions, there is potential to generate airborne dust. Therefore, as required, the contractor would apply a water mist to the excavation and soil handling and haul routes to reduce the potential for dust generation. Soil would be wetted as needed to reduce the occurrence of visible dust. Air monitoring would be conducted in accordance with local air quality management regulations as described in the RDIP and/or the contractor's HSP.

11.1.6 Decontamination

Equipment used to excavate, transport, and manage the affected soil would be decontaminated prior to leaving the site. The equipment will first be decontaminated by removing visible soil by sweeping or brushing. Soil that cannot be removed by this procedure would be removed from equipment by washing in a prepared decontamination area. The decontamination area would be constructed in a central location that would be utilized for all remediation activities at the site. Decontamination wash water will be collected, characterized, treated on site using the existing wastewater treatment system, and discharged to the sanitary sewer.

11.1.7 Excavation Backfilling

The excavations would be backfilled once verification soil sampling confirms that cleanup levels are met throughout the excavation area. The specific backfill requirements would be determined during remedial design and will incorporate geotechnical considerations for future residential and commercial construction. Procedures and specifications would be included in the RDIP. For portions of the excavation below the water table, backfilling would typically utilize recycled concrete and asphalt in the bottom of the excavations to bridge over the wet, fined-grained soils and then utilize imported granular fill to bring the grade back up to above the water table elevation. Above the water table, backfill will likely consist of clean

overburden, other excavated soils where COC concentrations are below the applicable cleanup levels, or treated soil, as appropriate.

11.2 Schedule of Remedial Action Implementation and Reporting

It is anticipated that the soil excavation would be completed during the 2008 construction season, approximately April through October, pending approval of this RI/FS/RAP, preparation of the RDIP, and issuance of the needed permits by the County and associated approvals. Approval of this document does not limit the County's normal environmental review associated with such permit(s) and related approvals. Depending on the total volume of soil requiring treatment from all the remediation areas (e.g., Areas 4 and 6), and the specific type of treatment utilized (e.g., biopiling, LTDD), treatment of excavated soils may extend beyond 2008 into 2009.

Treatability studies to develop design information for select technologies would be implemented during 2007. Initiation of these treatability studies is expected in the first quarter of 2007.

11.3 Performance Criteria

Evaluation of the progress of the soil and groundwater remediation program would be conducted throughout its implementation. The laboratory analytical results of the soil verification samples would be compared to the proposed target cleanup levels. If these compounds are detected in verification soil sampling above the proposed target cleanup levels and further excavation is not feasible, PES will consult with RWQCB staff to evaluate the appropriateness of instituting additional remedial measures, if warranted.

11.4 Reporting

Following completion of remediation activities, a remedial action implementation report will be prepared and submitted to RWQCB for review and approval. The report will summarize the work that was performed, verification soil and soil gas sample analytical results, and document that the cleanup levels have been achieved. Performance monitoring results for soil treatment will be reported and the final disposition of excavated soils will be documented. Copies of laboratory reports and chain-of-custody forms will be included.

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TABLES

**Table 1
Environmental Screening Levels
Napa Pipe Facility
Napa, California**

SOIL					GROUNDWATER	
Nondrinking Water Resource					Nondrinking Water Resource	
Parameter	ESL	ESL	ESL	ESL	Parameter	ESL
	Shallow Soil (<3m)	Shallow Soil (<3m)	Deep Soil (>3m)	Deep Soil (>3m)		
	Residential	Commercial	Residential	Commercial		(µg/l)
	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)		
TPH (gasoline)	100	500 ⁰	5000 ³	5000 ³	TPH (gasoline)	5000 ^{8,11}
TPH (middle distillates)	100/400 ¹	500/750 ²	5000 ³	5000 ³	TPH (middle distillates)	2500 ^{8,11}
TPH (residual fuels)	500/1000 ⁴	2500 ⁵	5000 ⁶	5000 ⁷	TPH (residual fuels)	2500 ⁸
Benzene	0.18	0.38	0.18	0.51	Benzene	540 ⁹
Naphthalene	0.46	1.5	0.46	1.5	Naphthalene	210 ¹⁰
TCE	0.26	0.73	0.26	0.73	TCE	530 ⁹
1,1-DCE	8.9 ¹²	2.1 ¹²	8.9 ¹²	21	1,1-DCE	6300 ⁹
cis-1,2-DCE	1.6	3.6	1.6	3.6	cis-1,2-DCE	6200 ⁹
Chloroethane	0.63	0.85	0.63	0.85	Chloroethane	160 ¹⁰
1,1-DCA	0.32	0.89	0.32	0.89	1,1-DCA	1000 ⁹
Vinyl Chloride	0.0067	0.019	0.0067	0.019	Vinyl Chloride	3.8
trans-1,2-DCE	3.1	7.3	3.1	7.3	trans-1,2-DCE	2600 ¹⁰
1,2-DCA	0.025	0.07	0.025	0.07	1,2-DCA	200
PCE	0.087	0.24	0.087	0.24	PCE	120 ⁹
1,1,1-TCA	98 ¹²	230 ¹²	98 ¹²	230 ¹²	1,1,1-TCA	50000 ¹⁰
1,1,2-TCA	0.032	0.089	0.032	0.089	1,1,2-TCA	350
Styrene	450 ¹²	1000 ¹⁴	450 ¹²	1100 ¹²	Styrene	110 ¹⁰
Methylene Chloride	0.52	1.5	0.52	1.5	Methylene Chloride	2400 ⁹
1,2-Dichlorobenzene	8.9 ¹²	21 ¹²	8.9 ¹²	21 ¹²	1,2-Dichlorobenzene	100 ¹⁰
1,4-Dichlorobenzene	0.046	0.13	0.046	0.13	1,4-Dichlorobenzene	110 ¹⁰
Chlorobenzene	2.7 ¹²	6.2 ¹²	2.7 ¹²	6.2 ¹²	Chlorobenzene	500 ¹⁰
Bromodichloromethane	0.014	0.039	0.014	0.039	Bromodichloromethane	170
Chloroform	0.88	1.9	78 ¹³	78 ¹³	Chloroform	330
Dibromochloromethane	0.019	0.054	0.019	0.054	Dibromochloromethane	170
Bromomethane	0.22	0.51	0.22	0.51	Bromomethane	580 ⁹
MTBE	2	5.6	2	5.6	MTBE	1800
Ethylbenzene	390 ¹²	390 ¹²	390 ¹²	390 ¹²	Ethylbenzene	300 ¹⁰
Xylenes	310 ¹²	420 ¹²	310 ¹²	420 ¹²	Xylenes	5300 ¹⁰
Toluene	100 ¹³	310 ¹²	130 ¹²	310 ¹²	Toluene	400 ¹⁰
2-Butanone	490 ¹²	1000 ¹⁴	490 ¹²	1300 ¹²	2-Butanone	50000 ¹⁰
Acetone	500 ¹⁴	1000 ¹⁴	1000 ¹⁴	2500 ¹⁴	Acetone	50000 ¹⁰
1,4-Dioxane	18	30	30	30	1,4-Dioxane	50000
Anthracene	6.1 ¹⁵	6.1 ¹⁵	6.1 ¹⁵	6.1 ¹⁵	Anthracene	22 ¹⁰
Fluorene	160 ¹⁵	160 ¹⁵	160 ¹⁵	160 ¹⁵	Fluorene	950 ¹⁰
Methylnaphthalene (total 1- & 2-)	110 ¹⁵	110 ¹⁵	110 ¹⁵	110 ¹⁵	Methylnaphthalene (total 1- & 2-)	100 ¹⁰
Phenanthrene	40 ¹⁶	40 ¹⁶	1000 ¹⁷	2500 ¹⁷	Phenanthrene	410 ¹⁰
Bis(2-ethylhexyl)Phthalate	160	570 ¹³	1000 ¹⁷	2500 ¹⁷	Bis(2-ethylhexyl)Phthalate	650 ¹⁰
Chrysene	3.8	13	150 ¹³	150 ¹³	Chrysene	0.8 ¹⁰
Fluoranthene	40	390 ¹⁵	1000 ¹⁷	2500 ¹⁷	Fluoranthene	130 ¹⁰
Pyrene	85	85 ¹⁵	85 ¹⁵	85 ¹⁵	Pyrene	68 ¹⁰
Antimony	6.1	40	280	280	Antimony	50000 ¹⁰
Arsenic	5.5	5.5	5.5	5.5	Arsenic	50000 ¹⁰
Barium	750	1500	2500	2500	Barium	50000 ¹⁰
Beryllium	4	8	36	36	Beryllium	50000 ¹⁰
Cadmium	1.7	7.4	38	38	Cadmium	50000 ¹⁰
Chromium	58	58	58	58	Chromium	50000 ¹⁰
Chromium VI	1.8	1.8	1.8	1.8	Chromium VI	50000 ¹⁰

**Table 1
Environmental Screening Levels
Napa Pipe Facility
Napa, California**

SOIL Nondrinking Water Resource					GROUNDWATER Nondrinking Water Resource	
Parameter	ESL	ESL	ESL	ESL	Parameter	ESL (µg/l)
	Shallow Soil (<3m) Residential (mg/kg)	Shallow Soil (<3m) Commercial (mg/kg)	Deep Soil (>3m) Residential (mg/kg)	Deep Soil (>3m) Commercial (mg/kg)		
Cobalt	10	10	10	10	Cobalt	50000 ¹⁰
Copper	230	230	2500	5000	Copper	50000 ¹⁰
Lead	150	750	750	750	Lead	50000 ¹⁰
Molybdenum	40	40	2500	3600	Molybdenum	50000 ¹⁰
Mercury	3.7	10	98	98	Mercury	50000 ¹⁰
Nickel	150	150	1000	1000	Nickel	50000 ¹⁰
Selenium	10	10	2500	3400	Selenium	50000 ¹⁰
Silver	20	40	2500	3600	Silver	50000 ¹⁰
Thallium	1	13	47	47	Thallium	50000 ¹⁰
Vanadium	110	200	2500	5000	Vanadium	50000 ¹⁰
Zinc	600	600	2500	5000	Zinc	50000 ¹⁰

Notes:

ESL = Environmental Screening Level (RWQCB, February 2005)

TPH (middle distillates) includes TPH as diesel

TPH (residual fuels) includes TPH as motor oil and TPH as hydraulic oil

0 = The final ESL from Table B-2 (commercial/industrial) of RWQCB, 2005 is 400 mg/kg, based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G.

This pathway does not apply and the cleanup value defaults to 500 mg/kg (gross contamination ceiling value) and with the recognition that confirmation soil gas testing may be required

1 = The final ESL from Table B-1 of RWQCB, 2005 is 100 mg/kg, based on the Gross Contamination Ceiling Value (Odors, etc.), Table H-2. However, the MADEP screening values, (Appendix 7, RWQCB, 2005) on which Table H-2 is based state that the nuisance ceiling value for C9 to C18 carbon range (equivalent to the lighter fraction of diesel is 1000 mg/kg (not 100 mg/kg). This value is higher than the next lowest value of 400 mg/kg (direct exposure) shown on Table B-1

For the shallowest soils (0-3 ft. bgs) the lower of the two values (100 mg/kg) is selected to conservatively protect for nuisance odor issues. For deeper soils (>3 ft bgs but <3 m), the proposed cleanup value is 400 mg/kg

2 = The final ESL from Table B-2 of RWQCB, 2005 is 500 mg/kg, based on both the gross contamination ceiling value (odors, etc.) from Table H-2 and protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. Note that the 500 mg/kg value for soil from Table G is already a non-drinking water number and is based on soil leaching protective of surface water discharge at 640 mg/l. This pathway would likely not apply

In addition, similar to footnote 1, the MADEP screening levels are listed as 1,000 mg/kg, not 500 mg/kg. The next highest value on Table B-2 is the direct contact value of 750 mg/kg.

For the shallowest soils (0-3 ft. bgs) the lower of the two values (500 mg/kg) is selected to conservatively protect for nuisance odor issues. For deeper soils (>3 ft bgs but <3 m), the proposed cleanup value is 750 mg/kg. It also recognized that confirmation soil gas testing may be required.

3 = The final ESL from Table D-1 (residential) and Table D-2 (commercial/industrial) of RWQCB, 2005 is 400 for TPH(gasolines) and 500 mg/kg for TPH(middle distillates), based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to 5000 mg/kg (gross contamination ceiling value) and with the recognition that confirmation soil gas testing may be required

4 = The final ESL from Table B-1 of RWQCB, 2005 is 500 mg/kg, based on the Gross Contamination Ceiling Value, Table H-2. However, the MADEP screening values, (Appendix 7, RWQCB, 2005) on which Table H-2 is based, states that the nuisance ceiling value for C19 to C36 carbon range (equivalent to motor oil and hydraulic oil) is 2500 mg/kg. This value is higher than the next lowest value of 1,000 (direct exposure) shown on Table B-

As in footnotes 1 and 2, the lower value (in this case 500 mg/kg) is retained to conservatively protect for nuisance odor issues in the shallowest soils (0-3 ft bgs). For the deeper soils (>3 ft and <3m), the direct exposure number (1,000 mg/kg)

5 = The final ESL from Table B-2 of RWQCB, 2005 is 1000 mg/kg, based on the Groundwater Protection (Soil Leaching), Non-Drinking Water Resource, Table G. However, the value listed follows the LARWQCB guidance, which is based on the protection of drinking water resource. Shallow groundwater is not a drinking water resource; the drinking water resource is over 150 feet below ground surface. At this depth, the LARWQCB's soil screening level would be 50,000 mg/kg (see Table 4-1 of LARWQCB, 1996). This value is higher than the next lowest value of 2,500 mg/kg, based on the nuisance ceiling as shown on Table B-2; therefore the proposed cleanup goal defaults to 2500 mg/kg

6 = The final ESL from Table D-1 of RWQCB, 2005 is 1000 mg/kg, based on the Groundwater Protection (Soil Leaching), Non-Drinking Water Resource, Table G. However, the value listed follows the LARWQCB guidance (see footnote on Table D-1 and Section 5.3.2 text of RWQCB, 2005), which is based on the protection of a drinking water resource. Shallow groundwater is not a drinking water resource; the drinking water resource is over 150 feet below ground surface. At this depth, the LARWQCB soil screening level would be 50,000 mg/kg (see Table 4-1 of LARWQCB, 1996). This value is higher than the next lowest value of 5000 (gross contamination ceiling value) shown on Table D-1; therefore the proposed cleanup goal defaults to 5000 mg/kg

7 = The final ESL from Table D-2 of RWQCB, 2005 is 1000 mg/kg, based on the Groundwater Protection (Soil Leaching), Non-Drinking Water Resource, Table G. However, the value listed follows the LARWQCB's guidance (see footnote on Table D-1 and Section 5.3.2 text of RWQCB, 2005), which is based on the protection of a drinking water resource. Shallow groundwater is not a drinking water resource; the drinking water resource is over 150 feet below ground surface. At this depth, the LARWQCB soil screening level would be 50,000 mg/kg (see Table 4-1 of LARWQCB, 1996). This value is higher than the next lowest value of 5000 (gross contamination) shown on Table D-2; therefore the proposed cleanup goal defaults to 5000 mg/kg

8 = No aquatic habitat pathway. Defaults to gross contamination ceiling level value.

9 = No aquatic habitat pathway. Defaults to vapor intrusion pathway.

10 = No aquatic habitat pathway. Defaults to gross contamination ceiling value.

11 = Soil gas values to be used for verifying cleanup.

12 = Protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water does not apply; therefore, the cleanup value defaults to the vapor intrusion pathway

13 = Protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water does not apply; therefore, the cleanup value defaults to the direct exposure pathway

14 = Protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water does not apply; therefore, the cleanup value defaults to the gross contamination ceiling value

15 = The final ESLs from Tables B-1 and D-1 (residential) and Tables B-2 and D-2 (Commercial/Industrial) of RWQCB, 2005 are based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to the vapor intrusion into buildings pathway

16 = The final ESLs from Tables B-1 and D-1 (residential) and Tables B-2 and D-2 (Commercial/Industrial) of RWQCB, 2005 are based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to the Urban Area Ecotoxicity Criteria

17 = The final ESLs from Tables D-1 (residential) and D-2 (Commercial/Industrial) of RWQCB, 2005 are based on protection of surface water resources via soil leaching to groundwater and discharge of groundwater to surface water, Table G. This pathway does not apply and the cleanup value defaults to the Gross Contamination Ceiling Value

Table 2
Water Level Survey Data - May 16, 2006 Monitoring Event
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Well Identification	TOC Elevation (ft MSL)	Depth to Water (ft bTOC)	Depth to FPLH (ft bTOC)	FPLH Thickness (feet)	Groundwater Elevation (feet MSL)	Screened Interval (feet bgs)	Screened Interval (ft MSL)
DW-2	5.33	2.34	--	--	2.99	32 to 37	-26.7 to -31.7
DW-6	5.38	1.91	--	--	3.47	31 to 36	-25.6 to -30.6
MW-4	5.12	2.27	--	--	2.85	7.5 to 12.5	-1.2 to -6.2
MW-5	5.97	2.90	--	--	3.07	20 to 25	-13.8 to -18.8
MW-14	6.17	3.30	--	--	2.87	15.5 to 20.5	-8.8 to -13.8
MW-15	6.67	4.76	--	--	1.91	4.5 to 9.5	1.7 to -3.3
MW-16	6.24	2.95	--	--	3.29	3 to 8	2.9 to -2.2
MW-17	5.85	3.31	--	--	2.54	2.5 to 7.5	4.3 to -0.7
MW-18	6.78	2.97	--	--	3.81	5 to 10	1.5 to -3.5
MW-19	6.46	2.70	--	--	3.76	5 to 10	-0.2 to -5.2
MW-25	4.81	0.03	--	--	4.78	4.5 to 9.5	1.5 to -3.5
MW-26	5.96	2.90	--	--	3.06	3.5 to 8.5	2.6 to -2.4
MW-27	6.13	na	na	na	nc	5 to 10	0.3 to -4.7
MW-32	5.34	3.80	--	--	1.54	4 to 9	1.6 to -3.4
MW-33	5.57	2.21	--	--	3.36	8 to 13	-0.6 to -5.6
MW-34	7.38	5.52	--	--	1.86	3.5 to 8.5	2.9 to -2.1
MW-35	6.44	na	na	na	nc	9 to 14	-0.5 to -5.5
MW-58	5.47	3.30	--	--	2.17	5.5 to 15.5	0.0 to -10
MW-59	5.44	2.66	--	--	2.78	5.5 to 15.5	-0.1 to -10.1
MW-60	7.95	4.97	--	--	2.98	5 to 15	3.0 to -7.0
MW-61	6.10	3.63	--	--	2.47	5 to 15	1.1 to -8.9
MW-62	6.04	3.45	--	--	2.59	5 to 15	1.0 to -9.0
MW-63	4.59	3.90	--	--	0.69	5 to 15	-0.4 to -10.4
MW-64	4.59	3.49	--	--	1.10	3.8 to 13.8	0.8 to -9.2
MW-65 ^a	5.58	4.65	--	--	0.93	4 to 14	1.6 to -8.4

Notes:

TOC = Top of casing

ft bTOC = Feet below top of casing

ft MSL = Feet mean sea level

na = Well was not accessible; not able to measure

nc = Not calculated

-- = Not observed

FPLH = Free Phase Liquid Hydrocarbons

^a = Oil absorbent sock in well

Table 3
Water Level Survey Data - October 3, 2006 Monitoring Event
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Well Identification	TOC Elevation (ft MSL)	Depth to Water (ft bTOC)	Depth to FPLH (ft bTOC)	FPLH Thickness (feet)	Groundwater Elevation (feet MSL)	Screened Interval (feet bgs)	Screened Interval (ft MSL)
DW-2	5.33	3.18	--	--	2.15	32 to 37	-26.7 to -31.7
DW-6	5.38	2.71	--	--	2.67	31 to 36	-25.6 to -30.6
MW-4	5.12	2.97	--	--	2.15	7.5 to 12.5	-1.2 to -6.2
MW-5	5.97	3.84	--	--	2.13	20 to 25	-13.8 to -18.8
MW-14	6.17	4.32	--	--	1.85	15.5 to 20.5	-8.8 to -13.8
MW-15	6.67	5.88	--	--	0.79	4.5 to 9.5	1.7 to -3.3
MW-16	6.24	3.73	--	--	2.51	3 to 8	2.9 to -2.2
MW-17	5.85	3.08	--	--	2.77	2.5 to 7.5	4.3 to -0.7
MW-18	6.78	2.95	--	--	3.83	5 to 10	1.5 to -3.5
MW-19	6.46	3.58	--	--	2.88	5 to 10	-0.2 to -5.2
MW-25	4.81	2.07	--	--	2.74	4.5 to 9.5	1.5 to -3.5
MW-26	5.96	3.81	--	--	2.15	3.5 to 8.5	2.6 to -2.4
MW-27	6.13	3.51	--	--	2.62	5 to 10	0.3 to -4.7
MW-32	5.34	4.14	--	--	1.20	4 to 9	1.6 to -3.4
MW-33	5.57	2.95	--	--	2.62	8 to 13	-0.6 to -5.6
MW-34	7.38	6.78	--	--	0.60	3.5 to 8.5	2.9 to -2.1
MW-35	6.44	na	na	na	nc	9 to 14	-0.5 to -5.5
MW-58	5.47	4.25	--	--	1.22	5.5 to 15.5	0.0 to -10
MW-59	5.44	3.64	--	--	1.80	5.5 to 15.5	-0.1 to -10.1
MW-60	7.95	6.19	--	--	1.76	5 to 15	3.0 to -7.0
MW-61	6.10	4.81	--	--	1.29	5 to 15	1.1 to -8.9
MW-62	6.04	4.55	--	--	1.49	5 to 15	1.0 to -9.0
MW-63	4.59	4.83	--	--	-0.24	5 to 15	-0.4 to -10.4
MW-64	4.59	4.24	--	--	0.35	3.8 to 13.8	0.8 to -9.2
MW-65 ^{ab}	5.58	5.97	5.23	0.74	0.23	4 to 14	1.6 to -8.4

Notes:

- TOC = Top of casing
- ft bTOC = Feet below top of casing
- ft MSL = Feet mean sea level
- na = Well was not accessible; not able to measure
- nc = Not calculated
- = Not observed
- FPLH = Free Phase Liquid Hydrocarbons
- ^a = Oil absorbent sock in well
- ^b = Groundwater level adjusted for FPLH thickness, such that:
 Groundwater Elevation = TOC Elevation - (Depth to water - [0.84*FPLH Thickness])

Table 4
TPH as Diesel and TPH as Motor Oil in Groundwater Monitoring Wells
Second and Fourth Quarter 2006 Monitoring Events
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Well Identification	Quarter	TPH as Gasoline (µg/l)	TPH as Diesel (µg/l)	TPH as Motor Oil (µg/l)
DW-2	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-4	2nd	--	--	--
	4th	ND [50]	57Y	ND [300]
MW-5	2nd	--	190 Y	ND (210)
	4th	--	ND (50)	ND (300)
MW-14	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-15	2nd	--	--	--
	4th	ND [50]	74Y	ND [300]
MW-16	2nd	--	--	--
	4th	110HY	200LY	ND [300]
MW-17	2nd	--	--	--
	4th	ND [50]	100Y	ND [300]
MW-18	2nd	--	--	--
	4th	ND [50]	54Y	ND [300]
MW-19	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-25	2nd	--	--	--
	4th	ND [50]	760HLY	380L
MW-26	2nd	--	--	--
	4th	ND [50]	92Y	ND [300]
MW-27	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-32	2nd	--	--	--
	4th	ND [50]	84Y	ND [300]
MW-33	2nd	--	--	--
	4th	ND [50]	67Y	ND [300]
MW-34	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-58	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-59	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-60	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-61	2nd	--	--	--
	4th	ND [50]	ND [50]	ND [300]
MW-62	2nd	--	--	--
	4th	--	ND [50]	ND [300]
MW-63	2nd	--	--	--
	4th	--	96HY	350
MW-64	2nd	--	--	--
	4th	--	840H	970L
MW-65	2nd	--	--	--
	4th	ND [50]	1,400,000HY	6,400,000
Groundwater ESL¹		5,000	2,500	2,500

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

ND = Not detected at or above the indicated laboratory reporting limit

TPH = Total petroleum hydrocarbons

-- = Not analyzed

H = Heavier hydrocarbons contributed to the quantitation

Y = Sample exhibits chromatographic pattern which does not resemble standard

L = Lighter hydrocarbons contributed to the quantitation

Table 5
Volatile Organic Compounds in Groundwater Monitoring Wells
Second and Fourth Quarter 2006 Monitoring Events
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Well Identification	Quarter	1,1-DCA (µg/l)	1,1-DCE (µg/l)	1,2,4-TMB (µg/l)	1,2-DCA (µg/l)	1,3,5-TMB (µg/l)	1,4-DCB (µg/l)	2-Butanone (µg/l)	1,4-Dioxane (µg/l)	Benzene (µg/l)	Carbon Disulfide (µg/l)	Chlorobenzene (µg/l)
DW-2	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
DW-6	4th	ND (3.1)	ND (3.1)	12	ND (3.1)	5.2	ND (3.1)	ND (63)	--	7.7	ND (3.1)	ND (0.5)
MW-4	4th	15	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	0.7	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-5	4th	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (5)	ND (100)	--	ND (5)	ND (5)	ND (0.5)
MW-14	2nd	ND (0.50)	ND (0.50)	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	ND (50)	ND (0.50)	ND (0.50)	ND (0.5)
	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-15	2nd	3.1	ND (0.50)	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	ND (50)	ND (0.50)	ND (0.50)	ND (0.5)
	4th	3.8	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	0.5	ND (0.5)	ND (0.5)
MW-17	4th	2.0	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	0.5	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-19	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-27	4th	1.1	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-34	2nd	6.0	100	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	80	ND (0.50)	ND (0.50)	ND (0.5)
	4th	9.7	150	ND (1.3)	ND (1.3)	ND (1.3)	ND (1.3)	ND (25)	--	ND (1.3)	ND (1.3)	ND (0.5)
MW-58	2nd	7,200	7,700	ND (1,000)	ND (100)	ND (100)	ND (100)	ND (100)	ND (10,000)	ND (100)	ND (100)	ND (0.5)
	4th	7,200	6,700	ND (50)	ND (50)	ND (50)	ND (50)	ND (1,000)	--	ND (50)	ND (50)	ND (0.5)
MW-59	2nd	ND (0.50)	ND (0.50)	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	ND (50)	ND (0.50)	ND (0.50)	ND (0.5)
	4th	2.9	4.0	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-60	2nd	ND (0.50)	ND (0.50)	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	ND (50)	ND (0.50)	ND (0.50)	ND (0.5)
	4th	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	ND (0.5)
MW-61	2nd	20	300	ND (25)	ND (2.5)	ND (2.5)	ND (2.5)	ND (2.5)	290	ND (2.5)	ND (2.5)	ND (0.5)
	4th	9.7	360	ND (1)	2.3	ND (1)	ND (1)	ND (20)	--	ND (1)	ND (1)	ND (0.5)
MW-62	2nd	12	570	ND (50)	ND (5.0)	ND (5.0)	ND (5.0)	ND (5.0)	ND (500)	ND (5.0)	ND (5.0)	ND (0.5)
	4th	21	310	ND (2)	ND (2)	ND (2)	ND (2)	ND (40)	--	ND (2)	ND (2)	ND (0.5)
MW-63	2nd	ND (0.50)	ND (0.50)	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	ND (50)	ND (0.50)	ND (0.50)	ND (0.5)
	4th	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	ND (1)	28	--	ND (1)	ND (1)	ND (0.5)
MW-64	2nd	400	750	ND (100)	ND (10)	ND (10)	ND (10)	ND (10)	ND (1,000)	ND (10)	ND (10)	ND (0.5)
	4th	44	97	ND (8.3)	ND (8.3)	ND (8.3)	ND (8.3)	ND (170)	--	ND (8.3)	ND (8.3)	ND (0.5)
MW-65	2nd	3.5	ND (0.50)	ND (5.0)	ND (0.50)	ND (0.50)	ND (0.50)	ND (10)	ND (50)	ND (0.50)	0.94	3.3
	4th	1.3	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (0.5)	ND (10)	--	ND (0.5)	ND (0.5)	1.8
Groundwater ESL¹		1,000	6,300	NE	200	NE	110	50,000	50,000	540	NE	500

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Table 6
Metals in Groundwater Monitoring Wells
Second and Fourth Quarter 2006 Monitoring Events
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Well Identification	Quarter	Aluminum (µg/l)	Arsenic (µg/l)	Barium (µg/l)	Chromium (µg/l)	Copper (µg/l)	Lead (µg/l)	Mercury (µg/l)	Selenium (µg/l)
MW-5	2nd	ND (500)	6.0	940	ND (5.0)	ND (5.0)	ND (5.0)	ND (0.2)	ND (5.0)
	4th	ND (50)	ND (1.0)	1,000	7.5	2.2	ND (1.0)	ND(0.2)	ND (1.0)
Groundwater ESL¹		NE	50,000	50,000	50,000	50,000	50,000	50,000	50,000

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

µg/l = Micrograms per liter

ND = Not detected at or above the indicated laboratory reporting limit

NE = Not established

Table 7
Summary of Analyses Performed on Soil and Groundwater Samples
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Location	Soil Analyses			Groundwater Analyses			Comments
	TPH-d/mo	VOCs	CAM 17 Metals	TPH-d/mo	VOCs	1,4-Dioxane	
Boring Locations							
MG1	X	NR	NR	NR	NR	NR	Soil samples collected at 3 and 5.5 feet bgs
PS1	X	NR	NR	NR	NR	NR	Soil samples collected at 3 and 7 feet bgs
PS2	X	NR	NR	NR	NR	NR	Soil samples collected at 3 and 6 feet bgs
PS3	X	NR	NR	NR	NR	NR	Soil samples collected at 3 and 7 feet bgs
PM1	X	X	NR	X	X	NR	Soil samples collected at 3 and 6.25 feet bgs
PM2	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 7 feet bgs
PM3	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM4	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM5	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM6	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM7	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM8	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM9	X	X	NR	X	X	NR	Soil samples collected at 2.5, 5 and 8 feet bgs
PM10	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 6 feet bgs
PM11	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 5 feet bgs
PM12	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM13	X	X	NR	X ¹	X ¹	NR	Soil samples collected at 2.5 and 5 feet bgs
PM14	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM15	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 7 feet bgs
PM16	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM17	X	X	NR	X	X	NR	Soil samples collected at 3 and 6.5 feet bgs
PM18	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM19	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM20	X	X	NR	X	X	NR	Soil samples collected at 3 and 5.5 feet bgs
PM21	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 6.75 feet bgs
PM22	X	X	NR	X	X	NR	Soil samples collected at 2.75, 6.5 and 13 feet bgs
PM23	X	X	NR	X	X	NR	Soil samples collected at 2 and 6 feet bgs
PM24	X	X	NR	X	X	NR	Soil samples collected at 3 and 5.75 feet bgs
PM25	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 7 feet bgs
PM26	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM27	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM28	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM29	X	X	NR	X	X	NR	Soil samples collected at 3 and 6.5 feet bgs
PM30	X	X	NR	X	X	NR	Soil samples collected at 2 and 7 feet bgs
PM31	X	X	X	X	X	NR	Soil samples collected at 3, 5.5 and 10 feet bgs
PM32	X	X	X	X	X	NR	Soil samples collected at 2.5 and 6 feet bgs
PM33	X	X	X	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM34	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM35	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM36	X	X	NR	X	X	NR	Soil samples collected at 3 and 6.5 feet bgs
PM37	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM38	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 8 feet bgs
PM39	X	X	X	X	X	NR	Soil samples collected at 2.5 and 6 feet bgs
PM40	X	X	NR	X	X	NR	Soil samples collected at 2 and 6.5 feet bgs
PM41	X	X	NR	X	X	NR	Soil samples collected at 3 and 6 feet bgs
PM42	NR	NR	NR	X	NR	NR	Groundwater only
PM43	NR	NR	NR	X	NR	NR	Groundwater only
PM44	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 7 feet bgs
PM45	X	X	NR	X	X	NR	Soil samples collected at 3 and 6.5 feet bgs
PM46	X	X	NR	X	X	NR	Soil samples collected at 3 and 7 feet bgs
PM47	X	X	NR	X	X	NR	Soil samples collected at 2.5 and 6.5 feet bgs
PM48	X	X	NR	X	X	X	Soil samples collected at 3, 6.5 and 10 feet bgs

