
**DYNAMIC WORKPLAN FOR SITE INVESTIGATION AND
REMEDIAL INVESTIGATION ACTIVITIES**

**ASSUNPINK CREEK GREENWAYS PROJECT
CITY OF TRENTON
TRENTON, NEW JERSEY**

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1.0 INTRODUCTION

Langan Engineering and Environmental Services (Langan) and S₂C₂ Inc. (S₂C₂) have prepared this Dynamic Workplan on behalf of the City of Trenton for Site Investigation/Remedial Investigation (SI/RI) activities to be conducted as part of the Assunpink Creek Greenway Project. This Dynamic Workplan presents the investigation procedures, technical approach and decision-making criteria to efficiently complete the SI/RI activities for two properties, the Crescent Wire and the Freight Yards Sites. These sites are located off of North Olden Avenue in the City of Trenton adjacent to the Assunpink Creek (Figure 1). In order to complete the environmental evaluation for these two properties in a timely and cost effective manner, the City of Trenton has requested that a dynamic field investigation approach be used to address areas of concern (AOCs) at these two sites, where applicable.

The Dynamic Workplan is a component of the US EPA's Triad Approach to field investigations and reflects systematic planning to implement a field decision-making approach. This approach incorporates the use of field analytical methods (FAMs) to enhance the results of the SI/RI process and ensure that obtained sampling results are more representative of conditions associated with potential contaminant sources and associated impacts. This includes ensuring that the implemented field program supports specific objectives identified for the project. By incorporating a Dynamic Workplan approach, increased effectiveness should result from the SI/RI process and be associated with a measurable decrease in time and overall cost. In addition, appropriate elements of the New Jersey Department of Environmental Protection (NJDEP) Technical Requirements for Site Remediation – NJAC 7:26 E have been incorporated with this work plan to ensure that applicable regulatory requirements are also met.

1.1 Assunpink Creek Greenway Project Background

The goal of the Assunpink Creek Greenway Project is to redevelop Brownfields properties situated along the Assunpink Creek in northern Trenton into a recreation area and greenway. In order to determine environmental remediation requirements for these properties, the City of Trenton entered into a Voluntary Memorandum of Agreement with the NJDEP to include four of the sites in the Voluntary Cleanup Program as part of the redevelopment effort.

These sites include:

- ◆ The Crescent Wire Site
- ◆ Massaro Property
- ◆ Hollywood Auto
- ◆ Former Freight Yard

The City of Trenton currently owns these sites except for the Rail Area of the Freight Yards, which the City plans to purchase from the current owner, New Jersey Transit.

In 2001, a conductivity probe investigation and two field sampling events were completed between April and August on all four sites. The objective of the conductivity probe investigation was to map the extent of historic fill across the sites. The objectives of the other two investigations were to provide initial environmental quality data on the types and concentrations of compounds on the site and evaluate the sediments along the creek. In the spring of 2002, the City of Trenton retained Langan and S₂C₂ to

conduct further SI/RI activities at areas of concern identified during these previous investigations.

Based upon the distribution of identified contaminant impacts at the Crescent Wire Site and the presence of widespread impacts associated with soil materials in the Freight Yards, it was determined that several of the AOCs would be investigated using a dynamic field investigation following the USEPA's Triad Approach.

These AOCs include:

- ◆ An area of soils within the saturated zone that had Polychlorinated Biphenyls (PCBs) and Oil Impacts at the Crescent Wire Site.
- ◆ Soil impacts across the Rail Area of the Freight Yards Site,
- ◆ An aboveground storage tank (AST) in the Rail Area of the Freight Yards Site,
- ◆ Areas of Fuel Oil Spills in the Rail Area of the Freight Yards Site,
- ◆ Areas of Distressed Vegetation in the Rail Area Freight Yards Site, and
- ◆ Soil Impacts in Block 305 in the Freight Yards Site near a small electrical building.

The locations of these AOCs are shown on Figure 2.

1.2 Utilization of the Triad Approach

In order to meet the objectives for the selected AOCs at the Crescent Wire Site and the Rail Area of the Freight Yards, Langan and S₂C₂ will utilize the Triad Approach. The Triad Approach, developed by the EPA Technology Innovation Office (Crumbling D. M., "Using the Trial Approach to Improve the Cost-Effectiveness of Hazardous Waste Site Cleanups", EPA 542-R-01-016, 2001), involves using systematic planning, implementing a dynamic workplan, and collection of near real-time measurement technologies to efficiently and quickly characterize sites.

An integral component of the Triad Approach is a systematic planning element, which is conducted prior to field mobilization. Such planning involves determining the objectives of the field investigation and the best field approach to be implemented based upon a conceptual site model. The outcome of this systematic planning is the generation of a Dynamic Workplan, which incorporates the technical approach and identifies the FAMs and the decision rules that will be used during the implementation of the dynamic field investigation to meet the objectives of the investigation.

Field analytical procedures and methods are used to generate data rapidly. The project team will make field decisions to determine the most appropriate sampling locations, or modify previously proposed sampling locations, based upon an evaluation of the field data using the planned decision making rules and criteria. By using cost-effective FAMs, a greater number of samples can be analyzed in the field. This will result in the completion of a more detailed and accurate field delineation program that is implemented in a single mobilization. A limited number of traditional fixed-base lab

analyses can then be used to help confirm the characterization of hot spots and/or clean zones depending upon program objectives.

2.0 SITE BACKGROUND AND SUMMARY OF PREVIOUS INVESTIGATIONS

2.1 Site Description and History

The following site descriptions and history are based on site observations and information provided by the City of Trenton.

2.1.1 Crescent Wire Site

The Crescent Wire site is located just southeast of the intersection of North Olden Avenue and Lawrence Street in Trenton, New Jersey (Figure 2). The site is currently a vacant lot almost entirely covered by a concrete slab. The Assunpink Creek flows along the southeastern boundary of the site. Current site use is a parking lot for a business across Olden Avenue.

The Crescent Insulated Wire and Cable Company occupied the site from 1933 to 1977; this company manufactured high-tension cables and wires. The City of Trenton acquired the property in 1995, and in 1996 a fire destroyed the building on site. According to Sanborn Maps of the area, a mill race ran through the subject site in 1890, but has been backfilled by 1908.

2.1.2 Freight Yards Site

The Freight Yards Site is located southwest of North Olden Avenue and adjacent to the Assunpink Creek (Figure 2). The site was historically used as a railroad freight depot, but is no longer in use. Several structures remain on the site, including a small concrete block building, two elevated railroad freight depot concrete platforms, two concrete roadways, and a defunct powerhouse. Numerous abandoned rail lines are present in the Rail Area of the Freight Yards, which makes up the southeastern portion of the site. The Assunpink Creek flows along the northwestern border of this site.

2.2 Summary of Previous Investigations

Several AOCs were identified in Preliminary Assessments conducted at these sites. To investigate these AOCs, the New Jersey Institute of Technology (NJIT) and S₂C₂, with assistance from USEPA, conducted three field investigation tasks in 2001, including a conductivity probe survey and two environmental sampling events. In the summer of 2002, Langan and S₂C₂ conducted limiting sampling to provide support to the development of this workplan. A summary of the portions of those investigations relevant to the dynamic investigation is provided below.

NJIT and S₂C₂ Conductivity Probe Survey - April 2001

The conductivity probe survey was conducted to determine the thickness of historic fill. At the Crescent Wire Site, the fill/native soil interface appeared to occur at an average depth of 8 to 9 feet below ground surface (bgs). However, this interface was also

encountered as deep as 14 feet bgs at some locations. The conductivity of the historic fill varied across the site with occasional zones of high conductivity. The native soil reportedly consisted of clay layers, silty clay, and medium sand.

At the Freight Yards Site the fill appeared to be thickest along the Assunpink Creek (8 to 11 feet thick) and thinned toward the active rail lines to the southeast (6 to 7 feet thick). The fill material present along the Assunpink Creek and near the active rail lines displayed high conductivity. The native soil at the Freight Yards had a fairly consistent conductivity indicative of medium sand with gravel and silt layers.

NJIT, S₂C₂ and USEPA- May 2001 Sampling

This episode involved the collection of soil samples from the following locations: historic fill at select locations consistent with zones of high conductivity, native soil underlying these historic fill locations, and previously identified AOCs. The primary purpose of this sampling event was to better characterize historic fill, and identify specific contaminants of concern (COCs) that could be used as the focus of subsequent delineation efforts. In addition, a variety of FAMs were tested, and verified with fixed based laboratory analyses, in order to identify reliable field analytical procedures that could be used to provide enhanced sample throughput as part of subsequent field evaluation programs.

The historic fill beneath the concrete slab at Crescent Wire was found to contain metals and low concentrations of PAHs, but the native soil was not impacted. PCBs were found in one sample collected from a boring collected just below the water table at 10 to 12 feet below grade.

Samples of historic fill collected from the Freight Yards generally contained levels of arsenic, lead and antimony above the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC). Exceedances of the RDCSCC were not found in the native soil beneath the fill. In the Rail Area of the Freight Yards, a black stained surficial soil layer was discovered, which had concentrations of metals, polychlorinated biphenyls (PCBs), and polycyclic aromatic hydrocarbons (PAHs) above the RDCSCC. The thickness of this layer ranged from one to three feet. Within the Rail Area, two hot spots of fuel oil or diesel fuel spills were identified with high total petroleum hydrocarbon (TPH) concentrations. Outside the Rail Area, samples around the electrical building in Block 305 contained high concentrations of PAHs and metals.

NJIT and USEPA- August 2001 Sampling

During the second round of environmental sampling, the thickness of the impacted surficial black soil in the Rail Area was further investigated. A distinct interface between the black surficial soil and the underlying light brown soil was observed. The light brown sand had significantly lower concentrations of metals and PAHs than the surficial black soil.

Langan and S₂C₂— July 2002 Sampling

Langan and S₂C₂ conducted limited sampling to prepare for the development of this workplan. One of the areas investigated was the groundwater at the PCB/Oil Impacted Area of Crescent Wire. A total of three depth-discrete grab groundwater samples were collected in this area using direct-push technology from the center of the previously identified PCB/Oil Impacted Area. The boring log for this boring, CW-1, is included as Appendix A. The water table was encountered at a depth of eight feet bgs. Mill slotted

rods were used to collect groundwater samples from depths of 9 to 12, 13 to 16, and 17 to 20 feet bgs. All three groundwater grab samples were screened for the presence of volatile organic compounds (VOCs) by S_2C_2 utilizing USEPA SW-846 Method 8260B-modified. In addition, a sample of the groundwater collected from the 9 to 12 feet bgs interval was also analyzed for priority pollutant VOCs plus 10 tentatively identified compounds (TICs) by Chemtech Consulting Group (Chemtech) of Mountainside, New Jersey, a New Jersey Certified Laboratory. No VOCs were detected in any of these samples, even though oil staining was observed in the soil at the water table and on the tubing used to grab the groundwater sample. The results obtained from the fixed base lab sample are provided in Table 1. Based on these results, VOCs have not been included as COCs in the groundwater at the PCB/Oil Impacted Area at Crescent Wire.

To support a bank stabilization project at the Crescent Wire site, Langan advanced 18 borings along the Assunpink Creek. These borings were advanced for geotechnical purposes only, however, visual observations were also noted. These borings established the vertical extent of fill in this area, which was generally less than twelve feet below grade. In the area of the site between the PCB/Oil impacts and the Assunpink Creek, oil impacts were observed at the water table in three borings.

The remaining areas investigated were the Distressed Vegetation Areas in the Rail Area of the Freight Yards. Langan identified four areas of Distressed Vegetation, as shown on Figure 3. The surface soil in these areas consists of loose, dark brown to black silty fine sand with gravel and coal fragments. Langan collected samples from the zero to six-inch depth interval from two of these areas, and had the samples analyzed for PAHs, PCBs, metals and TPH by Chemtech. The results for these two samples and one

duplicate sample are provided as Table 2. PAHs were detected above the RDCSCC in one of the samples, RA-2, and its corresponding duplicate. The concentrations of PAHs detected were consistent with previous samples collected within the Rail Area. Antimony, arsenic, and lead were detected above the RDCSCC and the Non-Residential Direct Contact SCC. One of these locations had very high antimony and lead results. PCBs and TPH were both detected below their most-stringent SCCs.

3.0 GEOLOGY AND HYDROGEOLOGY

3.1 Regional and Site Geology

The sites are located in of the Piedmont Geologic Province of New Jersey (New Jersey Geologic Survey, "Geologic Map of New Jersey", 1999), just north of the boundary of the Piedmont and Coastal Plain Geologic Provinces. They are situated within an area underlain by Cambrian and Precambrian crystalline bedrock known as the Trenton Prong. North of the Assunpink Creek at the Crescent Wire Site, the bedrock is mapped as gneiss and granofel. South of Assunpink Creek, in the Freight Yards the bedrock is mapped as the mica schist of the Lower Cambrian/Late Proterozoic Wissahicken Formation, which was thrust unconformably onto the Middle Proterozoic gneiss and granofel along the Morrisville Fault.

