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Steve P. Trifiletti
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June 15, 2010

Mr. William T. Ports, PE
Environmental Engineer 2
Remedial Section
New York State Department of Environmental Conservation
Division of Environmental Remediation
Remediation Bureau C, 11th Floor
625 Broadway
Albany, New York 12233 -7014

RE: Remedial Design/Remedial Action Work Plan
Former Tappan Terminal, Western Parcel, AOC 1
Hastings on Hudson, Westchester County, New York
Site No. 3-60-015

Dear Mr. Ports:

In response to your letter of May 21, 2010 and pursuant to Section II.B.1.(a) of Order on Consent and Administrative Settlement A3-0612-1208, enclosed are two bound copies and one unbound copy of the Remedial Design/Remedial Action Work Plan for AOC1 at the Western Parcel of the Tappan Terminal Site in Hastings-on-Hudson, New York. (An electronic version of the report will be sent separately by electronic mail.) Please contact me at (718) 383-7374 with any questions or comments pertaining to the enclosed Work Plan.

Sincerely,

S.P. Trifiletti

Steve P. Trifiletti
Project Manager

copy: N. Walz – NYSDOH, Troy, NY (2 copies)
G. Litwin – NYSDOH, Troy, NY (cover only)
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WOODARD
&CURRAN

Remedial Design/ Remedial Action Work Plan

Former Mobil Terminal Property
Hastings-on-Hudson, New York
Former Tappan Terminal
Site No. 3-60-015

STATE OF NEW YORK
ANNE E. PROCTOR
070786
LICENSED PROFESSIONAL ENGINEER

Anne Proctor

6/15/10

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June 15, 2010

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1. INTRODUCTION

On September 8, 2006, a Record of Decision (ROD) was issued by the New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation for the former Tappan Terminal in Hastings on Hudson, New York. Pursuant to the ROD, pre-design investigations were conducted on the parcels that comprise the former Tappan Terminal site in preparation for site remediation. Based on the pre-design investigation conducted on the former Mobil Terminal parcel of the former Tappan Terminal site, this Remedial Design/Remedial Action Work Plan ("Work Plan") is proposed to remediate soil in preparation for redevelopment of that parcel.

1.1 SITE DESCRIPTION

The former Mobil terminal property is part of the larger Tappan Terminal site, located on 15 acres along the Hudson River waterfront in the Village of Hastings-on-Hudson, Westchester County, New York. The Tappan Terminal is comprised of two parcels, the former Mobil terminal property (the Western Parcel, hereafter referred to as the "Site"), which is located adjacent to the Hudson River (the subject of this Work Plan), and the Uhlich Color Company property (the Eastern Parcel), which is located along the railroad tracks that define the eastern boundary of the Site (not included in this Work Plan). **Figure 1** shows the location of the Site, and **Figure 2** shows the boundaries and main features of the Western Mobil parcel.

The Site was used as a petroleum distribution terminal from 1961 until Mobil ceased operations on the Site in 1985. The Site has remained vacant since that time. Mobil Oil Corporation (now ExxonMobil Oil Corporation) remains the Site owner. All former buildings and aboveground storage tanks have been removed from the Site. The Site is relatively flat, located on the eastern shore of the Hudson River.

The northern two-thirds of the Site is surrounded by the remnants of an earthen containment berm that defined the former terminal tank farm and contains the concrete foundations of four former aboveground storage tanks, as depicted in **Figure 2**. A bare concrete pad is located in the former terminal loading area on the southern portion of the Site. A small portion of the extreme southern end of the ExxonMobil property is leased to the Pioneer Boat Club for use as a marina.

The remnants of aboveground piping runs are scattered on the ground around the bermed area. A visual survey of the piping conducted in 2008 determined that most, if not all, of the pipe is disconnected and empty. A complete survey was not possible due to the dense vegetation present onsite.

The Site was historically accessed from Railroad Avenue over the Zinsser Bridge that crosses the railroad tracks at the southeast corner of the Site. This bridge has fallen into disrepair and is no longer open to vehicular traffic. The only vehicular access to the Site currently is from the ARCO property abutting the Site on the north. The Site is secluded by a perimeter chain link fence.

1.2 SITE REGULATORY HISTORY

The Tappan Terminal has a long history of manufacturing and chemical use by several owners and occupants. The landmass of the Site itself was created by disposal of manmade fill into the Hudson River between 1868 and 1970. This fill material typically consisted of sand and gravel mixed with bricks, concrete, stone, timber, ash, slag, shells, and other debris. Filling progressed on the former Mobil Terminal parcel between 1920 and 1960. Tappan Tanker Terminal purchased the property in 1961 and began operating a petroleum distribution facility onsite. From 1961 to 1971 waste chemicals were stored on the property prior to open ocean disposal. Mobil Oil Company purchased the Site in 1975 and continued petroleum distribution operations until 1985. The Site has been vacant since that time.

Onsite sampling of various media was performed between 1985 and 1989. In 1987, the NYSDEC listed the Site as a Class 2 Site in the Registry of Inactive Hazardous Waste Disposal Sites in New York.

During a 1992 repair of a sewer pipe at the Site, evidence of a petroleum release on both the Mobil and abutting Uhlich properties was discovered. The extent of petroleum contamination was investigated between 1992 and 1994. In 1994, an oil remediation plan was approved by the NYSDEC. Mobil and Uhlich entered into a Stipulation Agreement to remediate this spill.

In 1996 Mobil entered into a Voluntary Agreement with the NYSDEC to investigate petroleum contamination on the Site. Multiple phases of investigation were conducted onsite between 1998 and 2008.

The Tappan Terminal site was the subject of a ROD issued by the NYSDEC Division of Environmental Remediation on September 8, 2006. The ROD addressed both the Mobil and Uhlich properties. This Work Plan addresses only soil issues on the Western Mobil parcel of the Tappan Terminal site.

The NYSDEC issued draft versions of an Order on Consent in October 31, 2006 and February 13, 2009, and meetings were conducted on November 11, 2007 and March 26, 2009. The NYSDEC requested that work proceed for the pre-design investigation (**Section 2.2**) and the Work Plan herein in parallel with negotiations for the Order. Order on Consent No. A3-0612-1208 was effective March 14, 2010.

1.3 SITE GEOLOGY AND HYDROGEOLOGY

The Tappan Terminal property is underlain by four geologic units, the upper fill layer, the Marine Grey Silt, the Basal Sand unit, and bedrock. The upper fill layer ranges from 11 to 32 feet in thickness, and consists of sand, silt and gravel variably mixed with ash, slag, glass, metal debris, wood, crushed stone, paper, coal, sawdust and brick fragments. This material is typical of historic waterfront fill material deposited during the late 19th and early 20th centuries. The historic fill is considered to be relatively permeable; however, intermediate bulkheads were built in stages along the shoreline as filling proceeded. These bulkheads are now buried beneath the property, and in some places act to restrict the flow of groundwater towards the river.

Groundwater flows through the fill layer from east to west and discharges to the Hudson River, subject to the tide stage of the river. At high tide, the groundwater flow direction reverses along the immediate shoreline and water enters the Site from the river. Generally, tidal fluctuations in the river affect groundwater levels within 100 feet of the shoreline. Site groundwater is generally 2 to 7 feet below grade and quality is influenced by the influx of river/ocean water during tidal cycles.

Beneath the fill unit lies the Marine Grey Silt unit that represents the historic sediment of the Hudson River. This unit consists of grey to black silt with a trace of fine sand and layers of shell fragments. The Marine Grey Silt is at least 8 feet thick beneath the property, and ranges from 10 to 62 feet thick in the local area. The silt unit acts as a confining layer. This unit is believed to be continuous beneath the Site.

The Basal Sand Unit that underlies the silt layer consists of permeable, medium to coarse sands and gravels. Although this unit was not investigated at the Tappan Terminal site, measurements in the vicinity indicate that the Basal Sand Unit is a confined aquifer under artesian conditions. That is, groundwater pressure in the Basal Sand is greater than in the fill unit, and flow would be upward in the absence of the confining silt unit.

The underlying bedrock in the area is reported to be either Inwood Marble or Fordham Gneiss at 50 to 100 feet below grade.

2. PREVIOUS INVESTIGATION HISTORY

A Remedial Investigation/Feasibility Study (RI/FS) was conducted to evaluate alternatives for addressing threats to human health and the environment. The 2006 Record of Decision (ROD) was issued based on this work. A subsequent Pre-Design Investigation was conducted in 2008 to further identify "grossly contaminated" soil onsite requiring removal.

2.1 SUMMARY OF THE REMEDIAL INVESTIGATION AND FEASIBILITY STUDY

The purpose of the Remedial Investigation (RI) was to define the nature and extent of any contamination resulting from previous activities at the Tappan Terminal site. The RI was conducted between July 1998 and September 1999. The field activities and findings of the investigation are described in the "September 1999 Remedial Investigation Report" (RI Report). The RI Report included:

- A compilation of historic data and preparation of a comprehensive map;
- Collection of soil samples from surface and subsurface locations;
- Water level measurements in existing monitoring wells to determine groundwater flow characteristics, and an evaluation of tidal impacts from the Hudson River;
- Sampling of groundwater in existing wells and temporary well points;
- Analysis of all soil and groundwater samples for a comprehensive list of contaminants; and
- Collection and analysis of sediment samples adjacent to the Tappan Terminal site and background locations.

The soil and groundwater data from the RI Reports was compared to the following regulatory criteria:

- Groundwater, drinking water and surface water Standards, Criteria and Guidance (SCGs) are based on NYSDEC "Ambient Water Quality Standards and Guidance Values" and Part 5 of the New York State Sanitary Code
- Soil SCGs are based on the NYSDEC "Technical and Administrative Guidance
- Memorandum (TAGM) 4046; Determination of Soil Cleanup Objectives and Cleanup Levels"
- Sediment SCGs are based on the NYSDEC "Technical Guidance for Screening
- Contaminated Sediments"

Based on the RI Report results, in comparison to the SCGs and potential public health and environmental exposure routes, certain media and areas of the Tappan Terminal site were determined to require remediation.

The Feasibility Study (FS) included additional soil and groundwater sampling to determine the volume of soil potentially requiring remediation as well as a pilot test of air sparging, soil vapor extraction and enhanced bioremediation conducted in 2002. ExxonMobil also conducted a pilot test to investigate biosparging in 2004. These studies were performed to further evaluate technologies under consideration in the draft Feasibility Study.

The contaminants of concern included Semivolatile Organic Compounds (SVOCs), Total Petroleum Hydrocarbons (TPH), and metals: arsenic, beryllium, copper, mercury, nickel and zinc. The metals were found throughout the surface and subsurface fill, and are commonly associated with historic fill containing ash and furnace slag.

The potential exposure pathways for soil related to current use or development of the Site include:

- Inhalation of contaminated dust or vapors by workers during onsite excavation activities;
- Inhalation of contaminated vapors in indoor air by future occupants of buildings that may be constructed on the Site;
- Incidental ingestion of contaminated soil by onsite workers or recreational users of the Site;
- Dermal contact with contaminated soil by workers or recreation users; and
- Exposure of wildlife to contaminants in Site surface soils.

2.2 SUMMARY OF THE PRE-DESIGN INVESTIGATION

A Pre-Design Investigation (PDI) for soil at the Site was implemented in early 2008 and was based on historic investigation programs and the requirements of the 2006 Record of Decision (ROD). Soil sampling was conducted on a grid pattern across the Site, with additional sampling locations completed in the central area of the former tank farm to evaluate the potential presence of grossly contaminated soil. Field work commenced February 4, 2008 and was completed on March 31, 2008 with the NYSDEC in attendance. The findings were documented in the Pre-Design Investigation Report dated May 13, 2008 and are summarized below:

- Efforts in the field to visually identify grossly contaminated soil were highly subjective and visual observations were not supported by either field screening or analytical laboratory analysis. The Site mainly consists of fill material which is generally dark in color and includes random debris (glass bottles, etc.). A targeted sample of a discolored, darker layer at the water table had Total SVOCs plus Tentatively Identified Compounds (+TICs) of 198.2 parts per million (ppm), well below criteria in the ROD of 500 ppm. Visual coloration of soil is not a consistent indication of gross contamination.
- Using the criterion established in the ROD of 500 ppm Total SVOCs+TICs, laboratory analytical results (**Table 1**) were mapped (**Figure 2**) to identify areas that exceeded this criteria. A total of forty-four samples were analyzed, of which only six centralized locations had concentrations of Total SVOCs+TICs in excess of the 500 ppm criteria (**Figure 3**). These locations that exceeded criteria were proposed to be excavated as part of the future Remedial Design/Remedial Action Work Plan (**Figure 4**).
- Unsuccessful attempts were made to sample below former structures. The former tank pad could not be breached, nor could the interior of the former tank rings. A follow-up investigation of the tank rings was conducted on April 21, 2009. Three borings were spaced throughout each of the four former tank rings and completed using a hand auger. Refusal was encountered between 12 inches and 18 inches below the top of each concrete ring. Based on the sound and feel of the auger on the encountered material, it is believed to be concrete. These structures will be demolished in-situ and investigated as part of the Work Plan herein.
- Attempts to visually catalogue and map surface and subsurface piping and structures on the Site (refer to Section 8 of the ROD) were incomplete due to dense vegetation and the scattered nature

of the piping. Piping was observed to be primarily disconnected pieces on grade with a red-colored exterior indicative of water piping for fire suppression. Piping will be removed for scrap value to the extent practicable as part of the Work Plan herein

3. REMEDIAL DESIGN/REMEDIAL ACTION WORK PLAN

The soil sampling performed to date identified contamination on the Site that exceeds applicable criteria as defined in the ROD. This Work Plan proposes additional investigation in areas not previously accessible for soil sampling, and remediation to address “grossly contaminated” soil onsite. These actions will minimize the potential for risk to human health or the environmental until such time as the Site is redeveloped and a final remedy is constructed per the ROD. The objectives and approach of this Work Plan are described below.

3.1 REMEDIATION OBJECTIVES

Per the ROD, the remediation goals for the Site have been established through the remedy selection process stated in 6 NYCRR Part 375-1.10. The remedy was selected to eliminate or mitigate all significant threats to the public health and/or the environment presented by the soil contamination identified at the Site, through the proper application of scientific and engineering principles. The remediation goals for this Site are to prevent direct contact with and/or ingestion of impacted Site soil.

The selected remedy for the Site includes excavation and removal of soil that is grossly contaminated with weathered petroleum, removal of former piping, and any other structures, as necessary, to allow adequate Site grading. The entire Site, which contains residual contamination and historic fill, will be covered with an engineered control (see below) to render the Site soils inaccessible.

After removal of the grossly contaminated soils and general Site grading, the final engineering control will include a demarcation layer, to be placed over the existing onsite soil. The demarcation layer (such as orange plastic snow fence or existing asphalt or concrete surfaces) will identify the presence of contaminated fill beneath it, and provide a physical barrier against unintended penetration. If the Site is to remain open space, the demarcation layer will be covered with an 18-inch thick layer of clean soil and a 6-inch layer of soil capable of supporting vegetation. The soil will be planted with a suitable ground cover. The demarcation layer is not intended as an infiltration barrier; however, the soil cover will be graded to promote runoff and development plans may include drainage swales, infiltration zones and/or other controls to prevent inadvertent ponding or erosion of the soil cap. Alternative surfaces such as new pavement or building slabs would be considered as a substitute for the soil cover, in conjunction with the final Site development. If a Site development plan is available when the cover system design is prepared, clean utility corridor(s) will be constructed. Soil excavated from the corridor(s) will either be re-graded onsite and covered or disposed offsite.

To ensure that future activity at the Site would not compromise the integrity of the engineering control, and to prevent future exposure to contaminated fill, an Environmental Easement will be filed on the property deed. This easement will specify the requirements for conducting intrusive activities beneath the cover system. These requirements will include NYSDEC, NYSDOH and Village of Hastings-on-Hudson notification and approval, health and safety planning, soil management and disposal planning, and barrier repair procedures prior to any work involving disturbance of the final cover. New structures would be permitted at the Site, provided that an effective barrier to subsurface contamination is maintained and building foundations are properly ventilated to prevent exposure to soil vapors.

3.2 REMEDIAL APPROACH

The following sections provide a brief summary of each area or media where remedial actions will be conducted and the approach intended to address the area or media. These actions will be conducted in the vicinity of well OW-5A, within the former tank pads/rings, and under the former concrete pad as depicted on **Figures 3 and 4**. Work will be guided by the project specific Health and Safety Plan for the Site (refer to Appendix B of the PDI Work Scope dated November 19, 2007).

3.2.1 Soil Remediation

On March 31, 2008, with NYSDEC representatives in attendance, only one area of "grossly contaminated" soil was identified during the pre-design investigation as shown on **Figure 3**. This area will be excavated and stockpiled for offsite transportation and disposal as detailed in the Contaminated Materials Management Plan (CMMP) in **Appendix A**.

Based on the approach outlined in a letter to the NYSDEC dated August 22, 2008 containing ExxonMobil's Response to Comments from the NYSDEC; and an April 29, 2009 conference call attended by ExxonMobil, Woodard & Curran and the NYSDEC, the following field screening method and analytical protocol to identify "grossly contaminated" soil will be used:

- If a soil layer in excess of six inches thick exhibits evidence of a petroleum sheen or petroleum globules, a sample of the soil will be placed in a 4-ounce or 9-ounce soil jar and submerged in distilled water. The soil will be stirred to break up any clumps and then allowed to settle for five minutes. If a continuous product layer develops, with a meniscus on the surface, the soil will be considered "grossly contaminated" and removed.
- When excavation of "grossly contaminated" soil is completed, soil samples at the extent of the excavation (sidewalls and base) will be collected and laboratory analyzed for total SVOCs (note: Per discussion with NYSDEC, TICs are applicable only to dye impacts and not required to assess petroleum impacts). If the total SVOC results exceed 500 ppm, additional iterations of excavation and sampling will be conducted at those locations until no further exceedances are encountered.

Limits of the excavation (side walls and base) will be sampled every 20 linear feet at two feet above and two feet below the water table, unless other locations or intervals are identified by visual observation or field screening, and submitted to Accutest Laboratories of Dayton, New Jersey for analysis of SVOCs by EPA Method 8270. Sampling quality assurance/quality control will be conducted in accordance with the Quality Assurance Project Plan (QAPP) included in **Appendix B**.

Excavation deeper than two feet into the water table is not anticipated since the residual petroleum is a light non-aqueous phase liquid (LNAPL) and is likely restricted to the top of the water table and accompanying "smear zone" associated with the seasonal fluctuation in the water table. However, the depth of excavation will be determined in the field based on testing as described above and the excavation will be continued until no further grossly contaminated soil is encountered.

Should dewatering become necessary during excavation the groundwater shall be pumped out and containerized onsite for characterization and offsite disposal. Dewatering shall be conducted in accordance with Section 8 of the CMMP included as **Appendix A**.

Excavated soils will be segregated at the time of removal based on visual evidence of contamination. Grossly contaminated soils will be loaded directly into trucks and moved to a prepared stockpile area to be managed in accordance with the CMMP (**Appendix A**) pending characterization and offsite disposal. Reusable soils will be stockpiled adjacent to the excavation or suitable area onsite.

The excavation may be temporarily left open pending receipt of laboratory analytical results on the confirmation samples. During this time the excavation shall be temporarily fenced (i.e. orange snow fencing) with appropriate signage to indicate the hazard.

The excavation will be subsequently backfilled with uncontaminated soil, free of extraneous debris or solid waste. Onsite material will be used as backfill, to the extent possible. This may include reusable excavation material and soil from the onsite tank area berm, to facilitate regrading of the Site and preparation of the Site for the final remedy cap or reuse. Where necessary, imported clean fill will be used to complete the backfilling.

Community air monitoring will be conducted during soil excavation in accordance with SOP-9 in Attachment A of the QAPP provided as **Appendix B**. Dust suppression will be implemented, as needed, in accordance with the CMMP provided as **Appendix A.** Equipment decontamination will be conducted following handling of grossly contaminated soil in accordance with SOP-4 in Attachment A of the QAPP provided as **Appendix B**.

3.2.2 Demolition of Remnant Concrete Foundations

One concrete pad, located near the terminal entrance (see **Figure 2**), and the four concrete tank rings and foundations will be mechanically broken up using an excavator with hoe ram attachment, or other suitable means. Any standing water will be allowed to drain. Concrete will then be rubblized and left in place to demark and stabilize the areas.

Community air monitoring will be conducted during break up of the concrete, and dust suppression will be implemented, as needed, as specified above in **Section 3.2.1**.

3.2.3 Soil Investigation Under Remnant Concrete Foundations

Soil under the rubblized concrete foundations will be investigated by excavating test pits into the underlying soil. One test pit is proposed central to each of the two smaller tank rings and under the loading terminal concrete pad. Three test pits are proposed under each of the two larger tank rings. Proposed test pit locations are indicated on **Figure 4**. Each test pit will be excavated at least two feet into the water table and inspected for evidence of grossly contaminated soil using the shake test method specified in **Section 3.2.1**. Any grossly contaminated soil will be removed and managed also as specified in **Section 3.2.1**.

Confirmatory soil samples will be collected from each test pit and submitted to Accutest Laboratories of Dayton, New Jersey for analysis of SVOCs by EPA Method 8270. Unless other intervals are dictated by field task or visual observation, soil samples will be collected from two feet (2') above and two feet (2') below the water table. If excavation is required to remove grossly contaminated soil, the fill excavation limits will be sampled per the criteria specified above in **Section 3.2.1**. The test pits will be left open temporarily pending laboratory analytical results and will be secured with fencing and signage, as appropriate, until they are backfilled. Backfilling will occur similar to that specified above in **Section 3.2.1**.

Test pits will be constructed in accordance with SOP-6 and equipment decontamination will be conducted in accordance with SOP-4 in Attachment A of the QAPP provided as **Appendix B**.

Community air monitoring will be conducted during test pitting, and dust suppression will be implemented, as needed, as specified above in **Section 3.2.1**.

3.2.4 Removal of Remnant Piping and Other Structures

Any piping or structures encountered during break up of the concrete structures, test pitting and/or Site grading will be removed. All previously inspected piping was noted to be empty and in discontinuous pieces. Pipe, conduits or structures containing liquid, sediment or sludge of unknown contents shall be handled so as to minimize breakage and contain the material. Prior to moving the structures, intact pipes shall be tapped and drained with the contents containerized. If the pipe cannot be drained, the pipe ends shall be sealed with 6 mil polyethylene sheeting and duct tape, or equivalent, to contain the contents in the pipes. The sealed pipes shall be stockpiled on polyethylene sheeting. Materials will be segregated and stockpiled for offsite recycling or disposal per Section 4 in CMMP provided as **Appendix A**.

3.2.5 Site Security

Once remediation is complete, including soil and pipe removals, in-situ demolition of the concrete pads, and any excavations have been backfilled, the Site perimeter fencing will be restored and signage will be posted to discourage trespassing.

3.3 REMEDIAL DESIGN/REMEDIAL ACTION REPORT

Once Work Plan activities have been completed, a report will be prepared detailing these activities and updating the Site status within ninety (90) days of receipt of laboratory analytical results. A survey will be conducted to document the Site topography and remaining Site features. Additional follow up activities will be specified (i.e. periodic Site inspection) and a schedule for the Final Remedial Design Work Plan for the cover design will be proposed in the report.

4. ADMINISTRATIVE AND FUTURE REMEDIAL ACTIVITIES

The future Site use has not yet been determined and remedial activities for the neighboring Uhlich parcel have not been finalized. Based on this uncertainty, ExxonMobil proposes to stabilize the Site as specified in **Section 3**, and leave the Site vegetated and secured until such time as the final remedy prescribed in the ROD can be practically designed, specified, implemented and coordinated for all parcels based on intended use. At that time, ExxonMobil will prepare to assist NYSDEC with filing an environmental easement as specified in the ROD and detailed below.

4.1 ANTICIPATED FINAL REMEDY

Since operations shut-down in 1985, the Site has naturally vegetated with a dense understory that mitigates soil erosion from the Site and deters trespassing. This vegetative cover will be left in place until such time as remedial measures have been implemented for soil and groundwater at both the Site and the neighboring Eastern Uhlich parcel. At that time, the protective vegetative cover will be cleared and grubbed in preparation for the final remedy and redevelopment as described below.

