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July 26, 2011

Mr. Jeffrey Vought
Engineering Geologist
New York State Department of Environmental Conservation
Hunters Point Plaza
47-40 21st Street
Long Island City, New York 11101-5407

Re: Revised Remedial Design/Remedial Action Work Plan for Operable Unit 3
Amtrak Sunnyside Yard, Queens, New York

Dear Mr. Vought:

Please find one copy of the enclosed report entitled Revised Remedial Design/Remedial Action Work Plan for Operable Unit 3, Sunnyside Yard, Queens, New York (RD/RA Work Plan). This report was prepared by Remedial Engineering, P.C. (Remedial Engineering) and Roux Associates, Inc. (Roux Associates) on behalf of the National Railroad Passenger Corporation (Amtrak) and the New Jersey Transit Corporation (NJTC). The date of this RD/RA Work Plan is July 26, 2011 (Revised).

This RD/RA Work Plan was initially submitted to the New York State Department of Environmental Conservation (NYSDEC) on June 30, 2011. As per our previous communications, since the initial submittal of this RD/RA Work Plan, Amtrak has identified the need for a new Running Rail Track at Sunnyside Yard. A portion of this proposed Running Rail Track will traverse the proposed Operable Unit 3 (OU-3) remediation system area. As such, this revised RD/RA Work Plan is being submitted to NYSDEC presenting the location of the proposed Running Rail Track in OU-3, as well as the updated proposed OU-3 remediation system configuration (see Drawing No. 1 of the enclosed document).

It is important to note that Amtrak designed the proposed Running Rail Track such that it only minimally impacted the above-grade components of the OU-3 remediation system, and would not impact the efficiency of the remedial design. Consequently, as presented in the enclosed document, only minor modifications of the OU-3 remediation system design were required to facilitate this new Running Rail Track.

Should you have any questions or require any additional information during your review of this RD/RA Work Plan, please do not hesitate to contact me at (631) 232-2600.

Sincerely,

REMEDIAL ENGINEERING, P.C.

Charles J. McGuckin, P.E.
Principal Engineer

Attachment

cc: Jane O'Connell, NYSDEC
Christopher Doroski, NYSDOH
Richard Mohlenhoff, P.E., Amtrak
Martin Judd, New Jersey Transit
Claudia Taccetta, Amtrak
Joseph D. Duminuco, Roux Associates, Inc.
Robert Kovacs, Roux Associates, Inc.

June 30, 2011
July 26, 2011 **(Revised)**

REVISED REMEDIAL DESIGN/ REMEDIAL ACTION WORK PLAN FOR OPERABLE UNIT 3

Amtrak Sunnyside Yard
Queens, New York

Prepared for:

NATIONAL RAILROAD PASSENGER CORPORATION
400 West 31st Street, 4th Floor
New York, New York 10001

Remedial Engineering, P.C.
Environmental Engineers

and ROUX ASSOCIATES, INC.
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CERTIFICATION

I, Charles J. McGuckin, certify that I am currently a NYS registered professional engineer and that this *Remedial Design/Remedial Action work plan* was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site Investigation and Remediation (DER-10).

Charles J. McGuckin, P.E.	July 26, 2011	
NYS Professional Engineer #069509	Date	Signature

STATE OF NEW YORK
CHARLES J. McGUCKIN
NO. 069509
LICENSED PROFESSIONAL ENGINEER

LIST OF ACRONYMS

Acronym	Definition
acfm	Actual Cubic Feet per Minute
AMTRAK	National Railroad Passenger Corporation
bls	Below land surface
BTEX	Benzene, toluene, ethylbenzene, and xylenes
C&D	Construction and Demolition
CAMP	Community Air Monitoring Plan
$CaNO_3$	Calcium Nitrate
CCR	Construction Completion Report
CFR	Code of Federal Regulations
CFU	Colony Forming Units
COCs	Compounds of Concern
Conrail	Consolidated Rail Corporation
cPAH	Seven specific PAHs that the NYSDEC considers carcinogenic
CQAP	Construction Quality Assurance Plan
CRZ	Contamination Reduction Zone
CY	Cubic Yards
DER	Division of Environmental Remediation
DO	Dissolved Oxygen
DPVE	Dual Phase Vacuum Extraction
DRO	Diesel Range Organics
DSHM	Division of Solid and Hazardous Materials
EC	Engineering Control
EZ	Exclusion Zone
FS	Feasibility Study
GPM	Gallons per Minute
GRA	General Response Action
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operation Worker
HDPE	High Density Polyethylene
Hp	Horsepower
HRO	Heavy Range Organics

Acronym	Definition
HSTF	High Speed Trainset Facility
IHWDS	Inactive Hazardous Waste Disposal Site
IC	Institutional Control
IRM	Interim remedial measures
LIRR	Long Island Rail Road
LPGAC	Liquid Phase Granular Activated Carbon
LRP	Liquid Ring Pump
LS	Level Switch
mg/kg	Milligrams per kilogram, equal to 1,000 µg/kg
µg/kg	Micrograms per kilogram, equal to 0.001 mg/kg
µg/L	Micrograms per liter
MCP	Main Control Panel
MTA	Metropolitan Transit Authority
NJTC	New Jersey Transit Corporation
NO_3	Nitrate
N:P:K	Nitrogen: Phosphorus: Potassium Ratio
NYCDEP	New York City Department of Environmental Protection
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
OOC	Order On Consent
OM&M	Operation, Maintenance and Monitoring
ORP	Oxidation Reduction Potential
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OWS	Oil/Water Separator
PAHs	Polycyclic aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
P&ID	Process and Instrumentation Diagram
PID	Photoionization detector
PLC	Programmable Logic Controller

Acronym	Definition
PPE	Personal protection equipment
ppm	Parts per million, equivalent to mg/kg
PS	Pressure Switch
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
RAOs	Remedial Action Objectives
RAWP	Remedial Action Work Plan
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
Redox	Oxidation-reduction
RI	Remedial Investigation
ROD	Record of Decision
ROI	Radius of Influence
RSCOs	Recommended Soil Cleanup Objectives
scfm	Standard Cubic Feet per Minute
SCGs	Standards, Criteria and Guidance
SCOs	Soil Cleanup Objective
SF	Square feet
SMP	Site Management Plan
SoMP	Soil Management Plan
SPH	Separate-Phase Petroleum Hydrocarbon
STARS	Spill Technology and Remediation Series
SVOCs	Semivolatile Organic Compounds
SWPPP	Stormwater Pollution Prevention Plan
SZ	Support Zone
TAL	Target Analyte List
TAGM	Technical and Administrative Guidance Memorandum
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substance Control Act

Acronym	Definition
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
VPGAC	Vapor Phase Granular Activated Carbon
Yard	Sunnyside Yard, Queens, New York

1.0 INTRODUCTION

On behalf of the National Railroad Passenger Corporation (Amtrak) and the New Jersey Transit Corporation (NJTC), Remedial Engineering, P.C. (Remedial Engineering) and Roux Associates, Inc. (Roux Associates) have prepared this Remedial Design/Remedial Action work plan (RD/RA) for the mobile separate-phase petroleum hydrocarbon (SPH) plume within Operable Unit 3 (OU-3) of the Sunnyside Yard (Yard) located at 39-29 Honeywell Street, Queens, New York (Figure 1). The Sunnyside Yard is listed as a Class II Site in the New York State Department of Environmental Conservation's (NYSDEC) Registry of Inactive Hazardous Waste Disposal Sites. As a result of the listing for the entire Yard, Amtrak, NJTC, and the NYSDEC entered into an Order on Consent (OOC) Index #W2-0081-87-06, effective October 1989. Further, effective May 2010 Amtrak, NJTC and NYSDEC entered into OOC Index #W2-0081-08-10 for the development and implementation of a remedial program at the Yard

Based on historic investigations completed at the Yard, the Yard has been divided into six Operable Units (OU-1 through OU-6):

- OU-1: Soil above the water table within the footprint of the High Speed Trainset Facility Service and Inspection (HSTF S&I) Building. A Record of Decision (ROD) was issued for OU-1 in August 1997, and the remedial work was completed in April 1998.

- OU-2: Soil above the water table within the footprint of the HSTF S&I Building ancillary structures. A No Further Action ROD was issued for OU-2 in November 1997.

- OU-3: Soil and SPH above the water table within approximately eight acres in the north central portion of the Yard.

- OU-4: Soil above the water table (unsaturated zone) in the remainder of the Yard.

- OU-5: Sewer system (water and sediment) beneath the Yard.

- OU-6: Saturated soil and the groundwater beneath the Yard.

1.1 Purpose

The purpose of this RD/RA Work plan is to discuss in detail the proposed remedial design and the necessary steps to implement the remedial action for SPH plume within OU-3. This RD/RA Work Plan was prepared in accordance with the approved Remedial Action Work Plan (RAWP) for OU-3 (Roux Associates, 2007), as amended by the September 18, 2009 Addendum to the OU-3

Remedial Action Work Plan (Roux Associates, 2009a), and the OU-3 Pilot Study and Conceptual Design Report (Roux Associates, 2011).

The RD/RA has been prepared to meet the following objectives:

- Provide a brief summary and history of the Site and OU-3, including previous investigations and the pilot study results;
- Identify the remedial action objectives;
- Provide an engineering evaluation of the proposed remedy in accordance with NYSDEC Division of Environmental Remediation Technical Guidance for Site Investigation and Remediation (DER-10);
- Provide remedial action design plans;
- Provide a schedule for completion of the work.

1.2 Site Location and Description

The Yard is located in an urban area in northwestern Queens County (Figure 1). The East River is located approximately one mile to the west while Newtown Creek, which defines the border between Queens and Kings Counties, is located less than 0.5 mile south of the western portion of the Yard. The Yard consists of a railroad maintenance and storage facility that currently encompasses approximately 133 acres. The Yard functions as a maintenance facility for electric locomotives and railroad cars for Amtrak and a train layover storage yard for NJTC. The land use surrounding the Yard is a combination of commercial, light industrial and residential areas. The Long Island Rail Road (LIRR) currently owns a portion of the original Yard along the northern boundary (including a portion of OU-3) and maintains rights of way through the Yard.

OU-3 encompasses approximately eight acres in the north central portion of the Yard, and, as mentioned above, includes property owned by the LIRR. Several former structures/features were present in OU-3, but have since been demolished to land surface, removed, closed, or rendered inoperable including:

- Engine House (including both interior and exterior service pits), which was used for locomotive servicing.
- Engine House Boiler Room, which was used to supply heat to the former Engine House.

- Petroleum tanker car unloading track where fuel was transferred to the USTs from tanker cars.
- UST Areas where nine USTs were used for hydrocarbon storage.
- Locomotive fueling area where fuel was transferred from the USTs to locomotives.
- Metro Shed, which served as the inspection and service facility.
- Turntable, which was used to turn locomotives around.
- Oil House, which was used for storage of drummed hydrocarbon products.