The bedrock is overlain in this area by Pleistocene sand and gravels. According to well records from the Crescent Wire Site included in Kemble Widmer's New Jersey Bureau of Geology and Topography's 1965 report "Geology of the Groundwater Resources of Mercer County", the overburden is approximately 40 feet thick in the area of the sites.

The U.S. Department of Agriculture has mapped the soil of the area as cut and fill land, gravely material in the Soil Survey of Mercer County, New Jersey (1972). This soil type consists of mixed gravelly and sand materials that have been mixed by excavation, filling or other disturbance that have destroyed the original soil horizons.

Based on previous work done at the site, it appears that fill materials are present at the surface across the entire Crescent Wire and Freight Yards Sites. At the Crescent Wire Site, the fill was found to range in thickness from 8 to 15 feet in some areas based on conductivity data and boring logs. The fill is primarily brown to black silt and sand, with miscellaneous debris (concrete, glass, wood, flooring tile, and ceramic fragments). The underlying native soil was reported to consist of silt underlain by sand with gravel. However, at several locations the silt layer was absent. At the Freight Yards site, the fill was found to range in thickness from 8 to 11 feet adjacent to Assunpink Creek and thinned across the site to a thickness of 6 to 7 feet at the active rail lines to the southeast. The fill in the Freight Yards is primarily light brown sand with ceramic, brick, and other debris. In the Rail Area of the Freight Yards, the first one to three feet of fill is black sand with cinders and coal fragments. The native material beneath the fill in the Freight Yards is a light brown medium to fine sand with some rounded gravel.

3.2 Hydrology and Hydrogeology

The Assunpink Creek flows along the southeastern boundary of the Crescent Wire Site and the northwestern boundary of the Freight Yards Site. The Assunpink Creek discharges into the Delaware River approximately 1.75 miles southeast of the site. All four sites are within the floodplain of the Assunpink Creek. The entire Freight Yards

property, as well as portions of Crescent Wire and Massaro, is within the floodway of the creek.

The Pleistocene overburden present near the site reportedly provides a moderate yield of approximately 100-200 gallons per minute, due to recharge from the Assunpink Creek (New Jersey Geologic Survey, "Geology of the Ground Water Resources of Mercer County", 1965). In the Cambrian and Precambrian basement rocks groundwater flow is dominated by fracture flow systems; wells drilled into these rocks typically yield an average of 10 gallons per minute.

The water table is present within the shallow overburden at both the Crescent Wire and Freight Yards Sites. Groundwater was observed at approximately 8 to 12 feet below ground surface at Crescent Wire Site within the historic fill. In the Freight Yards, the water table was observed at a depth of approximately 6 to 11 feet below ground surface, generally just beneath the fill material. Based on the topography of the area (Figure 1) the direction of shallow groundwater flow is expected to be towards the Assunpink Creek at both sites.

4.0 DYNAMIC WORK PLAN

4.1 Introduction

The technical approach for implementing this Dynamic Workplan in the context of the Triad Approach has been developed to generate the specific remaining environmental information needed by the City of Trenton to successfully complete the subject

redevelopment project in the most efficient and cost-effective manner possible. Careful consideration has been given to obtaining data required to evaluate and design a remedial strategy consistent with the reuse concepts for the Assunpink Creek Greenway Project and NJDEP Technical Requirements for Site Remediation.

The Dynamic Workplan technical approach was developed based upon Systematic Planning through the development of investigation objectives which were initially presented in the Request for Proposal and through subsequent meetings and discussions with project stakeholders including the City of Trenton, NJDEP and US EPA.

Specific recommendations for Field Analytical Methods and identified Decision Rules were developed based upon:

- ◆ The Conceptual Site Models for the Crescent Wire Site and Freight Yards Site.

- ◆ Site re-use planning and remedial action concepts for the Assunpink Creek Greenways Project. Re-use plans include improvements to the site such as landscaped parks, sports playing fields and possible recreational buildings for indoor sports activities. In addition, on site ground water use will not be necessary, as public water is available to the site.

- ◆ An evaluation of Contaminants of Concern to identify targeted compounds that are most representative and uniquely indicative of impacts at each investigation area.

- ◆ An understanding of available Field Analytical Methodologies that are appropriate for the identified targeted compounds of concern.

- ◆ Development of Delineation Criteria that are consistent with identified investigation objectives and NJDEP Remediation Requirements, as appropriate.

The rationale and identification of initial sampling locations, depths, media, and parameters to be utilized at each of the AOCs has been presented in this work plan. However, given the dynamic nature of the field investigation to be implemented, there will be the need to make decisions in the field regarding each of the above-mentioned factors with respect to required “step-out” sampling locations. The Decision Rules presented in this work plan are intended to identify the key factors that will be considered when making such step-out decisions as part of field delineation efforts. By identifying and agreeing upon these Decision Rules with all appropriate parties in advance of field program implementation, the risk of not meeting all required program objectives as part of the initial field mobilization will be greatly reduced or eliminated.

4.2 Dynamic Workplan Implementation

In general, the Dynamic Workplan will be implemented by an experienced field team utilizing rapid sample collection procedures in concert with a variety of FAMs to generate data quickly in the field. Such data will be utilized to direct the sampling program in the field until all project objectives have been met. This approach will rely upon the generation of a larger volume of data than conventional sampling programs in order to

reduce uncertainty. Accordingly, we anticipate that only a single site mobilization will be required to complete the implementation of this Dynamic Workplan.

The field team for this program will consist of a Field Team Leader (FTL) who will have overall responsibility for coordinating all field efforts, including in-field decision making. The FTL will be assisted in the field on a full time basis by an environmental scientist who will be responsible for sample logging and handling and careful documentation of all sampling locations. In addition, approximately three to four field personnel will be on-site to perform the various on-site sample collection and analysis functions.

As was the case during previous field activities conducted at this site, arrangements will be made with the Department of Corrections facility to house our trailers during the implementation of dynamic field activities. Such trailers will serve as housing to conduct all on-site analytical activities and to provide a field headquarters. Large site maps will be maintained in the field headquarters. All sampling locations will be marked in the field and hand-plotted on these maps each day. The spatial relationship of data will be tracked on the maps throughout the duration of the field program, thereby assisting the Field Team Leader in making in-field decisions.

The remainder of this section provides a detailed description of the conceptual model for each site, the contaminants of concern, remedial action assumptions, objectives, decision rules, and technical approach to be implemented as part of the Dynamic Workplan. This information is summarized for each of the three sites that will be addressed in the Dynamic Investigation on Tables 3, 4, and 5. A specific discussion on field sampling and analytical procedures is presented in Section 5.

4.3 Crescent Wire

4.3.1 *Site Conceptual Model*

Current site understanding is that PCB and TPH have migrated downward through overlying unsaturated soils and have formed a thin floating layer on the water table surface at a depth of 12 to 14 feet bgs. Based upon information obtained by the conductivity probe work, soils at this depth are identified as historic fill material and not native. The depth of the observed floating layer fluctuates upward and downward with the fluctuating water table surface and has impacted soils within this corresponding depth range. For example, a soil sample collected at 12 to 14 feet had concentrations of 2,000 ppm TPH and approximately 20 ppm PCB (primarily Aroclor 1260). The drilling rods at this sampling location also were noted to be coated with product indicating a possible floating product layer. Visual observations made during additional drilling indicated that the product layer might have migrated toward the creek. Finally, discrete depth interval groundwater sampling (groundwater grab samples collected from the upper portion of the water table) indicates that there are no dissolved VOCs present in ground water. Thus, it is possible to conclude that the floating layer is composed of poorly soluble hydrocarbons such as weathered fuel oil. Another interesting aspect of this problem is that one sediment sample from the bank along the Crescent Wire side of the creek reported a concentration of 122 ppm PCB (73 ppm Aroclor 1254 & 49 ppm Aroclor 1260). This sample was located immediately at the waters edge adjacent to the hexagonal concrete structure on the Crescent Wire pad.

4.3.2 Possible Scenarios to Complete the Conceptual Model

Based on the above description of the known site information it is possible to speculate on potential scenarios that will complete the conceptual model for the Crescent Wire site. These scenarios are described below and form the basis for developing a decision tree that will define the decision logic needed to implement the investigation such that it will complete the conceptual model.

- ◆ **Scenario No. 1:** That the impacted area is confined to a small “hot spot” type distribution near the original release point and there has been very limited contaminant migration. In this scenario, the release point would be situated directly above or immediately adjacent to the “hot spot”.

- ◆ **Scenario No. 2:** That a floating product layer plume of TPH and PCBs has migrated in the down gradient direction, but not as far as the creek. Due to the age of the release, the plume has stabilized. In this scenario, the source area would be located on the Crescent Wire site and in order to satisfy regulatory remediation requirements the exact location would need to be located. In this scenario, it is also assumed that the PCB result found in the sediment sample collected from along the creek edge is not related to the floating layer on the water table.

- ◆ **Scenario No. 3:** The floating product layer plume has migrated to the creek and we have identified a discharge area along the creek bank. However, the

associated findings do not indicate that the PCBs contained in the sediment sample are related to the PCBs found in the floating layer. This is because the Aroclor mix in the sediment sample is different to that found in the floating product layer. However, if this scenario is the correct model then sediment sampling along the Creek will be necessary to determine if the floating product discharge is partially responsible for the PCBs in sediment. Assuming that the source of the PCB impacts is situated on-site, further characterization of the sediment impacts would be completed in accordance with a separate workplan to be developed to evaluate background sediment impacts and satisfy NDEP ecological evaluation requirements.

- ◆ **Scenario No. 4:** The source area for the floating product layer is located up gradient and off site. In this scenario, due to groundwater gradients the floating product layer has migrated on to the Crescent Wire site. This scenario would negate the need to determine the location of the source area and limit the required delineation of the plume extent and dimensions and of sediment impacts from PCBs. It would also result in the need to expedite the installation of monitoring wells to verify groundwater gradients and flow direction.

4.3.3 Objectives

The occurrence of PCBs, TPH and apparent oil staining at or near the water table as characterized in soil samples during previous investigations resulted in the conclusion that there may have been a potential release of oil with PCBs in

this area. As described in the Conceptual Site Model and the discussion of COCs, to date we have only found impacts near the water table in this area.

The goals of the Dynamic Workplan for Crescent Wire Site are to delineate the lateral and vertical extent of impacts in soil and/or groundwater to achieve the most stringent NJDEP Soil Cleanup Criteria (SCC) and NJDEP Ground Water Quality Standards (GWQS), as appropriate (Table 6). This overall goal can be divided into three objectives:

- ◆ Delineate the lateral and vertical extent of PCB/Oil impacts in on-site saturated soils;
- ◆ Delineate lateral and vertical extent of PCB impacts in on-site groundwater;
- ◆ Delineate impacts, if any, in site unsaturated soils.

These objectives are summarized on Table 3. A secondary goal is to identify the location of any potential source area(s) on site. This will be accomplished by the interpretation of collected FAM results for soil samples collected from the saturated zone. Should the lateral extent of observed environmental impacts within saturated zone soil samples terminate within the site boundary, an inferred source location would be identified at the upgradient extent of the delineated impacted saturated soils.

Following completion of the Dynamic Workplan, installation of groundwater monitoring wells will be completed. Well locations will be selected based on the mapping of visual impacts and TPH and PCB data, and consideration of potential off-site impacts to further assess groundwater quality impacts for PCBs, Metals and VOCs. The results of the delineation activities will also be used to determine the optimal placement of sediment sampling locations along Assunpink Creek.

Based on the above, it is assumed that remedial concepts to be considered at the Crescent Wire Site will address the potential source area(s) that may be present, the potential migration pathway along the water table, the nearby stream bank and direct contact risks. Based on the absence of identified near surface impacts, direct contact risks in these deeper soils are considered to be of limited concern except to satisfy NJDEP delineation requirements to support establishment of an engineering and/or institutional control. NJDEP will require delineation of soil impacts to the most stringent SCC, therefore identified decision rules and FAMs were selected to achieve these criteria.

The obtained results from the implementation of this Dynamic Workplan, including results from confirmatory soil, groundwater sampling and sediment sampling will be used to complete a Remedial Alternatives Analysis

Specific FAMs were selected based on the identified objectives and Contaminants of Concern (COC) as discussed below.