**Table 7
Summary of Analyses Performed on Soil and Groundwater Samples
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Location	Soil Analyses			Groundwater Analyses			Comments
	TPH-d/mo	VOCs	CAM 17 Metals	TPH-d/mo	VOCs	1,4-Dioxane	
PM49	X	X	NR	X	X	X	Soil samples collected at 3, 6.5 and 10.5 feet bgs
PM50	X	X	NR	X	X	X	Soil samples collected at 3, 7.5 and 11 feet bgs
PM51	X	X	NR	X	X	X	Soil samples collected at 2.5, 6.5 and 9.5 feet bgs
PM52	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM53	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM54	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM55	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM56	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM57	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM58	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM59	X	X	NR	NR	NR	NR	Soil samples collected at 0 and 4.5 feet bgs
PM60	NR	NR	NR	X	X	X	Lithology boring and groundwater sample
PM61	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM62	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM63	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM64	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM65	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM66	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM67	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM68	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM69	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM70	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM71	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
PM72	NR	NR	NR	NR	NR	NR	Lithology boring; no soil samples submitted for analysis
Monitoring Wells							
MW-58	NR	NR	NR	NR	NR	X	Sampled well for 1,4-Dioxane only
MW-64	NR	NR	NR	NR	NR	X	Sampled well for 1,4-Dioxane only
MW-65	NR	NR	NR	NR	NR	X	Sampled well for 1,4-Dioxane only

Notes:

- bgs = below ground surface
- CAM 17 Metals = California Administrative Manual 17 metals (i.e., Title 22 metals)
- TPH-d/mo = Total petroleum hydrocarbons (TPH) as diesel and TPH as motor oil
- VOCs = Volatile organic compounds
- NR = Not requested
- X = Analysis performed on sample
- X¹ = Product sample collected from this boring

Table 8
TPH as Diesel and TPH as Motor Oil in Soil
Site 4 (Former Pipe Mill, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, CA

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	TPH as Diesel (mg/kg)		TPH as Motor Oil (mg/kg)	
MG1	MG1-3'	3-3.5	9/15/2006	ND(1)		ND(5)	
	MG1-5.5'	5.5-6	9/15/2006	6.0	HY	15	
PS1	PS1-3'	3-3.5	9/15/2006	1.2	HY	5.4	
	PS1-7'	7-7.5	9/15/2006	4.8	HY	8.6	
PS2	PS2-3'	3-3.5	9/15/2006	8.6	HY	34	H
	PS2-6'	6-6.5	9/15/2006	4.8	HY	16	H
PS3	PS3-3'	3-3.5	9/15/2006	8.1	HY	31	H
	PS3-7'	7-7.5	9/15/2006	4.4	HY	12	
PM1	PM1-3'	3-3.5	9/11/2006	3.4	HY	9.9	
	PM1-6.25'	6.25-6.75	9/11/2006	5.7	HY	22	
PM2	PM2-2.5'	2.5-3	9/11/2006	1.1	HY	ND(5)	
	PM2-7'	7-7.5	9/11/2006	3.1	HY	ND(5)	
PM3	PM3-3'	3-3.5	9/11/2006	1.3	HY	ND(5)	
	PM3-7'	7-7.5	9/11/2006	3.8	HY	14	H
PM4	PM4-3'	3-3.5	9/11/2006	1.9	HY	ND(5)	
	PM4-7'	7-7.5	9/11/2006	14	HLY	ND(5)	
PM5	PM5-3'	3-3.5	9/11/2006	1.7	HY	7.6	H
	PM5-7'	7-7.5	9/11/2006	5.6	HY	29	H
PM6	PM6-3'	3-3.5	9/11/2006	1.8	HY	13	H
	PM6-7'	7-7.5	9/11/2006	26	HY	10	L
PM7	PM7-3'	3-3.5	9/11/2006	2.5	HY	6.6	H
	PM7-7'	7-7.5	9/11/2006	2.7	HY	13	H
PM8	PM8-3	3-3.5	9/12/2006	ND(1)		ND(5)	
	PM8-7	7-7.5	9/12/2006	ND(1)		ND(5)	
PM9	PM9-2.5	2.5-3	9/12/2006	7,700	HY	15,000	L
	PM9-5.5	5.5-6	9/12/2006	130	HY	190	L
	PM9-8	8-8.5	9/12/2006	270	HY	360	L
PM10	PM10-2.5'	2.5-3	9/13/2006	58	HY	200	HL
	PM10-6'	6-6.5	9/13/2006	3.8	HY	26	
PM11	PM11-2.5	2.5-3	9/12/2006	3,600	HY	32,000	
	PM11-5.5	5.5-6	9/12/2006	2,500	HY	25,000	
PM12	PM12-3'	3-3.5	9/12/2006	710	HY	9,300	
	PM12-6'	6-6.5	9/12/2006	29	HY	360	
PM13	PM13-2.5'	2.5-3	9/12/2006	1.6	HY	ND(5)	
	PM13-5.5'	5.5-6	9/12/2006	19	HY	250	
PM14	PM14-3'	3-3.5	9/13/2006	1.6	HY	5.3	
	PM14-7'	7-7.5	9/13/2006	3.0	HY	14	
PM15	PM15-2.5'	2.5-3	9/13/2006	4,600	HY	29,000	
	PM15-7'	7-7.5	9/13/2006	30	HY	84	L
PM16	PM16-3'	3-3.5	9/13/2006	2,500	HY	13,000	
	PM16-6.5'	6.5-7	9/13/2006	18	HY	44	
PM17	PM17-3'	3-3.5	9/18/2006	600	HY	4,000	
	PM17-6.5'	6.5-7	9/18/2006	75	HY	370	
PM18	PM18-3'	3-3.5	9/13/2006	33	HY	220	
	PM18-7'	7-7.5	9/13/2006	1,500	HY	13,000	
PM19	PM19-3'	3-3.5	9/13/2006	6.3	HY	15	
	PM19-6'	6-6.5	9/13/2006	2.4	HY	7.9	

Table 8
TPH as Diesel and TPH as Motor Oil in Soil
Site 4 (Former Pipe Mill, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, CA

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	TPH as Diesel (mg/kg)		TPH as Motor Oil (mg/kg)	
PM20	PM20-3'	3-3.5	9/18/2006	ND(1)		ND(5)	
	PM20-5.5'	5.5-6	9/18/2006	34	HY	220	H
PM21	PM21-2.5'	2.5-3	9/13/2006	1,300	HY	7,700	
	PM21-6.75'	6.75-7.25	9/13/2006	7,900	HY	26,000	
PM22	PM22-2.75'	2.75-3.25	9/13/2006	1,700	HY	11,000	
	PM22-6.5'	6.5-7	9/13/2006	460	HY	6,100	
	PM22-13'	13-13.5	9/13/2006	580	HY	3,100	
PM23	PM23-2'	2-2.5	9/14/2006	4,700	HY	35,000	
	PM23-6'	6-6.5	9/14/2006	1,100	HY	9,800	
PM24	PM24-3'	3-3.5	9/14/2006	6.3	HY	17	L
	PM24-5.75'	5.75-6.25	9/14/2006	2,100	HY	7,100	
PM25	PM25-2.5'	2.5-3	9/14/2006	640	HY	2,500	
	PM25-7'	7-7.5	9/14/2006	14	HY	91	
PM26	PM26-3'	3-3.5	9/14/2006	2.0	HY	6.1	
	PM26-7'	7-7.5	9/14/2006	2.6	HY	ND(5)	
PM27	PM27-3'	3-3.5	9/14/2006	6.9	HY	39	H
	PM27-7'	7-7.5	9/14/2006	2,400	HY	15,000	
PM28	PM28-3'	3-3.5	9/14/2006	23	HY	63	H
	PM28-7'	7-7.5	9/14/2006	290	HLY	280	L
PM29	PM29-3'	3-3.5	9/14/2006	5,100	HY	18,000	
	PM29-6.5'	6.5-7	9/14/2006	7,100	HY	42,000	H
PM30	PM30-2'	2-2.5	9/14/2006	2.7	HY	12	
	PM30-7'	7-7.5	9/14/2006	4.8	HY	12	
PM31	PM31-3'	3-3.5	9/15/2006	620	HY	4,800	
	PM31-5.5'	5.5-6	9/15/2006	2,700	HY	28,000	
	PM31-10'	10-10.5	9/15/2006	16	HY	120	H
PM32	PM32-2.5'	2.5-3	9/15/2006	28,000	HY	61,000	
	PM32-6'	6-6.5	9/15/2006	6.6	HY	13	H
PM33	PM33-3'	3-3.5	9/15/2006	14,000	HY	45,000	
	PM33-6'	6-6.5	9/15/2006	3.3	HY	13	H
PM34	PM34-3'	3-3.5	9/15/2006	1,200	HY	14,000	H
	PM34-6'	6-6.5	9/15/2006	50	HY	440	
PM35	PM35-3'	3-3.5	9/15/2006	4.3	HY	10	
	PM35-6'	6-6.5	9/15/2006	4.3	HY	11	
PM36	PM36-3'	3-3.5	9/18/2006	1.7	HY	ND(5)	
	PM36-6.5'	6.5-7	9/18/2006	14	HY	140	H
PM37	PM37-3'	3-3.5	9/18/2006	6,300	HY	11,000	
	PM37-6'	6-6.5	9/18/2006	21	HY	190	H
PM38	PM38-2.5'	2.5-3	9/18/2006	ND(0.99)		ND(5)	
	PM38-8'	8-8.5	9/18/2006	12	HY	43	H
PM39	PM39-2.5'	2.5-3	9/18/2006	ND(1)		ND(5)	
	PM39-6'	6-6.5	9/18/2006	2.8	HY	10	HY
PM40	PM40-2'	2-2.5	9/18/2006	1.3	HY	ND(5)	
	PM40-6.5'	6.5-7	9/18/2006	5.4	HY	20	H
PM41	PM41-3'	3-3.5	9/19/2006	2.1	HY	8.3	H
	PM41-6'	6-6.5	9/19/2006	2.2	HY	13	H

Table 8
TPH as Diesel and TPH as Motor Oil in Soil
Site 4 (Former Pipe Mill, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, CA

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	TPH as Diesel (mg/kg)		TPH as Motor Oil (mg/kg)	
PM44	PM44-2.5'	2.5-3	11/6/2006	5.1	HY	17	
	PM44-7'	7-7.5	11/6/2006	6.7	HY	43	
PM45	PM45-3'	3-3.5	11/6/2006	1,200	HY	5,100	
	PM45-6.5'	6.5-7	11/6/2006	4.0	HY	24	
PM46	PM46-3'	3-3.5	11/6/2006	1.4	Y	ND(5)	
	PM46-7'	7-7.5	11/6/2006	2.6	HY	13	
PM47	PM47-2.5'	2.5-3	11/6/2006	ND(1)		ND(5)	
	PM47-6.5'	6.5-7	11/6/2006	12	HY	86	
PM48	PM48-3'	3-3.5	11/6/2006	3.2	HLY	9.4	Y
	PM48-6.5'	6.5-7	11/6/2006	17	HLY	55	L
	PM48-10'	10-10.5	11/6/2006	6.0	HY	29	H
PM49	PM49-3'	3-3.5	11/6/2006	250	HY	1,000	H
	PM49-6.5'	6.5-7	11/6/2006	6.3	HY	15	HL
	PM49-10.5'	10.5-11	11/6/2006	13	HY	42	HL
PM50	PM50-3'	3-3.5	11/13/2006	1,600	HY	11,000	H
	PM50-7.5'	7.5-8	11/13/2006	15	HY	110	H
	PM50-11'	11-11.5	11/13/2006	4.7	HY	36	H
PM51	PM51-2.5'	2.5-3	11/9/2006	200	HY	2,400	
	PM51-6.5'	6.5-7	11/9/2006	35	HY	260	
	PM51-9.5'	9.5-10	11/9/2006	5.9	HY	39	
PM59	PM59-0'	0-0.5	11/9/2006	5,300	HY	56,000	
	PM59-4.5'	4.5-5	11/9/2006	36	HY	170	
Shallow (<3 meters bgs) Soil ESL¹				100²/400³		500²/1,000³	
Deep (>3 meters bgs) Soil ESL¹				5,000		5,000	

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource, and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

² = 0 to 3 feet bgs interval, including samples collected from 0 to 3.5 feet bgs

³ = 3 to 10 feet bgs interval, excluding soil samples collected from 3 to 3.5 feet bgs

Results exceeding ESLs are shaded

bgs = below ground surface

mg/kg = milligrams per kilogram

ND = Not detected at or above the indicated laboratory reporting limit

TPH = Total petroleum hydrocarbons

H = Heavier hydrocarbons contributed to the quantitation

Y = Sample exhibits chromatographic pattern which does not resemble standard

L = Lighter hydrocarbons contributed to the quantitation

Table 9
Volatile Organic Compounds in Soil
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	1,1,1-TCA (µg/kg)	1,1-DCA (µg/kg)	1,1-DCE (µg/kg)	1,2,4-TMB (µg/kg)	1,2-DCB (µg/kg)	1,3,5-TMB (µg/kg)	1,4-DCB (µg/kg)	2-Butanone (µg/kg)	2-Hexanone (µg/kg)	4-Methyl-2-Pentanone (µg/kg)	Acetone (µg/kg)	Chloro-benzene (µg/kg)	Chloro-ethane (µg/kg)	Ethyl-benzene (µg/kg)	Xylenes (µg/kg)	Naphthalene (µg/kg)	para-Isopropyl Toluene (µg/kg)	Propyl-benzene (µg/kg)	PCE (µg/kg)	Toluene (µg/kg)	TCE (µg/kg)	
PM1	PM1-3'	3-3.5	9/11/2006	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(8.5)	ND(4.2)	ND(8.5)	ND(17)	ND(4.2)	ND(8.5)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)
	PM1-6.25'	6.25-6.75	9/11/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(5)	ND(10)	ND(20)	ND(5)	ND(10)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
PM2	PM2-2.5'	2.5-3	9/11/2006	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(7.9)	ND(4)	ND(7.9)	ND(16)	ND(4)	ND(7.9)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)	ND(4)
	PM2-7'	7-7.5	9/11/2006	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(11)	ND(5.4)	ND(11)	ND(22)	ND(5.4)	ND(11)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)
PM3	PM3-3'	3-3.5	9/11/2006	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(11)	ND(5.3)	ND(11)	ND(21)	ND(5.3)	ND(11)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)	ND(5.3)
	PM3-7'	7-7.5	9/11/2006	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(11)	ND(5.6)	ND(11)	ND(22)	ND(5.6)	ND(11)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)
PM4	PM4-3'	3-3.5	9/11/2006	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(11)	ND(5.6)	ND(11)	ND(22)	ND(5.6)	ND(11)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	58	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)
	PM4-7'	7-7.5	9/11/2006	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(10)	ND(5.1)	ND(10)	53	ND(5.1)	ND(10)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	36	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)
PM5	PM5-3'	3-3.5	9/11/2006	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(12)	ND(6.1)	ND(12)	36	ND(6.1)	ND(12)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)
	PM5-7'	7-7.5	9/11/2006	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(8.6)	ND(4.3)	ND(8.6)	ND(17)	ND(4.3)	ND(8.6)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)	ND(4.3)
PM6	PM6-3'	3-3.5	9/11/2006	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(9.1)	ND(4.5)	ND(9.1)	ND(18)	ND(4.5)	ND(9.1)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
	PM6-7'	7-7.5	9/11/2006	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	ND(9.6)	ND(4.8)	ND(9.6)	85	ND(4.8)	ND(9.6)	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)	53	ND(4.8)	ND(4.8)	ND(4.8)	ND(4.8)
PM7	PM7-3'	3-3.5	9/11/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(5)	ND(10)	ND(20)	ND(5)	ND(10)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
	PM7-7'	7-7.5	9/11/2006	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(250)	ND(130)	ND(250)	ND(500)	ND(130)	ND(250)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)
PM8	PM8-3	3-3.5	9/12/2006	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(10)	ND(5.1)	ND(10)	ND(20)	ND(5.1)	ND(10)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)
	PM8-7	7-7.5	9/12/2006	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(11)	ND(5.7)	ND(11)	ND(23)	ND(5.7)	ND(11)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)
PM9	PM9-2.5	2.5-3	9/12/2006	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(11)	ND(5.4)	ND(11)	26	ND(5.4)	ND(11)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)	ND(5.4)
	PM9-5.5	5.5-6	9/12/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(5)	ND(10)	ND(20)	ND(5)	ND(10)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
	PM9-8	8-8.5	9/12/2006	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(9.1)	ND(4.5)	ND(9.1)	30	ND(4.5)	ND(9.1)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
PM10	PM10-2.5'	2.5-3	9/13/2006	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(7.8)	ND(3.9)	ND(7.8)	ND(16)	ND(3.9)	ND(7.8)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)	ND(3.9)
	PM10-6'	6-6.5	9/13/2006	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(11)	ND(5.7)	ND(11)	ND(23)	ND(5.7)	ND(11)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)
PM11	PM11-2.5	2.5-3	9/12/2006	ND(4.6)	ND(4.6)	ND(4.6)	4.7	ND(4.6)	ND(4.6)	ND(4.6)	ND(9.3)	ND(4.6)	ND(9.3)	23	ND(4.6)	ND(9.3)	ND(4.6)	8.0	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
	PM11-5.5	5.5-6	9/12/2006	ND(4.5)	ND(4.5)	ND(4.5)	5.6	ND(4.5)	ND(4.5)	ND(4.5)	ND(8.9)	ND(4.5)	ND(8.9)	ND(18)	ND(4.5)	ND(8.9)	ND(4.5)	6.1	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
PM12	PM12-3'	3-3.5	9/12/2006	320	580	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(250)	ND(130)	ND(250)	ND(500)	ND(130)	ND(250)	ND(130)	310	ND(130)	ND(130)	ND(130)	ND(130)	190	ND(130)	ND(130)
	PM12-6'	6-6.5	9/12/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(5)	ND(10)	ND(20)	ND(5)	ND(10)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
PM13	PM13-2.5'	2.5-3	9/12/2006	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(10)	ND(5.2)	ND(10)	ND(21)	ND(5.2)	ND(10)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)
	PM13-5.5'	5.5-6	9/12/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(5)	ND(10)	ND(20)	ND(5)	ND(10)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
PM14	PM14-3'	3-3.5	9/13/2006	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(4.9)	ND(9.8)	ND(20)	ND(4.9)	ND(9.8)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
	PM14-7'	7-7.5	9/13/2006	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(4.9)	ND(9.8)	ND(20)	ND(4.9)	ND(9.8)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
PM15	PM15-2.5'	2.5-3	9/13/2006	ND(130)	ND(130)	ND(130)	180	ND(130)	140	ND(130)	ND(250)	ND(130)	ND(250)	ND(500)	ND(130)	ND(250)	ND(130)	140	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)
	PM15-7'	7-7.5	9/13/2006	ND(500)	ND(500)	ND(500)	ND(500)	ND(500)	ND(500)	ND(500)	ND(1,000)	ND(500)	ND(1,000)	ND(2,000)	ND(500)	ND(1,000)	ND(500)	ND(500)	6,800	ND(500)	ND(500)	ND(500)	ND(500)	ND(500)	ND(500)
PM16	PM16-3'	3-3.5	9/13/2006	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(10)	ND(5.2)	ND(10)	ND(21)	ND(5.2)	ND(10)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)
	PM16-6.5'	6.5-7	9/13/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(9.3)	ND(4.6)	ND(9.3)	26	ND(4.6)	ND(9.3)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
PM17	PM17-3'	3-3.5	9/18/2006	ND(4.9)	ND(4.9)	ND(4.9)	21	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(4.9)	ND(9.8)	ND(20)	ND(4.9)	ND(9.8)	9.0	11	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
	PM17-6.5'	6.5-7	9/18/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(9.4)	ND(4.7)	ND(9.4)	ND(19)	ND(4.7)	ND(9.4)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
PM18	PM18-3'	3-3.5	9/13/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(9.3)	ND(4.6)	ND(9.3)	26	ND(4.6)	ND(9.3)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
	PM18-7'	7-7.5	9/13/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(5)	ND(10)	23	ND(5)	ND(10)	ND(5)	14	ND(5)	ND(5)	ND(5)	ND(5)	5.8	ND(5)	ND(5)
PM19	PM19-3'	3-3.5	9/13/2006	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(8.9)	ND(4.5)	ND(8.9)	ND(18)	ND(4.5)	ND(8.9)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
	PM19-6'	6-6.5	9/13/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(9.4)	ND(4.7)	ND(9.4)	ND(19)	ND(4.7)	ND(9.4)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
PM20	PM20-3'	3-3.5	9/18/2006	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(10)	ND(5.1)	ND(10)	ND(20)	ND(5.1)	ND(10)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)
	PM20-5.5'	5.5-6	9/18/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(9.3)	ND(4.6)	ND(9.3)	ND(19)	ND(4.6)	ND(9.3)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)

Table 9
Volatile Organic Compounds in Soil
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	1,1,1-TCA (µg/kg)	1,1-DCA (µg/kg)	1,1-DCE (µg/kg)	1,2,4-TMB (µg/kg)	1,2-DCB (µg/kg)	1,3,5-TMB (µg/kg)	1,4-DCB (µg/kg)	2-Butanone (µg/kg)	2-Hexanone (µg/kg)	4-Methyl-2-Pentanone (µg/kg)	Acetone (µg/kg)	Chloro-benzene (µg/kg)	Chloro-ethane (µg/kg)	Ethyl-benzene (µg/kg)	Xylenes (µg/kg)	Naphthalene (µg/kg)	para-Isopropyl Toluene (µg/kg)	Propyl-benzene (µg/kg)	PCE (µg/kg)	Toluene (µg/kg)	TCE (µg/kg)	
PM41	PM41-3'	3-3.5	9/19/2006	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(4.9)	ND(9.8)	ND(20)	ND(4.9)	ND(9.8)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
	PM41-6'	6-6.5	9/19/2006	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(10)	ND(5.1)	ND(10)	ND(20)	ND(5.1)	ND(10)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)
PM44	PM44-2.5'	2.5-3	11/6/2006	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(8.5)	ND(8.5)	ND(8.5)	ND(17)	ND(4.2)	ND(8.5)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)	ND(4.2)
	PM44-7'	7-7.5	11/6/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(9.4)	ND(9.4)	ND(9.4)	ND(19)	ND(4.7)	ND(9.4)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
PM45	PM45-3'	3-3.5	11/6/2006	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(12)	ND(12)	ND(12)	ND(23)	ND(5.8)	ND(12)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)
	PM45-6.5'	6.5-7	11/6/2006	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(12)	ND(12)	ND(12)	ND(24)	ND(6.1)	ND(12)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)
PM46	PM46-3'	3-3.5	11/6/2006	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(12)	ND(12)	ND(12)	ND(23)	ND(5.8)	ND(12)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)	ND(5.8)
	PM46-7'	7-7.5	11/6/2006	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(9.8)	ND(9.8)	ND(20)	ND(4.9)	ND(9.8)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
PM47	PM47-2.5'	2.5-3	11/6/2006	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(12)	ND(12)	ND(12)	ND(24)	ND(6)	ND(12)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)
	PM47-6.5'	6.5-7	11/6/2006	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(10)	ND(10)	ND(10)	28	ND(5.2)	ND(10)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)	ND(5.2)
PM48	PM48-3'	3-3.5	11/6/2006	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(11)	ND(11)	ND(11)	ND(22)	ND(5.6)	ND(11)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)	ND(5.6)
	PM48-6.5'	6.5-7	11/6/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(9.3)	ND(9.3)	ND(9.3)	ND(19)	ND(4.6)	ND(9.3)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
	PM48-10'	10-10.5	11/6/2006	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(12)	ND(12)	ND(12)	ND(24)	ND(6)	ND(12)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)	ND(6)
PM49	PM49-3'	3-3.5	11/6/2006	ND(130)	150	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(250)	ND(250)	ND(250)	ND(500)	ND(130)	ND(250)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)
	PM49-6.5'	6.5-7	11/6/2006	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(9.3)	ND(9.3)	ND(9.3)	ND(19)	ND(4.6)	ND(9.3)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)	ND(4.6)
	PM49-10.5'	10.5-11	11/6/2006	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(9.8)	ND(9.8)	ND(20)	ND(4.9)	ND(9.8)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
PM50	PM50-3'	3-3.5	11/13/2006	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(10)	ND(10)	ND(10)	ND(20)	ND(5)	ND(10)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)	ND(5)
	PM50-7.5'	7.5-8	11/13/2006	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(8.9)	ND(8.9)	ND(8.9)	ND(18)	ND(4.5)	ND(8.9)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)	ND(4.5)
	PM50-11'	11-11.5	11/13/2006	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(12)	ND(12)	ND(12)	ND(24)	ND(6.1)	ND(12)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)	ND(6.1)
PM51	PM51-2.5'	2.5-3	11/8/2006	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(9.4)	ND(9.4)	ND(9.4)	ND(19)	ND(4.7)	ND(9.4)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)	ND(4.7)
	PM51-6.5'	6.5-7	11/8/2006	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(9.8)	ND(9.8)	ND(9.8)	33	ND(4.9)	ND(9.8)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)	ND(4.9)
	PM51-9.5	9.5-10	11/8/2006	ND(5.7)	ND(5.7)	ND(23)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(11)	ND(11)	ND(11)	ND(23)	ND(5.7)	ND(11)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)	ND(5.7)
PM59	PM59-0'	0-0.5	11/8/2006	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(250)	310	760	ND(500)	ND(130)	ND(250)	ND(130)	130	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)	ND(130)
	PM59-4.5'	4.5-5	11/8/2006	ND(5.1)	ND(5.1)	ND(5.1)	11	ND(5.1)	ND(5.1)	ND(5.1)	ND(10)	ND(10)	ND(10)	ND(20)	ND(5.1)	ND(10)	6.6	ND(5.1)	14	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	ND(5.1)	
Shallow (<3 meters bgs) soil ESL¹				98,000	320	8,900	NE	8,900	NE	46	490,000	NE	NE	500,000	2,700	630	390,000	310,000	460	NE	NE	87	100,000	260	
Deep (>3 meters bgs) soil ESL¹				98,000	320	8,900	NE	8,900	NE	46	490,000	NE	NE	1,000,000	2,700	630	390,000	310,000	460	NE	NE	87	130,000	260	

Notes:
ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource, and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).
Results exceeding ESLs are shaded
bgs = Below ground surface
µg/kg = Micrograms per kilogram
TCA = Trichloroethane
DCA = Dichloroethane
DCE = Dichloroethene
TMB = Trimethylbenzene
DCB = Dichlorobenzene
PCE = Tetrachloroethylene
TCE = Trichloroethylene
ND = Not detected at or above the indicated laboratory reporting limit
NE = Not established

**Table 10
Metals in Soil
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Sample Location	Sample Identification	Sample Depth (Feet bgs)	Sample Date	Arsenic (mg/kg)	Barium (mg/kg)	Beryllium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Cobalt (mg/kg)	Copper (mg/kg)	Lead (mg/kg)	Molybdenum (mg/kg)	Nickel (mg/kg)	Selenium (mg/kg)	Vanadium (mg/kg)	Zinc (mg/kg)	Mercury (mg/kg)
PM31	PM31-3'	3-3.5	9/15/2006	0.73	40	1.6	0.29	5.8	3.0	5.3	3.5	ND(1)	5.6	ND(0.25)	23	110	ND(0.02)
	PM31-5.5'	5.5-6	9/15/2006	0.79	32	0.45	ND(0.25)	3.6	7.0	3.8	2.7	ND(1)	6.0	ND(0.25)	12	35	ND(0.02)
	PM31-10'	10-10.5	9/15/2006	3.1	79	0.37	ND(0.26)	53	4.1	22	10	1.3	44	ND(0.26)	42	36	0.11
PM32	PM32-2.5'	2.5-3	9/15/2006	0.31	54	0.64	ND(0.25)	11	1.4	9.3	6.6	ND(1)	5.4	ND(0.25)	11	29	ND(0.02)
	PM32-6'	6-6.5	9/15/2006	ND(0.25)	57	1.1	ND(0.25)	3.5	5.8	6.5	3.2	ND(1)	12	ND(0.25)	24	51	ND(0.021)
PM33	PM33-3'	3-3.5	9/15/2006	0.74	40	0.56	ND(0.25)	3.9	1.2	4.1	6.4	ND(1)	2.5	ND(0.25)	9.5	24	ND(0.02)
	PM33-6'	6-6.5	9/15/2006	ND(0.25)	43	0.75	ND(0.25)	3.1	1.3	4.6	2.6	ND(1)	2.7	ND(0.25)	7.4	17	ND(0.02)
PM39	PM39-2.5'	2.5-3	9/18/2006	1.6	60	0.68	ND(0.25)	17	3.7	6.2	6.4	ND(1)	7.4	ND(0.25)	23	37	ND(0.02)
	PM39-6'	6-6.5	9/18/2006	10	50	0.35	ND(0.27)	47	4.2	30	4.0	9.5	28	0.68	44	26	ND(0.02)
Shallow (<3 meters bgs) Soil ESL¹				5.5	750	4.0	1.7	58	10	230	150	40	150	10	110	600	3.7
Deep (>3 meters bgs) Soil ESL¹				5.5	2,500	36	38	58	10	2,500	750	2,500	1,000	2,500	2,500	2,500	98

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource, and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

bgs = Below ground surface

mg/kg = Milligrams per kilogram

ND = Not detected at or above the indicated laboratory reporting limit

Table 11
TPH as Diesel and TPH as Motor Oil in Groundwater
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Date	TPH as Diesel (µg/l)		TPH as Motor Oil (µg/l)	
PM1	PM1-W	9/12/2006	ND(50)		ND(300)	
PM2	PM2-W	9/11/2006	390	HY	370	HLY
PM3	PM3-W	9/11/2006	93	HY	490	H
PM4	PM4-W	9/11/2006	1,500	Y	470	Y
PM5	PM5-W	9/11/2006	ND(50)		ND(300)	
PM6	PM6-W	9/11/2006	4,600	HL	ND(300)	
PM7	PM7-W	9/11/2006	1,100	YZ	ND(300)	
PM8	PM8-W	9/12/2006	980		ND(300)	
PM9	PM9-W	9/12/2006	14,000	HYZ	17,000	
PM10	PM10-W	9/14/2006	53	Y	ND(300)	
PM11	PM11-W	9/12/2006	300,000	HY	3,800,000	
PM12	PM12-W	9/13/2006	20,000	HY	190,000	
PM13	PM13-W ²	9/13/2006	42,000,000	HY	380,000,000	
PM14	PM14-W	9/13/2006	64	HY	ND(300)	
PM15	PM15-W	9/14/2006	16,000	HLY	2,100	LY
PM16	PM16-W	9/13/2006	340,000	HY	760,000	
PM17	PM17-W	9/18/2006	7,800	HY	50,000	
PM18	PM18-W	9/13/2006	19,000	HY	130,000	L
PM19	PM19-W	9/13/2006	ND(50)		ND(300)	
PM20	PM20-W	9/18/2006	1,800	HY	6,500	L
PM21	PM21-W	9/14/2006	74,000	HY	210,000	L
PM22	PM22-W	9/15/2006	40,000	HY	260,000	
PM23	PM23-W	9/14/2006	15,000	HY	110,000	
PM24	PM24-W	9/15/2006	190,000	HY	740,000	
PM25	PM25-W	9/14/2006	6,400	HY	41,000	
PM26	PM26-W	9/15/2006	560	HY	630	L
PM27	PM27-W	9/14/2006	5,700	HY	60,000	
PM28	PM28-W	9/15/2006	1,700	HLY	1,900	L
PM29	PM29-W	9/15/2006	22,000	HY	120,000	
PM30	PM30-W	9/15/2006	110	HY	ND(300)	
PM31	PM31-W	9/15/2006	3,200	HY	8,500	
PM32	PM32-W	9/15/2006	44,000	HY	68,000	L
PM33	PM33-W	9/18/2006	19,000	HY	62,000	
PM34	PM34-W	9/18/2006	7,900	HY	84,000	
PM35	PM35-W	9/18/2006	560	HY	4,200	
PM36	PM36-W	9/18/2006	160	Y	ND(300)	
PM37	PM37-W	9/19/2006	3,300	HY	4,200	
PM38	PM38-W	9/18/2006	87	Y	ND(300)	
PM39	PM39-W	9/19/2006	170	Y	ND(330)	
PM40	PM40-W	9/19/2006	ND(50)		ND(300)	