OU-3 originally included the soil and separate-phase petroleum hydrocarbon (SPH) above the water table in the area previously referred to as Area of Concern (Area) 1 (now OU-3) at the Yard. During a meeting with the NYSDEC on July 10, 2002, the definition of OU-3 was expanded to include groundwater and saturated soils within OU-3. Subsequent to that meeting, the NYSDEC indicated a further expansion of OU-3 to include former Areas 6 and 7 of the Yard, and later agreed that groundwater for the entire Yard will be addressed during the OU-6 RI. For purposes of this document, OU-3 encompasses Area 1 (including SPH and associated soil, soils [saturated and unsaturated], the nine USTs and the associated subsurface structures and remnants listed above), the former Oil House in Area 6, and the storage area for empty drums in Area 7. The portion of the sewer that lies within the extent of the OU-3 boundary will be addressed as part of OU-5 and groundwater within OU-3 will be addressed as part of OU-6.

1.3 Site History and Background

The Pennsylvania Tunnel and Terminal Company, a subsidiary of the Pennsylvania Railroad (later known as the Penn Central Transportation Company), originally constructed the Yard in the early 1900s. The Yard officially opened on November 27, 1910. On April 1, 1976, the Consolidated Rail Corporation (Conrail) acquired the Yard, and the same day conveyed it to Amtrak, which has continued to operate it as a storage and maintenance facility for railroad rolling stock.

1.3.1 Previous Environmental Investigations

In accordance with the OOC, several investigations have been performed at the Yard including a Phase I Remedial Investigation (RI), Phase II RI and Phase II RI Addendum, OU-3 RI and Supplemental OU-3 RI, as well as a health-based Risk Assessment. Each of these investigations was summarized in the Final OU-3 RI report, submitted to the NYSDEC on May 27, 2005 (Roux Associates, 2005). As a result of these investigations, several areas of the Yard were identified that required remedial action. Based on the results of Yard inspections, discussions with Amtrak personnel, and previous investigations, initially 16 Areas of Concern (Areas) were identified at the Yard. During the Phase I RI, one additional Area was identified giving a total of 17 Areas for the Yard; three of these Areas (Areas 1, 6, and 7) are located within the boundary of OU-3. To accommodate a rigid construction schedule for Amtrak's High Speed Trainset (HST) program and still address site-wide remedial efforts in a timely and orderly manner, with the NYSDEC's concurrence, in 1997, the Yard was subdivided into six OUs.

1.3.1.1 Summary of Remedial Investigations

The purpose of the RI was to define the nature and extent of any contamination resulting from previous activities in OU-3. The following activities were conducted during the RI:

- Research of historical operations;
- Installation of 186 soil borings for chemical analysis of soils as well as physical properties of soil;
- Excavation of 4 test pits to further characterize the physical properties of OU-3;
- Installation of 99 observation borings for characterization and delineation of the SPH plume;
- Installation of 20 cone penetrometer ultraviolet induced fluorescence borings to help determine the depth of petroleum hydrocarbon impact;
- Installation of four soil borings for the collection of soil samples for bench scale testing of *in situ* bioremediation;
- Installation of 54 monitoring wells for analysis of groundwater as well as physical properties of hydrogeologic conditions;
- Collection of 3 discrete groundwater samples using a direct push technique;
- A survey of public and private water supply wells in the area around the site;
- Collection of 65 SPH samples from groundwater monitoring wells; and
- Collection of 10 sewer water samples and 4 sewer sediment samples from sewer manholes within OU-3.

The field activities and findings of the investigation are described in the Final OU-3 RI report (Roux Associates, 2005a). Analytical results for soil sampling performed in OU-3 for the site-specific compounds of concern (COCs) were provided in the OU-3 RAWP (Roux Associates, 2007).

1.3.1.2 Previous Investigations of Subsurface Structures

Subsurface structures within OU-3 include the former Engine House service pits (e.g., inspection and drop table pits), the former Oil House basement, the former UST Areas (and former Fuel Transfer Areas), the former Metro Shed inspection pit, and the former Turntable. Background information for these structures and discussions regarding the previous investigations that have been performed were provided in the OU-3 RAWP (Roux Associates, 2007).

1.3.1.3 Summary of Nature and Extent of Contamination

Based on the collective results of previous RI investigations and completed Pre-Design Studies, a detailed description of the nature and extent of contamination in OU-3 was presented in the OU-3 RAWP (Roux Associates, 2007). This section provides a brief summary of these results. Specifically, in the sections below, the nature and extent of contamination will be evaluated for the following: the historic SPH plume; the soil (unsaturated and saturated); groundwater; and subsurface structures.

1.3.1.3.1 SPH

The SPH plume has been delineated both horizontally and vertically and is located entirely within the boundaries of OU-3 (Drawing 1). The historic outer boundary of the plume (historic zero-foot SPH contour), which is conservatively defined by the absence of a visible sheen on the water table, occupies an area of approximately three acres in the central part of OU-3. Physical evidence of residual petroleum and/or petroleum odor was noted up to 10 feet bls in several borings and deeper in some borings.

The extent of mobile SPH (i.e., SPH that may migrate vertically or horizontally through the soil) has been established by NYSDEC to lie within the 0.1-foot SPH thickness contour. The mobile SPH plume currently occupies approximately 0.35 acre (Drawing 1). A small portion of the mobile SPH plume exists on the MTA/LIRR property to the north. An estimated 6,300 gallons of recoverable and 85,000 gallons unrecoverable petroleum is present within the historic zero foot plume.

65 samples of SPH were collected from OU-3 monitoring wells and analyzed for PCBs. The results of the PCB sampling (detailed in the OU-3 RAWP, Roux Associates 2007) showed detections in 22 locations, ranging from 460 microgram per kilogram (µg/kg) to 360,000 µg/kg. Analytical results of SPH samples collected in 1994 indicate that the SPH in the plume consists of a slightly degraded No. 2 fuel oil.

1.3.1.3.2 Soil

A 0.5-acre area of hydrocarbon-impacted surface soil was visually delineated to the north, west, and east of the former Engine House, partly within the bounds of the historic SPH plume and partly within the limits of the mobile SPH plume. Based on observations from soil borings completed during multiple investigations, the average depth of hydrocarbon impacts was one foot below land surface (bls), within the unsaturated zone. In 2010, this soil, visually observed to be hydrocarbon-impacted, was excavated to a depth of one foot bls, transported offsite and properly disposed of as part of the approved remedy for OU-3. The excavation was then backfilled with clean fill and brought to grade. Approximately 0.2 acre of the visual hydrocarbon-impacted surface soil was located within the extent of the mobile SPH. Details of the excavation will be presented in the OU-3 Construction Completion Report currently being prepared by Roux Associates.

The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level for PCBs in OU-3 was located within the mobile SPH limits just east of the former Engine House. This hot spot was excavated, removed, and disposed of as part of the approved remedy for OU-3 in 2010. PCBs were detected at sample location CS-76 in the 0 to 0.5-foot interval at a concentration of 73,000 µg/kg. This exceedance was delineated by sample locations TSB-11 through TSB-14 and was limited to approximately 625 square feet (SF). Details of the excavation will be provided in the OU-3 Construction Completion Report currently being prepared by Roux Associates.

The one remaining exceedance of the site-specific NYSDEC-recommended soil cleanup level of lead was detected within the extent of visually hydrocarbon-impacted surface soil near the former Oil House and was excavated in 2010 as part of the approved remedy for OU-3. Lead was detected in the 0 to 2 foot sampling interval at soil boring location S-62 at a concentration of 1,080 mg/kg. Details of the excavation will be provided in the OU-3 Construction Completion Report currently being prepared by Roux Associates.

1.3.1.3.3 Groundwater

Groundwater in OU-3 is slightly impacted at concentrations above the GA standards and guidance values from the Yard-related activities. Groundwater in OU-3 is impacted by at least one suspected upgradient source, Standard Motor Products (Site No. 241016, Class 2 Site on NYSDEC Registry of Inactive Hazardous Waste Disposal Sites) by contamination (primarily chlorinated volatile organic compounds [VOCs], benzene, toluene, ethylbenzene, and xylenes [BTEX], and metals). Groundwater impacts in OU-3 are discussed in detail in the OU-6 RI/FS report (Roux Associates, 2009b).

1.3.1.3.4 Subsurface Structures

The only remaining subsurface structures within OU-3 include the northern footer of the former Engine House, the former UST Areas, and a 12-foot section of the former Metro Shed slab. The former USTs were closed in place in 2010 as part of the OU-3 remedy.

Additionally, sewer manhole MH-6 is located in the western section of OU-3. Currently MH-6 receives no inflow as all buildings and structures that provided flow were demolished during remedial activities. Recent analytical results associated with the OU-5 (sewer) Remedial Investigation indicate that sewer water and sewer sediments within MH-6 are impacted with PCBs. In May of 2011, Roux Associates prepared an Addendum to OU-3 RAWP for Sewer Manhole MH-6 (May 4, 2011) and proposed to vacuum extract sediments within the MH-6 vault and to seal off all influent piping. A response from NYSDEC is pending. In accordance with the Addendum, sewer manhole MH-6 will be remediated and rehabilitated prior to start up of the DPVE system.

Sewer manhole MH-7 is reported to be located in the eastern section of OU-3, however it has not been located and was not encountered during excavation; therefore MH-7 is presumed destroyed.

Details of the demolition and excavation performed within OU-3 will be provided in the OU-3 Construction Completion Report currently being prepared by Roux Associates.

2.0 REMEDIAL GOALS AND REMEDIAL ACTION OBJECTIVES

This section presents the remedial goals and remedial action objectives (RAOs) that apply to the environmental media (i.e., soil and SPH) within the mobile SPH portion of OU-3. The remedial goals are common for all registered inactive hazardous waste sites, as provided in 6NYCRR Part 375 and NYSDEC guidance (NYSDEC, 2002). The remedial goals for all registered inactive hazardous waste sites, as outlined in 6NYCRR Part 375, are:

- Restoration to pre-disposal/pre-release conditions, to the extent feasible and authorized by law; and
- Elimination or mitigation all significant threats to public health and the environment presented by the contaminants caused by site-related activities through the proper application of scientific and engineering principles.

The remedial goals serve to establish the foundation for developing RAOs specific to the impacted media in OU-3. RAOs are medium-specific objectives developed for the protection of public health and the environment and are expressed with regard to the concentration of COCs and potential exposure routes.

Based on the results of the RI and consistent with the OU-3 RAWP, RAOs have been identified for the mobile SPH plume. The RAOs for the mobile SPH plume are to eliminate or reduce to the extent practicable:

- The release of contaminants from soil into groundwater that may create exceedances of groundwater quality standards;
- Removal of petroleum present as mobile SPH on the groundwater surface or as visually impacted on the surface soils. Petroleum present at 0.1 foot apparent thickness or greater on the water table is defined as mobile SPH; and
- NYSDEC recommended site specific soil cleanup levels for PCBs (25 ppm), lead (1,000 ppm), cPAHs (25 ppm) and total SVOCs (500 ppm).

Note that subsequent to the OU-3 RAWP, as part of the OU-4 ROD prepared by NYSDEC and dated March 2009 (NYSDEC, 2009), the NYSDEC re-established the site specific soil cleanup levels for the Yard as follows:

- Total PCBs – 25 ppm;
- Total SVOCs – 500 ppm; and

- Lead – 3,900 ppm.