4.3.4 Contaminants of Concern (COCs)

Analytical results for soil samples previously collected at a single location in this area have indicated the presence of elevated concentrations of TPH, PCBs, and selected metals in saturated soils at the water table. Visual impacts including apparent oil staining were also observed in soil and groundwater samples collected at the water table. These observations suggest the possible release of PCB-contaminated oil. However, there was no indication of any environmental quality concerns in the overlying unsaturated soils.

Groundwater grab samples were recently collected at, and to a depth of about 10 feet below, the water table and were analyzed for VOCs only. Obtained results did not indicate the presence of any dissolved VOCs. Consequently, the COCs for this portion of the study area will consist of TPH, PCBs, and selected metals in soil and PCBs in groundwater.

Metals have not been identified as a COC as part of the dynamic portion of the groundwater grab-sampling program. This omission is based on the difficulty in obtaining a representative groundwater sample for dissolved metals analysis from a temporary groundwater sampling point, coupled with the fact that no viable FAM exists for the effective screening of dissolved metal concentrations in groundwater. Consequently, we plan to rely on dissolved PCB and visual data to serve as an indicator of overall groundwater quality impacts in this area and to attempt to differentiate between impacts observed within soils versus those found in groundwater. Obtained results from the Dynamic Workplan will also be used

to help select the optimal locations to install groundwater monitoring well as discussed in Section 4.3.4. Metals analysis in groundwater will subsequently be performed on samples to be collected from such groundwater monitoring wells.

4.3.5 Decision Rules

An important part of the Systemic Planning effort is to complete the conceptual model. Thus important decisions associated with Crescent Wire site are:

- ◆ Is the source of the PCB/TPH impacts on site or off site?

- ◆ Is the source of the contamination a thin floating layer of poorly soluble weathered hydrocarbons that has not produced a dissolved phase plume?

- ◆ Are subsurface impacts confined to a “hot spot” or a limited migration plume that has not reached creek?

- ◆ Has plume migrated to creek and if so are PCBs in creek sediments related to the plume or did they originate from sediment transport?

- ◆ Design (placement and construction details) of monitoring well network and sampling program.

- ◆ Can a Monitored Natural Remediation approach be proposed for groundwater impacts or is an active containment or extraction treatment approach more appropriate?

The following decision rules have been developed to address these identified decisions and are summarized on Table 3.

Saturated Soil Delineation Criteria at Crescent Wire

As stated herein, a combination of visual and field analytical screening/analysis will be utilized to evaluate saturated soils as part of the PCB/Oil evaluation to be conducted at Crescent Wire. Visual observations will be used to assist in selecting worst case samples for analysis. Analytical findings above the most stringent NJDEP SCC for total PCBs of 0.5 mg/kg (Table 6) or above 1,000 mg/kg for TPH will trigger additional delineation sampling within the site property boundaries. All soil samples will be analyzed for metals, but metals concentrations will not drive additional delineation sampling.

Lateral step-outs will be conducted at approximate 25-foot intervals. Step outs will continue in all directions until the specified criteria are achieved. In the inferred upgradient direction step outs will continue to the property boundary. Should delineation activities be achieved prior to reaching the property boundary, a decision will be made to determine if sampling should be conducted in the unsaturated zone at the upgradient limit of the impacted zone. This sampling would be conducted in order to identify and characterize the suspected occurrence of a source zone in nearby unsaturated soils.

Vertically, soil will be field screened with a PID and visually logged continuously, while analytical samples will be collected at five-foot depth intervals for delineation.

Given the relatively small area, and potentially self-contained nature of the impacts within this AOC, if no impacts above identified delineation criteria are observed at lateral step-out locations, additional delineation sampling will be conducted 10 feet inward towards previously existing sampling points. These detailed additional delineation samples will not be collected if the PCB/Oil impacts are found to be due to an off-site source.

Groundwater Delineation Criteria

A similar approach will be used for groundwater delineation as that described above for soil delineation at the Crescent Wire site. The criteria that will be utilized are the NJDEP Class IIA Groundwater Quality Standard (GWQS) of 0.5 ug/L for total PCBs. The initial sampling point will be in the area found to have the most PCB-oil impacts during the saturated soil investigation. Lateral groundwater delineation will occur at 25-foot intervals until concentrations are below the GWQS. At a minimum, we anticipate that lateral delineation efforts will extend to the most truck-accessible downgradient locations toward Assunpink Creek. Should truck access be limited in the direction of the Creek and additional delineation required, we would conduct these step outs using manual sampling equipment. Vertical delineation will be conducted at 5 to 10-foot sampling intervals until PCB concentrations are below the GWQS.

Following completion of the Dynamic Workplan, installation of permanent groundwater monitoring wells will be completed. Well locations will be selected based on the mapping of visual impacts and TPH and PCBs data, and consideration of potential off-site impacts to further assess groundwater quality impacts for PCBs, base-neutral organic compounds (BNs), and metals. It is anticipated that two to four wells will be installed. The locations of these wells depend on the results of the soil and groundwater delineation, three possible scenarios are envisioned.

- ◆ If the groundwater impacts are found to be due to an offsite source, one off-site upgradient well would be installed to monitor the groundwater quality coming onto the site. One additional well will be installed downgradient on-site along the Assunpink Creek, to assess potential groundwater impacts on the creek.
- ◆ If soil and groundwater impacts are found to be due to an on-site source, and groundwater impacts do not extend to the creek, three wells will be installed. A well will be installed within the source zone, upgradient of the source area, and downgradient along the creek. This well network will allow monitoring of the plume geometry through time and its impact on the creek.
- ◆ If an offsite source is found and groundwater impacts extend to the creek, four wells would be installed. Three wells will be installed on-site, including a source zone well, an upgradient well, and a downgradient well along the

creek. In addition, a fourth well will be installed off-site across the creek, to ensure that groundwater impacts do not extend beyond the creek.

The permanent wells will be constructed so that the screened interval encompasses the zone of groundwater impacts, as determined during groundwater delineation activities. The well installation will be completed separately from the Dynamic Investigation; therefore the well installation will not be discussed in detail as part of this Dynamic Workplan.

Unsaturated Soil Delineation Criteria at Crescent Wire

If the delineation of saturated soils and/or groundwater suggests the presence of an on-site source area for such impacts, then limited and focussed unsaturated soil delineation activities will be conducted using the same decision rules described for the saturated soil delineation. The potential for an on-site source area will generally be investigated if the highest concentration of COCs in saturated soils and/or groundwater is identified at an on-site location other than the property boundary. In this case, the source area of such impacts may be presumed to lie within unsaturated soils generally overlying the area displaying the elevated COC concentrations.

4.3.6 Technical Approach

The use of a dynamic field approach is clearly applicable to meeting the objectives of the soil and groundwater investigations at the Crescent Wire Site in the most efficient and cost effective manner possible. In general, a combination

of rapid direct-push sample collection used in conjunction with FAMs will allow in-field decision making to direct subsequent sampling locations as the delineation effort unfolds. Such sampling will then continue until all agreed upon task objectives have been satisfactorily met.

Saturated Soils Delineation

The delineation of impacts within saturated soils will be accomplished through a combination of visual observations coupled with a variety of FAMs and subsequent limited confirmation analysis at a fixed-based laboratory. Initially, a soil boring will be advanced immediately adjacent to, and at least 10 feet deeper than, the original boring previously advanced in this area. This boring will be advanced with the use of dual-tube sampling equipment. Such equipment will be used to install an outer temporary casing to preclude the possibility of any heavily impacted soils present at the water table zone from inadvertently being introduced into deeper zones. Visual observations will be made of all soils collected continuously from the ground surface to the base of the boring.

Soil samples from the initial boring will be collected from the first impacted zone (assumed to be at the water table) and subsequently at five-foot intervals until impacts are not longer observed. These samples will undergo field screening for the presence of PCBs, TPH and metals with the use of a variety of FAMs. A description of the specific analytical procedures to be employed is presented in Section 5.2.1. Data obtained from this boring will be used to correlate analytical results between these FAMs and the more formal data obtained during previous investigative activities. This correlation will also serve as an informal calibration

of the FAMs. Information obtained from this boring will also help establish the vertical extent of impacts within the saturated zone.

Once this initial boring has been completed, additional borings will be advanced at four locations radiating out approximately 25 feet away from the initial boring. These locations will be situated at presumed upgradient, downgradient, and two sidegradient locations. If there is visual evidence of impacts at any of these locations, then step-out borings will be advanced at 25-foot intervals, per the decision rules. If no impacts are observed, then additional borings will be advanced 10 feet closer to the starting point. If findings from the initial boring indicate that visual soil impacts are limited to the water table zone, then subsequent saturated soil samples will only be collected from a depth which intersects the water table (i.e., about 11 to 15 feet below grade). Otherwise, saturated soil sampling will be conducted to whatever depth the impacts were found to occur. If the delineation extends to the Creek, the final downgradient samples will be collected using hand equipment, since the Creek bank is not accessible to a truck mounted or track-mounted direct-push equipment.

Groundwater Delineation

Once the soil delineation activities have been concluded, a shallow groundwater delineation program will also be completed in the same vicinity. This program will be conducted in order to determine if observed impacts in soil have also impacted local shallow groundwater quality. If groundwater quality has been found to be impacted, the lateral and vertical extent of such impacts will be delineated.

The groundwater delineation program will be accomplished by collecting depth-discrete groundwater grab samples from temporary points consisting of Mill Slot rods and/or screen points. Such tooling will be advanced with direct-push units. Initial sampling locations will be selected based upon the results of saturated soil delineation activities. It is anticipated that two to three groundwater grab sampling locations will be situated within the zone of saturated soil impacts, with the balance of the locations being placed outside the area of observed soil impacts. Careful consideration will be given to placing an adequate number of groundwater sampling points in both upgradient and downgradient locations to sufficiently identify potential influences from off-site locations or on the Assunpink Creek. Lateral groundwater delineation will occur at 25-foot intervals until concentrations are below the GWQS. We anticipate that lateral delineation efforts will extend to the most truck-accessible downgradient locations toward Assunpink Creek.

We anticipate that initial groundwater grab samples will be collected from two to three depth-discrete sampling intervals (beginning at the water table). The specific depth-discrete sampling intervals to be used at subsequent groundwater grab sampling locations will be determined in the field and based upon the initial results. At least 5 to 10 vertical feet will separate each groundwater grab-sampling interval. The actual sampling scheme will be finalized in the field based upon information generated during the implementation of the dynamic workplan. Groundwater grab sampling activities will continue until PCB delineation is sufficiently defined on-site. All screening of groundwater grab samples for the presence of dissolved PCBs will be accomplished with the use of RaPID Assay (immunoassay) test kits.

Unsaturated Soils Delineation

If the delineation of saturated soils and/or groundwater suggests the presence of an on-site source area for such impacts, then limited and focussed unsaturated soil delineation activities will be conducted. The same field evaluation procedures described for saturated soils will be utilized during the unsaturated soils delineation.

4.3.7 FAM Delineation Requirements and Confirmatory Sampling

In order to ensure that delineation activities which rely upon FAM results account for potential matrix variability, duplicate samples will be analyzed on a minimum of 20% of the collected soil samples collected along the boundaries of impacts. The highest obtained result from collected FAM duplicate samples will be used for comparison to identified delineation criteria.

Upon completion of delineation activities using FAMs, “splits” of selected soil samples analyzed in the field will be submitted to an off-site NJDEP-certified laboratory as a formal confirmation of the analytical results obtained from the FAMs and to meet NJDEP requirements for certified data. Confirmatory samples that will be collected at the Crescent Wire Site are summarized on Table 7. Split samples will not be collected from the dynamic groundwater investigation to be sent to an off-site laboratory for confirmation analysis. Instead, samples collected from permanent groundwater monitoring wells to be installed after the dynamic groundwater delineation has been completed will be analyzed at an off-site NJDEP-certified laboratory. Such analysis will be used to provide

confirmation of the dynamic groundwater delineation results and meet the NJDEP requirements for certified data.

Up to seven soil samples will be split between the on-site mobile laboratory and an off-site NJDEP certified laboratory for PCB, TPH and metal analysis. Two of the samples will be collected from within the delineated impacted zone; the primary purpose of these samples is to provide for correlation between obtained FAM results and fixed base analytical laboratory results. Five soil samples will be collected from the boundary of the impacted zone if such boundary is identified on site. These samples are intended to confirm the delineation of impacts and to meet NJDEP requirements for certified data. Less than five samples will be collected if the boundaries of impacts are not delineated on-site, due to the presence of an upgradient source and/or impacts which extend downgradient to the Assunpink Creek.