Future Site use may involve redevelopment (buildings, pavement) or the Site may remain as open space. If the Site is to remain open space, or there are undeveloped portions of the Site, a soil cap will be installed and maintained under a Site Management Plan (SMP) as outlined in the sections below. Redeveloped portions of the Site will provide alternative barrier surfaces, such as new pavement or building slabs, in lieu of a soil cap.

4.1.1 Cap Design

The Site cap will be designed to act as a barrier to prevent incidental exposure to surface soils and to act as a warning layer to prevent accidental contact to soils during future onsite activities in open, unimproved areas. The cap will consist of geotextile fabric installed across open, unimproved areas covered by two feet of clean soil. The geotextile will be permeable to water and will have puncture strength sufficient to prevent penetration with a shovel. The geotextile is typically available in 22-foot wide rolls and will be installed in long strips that will be sewn together prior to being covered by the clean soil.

4.1.2 Redevelopment Plans

Future redevelopment of the Site is likely to include buildings, parking lots, and or paved areas that will render Site soils inaccessible and/or environmentally isolated and act as a barrier to incidental or accidental exposure. These improved features will be incorporated into the overall Site final remedy and the SMP as described in **Section 4.1.3**.

4.1.3 Site Management Plan (SMP)

For any institutional or engineered controls, such as the soil cap or barrier surfaces from Site redevelopment, a SMP will be developed and will specify the following:

- Identification of any use restrictions on the Site;
- Provisions for the construction of a clean utility corridor if and when Site development occurs;

- Provisions for the continued proper operation and maintenance of the components of the remedy;
- Provisions for evaluating the potential for vapor instruction to any buildings developed on the Site, including provision for mitigation of such impacts if identified; and
- Provisions for management of the final cover system to restrict excavation below the soil cover's demarcation layer, pavement or buildings. Identify protocols to handle necessary excavations including soil handling procedures, protections for the health and safety of workers and the nearby community, and cover restoration in a manner acceptable to the NYSDEC.

4.2 ENVIRONMENTAL EASEMENT

Environmental Conservation Law [ECL 27-1318(b)] requires that within sixty (60) days of commencement of the remedial design, the owner and/or responsible party of an inactive hazardous waste disposal site where institutional or engineering controls are employed must execute an environmental easement. At this time, in the absence of detailed redevelopment plans, the Site is vacant, private property and institutional or engineering controls are not proposed. Upon redevelopment, and the final remedy necessitates such institutional or engineering controls, an environmental easement as required by the ROD will provide the following restrictions:

- Limit the use and development of the property to recreational, commercial and industrial uses;
- Require compliance with an approved Site Management Plan (SMP);
- Restrict the use of groundwater as a source of potable water without proper treatment; and
- Require a periodic certification of the institutional and engineering controls.

NYSDEC will prepare a draft environmental easement form within 60 days of commencement of the final remedial design when institutional or engineering controls will be employed, including the necessary supporting documentation provided by ExxonMobil as follows:

- Copies of the current deeds;
- Survey drawings, and metes and bounds descriptions of the property;
- Subordination agreements for any existing easements;
- Updated title reports; and
- Title insurance policies naming the NYSDEC as an additional insured.

After NYSDEC accepts the environmental easement and returns the fully executed document to ExxonMobil, ExxonMobil will undertake the following actions:

- Within 30 days of execution, file the easement with the recorder of the county in which the Site is located;
- Provide a copy of the recorded easement to the affected municipalities; and
- Provide NYSDEC with a copy of the easement, a certification by the recording officer that it is a true and faithful copy, and a certification that a copy has been provided to the affected municipalities.

5. SCHEDULE

Following NYSDEC approval of this Work Plan, copies of the Work Plan will be sent to the public repositories for the project, including the Hastings Public Library, the Hastings Village Clerk, and the NYSDEC Region 3 office.

A Citizen Participation Plan has been in effect for the project since 1998, with the NYSDEC handling public notification requirements. It is assumed that the NYSDEC will continue to function in that role.

Currently, implementation of this Work Plan and subsequent milestone tasks are anticipated as follows:

Task	Proposed Date
Submit Final Work Plan	June 15, 2010
NYSDEC Review and Approval of Final Work Plan	June 2010
Work Plan Field Activities	Summer – Fall 2010
Submit Report of Work Plan Field Activities	February 2011
NYSDEC Review of Work Plan Field Activities Report	April 2011
Final Remedial Design (Cover Design) and Site Management Plan (SMP)	June 2011
NYSDEC Review and Approval of Final Remedial Design (Cover Design) and SMP	August 2011
NYSDEC Prepare Draft Environmental Easement	Within 60 days of Implementing Final Remedial Design (Cover Design)
ExxonMobil Record Environmental Easement	Within 30 days of Environmental Easement Full Execution
Progress Reports	By the 10th day of each month following Work Plan approval

The above schedule assumes vehicular access to the Site. If access is not readily available, this may become a key limiting factor in scheduling the Site work. The Zinsser Bridge is currently closed without any known schedule for reopening. Current access to the Site is only through the neighboring ARCO property, subject to remedial activities at that property. ExxonMobil is prepared to implement this Work Plan as specified above, upon notice from the NYSDEC to proceed, and verification of Site access.

Following completion of the scope of work herein, it is anticipated that the Site will remain in a stabilized state until remedial measures have been implemented for soil and groundwater at both the Site and the neighboring Uhlich parcel. At that time (anticipated mid-2011), a Final Remedial Design Work Plan and "biddable quality" documents for the cover design including specifications prepared, signed and sealed by a Professional Engineer, will be submitted. The time schedule to implement the final remedial design will depend on coordinating remedial activities for all parcels and cannot be anticipated at this time.

Following the final remedy, the Site will be maintained under the SMP, which will include a description of the operation, maintenance and monitoring activities to be undertaken after the NYSDEC has approved construction of the final remedial design, including the number of years during which such activities will be performed and a specific description of the criteria to be used to decide when operation of such activities may be discontinued. The SMP will also contain a contingency plan to be implemented if any element of the remedial design fails to achieve any of its objectives or otherwise fails to protect human health or the environment.

Periodic certification of the institutional and engineering controls will be prepared and submitted by a professional engineer stating that the controls remain in place and continue to protect the public health and the environment. The operation of the components of the remedy will continue until the remedial objectives have been achieved, or until the NYSDEC determined that continued operation is no longer needed, is technically impracticable, or is not feasible.

6. REFERENCES

"Ground-water and Soil Quality Investigation at the Mobil Oil Corp. Tappan Terminal"; Leggette, Brashears & Graham, Inc.; Wilton, CT; March 1987.

"Monitor Well Replacement, Mobil Oil Corp. Tappan Terminal No. 31-020"; Leggette, Brashears & Graham, Inc.; Wilton, CT; December 1993.

"Remedial Investigation Report, Tappan Terminal Site"; Dvirka and Bartilucci Consulting Engineers; Syracuse, NY; September 1999.

"Record of Decision, Tappan Terminal Site"; New York State Department of Environmental Conservation; September 2006.

"Pre-Design Investigation Work Scope, Former Mobil Terminal Property, Hastings-on-Hudson, New York, Former Tappan Terminal Site No. 3-60-015"; Woodard & Curran; Cheshire, CT; November 19, 2007, Rev. 2.

"Pre-Design Investigation Report, Former Mobil Terminal Property, Hastings-on-Hudson, New York, Former Tappan Terminal Site No. 3-60-015"; Woodard & Curran; Cheshire, CT; May 13, 2008.

Letter responding to NYSDEC comments on the May 13, 2008 Pre-Design Investigation Report submitted by ExxonMobil on August 22, 2008.

"Draft Interim Remedial Design Work Plan, Former Mobil Terminal Property, Hastings-on-Hudson, New York, Former Tappan Terminal Site No. 3-60-015"; Woodard & Curran; Cheshire, CT; June 4, 2009.

"Order on Consent and Administrative Settlement, Index # A3-0612-1208, Site # 360015"; New York State Department of Environmental Conservation; signed March 4, 2010 and effective March 14, 2010.

Letter to ExxonMobil from NYSDEC with comments on the June 4, 2009 Interim Remedial Design Work Plan sent May 21, 2010.

TABLES

Table 1
Pre-Design Investigation Soil Sampling Results
Former Mobil Terminal
Hastings-on-Hudson, NY

		TEST PIT SAMPLE IDENTIFICATION - DEPTH (ft) AND SAMPLE COLLECTION DATE																			
Parameter	**Units**	**TP1-4' 2/28/08**	**TP1-8' 2/28/08**	**TP2-2' 2/28/08**	**TP2A-2' 2/28/08**	**TP2A-6' 2/28/08**	**TP3-3' 2/28/08**	**TP3-7' 2/28/08**	**TP4-2' 2/28/08**	**TP4-6' 2/28/08**	**TP5-2' 2/29/08**	**TP5-6' 2/29/08**	**TP5A-4 3/31/08**	**TP6-3' 2/29/08**	**TP6-7' 2/29/08**	**TP7-3' 2/29/08**	**TP7-7' 2/29/08**	**TP7A-7' 3/31/08**	**TP9-6' 3/31/08**	**TP11-7' 3/31/08**	**TP18-6' 3/31/08**
Acenaphthene	ug/kg	159	15600		971	432		21.8				807	1160	181	434		592	6620	3050	1470	3480
Acenaphthylene	ug/kg		198	14.3		215	31.2		19.5	23.8		231		793	59.3	117			617	291	2290
Anthracene	ug/kg		3270			499						2370	310	1180	404	111	319	1690	1620	4210	4970
Benzo(a)anthracene	ug/kg	235	2980	14.7		1620	133	169	88.9	281		5120	444	3100	991	55.6	202	1830	3150	7070	4250
Benzo(a)pyrene	ug/kg	239	1280	24.3		1010	136	147	84.2	296	118	4600	344	2990	928	90.8	105	1350	4550	5330	1940
Benzo(b)floroanthene	ug/kg	286	1390			696	133	142	89.6	387	140	5330	355	3380	873	115	111	929	4910	5590	2390
Benzo(g,h,i)perylene	ug/kg	311	726	26.5		591	108	101	70	274	75.8	2980	259	2170	556	197	70.2	919	3900	3230	789
Benzo(k)fluoranthene	ug/kg	302	1000			166		126		334	80	3270	324	2610	703	66.3	44.9	827	3140	3900	1870
2-Chloronaphthalene	ug/kg									33.9											
4-Chloroaniline	ug/kg	964	1100																		
Carbazole	ug/kg		2980						14.6			1180		406	170		151		865	2090	1540
Chrysene	ug/kg	284	3020			1740	127	167	93.1	383	96.8	4970	537	3310	1000	63.7	264	2950	4100	6750	4040
1,2-Dichlorobenzene	ug/kg															20.3					
1,4-Dichlorobenzene	ug/kg								13.1												
Dibenzo(a,h)anthracene	ug/kg		265			237	43.7	40.8	26.9	114		1060		831	198				1300	1030	396
Dibenzofuran	ug/kg		11600		254	160						599	311	113	139		477	3710	1880	1220	4160
Di-n-butyl phthalate	ug/kg								109												
bis(2-ethylhexyl)phthalate	ug/kg								71	168		223		110			145	2130		1330	828
Fluoroanthene	ug/kg	357	14700	13.9		1720	189	319	151	372	79	15600	1100	5010	1970	53	652	2370	5400	21700	16200
Fluorene	ug/kg	98.1	12200		235	456		15.6				920	2160	165	634		870	10700	5510	1620	6730
Ideno(1,2,3-c,d)pyrene	ug/kg		685			486	106	108	63	249	76.4	2870		2100	521	130	46.4		3800	2910	777
2-Methylnaphthalene	ug/kg		17600								166	247		103	422	114	1260	32100	24700	362	3080
4-Nitroaniline	ug/kg		1890																		
Naphthalene	ug/kg		11800							392	67	318	193	75.3	254	25.8	1610	2210	1160	418	10100
N-Nitrosodiphenylamine	ug/kg		433																		
Phenanthrene	ug/kg		35300	9.6		893	33.6	22.9	61.3	69.8	163	11500	1110	2710	1920	66.5	1550	24800	15600	20400	17700
Pyrene	ug/kg	369	12000	20.2		3130	191	324	159	541	389	12600	1050	4750	1840	78.1	633	4270	5560	16600	10400
TICs	ug/kg	135400	309100	0	35700	13100	5460	54700	7010	57140	109900	27820	143000	16290	37680	6730	51600	1283000	640000	77800	100300
Total SVOCs+TICs	**mg/kg**	**139.0**	**461.1**	**0.1**	**37.2**	**27.2**	**6.7**	**56.4**	**8.1**	**61.1**	**111.4**	**104.6**	**152.7**	**52.4**	**51.7**	**8.0**	**60.7**	**1382.4**	**734.8**	**185.3**	**198.2**
Total VOCs by PID	*eq. PPMV*	*0.5*	*9.8*	*0.0*	*1.3*	*0.9*	*0.2*	*0.6*	*0.9*	*1.4*	*7.2*	*6.6*	*NR*	*0.3*	*44.2*	*1.6*	*38.9*	*NR*	*NR*	*NR*	*NR*

		SB-3/OW-5A TEST TRENCH SAMPLE IDENTIFICATION - DEPTH (ft) AND SAMPLE COLLECTION DATE																							
Parameter	**Units**	**E1-3' 2/28/08**	**E1-7' 2/28/08**	**E2-3' 2/28/08**	**E2-7' 2/28/08**	**E3-3' 2/28/08**	**E3-3' DUP 2/28/08**	**E3-7' 2/28/08**	**E4-2' 2/28/08**	**E4-6' 2/28/08**	**E5-2' 2/28/08**	**E5-6' 2/28/08**	**E6-2' 2/28/08**	**E6-6' 2/28/08**	**E7-2' 2/29/08**	**E7-6' 2/29/08**	**E8-2' 2/29/08**	**E8-6' 2/29/08**	**E9-2' 2/29/08**	**E9-6' 2/29/08**	**E10-1' 2/29/08**	**E10-1' DUP 2/29/08**	**E10-5' 2/29/08**	**E11-2' 2/29/08**	**E11-6' 2/29/08**
Acenaphthene	ug/kg	107	6440	5410	1740	67	106	997	1480	1560	70.9	1600			308	1570		6200		1710	26.2	39.6	203		2120
Acenaphthylene	ug/kg	135									95.3		150		82.2		133		127		93.4	119	57.2	127	
Anthracene	ug/kg	421	3760	1340	838	72.3	158	184		361	110	541			736	514	156	2600	156	270	137	189	200	167	575
Benzo(a)anthracene	ug/kg	1970	6090	566	986	87.1	334	176	108	329	112	570	629	345	1190	592	238	2500	246	258	298	352	458	186	764
Benzo(a)pyrene	ug/kg	1650	4340	448	807	68.2	244	177	125	303	134	406	443	328	1050	559	239	1720	354	308	321	378	361	275	784
Benzo(b)floroanthene	ug/kg	1720	3850	431	808	82.1	235	194	136	384	187	455	528	303	1210	630	411	1990	362	324	506	539	478	433	916
Benzo(g,h,i)perylene	ug/kg	1270	2660	325	586	63.7	164	168	116	288	186	451	388	280	665	439	233	825	339	235	340	348	205	394	607
Benzo(k)fluoranthene	ug/kg	1710	3240	324	549	62.4	114	80.4	109	242	126	430	436	294	915	423	226	1810	307	257	315	389	392	232	694
2-Chloronaphthalene	ug/kg																								
4-Chloroaniline	ug/kg																								
Carbazole	ug/kg	259	2040		452	52.8	102				49.1		185		426		46.4	1540	28.7		47.1	73.2	112	50.7	
Chrysene	ug/kg	2210	6210	632	1030	111	358	215	149	387	146	797	747	300	1200	636	317	3050	262	310	374	445	671	288	1020
1,2-Dichlorobenzene	ug/kg		142	139	75						40.7						79.5				119	96.6			
1,4-Dichlorobenzene	ug/kg		144	35	28.1															49.5					
Dibenzo(a,h)anthracene	ug/kg	415	994	132	191	33.3	64.1	57	46	129	59.2		172		258	151	91.3	392	120	95.9	112	124	75.3	122	259
Dibenzofuran	ug/kg	98.4	4040	3110	1040	375	376	551	688	978	101	1080	273		249	939	26.2	4130	30.3	935	33	39.3	126	124	1320
Di-n-butyl phthalate	ug/kg			362																					
bis(2-ethylhexyl)phthalate	ug/kg	67.6	1710	868	706	80.8	70	328	150	486	81.7	543	463				241		312	194	513	464	127	147	
Fluoroanthene	ug/kg	3720	14200	1660	2220	96	621	312	211	654	139	1020	1520	710	3400	1560	438	7410	249	547	551	685	1730	355	1510
Fluorene	ug/kg	92.1	10900	8980	2920	220	250	1570	2360	2940	166	2910	89	179	419	2690		10500		2790		66.1	347	76.2	4020
Ideno(1,2,3-c,d)pyrene	ug/kg	1180	2600	275	535	53.2	151	151	104		155	363	332		624	370	216	897	307	213	299	324	217	313	506
2-Methylnaphthalene	ug/kg	330	4360			6320	6390	1590		2840	1230	8870	271		231		153	12400	295	2470	177	257	1350	2140	14300
4-Nitroaniline	ug/kg																								
Naphthalene	ug/kg	167	859		345	3580	3420	773		555	391	1200	136		227		48.3		95.1		58.2	58.8	311	669	1380
N-Nitrosodiphenylamine	ug/kg																								
Phenanthrene	ug/kg	2160	35600	23900	9210	1100	1570	4700		5710	553	7250	1320	120	3170	7300	251	28900	244	6450	305	401	1580	691	10000
Pyrene	ug/kg	3630	13600	2110	2160	127	606	366	492	786	173	1340	1290	706	2740	1330	446	6570	238	568	602	747	1430	415	1520
TICs	ug/kg	11840	1050000	104800	164800	33860	32420	138700	155600	318000	34840	478500	72300	248000	9970	314500	16430	825000	7220	252600	74500	41010	30530	17830	537900
Total SVOCs+TICs	**PPM**	**35.2**	**1177.8**	**155.8**	**192.0**	**46.5**	**47.8**	**151.3**	**161.9**	**336.9**	**39.1**	**508.3**	**81.7**	**251.6**	**29.1**	**334.2**	**20.4**	**918.4**	**11.3**	**270.6**	**79.7**	**47.1**	**41.0**	**25.0**	**580.2**
Total VOCs by PID	*eq. PPMV*	*0.9*	*166.0*	*122.0*	*122.0*	*3.8*	*3.8*	*70.4*	*77.1*	*65.0*	*3.6*	*43.3*	*2.8*	*20.6*	*1.4*	*95.6*	*0.0*	*63.8*	*1.4*	*46.8*	*2.9*	*2.9*	*63.4*	*0.3*	*113.0*

Notes:

🟨 = Total SVOCs+TICs greater than 500 ppm
Water table is at 4-6 feet below grade.
eq. PPMV = Equivalent Parts Per Million by Volume

NR = Not Recorded; PID was not working properly on 3/31/08.
PID = Photoionization Detector
PPM - Parts Per Million or Milligrams per Kilogram

SVOCs+TICs = Semi-Volatile Organic Compounds plus Tentatively Identified Compounds
TICs = Tentatively Identified Compounds
ug/kg = Micrograms per Kilogram

VOCs = Volatile Organic Compounds

FIGURES

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1520 HIGHLAND AVENUE
CHESHIRE, CONNECTICUT 06410
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COMMITMENT & INTEGRITY DRIVE RESULTS

SITE LOCATION MAP

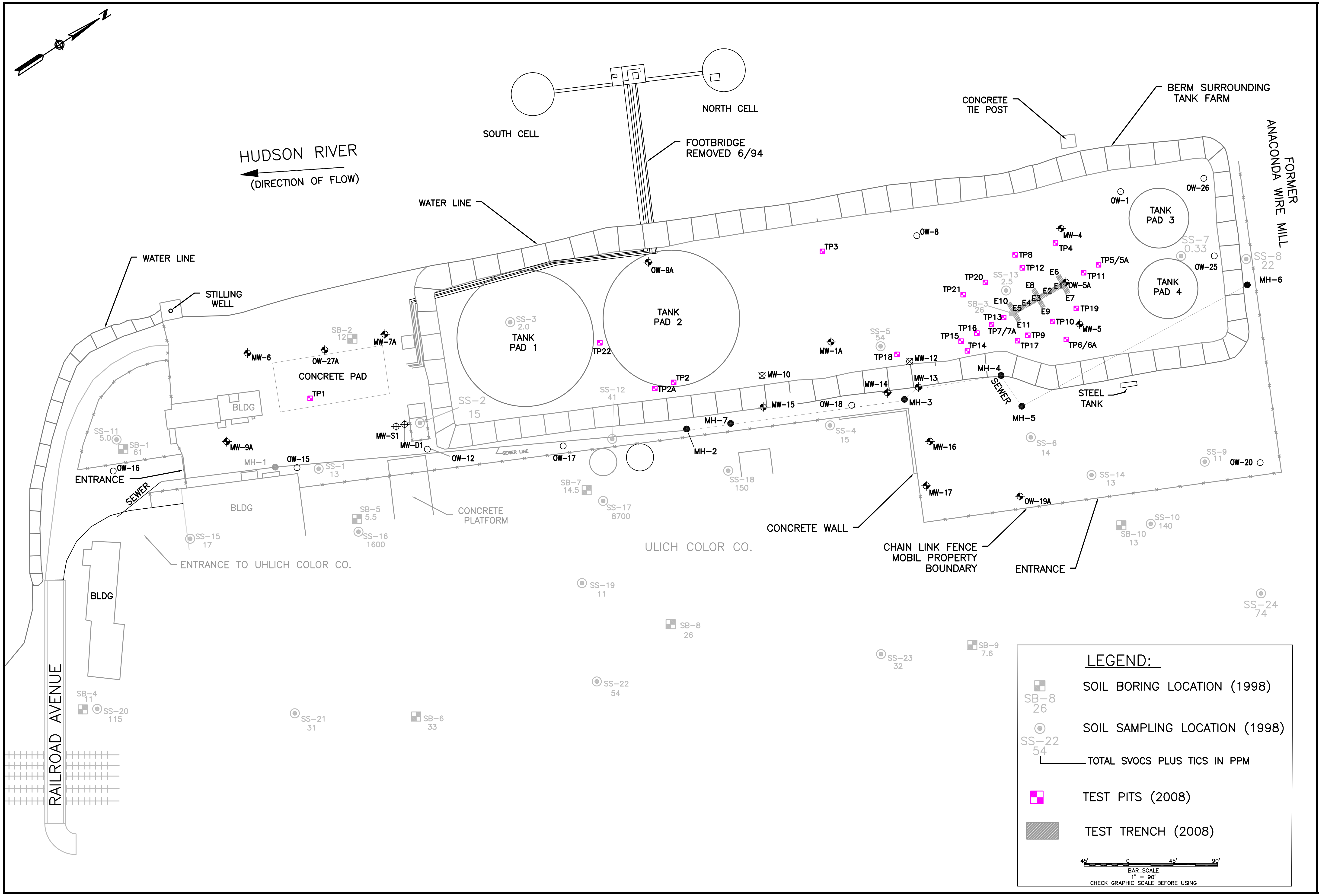
DESIGNED BY: BG	CHECKED BY: AP
DRAWN BY: SH	206925_U1 05 09.dwg

FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NY

TOPO! INTERACTIVE MAPS ON CD
U.S.G.S YONKERS, NY.
7.5 MIN SERIES 1966 PHOTOREVISED 1979

JOB NO: 206925.03
DATE: MAY 2009
SCALE: AS NOTED

FIGURE 1



WOODARD & CURRAN

1520 HIGHLAND AVENUE
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COMMITMENT & INTEGRITY DRIVE RESULTS

SITE PLAN

DESIGNED BY: BG
DRAWN BY: SH
CHECKED BY: AP
206925_U2 05 09.dwg

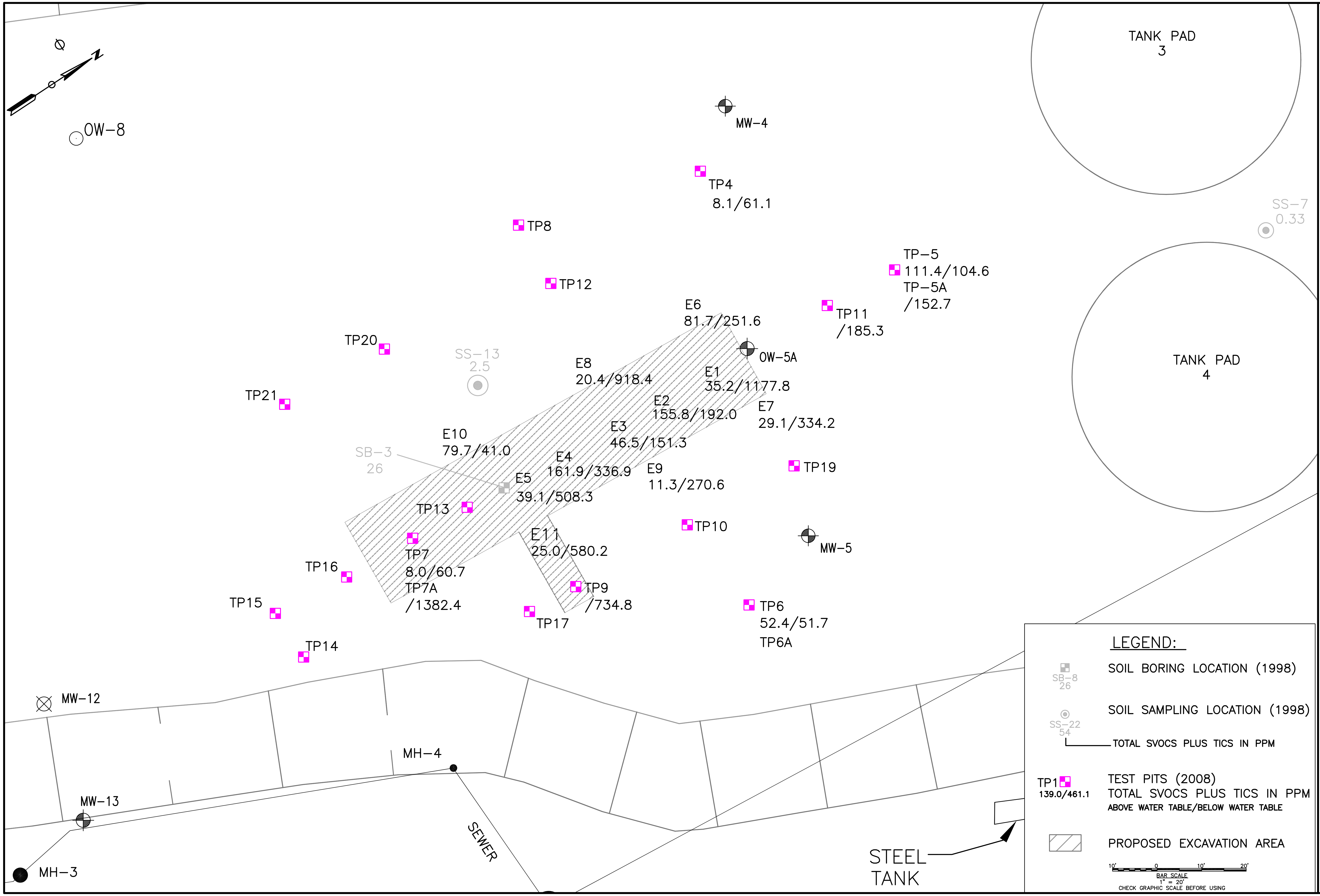
FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NY

REMEDIAL DESIGN/REMEDIAL
ACTION WORK PLAN

JOB NO: 206925.03
DATE: MAY 2009
SCALE: 1"= 90'

FIGURE 2

206629/wip/fig



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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

PROPOSED EXCAVATION PLAN

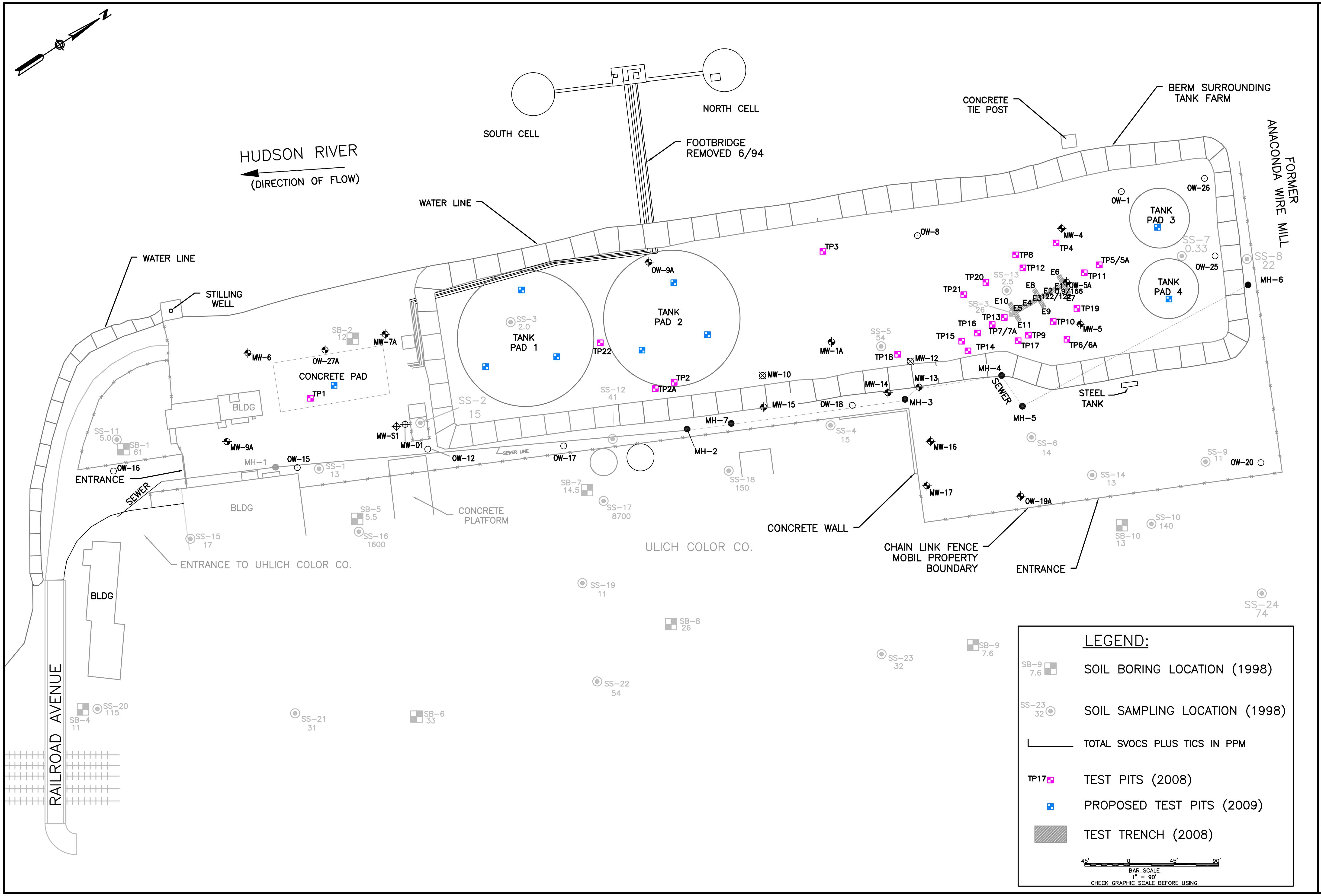
DESIGNED BY: BG
DRAWN BY: SH
CHECKED BY: AP
206925_U3 05 09.dwg

FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NY

REMEDIAL DESIGN/REMEDIAL
ACTION WORK PLAN

JOB NO: 206925.03
DATE: MAY 2009
SCALE: 1"= 20'

FIGURE 3



LEGEND:

SB-9 7.6 ▨	SOIL BORING LOCATION (1998)
SS-23 32 ◎	SOIL SAMPLING LOCATION (1998)
⎿	TOTAL SVOCS PLUS TICS IN PPM
TP17 ▣	TEST PITS (2008)
▣	PROPOSED TEST PITS (2009)
▨	TEST TRENCH (2008)

45' 0 45' 90'
BAR SCALE
1" = 90'
CHECK GRAPHIC SCALE BEFORE USING

1520 HIGHLAND AVENUE
CHESHIRE CONNECTICUT 06410
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COMMITMENT & INTEGRITY DRIVE RESULTS

WOODARD & CURRAN

PROPOSED TEST PIT LOCATIONS

DESIGNED BY: BG
DRAWN BY: SH
CHECKED BY: AP
206925_U4 05 09.dwg

FORMER TAPPAN TERMINAL
HASTINGS-ON-HUDSON, NY

REMEDIAL DESIGN/REMEDIAL
ACTION WORK PLAN

JOB NO: 206925.03
DATE: MAY 2009
SCALE: 1"= 90'

FIGURE 4

206629/wip/fig

APPENDIX A: CONTAMINATED MATERIAL MANAGEMENT PLAN

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Contaminated Materials Management Plan

Former Mobil Terminal Property
Hastings-on-Hudson, New York
Former Tappan Terminal
Site No. 3-60-015

206925.03

ExxonMobil Former Tappan Terminal

June 15, 2010

TABLE OF CONTENTS

SECTION PAGE NO.

1. INTRODUCTION

This Contaminated Materials Management Plan (CMMP) has been prepared for the former Mobil terminal property at the Tappan Terminal Site, located in Hastings-on-Hudson, New York (the "Site"). The CMMP is a companion document to the Remedial Design/Remedial Action Work Plan (the Work Plan), dated June 15, 2010. The proposed Site work includes the rubblizing of several onsite remnant concrete structures, sampling of subsurface soils, removal of any grossly contaminated soils as defined in the Work Plan, removal of any piping encountered during the Site work, and restoring excavations. A portion of the removed material (soil and piping) will require removal offsite. It is anticipated that all concrete structures will be rubblized and left in place. Any concrete required to be removed to gain access to underlying soils will be stockpiled onsite until the remedial work is complete and then returned to the area from which it came. This CMMP addresses procedures for the proper management of wastes generated during Site work.

1.1 OBJECTIVES

This CMMP will address the handling, storage, characterization, transportation, and off-site recycling, treatment or disposal of waste materials to be conducted in accordance with applicable federal, state and local regulations. In addition dust suppression, stockpile management, dewatering and decontamination procedures are addressed.

1.2 RESPONSIBILITIES

The Contractor conducting the Site work shall be responsible for understanding the contents of this CMMP and adhering to all requirements stated herein. The Contractor shall also comply with the direction of ExxonMobil's Environmental Professional in the field with regard to the identification, characterization, handling and management of contaminated or potentially contaminated materials. The Contractor's responsibilities shall include, but not be limited to the following:

- Responsible for all removal, handling, management, transportation and disposal of contaminated and potentially contaminated soil, concrete, structures and other materials in accordance with this CMMP.
- Establish and maintain contaminated and potentially contaminated material stockpiles in accordance with Section 5 of this CMMP.
- To notify the ExxonMobil's Environmental Professional of all fill sources to be used for the project. No fill materials shall be brought onsite until the ExxonMobil's Environmental Professional has reviewed and approved it for use as fill.
- Construct a decontamination pad in accordance with Section 7 of this CMMP prior to the start to Site work.
- Responsible for decontamination of equipment in accordance with Section 7.
- Manage decontamination wastewater generated during the course of the Site work in accordance with Section 9.
- Conduct excavation dewatering as necessary in accordance with Section 8.
- Provide ExxonMobil's Environmental Professional with disposal/recycling documentation for all contaminated or potentially contaminated material disposed offsite.

The ExxonMobil's Environmental Professional will provide a field representative who will be present in the field to observe the soil excavation and test pitting activities. He/she shall be responsible for the identification of contaminated or potentially contaminated materials in accordance with the protocols contained in the Work Plan, including any sampling or other characterization activities. He/she will also be responsible for directing the segregation and stockpiling of contaminated and potentially contaminated materials in accordance with the CMMP.

The specific responsibilities of the Environmental Professional's field representative will be:

- To observe the Site work as it proceeds and identify contaminated and potentially contaminated materials.
- To observe the removal and management of contaminated and potentially contaminated materials.
- To dictate the segregation of contaminated and potentially contaminated materials.
- To sample and analyze contaminated and potentially contaminated materials insitu or in stockpiles/staging areas to identify contaminants and concentrations as necessary.
- To review documentation of all proposed clean fill material identified by the Contractor before it is brought onsite. No fill materials shall be brought onsite until ExxonMobil's Environmental Professional has approved it for use as fill.
- To maintain a field log book and to record relevant observations and information.
- To conduct site boundary air monitoring as warranted.
- To calibrate and maintain the field screening equipment used during the project.
- To collect and manage documentation of contaminated waste disposal and/or onsite placement, as relevant.

2. EXCAVATION AND STRUCTURE REMOVAL PROCEDURES

All activities associated with the excavation or removal of contaminated or potentially contaminated concrete, soil, piping or structures shall be conducted in accordance with the procedures outlined in this CMMP. The Environmental Professional's field representative shall be present to observe all surface and subsurface Site work to the extent necessary to confirm compliance with this CMMP.

3. DUST SUPPRESSION

The Contractor shall control dust and air-borne materials generated during the Site work to protect the health of onsite workers and to minimize the release of dust into the surrounding area. General Site dust control (e.g. roadways, uncovered soils, rubblized concrete) shall be conducted using a water truck or other approved devices capable of applying a uniform spray of water. This spray shall be applied so as to minimize the amount of runoff water generated. A suitable device for regulating the flow and positive shutoff of water shall be provided by the Contractor.

Stockpiles of contaminated and potentially contaminated materials shall be maintained in a covered condition at all times when not in active construction/removal to minimize wind-blown dust as specified in Section 5. Dust generated from the disturbance or handling of contaminated or potentially contaminated materials will be controlled to the satisfaction of the Environmental Professional's field representative.

4. EXCAVATED MATERIALS MANAGEMENT

Contaminated or potentially contaminated material that is disturbed, excavated or removed shall be initially managed (i.e. segregated, screened and stockpiled) as directed by the Environmental Professional's field representative. Any soil or other material that does not meet criteria for onsite re-use shall be considered a waste. Any subsurface structures/utilities and any non-soil material (e.g. wood, bricks, sediment) generated during the excavation that cannot be reused onsite, shall be considered waste and handled in accordance with this CMMP.

4.1 SOIL

Soils will be segregated based on visual observation and field testing as outlined in the Work Plan and proposed for re-use or disposal. Soils with documented or suspected contamination shall be stockpiled and managed adjacent to the excavation, or transported to a designated onsite area for stockpiling or loading into DOT-approved containers. The most efficient and cost effective method of onsite storage shall be evaluated based on the available capacity of onsite storage areas, the type and amount of contamination present, weather conditions, and the volume of material being managed. Stockpile management will be conducted as described in Section 5 and container management will be conducted as described in Section 6.

Soil will not be transported offsite for disposal until the results of the waste characterization (see Section 10) have been reviewed and the material has been properly classified. Offsite recycling, treatment and/or disposal destinations for these materials will be arranged for in accordance with applicable regulations as described in Section 11.

4.2 PIPES, CONDUITS, STRUCTURES

Pipes, conduits and other structures encountered during the Site work shall be removed as specified in the Work Plan. If these items are suspected by the Environmental Professional's field representative to be potentially contaminated, the items shall be handled at his/her direction in accordance with the Work Plan. Pipe, conduits or structures containing liquid, sediment or sludge of unknown contents shall be handled so as to minimize breakage and contain the material. Prior to moving the structures, intact pipes shall be tapped and drained with the contents containerized and managed in accordance with Section 6. If the pipe cannot be drained, the pipe ends shall be sealed with 6 mil polyethylene sheeting and duct tape, or equivalent, to contain the contents in the pipes. The sealed pipes shall be stockpiled on polyethylene sheeting until the pipe can be cleaned in the Decontamination Pad (Section 7).

At the Decontamination Pad, items shall be cleaned with a biodegradable detergent, such as Simple Green, and triple rinsed. Then the items shall be stockpiled by material type pending arrangements for transportation and offsite recycling. Wastewater shall be handled in accordance with Section 9.

5. STOCKPILE MANAGEMENT

All waste solid materials that are not placed in containers shall be managed in stockpiles either adjacent to the excavations, in staging areas in close proximity to the excavations, or in other staging areas, depending upon the excavation sequencing and access limitations around the excavations. In all cases, general stockpile management procedures listed below shall be followed for all contaminated or potentially contaminated materials:

- The stockpile staging area(s) shall be prepared prior to excavation.
- Stockpiles shall be placed no closer than 2 feet from the edge of an excavation.
- No stockpile shall be located where access to a work area by emergency equipment would be prevented.
- Stockpile area(s) shall be clearly delineated in order to prevent possible exposure to workers at the Site.
- Each stockpile of material shall be labeled to identify the area from which the materials were removed and the date on which the material was first placed in the stockpile. These markers shall remain in place until the material is ready for backfilling or transportation for offsite recycling or disposal.
- The following materials shall be stockpiled and covered by a single layer of 6 mil (minimum) polyethylene sheeting: soils excavated from non-suspect areas; subsurface structures/utilities not suspected to be contaminated; and other non-soil materials not managed in containers, including asphalt, uncontaminated concrete, rocks, and other debris.
- Contaminated or potentially contaminated materials shall be placed on two layers of 6 mil (minimum) polyethylene sheeting, bermed, and covered with one layer of 6 mil (minimum) polyethylene sheeting.
- No excavated contaminated or potentially contaminated material is to be left uncovered or unsecured at the end of the work day. The polyethylene sheeting cover shall be secured with either hay bales, sand berms, tires, rope, or other method sufficient to withstand a sustained wind of up to 25 mph. The stockpiled material shall be kept covered at all times, except for a stockpile to which material is being added to or removed from on a particular day, to prevent formation of leachate from rainwater and the generation of dust on dry windy days. The plastic covers shall be inspected daily to evaluate whether the cover remains intact (i.e., cannot be blown off). Repairs to the covers and berms shall be made as necessary to maintain the stockpiles in good condition and to prevent contact with stormwater or blowing of the stockpiled material.
- Sediment and erosion control measures shall be in place prior to stockpiling and shall be maintained until the stockpiles have been removed.
- Separate stockpiles shall be maintained for each type of material.
- The Environmental Professional’s field representative will be responsible for evaluating whether a material is contaminated and the nature of the contamination, and directing stockpile segregation. For materials that are to be transported and disposed of at an off-site facility, the Professional’s field representative will be responsible to comply with any characterization requirements of the disposal facility.
- Unless specific knowledge indicates otherwise, all stockpiled materials shall be managed as non-hazardous until characterization is completed. Upon completion of characterization, any

necessary adjustments shall be made to meet applicable labeling, handling, and storage requirements.

6. CONTAINER AND TANK MANAGEMENT

Waste solid materials that are not stockpiled, and liquids and other waste materials generated (e.g., utility/structure contents, decontamination water, excavation water, and supplies used in the handling of contaminated materials that can't be disposed of with their associated materials) shall be placed in containers and/or tanks. These containers/tanks shall be stored in staging area(s), but may be temporarily staged in areas in close proximity to the excavations/activities generating the waste (depending upon the excavation sequencing and access and/or available space limitations at the Site) prior to being moved to a waste management area. The general container/tank management procedures listed below shall be followed:

- All empty containers (drums, tanks, roll-offs) shall be visually inspected upon arrival at the Site to determine that the containers are clean and in good condition. Containers that have residual material or are in poor condition (i.e., rusted) will not be used.
- Container management areas shall be constructed on stable surfaces (i.e., sufficient distance from open excavations). The Contractor shall be responsible for overseeing container storage, for instructing workers on requirements and prohibitions, and for exercising controls sufficient to achieve compliance.
- Materials shall be segregated into containers based on contaminant and material.
- Decontamination fluids and groundwater from dewatering operations may be held in separate containers/tanks based on suspected contamination as determined by the Environmental Professional's field representative.
- All liquid storage containers/tanks in staging areas will be managed to minimize the risk of spillage to the ground. Transferring of liquids to or between drums, containers, or tanks shall be conducted over a secondary containment structure (polyethylene sheeting) unless in an emergency situation. Any spill or release shall be immediately cleaned up to the satisfaction of the Environmental Professional's field representative.
- All containers/tanks shall be labeled as to their contents and satisfy the applicable regulatory requirements for the materials being stored. At a minimum, the label shall identify the contents of the container, the source location of the contents, and the date on which material was first placed in the container.
- All containers shall remain closed at all times except when material is being added or removed from them. Storage containers shall be used that are structurally compatible with the material stored and designed to prevent direct contact between the materials and the elements. Open top containers, such as roll-offs, will be covered with either an integral cover or one layer of 6 mil (minimum) polyethylene sheeting sloped to provide positive drainage of stormwater off of the cover. For short-term outdoor storage, this may be accomplished by the container alone, whereas the use of tarps or other suitable coverage may be used for long term outdoor storage. In the event rainwater accumulates inside roll-offs or other containers used for storing solid materials, the water will be pumped out and handled similarly to excavation water (see Sections 8 and 9). Roll-offs containing free liquids shall not be allowed offsite.

- The Environmental Professional's field representative shall conduct characterization of any containerized materials in accordance with disposal facility requirements.

7. DECONTAMINATION

7.1 EQUIPMENT DECONTAMINATION

All equipment used for excavation and/or handling of contaminated or potentially contaminated materials shall be cleaned/decontaminated between uses at different areas of the Site, and/or prior to removal from the Site. The purpose of equipment cleaning/decontamination is to reduce the likelihood of cross-contamination (i.e., transport of potential contaminants) between work areas and/or off of the Site. This shall include excavator buckets, loader blades, tracks and undercarriage and any other parts of the equipment that could reasonably be expected to be contaminated, truck tires, and hand tools. As much dirt/material as possible shall be scraped and removed from the equipment before moving it from the contaminated area where it was in use. The equipment will then be steam cleaned prior to subsequent use or transport offsite.

7.2 ESTABLISHMENT AND MAINTENANCE OF DECONTAMINATION PAD

The Contractor shall be responsible for establishing and maintaining a decontamination pad for heavy equipment. The decontamination pad shall be constructed in an area of the Site approved by the Contractor and that meets the following criteria:

- free from Site traffic
- available throughout the duration of the project
- away from work areas
- readily accessible

The design and construction of the decontamination pad shall be subject to the approval of the Environmental Professional's field representative, and shall meet or exceed the following design criteria:

- The base shall consist of multiple sheets of polyethylene liner or equivalent with a minimum 12-inch high supported perimeter berm.
- The pad shall be of adequate size to accommodate the width and length of the largest piece of equipment that will come into contact with the impacted material.
- The pad will be sloped to a low point water-tight sump for collection of decontamination water. During periods of precipitation, the decontamination pad will be covered with an impermeable tarp to divert stormwater runoff from the surface of the pad.
- Following completion of project activities requiring the use of the decontamination pad, the pad will be removed and all pad materials properly disposed.

The contractor shall maintain a water source at the decontamination pad to provide an adequate volume of clean water for equipment decontamination. Equipment decontamination will be conducted using a power washing unit capable of cleaning the largest piece of equipment in use on the Site.

In addition to the decontamination pad described above, remote decontamination of excavation equipment may be performed at or near the excavation locations where excavation equipment is used. This will be accomplished using a steam cleaner and an appropriate container for collection of decontamination water. Collected decontamination water shall be containerized and managed in accordance with Section 9

Liquids (wash water) and sediments or sludges removed during cleaning shall be pumped or drained from the decontamination pad and collected in either U.S. Department of Transportation (DOT)-approved 55-gallon drums (solids and/or liquids) or holding tanks (liquids only). To the extent possible, the amount of liquids in the sludge collection drums shall be kept to a minimum. Any disposable cleaning items (i.e., single use rags, mops, brushes) shall be decontaminated (as appropriate), collected in sealed plastic bags (with the bags labeled as to contents), and placed in DOT-approved containers. The containers of decontamination liquids and sludges shall be managed as described in Section 6.