The remedy proposed in the OU-3 RAWP (Roux Associates, 2007) to achieve these ROAs was excavation and *in situ* bioremediation through injections. However, the use of Dual Phase Vacuum Extraction (DPVE) was proposed as an alternative remedial technology in lieu of open excavation below the water table in OU-3 to address the mobile SPH plume in a letter work plan dated August 6, 2009 and approved by the NYSDEC on September 29, 2009. The letter work plan outlined a DPVE pilot study to be completed to evaluate the effectiveness of this alternative technology. This DPVE pilot study was completed in July and August 2010 and the results were submitted to the NYSDEC in the DPVE Pilot Study and Conceptual Design Work Plan Report (Roux Associates, 2011). The results are also summarized below in Section 3.0. *In situ* bioremediation will continue to be included as part of this remedy with a modification of the treatment zone as discussed in Section 6.7.

Due to the successful results of the pilot study, the RAOs for the mobile SPH plume and associated hydrocarbon impacted soils will be addressed using two technologies (DPVE and *in situ* bioremediation) to replace the previously proposed plume excavation and bioremediation as described in the OU-3 RAWP.

3.0 RESULTS OF THE DPVE PILOT STUDY

A DPVE pilot study was conducted from July 27, 2010 to August 18, 2010 following installation of a network of extraction wells. The purpose of the DPVE pilot study was to determine the feasibility of using high vacuum to recover the mobile SPH and obtain the necessary information for development of a full-scale design. The DPVE pilot study was conducted by Roux Associates and Remedial Engineering personnel with pilot study equipment (i.e., liquid ring pump) provided by ProAct Services Corporation (ProAct). The pilot was conducted over a four week period to allow sufficient time for the testing of multiple locations as requested by NYSDEC and for the collection of sufficient data representative of the overall plume area.

The use of DPVE was proposed as an alternative remedial technology in lieu of open excavation below the water table in OU-3 to address the mobile separate-phase hydrocarbon (SPH) plume. The DPVE pilot study was performed in accordance with the letter work plan dated August 6, 2009 (Roux Associates, 2009c), approved by NYSDEC in a letter dated September 29, 2009.

All data generated during the Pilot Study was tabulated, summarized and submitted to NYSDEC in the March 24, 2011 Pilot Study and Conceptual Design Report for OU-3 (Roux Associates, 2011). The following subsections provide a brief overview of the Pilot Study.

3.1 DPVE Pilot Study Equipment

A dual phase extraction system from ProAct was used for the pilot study. The dual phase extraction system from ProAct included a 20 horsepower (Hp) liquid ring pump (LRP), oil/water separator (OWS), bag filters, transfer pumps, and liquid and vapor phase carbon units. The LRP, the OWS, bag filters, transfer pumps and all meters and gauges were housed in a treatment trailer enclosure. The liquid and vapor phase carbon units and the 21,000 gallon frac tank were located outside.

The oil-sealed LRP was sized to handle 300 actual cubic feet per minute (acfm) at a vacuum of 28 inches of mercury (in. Hg). The LRP was connected to a manifold header to allow for the connection of up to 4 DPVE wells. Each connection on the manifold header consisted of clear pipe, in-line air flow meter, vacuum gauge, and valves. During the LRP operation, the recovered product, water and vapor passed through the manifold and entered the air/fluids separator (knock-out tank) prior to the LRP. The 120-gallon knock-out tank had three float switches to control the transfer pump. The recovered water/product was then pumped from the knock-out tank to the OWS. The OWS was designed for 10 gallons per minute (gpm) and had a coalescing pack constructed of hydrocarbon resistant polypropylene to enhance separation. A slotted oil skimmer recovered the product within the OWS. Recovered product was gravity discharged to a 55-gallon drum located outside the equipment enclosure. The product recovery drum was equipped with a high level float switch. The recovered groundwater was pumped from the OWS through two bag filters, a totalizer flow meter, four-220 pound organoclay units (two parallel pairs of units arranged in series) and four-180 pound liquid phase carbon (LPGAC) units (two parallel pairs of units arranged in series) prior to discharge to a 21,000 frac tank. The recovered vapor was discharged to four-180 vapor phase carbon (VPGAC) units (two parallel pairs of units arranged in series) prior to discharge to the atmosphere. A portable generator was used to provide power.

3.2 DPVE Pilot Study Methodology

During set-up of the LRP system, liquid and vapor phase carbon units and the frac tank, the treatment system was primed with clean water to test the system for leaks and ensure proper function of the equipment. Following set-up of the LRP system, the pilot study began. A baseline round of product and water levels was performed on each DPVE well and monitoring point. The DPVE wells and existing monitoring wells not being tested were sealed with well caps and tubing connected to a magnehelic vacuum gauge. All field activities and measurements were recorded in a field notebook and field forms. The details of the pilot study are outlined below.

The pilot study began by applying a vacuum to one DPVE well or existing monitoring well at a time. A one-inch diameter drop tube was installed in the DPVE well or existing monitoring well to be tested and extended to the middle or near the bottom of the well. The wellhead was then sealed to prevent leakage of the vacuum. The one-inch diameter drop tube was then connected to the LRP manifold. A total of eight wells (DPVE-1 to DPVE-6 and existing monitoring wells P-3 and P-4) were each tested individually over a sufficient period of time (i.e., 4 hours). During each test, the following measurements were also monitored and recorded:

- Vacuum readings at recovery test well;
- Vacuum readings at observation wells (existing monitoring wells and DPVE wells);

- Groundwater and SPH levels in observation wells;
- Amount of recovered groundwater (in gallons);
- Amount of SPH recovered (in gallons);
- Vapor flow rate;
- LRP temperature;
- Vacuum readings in LRP system; and
- Monitoring of the extracted vapor before and after the vapor phase carbon with a photoionization detector (PID).

The performance field readings were used to determine the following:

- The effectiveness of the high vacuum at recovering SPH;
- The radius of influence (ROI); and
- The effectiveness of the LRP and groundwater treatment system at removing product and treating the groundwater.

The product thicknesses in the knock-out tank, OWS, and product recovery drum were measured each morning before a new test was performed. A more accurate measurement was obtained by allowing the product to separate overnight (to not be as emulsified). The amount of recovered product was then calculated by using the measured product thickness with the appropriate dimensions of the knock-out tank, OWS, and product recovery drum.

Following the testing on each individual well, 4-mil polysheeting was placed on the ground surface around DPVE-3, DPVE-5, and DPVE-2. The polysheeting extended approximately 10 to 20 feet around the well and was sealed at the concrete collar. The purpose of the polysheeting was to evaluate if providing a surface seal significantly improved the product recovery rates. These three DPVE wells were selected for comparison to the SPH recovery rates without polysheeting in order to see any significant changes in the product recovery rates with the polysheeting.

Lastly, several DPVE wells were manifolded together and tested. The purpose of the manifold test was to simulate a full-scale system and what effect operating on several wells at a time had on the LRP and treatment system. A summary of the DPVE pilot study testing schedule is summarized as follows:

- DPVE-3 test (July 27, 2010);
- DPVE-5 test (July 28, 2010);
- DPVE-1 test (July 29, 2010);
- DPVE-2 test (July 29, 2010);
- DPVE-4 test (July 30, 2010);
- DPVE-3 second test with polysheeting (August 2, 2010);
- DPVE-5 second test with polysheeting (August 3 and 4, 2010);
- P-3 and P-4 tests (August 4 and 5, 2010);
- DPVE-2 second test with polysheeting (August 6, 2010);
- DPVE-6 test (August 9, 2010); and
- Manifold test on DPVE-1, DPVE-2, DPVE-3, and DPVE-5 (August 10, 2010 to August 18, 2010).

Three samples of the recovered groundwater were collected from the influent to the organoclay units (pre-treatment) and three samples of the effluent of the liquid phase carbon units (post-treatment) were collected and analyzed for New York City Department of Environmental Protection (NYCDEP) discharge standards. The samples of the recovered groundwater were collected on July 29, 2010, August 3, 2010, and August 17, 2010. The recovered groundwater samples were collected to evaluate the ability of the treatment system in meeting the NYCDEP discharge standards.

Two air samples were also collected for laboratory analysis using United States Environmental Protection Agency (USEPA) Method TO-15 and TO-3 (for methane) from the vapor stream (pre-carbon). One air sample was collected on July 28, 2010 during the individual test on DPVE-5 and the second air sample was collected on August 17, 2010 during the manifold test. The air samples were collected to evaluate the off-gas treatment requirements for a full-scale system.

3.3 DPVE Pilot Study Conclusions

As discussed above, the purpose of the DPVE pilot study was to evaluate the use of high vacuum extraction as an alternative remedial technology to address the mobile SPH plume. The following conclusions were determined based upon an evaluation of the data generated during the DPVE pilot study.

- The DPVE pilot study demonstrated that high vacuum was very effective at product recovery as evidenced by the reduced product thickness in the extraction wells and monitoring points observed during the testing period. For example, the product thickness in monitoring point P-2 decreased from 3.31 feet at the beginning of the pilot to 2.0 feet at the end. Monitoring point P-2 was influenced by several different extraction wells located between 9 and 38 feet away from P-2.

- The high vacuum (i.e., 20 in. Hg) applied during the DPVE pilot study enhanced the recovery of the SPH by allowing more SPH to be drawn to the extraction well and be recovered as a liquid by overcoming the capillary displacement pressures of water against the SPH (which can be as high as 29 in. Hg in clayey silt).

- Due to the low permeability of the soil and nearness of the well screens to ground surface, there was no measurable vacuum response in adjacent monitoring points except in a few instances where polysheeting was installed. However, as indicated by the effective drawdown and product recovery rates, the DPVE pilot study was effective at recovery of the SPH in the absence of a measurable vacuum field.

- The use of polysheeting did not significantly improve product recovery but it did impact vacuum. It may be necessary to use polysheeting for certain wells with less product where vacuum is more critical. It also may improve recovery in later stages of operations when product thickness is decreased and recovery becomes more difficult.

- The heterogeneity of the soil (i.e., relative permeability) across the pilot study area resulted in a different ROI found in northern portion (20 feet near DPVE-3) compared to southern portion of plume (10 feet near DPVE-2).

- The DPVE pilot study removed approximately 450 gallons of SPH and approximately 7,930 gallons of groundwater over a 4 week period. SPH was recovered from 7 out of the 8 wells tested. As would be expected, SPH recovery was generally more significant from wells that contained greater SPH thicknesses during the baseline monitoring.

- The majority of the recovered product occurred during the manifold test conducted over a two week period. Approximately 305 gallons of SPH was recovered during the manifold test. For comparison purposes, an average of 20 to 30 gallons of SPH is currently recovered each week with passive methods (i.e., bailing).

- The treatment system using bag filters, organoclay, and LPGAC units was able to treat the recovered groundwater to the NYCDEP sewer discharge standards.

- Due to the amount of recovered product, the OWS used in the pilot study was not large enough to handle some of the product recovery rates.

- The VPGAC units were able to treat the recovered vapor from the LRP.

4.0 DESCRIPTION OF SELECTED REMEDY

The revised selected remedy consists of installation of a DPVE system to address the mobile SPH plume and *in situ* bioremediation to address residual soil contamination once the remedial goals of the system have been met and temporary shutdown of the system has been approved. The remedy is described in detail below.