Table 11
TPH as Diesel and TPH as Motor Oil in Groundwater
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Date	TPH as Diesel (µg/l)		TPH as Motor Oil (µg/l)	
PM41	PM41-W	9/19/2006	30	Y	ND(170)	
PM42	PM42-W	11/6/2006	ND(50)		ND(300)	
PM43	PM43-W	11/6/2006	290	Y	ND(300)	
PM44	PM44-W	11/6/2006	6,100	HL	2,300	L
PM45	PM45-W	11/6/2006	1,100	HY	1,500	L
PM46	PM46-W	11/6/2006	57	Y	ND(300)	
PM47	PM47-W	11/6/2006	ND(50)		ND(300)	
PM48	PM48-W	11/7/2006	460	Y	350	Y
PM49	PM49-W	11/7/2006	3,100	HY	11,000	
PM50	PM50-W	11/13/2006	4,400	HY	48,000	H
PM51	PM51-W	11/10/2006	2,200	HY	15,000	H
PM60	PM60-W	11/10/2006	430	HY	1,900	H
Groundwater ESL¹			2,500		2,500	

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

Results exceeding ESLs are shaded

² = Product sample; concentrations are in micrograms per kilogram (µg/kg)

µg/l = Micrograms per liter

ND = Not detected at or above the indicated laboratory reporting limit

TPH = Total petroleum hydrocarbons

H = Heavier hydrocarbons contributed to the quantitation

Y = Sample exhibits chromatographic pattern which does not resemble standard

L = Lighter hydrocarbons contributed to the quantitation

Z = Sample exhibits unknown single peak or peak

Table 12
 Volatile Organic Compounds in Groundwater
 Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
 Napa Pipe Facility
 Napa, California

Sample Location	Sample Identification	Sample Date	1,1,1-TCA (µg/l)	1,1,2-TCA (µg/l)	1,1-DCA (µg/l)	1,1-DCE (µg/l)	1,2,4-TMB (µg/l)	1,2-DCB (µg/l)	1,2-DCA (µg/l)	1,3,5-TMB (µg/l)	1,4-DCB (µg/l)	2-Butanone (µg/l)	2-Chloro-toluene (µg/l)	2-Hexanone (µg/l)	4-Methyl-2-Pentanone (µg/l)	Acetone (µg/l)	Benzene (µg/l)	Carbon Disulfide (µg/l)	Chloro-benzene (µg/l)	Chloro-ethane (µg/l)	cis-1,2-DCE (µg/l)	Ethyl-benzene (µg/l)	Isopropyl-benzene (µg/l)	Xylenes (µg/l)	MTBE (µg/l)	Naphthalene (µg/l)	para-Isopropyl Toluene (µg/l)	Propyl-benzene (µg/l)	sec-Butyl-benzene (µg/l)	Toluene (µg/l)	TCE (µg/l)	PCE (µg/l)	1,4-Dioxane ³ (µg/l)	Vinyl Chloride (µg/l)
PM1	PM1-W	9/12/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	1.1	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM2	PM2-W	9/11/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM3	PM3-W	9/11/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM4	PM4-W	9/11/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	91	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM5	PM5-W	9/11/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	3.5	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM6	PM6-W	9/11/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	2.1	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	11	ND(0.5)	ND(0.5)	1.3	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM7	PM7-W	9/11/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	0.7	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	200	0.6	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	1.9	ND(0.5)	ND(2)	16	ND(0.5)	ND(0.5)	1.4	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM8	PM8-W	9/12/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	0.5	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM9	PM9-W	9/12/2006	ND(0.5)	ND(0.5)	1.7	ND(0.5)	ND(0.5)	1.5	ND(0.5)	ND(0.5)	1.1	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	2.6	96	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	1.3	ND(0.5)	ND(0.5)	NA	3.2
PM10	PM10-W	9/14/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM11	PM11-W	9/12/2006	ND(0.5)	ND(0.5)	1.2	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	20	ND(0.5)	ND(0.5)	ND(0.5)	1.6	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM12	PM12-W	9/13/2006	8.5	ND(0.7)	160	13	ND(0.7)	ND(0.7)	4.7	ND(0.7)	ND(0.7)	ND(14)	ND(0.7)	ND(14)	ND(14)	19	ND(0.7)	ND(0.7)	ND(0.7)	390	ND(0.7)	1.5	ND(0.7)	5.8	ND(0.7)	ND(2.9)	ND(0.7)	ND(0.7)	ND(0.7)	13	ND(0.7)	ND(0.7)	NA	ND(0.7)
PM13	PM13-W ²	9/13/2006	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(1,300)	ND(630)	ND(1,300)	ND(1,300)	ND(2,500)	ND(630)	ND(630)	ND(630)	ND(1,300)	ND(630)	ND(630)	ND(630)	680	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	ND(630)	NA	ND(1,300)	
PM14	PM14-W	9/13/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM15	PM15-W	9/14/2006	ND(0.5)	0.7	0.6	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	140	ND(0.5)	28	ND(10)	490	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	7.3	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM16	PM16-W	9/13/2006	ND(0.5)	ND(0.5)	8.1	ND(0.5)	ND(0.5)	1.0	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	13	0.6	ND(0.5)	2.4	31	ND(0.5)	ND(0.5)	ND(0.5)	2.1	2.5	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	2.3	ND(0.5)	ND(0.5)	NA	2.9
PM17	PM17-W	9/18/2006	ND(0.5)	ND(0.5)	3.0	ND(0.5)	2.3	ND(0.5)	ND(0.5)	0.6	ND(0.5)	ND(10)	0.7	ND(10)	ND(10)	ND(10)	6.3	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	0.6	0.9	3.1	ND(0.5)	ND(2)	ND(0.5)	0.9	0.6	1.3	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM18	PM18-W	9/13/2006	ND(0.5)	ND(0.5)	3.7	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	1.4	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	0.8	ND(0.5)	10.8	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	6.4	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM19	PM19-W	9/13/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM20	PM20-W	9/18/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM21	PM21-W	9/14/2006	1.7	1.2	110	14	5.5	0.8	0.8	2.2	0.6	ND(10)	ND(0.5)	ND(10)	ND(10)	59	ND(0.5)	ND(0.5)	1.8	370	0.5	2.0	ND(0.5)	23	ND(0.5)	ND(2)	ND(0.5)	1.0	ND(0.5)	2.7	1.0	ND(0.5)	NA	14
PM22	PM22-W	9/15/2006	ND(0.5)	ND(0.5)	1.2	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	0.5	ND(0.5)	ND(0.5)	13	22	ND(0.5)	ND(0.5)	0.8	8.7	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	3.3	16	ND(0.5)	NA	ND(0.5)
PM23	PM23-W	9/14/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	0.8	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	15	ND(0.5)	ND(10)	ND(10)	28	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	1.4	7.0	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	7.0	1.6	ND(0.5)	NA	ND(0.5)
PM24	PM24-W	9/14/2006	8.2	ND(0.5)	57	1.4	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	0.8	1.2	4.1	8.7	ND(0.5)	ND(0.5)	ND(0.5)	1.9	0.5	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	3.0	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM25	PM25-W	9/14/2006	ND(0.5)	ND(0.5)	46	38	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	10	51	ND(0.5)	ND(0.5)	ND(0.5)	7.4	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	1.6	
PM26	PM26-W	9/15/2006	5.8	ND(1.3)	300	110	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(25)	ND(1.3)	ND(25)	ND(25)	ND(25)	ND(1.3)	ND(1.3)	ND(1.3)	33	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(5)	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	NA	14	
PM27	PM27-W	9/14/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	1.8	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	0.6	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM28	PM28-W	9/15/2006	ND(0.5)	ND(0.5)	1.1	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	0.6	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM29	PM29-W	9/15/2006	ND(1.3)	ND(1.3)	150	4.9	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(1.3)	ND(25)	ND(1.3)	ND(25)	ND(25)	ND(25)	1.3	ND(1.3)	ND(1.3)	39	ND(1.3)	ND(1.3)	ND(1.3)	3.1	ND(1.3)	ND(5)	ND(1.3)	ND(1.3)	ND(1.3)	18	ND(1.3)	ND(1.3)	NA	1.5
PM30	PM30-W	9/15/2006	ND(0.5)	ND(0.5)	31	3.7	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM31	PM31-W	9/15/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	0.8	ND(0.5)	ND(0.5)	0.8	ND(10)	ND(0.5)	ND(10)	ND(10)	20	2.4	ND(0.5)	27	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	4.5	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	8.3	5.5	ND(0.5)	NA	ND(0.5)	
PM32	PM32-W	9/15/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	1.1	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	1.7	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM33	PM33-W	9/15/2006	ND(0.5)	ND(0.5)	2.7	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	22	ND(0.5)	ND(10)	ND(10)	89	ND(0.5)	ND(0.5)	ND(0.5)	6.5	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM34	PM34-W	9/18/2006	ND(0.5)	ND(0.5)	3.1	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	1.5	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	1.7	ND(0.5)	ND(0.5)	NA	ND(0.5)
PM35	PM35-W	9/15/2006	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(10)	ND(0.5)	ND(10)	ND(10)	ND(10)	ND(0.5)	ND(0.5)	ND(0.5)	ND(1)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(2)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	ND(0.5)	NA	ND(0.5)	
PM36	PM36-W	9/18/2006	ND(0																															

**Table 13
Soil Gas Sample Results
Site 4 (Former Pipe Mill, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Sample Location	Sample Identification	Sample Date	1,1,2,2-TCA (µg/l)	Chloroethane (µg/l)	1,1-DCE (µg/l)	1,1-DCA (µg/l)	Vinyl Chloride (µg/l)	Total Xylenes (µg/l)
PMSG1 ²	PMSG1-1	11/7/2006	3.0	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
	PMSG1-3	11/7/2006	ND(2.0)	120	6.1	ND(2.0)		ND(3.0)
	PMSG1-7	11/7/2006	ND(2.0)	13	ND(2.0)	ND(2.0)		ND(3.0)
PMSG2	PMSG2	11/7/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG3	PMSG3	11/7/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG4	PMSG4	11/7/2006	ND(2.0)	3.0	ND(2.0)	27		ND(3.0)
PMSG5	PMSG5	11/7/2006	ND(2.0)	50	ND(2.0)	11		ND(3.0)
PMSG6	PMSG6	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG7	PMSG7	11/7/2006	ND(2.0)	ND(2.0)	ND(2.0)	15	ND(2.0)	ND(3.0)
PMSG8	PMSG8	11/7/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG9	PMSG9	11/7/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG10	PMSG10	11/7/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG11	PMSG11	11/8/2006		ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	5.3
PMSG12	PMSG12	11/8/2006	2.7	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG13	PMSG13	11/8/2006	ND(2.0)	9.2	ND(2.0)	70	ND(2.0)	ND(3.0)
PMSG14	PMSG14	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG15	PMSG15	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG16	PMSG16	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG17	PMSG17	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG18	PMSG18	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG19	PMSG19	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
PMSG20	PMSG20	11/8/2006	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(2.0)	ND(3.0)
Soil Gas ESL¹			0.043	2.9	42	1.5	0.032	150

Notes:

¹ = California Regional Water Quality Control Board (RWQCB), San Francisco Bay Region, Screening for Environmental Concerns at Sites With Contaminated Soil and Groundwater, February 2005. Table E-2, Shallow Soil Gas Screening Levels For Evaluation of Potential Vapor Intrusion Concerns.

All samples collected between 3.5 and 4 feet bgs

² = Results for PMSG1-1, PMSG1-3, and PMSG1-7 are for samples collected after purging 1, 3, and 7 volumes, respectively.

 = Exceeds ESL

 = Exceeds ESL by at least 100 times

 = Exceeds ESL by at least 1,000 times

µg/l = Micrograms per liter of air

TCA = Trichloroethane

DCE = Dichloroethene

DCA = Dichloroethane

ND = Not detected at or above the indicated laboratory reporting limit

Table 14
Volatile Organic Compounds in Storm Drain Sediment Samples
Site 4 (Former Pipe Mill, Maintenance Garage and Paint Storage Building)
Napa Pipe Facility
Napa, California

Sample Location	Sample Identification	Sample Date	Units	Matrix	Xylenes	Toluene
PMSD1	PMSD1	11/8/2006	µg/l	Sediment ¹	ND(0.5)	0.6
PMSD2	PMSD2	11/8/2006	µg/kg	Sediment ²	ND(6.9)	ND(6.9)
PMSD3	PMSD3	11/8/2006	µg/l	Sediment ¹	0.5	0.6

Notes:

µg/l = Micrograms per liter

µg/kg = Micrograms per kilogram

ND = Not detected at or above the indicated laboratory reporting limit

Sediment ¹ = Analyzed as a water sample; units are in µg/l

Sediment ² = Analyzed as a soil sample; units are in µg/kg

**Table 15
Summary of Petroleum Hydrocarbons in Soil
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Constituent	Maximum Detection (mg/kg)	Minimum Detection (mg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL¹ (mg/kg)	Deep (>3 meters bgs) Soil ESL¹ (mg/kg)	# of Detections Above ESL
TPH ²	37,000	ND	30	16	53%	100 ⁴ /400 ⁵	5,000	2
O&G	40,000	ND	21	13	62%	500 ^{3,4} /1,000 ⁵	5,000	2
TPH-d	28,000	ND	152	129	85%	100 ⁴ /400 ⁵	5,000	37
TPH-mo	61,000	ND	137	107	78%	500 ⁴ /1,000 ⁵	5,000	34
TPH-g	670	ND	6	3	50%	100	5,000	1

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

² = Results represent the sum of TPH-d and TPH-mo concentrations. Therefore, the results are compared to the more conservative ESLs for TPH-d (i.e., TPH [middle distillates]).

³ = ESL for residual fuels

⁴ = 0 to 3 feet bgs interval, including samples collected from 3 to 3.5 feet bgs

⁵ = 3 to 10 feet bgs interval, excluding soil samples collected from 3 to 3.5 feet bgs

mg/kg = milligrams per kilogram

ND = Not detected

O&G = Oil & grease

TPH = Total petroleum hydrocarbons

TPH-d = TPH as diesel

TPH-g = TPH as gasoline

TPH-mo = TPH as motor oil

**Table 16
Summary of Volatile Organic Compounds in Soil
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Constituent	Maximum Detection (µg/kg)	Minimum Detection (µg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL1 (µg/kg)	Deep (>3 meters bgs) Soil ESL1 (µg/kg)	# of Detections Above ESL
2-Butanone (MEK)	24	ND	163	2	1%	490,000	490,000	0
1,1-DCA	990	ND	163	17	10%	320	320	2
1,1-DCE	13	ND	163	2	1%	8,900	8,900	0
1,1,1-TCA	320	ND	163	5	3%	98,000	98,000	0
1,2,4-TMB	180	ND	163	13	8%	NE	NE	N/A
1,3,5-TMB	140	ND	163	6	4%	NE	NE	N/A
Acetone	100	ND	163	23	14%	500,000	1,000,000	0
Ethylbenzene	48	ND	163	7	4%	390,000	390,000	0
Methylene Chloride	400	ND	163	3	2%	520	520	0
Naphthalene	6,800	ND	163	2	1%	460	460	1
Para(4)-Isopropyl Toluene	180	ND	163	6	4%	NE	NE	N/A
Propylbenzene	7.4	ND	163	2	1%	NE	NE	N/A
Toluene	670	ND	165	13	8%	100,000	130,000	0
Xylenes	310	ND	164	15	9%	310,000	310,000	0
1,2-DCB	40	ND	163	2	1%	8,900	8,900	0
1,4-DCB	6.3	ND	163	1	1%	46	46	0
2-Hexanone	310	ND	163	1	1%	NE	NE	N/A
4-Methyl-2-Pentanone	760	ND	163	3	2%	NE	NE	N/A
Chlorobenzene	12	ND	163	2	1%	2,700	2,700	0
Chloroethane	35	ND	163	4	2%	630	630	0
PCE	130	ND	163	4	2%	87	87	1
TCE	890	ND	163	6	4%	260	260	1
1,2-DCA	6	ND	163	1	1%	25	25	0
Carbon Disulfide	200	ND	163	4	2%	NE	NE	N/A
Tetrahydrofuran	300	ND	163	2	1%	NE	NE	N/A
n-Propylbenzene	42	ND	163	2	1%	NE	NE	N/A

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

bgs = Below ground surface

µg/kg = Micrograms per kilogram

ND = Not detected

NE = No established ESL

N/A = Not applicable

DCA = Dichloroethane

DCE = Dichloroethene

MEK = Methyl ethyl ketone

TCA = Trichloroethane

TMB = Trimethylbenzene

PCE = Tetrachloroethylene

TCE = Trichloroethylene

**Table 17
Summary of Semivolatile Organic Compounds in Soil
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Constituent	Maximum Detection (µg/kg)	Minimum Detection (µg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL¹ (µg/kg)	Deep (>3 meters bgs) Soil ESL¹ (µg/kg)	# of Detections Above ESL
Pyrene	1,400	ND	21	1	5%	85,000	85,000	0
Fluoranthene	1,200	ND	21	1	5%	40,000	1,000,000	0
Chrysene	500	ND	21	1	5%	3,800	150,000	0
Phenanthrene	500	ND	21	1	5%	40,000	1,000,000	0
bis(2-ethylhexyl)phthalate	5,100	ND	21	1	5%	160,000	1,000,000	0

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

bgs = Below ground surface

µg/kg = Micrograms per kilogram

ND = Not detected

**Table 18
Summary of Metals in Soil
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Constituent	Maximum Detection (mg/kg)	Minimum Detection (mg/kg)	Number of Samples	Number of Detections	Frequency of Detection	Shallow (<3 meters bgs) Soil ESL ¹ (mg/kg)	Deep (>3 meters bgs) Soil ESL ¹ (mg/kg)	# of Detections Above ESL	Background (mg/kg)	# of Detections Above Background
Aluminum	15,000	4,000	7	7	100%	NE	NE	N/A	20,293	0
Antimony	ND	ND	5	0	0%	6.1	280	0	NE	N/A
Arsenic	20	ND	23	20	87%	5.5	5.5	8	15.3	1
Barium	230	18	23	23	100%	750	2,500	0	248	0
Beryllium	1.6	ND	14	10	71%	4.0	36	0	NE	N/A
Cadmium	11	ND	23	4	17%	1.7	38	2	13.7	0
Chromium	65	ND	23	18	78%	58	58	1	98	0
Chromium VI	5.2	ND	5	5	100%	1.8	1.8	1	NE	N/A
Cobalt	7.0	ND	14	11	79%	10	10	0	NE	N/A
Copper	66	ND	23	22	96%	230	2,500	0	49	3
Lead	53	ND	23	20	87%	150	750	0	27	3
Molybdenum	9.5	ND	14	2	14%	40	2,500	0	NE	N/A
Mercury	0.12	ND	21	9	43%	3.7	98	0	0.69	0
Nickel	150	ND	23	19	83%	150	1,000	0	125	2
Selenium	0.68	ND	23	1	4%	10	2,500	0	0.9	0
Silver	7.8	ND	5	5	100%	20	2,500	0	NE	N/A
Thallium	ND	ND	5	0	0%	1.0	47	0	NE	N/A
Vanadium	42	ND	14	13	93%	110	2,500	0	NE	N/A
Zinc	110	ND	23	22	96%	600	2,500	0	134	0

Notes:

ESL¹ = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) for residential land use where potentially impacted groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

bgs = Below ground surface

mg/kg = milligrams per kilogram

ND = Not detected

NE = No established ESL or background level

N/A = Not applicable

Background = Proposed threshold concentrations, Table B-3 of JMM, 1990

**Table 19
Summary of Petroleum Hydrocarbons in Groundwater
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Constituent	Maximum Detection (µg/l)	Minimum Detection (µg/l)	Number of Samples¹	Number of Detections	Frequency of Detection	Groundwater ESL² (µg/l)	# of Detections Above ESL
TPH-g	110	ND	19	1	5%	5,000	0
TPH-d	1,400,000	ND	83	66	80%	2,500	28
TPH-mo	6,400,000	ND	83	44	53%	2,500	27

Notes:

¹ = Unless otherwise noted, groundwater results from: (1) the fourth quarter 2006 monitoring event; (2) Shaw Environmental Inc.'s 2005 *Phase II Site Investigation*; and (3) PES's 2006 *Supplemental Remedial Investigation* were used to compile the information presented on this table.

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

µg/l = Micrograms per liter

ND = Not detected

TPH = Total petroleum hydrocarbons

TPH-d = TPH as diesel

TPH-g = TPH as gasoline

TPH-mo = TPH as motor oil

Table 20
Summary of Volatile Organic Compounds in Groundwater
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California

Constituent	Maximum Detection (µg/l)	Minimum Detection (µg/l)	Number of Samples ¹	Number of Detections	Frequency of Detection	Groundwater ESL ² (µg/l)	# of Detections Above ESL
2-Butanone (MEK)	140	ND	74	4	5%	50,000	0
1,1,1-TCA	8.5	ND	74	6	8%	50,000	0
1,1,2-TCA	1.2	ND	74	2	3%	350	0
1,1-DCA	7,200	ND	74	34	46%	1,000	1
1,2-DCA	4.7	ND	74	3	4%	200	0
1,1-DCE	6,700	ND	74	16	22%	6,300	1
1,4-Dioxane ³	290	ND	16	7	44%	50,000	0
1,2,4-Trimethylbenzene	12	ND	74	6	8%	NE	N/A
1,3,5-Trimethylbenzene	5.3	ND	74	3	4%	NE	N/A
1,2-Dichlorobenzene	1.5	ND	74	5	7%	100	0
1,4-Dichlorobenzene	1.1	ND	74	6	8%	110	0
2-Chlorotoluene	0.7	ND	74	1	1%	NE	N/A
2-Hexanone	28	ND	74	1	1%	NE	N/A
4-Methyl-2-pentanone	10	ND	74	1	1%	NE	N/A
Acetone	490	ND	74	15	20%	50,000	0
Benzene	7.7	ND	74	13	18%	540	0
Carbon Disulfide	3.5	ND	74	4	5%	NE	N/A
Chlorobenzene	27	ND	74	10	14%	500	0
Chloroethane	390	ND	74	19	26%	160	3
cis-1,2-DCE	22	ND	74	6	8%	6,200	0
Ethylbenzene	67	ND	74	6	8%	300	0
Isopropylbenzene	0.9	ND	74	1	1%	NE	N/A
MTBE	98	ND	74	10	14%	1,800	0
Naphthalene	7.3	ND	74	1	1%	210	0
PCE	5.7	ND	74	1	1%	120	0
para(4)-Isopropyl Toluene	91	ND	74	3	4%	NE	N/A
Propylbenzene	1.0	ND	67	2	3%	NE	N/A
sec-Butylbenzene	0.6	ND	74	3	4%	NE	N/A
Tert-butyl alcohol	8.7	ND	7	3	43%	NE	N/A
Toluene	490	ND	74	25	34%	400	1
TCE	16	ND	74	6	8%	530	0
Vinyl Chloride	110	ND	74	11	15%	3.8	6
Xylenes	570	ND	74	17	23%	5,300	0

Notes:

¹ = Unless otherwise noted, groundwater results from: (1) the fourth quarter 2006 monitoring event; (2) Shaw Environmental Inc.'s 2005 Phase II Site Investigation; and (3) PES's 2006 *Supplemental Remedial Investigation* were used to compile the information presented on this table.

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL)

where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

³ = 1,4-dioxane results from the second quarter 2006 monitoring event, with the exception of those for wells MW-58, MW-64, and MW-65, were used because the samples collected during the fourth quarter 2006 monitoring event were not analyzed for this constituent.

µg/l = Micrograms per liter

DCA = Dichloroethane

DCE = Dichloroethene

MEK = Methyl ethyl ketone

MTBE = Methyl-tert-butyl ether

PCE = Tetrachloroethylene

TCA = Trichloroethane

TCE = Trichloroethylene

N/A = Not applicable

ND = Not detected

NE = Not established

Table 21
Summary of Semivolatile Compounds in Groundwater
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California

Constituent	Maximum Detection (µg/l)	Minimum Detection (µg/l)	Number of Samples¹	Number of Detections	Frequency of Detection	Groundwater ESL² (µg/l)	# of Detections Above ESL
Methylnaphthalene (total 1- & 2-)	1.6	ND	8	1	13%	100	0

Notes:

¹ = Results used to compile the information presented on this table are from Shaw Environmental Inc. 2005 *Phase II*

Site Investigation at Napa Pipe Facility, 1025 Kaiser Road, Napa, CA

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL)

where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

µg/l = Micrograms per liter

ND = Not detected

**Table 22
Summary of Metals in Groundwater
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility
Napa, California**

Constituent	Maximum Detection (µg/l)	Minimum Detection (µg/l)	Number of Samples¹	Number of Detections	Frequency of Detection	Groundwater ESL² (µg/l)	# of Detections Above ESL
Aluminum	ND	ND	2	0	0%	NE	N/A
Arsenic	6.0	ND	2	1	50%	50,000	0
Barium	1,000	940	2	2	100%	50,000	0
Chromium	7.5	ND	2	1	50%	50,000	0
Copper	2.2	ND	2	1	50%	50,000	0
Lead	ND	ND	2	0	0%	50,000	0
Mercury	ND	ND	2	0	0%	50,000	0
Selenium	ND	ND	2	0	0%	50,000	0
Zinc	12	ND	2	1	50%	50,000	0

Notes:

¹ = Groundwater results from well MW-5 for the second and fourth quarter 2006 monitoring events were used to compile the information presented on this table. This is the only Site 4 well that has recently been sample for metals.

ESL² = San Francisco Bay Regional Water Quality Control Board (RWQCB) Environmental Screening Level (ESL) where groundwater is not a current or potential drinking water resource and where the soil leaching to groundwater and discharge of groundwater to surface water pathway does not apply (i.e., no aquatic habitat pathway).

µg/l = Micrograms per liter

ND = Not detected

NE = Not established

N/A = Not applicable

Table 23a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Soil Vapor Extraction	Vacuum is applied to the subsurface to extract contaminant-laden soil gas. Induced concentration gradients result in desorption and mobilization of contaminants to fresh air pulled in from outside the target zone.	<p>Applicability. Applicable to volatile organics and some fuels (Henry's law constant greater than 0.01 or vapor pressure greater than 0.5 mm Hg). Moisture content, organic content, and air permeability of soil affect applicability. Aeration by SVE can promote <i>in situ</i> aerobic biodegradation but can also limit anaerobic biodegradation.</p> <p>Limitations. Performance is function of air permeability and contaminant volatility. High amount of fines and high degree of saturation limit airflow require higher vacuums. Stratified soils result in non-uniform airflow causing hot spots to remain. High sorption capacity can reduce removal rates. Off-gas and residual liquids may require treatment/disposal.</p>	<p>Low Primary site contaminants (TPH-mo and TPH-d) are not readily amenable to SVE. Unsaturated zone is not very thick and consists of low permeability silts and clays. Site lithology is not conducive to technologies relying on subsurface air flow. Potential for free product makes this technology even less viable.</p>	<p>Easy After all aboveground structures are removed, implementing this technology is fairly easy. The system is simple to operate and maintain, requiring no specialized skill level and experience. Equipment is readily available with numerous vendors.</p>	<p>Low ⑤ SVE is a proven and relatively easy to operate remediation technology. System installation and operating costs are not excessive requiring no special equipment and consumables. High uncertainty since no data is available to determine long-term effectiveness and remediation duration, and contaminants are not prone to volatilization.</p>	No – due to low effectiveness.
Thermally Enhanced Soil Vapor Extraction	Hot air, steam, or soil heating is used to enhance desorption, volatilization and mobility. Vacuum is applied to subsurface to remove the volatilized contaminants.	<p>Applicability. Technology improves volatility of VOCs and SVOCs. Heating soil may increase air permeability by drying soils or interstitial pore space. Thermally enhanced SVE can improve conditions for biodegradation of residual contaminants.</p> <p>Limitations. Performance is function of attainable soil temperature, air permeability, and contaminant volatility. Same limitations as SVE. Offgas and residual liquids may be required treatment/disposal. Higher process temperatures require specialized equipment.</p>	<p>Low to Medium Thermal enhancement may provide limited improvement of contaminant extraction rates compared to SVE. Soils can become more permeable as they dry out. Motor oil range TPH contaminants will volatilize more when heated. Thin unsaturated zone, low permeability silts and clays, and heterogeneous lithology is not conducive to technologies relying on subsurface air flow. Potential for free product further reduces effectiveness.</p>	<p>Moderately Difficult Similar to SVE except specialized process equipment and higher temperature-rated components are needed. Also, specialized skills are required to operate and maintain the heat source systems. Boundary control becomes a challenge to ensure contaminated vapors and liquids do not contaminate previously clean areas.</p>	<p>Moderate to High ⑤ Significantly higher costs than conventional SVE due to need for high temperature rated equipment and material. Also, electrical and/or fuel costs are significantly higher to supply the heat source. Shallow water table may require additional measures to ensure contaminated vapors are not released from the site. Maximum soil temperatures may be limited by low air permeability and shallow water table. High uncertainty since no data is available to determine long-term effectiveness and remediation duration. Site lithology not conducive to technologies relying on subsurface air flow.</p>	No – due to low effectiveness and relatively high cost

**Table 23a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Excavation	Contaminated soils are excavated using standard construction techniques such as excavators, bulldozers, and scrapers. Excavation of saturated soils may require dewatering. Excavated soils are managed using other remediation technologies depending on contaminant type and concentration, cleanup levels, and regulatory requirements.	<p>Applicability. Excavation of soils above water table is a common remediation method. Relatively shallow unsaturated zone minimizes excavation volumes and limits need for shoring or slope stabilization. Excavation of soils below water table is less common, but limited depth of contamination below the water table makes this approach feasible.</p> <p>Limitations. Requires heavy construction equipment. Potential free phase product and high concentrations may present safety concerns requiring engineering controls to prevent exposure and fire/explosion. Silty/clayey soils may involve additional handling requirements.</p>	<p>High Impacted soil and contaminants are removed and no longer provide a potential source of exposure or secondary source of contamination to groundwater.</p>	<p>Moderately Easy After all aboveground structures are removed, excavation is fairly straightforward to implement using standard construction techniques. Large excavations below the water table will require dewatering and/or specialized excavation methods.</p>	<p>Moderate ① Large contaminated area and potential need to use respiratory equipment and handle contaminated soils and free phase product increase costs. Also, all contaminants are excavated and clean boundaries are confirmed via on-site sampling.</p>	Yes – effective and readily implemented at reasonable cost.
<i>Ex Situ</i> Low Temperature Thermal Desorption	Excavated soil is processed through an aboveground low temperature thermal desorption (LTTD) unit where it is heated to upwards of 600°F. Contaminants volatilize and are removed and treated in the vapor phase. Clean soils can be used as backfill material. Pre-processing of contaminated soils may be required to remove debris or oversize material, reduce moisture content to <20 to 30%, and reduce excessively high contaminant concentrations.	<p>Applicability. Site 4 contaminants will desorb at temperatures achievable by LTTD and are readily destroyed in standard vapor phase treatment systems (e.g., thermal oxidizers).</p> <p>Limitations. Moisture content of saturated soils and silty/clayey soils may involve additional handling requirements (e.g., drying). Large LTTD units require significant mobilization of equipment and access to large supplies of natural gas or propane. Operation of LTTD units will likely require air discharge permitting and associated emission limits.</p>	<p>High LTTD is a proven technology that has been shown effective at reducing contaminant concentrations to well below site cleanup levels. Effective operation results in soil suitable for reuse and destruction of contaminants in vapor phase treatment systems.</p>	<p>Moderately Difficult LTTD units of the size potentially required at Site 4 are large specialized systems and require significant mobilization and setup. Permitting requirements can be significant, but rarely prevent operations. Once set up, operations are relatively straightforward and involve providing a constant feed of contaminated soil to the LTTD unit, operation and monitoring of the unit itself, and managing the treated soils.</p>	<p>Moderate to High ③ Fuel requirements to run the LTTD unit increase operating costs. Contaminants are heated well above the boiling point, and soils can be blended to ensure soil is uniformly heated. Soils excavated from the capillary fringe will be wet and likely require drying. Although this is a proven technology for the site contaminants and confirmation sampling documents treatment effectiveness, moderate uncertainty associated with permitting requirements and exact nature of soil pre-processing requirements.</p>	Yes – effective and implementable for site contaminants at moderate cost.