4.4 Rail Area of the Freight Yards

4.4.1 Site Conceptual Model

Current understanding is that there is a large area within the overall Rail Area of the Freight Yards that consists of near surface soils (between 0 to 3 feet bgs) that have been impacted by historical Rail Area activities. The soil is dark stained and results obtained from previous limited soil sampling indicates that it is contaminated with selected metals (arsenic, lead, zinc & copper), levels of PAHs & PCBs slightly above the RDCSCC and elevated concentrations of TPH. The

horizontal extent of the impacted area along the west and northern property boundaries are not well defined and the vertical extent appears to be defined by a distinct color change between the dark stained soil and an underlying tan soil. Previous data indicates that contaminants in the dark stained soil have not migrated vertically downward and impacted the underlying tan soil. Additionally, within this large area of dark stained soil are “hot spots” of TPH contamination that have concentrations significantly above the general background values contained in the dark stained soil. These locations are considered likely related to fuel storage areas or past spills. Information to date suggests that groundwater may not be impacted from contaminants in the dark stained soil.

4.4.2 Possible Scenarios to Complete the Conceptual Model

- ◆ **Scenario No. 1:** The depth of the dark stained soils is shallow (predominantly less than 1.5 feet); there has been no migration of COCs into underlying tan soils; “hot spots” are relatively small and TPH has not migrated below 2 feet; groundwater has not been impacted, and; the horizontal boundaries of dark stained soil are fairly consistent with current estimates.

- ◆ **Scenario No. 2:** The depth of the dark stained soil is moderate (50% is 3 feet or greater); no impact to tan soil; “hot spot” size is moderate (150 ft x 100 ft) and TPH has migrated below 5 ft; there have been no groundwater impacts, and; the horizontal boundaries of the dark stained soil in west and north are less than current estimates

- ◆ **Scenario No. 3:** 75% of the dark stained soil area has a thickness greater than 3 feet; PCB, metal & PAH concentrations are more variable than previous sampling indicates (which may indicate the presence of PAH, PCB or metal “hot spots”); TPH “hot spots” have merged together to form fairly large area of TPH concentrations over 10,000 ppm; TPH has migrated downward to within 2 feet of water table which may indicate the need for limited groundwater characterization, and; the horizontal boundaries of the dark stained soil are well defined.

4.4.3 Objectives

Based on previous characterization of the site as described in Section 2.0 and as discussed during previous meetings and planning sessions, the identified contaminants of concern in the Rail Area of the Freight Yards are generally not expected to be associated with groundwater impacts based on their low solubility and soil adsorption characteristics (i.e. PAHs, PCBs, and metals). The greatest concern for these COCs is the direct contact pathway. However, there are several “hot spot” locations where the occurrence of elevated TPH concentrations may represent potential groundwater impact areas.

Based on the above considerations, it is assumed that remedial concepts that will be considered for the Rail Area will be focused on addressing direct contact risks to persons enjoying the use of the planned Greenways. These risks will likely manifest themselves in the potential contact with near surface dark stained soil

that occurs in this area. As such, the primary application of the Dynamic Workplan will be to map the extent of the dark stained soils using a uniform sampling grid with visual screening to determine the lateral and vertical extent of this material. In addition, FAMs have been identified to characterize levels of COCs (PAHs, selected metals, TPH and PCBs) to:

- ◆ Determine if there are any areas of significant lateral extent in the Rail Area of the Freight Yards where the dark stained soils do not exist;
- ◆ Accomplish lateral delineation to NJDEP SCC along the north 'interior property' boundary of the Rail Area;
- ◆ Identify any unknown "hot spot locations".
- ◆ Characterize 'hot spots' that may represent potential sources of impacts to groundwater by analysis and evaluation of obtained TPH results.
- ◆ Characterize potential impacts to underlying light brown soils and to underlying groundwater by comparison to NJDEP SCC for targeted COCs.

These objectives are summarized on Table 4.

With this information and the understanding of the planned site re-use and NJDEP Technical Requirements for Site Remediation (NJAC 7:26E), we expect to satisfy requirements for lateral and vertical delineation within the site boundary

of all impacts above the most stringent NJDEP SCC (Table 6). Interior site delineation will largely be accomplished using a uniform sampling grid. We expect to address anticipated exceedances through a combination of engineering and institutional controls that would be incorporated into the planned site reuse plan.

Active remediation is anticipated to be limited to identified “hot spots” where potential impacts to groundwater have been identified based on the use of TPH results to identify potential source areas and targeted COCs in comparison to appropriate NJDEP SCC. However, should the incorporation of engineering and institutional controls not be appropriate based on potential site re-use constraints, data obtained through the implementation of the grid sampling program would allow evaluation of active remediation options for the dark stained soil as part of the planned Remedial Alternatives Analysis.

Specific FAMs were selected based on the identified objectives and Contaminants of Concern (COC) as discussed below.

4.4.4 Contaminants of Concern (COCs)

Based on our evaluation of sampling data from previous investigations, surface soils within the Rail Area are impacted by a variety of PAH compounds above the RDCSCC. In addition, selected metals, and PCBs have also been identified in these soils. With the exception of PCBs, the same COCs are generally present at the “hot spot” locations. In addition, TPH is generally considered to be a

concern at each of the “hot spot” areas. Elevated concentrations of TPH in soils at the “hot spot” locations are considered to be the most likely indicator of potential impacts to groundwater.

4.4.5 Decision Rules

An important part of the Systemic Planning effort is to complete the conceptual model. Thus important decisions associated with the Rail Area of the Freight Yards are:

- ◆ Have the horizontal and vertical boundaries of the dark stained soil been sufficiently defined to develop accurate estimates of soil area & volumes to allow determination of a remediation approach (this could include a cap and deed restriction option)?
- ◆ Have “hot spots” been found that are characterized by values of over 10,000 ppm?
- ◆ Have “hot spots” been defined sufficiently to determine if a surgical removal remedial approach is appropriate and cost effective to reduce overall potential risk?
- ◆ Has sufficient information been collected to demonstrate to NJDEP that groundwater impacts have not occurred?

- ◆ Is the information provided from the characterization sufficient to allow Trenton to successfully negotiate with NJ Transit for acquisition of the property?

The decision rules for Rail Area of the Freight Yards are summarized by objective on Table 4, and are presented in more detail below.

Surficial Black Soil

Visual observations and results from chemical analysis conducted on soil samples will be evaluated in comparison to the most stringent of the NJDEP SCC (Table 6) to identify remediation requirements throughout the Rail Area using a uniform grid sampling approach, including individual hot spot sampling location results. The uniform grid will be established using a 100-foot grid spacing with visual observations made at each location. In addition, at approximately 48 selected locations, analysis for identified COCs will be conducted. Proposed sampling locations are depicted on Figure 3. Actual selected field locations may be offset in the field based on visual observations of distressed vegetation or obvious visual impacts. If TPH is measured at a concentration above 10,000 ppm at any location, then that location will be identified as a “hot spot”, and additional samples will be collected according to the decision rules for “hot spots”.

If visual observations and analytical results indicate that there is a portion of the Rail Area where surficial soils are not impacted, additional samples will be collected to verify this boundary. Samples will be collected at a 100-foot spacing

on all grid points that fall along this boundary and analyzed for PAHs, PCBs, TPH and metals.

Each identified “hot spot” (Areas of Fuel Oil Spills, Areas of Distressed Vegetation, and the AST Area) and any new “hot spot” area identified during the site wide grid sampling will be delineated to determine the extent of heavily impacted soils. Lateral delineation within the black surficial soils will be conducted at 25-intervals until TPH concentrations are below 10,000 mg/kg. This criteria is considered representative of a potential source of impacts to groundwater quality.

Northwest Boundary of the Rail Area

As shown on Figure 3, contingent lateral step-out samples are proposed along the northwestern boundary of the Rail Area, which is within the Freight Yards, to support a potential deed restriction. If impacts above the most-stringent SCCs, or a TPH concentration in excess of 10,000 mg/kg are found at this boundary, two step-out borings will be advanced in the middle of the concrete roadway to the northwest of the boundary and four step-out borings will be advanced just northwest of this concrete platform. Soil samples collected from these borings will be analyzed in the field for PAHs, selected metals, PCBs, and TPH. If impacts above the SCCs or TPH concentrations above 10,000 mg/kg continue on the far side of the concrete roadway, additional step-out borings will be advanced at 50-foot intervals until the applicable delineation criteria is met for each COC.

Light Brown Soil Characterization

The uniform grid sampling approach will also be conducted to assess potential impacts to the light brown soils underlying the dark stained soil. In most cases, the initial samples to be analyzed will be collected from the uppermost 6 to 12 inches of soil immediately underling the interface between these soils and the overlying black soils at each of the 48 grid sampling locations (Figure 3). However, in the event that a clear visual or field screening observation indicates the presence of impacts which extend into the underlying light brown soil below a hot spot area, then the initial soil samples collected from within this zone will be from a depth immediately below such observed impacts.

Vertical Delineation

At the grid sample locations, if impacts are found to be present within the light brown soils, such impacts will be delineated at five-foot depth intervals until the most-stringent SCCs have been met for the COCs in question. If TPH is found to be present at a concentration above 10,000 mg/kg, then that location will be addressed as a “hot spot”.

At “hot spot” sampling locations, vertical delineation will be conducted at a minimum of 25% of the sampling locations where TPH concentrations in the overlying dark soils exceed 10,000 mg/kg. Vertical delineation will be completed at five-foot depth intervals until TPH concentrations are below 10,000 mg/kg. In addition, one boring at each “hot spot” will be extended to the water table at the location with the worst-case impacts. The six-inch soil interval above the water

table in this boring will be sampled for TPH to determine if the “hot spot” in question has impacted the groundwater.

Groundwater Characterization

At all boring locations that are extended to the water table, visual observations of the potential occurrence of petroleum product will be made. Should petroleum product be observed, TPH concentrations exceed 10,000 mg/kg, or an IGWSCC is exceeded within two feet of the determined water table, a temporary well point will be installed. The temporary well point will consist of slotted PVC. A groundwater grab sample will be collected approximately 48 hours after well installation for off-site laboratory analysis for BNs and VOCs. The temporary well point will be abandoned immediately after sampling.

4.4.6 Technical Approach

General

Our general sampling strategy for the overall Rail Area of the Freight Yards is to establish a grid of boring locations at approximate 100-foot intervals across the Rail Area, as shown on Figure 3. Additional borings are planned at each of the defined hot-spot locations.

Due to the thick vegetation expected to be present during much of the year coupled with remaining rail tracks in much of this area, we anticipate there will be some difficulty in maneuvering field sampling equipment throughout the Rail Area. In order maximize the mobility around such obstacles without requiring the

need to remove them, we anticipate conducting all soil sampling within this area with the use of a direct-push unit mounted on a bobcat.

Rail Area of the Freight Yards

Approximately 84 soil borings are planned in this area based on a 100-foot grid (Figure 3). All soil borings advanced in this area will extend at least one foot into the underlying light brown soil, a depth anticipated to range between four and six feet bgs. Soil samples collected from each of these grid locations will be carefully logged. Visual color observations will be an important element of such logging. In addition to the logging, representative intervals from within the black impacted soil zone and the underlying light brown layer from 48 grid locations outside the known “hot spot” areas will undergo field analysis for PAHs, metals, TPH, and PCB screening. The intervals for chemical analysis will be selected based on an indication of visual impacts, and to ensure representative characterization of the dark stained soil and the underlying light brown soil. Per the decision rules, vertical delineation in the light brown soils will be conducted at five-foot intervals if COCs are found above the most-stringent SCC. If TPH is found at a concentration above 10,000 mg/kg, such location will be defined as a “hot spot”, and will be addressed as described below. In accordance with the decision rules, should product be observed, an IGWSCC be exceeded, or TPH exceed 10,000 mg/kg within two feet of the determined water table, a temporary well point will be installed and a groundwater sample collected for laboratory analysis for BNs and VOCs.

Additional samples will be analyzed if a significant area is identified where surficial impacts are not present. Such an area may be identified through visual observations and/or analytical results. At an internal boundary of surficial impacts, analytical samples will be collected at a 100-foot spacing. This corresponds to collecting a sample for analysis at every grid location along the identified boundary.

As shown on Figure 3, approximately 19 of the borings will be located along the northwest boundary of the Rail Area, which is the anticipated northwest extent of the shallow black impacted soils. Samples collected from 10 of these 19 boring locations will be analyzed at the mobile laboratory. If the results of these samples indicate impacts above the most-stringent SCCs, step out borings will be conducted at four of these locations, directly across the road (approximately 75 feet to the northwest) and two samples will be collected in the center of the roadway. If the analytical results of the four samples collected across the road indicate impacts above the SCCs, then step outs will be conducted to the northwest at 50-foot intervals until the limits of impacts above the SCC are identified.