The remedial objective of the full-scale DPVE system is to achieve an SPH thickness of 0.1 feet or less within the treatment area (the same remedial goal as excavation of the OU-3 SPH area, when excavation was the selected remedy). Once this product thickness is achieved, *in situ* enhanced bioremediation will be performed through injections of calcium nitrate to address any residual SPH within the designated footprint of the former mobile SPH plume to a depth of 10 feet. The enhanced bioremediation injection program would be a one-time event within the treatment area to be followed by an SPH and groundwater monitoring program to be defined in the Site Management Plan.

4.1 Overview of DPVE System

Based on the results of the DPVE pilot study and to achieve the remedial goals for OU-3, the proposed layout of the full-scale system will consist of 34 DPVE wells. The DPVE wells will be operated in zones with multiple zones utilizing the same liquid ring pump (LRP). Each zone will consist of up to 5 to 6 DPVE wells. One LRP will be used to apply a vacuum to up to five to six DPVE wells and/or one zone. Therefore, up to four zones or 24 DPVE wells can be operated at the same time. Based on the full-scale DPVE system, four LRPs will be needed for the DPVE system. Each LRP will be equipped with a dedicated liquid knock out system to assist in the product recovery.

The LRPs will draw vapor, product, and groundwater to the knockout tanks. The recovered total fluids (groundwater and product) will be pumped from the knockout tanks to an oil water separator (OWS). The product will be pumped to the existing product holding tank. The recovered product will ultimately be pumped out using a vacuum truck, as necessary, and transported and properly disposed offsite. After the OWS, the groundwater will be pumped through two bag filters arranged in parallel, followed by two organoclay units and two liquid phase carbon units prior to discharge to the groundwater holding tank. The treated groundwater will then be gravity discharged to the existing sewer manhole (Amtrak Manhole MH-6) for discharge to the NYCDEP sewer via an existing 4-inch diameter line.

The extracted vapor will be transferred by the LRPs to the vapor phase treatment system prior to discharge to the atmosphere. The vapor phase treatment system will consist of two vapor phase carbon (VPGAC) units (arranged in series) prior to discharge to the atmosphere.

A detailed description of the remedial design for the DPVE system is provided in Section 6.0.

4.2 *In Situ* Bioremediation

Following approval from NYSDEC to temporarily shut down the DPVE system, an *in situ* enhanced bioremediation program will be performed. In accordance with the OU-3 RAWP (Roux Associates, 2007), *in situ* enhanced bioremediation will be performed to address residual SPH through the injection of calcium nitrate. Approximately 150 to 200 injection points are expected to be required. In addition, the DPVE wells may also be used as injection points for the calcium nitrate. The injection program will be expanded from the OU-3 RAWP in that the injection zone will be from the water table (average depth of 2 to 3 feet below grade) to a depth of 10 feet. The previous injection zone was from below the excavation depth of approximately 5 feet to a depth of 10 feet.

Further details regarding the *in situ* enhanced bioremediation are provided in Section 6.7.

5.0 ENGINEERING EVALUATION OF PROPOSED REMEDY

In accordance with Section 4.2 of DER-10, the sections below provide an engineering evaluation to demonstrate that the proposed remedy can achieve the RAOs for the Site.

5.1 Evaluation Criteria

Each alternative was evaluated based on the following nine evaluation criteria presented in Section 4.2 of the DER-10 Technical Guidance:

- Overall protectiveness of the public health and the environment;
- Standards, criteria and guidance (SCGs);
- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume of contamination through treatment;
- Short-term impact and effectiveness;
- Implementability;
- Cost effectiveness;
- Land Use; and
- Community Acceptance.

5.1.1 Overall Protectiveness of the Public Health and the Environment

The proposed remedy will be protective of human health and the environment by reducing the thicknesses of mobile SPH and reducing the concentrations in soil of petroleum-related constituents through source removal. The potential for human and environmental exposure to these constituents will be eliminated by recovery of mobile SPH and reduction of soil concentrations through the use of *in situ* bioremediation. Though active groundwater remediation is not proposed for OU-3, mobile SPH recovery and *in situ* bioremediation of the impacted soil described above will also help to improve groundwater quality across the Site.

5.1.2 Standards, Criteria and Guidance (SCGs)

The NYSDEC identified four COCs for soil in the Yard: PCBs, seven specific polycyclic aromatic hydrocarbons (PAHs) that the NYSDEC considers carcinogenic (cPAHs), lead, and total SVOCs. The seven cPAHs that were collectively identified as a COC by the NYSDEC are benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene. As per the OU-3 RAWP, the site specific recommended soil cleanup levels are:

- PCBs (total) – 25 ppm;
- cPAHs (total) – 25 ppm;
- Lead – 1,000 ppm; and
- Total SVOCS – 500 ppm.

As stated above in Section 2.0, however, in March 2009 as part of the OU-4 ROD, NYSDEC re-established the site specific site specific soil cleanup levels for the Yard as follows:

- Total PCBs – 25 ppm;
- Total SVOCs – 500 ppm; and
- Lead – 3,900 ppm.

The proposed remedy (DPVE system and *in situ* bioremediation) will achieve compliance with the goals provided above in relation to the SPH plume. The DPVE system will remove the mobile SPH and *in situ* bioremediation will address the residual contamination, thereby meeting the standards for PCBs and SVOCs.

5.1.3 Long-term Effectiveness and Permanence

The proposed remedy removes all mobile SPH practical and reduces soil concentrations through the use of *in situ* bioremediation. Therefore, incremental risk from these impacts is eliminated, engineering and institutional controls are not necessary, and the remedy will continue to meet RAOs in the future, thus providing a permanent long-term solution for the Site.

The magnitude of the remaining risk following remediation is minimal since the potential for direct contact with impacted soil will be eliminated.

5.1.4 Reduction in Toxicity, Mobility or Volume of Contamination through Treatment

By recovering all mobile SPH as practical and treating the residual soil contamination with *in situ* bioremediation, the proposed remedy will permanently eliminate the toxicity, mobility, and volume of contaminants within the Site.

5.1.5 Short-term Impact and Effectiveness

The health and environmental risks associated with implementation of the proposed remedy are minimal. This remedy is much more advantageous than excavation in limiting short term impacts. The remedy implementation time is short and the potential adverse impacts to the community and workers is minimal (little soil disturbance and exposure to impacted soil). It is possible that workers will be exposed to impacted soil and chemicals used for the *in situ* bioremediation. The workers will be required to review the site specific health and safety plan (HASP, OU-3 RAWP, 2007).

5.1.6 Implementability

The materials, equipment, and personnel associated with the implementation of the proposed remedy are commercially available and have been proven effective and reliable for remediation of the media of concern at the Site, as described above in the DPVE pilot study. It is not anticipated that future remedial action following the remedial construction will be required.

5.1.7 Cost Effectiveness

The construction and equipment costs associated with the proposed remedy are estimated at approximately $1,000,000. It is anticipated that Operation, Maintenance, and Monitoring (OM&M) will be required due to the nature of the remedy. The costs for OM&M for the DPVE system are estimated to be $600,000 for an estimated three years of system operation.

5.1.8 Land Use

The current and reasonably anticipated continued use of OU-3 will be as a railroad maintenance and storage facility. Specific plans for redevelopment of OU-3, aside from replacement of railroad tracks, have not been contemplated at this time. Following implementation of the remedy, the area will be restored to current use conditions, thereby retaining and enhancing compatibility with future land use.

5.1.9 Community Acceptance

The proposed remedy should be acceptable to the community due to the short-term activities associated with installation of the DPVE system and use of *in situ* bioremediation.

6.0 REMEDIAL DESIGN

The proposed layout of the full-scale system will consist of approximately 34 DPVE wells. The locations of the proposed DPVE wells are shown on Drawing No. 1. The proposed location of the treatment system compound, piping, controls, and associated off-gas treatment will be located within a fenced area as shown on Drawing No. 1.

6.1 Design Criteria

The anticipated vapor flow rates and vacuums are based on the results of the pilot study. The DPVE wells in Area A will be designed for a flow rate of up to 40 standard cubic feet per minute (scfm) at 18 inches of mercury (in. of Hg.). The DPVE wells in Area B will be designed for a flow rate of 20 scfm at 20 in. of Hg. The DPVE wells will be operated in zones with multiple zones utilizing the same liquid ring pump (LRP). Each zone will consist of up to 5 to 6 DPVE wells. Each well and separate zone will be equipped with an isolation valve. The zones will be manually operated, as needed, to optimize SPH recovery.

The water and product production rates observed during the pilot study were summed and averaged to derive the total estimated liquid product rates. The anticipated average total system design groundwater flow rate has been estimated to be 10 gallons per minute (gpm). In addition, the anticipated total maximum product recovery rate, based on the pilot study, has been estimated to be approximately 5 gpm. To ensure adequate separation of recovered SPH and groundwater, the OWS will be conservatively designed to handle the maximum expected flow rate for total recovered liquids. Based on the pilot study results, the maximum expected flow rate for total recovered liquids is estimated to be approximately 25 gpm. Adding a level of safety to this flow rate, the OWS will be designed to handle up to 45 gpm.

6.2 Major Equipment and Controls

The major equipment and related controls for the DPVE system will include:

- Four LRPs. One LRP will be used to apply a vacuum to up to five to six DPVE wells and/or one zone. Therefore, up to four zones or 24 DPVE wells can be operated at the same time. Each LRP will be equipped with a dedicated liquid knock out system to assist in the product recovery. The LRPs will be oil-sealed to minimize operation and maintenance requirements. Each LRP will be capable of handling approximately 300 cfm and 28 in. of Hg.

- Oil/water separator (OWS) sized for 45 gpm.
- Two bag filters arranged in parallel.
- Two transfer pumps.
- Two liquid phase carbon units.
- Two organoclay units.
- Two vapor phase carbon units.
- 2,000-gallon product storage tank.
- 4,000-gallon treated groundwater holding tank.
- Interlocks between LRPs, knockout tanks, OWS and transfer pumps tied into a programmable logic controller (PLC) and control panel.

6.3 DPVE and Observation Wells

The DPVE wells within each zone will be manifolded together to a common header using aboveground piping. The aboveground piping will be installed on pipe supports 18 to 24 inches above the ground. The piping will be sloped back towards the last DPVE well on each zone to minimize the potential for freezing. The system will be designed to operate individual zones and/or DPVE wells to focus operation in certain areas as necessary.

Each DVPE well will be constructed of 4-inch diameter Schedule 40 polyvinyl chloride (PVC) fitted with 1-inch diameter Schedule 40 PVC drop tubes and screened from 2 to 10 ft bls. A flexible connection will be provided from the main header to the top of the DPVE well. The flexible connection to the DPVE well will also allow for the adjustment of the drop tube depth. A vacuum gauge (0 to 30 in. of Hg) will be provided at the DPVE well head. A schematic of the DPVE well head is provided on Drawing No. 3.