The Environmental Professional’s field representative shall be responsible for collecting and analyzing samples of the containerized wash water and arranging for appropriate disposal.

8. DEWATERING

Dewatering of excavations may be required during the Site work. If dewatering is necessary, the Contractor shall provide appropriate pumps, hoses, and drums, tanks or other suitable containers as required based on the estimated volume of water to be managed. Dewatering shall be conducted so as to minimize the amount of sediment in the water. Water generated by dewatering operations shall be containerized until it can be characterized and the proper method of disposal determined in accordance with Section 9.

9. WASTEWATER MANAGEMENT

Wastewater that may potentially be generated during the work includes:

- Groundwater removed from excavations; and
- Decontamination fluids and wastewater from the decontamination pad.

Wastewater streams shall be containerized and maintained based on the anticipated wastewater content. Wastewater streams that would require different protocols for treatment or disposal shall not be mixed. The wastewater containers shall be managed as described in Section 6.

If it is anticipated that onsite treatment and disposal (to the public sanitary sewer or a surface water body) of all or a portion of the containerized water will occur, ExxonMobil’s Environmental Professional shall be responsible for obtaining all necessary approvals, treatment equipment and discharge permits prior to initiation of the treatment and/or discharge.

10. WASTE CHARACTERIZATION

All contaminated waste materials designated for disposal shall be characterized to determine the proper handling and disposition procedures for the materials. Materials will be characterized based on one or more of the following data items:

- Available analytical results from the in place materials prior to removal;
- Analytical results for additional samples collected from stockpiles, tanks, or containers to characterize waste in accordance with applicable regulations and the requirements of the offsite recycling, treatment, and/or disposal facility to receive the waste.

The number of samples and analytical testing parameters for the purpose of waste characterization will vary depending upon the specific waste material, previous analytical testing, suspected contaminants, and the specific destination facility requirements.

Sample identification, chain of custody procedures, data management, and tracking for waste characterization samples will be conducted in accordance with the applicable laws, regulations, and standards of practice.

The stockpiles and containers of materials which require characterization sampling and analysis shall be sampled at a minimum frequency of one sample for every type of segregated material, or at the frequency required by the destination recycling, treatment, and/or disposal facility. Composite and/or discrete samples shall be collected from the materials in the stockpile(s)/container(s) following an appropriate protocol. All analyses shall be conducted in a manner consistent with USEPA analytical methods appropriate for the waste.

Based on the results of the waste characterization, the materials shall be classified as either regulated waste or unregulated material in accordance with applicable regulations.

All wastes will initially (prior to waste characterization) be considered and managed as non-hazardous. Based on the results of the waste characterization, the handling and management of some materials may need to be adjusted (i.e., some materials may be classified as regulated waste). If the waste is determined to be a regulated waste, the labels on containers and/or placard identification on stockpiles shall be changed, as necessary, and management procedures modified (e.g., stockpiled hazardous soils will be immediately placed in containers) in accordance with applicable regulations. The resulting classification will also be used to select the appropriate method for transportation, the appropriate documentation requirements, and the recycling, treatment, and/or disposal facility as described in Section 11.

11. OFFSITE RECYCLING, TREATMENT OR DISPOSAL

The handling, transportation, and ultimate disposition of all contaminated waste materials shall be the responsibility of ExxonMobil's Environmental Professional. The information presented in this section should be considered as guidance and does not remove the Contractor's responsibility to comply with all applicable laws, regulations, and standards of practice.

Following contaminated waste characterization, an evaluation shall be conducted to determine the most appropriate offsite transportation and recycling, treatment, and/or disposal options for impacted soil and wastewater. The disposal facility shall be an approved ExxonMobil vendor and/or meet ExxonMobil's approval prior to the impacted material leaving the Site.

Workers, transportation companies, and recycling, treatment, and/or disposal facilities used for the handling, transport, or disposal of impacted soil and wastewater shall be certified, licensed, insured, and fully capable of handling and/or accepting the impacted materials from the Site. These efforts shall comply with laws, ordinances, rules and regulations of federal, state, and local authorities regarding the handling, storing, transporting, and disposing of these materials. Where specification requirements and referenced documents vary, the most stringent applicable requirement will be applied.

Copies of the waste characterization analysis shall be provided to the destination recycling, treatment, and/or disposal facility for acceptance, if applicable. No transport or disposal of any impacted material shall be conducted until acceptance/approval for the material has been received from the destination facilities.

All roll-off containers and dump trucks will be inspected following loading of the impacted material to ensure that the load is covered and secured. All containers shall be properly loaded, packaged, labeled, placarded, and transported in accordance with applicable federal and state laws and regulations.

All documentation required for the characterization, transportation, and disposal of the impacted materials (i.e., laboratory analytical data, bills of lading, manifests) shall be generated and maintained as required by applicable regulations. Copies of all transport manifests, bills of lading, and certified weigh tickets for recycling and/or disposal of all materials shall be forwarded to ExxonMobil's Environmental Professional. Receipts shall indicate (at a minimum) the following information: date; driver; treatment, recycling, and/or disposal facility; quantity and type of material delivered; and facility permit number (as appropriate). All chain of custody information, including volume or quantity delivered; facility location and phone number; and the method of recycling, treatment, and/or disposal shall be included in the documentation. Certified quantity receipts shall indicate weight of solid wastes in tons and liquid wastes in gallons. A recycling certificate from the recycling firm, if applicable, shall be obtained for all materials processed.

The number of roll-off containers and/or dump trucks which transport excavated materials from the Site will be tracked each day and recorded. All supporting documentation (analytical results, weigh tickets, transportation documentation, certificates of destruction/recycling) will be maintained with the tracking forms.

12. CLOSURE OF WASTE MANAGEMENT AREAS

Following removal of all waste materials from the stockpile and container management area(s), the polyethylene sheeting and materials used for staging and secondary containment shall be removed. Staging and secondary containment materials known or suspected to have come in contact with contaminated materials shall be disposed with the associated materials (if accepted by the destination facility) or placed in DOT-approved containers and characterized by the Environmental Professional's field representative as required by the destination facility.

All waste management areas shall be closed, materials removed, and site restoration completed prior to the dismantling of the decontamination pad. Potentially contaminated materials from the decontamination pad shall be properly containerized and shipped off-site with other like waste materials. Any remaining non contaminated materials shall be disposed by the Contractor.

APPENDIX B: QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN (QAPP)

Former Tappan Terminal
Hastings-on-Hudson, New York

June 15, 2010

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ATTACHMENTS

Attachment A: Project Sampling SOPs

Attachment B: Analytical Laboratory SOPs

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) includes the following four basic element groups: Project Management, Measurement Data Acquisition; Assessment/Oversight; and Data Validation and Usability. This QAPP follows EPA's Quality Assurance Guidance for Conducting Brownfields Site Assessments (EPA 540-R-98-038) and is incorporated within the remedial design work scope ("Field Work Scope") for the former Mobil terminal property in Hastings-on-Hudson, New York.

This QAPP is applicable only to the work specified. Revisions to the QAPP for additional work or changes to the Field Work Scope will be made and approved in accordance with standard Woodard & Curran Inc. practices and submitted to ExxonMobil Refining & Supply, the present owner of the subject property, for approval. Notification and distribution of any changes will be conducted by Woodard & Curran.

2.0 PROJECT MANAGEMENT

This element group encompasses aspects of project management, objectives and background. It identifies the roles and responsibilities of project personnel, describes communication procedures and details the proposed project schedule.

FORM A

TITLE AND APPROVAL PAGE

Quality Assurance Project Plan (QAPP) for Work Associated with the former Tappan Terminal
Document Title

Anne Proctor **Woodard & Curran**
Prepared by: Preparer's Name and Organizational Affiliation)

1520 Highland Avenue
Cheshire, CT 06410 **(203) 271-0379**
Address and Telephone Number

15/6/10
Day/Month/Year

Project Manager: Anne E Proctor
Signature

Anne E. Proctor - Woodard & Curran
Printed Name/Date

Project Director: Nicholas A. Hastings (AEP)
Signature

Nicholas A. Hastings – Woodard & Curran
Printed Name/Date

FORM B

PROJECT ORGANIZATION AND RESPONSIBILITY/DISTRIBUTION LIST

Woodard & Curran of Cheshire, Connecticut was retained by ExxonMobil to provide environmental consulting services for the former Tappan Terminal property in Hastings-on-Hudson, New York.

ExxonMobil Refining & Supply			
Steve Trifiletti	Global Remediation	(516) 239-5232	steve.p.trifiletti@exxonmobil.com

NYSDEC			
William Ports	Div. of Environmental Remediation	(518) 402-9667	wfports@gw.dec.state.ny.us

Woodard & Curran			
Nick Hastings	Project Director, Regulatory Specialist	(203) 271-0379 Ext: 2305	nhastings@woodardcurran.com
Anne Proctor	Project Manager, Project QA Officer	(203) 271-0379 Ext: 2327	aproctor@woodardcurran.com

Roux Associates			
Tracy Bispham	Project Field Task Manager	(631) 232-2600	tbispham@rouxinc.com

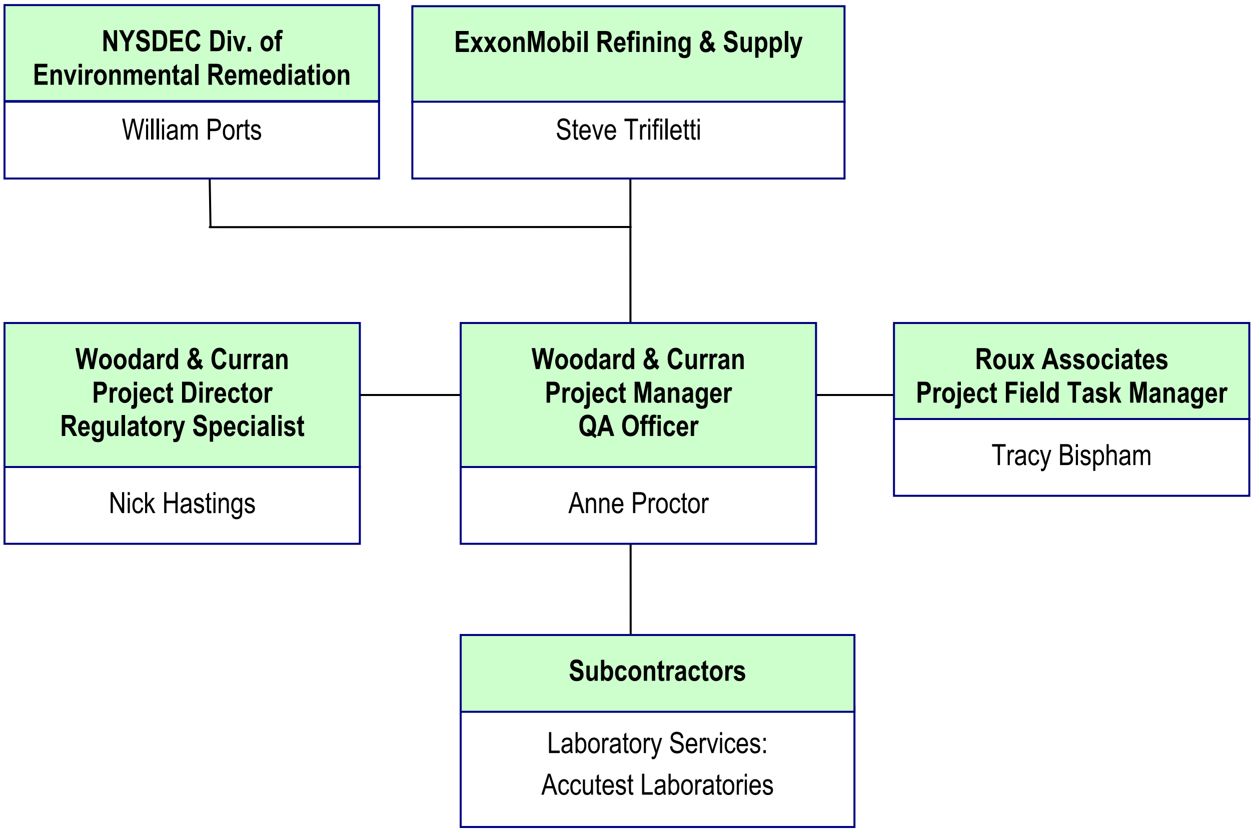
Laboratory			
Accutest Dayton, NJ	Laboratory Services	(732) 329-0200	www.**accutest**.com

Effective communication between all parties will be critical to ensure project goals are met. It will be the responsibility of the Project Manager to maintain communications internally and externally. The Project Manager will be in frequent contact with project personnel to keep the project team informed as to progress and potential changes as project activities are conducted.

All project personnel will communicate frequently to ensure field activities and reporting requirements are in accordance with this QAPP. Daily calls will be conducted to facilitate communication and evaluate progress. During field activities, field personnel will communicate with the Project Field Task Manager as needed.

Scheduling information, billing and any changes to the QAPP or work scope will be communicated to subcontractors by the Project Manager or Project Field Task Manager. Subcontractors must immediately report any problems to the Project Field Task Manager.

Project Organization and Communication Chart



FORM C

PROBLEM DEFINITION

The subject property is owned by ExxonMobil and is presently vacant, pending approval for redevelopment by NYSDEC and ExxonMobil. A Record of Decision (ROD) was issued by the NYSDEC in September 2006. Historic investigation programs and requirements of the ROD were used to develop a Remedial Design/Remedial Action Work Plan (the "Work Plan") for the former Mobil terminal property. The Work Plan was developed to refine delineation and/or remove "grossly contaminated soil" (see Work Plan Section 3.2).

FORM D

PROJECT DESCRIPTION

The Remedial Design/Remedial Action Work Plan includes the following tasks:

- Grossly contaminated soil (as defined in Section 3.2 of the Work Plan) will be excavated by backhoe for characterization and proper offsite disposal. The anticipated excavation area is indicated in Figure 3 in the Work Plan. Limits of the excavation, side walls and bottom, will be sampled and analyzed for SVOCs by EPA Method 8270. Sidewall and base samples will be collected at a rate of one every 20 linear feet of excavation.

- Concrete pads and structures will be rubblized and demolished in place using an excavator with hoe ram attachment, or other appropriate means.

- Nine (9) test pits will be excavated by backhoe or excavator as depicted on Figure 4 in the Work Plan. If visual observations or field screening (shake test results) indicated gross impact, the soil will be removed until no further evidence of gross impact is noted. The limits of the excavation will be sampled as specified above and analyzed for SVOCs by EPA Method 8270.

- Excavations will be fenced off until laboratory results are received and it is confirmed that the end point samples are all less than 500 ppm total SVOCs. If analytical results indicate an exceedance of the SVOC criteria, additional iterations of excavation and sampling will be conducted until all sample results are below criteria.

- Once the excavation results indicate no further grossly contaminated soil, the excavation will be backfilled using clean onsite soil or imported backfill, and the site grade restored.

- Surface and subsurface piping will be identified and removed for offsite recycling or disposal.

- The Site perimeter fence will be restored as able and posted with No Trespassing signs to control access. The Site will be maintained in a secure state until future development plans are finalized, at which time the final remedy will be implemented (see Work Plan Section 4.0).

3.0 MEASUREMENT DATA ACQUISITION

This element group describes the design and implementation of measurement systems that will be used during the project. Sampling procedures, analytical methods/procedures, and data handling and documentation procedures are described in this section. Field sampling SOPs are included in **Attachment A**. Analytical laboratory SOPs are included in **Attachment B**.

FORM E

SAMPLING DESIGN

The proposed Work Plan includes investigative and remedial tasks. The proposed tasks include the following specific and related tasks:

- Removal of grossly contaminated soil and subsequent confirmatory soil sampling;
- Excavation of test pits and the collection of investigative soil samples; and
- Assessment of subsurface piping and structures.

Soil sampling, including the number of samples and analytical parameters, are outlined in the Work Plan. The work is designed to identify the presence/absence of areas where SVOCs exceed 500 ppm. A site map showing the proposed excavation location is included as Figure 3 in the Work Plan. A site map showing the proposed test pit locations is included as Figure 4 in the Work Plan.

Equipment and methods used will be applied consistently from one test pit to another in order to maximize data comparability. If it becomes necessary to deviate from customary methodology, the effects of such change will be examined and documented for future reference.

Individuals responsible for conducting sampling and analysis of soil will be familiar with the Work Plan and QAPP prior to performing their duties. Individuals conducting field work will have completed OSHA 40-hour training. Training records will be provided upon request.

FORM F – 1
METHOD AND SOP REFERENCE TABLE

Analytical Method Reference: Include document title, method name/number, revision number, date	**Project Analytical SOPs: [1] Include document title, date revision number, and originator's name**
1a. SW-846, Semi-Volatile Organic Compounds, Method 8270C	1b. SOP for Test Method 8270C, Rev. 3, December 1996, Accutest Laboratories

Project Sampling SOPs:[2] Include document title, date, revision number, and originator's name
1c. SOP for Test Pit Sampling, SOP No. S-6, Rev. 2, April 2002, W&C
2c SOP for Equipment Decontamination, SOP No. S-4, Rev. 2, April 2002, W&C
3c. SOP for Air Monitoring, SOP No. S-9, Rev. 2, April 2002, W&C

Notes:

1. Analytical Laboratory SOPs are included in Attachment B of this document.
2. Project Sampling SOPs are included in Attachment A of this document.

FORM F-2
SAMPLING AND ANALYTICAL METHODS REQUIREMENTS

Parameter	**Matrix**	**Number of Samples (include field QC)**	**Analytical Method(1)**	**Sampling SOP(1)**	**Containers per Sample (number, size and type)**	**Preservation Requirements (temperature, light, chemical)(2)**	**Maximum Holding Time at Lab (preparation/ analysis)**
SVOCs	Soil	TBD	1a	1c	1, 8oz. glass jar Teflon cap	4°C	Extract in 14 days Analyze in 40 days

Notes:

1. Form F-1 contains the Method and SOP Reference Table
2. Sample containers to be pre-preserved by the laboratory

FORM G

PREVENTIVE MAINTENANCE – FIELD EQUIPMENT (1)

Instrument	Activity	Frequency	SOP Ref.(2)
Photo-ionization detector	Check charge/Battery Replace Filter Clean Lamp Window	Daily As needed As needed	Manual
O2/LEL Meter	Check charge/Battery Replace Filter	Daily As needed	Manual

Notes:

1. Field crews responsible for daily maintenance as per manufacturer's specifications outlined in equipment manuals.
2. All operation and maintenance procedures will be in accordance with manufacturer's specifications as outlined in the equipment manual.

FORM H

CALIBRATION AND CORRECTIVE ACTION – FIELD EQUIPMENT (1)

Instrument	Activity	Frequency	Acceptance Criteria	Corrective Action	SOP Ref. (2)
Photo-ionization detector	Field Screening and Air Monitoring	Calibrate beginning and end of day Calibration Checks throughout the day	75 to 125% Response to 100 ppm Isobutylene Calibration Standard	Perform filter change and battery check, recalibrate instrument. If still out of range clean lamp window then recalibrate instrument. Lastly, if still out of range call vendor for troubleshooting guidance or a replacement instrument.	Manual
O2/LEL Meter	Field Screening and Air Monitoring	Calibrate once/day Calibration Checks as needed	75 to 125% Response to Calibration Standard	Perform filter change, battery check, and flow check, then recalibrate instrument. If still out of range call vendor for troubleshooting guidance or a replacement instrument.	Manual

Notes:

1. Field crews responsible for daily maintenance as per manufacturer’s specifications outlined in equipment manuals.
2. All operation and maintenance procedures will be in accordance with manufacturer’s specifications as outline in equipment manual.

FORM I

PREVENTIVE MAINTENANCE – LABORATORY EQUIPMENT

The purpose of this section is to delineate the SOPs/methods used to ensure the optimum performance of laboratory equipment. All laboratory equipment should be maintained in accordance with each respective instrument manufacturer's operating instructions with all maintenance activities recorded. The selected laboratory, Accutest, will provide the analytical support for Field Work Scope. Consequently, the analytical laboratory is responsible for performing preventative maintenance on the laboratory equipment. The analytical laboratory is required to follow their quality assurance program, including preventative maintenance. Form F-1 of this QAPP contains the Method Reference Table.

FORM J

CALIBRATION AND CORRECTIVE ACTION – LABORATORY EQUIPMENT

The purpose of this section is to define the analytical techniques that will ensure the laboratory instrumentation employed will accurately and precisely quantitate the analytes of concern. The analytical laboratory will provide this information upon request for any target compounds such that the data objectives of the Field Work Scope and QAPP are supported. Additionally, the analytical laboratory will be required to submit and follow their approved quality assurance program, including calibration and corrective action procedures for laboratory equipment. Form F-1 of this QAPP contains the Method Reference Table.

FORM K

SAMPLE HANDLING AND CUSTODY REQUIREMENTS

All samples collected will be immediately placed on ice in a sample cooler to fulfill the necessary preservation requirements. At the end of each work day, samples will be shipped to the analytical laboratory by courier.

A Chain of Custody (COC) program will be utilized during sample collection, handling and transport. The COC program is designed to ensure that each sample is properly handled and accounted for at all times from collection in the field to the analysis at the laboratory. In addition to the COC, sample collection will be documented in site-specific field log books and each sample will be individually labeled. Labeling of each sample will consist of: sample identification, source of sample, date and time collected, the initials of personnel collecting the sample, the analysis required, and the preservation method. The purpose of this program is to ensure that each sample is analyzed for the correct parameters and protected from loss, damage or contamination. COC forms will be placed in the sample coolers with the respective samples for transport to the laboratory.

FORM L

ANALYTICAL PRECISION AND ACCURACY

Analytical precision and accuracy for each method can be found in the SOP referenced in Form F-1 of this document. Applicable information includes the analytical method and equipment required, laboratory decontamination procedures, and specific performance requirements such as detection limits, quantitation limits, precision requirements and accuracy requirements. Detection limits will be based upon the laboratory-calculated detection limits.

FORM M

FIELD QUALITY CONTROL REQUIREMENTS

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Duplicate	One per every 20 samples collected (Blind duplicate)	RPD ≤ 40% for soil/sediment samples	Review field notes and determine if data is useable and/or reanalysis is required.
Matrix Spike/ Matrix Spike Duplicate	One set per 20 samples collected.	RPD ≤ 30% for soil/sediment samples	Results will be qualified or rejected.
Temperature Blank	One per sample cooler	4^0C +/- 2^0	Results will be qualified or rejected.
Equipment Inspection	Each item prior to use	Physical integrity, contains proper preservative.	Discard item.
Reagent/Method Blanks	Each group of samples (Maximum of 20 samples per group). GC/MS spiked with surrogates 1 out of 10.	Positive sample results less than two times (2X) the method detection limit.	Halt analysis. Locate the source of contamination; correct problem; reanalyze method blank.
Replicate Sample	One out of every 15 samples.	Within RPD established control limits.	Reanalyzed for parameter in question.
Laboratory Control Sample (LCS)	Every 20 samples.	Laboratory and/or manufacturer established acceptance ranges.	Reanalyze associated samples.

QC Sample	Frequency	Acceptance Criteria	Corrective Action
Continuing Calibration Verification	Each group of samples.	Within % Recovery control limits.	Locate and correct source of error. Reanalyze check standard.
Matrix Spike	Every 20 samples or every batch whichever is less.	Accuracy, as defined by % Recoveries, within laboratory established quality control limits.	Sample set reanalyzed for parameter in question.
Surrogate Analysis	All method blanks and samples.	% Recovery meet laboratory established control limit acceptance criteria (established quarterly).	Locate and correct source of error. Reanalyze internal standard. Determine if reanalysis is required.
Internal Standards	All samples and method blanks.	% Recovery meet Laboratory Established control limit acceptance criteria (established quarterly).	Locate and correct source of error. Reanalyze internal standard. Determine if reanalysis is required.