“Hot Spots” Within the Rail Area of the Freight Yards

Three “hot spots” have been identified in the Rail Area of the Freight Yards; these include an AST, Fuel Oil Spills at Block 301, and Areas of Distressed Vegetation (Figure 3). Soil samples in these areas which are collected from locations that also correspond to the overall grid pattern, will be analyzed in the field for the same parameter list to be used for the Rail Area (i.e., PAHs, metals

and PCBs), plus TPH. The results of the grid sampling may identify additional “hot spots”, defined by the decision rules as locations where TPH is above 10,000 mg/kg.

Additional samples will be collected to specifically address each the “hot spot”, including previously identified and any new “hot spots”, and analyzed for TPH. An initial boring will be conducted at the center of the hot spot. Four step outs will be conducted in the apparent downgradient, upgradient, and two sidegradient directions at the observed edge of the hot spot. As described in the decision rules, if measured TPH concentrations in the step out borings are above 10,000 mg/kg, then additional step out samples will be collected at 25 foot intervals until the TPH values are below 10,000 mg/kg. Alternatively, if TPH concentrations are below the delineation criteria, then an additional four borings will be advanced halfway between the original boring and the step out borings. At each hot spot a minimum of eight samples will be collected.

Vertical delineation within the underlying light brown soils will be conducted at a minimum of 25% of these locations where TPH concentrations are found to be above 10,000 mg/kg. If vertical impacts extend to the underlying tan soils, vertical delineation will be conducted at five-foot intervals until TPH concentrations are less than 10,000 mg/kg.

If no TPH concentrations are identified above 10,000 mg/kg at a given “hot spot” location, then at least one boring will be advanced to the water table at each such “hot spot”. That boring will be extended beneath the highest TPH

concentration measured in shallow soils. A sample will be collected from the six-inch interval above the water table and analyzed for TPH. At locations where vertical delineation is completed, visual observations of the potential occurrence of petroleum product will be completed. Per the decision rules, should product be observed or should TPH concentrations exceed 10,000 mg/kg within two feet of the determined water table, a temporary well point will be installed. Approximately 24 hours after installation of the temporary well point, a groundwater grab sample collected for off-site laboratory analysis for BNs and VOCs. The temporary well point will be abandoned immediately after sampling.

4.4.7 FAM Delineation Requirements and Confirmatory Data

In order to ensure that delineation activities which rely upon results obtained from FAMs accounts for potential matrix variability, duplicate samples will be analyzed on a minimum of 20% of the collected soil samples used for vertical delineation, and 50% of the collected soil samples for lateral delineation at interior boundaries of surficial impacts. This frequency is recommended based on an anticipated high degree of matrix variability in the surface soils. The highest obtained result from collected FAM duplicate samples will be used for comparison to identified delineation criteria.

Upon completion of delineation activities using FAMs, “splits” of selected soil samples analyzed in the field will be sent to an off-site NJDEP-certified laboratory to undergo analysis as a formal confirmation of the FAMs and to meet NJDEP requirements for certified data. Confirmatory samples that will be collected in the

Rail Area of the Freight Yard are summarized on Table 7. Two split samples will be collected for PAHs, metals, PCBs, and TPH from the surficial black impacted soil to provide for correlation between obtained FAM results and fixed base analytical laboratory results. Additional fixed base laboratory samples will be collected to verify clean zones and meet NJDEP requirements for certified data, including:

- ◆ Three samples from the light brown soil identified as not-impacted by the mobile laboratory for PAHs, PCBs, metals and TPH;
- ◆ One sample every 400 feet along any boundary of impacts delineated within the interior of the Rail Area for PAHs, PCBs, metals and TPH;
- ◆ Four samples collected from the delineated northwestern boundary of the impacted soils for PAHs, PCBs, metals and TPH; and
- ◆ One sample from beneath each hot spot, at the six-inch interval above the water table for TPH.

If, per the decision rules, a temporary well point is installed, then the groundwater sample collected from such temporary well point will be analyzed off-site by a NJDEP-certified laboratory for VOCs and BNs.

4.5 Block 305 of the Freight Yards

4.5.1 Site Conceptual Model

Block 305 is situated outside the Rail Area of the but still within the Freight Yard property. At this location there is a relatively small abandoned concrete block building, believed to have contained electrical equipment. Adjacent to the building, several rusting and substantially degraded 55-gallon drums were previously found and subsequently removed. In samples collected around these drums, surface soil samples were found to have concentrations of TPH, several metals, and PAHs above NJDEP SCC.

The conceptual site model for this site is an apparent release of COCs to surface soils from a suspected above ground source. Potential migration pathways are expected to be overland flow of surface water runoff and infiltration into underlying soils.

4.5.2 Objectives

The objective of the Dynamic Workplan for Block 305 of the Freight Yards is to delineate the lateral and vertical extent of impacts in soil to achieve the most stringent NJDEP SCCs. This objective is summarized on Table 5. A secondary objective is to determine if COC concentrations in soil have the potential to impact groundwater. The COCs identified through previous sampling activities at Block 305 of the Freight Yards include TPH, PAHs, and selected metals. The

greatest concern for the PAHs and TPH is the direct contact pathway. However, the occurrence of elevated TPH concentrations may represent potential groundwater quality impacts.

Based on the above considerations, it is assumed that the remedial concepts to be considered for Block 305 of the Freight Yards will address direct contact risks to persons enjoying the use of the planned Greenways, and if groundwater impacts are identified, addressing potential source area(s) and potential migration pathways.

In order to support an evaluation of applicable remedial concepts, delineation results will be completed to the most conservative NJDEP SCC (Table 6). This information will support an evaluation of all NJDEP remedial requirements for delineation, active remediation and, or establishment of engineering and/or institutional controls. This information will also enable the determination of potential on-site source areas, allow an estimation of the area impacted and the direction of contaminant transport.

Specific FAMs were selected based on the identified objectives and COCs as discussed below.

4.5.3 Contaminants of Concern (COCs)

Based on the previous analytical results of surface soil samples collected in the area, the COCs include PAHs, metals, and TPH. PCBs are also included as COCs based on the small building's history of storing electrical equipment.

4.5.4 Decision Rules

Block 305 is situated outside the impacted Rail Area of the Freight Yards. To estimate the area of impacted soil around this isolated AOC, soil sampling is proposed for this area. COCs, including PAHs, PCBs, metals, and TPH, will be vertically and horizontally delineated to the most-stringent SCCs. The decision rules Block 305 of the Freight Yards are summarized on Table 5, and are presented in more detail below.

Initial soil sampling will be conducted near the location of previous sampling points where impacts were found. Lateral step-out sampling locations will be spaced at about 25-foot intervals until concentrations are below the SCCs and TPH is less than 10,000 mg/kg. Vertical delineation will be conducted at five-foot depth intervals until the concentrations are below the SCCs and TPH is less than 10,000 mg/kg. Since the City of Trenton is planning to remove this building as part of the redevelopment project, a limited evaluation will be conducted within and/or beneath the building as well.

At all boring locations that are extended to the water table, visual observations of the potential occurrence of petroleum product will be made. Should product be observed, TPH exceed 10,000 mg/kg, or an IGWSCC be exceeded within two feet of the determined water table, a temporary well point will be installed. The temporary well point will consist of slotted PVC. A groundwater grab sample will be collected approximately 48 hours after well installation for off-site laboratory analysis for BNs and VOCs. The temporary well point will be abandoned immediately after sampling.

4.5.5 Technical Approach

We plan to initiate soil sampling near the previous sampling points. Soil samples will be analyzed for PAHs, while metals, PCB and TPH screening will also be conducted. Analytical results obtained from samples collected at these locations will be used to help calibrate the proposed FAMs against existing data, and to determine the vertical extent of soil impacts from the various COCs.

Initial step-out sampling locations will be spaced at about 25-foot intervals. Subsequent sampling locations will be determined based upon the criteria established under the decision rules. It will be important to delineate each COC group (i.e., PAHs, metals, TPH) out to the appropriate criteria for each group. Accordingly, the actual lateral and/or vertical extent of delineation may vary for each of these COC groups. Per the decision rules, a groundwater grab sample will be collected from a temporary well point if product is observed, TPH exceed

10,000 mg/kg, or an IGWSCC be exceeded within two feet of the determined water table.

4.5.6 FAM Delineation Requirements and Confirmatory Data

In order to ensure that delineation using FAM results accounts for potential matrix variability, duplicate samples will be analyzed on a minimum of 20% of the soil samples collected along the boundary of impacts. The highest obtained result from collected FAM duplicate samples will be used for comparison to identified delineation criteria.

Upon completion of delineation activities using FAMs, selected soil samples will be split between the mobile laboratory and an off-site NJDEP certified laboratory as a formal confirmation of the FAMS and to meet NJDEP requirements for certified data. Confirmatory samples that will be collected within Block 305 of the Freight Yards are summarized on Table 7. Up to 10 soil samples analyzed on site will be split and submitted to an off-site NJDEP-certified laboratory to undergo chemical analysis. Although the on-site analysis will consist of PAHs, TPH, PCBs and metals, the NJDEP-certified laboratory will analyze the split sample for these parameters as well as VOCs. VOC analysis will be performed to further verify that VOCs are not COCs in this area. Two split samples will be collected from within the delineated impacted zone to provide for correlation between obtained FAM results and fixed base analytical laboratory results. Up to eight soil samples will be collected from the boundary of the impacted zone, to

confirm the boundary of impacts and to meet NJDEP requirements for certified data.

5.0 FIELD PROCEDURES

5.1 Soil and Groundwater Sampling

All soil and groundwater grab sampling conducted as part of this dynamic workplan implementation will be accomplished with the use direct-push sampling equipment. Where possible (i.e., at Crescent Wire), such equipment will be mounted on a four-wheel drive truck. In the Freight Yards area, we anticipate that a track-mounted configuration will be required to access required sampling locations. This type of equipment will allow for rapid sample collection with minimum disturbance to the property.

Soil samples will be collected at continuous four-foot depth intervals with the use of either a dual-tube sampling system (at Crescent Wire), or an enclosed-piston sampling system (in the Freight Yards area). Both of these sampling systems effectively reduce the risk of cross-contamination between sampling intervals by continuously casing the borehole (dual-tube), or sealing the sampling unit until the desired sampling depth is reached (enclosed piston sampler). In addition, all soil samples will be collected within dedicated disposable acetate liners.

Once the soil cores have been retrieved, the liners will be opened and the contents scanned with an organic vapor meter (OVM) prior to being visually logged. Portions of the soil cores (generally from six inch depth intervals) will be retained for possible

chemical analysis/screening will be removed from the liners and placed into clean stainless-steel bowls and homogenized prior to being placed into labeled sample jars. Such homogenization will help assure sample representativeness as aliquots are removed for testing and/or split for subsequent conformation analysis.

Depth-discrete groundwater grab samples will be collected from temporary points consisting of Mill Slot rods or Screen Point samplers fitted with expendable points. Once the slotted rod or screen point has been set at the desired sample collection depth, groundwater within the rods will be purged, and a representative groundwater grab sample will be collected. Purging and sample collection will be accomplished with the use of a peristaltic pump fitted with a dedicated length of polyethylene tubing with a stainless-steel check valve and ball set at the bottom. Groundwater grab samples will be placed directly into labeled sample bottles.

Once sample collection activities have been completed at each boring location, the borehole will be filled with bentonite, and the location will be marked for subsequent mapping.

5.2 Field Analytical Program

This data will be generated in the field through the use of a combination of modified standard USEPA SW-846 methodology (e.g., GC/MS method 8270C) and a variety of FAMs, (e.g., Immunoassay test kits and X-Ray fluorescence). The practical quantitation limits for each FAM are presented on Table 8. In addition, a portion of the samples analyzed in the field will also be sent off site to be analyzed under strict NJDEP-certified

protocol. Such “split” samples will be used to generate collaborative data to help verify the quality of the data generated on-site. This information combined with the data previously generated both on-site, and more formally at the US EPA Region II laboratory, will ultimately create a thorough database with which to understand the distribution of COCs across these sites.

The remainder of this Section provides a description of the analytical procedures and/or methods to be utilized to accomplish the data needs of this program. In addition, the QA/QC steps to be taken to assure that data quality objectives are met is also presented.

5.2.1 Proposed Field Analytical Procedures and/or Methods

PAHs

Based upon information obtained from previous sampling and analysis events conducted at this Site, it appears that PAHs are commonly distributed throughout the site (primarily in the Rail Area of the Freight Yards) at concentrations that hover right around the most-stringent SCCs for individual compounds. Due to the disparity in specific cleanup criteria for the individual PAH compounds a modified version of USEPA SW-846 (GC/MS) Method 8270C will be employed in the field so the necessary detection limits for each individual PAH may be obtained. This modified analytical method for PAH analysis has been successfully conducted at the subject Freight Yards as part of previous evaluation activities.