Several observation wells will also be installed at the SPH perimeter and at interior points within Areas A and B. The observation wells will be used to monitor the effectiveness of the product recovery efforts for a particular area and/or zone. The observation wells will be constructed of 4-inch diameter Schedule 40 polyvinyl chloride (PVC) fitted and screened from approximately 2 to 7 ft bls.

6.4 DPVE Treatment Process

The LRPs will draw vapor, product, and groundwater to the knockout tanks. The recovered total fluids (groundwater and product) will be pumped from the knockout tanks to an OWS. The OWS will be sized for 45 gpm to ensure adequate separation of recovered product and groundwater. The OWS will have a coalescing pack constructed of hydrocarbon resistant polypropylene to assist with separation. The product will be pumped to the existing 2,000-gallon product holding tank using 1-inch diameter steel pipe. The recovered product will ultimately be pumped out using a vacuum truck as necessary, and transported and properly disposed off-site.

After the OWS, the groundwater will be pumped through two bag filters arranged in parallel, followed by two 1,000-pound organoclay units and two 1,000-pound liquid phase carbon units prior to discharge to a 4,000-gallon aboveground groundwater holding tank. The treated groundwater will then be gravity discharged to the existing sewer manhole (Amtrak Manhole MH-6) for discharge to the NYCDEP sewer via an existing below-grade 4-inch diameter line.

The treatment system components that are most susceptible to freezing will be housed in the treatment enclosures. These treatment systems components would include the OWS, the LRPs, the transfer pumps and associated meters, gauges and controls. The manifolds for the DPVE wells will also be housed in the treatment enclosures. Water treatment media vessels (e.g., granular activated carbon) will be located outside and piping to and from these vessels will be insulated. During severe winter conditions, the DPVE system may need to be temporarily shut down (i.e., one to two weeks) as certain components such as the DPVE well piping network will necessarily be subject to weather conditions.

As discussed above, treatment enclosures will be used to house the OWS, LRPs and the groundwater treatment system and controls. A total of three treatment enclosures will be located in the fenced area as shown on Drawing No. 1. The treatment enclosure for the LRPs will be designed according to Class 1 Division 2 requirements. The treatment enclosure with the OWS will designed according to Class 1 Division 1 requirements.

The extracted vapor will be transferred by the LRPs to the vapor phase treatment system prior to discharge to the atmosphere. The vapor phase treatment system will consist of two 1,000-pound vapor phase carbon (VPGAC) units (arranged in series) prior to discharge to the atmosphere. The VPGAC units will be located outside the enclosures.

6.5 Utility Service

An electrical power drop will be required at the location of the treatment enclosures to power the equipment and controls. The anticipated electrical load requirement is a 400 Amp, 3-phase, 4-wire, 230 Volt service. The power will be transferred via underground conduit from the power pole to the proposed treatment enclosures. Controls and instrumentation for the operation of the treatment system will be located in one of the treatment enclosures.

6.6 Process Controls and Operation

The DPVE system will be equipped with instrumentation to monitor system operation and controls to regulate system operation and activate an alarmed system shutdown in the event of a malfunction. A preliminary process and instrumentation diagram (P&ID) is provided on Drawing No. 2. System logic will be controlled by a programmable logic controller (PLC). The main system controls will consist of safety interlocks (i.e., high level alarms). If an alarm condition were to occur, the alarm condition would require a manual reset and start-up. The operation of the zones and/or DPVE wells will be controlled by manual valves.

The process control system will provide the necessary alarms and interlocks to ensure that the LRPs, transfer pumps, and OWS operate smoothly, efficiently, and as a unit. The main control panel (MCP), will house the PLC to monitor and integrate the operation of the LRPs and transfer pumps, and all treatment system interlocks. In addition, the MCP will house an autodialer system that will automatically notify a pre-set telephone number if an alarm condition occurs.

The following sections describe the operation, system monitoring, and alarm conditions.

6.6.1 Operation and Programmable Logic Controller

The process equipment will include switches tied to alarms mounted on the MCP. The PLC will be utilized to provide the necessary control logic to coordinate the control signals from the switches and instrumentation throughout the treatment system. These interlocks will provide fail-safes and monitor operating conditions to maintain performance of the treatment system.

6.6.1.1 Monitoring

Flow meters will be provided on the LRP inlet piping manifold, and the influent line to the treated water holding tanks to monitor flow totalization.

6.6.1.2 Alarms and Interlocks

The LRPs, transfer pumps, and OWS will be interlocked and alarmed to ensure that the product and water are separated and that the water is properly treated. All process equipment motors will have hand-off-auto switches located at the MCP. Operation of the DPVE system components including the transfer pumps will be dependent on various pressure switches and level switches located throughout the system.

Level switches will be installed within the knockout tanks, OWS and treated groundwater holding tank in order to ensure efficient operation of the system. The level switches will include the following:

- Level Switch High High (LSHH)
- Level Switch High (LSH)
- Level Switch Normal (LSN)
- Level Switch Low (LSL)
- Pressure Switch Low (PSL)
- Pressure Switch High (PSH)

A summary of the system controls is provided in Table 1.

Technical Specifications for the DPVE system will be prepared as part of the DPVE System Bid Package to be provided to the Contractors for installation.

6.7 *In Situ* Bioremediation

Following approval from NYSDEC to temporarily shut down the DPVE system, an *in situ* enhanced bioremediation program will be performed. In accordance with the OU-3 RAWP (Roux Associates, 2007), *in situ* enhanced bioremediation will be performed to address residual SPH through the injection of calcium nitrate. The calcium nitrate will be injected as a 6% solution (by weight) with potable water. A Geoprobe™ unit will be used to inject the calcium nitrate solution into temporary points. Approximately 25 pounds of calcium nitrate will be injected per injection point to address the residual SPH from the water table to a depth of approximately 10 ft bls. The injection points will be spaced approximately 10 feet on center within the SPH plumes (Area A and Area B). Approximately 150 to 200 injection points are expected to be required. In addition, the DPVE wells may also be used as injection points for the calcium nitrate. The DPVE system will remain in place until after completion of the bioremediation injections and after verifying that there is no need for further product recovery.

Final details of the *in situ* bioremediation (injection locations, amount of calcium nitrate, etc.) will be re-evaluated based on site conditions following operation of the DPVE system and adjusted as necessary. Any changes to the injection plan will be summarized under separate cover.

7.0 OPERATION, MAINTENANCE AND MONITORING PLAN

Following installation of the DVPE system, an Operation, Maintenance, and Monitoring Plan (OM&M) Plan will be prepared to detail the required maintenance to operate the system and proposed monitoring to evaluate system efficiency. In accordance with the OU-3 RAWP, Section 6.1 and 6.2, the Residual SPH Contingency Plan and Performance Monitoring will be implemented. In addition, the temporary and permanent shut down criteria for the DVPE will be established. The OM&M Plan will be prepared in accordance with DER-10 Section 6.2.3, following installation of the system. In addition, details of the OM&M Plan will be submitted as part of the Site Management Plan (SMP). The SMP is further described below in Section 8.2.

8.0 INSTITUTIONAL AND ENGINEERING CONTROLS

After the remedy is complete, the Site will have residual contamination remaining in place. Engineering Controls (ECs) for the residual contamination have been incorporated into the remedy to render the overall Site remedy protective of public health and the environment. Two elements have been designed to ensure continual and proper management of residual contamination in perpetuity: an Environmental Easement and a Site Management Plan (SMP). These elements are described in this Section.

8.1 Environmental Easement

A Site-specific Environmental Easement will be recorded with Queens County to provide an enforceable means of ensuring the continual and proper management of residual contamination and protection of public health and the environment in perpetuity or until released in writing by NYSDEC. It requires that the grantor of the Environmental Easement and the grantor's successors and assigns adhere to all Engineering and Institutional Controls (ECs/ICs) placed on this Site by this NYSDEC-approved remedy. ICs provide restrictions on Site usage and mandate operation, maintenance, monitoring, and reporting measures for all ECs and ICs.

8.2 Site Management Plan

The SMP describes appropriate methods and procedures to ensure compliance with all ECs and ICs that are required by the Environmental Easement. Once the SMP has been approved by the NYSDEC, compliance with the SMP is required by the grantor of the Environmental Easement and grantor's successors and assigns.

The SMP is intended to provide a detailed description of the procedures required to manage residual contamination left in place at the Site following completion of the DPVE system operation. This includes: (1) development, implementation, and management of all Engineering and Institutional Controls; (2) development and implementation of monitoring systems and a Monitoring Plan; (3) submittal of Site Management Reports, performance of inspections and certification of results, and demonstration of proper communication of Site information to NYSDEC; and (4) defining criteria for termination of treatment system operation.

Site management activities, reporting, and EC/IC certification will be scheduled on a certification period basis. The certification period will be annually. The Site Management Plan will be based on a calendar year and will be due for submission to NYSDEC by March 1 of the year following the reporting period.

9.0 CONSTRUCTION COMPLETION REPORT

A Construction Completion Report (CCR) will be prepared following completion of the remedial activities in accordance with Section 5.8 of the DER-10. The CCR will describe the work performed as part of the remediation and will include:

- Disposal documentation for all material removed from the Site, including impacted soil, solid waste, and fluids (if any).
- Survey drawings, site maps and as-builts of the DPVE system.
- A certification by a New York professional engineer that all construction activities completed during the remediation were performed in accordance with the specifications provided in this RD/RA, as approved by the NYSDEC, and that the activities were personally witnessed by a person under the direct supervision of the professional engineer.
- Any changes or modifications to the work, as well as any problems encountered during construction and their resolution, will be documented.
- A description of all backfill material used for site restoration, including source and quality.
- A summary of the *in situ* bioremediation completed at the Site, including results from all post-remedial sampling.
- A summary of all residual contamination left onsite following completion of the work.