**Table 23a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Incineration	Excavated soil is processed through an aboveground incinerator unit where it is heated to high temperatures (upwards of 1,800°F). Contaminants are destroyed due to the high combustion temperatures. Clean soils can be used as backfill material.	<p>Applicability. Use of incinerator requires mobilizing a unit to the site (readily available technology). Contaminants are suitable for high temperature volatilization and removal/destruction.</p> <p>Limitations. Moisture content of saturated soils and silty/clayey soils may involve additional handling requirements. Large soil incineration units require significant mobilization of equipment and access to large supplies of natural gas or propane. Operation of incinerator unit will likely require air discharge permitting and associated emission limits.</p>	<p>High Incineration is a proven technology that has been shown effective at reducing contaminant concentrations to well below site cleanup levels. Effective operation results in soil suitable for reuse.</p>	<p>Moderately Difficult Incineration units of the size potentially required at Site 4 are large and specialized systems and require significant mobilization and setup. Permitting requirements can be significant.</p>	<p>High ③ Due to significantly higher operational temperatures, incinerators are more expensive to build and operate, with large fuel requirements increasing operating costs. Soils excavated from the capillary fringe will be wet and likely require drying. Although this is a proven technology for the site contaminants, the moderate uncertainty is associated with permitting requirements and exact nature of soil pre-processing requirements.</p>	No – Higher costs compared to LTTD with no benefit.
In-Pile Thermal Desorption	Excavated soil is stockpiled in engineered cells with embedded thermal desorption heaters and extractors. A heat source adds thermal energy to the pile to volatilize VOCs and SVOCs. Depending on the temperature (upwards of 1,600°F), contaminants can be destroyed or extracted and treated. Clean soils can be used as backfill material.	<p>Applicability. Contaminants are susceptible to high temperature volatilization and removal/destruction. Large available land area to set up cells.</p> <p>Limitations. Requires heavy construction equipment. Contaminant aeration is likely during excavation, potentially requiring respiratory protection for on-site workers. Potential free phase product and high concentrations present safety concerns due to exposure and fire/explosion. Desorbed vapors and drained liquids require containment measures and treatment systems.</p>	<p>High Thermal desorption is a proven technology that has been shown effective at reducing contaminant concentrations, although in-pile technique utilized less than continuous feed LTTD and incineration technologies. Effective operation results in soil suitable for reuse and destruction of contaminants in vapor phase treatment systems.</p>	<p>Moderately Difficult to Difficult Specialized skills and experience required to operate the IPTD system. If necessary, vapor treatment technologies are readily available for diesel and motor oil.</p>	<p>High ④ Large contaminated area and potential need to use respiratory equipment and handle contaminated soils and free phase product increase costs. Fuel or electrical requirements to provide the heat source increase operating costs. Uncertainty higher compared to LTTD due to difficulties ensuring uniform treatment and management of vapors and liquids from piles.</p>	No – higher cost and uncertainty compared to LTTD.
<i>In Situ</i> Thermal Desorption (ISTD)	ISTD is similar to In-Pile Thermal Desorption except heat is applied in-situ (without excavation) through heater wells and contaminant vapors extracted through heated extraction wells. The thermal energy is transmitted to the subsurface via thermal convection and radiant heating to volatilize VOCs and SVOCs. Temperatures of greater than 1,000°F can be achieved. Contaminants can be destroyed in situ or extracted and treated.	<p>Applicability. Site contaminants are susceptible to high temperature volatilization and removal/destruction.</p> <p>Limitations. Sites with thin contaminated zones less suited to technology due to cost considerations. Certain underground utilities can must be removed prior to treatment.</p>	<p>High Thermal desorption is a proven technology that has been shown effective at reducing contaminant concentrations.</p>	<p>Moderately Difficult to Difficult Specialized skills and experience required to operate the ISTD system. If necessary, vapor treatment technologies are readily available for diesel and motor oil.</p>	<p>High ④ Relatively thin contaminated zone significantly increases unit cost of ISTD compared to other thermal technologies. Uncertainty higher compared to LTTD due to difficulties ensuring uniform treatment and collection and treatment of vapors from subsurface.</p>	No – higher cost and uncertainty compared to <i>Ex Situ</i> LTTD.

Table 23a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Bioventing	Oxygen is delivered <i>in situ</i> by forced air movement to stimulate aerobic biodegradation.	<p>Applicability. Generally applies to aerobic biodegradation of contaminants sorbed to soil particles. Target contaminants are typically petroleum hydrocarbons, nonchlorinated solvents, and other organic chemicals.</p> <p>Limitations. Shallow water table, saturated soils, high concentrations and/or free phase product, and low permeability soils reduce bioventing performance.</p>	<p>Low Could enhance aerobic degradation in areas with lower contaminant concentrations. Unsaturated zone is not very thick and consists of low permeability silts and clays. Potential free product and high contaminant concentrations may be too toxic for effective biodegradation.</p>	<p>Easy After all aboveground structures are removed, implementing this technology is fairly easy. The system is easy to operate and maintain, requiring no specialized skill level and experience. Also, the equipment is readily available with numerous vendors.</p>	<p>Low ⑤ Adding oxygen to the subsurface involves easy-to-operate and fairly common equipment. High uncertainty since biodegradation rates adversely affected by high contaminant concentrations and potential free phase product. Also, site lithology not conducive to technologies relying on subsurface air flow.</p>	No – ineffective due to site conditions.
Bio-Piling	Excavated soils are stockpiled in engineered cells with embedded injectors to add oxygen, nutrients, and/or amendments as needed to stimulate biodegradation. Clean soils can be used as backfill material.	<p>Applicability. Similar to bioventing except <i>ex situ</i>. Target contaminants are typically petroleum hydrocarbons, nonchlorinated solvents, and other organic chemicals. Large available land area to set up cells.</p> <p>Limitations. Potential free phase product and high concentrations present safety concerns due to exposure, and may be toxic to bacteria. Potential vapors and drained liquids may require containment measures and treatment. Depending on biodegradation rates, cleanup levels, and quantity of soil requiring remediation, treatment can a significant amount of time (months or years).</p>	<p>Medium to High Could enhance aerobic degradation in areas with low to moderate contaminant concentrations. Silts and clays are low permeability, which would adversely affect airflow through the pile. Potential free product and high contaminant concentrations may inhibit bioactivity. These factors may improve with proper blending/mixing with cleaner more permeable soils.</p>	<p>Moderate Skill and experience requirements to construct and operate biopiles are relatively common. Equipment requirements are minimal, and equipment is readily available. Management of vapors and liquids increase complexity.</p>	<p>Low to Moderate ④ Large contaminated area and potential need to use respiratory equipment and handle contaminated soils and free phase product increase costs. Higher uncertainty since biodegradation rates are unknown and would need to be evaluated in treatability studies. Rates adversely affected by high contaminant concentrations and potential free phase product.</p>	Yes – effective and implementable treatment at moderate cost.
Landfarming	Excavated soil is spread in thin layers on the ground. Soil is aerated by tilling and/or plowing to stimulate biodegradation. Nutrients or amendments can be utilized if needed. Clean soils can be used as backfill material.	<p>Applicability. Similar to bio-piling, except land requirements are significantly higher in order to set up “landfarms”.</p> <p>Limitations. Similar to bio-piling, except more difficult to control moisture content since landfarms are not typically covered and are exposed to rainfall. Also more difficult to control vapors.</p>	<p>Medium Similar to bio-piling except it can be more difficult to control factors effecting biodegradation (e.g., moisture content, temperature). Technology may not be effective during wet season due to excessive rainfall.</p>	<p>Moderately Easy Skills, experience and equipment requirements to implement this technology are minimal. Because soil is treated in relatively shallow lifts, treatment of large volumes of soil require either very large areas to conduct treatment or longer treatment periods to process multiple lifts.</p>	<p>Low ④ Costs lower than bio-piling due to minimal equipment and operational requirements. Uncertainty similar to or slightly higher than bio-piling due to potential impacts of rainfall on performance.</p>	Yes – potentially effective treatment at low cost.

Table 23a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Monitored Natural Attenuation	Natural processes (volatilization, biodegradation, adsorption, and chemical reactions) are used to reduce contaminant concentrations to acceptable levels.	<p>Applicability. Natural attenuation is a common element of cleanup programs for fuel hydrocarbons and halogenated VOCs. Can be used to manage residual contamination following site stabilization and source control activities. Timeframe for cleanup not consistent with RAOs.</p> <p>Limitations. Extensive site characterization, modeling, and monitoring are required to document the natural attenuation of the contaminants. High contaminant concentrations and/or free phase product limit applicability of biodegradation. Similarly, higher molecular weight contaminants hinder volatilization.</p>	<p>Low As compared to other remedial technologies, use of MNA will take much longer (e.g., decades) to achieve cleanup levels. Diesel and motor oil are not amenable to volatilization, and areas of high concentrations and/or free phase product may be toxic to the bacteria.</p>	<p>Moderately Easy The required equipment, skills, and experience to implement monitored natural attenuation is minimal, although extensive sampling and analysis are needed to baseline the process and monitor ongoing progress.</p>	<p>Low ⑤ Because there are no major equipment and construction requirements, the cost to implement this technology is low although long-term monitoring costs could be significant. The uncertainty of achieving the RAOs is high since contaminant concentrations have remained high after many years of potential bioactivity. High concentrations and free product inhibit natural biodegradation, and the site contaminants are not amenable to natural volatilization.</p>	No –not suitable to achieve cleanup goals.
<i>In Situ</i> Chemical Oxidation	Strong oxidizer is injected into subsurface to oxidize and destroy organic contaminants.	<p>Applicability. Chemical oxidation commonly applied to wide range of organic compounds including unsaturated aliphatic (i.e., TCE), aromatic compounds (i.e., benzene), and fuel hydrocarbons. Fast reaction rates can be achieved depending on oxidant type used.</p> <p>Limitations. Incomplete oxidation can result in intermediate contaminants. Some oxidizers can be explosive, particularly in high concentrations of high energy contaminants. Uniform application of oxidants required to ensure all contaminants are being treated can be difficult to achieve in stratified soils. Indiscriminant and rapid reactions with other oxidant-consuming substances (e.g., natural organic matter) reduce effectiveness.</p>	<p>Medium Heavier motor oil range TPH contaminants are amenable to treatment using chemical oxidation, but can require higher chemical dosing rates compared to lighter TPH compounds. Low soil permeability from silts and clays will make uniform distribution of the chemical oxidizer within the subsurface more difficult although relatively shallow and thin treatment zone will help this. Also, high contaminant concentrations and/or free phase product could require large amount of oxidizer.</p>	<p>Moderately Difficult After all aboveground structures are removed, injecting the oxidants would not be difficult, although effective distribution of oxidants through treatment zone may be challenging. Handling large quantities of strong oxidizers presents health and safety concerns.</p>	<p>Medium to High ④ Costs dependent on contaminant concentrations. High concentrations and the potential presence of free phase product could require large quantities and frequent applications of the oxidizer and result in much higher costs. Less contaminated soils will require less oxidant, fewer applications, and would cost less. Handling and safety requirements add additional costs. The uncertainty is moderate to high since the stratified lithology and low soil permeability could prevent oxidant from being uniformly distributed within the contaminated regions – treatability studies would be required to address uncertainty.</p>	Yes – although site soils not well suited for <i>in situ</i> approach, chemical oxidation retained as representative <i>in situ</i> remediation technology. May not be appropriate for treating source area soils.

**Table 23a
Preliminary Screening of Remedial Technologies for Soil
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
<i>In Situ</i> Soil Washing	Water, or water containing an additive to enhance contaminant mobility, is applied to the soil surface or injected into the ground to flush contaminants into the groundwater. The groundwater is then extracted and treated.	<p>Applicability. Soil washing can be used to treat VOCs, SVOCs, and some fuels and enhance recovery of NAPL.</p> <p>Limitations. Different contaminants require different wash water mixtures. Clayey soil causes the contaminant to adhere more strongly to the soil, making it difficult to desorb. Also, the wash water may alter the physical and chemical properties of soil.</p>	<p>Low</p> <p>Contaminants are hydrophobic and soil washing would not mobilize the contaminants to the water table. Amendments may help, but there is significant uncertainty as to effectiveness. Soil washing could also result in contaminating previously clean areas.</p>	<p>Moderately Difficult</p> <p>Implementation requires uniform application of water and amendments through the contaminated region, which would be difficult given stratified and low-permeability soils.</p>	<p>Low to Medium ⑤</p> <p>This technology involves a low-cost network of aboveground piping and systems to inject the wash water. The high uncertainty is a result of the stratified lithology, low soil permeability, and oleophobic contaminants.</p>	No – effectiveness uncertain
Off-Site Disposal	Excavated soil is disposed off-site at an approved and permitted facility.	<p>Applicability. Off-site disposal facilities are readily available that accept soils contaminated with fuels and VOCs.</p> <p>Limitations. None.</p>	<p>High</p> <p>Impacted soil is removed and no longer provides a potential source of contamination to groundwater.</p>	<p>Easy</p> <p>Off-site disposal facilities readily available and only require transportation of contaminated soils.</p>	<p>Moderate to High ①</p> <p>Costs for off-site disposal are moderate to high depending on waste classification of soils. Costs further increased due to need for importing of additional fill to site. Low uncertainty.</p>	Yes – retained for use with soils that may not be amenable for treatment with on-site technologies.
<p>NOTE: Uncertainty rating reflects additional data needs or technology development needed to demonstrate applicability, implementability, and cost uncertainty. ① = low degree of uncertainty. Site data generally available to determine applicability. ⑤ = high degree of uncertainty. Additional data, analysis, pilot testing, or technology development required to determine applicability to site.</p> <p>^a Preliminary effectiveness ratings of high, medium, and low reflect estimated relative effectiveness of the technology to treat the site contaminants and meet RAOs.</p> <p>^b Implementability rating of easy, moderately easy, moderately difficult, and difficult reflect estimated relative complexity and cost of implementing the technology.</p> <p>^c Cost reflects the relative overall costs (low, medium, high) of implementing the technology at the site.</p>						

**Table 23b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Groundwater Extraction	Groundwater is pumped to extract contaminants and generate hydraulic gradients that can contain the plume and mobilize the contaminants to the extraction wells. Extracted groundwater is treated aboveground as needed and discharged.	<p>Applicability. Groundwater pumping is common for achieving hydraulic control and recovering contaminant mass. The contaminants are removed from the subsurface in the dissolved phase and then removed by the carbon. Technology is applicable to high contaminant concentrations in the dissolved phase in soils with high permeability and yields.</p> <p>Limitations. Groundwater extraction for contaminant removal is dependent on the hydraulic permeability of the formation.</p>	<p>Low Given low permeability and stratified soils at Site 4, achieving cleanup goals with groundwater extraction will be slow and may not affect residual free phase product.</p>	<p>Easy Groundwater extraction involves installing pumping systems to remove groundwater from the subsurface. These systems are relatively easy to install and operate. The required skills and experience for this technology is widely available. There are numerous vendors that can supply the equipment.</p>	<p>Medium to High ⑤ System installation costs are not excessive. Due to long cleanup timeframe, however, life-cycle costs for groundwater extraction and treatment systems are often high. Treatment costs could be high due to potentially significant contaminant mass. There is a high uncertainty regarding the timeframe required to achieve cleanup goals, if they can be achieved with this technology at all.</p>	No – low effectiveness due to site conditions (presence of free-phase product) and inability to meet RAOs.
Existing Wastewater Treatment System and Sanitary Sewer Discharge	The Napa Pipe facility currently maintains a wastewater treatment system that discharges into the sanitary sewer under a permit with the Napa County Sanitation District. This system includes storage tanks, chemical injection systems (flocculant injection), settling tanks, an oil/water separator. Groundwater generated during dewatering will be treated using this existing wastewater treatment system and discharged to the sanitary sewer under the existing permit. If additional treatment is required to remove dissolved organic constituents (TPH, VOCs) to below permit limits, a series of granular activated carbon (GAC) vessels will be added as a polishing step prior to discharge.	<p>Applicability. The existing wastewater treatment system appears to be suitable for use in treating groundwater with only minimal modification required, including the potential addition of GAC vessels to remove dissolved organics.</p> <p>Limitations. The existing wastewater treatment system must be operated within the requirements of the sanitary sewer discharge permit. Temporary transfer piping may be required to get groundwater from remediation areas to the system, or it can be moved using portable tanks or tanker trucks.</p>	<p>High The existing system has been demonstrated effective at meeting discharge requirements for the sanitary sewer and has the major treatment components needed to be treat groundwater, with the possible addition of GAC vessels.</p>	<p>Easy The existing facility is already constructed and permitted, and modifications necessary for use in treating groundwater are relatively straightforward to implement.</p>	<p>Low ③ The existing system will cost very little to modify for use as a groundwater treatment system, and operational costs are expected to be moderate. Uncertainty is associated with need to determine whether GAC adsorption vessels will be required and the means in getting the groundwater to the system.</p>	Yes – will be effective in managing groundwater extracted as part of excavation dewatering activities.
Permeable Reactive Barrier	Subsurface barrier allows passage of groundwater and controls movement of contaminants. The barrier is filled with reactive agents or microorganisms where the concentrated contaminants are either degraded or retained in the barrier material.	<p>Applicability. Reactive barriers apply to VOCs, SVOCs, and inorganics. A variety of media have been used to treat various classes of contaminants.</p> <p>Limitations. Requires heavy construction equipment. The reactive agents must be matched to the contaminants. Effectiveness is specific to barrier media and contaminants. Needs to be keyed into a confining layer. Barriers can lose hydraulic or reactive capacity over time. May be susceptible to fouling or excessive leakage if not designed and/or installed properly.</p>	<p>Low At the site, with the low groundwater flowrates, there may be limited effectiveness in achieving cleanup goals. Contaminant mass removal is a function of the flowrates through the wall. Unlikely to have efficiency for TPH compounds dissolved in groundwater.</p>	<p>Moderately Difficult Because of the shallow water table and relatively shallow depth to confining layer, installing the slurry wall barrier is straightforward. However, the extent of the contaminant boundary requires a large area to be contained and the plume would need to be more clearly delineated.</p>	<p>Medium to High ③ This technology involves excavating a large quantity of soil, but significantly less than the entire contaminated volume. Additional costs would be incurred. The medium uncertainty is associated with the determining the nature of the permeable barrier and evaluating the site hydraulics to effectively design the slurry wall/barrier system.</p>	No – not effective given site conditions and TPH contaminants.

**Table 23b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
<i>In Situ</i> Enhanced Bioremediation	<p>Adding oxygen, nutrients, co-substrates, or amendments to the groundwater to increase the rate of biodegradation.</p> <p>Can also implement this technology by applying amendments to open excavations during backfilling for treatment of residual contamination.</p>	<p>Applicability. Bioremediation is applicable to petroleum hydrocarbons, some solvents, and other organic chemicals. Can be effective for remediating low level residual contamination in conjunction with source removal.</p> <p>Limitations. Applies to contaminants that can be biodegraded. Low permeability soils can hinder contact between contaminant, oxygen, and applied nutrients. Bio-fouling can result from biomass accumulation on well screens. Too low or too high contaminant concentrations adversely affect biodegradation rates.</p>	<p>Medium</p> <p>Could enhance aerobic degradation in areas with lower contaminant concentrations. Potential for free product and high contaminant concentrations in source areas may be too toxic for effective biodegradation. Can be effective in controlling residual contamination in excavations by adding amendments to backfill in the saturated zone.</p>	<p>Moderately Easy</p> <p>Implementing this technology is fairly easy, and skills, experience and equipment requirements are minimal. However, ensuring uniform application throughout the subsurface may be problematic due to the silty and clayey soils. This could result in hot spots continuing to contaminate the groundwater. Implementation as a backfill amendment is very simple.</p>	<p>Low ④</p> <p>Adding oxygen, nutrients, and amendments to the subsurface involves easy-to-operate and fairly common equipment. Moderate uncertainty associated with need to determine nature of amendments through treatability studies and uncertainty related to timeframe for achieving cleanup goals. Also, stratified lithology/ low permeability soils may prevent complete contact with all contaminant mass.</p>	<p>Yes – may be cost effective for lower concentration groundwater plumes but would require treatability studies to evaluate further.</p>
Monitored Natural Attenuation	<p>Natural processes (volatilization, biodegradation, adsorption, and chemical reactions) are used to reduce contaminant concentrations to acceptable levels.</p>	<p>Applicability. Natural attenuation is a common element of cleanup programs for fuel hydrocarbons and halogenated VOCs. Can be used to manage residual contamination following site stabilization and source control activities.</p> <p>Limitations. Extensive site characterization, modeling, and monitoring are required to document the natural attenuation of the contaminants. Typically involves long cleanup timeframe. High contaminant concentrations and/or free phase product limit applicability of biodegradation. Similarly, higher molecular weight contaminants hinder volatilization.</p>	<p>Low</p> <p>As compared to other remedial technologies, use of MNA will result in an extended cleanup timeframe. Diesel and motor oil are not amenable to volatilization, and areas of high concentrations and/or free phase product will be toxic to the bacteria. MNA has demonstrated effectiveness for VOCs at the Site.</p>	<p>Easy</p> <p>The skills and experience to implement monitored natural attenuation is minimal. Sampling and analysis are needed to baseline the process and monitor ongoing progress.</p>	<p>Low to Medium ⑤</p> <p>Because there are no major equipment and construction requirements, the cost to implement this technology is low, although long-term monitoring costs can be significant. The uncertainty of achieving the RAOs is high since contaminant concentrations have remained high after many years of potential bioactivity. High concentrations and free product inhibit natural biodegradation, and the site contaminants are not amenable to natural volatilization.</p>	<p>No –not effective in achieving cleanup goals in reasonable timeframe.</p>
Air Sparging	<p>Air is injected into groundwater to volatilize contaminants, and oxygen potentially increases biodegradation rates. Contaminants sparged from groundwater are recovered in the unsaturated zone by SVE.</p>	<p>Applicability. Target contaminants for sparging include VOCs and volatile fuels. Removal mechanisms can include volatilization and enhanced bioremediation.</p> <p>Limitations. Non-volatile contaminants not removed with this technology. Effectiveness requires uniform flow of air through saturated soil. Heterogeneous soils can result in non-uniform treatment and uncontrolled movement of contaminated vapors. High contaminant solubility limits transfer to the vapor phase. Addition of oxygen could cause oxidation and precipitation of iron and impact air permeability.</p>	<p>Low</p> <p>Diesel and motor oil are not readily amenable to this technology with lower volatilization rate. Silts and clays result in areas of low permeability, adversely affecting air flowrates. High contaminant concentrations and/or free phase product increase the potential for spreading contamination into previously clean areas.</p>	<p>Easy</p> <p>Equipment to implement this technology is readily available and easy to operate. Similarly, the necessary skills and experience are minimal.</p>	<p>Medium ④</p> <p>Air sparging equipment costs are relatively low due to minimal equipment, although operating costs would add to the total cost. The uncertainty is high due to low air permeability, high contaminant concentrations, and unknown design parameters. Site lithology not conducive to technologies relying on subsurface air flow.</p>	<p>No – technology ineffective with heavier contaminants and not suited to soil conditions.</p>

**Table 23b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
Thermally Enhanced Air Sparging	Hot air, steam, or electric heating is used to enhance desorption and volatilization of the contaminants. Other potential benefits are increased contaminant mobility and biodegradation rates.	<p>Applicability. Heating improves the volatility of VOCs and SVOCs. Effective for subsurfaces with higher air permeability.</p> <p>Limitations. Performance is function of attainable temperature, air permeability, and contaminant volatility. Off-gas and residual liquids may be required treatment/disposal. Higher process temperatures require specialized equipment. Shallow water tables may allow contaminated vapors to escape.</p>	<p>Medium</p> <p>Thermal enhancement may improve volatilization. Diesel and motor oil contaminants will volatilize more when heated. Maximum groundwater temperatures are limited by low air permeability and shallow water table. Stratified lithology may result in cold spots where contaminants are not treated, thereby continuing to contaminate the groundwater above RAO requirements.</p>	<p>Moderately Difficult</p> <p>Similar to air sparging except process equipment rated for higher temperature may be needed. Also, specialized skills are required to operate and maintain the heat source systems. Vapor control becomes a challenge to ensure contaminated vapors and liquids do not contaminate previously clean areas.</p>	<p>Medium to High ⑤</p> <p>Costs are higher than conventional air sparging due to need for high temperature rated equipment and material. Also, electrical and/or fuel costs are significantly higher to supply the heat source. Shallow water table may require additional measures to ensure contaminated vapors are not released from the site. Maximum soil temperatures are limited by low air permeability and shallow water table. High uncertainty since no data is available to determine long-term effectiveness and remediation duration. Site lithology not conducive to technologies relying</p>	No – technology likely ineffective due to soil conditions
In Well Vapor Stripping	In this technology, a groundwater circulation cell is created around a circulation well. Contaminated groundwater is cycled through lower and upper screened intervals. The lower screened interval is below the water table, and the upper screened interval is across or above the water table. This causes the water to aerated as it discharges into the unsaturated zone, causing contaminants to volatilize.	<p>Applicability. Air stripping is applicable to VOCs with Henry's law constant greater than 0.01 or vapor pressure greater than 0.5 mm Hg. Some compounds that have been successfully separated from water using air stripping include BTEX, chloroethane, TCE, vinyl chloride, DCE, and PCE.</p> <p>Limitations. High solubility, low Henry's constant, and low permeability reduce the overall effectiveness. High iron and hardness or biomass accumulation can cause operational problems and reduce efficiency or require pretreatment. Similarly, presence of free phase product will coat the circulation well and significantly decrease performance.</p>	<p>Low</p> <p>For stripping, diesel and motor oil are not readily amenable for air stripping with low volatilization rates. Silts and clays and stratified lithology result in areas of low permeability, adversely vertical flow of groundwater through subsurface.</p>	<p>Moderately Difficult</p> <p>The shallow water table makes this an easy technology to implement. With the confining layer close to the water table, short-circuiting may occur.</p>	<p>Medium ④</p> <p>Costs are moderate because although readily available conventional equipment is used, shallow groundwater zone being treated would require numerous wells. The uncertainty is high due to soil conditions and since the contaminants are not amenable to vapor phase partitioning.</p>	No – not effective with site contaminants or soil conditions.

**Table 23b
Preliminary Screening of Remedial Technologies for Groundwater
Napa Pipe Facility, Napa, California**

Technology	Description	General Applicability/Limitations	Comments Specific to Site 4			Retained?
			Effectiveness ^a	Implementability ^b	Relative Cost ^c	
<i>In Situ</i> Chemical Oxidation	Strong oxidizer is injected into subsurface to oxidize and destroy organic contaminants.	<p>Applicability. Chemical oxidation commonly applied to wide range of organic compounds including unsaturated aliphatic (i.e., TCE), aromatic compounds (i.e., benzene), and fuel hydrocarbons. Fast reaction rates can be achieved depending on oxidant type used.</p> <p>Limitations. Incomplete oxidation can result in intermediate contaminants. Uniform application of oxidants required to ensure all contaminants are being treated can be difficult to achieve in stratified soils. Indiscriminant and rapid reactions with other oxidant-consuming substances reduce effectiveness.</p>	<p>Medium to High</p> <p>Diesel and motor oil amendable to treatment using chemical oxidation. Effectiveness largely dependent on ability to distribute oxidant through target zone and low soil permeability from silts and clays will make uniform distribution of within the subsurface more difficult. Relatively shallow and thin treatment zone may help overcome this difficulty. Also, high contaminant concentrations and/or free phase product could require large amount of oxidizer.</p>	<p>Moderately Difficult</p> <p>After all aboveground structures are removed, injecting the oxidants would not be difficult, although effective distribution of oxidants through treatment zone may be challenging. Handling large quantities of strong oxidizers presents health and safety concerns.</p>	<p>Medium ④</p> <p>Costs dependent on contaminant concentrations. High concentrations and the potential presence of free phase product could require large quantities and frequent applications of the oxidizer and result in much higher costs. Handling and safety requirements add additional costs. The uncertainty is moderate to high since the stratified lithology and low soil permeability could prevent oxidant from being uniformly distributed within the contaminated regions – treatability studies would be required to address uncertainty.</p>	<p>Yes – although site soils not well suited for in situ approach, may be cost effective for lower concentration groundwater plumes.</p>
Saturated Soil Excavation	The contaminated groundwater plume is physically removed by excavating the saturated soil within the groundwater plume boundaries. Excavated soil is managed on-site through treatment or other appropriate methods and used as fill.	<p>Applicability. Excavation of soils below water table as a means of groundwater plume remediation is not a common approach, although shallow depth to water, relatively thin contaminated zone, and need for a short remediation timeframe may make it applicable at this site.</p> <p>Limitations. Requires heavy construction equipment. Dewatering likely required as part of saturated zone excavation. Extent of excavation is fairly large to ensure removal of all contaminated material. Contaminant aeration is likely during excavation, potentially requiring respiratory protection for on-site workers.</p>	<p>High</p> <p>Impacted groundwater (and associated saturated soil) is physically removed and no longer provides a potential source of contamination to groundwater.</p>	<p>Moderately Difficult</p> <p>Although standard soil excavation techniques would likely be utilized, implementing this approach will be complicated by need for dewatering and by the relatively large area to be excavated.</p>	<p>Medium ①</p> <p>Large contaminated area may require dewatering and hydraulic control. Costs impacted by approach to managing soil and groundwater once excavated. Potential need to use respiratory equipment and possible exposure to contaminated soils and groundwater increase costs. Low uncertainty since all contaminants are excavated and confirmed via on-site sampling.</p>	<p>Yes – would quickly and effectively eliminate groundwater contamination</p>

NOTE: Uncertainty rating reflects additional data needs or technology development needed to demonstrate applicability, implementability, and cost uncertainty. ① = low degree of uncertainty. Site data generally available to determine applicability. ⑤ = high degree of uncertainty. Additional data, analysis, pilot testing, or technology development required to determine applicability to site.

^a Preliminary effectiveness ratings of high, medium, and low reflect estimated relative effectiveness of the technology to treat the site contaminants and meet RAOs.

^b Implementability rating of easy, moderately easy, moderately difficult, and difficult reflect estimated relative complexity and cost of implementing the technology.

^c Cost reflects the relative overall costs (low, medium, high) of implementing the technology at the site.