As described in more detail below, the use of this modified GC/MS method for PAH analysis will provide accurate data at the necessary lower reporting limits for PAHs, while reducing the frequency of some quality assurance steps and data reporting requirements, thereby allowing a larger daily sample throughput. In addition, by utilizing an Accelerated Solvent Extraction technique coupled with a large volume injector, the turnaround times can be decreased and the daily sample throughput increased further.

Metals

The analysis of metals in soils will be performed with the use of a Spectrace 6000 XRF unit. The XRF has been previously proven to be extremely effective for metals analysis on these soils.

PCBs

PCBs were identified at elevated concentrations at the Crescent Wire Site and at lower concentrations at limited locations within the Rail Area of the Freight Yards. As a result of these varying concentrations, and in an effort to complete the delineation in an expeditious and cost effective manner, screening analysis of these compounds will be accomplished with the use of the RaPID Assay (immunoassay) test kits (EPA SW-846 Method # 4020) distributed by Strategic Diagnostics Inc. (SDI)

TPH

As described above, TPH was also identified at numerous locations throughout the Crescent Wire Site and Rail Yard area. All soil samples to be analyzed for

TPH at the Crescent Wire Site and at “hot spots” in the Freight Yards area as part of this dynamic field program, will be done so with the use of the Petro Flag (immunoassay) test kits specific to petroleum hydrocarbons. These test kits are capable of generating quantitative analysis of total TPH provided the type of petroleum hydrocarbon is known. In addition, limited TPH screening will also be conducted at selected presumed “clean” locations within the Rail Area of the Freight Yards. Such limited screening will be accomplished with a modified version of USEPA SW-846 Method 8270C as part of PAH analytical runs. In the event such screening indicates the presence of elevated concentrations of TPH, subsequent delineation samples will be analyzed with the use of test kits.

5.2.2 Field Analytical QA/QC Considerations

The QA/QC procedures for the FAMs are summarized on Table 9, and discussed in detail below.

GC/MS for PAH Analysis

Sample preparation for PAH analysis will involve extracting the samples in accordance with SW-846 method 3545 (Accelerated solvent extraction). Once extracted, sample analysis will be performed using a Hewlett Packard (HP) 5890*plus* Gas Chromatograph (GC) attached to a HP 5972 Mass Spectrometer (MS). Additionally, the GC will be equipped with the APEX Large Volume Injector capable of accepting up to 100ul injections onto a capillary column. With this combination of extraction and analytical equipment we will have the capability of generating definitive PAH data in real time fashion.

Quality Control measures will consist of a DFTPP tune, an initial 5 to 6 point calibration, and analysis of a method blank. Subsequent DFTPP tunes, continuing calibrations and method blank analysis will be conducted at a frequency of one every 24 hours. Matrix spike/Matrix Spike Duplicates may be analyzed at the discretion of the field analyst if matrix interference is deemed to be a concern. Practical quantitation limits will be approximately 660 ppb. Instrument-specific practical quantitation limits are attached as Table 8.

Immunoassay for PCB Screening

Screening for PCBs with the use of test kits will be accomplished with the use of RaPID Assay (immunoassay) test kits distributed by Strategic Diagnostics Inc. (SDI), in accordance with US EPA SW-846 Method 4020. These test kits are capable of generating quantitative analysis of PCBs with detection limits of 0.5 to 10.0 ug/L (ppb) total PCBs as Aroclor 1254 in water, and 0.5 to 10 ppm in soil. Basic test procedures consist of an initial 3 point calibration utilizing standards with concentrations of 0.25, 1.0 and 5.0 ppb as Aroclor 1254 for water, and 0.5, 2.0, 10 ppm for soil. Additionally a control and a blank sample will be analyzed prior to the initiation of environmental sample screening. All standards, control samples, blank samples and environmental samples will be quantified using an RPA-1 (or equivalent) spectrophotometer set at 450 nm.

Initially, a soil sample will be collected adjacent to a location previously tested at the Site with a known concentration of PCBs. This sample will be analyzed using the RaPID Assay test kit and results compared to the Laboratory generated data

previously acquired. This comparison will further assist in the calibration of the test kit method and increase the accuracy of this FAM.

Immunoassay for TPH Screening

As described above, TPH was identified at numerous locations throughout the Crescent Wire Site and Rail Yard area. Consequently, the use of Petro Flag Hydrocarbon (immunoassay) test kits specific to petroleum hydrocarbons will be employed at both areas. These test kits are capable of generating quantitative analysis of total TPH provided the type of petroleum hydrocarbon is known. For the purposes of this program, the quantitation and subsequent delineation of TPH will be based upon #6 fuel oil. Detection limits of 18 ppm TPH as #6 fuel oil will be achievable in soil. The basic test procedures consist of an initial 3-point calibration, sample extraction, and sample analysis. Additionally, a control and blank sample will be analyzed prior to environmental sample screening. All standards, control samples, blank samples and environmental samples will be quantified using the Petro Flag Analyzer Set to the preprogrammed response factor for #6 fuel oil.

GC/MS for TPH Screening

In addition to PCBs, S₂C₂ has also developed a method by which screening level data for TPH can be acquired concurrently with PAH analysis. Such screening is accomplished by analyzing specific petroleum hydrocarbon mixtures (e.g., fuel oil or motor oil) of known concentration. The primary ion specific to petroleum hydrocarbons, (i.e., the 57 ion) is then extracted from the acquired chromatogram and responses plotted to create a calibration curve. The same ion extraction

process is then followed for the environmental samples. This procedure will provide both qualitative and semi-quantitative information.

X-Ray Fluorescence (XRF) for Metals Screening

The analysis of metals in soils will be performed with the Spectrace 6000 XRF unit. Previous sampling events have indicated that Lead, Arsenic, Antimony, Copper and Zinc are of the greatest concern in this area. Because the greatest disparity in the results of sample analysis performed by XRF generally results from sample preparation, a very careful and specific sample preparation procedure will be performed on all soils to undergo XRF screening in the field in order to minimize such disparity.

Upon sample receipt in the mobile lab, all samples will be thoroughly dried in an oven for a minimum of 2 hours at a temperature of 300°C. A daily blank consisting of approximately 20 grams of clean sand will first be placed in a titanium cell ball mill and milled for approximately 5 minutes or until pulverized into dust. This same milling procedure will be followed for all environmental samples. An aliquot of this prepared sample will then be placed into a plastic cup covered with a mylar film window. The sample is now ready to undergo XRF screening within the Spectrace 6000 XRF unit.

XRF instrument calibration will consist of an initial X-axis calibration followed by an element response update using NIST calibration standards: 2709, 2710 and 2711. A daily X axis calibration and calibration check using NIST 2709 will also be performed. All sample screening will be performed under the 200-count

method utilizing 3 filters to generate the best possible detection limits while minimizing spectral interferences. This procedure generally yields practical quantitation limits of approximately 20 ppm in soil for the above mentioned metals (Table 8).

Field Duplicate Analysis

In addition to all the sample analysis/screening described above, field duplicate analysis/screening will also be conducted at minimum rate of one in 20 samples. Although it is difficult to obtain a true duplicate with soil samples, such analysis/screening will serve as another QA/QC check on the accuracy of the methods being employed in the field.

Additional field duplicate samples will be collected to verify the boundary of impacted soils (Table 9). Additional field duplicates will be collected of:

- ◆ 20% of samples collected from the delineated boundary of impacts at Crescent Wire;
- ◆ 50% of samples collected from along the northwestern boundary of impacts from the Rail Area, as well as samples along any other identified interior boundary of impacts;
- ◆ 20% of non-impacted samples from the subsurface, light brown soils in the Rail Area Freight Yards; and,

- ◆ 20% of samples from the delineated boundary of impacts at Block 305 of the Freight Yards.

These duplicate samples will be collected to minimize the uncertainty with the delineation; which will be further confirmed by the analysis of samples by a NJDEP certified laboratory, as discussed in Section 4. The high rate of duplicates in shallow soil delineating impacts of the Rail Area was chosen because of the high variability that is expected in these surface soils.

5.2.3 Reporting Requirements

Data reporting for all field analytical methods/procedures to be utilized as part of this program will consist of Form I's or summary data tables in excel format. Form I's will be generated for all data obtained via GC/MS. All other data will be reported on summary tables.

5.2.4 Collaborative/Confirmation Data

As described in Section 4, at the conclusion of field evaluation procedures, a number of samples will be split with an aliquot being analyzed by the mobile laboratory and the other aliquot sent off-site to undergo NJ-certified analysis with associated NJ-reduced deliverable data packages. The purpose of such analysis is to satisfy the NJDEP Technical Requirements for Site Remediation NJAC 7:26E and to serve as a further QA/QC check to help verify the quality and accuracy of the data generated in the field and the boundaries of the impacted

soil zones. These split samples that will be collected are summarized on Table 7.

In addition to such off-site collaborative data, it should be noted that a variety of on-site observations will also serve to collaborate the effectiveness of the on-site data. Such observations will include correlation to visual impacts, field screening (i.e., OVM PID, etc.), previous data generated, and consistency with the pattern of contaminant distribution observed. The value of this last correlation should not be underestimated. Given the large sample volume we intend to collect as part of the implementation of the Triad Approach, verifying the quality of a data set by evaluating it against the pattern of COC distribution observed can be an extremely valuable QA/QC tool when considered in context of the overall QA/QC program.

6.0 MANAGEMENT OF FIELD DATA AND COMMUNICATION OF FINDINGS

6.1 Daily Management of Field Data

A record of all field observations and procedural methodologies will be kept in field books throughout the duration of the dynamic field effort. The field team will review all analytical results generated in the field each day. Large site maps will be maintained in the field headquarters, and all sampling locations will be marked in the field and hand-plotted on these maps each day. The spatial relationship of data will be tracked on the maps throughout the duration of the field program, thereby assisting the field team in making in-field decisions. Given the relatively shallow focus of the sampling program,

the need to depict results in a 3-dimensional format in the field is not considered to be warranted in this particular situation.

Analytical results for all GC/MS analysis will be presented on Form I's, while results generated from the implementation of FAMs will be presented on summary tables prepared on excel spreadsheets. Either hard or electronic copies of these results can be provided at any time during the field program.

6.2 Protocol for Communicating Findings During Dynamic Field Events

All new findings, observations, and analytical results will be reported to the FTL in the field each day. Members of the field team will review updated information at the end of each field day, or the following morning prior to the start of daily sampling events. The FTL will be in regular communication with the overall project management team to convey the progress and the status of the dynamic field investigation. Current findings and implementation of decision rules will be discussed. In addition, any information that may result in a change in scope will also be addressed.

A representative of the project management team will be responsible for providing representatives of the City of Trenton with periodic project updates. At a minimum, such updates will occur when the field team believes that all field delineation efforts are about to be completed at any particular AOC, or in the event of an anticipated scope and/or schedule change. Ideally, representatives from the project team, the City of Trenton, and the NJDEP will be able to meet at the field headquarters to review the findings of the

dynamic field efforts prior to demobilizing from the site. In this way, a consensus can be reached with respect to the adequate acquisition of all required field information.

7.0 SCHEDULE AND LOGISTICS

As mentioned earlier, much of the geographic area to be addressed under this program is situated in an area of thick underbrush. Consequently, from a logistical perspective, it would be most efficient to conduct the subject field program in the autumn and/or winter when vegetation is least disruptive. We are currently planning to conduct this field program in December 2002. The schedule will need to be coordinated with the Department of Corrections prior to implementation. We anticipate that approximately two to three weeks will be required to complete the subject scope of work. The actual duration of the field program will be somewhat dependent upon access considerations and a review of analytical results obtained in the field.