10.0 SCHEDULE

The proposed schedule for construction and start-up of the DPVE system is provided on Figure 2. A key assumption in the preparation of this schedule is that the NYSDEC will formally approve this RD/RA Work Plan by August 29, 2011. Below is a summary of the major components of the schedule:

- NYSDEC approval of this RD/RA Work Plan
- Preparation of DPVE System Bid Package
- Solicitation of Bids for full scale system installation
- Contractor Selection
- Installation of DPVE Wells
- Begin system construction
- Full scale system startup
- Shut down of full scale system
- Completion of enhanced bioremediation injections
- Preparation of Construction Completion Report (CCR)

Respectfully submitted,

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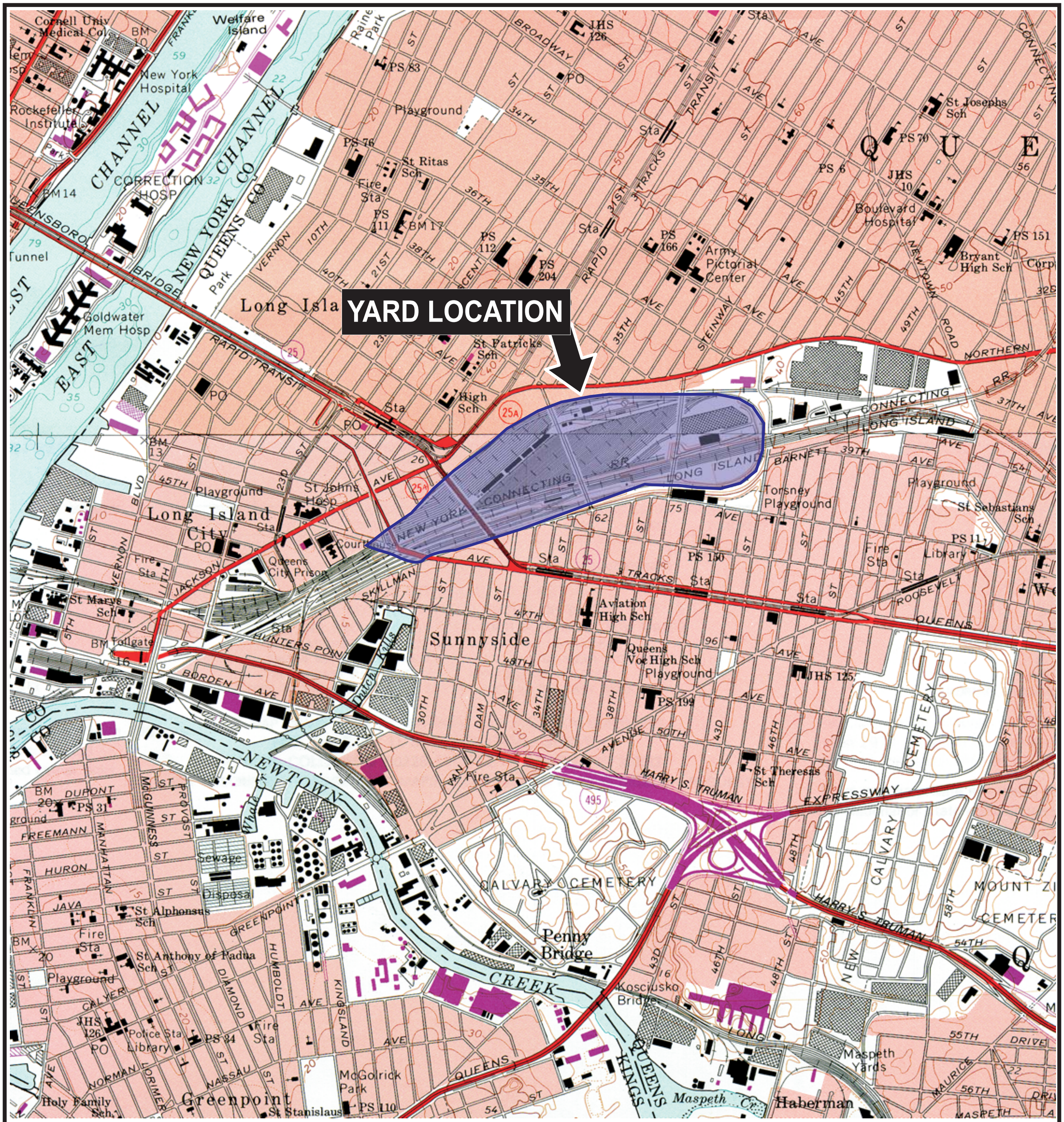
Table 1. Summary of System Controls, DPVE System, OU-3, Sunnyside Yard, Queens, New York

System Component	Controls	Description
Liquid Ring Pump System		
Knockout Units	Level Switch Low (LSL)	Turns off product/water transfer pumps.
	Level Switch Normal (LSN)	Activates transfer pumps so that product/water is transferred to the OWS.
	Level Switch High (LSH) with level alarm high (LAH)	Alarm condition, indicates excessive fluid level; triggers alarm, system shutdown, and autodialer alarm condition notification.
Seal Oil Tanks	Level Switch Low (LSL) with level alarm low (LAL)	Indicates critically low oil level; triggers alarm, system shutdown, and autodialer alarm condition notification.
	Level Switch High (LSH) with level alarm high (LAH)	Alarm condition, indicates excessive oil level; triggers alarm, system shutdown, and autodialer alarm condition notification.
Liquid Ring Pumps	Temperature control valve (TCV)	Controls oil flow through heat exchanger based on oil temperature.
Oil/Water Separator	Level Switch Low (LSL) (low water level)	Maintains sufficient water level to prevent product from entering the treatment system. Indicates low water level; turns off transfer pump. LSL to be set above pump intake, alarm not needed.
	Level Switch Normal (LSN)	Activates transfer pump to pump water through bag filters, organoclay units, liquid phase carbon units to 4,000 gallon treated groundwater storage tank.
	Level Switch High (LSH) with level alarm high (LAH)	Prevents excessive water level or critically low product level. Prevents water from entering the product discharge line and holding tank; triggers alarm, system shutdown, and autodialer alarm condition notification.
	Level Switch Low (LSL) (low product level)	Turns off product transfer pump to prevent critically low product level; triggers alarm, system shutdown, and autodialer alarm condition notification.
	Level Switch Normal (LSN) (normal product level)	Activates product transfer pump to pump product to holding tank.
	Level Switch High (LSH) with level alarm high (LAH)	Indicates excessive product level and triggers an alarm and system shutdown, and autodialer alarm condition notification.
Product Holding Tank	Level Alarm High (LAH)	Indicates excessively high product level in holding tank and triggers an alarm, system shutdown, and autodialer alarm condition notification



SOURCE:
CENTRAL PARK AND BROOKLYN, NEW YORK
QUADRANGLE 7.5 MINUTE SERIES (TOPOGRAPHIC)

QUADRANGLE LOCATION

N

0 2000'

Title:

LOCATION OF SITE

OU-3 REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN
SUNNYSIDE YARD, QUEENS, NEW YORK

Prepared for:

AMTRAK

ROUX
ROUX ASSOCIATES, INC.
Environmental Consulting & Management

Compiled by: D.M.H.	Date: 07JUN11	FIGURE
Prepared by: J.A.D.	Scale: AS SHOWN	1
Project Mgr.: H.G.	Project No.: 0055.0045Y018	
File: 0055.0045Y269.01.CDR		

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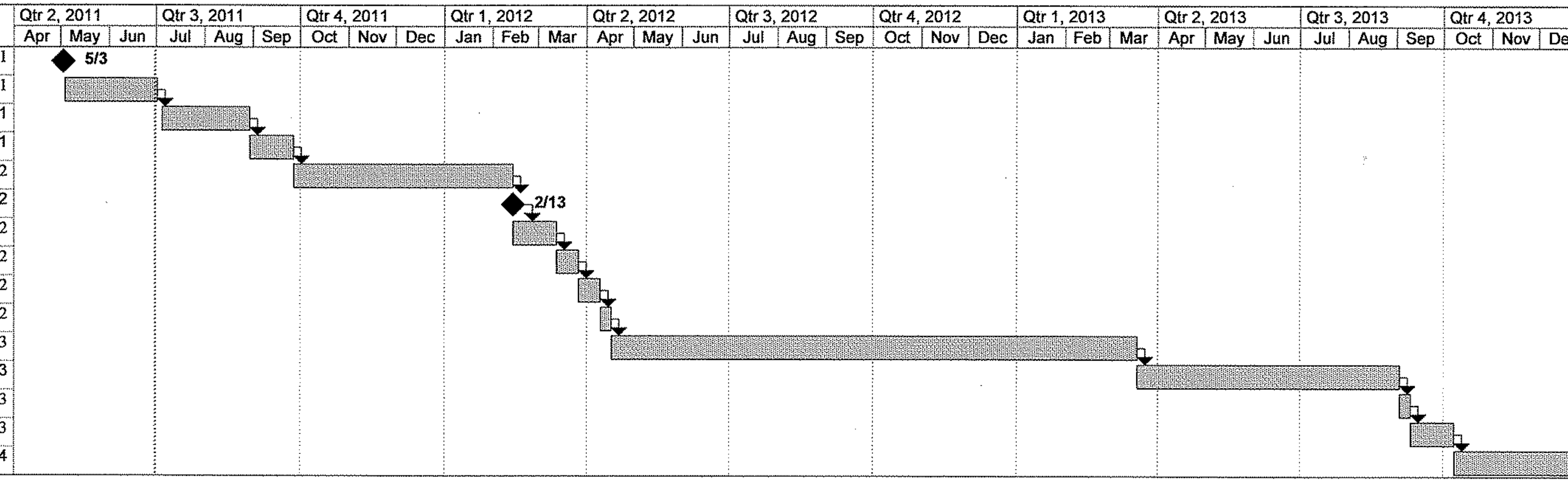
Figure 2. Proposed Preliminary Schedule, OU-3, Sunnyside Yard, Queens, NY

ID	Task Name	Duration	Start	Finish
1	NYSDEC Approval of OU-3 DPVE Pilot Study/Conceptual Design Report	0 days	Tue 5/3/11	Tue 5/3/11
2	Preparation of RD/RA Work Plan for DPVE and Enhanced Bioremediation	8.6 wks	Wed 5/4/11	Fri 7/1/11
3	NYSDEC Review of RD/RA Work Plan	8 wks	Tue 7/5/11	Mon 8/29/11
4	Preparation of Bid Package for DPVE System	4 wks	Tue 8/30/11	Mon 9/26/11
5	Solicit bids/Amtrak Procurement for DPVE System	5 mons	Tue 9/27/11	Mon 2/13/12
6	Select subcontractors/order equipment	0 days	Mon 2/13/12	Mon 2/13/12
7	Installation of DPVE Wells	4 wks	Tue 2/14/12	Mon 3/12/12
8	Installation of aboveground piping	2 wks	Tue 3/13/12	Mon 3/26/12
9	Installation of treatment enclosures/equipment	2 wks	Tue 3/27/12	Mon 4/9/12
10	Start-up of DPVE System	5 days	Tue 4/10/12	Mon 4/16/12
11	Operation of DPVE System	12 mons	Tue 4/17/12	Mon 3/18/13
12	Operate DPVE System in Pulse Mode/Preparation of SMP	6 mons	Tue 3/19/13	Mon 9/2/13
13	DPVE System Shutdown	5 days	Tue 9/3/13	Mon 9/9/13
14	Performace of Enhanced Bioremediation	4 wks	Tue 9/10/13	Mon 10/7/13
15	Prepare CCR	90 days	Tue 10/8/13	Mon 2/10/14



Project: Amtrak DPVE OU-3
Date: Thu 6/30/11

Task	Progress	Summary	External Tasks	Deadline
Split	Milestone	Project Summary	External Milestone	