FORM N

DATA MANAGEMENT AND DOCUMENTATION

Following receipt of laboratory analytical reports, each report will be reviewed to confirm that relevant laboratory quality control/quality assurance documentation is included. The laboratory will provide the following minimum data with each package:

- Data Results Sheets (include any performance evaluation sample results)
- Surrogate Recoveries and Acceptance Limits
- Matrix Spike/Matrix Spike Duplicate Results and Acceptance Limits
- Spike/Duplicate Results and Acceptance Limits
- Laboratory Control Sample Results and Acceptance Limits
- ICP Serial Dilution Results
- ICP Interference Check Sample Results
- Project Narrative which contains all observations and deviations

All laboratory results will be delivered to Woodard & Curran both electronically (i.e., Excel and GIS/Key electronic data deliverables) and in hard-copy form. Raw data including chromatograms and copies of internal COCs will be maintained by the laboratory.

Field data will be recorded in bound field log books to maintain a permanent record of all field activities. Information will include date, weather conditions, individuals on-site, field screening results, sampling observations and techniques, and any additional relevant information. All field notes and photographs will be maintained and stored in dedicated project files according to the Woodard & Curran Project Records Retention System.

4.0 ASSESSMENT/OVERSIGHT

This element group of the QAPP details procedures used to ensure implementation of the QAPP. It describes minimum requirements for quality assurance for management and final project reports.

FORM O

ASSESSMENT AND RESPONSE ACTIONS

Throughout the course of the project, Woodard & Curran will implement the following procedures to detect and correct problems that may occur:

- project management meetings (daily/weekly calls or as needed);
- peer review of all reports, documents, and correspondence; and
- ongoing communication between Woodard & Curran's project team, ExxonMobil and the NYSDEC.

As warranted, problems that occur will be communicated by project memorandums and telephone conversations. All memorandums and telephone notes will detail the problem encountered and any corrective actions taken. All documentation will be maintained in dedicated project files.

Changes to the QAPP will be made under the direction of the Project Manager and carried out by the appropriate project personnel.

FORM P

PROJECT REPORTS

Following implementation of the Field Work Scope and receipt and analysis of analytical data, a Report will be prepared to document all activities conducted during the Field Work Scope implementation as well as conclusions made and status of the various aspects of the investigation. Additional detailed reports will be prepared to document the conduct and findings of subsurface investigations performed at the site, if warranted.

5.0 DATA VALIDATION AND USEABILITY

This element group details the quality assurance activities that will be performed to ensure that the collected data are scientifically defensible, properly documented, of known quality, and meet the project objectives. Analytical data collected will be validated to 10% by an outside data validation contractor in accordance with the NYSDEC Data Usability Summary Report (DUSR) guidelines.

FORM Q-1

VERIFICATION OF SAMPLING PROCEDURES

Upon completion of the Field Work Scope, all data collected will be verified to ensure that sampling SOPs were adhered to and that specified samples were collected and analyzed for specified parameters. This evaluation will include (but is not limited to) the following:

- identify all samples;
- compare to samples documented in field log books;
- compare to Chain of Custody;
- check analytical parameters with those specified in the Field Work Scope;
- check detection limits with those specified in this QAPP; and
- review laboratory and field quality assurance and quality control (QA/QC) sample results.

FORM Q-2

DATA VERIFICATION AND VALIDATION

This section of the QAPP describes the process that will be followed to verify and validate the project data.

Internal Verification

Prior to release by the off-site laboratory, the data will be reviewed internally against all specific QA/QC parameters. The laboratory will perform analyses and review QA/QC consistent with the requirements of the specific laboratory method SOPs. Any deviations will be documented and explained in the final report. The off-site laboratory is responsible for the final results and overall quality of the data.

External Verification

Data validation to 10% of samples will be performed by an outside data validation contractor in accordance with the NYSDEC DUSR guidelines.

Validation

Validation of measurements is a systematic process of reviewing a body of data to provide assurance that the quality is adequate for the intended use. The validation process includes the following activities, as an example:

- Reviewing QC activities and results;
- Screening data sets and quality control results for outliers;
- Reviewing field sample data records and chains-of-custody;
- Reviewing sample handling and preservation procedures; and
- Verifying the above process.

Quality control results will also be compared against acceptance criteria described on Form M of this QAPP to determine completeness and to assess analytical control, precision, matrix effects or other interferences that could affect the quality of sample results. Specific quality control components, which will be evaluated in the validation procedures, include:

- Sampling and analysis date;
- Sample custody;
- Holding times;
- Sample preservation;
- Field and laboratory duplicate sample results;
- Surrogate recoveries;
- Matrix spike/matrix spike duplicate results;

- Laboratory control standards; and
- Laboratory method blanks and lot assignment reports.

The laboratory will also provide a case narrative indicating that the following parameters were reviewed as part of the sample analyses and the outcome of that review:

  - Tune summaries
  - Initial Calibration (ICAL)
  - Continuing Calibration Verification (CCV)
  - Internal standards
  - Prep sheets (analytical batch sheets)
  - Instrument log sheets

The laboratory case narrative will be reviewed during the data validation process and pending the outcome of that review the Project Manager will determine if additional validation activities are warranted.

DATA QUALIFIERS

Once sample concentrations have been through the data validation process, data qualifiers will be added, as necessary. Data qualifiers indicate that the reported sample concentration is below the detection limit, is estimated, or is rejected depending upon analytical conditions at the time of sample analysis. Specific data qualifiers, which may be applied as a result of data validation, include the following:

U - The analyte was not detected above the quantitation limit (QL).

J - The analyte was detected but the associated reported concentration is approximate and is considered estimated.

R - The reported analyte concentration is rejected due to serious deficiencies with associated quality control results. The presence or absence of the analyte cannot be confirmed.

UJ - The analyte was not detected above the QL. However, due to quality control results that did not meet acceptance criteria, the quantitation limit is uncertain and may not accurately represent the actual limit.

All analyte concentrations will be reported to the QL. Sample detections below the QL will be reported with a “J” qualifier.

DATA REPORTING

After data qualifiers have been added to the data set, an electronic version of the validated off-site laboratory data will be entered into a database in a format that is then available for interpretation.

Information for each sample that is entered into the database will include, but is not limited to the following:

- Sample identification number;

- Date sampled;
- Analytical method;
- Analyte name;
- Reporting units;
- Quantitation limit (QL);
- Analytical results;
- Validation qualifiers; and
- Any required footnotes.

Data validation will be performed by an entity independent of the laboratory generating the data.

FORM R

DATA USABILITY

Assessing data usability involves the process of reviewing and validating laboratory data and assessing whether it meets the prescribed project quality objectives. The environmental quality data to be collected throughout the execution of the Field Work Scope have specific end uses. For example, field screening data will be used to delineate excavation areas or to clear areas for redevelopment. Data will also be incorporated into the body of historical environmental data that has been collected for the property.

The validated data will be evaluated in terms of its precision, accuracy, representativeness, sensitivity, completeness, and comparability (PARCC).

The following subsections describe the measurement performance criteria and data usability for this investigation. In general, if issues with data quality are found in the data sets, they will be discussed and reviewed with the project team (including the laboratory, ExxonMobil and NYSDEC). If data quality is determined to be compromised for any given sampling event, a data quality assessment will be included in the applicable project reports. This assessment will evaluate the potential impact on the project, establish limitations of the data, and propose corrective actions, as appropriate.

Precision

Precision is a measure of the mutual agreement among individual measurements of the same property under prescribed conditions. Precision is measured by performing duplicate measurements in the field or laboratory and is expressed in terms of Relative Percent Difference (RPD).

Field and analytical duplicates have been incorporated into the program to assess the precision of the data. Field duplicate imprecision might be a reflection of several factors including: laboratory imprecision, sampling technique, decontamination procedures, and/or heterogeneity of contaminant distribution within the matrix. Analytical duplicates are a direct indication of laboratory precision.

The QC requirements, acceptance criteria, and potential corrective actions for field and laboratory duplicates are described on Form M. If data validation and assessment indicates that field and/or laboratory duplicates do not meet measurement performance criteria for precision, the potential impact on the project will be evaluated in the data quality assessment included in the applicable project reports. This data quality assessment will establish limitations and potential corrective actions for the affected data. If field duplicates appear to be the source of imprecision, sampling procedures may be re-evaluated and adjusted accordingly for future sampling and analysis events. If poor precision is indicated in analytical duplicates, laboratory QA/QC procedures may need to be reviewed.

Accuracy/Bias

Accuracy/Bias is the degree of agreement of a measurement with an accepted reference or true value and is usually expressed in terms of Percent Difference (%D) or Percent Recovery (%R). Accuracy is a measure of the bias of a system.

Routine calibration checks of field instrumentation are performed to assess the accuracy of field measurements. Equipment and trip blanks collected during field sampling activities measure accuracy by assessing potential contamination introduced during sample collection and transport. In the laboratory, initial calibrations, initial/continuing calibration verifications (ICVs/CCVs), sample matrix spike/matrix spike duplicates (MS/MSDs), internal standards (IS), sample surrogate recoveries, and laboratory control samples (LCS) are performed/checked to evaluate the accuracy of laboratory instrumentation. The accuracy of laboratory analytical procedures is further evaluated through the analysis of method blanks that can assess potential contamination introduced during sample preparation and/or analysis.

The QC requirements, acceptance criteria, and potential corrective actions for laboratory QC checks that measure accuracy and field and trip blank QC are described on Form M. If data validation and assessment indicates that field and/or laboratory QC checks for accuracy do not meet measurement performance criteria, the potential impact on the project will be evaluated in the data quality assessment included in the applicable project reports. Limitations and potential corrective actions for the affected data will be established in this data quality assessment. If poor accuracy is indicated by analytical QC checks, laboratory procedures may need to be reviewed.

Representativeness

Sample representativeness will be assessed through the measures of precision and accuracy. Field documentation, field duplicate analyses, and laboratory QC sample results will provide indices for the evaluation of data representativeness. Field duplicates will be used to assess heterogeneity within a sampling medium.

The representativeness of sample results will be based on the evaluation of precision and accuracy. The data quality assessment included in the applicable project reports will address any issues concerning representativeness that develop upon data review and validation. This data quality assessment will evaluate the potential impact on the project and establish limitations and potential corrective actions for the affected data.

Sensitivity and Quantitation limits

Sensitivity is the ability of the method or instrument to detect the constituents of concern and other target analytes at the project specified quantitation limits (QLs). For this project, the minimum QLs will be based on the laboratory Practical Quantitation Limit (PQL). PQLs represent the minimum concentration that can be routinely identified and quantitated above the method detection limit (MDL) by the laboratory. If problems regarding sensitivity and quantitation limits arise during data review and validation, the potential impact on the project will be evaluated in the data quality assessment included in the applicable project reports. This data quality assessment will establish limitations and potential corrective actions for the affected data.

Comparability

Comparability between data sets will be made qualitatively to indicate the extent to which comparisons among different measurements of the same quantity will yield valid conclusions. The quality assurance objective for comparability is to ensure the comparability of results from each sampling event performed. The assessment of data comparability will begin once multiple sampling events have been performed. The data quality assessment included in the applicable project reports will address any issues concerning data comparability that arise upon data review and validation. The potential impact on the project will be evaluated in this data quality assessment and will establish limitations and potential corrective actions for the affected data.

Completeness

Completeness is a measure (percentage) of the amount of valid data obtained from a measurement system relative to the amount that would be expected to be obtained under correct, normal conditions. A data set for a specific medium will be considered complete if 85% of the data packages are validatable and fully meet the data quality objectives provided in this QAPP. If data validation and assessment indicates that measurement performance criteria for completeness has not been achieved, the potential impact on the project will be evaluated in the data quality assessment included in the applicable project reports. This data quality assessment will establish limitations and potential corrective actions for the affected data.

Data Limitations and Actions

Data will be assessed with regard to the data quality objectives, measurement performance criteria, PARCC parameters, and the QC requirements included in Form M. If data quality is determined to be compromised for any given sampling event, a data quality assessment will be included in the applicable project report. This assessment will be used to describe and document data limitations based on the qualitative and quantitative performance criteria. Based on how the data are to be used, data that do not meet all the criteria will be appropriately qualified and limited in its use.

During field activities, QA/QC samples designed to assess sampling techniques (duplicates) will be collected and shipped at the frequencies provided on Form M. If the need for corrective action is identified based on data validation and evaluation, actions will be outlined in the data quality assessment included in the applicable project reports. The data assessment process is to be an on-going process, implemented by the project team and the laboratory.

ATTACHMENT A: PROJECT SAMPLING SOPS

SOP-4

STANDARD OPERATING PROCEDURE FOR EQUIPMENT DECONTAMINATION

Woodard & Curran, Inc.

FIELD EQUIPMENT DECONTAMINATION PROCEDURE

Decontamination of field equipment is necessary to ensure the quality of samples by preventing cross-contamination. In addition, decontamination reduces health hazards and prevents the spread of contaminants off-site.

Equipment needed:

Large/heavy Equipment (i.e., Drill rigs, backhoes, augers, drill pipe, bits, casing, and screen):

- High-pressure pump with steam-spray unit.
- Stiff-bristle brushes.

Small/sampling Equipment (i.e., Split spoons, bailers, bowls, and pumps):

- Soap
- Polyethylene sheeting
- Stiff-bristle brushes.
- Wash bottles or manual pump sprayer.
- 10% methanol solution (optional)
- Distilled water
- Tap water

Procedure. The following steps will be followed when decontaminating large/heavy equipment:

1. The field crew or contractor will construct a decontamination area at a designated area on site of 6-mil polyethylene, large enough to capture decontamination fluids. Decontamination of equipment will be performed over the decontamination pad. Depending on site contaminants, equipment may be decontaminated at each drilling location. Decon water will be collected and drummed for proper disposal.
2. Equipment and tools will be cleaned between each location and prior to the initiation of any sampling.
3. Spray areas (rear of rig or backhoe) exposed to contaminated soils using steam or high-pressure sprayer. Be sure to spray down all surfaces, including the undercarriage.
4. Document that decontamination was performed in the appropriate logbook.

Procedure. The following steps will be followed when decontaminating sampling equipment including split-spoons, spatulas, and hand tools that directly contact samples.

1. Set up a decontamination line. The decontamination line should progress from "dirty" to "clean", with an area for drying decontaminated equipment. The decontamination line should be set up on polyethylene sheeting.
2. Wash the item thoroughly in a bucket of soapy water (tap water). Use a stiff-bristle brush to dislodge any clinging dirt. Disassemble any items that might trap contaminants internally before washing. Do not reassemble until decontamination is complete.
3. Rinse the item in a bucket containing clear tap water. Rinse water should be replaced as needed.
4. Document that decontamination was performed in the appropriate logbook.
5. Disposable items will be bagged for disposal as general refuse.
6. Decontamination water will be drummed for proper disposal.

QA/QC

The Project Field Task Manager or designated alternate will oversee decontamination procedures to ensure that they have been completed according to the procedures outlined above. Equipment blanks will be collected and analyzed throughout the program to determine the effectiveness of decontamination procedures. Blank number and frequencies are presented in the QAPP.

References

None.

SOP-6

Revised November 2007

STANDARD OPERATING PROCEDURE FOR TEST PIT SAMPLING

Woodard & Curran, Inc.

Test Pit Sampling Procedure

Test Pits will be excavated with backhoe equipment to provide detailed visual examination of near surface soil, groundwater, and bedrock conditions. Test Pit soil samples may be collected using stainless steel and/or Teflon-lined scoops, trowels, shovels, spoons, or spatulas.

Equipment needed:

- Bound field logbook.
- Sample tags.
- Appropriate sample containers and labels.
- Insulated cooler and ice.
- Decontamination equipment and supplies.
- Personal protective clothing and equipment as required by the site-specific Health and Safety Plan (HASP).
- Stainless steel or aluminum trays or bowls.
- Stainless steel shovels, trowels, spoons, or spatulas.
- Backhoe Equipment

Test Pit Sampling Procedure:

1. Contact DIG SAFELY.NEW YORK at (800) 962-7962 prior to any subsurface investigation. In addition, contact local utilities that may have underground services on or near the Site.
2. Follow the sampling pattern outlined in the QAPP.
3. Mark the location of potential test pits.
4. At the direction of the project staff on-site, the backhoe operator will excavate the test pit in increments.
5. Test pit excavations will cease if any of the following occurs:
    - Distinct changes in stratigraphy or materials
    - Odors
    - Groundwater or fluid phase contaminants
6. The requirements for collecting grab samples of soil are as follows:
    a. Use a clean stainless steel trowel or spoon to collect sufficient material to fill the sample containers.
    b. Fill the sample containers directly from the sampling device, removing stones, twigs, grass, etc., from the sample. Additional sample containers may be required to obtain enough material for a minimum of 30 percent solids.
    c. Immediately secure the caps on the sample container.

d. Label container with the appropriate information. NOTE: Container may be labeled prior to sample collection.
e. Record samples (e.g., sample ID, location, depth, method, etc.) in the bound field logbook.
f. Pack sample in cooler with ice. The only preservation required for soil samples is to cool them to 4 degrees Celsius. A small plastic temperature blank will be filled with water and placed in the cooler with the samples. The temperature of the samples will be determined at the laboratory by measuring the temperature of the temperature blank.
g. Use decontaminated sampling equipment at each sample location to minimize cross-contamination.
h. In the event that a duplicate sample is collected: fill duplicate jars for VOAs as described above. For other parameters, place sufficient sample quantity in a stainless steel bowl and mix. Split the mixed sample into duplicate sampling jars.
i. VOC containers will be preserved with methanol. Pre-measured vials containing the appropriate quantity of methanol will be provided by the laboratory.

Field Log Information:

At a minimum, field logs for test pit excavation will include the following documentation:

- Plan and profile sketches of the test pit showing materials encountered, the depth of material, and sample locations
- Sketch of the test pit and distance and direction from permanent, identifiable location marks as appropriate
- A description of the material removed from the excavation
- A record of samples collected
- The presence or absence of water in the test pit and the depth encountered
- Other readings, or measurements taken during excavation, including field screening reading

Unless otherwise specified and the site-specific HASP discusses appropriate procedures, no personnel will enter the test pit. In addition, all test pits will be backfilled on the day of excavation. In most cases, excavation materials will be stockpiled on polyethylene sheeting and then returned to the test pit as backfill. In the event that grossly contaminated soil is excavated, excavated soils will be placed in roll-offs pending characterization and proper disposal at an appropriate off-site facility. The excavation will then be backfilled with uncontaminated soil pursuant to 6 NYCRR 375-6.7(d), free of extraneous debris or solid waste The backfill will be certified clean or sampled at a frequency of one sample per 50 cubic yards.

QA/QC

QA/QC procedures are outlined in the sampling procedures discussed above. Duplicates, blanks, and spikes have been incorporated into the QAPP to assess potential for sampling, shipping, and laboratory impacts on data quality. Percent solids will also be analyzed for each sediment sample so that proper concentration adjustments can be made.

References

"Soil Covers and Backfill" - 6 NYCRR 375-6.7(d).

SOP-9

Revised November 2007

STANDARD OPERATING PROCEDURE FOR AIR MONITORING

Woodard & Curran, Inc.

AIR MONITORING PROCEDURES - BREATHING ZONE

Air monitoring will be performed during invasive field activities to obtain qualitative volatile organic compound (VOC) and particulate concentrations in order to protect site workers and the community. Air monitoring will be completed upwind, near the activity in the worker's breathing zone, and downwind during sampling and intrusive activities. ***If a detection of total VOCs or particulate above the action levels indicated below is observed, stop work and immediately notify the Project Field Task Manager prior to implementing actions***. Refer to the site-specific HASP for additional health and safety procedures. All monitoring records (readings) and instrument calibration sheets must be available for NYSDEC or NYSDOH personnel to review.

Equipment Needed:

- Two Photoionization Detectors (PIDs) equipped with 10.0 or greater eV lamps, one hand-held and one monitoring station, capable of calculating 15-minute running average concentrations
- Two particulate monitoring stations capable of measuring particulate matter less than 10 micrometers in size (PM-10) integrated over a period of 15 minutes (or less) and equipped with audible alarm
- Calibration Sheets
- Field Log Book
- Personal Protective Equipment as outlined in the HASP

Air Monitoring Steps - PID measurements:

1. Calibrate the PIDs using procedures outlined in the instrument operations manual. The instrument should be calibrated at the beginning of each day of use and a check calibration at the finish of each field day. Consult the instrument operations manual for troubleshooting suggestions.
2. Set-up a monitoring station at the downwind perimeter of the work area or exclusion zone.
3. Using the hand-held instrument, measure upwind/background VOC concentrations at the start of each day and every 4-hours thereafter.
4. Also using the hand-held instrument, approximately every hour near the planned activities, measure VOC concentrations in the breathing zone, approximately 2-5 feet above the ground surface.

If the ambient air concentration of total VOCs at the downwind perimeter of the exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total VOC level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

If total VOC levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total VOC level in the worker's breathing zone is in compliance with the action level in the site-specific H&SP, and 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

If the VOC level is above the action level for worker safety in the site-specific H&SP, or above 25 ppm at the perimeter of the work area, activities must be shutdown.

Particulate Monitoring Steps:

1. Calibrate the meter using procedures outlined in the instrument operations manual. The instrument should be calibrated at the beginning of each day of use and a check calibration at the finish of each field day. Consult the instrument operations manual for troubleshooting suggestions.
2. Set-up monitoring stations at the upwind/background and downwind perimeter of the exclusion zone.
3. Throughout the day, visually monitor fugitive dust migration.

If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/m3) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed (for example, wetting selected areas). Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/m3 above the upwind level and provided that no visible dust is migrating from the work area.

If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/m3 above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/m3 of the upwind level and in preventing visible dust migration.

QA/QC

See above.

References

NYSDOH Generic Community Air Monitoring Plan – Appendix D to the NYSDEC Voluntary Cleanup Program Guide, Draft May 22, 2002.

ATTACHMENT B: ANALYTICAL LABORATORY SOPS

ACCUTEST LABORATORIES
Standard Operating Procedure

FN: EMS8270-12
Pub. Date: 06/08/1998
Rev. Date: 5/9/2007
Page 1 of 35

Lab Manager______________

QA Manager_______________

Effective Date:________________________

TEST NAME: **METHOD 8270C, SEMIVOLATILE ORGANIC COMPOUNDS BY GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)**

REFERENCE: SW846 8270C (Revision 3, December 1996)

Revised Sections: ***Table 9***

1.0 SCOPE AND APPLICATION

1.1 The following method describes the analytical procedure that is utilized by Accutest to analyze semivolatile organic compounds in extracts prepared from all types of solid waste matrices, soils, and water samples. Options are incorporated for the analysis of sixteen (16) polyaromatic hydrocarbons (PAH) and other compounds listed in table 8A by selected ion monitoring GC/MS (GC/MS-SIM).

1.2 Table 1 lists the neutral, acidic, and basic organic compounds that can be determined by this method. The applicable concentration range of this method is compound and instrument dependent. Some compounds may require special treatment due to the limitations caused by sample preparation and/or chromatographic problems.

2.0 SUMMARY OF METHOD

2.1 This method is performed in accordance with the following extraction methodologies in SW846, 3rd Edition: 3510, 3520, 3540, 3550 and 3580.

2.2 The resultant methylene chloride extract is injected into a tuned and calibrated GC/MS system equipped with a fused silica capillary column. The GC column is temperature-programmed to separate the analytes, which are then detected with a mass spectrometer (MS) connected to the gas chromatograph.

2.3 The peaks detected are qualitated by comparison to characteristic ions and retention times specific to the known target list of compounds.

2.4 Once identified, the compound is quantitated by internal standard techniques with an average response factor generated from the calibration curve.

2.5 Additional unknown peaks with a response greater than 10 % of the closest internal standard may be processed through a library search with comparison to a NIST98 database. An estimated concentration is quantitated by assuming a response factor of 1.

2.6 This method includes analytical options for PAHs and other selected compounds by GC/MS-SIM. The extract is fortified with an additional SIM specific internal standard mix and analyzed using selected ions that are characteristic of the compounds of interest following the analysis of lower concentration calibration standards analyzed under the same MS scan conditions. Qualitative and quantitative identification is conducted using the procedures employed for full scan analysis.

3.0 REPORTING LIMIT & METHOD DETECTION LIMIT

3.1 Reporting Limit. The reporting limit for this method is established at either method detection limit or the lowest concentration standard in the calibration curve, depending on the requirements of different regulatory programs. Detected concentrations below this concentration cannot be reported without qualification. See table 9.

3.1.1 Compounds detected at concentrations between the reporting limit and MDL are quantitated and qualified as “J”, estimated value. Program or project specifications may dictate that “J” qualified compounds are not to be reported.