Table 24
Estimated Capital and O&M Costs - Alternative 3
Ex Situ Source Area Soil and Groundwater Treatment and In Situ Groundwater Plume Remediation
Site 4, Former Pipe Mill, Maintenance Garage and Paint Storage Building
Napa Pipe Facility, Napa, California

Construction Costs							
ITEM	UNIT COST		UNITS	QUANTITY		COST	
	low	high		low	high	low	high
Construction Costs							
1. Mobilization/demobilization	\$ 75,000	\$ 125,000	LS	1	1	\$ 75,000	\$ 125,000
2. Excavate, stockpile, and replace clean overburden	\$ 11	\$ 14	CY	4,600	4,600	\$ 51,000	\$ 64,000
3. Excavate contaminated unsaturated soil >cleanup levels and stockpile for on-site treatment	\$ 4	\$ 7	CY	16,900	16,900	\$ 68,000	\$ 118,000
4. Excavate saturated source area soil >cleanup levels and stockpile for on-site treatment	\$ 6	\$ 9	CY	17,440	17,440	\$ 105,000	\$ 157,000
5. Excavation dewatering, treat groundwater on-site, and discharge to sewer	\$ 100,000	\$ 200,000	LS	1	1	\$ 100,000	\$ 200,000
6. <i>In situ</i> treatment of area where groundwater >cleanup levels	\$ 30	\$ 45	CY	27,500	27,500	\$ 825,000	\$ 1,238,000
7. Amend excavation bottom prior to backfill	\$ 40,000	\$ 80,000	acre	1.5	2.0	\$ 60,000	\$ 160,000
8. Treatment of contaminated soil on-site							
- Move and replace untreated in commercial area (10% of volume)	\$ 9	\$ 12	CY	3,400	3,400	\$ 31,000	\$ 41,000
- Biopile Treatment (30% of total volume)	\$ 20	\$ 60	CY	10,300	10,300	\$ 206,000	\$ 618,000
- Low Temperature Thermal Desorption (50% of total volume)	\$ 40	\$ 75	CY	17,200	17,200	\$ 688,000	\$ 1,290,000
- Off-Site Disposal (10% of total volume)	\$ 60	\$ 90	CY	3,400	3,400	\$ 204,000	\$ 306,000
9. Installation of monitoring wells	\$ 40,000	\$ 70,000	LS	1	1	\$ 40,000	\$ 70,000
10. Confirmation soil/soil gas sampling	\$ 40,000	\$ 70,000	LS	1	1	\$ 40,000	\$ 70,000
				Subtotal		\$ 2,493,000	\$ 4,457,000
				Engineering and Permitting (15%)		\$ 374,000	\$ 669,000
				Construction Cost Contingency (30%)		\$ 748,000	\$ 1,337,000
				Total Estimated Capital Costs		\$ 3,620,000	\$ 6,460,000
				Average Capital Cost		\$ 5,040,000	
Operation and Maintenance Costs							
Activity					Estimated Annual Cost		
					low	high	
1. Confirmation Monitoring for <i>In Situ</i> Groundwater Treatment Area (assume 1 year)					\$ 75,000	\$ 100,000	
2. Monitoring well abandonment					\$ 40,000	\$ 80,000	
				Subtotal	\$ 115,000	\$ 180,000	
				O&M Cost Contingency (20 %)	\$ 23,000	\$ 36,000	
				Total Estimated O&M Costs	\$ 138,000	\$ 216,000	
				Average O&M Cost	\$ 177,000		
				TOTAL ESTIMATED COST	\$ 5,220,000		

Table 25
Estimated Capital and O&M Costs - Alternative 4
Ex Situ Soil and Groundwater and Groundwater Remediation
Site 4, Former Pipe Mill, Maintenance Garage and Paint Storage Building
Napa Pipe Facility, Napa California

Construction Costs							
ITEM	UNIT COST		UNITS	QUANTITY		COST	
	low	high		low	high	low	high
Construction Costs							
1. Mobilization/demobilization	\$ 75,000	\$ 125,000	LS	1	1	\$ 75,000	\$ 125,000
2. Excavate, stockpile, and replace clean overburden	\$ 11	\$ 14	CY	10,600	10,600	\$ 117,000	\$ 148,000
3. Excavate unsaturated and saturated soil >cleanup levels and stockpile for on-site treatment	\$ 4	\$ 7	CY	34,340	34,340	\$ 137,000	\$ 240,000
4. Excavate soil in area where groundwater >cleanup levels	\$ 6	\$ 9	CY	27,500	27,500	\$ 165,000	\$ 248,000
5. Pump groundwater from excavations, treat on-site, and discharge to sewer	\$150,000	\$ 250,000	LS	1	1	\$ 150,000	\$ 250,000
6. Amend excavation bottom prior to backfill	\$ 40,000	\$ 80,000	acre	4	5	\$ 160,000	\$ 400,000
7. Treatment of contaminated soil on-site (with other soils)							
- Move and replace untreated in commercial area (50% of volume)	\$ 9	\$ 12	CY	30,900	30,900	\$ 278,000	\$ 371,000
- Biopile Treatment (17% of total volume)	\$ 20	\$ 60	CY	10,300	10,300	\$ 206,000	\$ 618,000
- Low Temperature Thermal Desorption (28% of total volume)	\$ 40	\$ 75		17,200	17,200	\$ 688,000	\$ 1,290,000
- Off-Site Disposal (5% of total volume)	\$ 60	\$ 90	CY	3,400	3,400	\$ 204,000	\$ 306,000
8. Confirmation groundwater sampling (Geoprobe)	\$ 30,000	\$ 50,000	LS	1	1	\$ 30,000	\$ 50,000
9. Confirmation soil/soil gas sampling	\$ 40,000	\$ 75,000	LS	1	1	\$ 40,000	\$ 75,000
				Subtotal		\$ 2,250,000	\$ 4,121,000
				Engineering and Permitting (15%)		\$ 338,000	\$ 618,000
				Construction Cost Contingency (30%)		\$ 675,000	\$ 1,236,000
				Total Estimated Capital Costs		\$ 3,260,000	\$ 5,980,000
				Average Capital Cost		\$ 4,620,000	

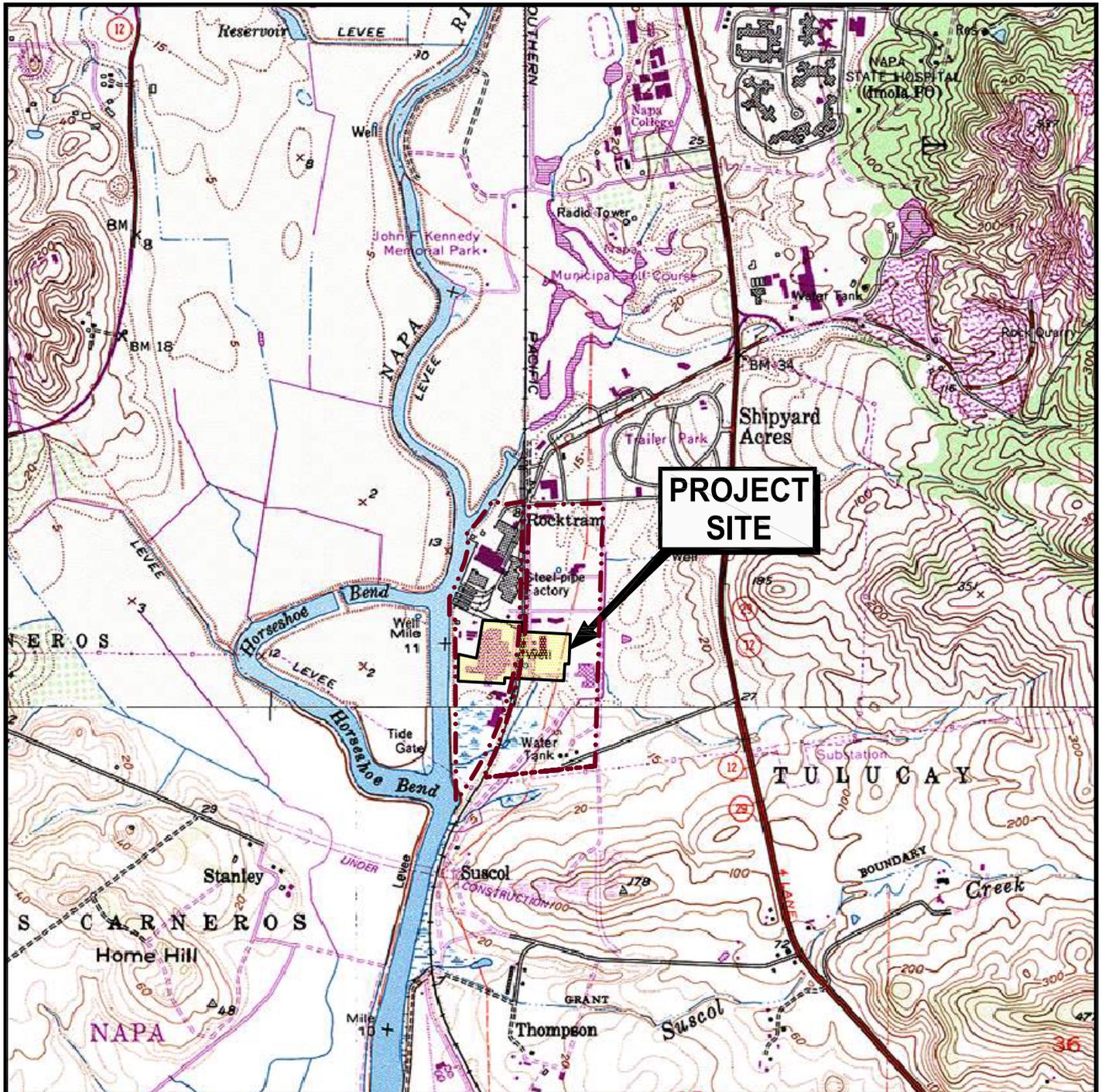
Table 26
Evaluation of Remedial Alternatives
Site 4, Former Pipe Mill, Maintenance Garage and Paint Storage Building
Napa Pipe Facility
Napa, California

Evaluation Criteria	Remedial Alternatives				Comparison of Alternatives
	Alternative 1 - No Action	Alternative 2 - Maintain Existing Remedial Actions	Alternative 3 - <i>Ex Situ</i> Source Area Treatment with <i>In Situ</i> Groundwater Remediation	Alternative 4 - <i>Ex Situ</i> Soil and Groundwater Remediation	
NCP Threshold Criteria					
Overall Protection of Human Health and the Environment	Not protective. Would leave COCs in place above cleanup levels in both soil and groundwater.	Not protective for the range of foreseeable land uses. Would require long-term institutional and engineering controls to be protective. Would leave COCs in place above residential-based cleanup levels in both soil and groundwater.	By reducing COCs to below the risk-based cleanup levels, human health and the environment would be protected.	By excavating soil and groundwater with COCs above cleanup levels and treating this soil and groundwater to below the risk-based cleanup levels, Alternative 4 would be protective of human health and the environment.	Alternatives 1 and 2 are not protective of human health and the environment. Both Alternatives 3 and 4 appear to offer similar high levels of protectiveness through aggressive treatment of contaminants.
Compliance With ARARs	Would not comply with ARARs related to protection of human health.	May not fully comply with some ARARs.	Alternative 3 is expected to comply with the applicable ARARs. Treatment technologies would be designed and implemented in compliance with applicable regulations and permit requirements.	Alternative 4 is expected to comply with applicable ARARs. Treatment technologies would be designed and implemented in compliance with applicable regulations and permit requirements.	Alternative 1 would not comply with ARARs. Alternative 2 would comply with the few applicable ARARs, but only through extensive use of institutional and engineering controls. Alternatives 3 and 4 would comply with ARARs to essentially the same degree.
NCP Primary Balancing Criteria					
Long-Term Effectiveness	Ineffective in the long-term as alternative does not achieve, nor maintain, protection of human health and the environment.	Ineffective in the long-term as alternative does not achieve cleanup levels in all but the longest term and requires institutional and engineering controls to maintain protection of human health and the environment.	Through a combination of excavating with <i>ex situ</i> treatment and <i>in situ</i> chemical oxidation, Alternative 3 would permanently reduce contaminant concentrations to below cleanup levels and would therefore be effective in the long-term.	By excavating soil and groundwater exceeding ESLs and treating them <i>ex situ</i> to destroy the contaminants, Alternative 4 would permanently reduce contaminant concentrations to below cleanup levels and therefore would be effective in the long-term.	Alternatives 1 and 2 would not be effective in the long-term. By significantly reducing contaminant concentrations in soil and groundwater, both Alternatives 3 and 4 would be effective in the long-term. By relying solely on excavation to remove contaminants from the subsurface, Alternative 4 would appear to achieve this with a higher degree of certainty as compared to Alternative 3 which uses <i>in situ</i> treatment.
Reduction of Mobility, Toxicity, Volume	Alternative 1 does not achieve reduction in contaminant mobility, toxicity, or volume.	Alternative 2 achieves limited reduction in contaminant mobility, toxicity, or volume via MNA.	The mobility, toxicity, and volume of contaminants would be effectively and significantly reduced through the use of treatment technologies in Alternative 3. The majority of the contaminant mass would be excavated and managed <i>ex situ</i> , thereby effectively eliminating the majority of contaminants from the subsurface. The remaining contaminants present in excess of cleanup levels would be treated <i>in situ</i> to below cleanup levels.	Alternative 4 would significantly reduce the mobility, toxicity, and volume of contaminants through the use of excavation and treatment. This approach would effectively eliminate the majority of contaminants from the subsurface.	Alternative 1 would not reduce contaminant mobility, toxicity, and volume. Over the long-term, Alternative 2 would achieve moderate reduction in contaminant mobility, toxicity, and volume via groundwater extraction, but would not address soil contamination. Both Alternative 3 and 4 would provide significant reductions through treatment, although Alternative 4 may achieve this more reliably compared to Alternative 3, as noted above.
Short-Term Effectiveness	Because there are no remedial activities to be implemented or constructed, there are very few short-term risks with this alternative.	There are few short-term risks with this alternative.	There are several potential short-term risks associated with implementing Alternative 3 that would need to be managed to maintain worker health and safety including risks associated with heavy excavation and earthmoving equipment, handling the chemical oxidants, potential vapors present during excavation and treatment operations, and risks related to the <i>ex situ</i> treatment technologies (e.g., LTTD). These risks can be effectively mitigated through careful design, appropriate use of health and safety procedures, personal protective equipment, and engineering controls during implementation.	As with Alternative 3, there are several potential short-term risks associated with implementing Alternative 4. These include risks associated with heavy excavation and earthmoving equipment, potential vapors present during excavation and treatment operations, and risks related to the <i>ex situ</i> treatment technologies (e.g., LTTD). These risks can be effectively mitigated through careful design, appropriate use of health and safety procedures, personal protective equipment, and engineering controls during implementation.	Alternatives 1 and 2 would have few if any short-term risks associated with their implementation. Both Alternatives 3 and 4 would have short-term implementation risks, but in general these are common construction-related concerns encountered at environmental remediation sites and would be easily mitigated through careful design and use of appropriate health and safety procedures. Alternative 3 may have a slightly higher short-term risk due to the use of large quantities of chemical oxidants for the <i>in situ</i> treatment component of this alternative.

**Table 26
Evaluation of Remedial Alternatives
Site 4, Former Pipe Mill, Maintenance Garage and Paint Storage Building
Napa Pipe Facility
Napa, California**

Evaluation Criteria	Remedial Alternatives				Comparison of Alternatives
	Alternative 1 - No Action	Alternative 2 - Maintain Existing Remedial Actions	Alternative 3 - Ex Situ Source Area Treatment with In Situ Groundwater Remediation	Alternative 4 - Ex Situ Soil and Groundwater Remediation	
Implementability	The no action alternative is technically implementable.	Alternative 2 is technically implementable.	The technologies utilized in Alternative 3 are generally well established and proven technologies. There are, however, implementability issues that need to be addressed to ensure the effectiveness of the remedial activities. Most notable of these are the issues related to <i>in situ</i> chemical oxidation, specifically potential problems with uniformly distributing the oxidant blend throughout the fine-grained soils of the treatment zone. Treatability studies would be performed to develop the appropriate injection approach and spacing and the correct oxidant dosing. Other less significant implementability issues include treatability studies for <i>ex situ</i> biological treatment and conducting significant excavations below the water table; these potential issues can be addressed during the design process. Administratively, the most significant implementability issues would likely be permitting requirements associated with the <i>ex situ</i> treatment technologies, most importantly the air permitting requirements for the low temperature thermal desorption unit.	Alternative 4 utilizes well established construction and treatment technologies with relative few implementability issues including: the need to conduct treatability studies to establish the design parameters for <i>ex situ</i> biological treatment and procedures for conducting significant excavations below the water table. These potential issues can be addressed during the design process and should not pose significant problems for implementation of Alternative 4. Permitting requirements for the soil treatment technologies, especially the air permitting requirements for the low temperature thermal desorption unit present the most significant administrative implementability concerns.	Although Alternatives 1 and 2 are technically implementable; they would not be administratively implementable. The excavation and <i>ex situ</i> components of Alternatives 3 and 4 would utilize the same construction and treatment technologies and therefore this aspect of these alternatives have identical implementability. The <i>in situ</i> component of Alternative 3 would present some potentially more significant implementability issues related to the difficulties in uniformly distributing the oxidant blend throughout the treatment zone, especially given the low permeability soils present at the Site. Bench and pilot scale treatability studies would help address this concern, but even then this aspect of Alternative 3 would make it's implementation somewhat less certain compared to Alternative 4. Administratively, the main issue for Alternatives 3 and 4 would be permitting requirements associated with the soil and groundwater treatment technologies, especially the LTTD unit.
Cost	There is little to no costs associated with the no action alternative.	Groundwater monitoring for 20 years would cost approximately \$1 million.	Average estimated capital costs for Alternative 3 are \$5.04 million and O&M costs consisting of an estimated one year of groundwater monitoring and well abandonment total \$177,000. The total estimated cost of this alternative is \$5.22 million.	Average estimated capital costs for Alternative 4 are \$4.62 million. There are no O&M costs. The total estimated cost of this alternative is \$4.62 million.	Alternative 1 is by far the least costly, but does not achieve the comparison criteria or remedial objectives. Alternative 2, which only involves maintaining the existing monitoring system, still would cost \$1.00 million over 20 years. Within the accuracy of these feasibility study cost estimates, Alternatives 4 has an estimated cost of approximately \$4.62 million, approximately \$600,000 less than the estimated \$5.22 million cost for Alternative 3.
NCP Modifying Criteria					
State Acceptance	Would not likely be accepted by State regulatory agencies.	Would not likely be accepted by State regulatory agency given the range of foreseeable land uses.	Given the protectiveness that would be achieved almost exclusively through contaminant treatment, it is expected that State agencies would accept this alternative.	Given the protectiveness that would be achieved almost exclusively through contaminant treatment, it is expected that State agencies would accept this alternative.	Alternatives 1 and 2 would not likely be acceptable to the State; they would not be protective nor comply with one or more of the applicable regulatory requirements. Given the protectiveness that would be achieved almost exclusively through contaminant treatment, both Alternatives 3 and 4 would likely be acceptable to the State.
Community Acceptance	Would not likely be accepted by public.	Would not likely be accepted by public given the range of foreseeable land uses.	Assuming that the short-term risks identified above can be addressed, it is anticipated that the community would accept this alternative due to its high level of protectiveness and permanence.	Potentially more acceptable to the community because all of the contaminants exceeding cleanup levels are removed and treated elsewhere instead of a portion of them being treated <i>in situ</i> .	Alternatives 1 and 2 would not likely be acceptable to the public. Alternatives 3 and 4 are anticipated to both be acceptable to the public given the aggressive approach to treating the contaminants and the cleanup levels achieved.
Summary of Evaluation for Alternatives	The no action alternative does not meet the NCP threshold, primary balancing, or modifying criteria.	Alternative 2 does not meet the NCP threshold, primary balancing, or modifying criteria.	Alternative 3 will meet both the threshold NCP requirements as well as most if not all of the balancing and modifying criteria. The one possible exception is the implementability concerns related to the <i>in situ</i> chemical oxidation. Treatability studies can be conducted to help address these concerns.	Alternative 4 appears to meet all of the NCP criteria with a high degree of certainty.	

ILLUSTRATIONS



--- Napa Pipe Facility Boundary



Scale In Feet

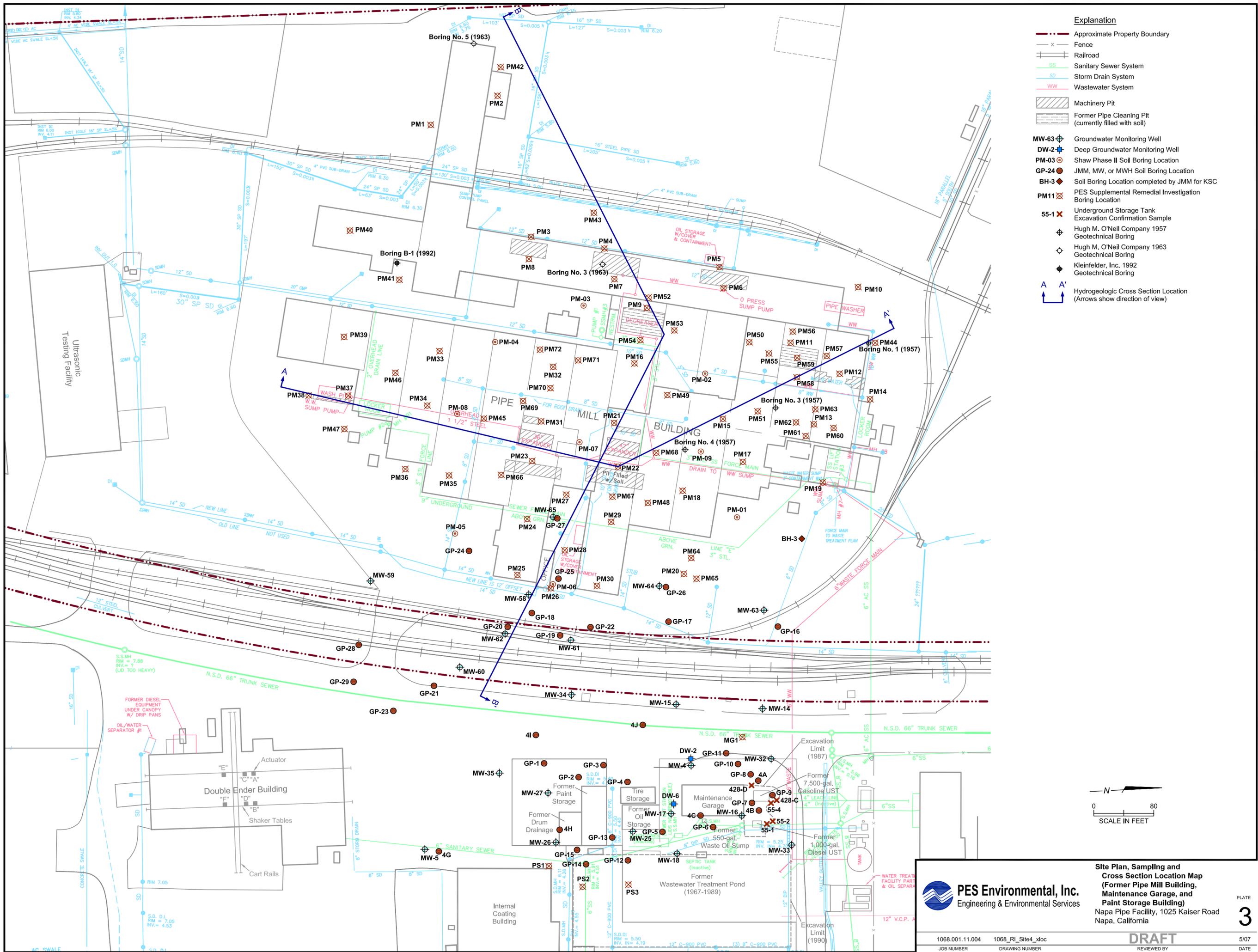


U.S.G.S. Topo Map - Napa, California, 7.5-minute quadrangle. Map version 1978; current as of 1980.
 U.S.G.S. Topo Map - Cuttings Wharf, California, 7.5-minute quadrangle. Map version 1978; current as of 1981.

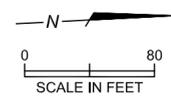


Site Location Map
 Napa Pipe Facility
 1025 Kaiser Road
 Napa, California

PLATE
1



- Explanation**
- Approximate Property Boundary
 - x- Fence
 - ⊢ Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▩ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-63 ⊕ Groundwater Monitoring Well
 - DW-2 ⊕ Deep Groundwater Monitoring Well
 - PM-03 ⊕ Shaw Phase II Soil Boring Location
 - GP-24 ⊕ JMM, MW, or MWH Soil Boring Location
 - BH-3 ⊕ Soil Boring Location completed by JMM for KSC
 - PM11 ⊕ PES Supplemental Remedial Investigation Boring Location
 - 55-1 ⊕ Underground Storage Tank Excavation Confirmation Sample
 - ⊕ Hugh M. O'Neil Company 1957 Geotechnical Boring
 - ⊕ Hugh M. O'Neil Company 1963 Geotechnical Boring
 - ⊕ Kleinfelder, Inc. 1992 Geotechnical Boring
 - A A' Hydrogeologic Cross Section Location (Arrows show direction of view)



PES Environmental, Inc.
Engineering & Environmental Services

Site Plan, Sampling and Cross Section Location Map (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Facility)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