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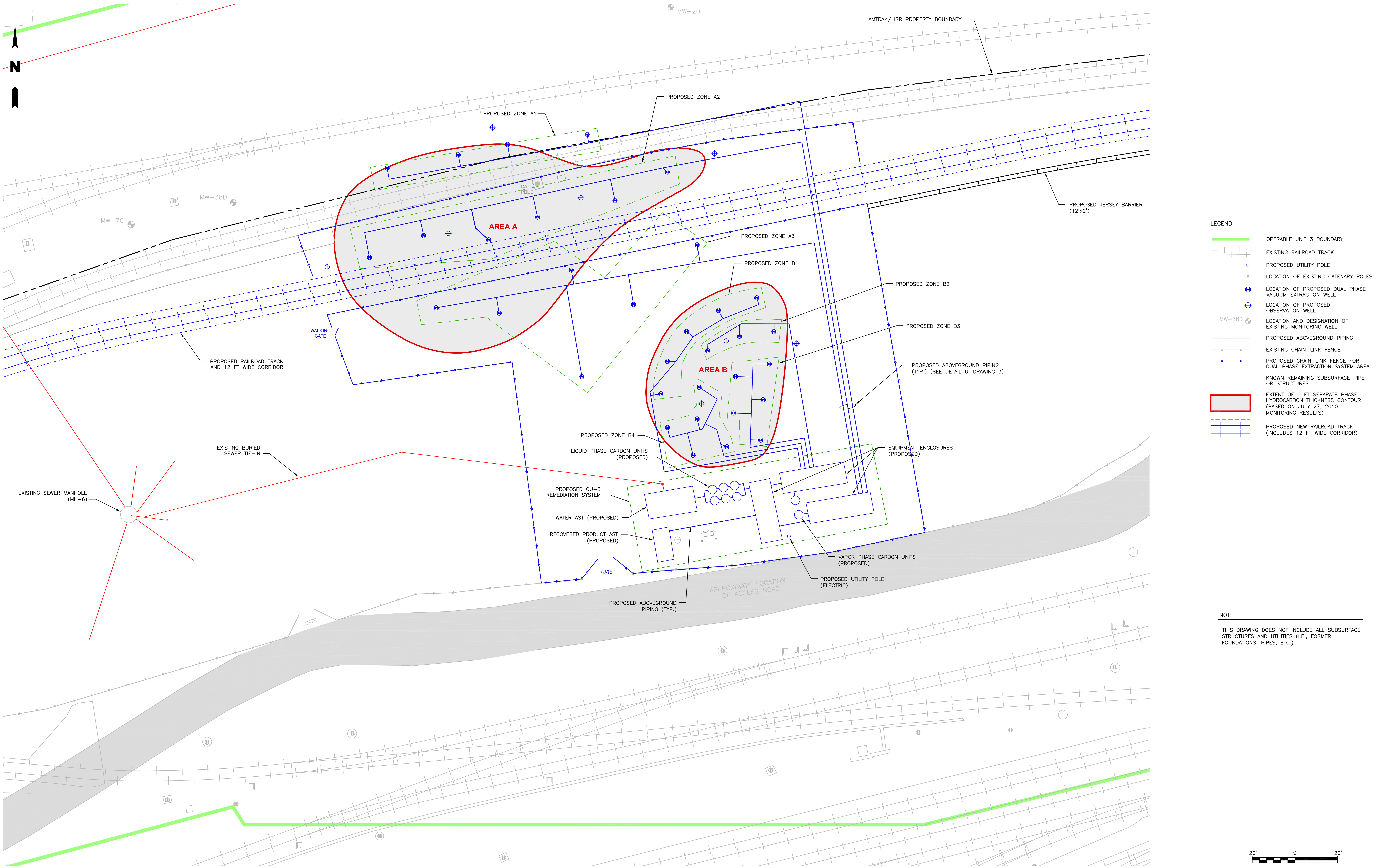

NOTE

THIS DRAWING DOES NOT INCLUDE ALL SUBSURFACE STRUCTURES AND UTILITIES (I.E., FORMER FOUNDATIONS, PIPES, ETC.)

NO.	DATE	REVISION DESCRIPTION	INT.

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PROJECT NO.: 0055.0045Y018	
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Remedial
REMEDIAL ENGINEERING, P.C.
209 Shafter Street
Islandia, New York 11749 (631) 232-2600

PROJECT NAME:
REMEDIAL DESIGN/ REMDIAL ACTION WORK PLAN OU-3

PROJECT FOR:
AMTRAK SUNNYSIDE YARD
QUEENS, NEW YORK

TITLE:
DUAL PHASE VACUUM EXTRACTION SYSTEM EQUIPMENT AND PIPING LAYOUT (REVISED)

DRAWING NO.
1
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1 OF 3

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209 Shafter Street
Islandia, New York 11749 (631) 232-2600

PROJECT NAME:

REMEDIAL DESIGN/ REMEDIAL ACTION WORK PLAN OU-3

PROJECT FOR:

AMTRAK SUNNYSIDE YARD
QUEENS, NEW YORK

TITLE:

PROCESS AND INSTRUMENTATION DIAGRAM

DRAWING NO.

2

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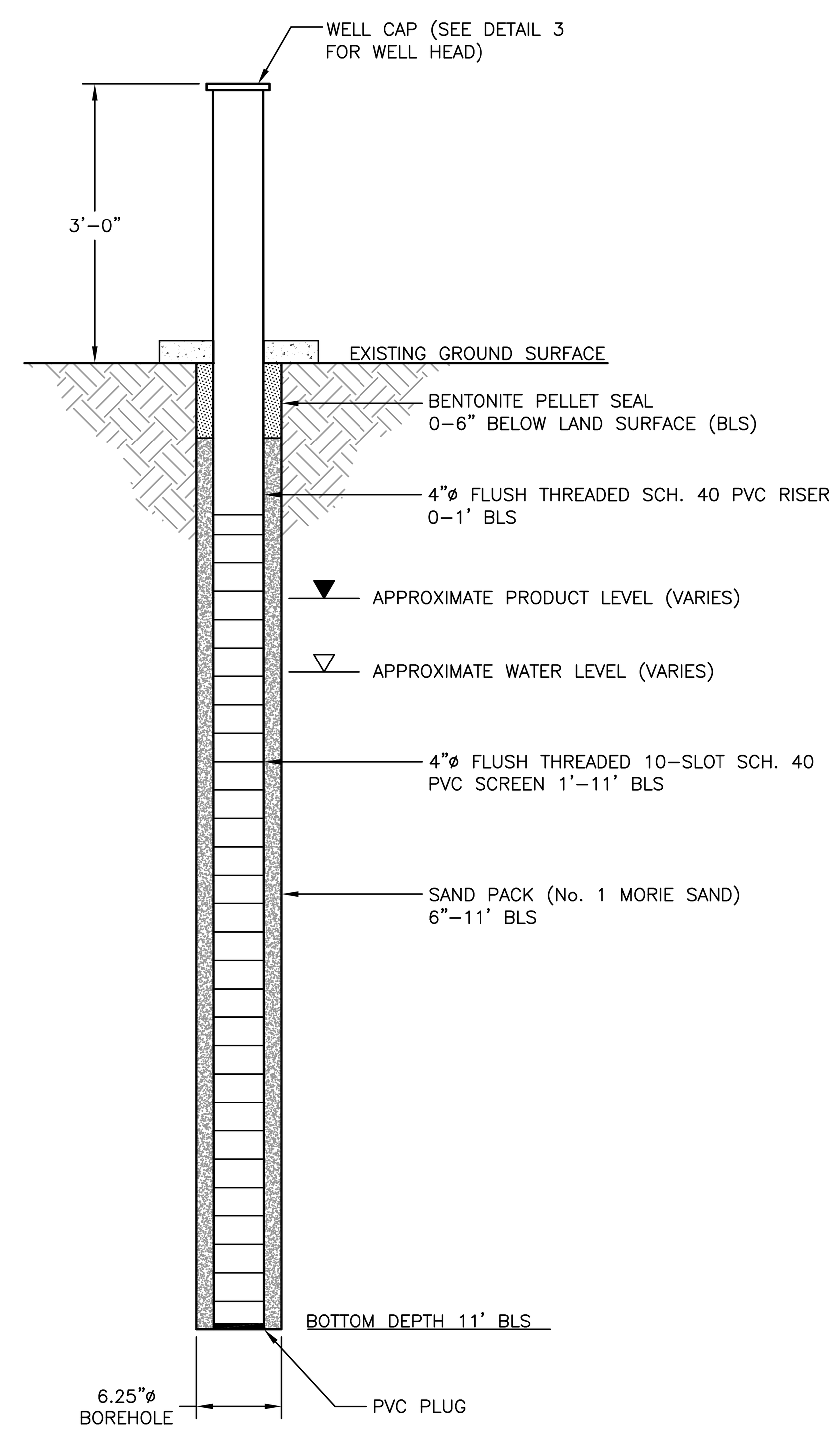
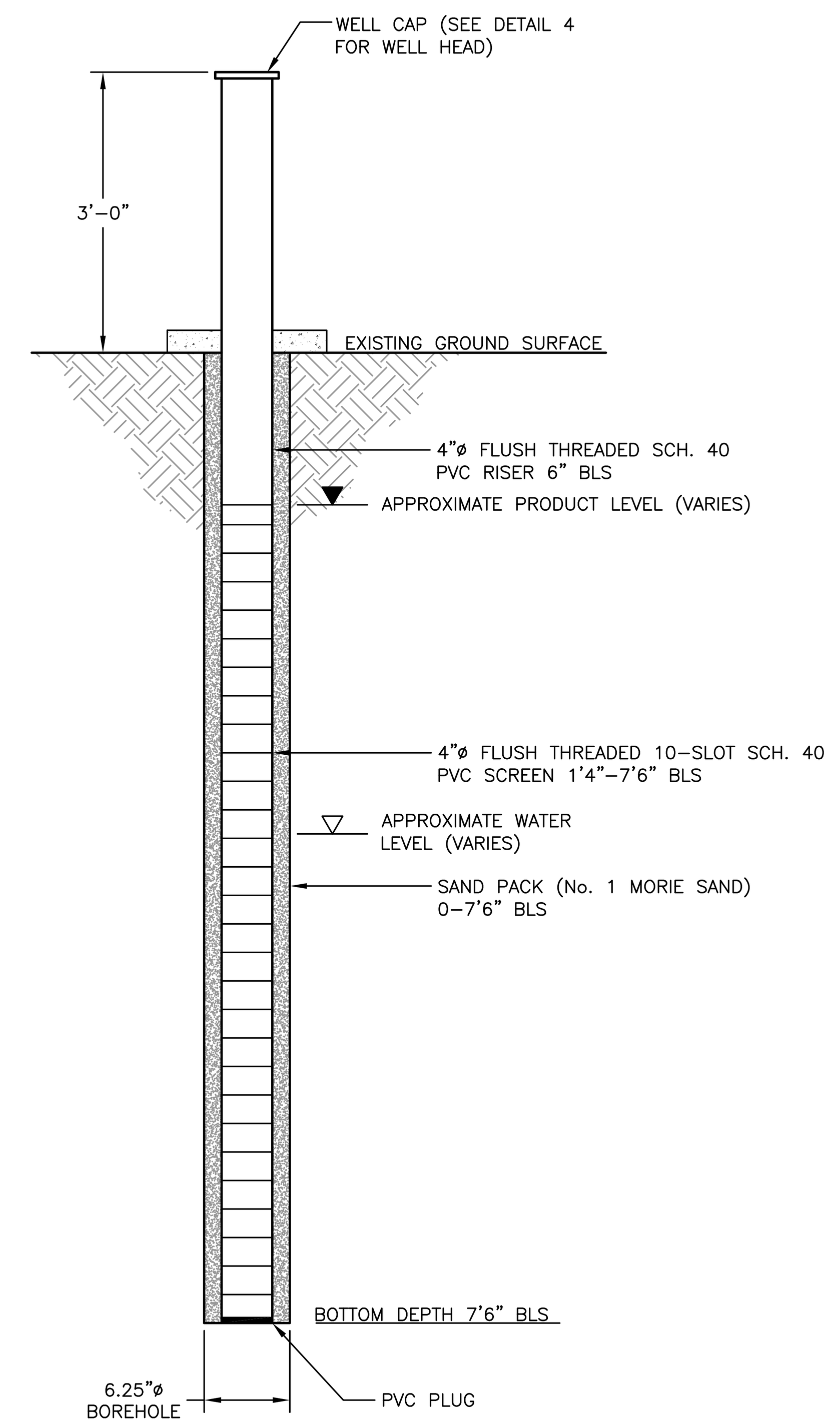
2 OF 3