Table 1
Groundwater Sample Results
PCB/Oil Impacted Area of the Crescent Wire Site
Assumpink Creek Greenway Project
Trenton, New Jersey

PARAMETER	UNIT	Higher of PQLs and Groundwater Quality Criteria*	Matrix: Date: Sample ID: Location: Depth (ft.): Lab ID:	Grounwater	
				CONC	MDL
				7/9/2002	
				CW-1-070902	
				CW-1	
				9-12	
				P3258-01	
Volatile Organic Compounds					
1,1,1-Trichloroethane	ug/l	30		ND	0.75
1,1,2,2-Tetrachloroethane	ug/l	2		ND	0.7
1,1,2-Trichloroethane	ug/l	3		ND	0.62
1,1-Dichloroethane	ug/l	70		ND	0.66
1,1-Dichloroethene	ug/l	2		ND	0.69
1,2-Dichlorobenzene	ug/l	600		ND	0.88
1,2-Dichloroethane	ug/l	2		ND	0.56
1,2-Dichloropropane	ug/l	1		ND	0.73
1,3-Dichlorobenzene	ug/l	600		ND	0.74
1,4-Dichlorobenzene	ug/l	75		ND	0.93
2-Chloroethyl vinyl ether	ug/l	NS		ND	2.2
Acrolein	ug/l	NS		ND	4.9
Acrylonitrile	ug/l	50		ND	3.5
Benzene	ug/l	1		ND	0.71
Bromodichloromethane	ug/l	1		ND	0.73
Bromoform	ug/l	4		ND	0.49
Bromomethane	ug/l	10		ND	0.38
Carbon Tetrachloride	ug/l	2		ND	0.47
Chlorobenzene	ug/l	4		ND	0.78
Chloroethane	ug/l	NS		ND	2.4
Chloroform	ug/l	6		ND	0.61
Chloromethane	ug/l	30		ND	0.51
cis-1,3-Dichloropropene	ug/l	NS		ND	0.66
Dibromochloromethane	ug/l	10		ND	0.66
Ethyl Benzene	ug/l	700		ND	0.76
Methylene Chloride	ug/l	2		ND	1.8
t-1,3-Dichloropropene	ug/l	NS		ND	0.66
Tetrachloroethene	ug/l	1		ND	0.7
Toluene	ug/l	1000		ND	0.71
trans-1,2-Dichloroethene	ug/l	100		ND	0.81
Trichloroethene	ug/l	1		ND	0.72
Trichlorofluoromethane	ug/l	NS		ND	0.73
Vinyl Chloride	ug/l	5		ND	0.79
m/p-Xylenes	ug/l	NS		ND	1.5
o-Xylene	ug/l	NS		ND	0.72
Total Xylenes	ug/l	40		ND	2.22
Total Volatiles	ug/l	NS		ND	
Volatile TICS	ug/l	NS		ND	
Total Volatiles +TICs	ug/l	NS		ND	

Notes:

NS - No Groundwater Quality Criteria Exists for that parameter.

ND- Parameter not detected in the sample.

MDL- Method Detection Limit

Table 2
Areas of Distressed Vegetation Surface Soil Analytical Results
Rail Area of the Freight Yards
Assunpink Creek Greenway Project
Trenton, New Jersey

	UNITS	NJDEP Residential Direct Contact Soil Cleanup Criteria	NJDEP Non-Residential Direct Contact Soil Cleanup Criteria	NJDEP Impact to Groundwater Soil Cleanup Criteria	Matrix Date Sample ID Location Depth (ft) Lab ID	FREIGHT YARDS-RAIL YARDS					
						SOIL 7/10/2002 RA-1-0-0.5		SOIL 7/10/2002 RA-2-0-0.5		SOIL 7/10/2002 DUP-071002 RA-2 0-0.5	
						P3276-02		P3276-03		P3276-04	
						Result	MDL	Result	MDL	Result	MDL
Polycyclic Aromatic Hydrocarbons (PAHs)											
Acenaphthene	mg/kg	3,400	10,000	100		ND 0.04		ND 0.042		ND ND	0.043
Acenaphthylene	mg/kg	3,400	10,000	100		ND 0.04		0.16 J 0.042		0.18 J	0.043
Anthracene	mg/kg	10,000	10,000	100		0.12 J 0.044		0.35 J 0.046		0.27 J	0.046
Benzo(a)anthracene	mg/kg	<u>0.9</u>	4	500		0.11 J 0.034		0.44 0.035		0.53	0.036
Benzo(a)pyrene	mg/kg	<u>0.66</u>	<u>0.66</u>	100		0.066 J 0.05		0.46 0.053		0.62	0.053
Benzo(b)fluoranthene	mg/kg	<u>0.9</u>	4	50		0.5 0.034		2 0.035		2.5	0.036
Benzo(g,h,i)perylene	mg/kg	NS	NS	NS		ND 0.044		0.2 J 0.046		0.29 J	0.046
Benzo(k)fluoranthene	mg/kg	<u>0.9</u>	4	500		0.32 J 0.087		1.3 0.092		1.4	0.092
Chrysene	mg/kg	9	40	500		0.41 0.054		1.2 0.057		NA	0.057
Dibenzo(a,h)anthracene	mg/kg	0.66	0.66	100		ND 0.05		ND 0.053		0.06 J	0.053
Fluoranthene	mg/kg	2,300	10,000	100		0.58 0.034		1.6 0.035		1.7	0.036
Fluorene	mg/kg	2,300	10,000	100		ND 0.037		0.045 J 0.039		0.046 J	0.039
Indeno(1,2,3-cd)pyrene	mg/kg	0.9	4	500		ND 0.054		ND 0.057		ND	0.057
Isophorone	mg/kg	1,100	10,000	50		NA		NA		NA	
Naphthalene	mg/kg	230	4,200	100		0.37 0.04		1.1 0.042		1.2	0.043
Phenanthrene	mg/kg	NS	NS	NS		0.45 0.034		1.6 0.035		1.6	0.036
Pyrene	mg/kg	1,700	10,000	100		0.45 0.034		1.9 0.035		1.9	0.036
Total PAHs	mg/kg	NS	NS	NS		3.376		12.4		12.3	
Polychlorinated Biphenyls (PCBs)											
Aroclor-1016	mg/kg	NS	NS	NS		ND 0.0053		ND 0.006		ND	0.0056
Aroclor-1221	mg/kg	NS	NS	NS		ND 0.0013		ND 0.001		ND	0.0014
Aroclor-1232	mg/kg	NS	NS	NS		ND 0.0081		ND 0.009		ND	0.0086
Aroclor-1242	mg/kg	NS	NS	NS		ND 0.0022		ND 0.002		ND	0.0024
Aroclor-1248	mg/kg	NS	NS	NS		ND 0.0056		ND 0.006		ND	0.0059
Aroclor-1254	mg/kg	NS	NS	NS		ND 0.011		ND 0.011		ND	0.011
Aroclor-1260	mg/kg	NS	NS	NS		0.12 0.002		0.14 0.002		0.23	0.0022
Total PCBs	mg/kg	0.49	2	50		0.12		0.14		0.23	
Metals											
Antimony	mg/kg	14	340	NS		1,980 0.48		27.3 0.5		18.7	0.5
Arsenic	mg/kg	20	20	NS		27.5 0.29		21.9 0.3		21.5	0.3
Beryllium	mg/kg	2	2	NS		0.24 B 0.01		0.34 B 0.01		0.38 B	0.01
Cadmium	mg/kg	39	100	NS		ND 0.04		ND 0.04		ND	0.04
Chromium	mg/kg	500 ¹	500 ¹	500 ¹		71.5 0.06		132 0.06		142	0.06
Copper	mg/kg	600	600	NS		307 0.09		154 0.1		136	0.1
Lead	mg/kg	400	600	NS		18,700 0.21		514 0.22		468	0.22
Mercury	mg/kg	14	270	NS		0.15 N 0.01		0.16 N 0.01		0.24 N	0.01
Nickel	mg/kg	250	2,400	NS		43.4 0.18		56.5 0.19		51.3	0.19
Selenium	mg/kg	63	3,100	NS		2 0.31		2.1 0.32		3.5	0.32
Silver	mg/kg	110	4,100	NS		3 0.1		0.6 B 0.11		0.66 B	0.11
Thallium	mg/kg	2	2	NS		ND 0.55		ND 0.57		ND	0.58
Zinc	mg/kg	1,500	1,500	NS		464 0.11		206 0.12		212	0.12
Wet Chemistry											
Total Petroleum Hydrocarbons	mg/kg	10,000	10,000	10,000		2,600 41		3,800 43		1,700 44	

Notes:

mg/kg - Milligrams per kilogram

ND - Compound not detected

NS - No Soil Cleanup Criteria exists for that compound.

MDL - Method detection limit

J - The result is less than the quantitation limit but greater than the MDL. The concentration given is an approximate value.

¹ The Soil Cleanup Criteria is an interim number.

12 - Indicates the concentration exceeds one or more of the NJDEP Soil Cleanup Criteria
400 - Indicates which NJDEP Soil Cleanup Criteria is exceeded.

Table 3
Dynamic Workplan Summary
PCB/Oil Impacted Area of Crescent Wire
Assunpink Creek Greenway Project
Trenton, New Jersey

Path	Objective(s)	Sampling Requirements	COC	Field Analytical Method	Delineation Criteria	Decision Rule
1	Delineate the lateral and vertical extent of PCB/Oil impacts in on-site saturated soils, identify a possible on-site source area(s).	Saturated soils around the known impacted area.	PCBs	Immunoassay test kits	SCC	From location where impacts were previously observed, step out at 25-foot intervals and down at 5-foot intervals until concentrations are below the delineation criteria. Once concentrations are below delineation criteria, step in once 10 feet. If a potential on-site source is identified, follow Path 3.
			TPH	Immunoassay test kits	1,000 mg/kg	
			metals	XRF	No Criteria	
2	Delineate the lateral and vertical extent of PCB/Oil impacts in on-site groundwater.	Groundwater around the known impacted area.	PCBs	Immunoassay test kits	Class IIA GWQS	From center of worst case soil impacts determined from Path 1, step out at 25-foot intervals and down at 5 to 10-foot intervals until concentrations are below delineation criteria.
3	Delineate PCB/Oil impacts in unsaturated soils, a potential on-site source area(s).	Unsaturated soils overlying most impacted saturated soils and/or groundwater.	PCBs	Immunoassay test kits	SCC	From the potential on-site source area, step out at 25-foot intervals and down at 5-foot intervals until concentrations are below delineation criteria. Once concentrations are below delineation criteria, step in once 10 feet.
			TPH	Immunoassay test kits	10,000 mg/kg	
			metals	XRF	No Criteria	

Notes:

SCC Most stringent of the NJDEP Soil Cleanup Criteria. Below the water table, the impact to groundwater (IGW) SCCs are no longer applicable.

Refer to Table 7 for a listing of the SCCs for COCs.

GWQS NJDEP Groundwater Quality Standards

PCBs Polychlorinated Biphenyls

TPH Total Petroleum Hydrocarbons

PAHs Polycyclic Aromatic Hydrocarbons

GC/MS Gas Chromatograph/Mass Spectrometer

XRF X-Ray fluorescence

Table 4
Dynamic Workplan Summary
Rail Area of the Freight Yards
Assunpink Creek Greenway Project
Trenton, New Jersey

Path	Objective(s)	Sampling Requirements	COC	Field Analytical Method	Delineation Criteria	Decision Rule
1	Determine if there are areas where the dark stained soils do not exist.	Sample Rail Area across a 100-foot grid, analyze surficial samples at 50 locations. ¹	PAHs	GC/MS	SCC	If sample results indicate that there is an interior boundary, verification samples will be collected along this boundary at 100-foot intervals, using the sampling grid locations.
			metals	XRF	SCC or MDL	
			PCBs	Immunoassay test kits	SCC	
			TPH	GC/MS	10,000 mg/kg	
2	Delineate surficial black impacted soils along the north "interior property boundary"	Surficial soils along the northwest boundary, with contingent samples in and across the concrete roadway. ¹	PAHs	GC/MS	SCC	If results exceed delineation criteria, conduct six additional step outs. ¹ If results continue to exceed delineation criteria, step out to the northwest at 50-foot intervals until delineation criteria are reached.
			metals	XRF	SCC or MDL	
			PCBs	Immunoassay test kits	SCC	
			TPH	GC/MS	10,000 mg/kg	
3	Identify any unknown "hot spots".	Sample Rail Area across a 100-foot grid, analyze surficial samples at 50 locations. ¹	TPH	GC/MS	10,000 mg/kg	If exceeds delineation criteria, location is identified as a hot spot. Sample according to Path 5.
4	Characterize hot spot areas that may represent potential sources of impacts to groundwater.	Sample surficial black soils and underlying brown soils. Collect one sample from the six inch interval above the water table below the worst case surficial impacts.	TPH	GC/MS	10,000 mg/kg	Start at the center of the "hot spot" and continue lateral delineation at 25-foot intervals, until TPH is < 10,000 mg/kg. Vertical delineation will be conducted at 25% of the locations where TPH > 10,000 mg/kg at 5-foot intervals until TPH < 10,000. A minimum of one sample will be collected from the six-inch interval above the water table, even if no impacts are identified. If TPH is above delineation criteria within 2 feet of the water table, install a temporary well point. ²
5	Characterize potential impacts to underlying light brown soils and underlying groundwater.	Sample Rail Area across a 100-foot grid, analyze light brown soil samples at 50 locations. ¹	PAHs	GC/MS	SCC	Continue vertical delineation at 5-foot intervals for those COCs which exceed delineation criteria, until the delineation criteria is achieved. If IGW SCC is exceeded within 2 feet of the water table, install a temporary well point. ²
			metals	XRF	SCC or MDL	
			PCBs	Immunoassay test kits	SCC	
			TPH	GC/MS	10,000 mg/kg	

Notes:

SCC Most stringent of the NJDEP Soil Cleanup Criteria. Below the water table, the impact to groundwater (IGW) SCCs are no longer applicable.