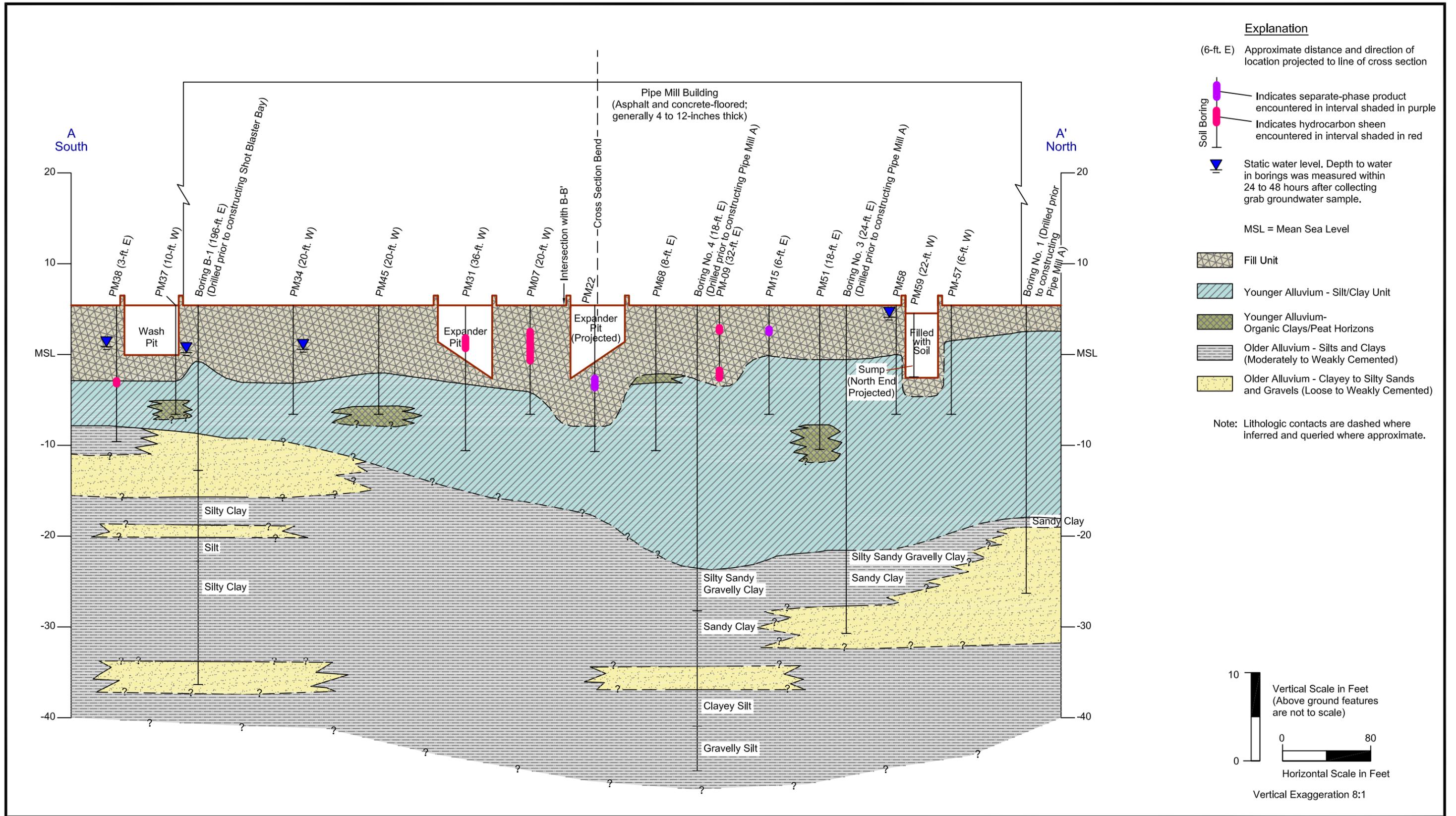
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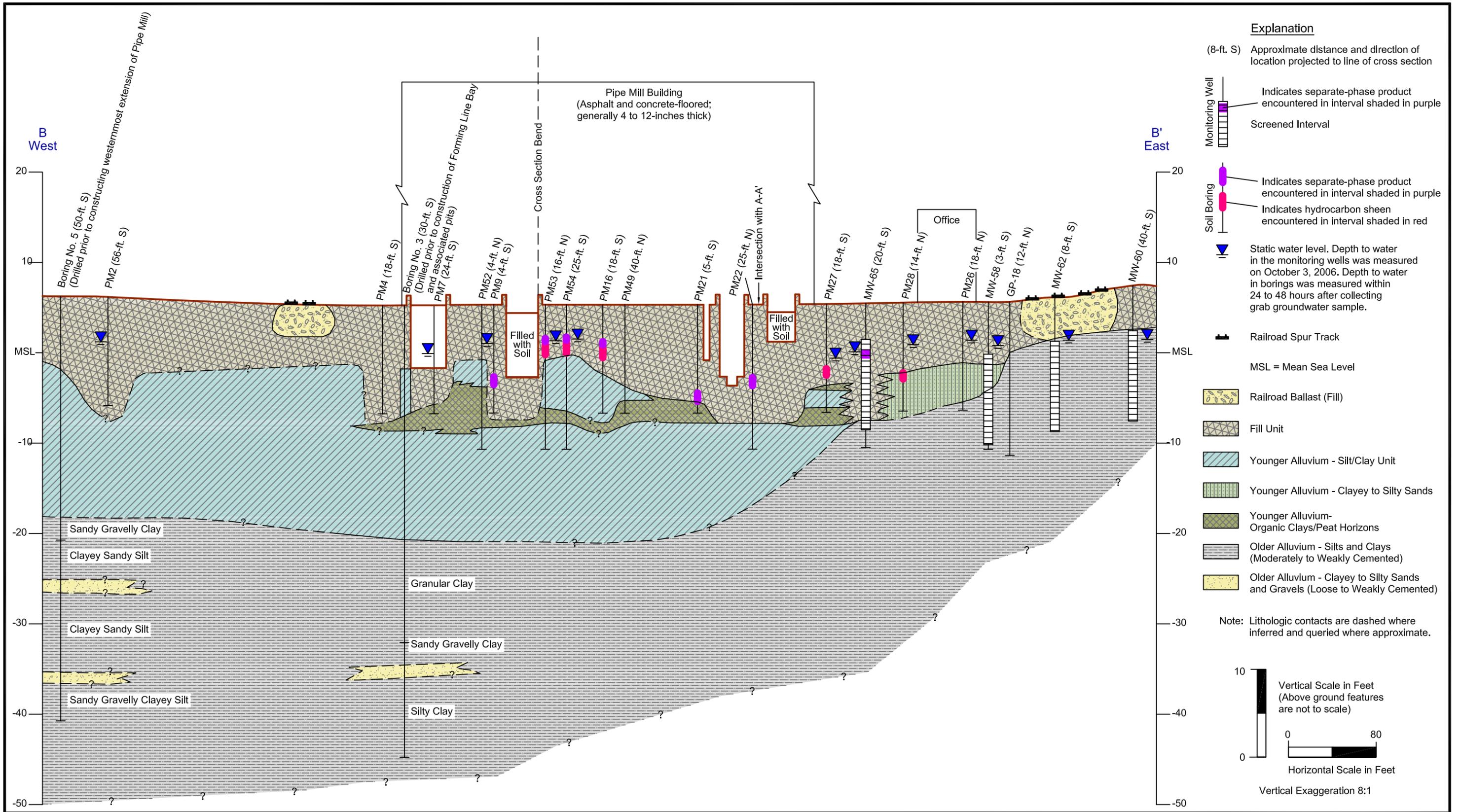
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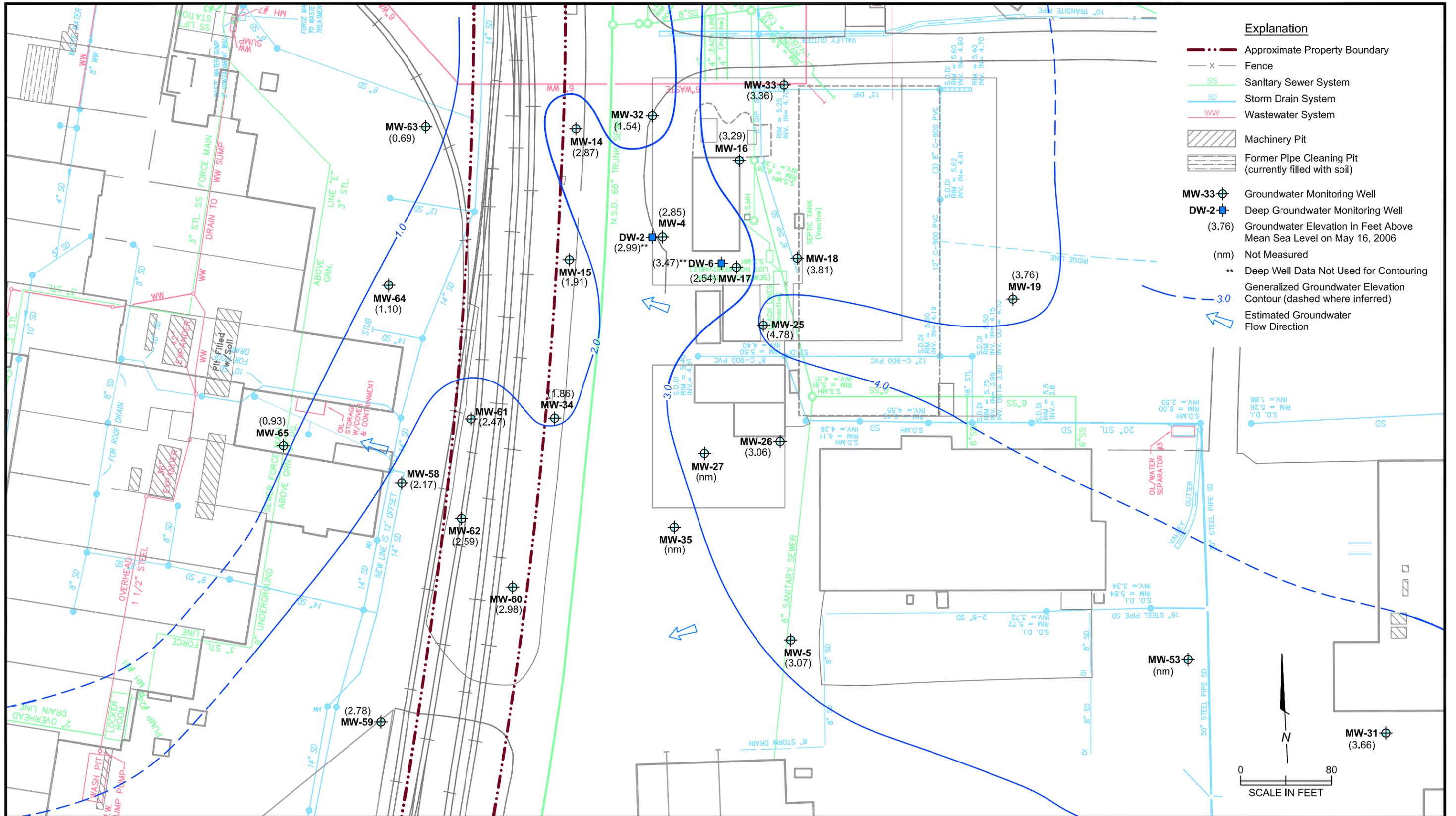
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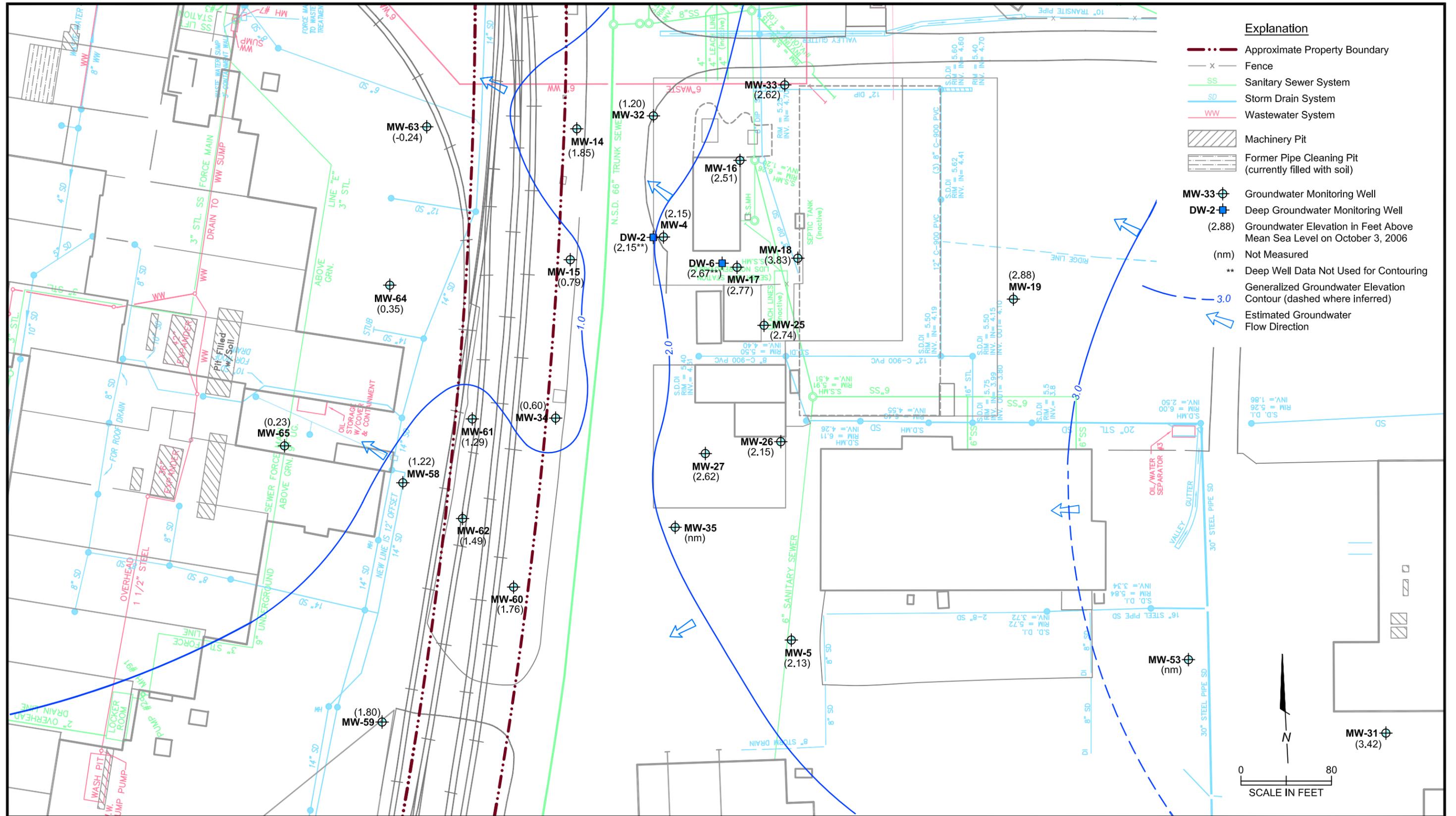
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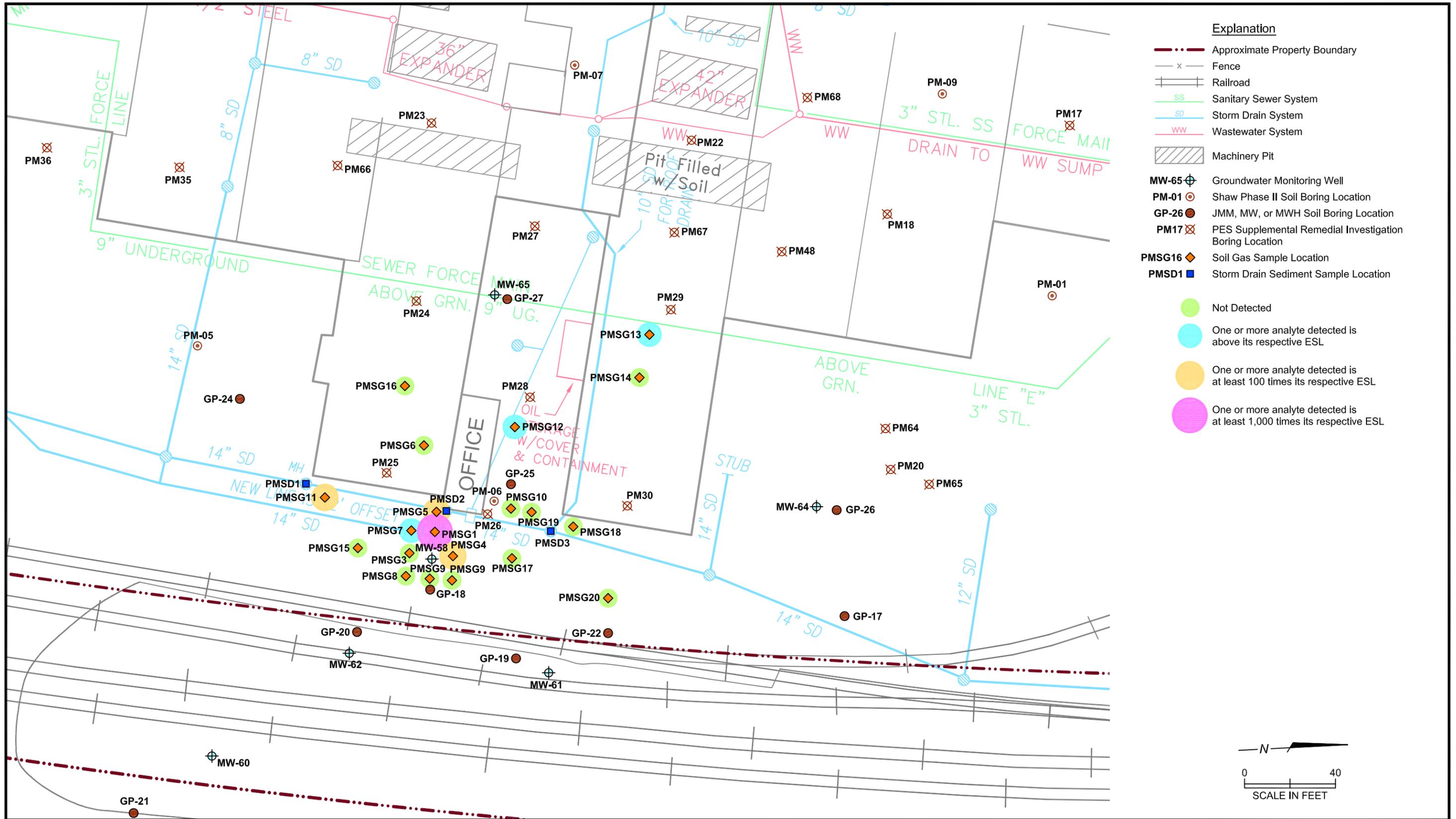




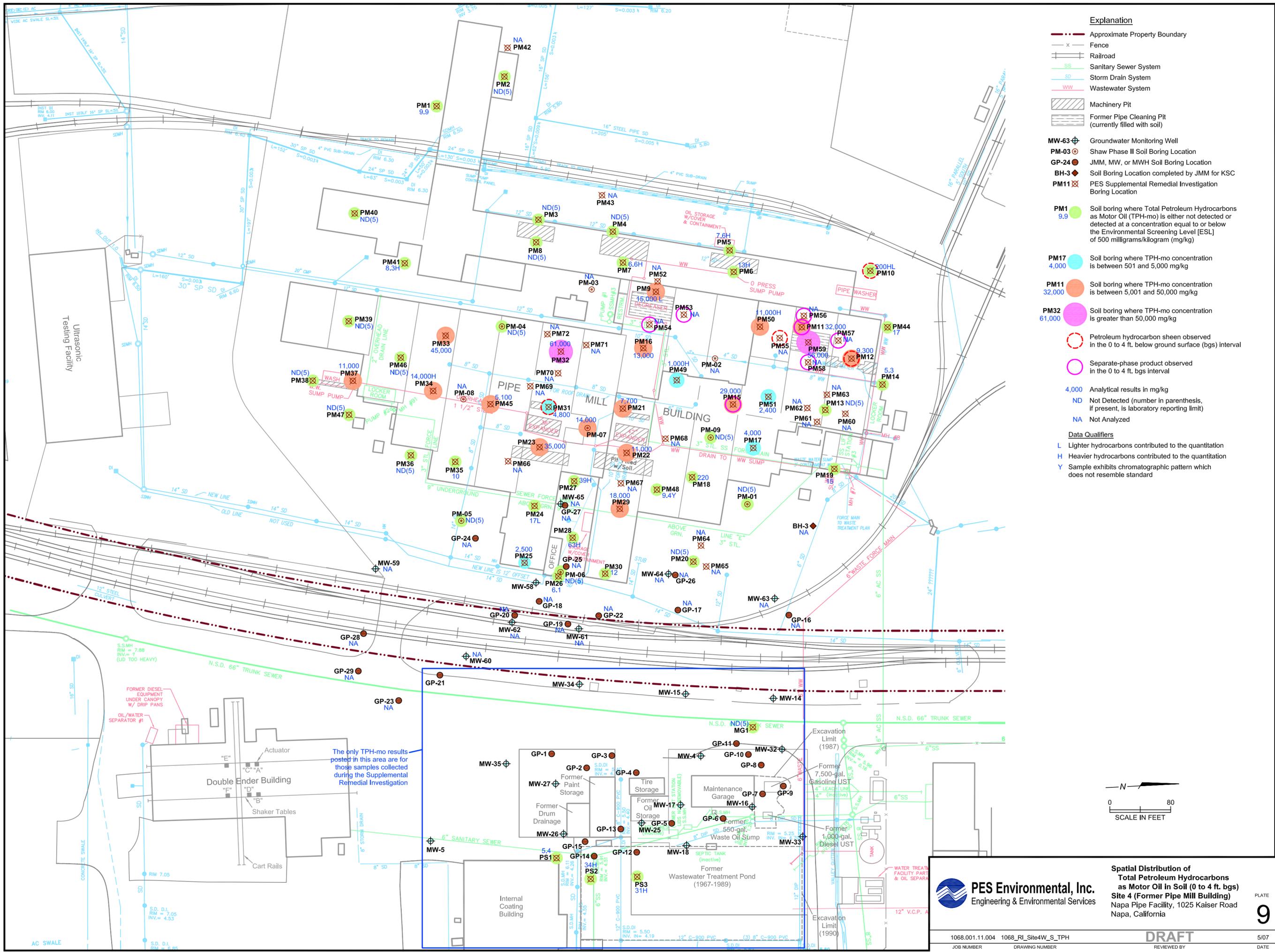


- Explanation**
- - - Approximate Property Boundary
 - x — Fence
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - Machinery Pit
 - Former Pipe Cleaning Pit (currently filled with soil)
 - ⊕ MW-33 Groundwater Monitoring Well
 - ⊕ DW-2 Deep Groundwater Monitoring Well
 - (3.76) Groundwater Elevation in Feet Above Mean Sea Level on May 16, 2006
 - (nm) Not Measured
 - ** Deep Well Data Not Used for Contouring
 - - - Generalized Groundwater Elevation Contour (dashed where inferred)
 - Estimated Groundwater Flow Direction





- Explanation**
- Approximate Property Boundary
 - x - Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - MW-65 ⊕ Groundwater Monitoring Well
 - PM-01 ⊙ Shaw Phase II Soil Boring Location
 - GP-26 ● JMM, MW, or MWH Soil Boring Location
 - PM17 ⊗ PES Supplemental Remedial Investigation Boring Location
 - PMSG16 ◆ Soil Gas Sample Location
 - PMSD1 ■ Storm Drain Sediment Sample Location
- Not Detected
 - One or more analyte detected is above its respective ESL
 - One or more analyte detected is at least 100 times its respective ESL
 - One or more analyte detected is at least 1,000 times its respective ESL



The only TPH-mo results posted in this area are for those samples collected during the Supplemental Remedial Investigation

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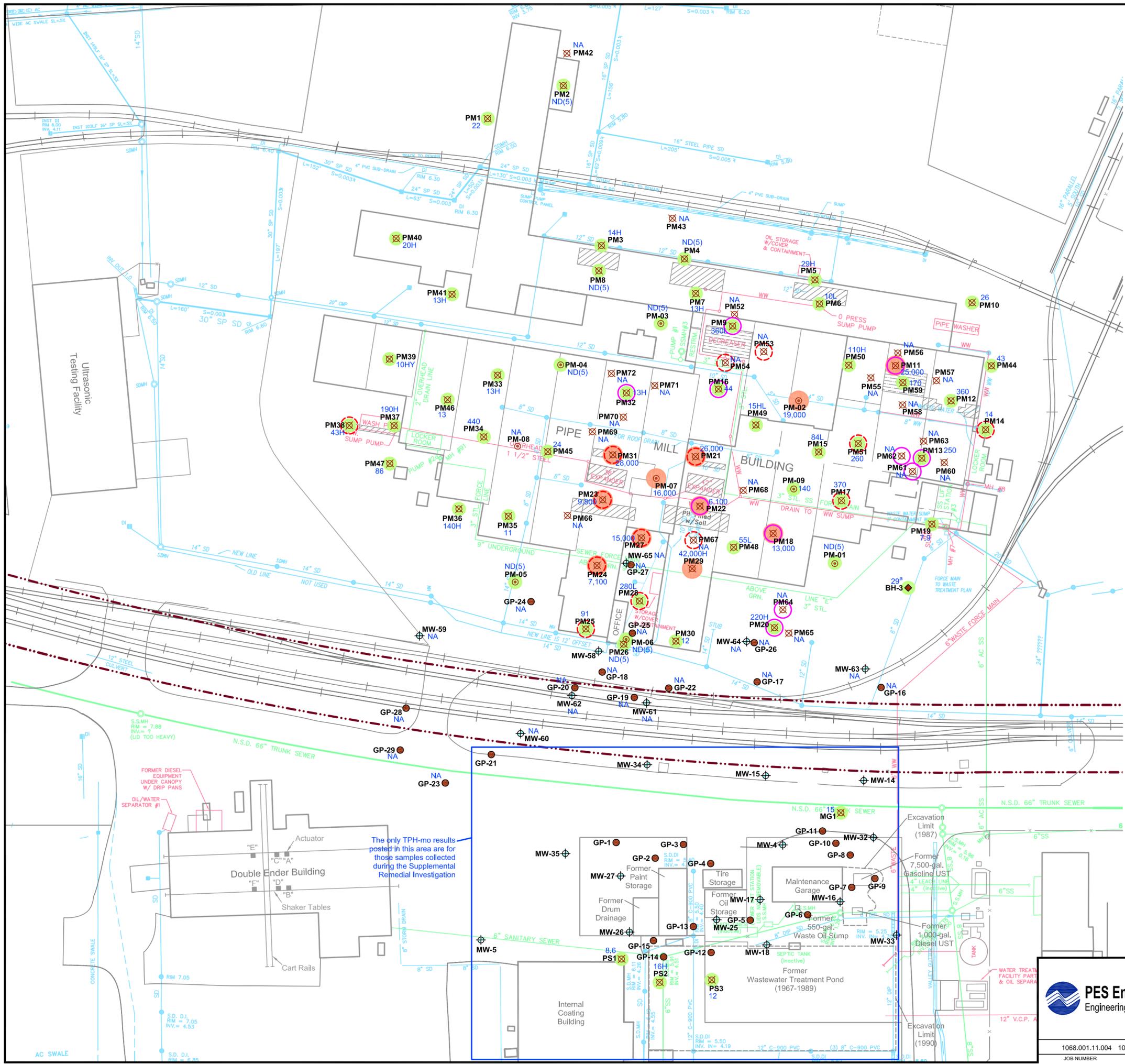
Spatial Distribution of Total Petroleum Hydrocarbons as Motor Oil in Soil (0 to 4 ft. bgs) Site 4 (Former Pipe Mill Building) Napa Pipe Facility, 1025 Kaiser Road Napa, California

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JOB NUMBER DRAWING NUMBER

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5/07
REVIEWED BY DATE

PLATE **9**



- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
- MW-63** Groundwater Monitoring Well
- PM-03** Shaw Phase II Soil Boring Location
- GP-24** JMM, MW, or MWH Soil Boring Location
- BH-3** Soil Boring Location completed by JMM for KSC
- PM11** PES Supplemental Remedial Investigation Boring Location
- PM9** Soil boring where Total Petroleum Hydrocarbons as Motor Oil (TPH-mo) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 1,000 milligrams/kilogram (mg/kg)
- 360L**
- PM24** Soil boring where TPH-mo concentration is between 5,001 and 50,000 mg/kg
- 7,100**
- Petroleum hydrocarbon seen observed in the 4 to 10 ft. below ground surface (bgs) interval
- Separate-phase product observed in the 4 to 10 ft. bgs interval
- 7,100 Analytical results in mg/kg
- ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
- NA Not Analyzed
- a Reported as Total Petroleum Hydrocarbons (i.e., TPH-d and TPH-mo combined)
- b Result posted for PM-02 is for sample collected at 4 to 4.5 ft bgs; result for sample collected at 8 to 8.5 ft bgs was 110 mg/kg.
- Data Qualifiers**
- L Lighter hydrocarbons contributed to the quantitation
- H Heavier hydrocarbons contributed to the quantitation
- Y Sample exhibits chromatographic pattern which does not resemble standard

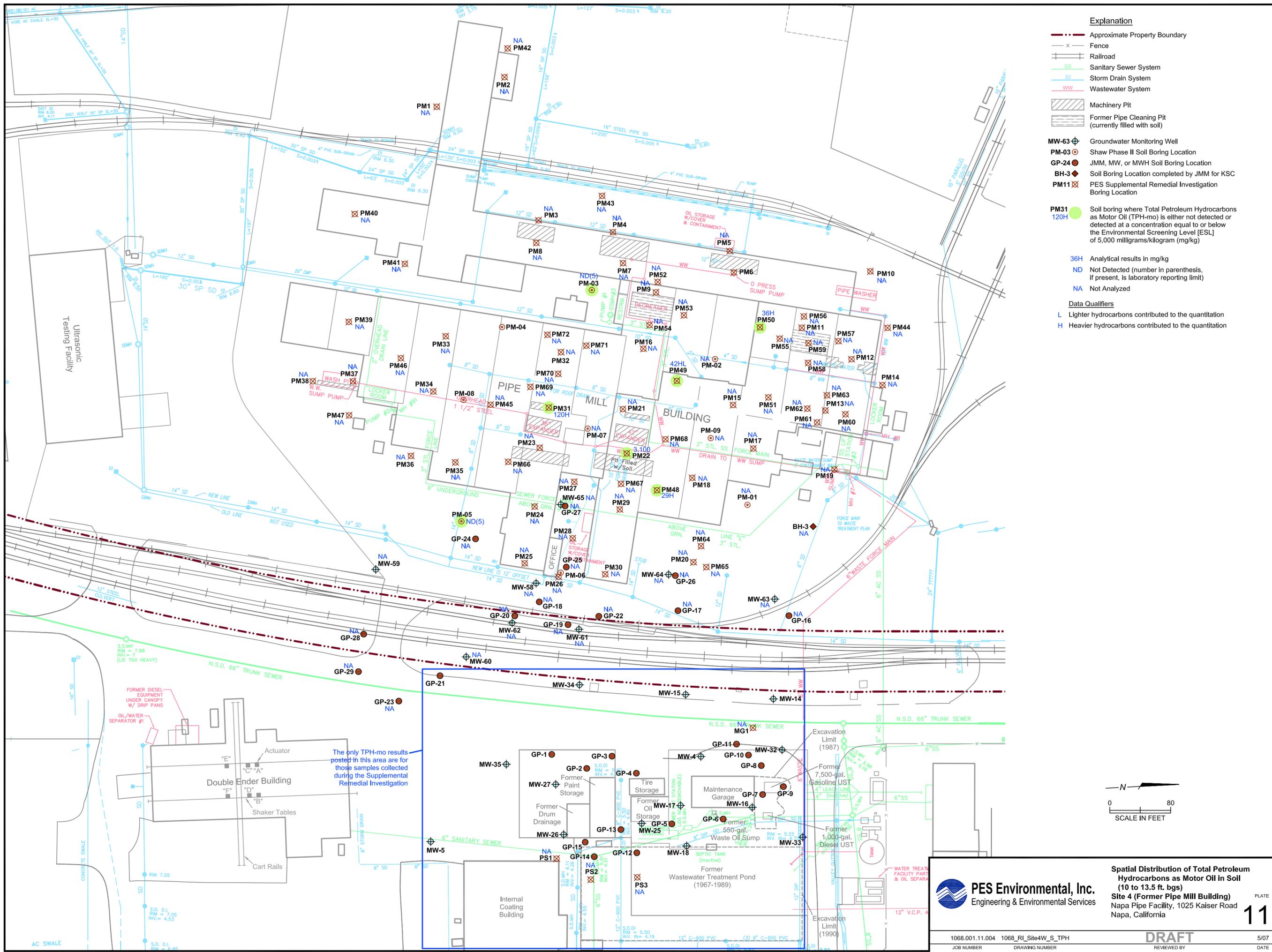
The only TPH-mo results posted in this area are for those samples collected during the Supplemental Remedial Investigation

PES Environmental, Inc.
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Spatial Distribution of Total Petroleum Hydrocarbons as Motor Oil In Soil (4 to 10 ft. bgs)
Site 4 (Former Pipe Mill Building)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

SCALE IN FEET
0 80

10



- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-63 Groundwater Monitoring Well
 - PM-03 Shaw Phase II Soil Boring Location
 - GP-24 JMM, MW, or MWH Soil Boring Location
 - BH-3 Soil Boring Location completed by JMM for KSC
 - PM11 PES Supplemental Remedial Investigation Boring Location
 - PM31 Soil boring where Total Petroleum Hydrocarbons as Motor Oil (TPH-mo) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 5,000 milligrams/kilogram (mg/kg)
- 36H Analytical results in mg/kg
 ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
 NA Not Analyzed
- Data Qualifiers**
- L Lighter hydrocarbons contributed to the quantitation
 - H Heavier hydrocarbons contributed to the quantitation

The only TPH-mo results posted in this area are for those samples collected during the Supplemental Remedial Investigation



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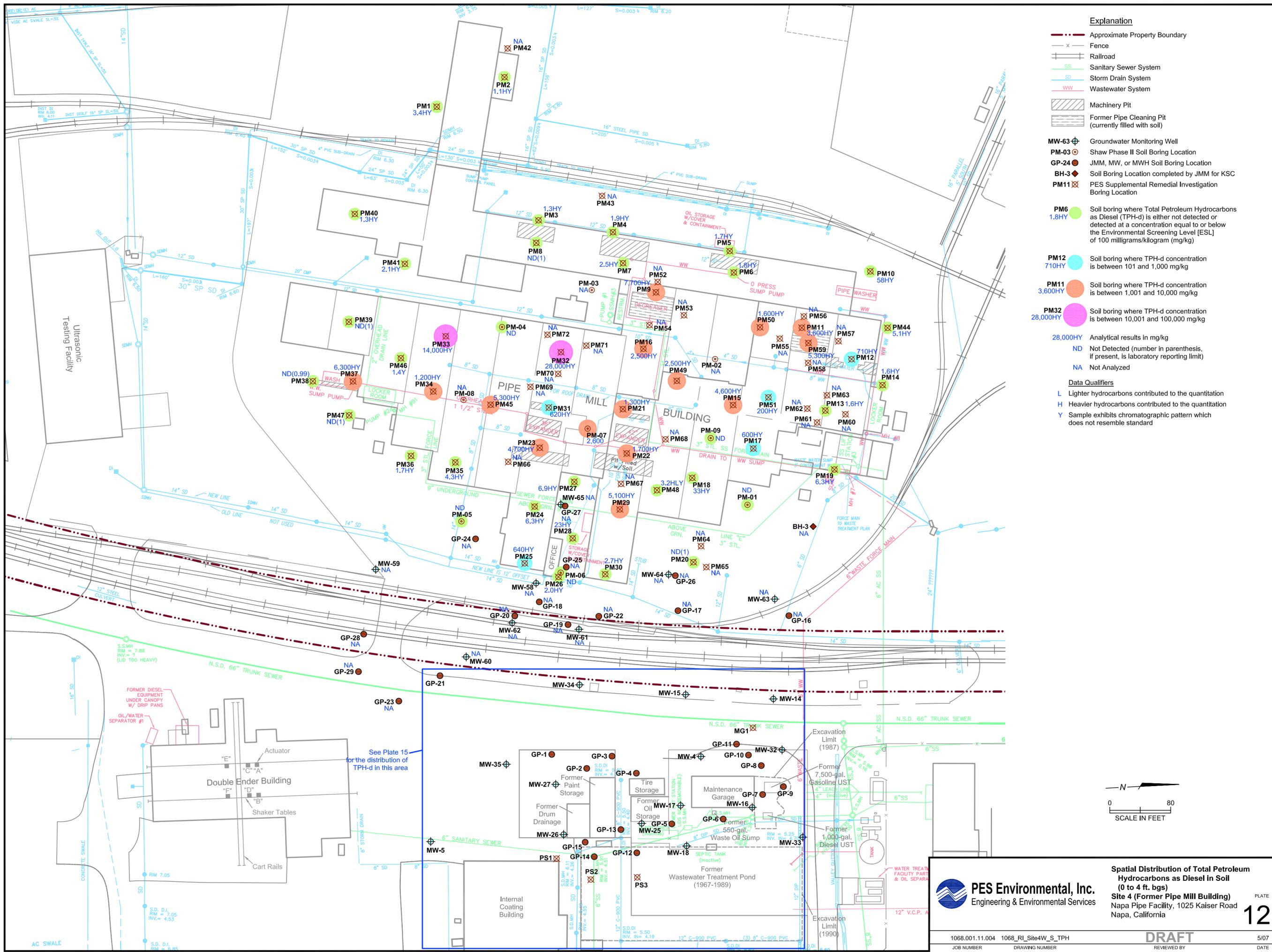
Spatial Distribution of Total Petroleum Hydrocarbons as Motor Oil in Soil (10 to 13.5 ft. bgs)
Site 4 (Former Pipe Mill Building)
 Napa Pipe Facility, 1025 Kaiser Road
 Napa, California

1068.001.11.004 1068_RI_Site4W_S_TPH
 JOB NUMBER DRAWING NUMBER

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- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
- MW-63** Groundwater Monitoring Well
- PM-03** Shaw Phase II Soil Boring Location
- GP-24** JMM, MW, or MWH Soil Boring Location
- BH-3** Soil Boring Location completed by JMM for KSC
- PM11** PES Supplemental Remedial Investigation Boring Location
- PM6** Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 100 milligrams/kilogram (mg/kg)
- PM12** Soil boring where TPH-d concentration is between 101 and 1,000 mg/kg
- PM11** Soil boring where TPH-d concentration is between 1,001 and 10,000 mg/kg
- PM32** Soil boring where TPH-d concentration is between 10,001 and 100,000 mg/kg
- 28,000HY** Analytical results in mg/kg
- ND** Not Detected (number in parenthesis, if present, is laboratory reporting limit)
- NA** Not Analyzed
- Data Qualifiers**
- L** Lighter hydrocarbons contributed to the quantitation
 - H** Heavier hydrocarbons contributed to the quantitation
 - Y** Sample exhibits chromatographic pattern which does not resemble standard



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Engineering & Environmental Services

Spatial Distribution of Total Petroleum Hydrocarbons as Diesel in Soil (0 to 4 ft. bgs) Site 4 (Former Pipe Mill Building) Napa Pipe Facility, 1025 Kaiser Road Napa, California