3.2 Method Detection Limit. Experimentally determine MDLs using the procedure specified in 40 CFR, Part 136, Appendix B. This value represents the lowest reportable concentration of an individual compound that meets the method qualitative identification criteria.

3.2.1 Experimental MDLs must be determined annually for this method.

3.2.2 Process all raw data for the replicate analysis in each MDL study. Forward the processed data to the QA group for archiving.

4.0 DEFINITIONS

BATCH - a group of samples which behave similarly with respect to the sampling or the testing procedures being employed and which are processed as a unit. For QC purposes, if the number of samples in a group is greater than 20, then each group of 20 samples or less will all be handled as a separate batch.

BLANK - an analytical sample designed to assess specific sources of laboratory contamination.

CONTINUING CALIBRATION - a mid-range calibration check standard run every 12 hours to verify the initial calibration of the system.

EXTRACTED ION CURRENT PROFILE (EICP) - a plot of ion abundance versus time (or scan number) for ion(s) of specified mass (Es).

INITIAL CALIBRATION - analysis of analytical standards for a series of different specified concentrations which cover the working range of the instrument; used to define the linearity and dynamic range of the response of the mass spectrometer to the target compounds.

INTERNAL STANDARDS - compounds added to every standard, blank, matrix spike, matrix spike duplicate, and sample extract at a known concentration, prior to analysis. Internal standards are used as the basis for quantitation of the target compounds and must be analytes that are not sample components.

MATRIX - the predominant material of which the sample to be analyzed is composed.

MATRIX SPIKE - aliquot of a matrix (water or soil) fortified (spiked) with known quantities of specific compounds and subjected to the entire analytical procedure in order to indicate the appropriateness of the method for the matrix by measuring recovery.

MATRIX SPIKE DUPLICATE - a second aliquot of the same matrix as the matrix spike (above) that is spiked in order to determine the precision of the method.

METHOD BLANK - an analytical control consisting of all reagents, internal standards and surrogate standards, is carried throughout the entire preparatory and analytical procedure. The method blank is used to define the level of laboratory, background and reagent contamination.

METHOD DETECTION LIMITS (MDLs) - The minimum concentration of a substance that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. MDLs should be determined approximately once per year for frequently analyzed parameters.

PERCENT DIFFERENCE (%D) - As used to compare two values, the percent difference indicates both the direction and the magnitude of the comparison, i.e., the percent difference may be either negative, positive, or zero. (In contrast, see relative percent difference.)

PRIMARY QUANTITATION ION - a contract specified ion used to quantitate a target analyte.

REAGENT WATER - water in which no interferant is observed at or above the minimum detection limit of the parameters of interest.

RECONSTRUCTED ION CHROMATOGRAM (RIC) - a mass spectral graphical representation of the separation achieved by a gas chromatograph; a plot of total ion current versus retention time.

RELATIVE PERCENT DIFFERENCE (RPD) - As used to compare two values, the relative percent difference is based on the mean of the two values, and is reported as an absolute value, i.e., always expressed as a positive number or zero. (In contrast, see percent difference.)

RELATIVE RESPONSE FACTOR (RRF) - a measure of the relative mass spectral response of an analyte compared to its internal standard. Relative Response Factors are determined by analysis of standards and are used in the calculation of concentrations of analytes in samples.

RELATIVE RETENTION TIME (RRT) - the ratio of the retention time of a compound to that of a standard (such as an internal standard).

RESOLUTION - also termed separation or percent resolution, the separation between peaks on a chromatogram, calculated by dividing the depth of the valley between the peaks by the peak height of the smaller peak being resolved, multiplied by 100.

SECOND SOURCE CALIBRATION CHECK STANDARD - a standard from a separate source than the calibration curve that is used to verify the accuracy of the calibration standards. An external check must be run whenever an initial calibration is performed.

SURROGATES - pure analytes added to every blank, sample, matrix spike, matrix spike duplicate, and standard in known amounts before extraction or other processing; used to evaluate analytical efficiency by measuring recovery. Surrogates are brominated, fluorinated, or isotopically labeled compounds not expected to be detected in environmental media.

5.0 HEALTH & SAFETY

5.1 The analyst must follow normal safety procedures as outlined in the Accutest Health and Safety Plan and Personal Protection Policy, which include the use of safety glasses and lab coats. In addition, all acids are corrosive and should be handled with care. Flush spills with plenty of water. If acids contact any part of the body, flush with water and contact the supervisor.

5.2 The toxicity or carcinogenicity of each reagent used in this method has not been precisely determined; however, each chemical should be treated as a potential health hazard. Exposure to these reagents should be reduced to the lowest possible level. The laboratory is responsible for maintaining a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of data handling sheets is made available to all personnel involved in these analyses.

5.3 The following analytes covered by this method have been tentatively classified as known or suspected human or mammalian carcinogens: benzo(a)anthracene, benzidine, 3,3'-dichlorobenzidine, benzo(a)pyrene, dibenzo(a,h)anthracene, N-nitrosodimethylamine, and 4,4'-DDT. Prepare primary standards of these toxic compounds in a hood. A NIOSH/Mass approved toxic gas respirator must be worn when the analyst handles high concentrations of these toxic compounds.

6.0 INTERFERENCES

6.1 The data from all blanks, samples, and spikes must be evaluated for interferences.

6.2 Method interferences may be caused by contaminants in solvents, reagents, glassware, and other stages of sample processing. Refer to "The Preparation of Glassware for Extraction of organic contaminants" SOP for practices utilized in the extraction department.

6.3 Matrix interferences may be caused by contaminants that are co-extracted from the sample. The extent of matrix interferences will vary considerably from source to source, depending upon the nature and diversity of the industrial complex or municipality being sampled.

6.4 To reduce carryover when high-concentration samples are sequentially analyzed, the syringe must be rinsed out between samples with solvent. Whenever an unusually concentrated sample is encountered, it should be followed by the analysis of solvent to check for cross contamination.

7.0 SAMPLE COLLECTION, PRESERVATION, & HOLDING TIMES

7.1 Water samples may be collected in 1-liter glass bottles with Teflon insert in caps. Soil samples may be collected in 250-ml widemouth amber glass bottles.

7.1.1 Sample should be taken with care so as to prevent any portion of the collected sample coming in contact with the sampler's gloves, thus avoiding possible phthalate contamination.

7.2 Test all aqueous samples for residual chlorine using test paper for free and total chlorine. If the sample tests positive for residual chlorine, add 80 mg of sodium thiosulfate to each liter of sample.

7.3 The samples must be protected from light and refrigerated at 4° C from the time of receipt until extraction and analysis.

7.4 Store the sample extracts at -10 °C in amber vials (protected from light), in sealed vials equipped with unpierced PTFE-lined septa.

7.5 HOLDING TIME

7.5.1 Aqueous samples must be extracted within 7 days of sampling.

7.5.2 Soil, sediments and concentrated waste samples must be extracted within 14 days of sampling.

7.5.3 Extracts must be analyzed within 40 days following extraction.

8.0 APPARATUS & MATERIALS

8.1 GAS CHROMATOGRAPH/MASS SPECTROMETER SYSTEM

8.1.1 Gas Chromatograph. HP-5890, HP-6890, or Agilent 6890-N which includes an analytical system that is complete with a temperature programmable gas chromatograph and all required accessories including syringes, capillary chromatographic columns, and gases.

8.1.1.1 The injection port is designed for splitless injection with capillary columns.

8.1.1.2 The capillary column is directly coupled to the source.

8.1.2 Column.

8.1.2.1 30 m x 0.25 mm fused silica (0.25 μm film thickness) DB-5MS or equivalent capillary column. Condition the column as per manufacture's directions.

8.1.3 Mass Spectrometer (HP-5972, HP-5973 or Agilent 5975).

8.1.3.1 Full Scan Mode -Capable of scanning from 35-500 amu every 1 second or less utilizing 70 volt (nominal) electron energy in the electron impact ionization mode.

8.1.3.2 SIM Mode- Capable of selective ion grouping at specified retention times for increased compound sensitivity (table 2a).

8.1.3.3 Capable of producing a mass spectrum which meets all the EPA performance criteria in Table 3 when injecting 50 ng of Decafluorotriphenyl phosphine (DFTPP).

8.2 DATA SYSTEM

8.2.1 Acquisition and Instrument Control: HP Chemstation. A computer system is interfaced to the mass spectrometer that allows the continuous acquisition and storage on machine readable media (disc) of all mass spectra obtained throughout the duration of the chromatographic program.

8.2.2 Data Processing: HP Enviroquant. The software accommodates searching of GC/MS data files for analytes which display specific fragmentation patterns. The software also allows integrating the abundance of an EICP between specified time or scan number limits. The data system includes the NIST98 spectra library for qualitative searches of non-target compounds present in the chromatogram. It flags all data files that have been edited manually by laboratory personnel.

8.2.3 Offline Magnetic Tape Storage Device (Lagato Networker) - the magnetic tape storage device copies data for long term, offline storage.

8.3 SYRINGE

8.3.1 10 μl graduated, auto sampler (Hamilton or equiv.).

9.0 REAGENTS AND STANDARDS

9.1 Solvents - Ultra pure, chromatography grade methylene chloride and acetone.

9.2 Stock Standard Solutions.

9.2.1 Certified, commercially prepared standards, from two separate sources are used.

9.2.1.1 Base Neutrals.

- Base/Neutrals Mix #1 (Absolute: Semivolatile Organics Standard Mix # 1).
- Base/Neutrals Mix #2 (Absolute: Semivolatile Organics Standard Mix # 2).
- PAH Mix (Absolute: Semivolatile Organics Standard Mix # 7).
- PAH Mixture #2 (Ultra).
- PAH Selected Ion Monitoring Mixture
- Benzidines Mix (Absolute: Semivolatile Organics Standard Mix # 6).
- Toxic Substances #2 (Absolute: Semivolatile Organics Standard Mix # 5).
- Pyridines Mixture (Ultra).
- Additonal requested compound(s) mix (Absolute).
- Base Neutral Mixture (2nd Source).

Acids.

- Phenols Mix (Absolute: Semivolatile Organics Standard Mix # 8).
- Toxic Substances #1(Absolute: Semivolatile Organics Standard Mix # 4).
- Acid Mixture (2nd Source).

9.2.2 Internal Standard Mixtures.

9.2.2.1 Ultra (or equivalent) at a concentration of 4,000 μg/ml for each of the following compounds.

Full Scan
- 1,4-Dichlorobenzene-d4
- Naphthalene-d8
- Acenaphthene-d10
- Phenanthrene-d10
- Chrysene-d12
- Perylene-d12

SIM

- 1,2-Dichlorobenzene-d4
- 1-Methylnaphthalene-d10
- Fluorene-d10
- Fluoranthene-d10
- Benzo(a)pyrene-d12

9.2.2.2 The internal standards should permit most of the components of interest in a chromatogram to have retention times of 0.8 - 1.20 relative to one of the internal standards.

9.2.2.3 Each 1 ml sample extract, and standard undergoing analysis should be spiked with 10 μl of the internal standard mixtures, resulting in a concentration of 40 μg/ml of each internal standard for full scan analysis and 4 ug/ml for SIM analysis.

9.2.3 Surrogate Standard Mixture.

9.2.3.1 B/N Surrogate Standard Mix: RESTEK (or equivalent) at a concentration of 5,000 μg/ml each surrogate compound.

- Nitrobenzene-d5.
- 2-Fluorobiphenyl.
- p-Terphenyl-d14.

9.2.3.2 Acid Surrogate Standard Mix: RESTEK (or equivalent) at a concentration of 7,500 μg/ml each surrogate compound.

- Phenol-d5.
- 2-Fluorophenol.
- 2,4,6-Tribromophenol.

9.2.4 DFTPP Tune Stock.

9.2.4.1 Protocol (or equivalent) at a concentration of 2,500 μg/ml for the following compounds.

- Decafluorotriphenylphosphine.
- 4,4’-DDT.
- Benzidine.
- Pentachlorophenol.

9.2.5 Store at -10 ^{o}C or less when not in use or according to the manufacturer's documented holding time and storage temperature recommendations. Stock standard solutions must be replaced after 1 year or sooner if manufacture’s expiration date comes first or comparison with quality control check samples indicates degradation.

9.3 Surrogate Spiking Solutions.

9.3.1 Two surrogate spiking solutions, base/neutral surrogate solution and acid surrogate solution, at a concentration of 100 μg/ml are prepared in Extraction. Spike each sample, and blank with 0.5 ml of each solution, prior to extraction, for a final concentration of 50 μg/l of each surrogate compound in the extract.

9.3.2 A calibration range must be constructed for the surrogate compounds. Accordingly, appropriate amounts of surrogates are mixed with each calibration solution to define a range similar to the target compounds.

9.3.3 Store at -10 °C or less or according to the manufacturer's documented storage temperature recommendations. Prepare fresh surrogate spiking solutions every year, or sooner, if the manufacturer's expiration dates come first or if the solution has degraded or evaporated.

9.4 Intermediate Calibration Standard Solution.

9.4.1 The calibration stock solution is prepared by adding an appropriate amount of each stock and surrogate compounds into a 10 ml volumetric flask. Dilute the solution to the volume with methylene chloride and mix thoroughly. Refer to Table 7A for details.

9.5 Calibration Standards.

9.5.1 Initial Calibration Standards.

9.5.1.1 Calibration standards containing the surrogate compounds should be made by quantitative dilutions of the above intermediate solution. The calibration standards are prepared at a minimum of five concentrations to cover the range of 2 - 100 μg/ml for full scan and 0.2 – 15ug/ml for SIM, depending upon project specific requirements. Suggested levels and preparations are shown in Table 7B.

9.5.2 Continuing Calibration Verification.

9.5.2.1 The concentration of the mid range standard used for continuing calibration verification is alternated between 25 and 50 μg/ml for full scan and 2.5 and 5.0 for SIM.

9.5.3 Store the calibration standards in a refrigerator at 4 °C and prepare every 6 months or before the manufacturer's expiration date, whichever is sooner. Standards must be replaced immediately if the analysis of check standards indicates degradation.

9.6 Second Source Calibration Check Standard.

9.6.1 Second source calibration check standard is prepared per Table 7C, using the intermediate solutions prepared in Extraction.

9.6.2 A second source calibration check standard is analyzed after each initial calibration.

9.7 Daily GC/MS Performance Checks.

9.7.1 The solution is prepared at 50 µg/ml by making a 1:50 dilution of DFTPP stock solution (Section 9.2.4) in methylene chloride.

9.8 Matrix Spike Solutions.

9.9.1 The matrix spike solutions for both Base/Neutral and Acid are prepared in Acetone at a concentration of 100 µg/ml for each compound. Prepare the matrix spike, matrix spike duplicate and blank spike by spiking the selected sample and the blank with 0.5 ml of these solutions for a final concentration of 50 µg/l of each compound.

9.10 All organic new standard solutions are analyzed prior to use to verify the accuracy of the prepared concentration.

9.10.1 The prepared standard solution is analyzed using the determinative (instrumental) technique for the method.

9.10.2 The solution is analyzed following the completion of instrument calibration or a calibration check.

9.10.3 The concentration of the standard solution is determined using the software routines used in determining the acceptability of calibration verification.

9.10.4 The data is evaluated and the percent difference determined. The standard solution is approved for use if all designated compounds are present in the solution and the percent difference is less than the established criteria (±20%).

10.0 CALIBRATION

10.1 Initial Calibration.

10.1.1 The calibration range covered for routine analysis under RCRA employs standards of 2, 5, 10, , 25, 50, 80, 100 µg/ml for full scan and 0.2, 1, 2.5, 5, 10, and 15 ug/ml for SIM. A minimum of five standards must be run sequentially. The reporting limit is established by the concentration of the lowest standard analyzed during the initial calibration. Lower concentration standard may be needed to meet the reporting limit requirements of state specific regulatory program. The linear range covered by this calibration is the highest concentration standard.

10.1.2 A calibration range must be constructed for each surrogate compound. Accordingly, add appropriate amounts of surrogate spiking solutions to the calibration solution to define a range similar to the target compounds.

10.1.3 Aliquot 1 ml of each calibration standard into a 2 ml crimp top vial.

10.1.4 Prior to analysis, add 10 µl of the applicable (Full acan and/or SIM) internal standard solution (Section 9.2.2) to each standard. This results in a concentration of 40 µg/ml (Full scan) and 4ug/ml (SIM) for each internal standard.

10.1.5 Analyze the standard solutions using the conditions established in Section 11.0. Each analyte is quantitatively determined by internal standard technique using the closest eluting internal standard and the corresponding area of the major ion. See Table 6.

10.1.6 The Response Factor (RF) is defined in Section 13.1. Calculate the mean RF for each target analyte, using minimum of five RF values calculated from the initial calibration curve.

10.1.7 For the initial calibration to be valid, the following criteria must be met.

10.1.7.1 The System Performance Check Compounds (SPCCs) (Table 5) must be checked for a minimum average response factor. The minimum mean response factor for these compounds is 0.05. If the initial calibration criteria for SPCCs are not achieved, perform corrective action before completing the calibration.

10.1.7.2 The % RSD for each individual Calibration Check Compound (CCC) (Table 5) must be less than 30 %. This check is used to identify gross instrument operating problems. If the initial calibration criteria for CCCs are not achieved, perform corrective action before completing the calibration.

10.1.7.3 The percent relative standard deviation (% RSD) (see Section 13.2) of all target analytes must be less than 15 %.

10.1.7.4 If the %RSD of any individual (non CCC) compound is >15%, employ an alternative calibration linearity model. Specifically, linear regression using a least squares approach may be employed.

10.1.7.4.1 If a linear regression is employed, select the linear regression calibration option of the mass spectrometer data system. Do not force the regression line through the origin and do not employ 0,0 as a sixth calibration standard.

10.1.7.4.2 The correlation coefficient (r value) must be ≥0.99 for each compound to be acceptable.

10.1.7.4.3 Perform corrective action and recalibrate if the calibration criteria cannot be achieved.

10.1.7.5 The initial calibration criteria for this method applies to all additional compounds of concern specified by the client.

10.1.7.6 The relative retention times of each target analyte in each calibration standard should agree within 0.06 relative retention time units.

10.2 Second Source Calibration Check Standard.

10.2.1 The calibration is verified with a calibration check standard at 50 μg/ml (Full scan) or 5ug/ml (SIM) from an external source (Section 9.6). It must be analyzed immediately following the initial calibration.

10.2.2 The percent difference (% D) (Section 13.3) for this standard must meet the criteria of 20% for all the target compounds.

10.2.2.1 If % D is greater than 20%, reanalyze the second source check. If the criteria cannot be met upon re-injection, re-prepare the second source solution using a fresh ampoule and repeat the process.

10.2.2.2 If the %D criteria cannot be achieved after re-preparation of the second source, prepare a third source and repeat the process. Make fresh calibration standards using one of the two standard sources that match each other.

10.3 Continuing Calibration Verification Standard.

10.3.1 A calibration verification standard at close mid-level concentration of the initial calibration range at alternating 25 and 50ug/ml for full scan and 2.5ug/ml and 5ug/ml for SIM must be acquired every 12 hrs.

10.3.1.1 Vary the concentration of calibration verification standard on alternate verifications (i.e. every other calibration verification) using an alternative concentration standard. The standard selected must be lower than the midpoint calibration standard.

10.3.2 For the continuing calibration to be valid, all of the following specified criteria must be met.

10.3.2.1 The minimum RF for SPCC compounds must be 0.05. Each SPCC compound in the calibration verification standard must meet its minimum response factor. The percent difference (% D) for CCC compounds must be less than 20%.

10.3.2.1.1 If the CCCs are not part of the target list, then all targeted analytes must meet the 20% D criteria. All non-CCC compounds should also meet the 20% D criteria.

10.3.3 If the first continuing calibration verification does not meet criteria, a second standard may be injected after notify the team leader/manager and checking the system for defects.

10.3.3.1 A continuing calibration check is allowed to be repeated only once; if the second trial fails, a new initial calibration must be performed. In situations where the first check fails to meet the criteria, the instrument logbook should have clear documented notations as to what the problem was and what corrective action was implemented to enable the second check to pass.

10.3.4 If the verification criteria cannot be achieved, a new initial calibration must be performed.

10.3.5 If any of the internal standard areas change by a factor of two (- 50% to + 100%) or the retention time changes by more than 30 seconds from the midpoint standard of the last initial calibration, the mass spectrometer must be inspected for malfunctions and corrections must be made, as appropriate.

10.3.5.1 Reanalyze the continuing calibration standard. New initial calibration is required if reanalyzed standard continues to fail the internal standard requirements.

10.3.5.2 All samples analyzed while the system was out of control must be reanalyzed following corrective action.

11.0 PROCEDURE

11.1 Instrument Conditions.

11.1.1 Recommended instrument conditions are listed in Table 2 and 2a (SIM only). Modifications of parameters specified with an asterisk are allowed as long as criteria of calibration are met. Any modification should be approved by team leader/manger.

11.2 Daily GC/MS Performance Checks.

11.2.1 Mass Spectrometer Tuning. Every 12-hour, inject 1 μl of 50 ng/μl or 2 μl of 25 ng/μl DFTPP solution directly on to the column.

11.2.2 The GC/MS system must be checked to verify that acceptable performance criteria are achieved (see Table 3).

11.2.3 This performance test must be passed before any sample extracts, blanks or standards are analyzed. Evaluate the tune spectrum using three mass scans from the chromatographic peak and a subtraction of instrument background.

11.2.3.1 Select the scans at the peak apex and one to each side of the apex.

11.2.3.2 Calculate an average of the mass abundances from the three scans.

11.2.3.3 Background subtraction is required. Select a single scan in the chromatogram that is absent of any interfering compound peak and no more than 20 scans prior to the elution of DFTPP. The background subtraction should be designed only to eliminate column bleed or instrument background ions. Do not subtract part of the tuning compound peak.

11.2.4 If all the criteria are not achieved, the analyst must retune the mass spectrometer with team leader/manager and repeat the test until all criteria are met.

11.2.4.1 Alternatively, an additional scan on each side of the peak apex may be selected and included in the averaging of the mass scans. This will provide a mass spectrum of five averaged scans centered on the peak apex. NOTE: The selection of additional mass scans for tuning may only be performed with supervisory approval on a case by case basis.

11.2.5 The injection time of the acceptable tune analysis is considered the start of the 12-hour clock.

11.2.6 In order to assess GC column performance and injection port inertness, the DFTPP tune standard also contains appropriate amount of 4,4'-DDT, benzidine and pentachlorophenol.

11.2.6.1 Injection Port Inertness Check.

11.2.6.1.1 The injection port inertness of the GC portion of the GC/MS is evaluated by the percent breakdown of 4,4'-DDT. DDT is easily degraded in the injection port. Breakdown occurs when the injection port liner is contaminated by high boiling residue from sample injection or when the injector contains metal fittings. Check for degradation problems by injecting a GC/MS tune standard containing 4,4’-DDT every 12 hour, regardless of whether DDT is a target analyte. The degradation of DDT to DDE and DDD should not exceed 20%, in order to proceed with calibration procedures. Refer to Section 13.7 for calculation.

11.2.6.2 Column Performance Check.

11.2.6.2.1 The condition of the GC column is evaluated by the tailing of benzidine and pentachlorophenol every 12 hour. Benzidine and pentachlorophenol should be present at their normal responses, with no visible peak tailing, as demonstrated by the peak tailing factors. The tailing factor criteria for benzidine (base-neutral fraction) must be < 3 and for pentachlorophenol (acid fraction) must be < 5.

11.2.6.3 If degradation is excessive and/or poor chromatography is observed, the injector port may require cleaning. It may also be necessary to break off the first 6-12 in. of the capillary column.

11.3 Initial Calibration

11.3.1 Refer to Section 10.1.

11.4 Second Source Calibration Check

11.4.1 This standard must at least be analyzed when initial calibration provided. Refer to Section 10.2.

11.5 Continuing Calibration Checks

11.5.1 Refer to Section 10.3.

11.6 Sample Analysis.

11.6.1 Allow the sample extract to warm to room temperature. Spike 10 μl of the appropriate internal standard mix (4,000 μg/ml for full scan and 400ug/ml for SIM) into 1 ml sample extract, just prior to analysis. This is equivalent to a concentration of 40 μg/ml (full scan) and 4ug/ml (SIM) of each internal standard.