Refer to Table 7 for a listing of the SCCs for COCs.

MDL Method detection limit, refer to Table 8 for a listing of field analytical method MDLs.

PCBs Polychlorinated Biphenyls

TPH Total Petroleum Hydrocarbons

PAHs Polycyclic Aromatic Hydrocarbons

GC/MS Gas Chromatograph/Mass Spectrometer

XRF X-Ray fluorescence

¹ Refer to Figure 3 for proposed sampling locations.

² After a 48 hour wait after well installation, a groundwater grab sample will be collected from the temporary well point. The sample will be submitted to an off-site lab to undergo volatile organic and base neutral organic compound analysis. The temporary well point will be abandoned immediately after installation.

**Table 5
Dynamic Workplan Summary
Block 305 of the Freight Yards
Assunpink Creek Greenway Project
Trenton, New Jersey**

Path	Objective(s)	Sampling Requirements	COC	Field Analytical Method	Delineation Criteria	Decision Rule
1	Delineate the lateral and vertical extent of impacts in soil	Unsaturated and/or saturated soils around the known impacted area.	PAHs	GC/MS	SCC	Begin sampling at the location where impacts were previously observed. Step out laterally at 25-foot intervals and down at 5-foot intervals until the concentrations are below the delineation criteria for each COC. If TPH is >10,000 and/or concentrations within 2 feet of the water table are above the IGW SCCs, install a temporary well. ¹
			metals	XRF	SCC or MDL	
			PCBs	Immunoassay test kits	SCC	
			TPH	GC/MS	10,000 mg/kg	

Notes:

SCC Most stringent of the NJDEP Soil Cleanup Criteria. Below the water table, the impact to groundwater (IGW) SCCs are no longer applicable. Refer to Table 7 for a listing of the SCCs for COCs.

MDL Method detection limit, refer to Table 8 for a listing of field analytical method MDLs.

PCBs Polychlorinated Biphenyls

TPH Total Petroleum Hydrocarbons

PAHs Polycyclic Aromatic Hydrocarbons

GC/MS Gas Chromatograph/Mass Spectrometer

XRF X-Ray fluorescence

1 After a 48 hour wait after well installation, a groundwater grab sample will be collected from the temporary well point. The sample will be submitted to an off-site lab to undergo volatile organic and base neutral organic compound analysis. The temporary well point will be abandoned immediately after installation.

Table 6
NJDEP Standards to be Used as Delineation Criteria
Assunpink Creek Greenway Project
Trenton, New Jersey

Compound	SOIL			GROUNDWATER		
	Units	Residential Direct Contact Soil Cleanup Criteria	Non-Residential Direct Contact Soil Cleanup Criteria	Impact to Groundwater Soil Cleanup Criteria ³	Units	Class IIA Grounwater Quality Criteria
Poly-Aromatic Hydrocarbons (PAHs)						
Acenaphthene	mg/kg	3,400	10,000	100	NA	NA
Acenaphthylene	mg/kg	3,400	10,000	100	NA	NA
Anthracene	mg/kg	10,000	10,000	100	NA	NA
Benzo(a)anthracene	mg/kg	0.9	4	500	NA	NA
Benzo(a)pyrene	mg/kg	0.66	0.66	100	NA	NA
Benzo(b)fluoranthene	mg/kg	0.9	4	50	NA	NA
Benzo(g,h,i)perylene	mg/kg	NS	NS	NS	NA	NA
Benzo(k)fluoranthene	mg/kg	0.9	4	500	NA	NA
Chrysene	mg/kg	9	40	500	NA	NA
Dibenzo(a,h)anthracene	mg/kg	0.66	0.66	100	NA	NA
Fluoranthene	mg/kg	2,300	10,000	100	NA	NA
Fluorene	mg/kg	2,300	10,000	100	NA	NA
Indeno(1,2,3-cd)pyrene	mg/kg	0.9	4	500	NA	NA
Isophorone	mg/kg	1,100	10,000	50	NA	NA
Naphthalene	mg/kg	230	4,200	100	NA	NA
Phenanthrene	mg/kg	NS	NS	NS	NA	NA
Pyrene	mg/kg	1,700	10,000	100	NA	NA
Total PAHs	mg/kg	NS	NS	NS	NA	NA
PCBs						
Total PCBs	mg/kg	0.49	2	50	ug/l	0.5
Metals						
Antimony	mg/kg	14	340	NS	NA	NA
Arsenic	mg/kg	20	20	NS	NA	NA
Beryllium	mg/kg	2	2	NS	NA	NA
Cadmium	mg/kg	39	100	NS	NA	NA
Chromium	mg/kg	500 ¹	500 ¹	500 ¹	NA	NA
Copper	mg/kg	600	600	NS	NA	NA
Lead	mg/kg	400	600	NS	NA	NA
Mercury	mg/kg	14	270	NS	NA	NA
Nickel	mg/kg	250	2,400	NS	NA	NA
Selenium	mg/kg	63	3,100	NS	NA	NA
Silver	mg/kg	110	4,100	NS	NA	NA
Thallium	mg/kg	2	2	NS	NA	NA
Zinc	mg/kg	1,500	1,500	NS	NA	NA
Wet Chemistry						
Total Petroleum Hydrocarbons	mg/kg	10,000 ²	10,000 ²	10,000 ²	NA	NA

Notes:

mg/kg - Milligrams per kilogram

ug/l - Microgram per liter

NS - No Soil Cleanup Criteria (SCC) exists for that compound.

NA - Not applicable, the parameter will not be analyzed for in groundwater as part of the dynamic investigation.

¹ The SCC is an interim number.

² Value is not an SCC, but based on the maximum concentration for total organic contaminants.

³ The Impact to Ground water SCCs do not apply to soils from below the water table.

Table 7
Confirmatory Sample Summary
Assunpink Creek Greenway Project
Trenton, New Jersey

Site	Location	Matrix	Number of Samples	Analytical Parameters
Crescent Wire	Within the impacted zone	soil	2	PCBs, TPH, Metals
	Boundary of the impacted zone	soil	5	PCBs, TPH, Metals
Rail Area of the Freight Yards	Impacted black surface soil	soil	2	PAHs, PCBs, TPH, Metals
	Light brown soil	soil	3	PAHs, PCBs, TPH, Metals
	Boundary of impacts within the interior of the Rail Area (if identified)	soil	1 every 400 feet	PAHs, PCBs, TPH, Metals
	Northwest boundary of the black impacted soils	soil	4	PAHs, PCBs, TPH, Metals
	Hot spots at the six-inch depth above the water table	soil	1 per hot spot	PAHs, PCBs, TPH, Metals
	Where within 2 feet of the water table soil TPH>10,000 ppm or where product is observed	groundwater	1 per location	BN+15, VO+10
	Block 305 of the Freight Yards	Impacted soil	soil	2
Block 305 of the Freight Yards	Boundary of the impacted zone	soil	8	VO+10, PAHs, PCBs, TPH, Metals
	Where within 2 feet of the water table soil TPH>10,000 ppm or where product is observed	groundwater	1 per location	BN+15, VO+10

Analytical Methods:

- PCBs Priority Pollutant List (PP) Polychlorinated Biphenyls (PCBs) by USEPA Method 8082.
- TPH Total Petroleum Hydrocarbons (TPH) by USEPA Method 418.1.
- Metals PP Metals by USEPA Method 6010/7471.
- PAHs Polycyclic Aromatic Hydrocarbons (PAHs) by USEPA Method 8270C.
- BN+15 PP Base-Neutral Organic Compounds (BN) plus 15 tentatively identified compounds (TICs) by USEPA Method 8270C.
- VO+10 PP Volatile Organic Compounds (VO) plus 10 TICs by USEPA Method 8260B.

Notes:

Confirmation samples will be analyzed off-site at an NJDEP certified laboratory. With the exception of any groundwater samples, such samples will be "splits" of samples being analyzed in the mobile lab, and will help serve as a QA/QC check of the mobile laboratory data.

Table 8
Field Analytical Practical Quantitation Limits
Assunpink Creek Greenways Project
Trenton, New Jersey

GC/MS Method 8270C – Modified (PAHs)

<u>Analyte</u>	Extraction Method 3545 (ASE) <u>Soils (mg/kg)</u>
Naphthalene	0.5
Acenaphthylene	0.5
Acenaphthene	0.5
Fluorene	0.5
Phenanthrene	0.5
Anthracene	0.5
Fluoranthene	0.5
Pyrene	0.5
Benzo(a)anthracene	0.5
Chrysene	0.5
Indeno(1,2,3-cd)pyrene	0.5
Dibenz(a,h)anthracene	0.5
Benzo(g,h,i)perylene	0.5
Benzo(b)fluoranthene	0.5
Benzo(k)fluoranthene	0.5
Benzo(a)pyrene	0.5

IMMUNOASSAY Method 4020 (PCBs)

<u>Analyte</u>	<u>Soils (mg/kg)</u>
PCBs as Aroclor 1254	0.5
	<u>Water (ug/l)</u>
PCBs as Aroclor 1254	0.2

IMMUNOASSAY PetroFLAG (TPH)

<u>Analyte</u>	<u>Soils (mg/kg)</u>
TPH as #6 Fuel Oil	18.0

Table 8
Field Analytical Practical Quantitation Limits
Assunpink Creek Greenways Project
Trenton, New Jersey

GC/MS Method 8270C – Modified PCBs

<u>Analyte</u>	Extraction Method 3545 (ASE) <u>Soils (mg/kg)</u>
Aroclor 1242	0.5
Aroclor 1248	0.5
Aroclor 1254	0.4
Aroclor 1260	0.5

GC/MS Method 8270C – Modified (TPH)

<u>Analyte</u>	Extraction Method 3545 (ASE) <u>Soils (mg/kg)</u>
TPH	10

X-Ray Fluorescence (Metals)

<u>Analyte</u>	<u>Soils (mg/kg)</u>
Arsenic	20.0
Lead	12.0
Antimony	28.0
Copper	20.0
Zinc	20.0

Table 9
Field Laboratory QA/QC Summary
Assunpink Creek Greenway Project
Trenton, New Jersey

Analyte	Analytical Method	QA/QC Check	Interval
Metals	Spectrace 600 XRF	3 Point Calibration	at the start of the investigation, then every 24 hours
		Field Duplicate	minimum of one per twenty samples ¹
PAHs	GC/MS Modified 8270C with accelerated solvent extraction (3545)	DFTPP Tune	at the start of the investigation, then every 24 hours
		5 to 6 Point Calibration	at the start of the investigation
		Mid-level Continuing Calibration	every 24 hours
		Laboratory Blank	at the start of the investigation, then every 24 hours
		Field Duplicate	minimum of one per twenty samples ¹
PCBs	RaPID Immunoassay Test Kits	3 Point Calibration	per analytical batch
		Control Sample	per analytical batch
		Laboratory Blank	per analytical batch
		Comparison to Previous Results	at the start of the investigation
		Field Duplicate	minimum of one per twenty samples ¹
TPH	Petro Flag Immunoassay Test Kits	1 Point Calibration	per analytical batch
		Laboratory Blank	per analytical batch
		Field Duplicate	minimum of one per twenty samples ¹
	GC/MS Screening	5 to 6 Point Calibration	at the start of the investigation
		Mid-level Continuing Calibration	every 24 hours
		Laboratory Blank	at the start of the investigation, then every 24 hours
		Field Duplicate	minimum of one per twenty samples ¹

Notes:

- XRF X-ray fluorescence
- PCBs Polychlorinated Biphenyls
- TPH Total Petroleum Hydrocarbons
- PAHs Polycyclic Aromatic Hydrocarbons
- GC/MS Gas Chromatograph/Mass Spectrometer

Confirmatory samples split between the mobile lab and a NJDEP-certified fixed lab will serve as an additional QA/QC check. These sample locations are summarized on Table 7.

- 1 Additional field duplicates will be collected at the boundary of impacted zones to confirm delineation, as follows:
- 20% of the soil samples collected from the boundary of impacts at the Crescent Wire Site.
 - 50% of samples collected along the northwest extent of impacts and any interior boundary of impacts within the Rail Area of the Freight Yards
 - 20% of samples in the light brown soils in the Rail Area identified as not impacted