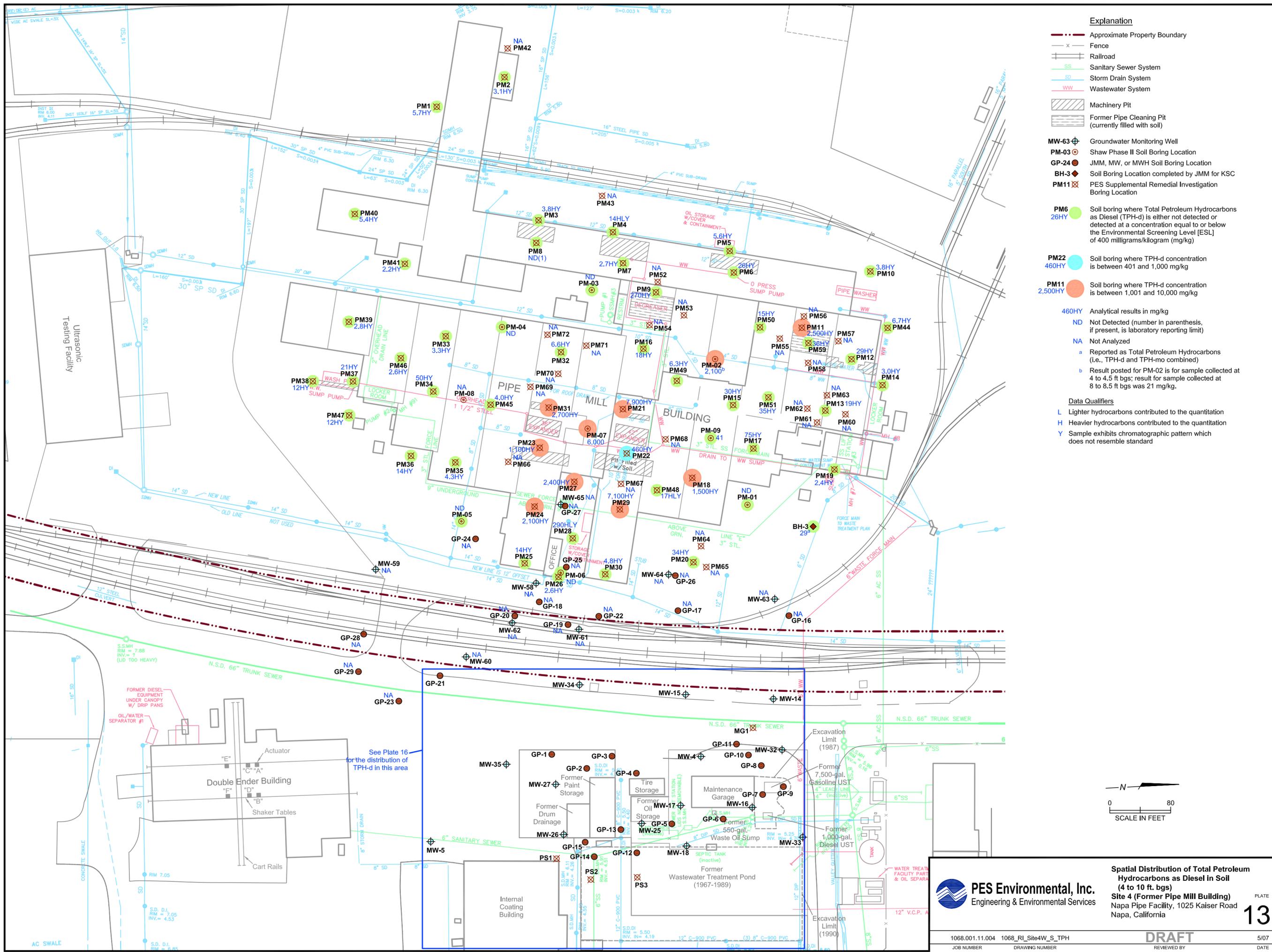
1068.001.11.004 1068_RI_Site4W_S_TPH
JOB NUMBER DRAWING NUMBER

DRAFT

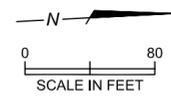
REVIEWED BY DATE

PLATE
12

5/07
DATE

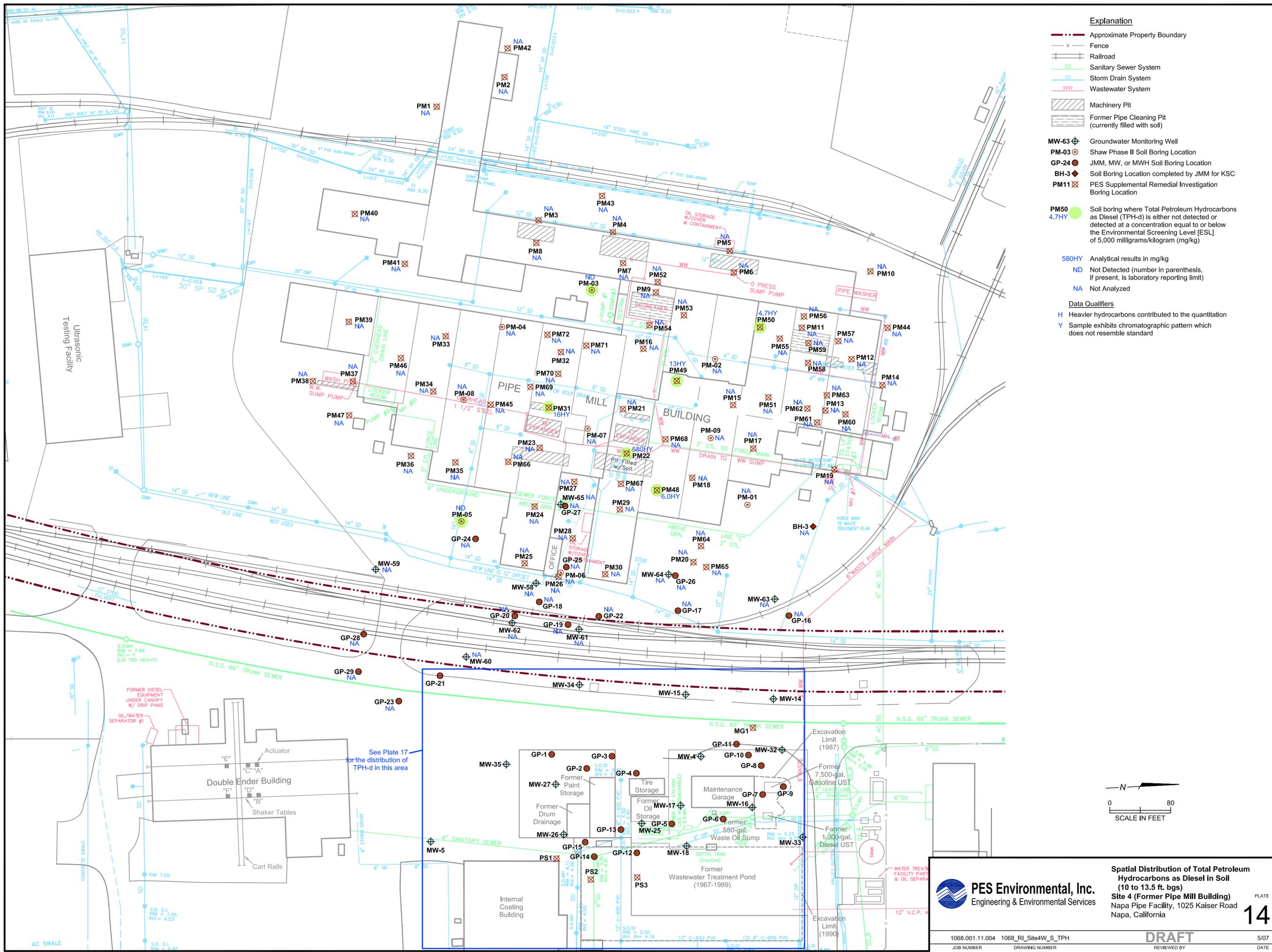


- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-63 Groundwater Monitoring Well
 - PM-03 Shaw Phase II Soil Boring Location
 - GP-24 JMM, MW, or MWH Soil Boring Location
 - BH-3 Soil Boring Location completed by JMM for KSC
 - PM11 PES Supplemental Remedial Investigation Boring Location
 - PM6 Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 400 milligrams/kilogram (mg/kg)
 - PM22 Soil boring where TPH-d concentration is between 401 and 1,000 mg/kg
 - PM11 Soil boring where TPH-d concentration is between 1,001 and 10,000 mg/kg
 - 460HY Analytical results in mg/kg
 - ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
 - NA Not Analyzed
 - a Reported as Total Petroleum Hydrocarbons (i.e., TPH-d and TPH-mo combined)
 - b Result posted for PM-02 is for sample collected at 4 to 4.5 ft bgs; result for sample collected at 8 to 8.5 ft bgs was 21 mg/kg.
- Data Qualifiers**
- L Lighter hydrocarbons contributed to the quantitation
 - H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard



PES Environmental, Inc.
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Spatial Distribution of Total Petroleum Hydrocarbons as Diesel in Soil (4 to 10 ft. bgs)
Site 4 (Former Pipe Mill Building)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California



- Explanation**
- Approximate Property Boundary
 - x Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-63 Groundwater Monitoring Well
 - PM-03 Shaw Phase II Soil Boring Location
 - GP-24 JMM, MW, or MWH Soil Boring Location
 - BH-3 Soil Boring Location completed by JMM for KSC
 - PM11 PES Supplemental Remedial Investigation Boring Location
 - PM50 Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 5,000 milligrams/kilogram (mg/kg)
 - 4.7HY Analytical results in mg/kg
 - ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
 - NA Not Analyzed
- Data Qualifiers**
- H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard

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Spatial Distribution of Total Petroleum Hydrocarbons as Diesel in Soil (10 to 13.5 ft. bgs)
Site 4 (Former Pipe Mill Building)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

1068.001.11.004 1068_RI_Site4W_S_TPH
JOB NUMBER DRAWING NUMBER

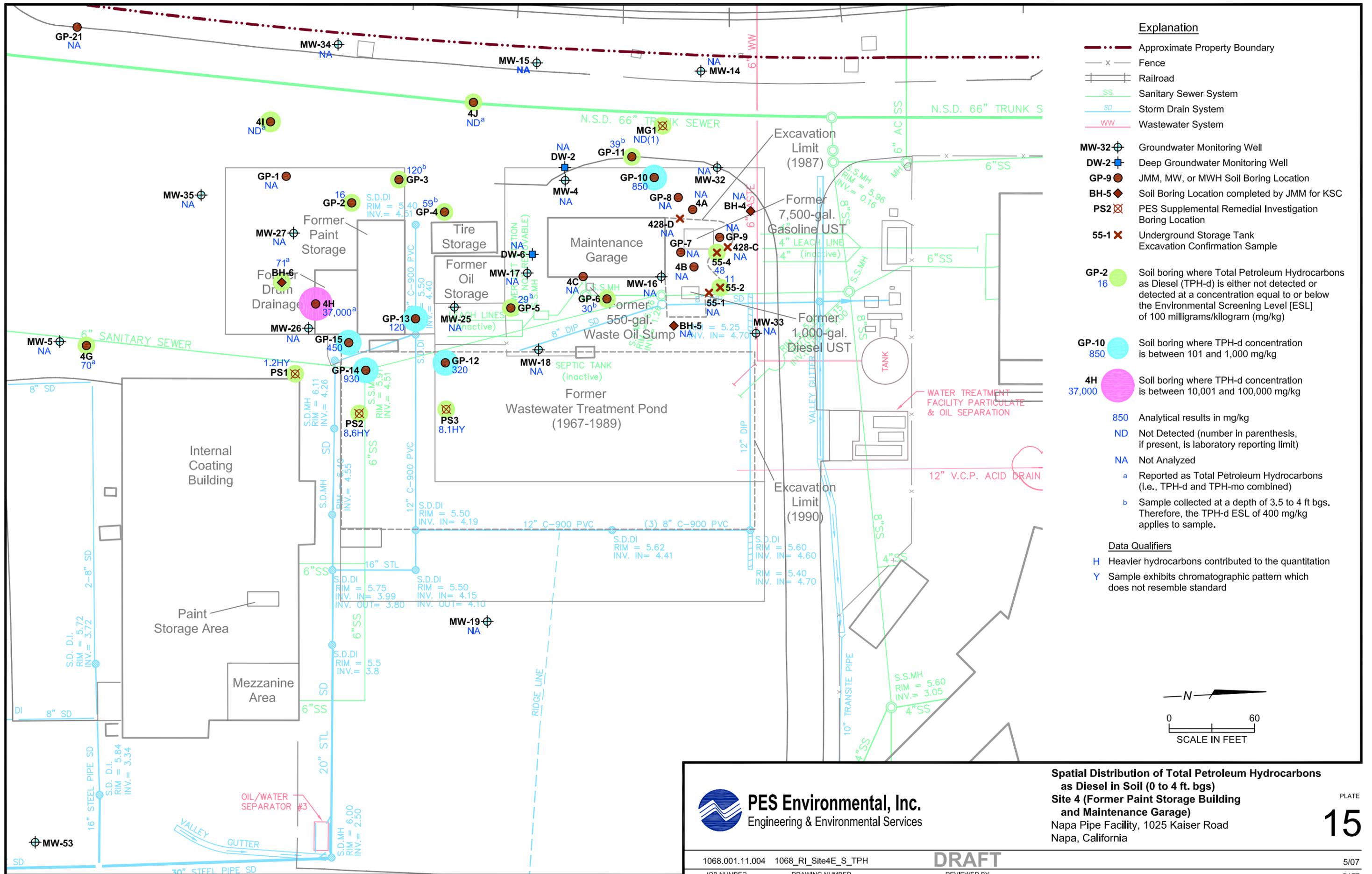
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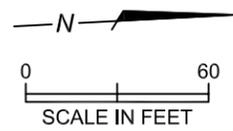
14

PLATE 14

5/07 DATE



- Explanation**
- Approximate Property Boundary
 - x - Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
- MW-32 ⊕ Groundwater Monitoring Well
 - DW-2 ⊕ Deep Groundwater Monitoring Well
 - GP-9 ● JMM, MW, or MWH Soil Boring Location
 - BH-5 ◆ Soil Boring Location completed by JMM for KSC
 - PS2 ⊗ PES Supplemental Remedial Investigation Boring Location
 - 55-1 ⊗ Underground Storage Tank Excavation Confirmation Sample
- GP-2 ● Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 100 milligrams/kilogram (mg/kg)
 - GP-10 ● Soil boring where TPH-d concentration is between 101 and 1,000 mg/kg
 - 4H ● Soil boring where TPH-d concentration is between 10,001 and 100,000 mg/kg
- 850 Analytical results in mg/kg
 - ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
 - NA Not Analyzed
 - a Reported as Total Petroleum Hydrocarbons (i.e., TPH-d and TPH-mo combined)
 - b Sample collected at a depth of 3.5 to 4 ft bgs. Therefore, the TPH-d ESL of 400 mg/kg applies to sample.
- Data Qualifiers**
- H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard



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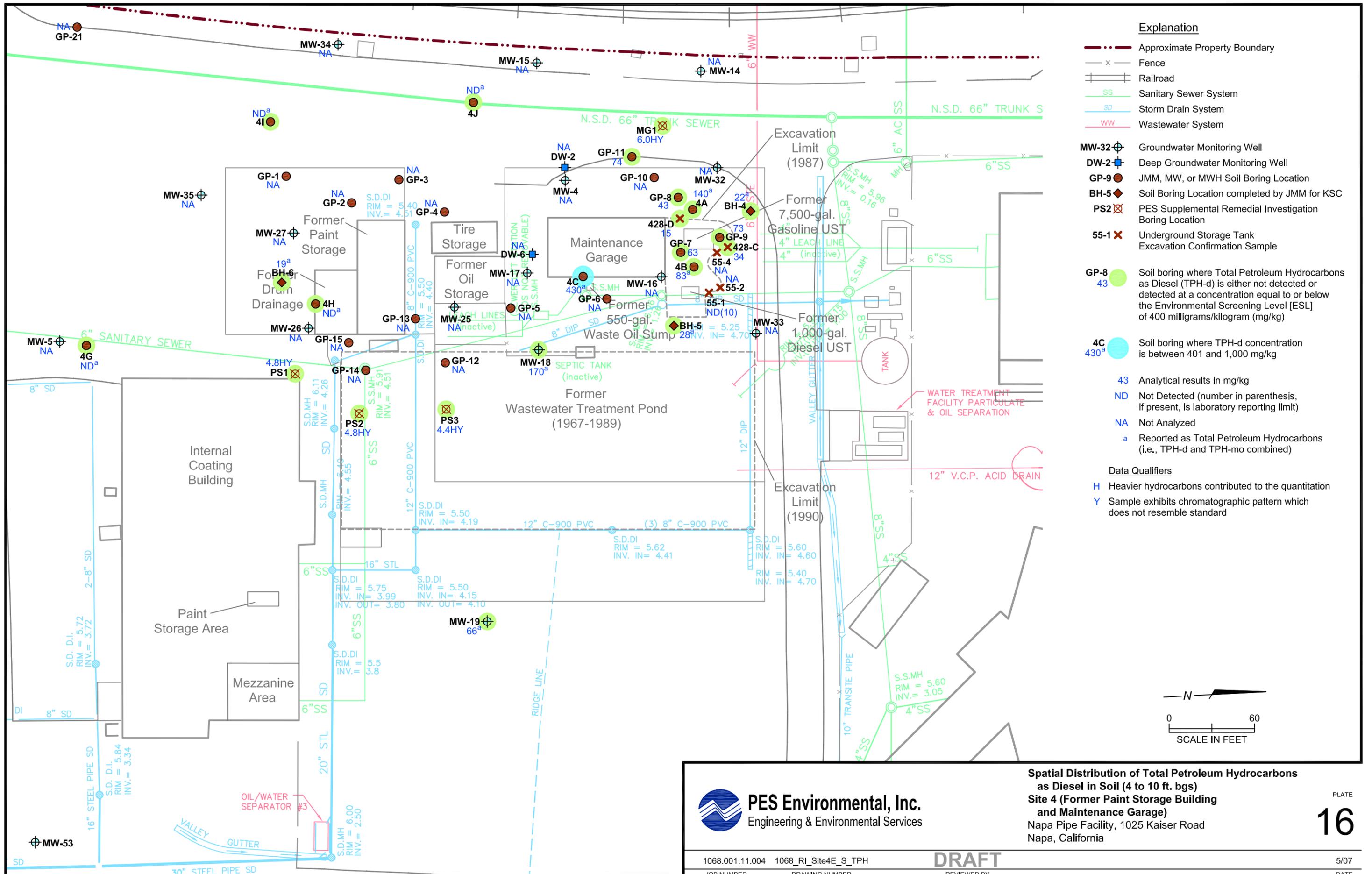
Spatial Distribution of Total Petroleum Hydrocarbons as Diesel in Soil (0 to 4 ft. bgs)
Site 4 (Former Paint Storage Building and Maintenance Garage)
 Napa Pipe Facility, 1025 Kaiser Road
 Napa, California

PLATE
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1068.001.11.004 1068_RI_Site4E_S_TPH
JOB NUMBER DRAWING NUMBER

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REVIEWED BY

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DATE



- Explanation**
- - - Approximate Property Boundary
 - x Fence
 - | | Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
- ⊕ MW-32 Groundwater Monitoring Well
 - ⊕ DW-2 Deep Groundwater Monitoring Well
 - GP-9 JMM, MW, or MWH Soil Boring Location
 - ◆ BH-5 Soil Boring Location completed by JMM for KSC
 - ⊗ PS2 PES Supplemental Remedial Investigation Boring Location
 - ⊗ 55-1 Underground Storage Tank Excavation Confirmation Sample
 - GP-8 Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 400 milligrams/kilogram (mg/kg)
 - 4C Soil boring where TPH-d concentration is between 401 and 1,000 mg/kg
 - 43 Analytical results in mg/kg
 - ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
 - NA Not Analyzed
 - ^a Reported as Total Petroleum Hydrocarbons (i.e., TPH-d and TPH-mo combined)
- Data Qualifiers**
- H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard

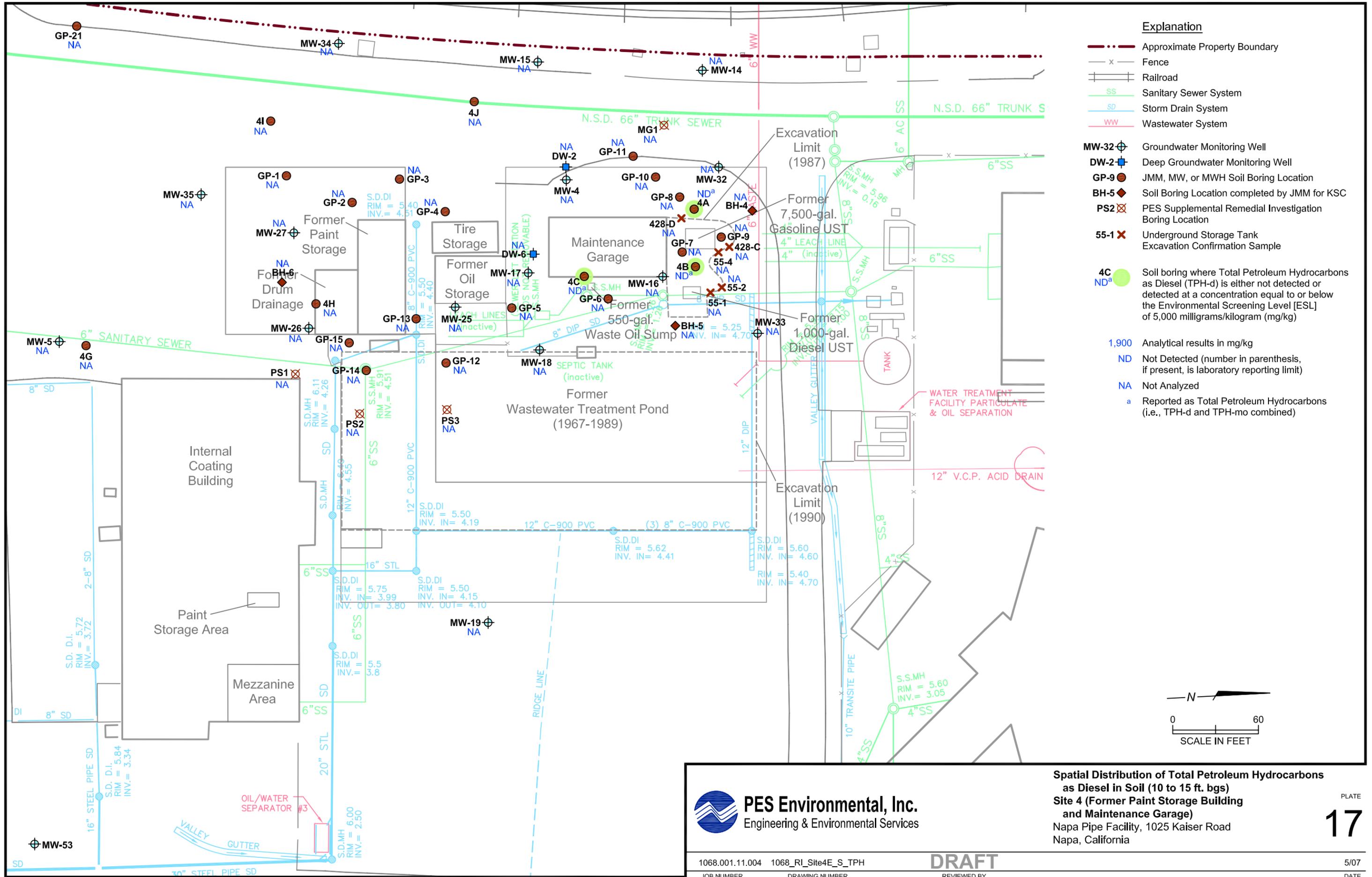
Spatial Distribution of Total Petroleum Hydrocarbons as Diesel in Soil (4 to 10 ft. bgs)
Site 4 (Former Paint Storage Building and Maintenance Garage)
 Napa Pipe Facility, 1025 Kaiser Road
 Napa, California



1068.001.11.004 1068_RI_Site4E_S_TPH
 JOB NUMBER DRAWING NUMBER

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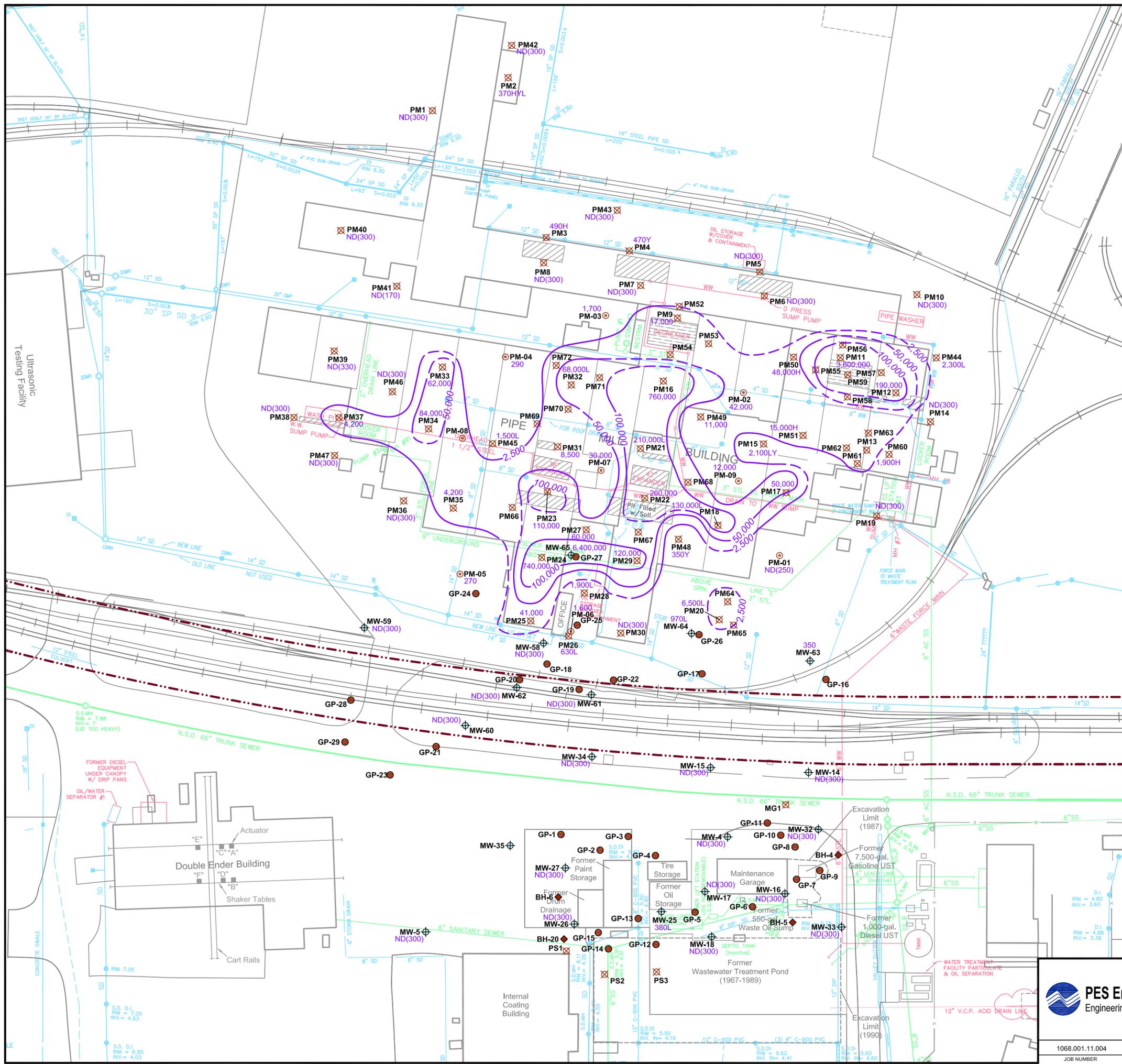
PLATE
16
 5/07
 DATE



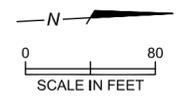
- Explanation**
- - - Approximate Property Boundary
 - x Fence
 - | | Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
- ⊕ MW-32 Groundwater Monitoring Well
 - ⊕ DW-2 Deep Groundwater Monitoring Well
 - GP-9 JMM, MW, or MWH Soil Boring Location
 - ◆ BH-5 Soil Boring Location completed by JMM for KSC
 - ⊗ PS2 PES Supplemental Remedial Investigation Boring Location
 - ⊗ 55-1 Underground Storage Tank Excavation Confirmation Sample
 - 4C ND^a Soil boring where Total Petroleum Hydrocarbons as Diesel (TPH-d) is either not detected or detected at a concentration equal to or below the Environmental Screening Level [ESL] of 5,000 milligrams/kilogram (mg/kg)
- 1,900 Analytical results in mg/kg
 - ND Not Detected (number in parenthesis, if present, is laboratory reporting limit)
 - NA Not Analyzed
 - ^a Reported as Total Petroleum Hydrocarbons (i.e., TPH-d and TPH-mo combined)

Spatial Distribution of Total Petroleum Hydrocarbons as Diesel in Soil (10 to 15 ft. bgs)
Site 4 (Former Paint Storage Building and Maintenance Garage)
 Napa Pipe Facility, 1025 Kaiser Road
 Napa, California





- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - Machinery Pit
 - Former Pipe Cleaning Pit (currently filled with soil)
- MW-63** Groundwater Monitoring Well
- PM-03** Show Phase II Soil Boring Location
- GP-24** JMM, MW, or MWH Soil Boring Location
- BH-3** Soil Boring Location completed by JMM for KSC
- PM11** PES Supplemental Remedial Investigation Boring Location
- 1,700 Concentration in micrograms per liter (µg/l)
- ND(10) Not Detected (number in parenthesis is laboratory reporting limit)
- 2,500 Estimated Distribution of Total Petroleum Hydrocarbons as Motor Oil (TPH-mo) in Groundwater in µg/l (dashed where inferred)
- Environmental Screening Level [ESL] for TPH-mo in groundwater is 2,500 µg/l
- Data Qualifiers**
- L Lighter hydrocarbons contributed to the quantitation
 - H Heavier hydrocarbons contributed to the quantitation
 - Y Sample exhibits chromatographic pattern which does not resemble standard
- Note: Posted monitoring well results are from the October 2006 monitoring event.

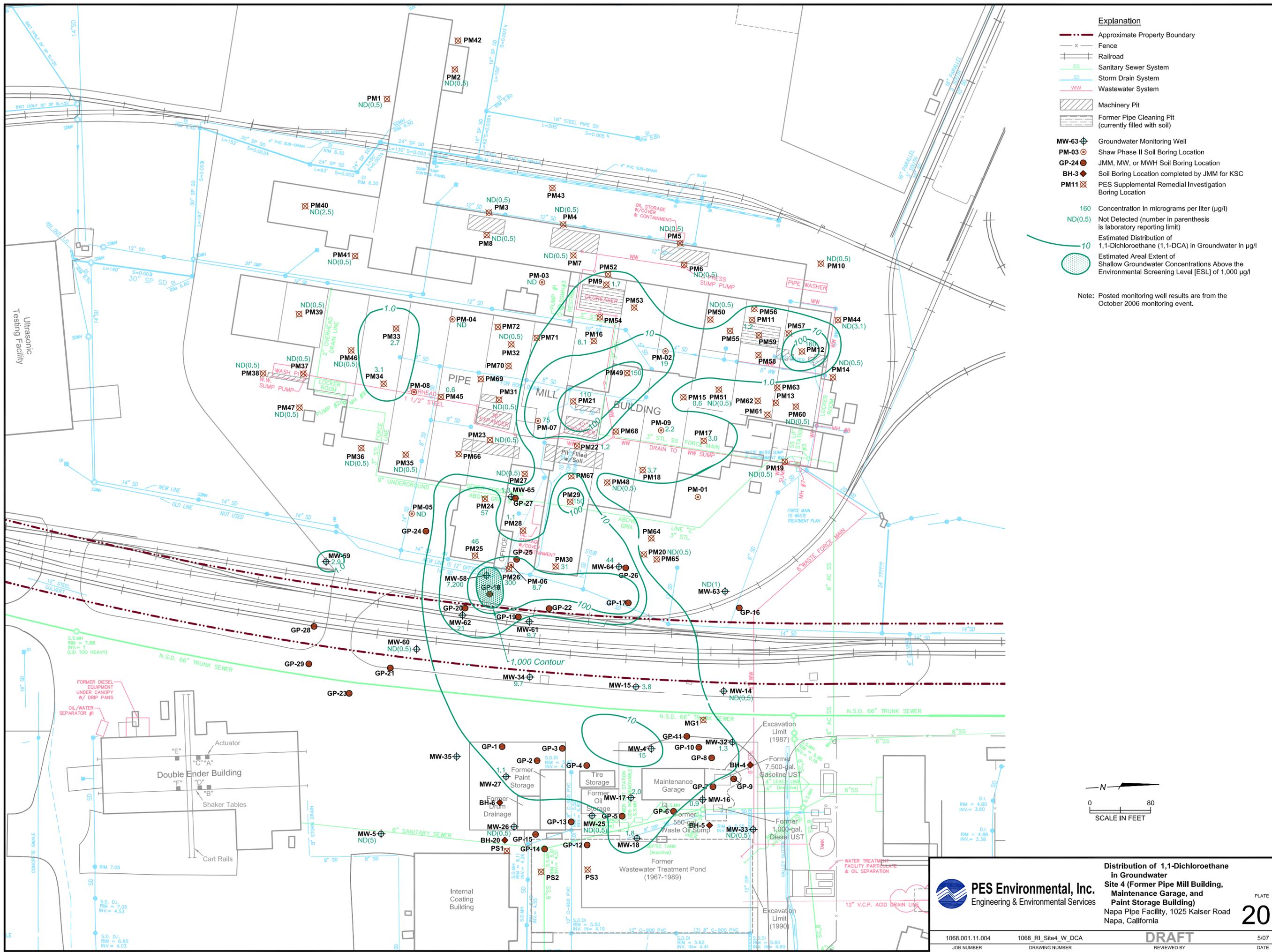


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Distribution of Total Petroleum Hydrocarbons as Motor Oil in Groundwater
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

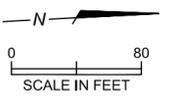
JOB NUMBER: 1068.001.11.004
DRAWING NUMBER: 1068_RI_Site4_W_TPHmo
REVIEWED BY: **DRAFT**
DATE: 5/07

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- Explanation**
- Approximate Property Boundary
 - x Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - Machinery Pit
 - Former Pipe Cleaning Pit (currently filled with soil)
 - + MW-63 Groundwater Monitoring Well
 - o PM-03 Shaw Phase II Soil Boring Location
 - o GP-24 JMM, MW, or MWH Soil Boring Location
 - o BH-3 Soil Boring Location completed by JMM for KSC
 - x PM11 PES Supplemental Remedial Investigation Boring Location
 - 160 Concentration in micrograms per liter (µg/l)
 - ND(0.5) Not Detected (number in parenthesis is laboratory reporting limit)
 - 10 Estimated Distribution of 1,1-Dichloroethane (1,1-DCA) in Groundwater in µg/l
 - Estimated Areal Extent of Shallow Groundwater Concentrations Above the Environmental Screening Level [ESL] of 1,000 µg/l

Note: Posted monitoring well results are from the October 2006 monitoring event.