11.6.2 Inject 1 μl aliquot of the sample extract into the GC/MS system. A splitless injection technology is used.

11.6.3 If the response for any ion of interest exceeds the working range of the GC/MS system, dilute the extract and reanalyze.

11.6.4 When the extracts are not being used for the analyses, store them at -10^{o}C, protected from light, in sealed vials equipped with unpierced PTFE-lined septa.

11.7 Sample Dilution

11.7.1 Establish dilution of sample in order to fall within calibration range or to minimize the matrix interference.

- Utilize screen data (specific project only).
- Utilize acquired sample data.
- Utilize the history program or approval from client/project.
- Sample characteristics (appearance, odor).

11.7.2 If no lower dilution has been reported, the dilution factor chosen should keep the response of the largest peak for a target analyte in the upper half of the initial calibration range of the instrument.

11.7.3 Preparing Dilutions.

11.7.3.1 Prepare sample dilutions quantitatively. Dilute the sample extract with methylene chloride using logical volume to volume ratios, i.e., 1:5, 1:10, 1:50, etc. Large dilutions may require serial dilutions or the use of a Class A 10 ml volumetric flask.

11.7.3.2 Syringe dilutions. – Calibrated syringes are used to prepare dilutions. Add the appropriate amount of methylene chloride to a clean autosampler vial. Add the proper amount of sample using a calibrated syringe of the appropriate volume for the dilution. Add sufficient internal standard to maintain a concentration of 40ug/ml. Cap the vial and gently shake to disperse the sample through the solvent.

11.7.3.3 Volumetric Flask Dilutions – Large dilutions may require the use of a 10 ml Class A Volumetric flask.

11.8 Establishing Search Criteria. Search criteria for each compound listed in the method must be entered into the method quantitation/identification file in the Enviroquant software package. This activity must be performed before attempting qualitative and quantitative analysis on any acquired data file. The search criteria are based on compound retention time and the characteristic ions from the reference mass spectrum. Characteristic ions are defined as the three ions of greatest relative intensity, or any ions over 30% relative intensity, if less than three such ions occur in the reference spectrum. The number of secondary ions displayed for each compound search varies between compounds.

11.8.1 Select the primary ion for the target compound from the characteristic ions in Table 6. If multiple characteristic ions are listed, the first ion is the major (primary) ion. Enter this ion as the search ion. Enter the relative abundance of this ion (100% for base peak ions) and set the relative abundance window at ± 30%.

11.8.1.2 Alternate primary ions may be selected when interferences exist from ion abundance contribution from close eluting compounds.

11.8.2 Enter the remaining ions as secondary ions. Secondary ions are not be used to locate peaks within the search window, but are be used to support the qualitative identification of selected peaks. The number of secondary ions displayed for each compound search varies between compounds depending on the number of ions in the spectra >30% relative abundance.

11.8.3 Set the relative abundance windows for the secondary ions at ± 30%.

11.8.4 Establish the relative retention window for each compound. Because it is a relative retention window the same width window applies to all compounds on the quantitation list. The window must be established at a minimum of 0.06 relative retention time units.

11.9 Data Interpretation.

11.9.1 Executing Qualitative Searches. The target compounds shall be identified by analyst with competent knowledge in the interpretation of mass spectra by comparison of the sample mass spectrum to the mass spectrum of a standard of the suspected compound.

11.9.1.1 The search procedure will identify peaks within the search window using the primary ion only. Secondary ions and the relative retention are used to determine “the best match”. If the best match contains secondary ions outside the relative abundance window, they will be flagged with a # sign.

11.9.2 Qualitative Identification. The qualitative identification of compounds determined by this method is based on retention time and on comparison of the sample mass spectrum, after background correction, with characteristic ions in a reference mass spectrum. Compounds are identified when the following criteria are met.

11.9.2.1 The intensities of the characteristic ions of a compound must maximize in the same scan or within one scan of each other.

11.9.2.2 The sample component must elute at the same relative retention time (RRT) as the daily standard. Criterion is the RRT of sample component must be within ± 0.06 RRT units of the standard.

11.9.2.3 The relative intensities of the characteristic ions agree within 30% of the relative intensities of these ions in the reference spectrum. (Example: For an ion with an abundance of 50% in the reference spectrum, the corresponding abundance in a sample spectrum can range between 20% and 80%.)

11.9.2.3.1 If a chromatographic peak exhibits a spectrum containing an ion with relative abundance outside the relative abundance window is selected for reporting, the analyst must annotate the spectra that the compound qualified based on his/her best judgement. This circumstance will most often occur from coeluting compounds with similar ions or background matrix interferences.

11.9.3 Quantitative Analysis.

11.9.3.1 Once a target compound has been identified, its concentration (Section 13.4) will be based on the integrated area of the quantitation ion, normally the base peak (Table 6). The compound is quantitated by internal standard technique with an average response factor generated from the initial calibration curve.

11.9.3.2 If the sample produces interference for the primary ion, use a secondary ion to quantitate. This may be characterized by an excessive background signal of the same ion, which distorts the peak shape beyond a definitive integration. Also interference could severely inhibit the response of the internal standard ion. The secondary ion must be used to generate a new response factor.

11.10 Library Search for Tentatively Identified Compounds.

11.10.1 If a library search is requested, the analyst should perform a forward library search of the NIST98 mass spectral library to tentatively identify 10 to 15 non-reported compounds (15 for base, 10 for acid, 25 for base/acid fraction).

11.10.2 Guidelines for making tentative identification are listed below.

11.10.2.1 These compounds should have a response greater than 10% of the nearest internal standard. The response is obtained from the integration for peak area of the Total Ion Chromatogram (TIC).

11.10.2.2 The search is to include a spectral printout of the 3 best library matches for a particular substance. The results are to be interpreted by analyst.

11.10.2.3 Molecular ions present in the reference spectrum should be present in the sample spectrum.

11.10.2.4 Relative intensities of major ions in the reference spectrum (ions > 10 % of the most abundant ion) should be present in the sample spectrum.

11.10.2.5 The relative intensities of the major ions should agree within ± 20 %. (Example: For an ion with an abundance of 50% in the standard spectrum, the corresponding sample ion abundance must between 30 and 70%).

11.10.2.6 Ions present in the sample spectrum but not in the reference spectrum should be reviewed for possible background contamination or presence of coeluting compounds.

11.10.2.7 Ions present in the reference spectrum but not in the sample spectrum should be verified by performing further manual background subtraction to eliminate the interference created by coeluting peaks and/or matrix interference.

11.10.3 Quantitation of the tentatively identified compounds is obtained from the total ion chromatogram based on a response factor of 1 and is to be tabulated on the library search summary data sheet.

11.10.4 The resulting concentration should be reported indicating: (1) that the value is estimate, and (2) which internal standard was used to determine concentration. Quantitation is performed on the nearest internal standard.

11.11 Selected Ion Monitoring (SIM) Option

11.11.1 <u>Instrument Set-Up</u>: Modify the method for SIM analysis and define ion groups with retention times, ions and dwell times to include base peak ion for the target compounds of interest, surrogates, and internal standards (Table 2a, Table 8a) Select a mass dwell time of 50 milliseconds for all compounds.

11.11.2 Calibration: Calibrate the mass spectrometer in the selected ion monitoring mode using 6 calibration standards of 0.2, 1.0, 2.5, 5.0, 10.0 and 15.0 ug/ml. Spike each standard with the SIM specific internal standard solution at 4ug/ml. Calculate individual response factors and response factor RSDs using the procedures and criteria described in Section 10.1.6, 10.1.7.3 and 10.1.7.4.

11.11.3 Initial Calibration Verification. Verify the initial calibration after its completion using a 5.0 ug/ml calibration standard purchased or prepared from a second standards reference materials source. The initial calibration verification must meet the criteria of Section 10.2.2.

11.11.4 Continuing Calibration Verification. Verify the initial calibration every 12 hours using a 5.0 ug/ml calibration. The continuing calibration verification must meet the criteria of Section 10.3.

11.11.5 Sample Extract Analysis: Each extract has been previously spike with the SIM internal standard at 4 ug/ml. Analyze the sample extracts for the compounds of interest using the SIM scan parameters employed for the calibration standards.

11.11.6 Surrogate Standard Calculation.. Report surrogate spike accuracy for the surrogates spiked for the full scan GC/MS analysis at 40 ug/ml.

12.0 QUALITY CONTROL

12.1 QC Requirements Summary.

Daily GC/MS Performance Checks	Beginning of the analytical shift and every 12 hours
Initial Calibration	Whenever needed.
Second Source Calibration Check	Following initial calibration
Continuing Calibration Verification	Every 12 hours.
Method Blank	One per extraction batch*.
Blank Spike	One per extraction batch*.
Matrix Spike	One per extraction batch*.
Matrix Spike Duplicate	One per extraction batch*.
Surrogate	Every sample extract and standard.
Internal Standard	Every sample extract and standard.

*The maximum number of samples per batch is twenty or per project specification.

12.2 Daily GC/MS Performance Checks.

12.2.1 Refer to Section 11.2.

12.3 Initial Calibration.

12.3.1 Refer to Section 10.1.

12.4 Second Source Calibration Check.

12.4.1 Refer to Section 10.2.

12.5 Continuing Calibration Verification.

12.5.1 Refer to section 10.3.

12.6 Method blank.

12.6.1 The method blank is either reagent water or anhydrous sodium sulfate (depending on the sample matrix) which must be extracted with each set of 20 or less samples. For a running batch, a new method blank is required for each different extraction day. The method blank is then extracted and carried through all stages of the sample preparation and measurement.

12.6.2 If the method blank contains a target analyte above its MDL (Appendix I), the entire batch must be re-extracted and re-analyzed.

12.6.3 Surrogate compounds are added to the method blank prior to extraction. If the surrogate accuracy in the method blank does not meet in house criteria (Appendix I), it must be reanalyzed. If the reanalysis confirms the original data, the entire batch should be re-extracted.

12.7 Blank Spike

12.7.1 A blank spike must be extracted with each set of 20 or less samples. For a running batch, a new blank spike is required for each different extraction day. The blank spike consists of an aliquot of a clean (control) matrix similar to the sample matrix and of the same volume. It is spiked with the same analytes at the same concentrations as the matrix spike/matrix spike duplicate.

12.7.1.1 An additional blank spike is prepared for sample batches that contain samples which are analyzed for Polynuclear aromatic hydrocarbons. The concentration of tye bl;ank spike is prepared at

12.7.2 The blank spike recoveries should be assessed using in house limits specified in Appendix I.

12.7.3 If a blank spike is out of control, the following corrective actions must be taken and all the associated samples must be re-extracted and reanalyzed. The exception is if the blank spike recovery is high and no hits reported in associated samples and QC batch. In that case, the sample results can be reported with footnote (remark) and no further action is required.

12.7.3.1 Check to be sure that there are no errors in the calculations, or spike solutions. If errors are found, recalculate the data accordingly.

12.7.3.2 Check instrument performance. If an instrument performance problem is identified, correct the problem and reanalyze the sample batch.

12.7.3.3 If no problem is found, re-extract and reanalyze the sample batch.

12.8 Matrix Spike(MS) / Matrix Spike Duplicate(MSD)

12.8.1 One sample is randomly selected from each extraction batch and spiked in duplicate to assess the performance of the method as applied to a particular matrix and to provide information on the homogeneity of the matrix. Both the MS and MSD are carried through the complete sample preparation, and determinative procedures.

12.8.2 Matrix spikes are prepared by spiking an actual sample at a concentration of 50 μg/l for both base/neutral and acids.

12.8.3 Assess the matrix spike recoveries (% R) (Section 13.5) and relative percent difference (RPD) (Section 13.6) against the control limits in Appendix I.

12.8.4 If the matrix spike accuracy of any individual compound is out of control, the accuracy for the compound in the blank spike must be within control. In such case, matrix interference is assumed and the data is reported with footnote (e.g., spike recovery indicates possible matrix interference). No further corrective action is required.

12.9 Surrogates

12.9.1 All standards, blanks, sample extracts, and matrix spikes contain surrogate compounds which are used to monitor the performance of the extraction and analytical system.

12.9.2 The recoveries (Section 13.5) of the surrogates must be evaluated to determine whether or not they fall within surrogate control limits (Appendix I) developed by the laboratory annually.

12.9.3 If the recovery of any surrogate compound does not meet the control limits, the calculation must be checked for possible error. The surrogate solution should be checked for degradation. Contamination and instrument performance should also be reviewed.

12.9.3.1 Reanalyze the extract if no calculation errors are detected. If the surrogate recoveries for the reanalyzed extract are in control, report the data from the reanalysis only.

12.9.3.2 If the data from the reanalysis is also out of control, re-extract and reanalyze the sample.

12.9.3.3 If, upon reanalysis, the surrogate recoveries are acceptable, report the reanalysis data. If the holding time has expired prior to the reanalysis, report both the original and reanalysis results and note the holding time problem.

12.9.3.4 If the recovery is again not within limits, the problem is considered to be matrix interference. Submit both data sets with the original analysis being reported.

12.9.4 If the sample exhibits matrix interference, defined as excessive signal where target or non-target responses are greater than the response of the internal standards. In this case, reanalysis may not be required following team leader/manager approval; the surrogates will be qualified as outside the limits due to matrix interference. Alternatively, sample may be reanalyzed on dilution, if the reanalysis is again not within the limit, the sample should be reported with a footnote indicating that there were possible matrix interference.

12.10 Internal Standards.

12.10.1 Retention time for all internal standards must be within ± 30 seconds of the corresponding internal standard in the latest continuing calibration or 50 µg/ml standard of initial calibration.

12.10.2 The area (Extracted Ion Current Profile) of the internal standard in all analyses must be within 50 to 200 % of the corresponding area of the latest calibration standard (12 hr. time period).

12.10.3 If the area of internal standard does not meet control limits, the calculations must be checked. If a problem is not discovered, the sample must be reanalyzed.

12.10.4 If the areas are acceptable upon reanalysis, the reanalysis data is reported.

12.10.5 If the areas are unacceptable upon reanalysis, then both sets of data are submitted with the original analysis reported.

13.0 CALCULATION

13.1 Response Factor (RF).

$$RF = \frac{A_s \times C_{is}}{A_{is} \times C_s}$$

where:

A_s = Area of the characteristic ion for the compound being measured.
A_{is} = Area of the characteristic ion for the specific internal standard.
C_s = Concentration of the compound being measured (µg/ml).
C_{is} = Concentration of the specific internal standard (µg/ml).

13.2 Percent Relative Standard Deviation (%RSD).

$$\%RSD = \frac{SD}{RF_{av}} \times 100$$

where:

SD = Standard Deviation.
RF_{av} = Average response factor from initial calibration.

13.3 Percent Difference (%D).

$$\%\ D = \frac{|RF_{av} - RF_{cv}|}{RF_{av}} \times 100$$

where: RF_{cv} = Response factor from Calibration Verification Standard.

13.4 Concentration (Conc.).

13.4.1 for water:

$$\text{Conc. } (\mu g/l) = \frac{A_s \times C_{is} \times V_f \times D \times 1000}{A_{is} \times RF_{av} \times V_i}$$

13.4.2 for soil/sediment (on a dry weight basis):

$$\text{Conc. } (\mu g/kg) = \frac{A_s \times C_{is} \times V_f \times D \times 1000}{A_{is} \times RF_{av} \times W_s \times S}$$

where:

V_f = Final Volume of total extract (ml).
D = Secondary dilution factor.
V_i = Initial volume of water extracted (ml).
W_s = Weight of sample extracted (g).
S = (100 - % moisture in sample) / 100.

13.5 Percent Recovery (%R).

$$\% R = \frac{\text{Concentration found}}{\text{Concentration spiked}} \times 100$$

13.6 Relative Percent Difference (RPD).

$$RPD = \frac{\left| MSC - MSDC \right|}{(1/2)(MSC+MSDC)} \times 100$$

where:

MSC = Matrix Spike Concentration.
MSDC = Matrix Spike Duplicate Concentration.

13.7 Percent Breakdown.

$$\% \text{ Breakdown for DDT} = \frac{\text{Total DDT degradation peak area}}{\text{Total DDT peak area}} \times 100$$

where:

Total DDT degradation peak area = DDE + DDD
Total DDT peak area = DDT + DDE + DDD.

13.8 Linear regression by the internal standard technique.

$$C_s = \left(\frac{\frac{A_s}{A_{is}} - b}{a} \right) \times C_{is}$$

Where:
Cs = concentration of target analyte
As = Area of target analyte
Cis = concentration of the internal standard
b = Intercept
a = slope of the line

$$a = \frac{N\,\Sigma xy - \Sigma x\,\Sigma y}{N\,\Sigma x^2 - (\Sigma x)^2}$$

$$b = \frac{\Sigma y - a\,\Sigma x}{N}$$

N = number of points
x = amount of analyte
y = response of instrument

13.9 Correlation Coefficient

$$r = \frac{\Sigma(x - \bar{x})(y - \bar{y})}{\sqrt{\Sigma(x - \bar{x})^2\,\Sigma(y - \bar{y})^2}}$$

Where r = correlation coefficient
x = amount of analyte
y = response of instrument

$\bar{x}$ = average of x values

$\bar{y}$ = average of y values

14.0 DOCUMENTATION

14.1 The Analytical Logbook is a record of the analysis sequence; the logbook must be completed daily. Each instrument will have a separate logbook.

14.1.1 If samples require reanalysis, a brief explanation of the reason must be documented in this log.

14.2 The Standard Preparation Logbook must be completed for all standard preparations. All information requested must be completed, the page must be signed and dated by the respective person.

14.2.1 The Accutest Lot Number must be cross-referenced on the standard vial.

14.3 The Instrument Maintenance Logbook must be completed when any type of maintenance is performed on the instrument. Each instrument has a separate log.

14.4 Any corrections to laboratory data must be done using a single line through the error. The initials of the person and date of correction must appear next to the correction.

14.5 Unused blocks of any form must be X'ed and Z'ed by the analyst before submitting the data for review.

14.6 Supervisory (or peer) personnel must routinely review (at least once per month) all laboratory logbooks to ensure that information is being recorded properly. Additionally, the maintenance of the logbooks and the accuracy of the recorded information should also be verified during this review.

15.0 DATA REVIEW AND REPORTING

15.1 Initial and continuing calibration check. Verify that all calibration and continuing calibration criteria have been achieved. If the criteria had not been achieved, corrective action must be performed to bring the system in control before analyzing any samples.

15.1.1 If samples had been analyzed under non-compliant calibration criteria, all sample extracts must be re-analyzed once the system is brought into control.

15.2 Quality Control Data Review. Review all QC data. If QC criteria were not achieved, perform corrective action before proceeding with analysis.

15.2.1 In some situation, corrective action may demand that the entire sample batch be re-extracted and re-analyzed before processing data.

15.3 Chromatogram Review. The chromatogram of each sample is evaluated for target analytes.

15.3.1 Each sample may require the reporting of different target analytes. Review the login to assure that the correct target compounds are identified.

15.3.2 Manual integration of chromatographic peaks must be identified by the analysts by initialing and dating the changes made to the report.

15.4 Transfer to LIMS. Following the initial screen review, transfer the processed data to the LIMS.

15.4.1 Print the processed data and compare the printed values to the original values to verify transfer accuracy.

15.4.2 If transfer errors occurred, the errors must be corrected before the data is re-submitted.

15.5 Hardcopy Print & Data Package Assembly.

15.5.1 After successful transfer is verified, approve the data and print a hard copy.

15.5.2 Assemble the data package combining the LIMS output and instrumental data.

15.5.3 Pass the entire package forward to the supervisor for final review and release approval.

16.0 POLLUTION PREVENTION & WASTE MANAGEMENT

16.1 Users of this method must perform all procedural steps in a manner that controls the creation and/or escape of wastes or hazardous materials to the environment. The amounts of standards, reagents, and solvents must be limited to the amounts specified in this SOP. All safety practices designed to limit the escape of vapors, liquids or solids to the environment must be followed. All method users must be familiar with the waste management practices described in section 16.2.

16.2 Waste Management. Individuals performing this method must follow established waste management procedures as described in the waste management SOP, ESM003. This document describes the proper disposal of all waste materials generated during the testing of samples as follows:

16.2.1 Non hazardous aqueous wastes.

16.2.2 Hazardous aqueous wastes

16.2.3 Chlorinated organic solvents

16.2.4 Non-chlorinated organic solvents

16.2.5 Hazardous solid wastes

16.2.6 Non-hazardous solid wastes

17.0 ADDITIONAL REFERENCES

17.1 No additional references are required for this SOP.

Table 1 – Target Compounds by SW846 8270C			
Benzenethiol (1)	4-Bromophenyl phenyl ether	Di-n-octyl phthalate	5-Nitro-o-toluidine
Benzoic Acid	Butyl benzyl phthalate	Diethyl phthalate	Naphthalene
2-Chlorophenol	Benzyl Alcohol	Dimethyl phthalate	Nitrobenzene
4-Chloro-3-methyl phenol	1,1'-Biphenyl (1)	2,3-Dichloroaniline (1)	n-Nitrosodimethylamine
2,4-Dichlorophenol	Butyl Stearate (1)	Decane	4-Nitroquinoline 1-Oxide
2,4-Dimethylphenol	2-Chloronaphthalene	Octadecane (1)	N-Nitroso-di-n-propylamine
2,4-Dinitrophenol	4-Chloroaniline	bis(2-Ethylhexyl)phthalate	N-Nitrosodi-n-butylamine
2,6-Dichlorophenol	Carbazole	Ethyl methanesulfonate	N-Nitrosodiethylamine
4,6-Dinitro-2-methylphenol	Caprolactam (1)	Famphur	N-Nitrosodiphenylamine
Dinoseb	Chlorobenzilate	Fluoranthene	N-Nitrosomethylethylamine
2-Methylphenol	Chrysene	Fluorene	N-Nitrosomorpholine
3&4-Methylphenol	Cumene (1)	Hexachlorobenzene	N-Nitrosopiperidine
2-Nitrophenol	bis(2-Chloroethoxy)methane	Hexachlorobutadiene	N-Nitrosopyrrolidine
4-Nitrophenol	bis(2-Chloroethyl)ether	Hexachlorocyclopentadiene	O,O,O-Triethyl phosphorothioat
Pentachlorophenol	bis(2-Chloroisopropyl)ether	Hexachloroethane	2-Picoline
Phenol	4-Chlorophenyl phenyl ether	Hexachlorophene	Parathion
2,3,4,6-Tetrachlorophenol	1,2-Dichlorobenzene	Hexachloropropene	Pentachloroethane (1)
2,4,5-Trichlorophenol	1,2-Diphenylhydrazine	Indene (1)	Pentachlorobenzene
2,4,6-Trichlorophenol	1,3-Dichlorobenzene	Indeno(1,2,3-cd)pyrene	Pentachloronitrobenzene
2-Acetylaminofluorene	1,4-Dichlorobenzene	Isodrin	Phenacetin
4-Aminobiphenyl	2,4-Dinitrotoluene	Isophorone	Phenanthrene
Acenaphthene	2,6-Dinitrotoluene	Isosafrole	Phorate
Acenaphthylene	3,3'-Dichlorobenzidine	Kepone	Pronamide
Acetophenone	3,3'-Dimethylbenzidine	1-Methylnaphthalene	Pyrene
Aniline	1,4-Dioxane (1)	2-Methylnaphthalene	Pyridine
Anthracene	7,12-Dimethylbenz(a)anthracene	3-Methylcholanthrene	p-Phenylenediamine
Aramite	Dimethylnaphthalenes (total) (1)	4,4'-Methylenebis(2-chloroaniline)	Quinoline (1)
Atrazine (1)	Diallate	Methapyrilene	Safrole
alpha-Terpineol	Dibenz(a,h)acridine	Methyl methanesulfonate	1,2,4,5-Tetrachlorobenzene
A,A-Dimethylphenethylamine	Dibenzo(a,h)anthracene	Methyl parathion	1,2,4-Trichlorobenzene
Benzidine	Dibenzofuran	6-Methyl Chrysene (1)	1,2,3-Trichlorobenzene (1)
Benzaldehyde (1)	Dimethoate	1,4-Naphthoquinone	1,3,5-Trichlorobenzene (1)
Benzo(a)anthracene	Diphenylamine	1-Naphthylamine	Thionazin
Benzo(a)pyrene	Disulfoton	2-Naphthylamine	o-Toluidine
Benzo(b)fluoranthene	m-Dinitrobenzene	2-Nitroaniline	sym-Trinitrobenzene
Benzo(g,h,i)perylene	p-(Dimethylamine)azobenzene	3-Nitroaniline	Tetraethyl dithiopyrophosphate
Benzo(k)fluoranthene	Di-n-butyl phthalate	4-Nitroaniline	

(1) NELAC Accreditation is not offered for this compound. Results may not be useable for regulatory purposes in States where this accreditation option is not offered.