1 TYPICAL DPVE WELL CONSTRUCTION DETAIL
SCALE: NOT TO SCALE



2 TYPICAL OBSERVATION MONITORING WELL CONSTRUCTION DETAIL
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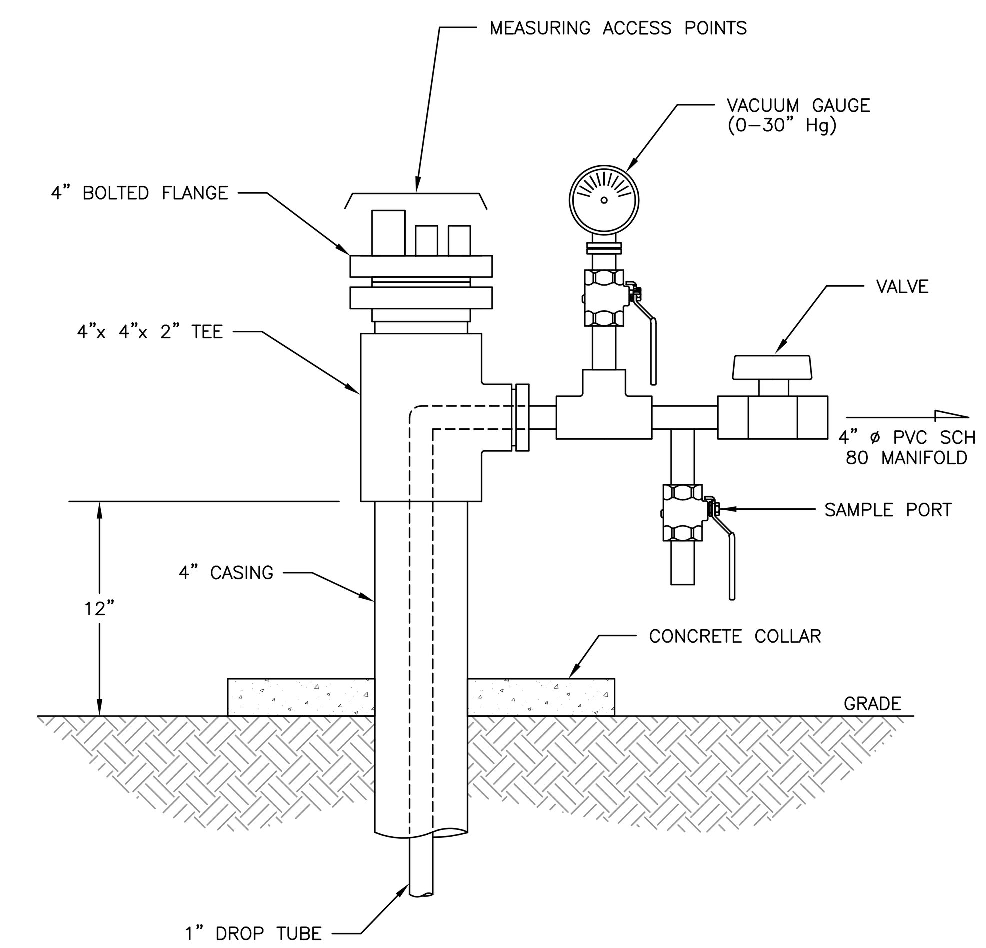

3 PROPOSED DPVE WELL HEAD
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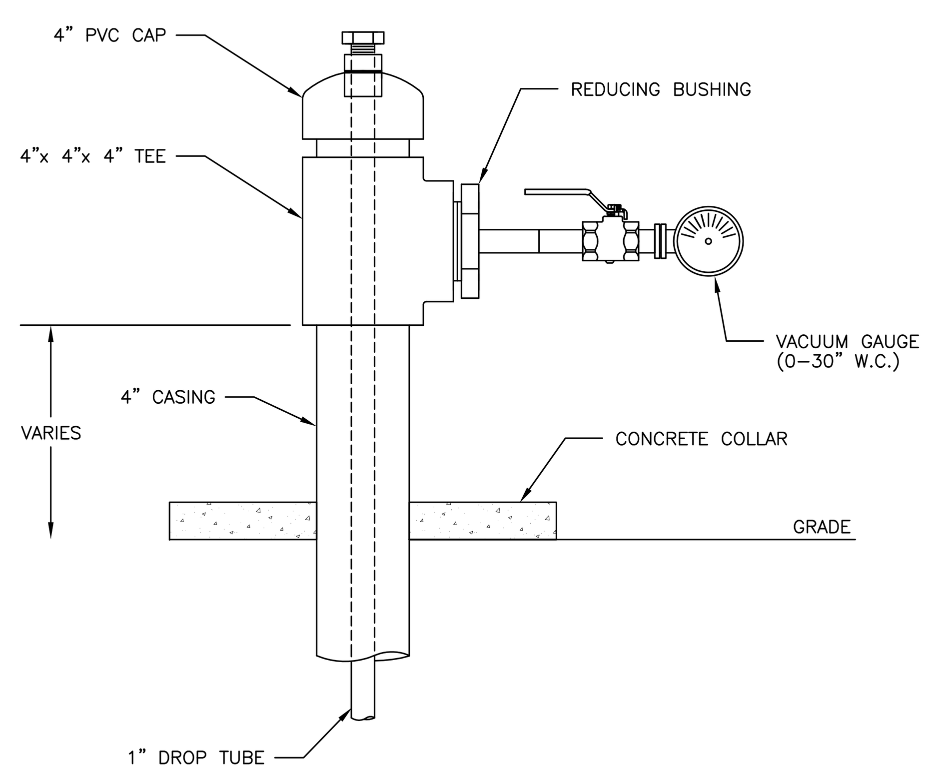

4 PROPOSED OBSERVATION MONITORING WELL HEAD CONFIGURATION
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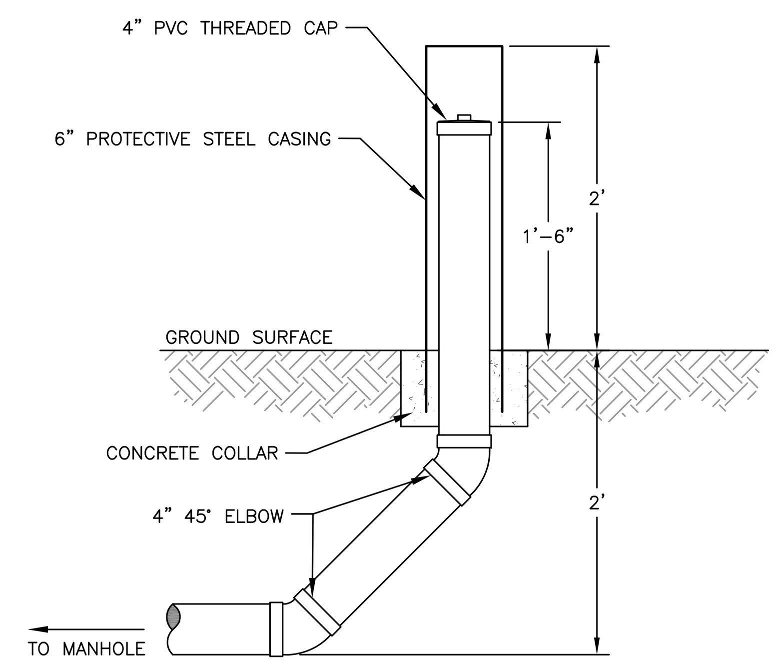
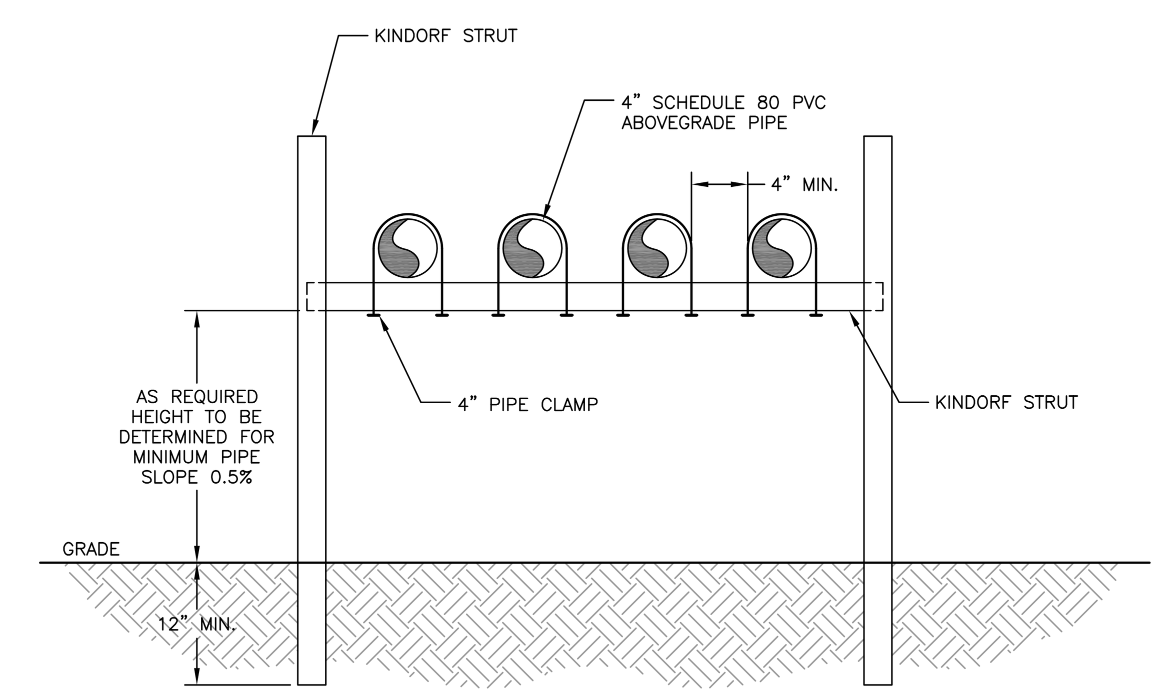


5 PIPE TERMINATION DETAIL
SCALE: 1"=1'



6 ABOVEGRADE PIPING SUPPORT DETAIL
SCALE: NTS

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REMEDIAL DESIGN/ REMEDIAL ACTION WORK PLAN OU-3
PROJECT FOR:
AMTRAK SUNNYSIDE YARD
QUEENS, NEW YORK

TITLE:
WELL CONSTRUCTION AND PIPING DETAILS

DRAWING NO.
3
DRAWING 3 OF 3