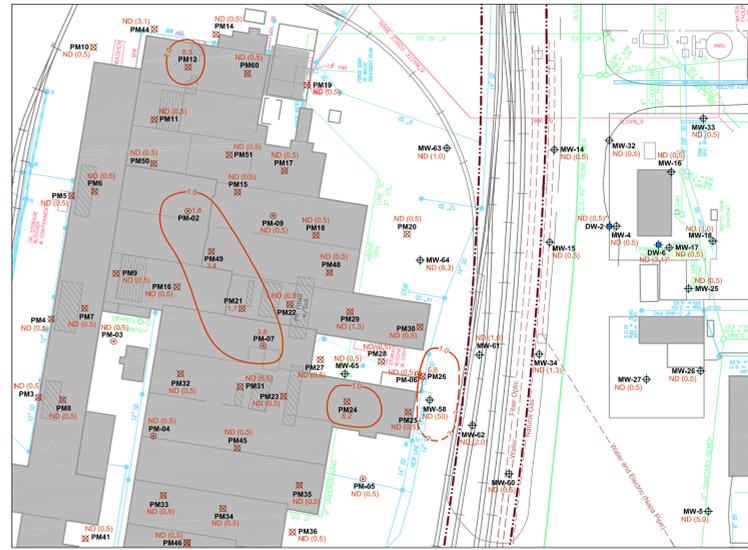


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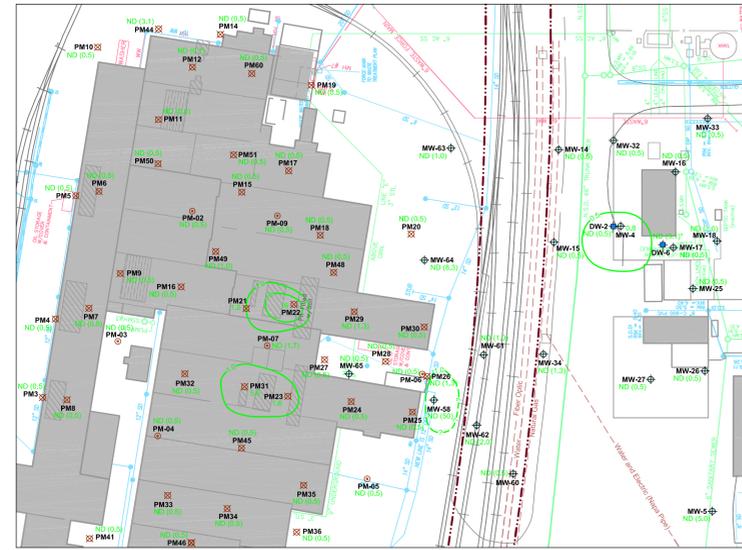
Distribution of 1,1-Dichloroethane in Groundwater
Site 4 (Former Pipe Mill Building, Maintenance Garage, and Paint Storage Building)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

PLATE
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Parent Compounds



1,1,1-Trichloroethane

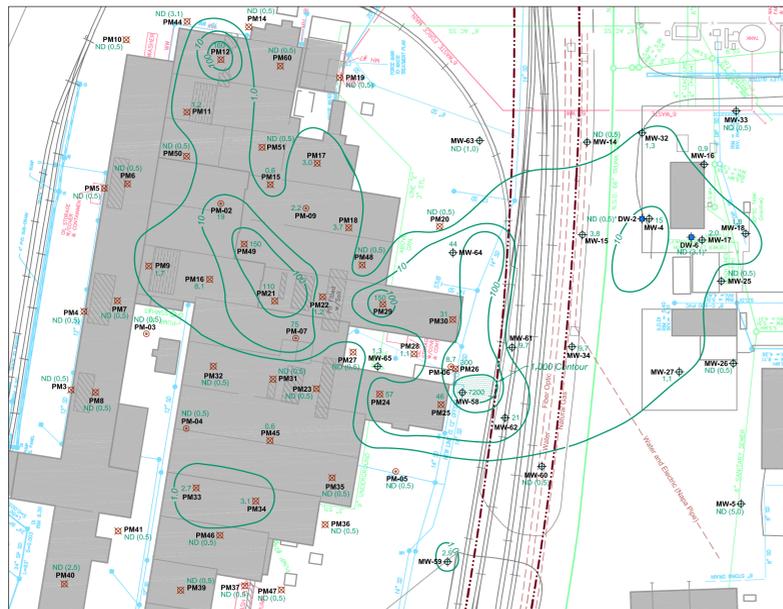


Trichloroethylene

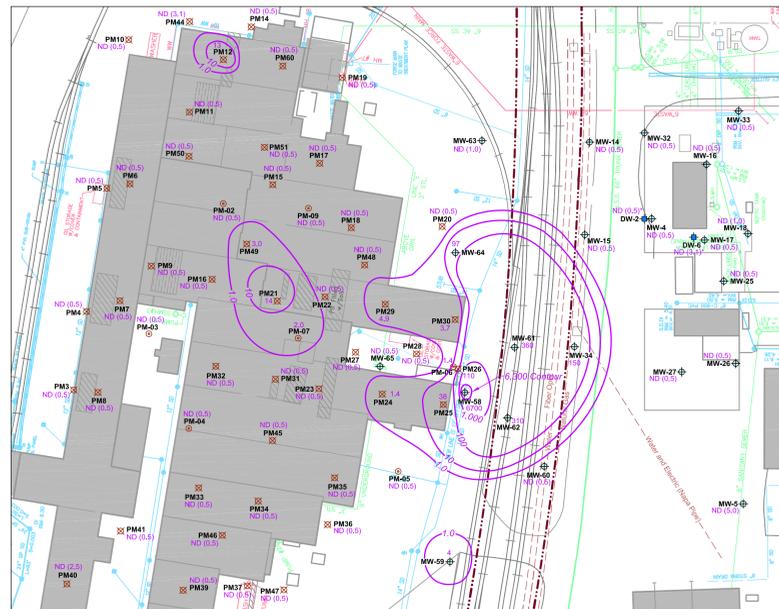
- Explanation**
- Approximate Property Boundary
 - Fence
 - Railroad
 - Sanitary Sewer System
 - Storm Drain System
 - Wastewater System
 - Utility Lines
 - ▭ Machinery Pit
 - ▭ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-34 ⊕ Groundwater Monitoring Well
 - DW-2 ⊕ Deep Groundwater Monitoring Well
 - PM-06 ⊕ Shaw Phase II Soil Boring Location
 - PM-30 ⊕ PES Supplemental Remedial Investigation Boring Location
 - 16 Concentration in micrograms per liter (µg/l)
 - ND (10) Not Detected (number in parenthesis is laboratory reporting limit)
 - Chemical Isoconcentration Contour in µg/l (dashed where inferred; queried where approximate)
 - Estimated Areal Extent of Shallow Groundwater Concentrations Above the Environmental Screening Level [ESL]
 - Deep Groundwater Monitoring Well; data not used for contouring purposes

- Notes:**
- (1) Posted monitoring well results are from the October 2006 monitoring event.
 - (2) Posted grab groundwater results are from the 2006 PES Supplemental Remedial Investigation
 - (3) Utility line locations are conceptual and for discussion purposes only.

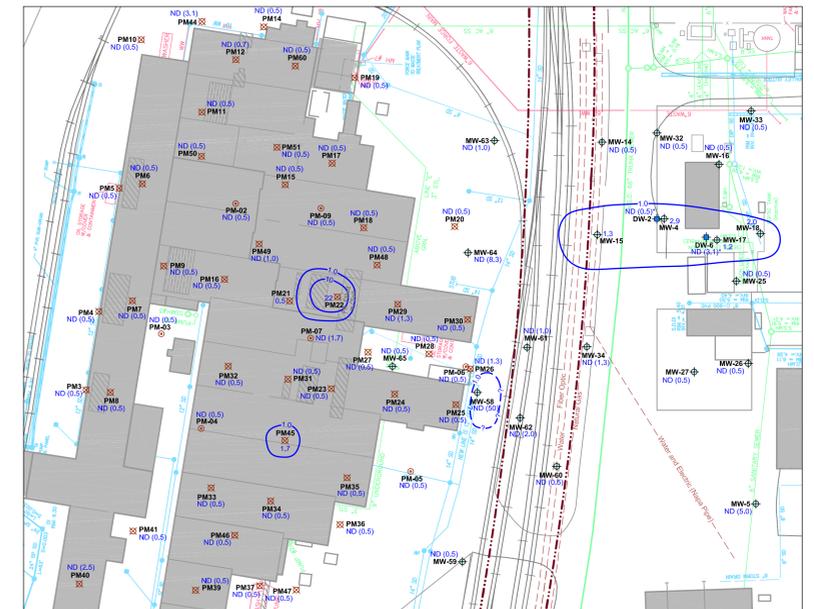
Degradation Products



1,1-Dichloroethane

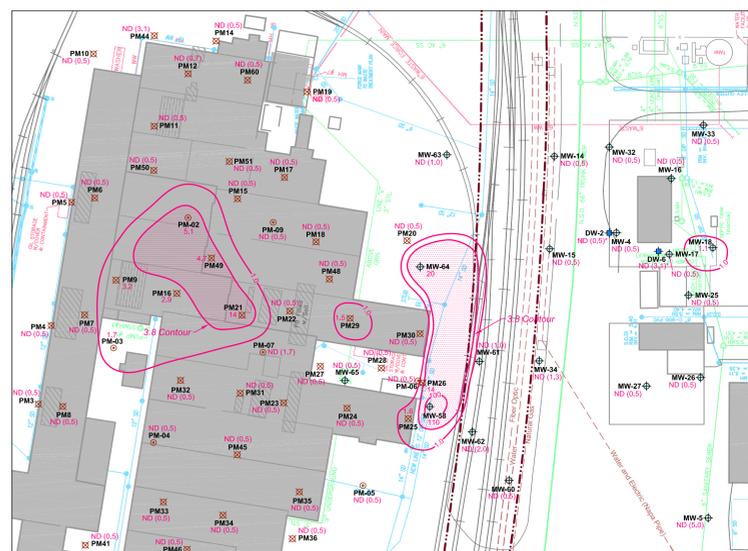


1,1-Dichloroethane

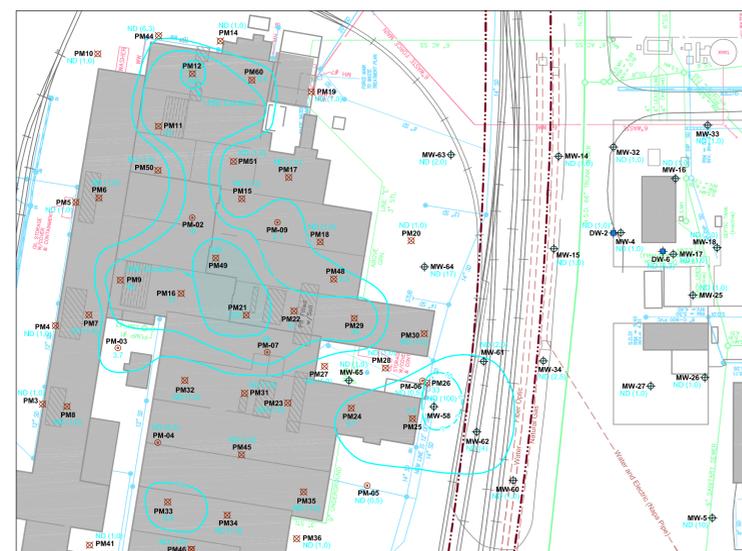


cis-1,2-Dichloroethane

Final By-Products

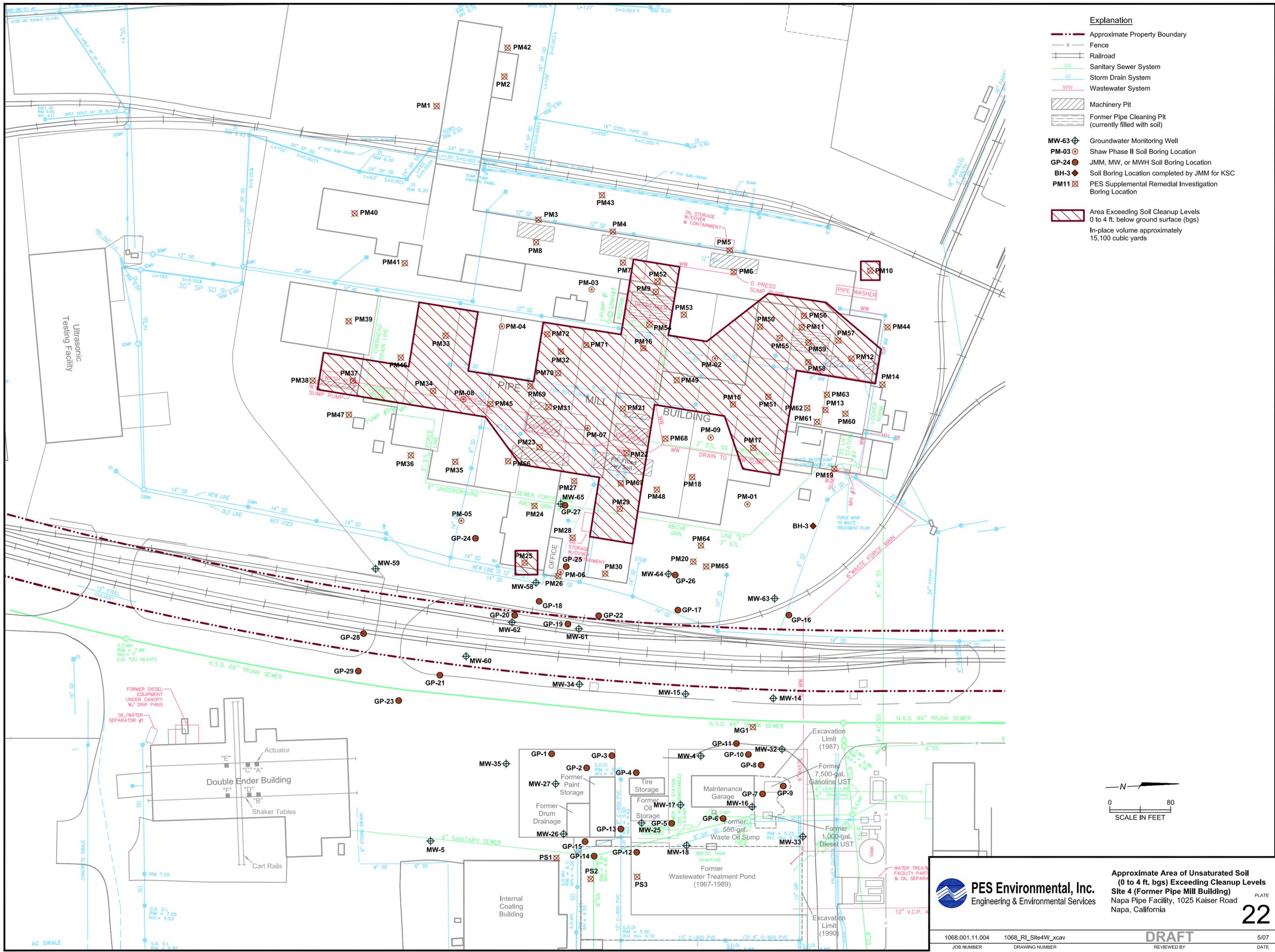


Vinyl Chloride

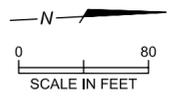


Chloroethane

- Environmental Screening Levels [ESLs]**
- 1,1,1-Trichloroethane = 50,000 µg/l
 - Trichloroethylene = 530 µg/l
 - 1,1-Dichloroethane = 1,000 µg/l
 - 1,1-Dichloroethane = 6,300 µg/l
 - cis-1,2-Dichloroethane = 6,200 µg/l
 - Vinyl Chloride = 3.8 µg/l
 - Chloroethane = 160 µg/l



- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-63 Groundwater Monitoring Well
 - PM-03 Shaw Phase II Soil Boring Location
 - GP-24 JMM, MW, or MWH Soil Boring Location
 - BH-3 Soil Boring Location completed by JMM for KSC
 - PM11 PES Supplemental Remedial Investigation Boring Location
 - ▨ Area Exceeding Soil Cleanup Levels 0 to 4 ft. below ground surface (bgs)
In-place volume approximately 15,100 cubic yards





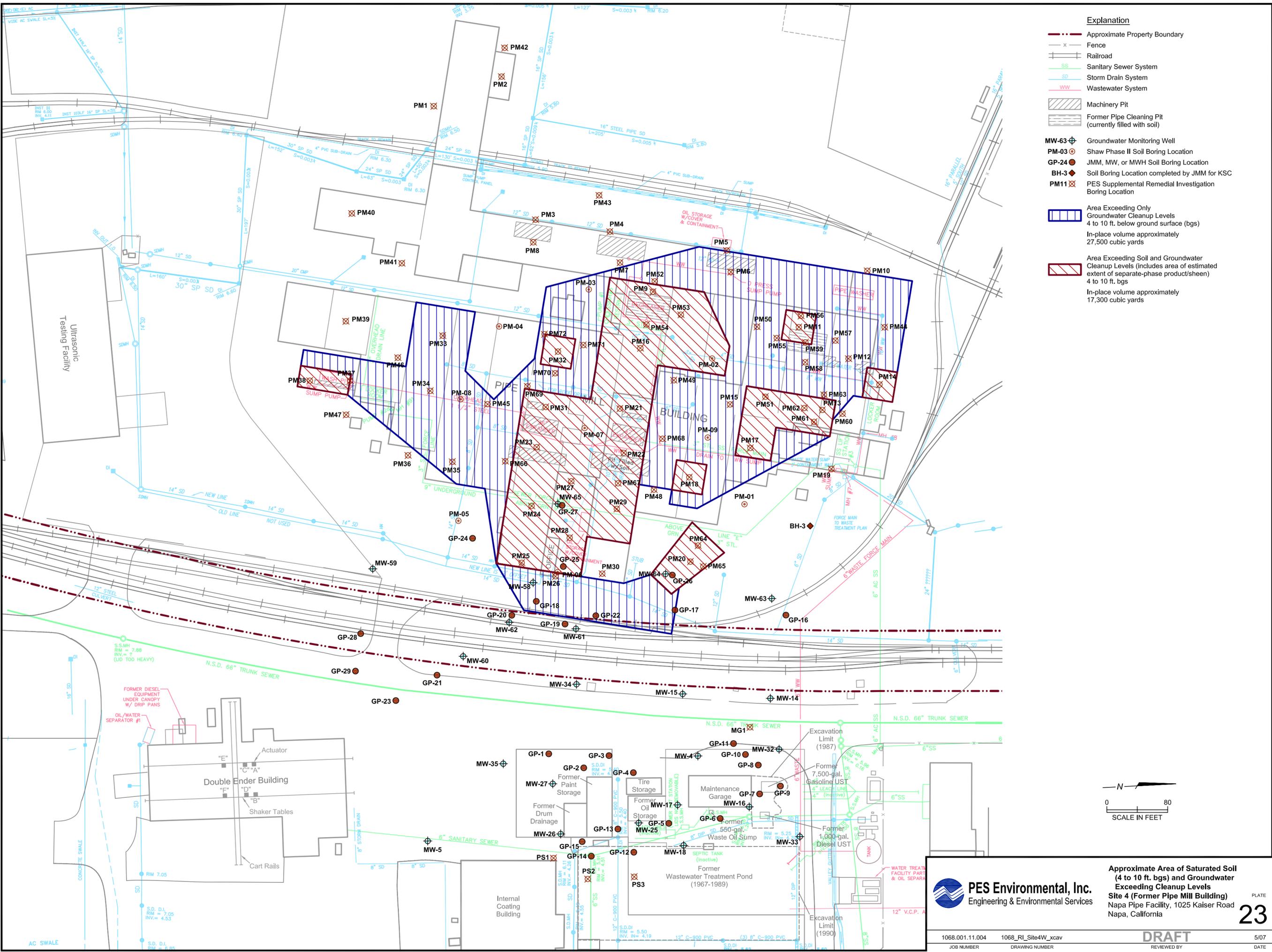
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**Approximate Area of Unsaturated Soil
(0 to 4 ft. bgs) Exceeding Cleanup Levels
Site 4 (Former Pipe Mill Building)**
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

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1068.001.11.004 1068_RI_Site4W_xcav **DRAFT** 5/07

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- Explanation**
- Approximate Property Boundary
 - x- Fence
 - Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ▨ Machinery Pit
 - ▨ Former Pipe Cleaning Pit (currently filled with soil)
 - MW-63 Groundwater Monitoring Well
 - PM-03 Shaw Phase II Soil Boring Location
 - GP-24 JMM, MW, or MWH Soil Boring Location
 - BH-3 Soil Boring Location completed by JMM for KSC
 - PM11 PES Supplemental Remedial Investigation Boring Location
 - ▨ Area Exceeding Only Groundwater Cleanup Levels 4 to 10 ft. below ground surface (bgs) In-place volume approximately 27,500 cubic yards
 - ▨ Area Exceeding Soil and Groundwater Cleanup Levels (includes area of estimated extent of separate-phase product/sheen) 4 to 10 ft. bgs In-place volume approximately 17,300 cubic yards

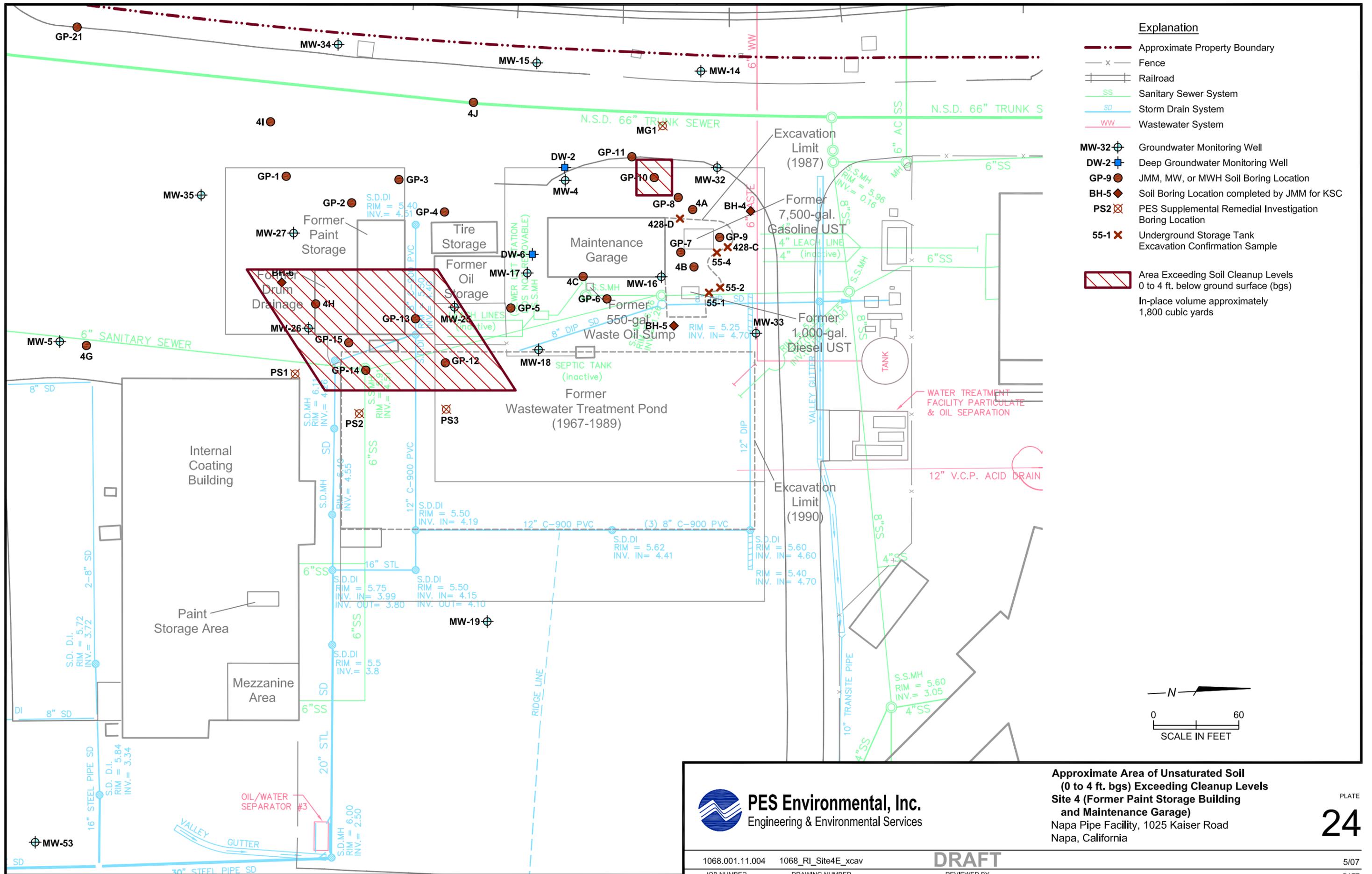


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Approximate Area of Saturated Soil (4 to 10 ft. bgs) and Groundwater Exceeding Cleanup Levels Site 4 (Former Pipe Mill Building) Napa Pipe Facility, 1025 Kaiser Road Napa, California

1068.001.11.004 JOB NUMBER 1068_RI_Site4W_xcav DRAWING NUMBER **DRAFT** REVIEWED BY 5/07 DATE

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Approximate Area of Unsaturated Soil (0 to 4 ft. bgs) Exceeding Cleanup Levels Site 4 (Former Paint Storage Building and Maintenance Garage)
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

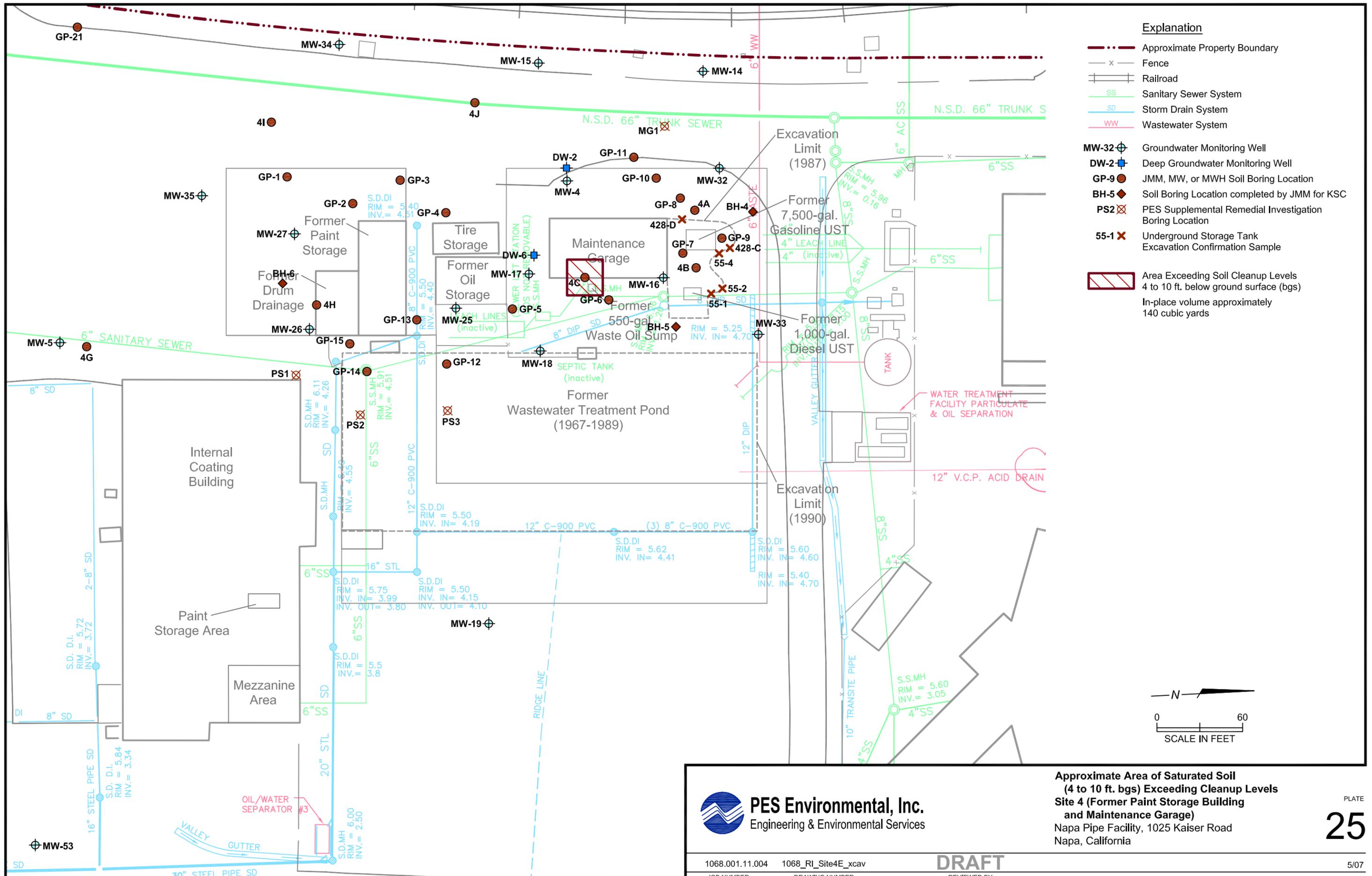
PLATE

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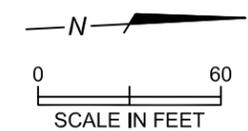
1068.001.11.004 1068_RI_Site4E_xcav
JOB NUMBER DRAWING NUMBER

DRAFT
REVIEWED BY

5/07
DATE



- Explanation**
- - - Approximate Property Boundary
 - x - Fence
 - =| Railroad
 - SS Sanitary Sewer System
 - SD Storm Drain System
 - WW Wastewater System
 - ⊕ MW-32 Groundwater Monitoring Well
 - ⊕ DW-2 Deep Groundwater Monitoring Well
 - GP-9 JMM, MW, or MWH Soil Boring Location
 - ◆ BH-5 Soil Boring Location completed by JMM for KSC
 - ⊗ PS2 PES Supplemental Remedial Investigation Boring Location
 - ⊗ 55-1 Underground Storage Tank Excavation Confirmation Sample
 - Area Exceeding Soil Cleanup Levels 4 to 10 ft. below ground surface (bgs)
In-place volume approximately 140 cubic yards





PES Environmental, Inc.
Engineering & Environmental Services

**Approximate Area of Saturated Soil
(4 to 10 ft. bgs) Exceeding Cleanup Levels
Site 4 (Former Paint Storage Building
and Maintenance Garage)**
Napa Pipe Facility, 1025 Kaiser Road
Napa, California

PLATE
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NAPA PIPE FACILITY
1025 KAISER ROAD
NAPA, CALIFORNIA**

**VOLUME 3
SITE 4 - FORMER PIPE MILL BUILDING, MAINTENANCE GARAGE,
AND PAINT STORAGE BUILDING**

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