Table 2 - RECOMMENDED OPERATING CONDITIONS: Gas Chromatograph/ Mass Spectrometer	
Injection Type	Splitless
Carrier Gas (linear velocity)	Helium at 30 cm/sec*
Mass range	35-500 AMU
Electron Energy	70 volts (nominal)
Scan time	not to exceed 1 sec. per scan
Injection port temperature	200-300 °C
Source temperature	220-270 °C
Transfer line temperature	250-300 °C
Analyzer temperature	220-250 °C
Gas Chromatograph Temperature Program*	
Initial temperature	40-50 °C*
Time 1	2-4 minutes*
Column temperature rate	8-25 degrees/min*
Final temperature	290-320 °C according to column type*
Total run time	*20-40 minutes*

***** Parameter modification allowed for performance optimization as long as QC criteria are achieved.

	Table 2a – SIM Group Parameters	
Group No.	**Retention Time (minutes)**	**Ions**
1	0 – 7.8	150, 64, 93, 82, 152, 99, 63, 128, 112, 42, 95
2	7.8 – 11	150, 128, 225, 142, 172, 152, 129, 223, 141, 171, 122, 127, 227, 115, 170
3	11 – 13.8	172, 152, 166, 182, 334, 266, 176, 153, 165, 330, 284, 264, 174, 154, 77, 332, 286, 268
4	13.8 – 18	266, 179, 202, 122, 268, 212, 203, 284, 178, 213, 244, 286
5	18 – 22	244, 229, 167, 122, 226, 202, 228, 149, 203
6	22 – 34.7	264, 149, 253, 278, 263, 150, 250, 139, 265, 252, 276, 138

Table 3 - DFTPP KEY IONS AND ION ABUNDANCE CRITERIA	
Mass	**Ion Abundance Criteria**
51	30-60 of mass 198
68	<2 % of mass 69
70	<2 % of mass 69
127	40-60 % of mass 198
197	<1 % of mass 198
198	Base peak, 100 % relative abundance
199	5-9 % of mass 198
275	10-30 % of mass 198
365	>1 % of mass 198
441	Present but less than mass 443
442	>40 % of mass 198
443	17-23 % of mass 442

Table 4 - INTERNAL STANDARDS	
Internal Standard (Full Scan)	**Prim/Sec. ions**
1,4-Dichlorobenzene-d4	152 / 150, 115
Naphthalene-d8	136 / 68
Acenaphthene-d10	164 / 162, 160
Phenanthrene-d10	188 / 94, 80
Chrysene-d12	240 / 120, 236
Perylene-d12	264 / 260, 265
Internal Standard (SIM)	**Prim/Sec. ions**
1,2-Dichlorobenzene-d4	152/ 150
1-Methylnaphthalene-d10	150/ 152, 122
Fluorene-d10	174/ 176
Fluoranthene-d10	212/ 213
Benzo(a)pyrene- d12	264/ 263, 265

Table 5 - Criteria for CCC and SPCC	
Initial Calibration: CCC % RSD is ≤ 30 %.	Continuing Calibration: CCC % D is ≤ 20 %
Calibration Check Compounds (CCC)	
Base Neutral	**Acid**
1,4-Dichlorobenzene	Phenol
Hexachlorobutadiene	2,4-Dichlorophenol
Acenaphthene	2-Nitrophenol
Fluoranthene	4-Chloro-3-methylphenol
N-Nitrosodiphenylamine	2,4,6-Trichlorophenol
Di-n-octyl phthalate	Pentachlorophenol
Benzo (a) pyrene	
System Performance Check Compounds (SPCC)	
Base Neutral	**Acid**
N-Nitroso-di-n-propylamine	2,4-Dinitrophenol
Hexachlorocyclopentadiene	4-Nitrophenol
Minimum acceptable average relative response factor (RRF) is 0.050 for SPCC.	

Table 6 – Full Scan Semivolatile Internal Standards with Corresponding Analytes Assigned for Quantitation

1,4-Dichlorobenzene-d4	**Ions**	**Acenaphthene-d10**	**Ions**
Aniline	(93/66,65)	Acenaphthene	(154/153,152)
Benzaldehyde	(105)	Acenaphthylene	(152/151,153)
*Benzenethiol	(110)	*1-Chloronaphthalene	(162/127,164)
Benzyl alcohol	(108/79,77)	2-Chloronaphthalene	(162/127,164)
Bis(2-chloroethyl)ether	(93/63,95)	4-Chlorophenylphenyl ether	(204/206,141)
Bis (2-chloroisopropyl)ether	121	Dibenzofuran	(168/139)
2-Chlorophenol	(128/64,130)	Diethyl phthalate	(149/177,150)
Cumene	(105,120)	Dimethyl phthalate	(163/149,164)
Decane	(43)	*m-Dinitrobenzene	(168)
1,3-Dichlorobenzene	(146/148,111)	2,4-Dinitrophenol	(184/63,154)
1,4-Dichlorobenzene	(146/148,111)	2,4-Dinitrotoluene	(165/63,89)
1,2-Dichlorobenzene	(146/148,111)	2,6-Dinitrotoluene	(165/63,89)
1,4 Dioxane	(88)	Fluorene	(166/165,167)
*Ethyl methanesulfonate	(79/109,97)	Hexachlorocyclopentadiene	(295/237,142)
2-Fluorophenol (SURR.)	(112)	*1,4 – Naphthoquinone	(158)
Hexachloroethane	(117/201,199)	*1- Naphthylamine	(143/115,116)
Indene	(116)	*2- Naphthylamine	(143/115,116)
*Methyl methanesulfonate	(80/79,64)	2-Nitroaniline	(65/92,138)
2-Methylphenol	(108/107,79)	3-Nitroaniline	(138/108,92)
4-Methylphenol	(108/107,79)	4-Nitroaniline	(138/108,92)
*N-Nitrosodiethylamine	(102)	4-Nitrophenol	(139/109,65)
N-Nitrosodimethylamine	(74/42)	* 5 Nitro-o-toluidine	(152)
N-Nitroso-di-n-propylamine	(70/101,130)	Pentachlorobenzene	(250/252,248)
*N-Nitrosomethyethylamine	(42)	*Pentachloronitrobenzene	(237/235,272)
* N-Nitrosomorpholine	(56)	*Phenacetin	(108/109,179)
* N-Nitrosoptrrolidine	(41)	*Phorate	(75)
*O-Toluidine	(106)	*Pronamide	(173/175,145)
* Petachloroethane	(167)	*1,2,4,5-Tetrachlorobenzene	(216/214,218)
Phenol	(94)	*2,3,4,6-Tetrachlorphenol	(232/230,131)
Phenol-d5 (SURR.)	(99)	*Tetraethyldithiopyrophosphate	(322)
*2-Picoline	(93/66,92)	*Thioazin	(143)
Pyridine	(79)	2,4,6-Trichlorophenol	(196/198,200)
		2,4,5-Trichlorophenol	(196/198,200)

Table 6 (cont'd) – Full Scan Semivolatile Internal Standards with Corresponding Analytes Assigned for Quantitation

Naphthalene-d8	**Ions**	**Phenanthrene-d10**	**Ions**
*A,A-Dimethylphenethylamine	(58)	*4-Aminobiphenyl	(169/168,170)
*Acetophenone	(105/77,51)	Anthracene	(178/176,179)
Benzoic acid	(184/92,185)	Atrazine	(58)
Bis(2-chloroethoxy)methane	(93/95,123)	4-Bromophenyl phenyl ether	(248/250,141)
Caprolactam	(55)	Carbazole	(167)
4-Chloroaniline	(127)	*Diallate	(86)
4-Chloro-methylphenol	(107/144)	*Dimethoate	(87)
2,3 Dichloroaniline	(161)	Di-n-Butyl phthalate	(149/150)
2,4-Dichlorophenol	(162/164,98)	4,6-Dinitro-2-methylphenol	(198/51,105)
*2,6-Dichlorophenol	(162/164,98)	*Dinoseb	(211)
Dimethylnaphthalene	(156)	*Diphenylamine	(169/168,167)
2,4-Dimethylphenol	(122/107)	1,2-Diphenylhydrazine	(77/105)
*a,a-Dimethyl-phenethylamine	(58/91,42)	*Disulfoton	(88)
Hexachlorobutadiene	(225/223,227)	Fluoranthene	(202/101,203)
*Hexachloroprene	(213)	2-Fluorobiphenyl (SURR)	(172)
Isophorone	(82/95,138)	Hexachlorobenzene	(284/142,249)
*Isosafrole	(127)	*Isodrin	(193)
1-Methylnaphthalene	(142)	*Methapyriline	(58)
2-Methylnaphthalene	(142/141)	*Methyl Parathion	(125)
Naphthalene	(128/129,127)	N-Nitrosodiphenylamine	(169/168,167)
Nitrobenzene	(77/123,65)	*4-Nitroquinoline 1-oxide	(190)
Nitrobenzene-d5 (SURR.)	(82)	Octadecane	(57)
N-Nitroso-di-n-butylamine	(84/57/41)	*Parathion	(109)
2-Nitrophenol	(139/109,65)	Pentachlorophenol	(266/264,268)
Quinoline	(129)	Phenanthrene	(178/179,176)
*N-Nitrosopiperidine	(42/114,55)	*Pronamide	(173)
*p-Phenylenediamine	(108)	sym- Trinitrobenzene	(213)
*O,O,O-Triethylphosphorthioat	(198)	2,4,6 Tribromophenol (SURR)	(330)
*Safrole	(162)		
alpha –Terpineol	(128)	**Perylene-d12**	**Ions**
1,2,3-Trichlorobenzene	(180/182,145)	Benzo(b)fluoranthene	(252/125)
1,2,4-Trichlorobenzene	(180/182,145)	Benzo(k)fluoranthene	(252/125)
1,3,5-Trichlorobenzene	(180/182,145)	Benzo(g.h.i)perylene	(276/138,277)
		Benzo(a)pyrene	(252/253,125)
Chrysene-d12	**Ions**	*Dibenz(a,j)acridine	(279/280)
2 –Acetylaminofluorene	(181)	Dibenz(a,h)anthracene	(278/139,279)
*Aramite	(194)	*7,12-Dimethylbenz(a)anthracene	(256/241,257)
Benzidine	(184)	Di-n-Octyl Phthalate	(149)
Benzo(a)anthracene	(228/229/226)	Hexachlorophene	(196)
Bis(2-ethylhexyl)phthalate	(149/167,279)	Indeno(1,2,3-d)pyrene	(276)
Butylbenzyl phthalate	(149/91)	*3-Methylchloanthrene	(268/253)
*Chlorobenzilate	(251)	* non-routine target compound	
Chrysene	(228/226,229)		
3,3'-Dichlorobenzidine	(252/254,126)		
*p-Dimethylaminoazobenzene	(120/225,77)		
*3,3 Dimethylbenzidine	(212)		
*Famphur	(218)		
*Kepone	(272)		
* Methyl Chrysene	(242)		
Pyrene	(202/200,203)		
Terphenyl-d14 (SURR.)	(244)		

Table 6a – SIM Semivolatile Internal Standards with Corresponding Analytes Assigned for Quantitation

1,4-Dichlorobenzene-d4	**Ions**	**Fluoranthene-d10**	**Ions**
2-Fluorophenol (Surr)	(112)	Fluoranthene	202, 101, 203
Phenol-d5 (Surr)	(99)	Pyrene	202, 203
Bis-(2-chloro-ethyl)ether	93, 63, 95	Terphenyl-d14 (Surr)	(244)
Nitrobenzene-d5 (Surr)	(82)	Benzo(a)anthracene	228, 229, 226
		Chrysene	228, 226, 229
1-Methylnaphthalene-d10	**Ions**	Bis(2-ethylhexylphthalate	149, 167, 279
Naphthalene	128, 129, 127		
Hexachlorobutadiene	225, 223, 227	**Benzo(a) pyrene-d12**	**Ions**
2-Methyl Naphthalene	142, 141, 115	Di-n-octyl phthalate	149, 150, 43
2-Fluorobiphenyl (Surr)	(172)	Benzo(b)fluoranthene	252, 253
		Benzo(k)fluoranthene	252, 125
Fluorene-d10	**Ions**	Benzo(a)pyrene	252, 253, 125
Acenaphthylene	152, 151, 153	Indeno(1,2,3-cd)pyrene	276, 277, 138
Acenaphthene	153, 152, 154	Dibenzo(a,h)anthracene	278, 139, 279
Fluorene	166, 165, 167	Benzo(g,h,i)perylene	276, 138, 277
1,2-Diphenylhydrazine	77, 105, 182		
2,4,6-Tribromophenol (Surr)	(330)		
Hexachlorobenzene	284, 286		
Pentachlorophenol	266, 264		
Phenanthrene	178, 179, 176		
Anthracene	178, 176, 179		

Table 7. STANDARD PREPARATION

Table 7A – Intermediate Calibration Standard Solution

Stock Solution	**Stock Conc., μg/ml**	**Volume Added, μl**	**Final Vol. in $MeCl_2$, ml**	**Final Conc. μg/ml**
Semivolatile Standard Mix # 1	2,000	500	10	100
Semivolatile Standard Mix # 2	2,000	500	10	100
Semivolatile Standard Mix # 4	2,000	500	10	100
Semivolatile Standard Mix # 5	2,000	500	10	100
Semivolatile Standard Mix # 6	2,000	500	10	100
Semivolatile Standard Mix # 7	2,000	500	10	100
PAH Mixture #2	2,000	500	10	100
Semivolatile Standard Mix # 8	2,000	500	10	100
Additional Requested Compound(s) Mix	2,000	500	10	100
Pyridines Mixture	2,000	500	10	100
1,2,3-Trichlorobenzene	1,000	1,000	10	100
1,3,5-Trichlorobenzene	1,000	1,000	10	100
Butyl Stearate	10,000	200	10	200
Pentachlorophenol	1,000	1,000	10	100
B/N Surrogate Standard Mix	5,000	200	10	100
Acid Surrogate Standard Mix	7,500	134	10	100.5

Table 7A – Intermediate Calibration Standard Solution -SIM

Stock Solution	Stock Conc., µg/ml	Volume Added, µl	Final Vol. in $MeCl_2$, ml	Final Conc. µg/ml
Semivolatile Standard Mix # 1	2,000	500	10	100
Semivolatile Standard Mix # 2	2,000	500	10	100
PAH Mixture #2	2,000	500	10	100
Semivolatile Standard Mix # 8 (Acids)	2,000	2,500	10	500
Additional Requested Compound(s) Mix	2,000	500	10	100
B/N Surrogate Standard Mix	5,000	200	10	100
Acid Surrogate Standard Mix (Full Scan)	7500	66.7	10	500

Table 7B – Initial Calibration Standards Preparation Scheme

Standard Solution	Intermediate Conc., µg/ml	Intermediate added, µl Full Scan	Intermediate added, µl SIM	Final Volume in $MeCl_2$, ml	Final Conc., µg/ml – Full Scan	Final Conc., µg/ml – SIM Scan
STD 1	100	1,000	150	1	100	15/75 (Acids)
STD 2	100	800	100	1	80	10/50 (Acids)
STD 3	100	500	50	1	50	5/25 (Acids)
STD 4	100	250	25	1	25	2.5/12/5 (Acids)
STD 5	100	200	10	1	20	1/5 (Acids)
STD 6	100/10 (SIM)	100	20	1	10	0.2/1 (Acids)
STD 7	100	50	10	1	5	
STD 8	100	20	-	1	2	-

Table 7C – Second Source Calibration Check Standard

Intermediate	Intermediate Conc., µg/ml	Volume Used, µl (Full/SIM)	Final Volume in Acetone, ml	Final Conc., µg/ml (Full/SIM)
Base Neutrals Mixture	100	500/ 50	1	50/ 5
Acid Mixture	100	500/ 50	1	50/ 5

Table 8a –Selected Ion Monitoring: Masses and Dwell Times

Compound	**Mass Ion (m/z)**	**Dwell Time (ms)**
Acenaphthene	153, 152, 154	50
Acenaphthylene	152, 151, 153	50
Anthracene	178, 176, 179	50
Benzo(a)anthracene	228, 229, 226	50
Benzo(a)pyrene	252, 253, 125	50
Benzo(b)fluoranthene	252, 253	50
Benzo(g,h,i)perylene	276, 138, 277	50
Benzo(k)fluoranthene	252, 125	50
Chrysene	228, 226, 229	50
Dibenzo(a,h)anthracene	278, 139, 279	50
Fluoranthene	202, 101, 203	50
Fluorene	166, 165, 167	50
Indeno(1,2,3-cd)pyrene	276, 277, 138	50
Naphthalene	128, 129, 127	50
Phenanthrene	178, 179, 176	50
Pyrene	202, 203	50
2-Methyl Naphthalene	142, 141, 115	50
Bis-(2-chloro-ethyl)ether	93, 63, 95	50
Pentachlorophenol	266, 264	50
Hexachlorobutadiene	225, 223, 227	50
1,2-Diphenylhydrazine	77, 105, 182	50
Bis(2-ethylhexylphthalate	149, 167, 279	50
Di-n-octyl phthalate	149, 150, 43	50
Hexachlorobenzene	284, 286	50
2-Fluorophenol	112, 64, 63	50
Phenol-d5	99, 42	50
Nitrobenzene-d5	82, 128	50
2-Fluorobiphenyl	172, 171, 170	50
2,4,6-Tribromophenol	330, 332, 334	50
Terphenyl-d14	244, 122	50

Table 9. REPORTING LIMITS

Compound	Water	Soil	Compound	Water	Soil
	µg/l	µg/kg		µg/l	µg/kg
Benzoic Acid	20	667	Carbazole	5	167
2-Chlorophenol	5	167	Chlorobenzilate	5	167
4-Chloro-3-methylphenol	5	167	Chrysene	5	167
2,4-Dichlorophenol	5	167	bis(2-Chloroethoxy)methane	5	167
2,4-Dimethlyphenol	5	167	bis(2-Chloroethyl)ether	5	167
2,4-Dinitrophenol	20	667	Bis(2-Chloroisopropyl)ether	5	167
4,6-Dinitro-o-cresol	20	667	4-Chlorophenyl phenyl ether	5	167
Dinoseb	5	167	1,2-Dichlorobenzene	5	167
2-Methylphenol	5	167	1,3-Dichlorobenzene	5	167
4-Methylphenol	5	167	1,4-Dichlorobenzene	5	167
2-Nitrophenol	5	167	2,4-Dinitrotoluene	5	167
4-Nitrophenol	20	667	2,6-Dinitrotoluene	5	167
Pentachlorophenol	20	667	3,3'-Dichlorobenzidine	5	167
Phenol	5	167	3,3’-Dimethylbenzidine	5	167
2,3,4,6-Tetrachlorophenol	5	167	7,12-Dimethylbenz(a)anthracene	5	167
2,4,5-Trichlorophenol	5	167	Diallate	5	167
2,4,6-Trichlorophenol	5	167	Dibenzo(a,h)anthracene	5	167
2-Acetylaminofluorene	5	167	Dibenzofuran	5	167
4-Aminobiphenyl	5	167	Dimethoate	5	167
Acenaphthene	5	167	Diphenylamine	5	167
Acenaphthylene	5	167	Disulfuton	5	167
Acetophenone	5	167	m-Dinitrobenzene	5	167
Aniline	2	67	p-(Dimethylamine)azobenzene	5	167
Anthracene	5	167	Di-n-butyl phthalate	5	167
Aramite	5	167	Di-n-octyl phthalate	5	167
A,A-Dimethylphenethylamine	5	167	Diethyl phthalate	5	167
Benzo(a)anthracene	5	167	Dimethyl phthalate	5	167
Benzo(a)pyrene	5	167	bis(2-Ethylhexyl)phthalate	5	167
Benzo(b)fluoranthene	5	167	Ethyl methansulfonate	5	167
Benzo(g,h,i)perylene	5	167	Famphur	5	167
Benzo (k)fluoranthene	5	167	Fluoranthene	5	167
4-Bromophenyl phenyl ether	5	167	Fluorene	5	167
Butyl benzyl phthalate	5	167	Hexachlorobenzene	5	167
Benzyl Alcohol	5	167	Hexachlorobutadiene	5	167
2-Chloronaphthalene	5	167	Hexachlorocyclopentadiene	20	667
4-Chloroaniline	5	167	Hexahloroethane	5	167

Compound	Water	Soil	Compound	Water	Soil
	μg/l	μg/kg		μg/l	μg/kg
Hexachlorophene	5	167	N-Nitrosodiethylamine	5	167
Hexachloropropene	5	167	N-Nitrosodiphenylamine	5	167
Indeno(1,2,3-cd)pyrene	5	167	N-Nitrosomethylethylamine	5	167
Isodrin	5	167	N-Nitrosomorpholine	5	167
Isophorone	5	167	N-Nitrosopiperidine	5	167
Isosafrole	5	167	N-Nitrosopyrrolidine	5	167
Kepone	5	167	O,O,O Triethylphosphorothioat	5	167
2-Methylnaphthalene	5	167	2-Picoline	5	167
3-Methylcholanthene	5	167	Parathion	5	167
Methapyrilene	5	167	Pentachlorobenzene	5	167
Methyl Methanesulfonate	5	167	Pentachloronitrobenzene	5	167
Methyl Parathion	5	167	Phenacetin	5	167
1,4 Naphthoquinone	5	167	Phenanthrene	2	67
1-Naphthylamine	5	167	Phorate	5	167
2-Naphthylamine	5	167	Pronamide	5	167
2-Nitroaniline	5	167	Pyrene	2	67
3-Nitroaniline	5	167	Pyridine	2	67
4-Nitroaniline	5	167	p-Phenylenediamine	5	167
5-Nitro-o-toluidine	5	167	Safrole	5	167
Naphthalene	5	167	1,2,4,5 Tetrachlorobenzene	5	167
Nitrobenzene	5	167	1,2,4-Trichlorobenzene	2	67
n-Nitrosodimethylamine	2	67	Thionazin	5	167
4-Nitroquinoline-1-Oxide	10	333	o-Toluidine	5	167
N-Nitroso-di-n-propylamine	2	33	sym-Trinitrobenzene	5	167
N-Nitrosodi-n-butylamine	5	167	Tetraethyl dithiopyrophosphate	5	167

Table 10. Selected Ion Monitoring Reporting Limits

Compound	Water	Soil	Compound	Water	Soil
	μg/l	μg/kg		μg/l	μg/kg
Pentachlorophenol	1.0	33	Fluoranthene	0.2	3.3
Acenaphthene	0.2	6.6	Fluorene	0.2	6.6
Acenaphthylene	0.2	6.6	Hexachlorobenzene	0.2	6.6
Anthracene	0.2	6.6	Hexachlorobutadiene	0.2	6.6
Benzo(a)anthracene	0.2	6.6	Indeno(1,2,3-cd)pyrene	0.2	6.6
Benzo(a)pyrene	0.2	6.6	2-Methylnaphthalene	0.2	6.6
Benzo(b)fluoranthene	0.2	6.6	Naphthalene	0.2	6.6
Benzo(g,h,i)perylene	0.2	6.6	Phenanthrene	0.2	6.6
Benzo (k)fluoranthene	0.2	6.6	Pyrene	0.2	6.6
Chrysene	0.2	6.6	bis(2-Chloroethyl)ether	0.2	6.6
Dibenzo(a,h)anthracene	0.2	6.6	Bis (2-ethylhexyl) phthalate	0.2	6.6

1,2-Diphenylhydrazine	0.2	6.6	Di-n-octyl phthalate	0.2	6.6